

# 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<sup>2</sup> 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<sup>2</sup> 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	e <sup>2</sup> studio 2021-07 (21.07.0)				
environment	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-				
	<u>quick-connect-iot</u>				
	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				



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Notes:

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



## 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.

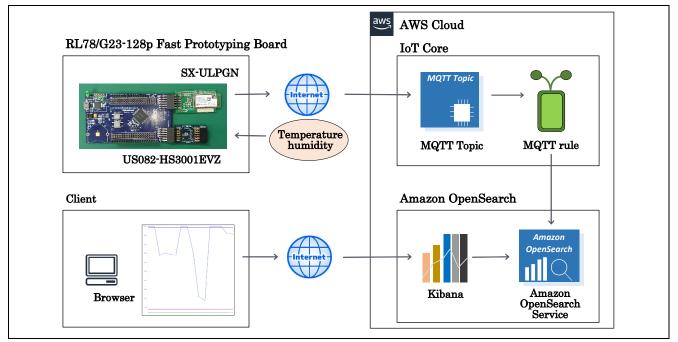


Figure 1.1 System Diagram from Acquisition of Sensor Information to Visualization



## 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<sup>2</sup> studio. Use Git to download the source code from GitHub. In this document, we recommend using Git for Windows (<u>https://gitforwindows.org/</u>).

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 e<sup>2</sup> studio.

1. Launch e<sup>2</sup> studio and specify a workspace directory.

e² studio Launcher	×
Select a directory as workspace e <sup>2</sup> studio uses the workspace directory to store its preference	and development artifacts.
<u>W</u> orkspace: <sup>0</sup>	→ Browse
□ <u>U</u> se this as the default and do not ask again  • <u>R</u> ecent Workspaces	
	Launch Cancel

Figure 2.1 Workspace Selection Menu

2. Select [File] -> [Import...].

Fil	e Edit Source Refactor Navigate Search Project Rer
	New Alt+Shift+N > th Co
_	Open File
	Recent Files >
	Close Editor Ctrl+W
	Close AL Editors Ctrl+Shift+W
	Save Ctrl+S
	Save As
R	Save All Ctrl+Shift+S
	Revert
	Move
	Rename F2
8	Refresh F5
	Convert Line Delimiters To >
0	Print Ctrl+P
25	Import
4	Export

Figure 2.2 Select Import



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

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

Select Create new projects from an archive file or directory.		×	
Select an import wizard:         type filter text	Cance		

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

Import	
Import Projects Select a directory to search for existing Eclipse projects.	
Select root directory:     Select <u>a</u> rchive file:	Browse
Projects:	Select All
	Deselect All Refresh
Options Search for nested projects	
<u>C</u> opy projects into workspace     Cl <u>o</u> se newly imported projects upon completion     Hide projects that already exist in the workspace	
Working sets	Ne <u>w</u>
W <u>o</u> rking sets:	S <u>e</u> lect
Rext > Einish	Cancel
	Carreer

#### 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

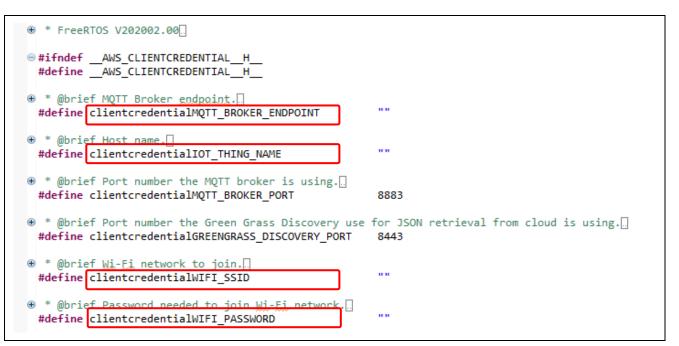


Figure 3.1 Macro Settings



## 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" (R20UT4870xxxxx).

https://www.renesas.com/document/mat/rl78g23-128p-fast-prototyping-board-users-manualrev100?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-relativehumidity-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 <<u>https://realtimelogic.com/downloads/sharkssl/</u>>

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)

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

Intended purpose: <a< th=""><th>  &gt;</th><th></th><th></th><th></th><th>`</th></a<>	>				`
Intermediate Certification	Authorities Tru	usted Ro	ot Certification Authorities	Trusted Pub	• •
Issued To			Issued By	Expiratio	^
Security Communica	tion RootCA1		Security Communicati	9/30/2023	
Security Communica	tion RootCA2		Security Communicati	5/29/2029	
Sophos Web Appliar	ice		Sophos Web Appliance	9/13/2027	
Starfield Class 2 Cer	tification Author	rity	Starfield Class 2 Certi	6/30/2034	
Starfield Root Certif			Starfield Root Certific	1/1/2038	
Symantec Enterprise		r Micr		3/15/2032	
Thawte Premium Ser				1/1/2021	
thawte Primary Roo	t CA		thawte Primary Root CA	7/17/2036	×
Import Export	<u>R</u> emo	ove		<u>A</u> dvar	nced
Certificate intended purpo	oses				
Client Authentication, Cod	le Signing, Secur	re Email,	Server Authentication		
,	5 5,			View	

Figure 4.2 Obtaining a CA List



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

Export File Format Certificates can be exported in a variety of file formats.
Select the format you want to use:
O DER encoded binary X.509 (.CER)
Base-64 encoded X.509 (.CER)
O Cryptographic Message Syntax Standard - PKCS #7 Certificates (.P7B)
Include all certificates in the certification path if possible
<u>Personal Information Exchange - PKCS #12 (.PFX)</u>
Indude all certificates in the certification path if possible
Delete the private key if the export is successful
Export all extended properties
Enable certificate privacy
Microsoft Serialized Certificate Store (.SST)

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".

Certificate Export W File to Export Specify the name of <u>Fi</u> le name:	/izard of the file you want	to export		
Specify the name of	of the file you want	to export		
File name:				
				_
			Browse	
			<u></u>	<u>N</u> ext Can

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 yyyy.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

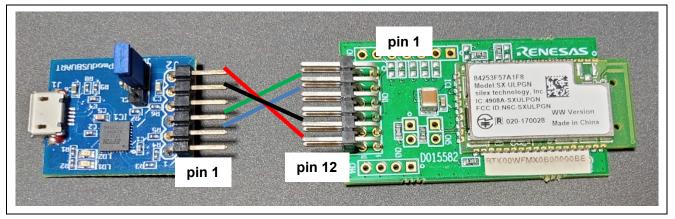


Figure 4.5 Connections between DIGILENT Pmod USBUART and SX-ULPGN



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*
- 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.

