



# AmebaD Amazon FreeRTOS Getting Started Guide

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**USING THIS DOCUMENT**

Though every effort has been made to ensure that this document is current and accurate, more information may have become available subsequent to the production of this guide.

# 1 AmebaD RTL8722DM Board

## 1.1 AmebaD Demo EVB

Ameba Demo board home page: <https://www.amebaiot.com/amebad/>

### Ameba RTL8722DM Board (AMB 21)



[Manual](#) / [Schematic](#) / [Layout](#)

Buy it 

#### CPU

- 32-bit Arm®Cortex®-M4, up to 200MHz
- 32-bit Arm®Cortex®-M0, up to 20MHz

#### Memory

- 512KB SRAM + 4MB PSRAM

#### Key Features

- Integrated 802.11a/n Wi-Fi SoC
- Trustzone-M Security
- Hardware SSL Engine
- Root Trust Secure Boot
- USB Host/Device
- SD Host
- BLE5.0
- Codec
- LCDC
- Key Matrix

#### Other Features

- 1 PCM interface
- 4 UART interface
- 1 I2S Interface
- 2 I2C interface
- 7 ADC
- 17 PWM
- Max 54 GPIO

## 1.2 PCB Layout Overview

The PCB layout of 2D and 3D are shown in Fig 1-1 and Fig 1-2.

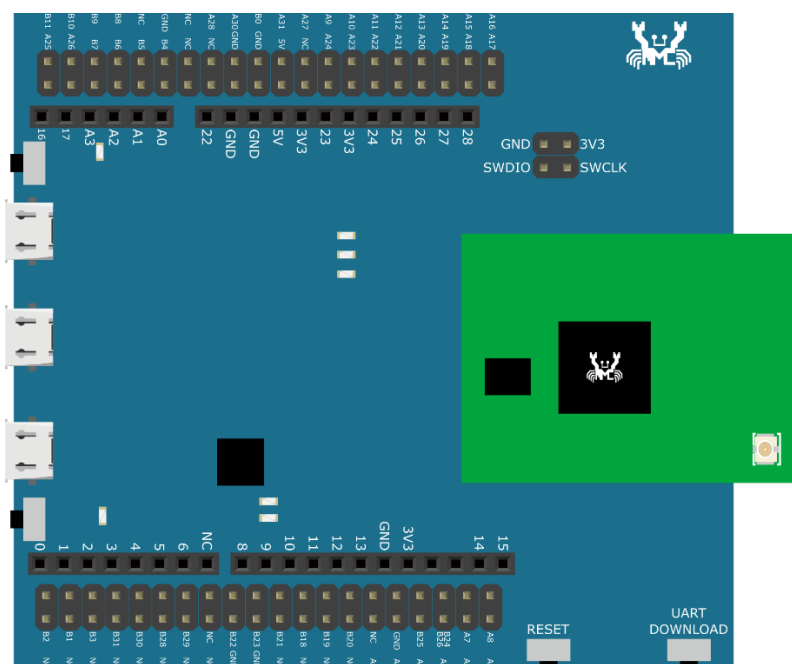
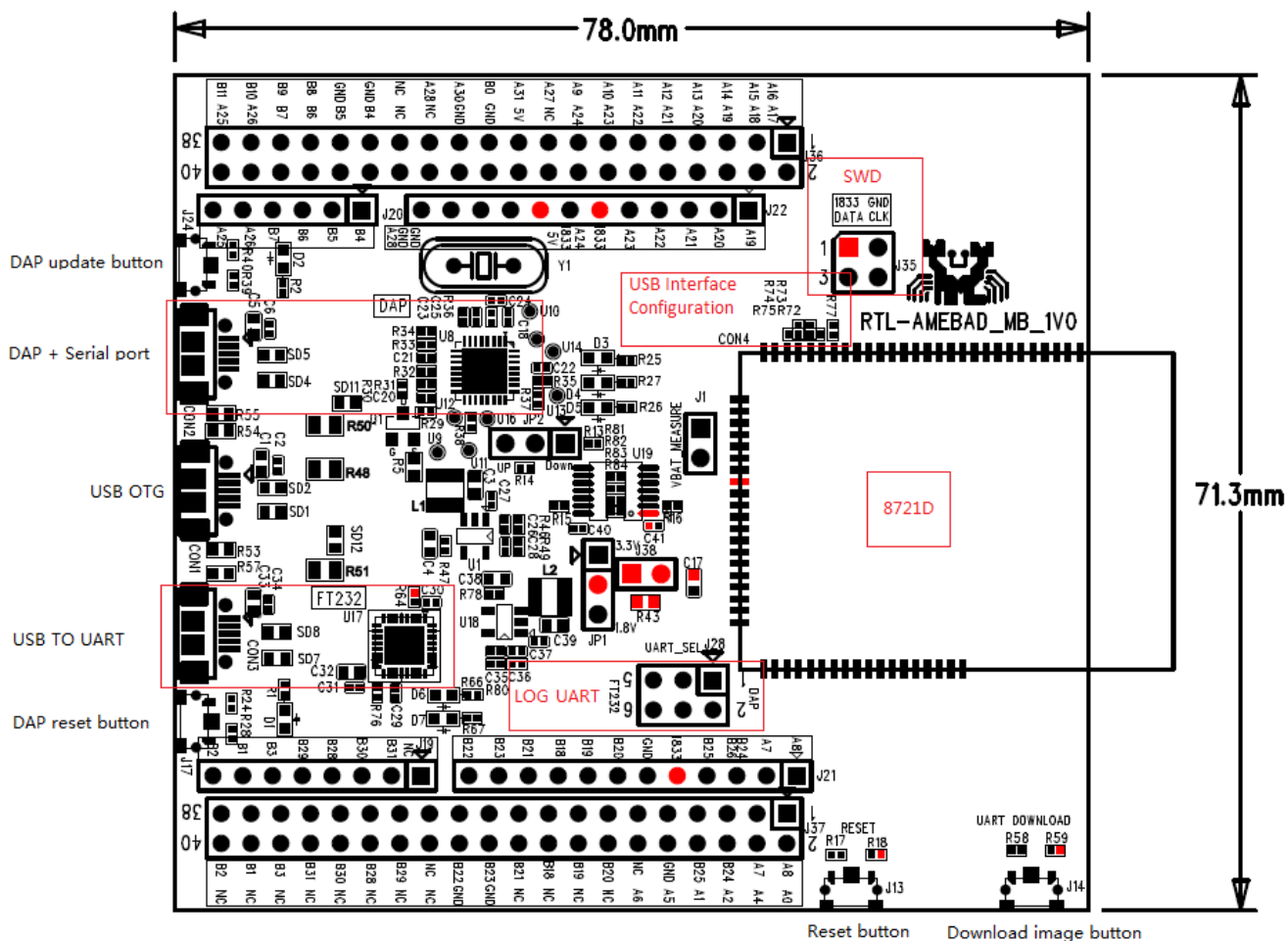


Fig 1-2 Demo board – PCB layout (3D)

## 1.3 Pin Out

The pin out board is shown in Fig 1-3.

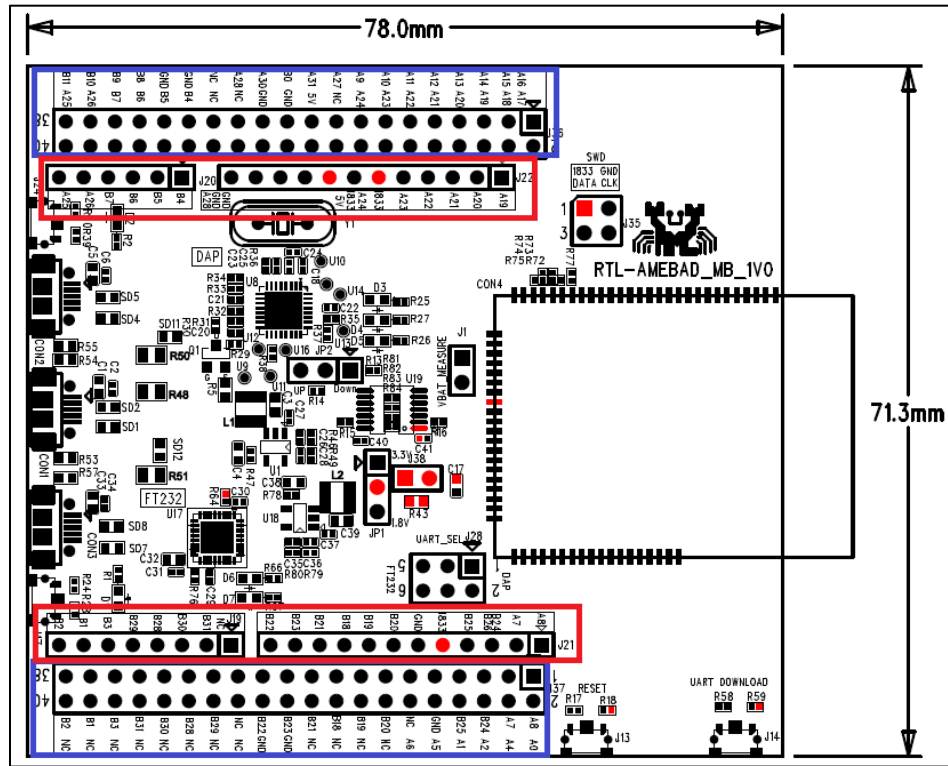


Fig 1-3 Demo board – pin out

There are four rows of pins on the board.

- The pins in the red box are used for Arduino REF.
- The pins in the blue box are all the GPIO pins.

## 1.4 DC Power Supply

The 3.3V/1.8V power supply board is shown in Fig 1-4.

- Jump JP1 is used to select 3.3V or 1.8V power supply
- Jump J38 is for current test. You can test the current power after taking off the R43.

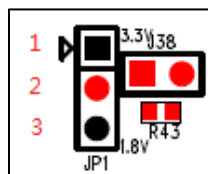


Fig 1-4 Demo board – 3.3V/1.8V power supply

When you select power supply, refer to Table 1-1.

Table 1-1 3.3V/1.8V power supply selection

Power Supply Select	JP1
3.3V	1-2 connected
1.8V	2-3 connected

## 1.5 USB Interface Configuration

The USB interface configuration board is shown in Fig 1-5 and Fig 1-6.

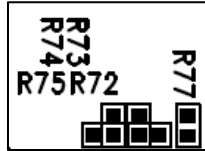


Fig 1-5 Mother board – USB interface configuration

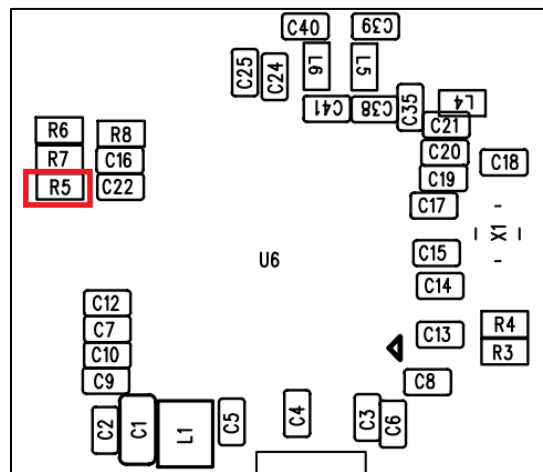


Fig 1-6 Module board – USB interface configuration

For normal GPIO usage by default, R72/R75/R77 on mother board will part on with 0 Ohm resistors, R5 on module board needs to take off. For USB usage, you need to take off R77, part on R73&R74 with 0 Ohm resistors on mother board and part on R5 on module board with a 12K Ohm 1% precision resistor.

## 1.6 LOGUART

The LOGUART board is shown in Fig 1-7. When you select LOGUART, please refer to Table 1-2.

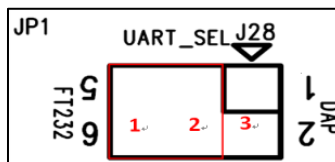


Fig 1-7 Demo board – LOGUART

Table 1-2 LOGUART selection

LOGUART Select	JP1
FT232	1-2 connected
DAP	2-3 connected

## 1.7 SWD

The SWD board is shown in Fig 1-8.

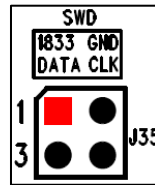


Fig 1-8 Demo board – SWD

**Note:** For 1V0 board, there is an issue, you should use CLK as DATA, and use DATA as CLK.

## 1.8 VBAT ADC

The VBAT ADC board is shown in Fig 1-9. J1 is used to test VBAT ADC.

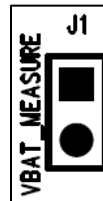
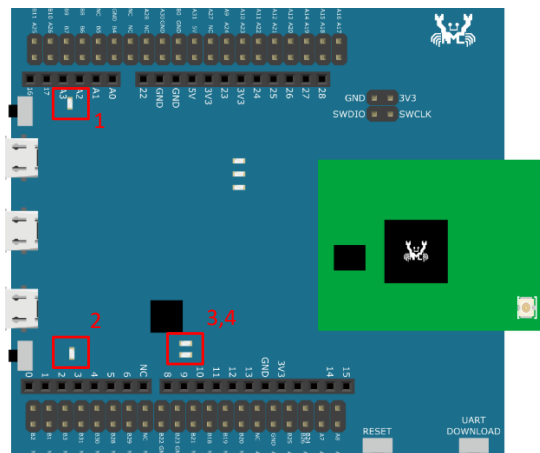


Fig 1-9 Demo board – VBAT ADC

## 1.9 LED State

There are four LED on the AmebaD EVB. LED1 and LED2 lights steady green when device have power. LED3 and LED4 go with log uart, they flash red and green when uart communicating.

