USER GUIDE

MAN0141 rev 26

CBXi IP Controller

Style conventions used in this document:

UI Text: Text that represents elements of the UI such as button names, menu options etc. is presented with a grey background and border, in Tahoma font which is traditionally used in Windows UIs. For example:

Ok

Standard Terms (Jargon): Text that is not English Language but instead refers to industry standard concepts such as Strategy, BACnet, or Analog Input is represents in slightly condensed font. For example:

BACnet

Code: Text that represents File paths, Code snippets or text file configuration settings is presented in fixed-width font, with a grey background and border. For example:

```
$config_file = c:\CYLON\settings\config.txt
```

Parameter values: Text that represents values to be entered into UI fields or displayed in dialogs is represented in fixed-width font with a shaded background. For example

10°C

Product Names: Text that represents a product name is represented in bold colored text. For example

INTEGRA™

Company Brand names: Brands that are not product names are represented by bold slightly compressed text:

ABB Active Energy

PC Keyboard keys: Text representing an instruction to press a particular key on the keyboard is enclosed in square brackets and in bold font. For example:

[Ctrl]+[1]

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1 The CBXi Series

INTRODUCTION

The CBXi-8R8 and CBXi-8R8-H are fully programmable IP-based BTL-listed BACnet® Building Controllers (B-BC) that supports simultaneous multi-protocol communications including BACnet/IP, BACnet MS/TP, Modbus TCP, and Modbus RTU.

Part of Cylon's CB Line of BACnet field controllers, the CBXi Series of controllers are built on an extendible platform that features 8 UniPuts™ with Relay and 8 Universal Inputs, and feature support for up to five FLX (Field Level e*X*pansion) Series extension modules providing a scalable solution from 16 up to 96 points of control. FLX expansion modules are available in a variety of options to allow maximum flexibility in achieving the required point configuration. The CBXi-8R8-H provides local Hand-Off-Auto override functionality.

The fully programmable CBXi-8R8(-H) can be tailored to meet a variety of applications by creating and modifying strategies using Cylon's CXpro^{HD} programming interface.

CYBERSECURITY DISCLAIMER:

This product is designed to be connected to and to communicate information and data via a network interface. It is your sole responsibility to provide and continuously ensure a secure connection between the product and your network or any other network (as the case may be). You shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, secure VPNs, application of authentication measures, encryption of data, installation of anti-virus programs, etc.) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB Ltd and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

APPLICATION

The CBXi-8R8(-H) is designed for a wide range of energy management applications for intelligent control of:

- HVAC equipment such as Central Plant, Boilers, Chillers, Cooling Towers, Pump Systems, Air Handling Units (Constant Volume, Variable Air Volume, and Multi-zone), and Rooftop Units,
- Electrical systems such as lighting control, variable frequency drives and metering.

The CBXi-8R8(-H) can be used as an integration platform and natively supports the routing of either BACnet MS/TP to BACnet/IP or Modbus RTU to Modbus TCP without the need for gateways or additional hardware.

2 IP Networking

WHAT IS IP?

IP (Internet Protocol) is an agreed standard that defines how devices communicate over the Internet or other Internet-like Ethernet network.

IP is part of a 7-layer architecture consisting of

- Physical Layer (Layer 1)
- DataLink Layer (Layer 2)
- Network Layer (Layer 3)
- Transport Layer (Layer 4)
- Session Layer (Layer 5)
- Presentation Layer (Layer 6)
- Applications Layer (Layer 7)

PHYSICAL LAYER (LAYER 1)

This refers to the electrical impulses (or light signal or radio signals) carried on the cable (or fiber, air or other physical medium). For IP, the physical layer is usually Ethernet.

DATALINK LAYER (LAYER 2)

This is where data packets are translated to and from bits, which can be transferred on the Physical Layer

NETWORK LAYER (LAYER 3)

Layer 3 provides switching and routing to create paths for data to be transmitted from node to node within the network. This is the layer that gives IP its name.

TRANSPORT LAYER (LAYER 4)

This layer is responsible for end-to-end error recovery and flow control, enabling transparent transfer of data between hosts.

SESSION LAYER (LAYER 5)

The Session layer manages exchanges (conversations) between the “applications” on each host.

PRESENTATION LAYER (LAYER 6)

This layer translates between application and network formats, so that communication independent of data representation such as ASCII, GIF, JPEG etc.

APPLICATIONS LAYER (LAYER 7)

Everything at layer 7 is application-specific, such as Telnet, FTP, WWW browsers, HTTP etc.

IP ADDRESSING

Each device has at least one IP address, which uniquely identifies it from all other devices on the network.

There are several forms of IP addresses, but the most commonly used is IPv4, which consists of 4 numbers (between `0` and `255`) separated by dots e.g. `192.168.222.51`

DHCP (DYNAMIC HOST CONFIGURATION PROTOCOL)

The address can be set manually on the device itself, or else the device can be assigned one by a master controller on the network. This master controller is known as the Dynamic Host Configuration Protocol (DHCP) server.

To use an IP address, a device must know several pieces of data, including the IPv4 address that the device will use, the IP address of the Domain Name Server (DNS) where the device can find IP addresses of other devices, and the IP address of the Default Gateway device through which communications are routed.

Using DHCP means that all these pieces of information are set automatically avoiding the need for specialist knowledge of IP networking. If DHCP is available on your network is the most convenient way to configure your devices.

DHCP reservation

A DHCP server can be configured to always assign a particular IP address to a specific device. This is called a DHCP reservation and enables a user to access a device by IP address even if the device power-cycles and makes a new DHCP request.

SUBNETWORK (SUBNET)

A subnet is a logical division of a network – that is while it might be physically connected to other subnets, communications traffic from one subnet can be kept separate from comms origination on other subnets.

A group of the most significant bits of the IPv4 address (the numbers at the start of the address) specifies the address of a network or subnetwork. This is called the Network Prefix. The remainder specifies the host – the address unique to the specific device.

For example:

- on the 192.168 subnet, an IP address of 192.168.2.54 refers to device 2.54.
- On the 55.231.77 subnet, IP address 55.231.77.3 refers to device 3

The specific parts of the address that are in each portion is defined by the device's 'Subnet Mask'. This can be expressed as a "bitmask" that is applied by a bitwise AND operation – e.g. 255.255.0.0 means that only the last 2 segments of the address apply to the local subnet.

For example,

- if the address 192.168.2.54 has a subnet mask "255.255.0.0", that means that 192.168 is the subnet address, and 2.54 is the device address.
- if the address 55.231.77.3 has a subnet mask "255.255.255.0", that means that 55.231.77 is the subnet address, and 3 is the device address.

The network can also be identified by a decimal number following the first IP address on the network – e.g. `55.231.77.0/24`. This is called Classless Inter-Domain Routing (CIDR) notation. The decimal number represents the number of bits allocated for the Network Prefix.

Each segment of an IP address represents 8 bits,

i.e. `192.168.2.54` could also be written `11000000` . `10101000` . `00000010` . `00110110`

In CIDR notation, /16 means that 16 of these bits represents the subnet, and the remainder specifies the host:

CIDR	192.168.2.54/16						
IP Address decimal	192	.	168	.	2	.	54
IP Address Binary	1 1 0 0 0 0 0 0	.	1 0 1 0 1 0 0 0	.	0 0 0 0 0 0 1 0	.	0 0 1 1 0 1 1 0
	16 bits representing the subnet				host		
Equivalent subnet mask	255	.	255	.	0	.	0

CIDR	55.231.77.3/24						
IP Address decimal	55	.	231	.	77	.	3
IP Address Binary	0 0 1 1 0 1 1 1	.	1 1 1 0 0 1 1 1	.	0 1 0 0 1 1 0 1	.	0 0 0 0 0 0 1 1
	24 bits representing the subnet						host
Equivalent subnet mask	255	.	255	.	255	.	0

DEFAULT GATEWAY

Devices on the same subnet can address IP packets to each other without using a router device.

To communicate with devices on another subnetwork, the traffic must be routed through a router device's WAN port. When a device needs to communicate with an IP address that is not on the same network, it sends the packet to the Default Gateway, which is usually the subnet's Router.

Note: When connecting between networks ensure appropriate security measures, such as VPN or firewall, are in place.

Note: Some BACnet services use "broadcasts" (e.g. "`Who-Is`"). On a LAN with standard routers, these broadcasts are "blocked". As a result, BACnet broadcasts are limited to the IP Subnet of the BACnet device. With a BACnet/IP network of 2 or more IP subnets, a device that can act as a BACnet/IP Broadcast Management Device (BBMD) must be used.

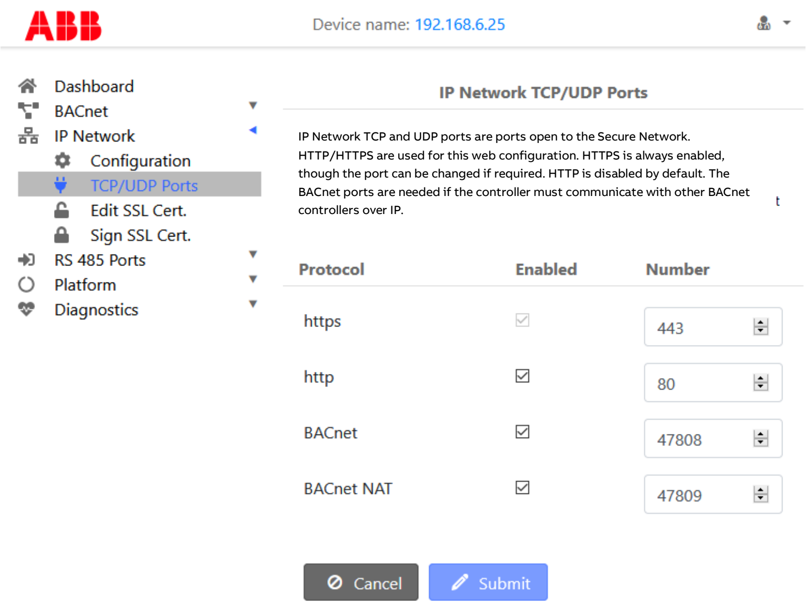
PORT NUMBERS

A “Port” on an IP device is a concept that allows traffic to be mapped within a device’s address to a specific process running in that device. A Port number forms part of a data packet’s IP address, but is often set by convention, depending on the protocol that the packet uses. For example, HTTP traffic by convention uses port `80`. If no port is specified in the IP address for HTTP traffic, port 80 will be assumed. If a port is specified (e.g. port `8080` as in the address `192.168.100.33:8080`), the specified port will be used instead. This allows the device to communicate on multiple protocols at the same time.

Some of the services associated with port numbers include:

Service	Protocol	Default Port Number
SMTP	TCP	25
DNS	TCP, UDP	53
DHCP	UDP	67
HTTP	TCP	80
HTTPS	TCP	443
BACnet/IP	UDP	47808

Some of the port numbers recognized by CBXi are shown below. These can be changed in the controllers Web UI at Communications > Serial Ports > IP Ports



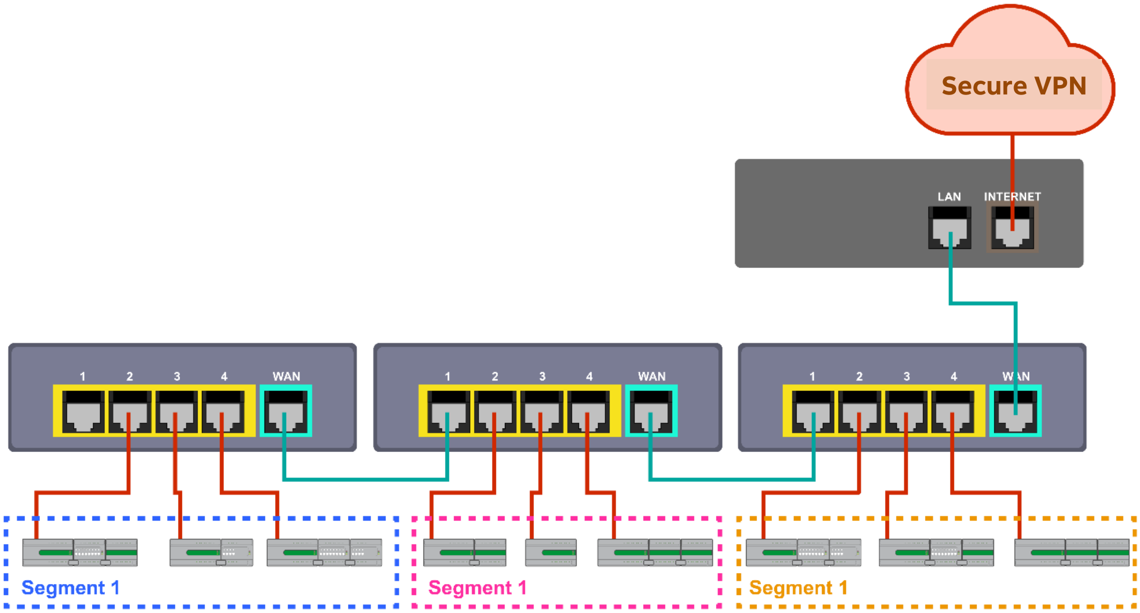
IP Network TCP/UDP Ports

IP Network TCP and UDP ports are ports open to the Secure Network. HTTP/HTTPS are used for this web configuration. HTTPS is always enabled, though the port can be changed if required. HTTP is disabled by default. The BACnet ports are needed if the controller must communicate with other BACnet controllers over IP.

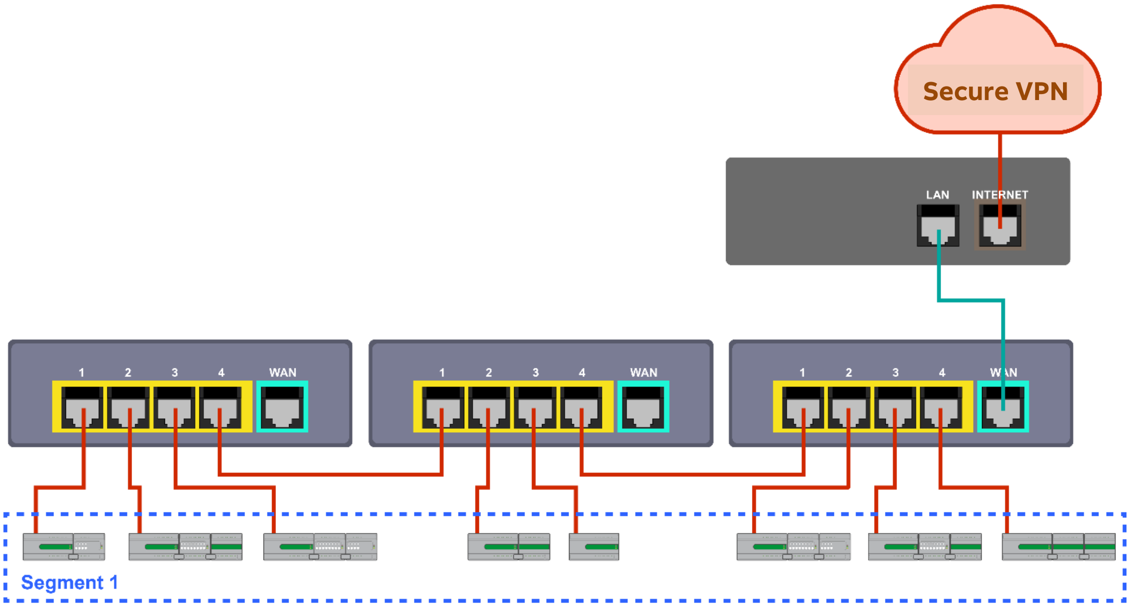
Protocol	Enabled	Number
https	☑	443
http	☑	80
BACnet	☑	47808
BACnet NAT	☑	47809

UPLINK/WAN AND SEGMENTATION

Physically splitting a network into different function groups is known as “Network segmentation”. This is done to improve performance (by reducing the amount of traffic on each segment) and to improve security. It is achieved by connecting Routers together by their “WAN” or “UPLINK” ports.



If routers are connected without using their “WAN” or “UPLINK” ports, the result is a single segment:



NETWORK ADDRESS TRANSLATION (NAT)

Network Address Translation is a function of a router or firewall, which maps multiple local IP addresses to a single public IP address. This is necessary because the number of IPv4 addresses is finite.

DOMAIN NAME SYSTEM (DNS)

When communicating on the wider Internet*, it can be difficult to remember the numeric IP address for each device with which you want to communicate. The Domain Name System (DNS) was created to allow internet users to use a text-based Uniform Resource Locator (URL) with meaningful values such as “www.ABB.com” to connect to a site or device without having to know the server’s IP address. The DNS finds the URL in its distributed database and passes the corresponding numeric IP address to the requesting device. If a device’s IP address changes, the DNS server can be updated with its new IP address, ensuring that other networked devices can still find this device from its URL.

When setting a devices IP parameter manually, between one and three DNS IP address are usually provided. The second and third addresses are used if the first DNS becomes unavailable.

If you do not know the address of your DNS server(s), you can use publicly available DNS server addresses for example primary = `8.8.8.8` and secondary = `4.4.4.4`

*with appropriate security measures, such as VPN or firewall.

3 BACnet Networking

WHAT IS BACNET?

BACnet is "a data communication protocol for building automation and control networks." This means it is a set of rules for exchanging BMS information between systems from different manufacturers.

The rules take the form of a written specification that spells out what is required to conform to the protocol

The key feature of BACnet is that the rules relate specifically to the needs of building automation and control equipment - for example, how to ask for the value of a temperature, define a fan operating schedule, or send a pump status alarm.

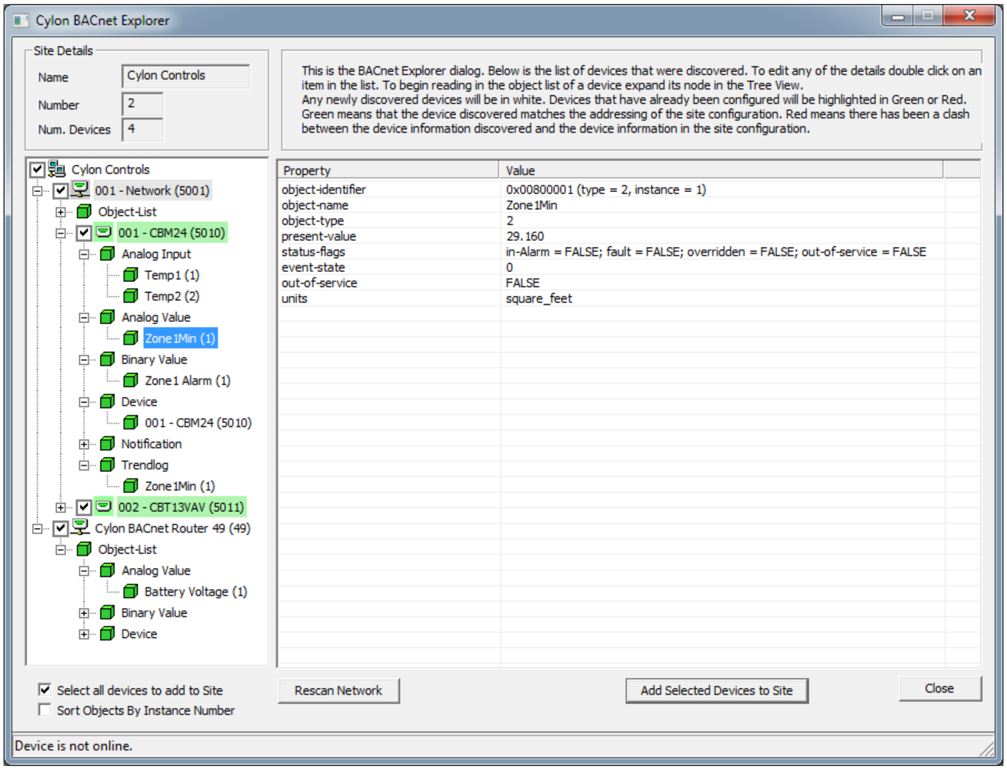
BACnet provides a standard way of representing the functions of any device - for example analog or binary inputs or outputs, schedules, control loops and alarms.

The standardized model of a device represents these common functions as collections of related information called objects

Each object has a set of properties that further describe it. Each analog input, for instance, is represented by a BACnet "Analog Input object", which has a set of standard properties such as 'Present Value', 'Sensor Type', 'Location', 'Alarm Limits' etc. Some of these properties are required, while others are optional.

The only required object in each BACnet controller is the Device object. This object contains the properties that define the controller's behavior on the network. Each controller's Device object has an associated number called the Device Instance. It is this unique number that allows all other BACnet devices to unambiguously access the controller.

Here is an illustration of BACnet objects:



Site Details

Name: Cylon Controls
Number: 2
Num. Devices: 4

This is the BACnet Explorer dialog. Below is the list of devices that were discovered. To edit any of the details double click on an item in the list. To begin reading in the object list of a device expand its node in the Tree View.
Any newly discovered devices will be in white. Devices that have already been configured will be highlighted in Green or Red. Green means that the device discovered matches the addressing of the site configuration. Red means there has been a clash between the device information discovered and the device information in the site configuration.

- ☑ Cylon Controls
  - ☑ 001 - Network (5001)
    - Object-List
    - ☑ 001 - CBM24 (5010)
      - Analog Input
        - Temp1 (1)
        - Temp2 (2)
      - Analog Value
        - Zone1Min (1)
      - Binary Value
        - Zone1 Alarm (1)
      - Device
        - 001 - CBM24 (5010)
      - Notification
      - Trendlog
        - Zone1Min (1)
    - ☑ 002 - CBT13VAV (5011)
  - ☑ Cylon BACnet Router 49 (49)
    - Object-List
      - Analog Value
        - Battery Voltage (1)
      - Binary Value
      - Device

Property	Value
object-identifier	0x00800001 (type = 2, instance = 1)
object-name	Zone1Min
object-type	2
present-value	29.160
status-flags	in-Alarm = FALSE; fault = FALSE; overridden = FALSE; out-of-service = FALSE
event-state	0
out-of-service	FALSE
units	square_feet

☑ Select all devices to add to Site
☐ Sort Objects By Instance Number

Device is not online.

BACNET OBJECT TYPES

The BACnet standard defines a number of standard object types, and this number is increasing over time. Cylon uses the following standard types (* indicates that the object is proprietary):

- Device
- Analog Input
- Analog Value
- Analog Output
- Binary Input
- Binary Value
- Binary Output
- Schedule
- Calendar
- Unitron Schedule *
- Notification Class
- File
- Trend Log
- Manufacturing Object *

BACNET SERVICES

The BACnet standard defines numerous services for interaction between BACnet devices. The following are supported by Cylon BACnet products:

- ReadProperty
- WriteProperty
- ReadPropertyMultiple
- WritePropertyMultiple
- Read Range
- WhoIs
- IAm
- WhoHas
- IHave
- UnconfirmedPrivateTransfer
- TimeSynchronization
- UTCTimeSynchronization
- DeviceCommunicationControl
- ReinitializeDevice
- AtomicWriteFile
- AtomicReadFile
- AcknowledgeAlarm
- GetAlarmSummary
- GetEventInformation
- ConfirmedEventNotification
- UnconfirmedEventNotification
- SubscriveCOV
- ConfirmedCOVNotification
- UnconfirmedOVNotification

BACNET'S CLIENT / SERVER NATURE

BACnet uses a “Client/Server" architecture. BACnet messages are called service requests. A Client machine sends a service request to a Server machine that then performs the service and reports the result to the Client.

Example:

A simple device such as a fixed function VAV controller would typically act as Server.

Front-end software running on a PC would act as a BACnet Client reading status values from the VAV and changing set-points.

Notes:

Server devices cannot initiate communication. Higher end embedded controllers generally include both server and client functionality. This allows them to share information such as outside temperature with each other or send alarms to a PC.

BACnet currently defines 35 message types that are divided into 5 groups or classes. For example, one class contains messages for accessing and manipulating the properties of the objects described above.

A common message type is the "`ReadProperty`" service request. This message causes the server machine to locate the requested property of the requested object and send its value back to the client.

Other classes of services deal with: alarms and events, file uploading and downloading, managing the operation of remote devices and virtual terminal functions.

NETWORK TYPES

BACnet messages can be carried over the following types of network:

- Ethernet
- ARCnet
- Master-Slave/Token-Passing (MS/TP)
- Point-to-Point (PTP)
- LON
- BACnet/IP (with appropriate security measures, such as VPN or firewall)

PIC STATEMENT

Every BACnet device is required to have a "protocol implementation conformance statement“ (PICS). A PICS is a BACnet specification sheet, containing a list of a device's BACnet capabilities.

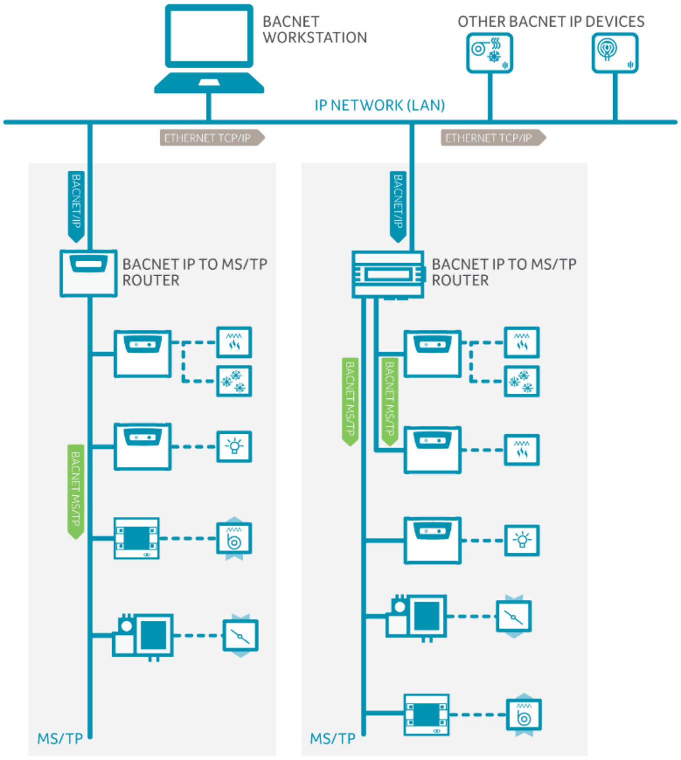
It contains:

- a general product description
- details of a product's BACnet capabilities
- which LAN options are available
- a few other items relating to character sets and special functionality

The PICS is the place to start to see what a device's capabilities are.

