

# Smart Configurator

User's Manual: RISC-V MCU API Reference

RENESAS MCU  
RISC-V MCU Family

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### 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.

# How to Use This Manual

Readers	The target readers of this manual are the application system engineers who use the Smart Configurator and need to understand its function.												
Purpose	The purpose of this manual is to explain the user for understanding and using the Smart Configurator functions. We aim to help their system development including their hardware and software.												
Organization	This manual can be broadly divided into the following units. <a href="#">1.GENERAL</a> <a href="#">2.OUTPUT FILES</a> <a href="#">3.API FUNCITONS</a>												
How to Read This Manual	It is assumed that the readers of this manual have general knowledge of electricity, logic circuits, and microcontrollers.												
Conventions	<table><tr><td>Deata significance:</td><td>Higher digits on the left and lower digits on the right</td></tr><tr><td>Active low representation:</td><td><math>\overline{\text{XXX}}</math> (overscore over pin or signal name)</td></tr><tr><td>Note:</td><td>Footnote for item marked with Note in the text</td></tr><tr><td>Caution:</td><td>Information requiring particular attention</td></tr><tr><td>Remark:</td><td>Supplementary information</td></tr><tr><td>Numeric representation:</td><td>Decimal ... XXXX Hexadecimal ... 0xXXXX</td></tr></table>	Deata significance:	Higher digits on the left and lower digits on the right	Active low representation:	$\overline{\text{XXX}}$ (overscore over pin or signal name)	Note:	Footnote for item marked with Note in the text	Caution:	Information requiring particular attention	Remark:	Supplementary information	Numeric representation:	Decimal ... XXXX Hexadecimal ... 0xXXXX
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Active low representation:	$\overline{\text{XXX}}$ (overscore over pin or signal name)												
Note:	Footnote for item marked with Note in the text												
Caution:	Information requiring particular attention												
Remark:	Supplementary information												
Numeric representation:	Decimal ... XXXX Hexadecimal ... 0xXXXX												

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# TABLE OF CONTENTS

1. GENERAL.....	7
1.1 Overview .....	7
1.2 Features.....	7
2. OUTPUT FILES.....	8
2.1 Description.....	8
3. INITIALIZATION .....	17
4. API FUNCTIONS.....	18
4.1 Overview .....	18
4.2 Function Reference.....	19
4.2.1 General.....	20
4.2.2 Low Voltage Detection.....	60
4.2.3 Interrupt Controller.....	66
4.2.4 Data Transfer Controller.....	73
4.2.5 Event Link Controller .....	79
4.2.6 I/O ports.....	87
4.2.7 Key Interrupt.....	93
4.2.8 Interval Timer (Timer Array Unit) .....	100
4.2.9 Square Wave Output (Timer Array Unit) .....	113
4.2.10 External Event Counter (Timer Array Unit).....	122
4.2.11 Divider Function (Timer Array Unit) .....	131
4.2.12 Input Pulse Interval Measurement (Timer Array Unit).....	138
4.2.13 Measurement of High-/Low-Level Width of Input Signal (Timer Array Unit).....	146
4.2.14 Delay Counter (Timer Array Unit) .....	154
4.2.15 One-Shot Pulse Output (Timer Array Unit).....	164
4.2.16 PWM Output (Timer Array Unit) .....	173
4.2.17 Interval Timer (32-bit Interval Timer using 8-bit counter mode) .....	181
4.2.18 Interval Timer (32-bit Interval Timer using 16-bit counter mode) .....	189
4.2.19 Interval Timer (32-bit Interval Timer using 32-bit counter mode) .....	199
4.2.20 Real-Time Clock.....	207
4.2.21 Watchdog Timer .....	228
4.2.22 Independent Watchdog Timer.....	234
4.2.23 Simplified SPI Communication .....	240
4.2.24 UART Communication (Serial array unit).....	253

4.2.25	Simplified I2C Communication (Master mode) (Serial Array Unit) .....	270
4.2.26	I2C Bus Interface Communication (Master mode) .....	284
4.2.27	I2C Bus Interface Communication (Slave mode) .....	298
4.2.28	UART Communication (Serial Interface UARTA) .....	313
4.2.29	Remote Control Signal Receiver .....	331
4.2.30	A/D Converter .....	347
4.2.31	D/A Converter .....	363
4.2.32	Comparator .....	370
Revision Record .....		377

# 1. GENERAL

This chapter gives an overview of the driver code generator of the Smart Configurator.

## 1.1 Overview

This tool can output source code (device driver programs as C source and header files) for controlling peripheral modules (clock generation circuit, voltage detection circuit, etc.) of the device by using a GUI to set various types of information on the requirements of the project.

## 1.2 Features

The features of the Smart Configurator are as follows.

### - Generating code

The Code Generator outputs not only device driver files in accord with the information set in the GUI but also a complete set of programs for the build environment, such as a sample program containing the call of the main function.

### - Reporting

Information that was set by using the Smart Configurator can be output to files in various formats and used as design documentation.

### - Renaming

Default names are given to folders and files output by the Smart Configurator and to the API functions in the source code, but these can be changed to user-specified names.

### - Protecting user code

The user can add user's original source code to each API function. When user generated the device driver programs again by the Smart Configurator, user's source code within this comment is protected.

[Comment for user source code descriptions]

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

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

“xxxx” is changed for different user code:

- “global” – user can add global variables and functions
- “function” – user can add functions declaration in .h file
- “user init” – user can add initializing code
- Interrupt function name – user can add service routine code
- “adding” – user can add functions in .c file
- “include” – user can add including file in .c file
- “pragma” – user can add pragma declaration in .c file

Code written by the user between these comments will be preserved even when the code is generated again.

## 2. OUTPUT FILES

This chapter explains the file output by the Smart Configurator.

### 2.1 Description

The Smart Configurator outputs the following files.

**Table 2-1 Output File List (1/9)**

Component / Folder Name	File Name	API Function Name
General	{project name}.c	main
	r_smc_entry.h	—
	r_cg_systeminit.c	R_Systeminit
	r_cg_macrodriver.h	—
	r_cg_userdefine.h	—
	r_cg_interrupt_handlers.h	—
	r_cg_inthandler.c	—
	r_cg_vect_table.c	—
	r_cg_port.h	—
	r_cg_kr.h	—
	r_cg_wdt.h	—
	r_cg_icu.h	—
	r_cg_elc_common.c	R_ELC_Cancel_ModuleStop R_ELC_Enter_ModuleStop
	r_cg_elc.h	—
	r_cg_lvd.h	—
	r_cg_dtc_common.c	R_DTC_Cancel_ModuleStop R_DTC_Enter_ModuleStop
	r_cg_dtc_common_user.c	r_dtc_interrupt
	r_cg_dtc_common.h	—
	r_cg_dtc.h	—
	r_cg_tau_common.c	R_TAUm_Create R_TAUm_Cancel_ModuleStop R_TAUm_Enter_ModuleStop
	r_cg_tau_common.h	—
	r_cg_tau.h	—
	r_cg_itl_common.c	R_ITL_Create R_ITL_Start_Interrupt R_ITL_Stop Interrupt R_ITL_Cancel_ModuleStop R_ITL_Enter_ModuleStop
	r_cg_itl_common_user.c	r_itl_interrupt
	r_cg_itl_common.h	—
	r_cg_itl.h	—
	r_cg_rtc.h	—



Table 2-2 Output File List (2/9)

Component / Folder Name	File Name	API Function Name
General	r_cg_ad_common.c	R_ADC_Cancel_ModuleStop R_ADC_Enter_ModuleStop
	r_cg_ad_common.h	—
	r_cg_ad.h	—
	r_cg_da_common.c	R_DAC_Create R_DAC_Cancel_ModuleStop R_DAC_Enter_ModuleStop
	r_cg_da_common.h	—
	r_cg_da.h	—
	r_cg_comp_common.c	R_COMP_Create R_COMP_Cancel_ModuleStop R_COMP_Enter_ModuleStop
	r_cg_comp_common.h	—
	r_cg_comp.h	—
	r_cg_sau_common.c	R_SAUm_Create R_SAUm_Cancel_ModuleStop R_SAUm_Enter_ModuleStop R_SAUm_Set_SnoozeOn R_SAUm_Set_SnoozeOff
	r_cg_sau_common.h	—
	r_cg_sau.h	—
	r_cg_iica_common.c	R_IICAn_Cancel_ModuleStop R_IICAn_Enter_ModuleStop
	r_cg_iica_common.h	—
	r_cg_iica.h	—
	r_cg_uarta.h	—
	r_cg_remc_common.c	R_REMC_Cancel_ModuleStop R_REMC_Enter_ModuleStop
	r_cg_remc_common.h	—
	r_cg_remc.h	—
Low Voltage Detection	{Config_LVDn}.c	R_{Config_LVDn}_Create R_{Config_LVDn}_Start R_{Config_LVDn}_Stop
	{Config_LVDn}_user.c	R_{Config_LVDn}_Create_UserInit
	{Config_LVDn}.h	—
Interrupt Controller	{Config_ICU}.c	R_{Config_ICU}_Create R_{Config_ICU}_IRQn_Start R_{Config_ICU}_IRQn_Stop
	{Config_ICU}_user.c	R_{Config_ICU}_Create_UserInit r_{Config_ICU}_IRQn_interrupt
	{Config_ICU}.h	—

Table 2-3 Output File List (3/9)

Component / Folder Name	File Name	API Function Name
Data Transfer Controller	{Config_DTC}.c	R_{Config_DTC}_Create R_{Config_DTC}_Start R_{Config_DTC}_Stop
	{Config_DTC}_user.c	R_{Config_DTC}_Create_UserInit
	{Config_DTC}.h	—
Event Link Controller	{Config_ELC}.c	R_{Config_ELC}_Create R_{Config_ELC}_Stop
	{Config_ELC}_user.c	R_{Config_ELC}_Create_UserInit
	{Config_ELC}.h	—
I/O Ports	{Config_PORT}.c	R_{Config_PORT}_Create R_{Config_PORT}_Set_Output_Level R_{Config_PORT}_Set_Output_Level_ELC
	{Config_PORT}_user.c	R_{Config_PORT}_Create_UserInit
	{Config_PORT}.h	—
Key Interrupt	{Config_KR}.c	R_{Config_KR}_Create R_{Config_KR}_Start R_{Config_KR}_Stop
	{Config_KR}_user.c	R_{Config_KR}_Create_UserInit r_{Config_KR}_interrupt
	{Config_KR}.h	—
Interval Timer (Timer Array Unit)	{Config_TAUm_n}.c	R_{Config_TAUm_n}_Create R_{Config_TAUm_n}_Start R_{Config_TAUm_n}_Stop R_{Config_TAUm_n}_Higher8bits_Start R_{Config_TAUm_n}_Higher8bits_Stop R_{Config_TAUm_n}_Lower8bits_Start R_{Config_TAUm_n}_Lower8bits_Stop
	{Config_TAUm_n}_user.c	R_{Config_TAUm_n}_Create_UserInit r_{Config_TAUm_n}_interrupt r_{Config_TAUm_n}_higher8bits_interrupt
	{Config_TAUm_n}.h	—
Square Wave Output (Timer Array Unit)	{Config_TAUm_n}.c	R_{Config_TAUm_n}_Create R_{Config_TAUm_n}_Start R_{Config_TAUm_n}_Stop R_{Config_TAUm_n}_Lower8bits_Start R_{Config_TAUm_n}_Lower8bits_Stop
	{Config_TAUm_n}_user.c	R_{Config_TAUm_n}_Create_UserInit r_{Config_TAUm_n}_interrupt
	{Config_TAUm_n}.h	—

Table 2-4 Output File List (4/9)

Component / Folder Name	File Name	API Function Name
External Event Counter (Timer Array Unit)	{Config_TAUm_n}.c	R_{Config_TAUm_n}_Create R_{Config_TAUm_n}_Start R_{Config_TAUm_n}_Stop R_{Config_TAUm_n}_Lower8bits_Start R_{Config_TAUm_n}_Lower8bits_Stop
	{Config_TAUm_n}_user.c	R_{Config_TAUm_n}_Create_UserInit r_{Config_TAUm_n}_interrupt
	{Config_TAUm_n}.h	—
Divider Function (Timer Array Unit)	{Config_TAUm_n}.c	R_{Config_TAUm_n}_Create R_{Config_TAUm_n}_Start R_{Config_TAUm_n}_Stop
	{Config_TAUm_n}_user.c	R_{Config_TAUm_n}_Create_UserInit r_{Config_TAUm_n}_interrupt
	{Config_TAUm_n}.h	—
Input Pulse Interval Measurement (Timer Array Unit)	{Config_TAUm_n}.c	R_{Config_TAUm_n}_Create R_{Config_TAUm_n}_Start R_{Config_TAUm_n}_Stop R_{Config_TAUm_n}_Get_PulseWidth
	{Config_TAUm_n}_user.c	r_{Config_TAUm_n}_interrupt R_{Config_TAUm_n}_Create_UserInit
	{Config_TAUm_n}.h	—
Measurement of High-/Low-Level Width of Input Signal (Timer Array Unit)	{Config_TAUm_n}.c	R_{Config_TAUm_n}_Create R_{Config_TAUm_n}_Start R_{Config_TAUm_n}_Stop R_{Config_TAUm_n}_Get_PulseWidth
	{Config_TAUm_n}_user.c	R_{Config_TAUm_n}_Create_UserInit r_{Config_TAUm_n}_interrupt
	{Config_TAUm_n}.h	—
Delay Counter (Timer Array Unit)	{Config_TAUm_n}.c	R_{Config_TAUm_n}_Create R_{Config_TAUm_n}_Start R_{Config_TAUm_n}_Stop R_{Config_TAUm_n}_Lower8bits_Start R_{Config_TAUm_n}_Lower8bits_Stop R_{Config_TAUm_n}_Set_SoftwareTriggerOn
	{Config_TAUm_n}_user.c	R_{Config_TAUm_n}_Create_UserInit r_{Config_TAUm_n}_interrupt
	{Config_TAUm_n}.h	—

Table 2-5 Output File List (5/9)

Component / Folder Name	File Name	API Function Name
One-Shot Pulse Output (Timer Array Unit)	{Config_TAUm_n}.c	R_{Config_TAUm_n}_Create R_{Config_TAUm_n}_Start R_{Config_TAUm_n}_Stop R_{Config_TAUm_n}_Set_SoftwareTriggerOn R_{Config_TAUm_n}_Set_Get_PulseWidth
	{Config_TAUm_n}_user.c	R_{Config_TAUm_n}_Create_UserInit r_{Config_TAUm_n}_channeln_interrupt r_{Config_TAUm_n}_channelp_interrupt
	{Config_TAUm_n}.h	—
PWM Output (Timer Array Unit)	{Config_TAUm_n}.c	R_{Config_TAUm_n}_Create R_{Config_TAUm_n}_Start R_{Config_TAUm_n}_Stop
	{Config_TAUm_n}_user.c	R_{Config_TAUm_n}_Create_UserInit r_{Config_TAUm_n}_channeln_interrupt r_{Config_TAUm_n}_channelp_interrupt
	{Config_TAUm_n}.h	—
Interval Timer (32-bit Interval Timer using 8-bit counter mode)	{Config_ITLn}.c	R_{Config_ITLn}_Create R_{Config_ITLn}_Start R_{Config_ITLn}_Stop R_{Config_ITLn}_Set_OperationMode R_{Config_ITLn}_Get_CaptureValue
	{Config_ITLn}_user.c	R_{Config_ITLn}_Create_UserInit r_{Config_ITLn}_Callback_Shared_Interrupt
	{Config_ITLn}.h	—
Interval Timer (32-bit Interval Timer using 16-bit counter mode)	{Config_ITLn_ITLm}.c	R_{Config_ITLn_ITLm}_Create R_{Config_ITLn_ITLm}_Start R_{Config_ITLn_ITLm}_Stop R_{Config_ITLn_ITLm}_Set_SoftwareTriggerOn R_{Config_ITLn_ITLm}_Set_OperationMode R_{Config_ITLn_ITLm}_Get_CaptureValue
	{Config_ITLn_ITLm}_user.c	R_{Config_ITLn_ITLm}_Create_UserInit r_{Config_ITLn_ITLm}_Callback_Shared_Interrupt
	{Config_ITLn_ITLm}.h	—

Table 2-6 Output File List (6/9)

Component / Folder Name	File Name	API Function Name
Interval Timer (32-bit Interval Timer using 32-bit counter mode)	{Config_ITL000_ITL001_ITL012_ITL013}.c	R_{Config_ITL000_ITL001_ITL012_ITL013}_Create R_{Config_ITL000_ITL001_ITL012_ITL013}_Start R_{Config_ITL000_ITL001_ITL012_ITL013}_Stop R_{Config_ITL000_ITL001_ITL012_ITL013}_Set_OperationMode
	{Config_ITL000_ITL001_ITL012_ITL013}_user.c	R_{Config_ITL000_ITL001_ITL012_ITL013}_Create_UserInit r_{Config_ITL000_ITL001_ITL012_ITL013}_Callback_Shared_Interrupt
	{Config_ITL000_ITL001_ITL012_ITL013}.h	—
Real-time Clock	{Config_RTC}.c	R_{Config_RTC}_Create R_{Config_RTC}_Start R_{Config_RTC}_Stop R_{Config_RTC}_Set_HourSystem R_{Config_RTC}_Set_CounterValue R_{Config_RTC}_Get_CounterValue R_{Config_RTC}_Set_ConstPeriodInterruptOn R_{Config_RTC}_Set_ConstPeriodInterruptOff R_{Config_RTC}_Set_AlarmOn R_{Config_RTC}_Set_AlarmOff R_{Config_RTC}_Set_AlarmValue R_{Config_RTC}_Get_AlarmValue R_{Config_RTC}_Set_RTC1HZOn R_{Config_RTC}_Set_RTC1HZOff
	{Config_RTC}_user.c	R_{Config_RTC}_Create_UserInit r_{Config_RTC}_interrupt r_{Config_RTC}_callback_constperiod r_{Config_RTC}_callback_alarm
	{Config_RTC}.h	—
Watchdog Timer	{Config_WDT}.c	R_{Config_WDT}_Create R_{Config_WDT}_Restart
	{Config_WDT}_user.c	R_{Config_WDT}_Create_UserInit r_{Config_WDT}_interrupt
	{Config_WDT}.h	—
Independant Watchdog Timer	{Config_IWDT}.c	R_{Config_IWDT}_Create R_{Config_IWDT}_Restart
	{Config_IWDT}_user.c	R_{Config_IWDT}_Create_UserInit r_{Config_IWDT}_interrupt
	{Config_IWDT}.h	—

Table 2-7 Output File List (7/9)

Component / Folder Name	File Name	API Function Name
Simplified SPI Communication	{Config_SPIp}.c	R_{Config_SPIp}_Create R_{Config_SPIp}_Start R_{Config_SPIp}_Stop R_{Config_SPIp}_Send R_{Config_SPIp}_Receive R_{Config_SPIp}_Send_Receive
	{Config_SPIp}_user.c	R_{Config_SPIp}_Create_UserInit r_{Config_SPIp}_interrupt r_{Config_SPIp}_callback_sendend r_{Config_SPIp}_callback_receiveend r_{Config_SPIp}_callback_error
	{Config_SPIp}.h	—
UART Communication (Serial array unit)	{Config_UARTq}.c	R_{Config_UARTq}_Create R_{Config_UARTq}_Start R_{Config_UARTq}_Stop R_{Config_UARTq}_Send R_{Config_UARTq}_Receive R_{Config_UARTq}_Loopback_Enable R_{Config_UARTq}_Loopback_Disble
	{Config_UARTq}_user.c	R_{Config_UARTq}_Create_UserInit r_{Config_UARTq}_interrupt_send r_{Config_UARTq}_interrupt_receive r_{Config_UARTq}_interrupt_error r_{Config_UARTq}_callback_sendend r_{Config_UARTq}_callback_receiveend r_{Config_UARTq}_callback_error r_{Config_UARTq}_callback_softwareoverrun
	{Config_UARTq}.h	—
Simplified I2C Communication (Master mode) (Serial Array Unit)	{Config_IICr}.c	R_{Config_IICr}_Create R_{Config_IICr}_StartCondition R_{Config_IICr}_StopCondition R_{Config_IICr}_Stop R_{Config_IICr}_Master_Send R_{Config_IICr}_Master_Receive
	{Config_IICr}_user.c	R_{Config_IICr}_Create_UserInit r_{Config_IICr}_interrupt r_{Config_IICr}_callback_master_sendend r_{Config_IICr}_callback_master_receiveend r_{Config_IICr}_callback_master_error
	{Config_IICr}.h	—

Table 2-8 Output File List (8/9)

Component / Folder Name	File Name	API Function Name
I2C Bus Interface Communication (Master mode)	{Config_IICAn}.c	R_{Config_IICAn}_Create R_{Config_IICAn}_StopCondition R_{Config_IICAn}_Stop R_{Config_IICAn}_Master_Send R_{Config_IICAn}_Master_Receive
	{Config_IICAn}_user.c	R_{Config_IICAn}_Create_UserInit r_{Config_IICAn}_interrupt r_{Config_IICAn}_master_handler r_{Config_IICAn}_callback_master_sendend r_{Config_IICAn}_callback_master_receiveend r_{Config_IICAn}_callback_master_error
	{Config_IICAn}.h	—
I2C Bus Interface Communication (Slave mode)	{Config_IICAn}.c	R_{Config_IICAn}_Create R_{Config_IICAn}_Stop R_{Config_IICAn}_Slave_Send R_{Config_IICAn}_Slave_Receive R_{Config_IICAn}_Set_WakeupOn R_{Config_IICAn}_Set_WakeupOff
	{Config_IICAn}_user.c	R_{Config_IICAn}_Create_UserInit r_{Config_IICAn}_interrupt r_{Config_IICAn}_slave_handler r_{Config_IICAn}_callback_slave_sendend r_{Config_IICAn}_callback_slave_receiveend r_{Config_IICAn}_callback_slave_error r_{Config_IICAn}_callback_getstopcondition
	{Config_IICAn}.h	—
UART Communication (Serial Interface UARTA)	{Config_UARTAn}.c	R_{Config_UARTAn}_Create R_{Config_UARTAn}_Start R_{Config_UARTAn}_Stop R_{Config_UARTAn}_Send R_{Config_UARTAn}_Receive R_{Config_UARTAn}_Loopback_Enable R_{Config_UARTAn}_Loopback_Disable
	{Config_UARTAn}_user.c	R_{Config_UARTAn}_Create_UserInit R_{Config_UARTAn}_PollingEnd_UserCode r_{Config_UARTAn}_interrupt_send r_{Config_UARTAn}_interrupt_receive r_{Config_UARTAn}_interrupt_error r_{Config_UARTAn}_callback_sendend r_{Config_UARTAn}_callback_receiveend r_{Config_UARTAn}_callback_error
	{Config_UARTAn}.h	—

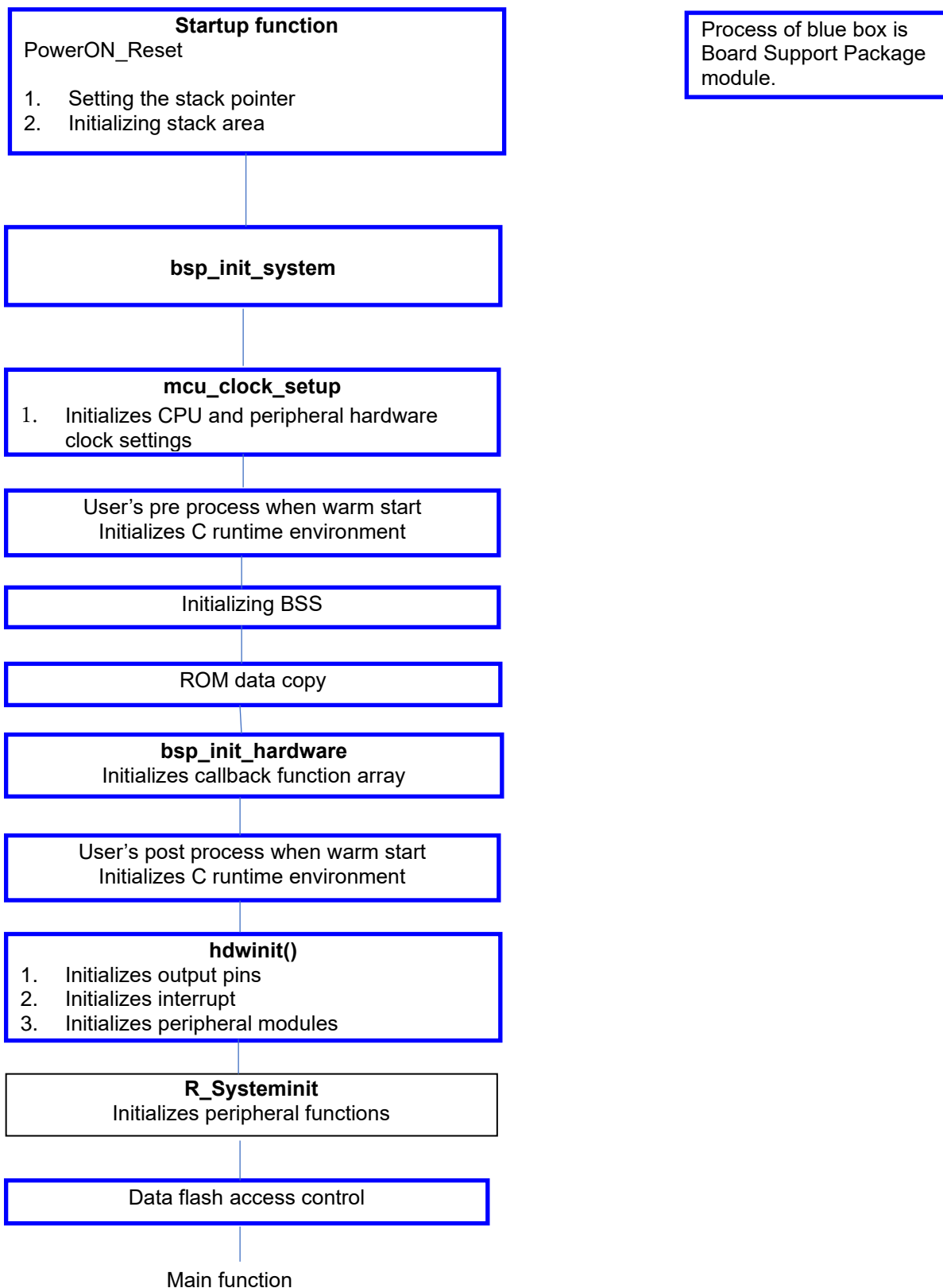
Table 2-9 Output File List (9/9)

Component / Folder Name	File Name	API Function Name
Remote Control Signal Receiver	{Config_REMC}.c	R_{Config_REMC}_Create R_{Config_REMC}_Start R_{Config_REMC}_Stop R_{Config_REMC}_Read
	{Config_REMC}_user.c	R_{Config_REMC}_Create_UserInit r_{Config_REMC}_interrupt r_{Config_REMC}_callback_receiveend r_{Config_REMC}_callback_comparematch r_{Config_REMC}_callback_receiveerror r_{Config_REMC}_callback_bufferfull r_{Config_REMC}_callback_header r_{Config_REMC}_callback_data0 r_{Config_REMC}_callback_data1 r_{Config_REMC}_callback_specialdata
	{Config_REMC}.h	—
A/D Convertor	{Config_ADC}.c	R_{Config_ADC}_Create R_{Config_ADC}_Start R_{Config_ADC}_Stop R_{Config_ADC}_Set_OperationOn R_{Config_ADC}_Set_OperationOff R_{Config_ADC}_Set_ADChannel R_{Config_ADC}_Set_SnoozeOn R_{Config_ADC}_Set_SnoozeOff R_{Config_ADC}_Set_TestChannel R_{Config_ADC}_Get_Result_10bit R_{Config_ADC}_Get_Result_8bit R_{Config_ADC}_Get_Result_12bit
	{Config_ADC}_user.c	R_{Config_ADC}_Create_UserInit r_{Config_ADC}_interrupt
	{Config_ADC}.h	—
D/A Converter	{Config_DACn}.c	R_{Config_DACn}_Create R_{Config_DACn}_Start R_{Config_DACn}_Stop R_{Config_DACn}_Set_ConversionValue
	{Config_DACn}_user.c	R_{Config_DACn}_Create_UserInit
	{Config_DACn}.h	—
Comparator	{Config_COMPn}.c	R_{Config_COMPn}_Create R_{Config_COMPn}_Start R_{Config_COMPn}_Stop
	{Config_COMPn}_user.c	R_{Config_COMPn}_Create_UserInit r_{Config_COMPn}_interrupt
	{Config_COMPn}.h	—



### 3. INITIALIZATION

This chapter describes the flow of initialization by the API functions of the Smart Configurator.