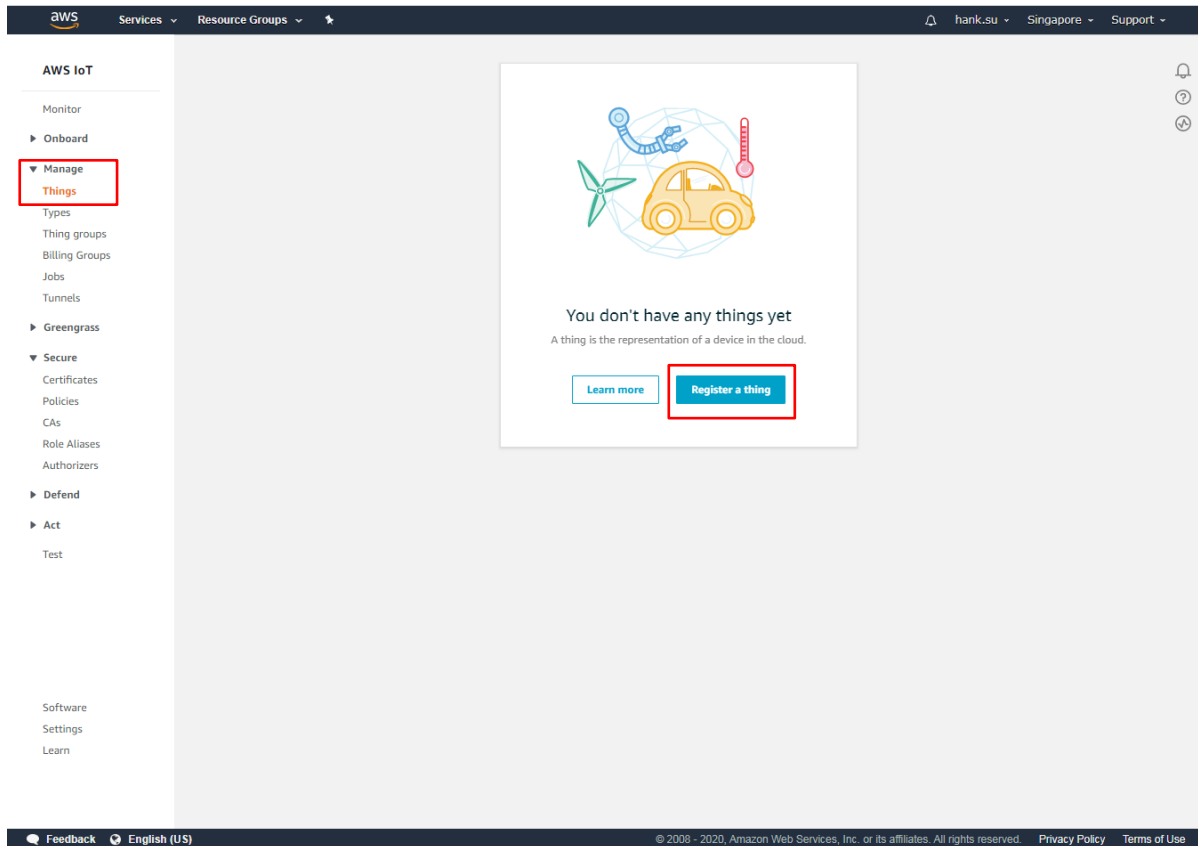


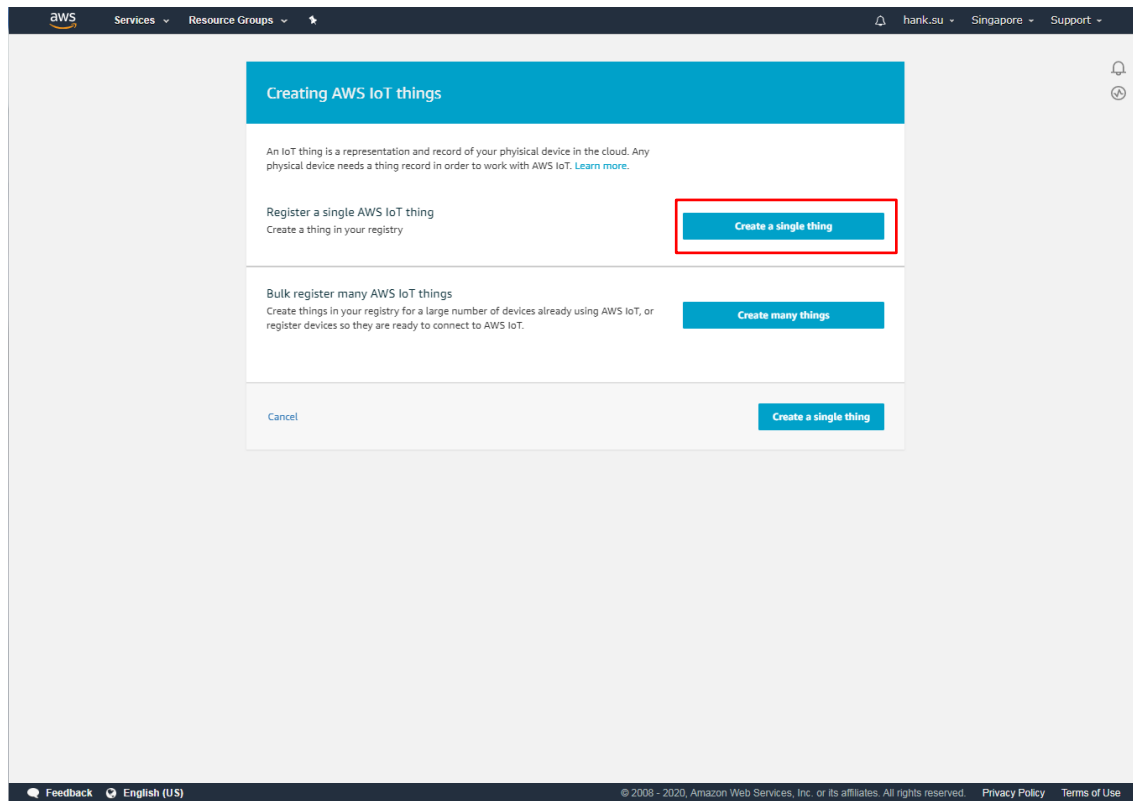


## 2 Configure AWS IoT Core

### 2.1 Create a New Device

To create a new device, navigate to Manage -> Things in the left-hand navigation menu. Then click “Register a thing”.





**Creating AWS IoT things**

An IoT thing is a representation and record of your physical device in the cloud. Any physical device needs a thing record in order to work with AWS IoT. [Learn more.](#)

Register a single AWS IoT thing  
Create a thing in your registry

**Create a single thing**

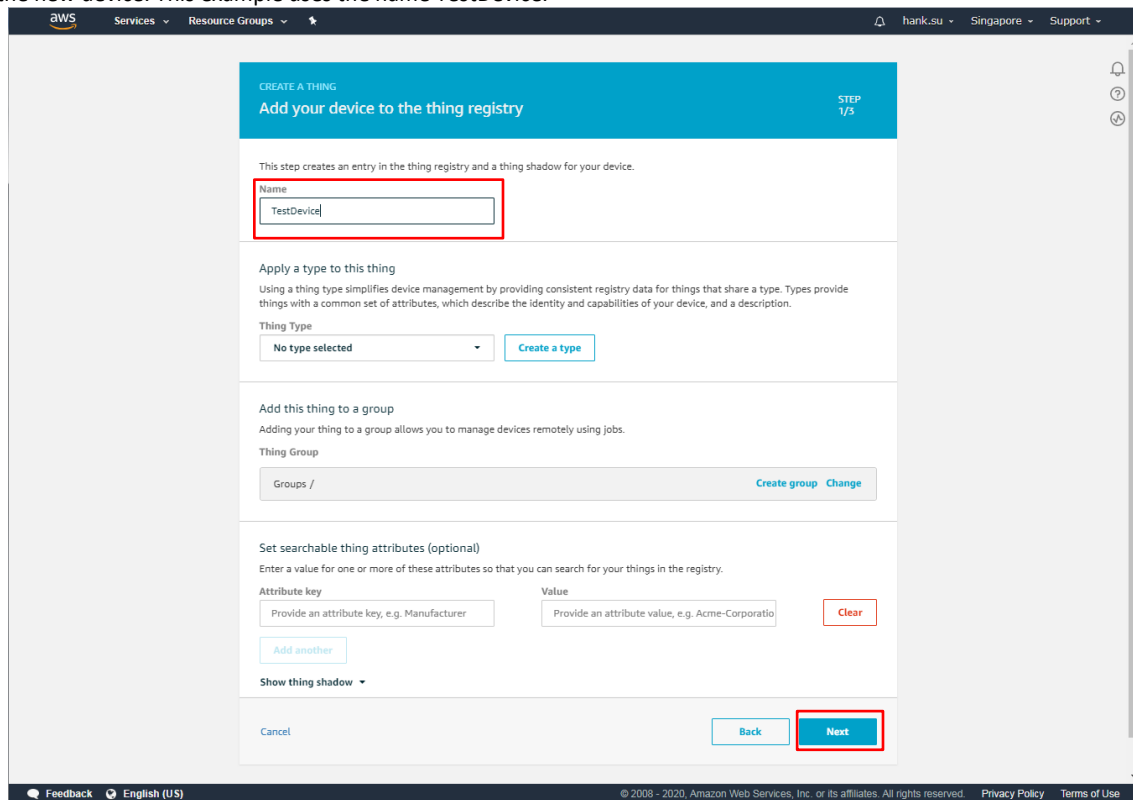
Bulk register many AWS IoT things  
Create things in your registry for a large number of devices already using AWS IoT, or register devices so they are ready to connect to AWS IoT.

**Create many things**

Cancel **Create a single thing**

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Then, name the new device. This example uses the name TestDevice.



**CREATE A THING** STEP 1/5

**Add your device to the thing registry**

This step creates an entry in the thing registry and a thing shadow for your device.

Name  
TestDevice

Apply a type to this thing  
Using a thing type simplifies device management by providing consistent registry data for things that share a type. Types provide things with a common set of attributes, which describe the identity and capabilities of your device, and a description.

Thing Type  
No type selected **Create a type**

Add this thing to a group  
Adding your thing to a group allows you to manage devices remotely using Jobs.

Thing Group  
Groups / **Create group** **Change**

Set searchable thing attributes (optional)  
Enter a value for one or more of these attributes so that you can search for your things in the registry.

Attribute key  
Provide an attribute key, e.g. Manufacturer

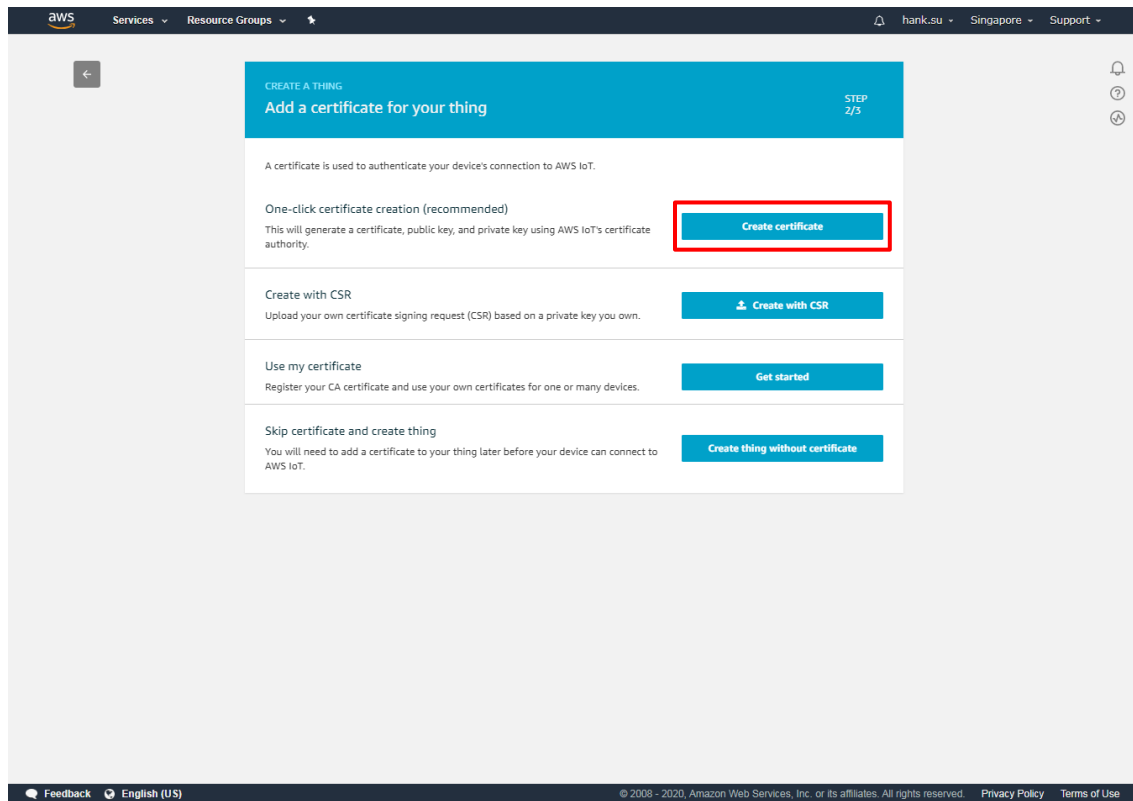
Value  
Provide an attribute value, e.g. Acme-Corporatio **Clear**

