

CPX-IOT with EtherNet/IP

This document describes how to set up a CPX-IOT gateway and how to use all the performances of the device in EtherNet/IP environment.

CPX-IOT

Title CPX-IOT in EtherNet/IP network
Version 1.10
Document no. 100359
Originalen
AuthorFesto
Last saved 21.12.2021

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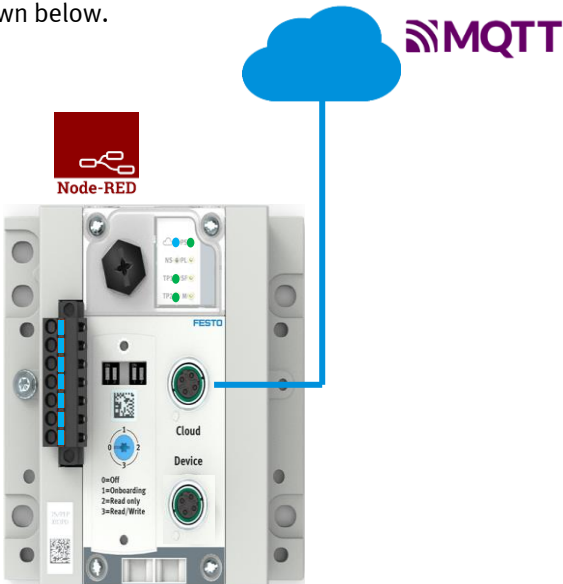
1 Components/Software used

Type/Name	Version Software/Firmware	Date of manufacture
CPX-IOT-O	1.0.6-ac67942f6M.20210831	

Table 1.1: 1 Components/Software used

1.1 Overview Connectivity

Node-RED is optional and must be installed separately. In order to get the latest security fixes, the correct procedure for updating the CPX-IOT is shown below.



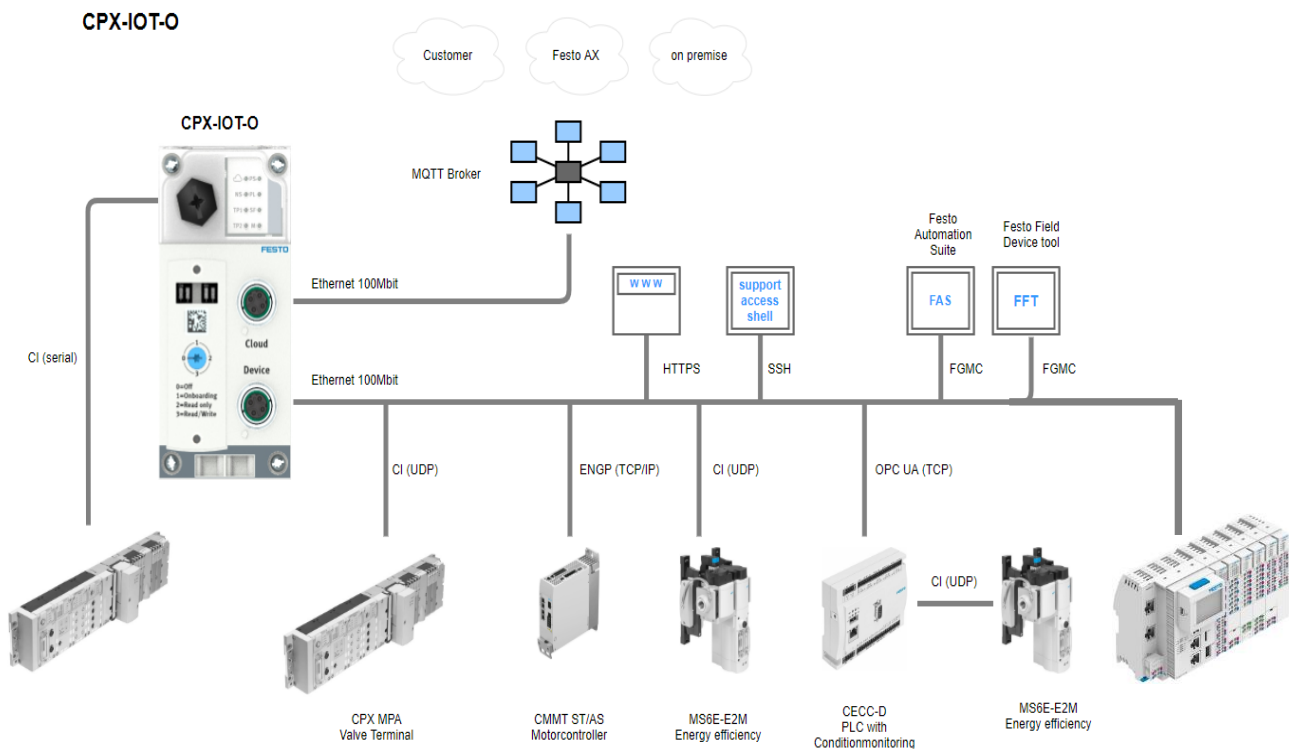
No.	How to update CPX-IOT															
1.	Update the bootloader file using Festo Field Device tool. Hint: Bootloader should be updated if there is a new version.															
	<table><tr><th>Device name</th><th>IP Address</th><th>Device type</th><th>MAC</th><th></th></tr><tr><td>cpx-iot-o</td><td>192.168.0.4</td><td>CPX-IOT-O</td><td>00:0E:F0:60:9A:40</td><td>1</td></tr><tr><td colspan="5"> Firmware Firmware with Backup Network Diagnosis Backup Restore Identification > Versions Bootapplication Reboot Telnet Homepage FST FMT Copy IP address Favorite </td></tr></table>	Device name	IP Address	Device type	MAC		cpx-iot-o	192.168.0.4	CPX-IOT-O	00:0E:F0:60:9A:40	1	Firmware Firmware with Backup Network Diagnosis Backup Restore Identification > Versions Bootapplication Reboot Telnet Homepage FST FMT Copy IP address Favorite				
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Firmware Firmware with Backup Network Diagnosis Backup Restore Identification > Versions Bootapplication Reboot Telnet Homepage FST FMT Copy IP address Favorite																

The image displays two screenshots of the Festo Automation Suite software interface, illustrating the process of updating a device's firmware.

Top Screenshot: The interface shows the 'Device Scan' section. A table lists the discovered device: CPX-IOT-O at address 192.168.0.4. To the right, the 'Actions' menu is open, highlighting the 'Firmware' option.

Bottom Screenshot: The 'Firmware' option in the 'Actions' menu is selected, displaying a list of available firmware files. The file '1.2.36-a9d87e961.20200124 cpx-iot-firmware-1.2.36-a9d87e961.2020...' is highlighted, indicating the selected firmware for update.

An overview of the connectivity of the CPX-IOT is shown in the following image. The MQTT broker could be also connected to the Device interface.

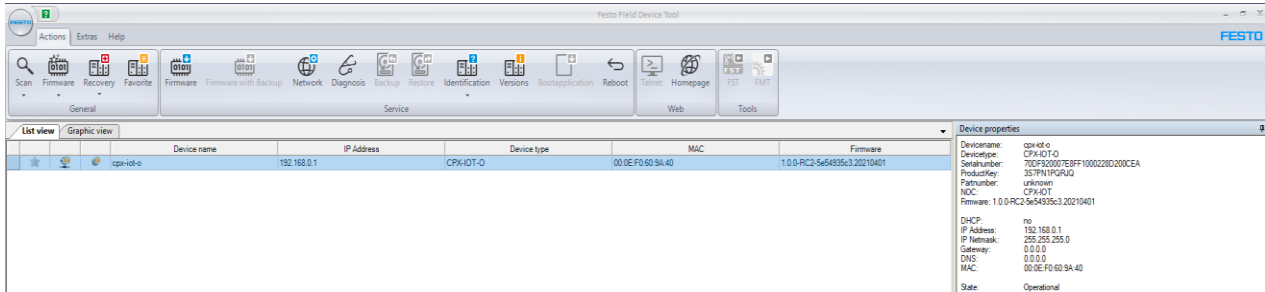


2 CPX_IOT

2.1 Login

Default IP address: 192.168.0.1

Festo Field Device tool:

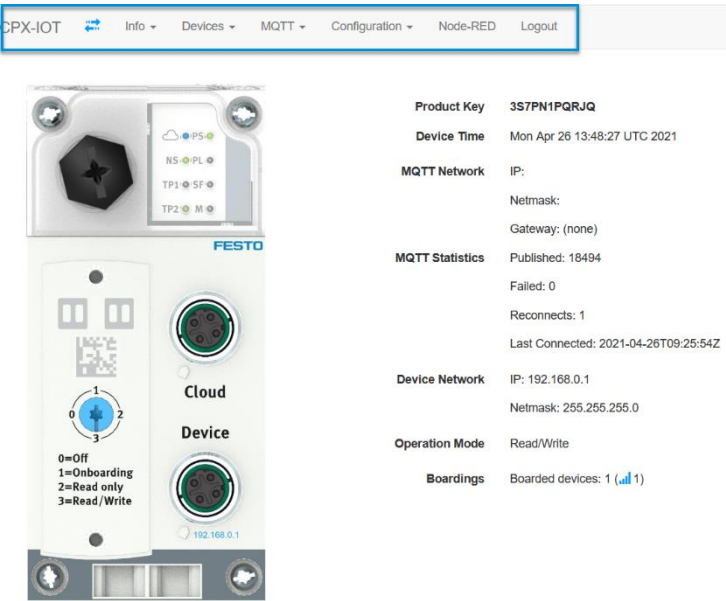


- Open a browser <https://your-device-ip-address>
- User name: admin
- Password: Festo Product Key

The login page has a white background with a light gray border. At the top, it says 'Login' in a large, bold font. Below that, it says 'Authentication required' in a smaller font. There are two input fields: 'User name' with the text 'admin' and 'Password' with masked characters (dots). A blue 'Log In' button is located at the bottom left of the form.

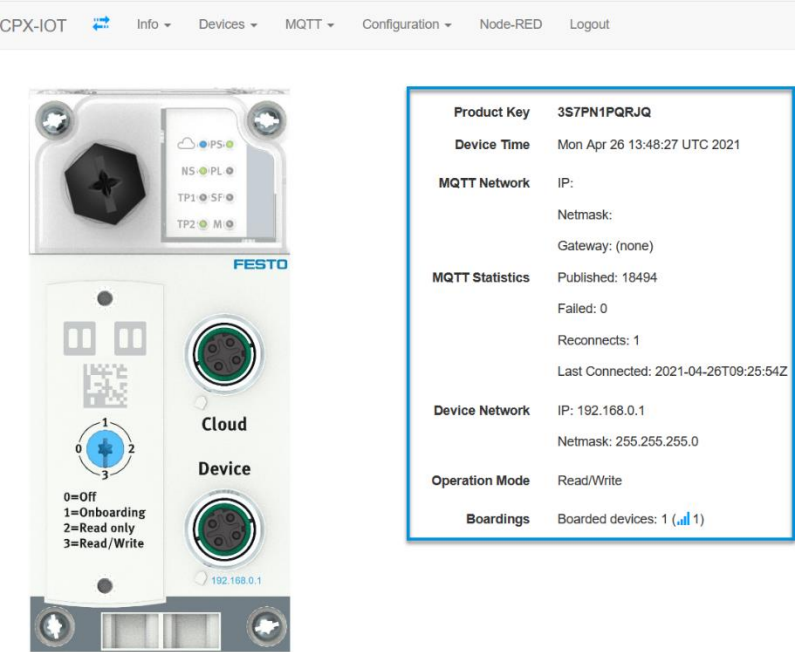


2.2 Webserver Toolbar.



MQTT connection status.
Red: MQTT disconnected.
Blue: MQTT connected.
Orange: Logout.
Info: General information and diagnosis.
Devices: Device boarding and configuration.
MQTT: MQTT configuration.
Configuration: MQTT and NTP configuration.
Node-RED: Node-Red for custom code.
User: Change user credentials.

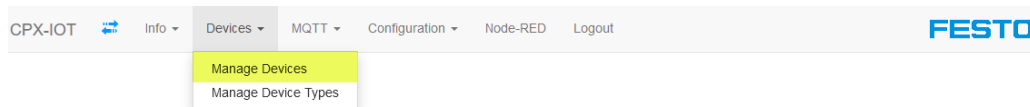
2.3 Webserver home page



Product Key: Device Product Key.
Devices Time: Data and time from CPX-IOT.
MQTT Network: MQTT network configuration.
MQTT Network: Basic MQTT statistics.
Device Network: Device network configuration.
Operation Mode: Should be on “Read/Write”.
Boardings: Count of boarded devices.

2.4 Manage Devices

In order to establish the connection between CPX_IOT and a slave device, click on scan
Devices must be connected to CPX_IOT Device port



- Scan automatically.

Scan Devices

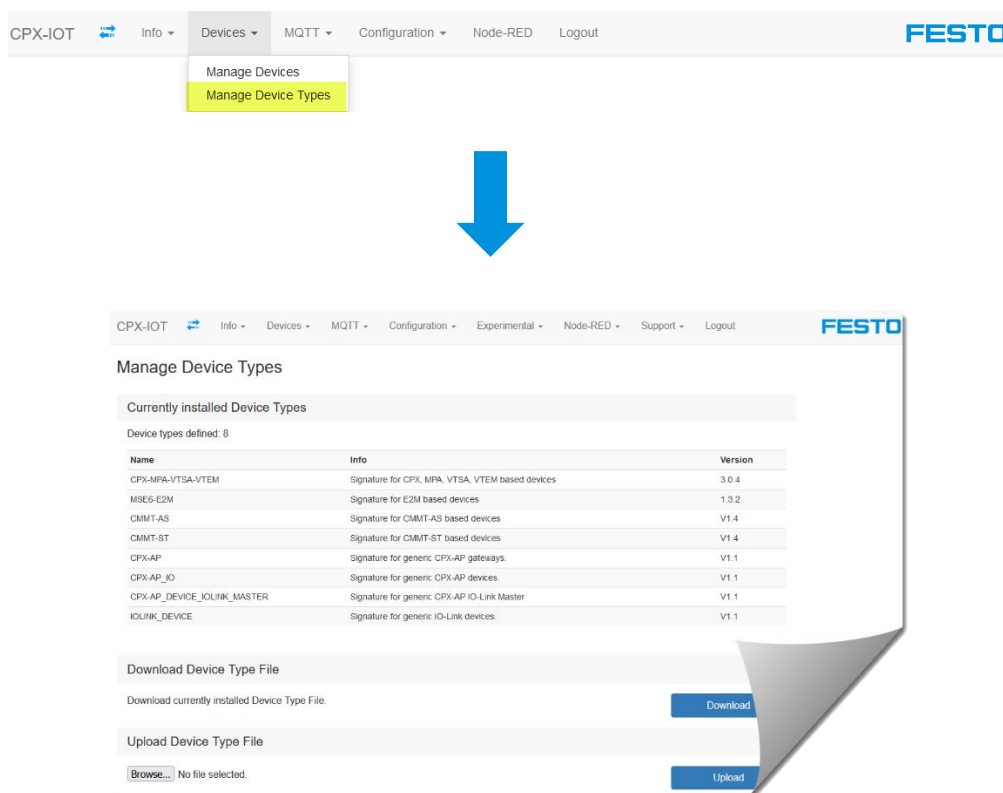
 Scan

- Write the device IP address.

Scan Devices

 Scan

CPX-IOT supports all the devices shown below. As soon as the device is connected to CPX-IOT the data is automatically received on Node-RED. As mentioned in the section “Overview Connectivity” Node-RED is optional, the data is transmitted via MQTT. If Node-RED is installed the default MQTT setup is transferring the data to Node-RED.