## 4. API FUNCTIONS

This chapter describes the API functions output that are output by the Smart Configurator.

### 4.1 Overview

The following are the naming conventions for the API functions output by the Smart Configurator.

- Macro names

These are in all-capital letters.

Note that if a name includes a number as a prefix, the relevant number is equal to the hexadecimal value of the macro.

- Local variable names

These are in low-case letters only.

- Global variable names

These are prefixed with “g”, and only the first letters of words that are elements of the names are capitals.

- Names of pointers to global variables

These are prefixed with “gp”, and only the first letters of words that are elements of the names are capitals.

- Names of elements in enumeration specifiers “enum”

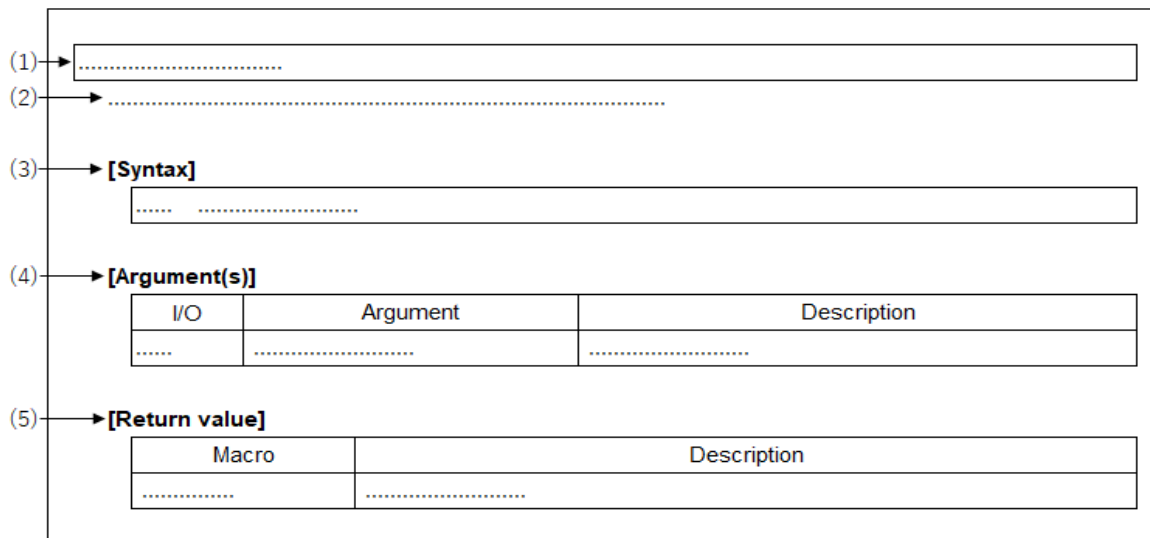
These are in all-capital letters.

**Remarks** In the generated code by the Smart Configurator tool, the for statement, the while statement, the do-while statement (loop processing) are used in register setting reflected waiting process etc. If fail-safe processing for infinite loop is required, check the generated code and add processing.

## 4.2 Function Reference

This section describes the API functions output by the Smart Configurator, using the following notation format.

**Figure 4.1 Notation Format of API Functions**



- (1) **Name**  
Indicates the name of the API function.
- (2) **Outline**  
Outlines the functions of the API function
- (3) **[Syntax]**  
Indicates the format to be used when describing an API function to be called in C language.
- (4) **[Argument(s)]**  
API function arguments are explained in the following format.

I/O	Argument	Description
(a)	(b)	(c)

- (a) I/O  
Argument classification  
I ... Input argument  
O ... Output argument
- (b) Argument  
Argument data type
- (c) Description  
Description of argument

- (5) **[Return value]**  
API function return value is explained in the following format.

Macro	Description
(a)	(b)

- (a) Macro  
Macro of return value
- (b) Description

Description of return value

#### 4.2.1 General

Below is a list of API functions output by the Smart Configurator for common use.

Table 4-1 API Functions: (1/2)

API Function Name	Peripheral Name	Description
main	-	Main function.
R_Systeminit	-	Executes initialization processing that is required before controlling various peripheral modules.
R_DTC_Cancel_ModuleStop	Data Transfer	Cancel the module-stop state for DTC.
R_DTC_Enter_ModuleStop	Controller	Enter the module-stop state for DTC.
R_ELC_Cancel_ModuleStop	Event Link	Cancel the module-stop state for ELC.
R_ELC_Enter_ModuleStop	Controller	Enter the module-stop state for ELC.
R_TAUm_Create	Timer Array Unit	Executes initialization processing that is required before controlling TAUm (enables TAUm input clock supply and initializes TAUm module).
R_TAUm_Cancel_ModuleStop		Cancel the module-stop state for TAUm.
R_TAUm_Enter_ModuleStop		Enter the module-stop state for TAUm.
R_ITL_Create	32-Bit Interval Timer	Executes initialization processing that is required before controlling the 32-bits IT (enables input clock supply and initializes ITLm module).
R_ITL_Start_Interrupt		Starts 32-bit interval timer interrupt.
R_ITL_Stop Interrupt		Stops 32-bit interval timer interrupt.
R_ITL_Cancel_ModuleStop		Cancel the module-stop state for 32-bits IT.
R_ITL_Enter_ModuleStop		Enter the module-stop state for 32-bits IT.
R_ADC_Cancel_ModuleStop	A/D Converter	Cancel the module-stop state for AD converter.
R_ADC_Enter_ModuleStop		Enter the module-stop state for AD converter.
R_DAC_Create	D/A Converter	Executes initialization processing that is required before controlling the DAC module (enables input clock supply and initializes DAM module).
R_DAC_Cancel_ModuleStop		Cancel the module-stop state for DA converter.
R_DAC_Enter_ModuleStop		Enter the module-stop state for DA converter.
R_REMC_Cancel_ModuleStop	Remote Control	Cancel the module-stop state for REMC.
R_REMC_Enter_ModuleStop	Signal Receiver	Enter the module-stop state for REMC.
R_COMP_Create	Comparator	Executes initialization processing that is required before controlling the COMP module (enables input clock supply and initializes COMP module).
R_COMP_Cancel_ModuleStop		Cancel the module-stop state for comparator.
R_COMP_Enter_ModuleStop		Enter the module-stop state for comparator.
R_SAUm_Create	Serial Array Unit	Executes initialization processing that is required before controlling SAUm (enables input clock supply and initializes SAUm module).
R_SAUm_Cancel_ModuleStop		Cancel the module-stop state for SAUm.
R_SAUm_Enter_ModuleStop		Enter the module-stop state for SAUm.
R_SAUm_Set_SnoozeOn		Enables SAUm wakeup function.
R_SAUm_Set_SnoozeOff		Disables SAUm wakeup function.

Table 4-2 API Functions: (2/2)

API Function Name	Peripheral Name	Description
<a href="#">R_UARTA_Create</a>	Serial Interface UARTA	Executes initialization processing that is required before controlling UARTA0/UARTA1 (enables input clock supply and initializes module).
<a href="#">R_UARTA_Cancel_ModuleStop</a>		Cancel the module-stop state for UARTA0/UARTA1.
<a href="#">R_UARTA_Enter_ModuleStop</a>		Enter the module-stop state for UARTA0/UARTA1.
<a href="#">R_IICAn_Cancel_ModuleStop</a>	Serial Interface	Cancel the module-stop state for IICAn.
<a href="#">R_IICAn_Enter_ModuleStop</a>	IICA	Enter the module-stop state for IICAn.

main
------

This API function implements main function.

**[Syntax]**

void main(void);
------------------

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_Systeminit**

This API function executes initialization processing that is required before controlling various peripheral modules.

**[Syntax]**

```
void R_Systeminit(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.



**R\_DTC\_Cancel\_ModuleStop**

This API function Cancel the module-stop state for DTC.

**[Syntax]**

```
void R_DTC_Cancel_ModuleStop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_DTC\_Enter\_ModuleStop**

This API function Enter the module-stop state for DTC.

**[Syntax]**

```
void R_DTC_Enter_ModuleStop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**r\_dtc\_interrupt**

This API function executes processing in response to Data Transfer Controller (DTC) interrupt.

**Remark** This API function is called as the interrupt handler for the CPU on a DTC activation interrupt or the CPU after a single data transfer or the CPU after a data transfer of a specified volume.

**[Syntax]**

```
void r_dtc_interrupt(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_ELC\_Cancel\_ModuleStop**

This API function Cancel the module-stop state for ELC.

**[Syntax]**

```
void R_ELC_Cancel_ModuleStop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_ELC\_Enter\_ModuleStop**

This API function Enter the module-stop state for ELC.

**[Syntax]**

```
void R_DTC_Enter_ModuleStop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_TAU $m$ \_Create**

This API function executes initialization processing that is required before controlling TAU $m$  (enables TAU $m$  input clock supply and initializes TAU $m$  module).

Remark This API function is called from [R\\_Systeminit](#) before the main() function is executed.

**[Syntax]**

```
void R_TAU $m$ _Create(void);
```

Remark  $m$  is the unit number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_TAUm\_Cancel\_ModuleStop**

This API function Cancel the module-stop state for TAUm.

**[Syntax]**

```
void R_TAUm_Cancel_ModuleStop(void);
```

Remark *m* is the unit number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_TAUm\_Enter\_ModuleStop**

This API function Enter the module-stop state for TAUm.

**[Syntax]**

```
void R_TAUm_Enter_ModuleStop(void);
```

Remark *m* is the unit number.

**[Argument(s)]**

None.

**[Return value]**

None.



**R\_ITL\_Create**

This API function executes initialization processing that is required before controlling the 32-bits IT (enables input clock supply and initializes ITL*m* module).

Remark This API function is called from [R\\_Systeminit](#) before the main() function is executed.

**[Syntax]**

```
void R_ITL_Create(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_ITL\_Start\_Interrupt**

This API function starts 32-bit interval timer interrupt.

**Remark** The 32-bit interval timer interrupt is enabled by calling this API function. For this reason, to use 32-bit interval timer interrupt, please call this API function together with [R\\_{Config\\_ITL000\\_ITL001\\_ITL012\\_ITL013}\\_Start](#) or [R\\_{Config\\_ITLn\\_ITLm}\\_Start](#) or [R\\_{Config\\_ITLn}\\_Start](#).

**[Syntax]**

```
void R_ITL_Start_Interrupt(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_ITL\_Stop\_Interrupt**

This API function stops 32-bit interval timer interrupt.

**[Syntax]**

```
void R_ITL_Stop_Interrupt(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_ITL\_Cancel\_ModuleStop**

This API function Cancel the module-stop state for 32-bits IT.

**[Syntax]**

```
void R_ITL_Cancel_ModuleStop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_ITL\_Enter\_ModuleStop**

This API function Enter the module-stop state for 32-bits IT.

**[Syntax]**

```
void R_ITL_Enter_ModuleStop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**r\_itl\_interrupt**

This API function executes processing in response to 32-bit interval timer interrupt.

**Remark** This API function is called as the interrupt handler for compare match interrupt, which occur when the counter value in any of channels 0 to 3 matches the compare value.

**[Syntax]**

```
void r_itl_interrupt(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_ADC\_Cancel\_ModuleStop**

This API function Cancel the module-stop state for AD converter.

**[Syntax]**

```
void R_ADC_Cancel_ModuleStop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_ADC\_Enter\_ModuleStop**

This API function Enter the module-stop state for AD converter.

**[Syntax]**

```
void R_ADC_Enter_ModuleStop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.



**R\_DAC\_Create**

This API function executes initialization processing that is required before controlling the DAC module (enables input clock supply and initializes *DAM* module).

Remark This API function is called from [R\\_Systeminit](#) before the `main()` function is executed.

**[Syntax]**

```
void R_DAC_Create(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_DAC\_Cancel\_ModuleStop**

This API function Cancel the module-stop state for DA converter.

**[Syntax]**

```
void R_DAC_Cancel_ModuleStop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_DAC\_Enter\_ModuleStop**

This API function Enter the module-stop state for DA converter.

**[Syntax]**

```
void R_DAC_Enter_ModuleStop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_COMP\_Create**

This API function executes initialization processing that is required before controlling the comparator module (enables input clock supply and initializes COMP $m$  module).

Remark This API function is called from [R\\_Systeminit](#) before the main() function is executed.

**[Syntax]**

```
void R_COMP_Create(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_COMP\_Cancel\_ModuleStop**

This API function Cancel the module-stop state for comparator.

**[Syntax]**

```
void R_COMP_Cancel_ModuleStop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_COMP\_Enter\_ModuleStop**

This API function Enter the module-stop state for comparator.

**[Syntax]**

```
void R_COMP_Enter_ModuleStop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_SAUm\_Create**

This API function executes initialization processing that is required before controlling SAU*m* (enables input clock supply and initializes SAU*m* module).

Remark This API function is called from [R\\_Systeminit](#) before the main() function is executed.

**[Syntax]**

```
void R_SAUm_Create(void);
```

Remark *m* is the unit number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_SAUm\_Cancel\_ModuleStop**

This API function Cancel the module-stop state for SAUm.

**[Syntax]**

```
void R_SAUm_Cancel_ModuleStop(void);
```

Remark *m* is the unit number.

**[Argument(s)]**

None.

**[Return value]**

None.



**R\_SAUm\_Enter\_ModuleStop**

This API function Enter the module-stop state for SAUm.

**[Syntax]**

```
void R_SAUm_Enter_ModuleStop(void);
```

Remark *m* is the unit number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_SAUm\_Set\_SnoozeOn**

This API function enables SAUm wakeup function.

**[Syntax]**

```
void R_SAUm_Set_SnoozeOn(void);
```

Remark *m* is the unit number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_SAUm\_Set\_SnoozeOff**

This API function disables SAUm wakeup function.

**[Syntax]**

```
void R_SAUm_Set_SnoozeOff(void);
```

Remark *m* is the unit number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_UARTA\_Create**

This API function executes initialization processing that is required before controlling UARTA0/UARTA1 (enables input clock supply and initializes module).

Remark This API function is called from [R\\_Systeminit](#) before the main() function is executed.

**[Syntax]**

```
void R_UARTA_Create(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_UARTA\_Cancel\_ModuleStop**

This API function Cancel the module-stop state for UARTA0/UARTA1.

**[Syntax]**

```
void R_UARTA_Cancel_ModuleStop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_UARTA\_Enter\_ModuleStop**

This API function Enter the module-stop state for UARTA0/UARTA1.

**[Syntax]**

```
void R_UARTA_Enter_ModuleStop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_IICAn\_Cancel\_ModuleStop**

This API function Cancel the module-stop state for IICAn.

**[Syntax]**

```
void R_IICAn_Cancel_ModuleStop(void);
```

Remark *n* is the unit number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_IICAn\_Enter\_ModuleStop**

This API function Enter the module-stop state for IICAn.

**[Syntax]**

```
void R_IICAn_Enter_ModuleStop(void);
```

Remark *n* is the unit number.

**[Argument(s)]**

None.

**[Return value]**

None.



**R\_REMC\_Cancel\_ModuleStop**

This API function Cancel the module-stop state for REMC.

**[Syntax]**

```
void R_REMC_Cancel_ModuleStop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_REMC\_Enter\_ModuleStop**

This API function Enter the module-stop state for REMC.

**[Syntax]**

```
void R_REMC_Enter_ModuleStop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

## Usage example

This is an example for using R\_Xxxx\_Cancel\_ModuleStop(), R\_Xxxx\_Enter\_ModuleStop(), R\_Xxxx\_Start\_Interrupt(), R\_Xxxx\_Stop\_Interrupt():

(Xxxx is peripheral name which user want to use, the following sample code takes 32-bit Interval Timer(TML32) as an example)

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"

int main(void);

int main(void)
{
    // To enable 32-bit interval timer interrupt which is shared among TML32 each channels
    R_ITL_Start_Interrupt();

    R_Config_ITL000_Start();
    R_Config_ITL001_Start();
    R_Config_ITL000_Stop();
    R_Config_ITL001_Stop();

    // To Disable 32-bit interval timer interrupt which is shared among TML32 each channels
    R_ITL_Stop_Interrupt();

    // When ITL is stopped, to reduce the power consumption and noise
    R_ITL_Enter_ModuleStop();

    R_ITL_Create();
    R_Config_ITL000_Start();
    R_Config_ITL000_Stop();

    return 0;
}
```

### 4.2.2 Low Voltage Detection

Below is a list of API functions output by the Smart Configurator for low voltage detection use.

**Table 4-3 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_LVDn}_Create</a>	Voltage Detector	Executes initialization processing that is required before controlling the voltage detector module.
<a href="#">R_{Config_LVDn}_Start</a>		Starts the voltage detector operation.
<a href="#">R_{Config_LVDn}_Stop</a>		Stops the voltage detector operation.
<a href="#">R_{Config_LVDn}_Create_UserInit</a>		Executes user-specific initialization processing for the voltage detector.

**R\_{Config\_LVD*n*}\_Create**

This API function executes initialization processing that is required before controlling the voltage detector module.

Remark This API function is called from [R\\_Systeminit](#) before the main() function is executed.

**[Syntax]**

```
void R_{Config_LVDn}_Create(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_LVDn}\_Start**

This API function starts the voltage detector operation.

**[Syntax]**

```
void R_{Config_LVDn}_Start(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_LVDn}\_Stop**

This API function stops the voltage detector operation.

**[Syntax]**

```
void R_{Config_LVDn}_Stop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_LVDn}\_Create\_UserInit**

This API function executes user-specific initialization processing for the voltage detector.

Remark This API functions is called from [R\\_{Config\\_LVDn}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_LVDn}_Create_UserInit(void);
```

Remark *n* is the unit number.

**[Argument(s)]**

None.

**[Return value]**

None.



### Usage example

This is an example for LVD operating in interrupt mode:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"

int main(void);

int main(void)
{
    R_Config_LVD1_Start();
    while(1);

    return 0;
}
```

### 4.2.3 Interrupt Controller

Below is a list of API functions output by the Smart Configurator for interrupt controller use.

**Table 4-4 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_ICU}_Create</a>	Interrupt function	Executes initialization processing that is required before controlling interrupt detection selection module.
<a href="#">R_{Config_ICU}_IRQn_Start</a>		Clears IRQn interrupt flag and enables interrupt.
<a href="#">R_{Config_ICU}_IRQn_Stop</a>		Disables IRQn interrupt and clears interrupt flag.
<a href="#">R_{Config_ICU}_Create_UserInit</a>		Executes user-specific initialization processing for the interrupt detection selection module.
<a href="#">r_{Config_ICU}_IRQn_interrupt</a>		Executes processing in response to IRQn interrupt.

**R\_{Config\_ICU}\_Create**

This API function executes initialization processing that is required before controlling the interrupt detection selection module.

Remark This API function is called from [R\\_Systeminit](#) before the main() function is executed.

**[Syntax]**

```
void R_{Config_ICU}_Create(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_ICU}\_IRQn\_Start**

This API function clears IRQn interrupt flag and enables interrupt.

**[Syntax]**

```
void R_{Config_ICU}_IRQn_Start(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_ICU}\_IRQn\_Stop**

This API function disables IRQn interrupt and clears interrupt flag.

**[Syntax]**

```
void R_{Config_ICU}_IRQn_Stop(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_ICU}\_Create\_UserInit**

This API function executes user-specific initialization processing for the interrupt detection selection module.

Remark This API functions is called from [R\\_{Config\\_ICU}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_ICU}_Create_UserInit(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_ICU}_IRQn_interrupt`

This API function executes processing in response to IRQn interrupt.

**[Syntax]**

`void r_{Config_ICU}_IRQn_interrupt(void);`

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

## Usage example

This is an example for setting a flag when detecting IRQ0 valid edge input:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"
extern uint8_t irq0_int_flag;

int main(void);

int main(void)
{
    irq0_int_flag = 0U;
    R_Config_ICU_IRQ0_Start ();
    while(intp0_int_flag != 1U);
    R_Config_ICU_IRQ0_Stop ();
}
```

Config\_ICU\_user.c

```
/* Start user code for global. Do not edit comment generated here */
uint8_t irq0_int_flag = 0U;
/* End user code. Do not edit comment generated here */

static void __near r_Config_ICU_irq0_interrupt(void)
{
    /* Start user code for r_Config_ICU_irq0_interrupt. Do not edit comment generated here */
    /* Set the flag */
    irq0_int_flag = 1U;
    /* End user code. Do not edit comment generated here */
}
```



#### 4.2.4 Data Transfer Controller

Below is a list of API functions output by the Smart Configurator for data transfer controller use.

**Table 4-5 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_DTC}_Create</a>	Data Transfer Controller	Executes initialization processing that is required before controlling the DTC module.
<a href="#">R_{Config_DTC}_Start</a>		Starts DTC module operation.
<a href="#">R_{Config_DTC}_Stop</a>		Stops DTC module operation.
<a href="#">R_{Config_DTC}_Create_UserInit</a>		Executes user-specific initialization processing for the data transfer controller.

**R\_{Config\_DTC}\_Create**

This API function executes initialization processing that is required before controlling the DTC module.

Remark This API function is called from [R\\_Systeminit](#) before the main() function is executed.

**[Syntax]**

```
void R_{Config_DTC}_Create(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

R\_{Config\_DTC}\_Start

This API function starts DTC module operation

**[Syntax]**

```
void R_{Config_DTC}_Start(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

R\_{Config\_DTC}\_Stop

This API function stops DTC module operation

**[Syntax]**

```
void R_{Config_DTC}_Stop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_DTC}\_Create\_UserInit**

This API function executes user-specific initialization processing for the data transfer controller.

