RL78/G23

Getting Started Guide for Connecting Amazon Web Services in LTE Communication: RL78/G23-128p Fast Prototyping Board + FreeRTOS

Introduction

This document describes how to connect to Amazon Web Services (AWS) by using a Renesas MCU board combined with a cellular IoT module.

Related Documents

RL78/G23 User’s Manual: Hardware (R01UH0896)

RL78/G22, RL78/G23, RL78/G24 Firmware Update Module (R01AN6374)

RL78/G23-128p Fast Prototyping Board User’s Manual (R20UT4870)

Renesas Flash Driver RL78 Type 01 User’s Manual (R20UT4830)

Notification: End-Of-Life (EOL) process on RYZ024A Cellular module

Renesas announces to discontinue the existing Sequans-sourced LTE module known as the RYZ024A part number and will no longer be shipping this product.

If you have one in a current design or in production, the Sequans part number, GM02S is pin for pin, form fit and function exact drop-in replacement from the RYZ024A. Below Cellular driver of RX family works the below alternate product combination.

- RYZ024A Cellular module control module: Sequans GM02S is the compatible module.

Regarding EOL notice of the RYZ024A, see the link at the product page.

Contents

Notes:

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1. Overview

The sample program iot-reference-rl78 provides the reference of IoT solution with using RL78 family, AWS, and FreeRTOS. You can easily try to run AWS IoT demos while it works with our various other products.

1.1 Overview of Demo Projects

The sample program contains the following demo projects. These demo projects realize the operation for connecting to the AWS clouds by using the Renesas MCU board RL78/G23-128p Fast Prototyping Board and cellular IoT module.

Table **1-1 List of demo projects**

ItemName of Demo Project	**Description**
Demo project (PubSub)	Perform simple data upload via MQTT communication.
Demo project (OTA)	Perform firmware update via OTA.

For details about summary of each demo projects, refer to the following chapters.

- Section 2, Description of Hardware
- Section 3, Description of Software

For details about how to run the demo projects, refer to the following chapters.

- Demo project (PubSub)
  - Section 4, Setup Common to Demo Projects (PubSub and OTA)
  - Section 5, Setup Specific to Demo Project (PubSub)
- Demo project (OTA)
  - Section 4, Setup Common to Demo Projects (PubSub and OTA)
  - Section 6, Setup Specific to Demo Project (OTA)

1.2 Operation Confirmation Conditions

Demo project operations have been confirmed in the following conditions.

Table 1-2 Operation Confirmation Conditions (RL78/G23)

Item	Description
MCU used	RL78/G23 (R7F100GSN CF 768KB)
Board used	RL78/G23-128p Fast Prototyping Board (RTK7RLG230CSN000BJ)
Operating frequency	High-speed on-chip oscillator clock: 32 MHz
Operating voltage	3.3 V
IDE (Integrated Development Environment)	Renesas Electronics e^2 studio 2024-01.1
C compiler	Renesas Electronics CC-RL V1.12.01
Firmware programming tool	Renesas Flash Programmer V3.14.00
Smart Configurator (SC)	Renesas Smart Configurator for RL78 24.1.0.v20231218-0132
Board support package (BSP)	v1.60 (r_bsp)
Flash library (RFD)	Renesas Flash Driver (RFD) RL78 Type01 for RL78/G2x V1.20 Note: Code Flash Libraries (Flash Self Programming Libraries) -> Renesas Flash Driver RL78 Type 01 Package V1.20 for RL78/G2x
Firmware update module (FWUP)	RL78/G22,RL78/G23,RL78/G24 Firmware Update Module v2.01
Utility tool to generate firmware images	Renesas Image Generator V3.03 Note: Included in the firmware update module (FWUP)
Python	Python 3.10.1
OpenSSL	OpenSSL 3.1.4

Table 1-3 Operation Confirmation Conditions (Others, such as OSS Library)

Item	Description
iot-reference-rl78	v202210.01-LTS-rl78-1.0.0 (Based FreeRTOS 202210.01-LTS) https://github.com/renesas/iot-reference-rl78/tree/v202210.01-LTS-rl78-1.0.0
FreeRTOS Cellular Interface	1.3.0 https://github.com/FreeRTOS/FreeRTOS-Cellular-Interface
FreeRTOS Kernel	10.5.1 https://github.com/FreeRTOS/FreeRTOS-Kernel
backoffAlgorithm	1.3.0 https://github.com/FreeRTOS/backoffAlgorithm
coreJSON	3.2.0 https://github.com/FreeRTOS/coreJSON
coreMQTT Client	2.1.1 https://github.com/FreeRTOS/coreMQTT
coreMQTT Agent	1.2.0 https://github.com/FreeRTOS/coreMQTT-Agent
AWS IoT Over-the-air Update	3.4.0 https://github.com/aws/ota-for-aws-iot-embedded-sdk
tinycbor	0.5.2 https://github.com/intel/tinycbor
FreeRTOS-Plus network_transport	No version https://www.freertos.org/network-interface.html
Logging Interface	1.1.3 https://github.com/aws/amazon-freertos/tree/main/libraries/logging
TinyCrypt Cryptographic Library	0.2.8 https://github.com/intel/tinycrypt

1.3 Equipment List

The following lists the equipment required for the demo projects.

Table 1-4 Equipment List

Item	Description
MCU board	RL78/G23-128p Fast Prototyping Board RTK7RLG230CSN000BJ - RL78/G23-128p Fast Prototyping Board
Cellular IoT module	PMOD Expansion Board for RYZ024A (referred to as RYZ024A hereafter) RTKYZ024A0B00000BE - PMOD Expansion Board for RYZ024A
SIM card	LTE communication must be possible. Example: SIM card by Truphone bundled with RTKYZ024A0B00000BE (Note) DHA-SIM-132 by Nippon SIM
USB-UART conversion board	Pmod USBUART https://reference.digilentinc.com/reference/pmod/pmodusbuart/start
Micro USB Type-B cable x 3	• Used to connect the USB-UART conversion board to the PC • Used to connect the MCU board to the PC • Used to supply power to RYZ024A
Jumper wire x 3	Used to connect the USB-UART conversion board to the MCU board
Jumper pin x 3	Pins J15, J16, and J19 are used to select the MCU board power supply.

Note:

When using a SIM card by Truphone bundled with PMOD Expansion Board for RYZ024A (RTKYZ024A0B00000BE), you must activate your SIM card by the following document: RA6M5 Group RYZ024A PMOD LTE Connectivity with RA6M5 MCU Quick Start Guide (R21QS0007).

Overall figure of equipment connections

Refer to the followings for overall figure of equipment connections for each demo.

- demo project (PubSub): Figure 4-1 Overall Hardware Configuration of the Demo Project
- demo project (OTA): Same as above

Precaution about equipment for debugging

The demo projects use the COM port for debugging, but debugging with the emulator is also possible. When using the emulator, you need to mount the connector for connecting the emulator and change the circuit. For details, refer to section 7.2.1, Setting Jumper Pins, Mounting the Connector, and Cutting Patterns or the following manual.

Table 1-5 Debug Equipment

Item	Description
Emulator	E2 emulator Lite https://www.renesas.com/us/en/software-tool/e2-emulator-lite-rte0t0002lkce00000r

2. Description of Hardware

2.1 Demo Project (PubSub)

2.1.1 System Configuration

The following shows the system configuration of the demo project (PubSub).

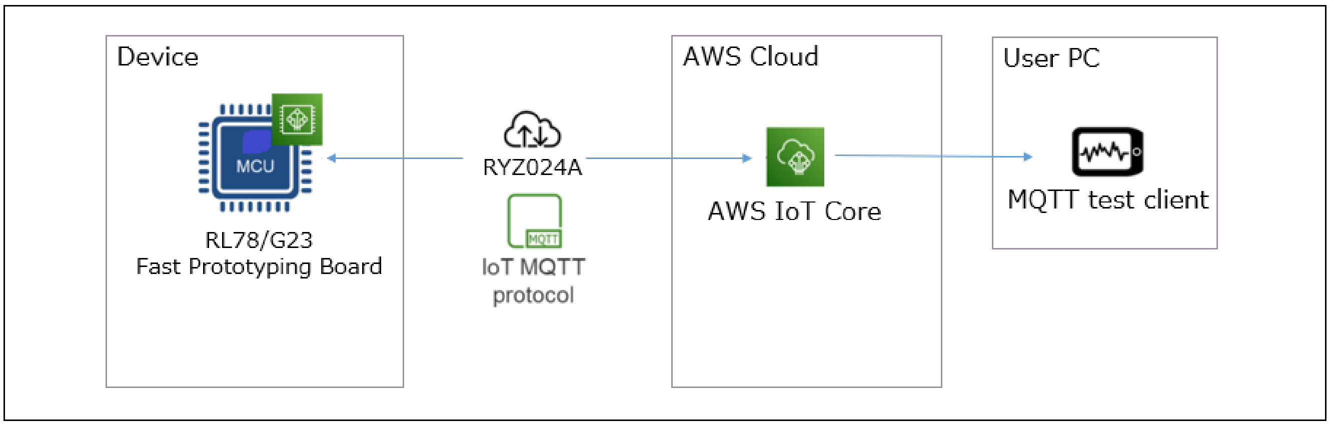


Figure 2-1 System Configuration of Demo Project (PubSub)

2.1.2 List of Pins Used

The following lists and describes the pins used with the demo project (PubSub).

Table 2-1 Pins Used with Demo Project (PubSub) and Their Functions

Pin Name	I/O	Description
P143/RxD3	Input	UART communication (reception) with RYZ024A
P144/TxD3	Output	UART communication (transmission) with RYZ024A
P00	Output	Reset to RYZ024A
P142	Output	UART communication (RTS) with RYZ024A
P14/RxD2	Input	Terminal input
P13/TxD2	Output	Terminal output
P50	Output	LED1

2.2 Demo Project (OTA)

2.2.1 System Configuration

The following shows the system configuration of the demo project (OTA).

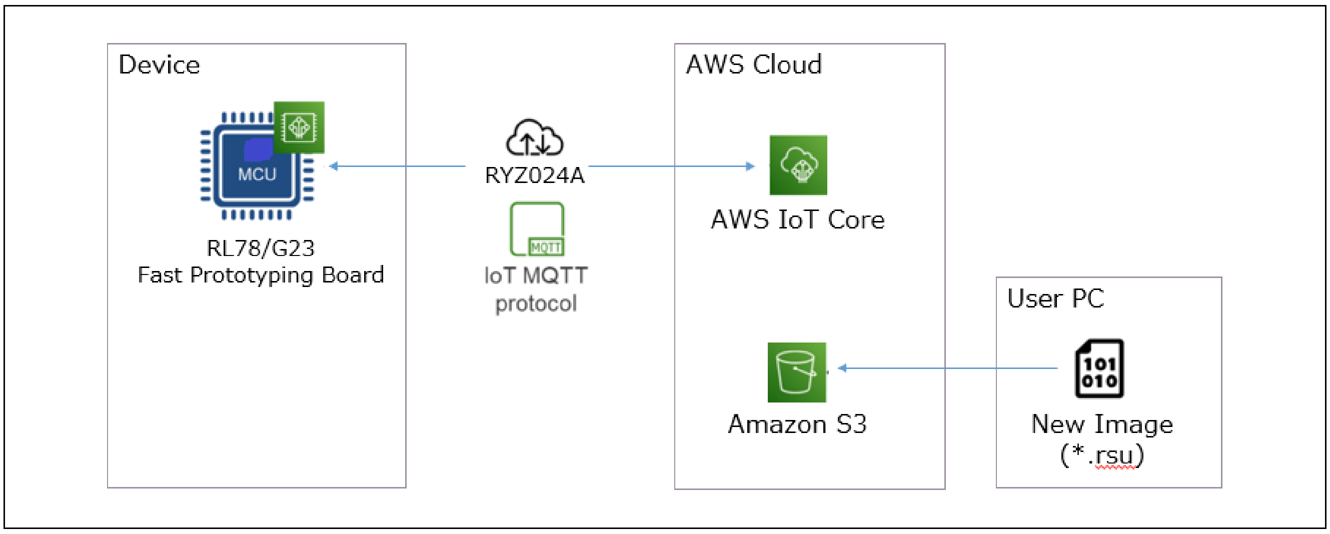


Figure 2-2 System Configuration of Demo Project (OTA)

2.2.2 List of Pins Used

The following lists and describes the pins used with the demo project (OTA).

Table 2-2 Pins Used with Demo Project (OTA) and Their Functions

Pin Name	I/O	Description
P143/RxD3	Input	UART communication (reception) with RYZ024A
P144/TxD3	Output	UART communication (transmission) with RYZ024A
P00	Output	Reset to RYZ024A
P142	Output	UART communication (RTS) with RYZ024A
P14/RxD2	Input	Terminal input
P13/TxD2	Output	Terminal output
P50	Output	LED1

3. Description of Software

3.1 Demo Project (PubSub)

3.1.1 Demo Project Structure

This demo project connects to the AWS from the MCU board, and then issues messages on a regular basis by using the MQTT library.

3.1.2 List of Option Bytes Settings

The followings show the option bytes settings.

Table 3-1 Option Bytes Settings

Address	Settings	Description
000C0H/040C0H	11101111B	Stops the watchdog timer operation. (Stops counting after the release from the reset state.)
000C1H/040C1H	00111010B	LVD0 off (using an external reset input from the RESET pin)
000C2H/040C2H	11101000B	HS (high-speed main) mode and High-speed on-chip oscillator clock (fIH): 32 MHz
000C3H/040C3H	10000100B	Enables on-chip debugging.

3.2 Demo Project (OTA)

3.2.1 Demo Project Structure

The firmware update mechanism of this demo project uses the partial update method (buffer side is internal flash) provided by the firmware update module. For details, refer to "RL78/G22,RL78/G23,RL78/G24 Firmware Update Module".

The following illustrates the firmware update mechanism and shows the memory map.

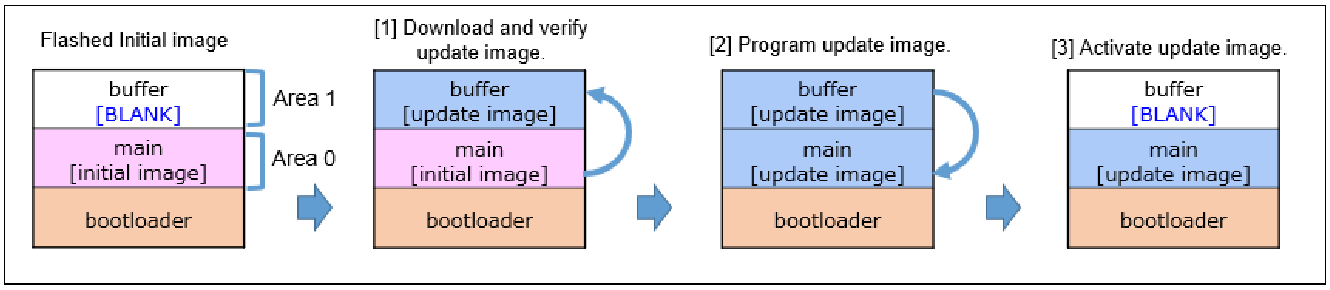


Figure 3-1 Firmware Update Mechanism

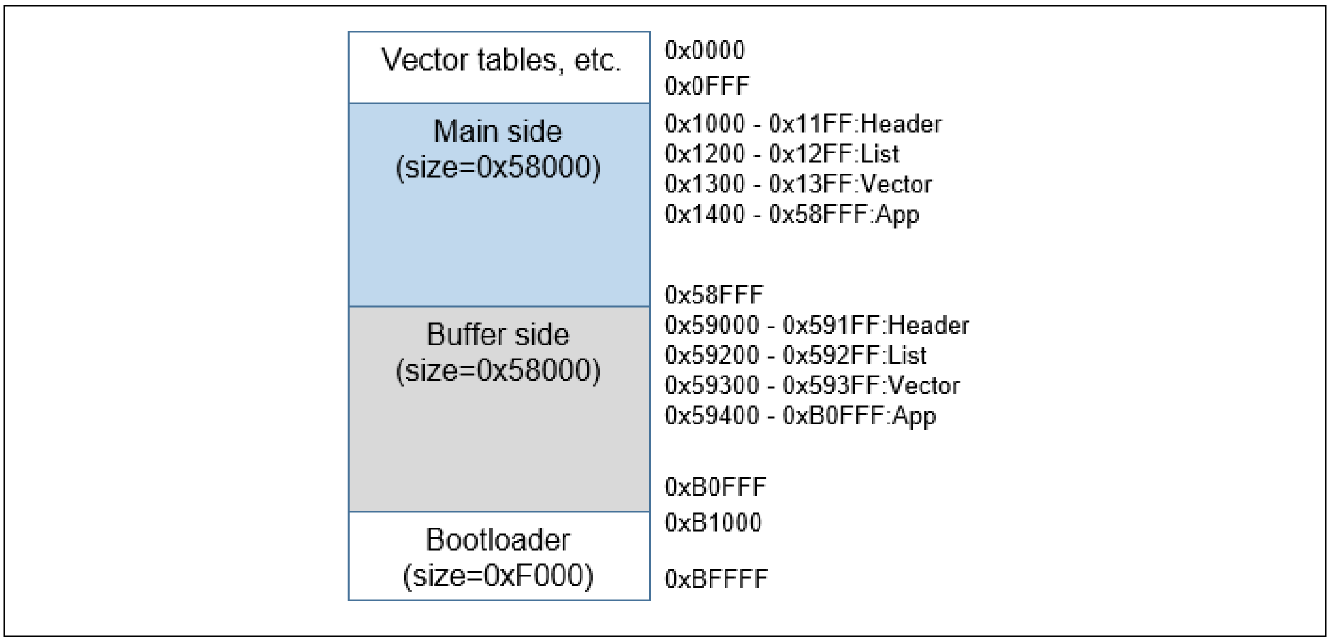


Figure 3-2 Memory Map of Demo Project (OTA)

3.2.2 List of Option Bytes Settings

The followings show the option bytes settings.

Table 3-2 Option Bytes Settings

Address	Settings	Description
000C0H/040C0H	11101111B	Stops the watchdog timer operation. (Stops counting after reset.)
000C1H/040C1H	00111010B	LVD0 off (using an external reset input from the RESET pin)
000C2H/040C2H	11101000B	HS (high-speed main) mode and High-speed on-chip oscillator clock (fIH): 32 MHz
000C3H/040C3H	10000100B	Enables on-chip debugging.

3.3 Folder Structure

The following shows the folder structure of the sample program.

Table 3-3 Folder Structure of the Sample Program

Folder Name	Description
iot-reference-rl78	The sample program described in this Getting Started Guide.
├─Common	
│ ├─FreeRTOS_common	
│ └─ports	
│ └─ota_pal	
├─Configuration	
│ └─rl78g23-fpb	
│ ├─ota	OTA demo configurations.
│ ├─pubsub	PubSub demo configurations.
│ └─test	
├─Demos	
│ ├─common	
│ ├─include	
│ ├─mqtt_agent	
│ ├─OtaOverMqtt	OTA demo source codes.
│ └─SimplePubSub	PubSub demo source codes.
├─IDT_config	
├─Middleware	
│ ├─3rdparty	
│ ├─Application-Protocols	
│ │ └─network_transport	
│ ├─AWS	
│ │ └─ota-for-aws-iot-embedded-sdk	
│ ├─FreeRTOS	FreeRTOS Kernel and libraries.
│ │ ├─backoffAlgorithm	
│ │ ├─coreJSON	
│ │ ├─coreMQTT	
│ │ ├─coreMQTT-Agent	
│ │ ├─FreeRTOS-Cellular-Interface	
│ │ └─FreeRTOS-Kernel	
│ └─logging	
├─Projects	
│ └─rl78g23-fpb	
│ ├─application_code	
│ ├─flash_proj	
│ ├─helper	
│ ├─modules	
│ ├─projects	Import below folders to IDE.
│ │ ├─aws_ryz024a_rl78g23-fpb	PubSub demo and OTA demo. Select by Build Configurations.
│ │ ├─boot_loader	Boot loader for OTA demo.
│ │ └─test_aws_cellular_ryz024a	
│ └─rtos_skelton	
├─Test	
└─Tools	

3.4 Code Size

The following table shows the ROM and RAM size of demo projects confirmed in the following conditions.

- CC-RL
  - Compile options:
    - -Odefault: Optimization that is effective for both the object size and execution speed.
  - Link options:
    - -optimize=symbol_delete: Deleting variables or functions that have not been referenced even once.

Table 3-4 ROM and RAM Size of Demo Projects

Demo Project Name	ROM (byte)	RAM (byte)
aws_ryz024a_rl78g23-fpb (demo project (PubSub))	142311	29913
aws_ryz024a_rl78g23-fpb (demo project (OTA))	234729	36790
boot_loader	22147	1348

4. Setup Common to Demo Projects (PubSub and OTA)

The following describes the setup procedure applicable to demo project (PubSub) and demo project (OTA).

4.1 Hardware Setup

4.1.1 Overall Configuration

First, the following shows the overall configuration of hardware that makes up the demo project.

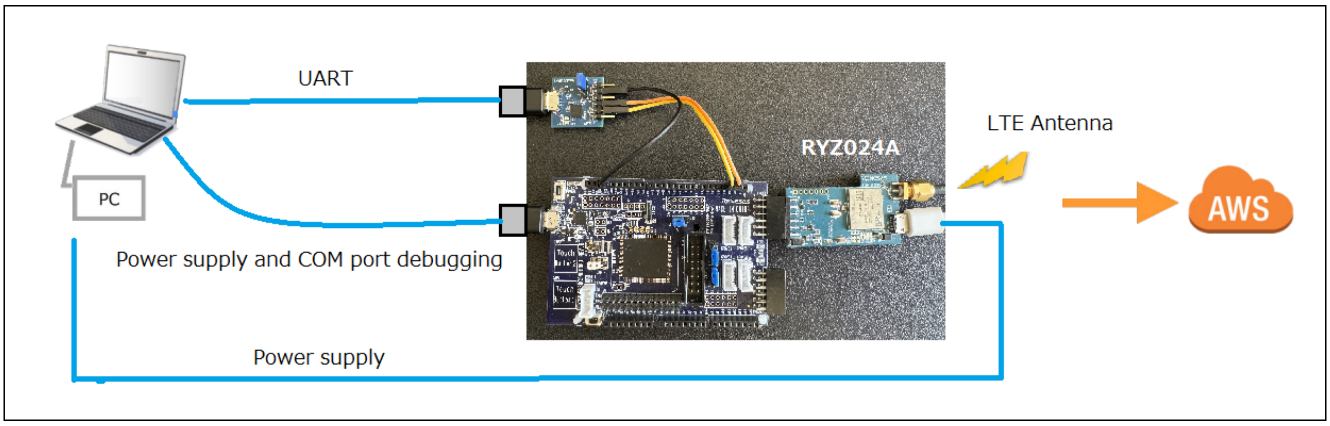


Figure 4-1 Overall Hardware Configuration of the Demo Project

4.1.2 Connecting Hardware

The following describes how to connect hardware.

(1) Insert the activated SIM cart into RYZ024A.

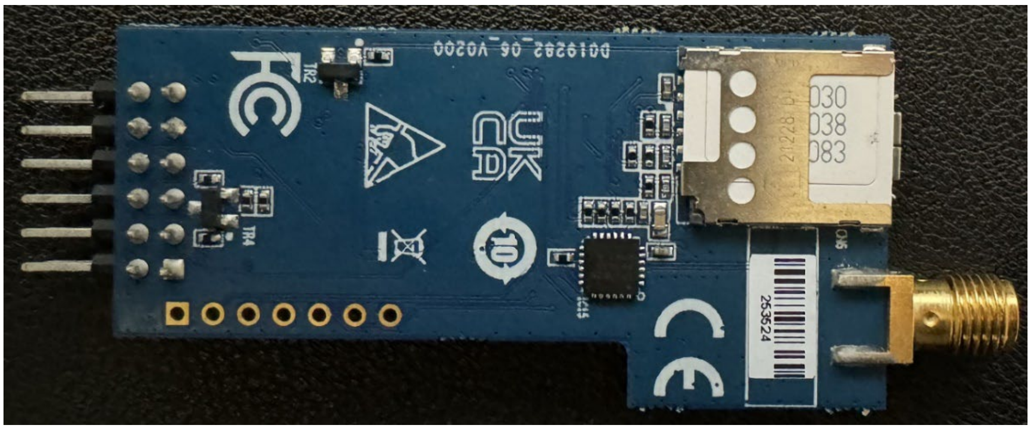


Figure 4-2 Inserting Activated SIM Cart into RYZ024A

(2) Connect the antenna and power supply USB cable to RYZ024A.

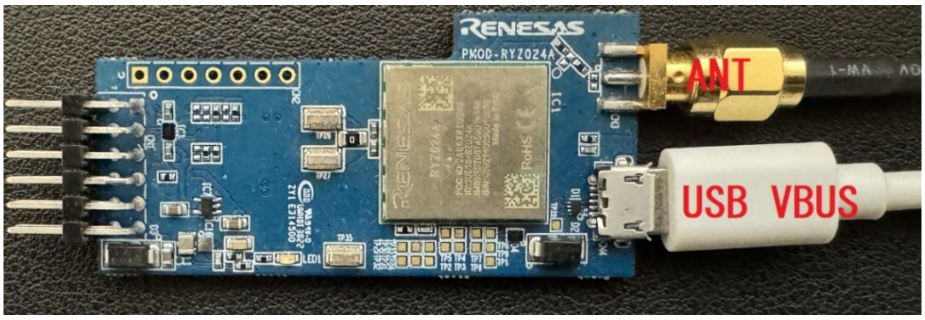


Figure 4-3 Connecting Antenna and Power Supply USB Cable to RYZ024A

(3) Connect RYZ024A to PMOD1 of the MCU board.

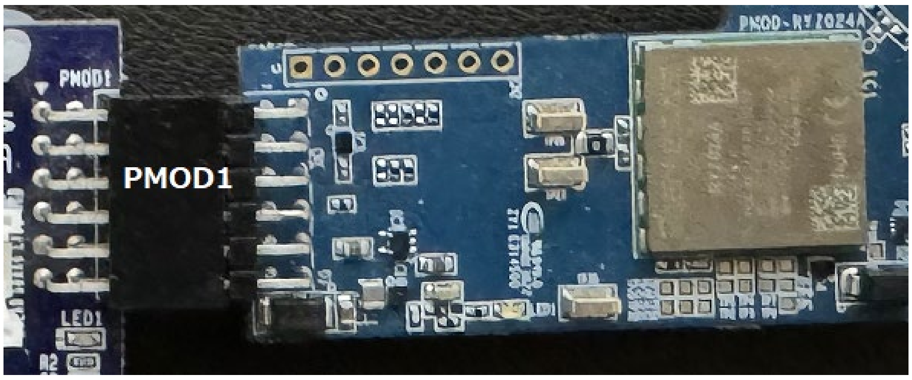
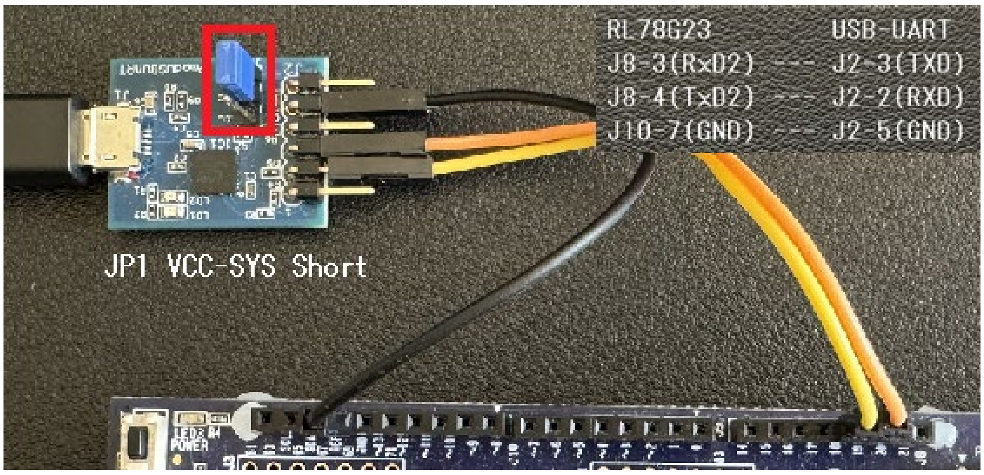


Figure 4-4 Connecting RYZ024A to PMOD1 of the MCU Board

(4) Connect the USB-UART conversion board to the MCU board.



RL78G23		USB-UART
J8-3(RxD2)	---	J2-3(TXD)
J8-4(TxD2)	---	J2-2(RXD)
J10-7(GND)	---	J2-5(GND)

Figure 4-5 Connecting the USB-UART Conversion Board to the MCU Board

(5) On the MCU board, set the power supply selection header to J20 2-3 Short to select 3.3 V power supply.

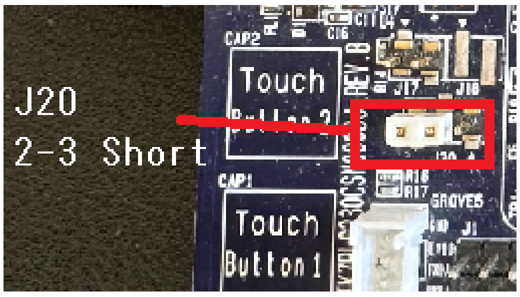


Figure 4-6 Setting MCU Board Power Supply to 3.3 V

(6) If you changed circuit to mount emulator connector on the MCU board, configure the COM port debugging that uses a USB-to-serial converter.
If you don't change circuit, you don't need this process.

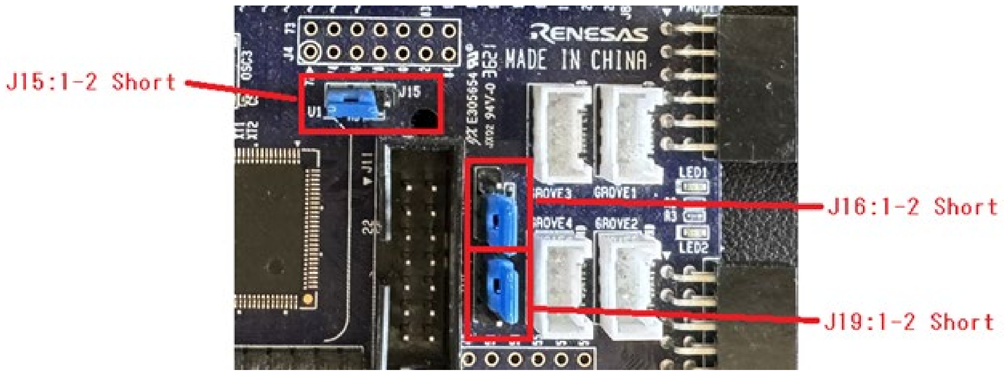


Figure 4-7 Settings for Using COM Port Debugging (Top Side)

(7) Connect the USB cable to supply power to the MCU board.

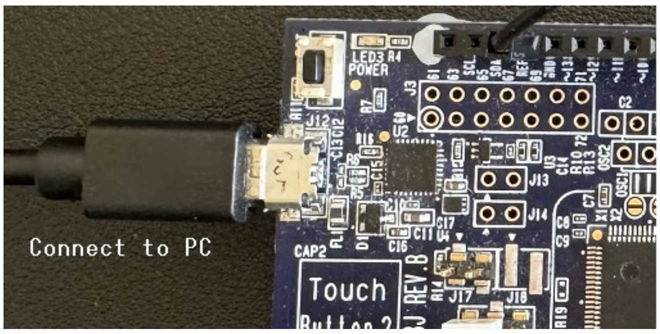


Figure 4-8 Supplying Power to the MCU Board

(8) Confirm the COM port number.

The COM port number will be used for programming and debugging firmware.

(9) Remove the USB cable to stop power supply to the MCU board.

4.2 Software Setup

4.2.1 Terminal Software Settings

Terminal software (example: Tera Term) is required to output demo project logs. The followings show the serial port settings.

Table 4-1 Serial Port Settings

Item	Description
Baud rate	115200 bps
Data	8 bits
Parity	None
Stop bit	1 bit
Flow control	None

4.2.2 Installing Flash Writer

A flash writer is used for programming initial images.

Renesas Flash Programmer (Programming GUI)

4.2.3 Adding SIM Card Information to the Demo Project

Specify the SIM card information for the following macros in the demo project. Refer to a manual of your SIM card for SIM card information.

- iot-reference-rl78\Projects\rl78g23-fpb\modules\r_config\r_aws_cellular_config.h
  - AWS_CELLULAR_CFG_AP_NAME: Access point name
  - AWS_CELLULAR_CFG_AP_USERID: User ID for access point (Note 1)
  - AWS_CELLULAR_CFG_AP_PASSWORD: Password for access point (Note 1)
  - AWS_CELLULAR_CFG_PIN_CODE: PIN code (Note 2)
  - AWS_CELLULAR_CFG_AUTH_TYPE: Authentication type

Note 1: Specify an empty value for the macro if there is no information.
Note 2: Specify an empty string for the macro if there is no information.

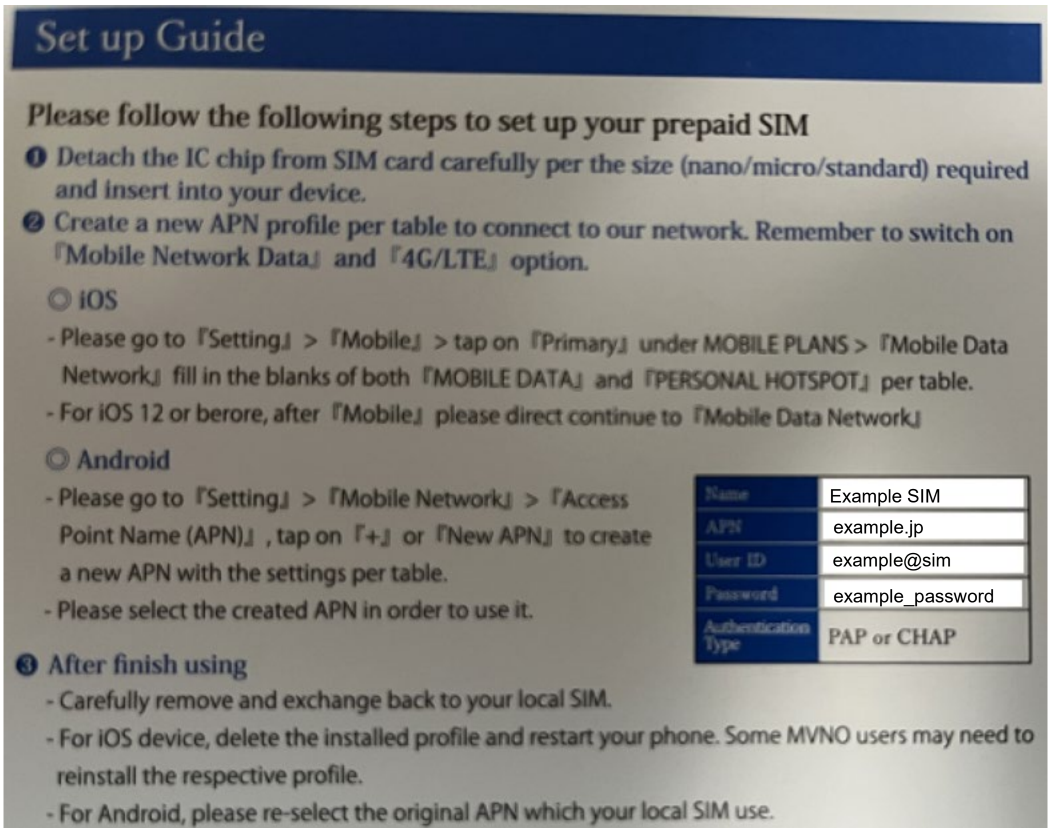
The followings show setting examples of each SIM card described in this document.

(1) Case: SIM card by Truphone bundled with RTKYZ024A0B00000BE

iot-reference-rl78\Projects\rl78g23-fpb\modules\r_config\r_aws_cellular_config.h

```
#define AWS_CELLULAR_CFG_AP_NAME        "iot.truphone.com" /* Access point name */
#define AWS_CELLULAR_CFG_AP_USERID      ""     /* Login ID */
#define AWS_CELLULAR_CFG_AP_PASSWORD    ""     /* Access point password */
#define AWS_CELLULAR_CFG_PIN_CODE              /* SIM card PIN code */
#define AWS_CELLULAR_CFG_AUTH_TYPE      (0)    /* Authentication protocol type
(0=None,1=PAP,2=CHAP)*/
```

(2) Case: DHA-SIM-132 by Nippon SIM



Set up Guide

Please follow the following steps to set up your prepaid SIM

❶ Detach the IC chip from SIM card carefully per the size (nano/micro/standard) required and insert into your device.

❷ Create a new APN profile per table to connect to our network. Remember to switch on 「Mobile Network Data」 and 「4G/LTE」 option.

◎ iOS

- Please go to 「Setting」 > 「Mobile」 > tap on 「Primary」 under MOBILE PLANS > 「Mobile Data Network」 fill in the blanks of both 「MOBILE DATA」 and 「PERSONAL HOTSPOT」 per table.
- For iOS 12 or berore, after 「Mobile」 please direct continue to 「Mobile Data Network」

◎ Android

- Please go to 「Setting」 > 「Mobile Network」 > 「Access Point Name (APN)」, tap on 「+」 or 「New APN」 to create a new APN with the settings per table.
- Please select the created APN in order to use it.

