# RENESAS

# Getting started with the Renesas Starter Kit+ for RX65N-2MB

This tutorial provides instructions for getting started with the Renesas Starter Kit+ for RX65N-2MB. If you do not have the Renesas Starter Kit+ for RX65N-2MB, visit the <u>AWS Partner Device Catalog</u>, and purchase one from our partners.

This document explains how to configure AWS IoT Core and FreeRTOS to connect your device to the AWS Cloud.

## Overview

This tutorial contains instructions for the following getting started steps:

- A Hardware Requirement.
- B Installing tool and software on the host machine for developing.
- C Creating Policy for Device
- D Device on AWS IoT Core
- E Set up the Renesas Starter Kit+ for RX65N-2MB.
- F Cross compiling a FreeRTOS demo application to a binary image.
- G Loading the application binary image to your board, and then running the application.
- H Monitoring MQTT messages on the cloud.

## A. Hardware Requirement

 Renesas Starter Kit+ for RX65N-2MB with Trusted Secure IP (R5F565NEHDFC) or Renesas Starter Kit+ for RX65N-2MB without Trusted Secure IP (R5F565NEDDFC)

https://www.renesas.com/us/en/products/microcontrollers-microprocessors/rx-32-bit-performance-efficiency-mcus/rx65n-2mb-starter-kit-plus-renesas-starter-kit-rx65n-2mb

- 2. Mini-B USB cables x1 These cables can be used to connect the PC to the Renesas Starter Kit+ for RX65N-2MB
- E2 Lite Emulator (required) https://www.renesas.com/us/en/software-tool/e2-emulator-lite-rte0t0002lkce00000r.
- 4. +5V power adapter

**Recommend** to use Renesas Starter Kit+ for RX65N-2MB with Trusted Secure IP (**R5F565NEHDFC**). Go to Troubleshooting section to solve any issues.

# B. Installing software and tool on the host machine for developing

Note: Host machine running Windows 8.1 or 10.

#### To download and install e<sup>2</sup>studio

- 1. Go to the <u>Renesas e<sup>2</sup>studio installer</u> download page and download the offline installer.
- 2. You are directed to a Renesas Login page.

If you have an account with Renesas, enter your username and password and then choose **Login**.

If you do not have an account, choose **Register now**, and follow the first registration steps. You should receive an email with a link to activate your Renesas account. Follow this link to complete your registration with Renesas, and then login to Renesas.

- 3. After you log in, download the e<sup>2</sup>studio installer to your computer.
- 4. Open the installer and follow the steps to completion.

For more information, see the <u>e<sup>2</sup>studio</u> on the Renesas website. Note: Linux and MacOS are not supported.

#### To download and install the GCC for Renesas 8.3.0.202004-GNURX Toolchain Package

- 1. Download GCC for Renesas 8.3.0.202004-GNURX Toolchain.
- 2. Open the executable and install the compiler.

#### To download Tera Term

Go to https://ttssh2.osdn.jp/index.html.en to download the software.

# C. Create a Policy for a Device

User needs to create AWS account. Refer to the instructions at <u>Set up your AWS Account</u>. Follow the steps outlined in these sections to create your account and a user and get started:

- Sign up for an AWS account.
- Create a user and grant permissions.
- Open the AWS IoT console.

Pay special attention to the Notes.

If user created AWS account already in the past, please skip this step.

1. Type IoT Core in search bar and click IoT Core



**AWS IoT Core Selection** 

2. Go to Secure → Policies

Click on **Create** to create a policy

AWS IoT ×	Avs tot > Policies Policies	Create
Activity		
<ul> <li>Onboard</li> </ul>	Search polities Q	
<ul> <li>▶ Manage</li> <li>▶ Fleet Hub</li> </ul>	Name	
Greengrass	- manage	
▼ Secure	International	
Certificates Policies	<ul> <li>menymap mics</li> </ul>	
CAs	C respects	

Create a policy

# In the **Name** field, enter a name for the policy. Then, change to **Advanced mode**

<ul> <li>Manage Things Types Thing groups</li> </ul>	Create a policy to define a set of authorized actions. You can authorize actions on one or more resources more about IoT policies go to the AWS IoT Policies documentation page. Name policy	(things, topics, topic filters). To learn
Billing groups Jobs Job templates Tunnels	Add statements Policy statements define the types of actions that can be performed by a resource.	Advanced mode
<ul> <li>Fleet Hub</li> <li>Greengrass</li> </ul>	Action lot:Connect	
<ul> <li>Greengrass</li> <li>Secure</li> <li>Certificates</li> </ul>	Resource ARN	
Policies CAs Role Aliases	Effect The Allow Deny	Remove
Authorizers	*	

