

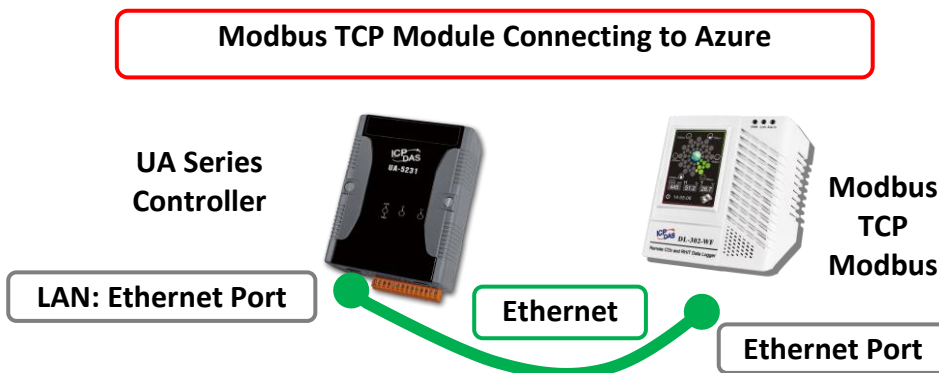
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Author	Eva Li	Version	3.0.0	Date	2024, 04	Page	1 / 23

## FAQ-AZR-01: UA Web UI Function Wizard – Module Connecting to Azure - How to Connect Modbus TCP <=> Azure ? (Use DL-302)

This FAQ introduces the settings of the [Modbus TCP <=> Azure], using the DL-302 module of ICP DAS (see the Wiring Diagram below). The UA series provides the MQTT function for the module to connect to the Microsoft Azure platform and allows the user to publish messages to Azure and receive messages from Azure. When the UA series connecting with a Modbus TCP module needs to read/write the I/O data through the MQTT Service and transmit them to the Microsoft Azure cloud platform, the user can use the [Modbus TCP <=> Azure] function.

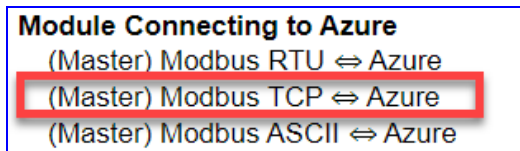
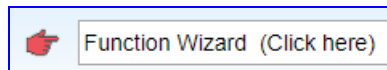
When setting the UA and Azure connection, the user needs to upload the Root CA (Step 2) and enter the SAS Token (Step 3) that applied from Microsoft Azure. The description (See "Azure side settings") is placed between Step 2 and Step 3, there are many setting steps, users can refer to it first.

- Wiring Diagram of Modbus TCP Module Connecting to Azure:

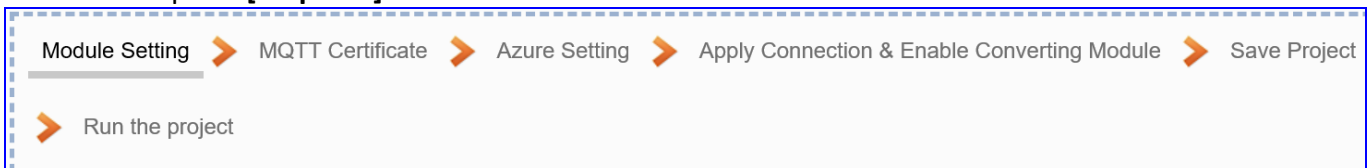


**Note:** The hardware/network connection methods please see the UA manual [Chapter 2](#).

First click the item [Modbus TCP <=> Azure] of the “Module Connecting to Azure” in the Function Wizard.



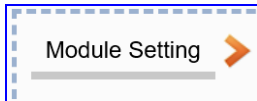
Then show up the [Step Box]:



When enabling the Step Box, it auto enters the first step setting page (The step with a bold underline means it is the current step.). The user only needs to follow the “Step Box” step-by-step and then can complete the project quickly and correctly.

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● **Step 1. Module Setting**



This step is mainly to set the module connected to the UA controller.

1. Click the [Switch] button to change to the [Select The Module] mode.
2. Select the DL-302 module of the DL series
3. Click the [ + ] button to add the module.

4. Click [Edit] button of the DL-302 module to enter the [Module Content Setting] page.

**Module Content Setting**

No.	1
Module Name	DL-302
IP	192 . 168 . 81 . 251
Port	502
Slave ID	1
Timeout(ms)	500
Polling Rate(ms)	500

**Modbus Mapping Table Setting**

Data Model	01 Coil Status(0x)
Start Address	0
Data Number	1
Create Tables	<input type="button" value="Add"/>

**The user fills in the actual connected IP address**

**[Modbus Mapping Table Setting]**  
 If use the ICP DAS module, system will auto-set the module's Modbus mapping table.  
 If not, user needs to check the module I/O & Modbus address via the module user manual.  
 For example:  
 Data Model: 04 Input Registers (3x)  
 Start Address: 0  
 Data Number: 6  
 Type: 16-bit Short  
 ⇨ Click [Add]

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**Address**

**Address:** Display and edit the Modbus Mapping Table.

Modbus Mapping Table		Address	Nickname	Scaling	Bitwise
Coil Status(0x)	Input Status(1x)	Holding Registers(4x)		Input Registers(3x)	
		Address	0		
		Number	6		
		Type	Short		
				<input type="button" value="Edit"/>	
				<input type="button" value="OK"/> <input type="button" value="Cancel"/>	

**Nickname**

**Nickname:** Setting the variable nickname and description.

Modbus Mapping Table		Address	Nickname	Scaling	Bitwise
01 Coil Status(0x)		Table Display <input type="button" value="Show"/> <input type="button" value="Hide"/>			
Address	Variable name	Data Type	Description		
02 Input Status(1x)		Table Display <input type="button" value="Show"/> <input type="button" value="Hide"/>			
Address	Variable name	Data Type	Description		
03 Holding Registers(4x)		Table Display <input type="button" value="Show"/> <input type="button" value="Hide"/>			
Address	Variable name	Data Type	Swap	Description	
04 Input Registers(3x)		Table Display <input type="button" value="Show"/> <input type="button" value="Hide"/>			
Address	Variable name	Data Type	Swap	Description	
0	<input type="text" value="CO2"/>				
1	<input type="text" value="Relative_humidity"/>				
2	<input type="text" value="Temperature_Celsius"/>				
3	<input type="text" value="Temperature_Fahrenheit"/>				
4	<input type="text" value="Dew_point_temperature_Cel"/>				
5	<input type="text" value="Dew_point_temperature_Fah"/>				

**Get from the module user manual**

**C-2. DL-302 Modbus Address Mappings**

Address	Description
30001 ~ 30006	Analog input value of channel 0 to 5.
40001 ~ 40006	channel 0: CO <sub>2</sub> in 1ppm, channel 1: relative humidity in 0.01%, channel 2: temperature in 0.01°C, channel 3: temperature in 0.01°F, channel 4: dew point temperature in 0.01°C, channel 5: dew point temperature in 0.01°F

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### Scaling

**Scaling:** Convert/scale the original value to an easily identifiable value.

1. Click the **[Show Detail]** of the variable
2. Input **[Min.]** & **[Max.]** in **[Reference]** by the **measure range** value, scaling by the unit (1 or 0.01); Input **[Min.]** & **[Max.]** in **[Output]** by the **display range** wanted, and [Offset] value if needed; Add a [Description] to make the values more clear.  
(Check the module specifications and Modbus address table..., as same as the figure below)
3. Click the **[Enabled]** box, then the Scaling function will be active when the project restarts.

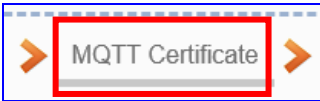
Modbus Mapping Table
Address
Nickname
Scaling
Bitwise

Address	Reference	Output	Scaling	Enabled	Description
0	CO2 Min. 0 Max. 9999	Scale_CO2 Min. 0 Max. 9999 Offset 0	Hide Detail	<input checked="" type="checkbox"/>	
1	Relative_humidity Min. 0 Max. 10000	Scale_Relative_humidity Min. 0 Max. 100 Offset 0			<b>CO<sub>2</sub> Measurement</b> Range - 0 ~ 9999 ppm Resolution - 1 ppm Accuracy - ±30 ppm ±3% Response Time - 20 seconds Warm-up Time - 60 seconds
2	Temperature_Celsius Min. -1000 Max. 5000	Scale_Temperature_Cel Min. -10 Max. 50 Offset 0			<b>Temperature Measurement</b> Range -10 ~ +50°C Resolution 0.1°C Accuracy ±0.6°C
3	Temperature_Fahreni Min. 1400 Max. 12200	Scale_Temperature_Fah Min. 14 Max. 122 Offset 0			<b>Relative Humidity Measurement</b> Range 0 ~ 100% RH, Non-condensing Resolution 0.1% RH, Non-condensing Accuracy ±5% RH, Non-condensing
4	Dew_point_temperati Min. -1000 Max. 5000	Scale_Dew_point_tempe Min. -10 Max. 50 Offset 0			<b>Dew Point</b> Range Calculated using temperature an Resolution 0.1°C
5	Dew_point_temperati Min. 1400 Max. 12200	Scale_Dew_point_tempe Min. 14 Max. 122 Offset 0	Hide Detail	<input checked="" type="checkbox"/>	Analog input value of channel 0 to 5. channel 0: CO <sub>2</sub> in 1ppm, channel 1: relative humidity in 0.01%, channel 2: temperature in 0.01°C, channel 3: temperature in 0.01°F, $[^{\circ}\text{F}] = [^{\circ}\text{C}] \times \frac{9}{5} + 32$ channel 4: dew point temperature in 0.01°C, channel 5: dew point temperature in 0.01°F

p.s. Scaling is only available in the AI/AO settings of Modbus RTU/TCP.

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● **Step 2. MQTT Certificate**



For MQTT communication security to **upload** the **MQTT Certificate**.

To upload the device's certificate, first, you need to obtain the MQTT certificate file for connecting the device and then upload it to the UA controller.

**There are 3 types of certificates:** Upload certificates according to the **authentication mode**.

To perform **Broker authentication**, you need to upload the **Trusted Certificate**.

To perform **Broker/Client two-way authentication**, you need to upload the **additional Certificate and Private Key**.

