# Connecting the Wago PFC200 to Ubidots Via Codesys

## Glossary:

1. Ubidots Setup
   a) Login
   b) Create New Device
   c) Get API Label, ID, & Token
   d) Download PEM Certs

2. PFC200 Setup
   a) Go online
   b) WBM Cloud Connectivity

3. Codesys Setup
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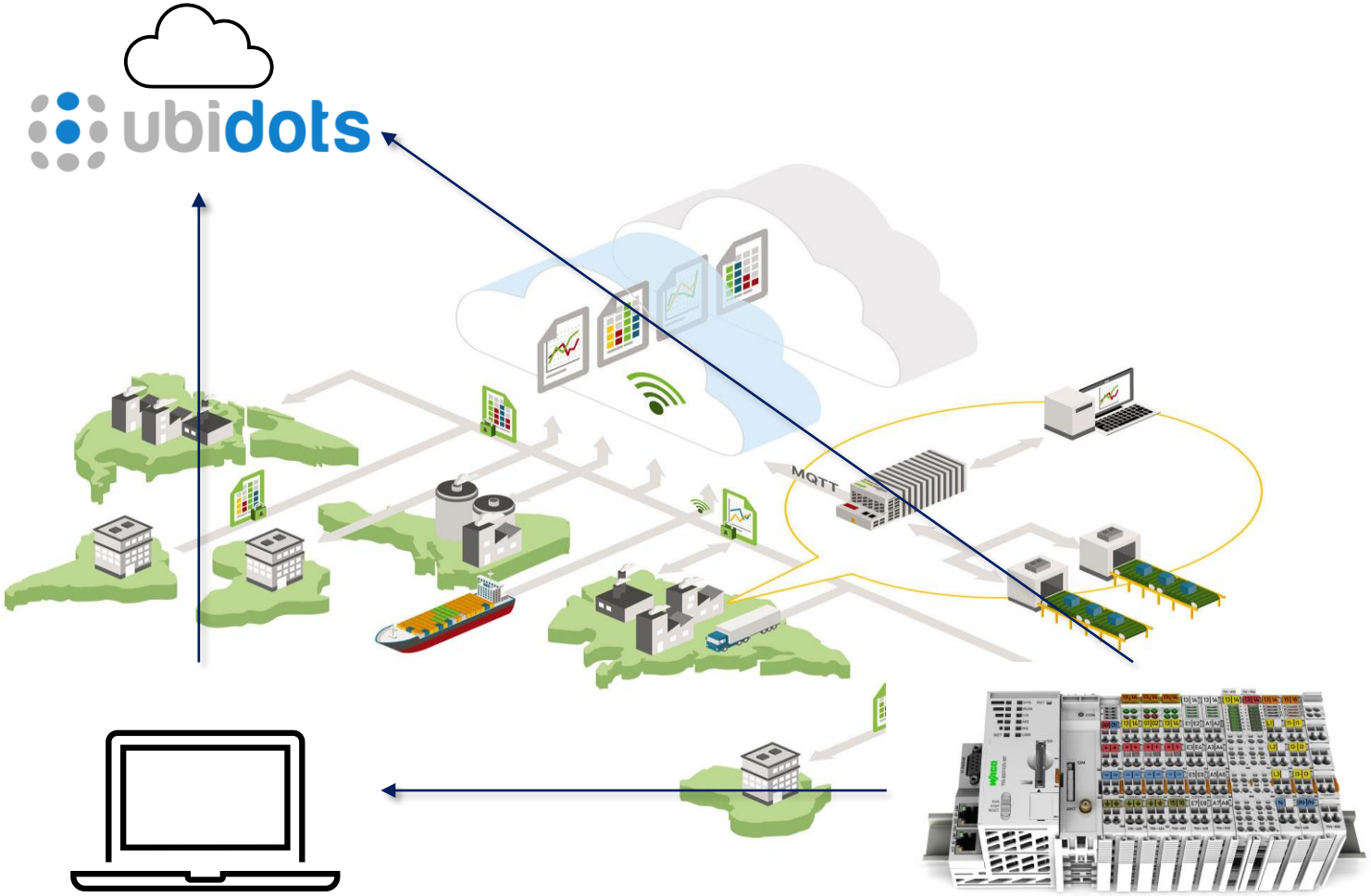
   b) Add Device
   c) Create POU and Task
   d) Go online

4. The Code (MQTT Publishing)
   a) The MQTT library
   b) Example 1: Simple Hard-code
   c) The JSON library
   d) Example 2: Parameterized JSON



# Connecting the Wago PFC200 to Ubidots Via Codesys

## Ubidots Setup

1a) Login your Ubidots Account

1b)

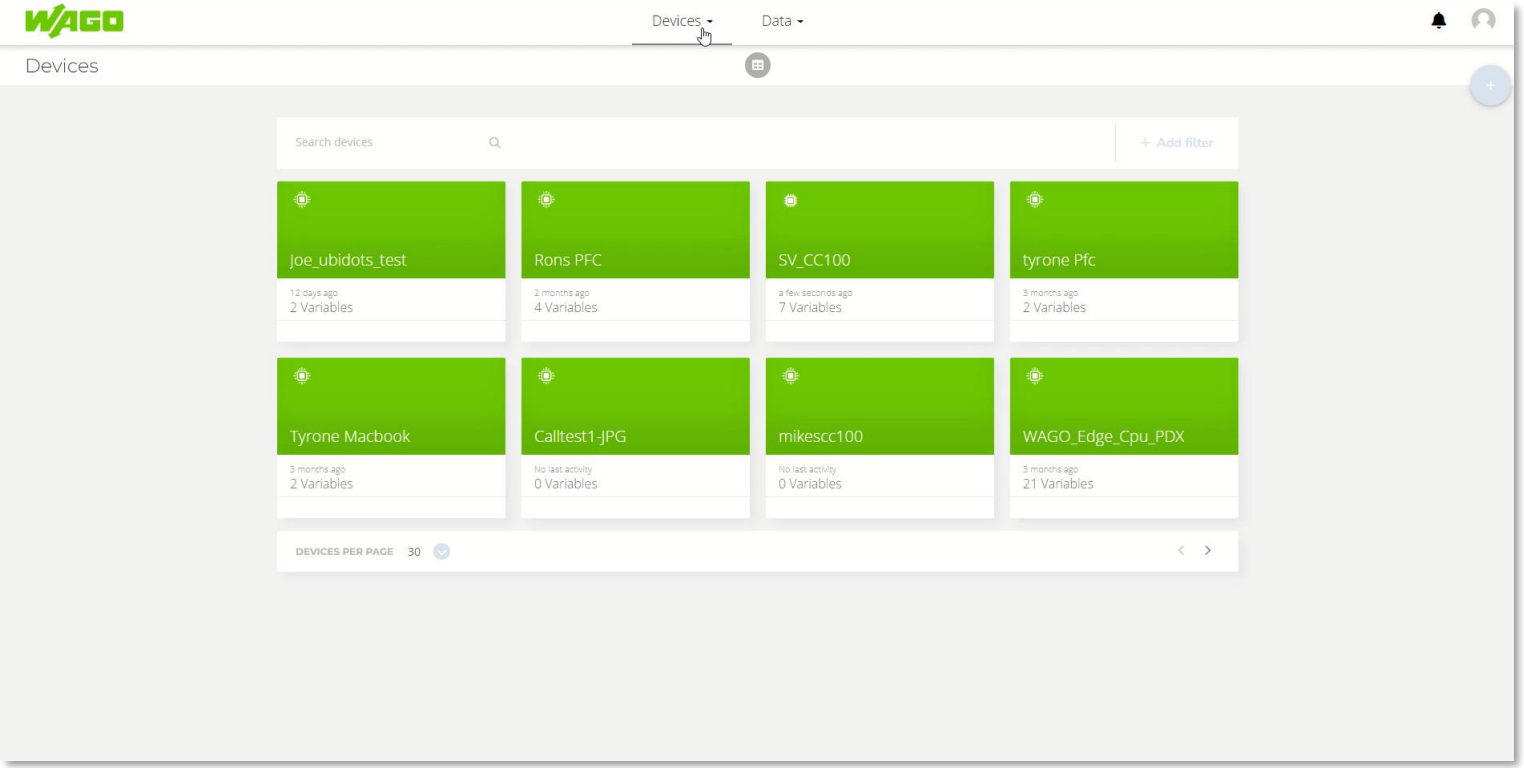
Go to the 'Devices' tab on the top of the page, then click 'devices' in the drop-down.