🔟 Tera Term: Send	file		×
ファイルの場所(I):	📑 aaa	- 😳 🤌 🖓	
名前	^	更新日時	種類
🖻 calist.bin		2021/04/12 12:47	Tracealyze
🛱 calist.cer		2021/04/11 12:30	セキュリティ
Cert1.bin		2021/04/12 12:47	Tracealyze
🔄 d666c26201-ce	ertificate.pem.crt	2021/04/11 9:59	セキュリティ
d666c26201-p	rivate.pem.key	2021/04/11 9:59	KEY ファイノ
d666c26201-p	ublic.pem.key	2021/04/11 9:59	KEY ファイノ
<			>
ファイル名(N):	cert1.bin		開く(O)
ファイルの種類(T):	All(*.*)	~	キャンセル
			ヘルプ(H)
Option Binary			

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*
- 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**.
- 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.

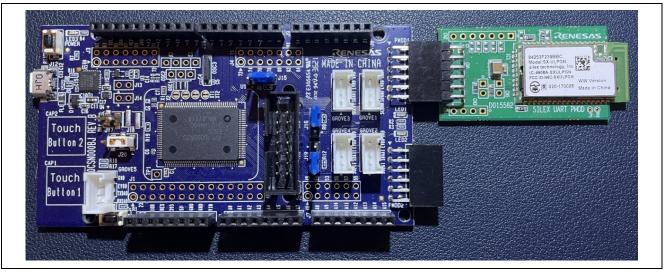


Figure 4.7 Connecting the SX-ULPGN to the RL78/G23-128p Fast Prototyping Board



## 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.

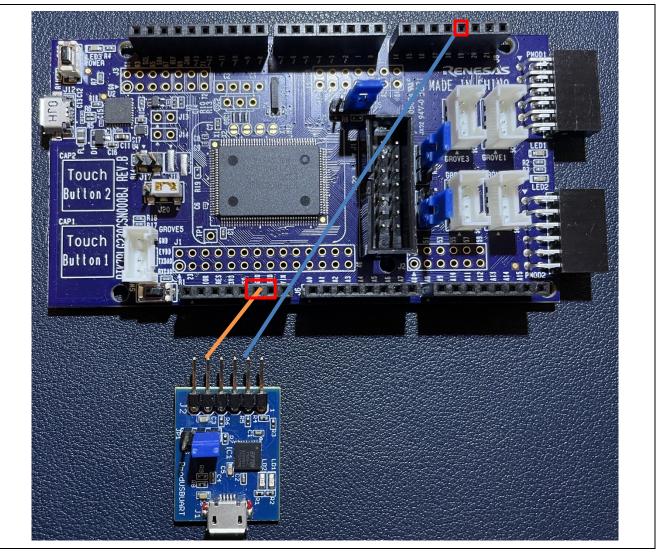


Figure 4.8 Connecting the DIGILENT Pmod USBUART to the RL78/G23-128p Fast Prototyping Board



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.

Debug Configurations			-	- 🗆 X		
Create, manage, and run configurations				Ť		
	Name: aws_demos Hare	dwareDebug				
type filter text	📄 Main 🛛 🕸 Debug	ger 🕨 🕨 Startup 🦆 Sour	ce 🔲 <u>C</u> ommon			
C/C++ Application C/C++ Remote Application	Project:					
EASE Script	aws_demos			<u>B</u> rowse		
GDB Hardware Debugging	C/C++ Application:					
C GDB Simulator Debugging (RH850)         Image: A state of the s						
Java Application			<u>V</u> ariables Searc <u>h</u> Project	B <u>r</u> owse		
🖶 Launch Group 🍉 Launch Group (Deprecated)	Build (if required) bef	ore launching				
Remote Java Application	Build Configuration:	Select Automatically		~		
✓ C <sup>3</sup> Renesas GDB Hardware Debugging	C Enable auto build		O Disable auto build			
c* aws_demos HardwareDebug c* Renesas Simulator Debugging (RX, RL78)	<ul> <li>Use workspace set</li> </ul>	tings	Configure Workspace Settings			
Filter matched 13 of 15 items			Re <u>v</u> ert	Apply		
	L					
?			<u>D</u> ebug	Close		

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.

Debug Configurations		_				
Create, manage, and run configurations Erase Flash on Start is Enabled. Please Disable this	option after sucessful connection.		TO.			
Image: Second secon	Name: aws_demos HardwareDebug	<u>Common</u>				
C C/C++ Application C C/C++ Remote Application EASE Script GDB Hardware Debugging	Debug hardware: E2 Lite (RL78) V Target D	Device: R7F100GSN				
© GDB Simulator Debugging (RH850)	Clock	settings				
😇 Java Applet	Main Clock Frequency[MHz]	Using Internal Clock	~			
Java Application	Sub Clock Frequency[kHz]	Using Internal Clock	~			
🚭 Launch Group	Monitor Clock	System	~			
	Launch Group (Deprecated)     Connection with Target Board					
🖳 Remote Java Application	Emulator	(Auto)				
✓ C <sup>∗</sup> Renesas GDB Hardware Debugging	Low voltage OCD board	No	×			
c* aws_demos HardwareDebug	Power Target From The Emulator (MAX 200m	~				
💽 Renesas Simulator Debugging (RX, RL78)	Supply Voltage[V]	3.3	~			
	Hot Plug	No	×			
	✓ Flash		~			
Filter matched 13 of 15 items		Re <u>v</u> ert	Appl <u>y</u>			
?		<u>D</u> ebug	Close			

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.

