RL78/G23

Visualization of Sensor Information on Amazon Web Services using RL78/G23-128p Fast Prototyping Board and FreeRTOS

Introduction

Amazon FreeRTOS is a real-time operating system that enhances the FreeRTOS kernel with functionality for connections, security, and over-the-air (OTA) updates. It includes demo applications for demonstrating the functionality of Amazon FreeRTOS.

e^2 studio is a development environment based on the open-source Eclipse CDT (C/C++ Development Tooling) project. In addition to a debugging interface, it provides support for building projects (editor, compiler, linker control). It also supports integration of Amazon FreeRTOS demo applications, enabling them to run on Renesas evaluation boards.

This document describes a system combining the RL78/G23-128p Fast Prototyping Board from Renesas, a Wi-Fi module (SX-ULPGN (from Silex Technology)), and a Relative Humidity Sensor Pmod Board (US082-HS3001EVZ (from Renesas)). In this system, Amazon FreeRTOS runs on the RL78/G23-128p, and sensor information (temperature and humidity data) is sent via Wi-Fi to Amazon Web Services (AWS) for visualization.

Purpose of This Document

This document provides an easy-to-understand description of how to use e^2 studio to run an Amazon FreeRTOS demo application (from downloading the Renesas GitHub Amazon FreeRTOS project to running the demo).

Operating Environment

Operation on the following environment has been confirmed.

Integrated development environment	e^2 studio 2021-07 (21.07.0) https://www.renesas.com/software-tool/e-studio
Board	RL78/G23-128p Fast Prototyping Board https://www.renesas.com/rl78g23-128p_fpb Wi-Fi Pmod expansion board https://www.renesas.com/wi-fi-pmod-expansion-Board Relative Humidity Sensor Pmod Board US082-HS3001EVZ https://www.renesas.com/us/en/products/sensor-products/humidity-sensors/us082-hs3001evz-relative-humidity-sensor-pmod-board-renesas-quick-connect-iot DIGILENT Pmod USBUART https://store.digilentinc.com/pmod-usbuart-usb-to-uart-interface/
Toolchain	CCRL Compiler v1.10.00 https://www.renesas.com/software-tool/c-compiler-package-rl78-family
Emulator	E2 Emulator Lite (onboard) https://www.renesas.com/software-tool/e2-emulator-lite-rte0t0002lkce00000r

Contents

Notes:

- AWS™ is a trademark of Amazon.com, Inc. or its affiliates. (https://aws.amazon.com/trademark-guidelines/)
- FreeRTOS™ is a trademark of Amazon Web Services, Inc. (https://freertos.org/copyright.html)
- GitHub® is a trademark of GitHub, Inc. (https://github.com/logos)
- Pmod is a trademark of Digilent Inc. (https://store.digilentinc.com/)

1. Overview

This document describes the procedure from preparation of Amazon FreeRTOS projects on the Renesas RL78/G23-128p Fast Prototyping Board to running the demos.

1.1 System Diagram

The system diagram below shows the steps from acquisition of temperature and humidity sensor information to visualization.

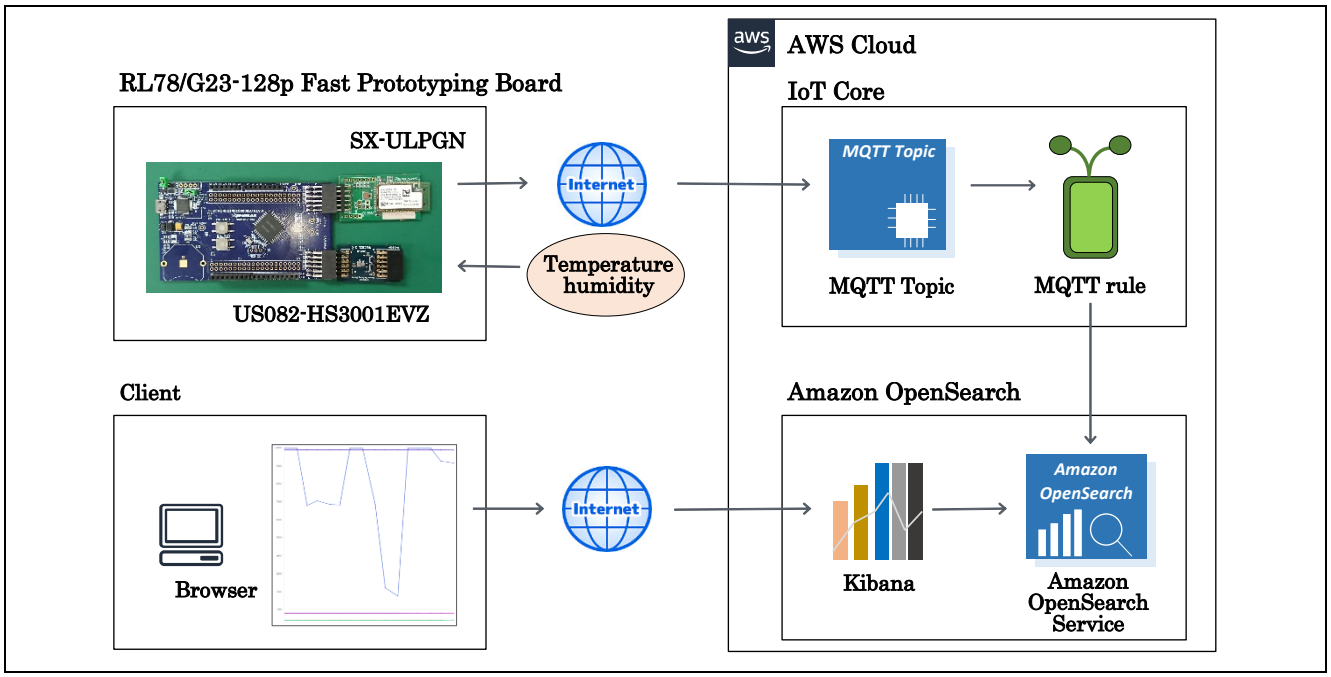

Figure 1.1 System Diagram from Acquisition of Sensor Information to Visualization

2. Amazon FreeRTOS Project Preparation

Amazon FreeRTOS projects of this document can be downloaded from the following GitHub repository.

GitHub repository

https://github.com/renesas/amazon-freertos/tree/rl78_developmment_202012.00_sensor

Alternatively, you can use amazon-freertos.zip, which is contained in the .zip file accompanying this application note.

2.1 Downloading Source Code from GitHub

After downloading the source code from GitHub, you will need to import the project into the workspace in e^2 studio. Use Git to download the source code from GitHub. In this document, we recommend using Git for Windows (https://gitforwindows.org/).

An example of the procedure for downloading from GitHub is shown below.

1. Create a clone of the master branch.
   git clone https://github.com/renesas/amazon-freertos.git

Note: After cloning the files, copy them to a location with a short file path, such as the root folder on the C: drive. If the file path is too long, a build error may result.

2. Change the current directory to the root of the directory cloned.
   cd amazon-freertos
3. Check out the release tag.
   git checkout v202012.00-rl78-1.0.0-sensor
4. Update the submodules.
   git submodule update --init --recursive

2.2 Sample Code Accompanying This Application Note

You can also use amazon-freertos.zip, which is contained in the .zip file accompanying this application note.

Please unzip this file.

Note: After unzipping the files, copy them to a location with a short file path, such as the root folder on the C: drive. If the file path is too long, a build error may result.

2.3 Importing Demo Project

Import the following RL78/G23-128p demo project in e² studio.

1. Launch e² studio and specify a workspace directory.

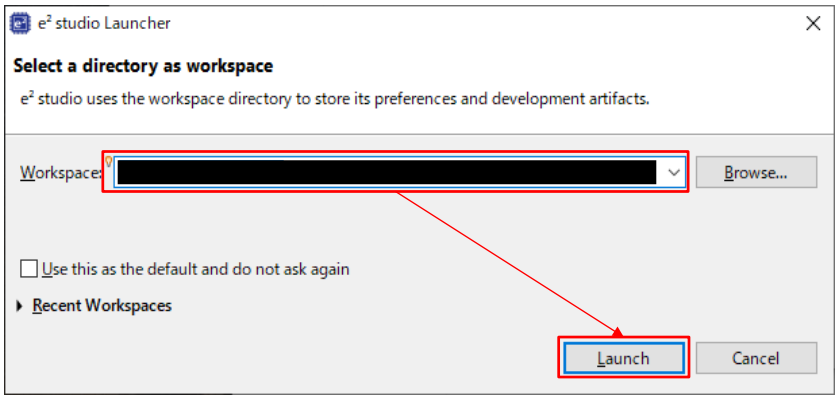

Figure 2.1 Workspace Selection Menu

2. Select [File] -> [Import…].

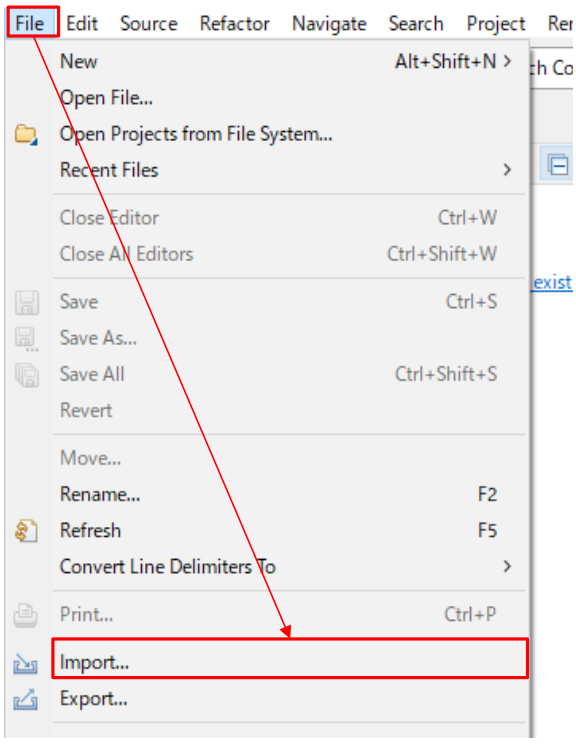

Figure 2.2 Select Import

3. Click [General] -> [Existing Projects into Workspace] -> [Next >].

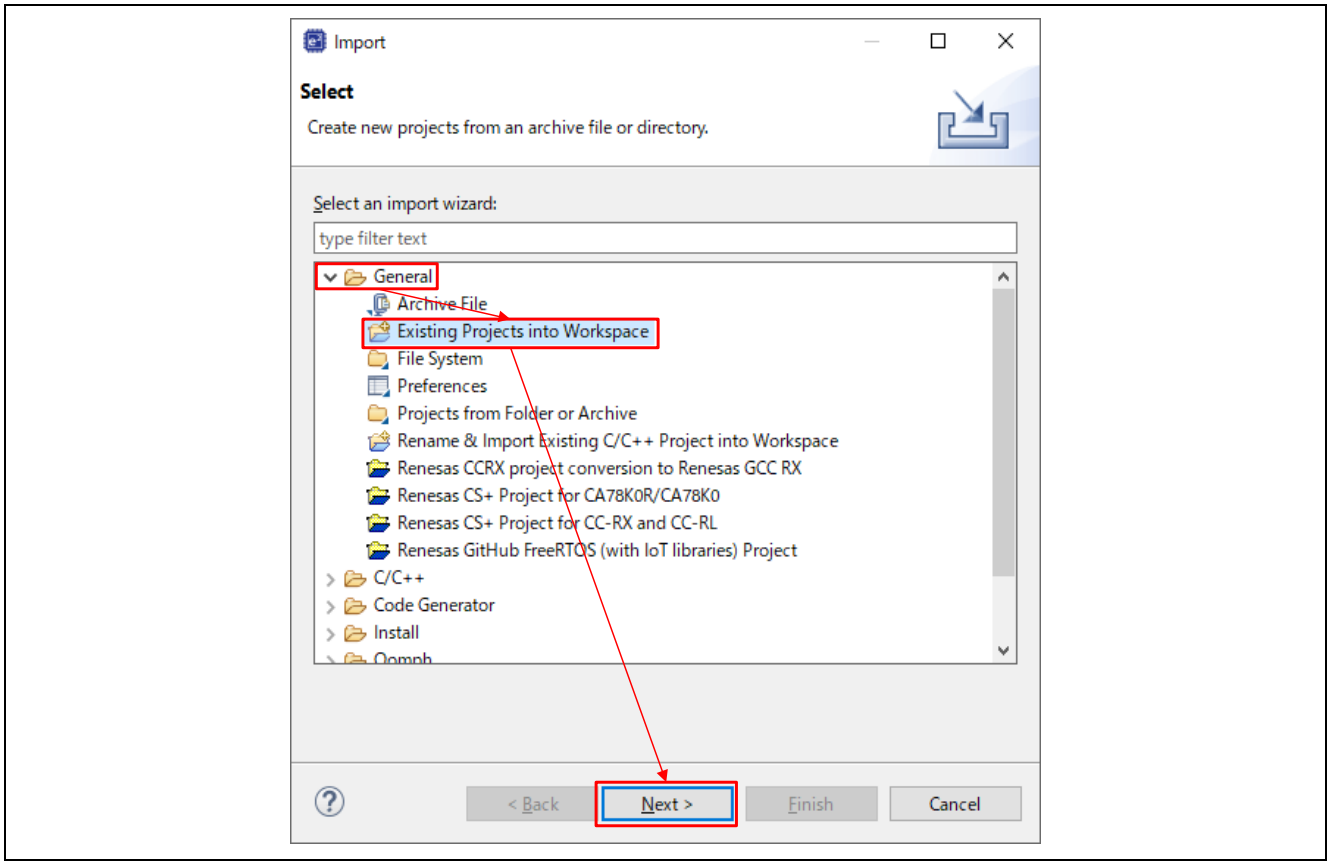

Figure 2.3 Select [Existing Projects into Workspace]

4. Click [Browse…], then specify the root directory as follows. Finally, click [Finish].
   projects -> renesas -> rl78g23-fpb-sx-ulpgn -> e2studio -> aws_demos

Note: Make sure [Copy projects into workspace] is unchecked.

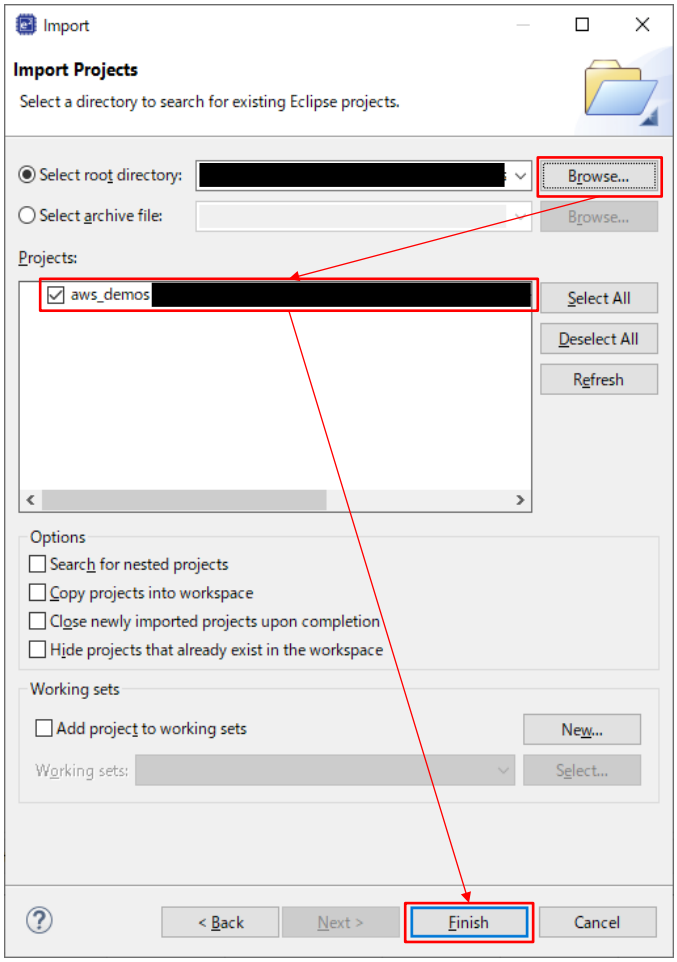

Figure 2.4 Import demo project

3. AWS Preparation

Some preparations on running AWS demo project are necessary before the demo can be run. Refer to the tutorial below and make the appropriate settings in AWS.

- Register device to AWS IoT
  https://github.com/renesas/amazon-freertos/wiki/Register-device-to-AWS-IoT

Also, make the following four macro settings in aws_demos -> demos -> include -> aws_clientcredential.h of the demo project.

- clientcredentialMQTT_BROKER_ENDPOINT -> endpoint name confirmed as described in “Registering the device in AWS IoT.”
- clientcredentialIOT_THING_NAME -> thing name registered as described in “Registering the device in AWS IoT.”
- clientcredentialWIFI_SSID (when using Wi-Fi) -> SSID for access point to connect to
- clientcredentialWIFI_PASSWORD (when using Wi-Fi) -> password for access point to connect to

```
 * FreeRTOS V202002.00

#ifndef __AWS_CLIENTCREDENTIAL__H__
#define __AWS_CLIENTCREDENTIAL__H__

 * @brief MQTT Broker endpoint.
#define clientcredentialMQTT_BROKER_ENDPOINT          ""

 * @brief Host name.
#define clientcredentialIOT_THING_NAME                ""

 * @brief Port number the MQTT broker is using.
#define clientcredentialMQTT_BROKER_PORT              8883

 * @brief Port number the Green Grass Discovery use for JSON retrieval from cloud is using.
#define clientcredentialGREENGRASS_DISCOVERY_PORT     8443

 * @brief Wi-Fi network to join.
#define clientcredentialWIFI_SSID                     ""

 * @brief Password needed to join Wi-Fi network.
#define clientcredentialWIFI_PASSWORD                 ""
```

Figure 3.1 Macro Settings

4. Hardware Preparation

Some hardware preparations are necessary to run the Amazon FreeROTS demo.

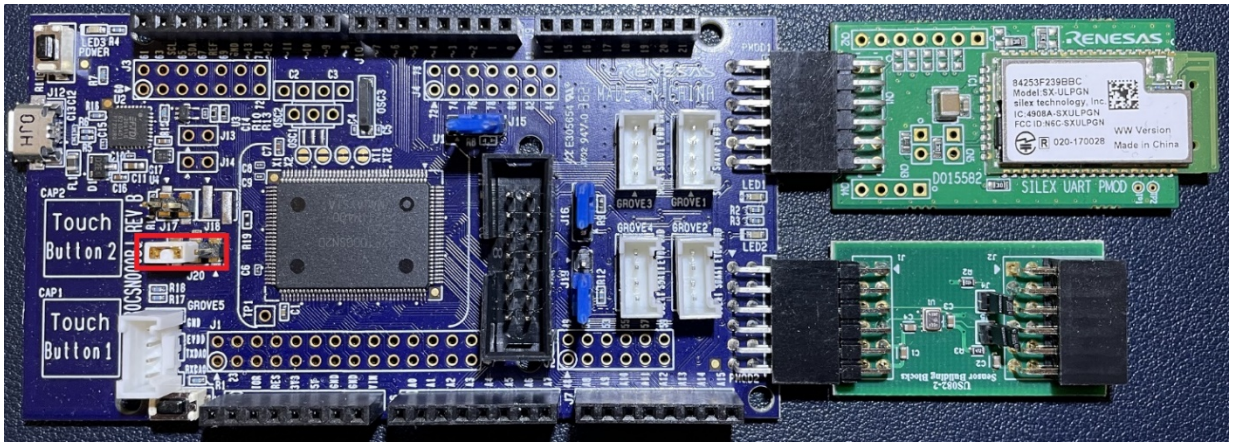

Figure 4.1 RL78/G23-128p Fast Prototyping Board and Wi-Fi Module (SX-ULPGN (Silex Technology))

4.1 RL78/G23-128p Fast Prototyping Board

The RL78/G23-128p Fast Prototyping Board is necessary to run the Amazon FreeRTOS demo for RL78/G23-128p.

Purchasing information is provided on the following webpage.

https://www.renesas.com/rl78g23-128p_fpb

You need to configure 3.3V power-supply by being short-circuit 2-3 of the power-supply selection header (the J20 in Figure 4.1 RL78/G23-128p Fast Prototyping Board and Wi-Fi Module (SX-ULPGN (Silex Technology))).

Demo project needs to connect with E2 Lite emulator, so it is necessary to attach an emulator connector to board. For attach method, please refer to “RL78/G23-128p Fast Prototyping Board User’s Manual” (R20UT4870xxxxxx).

https://www.renesas.com/document/mat/rl78g23-128p-fast-prototyping-board-users-manual-rev100?language=ja&r=1537821

4.2 SX-ULPGN

A wireless LAN module that connects to the RL78/G23-128p Fast Prototyping Board is also necessary. Operation of the Amazon FreeRTOS demo for RL78/G23-128p has been confirmed when using the SX-ULPGN.

Purchasing information for the SX-ULPGN is provided on the following webpage.

https://www.renesas.com/products/software-tools/boards-and-kits/eval-kits/wi-fi-pmod-expansion-board.html

4.3 US082-HS3001EVZ

A humidity and temperature sensor module that connects to the RL78/G23-128p Fast Prototyping Board is also necessary. Operation of the Amazon FreeRTOS demo for RL78/G23-128p has been confirmed when using the US082-HS3001EVZ.

Purchasing information for the US082-HS3001EVZ is provided on the following webpage.

https://www.renesas.com/us/en/products/sensor-products/humidity-sensors/us082-hs3001evz-relative-humidity-sensor-pmod-board-renesas-quick-connect-iot

4.4 DIGILENT Pmod USBUART

The DIGILENT Pmod USBUART is used to write certificates and CA lists to the SX-ULPGN and to receive debug logs when running the RL78/G23-128p demo.

Purchasing information for the DIGILENT Pmod USBUART is provided on the following webpage.

https://store.digilentinc.com/pmod-usbuart-usb-to-uart-interface/

4.5 Writing Certificates

Certificates and CA lists are written to the SX-ULPGN. Before writing them to the SX-ULPGN, certificate data needs to be converted to SharkSSLParseCert binary format and CA lists to SharkSSLPerseCAList binary format.

The procedure for writing a certificate to the SX-ULPGN using Tera Term is described below.

4.5.1 Downloading SharkSSL

You can use the following free software program to convert certificate data to the required format.

SharkSSL <https://realtimelogic.com/downloads/sharkssl/>

Choose [SharkSSL for Windows]. Download the software, and then follow the prompts to install it.

4.5.2 Obtaining Certificate Data

You will use the certificate and secret key obtained as described in 3, AWS Preparation.

4.5.3 Obtaining a CA List (Class 2 Root CA)

1. In Microsoft Edge, select **Settings** -> **Privacy, search, and services** -> **Manage certificates** -> **Certificates** -> **Trusted Root Certification Authorities**, then export **Starfield Class 2 Certification Authority**.

