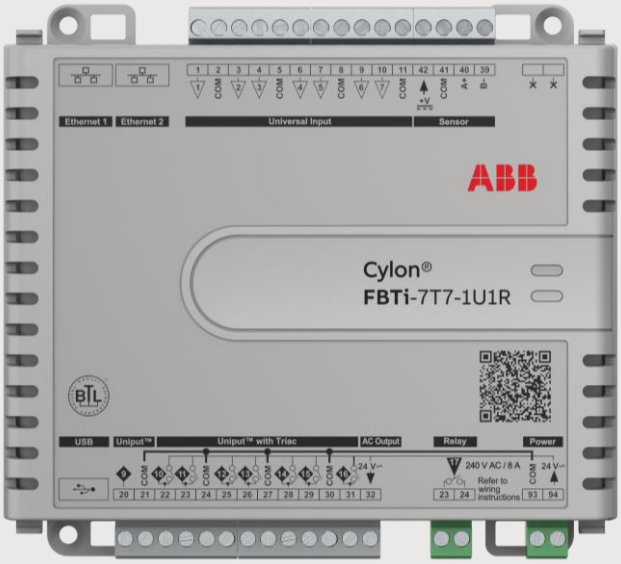
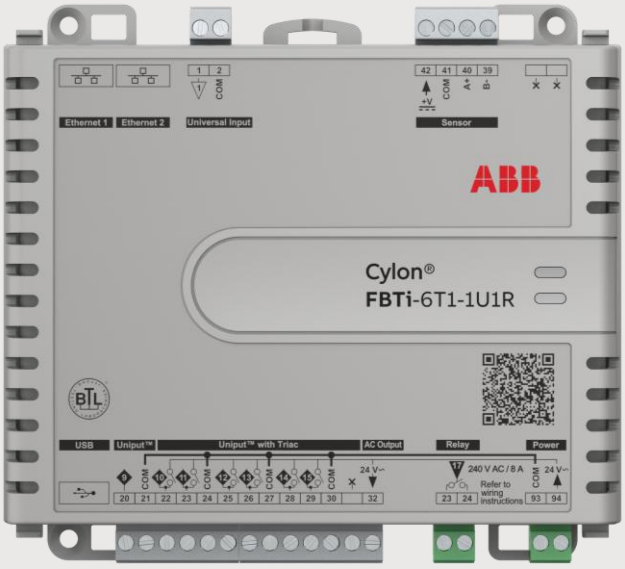
USER GUIDE

MAN0153 rev 14

Cylon® FBTi Series





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 Cylon®

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 Cylon® FBTi Series

INTRODUCTION

The **FBTi Series** is a high performance, low cost **BACnet® Unitary Controller** with native **BACnet/IP** communications support. **BTL** listed as **BACnet Building Controller (B-BC)**, it perfectly complements the **FBVi (IP VAV controller)** in the IP terminal unit controller range. Utilizing the patented UniPut technology, it provides reliable and cost-effective control solutions for Fan Coil Units, Chilled Ceilings, Heat Pumps and Roof Top Units.

Dual IP ports with failsafe switchover connects the FBTi to any open BACnet network and also provides seamless integration to the **ABB Cylon** system.

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 **FBTi Series** is designed to cover applications from Fan Coil Unit, Chilled Ceiling, Heat Pump and Roof Top Units. Leveraging the **ABB Cylon FusionAir** sensor series, the **FBTi** can execute IAQ applications such as Demand Control Ventilation and optimize energy usage in the controlled terminal equipment.

It is programmed using **CXpro^{HD}** programming software as with other ABB Cylon controllers.

Reference strategies for Fan Coil Units and Roof Top Units are available for download and customization.

The **FBTi-7T7-1U1R** features 7 UniPuts™ with Triac, and 7 Universal Inputs. **FBTi-6T1-1U1R** features 6 **UniPuts™** with **Triac**, and 1 Universal Input. Both feature 1 UniPut™ without Triac, a 240 V AC relay and a dedicated input for **ABB Cylon® FusionAir** sensors.

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.

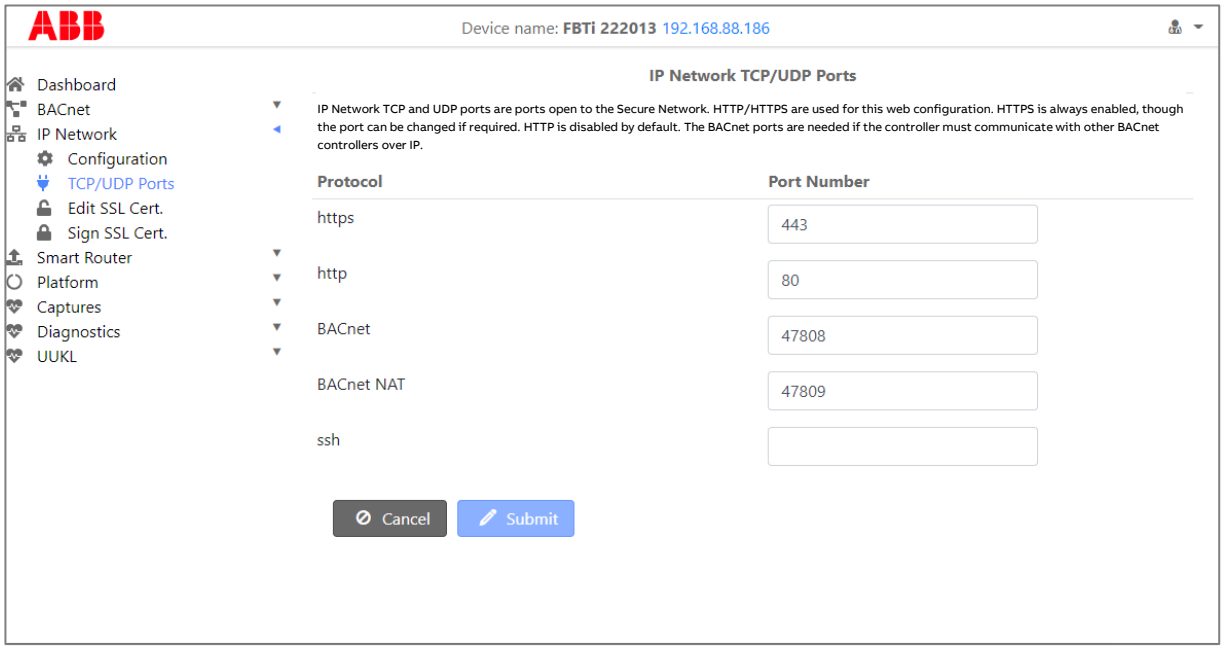
PORT NUMBERS

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:

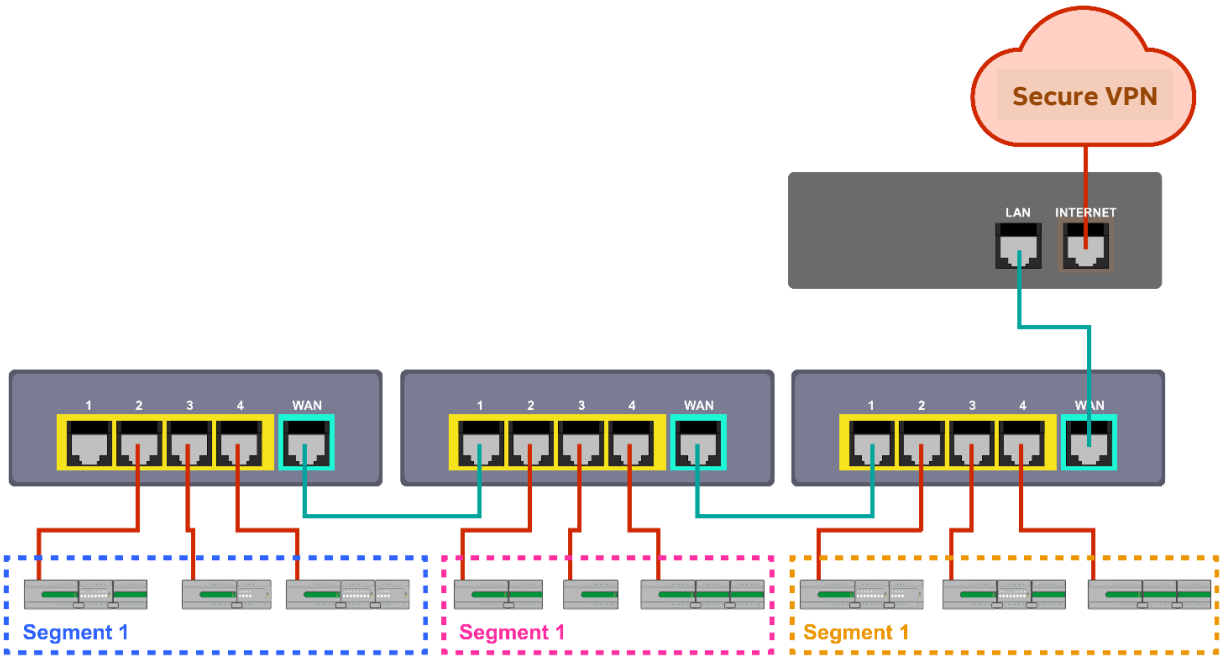
Service	Protocol	Default Port Number
SMTP	TCP	25
DNS	TCP, UDP	53
DHCP	UDP	67
HTTP	TCP	80
HTTPS	TCP	443
BACnet/IP	UDP	47808

Some of the port numbers recognized by **FLXeon Controllers** are shown below. These can be changed in the controller’s Web UI at `IP Network` > `TCP/UDP Ports`

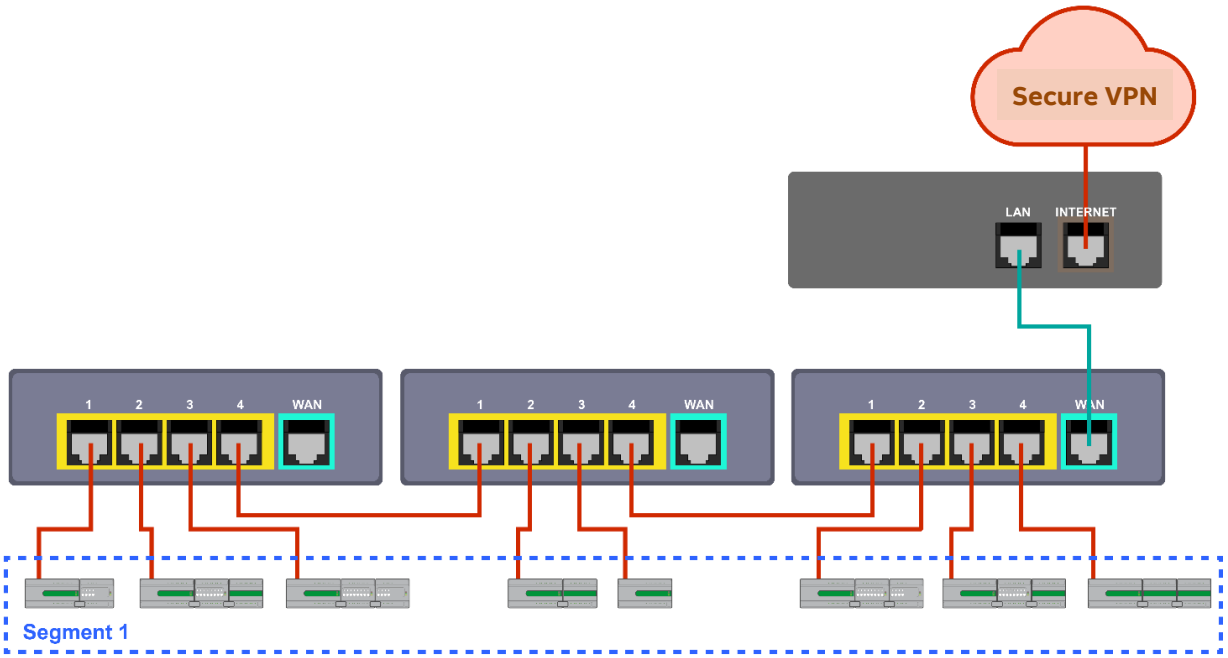


UPLINK/WAN AND SEGMENTATION

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.cylon.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.