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

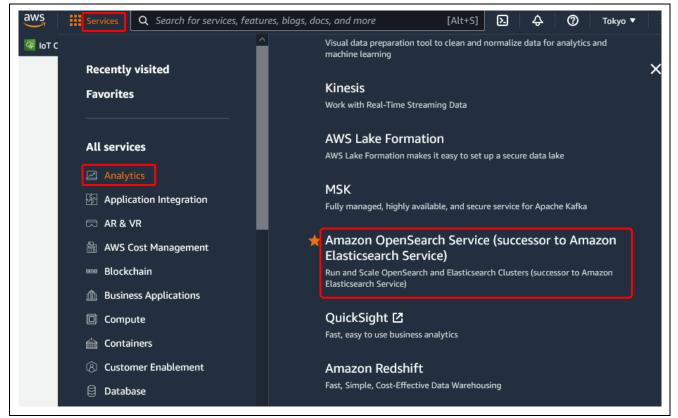


Figure 6.1 Selecting Amazon OpenSearch Service

2. Click Domains -> Create domain.

Amazon OpenSearch Service (successor to	×	Amazon OpenSearch Se	ervice > Domains				
Amazon Elasticsearch Service)		Domains (1) Info	D	C	Actions <b>v</b>	Delete	Create domain
Dashboard		<b>Q</b> Filter domains			All cluste	er health 🔻	< 1 > ⊚
Domains Reserved Instance leases Packages		Name 5	⊽ Engine ⊽	Version ⊽	Status ⊽	Endpoint ⊽	Cluster health ▼
			Elasticsearch	7.9	O Active	Internet	Green
Notifications 3 New		<					
Jse the old console							





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

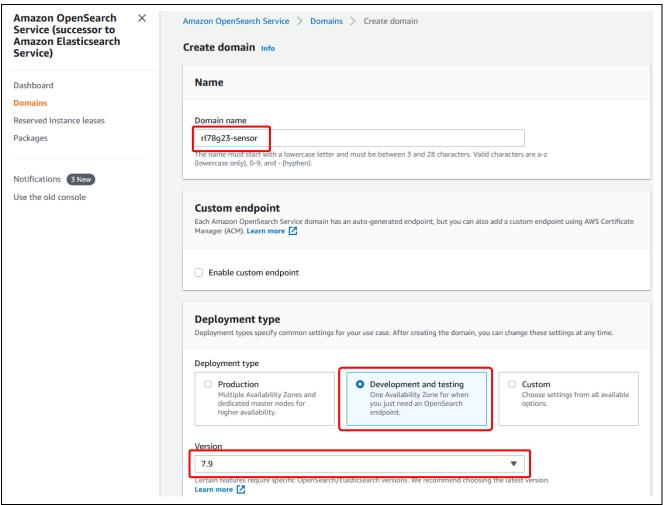


Figure 6.3 Configure domain name and deploy type



Amazon OpenSearch × Service (successor to Amazon Elasticsearch Service)	Data nodes Select an instance type that corresponds to the compute, memory, and storage needs of your application. Consider the size of your indices, number of shards and replicas, type of queries, and volume of requests. Learn more 🔀
Dashboard	Instance type
Domains	t2.small.search
Reserved Instance leases	The AWS Free Tier includes usage of up to 750 hours per month of t2.micro or t2.small instance usage and up to 10 GiB of Magnetic or General Purpose EBS storage.
Packages	Amazon OpenSearch Service Free Tier t2.small.search instance type needs EBS storage.
Notifications 3 New	(i) The selected instance type (t2.small.search) does not support encryption at rest.
Use the old console	
	Number of nodes
	1
	The number must be between 1 and 10.
	Storage type Choose a storage type for your data nodes.
	EBS volume type EBS volumes enable you to independently scale the storage resources of your domain from its compute resources. EBS volumes are most useful for domains with very large data sets, but without the need for large compute resources.
	General Purpose (SSD)
	EBS storage size per node
	10
	EBS storage size per node in GiB. Minimum 10 GiB and maximum 35 GiB.

Figure 6.4 Configure data nodes

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

Amazon OpenSearch × Service (successor to Amazon Elasticsearch Service)	<b>Network</b> Choose internet or VPC access. To enable VPC access, we use private IP addresses from your VPC, which provides an inherent layer of security. You control network access within your VPC using security groups. Optionally, you can add an additional layer of security by applying a restrictive access policy. Internet endpoints are publicly accessible. If you select public access, you should secure your domain with an access policy that only allows specific users or IP addresses to access the domain.
Dashboard Domains Reserved Instance leases Packages	Network <ul> <li>VPC access (recommended)</li> <li>Public access</li> </ul>

Figure 6.5 Configure Network



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

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.

Amazon OpenSearch × Service (successor to Amazon Elasticsearch Service)	Access policy Access policies control whether a request is accepted or rejected when it reaches the Amazon OpenSearch Service domain. If you specify an account, user, or role in this policy, you must sign your requests. Learn more 🔀
Dashboard Domains Reserved Instance leases Packages	Domain access policy         Only use fine-grained access control         Allow open access to the domain.         Do not set domain level access policy         All requests to the domain will be denied.
Notifications <b>3 New</b> Use the old console	<ul> <li>Configure domain level access policy</li> <li>Visual editor</li> <li>JSON</li> <li>Import policy</li> <li>Elements</li> <li>Allow or deny access by specifying a principal AWS account ID, account ARN, IAM user ARN, IAM role ARN, IPv4 address, or CIDR block.</li> <li>Constrained access policy to define a policy with more than 10 elements. Learn more </li> <li>Type</li> <li>Principal</li> <li>Import policy</li> <li>Add new element</li> <li>You can add 9 more elements.</li> </ul>

Figure 6.6 Configure access policy



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

Amazon OpenSearch Service (successor to Amazon Elasticsearch Service)	×	You can add 9 more elements.
Dashboard		Encryption
Domains		
Reserved Instance leases		③ The selected instance type (t2.small.search) does not support encryption at rest.
Packages		Exemption
		Encryption
Notifications 3 New		Require HTTPS for all traffic to the domain When enabled, your domain only accepts requests over HTTPS.
Use the old console		Node-to-node encryption This setting provides an additional layer of security. Each Amazon OpenSearch domain operates within a secure, dedicated VPC. Node- to-node encryption enables TLS encryption for all communications within that VPC. After you enable node-to-node encryption, you can't disable it. This setting requires Elasticsearch version 6.7 and above.
		Enable encryption of data at rest Encryption at rest secures the indices and automated snapshots associated with the domain. After you enable encryption of data at rest, you can't disable it. This setting requires Elasticsearch version 6.7 and above
		Tags - optional         You can add tags to describe your domain. A tag consists of a case-sensitive key-value pair. For example, you can define a tag with a key-value pair of Environment Name-Development. Learn More
		No tags associated with this domain
		Add new tag
		You can add 50 more tags.
		Advanced cluster settings - optional
		Cancel

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.

