

## **RX** Family

## Amazon FreeRTOS download with e<sup>2</sup> studio

## Introduction

Amazon FreeRTOS is a real-time operating system that augments the FreeRTOS kernel with libraries for connectivity, security, and over-the-air (OTA) updates. Amazon FreeRTOS also includes some demo applications that demonstrate Amazon FreeRTOS features on qualified boards.

Renesas e<sup>2</sup> studio is a development environment based on the popular Eclipse CDT (C/C++ Development Tooling), covers build (editor, compiler and linker control) as well as debug interface. It also supports to integrate the Amazon FreeRTOS demo applications and run them on Renesas boards.

Amazon FreeRTOS configuration feature in Smart Configurator provides a graphical user interface (GUI) configuration and code generation tool for Renesas RX microcontroller family. It helps user save valuable time to import project and take advantage of the functionality provided by the additional libraries. It also provides a function to change the setting of Amazon FreeRTOS kernel through GUI easily.

## Objectives

This document helps users to be familiar with the procedures to download, configure and run the Amazon FreeRTOS demo applications using the new features of e<sup>2</sup> studio: downloading Renesas GitHub Amazon FreeRTOS projects and configuring FreeRTOS libraries using Smart Configurator.

## **Operating Environment**

Operation was confirmed in the following environments.

IDE	e2 studio 7.5.0
Toolchains	CCRX Compiler v3.0.1
Target devices	Renesas RX Family
Emulators	E2, E2 Lite, E1 and E20



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#### Note

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- GitHub<sup>®</sup> is a trademark of GitHub, Inc. (<u>https://github.com/logos</u>)



## 1. Outline

This document describes the procedure to perform the demonstration for Amazon FreeRTOS on Renesas RX family by introducing following steps:

- Prepare and configure the demo project
- Select the demo to run
- Set up AWS corresponding to the demo
- Set up hardware (target device)
- Configure debug serial port
- Build and run the demo



## 2. Downloading from Renesas GitHub

#### 2.1 Download source code from GitHub

Before  $e^2$  studio v7.5, user must download the source code from GitHub manually, then import the project to  $e^2$  studio workspace. The new version of  $e^2$  studio supports user to import the source code right inside the IDE. Amazon FreeRTOS project importing functionality is supported in  $e^2$  studio v7.5 and above.

At the beginning, user would be able to choose the version of Amazon FreeRTOS package, and 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 application code.

The figure below shows how to import Amazon FreeRTOS project:

- 1. Launch  $e^2$  studio v7.5
- 2. Select [File]  $\rightarrow$  [Import..]
- 3. Select "Renesas GitHub Amazon FreeRTOS Project"

e <sup>2</sup> Import			$\times$
Select			p.L.
Renesas GitHub Amazon FreeRTOS Project			
<u>S</u> elect an import wizard:			
type filter text			
🕆 🗁 General			~
🔑 Archive File			
😂 Existing Projects into Workspace			
📮 File System			
🖗 HEW Project			
🗔 Preferences			
🖴 Projects from Folder or Archive			
Rename & Import Existing C/C++ Project into Workspace			
穿 Renesas CCRX project conversion to Renesas GCC RX			
☞ Renesas CS+ Project for CA78K0R/CA78K0			
➡ Renesas CS+ Project for CC-RX and CC-RL			
🞏 Renesas GitHub Amazon FreeRTOS Project			
> 🗁 C/C++			$\sim$
? < Back Next > Finite	sh	Cano	el

Figure 2-1 Download Amazon FreeRTOS projects from GitHub



4. If there is no Renesas GitHub Amazon FreeRTOS project which is already downloaded, "RTOS Version setting" list box will be empty.

e²									×
Renesa	s GitHub An	nazon FreeR	TOS Pro	oject					
🤨 Missir	ig RTOS Versio	n.							
Specify	a folder to cor	by selected Am	iazon Fre	eRTOS ver	sion in ord	der to import	the projec	rt.	
		orkspace\aws							wse
RTOS v	ersion setting								
Version									~
	Check for m	ore version							
?		< <u>B</u> ack		<u>N</u> ext >		<u>F</u> inish		Cancel	
		4							

#### Figure 2-2 There is no Amazon FreeRTOS project downloaded yet

5. Select "Check for more version..." to show the download dialog.

e <sup>2</sup>			—	
Amazon FreeRTOS Select the Amazon Fre	Module Download eRTOS modules for down	load		Ľ
Title	Rev. v0.1.9	Issue date 2019-05		Select All Deselect All
Module Folder Path:	lipse\org.eclipse.platform_	_download\RT	DS	Browse
			Download	Cancel

Figure 2-3 Amazon FreeRTOS download dialog



#### 6. Agree the end user license agreement.

e	<sup>2</sup> End User License Agreement(Sample Code)	×	
	This content is subject to the following license agreements: • <u>Renesas EULA</u> • <u>Amazon EULA</u>		
	Agree	Disagree	

Figure 2-4 User license agreement

7. Wait for downloading completed.

Pi	rogress Information		
	FreeRTOS module download		
	Downloading amazon-freertos-v0.1.9.zip - 2229443 bytes		
		Cancel	

Figure 2-5 Downloading Amazon FreeRTOS project dialog

8. The downloaded version is shown.

e²		_		×
Renesas GitHub Amazon FreeRTC Select RTOS version	9S Project			
Specify a folder to copy selected Amaz	on FreeRTOS version in a	order to import the projec	:t	
Folder: C:\Renesas\Workspace\aws			Bro	owse
RTOS version setting Version: Amazon FreeRTOS v0.1.9 Check for more version				~
? < Back	<u>N</u> ext >	<u>F</u> inish	Cancel	

Figure 2-6 Select source code version



# 9. Select the project to import. Only 1 project can be imported to 1 workspace. Keep "Copy projects into workspace" unchecked.

e <sup>2</sup> Import Projects				Х
Import Projects				
Select a directory to sea	rch for existing Eclipse projects.			
• Select roo <u>t</u> directory:	C:\Renesas\Workspace\aws\amazon-freertos-v0.1.9\demos\renesas	~	B <u>r</u> owse	
O Select <u>a</u> rchive file:		~	<u>Br</u> owse	
Projects:				
aws_demos (C:\Rer	nesas\Workspace\aws\amazon-freertos-v0.1.9\demos\renesas\rx65n-gr-rose-uart-esp8266\gnurx-e2studio)	^	<u>S</u> elect A	JI
	nesas\Workspace\aws\amazon-freertos-v0.1.9\demos\renesas\rx65n-gr-rose\ccrx-e2studio)		<u>D</u> eselect	All
	nesas\Workspace\aws\amazon-freertos-v0.1.9\demos\renesas\rx65n-gr-rose\gnurx-e2studio-cpp) nesas\Workspace\aws\amazon-freertos-v0.1.9\demos\renesas\rx65n-gr-rose\gnurx-e2studio)		R <u>e</u> fresł	
	nesas\Workspace\aws\amazon-freertos-v0.1.9\demos\renesas\rx65n-rsk-uart-sx-ulpgn\ccrx-e2studio)			
	nesas\Workspace\aws\amazon-freertos-v0.1.9\demos\renesas\rx65n-rsk-uart-sx-ulpgn\gnurx-e2studio)			
	nesas\Workspace\aws\amazon-freertos-v0.1.9\demos\renesas\rx65n-rsk\ccrx-e2studio)			
	nesas\Workspace\aws\amazon-freertos-v0.1.9\demos\renesas\rx65n-rsk\e2studio\ccrx\user_application) nesas\Workspace\aws\amazon-freertos-v0.1.9\demos\renesas\rx65n-rsk\gnurx-e2studio)			
	nesas (Workspace (aws \amazon-freertos-vo. 1.9 \demos \renesas (x05) risk \grant-ezstudio) nesas \Workspace \aws \amazon-freertos-v0.1.9 \demos \renesas \rx65n-rsk \e2studio \ccrx\boot loader)			
Options	·			
Search for nested pro	piects			
<u>Copy projects into we</u>	•			
Hide projects that alre	eady exist in the workspace			
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Add projec <u>t</u> to worki	ing sets		Ne <u>w</u>	
Working sets:		~	S <u>e</u> lect	
?			C	
Ū	Einish		Cancel	