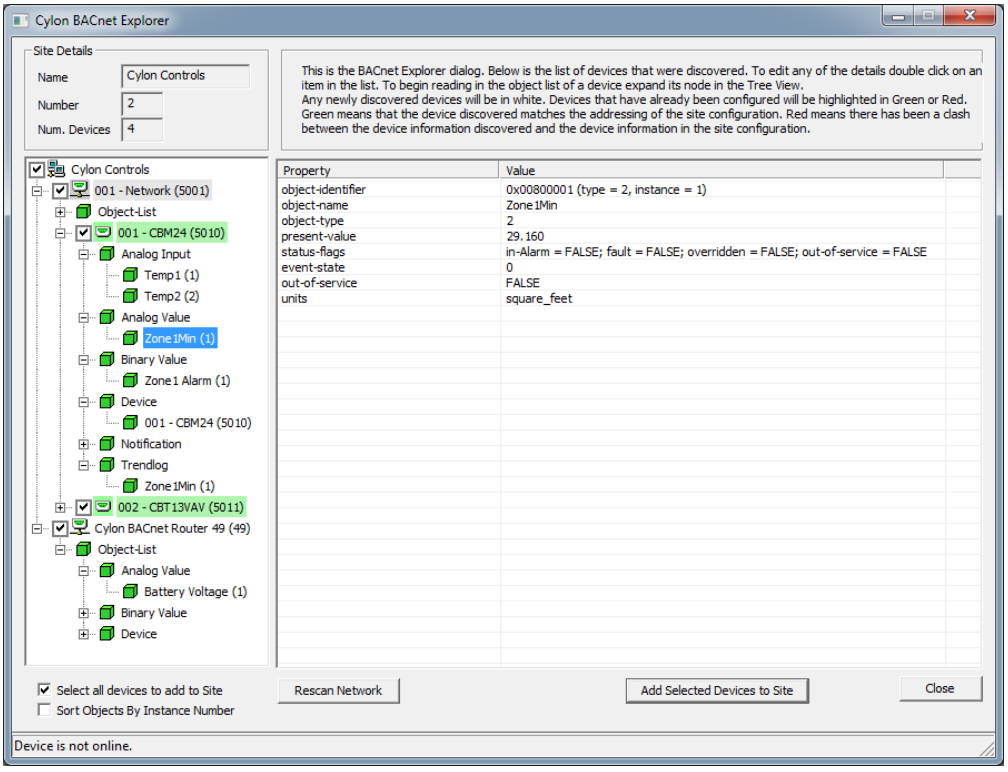
BACnet provides a standard way of representing the functions of any device - for example analog or binary inputs or outputs, schedules, control loops and alarms.

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:



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
- UnconfirmedCOVNotification

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.

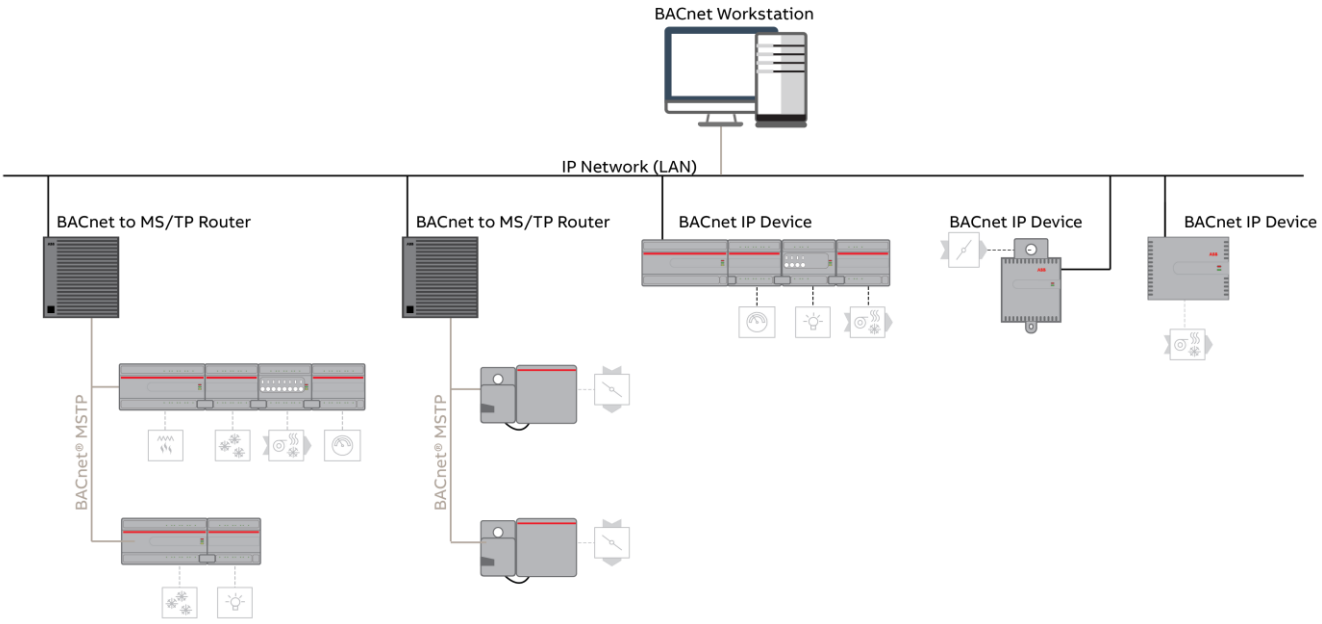
It contains:

- 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

BACnet/IP uses the User Datagram Protocol (UDP) to send data packets. ASHRAE adopted BACnet/IP in annex j of the 135- 1995 standard.

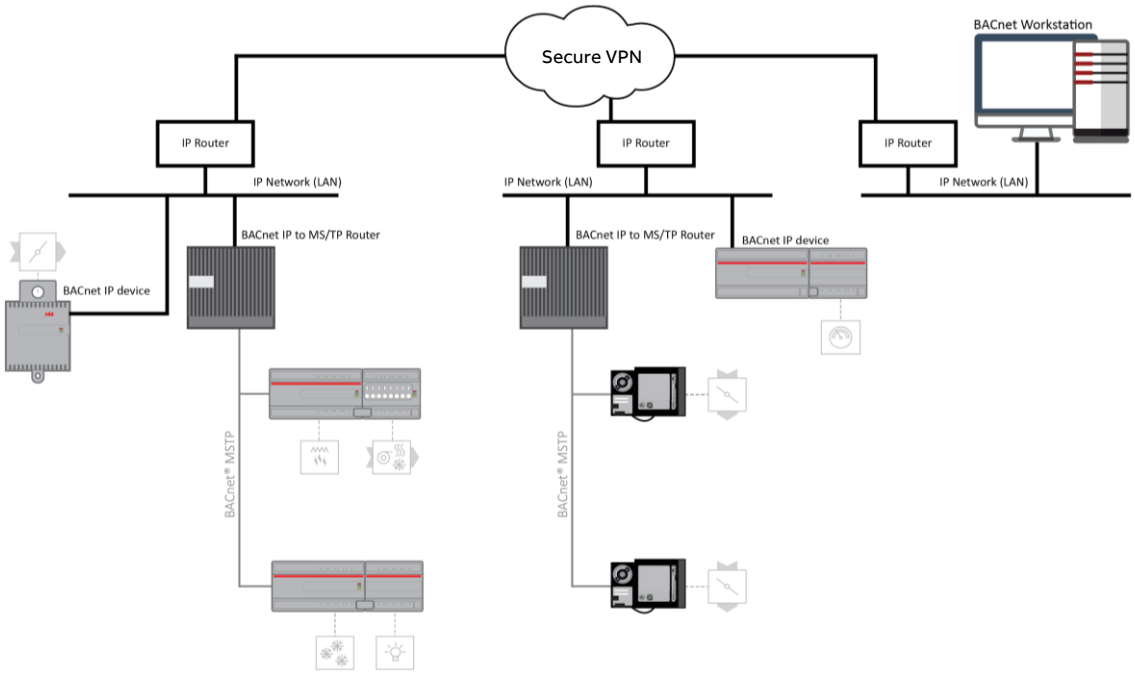
BACnet/IP communicates using four methods.

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

- BACnet/IP to BACnet/IP (same subnet): Assuming that two devices know each other's IP addresses and the UDP ports they are using, i.e., their respective B/IP addresses, there is nothing that restricts them from communicating directly.
- BACnet/IP to BACnet/IP (different subnet): The location of the two devices is already known by the host and the message is routed to the device using switches and routers.
- Broadcast (same subnet): This is a standard Who is/ I am message sent across a local subnet for the BBMD to discover what the address are for the BACnet devices on the subnet.
- Broadcast (different subnet): This is a standard Who is/ I am message sent across a local subnet for the BBMD to discover what the address are for the BACnet devices on other subnets.

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.



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

Note: Cylon® FBTi Series is IP only, this section is provided for general information.

BACnet MS/TP (**M**aster-**S**lave **T**oken **P**assing) is an EIA-485 network layer intended for use with lower-level devices such as Unitary Controllers. In comparison to BACnet/IP and BACnet/Ethernet, MS/TP is more cost-effective to implement due to the lower cost of wiring. Given the MS/TP network is a serial-based network, devices may be configured to communicate at different baud rates specified by BACnet. Therefore, it is essential to know information regarding the BACnet network you are connecting to before installing.

TOKEN PASSING

BACnet MS/TP uses token passing to allow devices to communicate on the network. Token passing is controlled by each device, which contains an internal memory list of other MS/TP peers connected to the network. The token is passed in order of the MAC Address (Unit ID) from lowest to highest. In most MS/TP networks, each device is configured to be a master. Given all devices may be a master, MS/TP may appear and react slower than traditional building automation protocols. However, configuring your network for faster baud rates will help provide better bandwidth and transport speed of network messaging.

Token passing is a communications scheme that allows connected devices connected to intercommunicate with one another. A network “token” is passed from unit to unit on the network in a round-robin fashion by order of the MAC Address (lowest to highest) to provide a transport to access the network. When a unit possesses the token, it may perform any network activity for which it is responsible. When finished, the token is then passed onto the next device. At any time, the unit that possesses the token is the only device permitted to initiate communications with another device on the network or to request information from it. A device that receives the token may or may not need to perform network functions (e.g. read values from a remote device, broadcast information, etc.). If not, it will simply pass the token along the network.

If you are connecting devices to an existing MS/TP network consisting of third-party devices, consult third-party vendor documentation regarding MS/TP network considerations.

ADDRESSING

BACnet MS/TP devices contain two device addresses. One device address is known as a Device Instance, and the other is a MAC Address. The Device Instance is an address assignment that is used to identify the BACnet device on a global BACnet network. When a device is connected to a global BACnet network consisting of multiple data layers joined together using routers, the Device Instance is used to uniquely identify the device on a global basis. The valid range for the device instance in a BACnet device is 0 to 4,194,302. Devices must be configured for a unique, non-conflicting Device Instance. In the event that multiple devices are assigned the same Device Instance, both devices will simply not communicate on the BACnet network or could be subject to misdirected messaging (a message intended for Device-A may be routed to Device-B)

The MAC Address is an address assignment used within the BACnet MS/TP segment to permit a device to actively communicate on the BACnet MS/TP network. Valid MAC Address assignments range from 0 to 127 and are typically assigned in a logical and incremental order to permit faster token passing between devices. The MAC Address of a BACnet MS/TP device must be a unique, non-conflicting value that exists on the local MS/TP network. In the event that multiple devices are assigned with the same MAC Address, the effects can be far detrimental than that of a conflicting Device Instance; potentially resulting in a failure of the entire local MS/TP network. In the event that the unitary controller encounters a duplicate of its MAC Address, devices will inform the user that a duplicate MAC Address has been detected and will not perform client communications until resolved.

BAUD RATES

As a serial-based protocol, BACnet MS/TP supports the following four baud rates: 9.6kbps, 19.2kbps, 38.4kbps, and 76.8kbps. Devices can be configured for any of these baud rates, as well as native PC baud rates 57.6kbps and 115.2kbps which are currently not supported by the BACnet standard. Each device communicating on an MS/TP network must be configured for the same baud rate at all times

NETWORK OPTIMIZATION

In BACnet MS/TP devices, specific device properties are available to permit optimization. Network communications. By adjusting Device properties max-master and max-info-frames, users can adjust the token passing abilities of devices. The functionality of these two properties is described as follows:

- ***Max-Master*** - defines the highest unit ID of an MSTP master that is connected to the network. This value specifies to what address extent a token may pass. For example, if you have 64 devices addressed in a logical order, this value would be assigned to 64. This value should be set to the same value across all devices connected to an MSTP network.
- ***Max-Info-Frames*** - defines the number of data frames that an MSTP master can use the token before passing onto the next device. This value is typically set by the factory but can be modified if necessary. In the event a device does not need to keep the token for the number of frames specified, devices will automatically pass the token onto the next device.

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, FTVi will read 5 properties at once.