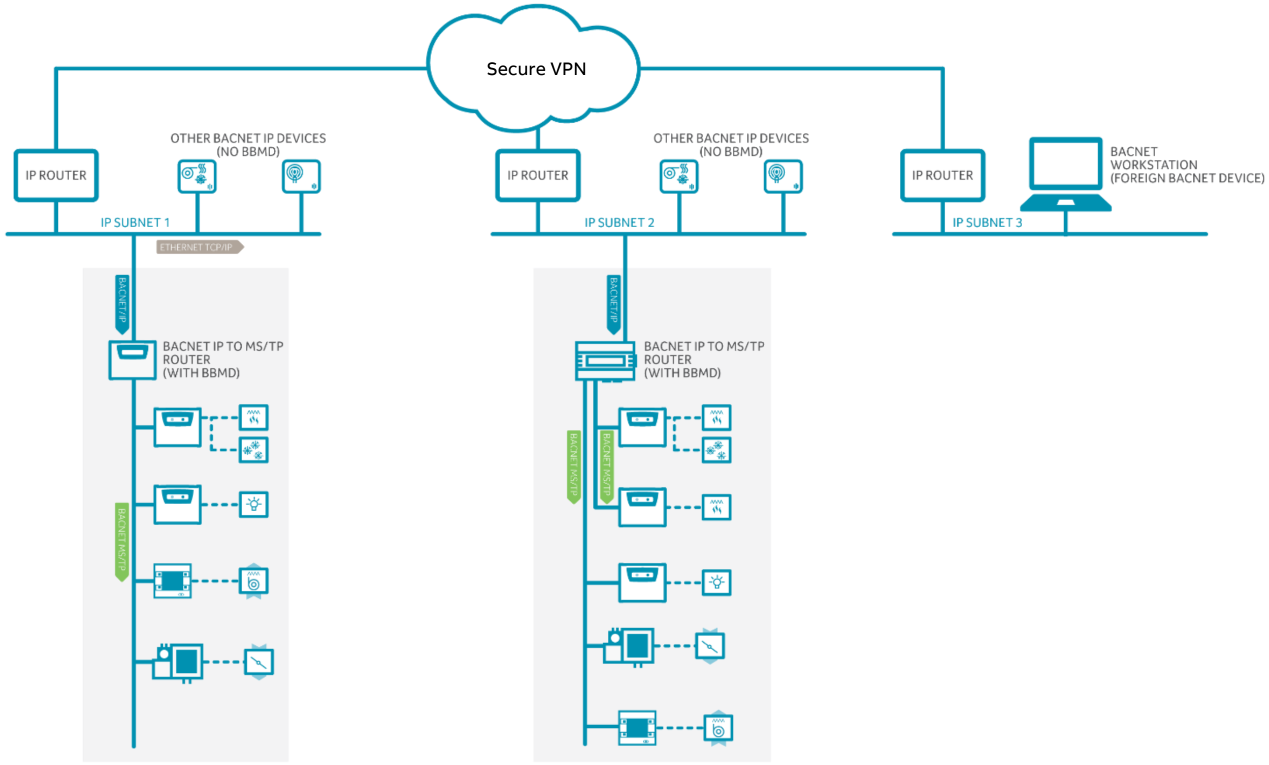
BACNET TOPOLOGY

A typical BACnet Network consists of devices connected to physical networks. Each device is a separate piece of hardware and has a physical connection to the network. Devices are given a unique Device Instance Number which can be a number between 0 and 4194302. BACnet MS/TP devices have additional addressing designations called MAC addresses. For most users it is the Device Instance Number which is used as a reference, but the combination of the Network Number and MAC address of an MS/TP device may be configured by a System Integrator to avoid any MAC address conflicts on the EIA-485 network.



BACNET IP BROADCAST MANAGEMENT DEVICE (BBMD)

Some BACnet services use “broadcasts” (e.g. “`Who-Is`”). On a LAN with standard routers, these broadcasts are “blocked”. Thus, BACnet broadcasts are limited to the IP Subnet of the BACnet device. With a BACnet/IP network of 2 or more IP subnets, a device with BBMD can be used.


Secure VPN
IP ROUTER
OTHER BACNET IP DEVICES (NO BBMD)
IP SUBNET 1
ETHERNET TCP/IP
BACNET/IP
BACNET IP TO MS/TP ROUTER (WITH BBMD)
BACNET MS/TP
IP ROUTER
OTHER BACNET IP DEVICES (NO BBMD)
IP SUBNET 2
BACNET/IP
BACNET IP TO MS/TP ROUTER (WITH BBMD)
BACNET MS/TP
BACNET MS/TP
IP ROUTER
BACNET WORKSTATION (FOREIGN BACNET DEVICE)
IP SUBNET 3

A BBMD located on an IP subnet monitors the origin of a broadcast message on that subnet and, in turn, constructs a “peer to peer” *message* in order to pass through an IP router. This “peer to peer” message is received by other BBMDs on other IP subnets and transmitted as a broadcast on their attached subnets.

Since the BBMD messages are directed messages, individual messages must be sent to each BBMD. Each BBMD device maintains a *Broadcast Distribution Table (BDT),* the content of which is usually the same for all BBMDs within the network. BBMDs must know the IP address of all other BBMDs in the network.

It is possible to communicate to a device on a subnet that does not have a BBMD as in the BACnet Workstation example above. This type of device is called a foreign device since it resides on a different IP subnet from devices attempting to communicate with it.

Usually, in BACnet/IP, a foreign device is on a different subnet.

The foreign device (e.g. BOWS) registers with each BBMD, after which it can communicate with all other devices on the network. The BBMD then maintain a Foreign Device Table (FDT) which keeps track of foreign devices.

BACNET MS/TP DEVICE LOADING

MS/TP (Master-Slave Token Passing) is a protocol where each device is wired in series and they take turns communicating, depending on which device currently holds a “token”. It is a robust design, and simpler/cheaper than IP though less flexible in terms of interoperability.

BACnet MS/TP is widely used in building automation, and usually uses RS-485 networking. As a result, the number of devices that can be connected together (on a “trunk” or “Fieldbus”) is limited by the electrical load the device puts on the network.

Unit Load is a concept created by the RS-485 specification to help determine how many devices can be connected to each fieldbus. The number of devices that can be connected depends on how much each device loads the fieldbus so the more a device loads the fieldbus, the fewer additional devices can be used. The total Unit Loads on a fieldbus must be 32 or less.

BACnet MS/TP allows 127 master device addresses, but the Unit Loading usually prevents that number of devices being active on a fieldbus.

READ PROPERTY MULTIPLE

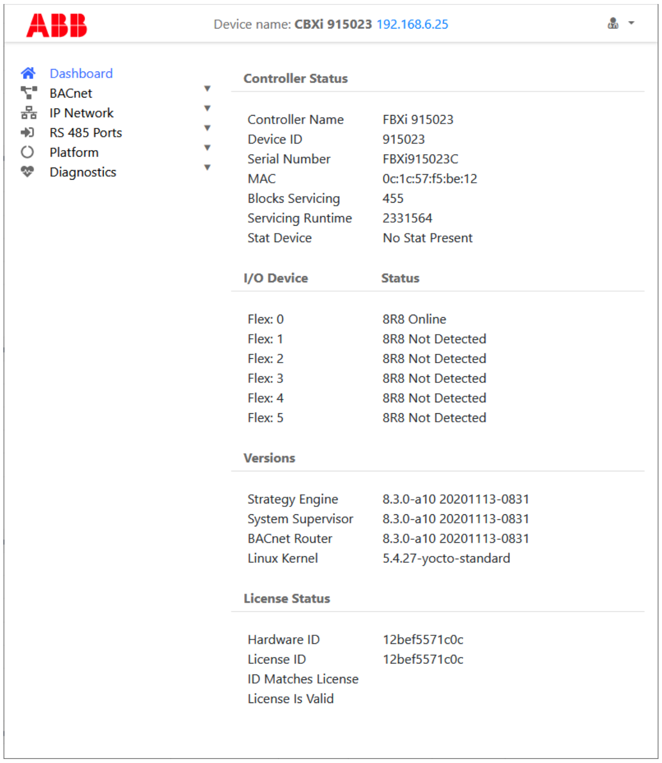
A single BACnet request can contain a sequence of BACnet property references, each representing a single BACnet property. This allows multiple properties to be read with a single BACnet request.

By default, CBXi will read 5 properties at once.

4 CBXi Web UI

SUMMARY DASHBOARD

The Summary Dashboard displays the controller status including important information such as firmware versions and I/O status.



Controller Status

Controller Name	FBXi 915023
Device ID	915023
Serial Number	FBXi915023C
MAC	0c:1c:57:f5:be:12
Blocks Servicing	455
Servicing Runtime	2331564
Stat Device	No Stat Present

I/O Device	Status
Flex: 0	8R8 Online
Flex: 1	8R8 Not Detected
Flex: 2	8R8 Not Detected
Flex: 3	8R8 Not Detected
Flex: 4	8R8 Not Detected
Flex: 5	8R8 Not Detected

Versions

Strategy Engine	8.3.0-a10 20201113-0831
System Supervisor	8.3.0-a10 20201113-0831
BACnet Router	8.3.0-a10 20201113-0831
Linux Kernel	5.4.27-yocto-standard

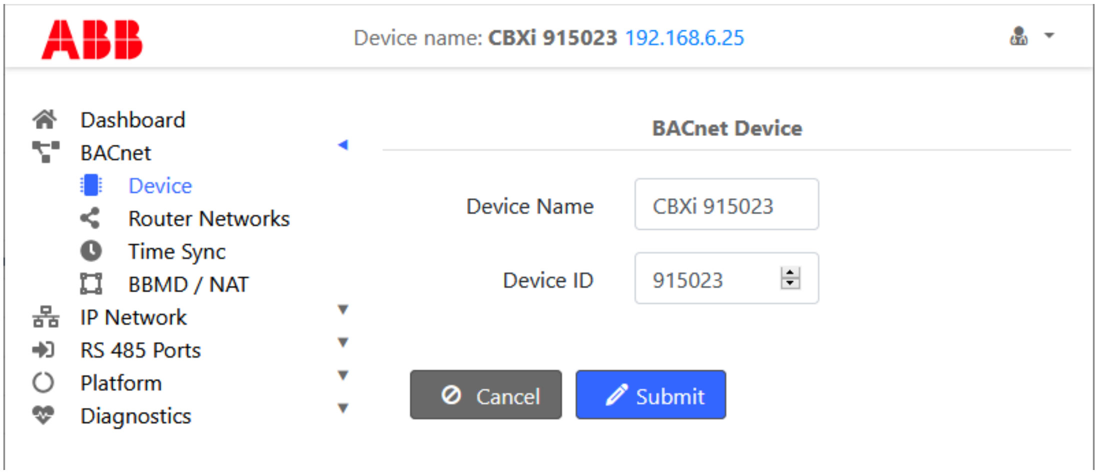
License Status

Hardware ID	12bef5571c0c
License ID	12bef5571c0c
ID Matches License	
License Is Valid	

BACNET MENU

DEVICE

The BACnet Device Name and Device ID are set from this page.



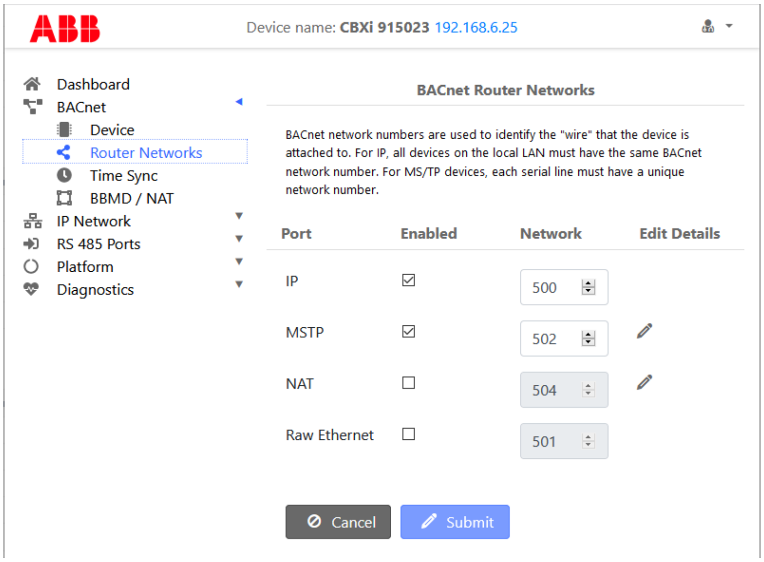
BACnet Device

Device Name	CBXi 915023
Device ID	915023

ROUTER NETWORKS

BACnet Network numbers are used to identify the “wire” to which the device is attached.

- For IP, all devices on the local LAN must have the same BACnet Network number.
- For MS/TP devices, each serial bus line must have a unique BACnet Network number.



BACnet Router Networks

BACnet network numbers are used to identify the "wire" that the device is attached to. For IP, all devices on the local LAN must have the same BACnet network number. For MS/TP devices, each serial line must have a unique network number.

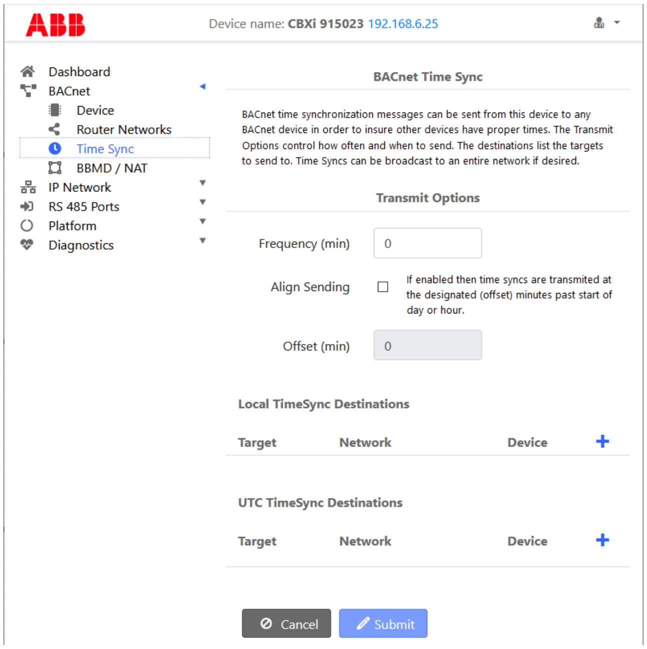
Port	Enabled	Network	Edit Details
IP	☑	500	
MSTP	☑	502	✎
NAT	☐	504	✎
Raw Ethernet	☐	501	

TIME SYNC

BACnet Time Synchronization messages can be sent from this device to any BACnet device in order to ensure that those devices have the correct times.

- The Transmit Options control how often and when to send.
- The Destinations list the targets to which the Time Sync messages will be sent.

Time Sync messages can be broadcast to an entire network if desired.



BACnet Time Sync

BACnet time synchronization messages can be sent from this device to any BACnet device in order to insure other devices have proper times. The Transmit Options control how often and when to send. The destinations list the targets to send to. Time Syncs can be broadcast to an entire network if desired.

Transmit Options

Frequency (min): 0

Align Sending: ☐ If enabled then time syncs are transmited at the designated (offset) minutes past start of day or hour.

Offset (min): 0

Local TimeSync Destinations

Target	Network	Device	+

UTC TimeSync Destinations

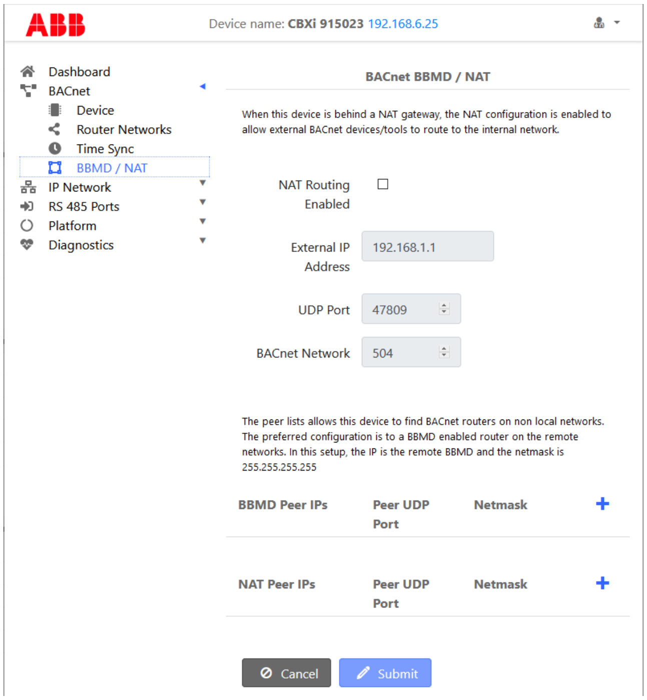
Target	Network	Device	+

BBMD / NAT

BBMD connects BACnet IP networks that are not on the same local network (see *BACnet IP Broadcast Management Device (BBMD)* on page 16 for details).

Note: When connecting between networks ensure appropriate security measures, such as VPN or firewall, are in place.

NAT connects sites where there is a NAT gateway between them.



BACnet BBMD / NAT

When this device is behind a NAT gateway, the NAT configuration is enabled to allow external BACnet devices/tools to route to the internal network.

NAT Routing Enabled □

External IP Address 192.168.1.1

UDP Port 47809

BACnet Network 504

The peer lists allows this device to find BACnet routers on non local networks. The preferred configuration is to a BBMD enabled router on the remote networks. In this setup, the IP is the remote BBMD and the netmask is 255.255.255.255

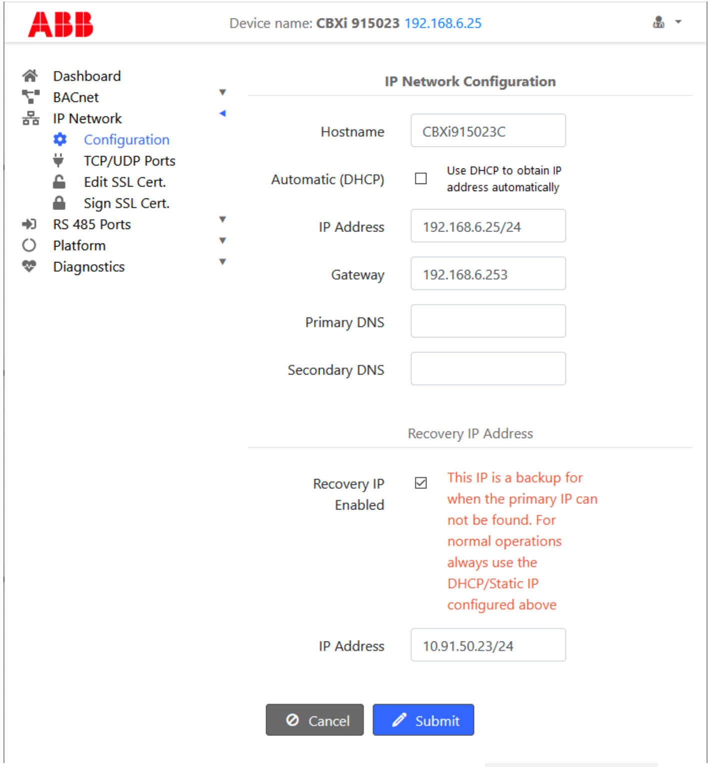
BBMD Peer IPs	Peer UDP Port	Netmask	+

NAT Peer IPs	Peer UDP Port	Netmask	+

IP NETWORK

CONFIGURATION

This page allows basic IP configuration, identifying the current device on the IP network.



Device name: **CBXi 915023** 192.168.6.25

IP Network Configuration

Hostname: CBXi915023C

Automatic (DHCP): □ Use DHCP to obtain IP address automatically

IP Address: 192.168.6.25/24

Gateway: 192.168.6.253

Primary DNS:

Secondary DNS:

Recovery IP Address

Recovery IP Enabled: ☑ This IP is a backup for when the primary IP can not be found. For normal operations always use the DHCP/Static IP configured above

IP Address: 10.91.50.23/24

If your network has a DHCP server, click the Automatic (DHCP) box. You can then use BACnet discovery to list controllers along with their IP addresses, and can use the hostname to identify the IP address of a specific controller. By default, all CBXi devices leaving the factory are configured to use DHCP, and have a hostname set to "`CBXi`" followed by the controller's serial number – e.g. `CBXi901004A`

If your network does not have a DHCP server, then the CBXi controller will use a default IP address, which is made up as follows:

- The first byte of the IP address is set to `10`
- The 6 digits of the numerical part of the serial number grouped into 3 sets of 2 digits to form the last 3 bytes of the IP address.

For example, CBXi with serial number `901001A` will be allocated the default IP address of `10.90.10.01`. See also *Configuring the IP connection* on page 31. The IP Address input is also used to specify the subnet mask in CIDR format. See *Subnetwork (Subnet)* on page 7 for a full explanation.

Recovery IP Address

If the primary IP cannot be reached – for example if the primary is set to automatic and there is no DHCP server available, then the user must use the Recovery IP Address to access the Web UI and properly configure the primary. The recovery is only designed for access to the web UI.

The factory default value is based on the serial number in the same way as the primary, but the Recovery IP Address should **not** be changed or disabled unless it interferes with other network operations.

Note: A button-press reset (see ***Restarting and Resetting the CBXi***

Restarting and Resetting the CBXi on page 73) will revert all IP configuration to factory defaults.

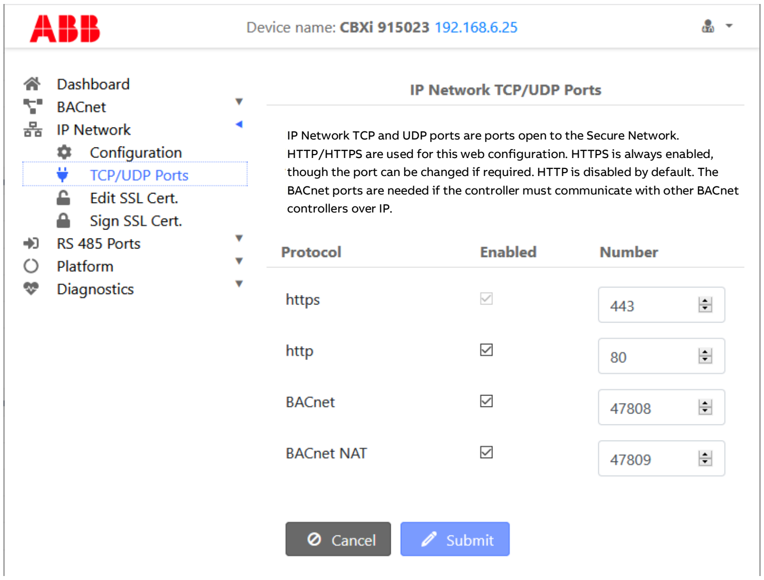
TCP/UDP PORTS

This page defines IP ports that are open to the secure network, and the protocols those ports expect to use.

HTTPS/HTTP are used for this web configuration.

- HTTPS is always enabled, though the port can be changed if required.
- HTTP is disabled by default.

The BACnet ports are needed if the controller must communicate with other BACnet controllers over IP.



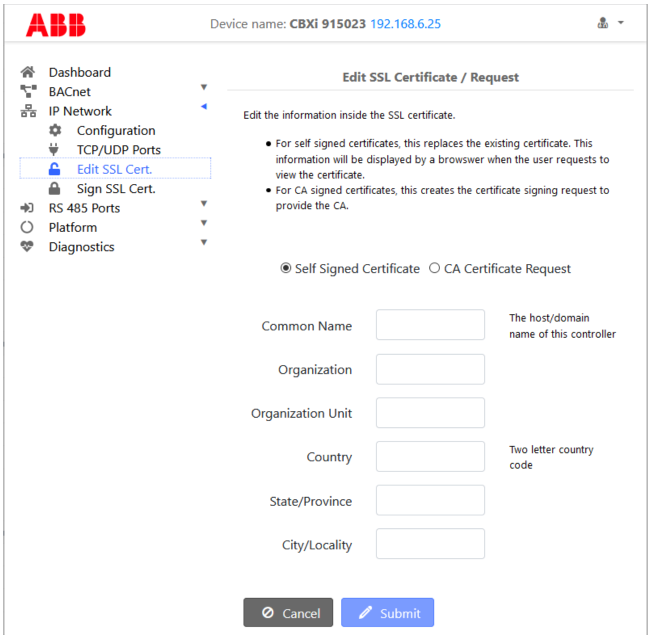
IP Network TCP/UDP Ports

IP Network TCP and UDP ports are ports open to the Secure Network. HTTP/HTTPS are used for this web configuration. HTTPS is always enabled, though the port can be changed if required. HTTP is disabled by default. The BACnet ports are needed if the controller must communicate with other BACnet controllers over IP.

Protocol	Enabled	Number
https	☑	443
http	☑	80
BACnet	☑	47808
BACnet NAT	☑	47809

EDIT SSL CERT / SIGN SSL CERT

The IP Network > Edit SSL Cert page allows you to enter the details for an SSL certificate, which can be applied to the current **CBXi** as a self-signed certificate, or else these details can be used to generate a request for a 3rd-party SSL Cert on the IP Network > Sign SSL Cert page



Edit SSL Certificate / Request

Edit the information inside the SSL certificate.

- For self signed certificates, this replaces the existing certificate. This information will be displayed by a browswer when the user requests to view the certificate.
- For CA signed certificates, this creates the certificate signing request to provide the CA.