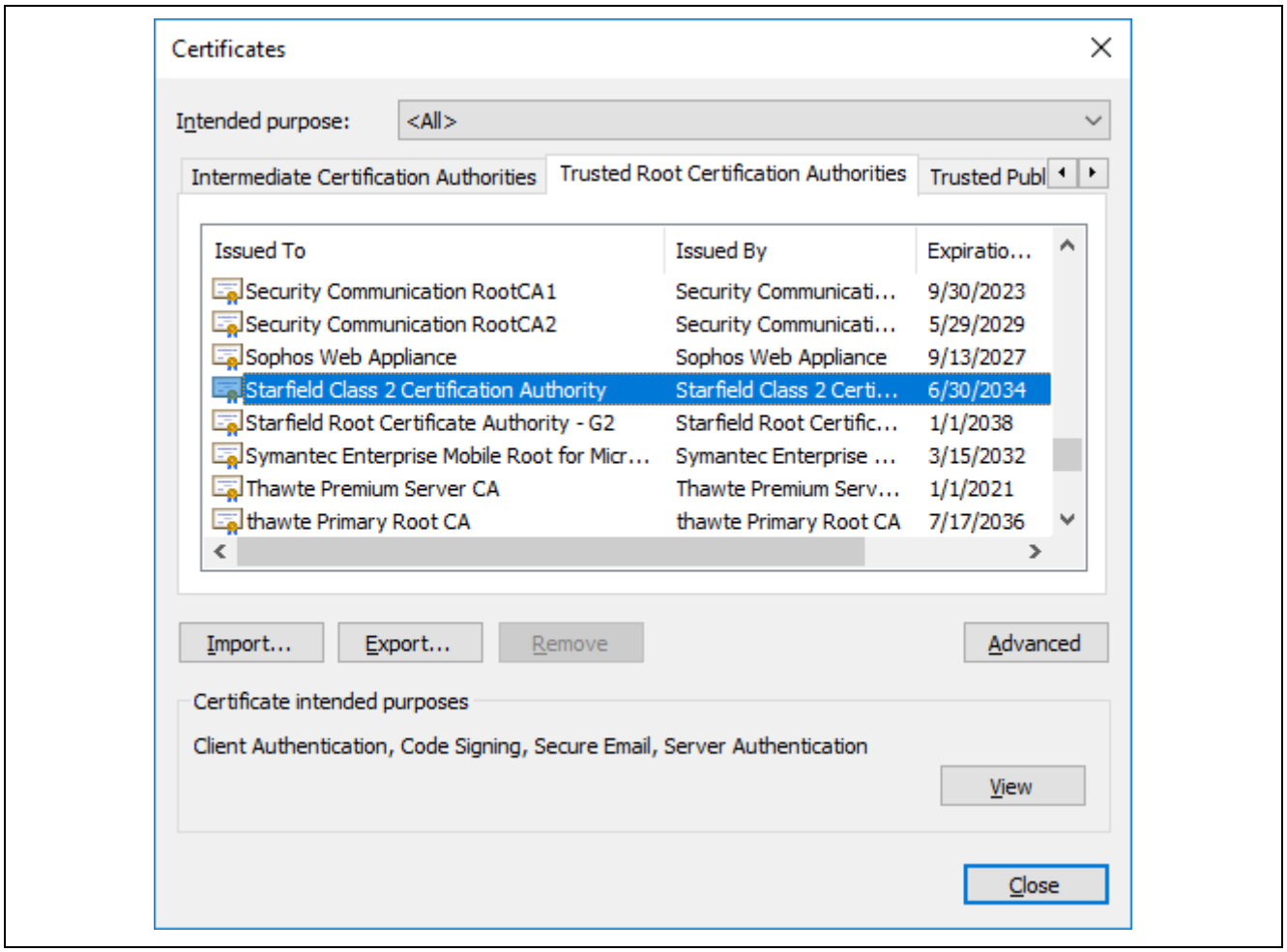

Figure 4.2 Obtaining a CA List

2. Select Base 64 encoded X.509 (.CER).

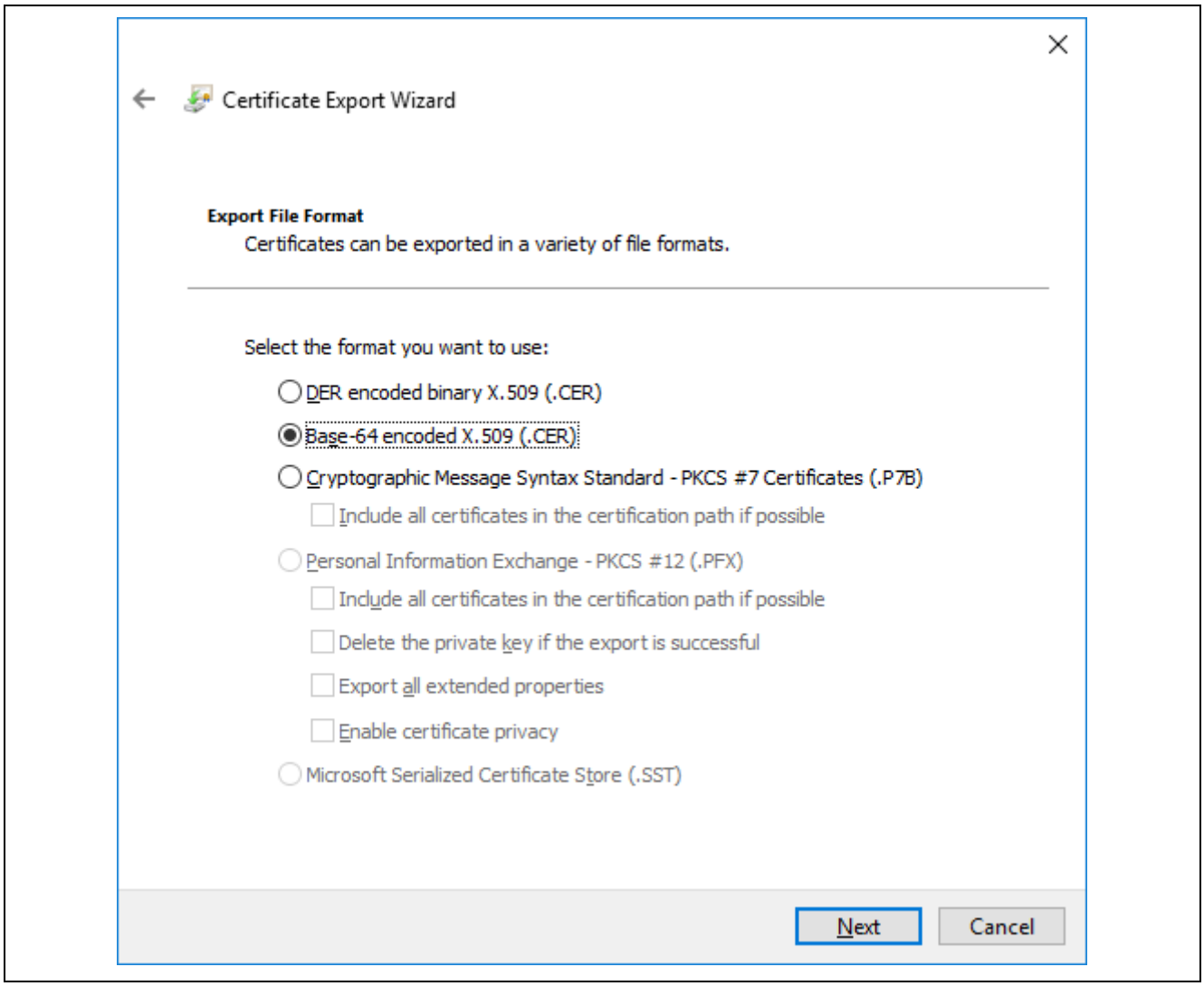

Figure 4.3 Selecting Base 64 encoded X.509 (.CER)

3. Enter a file name “calist1” and export the certificate. The exported file will have the extension c added to it as "calist1.cer".

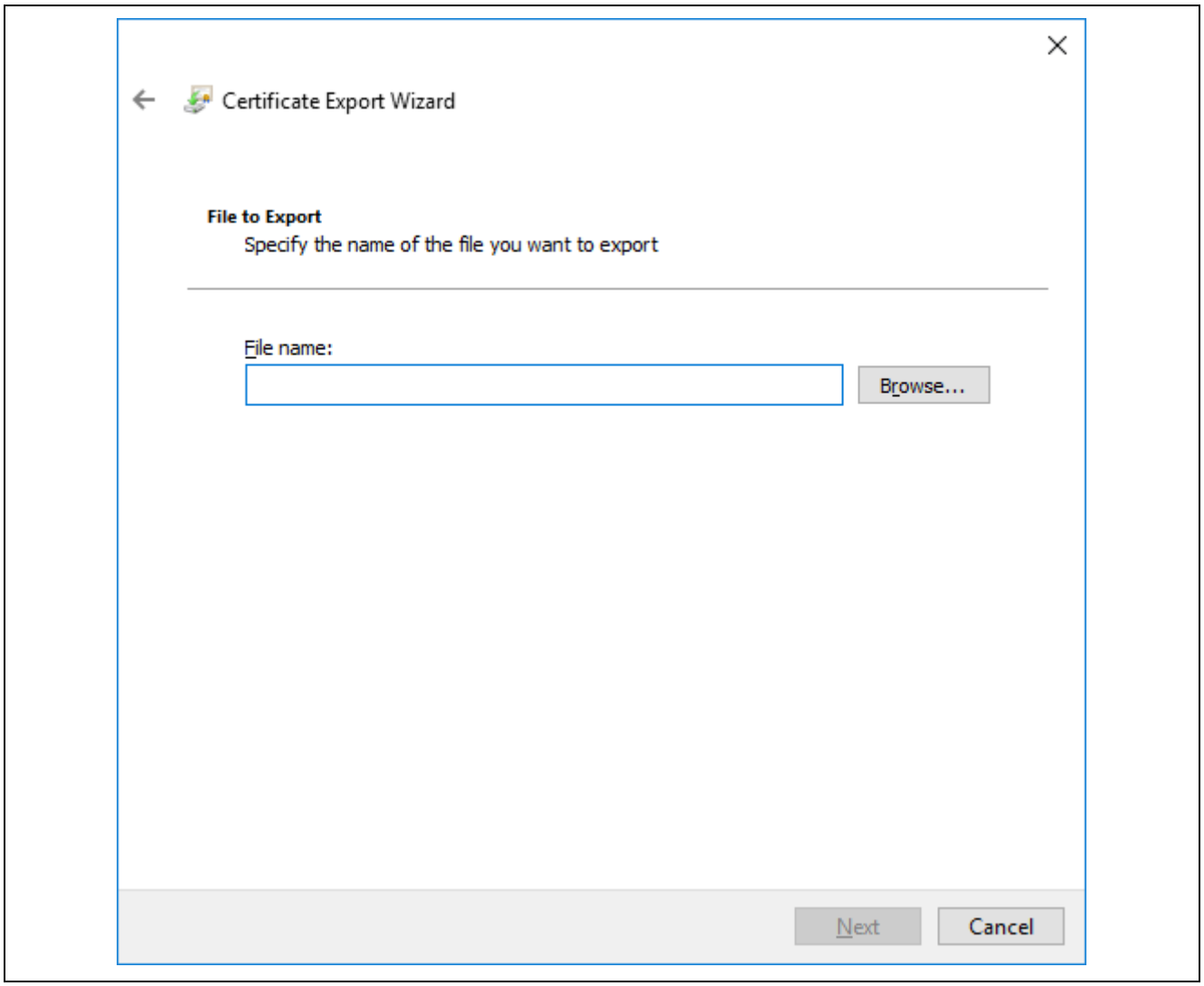

Figure 4.4 Exporting the Certificate

4.5.4 Converting the Certificate and Secret Key to SharkSSL Binary Format

1. In the Command Prompt, run the following command to convert the certificate and private key to SharkSSL binary format.
   SharkSSLParseCert xxxxx-certificate.pem.crt xxxxx-private.pem.key –b cert1.bin

Note:
xxxxx is a fragment of the hash value such as "d666c26201"in a file name of a private key and device certificate obtained from AWS in “3 AWS Preparation”.
Need to fill in the exact name “cert1”.

4.5.5 Converting the CA List to SharkSSLPerseCAList Binary Format

1. In the Command Prompt, run the following command to convert the CA list to SharkSSLPerseCAList binary format.
   SharkSSLParseCAList.exe -b calist1.bin yyyyy.cer

Note:
Need to fill in the exact name “calist1”.
yyyyy is a CA List file name that created in Figure 4.4 Exporting the Certificate.

4.5.6 Writing the Certificate to the SX-ULPGN

Write the converted certificate and CA list (binary files) to the SX-ULPGN. Connect the PC to the TX and RX pins of the Wi-Fi module via a USB-to-serial converter, then use AT commands to write the data. Use a baud rate of 115,200 bps.

As an example, settings for writing the certificate and CA list using a terminal emulator (Tera Term) are given below.

Make sure to use version 4.105 or later of Tera Term.

[Serial port settings in Setup tab]

- Baud rate: 115200 bps
- Data: 8 bit
- Parity: none
- Stop: 1 bit
- Flow control: none

[Terminal settings in Setup tab]

- New line code Receive: CR
- New line code Transmit: CR
- Local echo: Unchecked

As an example, connections between the DIGILENT Pmod USBUART and SX-ULPGN are shown below. The connector on the SX-ULPGN has two rows. Connect wires from the DIGILENT Pmod USBUART to the top-row connectors on the SX-ULPGN.

- Short VCC and SYS on the DIGILENT Pmod USBUART by using a jumper (power supply from DIGILENT Pmod USBUART to SX-ULPGN)
- Connect pin 2 (RxD) on DIGILENT Pmod USBUART to pin 3 (TxD) on SX-ULPGN
- Connect pin 3 (TxD) on DIGILENT Pmod USBUART to pin 2 (RxD) on SX-ULPGN
- Connect pin 5 (GND) on DIGILENT Pmod USBUART to pin 5 (GND) on SX-ULPGN
- Connect pin 6 (VCC) on DIGILENT Pmod USBUART to pin 6 (VCC) on SX-ULPGN

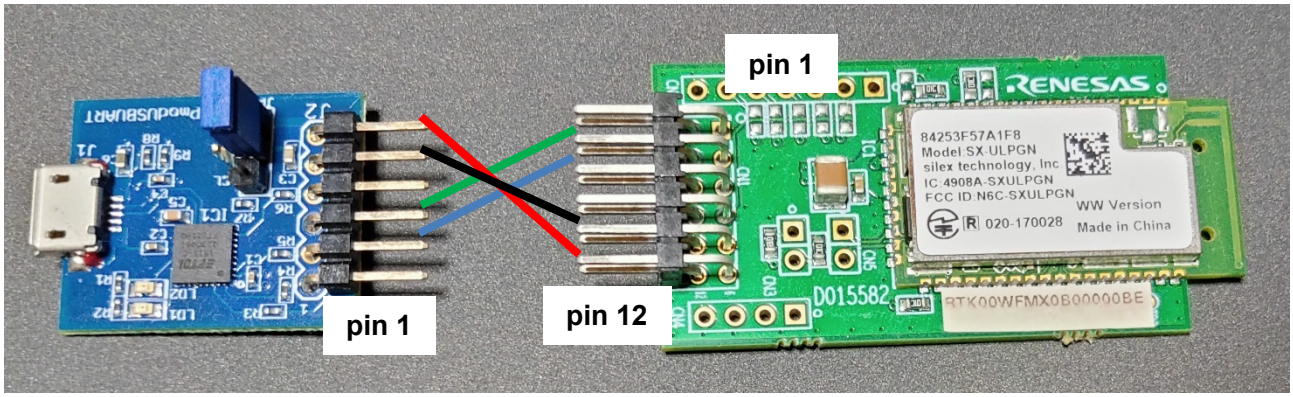

Figure 4.5 Connections between DIGILENT Pmod USBUART and SX-ULPGN

The procedure for registering a certificate using a terminal emulator (Tera Term) is described below.

1. Run the following command.
   ATNSSLCERT=cert1.crt,< binary file size of converted certificate>
   Example: *ATNSSLCERT=cert1.crt,1768*

2. Within 30 seconds, send the binary file converted as described in “Converting the Certificate and Secret Key to SharkSSL Binary Format” by file transfer [**Send file…**] from Tera Term.
   Note:
   Make sure that **Binary** is checked under **Option**.
   Extension of file name on PC is *.bin.

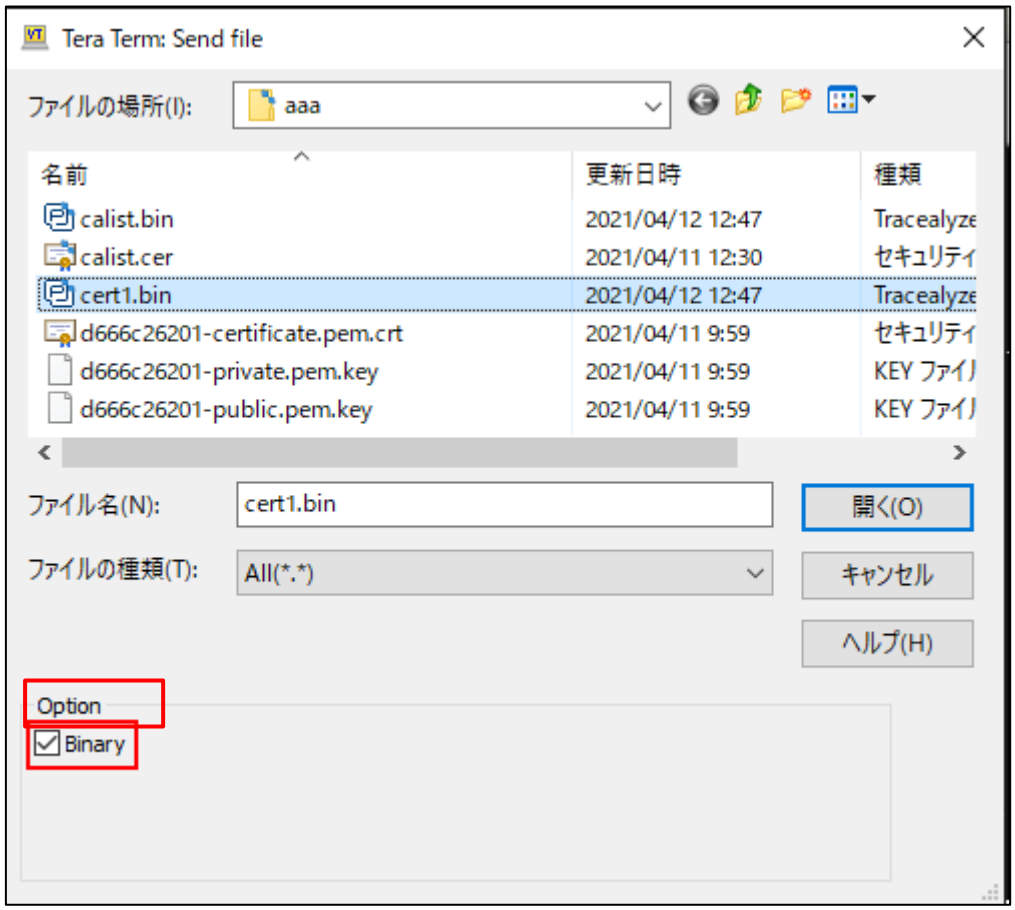

Figure 4.6 Registering a Certificate

3. Run the following command.
   ATNSSLCERT= calist1.crt,< binary file size of converted CA list>
   Example: *ATNSSLCERT=calist1.crt,1059*

4. Within 30 seconds, send the binary file converted as described in “Converting the CA List to SharkSSLPerseCAList Binary Format” by file transfer from Tera Term.
   Note: Make sure that **Binary** is checked under **Option**.

5. Run the ”*ATNSSLCERT=?*“ command, then confirm that the following lines are displayed.
   calist1.crt
   cert1.crt

Note: If you accidentally register the certificate, you can delete the registered certificate by executing the "*ATNSSLCERT=<file name>,0*" command.

4.5.7 Connecting the SX-ULPGN

Connect the SX-ULPGN to PMOD1 on the RL78/G23-128p Fast Prototyping Board.

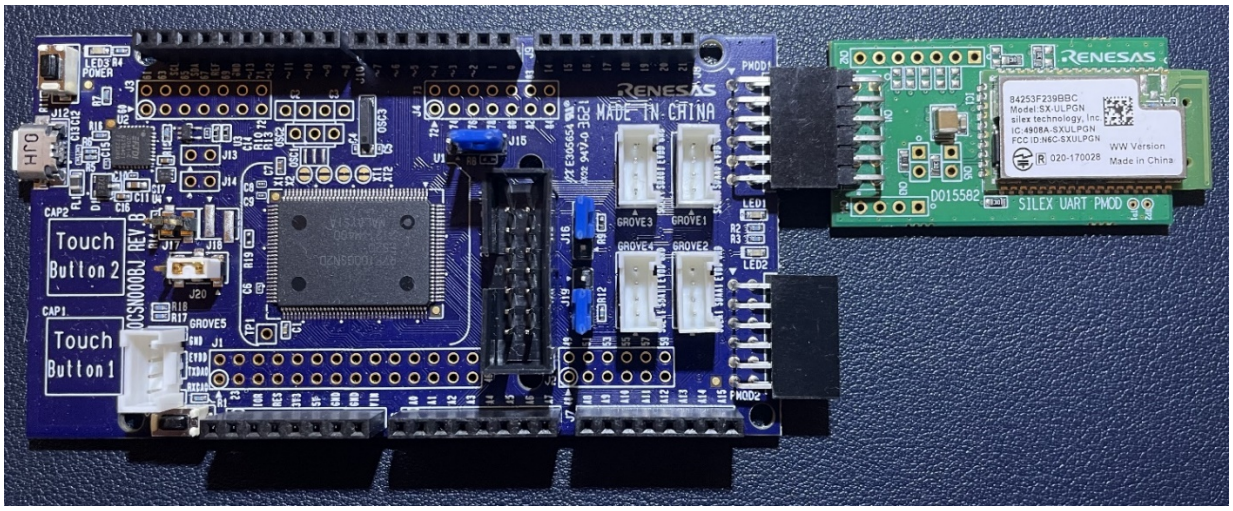

Figure 4.7 Connecting the SX-ULPGN to the RL78/G23-128p Fast Prototyping Board

4.6 Preparation to Receive Debug Logs

The demo outputs debug logs via the SCI port. To check the debug logs, use a terminal emulator (Tera Term, etc.) to connect to the serial port used by the SCI driver. As an example, connection of the DIGILENT Pmod USBUART and RL78/G23-128p Fast Prototyping Board is shown below.

- Connect pin 2 (RxD) on DIGILENT Pmod USBUART to J8 pin 4 (TxD) on RL78/G23-128p Fast Prototyping Board
- Connect pin 5 (GND) on DIGILENT Pmod USBUART to J5 pin 6 or 7 (GND) on RL78/G23-128p Fast Prototyping Board

Power is supplied from the PC to the RL78/G23-128p Fast Prototyping Board via a USB cable, so there is no need to supply power from the DIGILENT Pmod USBUART. In addition, it is not necessary to send data from the DIGILENT Pmod USBUART because debug logs are only received, not sent.

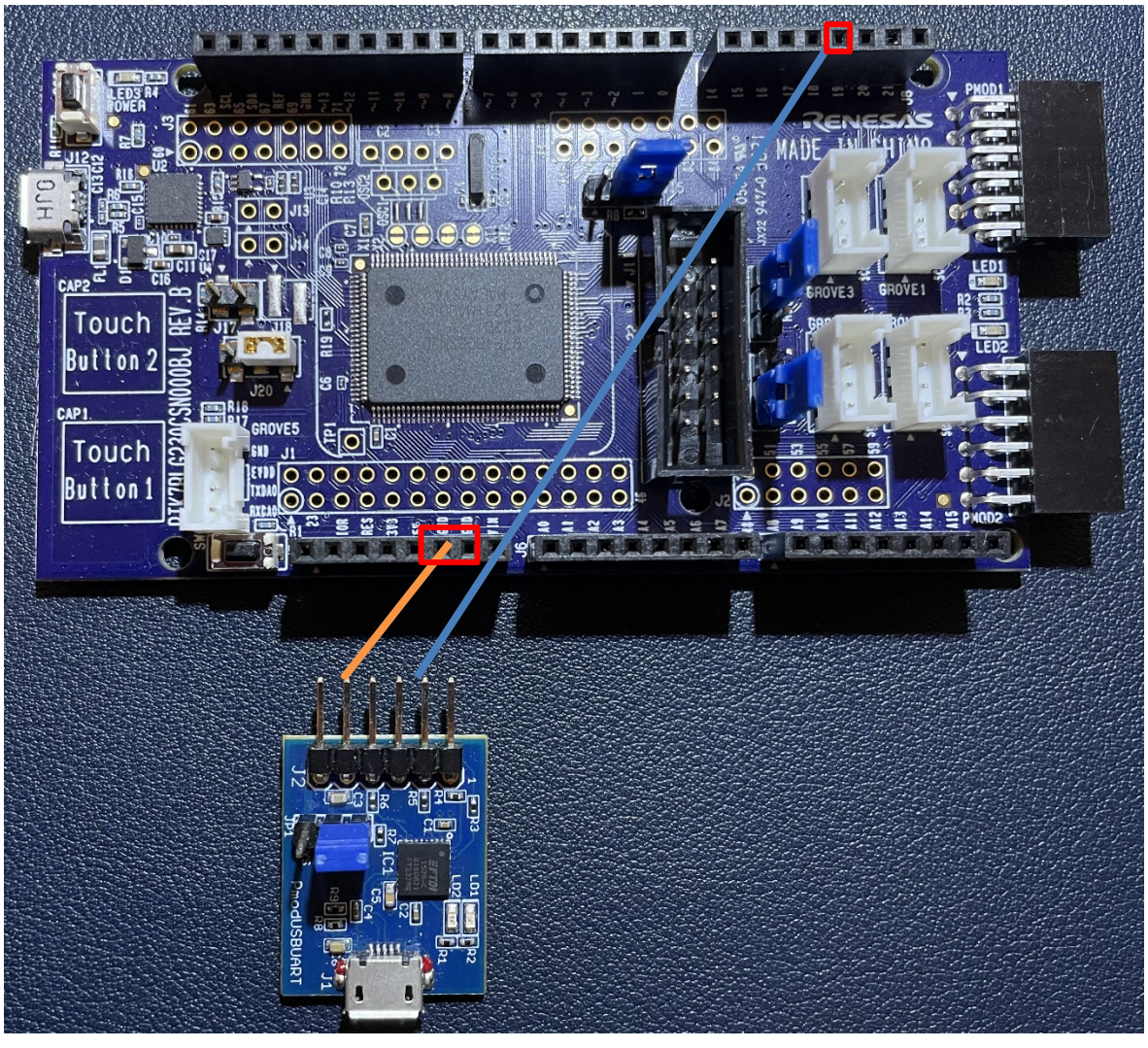

Figure 4.8 Connecting the DIGILENT Pmod USBUART to the RL78/G23-128p Fast Prototyping Board

When using Tera Term to receive debug logs, make sure to use version 4.105 or later. The Tera Term settings are given below.

[Serial port settings in Setup tab]

- Baud rate: 115200 bps
- Data: 8 bit
- Parity: none
- Stop: 1 bit
- Flow control: none

[Terminal settings in Setup tab]

- New line code Receive: CR
- New line code Transmit: CR
- Local echo: Unchecked

5. Demo Project Preparation

Follow the steps below to build and run the demo.

1. In Project Explorer, right-click the project and select **Build**.
2. From the menu, select [Run] -> [Debugging Configuration].
3. Expand Renesas GDB Hardware Debugging and select **aws_demos HardwareDebug**.

