

RX671 Group

RX671 OTA-supported flat panel HMI PoC with touch keys and LCD

Introduction

This kit for RX671 touch keys and OTA-supported flat panel HMI PoC using LCD (hereinafter referred to as "RX671 PoC") is ideal for the development of IoT devices with HMI using capacitive touch sensors.

This application note introduces the HMI solution using RX671 PoC to realize touch functionality and LCD display with serial connection LCD. In addition, introduce the function to connect to the cloud and perform firmware updates using OTA.

The sample program described in this application note is configured using the following libraries.

• LCD Display : Embedded GUI software emWin

(hereinafter referred to as "emWin")

Target Device

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When using this application note with other Renesas MCUs, careful evaluation is recommended after making modifications to comply with the alternate MCU.2

Target Tool

RX671 PoC

For more information on security, please refer to "Renesas MCU Firmware Update Design Policy (R01AN5548)"



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1. Outline

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This application note describes the operation and structure of the RX671 PoC. RX671 PoC is equipped with touch buttons, touch slider and LCD (240 x 320) and can be used as a demonstration to control the display and settings by imagining a microwave oven. In addition, RX671 PoC can rewrite the program OTA from the cloud.

The overall RX671 PoC image is shown below.



Figure 1-1 Overall RX671 PoC image



The system configuration is shown below.



Figure 1-2 System configuration

The software configuration is shown below.







2. Operation Confirmation Conditions

The operation of the sample program has been confirmed under the following conditions.

Table 2-1 Operation	Confirmation	Conditions
----------------------------	--------------	------------

Item	Contents	
MCU used	R5F5671EHDFM (RX671 Group)	
Operating frequency	Operating frequency (ICLK) : 120MHz	
	Peripheral operating frequency (PCLKB) : 60MHz	
Operating voltage	3.3 V	
Integrated development	Renesas Electronics	
	e ² studio Version 2023-01 (23.1.0)	
C compiler	Renesas Electronics	
	C/C++ Compiler Package for RX Family V3.05.00	
	Compiler option	
	Default settings of integrated development environment	
Smart Configurator	V2.16.0	
Board support package (r_bsp)	V7.20	
Endian order	Little Endian	
Operating mode	Single chip mode	
Processor mode	Super visor mode	
Sample code version	V1.00	
Emulator	E2 Emulator Lite	

Table 2-2 Operation Confirmation Conditions (LCD, Wi-Fi)

Item	Contents	
LCD module	2.8 TFT SPI 240 × 320 serial port module	
Wi-Fi module	Wi-Fi-Pmod-Expansion-Board (RTK00WFMX0B00000BE)	



3. Sample Programs

3.1 Demonstration Screen Flowchart

The demonstration screen flowchart of this sample program is shown below. For detail on each screen, refer to chapter 5.



Figure 3-1 Flowchart of demonstration screen (Cook)





Figure 3-2 Flowchart of demonstration screen (Defrost)



Recipe mode is not available with the firmware ver.0.90.







3.2 Flowchart

3.2.1 Overall flowchart of LCD control

The overall flowchart of LCD control is shown below.



Figure 3-4 Overall flowchart of LCD control



3.2.2 Processing at touch keys operation

The flowchart for touch keys operation is shown below.



Figure 3-5 Flowchart for touch keys operation



3.2.3 Processing at touch slider operation

The flowchart for touch slider operation is shown below.



Figure 3-6 Flowchart for touch slider operation



3.2.4 Processing when the "home" button is touched

The flowchart when the "home" button is touched is shown below.



Figure 3-7 Flowchart when the "home" button is touched



3.2.5 Processing when the "select" button is touched

The flowchart when the "select" button is touched is shown below.



Figure 3-8 Flowchart when the "select" button touch is touched



3.2.6 Processing when the "start" button is touched

The flowchart when the "start" button is touched is shown below.



Figure 3-9 Flowchart when the "select" button is touched

3.2.7 Processing during cooking

The flowchart during cooking is shown below.



Figure 3-10 Flowchart during cooking



3.2.8 Overall flowchart of touch control

The overall flowchart of touch control is shown below.



Figure 3-11 Overall flowchart of touch control



3.2.9 Processing of touch judgement

The flowchart of touch judgement is shown below.

If the left side of the touch slider is touched after touching the right side of the touch slider, the touch slider is judged to have slid to the left. The same is true on the opposite side.



Figure 3-12 Flowchart of touch judgement



3.2.10 Processing of startup screen display

The flowchart of startup screen display is shown below.



Figure 3-13 Flowchart of startup screen display



3.2.11 Processing of 5 seconds wait

The flowchart of 5 seconds wait is shown below.



Figure 3-14 Flowchart of 5 seconds wait



3.2.12 Processing of flag clear for touch

The flowchart of flag clear for touch is shown below.



Figure 3-15 Flowchart of flag clear touch



3.2.13 Processing of screen initialization

The flowchart of screen initialization is shown below.



Figure 3-16 Flowchart of screen initialization



3.2.14 Processing at moving to the menu screen

The flowchart for moving to the menu screen is shown below.



Figure 3-17 Flowchart for moving to the menu screen



3.2.15 Processing of setting LED pattern to sleep

The flowchart of setting LED pattern to sleep is shown below.



Figure 3-18 Flowchart of setting LED pattern to sleep



3.3 Pins Used

The following shows lists pins used in this sample program.

Table 3-1 List of Pins and Functions

Pin name	Input/Output	Function
P12/RXD2	Input	UART2 receiving pin
P13/TXD2	Output	UART2 sending pin
PE1/TXD12	Output	UART12 sending pin
PE2/RXD12	Input	UART12 receiving pin
PA6/CTS12	Input	CTS signal input pin
P16/RXD3	Input	USB-UART3 receiving pin
P17/TXD3	Output	USB-UART3 sending pin
P27/RSPCKB-A	Input/Output	RSPI1 clock pin
PE7/MISOB-B	Input	RSPI1 MISO pin
PE6/MOSIB-B	Output	RSPI1 MOSI pin
PC4/TSCAP	-	TSCAP pin
P34/TS0	Input	Electrostatic capacitance measurement pin
P26/TS3	Input	Electrostatic capacitance measurement pin
P53/TS12	Input	Electrostatic capacitance measurement pin
PC6/TS13	Input	Electrostatic capacitance measurement pin
PC5/TS14	Input	Electrostatic capacitance measurement pin
PC1/TS15	Input	Electrostatic capacitance measurement pin
PC0/TS16	Input	Electrostatic capacitance measurement pin
PD40~43, PD2, PD3	Output	LED pin
PB6/TIOCA5	Output	Buzzer pin



3.4 Sample Program Structure

3.4.1 Peripheral Functions Used

The following shows lists peripheral functions used in this sample program.

Table 3-2 List of Peripheral Functions Used and Functions

Peripheral Functions	Functions	
RSPI1	SPI Communication with LCD module	
DMAC	Used for RAM to RSPI transfer	
SCI2, SCI12	UART communication with Wi-Fi module (2 systems)	
S12AD0	Used for inside CTSU FIT	
CTSU	Used for touch buttons and touch slider	
CMT0	Used for internal emWin FIT	
CMT2	Used for RTOS	
PORT	Used for LED	
TPU5	Used for buzzer	



3.4.2 Components Used

The following shows lists components used in this sample program.

Components	Abbreviation	Version
ADC Driver	r_s12ad_rx	5.00
AWS_device_shadow	AWS_device_shadow	1.0.110
AWS_ggd	AWS_ggd	1.0.110
AWS_mqtt	AWS_mqtt	1.0.110
AWS_secure_socket	AWS_secure_socket	1.0.110
AWS_tcp_ip	AWS_tcp_ip	1.0.110
Board Support Package	r_bsp	7.21
Byte-based circular buffer library	r_byteq	2.10
CMT driver	r_cmt_rx	5.40
CTSU QE API	r_ctsu_qe	2.20
DMAC driver	r_dmaca_rx	3.00
Flash API for RX100, RX200, RX600, and RX700	r_flash_rx	4.91
FreeRTOS_kernel	FreeRTOS_kernel	1.0.110
FreeRTOS_Object	FreeRTOS_Object	1.0.112
GPIO Driver	r_gpio_rx	4.70
Graphic Library with Graphical User Interface	r_emwin_rx	6.32.a.1.00
PWM Mode Timer	Config_TPU5	1.12.0
RSPI Driver	r_rspi_rx	3.04
SCI Driver	r_sci_rx	4.60
Touch QE API	rm_touch_qe	2.20
Wi-Fi Module control functions for Renesas MCUs	r_wifi_sx_ulpgn	1.16
Port	Config_PORT	2.4.1



3.4.3 Peripheral Function Settings

The Smart Configurator settings used in this sample program are shown below. The items and settings in each table in the Smart Configurator settings are described in the notation on the configuration screen.

Settings not listed are assumed to be default settings.

Table 3-4 Parameters of Smart Configurator (1/6)

Category	Item	Setting/Description
Smart Configurator >> Clock		The following settings are made on the
		"Clocks" Tab.
	VCC	3.3 (V)
	Main clock	Stopped: Unchecked.
	PLL circuit setting	Frequency Division: ×1
		Frequency Multiplication: ×15
	HOCO clock	Operation: Checked.
		HOCO oscillation enabled after reset
	LOCO clock	Stopped: Unchecked.
	IWDT dedicated clock	Clock source: HOCO
		Flash IF clock (FCLK): 60MHz
		System clock (ICLK): 120MHz
		Peripheral module clock (PCLKA): 120MHz
		Peripheral module clock (PCLKB): 60MHz
		Peripheral module clock (PCLKC): 60MHz
		Peripheral module clock (PCLKD): 60MHz
Smart Cont	figurator >> System	Debugging interfaces setting: FINE
Smart Con	figurator >> Components >> r_bsp	Default settings except following changes
	Heap size	0x4000
	ROM Cache Enable Register	Disabled
	Software Interrupt Unit2 (SWINT2)	Used
	Software Interrupt Task Buffer Number	8
	Initial value of the software interrupt priority	Priority level 1
	Serial terminal select	Enabled
	Channel for serial terminal	Channel 3
	Bitrate for serial terminal	115200
	Interrupt priority serial terminal	Priority level 3
	HOCO Trimming select	Disabled
Smart Con	figurator >> Components >> r_dmaca_rx	Default settings are used.
Smart Con	figurator >> Components >> r_s12ad_rx	Default settings except following changes
	Resources >> S12AD	
	S12AD0	Checked.
Smart Con	figurator >> Components >> r_ctsu_ge	Default settings except following changes
	TSCAP pin	Use: Checked.
	TS0 pin	Use: Checked.
	TS2 pin	Use: Checked.
	TS3 pin	Use: Checked.
	TS12 pin	Use: Checked.
	TS13 pin	Use: Checked.
	TS14 pin	Use: Checked.
	TS15 pin	Use: Checked
	TS16 pin	Use: Checked.