Amazon OpenSearch X Service (successor to Amazon Elasticsearch Service)	<ul> <li>You have successfully created an OpenSearch domain.</li> <li>Amazon OpenSearch Service &gt; Domains &gt; rl78g23-sensor</li> </ul>			
Dashboard Domains	rl78g23-sensor Info	[	Delete Actions V	
Reserved Instance leases Packages	General information			
Notifications <b>3 New</b> Use the old console	Name Domain st rl78g23-sensor ② Loadin Domain ARN Cluster he	Elasticsearch 7.9	Kibana URL - Domain endpoint -	

Figure 6.8 Stand by Until Domain status Changes to Active

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

Amazon OpenSearch Service (successor to Amazon Elasticsearch	×	Amazon OpenSearch Service > Domains > rl78g23-sensor			
Service)		rl78g23-senso	r Info		Delete Actions <b>v</b>
Dashboard					
Domains		General information	n		
Reserved Instance leases Packages Notifications <b>3 New</b> Use the old console		Name rl78g23-sensor Domain ARN	Domain status Active Cluster health Info	Version Info Elasticsearch 7.9 Service software version Info R20210816-P3 (latest)	Kibana URL Domain endpoint

Figure 6.9 Domain status: Active



## 7. Kibana Preparation

1. Click a red frame.

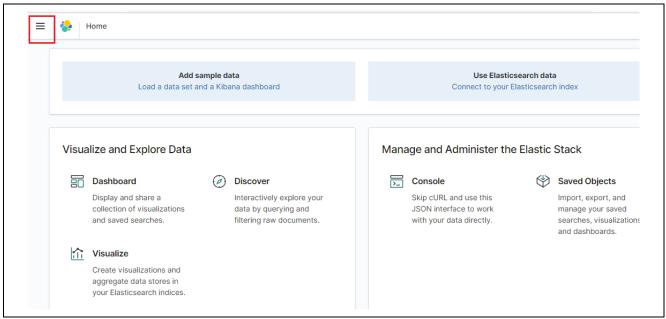


Figure 7.1 Kibana Preparation

2. Click the **Dev Tools**.

🔳 🛟 Stack Management /	Index patterns
△ <u>Home</u>	
Recently viewed	✓ atterns ②
No recently viewed items	
Kibana	>
Open Distro for Elasticsearch	> lefault
Management	✓ <sup>age: 10</sup> ✓
Dev Tools	
Stack Management	
Dock navigation	4.5

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





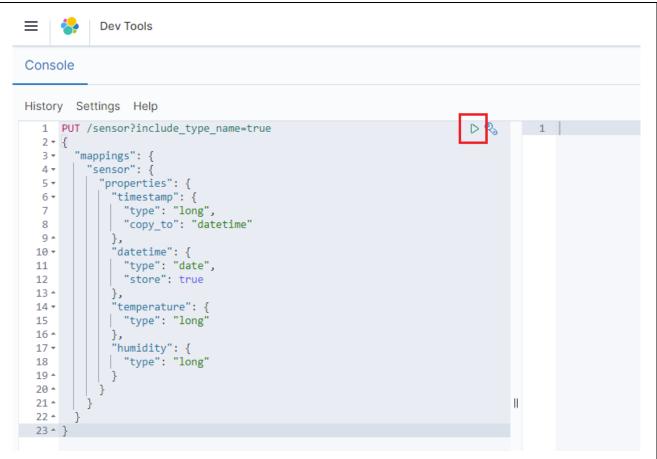


Figure 7.4 click to send request



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

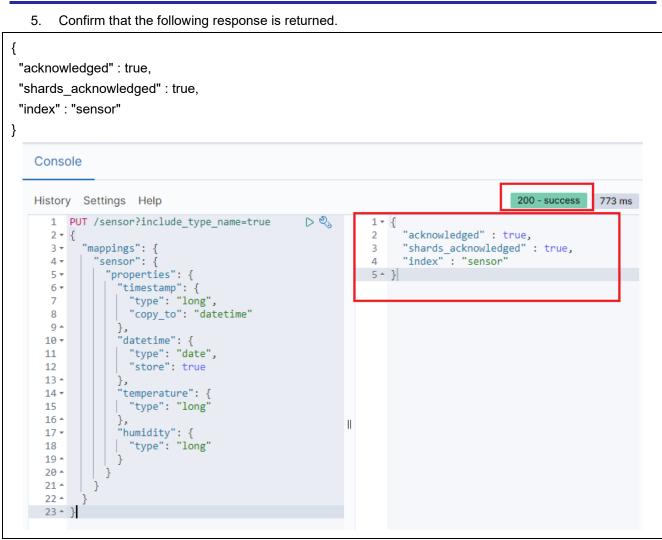


Figure 7.5 Confirming Response



## 8. IoT Rule Preparation

Create a rule by AWS IoT.

	AWS IoT >	< l	AWS IoT > Rules	
	Monitor		Rules	Create
	Activity			
►	Connect		Search rules Q	
Þ	Manage			
▶	Fleet Hub			
Þ	Greengrass			
▶	Wireless connectivity			
Þ	Secure			
Þ	Defend			
V	Act Rules Destinations			

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

Figure 8.1 Create a rule



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

#### 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 ente	er a line break after the rule query statement as the following figure.
AWS IoT ×	AWS IoT > Rules > Create a rule
Monitor Activity	Create a rule
► Connect	
Manage	Create a rule to evaluate messages sent by your things and specify what to do when a message is received (for example, write data to a DynamoDB table or invoke a Lambda function).
▶ Fleet Hub	Name
▶ Greengrass	rule_rt78g23_sensor
<ul> <li>Wireless connectivity</li> </ul>	Description
▶ Secure	
Defend	
▼ Act	
Rules	
Destinations     Test	Rule query statement Indicate the source of the messages you want to process with this rule.
Software	Using SQL version
Settings	2016-03-23
Learn	Rule query statement
Feature spotlight	SELECT <attribute> FROM <topic filter=""> WHERE <condition>. For example: SELECT temperature FROM 'iot/topic' WHERE temperature &gt; 50. To learn more, see AWS IoT SQL Reference.</condition></topic></attribute>
Documentation 🗹	<pre>learn more, see AWS IoT SQL Reference. 1SELECT *, timestamp() as timestamp FROM 'iotdemo/topic/sensor'</pre>
New console experience Tell us what you think	

