RA Family, RX Family, RL78 Family, RE01 256KB or 1500KB Group

OB1203 Sample Software Manual

Introduction

This application note describes the sample software that is for use with the OB1203 sensor and runs on certain MCUs of the RA family, RX family, and RL78 family, and RE01 group MCUs with 256 KB or 1500 KB of flash memory.

The application note and the sample software are not medical devices.

Also, the algorithm for biometric data calculation used in this sample project has the constraint of sampling rate (Default: 10ms).

Please refer to the application note [R36AN0001EU] and OB1203 sensor page (OB1203 - Heart Rate, Blood Oxygen Concentration, Pulse Oximetry, Proximity, Light and Color Sensor | Renesas)

Target Devices

RA6M4 Group

RX65N Group

RL78/G14 Group

RL78/G23 Group

RE01 Group with 256 KB or 1500 KB of flash memory

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1. Overview

This sample software acquires data from the OB1203 sensor and handles calculation on the data. In combination with the I2C driver of the FSP, FIT, or code generator, the sample software controls the OB1203 through the I2C in the MCU to execute measurement, acquire ADC data, and calculate the acquired data.

2. Environment for Confirming Operation

2.1 Environment for Confirming Operation on an RA Family MCU

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

Table 2-1 Operating Environment for the RA Family MCU

Item	Description
Demonstration board	RTK7EKA6M4S00001BE (EK-RA6M4)
Microcontroller	RA6M4 (R7FA6M4AF3CFB: 144 pins)
Operating frequency	200 MHz
Operating voltage	5 V
Integrated development environment	e^2 Studio 2023-01
C compiler	GCC 10.3.1.20210824 IAR ANSI C/C++ Compiler V9.20.2.320/LNX for ARM BX ARM Compiler 6.17
FSP	V.3.7.0
RTOS	FreeRTOS™ or Microsoft® Azure RTOS
Emulator	On-board debugger (J-LINK)
Interposer	Interposer board to convert Type2/3 to Type 6A PMOD standard (US082-INTERPEVZ)
Sensor board	Pulse oximetry, proximity, light, and color sensor Pmod™ board (US082-OB1203EVZ)

Table 2-2 Amount of Memory Used in the RA Family MCU

Area	Size (Non-OS)	Size (Free RTOS)	Size (Azure RTOS)
ROM	14,054 bytes	14,755 bytes	14,691 bytes
RAM	5,564 bytes	5,922 bytes	6,049 bytes

Calculation of these sizes in memory only takes functions and variables related to the OB1203 sensor into account. They do not include the sizes of RTOS threads for the RTOS versions.

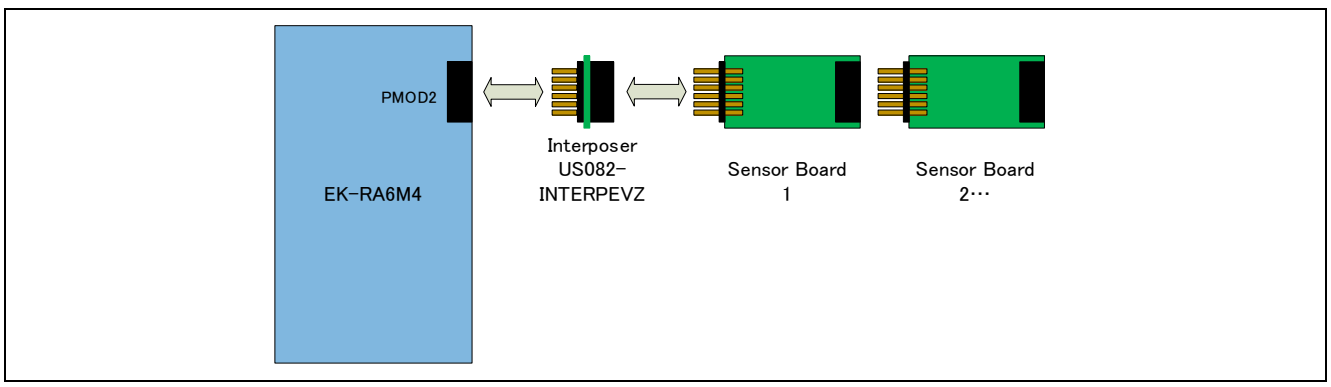


Figure 2-1 Hardware Connections for the RA Family

2.2 Environment for Confirming Operation on an RX Family MCU

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

Table 2-3 Operating Environment for the RX Family MCU

Item	Description
Demonstration board	RPBRX65N (Envision Kit RX65N)
Microcontroller	RX65N (R5F565NEDDFB: 144 pins)
Operating frequency	12 MHz
Operating voltage	5 V
Integrated development environment	e^2 Studio 2023-01 IAR EW for RX 4.20.1
C compiler	Renesas Electronics C/C++ compiler for RX family V.3.03.00 GCC 8.3.0.202004 IAR Toolchain for RX 8.4.10.7051
FIT	BSP V.7.20
RTOS	FreeRTOS™
Emulator	On-board debugger (E2OB)
Interposer	Interposer board to convert Type2/3 to Type 6A PMOD standard (US082-INTERPEVZ)
Sensor board	Pulse oximetry, proximity, light, and color sensor Pmod™ board (US082-OB1203EVZ)

Table 2-4 Amount of Memory Used in the RX Family MCU

Area	Size (Non-OS)	Size (FreeRTOS)	Size (Azure RTOS)
ROM	12,343 bytes	12,839 bytes	12,874 bytes
RAM	6,204 bytes	6,312 bytes	6,680bytes

Calculation of these sizes in memory only takes functions and variables related to the OB1203 sensor into account. They do not include the sizes of RTOS threads for the RTOS versions.

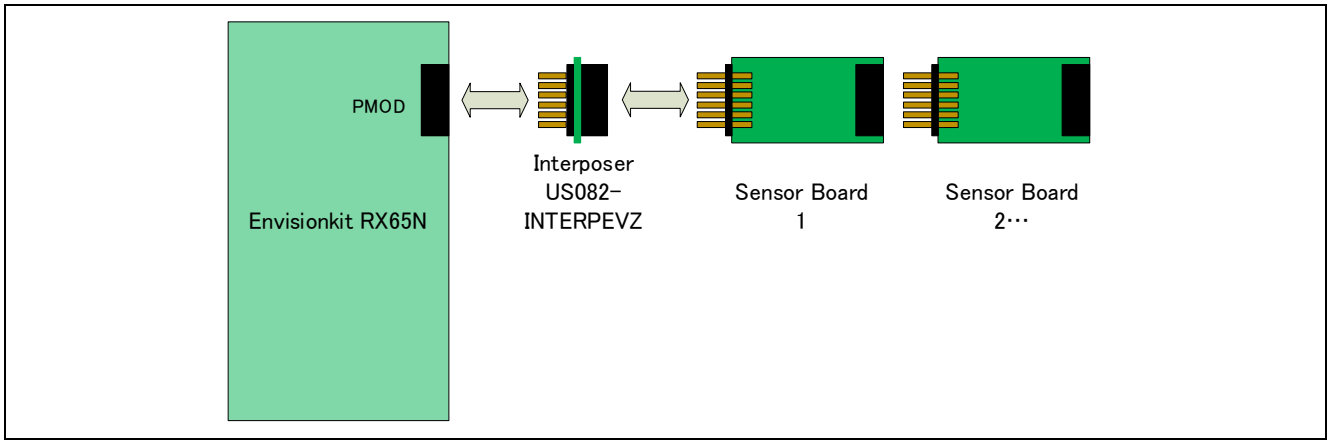


Figure 2-2 Hardware Connections for the RX Family

2.3 Environment for Confirming Operation on an RL78/G14 Group MCU

The operation of this software has been confirmed on an MCU of the RL78/G14 group in the following environment.

Table 2-5 Operating Environment for the RL78/G14 Group MCU

Item	Description
Demonstration board	RTK5RLG140C00000BJ (RL78/G14 Fast Prototyping Board)
Microcontroller	RL78/G14 (R5F104MLAFB: 80 pins)
Operating frequency	32 MHz
Operating voltage	3.3 V
Integrated development environment	e^2 studio 2023-01 IAR EW for RL78 4.21.1
C compiler	C compiler package for RL78 family V1.11.00 GCC for Renesas RL78 4.9.2.202103 IAR Toolchain for RL78 4.21.1.2409
Emulator	On-board debugger (E2OB)
Sensor board	Pulse oximetry, proximity, light, and color sensor Pmod™ board (US082-OB1203EVZ)

Table 2-6 Amount of Memory Used in the RL78/G14 Group MCU

Area	Size
ROM	3,387 bytes
RAM	308 bytes

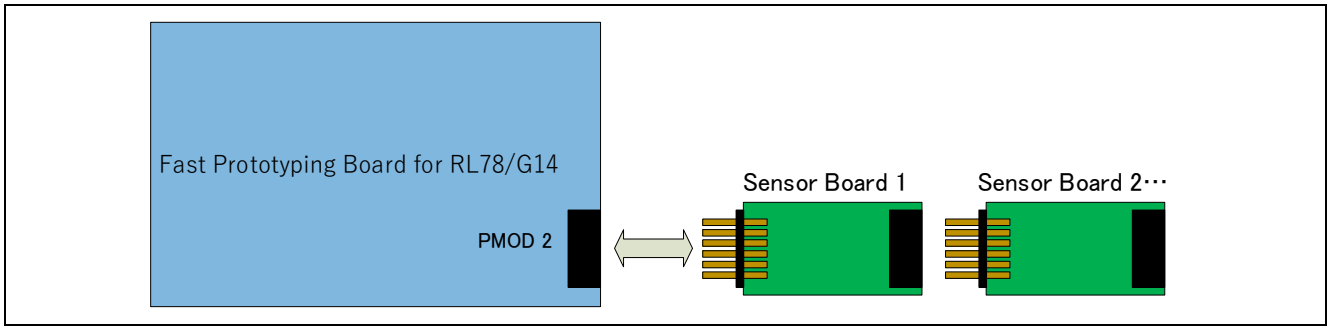


Figure 2-3 Hardware Connections for the RL78/G14 Group

2.4 Environment for Confirming Operation on an RL78/G23 Group MCU

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

Table 2-7 Operating Environment for the RL78/G23 Group MCU

Item	Description
Demonstration board	RTK7RLG230CSN000BJ (RL78/G23-128p Fast Prototyping Board)
Microcontroller	RL78/G23 (R7F100GSN2DFB: 128 pins)
Operating frequency	32 MHz
Operating voltage	3.3 V
Integrated development environment	e^2 studio 2023-01 IAR EW for RL78 4.21.1
C compiler	C compiler package for RL78 family V1.11.00 LLVM for RL78 10.0.0.202209 IAR Toolchain for RL78 4.21.1.2409
Emulator	E2 Lite
Sensor board	Pulse oximetry, proximity, light, and color sensor Pmod™ board (US082-OB1203EVZ)

Table 2-8 Amount of Memory Used in the RL78/G23 Group MCU

Area	Size
ROM	3,814 bytes
RAM	308 bytes

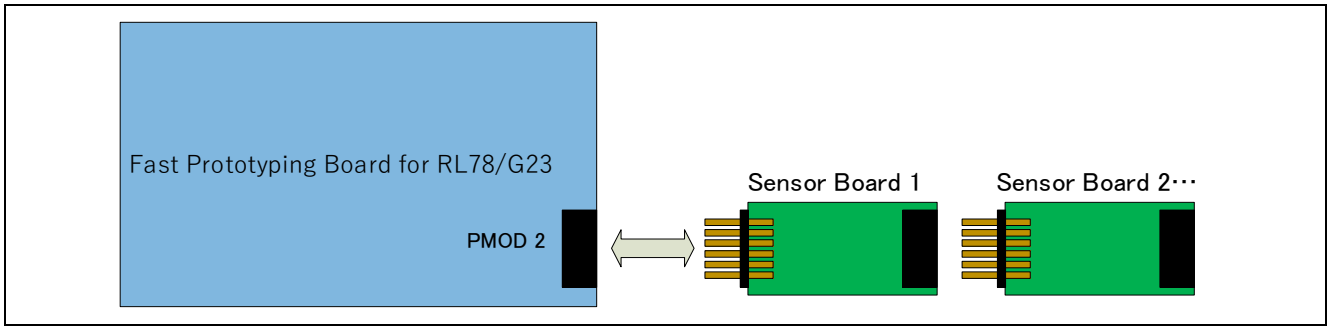


Figure 2-4 Hardware Connections for the RL78/G23 Group

2.5 Environment for Confirming Operation on an RE01 256KB Group MCU

The operation of this software has been confirmed on an MCU of the RE01 256KB group in the following environment.

Table 2-9 Operating Environment for the RE01 256KB Group MCU

Item	Description
Demonstration board	EK-RE01 256KB
Microcontroller	RE01 256KB (R7F0E01182CFP: 100 pins)
Operating frequency	32 MHz (HOCO)
Supply voltage to demo board	5V (3.3V generated by regulator on board)
Device operating voltage	3.3V
Integrated development environment	e^2 studio 2022-01 IAR EW for ARM 8.50.9
C compiler	GCC 6.3.1.20170620 IAR Toolchain for ARM (8.30.x - 8.50.x) 8.1.0.202106261031 IAR C/C++ Compiler for ARM 8.50.9.278 (8.50.9.278)
Emulator	On-board debugger (J-LINK)
Interposer	DIGILENT Pmod shield adapter
Sensor board	Pulse oximetry, proximity, light, and color sensor Pmod™ board (US082-OB1203EVZ)

Table 2-10 Amount of Memory Used in the RE01 256KB Group MCU

Area	Size
ROM	1,872 bytes
RAM	176 bytes

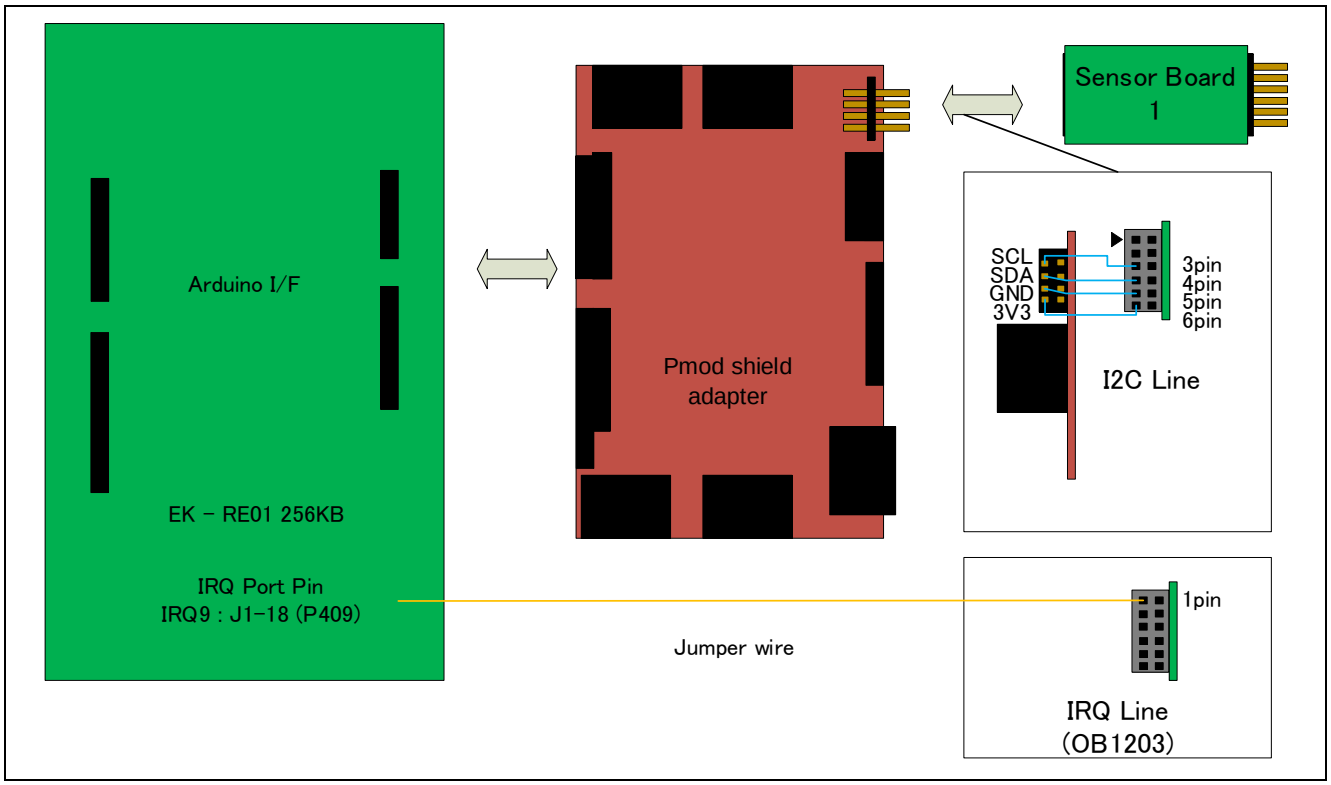


Figure 2-5 Hardware Connections for the RE01 256KB Group

2.6 Environment for Confirming Operation on an RE01 1500KB Group MCU

The operation of this software has been confirmed on an MCU of the RE01 1500KB group in the following environment.

Table 2-11 Operating Environment for the RE01 1500KB Group MCU

Item	Description
Demonstration board	EK-RE01 1500KB
Microcontroller	RE01 1500KB (R7F0E015DCFB: 144 pins)
Operating frequency	32 MHz (HOCO)
Supply voltage to demo board	5 V (3.3V generated by regulator on board)
Device operating voltage	3.3V
Integrated development environment	e^2 studio 2022-01 IAR EW for ARM 8.50.9
C compiler	GCC 6.3.1.20170620 IAR Toolchain for ARM (8.30.x - 8.50.x) 8.1.0.202106261031 IAR C/C++ Compiler for ARM 8.50.9.278 (8.50.9.278)
Emulator	On-board debugger (J-LINK)
Interposer	DIGILENT Pmod shield adapter
Sensor board	Pulse oximetry, proximity, light, and color sensor PMOD™ board (US082-OB1203EVZ)

Table 2-12 Amount of Memory Used in the RE01 1500KB Group MCU

Area	Size
ROM	1,872 bytes
RAM	176 bytes

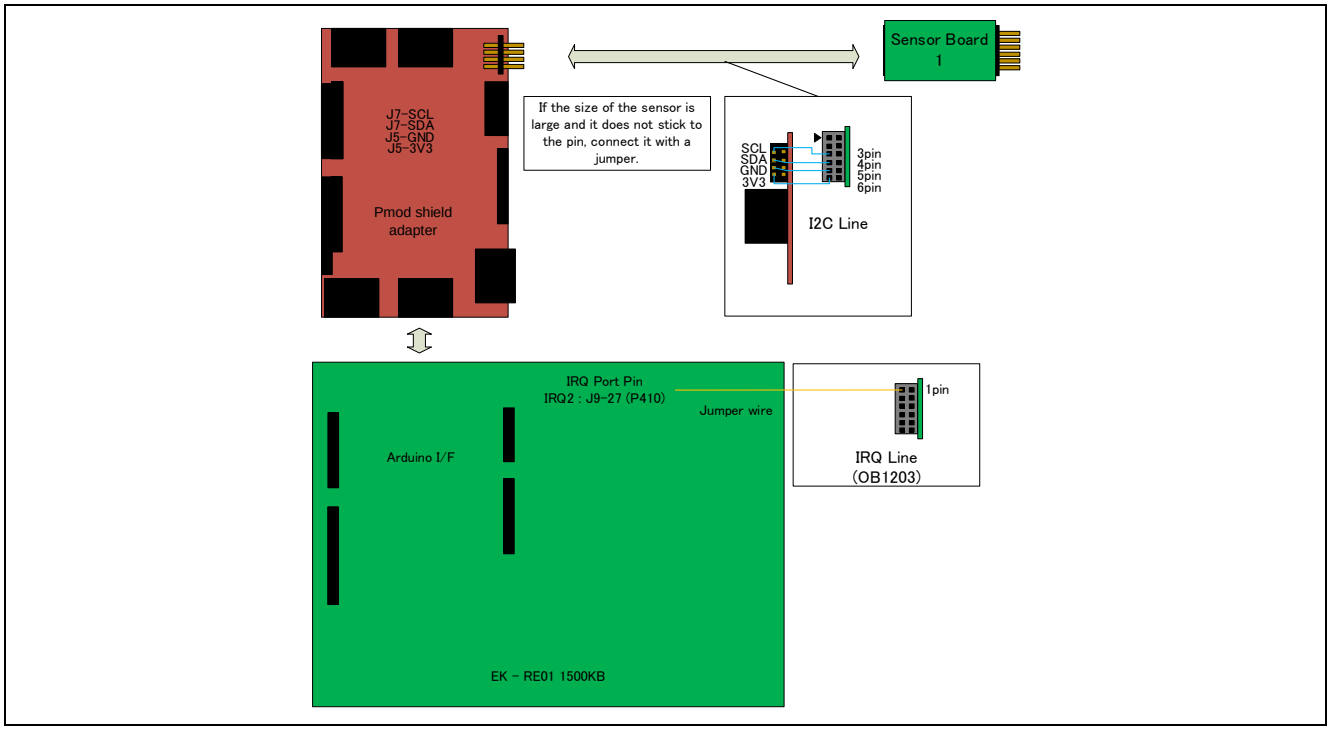


Figure 2-6 Hardware Connections for the RE01 1500KB Group

3. OB1203 Sensor Specifications

3.1 Overview of Sensor Specifications

Table 3-1 gives an overview of the specifications of the OB1203 pulse oximetry, proximity, and light sensor.

The listed values are measured under the international measurement conditions of V_{DD} = 2.8 V and T_{AMB} = 25°C unless specifically stated otherwise.

Table 3-1 Specifications of Sensor Operation

Symbol	Parameter	Conditions	Minimum	Typical	Maximum	Unit [a]
Power-On Reset						
POR_{LH}	DC power-on reset level	Slow variation of VDD (< 1 ms), TA = 25°C		1.2		V
POR_{HL}						
Current Consumption						
I_{LS}	LS/CS (clear and color sensor) active mode current [a]	Default setting; 100% duty cycle; VDD = 2.8 V; Gain Mode 3		110		µA
I_{PS_pk}	PS (proximity sensor) active mode peak current [b]	Default setting; 100 ms period; VDD = 2.8 V		750		µA
I_{PS_avg}	PS (proximity sensor) active mode average current [b]	Default setting; 100 ms period; VDD = 2.8 V		80		µA
I_{PPG1_VDD}	PPG1 active mode VDD average current	Default measurement period and pulse width		730		µA
I_{PPG2_VDD}	PPG2 active mode VDD average current	Minimum PPG pulse width and period setting (maximum rate)		780		µA
I_{PPG1_LED}	PPG1 active mode LED average current	125 mA LED current setting, default PPG pulse width and period settings		30		mA
		125 mA LED current setting, minimum PPG pulse width and period settings (maximum rate)		50		mA
I_{PPG2_LED}	PPG2 active mode LED average current	125 mA LED current setting, default PPG pulse width and period settings		48		mA
		125 mA LED current setting, minimum PPG pulse width and period settings (maximum rate)		43		mA
I_{SBY}	Standby VDD current [c]	The OB1203 is in Standby Mode; no active I2C communication		< 2	5	µA
I2C Interface						
$V_{I2Chigh}$	I2C signal input high		1.26		V_{DD}	V
V_{I2Clow}	I2C signal input low		0		0.54	V
LS Light Sensor Characteristics						
RES_{LS}	LS output resolution	Programmable to 13, 16, 17, 18, 19, 20 bits	13	18	20	bit
	Dark level count	0 lx, 18-bit range		0		count
t_{LS}	Measurement repetition period [d]	Programmable in 8 steps	25		2000	ms
t_{INT}	Measurement integration period [d]	Programmable in 6 steps	50		400	ms
G_1	Sensitivity at gain 1	Example for 3050 K, 5 klx LED light, 18-bit sensor resolution.		C: 9160 R: 3160 G: 4280 B: 1470		counts
G_3	Sensitivity at gain 3			C: 27480		counts

				R: 9480 G: 12840 B: 4410		
G_6	Sensitivity at gain 6			C: 54960 R: 18960 G: 25680 B: 8820		counts
PS Proximity Sensor Characteristics						
RES_{PS_bit}	Measurement resolution	Depends on pulse width and number of LED pulses	10	15	16	bit
RES_{PS_irr}	Signal strength IR	125 mA LED current; 8 pulse average; gain mode 1; 4.6 cm round white reflective target [e] in 4.6 cm distance	2830	3300	4030	counts
RES_{PS_red}	Signal strength Red		2300	2660	3200	counts
ALC_{max}	Ambient light cancellation			>100000		lx
N_{PULSE}	Number of LED pulses		1	8	32	
t_{PS}	Measurement period	Programmable in 8 steps		3.125 to 400		ms
t_{PS_pw}	Pulse width	Three possible settings; configurable via register setting		26 42 71		µs
	Analog crosstalk cancellation	Programmable 0 or 50% FS		50%		Full scale
	Digital crosstalk cancellation	Programmable: 0 to full signal level. For 16-bit resolution.	0		65535	count
PPG Characteristics						
RES_{PPG}	Measurement resolution		16	18	18	bit
A_{PPG}	Digital averaging factor		1		32	
t_{PPG}	Measurement period	Programmable in 8 steps		0.3125 to 20		ms
t_{PPG_pw}	Pulse width	Configurable via register setting		130 247 481 949		µs
	IR counts	18% grey card reflector (6 mm from top of package); sample under clear cover glass; 125 mA LED current; 130 µs LED on time; average over 100 samples per second.		28000		count
	Red counts			28000		count
	Analog crosstalk cancellation	Programmable 0 or 50% FS		50%		Full scale
	Sample rate accuracy vs. nominal		-2		2	%
Measurement Timing						
$t_{WAKE-STB}$	Wake-up time from Standby Mode	From Standby to Active Mode (measurement can start)		1.5		ms
t_{Start}	Start time from VDD apply to Standby Mode			10		ms
IR LED (LED1 Pin) Characteristics						
λ_{Peak}	Peak wavelength	I_{LED} = 100 mA, T_A = 25ºC		940		nm
$I_{IR_LED(Max)}$	IR LED current	Programmable in 1024 steps		250		mA
Red LED (LED2 Pin) Characteristics						

λ_{Peak}	Peak wavelength	I_{LED} = 20 mA, T_A = 25ºC		700		nm
$I_{RED_LED(Max)}$	Red LED current	Programmable in 512 steps		125		mA

[a] For the LS, the maximum duty cycle is selected with 100ms measurement time (default) and 100ms period at an illumination of 1000 lux.

[b] For the PS, 100ms measurement period, 42µs pulse width, 8 pulses, 15-bit resolution, and Gain Mode 1 are selected.

[c] Refer to Figure 16 for typical temperature dependence.

[d] Typical timing accuracy applied.

[e] 90 % reflective Kodak R-27.

4. Specifications of Sample Software

This section describes the specifications of the sample software.

4.1 Configuration of the Sample Software

Figure 4-1 shows the configuration of sample software blocks.

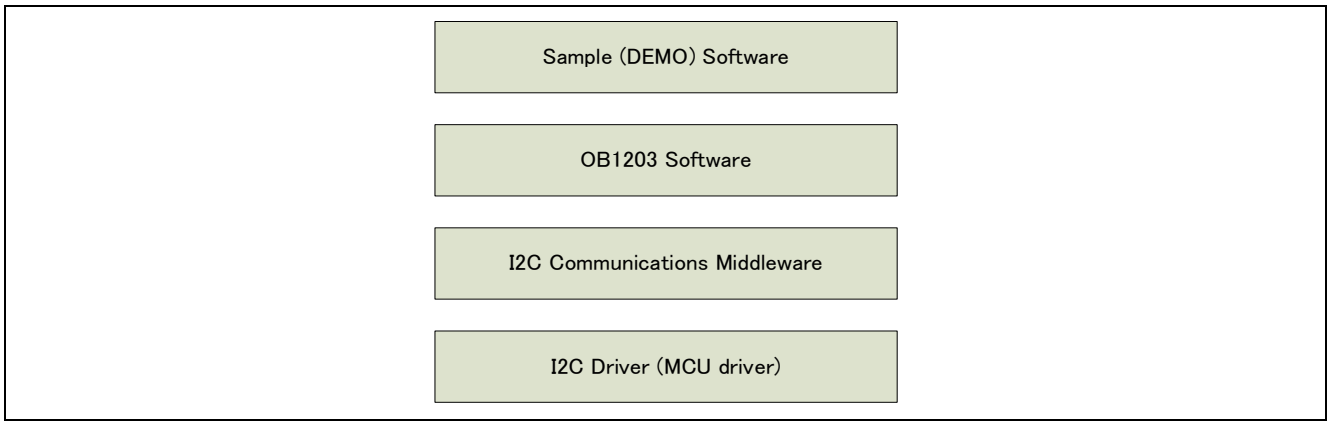


Figure 4-1 Block Diagram of the Sample Software

4.2 Specifications of Sensor API Functions

4.2.1 List of Sensor API Functions

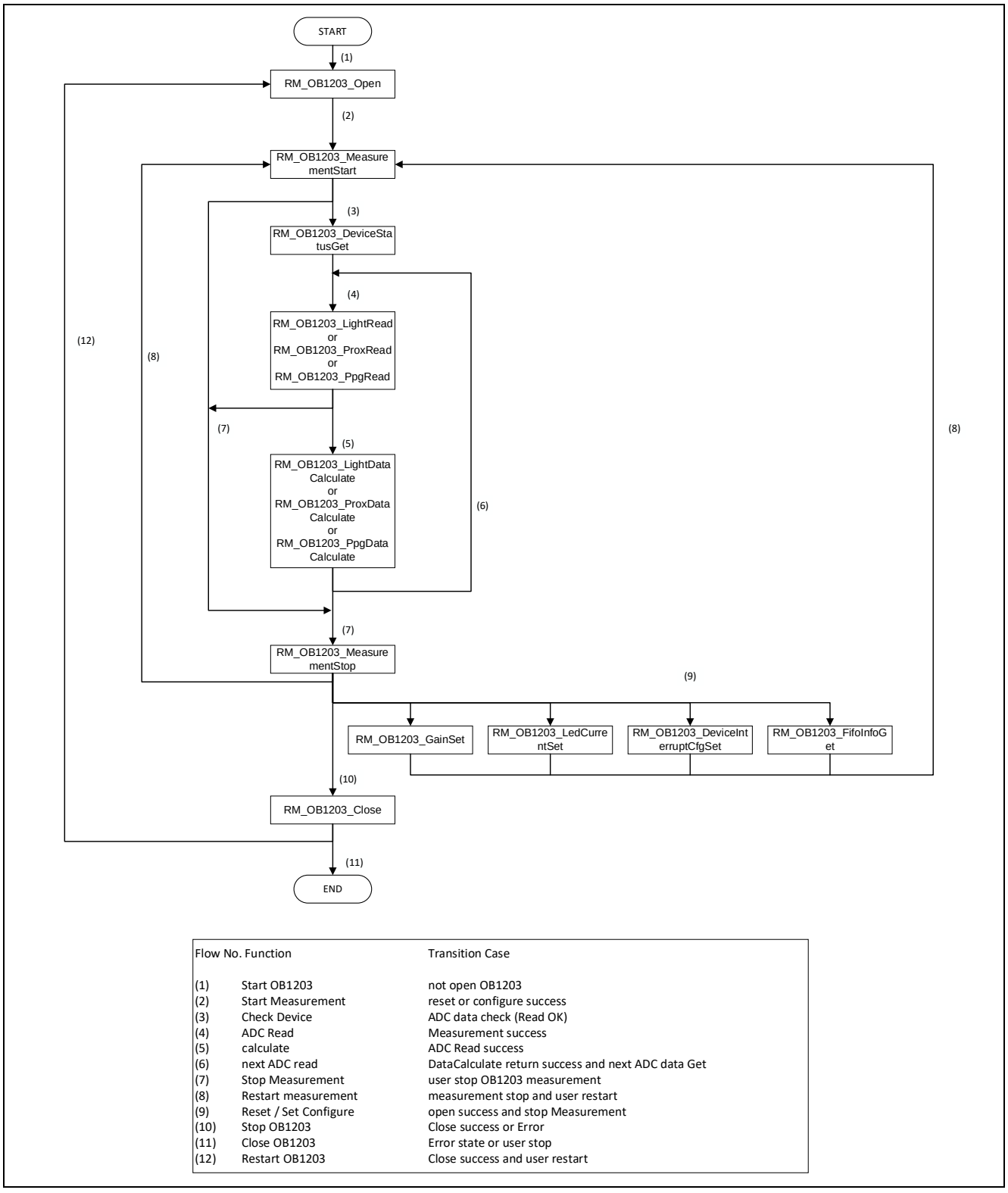
The following table lists the sensor API functions. For details of the API functions, refer to the RA Flexible Software Package Documentation.