Give a policy name

#### Add following text to Advanced mode

{ "Version": "2012-10-1	17",
"Statement":	
[ ,	
{	
	"Effect": "Allow", "Action": "iot:Connect",
	"Resource": "*"
},	
{	
	"Effect": "Allow",
	"Action": "iot:Publish",
	"Resource": "*"
},	
ł	"Effect": "Allow",
	"Action": "iot:Subscribe",
	"Resource": "*"
},	
{	
	"Effect": "Allow",
	"Action": "iot:Receive",
,	"Resource": "*"
}	
}	
,	Add statements for policy

- Add statements for policy
- 3. Create a policy

<ul> <li>Greengrass</li> <li>Secure         <ul> <li>Certificates</li> <li>Policies</li> <li>CAs</li> <li>Role Aliases</li> <li>Authorizers</li> </ul> </li> <li>Defend</li> <li>Act</li> </ul>	<pre>4 { 5  6  7  7  7  7  7  7  7  7  7  7  7  7  7</pre>
Test     Device Advisor	
MQTT test client	Add statement
Software Settings Learn	Create

#### Create a policy

Note: The examples in this document are intended only for dev environments. All devices in your fleet must have credentials with privileges that authorize only intended actions on specific resources. The specific permission policies can vary for your use case. Identify the permission policies that best meet your business and security requirements. For more information, refer to <u>Example policies</u> and <u>Security Best practices</u>.

# D. Creating Device on AWS IoT Core

### 4. Create a Thing

Select Manage→ Things→Create to create a thing

AWS IoT ×	() Introducing the new AWS IoT console experience We're updating the console experience for you. Learn more [2] Try the new experiences and let us know what you think. You can turn off the new experience from the navigation menu.	
Monitor Activity > Onboard	AWS INT > Things	Create
Manage     Things     Types     Thing groups	Search things. Q Reet Indexing Info	

#### Create a thing

5. Select the Create a single thing

OT > Things > Create things Creating AWS IoT things	
An IoT thing is a representation and record of your physical device in the cloud. Any physical device needs a thing record in order to work with AWS IoT. Learn more.	
Register a single AWS IoT thing Create a thing in your registry	Create a single thing
Bulk register many AWS IoT things	
reate things in your registry for a large number of devices already using AWS IoT, or egister devices so they are ready to connect to AWS IoT.	Create many things
Cancel	Create a single thing

Create a single thing

## 6. Add name to thing and **Next**

AWS IoT > Things > Create things > Add your devia	ce to the thing registry
CREATE A THING Add your device to the thing reg	istry V3
This step creates an entry in the thing registry and a th Name Thing	ing shadow for your device.
Apply a type to this thing Using a thing type simplifies device management by pr common set of attributes, which describe the identity a Thing Type No type selected	roviding consistent registry data for things that share a type. Types provide things with a and capabilities of your device, and a description.
Groups /	Create group Change
Set searchable thing attributes (optional) Enter a value for one or more of these attributes so tha Attribute key Provide an attribute key, e.g. Manufacturer	t you can search for your things in the registry.           Value         Provide an attribute value, e.g. Acme-Corporation         Clear
Add another Show thing shadow 👻	
Cancel	Back

## Add name to a single thing

7. Add a certificate for thing

Add a certificate for your thing	STEP 2/3
A certificate is used to authenticate your device's connection to AWS IoT.	
One-click certificate creation (recommended) This will generate a certificate, public key, and private key using AWS IoT's certificate authority.	Create certificate
Create with CSR Upload your own certificate signing request (CSR) based on a private key you own.	Create with CSR
Use my certificate Register your CA certificate and use your own certificates for one or many devices.	Get started
Skip certificate and create thing	Create thing without certificate

Create a certificate for thing

- 8. Attach a policy to thing
  - Click the **Download** button next to each of the certificates, keys and save in local PC or host machine.
  - Click the **Activate** button to activate the certificate.
  - Select Attach a policy and choose the policy you created in section C.