Name	Example SIM
APN	example.jp
User ID	example@sim
Password	example_password
Authentication Type	PAP or CHAP

❸ After finish using

- Carefully remove and exchange back to your local SIM.
- For iOS device, delete the installed profile and restart your phone. Some MVNO users may need to reinstall the respective profile.
- For Android, please re-select the original APN which your local SIM use.

Figure 4-9 Example of SIM Card Manual

iot-reference-rl78\Projects\rl78g23-fpb\modules\r_config\r_aws_cellular_config.h

```
#define AWS_CELLULAR_CFG_AP_NAME        "example.jp"       /* Access point name */
#define AWS_CELLULAR_CFG_AP_USERID      "example@sim"      /* Login ID */
#define AWS_CELLULAR_CFG_AP_PASSWORD    "example_password" /* Access point password */
#define AWS_CELLULAR_CFG_PIN_CODE                          /* SIM card PIN code */
#define AWS_CELLULAR_CFG_AUTH_TYPE      (2)     /* Authentication protocol type
(0=None,1=PAP,2=CHAP)*/
```

4.2.4 Adding AWS IoT Connection Settings to the Demo Project

Add the settings required for AWS IoT connection to the demo project. The following describes the procedure.
The parts that should be changed according to the user environment are highlighted in yellow.

(1) Register the device to the IoT Core service then obtain the information (endpoint, thing name, and credential) required for connection. For details, refer to the following.

Register device to AWS IoT · renesas/iot-reference-rx Wiki · GitHub

(2) Set the endpoint and thing name to the demo project.
iot-reference-rl78\Demos\include\aws_clientcredential.h

```
/*
 * @brief MQTT Broker endpoint.
 *
 * @todo Set this to the fully-qualified DNS name of your MQTT broker.
 */
#define clientcredentialMQTT_BROKER_ENDPOINT    "YOUR_ENDPOINT"

/*
 * @brief Host name.
 *
 * @todo Set this to the unique name of your IoT Thing.
 * Please note that for convenience of demonstration only we
 * are using a #define here. In production scenarios the thing
 * name can be something unique to the device that can be read
 * by software, such as a production serial number, rather
 * than a hard coded constant.
 */
#define clientcredentialIOT_THING_NAME           "YOUR_THING_NAME"
```

(3) Set the credential (client certificate and private key) to the demo project.
iot-reference-rl78\Demos\include\aws_clientcredential_keys.h

Note: Add \n" to the end of each line.

```
/*
 * @brief PEM-encoded client certificate.
 *
 * @todo If you are running one of the FreeRTOS demo projects, set this
 * to the certificate that will be used for TLS client authentication.
 *
 * @note Must include the PEM header and footer:
 * "-----BEGIN CERTIFICATE-----\n"\
 * "...base64 data...\n"\
 * "-----END CERTIFICATE-----\n"
 */
#define keyCLIENT_CERTIFICATE_PEM \
"-----BEGIN CERTIFICATE-----\n"\
"MIIDWTCCAkGgAwIBAgIUFeYR3JSsJbTOS7huEq++YBGgwtowDQYJKoZIhvcNAQEL\n"\
...
"7qHumsC6fsEapoptgcfEpdERl4c9hJR45jHamDVhxZjitQD4klLA0gqTlBNL\n"\
"-----END CERTIFICATE-----\n"
…
/*
 * @brief PEM-encoded client private key.
 *
 * @todo If you are running one of the FreeRTOS demo projects, set this
…
* @note Must include the PEM header and footer:
 * "-----BEGIN RSA PRIVATE KEY-----\n"\
 * "...base64 data...\n"\
 * "-----END RSA PRIVATE KEY-----\n"
 */
#define keyCLIENT_PRIVATE_KEY_PEM \
"-----BEGIN RSA PRIVATE KEY-----\n"\
"MIIEowIBAAKCAQEA3Fb7O7jQW4lgHmPE3AInUTWUCaR7kWeWHubEk9YbNf3xwxdg\n"\
...
"s/OlVUiygf0RgeoMVx/3GzZPfmTrB0cQ8XZ7mxCd2dgY9UXQ/oja\n"\
"-----END RSA PRIVATE KEY-----\n"
```

5. Setup Specific to Demo Project (PubSub)

The following describes the setup procedure specific to the demo project (PubSub).

5.1 Preparation

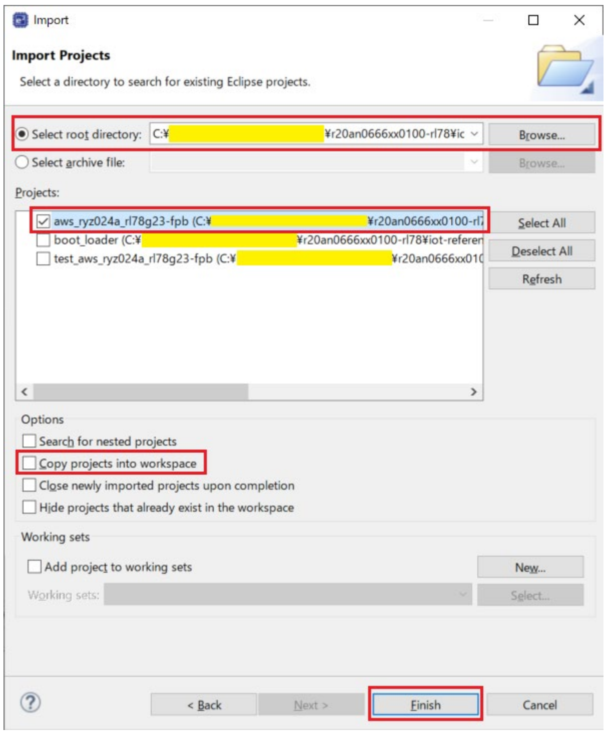
None

5.2 Importing the Project

Import the aws_ryz024a_rl78g23-fpb project to e^2 studio. Open the Import wizard according to the following process.

File > Import… > Existing Projects into Workspace > Next

Next, select the aws_ryz024a_rl78g23-fpb project. Ensure that copy projects into workspace is not selected. Then click the Finish button.


Import

Import Projects

Select a directory to search for existing Eclipse projects.

(●) Select root directory: C:¥[redacted]¥r20an0666xx0100-rl78¥ic

( ) Select archive file:

Projects:

- [✓] aws_ryz024a_rl78g23-fpb (C:¥[redacted]¥r20an0666xx0100-rl7
- [ ] boot_loader (C:¥[redacted]¥r20an0666xx0100-rl78¥iot-referen
- [ ] test_aws_ryz024a_rl78g23-fpb (C:¥[redacted]¥r20an0666xx010

Options

- [ ] Search for nested projects
- [ ] Copy projects into workspace
- [ ] Close newly imported projects upon completion
- [ ] Hide projects that already exist in the workspace

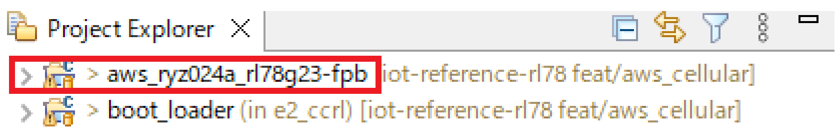
Working sets

- [ ] Add project to working sets

Working sets:

Figure 5-1 Selecting the aws_ryz024a_rl78g23-fpb Project

The imported project is showed in the Project Explorer view.


Project Explorer

> aws_ryz024a_rl78g23-fpb [iot-reference-rl78 feat/aws_cellular]

> boot_loader (in e2_ccrl) [iot-reference-rl78 feat/aws_cellular]

Figure 5-2 Completing to Import the aws_ryz024a_rl78g23-fpb Project

5.3 Setting the Build Configuration

Activate the build configuration "HardwareDebug" of the aws_ryz024a_rl78g23-fpb project.

Build Configurations > Set Active > Select "HardwareDebug"

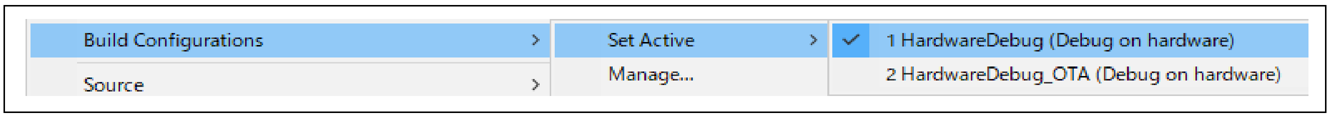

Build Configurations
Source
Set Active
Manage...
✓ 1 HardwareDebug (Debug on hardware)
2 HardwareDebug_OTA (Debug on hardware)

Figure 5-3 Activating Build Configuration "HardwareDebug"

5.4 Building the Demo Project

Build the aws_ryz024a_rl78g23-fpb project to create a MOT file.
Then, make sure that aws_ryz024a_rl78g23-fpb.mot has been created in the HardwareDebug folder directly under the project folder.

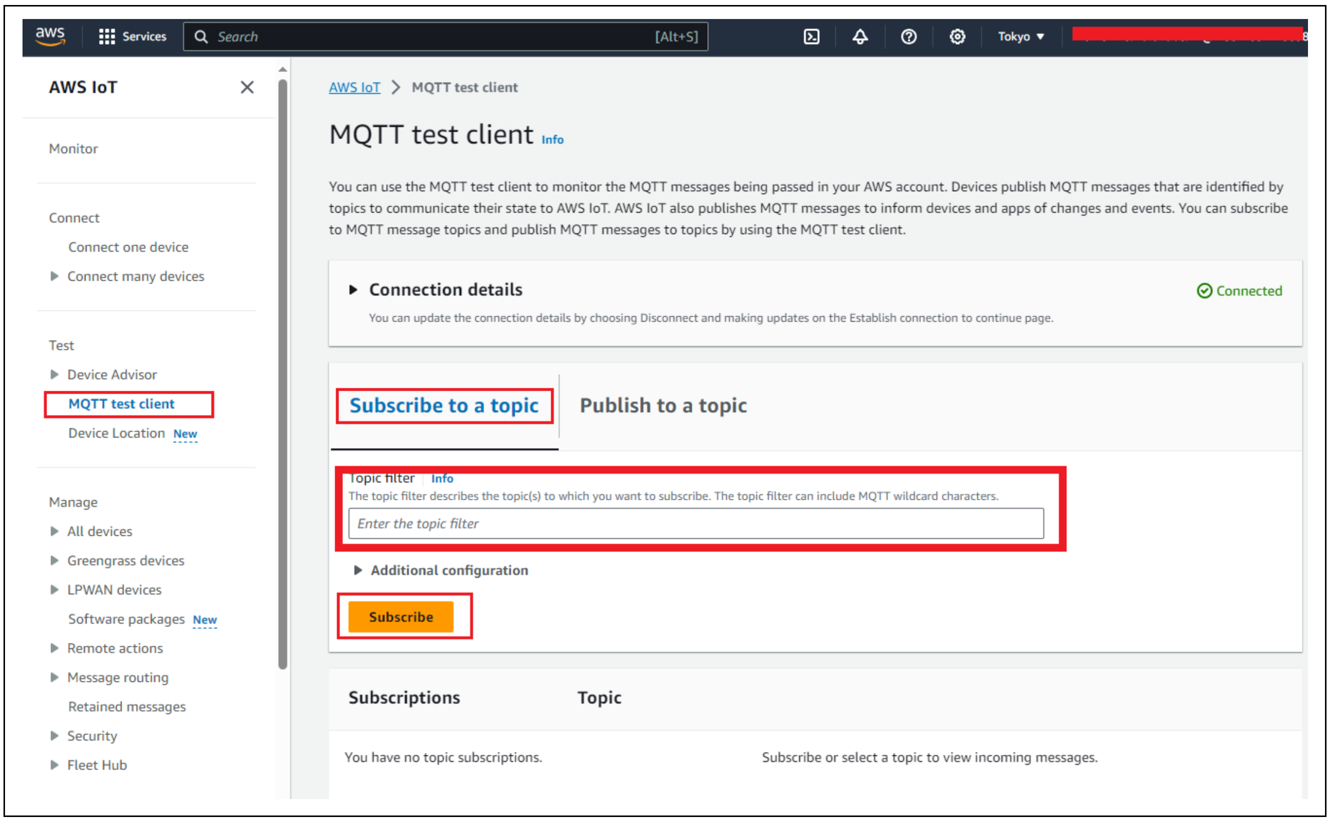
5.5 Preparing the MQTT Test Client

Access to the AWS Management Console, then subscribe "pubsub_demo" in the MQTT test client in the IoT Core service so that messages sent from the MCU board can be checked in text format.

(1) Select the "Subscribe to a topic" tab.

AWS IoT > MQTT test client >Select "Subscribe to a topic"

(2) Enter "pubsub_demo/#" for the topic filter, and then click "Subscribe".



[redacted]

MQTT test client Info

You can use the MQTT test client to monitor the MQTT messages being passed in your AWS account. Devices publish MQTT messages that are identified by topics to communicate their state to AWS IoT. AWS IoT also publishes MQTT messages to inform devices and apps of changes and events. You can subscribe to MQTT message topics and publish MQTT messages to topics by using the MQTT test client.

Connection details — Connected

You can update the connection details by choosing Disconnect and making updates on the Establish connection to continue page.

Subscribe to a topic | Publish to a topic

Topic filter Info

The topic filter describes the topic(s) to which you want to subscribe. The topic filter can include MQTT wildcard characters.

Enter the topic filter

Additional configuration

Subscribe

Subscriptions | Topic

You have no topic subscriptions. | Subscribe or select a topic to view incoming messages.

Figure 5-4 MQTT Test Client Settings

5.6 Running the Demo Project

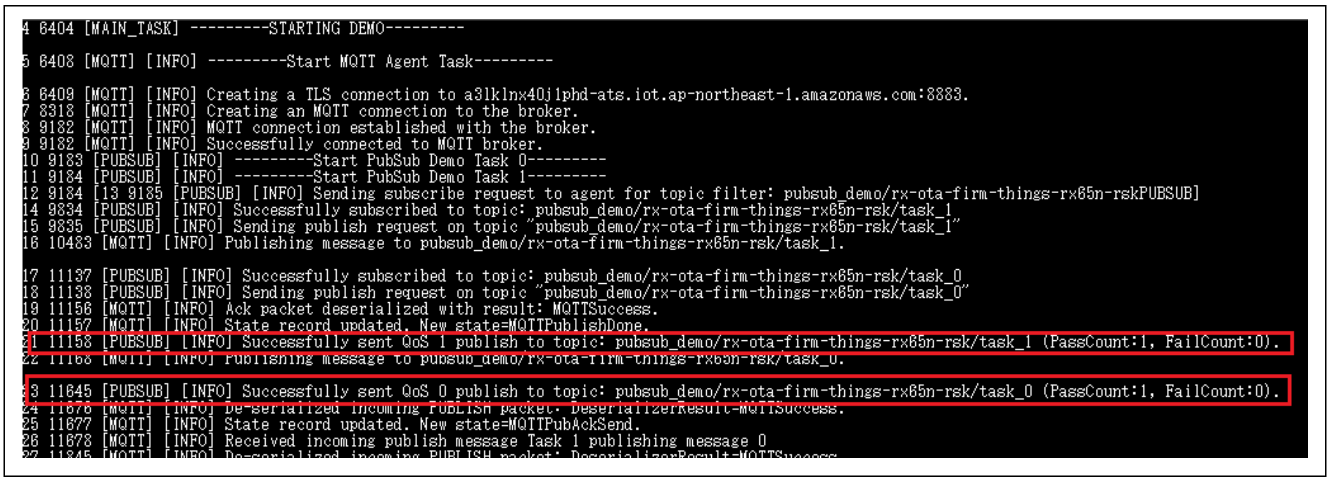
The following describes the running procedure for the demo project (PubSub).

(1) Use Renesas Flash Programmer to program aws_ryz024a_rl78g23-fpb.mot to the MCU board.

For the programming method, refer to Chapter 7, Using Renesas Flash Programmer.

(2) When programming terminates, the demo project (PubSub) starts.

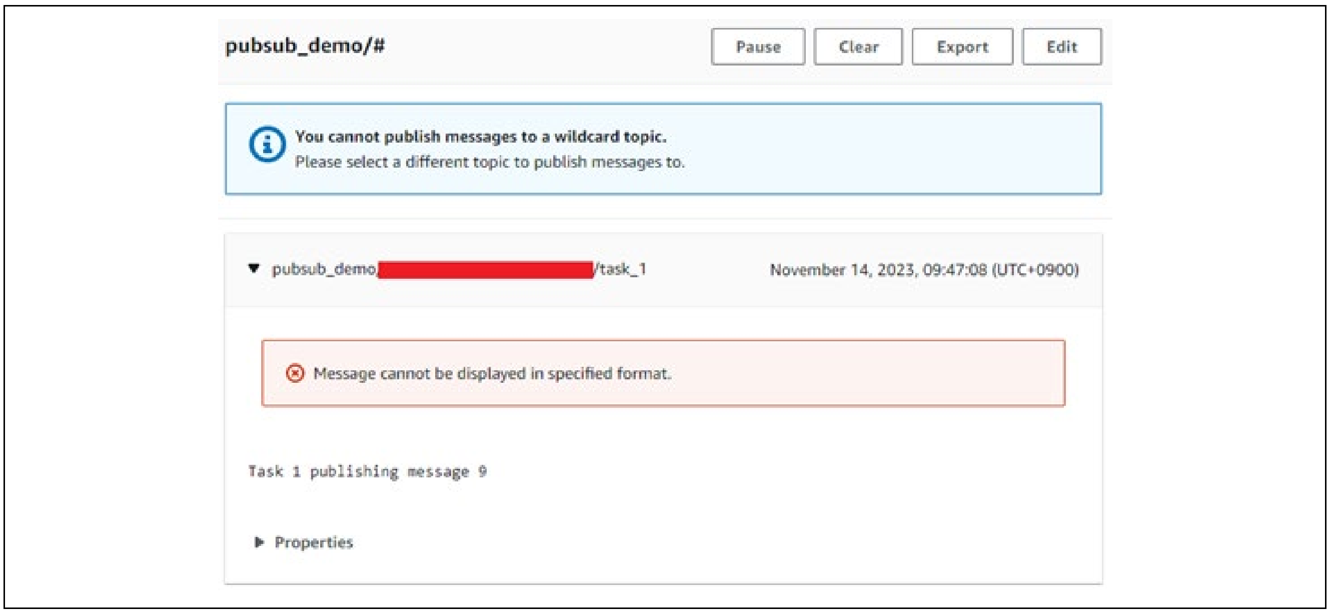
Check the terminal to make sure that the message transmission results of PubSub Demo Task0 and PubSub Demo Task1 are successful.



```
4 6404 [MAIN_TASK] ---------STARTING DEMO---------

5 6408 [MQTT] [INFO] ---------Start MQTT Agent Task---------

6 6409 [MQTT] [INFO] Creating a TLS connection to a3lklnx40j1phd-ats.iot.ap-northeast-1.amazonaws.com:8883.
7 8318 [MQTT] [INFO] Creating an MQTT connection to the broker.
8 9182 [MQTT] [INFO] MQTT connection established with the broker.
9 9182 [MQTT] [INFO] Successfully connected to MQTT broker.
10 9183 [PUBSUB] [INFO] ---------Start PubSub Demo Task 0---------
11 9184 [PUBSUB] [INFO] ---------Start PubSub Demo Task 1---------
12 9184 [13 9185 [PUBSUB] [INFO] Sending subscribe request to agent for topic filter: pubsub_demo/rx-ota-firm-things-rx65n-rskPUBSUB]
14 9834 [PUBSUB] [INFO] Successfully subscribed to topic: pubsub_demo/rx-ota-firm-things-rx65n-rsk/task_1
15 9835 [PUBSUB] [INFO] Sending publish request on topic "pubsub_demo/rx-ota-firm-things-rx65n-rsk/task_1"
16 10483 [MQTT] [INFO] Publishing message to pubsub_demo/rx-ota-firm-things-rx65n-rsk/task_1.

17 11137 [PUBSUB] [INFO] Successfully subscribed to topic: pubsub_demo/rx-ota-firm-things-rx65n-rsk/task_0
18 11138 [PUBSUB] [INFO] Sending publish request on topic "pubsub_demo/rx-ota-firm-things-rx65n-rsk/task_0"
19 11156 [MQTT] [INFO] Ack packet deserialized with result: MQTTSuccess.
20 11157 [MQTT] [INFO] State record updated. New state=MQTTPublishDone.
21 11158 [PUBSUB] [INFO] Successfully sent QoS 1 publish to topic: pubsub_demo/rx-ota-firm-things-rx65n-rsk/task_1 (PassCount:1, FailCount:0).
22 11168 [MQTT] [INFO] Publishing message to pubsub_demo/rx-ota-firm-things-rx65n-rsk/task_0.

23 11645 [PUBSUB] [INFO] Successfully sent QoS 0 publish to topic: pubsub_demo/rx-ota-firm-things-rx65n-rsk/task_0 (PassCount:1, FailCount:0).
24 11676 [MQTT] [INFO] De-serialized incoming PUBLISH packet: DeserializerResult=MQTTSuccess.
25 11677 [MQTT] [INFO] State record updated. New state=MQTTPubAckSend.
26 11678 [MQTT] [INFO] Received incoming publish message Task 1 publishing message 0
27 11845 [MQTT] [INFO] De-serialized incoming PUBLISH packet: DeserializerResult=MQTTSuccess
```

Figure 5-5 Checking Demo Project Execution Results on the Terminal

(3) Use the MQTT test client to make sure that the messages sent from PubSub Demo Task0 and PubSub Demo Task1 are displayed.



You cannot publish messages to a wildcard topic.
Please select a different topic to publish messages to.

pubsub_demo[redacted]/task_1 November 14, 2023, 09:47:08 (UTC+0900)

Message cannot be displayed in specified format.

```
Task 1 publishing message 9
```

Figure 5-6 Checking Demo Project Execution Results with the MQTT Test Client

5.7 Debugging the Demo Project

The following describes the procedure for starting the demo project (PubSub) from e^2 studio and debugging it.

(1) Build the demo project.

Refer to section 5.2, Importing the Project, section 5.3, Setting the Build Configuration, and section 5.4, Building the Demo Project.

(2) Start debugging.

Refer to Chapter 8, Debug Procedure.

6. Setup Specific to Demo Project (OTA)

This demo project connects to the AWS from the MCU board, and then performs firmware update by using AWS IoT OTA. This chapter describes the setup procedure.

6.1 Preparation

6.1.1 Installing Tools

Install the tools necessary for running the demo project.

(1) Install Python

1. Python is required for operation of Renesas Image Generator. Install version 3.9.0 or later. You can download Python from https://www.python.org/.
2. After installing Python, install the package pycryptodome by using the following command:

```
> pip install pycryptodome
```

(2) Install OpenSSL

Create the key necessary for verifying the code signature when creating an initial image and update image. Use OpenSSL to create the key.

1. If OpenSSL is not installed, open the following URL on your browser:
   Win32/Win64 OpenSSL Installer for Windows - Shining Light Productions (slproweb.com)
2. Download and install Win64OpenSSL v3.x.x Light.

(3) Download Renesas Image Generator

Download Renesas Image Generator (V3.03) contained in the RL78/G22,RL78/G23,RL78/G24 firmware update module.

6.1.2 Generating Keys for Signature Generation and Verification

Use OpenSSL to generate firmware verification keys. The parts highlighted in yellow indicate the commands to be entered.

(1) CA certificate

```
$ openssl ecparam -genkey -name secp256r1 -out ca.key
using curve name prime256v1 instead of secp256r1
$ openssl req -x509 -sha256 -new -nodes -key ca.key -days 3650 -out ca.crt
You are about to be asked to enter information that will be incorporated
into your certificate request.
What you are about to enter is what is called a Distinguished Name or a DN.
There are quite a few fields but you can leave some blank
For some fields there will be a default value,
If you enter '.', the field will be left blank.
-----
Country Name (2 letter code) [AU]:JP
State or Province Name (full name) [Some-State]:Tokyo
Locality Name (eg, city) []:Kodaira
Organization Name (eg, company) [Internet Widgits Pty Ltd]:Renesas Electronics
Organizational Unit Name (eg, section) []:Software Development Division
Common Name (e.g. server FQDN or YOUR name) []:Renesas Tarou
Email Address []:Tarou.Renesas@sample.com
```

(2) Elliptic curve cryptography (secp256r1) key pair

```
$ openssl ecparam -genkey -name secp256r1 -out secp256r1.keypair
using curve name prime256v1 instead of secp256r1
```

(3) Key pair certificate

```
$ openssl req -new -sha256 -key secp256r1.keypair > secp256r1.csr
You are about to be asked to enter information that will be incorporated
into your certificate request.
What you are about to enter is what is called a Distinguished Name or a DN.
There are quite a few fields but you can leave some blank
For some fields there will be a default value,
If you enter '.', the field will be left blank.
-----
Country Name (2 letter code) [AU]:JP
State or Province Name (full name) [Some-State]:Tokyo
Locality Name (eg, city) []:Kodaira
Organization Name (eg, company) [Internet Widgits Pty Ltd]:Renesas Electronics
Organizational Unit Name (eg, section) []:Software Development Division
Common Name (e.g. server FQDN or YOUR name) []: Renesas Tarou
Email Address []: Tarou.Renesas@sample.com
Please enter the following 'extra' attributes
to be sent with your certificate request
A challenge password []:
An optional company name []:
```

(4) Genarating a key pair certificate by using the CA certificate

```
$ openssl x509 -req -sha256 -days 3650 -in secp256r1.csr -CA ca.crt -CAkey ca.key -
CAcreateserial -out secp256r1.crt
Signature ok
subject=C = JP, ST = Tokyo, L = Kodaira, O = Renesas Electronics, OU = Software
Development Division, CN = Renesas Tarou, emailAddress = Tarou.Renesas@sample.com
Getting CA Private Key
```

(5) Extracting the elliptic curve cryptography (secp256r1) private key

```
$ openssl ec -in secp256r1.keypair -outform PEM -out secp256r1.privatekey
read EC key
writing EC key
```

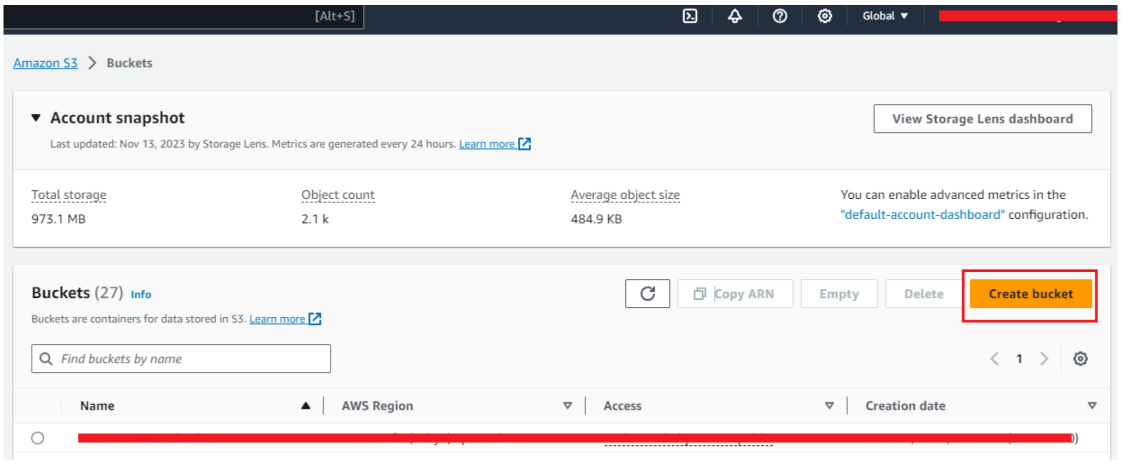
(6) Extracting the elliptic curve cryptography (secp256r1) public key

```
$ openssl ec -in secp256r1.keypair -outform PEM -pubout -out secp256r1.publickey
read EC key
writing EC key
```

6.1.3 Settings for OTA Update

6.1.3.1 Creating Amazon S3 Buckets

(1) Amazon S3 > Buckets > “Create bucket”



[redacted]

Amazon S3 > Buckets

▼ Account snapshot

Last updated: Nov 13, 2023 by Storage Lens. Metrics are generated every 24 hours. Learn more

View Storage Lens dashboard

Total storage	Object count	Average object size	You can enable advanced metrics in the "default-account-dashboard" configuration.
973.1 MB	2.1 k	484.9 KB	

Buckets (27) Info

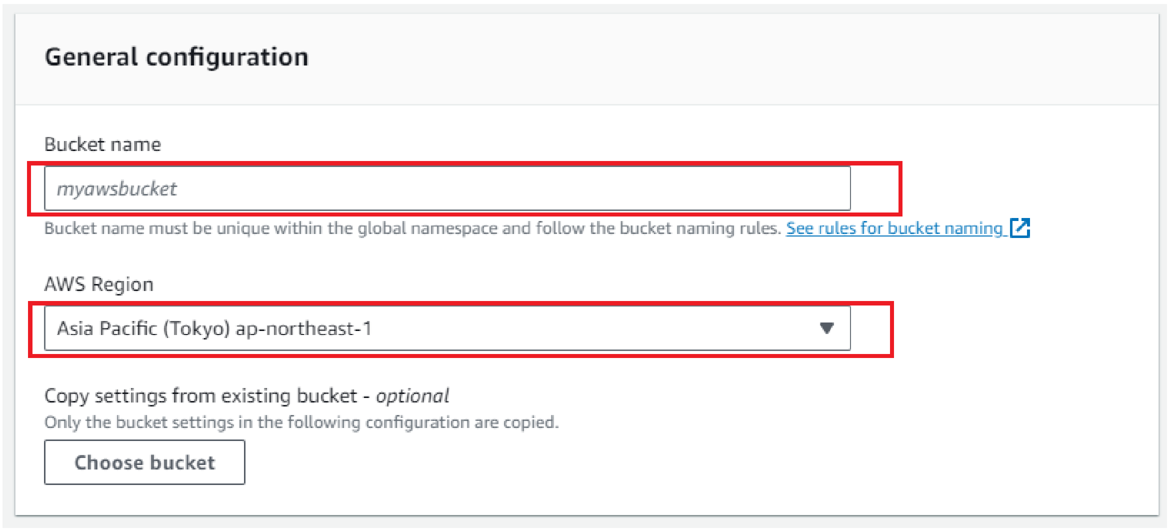
Buckets are containers for data stored in S3. Learn more

	Name ▲	AWS Region	Access	Creation date
○	[redacted]	[redacted]	[redacted]	[redacted]

Figure 6-1 Crate Bucket

(2) General configuration

- Bucket name: Your bucket name
- AWS Region: Asia Pacific (Tokyo) ap-northeast-1



General configuration

Bucket name

myawsbucket

Bucket name must be unique within the global namespace and follow the bucket naming rules. See rules for bucket naming

AWS Region

Asia Pacific (Tokyo) ap-northeast-1 ▼

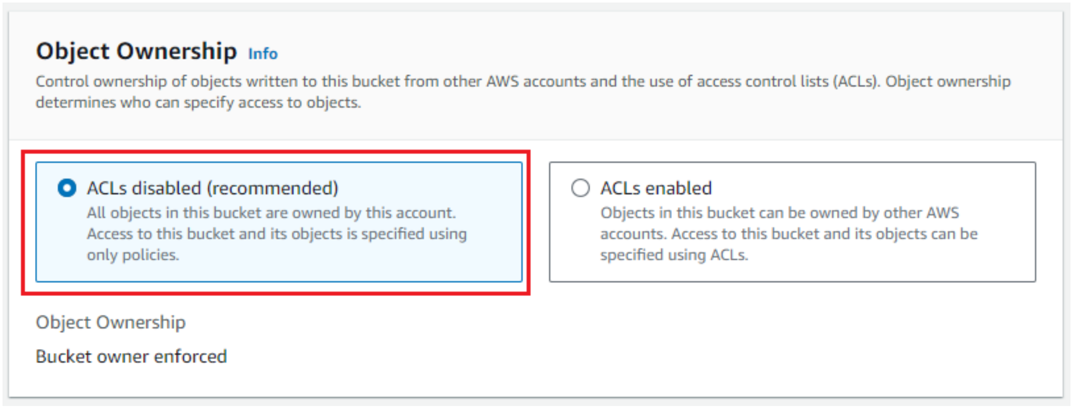
Copy settings from existing bucket - *optional*

Only the bucket settings in the following configuration are copied.

Figure 6-2 General Configuration

(3) Object Ownership

- Choose ACLs disabled



Object Ownership Info

Control ownership of objects written to this bucket from other AWS accounts and the use of access control lists (ACLs). Object ownership determines who can specify access to objects.

[✓ ACLs disabled (recommended)] All objects in this bucket are owned by this account. Access to this bucket and its objects is specified using only policies.

ACLs enabled — Objects in this bucket can be owned by other AWS accounts. Access to this bucket and its objects can be specified using ACLs.

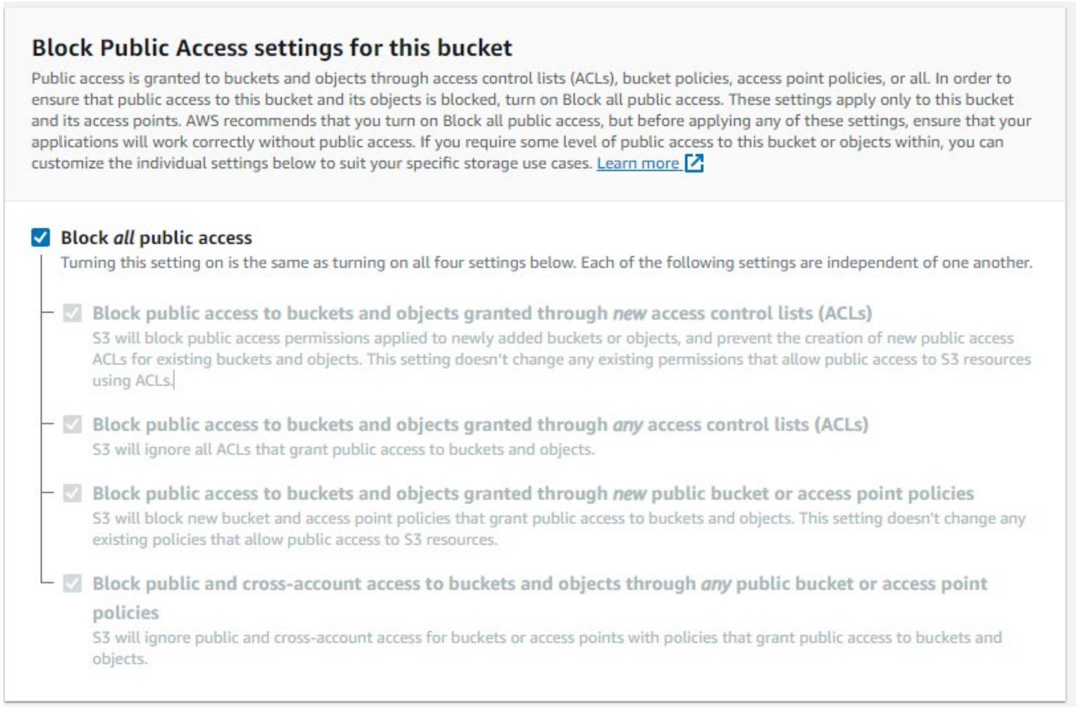
Object Ownership

Bucket owner enforced

Figure 6-3 Object Ownership

(4) Block Public Access settings for this bucket

- Choose Block all public access



Block Public Access settings for this bucket

Public access is granted to buckets and objects through access control lists (ACLs), bucket policies, access point policies, or all. In order to ensure that public access to this bucket and its objects is blocked, turn on Block all public access. These settings apply only to this bucket and its access points. AWS recommends that you turn on Block all public access, but before applying any of these settings, ensure that your applications will work correctly without public access. If you require some level of public access to this bucket or objects within, you can customize the individual settings below to suit your specific storage use cases. Learn more

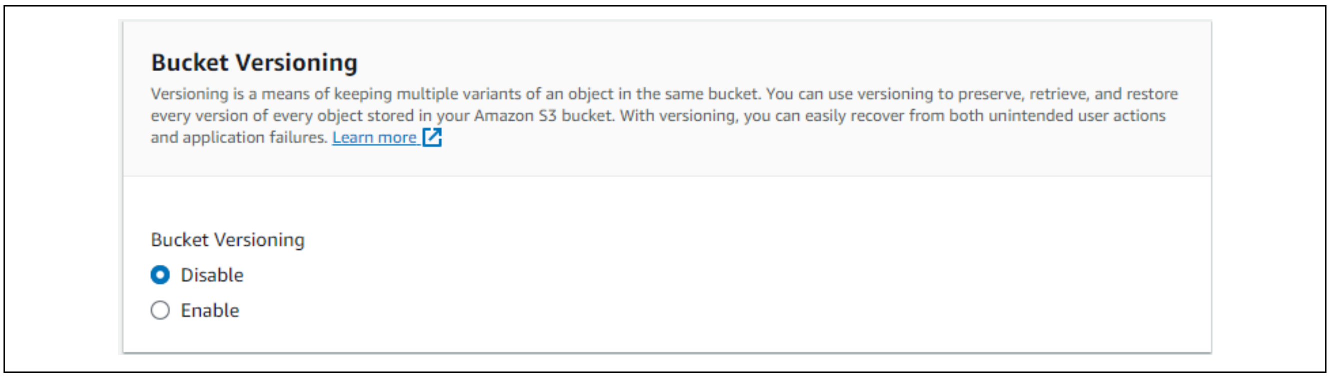
[✓] Block *all* public access
Turning this setting on is the same as turning on all four settings below. Each of the following settings are independent of one another.