Click the '+' symbol on the top right corner of the screen.

Select 'Blank device'

Create a device name and then you should see the new device pop up.


Video: Add device in Ubidots



# Connecting the Wago PFC200 to Ubidots Via Codesys

## Ubidots Setup

1c)

Click on the newly created device and record the API Label, ID, and Token of the device.

You'll need it for later.

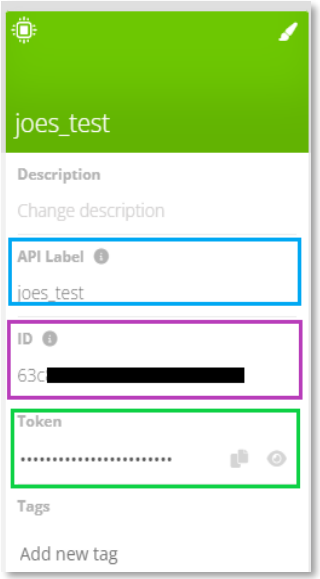
1d)

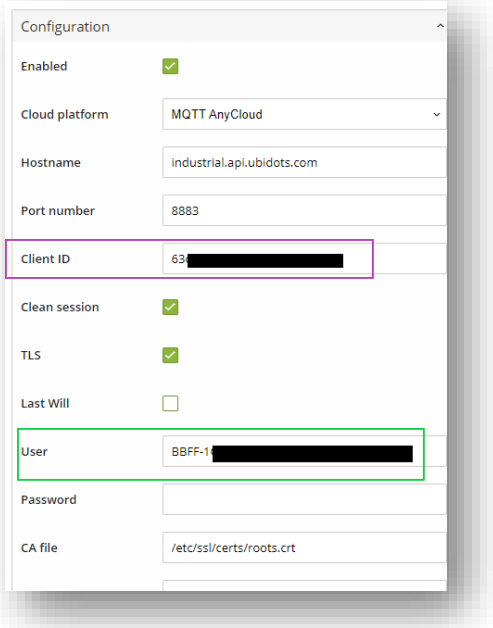
You'll need the Ubidots PEM certificate for TLS encryption to secure messages going to the cloud.

Found here:

https://docs.ubidots.com/v1.6/reference/broker-urls

Click on the link PEM cert download link then save the file as 'roots.crt'




## MQTT

| Security | Ubidots Account | Endpoint | Port |
|---|---|---|---|
| No TLS | Industrial | industrial.api.ubidots.com | 1883 |
| TLS | Industrial | industrial.api.ubidots.com | 8883 |

You can download the Ubidots PEM certificate for TLS here

# Connecting the Wago PFC200 to Ubidots Via Codesys

## PFC200 Setup

2a)

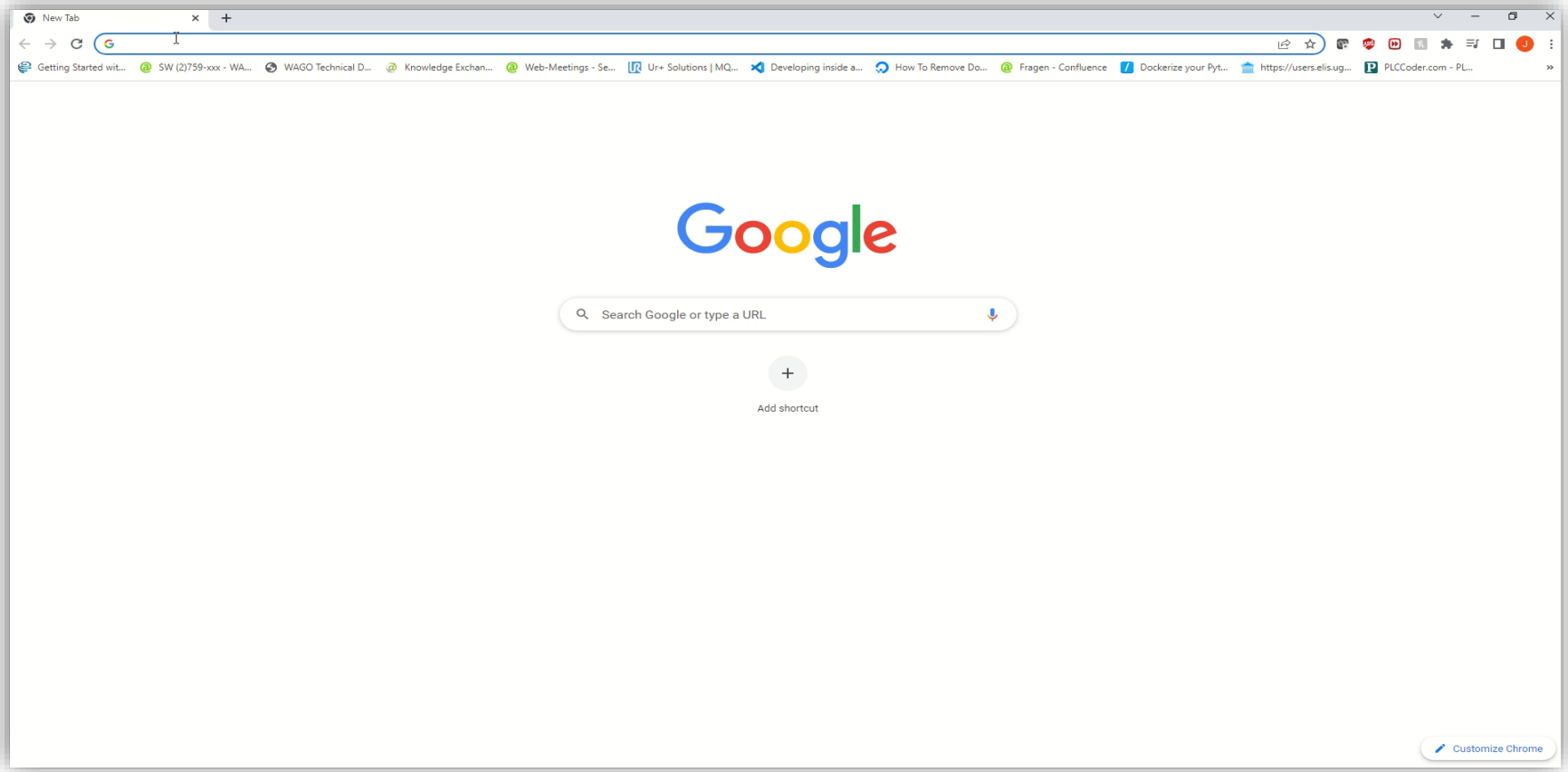
i. Log onto the WBM of your PFC200 by using any web browser and type in the IP address of your device.