Table 4-1 List of Sensor API Functions

Function	Feature
RM_OB1203_Open	Opens the sensor.
RM_OB1203_Close	Closes the sensor.
RM_OB1203_MeasurementStart	Starts measurement by the sensor.
RM_OB1203_MeasurementStop	Stops measurement by the sensor.
RM_OB1203_DeviceStatusGet	Acquires the state of the sensor.
RM_OB1203_DeviceInterruptCfgSet	Sets up interrupt processing.
RM_OB1203_GainSet	Sets the gain.
RM_OB1203_LedCurrentSet	Sets the LED brightness.
RM_OB1203_FifoInfoGet	Reads information from the FIFO.
RM_OB1203_LightRead	Reads raw data from the light sensor (LS).
RM_OB1203_ProxRead	Reads raw data from the proximity sensor (PS).
RM_OB1203_PpgRead	Reads raw data from the photoplethysmography sensor (PPG).
RM_OB1203_LightDataCalculate	Calculates LS values from the raw data read from the sensor.
RM_OB1203_ProxDataCalculate	Calculates PS values from the raw data read from the sensor.
RM_OB1203_PpgDataCalculate	Calculates PPG values from the raw data read from the sensor.

4.2.2 Guide to Using the API Functions

Figure 4-2 is a diagram of transitions between API function calls. This diagram shows the conditions on the usage of the individual API functions and the expected orders of function calls.



Flow No.	Function	Transition Case
(1)	Start OB1203	not open OB1203
(2)	Start Measurement	reset or configure success
(3)	Check Device	ADC data check (Read OK)
(4)	ADC Read	Measurement success
(5)	calculate	ADC Read success
(6)	next ADC read	DataCalculate return success and next ADC data Get
(7)	Stop Measurement	user stop OB1203 measurement
(8)	Restart measurement	measurement stop and user restart
(9)	Reset / Set Configure	open success and stop Measurement
(10)	Stop OB1203	Close success or Error
(11)	Close OB1203	Error state or user stop
(12)	Restart OB1203	Close success and user restart

Figure 4-2 Transitions between API Function Calls

The conditions for calling the individual functions are shown below:

- RM_OB1203_Open:	(1) Starting the OB1203 (12) Restating after a call of RM_OB1203_Close
- RM_OB1203_Close:	(10) Successful completion or abnormal end of individual processing
- RM_OB1203_MeasurementStart:	(2) Starting measurement after a call of RM_OB1203_Open (8) Reading next measured data
- RM_OB1203_MeasurementStop:	(7) Stopping measurement
- RM_OB1203_DeviceStatusGet:	(3) Checking the state of the sensor
- RM_OB1203_DeviceInterruptCfgSet:	(9) Setting the configuration again
- RM_OB1203_GainSet:	(9) Setting the configuration again
- RM_OB1203_LedCurrentSet:	(9) Setting the configuration again
- RM_OB1203_FifoInfoGet: :	(9) Setting the configuration again
- RM_OB1203_xxxxRead:	(4) (6) Reading measured data
- RM_OB1203_xxxxDataCalculate:	(5) Calculating measured data

xxxx is the name or abbreviated name of the target function of the sensor (Light, Prox, or Ppg).

Notes:

Since RM_OB1203_Open checks the state of the I2C driver, the I2C driver must be opened before the RM_OB1203_Open processing.

Regarding how to open the I2C driver, refer to the g_comms_i2c_bus0_quick_setup() function in the sample software. This is not necessary in the RL78 family devices because the I2C driver will be opened in the startup processing.

When using these API functions in an RTOS system, the user will need to control the bus by using a semaphore if the sensor is controlled in multiple threads or tasks at the same time.

4.3 Flowchart of the Main Processing in the Sample Software

The sample software first opens the driver and then repeats the process of starting the measurement by the sensor, acquiring data from the sensor, and calculating values from the results of measurement.

The OS version is controlled by semaphores, and two threads that control the sensor run in parallel.

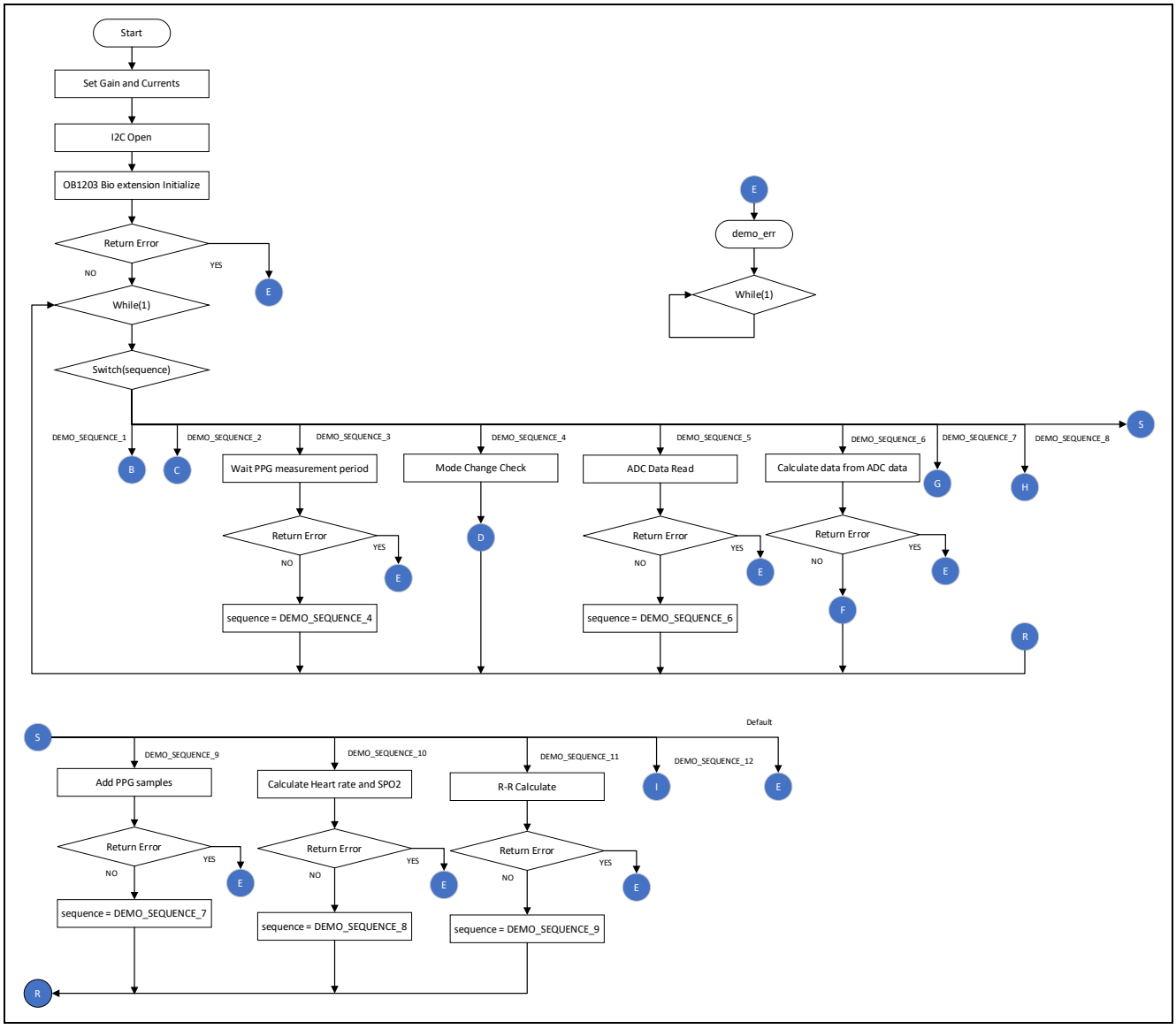


Figure 4-3 Flowchart 1 of the Main Processing in the OB1203 Sample Software

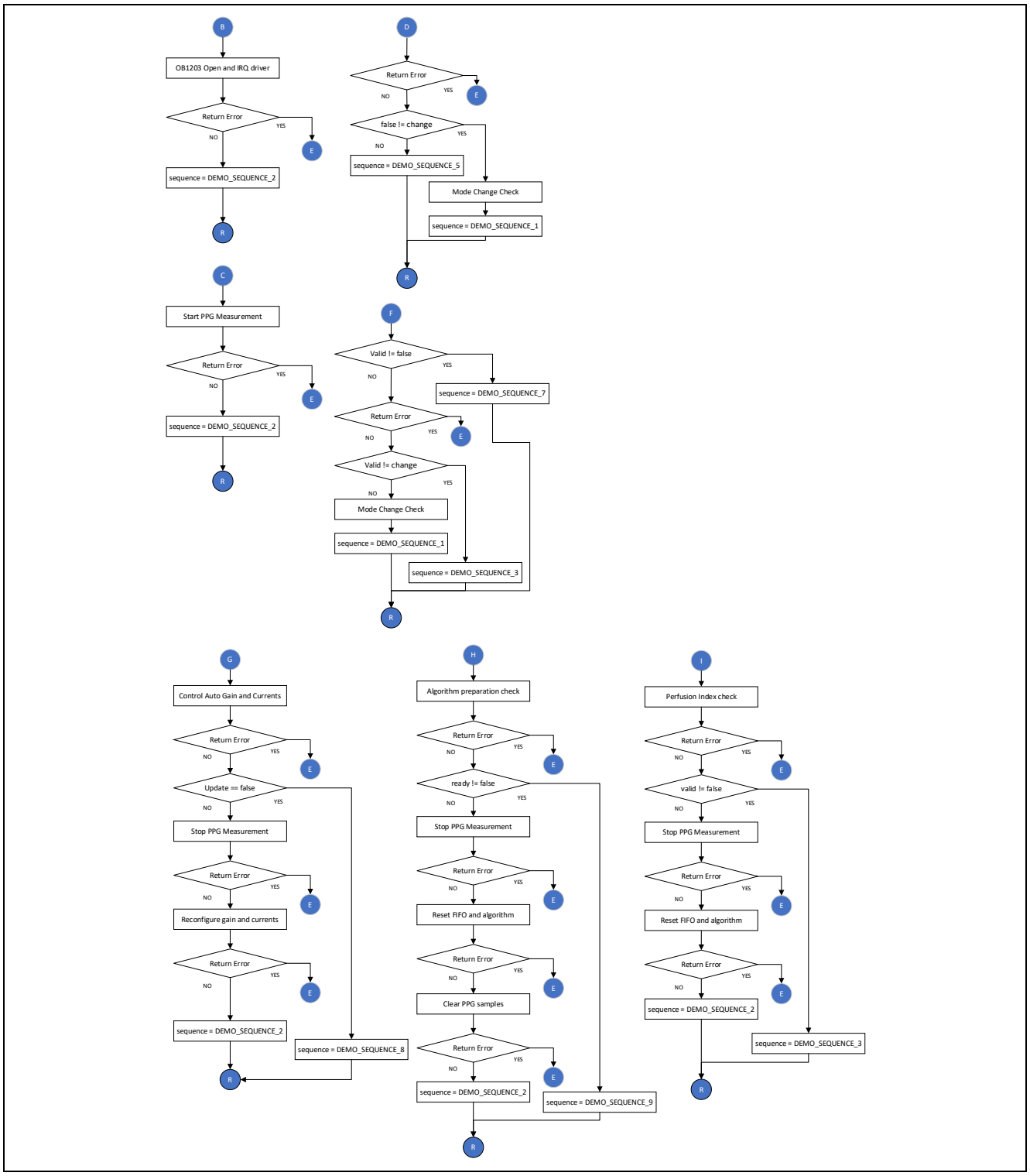


Figure 4-4 Flowchart 2 of the Main Processing in the OB1203 Sample Software

4.3.1 Azure RTOS Project

The RX project for use with the Azure RTOS has the following changes from the default source files generated by the RX Smart Configurator.

1. src/demo_thread.c

   Line 57: Addition of extern void tx_application_define_user (void);

   Line 177: Addition of tx_application_define_user();

5. Configuration Settings

5.1 OB1203 Sensor Settings

5.1.1 RA Family

Select the rm_ob1203 stack on the [Stack] tabbed page of the FSP Configurator, and the configurable items will be shown on the [Properties] tabbed page.

The following items and values can be specified.

Table 5-1 OB1203 Settings for the RA Family MCU

Configurable Item	Value	Description
Common		
Parameter Checking	Default (BSP) Enabled Disabled	Specify whether to include the processing to check parameters in the code to be generated. When "Disabled" is selected, the generated code does not include the processing to check parameters. When "Enabled" is selected, the generated code includes the processing to check parameters.
Module g_ob1203_sensor OB1203 Light/Proximity/PPG Sensor (rm_ob1203)		
Name	g_ob1203_sensor0	Specify the name of the module. A module name conforming to the C language standard can be specified.
Semaphore Timeout (RTOS only)	0xFFFFFFFF	For an RTOS project, specify the time of semaphore timeout.
Comms I2C Callback	ob1203_comms_i2c_callback	Specify the name of the user callback function. A callback function name conforming to the C language standard can be specified. When "NULL" is specified, no callback function is used.
IRQ Callback	ob1203_irq_callback	Specify the name of the IRQ user callback function. A callback function name conforming to the C language standard can be specified. When "NULL" is specified, no callback function is used.

5.1.1.1 Light mode settings

Select the rm_ob1203 Light mode stack in the "Stack" tabbed page of the FSP Configurator, and the configurable items are shown in the "Properties" tabbed page.

The following items and values can be specified.

Table 5-2 OB1203 Light mode Settings for RA Family MCU

Configurable Item	Value	Description
Module OB1203 Light mode (rm_ob1203)		

Operation Mode	LS mode	Select the measurement mode. Select ambient light sensor (LS) mode or RGB color sensor (CS) mode.
	CS mode	
Interrupt Type	Threshold	Select an interrupt type.
	Variation	
Interrupt Source	Clear channel	Select the interrupt source. Red and blue of RGB channels are only valid in CS mode.
	Green channel	
	Red channel (CS mode only)	
	Blue channel (CS mode only)	
The Number of Similar Consecutive Interrupt Events	0x02	Sets the number of interrupt events. Values range from 0x00 to 0x0F.
Sleep after Interrupt	Enabled	Select the Sleep function after interrupting.
	Disabled	
Gain	1	Select the Gain value.
	3	
	6	
Resolution and Measurement Period	Resolution:13bit. Measurement Period:200ms	Select a combination of the resolution of the measurement and the measurement period.
	Resolution:13bit. Measurement Period:500ms	
	Resolution:13bit. Measurement Period:1000ms	
	Resolution:13bit. Measurement Period:2000ms	
	Resolution:16bit. Measurement Period:25ms	
	Resolution:16bit. Measurement Period:50ms	
	Resolution:16bit. Measurement Period:100ms	
	Resolution:16bit. Measurement Period:200ms	
	Resolution:16bit. Measurement Period:500ms	
	Resolution:16bit. Measurement Period:1000ms	
	Resolution:16bit. Measurement Period:2000ms	
	Resolution:17bit. Measurement Period:50ms	
	Resolution:17bit. Measurement Period:100ms	
	Resolution:17bit. Measurement Period:200ms	
	Resolution:17bit. Measurement Period:500ms	
	Resolution:17bit. Measurement Period:1000ms	
	Resolution:17bit. Measurement Period:2000ms	
	Resolution:18bit. Measurement Period:100ms	
	Resolution:18bit. Measurement Period:200ms	
	Resolution:18bit. Measurement Period:500ms	

	Resolution:18bit. Measurement Period:1000ms	
	Resolution:18bit. Measurement Period:2000ms	
	Resolution:19bit. Measurement Period:200ms	
	Resolution:19bit. Measurement Period:500ms	
	Resolution:19bit. Measurement Period:1000ms	
	Resolution:19bit. Measurement Period:2000ms	
	Resolution:20bit. Measurement Period:500ms	
	Resolution:20bit. Measurement Period:1000ms	
	Resolution:20bit. Measurement Period:2000ms	
Upper Threshold	0x00CCC	Sets the upper threshold. Any value from 0x00000 to 0xFFFFF is valid.
Lower Threshold	0x00000	Sets the lower threshold. Any value from 0x00000 to 0xFFFFF is valid.
Variance Threshold	+/- 8 counts	Choose to threshold variance.
	+/- 16 counts	
	+/- 32 counts	
	+/- 64 counts	
	+/- 128 counts	
	+/- 256 counts	
	+/- 512 counts	
	+/- 1024 counts	

5.1.1.3 PPG mode settings

Select the rm_ob1203 PPG mode stack in the "Stack" tabbed page of the FSP Configurator, and the configurable items are shown in the "Properties" tabbed page.

The following items and values can be specified.

Table 5-3 OB1203 PPG mode Settings for RA Family MCU

Configurable Item	Value	Description
Module OB1203 PPG mode (rm_ob1203)		
Operation Mode	PPG1 mode	Select the measurement mode. PPG1 operates with RED or IR, and PPG2 interleaves in IR and RED order.
	PPG2 mode	
Interrupt Type	Data	Select an interrupt type.
	FIFO Almost Full	
Gain	1	Select the Gain value.
	1.5	
	2	
	4	
IR LED Current	0x366	Sets the current value of the IR LED. Any value from 0x000 to 0x3FF is valid.
Red LED Current	0x1B3	Sets the current value of the RED LED. Any value from 0x000 to 0x1FF is valid.
Power Save Mode	Enabled	Select Power Save Mode on or off.
	Disabled	
LED Order	IR LED first, Red LED second	Sets the order in which the LEDs are selected.
	RED LED first, IR LED second	
IR LED Analog Cancellation	Enabled (50% offset of the full-scale value)	Select Enable and disable analog cancellation for IR LEDs.
	Disabled	
Red LED Analog Cancellation	Enabled (50% offset of the full-scale value)	Select Enable and disable red LED analog cancellation.
	Disabled	
Number of Averaged PPG Samples	1 (No averaging)	Select the number of PPG samples to average.
	2 consecutives samples are averaged	
	4 consecutives samples are averaged	
	8 consecutives samples are averaged	
	16 consecutives samples are averaged	
	32 consecutives samples are averaged	
Pulse Width and Measurement Period	Pulse width:130us. Measurement Period:0.3125ms (PPG1 mode only)	Select the pulse width and measurement period.
	Pulse width:130us. Measurement Period:0.625ms	
	Pulse width:130us. Measurement Period:1ms	
	Pulse width:130us. Measurement Period:1.25ms	
	Pulse width:130us. Measurement Period:2.5ms	

	Pulse width:130us. Measurement Period:5ms	
	Pulse width:130us. Measurement Period:10ms	
	Pulse width:130us. Measurement Period:20ms	
	Pulse width:247us. Measurement Period:0.625ms (PPG1 mode only)	
	Pulse width:247us. Measurement Period:1ms	
	Pulse width:247us. Measurement Period:1.25ms	
	Pulse width:247us. Measurement Period:2.5ms	
	Pulse width:247us. Measurement Period:5ms	
	Pulse width:247us. Measurement Period:10ms	
	Pulse width:247us. Measurement Period:20ms	
	Pulse width:481us. Measurement Period:1ms (PPG1 mode only)	
	Pulse width:481us. Measurement Period:1.25ms (PPG1 mode only)	
	Pulse width:481us. Measurement Period:2.5ms	
	Pulse width:481us. Measurement Period:5ms	
	Pulse width:481us. Measurement Period:10ms	
	Pulse width:481us. Measurement Period:20ms	
	Pulse width:949us. Measurement Period:2.5ms (PPG1 mode only)	
	Pulse width:949us. Measurement Period:5ms	
	Pulse width:949us. Measurement Period:10ms	
	Pulse width:949us. Measurement Period:20ms	
FIFO Rollover	Enabled	Choose to enable and disable FIFO overrides.
	Disabled	
FIFO Almost Full Value	0x0C	Values determines the number of empty FIFO words when the FIFO almost full interrupt is issued. Any value from 0x00 to 0x0F is valid.

5.1.1.5 Proximity mode settings

Select the rm_ob1203 Proximity mode stack in the "Stack" tabbed page of the FSP Configurator, and the configurable items are shown in the "Properties" tabbed page.

The following items and values can be specified.

Table 5-4 OB1203 Proximity mode Settings for RA Family MCU

Configurable Item	Value	Description
Module OB1203 Proximity mode (rm_ob1203)		
Interrupt Type	Normal	Select an interrupt type.
	Logic	
The Number of Similar Consecutive Interrupt Events	0x02	Sets the number of interrupt events. Any value from 0x00 to 0x0F is valid.
Sleep after Interrupt	Enabled	Selects the sleep feature to be enabled and disabled after interrupting.
	Disabled	
Gain	1	Select the Gain value.
	1.5	
	2	
	4	
LED Current	0x100	Sets the LED current value. Any value from 0x000 to 0x3FF is valid.
LED Order	IR LED first, Red LED second	Sets the order in which the LEDs are selected.
	RED LED first, IR LED second	
LED Analog Cancellation	Enabled (50% offset of the full-scale value)	Choose to enable and disable analog cancellation.
	Disabled	
LED Digital Cancellation	0x100	Set the digital cancellation value. Any value from 0x0000 to 0xFFFF is valid.
Number of LED pulses	1 pulses	Select the number of PULSES of LEDs.
	2 pulses	
	4 pulses	
	8 pulses	
	16 pulses	
	32 pulses	
Pulse Width and Measurement Period	Pulse width:26us. Measurement Period:3.125ms (except for the number 32 of LED pulses)	Select the pulse width and measurement period.
	Pulse width:26us. Measurement Period:6.25ms	
	Pulse width:26us. Measurement Period:12.5ms	
	Pulse width:26us. Measurement Period:25ms	
	Pulse width:26us. Measurement Period:50ms	
	Pulse width:26us. Measurement Period:100ms	
	Pulse width:26us. Measurement Period:200ms	
	Pulse width:26us. Measurement Period:400ms	

	Pulse width:42us. Measurement Period:3.125ms (except for the number 32 of LED pulses)	
	Pulse width:42us. Measurement Period:6.25ms	
	Pulse width:42us. Measurement Period:12.5ms	
	Pulse width:42us. Measurement Period:25ms	
	Pulse width:42us. Measurement Period:50ms	
	Pulse width:42us. Measurement Period:100ms	
	Pulse width:42us. Measurement Period:200ms	
	Pulse width:42us. Measurement Period:400ms	
Moving Average	Enabled	Choose to use moving averages.
	Disabled	
Hysteresis	0x00	Sets the value of hysteresis. Any value from 0x00 to 0x7F is valid.
Upper Threshold	0x0600	Sets the upper threshold. Any value from 0x0000 to 0xFFFF is valid.
Lower Threshold	0x0000	Sets the lower threshold. Any value from 0x0000 to 0xFFFF is valid.

5.1.1.7 Light Proximity mode settings

Select the rm_ob1203 Light Proximity mode stack in the "Stack" tabbed page of the FSP Configurator, and the configurable items are shown in the "Properties" tabbed page.

The following items and values can be specified.

Table 5-5 OB1203 Light Proximity mode Settings for RA Family MCU

Configurable Item	Value	Description
Module OB1203 Light Proximity mode (rm_ob1203)		
General		
Device Interrupt	Light mode	Select the interrupt mode.
	Proximity mode	
Light mode		
Operation Mode	LS mode	Select the measurement mode. Select ambient light sensor (LS) mode or RGB color sensor (CS) mode.
	CS mode	
Interrupt Type	Threshold	Select an interrupt type.
	Variation	
Interrupt Source	Clear channel	Select the interrupt source. Red and blue of RGB channels are only valid in CS mode.
	Green channel	
	Red channel (CS mode only)	
	Blue channel (CS mode only)	
The Number of Similar Consecutive Interrupt Events	0x02	Sets the number of interrupt events. Any value from 0x00 to 0x0F is valid.
Sleep after Interrupt	Enabled	Select the Sleep function after interrupting.
	Disabled	
Gain	1	Select the Gain value.
	3	
	6	
Resolution and Measurement Period	Resolution:13bit. Measurement Period:200ms	Select a combination of the resolution of the measurement and the measurement period.
	Resolution:13bit. Measurement Period:500ms	
	Resolution:13bit. Measurement Period:1000ms	
	Resolution:13bit. Measurement Period:2000ms	
	Resolution:16bit. Measurement Period:25ms	
	Resolution:16bit. Measurement Period:50ms	
	Resolution:16bit. Measurement Period:100ms	
	Resolution:16bit. Measurement Period:200ms	
	Resolution:16bit. Measurement Period:500ms	
	Resolution:16bit. Measurement Period:1000ms	
	Resolution:16bit. Measurement Period:2000ms	

	Resolution:17bit. Measurement Period:50ms	
	Resolution:17bit. Measurement Period:100ms	
	Resolution:17bit. Measurement Period:200ms	
	Resolution:17bit. Measurement Period:500ms	
	Resolution:17bit. Measurement Period:1000ms	
	Resolution:17bit. Measurement Period:2000ms	
	Resolution:18bit. Measurement Period:100ms	
	Resolution:18bit. Measurement Period:200ms	
	Resolution:18bit. Measurement Period:500ms	
	Resolution:18bit. Measurement Period:1000ms	
	Resolution:18bit. Measurement Period:2000ms	
	Resolution:19bit. Measurement Period:200ms	
	Resolution:19bit. Measurement Period:500ms	
	Resolution:19bit. Measurement Period:1000ms	
	Resolution:19bit. Measurement Period:2000ms	
	Resolution:20bit. Measurement Period:500ms	
	Resolution:20bit. Measurement Period:1000ms	
	Resolution:20bit. Measurement Period:2000ms	
Upper Threshold	0x00CCC	Sets the upper threshold. Any value from 0x00000 to 0xFFFFF is valid.
Lower Threshold	0x00000	Sets the lower threshold. Any value from 0x00000 to 0xFFFFF is valid.
Variance Threshold	+/- 8 counts	Choose to threshold variance.
	+/- 16 counts	
	+/- 32 counts	
	+/- 64 counts	
	+/- 128 counts	
	+/- 256 counts	
	+/- 512 counts	
	+/- 1024 counts	
Proximity mode		
Interrupt Type	Normal	Select an interrupt type.
	Logic	
The Number of Similar Consecutive Interrupt Events	0x02	Sets the number of interrupt events. Any value from 0x00 to 0x0F is valid.
Sleep after Interrupt	Enabled	Selects the sleep feature to be enabled and disabled after interrupting.
	Disabled	

Gain	1	Select the Gain value.
	1.5	
	2	
	4	
LED Current	0x100	Sets the LED current value. Any value from 0x000 to 0x3FF is valid.
LED Order	IR LED first, Red LED second	Sets the order in which the LEDs are selected.
	RED LED first, IR LED second	
LED Analog Cancellation	Enabled (50% offset of the full-scale value)	Choose to enable and disable analog cancellation.
	Disabled	
LED Digital Cancellation	0x100	Set the digital cancellation value. Any value from 0x0000 to 0xFFFF is valid.
Number of LED pulses	1 pulses	Select the number of PULSES of LEDs.
	2 pulses	
	4 pulses	
	8 pulses	
	16 pulses	
	32 pulses	
Pulse Width and Measurement Period	Pulse width:26us. Measurement Period:3.125ms (except for the number 32 of LED pulses)	Select the pulse width and measurement period.
	Pulse width:26us. Measurement Period:6.25ms	
	Pulse width:26us. Measurement Period:12.5ms	
	Pulse width:26us. Measurement Period:25ms	
	Pulse width:26us. Measurement Period:50ms	
	Pulse width:26us. Measurement Period:100ms	
	Pulse width:26us. Measurement Period:200ms	
	Pulse width:26us. Measurement Period:400ms	
	Pulse width:42us. Measurement Period:3.125ms (except for the number 32 of LED pulses)	
	Pulse width:42us. Measurement Period:6.25ms	
	Pulse width:42us. Measurement Period:12.5ms	
	Pulse width:42us. Measurement Period:25ms	
	Pulse width:42us. Measurement Period:50ms	
	Pulse width:42us. Measurement Period:100ms	
	Pulse width:42us. Measurement Period:200ms	
	Pulse width:42us. Measurement Period:400ms	
Moving Average	Enabled	Choose to use moving averages.
	Disabled	

Hysteresis	0x00	Sets the value of hysteresis. Any value from 0x00 to 0x7F is valid.
Upper Threshold	0x0600	Sets the upper threshold. Any value from 0x0000 to 0xFFFF is valid.
Lower Threshold	0x0000	Sets the lower threshold. Any value from 0x0000 to 0xFFFF is valid.