**Add another**

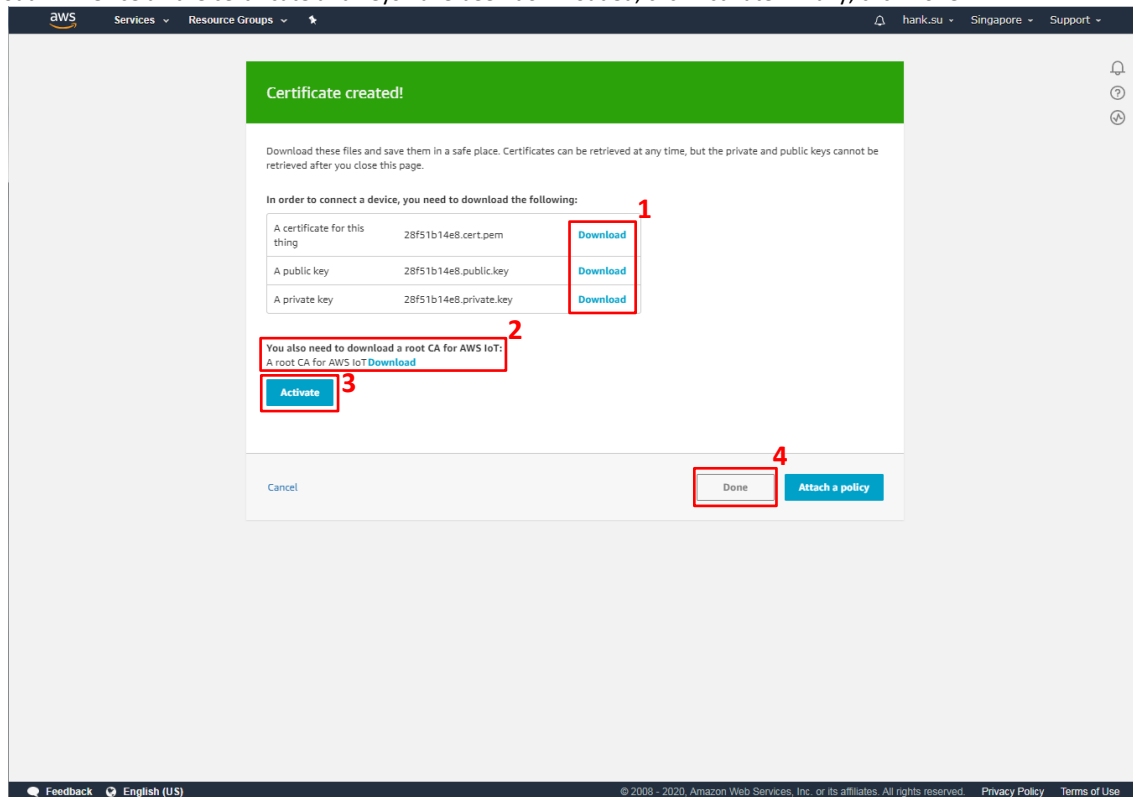
Show thing shadow ▾

Cancel **Back** **Next**

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Download the certificate, public key, and private key for the device by clicking Download. Next, download the root CA for AWS IoT by clicking to the Download link. Once all the certificate and keys have been downloaded, click Activate. Finally, click Done



## CA certificates for server authentication

Depending on which type of data endpoint you are using and which cipher suite you have negotiated, AWS IoT Core server authentication certificates are signed by one of the following root CA certificates:

### VeriSign Endpoints (legacy)

- RSA 2048 bit key: [VeriSign Class 3 Public Primary G5 root CA certificate](#)

### Amazon Trust Services Endpoints (preferred)

#### Note

You might need to right click these links and select **Save link as...** to save these certificates as files.

- RSA 2048 bit key: [Amazon Root CA 1](#)
- RSA 4096 bit key: Amazon Root CA 2. Reserved for future use.
- ECC 256 bit key: [Amazon Root CA 3](#)
- ECC 384 bit key: Amazon Root CA 4. Reserved for future use.

These certificates are all cross-signed by the [Starfield Root CA Certificate](#). All new AWS IoT Core regions, beginning with the May 9, 2018 launch of AWS IoT Core in the Asia Pacific (Mumbai) Region, serve only ATS certificates.

### On this page

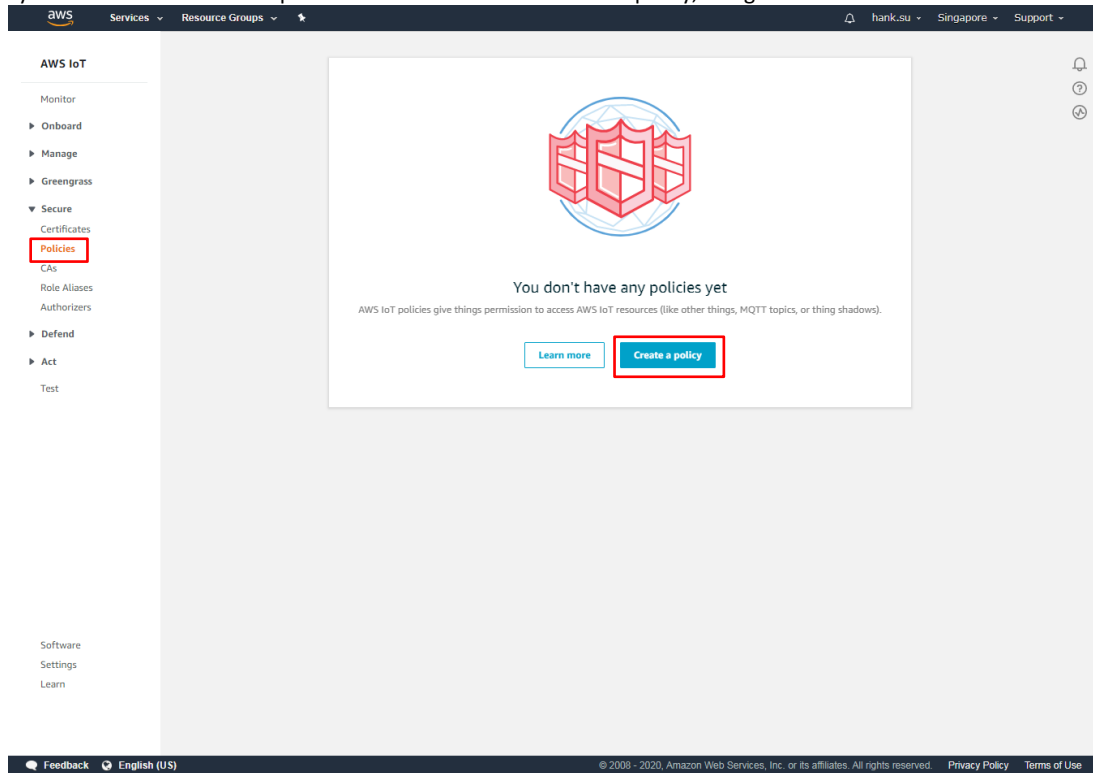
Endpoint types

**CA certificates for server authentication**

Server authentication guidelines

## 2.2 Create a policy

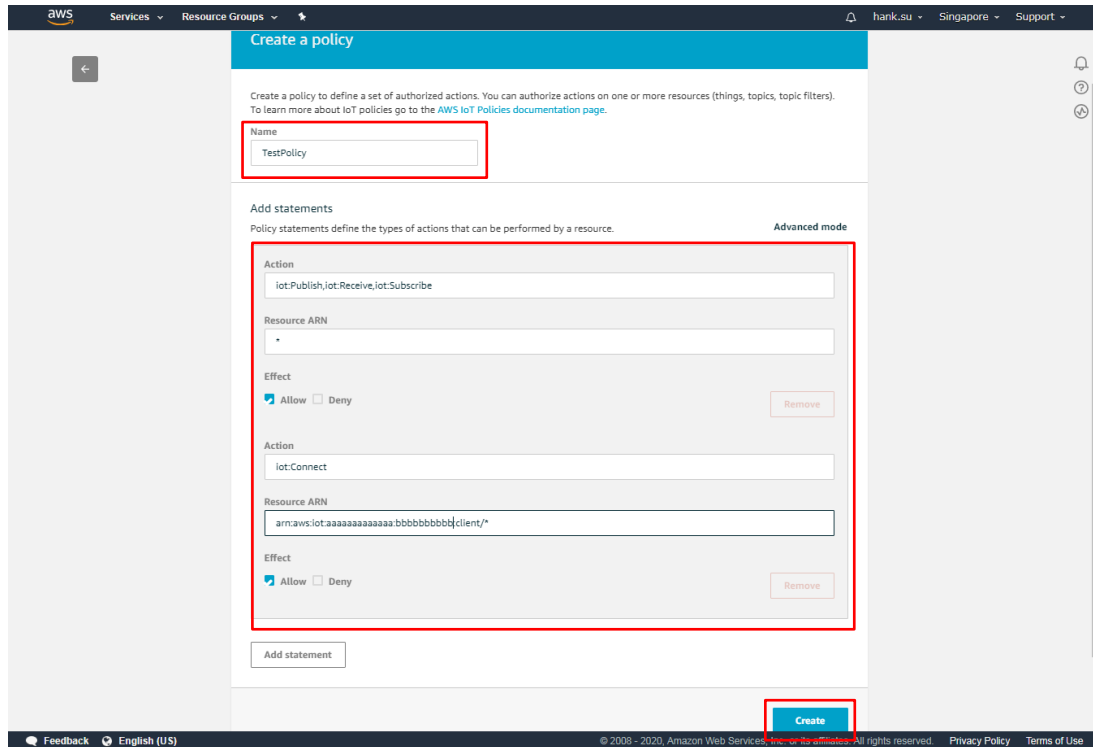
A policy defines a device's access permissions to IoT Core. To create a policy, navigate to Secure -> Policies. Then click "Create a policy"



NOTE – this policy grants unrestricted access for all iot operations, and is to be used only in a development environment. For non-dev environments, all devices in your fleet must have credentials with privileges that authorize intended actions only, which include (but not limited to) AWS IoT MQTT actions such as publishing messages or subscribing to topics with specific scope and context. The specific permission policies can vary for your use cases. Identify the permission policies that best meet your business and security requirements.

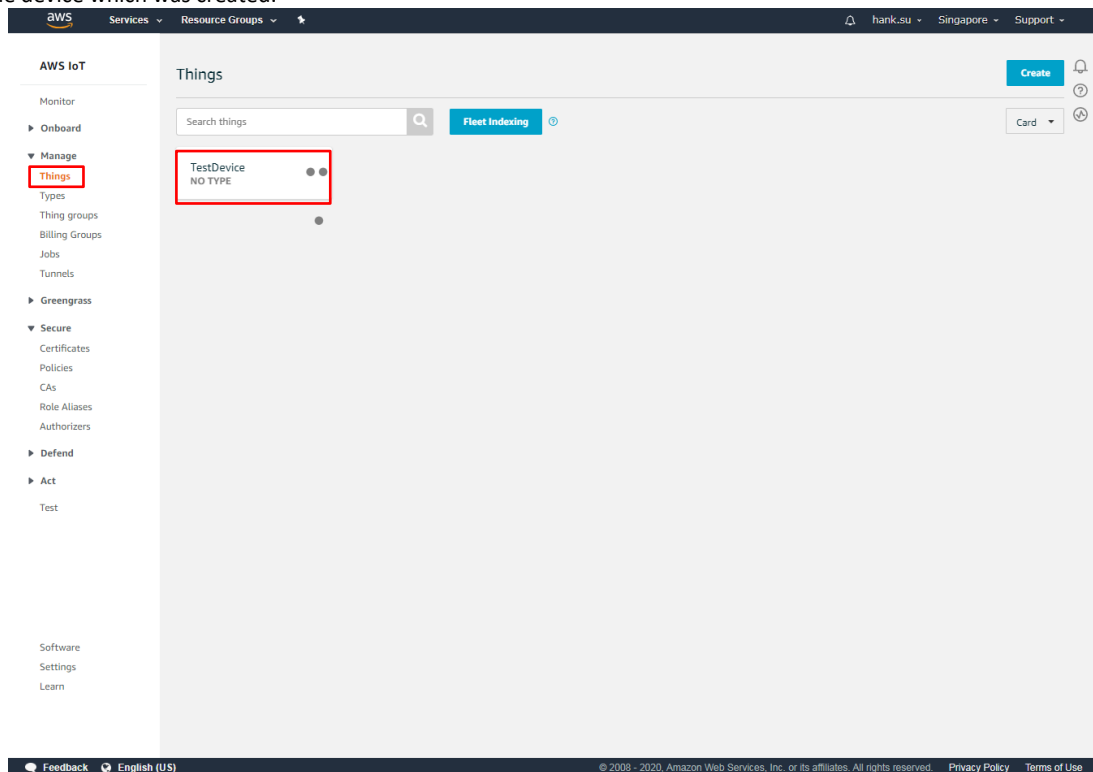
For sample policies, refer to <https://docs.aws.amazon.com/iot/latest/developerguide/example-iot-policies.html>.