ii. Type in default username/password = admin/wago if prompted.

iii. Ensure the FW of the device is FW23 or above. Then check that the IP address, gateway, and subnet are all set for an outbound connection.

iv. Check that your clock on the PFC200 is formatted to the correct time/timezone

Video: PFC Config in WBM




Note: My router is set to IP address 192.168.1.1, thus I've used it as the gateway address

Note: If you need to change the FW use the below link as a guide:

https://www.youtube.com/watch?v=6CxdrmHIIMo

https://github.com/WAGO/pfc-firmware

# Connecting the Wago PFC200 to Ubidots Via Codesys

## PFC200 Setup

2a)

v. Verify that you are connected online by using any ssh program to access the PFC terminal.

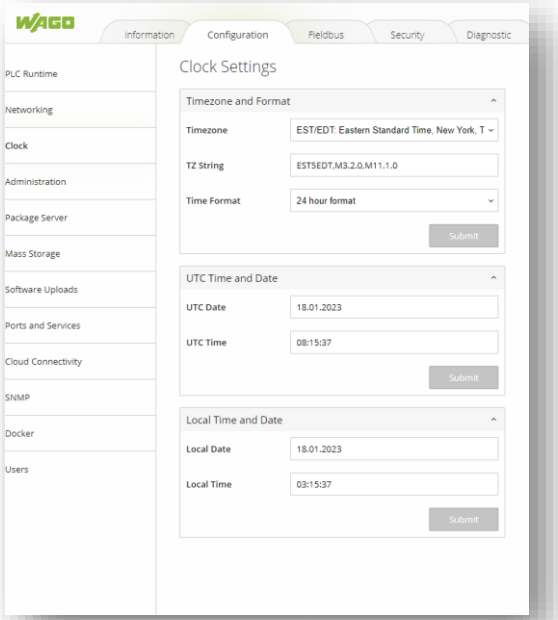
default credentials: root/wago

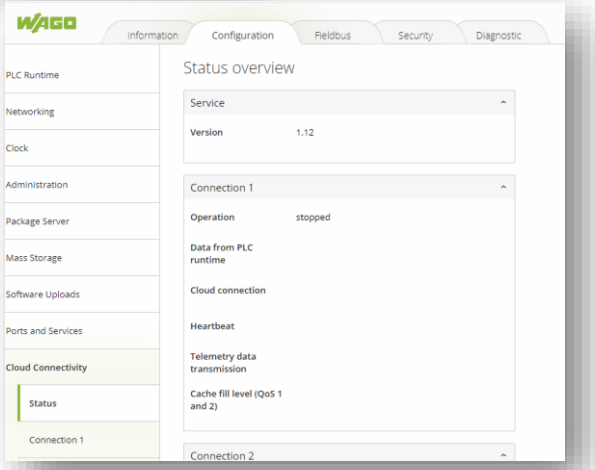
ping www.google.com

If you receive an immediate response with ping statistics, then you are connected.

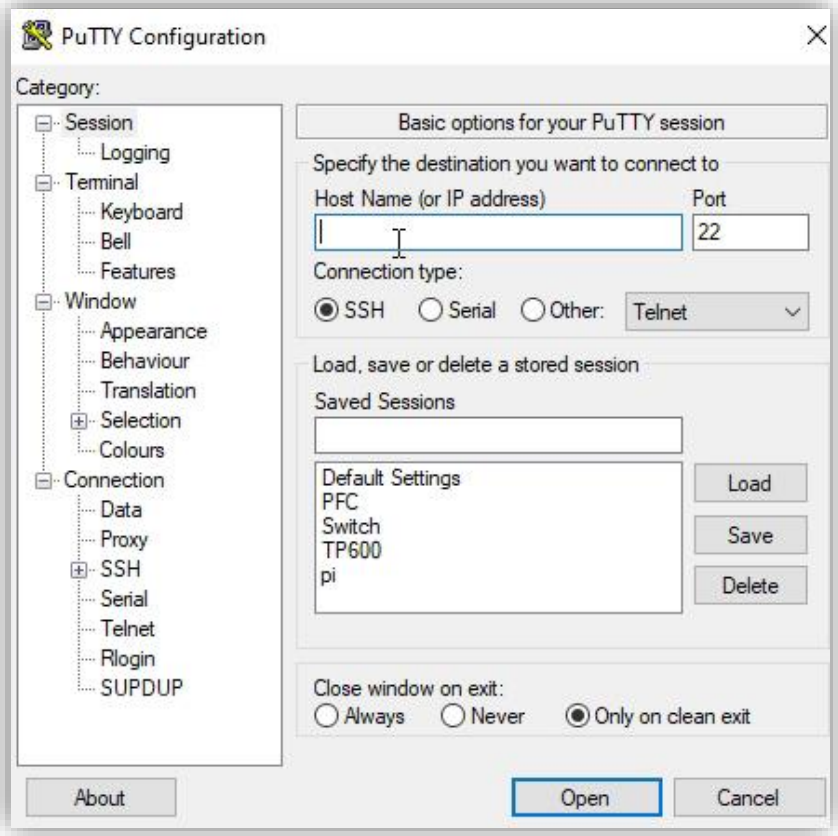
2b)

i. Go to the 'Cloud connectivity' tab under 'Configuration. Click on 'Connection 1'. Here is where we input the Ubidots credentials.




Video: Confirm online connection via SSH



# Connecting the Wago PFC200 to Ubidots Via Codesys

## PFC200 Setup

2b)

ii. Once on the 'Connection 1' page, select 'MQTT AnyCloud.

Input the Hostname 'industrial.api.ubidots.com'

iii. Click the 'TLS' box then use port number 8883.