Remark This API functions is called from [R\\_{Config\\_DTC}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_DTC}_Create_UserInit(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

## Usage example

This is an example for using DTC data transfer in response to fixed-cycle signal of real-time clock/alarm match detection:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"

int main(void);

int main(void)
{
    R_DTC_Start();
    R_Config_RTC_Start();

    R_Config_RTC_Stop();
    R_DTC_Stop();

    return 0;
}
```

#### 4.2.5 Event Link Controller

Below is a list of API functions output by the Smart Configurator for event link controller (ELC) use.

**Table 4-6 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_ELC}_Create</a>	Event Link Controller	Executes initialization processing that is required before controlling the ELC module.
<a href="#">R_{Config_ELC}_GenerateSoftwareEvent1</a>		Triggers a software event.
<a href="#">R_{Config_ELC}_GenerateSoftwareEvent2</a>		Triggers a software event.
<a href="#">R_{Config_ELC}_Start</a>		Enables all ELC event links.
<a href="#">R_{Config_ELC}_Stop</a>		Disables all ELC event links.
<a href="#">R_{Config_ELC}_Create_UserInit</a>		Executes user-specific initialization processing for the ELC.

**R\_{Config\_ELC}\_Create**

This API function executes initialization processing that is required before controlling the ELC module.

Remark This API function is called from [R\\_Systeminit](#) before the main() function is executed.

**[Syntax]**

```
void R_{Config_ELC}_Create(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.



**R\_{Config\_ELC}\_GenerateSoftwareEvent1**

This API function triggers a software event.

**[Syntax]**

```
void R_{Config_ELC}_GenerateSoftwareEvent1( void );
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_ELC}\_GenerateSoftwareEvent2**

This API function triggers a software event.

**[Syntax]**

```
void R_{Config_ELC}_GenerateSoftwareEvent2( void );
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_ELC}\_Start**

This API function enables all ELC event links.

**[Syntax]**

```
void R_{Config_ELC}_Start( void );
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_ELC}\_Stop**

This API function stops all ELC event links.

**[Syntax]**

```
void R_{Config_ELC}_Stop( void );
```

**[Argument(s)]**

None

**[Return value]**

None.

**R\_{Config\_ELC}\_Create\_UserInit**

This API function executes user-specific initialization processing for ELC.

Remark This API functions is called from [R\\_{Config\\_ELC}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_ELC}_Create_UserInit(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

## Usage example

This is an example for ELC is used to start ELC event generation:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"

int main(void);

int main(void)
{
    R_Config_ELC_Start();
    R_Config_ELC_GenerateSoftwareEvent1();

    while(1);

    return 0;
}
```

#### 4.2.6 I/O ports

Below is a list of API functions output by the Smart Configurator for I/O ports use.

**Table 4-7 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_PORT}_Create</a>	I/O Port	Executes initialization processing that is required before controlling the I/O ports.
<a href="#">R_{Config_PORT}_Set_Output_Level</a>		Set pin output level.
<a href="#">R_{Config_PORT}_Set_Output_Level_ELC</a>		Set pin output level when an ELC_PORTx signal occurs.
<a href="#">R_{Config_PORT}_Create_UserInit</a>		Executes user-specific initialization processing for the I/O ports.

**R\_Config\_PORT\_Create**

This API function executes initialization processing that is required before controlling the I/O ports.

Remark This API function is called from [R\\_Systeminit](#) before the main() function is executed.

**[Syntax]**

```
void R_{Config_PORT}_Create(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.



### R\_{Config\_PORT}\_Set\_Output\_Level

This API function set specified pin output level.

#### [Syntax]

```
MD_STATUS R_{Config_PORT}_Set_Output_Level(char Pmn[], e_output_level_t outputlevel);
```

#### [Argument(s)]

I/O	Argument(s)	Description
I	char Pmn[]	Specify the pin you want to set, ex: 'p101'.
I	e_output_level_t outputlevel	Define high/low output level

#### [Return value]

Macro	Description
MD_OK	Normal end
MD_ARGERROR	Error argument input error.

### R\_{Config\_PORT}\_Set\_Output\_Level\_ELC

This API function specifies the output level on a port pin is read when the pin is in output mode.

#### [Syntax]

```
void R_{Config_PORT}_Set_Output_Level_ELC(char Pmn[], e_output_level_t outputlevel);
```

#### [Argument(s)]

I/O	Argument(s)	Description
I	char Pmn[]	Specify the pin you want to set, ex: 'p101'.
I	e_output_level_t outputlevel	Define high/low output level

#### [Return value]

Macro	Description
MD_OK	Normal end
MD_ARGERROR	Error argument input error.

**R\_Config\_PORT\_Create\_UserInit**

This API function executes user-specific initialization processing for the port I/O.

Remark This API functions is called as the [R\\_{Config\\_PORT}\\_Create](#) callback routine.

**[Syntax]**

```
void R_{Config_PORT}_Create_UserInit(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

## Usage example

This is an example for setting the output level on a port pin is read when the pin is in output mode:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"

int main(void);

int main(void)
{
    char Pmn[] = "P101";

    R_Config_PORT_Set_Output_Level(Pmn, LOW);

    return 0;
}
```

### 4.2.7 Key Interrupt

Below is a list of API functions output by the Smart Configurator for key Interrupt use.

**Table 4-8 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_KR}_Create</a>	Key Interrupt	Executes initialization processing that is required before controlling the key interrupt module.
<a href="#">R_{Config_KR}_Start</a>		Clears key interrupt flag and enables interrupt.
<a href="#">R_{Config_KR}_Stop</a>		Disables key interrupt and clears interrupt flag.
<a href="#">R_{Config_KR}_Create_UserInit</a>		Executes user-specific initialization processing for the key interrupt.
<a href="#">r_{Config_KR}_interrupt</a>		Executes processing in response to key interrupt.

**R\_{Config\_KR}\_Create**

This API function executes initialization processing that is required before controlling the key interrupt module.

Remark This API function is called from [R\\_Systeminit](#) before the main() function is executed.

**[Syntax]**

```
void R_{Config_KR}_Create(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_KR}\_Start**

This API function clears key interrupt flag and enables interrupt.

**[Syntax]**

```
void R_{Config_KR}_Start(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_KR}\_Stop**

This API function disables key interrupt and clears interrupt flag.

**[Syntax]**

```
void R_{Config_KR}_Stop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.



**R\_{Config\_KR}\_Create\_UserInit**

This API function executes user-specific initialization processing for the key interrupt.

Remark This API functions is called from [R\\_{Config\\_KR}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_KR}_Create_UserInit(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_KR}_interrupt`

This API function executes processing in response to key interrupt.

**[Syntax]**

```
void r_{Config_KR}_interrupt(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

## Usage example

This is an example for setting a flag when detecting key interrupt:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"
extern uint8_t kr_int_flag;

int main(void);

int main(void)
{
    kr_int_flag = 0U;
    R_Config_KR_Start ();
    while(kr_int_flag != 1U);
    R_Config_KR_Stop ();

    return 0;
}
```

Config\_KR\_user.c

```
/* Start user code for global. Do not edit comment generated here */
uint8_t kr_int_flag = 0U
/* End user code. Do not edit comment generated here */

static void __near r_Config_KR_interrupt(void)
{
    /* Start user code for r_Config_KR_interrupt. Do not edit comment generated here */
    /* Set the flag */
    kr_int_flag = 1U;
    /* End user code. Do not edit comment generated here */
}
```

### 4.2.8 Interval Timer (Timer Array Unit)

Below is a list of API functions output by the Smart Configurator for interval timer (for timer array unit) use.

**Table 4-9 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_TAUm_n}_Create</a>	Timer Array Unit	Executes initialization processing that is required before controlling the TAUm channel <i>n</i> module in interval timer mode.
<a href="#">R_{Config_TAUm_n}_Start</a>		Starts the TAUm channel <i>n</i> counter.
<a href="#">R_{Config_TAUm_n}_Stop</a>		Stops the TAUm channel <i>n</i> counter.
<a href="#">R_{Config_TAUm_n}_Higher8bits_Start</a>		Starts the TAUm channel <i>n</i> higher 8 bits counter.
<a href="#">R_{Config_TAUm_n}_Higher8bits_Stop</a>		Stops the TAUm channel <i>n</i> higher 8 bits counter.
<a href="#">R_{Config_TAUm_n}_Lower8bits_Start</a>		Starts the TAUm channel <i>n</i> lower 8 bits counter.
<a href="#">R_{Config_TAUm_n}_Lower8bits_Stop</a>		Stops the TAUm channel <i>n</i> lower 8 bits counter.
<a href="#">R_{Config_TAUm_n}_Create_UserInit</a>		Executes user-specific initialization processing for the TAUm channel <i>n</i> .
<a href="#">r_{Config_TAUm_n}_interrupt</a>		Executes processing in response to timer channel <i>n</i> count end interrupt.
<a href="#">r_{Config_TAUm_n}_higher8bits_interrupt</a>		Executes processing in response to timer channel <i>n</i> count end interrupt at higher 8-bit timer operation.

**R\_{Config\_TAU $m$ \_ $n$ }\_Create**

This API function executes initialization processing that is required before controlling the TAU $m$  channel $n$  module in interval timer mode.

Remark This API function is called from [R\\_TAU \$m\$ \\_Create](#).

**[Syntax]**

```
void R_{Config_TAU $m$ _ $n$ }_Create(void);
```

Remark  $m$  is the unit number,  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAU $m$ \_ $n$ }\_Start**

This API function starts the TAU $m$  channel $n$  counter.

**[Syntax]**

```
void R_{Config_TAU $m$ _ $n$ }_Start(void);
```

Remark  $m$  is the unit number,  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAU $m$ \_ $n$ }\_Stop**

This API function stops the TAU $m$  channel $n$  counter.

**[Syntax]**

```
void R_{Config_TAU $m$ _ $n$ }_Stop(void);
```

Remark  $m$  is the unit number,  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

---

R_{Config_TAUm_n}_Higher8bits_Start
-------------------------------------

Starts the TAUm channel *n* higher 8 bits counter.

**[Syntax]**

void R_{Config_TAUm_n}_Higher8bits_Start(void);
---

Remark *m* is the unit number, *n* is the channel number 1 or 3.

**[Argument(s)]**

None.

**[Return value]**

None.



---

R_{Config_TAUm_n}_Higher8bits_Stop
------------------------------------

Stops the TAUm channel *n* higher 8 bits counter.

**[Syntax]**

void R_{Config_TAUm_n}_Higher8bits_Stop(void);
--

Remark *m* is the unit number, *n* is the channel number 1 or 3.

**[Argument(s)]**

None.

**[Return value]**

None.

`R_{Config_TAUm_n}_Lower8bits_Start`

Starts the TAUm channel *n* lower 8 bits counter.

**[Syntax]**

`void R_{Config_TAUm_n}_Lower8bits_Start(void);`

Remark *m* is the unit number, *n* is the channel number 1 or 3.

**[Argument(s)]**

None.

**[Return value]**

None.

`R_{Config_TAUm_n}_Lower8bits_Stop`

Stops the TAUm channel *n* lower 8 bits counter.

[Syntax]

`void R_{Config_TAUm_n}_Lower8bits_Stop(void);`

Remark *m* is the unit number, *n* is the channel number 1 or 3.

[Argument(s)]

None.

[Return value]

None.

**R\_{Config\_TAUm\_n}\_Create\_UserInit**

This API function executes user-specific initialization processing for the TAUm channel *n*.

Remark This API functions is called from [R\\_{Config\\_TAUm\\_n}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_TAUm_n}_Create_UserInit(void);
```

Remark *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

```
r_{Config_TAUm_n}_interrupt
```

This API function executes processing in response to timer channel  $n$  count end interrupt.

**Remark** This API function is called as the interrupt handler for count end interrupt, which occur when the current counter value (TCR $mn$ ) reaches 0000H.

**[Syntax]**

```
void r_{Config_TAUm_n}_interrupt(void);
```

**Remark**  $m$  is the unit number,  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_TAUm_n}_higher8bits_interrupt`

This API function executes processing in response to timer channel  $n$  count end interrupt at higher 8-bit timer operation.

Remark This API function is called as the interrupt handler for count end interrupt, which occur when the current counter (TCR $mn$ ) higher 8-bit value reaches 00H.

[Syntax]

```
void r_{Config_TAUm_n}_higher8bits_interrupt(void);
```

Remark  $m$  is the unit number,  $n$  is the channel number 1 or 3.

[Argument(s)]

None.

[Return value]

None.

## Usage example

This is an example for using TAU channel 0 counting interval timer, channel 3 counting as high 8-bit interval timer and channel 1 counting as low 8-bit interval timer for a user-defined period:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"
extern uint8_t ch0_run_count;
extern uint8_t ch1_run_count;
extern uint8_t ch3_run_count;

int main(void);

int main(void)
{
    R_Config_TAU0_0_Start();
    while (ch0_run_count < 20);
    R_Config_TAU0_0_Stop();

    R_Config_TAU0_1_Lower8bits_Start();
    while (ch1_run_count < 20);
    R_Config_TAU0_1_Lower8bits_Stop();

    R_Config_TAU0_3_Higher8bits_Start();
    while (ch3_run_count < 20);
    R_Config_TAU0_3_Higher8bits_Stop();

    return 0;
}
```

Config\_TAU0\_0\_user.c

```
/* Start user code for global. Do not edit comment generated here */
uint8_t ch0_run_count;
/* End user code. Do not edit comment generated here */

static void __near r_Config_TAU0_0_interrupt (void)
{
    /* Start user code for r_Config_TAU0_0_interrupt. Do not edit comment generated here */
    ch0_run_count++;
    /* End user code. Do not edit comment generated here */
}
```

Config\_TAU0\_1\_user.c

```
/* Start user code for global. Do not edit comment generated here */
uint8_t ch1_run_count;
/* End user code. Do not edit comment generated here */

static void __near r_Config_TAU0_1_interrupt (void)
{
    /* Start user code for r_Config_TAU0_1_interrupt. Do not edit comment generated here */
    ch1_run_count++;
    /* End user code. Do not edit comment generated here */
}
```

## Config\_TAU0\_3\_user.c

```
/* Start user code for global. Do not edit comment generated here */
uint8_t ch3_run_count;
/* End user code. Do not edit comment generated here */

static void __near r_Config_TAU0_3_interrupt (void)
{
    /* Start user code for r_Config_TAU0_3_interrupt. Do not edit comment generated here */
    ch3_run_count++;
    /* End user code. Do not edit comment generated here */
}
```



### 4.2.9 Square Wave Output (Timer Array Unit)

Below is a list of API functions output by the Smart Configurator for square wave output use.

**Table 4-10 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_TAUm_n}_Create</a>	Timer Array Unit	Executes initialization processing that is required before controlling the TAUm channel <i>n</i> module in square wave output mode.
<a href="#">R_{Config_TAUm_n}_Start</a>		Starts the TAUm channel <i>n</i> counter.
<a href="#">R_{Config_TAUm_n}_Stop</a>		Stops the TAUm channel <i>n</i> counter.
<a href="#">R_{Config_TAUm_n}_Lower8bits_Start</a>		Starts the TAUm channel <i>n</i> lower 8 bits counter.
<a href="#">R_{Config_TAUm_n}_Lower8bits_Stop</a>		Stops the TAUm channel <i>n</i> lower 8 bits counter.
<a href="#">R_{Config_TAUm_n}_Create_UserInit</a>		Executes user-specific initialization processing for the TAUm channel <i>n</i> .
<a href="#">r_{Config_TAUm_n}_interrupt</a>		Executes processing in response to timer channel <i>n</i> measurement end interrupt.

**R\_{Config\_TAUm\_n}\_Create**

This API function executes initialization processing that is required before controlling the TAUm channel module in square wave output mode.

Remark This API function is called from [R\\_TAUm\\_Create](#).

**[Syntax]**

```
void R_{Config_TAUm_n}_Create(void);
```

Remark *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAUm\_n}\_Start**

This API function starts the TAUm channeln counter.

**[Syntax]**

```
void R_{Config_TAUm_n}_Start(void);
```

Remark *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAU $m$ \_ $n$ }\_Stop**

This API function stops the TAU $m$  channel $n$  counter.

**[Syntax]**

```
void R_{Config_TAU $m$ _ $n$ }_Stop(void);
```

Remark  $m$  is the unit number,  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAUm\_n}\_Lower8bits\_Start**

This API function starts the TAUm channeln lower 8 bits counter.

**[Syntax]**

```
void R_{Config_TAUm_n}_Lower8bits_Start(void);
```

Remark *m* is the unit number, *n* is the channel number 1 or 3.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAUm\_n}\_Lower8bits\_Stop**

This API function stops the TAUm channeln lower 8 bits counter.

**[Syntax]**

```
void R_{Config_TAUm_n}_Lower8bits_Stop(void);
```

Remark *m* is the unit number, *n* is the channel number 1 or 3.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAUm\_n}\_Create\_UserInit**

This API function executes user-specific initialization processing for the TAUm channeln.

Remark This API functions is called from [R\\_{Config\\_TAUm\\_n}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_TAUm_n}_Create_UserInit(void);
```

Remark *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

```
r_{Config_TAUm_n}_interrupt
```

This API function executes processing in response to timer channelmn count end interrupt.

Remark This API function is called as the interrupt handler for measurement end interrupt, which occur when the current counter value (TCRmn) reaches 0000H.

#### [Syntax]

```
void r_{Config_TAUm_n}_interrupt(void);
```

Remark *m* is the unit number, *n* is the channel number.

#### [Argument(s)]

None.

#### [Return value]

None.



## Usage example

This is an example for using TAU channel 0 counter and channel 1 lower 8-bit counter to output square wave for a user-defined period:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"
extern uint8_t ch0_run_count;
extern uint8_t ch1_run_count;

int main(void);

int main(void)
{
    R_Config_TAU0_0_Start();
    while (ch0_run_count < 20);
    R_Config_TAU0_0_Stop();

    R_Config_TAU0_1_Lower8bits_Start();
    while (ch1_run_count < 20);
    R_Config_TAU0_1_Lower8bits_Stop();

    return 0;
}
```

Config\_TAU0\_0\_user.c

```
/* Start user code for global. Do not edit comment generated here */
uint8_t ch0_run_count;
/* End user code. Do not edit comment generated here */

static void __near r_Config_TAU0_0_interrupt (void)
{
    /* Start user code for r_Config_TAU0_0_interrupt. Do not edit comment generated here */
    ch0_run_count++;
    /* End user code. Do not edit comment generated here */
}
```

Config\_TAU0\_1\_user.c

```
/* Start user code for global. Do not edit comment generated here */
uint8_t ch1_run_count;
/* End user code. Do not edit comment generated here */

static void __near r_Config_TAU0_1_interrupt (void)
{
    /* Start user code for r_Config_TAU0_1_interrupt. Do not edit comment generated here */
    ch1_run_count++;
    /* End user code. Do not edit comment generated here */
}
```

#### 4.2.10 External Event Counter (Timer Array Unit)

Below is a list of API functions output by the Smart Configurator for external event counter use.

**Table 4-11 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_TAUm_n}_Create</a>	Timer Array Unit	Executes initialization processing that is required before controlling the TAU $m$ channel $n$ module in external event counter mode.
<a href="#">R_{Config_TAUm_n}_Start</a>		Starts the TAU $m$ channel $n$ counter.
<a href="#">R_{Config_TAUm_n}_Stop</a>		Stops the TAU $m$ channel $n$ counter.
<a href="#">R_{Config_TAUm_n}_Lower8bits_Start</a>		Starts the TAU $m$ channel $n$ lower 8 bits counter.
<a href="#">R_{Config_TAUm_n}_Lower8bits_Stop</a>		Stops the TAU $m$ channel $n$ lower 8 bits counter.
<a href="#">R_{Config_TAUm_n}_Create_UserInit</a>		Executes user-specific initialization processing for the TAU $m$ channel $n$ .
<a href="#">r_{Config_TAUm_n}_interrupt</a>		Executes processing in response to end of timer channel $n$ count end interrupt.

**R\_{Config\_TAUm\_n}\_Create**

This API function executes initialization processing that is required before controlling the TAUm channel module in external event counter mode.

Remark This API function is called from [R\\_TAUm\\_Create](#).

**[Syntax]**

```
void R_{Config_TAUm_n}_Create(void);
```

Remark *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAUm\_n}\_Start**

This API function starts the TAUm channeln counter.

**[Syntax]**

```
void R_{Config_TAUm_n}_Start(void);
```

Remark *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAU $m$ \_ $n$ }\_Stop**

This API function stops the TAU $m$  channel $n$  counter.

**[Syntax]**

```
void R_{Config_TAU $m$ _ $n$ }_Stop(void);
```

Remark  $m$  is the unit number,  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAUm\_n}\_Lower8bits\_Start**

This API function starts the TAUm channeln lower 8 bits counter.

**[Syntax]**

```
void R_{Config_TAUm_n}_Lower8bits_Start(void);
```

Remark *m* is the unit number, *n* is the channel number 1 or 3.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAUM\_n}\_Lower8bits\_Stop**

This API function stops the TAUM channeln lower 8 bits counter.

**[Syntax]**

```
void R_{Config_TAUM_n}_Lower8bits_Stop(void);
```

Remark *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAU $m$ \_ $n$ }\_Create\_UserInit**

This API function executes user-specific initialization processing for the TAU $m$  channel.

Remark This API functions is called from [R\\_{Config\\_TAU \$m\$ \\_ \$n\$ }\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_TAU $m$ _ $n$ }_Create_UserInit(void);
```

Remark  $m$  is the unit number,  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.



`r_{Config_TAUm_n}_interrupt`

This API function executes processing in response to end of timer channelmn count end interrupt.

Remark This API function is called as the interrupt handler for count end interrupt, which occur when the current counter value (TCRmn) reaches 0000H.

[Syntax]

```
void r_{Config_TAUm_n}_interrupt(void);
```

Remark *m* is the unit number, *n* is the channel number.

[Argument(s)]

None.

[Return value]

None.

## Usage example

This is an example for using TAU channel 0 counting as external event counter and channel 1 counting as 8-bit external event counter for a user-defined period:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"
extern uint8_t ch0_run_count;
extern uint8_t ch1_run_count;

int main(void);

int main(void)
{
    R_Config_TAU0_0_Start();
    while (ch0_run_count < 20);
    R_Config_TAU0_0_Stop();

    R_Config_TAU0_1_Lower8bits_Start();
    while (ch1_run_count < 20);
    R_Config_TAU0_1_Lower8bits_Stop();

    return 0;
}
```

Config\_TAU0\_0\_user.c

```
/* Start user code for global. Do not edit comment generated here */
uint8_t ch0_run_count;
/* End user code. Do not edit comment generated here */

static void __near r_Config_TAU0_0_interrupt (void)
{
    /* Start user code for r_Config_TAU0_0_interrupt. Do not edit comment generated here */
    ch0_run_count++;
    /* End user code. Do not edit comment generated here */
}
```

Config\_TAU0\_1\_user.c

```
/* Start user code for global. Do not edit comment generated here */
uint8_t ch1_run_count;
/* End user code. Do not edit comment generated here */

static void __near r_Config_TAU0_1_interrupt (void)
{
    /* Start user code for r_Config_TAU0_1_interrupt. Do not edit comment generated here */
    ch1_run_count++;
    /* End user code. Do not edit comment generated here */
}
```

#### 4.2.11 Divider Function (Timer Array Unit)

Below is a list of API functions output by the Smart Configurator for divider function use.

**Table 4-12 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_TAUm_n}_Create</a>	Timer Array Unit	Executes initialization processing that is required before controlling the TAUm channel <i>n</i> module in divider function mode.
<a href="#">R_{Config_TAUm_n}_Start</a>		Starts the TAUm channel <i>n</i> counter.
<a href="#">R_{Config_TAUm_n}_Stop</a>		Stops the TAUm channel <i>n</i> counter.
<a href="#">R_{Config_TAUm_n}_Create_UserInit</a>		Executes user-specific initialization processing for the TAUm channel.
<a href="#">r_{Config_TAUm_n}_interrupt</a>		Executes processing in response to end of timer channel <i>n</i> count end interrupt.

**R\_{Config\_TAUm\_n}\_Create**

This API function executes initialization processing that is required before controlling the TAUm channel module in divider function mode.

Remark This API function is called from [R\\_TAUm\\_Create](#).

**[Syntax]**

```
void R_{Config_TAUm_n}_Create(void);
```

Remark *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAUm\_n}\_Start**

This API function starts the TAUm channeln counter.

**[Syntax]**

```
void R_{Config_TAUm_n}_Start(void);
```

Remark *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAU $m$ \_ $n$ }\_Stop**

This API function stops the TAU $m$  channel $n$  counter.

**[Syntax]**

```
void R_{Config_TAU $m$ _ $n$ }_Stop(void);
```

Remark  $m$  is the unit number,  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAUm\_n}\_Create\_UserInit**

This API function executes user-specific initialization processing for the TAUm channeln.