- [✓] Block public access to buckets and objects granted through *new* access control lists (ACLs)
  S3 will block public access permissions applied to newly added buckets or objects, and prevent the creation of new public access ACLs for existing buckets and objects. This setting doesn't change any existing permissions that allow public access to S3 resources using ACLs.
- [✓] Block public access to buckets and objects granted through *any* access control lists (ACLs)
  S3 will ignore all ACLs that grant public access to buckets and objects.
- [✓] Block public access to buckets and objects granted through *new* public bucket or access point policies
  S3 will block new bucket and access point policies that grant public access to buckets and objects. This setting doesn't change any existing policies that allow public access to S3 resources.
- [✓] Block public and cross-account access to buckets and objects through *any* public bucket or access point policies
  S3 will ignore public and cross-account access for buckets or access points with policies that grant public access to buckets and objects.

Figure 6-4 Block Public Access Settings for this bucket

(5) Bucket Versioning

- Bucket Versioning: Disable



Bucket Versioning

Versioning is a means of keeping multiple variants of an object in the same bucket. You can use versioning to preserve, retrieve, and restore every version of every object stored in your Amazon S3 bucket. With versioning, you can easily recover from both unintended user actions and application failures. Learn more

Bucket Versioning

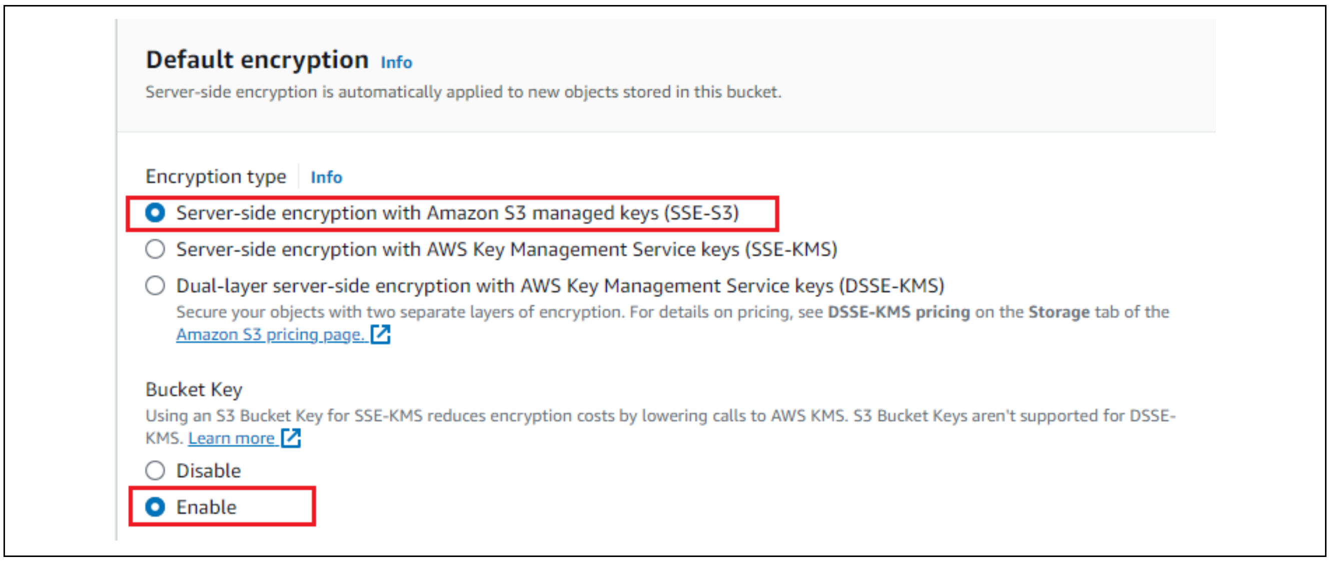
● Disable

○ Enable

Figure 6-5 Bucket Versioning

(6) Default encryption

- Encryption type: Server-side encryption with Amazon S3 managed keys (SSE-S3)
- Bucket Key: Enable



Default encryption Info

Server-side encryption is automatically applied to new objects stored in this bucket.

Encryption type Info

● Server-side encryption with Amazon S3 managed keys (SSE-S3)

○ Server-side encryption with AWS Key Management Service keys (SSE-KMS)

○ Dual-layer server-side encryption with AWS Key Management Service keys (DSSE-KMS)

Secure your objects with two separate layers of encryption. For details on pricing, see **DSSE-KMS pricing** on the **Storage** tab of the Amazon S3 pricing page.

Bucket Key

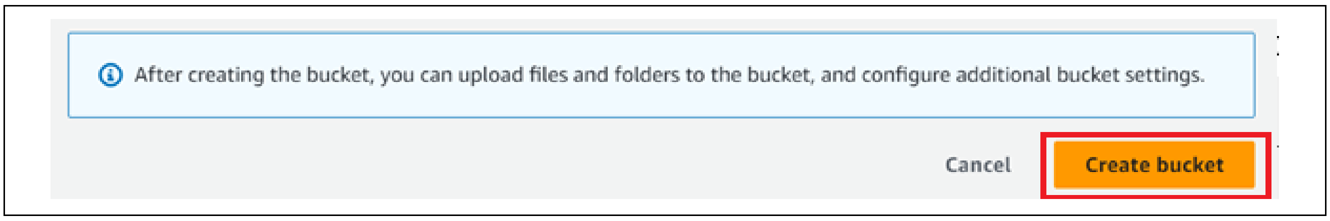
Using an S3 Bucket Key for SSE-KMS reduces encryption costs by lowering calls to AWS KMS. S3 Bucket Keys aren't supported for DSSE-KMS. Learn more

○ Disable

● Enable

Figure 6-6 Default encryption

(7) Click “Create bucket”

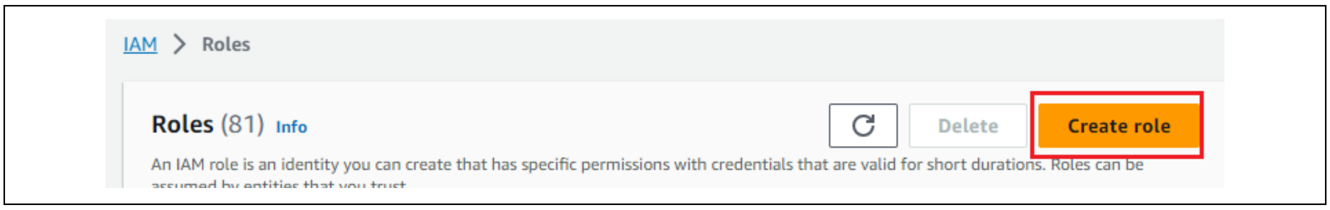


After creating the bucket, you can upload files and folders to the bucket, and configure additional bucket settings.

Figure 6-7 Clicking “Crate bucket”

6.1.3.2 Creating an OTA Update Service Role

(1) IAM > Roles > "Create role"

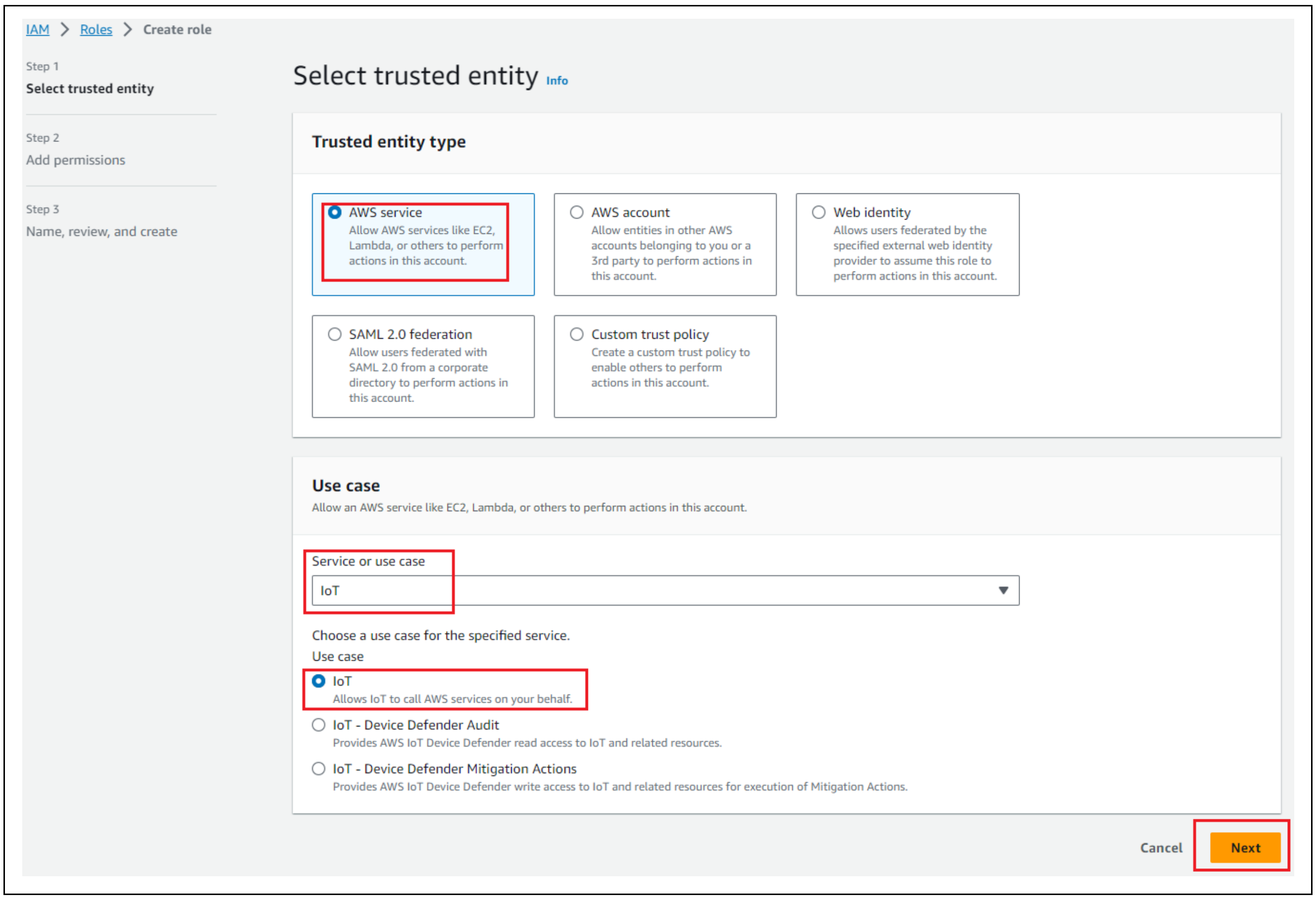


An IAM role is an identity you can create that has specific permissions with credentials that are valid for short durations. Roles can be assumed by entities that you trust.

Figure 6-8 IAM > Roles > Create role

(2) Step 1: Select trusted entity

- Trusted entity type: AWS service
- Use case: Service or use case > IoT



AWS service — Allow AWS services like EC2, Lambda, or others to perform actions in this account.

AWS account — Allow entities in other AWS accounts belonging to you or a 3rd party to perform actions in this account.

Web identity — Allows users federated by the specified external web identity provider to assume this role to perform actions in this account.

SAML 2.0 federation — Allow users federated with SAML 2.0 from a corporate directory to perform actions in this account.

Custom trust policy — Create a custom trust policy to enable others to perform actions in this account.

Use case

Allow an AWS service like EC2, Lambda, or others to perform actions in this account.

Service or use case: IoT

Choose a use case for the specified service.

Use case

[✓ IoT] — Allows IoT to call AWS services on your behalf.

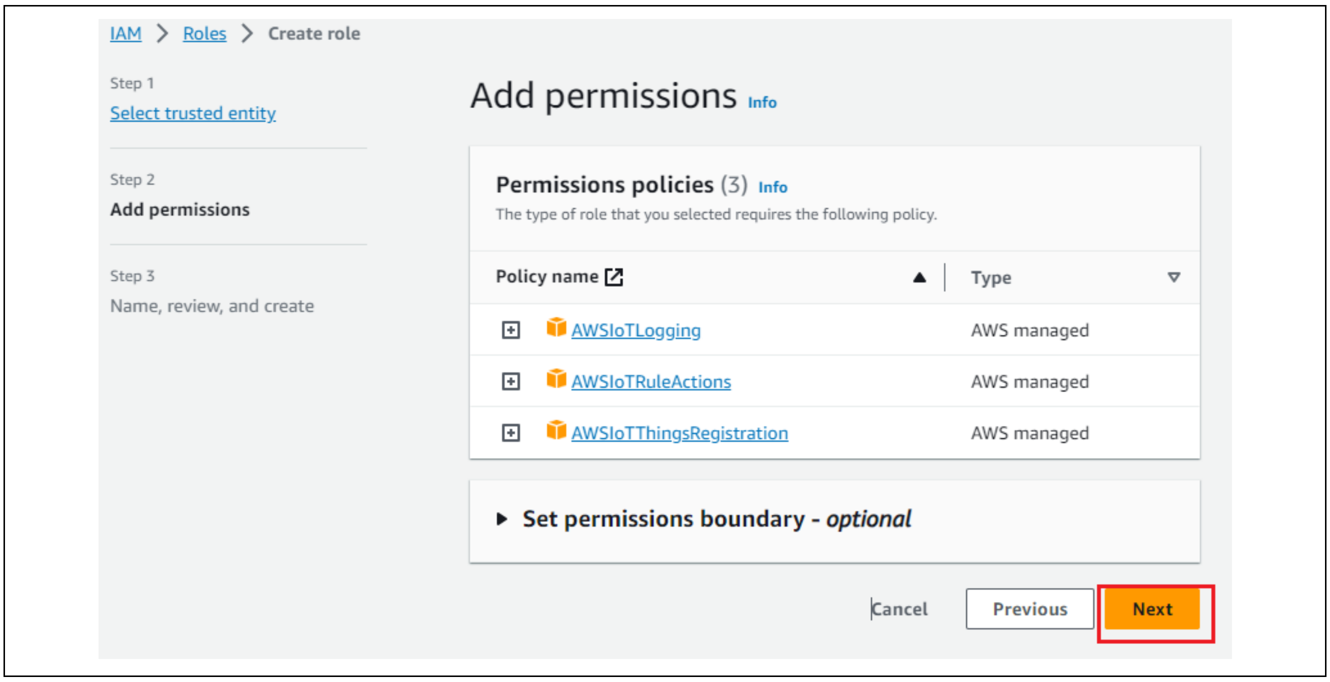
IoT - Device Defender Audit — Provides AWS IoT Device Defender read access to IoT and related resources.

IoT - Device Defender Mitigation Actions — Provides AWS IoT Device Defender write access to IoT and related resources for execution of Mitigation Actions.

Figure 6-9 Step 1: Select trusted entity

(3) Step 2: Add permissions

- AWSIoTLogging
- AWSIoTRuleActions
- AWSIoTThingsRegistration



IAM > Roles > Create role

Step 1
Select trusted entity

Step 2
Add permissions

Step 3
Name, review, and create

Add permissions Info

Permissions policies (3) Info
The type of role that you selected requires the following policy.

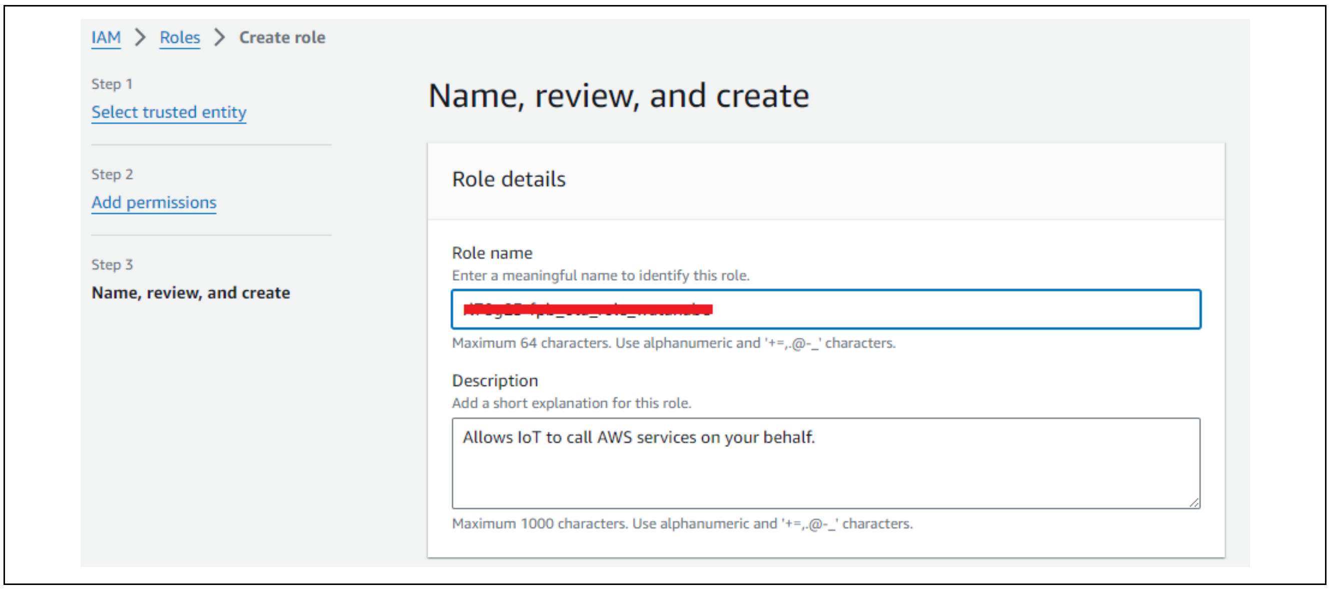
Policy name	Type
AWSIoTLogging	AWS managed
AWSIoTRuleActions	AWS managed
AWSIoTThingsRegistration	AWS managed

Set permissions boundary - *optional*

Figure 6-10 Step 2: Add permissions

(4) Step 3: Name, review, and create > Role details

- Role name: Any
- Description: Any



IAM > Roles > Create role

Step 1
Select trusted entity

Step 2
Add permissions

Step 3
Name, review, and create

Name, review, and create

Role details

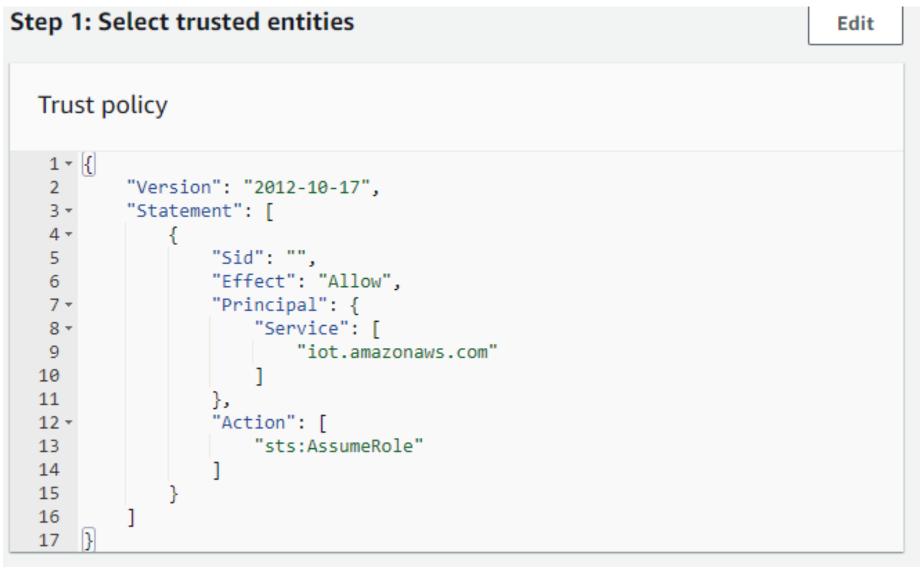
Role name
Enter a meaningful name to identify this role.
[redacted]
Maximum 64 characters. Use alphanumeric and '+=,.@-_' characters.

Description
Add a short explanation for this role.
Allows IoT to call AWS services on your behalf.
Maximum 1000 characters. Use alphanumeric and '+=,.@-_' characters.

Figure 6-11 Step 3: Name, review, and create > Role details

(5) Step 3: Name, review, and create > Step 1: Selected trusted entities

- Default



Step 1: Select trusted entities

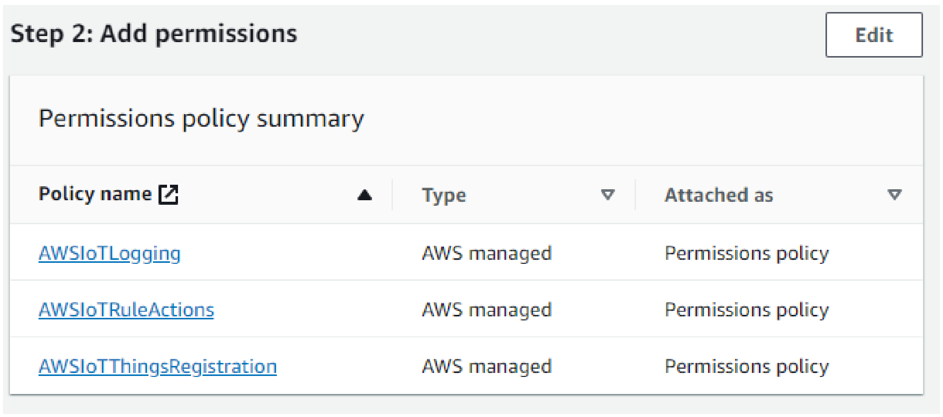
Trust policy

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Sid": "",
            "Effect": "Allow",
            "Principal": {
                "Service": [
                    "iot.amazonaws.com"
                ]
            },
            "Action": [
                "sts:AssumeRole"
            ]
        }
    ]
}
```

Figure 6-12 Step 3: Name, review, and create > Step 1: Selected trusted entities

(6) Step 3: Name, review, and create > Step 2: Add permissions

- Default



Step 2: Add permissions

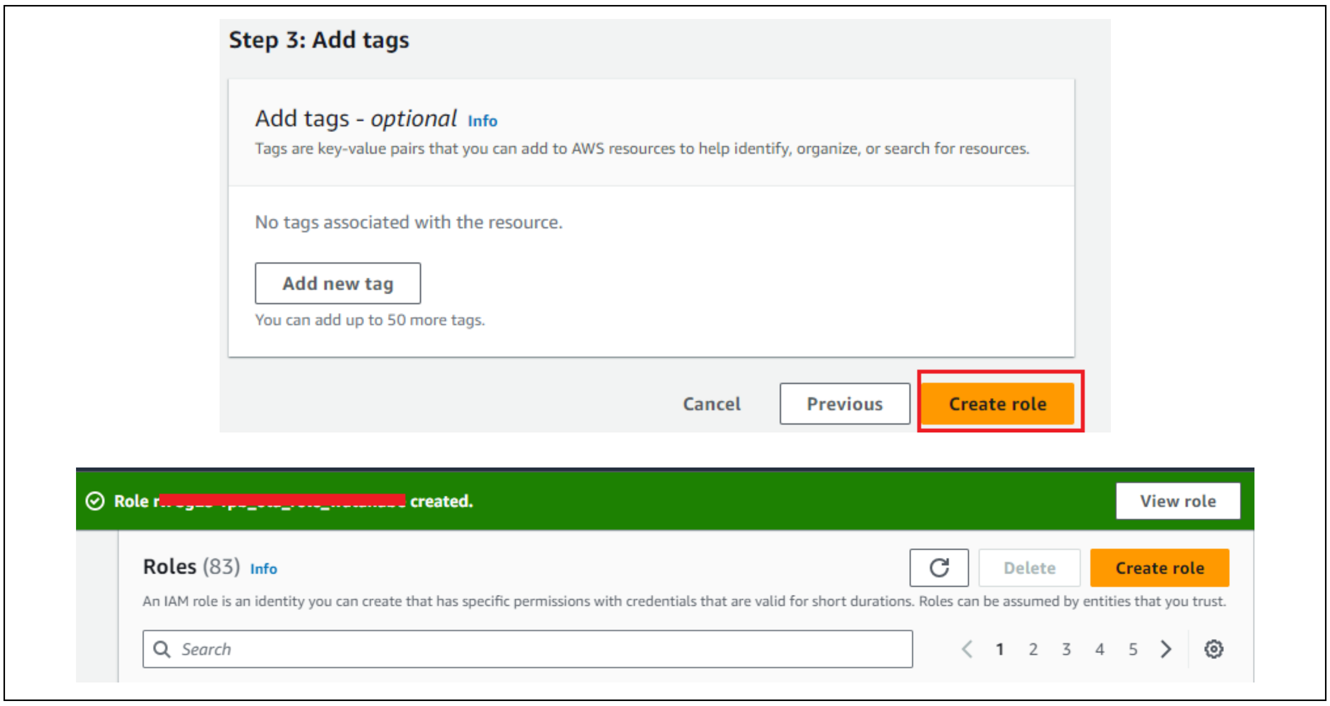
Permissions policy summary

Policy name	Type	Attached as
AWSIoTLogging	AWS managed	Permissions policy
AWSIoTRuleActions	AWS managed	Permissions policy
AWSIoTThingsRegistration	AWS managed	Permissions policy

Figure 6-13 Step 3: Name, review, and create > Step 2: Add permissions

(7) Step 3: Name, review, and create > Step 3: Add tags

- Default
- Click "Create role"



Step 3: Add tags

Add tags - *optional* Info

Tags are key-value pairs that you can add to AWS resources to help identify, organize, or search for resources.

No tags associated with the resource.

You can add up to 50 more tags.

Role [redacted] created.

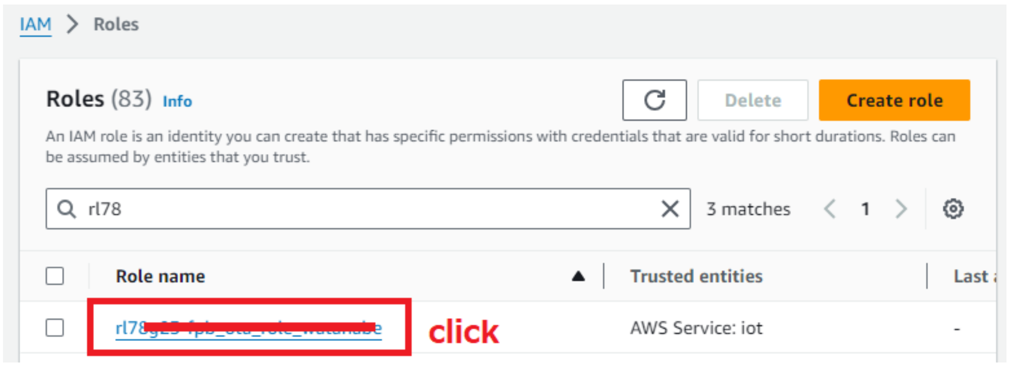
Roles (83) Info

An IAM role is an identity you can create that has specific permissions with credentials that are valid for short durations. Roles can be assumed by entities that you trust.

Figure 6-14 Step 3: Name, review, and create > Step 3: Add tags

6.1.3.3 Creating an OTA Update User Policy

(1) Click to open the role created in section 6.1.3.2, Creating an OTA Update Service Role.



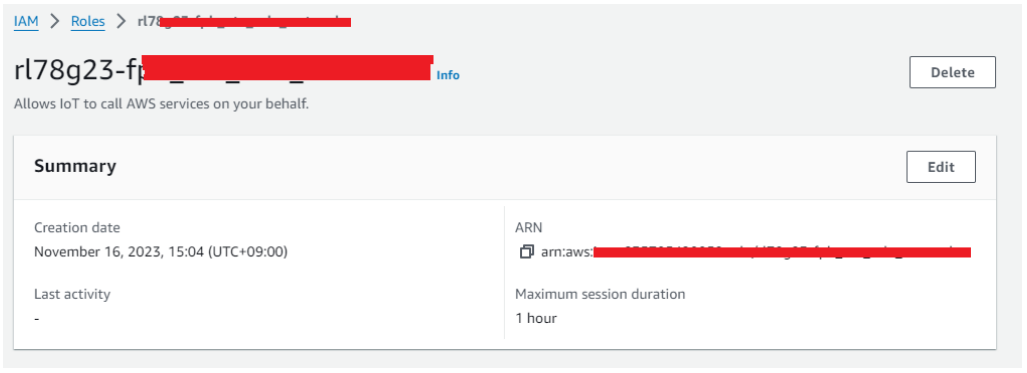
An IAM role is an identity you can create that has specific permissions with credentials that are valid for short durations. Roles can be assumed by entities that you trust.

rl78 — 3 matches

Role name	Trusted entities	Last
rl78[redacted] click	AWS Service: iot	-

Figure 6-15 Opening the Created OTA Update Service Role

(2) My role > Summary: Default



Allows IoT to call AWS services on your behalf.

Creation date
November 16, 2023, 15:04 (UTC+09:00)

ARN
arn:aws:[redacted]

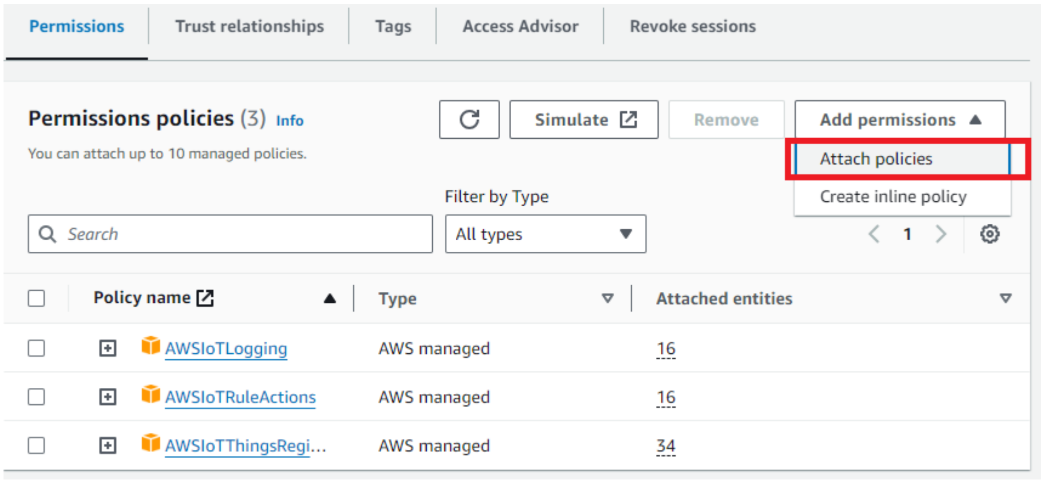
Last activity
-

Maximum session duration
1 hour

Figure 6-16 Displaying the Summary of the Created OTA Update Service Role

(3) Attach the policy “AmazonFreeRTOSOTAUpdate”.

- My role > Permissions policies > “Add permissions” > Attach policies

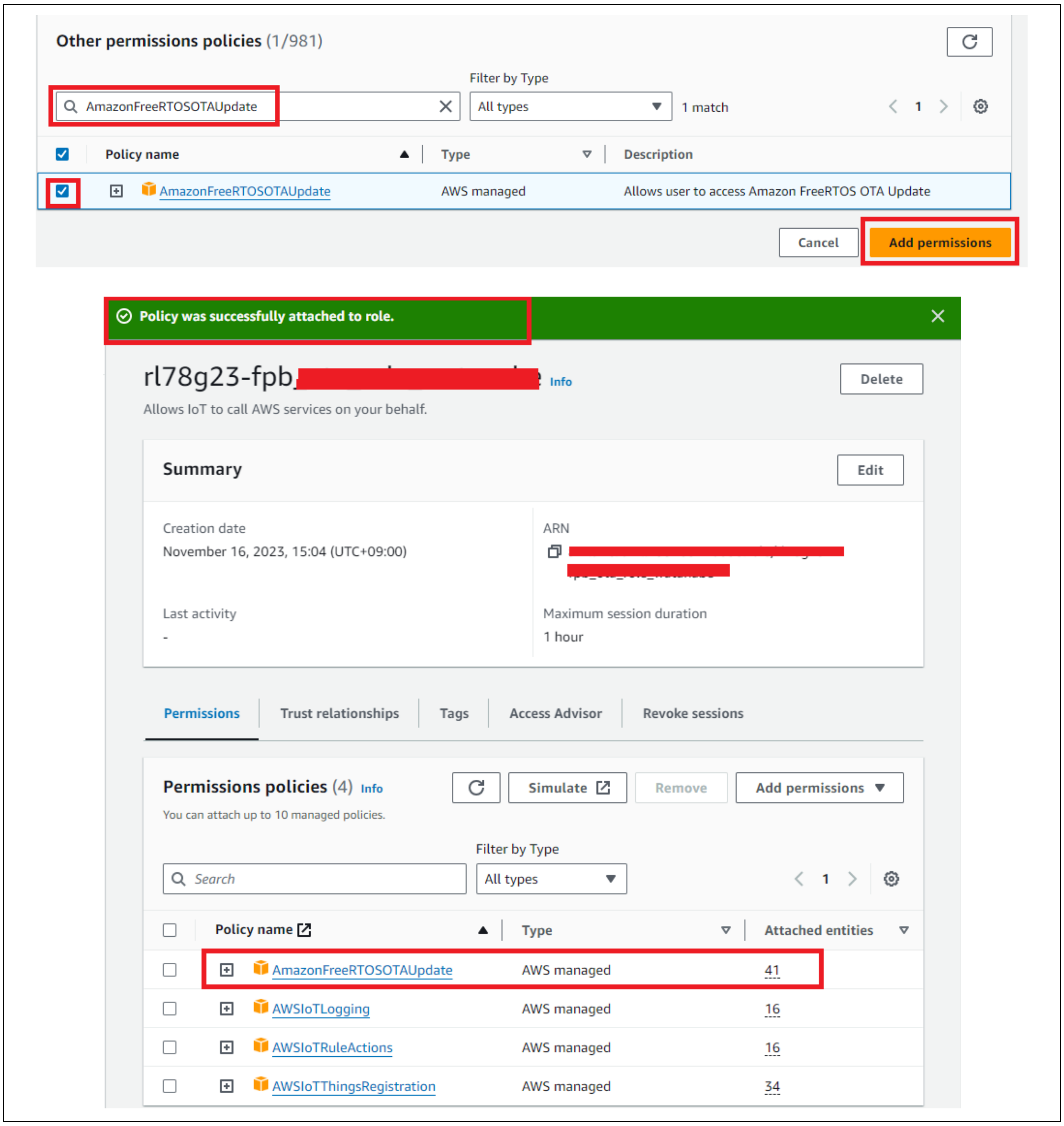


You can attach up to 10 managed policies.

Policy name	Type	Attached entities
AWSIoTLogging	AWS managed	16
AWSIoTRuleActions	AWS managed	16
AWSIoTThingsRegi...	AWS managed	34

Figure 6-17 Attaching Policies to the Created OTA Update Service Role

- Choose "AmazonFreeRTOSOTAUpdate" > "Add permissions"



Other permissions policies (1/981)

Filter by Type

AmazonFreeRTOSOTAUpdate | All types | 1 match

Policy name	Type	Description
AmazonFreeRTOSOTAUpdate	AWS managed	Allows user to access Amazon FreeRTOS OTA Update

Cancel | Add permissions

Policy was successfully attached to role.

rl78g23-fpb_[redacted] Info

Allows IoT to call AWS services on your behalf.

Summary

Creation date	ARN
November 16, 2023, 15:04 (UTC+09:00)	[redacted]
Last activity	Maximum session duration
-	1 hour

Permissions | Trust relationships | Tags | Access Advisor | Revoke sessions

Permissions policies (4) Info

You can attach up to 10 managed policies.

Filter by Type

Policy name	Type	Attached entities
AmazonFreeRTOSOTAUpdate	AWS managed	41
AWSIoTLogging	AWS managed	16
AWSIoTRuleActions	AWS managed	16
AWSIoTThingsRegistration	AWS managed	34

Figure 6-18 Attaching the Policy "AmazonFreeRTOSOTAUpdate" to the Created OTA Update Service Role

(4) Add the inline policy (S3).

- “Add permissions” > Create inline policy > “JSON”

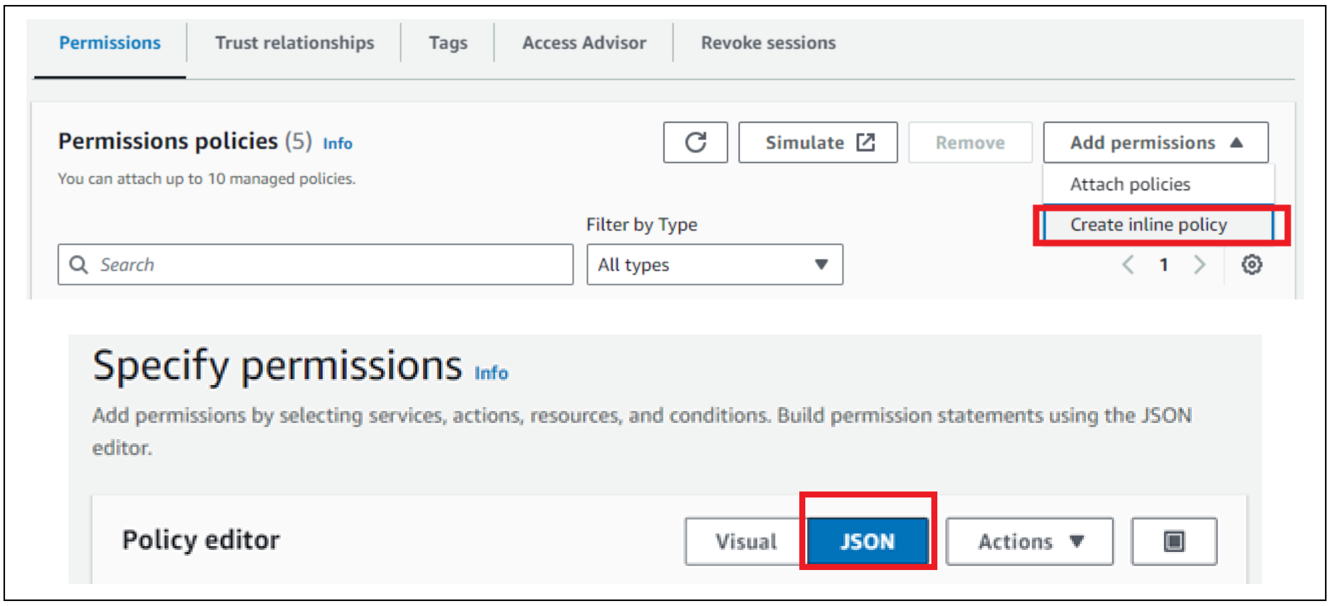
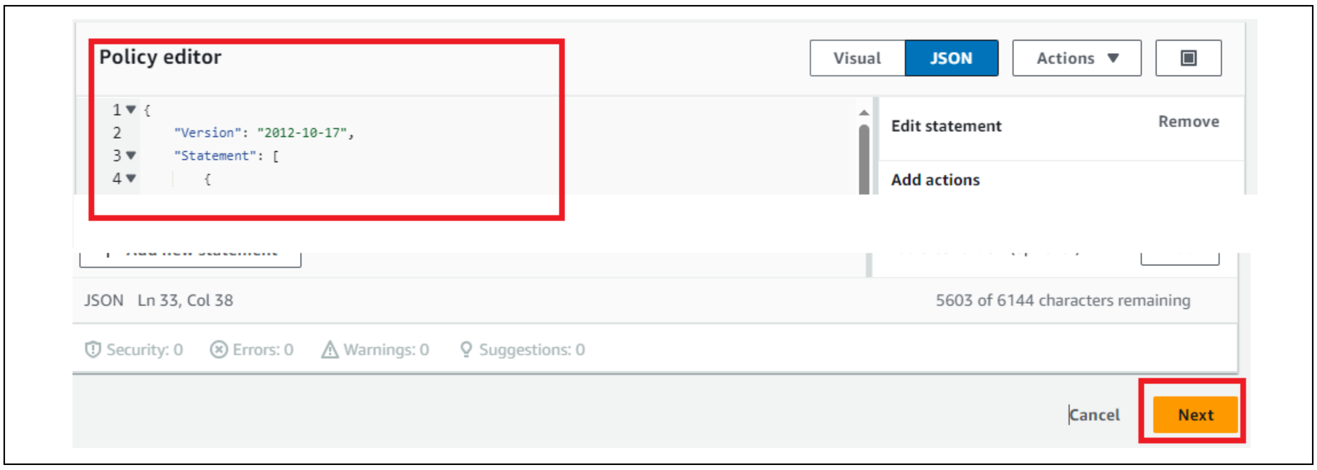


Figure 6-19 Creating an S3 Inline Policy

- Paste the following information to the Policy editor, and then click “Next”.
  — Change s3-bucket-test to the bucket name created in section 6.1.3.1, Creating Amazon S3 Buckets.

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "s3:GetObjectVersion",
                "s3:GetObject",
                "s3:PutObject"
            ],
            "Resource": "arn:aws:s3:::s3-bucket-test/*"
        }
    ]
}
```


