

# ARM<sup>®</sup> Cortex<sup>®</sup>-M 32-bit Microcontroller

# Nuvoton-AWS-IoT User Manual

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www.nuvoton.com

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### **1 OVERVIEW**

This user manual is aimed to give users a fast introduction to how to use NuMaker-PFM-M487 board to connect to the AWS IoT.

#### 1.1 Introduction to AWS IoT

AWS IoT is a managed cloud platform that lets connected devices easily and securely interact with cloud applications and other devices. AWS IoT can support billions of devices and trillions of messages, and can process and route those messages to AWS endpoints and to other devices reliably and securely. Visit AWS IoT website: https://aws.amazon.com/ for more information.

#### 1.2 Introduction to NuMaker-PFM-M487 Board

The NuMaker-PFM-M487 is a development board based on an ARM<sup>®</sup> Cortex<sup>®</sup>-M4 microcontroller (MCU) – M480 series which has very rich peripherals.

This board is provided by Nuvoton and created specially to support the ARM<sup>®</sup> mbed<sup>™</sup> IoT Device Platform, and let user easily to develop the IoT application program on this board. The NuMaker-PFM-M487 also provides user many useful and powerful learning materials for how to develop and verify the application programs through the peripherals and interfaces on MCU and this board.

Furthermore, this board also provides an Arduino UNO compatible interface for user to develop the specific function with any of Arduino modules or kits. Regarding to the Arduino, user can link directly to the Wikipedia website: <u>en.wikipedia.org/wiki/Arduino</u> to get more detailed introductions.

The NuMaker-PFM-M487 board consists of M487 Platform and Nu-Link-Me ICE Bridge. Figure 1-1 shows the NuMaker-PFM-M487 board.



#### Figure 1-1 NuMaker-PFM-M487 Board

The left portion of this board is the M487 Platform that includes the target chip M487 MCU which embedded ARM<sup>®</sup> Cortex<sup>®</sup>-M4 core with DSP extensions and a Floating Point Unit (FPU) and the other related on-board application parts and connectors.

The right portion of this board is a Nu-Link-Me ICE Bridge based on the SWD (Serial Wire Debug) interface connected with the target chip, allowing user to program the application code to the flash of target chip through the USB port from PC Host.

For more information on the NuMaker-PFM-M487 board for the ARM® mbed<sup>™</sup> Device Platform, please visit the ARM® mbed<sup>™</sup> hardware board website:

https://developer.mbed.org/platforms/NUMAKER-PFM-M487/

### 1.3 Introduction to ARM<sup>®</sup> mbed<sup>™</sup>

The ARM<sup>®</sup> mbed<sup>™</sup> IoT Device Platform provides the operating system, cloud services, tools and developer ecosystem to make the creation and deployment of commercial, standards-based IoT solutions possible.

The ARM<sup>®</sup> mbed<sup> $^{^{\text{M}}}$ </sup> allows IoT devices to collaborate and communicate with each other on the basis of transparency - otherwise each of the devices will not be able to talk to each other or to the cloud. For more detailed information about ARM<sup>®</sup> mbed<sup> $^{^{\text{M}}}$ </sup>, user can visit the related ARM<sup>®</sup> mbed<sup> $^{^{\text{M}}}$ </sup> websites as the follows:

ARM<sup>®</sup> mbed<sup>™</sup> homepage: <u>www.mbed.com/en/</u>

Software homepage: docs.mbed.com/docs/mbed-os-handbook/en/

Official C/C++ SDK: <u>developer.mbed.org/users/mbed\_official/code/mbed/</u>

### 2 CONFIGURING THE AWS IOT SERVICE

### 2.1 Create AWS IoT Account

- ♦ Visit AWS IoT website: <u>https://aws.amazon.com/</u> to create a account for AWS IoT
- $\diamond$  Sign in the console and select the service of AWS IoT to enter the homepage of AWS IoT service



### 2.2 Create Thing

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### ♦ Key in the name of Thing then click the [Next] button