Table 3-5 Parameters of Smart Configurator (2/6)			
Category	Item	Setting/Description	
Smart Conf	igurator >> Components >> r_gpio_rx	Default settings are used.	
Smart Configurator >> Components >> r_flash_rx		Default settings except following changes	
	Enable code flash programming	Includes code to program ROM area	
	(FLASH_CFG_CODE_FLASH_ENABLE)		
	Enable BGO/Non-blocking data flash operations	Enable BGO mode	
	(FLASH_CFG_DATA_FLASH_BGO)		
	Enable BGO/Non-blocking code flash operations	Enable BGO mode	
	(FLASH_CFG_CODE_FLASH_BGO)		
	Enable code flash self-programming	Programming code flash while executing	
	(FLASH_CFG_CODE_FLASH_RUN_FROM_ROM)	from another segment in ROM	
Smart Conf	igurator >> Components >> r_rspi_rx	Default settings except following changes	
	Dummy data of reception	0x00	
	RSPI channel 0	Unused	
	RSPI channel 1	Used	
	RSPI channel 2	Unused	
	Interrupt priority level of RSPI channel 1	Level 3	
	RSPI1	Checked	
	RSPCKB pin	Use: Checked.	
	MOSIB pin	Use: Checked.	
	MISOB pin	Use: Checked.	
Smart Conf	igurator >> Components >> r_sci_rx	Default settings except following changes	
	Use ASYNC mode	Include	
	Use SSPI mode	Include	
	Include software support for channel 2	Include	
	(SCI_CFG_CH2_INCLUDED)		
	Include software support for channel 3	Include	
	(SCI_CFG_CH3_INCLUDED)		
	Include software support for channel 12	Include	
	(SCI_CFG_CH12_INCLUDED)		
	ASYNC mode TX queue buffer size for channel 3	2048	
	(SCI_CFG_CH3_TX_BUFSIZ)		
	ASYNC mode TX queue buffer size for channel 12	2048	
	(SCI_CFG_CH12_TX_BUFSIZ)		
	ASYNC mode RX queue buffer size for channel 3	2048	
	(SCI_CFG_CH3_RX_BUFSIZ)		
	ASYNC mode RX queue buffer size for channel 12	2048	
	(SCI_CFG_CH12_RX_BUFSIZ)		
	Resources >> SCI		
	SCI2	Checked.	
	RXD2/SMISO2/SSCL2 Pin	Use: Checked.	
	TXD2/SMOSI2/SSDA2 Pin	Use: Checked.	
	SCI3	Checked	
	RXD3/SMISO3/SSCL3 Pin	Use: Checked	
	TXD3/SMOSI3/SSDA3 Pin	Use: Checked	
	SCI12	Checked.	
	RXD12/SMISO12/SSCL12 Pin	Use: Checked.	
	TXD12/SMOSI12/SSDA12 Pin	Use: Checked.	
	CTS12#/RTS12#/SS12# Pin	Use: Checked.	



Table 3-6 Parameters of Smart Configurator (3/6)

Category	Item	Setting/Description
Smart Con	figurator >> Components >> r_cmt_rx	Default settings are used.
Smart Configurator >> Components >> rm_touch_qe		Default settings are used.
Smart Con	figurator >> Components >> r_byteq	Default settings are used.
Smart Configurator >> Components >> r_wifi_sx_ulpgn		Default settings except following
		changes
	SCI Channel number for SX-ULPGN Initial Command	12
	Port for AT command communication	
	(WIFI_CFG_SCI_CHANNEL)	
	SCI Channel number for SX-ULPGN Second Command	2
	Port for AT command communication	
	(WIFI_CFG_SCI_SECOND_CHANNEL)	
	General-purpose port PDR register connected to the SX- ULPGN EN pin (WIFI_CFG_RESET_PORT)	PORTH
	Configure RTS Port No. for WIFI_CFG_SCI_CHANNEL (WIFI_CFG_RTS_PORT)	PORTH
	Configure RTS Pin No. for WIFI_CFG_SCI_CHANNEL (WIFI_CFG_RTS_PIN)	1
	Socket Receive buffer size	1024
	(WIFI_CFG_SOCKETS_RECEIVE_BUFFER_SIZE)	
Smart Con	figurator >> Components >> r_emwin_rx	Other than the changes listed
		below, default settings are used.
	Configurations >> BasicSetting	
	Work area size for GUI	10000
	Horizontal LCD size	240
	Vertical LCD size	320
	Color depth	16 bit per pixel
	LCD orientation	ORIENTATION_CCW
	Configurations >> Select LCD Interface	
	LCD interface	LCD_IF_RSPI
	Configurations >> Select LCD Interface >> SPI Interface S	etting
	LCD interface channel number	1
	Select LCD Driver IC	LCD_DRV_IC_ILI9341
	Communication baud rate of LCD interface	3000000
	Use or unused display cache	Unuse: Unchecked.
Configurations >> Select LCD Interface >> LCD Interface Pin Setting		
	Use Display Signal Pin	Use Display Signal Pin
	Display Signal Pin	GPIO_PORT_A_PIN_1
	Use Backlight Pin	Use Backlight Pin
	Backlight Pin	GPIO_PORT_D_PIN_6
	Use Data/Command Pin	Use Data/Command Pin
	Data/Command Pin	GPIO_PORT_A_PIN_2
	Use Chip Select Pin	Use Chip Select Pin
	Chip Select Pin	GPIO_PORT_D_PIN_5
	Configurations >> Select Touch Interface	
	Use Touch function	Not use Touch function: Unchecked.



Table 3-7 Parameters of Smart Configurator (4/6)

Category	Item	Setting/Description
Smart Configurator >> Components >> FreeRTOS_Kernel		Other than the changes listed
		below, default settings are used.
	The total amount of RAM available in the FreeRTOS	(size_t)(200U * 1024U)
	heap	
	Tick vector	_CMT2_CMI2
Smart Con	figurator >> Components >> FreeRTOS_Object	Other than the changes listed
		below, default settings are used.
	Tasks	Initialize: kernel start
		Task Code: touch_task
		Task Name: touch_task
		Stack Size: 512
		Task Handler: NULL
		Parameter: NULL
		Priority: 1
		Initialize: kernel start
		Task Code: emwin_task
		Task Name: emwin_task
		Stack Size: 512
		Task Handler: NULL
		Parameter: NULL
		Priority: 1
Smart Configurator >> Components >> AWS_device_shadow		Default settings are used.
Smart Configurator >> Components >> AWS_ggd		Default settings are used.
Smart Configurator >> Components >> AWS_mqtt		Default settings are used.
Smart Configurator >> Components >> AWS_secure_soket		Default settings are used.
Smart Configurator >> Components >> AWS_tcp_ip		Default settings are used.



Table 3-8 Parameters of Smart Configurator (5/6)

Category	Item	Setting/Description
Smart Configurator >> Pins >> Serial Communication Interface >>		Uncheck all settings except the
SCI2		following
	RXD2	Use: Checked.
		Terminal Assignment: Set P12
	TXD2	Use: Checked.
		Terminal Assignment: Set P13
Smart Con SCI3	figurator >> Pins >> Serial Communication Interface >>	Uncheck all settings except the following
	RXD3	Use: Checked.
		Terminal Assignment: Set P16
	TXD3	Use: Checked.
		Terminal Assignment: Set P17
Smart Configurator >> Pins >> Serial Communication Interface >>		Uncheck all settings except the
SCI5		following
	SCK5	Use: Checked.
		Terminal Assignment: Set PA1
	SMISO5	Use: Checked.
		Terminal Assignment: Set PA2
	SMOSI5	Use: Checked.
		Terminal Assignment: Set PA4
	figurator >> Pins >> Serial Communication Interface >>	Uncheck all settings except the
RSPI1		following
	MISOB	Use: Checked.
		Terminal Assignment: Set PE7
	MOSIB	Use: Checked.
		Terminal Assignment: Set PE6
	RSPCKB	Use: Checked.
		Terminal Assignment: Set P27



Table 3-9 Parameters of Smart Configurator (6/6)

Category	Item	Setting/Description
Smart Configurator >> Components >> Config_PORT		Other than the changes listed below, default
		settings are used.
	PORT4	Checked.
	P40	Output: Checked
		Output 1: Checked
	P41	Output: Checked
		Output 1: Checked
	P42	Output: Checked
		Output 1: Checked
	P43	Output: Checked
		Output 1: Checked
	PORTD	Checked.
	PD2	Output: Checked
		Output 1: Checked
	PD3	Output: Checked
		Output 1: Checked
Smart Configurator >> Components >> Config_TPU5		Other than the changes listed below, default settings are used.
	Counter clear source	TGRB5 compare match
	Counter clock selection	PCLK/64, rising edge
	TIOCA5 pin	Output initial 0, 1 at compare match
	TGRB compare match operation	Output 0 from TIOCA5 pin
	PWM cycle	504µs
	TGRA initial value	38
	TGRB initial value	472



3.4.4 File Structure

The following shows file structure by sample program.

Table 3-10 File Structure

Folder name, File name	Outline
application_code	-
F LCD	•
Resource	Folders for images and fonts
│ └ Source	-
LCD_custom_func.c	Source file for LCD related
LCD_custom_func.h	Header file for LCD related
⊢ renesas_code	-
I ⊢ frtos_startup	Generated folder for Amazon FreeRTOS
I ⊢ utility	
│	Amazon FreeRTOS main task
I └ frtos_skeleton	-
emwin_task.c	Task for emWin control
↓ + task_function.h	Include file for emwin_task.c, touch_task.c
└ touch_task.c	Task for touch control
├ touch	•
↓ + touch_func.c	Source file for touch related
L touch_func.h	Header file for touch related
⊢qe_gen	Generated folder for QE for capacitive touch
└ main.c	Source file for main processing
config_files	Generated folder for Amazon FreeRTOS
demos	
freertos_kernel	
libraries	
QE-Touch	Generated folder for QE for capacitive touch
vendors	Generated folder for Amazon FreeRTOS
└ renesas	-
└ boards	-
└ rx671-rsk	-
Laws_demos	-
L src	•
└ smc_gen	Smart Configurator generation
Config_PORT	
Config_TPU5	
⊢ general	
⊢ r_cmt_rx	
⊢ r_config	
⊢ r_ctsu_qe	
⊢ r_dmaca_rx	
⊢ r_emwin_rx	
⊢ r_gpio_rx	
⊢ r_pincfg	
⊢ r_rspi_rx	
└ rm_touch_qe	



3.4.5 Variables

The following shows the variables that are used in this sample program.