Policy editor

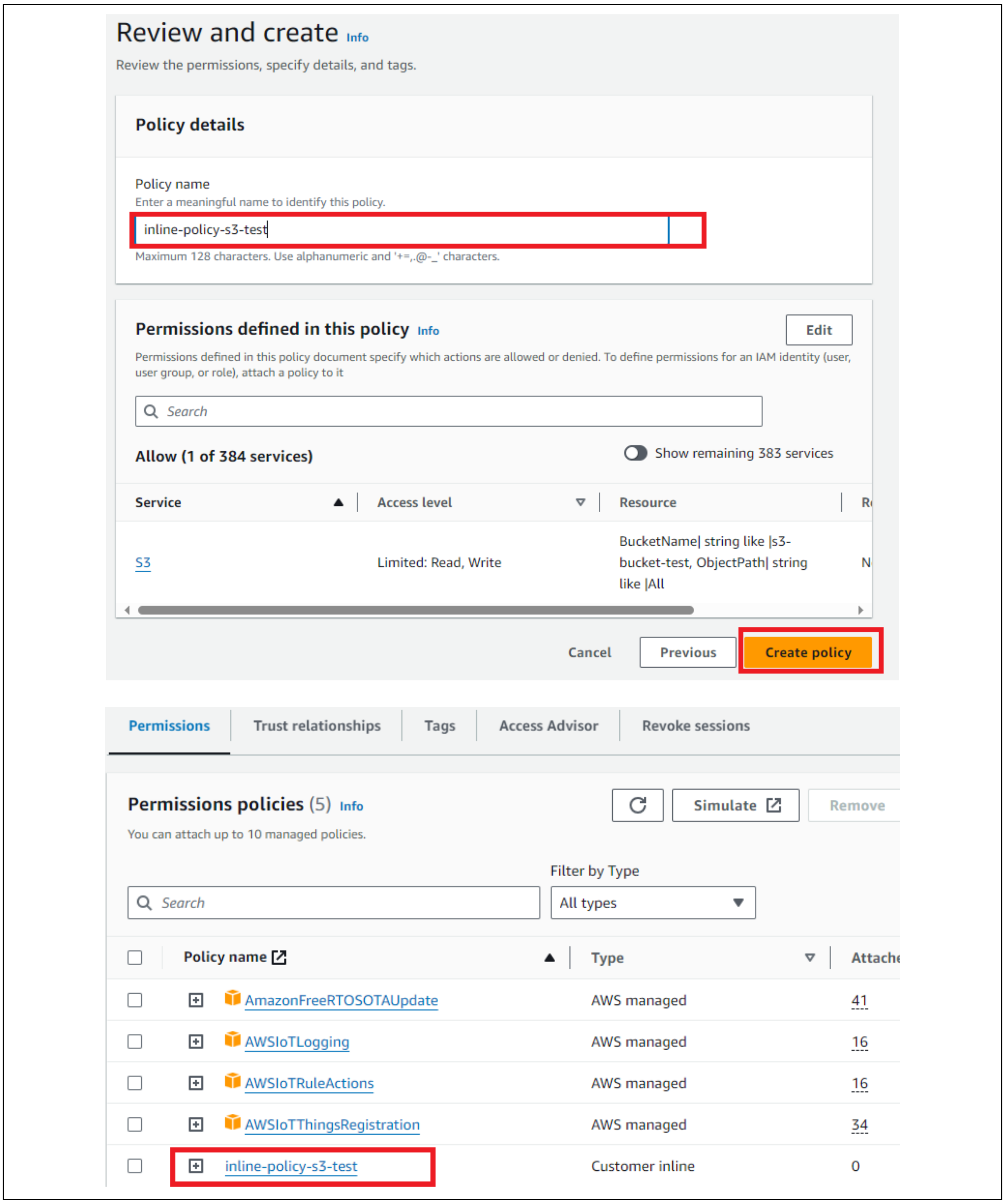
```
{
    "Version": "2012-10-17",
    "Statement": [
        {
```

JSON Ln 33, Col 38 5603 of 6144 characters remaining

Security: 0 Errors: 0 Warnings: 0 Suggestions: 0

Figure 6-20 Adding S3 Policies to the Policy Editor

- Policy name: Any (Example: inline-policy-s3-test) > "Create policy"



Review and create Info

Review the permissions, specify details, and tags.

Policy details

Policy name

Enter a meaningful name to identify this policy.

inline-policy-s3-test

Maximum 128 characters. Use alphanumeric and '+=,.@-_' characters.

Permissions defined in this policy Info

Permissions defined in this policy document specify which actions are allowed or denied. To define permissions for an IAM identity (user, user group, or role), attach a policy to it

Allow (1 of 384 services) — Show remaining 383 services

Service	Access level	Resource	R
S3	Limited: Read, Write	BucketName| string like |s3-bucket-test, ObjectPath| string like |All	N

Permissions policies (5) Info

You can attach up to 10 managed policies.

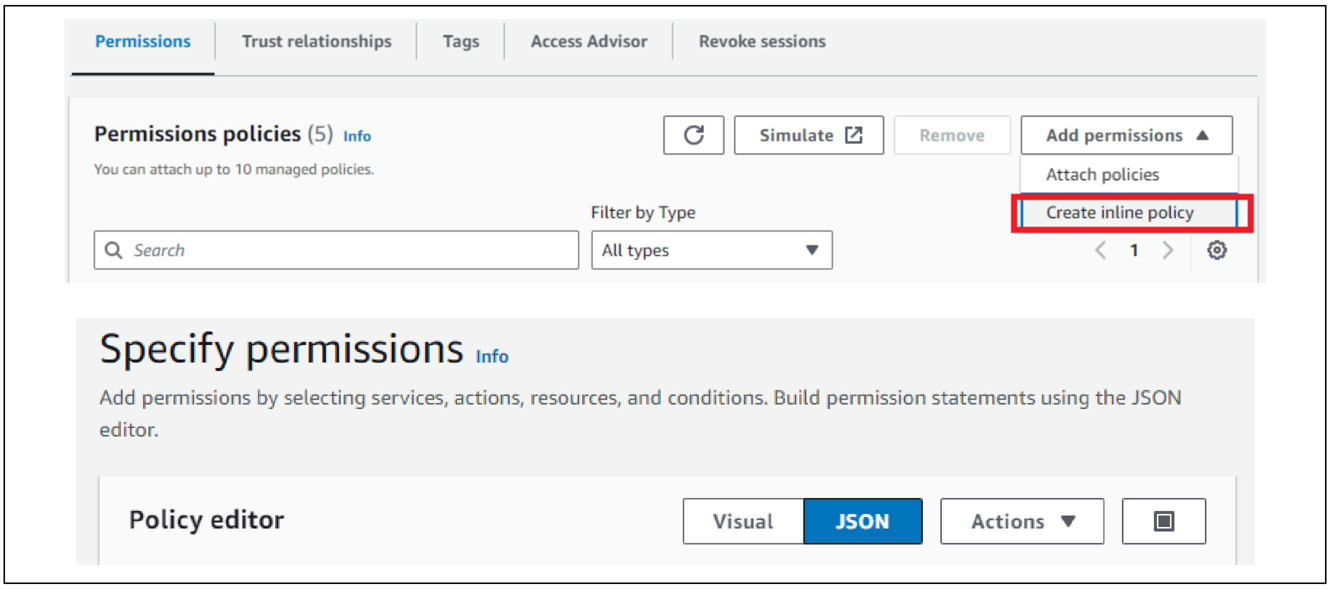
Filter by Type: All types

Policy name	Type	Attache
AmazonFreeRTOSOTAUpdate	AWS managed	41
AWSIoTLogging	AWS managed	16
AWSIoTRuleActions	AWS managed	16
AWSIoTThingsRegistration	AWS managed	34
inline-policy-s3-test	Customer inline	0

Figure 6-21 Creating the S3 Policy with a Name (Example: inline-policy-s3-test)

(5) Add an IAM inline policy.

- “Add permissions” > Create inline policy > “JSON”



You can attach up to 10 managed policies.

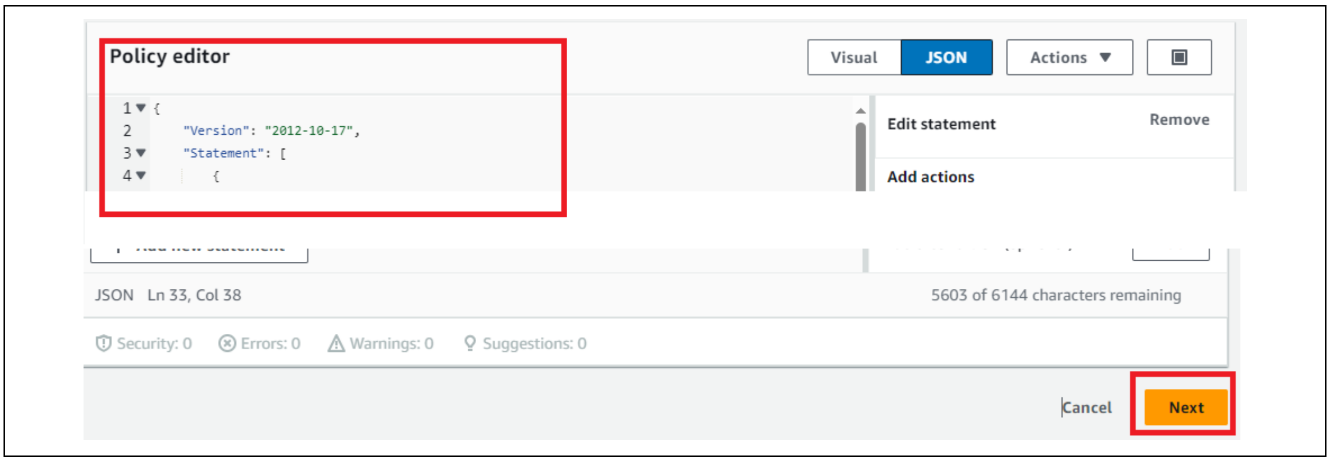
Specify permissions Info

Add permissions by selecting services, actions, resources, and conditions. Build permission statements using the JSON editor.

Figure 6-22 Creating an Inline Policy

- Paste the following information to the Policy editor, and then click “Next”.
  — Change ota-role-test to the role name created in section 6.1.3.2, Creating an OTA Update Service Role.

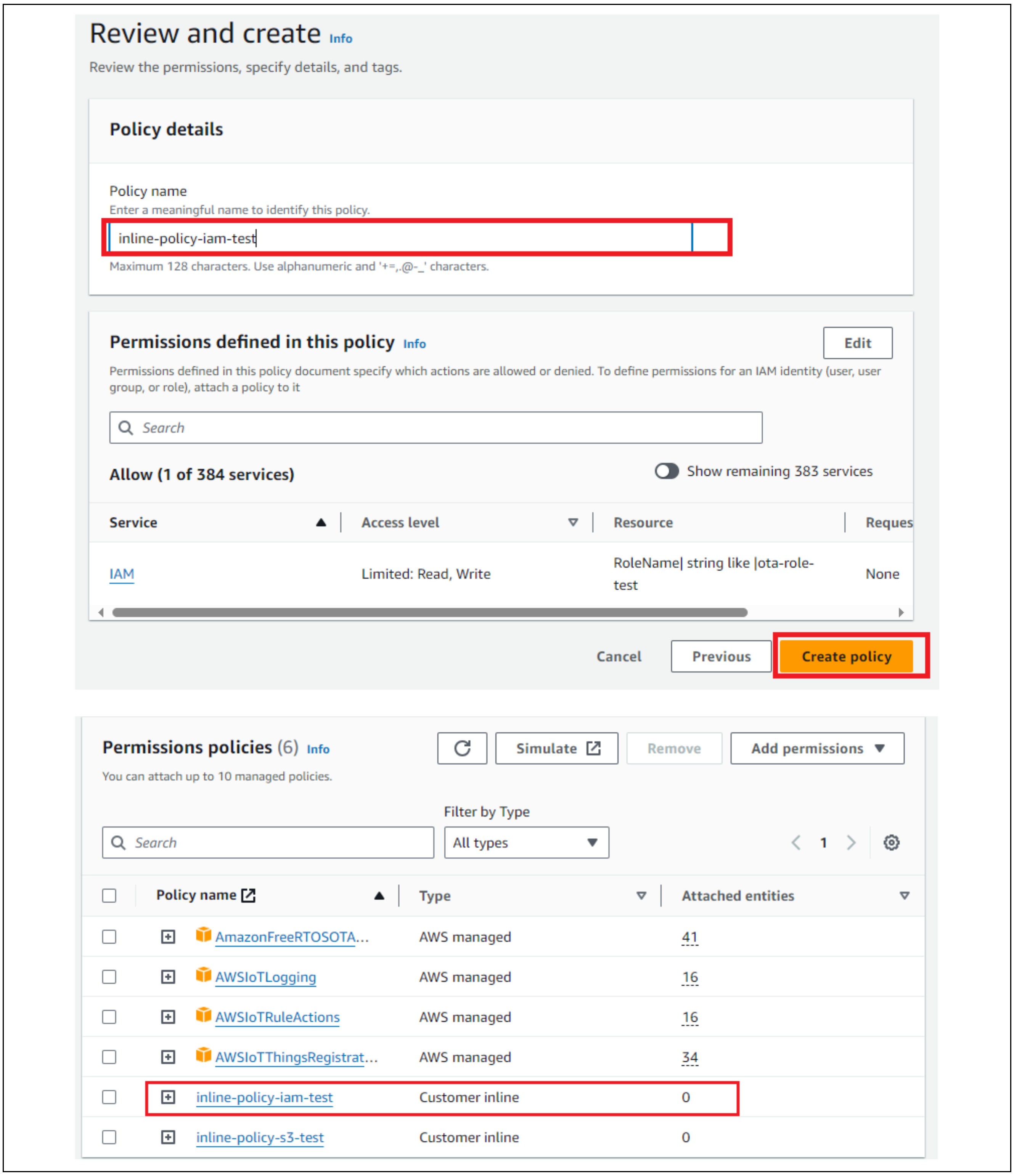
```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "iam:GetRole",
                "iam:PassRole"
            ],
            "Resource": "arn:aws:iam::xxxxxxxxxx:role/ota-role-test"
        }
    ]
}
```


```
{
    "Version": "2012-10-17",
    "Statement": [
        {
```
JSON   Ln 33, Col 38   5603 of 6144 characters remaining

Security: 0   Errors: 0   Warnings: 0   Suggestions: 0

Figure 6-23 Adding the IAM Role to the Inline Policy

- Policy name: Any (Example: inline-policy-iam-test) > "Create policy"



Review and create Info

Review the permissions, specify details, and tags.

Policy details

Policy name
Enter a meaningful name to identify this policy.
inline-policy-iam-test
Maximum 128 characters. Use alphanumeric and '+=,.@-_' characters.

Permissions defined in this policy Info

Permissions defined in this policy document specify which actions are allowed or denied. To define permissions for an IAM identity (user, user group, or role), attach a policy to it

Allow (1 of 384 services) — Show remaining 383 services

Service	Access level	Resource	Reques
IAM	Limited: Read, Write	RoleName| string like |ota-role-test	None

Cancel | Previous | Create policy

Permissions policies (6) Info

You can attach up to 10 managed policies.

Filter by Type: All types

	Policy name	Type	Attached entities
☐	AmazonFreeRTOSOTA...	AWS managed	41
☐	AWSIoTLogging	AWS managed	16
☐	AWSIoTRuleActions	AWS managed	16
☐	AWSIoTThingsRegistrat...	AWS managed	34
☐	inline-policy-iam-test	Customer inline	0
☐	inline-policy-s3-test	Customer inline	0

Figure 6-24 Saving the IAM Inline Policy with a Name (Example: inline-policy-iam-test)

6.1.3.4 Allocating an OTA Update Policy to IAM User

(1) Create an OTA Update policy.

- IAM > Policies > "Create policy" > "JSON"

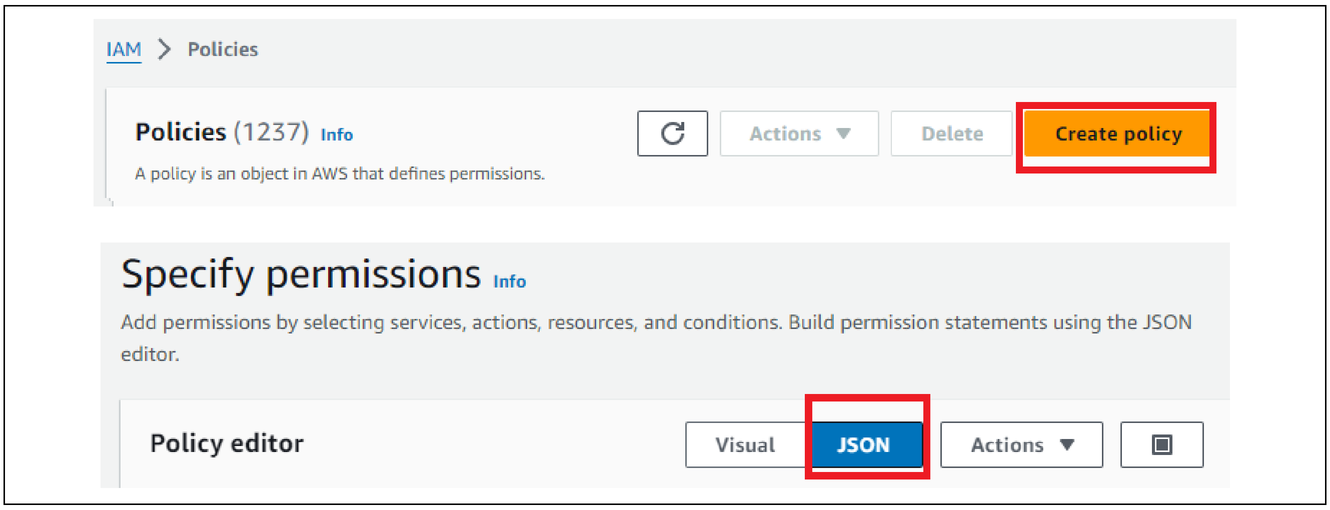
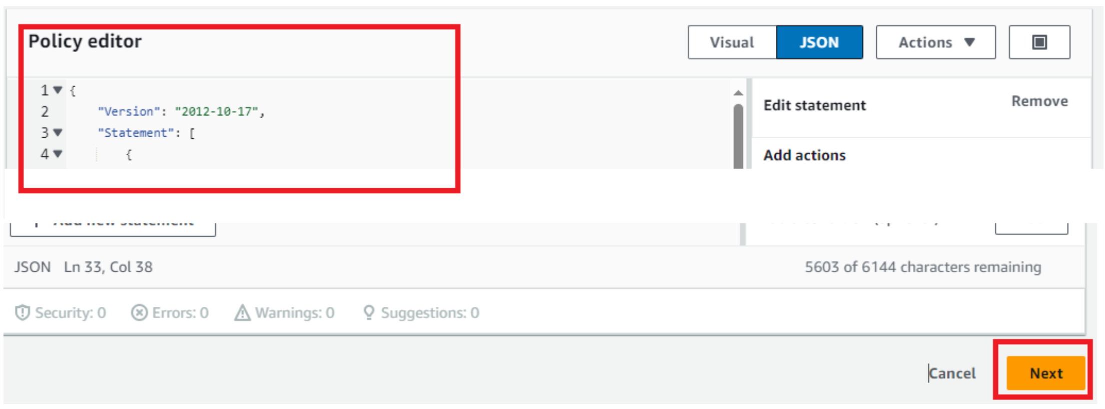

IAM > Policies
Policies (1237) Info
A policy is an object in AWS that defines permissions.
Actions
Delete
Create policy
Specify permissions Info
Add permissions by selecting services, actions, resources, and conditions. Build permission statements using the JSON editor.
Policy editor
Visual
JSON
Actions

Figure 6-25 Creating an OTA Update Policy

- Paste the following information to the Policy editor, and then click “Next”.
  - Change s3-bucket-test to the bucket name specified in section 6.1.3.1, Creating Amazon S3 Buckets.
  - Change ota-role-test to the role name specified in section 6.1.3.2, Creating an OTA Update Service Role.

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "s3:ListBucket",
                "s3:ListAllMyBuckets",
                "s3:CreateBucket",
                "s3:PutBucketVersioning",
                "s3:GetBucketLocation",
                "s3:GetObjectVersion",
                "acm:ImportCertificate",
                "acm:ListCertificates",
                "iot:*",
                "iam:ListRoles",
                "freertos:ListHardwarePlatforms",
                "freertos:DescribeHardwarePlatform"
            ],
            "Resource": "*"
        },
        {
            "Effect": "Allow",
            "Action": [
                "s3:GetObject",
                "s3:PutObject"
            ],
            "Resource": "arn:aws:s3:::s3-bucket-test/*"
        },
        {
            "Effect": "Allow",
            "Action": "iam:PassRole",
            "Resource": "arn:aws:iam::xxxxxxxxxx:role/ota-role-test"
        }
    ]
}
```



```
{
    "Version": "2012-10-17",
    "Statement": [
        {
```

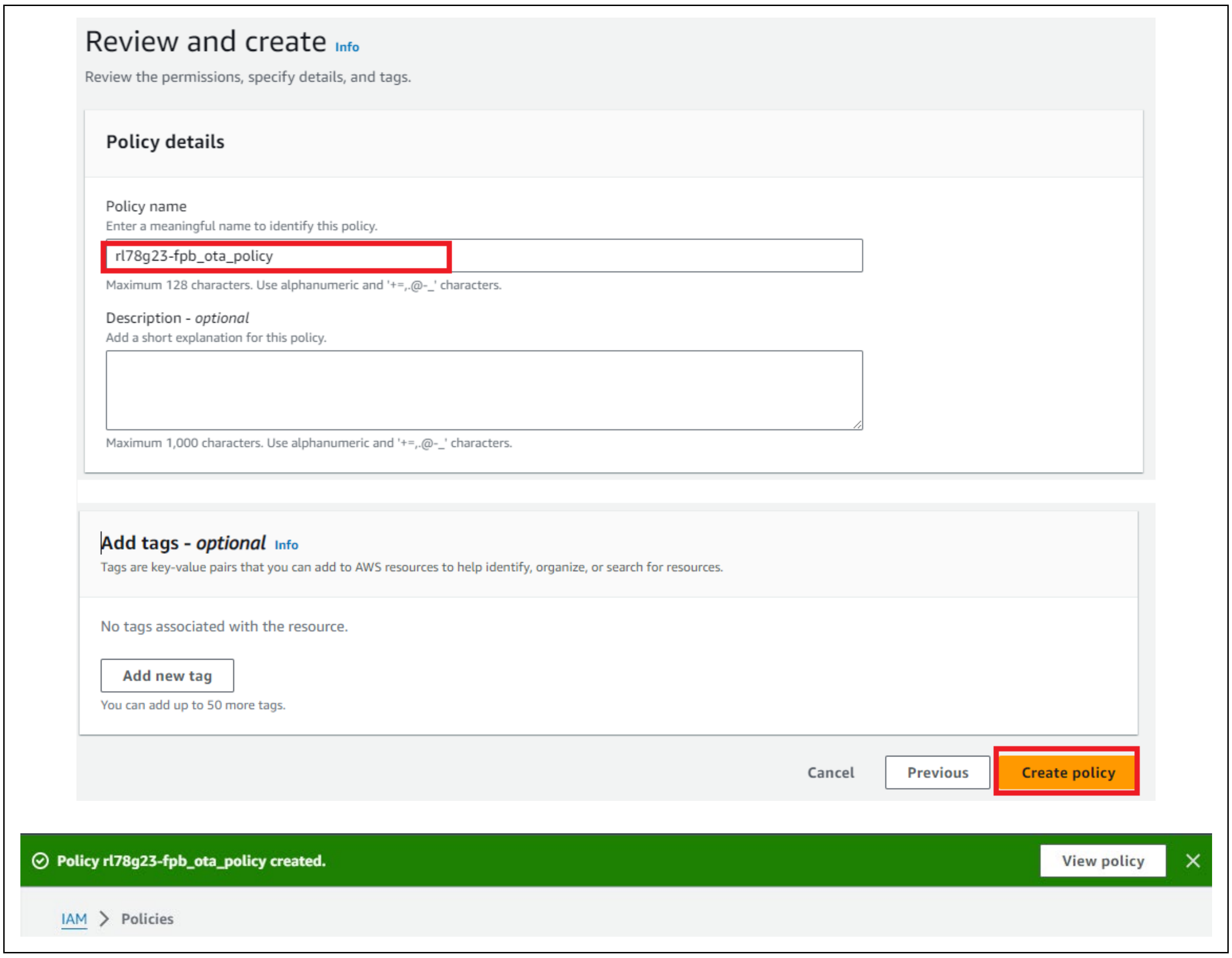
JSON Ln 33, Col 38

5603 of 6144 characters remaining

Security: 0 Errors: 0 Warnings: 0 Suggestions: 0

Figure 6-26 Creating an OTA Update Policy with the Policy Editor

- Policy name: Any (Example: rl78g23-fpb_ota_policy) > "Create policy"



Review and create Info

Review the permissions, specify details, and tags.

Policy details

Policy name
Enter a meaningful name to identify this policy.
rl78g23-fpb_ota_policy
Maximum 128 characters. Use alphanumeric and '+=,.@-_' characters.

Description - *optional*
Add a short explanation for this policy.

Maximum 1,000 characters. Use alphanumeric and '+=,.@-_' characters.

Add tags - *optional* Info
Tags are key-value pairs that you can add to AWS resources to help identify, organize, or search for resources.

No tags associated with the resource.

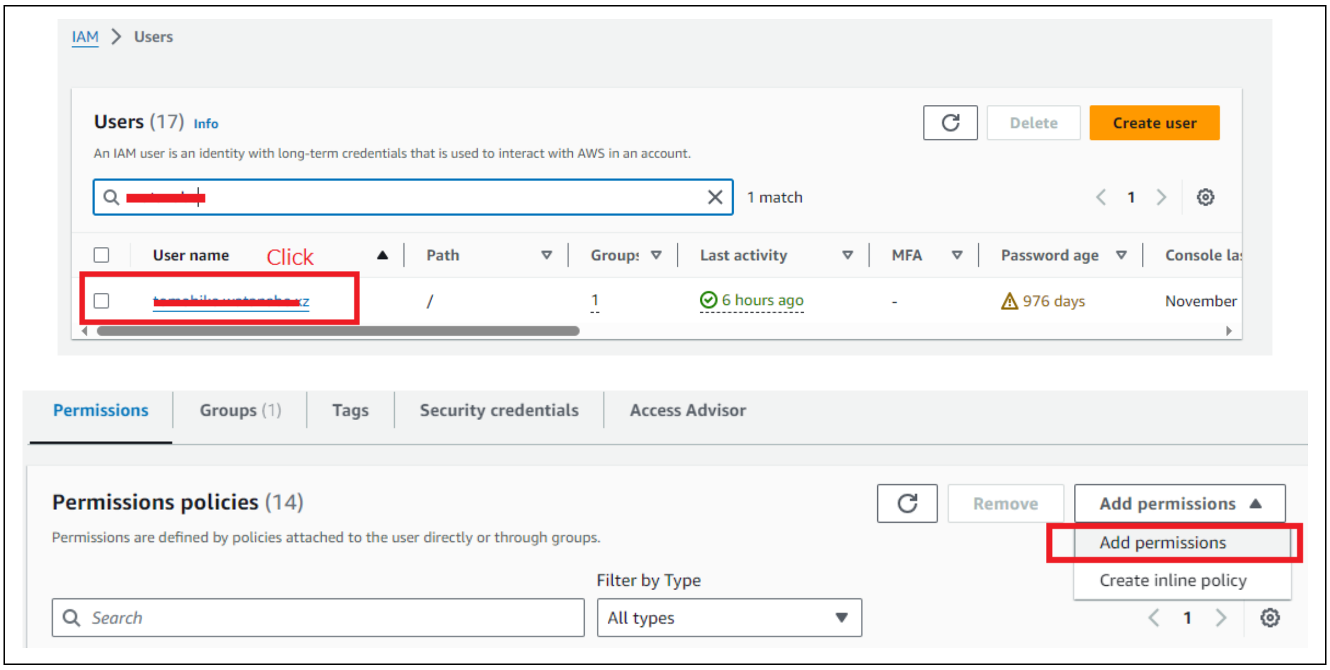
You can add up to 50 more tags.

Policy rl78g23-fpb_ota_policy created.

Figure 6-27 Saving the OTA Update Policy with a Name (Example: rl78g23-fpb_ota_policy)

(2) Add the created OTA Update policy to the IAM user.

- IAM > Users > Choose User > Add permissions



IAM > Users

Users (17) Info

An IAM user is an identity with long-term credentials that is used to interact with AWS in an account.

Search: [redacted] — 1 match

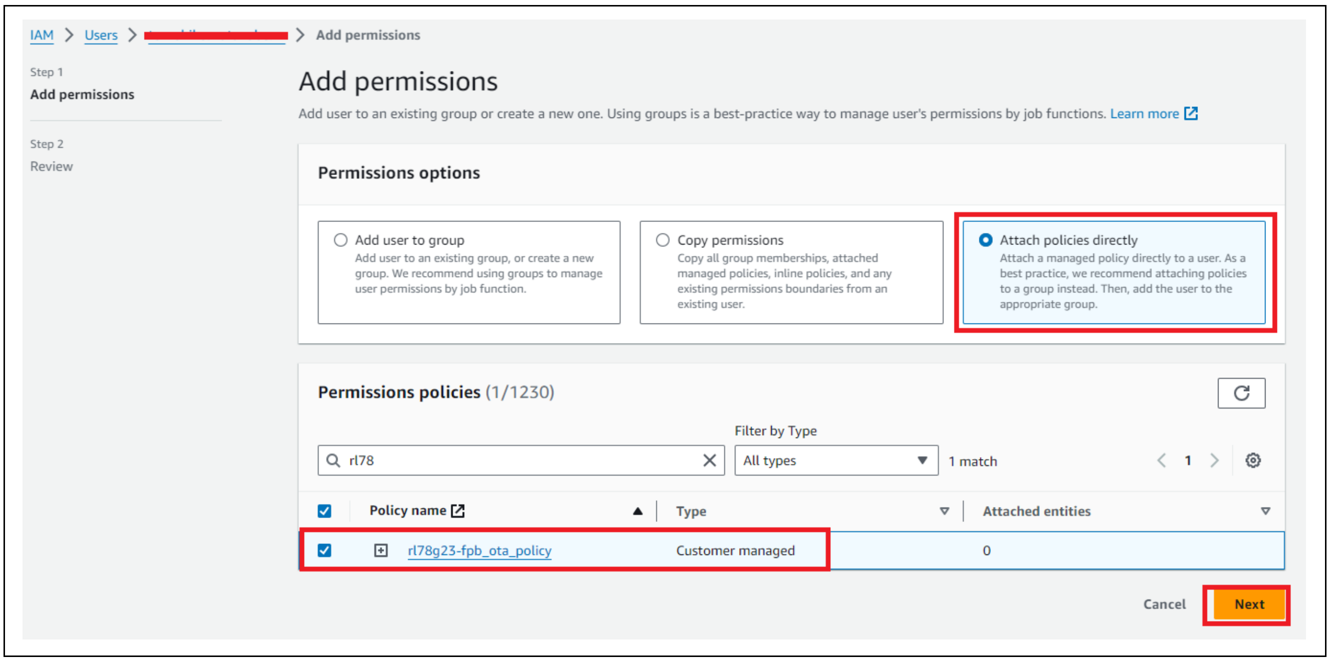
User name	Path	Groups	Last activity	MFA	Password age	Console last
[redacted]	/	1	6 hours ago	-	976 days	November

Permissions policies (14)

Permissions are defined by policies attached to the user directly or through groups.

Figure 6-28 Selecting the IAM User

- Permissions options: Attach policies directly
- Permissions policies > Policy name: Name of created OTA Update policy (Example: rl78g23-fpb_ota_policy)
- Click "Next"



IAM > Users > [redacted] > Add permissions

Step 1 Add permissions

Step 2 Review

Add permissions

Add user to an existing group or create a new one. Using groups is a best-practice way to manage user's permissions by job functions. Learn more

Permissions options

- ○ Add user to group — Add user to an existing group, or create a new group. We recommend using groups to manage user permissions by job function.
- ○ Copy permissions — Copy all group memberships, attached managed policies, inline policies, and any existing permissions boundaries from an existing user.
- ● Attach policies directly — Attach a managed policy directly to a user. As a best practice, we recommend attaching policies to a group instead. Then, add the user to the group.

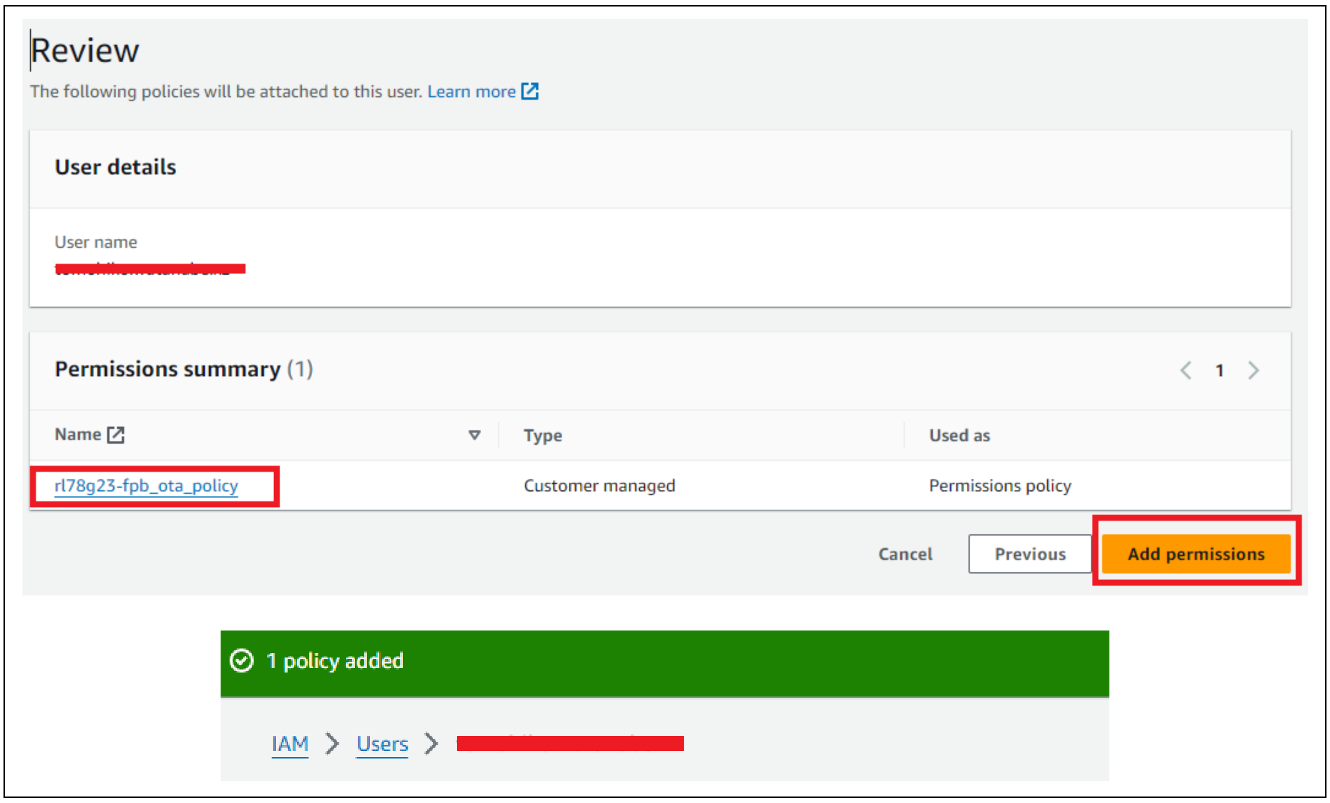
Permissions policies (1/1230)

Search: rl78 — Filter by Type: All types — 1 match

	Policy name	Type	Attached entities
✓	rl78g23-fpb_ota_policy	Customer managed	0

Figure 6-29 Selecting the OTA Update Policy for Permissions to Be Added to the IAM User

- User details: Your account
- Permissions summary > Name: Name of created OTA Update policy (Example: rl78g23-fpb_ota_policy)
- Click “Add permission”



Review

The following policies will be attached to this user. Learn more

User details

User name
[redacted]

Permissions summary (1)

Name	Type	Used as
rl78g23-fpb_ota_policy	Customer managed	Permissions policy

1 policy added

IAM > Users > [redacted]

Figure 6-30 Adding the OTA Update Policy to the Selected IAM User

6.1.3.5 Granting Access Permissions to AWS IoT Code Signature

(1) Create an IAM policy.

- IAM > Policies > “Create policy” > “JSON”

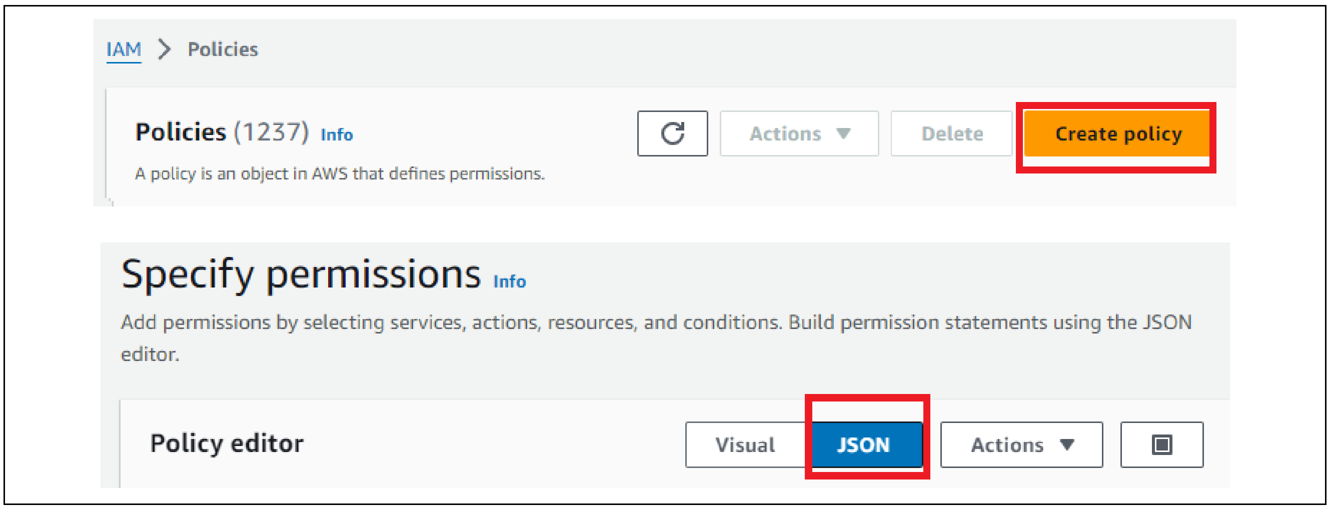
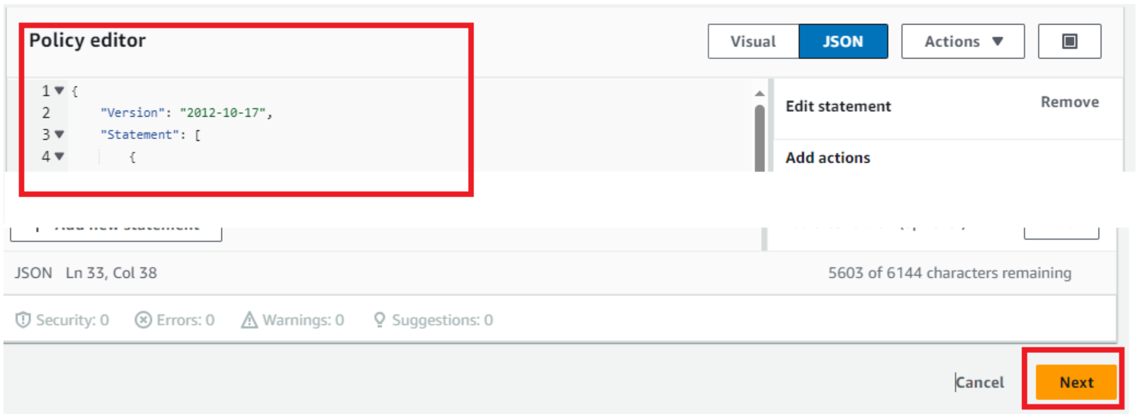

IAM > Policies
Policies (1237) Info
A policy is an object in AWS that defines permissions.
Actions
Delete
Create policy
Specify permissions Info
Add permissions by selecting services, actions, resources, and conditions. Build permission statements using the JSON editor.
Policy editor
Visual
JSON
Actions

Figure 6-31 Creating an IAM Policy

- Paste the following information to the Policy editor, and then click "Next".

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "iam:CreatePolicy",
                "iam:DetachRolePolicy",
                "iam:DeleteRolePolicy",
                "iam:DeletePolicy",
                "iam:CreateRole",
                "iam:DeleteRole",
                "iam:AttachRolePolicy"
            ],
            "Resource": [
                "arn:aws:iam::*:policy/idt*",
                "arn:aws:iam::*:role/idt*"
            ]
        }
    ]
}
```