Remark This API functions is called from [R\\_{Config\\_TAUm\\_n}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_TAUm_n}_Create_UserInit(void);
```

Remark *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

---

<code>r_{Config_TAUm_n}_interrupt</code>
--

This API function executes processing in response to end of timer channelmn count end interrupt.

Remark This API function is called as the interrupt handler for count end interrupt, which occur when the current counter value (TCRmn) reaches 0000H.

**[Syntax]**

<code>void r_{Config_TAUm_n}_interrupt(void);</code>
--

Remark *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.



## Usage example

This is an example for using TAU channel 0 counting as divider mode for a user-defined period:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"
extern uint8_t ch0_run_count

int main(void);

int main(void)
{
    R_Config_TAU0_0_Start();
    while( ch0_run_count < 20);
    R_Config_TAU0_0_Stop();

    return 0;
}
```

Config\_TAU0\_0\_user.c

```
/* Start user code for global. Do not edit comment generated here */
uint8_t ch0_run_count
/* End user code. Do not edit comment generated here */

static void __near r_Config_TAU0_0_interrupt (void)
{
    /* Start user code for r_Config_TAU0_0_interrupt. Do not edit comment generated here */
    ch0_run_count ++;
    /* End user code. Do not edit comment generated here */
}
```

#### 4.2.12 Input Pulse Interval Measurement (Timer Array Unit)

Below is a list of API functions output by the Smart Configurator for input pulse interval measurement use.

**Table 4-13 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_TAUm_n}_Create</a>	Timer Array Unit	Executes initialization processing that is required before controlling the TAUm channel <i>n</i> module in input pulse interval measurement mode
<a href="#">R_{Config_TAUm_n}_Start</a>		Starts the TAUm channel <i>n</i> counter.
<a href="#">R_{Config_TAUm_n}_Stop</a>		Stops the TAUm channel <i>n</i> counter.
<a href="#">R_{Config_TAUm_n}_Get_PulseWidth</a>		Measures TAUm channel <i>n</i> input pulse width.
<a href="#">R_{Config_TAUm_n}_Create_UserInit</a>		Executes user-specific initialization processing for the TAUm channel <i>n</i> .
<a href="#">r_{Config_TAUm_n}_interrupt</a>		Executes processing in response to timer channel <i>n</i> capture interrupt.

**R\_{Config\_TAU $m$ \_ $n$ }\_Create**

This API function executes initialization processing that is required before controlling the TAU $m$  channel module in input pulse interval measurement mode.

Remark This API function is called from [R\\_TAU \$m\$ \\_Create](#).

**[Syntax]**

```
void R_{Config_TAU $m$ _ $n$ }_Create(void);
```

Remark  $m$  is the unit number,  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAUm\_n}\_Start**

This API function starts the TAUm channeln counter.

**[Syntax]**

```
void R_{Config_TAUm_n}_Start(void);
```

Remark *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAU $m$ \_ $n$ }\_Stop**

This API function stops the TAU $m$  channel $n$  counter.

**[Syntax]**

```
void R_{Config_TAU $m$ _ $n$ }_Stop(void);
```

Remark  $m$  is the unit number,  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

R_{Config_TAUm_n}_Get_PulseWidth
----------------------------------

Measures TAUm channel n input pulse width.

## [Syntax]

void R_{Config_TAUm_n}_Get_PulseWidth(uint32_t * const width);
--

Remark *m* is the unit number, *n* is the channel number.

## [Argument(s)]

I/O	Argument(s)	Description
O	uint32_t * const width;	the address where to write the input pulse width

## [Return value]

None.

**R\_{Config\_TAUm\_n}\_Create\_UserInit**

This API function executes user-specific initialization processing for the TAUm channeln.

Remark This API functions is called from [R\\_{Config\\_TAUm\\_n}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_TAUm_n}_Create_UserInit(void);
```

Remark *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

---

<code>r_{Config_TAUm_n}_interrupt</code>
--

This API function executes processing in response to timer channelmn capture interrupt.

**Remark** This API function is called as the interrupt handler for capture interrupts which occur when the valid capture edge is detected and the current counter value (TCRmn) is transferred to timer data register mn (TDRmn).

**[Syntax]**

<code>void r_{Config_TAUm_n}_interrupt(void);</code>
--

**Remark** *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.



## Usage example

This is an example for getting TAU channel 0 input interval width:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"
extern volatile uint8_t tau_interrupt_flag;
uint32_t width;

int main(void);

int main(void)
{
    tau_interrupt_flag = 0;
    R_Config_TAU0_0_Start();
    while (tau_interrupt_flag == 0);
    R_Config_TAU0_0_Stop();
    R_Config_TAU0_0_Get_PulseWidth(&width);

    return 0;
}
```

Config\_TAU0\_0\_user.c

```
/* Start user code for global. Do not edit comment generated here */
uint8_t tau_interrupt_flag;
/* End user code. Do not edit comment generated here */

static void __near r_Config_TAU0_0_interrupt (void)
{
    ...
    /* Start user code for r_Config_TAU0_0_interrupt. Do not edit comment generated here */
    tau_interrupt_flag = 1U; // Set the flag
    /* End user code. Do not edit comment generated here */
}
```

### 4.2.13 Measurement of High-/Low-Level Width of Input Signal (Timer Array Unit)

Below is a list of API functions output by the Smart Configurator for input pulse high-/low-level width measurement use.

**Table 4-14 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_TAUm_n}_Create</a>	Timer Array Unit	Executes initialization processing that is required before controlling the TAUm channel <i>n</i> module in input pulse high-/low-level width measurement mode.
<a href="#">R_{Config_TAUm_n}_Start</a>		Starts the TAUm channel <i>n</i> counter.
<a href="#">R_{Config_TAUm_n}_Stop</a>		Stops the TAUm channel <i>n</i> counter.
<a href="#">R_{Config_TAUm_n}_Get_PulseWidth</a>		Measures TAUm channel <i>n</i> input pulse width.
<a href="#">R_{Config_TAUm_n}_Create_UserInit</a>		Executes user-specific initialization processing for the TAUm channel <i>n</i> .
<a href="#">r_{Config_TAUm_n}_interrupt</a>		Executes processing in response to timer channel <i>n</i> capture interrupt.

**R\_{Config\_TAU $m$ \_ $n$ }\_Create**

This API function executes initialization processing that is required before controlling the TAU $m$  channel module in input pulse high-/low-level width measurement mode.

Remark This API function is called from [R\\_TAU \$m\$ \\_Create](#).

**[Syntax]**

```
void R_{Config_TAU $m$ _ $n$ }_Create(void);
```

Remark  $m$  is the unit number,  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAU $m$ \_ $n$ }\_Start**

This API function starts the TAU $m$  channel $n$  counter.

**[Syntax]**

```
void R_{Config_TAU $m$ _ $n$ }_Start(void);
```

Remark  $m$  is the unit number,  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAU $m$ \_ $n$ }\_Stop**

This API function stops the TAU $m$  channel $n$  counter.

**[Syntax]**

```
void R_{Config_TAU $m$ _ $n$ }_Stop(void);
```

Remark  $m$  is the unit number,  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

R_{Config_TAUm_n}_Get_PulseWidth
----------------------------------

This API function measures TAUm channeln input pulse width.

## [Syntax]

void R_{Config_TAUm_n}_Get_PulseWidth(uint32_t * const width);
--

Remark *m* is the unit number, *n* is the channel number.

## [Argument(s)]

I/O	Argument(s)	Description
O	uint32_t * const width;	The address where to write the input pulse width

## [Return value]

None.

**R\_{Config\_TAUm\_n}\_Create\_UserInit**

This API function executes user-specific initialization processing for the TAUm channeln.

Remark This API functions is called from [R\\_{Config\\_TAUm\\_n}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_TAUm_n}_Create_UserInit(void);
```

Remark *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_TAUm_n}_interrupt`

This API function executes processing in response to timer channelmn capture interrupt.

**Remark** This API function is called as the interrupt handler for capture interrupts, which occur when the valid capture edge is detected, and the current counter value (TCRmn) is transferred to timer data register mn (TDRmn).

**[Syntax]**

`void r_{Config_TAUm_n}_interrupt(void);`

**Remark** *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.



## Usage example

This is an example for getting TAU channel 0 input low-level width:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"
extern volatile uint8_t tau_interrupt_flag;
uint32_t width;

int main(void);

int main(void)
{
    tau_interrupt_flag = 0;
    R_Config_TAU0_0_Start();
    while( tau_interrupt_flag == 0);
    R_Config_TAU0_0_Stop();
    R_Config_TAU0_0_Get_PulseWidth(&width);

    return 0;
}
```

Config\_TAU0\_0\_user.c

```
/* Start user code for global. Do not edit comment generated here */
uint8_t tau_interrupt_flag;
/* End user code. Do not edit comment generated here */

static void __near r_Config_TAU0_0_interrupt (void)
{
    ...
    /* Start user code for r_Config_TAU0_0_interrupt. Do not edit comment generated here */
    tau_interrupt_flag = 1U; // Set the flag
    /* End user code. Do not edit comment generated here */
}
```

#### 4.2.14 Delay Counter (Timer Array Unit)

Below is a list of API functions output by the Smart Configurator for delay counter use.

**Table 4-15 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_TAUm_n}_Create</a>	Timer Array Unit	Executes initialization processing that is required before controlling the TAUm channel <i>n</i> module in delay counter mode.
<a href="#">R_{Config_TAUm_n}_Start</a>		Starts the TAUm channel <i>n</i> counter.
<a href="#">R_{Config_TAUm_n}_Stop</a>		Stops the TAUm channel <i>n</i> counter.
<a href="#">R_{Config_TAUm_n}_Lower8bits_Start</a>		Starts the TAUm channel <i>n</i> lower 8 bits counter.
<a href="#">R_{Config_TAUm_n}_Lower8bits_Stop</a>		Stops the TAUm channel <i>n</i> lower 8 bits counter.
<a href="#">R_{Config_TAUm_n}_Set_SoftwareTriggerOn</a>		Generates software trigger.
<a href="#">R_{Config_TAUm_n}_Create_UserInit</a>		Executes user-specific initialization processing for the TAUm channel <i>n</i>
<a href="#">r_{Config_TAUm_n}_interrupt</a>		Executes processing in response to end of timer channel <i>n</i> count end interrupt.

**R\_{Config\_TAU $m$ \_ $n$ }\_Create**

This API function executes initialization processing that is required before controlling the TAU $m$  channel module in delay counter mode.

Remark This API function is called from [R\\_TAU \$m\$ \\_Create](#).

**[Syntax]**

```
void R_{Config_TAU $m$ _ $n$ }_Create(void);
```

Remark  $m$  is the unit number,  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAUm\_n}\_Start**

This API function starts the TAUm channeln counter.

**[Syntax]**

```
void R_{Config_TAUm_n}_Start(void);
```

Remark *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAU $m$ \_ $n$ }\_Stop**

This API function stops the TAU $m$  channel $n$  counter.

**[Syntax]**

```
void R_{Config_TAU $m$ _ $n$ }_Stop(void);
```

Remark  $m$  is the unit number,  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAUm\_n}\_Lower8bits\_Start**

This API function starts the TAUm channeln lower 8 bits counter.

**[Syntax]**

```
void R_{Config_TAUm_n}_Lower8bits_Start(void);
```

Remark *m* is the unit number, *n* is the channel number 1 or 3.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAUM\_n}\_Lower8bits\_Stop**

This API function stops the TAUM channeln lower 8 bits counter.

**[Syntax]**

```
void R_{Config_TAUM_n}_Lower8bits_Stop(void);
```

Remark *m* is the unit number, *n* is the channel number 1 or 3.

**[Argument(s)]**

None.

**[Return value]**

None.

`R_{Config_TAU $m$ _ $n$ }_Set_SoftwareTriggerOn`

Generates software trigger.

**[Syntax]**

`void R_{Config_TAU $m$ _ $n$ }_Set_SoftwareTriggerOn(void);`

Remark  $m$  is the unit number,  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.



**R\_{Config\_TAUm\_n}\_Create\_UserInit**

This API function executes user-specific initialization processing for the TAUm channeln.

Remark This API functions is called from [R\\_{Config\\_TAUm\\_n}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_TAUm_n}_Create_UserInit(void);
```

Remark *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

---

```
r_{Config_TAUm_n}_interrupt
```

This API function executes processing in response to end of timer channelmn count end interrupt.

Remark This API function is called as the interrupt handler for count end interrupt, which occur when the current counter value (TCRmn) reaches 0000H.

[Syntax]

```
void r_{Config_TAUm_n}_interrupt(void);
```

Remark *m* is the unit number, *n* is the channel number.

[Argument(s)]

None.

[Return value]

None.

## Usage example

This is an example for using TAU channel 0 counting as delay counter mode and channel 1 counting as 8-bit delay counter for a user-defined period:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"
extern uint8_t ch0_run_count;
extern uint8_t ch1_run_count;

int main(void);

int main(void)
{
    ch0_run_count = 0;
    R_Config_TAU0_0_Start();
    R_Config_TAU0_0_Set_SoftwareTriggerOn();
    while (ch0_run_count < 20);
    R_Config_TAU0_0_Stop();

    Ch1_run_count = 0;
    R_Config_TAU0_1_Lower8bits_Start();
    R_Config_TAU0_1_Set_SoftwareTriggerOn();
    while (ch0_run_count < 20);
    R_Config_TAU0_1_Lower8bits_Stop();

    return 0;
}
```

Config\_TAU0\_0\_user.c

```
/* Start user code for global. Do not edit comment generated here */
uint8_t ch0_run_count;
/* End user code. Do not edit comment generated here */

static void __near r_Config_TAU0_0_interrupt (void)
{
    /* Start user code for r_Config_TAU0_0_interrupt. Do not edit comment generated here */
    ch0_run_count++;
    /* End user code. Do not edit comment generated here */
}
```

Config\_TAU0\_1\_user.c

```
/* Start user code for global. Do not edit comment generated here */
uint8_t ch1_run_count;
/* End user code. Do not edit comment generated here */

static void __near r_Config_TAU0_1_interrupt (void)
{
    /* Start user code for r_Config_TAU0_1_interrupt. Do not edit comment generated here */
    ch1_run_count++;
    /* End user code. Do not edit comment generated here */
}
```

#### 4.2.15 One-Shot Pulse Output (Timer Array Unit)

Below is a list of API functions output by the Smart Configurator for one-shot pulse output use.

**Table 4-16 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_TAUm_n}_Create</a>	Timer Array Unit	Executes initialization processing that is required before controlling the TAU $m$ channel $n$ module in one-shot pulse output mode.
<a href="#">R_{Config_TAUm_n}_Start</a>		Starts the TAU $m$ channel $n$ counter.
<a href="#">R_{Config_TAUm_n}_Stop</a>		Stops the TAU $m$ channel $n$ counter.
<a href="#">R_{Config_TAUm_n}_Set_SoftwareTriggerOn</a>		Generates software trigger.
<a href="#">R_{Config_TAUm_n}_Create_UserInit</a>		Executes user-specific initialization processing for the TAU $m$ channel $n$ .
<a href="#">r_{Config_TAUm_n}_channeln_interrupt</a>		Executes processing in response to timer channel $n$ count end interrupt.
<a href="#">r_{Config_TAUm_n}_channelp_interrupt</a>		Executes processing in response to timer channel $p$ count end interrupt.

**R\_{Config\_TAU $m$ \_ $n$ }\_Create**

This API function executes initialization processing that is required before controlling the TAU $m$  channel module in one-shot pulse output mode.

Remark This API function is called from [R\\_TAU \$m\$ \\_Create](#).

**[Syntax]**

```
void R_{Config_TAU $m$ _ $n$ }_Create(void);
```

Remark  $m$  is the unit number,  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAUm\_n}\_Start**

This API function starts the TAUm channeln counter.

**[Syntax]**

```
void R_{Config_TAUm_n}_Start(void);
```

Remark *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAU $m$ \_ $n$ }\_Stop**

This API function stops the TAU $m$  channel $n$  counter.

**[Syntax]**

```
void R_{Config_TAU $m$ _ $n$ }_Stop(void);
```

Remark  $m$  is the unit number,  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAUm\_n}\_Set\_SoftwareTriggerOn**

This API function generates software trigger.

**[Syntax]**

```
void R_{Config_TAUm_n}_Set_SoftwareTriggerOn(void);
```

Remark  $m$  is the unit number,  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.



**R\_{Config\_TAUm\_n}\_Create\_UserInit**

This API function executes user-specific initialization processing for the TAUm channeln.

Remark This API functions is called from [R\\_{Config\\_TAUm\\_n}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_TAUm_n}_Create_UserInit(void);
```

Remark *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

```
r_{Config_TAUm_n}_channeln_interrupt
```

This API function executes processing in response to timer channel $m$ n count end interrupt.

Remark This API function is called as the interrupt handler for count end interrupt, which occur when the current counter value (TCR $m$ n) reaches 0000H.

[Syntax]

```
void r_{Config_TAUm_n}_channeln_interrupt(void);
```

Remark  $m$  is the unit number,  $n$  is the master channel number.

[Argument(s)]

None.

[Return value]

None.

**r\_{Config\_TAU $m$ \_ $n$ }\_channel $p$ \_interrupt**

This API function executes processing in response to timer channel $mp$  count end/capture interrupt.

Remark1. In one-shot pulse output function, this API function is called as the interrupt handler for count end interrupt, which occur when the current counter value (TCR $mp$ ) reaches 0000H.

Remark2. In two-channel input with one-shot pulse output function, this API function is called as the interrupt handler for capture interrupt, which occur when the valid capture edge is detected, and the current counter value (TCR $mp$ ) is transferred to timer data register  $mp$  (TDR $mp$ ).

**[Syntax]**

```
void r_{Config_TAU $m$ _ $n$ }_channel $p$ _interrupt(void);
```

Remark1.  $m$  is the unit number,  $n$  is the master channel number,  $p$  is slave channel number.

Remark2.  $n < p \leq 7$ .

**[Argument(s)]**

None.

**[Return value]**

None.

## Usage example

This is an example for TAU channel 0 outputting one-shot pulse by software trigger:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"
extern uint8_t tau_oneshot_count

int main(void);

int main(void)
{
    tau_oneshot_count = 0;
    R_Config_TAU0_0_Start();
    R_Config_TAU0_0_Set_SoftwareTriggerOn();
    while (tau_oneshot_count < 10);
    R_Config_TAU0_0_Stop();

    return 0;
}
```

Config\_TAU0\_0\_user.c

```
/* Start user code for global. Do not edit comment generated here */
uint8_t tau_oneshot_count
/* End user code. Do not edit comment generated here */

static void __near r_Config_TAU0_01_channel1_interrupt (void)
{
    /* Start user code for r_Config_TAU0_01_channel1_interrupt. Do not edit comment generated here
    */
    tau_oneshot_count ++;
    /* End user code. Do not edit comment generated here */
}
```

#### 4.2.16 PWM Output (Timer Array Unit)

Below is a list of API functions output by the Smart Configurator for PWM output use.

**Table 4-17 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_TAUm_n}_Create</a>	Timer Array Unit	Executes initialization processing that is required before controlling the TAUm channel <i>n</i> module in PWM mode.
<a href="#">R_{Config_TAUm_n}_Start</a>		Starts the TAUm channel <i>n</i> counter.
<a href="#">R_{Config_TAUm_n}_Stop</a>		Stops the TAUm channel <i>n</i> counter.
<a href="#">R_{Config_TAUm_n}_Create_UserInit</a>		Executes user-specific initialization processing for the TAUm channel <i>n</i> .
<a href="#">r_{Config_TAUm_n}_channel<i>n</i>_interrupt</a>		Executes processing in response to timer channel <i>n</i> count end interrupt.
<a href="#">r_{Config_TAUm_n}_channel<i>p</i>_interrupt</a>		Executes processing in response to timer channel <i>p</i> count end interrupt

**R\_{Config\_TAUm\_n}\_Create**

This API function executes initialization processing that is required before controlling the TAUm channel module in PWM mode.

Remark This API function is called from [R\\_TAUm\\_Create](#).

**[Syntax]**

```
void R_{Config_TAUm_n}_Create(void);
```

Remark *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAUm\_n}\_Start**

This API function starts the TAUm channeln counter.

**[Syntax]**

```
void R_{Config_TAUm_n}_Start(void);
```

Remark *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_TAU $m$ \_ $n$ }\_Stop**

This API function stops the TAU $m$  channel $n$  counter.

**[Syntax]**

```
void R_{Config_TAU $m$ _ $n$ }_Stop(void);
```

Remark  $m$  is the unit number,  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.



**R\_{Config\_TAUm\_n}\_Create\_UserInit**

This API function executes user-specific initialization processing for the TAUm channeln.

Remark This API functions is called from [R\\_{Config\\_TAUm\\_n}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_TAUm_n}_Create_UserInit(void);
```

Remark *m* is the unit number, *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_TAUm_n}_channeln_interrupt`

This API function executes processing in response to timer channelmn count end interrupt.

Remark This API function is called as the interrupt handler for count end interrupt, which occur when the current counter value (TCRmn) reaches 0000H.

[Syntax]

```
void r_{Config_TAUm_n}_channeln_interrupt(void);
```

Remark *m* is the unit number, *n* is the master channel number.

[Argument(s)]

None.

[Return value]

None.

---

<code>r_{Config_TAUm_n}_channelp_interrupt</code>
---

This API function executes processing in response to timer channelmp count end interrupt.

Remark This API function is called as the interrupt handler for count end interrupt, which occur when the current counter value (TCRmp) reaches 0000H.

**[Syntax]**

<code>void r_{Config_TAUm_n}_channelp_interrupt(void);</code>
---

Remark1.  $m$  is the unit number,  $n$  is the master channel number,  $p$  is slave channel number.

Remark2.  $n < p \leq 7$ .

**[Argument(s)]**

None.

**[Return value]**

None.

## Usage example

This is an example for starting TAU channel 0/1 to output PWM pulses:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"
extern uint8_t tau_pwm_count;

int main(void);

int main(void)
{
    tau_pwm_count = 0;
    R_Config_TAU0_0_Start();
    while (tau_interrupt_flag < 10);
    R_Config_TAU0_0_Stop();

    return 0;
}
```

Config\_TAU0\_0\_user.c

```
/* Start user code for global. Do not edit comment generated here */
uint8_t tau_pwm_count;
/* End user code. Do not edit comment generated here */

static void __near r_Config_TAU0_01_channel1_interrupt (void)
{
    /* Start user code for r_Config_TAU0_01_channel1_interrupt. Do not edit comment generated here
    */
    tau_pwm_count++;
    /* End user code. Do not edit comment generated here */
}
```

#### 4.2.17 Interval Timer (32-bit Interval Timer using 8-bit counter mode)

Below is a list of API functions output by the Smart Configurator for interval timer (for 32-bit interval timer when using 8bit counter mode) use.

**Table 4-18 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_ITLn}_Create</a>	32-bit Interval Timer	Executes initialization processing that is required before controlling the ITLn module in interval timer mode (8bit mode).
<a href="#">R_{Config_ITLn}_Start</a>		Starts the ITLn channel.
<a href="#">R_{Config_ITLn}_Stop</a>		Stops the ITLn channel.
<a href="#">R_{Config_ITLn}_Set_OperationMode</a>		Used to stop counter and clear interrupt flag before changing 32-bit interval timer operation mode.
<a href="#">R_{Config_ITLn}_Create_UserInit</a>		Executes user-specific initialization processing for the ITLn channel.
<a href="#">r_{Config_ITLn}_Callback_Shared_Interrupt</a>		Executes processing in response to 32-bit interval timer interrupt.

**R\_{Config\_ITLn}\_Create**

This API function executes initialization processing that is required before controlling the ITL $n$  module in interval timer mode (8bit mode).

Remark This API function is called from [R\\_ITL\\_Create](#).

**[Syntax]**

```
void R_{Config_ITLn}_Create(void);
```

Remark  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_ITLn}\_Start**

This API function starts the ITL $n$  channel.

Remark The 32-bit interval timer interrupt is enabled by calling [R\\_ITL\\_Start\\_Interrupt](#). For this reason, to use 32-bit interval timer interrupt, please call this API function together with [R\\_ITL\\_Start\\_Interrupt](#).

**[Syntax]**

```
void R_{Config_ITLn}_Start(void);
```

Remark  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_ITL*n*}\_Stop**

This API function stops the ITL*n* channel.

**[Syntax]**

```
void R_{Config_ITLn}_Stop(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.



**R\_{Config\_ITLn}\_Set\_OperationMode**

This API function is used to stop counter and clear interrupt flag before changing 32-bit interval timer operation mode.

**[Syntax]**

```
void R_{Config_ITLn}_Set_OperationMode(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_ITLn}\_Create\_UserInit**

This API function executes user-specific initialization processing for the ITLn channel.

Remark This API functions is called from [R\\_{Config\\_ITLn}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_ITLn}_Create_UserInit(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**r\_{Config\_ITLn}\_Callback\_Shared\_interrupt**

This API function executes processing in response to 32-bit interval timer interrupt.

Remark 1. This API function is called as a callback routine from [r\\_itl\\_interrupt](#), which is the interrupt handler for 32-bit interval timer interrupts.

Remark 2. User should only keep necessary flag set/clear in callback function, other processing code should be moved out of callback and interrupt function. Otherwise, the interrupt is not processed at the correct timing.