BACNET PRIORITY ARRAY

BACnet uses a command prioritization scheme for objects that control equipment or software parameters that affect the operation of equipment connected to devices. The use of this command prioritization scheme (commonly referred to as Priority Array) allows a device to determine the order in which an object is controlled. Command Prioritization assigns unique levels of priority to the different types of devices that can write values to a device. There are 16 prioritization levels with Level 1 being highest and Level 16 the lowest. For example:

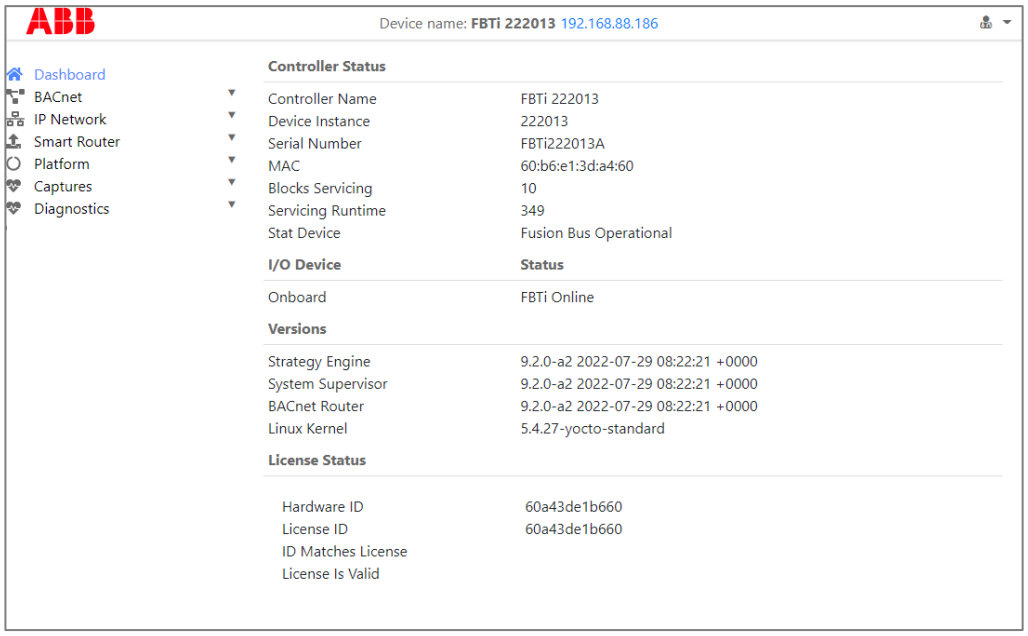
Priority Level	Application	Priority Level	Application
1	Manual-Life Safety	9	Available
2	Automatic-Life Safety	10	Available
3	Available	11	Available
4	Available	12	Available
5	Critical Equip. Control	13	Available
6	Minimum On/Off	14	Available
7	Available	15	Available
8	Manual Operator	16	Available

BACnet defines the types of objects that are either required or may optionally support the command prioritization scheme.

4 The Cylon® FBTi Series Web UI

SUMMARY DASHBOARD

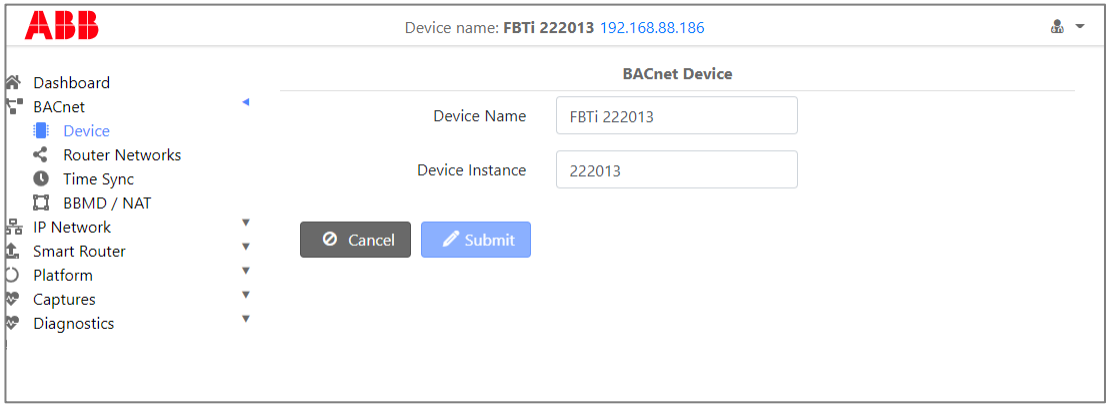
The Summary Dashboard displays the controller status including important information such as firmware versions and I/O status.



BACNET MENU

DEVICE

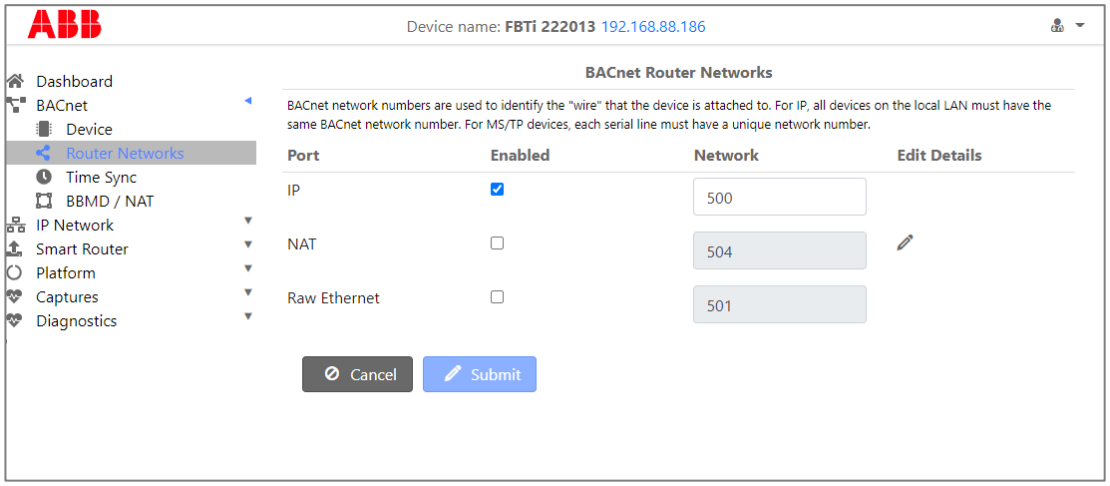
The BACnet Device Name and Device ID are set from this page.



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.

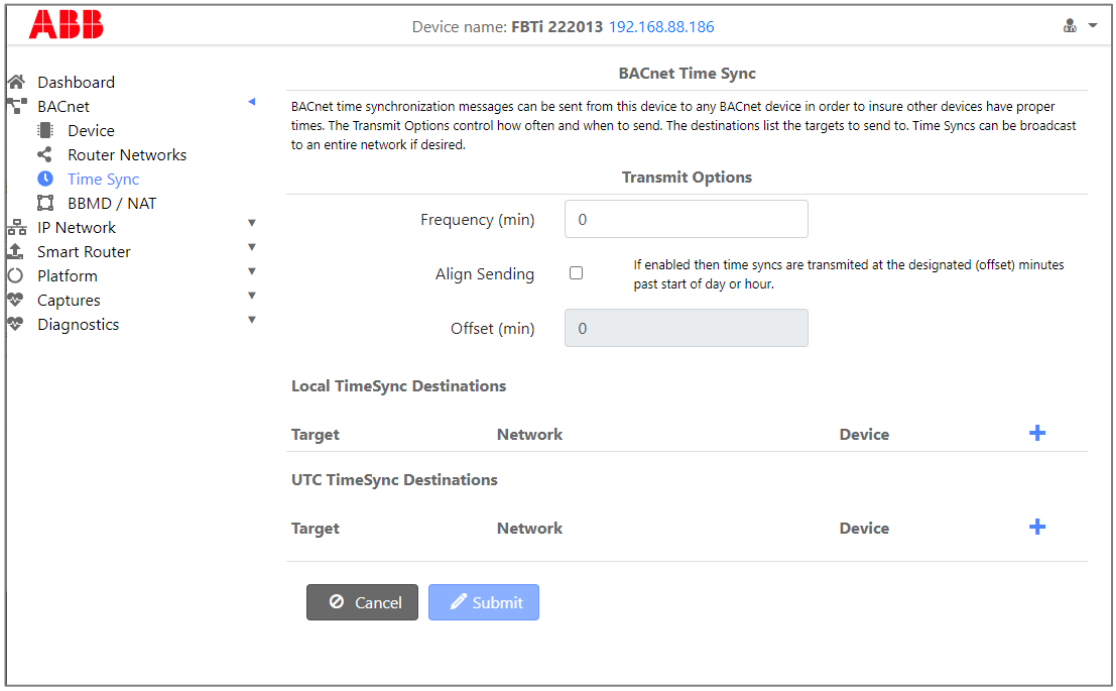


TIME SYNC

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.

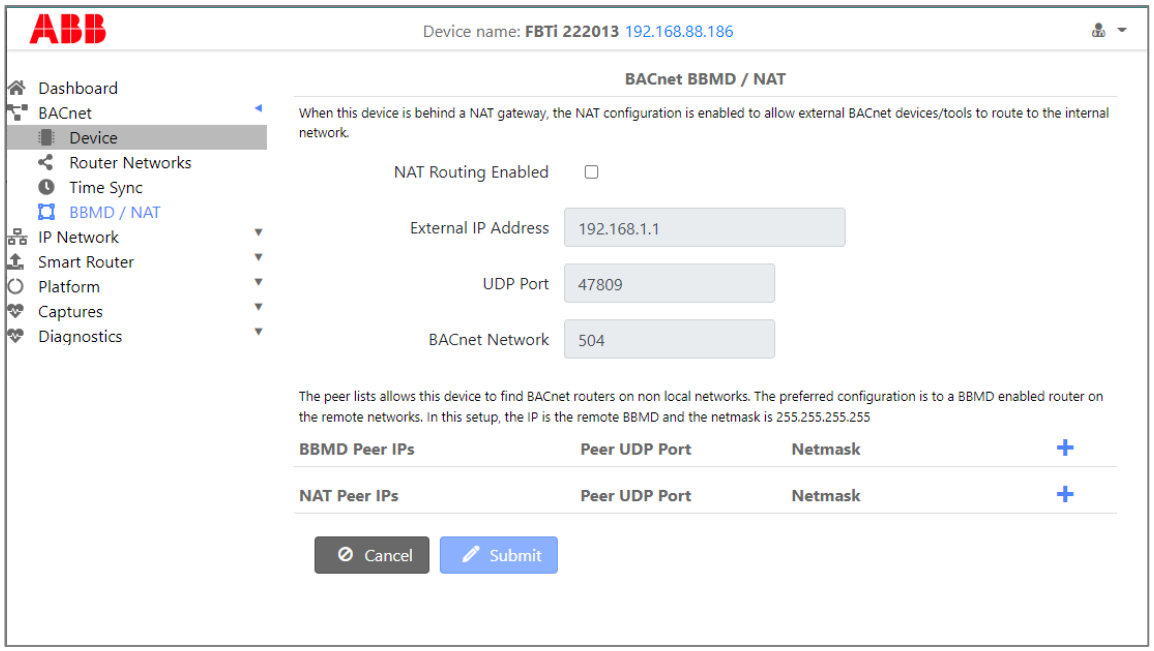


BBMD / NAT

BBMD connects BACnet IP networks that are not on the same local network (*see BACnet IP Broadcast Management Device (BBMD)* on page 17 for details).

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

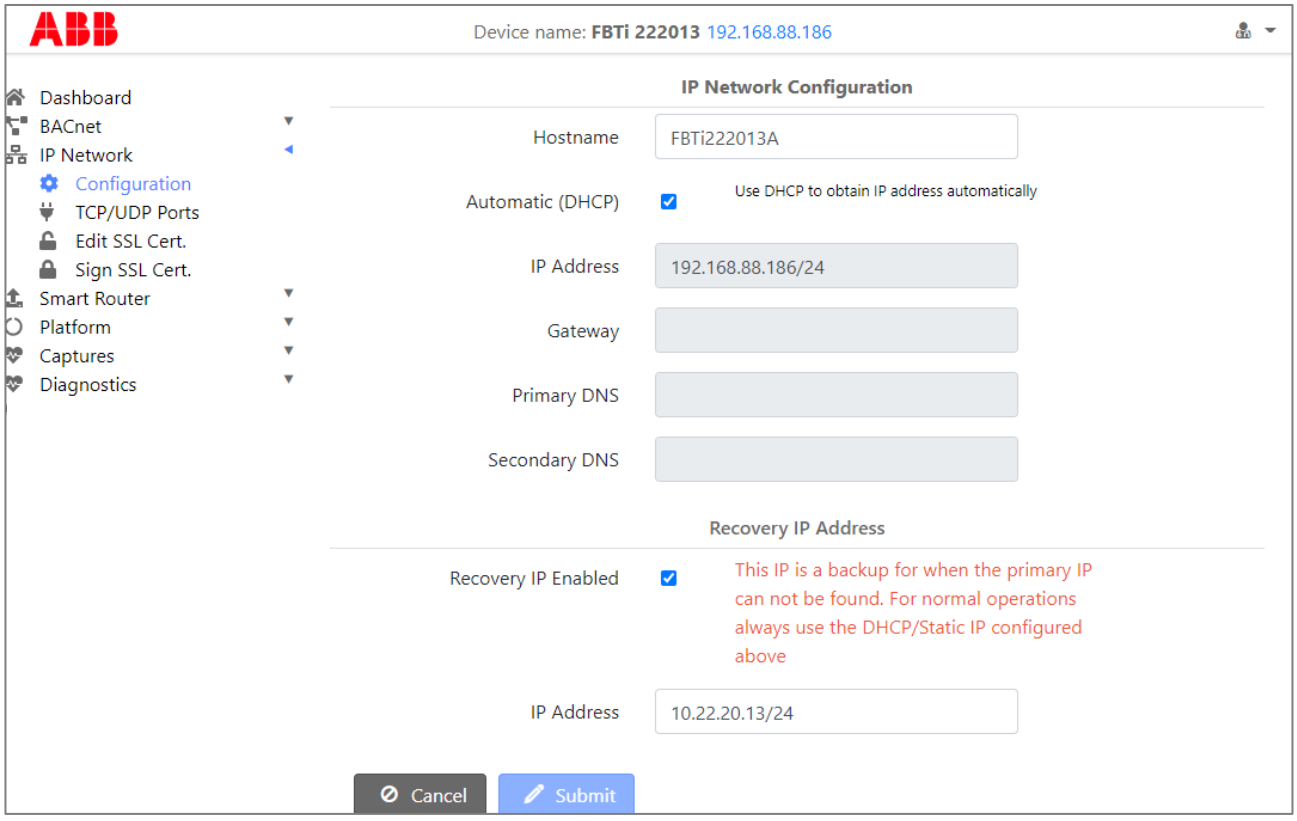
NAT connects sites where there is a NAT gateway between them.