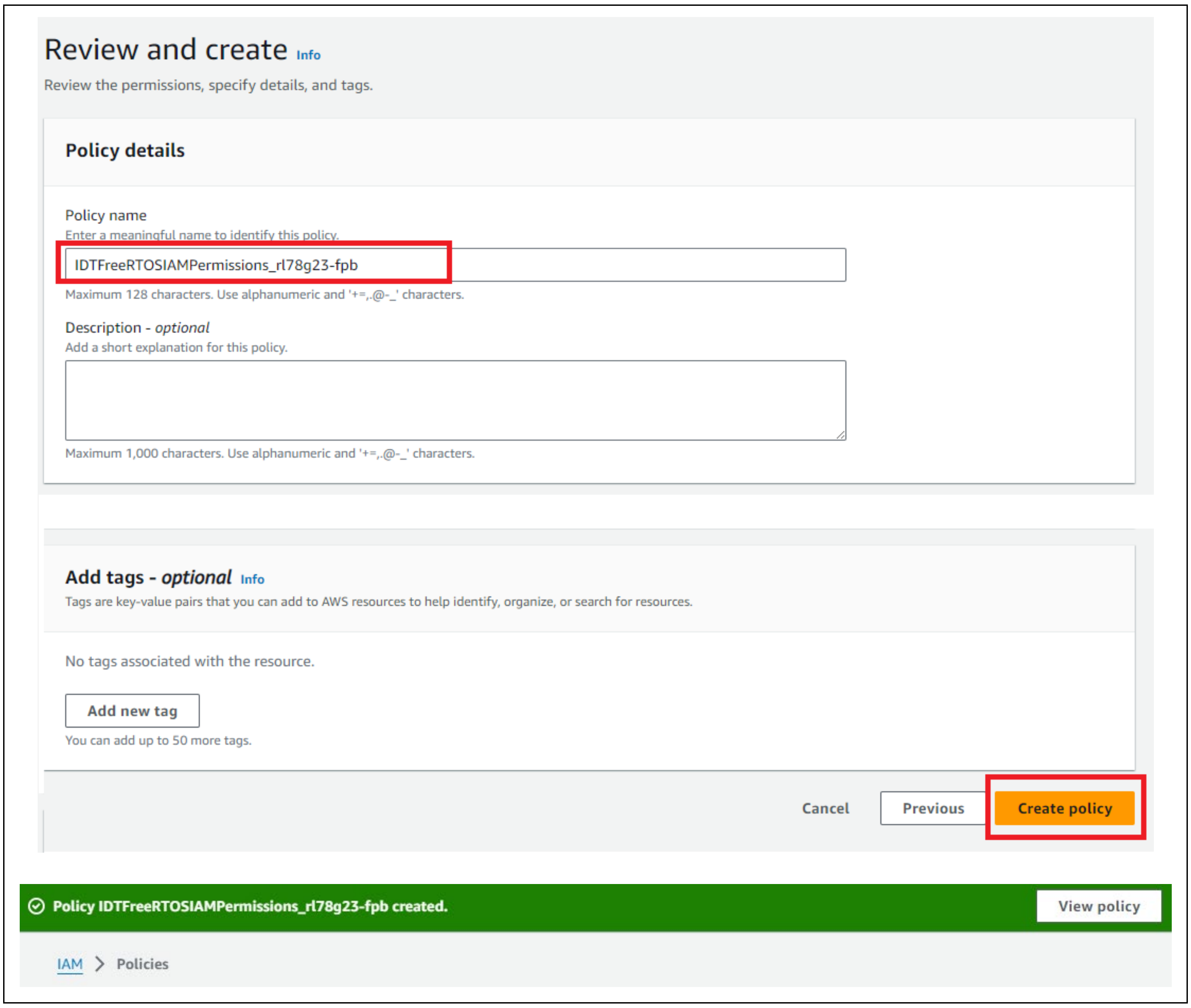
```
{
    "Version": "2012-10-17",
    "Statement": [
        {
```

JSON Ln 33, Col 38 5603 of 6144 characters remaining

Security: 0 Errors: 0 Warnings: 0 Suggestions: 0

Figure 6-32 Creating an IAM Policy with the Policy Editor

- Policy name: Any (Example: IDTFreeRTOSIAMPermissions_rl78g23-fpb) > “Create policy”


Review and create Info

Review the permissions, specify details, and tags.

Policy details

Policy name

Enter a meaningful name to identify this policy.

IDTFreeRTOSIAMPermissions_rl78g23-fpb

Maximum 128 characters. Use alphanumeric and '+=,.@-_' characters.

Description - *optional*

Add a short explanation for this policy.

Maximum 1,000 characters. Use alphanumeric and '+=,.@-_' characters.

Add tags - *optional* Info

Tags are key-value pairs that you can add to AWS resources to help identify, organize, or search for resources.

No tags associated with the resource.

Add new tag

You can add up to 50 more tags.

Cancel Previous Create policy

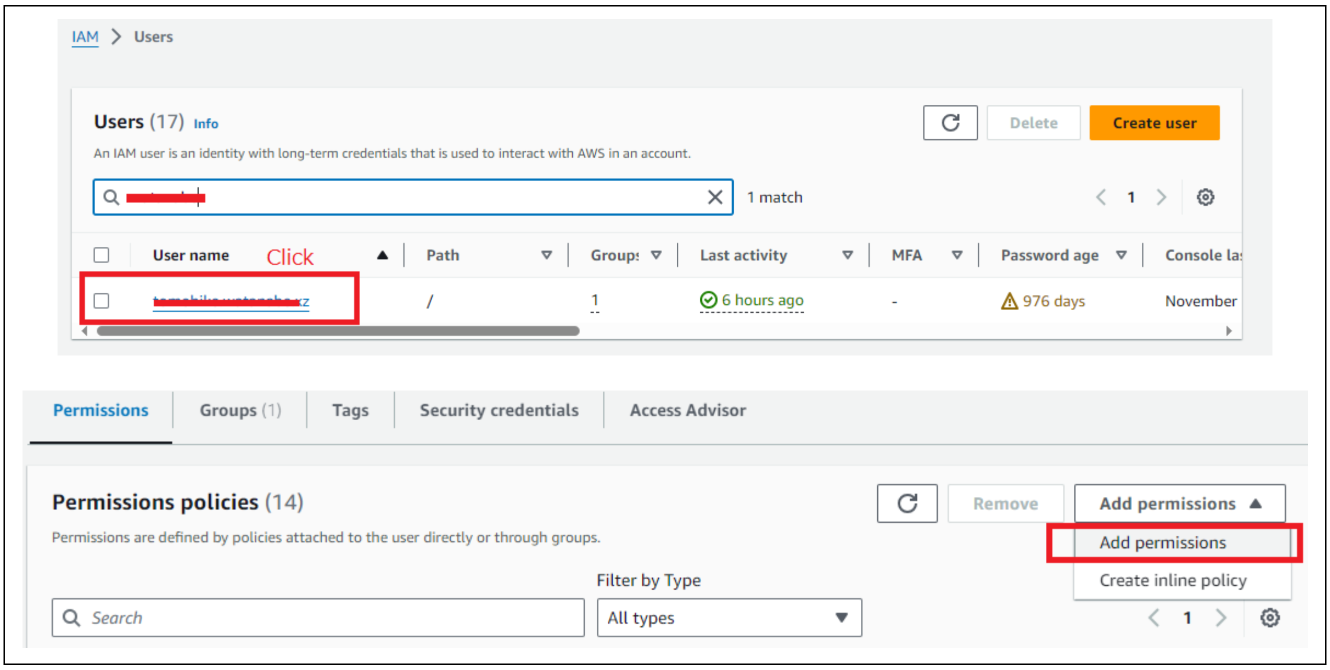
Policy IDTFreeRTOSIAMPermissions_rl78g23-fpb created. View policy

IAM > Policies

Figure 6-33 Saving the IAM Policy with a Name (Example: IDTFreeRTOSIAMPermissions_rl78g23-fpb)

(2) Attach the created IAM policy to the IAM user.

- IAM > Users > Choose User > Add permissions



An IAM user is an identity with long-term credentials that is used to interact with AWS in an account.

[redacted]

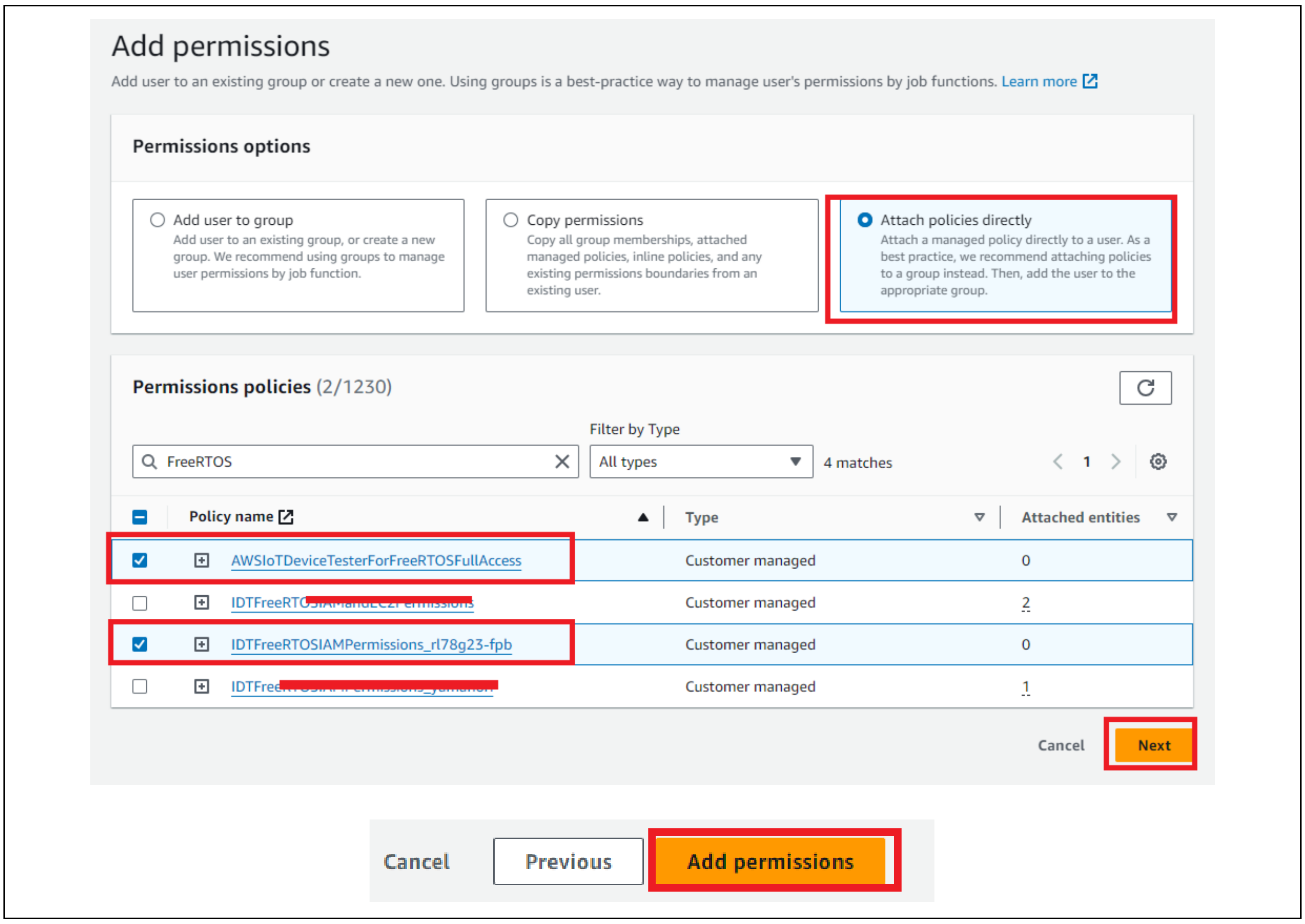
	User name	Path	Groups	Last activity	MFA	Password age	Console la
☐	[redacted]	/	1	6 hours ago	-	976 days	November

Permissions policies (14)

Permissions are defined by policies attached to the user directly or through groups.

Figure 6-34 Selecting the User to Assign the Created IAM Policy

- Permissions options: Attach policies directly
- Policy name:
  - AWSIoTDeviceTesterForFreeRTOSFullAccess
  - Name of created IAM policy (Example: IDTFreeRTOSIAMPermissions_rl78g23-fpb)
- Click “Next” > Click “Add permissions”



Add permissions

Add user to an existing group or create a new one. Using groups is a best-practice way to manage user's permissions by job functions. Learn more

Permissions options

- ○ Add user to group — Add user to an existing group, or create a new group. We recommend using groups to manage user permissions by job function.
- ○ Copy permissions — Copy all group memberships, attached managed policies, inline policies, and any existing permissions boundaries from an existing user.
- ● Attach policies directly — Attach a managed policy directly to a user. As a best practice, we recommend attaching policies to a group instead. Then, add the user to the appropriate group.

Permissions policies (2/1230)

Filter by Type: FreeRTOS | All types | 4 matches

	Policy name	Type	Attached entities
✓	AWSIoTDeviceTesterForFreeRTOSFullAccess	Customer managed	0
	IDTFreeRT[redacted]	Customer managed	2
✓	IDTFreeRTOSIAMPermissions_rl78g23-fpb	Customer managed	0
	IDTFree[redacted]	Customer managed	1

Figure 6-35 Adding Permissions to the Selected IAM User

6.2 Creating an Initial Image

An initial image is a MOT file generated by joining a bootloader's MOT file and an initial application's MOT file by using Renesas Image Generator.

Renesas Image Generator is a tool provided with the RL78/G22,RL78/G23,RL78/G24 firmware update module. For details, refer to the application note in this link.

The file names related to an initial image are as follows in this document.

- Bootloader: boot_loader.mot
- Initial application: aws_ryz024a_rl78g23-fpb_ota.mot
- Initial image: initial_image.mot

6.2.1 Creating a Bootloader

6.2.1.1 Importing the Bootloader Project

Import the boot_loader project to e^2 studio. Open the Import wizard according to the following process.

File > Import… > Existing Projects into Workspace > Next

Next, select the boot_loader project. Ensure that copy projects into workspace is not selected. Then click the Finish button.

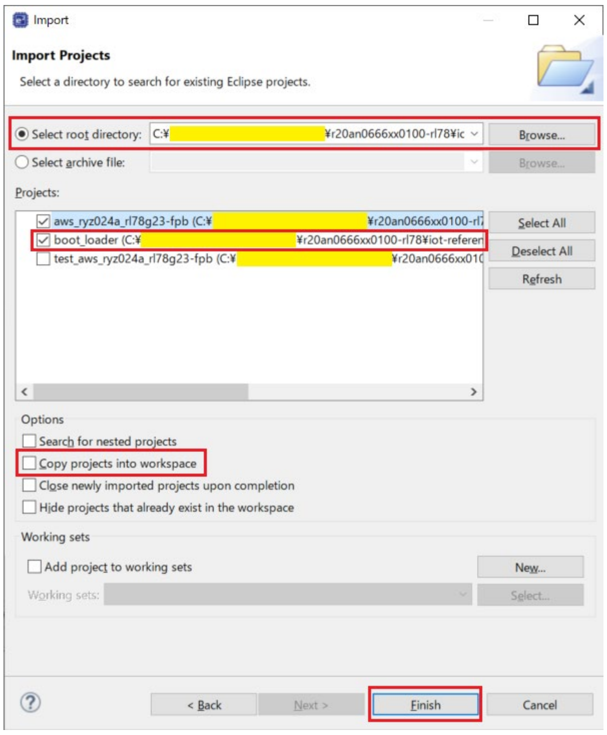

Import
Import Projects
Select a directory to search for existing Eclipse projects.
Select root directory: C:¥ ¥r20an0666xx0100-rl78¥ic
Browse...
Select archive file:
Browse...
Projects:
aws_ryz024a_rl78g23-fpb (C:¥ ¥r20an0666xx0100-rl
boot_loader (C:¥ ¥r20an0666xx0100-rl78¥iot-referen
test_aws_ryz024a_rl78g23-fpb (C:¥ ¥r20an0666xx010
Select All
Deselect All
Refresh
Options
Search for nested projects
Copy projects into workspace
Close newly imported projects upon completion
Hide projects that already exist in the workspace
Working sets
Add project to working sets
New...
Working sets:
Select...
< Back
Next >
Finish
Cancel

Figure 6-36 Selecting the boot_loader Project

The imported project is showed in the Project Explorer view.

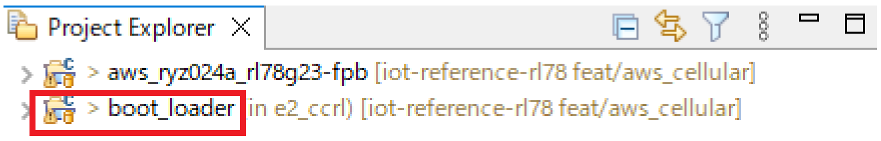
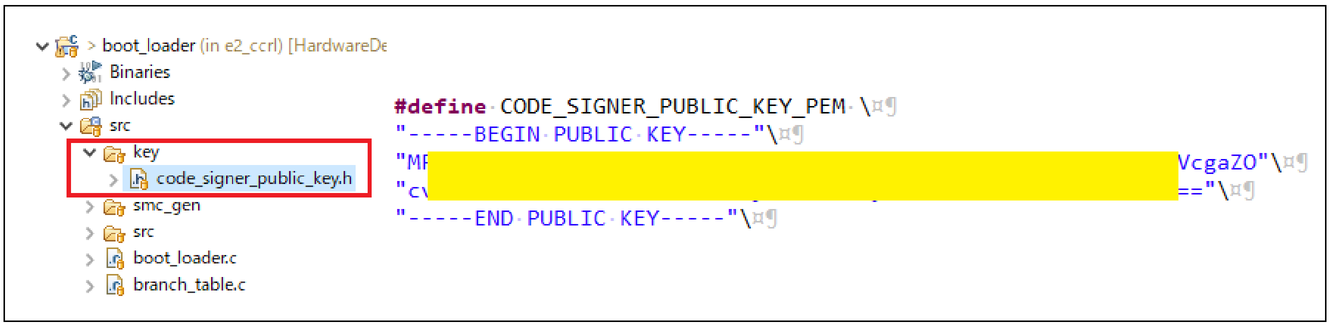

Project Explorer
> aws_ryz024a_rl78g23-fpb [iot-reference-rl78 feat/aws_cellular]
> boot_loader in e2_ccrl) [iot-reference-rl78 feat/aws_cellular]

Figure 6-37 Completing to Import the boot_loader Project

6.2.1.2 Adding the Firmware Verification Key to the Bootloader Project

(1) Add the firmware verification key (secp256r1.publickey) to code_signer_public_key.h in the boot_loader project.

Note: Add \ to the end of each line.



```
#define CODE_SIGNER_PUBLIC_KEY_PEM \
"-----BEGIN PUBLIC KEY-----"\
"MF[redacted]VcgaZO"\
"c\[redacted]=="\
"-----END PUBLIC KEY-----"\
```

Figure 6-38 Adding the Firmware Verification Key to the Bootloader

6.2.1.3 Building the Bootloader Project

Build the boot_loader project to create a MOT file.
Then, make sure that boot_loader.mot has been created in the HardwareDebug folder directly under the project folder.

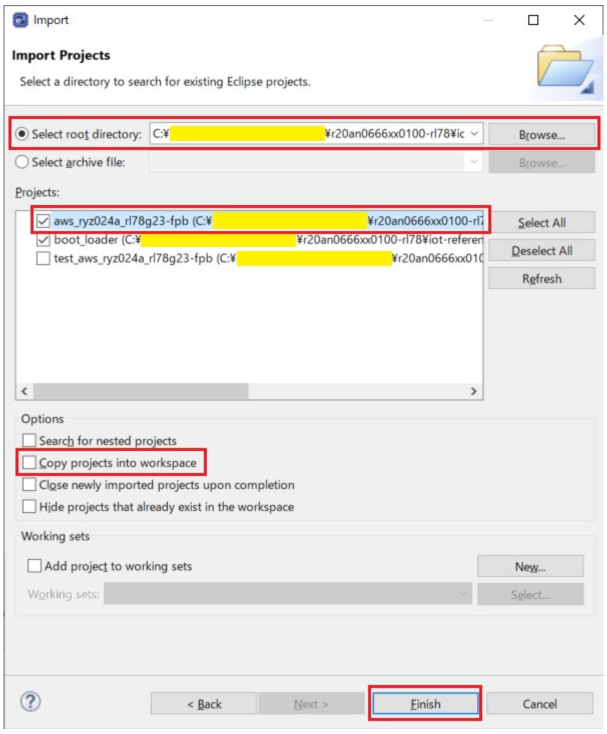
6.2.2 Creating an Initial Application

6.2.2.1 Importing the Initial Application

Import the aws_ryz024a_rl78g23-fpb project to e^2 studio. Open the Import wizard according to the following process.

File > Import… > Existing Projects into Workspace > Next

Next, select the aws_ryz024a_rl78g23-fpb project. Ensure that copy projects into workspace is not selected. Then click the Finish button.



Import

Import Projects

Select a directory to search for existing Eclipse projects.

(●) Select root directory: C:¥[redacted]¥r20an0666xx0100-rl78¥ic

( ) Select archive file:

Projects:

- [✓] aws_ryz024a_rl78g23-fpb (C:¥[redacted]¥r20an0666xx0100-rl
- [✓] boot_loader (C:¥[redacted]¥r20an0666xx0100-rl78¥iot-referen
- [ ] test_aws_ryz024a_rl78g23-fpb (C:¥[redacted]¥r20an0666xx01(

Options

- [ ] Search for nested projects
- [ ] Copy projects into workspace
- [ ] Close newly imported projects upon completion
- [ ] Hide projects that already exist in the workspace

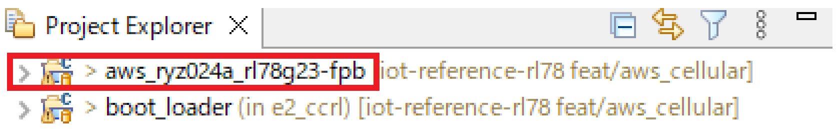
Working sets

- [ ] Add project to working sets

Working sets:

Figure 6-39 Selecting the aws_ryz024a_rl78g23-fpb Project

The imported project is showed in the Project Explorer view.



Project Explorer

> aws_ryz024a_rl78g23-fpb [iot-reference-rl78 feat/aws_cellular]

> boot_loader (in e2_ccrl) [iot-reference-rl78 feat/aws_cellular]

Figure 6-40 Completing to Import the aws_ryz024a_rl78g23-fpb Project

6.2.2.2 Setting the Build Configuration of the the Initial Application

Set the build configuration of the aws_ryz024a_rl78g23-fpb project to “HardwareDebug_OTA”.

Build Configurations > Set Active > Select “HardwareDebug_OTA”

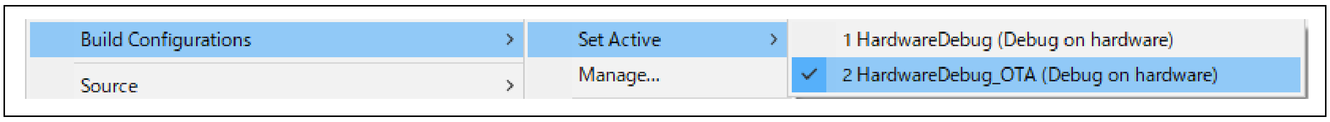
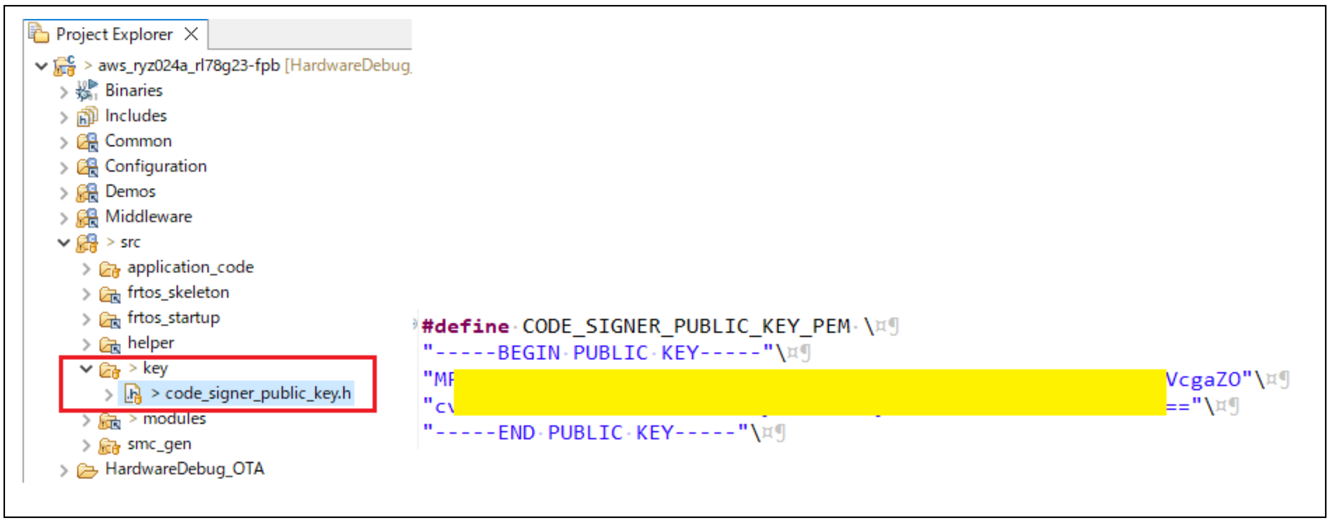

Build Configurations
Source
Set Active
Manage...
1 HardwareDebug (Debug on hardware)
✓ 2 HardwareDebug_OTA (Debug on hardware)

Figure 6-41 Activating Build Configuration “HardwareDebug_OTA”

6.2.2.3 Adding the Firmware Verification Key to the Initial Application

Add the firmware verification key (secp256r1.publickey) to code_signer_public_key.h in the aws_ryz024a_rl78g23-fpb project.

Note: Add \ to the end of each line.



```
#define CODE_SIGNER_PUBLIC_KEY_PEM \
"-----BEGIN PUBLIC KEY-----"\
"MF[redacted]VcgaZO"\
"cV[redacted]=="\
"-----END PUBLIC KEY-----"\
```

Figure 6-42 Adding the Firmware Verification Key to the Initial Application

6.2.2.4 Building the Initial Application

Build the aws_ryz024a_rl78g23-fpb project to create a MOT file.
Then, make sure that aws_ryz024a_rl78g23-fpb_ota.mot has been created in the HardwareDebug_OTA folder directly under the project folder.

6.2.3 Creating an Initial Image by Using Renesas Image Generator

Join the bootloader and the initial application by using Renesas Image Generator to generate the initial image.

(1) Store the following files in the same folder as Renesas Image Generator.

- Bootloader: boot_loader.mot
- Initial application: aws_ryz024a_rl78g23-fpb_ota.mot
- Private key for initial application verification: secp256r1.privatekey

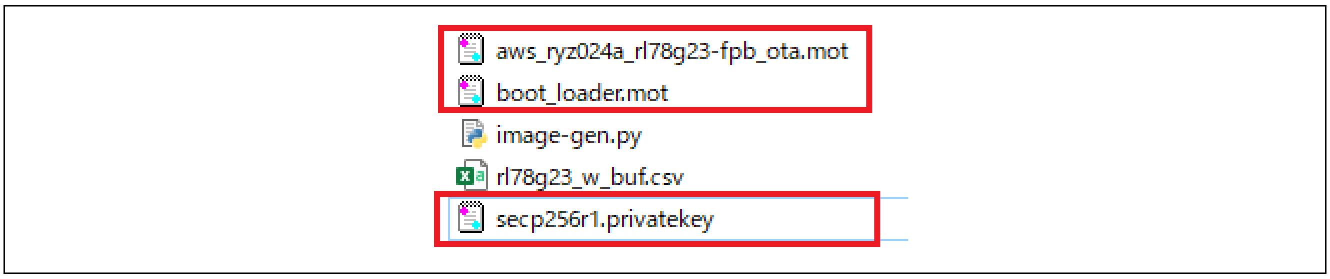

aws_ryz024a_rl78g23-fpb_ota.mot
boot_loader.mot
image-gen.py
rl78g23_w_buf.csv
secp256r1.privatekey

Figure 6-43 Storing Necessary Files in the Same Folder as Renesas Image Generator

(2) Run the following command to generate the initial image.

```
python image-gen.py -iup .\aws_ryz024a_rl78g23-fpb_ota.mot -ibp
boot_loader.mot -o initial_image -ip .\RL78_G23_ImageGenerator_PRM.csv
```

(3) Make sure that the initial image (initial_image.mot) has been generated.

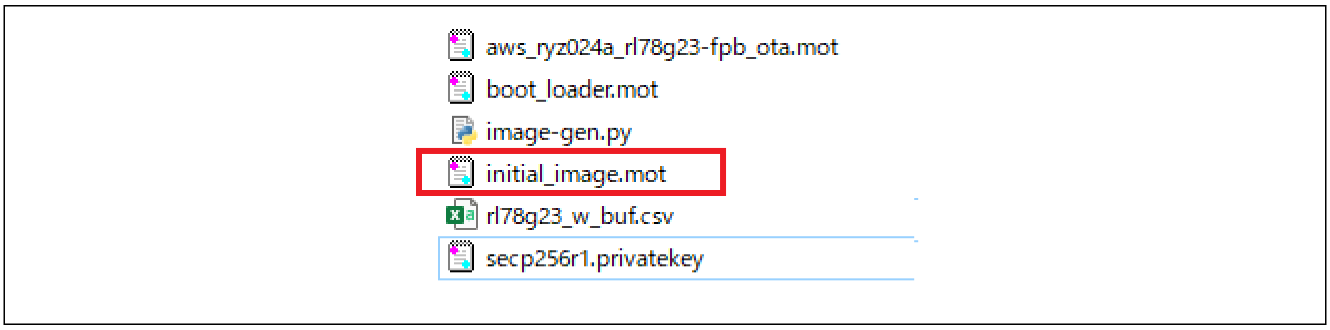

aws_ryz024a_rl78g23-fpb_ota.mot
boot_loader.mot
image-gen.py
initial_image.mot
rl78g23_w_buf.csv
secp256r1.privatekey

Figure 6-44 Initial Image Generated in the Same Folder as Renesas Image Generator

6.3 Creating an Update Image

An update image is a binary format (extension: rsu) firmware used for update which are converted an update application's MOT file by using Renesas Image Generator. Update images can be generated by Renesas Image Generator. For details about the update image format, refer to "RL78/G22,RL78/G23,RL78/G24 Firmware Update Module".