Also refer to <https://docs.aws.amazon.com/iot/latest/developerguide/security-best-practices.html>

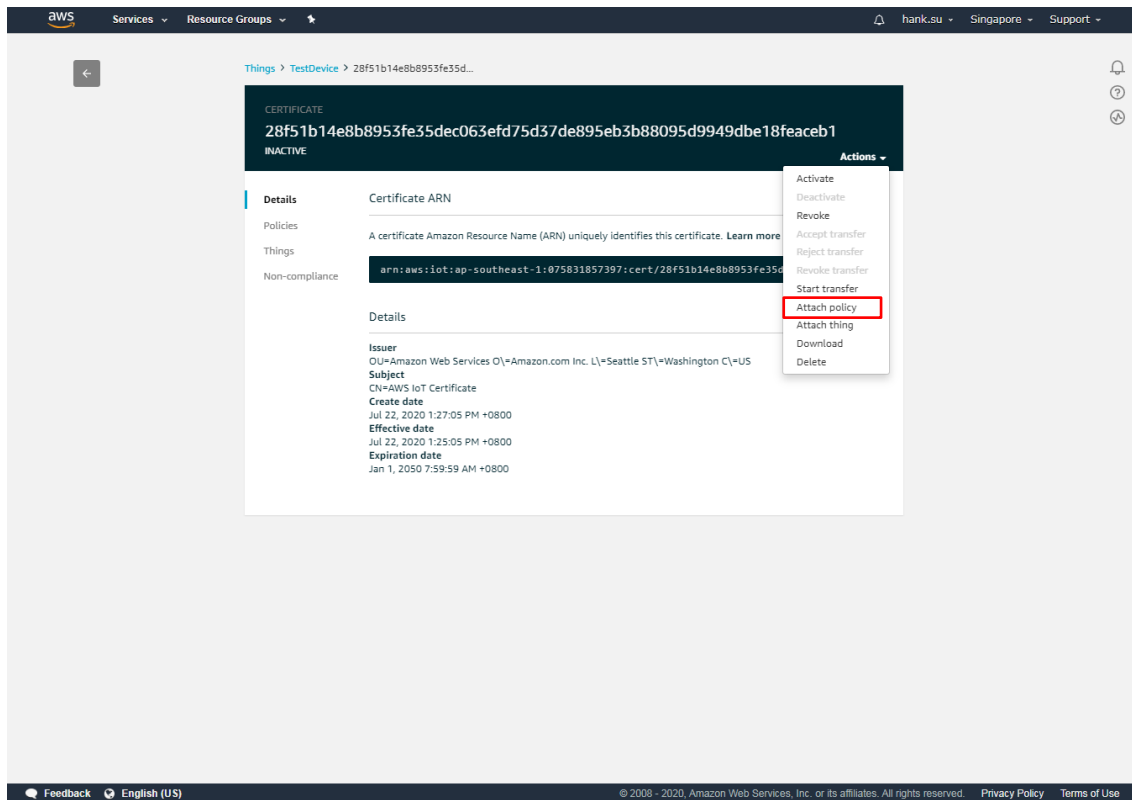
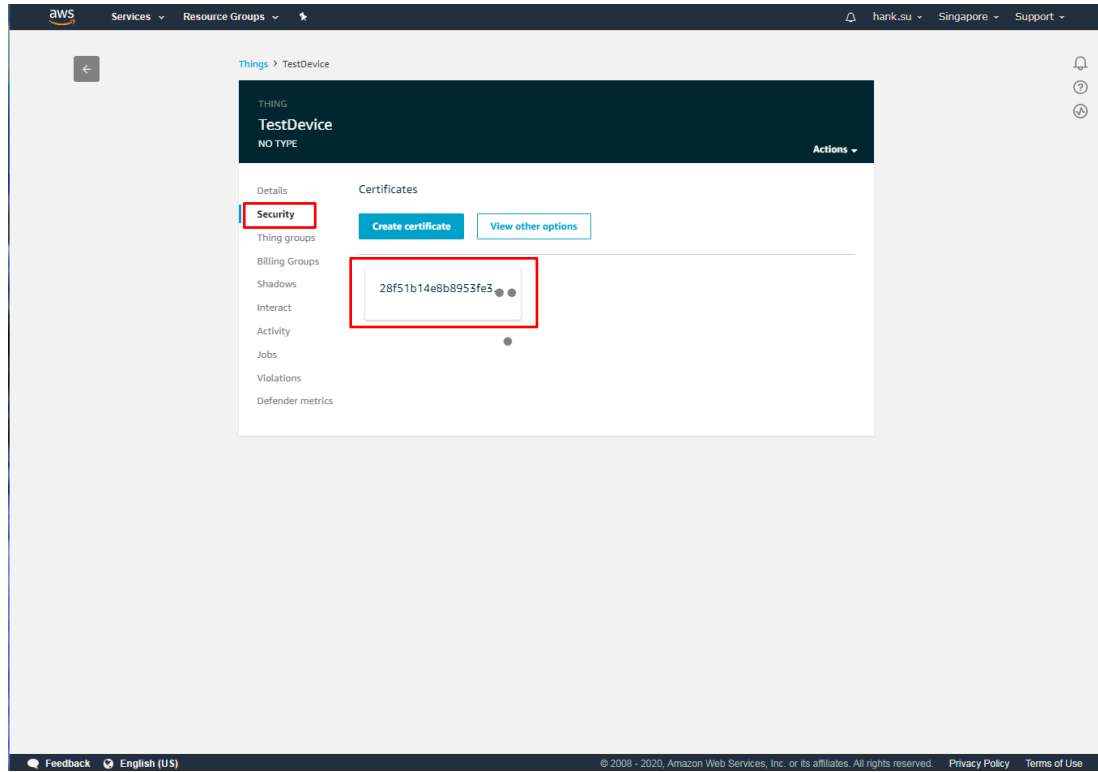


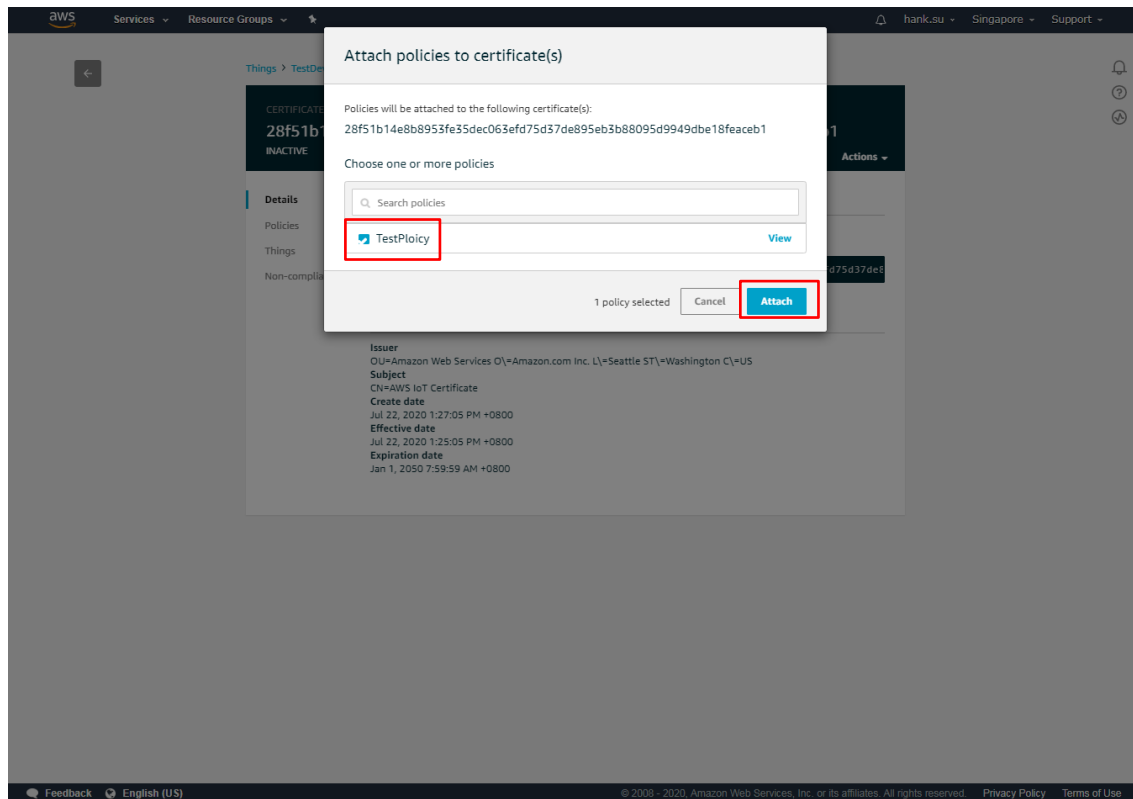
## 2.3 Attach Policy

The last step to configuring the device is attaching a policy. To attach a policy to new device, navigate to Manage -> Things. Then click on the device which was created.



Click Security, then click the certificate create in previous step.

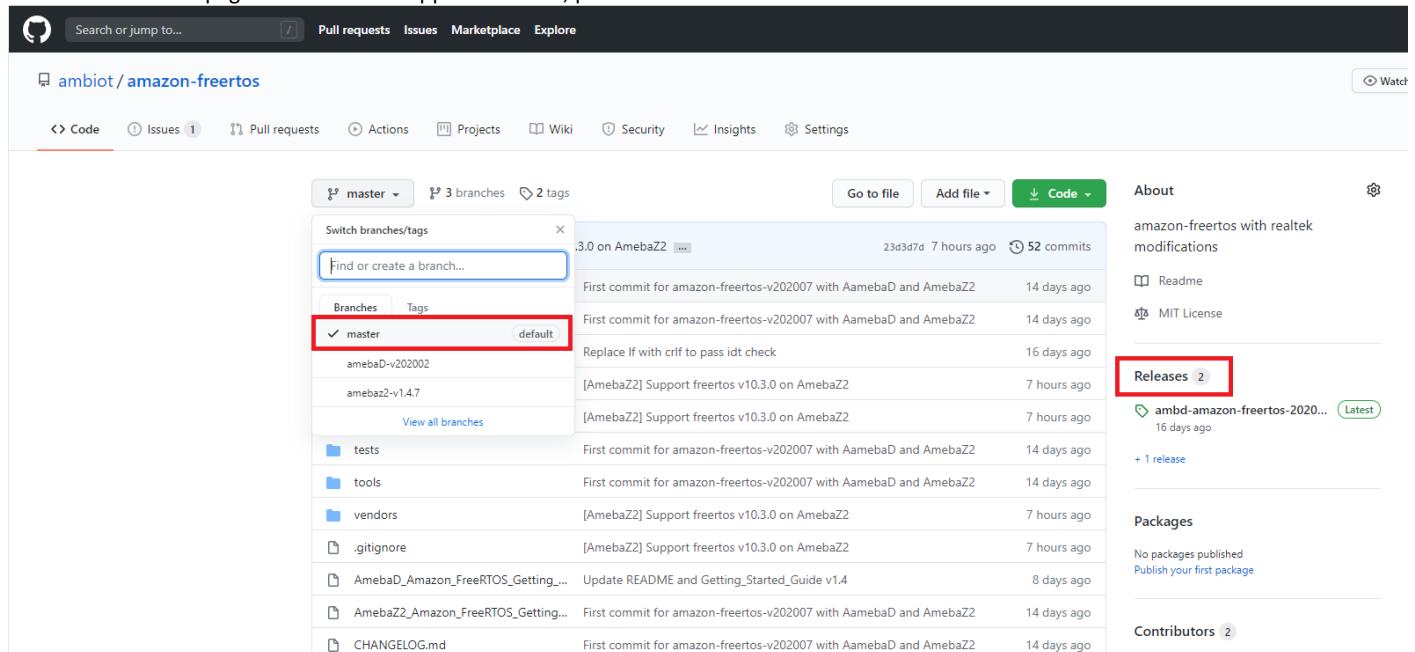




## 3 Configure AmebaD Amazon FreeRTOS

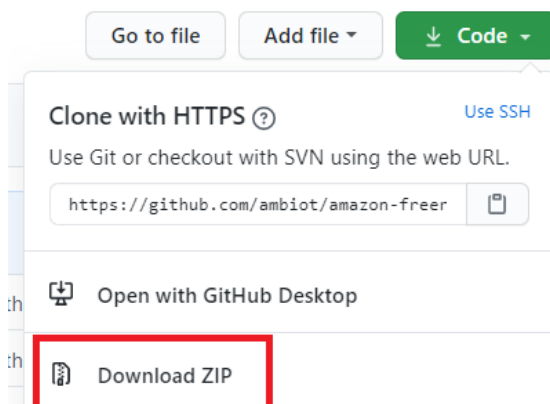
### 3.1 Download Source Code from github

Open source link: <https://github.com/ambiot/amazon-freertos> and select master for get newest source code. The stable version could be found in "Releases" page. AmebaD also support v202002, please find source in "amebaD-v202002" branch.



#### 3.1.1 Cloning a repository by Download ZIP

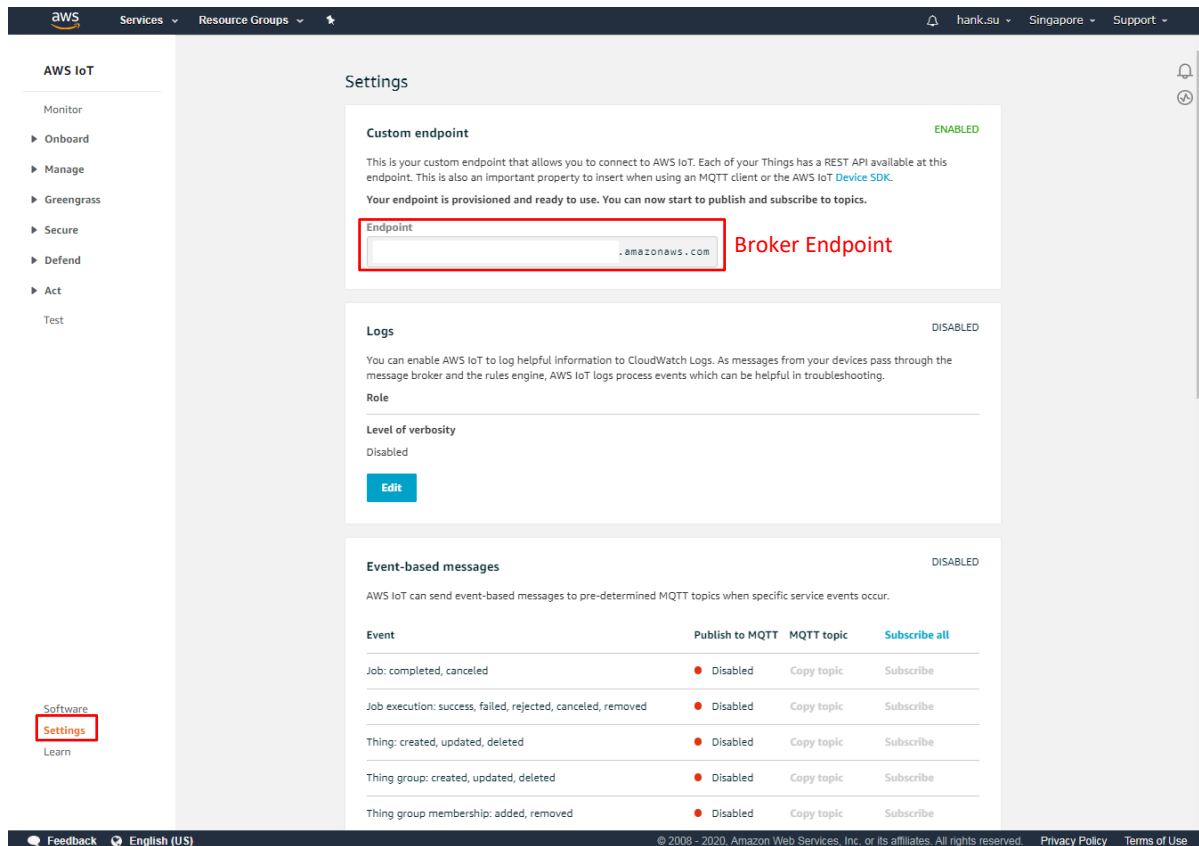
1. On GitHub, navigate to the main page of the repository.
2. Above the list of files, click **Code**.
3. Click **Download ZIP** to get source code.