You can skip this step if your project does not use certificate transmission security.

**For this example**, connecting to **Azure** requires **Azure's MQTT Trusted Certificate**, you can **upload it in the [Trust Credential] field**. (The MQTT trust certificate **"BaltimoreCyberTrustRoot.crt"** has been **attached to this FAQ**, you can **download it in the [FAQ-azr-1](#)**.)

Trusted Certificate	<ul style="list-style-type: none"> <li>• <b>File format must be PEM</b>. Extension name must be <b>".pem", ".cer", or ".crt"</b>.</li> <li>• If select a wrong file, the system will show an error message.</li> </ul>
---------------------	--

Trusted Certificate  Certificate\_192.168.255.10 Certificate type is wrong.

I/O Status
File Setting

File Setting
MQTT Certificate

Project File

OPC UA Certificate

MQTT Certificate

Log FileDownload

### MQTT Client

#### Remove the File

Trusted Certificate	<input type="button" value="Remove"/>
Certificate	<input type="button" value="Remove"/>
Private Key	<input type="button" value="Remove"/>

#### Upload the file to the controller

Trusted Certificate	<input type="button" value="Select File"/>	<input style="width: 100px;" type="text"/>	<input type="button" value="Upload"/>
Certificate	<input type="button" value="Select File"/>	<input style="width: 100px;" type="text"/>	<input type="button" value="Upload"/>
Private Key	<input type="button" value="Select File"/>	<input style="width: 100px;" type="text"/>	<input type="button" value="Upload"/>

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- **Azure Side Settings**

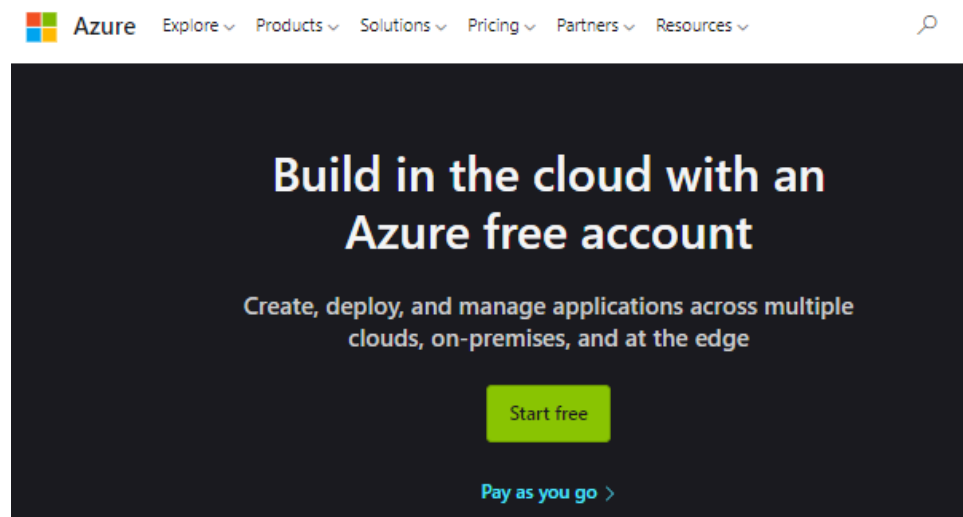
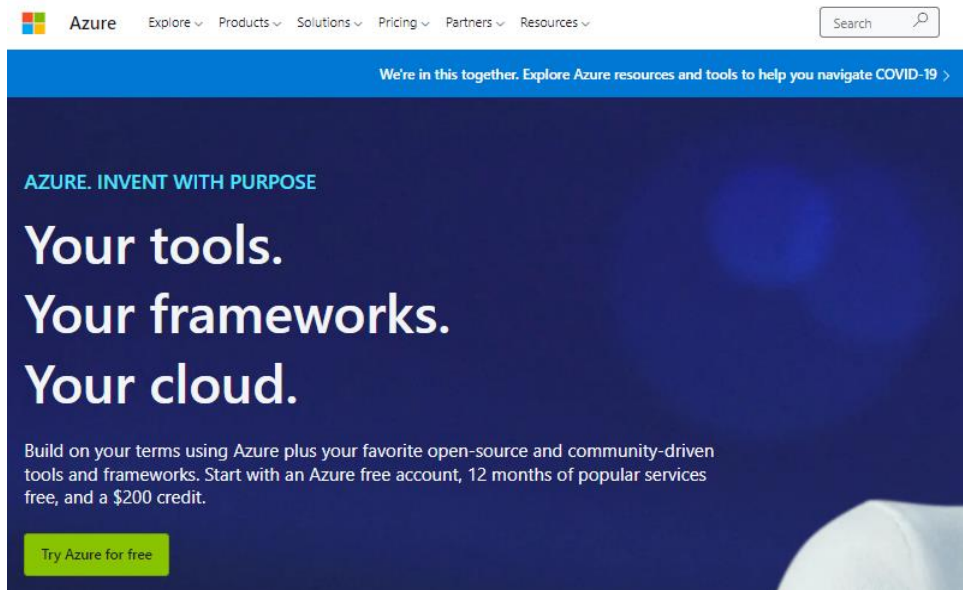
Before setting the next step [Azure Settings], please go to the **Microsoft Azure platform** to obtain Azure-related information, such as connection name, SAS token, etc. This section will explain the steps for getting data on the Azure side (including Azure account application, resource settings, trust credentials, SAS tokens... etc.).

**Please go to the Microsoft Azure website:**

### A. Microsoft Azure Account: Create / Sign-in

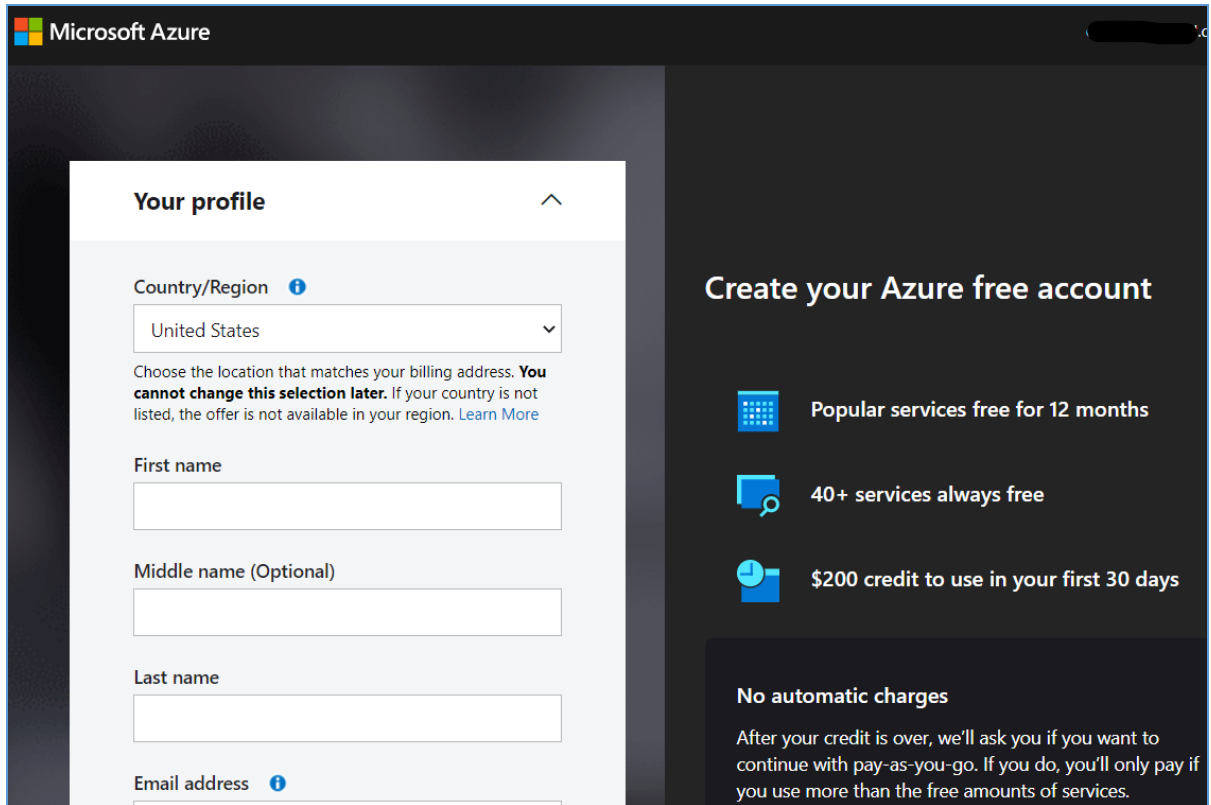
Using the Azure services, the user needs an Azure account. Microsoft Azure currently (2022/02) provides a free trial activity. Users can create a free account to try Azure for free. And then apply for an appropriate paid account according to the user's needs.

<https://azure.microsoft.com/en-us/>

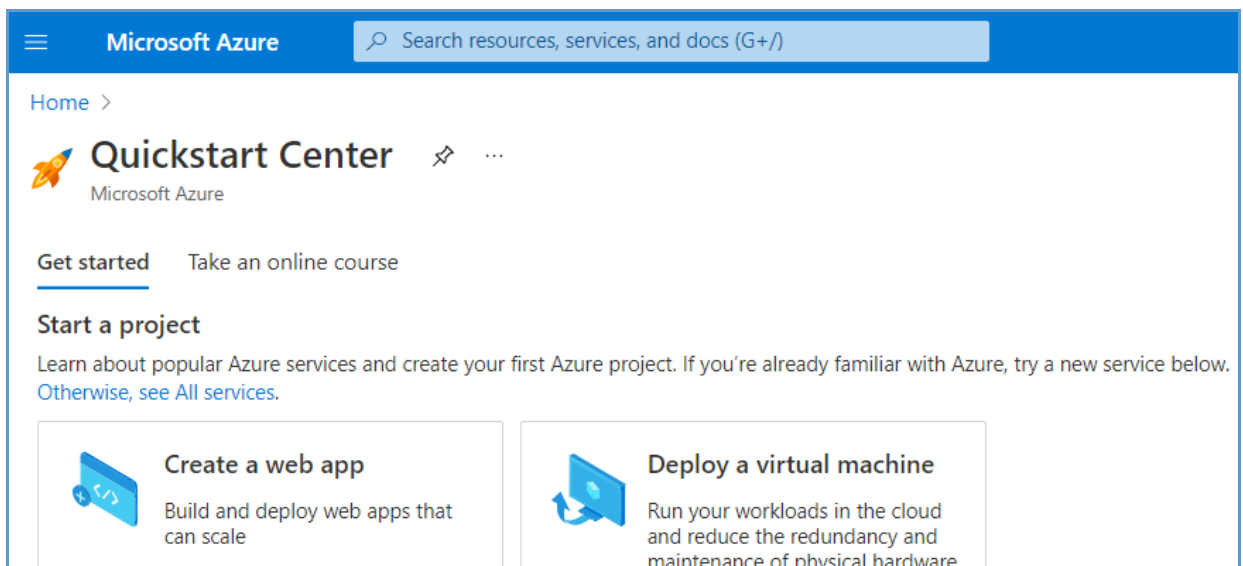


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If the user already has an Azure account, please sign in directly. If doesn't has an account, please create one account. Click "Start Free" (see previous page) to create a free account, (or "Pay as you go" by user need), and fill in the registration information, including: Country First Name Last Name, Email Address, Phone number, etc.