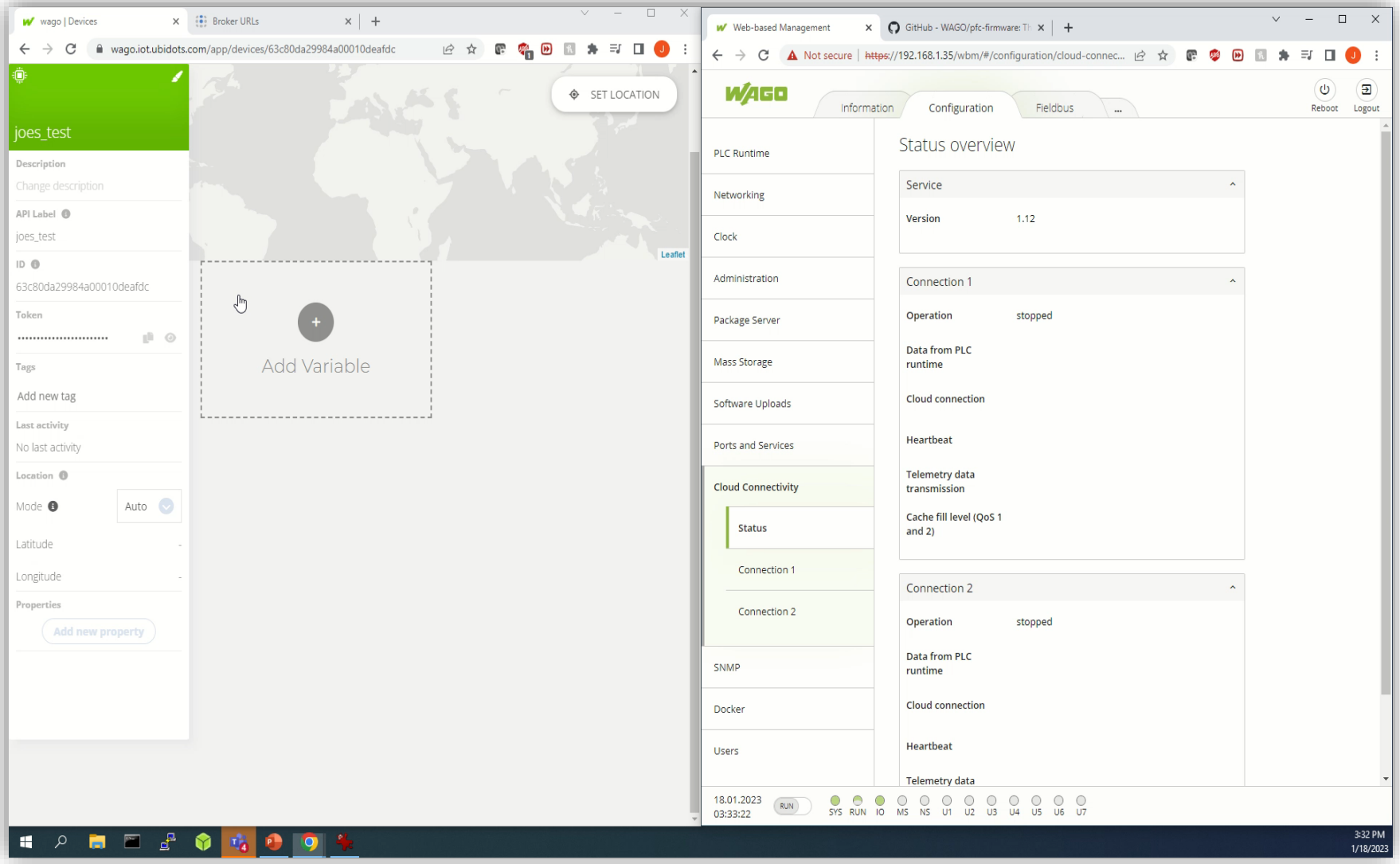
iv. Input the Ubidots ID into the Client ID field of the Wago WBM.

v. Input the Ubidots Token into the User field in the Wago WBM.

vi. Select 'Native MQTT' as the Data protocol in the WBM.

vii. Enable FTP via the 'Ports and Services' tab, then FTP into the Wago controller. Once this is done, insert the root.crt file into the CA file path 'etc/ssl/certs/roots.crt'.

Video: Cloud setup in WBM



# Connecting the Wago PFC200 to Ubidots Via Codesys

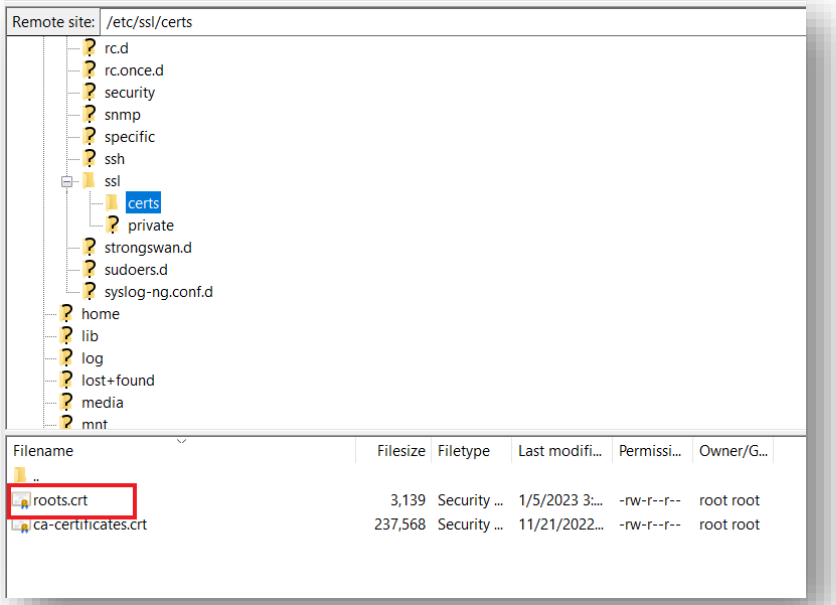
## PFC200 Setup

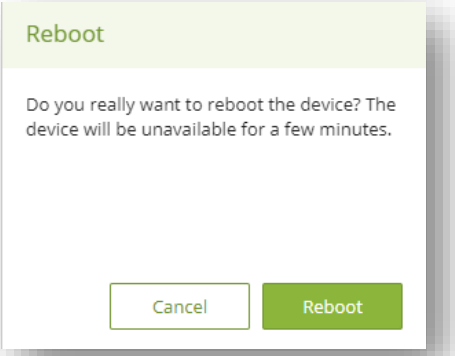
2b)

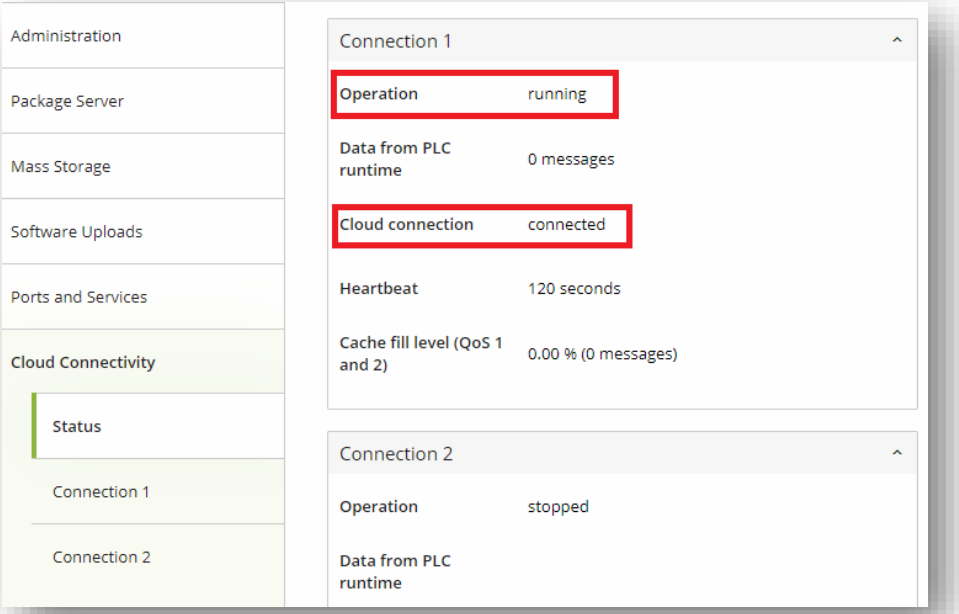
viii. Hit 'Submit', then reboot the controller via the 'Reboot' button the top right corner of the WBM.

ix. After waiting for the reboot, revisit the connection status on the WBM. You should now see a running connection.