The file names related to an update image are as follows in this document.

- Update application: aws_ryz024a_rl78g23-fpb_ota_093.mot
- Update image: aws_ryz024a_rl78g23-fpb_ota_093.rsu

6.3.1 Creating an Update Application

6.3.1.1 Changing the Source Code of the Application

To create an update application,
in iot-reference-rl78\Configuration\rl78g23-fpb\ota\cellular\frtos_config\demo_config.h, change the definition of the APP_VERSION_BUILD macro from 2 to 3.

```
iot-reference-rl78\Configuration\rl78g23-
fpb\ota\cellular\frtos_config\demo_config.h

/**
 * @brief Build version of the firmware.
 *
 * This is used in the OTA demo to set the appFirmwareVersion variable that
is
 * declared in the ota_appversion32.h file in the OTA library.
 */
#ifndef APP_VERSION_BUILD
    #define APP_VERSION_BUILD    3
#endif
```

6.3.1.2 Building the Update Application

Build the aws_ryz024a_rl78g23-fpb project to create a MOT file.
Then, make sure that aws_ryz024a_rl78g23-fpb_ota.mot has been overwritten and created in the HardwareDebug_OTA folder directly under the project folder.

6.3.1.3 Renaming the MOT File of the Update Application

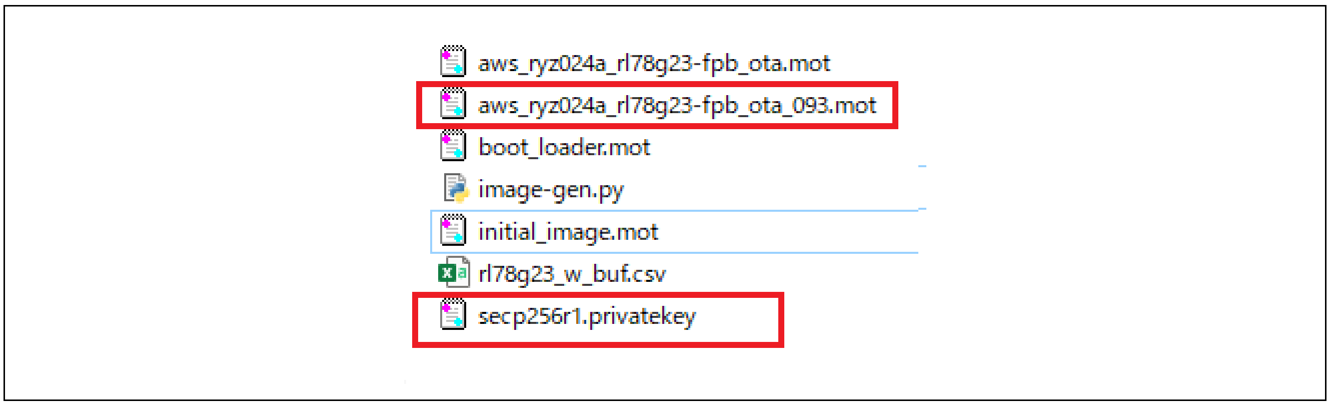
Rename aws_ryz024a_rl78g23-fpb_ota.mot to aws_ryz024a_rl78g23-fpb_ota_093.mot.

6.3.2 Generating an Update Image by Using Renesas Image Generator

Convert the update application to an update image by using Renesas Image Generator.

(1) Store the following files in the same folder as Renesas Image Generator.

- MOT file of the update application: aws_ryz024a_rl78g23-fpb_ota_093.mot
- Private key for update application verification: secp256r1.privatekey



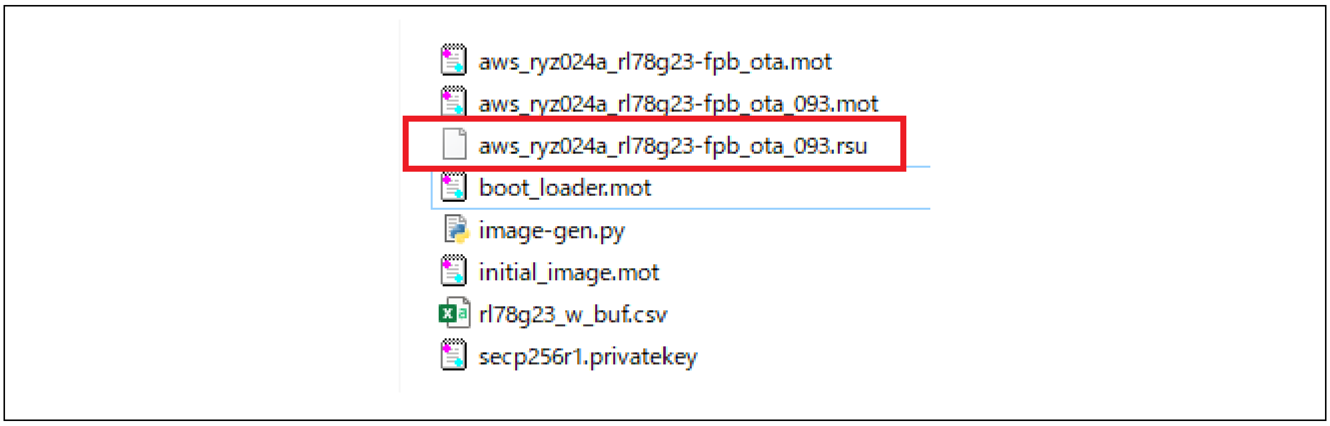
aws_ryz024a_rl78g23-fpb_ota.mot
aws_ryz024a_rl78g23-fpb_ota_093.mot
boot_loader.mot
image-gen.py
initial_image.mot
rl78g23_w_buf.csv
secp256r1.privatekey

Figure 6-45 Storing Necessary Files in the Same Folder as Renesas Image Generator

(2) Run the following command to generate an update image (aws_ryz024a_rl78g23-fpb_ota_093.rsu) in RSU format.

```
python image-gen.py -iup .\aws_ryz024a_rl78g23-fpb_ota_093.mot -o
aws_ryz024a_rl78g23-fpb_ota_093 -ip .\RL78_G23_ImageGenerator_PRM.csv -vt
ecdsa -ff RTOS
```

(3) Make sure that aws_ryz024a_rl78g23-fpb_ota_093.rsu has been generated.



aws_ryz024a_rl78g23-fpb_ota.mot
aws_ryz024a_rl78g23-fpb_ota_093.mot
aws_ryz024a_rl78g23-fpb_ota_093.rsu
boot_loader.mot
image-gen.py
initial_image.mot
rl78g23_w_buf.csv
secp256r1.privatekey

Figure 6-46 Update Image Generated in the Same Folder as Renesas Image Generator

6.4 Running the Demo Project

The following describes the running procedure for the demo project (OTA).

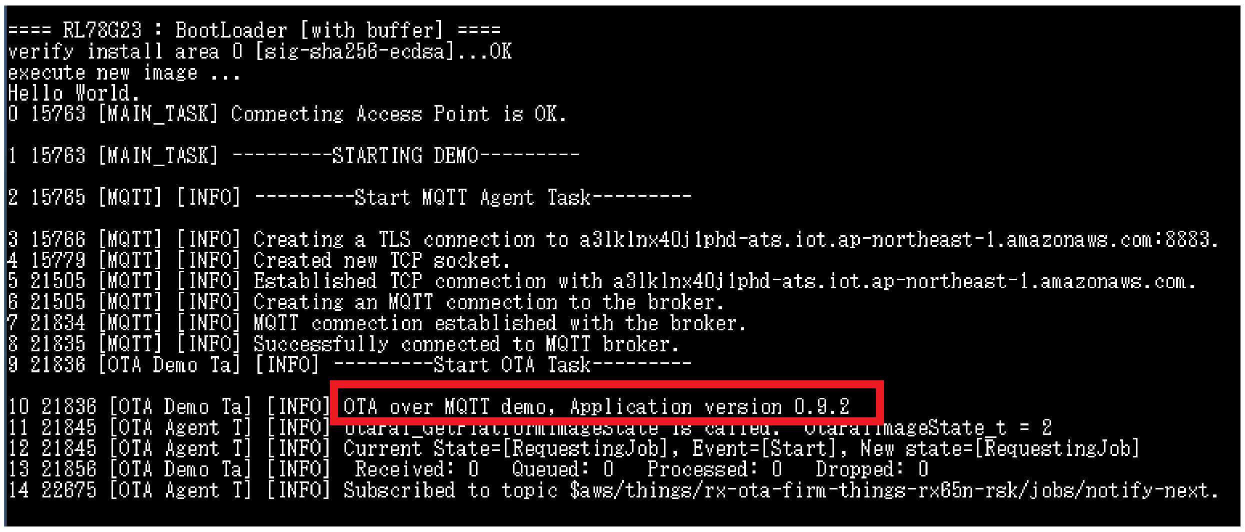
6.4.1 Programming the Initial image (initial_image.mot) to Board

(1) Program the initial image (initial_image.mot).

For the programming method, refer to Chapter 7, Using Renesas Flash Programmer.

(2) When programming terminates, the demo project starts.

(3) Check the terminal to make sure that the initial application (version 0.9.2) has started.

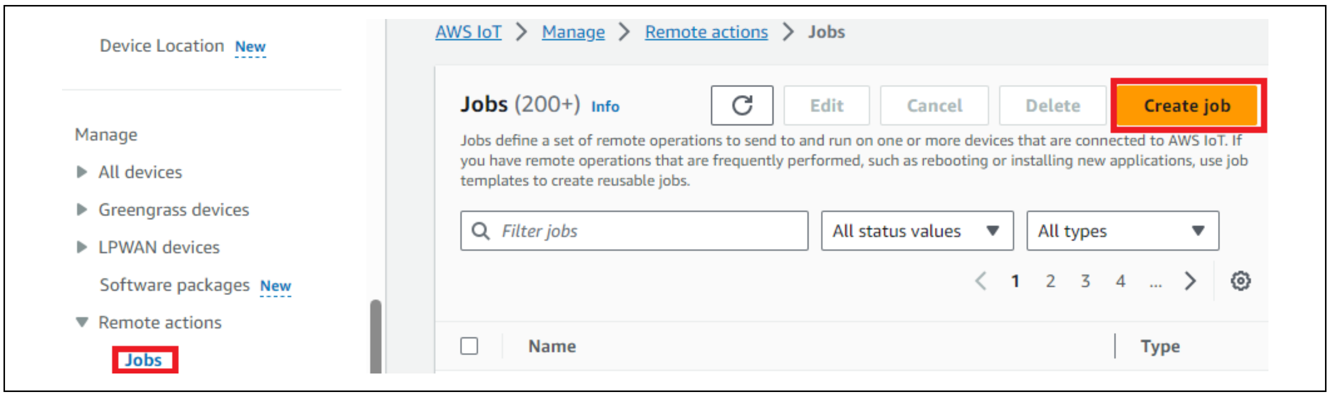


```
==== RL78G23 : BootLoader [with buffer] ====
verify install area 0 [sig-sha256-ecdsa]...OK
execute new image ...
Hello World.
0 15763 [MAIN_TASK] Connecting Access Point is OK.

1 15763 [MAIN_TASK] ---------STARTING DEMO---------

2 15765 [MQTT] [INFO] ---------Start MQTT Agent Task---------

3 15766 [MQTT] [INFO] Creating a TLS connection to a31klnx40j1phd-ats.iot.ap-northeast-1.amazonaws.com:8883.
4 15779 [MQTT] [INFO] Created new TCP socket.
5 21505 [MQTT] [INFO] Established TCP connection with a31klnx40j1phd-ats.iot.ap-northeast-1.amazonaws.com.
6 21505 [MQTT] [INFO] Creating an MQTT connection to the broker.
7 21834 [MQTT] [INFO] MQTT connection established with the broker.
8 21835 [MQTT] [INFO] Successfully connected to MQTT broker.
9 21836 [OTA Demo Ta] [INFO] ---------Start OTA Task---------

10 21836 [OTA Demo Ta] [INFO] OTA over MQTT demo, Application version 0.9.2
11 21845 [OTA Agent T] [INFO] OtaPal_GetPlatformImageState is called.  OtaPalImageState_t = 2
12 21845 [OTA Agent T] [INFO] Current State=[RequestingJob], Event=[Start], New state=[RequestingJob]
13 21856 [OTA Demo Ta] [INFO]  Received: 0   Queued: 0   Processed: 0   Dropped: 0
14 22675 [OTA Agent T] [INFO] Subscribed to topic $aws/things/rx-ota-firm-things-rx65n-rsk/jobs/notify-next.
```

Figure 6-47 Initial Application (Version 0.9.2) Started

6.4.2 Registering the Update Image (aws_ryz024a_rl78g23-fpb_ota_093.rsu) with OTA Jobs

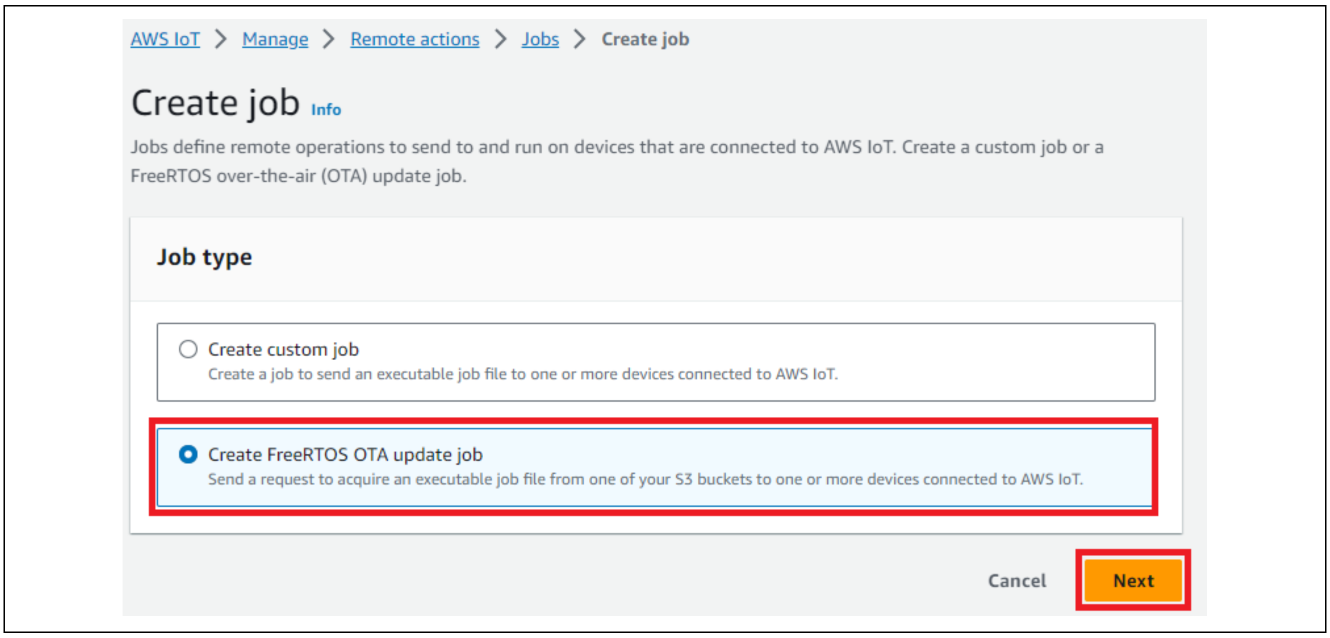
(1) AWS IoT > Manage > Remote actions > Jobs > Click "Create job"



Jobs define a set of remote operations to send to and run on one or more devices that are connected to AWS IoT. If you have remote operations that are frequently performed, such as rebooting or installing new applications, use job templates to create reusable jobs.

Figure 6-48 Jobs

(2) Check "Create FreeRTOS OTA update job" > Click "Next"


AWS IoT > Manage > Remote actions > Jobs > Create job
Create job Info
Job type
Create custom job
Create FreeRTOS OTA update job
Cancel
Next

Jobs define remote operations to send to and run on devices that are connected to AWS IoT. Create a custom job or a FreeRTOS over-the-air (OTA) update job.

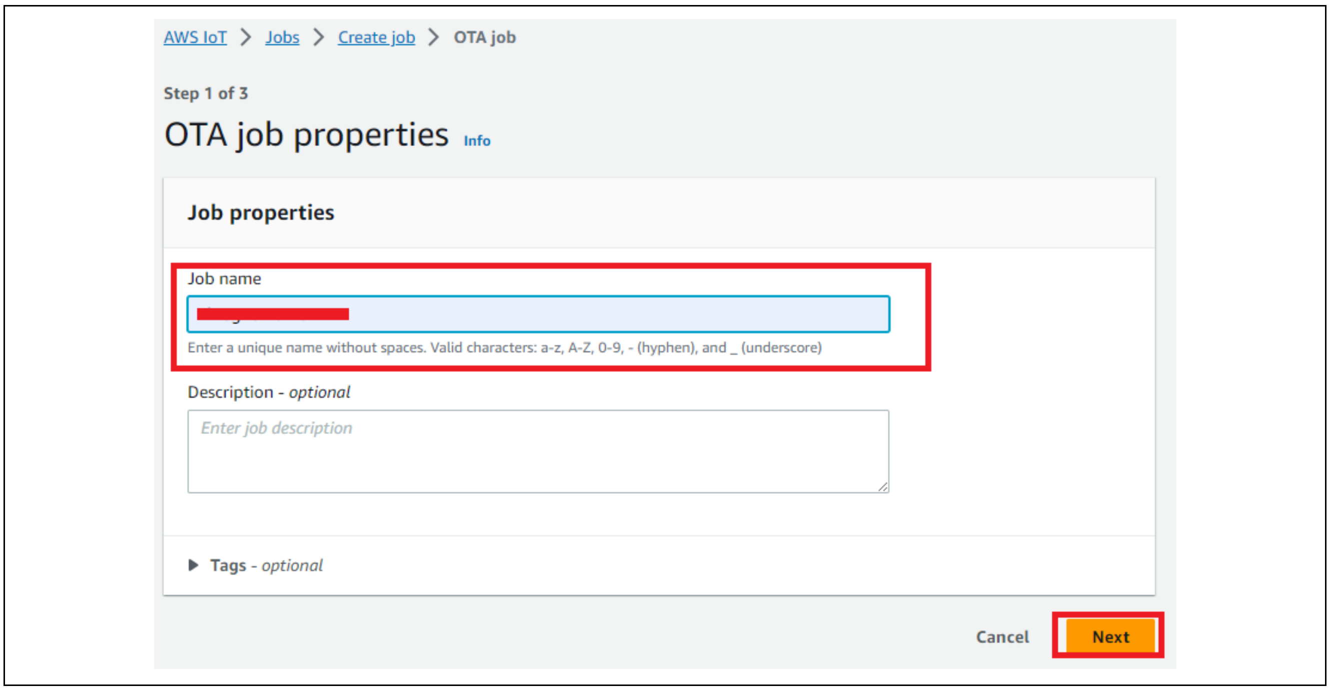
Create a job to send an executable job file to one or more devices connected to AWS IoT.

Send a request to acquire an executable job file from one of your S3 buckets to one or more devices connected to AWS IoT.

Figure 6-49 Crate Job

(3) Step 1: OTA job properties

- Job name: Any


AWS IoT > Jobs > Create job > OTA job

Step 1 of 3

OTA job properties Info

Job properties

Job name

[redacted]

Enter a unique name without spaces. Valid characters: a-z, A-Z, 0-9, - (hyphen), and _ (underscore)

Description - *optional*

Enter job description

▶ Tags - *optional*

Cancel Next

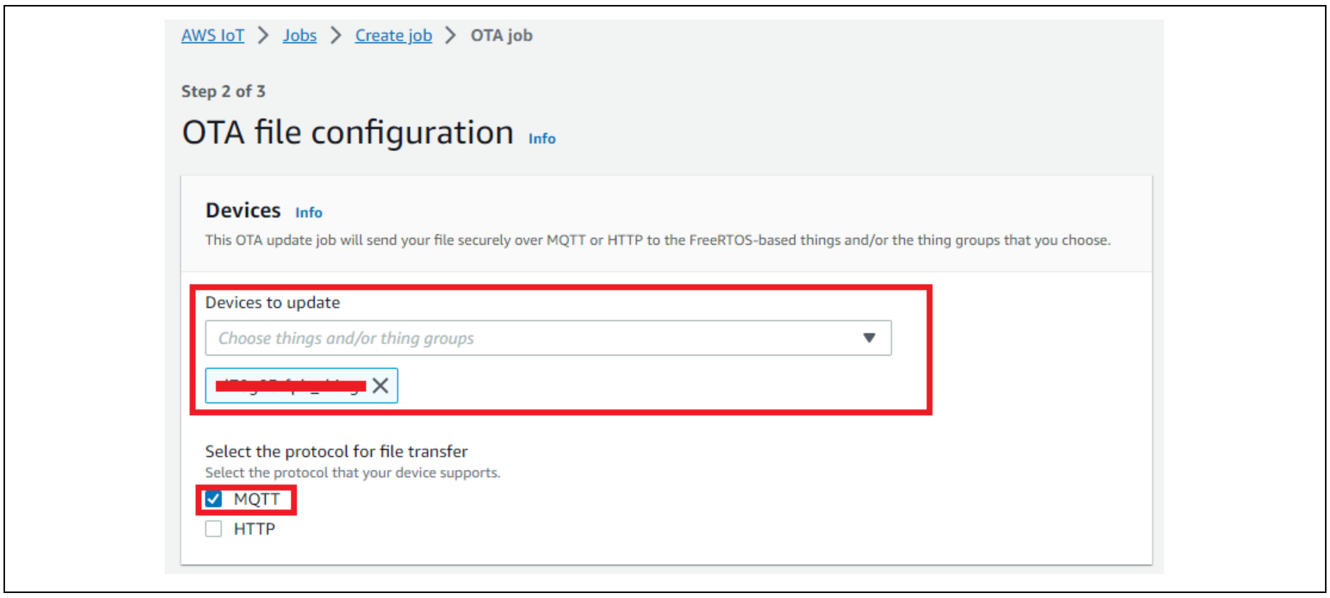
Figure 6-50 Step 1: OTA job properties

(4) Step 2: OTA file configuration > Devices

- Devices to update: "Name of the thing" in aws_clientcredential.h

```
  #define clientcredentialIOT_THING_NAME          "YOUR_THING_NAME
```

- Select the protocol for file transfer: MQTT


AWS IoT > Jobs > Create job > OTA job

Step 2 of 3

OTA file configuration Info

Devices Info

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.

Devices to update

Choose things and/or thing groups

[redacted] ✕

Select the protocol for file transfer

Select the protocol that your device supports.

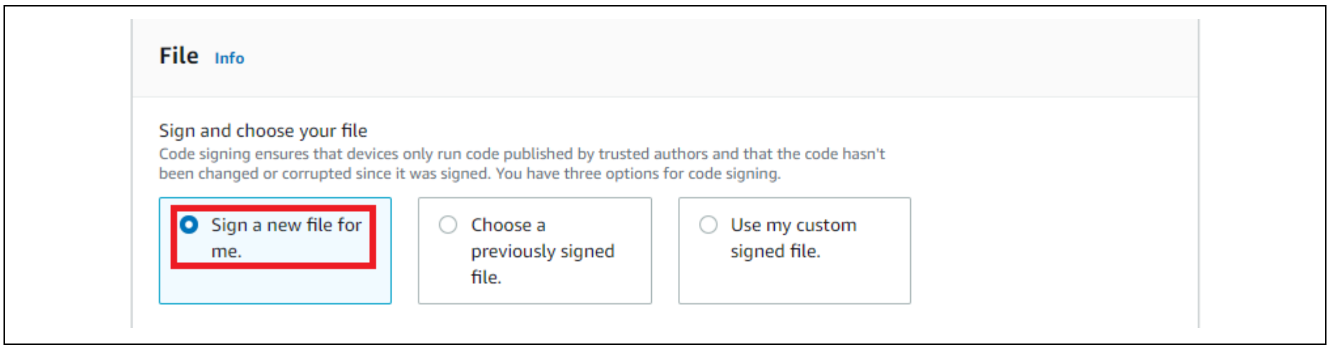
[✓ MQTT]

☐ HTTP

Figure 6-51 Step 2: OTA file configuration > Devices

(5) Step 2: OTA file configurations > File

- Sign and choose your file: Sign a new file for me.



File Info

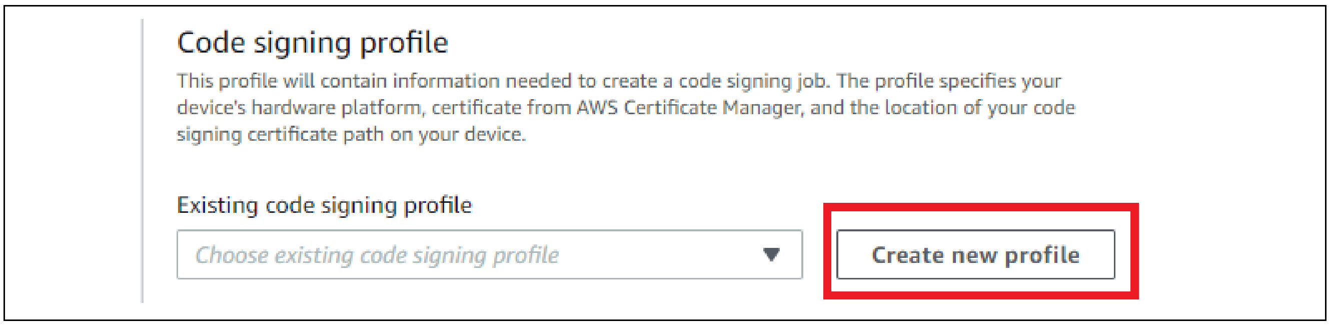
Sign and choose your file

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 me.] Choose a previously signed file. Use my custom signed file.

Figure 6-52 Step 2: OTA file configurations > File (1)

- Code signing profile: Click “Create new profile”



Code signing profile

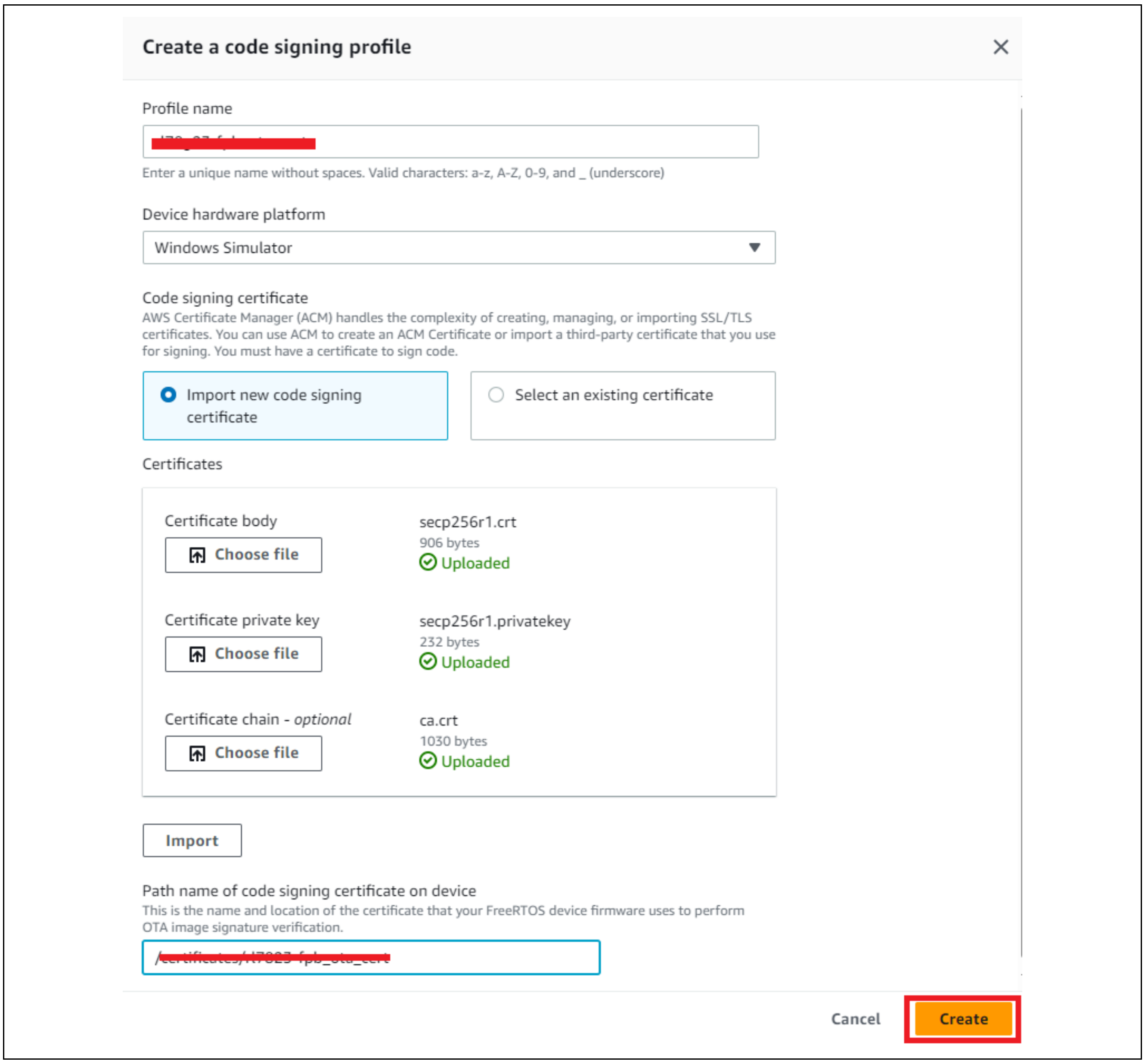
This profile will contain information needed to create a code signing job. The profile specifies your device's hardware platform, certificate from AWS Certificate Manager, and the location of your code signing certificate path on your device.

Existing code signing profile

Choose existing code signing profile

Figure 6-53 Step 2: OTA file configurations > File (2)

- Create a code signing profile.
  - Profile name: Any (Example: rl78g23_fpb_ota_cert)
  - Device hardware platform: Windows Simulator
  - Code signing certificate: “Import new code signing certificate”
  - Certificate body: secp256r1.crt
  - Certificate private key: secp256r1.privatekey
  - Certificate chain – optional: ca.crt
  - Path name of code signing certificate on device: Any


Create a code signing profile

Profile name

[redacted]

Enter a unique name without spaces. Valid characters: a-z, A-Z, 0-9, and _ (underscore)

Device hardware platform

Windows Simulator

Code signing certificate

AWS Certificate Manager (ACM) handles the complexity of creating, managing, or importing SSL/TLS certificates. You can use ACM to create an ACM Certificate or import a third-party certificate that you use for signing. You must have a certificate to sign code.

[✓ Import new code signing certificate] Select an existing certificate

Certificates

Certificate body	Choose file	secp256r1.crt 906 bytes Uploaded
Certificate private key	Choose file	secp256r1.privatekey 232 bytes Uploaded
Certificate chain - *optional*	Choose file	ca.crt 1030 bytes Uploaded

Import

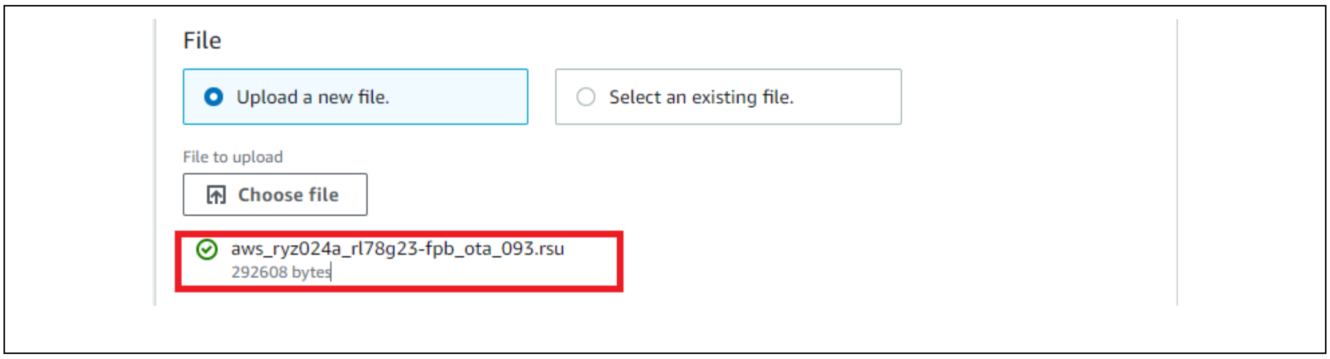
Path name of code signing certificate on device

This is the name and location of the certificate that your FreeRTOS device firmware uses to perform OTA image signature verification.

[redacted]

Figure 6-54 Create a code signing profile

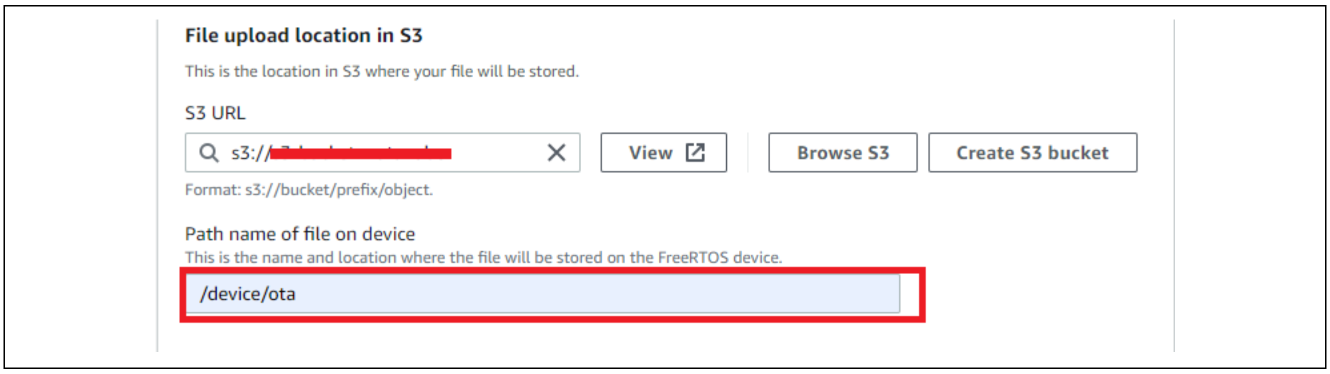
- File > "Upload a new file." > "Choose file" > aws_ryz024a_rl78g23-fpb_ota_093.rsu



aws_ryz024a_rl78g23-fpb_ota_093.rsu
292608 bytes

Figure 6-55 Upload a new file > aws_ryz024a_rl78g23-fpb_ota_093.rsu

- File upload location in S3: Specify the created bucket (Bucket name specified in section 6.1.3.1, Creating Amazon S3 Buckets.
- Path name of file on device: Any


File upload location in S3

This is the location in S3 where your file will be stored.

S3 URL: s3://[redacted]

Format: s3://bucket/prefix/object.

Path name of file on device

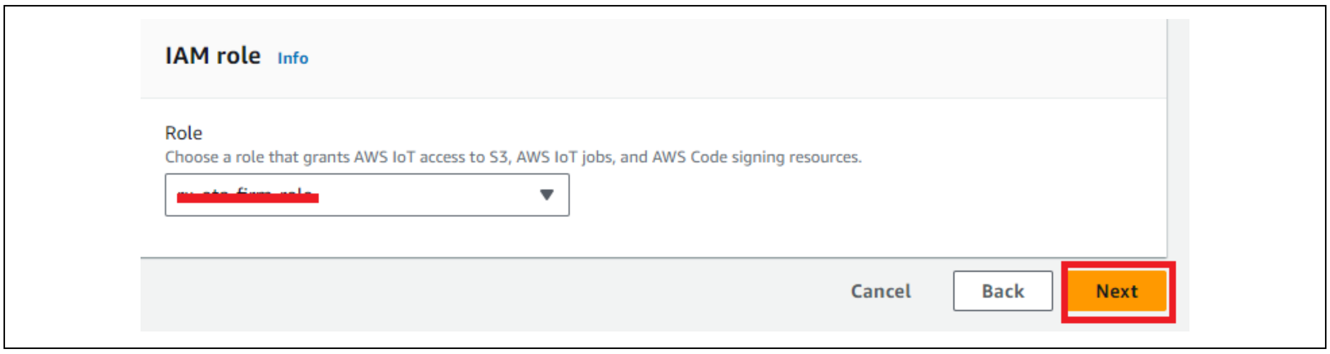
This is the name and location where the file will be stored on the FreeRTOS device.

/device/ota

Figure 6-56 File upload location in S3

(6) Step 2: OTA file configurations > IAM role

- Role: Specify the created role (Role name specified in section 6.1.3.2, Creating an OTA Update Service Role).