Certificate created!		
Download these files and save them in a safe place. Certificates car after you close this page.		any time, but the private and public keys cannot be retrieved
In order to connect a device, you need to download the following A certificate for this thing	g: Download	
A public key public.key A private key	Download Download	
You also need to download a root CA for AWS IoT: A root CA for AWS IoT Download Activate		
Cancel		Done Attach a policy

Attach a policy

9. Register policy to thing

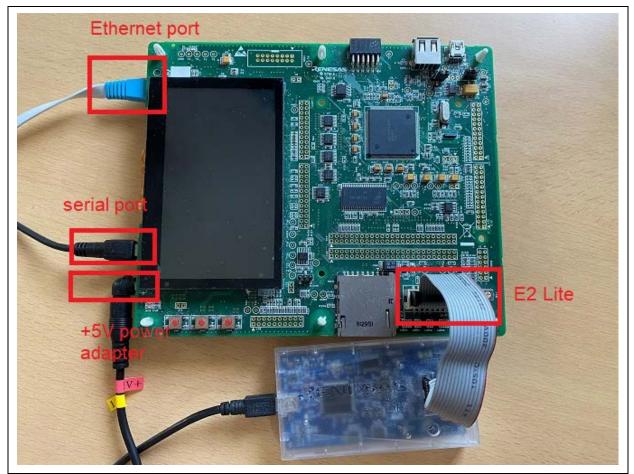
dd a policy for your thing	STEP 3/3
a policy for your thing	
da a ponej for your annig	

#### Register policy to thing

# E. Set up the Renesas Starter Kit+ for RX65N-2MB

### To confirm functionality on Renesas Starter Kit+ for RX65N-2MB

- Connect the positive +5V power adapter to the PWR connector on the RSK+ for RX65N-2MB.
- Connect your computer to the USB-to-serial port on the RSK+ for RX65N-2MB.
- Connect a router or internet-connected Ethernet cable to the Ethernet port on the RSK+ for RX65N-2MB.



Connect Renesas Starter Kit+ for RX65N-2MB to power PC

To set up the E2 Lite Debugger module

- Use the 14-pin ribbon cable to connect the E2 Lite Debugger module to the 'E1/E2 Lite' port on the RSK+ for RX65N-2MB.
- Use a USB cable to connect the E2 Lite debugger module to your host machine. When the E2 Lite debugger is connected to both the board and your computer, a green 'ACT' LED on the debugger flashes.
- After the debugger is connected to your host machine and RSK+ for RX65N-2MB, the E2 Lite debugger drivers begin installing.

Note that administrator privileges are required to install the drivers.

# F. Cross compiling a FreeRTOS demo application to a binary image

Now that you have configured your board, you are ready to build and run the project on your board.

## Build the FreeRTOS Demo in e<sup>2</sup>studio

#### To download and build the demo in e<sup>2</sup>studio

- 1. Launch e<sup>2</sup>studio from the Start menu.
- 2. On the **Select a directory as a workspace** window, browse to the folder that you want to work in, and choose **Launch**.
- 3. The first time you open e2studio, the **Toolchain Registry** window opens. Choose **Renesas Toolchains** and confirm that GCC for Renesas 8.3.0.202004-GNURX is selected. Choose **Register**, and then choose **OK**.
- 4. If you are opening e<sup>2</sup>studio for the first time, the **Code Generator Registration** window appears. Choose **OK**.
- 5. The Code Generator COM component register window appears. Under Please restart e<sup>2</sup>studio to use Code Generator, choose OK.
- 6. The Restart e<sup>2</sup>studio window appears. Choose OK.
- 7. e<sup>2</sup>studio restarts. On the **Select a directory as a workspace** window, choose **Launch**.
- 8. On the e<sup>2</sup>studio welcome screen, choose the **Go to the e<sup>2</sup>studio workbench** arrow icon.
- 9. Right-click the Project Explorer window and choose Import.
- 10. In the import wizard, choose General, Renesas GitHub FreeRTOS (with IoT libraries) Project, and the choose Next.
- 11. Choose Browse to specify a folder to copy downloaded RTOS content in order to import project.
- 12. In RTOS version setting, choose **Check for more version...** to see a list of all supported RTOS version. On the **FreeRTOS (with IoT libraries) Module Download** window, select the FreeRTOS version (recommended: <u>v202012.00-rx-1.0.0</u>) you want to work on by clicking the checkbox, then choose **Download**.