2.5 MQTT

MQTT is an OASIS standard messaging protocol for the Internet of Things (IoT). It is designed as an extremely lightweight publish/subscribe messaging transport that is ideal for connecting remote devices.

2.5.1 Configure localhost MQTT Broker

In order to read the data from the boarded devices, MQTT communication must be enabled otherwise the MQTT_IN function will be connected but no transmission is possible. How to make a Board of the devices will be explained in the next chapters. It is only detailed on this chapter the principle of localhost MQTT Broker.

Local MQTT broker --> mqtt://localhost:1883

CPX-IOT Info Devices MQTT Configuration Node-RED Logout

Broker Configuration

Broker 1 *

Broker 2

Broker 3

Clientid *

Last Will ☐

Username

Password

Keep Alive (s)

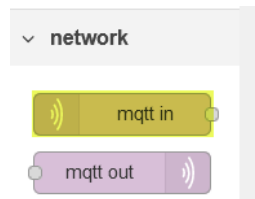
Apply

How to open Node-red in order to read the data published.

CPX-IOT Info Devices MQTT Configuration Experimental Node-RED Support Logout

Open Node-RED
Open Node-RED Dashboard
Manage Node-RED

Go to the Node-red palette and choose MQTT in and drag&drop



Configure the MQTT in:

The screenshot shows the Node-RED web interface in a browser. A flow named 'Flow 1' contains an 'mqtt' node. The 'Edit mqtt in node' dialog is open, showing the following configuration:

- Server:** Add new mqtt-broker... (indicated by a blue circle 3)
- Topic:** # (indicated by a blue circle 2)
- QoS:** 2
- Output:** a parsed JSON object (indicated by a blue circle 1)
- Name:** auto-detect (string or buffer), a Buffer, a String, a parsed JSON object, a Base64 encoded string

Arrows indicate the flow from the 'mqtt' node in the workspace to the 'Edit mqtt in node' dialog, and from the 'Output' dropdown to the 'a parsed JSON object' option.

Edit mqtt in node > Add new mqtt-broker config node

Cancel Add

Properties

3 Name localhost

Connection Security Messages

Server 127.0.0.1 Port 1883

☐ Enable secure (SSL/TLS) connection

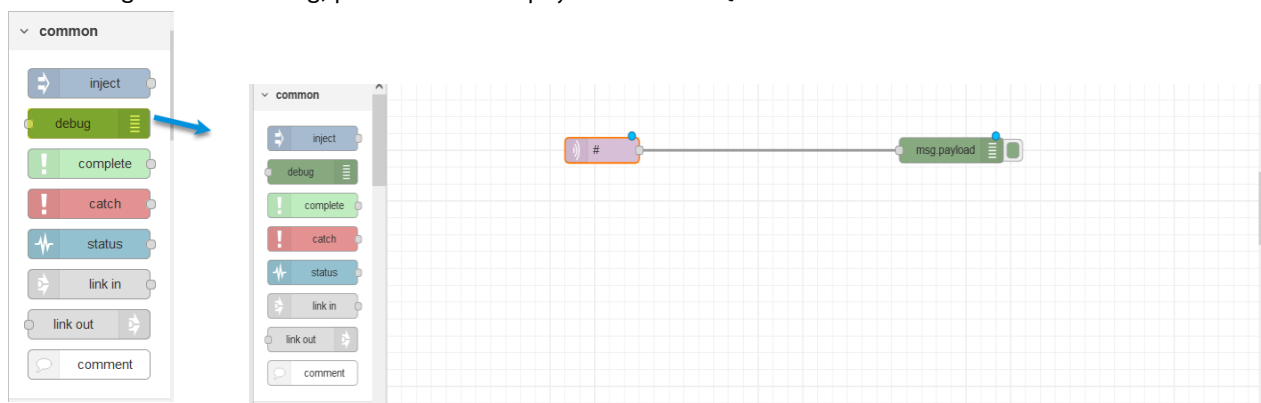
Client ID Leave blank for auto generated

☒ Keep alive time (s) 60 ☒ Use clean session

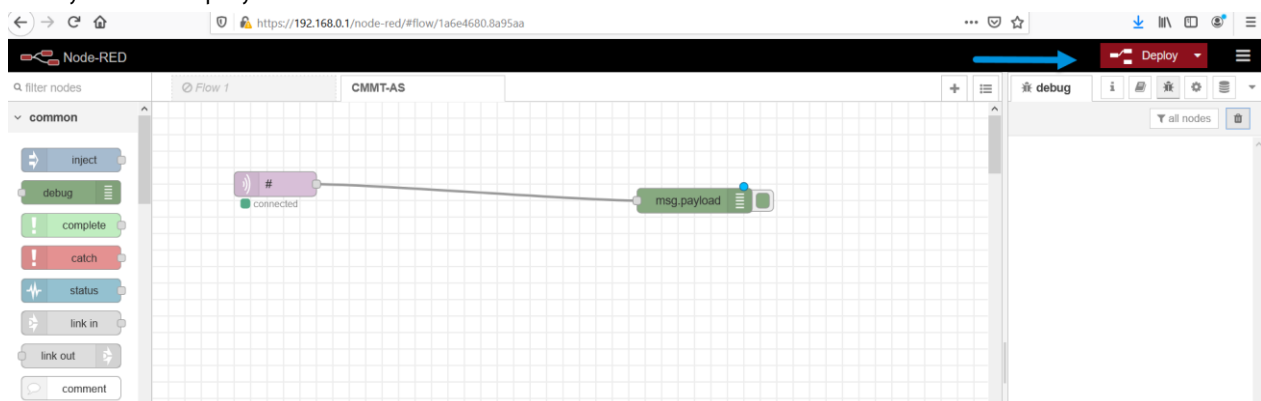
☐ Use legacy MQTT 3.1 support

☐ Enabled 0 nodes use this config On all flows

For reading the data coming, please connect a payload to the MQTT in.



Finally click on deploy



After deploying, please click on debug messages in order to check the data:

The screenshot shows the Node-RED web interface in a browser. The URL is <https://192.168.0.1/node-red/#flow/1a6e4680.8a95aa>. The interface includes a left sidebar with node categories (common and function), a central workspace with a flow named 'CMMT-AS' containing a 'debug' node and a 'msg.payload' node, and a right sidebar with a 'debug' tab showing a list of messages.

The 'debug' tab in the right sidebar displays the following messages:

```
5/4/2021, 11:48:41 AM node: 70596dae 23e9a4
v1/itsolutions/as/357PP8JQ5KX/: msg.payload :
Object
  { fields: object, comId:
    "357PP8JQ5KX", deviceId:
    "357PP8JQ5KX", messageType:
    "diagnosis", timestamp:
    "2021-05-04T09:48:44.228Z" }

5/4/2021, 11:48:42 AM node: 70596dae 23e9a4
v1/itsolutions/as/357PP8JQ5KX/: msg.payload :
Object
  { fields: object, comId:
    "357PP8JQ5KX", deviceId:
    "357PP8JQ5KX", messageType:
    "process", timestamp:
    "2021-05-04T09:48:48.212Z" }

5/4/2021, 11:48:43 AM node: 70596dae 23e9a4
v1/itsolutions/as/357PP8JQ5KX/: msg.payload :
Object
  { fields: object, comId:
    "357PP8JQ5KX", deviceId:
    "357PP8JQ5KX", messageType:
    "process", timestamp:
    "2021-05-04T09:48:49.212Z" }

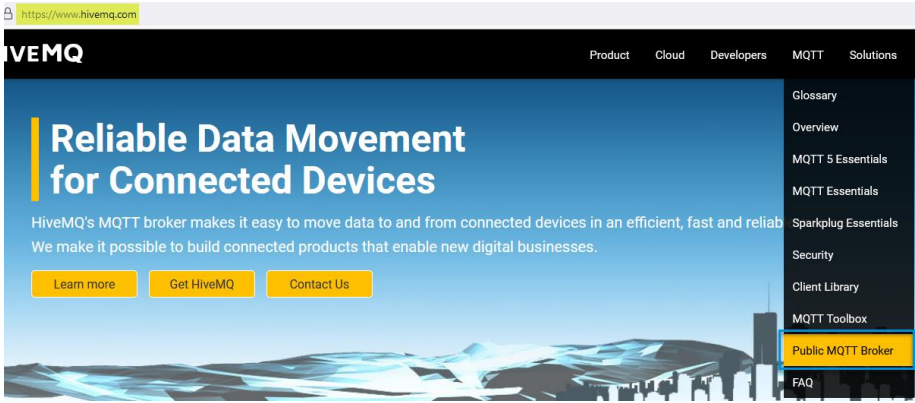
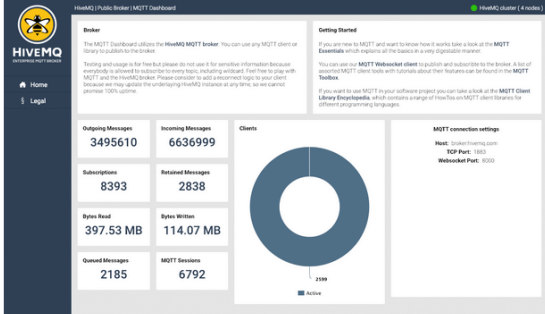
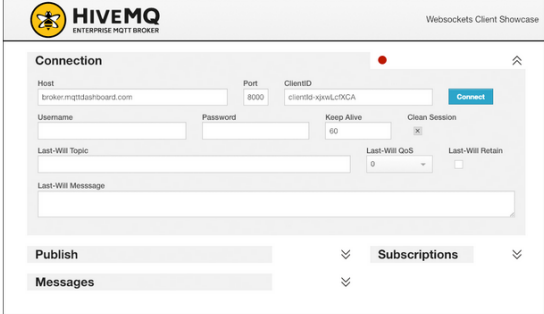
5/4/2021, 11:48:44 AM node: 70596dae 23e9a4
v1/itsolutions/as/357PP8JQ5KX/: msg.payload :
Object
  { fields: object, comId:
    "357PP8JQ5KX", deviceId:
    "357PP8JQ5KX", messageType:
    "diagnosis", timestamp:
    "2021-05-04T09:48:49.212Z" }
```

2.5.2 Broker Configuration HIVE MQ

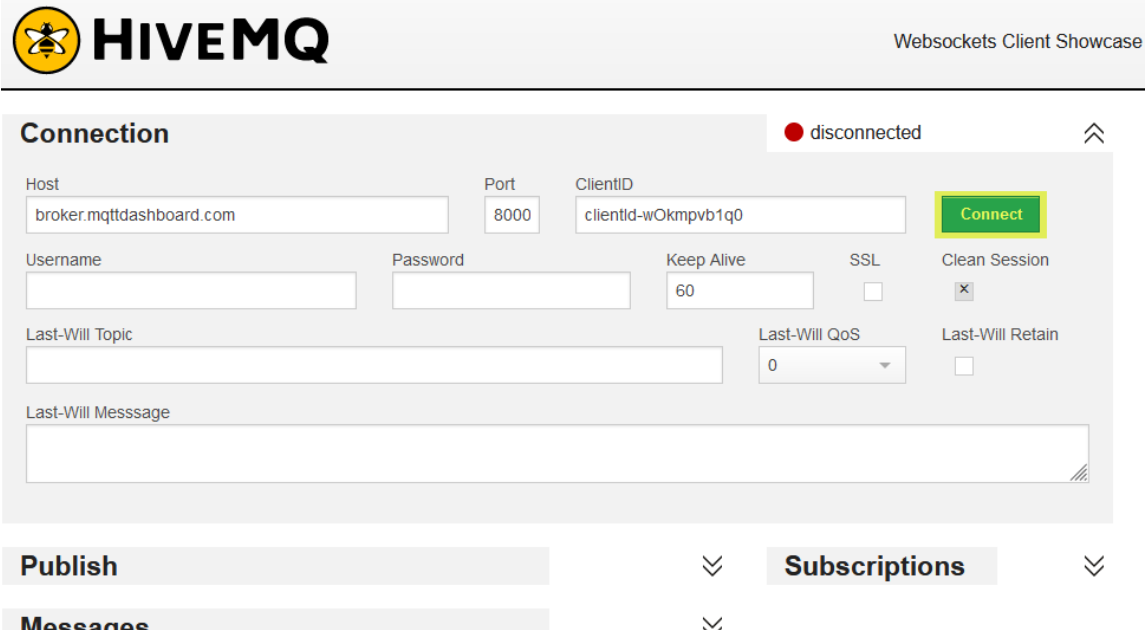
This chapter shows an example how to setup a MQTT communication to a broker. This section is not mandatory for the configuration of the CPX-IOT itself. The aim of this chapter is to show a practical example of a broker connection. A free public broker will be used and only the basic parameters will be configured.



No.	Action
1	Connect cloud port to the Internet. The Router via DHCP assign an IP to the CPX-IOT cloud port. The router assign to CPX_IOT 172.18.92.110
	Product Key 3S7PN1PQRJQ Device Time Wed Aug 25 14:07:02 UTC 2021 MQTT Network IP: 172.18.92.110 Netmask: 255.255.254.0 Gateway: 172.18.92.1 MQTT Statistics Published: 58 Failed: 0 Reconnects: 29 Last Connected: 2021-08-25T12:36:38Z Device Network IP: 192.168.0.4 Netmask: 255.255.255.0 Operation Mode Read/Write Boardings Boarded devices: 1 (1/0)

2	On this step, set up a MQTT communication to the public broker (HiveMQ), as an example. Open a browser and write the following URL: https://www.hivemq.com/public-mqtt-broker/
	
	Click on Try MQTT Browser Client, as shown on the image below.
	Public MQTT Broker  MQTT Browser Client  Our Public HiveMQ MQTT broker is open for anyone to use. Feel free to write an MQTT client that connects with this broker. We have a dashboard so you can see the amount of traffic on this broker. We also keep a list of MQTT client libraries that can be used to connect to HiveMQ. You can access the broker at: Broker: <code>broker.hivemq.com</code> TCP Port: 1883 Websocket Port: 8080 Try MQTT Browser Client

- 3 By default, the public broker provide a Host, Port and ClientID. Please keep the default values provided by HiveMQ.