Figure 8.2 Entering Code



#### 3. Click Add action.

	: actions actions to happen when the above rule is matched by an inbound message. Actions define additional activities that occi ve, like storing them in a database, invoking cloud functions, or sending notifications. (*.required)
Add action	
Error action Optionally set an ad	tion that will be executed when something goes wrong with processing your rule.
Add action	

#### Figure 8.3 Add action

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

۲	¢	Send a message to the Amazon OpenSearch Service (successor to Amazon Elas AMAZON OPENSEARCH SERVICE (SUCCESSOR TO AMAZON ELASTICSEARCH SERVICE)	sticsearch Service)
0	salesforce	Send a message to a Salesforce IoT Input Stream	
0		Send a message to IoT Analytics	
0	<b>~</b> (;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;	Send a message to an IoT Events Input	
0	e fe	Send message data to asset properties in AWS IoT SiteWise	
0		Start a Step Functions state machine execution	
0		Send a message to a downstream HTTPS endpoint	
Cancel			Configure action

#### Figure 8.4 Configure action



 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 elick Create Bala

Configure action					
Send a message to the A AMAZON OPENSEARCH SERVICE (SUC	Mazon OpenSearc	ch Service (successor t csearch service)	o Amazon Elasticsearc	h Service)	
This action will send the messa *Domain name rl78g23-sensor	age to an Amazon 🔹 🧟	OpenSearch cluster. Create a new resource			
*Endpoint					
*ID ⑦ \${newuuid()}					
*Index ⑦ sensor *Type ⑦					
sensor Choose or create a role to grant AWS	InT access to perform	this action.			
No role selected	ion access to perform			Create Role	Select

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



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

Create a new role	
A new IAM role will be created in your account. An inline polic scoped-down permissions allowing AWS IoT to access resource Name	
role_rl78g23_sensor	
	Cancel Create role

Figure 8.6 Create role

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

Choose or create a role to grant AWS IoT access to perform this action.		
rule_rl78g23_sensor Policy Attached	Create Role	Select
Cancel	A	ld action

Figure 8.7 Add action



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

Send a message to the Amazon O https://search-rl78g23-sensor-xrhy65slcazy5r4bdeni		Remove Edit ▶
Add action		
Fror action Optionally set an action that will be executed when some Add action	thing goes wrong with processing your rule.	
ags Apply tags to your resources to help organize and identif WS resources.	y them. A tag consists of a case-sensitive key-value p	air. <mark>Learn more</mark> about tagging your
ag name Provide a tag name, e.g. Manufacturer	Value Provide a tag value, e.g. Acme-C	
		Clear

Figure 8.8 Create rule



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

Success Successfully created rule.					×
AWS IOT > Rules				Create	^
Search rules	Q				
Name		Status			
role_rl78g23_sensor			Disable Enable Delete		

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.

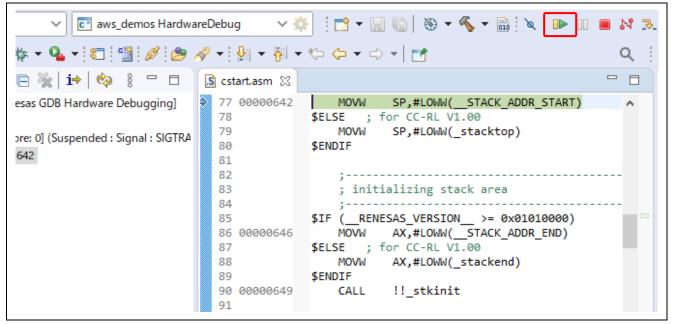


Figure 9.2 Running the Demo Program



# 10. Visualizing Sensor Information with Kibana

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

E 😽 Stack Management / Index pa	terns	
△ Home		
Recently viewed $\checkmark$ No recently viewed items	atterns <sup>®</sup>	
Kibana >		
Open Distro for Elasticsearch	efault	
Management ~	age: 10 🗸	
Dev Tools		
Stack Management		
 Dock navigation	t <u>y</u>	

Figure 10.1 Kibana Setup

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

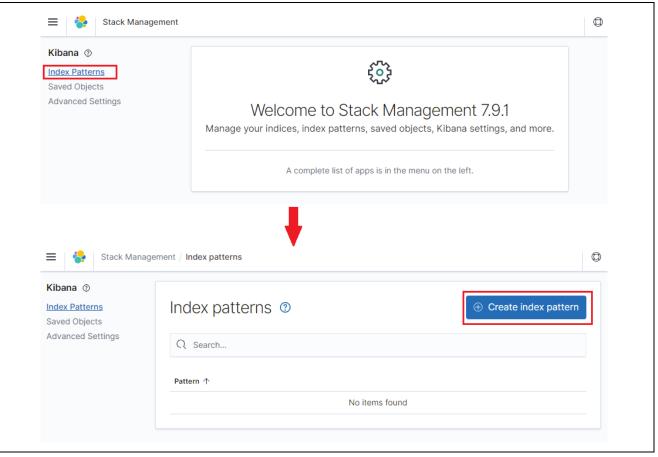


Figure 10.2 Define index pattern



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**.

Index Patterns	Create index pattern
Saved Objects Advanced Settings	An index pattern can match a single source, for example, filebeat-4-3-22, or <b>multiple</b> data sources, filebeat-*. Read documentation 2
	Step 1 of 2: Define index pattern
	sensor       Next step >         Use an asterisk (*) to match multiple indices. Spaces and the characters  /, ?, ", <, >,   are not allowed.         Next step >
	<ul> <li>Your index pattern matches 1 source.</li> </ul>
	sensor Index
	Rows per page: 10 $\sim$
Kibana ®	
Index Patterns	Create index pattern
Saved Objects Advanced Settings	An index pattern can match a single source, for example, filebeat-4-3-22, or <b>multiple</b> data sources, filebeat-*. Read documentation &
	Step 2 of 2: Configure settings
	sensor
	Select a primary time field for use with the global time filter.
	Time field Refresh
	datetime Select "datetime"
	datetime
	I don't want to use the Time Filter