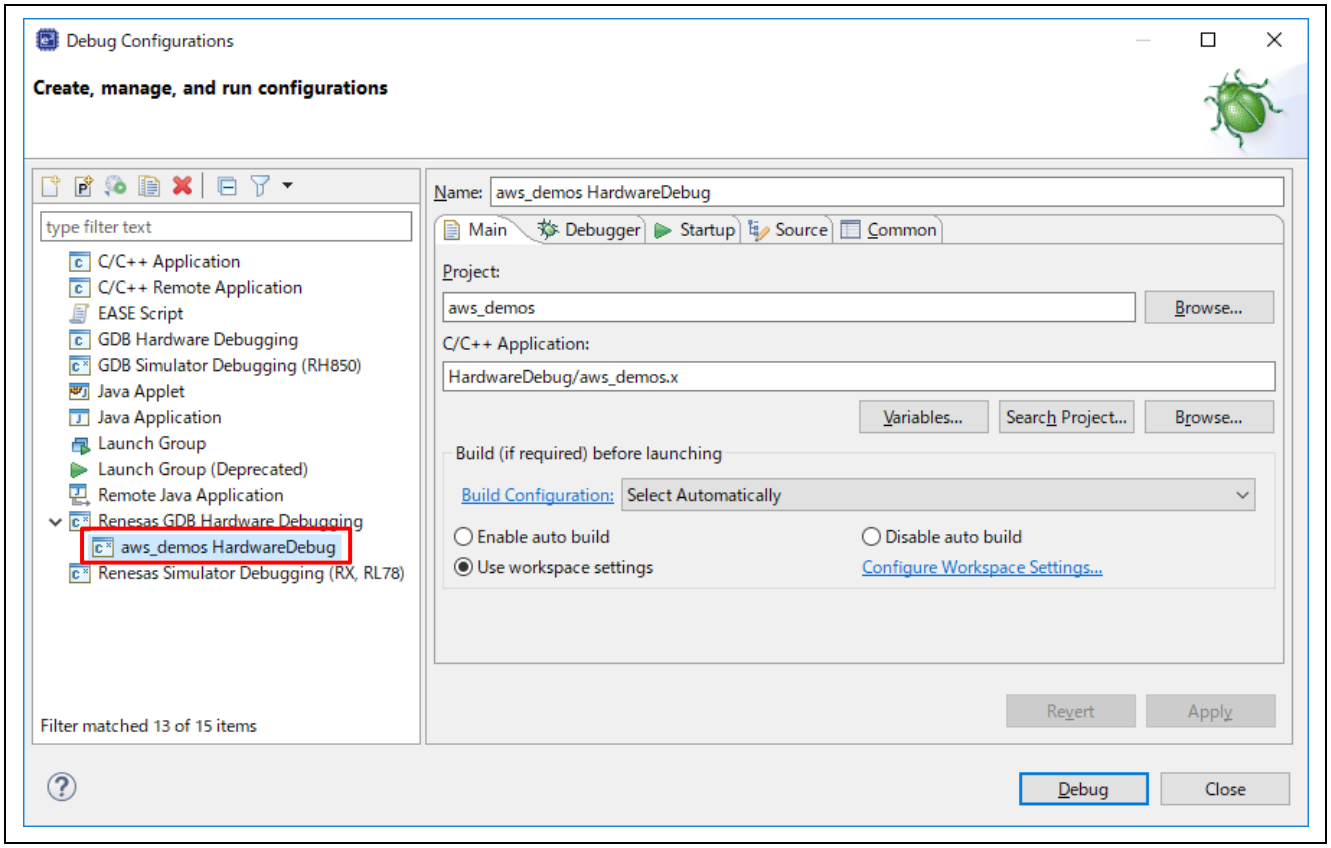

Figure 5.1 Selecting Startup Settings

4. Select the **Debugger** tab, then the **Connection Settings** tab. Check to make sure the connection settings are correct.

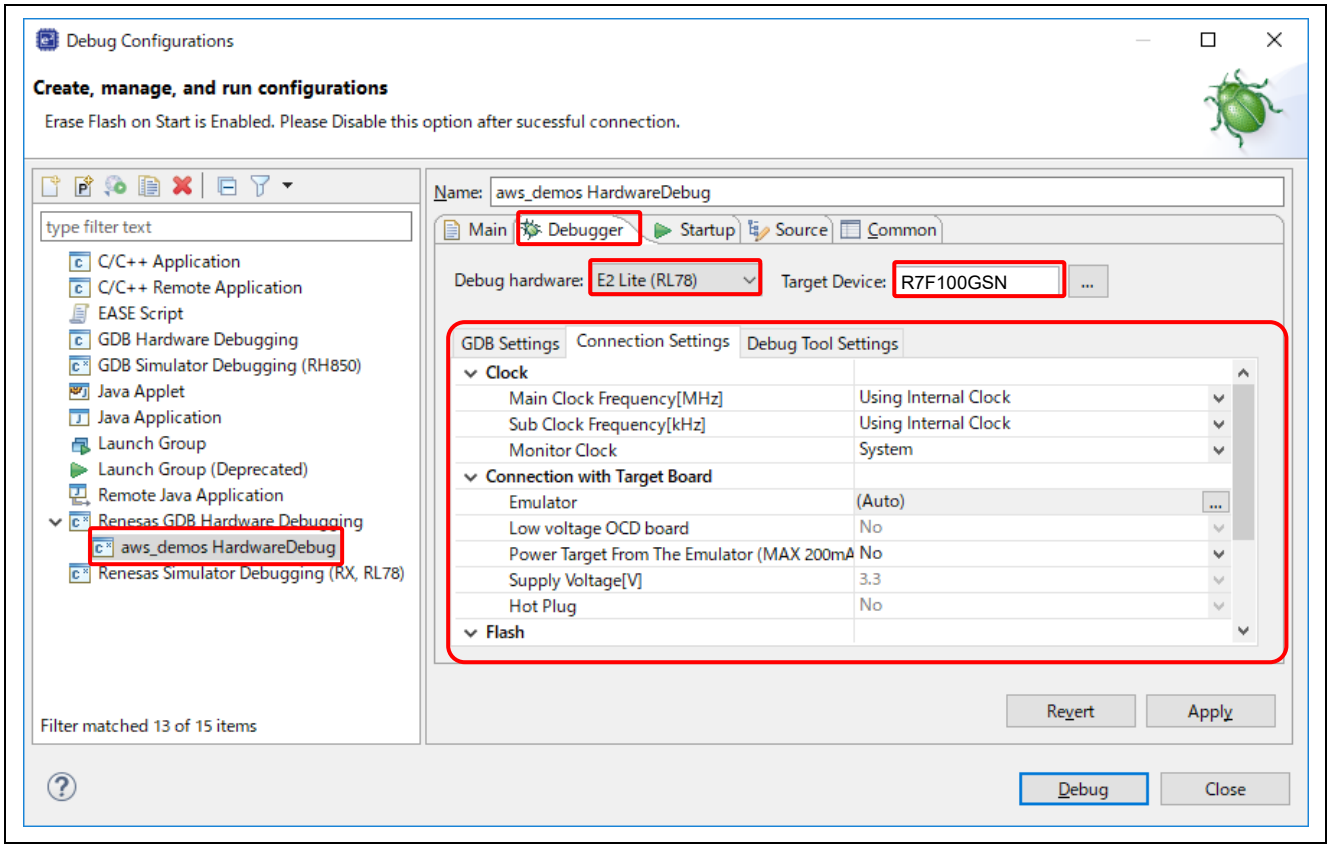

Figure 5.2 Hardware Debugging Settings

6. Amazon OpenSearch Service Preparation

Amazon OpenSearch Service can be used to visualize in AWS data obtained from a sensor module connected to the RL78/G23-128p Fast Prototyping Board.

Fees are incurred when using the Amazon OpenSearch Service.
Make sure to delete your domain after you finish using the demo program.

Follow the steps below to set up Amazon OpenSearch Service. The latest setting items may differ from the images below, so items not shown should be set by default.

1. Create a domain on the Amazon OpenSearch Service.
   On the AWS Management Console, click **Services** -> **Analytics** -> **Amazon OpenSearch Service**.

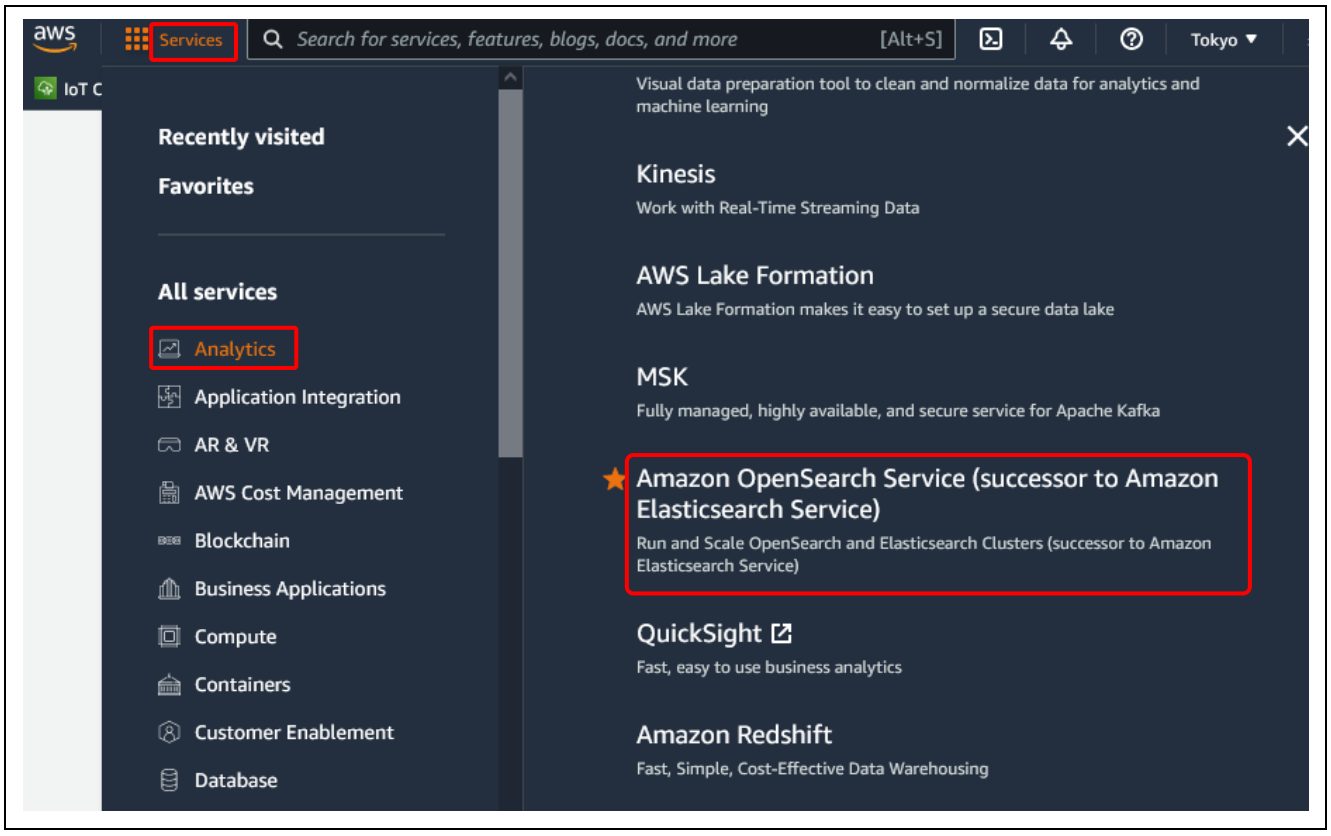

Figure 6.1 Selecting Amazon OpenSearch Service

2. Click **Domains** -> **Create domain**.

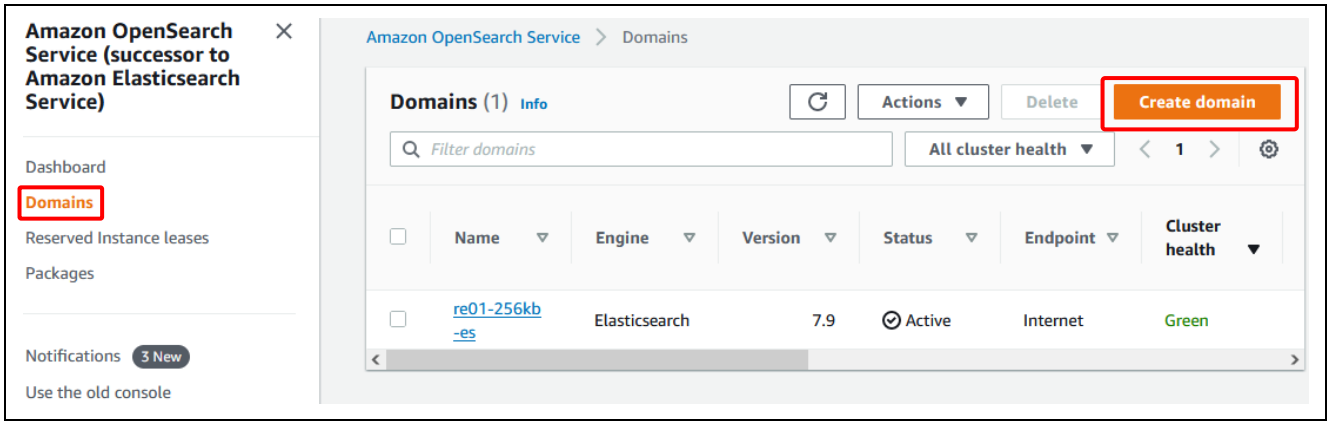

Figure 6.2 Create a new domain

3. Input **Domain name**, select the radio button of **Development and testing**, and set version to **7.9**. Then scroll down the screen.

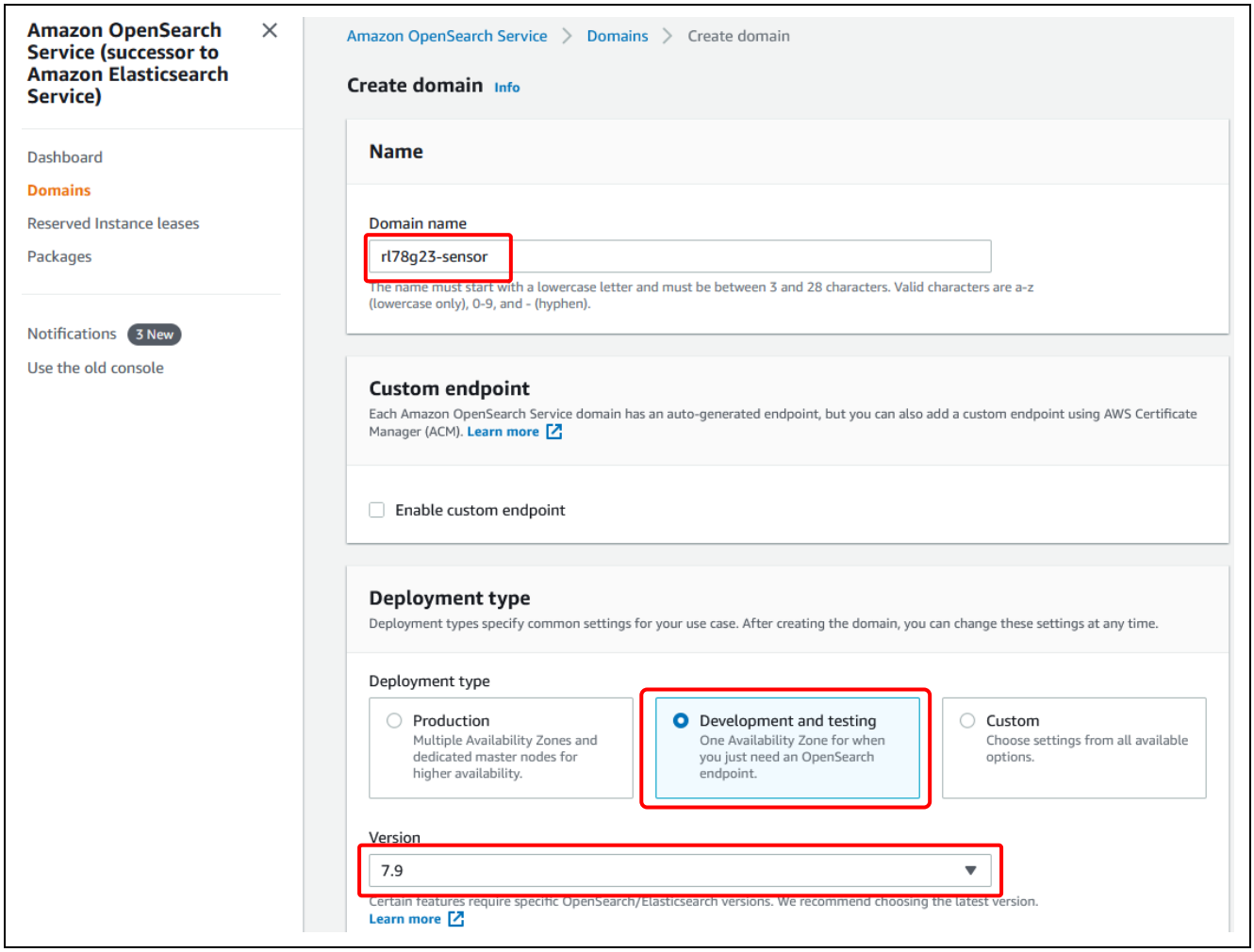

Figure 6.3 Configure domain name and deploy type

4. Change the **Instance type** to **t2.small.search** and **Numbers of nodes** to **1**, then scroll down.

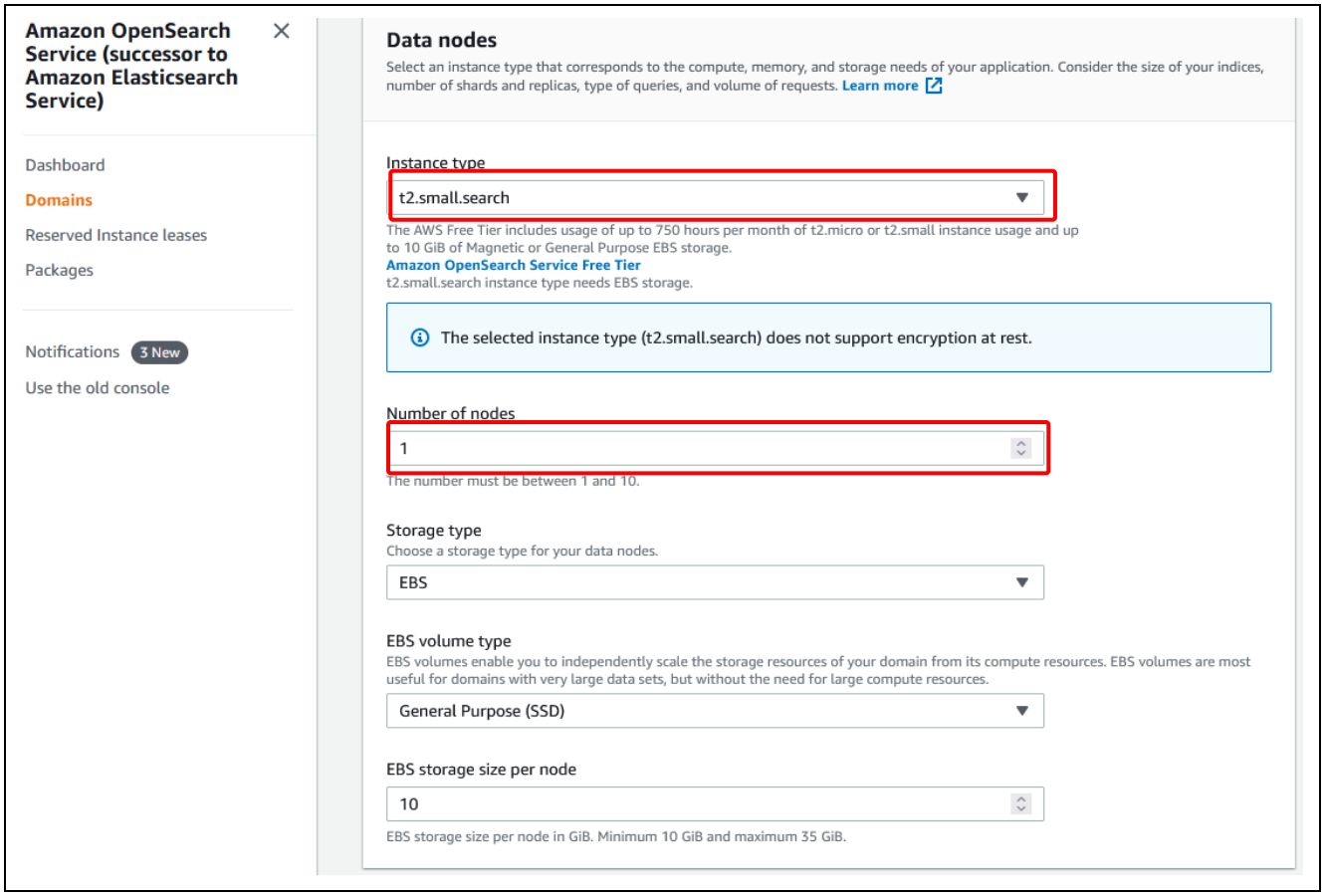

Figure 6.4 Configure data nodes

5. Select **Public access**, then scroll down.

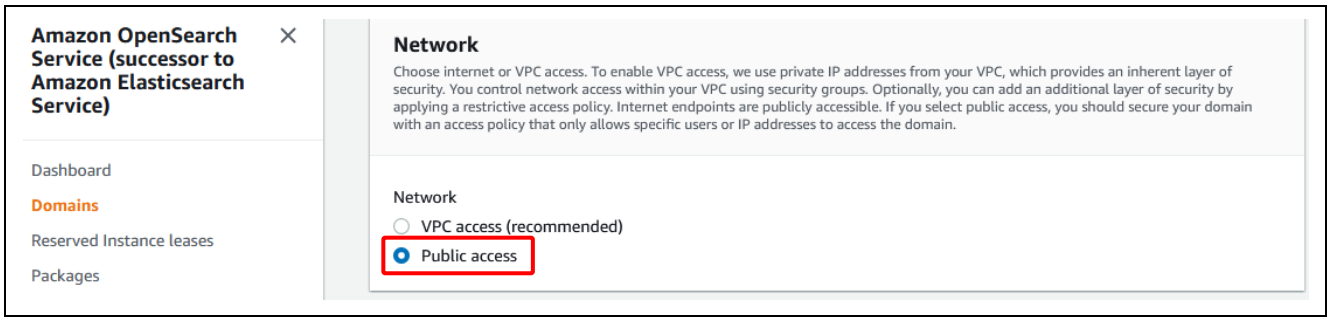

Figure 6.5 Configure Network

6. Set **Configure domain level access policy** and select **IPv4 address**. Enter the global IP address of RL78 Fast Prototyping Board and select **Allow**.
   To find out the global IP address of the RL78/G23-128p Fast Prototyping Board, connect your PC to the same network as the RL78/G23-128p Fast Prototyping Board, and search the Internet for "Global IP Address Confirmation Method" to confirm.