	4		Oregon *	Support *
CREATE A THING Add your device to the thing registry	STEP 1/3			ф (9) (8)
This step creates an entry in the thing registry and a thing shadow for your device. Name NUVOTON-AWS-IOT				
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 thin common set of attributes, which describe the identity and capabilities of your device, and a description.         Thing Type         No type selected <ul> <li>Create a type</li> </ul>	igs with a			
Add this thing to a group Adding your thing to a group allows you to manage devices remotely using jobs. Thing Group				
	CREATE ASTRANG Add your device to the thing registry This step creates an entry in the thing registry and a thing shadow for your device.           Image:       Image:	CREATE AT THEM         Add your device to the thing registry         The step creates an entry in the thing registry and a thing shadow for your device.         Image:         VOUTON-AWS-IOT    Apply a type to this thing          By a thing type simplifies device management by providing consistent registry data for things that share a type. Types provide things with a casebilities of your device, and a description.         Dipply a type to this thing         Image to prove the device the identity and capabilities of your device, and a description.    Create a type:      Add this thing to a group.    Add this thing to a group. Add this thing	CENTER TAY THE Add your device to the thing registry         Add your device to the thing registry and a thing shadow for your device.         In this tep creates an entry in the thing registry and a thing shadow for your device.         Imme         NUTOTION-AWS-IOT    Apply a type to this thing          Image to this thing to generate the identity and capabilities or your device, and a description.          Image to the provide the identity on origination of the provide the identity of the set of the provide the identity of the provide t	CREATE AT THEME       Step '2'         Add your device to the thing registry       at thing shadow for your device.         In this tep creates an entry in the thing registry and a thing shadow for your device.       Image: Comparison of the thing 'Comparison' of the thing the shadow for your device.         Add your dovice to this thing       Image: Comparison of the thing the shadow for your device.         Apply a type to this thing       Image: Create a type: Cre

aws Services -	Resource Groups 🐱 🔸	Δ	♥ Oregon ♥ 5	Support 👻
e	CREATE A THEMS Add a certificate for your thing	STEP 2/3		ф ©
	A certificate is used to authenticate your device's connection to AWS IoT.			6
	One-click certificate creation (recommended) This will generate a certificate, public key, and private key using AWS IoT's certificate authority. Create certificate			
Create with CSR Upload your own certificate signing request (CSR) based on a private key you own.				
	Use my certificate Register your CA certificate and use your own certificates for one or many devices. Get started			
	Skip certificate and create thing You will need to add a certificate to your thing later before your device can connect to AWS IoT. Create thing without certificate	ate		
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#### ♦ The Thing we created will show on the list of things

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Jobs								
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Settings								
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<sup>♦</sup> Click [Create thing without certificate] button, we will create certificate at next chapter

### 2.3 Create Policies

♦ Enter the Policies page of secure

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♦ Key in the name of Policies then click the [Next] button

aws Services -	Resource Groups 🗸 🖒		Oregon ¥ S	upport 👻
¢	Create a policy to define a set of authorized actions. You can authorize actions on one or more resources (things, topics, topic filters). To learn more about IoT policies go to the AWS IoT Policies documentation page.			ф © &
	Add statements Policy statements define the types of actions that can be performed by a resource. Advanced mode			
	Action Please use commas to separate actions, e.g. iot:Publish, iot:Subscribe			
	Resource ARN Specific resources could include client ID ARN, topic ARN, or topic filter ARN. Effect			
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♦ Change to [Advanced mode] and modify statements then click [Create] button

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "iot:*",
            "Resource": "*"
        }
    ]
}
```



♦ The Policy we created will show on the list of policies

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### 2.4 Create Certificate

♦ Enter the Certificate page of secure

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### ♦ Click the [Create] button

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### ♦ Click the [Create certificate] button

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	A certificate is used to authenticate your device's connection to AWS IoT. One-click certificate creation (recommended) This will generate a certificate, public key, and private key using AWS IoT's certificate authori	Create certificate	]		U
	Create with CSR Upload your own certificate signing request (CSR) based on a private key you own.	2 Create with CSR			
	Use my certificate Register your CA certificate and use your own certificates for one or many devices.	Get started			
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♦ Download the certificate, public key, private key and root CA then click the [Active] button

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¢	Certificate created!	ф © Ю
	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.	
	A certificate for this Download A public key Download	
	A private key Download You also need to download a root CA for AWS IoT from Symantee:	
	A root CA for AWS Io Downtoad	
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♦ Attach the certificate to the policy we created before

Policies will be atttached to the following cert	ificate(s):
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noose one or more policies	
Q Search policies	
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≻	Attach the	certificate to the	Thing we	created before
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ngs will be atttached to the following ce	rtificate(s):
oose one or more things	
Q Search things	
house_keeper_demo	
m487_https_test	
NUVOTON-AWS-IOT	

### 2.5 Things Shadow for AWS IoT

♦ Enter the Things page of manage and select the thing we created before

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♦ Enter the shadow page and modify the shadow document