HIVEMQ Websockets Client Showcase

Connection ● disconnected

Host: Port: ClientID: **Connect**

Username: Password: Keep Alive: SSL: ☐ Clean Session: ☒

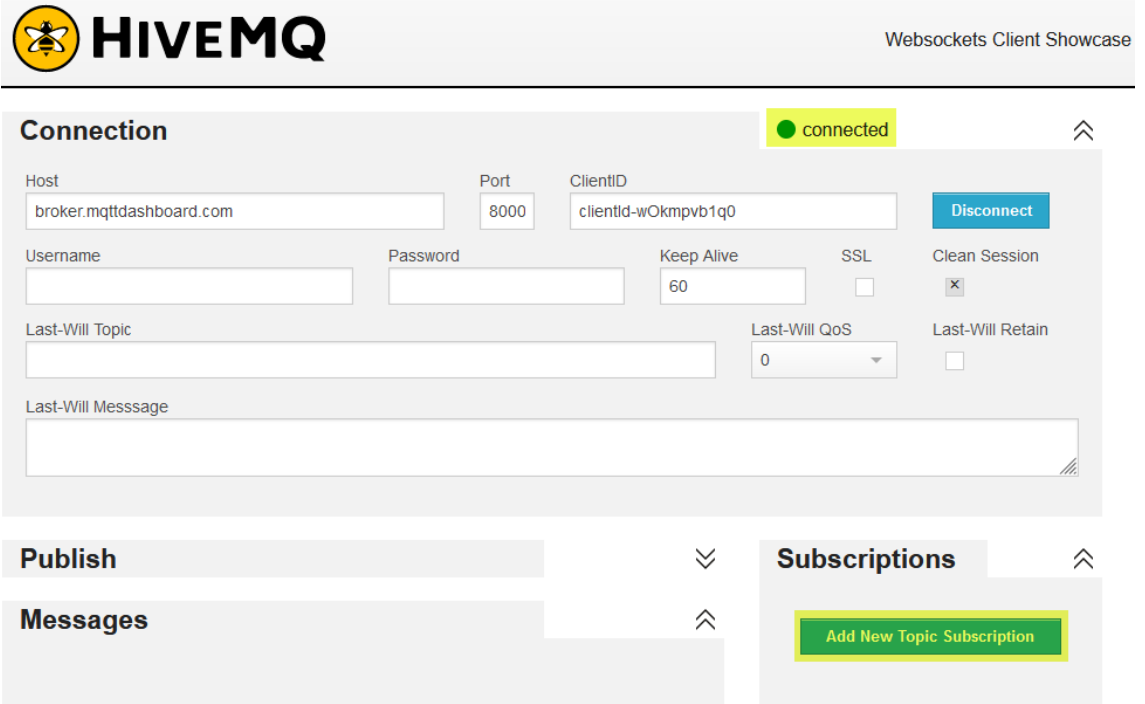
Last-Will Topic: Last-Will QoS: Last-Will Retain: ☐

Last-Will Message:

Publish ⌵ **Subscriptions** ⌵

Messages ⌵

- 4 Now the Broker is connected successfully. Then please click on “Add New Topic Subscription”



HIVEMQ Websockets Client Showcase

Connection ● connected

Host: Port: ClientID: **Disconnect**

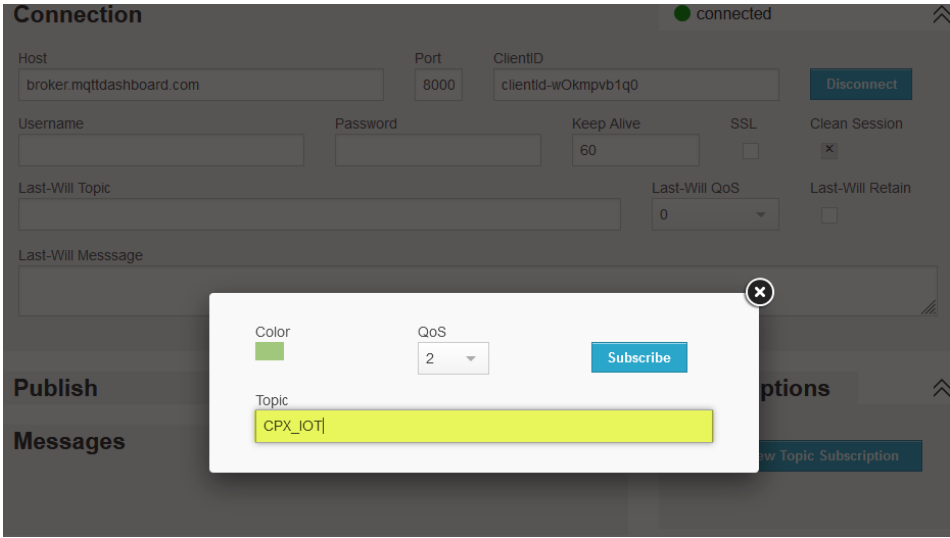
Username: Password: Keep Alive: SSL: ☐ Clean Session: ☒

Last-Will Topic: Last-Will QoS: Last-Will Retain: ☐

Last-Will Message:

Publish ⌵ **Subscriptions** ⌵

Messages ⌵ **Add New Topic Subscription**

5	Create a subscription and write a topic name. For example CPX_IOT.
	 A screenshot of an MQTT dashboard interface. At the top, it says 'connected' with a green dot. Below this are fields for Host (broker.mqttdashboard.com), Port (8080), and ClientID (clientId-wOkmpvb1q0), along with a Disconnect button. Further down are fields for Username, Password, Keep Alive (60), SSL (checkbox), Clean Session (checkbox), Last-Will Topic, Last-Will QoS (0), and Last-Will Retain (checkbox). A modal dialog box is open in the center, titled 'Subscribe'. It has a Color selector (green), a QoS dropdown (2), and a blue 'Subscribe' button. Below these is a 'Topic' field containing 'CPX_IOT'. The background shows sections for 'Publish' and 'Messages'.
6	Go to CPX-IOT webserver and click con MQTT --> Broker configuration.
	 A screenshot of the CPX-IOT webserver interface. The top navigation bar includes 'CPX-IOT', 'Info', 'Devices', 'MQTT', and 'Configuratic'. The 'MQTT' menu is open, showing options: 'Broker Configuration' (highlighted in yellow), 'Manage Certificates', and 'Test Message'. Below the menu is a graphic of a Festo CPX-IOT device with a star logo and labels for NS, PL, TP1, SF, TP2, M, and a 'FESTO' logo at the bottom.

7	Write the URL: mqtt://www.MQTT-dashboard.com:1883 This URL allows CPX-IOT to connect to the broker.
Broker Configuration Broker 1 * mqtt://www.MQTT-dashboard.com:1883 Broker 2 Broker 3 ClientId * festo Last Will☐ Username Password Keep Alive (s) 60 Apply	

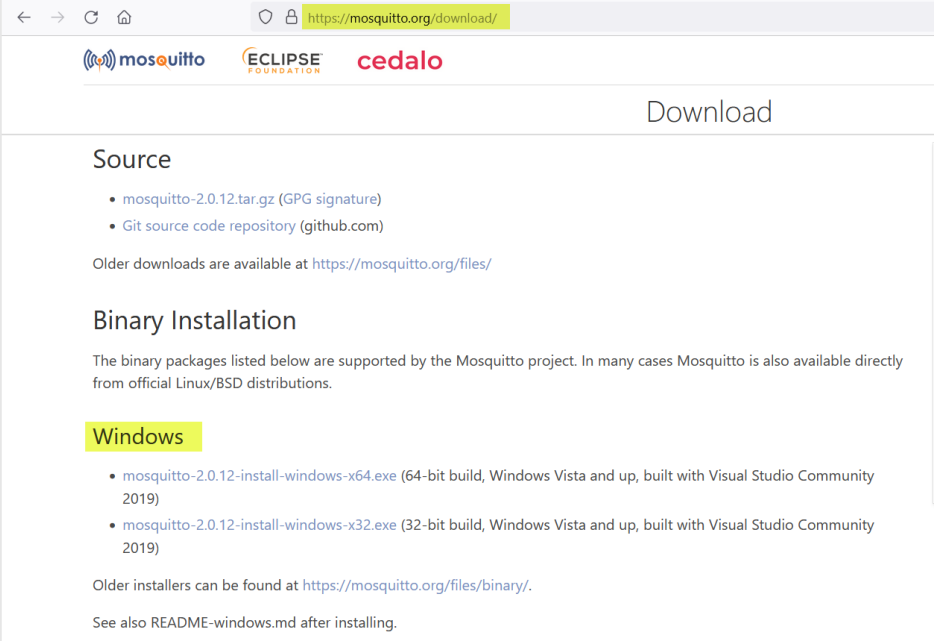
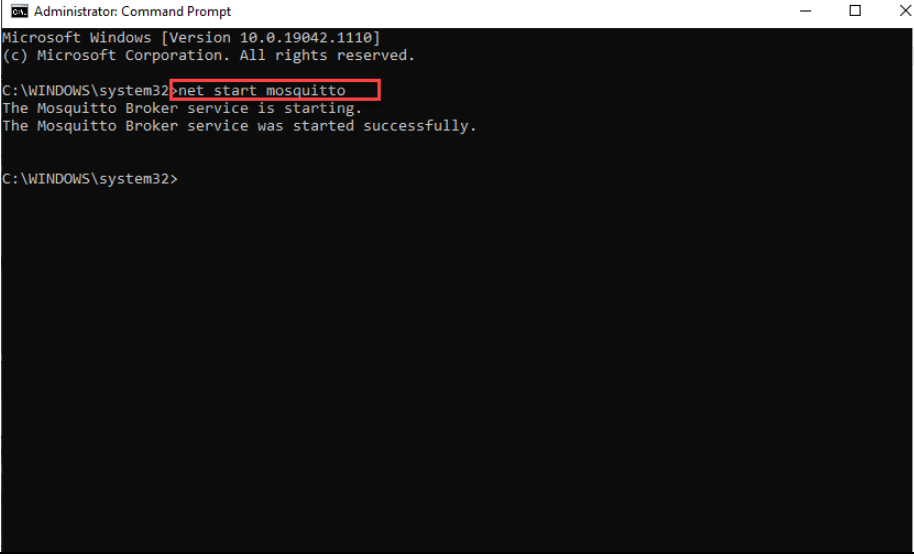
8	Write the topic: CPX_IOT
	Test Message Topic * CPX_IOT Message Hello Broker. I am CPX-IOT QoS 1 - At least once ▼ Send sending test message successful ×
9	Receive the message on HIVEMQ MQTT Broker
	 HIVEMQ Websockets Client Showcas Connection ● connected ⌵ Host broker.mqttdashboard.com Port 8000 ClientID clientId-wOkmpvb1q0 Disconnect Username Password Keep Alive 60 SSL ☐ Clean Session ☒ Last-Will Topic Last-Will QoS 0 Last-Will Retain ☐ Last-Will Message Publish ⌵ Subscriptions ⌵ Add New Topic Subscription Qos: 2 × CPX_IOT Messages ⌵ 2021-08-26 08:56:55 Topic: CPX_IOT Qos: 1 Hello Broker. I am CPX-IOT

2.5.3 Broker Configuration Mosquitto

This chapter shows an example how to setup a MQTT communication to another broker well-known. This section is not mandatory for the configuration of the CPX-IOT itself. The aim of this chapter is to show a practical example of a broker connection. A free public broker will be used and only the basic parameters will be configured.



No.	Action
1	Connect the cloud port to the Internet. The Router via DHCP assign an IP to the CPX_IOT cloud port. The router assign to CPX_IOT 172.18.92.110
	Product Key 3S7PN1PQRJQ Device Time Wed Aug 25 14:07:02 UTC 2021 MQTT Network IP: 172.18.92.110 Netmask: 255.255.254.0 Gateway: 172.18.92.1 MQTT Statistics Published: 58 Failed: 0 Reconnects: 29 Last Connected: 2021-08-25T12:36:38Z Device Network IP: 192.168.0.4 Netmask: 255.255.255.0 Operation Mode Read/Write Boardings Boarded devices: 1 (1/0)

2	First of all, open a browser and write: https://mosquitto.org/download/ and choose correct package depending on your operating system.
	 The screenshot shows the Mosquitto download page in a web browser. The address bar displays https://mosquitto.org/download/. The page features logos for Mosquitto, Eclipse Foundation, and cedalo. The main heading is "Download". Under the "Source" section, there are links for "mosquitto-2.0.12.tar.gz (GPG signature)" and "Git source code repository (github.com)". A note states "Older downloads are available at https://mosquitto.org/files/". The "Binary Installation" section explains that binary packages are supported by the Mosquitto project. A yellow highlight is placed over the "Windows" sub-section, which lists two installers: "mosquitto-2.0.12-install-windows-x64.exe (64-bit build, Windows Vista and up, built with Visual Studio Community 2019)" and "mosquitto-2.0.12-install-windows-x32.exe (32-bit build, Windows Vista and up, built with Visual Studio Community 2019)". A note mentions "Older installers can be found at https://mosquitto.org/files/binary/" and another note says "See also README-windows.md after installing."
3	Open a Command Prompt and write: net start mosquitto  The screenshot shows an Administrator Command Prompt window. The text displayed is: "Microsoft Windows [Version 10.0.19042.1110] (c) Microsoft Corporation. All rights reserved. C:\WINDOWS\system32>net start mosquitto The Mosquitto Broker service is starting. The Mosquitto Broker service was started successfully. C:\WINDOWS\system32>". The command "net start mosquitto" is highlighted with a red box.

- 4 Open a Web Browser and please download MQTT Explorer. MQTT Explorer is a comprehensive MQTT client that provides a structured overview of your MQTT topics and makes working with devices/services on your broker dead-simple.
<http://mqtt-explorer.com> Please select exe file according to your operating system.

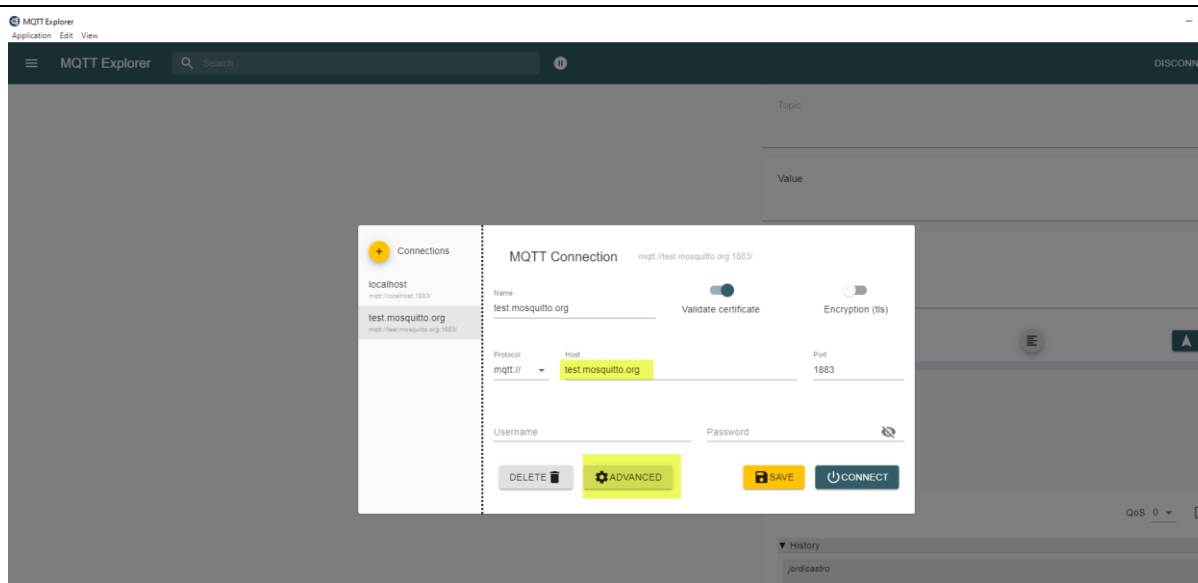
// Download

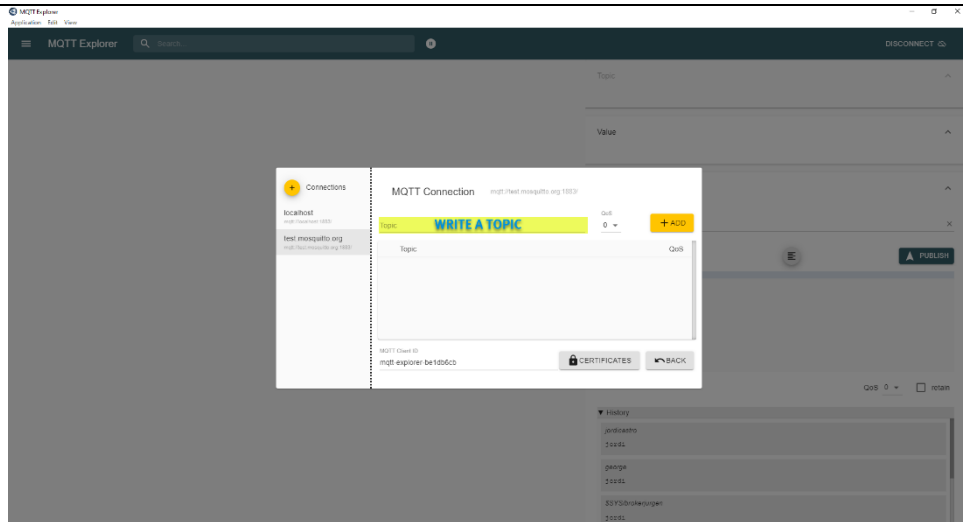
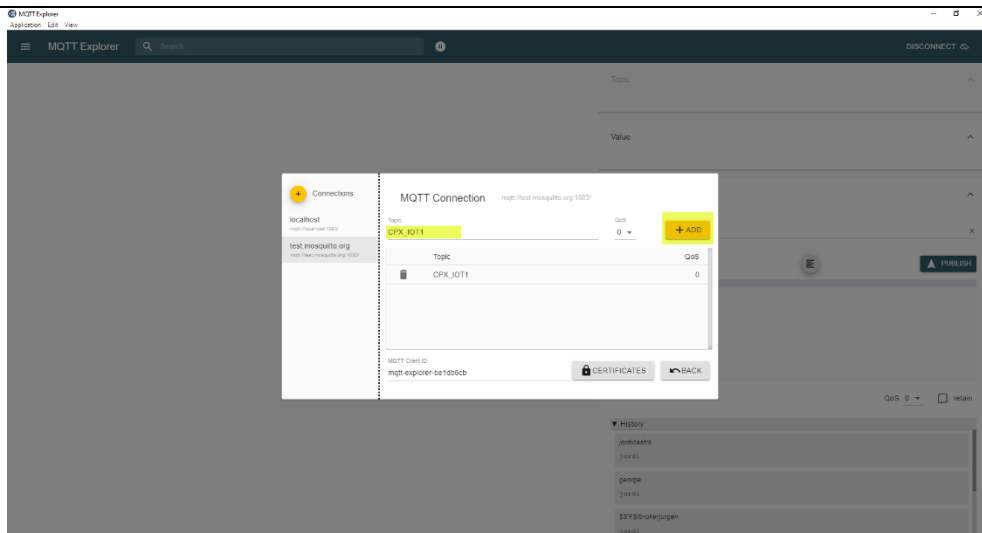
Developing this tool takes a lot of effort, sweat and time, please consider rating the App on the Windows or Mac app store ★★★★★. If you feel like a feature is missing or you found a bug, please leave me a [comment](#) / [issue](#) and I'll see what I can do.