Variable name	Туре	Contents
g_sleep_flg	uint8_t	Flag indicating LCD sleep state
g_lcd_left_slide_flg	uint8_t	Flag indicating that touch slider is slid to the left
g_lcd_right_slide_flg	uint8_t	Flag indicating that touch slider is slid to the right
g_lcd_push_enter_flg	uint8_t	Flag indicating that "2" button was touched.
g_lcd_push_back_flg	uint8_t	Flag indicating that "1" button was touched.
g_screen_en_flg	uint8_t	Flag indicating initial screen status
s_flg_countdown	uint8_t	The countdown is in progress on the LCD flag
s_flg_touch	uint8_t	Touch buttons status
s_startup_cnt	uint8_t	Counter for initial screen display time management
s_sleep_cnt	uint16_t	Counter for no-operation time management
s_mode_num	uint8_t	Mode status
s_setting_target	uint8_t	Flags indicating screen status

Table 3-11 List of variables used in the sample code



3.4.6 Constants

The following shows the constants that are used in this sample program.

Constant Name	Setting Value	Contents
LCD_BACKLIGHT	(PORT7.PODR.BIT.B1)	Pin to control LCD backlight
OFF	(0U)	Value at backlight off
ON	(1U)	Value at backlight on
TOUCH_NO	(0U)	Value at no-operation
TOUCH_LEFT_SLIDE	(4U)	Value indicating that touch slider is slid to the left
TOUCH_RIGHT_SLIDE	(3U)	Value indicating that touch slider is slid to the right
TOUCH_SELECT	(1U)	Value indicating that "2" button was touched
TOUCH_HOME	(2U)	Value at moving to the previous screen
SLEEP_COUNT	(SLEEP_TIME / DELAY_TIME)	When the counter in the program equals this value, the LCD is turned off
MODE_RECIPE_DETAIL	(6U)	Value of detail setting in Recipe mode
MODE_COOK_DETAIL	(3U)	Value of detail setting in Cook mode
MODE_DEFROST_DETAIL	(4U)	Value of detail setting in Defrost mode
MODE_COOK	(1U)	Value of start cooking in Cook mode
MODE_DEFROST	(2U)	Value of start cooking in Defrost mode
MODE_RECIPE	(5U)	Value of start cooking in Recipe mode
TOUCH_START	(5U)	Value of execution in each mode
SETTING_TOP	(0U)	Value of initial screen
MODE_MENU	(0U)	Value of mode not selected
LED_HOME	(PORT4.PODR.BIT.B0)	P40
LED_SELECT	(PORT4.PODR.BIT.B1)	P41
LED_START	(PORT4.PODR.BIT.B2)	P42
LED_MINUS	(PORT4.PODR.BIT.B3)	P43
LED_BAR	(PORTD.PODR.BIT.B3)	PD3
LED_PLUS	(PORTD.PODR.BIT.B2)	PD2
LED_ON	(1U)	Value of LED turning on
LED_OFF	(0U)	Value of LED turning off
APP_VERSION_MAJOR	(1U)	Version display
STARTUP_COUNT	(STARTUP_TIME / DELAY_TIME)	Display the initial screen until the counter in the program equals this value

Table 3-12 List of constants used in the sample code


3.4.7 Functions

The following shows the functions that are used in this sample program.

Function name	Outline
emwin_task	LCD Control
GUI_Init	Initializing emWin
screen_init	Menu screen is displayed on LCD
change_screen	LCD screen update
slide_func	Processing at touch slider operation
select_pushed_func	Processing when "select" button is touched
home_pushed_func	Processing when "home" button is touched
start_pushed_func	Processing when "start" button is touched
countdown_func	Processing the countdown
slide_icons	Processing of cursor movement on menu screens and mode selection screens for Cook, Defrost and Recipe
setting_cook	Setting the number of watts and seconds in Cook mode
setting_defrost	Setting the level of defrosting and the number of grams in Defrost mode
setting_recipe	Setting the number of cupcakes in Recipe mode
mode_select_enter	Change the mode and display the LCD screen according to the mode
change_target_cook	Change the setting target of the detail setting screen in Cook mode
change_target_defrost	Change the setting target of the detail setting screen in Defrost mode
mode_change_menu	Move to the menu screen
start_cook	Start cooking in Cook mode
start_defrost	Start defrosting in Defrost mode
start_recipe	Start cooking in Recipe mode
countdown_cook	Processing during cooking in Cook mode
countdown_defrost	Processing during defrosting in Defrost mode
countdown_recipe	Processing during cooking in Recipe mode
touch_task	Initializes CTSU and calls the touch judgement function
touch_judge	Touch judgement
show_startup_screen	Processing of startup screen display
led_sleep_on	Set LED pattern to sleep
wait_5sec_once	Processing of 5 seconds wait
clear_touch_flags	Processing of flag clear for touch
draw_choices_v09	Processing of version 0.90 display
draw_choices	Processing of version 1.00 display
cnt_1s	Processing of 1 second count
end_show_comp	Processing of cooking completion screen wait
show_comp	Processing of cooking completion screen display
start_cook_detail	Start of detail setting in Cook mode
start_defrost_detail	Start of detail setting in Defrost mode
start_recipe_detail	Start of detail setting in Recipe mode
led_off	Processing of LED turning off

Table 3-13 List of functions used in the sample code



3.4.8 Function Specifications

The following shows function specifications that are used in this sample program.

Outline	LCD Control
Header	task_function.h
Declaration	void touch_task (void * pvParameters)
Description	Initializes emWin FIT and controls LCD.
-	
Arguments Return value	pvParameters None
Remarks	None
Remarks	None
[Function name]	GUI_Init
Outline	Initializing emWin
Header	GUI.h
Declaration	void GUI_Init (void)
Description	Initializes emWin's internal data structures and variables.
Arguments	None
Return value	None
Remarks	None
[Function name]	
Outline	Menu screen is displayed on LCD
Header	LCD_custom_func.h
Declaration	void screen_init (void)
Description	Menu screen is displayed on LCD.
Arguments	None
Return value	None
Remarks	None
[Function name]	change_screen
Outline	LCD screen update
Header	LCD_custom_func.h
Declaration	void change_screen (void)
Description	Updates the LCD screen by touch operation.
Arguments	None
Return value	None
Remarks	None
[Function name]	show_startup_screen
Outline	Processing of startup screen display
Header	LCD_custom_func.h
Declaration	void shoe_startup_screen (void)
Description	Performs startup screen display.
Arguments	None
Return value	None
Remarks	None



RX671 OTA-supported flat panel HMI PoC with touch keys and LCD

RX671 Group

[Function name] led_sleep_on

Outline	Set LED pattern to sleep
Header	LCD_custom_func.h
Declaration	Void led_sleep_on (void)
Description	Sets LED pattern to sleep
Arguments	None
Return value	None
Remarks	None

[Function name] touch_task

Outline	Initializes CTSU and calls the touch judgement function
Header	task_function.h
Declaration	void touch_task (void * pvParameters)
Description	Initializes CTSU and calls the touch judgement function.
Arguments	pvParameters
Return value	None
Remarks	None

[Function name] touch_judge

Outline	Touch judgement
Header	touch_func.h
Declaration	void touch_judge (uint64_t button_status, uint16_t slider_position)
Description	Performs touch judgement and sets the judgement result to a flag.
Arguments	button_status, slider_position
Return value	None
Remarks	None



3.4.9 ROM/RAM usage

ROM/RAM usage for this sample program is shown below.

Table 3-14 ROM usage

Size(KByte)	Description
550	Amazon FreeRTOS
200	LCD Graphic data
115	emWin, LCD control
15	demo program, LCD_custom_func
24	Other
Total 904KByte	MAX 1024KByte (88% Used) : 1024KByte x 2Bank

Table 3-15 RAM usage

Size(KByte)	Description
200	OS Heap area
16	Heap area
64	AWS demo program
37	AWS cloud (exp. OTA)
11	emWin
18	Other
Total 356KByte	MAX 384KByte (92.7% Used)



4. Importing a Project

The sample programs are distributed in e² studio project format. This section shows how to import a project into e² studio or CS+. After importing a project, check the build and debug settings.

4.1 **Procedure in e² studio**

To use sample programs in e² studio, follow the steps below to import them into e² studio. In projects managed by e² studio, do not use space codes, multibyte characters, and symbols such as "\$", "#", "%" in folder names or paths to them.

(Note that depending on the version of e² studio you are using, the interface may appear somewhat different from the screenshots below.)