● Self Signed Certificate ○ CA Certificate Request

Common Name — The host/domain name of this controller

Organization

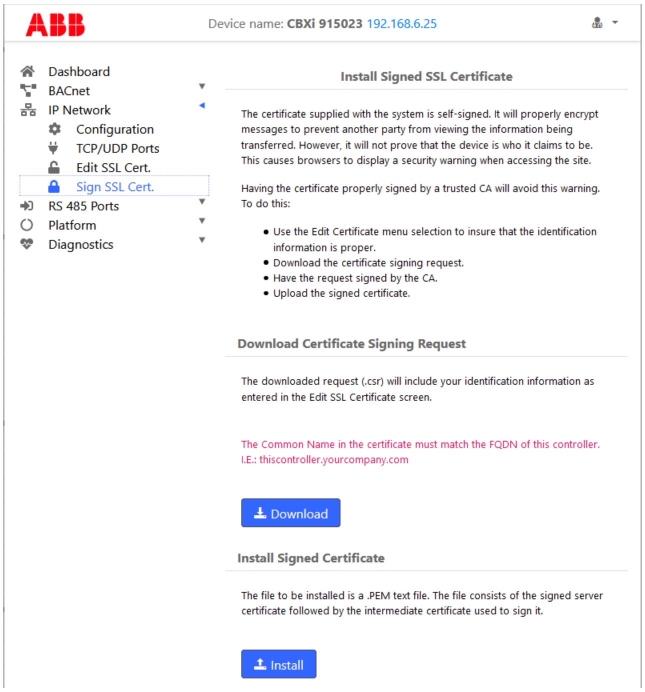
Organization Unit

Country — Two letter country code

State/Province

City/Locality

To install a 3rd-party SSL Cert, or to generate a request for a 3rd-party SSL Cert, use the IP Network > Sign SSL Cert page:



Install Signed SSL Certificate

The certificate supplied with the system is self-signed. It will properly encrypt messages to prevent another party from viewing the information being transferred. However, it will not prove that the device is who it claims to be. This causes browsers to display a security warning when accessing the site.

Having the certificate properly signed by a trusted CA will avoid this warning. To do this:

- Use the Edit Certificate menu selection to insure that the identification information is proper.
- Download the certificate signing request.
- Have the request signed by the CA.
- Upload the signed certificate.

Download Certificate Signing Request

The downloaded request (.csr) will include your identification information as entered in the Edit SSL Certificate screen.

The Common Name in the certificate must match the FQDN of this controller. I.E.: thiscontroller.yourcompany.com

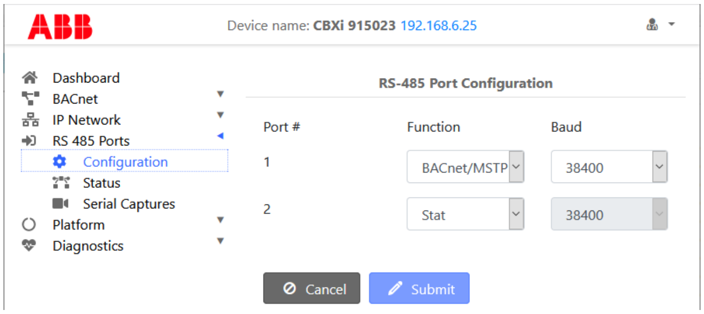
Install Signed Certificate

The file to be installed is a .PEM text file. The file consists of the signed server certificate followed by the intermediate certificate used to sign it.

RS-485 PORT

Configuration

The RS-485 port can be configured for BACnet or Modbus on the RS 485 > Configuration page, and the baud rate can be set as appropriate. See *Configuring a Modbus RTU connection* on page 52 for more detail.



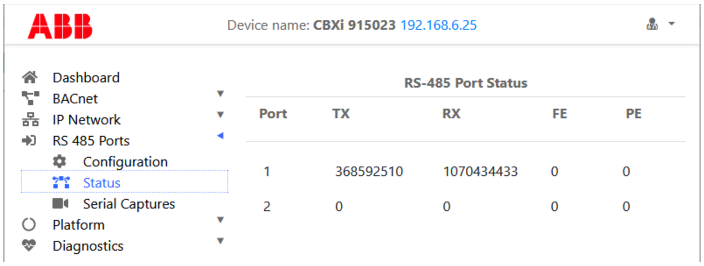
Device name: **CBXi 915023** 192.168.6.25

RS-485 Port Configuration

Port #	Function	Baud
1	BACnet/MSTP	38400
2	Stat	38400

Status

The status of the ports can be viewed on the RS 485 > Status page. It includes the number of characters transmitted, and also received errors.



Device name: **CBXi 915023** 192.168.6.25

RS-485 Port Status

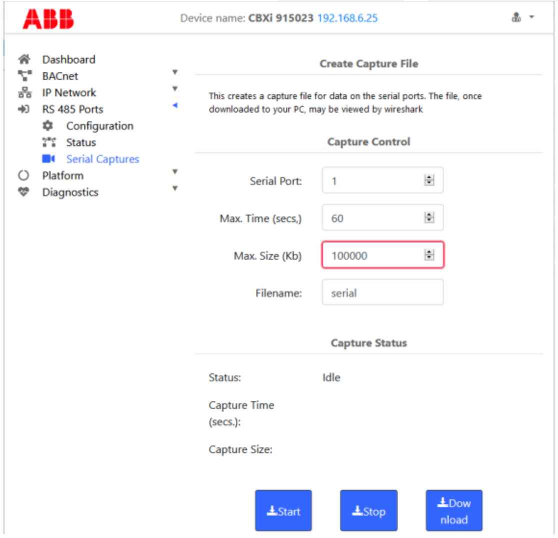
Port	TX	RX	FE	PE
1	368592510	1070434433	0	0
2	0	0	0	0

Note: If the RX errors value is a large percentage of the RX characters value (for example > 10 %), it may be beneficial to review your wiring for correct termination or unexpected line breaks.

Serial Captures

If required for diagnosing errors or tuning network performance, the CBXi can capture serial port communications and store it in a file that can be analysed using WireShark.

This is done through the RS-485 Ports > Serial Captures dialog:



Device name: **CBXi 915023** 192.168.6.25

Create Capture File

This creates a capture file for data on the serial ports. The file, once downloaded to your PC, may be viewed by wireshark

Capture Control

Serial Port: 1

Max. Time (secs,): 60

Max. Size (Kb): 100000

Filename: serial

Capture Status

Status: Idle

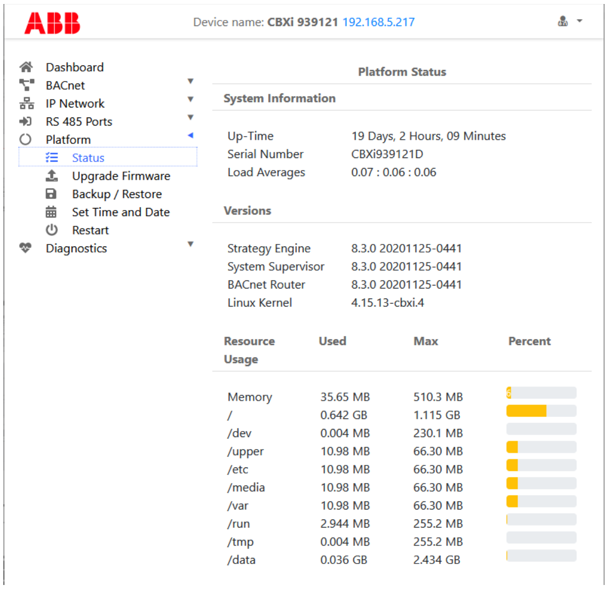
Capture Time (secs.):

Capture Size:

PLATFORM

STATUS REPORT

The Platform > Status page is useful for technical support and shows the Up-Time (running time) of the CBXi and its serial number, along with the versions of various software components of the CBXi. Memory usage is also displayed.



Platform Status

System Information

Up-Time	19 Days, 2 Hours, 09 Minutes
Serial Number	CBXi939121D
Load Averages	0.07 : 0.06 : 0.06

Versions

Strategy Engine	8.3.0 20201125-0441
System Supervisor	8.3.0 20201125-0441
BACnet Router	8.3.0 20201125-0441
Linux Kernel	4.15.13-cbxi.4

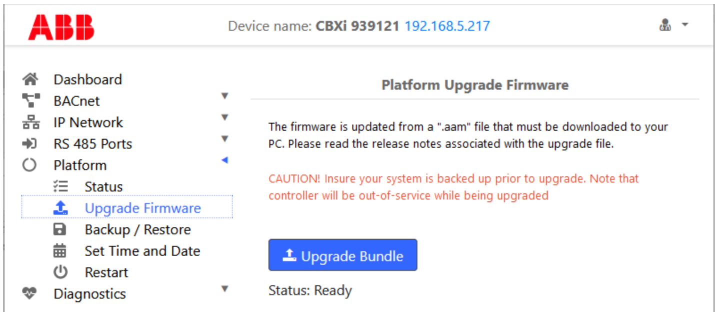
Resource Usage	Used	Max	Percent
Memory	35.65 MB	510.3 MB	
/	0.642 GB	1.115 GB	
/dev	0.004 MB	230.1 MB	
/upper	10.98 MB	66.30 MB	
/etc	10.98 MB	66.30 MB	
/media	10.98 MB	66.30 MB	
/var	10.98 MB	66.30 MB	
/run	2.944 MB	255.2 MB	
/tmp	0.004 MB	255.2 MB	
/data	0.036 GB	2.434 GB	

FIRMWARE UPGRADE UTILITY

With assistance from technical support, you may upgrade the firmware of the CBXi. Please be sure to back up your system before commencing the upgrade.

Note : The controller will be out of service while being upgraded.

To upgrade, click Platform > Upgrade Firmware and an Open File dialog will appear. Find the `.aam` file that you would like to upload. Once uploading has started, your system will be out of service. After approximately 30 seconds, your system will be online with the new firmware.



Platform Upgrade Firmware

The firmware is updated from a ".aam" file that must be downloaded to your PC. Please read the release notes associated with the upgrade file.

CAUTION! Insure your system is backed up prior to upgrade. Note that controller will be out-of-service while being upgraded

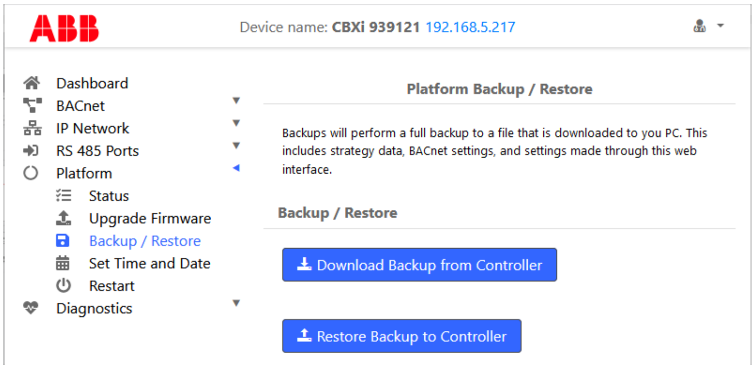
Status: Ready

BACKUP/RESTORE UTILITY

You may perform a full backup to a file that can be downloaded to your PC. This includes Strategy data, BACnet settings and system settings configured via this web interface. Simply click the Download Backup from Controller button and save the backup to your PC.

Note: This backup cannot be used by CXpro^HD to edit a restored Strategy

You may also restore a backup to the CBXi. By clicking the Restore Backup to Controller button. An Open File dialog will appear. Find the appropriate backup file and select it for restoring. After a few moments, the controller will restart with the new Strategy and data.


Device name: CBXi 939121 192.168.5.217

Platform Backup / Restore

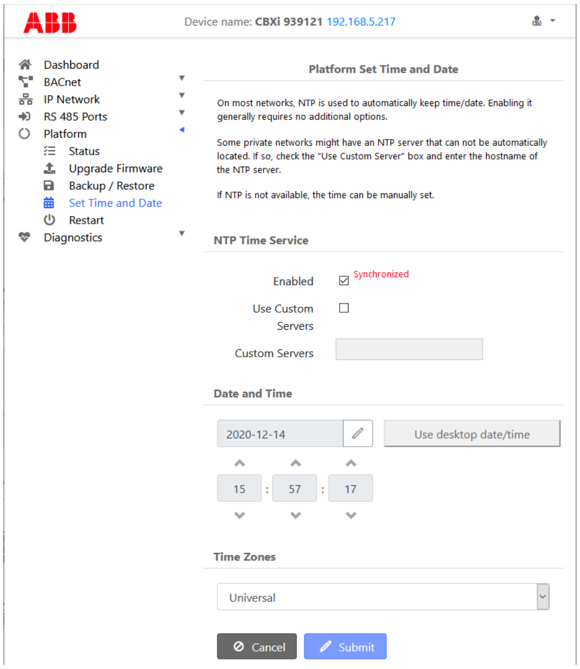
Backups will perform a full backup to a file that is downloaded to you PC. This includes strategy data, BACnet settings, and settings made through this web interface.

Backup / Restore

SET TIME AND DATE

On most networks, NTP is used to automatically keep the time and date correct. Enabling it generally requires no additional configuration.

Some private networks may have an NTP server that cannot be automatically located. If so, check the Use Custom Server box and enter the hostname of the NTP server if available. If an NTP server is not available, the time can be manually set.



Device name: **CBXi 939121** 192.168.5.217

Platform Set Time and Date

On most networks, NTP is used to automatically keep time/date. Enabling it generally requires no additional options.

Some private networks might have an NTP server that can not be automatically located. If so, check the "Use Custom Server" box and enter the hostname of the NTP server.

If NTP is not available, the time can be manually set.

NTP Time Service

Enabled ☑ Synchronized

Use Custom Servers □

Custom Servers

Date and Time

2020-12-14

15 : 57 : 17

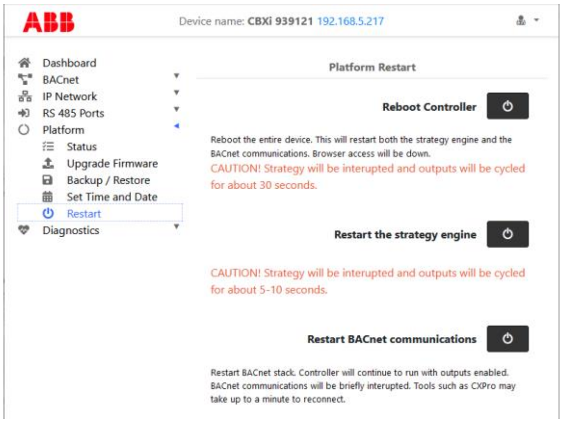
Time Zones

Universal

RESTART UTILITY

Several options are available for refreshing the CBXi platform, in case a condition has occurred which stopped a portion of the functionality of the CBXi and you do not wish to reboot the entire CBXi platform.

- Choose Reboot Platform to cleanly shutdown the CBXi and then restart it. This is equivalent to rebooting your PC.
- Choose Restart Strategy Engine to stop and restart the processing of the Strategy.
- Restart the BACnet Router and MSTP stops and restarts the internal BACnet Router and MS/TP network engine.



Device name: **CBXi 939121** 192.168.5.217

Platform Restart

Reboot Controller

Reboot the entire device. This will restart both the strategy engine and the BACnet communications. Browser access will be down.
CAUTION! Strategy will be interupted and outputs will be cycled for about 30 seconds.

Restart the strategy engine

CAUTION! Strategy will be interupted and outputs will be cycled for about 5-10 seconds.

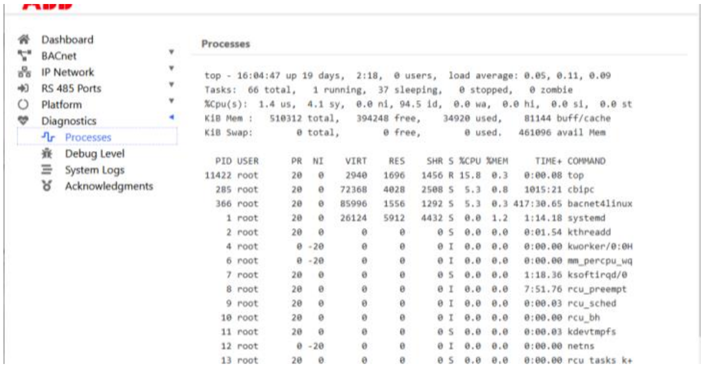
Restart BACnet communications

Restart BACnet stack. Controller will continue to run with outputs enabled. BACnet communications will be briefly interupted. Tools such as CXPro may take up to a minute to reconnect.

DIAGNOSTICS

PROCESSES

The Diagnostic > Processes page displays a list of the processes that are running in the **CBXi**. If requested by Technical Support, a screenshot of this page can be useful in diagnosing certain types of problems.

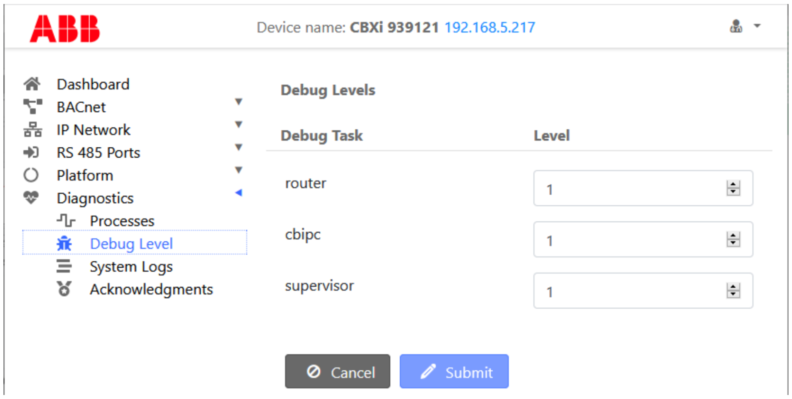


```
top - 16:04:47 up 19 days,  2:18,  0 users,  load average: 0.05, 0.11, 0.09
Tasks:  66 total,   1 running,  37 sleeping,   0 stopped,   0 zombie
%Cpu(s):  1.4 us,  4.1 sy,  0.0 ni, 94.5 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
KiB Mem :   510312 total,   394248 free,    34920 used,    81144 buff/cache
KiB Swap:        0 total,        0 free,        0 used.   461096 avail Mem

  PID USER      PR  NI    VIRT    RES    SHR S %CPU %MEM     TIME+ COMMAND
11422 root      20   0    2940   1696   1456 R 15.8  0.3   0:00.08 top
  285 root      20   0   72368   4028   2508 S  5.3  0.8   1015:21 cbipc
  366 root      20   0   85996   1556   1292 S  5.3  0.3 417:30.65 bacnet4linux
    1 root      20   0   26124   5912   4432 S  0.0  1.2   1:14.18 systemd
    2 root      20   0       0      0      0 S  0.0  0.0   0:01.54 kthreadd
    4 root       0 -20       0      0      0 I  0.0  0.0   0:00.00 kworker/0:0H
    6 root       0 -20       0      0      0 I  0.0  0.0   0:00.00 mm_percpu_wq
    7 root      20   0       0      0      0 S  0.0  0.0   1:18.36 ksoftirqd/0
    8 root      20   0       0      0      0 I  0.0  0.0   7:51.76 rcu_preempt
    9 root      20   0       0      0      0 I  0.0  0.0   0:00.03 rcu_sched
   10 root      20   0       0      0      0 I  0.0  0.0   0:00.00 rcu_bh
   11 root      20   0       0      0      0 S  0.0  0.0   0:00.03 kdevtmpfs
   12 root       0 -20       0      0      0 I  0.0  0.0   0:00.00 netns
   13 root      20   0       0      0      0 S  0.0  0.0   0:00.00 rcu tasks k+
```

DEBUG LEVEL

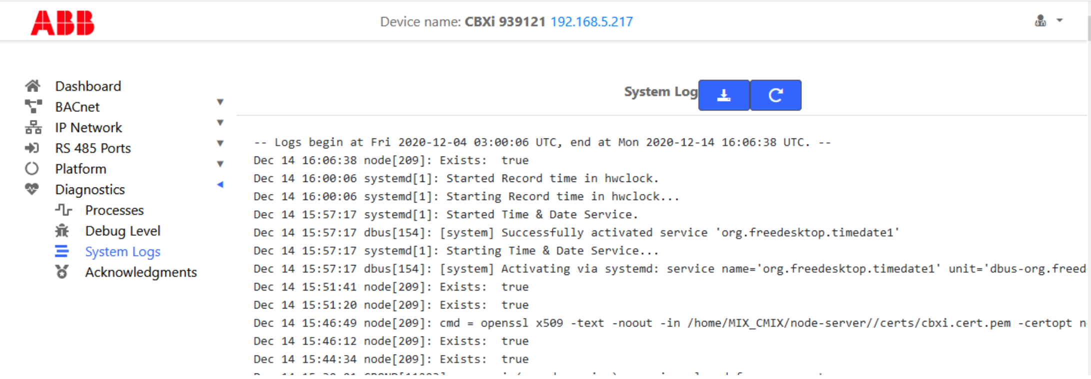
If directed by Technical Support, you can change the debug levels to assist in troubleshooting difficult field problems should the need arise.



Debug Task	Level
router	1
cbipc	1
supervisor	1

SYSTEM LOGS

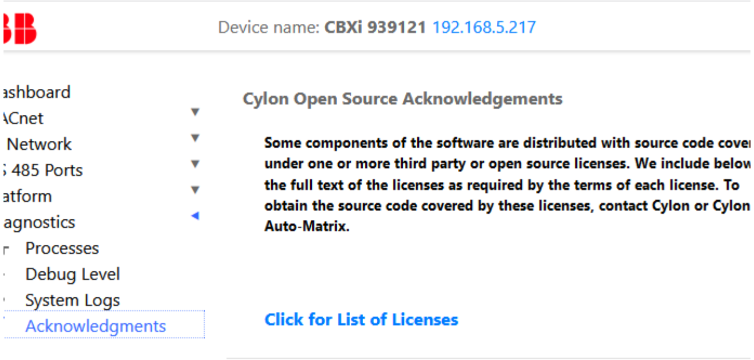
If directed by Technical Support, a download of the system log may assist in troubleshooting difficult field problems should the need arise. The Download button will instruct you to save the file to your PC, from where you can email it to Technical Support.



```
-- Logs begin at Fri 2020-12-04 03:00:06 UTC, end at Mon 2020-12-14 16:06:38 UTC. --
Dec 14 16:06:38 node[209]: Exists:  true
Dec 14 16:00:06 systemd[1]: Started Record time in hwclock.
Dec 14 16:00:06 systemd[1]: Starting Record time in hwclock...
Dec 14 15:57:17 systemd[1]: Started Time & Date Service.
Dec 14 15:57:17 dbus[154]: [system] Successfully activated service 'org.freedesktop.timedate1'
Dec 14 15:57:17 systemd[1]: Starting Time & Date Service...
Dec 14 15:57:17 dbus[154]: [system] Activating via systemd: service name='org.freedesktop.timedate1' unit='dbus-org.freed
Dec 14 15:51:41 node[209]: Exists:  true
Dec 14 15:51:20 node[209]: Exists:  true
Dec 14 15:46:49 node[209]: cmd = openssl x509 -text -noout -in /home/MIX_CMIX/node-server//certs/cbxi.cert.pem -certopt n
Dec 14 15:46:12 node[209]: Exists:  true
Dec 14 15:44:34 node[209]: Exists:  true
```

OPEN-SOURCE ACKNOWLEDGMENT NOTICES

Some components of the software used in CBXi are distributed under one or more 3rd-party and open-source licenses. The licenses are listed on the Diagnostic > Acknowledgements page.



Device name: **CBXi 939121** 192.168.5.217

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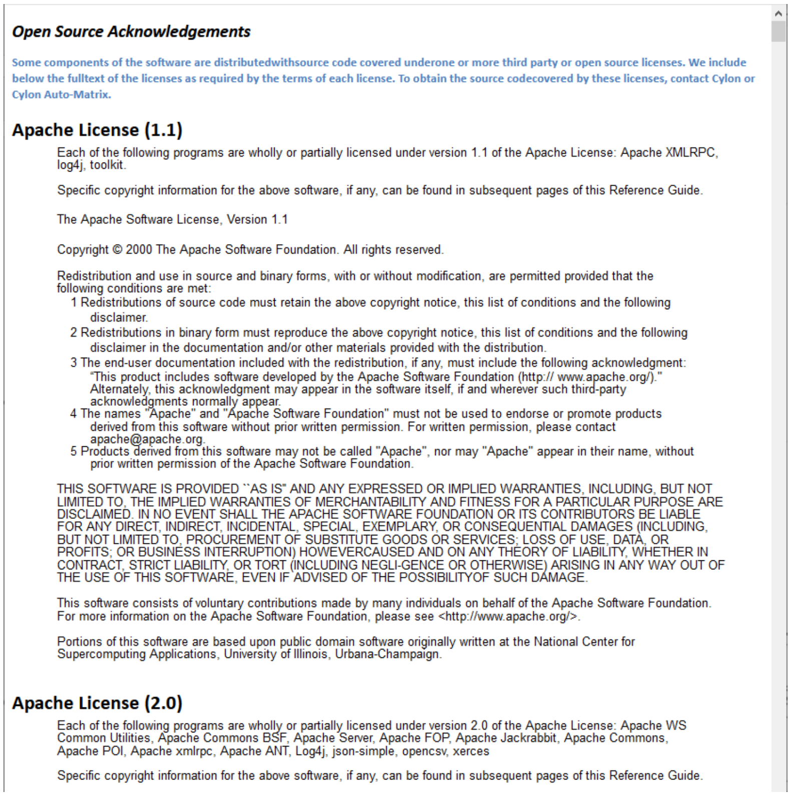

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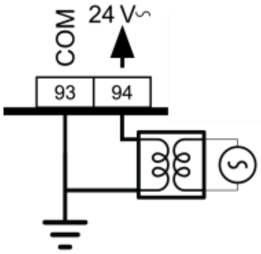
5 Installation

APPLY POWER TO THE CBXI-8R8(-H)

For the initial configuration of the device, the controller must first be powered on.

Note: Service Port (USB connection) must not be connected until after the device is powered on.

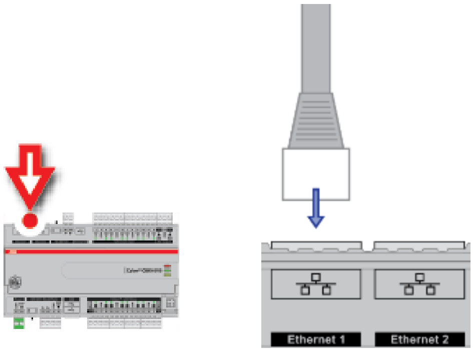
The CBXi-8R8(-H) requires 24 V AC/DC supplied from an externally mounted power transformer. One conductor of the transformer must be grounded to an earth ground to avoid damage to the controller. This conductor will be wired to the `COM` (common) terminal of the controller. The wiring diagram is shown here:



Note: Ensure the 24 V AC/DC and Common wires are correctly connected to the controller. If the wires are swapped, it may cause damage to anything connected to the controller.