After creating your account, the user can set up the Azure service.

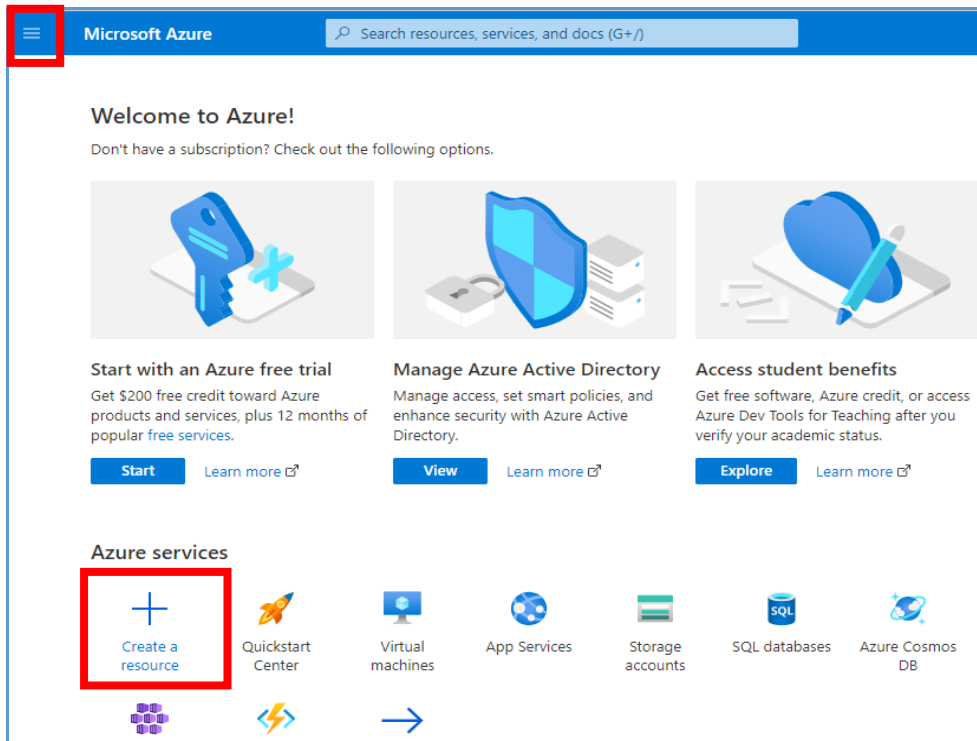




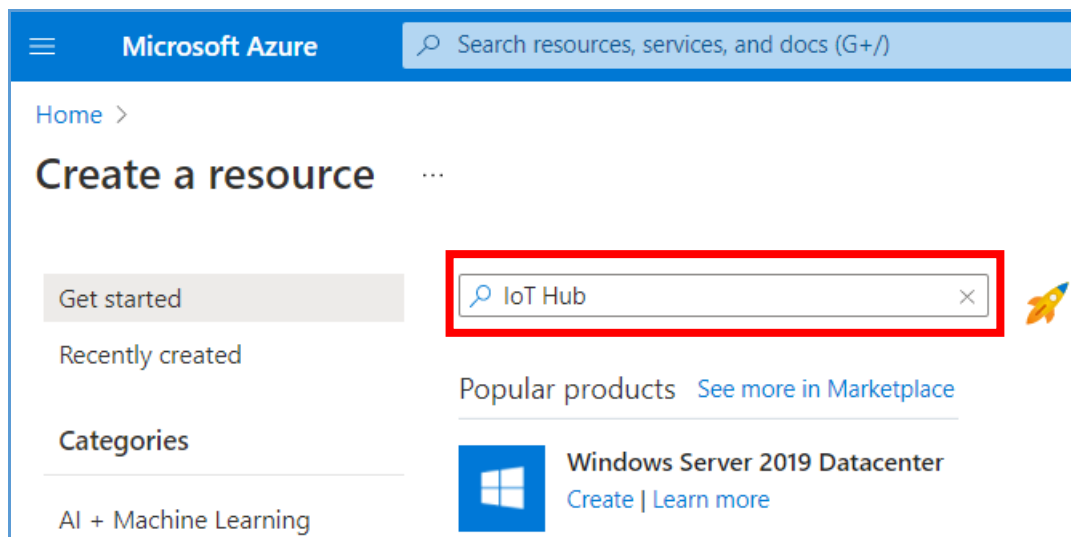
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## B. Create Azure IoT Service IoT Hub: to get the “Connection string”

Entering the Azure, click on the menu icon of the upper left corner 【☰ > Home】 to enter the home page (as shown in the figure below, you can view various services of Azure), please click 【Create a resource】 to create and set up the required resources.



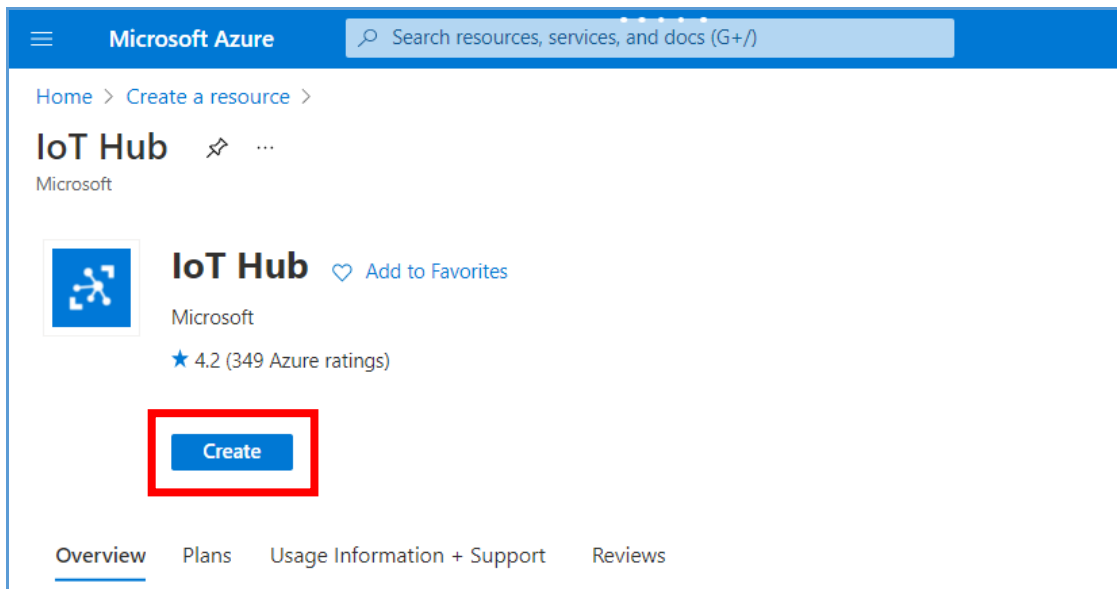
The UA communication server uses Azure's "IoT Hub" resource service, please search for "IoT Hub" (as shown below).



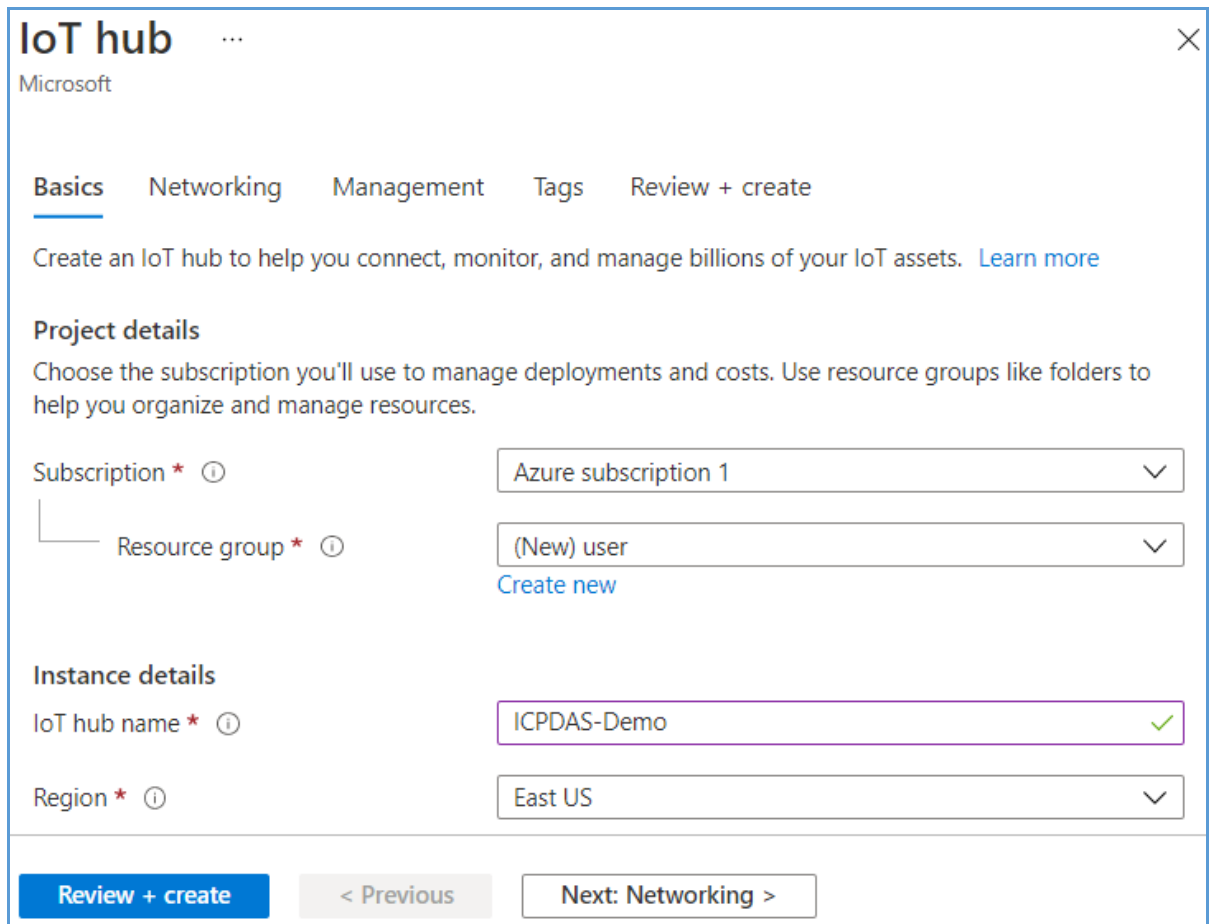


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On the “IoT Hub” webpage, click “Create” to create a resource.