Figure 10.3 Create index pattern



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

<u>x Patterns</u>	🚖 sensor			1	C 🖞
ed Objects anced Settings	Time Filter field name: 'datetime'	Default			
	This page lists every field in the by Elasticsearch. To change a field	eld type, use the Elastic	search Mappi		e as recorded
	Fields (9) Scripted fields (0	0) Source filters (0)			
	Q Search			All	field types 🗸
	Name	Type Format	Searcha	Aggrega E	xcluded
	_id	string	•	•	Ø
	_index	string	•	•	Ø
	_score	number			Ø
	_source	_source			Ø
	_type	string	•	•	Ø
	datetime (9	date	•	•	Ø
	humidity	number	•	•	Ø
	temperature	number	•	•	Ø
	timestamp	number	•	•	Ø
	Rows per page: 10 🗸				< 1 >

Figure 10.4 Confirm index pattern



	Add s Load a data set a	ample da Ind a Kiba		Use Elasticsearch da Connect to your Elasticsear
Vis	sualize and Explore Data			Manage and Administer the Elastic
UOO	Dashboard Display and share a collection of visualizations and saved searches.	Ø	<b>Discover</b> Interactively explore your data by querying and filtering raw documents.	Console
-	<b>Visualize</b> Create visualizations and aggregate data stores in your Elasticsearch indices.			
				ou were looking for?
			View full directory	y of Kibana plugins
			•	
-	Visualize			
			•	~ 11
			Create your fi	irst visualization
			You can create different vis	ualizations based on your data.
			① Create n	ew visualization

Figure 10.5 Create a Visualization



6. Click the Line icon.

Q Filter				Select a visualization type
Area	Controls	Ocoordinate Map	Data Table	Start creating your visualization by selecting a type for that visualization.
Gantt Chart	Gauge	<b>G</b> oal	e O Heat Map	
Horizontal Bar	Line	[]] Markdown	8 Metric	
Pie	Region Map	<u>П</u> TSVB	Tag Cloud	

Figure 10.6 Line



7. Click s	sensor.			
	New Line / Choose a source		>	<
	Q Search	Sort 🗸	Types 2 🗸	
	a 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**.

🕒 🗸 Search	KQL 🛗 🗸 Last 15 minutes	s Show date	C Refresh
(⇒) - + Add filter	Quick select	$\langle \rangle$	
	Last 🗸 15	minutes ~ Apply	⇒
	Commonly used		settings
	Today	Last 24 hours	
	This week	Last 7 days	
	Last 15 minutes	Last 30 days	
	Last 30 minutes	Last 90 days	
	Last 1 hour	Last 1 year	
	Recently used date range	es	
+	Last 15 minutes		
Count	Nov 9, 2021 @ 14:27:1	13.380 to Nov 9, 2021 @ 14:27:13.380	
0	Nov 9, 2021 @ 11:40:4	41.299 to Nov 9, 2021 @ 11:40:41.299	
	Last 30 minutes		
	Nov 9, 2021 @ 11:37:4	14.987 to Nov 9, 2021 @ 11:37:44.987	
	Refresh every		

Figure 10.8 Refresh every Setting



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

<b>Netrics</b>	Metrics		Metrics	
✓ Y-axis	∨ Y-axis		✓ Y-axis	$\odot = \times$
Aggregation Average help	Aggregation	Average help	Aggregation	Average help
Average 🗸 🗸	Average	$\checkmark$	Average	~
Field	Field		Field	
temperature 🗸	temperatu	re v	temperature	~
Custom label	Custom label		Custom label	
> Advanced	> Advan	ced 🕒 Add	> Advanced	
	Buckets	ADD METRIC	V Y-axis	⊚ = × Average help
		Y-axis	Average	~
		Dot size	Field	
		Dot size	humidity	~
			Custom label	
			> Advanced	
			🕀 Ad	id.

Figure 10.9 Metrics (Y-axis) Settings

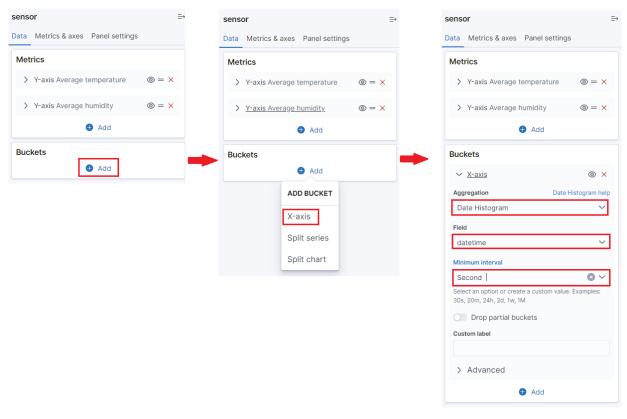


Figure 10.10 Metrics (X-axis) Settings



10. Click the Update.

🗈 🗸 Search	KQL	🕒 🗸 Last 15 minutes	S	Show dates C Refresh
🗇 – + Add filter				
(=) = + Add liiter				
		Count	sensor	$\Rightarrow$
			Data Metrics & axes	Panel settings
			Metrics	1
			✓ Y-axis	
			Aggregation	Average help
			Average	~
			Field	
÷			temperature	~
Count			Custom label	
			"	
			> Advanced	
			•	Đ Add
			Buckets	
			✓ X-axis	© ×
			Aggregation	Date Histogram help

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.

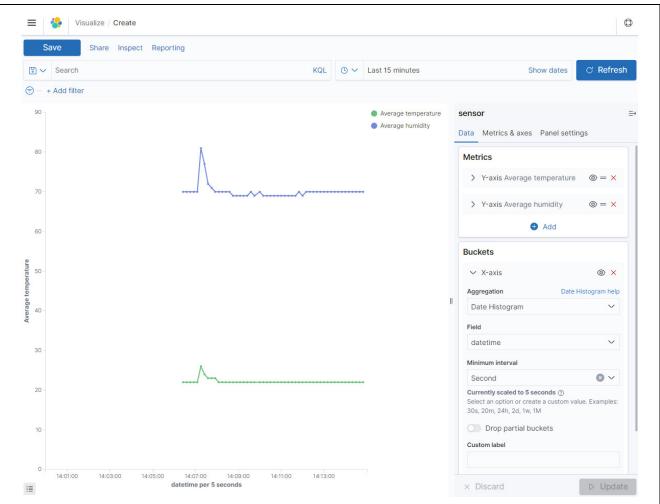


Figure 10.12 Visualization of Humidity and Temperature Sensor Information



# 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.

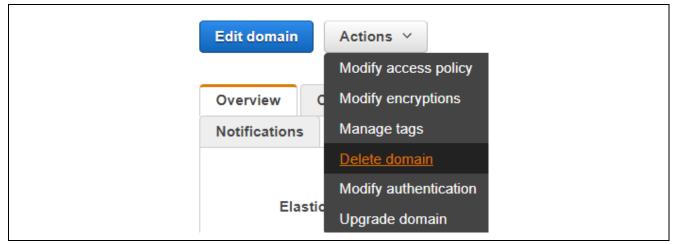


Figure 11.1 Don't Forget to Delete Your Amazon OpenSearch Service Domain!