CONNECT THE CBXi TO AN IP NETWORK

Place an Ethernet cable from the Network's Ethernet switch into one of the 2 Ethernet ports on the top of the CBXi:

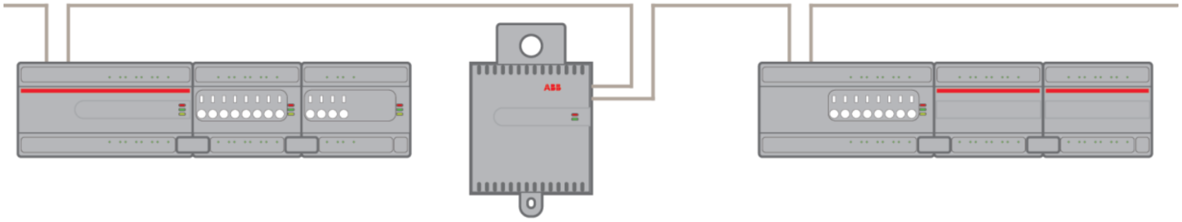


IP Cabling requirements

Cable	Standard patch cable, Cat 5e with 4 pairs of wires fitted with RJ-45 connectors
RJ-45 pin connections	Straight-through wiring
Characteristic impedance	100-130 Ohms
Distributed capacitance	Less than 100 pF per meter (30 pF per foot)
Maximum Cable length between IP devices	328 ft. (100 m) maximum

THE CBXI INTEGRATED ETHERNET SWITCH

The **CBXi-8R8(-H)** includes an integrated Ethernet Switch, with 2 ports. This allows the device to forward IP packets from each port to the other, allowing **CBXi** devices to be connected in a Daisy-Chain topology:



It is recommended is that both ends of an **FBXi** / **FBVi** / **CBXi** daisy chain network are connected to a single switch that supports the Spanning Tree network switch protocol (STP). In this scenario a single line break or controller failure in the loop will allow all controllers to continue to communicate.

For example, if controllers `A`, `B`, `C`, `D` and `E` are daisy-chained, connected on both sides, with a single switch supporting Spanning Tree Protocol:

- If controller `B` loses power, controller `A` will be on one trunk, and `C` / `D` / `E` will be on another all communicating.
- If controllers `B` and `D` lose power, controllers `A` and `E` will communicate, but controller `C` will not.

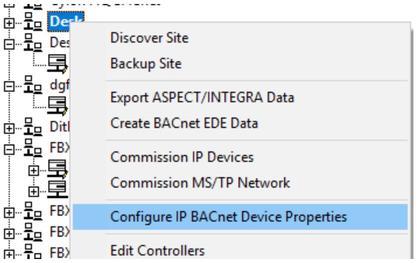
Note: The **FBVi Series** controller has a pass-through across its IP switches, such that if it loses power controllers 'downstream' will continue to be connected. Only the **FBVi Series** has this feature.

Note: If you plug both ends of the daisy chain network into a switch that does not support the Spanning Tree Protocol, it will flood the network with requests. The switch will send and receive the same messages over and over again, until something breaks.

CONFIGURING THE IP CONNECTION

Configuring the IP connection using CXpro^{HD}

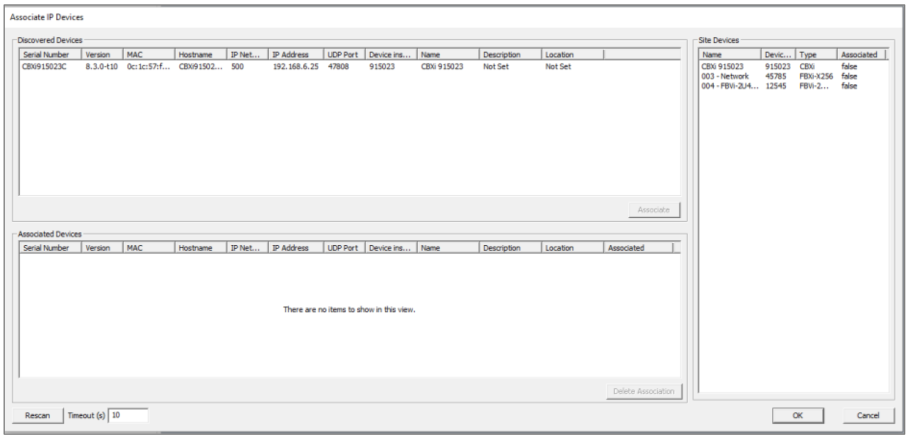
CXpro^{HD} includes a utility to quickly configure BACnet properties for IP devices. To launch this utility, right-click on a Site in the `Site List` and select `Configure IP BACnet Device Properities`



The utility will scan for all **CBXi**, **FBXi** and **FBVi** devices on the selected network.

Note: The devices must be configured within **CXpro**^{HD} before they can be accessed by this utility.

When scanning is complete, the Associate IP Devices dialog will open:



Discovered Devices

Serial Number	Version	MAC	Hostname	IP Net...	IP Address	UDP Port	Device ins...	Name	Description	Location
CBXi915023C	8.3.0-t10	0c:1c:57:f...	CBXi91502...	500	192.168.6.25	47808	915023	CBXi 915023	Not Set	Not Set

Associated Devices

Serial Number	Version	MAC	Hostname	IP Net...	IP Address	UDP Port	Device ins...	Name	Description	Location	Associated

There are no items to show in this view.

Site Devices

Name	Devic...	Type	Associated
CBXi 915023	915023	CBXi	false
003 - Network	45785	FBXi-X256	false
004 - FBVi-2U4...	12545	FBVi-2...	false

Timeout (s) 10

The Site Devices panel on the right lists all of the relevant IP devices configured in the CXpro^{HD} Site that have been successfully discovered on the BACnet network.

The Discovered Devices panel on the top left lists all of the relevant devices that have been discovered on the network

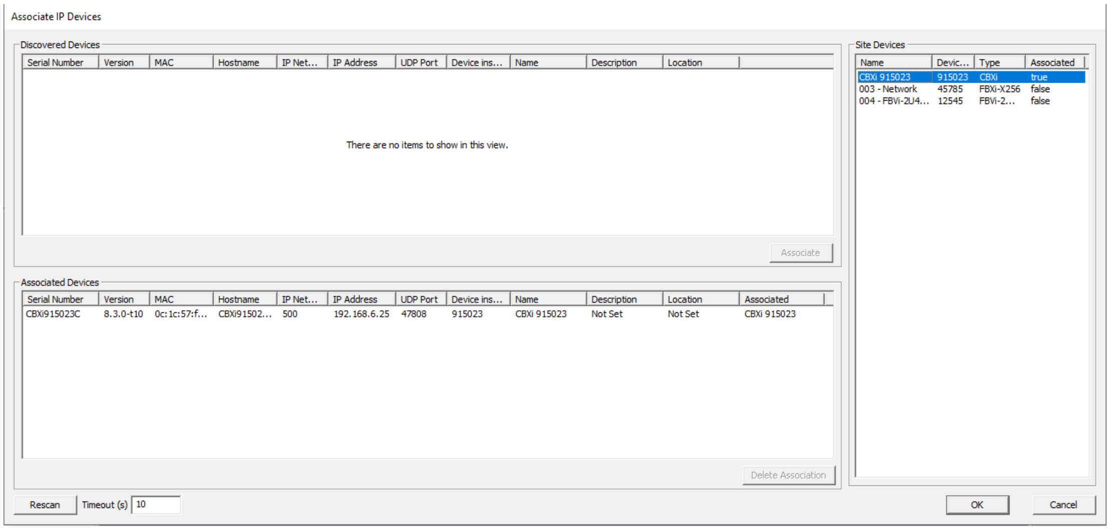
The Associated Devices panel on the bottom left lists any Discovered Device that has been associated with a configured Site Device.

How to Associate devices

To associate a Discovered Device with a Site Device, select a device in the Site Devices list and a device in the Discovered Devices list and click the Associate button. Alternatively, you can drag the Site Device and drop it over a Discovered Device.

Once this is done, the discovered device is moved to the Associated Devices list. The device on the Site PC is updated with the Device Instance of the physical devices.

The MAC address will be stored in the site configuration as the key, so associations are maintained if the tool is run again.



Discovered Devices

Serial Number	Version	MAC	Hostname	IP Net...	IP Address	UDP Port	Device ins...	Name	Description	Location

There are no items to show in this view.

Associated Devices

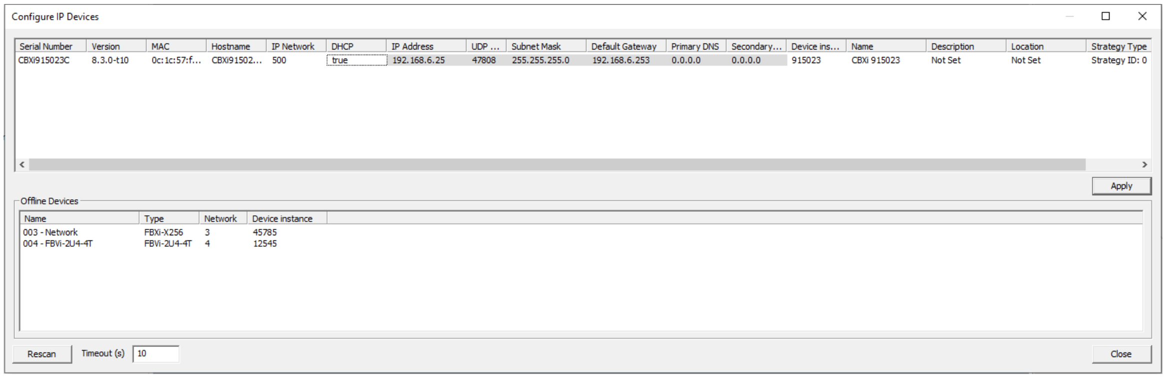
Serial Number	Version	MAC	Hostname	IP Net...	IP Address	UDP Port	Device ins...	Name	Description	Location	Associated
CBXi915023C	8.3.0-t10	0c:1c:57:f...	CBXi91502...	500	192.168.6.25	47808	915023	CBXi 915023	Not Set	Not Set	CBXi 915023

Site Devices

Name	Devic...	Type	Associated
CBXi 915023	915023	CBXi	true
003 - Network	45785	FBXi-X256	false
004 - FBVi-2U4...	12545	FBVi-2...	false

Timeout (s) 10

When all required devices have been associated, click OK to open the Configure IP device dialog where the IP Properties of Associated devices can be edited.



Serial Number	Version	MAC	Hostname	IP Network	DHCP	IP Address	UDP ...	Subnet Mask	Default Gateway	Primary DNS	Secondary...	Device ins...	Name	Description	Location	Strategy Type
CBXi915023C	8.3.0-t10	0c:1c:57:f...	CBXi91502...	500	true	192.168.6.25	47808	255.255.255.0	192.168.6.253	0.0.0.0	0.0.0.0	915023	CBXi 915023	Not Set	Not Set	Strategy ID: 0

Offline Devices

Name	Type	Network	Device instance
003 - Network	FBXi-X256	3	45785
004 - FBVi-2U4-4T	FBVi-2U4-4T	4	12545

Timeout (s): 10

The list on the bottom shows the unassociated or offline devices.

When the properties are set as required, click Apply to send the changes to that controller.

Configuring the IP connection without CXpro^{HD}

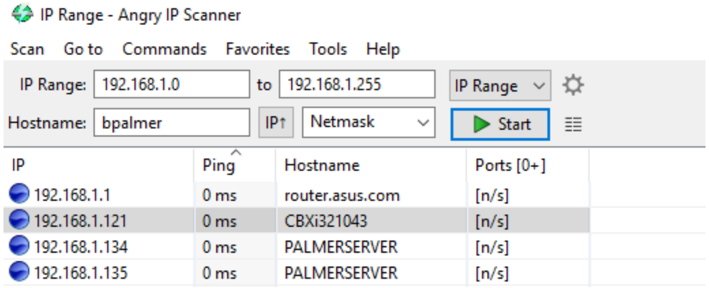
If there is no instance of CXpro^{HD} available with the appropriate Site configuration, it is possible to configure an individual CBXi controller using its built-in Web UI.

To access the Web UI, you must know the controller's IP address.

How to determine the IP address of a specific CBXi controller without CXpro^{HD}

By default, all CBXi devices leaving the factory are configured to use DHCP, and have a hostname set to "`CBXi`" followed by the controller's serial number – e.g. `CBXi901004A`

If your network has a DHCP server, you can use IP scanning software such as AngryIP to locate controllers and use the hostname to identify the IP address of a specific controller.



IP Range: 192.168.1.0 to 192.168.1.255

Hostname: bpalmer

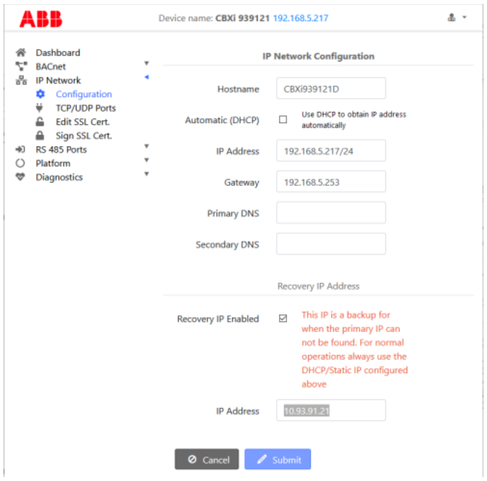
IP	Ping	Hostname	Ports [0+]
192.168.1.1	0 ms	router.asus.com	[n/s]
192.168.1.121	0 ms	CBXi321043	[n/s]
192.168.1.134	0 ms	PALMERSERVER	[n/s]
192.168.1.135	0 ms	PALMERSERVER	[n/s]

For example, In the screenshot above, the DHCP server has allocated IP address `192.168.1.121` to CBXi with hostname `CBXi321043`.

If your network does not have a DHCP server, then the CBXi controller will use a default IP address, which is made up as follows:

- The first byte of the IP address is set to 10
- The 6 digits of the numerical part of the serial number grouped into 3 sets of 2 digits to form the last 3 bytes of the IP address.

  For example, a CBXi with serial number `939121D` will be allocated the Default IP address of `10.93.91.21`, which is also used as the Recovery IP. The IP address can be changed from the default, as shown below, but the recovery IP address should be left at the default value so that it is known in case of emergency.



Device name: CBXi 939121 192.168.5.217

IP Network Configuration

Hostname: CBXi939121D

Automatic (DHCP): ☐ Use DHCP to obtain IP address automatically

IP Address: 192.168.5.217/24

Gateway: 192.168.5.253

Primary DNS:

Secondary DNS:

Recovery IP Address

Recovery IP Enabled: ☑ This IP is a backup for when the primary IP can not be found. For normal operations always use the DHCP/Static IP configured above

IP Address: 10.93.91.21

Note: For a laptop (or PC) to communicate with a CBXi configured in this way, the IP address of the laptop's Ethernet port must be set to a subnet that is compatible with the CBXi's IP address.

For example, if the CBXi has an IP address of `10.90.10.01`, the laptop could have an address something like `10.90.10.nn` with a subnet mask of `255.255.255.0`.

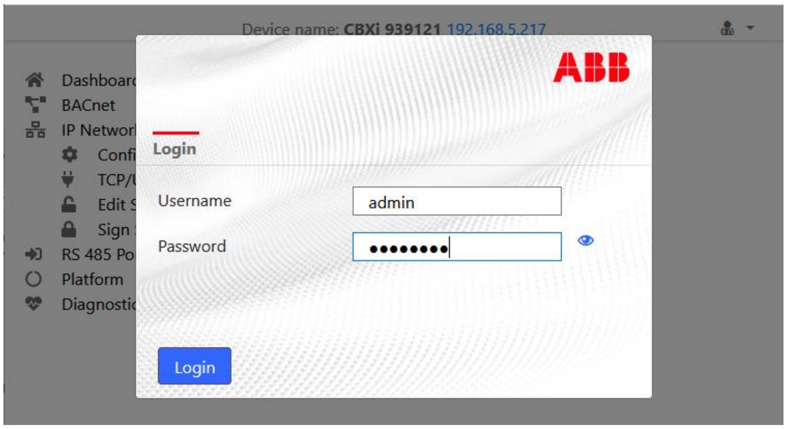
Note: If the default IP address is used on a network, it can cause an IP Address conflict if the network's subnet mask is `10.0.0.0/8` (see *Subnetwork (Subnet)* on page 7).

It may be possible to reach the CBXi over the network but BACnet messaging may fail.

In this case you may need to use a directly-connected laptop, or a different network to configure the CBXi. Alternatively you could change the CBXi's subnet mask to `10.ss.ss.ss/24`, (where `ss` is the serial number) to reduce the size of the subnet that could give rise to conflicts. For example, a CBXi with serial number `901001A` should have a subnet mask of `10.90.10.01/24`.

Accessing the CBXi's Web UI

Point a web browser at the CBXi device's IP address, and log in to the Web UI.



Device name: CBXi 939121 192.168.5.217

Login

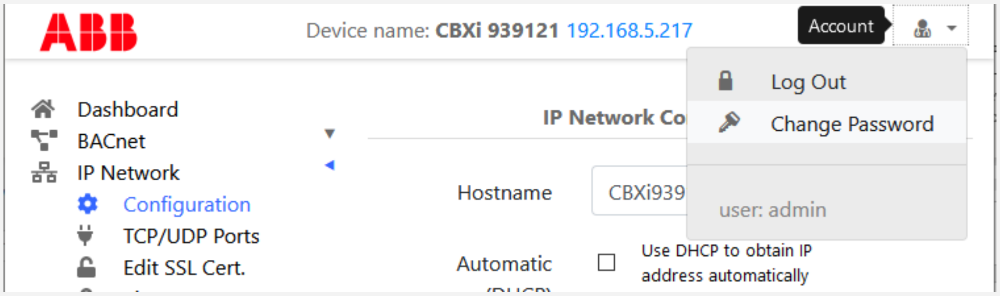
Username: admin

Password: ●●●●●●●●●

Note: By default, all CBXi devices leaving the factory are configured with the following login:

username:	`admin`
password:	`cylonctl`

It is recommended that you change these credentials by clicking on the User icon in the top-right of the Web UI page and selecting Change Password.



Device name: CBXi 939121 192.168.5.217

IP Network Co

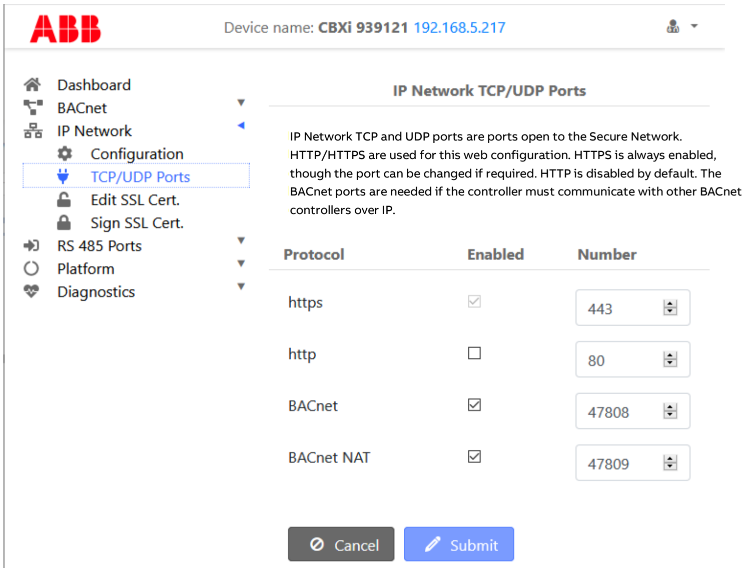
Hostname: CBXi939

Automatic (DHCP): □ Use DHCP to obtain IP address automatically

user: admin

Configuring IP Ports and IP security

Specify the Ports for each protocol that the device will use, on the IP Network > TCP/UDP Ports page:



IP Network TCP/UDP Ports

IP Network TCP and UDP ports are ports open to the Secure Network. HTTP/HTTPS are used for this web configuration. HTTPS is always enabled, though the port can be changed if required. HTTP is disabled by default. The BACnet ports are needed if the controller must communicate with other BACnet controllers over IP.

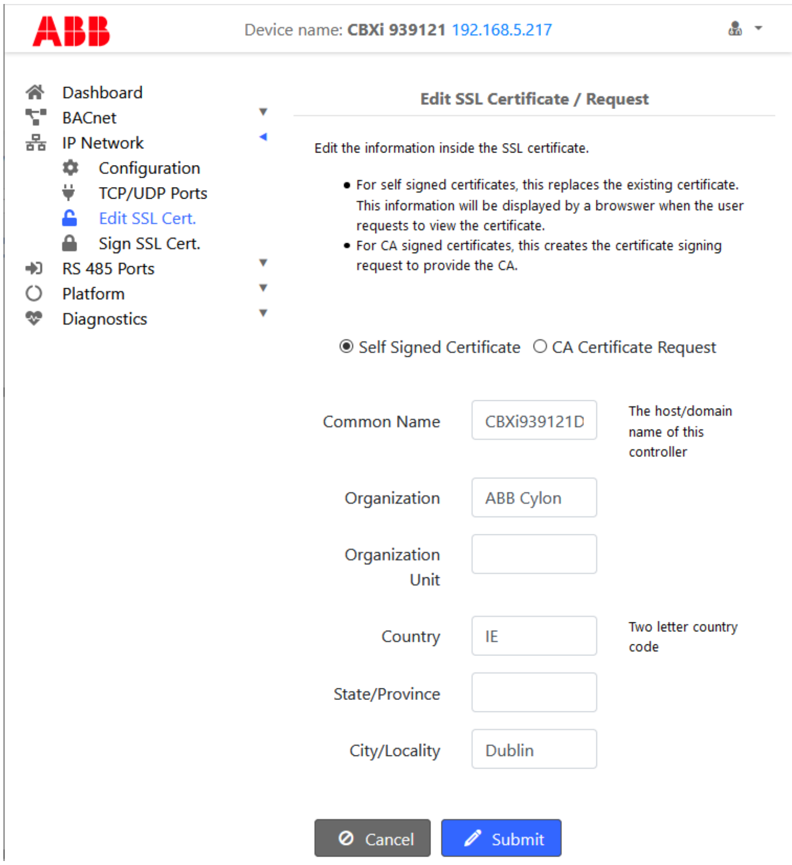
Protocol	Enabled	Number
https	☑	443
http	□	80
BACnet	☑	47808
BACnet NAT	☑	47809

Note: BACnet NAT is used for accessing the BACnet device from the Internet (ensure that this is always via a secure VPN), for example in the case of remote supervision. The Port Number set here should match the corresponding settings on the BACnet > BBMD/NAT page.

Warning: **Controllers must not be exposed on the Internet without a secure VPN**. See *HT0038 FBXi, CBXi and ASPECT® Solutions Network Security Best Practice* for detailed discussion of security issues.

Note: VPNs can themselves have security issues. It is the responsibility of the VPN owner to ensure that their VPN is kept up-to-date and secure.

CBXi controllers are shipped with a self-signed certificate. If a new self-signed certificate is required, then one can be created with the form on the IP Network > Edit SSL Cert page. If a signed certificate is required, then a signing request can be generated on the IP Network > Sign SSL Cert page, based on the information entered on the IP Network > Edit SSL Cert page.



Device name: **CBXi 939121** 192.168.5.217

Edit SSL Certificate / Request

Edit the information inside the SSL certificate.

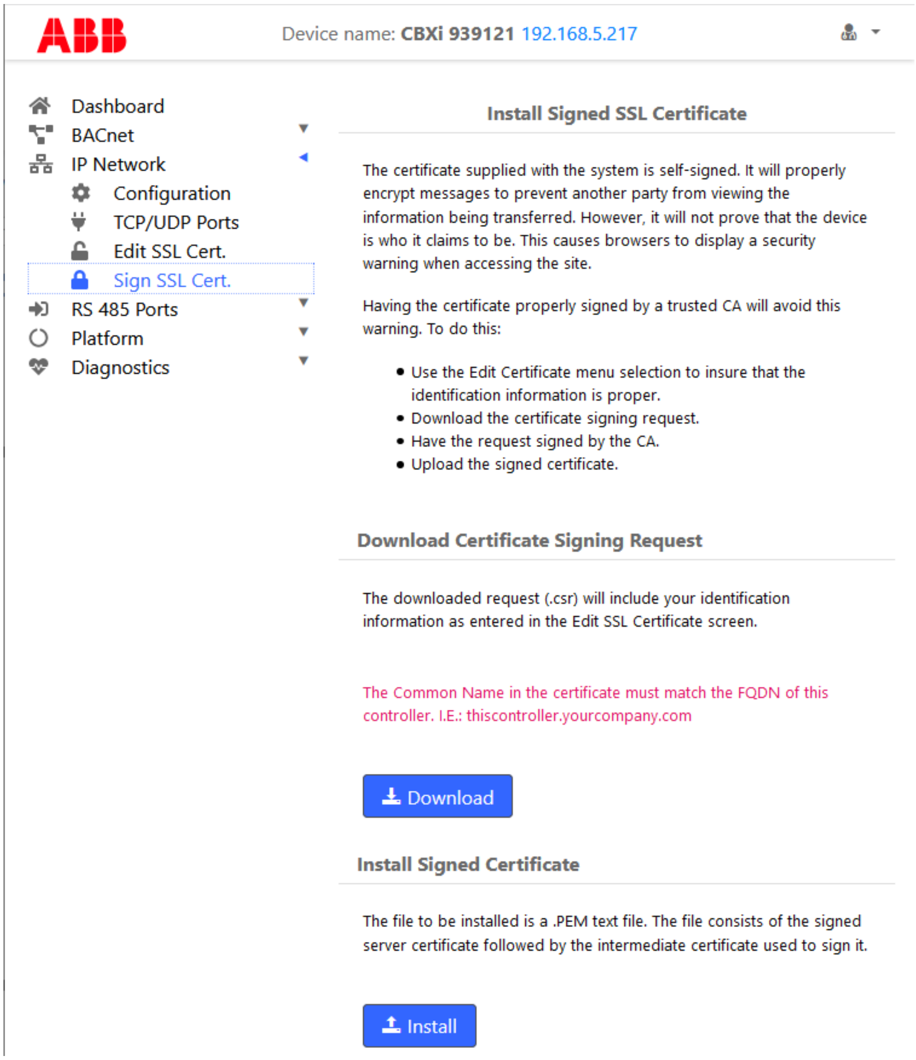
- For self signed certificates, this replaces the existing certificate. This information will be displayed by a browswer when the user requests to view the certificate.
- For CA signed certificates, this creates the certificate signing request to provide the CA.