Platform	Downloads
 Windows	
 Mac	 dmg
 Ubuntu <i>debian, mint, neon, fedora, etc...</i>	 <code>snap install mqtt-explorer</code> Ubuntu Store
 Linux <i>almost every linux</i>	Applmage Run Applmage: Make it executable and double-click it.

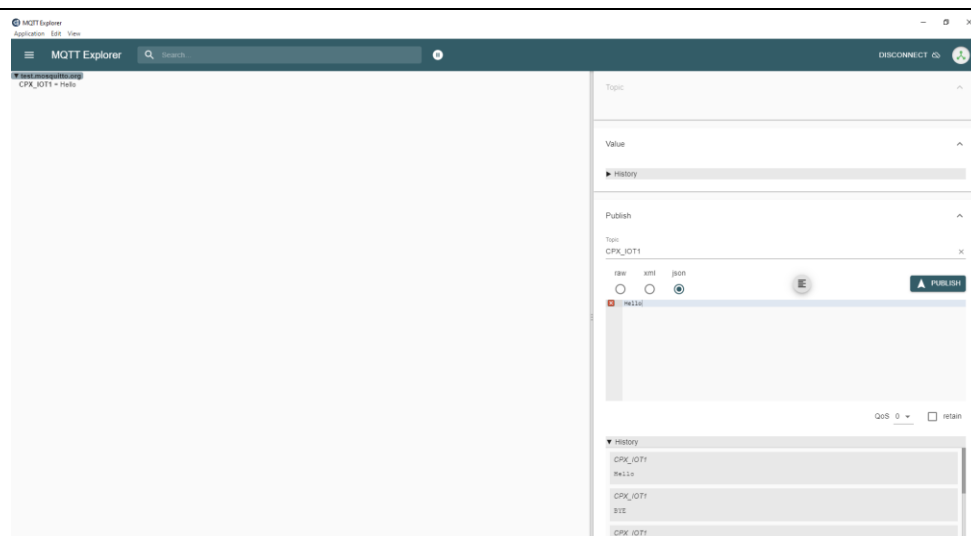
[More Downloads](#)

- 5 Host: test.mosquitto.org Port: 1883
Please click on ADVANCED.



6 Create a **Topic**.7 In this example the TOPIC is **CPX_IOT1** Then, please click on ADD.

8 On MQTT Explorer write an message using the topic that we created before (CPX_IOT1) in order to check that the communication is working.



9	Send a Test Message from CPX-IOT Test Message Topic * CPX_IOT1 Message Hello Mosquitto. I send a messae from CPX_IOT QoS 1 - At least once Send sending test message successful MQTT Explorer Application Edit View MQTT Explorer Search test.mosquitto.org CPX_IOT1 = Hello Mosquitto. I send a message from CPX_IOT Topic Value History Publish Topic CPX_IOT1 raw xml json PUBLISH MQTT Explorer Application Edit View MQTT Explorer Search test.mosquitto.org CPX_IOT1 = Hello Mosquitto. I send a message from CPX_IOT
---	--

2.5.4 Test Message

Test Message

Topic *

Message

QoS 1 - At least once ▾

- 0 - At most once
- 1 - At least once
- 2 - Exactly once

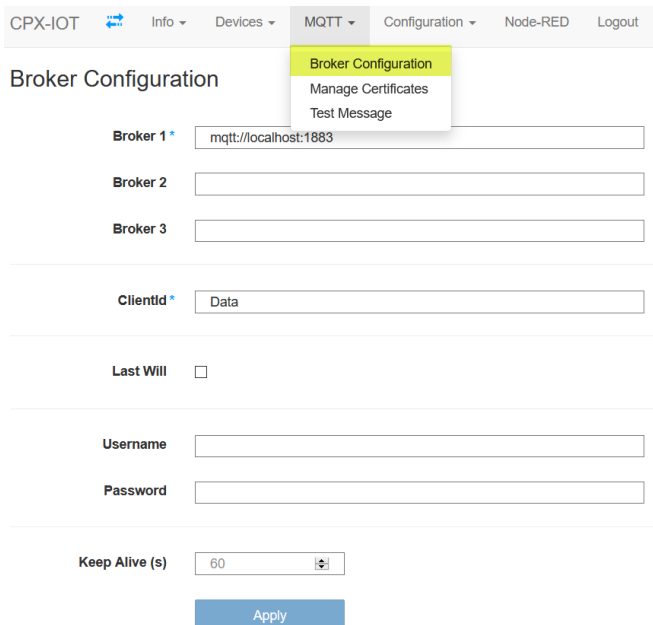
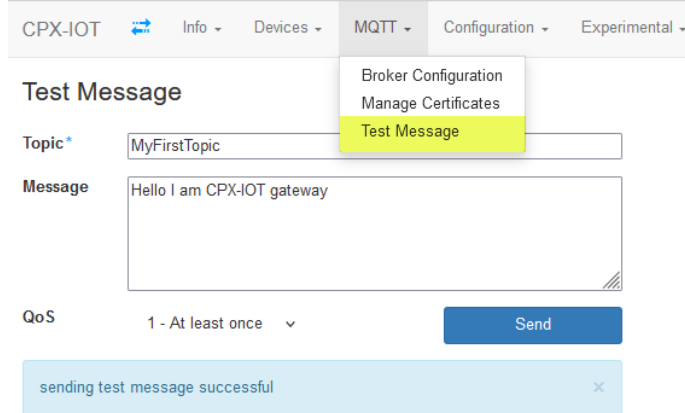
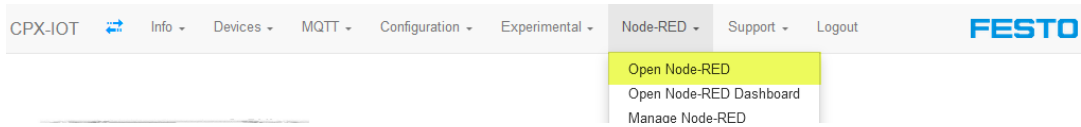
Topic : Topics are an alphanumeric identifier that is assigned to MQTT messages in order to MQTT messages to classify them according to a context.

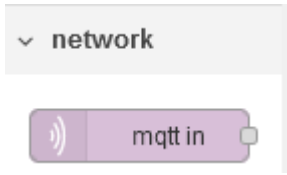
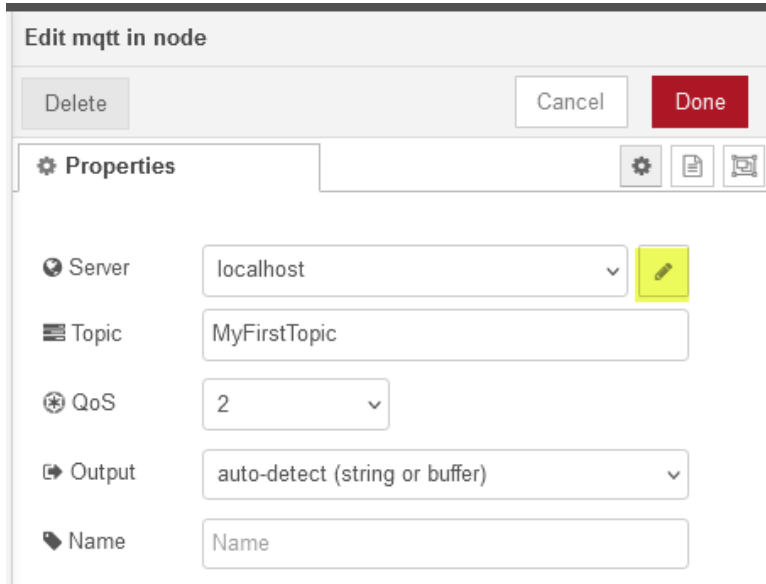
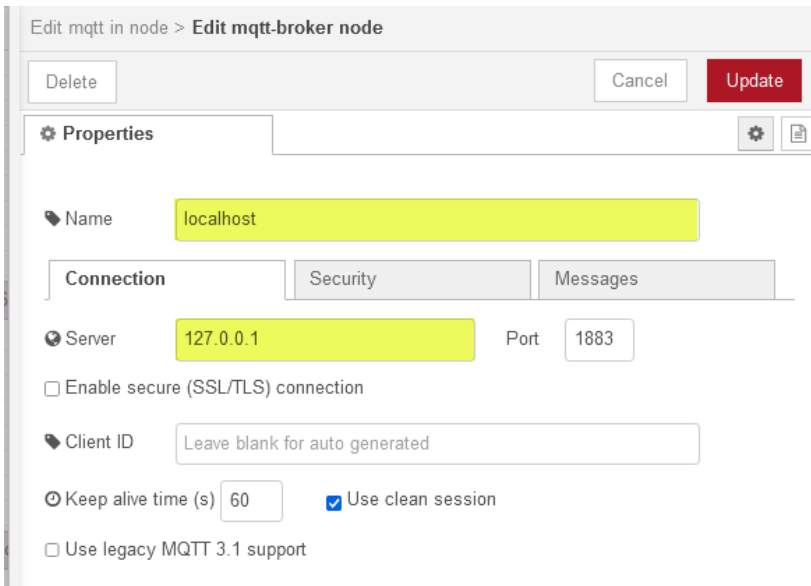
Message : Write the message to be sent here.

QoS (Quality of Service) : It is an agreement between the sender of a message and the receiver of a message that defines the guarantee of delivery for a specific message.

- QoS 0 – at most once : The minimal QoS level is zero. There is no guarantee of delivery. The receiver does not acknowledge receipt of the message and the message is not stored and retransmitted by the sender.
- QoS 1 – At least once: Level 1 guarantees that a message is delivered at least one time to the receiver. The sender stores the message until it gets a Puback packet from the receiver that acknowledges receipt of the message. It is possible for a message to be sent or delivered multiple times.
- QoS 2 – Exactly once : QoS2 is the highest level of service in MQTT protocol. This quality level guarantees that each message is received only once by the intended recipients. QoS 2 is the safest and slowest quality of service level. The guarantee is provided by at least two request/response flows (a four-part handshake) between the sender and the receiver. The sender and receiver use the packet identifier of the original PUBLISH message to coordinate delivery of the message.

There are 3 brokers. They are used for load distribution and fault tolerance. Data is distributed between them randomly. If there is only one broker, always configure broker 1.

No.	Action
1	Go to MQTT --> Broker Configuration. Configure the local Broker: mqtt://localhost:1883
	
2	Go to Test Message and write: Topic = <i>MyFirstTopic</i> and Message: <i>Hello I am CPX-IOT gateway</i>
	
3	Open NodeRed
	

4	Select a MQTT in
	
5	Double click on MQTT in and configure the Server
	
6	Write a name to the server and configure localhost: 127.0.0.1
	

7	Connect a Payload to the MQTT in
	Test Message Topic* MyFirstTopic Message Hello I am CPX-IOT gateway QoS 2 - Exactly once Send sending test message successful
	MyFirstTopic connected msg.payload all nodes 10/7/2021, 9:34:40 AM node: 5c05dc2e.29192c MyFirstTopic : msg.payload : string[26] "Hello I am CPX-IOT gateway"

2.6 Configuration

2.6.1 Setup Device Network

Configuration of the IP address and the subnet mask of the device port.

CPX-IOT Info Devices MQTT Configuration Experimental Node-RED Support Logout **FESTO**

Setup Device Network

Hostname cpx-iot-0

MAC 00:0e:f0:60:9a:40

DHCP ☐

IP 192 . 168 . 0 . 4

Netmask 255 . 255 . 255 . 0

Apply

2.6.2 Setup Broker Network

Configuration of the IP address and the subnet mask of the cloud port. It is possible to select DHCP.