#### Figure 2-7 Select project to import

10. Open project properties, select toolchain and builder, then specify toolchain version.

e <sup>2</sup> Properties for aws_dem	IOS .	$ \Box$ $\times$
type filter text	Tool Chain Editor	♦ ▼  ▼
<ul> <li>Resource</li> <li>Builders</li> <li>C/C++ Build</li> <li>Build Variables</li> </ul>	Configuration: HardwareDebug [Active]	V Manage Configurations
Environment Logging Settings	Display compatible toolchains only     Current toolchain: Renesas CCRX Toolchain	▼
Tool Chain Editor > C/C++ General Project References Renesas QE	Current builder: CCRX Builder	~
Run/Debug Settings	Used tools DSP Assembler Common Compiler	Select Tools
	Assembler Linker Library Generator	
	Converter RTOS Configurator	~
		Restore Defaults Apply
0		Apply and Close Cancel



e <sup>2</sup> Properties for aws_demos	— 🗆 X	
type filter text	Settings $\Leftrightarrow \checkmark \diamond \checkmark$	•
<ul> <li>Resource Builders</li> <li>C/C++ Build Build Variables Environment Logging Settings Tool Chain Editor</li> <li>C/C++ General Project References Renesas QE Run/Debug Settings</li> </ul>	Configuration: HardwareDebug [ Active ]   Manage Configurations Tool Settings Toolchain Device Puild Steps Puild Artifact Binary Parsers Parsers   Current Toolchain   Toolchain:   Renesas CCRX   Version:   v3.01.00   Version: v3.01.00 v3.01.00 v3.01.00	
?	Apply and Close Cancel	

Figure 2-8 Select toolchain

## 2.2 New folder structure

From version 0.1.9 of GitHub Amazon FreeRTOS source code, Renesas introduces a new folder structure for device driver libraries (FIT). Instead of using generated code from Smart Configurator, a .bat file is added to exclude the generated code from build and refer to modified FIT in the package.



Figure 2-9 New folder structure of the project



## 3. Configure the Amazon FreeRTOS

Smart Configurator perspective will be launched as shown below. In Amazon\_demos.scfg panel, FreeRTOS Kernel, Object and Amazon libraries packages are ready and displayed in Current Configuration in [Overview] tab

					6
Clocks			Application under development		
Allow clock configuration			development	-Components	
			Middleware	Components	
Components			Device		
Allow software component sele	ction and configuration		driver RTOS	J	
			101000000000000000000000000000000000000	🖛 Pins	
Pins					
Allow general pin configuration	and pin configuration fo	or selected software component			
Interrupt					
Allow general interrupt configu	ration and interrupt confi	iguration for selected software componen	t		
		iguration for selected software componen	t		
		-	t		
Click here to get more informat	ion on Tool News, Applic	ation Notes, Technical Update etc.	t		
Click here to get more informat Current Configuration Selected board/device: R5F565t	ion on Tool News, Applic	-	t		
Click here to get more informat Current Configuration Selected board/device: R5F5651 Selected components:	ion on Tool News, Applic	ration Notes, Technical Update etc. RAM size: 640KB, Pin count: 176)	t		
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Click here to get more informat  Current Configuration Selected board/device: R5F5651 Selected components: Component Component AWS ggd	ion on Tool News. Applic NEDxFC (ROM size: 2MB, I Version 1.0.0	RAM size: 640KB, Pin count: 176)	t		^
Click here to get more informat  Current Configuration Selected board/device: R5F5651 Selected components: Component OMVS.ggd Tubyteq	NEDxFC (ROM size: 2MB, I Version 1.0.0 1.71	RAM size: 640KB, Pin count: 176)			^
Click here to get more informat  Current Configuration Selected board/device: R5F565N Selected components: Component OMVS_ggd Or_byteq AWS_tcp_ip	VEDxFC (ROM size: 2MB, 1 VEDxFC (ROM size: 2MB, 1 Version 1.0.0 1.71 1.0.0	RAM size: 640KB, Pin count: 176) Configuration AWS_ggd(used) r_byteq(used) AWS_tcp_ip(used)			^
Click here to get more informat  Current Configuration Selected board/device: R5F565N Selected components: Component AWS_ggd Cr_byteq AWS_tcp_ip Cr_byteq Cr	ion on Tool News, Applic NEDxFC (ROM size: 2MB, 1 Version 1.0.0 1.71 1.0.0 1.15	RAM size: 640KB, Pin count: 176) Configuration AWS_ggd(used) r_byteq(used) AWS_tcp_ip(used) r_ether_nx(used)			
Click here to get more informat  Current Configuration Selected board/device: R5F5651 Selected components: Component AWS_aga r_byteq AWS_tcp_ip r_tbyteq r_t	VEDxFC (ROM size: 2MB, I Version 1.0.0 1.71 1.0.0 1.15 1.0.0	RAM size: 640KB, Pin count: 176) Configuration AWS_ggd(used) r_byteq(used) AWS_tcp_ip(used) r_chet_rx(used) FreeRTOS_Object(used)			
Click here to get more informat  Current Configuration Selected board/device: R5F565N Selected components: Component AWS_ggd Cr_byteq AWS_tcp_ip Cr_byteq Cr	ion on Tool News, Applic NEDxFC (ROM size: 2MB, 1 Version 1.0.0 1.71 1.0.0 1.15	RAM size: 640KB, Pin count: 176) Configuration AWS_ggd(used) r_byteq(used) AWS_tcp_ip(used) r_ether_nx(used)			

Figure 3-1 Smart Configurator perspective with Amazon FreeRTOS



## **3.1** Amazon FreeRTOS Kernel

- 1. In [Components] tab, select [FreeRTOS\_kernel] layer in the Components tree at the left panel.
- 2. The corresponding parameter is displayed in the right panel for users to quickly manage FreeRTOS kernel setting.

This provides all possible configuration setting options for FreeRTOS kernel.

3. Click on any configurations option setting in the right panel to display its definition as shown in the picture below.