New	Alt+Shift+N > h	C I I			N
Open File		Select			
Open Projects from File S		Create new projects fro	m an archive file or directory.		
Recent Files	>	Colortan investories d			
Close Editor	Ctrl+W	Select an import wizard:			
Close All Editors	Ctrl+Shift+W	🗸 🗁 General			^
Save Save As	Ctrl+S	Archive File			
Save All	Ctri+Shift+S		ts into Workspace		
Revert	art the e ² studio and	🖨 File System		Soloot (Evicting	Projects into Workspa
	lect the File >> [Import].	Preferences Projects from F	older or Archive	Select [Existing	
🖾 Rename	12		ort Existing C/C++ Project in	o Workspace	
 Refresh Convert Line Delim ters T 	F5		project conversion to Renesa	s GCC RX	
		😂 Renesas CS+ P	roject for CA78K0R/CA78K0		~
 Print Import 	Ctrl+P				
Export					
Properties	Alt+Enter				
Switch Workspace		?	< Back Nex	t > Finish	Cancel
Restart					
Exit					
Import Import Projects Select a directory to search Select root directory: Select archive file:	or existing Eclipse projects. 10-rx23e-a¥r01an4747_rx23ea_therm	ocouple × Browse	Select [Select	root directory:].]
Import Projects Select a directory to search select root directory: select archive file: Projects:		ocouple × Browse V Browse 10-rx23e-a¥ Select All Deselect All	Select the dire (e.g. r01an474	root directory:]. ctory which stored I7_rx23ea_thermo on note has its ow	couple)
Select a directory to search elect root directory: Select archive file: Projects: rx23ea_thermocouple	110-rx23e-a¥r01an4747_rx23ea_therm	ocouple → Browse → Browse 10-rx23e-a¥ Select All	Select the dire (e.g. r01an474	ctory which stored	couple)
Import Projects Select a directory to search Select root directory: Select archive file: Projects: rx23ea_thermocouple Coptions	(C:¥Application_note¥r01an4747_rx23ea_therm	ocouple → Browse → Browse 10-rx23e-a¥ Select All Deselect All Refresh	Select the dire (e.g. r01an474	ctory which stored	couple)
Select a directory to search elect root directory: Select archive file: Projects: rx23ea_thermocouple	(C:¥Application_note¥r01an4747_rx23ea_therm (S:¥Application_note¥r01an4747 s	ocouple → Browse → Browse 10-rx23e-a¥ Select All Deselect All Refresh	Select the dire (e.g. r01an474	ctory which stored	couple)
Import Projects Select a directory to search Select root directory: Select archive file: Projects: rx23ea_thermocouple options Search for nested project	(C:¥Application_note¥r01an4747_rx23ea_therm	ocouple → Browse → Browse 10-rx23e-a¥ Select All Deselect All Refresh	Select the dire (e.g. r01an474 Each applicatio	ctory which stored 7_rx23ea_thermo on note has its ow	n project name.
Import Projects Select a directory to search Select root directory: Select archive file: Projects: X rx23ea_thermocouple C options Search for nested project Copy projects into works	(C:¥Application_note¥r01an4747_rx23ea_therm (C:¥Application_note¥r01an4747 xx01 s	ocouple → Browse → Browse 10-rx23e-a¥ Select All Deselect All Refresh	Select the dire (e.g. r01an474 Each application	ctory which stored	n project name.
Import Projects Select a directory to search Select root directory: Select archive file: Projects: Yrx23ea_thermocouple rx23ea_thermocouple Copy projects into works Close newly imported pr	(C:¥Application_note¥r01an4747_rx23ea_therm (C:¥Application_note¥r01an4747 xx01 s	ocouple → Browse → Browse 10-rx23e-a¥ Select All Deselect All Refresh	Select the dire (e.g. r01an474 Each application	ctory which stored 7_rx23ea_thermo on note has its ow	n project name.
Import Projects Select a directory to search Select root directory: Select archive file: Projects: rx23ea_thermocouple rx23ea_thermocouple Copy projects into works Close newly imported pr Hide projects that alread Working sets	(C:¥Application_note¥r01an4747_rx23ea_therm (C:¥Application_note¥r01an4747 xx01 s pace ojects upon completion r exist in the workspace	ocouple → Browse → Browse 10-rx23e-a¥ Select All Deselect All Refresh	Select the dire (e.g. r01an474 Each application	ctory which stored 7_rx23ea_thermo on note has its ow	n project name.
Import Projects Select a directory to search Select root directory: Select archive file: Projects: R rx23ea_thermocouple C projects the alread Working sets Add project to working	(C:¥Application_note¥r01an4747_rx23ea_therm (C:¥Application_note¥r01an4747 xx01 s pace ojects upon completion r exist in the workspace	ocouple → Browse → Browse 10-rx23e-a¥ Select All Deselect All Refresh New	Select the dire (e.g. r01an474 Each application	ctory which stored 7_rx23ea_thermo on note has its ow	n project name.
Import Projects Select a directory to search Select root directory: Select archive file: Projects: rx23ea_thermocouple rx23ea_thermocouple Copy projects into works Close newly imported pr Hide projects that alread Working sets	(C:¥Application_note¥r01an4747_rx23ea_therm (C:¥Application_note¥r01an4747 xx01 s pace ojects upon completion r exist in the workspace	ocouple → Browse → Browse 10-rx23e-a¥ Select All Deselect All Refresh >	Select the dire (e.g. r01an474 Each application	ctory which stored 7_rx23ea_thermo on note has its ow	n project name.
Import Projects Select a directory to search Select root directory: Select archive file: Projects: R rx23ea_thermocouple C projects the alread Working sets Add project to working	(C:¥Application_note¥r01an4747_rx23ea_therm (C:¥Application_note¥r01an4747 xx01 s pace ojects upon completion r exist in the workspace	ocouple → Browse → Browse 10-rx23e-a¥ Select All Deselect All Refresh New	Select the dire (e.g. r01an474 Each application	ctory which stored 7_rx23ea_thermo on note has its ow	n project name.
Import Projects Select a directory to search Select root directory: Select archive file: Projects: R rx23ea_thermocouple C projects the alread Working sets Add project to working	(C:¥Application_note¥r01an4747_rx23ea_therm (C:¥Application_note¥r01an4747 pace jects upon completion r exist in the workspace	ocouple → Browse → Browse 10-rx23e-a¥ Select All Deselect All Refresh New	Select the dire (e.g. r01an474 Each application	ctory which stored 7_rx23ea_thermo on note has its ow	n project name.

Figure 4-1 Import a Project into e² Studio



4.2 Procedure in CS+

To use sample programs in CS+, follow the steps below to import them into CS+. In projects managed by CS+, do not use space codes, multibyte characters, and symbols such as "\$", "#", "%" in folder names or paths to them.

(Note that depending on the version of CS+ you are using, the interface may appear somewhat different from the screenshots below.)



Figure 4-2 Importing a Project into CS+



5. Start Demonstration

Disconnect the E2 Emulator Lite and turn on the RX671 PoC to start the demonstration program. This demonstration program assumes control of the display and settings of a microwave oven. Set the cooking conditions and recipe selections using the touch buttons and touch slider while checking the LCD.

Hereinafter, touch buttons are described as buttons and touch slider is described as slider.



Figure 5-1 Demonstration screen and operation panel



5.1 Powered on RX671 PoC and menu screen

When RX671 PoC is powered on, the LCD panel displays the RX logo and RX671 features (initial screen) for approximately 5 seconds. When the display finishes, the sample program starts and becomes a menu screen.

And while the initial screen is displayed, can immediately move to the menu screen by touching any button.



Figure 5-2 Start of the demonstration

5.2 Menu screen

"Cook", "Defrost" or "Recipe" can be selected with the slider operation on the menu screen.



Figure 5-3 How to operate the menu screen



5.3 Cook setting

5.3.1 Move to mode selection screen

While "Cook" is selected on the menu screen, touching the "select" button can move to the Cook mode selection screen.



Figure 5-4 Move to the Cook mode selection screen

5.3.2 Select mode

While the Cook mode selection screen is displayed, "Auto" or "Manual" can be selected with the slider operation.



Figure 5-5 How to operate the Cook mode selection screen



5.3.3 Select Auto

While "Auto" is selected on the Cook mode selection screen, touching the "start" button can start cooking.



Figure 5-6 Start cooking in Auto mode

5.3.4 Select Manual

While "Manual" is selected on the Cook mode selection screen, touching the "select" button can move to the Cook detail setting screen.



Figure 5-7 Move to the Cook detail setting screen



5.3.4.1 Set the number of watts

While the cursor is on the upper side, the number of watts can be set with the slider. "500W", "600W" and "700W" can be selected as the power level.



Figure 5-8 Setting the number of watts

5.3.4.2 Move the cursor

While the Cook detail setting screen is displayed, touching the "select" button can move the cursor. The item with a light-colored background is selected.



Figure 5-9 How to operate the cursor on the Cook detail setting screen



5.3.4.3 Set the number of seconds

While the cursor is on the lower side, the number of seconds can be set with the slider. "10s", "20s" and "30s" can be selected as the cooking time.



Figure 5-10 Setting the number of seconds

5.3.4.4 Start cooking

While the Cook detail setting screen is displayed and the cursor is on the lower side, touching the "start" button can start cooking.



Figure 5-11 Start cooking in Manual mode



5.4 Defrost setting

5.4.1 Move to mode selection screen

While "Defrost" is selected on the menu screen, touching the "select" button can move to the Defrost mode selection screen.



Figure 5-12 Move to the Defrost mode selection screen

5.4.2 Select mode

While the Defrost mode selection screen is displayed, "Manual", "Fish" or "Meat" can be selected with the slider operation.



Figure 5-13 How to operate the Defrost mode selection screen



5.4.3 Select Manual

While "Manual" is selected on the Defrost mode selection screen, touching the "select" button can move to the Defrost detail setting screen.



Figure 5-14 Move to the Defrost detail setting screen

5.4.3.1 Set the level of defrosting

While the cursor is on the upper side, the level of defrosting can be set with the slider. "Level1", "Level2" and "Level3" can be selected as the defrosting level.



Figure 5-15 Setting the level of defrosting



5.4.3.2 Move the cursor

While the Defrost detail setting screen is displayed, touching the "select" button can move the cursor. The item with a light-colored background is selected.



Figure 5-16 How to operate the cursor on the Defrost detail setting screen

5.4.3.3 Set the number of grams

While the cursor is on the lower side, the number of grams can be set with the slider. "100g", "200g" and "300g" can be selected as the defrosting amount.



Figure 5-17 Setting the number of grams



5.4.3.4 Start defrosting

While the Defrost detail setting screen is displayed and the cursor is on the lower side, touching the "start" button can start defrosting.



Figure 5-18 Start defrosting in Manual mode

5.4.4 Select Fish

While "Fish" is selected on the Defrost mode selection screen, touching the "start" button can start defrosting with the settings for "Fish".



Figure 5-19 Start defrosting in Fish mode



5.4.5 Select Meat

While "Meat" is selected on the Defrost mode selection screen, touching the "start" button can start defrosting with the settings for "Meat".



Figure 5-20 Start defrosting in Meat mode



5.5 Recipe setting

Recipe mode is not available with the firmware ver.0.90.

5.5.1 Move to recipe selection screen

While "Recipe" is selected on the menu screen, touching the "select" button can move to the Recipe selection screen.



Figure 5-21 Move to the Recipe selection screen

5.5.2 Select recipe

While the Recipe selection screen is displayed, "Beef Stew", "Garlic Shrimp" or "Cup Cake" can be selected with the slider operation.



Figure 5-22 How to operate the Recipe selection screen



5.5.3 Select Beef Stew

While "Beef Stew" is selected on the Recipe selection screen, touching the "start" button can start cooking for the Settings for Beef Stew.



Figure 5-23 Start cooking in Beef Stew mode

5.5.4 Select Garlic Shrimp

While "Garlic Shrimp" is selected on the Recipe selection screen, touching the "start" button can start cooking for the Settings for Garlic Shrimp.



Figure 5-24 Start cooking in Garlic Shrimp mode



5.5.5 Select Cup Cake

While "Cup Cake" is selected on the Recipe selection screen, touching the "start" button can start cooking for the Settings for Cup Cake.



Figure 5-25 Move to the Cup Cake detail setting screen

5.5.5.1 Set the number of cupcakes

You can set the number of cupcakes with the slider. "1pc", "2pcs" and "3pcs" can be selected as the cooking amount.



Figure 5-26 Setting the number of cupcakes



5.5.5.2 Start cooking

While the Cup Cake detail setting screen is displayed, touching the "start" button can start cooking.



Figure 5-27 Start cooking in Cup Cake mode



5.6 About the "home" button

The "home" button returns to the menu screen from any screen.



Figure 5-28 Example of "home" button operation



5.7 About the cooking completion screen

While completed cooking, the cooking completion screen is displayed for 3 seconds. After that, move to the menu screen automatically.



Figure 5-29 Example of cooking completion operation

5.8 Automatic LCD off function

If no touch operation is performed for 10 seconds, the LCD will turn off. Touching any buttons will return to the previous screen.



6. Update firmware version

Two version of firmware are available in this application note. One of them has firmware version 0.90 and its file name is userprog_v0.90.rsu, the other firmware version is 1.00 and its file name is userprog_v1.00.rsu. In the initial state, version 0.90 firmware including a bootloader that supports FOTA is written, and can update it to version 1.00 firmware by following the procedure described later.

The differences by firmware version are shown below. The firmware version in use is displayed on the initial screen. In addition, the menu screen is different for each version.