# 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.

S – – ×	3 – D X
New Renesas CC-RL Executable Project Select toolchain, device_debug settings Toolchain Settings Language: OC OC++ Toolchain: Renesas CCRL  Toolchain Version: V1.10.00 V	New Renesas CC-RL Executable Project Select Coding Assistant settings
Ioochain version:     VI.1000       Manage Toolchains     Configurations       Device Settings     Configurations       Target Board:     Custom       Target Device:     R7F 100GSNxFB	Smart Configurator encompasses unified clock configuration view, interrupt configuration view and pin configuration view. Hardware resources conflict in peripheral modules, interrupts and pins occurred in different types of drivers and middleware modules will be notified. (Smart Configurator is available only for the supported devices) User Application Driver and Middleware Driver Code Configured in GUI and Generated MCU Hardware MCU Hardware Driver and Middleware MCU Hardware MCU Hardware
Cancel	(?) < Back Next > Finish Cancel

Figure 12.1 Create a new project (CC-RL)



🔅 rl78g23_driver.scfg 🗙			
Overview information	Generate Code	Generate Repo	rt
✓ General Information		?	^
This editor allows you to modify the settings stored in configuration file (.scfg)			
Board Allow board and device selection			
Clocks Allow clock configuration	Application under development Middleware	<ul> <li>Components</li> </ul>	
Components Allow software component selection and configuration	Device RTOS	← Pins	
Pins Allow general pin configuration and pin configuration for selected software component			
Interrupt Allow general interrupt configuration and interrupt configuration for selected software component			~
Overview Board Clocks System Components Pins Interrupt			

Figure 12.2 Launch Smart Configurator

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

	3 New Component	- 🗆 ×		New Component		
	Software Component Selection Select component from those available in list	<del></del>		Add new configuration	on for selected component	
	Category  All Function  All Filter	~		- IIC Communication (N Configuration name: Resource:	Aaster mode) Config_IICA1 IICA1	
toftware component configuration	Components Short Name Type	Generator 1.0.0				
Compone 👌 🕀 Configure	HIC Communication (Slave mode) Code	Generator 1.0.0 Generator 1.0.0 Generator 1.0.0				
Type filter text	H Interrupt Controller Code	Generator 1.0.0 Generator 1.0.0 Generator 1.0.0				
✓ ⊱ Startup ✓ ⊱ Generic	Key Interrupt     Cod     One-Shot Pulse Output     Cod	Generator 1.0.0 Generator 1.0.0 Generator 1.0.0				
e r_bsp		Generator 1.0.0 ¥				
	Description This is a clocked communication function (Master mode) to communicate with using two lines: serial clock (SCL) and serial data (SDA).	two or more devices by				
	Coxinicad ELCL modules Download ELCL Software Integration System modules Configure general settings	~				
verview Board Clocks System Components Pins Interrupt	? <back next=""></back>	inish Cancel	_	(?)	< Back Next >	Finish Cancel

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.

Components	ª <sub>2</sub> = ∓	Configure					
	ت ن	Clock mode			fCLK/2 V	(C) 1.6 access	
type filter text		Clock mode	setting		fCLK/2 ~	(Clock frequency: 16000 k	(HZ)
✓  → Startup  ✓  → Generic	^	Local addre	ss setting				
v i denenc i r_bsp		Address			16		
🗸 🗁 Drivers		Operation n	node setting				
Communicatio		Standard			○ Fast mode	○ Fast mode plus	
		🗌 Digital fil					
		Transfer cloo	ck (fSCL)		100000 (bps)	(Actual value: 99378.88	32)
		tR and tF se					
			d tF manually				
		tR			0 (µs)		
		tF			0 (µs)		
		Interrupt set					
		Communica	tion end interrupt	priority (INTIICA1)	Level 3 (low) $\checkmark$		
			nction setting				
		Master tr	ansmission end		Master reception end	Master error	
			nction enhanced f		on/reception end callback function		
rerview Board Clocks S	v iystem Components P	<		Û			2
ŧ *r178g23_driver.scfg ×				Û		Generate Code	
*rl78g23_driver.scfg × Pin configuration		ins Interrupt	on	Û	,	Generate Code	
*rl78g23_driver.scfg × Pin configuration	ystem Components F	Pin Function		U ng. ? = any characte	n	Generate Code	Cenerate Report
*1789/23_driversofg × Pin configuration Hardware Resource	ystem Components F	Pin Function	r text (* = any strir	L ng. ? = any characte PIOR	r) Assignment	Generate Code	Generate Report
Intrag23_driverscfg × Pin configuration Hardware Resource V TAU1 ♥ TAU1 ♥ TAU10	ystem Components F	Pin Function  type filte  finabled	r text (* = any strin Function SCLA1		Assignment P62/CCD06/SCLA1	Generate Code	Generate Report
*1789/23_driversofg × Pin configuration Hardware Resource	ystem Components F	ins Interrupt  Pin Functio  type filte  Fnabled	r text (* = any strir Function		Assignment	Generate Code	Generate Report
Intrage2 driversofg × Pin configuration Hardware Resource          ✓       TAU1         ✓       TAU12         ✓       TAU13	ystem Components F	Pin Function  type filte  finabled	r text (* = any strin Function SCLA1		Assignment P62/CCD06/SCLA1	Generate Code	Generate Report
<ul> <li>**in78g/23_driversofg ×</li> <li>Pin configuration</li> <li>Hardware Resource</li> <li>TAU1</li> <li>TAU10</li> <li>TAU10</li> <li>TAU11</li> <li>TAU11</li> <li>TAU12</li> </ul>	ystem Components F	Pin Function  type filte  finabled	r text (* = any strin Function SCLA1		Assignment P62/CCD06/SCLA1	Generate Code	Generate Report
<ul> <li>► 1178g23 driverss(g ×</li> <li>► TAU1</li> <li>► TAU1</li> <li>■ TAU10</li> <li>■ TAU11</li> <li>■ TAU12</li> <li>■ TAU12</li> <li>■ TAU13</li> <li>■ TAU13</li> <li>■ TAU14</li> <li>■ TAU15</li> <li>■ TAU15</li> </ul>	ystem Components F	Pin Function  type filte  finaled	r text (* = any strin Function SCLA1		Assignment P62/CCD06/SCLA1	Generate Code	Generate Report
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> 1178g23_diversofg       ×         Pin configuration         Hardware Resource         (         > TAU1         ● TAU10         ● TAU10         ● TAU10         ● TAU10         ● TAU11         ● TAU12         ● TAU13         ● TAU14         ● TAU15         ● TAU16         ● TAU17         ● IS Serial Array Unit         ● SAU00         ● SAU01         ● SAU01         ● SAU01         ● SAU01         ● SAU01         ● SAU03         ✓ SAU03         ● SAU12         ● SAU11         ● SAU12         ● SAU13         ● Erial Interface I         ● ICA3         @ ICA4	ystem Components F	Pin Function  type filte  finaled	r text (* = any strin Function SCLA1		Assignment P62/CCD06/SCLA1	Generate Code	Generate Report
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Figure 12.4 Configure driver