We are now ready to create a Codesys project to publish data to Ubidots.



# Connecting the Wago PFC200 to Ubidots Via Codesys

## Codesys Setup

3a)

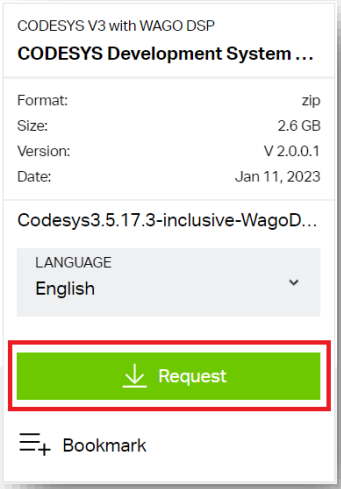
i. Go to Wago website to download and install the newest version of Codesys 3.5 w/ Device support package here:

[https://www.wago.com/us/d/swreg_codesys_v3_dsp_c](https://www.wago.com/us/d/swreg_codesys_v3_dsp_c)

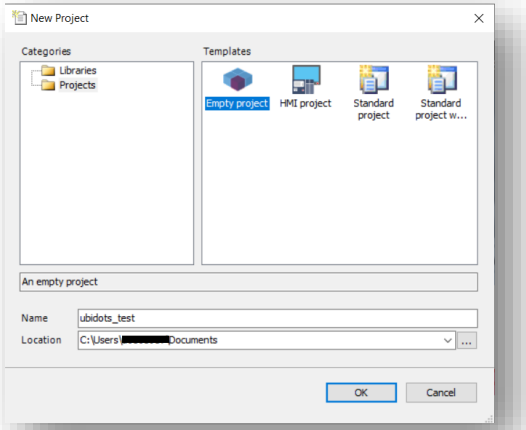
ii. Create a 'New project', select empty project, and then name the project.

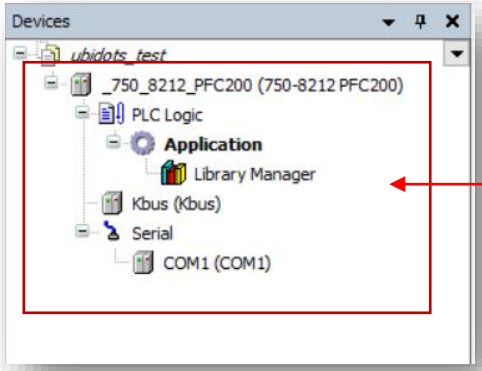
3b)

i. Add your Wago device. I'll be using the 750-8212 for this project (shown in video).




Note: At the time of this How-To the project is created with Codesys 3.5 SP17 Patch 3

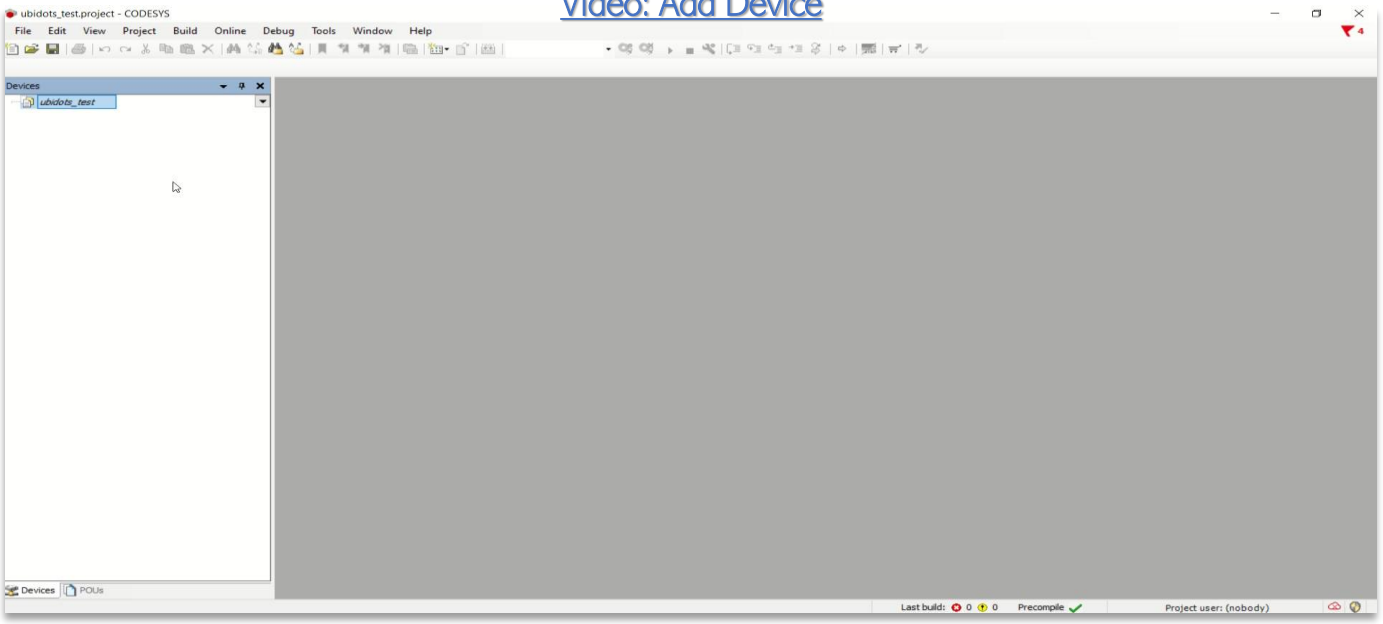



Note:

You'll see this added to the device screen once you've added your Wago Device

## Video: Add Device



# Connecting the Wago PFC200 to Ubidots Via Codesys

## Codesys Setup

3c)

i. Create a POU and Task configuration

ii. Setup a gateway and attempt to go online. Start by selecting 'Online' and 'Login'. Codesys will prompt you to create an active path