Figure 3-2 FreeRTOS\_Kernel configuration panel

## 3.2 Amazon FreeRTOS Object

- 1. In [Components] tab, select [FreeRTOS\_Object] layer in the Components tree at the left panel.
- 2. Go to option setting in the right panel to configure objects such as task, semaphores, queues, software timer, event groups, stream and message buffers.
- 3. Under object labels, click +/- buttons to create new objects. All options settings can be edited and updated at any time.
- Tasks:

New task will be created/deleted after clicking +/- buttons. Option setting will be showed in the right panel where **Initialize, Task Code, Task Name, Stack Size, Task Handler, Parameter and Priority** can be edited.

The task can be created by two ways:

- kernel start: created task will be executed after calling vTaskStartScheduler().
- manual: prepare some tasks that user thinks it will be useful later. The tasks created by this way will
  not be executed at the beginning after vTaskStarScheduler() is called unless changing to kernel start
  mode.



Components ↓ª □ □ □ □ → ▼ C	onfigure					
<b>i</b> 5	Tasks Semaphores Queues	Software Timers Even	t Groups Stream	n Buffers Messag	je Buffers	
type filter text	+/- Initialize Task C	ode Task Name	Stack Size	Task Handler	Parameter	Priority
🗸 🗁 Drivers 🔥	Gernel start ∨ task_1	task_1	512	NULL	NULL	1
✓ ⇒ A/D Converter	G kernel start ∨ task_2	task_2	512	NULL	NULL	1
😵 r_s12ad_rx	<b>O</b>				1	
V 🗁 Memory						
💁 r_flash_rx						
Communications						
💣 r_ether_rx						
💁 r_sci_rx						
✓ ➢ Middleware						
<ul> <li>Middleware</li> <li>Generic</li> </ul>						
_						
🗸 🗁 Generic						
✓ ➢ Generic ♥ r_byteq						
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<ul> <li>✓ ⇒ Generic</li> <li>№ r_byteq</li> <li>✓ ⇒ RTOS</li> <li>✓ ⇒ RTOS Libary</li> <li> AWS_device_shadov</li> </ul>						
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<ul> <li>Generic</li> <li>r_byteq</li> <li>RTOS</li> <li>RTOS Ibary</li> <li>AWS_device_shadov</li> <li>AWS_ggd</li> <li>AWS_mqtt</li> <li>AWS_secure_socket</li> </ul>						
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<ul> <li>✓ ➢ Generic</li> <li>Prost     <li>Prost     <li>AWS_device_shadov     <li>AWS_ggd     <li>AWS_secure_socket     <li>AWS_scure_socket     <li>AWS_stcp_ip     <li>V ➢ RIOS Object     </li> </li></li></li></li></li></li></li></ul>						
<ul> <li>✓ ➢ Generic</li> <li>Prostary     <li>Prostary     <li>AWS_device_shadov     <li>AWS_ggd     <li>AWS_ggd     <li>AWS_mqtt     <li>AWS_secure_socket     <li>AWS_tcp_ip     <li>&gt; &gt; Prostary     </li> </li></li></li></li></li></li></li></li></ul>						

## Figure 3-3 Tasks configuration panel

#### • Semaphores:

New **Semaphores** will be created/deleted after clicking +/- buttons. Option setting will be showed in the right panel where **Semaphore Type and Semaphore Handler** can be edited.

Softwal aws_demos/aws_demos.scfg rat	ion	6
Components $\downarrow_{Z}^{a} \models \ddagger \Rightarrow \bullet$ C	onfigure	
1 T	Tasks Semaphores Queues Software Timers Event Groups Stream Buffers Message Buffers	
type filter text		
	+/- Semaphore Type Semaphore Handler	
✓ → Drivers ∧ ✓ → A/D Converter	binary v semaphore_handle_1	
Pr_s12ad_rx	mutex v semaphore_handle_2	
V > Memory	0	
<pre>   r_flash_rx </pre>		
Communications		
💣 r_ether_rx		
💱 r_sci_rx		
🗸 🗁 Middleware		
V 🗁 Generic		
Pr_byteq RTOS		
V 🔁 RTOS Libary		
AWS_device_shadov		
AWS_ggd		
AWS_mqtt		
AWS_secure_socket		
💣 AWS_tcp_ip		
V 🕞 RTOS Object		
FreeRTOS_Object		
<ul> <li>RTOS Kernel</li> <li>FreeRTOS_Kernel</li> </ul>		

#### Figure 3-4 Semaphores configuration panel



#### • Queues:

New **Queues** will be created/deleted after clicking +/- buttons. Option setting will be showed in the right panel where **Queue Handler, Queue length and Items size** can be edited.

Software component cor	nfiguration					٦
Components	🐳 👻 Configu	ıre				
	Task	s Semaphores Que	ues Software Tim	ers Event Groups	Stream Buffers Message	Buffers
type filter text		/- Queue Handler	Queue Length	Items Size		
✓ ⇒ Drivers	<u>^</u>	queue_handle_2	100	sizeof(uint32_t)		
✓ 🗁 A/D Converter		queue_handle_3	100	sizeof(uint32_t)		
💁 r_s12ad_rx			1			
V 🗁 Memory		·				
😫 r_flash_rx						
🗸 🗁 Communications						
💣 r_ether_rx						
🔮 r_sci_rx						
🖌 🗁 Middleware						
🗸 🗁 Generic						
🍄 r_byteq						
🗸 🗁 RTOS						
🗸 🗁 RTOS Libary						
AWS_device_shade	ov					
aWS_ggd						
💣 AWS_mqtt						
AWS_secure_socke	et					
AWS_tcp_ip						
RTOS Object						
FreeRTOS Object						
Erros Kernel     Free PTOS Kernel						
FreeRTOS_Kernel	~					

#### Figure 3-5 Queue configuration panel

#### • Software timer:

New **Software timer** will be created/deleted after clicking +/- buttons. Option setting will be showed in the right panel where **specific parameters** can be edited.

	ration	۵
Components $\downarrow^a_{\ \ \ }$	Configure	
🔪 🗟	Tasks Semaphores Queues Software Timers Event Groups Stream Buffers Message Buffers	
type filter text	+/- swTimer Handler swTimer Name swTimer Period Auto Reload swTimer ID Callback Function	
V 🗁 Drivers 🔥	Swt_handle_1 Timer_1 100 False ∨ 0 NULL	
✓ ⇒ A/D Converter	swt_handle_2 Timer_2 100 False v 0 NULL	
💱 r_s12ad_rx	Ŏ	
V 🗁 Memory		
💕 r_flash_rx		
✓		
💣 r_ether_rx 🕸 r_sci_rx		
Y r_sci_rx ✓ → Middleware		
<ul> <li>Generic</li> </ul>		
Porteq		
V > RTOS		
V 🕞 RTOS Libary		
AWS_device_shadov		
aWS_ggd		
e AWS_mqtt		
AWS_secure_socket		
AWS_tcp_ip		
RTOS Object		
FreeRTOS_Object		
FreeRTOS_Object ✓		
FreeRTOS_Object		

#### Figure 3-6 Software timer configuration panel



#### • Event group:

New **Event group** will be created/deleted after clicking +/- buttons. Option setting will be showed in the right panel where **specific parameters** can be edited.