IP NETWORK MENU

CONFIGURATION

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



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 FBTi devices leaving the factory are configured to use DHCP, and have a hostname set to "FBTi" followed by the controller's serial number – e.g. FBTi901004A

If your network does not have a DHCP server, then the 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 controller with serial number 901001A will be allocated the default IP address of 10.90.10.01. See also *Configuring the IP connection* on page 36. The IP Address input is also used to specify the subnet mask in CIDR format. See *Subnetwork (Subnet)* on page 8 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.

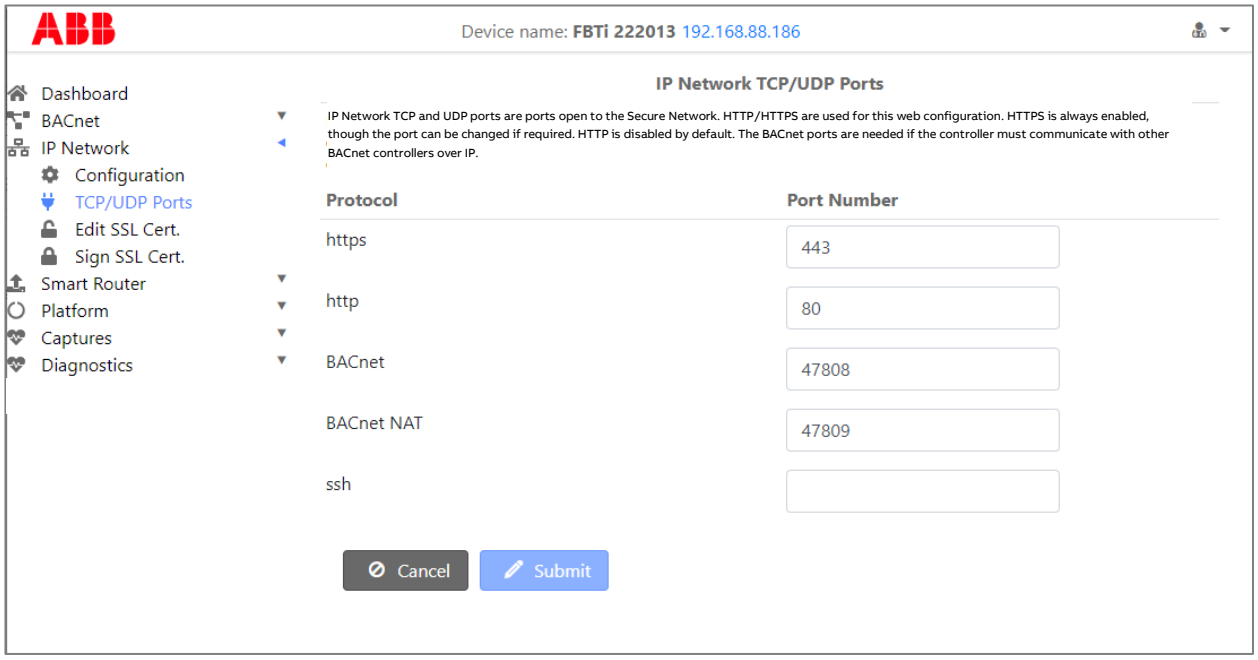
TCP/UDP PORTS

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.

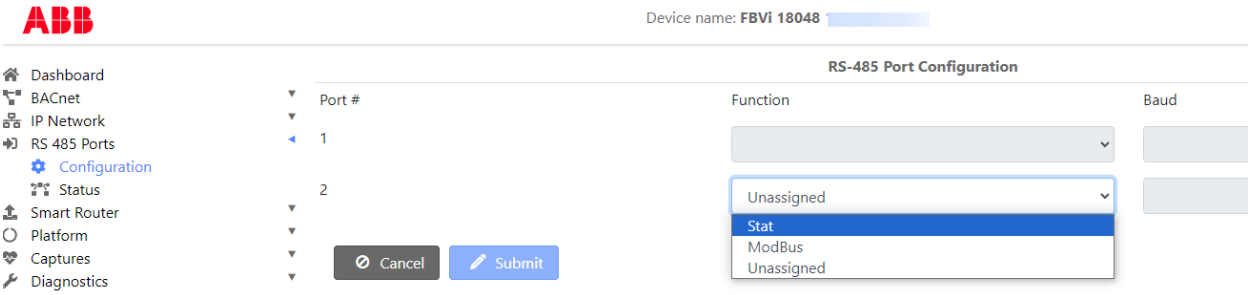
The BACnet ports are needed if the controller must communicate with other BACnet controllers over IP.



RS-485 PORT MENU

CONFIGURATION

The RS-485 “sensor” port is by default configured to communicate with a Room Sensor (e.g. FusionAir). However, it can be configured instead for `Modbus` on the RS 485 > Configuration page, and the baud rate can be set as appropriate. See *Configuring a Modbus RTU connection* on page 47 for more detail.



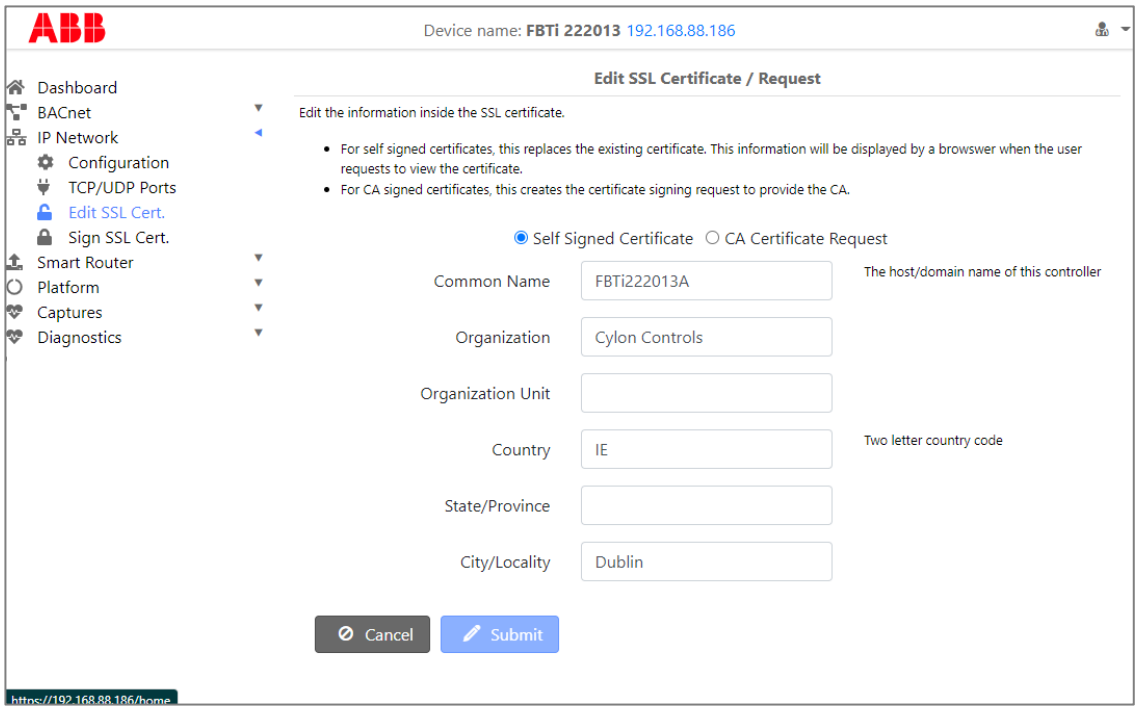
STATUS

The status of the ports can be viewed on the RS 485 > Status page. It includes the number of characters transmitted (TX), and also received errors (FE), for each of the two RS-485 ports.

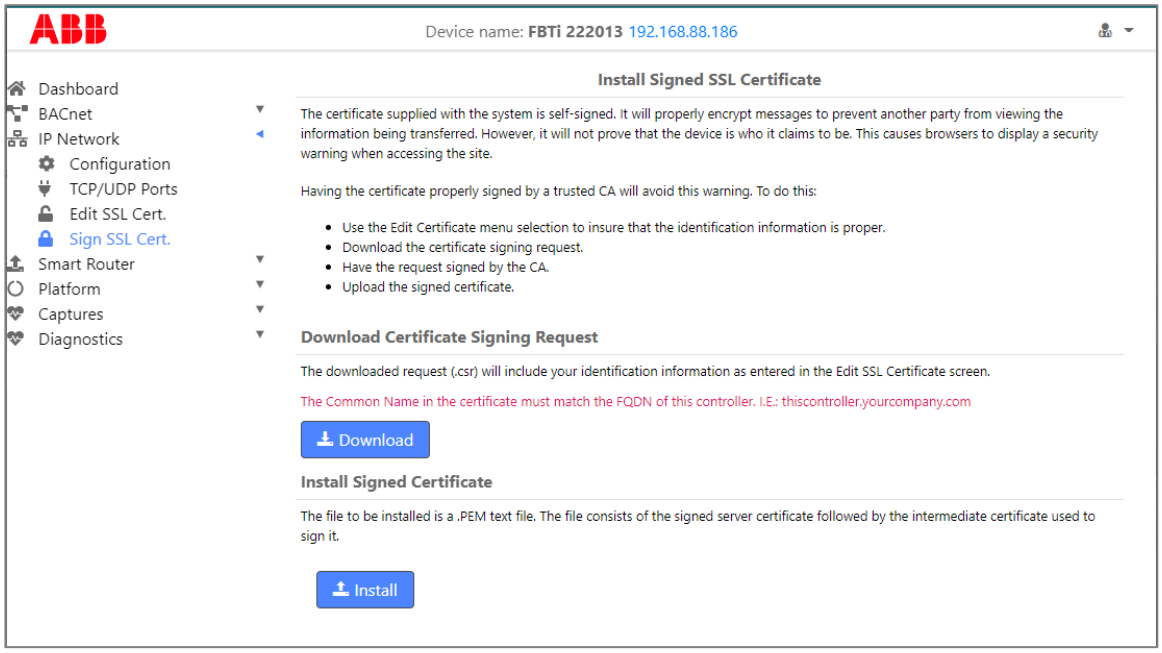
Note: If the FE value is a large percentage of the TX value (for example > `10` %), it may be beneficial to review your wiring for correct termination or unexpected line breaks.