● Self Signed Certificate ○ CA Certificate Request

Common Name	CBXi939121D	The host/domain name of this controller
Organization	ABB Cylon	
Organization Unit		
Country	IE	Two letter country code
State/Province		
City/Locality	Dublin	

The IP Network > Edit SSL Cert page allows you to enter the details for an SSL certificate, which can be applied to the current CBXi as a self-signed certificate, or else these details can be used to generate a request for a 3rd-party SSL Cert on the IP Network > Sign SSL Cert page.

To install a 3rd-party SSL Cert, or to generate a request for a 3rd-party SSL Cert, use the IP Network > Sign SSL Cert page:



Install Signed SSL Certificate

The certificate supplied with the system is self-signed. It will properly encrypt messages to prevent another party from viewing the information being transferred. However, it will not prove that the device is who it claims to be. This causes browsers to display a security warning when accessing the site.

Having the certificate properly signed by a trusted CA will avoid this warning. To do this:

- Use the Edit Certificate menu selection to insure that the identification information is proper.
- Download the certificate signing request.
- Have the request signed by the CA.
- Upload the signed certificate.

Download Certificate Signing Request

The downloaded request (.csr) will include your identification information as entered in the Edit SSL Certificate screen.

The Common Name in the certificate must match the FQDN of this controller. I.E.: thiscontroller.yourcompany.com

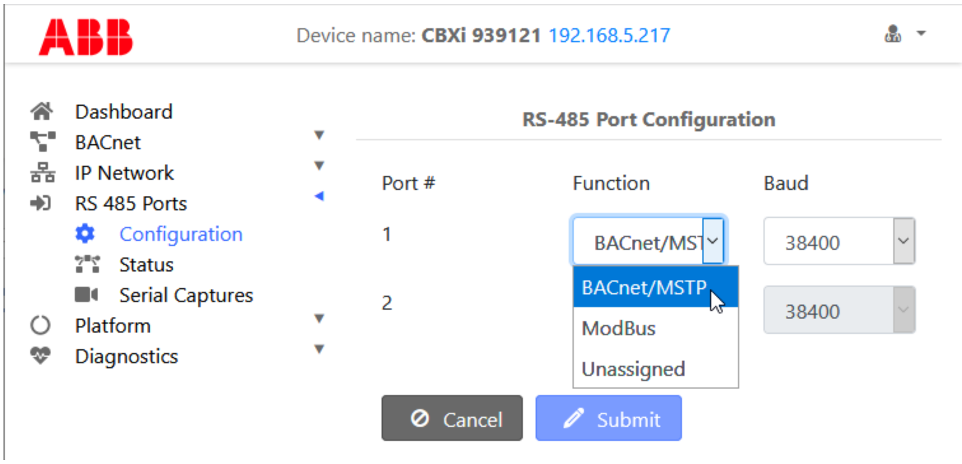
Install Signed Certificate

The file to be installed is a .PEM text file. The file consists of the signed server certificate followed by the intermediate certificate used to sign it.

CONFIGURE THE CBXI-8R8(-H) FOR BACNET® COMMUNICATIONS

The CBXi can act as an MS/TP router, passing BACnet comms to devices that are attached to its serial port.

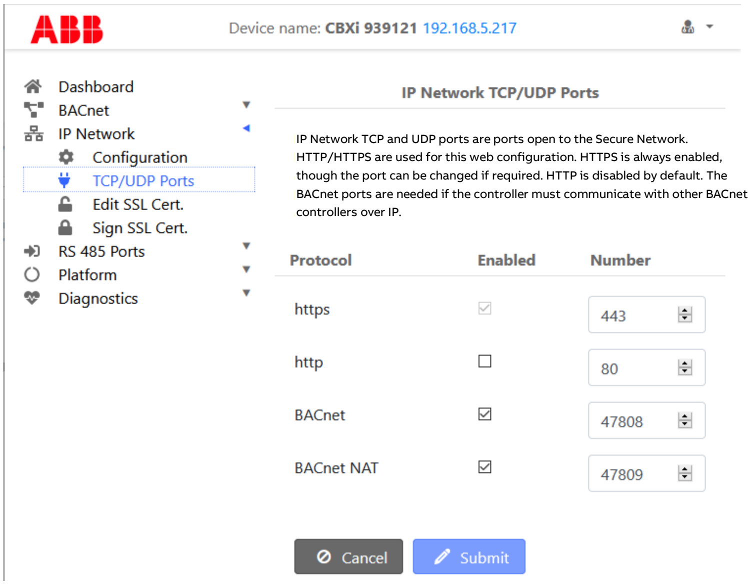
In order for this to happen, the port must be configured for MS/TP Comms using the RS 485 Port > Configuration page in the CBXi's web UI:



RS-485 Port Configuration

Port #	Function	Baud
1	BACnet/MST	38400
2	BACnet/MSTP ModBus Unassigned	38400

and, if necessary, on the IP Network > TCP/UDP Ports page:



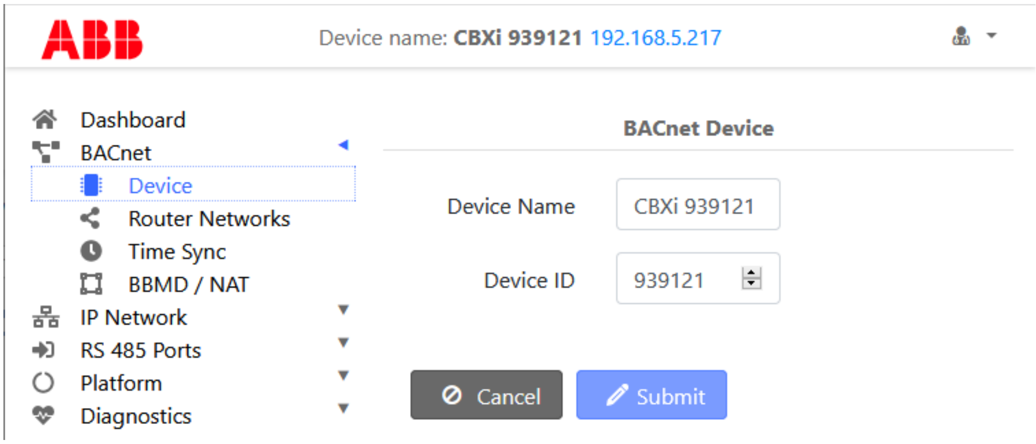
IP Network TCP/UDP Ports

IP Network TCP and UDP ports are ports open to the Secure Network. HTTP/HTTPS are used for this web configuration. HTTPS is always enabled, though the port can be changed if required. HTTP is disabled by default. The BACnet ports are needed if the controller must communicate with other BACnet controllers over IP.

Protocol	Enabled	Number
https	☑	443
http	□	80
BACnet	☑	47808
BACnet NAT	☑	47809

MAN0141 rev 26

Set the Device ID in the BACnet > Device page, and optionally set a Device Name:



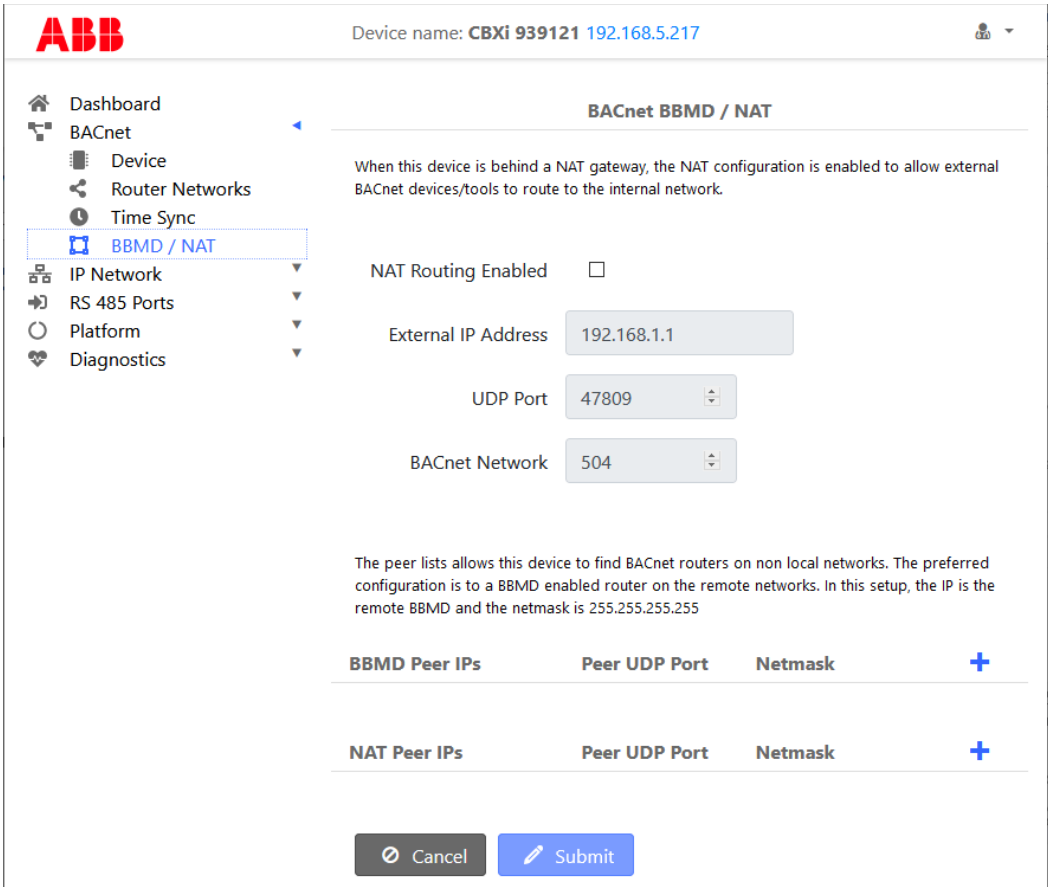
BACnet Device

Device Name: CBXi 939121

Device ID: 939121

Note: Device ID is the BACnet device instance number. Every BACnet controller within the site must receive a unique BACnet instance number to ensure proper communications. This BACnet instance number should be unique even across subnets. By default, it is set is set to the entire numeric portion of the Controller's serial number.

If the **CBXi** device is to act as a BBMD (allowing BACnet communication between Ethernet subnets), enter the relevant parameters on the BBMD/NAT page: (see *BACnet IP Broadcast Management Device (BBMD)* on page 16 for more detail)



BACnet BBMD / NAT

When this device is behind a NAT gateway, the NAT configuration is enabled to allow external BACnet devices/tools to route to the internal network.

NAT Routing Enabled ☐

External IP Address: 192.168.1.1

UDP Port: 47809

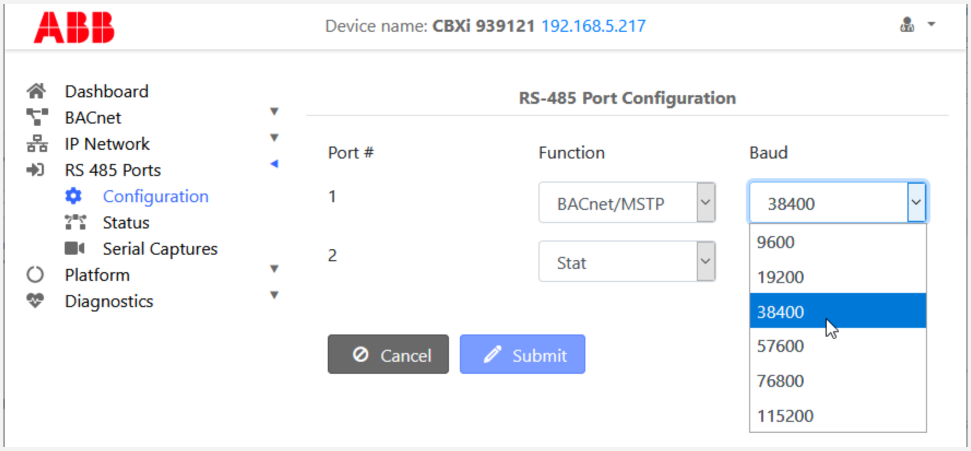
BACnet Network: 504

The peer lists allows this device to find BACnet routers on non local networks. The preferred configuration is to a BBMD enabled router on the remote networks. In this setup, the IP is the remote BBMD and the netmask is 255.255.255.255

BBMD Peer IPs	Peer UDP Port	Netmask	+

NAT Peer IPs	Peer UDP Port	Netmask	+

Note: The MS/TP baud rate must match on all devices on the MS/TP subnet. For the CBXi this is set in the RS485 Port > Configuration page:



Device name: **CBXi 939121** 192.168.5.217

RS-485 Port Configuration

Port #	Function	Baud
1	BACnet/MSTP	38400
2	Stat	

Note: A CBXi cannot have both BACnet MS/TP trunk and a Modbus RTU trunk simultaneously, but a CBXi controller that has an MS/TP subnet can read and write points to Modbus devices over IP.

CONNECT THE CBXI TO BACNET MS/TP

If the CBXi unit will be used with a BACnet MS/TP fieldbus, connect it as described in the following section.

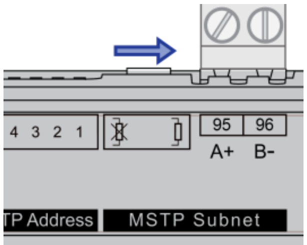
MS/TP Cabling Requirements

Note: Use Copper or Copper Clad Aluminum 70 °C conductors only.

Terminals	PCB mounted plug terminal connections
Conductor Area	Max: AWG 12 (3.31 mm2) Min: AWG 22 (0.355 mm2)
Max cable length	1.2 km @ 38K4 baud

TERMINATE THE MS/TP NETWORK

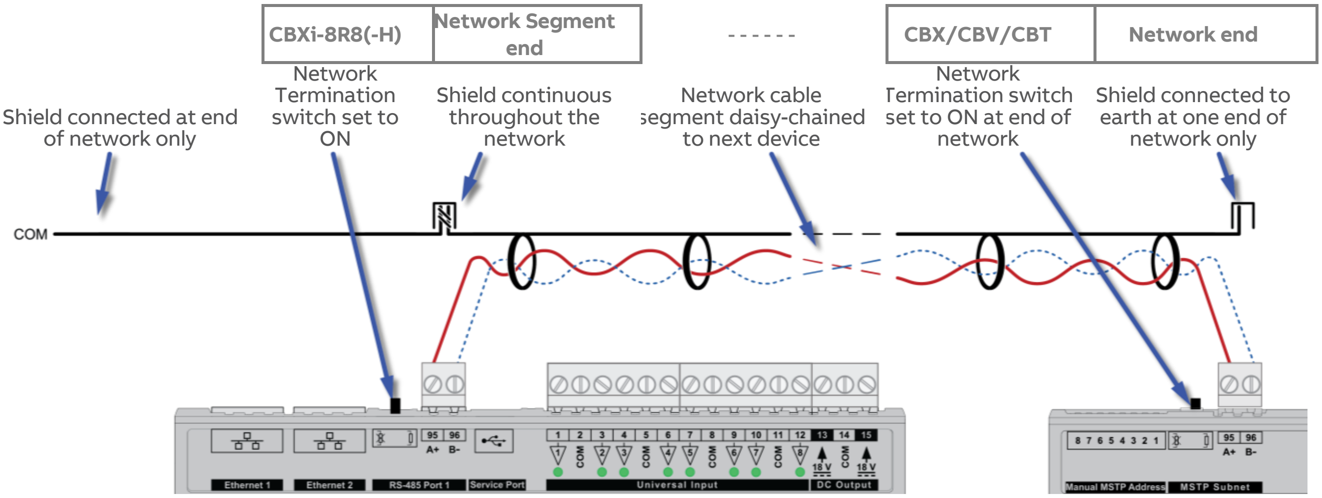
If the CBXi-8R8(-H) is the first or last device on the RS-485 network, then its MS/TP subnet terminator switch must be set to “`in`” ▯



ATTACH RS-485 COMMUNICATION WIRES TO THE MS/TP SUBNET PORT

Wiring the RS-485 network involves connecting the `A+` (95) and `B-` (96) terminals in a daisy-chained configuration. One end of the network will be connected to the Fieldbus of the CBXi. At the other end of the network, the last device must be “terminated” by either installing a 100 Ω … 120 Ω resistor or, if the last device is a CBX, users can switch the MS/TP Subnet terminator switch (located beside the MS/TP port) towards the ▯ icon. This will effectively terminate the network.

The shield (screen) must be carried through the entire network, and must be grounded at one point on the network as shown below:


CBXi-8R8(-H)
Network Segment end
- - - - - -
CBX/CBV/CBT
Network end
Shield connected at end of network only
Network Termination switch set to ON
Shield continuous throughout the network
Network cable segment daisy-chained to next device
Network Termination switch set to ON at end of network
Shield connected to earth at one end of network only
COM
95 96
A+ B-
Ethernet 1
Ethernet 2
RS-485 Port 1
Service Port
Universal Input
DC Output
18 V
Manual MSTP Address
MSTP Subnet
8 7 6 5 4 3 2 1

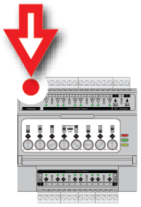
CONNECT THE CBXi-8R8(-H) TO FLX UNITS

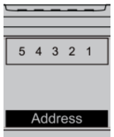
The I/O capabilities of a **CBXi-8R8(-H)** can be extended by the addition of **FLX-8R8** and **FLX-8R8-H** devices.

These are connected to the **CBXi-8R8(-H)** by means of a standard module interconnector (**FLX bus connector)**, one of which is shipped with each **FLX** device.

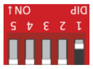
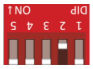
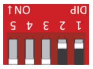
SET THE FLX ADDRESS

Each of the **FLX** units connected to a single **CBXi** must have an address that is unique on that **CBXi**'s FLX bus. The address is set by the 5-way DIP switch.





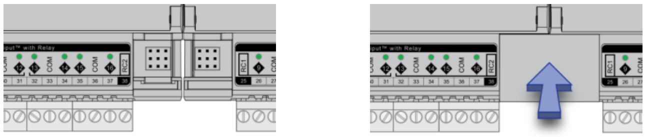
The terminals on a **FLX** unit will be accessible within the CBX Strategy with point numbers prefixed by this address as illustrated below:

Inter-module bus Address	DIP switch setting	Point numbers
00001 1		101 … 116
00010 2		201 … 216
00011 3		301 … 316

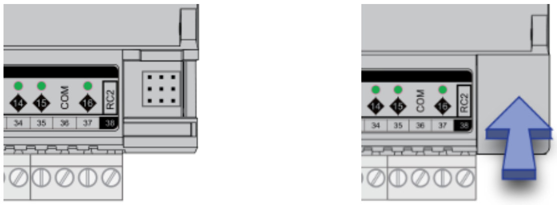
Note: If there are 2 devices on the same FLX bus with the same address – including `0`, the address of the **CBXi** - then the bottom (yellow) status LED will blink slowly to indicate a FLX bus address clash

JOIN OR TERMINATE THE FLX BUS

Place the devices side-by-side and place the **FLX bus connector** into the two adjacent sockets at once.

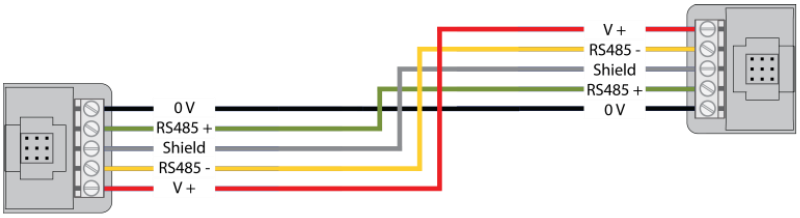


The end device on a FLX bus (either a **FLX** device or the **CBXi** itself if no **FLX** devices are connected) must have a terminator inserted into its interconnector socket. One terminator is shipped with each **CBXi-8R8(-H)** device.



(IF REQUIRED) SET UP FLX BUS EXTENSION

If a **FLX** device cannot be located beside a **CBXi** device or another **FLX** device then The FLX bus can be connected by cable using two **FLX-RMC** Remote Module Connectors, sold separately.

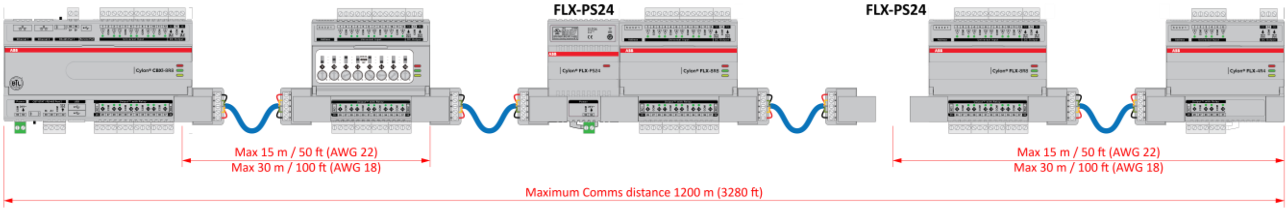


Connect cables to the two supplied **FLX-RMC** screw-terminal connectors as shown above with the appropriate length of cable.

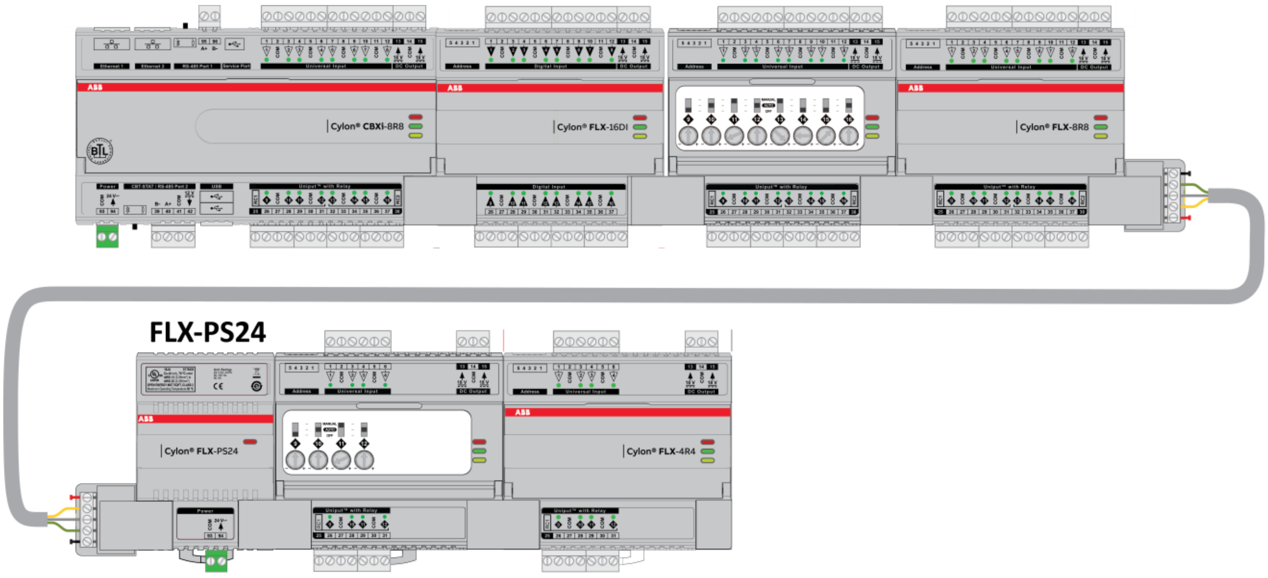
Note: Use Copper or Copper Clad Aluminum conductors only. Multiple wired connections can be used between **FLX** modules, but the total FLX bus length must be less than 1200 m (3280 ft) for RS-485 communications.

Note: The total length of FLX bus segments powered by one source (**CBX**, **CBXi** or **FLX-PS24**) must not exceed the following lengths:

Cable gauge	Max length
AWG 18	30 m / 100 ft.
AWG 22	15 m / 50 ft.


FLX-PS24
FLX-PS24
Max 15 m / 50 ft (AWG 22)
Max 30 m / 100 ft (AWG 18)
Max 15 m / 50 ft (AWG 22)
Max 30 m / 100 ft (AWG 18)
Maximum Comms distance 1200 m (3280 ft)

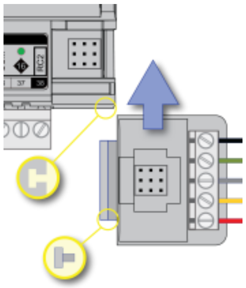
If the RMC is connected to the Left-Hand side of a FLX-PS24, then it is not strictly necessary to connect the 0 V and V+ lines:



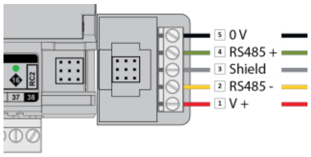
Attaching RMC terminals

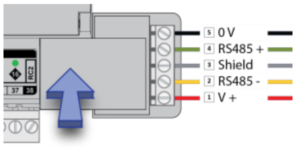
Remove the Interconnect (if installed) from the right-hand side of the FLX, FBXi, CBXi or CBX where the RMC is to be installed.

Slide one RMC connector into the T-slot of the CBX or FLX at the point at which the BUS is to be extended.

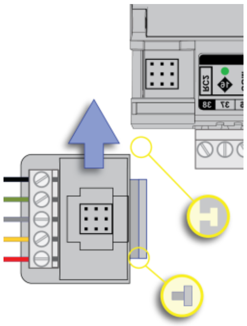


Replace the Interconnect

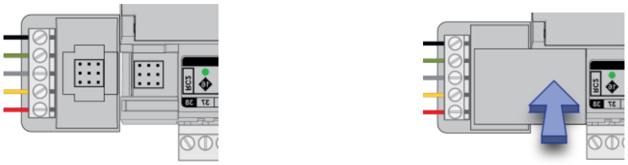




Slide the other RMC connector into the Left-Hand T-slot of the remote **FLX**.