For more information, please refer "[Cloning a repository from GitHub to GitHub Desktop](#)."



## 3.2 Get Broker Endpoint by AWS IoT Core



**Settings**

**Custom endpoint** ENABLED

This is your custom endpoint that allows you to connect to AWS IoT. Each of your Things has a REST API available at this endpoint. This is also an important property to insert when using an MQTT client or the [AWS IoT Device SDK](#). Your endpoint is provisioned and ready to use. You can now start to publish and subscribe to topics.

Endpoint  **Broker Endpoint**

**Logs** DISABLED

You can enable AWS IoT to log helpful information to CloudWatch Logs. As messages from your devices pass through the message broker and the rules engine, AWS IoT logs process events which can be helpful in troubleshooting.

**Role**

Level of verbosity  
Disabled

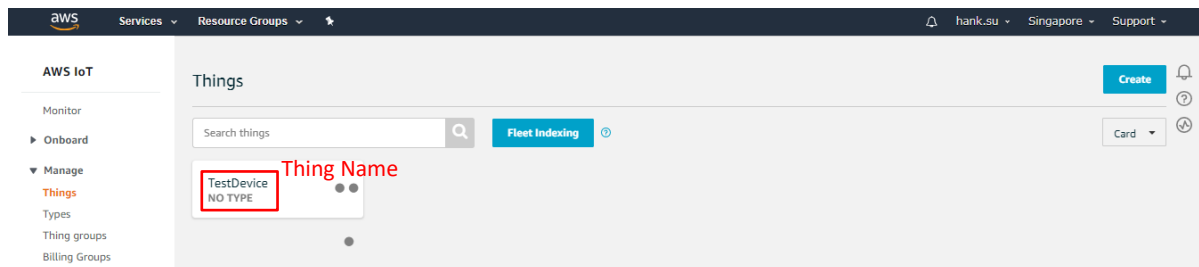
[Edit](#)

**Event-based messages** DISABLED

AWS IoT can send event-based messages to pre-determined MQTT topics when specific service events occur.

Event	Publish to MQTT	MQTT topic	Subscribe all
Job: completed, canceled	Disabled	<a href="#">Copy topic</a>	<a href="#">Subscribe</a>
Job execution: success, failed, rejected, canceled, removed	Disabled	<a href="#">Copy topic</a>	<a href="#">Subscribe</a>
Thing: created, updated, deleted	Disabled	<a href="#">Copy topic</a>	<a href="#">Subscribe</a>
Thing group: created, updated, deleted	Disabled	<a href="#">Copy topic</a>	<a href="#">Subscribe</a>
Thing group membership: added, removed	Disabled	<a href="#">Copy topic</a>	<a href="#">Subscribe</a>

## 3.3 Get Thing Name



**Things**

Search things  [Fleet Indexing](#) [Create](#)

**TestDevice** **Thing Name**  
NO TYPE

## 3.4 Setup IoT Core Information with AmebaD Amazon FreeRTOS

Setup BROKER\_ENDPOINT, THING\_NAME, WIFI\_SSID, PASSWORD in "amazon-freertos/demos/include/aws\_clientcredential.h"

```

/*
 * @brief Host name.
 * @todo Set this to the unique name of your IoT Thing.
 */
#define clientcredentialMQTT_BROKER_ENDPOINT "xxxxxxxxxxxxx.amazonaws.com"

/*
 * @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.
 * @todo If you are using Wi-Fi, set this to your network name.
 */
#define clientcredentialWIFI_SSID "TestAP"

/*
 * @brief Password needed to join Wi-Fi network.
 * @todo If you are using WPA, set this to your network password.
 */
#define clientcredentialWIFI_PASSWORD "password"

/*
 * @brief Wi-Fi network security type.
 * @see WiFiSecurity_t.
 * @note Possible values are eWiFiSecurityOpen, eWiFiSecurityWEP, eWiFiSecurityWPA,
 * eWiFiSecurityWPA2 (depending on the support of your device Wi-Fi radio).
 */
#define clientcredentialWIFI_SECURITY eWiFiSecurityWPA2

#endif /* ifndef __AWS_CLIENTCREDENTIAL_H__ */

```

### 3.4.1 Setup Thing's Private Key and Certificate

Filled keyCLIENT\_CERTIFICATE\_PEM and keyCLIENT\_PRIVATE\_KEY\_PEM in "amazon-freertos/demos/include/aws\_clientcredential\_keys.h" by xxxxxxxx-certifiacte.pem and xxxxxxxx-private.pem.key.

**Certificate created!**

Download these files and save them in a safe place. Certificates can be retrieved at any time, but the private and public keys cannot be retrieved after you close this page.

In order to connect a device, you need to download the following:

A certificate for this thing	<u>28f51b14e8.cert.pem</u>	<a href="#">Download</a>
A public key	28f51b14e8.public.key	<a href="#">Download</a>
A private key	<u>28f51b14e8.private.key</u>	<a href="#">Download</a>

You also need to download a root CA for AWS IoT:  
A root CA for AWS IoT [Download](#)

[Activate](#)

It can done by amazon-freertos/tools/certificate\_configuration/CertificateConfigurator.html

## Certificate Configuration Tool

### FreeRTOS Developer Demos

Provide client certificate and private key PEM files downloaded from the AWS IoT Console.

**Certificate PEM file:**

選擇檔案 未選擇任何檔案

**Private Key PEM file:**

選擇檔案 未選擇任何檔案

Generate and save aws\_clientcredential\_keys.h

Save the generated header file to the *demos/common/include* folder of the demo project.

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Final aws\_clientcredential\_keys.h overview.

```

/*
 * @brief PEM-encoded client certificate.
 *
 * @todo If you are running one of the FreeRTOS demo projects, set this
 * to the certificate that will be used for TLS client authentication.
 *
 * @note Must include the PEM header and footer:
 * "-----BEGIN CERTIFICATE-----\n"
 * "...base64 data...\n"
 * "-----END CERTIFICATE-----\n"
 */
#define keyCLIENT_CERTIFICATE_PEM \
"-----BEGIN CERTIFICATE-----\n"
"MIIDWjCCAkKgAwIBAgIWAIDLSSoG+EARSbBprT4Imluu8j2vMA0GCSqGSIb3DQEB\n"
"-----\n"
"-----END CERTIFICATE-----\n"

/*
 * @brief PEM-encoded client private key.
 *
 * @todo If you are running one of the FreeRTOS demo projects, set this
 * to the private key that will be used for TLS client authentication.
 *
 * @note Must include the PEM header and footer:
 * "-----BEGIN RSA PRIVATE KEY-----\n"
 * "...base64 data...\n"
 * "-----END RSA PRIVATE KEY-----\n"
 */
#define keyCLIENT_PRIVATE_KEY_PEM \
"-----BEGIN RSA PRIVATE KEY-----\n"
"MIIEpAIBAAKCAQEAwop96WNucGebARFjD8O+CLsqqBNn/AHyhEcozLZC8qoECUOn\n"
"-----\n"
"-----END RSA PRIVATE KEY-----\n"

```

### 3.4.2 Enable FreeRTOS demo on AmebaD

Find platform\_opts.h in amazon-freertos\vendors\realtek\boards\amebaD\aws\_demos\config\_files and enable **CONFIG\_EXAMPLE\_AMAZON\_FREERTOS**

```
/* For Amazon FreeRTOS SDK example */
#define CONFIG_EXAMPLE_AMAZON_FREERTOS 1
```

Find aws\_demo\_config.h in amazon-freertos\vendors\realtek\boards\amebaD\aws\_demos\config\_files and add **CONFIG\_CORE\_MQTT\_MUTUAL\_AUTH\_DEMO\_ENABLED**

```
/* To run a particular demo you need to define one of these.
 * Only one demo can be configured at a time
 *
 * CONFIG_CORE_HTTP_MUTUAL_AUTH_DEMO_ENABLED
 * CONFIG_CORE_HTTP_S3_DOWNLOAD_DEMO_ENABLED
 * CONFIG_CORE_HTTP_S3_DOWNLOAD_MULTITHREADED_DEMO_ENABLED
 * CONFIG_CORE_HTTP_S3_UPLOAD_DEMO_ENABLED
 * CONFIG_CORE_MQTT_MUTUAL_AUTH_DEMO_ENABLED
 * CONFIG_CORE_MQTT_CONNECTION_SHARING_DEMO_ENABLED
 * CONFIG_DEVICE_SHADOW_DEMO_ENABLED
 * CONFIG_DEVICE_DEFENDER_DEMO_ENABLED
 * CONFIG_JOBS_DEMO_ENABLED
 * CONFIG_MQTT_BLE_DEMO_ENABLED
 * CONFIG_GREENGRASS_DISCOVERY_DEMO_ENABLED
 * CONFIG_TCP_ECHO_CLIENT_DEMO_ENABLED
 * CONFIG_POSIX_DEMO_ENABLED
 * CONFIG_OTA_UPDATE_DEMO_ENABLED
 * CONFIG_BLE_GATT_SERVER_DEMO_ENABLED
 * CONFIG_BLE_NUMERIC_COMPARISON_DEMO_ENABLED
 *
 * These defines are used in iot_demo_runner.h for demo selection */
#define CONFIG_CORE_MQTT_MUTUAL_AUTH_DEMO_ENABLED
```

Now you can start to compile AmebaD Amazon FreeRTOS

## 4 Compile AmebaD Amazon FreeRTOS

### 4.1 IAR Build Environment Setup

Currently the amazon-freertos of AmebaD supported by the IAR Embedded workbench ver.8.30.1. For windows operating system only. This chapter illustrates how to setup IAR development environment for Realtek Ameba-D SDK, including building projects and downloading images.

### 4.2 Pre-Requisite

- Required source code. (<https://github.com/ambiot/amazon-freertos>)
- AmebaD Demo board
- Realtek Image Tool
- IAR Embedded Workbench ver.8.30.1

IAR provides an IDE environment for code building, downloading, and debugging. Check “IAR Embedded Workbench” on <http://www.iar.com/>, and a trail version is available for 30 days.

**Note:** To support ARMv8-M with Security Extension (Ameba-D HS CPU, also called KM4), IAR version must be 8.30 or higher.

### 4.3 How to Use IAR SDK

#### 4.3.1 IAR Project Introduction

Because Ameba-D is a dual-core CPU platform, two workspaces provided to build for each core in **amazon-freertos/projects/realtek/amebaD/IAR/aws\_demos**

- Project\_lp\_release.eww (KM0 workspace) contains the following projects:
  - km0\_bootloader
  - km0\_application
- Project\_hp\_release.eww (KM4 workspace) contains the following projects:
  - km4\_bootloader
  - km4\_application

#### 4.3.2 IAR Build

When building SDK for the first time, you should build both KM0 project and KM4 project. Other times, you only need to rebuild the modified project.

##### 4.3.2.1 Building KM0 Project

The following steps show how to build KM0 project:

- (1) Open **amazon-freertos\projects\realtek\amebaD\IAR\aws\_demos\Project\_lp\_release.eww**.
- (2) Make sure km0\_bootloader and km0\_application are in Workspace. Click **Project > Options, General Options > Target > Processor Variant > Core**, verify the CPU configurations according to Fig 4-1
- (3) Right click the project and choose “Rebuild All”, as Fig 4-2 shows. The km0\_bootloader and km0\_application should compile in order.