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 controller 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



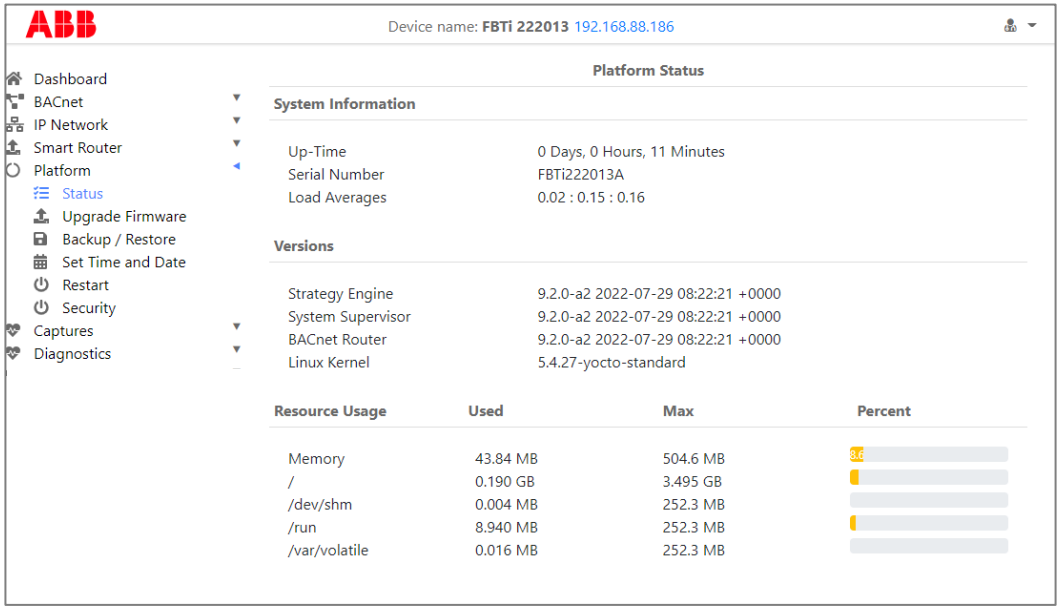
To install a 3rd-party SSL Cert, or to generate a request for a 3rd-party SSL Cert, use the IP Network > Sign SSL Cert page:



PLATFORM MENU

STATUS REPORT

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

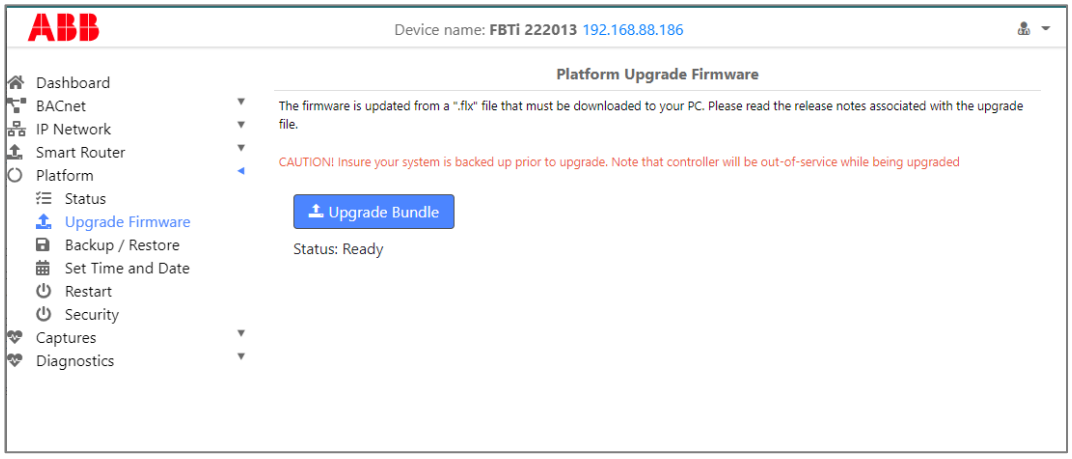


FIRMWARE UPGRADE UTILITY

With assistance from technical support, you may upgrade the firmware of the Controller. 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.

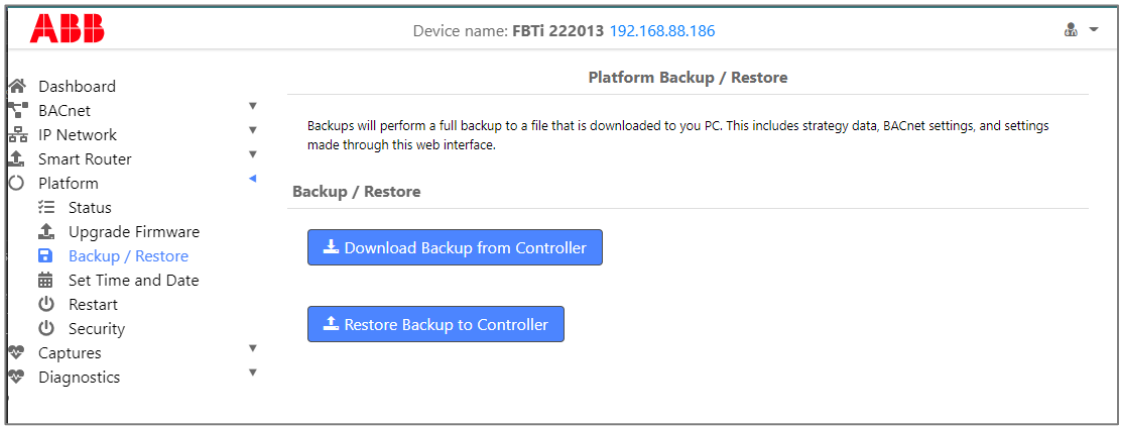


BACKUP/RESTORE UTILITY

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

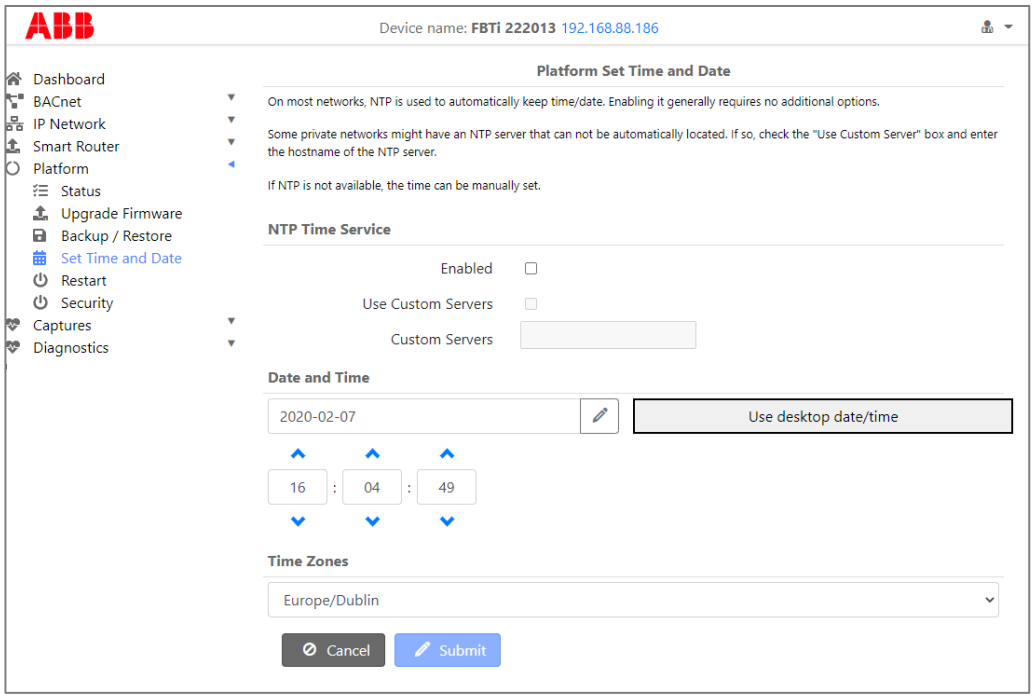
You may also restore a backup to the Controller. By clicking the Restore Backup to Controller button. An Open File dialog will appear. Find the appropriate backup file and select it for restoring. After a few moments, the controller will restart with the new Strategy and data.



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.

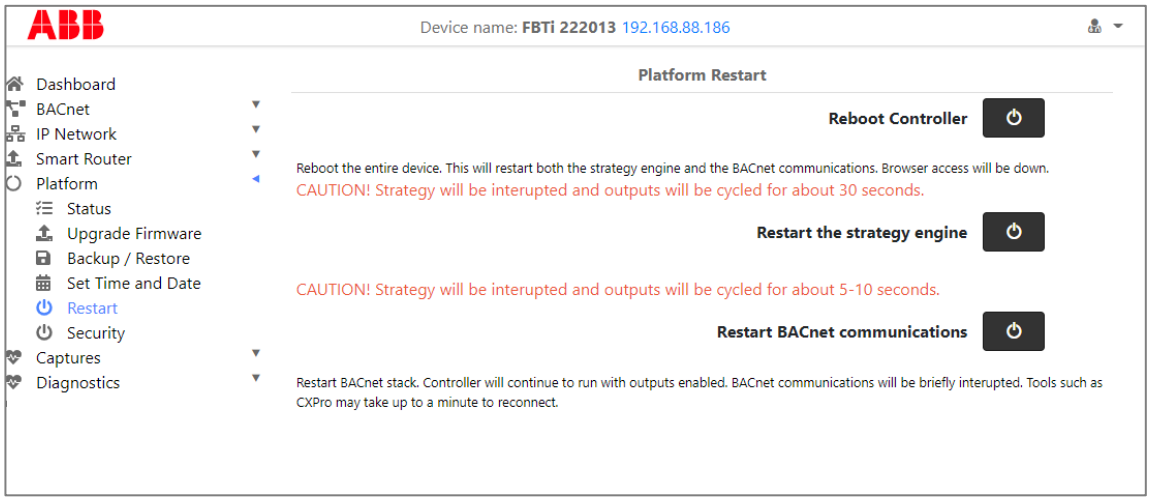
Some private networks may have an NTP server that cannot be automatically located. If so, check the Use Custom Server box and enter the hostname of the NTP server if available. If an NTP server is not available, the time can be manually set.



RESTART UTILITY

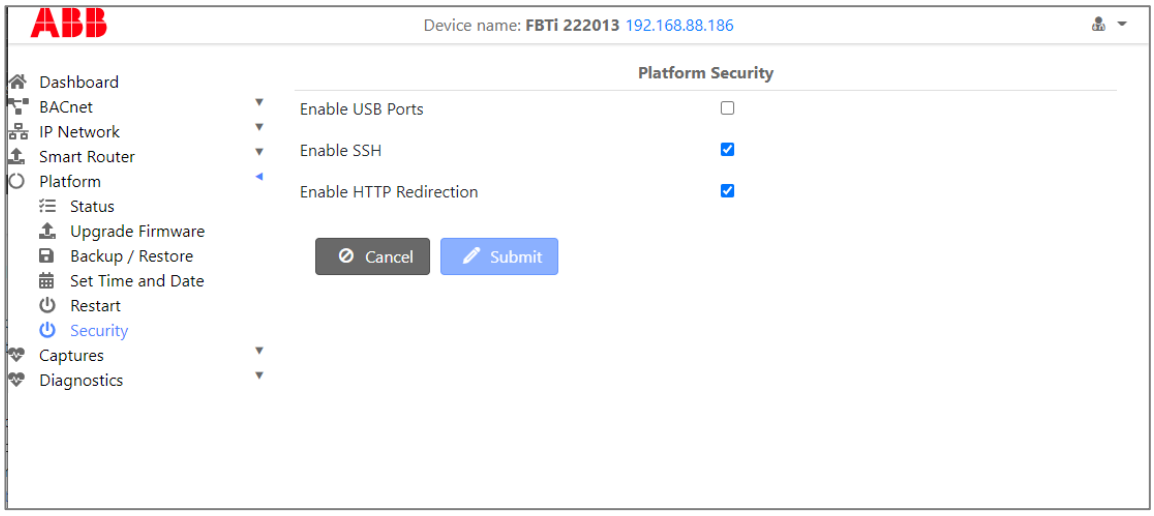
Several options are available for refreshing the Controller platform, in case a condition has occurred which stopped a portion of the functionality of the Controller and you do not wish to reboot the entire Controller platform.

- Choose Reboot Platform to cleanly shutdown the Controller 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.



SECURITY

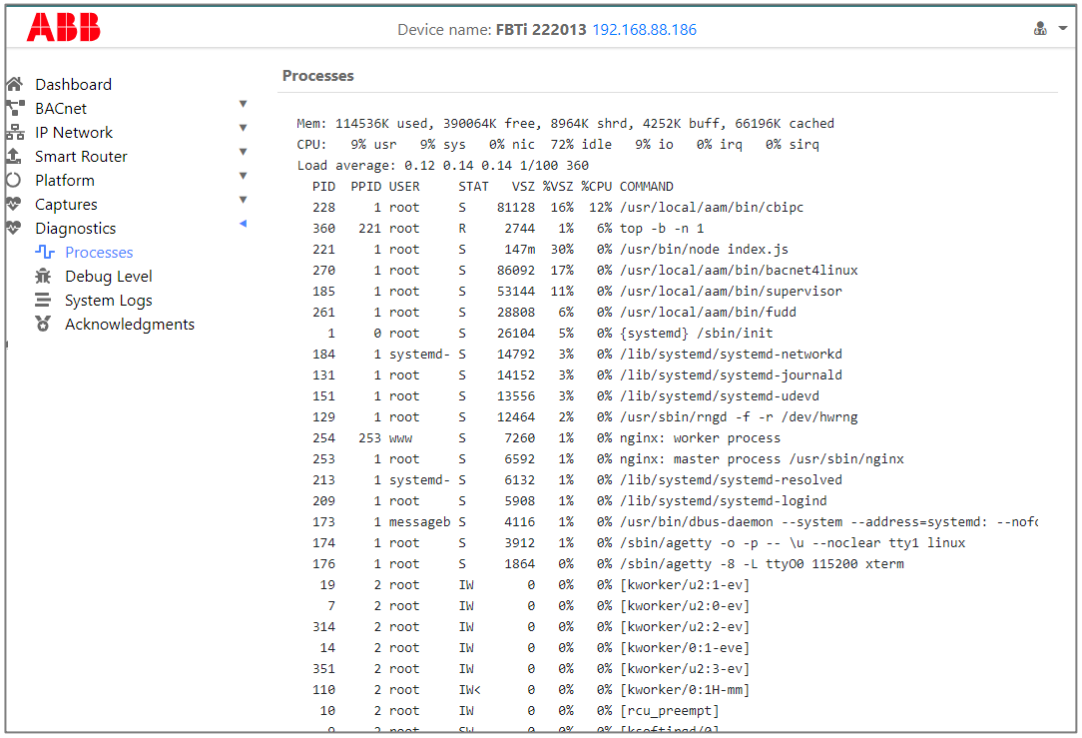
For security reasons, the USB ports, SSH and HTTP redirection are disabled by default. If required, they can be enabled by selecting the Platform > Security page.