5.1.2 RX Family

Select the r_ob1203_rx component on the [Component] tabbed page of the Smart Configurator, and the configurable items will be shown in the [Configure] panel.

The following items and values can be specified.

Table 5-6 OB1203 Settings for the RX Family MCU

Constant Name	Value	Description
Configurations		
RM_OB1203_CFG_PARAM_CHECKING_ENABLE	0 1	Specify whether to include the processing to check parameters in the code to be generated. When "0" is specified, the generated code does not include the processing to check parameters. When "1" is specified, the generated code includes the processing to check parameters.
RM_OB1203_CFG_DEVICE_NUM_MAX	1 2	Specify the number of OB1203 sensors.
RM_OB1203_CFG_DEVICE(x)_SENSOR_MODE (x = 0 – 1)	0 1 2 3 4	Specify OB1203 sensor operation mode. 0: Not selected 1: Light Sensor mode 2: Proximity Sensor mode 3: Light Proximity Sensor mode 4: PPG Sensor mode
RM_OB1203_CFG_DEVICE(x)_COMMS_INSTANCE (x = 0 – 1)	g_comms_i2c_device(y) (y = 0 – 4)	Specify the communications device number to be used by the sensor.
RM_OB1203_CFG_DEVICE(x)_COMMS_I2C_CALLBACK (x = 0 – 1)	ob1203_user_i2c_callback0	Specify the name of the I2C callback function.
RM_OB1203_CFG_DEVICE(x)_IRQ_CALLBACK (x = 0 – 1)	ob1203_user_irq_callback0	Specify the name of the external interrupt (IRQ) callback function.
RM_OB1203_CFG_DEVICE(x)_IRQ_NUMBER (x = 0 – 1)	IRQ(y) (y = 0 – 15)	Specify the number of the external interrupt (IRQ) pin.
RM_OB1203_CFG_DEVICE(x)_IRQ_TRIGGER (x = 0 – 1)	IRQ_TRIG_FALLING	Specify the trigger of the external interrupt (IRQ) pin.
RM_OB1203_CFG_DEVICE(x)_IRQ_ PRIORITY (x = 0 – 1)	IRQ_PRI_(y) (y = 0 - 15)	Specify the priority of the external interrupt (IRQ) pin.
RM_OB1203_CFG_DEVICE(x)_SEMAPHORE_TIMEOUT (x = 0 – 1)	0xFFFFFFFF	Specify the semaphore timeout.
RM_OB1203_CFG_DEVICE(x)_LIGHT_PROX_DEVIC	RM_OB1203_OPERATION_MODE_LIGHT	Specify OB1203 device interrupt.

E_INTERRUPT (x = 0 – 1)	RM_OB1203_OPERATION_MODE_PROXIMITY	
RM_OB1203_CFG_DEVICE(x)_PPG_PROX_GAIN (x = 0 – 1)	RM_OB1203_PPG_PROX_GAIN_1	Specify gain for PPG/Proximity Sensor mode.
	RM_OB1203_PPG_PROX_GAIN_1P5	
	RM_OB1203_PPG_PROX_GAIN_2	
	RM_OB1203_PPG_PROX_GAIN_4	
RM_OB1203_CFG_DEVICE(x)_LED_ORDER (x = 0 – 1)	RM_OB1203_LED_IR_FIRST_RED_SECOND	Specify LED order.
	RM_OB1203_LED_RED_FIRST_IR_SECOND	
RM_OB1203_CFG_DEVICE(x)_LIGHT_SENSOR_MODE (x = 0 – 1)	RM_OB1203_LIGHT_SENSOR_MODE_LS	Specify operation mode for Light Sensor mode.
	RM_OB1203_LIGHT_SENSOR_MODE_CS	
RM_OB1203_CFG_DEVICE(x)_LIGHT_INTERRUPT_TYPE (x = 0 – 1)	RM_OB1203_LIGHT_INTERRUPT_TYPE_THRESHOLD	Specify interrupt type for Light Sensor mode.
	RM_OB1203_LIGHT_INTERRUPT_TYPE_VARIATION	
RM_OB1203_CFG_DEVICE(x)_LIGHT_INTERRUPT_SOURCE (x = 0 – 1)	RM_OB1203_LIGHT_INTERRUPT_SOURCE_CLEAR_CHANNEL	Specify interrupt source for Light Sensor mode. (* Only CS mode)
	RM_OB1203_LIGHT_INTERRUPT_SOURCE_GREEN_CHANNEL	
	RM_OB1203_LIGHT_INTERRUPT_SOURCE_GREEN_CHANNEL	
	RM_OB1203_LIGHT_INTERRUPT_SOURCE_GREEN_CHANNEL	
RM_OB1203_CFG_DEVICE(x)_LIGHT_INTERRUPT_PERSIST (x = 0 – 1)	0x0 to 0x0F	Specify number of similar consecutive interrupt events for Light Senser mode.
RM_OB1203_CFG_DEVICE(x)_LIGHT_SLEEP_AFTER_INTERRUPT (x = 0 – 1)	RM_OB1203_SLEEP_AFTER_INTERRUPT_DISABLE	Specify sleep after interrupt for Light Sensor mode.
	RM_OB1203_SLEEP_AFTER_INTERRUPT_ENABLE	
RM_OB1203_CFG_DEVICE(x)_LIGHT_GAIN (x = 0 – 1)	RM_OB1203_LIGHT_GAIN_1	Specify gain for Light Sensor mode.
	RM_OB1203_LIGHT_GAIN_3	
	RM_OB1203_LIGHT_GAIN_6	
RM_OB1203_CFG_DEVICE(x)_LIGHT_RESOLUTION_PERIOD (x = 0 – 1)	RM_OB1203_LIGHT_RESOLUTION_13BIT_PERIOD_25MS	Specify resolution and measurement period for Light Sensor mode.
	RM_OB1203_LIGHT_RESOLUTION_13BIT_PERIOD_50MS	
	RM_OB1203_LIGHT_RESOLUTION_13BIT_PERIOD_100MS	
	RM_OB1203_LIGHT_RESOLUTION_13BIT_PERIOD_200MS	
	RM_OB1203_LIGHT_RESOLUTION_13BIT_PERIOD_500MS	
	RM_OB1203_LIGHT_RESOLUTION_13BIT_PERIOD_1000MS	

	RM_OB1203_LIGHT_RESOLUTION_13BIT_PERIOD_2000MS RM_OB1203_LIGHT_RESOLUTION_16BIT_PERIOD_25MS RM_OB1203_LIGHT_RESOLUTION_16BIT_PERIOD_50MS RM_OB1203_LIGHT_RESOLUTION_16BIT_PERIOD_100MS RM_OB1203_LIGHT_RESOLUTION_16BIT_PERIOD_200MS RM_OB1203_LIGHT_RESOLUTION_16BIT_PERIOD_500MS RM_OB1203_LIGHT_RESOLUTION_16BIT_PERIOD_1000MS RM_OB1203_LIGHT_RESOLUTION_16BIT_PERIOD_2000MS RM_OB1203_LIGHT_RESOLUTION_17BIT_PERIOD_50MS RM_OB1203_LIGHT_RESOLUTION_17BIT_PERIOD_100MS RM_OB1203_LIGHT_RESOLUTION_17BIT_PERIOD_200MS RM_OB1203_LIGHT_RESOLUTION_17BIT_PERIOD_500MS RM_OB1203_LIGHT_RESOLUTION_17BIT_PERIOD_1000MS RM_OB1203_LIGHT_RESOLUTION_17BIT_PERIOD_2000MS RM_OB1203_LIGHT_RESOLUTION_18BIT_PERIOD_100MS RM_OB1203_LIGHT_RESOLUTION_18BIT_PERIOD_200MS RM_OB1203_LIGHT_RESOLUTION_18BIT_PERIOD_500MS RM_OB1203_LIGHT_RESOLUTION_18BIT_PERIOD_1000MS RM_OB1203_LIGHT_RESOLUTION_18BIT_PERIOD_2000MS RM_OB1203_LIGHT_RESOLUTION_19BIT_PERIOD_200MS RM_OB1203_LIGHT_RESOLUTION_19BIT_PERIOD_500MS RM_OB1203_LIGHT_RESOLUTION_19BIT_PERIOD_1000MS RM_OB1203_LIGHT_RESOLUTION_19BIT_PERIOD_2000MS RM_OB1203_LIGHT_RESOLUTION_20BIT_PERIOD_500MS RM_OB1203_LIGHT_RESOLUTION_20BIT_PERIOD_1000MS RM_OB1203_LIGHT_RESOLUTION_20BIT_PERIOD_2000MS	
RM_OB1203_CFG_DEVICE0_LIGHT_UPPER_THRESHOLD (x = 0 – 1)	0x00000 to 0xFFFFF	Specify upper threshold of threshold interrupt for Light Sensor mode.
RM_OB1203_CFG_DEVICE(x)_LIGHT_LOWER_THRESHOLD (x = 0 – 1)	0x00000 to 0xFFFFF	Specify lower threshold of threshold interrupt for Light Sensor mode.
RM_OB1203_CFG_DEVICE(x)_LIGHT_VARIANCE_T	RM_OB1203_VARIANCE_THRESHOLD_8_COUNTS	Specify variance threshold of variance interrupt for Light Sensor mode.

HRESHOLD (x = 0 – 1)	RM_OB1203_VARIANCE_THRESHOLD_16_COUNTS	
	RM_OB1203_VARIANCE_THRESHOLD_32_COUNTS	
	RM_OB1203_VARIANCE_THRESHOLD_64_COUNTS	
	RM_OB1203_VARIANCE_THRESHOLD_128_COUNTS	
	RM_OB1203_VARIANCE_THRESHOLD_256_COUNTS	
	RM_OB1203_VARIANCE_THRESHOLD_512_COUNTS	
	RM_OB1203_VARIANCE_THRESHOLD_1024_COUNTS	
RM_OB1203_CFG_DEVICE(x)_PROX_INTERRUPT_TYPE (x = 0 – 1)	RM_OB1203_PROX_INTERRUPT_TYPE_NORMAL	Specify interrupt type for Proximity Sensor mode.
	RM_OB1203_PROX_INTERRUPT_TYPE_LOGIC	
RM_OB1203_CFG_DEVICE(x)_PROX_INTERRUPT_PERSIST	0x0 to 0xF	Specify number of similar consecutive interrupt events for Proximity Sensor mode.
RM_OB1203_CFG_DEVICE(x)_PROX_SLEEP_AFTER_INTERRUPT (x = 0 – 1)	RM_OB1203_SLEEP_AFTER_INTERRUPT_DISABLE	Specify sleep after interrupt for Proximity Sensor mode.
	RM_OB1203_SLEEP_AFTER_INTERRUPT_ENABLE	
RM_OB1203_CFG_DEVICE(x)_PROX_LED_CURRENT (x = 0 – 1)	0x000 to 0x3FF	Specify LED current for Proximity Sensor mode.
RM_OB1203_CFG_DEVICE(x)_PROX_ANA_CAN (x = 0 – 1)	RM_OB1203_ANALOG_CANCELLATION_DISABLE	Specify LED analog cancellation for Proximity Sensor mode.
	RM_OB1203_ANALOG_CANCELLATION_ENABLE	
RM_OB1203_CFG_DEVICE(x)_PROX_DIG_CAN (x = 0 – 1)	0x0000 to 0xFFFF	Specify LED digital cancellation for Proximity Sensor mode.
RM_OB1203_CFG_DEVICE(x)_PROX_NUM_LED_PULSES (x = 0 – 1)	RM_OB1203_NUM_LED_PULSES_1	Specify number of LED pulses for Proximity Sensor mode.
	RM_OB1203_NUM_LED_PULSES_2	
	RM_OB1203_NUM_LED_PULSES_4	
	RM_OB1203_NUM_LED_PULSES_8	
	RM_OB1203_NUM_LED_PULSES_16	
	RM_OB1203_NUM_LED_PULSES_32	
RM_OB1203_CFG_DEVICE(x)_PROX_WIDTH_PERIOD (x = 0 – 1)	RM_OB1203_PROX_WIDTH_26US_PERIOD_3P125MS	Specify pulse width and measurement period for Proximity Sensor mode.
	RM_OB1203_PROX_WIDTH_26US_PERIOD_6P25MS	
	RM_OB1203_PROX_WIDTH_26US_PERIOD_12P5MS	
	RM_OB1203_PROX_WIDTH_26US_PERIOD_25MS	

	RM_OB1203_PROX_WIDTH_26US_PERIOD_50MS	
	RM_OB1203_PROX_WIDTH_26US_PERIOD_100MS	
	RM_OB1203_PROX_WIDTH_26US_PERIOD_200MS	
	RM_OB1203_PROX_WIDTH_26US_PERIOD_400MS	
	RM_OB1203_PROX_WIDTH_42US_PERIOD_3P125MS	
	RM_OB1203_PROX_WIDTH_42US_PERIOD_6P25MS	
	RM_OB1203_PROX_WIDTH_42US_PERIOD_12P5MS	
	RM_OB1203_PROX_WIDTH_42US_PERIOD_25MS	
	RM_OB1203_PROX_WIDTH_42US_PERIOD_50MS	
	RM_OB1203_PROX_WIDTH_42US_PERIOD_100MS	
	RM_OB1203_PROX_WIDTH_42US_PERIOD_200MS	
	RM_OB1203_PROX_WIDTH_42US_PERIOD_400MS	
	RM_OB1203_PROX_WIDTH_71US_PERIOD_3P125MS	
	RM_OB1203_PROX_WIDTH_71US_PERIOD_6P25MS	
	RM_OB1203_PROX_WIDTH_71US_PERIOD_12P5MS	
	RM_OB1203_PROX_WIDTH_71US_PERIOD_25MS	
	RM_OB1203_PROX_WIDTH_71US_PERIOD_50MS	
	RM_OB1203_PROX_WIDTH_71US_PERIOD_100MS	
	RM_OB1203_PROX_WIDTH_71US_PERIOD_200MS	
	RM_OB1203_PROX_WIDTH_71US_PERIOD_400MS	
RM_OB1203_CFG_DEVICE(x)_PROX_MOVING_AVERAGE (x = 0 – 1)	RM_OB1203_MOVING_AVERAGE_DISABLE	Specify moving average for Proximity Sensor mode.
	RM_OB1203_MOVING_AVERAGE_ENABLE	
RM_OB1203_CFG_DEVICE(x)0_PROX_HYSTERESIS (x = 0 – 1)	0x00 to 0x7F	Specify hysteresis for Proximity Sensor mode.
RM_OB1203_CFG_DEVICE(x)_PROX_UPPER_THRESHOLD (x = 0 – 1)	0x0000 to 0xFFFF	Specify upper threshold of threshold interrupt for Proximity Sensor mode.
RM_OB1203_CFG_DEVICE(x)_PROX_LOWER_THRESHOLD (x = 0 – 1)	0x0000 to 0xFFFF	Specify lower threshold of threshold interrupt for Proximity Sensor mode.

RM_OB1203_CFG_DEVICE(x)_PPG_SENSOR_MODE (x = 0 – 1)	RM_OB1203_PPG_SENSOR_MODE_PPG1	Specify operation mode for PPG Sensor mode.
	RM_OB1203_PPG_SENSOR_MODE_PPG2	
RM_OB1203_CFG_DEVICE(x)_PPG_INTERRUPT_TYPE (x = 0 – 1)	RM_OB1203_PPG_INTERRUPT_TYPE_DATA	Specify interrupt type of PPG Sensor mode.
	RM_OB1203_PPG_INTERRUPT_TYPE_FIFO_AFULL	
RM_OB1203_CFG_DEVICE(x)_PPG_IR_LED_CURRENT (x = 0 – 1)	0x000 to 0x3FF	Specify IR LED current for PPG Sensor mode.
RM_OB1203_CFG_DEVICE(x)_PPG_RED_LED_CURRENT (x = 0 – 1)	0x000 to 0x1FF	Specify Red LED current for PPG Sensor mode.
RM_OB1203_CFG_DEVICE(x)_PPG_POWER_SAVE_MODE (x = 0 – 1)	RM_OB1203_POWER_SAVE_MODE_DISABLE	Specify power same mode for PPG Sensor mode.
	RM_OB1203_POWER_SAVE_MODE_ENABLE	
RM_OB1203_CFG_DEVICE(x)_PPG_IR_LED_ANA_CAN (x = 0 – 1)	RM_OB1203_ANALOG_CANCELLATION_DISABLE	Specify IR LED analog cancellation for PPG Sensor mode.
	RM_OB1203_ANALOG_CANCELLATION_ENABLE	
RM_OB1203_CFG_DEVICE(x)_PPG_RED_LED_ANA_CAN (x = 0 – 1)	RM_OB1203_ANALOG_CANCELLATION_DISABLE	Specify Red LED analog cancellation for PPG Sensor mode.
	RM_OB1203_ANALOG_CANCELLATION_ENABLE	
RM_OB1203_CFG_DEVICE(x)_PPG_NUM_AVERAGED_SAMPLES (x = 0 – 1)	RM_OB1203_NUM_AVERAGED_SAMPLES_1	Specify number of averaged PPG samples for PPG Sensor mode.
	RM_OB1203_NUM_AVERAGED_SAMPLES_2	
	RM_OB1203_NUM_AVERAGED_SAMPLES_4	
	RM_OB1203_NUM_AVERAGED_SAMPLES_8	
	RM_OB1203_NUM_AVERAGED_SAMPLES_16	
	RM_OB1203_NUM_AVERAGED_SAMPLES_32	
RM_OB1203_CFG_DEVICE(x)_PPG_WIDTH_PERIOD (x = 0 – 1)	RM_OB1203_PPG_WIDTH_130US_PERIOD_0P3125MS	Specify pulse width and measurement period for PPG Sensor mode.
	RM_OB1203_PPG_WIDTH_130US_PERIOD_0P625MS	
	RM_OB1203_PPG_WIDTH_130US_PERIOD_1MS	
	RM_OB1203_PPG_WIDTH_130US_PERIOD_1P25MS	
	RM_OB1203_PPG_WIDTH_130US_PERIOD_2P5MS	
	RM_OB1203_PPG_WIDTH_130US_PERIOD_5MS	
	RM_OB1203_PPG_WIDTH_130US_PERIOD_10MS	
	RM_OB1203_PPG_WIDTH_130US_PERIOD_20MS	

	RM_OB1203_PPG_WIDTH_247US_PERIOD_0P625MS	
	RM_OB1203_PPG_WIDTH_247US_PERIOD_1MS	
	RM_OB1203_PPG_WIDTH_247US_PERIOD_1P25MS	
	RM_OB1203_PPG_WIDTH_247US_PERIOD_2P5MS	
	RM_OB1203_PPG_WIDTH_247US_PERIOD_5MS	
	RM_OB1203_PPG_WIDTH_247US_PERIOD_10MS	
	RM_OB1203_PPG_WIDTH_247US_PERIOD_20MS	
	RM_OB1203_PPG_WIDTH_481US_PERIOD_1MS	
	RM_OB1203_PPG_WIDTH_481US_PERIOD_1P25MS	
	RM_OB1203_PPG_WIDTH_481US_PERIOD_2P5MS	
	RM_OB1203_PPG_WIDTH_481US_PERIOD_5MS	
	RM_OB1203_PPG_WIDTH_481US_PERIOD_10MS	
	RM_OB1203_PPG_WIDTH_481US_PERIOD_20MS	
	RM_OB1203_PPG_WIDTH_949US_PERIOD_2P5MS	
	RM_OB1203_PPG_WIDTH_949US_PERIOD_5MS	
	RM_OB1203_PPG_WIDTH_949US_PERIOD_10MS	
	RM_OB1203_PPG_WIDTH_949US_PERIOD_20MS	
RM_OB1203_CFG_DEVICE(x)_PPG_FIFO_ROLLOVER (x = 0 – 1)	RM_OB1203_FIFO_ROLLOVER_DISABLE	Specify FIFO rollover for PPG Sensor mode.
	RM_OB1203_FIFO_ROLLOVER_ENABLE	
RM_OB1203_CFG_DEVICE(x)_PPG_FIFO_EMPTY_NUM (x = 0 – 1)	0x0 to 0x0F	Specify FIFO almost full value for PPG Sensor mode.

5.1.3 RL78 Family

Settings can be modified by changing the values of constants defined in the \r_config\r_ob1203 _rl_config.h file in the project tree of the sample project.

The following items and values can be specified.

Table 5-7 OB1203 Settings for the RL78 Family MCU

Constant Name	Value	Description
Configurations		
RM_OB1203_CFG_PARAM_CHECKING_ENABLE	0 1	Specify whether to include the processing to check parameters in the code to be generated. When "0" is specified, the generated code does not include the processing to check parameters. When "1" is specified, the generated code includes the processing to check parameters.
RM_OB1203_CFG_DEVICE_NUM_MAX	1 2	Specify the number of OB1203 sensors.
RM_OB1203_CFG_DEVICE(x)_SENSOR_MODE (x = 0 – 1)	0 1 2 3 4	Specify OB1203 sensor operation mode. 0: Not selected 1: Light Sensor mode 2: Proximity Sensor mode 3: Light Proximity Sensor mode 4: PPG Sensor mode
RM_OB1203_CFG_DEVICE(x)_COMMS_INSTANCE (x = 0 – 1)	g_comms_i2c_device(y) (y = 0 – 4)	Specify the communications device number to be used by the sensor.
RM_OB1203_CFG_DEVICE(x)_COMMS_I2C_CALLBACK (x = 0 – 1)	Ob1203_user_i2c_callback0	Specify the name of the I2C callback function.
RM_OB1203_CFG_DEVICE(x)_IRQ_ENABLE (x = 0 – 1)	Disable Enabled	Enable or disable external interrupts (INTC).
RM_OB1203_CFG_DEVICE(x)_IRQ_CALLBACK (x = 0 – 1)	ob1203_user_irq_callback0	Specify the name of the external interrupt (INTC) callback function.
RM_OB1203_CFG_DEVICE(x)_IRQ_NUMBER (x = 0 – 1)	INTC(y) (y = 0 – 11)	Specify the number of the external interrupt (INTC) pin.
RM_OB1203_CFG_DEVICE(x)_LIGHT_PROX_DEVICE_INTERRUPT (x = 0 – 1)	RM_OB1203_OPERATION_MODE_LIGHT RM_OB1203_OPERATION_MODE_PROXIMITY	Specify OB1203 device interrupt.
RM_OB1203_CFG_DEVICE(x)_PPG_PROX_GAIN (x = 0 – 1)	RM_OB1203_PPG_PROX_GAIN_1 RM_OB1203_PPG_PROX_GAIN_1P5 RM_OB1203_PPG_PROX_GAIN_2 RM_OB1203_PPG_PROX_GAIN_4	Specify gain for PPG/Proximity Sensor mode.

RM_OB1203_CFG_DEVICE(x)_LED_ORDER (x = 0 – 1)	RM_OB1203_LED_IR_FIRST_RED_SECOND	Specify LED order.
	RM_OB1203_LED_RED_FIRST_IR_SECOND	
RM_OB1203_CFG_DEVICE(x)_LIGHT_SENSOR_MODE (x = 0 – 1)	RM_OB1203_LIGHT_SENSOR_MODE_LS	Specify operation mode for Light Sensor mode.
	RM_OB1203_LIGHT_SENSOR_MODE_CS	
RM_OB1203_CFG_DEVICE(x)_LIGHT_INTERRUPT_TYPE (x = 0 – 1)	RM_OB1203_LIGHT_INTERRUPT_TYPE_THRESHOLD	Specify interrupt type for Light Sensor mode.
	RM_OB1203_LIGHT_INTERRUPT_TYPE_VARIATION	
RM_OB1203_CFG_DEVICE(x)_LIGHT_INTERRUPT_SOURCE (x = 0 – 1)	RM_OB1203_LIGHT_INTERRUPT_SOURCE_CLEAR_CHANNEL	Specify interrupt source for Light Sensor mode. (* Only CS mode)
	RM_OB1203_LIGHT_INTERRUPT_SOURCE_GREEN_CHANNEL	
	RM_OB1203_LIGHT_INTERRUPT_SOURCE_GREEN_CHANNEL	
	RM_OB1203_LIGHT_INTERRUPT_SOURCE_GREEN_CHANNEL	
RM_OB1203_CFG_DEVICE(x)_LIGHT_INTERRUPT_PERSIST (x = 0 – 1)	0x0 to 0x0F	Specify number of similar consecutive interrupt events for Light Senser mode.
RM_OB1203_CFG_DEVICE(x)_LIGHT_SLEEP_AFTER_INTERRUPT (x = 0 – 1)	RM_OB1203_SLEEP_AFTER_INTERRUPT_DISABLE	Specify sleep after interrupt for Light Sensor mode.
	RM_OB1203_SLEEP_AFTER_INTERRUPT_ENABLE	
RM_OB1203_CFG_DEVICE(x)_LIGHT_GAIN (x = 0 – 1)	RM_OB1203_LIGHT_GAIN_1	Specify gain for Light Sensor mode.
	RM_OB1203_LIGHT_GAIN_3	
	RM_OB1203_LIGHT_GAIN_6	
RM_OB1203_CFG_DEVICE(x)_LIGHT_RESOLUTION_PERIOD (x = 0 – 1)	RM_OB1203_LIGHT_RESOLUTION_13BIT_PERIOD_25MS	Specify resolution and measurement period for Light Sensor mode.
	RM_OB1203_LIGHT_RESOLUTION_13BIT_PERIOD_50MS	
	RM_OB1203_LIGHT_RESOLUTION_13BIT_PERIOD_100MS	
	RM_OB1203_LIGHT_RESOLUTION_13BIT_PERIOD_200MS	
	RM_OB1203_LIGHT_RESOLUTION_13BIT_PERIOD_500MS	
	RM_OB1203_LIGHT_RESOLUTION_13BIT_PERIOD_1000MS	
	RM_OB1203_LIGHT_RESOLUTION_13BIT_PERIOD_2000MS	
	RM_OB1203_LIGHT_RESOLUTION_16BIT_PERIOD_25MS	
	RM_OB1203_LIGHT_RESOLUTION_16BIT_PERIOD_50MS	
	RM_OB1203_LIGHT_RESOLUTION_16BIT_PERIOD_100MS	
	RM_OB1203_LIGHT_RESOLUTION_16BIT_PERIOD_200MS	
	RM_OB1203_LIGHT_RESOLUTION_16BIT_PERIOD_500MS	

	RM_OB1203_LIGHT_RESOLUTION_16BIT_PERIOD_1000MS	
	RM_OB1203_LIGHT_RESOLUTION_16BIT_PERIOD_2000MS	
	RM_OB1203_LIGHT_RESOLUTION_17BIT_PERIOD_50MS	
	RM_OB1203_LIGHT_RESOLUTION_17BIT_PERIOD_100MS	
	RM_OB1203_LIGHT_RESOLUTION_17BIT_PERIOD_200MS	
	RM_OB1203_LIGHT_RESOLUTION_17BIT_PERIOD_500MS	
	RM_OB1203_LIGHT_RESOLUTION_17BIT_PERIOD_1000MS	
	RM_OB1203_LIGHT_RESOLUTION_17BIT_PERIOD_2000MS	
	RM_OB1203_LIGHT_RESOLUTION_18BIT_PERIOD_100MS	
	RM_OB1203_LIGHT_RESOLUTION_18BIT_PERIOD_200MS	
	RM_OB1203_LIGHT_RESOLUTION_18BIT_PERIOD_500MS	
	RM_OB1203_LIGHT_RESOLUTION_18BIT_PERIOD_1000MS	
	RM_OB1203_LIGHT_RESOLUTION_18BIT_PERIOD_2000MS	
	RM_OB1203_LIGHT_RESOLUTION_19BIT_PERIOD_200MS	
	RM_OB1203_LIGHT_RESOLUTION_19BIT_PERIOD_500MS	
	RM_OB1203_LIGHT_RESOLUTION_19BIT_PERIOD_1000MS	
	RM_OB1203_LIGHT_RESOLUTION_19BIT_PERIOD_2000MS	
	RM_OB1203_LIGHT_RESOLUTION_20BIT_PERIOD_500MS	
	RM_OB1203_LIGHT_RESOLUTION_20BIT_PERIOD_1000MS	
	RM_OB1203_LIGHT_RESOLUTION_20BIT_PERIOD_2000MS	
RM_OB1203_CFG_DEVICE0_LIGHT_UPPER_THRESHOLD (x = 0 – 1)	0x00000 to 0xFFFFF	Specify upper threshold of threshold interrupt for Light Sensor mode.
RM_OB1203_CFG_DEVICE(x)_LIGHT_LOWER_THRESHOLD (x = 0 – 1)	0x00000 to 0xFFFFF	Specify lower threshold of threshold interrupt for Light Sensor mode.
RM_OB1203_CFG_DEVICE(x)_LIGHT_VARIANCE_THRESHOLD (x = 0 – 1)	RM_OB1203_VARIANCE_THRESHOLD_8_COUNTS	Specify variance threshold of variance interrupt for Light Sensor mode.
	RM_OB1203_VARIANCE_THRESHOLD_16_COUNTS	
	RM_OB1203_VARIANCE_THRESHOLD_32_COUNTS	
	RM_OB1203_VARIANCE_THRESHOLD_64_COUNTS	
	RM_OB1203_VARIANCE_THRESHOLD_128_COUNTS	
	RM_OB1203_VARIANCE_THRESHOLD_256_COUNTS	
	RM_OB1203_VARIANCE_THRESHOLD_512_COUNTS	