	RTOS (with IoT libraries) Mod				
(dow	nload path should be short, for ex Title	ample "C:\afr") Rev.	Issue date	^	Select All
	FreeRTOS (with IoT libraries) FreeRTOS (with IoT libraries)	v202012.00-rx-1.0.0 v202002.00-rx-1.0.5	2021-06-18 2021-05-10		Deselect All
	FreeRTOS (with IoT libraries) FreeRTOS (with IoT libraries)	v202002.00-rx-1.0.4 v202002.00-rl78-1.0.3	2021-03-16 2021-02-17		
	FreeRTOS (with IoT libraries) FreeRTOS (with IoT libraries)	v202002.00-rx-1.0.3 202002.00-rl78-1.0.2	2021-01-28		
	FreeRTOS (with IoT libraries)	202002.00-rx-1.0.3	2020-10-16		
	FreeRTOS (with IoT libraries) FreeRTOS (with IoT libraries)	v202002.00-rx-1.0.2 202002.00-rl78-1.0.1	2020-10-14 2020-09-30		
П Мос	FreeRTOS (with IoT libraries) Jule Folder Path:	202002.00-rx-1.0.2	2020-09-29	~	
	D:\RTOS_loT				Browse
			Download		Cancel

- 13. Once download is completed, choose Next in the Renesas GitHub FreeRTOS (with IoT libraries) Project window.
- 14. If you are *not* using an empty folder, the **Copy Resources** warning message appears. Choose **Yes**.
- 15. Choose the project aws\_demos (\${FOLDER\_DIR}/projects/renesas/rx65nrsk/e2studio-gcc/aws\_demos), then choose **Finish**.
- 16. From Project menu, choose Build All.

The build console issues a warning message that the License Manager is not installed. You can ignore this message unless you have a license key for the CC-RX compiler. To install the License Manger, see the License Manager download page.

# G. Loading the application binary image to your board, and then running the application

#### To run the project in e<sup>2</sup>studio

- 1. Confirm that you have connected your computer to the USB-to-serial port on Renesas Starter Kit+ for RX65N-2MB.
- 2. From the top menu, choose Run, Debug Configurations....
- 3. Expand Renesas GDB Hardware Debugging and choose aws\_demos HardwareDebug.
- 4. Choose the **Debugger** tab, and then choose the **Connection Settings** tab. Confirm that your connection settings are correct.
- 5. Choose **Debug** to download the code to your board and begin debugging.

You might be prompted by a firewall warning for e2-server-gdb.exe. Check Private networks, such as my home or work network, and then choose Allow access.

- 6. e<sup>2</sup>studio might ask to change to **Renesas Debug Perspective**. Choose **Yes**.
- 7. 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.

#### H. Monitoring MQTT messages in the cloud

You can use the MQTT client in the AWS IoT console to monitor the messages that your device sends to the AWS Cloud.

#### To subscribe to the MQTT topic with the AWS IoT MQTT client

- 1. Sign in to the <u>AWS IoT console</u>.
- 2. In the navigation pane, choose Test to open the MQTT test client.
- 3. In Subscription topic, enter #, and then choose Subscribe to topic.
- 4. Successful demo run looks like following the picture

Activity		Addition	nal configur	ation	
Onboard		Subscrib	be		
▼ Manage					
Things					
Types		Subscript	tions	#	Pause Clear Export Edit
Thing groups					
Billing groups		#	$^{\diamond}\times$		hune 24, 2024, 00:55:45 (UTC: 00:00)
Jobs				▼ /example/topic	June 21, 2021, 09:55:45 (UTC+0900)
Job templates					
Tunnels				<ul> <li>Message cannot be displayed in specified format.</li> </ul>	
Fleet Hub				Hello World!	
Greengrass					
Secure				▼ /example/topic	June 21, 2021, 09:55:43 (UTC+0900)
Defend	-				

For the latest projects released by Renesas, see the renesas fork of the amazon-freertos repository on <u>GitHub</u>.

# Troubleshooting

For general troubleshooting information about Getting Started with FreeRTOS, see <u>Troubleshooting</u><u>getting started</u>.

The following information is for debugging if any troubles.

#### 1. Open e2studio to debug

Make sure that debug configuration is same as the following setting.