Software component configur	ation	6
Components $\downarrow_{Z}^{a} \boxdot \textcircled{+} \overset{+}{\Rightarrow} \checkmark$	Configure	
ie 😨	Tasks Semaphores Queues Software Timers Event Groups Stream Buffers Message Buffers	
type filter text	+/- Event Group Handler	
V 🗁 Drivers 🔺	event_grp_handle_1	
✓ 🗁 A/D Converter	Ŏ	
r_s12ad_rx		
V 🗁 Memory		
💁 r_flash_rx		
Communications		
r_ether_rx		
💁 r_sci_rx		
✓ → Middleware		
🗸 🗁 Generic		
😜 r_byteq		
V 🗁 RTOS		
🗸 🗁 RTOS Libary		
AWS_device_shadov		
e AWS_ggd		
e AWS_mqtt		
AWS_secure_socket		
💣 AWS_tcp_ip		
RTOS Object		
FreeRTOS_Object		
🗸 🗁 RTOS Kernel		
FreeRTOS_Kernel		
~		
< >	<	

#### Figure 3-7 Event group configuration panel

#### • Stream buffers:

New **Stream buffers** will be created/deleted after clicking +/- buttons. Option setting will be showed in the right panel where **specific parameters** can be edited.

Components 📳 🖬 🖶 🗸	Configure	
Components $\downarrow^a_Z \models \oiint \clubsuit$	Configure	
😺 🗟	Tasks Semaphores Queues Software Timers Event Groups Stream Buffers Message Buffers	
type filter text	+/- Stream Buffer Handler Stream Buffer Size Trigger Level	
🗸 🗁 Drivers 🔥	stream_bff_handle_1 100 10	
✓ → A/D Converter	Ŏ	
💕 r_s12ad_rx		
🗸 🗁 Memory		
😜 r_flash_rx		
Communications		
💣 r_ether_rx		
💁 r_sci_rx		
✓		
🗸 🗁 Generic		
💱 r_byteq		
V 🗁 RTOS		
🗸 🗁 RTOS Libary		
AWS_device_shadov		
e AWS_ggd		
aWS_mqtt		
AWS_secure_socket		
💣 AWS_tcp_ip		
RTOS Object		
FreeRTOS Object		
🗸 🗁 RTOS Kernel		
FreeRTOS_Kernel		

#### Figure 3-8 Semaphores configuration panel



#### • Message buffers:

New **message buffers** will be created/deleted after clicking +/- buttons. Option setting will be showed in the right panel where **specific parameters** can be edited.



Figure 3-9 Semaphores configuration panel



## **3.3** Amazon FreeRTOS libraries

All supported configurations of these Amazon FreeRTOS libraries are showed as following contents:

- Device shadow: AWS\_device\_shadow
- Green Grass: AWS\_ggd
- MQTT: AWS\_mqtt
- Secure Socket: AWS\_secure\_socket
- TCP IP: AWS\_tcp\_ip

#### 1. In [Components] tab, select [RTOS\_Library] layer in the Components tree at the left panel.

2. Go to option setting in the right panel to configure these Amazon FreeRTOS libraries as Figure 3-10.



Figure 3-10 Amazon FreeRTOS libraries configuration panel



For example, Amazon TCP IP configuration:

- The corresponding parameter is displayed in the right panel for user to quickly manage the Amazon TCP IP setting. This provides all possible configuration setting options for the Amazon TCP IP setting.
- Click on any configurations option setting in the right panel to display its definition as shown in the picture below.



Figure 3-11 TCP IP configuration panel



## 4. Code generation

1. After configuring, FreeRTOS kernel, object and libraries code or middleware modules can be generated and imported to the project source folder by clicking "Code Generation" button.

🔅 *aws_demos.scfg 🔀			
aws_demos/aws_dem	os.scfg		<b>6</b>
Components $\downarrow^{a}_{Z} \boxdot   \Rightarrow$	Configure		
type filter text	Property v 🏽 Configurations	Value	^
71	# Backward Compatibility	📝 Enable	
V 🗁 Drivers 🔨	# RTOS scheduler	Preemptive	
✓ → A/D Converter	# Port optimised task selection	Disable	
💱 r_s12ad_rx	# Maximum number of priorities to the applicatio	n 7	
V 🗁 Memory	# The frequency of the RTOS tick interrupt	1000	
💕 r_flash_rx	# The size of the stack used by the idle task	( unsigned short ) 512	
Communications	# The total amount of RAM available in the FreeR	T( ( size_t ) ( 128U * 1024U )	
er_ether_rx	# The maximum permissible length of name	12	
🐮 r_sci_rx	# Use trace facility	V Enable	
✓ ➢ Middleware	# Use 16bit ticks	Disable	
V 🔁 Generic	# Idle should yield	V Enable	
😫 r_byteq	# Mutex functionality	Enable	

Figure 4-1 "Code Generation" button

2. The source code will be generated under renesas\_code folder: [frtos\_skeleton] and [frtos\_startup]



## 5. Application development

1. Two folders are generated under renesas\_code folder: [frtos\_skeleton] and [frtos\_startup]

Project Explorer 🛛	□ 🕏	
🗸 😂 aws_demos [HardwareDebug]		
> 🖑 Binaries		
> 🔊 Includes		
✓ 🔀 application_code		
> 🔁 common_demos		
✓		
> 🔓 config_files		
✓		
> 🔂 task_1.c		
> h task_function.h		
✓		
> 🔂 freertos_object_init.c		
> c main.c		
✓ Call config_files		
> h aws_bufferpool_config.h		
> h aws_demo_config.h		
> h aws_ggd_config.h		
> h aws_mqtt_agent_config.h		
> h aws_mqtt_config.h		
> h aws_ota_agent_config.h		
> h aws_pkcs11_config.h		
> h aws_secure_sockets_config.h		
> h aws_shadow_config.h		
> h aws_wifi_config.h		
> h FreeRTOSConfig.h		
> h FreeRTOSIPConfig.h		
h mbedtls_user_config.h		
> 🔐 lib		
> 👝 HardwareDebug		
aws_demos HardwareDebug.launch		
aws_demos_build_path_check_and_mai	ake.bat	
嶽 aws_demos.scfg		

Figure 5-1 Project Explorer



frtos\_skeleton includes task's skeleton where user implements own code.

🎦 Project Explorer 💥 📄 🔄 🌣 🖓 🗖	🔅 *aws_demos.scfg	i ask_1.c ⊗
<ul> <li>✓ ∰ aws_demos [HardwareDebug]</li> <li>&gt; ∭ Includes</li> <li>✓ ∰ application_code</li> <li>&gt; ∰ common_demos</li> <li>✓ ▷ renesas_code</li> <li>&gt; ∰ tos_skeleton</li> <li>&gt; ⓒ frtos_skeleton</li> <li>&gt; ⓒ task_1.c</li> <li>&gt; ⓑ task_function.h</li> <li>&gt; ➢ frtos_startup</li> <li>&gt; ⓓ main.c</li> <li>&gt; 즪 config_files</li> <li>&gt; 즪 tail.e</li> </ul>	2 ⊕ * 1 20 ⊕ 1 22 ⊕ 1 23 ⊕ 4 24 /4 25 ⊕ 7 26 ⊕ 0 27 { 28 ⊕ 7 4 29 /4 30 } 31 } 32 ⊕ 4	<pre>  *task_1.c  DISCLAIMER DISCLAIMER include : <system includes="">, "Project Includes" include : task_function.h" * Start user code for import. Do not edit comment generated here */ * End user code. Do not edit comment generated here */ * Start user code for function. Do not edit comment generated here */ * End user code. Do not edit comment generated here */ * Start user code for other. Do not edit comment generated here */ * Start user code for other. Do not edit comment generated here */ * Start user code. Do not edit comment generated here */ * End user code. Do not edit comment generated here */ * Start user code for other. Do not edit comment generated here */ * End user code. Do not edit comment generated her</system></pre>
> ଜ src 📄 aws_demos HardwareDebug.launch 📸 aws_demos.scfg		