Figure 6-1 Differences by firmware version



1. Upload and save the OTA update firmware userprog_v0.90.rsu oruserprog_v1.00.rsu to Amazon S3 bucket as described in "1.2 Create an Amazon S3 bucket" in "How to implement FreeRTOS OTA by using Amazon Web Services on RX65N".

mazon S3 > Buckets > rx671		
x671		
Objects Properties Permissions Metrics Management Access Points		
Objects (3)		
Objects are the fundamental entities stored in Amazon S3. You can use Amazon S3 inventory 🔀 to get a list of all objects in your need to explicitly grant them permissions. Learn more 🔀	bucket. For others to	access your objects, you'll
C □ Copy S3 URI □ Copy URL □ Download Open □ Delete	Actions V	Create folder
Q. Find objects by prefix Show versions		< 1 > 🔘
Name ▲ Type ▼ Last modified ▼	Size ⊽	Storage class
□ DisignedImages/ Folder -	-	-
userprog_v0.90.rsu rsu October 5, 2022, 09:44:07 (UTC+09:00)	959.5 KB	Standard
Userprog_v1.00.rsu rsu October 5, 2022, 09:44:05 (UTC+09:00)	959.5 KB	Standard

Figure 6-2 userprog.rsu upload



2. Create job to update firmware on RX671 PoC.

AWS IoT Jobs is a service that notifies one or more connected devices that they have a pending "job". A job can be used to manage large numbers of devices, update firmware and security certificates on devices, or perform administrative tasks such as rebooting and diagnostics devices.

—Select [AWS IoT] \rightarrow [Manage] \rightarrow [Jobs] \rightarrow [Create] \rightarrow [Create OTA Update job] \rightarrow Set job name \rightarrow [Next]

 Create a FreeRTOS OTA update job as below: Select the name of the thing. (Figure 6-3 (a), Figure 7-11) Select Code signing profile. (Figure 6-3 (b)) Select firmware image from S3 for FOTA. (Figure 6-3 (c)) Select IAM role. (Figure 6-3 (d))

-Click [Next]

This OTA update job will send your file securely over MQTT or HTTP to the FreeRTOS-based things and/or the thing groups that you choose.
Choose things and/or thing groups rx671 (a) Select the protocol for file transfer select the protocol that your device supports. MQTT HTTP
rx671 (a) Select the protocol for file transfer Select the protocol that your device supports. ✓ MQTT HTTP
Select the protocol for file transfer Select the protocol that your device supports. MQTT HTTP
Select the protocol that your device supports. MQTT HTTP
Select the protocol that your device supports. MQTT HTTP
П НТТР
File Info
FILE Info
Sign and choose your file Code signing ensures that devices only run code published by trusted authors and that the code hasn't been changed or corrupted since it was signed. You have three options for code signing.
Sign a new file for Choose a Use my custom
me. previously signed signed file. file.
Existing code signing profile (b) Profile_rx671_ota Create new profile File Upload a new file. S3 URL (C) Q s3://rx671_vserprog_v1.00.rsu X View Z Browse S3 Format s5://bucket/prens/coject: Path name of file on device This is the name and location where the file will be stored on the FreeRTOS device. <i>e.g. /device/updates</i>
File type - optional
· merike obround
IAM role Info
Role Choose a role that grants AWS IoT access to S3, AWS IoT jobs, and AWS Code signing resources. rx671-poc-role (d)

Figure 6-3 Job creation (1)



3. Click [Create job].

	A job configuration Info
	oose how to run this job.
0	Your job will complete after deploying to the devices and groups that you chose (snapshot)
0	Your job will continue to deploy to any devices added to the groups that you chose (continuous)
	leb start velleut configuration options/
	Job start rollout configuration - optional Specify how quickly devices will be notified when a pending job starts.
Þ	Job stop configuration - optional
	These configurations define when to automatically stop the job. The job stops if a percentage of devices fail the deployment after a minimum number have deployed. The job cancels if any of the criteria are met after the job starts.
•	Job run timeout configuration - optional
	Specify how long the job will run.
	Cancel Back Create job

Figure 6-4 Job creation (2)



4. Open Tera Term and confirm that the firmware has been updated.

💆 COM3 - Tera Term VT —		×
<u>File Edit S</u> etup C <u>o</u> ntrol <u>W</u> indow <u>H</u> elp		
bute.72 373 [Tmr Svc] 73 373 [Tmr Svc] [INFO] [PKCS11] [core_pkcs11_mbedtls.c:2638] 74 373 [Tmr Svc] Creating a 0x3 type object.7	5 373	[Tm ^
r Svc] 76 373 [Tmr Svc] [DEBUG] [PKCS11] [core_pkcs11_mbedtls.c:2158] 77 373 [Tmr Svc] Successfully found the key		
he template.78 374 [Tmr Svc] 79 374 [Tmr Svc] [DEBUG] [PKCS11] [core_pkcs11_mbedtls.c:2187] 80 374 [Tmr Svc] Successfully found the labe		
template.81 374 [Tmr Svc] 82 374 [Tmr Svc] [DEBUG] [PKCS11] [core_pkcs11_mbedt1s.c:1243] 83 374 [Tmr Svc] Key was private type.84 374		
	_	
91 660 [Tmr Svc] [INFO] [PKCS11] [core_pkcs11_mbedtls.c:2033] 92 660 [Tmr Svc] Successfully closed PKCS #11 93 660 [Tmr Svc]	Sessi	on.
94 663 [iot_thread] [INFO][DEMO][663]STARTING DEMO		
95 663 [iot_thread] [INFO][INIT][663] SDK successfully initialized. 96 107527 [iot_thread] [INFO][DEMO][107527] Successfully initialized the demo. Network type for the demo: 97 107527 [iot_thread] [INFO][MQTT][107527] MQTT library successfully initialized. 98 107527 [iot_thread] [INFO][DEMO][107527] OTA demo version 1.0.0	1	
99 107527 [iot_thread] [INFO][DEMO][107527] Connecting to broker		*

Figure 6-5 Check Execution Result

The Tera Term setup is shown below. If do not have Tera Term on PC, please download from https://ttssh2.osdn.jp/index.html.en.

💆 COM11 - Tera Term VT			_		
File Edit Setup C Tera Term: Serial port	setup and connection		×		
Port: Speed:	COM11 ~	New setting			
Data: Parity:	8 bit ~	Cancel			
Stop bits: Flow control:	1 bit v	Help			
0 Device Friendly N	Aicrosoft -2006	11¥000000000001	Â		
<		>	~		
				~	

Figure 6-6 Tera Term



OTA demonstration version is 1.00 and has been updated successfully.

5. Check job status to be "Succeeded".

evice Advisor		674		
1QTT test client	AFR_OTA-job_ota_	rx6/1Info		C Edit Save as a job temp
	Details Job executions	Job document Job targets Tags		
iage III devices				
ireengrass devices	Execution overview			
PWAN devices		refresh this page if the summary does not match.		
emote actions				
Jobs	Succeeded	Failed	Canceled	Rejected
Job templates	1	0	0	0
Secure tunnels	Queued	In progress	Removed	Timed out
essage Routing	0	0	O	0
etained messages	0	0	0	0
ecurity				
leet Hub	Job executions (1) Info			C Cancel execu
	Devices currently processing this job.			
ce Software	Q Find job executions		All job executions (1)	
g groups				
ngs	□ Thing name ▼ Re	try attempts Retries remai Last updat 🔻	Queued at 🛛 🗸 Status	
1	rx671 -	Retries not set September 0	September 0 🛛 Succeeded	

Figure 6-7 Check Succeeded



7. How to create a user program that supports OTA

This section describes how to rewrite the program from the cloud by OTA.

The program is rewritten in the background and automatically switched to the new program at the next power-on.

First, user can select the version of Amazon FreeRTOS package. The selected version will be downloaded from GitHub and imported automatically into the project. This makes it easier for the user, so that the user can focus only on Amazon FreeRTOS configuration and writing program.

7.1 AWS Preparation

To perform OTA from the cloud, it is necessary to prepare a cloud environment. Use AWS as the cloud. Refer to the following for more information on preparing for AWS. RX Family How to implement FreeRTOS OTA by using Amazon Web Services on RX65N (R01AN5549).

7.2 Import, configurate head file and build aws_demos and boot_loader

The figure below shows how to import Amazon FreeRTOS project:

- 1. Launch e² studio.
- 2. Select [File] \rightarrow [Import...]
- 3. Select [Renesas GitHub FreeRTOS (with IoT libraries) Project]

Figure 7-1 Importing Projects



4. Click [Check for more version...] to show the "FreeRTOS (with IoT libraries)" dialog.

	—		×
aries) Project	t		
n in order to import t	ort the p	roject.	
		Br	rowse
			~
<u>F</u> inish		Cance	el
<u>F</u> inish		Cance	el

Figure 7-2 "FreeRTOS (with IoT libraries)" dialog

5. Select the latest version. (If the latest version is not displayed, create a new e² studio workspace)

	ev.	×.		
FreeRTOS (with IoT libraries)		Issue date	^	Select All
	202107.00-rx-1.0.1	2022-06		Deselect All
FreeRTOS (with IoT libraries) v	202107.00-rx-1.0.0	2022-04		Descreet
✓ FreeRTOS (with IoT libraries) v	202012.00-rx-1.0.1	2022-03		
FreeRTOS (with IoT libraries) v	202012.00-rza2m-1.0.0	2021-12		
FreeRTOS (with IoT libraries) v	202012.00-re-1.0.0	2021-10		
FreeRTOS (with IoT libraries) v	202012.00-rl78-1.0.0	2021-10		
FreeRTOS (with IoT libraries) v	202012.00-rx-1.0.0	2021-10		
FreeRTOS (with IoT libraries) v	202002.00-rx-1.0.5	2021-05		
FreeRTOS (with IoT libraries) v	202002.00-rx-1.0.4	2021-03		
FreeRTOS (with IoT libraries) v	202002.00-rl78-1.0.3	2021-02	\checkmark	
Module Folder Path:				
C:¥afr				Browse

Figure 7-3 Select OS version



6. Agree to the end user license agreement

End User License Agreement(Sample Code)	×	
This content is subject to the following license agreements:		
Accept Not Acce	ept	

Figure 7-4 Agree to End User License Agreement

7. Wait for the download to complete.

Progres	s Information
i	FreeRTOS module download
afr-v20	2012.00-rx-1.0.1 - doc/Amazon FreeRTOS Qualification Developer Guide.pdf
	Cancel

Figure 7-5 Waiting for download



8. Select the project to import. Select [aws_demos] and [boot_loader] project.

The aws_demos and boot_loader used in this demonstration have not been officially released in May 2023. Please contact our distributors and sales offices to request individual supplies. Import Projects Select a directory to search for existing Renesas projects. • Select root directory: C:¥afr-v202012.00-rx-1.0.1 ~ Browse... Projects: rx671 × Select All ✓ aws_demos (C:¥afr-v202012.00-rx-1.0.1¥projects¥renesas¥rx671-rsk¥e2studio¥aws_demos) Deselect All aws_demos (C:¥afr-v202012.00-rx-1.0.1¥projects¥renesas¥rx671-rsk¥e2studio-gcc¥aws_demos) Refresh aws_tests (C:¥afr-v202012.00-rx-1.0.1¥projects¥renesas¥rx671-rsk¥e2studio¥aws_tests) aws tests (C:¥afr-v202012.00-rx-1.0.1¥proiects¥renesas¥rx671-rsk¥e2studio-acc¥aws tests boot_loader (C:¥afr-v202012.00-rx-1.0.1¥projects¥renesas¥rx671-rsk¥e2studio¥boot_loader boot_loader (C:¥afr-v202012.00-rx-1.0.1¥projects¥renesas¥rx671-rsk¥e2studio-gcc¥boot_loader) Options Search for nested projects Hide projects that already exist in the workspace ? < <u>B</u>ack <u>N</u>ext > <u>F</u>inish Cancel

Figure 7-6 Select a project to import



9. Open [Project] \rightarrow [Properties] \rightarrow [C/C++ Build] \rightarrow [Tool Chain Editor] in both projects and select "Toolchain" and "Builder" to set the toolchain. Also, select [Setting]" \rightarrow [Toolchain] to set the version.