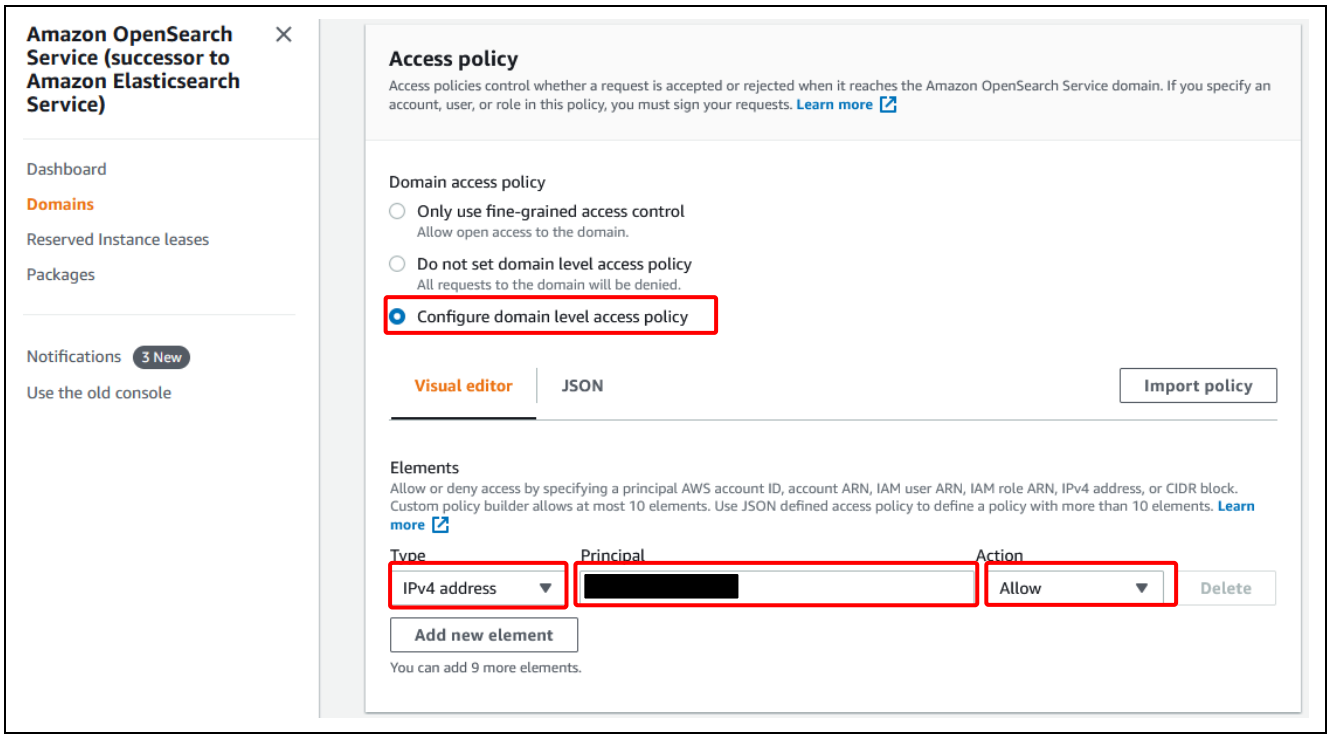

Figure 6.6 Configure access policy

7. Set **Encryption** as the red frame in following figure, then click **Create**.

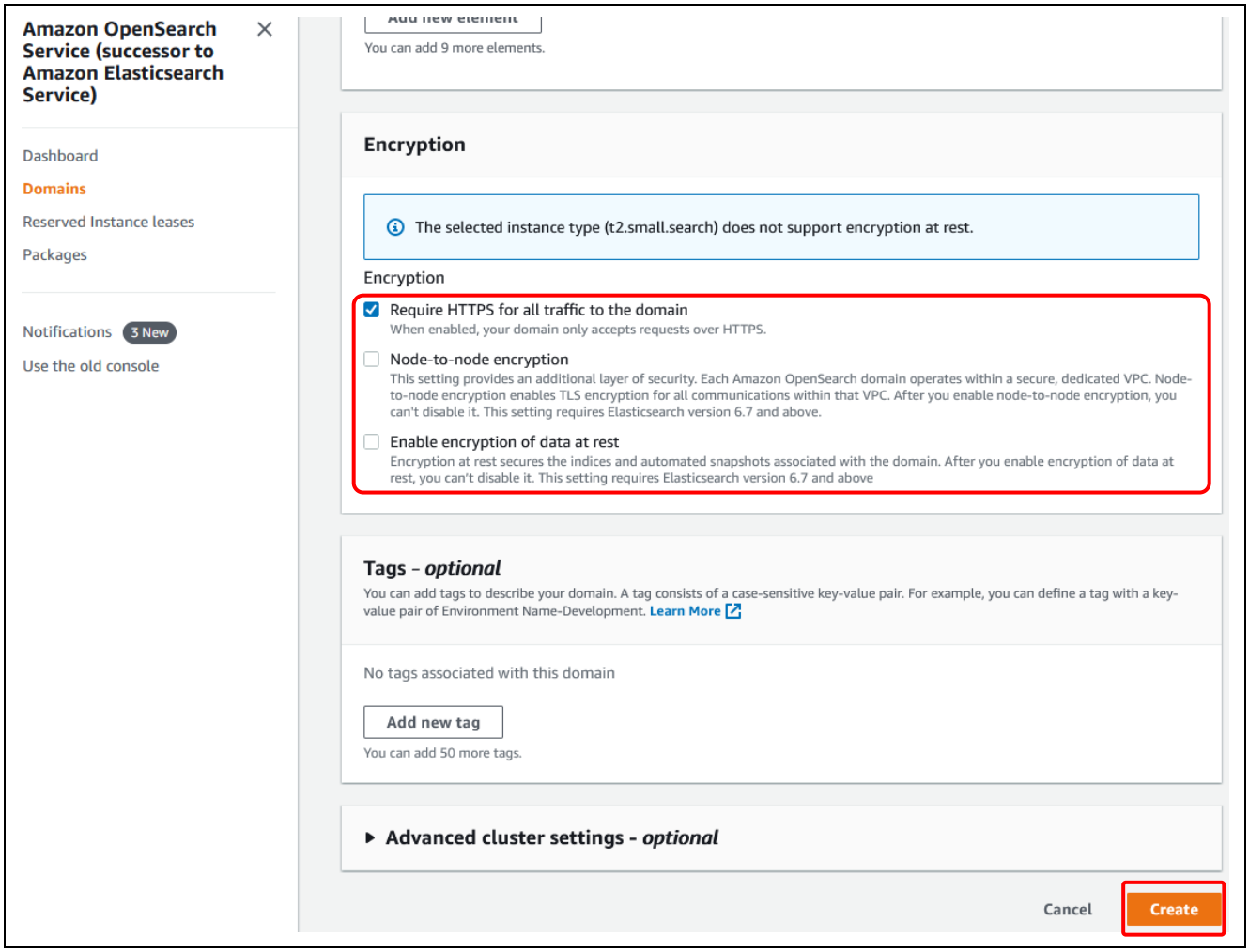

Figure 6.7 Configure encryption then create

8. Your domain is created. Stand by until **Domain status** changes to **Active**.

Note: It usually takes about 10 minutes to active the domain, but it may take longer.

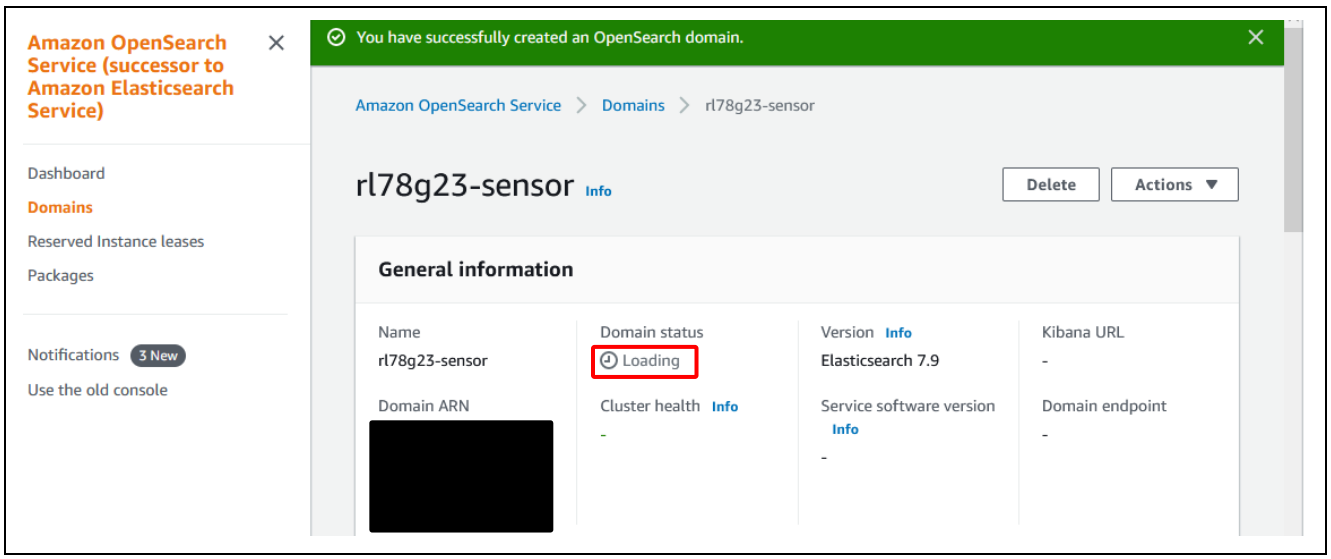

Figure 6.8 Stand by Until Domain status Changes to Active

9. Once **Domain status** changes to **Active**, access the **Kibana** URL.

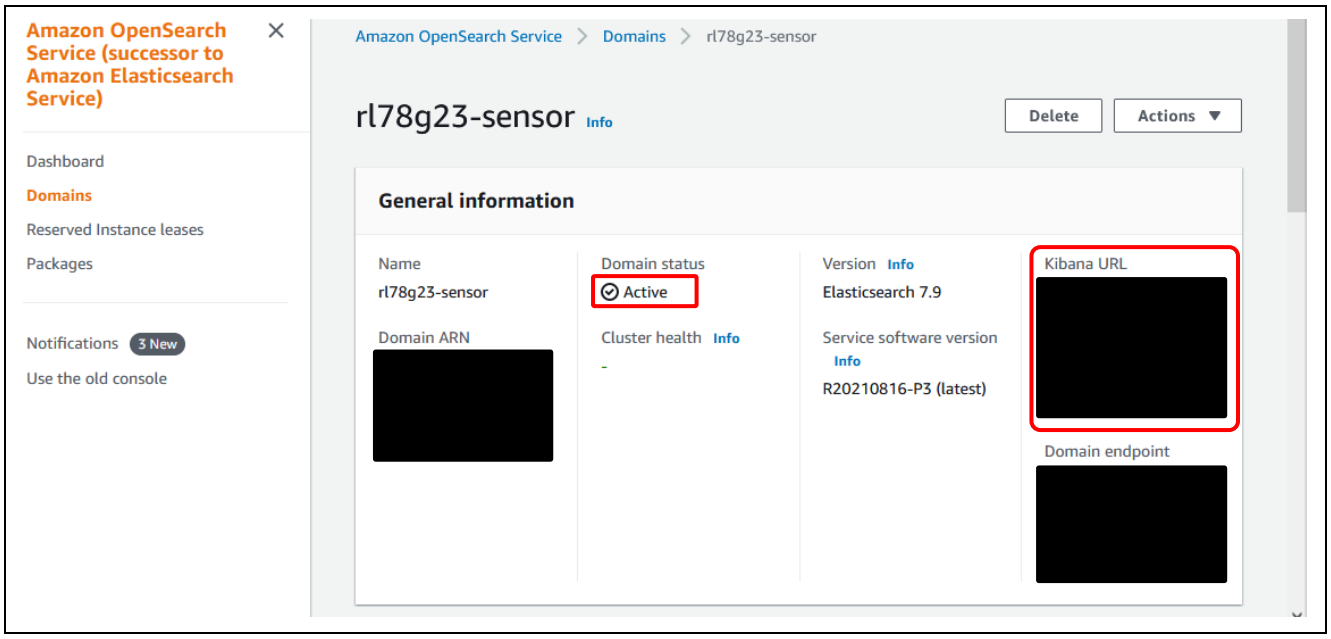

Figure 6.9 Domain status: Active

7. Kibana Preparation

1. Click a red frame.

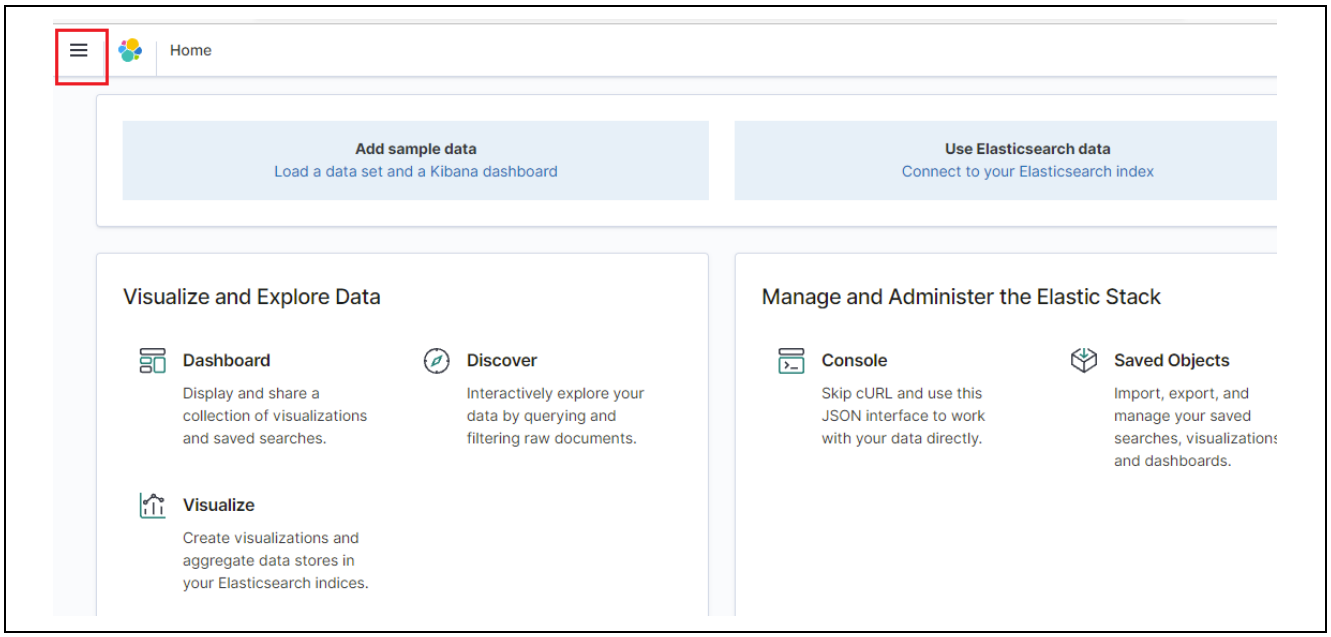

Figure 7.1 Kibana Preparation

2. Click the **Dev Tools**.

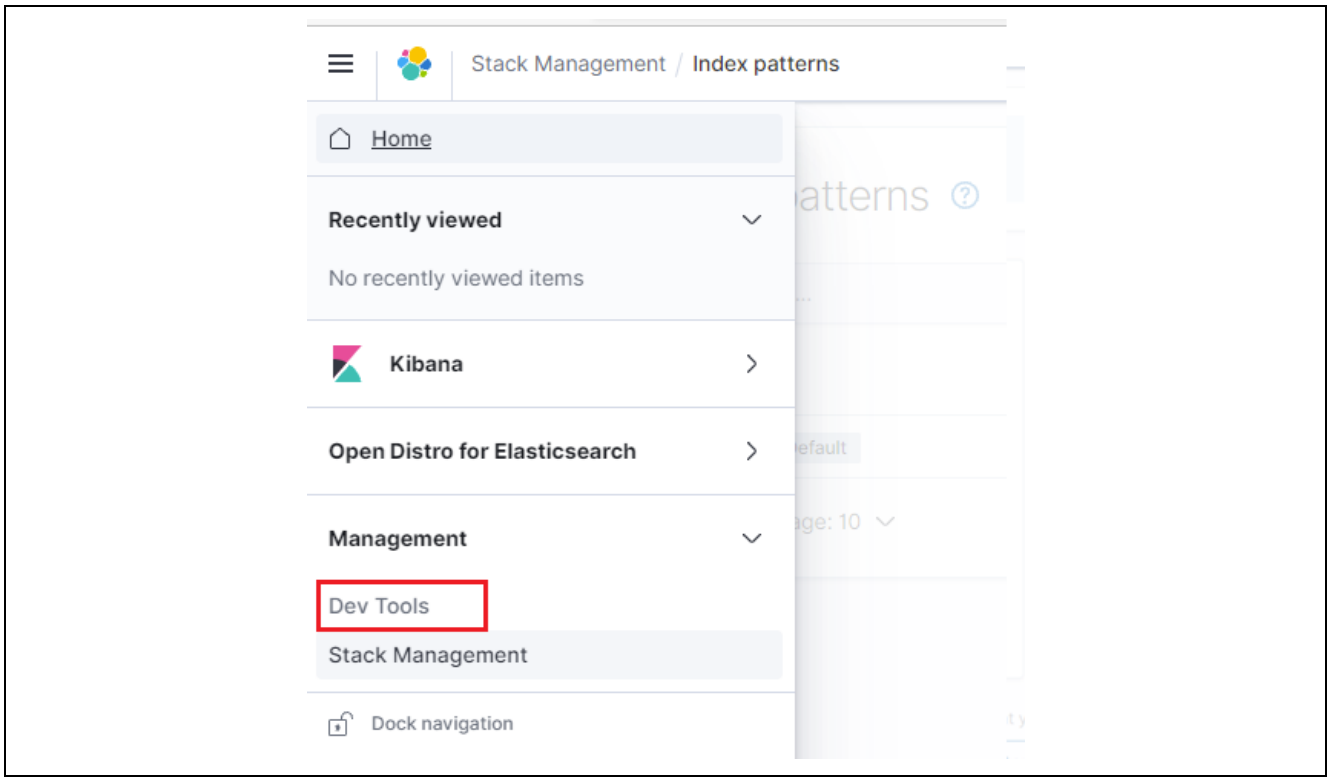

Figure 7.2 Dev Tools

3. In the console window on the left, enter the following code.

```
PUT /sensor?include_type_name=true
{
  "mappings": {
    "sensor": {
      "properties": {
        "timestamp": {
          "type": "long",
          "copy_to": "datetime"
        },
        "datetime": {
          "type": "date",
          "store": true
        },
        "temperature": {
          "type": "long"
        },
        "humidity": {
          "type": "long"
        }
      }
    }
  }
}
```

Figure 7.3 Code Entered in Console Window

4. Click once the **click to send request** icon in the upper right corner of the console.

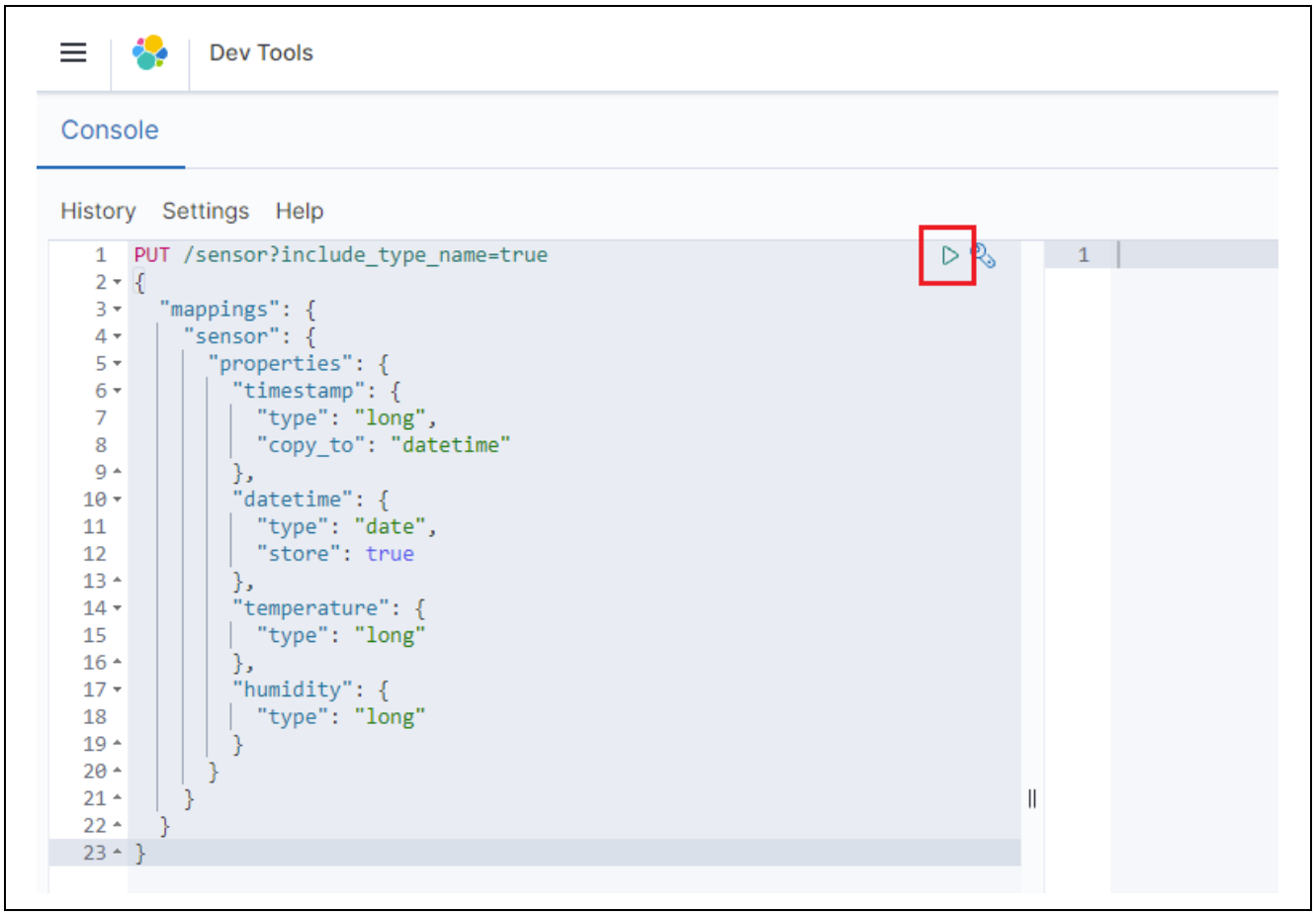

Figure 7.4 click to send request

5. Confirm that the following response is returned.

```
{
  "acknowledged" : true,
  "shards_acknowledged" : true,
  "index" : "sensor"
}
```

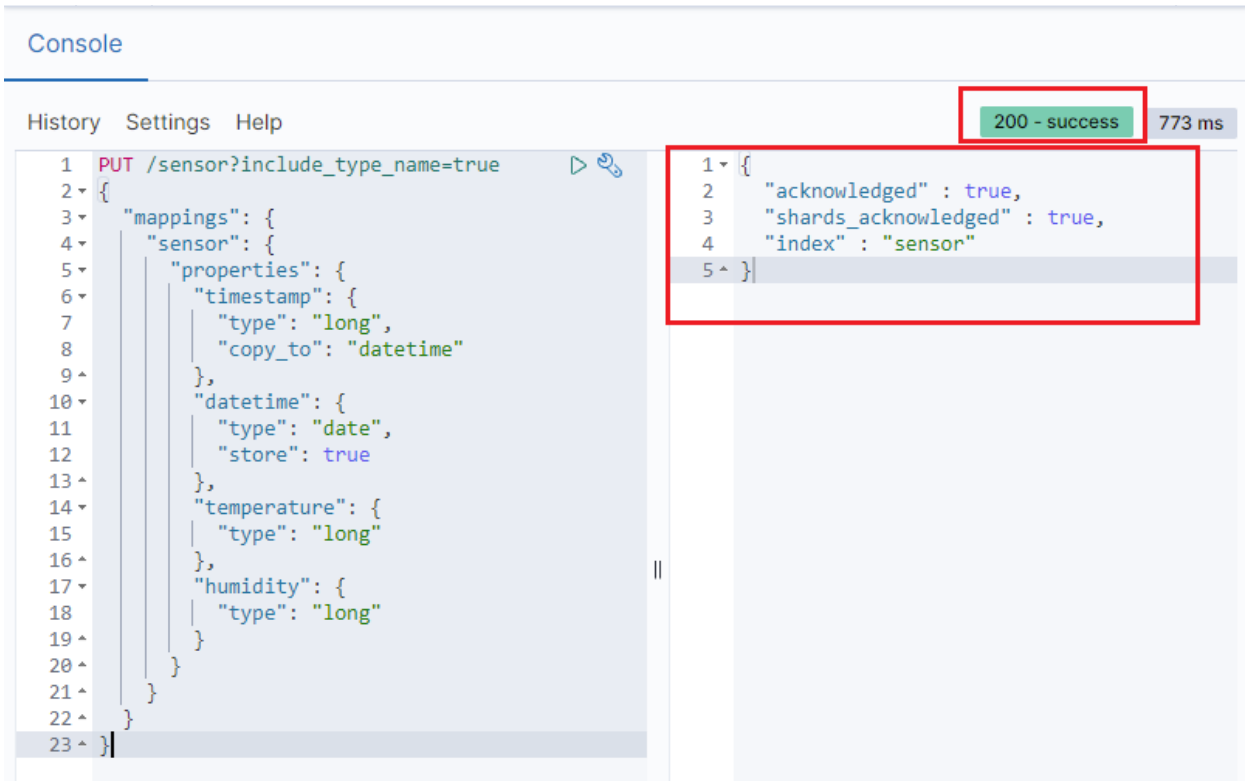

Figure 7.5 Confirming Response

8. IoT Rule Preparation

Create a rule by AWS IoT.

1. Go to the IoT Core control panel, select **Act** -> **Rules**, and click **Create**.

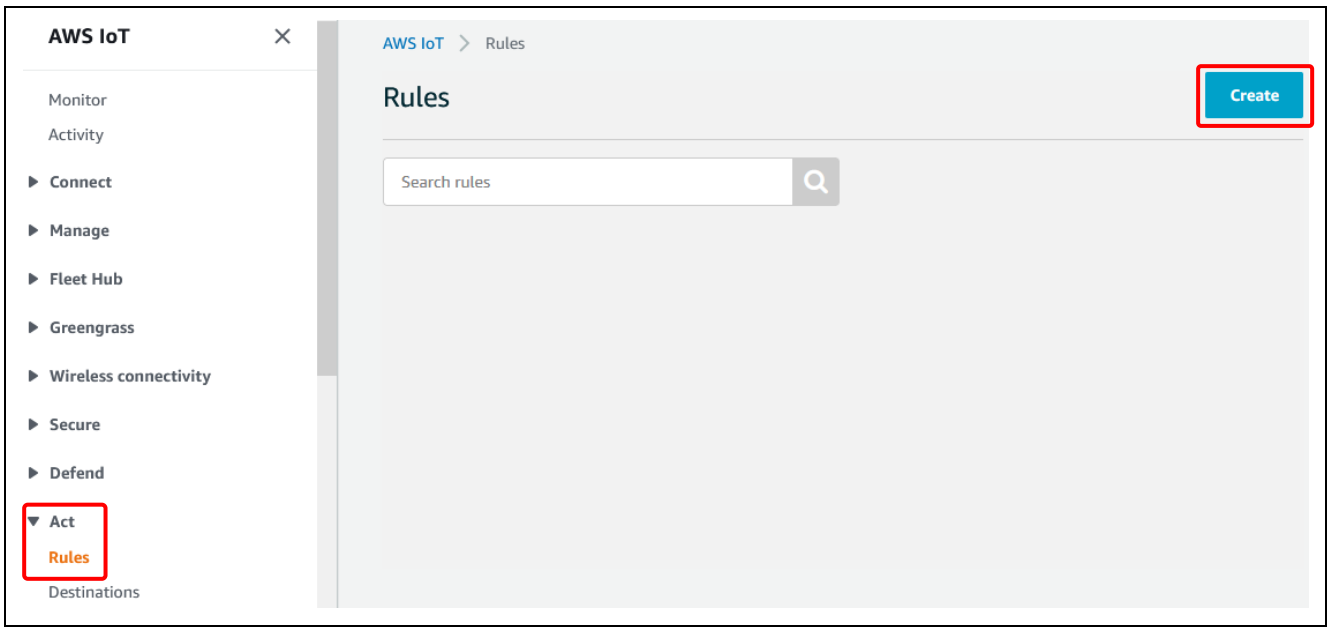

Figure 8.1 Create a rule

2. Enter a name for the rule, then enter the following code under **Rule query statement.**

```
SELECT *, timestamp() as timestamp FROM 'iotdemo/topic/sensor'
```

Note: Make sure to enter a line break after the rule query statement as the following figure.