Set up the “Basics” data for IoT hub. Click “Create new”, give a folder name for **resource group**. Give a name for “IoT hub name” and select the region. And click “Next: Networking”.



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On "**Networking**" page, select "**Public access**" or "**Private access**" for the IoT hub publicly according to the user project need. Then Click "**Next: Management**".


On "**Management**" page, user can select "F1: Free tier" for test, or click the blue text to learn how to choose the right IoT Hub tier for you solution. Then click "Next: Tags".

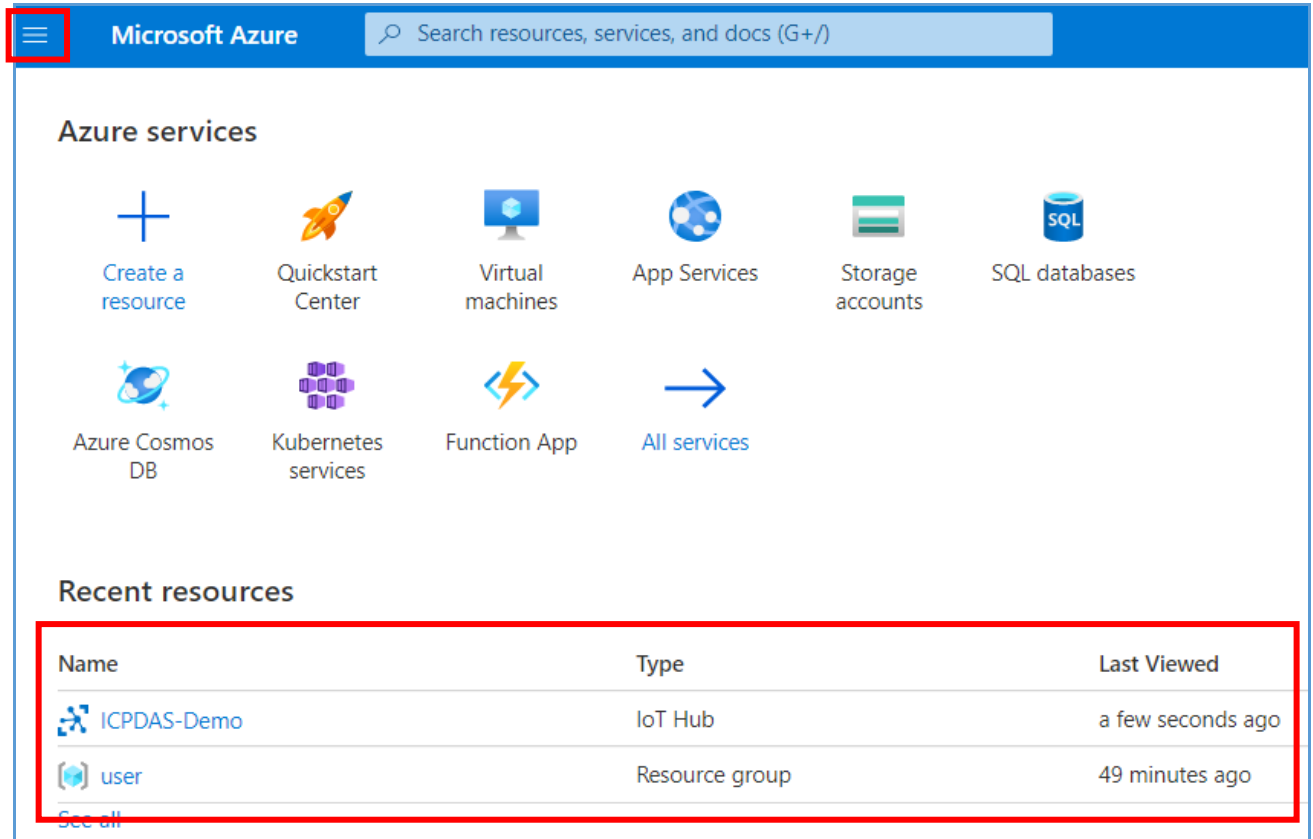
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On “**Tags**” page, set the tag name and value of the resource group, for example, ICPDAS-IoT-Hub. Users can apply the same tag to multiple resources and resource group. Then next.



On the “Review + create” page, when the validation passed, click the “**Create**” button to deploy the resource. When showing the following messages, the deployment is complete.

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Click the menu button in the upper left corner [  > Home ] .  
The created resources of "IoT Hub" and "Resource Group" will display in the "Recent resources".

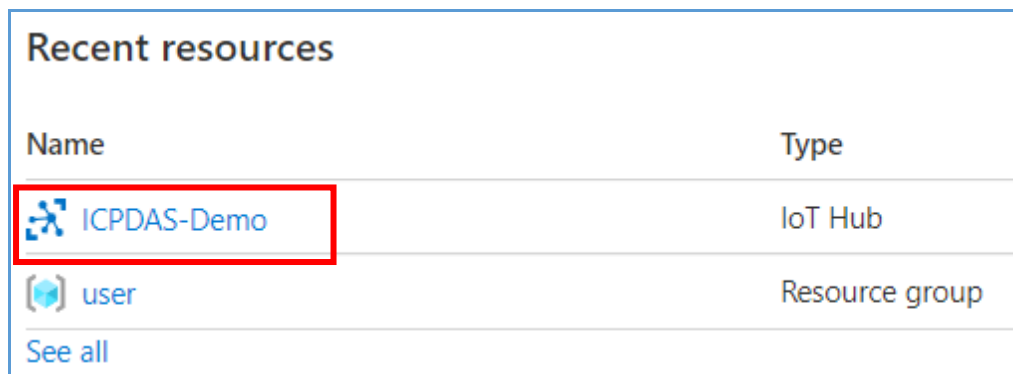


The screenshot shows the Microsoft Azure portal interface. At the top, there is a search bar and the text "Microsoft Azure". Below this, there are sections for "Azure services" and "Recent resources". The "Recent resources" section contains a table with the following data:



Name	Type	Last Viewed
 ICPDAS-Demo	IoT Hub	a few seconds ago
 user	Resource group	49 minutes ago

Below the table, there is a link that says "See all".

Double click the name of the IoT Hub, this example is "ICPDAS-Demo", enter the setting page of the ICPDAS-Demo.



This is a close-up view of the "Recent resources" table. The entry for "ICPDAS-Demo" is highlighted with a red rectangular box. The table structure is as follows:

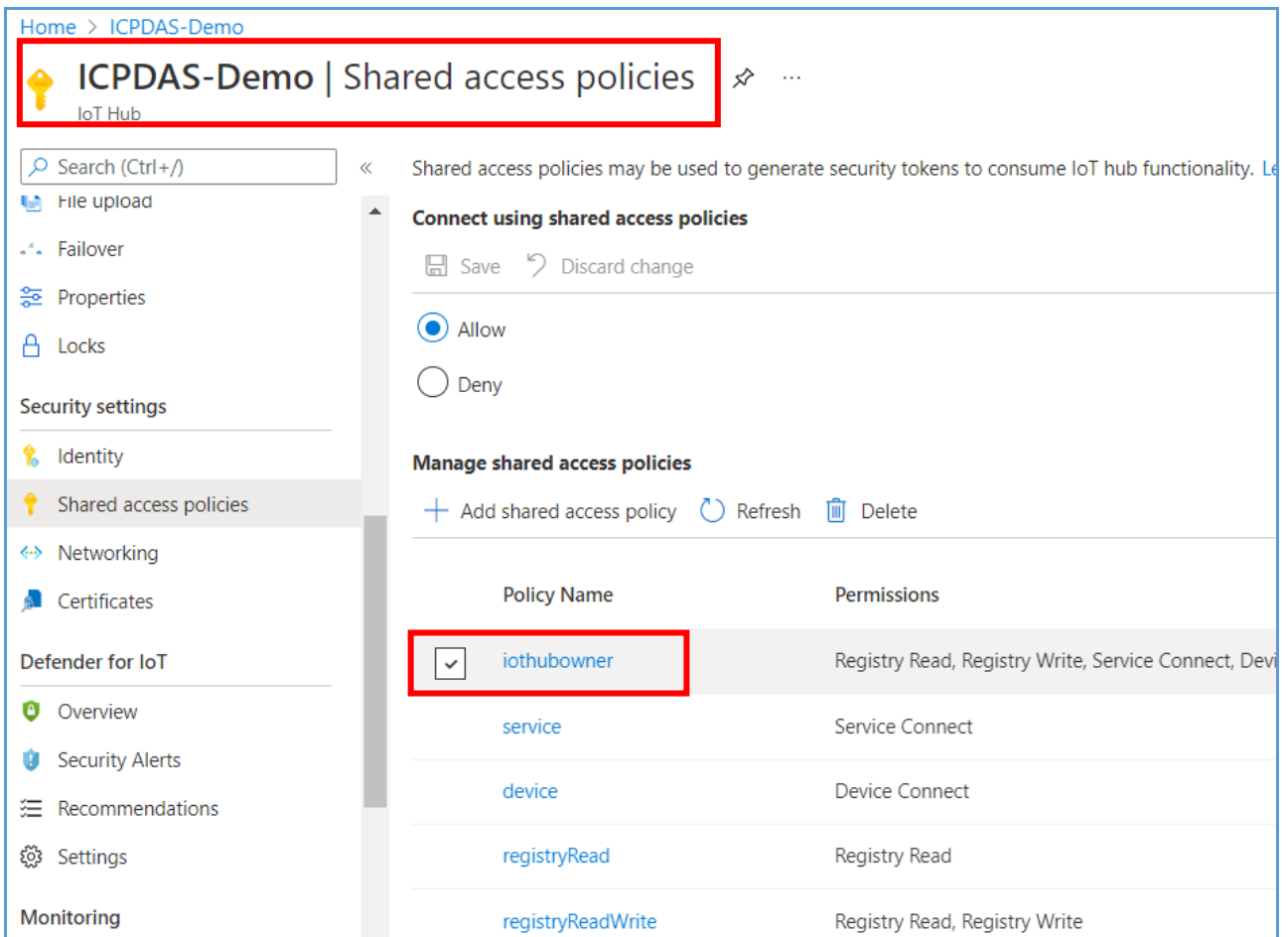
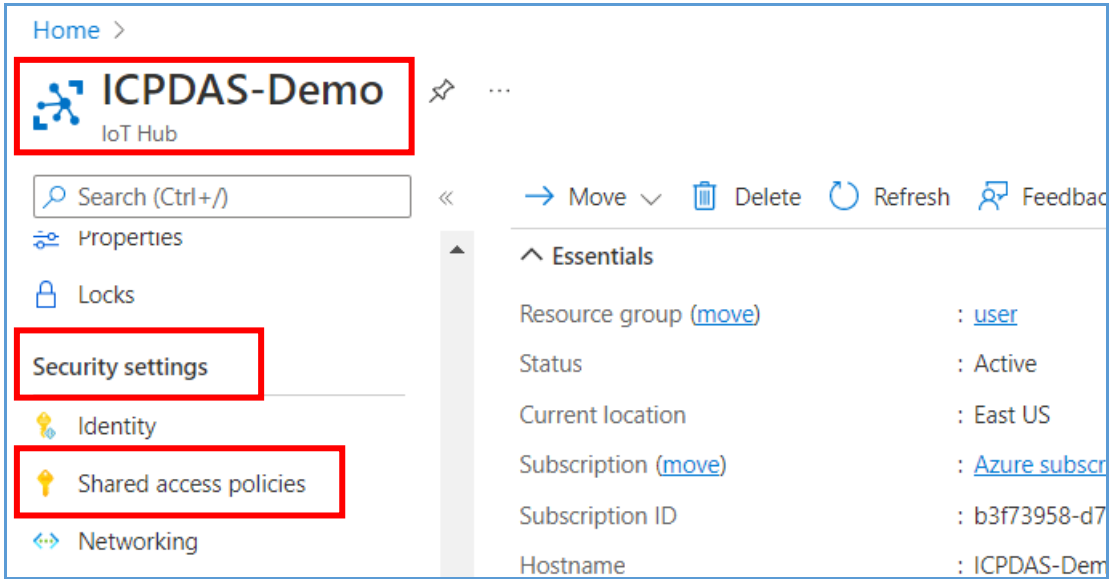
Name	Type
 ICPDAS-Demo	IoT Hub
 user	Resource group

Below the table, there is a link that says "See all".

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Enter "ICPDAS-Demo" setting page of IoT Hub, scroll left function menu:

1. Find the "Security Settings" category and click the "Shared Access Policies" function
2. Check the box of "iothobowner" in the "Policy Name" column, and click "iothobowner".

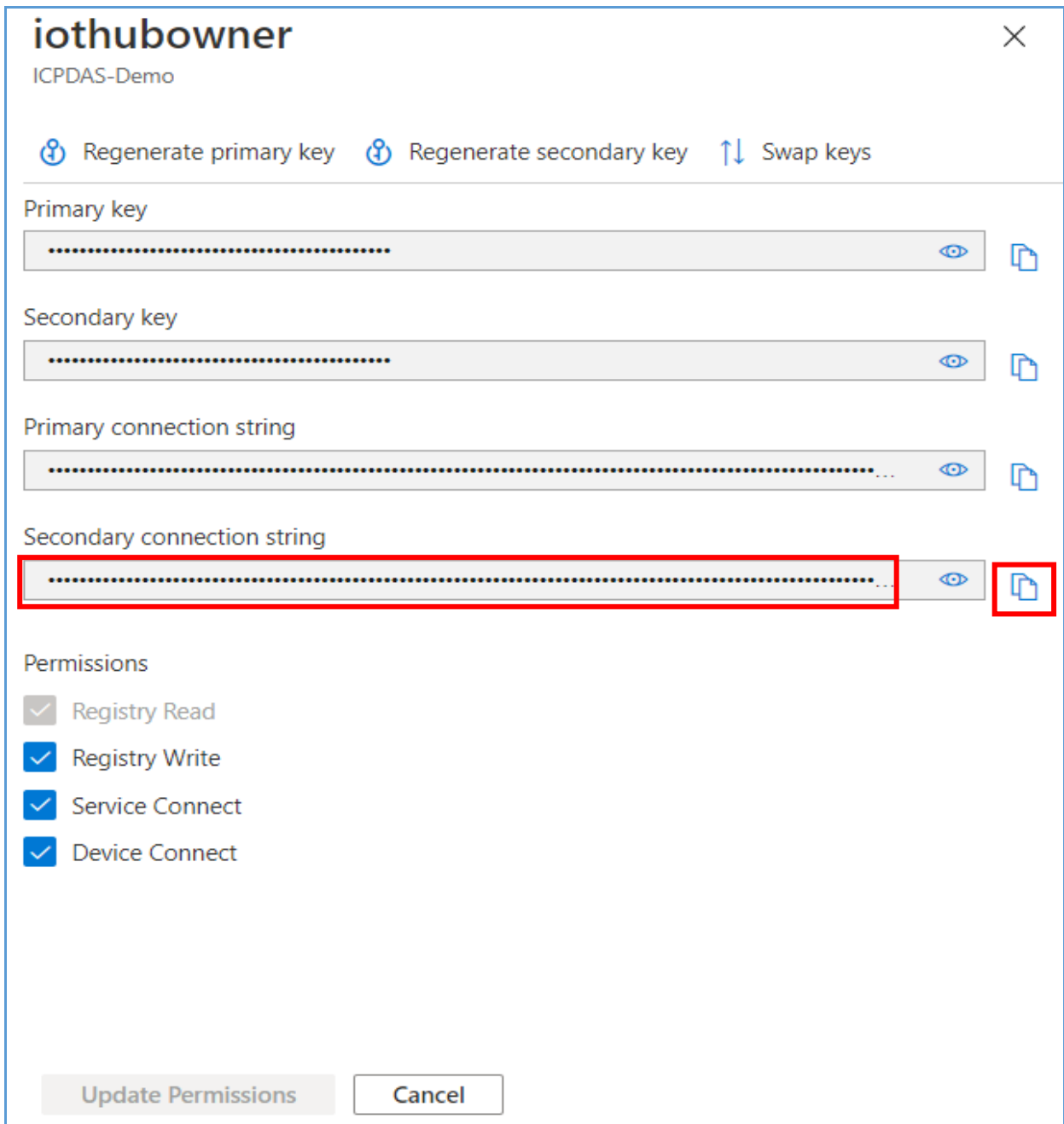


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In the “**iothubowner**” page:

1. Click the icon  on the right side of “**Secondary connection string**” to copy the string. This string is the “**Connection string**” of the next step for setting **Azure IoT Explorer**.
2. Recommend to save this string to a text file for the user easy past it to the other settings.

**Note.:** This string contains personal account and payment information. Do not provide it to others! The picture will make some mosaic when shown it.



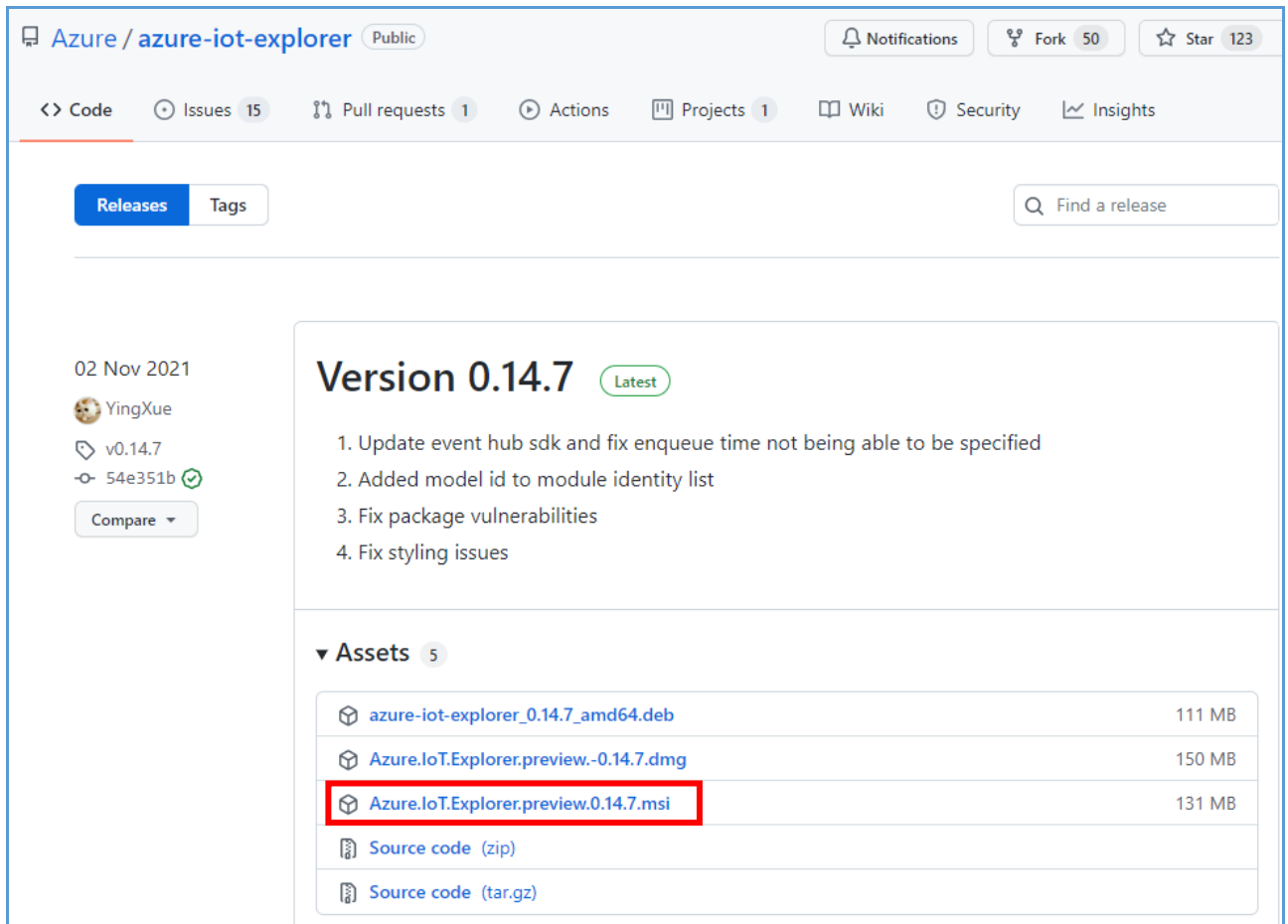
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### C. Create Azure Connection: PC side Azure IoT Tool “Azure IoT Explorer”