	RM_OB1203_VARIANCE_THRESHOLD_1024_COUNTS	
RM_OB1203_CFG_DEVICE(x)_PROX_INTERRUPT_TYPE (x = 0 – 1)	RM_OB1203_PROX_INTERRUPT_TYPE_NORMAL	Specify interrupt type for Proximity Sensor mode.
	RM_OB1203_PROX_INTERRUPT_TYPE_LOGIC	
RM_OB1203_CFG_DEVICE(x)_PROX_INTERRUPT_PERSIST	0x0 to 0xF	Specify number of similar consecutive interrupt events for Proximity Sensor mode.
RM_OB1203_CFG_DEVICE(x)_PROX_SLEEP_AFTER_INTERRUPT (x = 0 – 1)	RM_OB1203_SLEEP_AFTER_INTERRUPT_DISABLE	Specify sleep after interrupt for Proximity Sensor mode.
	RM_OB1203_SLEEP_AFTER_INTERRUPT_ENABLE	
RM_OB1203_CFG_DEVICE(x)_PROX_LED_CURRENT (x = 0 – 1)	0x000 to 0x3FF	Specify LED current for Proximity Sensor mode.
RM_OB1203_CFG_DEVICE(x)_PROX_ANA_CAN (x = 0 – 1)	RM_OB1203_ANALOG_CANCELLATION_DISABLE	Specify LED analog cancellation for Proximity Sensor mode.
	RM_OB1203_ANALOG_CANCELLATION_ENABLE	
RM_OB1203_CFG_DEVICE(x)_PROX_DIG_CAN (x = 0 – 1)	0x0000 to 0xFFFF	Specify LED digital cancellation for Proximity Sensor mode.
RM_OB1203_CFG_DEVICE(x)_PROX_NUM_LED_PULSES (x = 0 – 1)	RM_OB1203_NUM_LED_PULSES_1	Specify number of LED pulses for Proximity Sensor mode.
	RM_OB1203_NUM_LED_PULSES_2	
	RM_OB1203_NUM_LED_PULSES_4	
	RM_OB1203_NUM_LED_PULSES_8	
	RM_OB1203_NUM_LED_PULSES_16	
	RM_OB1203_NUM_LED_PULSES_32	
RM_OB1203_CFG_DEVICE(x)_PROX_WIDTH_PERIOD (x = 0 – 1)	RM_OB1203_PROX_WIDTH_26US_PERIOD_3P125MS	Specify pulse width and measurement period for Proximity Sensor mode.
	RM_OB1203_PROX_WIDTH_26US_PERIOD_6P25MS	
	RM_OB1203_PROX_WIDTH_26US_PERIOD_12P5MS	
	RM_OB1203_PROX_WIDTH_26US_PERIOD_25MS	
	RM_OB1203_PROX_WIDTH_26US_PERIOD_50MS	
	RM_OB1203_PROX_WIDTH_26US_PERIOD_100MS	
	RM_OB1203_PROX_WIDTH_26US_PERIOD_200MS	
	RM_OB1203_PROX_WIDTH_26US_PERIOD_400MS	
	RM_OB1203_PROX_WIDTH_42US_PERIOD_3P125MS	
	RM_OB1203_PROX_WIDTH_42US_PERIOD_6P25MS	

	RM_OB1203_PROX_WIDTH_42US_PERIOD_12P5MS	
	RM_OB1203_PROX_WIDTH_42US_PERIOD_25MS	
	RM_OB1203_PROX_WIDTH_42US_PERIOD_50MS	
	RM_OB1203_PROX_WIDTH_42US_PERIOD_100MS	
	RM_OB1203_PROX_WIDTH_42US_PERIOD_200MS	
	RM_OB1203_PROX_WIDTH_42US_PERIOD_400MS	
	RM_OB1203_PROX_WIDTH_71US_PERIOD_3P125MS	
	RM_OB1203_PROX_WIDTH_71US_PERIOD_6P25MS	
	RM_OB1203_PROX_WIDTH_71US_PERIOD_12P5MS	
	RM_OB1203_PROX_WIDTH_71US_PERIOD_25MS	
	RM_OB1203_PROX_WIDTH_71US_PERIOD_50MS	
	RM_OB1203_PROX_WIDTH_71US_PERIOD_100MS	
	RM_OB1203_PROX_WIDTH_71US_PERIOD_200MS	
	RM_OB1203_PROX_WIDTH_71US_PERIOD_400MS	
RM_OB1203_CFG_DEVICE(x)_PROX_MOVING_AVERAGE (x = 0 – 1)	RM_OB1203_MOVING_AVERAGE_DISABLE	Specify moving average for Proximity Sensor mode.
	RM_OB1203_MOVING_AVERAGE_ENABLE	
RM_OB1203_CFG_DEVICE(x)0_PROX_HYSTERESIS (x = 0 – 1)	0x00 to 0x7F	Specify hysteresis for Proximity Sensor mode.
RM_OB1203_CFG_DEVICE(x)_PROX_UPPER_THRESHOLD (x = 0 – 1)	0x0000 to 0xFFFF	Specify upper threshold of threshold interrupt for Proximity Sensor mode.
RM_OB1203_CFG_DEVICE(x)_PROX_LOWER_THRESHOLD (x = 0 – 1)	0x0000 to 0xFFFF	Specify lower threshold of threshold interrupt for Proximity Sensor mode.
RM_OB1203_CFG_DEVICE(x)_PPG_SENSOR_MODE (x = 0 – 1)	RM_OB1203_PPG_SENSOR_MODE_PPG1	Specify operation mode for PPG Sensor mode.
	RM_OB1203_PPG_SENSOR_MODE_PPG2	
RM_OB1203_CFG_DEVICE(x)_PPG_INTERRUPT_TYPE (x = 0 – 1)	RM_OB1203_PPG_INTERRUPT_TYPE_DATA	Specify interrupt type of PPG Sensor mode.
	RM_OB1203_PPG_INTERRUPT_TYPE_FIFO_AFULL	
RM_OB1203_CFG_DEVICE(x)_PPG_IR_LED_CURRENT (x = 0 – 1)	0x000 to 0x3FF	Specify IR LED current for PPG Sensor mode.

RM_OB1203_CFG_DEVICE(x)_PPG_RED_LED_CURRENT (x = 0 – 1)	0x000 to 0x1FF	Specify Red LED current for PPG Sensor mode.
RM_OB1203_CFG_DEVICE(x)_PPG_POWER_SAVE_MODE (x = 0 – 1)	RM_OB1203_POWER_SAVE_MODE_DISABLE RM_OB1203_POWER_SAVE_MODE_ENABLE	Specify power same mode for PPG Sensor mode.
RM_OB1203_CFG_DEVICE(x)_PPG_IR_LED_ANA_CAN (x = 0 – 1)	RM_OB1203_ANALOG_CANCELLATION_DISABLE RM_OB1203_ANALOG_CANCELLATION_ENABLE	Specify IR LED analog cancellation for PPG Sensor mode.
RM_OB1203_CFG_DEVICE(x)_PPG_RED_LED_ANA_CAN (x = 0 – 1)	RM_OB1203_ANALOG_CANCELLATION_DISABLE RM_OB1203_ANALOG_CANCELLATION_ENABLE	Specify Red LED analog cancellation for PPG Sensor mode.
RM_OB1203_CFG_DEVICE(x)_PPG_NUM_AVERAGED_SAMPLES (x = 0 – 1)	RM_OB1203_NUM_AVERAGED_SAMPLES_1 RM_OB1203_NUM_AVERAGED_SAMPLES_2 RM_OB1203_NUM_AVERAGED_SAMPLES_4 RM_OB1203_NUM_AVERAGED_SAMPLES_8 RM_OB1203_NUM_AVERAGED_SAMPLES_16 RM_OB1203_NUM_AVERAGED_SAMPLES_32	Specify number of averaged PPG samples for PPG Sensor mode.
RM_OB1203_CFG_DEVICE(x)_PPG_WIDTH_PERIOD (x = 0 – 1)	RM_OB1203_PPG_WIDTH_130US_PERIOD_0P3125MS RM_OB1203_PPG_WIDTH_130US_PERIOD_0P625MS RM_OB1203_PPG_WIDTH_130US_PERIOD_1MS RM_OB1203_PPG_WIDTH_130US_PERIOD_1P25MS RM_OB1203_PPG_WIDTH_130US_PERIOD_2P5MS RM_OB1203_PPG_WIDTH_130US_PERIOD_5MS RM_OB1203_PPG_WIDTH_130US_PERIOD_10MS RM_OB1203_PPG_WIDTH_130US_PERIOD_20MS RM_OB1203_PPG_WIDTH_247US_PERIOD_0P625MS RM_OB1203_PPG_WIDTH_247US_PERIOD_1MS RM_OB1203_PPG_WIDTH_247US_PERIOD_1P25MS RM_OB1203_PPG_WIDTH_247US_PERIOD_2P5MS RM_OB1203_PPG_WIDTH_247US_PERIOD_5MS RM_OB1203_PPG_WIDTH_247US_PERIOD_10MS	Specify pulse width and measurement period for PPG Sensor mode.

	RM_OB1203_PPG_WIDTH_247US_PERIOD_20MS	
	RM_OB1203_PPG_WIDTH_481US_PERIOD_1MS	
	RM_OB1203_PPG_WIDTH_481US_PERIOD_1P25MS	
	RM_OB1203_PPG_WIDTH_481US_PERIOD_2P5MS	
	RM_OB1203_PPG_WIDTH_481US_PERIOD_5MS	
	RM_OB1203_PPG_WIDTH_481US_PERIOD_10MS	
	RM_OB1203_PPG_WIDTH_481US_PERIOD_20MS	
	RM_OB1203_PPG_WIDTH_949US_PERIOD_2P5MS	
	RM_OB1203_PPG_WIDTH_949US_PERIOD_5MS	
	RM_OB1203_PPG_WIDTH_949US_PERIOD_10MS	
	RM_OB1203_PPG_WIDTH_949US_PERIOD_20MS	
RM_OB1203_CFG_DEVICE(x)_PPG_FIFO_ROLLOVER (x = 0 – 1)	RM_OB1203_FIFO_ROLLOVER_DISABLE	Specify FIFO rollover for PPG Sensor mode.
	RM_OB1203_FIFO_ROLLOVER_ENABLE	
RM_OB1203_CFG_DEVICE(x)_PPG_FIFO_EMPTY_NUM (x = 0 – 1)	0x0 to 0x0F	Specify FIFO almost full value for PPG Sensor mode.

5.1.4 RE01 256KB or 1500KB Group

Select the rm_ob1203 stack on the [Stacks] tabbed page of the SDK Configurator, and the configurable items will be shown on the [Properties] tabbed page.

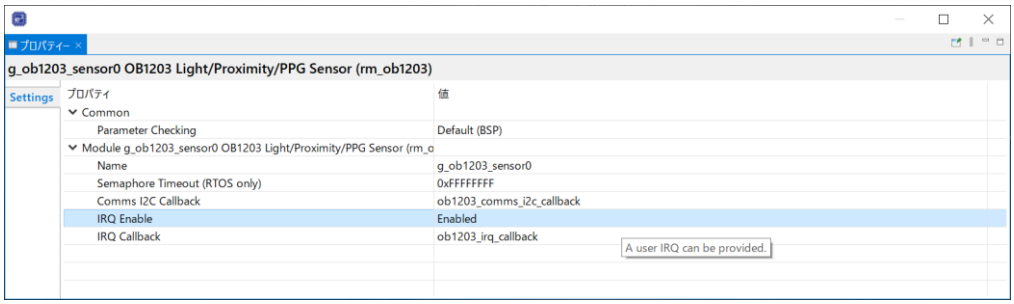
The following items and values can be specified.

Table 5-8 OB1203 Settings for the RE01 256KB or 1500KB Group MCU

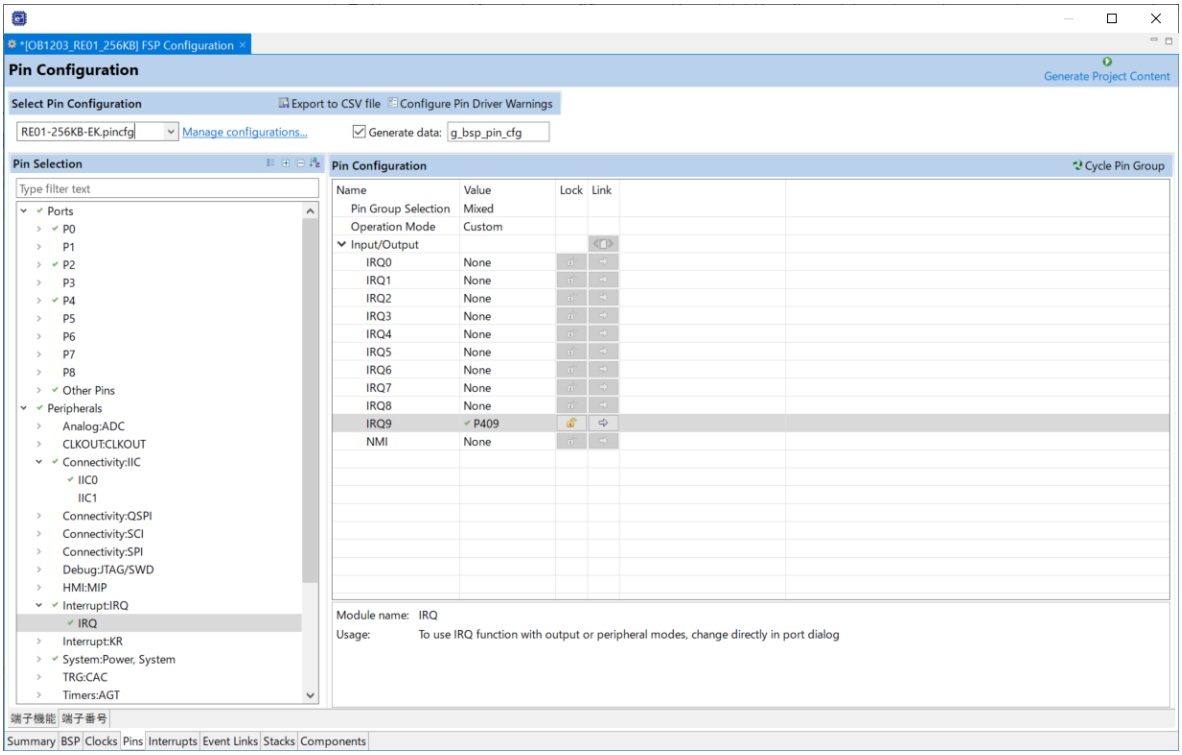
Configurable Item	Value	Description
Common		
Parameter Checking	Default (BSP) Enabled Disabled	Specify whether to include the processing to check parameters in the code to be generated. When "Disabled" is selected, the generated code does not include the processing to check parameters. When "Enabled" is selected, the generated code includes the processing to check parameters.
Module g_ob1203_sensor OB1203 Light/Proximity/PPG Sensor (rm_ob1203)		
Name	g_ob1203_sensor0	Specify the name of the module. A module name conforming to the C language standard can be specified.
Semaphore Timeout (RTOS only)	0xFFFFFFFF	For an RTOS project, specify the time of semaphore timeout.
Comms I2C Callback	ob1203_comms_i2c_callback	Specify the name of the user callback function. A callback function name conforming to the C language standard can be specified. When "NULL" is specified, no callback function is used.
IRQ Enable	Disable Enable	Enable IRQ interrupts. When "Enable" is selected, jumper settings on the board and interrupt settings through the SDK Configurator are required. The configuration method is described below.*
IRQ Callback	ob1203_irq_callback	Specify the name of the IRQ user callback function. A callback function name conforming to the C language standard can be specified. When "NULL" is specified, no callback function is used.

Note: * OB1203 IRQ interrupt settings are added through the SDK Configurator.

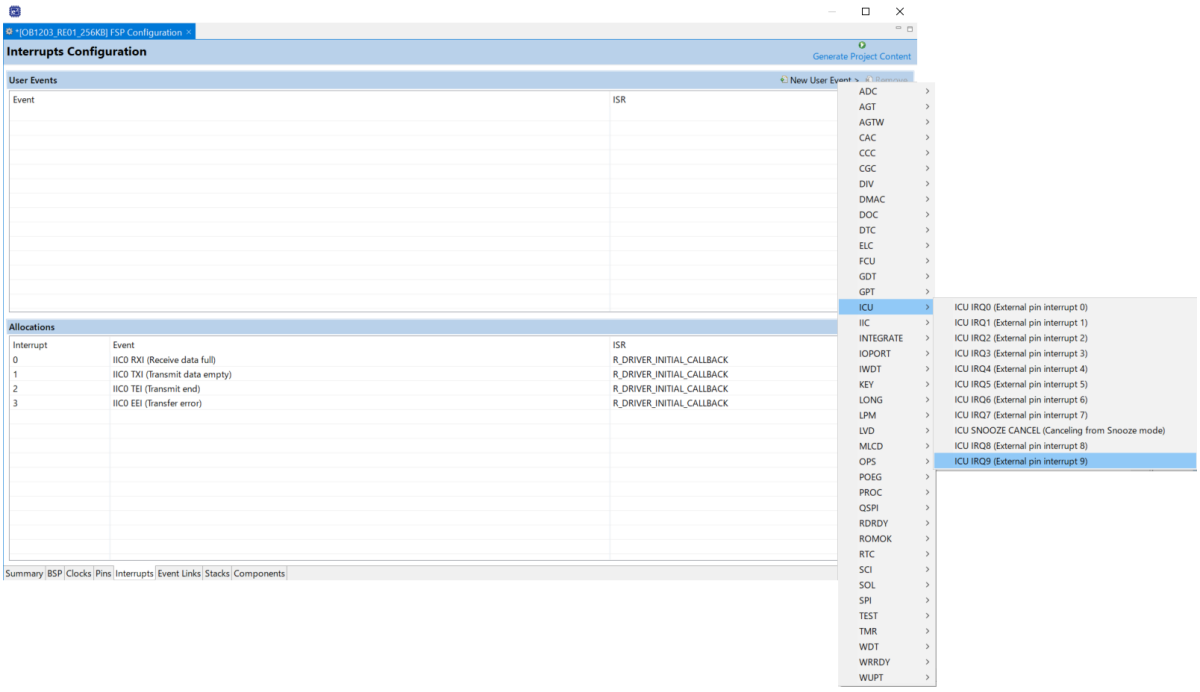
1. Set "IRQ Enable" to "Enable" in the properties of the g_ob1203_sensor OB1203 Light/Proximity/PPG Sensor on the [Stacks] tabbed page.



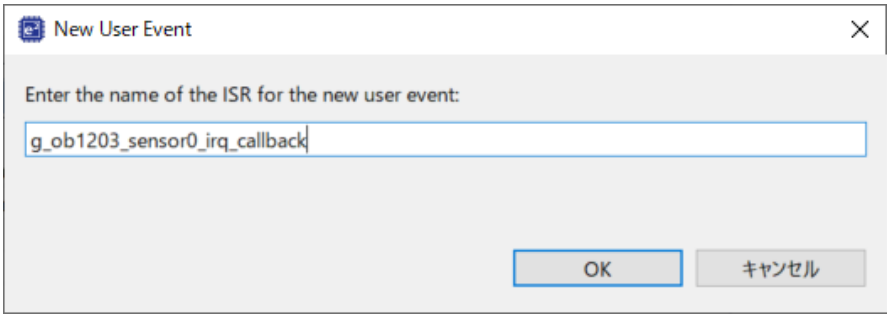
2. On the [Pins] tabbed page, select "Interrupt:IRQ" → "IRQ" in [Pin Selection], and set the IRQ of the port connected by a jumper in [Pin Configuration].



3. On the [Interrupts] tabbed page, select the ICU from [New User Event] in [User Events] and select the IRQ you set on the [Pins] tabbed page.



4. In the "Enter the name of ISR for the new user event:" dialog box, add " g_ob1203_sensor0_irq_callback " (naming is “module name”_irq_callback) to set the CMSIS interrupt.



5. Press the [General Project Content] button in the SDK Configurator to generate code.

Rewrite the six line of the sample project "RE_OB1203.c" to the IRQ number of the port connected by a jumper.

#define DEMO_EVENT_PORT_IRQ_NUM (SYSTEM_CFG_EVENT_NUMBER_PORT_IRQ9)

5.1.4.1 Light mode settings

Select the rm_ob1203 Light mode stack in the "Stack" tabbed page of the SDK Configurator, and the configurable items are shown in the "Properties" tabbed page.

The following items and values can be specified.

Table 5-9 OB1203 Light mode Settings for RE01 256KB / 1500KB Group MCU

Configurable Item	Value	Description
Module OB1203 Light mode (rm_ob1203)		
Operation Mode	LS mode	Select the measurement mode. Select ambient light sensor (LS) mode or RGB color sensor (CS) mode.
	CS mode	
Interrupt Type	Threshold	Select an interrupt type.
	Variation	
Interrupt Source	Clear channel	Select the interrupt source. Red and blue of RGB channels are only valid in CS mode.
	Green channel	
	Red channel (CS mode only)	
	Blue channel (CS mode only)	
The Number of Similar Consecutive Interrupt Events	0x02	Sets the number of interrupt events. Values range from 0x00 to 0x0F.
Sleep after Interrupt	Enabled	Select the Sleep function after interrupting.
	Disabled	
Gain	1	Select the Gain value.
	3	
	6	
Resolution and Measurement Period	Resolution:13bit. Measurement Period:200ms	Select a combination of the resolution of the measurement and the measurement period.
	Resolution:13bit. Measurement Period:500ms	
	Resolution:13bit. Measurement Period:1000ms	
	Resolution:13bit. Measurement Period:2000ms	
	Resolution:16bit. Measurement Period:25ms	
	Resolution:16bit. Measurement Period:50ms	
	Resolution:16bit. Measurement Period:100ms	
	Resolution:16bit. Measurement Period:200ms	
	Resolution:16bit. Measurement Period:500ms	
	Resolution:16bit. Measurement Period:1000ms	
	Resolution:16bit. Measurement Period:2000ms	
	Resolution:17bit. Measurement Period:50ms	
	Resolution:17bit. Measurement Period:100ms	
	Resolution:17bit. Measurement Period:200ms	

	Resolution:17bit. Measurement Period:500ms	
	Resolution:17bit. Measurement Period:1000ms	
	Resolution:17bit. Measurement Period:2000ms	
	Resolution:18bit. Measurement Period:100ms	
	Resolution:18bit. Measurement Period:200ms	
	Resolution:18bit. Measurement Period:500ms	
	Resolution:18bit. Measurement Period:1000ms	
	Resolution:18bit. Measurement Period:2000ms	
	Resolution:19bit. Measurement Period:200ms	
	Resolution:19bit. Measurement Period:500ms	
	Resolution:19bit. Measurement Period:1000ms	
	Resolution:19bit. Measurement Period:2000ms	
	Resolution:20bit. Measurement Period:500ms	
	Resolution:20bit. Measurement Period:1000ms	
	Resolution:20bit. Measurement Period:2000ms	
Upper Threshold	0x00CCC	Sets the upper threshold. Any value from 0x00000 to 0xFFFFF is valid.
Lower Threshold	0x00000	Sets the lower threshold. Any value from 0x00000 to 0xFFFFF is valid.
Variance Threshold	+/- 8 counts	Choose to threshold variance.
	+/- 16 counts	
	+/- 32 counts	
	+/- 64 counts	
	+/- 128 counts	
	+/- 256 counts	
	+/- 512 counts	
	+/- 1024 counts	

5.1.4.3 PPG mode settings

Select the rm_ob1203 PPG mode stack in the "Stack" tabbed page of the SDK Configurator, and the configurable items are shown in the "Properties" tabbed page.

The following items and values can be specified.

Table 5-10 OB1203 PPG mode Settings for RE01 256KB / 1500KB Group MCU

Configurable Item	Value	Description
Module OB1203 PPG mode (rm_ob1203)		
Operation Mode	PPG1 mode	Select the measurement mode. PPG1 operates with RED or IR, and PPG2 interleaves in IR and RED order.
	PPG2 mode	
Interrupt Type	Data	Select an interrupt type.
	FIFO Almost Full	
Gain	1	Select the Gain value.
	1.5	
	2	
	4	
IR LED Current	0x366	Sets the current value of the IR LED. Any value from 0x000 to 0x3FF is valid.
Red LED Current	0x1B3	Sets the current value of the RED LED. Any value from 0x000 to 0x1FF is valid.
Power Save Mode	Enabled	Select Power Save Mode on or off.
	Disabled	
LED Order	IR LED first, Red LED second	Sets the order in which the LEDs are selected.
	RED LED first, IR LED second	
IR LED Analog Cancellation	Enabled (50% offset of the full-scale value)	Select Enable and disable analog cancellation for IR LEDs.
	Disabled	
Red LED Analog Cancellation	Enabled (50% offset of the full-scale value)	Select Enable and disable red LED analog cancellation.
	Disabled	
Number of Averaged PPG Samples	1 (No averaging)	Select the number of PPG samples to average.
	2 consecutives samples are averaged	
	4 consecutives samples are averaged	
	8 consecutives samples are averaged	
	16 consecutives samples are averaged	
	32 consecutives samples are averaged	
Pulse Width and Measurement Period	Pulse width:130us. Measurement Period:0.3125ms (PPG1 mode only)	Select the pulse width and measurement period.
	Pulse width:130us. Measurement Period:0.625ms	
	Pulse width:130us. Measurement Period:1ms	
	Pulse width:130us. Measurement Period:1.25ms	
	Pulse width:130us. Measurement Period:2.5ms	

	Pulse width:130us. Measurement Period:5ms	
	Pulse width:130us. Measurement Period:10ms	
	Pulse width:130us. Measurement Period:20ms	
	Pulse width:247us. Measurement Period:0.625ms (PPG1 mode only)	
	Pulse width:247us. Measurement Period:1ms	
	Pulse width:247us. Measurement Period:1.25ms	
	Pulse width:247us. Measurement Period:2.5ms	
	Pulse width:247us. Measurement Period:5ms	
	Pulse width:247us. Measurement Period:10ms	
	Pulse width:247us. Measurement Period:20ms	
	Pulse width:481us. Measurement Period:1ms (PPG1 mode only)	
	Pulse width:481us. Measurement Period:1.25ms (PPG1 mode only)	
	Pulse width:481us. Measurement Period:2.5ms	
	Pulse width:481us. Measurement Period:5ms	
	Pulse width:481us. Measurement Period:10ms	
	Pulse width:481us. Measurement Period:20ms	
	Pulse width:949us. Measurement Period:2.5ms (PPG1 mode only)	
	Pulse width:949us. Measurement Period:5ms	
	Pulse width:949us. Measurement Period:10ms	
	Pulse width:949us. Measurement Period:20ms	
FIFO Rollover	Enabled	Choose to enable and disable FIFO overrides.
	Disabled	
FIFO Almost Full Value	0x0C	Values determines the number of empty FIFO words when the FIFO almost full interrupt is issued. Any value from 0x00 to 0x0F is valid.

5.1.4.5 Proximity mode settings

Select the rm_ob1203 Proximity mode stack in the "Stack" tabbed page of the SDK Configurator, and the configurable items are shown in the "Properties" tabbed page.

The following items and values can be specified.

Table 5-11 OB1203 Proximity mode Settings for RE01 256KB / 1500KB Group MCU

Configurable Item	Value	Description
Module OB1203 Proximity mode (rm_ob1203)		
Interrupt Type	Normal	Select an interrupt type.
	Logic	
The Number of Similar Consecutive Interrupt Events	0x02	Sets the number of interrupt events. Any value from 0x00 to 0x0F is valid.
Sleep after Interrupt	Enabled	Selects the sleep feature to be enabled and disabled after interrupting.
	Disabled	
Gain	1	Select the Gain value.
	1.5	
	2	
	4	
LED Current	0x100	Sets the LED current value. Any value from 0x000 to 0x3FF is valid.
LED Order	IR LED first, Red LED second	Sets the order in which the LEDs are selected.
	RED LED first, IR LED second	
LED Analog Cancellation	Enabled (50% offset of the full-scale value)	Choose to enable and disable analog cancellation.
	Disabled	
LED Digital Cancellation	0x100	Set the digital cancellation value. Any value from 0x0000 to 0xFFFF is valid.
Number of LED pulses	1 pulses	Select the number of PULSES of LEDs.
	2 pulses	
	4 pulses	
	8 pulses	
	16 pulses	
	32 pulses	
Pulse Width and Measurement Period	Pulse width:26us. Measurement Period:3.125ms (except for the number 32 of LED pulses)	Select the pulse width and measurement period.
	Pulse width:26us. Measurement Period:6.25ms	
	Pulse width:26us. Measurement Period:12.5ms	
	Pulse width:26us. Measurement Period:25ms	
	Pulse width:26us. Measurement Period:50ms	
	Pulse width:26us. Measurement Period:100ms	
	Pulse width:26us. Measurement Period:200ms	
	Pulse width:26us. Measurement Period:400ms	

	Pulse width:42us. Measurement Period:3.125ms (except for the number 32 of LED pulses)	
	Pulse width:42us. Measurement Period:6.25ms	
	Pulse width:42us. Measurement Period:12.5ms	
	Pulse width:42us. Measurement Period:25ms	
	Pulse width:42us. Measurement Period:50ms	
	Pulse width:42us. Measurement Period:100ms	
	Pulse width:42us. Measurement Period:200ms	
	Pulse width:42us. Measurement Period:400ms	
Moving Average	Enabled	Choose to use moving averages.
	Disabled	
Hysteresis	0x00	Sets the value of hysteresis. Any value from 0x00 to 0x7F is valid.
Upper Threshold	0x0600	Sets the upper threshold. Any value from 0x0000 to 0xFFFF is valid.
Lower Threshold	0x0000	Sets the lower threshold. Any value from 0x0000 to 0xFFFF is valid.

5.1.4.7 Light Proximity mode settings

Select the rm_ob1203 Light Proximity mode stack in the "Stack" tabbed page of the SDK Configurator, and the configurable items are shown in the "Properties" tabbed page.

The following items and values can be specified.