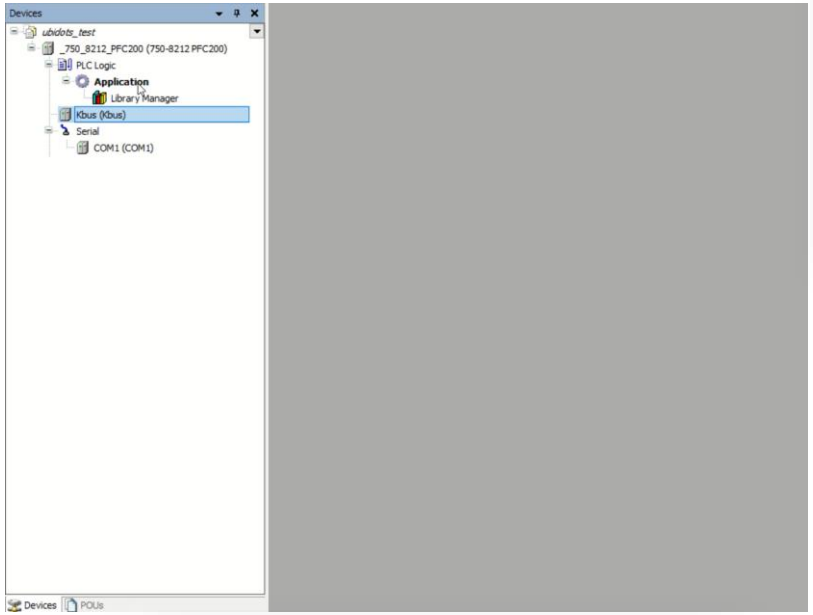
iii. Scan the network and select the PFC200. You'll be prompted for a username and password.

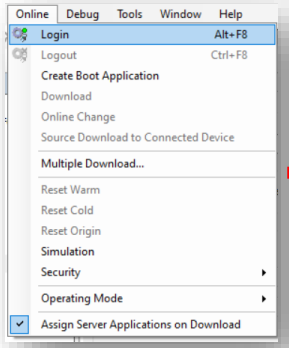
Default: admin/wago

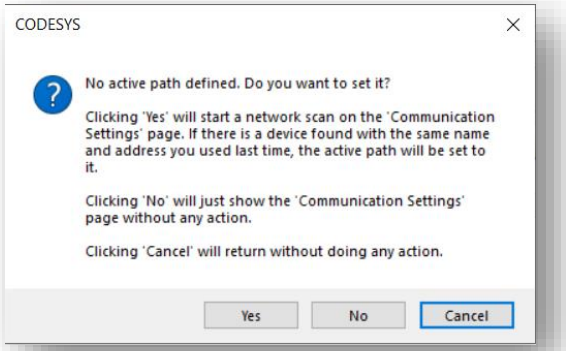
iv. Login and now you should be online!

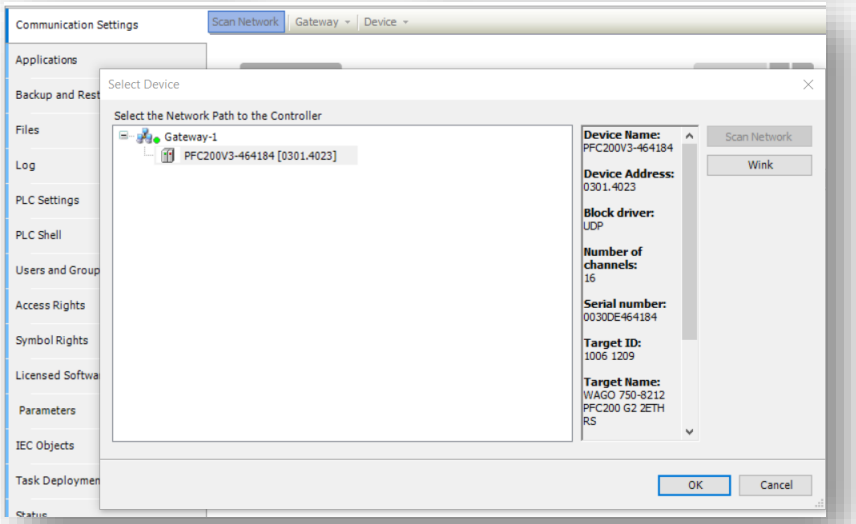
v. Go back offline. Go to library manager, add library, and install WagoAppCloud & WagoAppJSON

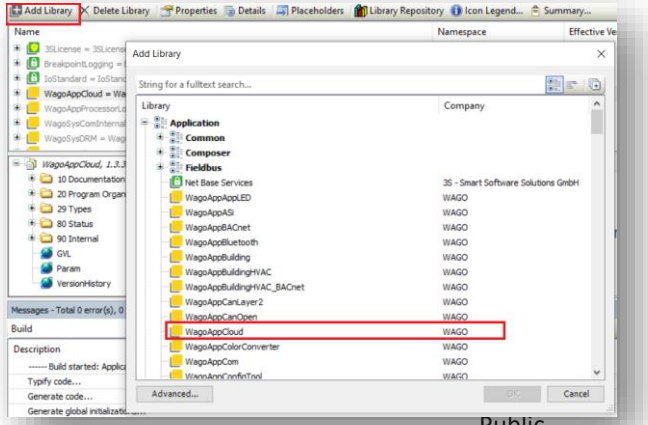
Video: POU/Task config



# Connecting the Wago PFC200 to Ubidots Via Codesys

## The Code (Publish): MQTT Library

For this application, we'll be using the FbPublishMQTT_2 function block.

sTopic will be a string representing the MQTT topic = '/v2.0/devices/{DEVICE_LABEL}'

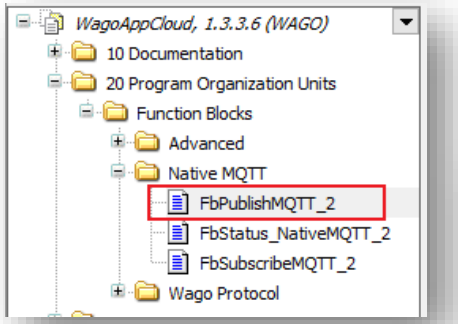
In this example the topic is as follows: '/v2.0/devices/joes_test'

eQualityOfService = 1 which indicates that the MQTT publisher will send the message at least once to the MQTT Broker aka Ubidots.

dwSize will be a dynamic variable that determines the length of the message string that will be sent to the broker, in bytes.

aData is the pointer of our JSON payload data to be published to the Broker. The data must be copied over from the JSON string to this aData array.

xTrigger will act as the trigger to begin publishing data and the outputs xBusy, xError, oStatus are troubleshooting indicators.




**Function Description**

This function block transmit data to the cloud in the own data structure. The PLC application engineer can choose the topic and his own data structure. The Quality of Service 0, 1 and 2 are supported.

To write the data in a JSON format the library WagoAppJSON could be used.

**Note**

If using the Native MQTT Protocol with the function blocks FbPublishMQTT_2 and/or FbSubscribeMQTT_2 it is necessary to configure the Data Protocol *Native MQTT* in the web based management.

**Note**

For secure data traffic it is recommended to send maximum 65kByte in one task interval.

**Note**

This function block must be executed in the background task (set the tasc priority to 15).