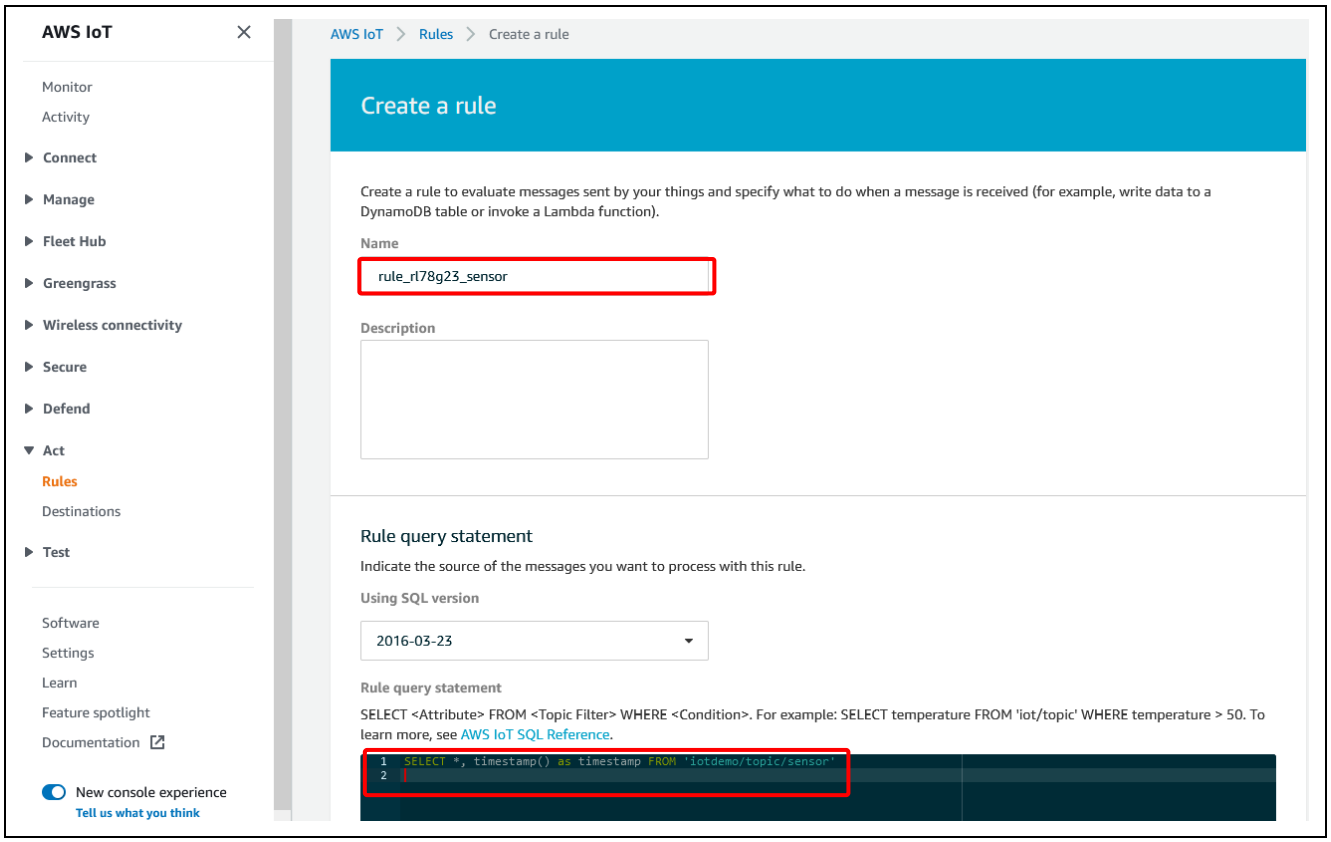

Figure 8.2 Entering Code

3. Click **Add action**.

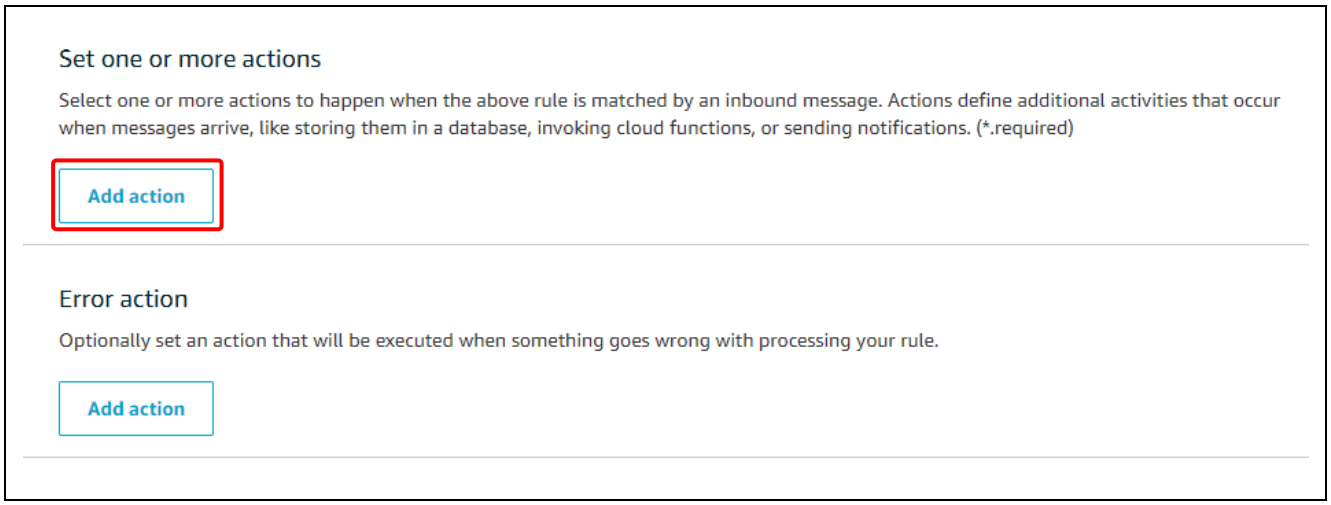

Figure 8.3 Add action

4. Select Send message to the Amazon OpenSearch Service and click Configure action.

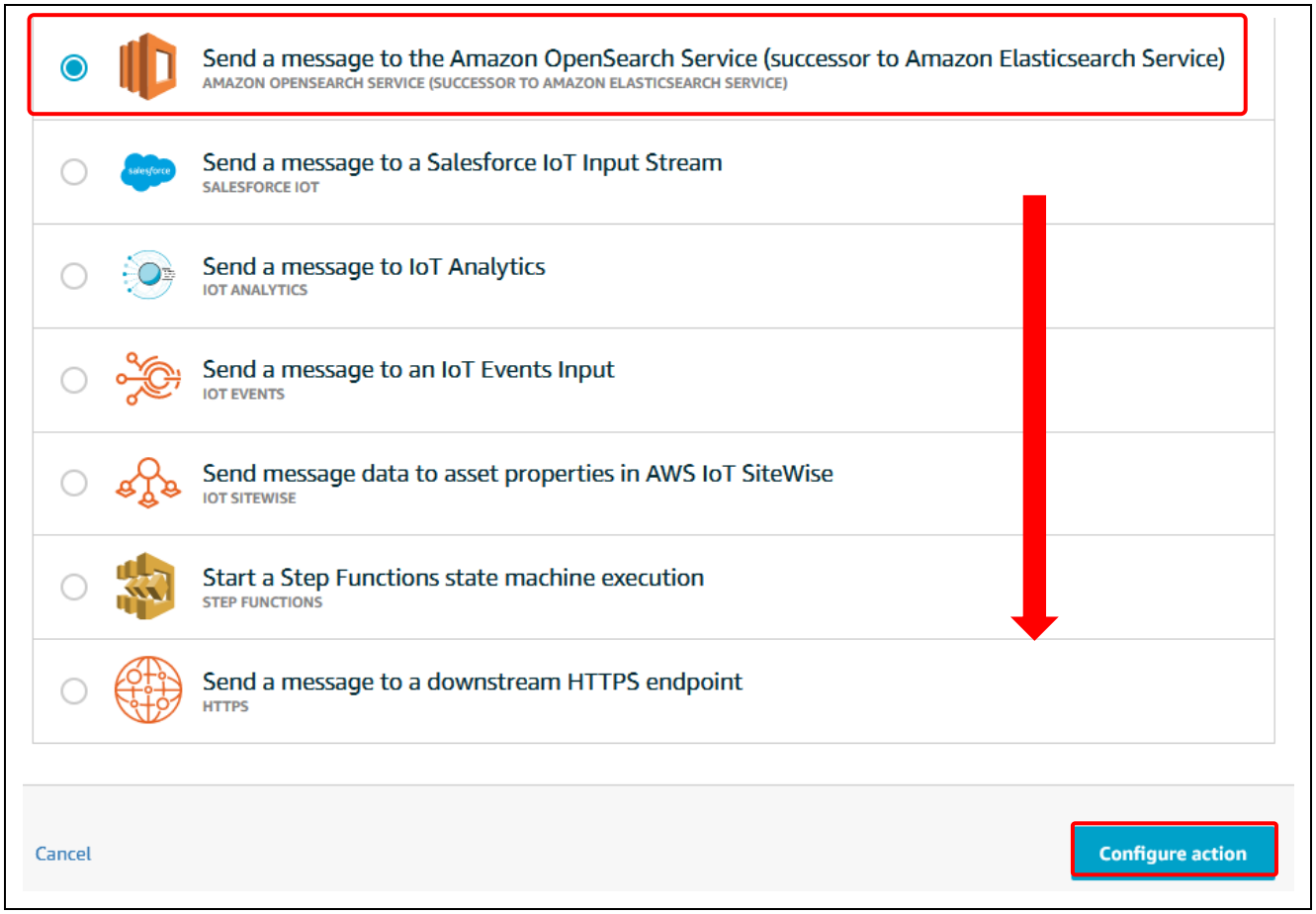

Figure 8.4 Configure action

5. For **Domain name** enter the domain name created on the Amazon OpenSearch Service (refer to 6 Amazon OpenSearch Service Preparation), for **ID** enter **${newuuid()}**, for **Index** enter **sensor**, and for **Type** enter **sensor**.
   Then click **Create Role**.

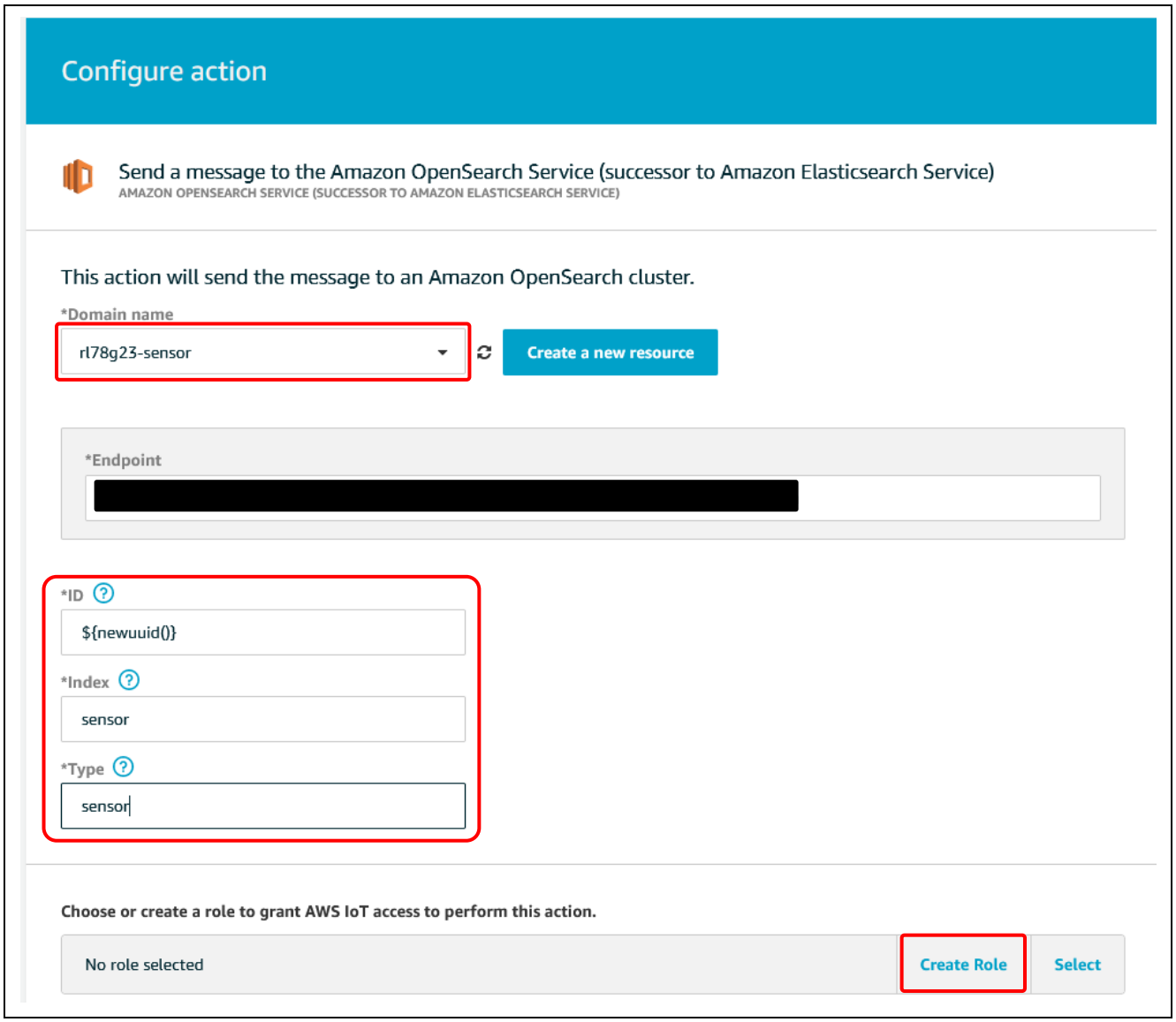

Figure 8.5 Domain name, ID, Index, and Type Settings

6. Enter the name of the role and click **Create role**.

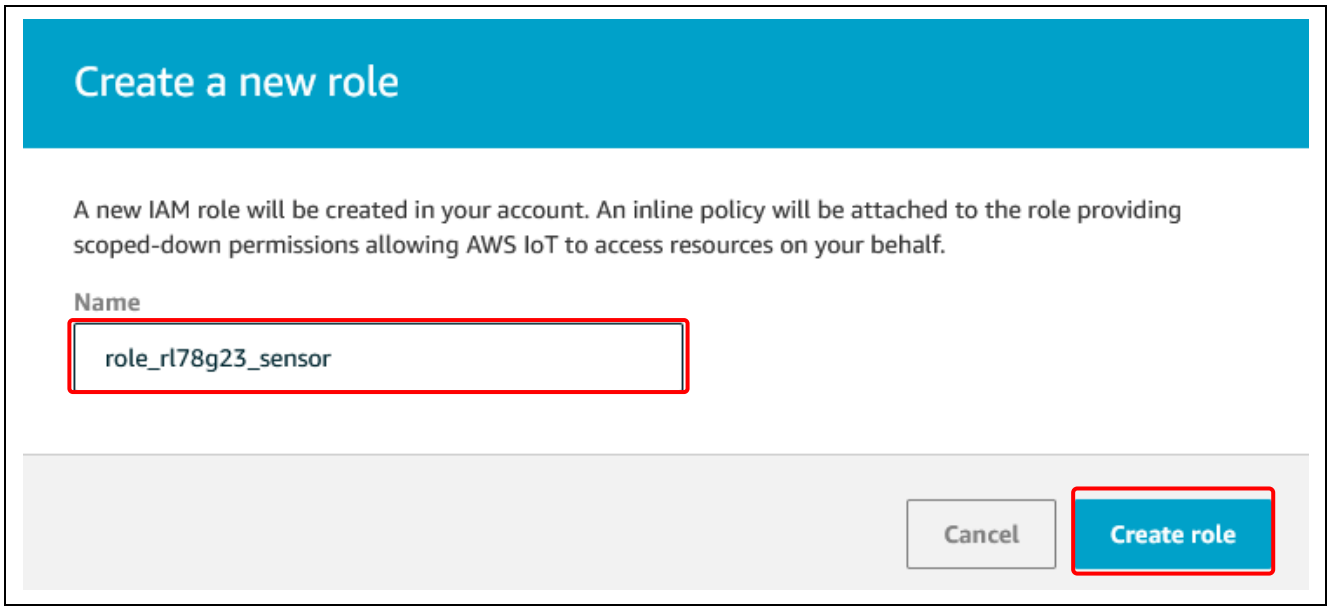

Figure 8.6 Create role

7. Confirm that the role you created is selected, then click **Add action**.

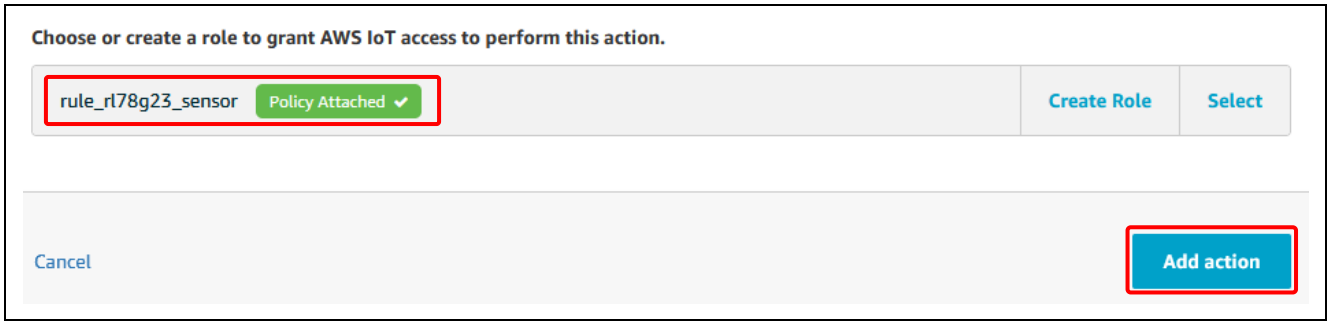

Figure 8.7 Add action

8. Confirm that the action was added, then click **Create rule**.

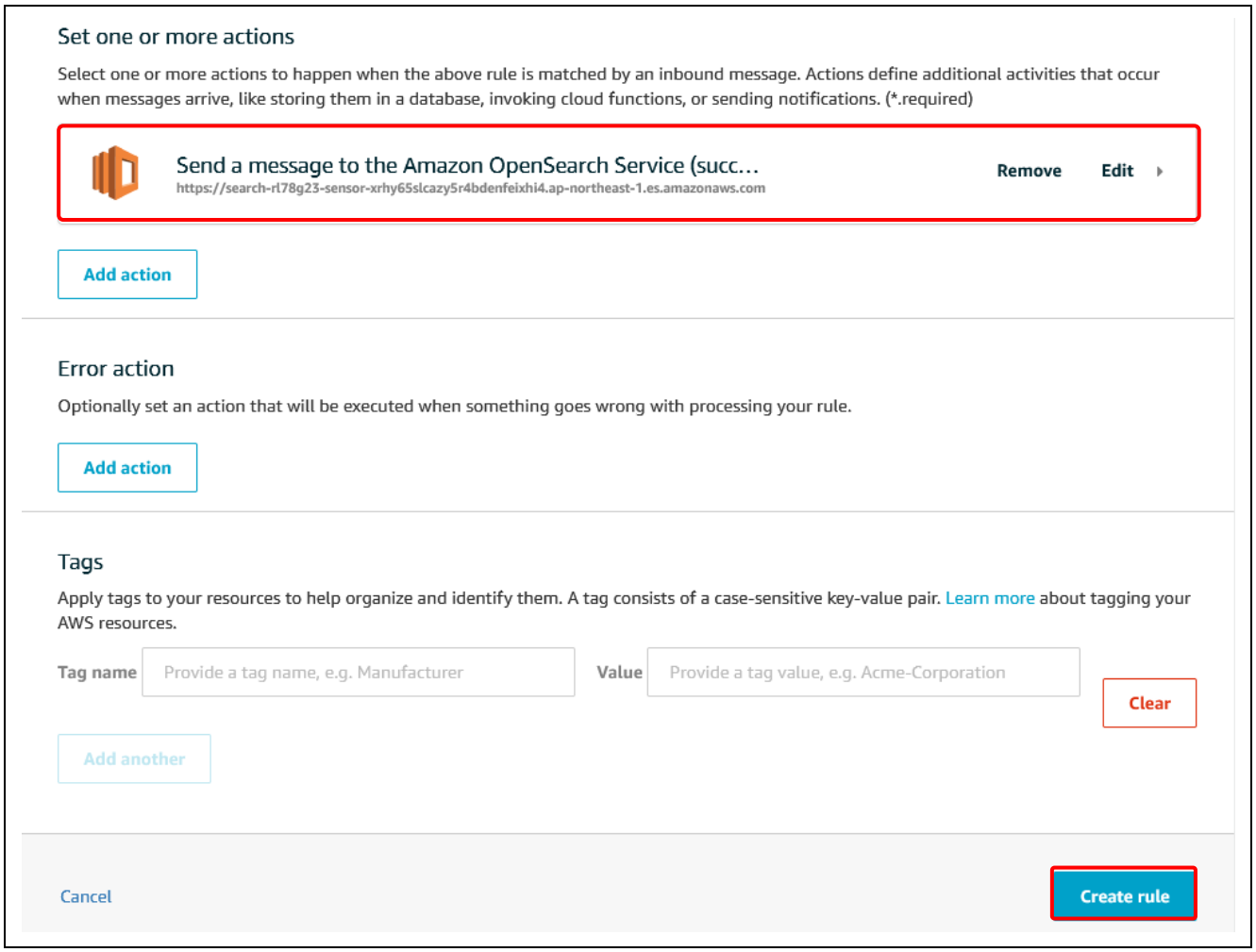

Figure 8.8 Create rule

9. Confirm that the rule was added, then click **Enable**.

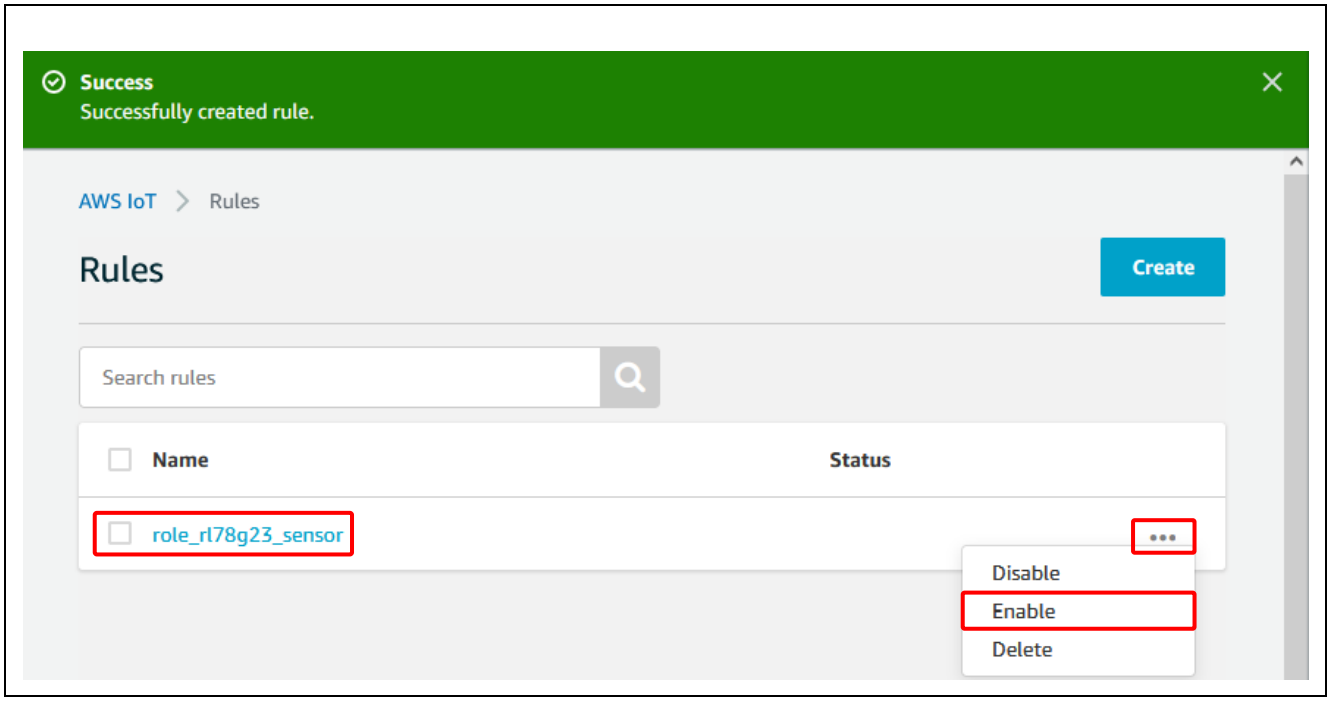

Figure 8.9 Enable rule

9. Running the Demo Program

Now you can run the demo program in the project prepared as described in 5, Demo Project Preparation.