Figure 5-2 Task's skeleton where user implement application

frtos\_startup includes corresponding initialization code which is created after clicking generation button

- 2. The configurator automatically generates the code reflecting the configuration choices
  - Kernel: in <Amazon\_demos>/config\_files/ FreeRTOSConfig.h"
  - Object: in <Amazon\_demos>/application\_code/renesas\_code/frtos\_startup/ FreeRTOSConfig.h"
  - Amazon libraries: in <Amazon\_demos>/config\_files/". For example, Amazon\_mqtt\_config.h



Figure 5-3 Kernel, object and Amazon libraries configuration file



## 6. Select the demo to run

User can select the project to run in

\${PROJECT\_LOC}/application\_code/common\_demos/source/aws\_demo\_runner.c by commenting out all functions except the selected one.



Figure 6-1 Demo runner file

The following table lists the functions in aws\_demon\_runner.c file and their corresponding demos.

Function	Demo	Description
vStartMQTTEchoDemo	MQTT Echo	Appendix 9.1.
vStartGreenGrassDiscoveryTask	Greengrass Discovery	Appendix 9.2.
vStartOTAUpdateDemoTask	OTA Update	T.B.D
vStartShadowDemoTasks	IoT Shadow	T.B.D
vStartSimpleTCPServerTasks	Simple TCP Server	Appendix 9.3
vStartTCPEchoClientTasks_SeparateTasks	TCP Echo	Appendix 9.4
vStartTCPEchoClientTasks_SingleTasks		
vStartDeviceDefenderDemo	Device Defender	T.B.D

#### Table 6-1 Functions and corresponding demos



## 7. Set up AWS

To run the Amazon FreeRTOS demos, user needs an AWS account, an IAM user with permission to access AWS IoT and Amazon FreeRTOS cloud services.

To set up AWS account and permission, please refer to <u>https://docs.aws.amazon.com/freertos/latest/userguide/freertos-account-and-permissions.html.</u>

Next, user needs to register the board with AWS IoT as described at <a href="https://docs.aws.amazon.com/freertos/latest/userguide/get-started-freertos-thing.html">https://docs.aws.amazon.com/freertos/latest/userguide/get-started-freertos-thing.html</a>.

To make the demo communicate with AWS, user needs to configure the source code as described at <u>https://docs.aws.amazon.com/freertos/latest/userguide/freertos-configure.html.</u>

For steps to set up the services for each demo in the package, please refer to the appendix as Table 3-1.



## 8. Hardware setup

User also needs to set up the specific hardware to work with the source code setup. For example:

- RSK64M:
  - J3: pin 1-2 shorted.
  - J4: pin 1-2 shorted.
  - Other pins/switches: default settings as RSK schematics.
- RSK71M:
  - J9: pin 1-2 shorted.
  - J13: pin 1-2 shorted.
  - Other pins/switches: default settings as RSK schematics.



## 9. Debug log

The demo outputs debug log via SCI port. If user wants to check the debug logs, connect a terminal emulator, such as Tera Term, to the serial port which is used by SCI driver.

Tera Term: Serial port setup		>
Port:	СОМ4 ~	ОК
Sp <u>e</u> ed:	115200 ~	·
<u>D</u> ata:	8 bit ~	Cancel
P <u>a</u> rity:	none ~	
<u>S</u> top bits:	1 bit ~	, <u>H</u> elp
Elow control:	none ~	•
Transmit delay	y c/ <u>c</u> har 0	msec/ <u>l</u> ine

Figure 9-1 Serial port setup for terminal emulator (e.g. Tera Term)



## 10. Build and run

After performing all above setups, continue following steps to build and run the demo.

- 1. Right click on the project in Project Explorer, select "Build".
- 2. Confirm that the emulator (E2/E2 Lite) is connected to the board.
- 3. From top menu, select [Run]  $\rightarrow$  [Debug Configuration].
- 4. Expand Renesas GDB Hardware Debugging, and choose aws\_demos HardwareDebug

e <sup>2</sup> Debug Configurations			×
Create, manage, and run configurations			Ť.
Image: Second State Sta	Name:       aws_demos HardwareDebug         Imain       Image: Debugger       Startup         Project:       aws_demos         C/C++ Application:       HardwareDebug/aws_demos.abs         Build (if required) before launching       Build Configuration:         Select Automatic       O Enable auto build         Image: Use workspace settings       Image: Debugs	<u>V</u> ariables Searc <u>h</u> Project	Browse Browse
Filter matched 13 of 15 items		Re <u>v</u> ert	Apply
?		Debug	Close

Figure 10-1 Select launch configuration



5. Choose the Debugger tab, and then choose the Connection Settings tab. Confirm that your connection settings are correct.