IAM role Info

Role

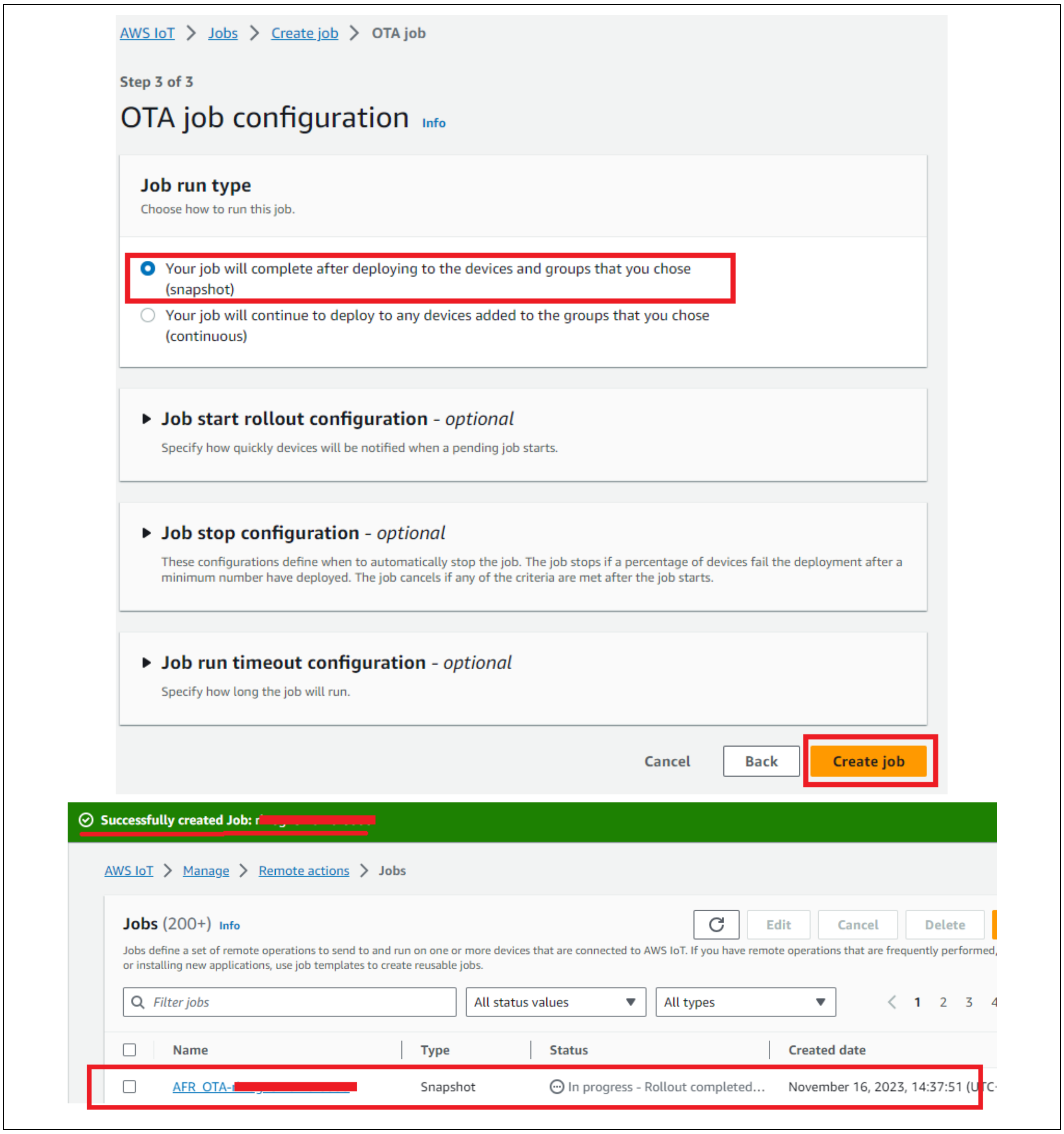
Choose a role that grants AWS IoT access to S3, AWS IoT jobs, and AWS Code signing resources.

[redacted]

Figure 6-57 Step 2: OTA file configurations > IAM role

(7) Step 3: OTA job configuration

- Job run type: Your job will complete after deploying to the devices and groups that you chose (snapshot)



AWS IoT > Jobs > Create job > OTA job

Step 3 of 3

OTA job configuration Info

Job run type
Choose how to run this job.

[✓ Your job will complete after deploying to the devices and groups that you chose (snapshot)]
Your job will continue to deploy to any devices added to the groups that you chose (continuous)

Job start rollout configuration - *optional*
Specify how quickly devices will be notified when a pending job starts.

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.

Successfully created Job: [redacted]

AWS IoT > Manage > Remote actions > Jobs

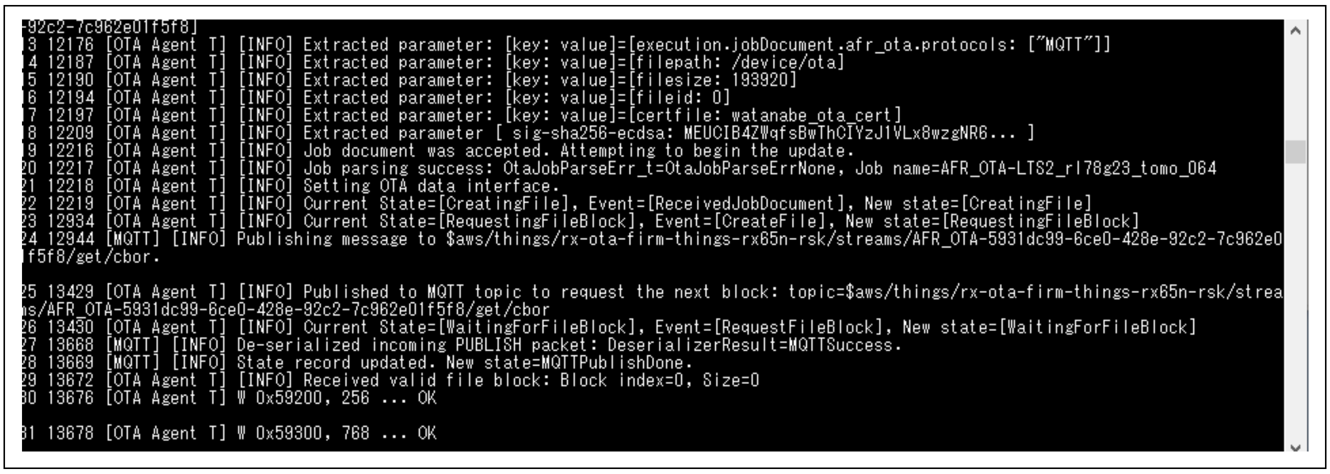
Jobs (200+) Info

Jobs define a set of remote operations to send to and run on one or more devices that are connected to AWS IoT. If you have remote operations that are frequently performed, or installing new applications, use job templates to create reusable jobs.

Name	Type	Status	Created date
AFR_OTA-[redacted]	Snapshot	In progress - Rollout completed...	November 16, 2023, 14:37:51 (UTC-

Figure 6-58 Step 3: OTA job configuration

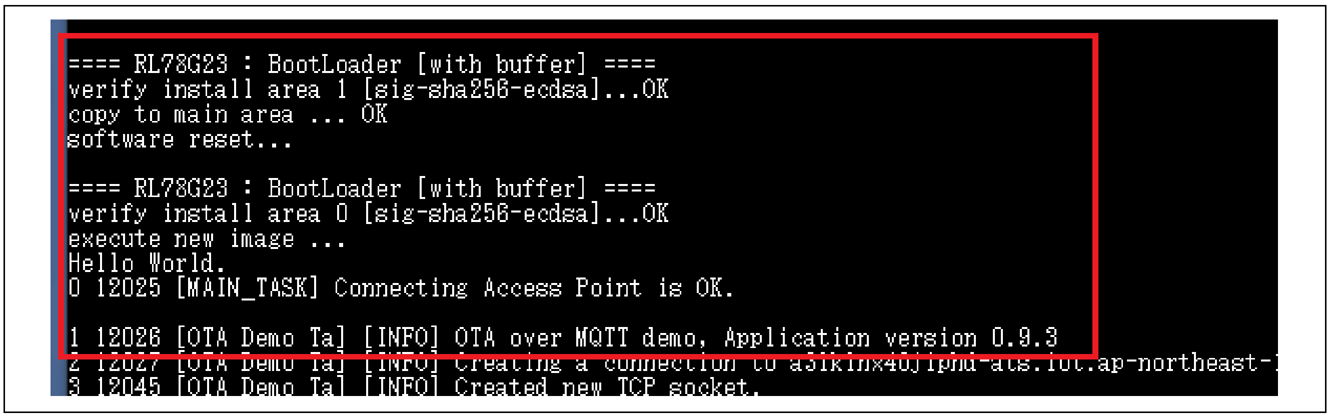
(8) After a while, the log of programming the update image to the MCU board is output to the terminal.



```
-92c2-7c962e01f5f8]
13 12176 [OTA Agent T] [INFO] Extracted parameter: [key: value]=[execution.jobDocument.afr_ota.protocols: ["MQTT"]]
14 12187 [OTA Agent T] [INFO] Extracted parameter: [key: value]=[filepath: /device/ota]
15 12190 [OTA Agent T] [INFO] Extracted parameter: [key: value]=[filesize: 193920]
16 12194 [OTA Agent T] [INFO] Extracted parameter: [key: value]=[fileid: 0]
17 12197 [OTA Agent T] [INFO] Extracted parameter: [key: value]=[certfile: watanabe_ota_cert]
18 12209 [OTA Agent T] [INFO] Extracted parameter [ sig-sha256-ecdsa: MEUCIB4ZWqfsBwThCIYzJ1VLx8wzgNR6... ]
19 12216 [OTA Agent T] [INFO] Job document was accepted. Attempting to begin the update.
20 12217 [OTA Agent T] [INFO] Job parsing success: OtaJobParseErr_t=OtaJobParseErrNone, Job name=AFR_OTA-LTS2_rl78g23_tomo_064
21 12218 [OTA Agent T] [INFO] Setting OTA data interface.
22 12219 [OTA Agent T] [INFO] Current State=[CreatingFile], Event=[ReceivedJobDocument], New state=[CreatingFile]
23 12934 [OTA Agent T] [INFO] Current State=[RequestingFileBlock], Event=[CreateFile], New state=[RequestingFileBlock]
24 12944 [MQTT] [INFO] Publishing message to $aws/things/rx-ota-firm-things-rx65n-rsk/streams/AFR_OTA-5931dc99-6ce0-428e-92c2-7c962e0
1f5f8/get/cbor.

25 13429 [OTA Agent T] [INFO] Published to MQTT topic to request the next block: topic=$aws/things/rx-ota-firm-things-rx65n-rsk/strea
ms/AFR_OTA-5931dc99-6ce0-428e-92c2-7c962e01f5f8/get/cbor
26 13430 [OTA Agent T] [INFO] Current State=[WaitingForFileBlock], Event=[RequestFileBlock], New state=[WaitingForFileBlock]
27 13668 [MQTT] [INFO] De-serialized incoming PUBLISH packet: DeserializerResult=MQTTSuccess.
28 13669 [MQTT] [INFO] State record updated. New state=MQTTPublishDone.
29 13672 [OTA Agent T] [INFO] Received valid file block: Block index=0, Size=0
30 13676 [OTA Agent T] W 0x59200, 256 ... OK

31 13678 [OTA Agent T] W 0x59300, 768 ... OK
```

Figure 6-59 Programming the Update Image to the MCU Board

(9) When programming terminates, the update image (version 0.9.3) starts.



```
==== RL78G23 : BootLoader [with buffer] ====
verify install area 1 [sig-sha256-ecdsa]...OK
copy to main area ... OK
software reset...

==== RL78G23 : BootLoader [with buffer] ====
verify install area 0 [sig-sha256-ecdsa]...OK
execute new image ...
Hello World.
0 12025 [MAIN_TASK] Connecting Access Point is OK.

1 12026 [OTA Demo Ta] [INFO] OTA over MQTT demo, Application version 0.9.3
2 12027 [OTA Demo Ta] [INFO] Creating a connection to a3lklnx40jlphd-ats.iot.ap-northeast-1
3 12045 [OTA Demo Ta] [INFO] Created new TCP socket.
```

Figure 6-60 Update Image (Version 0.9.3) Started after Programming Terminates

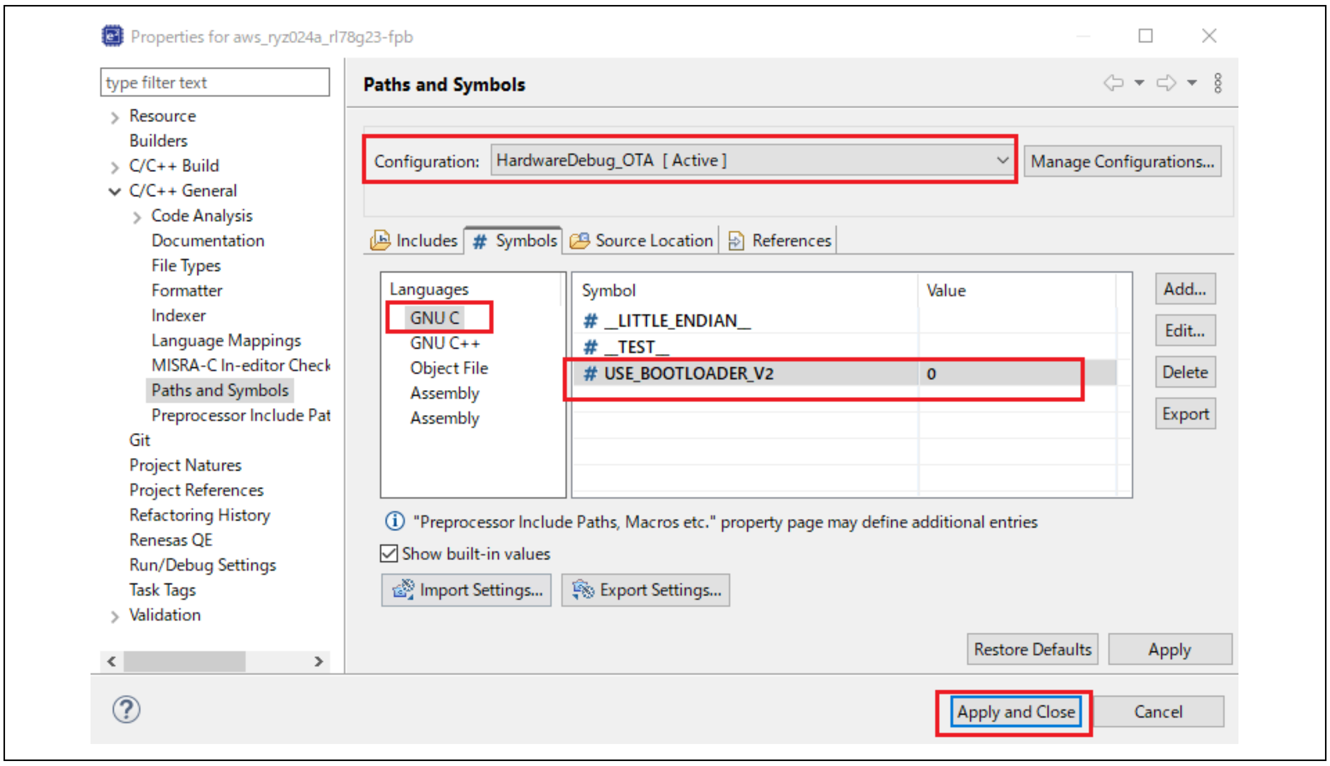
6.5 Debugging the Initial Application

The following describes the procedure for starting the initial application from e^2 studio and debugging it. Because the bootloader is not used in this procedure, downloaded update images cannot be started.

(1) Change the setting to not use the bootloader.

Change the “USE_BOOTLOADER_V2” macro of the aws_ryz024a_rl78g23-fpb project to 0, and then click “Apply and Close”.

- Configuration: HardwareDebug_OTA
- Languages: GNU C
- USE_BOOTLOADER_V2: 0



Configuration: HardwareDebug_OTA [Active]

Languages	Symbol	Value
GNU C	# __LITTLE_ENDIAN__	
GNU C++	# __TEST__	
Object File	# USE_BOOTLOADER_V2	0
Assembly		
Assembly		

"Preprocessor Include Paths, Macros etc." property page may define additional entries

☑ Show built-in values

Figure 6-61 Setting the “USE_BOOTLOADER_V2” Macro to 0

(2) Build the aws_ryz024a_rl78g23-fpb project.

(3) Start debugging.

Refer to Chapter 8, Debug Procedure.

7. Using Renesas Flash Programmer

The following describes the procedure for using Renesas Flash Programmer to program MOT files to the MCU board.

7.1 When Using COM Port

The following describes how to program a MOT file via the COM port.

7.1.1 Setting Jumper Pins

Set J15: 1-2 Short, J16: 1-2 Short, and J19: 1-2 Short. If you don't change circuit, you don't need this process.

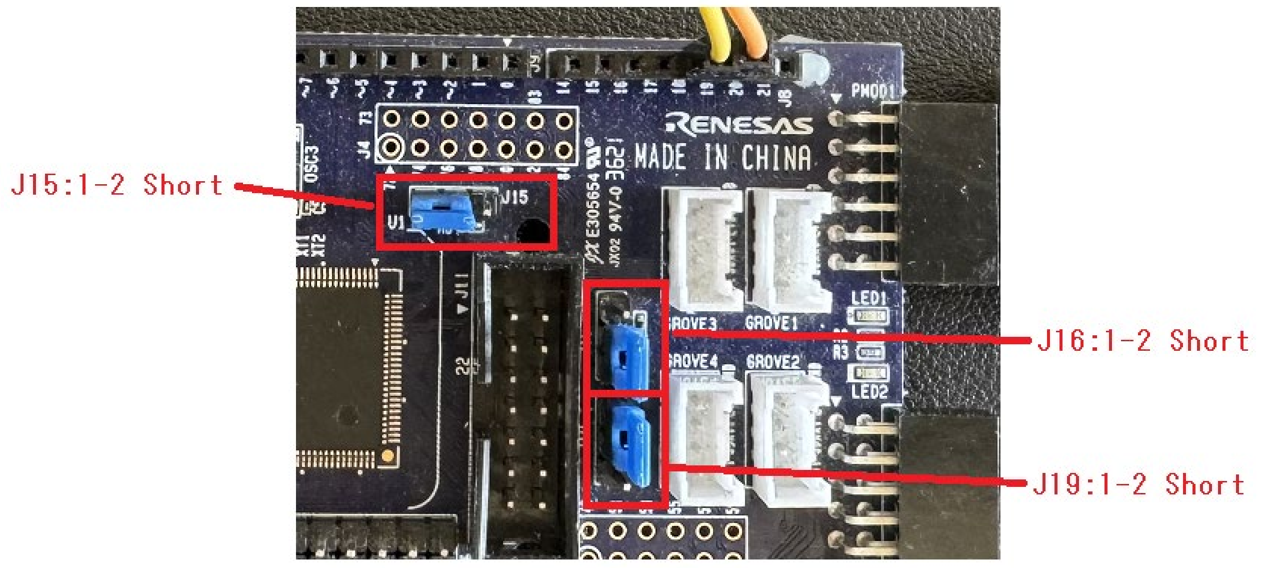


Figure 7-1 Settings for Using COM Port Debugging (Top Side)

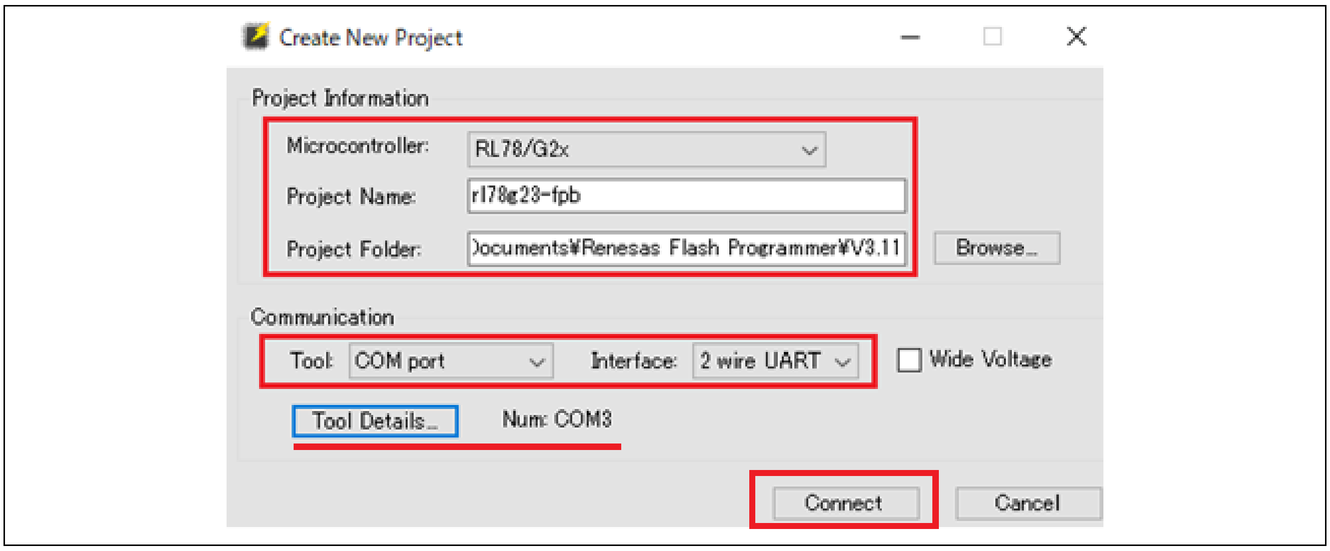
7.1.2 Supplying Power to the MCU Board

Connect the USB cable to supply power to the MCU board.

7.1.3 Creating a New Project and Connecting to the MCU Board

(1) File > New project

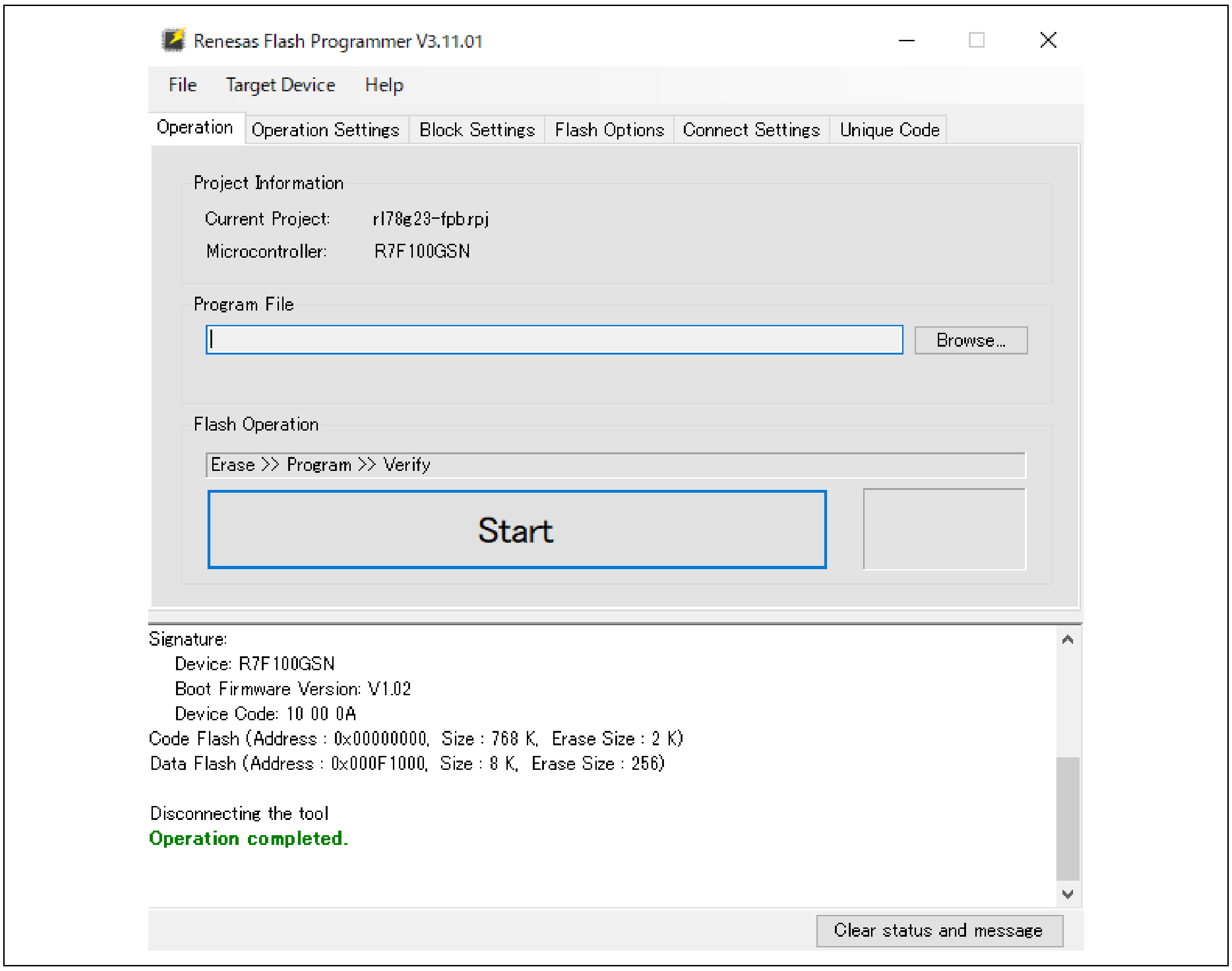
- Microcontroller: RL78/G2x
- Project Name: Any (Example: rl78g23-fpb)
- Project Folder: Any
- Tool: COM port
- Interface: 2 wire UART
- Tool Details…: COM port number
- Click “Connect”



Microcontroller: RL78/G2x
Project Name: rl78g23-fpb
Project Folder:)ocuments¥Renesas Flash Programmer¥V3.11
Tool: COM port
Interface: 2 wire UART
Num: COM3

Figure 7-2 Creating a New Project and Connecting to the MCU Board

(2) The connection is successful if the following window appears.



Project Information
Current Project: rl78g23-fpb.rpj
Microcontroller: R7F100GSN

Program File

Flash Operation
Erase >> Program >> Verify

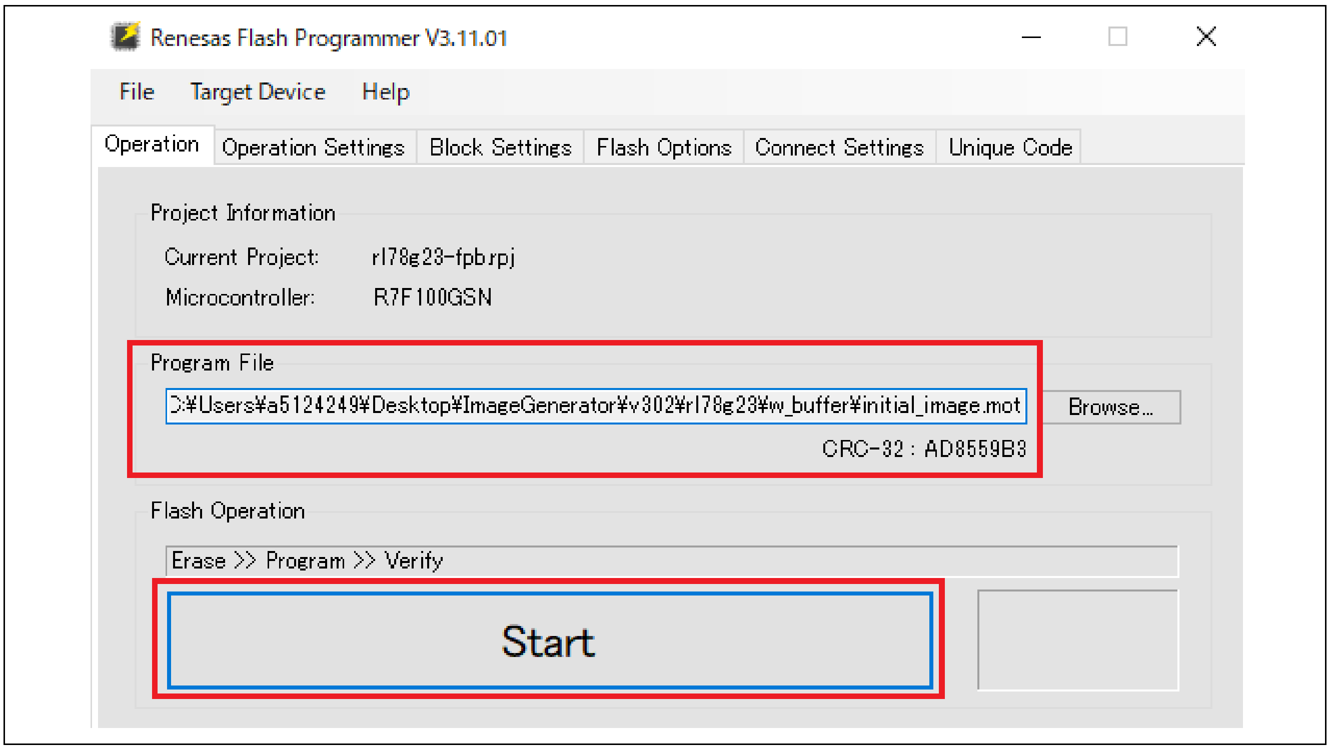
```
Signature:
    Device: R7F100GSN
    Boot Firmware Version: V1.02
    Device Code: 10 00 0A
Code Flash (Address : 0x00000000,  Size : 768 K,  Erase Size : 2 K)
Data Flash (Address : 0x000F1000,  Size : 8 K,  Erase Size : 256)

Disconnecting the tool
Operation completed.
```

Figure 7-3 Operation completed (Connect)

7.1.4 Programming a MOT File to the MCU Board

(1) In the Program File field, enter the path to the MOT file to be programmed, and then click “Start”.

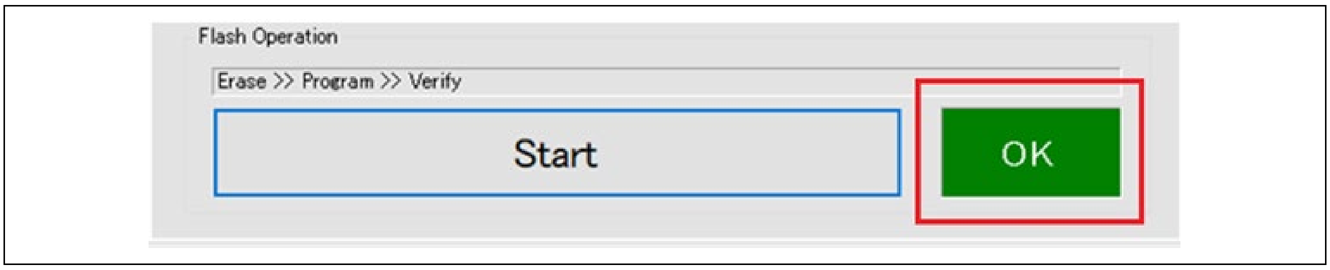
- Program File: MOT file to be programmed (Example: initial_image.mot, aws_ryz024a_rl78g23-fpb.mot)
- Click “Start”



Current Project: rl78g23-fpb.rpj
Microcontroller: R7F100GSN
Program File: C:¥Users¥a5124249¥Desktop¥ImageGenerator¥v302¥rl78g23¥w_buffer¥initial_image.mot
CRC-32 : AD8559B3
Erase >> Program >> Verify

Figure 7-4 Programming a MOT File to the MCU Board

(2) Make sure that programming is successful.



Erase >> Program >> Verify

Figure 7-5 Successful programming

7.2 When Using Emulator

The following describes how to program a MOT file via the emulator.

7.2.1 Setting Jumper Pins, Mounting the Connector, and Cutting Patterns

The 14-pin connector (J11) is used for connection with the E2 emulator or E2 emulator Lite, which are Renesas Electronics on-chip debug emulators with the programming feature (the connector component is not mounted). Use the emulator to program and debug the evaluation MCU.
When connecting the emulator, you need to change the circuit as following figures. For details, refer to section 5.20 in RL78/G23-128p Fast Prototyping Board User's Manual Rev.1.00.

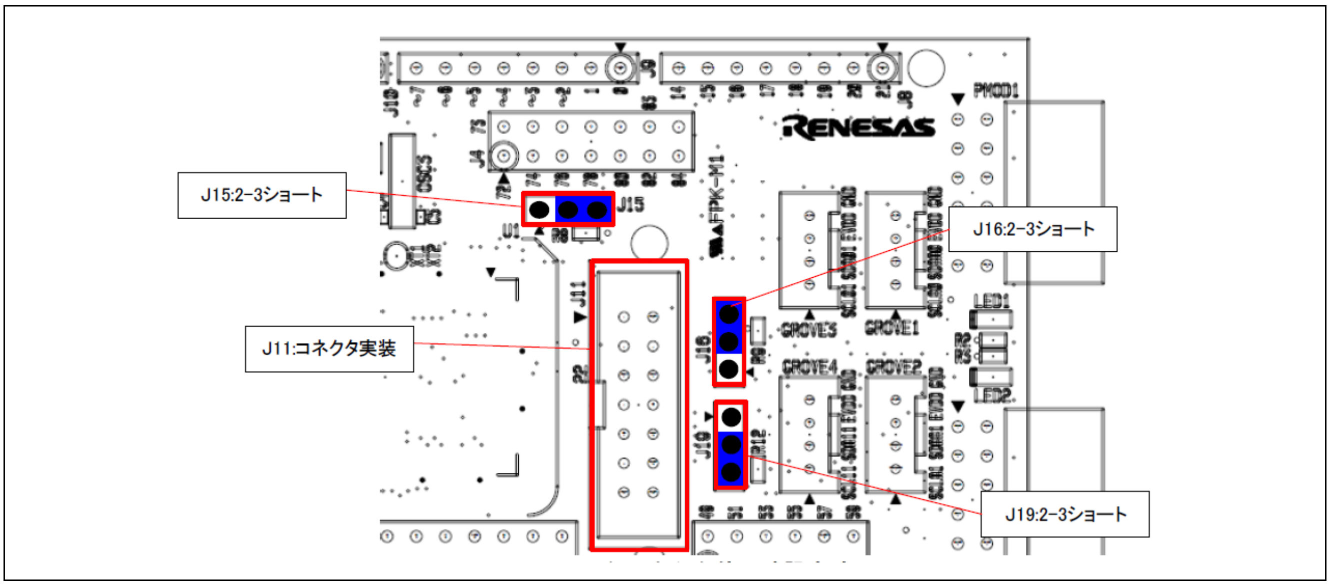


Figure 7-6 Settings for Using Emulator Connector (Top Side)

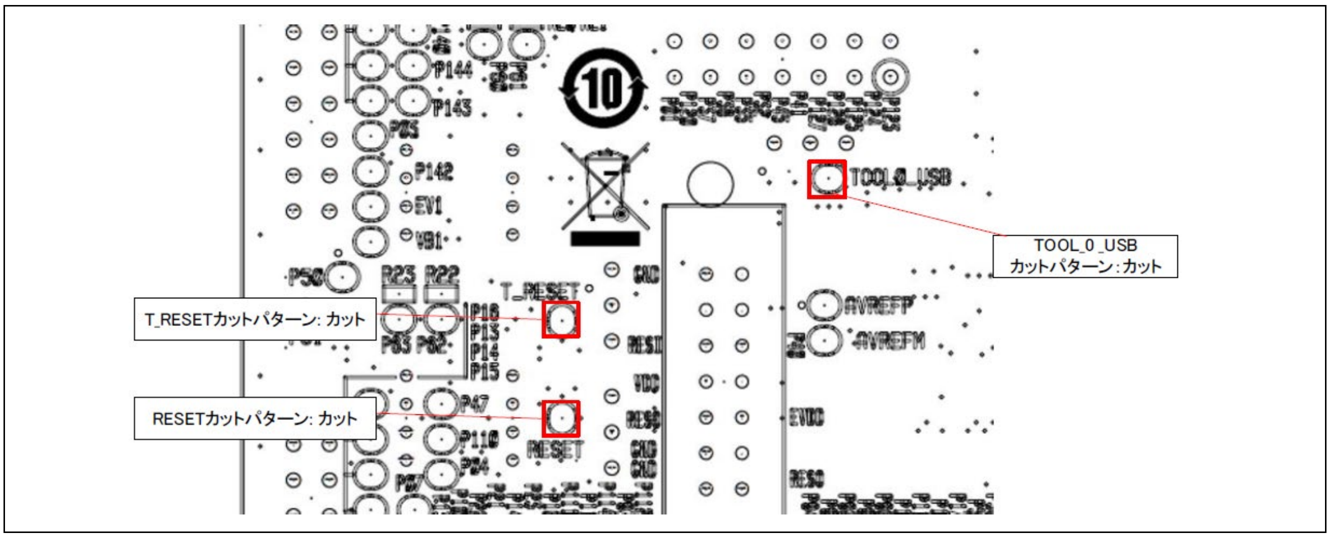


Figure 7-7 Settings for Using Emulator Connector (Solder Side)

For details about how to use the emulator, refer to "E1/E20/E2 Emulator, E2 Emulator Lite Additional Document for User's Manual (Notes on Connection of RL78)" (R20UT1994).

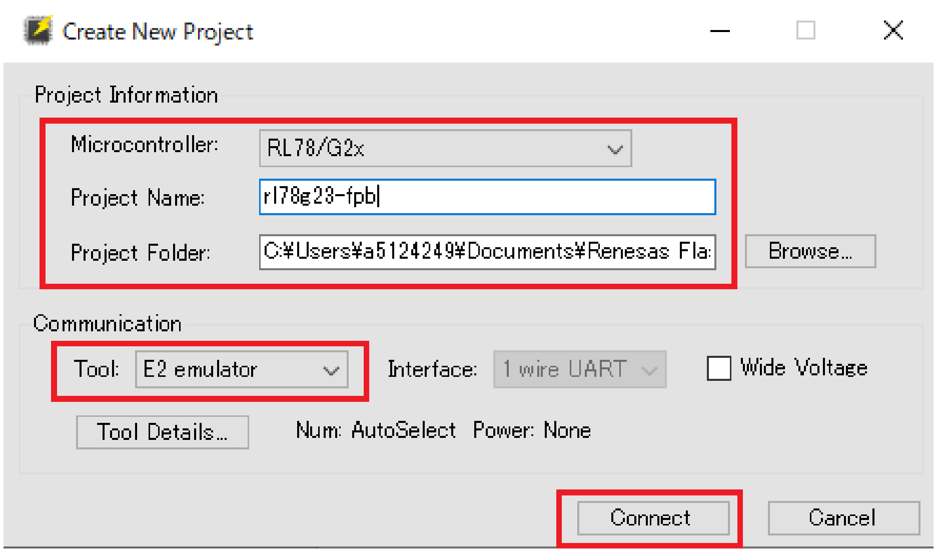
7.2.2 Supplying Power to the MCU Board

Connect the USB cable to supply power to the MCU board.