Figure 7-7 Tool Chain and Versioning



10. Select [Project] \rightarrow [Properties] \rightarrow [C/C++ Build] \rightarrow [Settings] \rightarrow [Converter] \rightarrow [Output] and set [Motorola S format file].



Figure 7-8 Motorola S format File output settings



11. Input the public key

In bootloader project, open

projects\renesas\rx671-rsk\e2studio\boot_loader\src\key\code_signer_public_key.h and input public key. Please refer to "Renesas MCU Firmware Update Design Policy" section "7.3 Generating ECDSA-SHA256 Key Pairs with OpenSSL" to create public key.

When completed to create public key, build and generate the boot_loader.mot file for the boot loader project.

The aws_demos and boot_loader used in this demonstration have not been officially released in May 2023. Please contact our distributors and sales offices to request individual supplies.



Figure 7-9 Input the public key


12. Open AWS IoT console

- —Browse to the AWS IoT console.
- ---Select [Settings]. Make a note of the Endpoint. (Figure 7-10(e))

Device data endpoint		
	Info	(
Your devices can use your accour	t's device data endpoint to connect to AWS.	
Each of your things has a RE	ST API available at this endpoint. MQTT clients and AWS IoT De	vice SDKs 🛃 also use this

Figure 7-10 Check AWS Endpoint

—Select [Manage] \rightarrow [Things]. Make a note of AWS IoT thing name. (Figure 7-11(f))

		> Things > rx671		
onitor	rx671	Info		
onnect	Thing details			
Connect one device				
Connect many devices	Name rx671 (f)			Type -
	ARN			Billing group
st	ð			-
Device Advisor				
MQTT test client				
	Attributes C	ertificates Thing groups Device S	hadows Interact Activity	Jobs Alarms Defender metric
anage				
All devices	Attributes (0)	Info		
Things	Attributes are key-val	ue pairs that can be searchable or non-searchable. Sea		
Thing groups		hings without using fleet indexing. Non-searchable at vhen fleet indexing is turned on.	ributes can be used to	
Thing types				
Fleet metrics	Key	♥ Value	⊽ Туре	
Greengrass devices				No attributes
LPWAN devices				NO attributes

Figure 7-11 thing name



13. Open aws_demos project.

—Open /demos/include/aws_clientcredential.h and specify the following values #define clientcredentialMQTT_BROKER_ENDPOINT "Figure 7-10 (e) The Endpoint" #define clientcredentialIOT_THING_NAME "Figure 7-11 (f) thing name"

2	* * FreeRTOS V202012.00
25	* Freekius V202012.00
26	<pre>*#ifndefAWS_CLIENTCREDENTIAL_H</pre>
27	#defineAWS_CLIENTCREDENTIALH
28	
29	
30	* @brief MQTT Broker <u>endpoint</u> .
31	8
832	* @todo Set this to the fully-qualified DNS name of your MQTT broker.
33	*/
34	<pre>#define clientcredentialMQTT_BROKER_ENDPOINT "iot.ap-northeast-1.amazonaws.com"</pre>
35	
36	⊕ /*
37	* @brief Host name.
38	*
39	* @todo Set this to the unique name of your IoT Thing.
40	* Please note that for convenience of demonstration only we
41	* are using a #define here. In production scenarios the thing
42	* name can be something unique to the device that can be read
43	* by software, such as a production serial number, rather
44	* than a hard coded constant.
45	*/
46	#define clientcredentialIOT_THING_NAME " " " " " " " " " " " " " " " " " " "
47	

Figure 7-12 Input the endpoint and thing name

14. Open "Certificate Configuration Tool"

- —Move to the FreeRTOS path downloaded in 7.1 step 5.
- $--\text{Open [tools]} \rightarrow [\text{certificate_congiguration}] \rightarrow \text{CertificateConfigurator.html}$
- —Import certificate PEM file and Private Key PEM file which were downloaded on 1.1 step (4) of "How to implement FreeRTOS OTA by using Amazon Web Services on RX65N"
- -Generate awa_clientcredential_keys.h.

Certificate Configuration Tool FreeRTOS Developer Demos
Provide client certificate and private key PEM files downloaded from the AWS IoT Console.
Certificate PEM file: Choose File No file chosen
Private Key PEM file: Choose File No file chosen
Generate and save aws_clientcredential_keys.h
Save the generated header file to the demos/common/include folder of the demo project. Copyright (C) 2017 Amazon.com, Inc. or its affiliates. All Rights Reserved.

Figure 7-13 Generate clientcredential key



15. Open aws_demos project again

---Replace the aws_clientcredentia_keys.h generated above with the file in /demos/include/.

- -Open /demos/include/aws_ota_codesigner_certificate.h specify values below
- signingcredentialSIGNING_CRETIFICATE_PEM [] = "xxxx";

"xxxx" is value from secp256r1.crt. Remember the "\" after each line of certification.

For creating secp256r1.crt please refer to "How to implement FreeRTOS OTA by using Amazon web Services on RX65N" section "7.3 Generating ECDSA-SHA256 Key Pairs with OpenSSL".



Figure 7-14 Input clientcredential



7.3 Install the initial version of firmware

1. Check the FreeRTOSApplicationConfig.h setting.

	FreeRTOSApplica	tionConfig.h $ imes$
4	1 2 3	<pre>#ifndef FREERTOS_APPLICATION_CONFIG_H #define FREERTOS_APPLICATION_CONFIG_H</pre>
8	4 5	#define OTA (Used)
	6 7 8	#define Used (1) #define Unused (0)
	9	#define CONNECTION (WIFI)
	11 12 13	#define ETHER (1) #define WIFI (0)
	14 15 16	<pre>#if (CONNECTION == 1) #error "Connection type ETHER not supported" #endif</pre>
	17 18	#endif

Figure 7-15 Check Setup

2. Open amazon-freertos/demos/include/ aws_application_version.h, set initial version of firmware to 0.90.

2	* FreeRTOS V202012.00.
25	
26	<pre>#ifndef _AWS_APPLICATION_VERSION_H_</pre>
27	#define _AWS_APPLICATION_VERSION_H_
28	
29	<pre>#include "iot_appversion32.h"</pre>
30	extern const AppVersion32_t xAppFirmwareVersion
31	
32	#define APP_VERSION_MAJOR (0U)
33	#define APP_VERSION_MINOR (9U)
34	#define APP_VERSION_BUILD (0U)
35	
36	#endif

Figure 7-16 Firmware initial version definition



3. Open Section Viewer by selecting [Project] \rightarrow [Properties] \rightarrow [C / C ++ Build] \rightarrow [Settings] \rightarrow [Tool Settings] tab \rightarrow [Linker] \rightarrow [Section] \rightarrow [...] and change section of aws_demos as following picture.