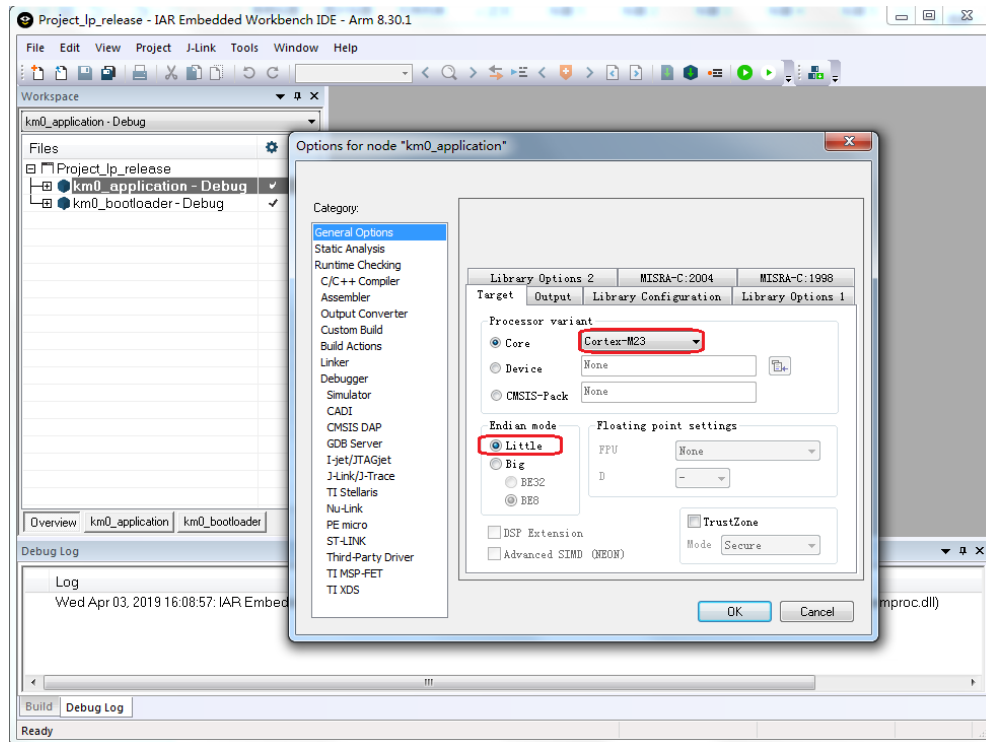


Fig 4-1 KM0 processor options

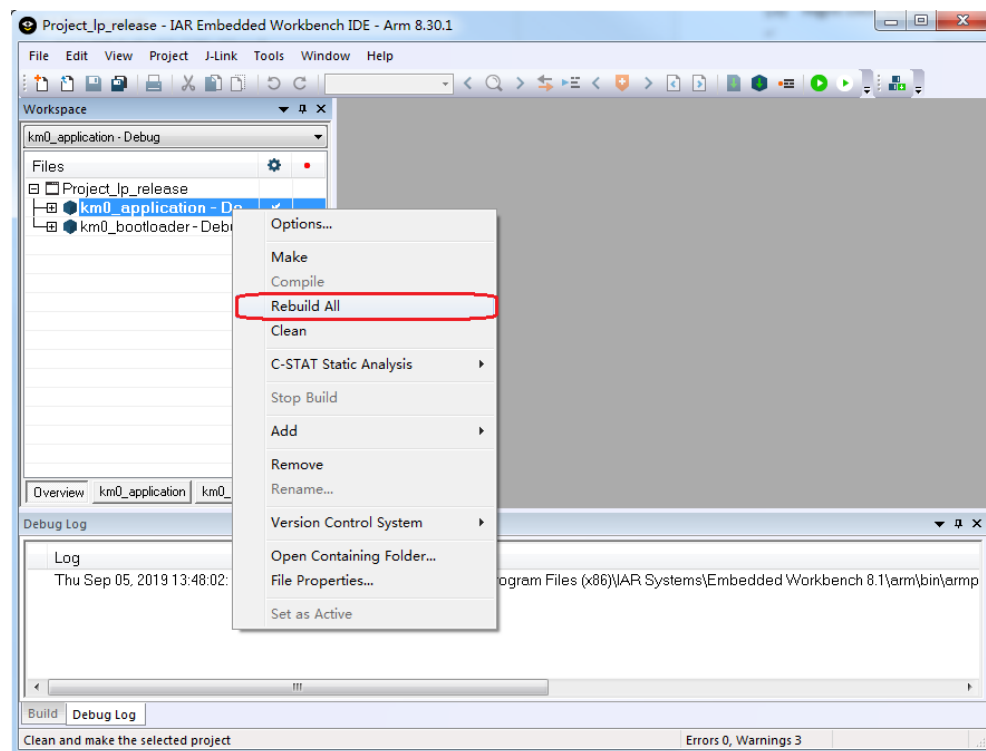


Fig 4-2 Building KM0 project

**Note:** After building each project, IAR will pop up a command prompt window to execute post-build action to generate images from executable files. This may takes several seconds. Do not stop it while it is in progress. After post-build action is completed, the window would disappear automatically.

```

C:\Windows\System32\cmd.exe
D:\Code\AmebaD\03_0903\project\realtek_amebaD_va0_example\EWARM-RELEASE>cmd /c
""D:\Code\AmebaD\03_0903\project\realtek_amebaD_va0_example\EWARM-RELEASE""\..\
..\component\soc\realtek\amebaD_misc\iar_utility\common\tools\nm Debug/Exe/km0
_image/km0_application.axf ! "D:\Code\AmebaD\03_0903\project\realtek_amebaD_va0
_example\EWARM-RELEASE""\..\..\component\soc\realtek\amebaD_misc\iar_utility\c
ommon\tools\sort > Debug/Exe/km0_image/km0_application.map"

D:\Code\AmebaD\03_0903\project\realtek_amebaD_va0_example\EWARM-RELEASE>cmd /c
""D:\Code\AmebaD\03_0903\project\realtek_amebaD_va0_example\EWARM-RELEASE""\..\
..\component\soc\realtek\amebaD_misc\iar_utility\common\tools\objdump -d Debug
/Exe/km0_image/km0_application.axf > Debug/Exe/km0_image/km0_application.asm"

D:\Code\AmebaD\03_0903\project\realtek_amebaD_va0_example\EWARM-RELEASE>for /P
"delins=" %i in ('cmd /c ""D:\Code\AmebaD\03_0903\project\realtek_amebaD_va0_ex
ample\EWARM-RELEASE""\..\..\component\soc\realtek\amebaD_misc\iar_utility\comm
on\tools\grep IMAGE2 Debug/Exe/km0_image/km0_application.map ! "D:\Code\AmebaD\0
3_0903\project\realtek_amebaD_va0_example\EWARM-RELEASE""\..\..\component\soc
\realtek\amebaD_misc\iar_utility\common\tools\grep Base ! "D:\Code\AmebaD\03_09
03\project\realtek_amebaD_va0_example\EWARM-RELEASE""\..\..\component\soc\real
tek\amebaD_misc\iar_utility\common\tools\gawk '{print $1}'"') do set ran2_start=
%xi

```

- (4) After compile, the images km0\_boot\_all.bin and km0\_image2\_all.bin can be find in **amazon-freertos\projects\realtek\amebaD\IAR\aws\_demos\Debug\Exe\km0\_image**.

### 4.3.2.2 Building KM4 Project

The following steps show how to build KM4 project:

- (1) Open **amazon-freertos\projects\realtek\amebaD\IAR\aws\_demos\Project\_hp\_release.eww**.
- (2) Refer to 4.3.1 and choose the build configurations for each project according to your application.
- (3) Click **Project > Options, General Options > Target > Processor Variant > Core**, verify the CPU configurations according to Fig 4-3.

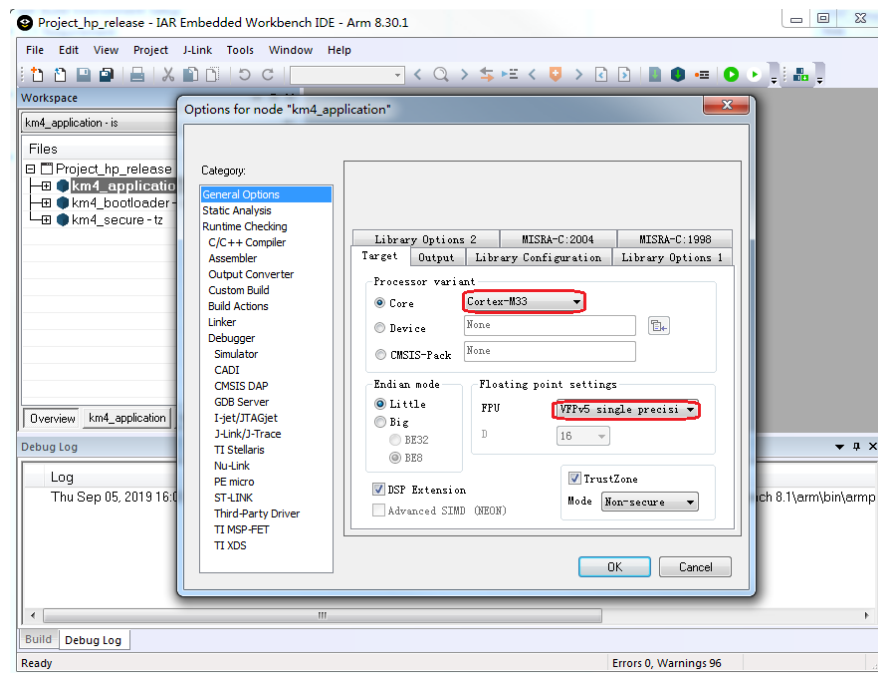


Fig 4-3 KM4 processor options

- (4) Right click the project and choose "Rebuild All", as Fig 4-4 shows. The km4\_bootloader, km4\_application should compile in order.

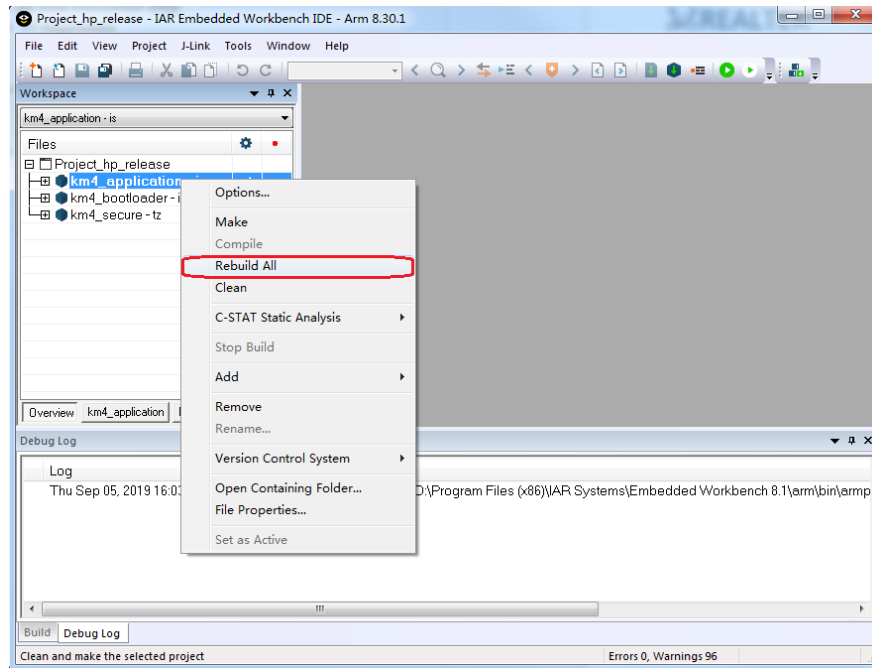
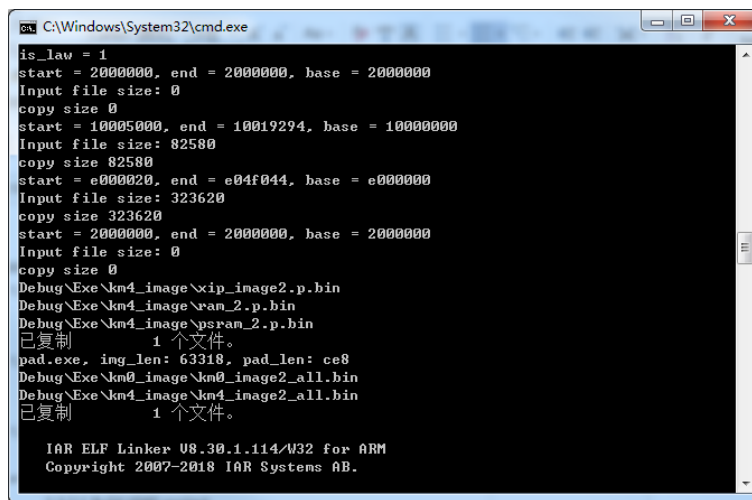


Fig 4-4 Building KM4 project

#### Note:

- After building each project, IAR will pop up a command prompt window shown in bellow to execute post-build action to generate images from executable files. This may takes several seconds. Do not stop it while it is in progress. After post-build action is completed, the window would disappear automatically.



- After compile, the images km4\_boot\_all.bin and km0\_km4\_image2.bin can be find in **amazon-freertos\projects\realtek\amebaD\IAR\aws\_demos\Debug\Exe\km4\_image**.
- The generated images can be downloaded to flash by ImageTool:



## 5 ImageTool

The tool can be find in amazon-freertos\vendors\realtek\tools\ameba-image-Tool-v2.4.1\

### 5.1 Introduction

This chapter introduces how to use ImageTool to encrypt, generate and download images. As show in Fig 5-1, ImageTool has four tabpages.

- Download: used as image download server to transmit images to Ameba through UART.

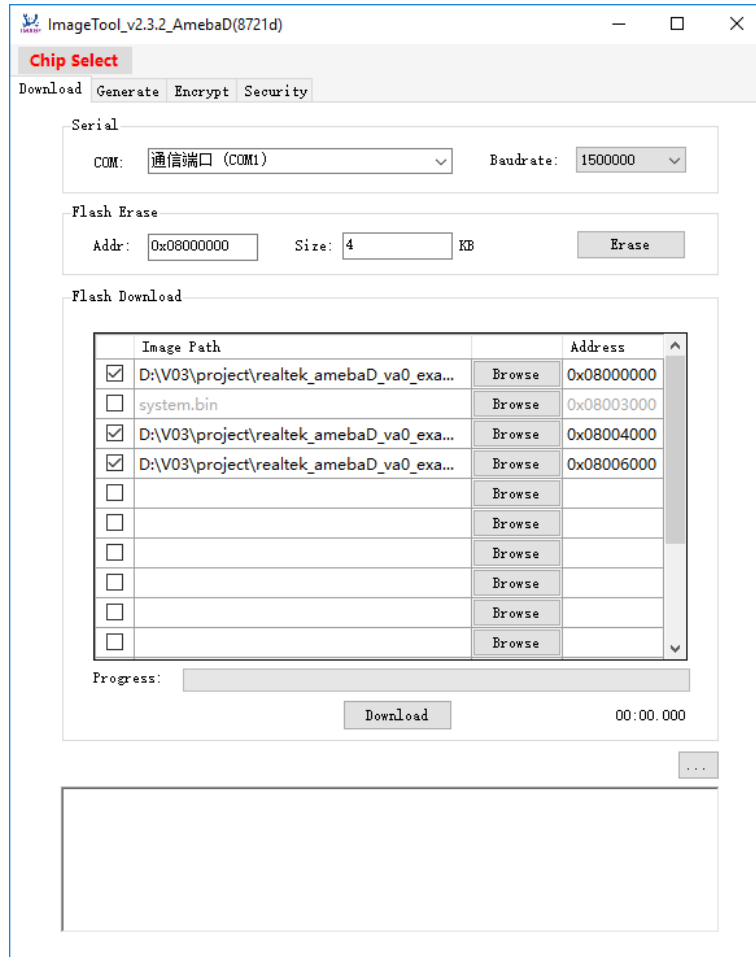


Fig 5-1 ImageTool UI

### 5.2 Environment Setup

#### 5.2.1 Hardware Setup

The hardware setup is shown in Fig 5-2.