```
{
    "state": {
        "desired": {
            "LED1": "0",
            "LED2": "0",
            "LED3": "0"
        },
        "reported": {
            "LED1": "0",
            "LED2": "0",
            "LED3": "0"
        }
    }
}
```

### 3 SETUP NUMAKER-PFM-M487

### 3.1 Hardware Requirement

♦ The NuMaker-PFM-M487



#### ♦ The ESP8266 Wi-Fi Module x1

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	/2.0			

♦ The Wi-Fi AP station to share network

### 3.2 Hardware Setting

♦ Enable [Mass Storage Update] function by dip switch



♦ Connect ESP8266 Wi-Fi module to NuMaker-PFM-M487

NuMaker-PFM-M487	ESP8266
VDD	VDD
GND	GND
UART_TX	RX
UART_RX	ТХ

### 4 NUVOTON-AWS-IOT

### 4.1 Create ARM<sup>®</sup> mbed<sup>™</sup> Account

♦ Visit ARM<sup>®</sup> mbed<sup>™</sup> website: <u>https://os.mbed.com/</u> to create a account for ARM<sup>®</sup> mbed<sup>™</sup>

Login or Signup				
Login	Signup			
Username:				
		ari	m	
l've forgotten my username Password:		uII		
		MARE		
I've forgotten my password				
Remember me		1		
Login	Signup	1		

### 4.2 Import [Nuvoton-AWS-IoT] to compile

♦ Sign in the on-line compile

				1	
OS Home Hardware♥ Code Docur	nentation  Questions	Forum	ompiler	Log In/Sig	nup
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Login	Signup				
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I've forgotten my password		VDLL			
Remember me					
Login	Signup				
© Mbed blog	we're hiring! support servic	e status privacy polic	cy terms and condition	ons	

♦ Add NuMaker-PFM-M487 platform to on-line compile

Visit <u>https://os.mbed.com/platforms/NUMAKER-PFM-M487/</u> and import NuMaker-PFM-M487 platform to on-line compiler

### Nuvoton-AWS-IoT





♦ Import NUVOTON-AWS-IOT project 補圖

### 4.3 Modify the Setting of [mbed\_app.json]

- ♦ Open the [mbed\_app.json] file
- ♦ Change the Wi-Fi SSID and password according network setting

```
"wifi-ssid": {
    "value": "\"NUVOTON\""
},
"wifi-password": {
    "value": "\"123456789\""
}
```

♦ Change the ESP8266 pin according hardware setting