0x00000004 SU SI R R_1 R_2 R R RPFRAM B_RX_DESC_1 B_TX_DESC_1 B_TX_DESC_1 B_1 B_2 Add Section New Overlay RPFRAM2 New Overlay 0x00100000 C_BOOTLO 0x00100000 C_BOOTLO 0x00100000 C_BOOTLO 0x00100000 C_PKCS11 C_SYSTEM Move Up Move Down Import C_2 C C C V* V* L P* C_8 C 0xFFFEF800 EXCEPTVECT	Section Viewer		
SI R_1 R_2 R RPFRAM B_RX_DESC_1 B_TX_DESC_1 B_1 B_2 Add Section New Overlay RPFRAM2 0x00100000 C_BOOTLO 0x00100800 C_PKCS11 C_SYSTEM 0xFFFF003000 C_1 C_2 C X* D* W* L P* C_8 0xFFFEFF80 EXCEPTVECT	Address	Section Na	
R_1 R_2 R RPFRAM B_RX_DESC_1 B_TX_DESC_1 B_TX_DESC_1 B_1 B_2 B_8 RPFRAM2 0x00100000 C_BOOTLO 0x00100800 C_PKCS11 C_SYSTEM 0xFFF00300 C_1 C_2 C C_2 C W* L P* C_8 0xFFFEFF80 EXCEPTVECT	0x00000004	SU	
R_2 R RPFRAM B_RX_DESC_1 B_TX_DESC_1 B_TX_DESC_1 B_1 B_2 B_8 R_8 RPFRAM2 0x00100000 C_BOOTLO 0x00100000 C_PKCS11 C_2 C C_2 C C\$* D* W* L P* C_8 0xFFFEFF80 EXCEPTVECT		SI	
R RPFRAM B_RX_DESC_1 B_TX_DESC_1 B_TX REGOVERNMENT 0x00100000 C_SOTLO 0xFFFF003000 C_1 C_2 C C_8 0xFFFEFF80 EXCEPTVECT			
RPFRAM B_RX_DESC_1 B_TX_DESC_1 B_1 B_2 Add Section New Overlay Remove Section 0x00100000 C_BOOTLO 0x00100800 C_PKCS11 C_SYSTEM 0xFFFF00300 C_1 C_2 C C_2 C C_8 0xFFFEFF80 EXCEPTVECT			
B_RX_DESC_1 B_TX_DESC_1 B_TX_DESC_1 B B_1 B_2 Add Section R_8 RPFRAM2 0x00100000 C_BOOTLO 0x00100800 C_PKCS11 0xFFF00300 C_1 C_2 C C\$* D* W* L P* C_8 0xFFFEFF80			
B_TX_DESC_1 B B_1 B_2 B_8 RPFRAM2 0x00100000 C_BOOTLO 0x00100800 C_PKCS11 C_SYSTEM 0xFFF00300 C_1 C_2 C C\$* D* W* L P* C_8 0xFFFEFF80 EXCEPTVECT			
B B B_1 B_2 B_8 Add Section R_8 New Overlay RPFRAM2 Remove Section 0x00100000 C_BOOTLO 0x00100000 C_PKCS11 C_SYSTEM Move Up 0x0FFF00300 C_1 C_2 Import C Export C C\$* D* W* L P* C_8 0xFFFEFF80 0xFFFEFF80 EXCEPTVECT			
B_1 B_2 B_8 R_8 RPFRAM2 0x00100000 C_BOOTLO 0x00100800 C_PKCS11 C_SYSTEM 0xFFF00300 C_1 C_2 C C\$* D* W* L P* C_8 0xFFFEFF80 EXCEPTVECT			
B_2 Add Section B_8 Remove Section 0x00100000 C_BOOTLO 0x00100800 C_PKCS11 0x00100800 C_PKCS11 0xFFF00300 C_1 C_2 Import C C C\$* D* W* L P* C_8 0xFFFEFF80 EXCEPTVECT			
B_0 New Overlay RPFRAM2 Remove Section 0x00100000 C_BOOTLO Move Up 0x00100800 C_PKCS11 Move Down C_SYSTEM Import Import 0xFFF00300 C_1 Export C_2 C Export C_3* D* V* L P* C_8 0xFFFEFF80 EXCEPTVECT EXCEPTVECT			
RPFRAM2 Remove Section 0x00100000 C_BOOTLO Move Up 0x00100800 C_PKCS11 Move Down C_SYSTEM Import Export 0xFFF00300 C_1 Export C_2 C * D* W* L P* C_8 0xFFFEFF80 0xFFFEFF80 EXCEPTVECT EXCEPTVECT		B_8	· · · · · · · · · · · · · · · · · · ·
0x00100000 C_BOOTLO 0x00100800 C_PKCS11 C_SYSTEM 0xFFF00300 C_1 C_2 C C C C C C C C C C C C C			
0x00100800 C_PKCS11 Move Down C_SYSTEM Import 0xFFF00300 C_1 Export C_2 Export C C C\$* D* W* L P* C_8 0xFFFEFF80 EXCEPTVECT			Remove Section
C_SYSTEM Import 0xFFF00300 C_1 Export C_2 Export C C D* W* L P* C_8 0xFFFEFF80 DxFFFEFF80 EXCEPTVECT			Move Up
0xFFF00300 C_1 Import C_2 C C C C C C C C C C C C C	0x00100800		Move Down
C_2 C C C C C C C C C C C C C	0xFFF00300		Import
C C\$* D* W* L P* C_8 0xFFFEFF80 EXCEPTVECT			Export
D* W* L P* C_8 0xFFFEFF80 EXCEPTVECT			
W* L P* C_8 0xFFFEFF80 EXCEPTVECT			
L P* C_8 0xFFFEFF80 EXCEPTVECT			
P* <u>C_8</u> 0xFFFEFF80 EXCEPTVECT			
C_8 0xFFFEFF80 EXCEPTVECT			
0xFFFEFF80 EXCEPTVECT			
	OvEFFFFF80		
	Override Lin	nker Script	Browse
Override Linker Script			DIOWSE
Browse		Re-Apply	
			OK Cancel

Figure 7-17 Section Settings

4. Build to create aws_demos.mot file.



5. Create userprog.mot from Renesas Secure Flash Programmer.

userprog.mot is a combination of aws_demos.mot and boot_loader.mot. Users can flash this file to RX671 PoC to install initial firmware.

Download Renesas Secure Flash Programmer release 1.0.1 and open Renesas Secure Flash Programmer.exe. Also downloads other files.

- -Select [Initial Firm] tab and then set parameters as following picture.
- Private Key Path : location to secp256r1.privatekey
- Boot Loader File Path : location to boot_loader.mot (¥projects¥renesas¥rx671-rsk¥e2studio¥boot_loader¥HardwareDebug)
- Bank 0 User Program File Path : location to aws_demos.mot (¥projects¥renesas¥rx671-rsk¥e2studio¥aws_demos¥HardwareDebug)

—Select [Generate] to generate userprog.mot and save it in the init_firmware folder. Check Generate succeeded is displayed.

Select MCU	RX671(ROM 2MB)/Secure Bootloader=64KB 🗸	
Select Firmware Verification Type	sig-sha256-ecdsa 🗸	
AES MAC Key (16 byte hex / 32 characters	3)	
Private Key Path (PEM Format)	C:¥tmp¥secp256r1privatekey	Browse
Select Output Format	Bank0 User Program + Boot Loader (Motorola S Format)	~
Boot Loader		
File Path (Motorola Format)	C:¥tmp¥boot_loader_64KB.mot	Browse
Bank0 User Program		
Firmware Sequence Number	1	_
File Path (Motorola Format)	C:¥tmp¥aws_demos.mot	Browse
Bank1 User Program (Option)		
Firmware Sequence Number	(1 - 4294967295)	
File Path (Motorola Format)		Browse

Figure 7-18 Generate userprog.mot



6. Erase the flash ROM of the RX671 PoC.

- —Download the latest version of Renesas Flash Programmer below. https://www.renesas.com/rfp
- —Open the following project in Renesas Flash Programmer. ¥vendors¥renesas¥rx_mcu_boards¥boards¥rx671-rsk¥aws_demos¥flash_project ¥erase_from_bank¥erase.rpj
- ---Select [Operation] tab and click [Start] to erase the flash ROM.

🛃 Renesas Flash Programmer V3.10.00	- 🗆 X
ファイル(<u>F</u>) ターゲットデバイス(<u>D</u>) ヘルプ(<u>H</u>)	
操作 操作設定 ブロック設定 接続設定 ユニークコード	
プロジェクト情報 現在のプロジェクト: eraserpj マイクロコントローラ: RX Group	エンディアン(<u>E</u>): リトル 〜
プログラムファイル	
フラッシュ操作 消去 スタート(<u>S</u>)	正常終了
通信速度:1500000ps ターゲットデバイスを設定します。 選択されたブロックを消去します。 [Data Flash 1] 0×00100000 - 0×00101FFF サイズ:8 K [Code Flash 1] 0×FFE00000 - 0×FFFFFFFF サイズ:2.0 M ツールから切断します。 操作が成功しました。	
ネーゲットデバイスを設定します。 望訳されたブロックを消去します。 [Data Flash 1] 0x00100000 - 0x00101FFF サイズ:8 K [Code Flash 1] 0xFFE00000 - 0xFFFFFFFFF サイズ:2.0 M ツールから切断します。	

Figure 7-19 Flash ROM erase



7. Write initial firmware on RX671 PoC.

- -Create a new project with Renesas Flash Programmer (Ex : flash_project.rpj)
- —Select [Operation] tab and set userprog.mot stored in the init_firmware folder of the Program File.
- -Click [Start].

	要修正
🌌 Renesas Fl	Flash Programmer V3.05.00 (Free-of-charge Edition) — 💿 🗙
File Device	te Information Help
Operation Ope	peration Settings Block Settings Connect Settings Unique Code
Project Init Current P Microcom Program Fi D/¥Tem	Project flash_projectrpj ntroller: RX Group Endian: Little ~
Flash Oper	
[Config Area] (Veritying data [Config Area] (
	Clear status and message

Figure 7-20 Writing initial firmware



8. Open Tera Term

The Tera Term setup is shown below.

M COM11 - Tera Term VT — · · · × File Edit Setup C Tera Term: Serial port setup and connection Port: COM11 → Port: COM11 → Data: 8 bit → Data: 8 bit → Stop bits: 1 bit → Flow control: none → Transmit delay 0 msec/char 0 msec/line Device Friendly Name: USB ジリブル デバイス (COM11)
Port: COM11 ✓ New setting Speed: 115200 ✓ Data: 8 bit ✓ Cancel Parity: none ✓ Stop bits: 1 bit ✓ Help Flow control: none ✓ Transmit delay 0 msec/char 0 msec/line Device Friendly Name: USB ◊·リアル·テ/(1ス (COM1))
Port: COM11 ✓ New setting Speed: 115200 ✓ Data: 8 bit ✓ Cancel Parity: none ✓ Stop bits: 1 bit ✓ Help Flow control: none ✓ Transmit delay 0 msec/char 0 msec/line Device Friendly Name: USB ジリアル・デパイス (COM11)
Data: 8 bit Cancel Parity: none Cancel Parity: 1 bit Help Flow control: none Cancel Flow control: 1 bit Help Flow control: none Cancel Device Friendly Name: USB ジリアル デパイス (COM11)
Stop bits: 1 bit Flow control: none Transmit delay 0 msec/char 0 msec/line Device Friendly Name: USB ジリアル デバイス (COM11)
Flow control: none Transmit delay 0 msec/char 0 msec/line Device Friendly Name: USB シリアル デパイス (COM11)
Transmit delay の msec/char の msec/line Device Friendly Name: USB ジリアル デパイス (COM11)
0 msec/char 0 msec/line Device Friendly Name: USB ジリアル デパイス (COM11)
Device Friendly Name: USB シリアル デパイス (COM11) ヘ
Device Instance ID: USB¥VID_045B&PID_8111¥000000000001 Device Manufacturer: Microsoft Provider Name: Microsoft Driver Date: 6-21-2006 Driver Version: 10.0.19041.1202
< >>

Figure 7-21 Tera Term

Version 0.90 (initial version) is installed in RX671 PoC. RX671 PoC is now ready to receive OTA updates. The output log is shown below.a

```
_____
RX671 secure boot program
_____
Checking data flash ROM status.
Loading user code signer public key: not found.
provision the user code signer public key: OK.
Checking code flash ROM status.
bank 0 status = 0xfc [LIFECYCLE_STATE_INITIAL_FIRM_INSTALLED]
bank 1 status = 0xff [LIFECYCLE_STATE_BLANK]
bank info = 1. (start bank = 0)
started 10us software timer using CMT channel 0.
integrity check scheme = sig-sha256-ecdsa
bank0(execute area) on code flash integrity check...OK
erase bank1 secure boot mirror area...OK
OK
copy secure boot (part2) from bank0 to bank1...OK
jump to user program
0 83 [Tmr Svc] [DEBUG] [PKCS11] [core pkcs11 mbedtls.c:449] 1 83 [Tmr Svc] PKCS #11
module was successfully initialized.2 83 [Tmr Svc]
3 83 [Tmr Svc] [INFO] [PKCS11] [core_pkcs11_mbedtls.c:1504] 4 83 [Tmr Svc] PKCS #11
successfully initialized.5 83 [Tmr Svc]
6 83 [Tmr Svc] [DEBUG] [PKCS11] [core_pkcs11_mbedtls.c:1717] 7 83 [Tmr Svc] Successfully
Returned a PKCS #11 slot with ID 1 with a count of 1.8 83 [Tmr Svc]
9 83 [Tmr Svc] [WARN] [PKCS11] [core_pkcs11_mbedtls.c:1749] 10 83 [Tmr Svc]
C_GetTokenInfo is not implemented.11 83 [Tmr Svc]
12 83 [Tmr Svc] [WARN] [PKCS11] [core pkcs11 mbedtls.c:1839] 13 83 [Tmr Svc] C InitToken
is not implemented.14 83 [Tmr Svc]
70 373 [Tmr Svc] [DEBUG] [PKCS11] [core pkcs11 mbedtls.c:471] 71 373 [Tmr Svc]
Successfully found object class attribute.72 373 [Tmr Svc]
```