			~~~~
° 🗈 🗙   🖻 ‡⇒ -	Name: aws_demos HardwareDebug		
type filter text	Mair 🔅 Debugger 🕨 Startup 🔲 Common 🖏	Source	
C/C++ Application C/C++ Remote Application E EASE Script	Debug hardware: E2 Lite (RX)  Target Device	e: R5F565NE_DUAL	
C GDB Hardware Debugging	GDB Settings Connection Settings Debug Tool Setting	ngs	
GDB Simulator Debugging	✓ Clock		
Java Applet	Main Clock Source	EXTAL	✓
Java Application	Extal Frequency[MHz]	24.0000	
🕞 Launch Group	Permit Clock Source Change On Writing Interna	Yes	×
Launch Group (Deprecated)	<ul> <li>Connection with Target Board</li> </ul>		
Remote Java Application	Emulator	(Auto)	
<ul> <li>Renesas GDB Hardware Deb</li> </ul>	Connection Type	JTag	✓
c× aws_demos HardwareD	JTag Clock Frequency[MHz]	6.00	✓
💽 Renesas Simulator Debuggi	Fine Baud Rate[Mbps]	1.50	$\sim$
	Hot Plug	No	~
	v Power		
	Power Target From The Emulator (MAX 200mA)	No	~
	Supply Voltage[V]	3.3	×
	✓ CPU Operating Mode		
	Register Setting	Single Chip	~
	Mode pin	Single-chip mode	V
	Change startup bank	No	~
	Startup bank	Bank 0	× .
< >>			
ilter matched 13 of 15 items		Revert	Apply

#### Figure 10-2 Hardware debug configuration

- 6. Choose Debug to download the code to your board and begin debugging.
- 7. e<sup>2</sup> studio might ask to change to Renesas Debug Perspective. Choose [Yes].
- 8. After the code is downloaded to the board, choose [Resume] to run the code up to the first line of the main function. Choose [Resume] again to run the rest of the code.
- 9. Check the debug log shown in terminal emulator.
- 10. Check the expected output on AWS console (if any) as described in appendix.



## 11. Website and support

AWS Amazon FreeRTOS forum: <u>http://forums.aws.amazon.com.</u> Renesas GitHub for RX MCUs: <u>https://github.com/renesas-rx/amazon-freertos.</u>



## 12. Appendix

The Appendix contains detailed descriptions of AWS setup for each demo, as well as steps to get the expected output.

## 12.1 MQTT Echo

This demo application uses the Amazon FreeRTOS MQTT library to connect to the AWS Cloud and then periodically publish messages to an MQTT topic hosted by the AWS IoT MQTT broker.

## 12.1.1 Set up AWS MQTT client

This setup is to check the messages sent by this demo.

- 1. Sign into the AWS IoT console.
- 2. In the navigation pane, choose [Test] to open the MQTT client.
- 3. In Subscription topic, enter "freertos/demos/echo", and then choose [Subscribe to topic].
- Then user can see the messages that device sends to AWS Cloud.

## 12.2 Greengrass Discovery

The Greengrass Discovery demo publishes a series of messages to the Greengrass core, and to the AWS IoT MQTT client. In addition to the setup described in chapter 4, user needs to set up AWS IoT Greengrass permission, Greengrass group, Greengrass Core.

#### 12.2.1 Set up environment for Greengrass Core

To set up the Greengrass Core, user need a Raspberry Pi 3 Model B+ or Model B with an 8 GB microSD card, or an Amazon EC2 instance.

To set up for Raspberry Pi, please refer to

https://docs.aws.amazon.com/greengrass/latest/developerguide/setup-filter.rpi.html.

To set up for EC2 instance, please refer to <u>https://docs.aws.amazon.com/greengrass/latest/developerguide/setup-filter.ec2.html.</u>

#### 12.2.2 Install Greengrass Core software

This procedure includes steps for configuring and starting the core software on the Greengrass Core device. These instructions are applied for Raspberry Pi, but user can use any supported device.

To configure AWS IoT Greengrass on AWS IoT, please refer to https://docs.aws.amazon.com/greengrass/latest/developerguide/gg-config.html.

To start AWS IoT Greengrass on core device, please refer to https://docs.aws.amazon.com/greengrass/latest/developerguide/gg-device-start.html.

#### 12.2.3 Set up AWS IoT Greengrass permission

After setting up AWS and AWS IoT Greengrass, user needs to configure some additional permissions for AWS IoT Greengrass. User can achieve this step by referring to

https://docs.aws.amazon.com/freertos/latest/userguide/gg-demo.html and focusing on following items:

- 1. To set up AWS IoT Greengrass permissions
- 2. To create a new AWS IoT Greengrass policy
- 3. To attach the AWS IoT Greengrass policy to your device's certificate (Renesas RX board)



## **RX** Family

#### 12.2.4 Add RX board to Greengrass group

In order to communicate with Greengrass Core, user needs to add the IoT thing associated with Renesas RX board to the Greengrass Group.

*Note:* Greengrass may not be available in some regions. If the existing device is not in the same region with new Greengrass group & core, user needs to create new IoT thing in the same region.

- 1. In the AWS IoT Core console, choose [Greengrass], choose [Groups], and then choose your group.
- 2. On the group configuration page, choose [Devices], and then choose [Add your first Device].

GREENGRASS GROUP MyFirstGrou Not deployed	p Actions ▼
Deployments	Devices Add Device
Subscriptions	
Cores	
Devices	
Lambdas	
Resources	
Connectors	LOD)
Settings	Make Devices aware of your Core
	Greengrass allows you to connect devices at the edge. Greengrass Devices share the same SDK as IoT Things. You can use Subscriptions to connect them to each other, to Lambda functions or directly to cloud services.
	Learn about Devices Add your first Device

Figure 12-1 Add device to Greengrass group

3. Choose [Select an IoT thing].

Add a Device					
Greengrass Devices can be created by re-purposing an existing IoT Thing fro them to a Greengrass Group.	m your Registry or by creating new Registry items, and then adding				
reate a new Device					
You will create a new Device and generate a certificate, a private key and a public key.	Create New Device				

#### Figure 12-2 Select device to add to Greengrass group

4. Select the IoT thing configured for RX board, then click [Finish].



#### 12.2.5 Create subscription and deploy the Greengrass group

- 1. On the group configuration page, choose [Subscriptions], and then choose [Add Subscription].
- 2. Configure the subscription.
  - a. Under [Select a source], choose [Devices], and then choose the IoT thing that associates with RX board.
  - b. Under Select a target, choose [Services], and then choose "IoT Cloud".
  - c. Choose Next.

CREATE A SUBSCRIPTION Select your source ar	d target	
A Subscription consists of a source, The first step is selecting your source Select a source		f the message. The target is the destination of the message.
د gg_aws_demo_mcu_rxdev	GREENGRASS DEVICE	Edit
Select a target		
iot Cloud	SERVICE	Edit

## Figure 1212-3 Configure subscription

3. On the group configuration page, from [Actions], choose [Deploy].

GREENGRASS GROUP MyFirstGrou Successfully com		Actions -
Deployments	Subscriptions	Deploy Delete Group

#### Figure 12-4 Deploy Greengrass group

This deploys the group configuration to your AWS IoT Greengrass core device.