Click the **Debug** button to connect to the RL78/G23-128p Fast Prototyping Board.

Figure 9.1 Debug

When you click the **Start** button, execution pauses at the main function. Click the **Start** button again to run the demo program.

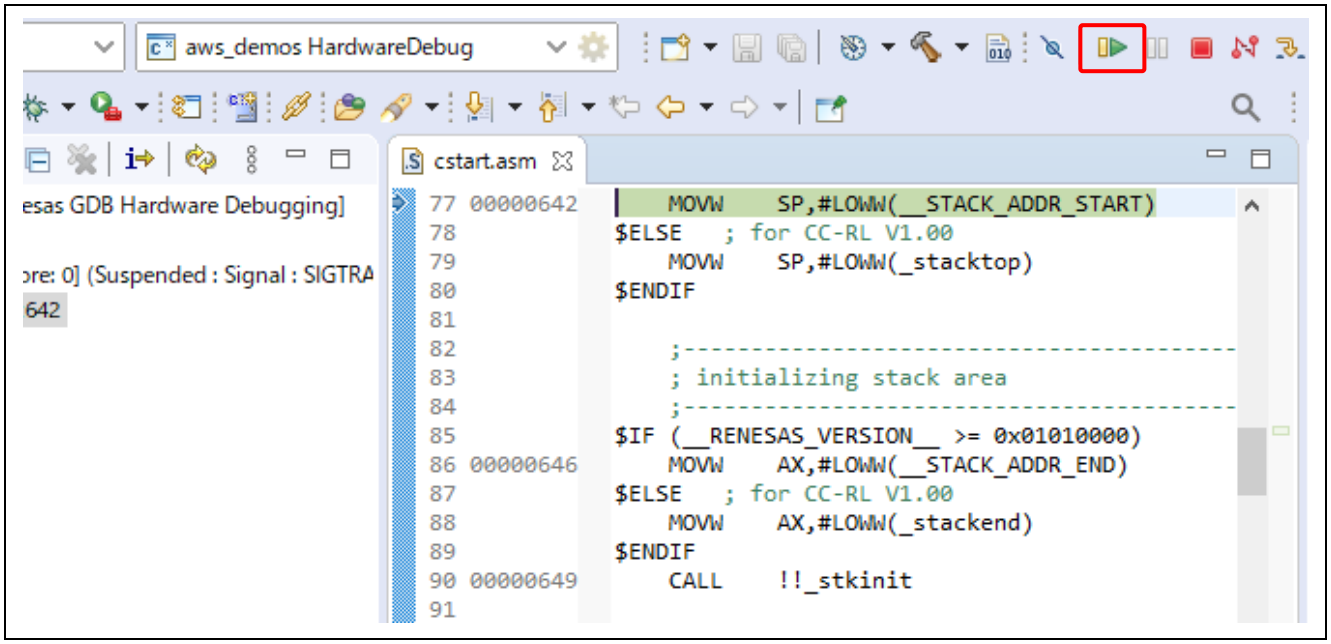

Figure 9.2 Running the Demo Program

10. Visualizing Sensor Information with Kibana

1. Go to Kibana, then click the **Stack Management** icon in the menu at left.

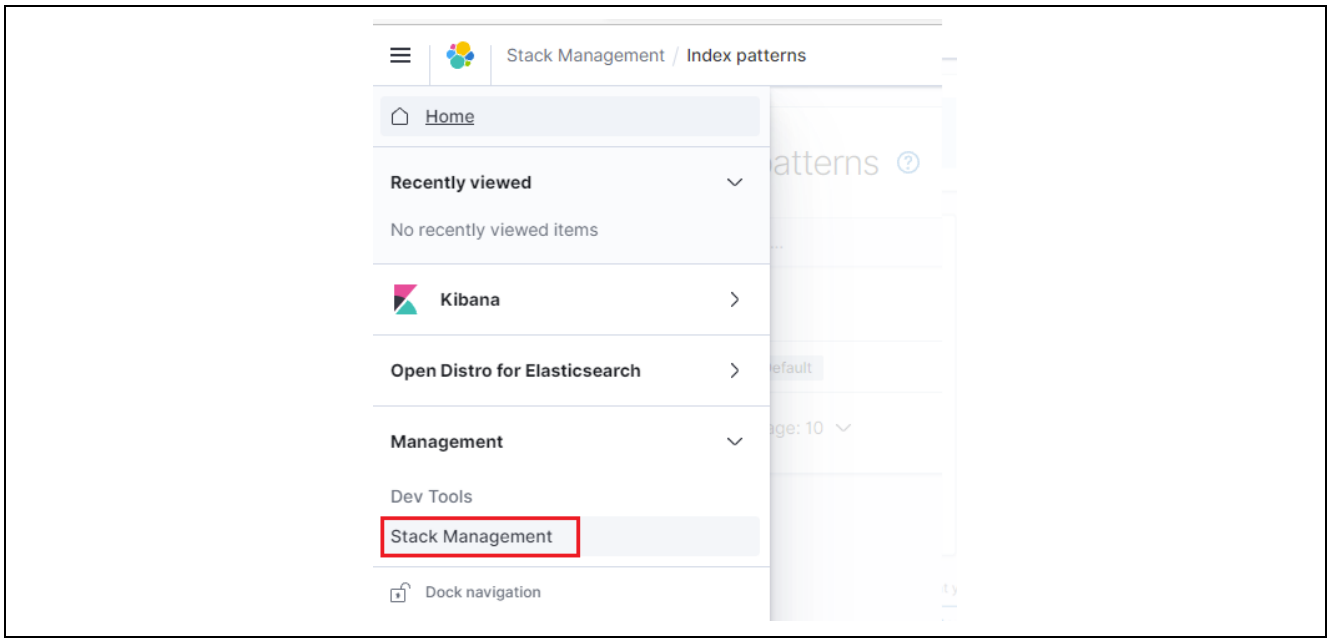

Figure 10.1 Kibana Setup

2. Click **Index Patterns**, then click **Create Index pattern**.

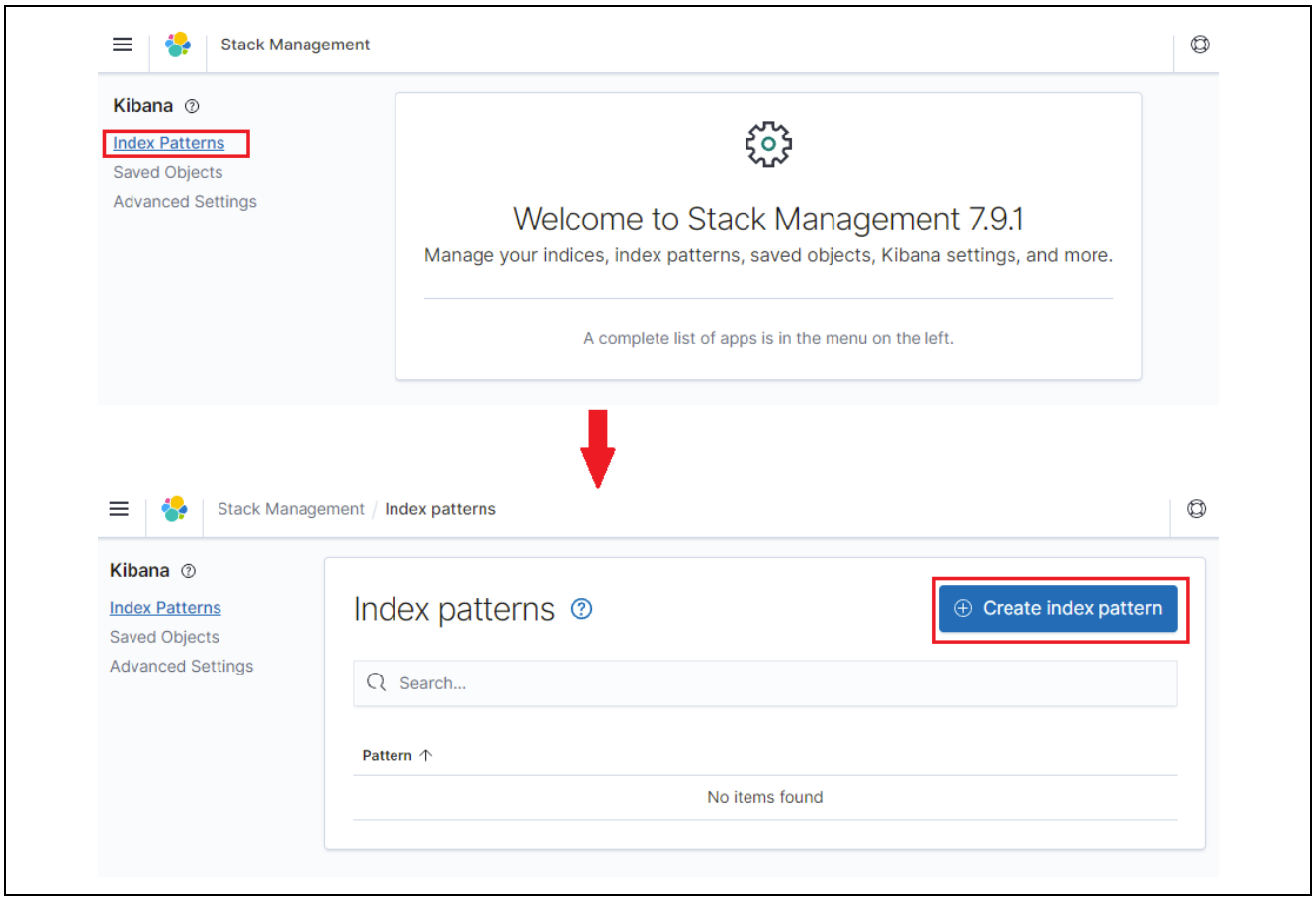

Figure 10.2 Define index pattern

3. Select **sensor** in **index pattern name** field and click **Next step**. Then the screen switches Step2 of 2, select **datetime** and click **Create index pattern**.