**[Syntax]**

```
void r_{Config_ITLn}_Callback_Shared_interrupt(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

## Usage example

This is an example for using 8-bit counting for a user-defined counter value and output a wave form P00 pin:  
(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"
extern volatile uint8_t interrupt_flag;

int main(void);

int main(void)
{
    interrupt_flag = 0;
    R_Config_ITL001_Start();
    R_ITL_Start_Interrupt();
    while (interrupt_flag < 20);
    R_Config_ITL001_Stop();

    return 0;
}
```

Config\_ITL001\_user.c

```
/* Start user code for global. Do not edit comment generated here */
uint8_t interrupt_flag;
/* End user code. Do not edit comment generated here */

void R_Config_ITL001_Callback_Shared_Interrupt(void)
{
    /* Start user code for R_Config_ITL000_Callback_Shared_Interrupt. Do not edit comment generated here */
    char Pmn[] = "P00";
    interrupt_flag ++;

    if(interrupt_flag % 2 == 0)
    {
        R_Config_PORT_Set_Output_Level(Pmn, LOW);
    }
    else
    {
        R_Config_PORT_Set_Output_Level(Pmn, HIGH);
    }
    /* End user code. Do not edit comment generated here */
}
```

#### 4.2.18 Interval Timer (32-bit Interval Timer using 16-bit counter mode)

Below is a list of API functions output by the Smart Configurator for interval timer (for 32-bit interval timer when using 16bit counter mode) use.

**Table 4-19 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_ITLn_ITLm}_Create</a>	32-bit Interval Timer	Executes initialization processing that is required before controlling the ITL <sub>n</sub> _ITL <sub>m</sub> module in interval timer mode (16bit mode).
<a href="#">R_{Config_ITLn_ITLm}_Start</a>		Starts the ITL <sub>n</sub> _ITL <sub>m</sub> channel.
<a href="#">R_{Config_ITLn_ITLm}_Stop</a>		Stops the ITL <sub>n</sub> _ITL <sub>m</sub> channel.
<a href="#">R_{Config_ITLn_ITLm}_Set_SoftwareTriggerOn</a>		Generates software trigger.
<a href="#">R_{Config_ITLn_ITLm}_Set_OperationMode</a>		Used to stop counter and clear interrupt flag before changing 32-bit interval timer operation mode.
<a href="#">R_{Config_ITLn_ITLm}_Get_CaptureValue</a>		Gets capture value.
<a href="#">R_{Config_ITLn_ITLm}_Create_UserInit</a>		Executes user-specific initialization processing for the ITL <sub>n</sub> _ITL <sub>m</sub> channel.
<a href="#">r_{Config_ITLn_ITLm}_Callback_Shared_Interrupt</a>		Executes processing in response to 32-bit interval timer interrupt.

**R\_{Config\_ITLn\_ITLm}\_Create**

This API function executes initialization processing that is required before controlling the ITLn\_ITLm module in interval timer mode (16bit mode).

Remark This API function is called from [R\\_ITL\\_Create](#).

**[Syntax]**

```
void R_{Config_ITLn_ITLm}_Create(void);
```

Remark When *n* is 000, *m* is 001; When *n* is 012, *m* is 013.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_ITLn\_ITLm}\_Start**

This API function starts the ITLn\_ITLm channel.

Remark The 32-bit interval timer interrupt is enabled by calling [R\\_ITL\\_Start\\_Interrupt](#). For this reason, to use 32-bit interval timer interrupt, please call this API function together with [R\\_ITL\\_Start\\_Interrupt](#).

**[Syntax]**

```
void R_{Config_ITLn_ITLm}_Start(void);
```

Remark When *n* is 000, *m* is 001; When *n* is 012, *m* is 013.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_ITLn\_ITLm}\_Stop**

This API function stops the ITLn\_ITLm channel.

**[Syntax]**

```
void R_{Config_ITLn_ITLm}_Stop(void);
```

Remark When *n* is 000, *m* is 001; When *n* is 012, *m* is 013.

**[Argument(s)]**

None.

**[Return value]**

None.



**R\_{Config\_ITLn\_ITLm}\_Set\_SoftwareTriggerOn**

This API function generates software trigger.

**[Syntax]**

```
void R_{Config_ITLn_ITLm}_Set_SoftwareTriggerOn(void);
```

Remark When  $n$  is 000,  $m$  is 001; When  $n$  is 012,  $m$  is 013.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_ITLn\_ITLm}\_Set\_OperationMode**

This API function is used to stop counter and clear interrupt flag before changing 32-bit interval timer operation mode.

**[Syntax]**

```
void R_{Config_ITLn_ITLm}_Set_OperationMode(void);
```

Remark When  $n$  is 000,  $m$  is 001; When  $n$  is 012,  $m$  is 013.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_ITLn\_ITLm}\_Get\_CaptureValue**

This API function gets capture value.

**[Syntax]**

```
void R_{Config_ITLn_ITLm}_Get_CaptureValue(uint16_t * const value);
```

Remark When *n* is 000, *m* is 001; When *n* is 012, *m* is 013.

**[Argument(s)]**

I/O	Argument(s)	Description
O	uint16_t * const value;	the address where to write the capture value

**[Return value]**

None.

**R\_{Config\_ITLn\_ITLm}\_Create\_UserInit**

This API function executes user-specific initialization processing for the ITLn\_ITLm channel.

Remark This API functions is called from [R\\_{Config\\_ITLn\\_ITLm}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_ITLn_ITLm}_Create_UserInit(void);
```

Remark When *n* is 000, *m* is 001; When *n* is 012, *m* is 013.

**[Argument(s)]**

None.

**[Return value]**

None.

**r\_{Config\_ITLn\_ITLm}\_Callback\_Shared\_interrupt**

This API function executes processing in response to 32-bit interval timer interrupt.

Remark 1. This API function is called as a callback routine from [r\\_itl\\_interrupt](#), which is the interrupt handler for 32-bit interval timer interrupts.

Remark 2. User should only keep necessary flag set/clear in callback function, other processing code should be moved out of callback and interrupt function. Otherwise, the interrupt is not processed at the correct timing.

**[Syntax]**

```
void r_{Config_ITLn_ITLm}_Callback_Shared_interrupt(void);
```

Remark When *n* is 000, *m* is 001; When *n* is 012, *m* is 013.

**[Argument(s)]**

None.

**[Return value]**

None.

## Usage example

This is an example for changing 32-bit interval timer operation mode to user setting (16-bit count mode change to 16-bit capture mode):

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"

int main(void);

int main(void)
{
    R_Config_ITL000_ITL001_Set_OperationMode();
    /* Capture setting */
    R_TML32->ITLCC0 |= _80_ITL_CAPTURE_ENABLE;
    R_TML32->ITLCC0_b.CAPF0CR = 1U;
    R_TML32->ITLCC0 |= _00_ITL_CAPTURE_COUNTER_RETAIN;
    R_TML32->ITLCC0 &= _FC_ITL_CAPTURE_TRIGGER_CLEAR;
    R_TML32->ITLCC0 |= _00_ITL_CAPTURE_TRIGGER_SOFTWARE;
    R_Config_ITL000_ITL001_Start();
    R_ITL_Start_Interrupt();
    R_Config_ITL000_ITL001_Set_SoftwareTriggerOn();

    return 0;
}
```

Config\_ITL000\_user.c

```
volatile uint16_t value = 0U;

void r_Config_ITL000_callback_shared_interrupt(void)
{
    R_Config_ITL000_ITL001_Get_CaptureValue (&value);
}
```

#### 4.2.19 Interval Timer (32-bit Interval Timer using 32-bit counter mode)

Below is a list of API functions output by the Smart Configurator for interval timer (for 32-bit interval timer when using 32bit counter mode) use.

**Table 4-20 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_ITL000_ITL001_ITL012_ITL013}_Create</a>	32-bit Interval Timer	Executes initialization processing that is required before controlling the ITL000_ITL001_ITL012_ITL013 module in interval timer mode (32bit mode).
<a href="#">R_{Config_ITL000_ITL001_ITL012_ITL013}_Start</a>		Starts the ITL000_ITL001_ITL012_ITL013 channel.
<a href="#">R_{Config_ITL000_ITL001_ITL012_ITL013}_Stop</a>		Stops the ITL000_ITL001_ITL012_ITL013 channel.
<a href="#">R_{Config_ITL000_ITL001_ITL012_ITL013}_Set_OperationMode</a>		Used to stop counter and clear interrupt flag before changing 32-bit interval timer operation mode.
<a href="#">R_{Config_ITL000_ITL001_ITL012_ITL013}_Create_UserInit</a>		Executes user-specific initialization processing for the ITL000_ITL001_ITL012_ITL013 channel.
<a href="#">r_{Config_ITL000_ITL001_ITL012_ITL013}_Callback_Shared_Interrupt</a>		Executes processing in response to 32-bit interval timer interrupt.

**R\_{Config\_ITL000\_ITL001\_ITL012\_ITL013}\_Create**

This API function executes initialization processing that is required before controlling the ITL000\_ITL001\_ITL012\_ITL013 module in interval timer mode (32bit mode).

Remark This API function is called from [R\\_ITL\\_Create](#).

**[Syntax]**

```
void R_{Config_ITL000_ITL001_ITL012_ITL013}_Create(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.



**R\_{Config\_ITL000\_ITL001\_ITL012\_ITL013}\_Start**

This API function starts the ITL000\_ITL001\_ITL012\_ITL013 channel.

**Remark** The 32-bit interval timer interrupt is enabled by calling [R\\_ITL\\_Start\\_Interrupt](#). For this reason, to use 32-bit interval timer interrupt, please call this API function together with [R\\_ITL\\_Start\\_Interrupt](#).

**[Syntax]**

```
void R_{Config_ITL000_ITL001_ITL012_ITL013}_Start(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

`R_{Config_ITL000_ITL001_ITL012_ITL013}_Stop`

This API function stops the ITL000\_ITL001\_ITL012\_ITL013 channel.

**[Syntax]**

`void R_{Config_ITL000_ITL001_ITL012_ITL013}_Stop(void);`

**[Argument(s)]**

None.

**[Return value]**

None.

`R_{Config_ITL000_ITL001_ITL012_ITL013}_Set_OperationMode`

This API function is used to stop counter and clear interrupt flag before changing 32-bit interval timer operation mode.

**[Syntax]**

```
void R_{Config_ITL000_ITL001_ITL012_ITL013}_Set_OperationMode(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_ITL000\_ITL001\_ITL012\_ITL013}\_Create\_UserInit**

This API function executes user-specific initialization processing for the ITL000\_ITL001\_ITL012\_ITL013 channel.

Remark This API functions is called from [R\\_{Config\\_ITL000\\_ITL001\\_ITL012\\_ITL013}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_ITL000_ITL001_ITL012_ITL013}_Create_UserInit(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_ITL000_ITL001_ITL012_ITL013}_Callback_Shared_interrupt`

This API function executes processing in response to 32-bit interval timer interrupt.

Remark 1. This API function is called as a callback routine from [r\\_itl\\_interrupt](#), which is the interrupt handler for 32-bit interval timer interrupts.

Remark 2. User should only keep necessary flag set/clear in callback function, other processing code should be moved out of callback and interrupt function. Otherwise, the interrupt is not processed at the correct timing.

[Syntax]

```
void r_{Config_ITL000_ITL001_ITL012_ITL013}_Callback_Shared_interrupt(void);
```

[Argument(s)]

None.

[Return value]

None.

## Usage example

This is an example for using 32-bit count mode for a user-defined period:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"
extern uint8_t itl_run_count;

int main(void);

int main(void)
{
    R_Config_ITL000_ITL001_ITL012_ITL013_Start();
    R_ITL_Start_Interrupt();
    while (itl_run_count < 20);
    R_Config_ITL000_ITL001_ITL012_ITL013_Stop();

    return 0;
}
```

Config\_ITL000\_ITL001\_ITL012\_ITL013\_user.c

```
/* Start user code for global. Do not edit comment generated here */
uint8_t itl_run_count;
/* End user code. Do not edit comment generated here */

void R_Config_ITL000_ITL001_ITL012_ITL013_Callback_Shared_Interrupt(void)
{
    /* Start user code for R_Config_ITL000_ITL001_ITL012_ITL013_Callback_Shared_Interrupt. Do not
    edit comment generated here */
    itl_run_count ++;
    /* End user code. Do not edit comment generated here */
}
```

### 4.2.20 Real-Time Clock

Below is a list of API functions output by the Smart Configurator for real-time clock use.

**Table 4-21 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_RTC}_Create</a>	Real-Time Clock	Executes initialization processing that is required before controlling the real-time clock module.
<a href="#">R_{Config_RTC}_Start</a>		Enables the real-time clock counter.
<a href="#">R_{Config_RTC}_Stop</a>		Disables the real-time clock counter.
<a href="#">R_{Config_RTC}_Set_HourSystem</a>		Chooses 12-hour system or 24-hour system.
<a href="#">R_{Config_RTC}_Set_CounterValue</a>		Changes the real-time clock counter value.
<a href="#">R_{Config_RTC}_Get_CounterValue</a>		Reads the results of real-time clock and store them in the variables.
<a href="#">R_{Config_RTC}_Set_ConstPeriodInterruptOn</a>		Enables constant-period interrupt.
<a href="#">R_{Config_RTC}_Set_ConstPeriodInterruptOff</a>		Disables constant-period interrupt.
<a href="#">R_{Config_RTC}_Set_AlarmOn</a>		Starts the alarm operation.
<a href="#">R_{Config_RTC}_Set_AlarmOff</a>		Stops the alarm operation.
<a href="#">R_{Config_RTC}_Set_AlarmValue</a>		Sets alarm value.
<a href="#">R_{Config_RTC}_Get_AlarmValue</a>		Gets alarm value.
<a href="#">R_{Config_RTC}_Set_RTC1HZOn</a>		Enables RTC1HZ output.
<a href="#">R_{Config_RTC}_Set_RTC1HZOff</a>		Disables RTC1HZ output.
<a href="#">R_{Config_RTC}_Create_UserInit</a>		Executes user-specific initialization processing for the real-time clock.
<a href="#">r_{Config_RTC}_interrupt</a>		Executes processing in response to alarm, fixed-period interrupt.
<a href="#">r_{Config_RTC}_callback_constperiod</a>		Executes processing in response to fixed-period interrupt.
<a href="#">r_{Config_RTC}_callback_alarm</a>	Executes processing in response to alarm interrupt.	

**R\_{Config\_RTC}\_Create**

This API function executes initialization processing that is required before controlling the real-time clock module.

Remark This API function is called from [R\\_Systeminit](#) before the main() function is executed.

**[Syntax]**

```
void R_{Config_RTC}_Create(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.



**R\_{Config\_RTC}\_Start**

This API function enables the real-time clock counter.

**[Syntax]**

```
void R_{Config_RTC}_Start(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_RTC}\_Stop**

This API function disables the real-time clock counter.

**[Syntax]**

```
void R_{Config_RTC}_Stop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

### R\_{Config\_RTC}\_Set\_HourSystem

Chooses 12-hour system or 24-hour system.

#### [Syntax]

```
MD_STATUS R_{Config_RTC}_Set_HourSystem(e_rtc_hour_system_t hour_system);
```

#### [Argument(s)]

I/O	Argument(s)	Description
I	e_rtc_hour_system_t hour_system;	Clock type HOUR12: 12-hour clock HOUR24: 24-hour clock

Remark Below is shown the structure e\_rtc\_hour\_system\_t (hour system).

```
typedef enum
{
    HOUR12,
    HOUR24
} e_rtc_hour_system_t;
```

#### [Return value]

Macro	Description
MD_OK	Normal end
MD_BUSY1	Busy 1.
MD_BUSY2	Busy 2.
MD_ARGERROR	Error argument input error.

**R\_{Config\_RTC}\_Set\_CounterValue**

Changes the real-time clock counter value.

**[Syntax]**

```
MD_STATUS R_{Config_RTC}_Set_CounterValue(st_rtc_counter_value_t counter_write_val);
```

**[Argument(s)]**

I/O	Argument(s)	Description
I	st_rtc_counter_value_t counter_write_val;	The expected real-time clock value (BCD code)

Remark Below is shown the structure st\_rtc\_counter\_value\_t (counter conditions).

```
typedef struct
{
    uint8_t sec;
    uint8_t min;
    uint8_t hour;
    uint8_t day;
    uint8_t week;
    uint8_t month;
    uint8_t year;
} st_rtc_counter_value_t;
```

**[Return value]**

Macro	Description
MD_OK	Normal end
MD_BUSY1	Busy 1.
MD_BUSY2	Busy 2.

### R\_{Config\_RTC}\_Get\_CounterValue

This API function reads the results of real-time clock and store them in the variables.

#### [Syntax]

```
MD_STATUS R_{Config_RTC}_Get_CounterValue(st_rtc_counter_value_t * const
counter_read_val);
```

#### [Argument(s)]

I/O	Argument(s)	Description
I	st_rtc_counter_value_t * const counter_read_val;	The current real-time clock value (BCD code)

Remark For structure st\_rtc\_counter\_value\_t, see [R\\_{Config\\_RTC}\\_Set\\_CounterValue](#).

#### [Return value]

Macro	Description
MD_OK	Normal end
MD_BUSY1	Busy 1.
MD_BUSY2	Busy 2.

**R\_{Config\_RTC}\_Set\_ConstPeriodInterruptOn**

Enables constant-period interrupt.

**[Syntax]**

```
MD_STATUS R_{Config_RTC}_Set_ConstPeriodInterruptOn(e_rtc_int_period_t period);
```

**[Argument(s)]**

I/O	Argument(s)	Description
I	e_rtc_int_period_t period;	The fixed-cycle period enumeration

Remark Below is shown the structure e\_rtc\_int\_period\_t period (period conditions).

```
typedef enum
{
    HALFSEC = 1U,
    ONESEC,
    ONEMIN,
    ONEHOUR,
    ONEDAY,
    ONEMONTH
} e_rtc_int_period_t;
```

**[Return value]**

Macro	Description
MD_OK	Normal end
MD_ARGERROR	Error argument input error.

`R_{Config_RTC}_Set_ConstPeriodInterruptOff`

Disables constant-period interrupt.

**[Syntax]**

```
void R_{Config_RTC}_Set_ConstPeriodInterruptOff(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_RTC}\_Set\_AlarmOn**

This API function starts the alarm operation.

**[Syntax]**

```
void R_{Config_RTC}_Set_AlarmOn(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.



**R\_{Config\_RTC}\_Set\_AlarmOff**

This API function stops the alarm operation.

**[Syntax]**

```
void R_{Config_RTC}_Set_AlarmOff(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_RTC}\_Set\_AlarmValue**

This API function sets alarm value.

**[Syntax]**

```
void R_{Config_RTC}_Set_AlarmValue(st_rtc_alarm_value_t alarm_val);
```

**[Argument(s)]**

I/O	Argument(s)	Description
I	st_rtc_alarm_value_t alarm_val;	The expected alarm value (BCD code)

Remark Below is shown the structure st\_rtc\_alarm\_value\_t alarm\_val (alarm conditions).

```
typedef struct
{
    uint8_t alarmwm;
    uint8_t alarmwh;
    uint8_t alarmww;
} st_rtc_alarm_value_t;
```

**[Return value]**

None.

**R\_{Config\_RTC}\_Get\_AlarmValue**

Gets alarm value.

**[Syntax]**

```
void R_{Config_RTC}_Get_AlarmValue(st_rtc_alarm_value_t * const alarm_val);
```

**[Argument(s)]**

I/O	Argument(s)	Description
O	st_rtc_alarm_value_t * const alarm_val;	The address to save alarm value (BCD code)

Remark For structure st\_rtc\_alarm\_value\_t \* const alarm\_val,  
see [R\\_{Config\\_RTC}\\_Set\\_AlarmValue](#).

**[Return value]**

None.

`R_{Config_RTC}_Set_RTC1HZOn`

Enables RTC1HZ output.

**[Syntax]**

```
void R_{Config_RTC}_Set_RTC1HZOn(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

`R_{Config_RTC}_Set_RTC1HZOff`

Disables RTC1HZ output.

**[Syntax]**

```
void R_{Config_RTC}_Set_RTC1HZOff(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_RTC}\_Create\_UserInit**

This API function executes user-specific initialization processing for the real-time clock.

Remark This API functions is called from [R\\_{Config\\_RTC}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_RTC}_Create_UserInit(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_RTC}_interrupt`

This API function executes processing in response to alarm, constant period interrupt.

**[Syntax]**

```
void r_{Config_RTC}_interrupt(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_RTC}_callback_constperiod`

This API function executes processing in response to fixed-cycle interrupt.

Remark This API function is called as the callback routine of interrupt process `r_{Config_RTC}_interrupt` corresponding to the fixed-cycle interrupt.

[Syntax]

```
static void r_{Config_RTC}_callback_constperiod(void);
```

[Argument(s)]

None.

[Return value]

None.



---

<code>r_{Config_RTC}_callback_alarm</code>
--

This API function executes processing in response to alarm interrupt.

Remark     This API function is called as the callback routine of interrupt process `r_{Config_RTC}_interrupt` corresponding to the alarm interrupt.

**[Syntax]**

<code>static void     r_{Config_RTC}_callback_alarm(void);</code>
---

**[Argument(s)]**

None.

**[Return value]**

None.

### Usage example 1 (alarm interrupt)

This is an example for using alarm interrupts to implement virtual processing for leap second correction (turning back the clock from 23:59:59 to 23:59:58 on a scheduled day):

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"

int main(void);

int main(void)
{
    R_Config_RTC_Set_AlarmOn();
    R_Config_RTC_Start();

    return 0;
}
```

Config\_RTC\_user.c

```
/* Start user code for global. Do not edit comment generated here */
volatile st_rtc_counter_value_t counter_val;
/* End user code. Do not edit comment generated here */

static void r_Config_RTC_callback_alarm(void)
{
    /* Start user code for r_Config_RTC_callback_alarm. Do not edit comment generated here */
    R_Config_RTC_Get_CounterValue ((st_rtc_counter_value_t *)&counter_val);

    /* Change the seconds */
    counter_val.rsecnt = 0x58U;

    R_Config_RTC_Set_CounterValue (counter_val);
    /* End user code. Do not edit comment generated here */
}
```

### Usage example 2 (constant-period interrupt)

This is an example for using constant-period interrupts to implement generating an alarm interrupt every 1 hour:  
(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"
st_rtc_counter_value_t currTime;
st_rtc_alarm_value_t alarm;

int main(void);

int main(void)
{
    R_Config_RTC_Set_ConstPeriodInterruptOn(ONEHOUR);
    R_Config_RTC_Start();

    return 0;
}
```

Config\_RTC\_user.c

```
/* Start user code for global. Do not edit comment generated here */
st_rtc_counter_value_t currTime;
st_rtc_alarm_value_t alarm;
/* End user code. Do not edit comment generated here */

static void r_Config_RTC_callback_constperiod (void)
{
    /* Start user code for r_Config_RTC_callback_constperiod. Do not edit comment generated here */
    R_Config_RTC_Get_CounterValue(&currTime);
    R_Config_RTC_Get_AlarmValue(&alarm);
    alarm.alarmww = currTime.week;
    alarm.alarmwh = currTime.hour;
    alarm.alarmwm = currTime.min + 5;
    R_Config_RTC_Set_AlarmValue(alarm);
    R_Config_RTC_Set_AlarmOn();
    /* End user code. Do not edit comment generated here */
}
```

#### 4.2.21 Watchdog Timer

Below is a list of API functions output by the Smart Configurator for watchdog timer use.

**Table 4-22 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_WDT}_Create</a>	Watchdog Timer	Executes initialization processing that is required before controlling the watchdog timer module.
<a href="#">R_{Config_WDT}_Restart</a>		Clears the counter in the watchdog timer, and then restarts counting by the counter.
<a href="#">R_{Config_WDT}_Create_UserInit</a>		Executes user-specific initialization processing for the watchdog timer.
<a href="#">r_{Config_WDT}_interrupt</a>		Executes processing in response to maskable WDT interrupt.

**R\_{Config\_WDT}\_Create**

This API function executes initialization processing that is required before controlling the watchdog timer module.

Remark This API function is called from [R\\_Systeminit](#) before the main() function is executed.

**[Syntax]**

```
void R_{Config_WDT}_Create(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_WDT}\_Restart**

This API function clears the counter in the watchdog timer, and then restarts counting by the counter.

**[Syntax]**

```
void R_{Config_WDT}_Restart(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_WDT}\_Create\_UserInit**

This API function executes user-specific initialization processing for the watchdog timer.

Remark This API functions is called from [R\\_{Config\\_WDT}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_WDT}_Create_UserInit(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_WDT}_interrupt`

This API function executes processing in response to maskable WDT interrupt.

**[Syntax]**

`void r_{Config_WDT}_interrupt(void);`

**[Argument(s)]**

None.

**[Return value]**

None.



## Usage example

This is an example for refreshing the counter value on every loop of the main function and issuing a software reset in response to an underflow of the counter:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"

int main(void);

int main(void)
{
    while (1U)
    {
        /* Restarts WDT module */
        R_Config_WDT_Restart();
    }

    return 0;
}
```

#### 4.2.22 Independent Watchdog Timer

Below is a list of API functions output by the Smart Configurator for independent watchdog timer use.

**Table 4-23 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_IWDT}_Create</a>	Watchdog Timer	Executes initialization processing that is required before controlling the watchdog timer module.
<a href="#">R_{Config_IWDT}_Restart</a>		Clears the counter in the watchdog timer, and then restarts counting by the counter.
<a href="#">R_{Config_IWDT}_Create_UserInit</a>		Executes user-specific initialization processing for the watchdog timer.
<a href="#">r_{Config_IWDT}_interrupt</a>		Executes processing in response to maskable IWDT interrupt.