#### 12.2.6 Check messages published by RX board

To view messages published by RX board to the Greengrass core, and to the AWS IoT MQTT client, please refer to chapter 8.1.1., but replace the subscription topic by "freertos/demos/ggd".

After build and run the demo, user can see the published messages in MQTT client.

Subscriptions	freertos/demos/ggd	Export Clear Pause
Subscribe to a topic Publish to a topic freertos/demos/ggd	<pre>Publish Specify a topic and a message to publish with a QoS of 0. freertos/demos/ggd  1 {     "message": "Hello from AWS IoT console" 3 }</pre>	Publish to topic
	freertos/demos/ggd Mar 6, 2019 5:14:08 PM +0700	Export Hide
	We cannot display the message as JSON, and are instead display	ying it as UTF-8 String.
	RX64M HelloWorld 11 ACK	
	freertos/demos/ggd Mar 6, 2019 5:14:07 PM +0700	Export Hide

Figure 12-5 Confirm messages sent by Greengrass Discovery demo



## 12.3 Simple TCP Server

This demo uses FreeRTOS+TCP to create an echo server that listens for echo requests on the standard echo protocol.

#### 12.3.1 Include demo to the build

This demo is not included in the project by default. To include it, please follow below steps.

1. In Project Explorer, right click on the folder \${PROJECT\_LOC}/application\_code/common\_demos/source and select [New] → [File].



Figure 12-6 Add source for TCP Server demo



2. In the new file dialog, click [Advanced], check "Link to file in the file system", and input "AFR\_HOME \demos\common\tcp\aws\_simple\_tcp\_echo\_server.c" to the text box. Click [Finish].

e <sup>2</sup> New File		— 🗆 X
File		
Create a new file resource.		
Enter or select the parent folder:		
aws_demos/application_code/common_demos/source		
> 🗁 .settings		~
🕆 🚘 application_code		
Y 🗠 common_demos		
🚘 include		
🖙 source		
> 🗁 renesas_code		
🚘 config_files		
> 🗠 lib		$\checkmark$
File name: aws_simple_tcp_echo_server.c		
<< <u>A</u> dvanced		
Link to file in the file system		
· · · ·	Duraura	Variables
AWS_IOT_MCU_ROOT\demos\common\tcp\aws_simple_tcp_echo_serv	e <mark>r.c</mark> Bro <u>w</u> se	<u>v</u> ariables
Choose file system: default 🗸		
Resolved location: C:\Renesas\Workspace\mcu\amazon-freertos-v0.1.9	\demos\common\tcp\aw	s_simple_tcp_echo_ser
?	<u>F</u> inish	Cancel

Figure 12-7 Add new source file to the TCP Server demo



3. Select Simple TCP Server demo to run as described in chapter 3, then re-build the source code.

aws_simple	e_tcp_echo_server.c 🖻 *aws_demo_runner.c 🛛	- 8
36	<pre>#include "aws_demo_runner.h"</pre>	^
37		
38		
39	<pre>/* extern void vStartDeviceDefenderDemo( void ); */</pre>	
40	<pre>/* extern void vStartGreenGrassDiscoveryTask( void ); */</pre>	
41	<pre>/* extern void vStartMQTTEchoDemo( void ); */</pre>	
42	<pre>/* extern void vStartOTAUpdateDemoTask( void ); */</pre>	
43	<pre>/* extern void vStartShadowDemoTasks( void ); */</pre>	
44	<pre>extern void vStartSimpleTCPServerTasks( void );</pre>	
45	<pre>&gt;/* extern void vStartSubpubDemoTasks( void ); */</pre>	
46	<pre>/* extern void vStartTCPEchoClientTasks_SeparateTasks( void ); */</pre>	
47	<pre>/* extern void vStartTCPEchoClientTasks_SingleTasks( void ); */</pre>	
48		
49	/**/	
50		
52	* @brief Runs demos in the system	
54	○void DEMO_RUNNER_RunDemos( void )	
55	{	
56	<pre>/* vStartDeviceDefenderDemo(); */</pre>	
57	<pre>/* vStartGreenGrassDiscoveryTask(); */</pre>	
58	<pre>&gt; /* vStartMQTTEchoDemo();</pre>	
59	<pre>/* vStartOTAUpdateDemoTask(); */</pre>	
60	<pre>/* vStartShadowDemoTasks(); */</pre>	
61	vStartSimpleTCPServerTasks();	
62	<pre>/* vStartSubpubDemoTasks(); */</pre>	
63	<pre>/* vStartTCPEchoClientTasks_SeparateTasks(); */</pre>	
64	<pre>/* vStartTCPEchoClientTasks_SingleTasks(); */</pre>	
65	}	~
	<	>

Figure 12-8 Select Simple TCP Server demo to run

#### 12.3.2 Configure EchoTool

It's necessary to send echo requests to the server (created by the demo) manually. The third party EchoTool utility can be used for this purpose.

User can build the tool from the source code on GitHub or download a pre-built executable. Please refer to this link for detailed information: https://github.com/PavelBansky/EchoTool.

Follow below steps to configure the tool.

1. Check the value of configTCP\_ECHO\_CLIENT\_PORT

aws_simple_tcp_	echo_server.c 🗈 *aws_demo_runner.c 🗈 *Fre	eeRTOSConfig.h ¤	
223	<pre>#define configECHO_SERVER_ADDR0</pre>	192	~
224	<pre>#define configECHO_SERVER_ADDR1</pre>	168	
225	<pre>#define configECHO_SERVER_ADDR2</pre>	1	
226	<pre>#define configECHO SERVER ADDR3</pre>	200	
227	#define configTCP_ECHO_CLIENT_POR	T 9001	
228			
229			
230	* connection that uses this MAC a	address by accessing the	raw Ether
231	* to and from a real network con		
232	<pre>* configNETWORK_INTERFACE_TO_USE</pre>		formation
233	* configure the real network con	nection to use. */	
234	<pre>#define configMAC_ADDR0</pre>	0x74	
235	<pre>#define configMAC_ADDR1</pre>	0×90	
236	<pre>#define configMAC_ADDR2</pre>	0×50	
237	<pre>#define configMAC_ADDR3</pre>	0×00	
238	<pre>#define configMAC_ADDR4</pre>	0x79	
239	<pre>#define configMAC_ADDR5</pre>	0×03	$\checkmark$
	<		>





2. Run the demo. Check the IP address of the board assigned by DHCP in debug terminal.

<u>F</u> ile <u>E</u> dit <u>S</u> etup C <u>o</u> ntrol <u>W</u> indow <u>H</u> elp
3 1698 [IP-task] data flash(mirror) hash check ^
5 1708 [IP-task] prvInitialiseDHCP: start after 250 ticks 6 1708 [IP-task] vDHCPP
rocess: discover
7 6958 [IP-task] vDHCPProcess: discover 8 6958 [IP-task] vDHCPPro
cess: timeout 10000 ticks 9 6965 [IP-task] vDHCPProcess: offer c0a80523ip 10 6965
ID 6965 [IP-task] vDHCPProcess: reply c0a80523ip 11 6975 [IP-task] vDHCPProcess: offer c0
a80523ip
12 6975 [IP-task] vDHCPProcess: acked c0a80523ip 13 6975 [IP-task] IP Add
ress: 192.168.5.35 14 6975 [IP-task] Subnet Mask: 255.255.255.0 15 6975 [IP-task]
Gateway Address: 192.168.5.1 16 6975 [IP-task] DNS Server Address: 192.168.5.1
9000 [Tmr Svc] data flash(main) hash check
18 9005 [Tmr Svc] OK
19 9005 [Tmr Svc] data flash(mirror) hash check 20 9010 [Tmr Svc] OK
21 9012 [Tmr Svc] Write certificate
22 9012 [Tmr Suc] data flash(main) hash check 23 9017 [Tmr Suc] OK
24 9017 [Tmr Suc] data flash(mirror) hash check
25 9022 [Tmr Suc] OK 26 9027 [Tmr Suc] erase dataflash(main)
27 9028 [Tmr Suc] OK
28 9028 [Tmr Suc] write dataflash(main) 29 9029 [Tmr Suc] OK
30 9029 [Tmr Suc] erase dataflash(mirror) 31 9030 [Tmr Suc] OK



3. Run the EchoTool to send echo requests to the demo using port and IP as confirmed above: echotool <ip\_address> /p tcp /r <echo\_client\_port> /n 0.

os. Com	nmand	l Prompt					_	×
d:\Shar	red\F	Pics≻echotool.exe 1	92.168	3.5	5.3	5 /p tcp /r 9001 /n 0		^
Hostnar	me 19	02.168.5.35 resolve	d as 1	192	2.10	58.5.35		
Reply f	from	192.168.5.35:9001,	time	0	ms	ОК		
Reply f	from	192.168.5.35:9001,	time	0	ms	ОК		
Reply f	from	192.168.5.35:9001,	time	0	ms	ОК		
Reply H	from	192.168.5.35:9001,	time	0	ms	OK		
		192.168.5.35:9001,						