Insert the second interconnect



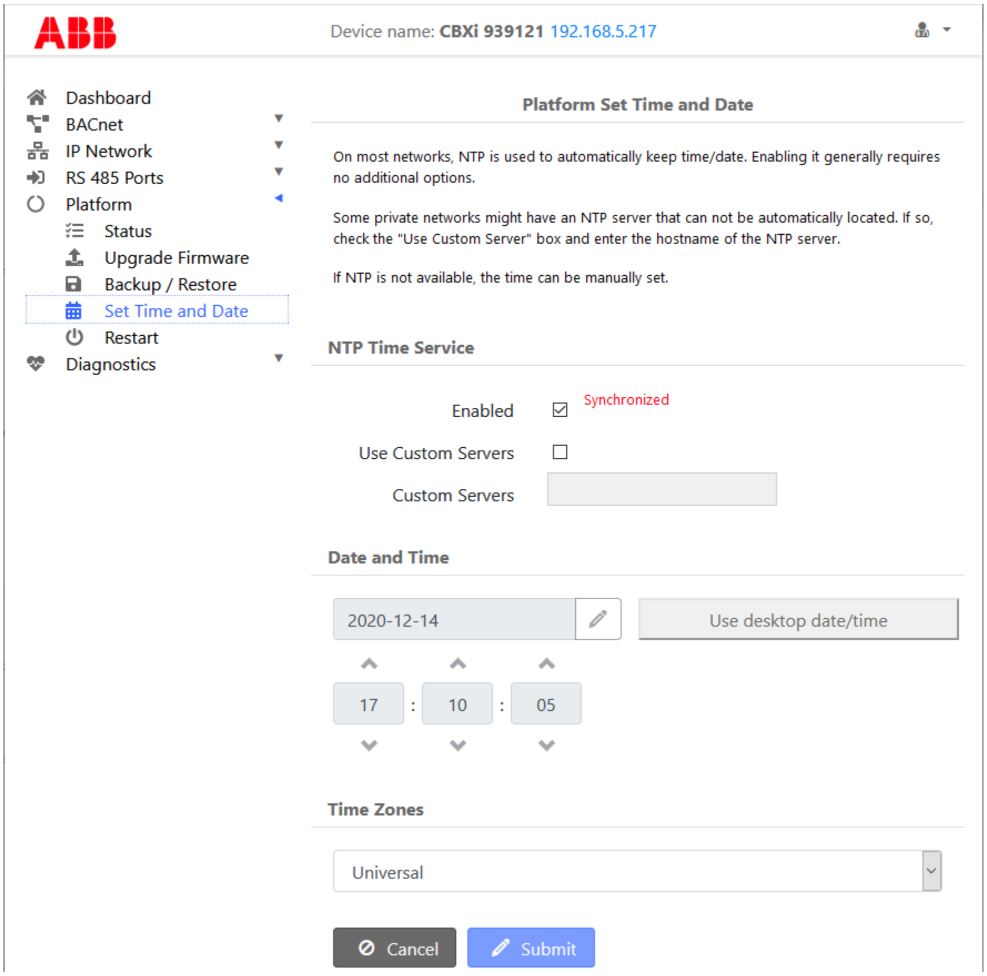
Note	The termination block can only be used on the **right-hand** interlink connector of the last **FLX** unit on the FLX bus. While it is possible, in a multi-tier system, to connect intermediate tiers from right to left to ease installation, the final tier **must** be wired from left to right so that the FLX bus can be terminated on the RHS connector of the last **FLX** on the bus

ADD THE CONTROLLER TO THE CXpro^{HD} SITE

SET CONTROLLER DATE AND TIME

Use the **CBXi** web UI (Platform > Set Time and Date) to set the controller's clock.

Alternatively, if a device on the site has been set up as a Time Sync Master, then click the Enabled checkbox under NTP Time Service, and the **CBXi-8R8(-H)** controller time will be automatically updated.



Device name: **CBXi 939121** 192.168.5.217

Platform Set Time and Date

On most networks, NTP is used to automatically keep time/date. Enabling it generally requires no additional options.

Some private networks might have an NTP server that can not be automatically located. If so, check the "Use Custom Server" box and enter the hostname of the NTP server.

If NTP is not available, the time can be manually set.

NTP Time Service

Enabled ☑ Synchronized

Use Custom Servers ☐

Custom Servers

Date and Time

2020-12-14

17 : 10 : 05

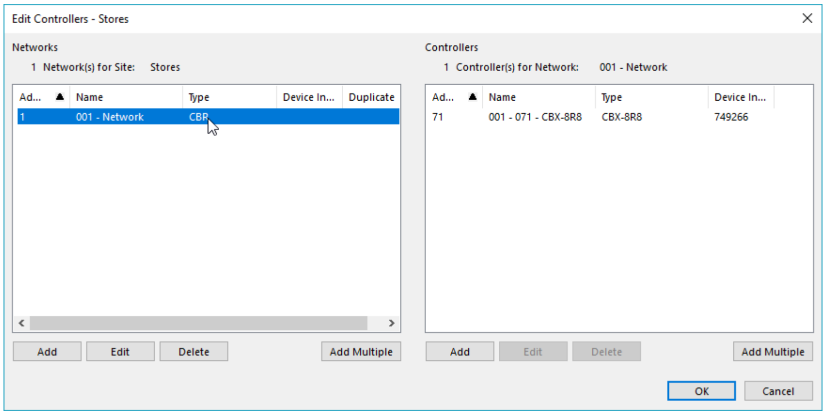
Time Zones

Universal

SET UP THE CBXI AND CONNECTED FLX MODULES IN A SITE IN CXPRO^{HD}

On an MS/TP trunk, a CBXi device acts as a Router. Because of this, CBXi controllers are configured in the Networks section of the Edit Controllers dialog in CXpro^{HD}'s Configuration utility.

Click the Add button, select the new Network that is created, and click the Edit button:



Edit Controllers - Stores

Networks

1 Network(s) for Site: Stores

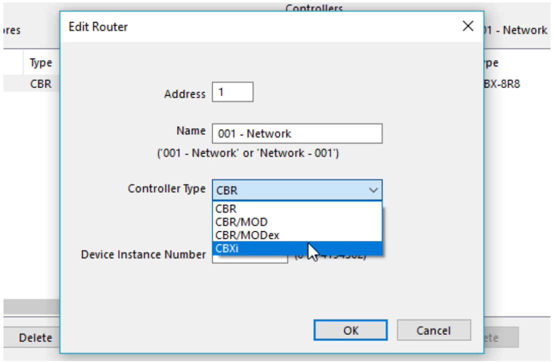
Ad...	Name	Type	Device In...	Duplicate
1	001 - Network	CBR		

Controllers

1 Controller(s) for Network: 001 - Network

Ad...	Name	Type	Device In...
71	001 - 071 - CBX-8R8	CBX-8R8	749266

Set the Controller Type to `CBXi`:



Edit Router

Address: 1

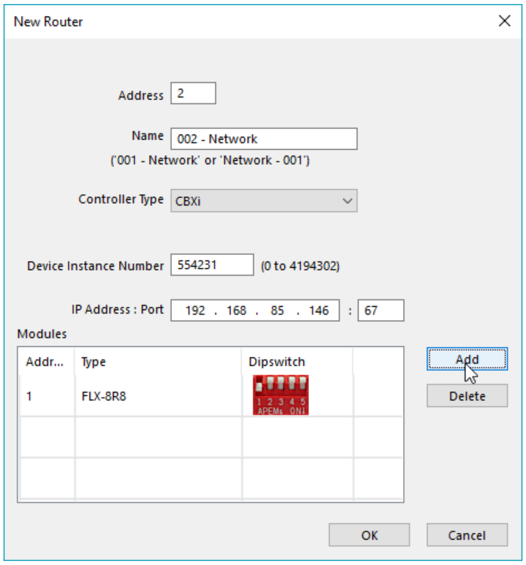
Name: 001 - Network

('001 - Network' or 'Network - 001')

Controller Type: CBR

Device Instance Number:

Set the controller Name, Device Instance Number and IP Address : Port (for exporting to ASPECT® and INTEGRA™) and if the CBX device has one or more FLX modules connected to it, add the same number of entries in the Modules table:



New Router

Address: 2

Name: 002 - Network

('001 - Network' or 'Network - 001')

Controller Type: CBXi

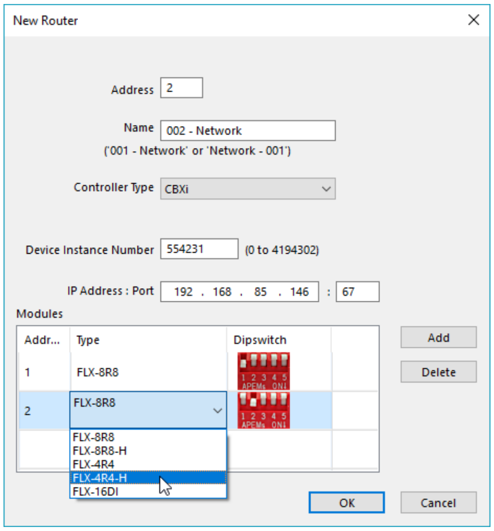
Device Instance Number: 554231 (0 to 4194302)

IP Address : Port: 192 . 168 . 85 . 146 : 67

Modules

Addr...	Type	Dipswitch
1	FLX-8R8	

When FLX modules have been added, the specific FLX type can be set in the Modules Table Type column:



Address 2

Name 002 - Network
('001 - Network' or 'Network - 001')

Controller Type CBXi

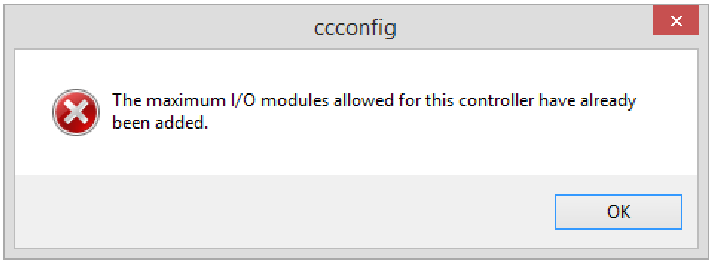
Device Instance Number 554231 (0 to 4194302)

IP Address : Port 192 . 168 . 85 . 146 : 67

Modules

Addr...	Type	Dipswitch
1	FLX-8R8	
2	FLX-8R8	

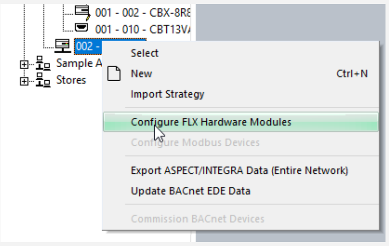
If you attempt to add more modules than the CBXi can support, an error message will be displayed:

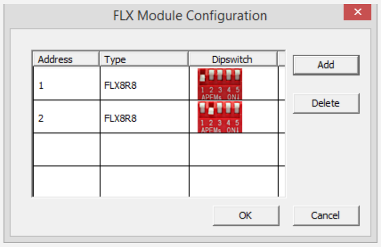


The maximum I/O modules allowed for this controller have already been added.

When the correct number of FLX modules has been added, click OK.

Note: The IO module configuration can be changed later by opening the FLX Module Configuration dialog from the Site Tree:

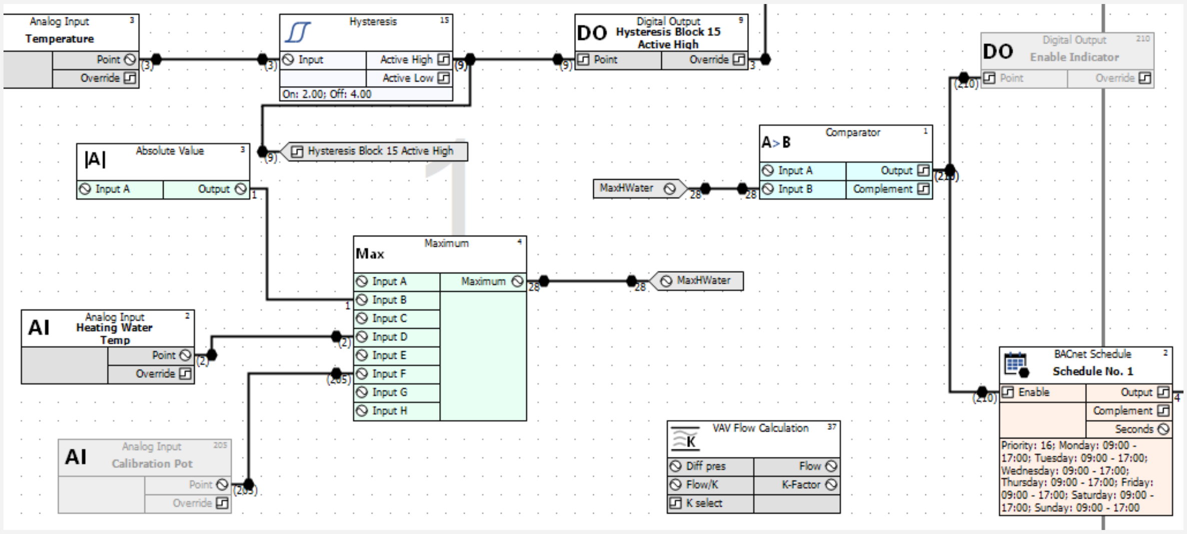




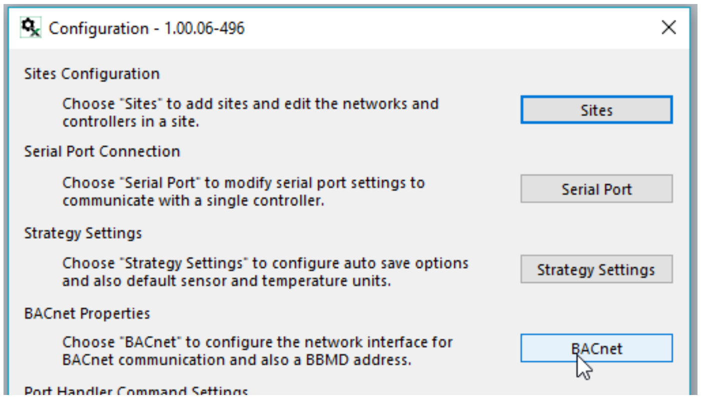
Address	Type	Dipswitch
1	FLX8R8	
2	FLX8R8	

In the Strategy drawing, IO blocks can be added up to the total on the configured **FLX** modules plus the **CBXi** onboard IO.

Note: If a **FLX** module is deleted from a **CBXi** configuration (**in CXpro^{HD}'s Configuration utility**) after the Strategy drawing has been set up, the blocks associated with that **FLX**'s IO will be 'greyed out' to indicate that they are inactive.



Set the BACnet properties for the new Network, by clicking the BACnet button in the **Configuration** utility's main menu:


Configuration - 1.00.06-496

Sites Configuration

Choose "Sites" to add sites and edit the networks and controllers in a site.

Serial Port Connection

Choose "Serial Port" to modify serial port settings to communicate with a single controller.

Strategy Settings

Choose "Strategy Settings" to configure auto save options and also default sensor and temperature units.

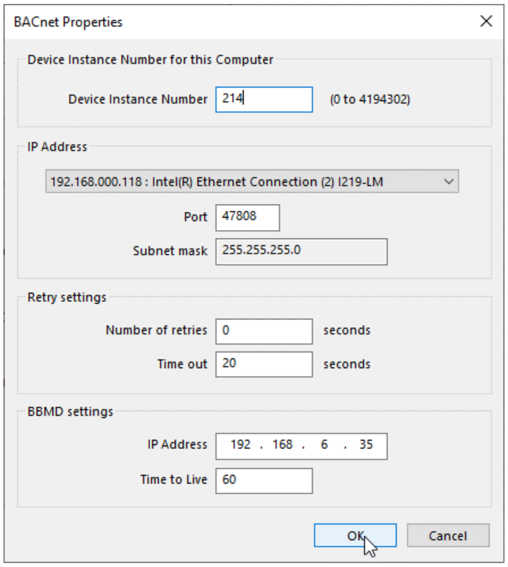
BACnet Properties

Choose "BACnet" to configure the network interface for BACnet communication and also a BBMD address.

Port Handler Command Settings

Note: If the **CBXi** needs to communicate with BACnet devices on other IP Subnetworks, enter the IP address of the BBMD device.

Enter a device instance number.



BACnet Properties

Device Instance Number for this Computer

Device Instance Number: 214 (0 to 4194302)

IP Address

192.168.000.118 : Intel(R) Ethernet Connection (2) I219-LM

Port: 47808

Subnet mask: 255.255.255.0

Retry settings

Number of retries: 0 seconds

Time out: 20 seconds

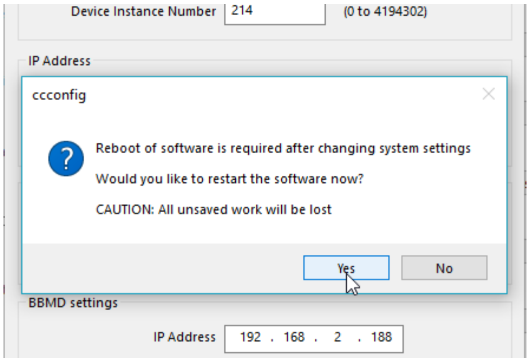
BBMD settings

IP Address: 192 . 168 . 6 . 35

Time to Live: 60

Click OK

Reboot the system to apply the new settings:



Device Instance Number: 214 (0 to 4194302)

IP Address

ccconfig

Reboot of software is required after changing system settings

Would you like to restart the software now?

CAUTION: All unsaved work will be lost

BBMD settings

IP Address: 192 . 168 . 2 . 188

(IF REQUIRED) CONFIGURE A MODBUS CONNECTION

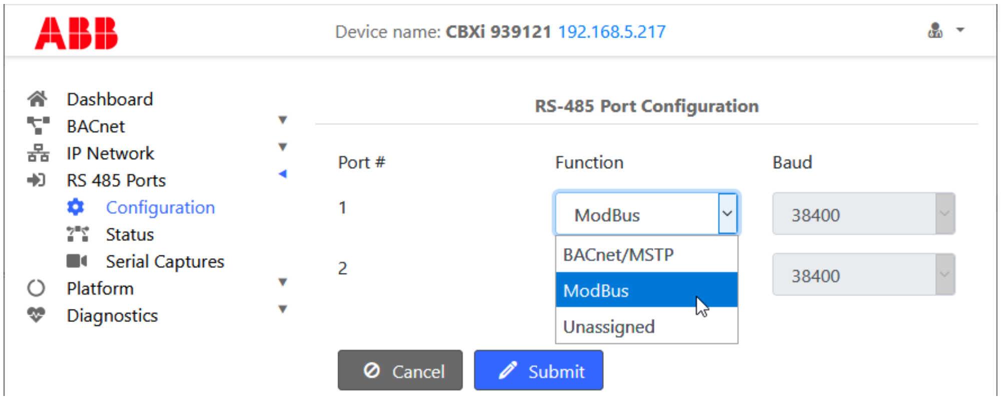
Modbus connections can be made directly to Modbus IP devices on an RTU trunk connected to the CBXi, or over IP to RTU devices attached to a separate router.

Note: A CBXi cannot have both BACnet MS/TP trunk and a Modbus RTU trunk simultaneously, but a CBXi controller that has an MS/TP subnet can read and write points to Modbus devices over IP.

Configuring a Modbus RTU connection

If a Modbus connection is to be through the Modbus RTU port (RS485 Port 1),

In the controllers' Web UI > RS 485 Port > Configuration page, set Protocol to Controller Modbus:

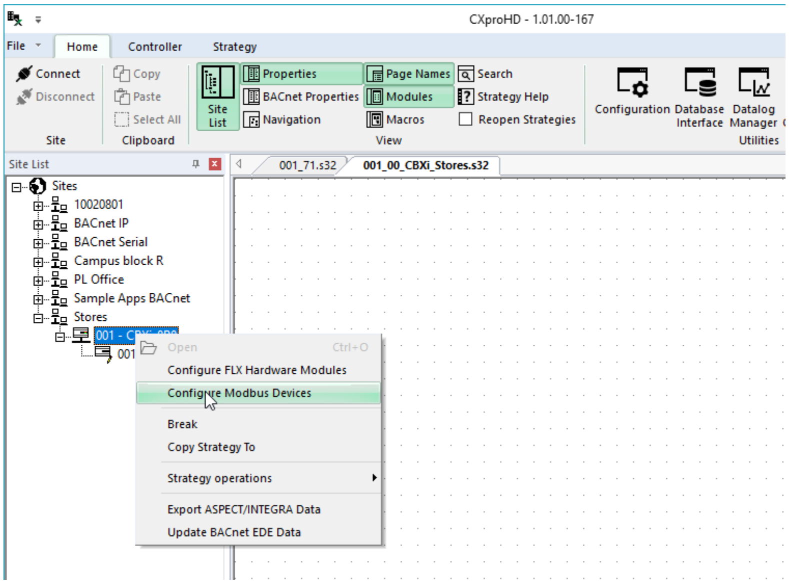


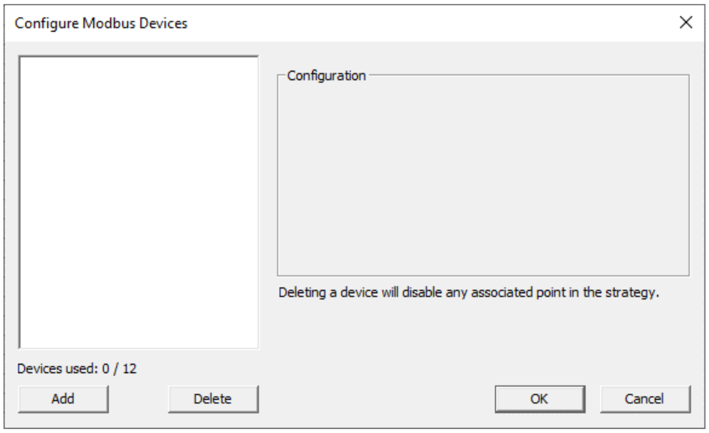
RS-485 Port Configuration

Port #	Function	Baud
1	ModBus	38400
2		38400

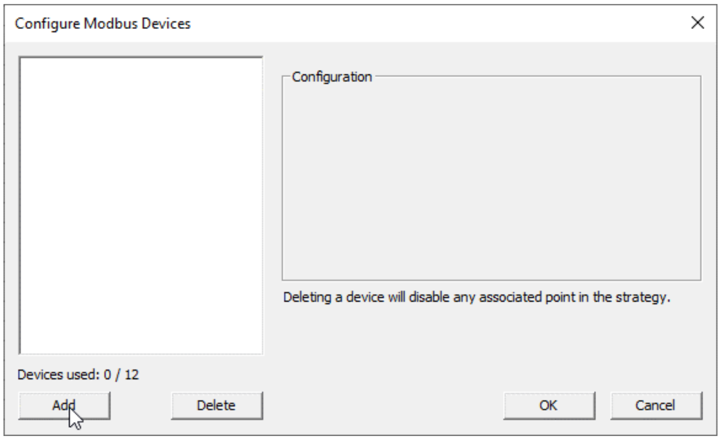
In CXpro^{HD}, open the Strategy drawing for the CBXi.

With the Strategy open, right-click on the CBXi in the Site Tree, and select Configure Modbus Devices to open the Modbus Configuration dialog:





Add a Modbus connection by clicking the Add button in the Configure Modbus Devices dialog

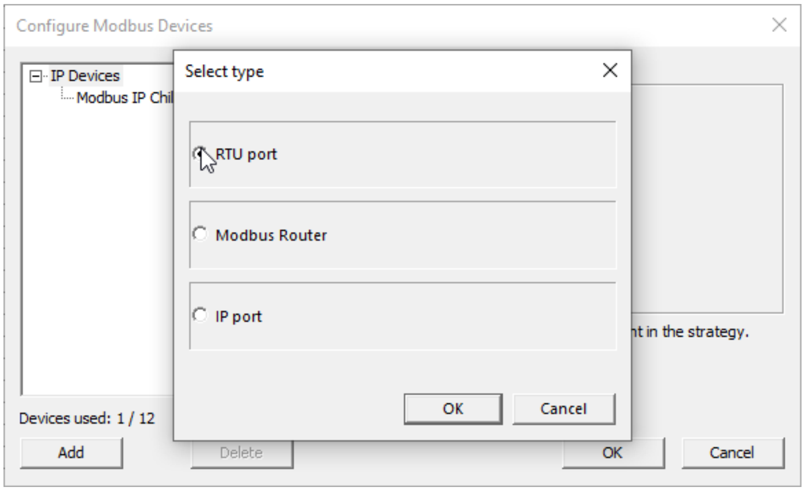


In CBXi controllers, each time you add a Modbus device you are offered the choice of adding

1. a Modbus RTU device connected to the CBXi's RTU port
2. a Modbus IP device
3. a Modbus RTU device connected to a separate IP Router

Connecting directly to a Modbus RTU device

Select RTU Port and click OK,



Configure Modbus Devices

Select type

● RTU port

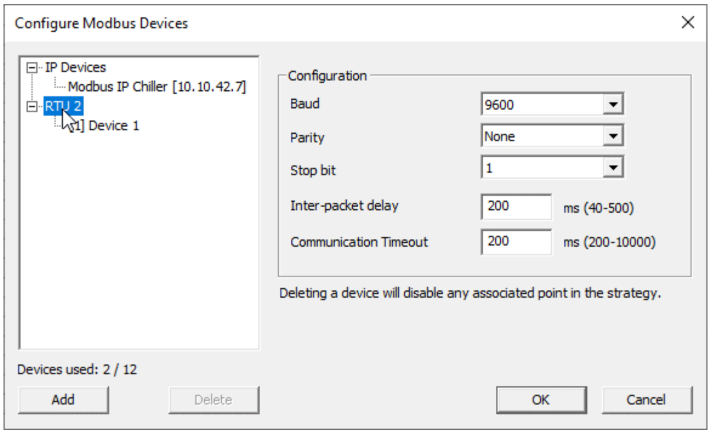
○ Modbus Router

○ IP port

Devices used: 1 / 12

...nt in the strategy.