Table 5-12 OB1203 Light Proximity mode Settings for RE01 256KB / 1500KB Group MCU

Configurable Item	Value	Description
Module OB1203 Light Proximity mode (rm_ob1203)		
General		
Device Interrupt	Light mode	Select the interrupt mode.
	Proximity mode	
Light mode		
Operation Mode	LS mode	Select the measurement mode. Select ambient light sensor (LS) mode or RGB color sensor (CS) mode.
	CS mode	
Interrupt Type	Threshold	Select an interrupt type.
	Variation	
Interrupt Source	Clear channel	Select the interrupt source. Red and blue of RGB channels are only valid in CS mode.
	Green channel	
	Red channel (CS mode only)	
	Blue channel (CS mode only)	
The Number of Similar Consecutive Interrupt Events	0x02	Sets the number of interrupt events. Any value from 0x00 to 0x0F is valid.
Sleep after Interrupt	Enabled	Select the Sleep function after interrupting.
	Disabled	
Gain	1	Select the Gain value.
	3	
	6	
Resolution and Measurement Period	Resolution:13bit. Measurement Period:200ms	Select a combination of the resolution of the measurement and the measurement period.
	Resolution:13bit. Measurement Period:500ms	
	Resolution:13bit. Measurement Period:1000ms	
	Resolution:13bit. Measurement Period:2000ms	
	Resolution:16bit. Measurement Period:25ms	
	Resolution:16bit. Measurement Period:50ms	
	Resolution:16bit. Measurement Period:100ms	
	Resolution:16bit. Measurement Period:200ms	
	Resolution:16bit. Measurement Period:500ms	
	Resolution:16bit. Measurement Period:1000ms	
	Resolution:16bit. Measurement Period:2000ms	

	Resolution:17bit. Measurement Period:50ms	
	Resolution:17bit. Measurement Period:100ms	
	Resolution:17bit. Measurement Period:200ms	
	Resolution:17bit. Measurement Period:500ms	
	Resolution:17bit. Measurement Period:1000ms	
	Resolution:17bit. Measurement Period:2000ms	
	Resolution:18bit. Measurement Period:100ms	
	Resolution:18bit. Measurement Period:200ms	
	Resolution:18bit. Measurement Period:500ms	
	Resolution:18bit. Measurement Period:1000ms	
	Resolution:18bit. Measurement Period:2000ms	
	Resolution:19bit. Measurement Period:200ms	
	Resolution:19bit. Measurement Period:500ms	
	Resolution:19bit. Measurement Period:1000ms	
	Resolution:19bit. Measurement Period:2000ms	
	Resolution:20bit. Measurement Period:500ms	
	Resolution:20bit. Measurement Period:1000ms	
	Resolution:20bit. Measurement Period:2000ms	
Upper Threshold	0x00CCC	Sets the upper threshold. Any value from 0x00000 to 0xFFFFF is valid.
Lower Threshold	0x00000	Sets the lower threshold. Any value from 0x00000 to 0xFFFFF is valid.
Variance Threshold	+/- 8 counts	Choose to threshold variance.
	+/- 16 counts	
	+/- 32 counts	
	+/- 64 counts	
	+/- 128 counts	
	+/- 256 counts	
	+/- 512 counts	
	+/- 1024 counts	
Proximity mode		
Interrupt Type	Normal	Select an interrupt type.
	Logic	
The Number of Similar Consecutive Interrupt Events	0x02	Sets the number of interrupt events. Any value from 0x00 to 0x0F is valid.
Sleep after Interrupt	Enabled	Selects the sleep feature to be enabled and disabled after interrupting.
	Disabled	

Gain	1	Select the Gain value.
	1.5	
	2	
	4	
LED Current	0x100	Sets the LED current value. Any value from 0x000 to 0x3FF is valid.
LED Order	IR LED first, Red LED second	Sets the order in which the LEDs are selected.
	RED LED first, IR LED second	
LED Analog Cancellation	Enabled (50% offset of the full-scale value)	Choose to enable and disable analog cancellation.
	Disabled	
LED Digital Cancellation	0x100	Set the digital cancellation value. Any value from 0x0000 to 0xFFFF is valid.
Number of LED pulses	1 pulses	Select the number of PULSES of LEDs.
	2 pulses	
	4 pulses	
	8 pulses	
	16 pulses	
	32 pulses	
Pulse Width and Measurement Period	Pulse width:26us. Measurement Period:3.125ms (except for the number 32 of LED pulses)	Select the pulse width and measurement period.
	Pulse width:26us. Measurement Period:6.25ms	
	Pulse width:26us. Measurement Period:12.5ms	
	Pulse width:26us. Measurement Period:25ms	
	Pulse width:26us. Measurement Period:50ms	
	Pulse width:26us. Measurement Period:100ms	
	Pulse width:26us. Measurement Period:200ms	
	Pulse width:26us. Measurement Period:400ms	
	Pulse width:42us. Measurement Period:3.125ms (except for the number 32 of LED pulses)	
	Pulse width:42us. Measurement Period:6.25ms	
	Pulse width:42us. Measurement Period:12.5ms	
	Pulse width:42us. Measurement Period:25ms	
	Pulse width:42us. Measurement Period:50ms	
	Pulse width:42us. Measurement Period:100ms	
	Pulse width:42us. Measurement Period:200ms	
	Pulse width:42us. Measurement Period:400ms	
Moving Average	Enabled	Choose to use moving averages.
	Disabled	

Hysteresis	0x00	Sets the value of hysteresis. Any value from 0x00 to 0x7F is valid.
Upper Threshold	0x0600	Sets the upper threshold. Any value from 0x0000 to 0xFFFF is valid.
Lower Threshold	0x0000	Sets the lower threshold. Any value from 0x0000 to 0xFFFF is valid.

5.2 Sensor Communication Middleware Settings

5.2.1 RA Family

Select the rm_comms_i2c stack on the [Stack] tabbed page of the FSP Configurator, and the configurable items will be shown on the [Properties] tabbed page.

The following items and values can be specified.

Table 5-13 Communication Middleware Settings for the RA Family MCU

Configurable Item	Value	Description
Common		
Parameter Checking	Default (BSP) Enabled Disabled	Specify whether to include the processing to check parameters in the code to be generated. When "Disabled" is selected, the generated code does not include the processing to check parameters. When "Enabled" is selected, the generated code includes the processing to check parameters.
Module g_comms_i2c_device I2C Communication Device on rm_comms_i2c		
Name	g_comms_i2c_device0	Specify the name of the module. A module name conforming to the C language standard can be specified.
Semaphore Timeout	0xFFFFFFFF	For an RTOS project, specify the time of semaphore timeout.
Slave Address	0x53	Specify the slave address. When rm_ob1203 is used, this value is automatically specified and cannot be modified.
Address Mode	7-Bit	Specify the number of slave address bits. When rm_ob1203 is used, this value is automatically specified and cannot be modified.
Callback	rm_ob1203_comms_i2c_callback	Specify the name of the user callback function. When rm_ob1203 is used, this value is automatically specified and cannot be modified.
Module g_comms_i2c_bus0 I2C Shared Bus on 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 processing for blocking.
Recursive Mutex for Bus	Unuse Use	For an RTOS project, enable or disable recursive operation when blocking is enabled.

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 will be shown in the [Configure] panel.

The following items and values can be specified.

Table 5-14 Communication Middleware Settings for the RX Family MCU

Configurable Item	Value	Description
Configurations		
Parameter Checking	System Default Enabled Disabled	Specify whether to include the processing to check parameters in the code to be generated. When "Disabled" is selected, the generated code does not include the processing to check parameters. When "Enabled" is selected, the generated code includes the processing to check parameters.
Number of I2C Shared Buses	Unused 1 2 – 16	Specify the number of I2C bus lines that can be connected.
Number of I2C Devices	Unused 1 2 – 16	Specify the number of I2C devices 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.
IIC Driver Type for I2C Shared bus(x) (x = 0 – 15)	RIIC SCI IIC Not selected	Specify the I2C type to be used for the communications bus. Using the RIIC requires r_riic_rx. Using the SCI IIC requires r_sci_iic_rx. If an unused FIT module is deleted, a warning message will appear but this will 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 communications bus.
Timeout for the bus lock of the I2C bus for I2C Shared Bus(x) (x = 0 – 15)	0xFFFFFFFF	Specify the time of I2C bus lock timeout for I2C bus x. (x = 0 – 15)
I2C Shared Bus No. for I2C Communication Device(x) (x = 0 – 15)	I2C Shared Bus(x) (x = 0 – 15)	Specify the configuration of the I2C bus to be used for the communications bus.
Slave address for communication device(x) (x = 0 – 15)	0x53	Specify the slave address of the device to be connected to the communications bus. When using r_ob1203_rx, specify 0x53.
Slave address mode for communication device(x) (x = 0 – 15)	7 bit address mode	Specify the slave address mode. When using r_ ob1203_rx, specify the 7-bit address mode.
Callback function for 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_ ob1203_rx, specify rm_ ob1203_callback(y) (y = 0).

5.2.3 RL78 Family

Settings can be modified by changing the values of constants defined in the \r_config\r_comms_i2c_rl_config.h file in the project tree of the sample project.

The following items and values can be specified.

Table 5-15 Communication Middleware Settings for the RL78 Family MCU

Constant Name	Value	Description
Configurations		
COMMS_I2C_CFG_PARAM_CHECKING_ENABLE	0	Specify whether to include the processing to check parameters in the code to be generated. When "0" is specified, the generated code does not include the processing to check parameters. When "1" is specified, the generated code includes the processing to check parameters.
	1	
COMMS_I2C_CFG_BUS_NUM_MAX	1	Specify the number of communications bus lines that can be connected.
	2	
	3	
	4	
	5	
COMMS_I2C_CFG_DEVICE_NUM_MAX	1	Specify the number of I2C devices that can be connected.
	2	
	3	
	4	
	5	
COMMS_I2C_CFG_BUS(x)_DRIVER_TYPE (x = 0 – 4)	COMMS_DRIVER_I2C	Specify the I2C type to be used for the communications bus.
	COMMS_DRIVER_SAU_I2C	
COMMS_I2C_CFG_DEVICE(x)_BUS_CH (x = 0 – 4)	g_comms_i2c_bus(x)_extended_cfg (x = 0 – 4)	Specify the configuration of the I2C bus to be used for the communications bus.
COMMS_I2C_CFG_DEVICE(x)_SLAVE_ADDR (x = 0 – 4)	0x53	Specify the slave address of the device to be connected to the communications bus. When using rm_ ob1203, specify 0x53.
COMMS_I2C_CFG_DEVICE(x)_CALLBACK (x = 0 – 4)	comms_i2c_user_callback1(x) (x = 0 – 4)	Specify the name of the user callback function. When using rm_ ob1203, specify rm_ ob1203_callback(y) (y = 0).

5.2.4 RE01 256KB or 1500KB Group

Select the rm_comms_i2c stack on the [Stacks] tabbed page of the SDK Configurator, and the configurable items will be shown on the [Properties] tabbed page.

The following items and values can be specified.

Table 5-16 Communication Middleware Settings for the RE01 256KB or 1500KB Group MCU

Configurable Item	Value	Description
Common		
Parameter Checking	Default (BSP) Enabled Disabled	Specify whether to include the processing to check parameters in the code to be generated. When "Disabled" is selected, the generated code does not include the processing to check parameters. When "Enabled" is selected, the generated code includes the processing to check parameters.
Module g_comms_i2c_device I2C Communication Device on rm_comms_i2c		
Name	g_comms_i2c_device0	Specify the name of the module. A module name conforming to the C language standard can be specified.
Semaphore Timeout	0xFFFFFFFF	For an RTOS project, specify the time of semaphore timeout.
Slave Address	0x53	Specify the slave address. When rm_ob1203 is used, this value is automatically specified and cannot be modified.
Address Mode	7-Bit	Specify the number of slave address bits. When rm_ob1203 is used, this value is automatically specified and cannot be modified.
Callback	rm_ob1203_comms_i2c_callback	Specify the name of the user callback function. When rm_ob1203 is used, this value is automatically specified and cannot be modified.
Module g_comms_i2c_bus0 I2C Shared Bus on 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 processing for blocking.
Recursive Mutex for Bus	Unuse Use	For an RTOS project, enable or disable recursive operation when blocking is enabled.

5.3 I2C Driver Settings

5.3.1 RA Family

Select the r_iic_master or r_sci_i2c stack on the [Stack] tabbed page of the FSP Configurator, and the configurable items will be shown on the [Properties] tabbed page.

The following items and values can be specified.

Table 5-17 r_iic_master Settings for the RA Family MCU

Configurable Item	Value	Description
Common		
Parameter Checking	Default (BSP) Enabled Disabled	Specify whether to include the processing to check parameters in the code to be generated. When "Disabled" is selected, the generated code does not include the processing to check parameters. When "Enabled" is selected, the generated code includes the processing to check parameters.
DTC on Transmission and Reception	Enabled Disabled	Specify whether to use the DTC in transmission and reception.
10-bit slave addressing	Enabled Disabled	Specify whether to support 10-bit slave addresses. When using rm_ ob1203, select "Disabled".
Module g_i2c_master0 I2C Master Driver on r_iic_master		
Name	g_i2c_master0	Specify the name of the module.
Channel	0	Specify the channel number to be used.
Rate	Standard Fast-mode Fast-mode plus	Specify the baud rate. When using rm_ ob1203, select "Standard" or "Fast-mode".
Rise Time (ns)	120	Specify the time for the SCL signal to rise according to the specifications of the target board to be used.
Fall Time (ns)	120	Specify the time for the SCL signal to fall according to the specifications of the target board to be used.
Duty Cycle (%)	50	Specify the SCL duty cycle.
Slave Address	0x00	This item specifies the slave address of the device to be connected but the user does not need to make this setting because rm_comms_i2c overwrites any setting made here.
Address Mode	7-Bit 10-Bit	This item specifies the salve address mode for the device to be connected but the user does not need to make this setting because rm_comms_i2c overwrites any setting made here.
Timeout Mode	Short Mode Long Mode	Specify the time of I2C bus timeout.
Callback	rm_comms_i2c_callback	The name of the user callback function is automatically specified by rm_comms_i2c.
Interrupt Priority Level	Priority 0 (highest) Priority 1 Priority 2 Priority 3	Specify the interrupt priority level of the I2C bus driver.

	Priority 4	
	Priority 5	
	Priority 6	
	Priority 7	
	Priority 8	
	Priority 9	
	Priority 10	
	Priority 11	
	Priority 12	
	Priority 13	
	Priority 14	
	Priority 15	
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	

Table 5-18 r_sci_i2c Settings for the RA Family MCU

Configurable Item	Value	Description
Common		
Parameter Checking	Default (BSP) Enabled Disabled	Specify whether to include the processing to check parameters in the code to be generated. When "Disabled" is selected, the generated code does not include the processing to check parameters. When "Enabled" is selected, the generated code includes the processing to check parameters.
DTC on Transmission and Reception	Enabled Disabled	Specify whether to use the DTC in transmission and reception.
10-bit slave addressing	Enabled Disabled	Specify whether to support 10-bit slave addresses. When using rm_ ob1203, select "Disabled".
Module g_i2c0 I2C Master Driver on r_sci_i2c		
Name	g_i2c0	Specify the name of the module.
Channel	0	For an RTOS project, specify the time of semaphore timeout.
Slave Address	0x00	This item specifies the slave address of the device to be connected but the user does not need to make this setting because rm_comms_i2c overwrites any setting made here.
Address Mode	7-Bit 10-bit	This item specifies the salve address mode for the device to be connected but the user does not need to make this setting because rm_comms_i2c overwrites any setting made here.
Rate	Standard Fast-mode Fast-mode plus	Specify the baud rate. Select "Standard" or "Fast-mode".
SDA Output Delay (nano seconds)	300	Specify the SDA output delay time.
Noise filter setting	Use clock signal divided by 1 with noise filter 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	Specify the noise filter to be used for input signals.
Bit Rate Modulation	Enable Disable	Enable or disable the bit rate modulation function.
Callback	rm_comms_i2c_callback	The name of the user callback function is automatically specified by rm_comms_i2c.
Interrupt Priority Level	Priority 0 (highest) Priority 1 Priority 2 Priority 3 Priority 4 Priority 5 Priority 6	Specify the interrupt priority level of the I2C bus driver.

	Priority 7	
	Priority 8	
	Priority 9	
	Priority 10	
	Priority 11	
	Priority 12	
	Priority 13	
	Priority 14	
	Priority 15	
RX Interrupt Priority Level [Only used when DTC is enabled]	Priority 0 (highest)	When using the DTC, specify the priority level of the reception interrupt.
	Priority 1	
	Priority 2	
	Priority 3	
	Priority 4	
	Priority 5	
	Priority 6	
	Priority 7	
	Priority 8	
	Priority 9	
	Priority 10	
	Priority 11	
	Priority 12	
	Priority 13	
	Priority 14	
	Priority 15	
	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	

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.

The following items and values can be specified.

Table 5-19 r_riic_rx Settings for the RX Family MCU

Configurable Item	Value	Description
Configurations		
Set parameter checking enable	System Default Not Include	Specify whether to include the processing to check parameters in the code to be generated. When "Not" is selected, the generated code does not include the processing to check parameters. When "Include" is selected, the generated code includes the processing to check parameters.
MCU supported channels for CHx (x = 0 – 2)	Not supported Supported	Specify whether to use channel x. When a channel is not to be used, select "Not supported". When "Not supported" is selected, the generated code does not include processing for the given channel. When "Supported" is selected, the generated code includes processing for the given channel.
CHx RIIC bps(kbps) (x = 0 – 2)	400	Specify the bit rate. Set this to a value no greater than 400 when using rm_ob1203.
Digital filter for CHx (x = 0 – 2)	Not One IIC phi Two IIC phi Three IIC phi Four IIC phi	Specify the number of stages in the noise filter for the specified channel. When "Not" is selected, the noise filter is disabled.
Setting port setting processing	Not include port setting Include port setting	Specify whether to include the settings for using port pins as the SCL and SDA pins in the code to be generated. When "Not include port setting" is selected, the generated code does not include the processing for setting port pins to serve as serial pins. When "Include port setting" is selected, the generated code includes the processing for setting port pins to serve as serial pins.
Master arbitration lost detection function for CHx (x = 0 – 2)	Unused Used	Enable or disable the master loss-in-arbitration detection function for the specified channel. When using multiple masters, select "Used" (enabled). When "Unused" is selected, master loss-in-arbitration detection is disabled. When "Used" is selected, master loss-in-arbitration detection is enabled.
Address y format for CHx (x = 0 – 2, y = 0 – 2)	Not 7 bit address format 10 bit address format	Specify whether to support 7-bit addressing or 10-bit addressing for the slave address of the specified RIIC. When using rm_ob1203, select "7 bit address format".

Slave Address y for CHx (x = 0 – 2, y = 0 – 2)	0x0025	This item specifies the slave address for the specified channel but the user does not need to make this setting because rm_comms_i2c overwrites any setting made here.
General call address for CHx	Unused Used	Enable or disable the use of the general call address with the specified channel. When "Unused" is selected, the use of the general call address is disabled. When "Used" is selected, the use of the general call address is enabled.
CHx RXI INT Priority Level (x = 0 – 2)	Level 1 Level 2 Level 3 Level 4 Level 5 Level 6 Level 7 Level 8 Level 9 Level 10 Level 11 Level 12 Level 13 Level 14 Level 15 (highest)	Specify the priority level of the reception data full interrupt (RXI) for the specified channel. Specify a level from 1 to 15.
CHx RXI INT Priority Level (x = 0 – 2)	Level 1 Level 2 Level 3 Level 4 Level 5 Level 6 Level 7 Level 8 Level 9 Level 10 Level 11 Level 12 Level 13 Level 14 Level 15 (highest)	Specify the priority level of the transmission data empty interrupt (TXI) for the specified channel. Specify a level from 1 to 15.
CHx EEI INT Priority Level (x = 0 – 2)	Level 1 Level 2 Level 3 Level 4 Level 5 Level 6 Level 7 Level 8 Level 9 Level 10 Level 11	Specify the priority level of the communication error or event generation interrupt (EEI) for the specified channel. Specify a level from 1 to 15.

	Level 12	
	Level 13	
	Level 14	
	Level 15 (highest)	
CHx TEI INT Priority Level (x = 0 – 2)	Level 1	Specify the priority level of the transmission end interrupt (TEI) for the specified channel. Specify a level from 1 to 15.
	Level 2	
	Level 3	
	Level 4	
	Level 5	
	Level 6	
	Level 7	
	Level 8	
	Level 9	
	Level 10	
	Level 11	
	Level 12	
	Level 13	
	Level 14	
	Level 15 (highest)	
Timeout function for CHx (x = 0 – 2)	Unused	Enable or disable the timeout detection function for the specified channel. When "Unused" is selected, timeout detection is disabled. When "Used" is selected, timeout detection is enabled.
	Used	
Timeout detection time for CHx (x = 0 – 2)	Long mode	Specify the time for timeout detection for the specified channel.
	Short mode	
Count up during low period of timeout detection for CHx (x = 0 – 2)	Unused	Enable or disable incrementing of the internal counter for detecting a timeout while the SCL signal is at the low level when the timeout detection function is enabled for the specified channel. When "Unused" is selected, incrementing of the counter while the SCL signal is at the low level is disabled. When "Used" is selected, incrementing of the counter while the SCL signal is at the low level is enabled.
	Used	
Count up during high period of timeout detection for CHx (x = 0 – 2)	Unused	Enable or disable incrementing of the internal counter for detecting a timeout while the SCL signal is at the high level when the timeout detection function is enabled for the specified channel. When "Unused" is selected, incrementing of the counter while the SCL signal is at the high level is disabled. When "Used" is selected, incrementing of the counter while the SCL signal is at the high level is enabled.
	Used	
Set Counter of checking bus busy	1000	The value of the timeout counter (the counter for bus checking) to be used in the processing of checking the bus busy state by API functions can be specified by software.
Resources		
SDAx Pins	Unchecked	Specify the pins to be used.

SCLx Pins	Unchecked	Select the checkboxes for the desired pins.

Table 5-20 r_sci_iic_rx Settings for the RX Family MCU

Configurable Item	Value	Description
Configurations		
Set parameter checking enable	System Default Not Include	Specify whether to include the processing to check parameters in the code to be generated. When "Not" is selected, the generated code does not include the processing to check parameters. When "Include" is selected, the generated code includes the processing to check parameters.
MCU supported channels for CHx (x = 0 – 12)	Not supported Supported	Specify whether to use channel x. When "Not supported" is selected, the generated code does not include processing for the given channel. When "Supported" is selected, the generated code includes processing for the given channel.
SCI IIC bitrate (bps) for CHx (x = 0 – 12)	384000	Specify the bit rate. Set to 384000 (384 Kbits/s) or a smaller value.
Interrupt Priority for CHx (x = 0 – 12)	Level 1 Level 2 Level 3 Level 4 Level 5 Level 6 Level 7 Level 8 Level 9 Level 10 Level 11 Level 12 Level 13 Level 14 Level 15 (highest)	Specify the priority level of interrupts triggered by the detection of a start or stop condition, reception, transmit data empty, and transmit end. Specify a level from 1 to 15.
Digital noise filter (NFEN bit) for CHx (x = 0 – 12)	Disable Enable	Specify whether to use the noise cancellation function for the SSCL and SSDA input signals. When "Disable" is selected, the noise cancellation function is disabled. When "Enable" is selected, the noise cancellation function is enabled.
Noise Filter Setting Register (NFCS bit) for CHx (x = 0 – 12)	The clock divided by 1 The clock divided by 2 The clock divided by 4 The clock divided by 8	Specify the sampling clock of the digital noise filter.
I2C Mode Register 1 (IICDL bit) for CHx (x = 0 – 12)	18	Specify the number of SSDA output delay cycles from the falling edge of the SSCL output. Specify a value from 1 to 31.

Software bus busy check counter	1000	Specify the counter value to be judged to represent the bus busy state. The value of the timeout counter (the counter for bus checking) to be used in the processing of checking the bus busy state by API functions for the simplified I2C can be specified by software.
Setting port setting processing	Not include port setting Include port setting	Specify whether to include the settings for using port pins as the SSCL and SSDA pins in the code to be generated. When "Not include port setting" is selected, the generated code does not include the processing for setting port pins to serve as serial pins. When "Include port setting" is selected, the generated code includes the processing for setting port pins to serve as serial pins.
Resources		
SSDAx Pins	Unchecked	Specify the pins to be used. Select the checkboxes for the desired pins.
SSCLx Pins	Unchecked	

5.3.3 RL78 Family

Select "Serial" from the peripheral functions in the Code Generator, and the configurable items will be shown on the [Peripheral Functions] tabbed page.

The following items and values can be specified.

Table 5-21 Serial Settings for the RL78 Family MCU

Configurable Item	Value	Description
SAUx		
Channel		
Channel x	Unused	Specify the communication function of the channel to be used. When using rm_ob1203, select IICxx.
	UARTxx	
	CSIxx	
	IICxx	
IICxx		
Transfer rate	1000000	Specify the bit rate. When using rm_ob1203, specify 100000.
Transfer end interrupt priority (INTIICxx)	High	Specify the priority level of the transfer end interrupt.
	Level1	
	Level2	
	Low	
Master transmission end	Checked	Specify whether to use the callback function when master transmission ends.
Master reception end	Checked	Specify whether to use the callback function when master reception ends.
Master error	Checked	Specify whether to use the callback function when a communication error occurs.
IICAx		
Transfer mode		
Transfer mode	Unused	Specify the communication function of the channel to be used. Select "Single master".
	Single master	
	Slave	
Setting		
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.
	Fast mode/Fast mode plus	
Transfer clock (fSCL)	100000	Specify the bit rate. Set to 400000 or a smaller value.
Communication end interrupt priority (INTIICAx)	High	Specify the priority level of the communication end interrupt.
	Level1	
	Level2	
	Low	
Master transmission end	Checked	Specify whether to use the callback function when master transmission ends.
Master reception end	Checked	Specify whether to use the callback function when master reception ends.
Master error	Checked	Specify whether to use the callback function when a communication error occurs.

Generated stop condition in master transmission/reception end callback function	Checked	Specify whether to generate a stop condition in the callback function. Deselect the checkbox.

5.3.4 RE01 256KB or 1500KB Group

Select the CMSIS Driver for I2C on the [Stack] tabbed page of the SDK Configurator, and the configurable items will be shown on the [Properties] tabbed page.

The following items and values can be specified.

Table 5-22 CMSIS Driver for I2C Settings for the RE01 256KB or 1500KB Group MCU

Configurable Item	Value	Description
Common		
Common		
Bus Speed Calculation		
Auto Calculation		
Standard Mode		
SCL Up Time(ns)	1000	Set the time for the SCL signal to rise in Standard Mode. A value of or greater than 0 is valid.
SCL Down Time(ns)	300	Set the time for the SCL signal to fall in Standard Mode. A value of or greater than 0 is valid.
Fast Mode		
SCL Up Time(ns)	300	Set the time for the SCL signal to rise in Fast Mode. A value of or greater than 0 is valid.
SCL Down Time(ns)	300	Set the time for the SCL signal to fall in Fast Mode. A value of or greater than 0 is valid.
Manual Calculation		
Standard Mode		
ICBRL Setting	15	Set the ICBRL in Standard Mode. Any value from 0 to 31 is valid.
ICBRH Setting	12	Set the ICBRH in Standard Mode. Any value from 0 to 31 is valid.
CKS Setting	3	Set the CKS in Standard Mode. Any value from 0 to 7 is valid.
Fast Mode		
ICBRL Setting	17	Set the ICBRL in Fast Mode. Any value from 0 to 31 is valid.
ICBRH Setting	6	Set the ICBRH in Fast Mode. Any value from 0 to 31 is valid.
CKS Setting	1	Set the CKS in Fast Mode. Any value from 0 to 7 is valid.
Auto/Manual Calculation	Auto Calculation Manual Calculation	Set whether auto or manual calculation is applied to the bus speed calculation settings.

Noise Filter	No digital noise filter circuit used	The noise filter is disabled.
	Filter out noise of up to 1 IIC cycle (Single-stage filter)	Noise removal is applied for no longer than 1 IICφ cycle.
	Filter out noise of up to 2 IIC cycle (2-stage filter)	Noise removal is applied for no longer than 2 IICφ cycles.
	Filter out noise of up to 3 IIC cycle (3-stage filter)	Noise removal is applied for no longer than 3 IICφ cycles.
	Filter out noise of up to 4 IIC cycle (4-stage filter)	Noise removal is applied for no longer than 4 IICφ cycles.
RIIC0		
Interrupt Priority		
TXI Priority Level	3	Set the priority level of the TXI interrupt. Any value from 0 to 3 is valid.
TEI Priority Level	3	Set the priority level of the TEI interrupt. Any value from 0 to 3 is valid.
RXI Priority Level	3	Set the priority level of the RXI interrupt. Any value from 0 to 3 is valid.
EEI Priority Level	3	Set the priority level of the EEI interrupt. Any value from 0 to 3 is valid.
RIIC1		
Interrupt Priority		
TXI Priority Level	3	Set the priority level of the TXI interrupt. Any value from 0 to 3 is valid.
TEI Priority Level	3	Set the priority level of the TEI interrupt. Any value from 0 to 3 is valid.
RXI Priority Level	3	Set the priority level of the RXI interrupt. Any value from 0 to 3 is valid.
EEI Priority Level	3	Set the priority level of the EEI interrupt. Any value from 0 to 3 is valid.
API Allocation		
ARM_I2C_GetVersion()	Code	Choose whether to run the ARM driver functions from the ROM or following deployment to the RAM.
	RAM Function	
ARM_I2C_GetCapabilities()	Code	
	RAM Function	
ARM_I2C_Initialize()	Code	
	RAM Function	
ARM_I2C_Uninitialize()	Code	
	RAM Function	
ARM_I2C_PowerControl()	Code	
	RAM Function	
ARM_I2C_MasterTransmit()	Code	
	RAM Function	
ARM_I2C_MasterReceive()	Code	
	RAM Function	
ARM_I2C_SlaveTransmit()	Code	

	RAM Function	
ARM_I2C_SlaveReceive()	Code	
	RAM Function	
ARM_I2C_GetDataCount()	Code	
	RAM Function	
ARM_I2C_Control()	Code	
	RAM Function	
ARM_I2C_GetStatus()	Code	
	RAM Function	
iic_txi_interrupt()	Code	
	RAM Function	
iic_tei_interrupt()	Code	
	RAM Function	
iic_rxi_interrupt()	Code	
	RAM Function	
iic_eei_interrupt()	Code	
	RAM Function	
Module CMSIS Driver for I2C on r_i2c_ch0		
Instance Name	g_i2c_0	Specify the name of the module.
Channel	0	Specify the channel number to be used.
Receive data full Interrupt Handler Registration	Enabled	Enable registration of the receive data full interrupt handler. This setting is fixed.
Transmit data empty Interrupt Handler Registration	Enabled	Enable registration of the transmit data empty interrupt handler. This setting is fixed.
Transmit end Interrupt Handler Registration	Enabled	Enable registration of the transmit end interrupt handler. This setting is fixed.
Transfer error Interrupt Handler Registration	Enabled	Enable registration of the transfer error interrupt handler. This setting is fixed.
Pins		
SCL	Pxxx	The pin numbers to be used by the driver are displayed. Use the [Pins] tabbed page to modify the pin configuration.
SDA	Pxxx	

6. Guide to Changing the Target Device

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

Before switching to a new device, import the original sample project for the current device to the workspace.

In this chapter, other sensors are used as example figures, but OB1203 works the same way.