**R\_{Config\_IWDT}\_Create**

This API function executes initialization processing that is required before controlling the watchdog timer module.

Remark This API function is called from [R\\_Systeminit](#) before the main() function is executed.

**[Syntax]**

```
void R_{Config_IWDT}_Create(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_IWDT}\_Restart**

This API function clears the counter in the watchdog timer, and then restarts counting by the counter.

**[Syntax]**

```
void R_{Config_IWDT}_Restart(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_IWDT}\_Create\_UserInit**

This API function executes user-specific initialization processing for the watchdog timer.

Remark This API functions is called from [R\\_{Config\\_IWDT}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_IWDT}_Create_UserInit(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_IWDT}_interrupt`

This API function executes processing in response to maskable IWDT interrupt.

**[Syntax]**

`void r_{Config_IWDT}_interrupt(void);`

**[Argument(s)]**

None.

**[Return value]**

None.

## Usage example

This is an example for refreshing the counter value on every loop of the main function and issuing a software reset in response to an underflow of the counter:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"

int main(void);

int main(void)
{
    while (1U)
    {
        /* Restarts WDT module */
        R_Config_IWDT_Restart();
    }

    return 0;
}
```

### 4.2.23 Simplified SPI Communication

Below is a list of API functions output by the Smart Configurator for Simplified SPI communication use.

**Table 4-24 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_SPIp}_Create</a>	Serial Array Unit	Executes initialization processing that is required before controlling the SPI $p$ module.
<a href="#">R_{Config_SPIp}_Start</a>		Starts the SPI $p$ module operation.
<a href="#">R_{Config_SPIp}_Stop</a>		Stops the SPI $p$ module operation.
<a href="#">R_{Config_SPIp}_Send</a>		Sends SPI $p$ data.
<a href="#">R_{Config_SPIp}_Receive</a>		Receives SPI $p$ data.
<a href="#">R_{Config_SPIp}_Send_Receive</a>		Sends and receives SPI $p$ data.
<a href="#">R_{Config_SPIp}_Create_UserInit</a>		Executes user-specific initialization processing for the SPI $p$ .
<a href="#">r_{Config_SPIp}_interrupt</a>		Executes processing in response to transfer end interrupt/buffer empty interrupt.
<a href="#">r_{Config_SPIp}_callback_sendend</a>		Executes processing in response to transmit end interrupt.
<a href="#">r_{Config_SPIp}_callback_receiveend</a>		Executes processing in response to receive end interrupt.
<a href="#">r_{Config_SPIp}_callback_error</a>		Executes processing in response to occur transfer error.



**R\_{Config\_SPIp}\_Create**

This API function executes initialization processing that is required before controlling the SPI $p$  module.

Remark1. This API function is called from [R\\_SAUm\\_Create](#).

Remark2. When  $m$  is 0,  $p$  is 00, 01, 10, 11; When  $m$  is 1,  $p$  is 20, 21.

**[Syntax]**

```
void R_{Config_SPIp}_Create(void);
```

Remark  $p$  is 00, 01, 10, 11, 20, 21.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_SPI*p*}\_Start**

This API function starts the SPI*p* module operation.

**[Syntax]**

```
void R_{Config_SPIp}_Start(void);
```

Remark *p* is 00, 01, 10, 11, 20, 21.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_SPI*p*}\_Stop**

This API function stops the SPI*p* module operation.

**[Syntax]**

```
void R_{Config_SPIp}_Stop(void);
```

Remark *p* is 00, 01, 10, 11, 20, 21.

**[Argument(s)]**

None.

**[Return value]**

None.

### R\_{Config\_SPIp}\_Send

This API function sends SPI $p$  data.

#### [Syntax]

```
MD_STATUS R_{Config_SPIp}_Send(uint8_t * const tx_buf, uint16_t tx_num);
```

Remark  $p$  is 00, 01, 10, 11, 20, 21.

#### [Argument(s)]

I/O	Argument(s)	Description
I	uint8_t * const tx_buf;	Transfer buffer pointer
I	uint16_t tx_num;	Buffer size

#### [Return value]

Macro	Description
MD_OK	Normal end
MD_ARGERROR	Error argument input error.

### R\_{Config\_SPIp}\_Receive

This API function receives SPIp data.

#### [Syntax]

```
MD_STATUS R_{Config_SPIp}_Receive(uint8_t * const rx_buf, uint16_t rx_num);
```

Remark  $p$  is 00, 01, 10, 11, 20, 21.

#### [Argument(s)]

I/O	Argument(s)	Description
O	uint8_t * const rx_buf;	Receive buffer pointer
I	uint16_t rx_num;	Buffer size

#### [Return value]

Macro	Description
MD_OK	Normal end
MD_ARGERROR	Error argument input error.

R_{Config_SPI <i>p</i> }_Send_Receive
---------------------------------------

Sends and receives SPI*p* data.

## [Syntax]

MD_STATUS	R_{Config_SPI <i>p</i> }_Send_Receive(uint8_t * const tx_buf, uint16_t tx_num, uint8_t * const rx_buf);
-----------	---

Remark *p* is 00, 01, 10, 11, 20, 21.

## [Argument(s)]

I/O	Argument(s)	Description
I	uint8_t * const tx_buf;	Transfer buffer pointer
O	uint8_t * const rx_buf;	Receive buffer pointer
I	uint16_t tx_num;	Buffer size

## [Return value]

Macro	Description
MD_OK	Normal end
MD_ARGERROR	Error argument input error.

**R\_{Config\_SPI

}\_Create\_UserInit**

This API function executes user-specific initialization processing for the SPI

.

Remark This API functions is called from [R\\_{Config\\_SPI

}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_SPI

}_Create_UserInit(void);


```

Remark *p* is 00, 01, 10, 11, 20, 21.

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_SPI

}_interrupt`

This API function executes processing in response to transfer end interrupt/buffer empty interrupt.

**[Syntax]**

`void r_{Config_SPI

}_interrupt(void);`

Remark  $p$  is 00, 01, 10, 11, 20, 21.

**[Argument(s)]**

None.

**[Return value]**

None.



**r\_{Config\_SPI*p*}\_callback\_sendend**

This API function executes processing in response to transmit end interrupt.

Remark 1. This API function is called as the callback routine of interrupt process [r\\_{Config\\_SPI\*p\*}\\_interrupt](#) corresponding to the SPI*p* interrupt.

Remark 2. User should only keep necessary flag set/clear in callback function, other processing code should be moved out of callback and interrupt function. Otherwise, the interrupt is not processed at the correct timing.

**[Syntax]**

```
static void r_{Config_SPIp}_callback_sendend(void);
```

Remark *p* is 00, 01, 10, 11, 20, 21.

**[Argument(s)]**

None.

**[Return value]**

None.

<code>r_{Config_SPI<p>}_callback_receiveend</p></code>
--

This API function executes processing in response to receive end interrupt.

Remark 1. This API function is called as the callback routine of interrupt process `r_{Config_SPI

}_interrupt` corresponding to the SPI

interrupt.

Remark 2. User should only keep necessary flag set/clear in callback function, other processing code should be moved out of callback and interrupt function. Otherwise, the interrupt is not processed at the correct timing.

#### [Syntax]

<code>static void r_{Config_SPI<p>}_callback_receiveend(void);</p></code>
---

Remark `p` is 00, 01, 10, 11, 20, 21.

#### [Argument(s)]

None.

#### [Return value]

None.

<code>r_{Config_SPIp}_callback_error</code>
---

This API function executes processing in response to occur transfer error.

Remark 1. This API function is called as the callback routine of interrupt process `r_{Config_SPIp}_interrupt` corresponding to the SPI $p$  interrupt.

Remark 2. User should only keep necessary flag set/clear in callback function, other processing code should be moved out of callback and interrupt function. Otherwise, the interrupt is not processed at the correct timing.

## [Syntax]

<code>static void r_{Config_SPIp}_callback_error(uint8_t err_type);</code>
--

Remark  $p$  is 00, 01, 10, 11, 20, 21.

## [Argument(s)]

I/O	Argument(s)	Description
I	uint8_t err_type;	Error type value Bit0: Overrun error

## [Return value]

None.

## Usage example

This is an example for SPI00 send data and SPI11 receive these data in continuous mode:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"

uint8_t tx_buf[6] = {0xA5,0x3F,0xC0,0x5C,0xB6,0x37};
uint8_t rx_buf[6] = {0x00,0x00,0x00,0x00,0x00,0x00};
volatile uint8_t transmitend_flag = 0U;
volatile uint8_t receiveend_flag = 0U;

int main(void);

int main(void)
{
    R_Config_SPI11_Start();
    R_Config_SPI00_Start();
    R_Config_SPI11_Receive(rx_buf, sizeof(rx_buf));
    R_Config_SPI00_Send(tx_buf, sizeof(tx_buf));
    while(transmitend_flag != 1U);
    transmitend_flag = 0U;
    while(receiveend_flag != 1U);
    receiveend_flag = 0U;
    R_Config_SPI00_Stop();
    R_Config_SPI11_Stop();

    return 0;
}
```

Config\_SPI00\_user.c

```
/* Start user code for global. Do not edit comment generated here */
extern volatile uint8_t transmitend_flag;
/* End user code. Do not edit comment generated here */

static void r_Config_SPI00_callback_sendend(void)
{
    /* Start user code for r_Config_SPI00_callback_sendend. Do not edit comment generated here */
    transmitend_flag = 1U;
    /* End user code. Do not edit comment generated here */
}
```

Config\_SPI11\_user.c

```
/* Start user code for global. Do not edit comment generated here */
extern volatile uint8_t receiveend_flag;
/* End user code. Do not edit comment generated here */

static void r_Config_SPI11_callback_receiveend (void)
{
    /* Start user code for r_Config_SPI11_callback_receiveend. Do not edit comment generated here */
    receiveend_flag = 1U;
    /* End user code. Do not edit comment generated here */
}
```

#### 4.2.24 UART Communication (Serial array unit)

Below is a list of API functions output by the Smart Configurator for UART Communication use.

**Table 4-25 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_UARTq}_Create</a>	Serial Array Unit	Executes initialization processing that is required before controlling the UART $q$ module.
<a href="#">R_{Config_UARTq}_Start</a>		Starts UART $q$ module operation.
<a href="#">R_{Config_UARTq}_Stop</a>		Stops UART $q$ module operation.
<a href="#">R_{Config_UARTq}_Send</a>		Sends UART $q$ data.
<a href="#">R_{Config_UARTq}_Receive</a>		Receives UART $q$ data.
<a href="#">R_{Config_UARTq}_Loopback_Enable</a>		Enables the UART $q$ loopback function.
<a href="#">R_{Config_UARTq}_Loopback_Disable</a>		Disables the UART $q$ loopback function.
<a href="#">R_{Config_UARTq}_Create_UserInit</a>		Executes user-specific initialization processing for the UART $q$ .
<a href="#">r_{Config_UARTq}_interrupt_send</a>		Executes processing in response to UART $q$ transmit end interrupt (in single-transfer mode) or buffer empty interrupt (in continuous transfer mode).
<a href="#">r_{Config_UARTq}_interrupt_receive</a>		Executes processing in response to UART $q$ receive end interrupt.
<a href="#">r_{Config_UARTq}_interrupt_error</a>		Executes processing in response to UART $q$ error interrupt.
<a href="#">r_{Config_UARTq}_callback_sendend</a>		Executes processing in response to transmit end interrupt.
<a href="#">r_{Config_UARTq}_callback_receiveend</a>		Executes processing in response to receive end interrupt.
<a href="#">r_{Config_UARTq}_callback_error</a>		Executes processing in response to receive error interrupt.
<a href="#">r_{Config_UARTq}_callback_softwareoverrun</a>	Executes processing in response to receive an overflow data.	

**R\_{Config\_UART $q$ }\_Create**

This API function executes initialization processing that is required before controlling the UART $q$  module.

Remark1. This API function is called from [R\\_SAUm\\_Create](#).

Remark2. When  $m$  is 0,  $q$  is 0, 1; When  $m$  is 1,  $q$  is 2, 3.

**[Syntax]**

```
void R_{Config_UART $q$ }_Create(void);
```

Remark  $q$  is 0, 1, 2.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_UART $q$ }\_Start**

This API function starts UART $q$  module operation.

**[Syntax]**

```
void R_{Config_UART $q$ }_Start(void);
```

Remark  $q$  is 0, 1, 2.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_UART $q$ }\_Stop**

This API function stops UART $q$  module operation.

**[Syntax]**

```
void R_{Config_UART $q$ }_Stop(void);
```

Remark  $q$  is 0, 1, 2.

**[Argument(s)]**

None.

**[Return value]**

None.



### R\_{Config\_UARTq}\_Send

This API function sends UART $q$  data.

#### [Syntax]

```
MD_STATUS R_{Config_UARTq}_Send(uint8_t * const tx_buf, uint16_t tx_num);
```

Remark  $q$  is 0, 1, 2.

#### [Argument(s)]

I/O	Argument(s)	Description
I	uint8_t * const tx_buf;	Transfer buffer pointer
I	uint16_t tx_num;	Buffer size

#### [Return value]

Macro	Description
MD_OK	Normal end (send the first data)
MD_ARGERROR	Error argument input error.

R_{Config_UARTq}_Receive
--------------------------

This API function receives UART $q$  data.

## [Syntax]

MD_STATUS	R_{Config_UARTq}_Receive(uint8_t * const rx_buf, uint16_t rx_num);
-----------	--

Remark  $q$  is 0, 1, 2.

## [Argument(s)]

I/O	Argument(s)	Description
O	uint8_t * const rx_buf;	Receive buffer pointer
I	uint16_t rx_num;	Buffer size

## [Return value]

Macro	Description
MD_OK	Normal end
MD_ARGERROR	Error argument input error.

`R_{Config_UARTq}_Loopback_Enable`

This API function enables the UART $q$  loopback function.

**[Syntax]**

```
void R_{Config_UARTq}_Loopback_Enable(void);
```

Remark  $q$  is 0, 1, 2.

**[Argument(s)]**

None.

**[Return value]**

None.

`R_{Config_UARTq}_Loopback_Disable`

This API function disables the UART $q$  loopback function.

**[Syntax]**

`void R_{Config_UARTq}_Loopback_Disable(void);`

Remark  $q$  is 0, 1, 2.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_UART $q$ }\_Create\_UserInit**

This API function executes user-specific initialization processing for the UART $q$ .

Remark This API functions is called from [R\\_{Config\\_UART \$q\$ }\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_UART $q$ }_Create_UserInit(void);
```

Remark  $q$  is 0, 1, 2.

**[Argument(s)]**

None.

**[Return value]**

None.

---

<code>r_{Config_UARTq}_interrupt_send</code>
--

This API function executes processing in response to UART $q$  transmit end interrupt (in single-transfer mode) or buffer empty interrupt (in continuous transfer mode).

**[Syntax]**

<code>void r_{Config_UARTq}_interrupt_send(void);</code>
--

Remark  $q$  is 0, 1, 2.

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_UARTq}_interrupt_receive`

This API function executes processing in response to UART $q$  receive end interrupt.

**[Syntax]**

`void r_{Config_UARTq}_interrupt_receive(void);`

Remark  $q$  is 0, 1, 2.

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_UARTq}_interrupt_error`

This API function executes processing in response to UART $q$  error interrupt.

**[Syntax]**

`void r_{Config_UARTq}_interrupt_error(void);`

Remark  $q$  is 0, 1, 2.

**[Argument(s)]**

None.

**[Return value]**

None.



**r\_{Config\_UARTq}\_callback\_sendend**

This API function executes processing in response to transmit end interrupt.

Remark 1. This API function is called as the callback routine of interrupt process

[r\\_{Config\\_UARTq}\\_interrupt\\_send](#) corresponding to the UART $q$  transmit end interrupt.

Remark 2. User should only keep necessary flag set/clear in callback function, other processing code should be moved out of callback and interrupt function. Otherwise, the interrupt is not processed at the correct timing.

**[Syntax]**

```
static void r_{Config_UARTq}_callback_sendend(void);
```

Remark  $q$  is 0, 1, 2.

**[Argument(s)]**

None.

**[Return value]**

None.

**r\_{Config\_UARTq}\_callback\_receiveend**

This API function executes processing in response to receive end interrupt.

Remark 1. This API function is called as the callback routine of interrupt process

[r\\_{Config\\_UARTq}\\_interrupt\\_receive](#) corresponding to the UART $q$  receive end interrupt.

Remark 2. User should only keep necessary flag set/clear in callback function, other processing code should be moved out of callback and interrupt function. Otherwise, the interrupt is not processed at the correct timing.

**[Syntax]**

```
static void r_{Config_UARTq}_callback_receiveend(void);
```

Remark  $q$  is 0, 1, 2.

**[Argument(s)]**

None.

**[Return value]**

None.

### `r_{Config_UARTq}_callback_error`

This API function executes processing in response to receive error interrupt.

Remark 1. This API function is called as the callback routine of interrupt process `r_{Config_UARTq}_interrupt_error` corresponding to the UART $q$  receive error interrupt.

Remark 2. User should only keep necessary flag set/clear in callback function, other processing code should be moved out of callback and interrupt function. Otherwise, the interrupt is not processed at the correct timing.

#### [Syntax]

```
static void r_{Config_UARTq}_callback_error(uint8_t err_type);
```

Remark  $q$  is 0, 1, 2.

#### [Argument(s)]

I/O	Argument(s)	Description
I	uint8_t err_type;	Error type info Bit0: Overrun error Bit1: Parity error Bit2: Framing error Bit3 to Bit7: 0

#### [Return value]

None.

<code>r_{Config_UARTq}_callback_softwareoverrun</code>
--

This API function executes processing in response to receive an overflow data.

Remark 1. This API function is called as the callback routine of interrupt process

[r\\_{Config\\_UARTq}\\_interrupt\\_receive](#) corresponding to the UARTq receive end interrupt.

Remark 2. User should only keep necessary flag set/clear in callback function, other processing code should be moved out of callback and interrupt function. Otherwise, the interrupt is not processed at the correct timing.

## [Syntax]

<code>static void r_{Config_UARTq}_callback_softwareoverrun(uint16_t rx_data);</code>
---

Remark `q` is 0, 1, 2.

## [Argument(s)]

I/O	Argument(s)	Description
I	<code>uint16_t rx_data;</code>	Receive data

## [Return value]

None.

## Usage example

This is an example for UART0 send data and UART1 receive these data:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"

uint8_t tx_buf[6] = {0xA5,0x3F,0xC0,0x5C,0xB6,0x37};
uint8_t rx_buf[6] = {0x00,0x00,0x00,0x00,0x00,0x00};
volatile uint8_t transmitend_flag = 0U;
volatile uint8_t receiveend_flag = 0U;

int main(void);

int main(void)
{
    R_Config_UART0_Start();
    R_Config_UART1_Start();
    R_Config_UART1_Receive(rx_buf, 6);
    R_Config_UART0_Send(tx_buf, 6);
    while(transmitend_flag != 1U && receiveend_flag != 1U);
    transmitend_flag = 0U;
    receiveend_flag = 0U;
    R_Config_UART0_Stop();
    R_Config_UART1_Stop();
}
```

Config\_UART0\_user.c

```
/* Start user code for global. Do not edit comment generated here */
extern volatile uint8_t transmitend_flag;
/* End user code. Do not edit comment generated here */

static void r_Config_UART0_callback_sendend(void)
{
    /* Start user code for r_Config_UART0_callback_sendend. Do not edit comment generated here */
    transmitend_flag = 1U;
    /* End user code. Do not edit comment generated here */
}
```

Config\_UART1\_user.c

```
/* Start user code for global. Do not edit comment generated here */
extern volatile uint8_t receiveend_flag;
/* End user code. Do not edit comment generated here */

static void r_Config_UART1_callback_receiveend (void)
{
    /* Start user code for r_Config_UART1_callback_receiveend. Do not edit comment generated here
    */
    receiveend_flag = 1U;
    /* End user code. Do not edit comment generated here */
}
```

#### 4.2.25 Simplified I2C Communication (Master mode) (Serial Array Unit)

Below is a list of API functions output by the Smart Configurator for simplified I2C communication (master mode) (serial array unit) use.

**Table 4-26 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_IICr}_Create</a>	Serial Array Unit	Executes initialization processing that is required before controlling the IICr master module.
<a href="#">R_{Config_IICr}_StartCondition</a>		Issues a start condition.
<a href="#">R_{Config_IICr}_StopCondition</a>		Issues a stop condition.
<a href="#">R_{Config_IICr}_Stop</a>		Stops the IICr module.
<a href="#">R_{Config_IICr}_Master_Send</a>		Starts transferring data for IICr in master mode.
<a href="#">R_{Config_IICr}_Master_Receive</a>		Starts receiving data for IICr in master mode.
<a href="#">R_{Config_IICr}_Create_UserInit</a>		Executes user-specific initialization processing for the IICr.
<a href="#">r_{Config_IICr}_interrupt</a>		Executes processing in response to IICr transfer end interrupt.
<a href="#">r_{Config_IICr}_callback_master_sendend</a>		Executes processing in response to master transmit end interrupt.
<a href="#">r_{Config_IICr}_callback_master_receiveend</a>		Executes processing in response to master receive completed interrupt.
<a href="#">r_{Config_IICr}_callback_master_error</a>		Executes processing in response to the detection of an overrun or NACK error.

**R\_{Config\_IICr}\_Create**

This API function executes initialization processing that is required before controlling the IICr master module.

Remark1. This API function is called from [R\\_SAUm\\_Create](#).

Remark2. When *m* is 0, *r* is 00, 01, 10, 11; When *m* is 1, *r* is 20, 21.

**[Syntax]**

```
void R_{Config_IICr}_Create(void);
```

Remark *r* is 00, 01, 10, 11, 20, 21.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_IICr}\_StartCondition**

This API function issues a start condition.

Remark This API function is used as an internal function of [R\\_{Config\\_IICr}\\_Master\\_Send](#) and [R\\_{Config\\_IICr}\\_Master\\_Receive](#) . For this reason, there is normally no need to call it from a user program.

**[Syntax]**

```
void R_{Config_IICr}_StartCondition(void);
```

Remark *r* is 00, 01, 10, 11, 20, 21.

**[Argument(s)]**

None.

**[Return value]**

None.



**R\_{Config\_IICr}\_StopCondition**

This API function issues a stop condition.

**[Syntax]**

```
void R_{Config_IICr}_StopCondition(void);
```

Remark *nm* is 00, 01, 10, 11, 20, 21.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_IICr}\_Stop**

This API function stops the IICr module.

**[Syntax]**

```
void R_{Config_IICr}_Stop(void);
```

Remark *r* is 00, 01, 10, 11, 20, 21.

**[Argument(s)]**

None.

**[Return value]**

None.

### R\_{Config\_IICr}\_Master\_Send

This API function starts transferring data for IICr in master mode.

Remark 1. This API function repeats the byte-level simple IIC master transmission from the buffer specified in argument *tx\_buf* the number of times specified in argument *tx\_num*.

Remark 2. Before calling this API, please check that communication is stopped/suspended and SDA/SCL are High level.

#### [Syntax]

```
void R_{Config_IICr}_Master_Send(uint8_t adr, uint8_t * const tx_buf, uint16_t tx_num);
```

Remark *r* is 00, 01, 10, 11, 20, 21.

#### [Argument(s)]

I/O	Argument(s)	Description
I	uint8_t adr;	Set address for select slave
I	uint8_t * const tx_buf;	Pointer to a buffer storing the transmission data
I	uint16_t tx_num;	Total amount of data to send

#### [Return value]

None.

### R\_{Config\_IICr}\_Master\_Receive

This API function starts receiving data for IICr in master mode.

Remark 1. This API function performs byte-level simple IIC master reception the number of times specified by the argument *rx\_num*, and stores the data in the buffer specified by the argument *rx\_buf*.

Remark 2. Before calling this API, please check that communication is stopped/suspended and SDA/SCL are High level.

#### [Syntax]

```
void R_{Config_IICr}_Master_Receive(uint8_t adr, uint8_t * const rx_buf, uint16_t rx_num);
```

Remark *r* is 00, 01, 10, 11, 20, 21.

#### [Argument(s)]

I/O	Argument(s)	Description
I	uint8_t adr;	Set address for select slave
O	uint8_t * const rx_buf;	Pointer to a buffer to store the received data
O	uint16_t rx_num;	Total amount of data to receive

#### [Return value]

None.

**R\_{Config\_IICr}\_Create\_UserInit**

This API function executes user-specific initialization processing for the IICr.

Remark This API functions is called from [R\\_{Config\\_IICr}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_IICr}_Create_UserInit(void);
```

Remark *r* is 00, 01, 10, 11, 20, 21.

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_IICr}_interrupt`

This API function executes processing in response to IICr transfer end interrupt.

**[Syntax]**

`void r_{Config_IICr}_interrupt(void);`

Remark *r* is 00, 01, 10, 11, 20, 21.

**[Argument(s)]**

None.

**[Return value]**

None.

**r\_{Config\_IICr}\_callback\_master\_sendend**

This API function executes processing in response to master transmit end interrupt.

Remark 1. This API function is called as the callback routine of interrupt process [r\\_{Config\\_IICr}\\_interrupt](#) corresponding to the IICr master transmit end interrupt.