When the first Modbus RTU device is added, an entry for the RTU trunk itself is added. Select this trunk, and set the Baud rate, Parity and Stop Bit to match all other devices on the RS485 trunk:



Configure Modbus Devices

Configuration

Baud: 9600

Parity: None

Stop bit: 1

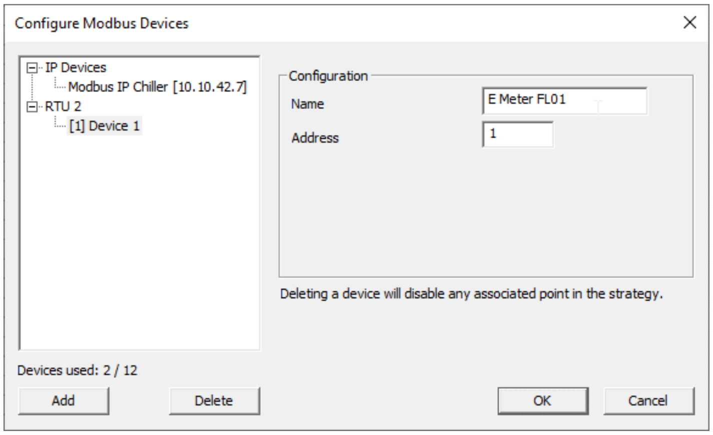
Inter-packet delay: 200 ms (40-500)

Communication Timeout: 200 ms (200-10000)

Deleting a device will disable any associated point in the strategy.

Devices used: 2 / 12

Set a name and Modbus address for the device that was added along with the RTU trunk



Configure Modbus Devices

Configuration

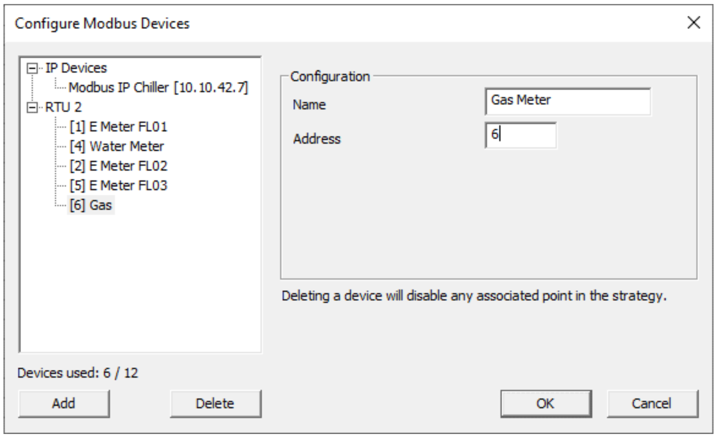
Name: E Meter FL01

Address: 1

Deleting a device will disable any associated point in the strategy.

Devices used: 2 / 12

For each additional device on the RTU trunk, click the Add button, select RTU and specify a name and RTU address.



Configure Modbus Devices

Configuration

Name: Gas Meter

Address: 6

Deleting a device will disable any associated point in the strategy.

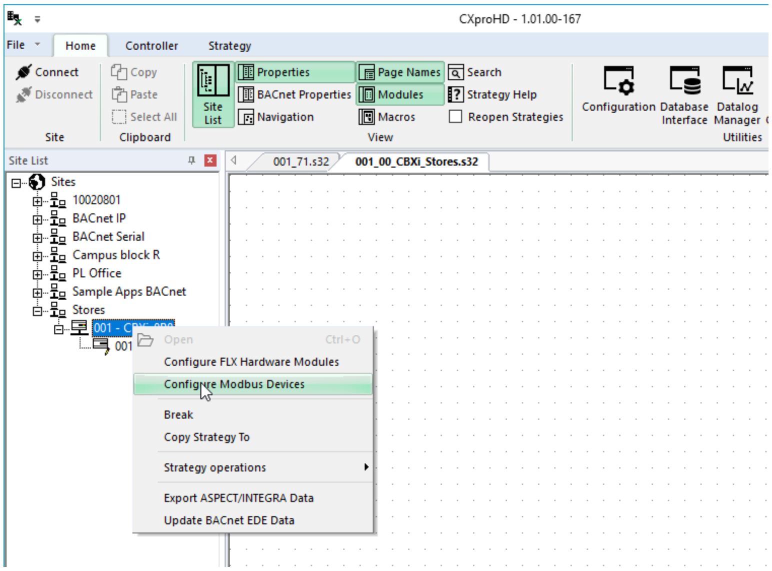
Devices used: 6 / 12

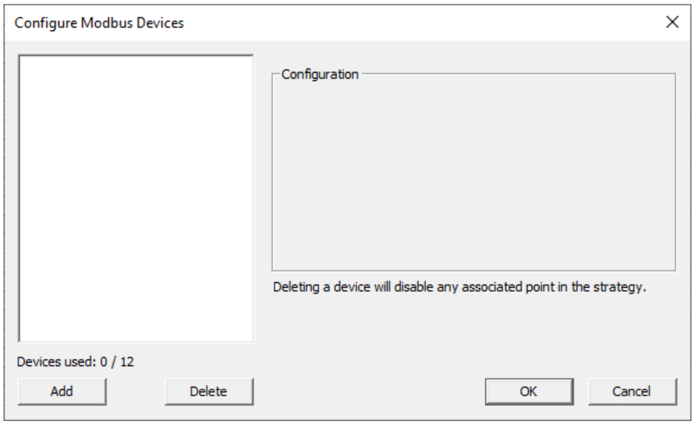
Configuring a Modbus IP connection

If a Modbus connection is to be over IP,

In **CXpro**^{HD}, open the Strategy drawing for the **CBXi**.

With the Strategy open, right-click on the **CBXi** in the Site Tree, and select Configure Modbus Devices to open the Configure Modbus Devices dialog:

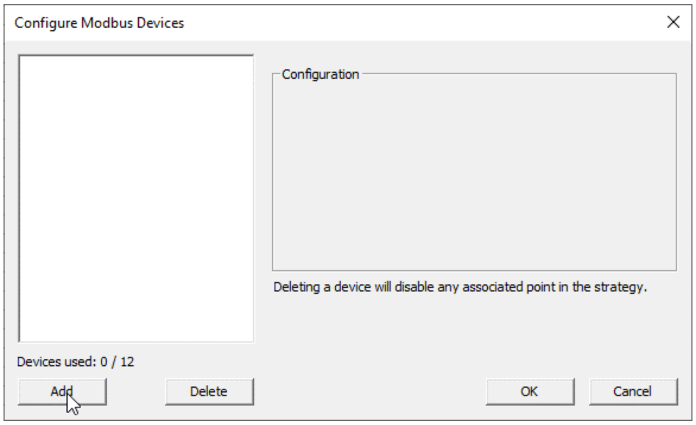




Deleting a device will disable any associated point in the strategy.

Devices used: 0 / 12

Add a Modbus connection by clicking the Add button in the Configure Modbus Devices dialog



Deleting a device will disable any associated point in the strategy.

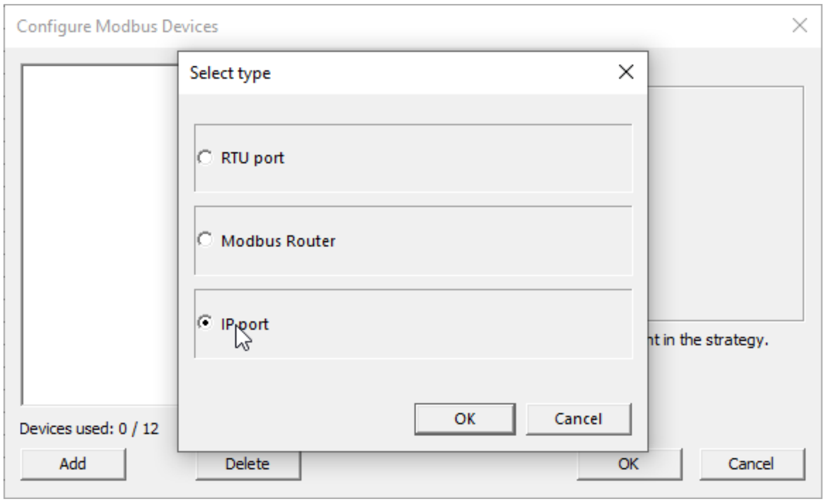
Devices used: 0 / 12

In CBXi controllers, each time you add a Modbus device you are offered the choice of adding

1. a Modbus RTU device connected to the CBXi's RTU port
2. a Modbus IP device
3. a Modbus RTU device connected to a separate IP Router

Connecting directly to an IP Modbus device

Select IP Port (device directly connected over IP) and click OK

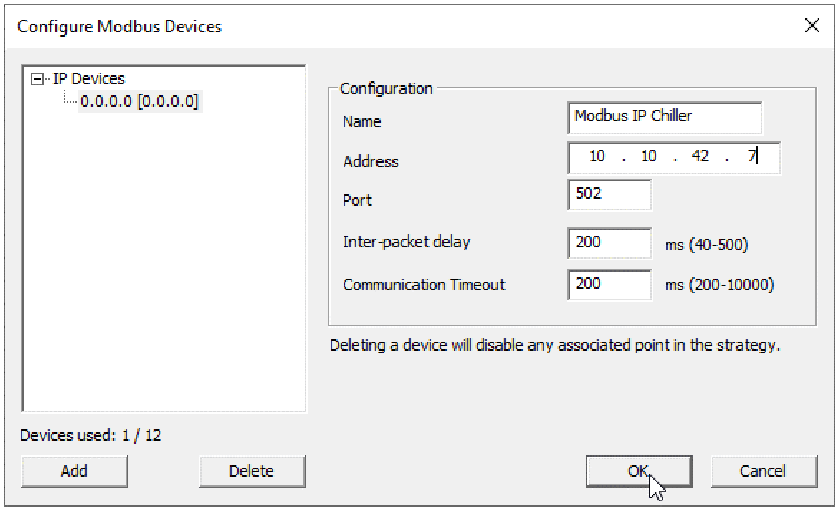


○ RTU port

○ Modbus Router

● IP port

Set the Name and IP Address for the device and Click OK



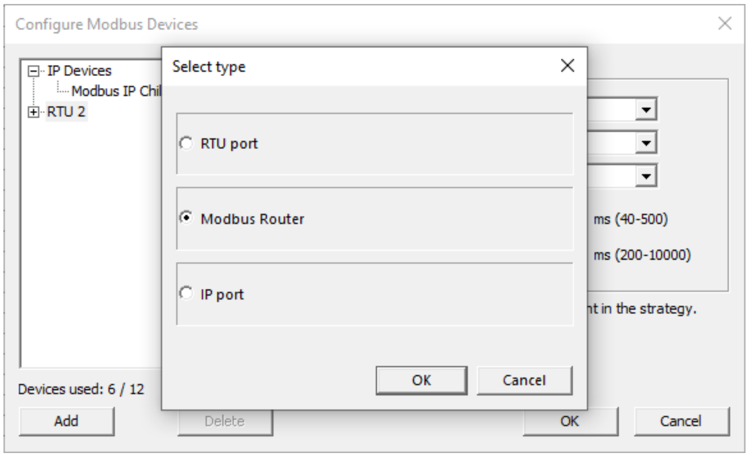
Name	Modbus IP Chiller	
Address	10 . 10 . 42 . 7	
Port	502	
Inter-packet delay	200	ms (40-500)
Communication Timeout	200	ms (200-10000)

Deleting a device will disable any associated point in the strategy.

Devices used: 1 / 12

Connecting to a remote Modbus RTU device through an IP router

Select Modbus Router


Configure Modbus Devices

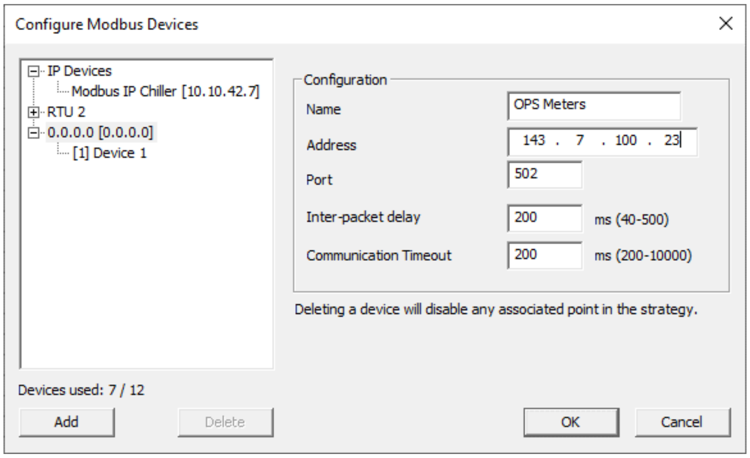
Select type

○ RTU port

● Modbus Router

○ IP port

Set a Name, IP address and IP Port for the Router


Configure Modbus Devices

Configuration

Name: OPS Meters

Address: 143 . 7 . 100 . 23

Port: 502

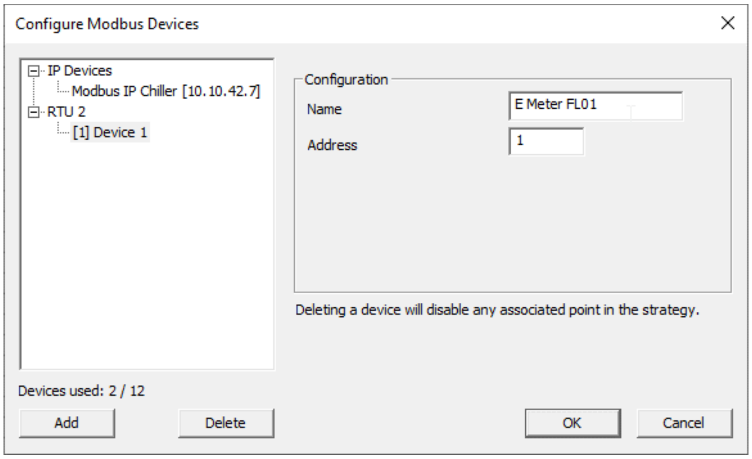
Inter-packet delay: 200 ms (40-500)

Communication Timeout: 200 ms (200-10000)

Deleting a device will disable any associated point in the strategy.

Devices used: 7 / 12

Set a name and Modbus address for the RTU device that was added along with the Router


Configure Modbus Devices

Configuration

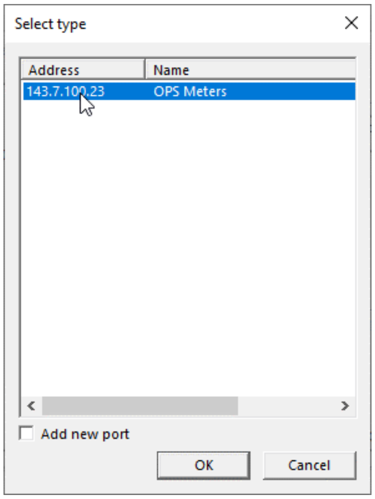
Name: E Meter FL01

Address: 1

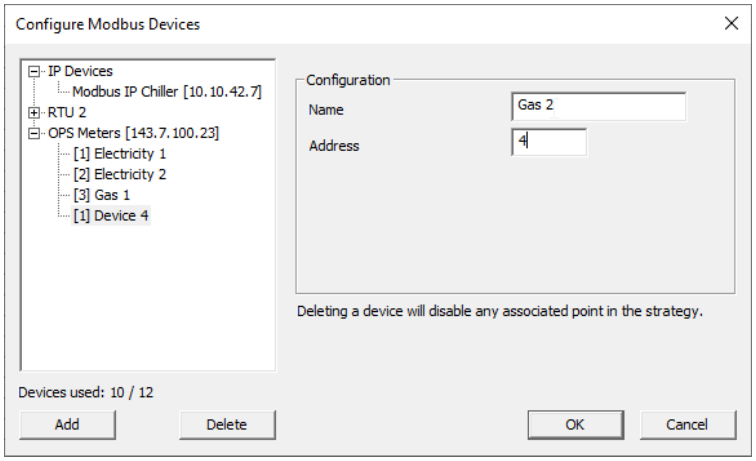
Deleting a device will disable any associated point in the strategy.

Devices used: 2 / 12

For each additional device on the Router's RTU trunk, click the Add button, select Modbus Router, select the existing Router in the additional Select Type dialog that is displayed:



and specify a name and RTU address.



Name: Gas 2

Address: 4

Deleting a device will disable any associated point in the strategy.

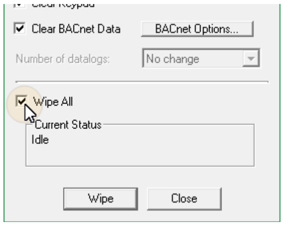
Devices used: 10 / 12

Click OK when Modbus device configuration is complete.

SET I/O TO A KNOWN SAFE MODE

Before connecting equipment to the CBXi-8R8(-H) or FLX devices, carry out a Wipe Controller command from CXpro^{HD} to put I/O into a Known Safe Mode:

- In CXpro^{HD} select Wipe Controller from the Controller tab on the Ribbon.
  In the Wipe Controller dialog, click in the 'Wipe All' checkbox.



☑ Clear BACnet Data

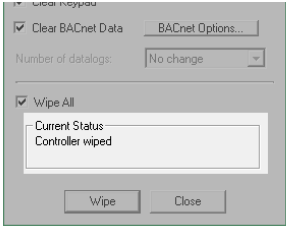
Number of datalogs: No change

☑ Wipe All

Current Status
Idle

- Click on the 'Wipe' button.

  When the Wipe operation is complete, a 'Controller Wiped' message is displayed:



☑ Clear BACnet Data

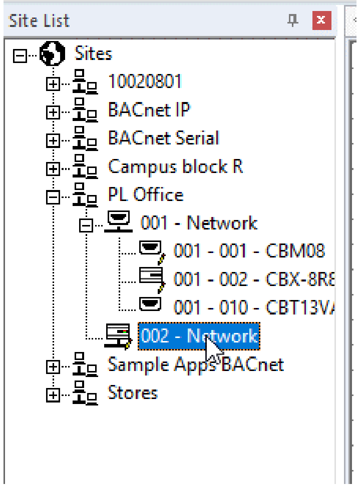
Number of datalogs: No change

☑ Wipe All

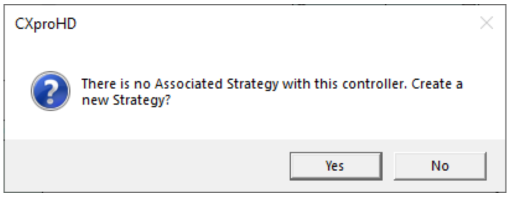
Current Status
Controller wiped

SET UP THE CONTROLLER STRATEGY

In CXpro^{HD}, double-click on the controller in the Site Tree to open its Strategy:



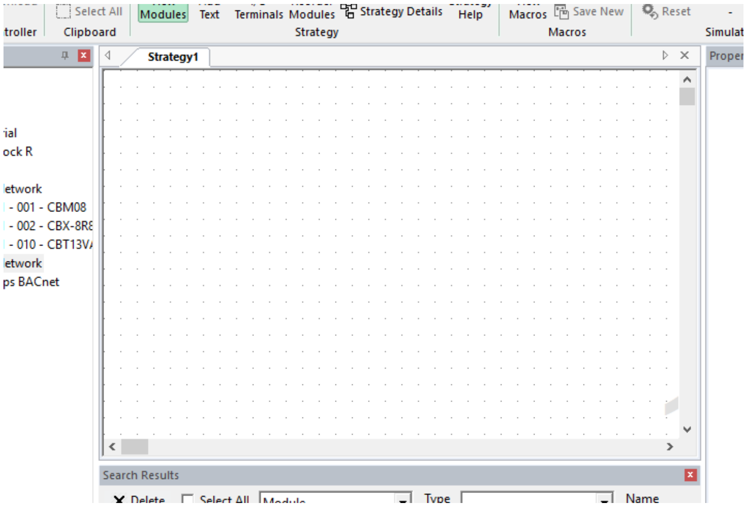
If there is no existing Strategy in the controller, an invitation to create a new one will be displayed:



CXproHD

There is no Associated Strategy with this controller. Create a new Strategy?

Click Yes to open a new blank strategy drawing:



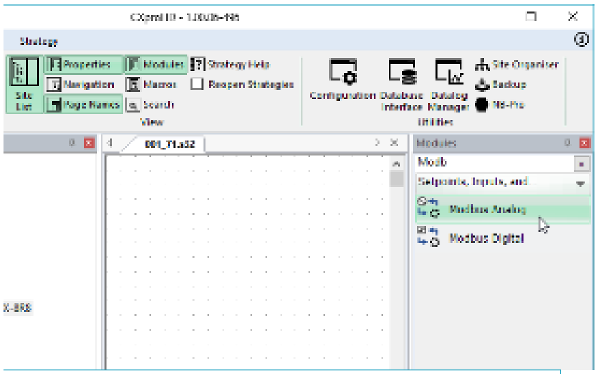
Add strategy blocks and points to create the required strategy – see *MAN0133 CXpro^{HD} User Guide* for more detail.

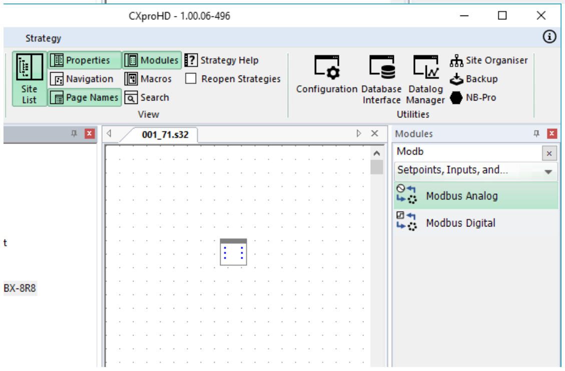
Note: In CBXi-8R8(-H) controllers there are:

- A total of 1500 strategy blocks, numbered 1 - 1500
- A maximum of 640 exposed BACnet points
- A minimum of 16 and a maximum of 64 hardware points:
  - The first 16 are numbered 1 - 16, representing the internal I/O in the CBXi
  - The 16 points in an attached **FLX** with MS/TP address set to “1” are numbered 101 … 116
  - The 16 points in an attached **FLX** with MS/TP address set to “2” are numbered 201 … 216
  - The 16 points in an attached **FLX** with MS/TP address set to “3” are numbered 301 … 316

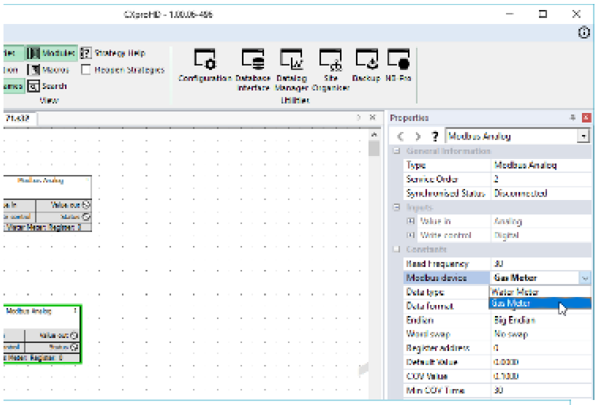
ACCESSING MODBUS POINTS IN THE STRATEGY

Select Modbus point modules and place them on the strategy drawing area:



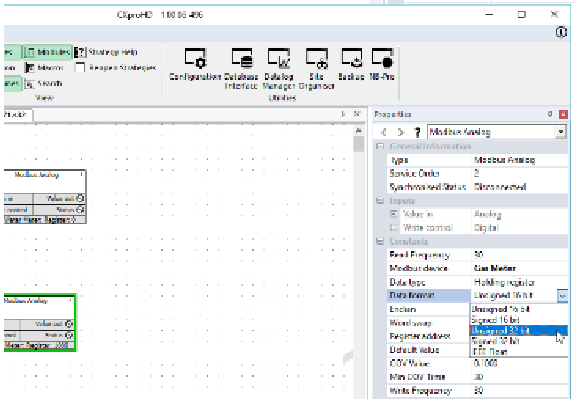


Select the Module Device to which each module will refer, specify the Data Format and Register to use:



Properties: Modbus Analog

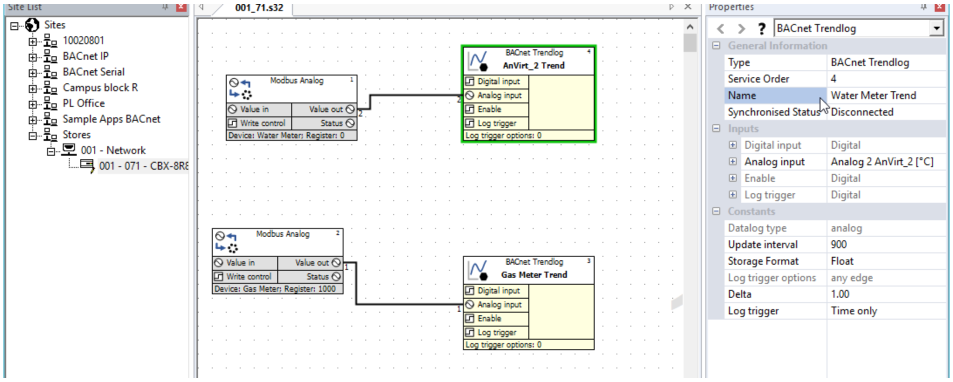
General Information	
Type	Modbus Analog
Service Order	2
Synchronised Status	Disconnected
Inputs	
Value in	Analog
Write control	Digital
Constants	
Read Frequency	30
Modbus device	Gas Meter
Data type	
Data format	
Endian	Big Endian
Word swap	No swap
Register address	0
Default Value	0.0000
COV Value	0.1000
Min COV Time	30



Properties: Modbus Analog

General Information	
Type	Modbus Analog
Service Order	2
Synchronised Status	Disconnected
Inputs	
Value in	Analog
Write control	Digital
Constants	
Read Frequency	30
Modbus device	Gas Meter
Data type	Holding register
Data format	Unsigned 16 bit
Endian	
Word swap	
Register address	
Default Value	
COV Value	0.1000
Min COV Time	30
Write Frequency	30

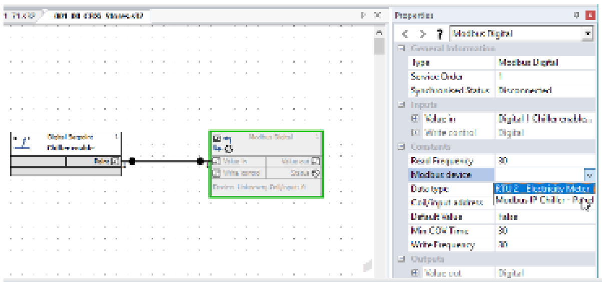
The Modbus point can be read and passed to points in the Strategy:



BACnet Trendlog

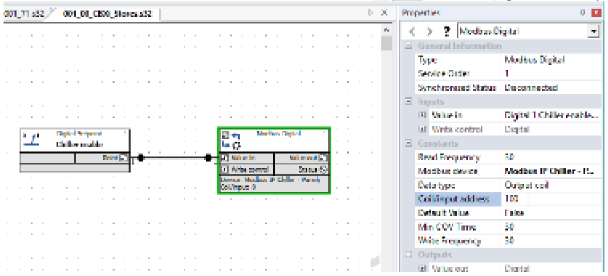
General Information	
Type	BACnet Trendlog
Service Order	4
Name	Water Meter Trend
Synchronised Status	Disconnected
Inputs	
Digital input	Digital
Analog input	Analog 2 AnVirt_2 [°C]
Enable	Digital
Log trigger	Digital
Constants	
Datalog type	analog
Update interval	900
Storage Format	Float
Log trigger options	any edge
Delta	1.00
Log trigger	Time only

or point values can be passed to the Modbus device by specifying the Coil/Input address:



Modbus Digital

General Information	
Type	Modbus Digital
Service Order	1
Synchronised Status	Disconnected
Inputs	
Value in	Digital 1 Chiller enable...
Write control	Digital
Constants	
Read Frequency	30
Modbus device	
Data type	RTU 2 - Electricity Meter Modbus IP Chiller - Panel
Coil/Input address	
Default Value	False
Min COV Time	30
Write Frequency	30
Outputs	
Value out	Digital



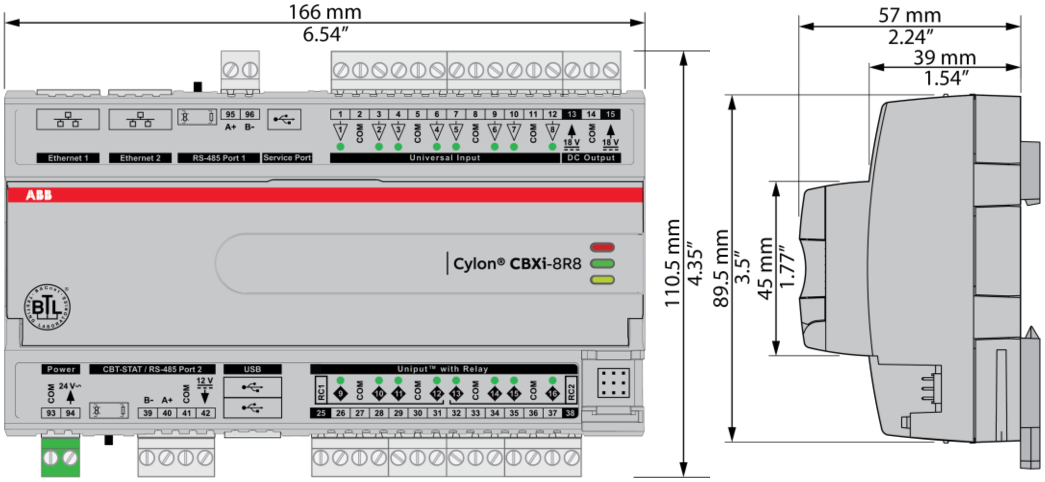
Modbus Digital

General Information	
Type	Modbus Digital
Service Order	1
Synchronised Status	Disconnected
Inputs	
Value in	Digital 1 Chiller enable...
Write control	Digital
Constants	
Read Frequency	30
Modbus device	Modbus IP Chiller - P...
Data type	Output coil
Coil/Input address	100
Default Value	False
Min COV Time	30
Write Frequency	30
Outputs	
Value out	Digital

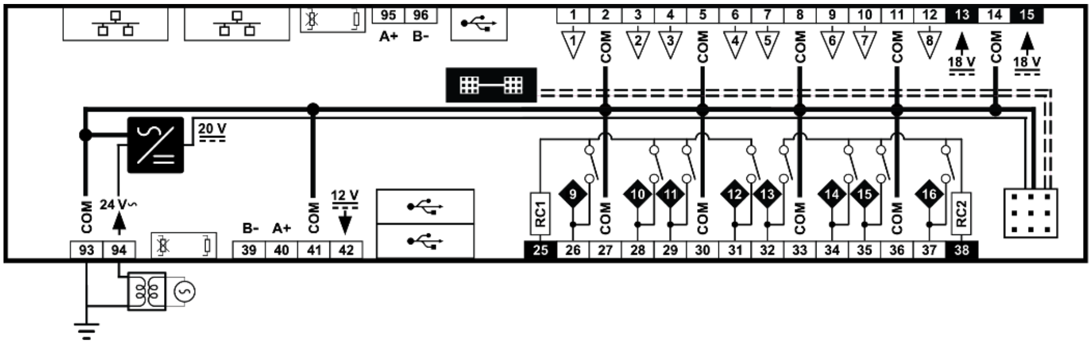
6 CBXi Operation

PHYSICAL LAYOUT

DIMENSIONS



WIRING

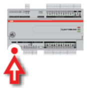
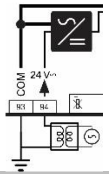
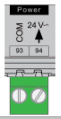
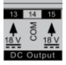
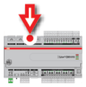
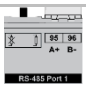
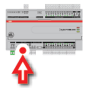
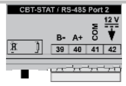
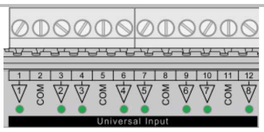
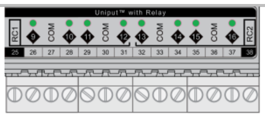


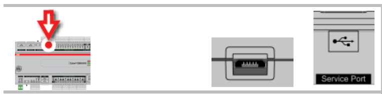
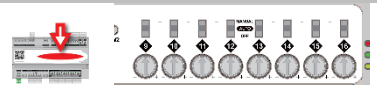
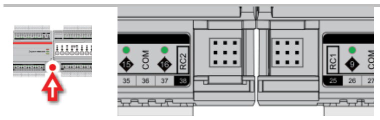
CAUTION - DANGER OF EXPLOSION IF BATTERY IS INCORRECTLY REPLACED.
REPLACE ONLY WITH THE SAME OR EQUIVALENT TYPE RECOMMENDED BY THE MANUFACTURER. DISPOSE OF USED BATTERIES ACCORDING TO THE MANUFACTURER'S INSTRUCTIONS.

Supply Requirements		24 V AC ±20 % 50/60 Hz
Supply Rating	CBXi	30 VA (no FLX modules)
	CBXi + 1 x FLX	42 VA
	CBXi + 2 x FLX	54 VA
	CBXi + 3 x FLX	66 VA
FLX Power Connection		Proprietary FLX bus connector carries power and comms from CBXi-8R8 unit. CBX-8R8 can supply power to up to 3 FLX modules.
Auxiliary Power		18 V DC / 60 mA output
BACnet Loading		¼ unit load device

⏚	Ground
COM	Common
10 4	Point Numbers
25 26	Terminal Numbers
RC1 RC2	Relay Common (24 V only)

TERMINALS

	Terminal Numbers	Description
  	93, 94	24 V AC Power
	13 … 15	Auxiliary Power: 18 V DC output on 2 terminals, 60 mA total
 	95, 96	RS-485 Port 1 (BACnet® MS/TP) screw terminal MS/TP subnet terminator switch is located beside the port. If the switch is towards the ▯ icon, then termination is `in` and if the switch is towards the ☒ icon then termination is `out`.
  CBT-STAT / RS-485 Port 2 B- A+ COM 12 V 39 40 41 42	39 … 42	CBT-STAT / RS-485 Port 2 (CBT-STAT / Modbus) The bus Terminator Switch is located beside the port. If the switch is towards the ▯ icon, then termination is `in` and if the switch is towards the ☒ icon then termination is `out`.
 1 2 3 4 5 6 7 8 9 10 11 12 COM Universal Input	1 … 12	Universal Inputs When input is configured as **Digital**: • LED **Off**: open circuit or logic 'off' • LED **On**: logic 'on' When input is configured as **Resistor/thermistor**: • LED **Off**: valid resistance connected (**Note**: 0 Ω is counted as valid) • LED **Slow blink**: resistor/thermistor not connected When input is configured as **Analog**: • LED intensity is modulated by the analog signal When the LED is blinking: • **Fast blink** indicates error condition • **Two short flashes followed by a value*** indicates the input is in an override state (overridden by **CXpro**^{HD}). *__Note__: The LED intensity illustrates the value measured at the input terminals. The flash indicates that this value has been overridden.
 Uniput™ with Relay RC1 COM RC2 25 26 27 28 29 30 31 32 33 34 35 36 37 38	25 … 38	UniPuts™ + Relay When a Uniput channel is configured as an input, the LED signals are identical to Universal Inputs above. When configured as an output the following apply: When output is configured as **Digital**: • LED **Off**: open circuit or logic 'off' • LED **On**: logic 'on' When output is configured as **Analog**: • LED intensity is modulated by the analog signal When the LED is blinking: • **Fast blink** indicates error condition • **Two short flashes followed by a value** indicates the output is in an override state (overridden by **CXpro**^{HD} or HOA).

	Service Port (Micro USB)
	Ethernet Ports
	Indicator LEDs (for LED signals see *CBXi Indicator LED Signals* on page 66)
	Output Override (**CBXi-8R8-H** only) Bottom position: Off - outputs forced off. Centre position: Auto - outputs are controlled by strategy. Top position: Manual - for digital outputs, the output is forced on. For analog outputs the knob setting controls the output value. **Note:** Manual position is supervised, i.e. the strategy is aware of the manual value.
	Push buttons Reset IP/Password : while the controller is *running*, press SW**1** until the LED lights up, then release SW1. Full factory reset : while the controller is *booting* hold SW1 until the LED lights up, then release SW1. Restart the controller : while the controller is *running*, press SW2 until the LED lights up. , then release SW2.
	Inter-module connection sockets To join the FLX bus, place the devices side-by-side and place the **FLX bus connector** into the two adjacent sockets at once. The end device on a FLX bus (either a **FLX** device or the **CBXi** itself) must have a terminator inserted into its interconnector socket. One terminator is shipped with each **CBXi-8R8(-H)** device.

CBXi INDICATOR LED SIGNALS

		Off	On	Slow Blink	Fast blink
🟥	Red LED (Power)	Power is off	Power is on	—— Unit Rebooting ——	
🟩	Green LED (Status)	Unit is not running	Strategy Loaded but no network connectivity	Strategy Loaded and device communicating on network	No Strategy loaded
🟨	Yellow LED (FLX)	FLX bus comms are ok	No FLX bus comms	FLX bus address clash	FLX bus comms error

During firmware upgrade the Yellow LED will remain on while the strategy/comms section reboots, and then the LEDs will rotate Red-Green-Yellow while the IO section reboots.

Note: During typical operation, the Red LED should be on, the Green LED should be blinking and the Yellow LED should be off.

INPUTS AND OUTPUTS

The CBXi-8R8(-H), FLX-8R8 and FLX-8R8-H have identical I/O capabilities – each has a set of 8 Universal Inputs and a set of 8 UniPuts™ with relay.

FLX-4R4 and FLX-4R4-H have 4 Universal Inputs and 4 UniPuts with relay.

FLX-16DI has 16 Digital Inputs only.

Any of the terminals can be configured as inputs. Any of the UniPut terminals can be configured as an output.

INPUT MODES

Universal Input terminals and UniPut™ terminals can be configured as inputs in almost identical fashion:

Measurement Mode	Universal Input	UniPut™ as Input:	Digital Input
Resistance	Resistance measurement Range:0 ... 450 kΩ Accuracy: ±0.5% of measured resistance		-
	Temperature measurement Range:-40 °C ... +110 °C Accuracy: 10k NTC sensors (e.g. 10k Type 2 (10K3A1) or 10k Type 3 (10K4A1): ±0.3 °C, -40 to 90 °C (-40°F to 194°F); ±0.4 °C > 90 °C (194°F)		-
	Digital Volt-Free contact, 2 mA contact-wetting current		
	Pulse counting (volt-free) up to 20 Hz, 25 ms – 25 ms		-
	-	24 V AC Detect	-
Voltage	Analog Input Range: 0 ... 10 V @ 130 kΩ Accuracy: ±0.5% full scale [50mV]	Analog Input Range: 0 ... 10 V @ 40 kΩ Accuracy: ±0.5% full scale [50mV]	-
	Pulse counting (0 … 10 V) up to 20 Hz, 25 ms – 25 ms		-
Current	Current input Range: 0 ... 20 mA @ 390 Ω Accuracy: ±0.5% full scale [100µA]	Current input Range: 0 ... 20 mA @ 390 Ω Note: Current Input requires user-supplied external 390 Ω resistance. Accuracy: depends on user supplied external resistor	-

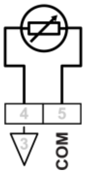
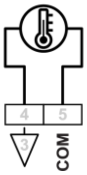
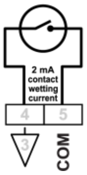
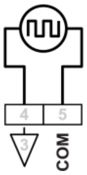
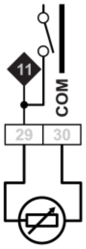
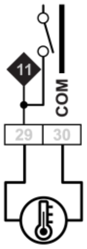
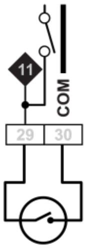
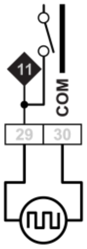
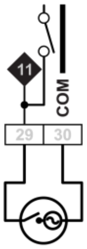
Note: Inputs use on-board 16-bit analog to digital convertor.
Note: All inputs and outputs are protected against short circuit, as well as over-voltage up to 24 V AC.

Hardware point numbers for these inputs in the CBXi-8R8(-H)'s strategy:

	CBXi	FLX address 1	FLX address 2	FLX address 3	FLX address 4	FLX address 5
Inputs	1 … 8	101 … 108	201 … 208	301 … 308	401 … 408	501 … 508
Outputs	9 … 16	109 … 116	209 … 216	309 …316	409 …416	509 …516

Resistance Input mode (Passive Input)

Passive Inputs are all those devices that vary in resistance, including switch contacts.

	Resistance measurement	Temperature Measurement	Switch Contact	Pulse counting	24 V AC Detection
Universal Input					n/a
Uniput					

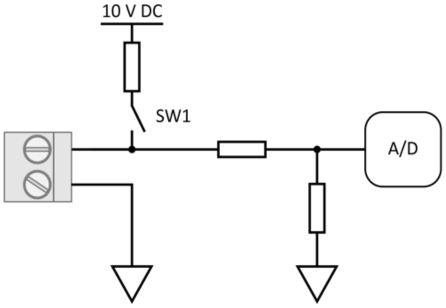
These all require a current supplied by the CBXi-8R8(-H) terminal so that this resistance can be measured.

The passive sensor types supported by the CBXi-8R8(-H) are:

- Pre-programmed Passive Temperature Sensors.
- Potentiometer (normally used as a 0 to 10 KΩ or a 1 KΩ to 11 KΩ variable resistor to give a 0 to 100 % output).
- Volt-Free Digital Input (the controller strategy measures the contact resistance and gives a `0` or `1` output).
- Straightforward Resistance measurement. This can be used with the Make Linear block to give a temperature output for temperature sensors that are not factory pre-programmed into the CBXi-8R8(-H).

In CXpro^{HD} simply select 'Resistance' sensor type in the Point Module and select Pulsed in the Advanced parameters (the Pulsed option increases accuracy by eliminating any self-heating in the passive temperature sensor, while the Continuous option can trade absolute accuracy for speed).

In Passive Input Mode the Uniputs™ and Universal Inputs configure like this:

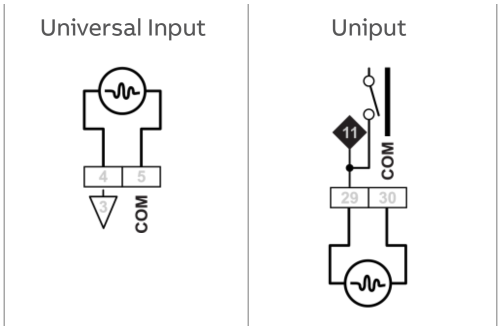


Note: The reference voltage can be pulsed or continuous, using the solid state switch.
A pulsed reference gives optimum accuracy by eliminating self-heating in the sensor, and this is the default setting.

UniPut™ 24 V AC Detection

If 24 V AC is connected to a Uniput™ terminal, then the 24 V AC Detect circuit will detect this and will open switch `SW1`. `SW1` stays open for the duration of the 24 V AC state. When 24 V AC is removed from the Uniput™ terminal then the short circuit or open circuit states can again be detected.

Voltage input mode (Active Input)

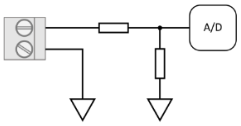


Note: Input Impedance for Universal Input terminals is 130 kΩ.
Input Impedance for Uniput™ terminals is 40 kΩ.

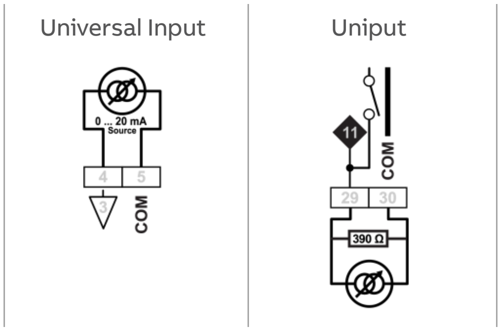
The 0 … 10 V input is used for Active analog and digital measurements. 'Active' means that there is no current supplied by the CBXi-8R8(-H) for the sensor, as the signal is generated completely by the Sensor.

The '`mV`' sensor setting gives a value between `0` and `10,000`, which represents voltage in mV.

In `0 ... 10V Input` Mode, the Uniputs™ configure like this:

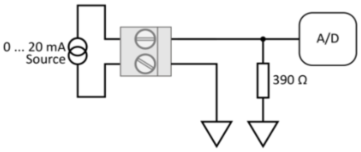


Current Input mode (Active Input)



The Current Input is used for `0 ... 20 mA` or `4 ... 20 mA` Active sensors.

`4 ... 20 mA` scaling can easily be achieved using CXpro^{HD} by entering range values in the Point Module '`Advanced`' parameters.

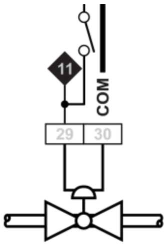


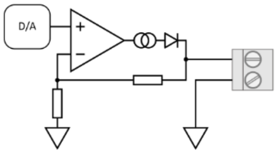
OUTPUT MODES

UniPut terminals can generate an output as follows:

- Analog Output 0 ... 10 V, 20 mA, 12-bit resolution
- Digital Output 0 ... 10 V, 20 mA
- Relay Contacts with ability to switch up to 24 V AC
  Maximum Load: 24 V AC, 2 (1) A resistive (inductive) for all relay contacts

Analog 0 … 10 V output mode

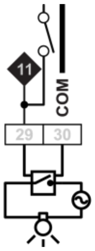


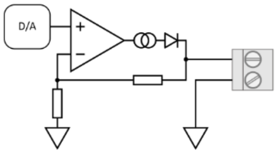


In `Analog 0 ... 10 V output` Mode, the Uniputs configure themselves like this:

where the D/A is the digital to analog converter. All circuitry is fully protected against 24 V AC.

Digital 0 … 10 V output mode

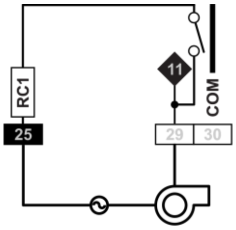


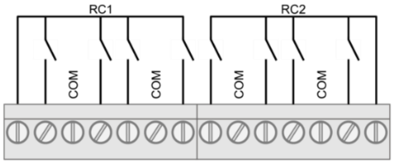


In `Digital 0 ... 10 V output` Mode, the Uniputs configure in the same way as for analog:

In this mode the output toggles between the voltages defined as “`ON`” and “`OFF`”.

Relay Mode

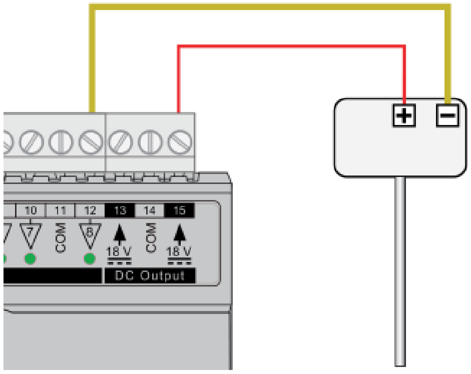




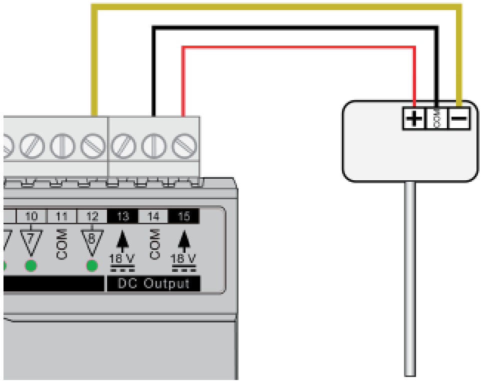
In Relay mode the Uniputs are configured with a single relay common for each half of the terminals:

AUXILIARY POWER OUTPUTS

The CBXi and FLX modules each have two 18 V DC outputs, for I/O devices that require loop power.



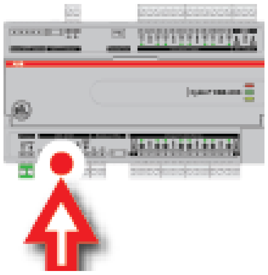
For 3-wire connections return can be through any COM terminal, but it is recommended that Auxiliary power wiring is through terminal 14, the COM between the two Auxiliary power terminals.

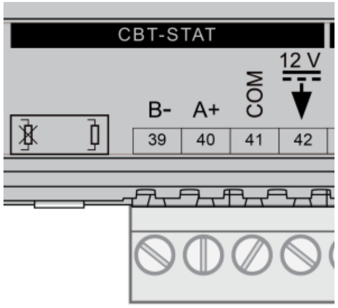


The DC output terminals provide a minimum of 18 V DC, but the combined load (on each IO module) must remain below 60 mA.

USING A KEYPAD WITH THE CBXi

A CBT-STAT or UCU Room Display keypad can be connected to the CBX at the CBT-STAT port.

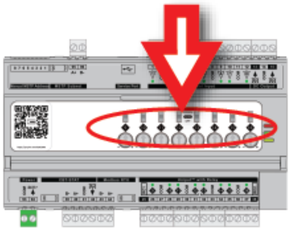




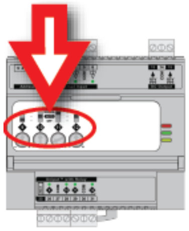
Note: If UCU Room Display is used, refer to the *DS0064 UCU10FC/K* for the corresponding Strategy Point Setup.

OUTPUT OVERRIDE

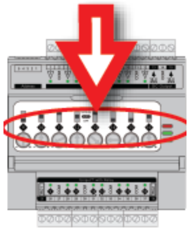
HOA variants (CBXi-8R8-H, FLX-4R4-H and FLX-8R8-H) include hardware override switches for each of their outputs. The override controls are located behind the flap on the front of the device:



CBXi-8R8-H

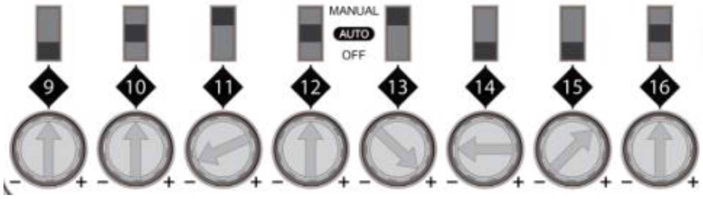


FLX-4R4-H



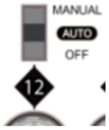
FLX-8R8-H

These controls consist of a switch and a rotary knob for each output:



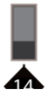
The channel number corresponding to the switch is shown directly below the switch.

The switch can be set to one of 3 positions:

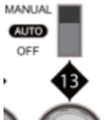


When a switch is set to the **Centre position** the corresponding output channel is set to `Auto` mode – the output is controlled by strategy.

The rotary knob has no effect in this mode.



When a switch is set to the **Bottom position** the corresponding output is forced to `Off` – both the strategy setting and the rotary knob have no effect.

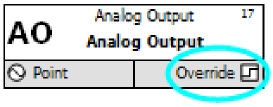


When a switch is set to the **Top position** the corresponding output is set to `Manual` mode

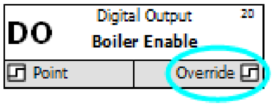
- for digital outputs, the output is forced `on`
- for analog outputs the rotary knob setting controls the output value.

Note: Manual position is supervised, i.e. the strategy is aware of the manual value.

The Controller Strategy can determine if an override is in place is by connecting to the Override point on the output module:



AO Analog Output 17
Analog Output
Point Override



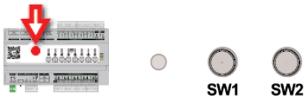
DO Digital Output 20
Boiler Enable
Point Override

The value of the Override point will be '`0`' when the output is active and '`1`' when the point has been manually overridden. This allows the strategy to react to the fact that a point has been overridden.

Note: The corresponding terminal LED will indicate the override condition.

RESTARTING AND RESETTING THE CBXi

The CBXi controller can be restarted or reset using the two switches located on the front panel (under the flap) beside the LED:



RESETTING THE WEBUI LOGIN

If the WebUI username / password or IP address have been changed to unknown values so that you cannot log in to the WebUI, you can reset them to known values, i.e.

- username: `admin`
- password: `cylonctl`
- IP address: based on serial number (see *Configuring the IP connection* on page 31)

To reset the IP address and password, press **SW1** while the controller is running, hold it until the LED lights up, and then release **SW1**.

FULL FACTORY RESET

To restore all settings in the CBXi, including any strategy configuration, press **SW1** while the controller is booting, hold it until the LED lights up, and then release **SW1**.

RESTARTING THE CONTROLLER WITHOUT POWER CYCLING

To restart the CBXi without disconnecting the power, press **SW2** while the controller is running, hold it until the LED lights up, and then release **SW2**.

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ABB CYLON CONTROLS

Clonshaugh Business &
Technology Park
Clonshaugh
Dublin 17
Ireland

Tel.: +353 1 245 0500
Fax: +353 1 245 0501
Email: info@cylon.com

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ABB CYLON CONTROLS

ONE TECHNOLOGY LANE
EXPORT,
PA 15632

Tel.: +1 724 733-2000
Fax: +1 724 327-6124

WWW.ABB.COM