```
"esp8266-tx": {
    "help": "Pin used as TX (connects to ESP8266 RX)",
    "value": "D1"
},
"esp8266-rx": {
    "help": "Pin used as RX (connects to ESP8266 TX)",
    "value": "D0"
},
```

### 4.4 Modify the Configurations of [NUVOTON-AWS-IOT]

- ♦ Open the [main.c] file
- ♦ Setting the root CA based on the root CA file downloaded at chapter 2.4

const char SSL_CA_CERT_PEM [] = \
"BEGIN CERTIFICATE\n"\
"MIIE0zCCA7ugAwIBAgIQGNr
"yjELMAkGA1UEBhMCVVMxFzA
·
"biwgSW5jLiAtIEZvciBhdXR
"U2lnbiBDbGFzcyAzIFB1Ymx
"END CERTIFICATE\0";

♦ Setting the certificate based on the certificate file downloaded at chapter 2.4



# nuvoton

♦ Setting the private key based on the private key file downloaded at chapter 2.4

const char SSL_USER_PRIV_KEY_PEM [] = \
"BEGIN RSA PRIVATE KEY\n"\
"MIIEpAIBAAKCAQEApbEEGN \n"\
"4DEo6NHuclgVxFLCzjQb5E \n"\
"WKbtCHvmP92LHJv3sG/g9h
"MG9fXtNCZz1xajUMRBSxQLs \n"\
"END RSA PRIVATE KEY\0";

♦ Setting the URI of RESTful API

#define	AWS_IO	T_HTTPS	_SERVER_	NAME	"	.iot.us-west-2.amazonaws.com"

aWS Services	Resource Groups  <	Oregon • Su	ipport 👻
AWS IOT	Settings		ф S
<ul> <li>Monitor</li> <li>Onboard</li> <li>Manage</li> <li>direngrass</li> <li>Secure</li> <li>Act</li> </ul>	Custom endpoint         DMARLED           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         -west-2.amazonawa.com         -west-2.amazonawa.com		
Software Software Go Settings C Learn	DISABLED Vou 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. View all Cloudwatch Logs Role Level of verbosity DISABLED Litit		
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♦ Setting the name of thing to [NUVOTON-AWS-IOT]

#define AWS\_IOT\_HTTPS\_THINGNAME "NUVOTON-AWS-IOT"

### 4.5 Compile and Install

♦ Click the [Compile] on the on-line compiler

) New 👻 🎦 Import 🛛 🔙 Sav	e 🔲 Save All 🔛 Compile 🗸	🕭 Commit 👻 🕜 Revision 🗌 🍋 🔿	🗸   🆓   🇞   🔨   🖽 Help		NuMaker-PFM-M48
rogram Workspace <	Program: /NuMaker-mbed-a	ws-iot			Program Details
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	Name	Size Type	Modified		Name NuMaker-mbed-aws-lot
	esp8266-driver	Published Library	moments ago		Created moments ago
	e main.cpp	5.3 kB C/C++ Source File	moments ago		Last Modified moments ago
	125 mbed_app.json	0.5 kB Script File	moments ago		URL n/a
	README.md	1.9 kB Generic File	moments ago		Revision -1:0000000+
	(c) mbed-os	Library	moments ago		Status uncommitted changes
					Export      Publish      Home     Description
	Compile output for program:	NuMaker-mbed-aws-iot		Ver	bose Errors: 0 Warnings: 0 Inf
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Program Workspace <	Program: /NuMaker-mbed-aws-iot					Program Details
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■ Reference metal reserved	Name  Remain.cop 5. main.cop 5. mbed_app.json 0. READE.end 1. mbed-os	Size   Type 318 C(24+Source File 518 Script File 918 Genetic File Ubrary Compiling Nuttab File State	Modified moments ago moments ago moments ago er mbtol arws-hot get: NuMaker-PFM-M487 gram: NuMaker-PFM-M487 usi: Initializing	Cancel		Name NuMaker-mbed-ave-iot Created S mirutes ago Last Modified moments ago Last Modified moments ago Last Multimed Never URL n/a Revision - 1:0000000 Status checking © Update @ Commt @ Revisions © Export @ Publish @ Homepage Description
( )	Compile output for program: NuMaker Description Compile Output Find Results Notific	mbed-aws-iot		Error Numbe	r Resource	bese Errors: 0 Warnings: 0 Erfos: 0 In Folder Location
Waiting for os.mbed.com					1 1	INS   📷   🍋

When the compiled file is ready, it's downloaded to your default download location.

### Nuvoton-AWS-IoT

# nuvoton

Program Workspace <	Program: /NuMaker-mbed-a	aws-iot				Program Details		
My Programs  NuMaker-mbed-aws-iot  main.cpp mbed app.ison	Type to filter the list	Match Case Whole Word			G Find		_	
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	main.con	5.3 kB C/C++ Source File	moments ann			Memory Usage		
README.md	mbed app.tson	0.5 kB Script File	moments ago					
🗄 🍥 mbed-os	README.md	1.9 kB Generic File	moments ago					
	(c) mbed-os	Library	moments ago					
						Flash	R	AM
						Type	Size	N
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						Type Jsage Compile for	Size n/a	M
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	Compile output for program: Description	: NuMaker-mbed-aws-iot		Error Number	Verbosi Resource	Type Jsage Compile for Errors: 0 In Folder	Size n/a stats details Warnings: 0	Mi Infos:
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#### ♦ Install

Connect NuMaker-PFM-M487 to computer over USB. NuMaker-PFM-M487 is shown as "MBED" removable storage.

Computer >	_		▼ 49	Search Computer
Organize 🔻 System properties	Uninstall or change a program	Map network drive	Open Control Panel	u≖ ▼ 🚺 🔞
<ul> <li>★ Favorites</li> <li>▲ Hard E</li> <li>▲ Devnloads</li> <li>■ Desktop</li> <li>▲ Device</li> </ul>	Disk Drives (1) OSDisk (C:) 276 GB free of 465 GB es with Removable Storage (1)			
<ul> <li>☐ Libraries</li> <li>☐ Documents</li> <li>J Music</li> <li>☐ Pictures</li> <li>☑ Videos</li> </ul>	MBED (D:) 512 KB free of 528 KB			
Computer Colisk (C:) MBED (D:)				
Domair Processo	n: nuvoton.com Memory: 8 r:	3.00 GB		

Drag and drop your program to the NuMaker-PFM-M487. The NuMaker-PFM-M487 installs the program.

### 5 TEST NUVOTON-AWS-IOT

♦ Enter the shadow page of [NUVOTON-AWS-IOT] on the AWS IoT console

hadow Document	D	elete	Edi
ast update: Dec 21, 2017 9:44:49 AM +0800			
hadow state:			
2 - "desired": { 3welcome": "aws-iot".			
4 "LED1": "1", 5 "LED2": "6", 6 "LED2": "4"			
7			
9 "welcome": "aws-iot", 10 "LED1": "1", 11 "LED2": "A"			
12 "LED3": "1" 13 }			
14			

♦ Change the led status in the desired of shadow state, the NuMaker-PFM-M487 will follow the shadow state to on/off the LEDs.



### 6 REVISION HISTORY

Date	Revision	Description	
2019.04.15	1.00	1.	Initially issued.

#### **Important Notice**

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