### FbPublishMQTT_2 (FB)

**Interface variables**

| Scope | Name | Type | Comment |
|---|---|---|---|
| Input | sTopic | STRING(255) | MQTT Topics are structured in a hierarchy similar to folders and files in a file system using the forward slash ( / )as a delimiter. Using this system you can create a user friendly and self descriptive naming structures of you own choosing. Topic names are: Case sensitive; use UTF-8 strings. |
| | eQualityOfService | eQualityOfService | Quality of Service: 0,1,2 |
| | xRetain | BOOL | Set to true to make the message retained |
| | dwSize | DWORD | DataCount to be transmitted |
| | aData | POINTER TO BYTE | Array of data which should be transmitted |
| Inout | xTrigger | BOOL | Trigger the transmission of data |
| Output | xBusy | BOOL | Transmission in progress |
| | xError | BOOL | Indicates that an Error has occured. |
| | oStatus | FbResult | Status object with detailed information about a happend error. (Listed in eStatus) The content of the error object could be displayed via the *FbShowResult* from the *WagoSysErrorBase* library. |

**Function**

Generate a MQTT message to publish to the cloud.

# Connecting the Wago PFC200 to Ubidots Via Codesys

```
PROGRAM Main
VAR
   oFbPublishMQTT_2 : WagoAppCloud.FbPublishMQTT_2(eConnection := eConnectionId.Connection1);
   aBuffer          : ARRAY[0..1999] OF BYTE;
   dwBytesCount    : DWORD;
   sPayload       : STRING(1024);
   xTrigger       : BOOL;
   TimerOn: TON;
   dwBusyCounter: DWORD;
   dwErrorCounter: DWORD;
END_VAR
```

## Example one: Simple Hard Code

Here we focus on initializing the MQTT publish function block as well as all of the variables the FB requires.

It's important to initialize the MQTT function block by specifying the specific cloud connection. Here we are using cloud connection 1.

Create a timer to act as the publishing interval, which in this case is every 1 second.

Create the JSON message payload. It's important to note that the type is a string with the format of quotes around the variable name and nothing around the value.

Example of one variable: '{"var_name": var_value}'
Example of two variables: '{"var_name_1": var_1_val, "var_name_2": var_2_val}'

Once the timer has completed the elapsed time and the previous publishing function is complete, store length of the payload and copy the payload value to the publishing buffer array.

Actuate the publish function block with the data and length of data you'd like to transmit

Assuming the code has run with no issues, you should be able to reload the Ubidots page and find the new values auto populated in the device tab.

```
TimerOn(IN := TRUE, PT := T#1S);
sPayload := '{"var1": 23, "var2": 46, "var3": 1}';

IF TimerOn.Q THEN
   xTrigger := TRUE;
   TimerOn(IN := FALSE);

   IF NOT oFbPublishMQTT_2.xBusy THEN

      // Copy payload string
      dwBytesCount := Length(sPayload);
      MemCopy(pDest := ADR(aBuffer), pSource := ADR(sPayload), udiSize := dwBytesCount);

      // Trigger the transmission
      xTrigger := TRUE;
   ELSE
      // Busy statistics counter
      dwBusyCounter := dwBusyCounter + 1;
   END_IF

   IF oFbPublishMQTT_2.xError THEN
      // Error statistics counter
      dwErrorCounter := dwErrorCounter + 1;
   END_IF

END_IF

oFbPublishMqtt_2(sTopic:= '/v2.0/devices/joes_test',
   eQualityOfService:= 1,
   dwSize := dwBytesCount,
   aData := aBuffer,
   xTrigger := xTrigger);
```

# Connecting the Wago PFC200 to Ubidots Via Codesys

ubidots_test.project - CODESYS

File Edit View Project Build Online Debug Tools Window Help

Application [_750_8212_PFC200: PLC Logic]

Devices

- ubidots_test
  - _750_8212_PFC200 (750-8212 PFC200)
    - PLC Logic
      - Application
        - Library Manager
        - Main (PRG)
        - Task Configuration
          - Task
            - Main
    - Kbus (Kbus)
      - _75x_16DI (75x-16DI)
      - _75x_8DO8DI (75x-8DO8DI)
    - Serial
      - COM1 (COM1)

Devices POUs

Main | Task | _750_8212_PFC200 | Library Manager

```
PROGRAM Main
VAR
    oFbPublishMQTT_2 : WagoAppCloud.FbPublishMQTT_2(eConnection := eConnectionId.Connection1);
    aBuffer          : ARRAY[0..1999] OF BYTE;
    dwBytesCount     : DWORD;
    sPayload         : STRING(1024);
    xTrigger         : BOOL;
    TimerOn: TON;
    dwBusyCounter: DWORD;
    dwErrorCounter: DWORD;
END_VAR
```

100 %

```
TimerOn(IN := TRUE, PT := T#1S);
sPayload := '{"var1": 23, "var2": 46, "var3": 1}';

IF TimerOn.Q THEN
    xTrigger := TRUE; //
    TimerOn(IN := FALSE);

    IF NOT oFbPublishMQTT_2.xBusy THEN

        // Copy payload string
        dwBytesCount := Length(sPayload);
        MemCopy(pDest := ADR(aBuffer), pSource := ADR(sPayload), udiSize := dwBytesCount);

        // Trigger the transmission
        xTrigger := TRUE;
    ELSE
        // Busy statistics counter
        dwBusyCounter := dwBusyCounter + 1;
    END_IF

    IF oFbPublishMQTT_2.xError THEN
        // Error statistics counter
        dwErrorCounter := dwErrorCounter + 1;
    END_IF

END_IF

oFbPublishMqtt_2(sTopic:= '/v2.0/devices/joes_test',
```

100 %

# Connecting the Wago PFC200 to Ubidots Via Codesys

## The Code (Publish): JSON Library

For this application, we'll be utilizing the Fb_JSON_Writer_02 function block in the WagoAppJSON library.

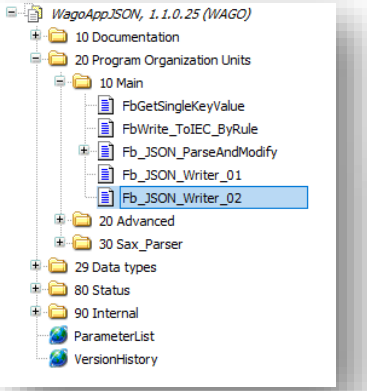
The functionality of this library is broken up into three parts: Creating the template string, the value string, and the execution of the function block

sJSON_BaseFrame will house the template of your JSON string. Any dynamic variables will have the placeholder '#Parameter' within the template string.

aParameterValues is an array of all variables that are represented in the template string as #Parameter. Since this array is a string, you'll need to convert your values into strings before putting them into the array.

xTrigger will cause the JSON function block to trigger its execution and create a JSON string represented by the string template and value array.

sOutput will be the final JSON string result.