DIAGNOSTICS MENU

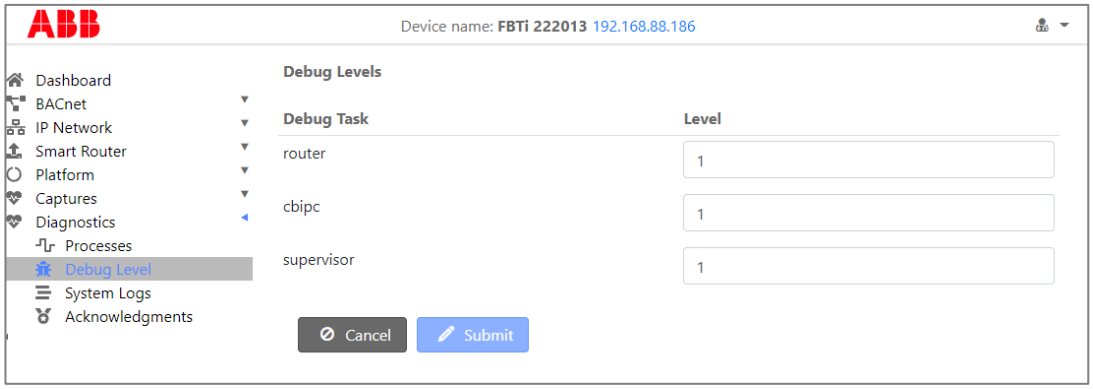
PROCESSES

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



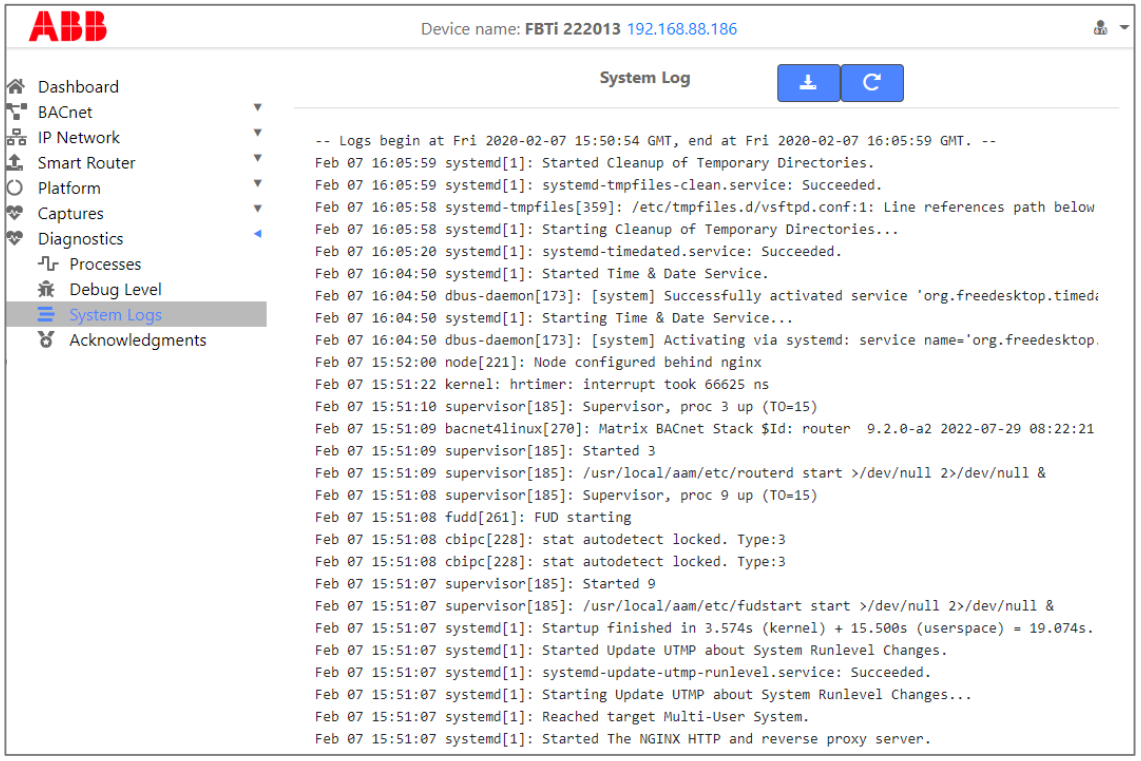
DEBUG LEVEL

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



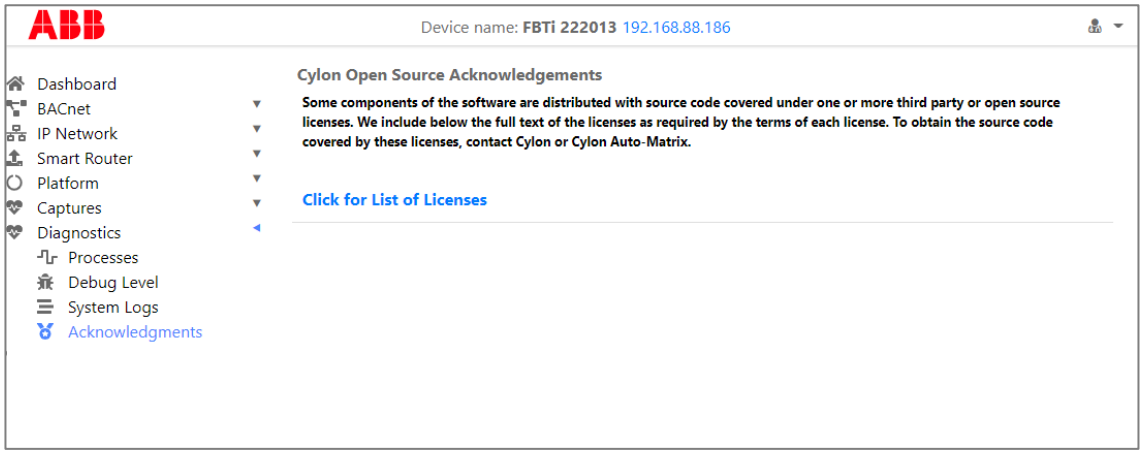
SYSTEM LOGS

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.



OPEN-SOURCE ACKNOWLEDGMENT NOTICES

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



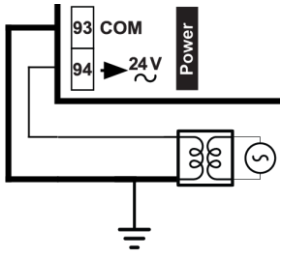
5 Installation

APPLY POWER TO THE CYLON® FBTI SERIES

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

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

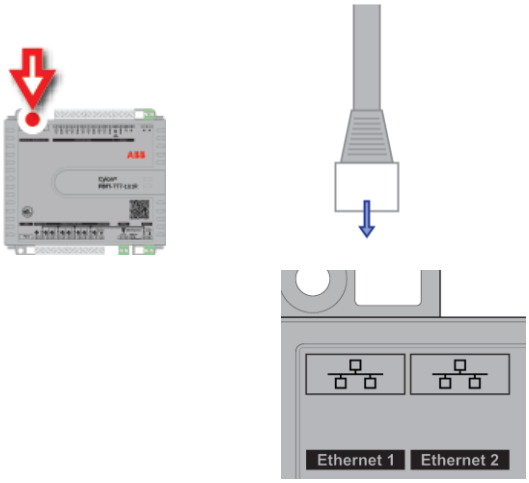
The Cylon® FBTi Series requires 24 V AC supplied from an externally mounted power transformer. One conductor of the transformer must be grounded to an earth ground to avoid damage to the controller. This conductor will be wired to the COM (common) terminal of the controller. The wiring diagram is shown here:



Note: Ensure the 24 V AC 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 CYLON® FBTI SERIES 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 controller:

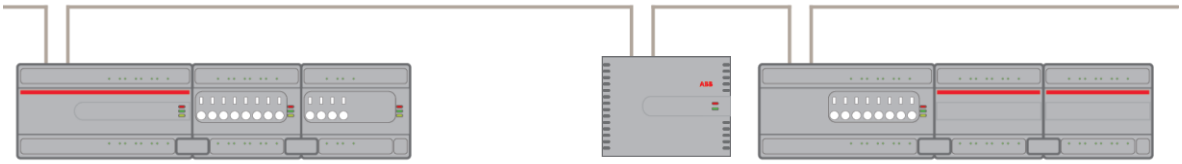


IP Cabling requirements

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 CYLON® FBTI SERIES INTEGRATED ETHERNET SWITCH

The **Cylon® FBTi Series** includes an integrated **Ethernet Switch**, with 2 ports. This allows the device to forward **IP** packets from each port to the other, allowing **FBTi**, **FBVi**, **FBXi** and **CBXi** devices to be connected in a **Daisy-Chain** topology:



Spanning Tree network switch protocol (**STP**) may be used to allow all controllers to continue to communicate in the event of a single line break or controller failure. However this is only advised if static IP addresses are used.

Note: It is not recommended that an **FBTi** / **FBXi** / **FBVi** / **CBXi** daisy chain network be placed in a ring configuration unless DHCP is disabled.

If all controllers have static IP addresses, and if **controllers** `A`, `B`, `C`, `D` and `E` are daisy-chained, connected on both sides to 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.

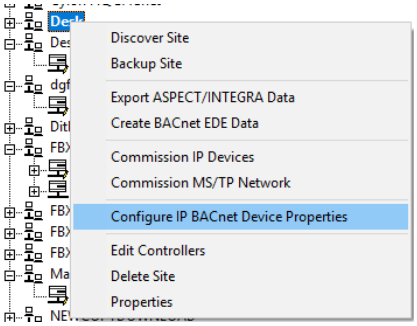
Note: The **Cylon® FBTi Series** controller has a pass-through across its IP switches, such that if it loses power controllers 'downstream' will continue to be connected.

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}

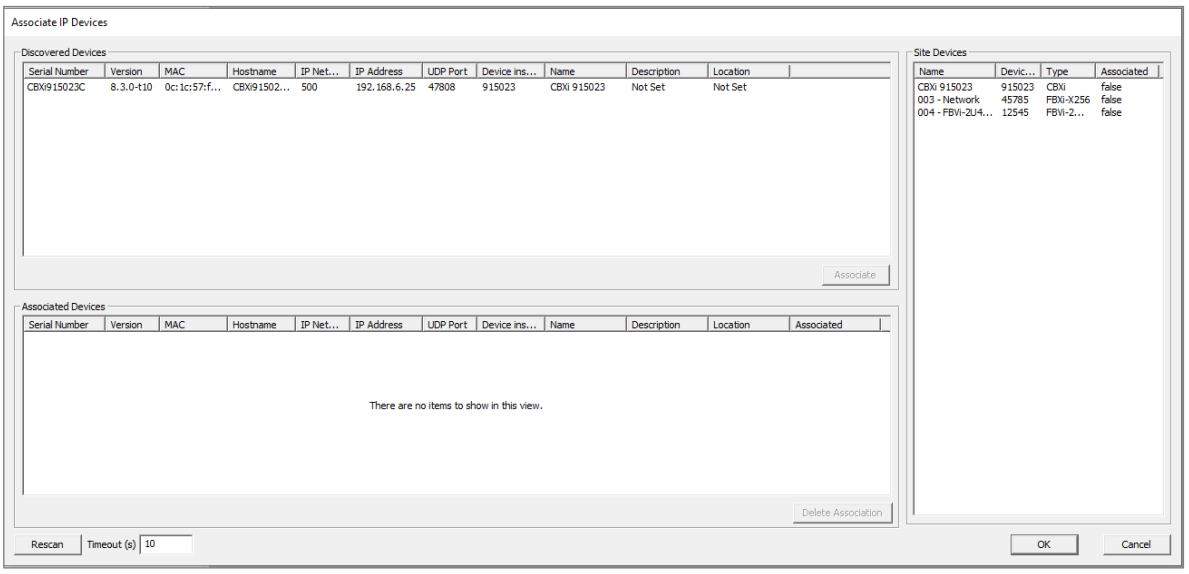
CXpro^{HD} includes a utility to quickly configure **BACnet** properties for **IP** devices. To launch this utility, right-click on a **Site** in the **Site List** and select **Configure IP BACnet Device Properities**



The utility will scan for all **CBXi**, **FBXi**, **FBTi** 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:



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

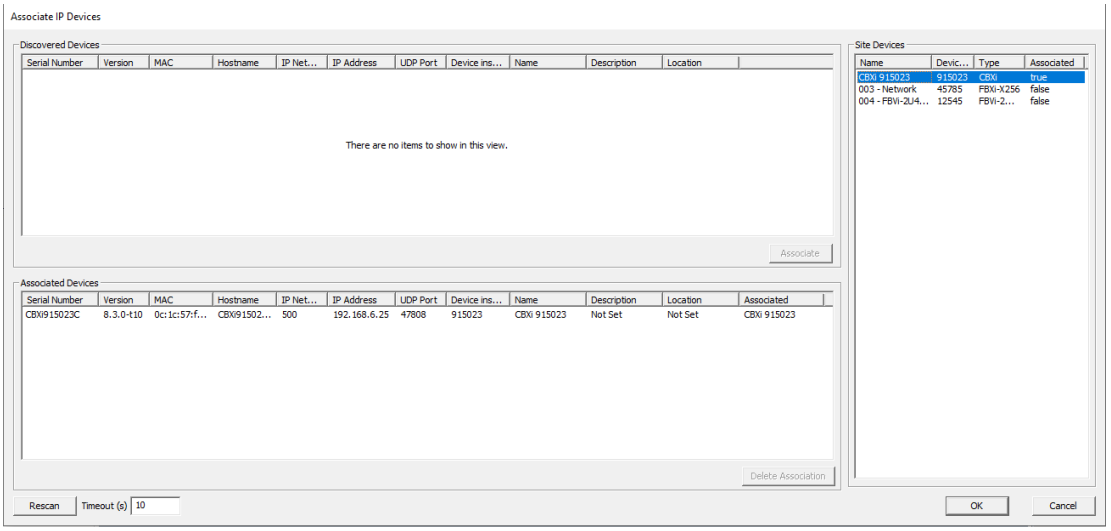
The Associated Devices panel on the bottom left lists any Discovered Device that has been associated with a configured Site Device.

How to Associate devices

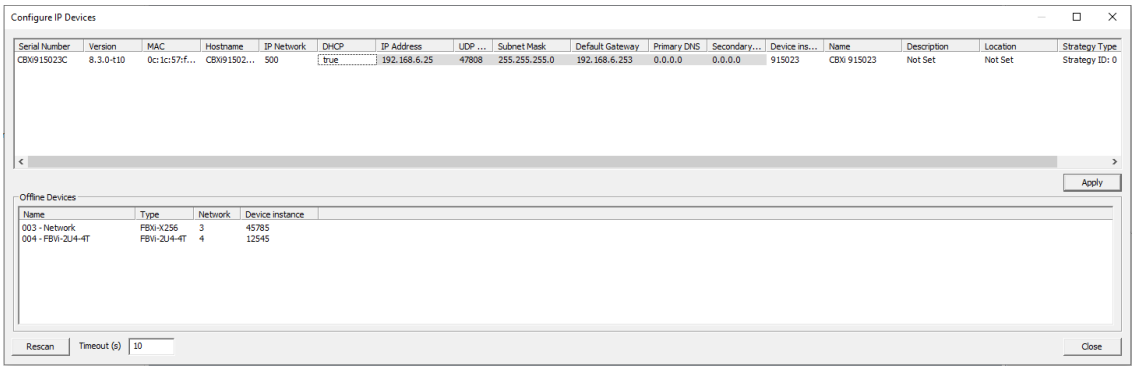
To associate a Discovered Device with a Site Device, select a device in the Site Devices list and a device in the Discovered Devices list and click the Associate button. Alternatively, you can drag the Site Device and drop it over a Discovered Device.

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.



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.



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

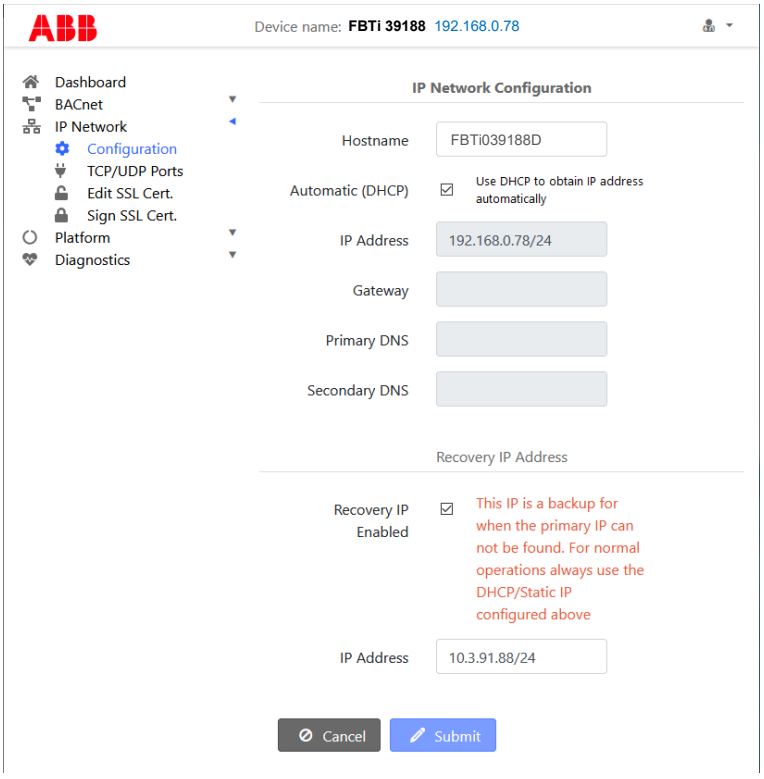
When the properties are set as required, click Apply to send the changes to that controller.

Configuring the IP connection without CXpro[HD]

If your network does not have a **DHCP** server, then the **Cylon® FBTi Series** controller will use a Recovery **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 **Controller** with serial number `039188D`
will be allocated the Recovery IP address of `10.03.91.88`



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

For example, if the **Controller** 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 8).

It may be possible to reach the **Controller** 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 **Controller**. Alternatively you could change the **Controller**'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 **Controller** with serial number `901001A` should have a subnet mask of `10.90.10.01/24`.

Accessing the Cylon® FBTi Series Web UI

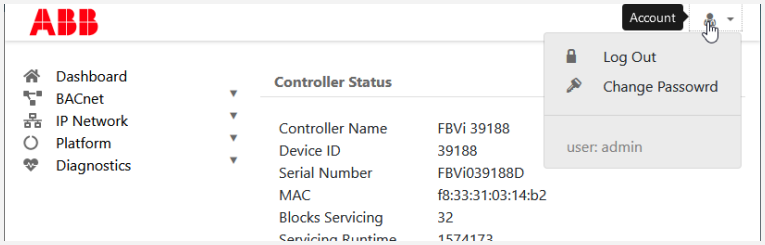
Point a web browser at the controller's IP address, and log in to the Web UI.

Warning: By default, all Cylon® FBTi Series devices leaving the factory are configured with the following login:

username: `admin`

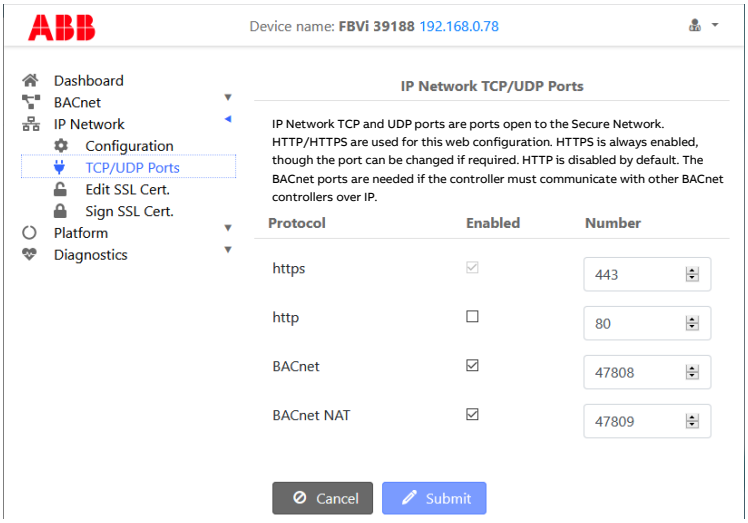
password: `cylonctl`

You must change these credentials by clicking on the User icon in the top-right of the Web UI page and selecting Change Password.



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:

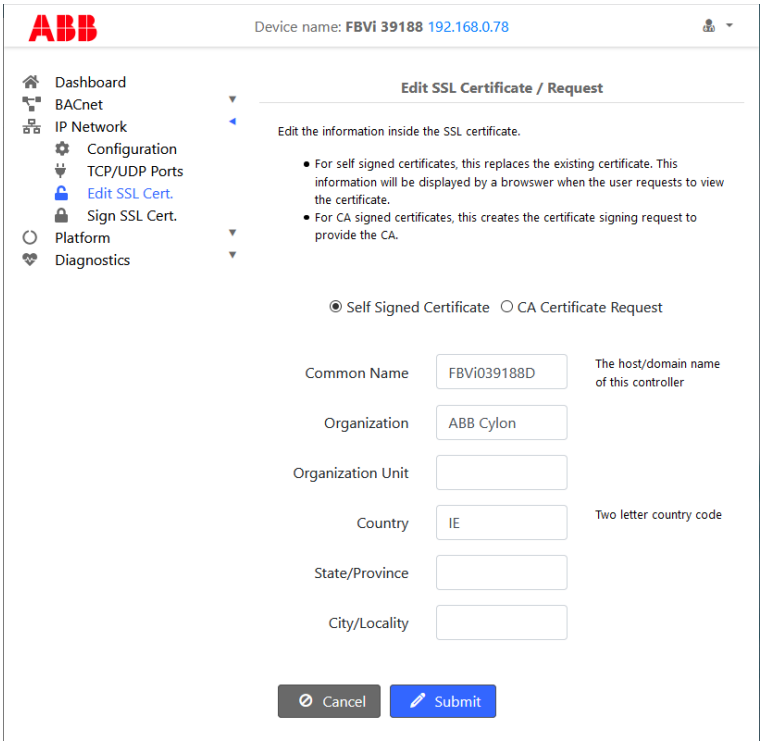


Note: BACnet NAT is used for accessing the BACnet device from the Internet (ensure that this is always via a secure VPN), for example in the case of remote supervision. The Port Number set here should match the corresponding settings on the BACnet > BBMD/NAT page.

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.

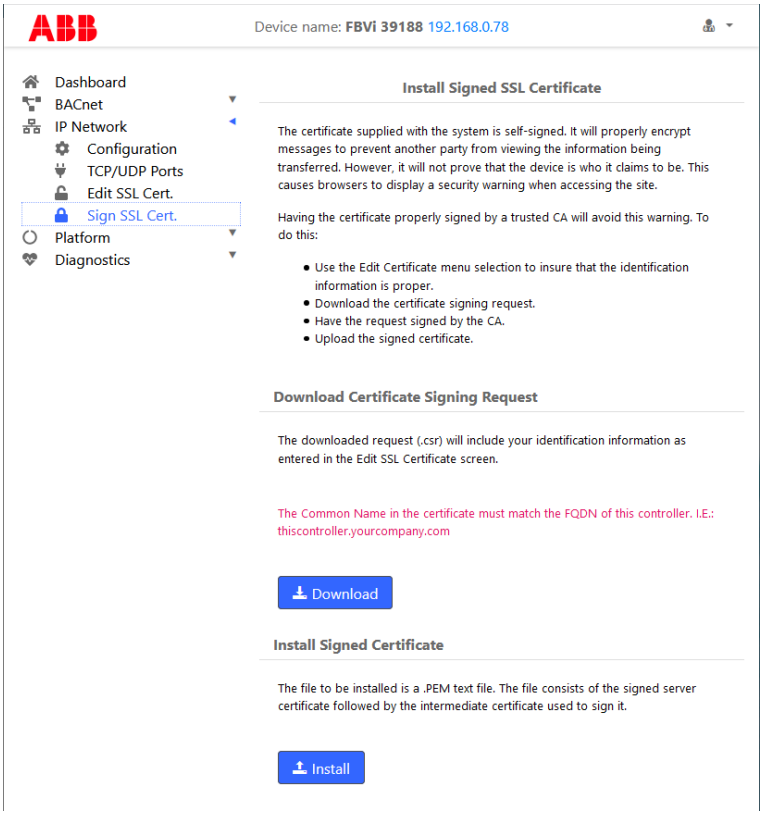
Note: VPNs can themselves have security issues. It is the responsibility of the VPN owner to ensure that their VPN is kept up-to-date and secure.

Cylon® FBTi Series 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.