Main]: Program does not exist			- X.
ype filter text C C/C++ Application C C/C++ Remote Application EASE Script G GDB Hardware Debugging G GDB OpenOCD Debugging G GDB Simulator Debugging ( Java Applet Java Applet Java Applet Aunch Group Launch Group Launch Group C Renesas GDB Hardware Deb C aws_tests HardwareDeb C aws_tests HardwareDeb C boot_loader HardwareDe C Renesas Simulator Debugging	Name: aws_demos HardwareDebug          Main        Debugger       Startup       Common       Source         Debug hardware:       E2 Lite (RX)       Target Device:       RSF565NE_DUAL         GDB Settings       Connection Settings       Debug Tool Settings         V Clock       HOCO         Extal Frequency[MHz]       24.0000         Operating Frequency [MHz]       Permit Clock Source Change On Writing Internal         Yes       Yes         V Connection Type       Fine         JTag Clock Frequency[MHz]       0.000         Fine Baud Rate[Mbps]       1.50         Hot Plug       No		
	Power     Power Target From The Emulator (MAX 200mA)     No       Supply Voltage (V)     3.3 <b>CPU Operating Mode</b> Register Setting     Single Chip       Mode pin     Single-chip mode       Change startup bank     No		>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
ter matched 16 of 18 items		Revert	Apply

#### 2. Tera term

Open tera term to check port, baud rate, Data, Parity, Stop and Flow control.

Tera Term: Serial port setu	р	×	
Port: Baud rate:	COM4 ~ 115200 ~	ОК	
Data:	8 bit v	Cancel	
Parity:	none ~		
Stop:	1 bit v	Help	
Flow control:	none ~	t	
Transmit dela		sec/line	

3. The Build errors

- Make sure that <u>v202012.00-rx-1.0.0</u> is located to C: or D: drive or etc. Windows has a path length limitation of 260 characters. The path structure of FreeRTOS is many levels deep, so if you are using Windows, keep your file paths under the 260-character limit. The build will be passed if file paths under the 260-character.
- 4. Can not connect to AWS IoT Core
  - Check aws\_demos/demos/include/aws\_clientcredential.h and confirm 4 settings: clientcredentialMQTT\_BROKER\_ENDPOINT clientcredentialIOT\_THING\_NAME clientcredentialWIFI\_SSID clientcredentialWIFI\_PASSWORD

For "clientcredentialIOT\_THING\_NAME", input name of the thing you created in section D.

⊕ * FreeRTOS V202002.00.	
<pre> @ #ifndefAWS_CLIENTCREDENTIALH #defineAWS_CLIENTCREDENTIALH</pre>	
<pre>      * @brief MQTT Broker endpoint.[]      #define clientcredentialMQTT_BROKER_ENDPOINT "" </pre>	
<pre>     * @brief Host name.[]     #define clientcredentialIOT_THING_NAME "" </pre>	
* @brief Port number the MQTT broker is using #define clientcredentialMQTT_BROKER_PORT	8883
* @brief Port number the Green Grass Discovery use #define clientcredentialGREENGRASS_DISCOVERY_PORT	for JSON retrieval from cloud is using 8443
* @brief <u>Wi-Fi</u> network to join. #define clientcredentialWIFI_SSID	
* @brief Password needed to join <u>Wi-Fi</u> network #define clientcredentialWIFI_PASSWORD	

#### aws\_clientcredential.h

To find the endpoint for your account, use the AWS IoT console at console.aws.amazon.com/iot. In the left panel, choose Settings. The endpoint is listed under Custom endpoint as following snapshot:

AWS loT × Monitor Activity > Onboard > Manage > Greengrass	Custom endpoint       This is your custom endpoint that allows you to connect to AWS IoT. Each of your Things has a REST API available at this endpoint. This is also an important property to insert when using an MQTT client or the AWS IoT Device SDK.         Your endpoint is provisioned and ready to use. You can now start to publish and subscribe to topics.         Endpoint         .amazonaws.com
▶ Secure	Logs
Defend	
▼ Act	You can enable AWS IOT to log helpful information to CloudWatch Logs. As messages from your devices pass through the message broker and the rules engine, AWS IOT logs process events which can be helpful in troubleshooting.
Rules	Role
Destinations	Level of verbosity
Test	Disabled
Software	Edit
Settings	
Documentation	Event-based messages DIGABLED
New console experience Tell us what you think	AWS IoT can send event-based messages to pre-determined MQTT topics when specific service events occur.

The endpoint in AWS IoT

#### 5. Check RX65N-RSK board

if your board is Renesas Starter Kit+ for RX65N-2MB without Trusted Secure IP (R5F565NEDDFC), please change BSP\_CFG\_MCU\_PART\_ENCRYPTION\_INCLUDED to false in vendors/renesas/boards/rx65n-rsk-gcc/aws\_demossmc\_gen/r\_config/r\_bsp\_config.h

#define BSP\_CFG\_MCU\_PART\_ENCRYPTION\_INCLUDED (false)