CPX-IOT Info Devices MQTT Configuration Experimental Support Logout **FESTO**

Setup Broker Network

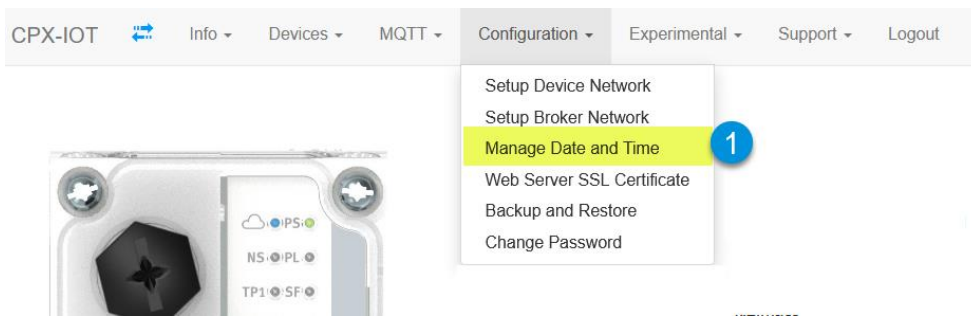
MAC 00:0e:f0:60:9a:41

Hostname cpx-iot-0

DHCP ☒

Apply

2.6.3 Manage Date and Time



CPX-IOT [Info](#) [Devices](#) [MQTT](#) [Configuration](#) [Experimental](#) [Support](#) [Logout](#)

- Setup Device Network
- Setup Broker Network
- Manage Date and Time** 1
- Web Server SSL Certificate
- Backup and Restore
- Change Password

Manage Date and Time

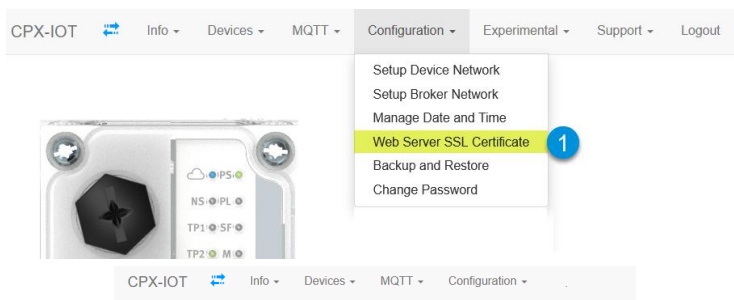
Enable NTP ☒

NTP Server via DHCP ☒ 2

Date and Time Thu, 2021-10-14, 09:43:40

Apply

2.6.4 Web Server SSL Certificate



CPX-IOT [Info](#) [Devices](#) [MQTT](#) [Configuration](#) [Experimental](#) [Support](#) [Logout](#)

- Setup Device Network
- Setup Broker Network
- Manage Date and Time
- Web Server SSL Certificate** 1
- Backup and Restore
- Change Password

Web Server SSL Certificate

 2

CA SSL certificate

installed [View](#)

[Browse...](#) No file selected. [Upload](#)

Server SSL certificate

installed [View](#)

[Browse...](#) No file selected. [Upload](#)

Server SSL certificate key

installed [View](#)

[Browse...](#) No file selected. [Upload](#)

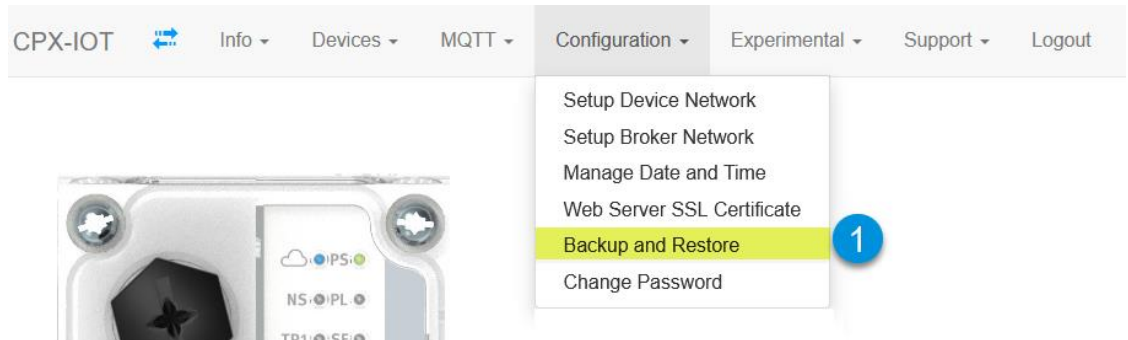
Restart Web Server

[Restart](#)

CA Certificate: This is used by the Gateway to verify the identity of the broker. It is needed to enable encryption. It can be obtained from the administrator of the broker (e.g. cloud provider or IT department).

Client Certificate and Client Certificate Key: They belong together and are used to identify the Gateway at the broker. Using client certificate and key is optional; it is also possible to configure username and password instead. Usually the client certificate and key is created by somebody who owns the CA certificate (e.g. the admin of the broker) and is created for a specific MQTT client.

2.6.5 Backup and Restore



The screenshot shows the CPX-IOT web interface. The top navigation bar includes 'CPX-IOT', 'Info', 'Devices', 'MQTT', 'Configuration', 'Experimental', 'Support', and 'Logout'. The 'Configuration' dropdown menu is open, showing options: 'Setup Device Network', 'Setup Broker Network', 'Manage Date and Time', 'Web Server SSL Certificate', 'Backup and Restore' (highlighted with a blue circle '1'), and 'Change Password'.

Backup and Restore

Create Backup

Backup file not available! Create Backup

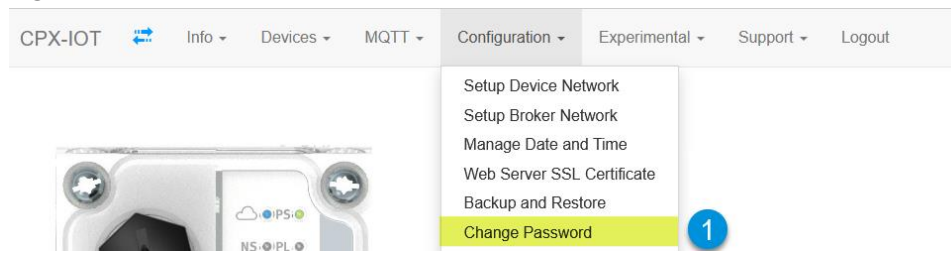
Restore Backup

☐ Restore Network Settings

Browse... No file selected. Restore

Restart System

2.6.6 Change Password



The screenshot shows the CPX-IOT web interface. The top navigation bar includes 'CPX-IOT', 'Info', 'Devices', 'MQTT', 'Configuration', 'Experimental', 'Support', and 'Logout'. The 'Configuration' dropdown menu is open, showing options: 'Setup Device Network', 'Setup Broker Network', 'Manage Date and Time', 'Web Server SSL Certificate', 'Backup and Restore', and 'Change Password' (highlighted with a blue circle '1').

Change Password

Passwords must be minimum 8 characters long and include at least 3 of the following groups: Lower case letters, upper case letters, digits, special characters.

admin

.....

New Password

Verify Password

Apply

2.7 Configuration of “Signature.json”

CPX-IOT Info Devices MQTT Configuration Experimental Node-RED Support Logout **FESTO**

Manage Device Types Manage Devices Manage Device Types 1

Currently installed Device Types

Device types defined: 8

Name	Info	Version
CPX-MPA-VTSA-VTEM	Signature for CPX, MPA, VTSA, VTEM based devices	3.0.4
MSE6-E2M	Signature for E2M based devices	1.3.2
CMMT-AS	Signature for CMMT-AS based devices	V1.4
CMMT-ST	Signature for CMMT-ST based devices	V1.4
CPX-AP	Signature for generic CPX-AP gateways.	V1.1
CPX-AP_IO	Signature for generic CPX-AP devices.	V1.1
CPX-AP_DEVICE_IOLINK_MASTER	Signature for generic CPX-AP IO-Link Master	V1.1
IOLINK_DEVICE	Signature for generic IO-Link devices.	V1.1

Download Device Type File

Download currently installed Device Type File. Download 2

Upload Device Type File

Browse... No file selected. Upload

2.7.1 Trigger interval

Each device sends three messages with a preconfigure time. Diagnosis message payload is sent each 5 seconds. This time can be modified.

```

1 {
2   "Signatures": [
3     {
4       "uid": "CPX-MPA-VTSA-VTEM",
5       "iname": "CPX",
6       "info": "Signature for CPX, MPA, VTSA, VTEM based devices",
7       "version": "3.0.4",
8       "rootnode": "",
9       "Subscriptions": [
10        {
11          "id": "Default",
12          "interval": 5000
13        },
14        {
15          "id": "Data",
16          "interval": 1000
17        }
18      ],
19       "messageTypes": [
20        {
21          "messageTypeId": "DIAGNOSIS",
22          "messageTypeName": "diagnosis",
23          "dataPrefix": "fields",
24          "triggerInterval": 5000,
25          "triggerOnDeviceConnect": false,
26          "triggerOnDeviceDisconnect": false,
27          "force": true,
28          "metaData": [
29            {
30              "id": "topic",
31              "value": "Festo/%deviceId%/%messageTypeName%"

```

Process message payload is sent each 1 second. This parameter is configurable.

```

54   "messageTypeId": "PROCESS",
55   "messageTypeName": "process",
56   "dataPrefix": "fields",
57   "triggerInterval": 1000,
58   "triggerOnDeviceConnect": false,
59   "triggerOnDeviceDisconnect": false,
60   "force": true,
61   "metaData": [
62     {
63       "id": "topic",
64       "value": "Festo/%deviceId%/%messageTypeName%"
65     }
66   ],

```

Asset message payload is sent each 20 seconds. This parameter is configurable.

```

88 "messageTypeName": "asset",
89 "dataPrefix": "fields",
90 "triggerInterval": 20000,
91 "triggerOnDeviceConnect": true,
92 "triggerOnDeviceDisconnect": false,
93 "force": true,
94 "metaData": [
95   {
96     "id": "topic",
97     "value": "Festo/%deviceId/%messageTypeName%"
98   }
99 ],

```

2.7.2 How to change MQTT topic.

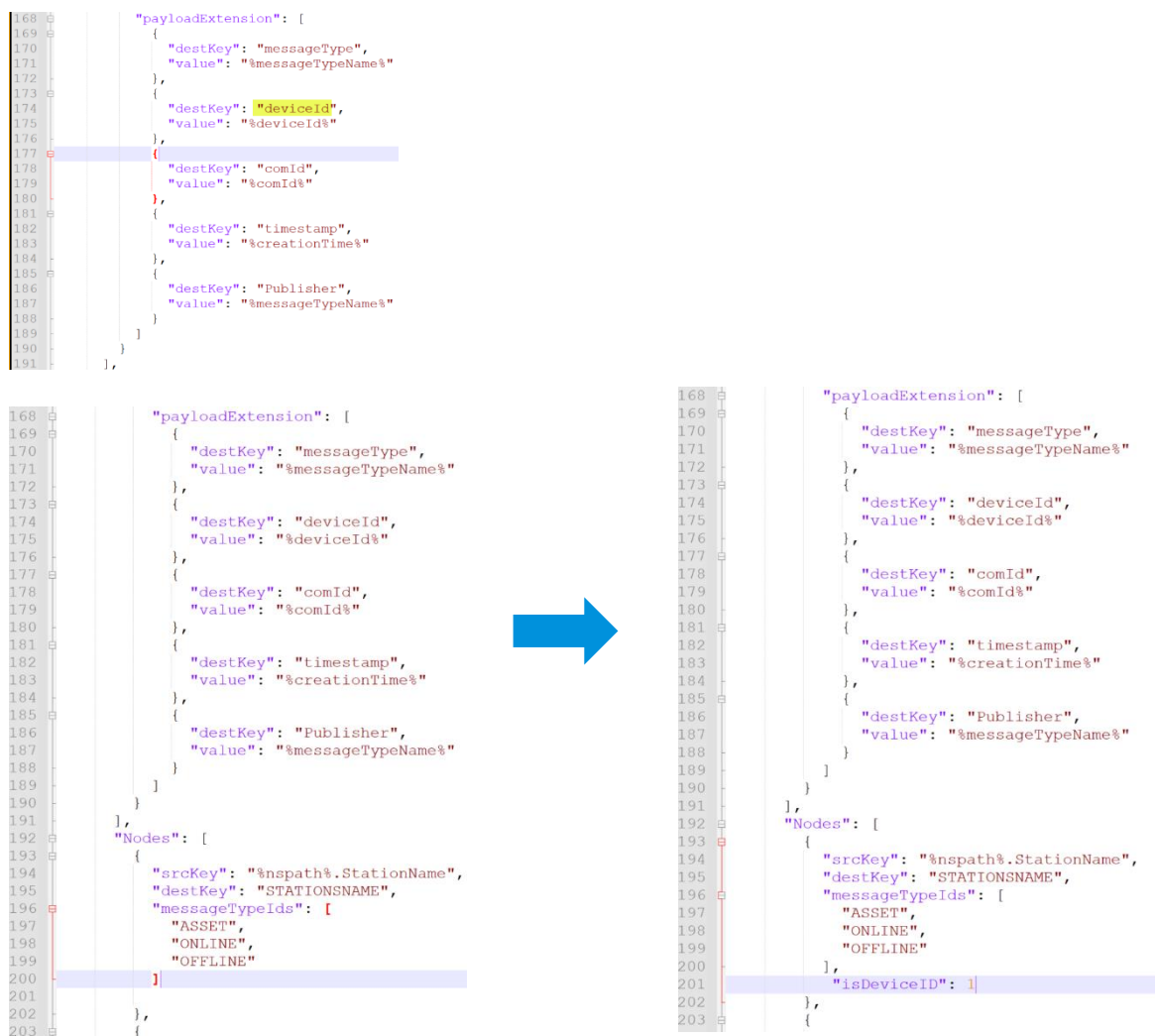
The MQTT topic is defined in the metadata. In that example the topic is *"Festo/%deviceId%/connectionState"*

```
120     "messageTypeId": "ONLINE",
121     "messageTypeName": "online",
122     "dataPrefix": "fields",
123     "triggerInterval": false,
124     "triggerOnDeviceConnect": true,
125     "triggerOnDeviceDisconnect": false,
126     "metaData": [
127     {
128         "id": "topic",
129         "value": "Festo/%deviceId%/connectionState"
130     },
131     ],
```

Note: You can use all variables from the section “Payload extension” as part of the MQTT topic.

2.7.3 How to change the content of the Device ID.

As a default, the DeviceID is the serial number of the valve terminal. In some case, it makes sense to change the DeviceID. Therefore, the tag “isDeviceID” must be relocate.



Finally, please delete the “isDeviceID”:1 as you can see in the image below.

```

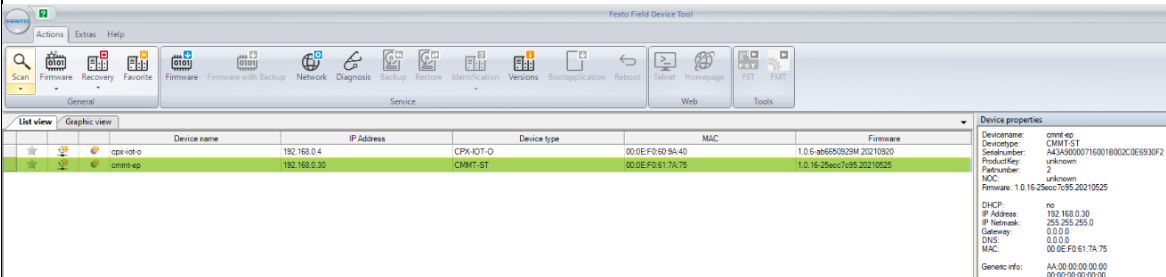
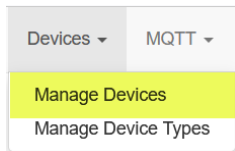
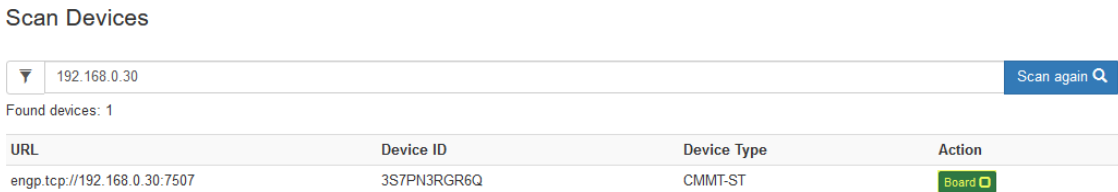
378  {
379    "srcKey": "%nspath%.Module00.SerialNumber",
380    "destKey": "SERIAL00",
381    "messageTypeIds": [
382      "ASSET"
383    ],
384    "isDeviceID": 1
385  },
386  {

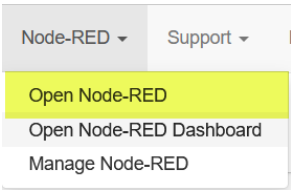
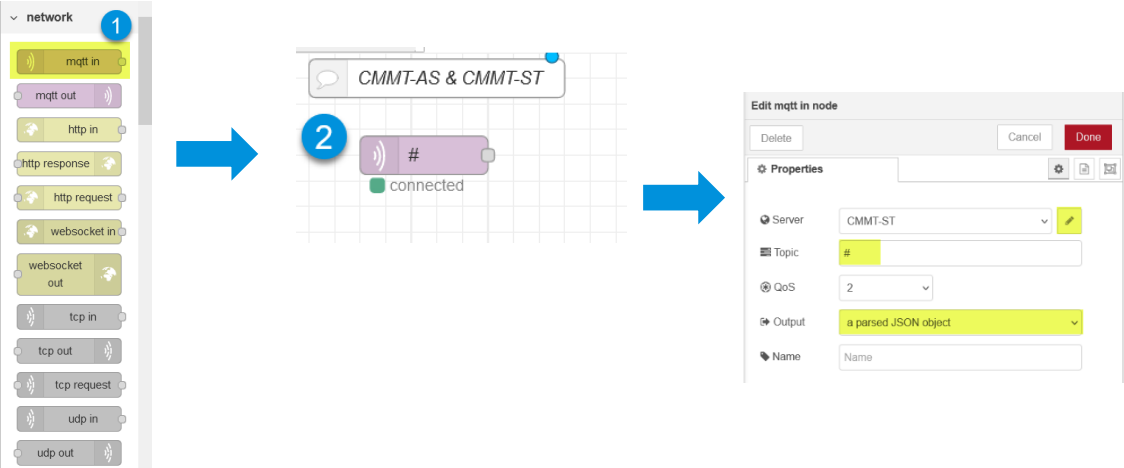
```