7.2.3 Creating a New Project and Connecting to the MCU Board

(1) File > New project

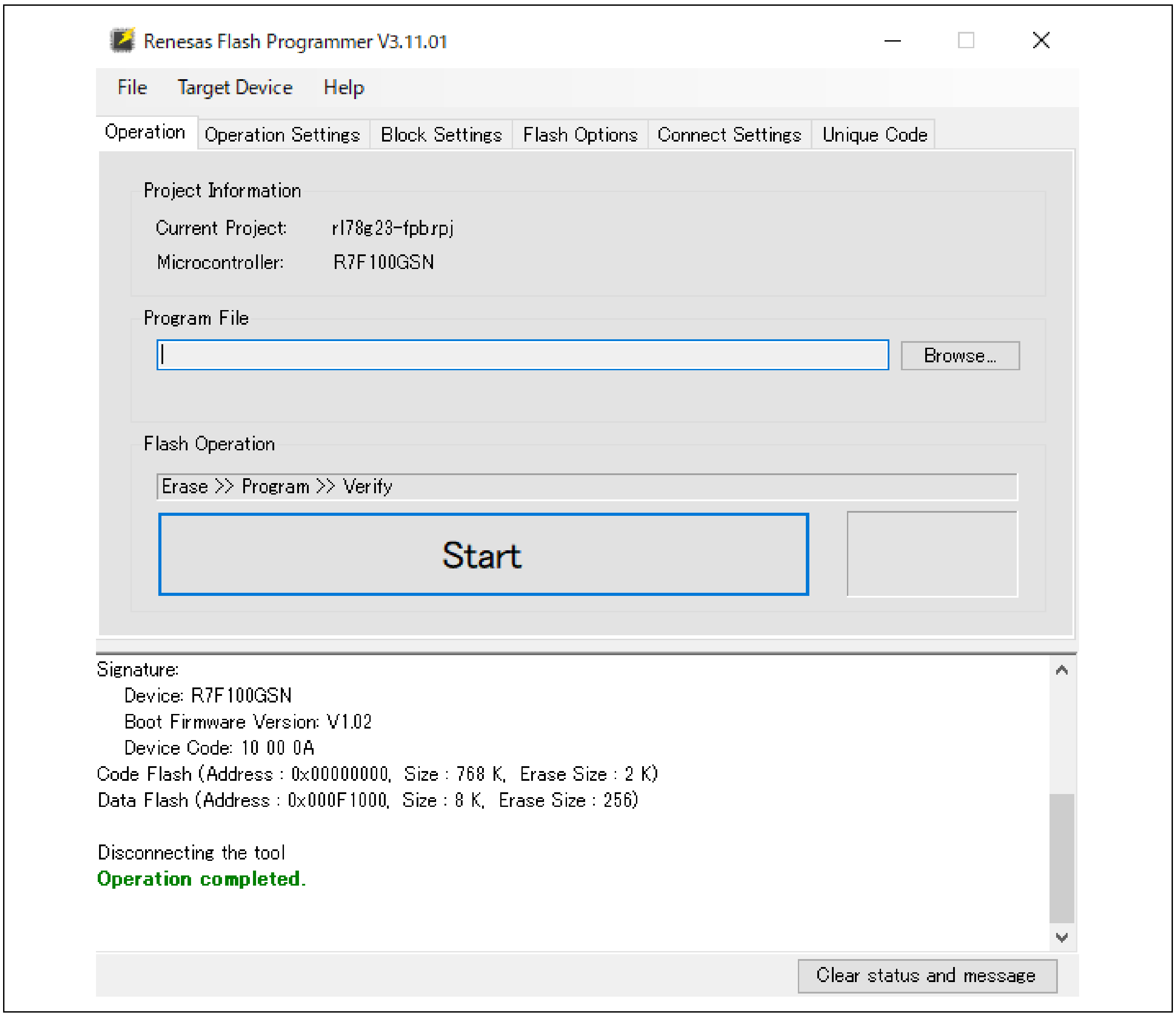
- Microcontroller: RL78/G2x
- Project Name: Any (Example: rl78g23-fpb)
- Project Folder: Any
- Tool: E2 emulator
- Click “Connect”



Microcontroller: RL78/G2x
Project Name: rl78g23-fpb
Project Folder: C:¥Users¥a5124249¥Documents¥Renesas Fla
Tool: E2 emulator
Interface: 1 wire UART
Wide Voltage
Num: AutoSelect Power: None

Figure 7-8 Creating a New Project and Connecting to the MCU Board

(2) The connection is successful if the following window appears.



Current Project: rl78g23-fpb.rpj
Microcontroller: R7F100GSN
Erase >> Program >> Verify

```
Signature:
    Device: R7F100GSN
    Boot Firmware Version: V1.02
    Device Code: 10 00 0A
Code Flash (Address : 0x00000000,  Size : 768 K,  Erase Size : 2 K)
Data Flash (Address : 0x000F1000,  Size : 8 K,  Erase Size : 256)

Disconnecting the tool
Operation completed.
```

Figure 7-9 Operation completed (Connect)

7.2.4 Programming a MOT File to the MCU Board

Refer to section 7.1.4, Programming a MOT File to the MCU Board.

8. Debug Procedure

8.1 When Using COM Port

The following describes how to perform debugging by using the COM port.

8.1.1 Setting Jumper Pins

Refer to section 7.1.1, Setting Jumper Pins.

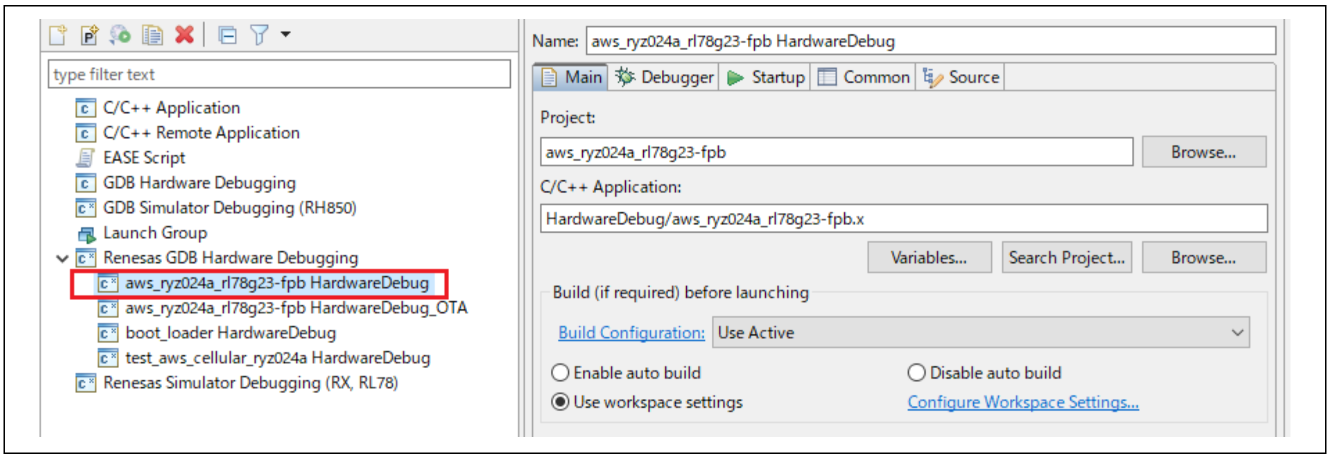
8.1.2 Supplying Power to the MCU Board

Connect the MCU board to the PC by using the USB cable.

8.1.3 Debug Configurations

Select the configuration you want to use for debugging.

- Debug Configurations > Renesas GDB Hardware Debugging
  — For the demo project (PubSub), select aws_ryz024a_rl78g23-fpb HardwareDebug.



Name: aws_ryz024a_rl78g23-fpb HardwareDebug

Project: aws_ryz024a_rl78g23-fpb

C/C++ Application: HardwareDebug/aws_ryz024a_rl78g23-fpb.x

Build (if required) before launching

Build Configuration: Use Active

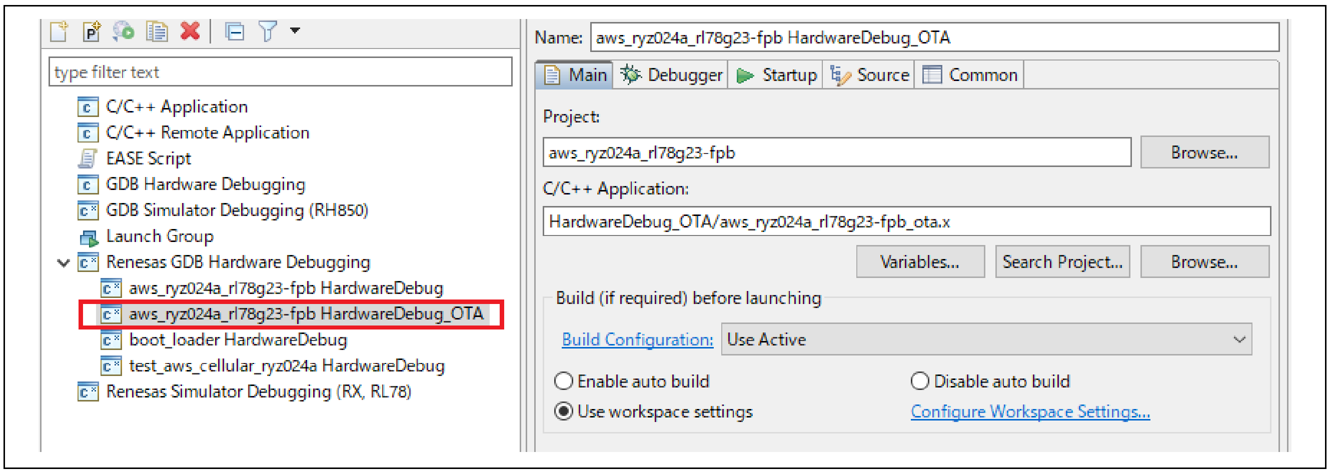
( ) Enable auto build ( ) Disable auto build

(●) Use workspace settings

type filter text
C/C++ Application
C/C++ Remote Application
EASE Script
GDB Hardware Debugging
GDB Simulator Debugging (RH850)
Launch Group
Renesas GDB Hardware Debugging
aws_ryz024a_rl78g23-fpb HardwareDebug
aws_ryz024a_rl78g23-fpb HardwareDebug_OTA
boot_loader HardwareDebug
test_aws_cellular_ryz024a HardwareDebug
Renesas Simulator Debugging (RX, RL78)
Main
Debugger
Startup
Common
Source
Browse...
Variables...
Search Project...
Configure Workspace Settings...

Figure 8-1 Debug Configurations of Project (PubSub)

— For the demo project (OTA), select aws_ryz024a_rl78g23-fpb HardwareDebug_OTA.



Name: aws_ryz024a_rl78g23-fpb HardwareDebug_OTA

Project: aws_ryz024a_rl78g23-fpb

C/C++ Application: HardwareDebug_OTA/aws_ryz024a_rl78g23-fpb_ota.x

Build (if required) before launching

Build Configuration: Use Active

( ) Enable auto build ( ) Disable auto build

(●) Use workspace settings

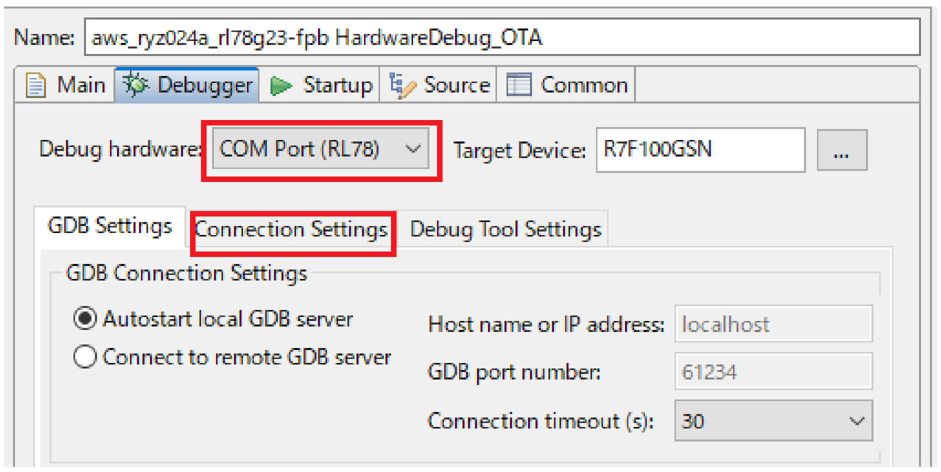
type filter text
C/C++ Application
C/C++ Remote Application
EASE Script
GDB Hardware Debugging
GDB Simulator Debugging (RH850)
Launch Group
Renesas GDB Hardware Debugging
aws_ryz024a_rl78g23-fpb HardwareDebug
aws_ryz024a_rl78g23-fpb HardwareDebug_OTA
boot_loader HardwareDebug
test_aws_cellular_ryz024a HardwareDebug
Renesas Simulator Debugging (RX, RL78)
Main
Debugger
Startup
Source
Common
Browse...
Variables...
Search Project...
Configure Workspace Settings...

Figure 8-2 Debug Configurations of Project (OTA)

8.1.4 Debugger Settings

Select ”Debugger” tab.

- Debug hardware: COM Port (RL78)



Name: aws_ryz024a_rl78g23-fpb HardwareDebug_OTA

Debug hardware: COM Port (RL78)

Target Device: R7F100GSN

GDB Connection Settings

(●) Autostart local GDB server

( ) Connect to remote GDB server

Host name or IP address: localhost

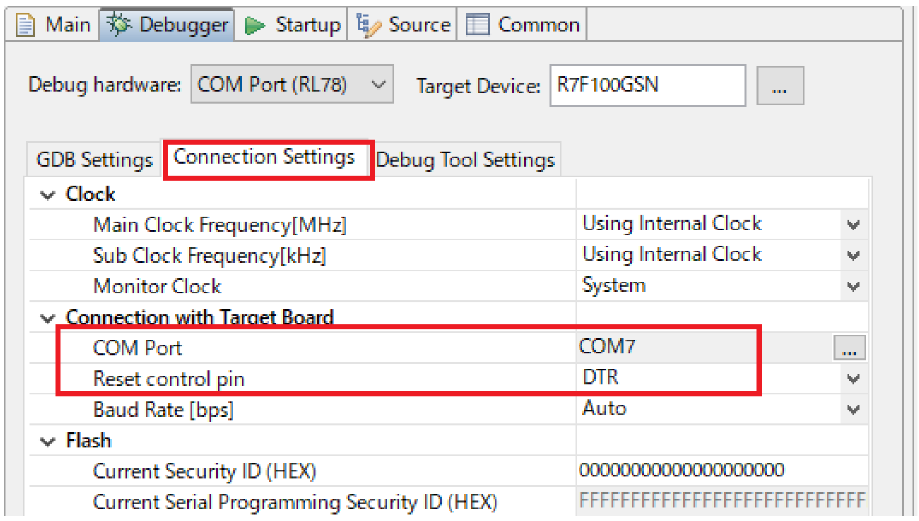
GDB port number: 61234

Connection timeout (s): 30

Figure 8-3 Debug hardware: COM Port (RL78)

Select “Connection Settings” tab > Connection with Target Borad.

- COM Port: COMxx
- Reset control pin: DTR

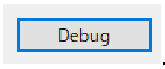


Debug hardware: COM Port (RL78)

Target Device: R7F100GSN

Clock	
Main Clock Frequency[MHz]	Using Internal Clock
Sub Clock Frequency[kHz]	Using Internal Clock
Monitor Clock	System
Connection with Target Board	
COM Port	COM7
Reset control pin	DTR
Baud Rate [bps]	Auto
Flash	
Current Security ID (HEX)	00000000000000000000
Current Serial Programming Security ID (HEX)	FFFFFFFFFFFFFFFFFFFFFFFFFFFF

Figure 8-4 Connection Settings for Using COM Port

Start debugging by clicking .

8.2 When Using Emulator

The following describes how to perform debugging by using the E2 emulator Lite.

8.2.1 Mounting the Connector, Setting Jumper Pins, and Cutting Patterns

Refer to section 7.2.1, Setting Jumper Pins, Mounting the Connector, and Cutting Patterns.

8.2.2 Connecting the Emulator to the MCU Board

Connect the emulator as shown in the following figure.

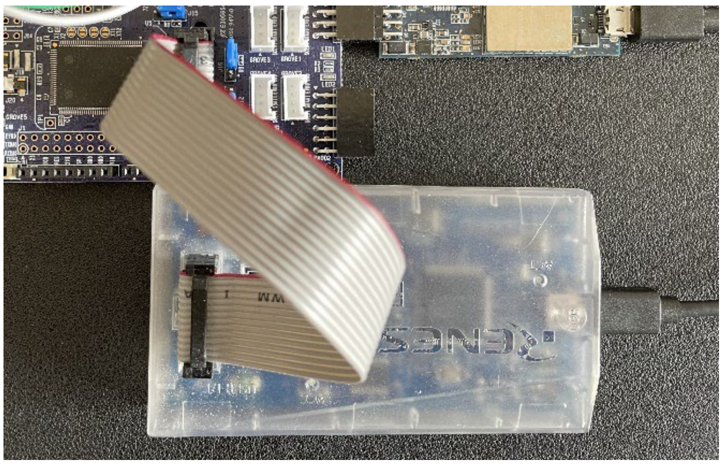
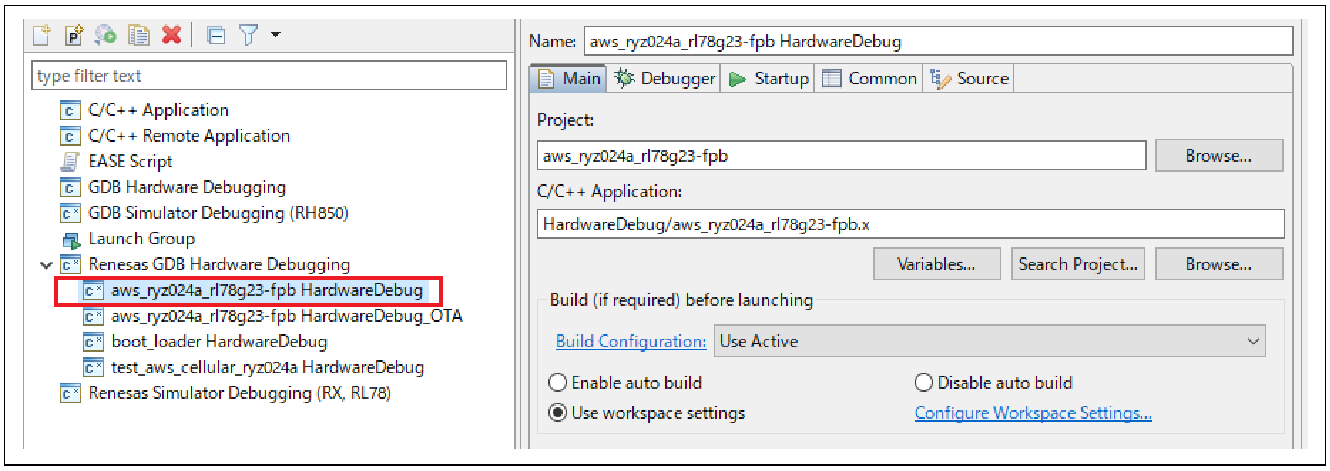


Figure 8-5 Connecting Emulator to MCU Board

8.2.3 Debug Configurations

Select the configuration you want to use for debugging.

- Debug Configurations > Renesas GDB Hardware Debugging
  — For the demo project (PubSub), select aws_ryz024a_rl78g23-fpb HardwareDebug.



type filter text

- C/C++ Application
- C/C++ Remote Application
- EASE Script
- GDB Hardware Debugging
- GDB Simulator Debugging (RH850)
- Launch Group
- Renesas GDB Hardware Debugging
  - aws_ryz024a_rl78g23-fpb HardwareDebug
  - aws_ryz024a_rl78g23-fpb HardwareDebug_OTA
  - boot_loader HardwareDebug
  - test_aws_cellular_ryz024a HardwareDebug
- Renesas Simulator Debugging (RX, RL78)

Name: aws_ryz024a_rl78g23-fpb HardwareDebug

Main | Debugger | Startup | Common | Source

Project: aws_ryz024a_rl78g23-fpb

C/C++ Application: HardwareDebug/aws_ryz024a_rl78g23-fpb.x

Build (if required) before launching

Build Configuration: Use Active

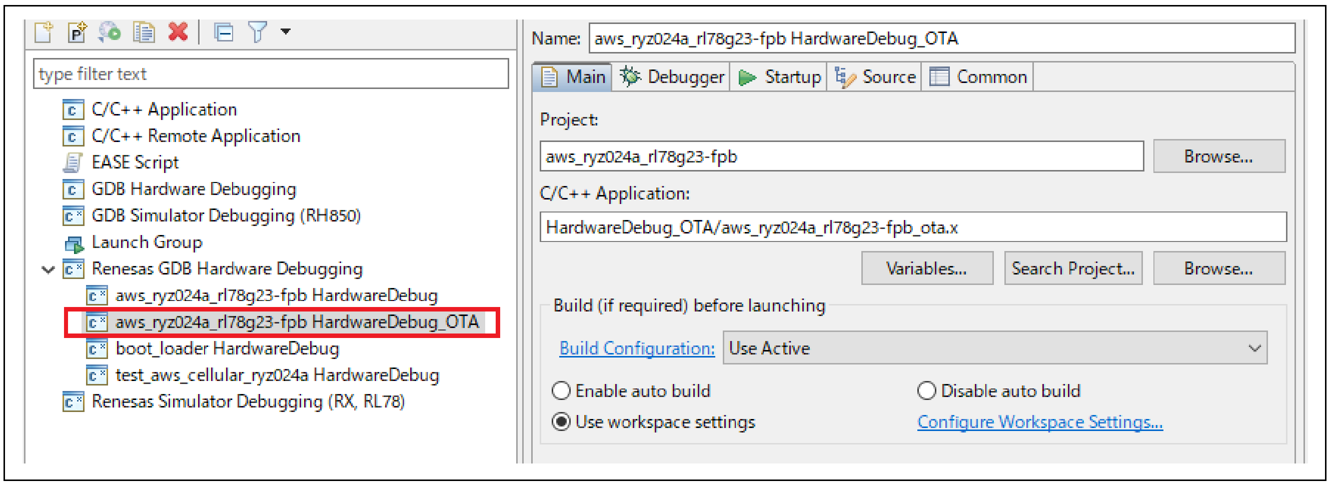
○ Enable auto build ○ Disable auto build

● Use workspace settings

Configure Workspace Settings...

Figure 8-6 Debug Configurations of Project (PubSub)

— For the demo project (OTA), select aws_ryz024a_rl78g23-fpb HardwareDebug_OTA.



type filter text

- C/C++ Application
- C/C++ Remote Application
- EASE Script
- GDB Hardware Debugging
- GDB Simulator Debugging (RH850)
- Launch Group
- Renesas GDB Hardware Debugging
  - aws_ryz024a_rl78g23-fpb HardwareDebug
  - aws_ryz024a_rl78g23-fpb HardwareDebug_OTA
  - boot_loader HardwareDebug
  - test_aws_cellular_ryz024a HardwareDebug
- Renesas Simulator Debugging (RX, RL78)

Name: aws_ryz024a_rl78g23-fpb HardwareDebug_OTA

Main | Debugger | Startup | Source | Common

Project: aws_ryz024a_rl78g23-fpb

C/C++ Application: HardwareDebug_OTA/aws_ryz024a_rl78g23-fpb_ota.x

Build (if required) before launching

Build Configuration: Use Active

○ Enable auto build ○ Disable auto build

● Use workspace settings

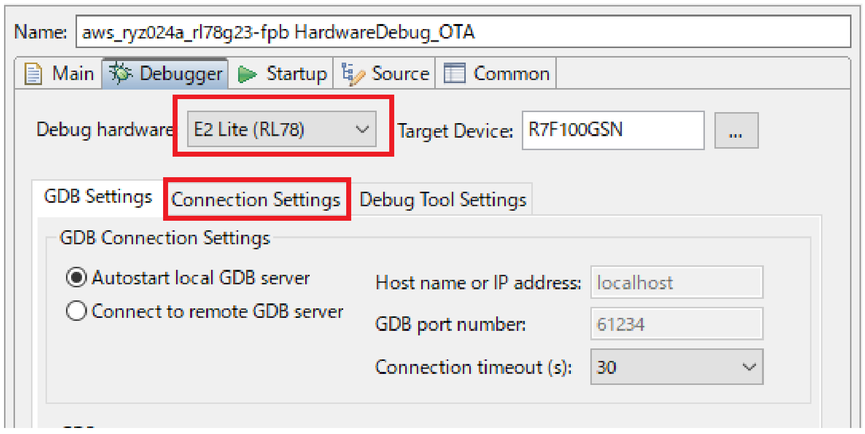
Configure Workspace Settings...

Figure 8-7 Debug Configurations of Project (OTA)

8.2.4 Debugger Settings

Select "Debugger" Tab.

- Debug hardware : E2 Lite (RL78)



Name: aws_ryz024a_rl78g23-fpb HardwareDebug_OTA

Debug hardware: E2 Lite (RL78)
Target Device: R7F100GSN

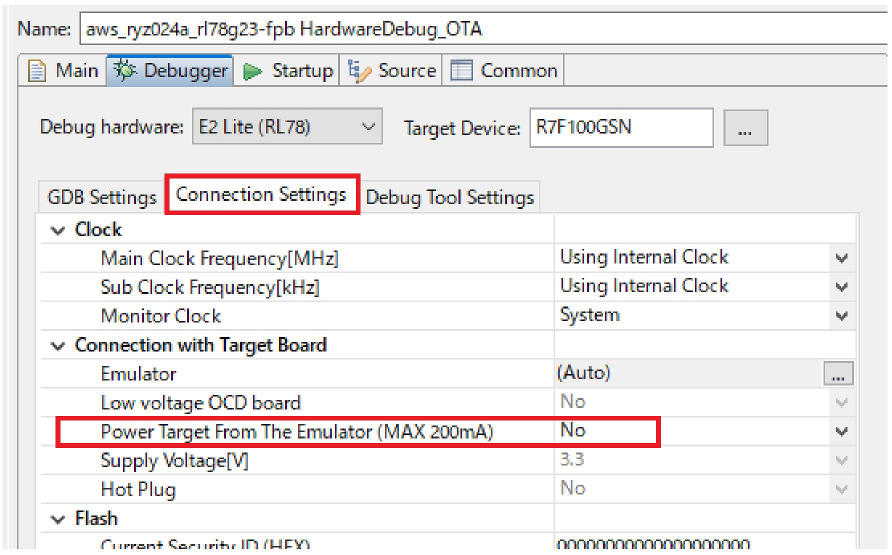
GDB Connection Settings
- ● Autostart local GDB server
- ○ Connect to remote GDB server

Host name or IP address: localhost
GDB port number: 61234
Connection timeout (s): 30

Figure 8-8 Debug hardware: E2 Lite (RL78)

Select "Connection Settings" tab > Connection with Target Borad.

- Power Target From The Emulator (MAX 200mA): No

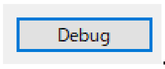


Name: aws_ryz024a_rl78g23-fpb HardwareDebug_OTA

Debug hardware: E2 Lite (RL78)
Target Device: R7F100GSN

Clock	
Main Clock Frequency[MHz]	Using Internal Clock
Sub Clock Frequency[kHz]	Using Internal Clock
Monitor Clock	System
Connection with Target Board	
Emulator	(Auto)
Low voltage OCD board	No
Power Target From The Emulator (MAX 200mA)	No
Supply Voltage[V]	3.3
Hot Plug	No
Flash	
Current Security ID (HEX)	00000000000000000000

Figure 8-9 Connection Settings for Using Emulator

Start debugging by clicking .

9. Appendix

9.1 Precautions on Porting Third-Party Libraries to RL78

Because RL78 is a 16-bit system, the following must be noted when using a third-party library with RL78.

9.1.1 Width of int Is 16 Bits

Code modification might be required in the parts in which processing-dependent types (such as int and size_t) are used. Pay particular attention in the case of variables that handle the size.

This demo projects modified the following third-party libraries:

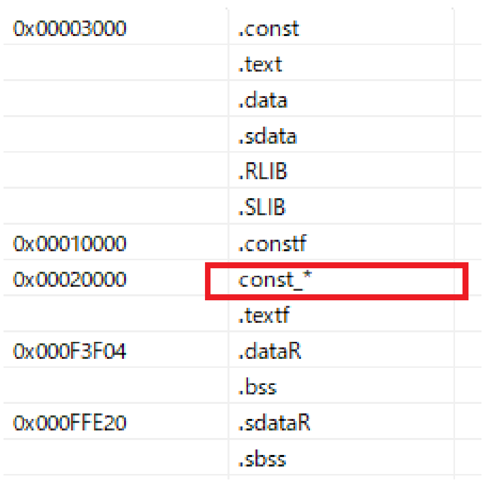
- tinycbor(0.5.2) https://github.com/intel/tinycbor
- TinyCrypt Cryptographic Library (0.2.8) https://github.com/intel/tinycrypt

9.1.2 Size Limitation of Section

Some sections cannot extend accross a boundary of 64KB - 1; in other words, they can only allocate a maximum size of 64KB. Therefore, for example, if porting a large third-party library to RL78, data larger than 64KB may be allocated in a default section, causing a linker error.
For details, refer to CC-RL Compiler User's Manual (R20UT3123).

To avoid this limitation, you need to adjust section size. The following explains how to adjust the default constant section (.constf) as an example.

First, define a new constant section.



0x00003000	.const
	.text
	.data
	.sdata
	.RLIB
	.SLIB
0x00010000	.constf
0x00020000	const_*
	.textf
0x000F3F04	.dataR
	.bss
0x000FFE20	.sdataR
	.sbss

Figure 9-1 Newly Defined Constant Section (e^2 studio)

Next, change section so that third-party library data is allocated in the newly defined constant section by one of the following methods, either (1) or (2). Note that this demo projects adapt the method (2).

(1) #pragma section directive

Add #pragma section directive to library source codes.

example:core_mqtt.c

```
#if defined(__CCRL__) || defined(__ICCRL78__) || defined(__RL)
#pragma section const const_coreMqtt
#endif

/**
 * @file core_mqtt.c
 * @brief Implements the user-facing functions in core_mqtt.h.
 */
#include <string.h>
#include <assert.h>

...Codes...

#if defined(__CCRL__) || defined(__ICCRL78__) || defined(__RL)
#pragma section
#endif
```

Figure 9-2 Added #pragma section Directive (3rd Party Library)

(2) Link option -REName

Change section so that third-party library data is allocated in the newly defined constant section for each file by specifying a link option as shown following. This method has the advantage that you don't need to modify source files.

```
-REName=.\Middleware\FreeRTOS\coreMQTT\source\core_mqtt.obj(.constf=const_coreMqtt_f)
```

9.1.3 Build Warning

When using third-party libraries AS-IS, the toolchain used for the build process may output warnings or other messages. Users should resolve the warning based on these messages as necessary.

Here is an example from this product.

This demo project uses third-party libraries, which are open-source software (OSS), as-is. Therefore, the CC-RL compiler outputs W0520167 (Argument of type "*type1*" is incompatible with parameter of type "*type2*".) at the following three locations and they cause memory corruption.

Middleware/AWS/ota-for-aws-iot-embedded-sdk/source/ota.c

```
static DocParseErr_t extractParameter( JsonDocParam_t docParam,
                                       void * pContextBase,
                                       const char * pValueInJson,
                                       size_t valueLength )
{
    ...
        char * pEnd;
        ...
        *pUint32 = ( uint32_t ) strtoul( pStart, &pEnd, 0 );
    ...
}
```

Figure 9-3 W0520167 in ota.c

Middleware/FreeRTOS/FreeRTOS-Cellular-Interface/source/cellular_at_core.c

```
CellularATError_t Cellular_ATStrtoi( const char * pStr,
                                     int32_t base,
                                     int32_t * pResult )
{
    ...
    char * pEndStr = NULL;
    ...
        retStrtol = ( int32_t ) strtol( pStr, &pEndStr, base );
    ...
}
```

Figure 9-4 W0520167 in cellular_at_core.c

Middleware/FreeRTOS/FreeRTOS-Cellular-Interface/source/cellular_pkthandler.c

```
static CellularPktStatus_t urcParseToken( CellularContext_t * pContext,
                                          char * pInputLine )
{
    ...
    char * pSavePtr = pInputLine, * pTokenPtr = pInputLine;
    ...
        pTokenPtr = strtok_r( pSavePtr, ":", &pSavePtr );
    ...
}
```

Figure 9-5 W0520167 in cellular_pkthandler.c

Using Figure 9-3 W0520167 in ota.c as an example, let's explain the cause of memory corruption. Because the -far_rom option is specified in the compile options in this demo project, the second argument of the strtoul function is compiled as a double pointer variable with the far attribute, and assembly code is generated that writes 3 bytes to the memory area specified by the argument. On the other hand, the automatic variable pEnd specified as the second argument is a pointer variable with the near attribute, so the size of pEnd allocated in memory is 2 bytes. Therefore, when the strtoul function is executed, the memory area following the 2 bytes of pEnd is corrupted by 1 byte.

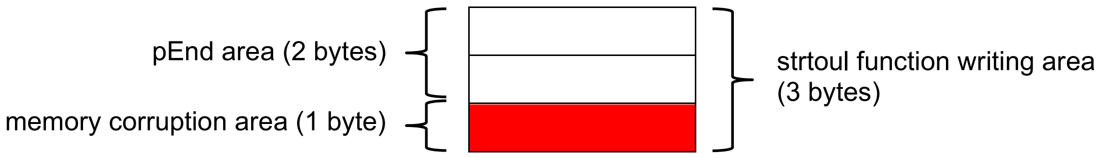

pEnd area (2 bytes)
memory corruption area (1 byte)
strtoul function writing area (3 bytes)

Figure 9-6 Memory corruption due to example of W0520167

The workaround is to change the pointer variable to be the far attribute, so that the size of the memory allocated to this pointer variable is 3 bytes.

Middleware/AWS/ota-for-aws-iot-embedded-sdk/source/ota.c

```
static DocParseErr_t extractParameter( JsonDocParam_t docParam,
                                       void * pContextBase,
                                       const char * pValueInJson,
                                       size_t valueLength )
{
     ...
          char __far * pEnd;
          ...
          *pUint32 = ( uint32_t ) strtoul( pStart, &pEnd, 0 );
     ...
}
```

Figure 9-7 Fixed W0520167 in ota.c

Middleware/FreeRTOS/FreeRTOS-Cellular-Interface/source/cellular_at_core.c

```
CellularATError_t Cellular_ATStrtoi( const char * pStr,
                                     int32_t base,
                                     int32_t * pResult )
{
     ...
     char __far * pEndStr = NULL;
     ...
          retStrtol = ( int32_t ) strtol( pStr, &pEndStr, base );
     ...
}
```

Figure 9-8 Fixed W0520167 in cellular_at_core.c

Middleware/FreeRTOS/FreeRTOS-Cellular-Interface/source/cellular_pkthandler.c

```
static CellularPktStatus_t urcParseToken( CellularContext_t * pContext,
                                          char * pInputLine )
{
     ...
     char __far * pSavePtr = pInputLine, * pTokenPtr = pInputLine;
     ...
          pTokenPtr = strtok_r( pSavePtr, ":", &pSavePtr );
     ...
}
```

Figure 9-9 Fixed W0520167 in cellular_pkthandler.c

Note that in the operating environment shown in Table 1-2 Operation Confirmation Conditions (RL78/G23), the corrupted memory area is not used. Therefore, this demo project does not implement the above workaround and uses OSS as-is.

However, in environments other than Table 1-2 Operation Confirmation Conditions (RL78/G23), memory corruption may affect operations. Environments other than Table 1-2 Operation Confirmation Conditions (RL78/G23) are outside the scope of our support.

9.2 License Information for Open-Source Software

The user must comply with the license terms stipulated by OSS used with this product. Check the license terms on the official website of the respective OSS. Table 1-3 Operation Confirmation Conditions (Others, such as OSS Library) shows the link of each OSS used with this product.

10. Websites and Supports

Sample programs in this Getting Started Guide: https://github.com/renesas/iot-reference-rl78

AWS forum: http://forums.aws.amazon.com

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Feb. 29, 2024	-	First edition issued
1.01	Aug. 30, 2024	1	Added information about EOL process on RYZ024A cellular module
		18, 71	Added information for cases of without changing circuit to mount emulator connector
		43	Fixed the value of "Resource" described to the Policy editor
1.02	Feb. 17, 2025	83 - 87	Added the chapter “Build Warning” and revised the wording in the chapter 9.

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

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

1. Precaution against Electrostatic Discharge (ESD)

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

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

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

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

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

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

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

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

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