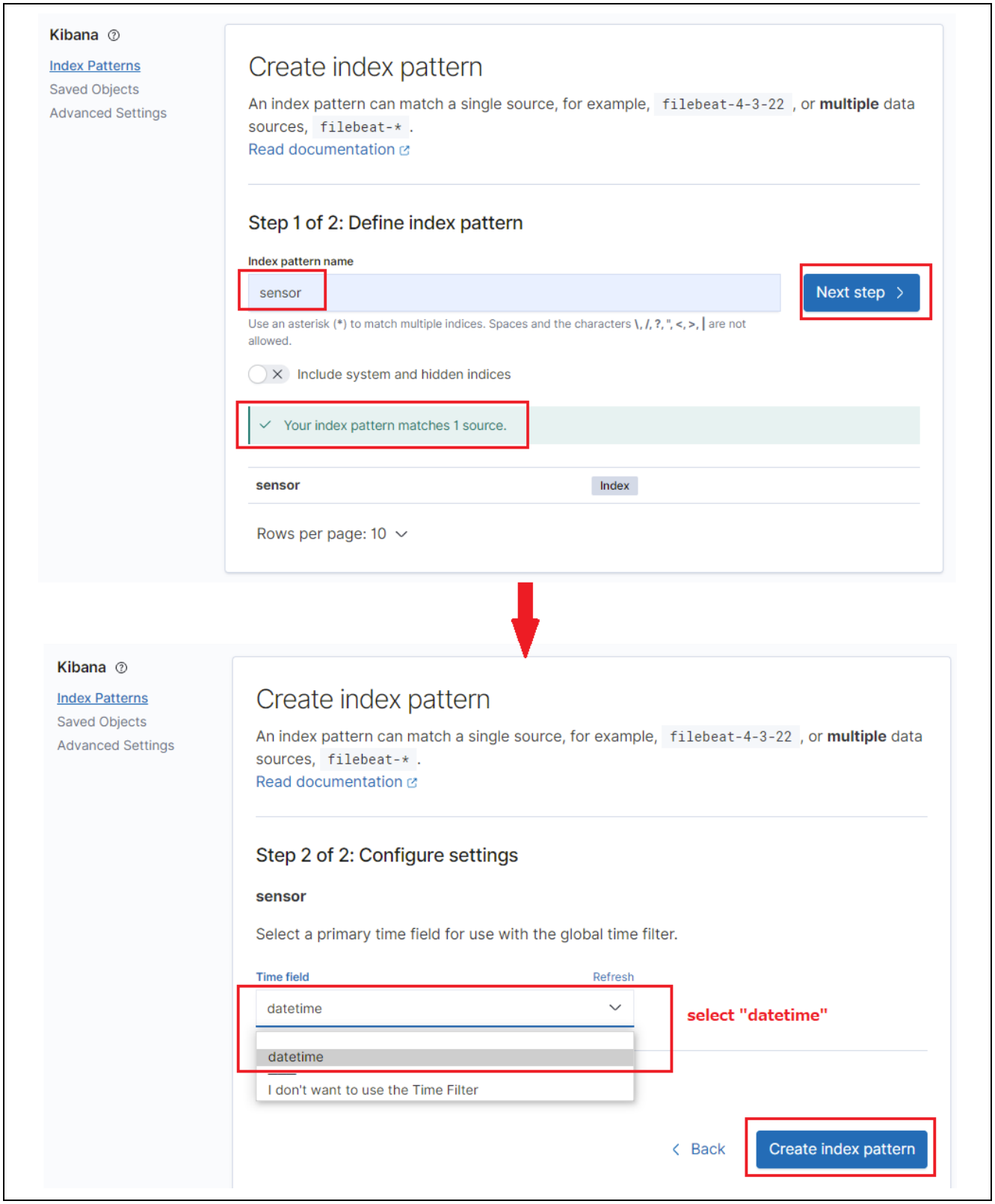

Figure 10.3 Create index pattern

4. It's succeeded in creating an index pattern when the following screen is showed.

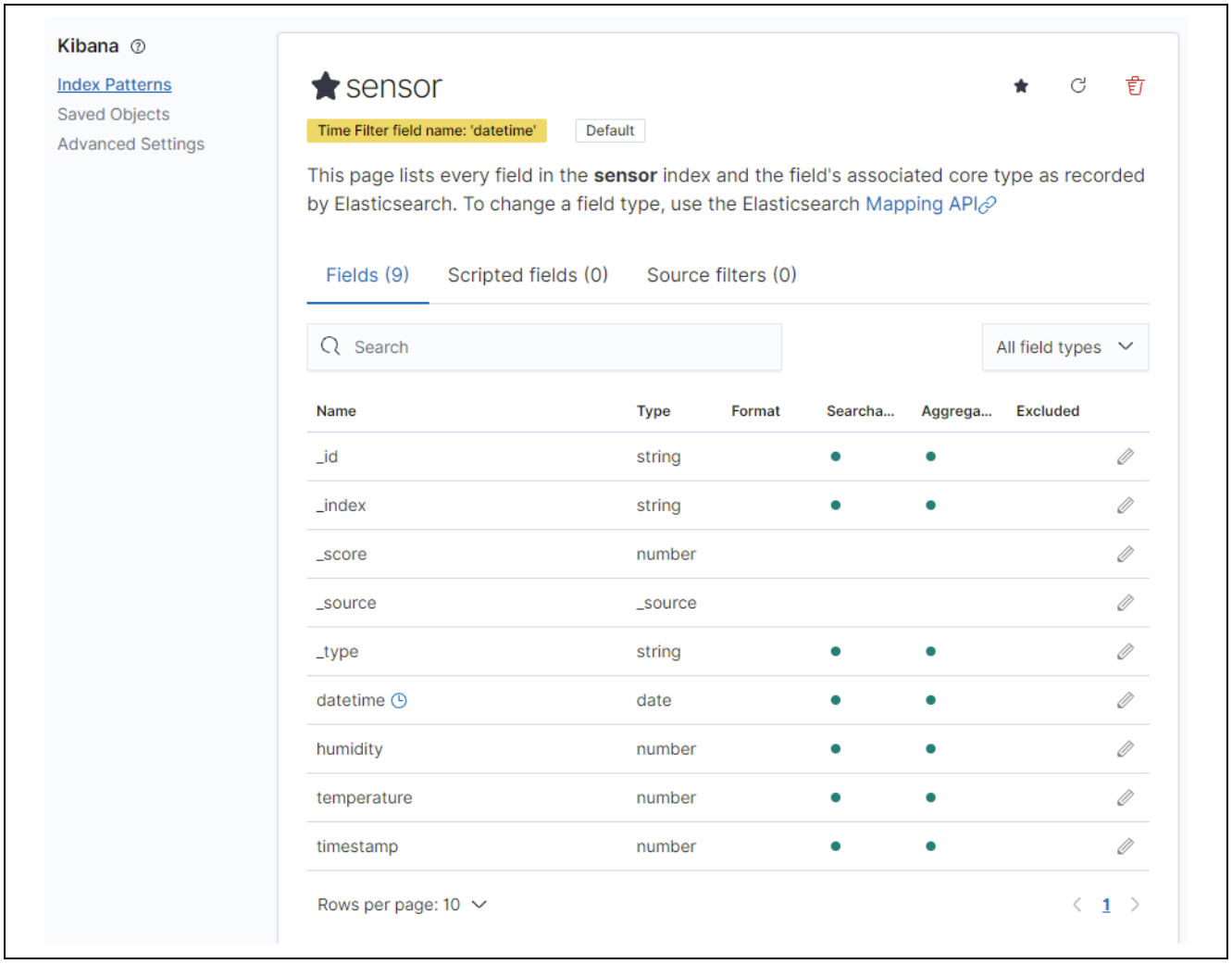

Figure 10.4 Confirm index pattern

5. Click the **Visualize** icon, then click the **Create a visualization**.

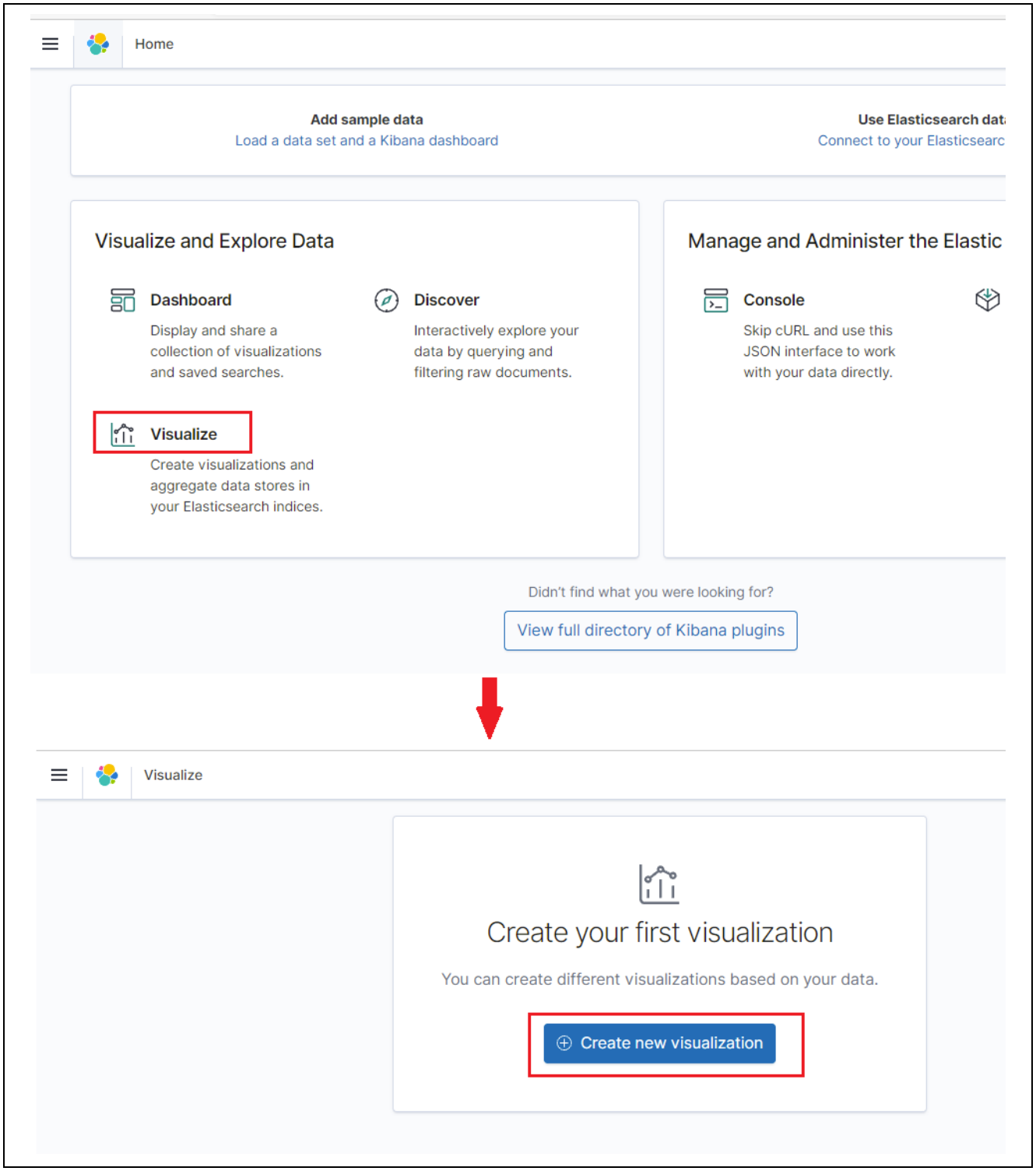

Figure 10.5 Create a Visualization

6. Click the **Line** icon.

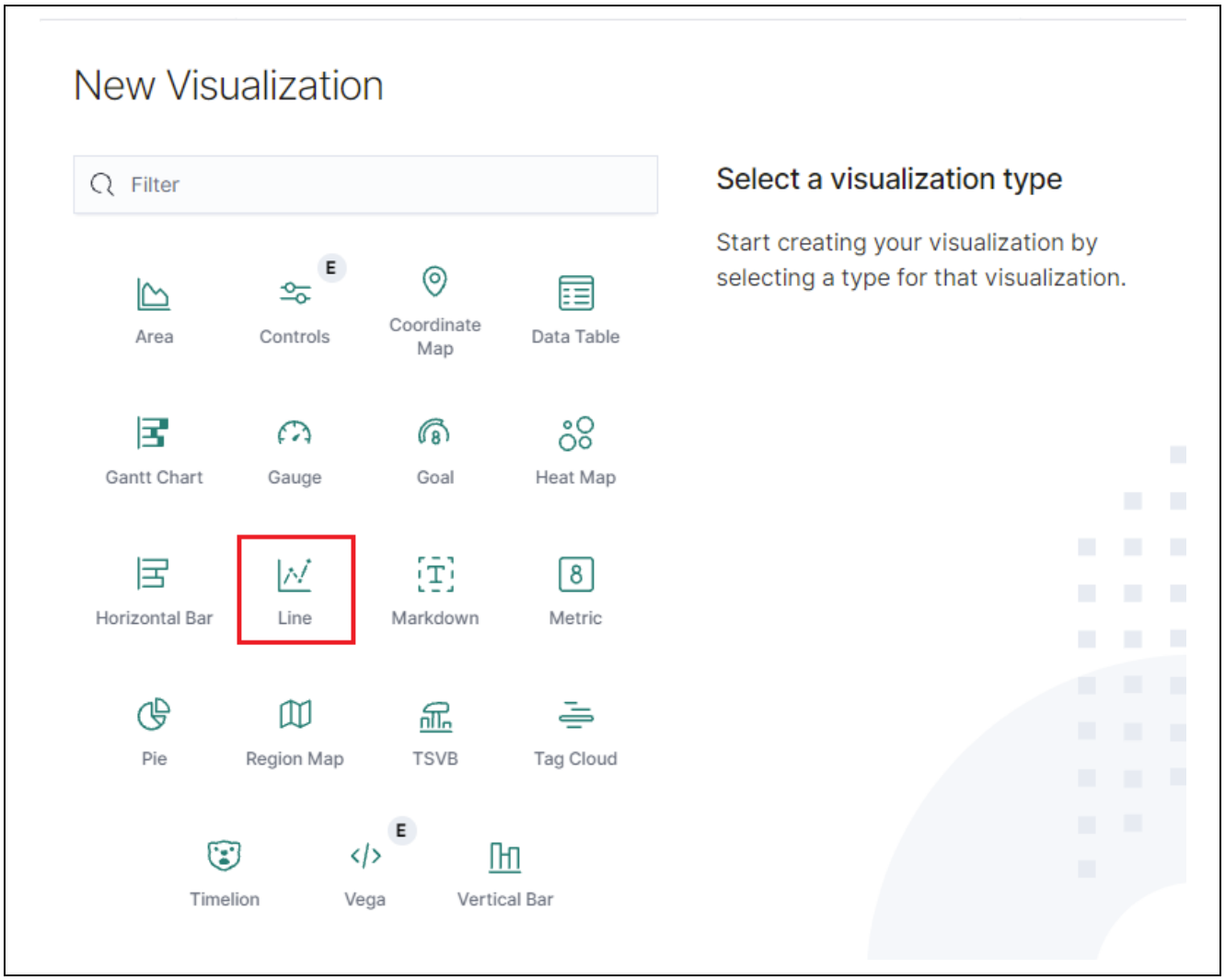

Figure 10.6 Line

7. Click **sensor**.

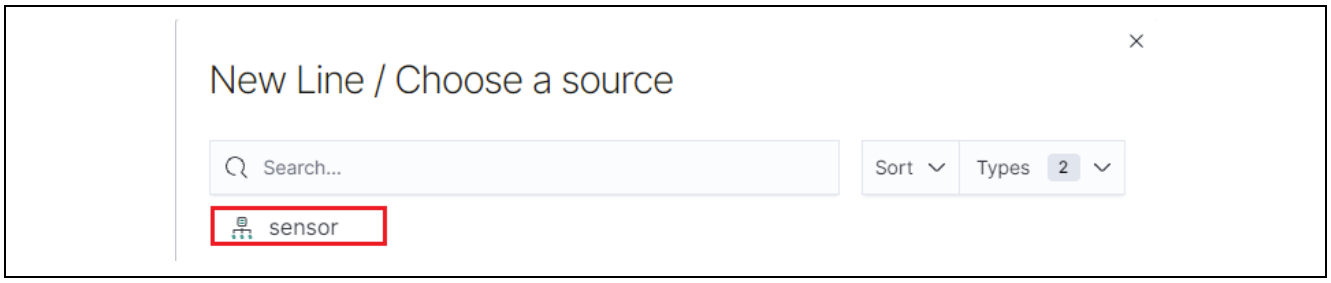

Figure 10.7 New Line / Choose a source

8. Click the calendar icon at the upper right, set **Refresh every** to **5 seconds**, and click **Start**.

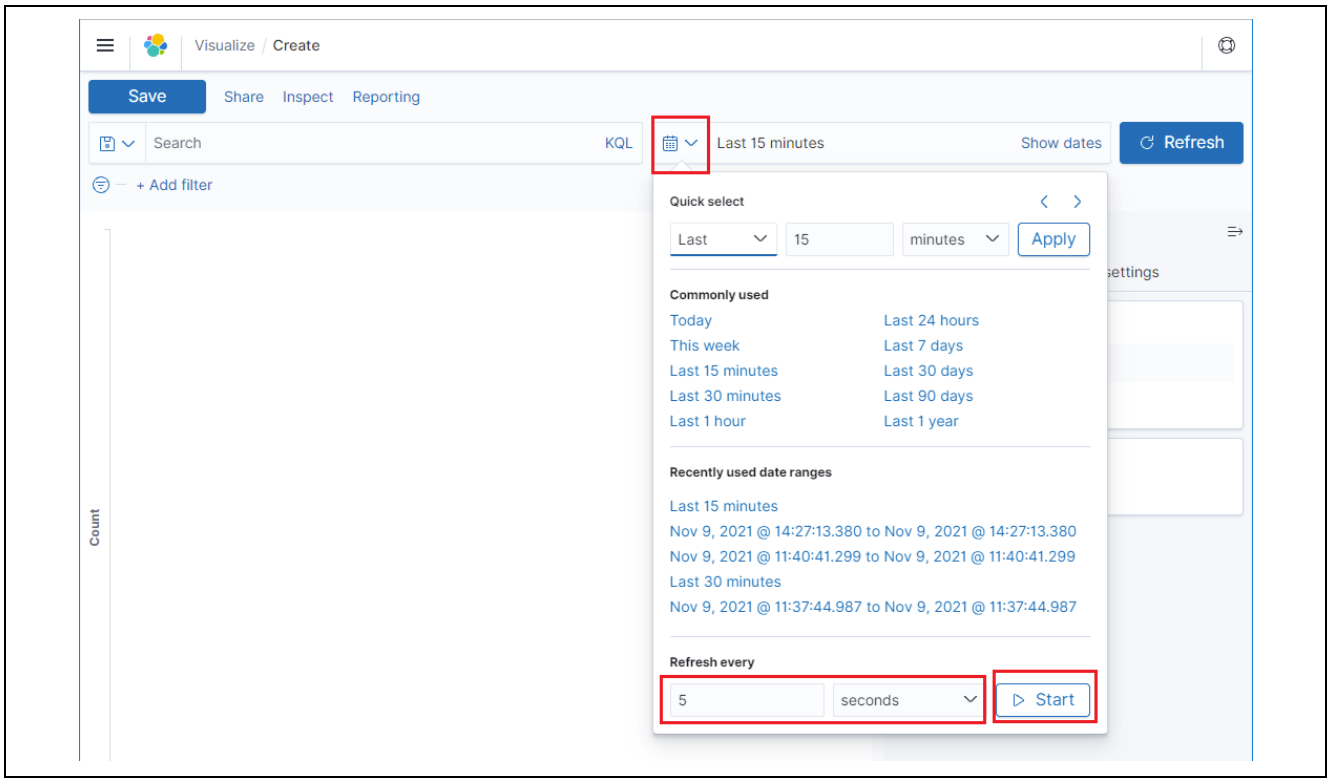

Figure 10.8 Refresh every Setting

9. For **Metrics**, set **Y-axis** and **X-axis** as the following figures.

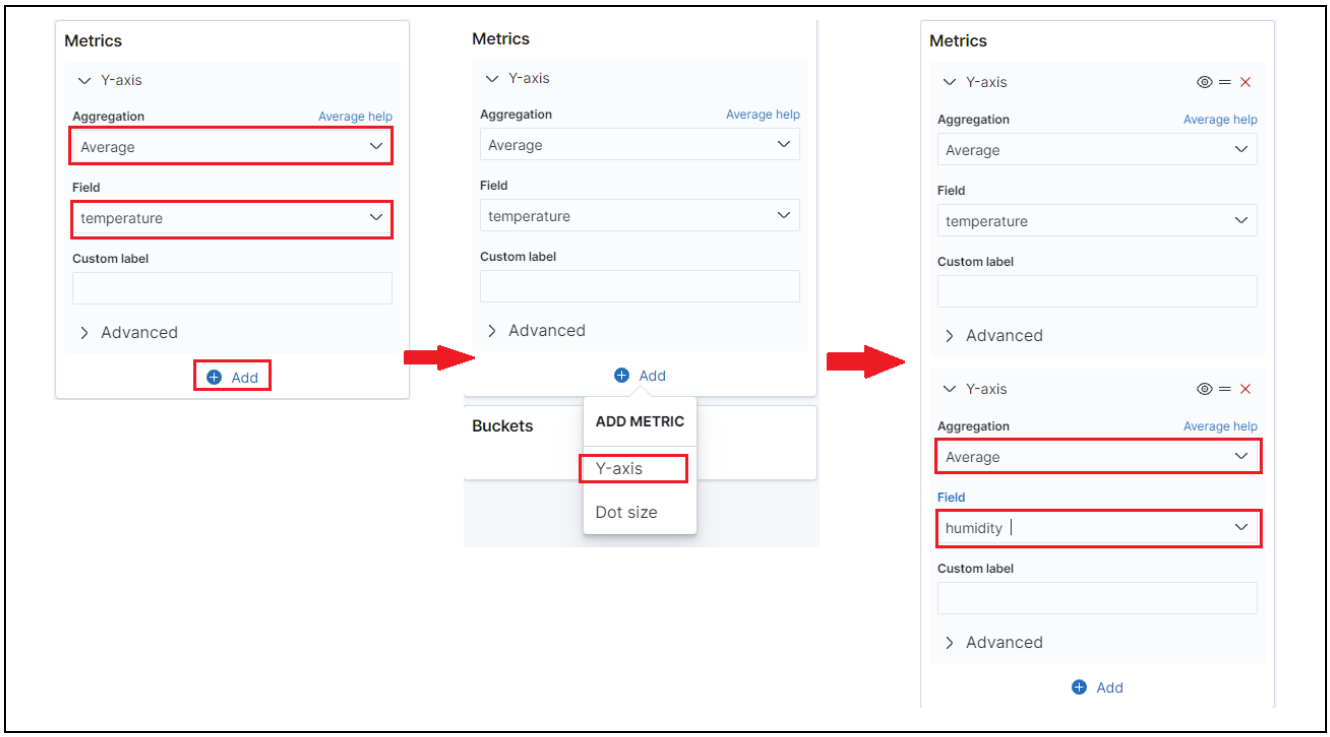

Figure 10.9 Metrics (Y-axis) Settings

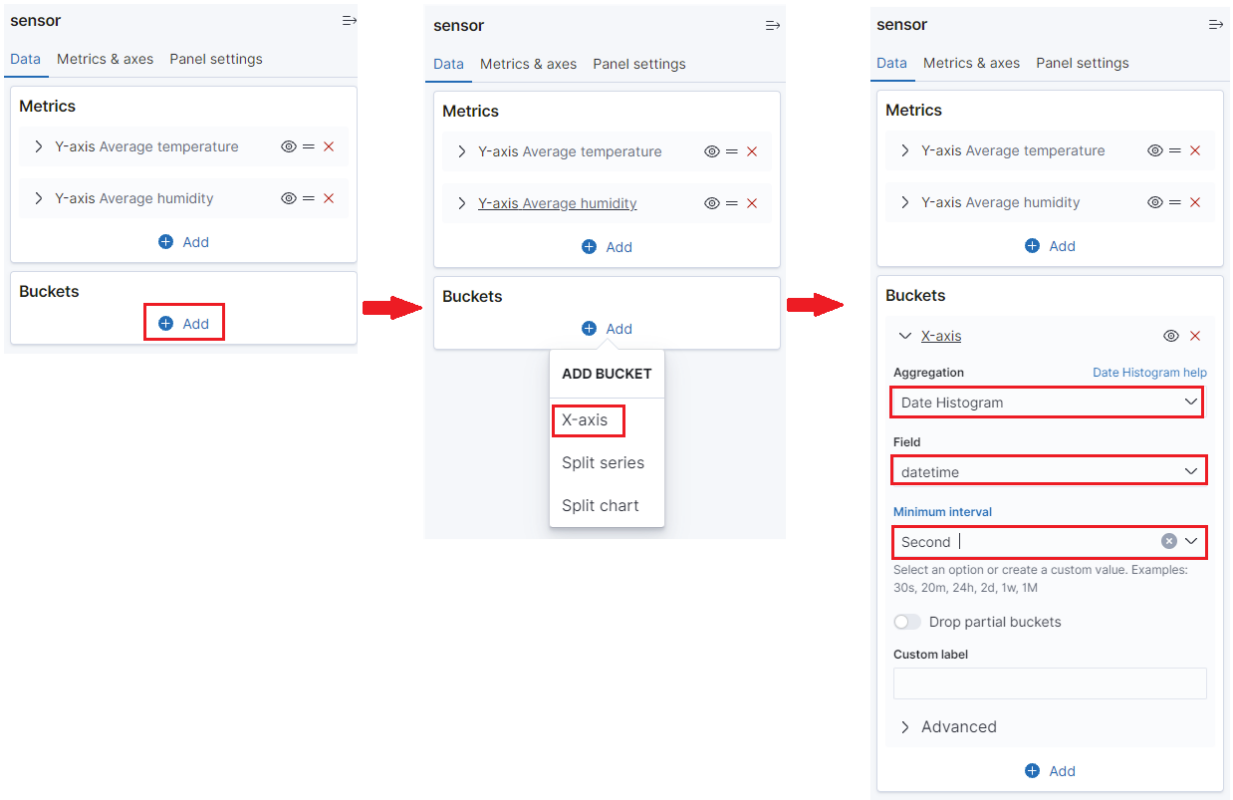

Figure 10.10 Metrics (X-axis) Settings

10. Click the **Update**.

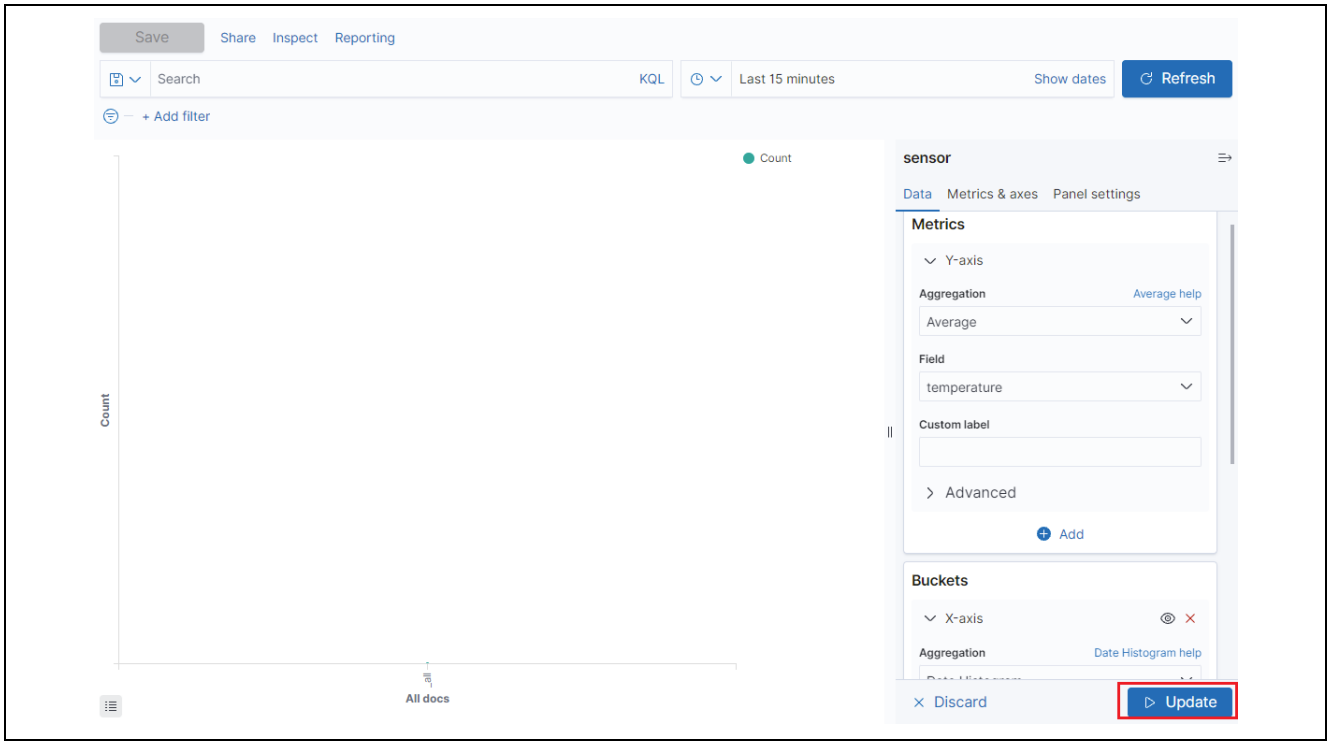

Figure 10.11 Update

11. Confirm that a graph showing sensor data is displayed and changed according to the values of humidity and temperature. A visualization of humidity and temperature sensor information is shown below.

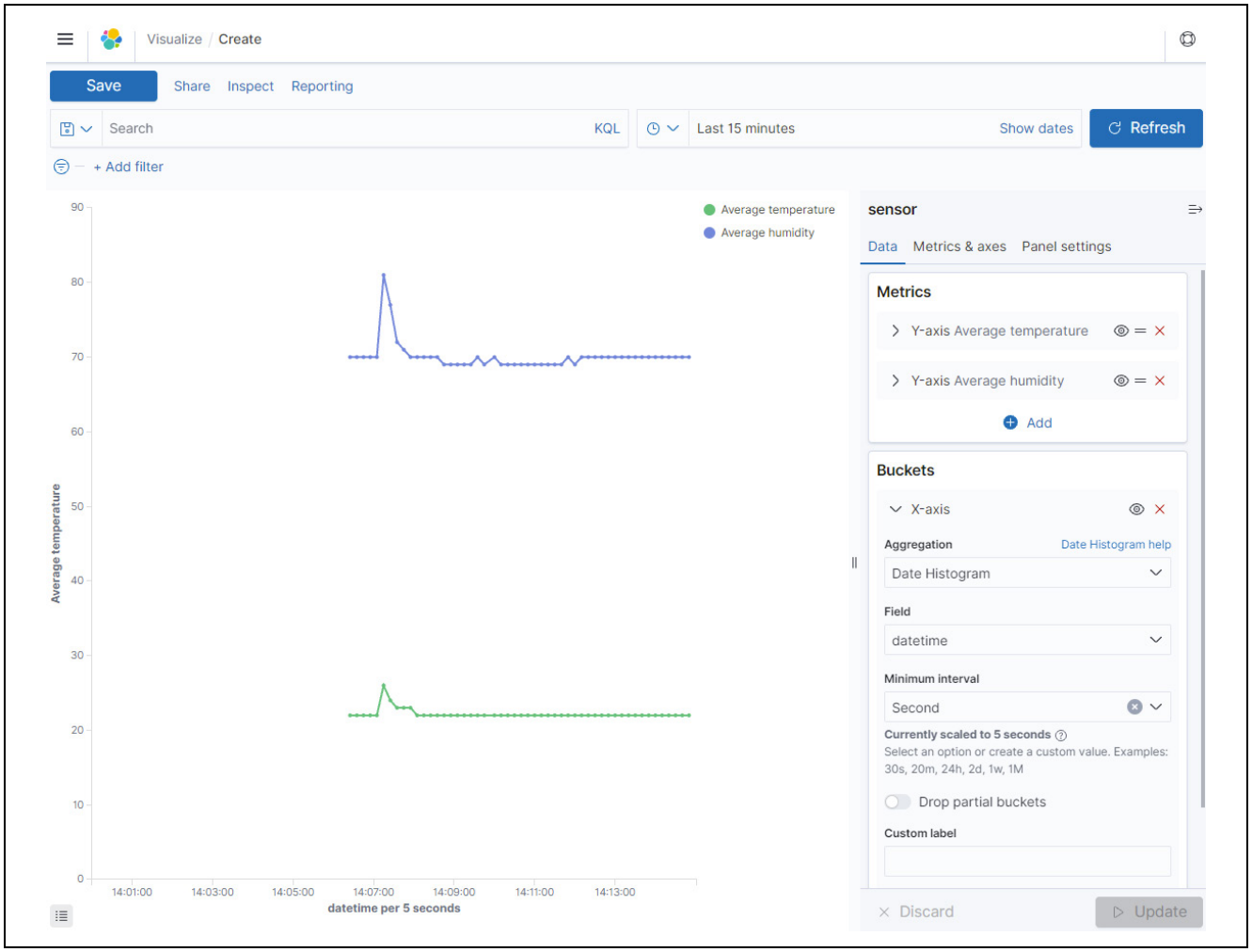

Figure 10.12 Visualization of Humidity and Temperature Sensor Information

11. Important Note after Running Demo Program

Fees are incurred when are using the Amazon OpenSearch Service.

Make sure to delete your domain after you finish using the demo program.

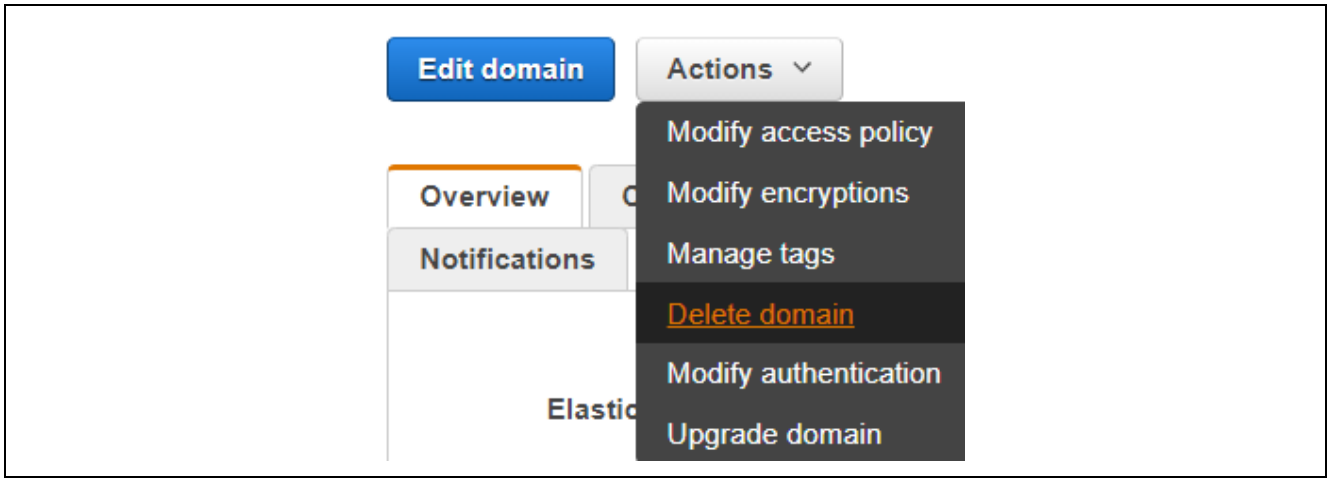

Figure 11.1 Don't Forget to Delete Your Amazon OpenSearch Service Domain!

12. Appendix

12.1 How to upgrade drivers

This section describes how to upgrade drivers into a demo project.

The following is how to upgrade the IIC driver with the Smart Configurator.

1. Create a new project. Note that check the **Use Smart Configurator** checkbox.
   Click the **Finish** button, then a new project is created and open the view for smart configurator.

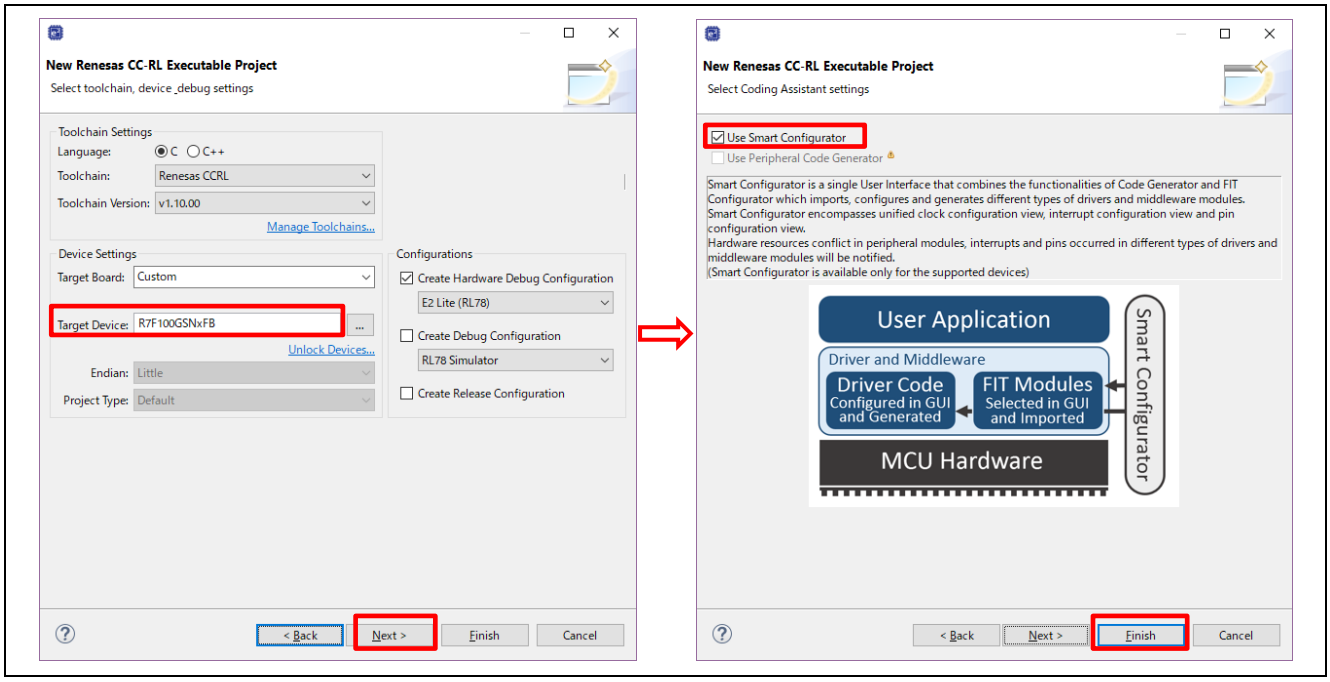

Figure 12.1 Create a new project (CC-RL)