6.1 RA Sample Project

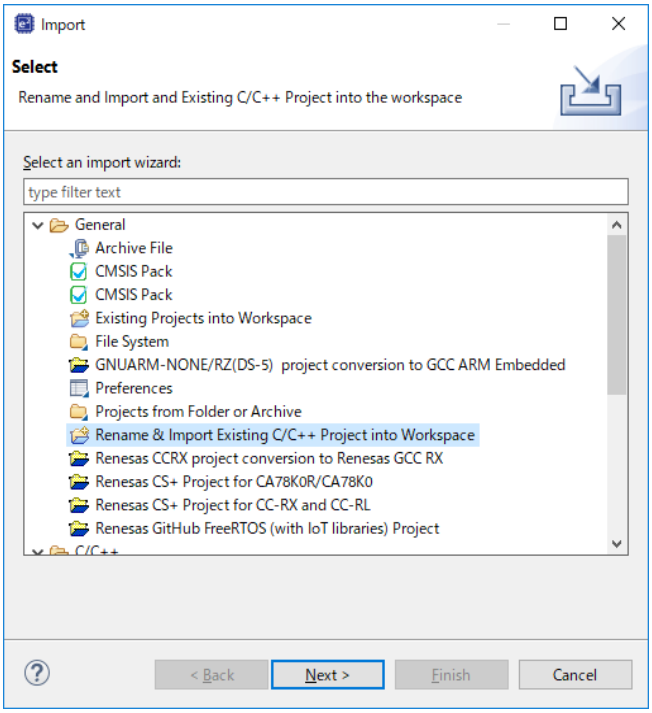
Use the following procedures to modify a sample project.

This section describes an example of modifying the sample project "OB1203_RA6M4_NonOS" so that it can be used on the EK-RA2E1 board.

6.1.1 Importing the Sample Project

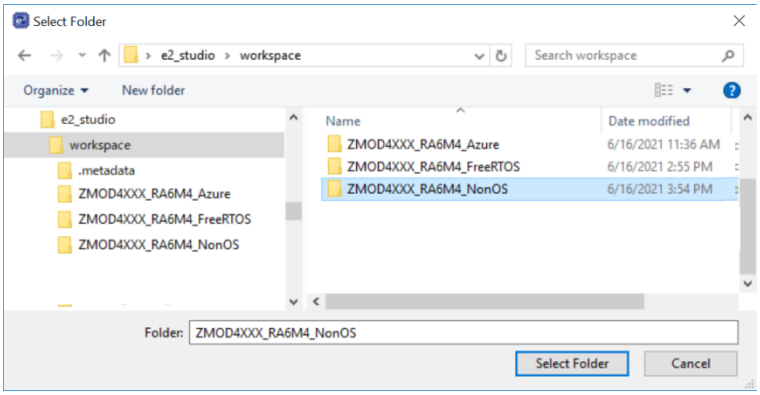
Select [Import] from the menu.

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

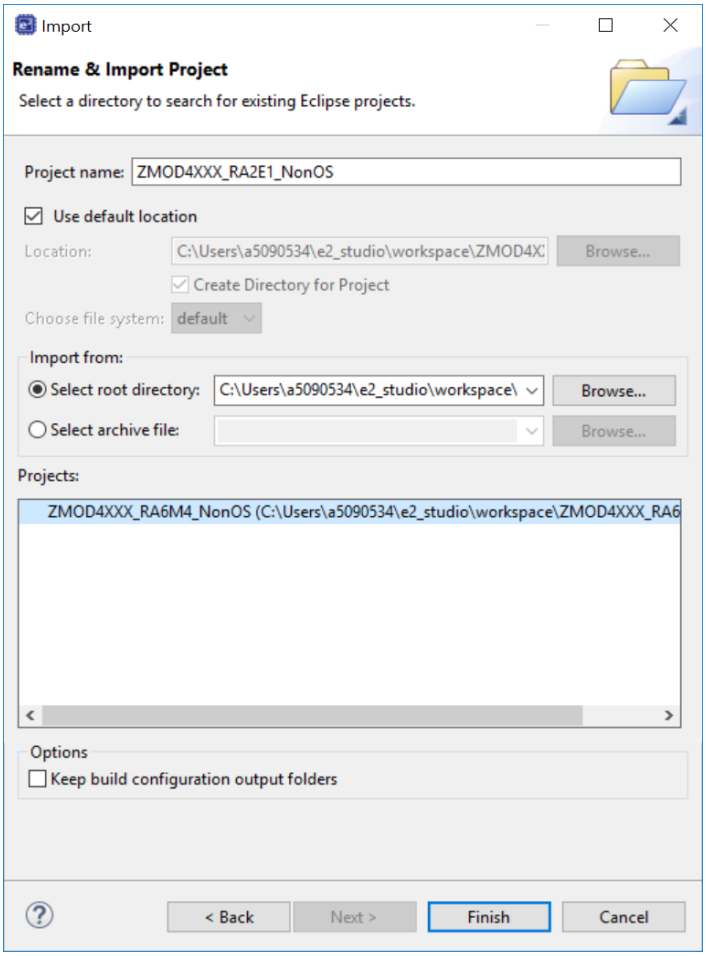


Press the [Browse] button to open the [Select Folder] window.

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



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



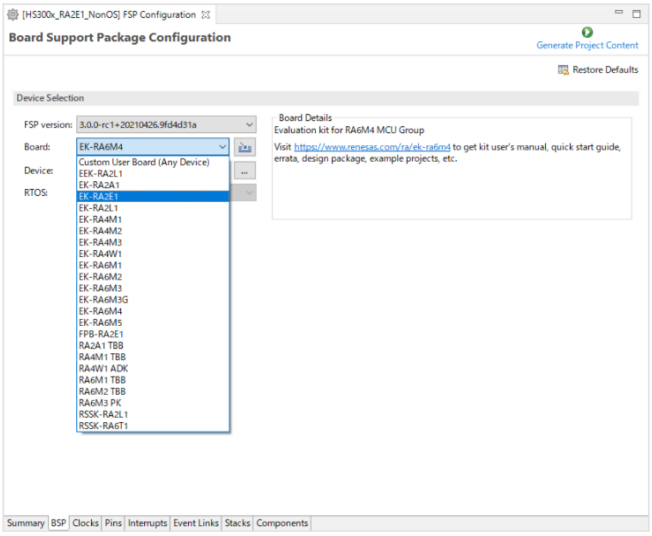
6.1.2 Modifying Settings of the FSP Configurator

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

Change the settings of "Board" and "Device" on the [BSP] tabbed page.

When selecting a Renesas board, you will only need to modify the "Board" setting.

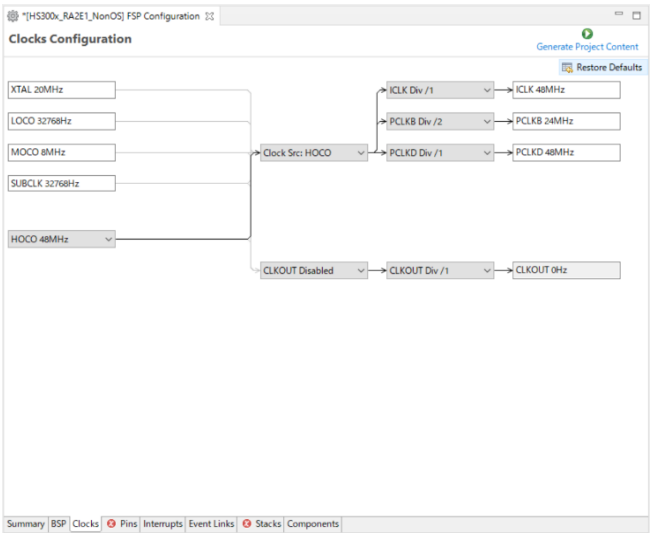
When selecting a board provided from other companies, change the "Board" setting to "Custom User Board (Any Device)" and then change the "Device" setting to the new device to be used.



Set up the clocks on the [Clocks] tabbed page.

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

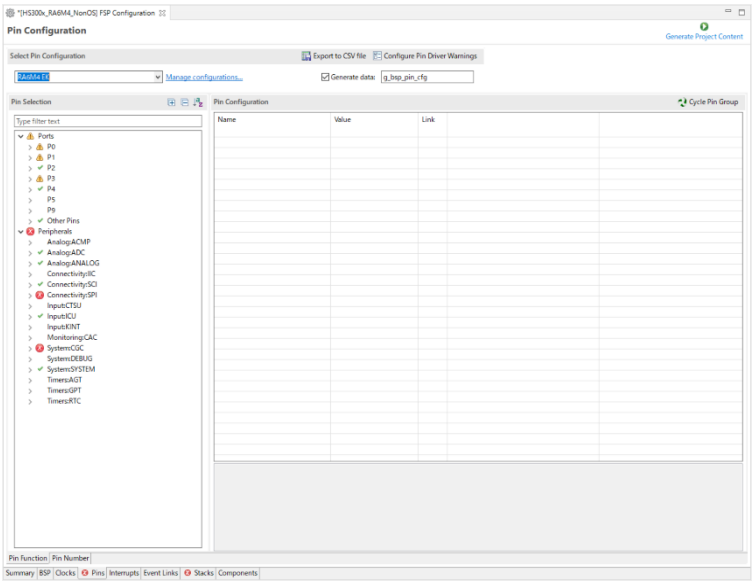
When a Renesas board is selected for "Board", the clocks are automatically set up.



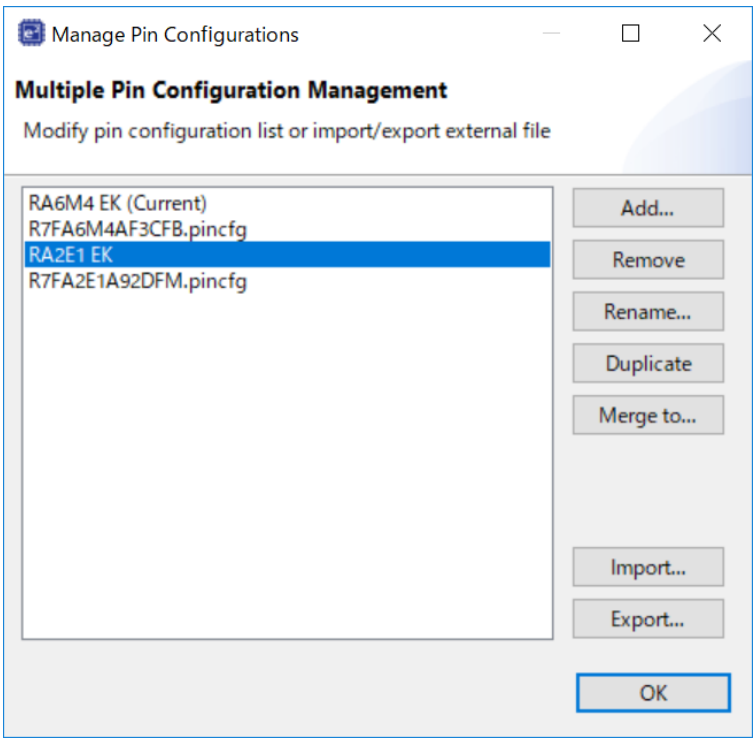
Modify the pin configuration on the [Pins] tabbed page.

Modify the settings of the pins for the IIC or SCI to suit the specifications of the target board.

When using a Renesas board, change the selection for "Select Pin Configuration" from "RA6M4 EK" to the target board; appropriate pins will be 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.



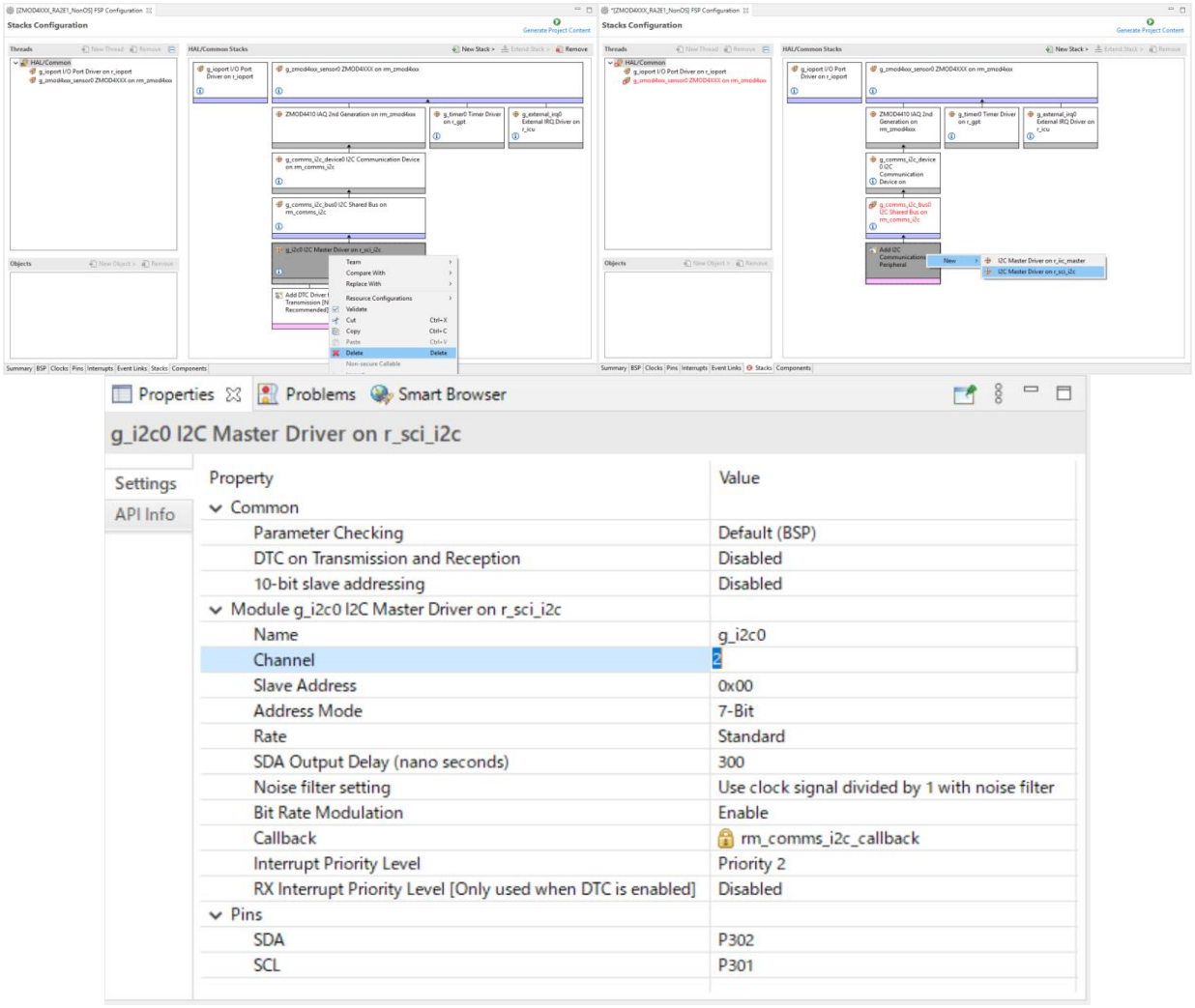
Modify the configuration for individual components on the [Stacks] tabbed page.

Modify the settings of r_iic_master or r_sci_i2c to suit the specifications of the target board.

To use the pins of the IIC, delete the "I2C Master Driver on r_sci_i2c" stack and then add the "I2C Master Driver on r_iic_master" stack.

SCI2 is assigned to PMOD1 and SCI1 is assigned to PMOD2 on the EK-RA2E1 board.

To use PMOD1, set "Channel" to "2". To use PMOD2, set to "1".



Press [Generate Project Content] to generate files.

Build the project.

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

6.1.3 Changing the Toolchain Setting

If you want to use a toolchain other than the GCC ARM Embedded toolchain, copy RA_OB1203.c for a non-OS system or ob1203_sensor_thread_entry.c for a FreeRTOS or Azure RTOS system from this project and create a new project.

6.2 RX Sample Project

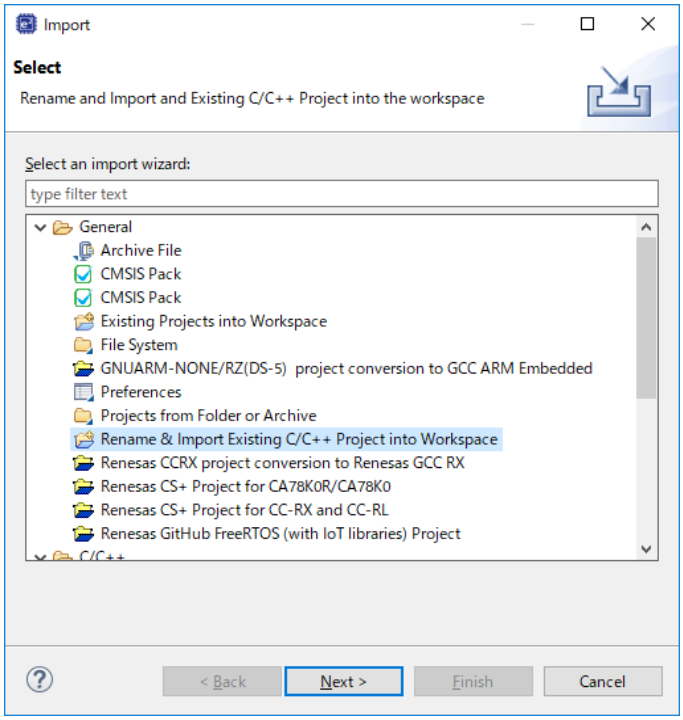
Use the following procedures to modify a sample project.

This section describes an example of modifying the sample project "OB1203_RX65N_NonOS" so that it can be used on the RSKRX231 board.

6.2.1 Importing the Sample Project

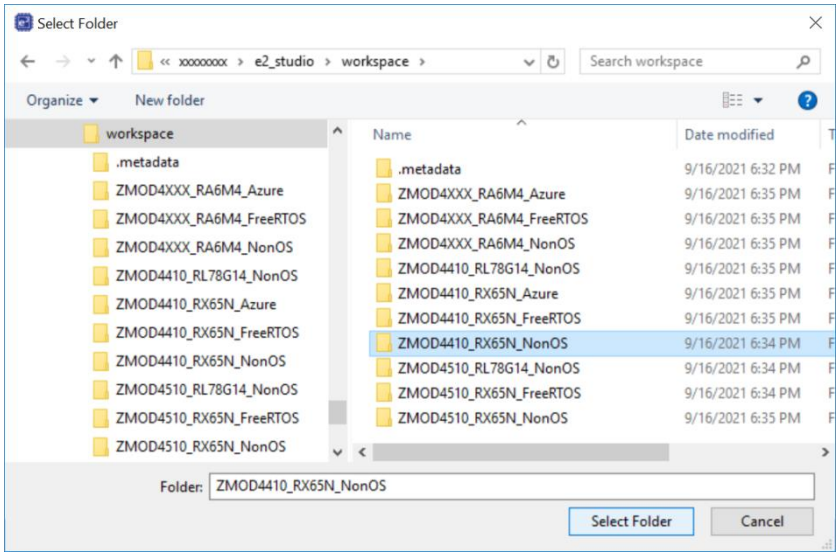
Select [Import] from the menu.

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

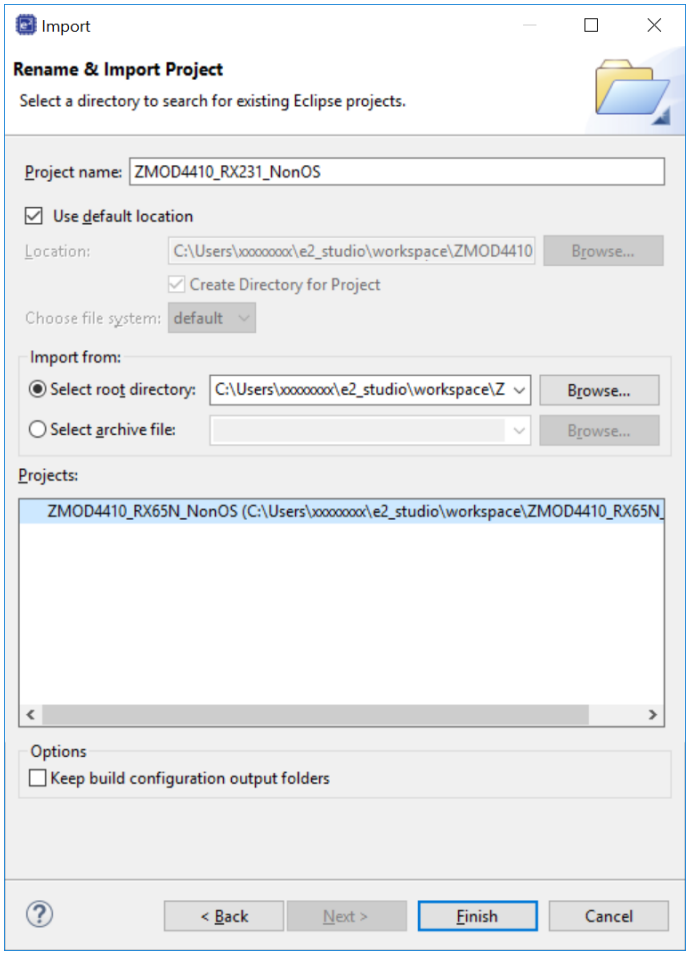


Press the [Browse] button to open the [Select Folder] window.

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

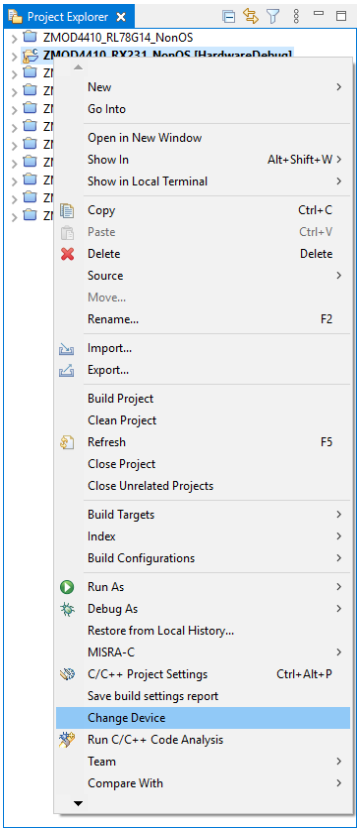


Enter the project name, select the original project for the current device, and press the [Finish] button.

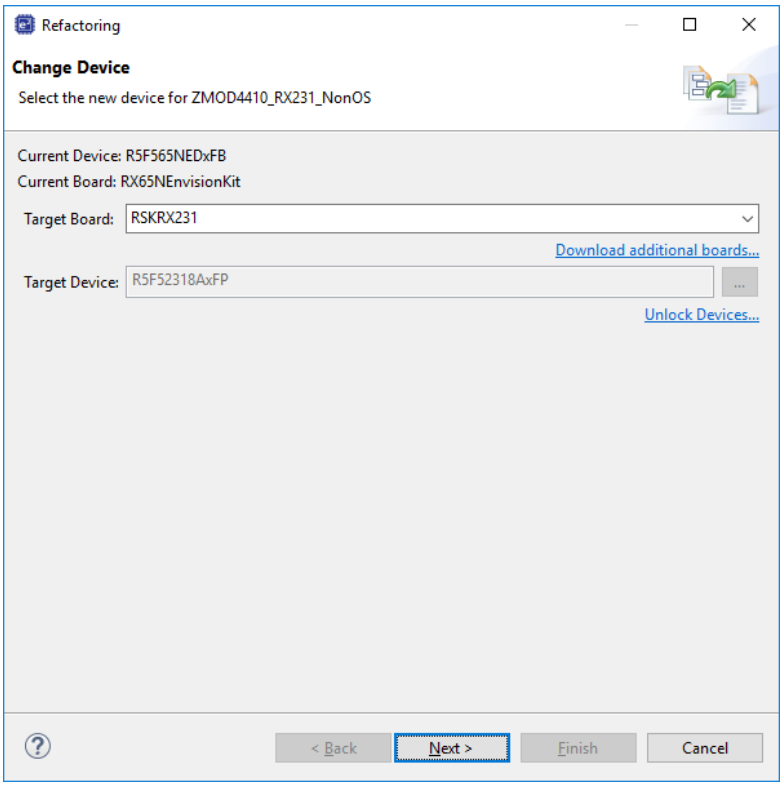


6.2.2 Changing the Device

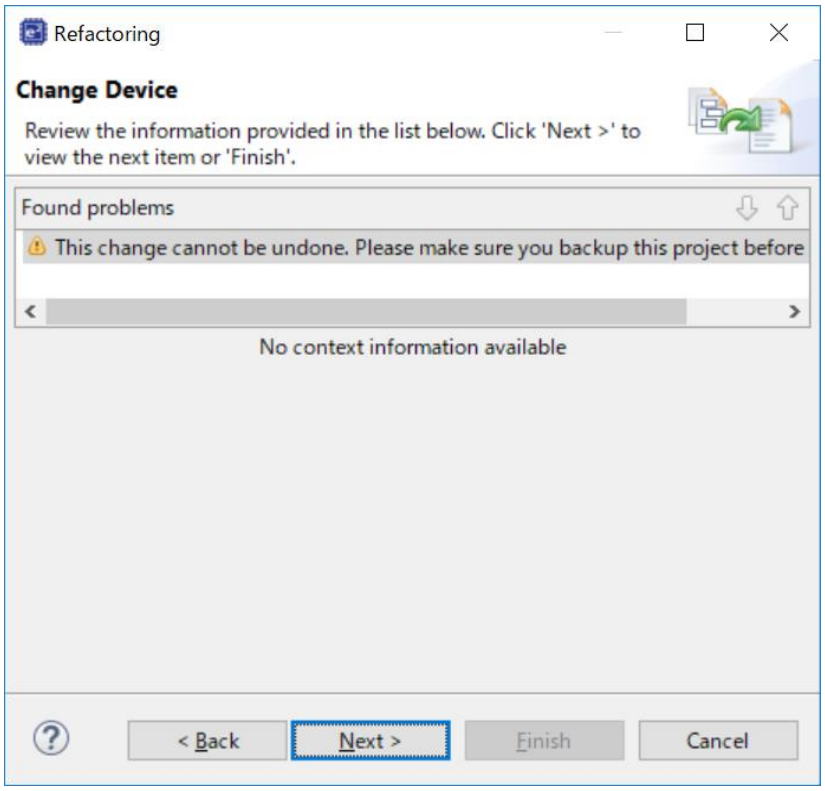
Select the imported project from the project tree and right-click on it to open the context menu. Select [Change Device] from the menu.



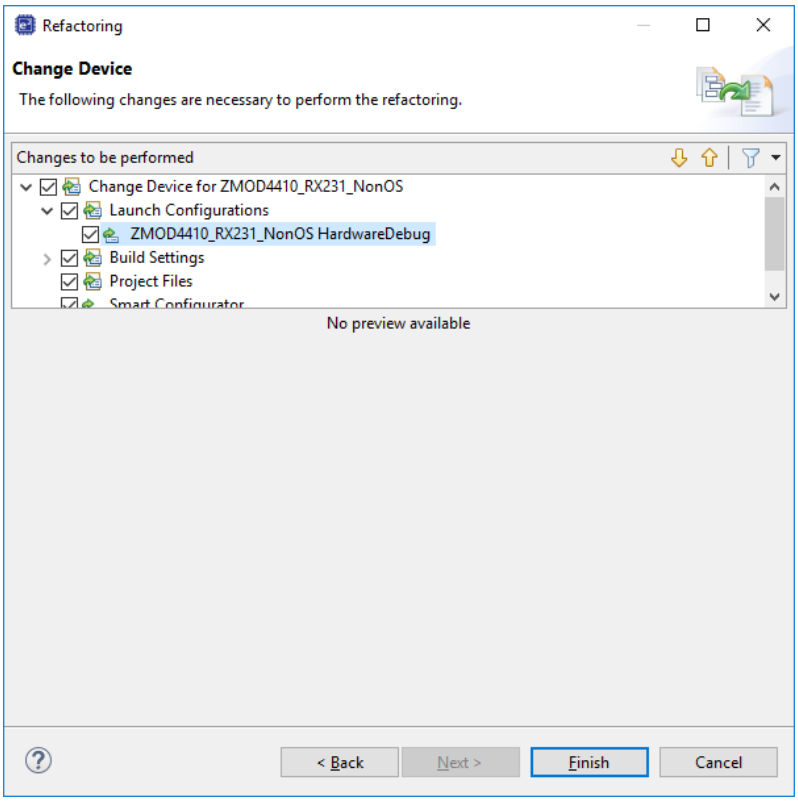
Select a desired board or device in the [Change Device] window and press the [Next] button.



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

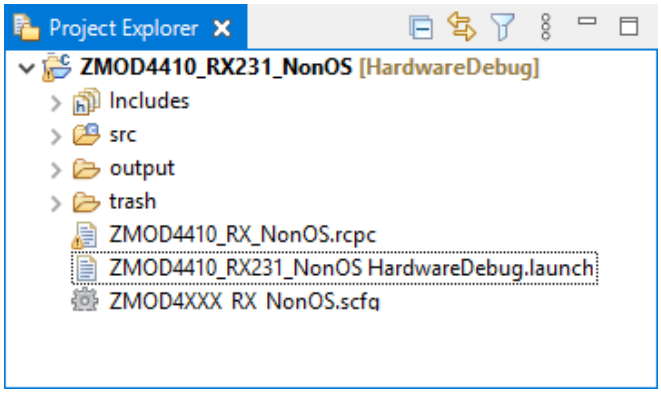


The changes you have made in the settings will be displayed. Press the [Finish] button to apply the changes to the project.

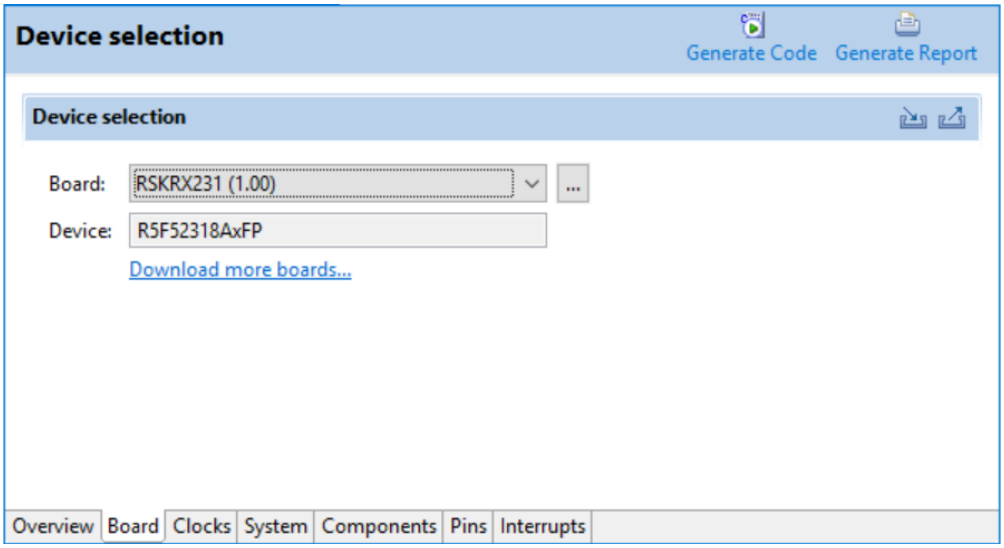


6.2.3 Modifying Settings of the Smart Configurator

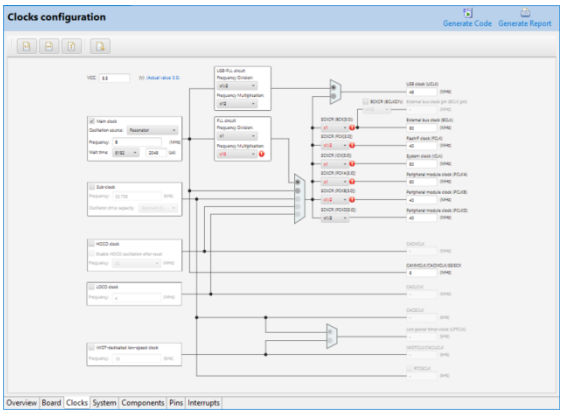
On the project tree, double-click on the .scfg file of the imported project in which the target device has been changed; this will open the Smart Configurator window.