For setting the Azure connection, the user has to set up the IoT Hub and needs to install an Azure IoT management tool, such as **Azure IoT Explorer**, on the PC side.

First, download and install the **Azure IoT Explorer** software, and create an Azure IoT management tool on the PC side to set up the device connected with Azure. Click the following link: <https://github.com/Azure/azure-iot-explorer/releases>

For Windows system, please download the file with the extension **.msi**.

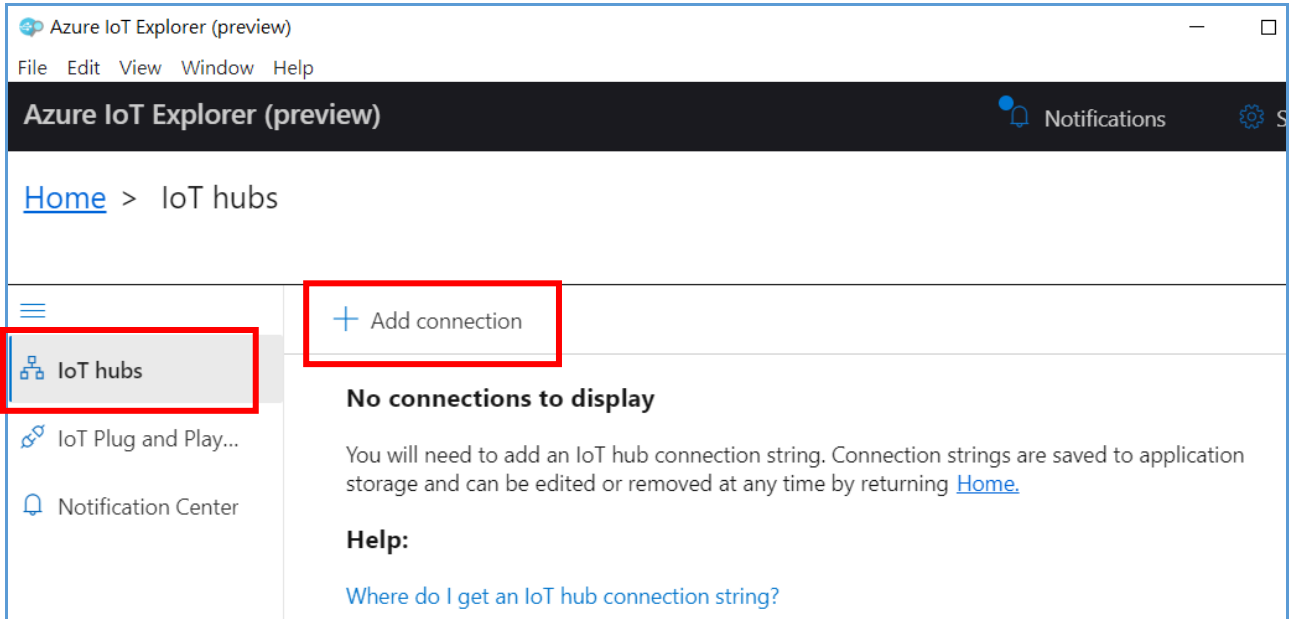


After the download is complete, please install Azure IoT Explorer. And then start and execute the software.

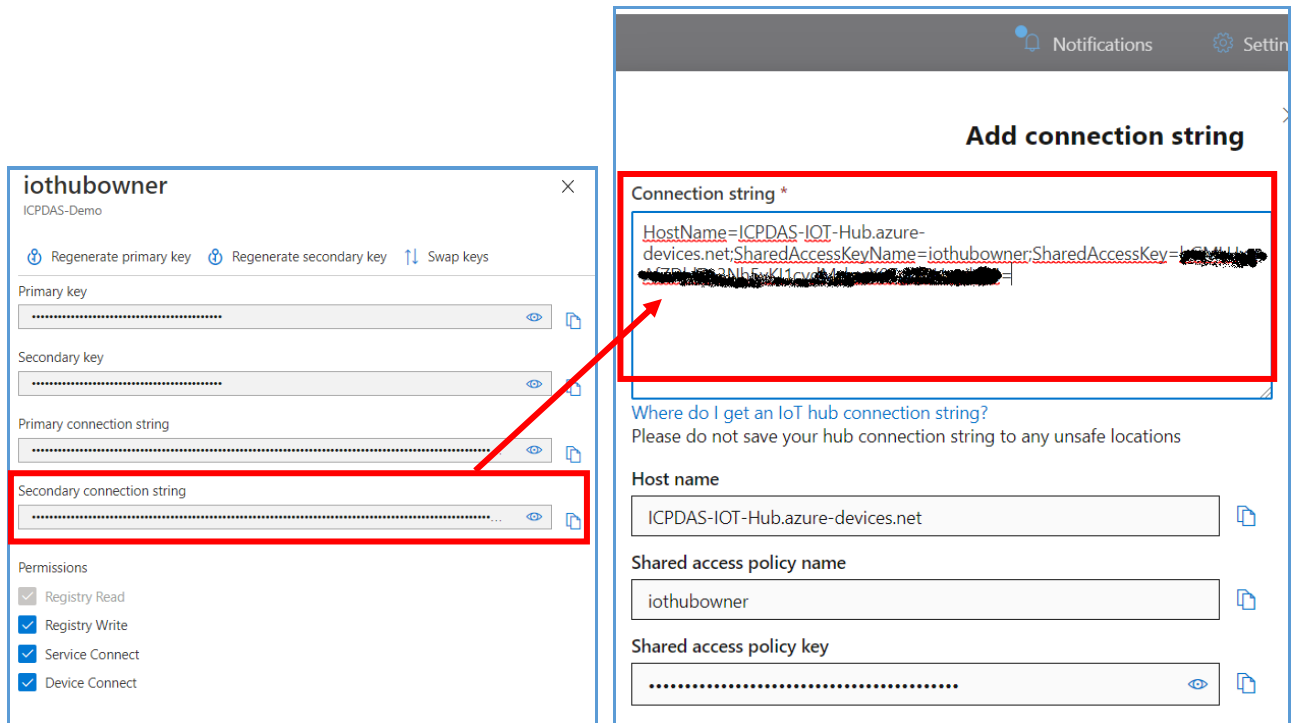


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Next, on the Azure IoT Explorer page, switch to the "IoT hubs" item in the left menu, and then click “ + Add connection” on the right side to create a new connection, as shown below.



Then copy the connection string obtained in the previous step (C) (as shown on the left image) into the “Connection string” field on this page (as shown on the right image). **Note.:** This string contains personal account and payment information. Do not provide it to others! The picture will make some mosaic when shown it.

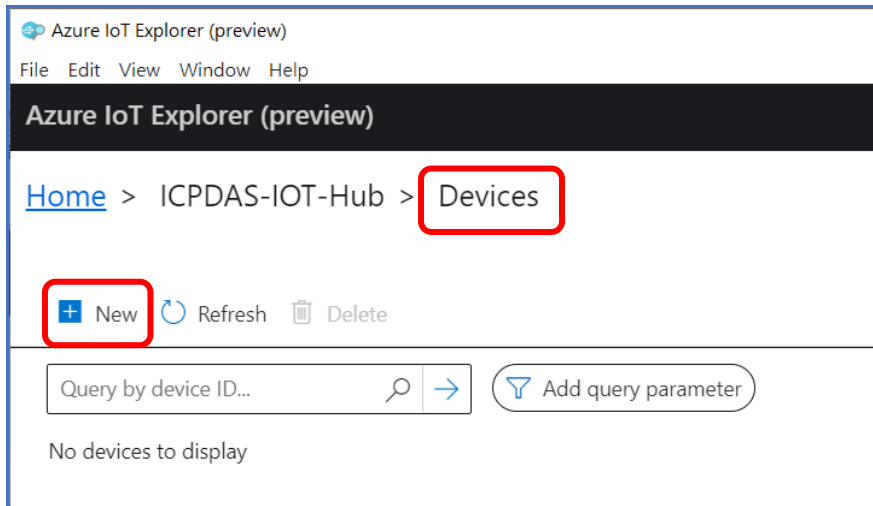


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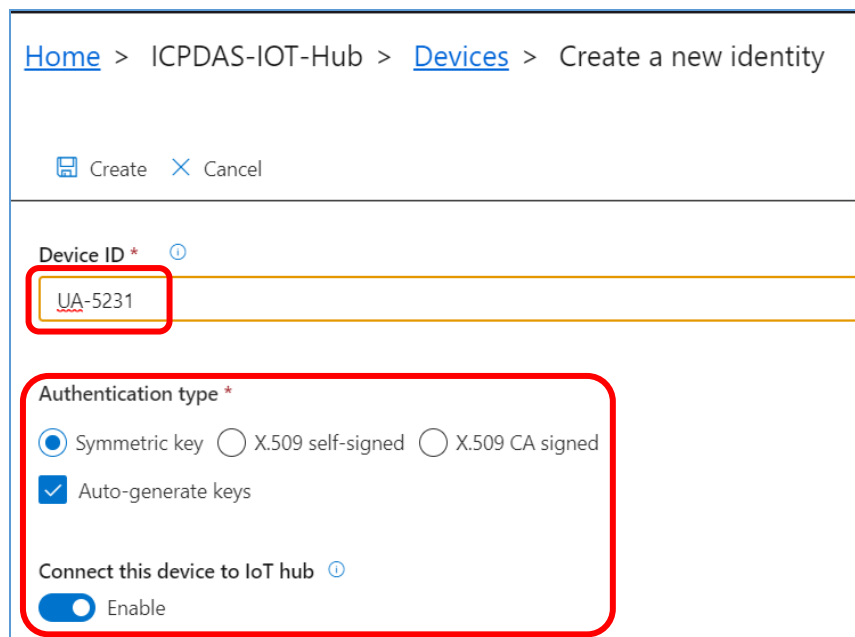
## D. Create Connection Devices: Get "SAS Token" for UA Settings

In the Azure IoT Explorer software, enter the "IoT hubs" connection. The next step is to create an UA device connecting with Azure.