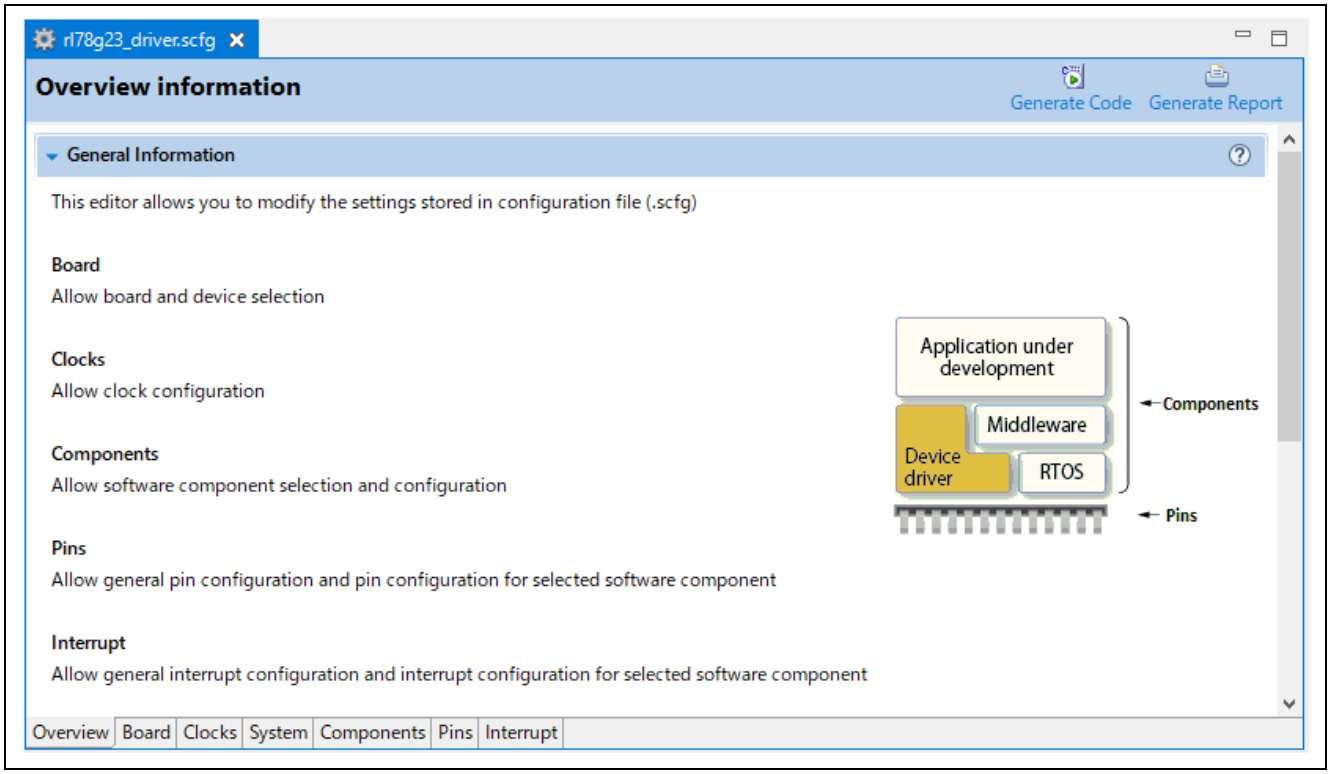

Figure 12.2 Launch Smart Configurator

2. Add a software component which is wanted to upgrade. (For example: IICA1)

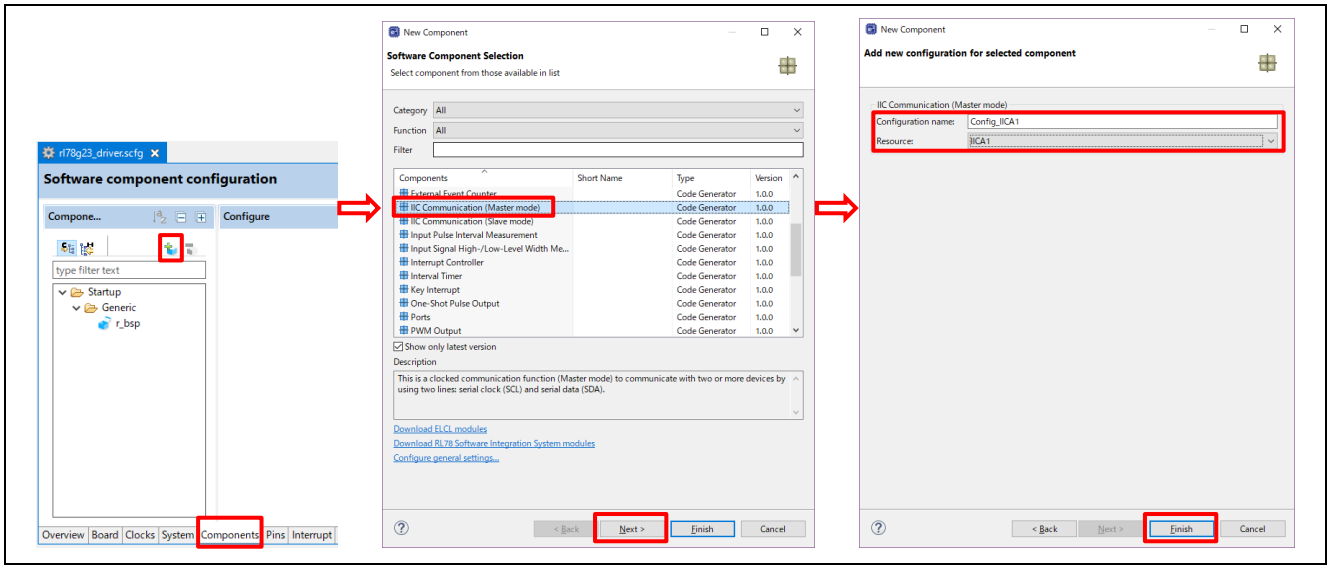

Figure 12.3 Add a software component

3. Set as red frame in the following figure and click **Generate Code**, then driver's codes are generated.

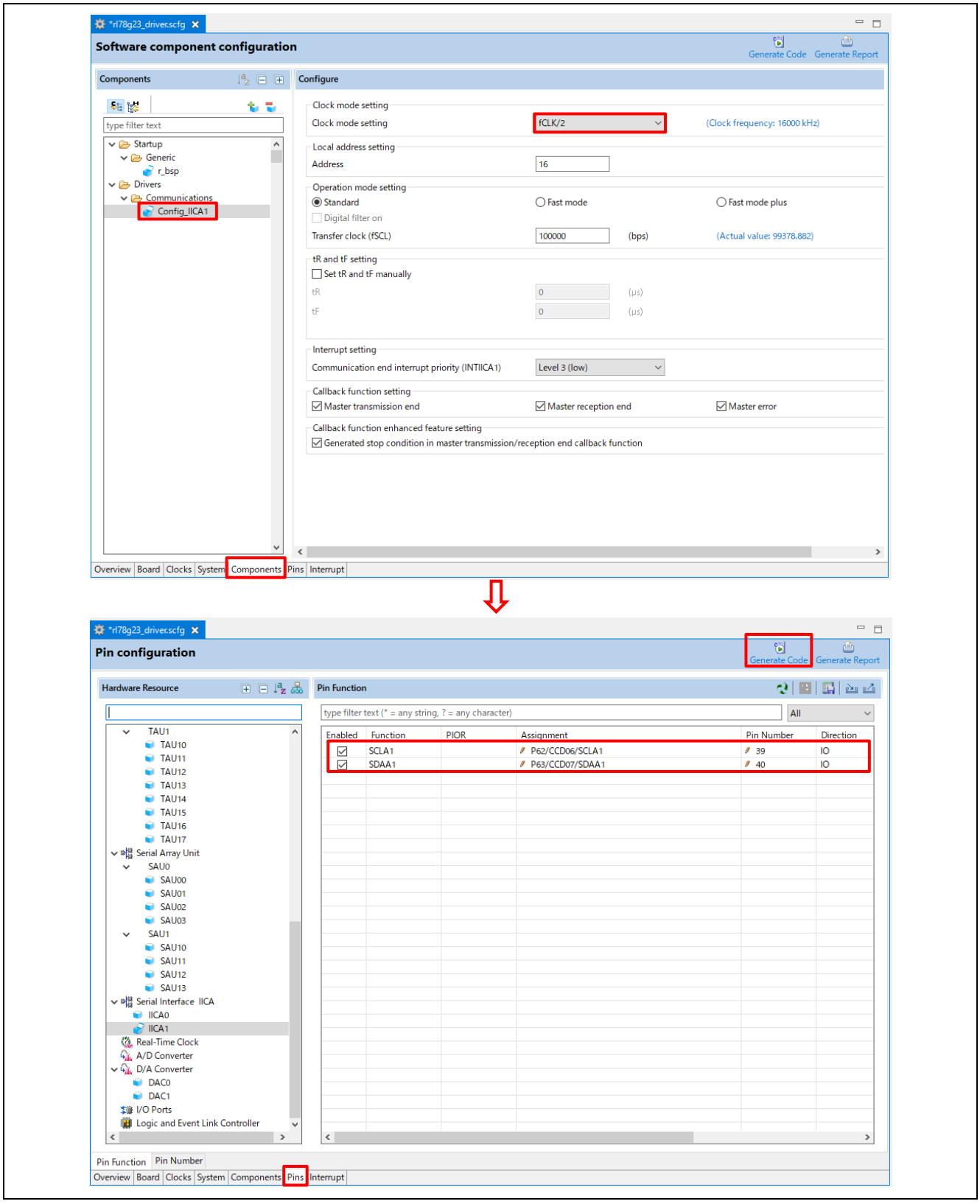

Figure 12.4 Configure driver

4. Confirm that driver's codes are generated into the file path <project name>/src/smc_gen.

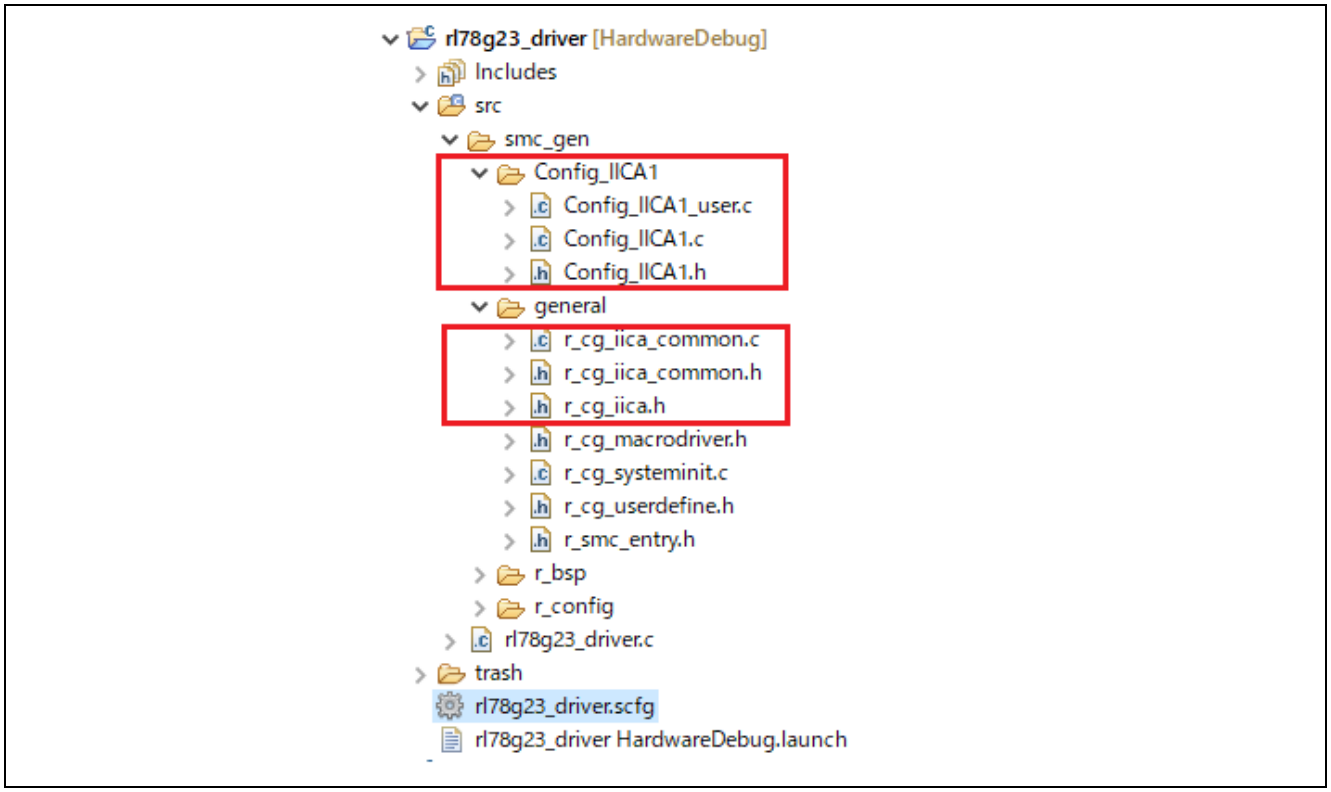

Figure 12.5 Generate driver's codes

5. Copy driver's codes to this project (aws_demos).

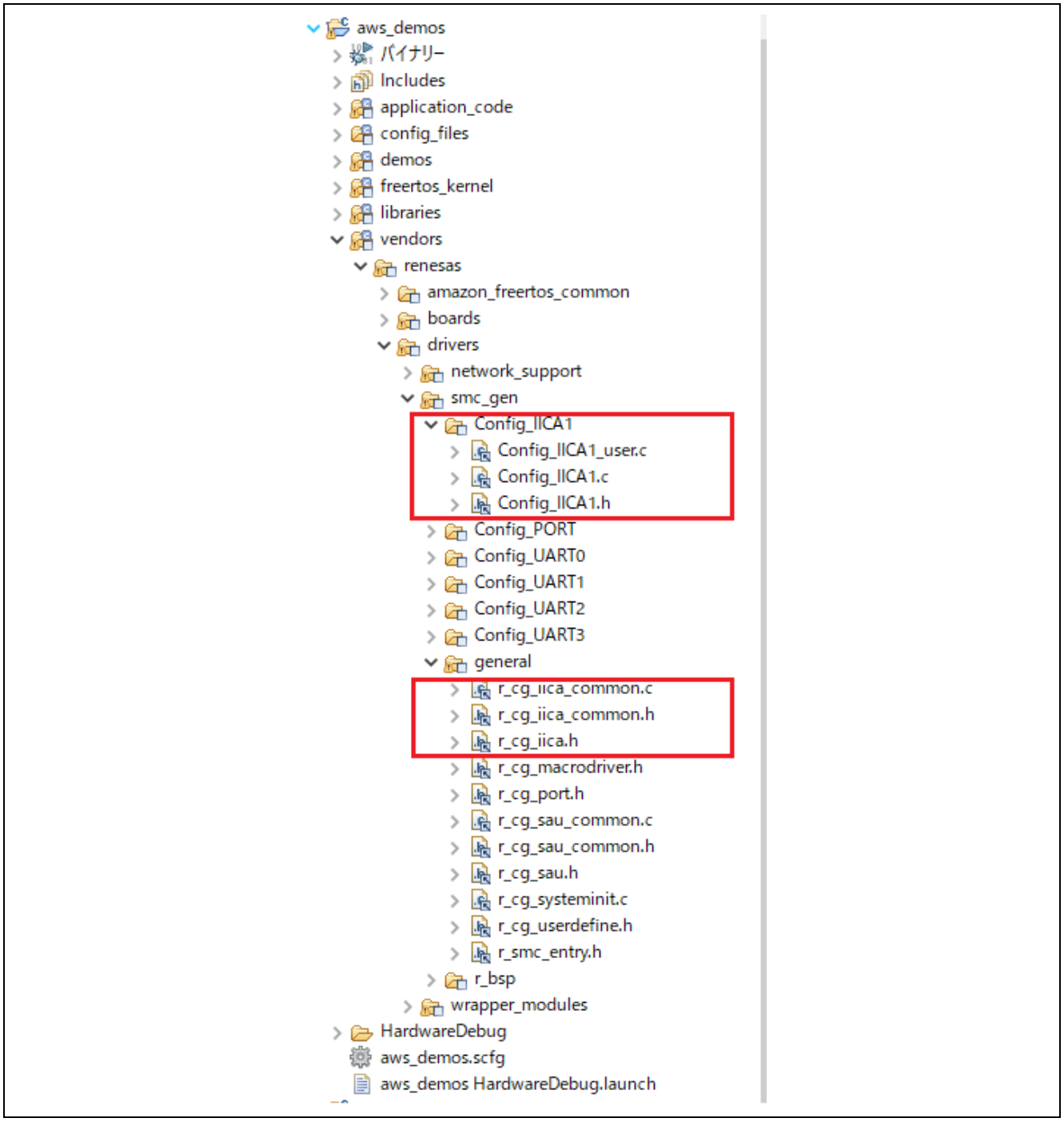

Figure 12.6 Copy driver's codes to the aws_demos project

6. Set that copied driver's codes can run.

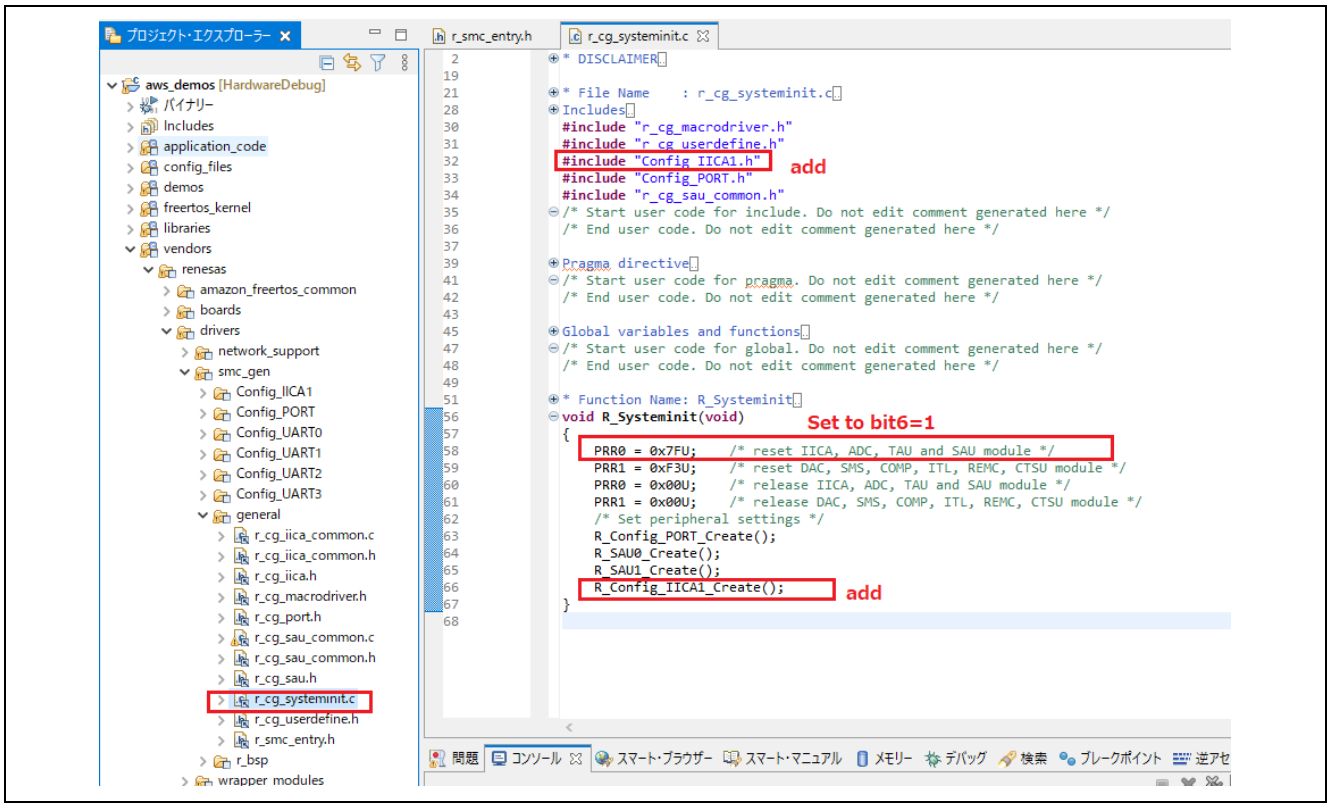

Figure 12.7 Set copied driver's codes - 1

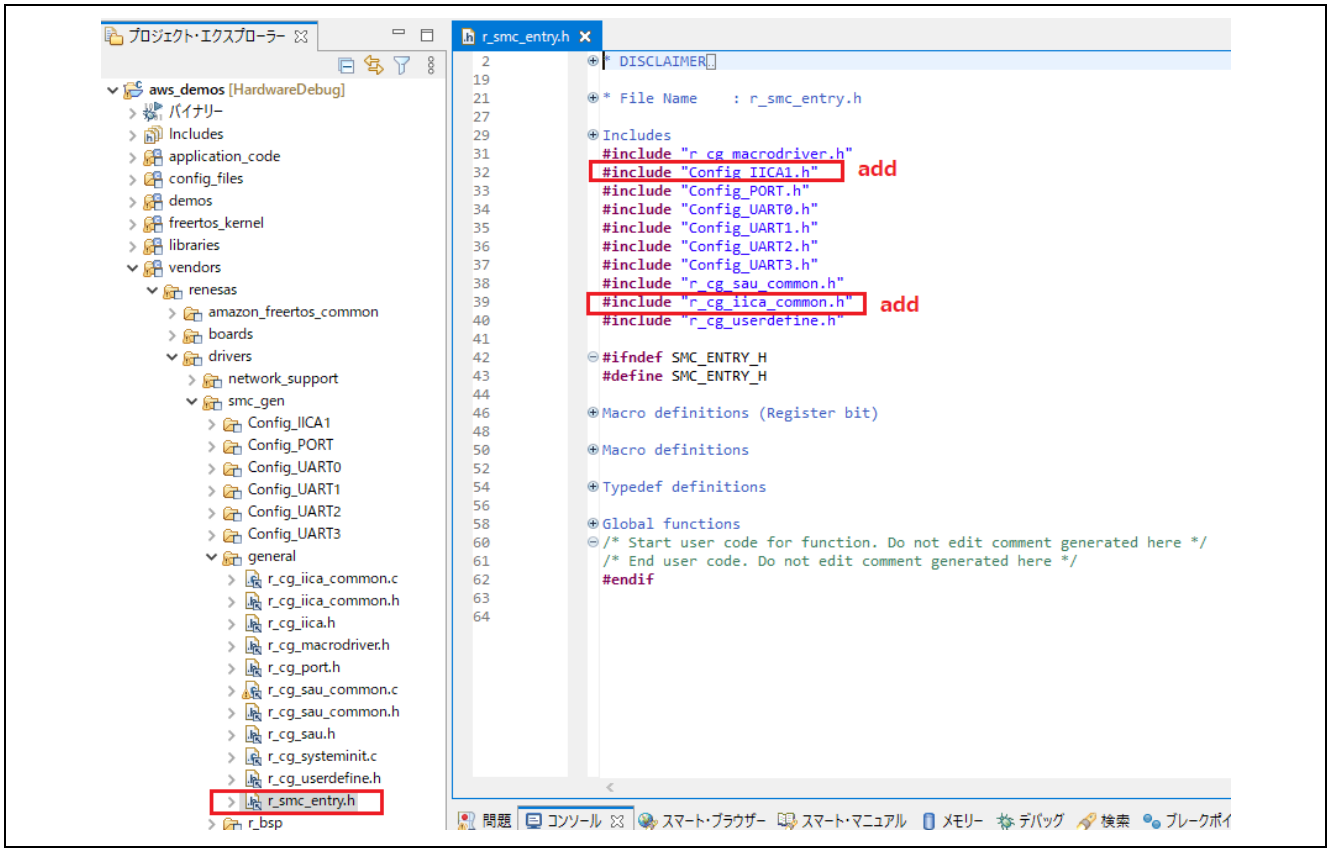

Figure 12.8 Set copied driver's codes -2

Websites and Support

AWS Amazon FreeRTOS forum: http://forums.aws.amazon.com
Renesas Amazon FreeRTOS GitHub: https://github.com/renesas/amazon-freertos

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Dec.01.21	-	First edition issued

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

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

1. Precaution against Electrostatic Discharge (ESD)
   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on
   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power 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.

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You shall be responsible for determining what licenses are required from any third parties, and obtaining such licenses for the lawful import, export, manufacture, sales, utilization, distribution or other disposal of any products incorporating Renesas Electronics products, if required.
5. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
6. Renesas Electronics products are classified according to the following two quality grades: “Standard” and “High Quality”. The intended applications for each Renesas Electronics product depends on the product’s quality grade, as indicated below.
   "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.
   "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.

   Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user’s manual or other Renesas Electronics document.
7. No semiconductor product is absolutely secure. Notwithstanding any security measures or features that may be implemented in Renesas Electronics hardware or software products, Renesas Electronics shall have absolutely no liability arising out of any vulnerability or security breach, including but not limited to any unauthorized access to or use of a Renesas Electronics product or a system that uses a Renesas Electronics product. RENESAS ELECTRONICS DOES NOT WARRANT OR GUARANTEE THAT RENESAS ELECTRONICS PRODUCTS, OR ANY SYSTEMS CREATED USING RENESAS ELECTRONICS PRODUCTS WILL BE INVULNERABLE OR FREE FROM CORRUPTION, ATTACK, VIRUSES, INTERFERENCE, HACKING, DATA LOSS OR THEFT, OR OTHER SECURITY INTRUSION (“Vulnerability Issues”). RENESAS ELECTRONICS DISCLAIMS ANY AND ALL RESPONSIBILITY OR LIABILITY ARISING FROM OR RELATED TO ANY VULNERABILITY ISSUES. FURTHERMORE, TO THE EXTENT PERMITTED BY APPLICABLE LAW, RENESAS ELECTRONICS DISCLAIMS ANY AND ALL WARRANTIES, EXPRESS OR IMPLIED, WITH RESPECT TO THIS DOCUMENT AND ANY RELATED OR ACCOMPANYING SOFTWARE OR HARDWARE, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE.
8. When using Renesas Electronics products, refer to the latest product information (data sheets, user’s manuals, application notes, “General Notes for Handling and Using Semiconductor Devices” in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
12. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
13. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
14. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.

(Note1) “Renesas Electronics” as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.

(Note2) “Renesas Electronics product(s)” means any product developed or manufactured by or for Renesas Electronics.

(Rev.5.0-1 October 2020)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.

Contact information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:
www.renesas.com/contact/.