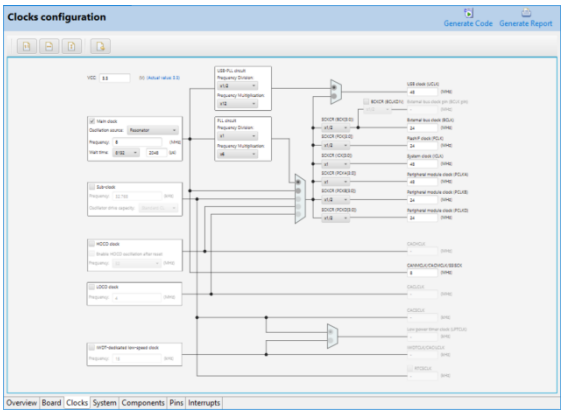


Select the [Board] tabbed page to check that the board and device have been changed correctly.



Set up the clocks on the [Clocks] tabbed page to suit the specifications of the target board to be used.

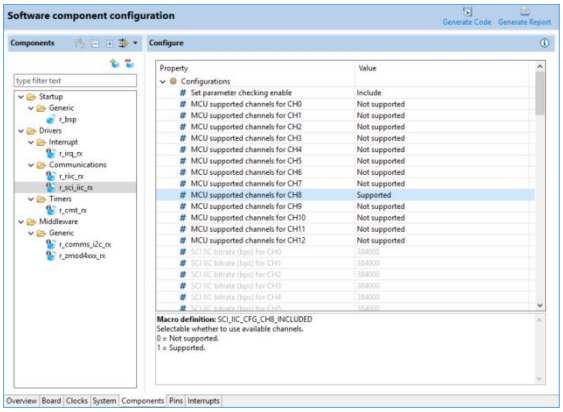


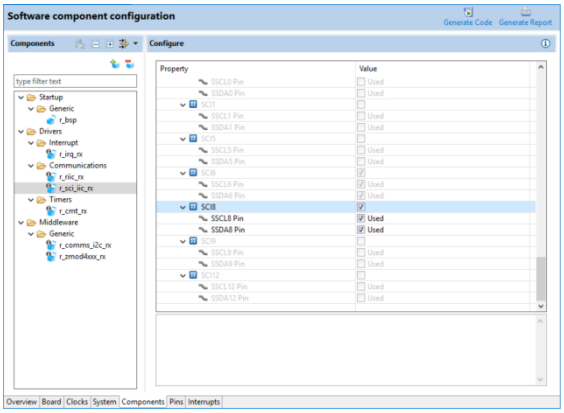


Modify the settings for individual components on the [Components] tabbed page to suit the specifications of the target board.

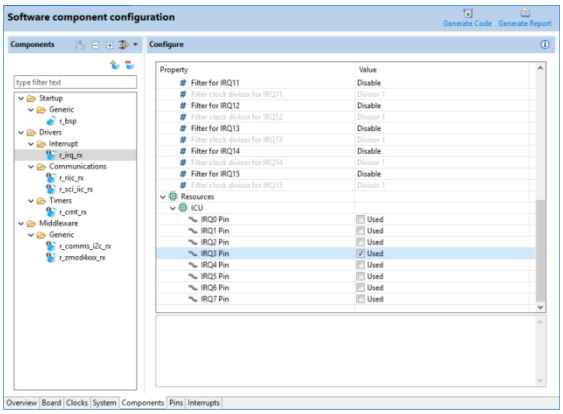
As SCI8 is assigned to PMOD on the RSK RX231 board, change the setting of "MCU supported channels for CH2" to "Not supported" and "MCU supported channels for CH8" to "Supported" in r_sci_iic_rx.

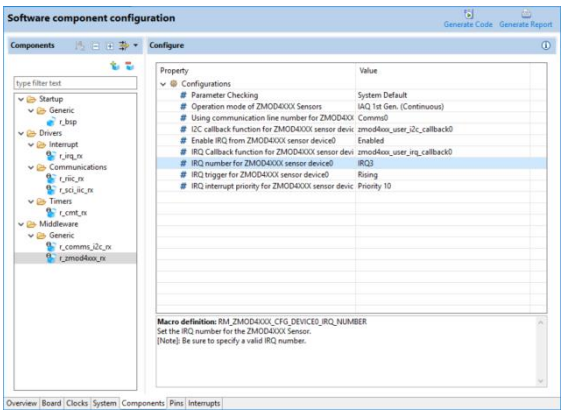
Select the checkboxes for "SSCL8 Pin" and "SSDA8 Pin" for "SCI8" under "Resources".



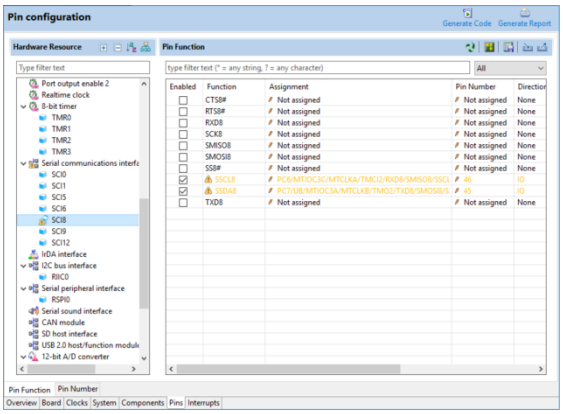


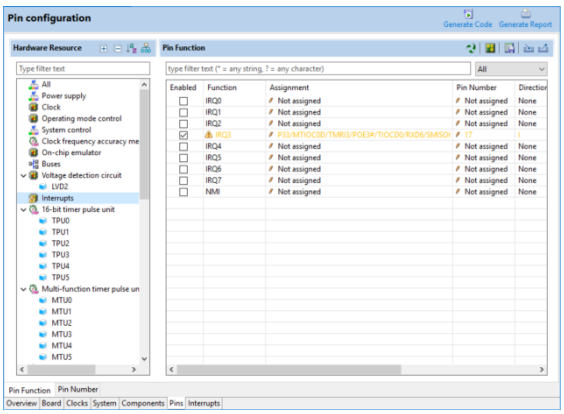
In addition, as IRQ3 is assigned to the PMOD interrupt signal pin of the sensor, select the checkbox for “IRQ3 Pin” under “Resources” in r_irq_rx and change the setting of “IRQ number for OB1203 sensor device0” to “IRQ3” in r_ob1203_rx.





Open the [Pins] tabbed page and check that functions are assigned to the SCI8 and IRQ3 pins on the [Pin function] panel.

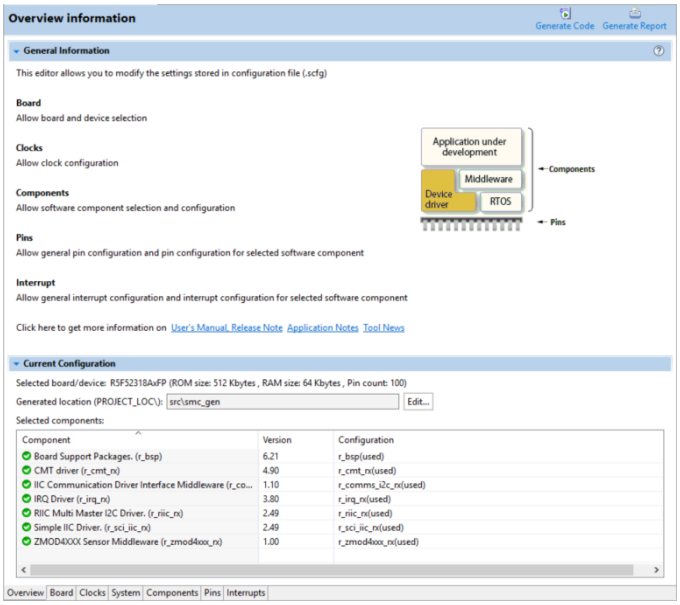




As the use of PMOD Type 2A (extended SPI) is specified in the RSK RX231 board information, a warning message will appear when I2C is used, but this does not produce any problems.

Connecting a sensor board requires a board for converting the PMOD Type 2A interface to PMOD Type 6A.

Press the [Generate Code] icon to generate code.



Build the project.

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

6.2.4 Changing the Toolchain Setting

If you want to use a toolchain other than the CC-RX toolchain, copy RX_OB1203.c for a non-OS system, main.c, ob1203_sensor_thread_entry.c for a FreeRTOS system, or ob1203_sensor_thread_entry.c for an Azure RTOS system.

6.3 RL78 Sample Project

Use the following procedures to modify a sample project created by using the Code Generator.

A sample project created by using the Smart Configurator cannot be modified to change the target device because the target device is fixed as the RL78/G23.

6.3.1 Sample Project Modification Using Code Generator

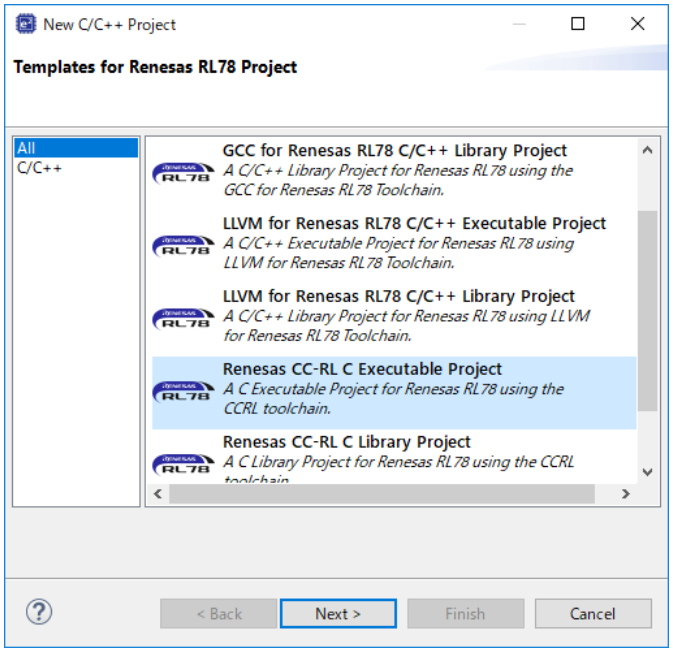
Changing the target device within the RL78 family requires creating a new project.

This section describes an example of creating a new project that can be used on the RSK RL78/G1G board.

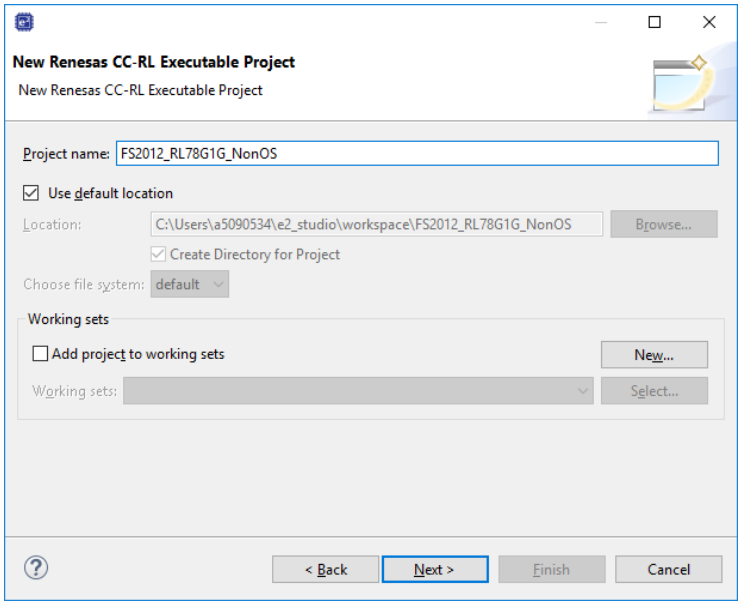
6.3.1.1 Creating a New Project

Select [File] → [New] → [Renesas C/C++ project] → [Renesas RL78] from the menu.

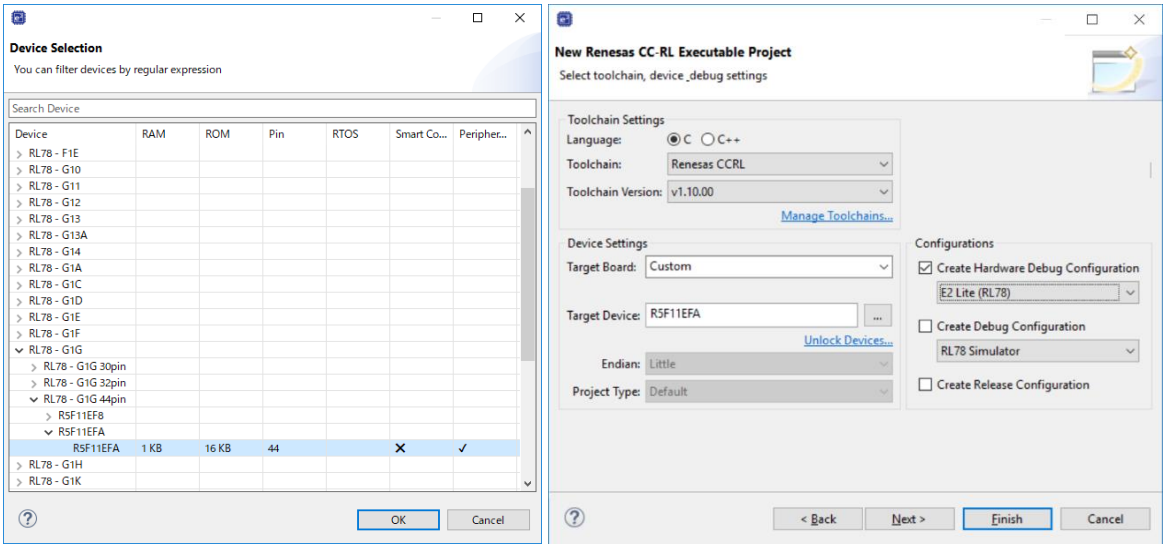
Select the template "Renesas CC-RL C Executable Project" and press the [Next] button.



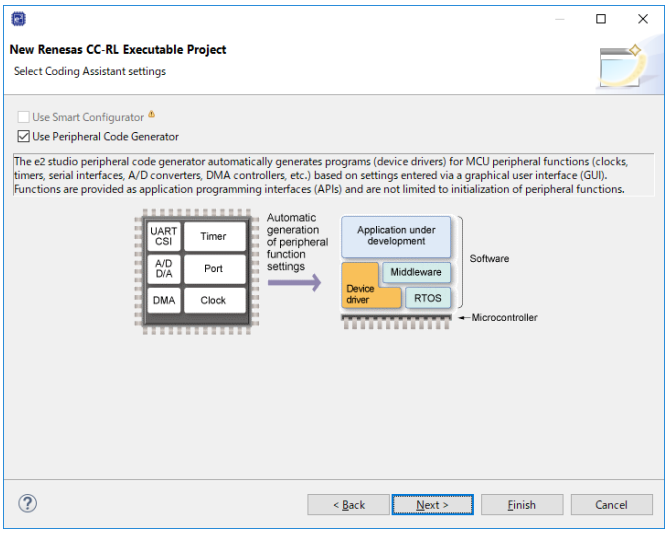
Enter the project name (example: "OB1203_RL78G1G_NonOS") and press the [Next] button.



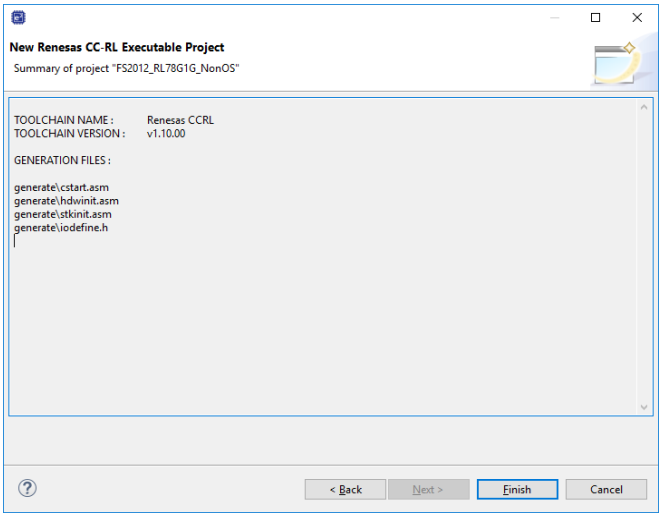
Change "Target Device" to a desired device (example: R5F11EFA) and press the [Next] button.



Select the checkbox for "Use Peripheral Code Generator" and press the [Next] button.

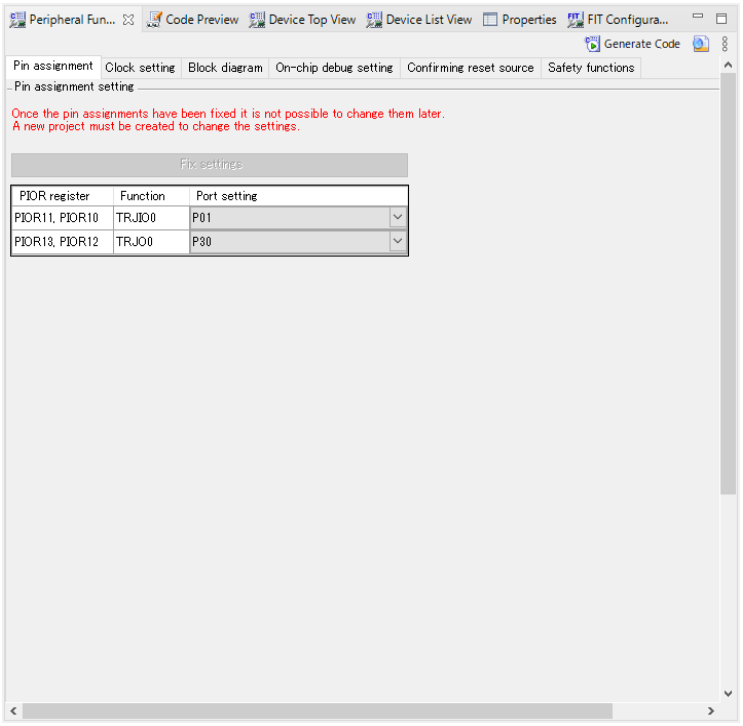


Press the [Finish] button.

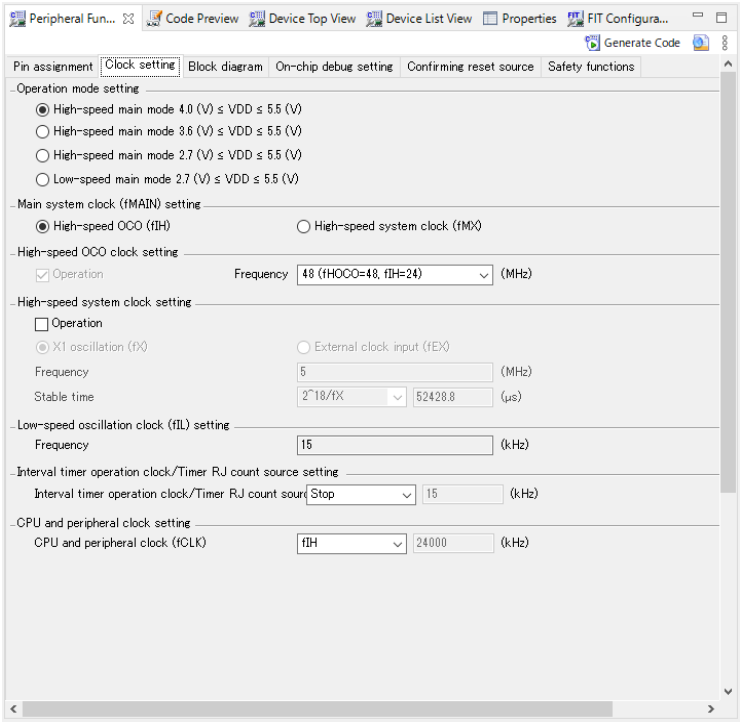


6.3.1.2 Settings of the Code Generator

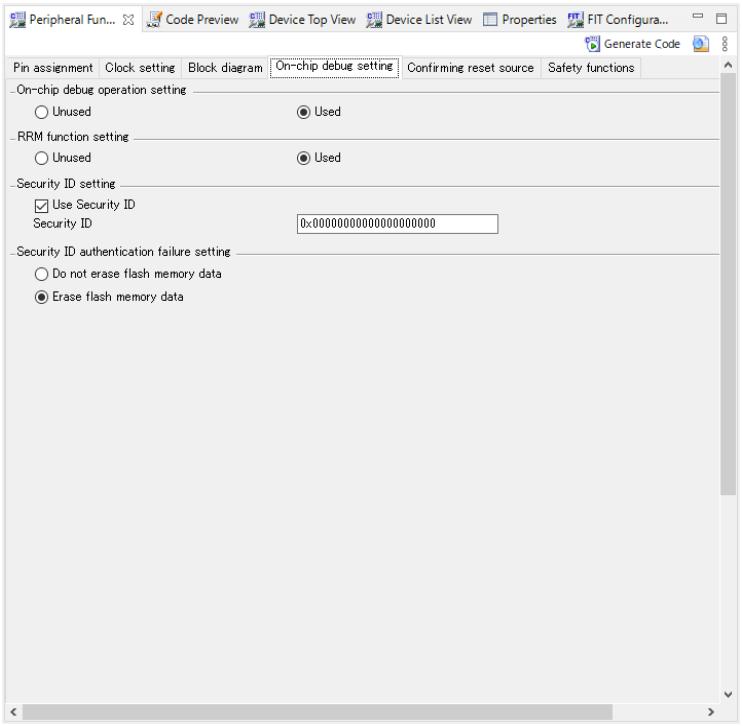
Modify the pin assignment on the [Pin assignment] tabbed page for "Peripheral Functions" to suit the specifications of the target board to be used.



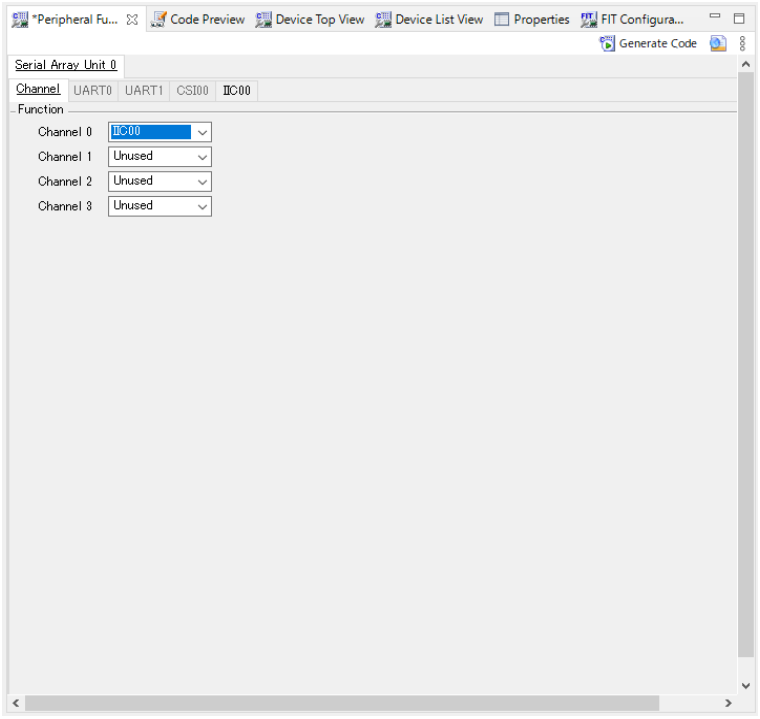
Modify the clock settings on the [Clock setting] tabbed page for "Peripheral Functions" to suit the specifications of the target board.



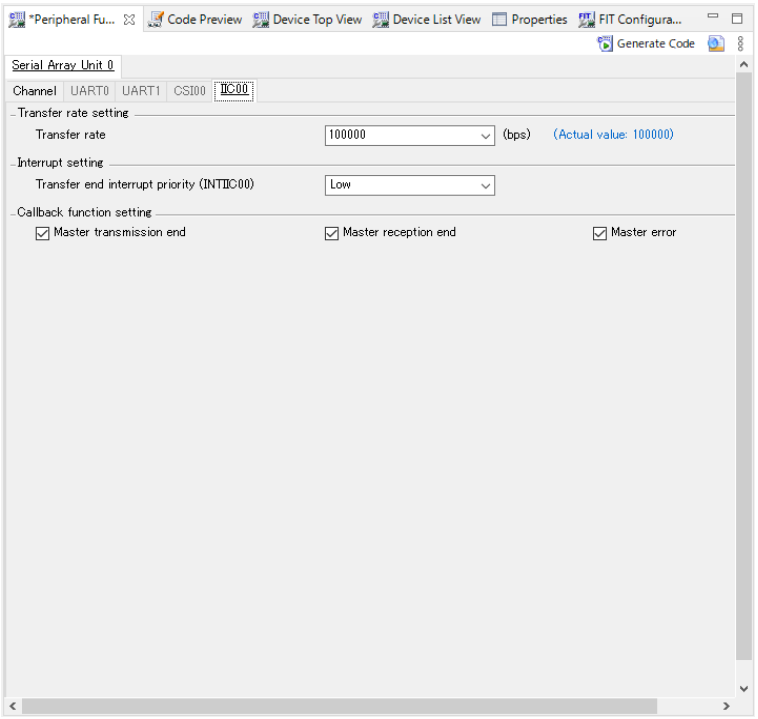
Select "Used" for "On-chip debug operation setting" on the [On-chip debug setting] tabbed page for "Peripheral Functions".



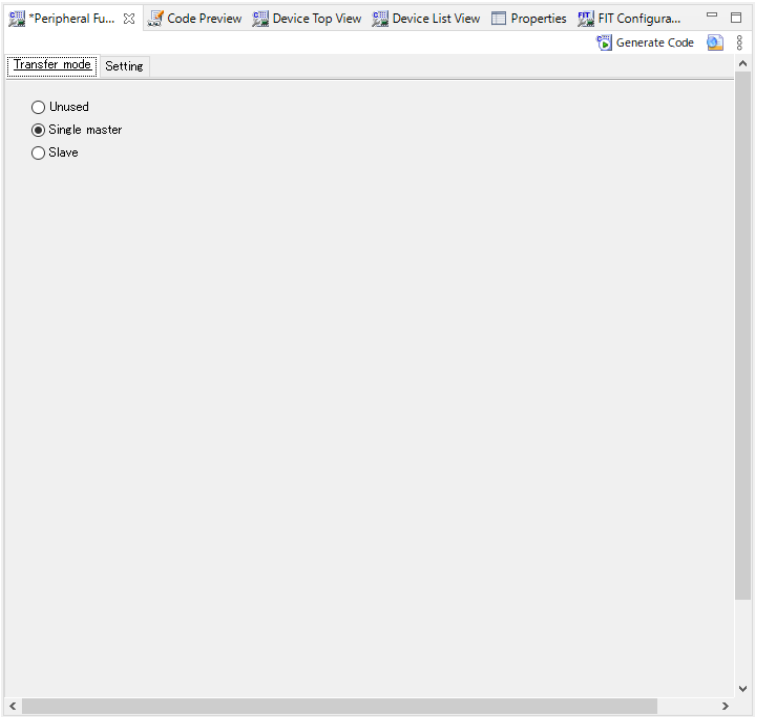
To use the serial array unit, set the channel assigned to PMOD on the target board to "IICxx" on the [Channel] tabbed page in the [Serial Array Unit] or [Serial] setting window.



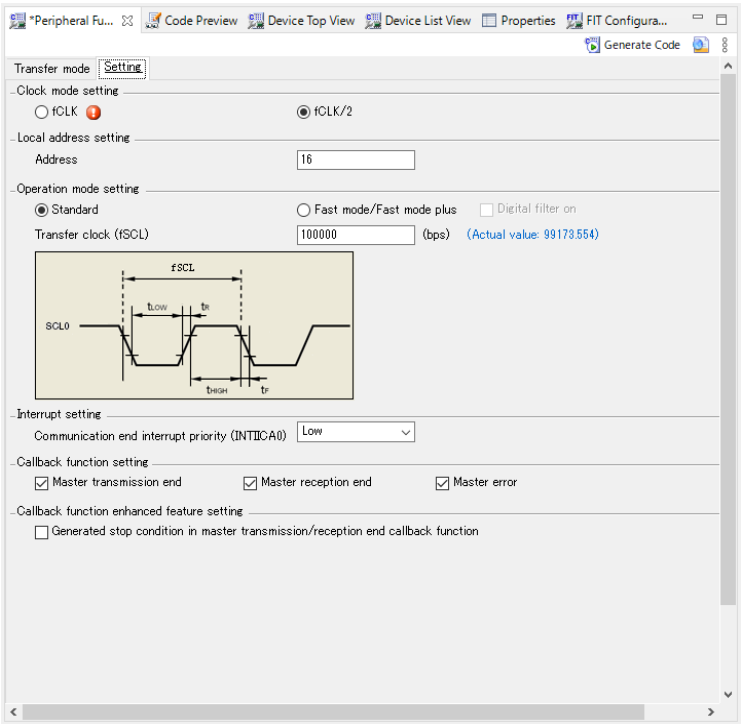
On the tabbed page for IICxx enabled in the serial array unit, set "Transfer rate" to 400000 or 100000, set "Transfer end interrupt priority" to a desired level, and enable all functions under "Callback function setting".