**Note:** If using external UART to download images, FT232 USB to UART dongle must be used.

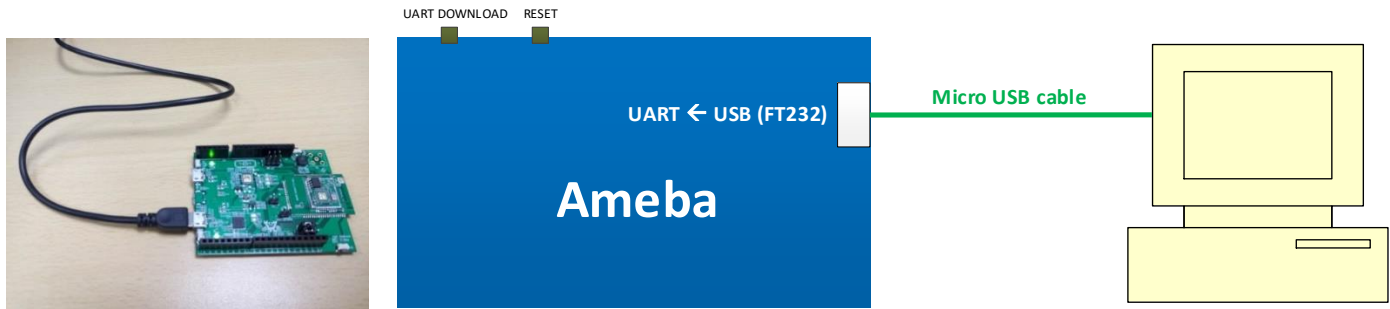


Fig 5-2 Hardware setup

## 5.2.2 Software Setup

- Environment Requirements: EX. WinXP, Win 7 Above, Microsoft .NET Framework 3.5
- ImageTool.exe Location: **vendors\realtek\tools\ameba-image-Tool-v2.4.1\ImageTool.exe**

Name	Date modified	Type	Size
ChangeLog.txt	7/29/2019 11:52 AM	Text Document	4 KB
Download.ini	11/4/2019 5:44 PM	Configuration sett...	2 KB
Encrypt.ini	11/4/2019 5:44 PM	Configuration sett...	1 KB
<b>ImageTool.exe</b>	7/29/2019 11:52 AM	Application	282 KB
ImageTool.pdb	7/29/2019 11:52 AM	VisualStudio.pdb....	178 KB
ImageTool.vshost.exe	8/20/2018 1:41 PM	Application	14 KB
ImageTool.vshost.exe.manifest	8/20/2018 1:41 PM	MANIFEST File	1 KB
imgtool_flashloader_amebad.bin	6/6/2019 3:15 PM	BIN File	5 KB
imgtool_flashloader_amebaz.bin	6/6/2019 3:15 PM	BIN File	6 KB
SB.exe	8/20/2018 1:41 PM	Application	189 KB
system.bin	8/6/2019 9:53 AM	BIN File	4 KB
TestListView.dll	8/20/2018 1:41 PM	Application extens...	5 KB
TestListView.pdb	8/20/2018 1:41 PM	VisualStudio.pdb....	14 KB

## 5.3 Download

### 5.3.1 Image Download

Assuming that the ImageTool on PC is a server, it sends images files to Ameba (client) through UART. There are two ways to download images to board.

#### 5.3.1.1 Based on Hardware Reset

The way based on hardware reset is a manual method to download images, and it is the primary and recommended method.

- Enter into UART\_DOWNLOAD mode.
  - Push the **UART DOWNLOAD** button and keep it pressed.
  - Re-power on the board or press the **Reset** button.
  - Release the **UART DOWNLOAD** button.

Now, Ameba board gets into UART\_DOWNLOAD mode and is ready to receive data.
- Click **Chip Select** (in red) on UI and select chip (AmebaD).
- Select the corresponding serial port and transmission baud rate. The default baud rate is 1.5Mbps (recommended).
- Click the **Browse** button to select the images (**km0\_boot\_all.bin/km4\_boot\_all.bin/km0\_km4\_image2.bin**) to be programmed and input addresses.
  - The image path is located in **{path}\projects\realtek\amebaD\IAR\aws\_demos\Debug\Exe\km0\_image** and **{path}\projects\realtek\amebaD\IAR\aws\_demos\Debug\Exe\km4\_image**, where **{path}** is the location of the project on your own computer.
  - The default target address is the SDK default image address, you can use it directly.

- (5) Click **Download** button to start. The progress bar will show the transmit progress of each image. You can also get the message of operation successfully or errors from the log window.

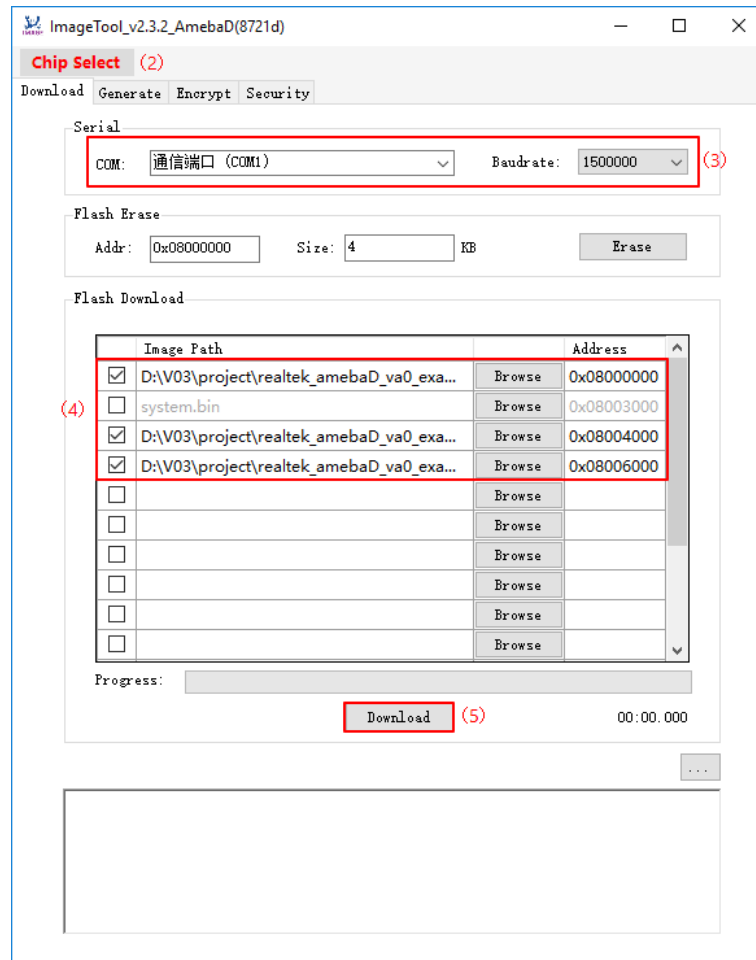


Fig 5-3 ImageTool 'Download' tabpage setting

## 6 MQTT Demo

### 6.1 Get Device Log

Install Tera Term to get device log

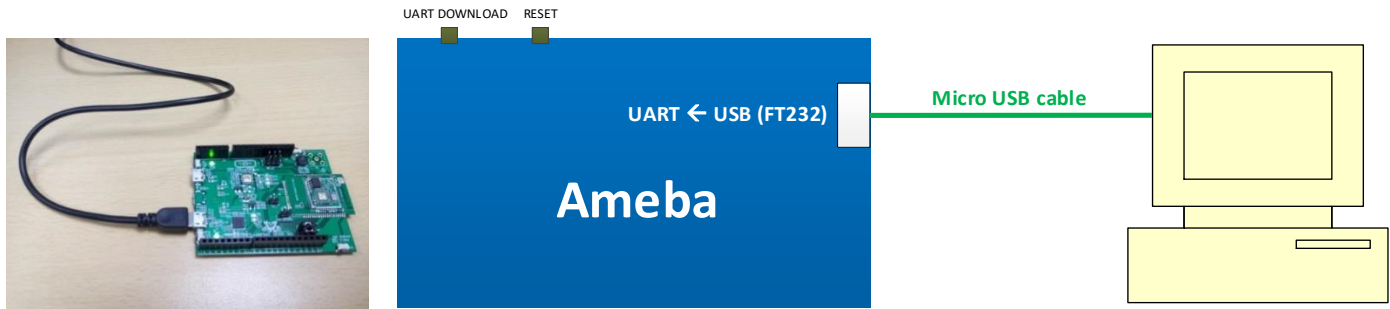
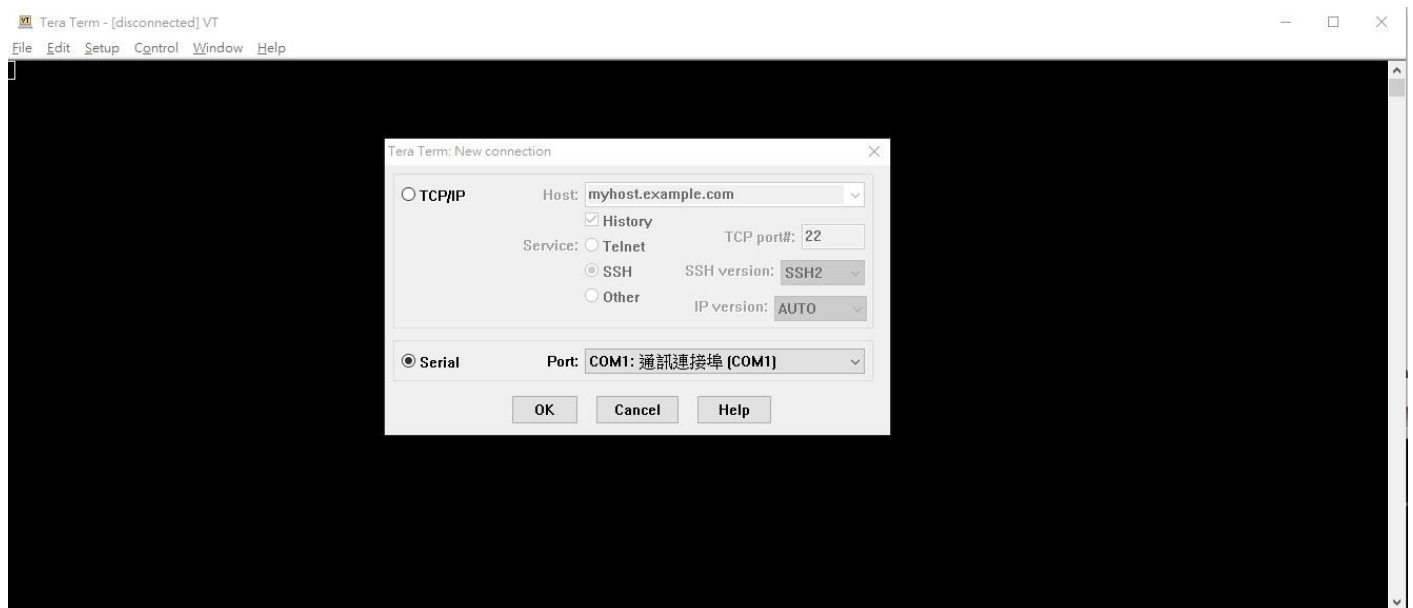


Fig 6-1 Hardware setup

The serial port is same with ImageTool that get from 5.3.1.1 step (3).