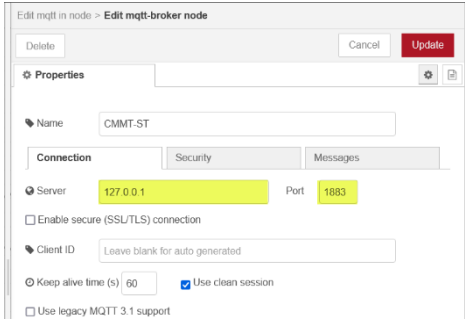
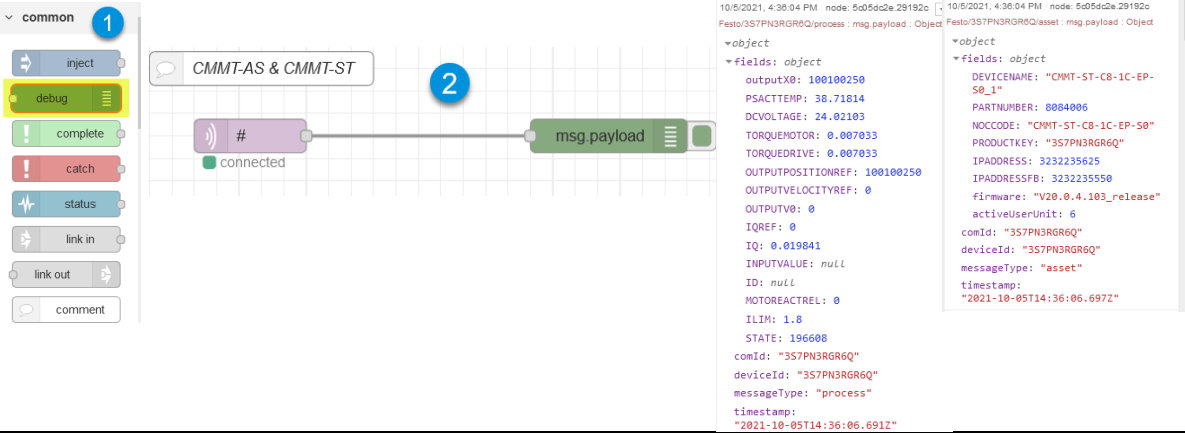
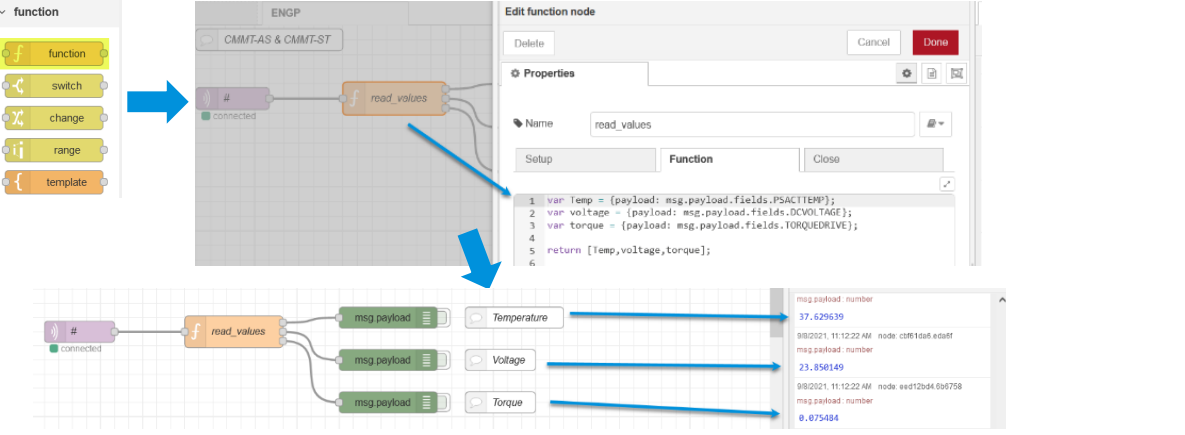
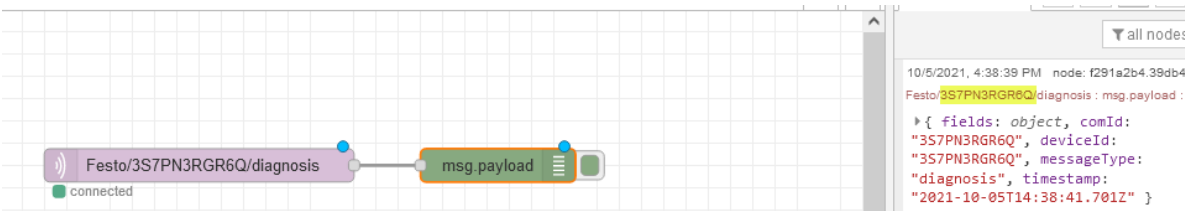
3 Integration of CPX-IOT in EthernetIP environment

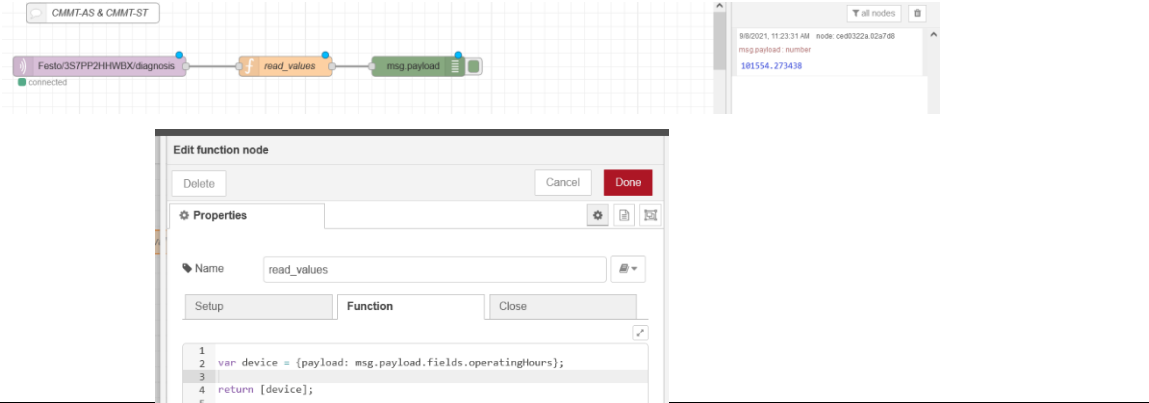
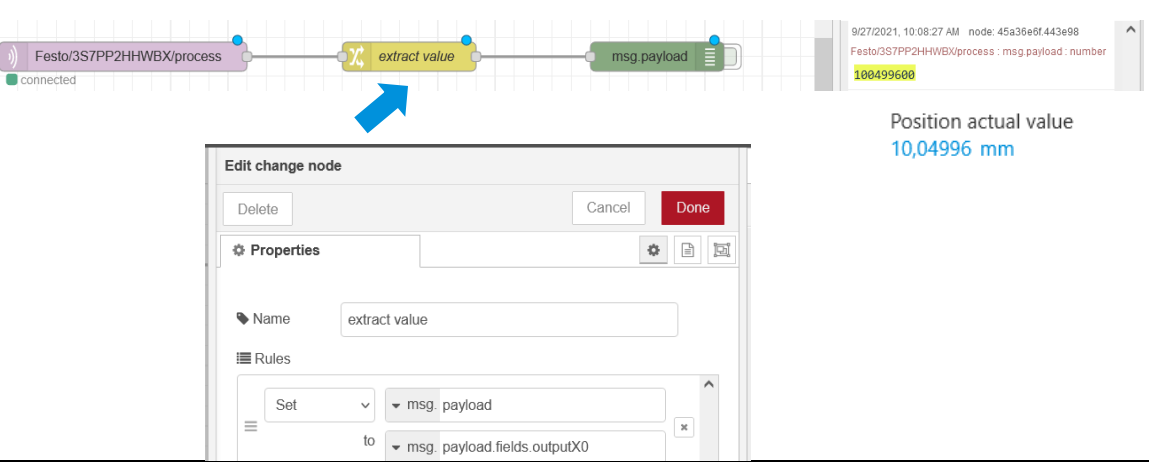
This chapter shows how to collect data from a CMMT-AS or CMMT-s via the CPX-IOT gateway.

3.1 Manage Devices: Connecting CMMT-AS-xx-EP or CMMT-ST-xx-EP Data to CPX-IOT.

No	Action
1	It is possible to assign the IP address via Festo Field Device Tool. In this example, CMMT IP address is: 192.168.0.30
	
2	Go to CPX-IOT webserver and click on Devices --> Manage Devices
	
3	Write on Scan Devices the Ethernet IP address of the CMMT and click on Scan again
	
4	The scan process has been completed successfully. Then click on "Board"
	
5	Boarding process has been completed successfully. Connection OK  Connection Not OK  . After boarding the message are going out. Node-RED is optional and used here as a demo.

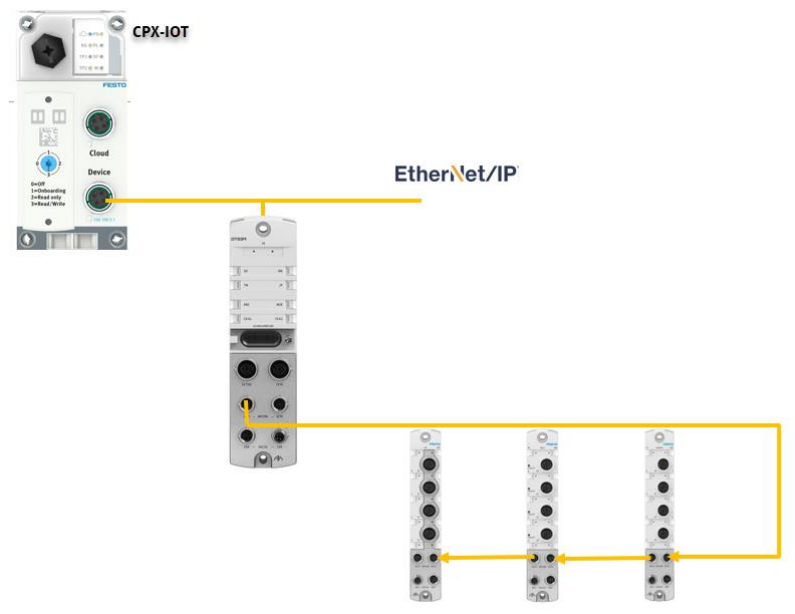
6	Open Node-RED
	
7	On Network palette please drag and drop MQTT in . Then press double click on the object MQTT in. Topic = # The subscription can be explicit or use Wildcards (#) Output = choose “a parsed JSON object”.
	

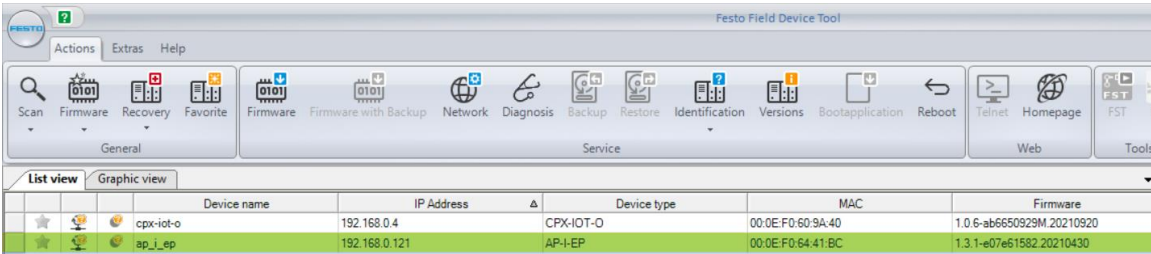
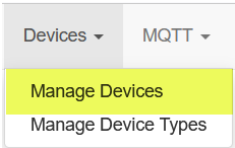
8	 Configure the server.
	
9	On Common Palette drag and drop a debug .
	 <pre> 10/5/2021, 4:36:04 PM node: 5d5dc2e.29192c Festo/3S7PN3RGR6Q/process : msg.payload : Object fields: Object outputX0: 100100250 PSACTEMP: 38.71814 DCVOLTAGE: 24.02103 TORQUEMOTOR: 0.007033 TORQUEDRIVE: 0.007033 OUTPUTPOSITIONREF: 100100250 OUTPUTVELOCITYREF: 0 OUTPUTV0: 0 IQREF: 0 IQ: 0.019841 INPUTVALUE: null ID: null MOTOREACTREL: 0 ILIM: 1.8 STATE: 196608 comId: "3S7PN3RGR6Q" deviceId: "3S7PN3RGR6Q" messageType: "process" timestamp: "2021-10-05T14:36:06.697Z" </pre>
10	It is possible to split the data into different and store them in variables. This is done using the object function.
	 <pre> 10/5/2021, 4:38:39 PM node: f291a2b4.39db4 Festo/3S7PN3RGR6Q/diagnosis : msg.payload : fields: Object, comId: "3S7PN3RGR6Q", deviceId: "3S7PN3RGR6Q", messageType: "diagnosis", timestamp: "2021-10-05T14:38:41.701Z" </pre>
11	Another way is to subscribe to the topic using the DeviceId.
	 <pre> 10/5/2021, 4:38:39 PM node: f291a2b4.39db4 Festo/3S7PN3RGR6Q/diagnosis : msg.payload : fields: Object, comId: "3S7PN3RGR6Q", deviceId: "3S7PN3RGR6Q", messageType: "diagnosis", timestamp: "2021-10-05T14:38:41.701Z" </pre>

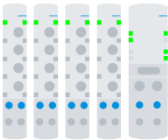
12	How to read the operation hours?
	
13	How to read the position of the drive?
	
14	Flow for reading the position of the drive.
	<pre>[{"id":"5ab20854.acdda","type":"change","z":"5c272f72.5fcdc8","name":"extract value","rules":[{"t":"set","p":"payload","pt":"msg","to":"payload.fields.outputX0","tot":"msg"}],"action":"","property":"","from":"","to":"","reg":false,"x":490,"y":160,"wires":[["697a728f.3a8ce4"]]},{"id":"9645f5ed.3bcdf","type":"mqtt in","z":"5c272f72.5fcdc8","name":"","topic":"Festo/3S7PP2HHWBX/process","qos":"2","datatype":"json","broker":"d2becf95.64dd9","x":190,"y":160,"wires":[["5ab20854.acdda"]]},{"id":"697a728f.3a8ce4","type":"debug","z":"5c272f72.5fcdc8","name":"","active":false,"tosidebar":true,"console":false,"tostatus":false,"complete":false,"statusVal":"","statusType":"auto","x":750,"y":160,"wires":[]},{"id":"d2becf95.64dd9","type":"mqtt-broker","name":"CMMT-ST","broker":"127.0.0.1","port":"1883","clientId":"","usetls":false,"compatmode":false,"keepalive":"60","cleansession":true,"birthTopic":"","birthQos":"0","birthPayload":"","closeTopic":"","closeQos":"0","closePayload":"","willTopic":"","willQos":"0","willPayload":""}]</pre>

3.2 Manage Devices: Connecting CPX_API-EP to CPX_IOT.

The device port of the CPX-IOT can be connected directly to the EthernetIP network.