Remark 2. Please take note to keep necessary flag set/clear in callback function and move other processing code out of callback and interrupt function. Otherwise, the next interrupt won't be processed at the correct timing.

**[Syntax]**

```
static void r_{Config_IICr}_callback_master_sendend(void);
```

Remark *r* is 00, 01, 10, 11, 20, 21.

**[Argument(s)]**

None.

**[Return value]**

None.

**r\_{Config\_IICr}\_callback\_master\_receiveend**

This API function executes processing in response to master receive completed interrupt.

Remark 1. This API function is called as the callback routine of interrupt process [r\\_{Config\\_IICr}\\_interrupt](#) corresponding to the IICr master receive completed interrupt.

Remark 2. Please take note to keep necessary flag set/clear in callback function and move other processing code out of callback and interrupt function. Otherwise, the next interrupt won't be processed at the correct timing.

**[Syntax]**

```
static void r_{Config_IICr}_callback_master_receiveend(void);
```

Remark *r* is 00, 01, 10, 11, 20, 21.

**[Argument(s)]**

None.

**[Return value]**

None.



r\_{Config\_IICr}\_callback\_master\_error

This API function executes processing in response to the detection of an overrun or NACK error.

Remark 1. This API function is called as the callback routine of interrupt process [r\\_{Config\\_IICr}\\_interrupt](#) corresponding to the IICr transmit error.

Remark 2. Please take note to keep necessary flag set/clear in callback function and move other processing code out of callback and interrupt function. Otherwise, the next interrupt won't be processed at the correct timing.

[Syntax]

```
static void r_{Config_IICr}_callback_error(MD_STATUS flag);
```

Remark r is 00, 01, 10, 11, 20, 21.

[Argument(s)]

I/O	Argument(s)	Description
I	MD_STATUS flag;	Error type: MD_NACK: Detection of NACK error MD_OVERRUN: Detection of overrun error

[Return value]

None.

## Usage example

This is an example for IIC0 master communication with IICA0 slave (including IIC0 master send, and master receive mode):

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"

uint8_t tx_buf[6] = {0xA5,0x3F,0xC0,0x5C,0xB6,0x37};
uint8_t rx_buf1[6] = {0x00,0x00,0x00,0x00,0x00,0x00};
uint8_t rx_buf2[6] = {0x00,0x00,0x00,0x00,0x00,0x00};
volatile uint8_t transmitend_flag = 0U;
volatile uint8_t receiveend_flag = 0U;

int main(void);

int main(void)
{
    R_Config_IIC00_StartCondition();

    R_Config_IIC00_Master_Receive(0x24,rx_buf1,sizeof(rx1_buf));
    R_Config_IICA1_Slave_Send(tx_buf,sizeof(tx_buf));

    while(receiveend_flag != 1);
    transmitend = 0;
    receiveend = 0;

    R_Config_IIC00_StopCondition();
    R_Config_IIC00_StartCondition();

    R_Config_IICA1_Slave_Receive(rx_buf2, sizeof(rx_buf2));
    R_Config_IIC00_Master_Send(0x24, tx_buf,sizeof(tx_buf));

    while(receiveend_flag != 1);
    transmitend_flag = 0;
    receiveend_flag = 0;

    R_Config_IIC00_StopCondition();
    R_Config_IIC00_Stop();
    R_Config_IICA0_Stop();

    return 0;
}
```

## Config\_IIC00\_user.c

```
/* Start user code for global. Do not edit comment generated here */
extern volatile uint8_t transmitend_flag;
extern uint8_t receiveend_flag
/* End user code. Do not edit comment generated here */

static void r_Config_IIC00_callback_master_sendend (void)
{
    /* Start user code for r_Config_IIC00_callback_master_sendend. Do not edit comment
generated here */
    transmitend_flag = 1U;
    /* End user code. Do not edit comment generated here */
}

static void r_Config_IIC00_callback_master_receiveend (void)
{
    /* Start user code for r_Config_IIC00_callback_master_receiveend. Do not edit comment
generated here */
    receiveend_flag = 1U;
    /* End user code. Do not edit comment generated here */
}
```

## Config\_IICA0\_user.c

```
/* Start user code for global. Do not edit comment generated here */
extern volatile uint8_t transmitend_flag;
extern uint8_t receiveend_flag;
/* End user code. Do not edit comment generated here */

static void r_Config_IICA0_callback_slave_sendend(void)
{
    /* Start user code for r_Config_IICA0_callback_slave_sendend. Do not edit comment generated
here */
    transmitend_flag = 1U
    /* End user code. Do not edit comment generated here */
}

static void r_Config_IICA0_callback_slave_receiveend(void)
{
    /* Start user code for r_Config_IICA0_callback_slave_receiveend. Do not edit comment
generated here */
    receiveend_flag = 1U;
    /* End user code. Do not edit comment generated here */
}
```

#### 4.2.26 I2C Bus Interface Communication (Master mode)

Below is a list of API functions output by the Smart Configurator for I2C bus interface communication (master mode) use.

**Table 4-27 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_IICAn}_Create</a>	Serial Interface IICA	Executes initialization processing that is required before controlling the IICAn master module.
<a href="#">R_{Config_IICAn}_StopCondition</a>		Issues a stop condition.
<a href="#">R_{Config_IICAn}_Stop</a>		Stops the IICAn master operation.
<a href="#">R_{Config_IICAn}_Master_Send</a>		Starts transferring data in master mode.
<a href="#">R_{Config_IICAn}_Master_Receive</a>		Starts receiving data in master mode.
<a href="#">R_{Config_IICAn}_Create_UserInit</a>		Executes user-specific initialization processing for the IICAn.
<a href="#">r_{Config_IICAn}_interrupt</a>		Executes processing in response to end of IICAn communication interrupt.
<a href="#">r_{Config_IICAn}_master_handler</a>		Controls IICAn data transmission / reception / error in master mode.
<a href="#">r_{Config_IICAn}_callback_master_sendend</a>		Executes processing in response to master transmit end.
<a href="#">r_{Config_IICAn}_callback_master_receiveend</a>		Executes processing in response to master receive completed.
<a href="#">r_{Config_IICAn}_callback_master_error</a>		Executes processing in response to the detection of a bus busy or NACK error.

**R\_{Config\_IICAn}\_Create**

This API function executes initialization processing that is required before controlling the IICAn master module.

Remark This API function is called from [R\\_Systeminit](#) before the main() function is executed.

**[Syntax]**

```
void R_{Config_IICAn}_Create(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

`R_{Config_IICAn}_StopCondition`

This API function issues a stop condition.

**[Syntax]**

```
void R_{Config_IICAn}_StopCondition(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_IICAn}\_Stop**

This API function stops the IICAn master operation.

**[Syntax]**

```
void R_{Config_IICAn}_Stop(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

### R\_{Config\_IICAn}\_Master\_Send

This API function starts transferring data in master mode.

#### [Syntax]

```
void R_{Config_IICAn}_Master_Send(uint8_t adr, uint8_t * const tx_buf, uint16_t tx_num,
uint8_t wait);
```

Remark  $n$  is the channel number.

#### [Argument(s)]

I/O	Argument(s)	Description
I	uint8_t adr;	Transfer address
I	uint8_t * const tx_buf;	Pointer to the buffer where the data to be transmitted are stored
I	uint16_t tx_num;	Number of bytes to be transmitted
I	uint8_t wait;	Wait for start condition

#### [Return value]

Macro	Description
MD_OK	Normal end
MD_ERROR1	The bus is busy.
MD_ERROR2	The specification of argument <i>adr</i> is invalid.



### R\_{Config\_IICAn}\_Master\_Receive

This API function starts receiving data in master mode.

#### [Syntax]

```
void R_{Config_IICAn}_Master_Receive(uint8_t adr, uint8_t * const rx_buf, uint16_t rx_num,
uint8_t wait);
```

Remark *n* is the channel number.

#### [Argument(s)]

I/O	Argument(s)	Description
I	uint8_t adr;	Receive address
O	uint8_t * const rx_buf;	Pointer to the buffer where the received data are to be stored
O	uint16_t rx_num;	Number of bytes to be received
	uint8_t wait	Wait for start condition

#### [Return value]

Macro	Description
MD_OK	Normal end
MD_ERROR1	The bus is busy.
MD_ERROR2	The specification of argument <i>adr</i> is invalid.

**R\_{Config\_IICAn}\_Create\_UserInit**

This API function executes user-specific initialization processing for the IICAn.

Remark This API functions is called from [R\\_{Config\\_IICAn}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_IICAn}_Create_UserInit(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_IICAn}_interrupt`

This API function executes processing in response to end of IICA0 communication interrupt.

**[Syntax]**

`void r_{Config_IICAn}_interrupt(void);`

Remark  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_IICAn}_master_handler`

This API function controls IICAn data transmission / reception / error in master mode.

Remark This API function is called as the callback routine of interrupt process `r_{Config_IICAn}_interrupt` corresponding to the IICAn interrupt.

**[Syntax]**

`void R_{Config_IICAn}_master_handler(void);`

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**r\_{Config\_IICAn}\_callback\_master\_sendend**

This API function executes processing in response to master transmit end.

Remark 1. This API function is called as the callback routine of interrupt process [R\\_{Config\\_IICAn}\\_master\\_handler](#).

Remark 2. Please take note to keep necessary flag set/clear in callback function and move other processing code out of callback and interrupt function. Otherwise, the next interrupt won't be processed at the correct timing.

**[Syntax]**

```
static void r_{Config_IICAn}_callback_master_sendend(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**r\_{Config\_IICAn}\_callback\_master\_receiveend**

This API function executes processing in response to master receive completed.

Remark 1. This API function is called as the callback routine of interrupt process [R\\_{Config\\_IICAn}\\_master\\_handler](#).

Remark 2. Please take note to keep necessary flag set/clear in callback function and move other processing code out of callback and interrupt function. Otherwise, the next interrupt won't be processed at the correct timing.

**[Syntax]**

```
static void r_{Config_IICAn}_callback_master_receiveend(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

### `r_{Config_IICAn}_callback_master_error`

This API function executes processing in response to the detection of a bus busy or NACK error.

Remark 1. This API function is called as the callback routine of interrupt process

[R\\_{Config\\_IICAn}\\_master\\_handler](#).

Remark 2. Please take note to keep necessary flag set/clear in callback function and move other processing code out of callback and interrupt function. Otherwise, the next interrupt won't be processed at the correct timing.

#### [Syntax]

```
static void r_{Config_IICAn}_callback_master_error(MD_STATUS flag);
```

Remark *n* is the channel number.

#### [Argument(s)]

I/O	Argument(s)	Description
I	MD_STATUS flag;	Status flag MD_NACK: NACK error MD_SPT: BUS busy error

#### [Return value]

None.

## Usage example

This is an example for IICA0 master communication with IICA1 slave (including both send and receive mode):  
(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"

uint8_t tx_buf[6] = {0xA5,0x3F,0xC0,0x5C,0xB6,0x37};
uint8_t rx_buf1[6] = {0x00,0x00,0x00,0x00,0x00,0x00};
uint8_t rx_buf2[6] = {0x00,0x00,0x00,0x00,0x00,0x00};
volatile uint8_t transmitend_flag = 0U;
volatile uint8_t receiveend_flag = 0U;

int main(void);

int main(void)
{
    R_Config_IICA1_Slave_Receive(rx_buf1, sizeof(tx_buf));
    R_Config_IICA0_Master_Send(0x24, tx_buf, sizeof(tx_buf), 100);

    while(receiveend_flag != 1);
    transmitend_flag = 0;
    receiveend_flag = 0;

    R_Config_IICA0_Master_Receive(0x24, rx_buf2, sizeof(rx_buf2), 100);
    R_Config_IICA1_Slave_Send(tx_buf, sizeof(tx_buf));

    while(receiveend_flag != 1);
    transmitend_flag = 0;
    receiveend_flag = 0;

    R_Config_IICA0_Stop();
    R_Config_IICA1_Stop();

    return 0;
}
```



## Config\_IICA0\_user.c

```
/* Start user code for global. Do not edit comment generated here */
extern volatile uint8_t transmitend_flag;
extern volatile uint8_t receiveend_flag;
/* End user code. Do not edit comment generated here */

static void r_Config_IICA0_callback_master_sendend (void)
{
    SPT0 = 1U;
    /* Start user code for r_Config_IICA0_callback_master_sendend. Do not edit comment
generated here */
    transmitend_flag = 1U;
    /* End user code. Do not edit comment generated here */
}

static void r_Config_IICA0_callback_master_receiveend (void)
{
    SPT0 = 0U;
    /* Start user code for r_Config_IICA0_callback_master_receiveend. Do not edit comment
generated here */
    receiveend_flag = 1U;
    /* End user code. Do not edit comment generated here */
}
```

## Config\_IICA1\_user.c

```
/* Start user code for global. Do not edit comment generated here */
extern volatile uint8_t transmitend_flag;
extern volatile uint8_t receiveend_flag;
/* End user code. Do not edit comment generated here */

static void r_Config_IICA1_callback_slave_sendend(void)
{
    /* Start user code for r_Config_IICA1_callback_slave_sendend. Do not edit comment generated
here */
    transmitend_flag = 1U
    /* End user code. Do not edit comment generated here */
}

static void r_Config_IICA1_callback_slave_receiveend(void)
{
    /* Start user code for r_Config_IICA1_callback_slave_receiveend. Do not edit comment
generated here */
    receiveend_flag = 1U;
    /* End user code. Do not edit comment generated here */
}
```

#### 4.2.27 I2C Bus Interface Communication (Slave mode)

Below is a list of API functions output by the Smart Configurator for I2C bus interface communication (slave mode) use.

**Table 4-28 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_IICAn}_Create</a>	Serial Interface IICA	Executes initialization processing that is required before controlling the IICAn slave module.
<a href="#">R_{Config_IICAn}_Stop</a>		Stops IICAn slave operation.
<a href="#">R_{Config_IICAn}_Slave_Send</a>		Starts transferring data in slave mode.
<a href="#">R_{Config_IICAn}_Slave_Receive</a>		Starts receiving data in slave mode.
<a href="#">R_{Config_IICAn}_Set_WakeupOn</a>		Enables operation of address match wakeup function in STOP mode.
<a href="#">R_{Config_IICAn}_Set_WakeupOff</a>		Disables operation of address match wakeup function in STOP mode.
<a href="#">R_{Config_IICAn}_Create_UserInit</a>		Executes user-specific initialization processing for the IICAn.
<a href="#">r_{Config_IICAn}_interrupt</a>		Executes processing in response to end of IICA0 communication interrupt.
<a href="#">r_{Config_IICAn}_slave_handler</a>		Controls IICAn data transmission / reception / error in slave mode.
<a href="#">r_{Config_IICAn}_callback_slave_sendend</a>		Executes processing in response to slave transmit end.
<a href="#">r_{Config_IICAn}_callback_slave_receiveend</a>		Executes processing in response to slave receive completed.
<a href="#">r_{Config_IICAn}_callback_slave_error</a>		Executes processing in response to the detection of an addresses not match or NACK error.
<a href="#">r_{Config_IICAn}_callback_getstopcondition</a>		Executes processing in response to IICAn get a slave stop condition.

**R\_{Config\_IICAn}\_Create**

This API function executes initialization processing that is required before controlling the IICAn slave module.

Remark This API function is called from [R\\_Systeminit](#) before the main() function is executed.

**[Syntax]**

```
void R_{Config_IICAn}_Create(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_IICAn}\_Stop**

This API function stops IICAn slave operation.

**[Syntax]**

```
void R_{Config_IICAn}_Stop(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

### R\_{Config\_IICAn}\_Slave\_Send

This API function starts transferring data in slave mode.

**Remark** For the case of the master restarts without issuing a stop condition when communication is completed, be careful to take note to call the corresponding slave function on slave device. For example, on master device, [R\\_{Config\\_IICAn}\\_Master\\_Receive](#) function is called to restart communication, while [R\\_{Config\\_IICAn}\\_Slave\\_Send](#) function is called on slave device. In other words, Master and Slave API should be called in pair, otherwise, the IICA operation is not guaranteed.

#### [Syntax]

```
void R_{Config_IICAn}_Slave_Send(uint8_t * const tx_buf, uint16_t tx_num);
```

**Remark**  $n$  is the channel number.

#### [Argument(s)]

I/O	Argument(s)	Description
I	uint8_t * const tx_buf;	Pointer to the buffer where the data to be transmitted are stored
I	uint16_t tx_num;	Number of bytes to be transmitted

#### [Return value]

None.

### R\_{Config\_IICAn}\_Slave\_Receive

This API function starts receiving data in slave mode.

**Remark** For the case of the master restarts without issuing a stop condition when communication is completed, be careful to take note to call the corresponding slave function on slave device. For example, on master device, [R\\_{Config\\_IICAn}\\_Master\\_Send](#) function is called to restart communication, while [R\\_{Config\\_IICAn}\\_Slave\\_Receive](#) function is called on slave device. In other words, Master and Slave API should be called in pair, otherwise, the IICA operation is not guaranteed.

#### [Syntax]

```
void R_{Config_IICAn}_Slave_Receive(uint8_t * const rx_buf, uint16_t rx_num);
```

**Remark**  $n$  is the channel number.

#### [Argument(s)]

I/O	Argument(s)	Description
O	uint8_t * const rx_buf;	Pointer to the buffer where the received data are to be stored
O	uint16_t rx_num;	Number of bytes to be received

#### [Return value]

None.

**R\_{Config\_IICAn}\_Set\_WakeupOn**

This API function enables operation of address match wakeup function in STOP mode.

**[Syntax]**

```
void R_{Config_IICAn}_Set_WakeupOn(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_IICAn}\_Set\_WakeupOff**

This API function disables operation of address match wakeup function in STOP mode.

**[Syntax]**

```
void R_{Config_IICAn}_Set_WakeupOff(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.



**R\_{Config\_IICAn}\_Create\_UserInit**

This API function executes user-specific initialization processing for the IICAn.

Remark This API functions is called from [R\\_{Config\\_IICAn}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_IICAn}_Create_UserInit(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_IICAn}_interrupt`

This API function executes processing in response to end of IICA0 communication interrupt.

**[Syntax]**

`void r_{Config_IICAn}_interrupt(void);`

Remark  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**r\_{Config\_IICAn}\_slave\_handler**

This API function controls IICAn data transmission / reception / error in slave mode.

Remark 1. This API function is called as the callback routine of interrupt process [r\\_{Config\\_IICAn}\\_interrupt](#) corresponding to the IICAn interrupt.

Remark 2. Smart Configurator use "g\_iican\_slave\_status\_flag" to control user program flow. The initialization of "g\_iica0\_slave\_status\_flag" is in [R\\_{Config\\_IICAn}\\_Slave\\_Send](#) function and [R\\_{Config\\_IICAn}\\_Slave\\_Receive](#) function.

**[Syntax]**

```
void R_{Config_IICAn}_slave_handler(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**r\_{Config\_IICAn}\_callback\_slave\_sendend**

This API function executes processing in response to slave transmit end.

Remark 1. This API function is called as the callback routine of interrupt process [R\\_{Config\\_IICAn}\\_slave\\_handler](#).

Remark 2. Please take note to keep necessary flag set/clear in callback function and move other processing code out of callback and interrupt function. Otherwise, the next interrupt won't be processed at the correct timing.

**[Syntax]**

```
static void r_{Config_IICAn}_callback_slave_sendend(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_IICAn}_callback_slave_receiveend`

This API function executes processing in response to slave receive completed.

Remark 1. This API function is called as the callback routine of interrupt process [R\\_{Config\\_IICAn}\\_slave\\_handler](#).

Remark 2. Please take note to keep necessary flag set/clear in callback function and move other processing code out of callback and interrupt function. Otherwise, the next interrupt won't be processed at the correct timing.

#### [Syntax]

```
static void r_{Config_IICAn}_callback_slave_receiveend(void);
```

Remark *n* is the channel number.

#### [Argument(s)]

None.

#### [Return value]

None.

### r\_{Config\_IICAn}\_callback\_slave\_error

This API function executes processing in response to the detection of an addresses not match or NACK error.

Remark 1. This API function is called as the callback routine of interrupt process

[R\\_{Config\\_IICAn}\\_slave\\_handler](#).

Remark 2. Please take note to keep necessary flag set/clear in callback function and move other processing code out of callback and interrupt function. Otherwise, the next interrupt won't be processed at the correct timing.

#### [Syntax]

```
static void r_{Config_IICAn}_callback_slave_error(MD_STATUS flag);
```

Remark  $n$  is the channel number.

#### [Argument(s)]

I/O	Argument(s)	Description
I	MD_STATUS flag;	Status flag MD_NACK: NACK error MD_ERROR: addresses not match error

#### [Return value]

None.

**r\_{Config\_IICAn}\_callback\_getstopcondition**

This API function executes processing in response to IICAn get a slave stop condition.

Remark 1. This API function is called as the callback routine of interrupt process [R\\_{Config\\_IICAn}\\_slave\\_handler](#).

Remark 2. Please take note to keep necessary flag set/clear in callback function and move other processing code out of callback and interrupt function. Otherwise, the next interrupt won't be processed at the correct timing.

**[Syntax]**

```
static void r_{Config_IICAn}_callback_getstopcondition(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

### Usage example

Refer to Serial Array Unit IIC master mode [Usage example](#).



#### 4.2.28 UART Communication (Serial Interface UARTA)

Below is a list of API functions output by the Smart Configurator for UART communication (for serial interface UARTA) use.

**Table 4-29 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_UARTAn}_Create</a>	Serial Interface UARTA	Executes initialization processing that is required before controlling the UARTAn module.
<a href="#">R_{Config_UARTAn}_Start</a>		Starts UARTAn module operation.
<a href="#">R_{Config_UARTAn}_Stop</a>		Stops UARTAn module operation.
<a href="#">R_{Config_UARTAn}_Send</a>		Sends UARTAn data.
<a href="#">R_{Config_UARTAn}_Receive</a>		Receives UARTAn data.
<a href="#">R_{Config_UARTAn}_Loopback_Enable</a>		Enables the UARTAn loopback function.
<a href="#">R_{Config_UARTAn}_Loopback_Disable</a>		Disables the UARTAn loopback function.
<a href="#">R_{Config_UARTAn}_Create_UserInit</a>		Executes user-specific initialization processing for the UARTAn.
<a href="#">R_{Config_UARTAn}_PollingEnd_UserCode</a>		Executes user code in response to completion of continuous transmission by polling.
<a href="#">r_{Config_UARTAn}_interrupt_send</a>		Executes processing in response to UARTAn transmission completion interrupt.
<a href="#">r_{Config_UARTAn}_interrupt_receive</a>		Executes processing in response to UARTAn reception transfer end interrupt.
<a href="#">r_{Config_UARTAn}_interrupt_error</a>		Executes processing in response to UARTAn reception communication error interrupt.
<a href="#">r_{Config_UARTAn}_callback_sendend</a>		Executes processing in response to UARTAn transmission completion interrupt.
<a href="#">r_{Config_UARTAn}_callback_receiveend</a>		Executes processing in response to UARTAn reception transfer end interrupt.
<a href="#">r_{Config_UARTAn}_callback_error</a>		Executes processing in response to UARTAn reception communication error interrupt.

**R\_{Config\_UARTAn}\_Create**

This API function executes initialization processing that is required before controlling the UARTAn module.

Remark This API function is called from [R\\_UARTA\\_Create](#).

**[Syntax]**

```
void R_{Config_UARTAn}_Create(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_UARTAn}\_Start**

This API function starts UARTAn module operation.

**[Syntax]**

```
void R_{Config_UARTAn}_Start(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_UARTAn}\_Stop**

This API function stops UARTAn module operation.

**[Syntax]**

```
void R_{Config_UARTAn}_Stop(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

R_{Config_UARTAn}_Send
------------------------

This API function sends UARTAn data.

## [Syntax]

MD_STATUS    R_{Config_UARTAn}_Send(uint8_t * const tx_buf, uint16_t tx_num);
---

Remark     *n* is the channel number.

## [Argument(s)]

I/O	Argument(s)	Description
I	uint8_t * const tx_buf;	Transfer buffer pointer
I	uint16_t tx_num;	Buffer size

## [Return value]

Macro	Description
MD_OK	Normal end (send the first data)
MD_ARGERROR	Error argument input error.

### R\_{Config\_UARTAn}\_Receive

This API function receives UARTAn data.

#### [Syntax]

```
MD_STATUS R_{Config_UARTAn}_Receive(uint8_t * const rx_buf, uint16_t rx_num);
```

Remark *n* is the channel number.

#### [Argument(s)]

I/O	Argument(s)	Description
O	uint8_t * const rx_buf;	Receive buffer pointer
I	uint16_t tx_num;	Buffer size

#### [Return value]

Macro	Description
MD_OK	Normal end
MD_ARGERROR	Error argument input error.

**R\_{Config\_UARTAn}\_Loopback\_Enable**

This API function enables the UARTAn loopback function.

**[Syntax]**

```
void R_{Config_UARTAn}_Loopback_Enable(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

`R_{Config_UARTAn}_Loopback_Disable`

This API function disables the UARTAn loopback function.