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

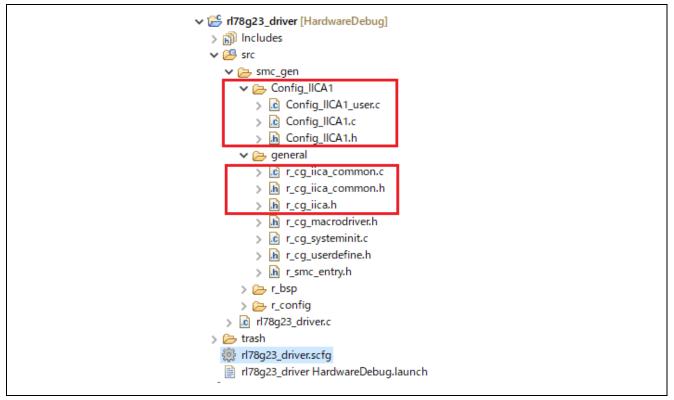


Figure 12.5 Generate driver's codes



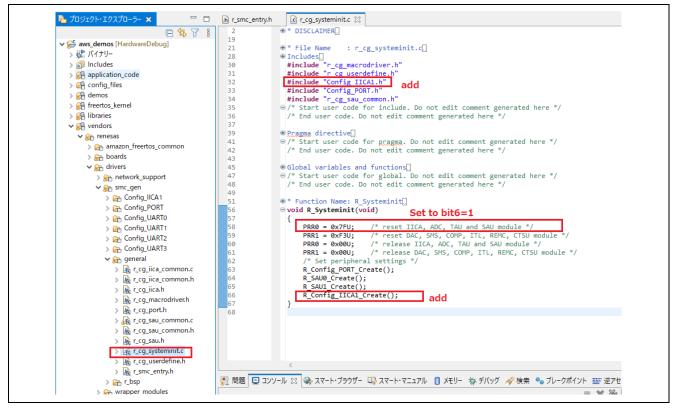
5. Copy driver's codes to this project (aws\_demos).

✓ ピ aws_demos > 操作 バイナリー	
> Dincludes	
> 🔏 application_code	
> 🚰 config_files	
> 🚰 demos	
> 🔐 freertos_kernel	
> 🔐 libraries	
V 🚰 vendors	
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> 🔁 amazon_freertos_common	
> 🔂 boards	
✓ in drivers	
> 🔂 network_support	
✓ 🔐 smc_gen	
✓ Config_IICA1	
> 🙀 Config_IICA1_user.c	
> 🙀 Config_IICA1.c	
> 🙀 Config_IICA1.h	
> Config_PORT	
> 🚰 Config_UART0	
> 🚰 Config_UART1	
> 🔁 Config_UART2	
> 🔁 Config_UART3	
✓ 🔐 general	
> 🙀 r_cg_lica_common.c	
> 🙀 r_cg_iica_common.h	
> 🙀 r_cg_iica.h	
> 🙀 r_cg_macrodriver.h	
> 🙀 r_cg_port.h	
> 🙀 r_cg_sau_common.c	
> 🙀 r_cg_sau_common.h	
> 🙀 r_cg_sau.h	
> 🙀 r_cg_systeminit.c	
> 🙀 r_cg_userdefine.h	
> 🙀 r_smc_entry.h	
> 🚰 r_bsp	
> 🔐 wrapper_modules	
> 🦳 HardwareDebug	
aws_demos.scfg	
aws_demos.strg	

Figure 12.6 Copy driver's codes to the aws\_demos project



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





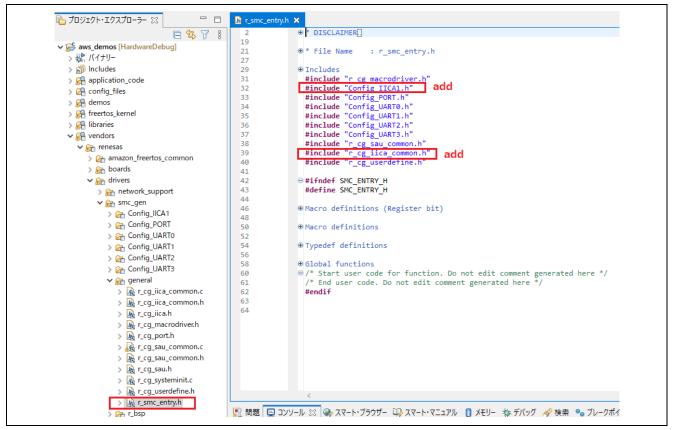


Figure 12.8 Set copied driver's codes -2



# Websites and Support

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



# **Revision History**

		Description	
Rev.	Date	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 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 systemevaluation test for the given product.

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(Rev.5.0-1 October 2020)

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