No.	Action																								
1	The PLC EthernetIP master assigns the IP address to the CPX-AP-I-EP module. In this example, the IP address is: 192.168.0.121																								
																									
2	Please go to CPX-IOT webserver and click on Devices --> Manage Devices																								
																									
3	Write on Scan Devices the Profinet IP address of the CMMT an click on Scan again																								
	Scan Devices ▼ 192.168.0.121 Scan 																								
4	After doing a Scan, the I/O modules connected to the CPX_AP_I_PN are displayed.																								
	Found devices: 5 <table><tr><th>URL</th><th>Device ID</th><th>Device Type</th><th>Action</th></tr><tr><td>engt.tcp://192.168.0.121:7508/32771</td><td>3S7PMZVC2H3</td><td>CPX-AP_IO</td><td>Board </td></tr><tr><td>engt.tcp://192.168.0.121:7508</td><td>3S7PNCB048G</td><td>CPX-AP</td><td>Board </td></tr><tr><td>engt.tcp://192.168.0.121:7508/32772</td><td>3S7PNCY87LN</td><td>CPX-AP_IO</td><td>Board </td></tr><tr><td>engt.tcp://192.168.0.121:7508/32770</td><td>3S7PNQQDVRK</td><td>CPX-AP_DEVICE_IOLINK_MASTER</td><td>Board </td></tr><tr><td>engt.tcp://192.168.0.121:7508/32773</td><td>3S7PNSW35F6</td><td>CPX-AP_IO</td><td>Board </td></tr></table>	URL	Device ID	Device Type	Action	engt.tcp://192.168.0.121:7508/32771	3S7PMZVC2H3	CPX-AP_IO	Board 	engt.tcp://192.168.0.121:7508	3S7PNCB048G	CPX-AP	Board 	engt.tcp://192.168.0.121:7508/32772	3S7PNCY87LN	CPX-AP_IO	Board 	engt.tcp://192.168.0.121:7508/32770	3S7PNQQDVRK	CPX-AP_DEVICE_IOLINK_MASTER	Board 	engt.tcp://192.168.0.121:7508/32773	3S7PNSW35F6	CPX-AP_IO	Board 
URL	Device ID	Device Type	Action																						
engt.tcp://192.168.0.121:7508/32771	3S7PMZVC2H3	CPX-AP_IO	Board 																						
engt.tcp://192.168.0.121:7508	3S7PNCB048G	CPX-AP	Board 																						
engt.tcp://192.168.0.121:7508/32772	3S7PNCY87LN	CPX-AP_IO	Board 																						
engt.tcp://192.168.0.121:7508/32770	3S7PNQQDVRK	CPX-AP_DEVICE_IOLINK_MASTER	Board 																						
engt.tcp://192.168.0.121:7508/32773	3S7PNSW35F6	CPX-AP_IO	Board 																						

5	Please check the order of the modules using the CPX_AP_I web server.																																																												
	Found devices: 5 <table><tr><th>URL</th><th>Device ID</th><th>Device Type</th><th>Action</th></tr><tr><td>engt.tcp://192.168.0.121:7508/32771</td><td>3S7PMZVC2H3</td><td>CPX-AP_IO</td><td>3 Board ☐</td></tr><tr><td>engt.tcp://192.168.0.121:7508</td><td>3S7PNCB048G</td><td>CPX-AP</td><td>1 Board ☐</td></tr><tr><td>engt.tcp://192.168.0.121:7508/32772</td><td>3S7PNCY87LN</td><td>CPX-AP_IO</td><td>4 Board ☐</td></tr><tr><td>engt.tcp://192.168.0.121:7508/32770</td><td>3S7PNQQDVRK</td><td>CPX-AP_DEVICE_IOLINK_MASTER</td><td>2 Board ☐</td></tr><tr><td>engt.tcp://192.168.0.121:7508/32773</td><td>3S7PNSW35F6</td><td>CPX-AP_IO</td><td>5 Board ☐</td></tr></table>  Modules <table><tr><th>Slot</th><th>Module</th><th>Code</th><th>FWVersion</th><th>Serial</th><th>Productkey</th></tr><tr><td>1</td><td>CPX-AP-I-EP-M12</td><td>8323</td><td>1.3.1</td><td>0x00044AF</td><td></td></tr><tr><td>2</td><td>CPX-AP-I-4IOL-M12</td><td>8206</td><td>1.4.13</td><td>0x0006524</td><td>3S7PNQQDVRK</td></tr><tr><td>3</td><td>CPX-AP-I-8DI-M12-5P</td><td>8200</td><td>1.43.10</td><td>0x0001147</td><td>3S7PMZVC2H3</td></tr><tr><td>4</td><td>CPX-AP-I-4DI4DO-M12-5P</td><td>8197</td><td>1.43.10</td><td>0x000477A</td><td>3S7PNCY87LN</td></tr><tr><td>5</td><td>CPX-AP-I-4AI-U-I-RTD-M12</td><td>8202</td><td>1.0.131</td><td>0x000767F</td><td>3S7PNSW35F6</td></tr></table> engt.tcp://192.168.0.121:7508 3S7PNCB048G CPX-AP 1 engt.tcp://192.168.0.121:7508/32770 3S7PNQQDVRK CPX-AP_DEVICE_IOLINK_MASTER 2 engt.tcp://192.168.0.121:7508/32771 3S7PMZVC2H3 CPX-AP_IO 3 engt.tcp://192.168.0.121:7508/32772 3S7PNCY87LN CPX-AP_IO 4 engt.tcp://192.168.0.121:7508/32773 3S7PNSW35F6 CPX-AP_IO 5	URL	Device ID	Device Type	Action	engt.tcp://192.168.0.121:7508/32771	3S7PMZVC2H3	CPX-AP_IO	3 Board ☐	engt.tcp://192.168.0.121:7508	3S7PNCB048G	CPX-AP	1 Board ☐	engt.tcp://192.168.0.121:7508/32772	3S7PNCY87LN	CPX-AP_IO	4 Board ☐	engt.tcp://192.168.0.121:7508/32770	3S7PNQQDVRK	CPX-AP_DEVICE_IOLINK_MASTER	2 Board ☐	engt.tcp://192.168.0.121:7508/32773	3S7PNSW35F6	CPX-AP_IO	5 Board ☐	Slot	Module	Code	FWVersion	Serial	Productkey	1	CPX-AP-I-EP-M12	8323	1.3.1	0x00044AF		2	CPX-AP-I-4IOL-M12	8206	1.4.13	0x0006524	3S7PNQQDVRK	3	CPX-AP-I-8DI-M12-5P	8200	1.43.10	0x0001147	3S7PMZVC2H3	4	CPX-AP-I-4DI4DO-M12-5P	8197	1.43.10	0x000477A	3S7PNCY87LN	5	CPX-AP-I-4AI-U-I-RTD-M12	8202	1.0.131	0x000767F	3S7PNSW35F6
URL	Device ID	Device Type	Action																																																										
engt.tcp://192.168.0.121:7508/32771	3S7PMZVC2H3	CPX-AP_IO	3 Board ☐																																																										
engt.tcp://192.168.0.121:7508	3S7PNCB048G	CPX-AP	1 Board ☐																																																										
engt.tcp://192.168.0.121:7508/32772	3S7PNCY87LN	CPX-AP_IO	4 Board ☐																																																										
engt.tcp://192.168.0.121:7508/32770	3S7PNQQDVRK	CPX-AP_DEVICE_IOLINK_MASTER	2 Board ☐																																																										
engt.tcp://192.168.0.121:7508/32773	3S7PNSW35F6	CPX-AP_IO	5 Board ☐																																																										
Slot	Module	Code	FWVersion	Serial	Productkey																																																								
1	CPX-AP-I-EP-M12	8323	1.3.1	0x00044AF																																																									
2	CPX-AP-I-4IOL-M12	8206	1.4.13	0x0006524	3S7PNQQDVRK																																																								
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5	CPX-AP-I-4AI-U-I-RTD-M12	8202	1.0.131	0x000767F	3S7PNSW35F6																																																								
6	After boarding the devices, let's subscribe to the modules. To do this, the Product Key must be used to subscribe to the module.																																																												
7	Device 1 CPX-AP-I-PN-M12 Festo/3S7PNC4J24K/# connected  Edit mqtt-broker node Delete Cancel Update Properties Name EINGP Connection Security Messages Server 127.0.0.1 Port 1883 Enable secure (SSL/TLS) connection Client ID Leave blank for auto generated Keep alive time (s) 60 Use clean session Use legacy MQTT 3.1 support																																																												
8	The same procedure should be done for each module. As a hint: It is not necessary to board all the CPX-AP-I. Only the ones that we want to receive data.																																																												
9	Device 1 CPX-AP-I-PN-M12 Festo/3S7PNC4J24K/# connected msg.payload Device 2 CPX-AP-I-4IOL Festo/3S7PNQQDVRK/# connected msg.payload Device 3 CPX-AP-I-8DI-M12 Festo/3S7PMZVC2H3/# connected msg.payload Device 4 CPX-AP-I-4DI4DO-M12 Festo/3S7PNCY87LN/# connected msg.payload Device 5 CPX-AP-I-4AI Festo/3S7PNSW35F6/# connected msg.payload																																																												

10	Each module send three payloads: Process, diagnosis and asset.
	<pre> Festo/3S7PMZVC2H3/process : msg.payload : Object ▼ object ▼ fields: object INPUTSTATE: 0 OUTPUTSTATE: null comId: "3S7PMZVC2H3" deviceId: "3S7PMZVC2H3" messageType: "process" timestamp: "2021-10-14T13:03:52.549Z" Festo/3S7PMZVC2H3/asset : msg.payload : Object ▼ object ▼ fields: object PRODUCTKEY: "3S7PMZVC2H3" FIRMWAREVERSIONSTRING: "v1.43.10" comId: "3S7PMZVC2H3" deviceId: "3S7PMZVC2H3" messageType: "asset" timestamp: "2021-10-14T13:03:52.563Z" Festo/3S7PMZVC2H3/diagnosis : msg.payload : Object ▼ object ▼ fields: object DIAGNOSISCURRENT: object UPTIME: 0 ULOADVALUE: 0 UELSENVALUE: 24420 TEMPERATUREVALUEASIC: 161 comId: "3S7PMZVC2H3" deviceId: "3S7PMZVC2H3" messageType: "diagnosis" timestamp: "2021-10-14T13:03:52.570Z" </pre>
11	Flow example
	<pre> [{"id":"445cccb.f8b9534","type":"comment","z":"7a3e81eb.53df58","name":"Device 1 CPX-AP-I-EP-M12","info":"","x":180,"y":40,"wires":[]},{id:"a3e396d4.c3a0a","type":"comment","z":"7a3e81eb.53df58","name":"Device 2 CPX-AP-I-4IOL","info":"","x":170,"y":160,"wires":[]},{id:"5687b5fd.833c9c","type":"comment","z":"7a3e81eb.53df58","name":"Device 3 CPX-AP-I-8DI-M12","info":"","x":160,"y":280,"wires":[]},{id:"687269a8.2b2e4","type":"comment","z":"7a3e81eb.53df58","name":"Device 4 CPX-AP-I-4DI4DO-M12","info":"","x":770,"y":40,"wires":[]},{id:"e778f8e5.bde88","type":"comment","z":"7a3e81eb.53df58","name":"Device 5 CPX-AP-I-4AI","info":"","x":740,"y":140,"wires":[]},{id:"bd76b67.0b5d8c8","type":"mqtt in","z":"7a3e81eb.53df58","name":"","topic":"Festo/3S7PNCB048G/#","qos":"2","datatype":"json","broker":"14b2d5c8.45878a","x":120,"y":80,"wires":[["6aa6ed9f.6e4924"]]},{"id":"6aa6ed9f.6e4924","type":"debug","z":"7a3e81eb.53df58","name":"","active":true,"toolbar":true,"console":false,"tostatus":false,"complete":false,"statusVal":"","statusType":"auto","x":390,"y":80,"wires":[]},{id:"a90de56.a6d9918","type":"mqtt in","z":"7a3e81eb.53df58","name":"","topic":"Festo/3S7PNQDVRK/#","qos":"2","datatype":"json","broker":"14b2d5c8.45878a","x":130,"y":200,"wires":[["f1364836.e0a608"]]},{"id":"f1364836.e0a608","type":"debug","z":"7a3e81eb.53df58","name":"","active":true,"toolbar":true,"console":false,"tostatus":false,"complete":false,"statusVal":"","statusType":"auto","x":390,"y":200,"wires":[]},{id:"d3ed1b.44a242e8","type":"mqtt in","z":"7a3e81eb.53df58","name":"","topic":"Festo/3S7PMZVC2H3/#","qos":"2","datatype":"json","broker":"14b2d5c8.45878a","x":120,"y":340,"wires":[["f9247fdb.98864"]]},{"id":"f9247fdb.98864","type":"debug","z":"7a3e81eb.53df58","name":"","active":true,"toolbar":true,"console":false,"tostatus":false,"complete":false,"statusVal":"","statusType":"auto","x":390,"y":340,"wires":[]},{id:"6c288eec.4a293","type":"mqtt in","z":"7a3e81eb.53df58","name":"","topic":"Festo/3S7PNCY87LN/#","qos":"2","datatype":"json","broker":"14b2d5c8.45878a","x":700,"y":80,"wires":[["646c0a6a.88cd2c"]]},{"id":"646c0a6a.88cd2c","type":"debug","z":"7a3e81eb.53df58","name":"","active":true,"toolbar":true,"console":false,"tostatus":false,"complete":false,"statusVal":"","statusType":"auto","x":1010,"y":80,"wires":[]},{id:"81e06257.410d4","type":"mqtt in","z":"7a3e81eb.53df58","name":"","topic":"Festo/3S7PNSW35F6/#","qos":"2","datatype":"json","broker":"14b2d5c8.45878a","x":700,"y":200,"wires":[["e9030e5a.e72db8"]]},{"id":"e9030e5a.e72db8","type":"debug","z":"7a3e81eb.53df58","name":"","active":true,"toolbar":true,"console":false,"tostatus":false,"complete":false,"statusVal":"","statusType":"auto","x":1010,"y":200,"wires":[]},{id:"14b2d5c8.45878a","type":"mqtt-broker","name":"CPX-AP-I","broker":"127.0.0.1","port":"1883","clientId":"","usetls":false,"compatmode":false,"keepalive":"60","cleansession":true,"birthTopic":"","birthQos":"0","birthPayload":"","closeTopic":"","closeQos":"0","closePayload":"","willTopic":"","willQos":"0","willPayload":""}] </pre>

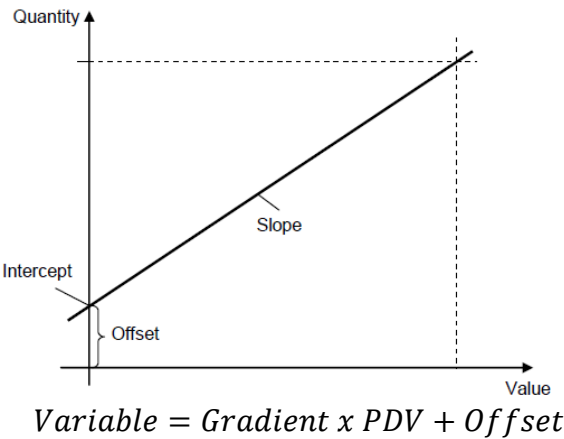
12	Each module of CPX-AP-I system send three message payload: Process, diagnosis and asset. Let's use CPX-AP-I-8DI-M12 to show an example.
	Device 3 CPX-AP-I-8DI-M12 Festo/3S7PMZVC2H3/# connected msg.payload Festo/3S7PMZVC2H3/process : msg.payload : Object object fields: object INPUTSTATE: 1 OUTPUTSTATE: null comId: "3S7PMZVC2H3" deviceId: "3S7PMZVC2H3" messageType: "process" timestamp: "2021-10-06T09:41:10.759Z" Festo/3S7PMZVC2H3/diagnosis : msg.payload : Object object fields: object comId: "3S7PMZVC2H3" deviceId: "3S7PMZVC2H3" messageType: "diagnosis" timestamp: "2021-10-06T09:41:10.794Z" Festo/3S7PMZVC2H3/asset : msg.payload : Object object fields: object PRODUCTKEY: "3S7PMZVC2H3" FIRMWAREVERSIONSTRING: "v1.43.10" comId: "3S7PMZVC2H3" deviceId: "3S7PMZVC2H3" messageType: "asset" timestamp: "2021-10-06T09:48:10.765Z"
13	Read the first input of the module CPX-AP-I-8DI-M12.
	Device 3 CPX-AP-I-8DI-M12 Festo/3S7PMZVC2H3/process connected Read Inputs msg.payload Edit change node Delete Cancel Done Properties Name Read Inputs Rules Set msg.payload to msg.payload.fields.INPUTSTATE Festo/3S7PMZVC2H3/process : msg.payload : number 1

3.2.1 CPX-AP-I-4IOL-M12.

This chapters show how to read data from a Io-Link device connected to a CPX-AP-I-4IOL-M12 module. The example is carried out with a SPAW flow sensor.