In the "Devices" page, click "+New" to create a new device.



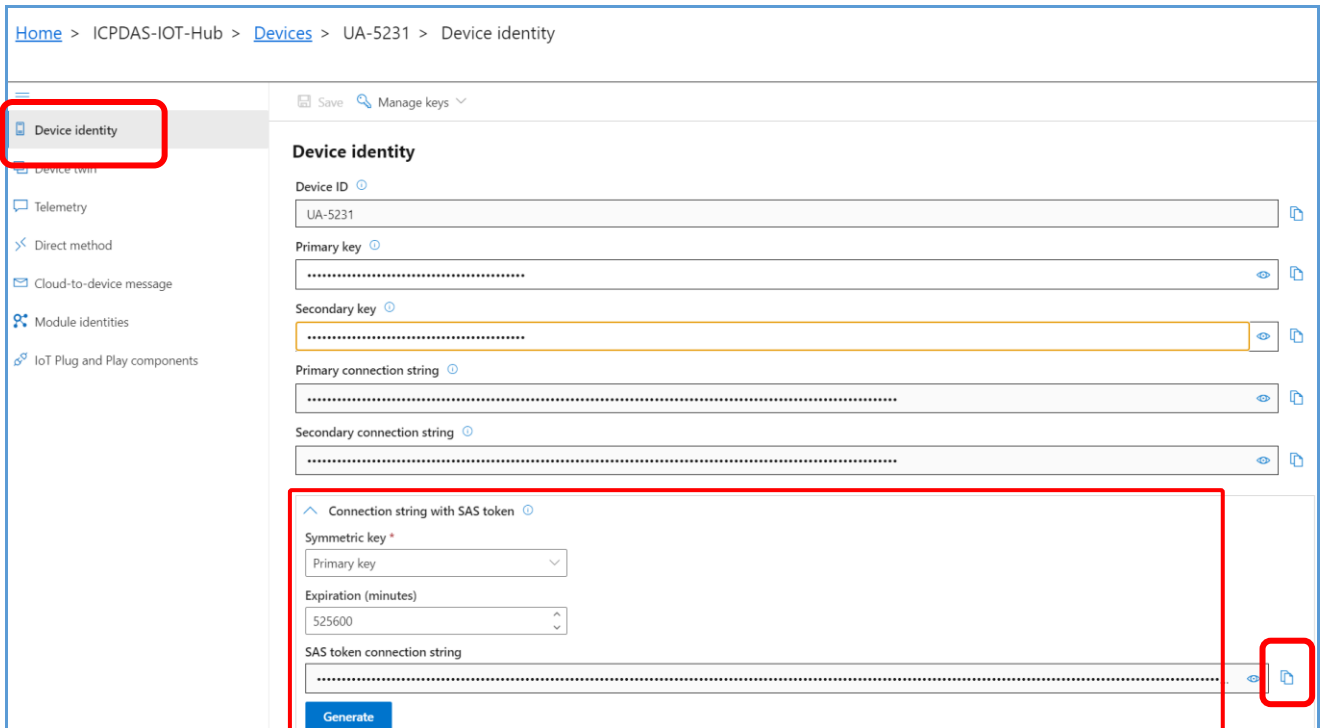
Enter the name of the connecting UA device in the "Device ID" item. Please refer to the figure below for the setting items.



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After setting the device, the system will generate the keys and token. Click the left menu "Device identity" and copy the "SAS token connection string" (click the copy icon on the right side of the field) that is the "SAS token" for the UA setting (Used in the next section). Or save this token string to a TXT file to paste in the UA side setting.

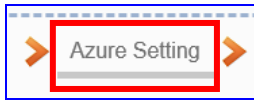
**Note.: This string contains private information. Do not provide it to others! The picture will make some mosaic when shown it.**



Now, the settings on the Azure side have finished. Next, please go back to the UA web setting interface to fill in the Azure strings applied in this section into the UA settings (see next section: Step 3).

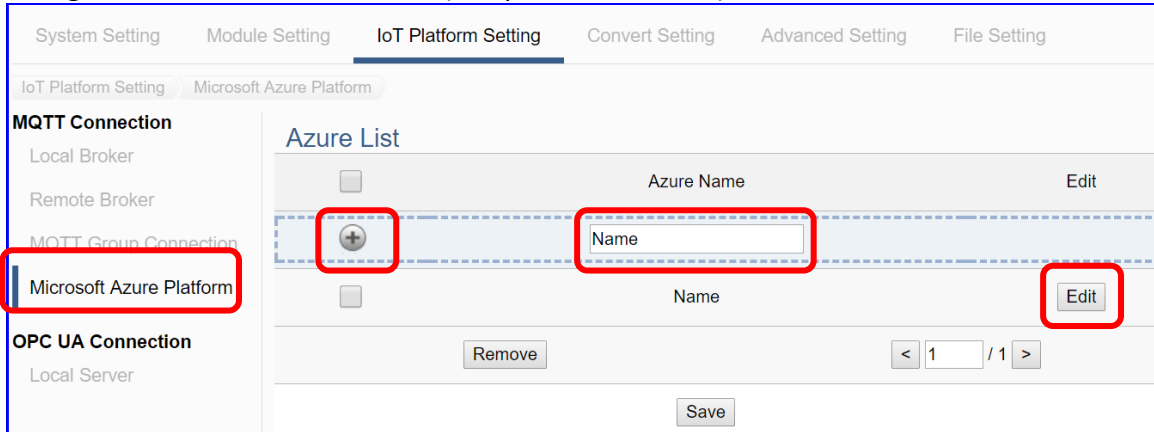
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● **Step 3. Azure Setting**



This step is to for setting the information that got from the Azure Platform

**Back to the UA web setting interface**, click the **Step 3 [Azure Setting]**. Enter the **[MQTT Connection] > [Microsoft Azure Platform]** to set the Azure information that got from the Azure website, e.g. the name, SAS Token, etc. (see previous section)



1. Set up an **Azure Name** for connection
2. Click the "+" button to create an Azure connection.
3. Click **[Edit]** button to enter the "Azure Content Settings" page.

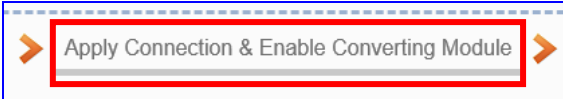
Copy and paste the **SAS Token Connection String** requested from the **Azure platform** that represents this device.

**Note.:**  
**This string contains private information. Do not provide it to others! The picture will make some mosaic when shown it.**

Enter the file name of the Root CA Certificate applied / downloaded from the Microsoft website. It is **attached to this FAQ.**

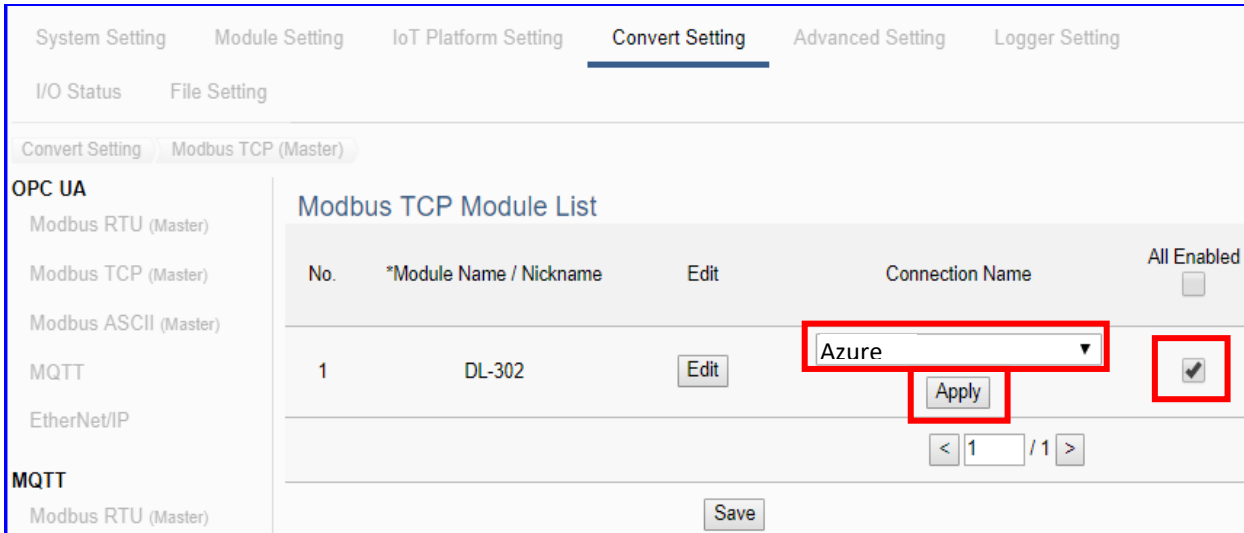
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● **Step 4. Apply Connection & Enable Converting Module**

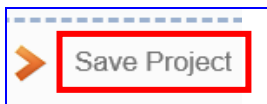


This step is to apply the connection and enabling the converting module.