Reply f	from	192.168.5.35:9001,	time	0	ms	OK		
		192.168.5.35:9001,						
		192.168.5.35:9001,						
Reply H	from	192.168.5.35:9001,	time	0	ms	OK		
		192.168.5.35:9001,						
		192.168.5.35:9001,						
		192.168.5.35:9001,						
		192.168.5.35:9001,						
		192.168.5.35:9001,						
Reply H	from	192.168.5.35:9001,	time	0	ms	OK		$\sim$

Figure 12-11 Run EchoTool

4. Confirm that the messages "Reply from..." appears. This shows that the requests from EchoTool are replied by the demo.



## **RX** Family

## 12.4 TCP Echo Client

This demo creates FreeRTOS tasks that send TCP echo requests to an external echo, then wait to receive the echo reply. There are 2 examples for this demo: the 1<sup>st</sup> one uses the same RTOS task to both send echo requests and listen for echo replies ("single task"); the 2<sup>nd</sup> one uses the same TCP socket from two different RTOS tasks – one RTOS task sends the echo request and another RTOS tasks receives the echo reply ("separate tasks").

To run this demo, please follow below steps.

 Select the demo to run: "vStartTCPEchoClientTasks\_SingleTasks" for 1<sup>st</sup> example, or "vStartTCPEchoClientTasks\_SeparateTasks" for 2<sup>nd</sup> example. Please note that only 1 example can be run at once.

*aws_demo	o_runner.c 🛛 🖻 FreeRTOSConfig.h 🖾 🖻 aws_tcp_echo_client_single_task.c 🛛 🖻 aws_tcp_echo_client_separate_tasks.c	- 8
55		^
36	<pre>#include "aws_demo_runner.h"</pre>	
37		
38	<pre>/* Demo declarations. */</pre>	
39	<pre>/* extern void vStartDeviceDefenderDemo( void ); */</pre>	
40	<pre>/* extern void vStartGreenGrassDiscoveryTask( void ); */</pre>	
41	/* extern void vStartMQTTEchoDemo( void ); */	
42	/* extern void vStartOTAUpdateDemoTask( void ); */	
43	/* extern void vStartShadowDemoTasks( void ); */	
44	/* extern void vStartSimpleTCPServerTasks( void ); */	
45	/* extern void vStartSubpubDemoTasks( void ); */	
46	<pre>/* extern void vStartTCPEchoClientTasks SeparateTasks( void ); */</pre>	
47	<pre>extern void vStartTCPEchoClientTasks_SingleTasks( void );</pre>	
48		
49	/**/	
50		
52	* * @brief Runs demos in the system.	
54	<pre>ovoid DEMO_RUNNER_RunDemos( void )</pre>	
55	{	
56	/* vStartDeviceDefenderDemo(); */	
57	/* vStartGreenGrassDiscoveryTask(); */	
58	<pre>&gt; /* vStartMQTTEchoDemo();</pre>	
59	/* vStartOTAUpdateDemoTask(); */	
60	/* vStartShadowDemoTasks(); */	
61	<pre>/* vStartSimpleTCPServerTasks(); */</pre>	
62	/* vStartSubpubDemoTasks(); */	
63	<pre>/* vStartTCPEchoClientTasks_SeparateTasks(); */</pre>	
64	vStartTCPEchoClientTasks_SingleTasks();	
65	}	
66		~
	<	>

Figure 12-12 Select the TCP Echo client demo

2. Build and run the demo.



- 3. Check the TCP port and IP address as chapter 9.3.2, then run the EchoTool in server mode using information about port and IP: echotool <IP\_address> /p tcp /s <port>
- 4. Check the debug message on debug terminal and debug log of the EchoTool to confirm that send & receive is OK.

💆 COM4 - Tera Term VT — 🗌 🗌 🕹			
File Edit Setup Control Window Help			
1150 20755 [Echo0] Connecting to echo server			
1151 20755 [Echo0] FreeRTOS_connect: 62771 to c0a8052fip:9999			
1152 20755 [Echo0] Socket 62771 → c0a8052fip:9999 State eCLOSED→eCONNECT_SYN 1153 2			
0755 [IP-task] prvSocketSetMSS: 1460 bytes for c0a8052fip:9999 1153 2			
1154 20755 [IP-task] Connect[c0a8052fip:9999]: next timeout 1: 3000 ms			
P-task] Socket 62771 -> c0a8052fip:9999 State eCONNECT_SYN->eESTABLISHED - 1155 20761 []			
1156 20761 [Echo0] Connected to echo server			
1157 20761 [Echo0] Sending TxRx message number 350 of length 351 to echo server 1158 20770 [Echo0] Received correct string from echo server.			
1159 20779 [Echolo] Received Correct string from echo server. 1159 20778 [Echolo] Received correct string from echo server.			
1160 20778 [Echo9] Received correct string from echo server.			
1161 20779 [Echo0] Sending TxRx message number 352 of length 353 to echo server 1162 20783 [Echo0] Received correct string from echo server.			
1163 20783 [Echo0] Sending IXRx message number 353 of length 354 to echo server 1164 20793 [Echo0] Received correct string from echo server.			
1164 20793 [Echo0] Received correct string from echo server. Li65 20793 [Echo0] Sending IxRx message number 354 of length 355 to echo server			
166 20801 [Echo0] Received correct string from echo server.			
1167 20001 [Echo0] Sending TxRx message number 355 of length 356 to echo server 1168 20003 [Echo0] Neceived correct string from echo server.			
1169 20804 [Echo0] Sending TxRx message number 356 of length 357 to echo server			
1170 20806 [Echo0] Received correct string from echo server.			
1171 20006 [Echo0] Sending TxRx message number 357 of length 358 to echo server 1172 20016 [Echo0] Received correct string from echo server.			
173 20810 [Echo0] Sending TxBx message number 358 of length 359 to echo server			
174 20815 [Echo0] Received correct string from echo server. 175 20815 [Echo0] Sending TxRx message number 359 of length 360 to echo server			
176 20819 [Echo0] Received correct string from echo server.			
181 20973 [Echo0] Connecting to echo server 182 20973 [Echo0] FreeRTOS_connect: 37325 to c0a8052fip:9999			
1183 20973 [Echo0] Socket 37325 $\rightarrow$ c0a8052fip:9999 State eCLOSED->eCONNECT_SYN			
1184 2			
0973 [IP-task] prvSocketSetMSS: 1460 bytes for c0a8052fip:9999 1185 20973 [IP-task] Connect[c0a8052fip:9999]: next timeout 1: 3000 ms			
- 1186 20975 [I			
P-task] Socket 37325 -> c0a8052fip:9999 State eCONNECT_SYN->eESTABLISHED 1187 20976 [Echo0] Connected to echo server			
1188 20976 [Echo0] Sending TxRx message number 360 of length 361 to echo server			
1189 20988 [Echo0] Received correct string from echo server. 1190 20988 [Echo0] Sending TxRx message number 361 of length 362 to echo server			
1191 20993 [Echo0] Received correct string from echo server.			
1192 20093 IEchol) Sending TXRx message number 362 of length 363 to echo server 1193 20099 IEchol) Received correct string from echo server.			
1193 20999 [Echold] Received correct string from echo server. 1194 20999 [Echold] Sending TARx message number 363 of Length 364 to echo server			









## **Revision History**

		Description	
Rev.	Date	Page	Summary
1.00	Aug. 20, 2019	-	First edition issued



# 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 resetting is specified.

3. Input of signal during power-off state

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

4. Handling of unused pins

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

5. Clock signals

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

#### 6. Voltage application waveform at input pin

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

7. Prohibition of access to reserved addresses

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

8. Differences between products

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

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