Please check the IO-Link Interface and system Specification: [IO-Link Interface and System Specification](#)

Value to quantity conversion via linear equation is taking from IO-Link Interface and System Specification.



1	As an example this is the input process data for IO-Link device																																			
	<table><tr><th colspan="3">process data input</th><th colspan="2">record i</th></tr><tr><td>PDV (InA)</td><td>1</td><td>24</td><td>UIntegerT_14</td><td>0 to 16383</td></tr><tr><td>PDV (InB)</td><td>2</td><td>8</td><td>UIntegerT_14</td><td>0 to 16383</td></tr><tr><td>BDC4 (OutD)</td><td>3</td><td>3</td><td>BooleanT</td><td></td></tr><tr><td>BDC3 (OutC)</td><td>4</td><td>2</td><td>BooleanT</td><td></td></tr><tr><td>BDC2 (OutB)</td><td>5</td><td>1</td><td>BooleanT</td><td></td></tr><tr><td>BDC1 (OutA)</td><td>6</td><td>0</td><td>BooleanT</td><td></td></tr></table>	process data input			record i		PDV (InA)	1	24	UIntegerT_14	0 to 16383	PDV (InB)	2	8	UIntegerT_14	0 to 16383	BDC4 (OutD)	3	3	BooleanT		BDC3 (OutC)	4	2	BooleanT		BDC2 (OutB)	5	1	BooleanT		BDC1 (OutA)	6	0	BooleanT	
process data input			record i																																	
PDV (InA)	1	24	UIntegerT_14	0 to 16383																																
PDV (InB)	2	8	UIntegerT_14	0 to 16383																																
BDC4 (OutD)	3	3	BooleanT																																	
BDC3 (OutC)	4	2	BooleanT																																	
BDC2 (OutB)	5	1	BooleanT																																	
BDC1 (OutA)	6	0	BooleanT																																	
2	Where InA is the flow, InB is the temperature. The IODD xml-File (can be obtained here: IODDfinder (io-link.com))																																			
	<pre><ProcessDataRefCollection> <ProcessDataRef processDataId="PI_ProcessDataIn"> <ProcessDataRecordItemInfo subindex="1" gradient="0.001953244217" off- set="0.000000000000" unitCode="1352" displayFormat="Dec.1" /> <ProcessDataRecordItemInfo subindex="2" gradient="0.006103888177" off- set="0.000000000000" unitCode="1001" displayFormat="Dec.1" /> <ProcessDataRecordItemInfo subindex="3" /> <ProcessDataRecordItemInfo subindex="4" /> <ProcessDataRecordItemInfo subindex="5" /> <ProcessDataRecordItemInfo subindex="6" /> </ProcessDataRef> </ProcessDataRefCollection></pre>																																			

3

Data from the flow sensor on NodeRED.

```
10/13/2021, 10:34:34 AM node: 8b516493.a6f618
Festo/3S7PNQDVRK/process : msg.payload : Object

▼ object
  ▼ fields: object
    ▼ INPUTSTATE: array[36]
      ▼ [0 ... 9]
        0: 0
        1: 0
        2: 16
        3: 245
        4: 0
        5: 0
        6: 0
        7: 0
        8: 0
        9: 0
      ▶ [10 ... 19]
      ▶ [20 ... 29]
      ▶ [30 ... 35]
    ▼ OUTPUTSTATE: array[36]
      ▼ [0 ... 9]
```

4

Conversion to HEX

- 16 = 0x10
- 245 = 0xF5

The raw value is: 0x10F5 = 4341

5

$Variable = Gradient \times PDV + Offset$

$Variable = 0.006103888177 \times 4341 + 0 = 26.4970 \text{ [}^{\circ}\text{C]}$

Name	Value	Unit
[-] Process data input		
PDV (InA)	0.0	L/min
PDV (InB)	26.4	°C
BDC4 (OutD)	0 (Off)	☐
BDC3 (OutC)	0 (Off)	☐
BDC2 (OutB)	0 (Off)	☐
BDC1 (OutA)	0 (Off)	☐

4 Appendix

In this appendix section you will find the payload message of the devices.

4.1 CMMT-AS and CMMT-ST MQTT payloads.

Process message	Parameter number	Description
outputX0	1.128.0	Actual Position
PSACTTEMP	0.920.0	Temperature Powerstage
AIRACTTEMP	0.930.0	Temperature Air in Case
MOTORACTTEMP	1.940.0	Temperature Motor
DCVOLTAGE	0.480.0	DCLinkManagement "Actual value of the DC link voltage"
TORQUEMOTOR	1.150.0	Actual value of the torque (current * torque constant)
TORQUEDRIVE	1.151.0	Actual value of the torque (current*torque constant*gear ratio)
OUTPUTPOSITIONREF	1.90.0	Setpoint Position
OUTPUTVELOCITYREF	1.91.0	Setpoint Velocity
OUTPUTV0	1.1210.0	Actual Velocity
IQREF	1.86.0	Setpoint Current (Active Current)
IQ	1.814.0	Actual Current (Active Current)
INPUTVALUE	1.9912.0	AnalogIn
ID	1.813.0	Actual value of the reactive current
MOTOREACTREL	1.6331.0	Actual value of the relative I2T monitoring of the motor to the limit
ILIM	1.6334.0	Actual value of the I2T monitoring of the total current
STATE	1.460.0	Status of movement monitoring

The motor controller send 3 groups of message: asset message, process message and diagnosis message. The table below show the data received.

Process message	Parameter number	Description
OUTPUTX0	1.128.0	Actual Position
PSACTTEMP	0.920.0	Temperature Powerstage
AIRACTTEMP	0.930.0	Temperature Air in Case
MOTORACTTEMP	1.940.0	Temperature Motor
DCVOLTAGE	0.480.0	DCLinkManagement "Actual value of the DC link voltage"
TORQUEMOTOR	1.150.0	Actual value of the torque (current * torque constant)
TORQUEDRIVE	1.151.0	Actual value of the torque (current*torque constant*gear ratio)
OUTPUTPOSITIONREF	1.90.0	Setpoint Position
OUTPUTVELOCITYREF	1.91.0	Setpoint Velocity
OUTPUTV0	1.1210.0	Actual Velocity
IQREF	1.86.0	Setpoint Current (Active Current)
IQ	1.814.0	Actual Current (Active Current)

INPUTVALUE	1.9912.0	Analog Input
ID	1.813.0	Actual value of the reactive current
MOTOREACTREL	1.6331.0	Actual value of the relative I2T monitoring of the motor to the limit
ILIM	1.6334.0	Actual value of the I2T monitoring of the total current
STATE	1.460.0	Status of movement monitoring

Asset message	Parameter number	Description
DEVICENAME	0.902.0.0	name
PARTNUMBER	0.70.0	part number
NOCCODE	0.71.0	order code
PRODUCTKEY	0.791.0	Festo product key
IPADDRESS	0.12004.0	IP Address
IPADDRESSFB	0.12004.1	ipAddressFieldbusInterface (IP address for engp via tcp/ip over the fieldbus interface (currently either Ethernet coexistence in case of Profinet or EoE in case of EtherCAT, depending on the device type)
firmware	0.960.0	CMMT Firmware version in string representation
activeUserUnit	1.1150.0	Currently active user unit

4.2 CPX-AP-I-EP-M12 payloads.

Process message	Description
Inputstate	status of the inputs
Outputstate	status of the outputs
ComID	comID
DeviceID	DeviceId
MessageType	"process"
Timestamp	timestamp

Diagnosis message
Diagnosiscurrent
Uptime
Uloadvalue
Uelsenvalue
TempreatureValueAsic
ComID
MessageType
Timestamp

Asset message
Productkey
FirmwareVersionString
ComID
DeviceID
MessageType
Timestamp

4.2.1 CPX-AP-I-4IOL-M12 payloads.

Process message	Description
Inputstate	status of the inputs
Outputstate	status of the outputs
ComID	comID
DeviceID	DeviceId
MessageType	"process"
Timestamp	timestamp

Diagnosis message
Diagnosiscurrent
Uptime
Uloadvalue
Uelsenvalue
TempreatureValueAsic
IoLinkVariant
SensorSupplyCurrentDrain
SensorSupplyEnable
ComID
MessageType
Timestamp

Asset message
Productkey
FirmwareVersionString
ComID
DeviceID
MessageType
Timestamp

4.2.2 CPX-AP-I-8DI-M12 payloads.

Process message	Description
Inputstate	status of the inputs
Outputstate	<i>Null</i>
ComID	comID
DeviceID	DeviceId
MessageType	"process"
Timestamp	timestamp

Diagnosis message
Diagnosiscurrent
Uptime
Uloadvalue
Uelsenvalue
TemperatureValueAsic
IoLinkVariant
ComID
MessageType
Timestamp

Asset message
Productkey
FirmwareVersionString
ComID
DeviceID
MessageType
Timestamp

4.2.3 CPX-AP-I-4DI4DO-M12-5P payloads.

Process message	Description
Inputstate	status of the inputs
Outputstate	status of the outputs
ComID	comID
DeviceID	DeviceId
MessageType	"process"
Timestamp	timestamp

Diagnosis message
Diagnosiscurrent
Uptime
Uloadvalue
Uelsenvalue
TemperatureValueAsic
ComID
MessageType
Timestamp

Asset message
Productkey
FirmwareVersionString
ComID
DeviceID
MessageType
Timestamp

4.2.4 CPX-AP-I-4AI-U-I-RTD-M12 payloads.

Process message	Description
Inputstate	status of the inputs
Outputstate	<i>Null</i>
ComID	comID
DeviceID	DeviceId
MessageType	"process"
Timestamp	timestamp

Diagnosis message
Diagnosiscurrent
Uptime
Uloadvalue
Uelsenvalue
TempreatureValueAsic
IoLinkVariant
ComID
MessageType
Timestamp

Asset message
Productkey
FirmwareVersionString
ComID
DeviceID
MessageType
Timestamp

4.3 MS6-E2M payloads

Process message	Description
ShutoffValveClosed	State of the shut off valve
AutooffPrepared	Auto off function prepared
AutooffActivated	Auto off function active
FlowRawValue	Flow raw value
FlowAvgValue:	Average flow for the last aggregation period
FlowMinValue: 117	Minimum flow for the last aggregation period
FlowMaxValue: 119	Maximum flow for the last aggregation period
PressureRawValue: 4600	Pressure raw value
PressureAvgValue: 4563.200195	Average pressure for the last aggregation period
PressureMinValue: 4520	Minimum pressure for the last aggregation period
PressureMaxValue: 4600	Maximum pressure for the last aggregation period
ConsumptionRawValue: 65535	Consumption counter (absolute)
ConsumptionAvgValue: 0	Consumption for the last aggregation period (relative)
AirSavingLastPeriod	Fictional saving due to the shutdown function (in the last aggregation period)
Operation_Time	Overall operation time
Switching_Cy- cles_Shutoffvalve	Number of switching cycles (if available)
CycleProcessCounter	Internal counter for aggregation

Diagnosis message	Description
ErrorChannel	Channel
iErrorNumber	Error code number
sChanneltext	Error code description

Asset message	Description
ProductKey	Festo ProductKey
CMLibVersion	Software version preaggregation
ProcessTimePeriod	Aggregation period
PressureUnit	Pressure Unit
FlowUnit	Flow Unit
ConsumptionUnit	Consumption Unit
Flow_Standard	Flow Standard
Serial_No	Serialnumber

4.4 MS6-C2M payloads.

Process message	Description
ShutoffValveClosed	State of the shut off valve
AutooffPrepared	Auto off function prepared
AutooffActivated	Auto off function active
FlowRawValue	Flow raw value
FlowAvgValue:	Average flow for the last aggregation period
FlowMinValue: 117	Minimum flow for the last aggregation period
FlowMaxValue: 119	Maximum flow for the last aggregation period
PressureRawValue: 4600	Pressure raw value
PressureAvgValue: 4563.200195	Average pressure for the last aggregation period
PressureMinValue: 4520	Minimum pressure for the last aggregation period
PressureMaxValue: 4600	Maximum pressure for the last aggregation period
ConsumptionRawValue: 65535	Consumption counter (absolute)
ConsumptionAvgValue: 0	Consumption for the last aggregation period (relative)
ConsumptionExtRawValue: 65535	Consumption counter extended (absolute)
ConsumptionExtAvgValue: 0	Consumption extended for the last aggregation period (relative)
AirSavingLastPeriod	Fictional saving due to the shutdown function (in the last aggregation period)
Operation_Time	Overall operation time
Switching_Cycles_Shutoffvalve	Number of switching cycles (if available)
CycleProcessCounter	Internal counter for aggregation

Diagnosis message	Description
ErrorChannel	channel
iErrorNumber	error code number
sChanneltext	error code description

Asset message	Description
ProductKey	Festo ProductKey
CMLibVersion	Software Version preaggregation
ProcessTimePeriod	Aggregation period
PressureUnit	Pressure Unit
FlowUnit	Flow Unit
ConsumptionUnit	Consumption Unit
ConsumptionExtUnit	Consumption Extended Unit
Flow_Standard	Flow Standard
Serial_No	Serialnumber

Error Code No	Available Error Codes - Error Description
10	Upper limit exceeded
15	Module/ Channel failed
25	Fault in parametrizing upper limit
26	Fault in actuator supply
29	Fault in parametrizing

4.5 VTUG via CPX-AP payloads.

Process message	Description
Inputstate	status of the inputs
Outputstate	status of the outputs
ComID	comID
DeviceID	DeviceId
MessageType	"process"
Timestamp	timestamp

Diagnosis message
Diagnosiscurrent
Uptime
Uloadvalue
Uelsenvalue
TempreatureValueAsic
ComID
MessageType
Timestamp

Asset message
Productkey
FirmwareVersionString
ComID
DeviceID
MessageType
Timestamp