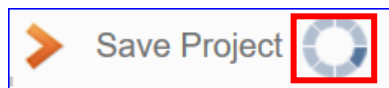
① **Select the Azure Connection Name** and ② **Apply it**, ③ **check the module enabled box.**



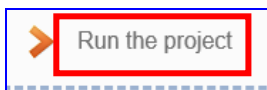
● **Step 5. Save Project**



The setting of this example is finished now. Click the next step [**Save Project**]. When the animation vanished, the project is saved completely.

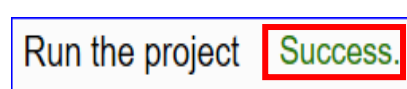
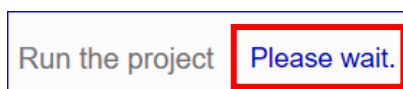


● **Step 6. Run the Project**



This step is to transfer the new project into UA controller, and execute it.

User also can click [**System Setting > Controller Service Setting > Run Project**] > [**Stop**] & [**Run**] the project.



When the words “**Success**” appears, the UA controller is running new project successfully. Then the **Step Box will disappear** automatically, and back to the first screen view of the Web UI.

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**Check I/O Data:**

Click the menu **[I/O Status]** > the **module [DL-302]** on the left side to view the real-time I/O status.

**[I/O]:** Display the I/O status and raw data of DL-302 module.

The screenshot shows the 'I/O Status' interface. On the left, there are three module selection panels: 'Modbus RTU Module (Master)', 'Modbus TCP Module (Master)', and 'Modbus ASCII Module (Master)'. The 'Modbus TCP Module (Master)' panel has 'DL-302' selected in the 'Name' column and 'LAN' in the 'LAN' column. The 'I/O Status' tab is selected in the top navigation bar. The main area displays a table of I/O data for the selected module.

Variable Name	Data Type	Value	Description	Status
CO2	Short	655		Good
Relative_humidity	Short	6383		Good
Temperature_Celsius	Short	2483		Good
Temperature_Fahrer	Short	7669		Good
Dew_point_temperal	Short	1750		Good
Dew_point_temperal	Short	6350		Good

**[Scaling]:** Displays scaled CO2, relative humidity, Celsius/Fahrenheit temperature and dew point temperature, making the data easier to identify.

The screenshot shows the 'I/O Status' interface with the 'Scaling' tab selected. The table displays scaled data for the selected module.

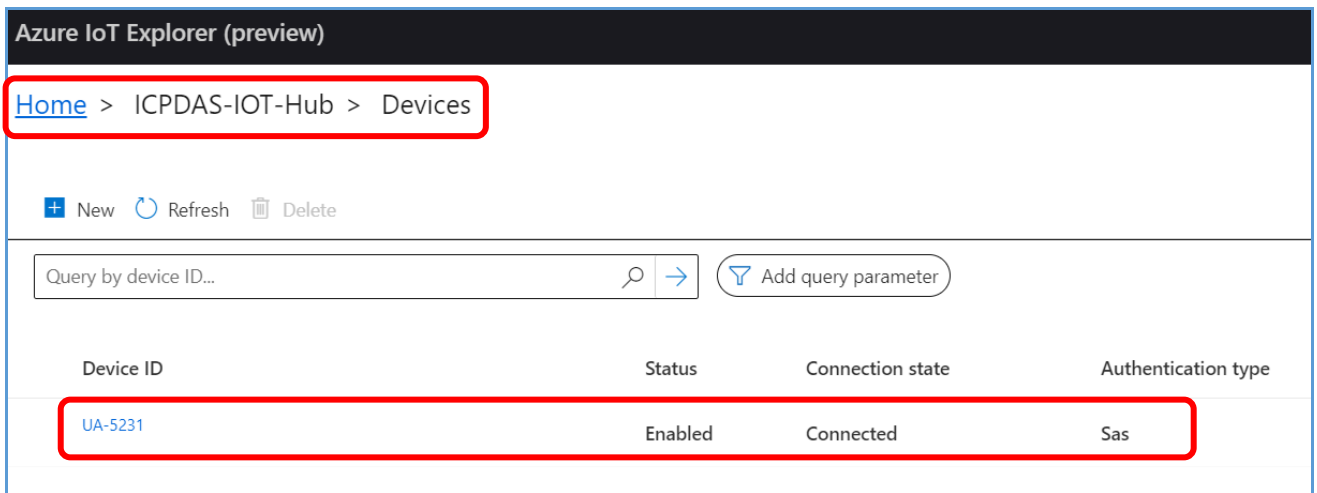
Variable Name	Data Type	Value	Description	Status
Scale_CO2	Float	655		Good
Scale_Relative_hum	Float	63.83		Good
Scale_Temperature_	Float	24.83		Good
Scale_Temperature_	Float	76.69		Good
Scale_Dew_point_te	Float	17.51		Good
Scale_Dew_point_te	Float	63.51		Good

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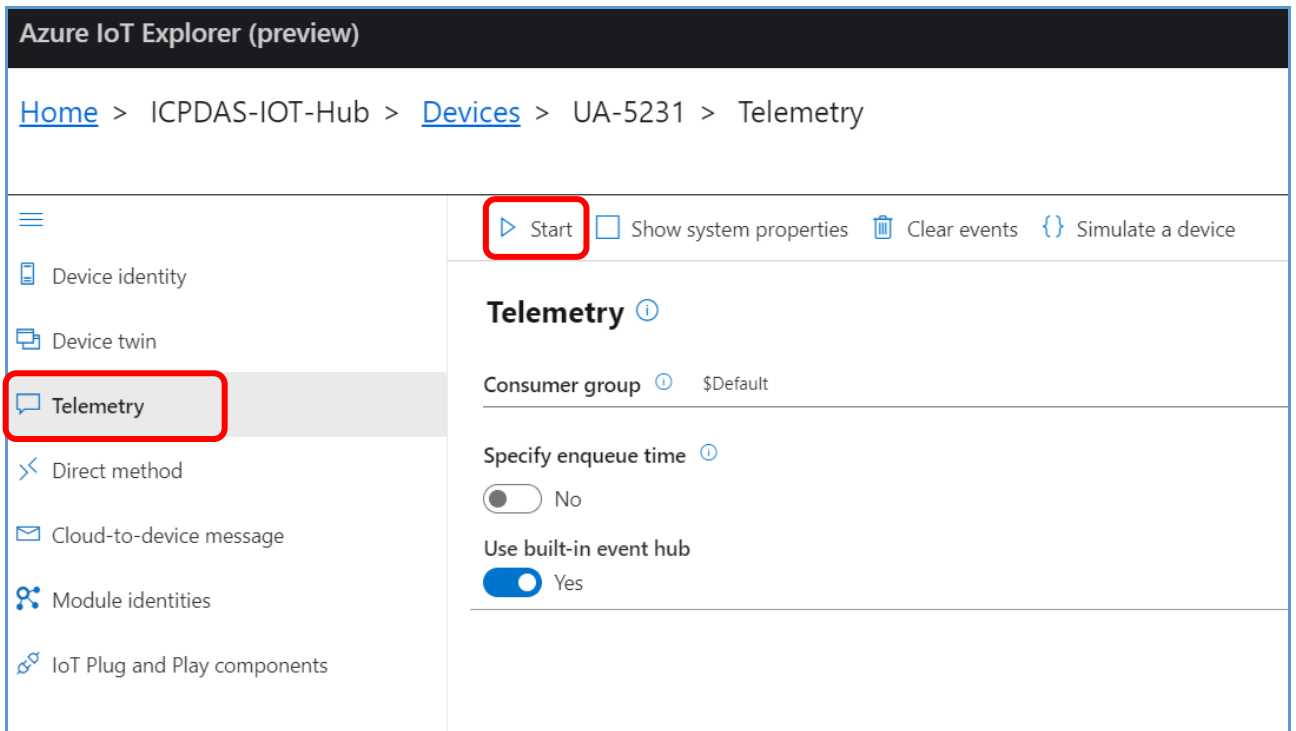
- **Verify Azure Connection Status**

To verify the Azure connection status, you can use the **Azure IoT Explorer** software to test the Azure connection status. For the installation and configuration of Azure IoT Explorer, please refer to steps "C" and "D" of "[Azure side Settings](#)" between Steps 2 and 3 of this FAQ.

In the Azure IoT Explorer software, go to **【IoT Hub】 > 【Devices】**, and then click the Device ID to set the connection, for example, Device ID "UA-5231" in this example.



Then click the function item **"Telemetry"** on the left side. And then click **"Start"** on the right side.





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After connecting, if the displayed I/O data is correct, as shown in the following I/O point data, it means that the Azure connection status is normal.

The screenshot shows the 'Telemetry' section of an IoT interface. On the left is a navigation menu with options like 'Device identity', 'Device twin', 'Telemetry', 'Direct method', 'Cloud-to-device message', 'Module identities', and 'IoT Plug and Play components'. The main area displays controls for 'Telemetry' monitoring, including 'Stop', 'Clear events', 'Simulate a device', and 'Customize Content Type'. Below these are settings for 'Consumer group' (set to '\$Default'), 'Specify enqueue time' (set to 'No'), and 'Use built-in event hub' (set to 'Yes'). A 'Show system properties' checkbox is also present. The 'Receiving events...' section shows a timestamp: 'Tue Apr 09 2024 11:02:17 GMT+0800 (台北標準時間):'. Below this, a JSON object is displayed, which is highlighted with a red border. The JSON object contains an array of variables with their respective names, attributes, data types, values, and quality indicators.

```

{
  "body": {
    "Variable": [
      {
        "Name": "Relative_humidity",
        "Attribute": "R",
        "DataType": "Int16",
        "Value": 6366,
        "Quality": "Good"
      },
      {
        "Name": "Temperature_Celsius",
        "Attribute": "R",
        "DataType": "Int16",
        "Value": 2463,
        "Quality": "Good"
      },
      {
        "Name": "Temperature_Fahrenheit",
        "Attribute": "R",
        "DataType": "Int16",
        "Value": 7633,
        "Quality": "Good"
      },
      {
        "Name": "Dew_point_temperature_Celsius",
        "Attribute": "R",
        "DataType": "Int16",
        "Value": 1727,
        "Quality": "Good"
      }
    ]
  }
}

```