**[Syntax]**

```
void R_{Config_UARTAn}_Loopback_Disable(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.



**R\_{Config\_UARTAn}\_Create\_UserInit**

This API function executes user-specific initialization processing for the UARTAn.

Remark This API functions is called from [R\\_{Config\\_UARTAn}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_UARTAn}_Create_UserInit(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_UARTAn}\_PollingEnd\_UserCode**

This API function executes user code in response to completion of continuous transmission by polling.

Remark This API function is called from [R\\_{Config\\_UARTAn}\\_Send](#) corresponding to data transmission completion.

**[Syntax]**

```
void R_{Config_UARTAn}_PollingEnd_UserCode(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_UARTAn}_interrupt_send`

This API function executes processing in response to UARTAn transmission completion interrupt.

**[Syntax]**

`void r_{Config_UARTAn}_interrupt_send(void);`

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_UARTAn}_interrupt_receive`

This API function executes processing in response to UARTAn reception transfer end interrupt.

**[Syntax]**

`void r_{Config_UARTAn}_interrupt_receive(void);`

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_UARTAn}_interrupt_error`

This API function executes processing in response to UARTAn reception communication error interrupt.

**[Syntax]**

`void r_{Config_UARTAn}_interrupt_error(void);`

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**r\_{Config\_UARTAn}\_callback\_sendend**

This API function executes processing in response to UARTAn transmission completion interrupt.

Remark 1. This API function is called as the callback routine of interrupt process [r\\_{Config\\_UARTAn}\\_interrupt\\_send](#) corresponding to the UARTAn transmission completion interrupt.

Remark 2. User should only keep necessary flag set/clear in callback function, other processing code should be moved out of callback and interrupt function. Otherwise, the interrupt is not processed at the correct timing.

**[Syntax]**

```
static void r_{Config_UARTAn}_callback_sendend(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**r\_{Config\_UARTAn}\_callback\_receiveend**

This API function executes processing in response to UARTAn reception transfer end interrupt.

Remark 1. This API function is called as the callback routine of interrupt process [r\\_{Config\\_UARTAn}\\_interrupt\\_receive](#) corresponding to the UARTAn reception transfer end interrupt.

Remark 2. User should only keep necessary flag set/clear in callback function, other processing code should be moved out of callback and interrupt function. Otherwise, the interrupt is not processed at the correct timing.

**[Syntax]**

```
static void r_{Config_UARTAn}_callback_receiveend(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

### `r_{Config_UARTAn}_callback_error`

This API function executes processing in response to UARTAn reception communication error interrupt.

Remark 1. This API function is called as the callback routine of interrupt process `r_{Config_UARTAn}_interrupt_error` corresponding to the UARTAn reception communication error interrupt.

Remark 2. User should only keep necessary flag set/clear in callback function, other processing code should be moved out of callback and interrupt function. Otherwise, the interrupt is not processed at the correct timing.

#### [Syntax]

```
static void r_{Config_UARTAn}_callback_error(uint8_t err_type);
```

Remark *n* is the channel number.

#### [Argument(s)]

I/O	Argument(s)	Description
I	uint8_t err_type;	Error type value: Bit0: Overrun error Bit1: Framing error Bit2: Parity error Bit3 to Bit7: 0

#### [Return value]

None.



## Usage example

This is an example for UARTA0 transmit and receive data by polling mode and UARTA1 also transmit and receive data twice:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"

uint8_t tx_buf0[] = {0x7A};
uint8_t tx_buf1[] = {0x7A, 0x6C, 0x27, 0x1F, 0xF8};
uint8_t rx_buf0[] = {0x00};
uint8_t rx_buf1[] = {0x00, 0x00, 0x00, 0x00, 0x00};
volatile uint8_t transmitend_flag = 0U;
volatile uint8_t receptend_flag = 0U;
int main(void);

int main(void)
{
    R_Config_UARTA0_Start();
    R_Config_UARTA1_Start();

    // 1st transmission (UARTA0 to UARTA1)
    R_Config_UARTA1_Receive(rx_buf0, sizeof(rx_buf0));
    R_Config_UARTA0_Send(tx_buf0, sizeof(tx_buf0));
    while((1U != transmitend_flag) || (1U != receptend_flag));

    // 2nd transmission (UARTA1 to UARTA0)
    R_Config_UARTA0_Receive(rx_buf1, sizeof(rx_buf1));
    R_Config_UARTA1_Send(tx_buf1, sizeof(tx_buf1));
    while((2U != transmitend_flag) || (2U != receptend_flag));

    R_Config_UARTA0_Stop();
    R_Config_UARTA1_Stop();

    return 0;
}
```

Config\_UARTA0\_user.c

```
/* Start user code for global. Do not edit comment generated here */
extern volatile uint8_t transmitend_flag;
extern volatile uint8_t receptend_flag;
/* End user code. Do not edit comment generated here */

void R_Config_UARTA0_PollingEnd_UserCode(void)
{
    /* Start user code for R_Config_UARTA0_PollingEnd_UserCode. Do not edit comment generated here */
    transmitend_flag++;
    /* End user code. Do not edit comment generated here */
}

static void r_Config_UARTA0_callback_receiveend (void)
{
    /* Start user code for r_Config_UARTA0_callback_sendend. Do not edit comment generated here */
    receptend_flag++;
    /* End user code. Do not edit comment generated here */
}
```

## Config\_UARTA1\_user.c

```
/* Start user code for global. Do not edit comment generated here */
extern volatile uint8_t transmitend_flag;
extern volatile uint8_t receptend_flag;
/* End user code. Do not edit comment generated here */

void R_Config_UARTA1_PollingEnd_UserCode (void)
{
    /* Start user code for R_Config_UARTA1_PollingEnd_UserCode. Do not edit comment generated
    here */
    transmitend_flag++;
    /* End user code. Do not edit comment generated here */
}

static void r_Config_UARTA1_callback_receiveend (void)
{
    /* Start user code for r_Config_UARTA1_callback_receiveend. Do not edit comment generated here
    */
    receptend_flag++;
    /* End user code. Do not edit comment generated here */
}
```

### 4.2.29 Remote Control Signal Receiver

Below is a list of API functions output by the Smart Configurator for remote control signal receiver use.

**Table 4-30 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_REMC}_Create</a>	Remote Control Signal Receiver	Executes initialization processing that is required before controlling the REMC module.
<a href="#">R_{Config_REMC}_Start</a>		Starts operation of the remote control signal receiver.
<a href="#">R_{Config_REMC}_Stop</a>		Stops operation of the remote control signal receiver.
<a href="#">R_{Config_REMC}_Read</a>		Specifies the location where the received data are to be stored and the number of bytes to be received.
<a href="#">R_{Config_REMC}_Create_UserInit</a>		Executes user-specific initialization processing for the the remote control signal receiver.
<a href="#">r_{Config_REMC}_interrupt</a>		Executes processing in response to REMC interrupt.
<a href="#">r_{Config_REMC}_callback_receiveend</a>		Executes processing in response to data reception complete interrupts.
<a href="#">r_{Config_REMC}_callback_comparematch</a>		Executes processing in response to compare match interrupts.
<a href="#">r_{Config_REMC}_callback_receiveerror</a>		Executes processing in response to receive error interrupt.
<a href="#">r_{Config_REMC}_callback_bufferfull</a>		Executes processing in response to receive buffer full interrupts.
<a href="#">r_{Config_REMC}_callback_header</a>		Executes processing in response to header pattern match interrupt.
<a href="#">r_{Config_REMC}_callback_data0</a>		Executes processing in response to data "0" pattern match interrupt.
<a href="#">r_{Config_REMC}_callback_data1</a>		Executes processing in response to data "1" pattern match interrupt.
<a href="#">r_{Config_REMC}_callback_specialdata</a>	Executes processing in response to special data pattern match interrupt.	

**R\_{Config\_REMC}\_Create**

This API function executes initialization processing that is required before controlling the remote control signal receiver.

Remark This API function is called from [R\\_Systeminit](#) before the main() function is executed.

**[Syntax]**

```
void R_{Config_REMC}_Create(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_REMC}\_Start**

This API function starts operation of the remote control signal receiver.

**[Syntax]**

```
void R_{Config_REMC}_Start(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_REMC}\_Stop**

This API function stops operation of the remote control signal receiver.

**[Syntax]**

```
void R_{Config_REMC}_Stop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

### R\_{Config\_REMC}\_Read

This API function specifies the location where the received data are to be stored and the number of bytes to be received.

**Remark** This API function specifies the location where the received data read by the REMC interrupt routine at the end of data reception are to be stored.

#### [Syntax]

```
MD_STATUS R_{Config_REMC}_Read(uint8_t * const rx_buf, uint8_t rx_num);
```

#### [Argument(s)]

I/O	Argument(s)	Description
O	uint8_t * const rx_buf;	Pointer to the buffer where the received data are to be stored
O	Uuint8_t rx_num;	Number of bytes to be received

#### [Return value]

Macro	Description
MD_OK	Normal end
MD_ERROR1	The specification of argument <i>rx_num</i> is invalid.

**R\_{Config\_REMC}\_Create\_UserInit**

This API function executes user-specific initialization processing for the the remote control signal receiver.

Remark This API functions is called from [R\\_{Config\\_REMC}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_REMC}_Create_UserInit(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.



`r_{Config_REMC}_interrupt`

This API function executes processing in response to REMC interrupt.

**[Syntax]**

```
void r_{Config_REMC}_interrupt(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_REMC}_callback_receiveend`

This API function executes processing in response to data reception complete interrupts.

Remark This API function is called as the callback routine of interrupt process `r_{Config_REMC}_interrupt` corresponding to data reception completion.

[Syntax]

```
static void r_{Config_REMC}_callback_receiveend(void);
```

[Argument(s)]

None.

[Return value]

None.

`r_{Config_REMC}_callback_comparematch`

This API function executes processing in response to compare match interrupts.

Remark This API function is called as the callback routine of interrupt process `r_{Config_REMC}_interrupt` corresponding to the REMC compare match is triggered.

[Syntax]

```
static void r_{Config_REMC}_callback_comparematch(void);
```

[Argument(s)]

None.

[Return value]

None.

```
r_{Config_REMC}_callback_receiveerror
```

This API function executes processing in response to receive error interrupt.

Remark This API function is called as the callback routine of interrupt process `r_{Config_REMC}_interrupt` corresponding to receive error.

**[Syntax]**

```
static void r_{Config_REMC}_callback_receiveerror(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

---

<code>r_{Config_REMC}_callback_bufferfull</code>
--

This API function executes processing in response to receive buffer full interrupts.

Remark This API function is called as the callback routine of interrupt process `r_{Config_REMC}_interrupt` corresponding to the REMC receive buffer full.

**[Syntax]**

<code>static void r_{Config_REMC}_callback_bufferfull(void);</code>
---

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_REMC}_callback_header`

This API function executes processing in response to header pattern match interrupt.

Remark This API function is called as the callback routine of interrupt process `r_{Config_REMC}_interrupt` corresponding to the REMC header pattern match.

[Syntax]

```
static void r_{Config_REMC}_callback_header(void);
```

[Argument(s)]

None.

[Return value]

None.

```
r_{Config_REMC}_callback_data0
```

This API function executes processing in response to data "0" pattern match interrupt.

Remark This API function is called as the callback routine of interrupt process [r\\_{Config\\_REMC}\\_interrupt](#) corresponding to the REMC data "0" pattern match.

**[Syntax]**

```
static void r_{Config_REMC}_callback_data0(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

```
r_{Config_REMC}_callback_data1
```

This API function executes processing in response to data "1" pattern match interrupt.

Remark This API function is called as the callback routine of interrupt process [r\\_{Config\\_REMC}\\_interrupt](#) corresponding to the REMC data "1" pattern match.

**[Syntax]**

```
static void r_{Config_REMC}_callback_data1(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.



---

<code>r_{Config_REMC}_callback_specialdata</code>
---

This API function executes processing in response to special data pattern match interrupt.

Remark     This API function is called as the callback routine of interrupt process  
`r_{Config_REMC}_interrupt` corresponding to the REMC special data pattern match.

**[Syntax]**

<code>static void     r_{Config_REMC}_callback_specialdata(void);</code>
--

**[Argument(s)]**

None.

**[Return value]**

None.

## Usage example

This is an example for stopping operation of the remote control signal receiver at the end of data reception:  
(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"

volatile uint8_t g_remc_rx_buf[8];

int main(void);

int main(void)
{
    /* Start the REMC operation */
    R_Config_REMC_Start();

    /* Read data from receive data buffer */
    R_Config_REMC_Read((uint8_t *)g_remc_rx_buf, 8U);

    return 0;
}
```

Config\_REMC\_user.c

```
static void r_Config_REMC_callback_receiveend(void)
{
    /* Start user code for r_Config_REMC_callback_receiveend. Do not edit comment generated here */
    R_Config_REMC_Stop();
    /* End user code. Do not edit comment generated here */
}
```

### 4.2.30 A/D Converter

Below is a list of API functions output by the Smart Configurator for A/D converter use.

**Table 4-31 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_ADC}_Create</a>	A/D Converter	Executes initialization processing that is required before controlling the ADC module.
<a href="#">R_{Config_ADC}_Start</a>		Starts the AD converter.
<a href="#">R_{Config_ADC}_Stop</a>		Stops the AD converter.
<a href="#">R_{Config_ADC}_Set_OperationOn</a>		Enables AD voltage comparator operation.
<a href="#">R_{Config_ADC}_Set_OperationOff</a>		Disables AD voltage comparator operation.
<a href="#">R_{Config_ADC}_Set_ADChannel</a>		Selects analog input channel.
<a href="#">R_{Config_ADC}_Set_SnoozeOn</a>		Enables AD wakeup function.
<a href="#">R_{Config_ADC}_Set_SnoozeOff</a>		Disables AD wakeup function.
<a href="#">R_{Config_ADC}_Set_TestChannel</a>		Sets test function.
<a href="#">R_{Config_ADC}_Get_Result_10bit</a>		Returns the high 10 bits conversion result in the buffer.
<a href="#">R_{Config_ADC}_Get_Result_8bit</a>		Returns the high 8 bits conversion result in the buffer.
<a href="#">R_{Config_ADC}_Get_Result_12bit</a>		Returns the low 12 bits conversion result in the buffer.
<a href="#">R_{Config_ADC}_Create_UserInit</a>		Executes user-specific initialization processing for the AD converter.
<a href="#">r_{Config_ADC}_interrupt</a>		Executes processing in response to A/D conversion end interrupt.

**R\_{Config\_ADC}\_Create**

This API function executes initialization processing that is required before controlling the ADC module.

Remark This API function is called from [R\\_Systeminit](#) before the main() function is executed.

**[Syntax]**

```
void R_{Config_ADC}_Create(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

R\_{Config\_ADC}\_Start

This API function starts the AD converter.

**[Syntax]**

```
void R_{Config_ADC}_Start(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_ADC}\_Stop**

This API function stops the AD converter.

**[Syntax]**

```
void R_{Config_ADC}_Stop(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

R\_{Config\_ADC}\_Set\_OperationOn

Enables AD voltage comparator operation.

**[Syntax]**

```
void R_{Config_ADC}_Set_OperationOn(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

R\_{Config\_ADC}\_Set\_OperationOff

Disables AD voltage comparator operation.

**[Syntax]**

```
void R_{Config_ADC}_Set_OperationOff(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.



## R\_{Config\_ADC}\_Set\_ADChannel

This API function selects analog input channel.

### [Syntax]

```
MD_STATUS R_{Config_ADC}_Set_ADChannel(e_ad_channel_t channel);
```

### [Argument(s)]

I/O	Argument(s)	Description
I	e_ad_channel_t channel;	Analog input channel

Remark Below is shown an example of the structure e\_ad\_channel\_t channel (channel conditions).

```
typedef enum
{
    ADCHANNEL0, ADCHANNEL1, ADCHANNEL2, ADCHANNEL3, ADCHANNEL4,
    ADCHANNEL5, ADCHANNEL6, ADCHANNEL7, ADCHANNEL8, ADCHANNEL9,
    ADCHANNEL10, ADCHANNEL11, ADCHANNEL12, ADCHANNEL13,
    ADCHANNEL14, ADCHANNEL16 = 16U, ADCHANNEL17, ADCHANNEL18,
    ADCHANNEL19, ADCHANNEL20, ADCHANNEL21, ADCHANNEL22,
    ADCHANNEL23, ADCHANNEL24, ADCHANNEL25, ADCHANNEL26,
    ADTEMPERSENSOR0 = 128U, ADINTERREFVOLT
} e_ad_channel_t;
```

### [Return value]

Macro	Description
MD_OK	Normal end
MD_ARGERROR	Error argument input error.

`R_{Config_ADC}_Set_SnoozeOn`

Enables AD wakeup function.

**[Syntax]**

```
void R_{Config_ADC}_Set_SnoozeOn(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

`R_{Config_ADC}_Set_SnoozeOff`

Disables AD wakeup function.

**[Syntax]**

```
void R_{Config_ADC}_Set_SnoozeOff(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

### R\_{Config\_ADC}\_Set\_TestChannel

This API function sets test function.

#### [Syntax]

```
MD_STATUS R_{Config_ADC}_Set_TestChannel(e_test_channel_t channel);
```

#### [Argument(s)]

I/O	Argument(s)	Description
I	e_test_channel_t channel;	Sets test channel

Remark Below is shown the structure e\_test\_channel\_t channel (input channel conditions).

```
typedef enum
{
    ADNORMALINPUT,
    ADAVREFM = 2U,
    ADAVREFP
} e_test_channel_t;
```

#### [Return value]

Macro	Description
MD_OK	Normal end
MD_ARGERROR	Error argument input error.

**R\_{Config\_ADC}\_Get\_Result\_10bit**

This API function returns the high 10 bits conversion result in the buffer.

**[Syntax]**

```
void R_{Config_ADC}_Get_Result_10bit(uint16_t * const buffer);
```

**[Argument(s)]**

I/O	Argument(s)	Description
I	uint16_t * const buffer;	The address where to write the conversion result

**[Return value]**

None.

**R\_{Config\_ADC}\_Get\_Result\_8bit**

This API function returns the high 8 bits conversion result in the buffer.

**[Syntax]**

```
void R_{Config_ADC}_Get_Result_8bit(uint8_t * const buffer);
```

**[Argument(s)]**

I/O	Argument(s)	Description
I	uint8_t * const buffer;	The address where to write the conversion result

**[Return value]**

None.

**R\_{Config\_ADC}\_Get\_Result\_12bit**

This API function returns the low 12 bits conversion result in the buffer.

**[Syntax]**

```
void R_{Config_ADC}_Get_Result_12bit(uint16_t * const buffer);
```

**[Argument(s)]**

I/O	Argument(s)	Description
I	uint16_t * const buffer;	the address where to write the conversion result

**[Return value]**

None.

**R\_{Config\_ADC}\_Create\_UserInit**

This API function executes user-specific initialization processing for the AD converter.

Remark This API functions is called from [R\\_{Config\\_ADC}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_ADC}_Create_UserInit(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.



`r_{Config_ADC}_interrupt`

This API function executes processing in response to A/D conversion end interrupt.

**[Syntax]**

```
void r_{Config_ADC}_interrupt(void);
```

**[Argument(s)]**

None.

**[Return value]**

None.

## Usage example

This is an example for getting the 8-bit A/D conversion result:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"
uint8_t adc_data[1] = {0};
extern uint8_t adc_Interrupt_flag;

int main(void);

int main(void)
{
    adc_Interrupt_flag = 0U;
    /* Start comparator 0 */
    R_Config_ADC_Set_OperationOn();
    R_Config_ADC_Start ();
    while(adc_Interrupt_flag != 1U);
    R_Config_ADC_Get_Result_8bit(adc_data);
    R_Config_ADC_Stop ();
    R_Config_ADC_Set_OperationOff();

    return 0;
}
```

Config\_ADC\_user.c

```
/* Start user code for global. Do not edit comment generated here */
uint8_t adc_Interrupt_flag;
/* End user code. Do not edit comment generated here */

static void __near r_Config_ADC_interrupt(void)
{
    /* Start user code for r_Config_ADC_interrupt. Do not edit comment generated here */
    adc_Interrupt_flag = 1U;           //Set the flag
    /* End user code. Do not edit comment generated here */
}
```

### 4.2.31 D/A Converter

Below is a list of API functions output by the Smart Configurator for D/A converter use.

**Table 4-32 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_DACn}_Create</a>	D/A Converter	Executes initialization processing that is required before controlling the DAC $n$ module.
<a href="#">R_{Config_DACn}_Start</a>		Starts the DAC $n$ module.
<a href="#">R_{Config_DACn}_Stop</a>		Stops the DAC $n$ module.
<a href="#">R_{Config_DACn}_Set_ConversionValue</a>		Sets the DAC $n$ value to convert.
<a href="#">R_{Config_DACn}_Create_UserInit</a>		Executes user-specific initialization processing for the DAC $n$ .

**R\_{Config\_DACn}\_Create**

This API function executes initialization processing that is required before controlling the DAC $n$  module.

Remark This API function is called from [R\\_DAC\\_Create](#).

**[Syntax]**

```
void R_{Config_DACn}_Create(void);
```

Remark  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_DACn}\_Start**

This API function starts the DAC $n$  converter.

**[Syntax]**

```
void R_{Config_DACn}_Start(void);
```

Remark  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_DACn}\_Stop**

This API function stops the DAC $n$  converter.

**[Syntax]**

```
void R_{Config_DACn}_Stop(void);
```

Remark  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_DACn}\_Set\_ConversionValue**

This API function sets the DAC $n$  value to convert.

**[Syntax]**

```
void R_{Config_DACn}_Set_ConversionValue(uint8_t reg_value);
```

Remark  $n$  is the channel number.

**[Argument(s)]**

I/O	Argument(s)	Description
I	uint8_t reg_value;	Value of conversion

**[Return value]**

None.

**R\_{Config\_DACn}\_Create\_UserInit**

This API function executes user-specific initialization processing for the DAC $n$ .

Remark This API functions is called from [R\\_{Config\\_DACn}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_DACn}_Create_UserInit(void);
```

Remark  $n$  is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.



## Usage example

This is an example for starting D/A conversion with a user-define value:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"

int main(void);

int main(void)
{
    R_Config_DAC0_Set_ConversionValue(0xF0);
    R_Config_DAC0_Start();

    return 0;
}
```

### 4.2.32 Comparator

Below is a list of API functions output by the Smart Configurator for comparator use.

**Table 4-33 API Functions:**

API Function Name	Peripheral Name	Description
<a href="#">R_{Config_COMPn}_Create</a>	Comparator	Executes initialization processing that is required before controlling the comparator <i>n</i> module.
<a href="#">R_{Config_COMPn}_Start</a>		Starts the comparator <i>n</i> .
<a href="#">R_{Config_COMPn}_Stop</a>		Stops the comparator <i>n</i> .
<a href="#">R_{Config_COMPn}_Create_UserInit</a>		Executes user-specific initialization processing for the comparator <i>n</i> .
<a href="#">r_{Config_COMPn}_interrupt</a>		Executes processing in response to comparator detection interrupt.

**R\_{Config\_COMPn}\_Create**

This API function executes initialization processing that is required before controlling the comparator *n* module.

Remark This API function is called from [R\\_COMP\\_Create](#).

**[Syntax]**

```
void R_{Config_COMPn}_Create(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_COMPn}\_Start**

This API function starts the comparator *n* converter.

**[Syntax]**

```
void R_{Config_COMPn}_Start(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_COMP*n*}\_Stop**

This API function stops the comparator *n* converter.

**[Syntax]**

```
void R_{Config_COMPn}_Stop(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

**R\_{Config\_COMP*n*}\_Create\_UserInit**

This API function executes user-specific initialization processing for the comparator *n*.

Remark This API functions is called from [R\\_{Config\\_COMP\*n\*}\\_Create](#) as a callback routine.

**[Syntax]**

```
void R_{Config_COMPn}_Create_UserInit(void);
```

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

`r_{Config_COMPn}_interrupt`

This API function executes processing in response to comparator detection interrupt.

Remark This API function is called as the interrupt handler for comparator detection interrupt, which occur when an active edge of the comparator output is detected.

**[Syntax]**

`void r_{Config_COMPn}_interrupt(void);`

Remark *n* is the channel number.

**[Argument(s)]**

None.

**[Return value]**

None.

## Usage example

This is an example for setting a flag when detecting an active edge of the comparator output:

(Blue code is user code.)

main.c

```
#include "r_smc_entry.h"
extern uint8_t comp0_trig_flag;

int main(void);

int main(void)
{
    comp0_trig_flag = 0U;

    /* Start comparator 0 */
    R_Config_COMP0_Start ();
    while(comp0_trig_flag != 1U);
    comp1_trig_flag = 0U;
    R_Config_COMP0_Stop ();

    return 0;
}
```

Config\_COMP0\_user.c

```
/* Start user code for global. Do not edit comment generated here */
uint8_t comp0_trig_flag = 0U;
/* End user code. Do not edit comment generated here */

static void __near r_Config_COMP0_interrupt(void)
{
    /* Start user code for r_Config_COMP0_interrupt. Do not edit comment generated here */
    /* Set the flag */
    comp0_trig_flag = 1U;
    /* End user code. Do not edit comment generated here */
}
```



## Revision Record

Rev.	Section	Description
1.00	–	First Edition issued
1.01	4.2.1 General	Add R_UARTA_Enter_ModuleStop for Table 4-2 API Functions: (2/2)
	–	Remove redundancy chapter.

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