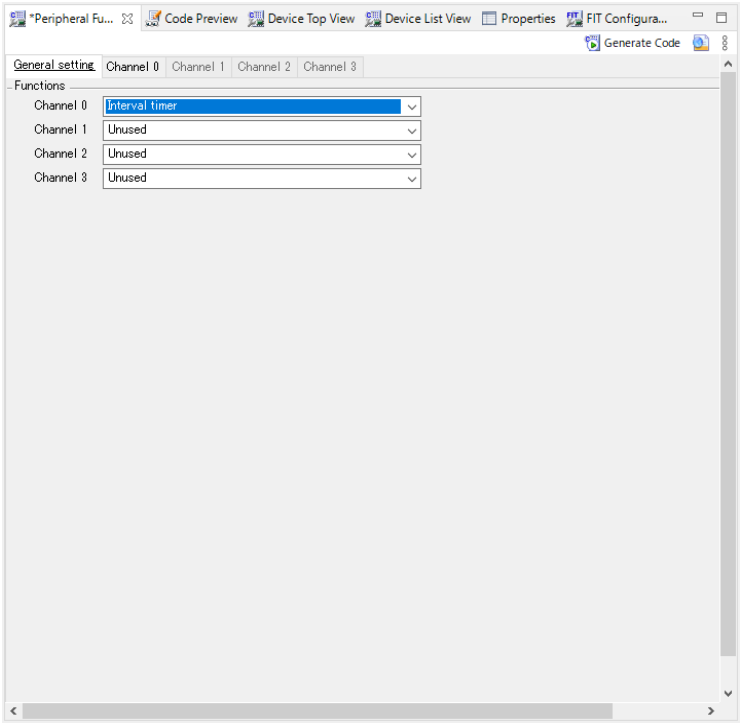
To use the serial interface IICA, select "Single master" on the [Transfer mode] tabbed page for the channel assigned to PMOD on the target board in the [Serial Interface IICA] or [Serial] setting window.



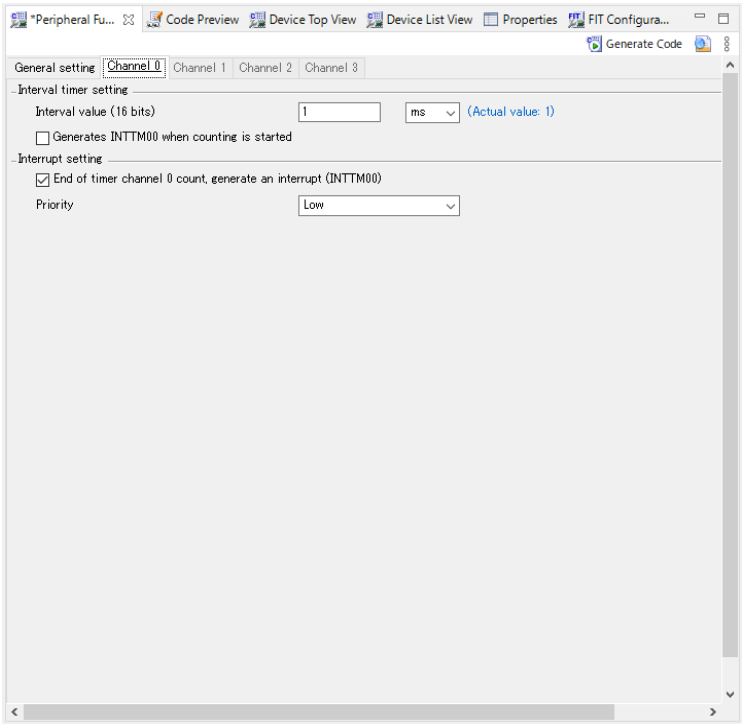
On the [Setting] tabbed page for the channel set to a single master in the previous step, set "Operation mode setting" to either the combination of "Fast mode" and "400000" or the combination of "Standard" and 100000, set the interrupt priority to a desired level, enable all functions under "Callback function setting", and disable "Callback function enhanced feature setting".



On the [General setting] tabbed page for a desired channel of the timer array unit or a desired TAU of the timer, select "Interval timer" under "Functions".



On the page for the channel set to an interval timer in the previous step, set "Interval value" to "1 ms", enable timer interrupts, and set the interrupt priority to a desired level.



Press the [Generate Code] button to generate code.

6.3.1.3 Modifying the Generated Code

Open r_cg_sau_user.c, r_cg_iica_user.c, or r_cg_serial_user.c and add the following code.

Definition for including r_comms_i2c_if.h:

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

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

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

```
/***********************************************************************
* Function Name: r_iic00_callback_master_error
* Description  : This function is a callback function when IIC00 master
err
* Arguments    : flag -
*                    status flag
* Return Value : None
***********************************************************************/
static void r_iic00_callback_master_error(MD_STATUS flag)
{
    /* Start user code. Do not edit comment generated here */
    rm_comms_i2c_bus0_callback(false);
    /* End user code. Do not edit comment generated here */
}
/***********************************************************************
* Function Name: r_iic00_callback_master_receiveend
* Description  : This function is a callback function when IIC00 finishes
* Arguments    : None
* Return Value : None
***********************************************************************/
static void r_iic00_callback_master_receiveend(void)
{
    /* Start user code. Do not edit comment generated here */
    rm_comms_i2c_bus0_callback(true);
    /* End user code. Do not edit comment generated here */
}
/***********************************************************************
* Function Name: r_iic00_callback_master_sendend
* Description  : This function is a callback function when IIC00 finishes
* Arguments    : None
* Return Value : None
***********************************************************************/
static void r_iic00_callback_master_sendend(void)
{
    /* Start user code. Do not edit comment generated here */
    rm_comms_i2c_bus0_callback(true);
    /* End user code. Do not edit comment generated here */
```

Open t_cg_tau_user.c or r_cg_timer_user.c and add the following code.

Declaration of external for the timer_callback() function:

```
/***********************************************************************
Global variables and functions
***********************************************************************/
/* Start user code for global. Do not edit comment generated here */
extern void timer_callback(void);
/* End user code. Do not edit comment generated here */
```

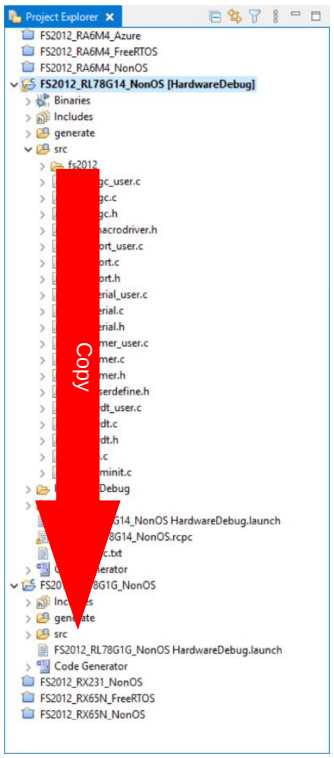
Addition of the call of the timer_callback() function to the timer interrupt callback function:

```
/***********************************************************************
* Function Name: r_tau0_channel0_interrupt
* Description  : This function INTTM00 interrupt service routine.
* Arguments    : None
* Return Value : None
***********************************************************************/
static void __near r_tau0_channel0_interrupt(void)
{
    /* Start user code. Do not edit comment generated here */
    timer_callback();
    /* End user code. Do not edit comment generated here */
}
```

6.3.1.4 Modifying Sample Source Files

Right-click on the "application" "general" "r_bsp" "r_comms_i2c_rl" "r_config" "r_ob1203"folder in the project tree of the sample project "OB1203_RL78G14_NonOS" and select [Copy] from the context menu.

Then, right-click on the "src" folder in the newly created project and select [Paste] from the context menu to paste the copied files to the folder.



Open r_comms_i2c_rl_config.h in the "r_config" folder and modify the values of the following definitions.

- COMMS_I2C_CFG_BUSx_DRIVER_TYPE
- COMMS_I2C_CFG_BUSx_DRIVER_CH

When channel 0 of the serial array unit is used:

```
/* SPECIFY DRIVER TYPE, CHANNEL NO. AND SLAVE ADDRESS EACH DEVICE */
/* For Bus No.0 */
#define COMMS_I2C_CFG_BUS0_DRIVER_TYPE      (COMMS_DRIVER_SAU_I2C) /*
Driver */
#define COMMS_I2C_CFG_BUS0_DRIVER_CH        (0) /* Channel No. */
#define COMMS_I2C_CFG_BUS0_SLAVE_ADDR       (0x53) /* Slave address */
#define COMMS_I2C_CFG_BUS0_CALLBACK         (rm_ob1203_callback0) /*
Callback */
```

When channel 0 of the serial interface IICA is used:

```
/* SPECIFY DRIVER TYPE, CHANNEL NO. AND SLAVE ADDRESS EACH DEVICE */
/* For Bus No.0 */
#define COMMS_I2C_CFG_BUS0_DRIVER_TYPE      (COMMS_DRIVER_I2C) /* Driver
type */
#define COMMS_I2C_CFG_BUS0_DRIVER_CH        (0) /* Channel No. */
#define COMMS_I2C_CFG_BUS0_SLAVE_ADDR       (0x53) /* Slave address */
#define COMMS_I2C_CFG_BUS0_CALLBACK         (rm_ob1203_callback0) /*
Callback */
```

For the other definitions, refer to section 5, Configuration Settings.

When "serial array unit", "serial interface IICA", or "timer array unit" is used as a peripheral function name in the code generator, modify the sample source code as follows.

r_comms_i2c_rl\r_comms_i2c_if.h

Modify "r_cg_serial.h" to "r_cg_sau.h" or "r_cg_iica.h".

```
#elif defined(__CCRL__) || defined(__ICCRL78__) || defined(__RL78__)
#include "inc/instances/rm_comms_i2c.h"
#include "r_cg_sau.h"
#endif
```

RL78_OB1203.c

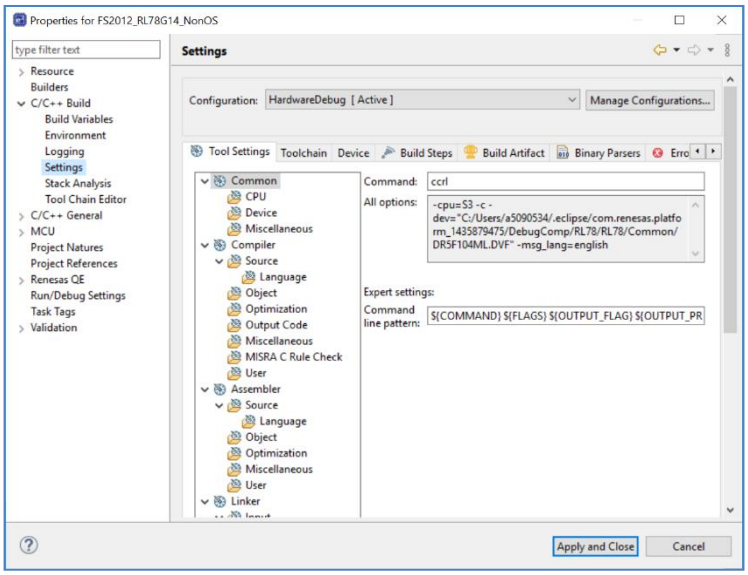
Modify "r_cg_serial.h" to "r_cg_sau.h" or "r_cg_iica.h".

Modify "r_cg_timer.h" to "r_cg_tau.h".

```
#include "r_cg_macrodriver.h"
#include "r_ob1203_if.h"
#include "r_comms_i2c_if.h"
#include "r_cg_sau.h"
#include "r_cg_wdt.h"
#include "r_cg_tau.h"
```

Open the [Properties] window for the project.

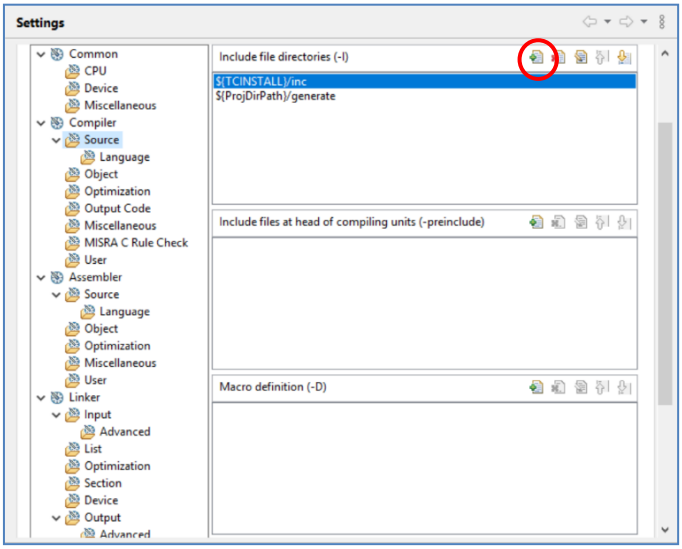
Select [C/C++ Build] → [Settings] in the [Properties] window to open the [Settings] panel.

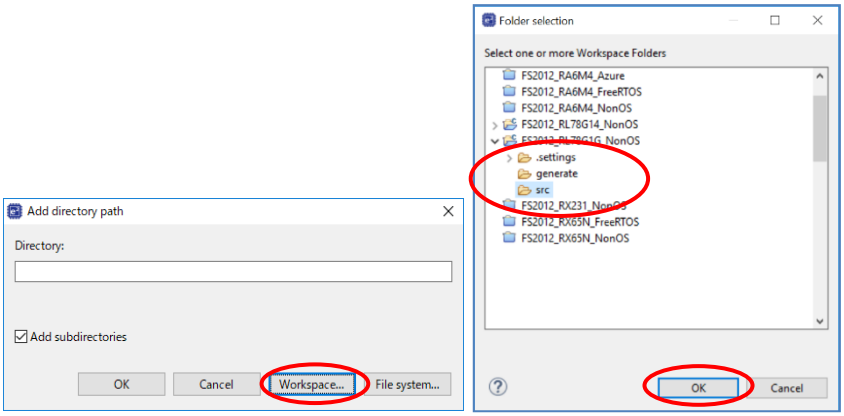

Properties for FS2012_RL78G14_NonOS
type filter text
Resource
Builders
C/C++ Build
Build Variables
Environment
Logging
Settings
Stack Analysis
Tool Chain Editor
C/C++ General
MCU
Project Natures
Project References
Renesas QE
Run/Debug Settings
Task Tags
Validation
Settings
Configuration: HardwareDebug [Active]
Manage Configurations...
Tool Settings
Toolchain
Device
Build Steps
Build Artifact
Binary Parsers
Common
CPU
Device
Miscellaneous
Compiler
Source
Language
Object
Optimization
Output Code
Miscellaneous
MISRA C Rule Check
User
Assembler
Source
Language
Object
Optimization
Miscellaneous
User
Linker
Command:
ccrl
All options:
-cpu=S3 -c -
dev="C:/Users/a5090534/.eclipse/com.renesas.platfo
rm_1435879475/DebugComp/RL78/RL78/Common/
DR5F104ML.DVF" -msg_lang=english
Expert settings:
Command
line pattern:
${COMMAND} ${FLAGS} ${OUTPUT_FLAG} ${OUTPUT_PR
Apply and Close
Cancel

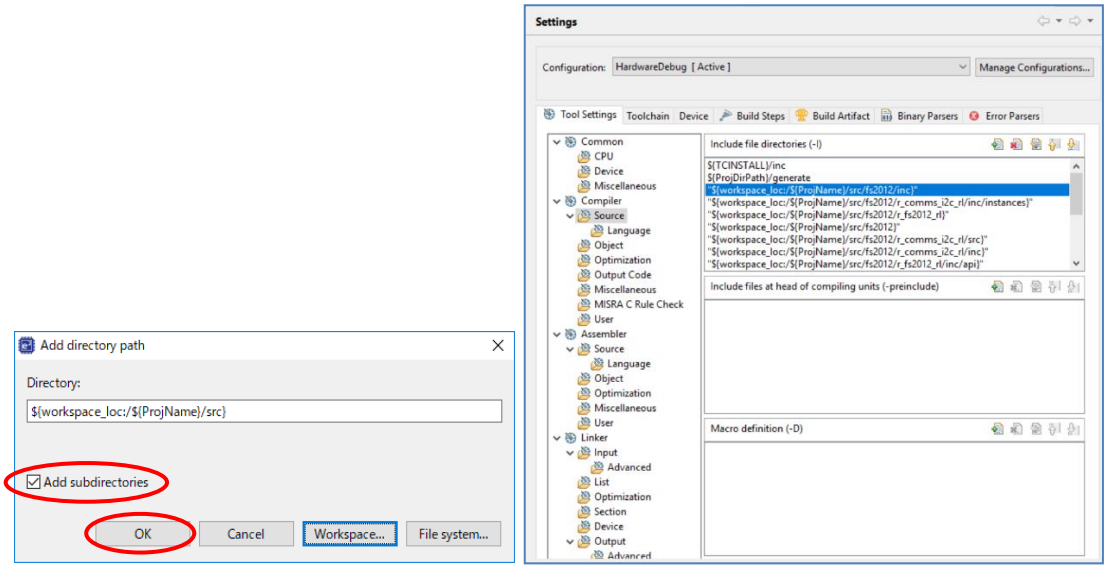
Select [Compiler] → [Source] on the [Tool Settings] tabbed page and press the [Add] icon.

Press the [Workspace] button in the [Add directory path] dialog box and a list of projects will appear. Select the "src" folder for the newly created project from the list and press the [OK] button.

Select the checkbox for "Add subdirectories" and press the [OK] button.

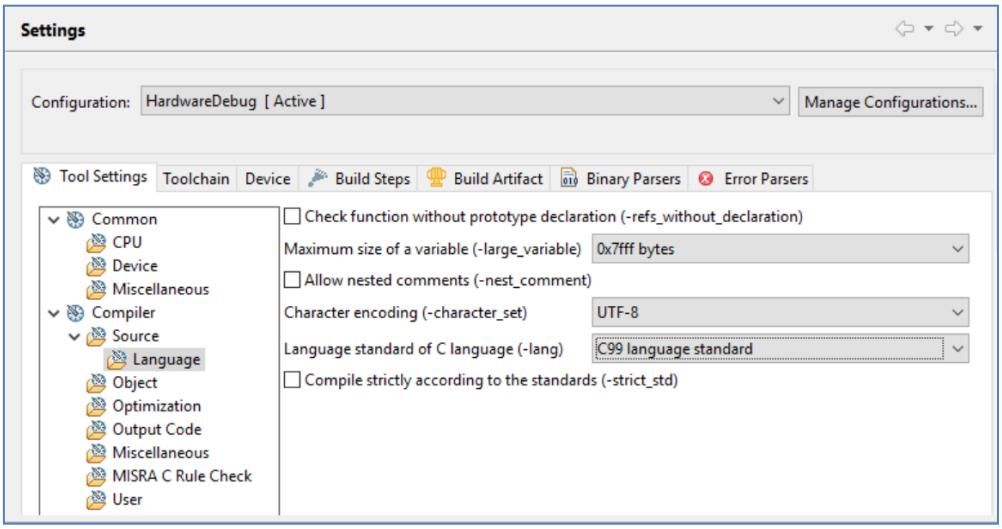






Select [Compiler] → [Source] → [Language] on the [Tool Settings] tabbed page and change the setting of "Language standard of C language" to "C99 language standard".

Press the [Apply and Close] button to close the [Properties] window.



Build the project.

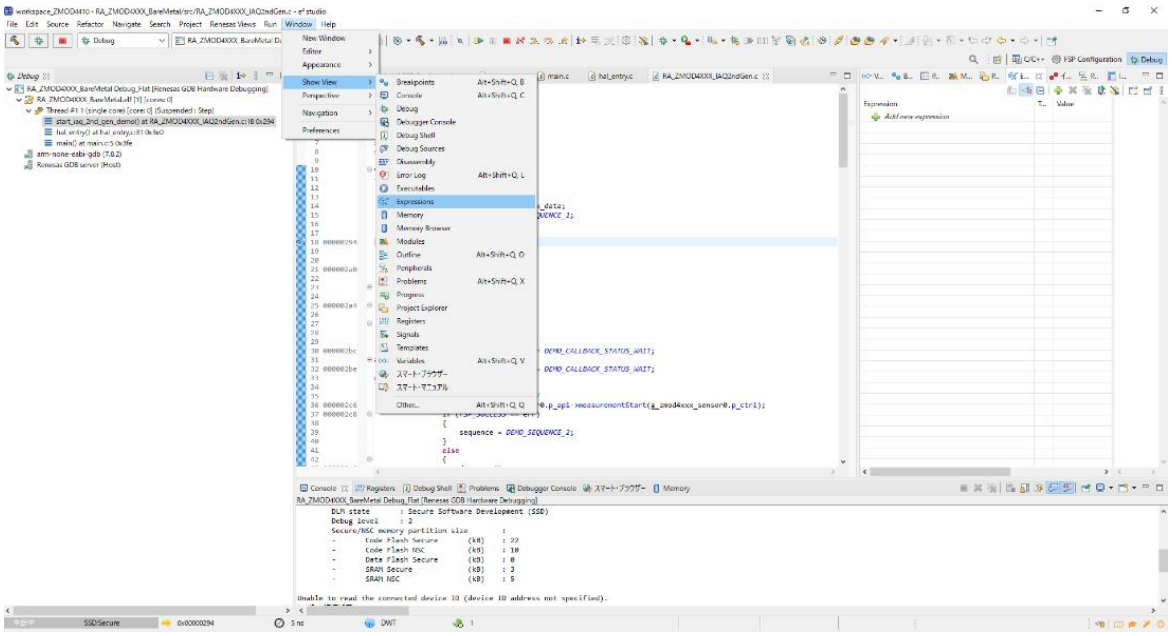
Select [Debug Configurations] from the menu and modify the debugger settings to suit the specifications of the emulator to be connected to the target board.

7. Viewing Bio Data

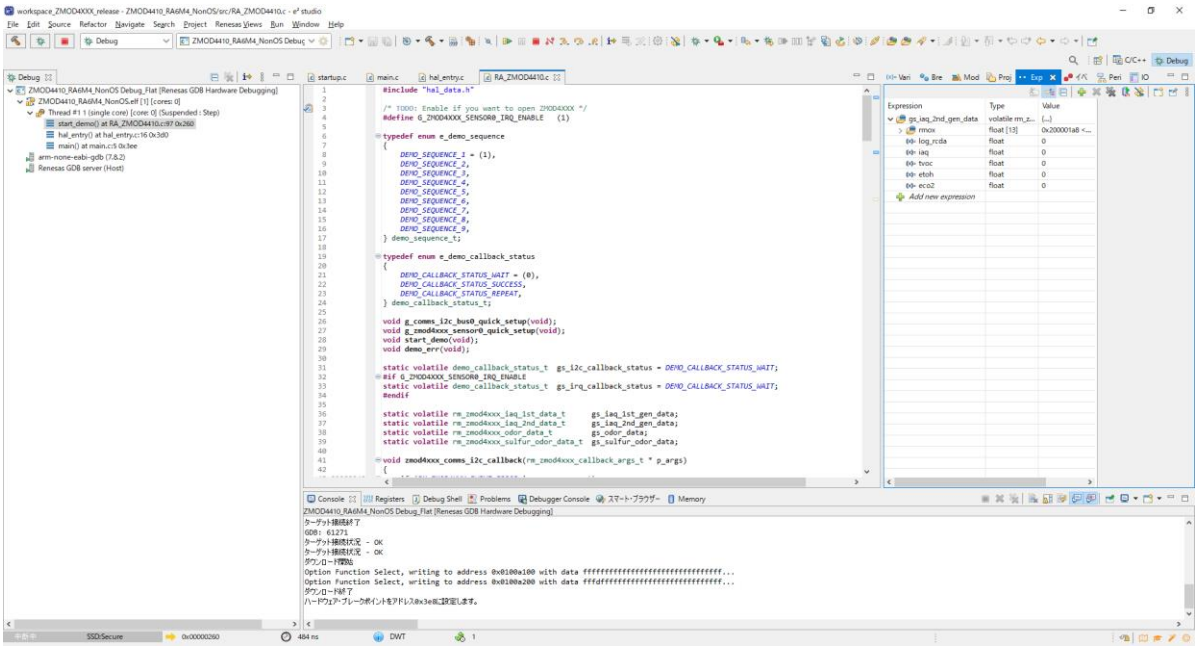
Use the following procedure to view gas data in real time.

In this chapter, ZMOD4XXX is used as example figures, but OB1203 works the same way.

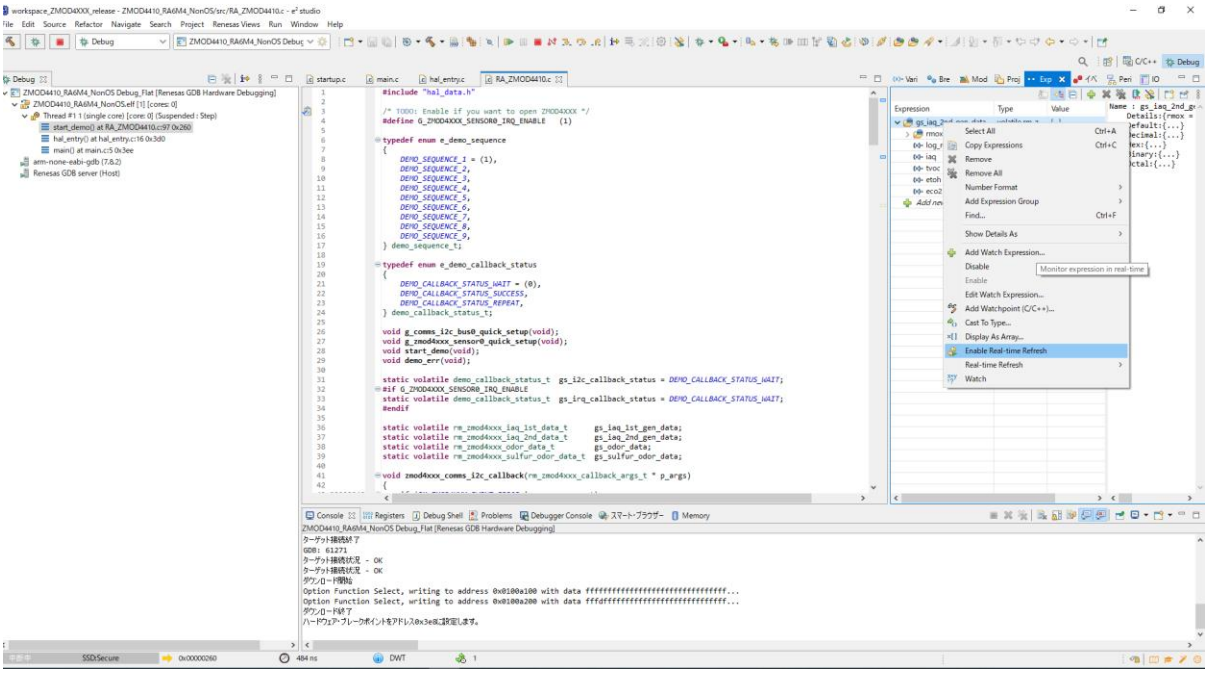
After executing debugging, select [Window] → [Show View] → [Expressions] tabbed page.



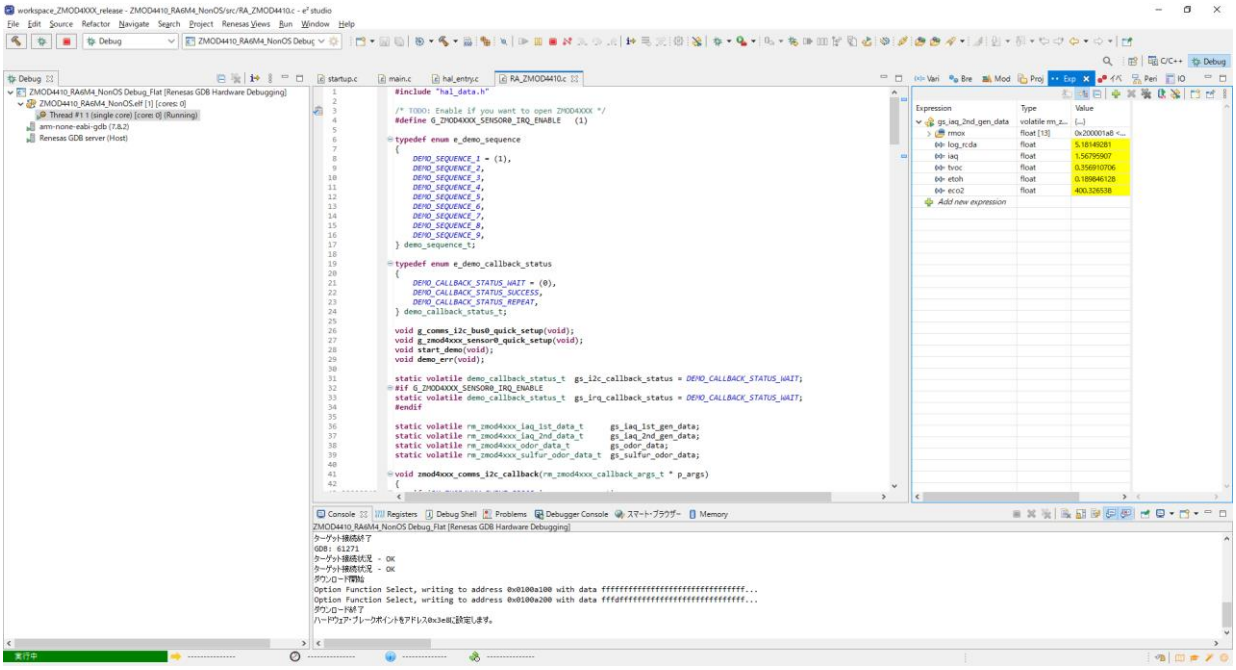
Click on [Add new expression] on the [Expressions] tabbed page and add “gs_ob1203_bio_data”.



Right-click on the added variable and select [Enable Real-time Refresh].



Start debugging, and the temperature and humidity values will be updated in real time.



Revision History

Rev.	Date	Description	
		Page	Summary
1.00	April 27, 2022	-	First Release
1.01	May 12, 2022	P1, P8, P9	Added the constraint of sampling rate. Changed table 2-9, 2-11 Operating Environment for the RE01 256KB / 1500KB Group MCU Changed figure 2-6 Hardware Connections for the RE01 1500KB Group
1.02	March 3, 2023	-	Updated: Environments for RL78
1.03	March 29, 2023	-	Updated: Environments for RA, RX, RL78, RZ Updated: Guide for Changing the Target Device

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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(Rev.5.0-1 October 2020)

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