RX671 Group RX671 OTA-supported flat panel HMI PoC with touch keys and LCD

73 373 [Tmr Svc] [INFO] [PKCS11] [core pkcs11 mbedtls.c:2638] 74 373 [Tmr Svc] Creating a 0x3 type object.75 373 [Tmr Svc] 76 373 [Tmr Svc] [DEBUG] [PKCS11] [core_pkcs11_mbedtls.c:2158] 77 373 [Tmr Svc] Successfully found the key type in the template.78 374 [Tmr Svc] 79 374 [Tmr Svc] [DEBUG] [PKCS11] [core_pkcs11_mbedtls.c:2187] 80 374 [Tmr Svc] Successfully found the label in the template.81 374 [Tmr Svc] 82 374 [Tmr Svc] [DEBUG] [PKCS11] [core pkcs11 mbedtls.c:1243] 83 374 [Tmr Svc] Key was private type.84 374 [Tmr Svc] 91 660 [Tmr Svc] [INFO] [PKCS11] [core_pkcs11_mbedtls.c:2033] 92 660 [Tmr Svc] Successfully closed PKCS #11 session.93 660 [Tmr Svc] 94 663 [iot_thread] [INFO][DEMO][663] -----STARTING DEMO------95 663 [iot thread] [INFO][INIT][663] SDK successfully initialized. 96 107527 [iot_thread] [INFO][DEMO][107527] Successfully initialized the demo. Network type for the demo: 1 97 107527 [iot thread] [INFO][MQTT][107527] MQTT library successfully initialized. 98 107527 [iot_thread] [INFO][DEMO][107527] OTA demo version 0.9.0 99 107527 [iot thread] [INFO][DEMO][107527] Connecting to broker... 100 107527 [iot thread] [INFO][DEMO][107527] MQTT demo client identifier is rx671 POC (length 9). 101 109439 [iot thread] [WARN] [PKCS11] [core pkcs11 mbedtls.c:1499] 102 109439 [iot thread] Failed to initialize PKCS #11. PKCS #11 was already initialized.103 109439 [iot_thread] 104 109439 [iot thread] [DEBUG] [PKCS11] [core pkcs11 mbedtls.c:1717] 105 109439 [iot thread] Successfully Returned a PKCS #11 slot with ID 1 with a count of 1.106 109439 [iot thread] 107 109439 [iot thread] [DEBUG] [PKCS11] [core pkcs11 mbedtls.c:1953] 108 109439 [iot_thread] Assigned a 0x2 Type Session.109 109439 [iot_thread] 110 109439 [iot thread] [DEBUG] [PKCS11] [core_pkcs11_mbedtls.c:1964] 111 109439 [iot_thread] Assigned Mechanisms to no operation in progress.112 109439 [iot_thread] 113 109439 [iot_thread] [DEBUG] [PKCS11] [core_pkcs11_mbedtls.c:1980] 114 109439 [iot thread] Current session count at 0115 109439 [iot thread] 167 111156 [iot_thread] [DEBUG] [PKCS11] [core_pkcs11_mbedtls.c:1073] 168 111156 [iot_thread] Found object in list by handle.169 111156 [iot_thread] 170 111156 [iot thread] [DEBUG] [PKCS11] [core pkcs11 mbedtls.c:3780] 171 111157 [iot thread] Successfully started sign operation.172 111157 [iot thread] 173 112138 [iot_thread] [DEBUG] [PKCS11] [core_pkcs11_mbedtls.c:3966] 174 112138 [iot thread] Ended Sign operation.175 112138 [iot thread] 176 112223 [iot_thread] [INFO][MQTT][112223] Establishing new MQTT connection. 177 112223 [iot_thread] [INFO][MQTT][112223] (MQTT connection 23f18, CONNECT operation 240b8) Waiting for operation completion. 178 112351 [NetRecv] [INFO] [MQTT] [core_mqtt_serializer.c:970] 179 112351 [NetRecv] CONNACK session present bit not set.180 112351 [NetRecv] 181 112351 [NetRecv] [INFO] [MQTT] [core mqtt serializer.c:912] 182 112351 [NetRecv] Connection accepted.183 112351 [NetRecv] no 184 112351 [iot thread] [INFO][MQTT][112351] (MQTT connection 23f18, CONNECT operation 240b8) Wait complete with result SUCCESS. 185 112351 [iot thread] [INFO][MQTT][112351] New MQTT connection 6a54 established. 186 112353 [iot thread] [OTA AgentInit internal] OTA Task is Ready. 187 112353 [OTA Agent T] [prvPAL_GetPlatformImageState] is called. 188 112353 [OTA Agent T] Function call: prvPAL GetPlatformImageState: [2] 189 112353 [OTA Agent T] [prvExecuteHandler] Called handler. Current State [Ready] Event [Start] New state [RequestingJob] 190 112358 [OTA Agent T] [INFO] [MQTT] [112358] (MQTT connection 23f18) SUBSCRIBE operation scheduled. 191 112358 [OTA Agent T] [INFO][MQTT][112358] (MQTT connection 23f18, SUBSCRIBE operation 2a960) Waiting for operation completion. 192 112473 [OTA Agent T] [INFO] [MQTT] [112473] (MQTT connection 23f18, SUBSCRIBE operation 2a960) Wait complete with result SUCCESS. 193 112473 [OTA Agent T] [prvSubscribeToJobNotificationTopics] OK: \$aws/things/rx671_POC/jobs/\$next/get/accepted 194 112478 [OTA Agent T] [INFO][MQTT][112478] (MQTT connection 23f18) SUBSCRIBE operation scheduled. 195 112478 [OTA Agent T] [INFO] [MQTT] [112478] (MQTT connection 23f18, SUBSCRIBE operation 241f8) Waiting for operation completion.



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196 112585 [OTA Agent T] [INFO] [MQTT] [112585] (MQTT connection 23f18, SUBSCRIBE operation 241f8) Wait complete with result SUCCESS. 197 112585 [OTA Agent T] [prvSubscribeToJobNotificationTopics] OK: \$aws/things/rx671 POC/jobs/notify-next 198 112585 [OTA Agent T] [prvRequestJob Mqtt] Request #0 199 112594 [OTA Agent T] [INFO][MQTT][112594] (MQTT connection 23f18) MQTT PUBLISH operation queued. 200 112594 [OTA Agent T] [INFO][MQTT][112594] (MQTT connection 23f18, PUBLISH operation 241f8) Waiting for operation completion. 201 112670 [OTA Agent T] [INFO][MQTT][112670] (MQTT connection 23f18, PUBLISH operation 241f8) Wait complete with result SUCCESS. 202 112670 [OTA Agent T] [prvExecuteHandler] Called handler. Current State [RequestingJob] Event [RequestJobDocument] New state [WaitingForJob] 203 112672 [OTA Agent T] [prvParseJSONbyModel] Extracted parameter [clientToken: 0:rx671 POC] 204 112672 [OTA Agent T] [prvParseJSONbyModel] Extracted parameter [timestamp: 1662611090] 205 112672 [OTA Agent T] [prvParseJSONbyModel] parameter not present: execution 206 112672 [OTA Agent T] [prvParseJSONbyModel] parameter not present: jobId 207 112672 [OTA Agent T] [prvParseJSONbyModel] parameter not present: jobDocument 208 112672 [OTA Agent T] [prvParseJSONbyModel] parameter not present: afr_ota 209 112672 [OTA Agent T] [prvParseJSONbyModel] parameter not present: protocols 210 112672 [OTA Agent T] [prvParseJSONbyModel] parameter not present: files 211 112672 [OTA Agent T] [prvParseJSONbyModel] parameter not present: filepath 212 112672 [OTA Agent T] [prvParseJSONbyModel] parameter not present: filesize 213 112672 [OTA Agent T] [prvParseJSONbyModel] parameter not present: fileid 214 112672 [OTA Agent T] [prvParseJSONbyModel] parameter not present: certfile 215 112672 [OTA Agent T] [prvParseJSONbyModel] parameter not present: sig-sha256-ecdsa 216 112672 [OTA Agent T] [prvParseJobDoc] No active jobs available in the service for execution. 217 112674 [OTA Agent T] [prvParseJobDoc] Ignoring job without ID. 222 113353 [iot thread] [INFO][DEMO][113353] State: Ready Received: 1 Queued: 0 Processed: 0 Dropped: 0 223 114353 [iot_thread] [INFO][DEMO][114353] State: WaitingForJob Received: 1 Queued: Processed: 0 Dropped: 0 0 224 115353 [iot thread] [INFO][DEMO][115353] State: WaitingForJob Received: 1 Queued: 0 Processed: $\overline{0}$ Dropped: 0 225 116353 [iot thread] [INFO][DEMO][116353] State: WaitingForJob Received: 1 Queued: Processed: 0 Dropped: 0 226 117353 [iot_thread] [INFO][DEMO][117353] State: WaitingForJob Received: 1 Queued: Processed: 0 0 Dropped: 0 227 118353 [iot thread] [INFO][DEMO][118353] State: WaitingForJob Received: 1 Queued: Processed: 0 Dropped: 0



8. Restriction

This section describes restriction for this application note.

• FreeRTOS OTA programs with big endian operate abnormally. Build and operate programs with little endian.



9. Reference Documents

- RX671Group User's Manual: Hardware (R01UH0905)
- Renesas Starter Kit+ for RX671User's Manual (R20UT4879)
- RX Family Using QE and FIT to Develop Capacitive Touch Applications (R01AN4516)
- RX Family QE for Display GUI Display Application Development Guide using Serial Connection LCD (R20AN0688)
- Renesas MCU Firmware Update Design Policy (R01AN5548)
- How to implement FreeRTOS OTA by using Amazon Web Serviceson RX65N (R01AN5549)

The latest version can be downloaded from the Renesas Electronics website.

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Revision History

		Description	
Rev.	Date	Page	Summary
1.00	Apr.24.23	-	First edition



General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)

A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.

2. Processing at power-on

The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power is supplied until the power is supplied until the power reaches the level at which reseting is specified.

3. Input of signal during power-off state

Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.

4. Handling of unused pins

Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.

5. Clock signals

After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.

6. Voltage application waveform at input pin

Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.)

7. Prohibition of access to reserved addresses

Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.

8. Differences between products

Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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TOYOSU FORESIA, 3-2-24 Toyosu, Koto-ku, Tokyo 135-0061, Japan

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