### 6.2 Run MQTT Demo

Default setting of SDK are enable MQTT demo. Once the AmebaD EVB has rebooted, the application will automatically start run MQTT demo and communicate to IoT Core.

```
COM10 - Tera Term VT
File Edit Setup Control Window Help

RTL8721D[Driver]: set ssid [RealEZ]

RTL8721D[Driver]: rtw_set_wpa_ie[1136]: AuthKeyMgmt = 0x2

RTL8721D[Driver]: rtw_restruct_sec_ie[3763]: no pmksa cached

RTL8721D[Driver]: start auth to 82:2a:a8:d5:93:c4

RTL8721D[Driver]: auth alg = 2

RTL8721D[Driver]:
OnAuthClient:alghm = 0, seq = 2, status = 0, sae_msg_len = 0

RTL8721D[Driver]: auth success, start assoc

RTL8721D[Driver]: association success(res=3)
wlan1: 1 DL RSVD page success! DLBcnCount:01, poll:00000001

RTL8721D[Driver]: ClientSendEAPOL[1522]: no use cache pmksa

RTL8721D[Driver]: set pairwise key to hw: alg:4(WEP40-1 WEP104-5 TKIP-2 AES-4)

RTL8721D[Driver]: set group key to hw: alg:4(WEP40-1 WEP104-5 TKIP-2 AES-4) keyid:1

1 6009 [example_a] Wi-Fi Connected to AP. Creating tasks which use network...
2 6016 [example_a] IP Address acquired 192.168.89.107
3 6030 [example_a] Write certificate...
4 6037 [iot_threa] [INFO ][DEMO][6037] -----STARTING DEMO-----
5 6047 [iot_threa] [INFO ][INIT][6047] SDK successfully initialized.
```

```
COM10 - Tera Term VT
File Edit Setup Control Window Help

22 14264 [iot_threa] [INFO ][MQTT][core_mqtt.c:1563] 23 14269 [iot_threa] Received MQTT CONNACK successfully from broker.24 14275 [iot_threa]
25 14277 [iot_threa] [INFO ][MQTT][core_mqtt.c:1829] 26 14282 [iot_threa] MQTT connection established with the broker.27 14290 [iot_threa]
28 14293 [iot_threa] [INFO ][MQTT_MutualAuth_Demo][mqtt_demo_mutual_auth.c:820] 29 14301 [iot_threa] An MQTT connection is established with a2zweh2b7yb784-ats.iot.ap-southeast-1.amazonaws.com.30 14311 [iot_threa]
31 14313 [iot_threa] [INFO ][MQTT_MutualAuth_Demo][mqtt_demo_mutual_auth.c:885] 32 14321 [iot_threa] Attempt to subscribe to the MQTT topic ameba-ota/example/topic.33 14329 [iot_threa]
34 14333 [iot_threa] [INFO ][MQTT_MutualAuth_Demo][mqtt_demo_mutual_auth.c:899] 35 14341 [iot_threa] SUBSCRIBE sent for topic ameba-ota/example/topic to broker.36 14348 [iot_threa]
37 14499 [iot_threa] [INFO ][MQTT][core_mqtt.c:886] 38 14506 [iot_threa] Packet received. ReceivedBytes=3.39 14511 [iot_threa]
40 14513 [iot_threa] [INFO ][MQTT_MutualAuth_Demo][mqtt_demo_mutual_auth.c:1053] 41 14522 [iot_threa] Subscribed to the topic ameba-ota/example/topic with maximum QoS 1.42 14531 [iot_threa]
43 15533 [iot_threa] [INFO ][MQTT_MutualAuth_Demo][mqtt_demo_mutual_auth.c:533] 44 15542 [iot_threa] Publish to the MQTT topic ameba-ota/example/topic.45 15549 [iot_threa]
46 15554 [iot_threa] [INFO ][MQTT_MutualAuth_Demo][mqtt_demo_mutual_auth.c:543] 47 15562 [iot_threa] Attempt to receive publish message from broker.48 15569 [iot_threa]
49 15684 [iot_threa] [INFO ][MQTT][core_mqtt.c:886] 50 15691 [iot_threa] Packet received. ReceivedBytes=2.51 15696 [iot_threa]
52 15698 [iot_threa] [INFO ][MQTT][core_mqtt.c:1162] 53 15703 [iot_threa] Ack packet deserialized with result: MQTTSuccess.54 15709 [iot_threa]
55 15712 [iot_threa] [INFO ][MQTT][core_mqtt.c:1175] 56 15717 [iot_threa] State record updated. New state=MQTTPublishDone.57 15723 [iot_threa]
58 15725 [iot_threa] [INFO ][MQTT_MutualAuth_Demo][mqtt_demo_mutual_auth.c:1031] 59 15733 [iot_threa] PUBACK received for packet Id 2.60 15738 [iot_threa]
61 15742 [iot_threa] [INFO ][MQTT][core_mqtt.c:886] 62 15749 [iot_threa] Packet received. ReceivedBytes=39.63 15754 [iot_threa]
64 15756 [iot_threa] [INFO ][MQTT][core_mqtt.c:1045] 65 15761 [iot_threa] De-serialized incoming PUBLISH packet: DeserializerResult=MQTTSuccess.66 15769 [iot_threa]
67 15771 [iot_threa] [INFO ][MQTT][core_mqtt.c:1058] 68 15776 [iot_threa] State record updated. New state=MQTTPubAckSen
```

```

COM10 - Tera Term VT
File Edit Setup Control Window Help
697 79968 [iot_threa] [INFO] [MQTT_MutualAuth_Demo] [mqtt_demo_mutual_auth.c:1104] 698 79976 [iot_threa] Incoming Publish
h Topic Name: ameba-ota/example/topic matches subscribed topic.Incoming Publish Message : Hello World!699 79989 [iot_thr
ea]
700 80493 [iot_threa] [INFO] [MQTT_MutualAuth_Demo] [mqtt_demo_mutual_auth.c:553] 701 80501 [iot_threa] Keeping Connecti
on Idle...702 80506 [iot_threa]
703 82509 [iot_threa] [INFO] [MQTT_MutualAuth_Demo] [mqtt_demo_mutual_auth.c:561] 704 82517 [iot_threa] Unsubscribe from
the MQTT topic ameba-ota/example/topic.705 82524 [iot_threa]
706 82878 [iot_threa] [INFO] [MQTT] [core_mqtt.c:886] 707 82885 [iot_threa] Packet received. ReceivedBytes=2.708 82890 [
iot_threa]
709 82893 [iot_threa] [INFO] [MQTT_MutualAuth_Demo] [mqtt_demo_mutual_auth.c:1062] 710 82901 [iot_threa] Unsubscribed fr
om the topic ameba-ota/example/topic.711 82908 [iot_threa]
712 83411 [iot_threa] [INFO] [MQTT_MutualAuth_Demo] [mqtt_demo_mutual_auth.c:583] 713 83419 [iot_threa] Disconnecting th
e MQTT connection with a2zweh2b7yb784-ats.iot.ap-southeast-1.amazonaws.com.714 83429 [iot_threa]
715 83433 [iot_threa] [INFO] [MQTT] [core_mqtt.c:2149] 716 83438 [iot_threa] Disconnected from the broker.717 83443 [iot
_threa]
718 83447 [iot_threa] [INFO] [MQTT_MutualAuth_Demo] [mqtt_demo_mutual_auth.c:612] 719 83455 [iot_threa] Demo completed a
n iteration successfully.720 83461 [iot_threa]
721 83464 [iot_threa] [INFO] [MQTT_MutualAuth_Demo] [mqtt_demo_mutual_auth.c:613] 722 83472 [iot_threa] Demo iteration 3
completed successfully.723 83478 [iot_threa]
724 83481 [iot_threa] [INFO] [MQTT_MutualAuth_Demo] [mqtt_demo_mutual_auth.c:625] 725 83489 [iot_threa] Short delay befo
re starting the next iteration.... 726 83496 [iot_threa]
727 88499 [iot_threa] [INFO] [MQTT_MutualAuth_Demo] [mqtt_demo_mutual_auth.c:636] 728 88507 [iot_threa] Demo run is succ
essful with 3 successful loops out of total 3 loops.729 88515 [iot_threa]
730 89518 [iot_threa] [INFO] [DEMO][89518] Demo completed successfully.
Interface 0 IP address : 192.168.89.107
LwIP_DHCP: dhcp stop.
Deinitializing WIFI ...
731 89708 [iot_threa] [INFO] [INIT][89708] SDK cleanup done.
732 89714 [iot_threa] [INFO] [DEMO][89714] -----DEMO FINISHED-----

```

Monitor connection summary.

## 6.3 Monitoring MQTT messages on the cloud

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

1. Sign in to the AWS IoT console.
2. In the navigation pane, choose Test to open the MQTT client.
3. In Subscription topic, enter “+/example/topic”, and then choose Subscribe to topic.

AWS IoT ×

Monitor

Activity

▶ Onboard

▶ Manage

▶ Greengrass

▶ Secure

▶ Defend

▶ Act

Test

Software

Settings

Learn

Documentation [↗](#)

☒ New console experience  
[Tell us what you think](#)

AWS IoT > MQTT test client

## MQTT test client [Info](#)

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

Subscribe to a topic

Topic filter [Info](#)

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

+/example/topic

▶ Additional configuration

Subscribe

Publish to a topic

Subscriptions	Topic
You have no topic subscriptions.	Subscribe to a topic to view incoming messages.

AWS IoT ×

Monitor

Activity

▶ Onboard

▶ Manage

▶ Greengrass

▶ Secure

▶ Defend

▶ Act

Test

Software

Settings

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☒ New console experience  
[Tell us what you think](#)

Subscriptions

+/example/topic

Pause

Clear

Export

Edit

+/example/topic ♥ ×

▼ ameba-ota/example/topic
March 08, 2021, 17:14:36 (UTC+0800)

Hello World!

▼ ameba-ota/example/topic
March 08, 2021, 17:14:23 (UTC+0800)

Hello World!

▼ ameba-ota/example/topic
March 08, 2021, 17:14:21 (UTC+0800)

Hello World!

▼ ameba-ota/example/topic
March 08, 2021, 17:14:20 (UTC+0800)

Hello World!

▼ ameba-ota/example/topic
March 08, 2021, 17:14:17 (UTC+0800)

Hello World!

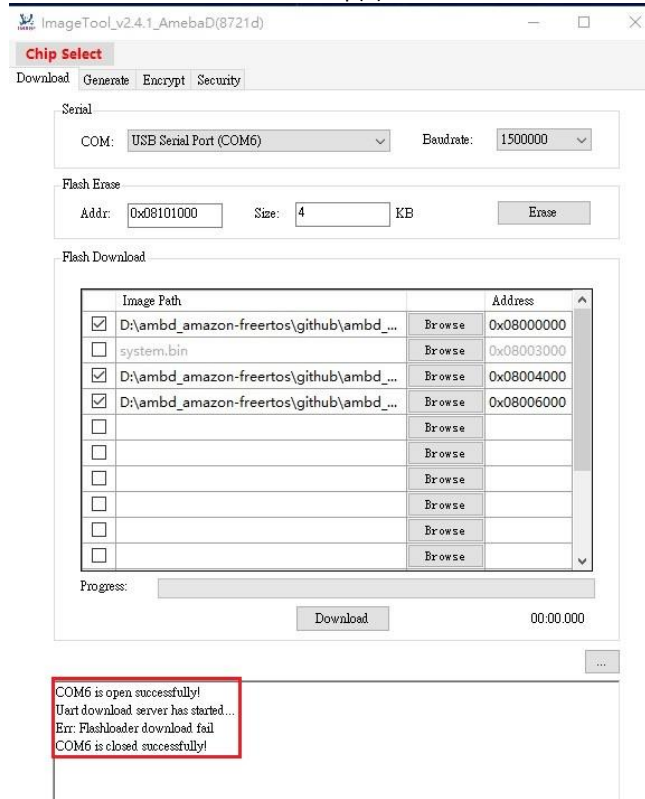
## 7 Troubleshooting

If these steps don't work, look at the device log in the serial terminal. You should see some text that indicates the source of the problem.

For general troubleshooting information about Getting Started with FreeRTOS, see [Troubleshooting getting started](#).

### 7.1 Flashloader download fail

Please check device in UART\_DOWNLOAD mode or not. Refer 5.3.1.1 Step(1) for more detail.



ImageTool\_v2.4.1\_AmebaD(8721d)

Chip Select

Download Generate Encrypt Security

Serial

COM: USB Serial Port (COM6) Baudrate: 1500000

Flash Erase

Addr: 0x08101000 Size: 4 KB Erase

Flash Download

Image Path	Address
<input checked="" type="checkbox"/> D:\ambd_amazon-freertos\github\ambd_...	Browse 0x08000000
<input type="checkbox"/> system.bin	Browse 0x08003000
<input checked="" type="checkbox"/> D:\ambd_amazon-freertos\github\ambd_...	Browse 0x08004000
<input checked="" type="checkbox"/> D:\ambd_amazon-freertos\github\ambd_...	Browse 0x08006000
<input type="checkbox"/>	Browse
<input type="checkbox"/>	Browse
<input type="checkbox"/>	Browse
<input type="checkbox"/>	Browse
<input type="checkbox"/>	Browse
<input type="checkbox"/>	Browse

Progress: 00:00.000

Download

COM6 is open successfully!  
Uart download server has started...  
Err: Flashloader download fail  
COM6 is closed successfully!

### 7.2 ERROR: Invalid Key

Please check **WIFI\_SSID** and **WIFI\_PASSWORD** in in amazon-freertos /demos/include/aws\_clientcredential.h



```

Enter SSID for Soft AP started
3 1098 [example_a] Wi-Fi configuration successful.
4 1108 [iot_threa] [INFO ][DEMO][1108] -----STARTING DEMO-----

5 1115 [iot_threa] [INFO ][INIT][1115] SDK successfully initialized.

LwIP_DHCP: dhcp stop.
Deinitializing WIFI ...
WIFI deinitialized
Initializing WIFI ...
WIFI initialized

Joining BSS by SSID ...

ERROR:Invalid Key
ERROR: Can't connect to AP
Joining BSS by SSID ...

ERROR:Invalid Key
ERROR: Can't connect to AP
Joining BSS by SSID ...

```

## 7.3 Failed to establish new MQTT connection

Please check `clientcredentialMQTT_BROKER_ENDPOINT` in `amazon-freertos/demos/include/aws_clientcredential.h`

```

6 12508 [iot_threa] [INFO ][DEMO][12508] Successfully initialized the demo. Network type for the demo: 1
7 12517 [iot_threa] [INFO ][MQTT][12517] MQTT library successfully initialized.
8 12524 [iot_threa] [INFO ][DEMO][12524] MQTT demo client identifier is ameba-ota (length 9).
9 12624 [iot_threa] [ERROR][NET][12624] Failed to resolve [redacted].amazonaws.com.
10 12934 [iot_threa] [ERROR][MQTT][12934] Failed to establish new MQTT connection, error NETWORK ERROR.
11 12943 [iot_threa] [ERROR][DEMO][12943] MQTT CONNECT returned error NETWORK ERROR.
12 12951 [iot_threa] [INFO ][MQTT][12950] MQTT library cleanup done.
13 12957 [iot_threa] [ERROR][DEMO][12957] Error running demo.
Interface 0 IP address : 192.168.90.185
LwIP_DHCP: dhcp stop.
Deinitializing WIFI ...
14 13094 [iot_threa] [INFO ][INIT][13094] SDK cleanup done.
15 13099 [iot_threa] [INFO ][DEMO][13099] -----DEMO FINISHED-----

```

## 7.4 TLS\_Connect fail

Please check `keyCLIENT_CERTIFICATE_PEM` and `keyCLIENT_PRIVATE_KEY_PEM` in `amazon-freertos/demos/include/aws_clientcredential_keys.h`

```

8 13501 [iot_threa] [INFO ][DEMO][13501] Successfully initialized the demo. Network type for the demo: 1
9 13511 [iot_threa] [INFO ][MQTT][13511] MQTT library successfully initialized.
10 13518 [iot_threa] [INFO ][DEMO][13518] MQTT demo client identifier is ameba-ota (length 9).
11 20102 [iot_threa] [ERROR][NET][20102] Private key not found. 12 20107 [iot_threa] TLS Connect fail (0x7d4, [redacted].amazonaws.com)
13 20115 [iot_threa] [ERROR][NET][20115] Failed to establish new connection. Socket status: -1.
14 20424 [iot_threa] [ERROR][MQTT][20424] Failed to establish new MQTT connection, error NETWORK ERROR.
15 20433 [iot_threa] [ERROR][DEMO][20433] MQTT CONNECT returned error NETWORK ERROR.
16 20441 [iot_threa] [INFO ][MQTT][20441] MQTT library cleanup done.
17 20447 [iot_threa] [ERROR][DEMO][20447] Error running demo.
Interface 0 IP address : 192.168.90.185
LwIP_DHCP: dhcp stop.
Deinitializing WIFI ...
18 20586 [iot_threa] [INFO ][INIT][20586] SDK cleanup done.
19 20591 [iot_threa] [INFO ][DEMO][20591] -----DEMO FINISHED-----

```