### Fb_JSON_Writer_02 (FB)

**Interface variables**

| Scope | Name | Type | Comment |
|---|---|---|---|
| Input | sJSON_BaseFrame | STRING(JSON_MAX_STRING) | String containing the general JSON data |
| | xDeleteFormattingCharacters | BOOL | delete Tab and CR LF |
| Output | oStatus | WagoSysErrorBase.FbResult | Status details |
| | xError | BOOL | Error occured |
| | xDone | BOOL | JSON data generated without error |
| Input | aParameterValues | POINTER TO STRING(JSON_MAX_PARAMETER_STRING) | An array containing the variable JSON values, start index must be 0 e.g. [0..9] |
| Inout | xTrigger | BOOL | Activate the build process |
| | sOutput | STRING(JSON_MAX_STRING) | Result string |

**Function**

Generate a JSON string from a base template and an array with appropriate JSON values Other than Fb_JSON_Writer_01 this block allows some more flexibility by skipping key value pairs from the basic template string.

```
//Define a template string, which contains ``#Parameter`` wherever a variable value should be inserted.
VAR
    MyTemplateString:String(JSON_MAX_STRING):='
        {"Menu": {"id": "#Parameter","value": "#Parameter","popup": {"menuitem": [{"value": "#Parameter","onclick": "#Parameter"},{"value": "#Parameter","onclick": "#Parameter"},
        {"value": "#Parameter","onclick": "#Parameter"}]}}}
    ';
// Define a second variable from type array which contains the variable values already converted to a string.
    MyValueArray:ARRAY[0..7] OF STRING:=['CountryCode','DE','4.1','down1','4.2','down2','4.3','down3'];
END_VAR



Assuming you just want to generate from time to time a different string like:

{"Menu":{"id":"CountryCode","value": "DE","popup": {"menuitem": [{"value": "4.1","onclick": "down1"}]}}}

than the parameter array should look like:

MyValueArray:ARRAY[0..7] OF STRING:=['CountryCode','DE','4.1','down1','##','##','##','##'];
```

# Connecting the Wago PFC200 to Ubidots Via Codesys

## The Code (Publish): Example 2 Parameterized JSON

Initializing the Template as MyTemplateString

Creating the value array of size three because we are passing three variables

Initializing the three integer values and creating a new xJSON trigger variable

## Variable Declaration

```
PROGRAM Main
VAR

//Variables for MQTT publish
    oFbPublishMQTT_2 : WagoAppCloud.FbPublishMQTT_2(eConnection := eConnectionId.Connection1);
    aBuffer          : ARRAY[0..1999] OF BYTE;
    dwBytesCount     : DWORD;

    dwBusyCounter: DWORD;
    dwErrorCounter: DWORD;
    xTrigger         : BOOL;

//Variables for JSON_Writer
    oFbJSON : WagoappJSON.Fb_JSON_Writer_02;
    MyTemplateString : STRING(JSON_MAX_STRING):= '{"val1": #Parameter, "val2" : #Parameter, "val3": #Parameter}'; //String template
    MyValueArray : ARRAY[0..2] OF STRING; //Array of values, must start at index 0
    xJSONTrigger     : BOOL;

    value_var1 : INT; //Raw values to be transmitted. Must be converted to string first.
    value_var2 : INT;
    value_var3 : INT;

TimerOn: TON;
sPayload         : STRING(2000);

END_VAR
```

# Connecting the Wago PFC200 to Ubidots Via Codesys

## Program Sequence

```
TimerOn(IN := TRUE, PT := T#1S);

value_var1  := 40;
value_var2  := 50;
value_var3  := 2;

MyValueArray[0] := INT_TO_STRING(value_var1);
MyValueArray[1] := INT_TO_STRING(value_var2);
MyValueArray[2] := INT_TO_STRING(value_var3);


IF TimerOn.Q THEN
    xTrigger := TRUE;
    xJSONTrigger := TRUE;
    TimerOn(IN := FALSE);

    IF NOT oFbPublishMQTT_2.xBusy THEN

        // Copy payload string
        dwBytesCount := Length(sPayload);
        MemCopy(pDest := ADR(aBuffer), pSource := ADR(sPayload), udiSize := dwBytesCount);

        // Trigger the transmission
        xTrigger := TRUE;

    ELSE
        // Busy statistics counter
        dwBusyCounter := dwBusyCounter + 1;
    END_IF

    IF oFbPublishMQTT_2.xError THEN
        // Error statistics counter
        dwErrorCounter := dwErrorCounter + 1;
    END_IF

END_IF

oFbJson(sJSON_BaseFrame := MyTemplateString,
    aParameterValues := MyValueArray,
    xTrigger := xJSONTrigger,
    sOutput := sPayload);

oFbPublishMqtt_2(sTopic:= '/v2.0/devices/joes_test',
    eQualityOfService:= 1,
    dwSize := dwBytesCount,
    aData := aBuffer,
    xTrigger := xTrigger);
```

## The Code (Publish): Example 2 Parameterized JSON

Individually setting values to the variables

We are then setting each value array element to the string form of the variable via Int_to_string conversion function

Add the JSON trigger to the timing if statement and then run the function block with sPayload as the output parameter.

# Connecting the Wago PFC200 to Ubidots Via Codesys

ubidots_test.project* - CODESYS

File Edit View Project Build Online Debug Tools Window Help

Application [_750_8212_PFC200: PLC Logic]

Devices

- ubidots_test
  - _750_8212_PFC200 (750-8212 PFC200)
    - PLC Logic
      - Application
        - Library Manager
        - Main (PRG)
        - Task Configuration
          - Task
            - Main
    - Kbus (Kbus)
      - _75x_16DI (75x-16DI)
      - _75x_8DO8DI (75x-8DO8DI)
    - Serial
      - COM1 (COM1)

Main | Library Manager

```
//Variables for JSON_Writer
    oFbJSON : WagoappJSON.Fb_JSON_Writer_02;
    MyTemplateString : STRING(JSON_MAX_STRING):= '{"val1": #Parameter, "val2" : #Parameter, "val3": #Parameter}'; //String template
    MyValueArray : ARRAY[0..2] OF STRING; //Array of values, must start at index 0
    xJSONTrigger    : BOOL;

    value_var1 : INT; //Raw values to be transmitted. Must be converted to string first.
    value_var2 : INT;
    value_var3 : INT;

TimerOn: TON;
sPayload        : STRING(2000);

END_VAR
```

100 %

```
TimerOn(IN := TRUE, PT := T#1S);

value_var1  := 40;
value_var2  := 50;
value_var3  := 2;

MyValueArray[0] := INT_TO_STRING(value_var1);
MyValueArray[1] := INT_TO_STRING(value_var2);
MyValueArray[2] := INT_TO_STRING(value_var3);


IF TimerOn.Q THEN
    xTrigger := TRUE;
    xJSONTrigger := TRUE;
    TimerOn(IN := FALSE);

    IF NOT oFbPublishMQTT_2.xBusy THEN

        // Copy payload string
        dwBytesCount := Length(sPayload);
        MemCopy(pDest := ADR(aBuffer), pSource := ADR(sPayload), udiSize := dwBytesCount);

        // Trigger the transmission
        xTrigger := TRUE;

    ELSE
        // Busy statistics counter
        dwBusyCounter := dwBusyCounter + 1;
    END_IF

    IF oFbPublishMQTT_2.xError THEN
        // Error statistics counter
```

100 %

Messages - Total 1 error(s), 0 warning(s), 49 message(s)

Build | 0 error(s) | 0 warning(s) | 49 message(s)

| Description | Project | Object | Position |
|---|---|---|---|

Devices | POUs

Last build: 0 0 Precompile