The IP Network > Edit SSL Cert page allows you to enter the details for an SSL certificate, which can be applied to the current **Cylon® FBTi Series** 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:



WIRING THE IO

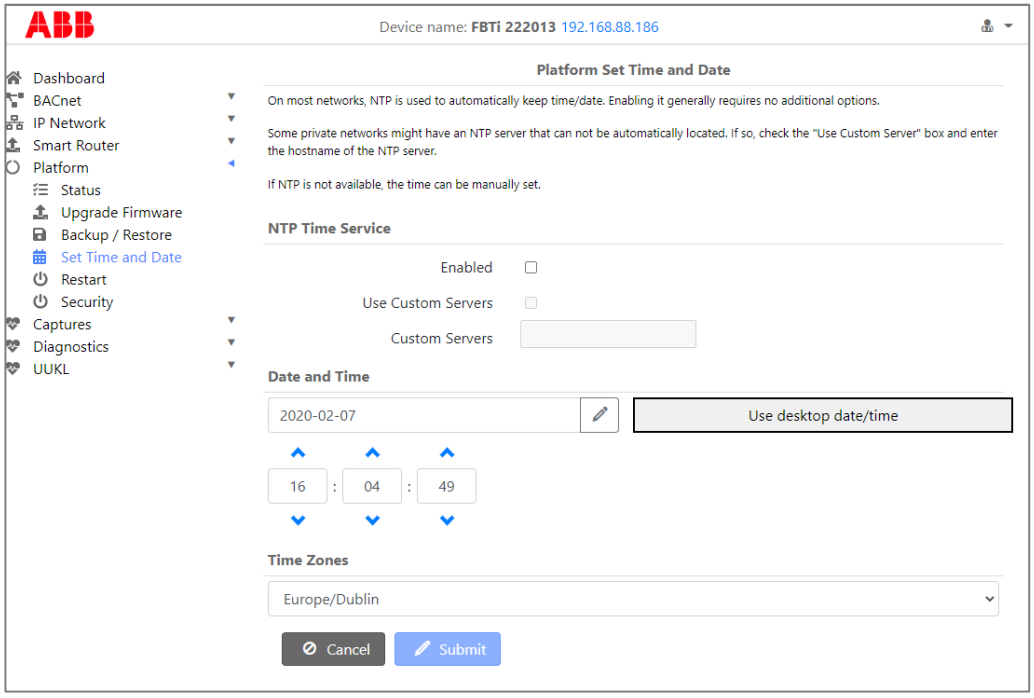
Wiring the Universal Inputs

The Cylon® FBTi Series comes with 7 universal inputs. U/I-1 through U/I-7 are used for wiring in-room sensors, setpoint adjust, discharge air sensors, CO_2 sensors, relative humidity sensors, window, and motion sensors, depending on the application.

ADD THE CONTROLLER TO THE CXpro^{HD} SITE

SET CONTROLLER DATE AND TIME

The device should be set up as a Time Sync Master, so click the Enabled checkbox under Platform > Set Time and Date > NTP Time Service, and the controller time will be automatically updated.

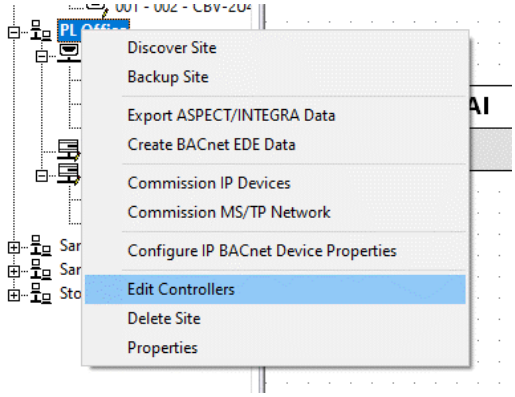


Note: The NTP Enabled checkbox is mirrored on the BACnet side with a proprietary property

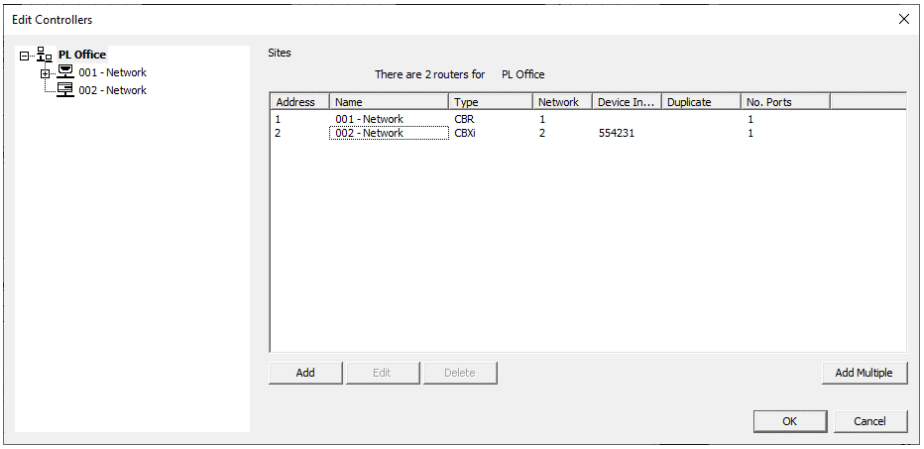
Note: If there is a local requirement not to use NTP, deselect the Enabled checkbox and use the inputs under Date and Time to set the controller's clock.

SET UP THE CONTROLLER IN A SITE IN CXpro[HD]

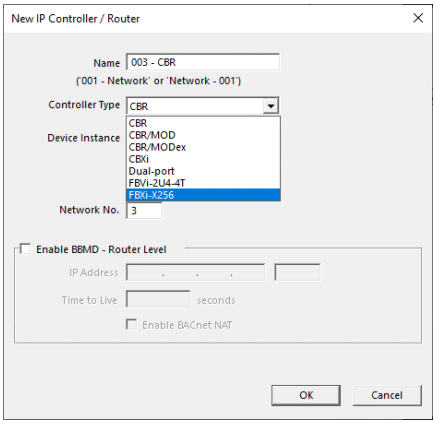
To add an **FBTi** to a side, right-click on the **Site** in the and select **Edit Controllers**:

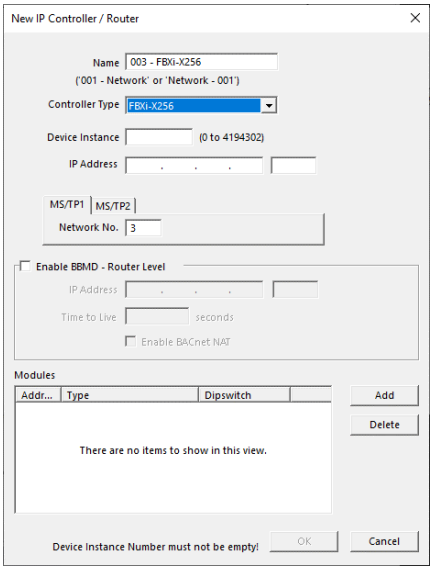


This opens the **Edit Controllers** dialog:



Click the **Add** button and select **FBTi** as the **Controller Type** in the **New IP Controller / Router** dialog:





Set the controller **Name**, **Device Instance Number** and **IP Address : Port** (for exporting to **ASPECT®** and **INTEGRA™**)

(IF REQUIRED) CONFIGURE A MODBUS CONNECTION

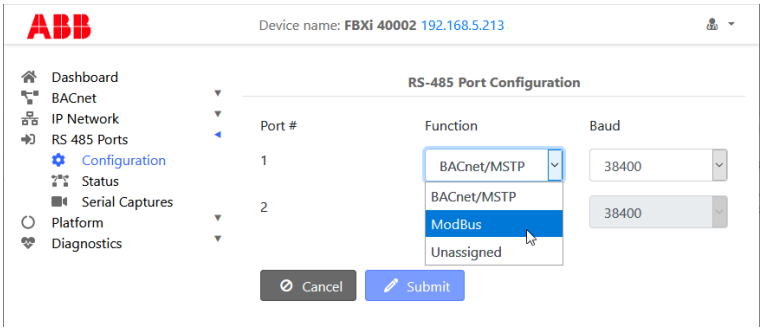
Modbus connections can be made directly to Modbus IP devices on an RTU trunk connected to the FBTi, or over IP to RTU devices attached to a separate router.

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

Configuring a Modbus RTU connection

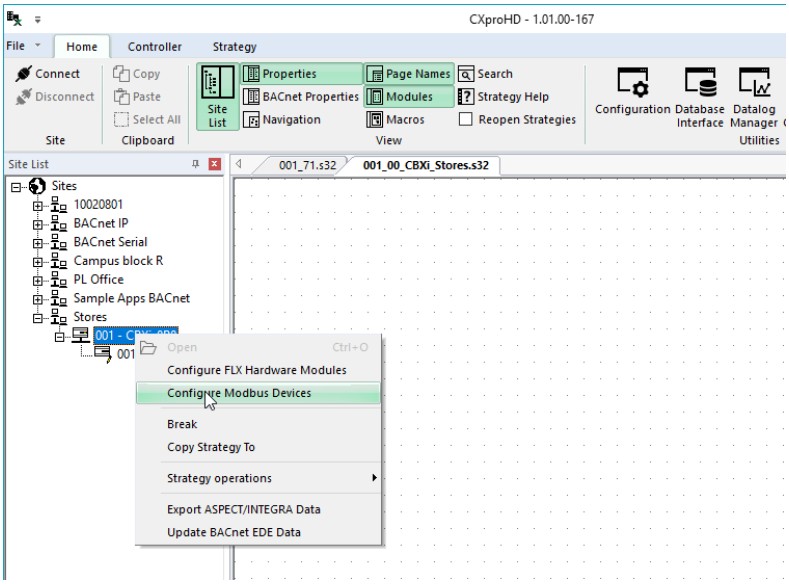
If a Modbus connection is to be through either of the RS485 Ports,

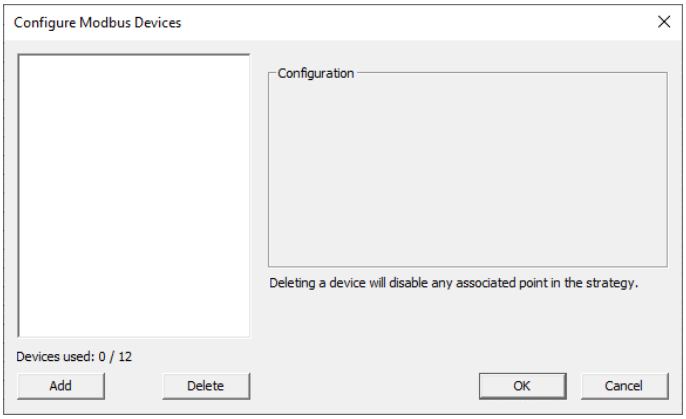
In the controller's Web UI > RS 485 Port > Configuration page, set Protocol of the required port to Controller Modbus:



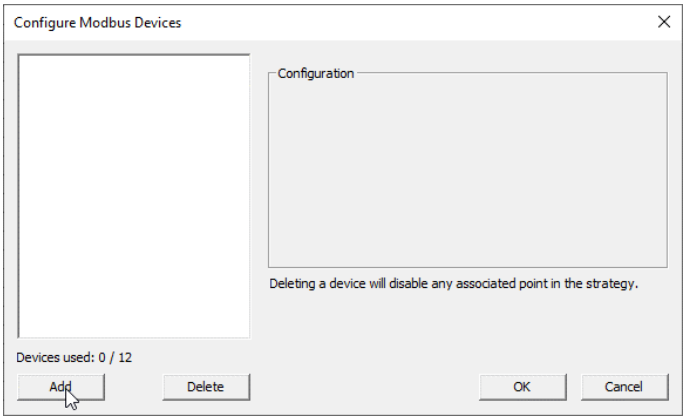
In CXpro^{HD}, open the Strategy drawing for the FBTi.

With the Strategy open, right-click on the FBTi 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

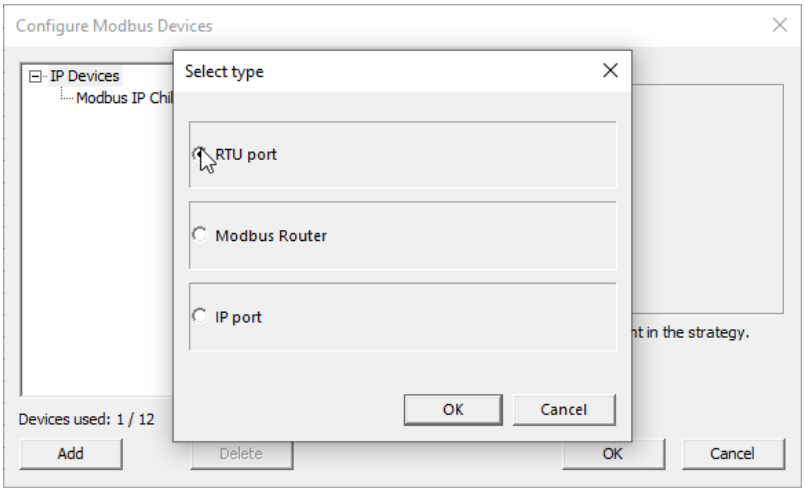


In **FBXi** controllers, each time you add a **Modbus** device you are offered the choice of adding

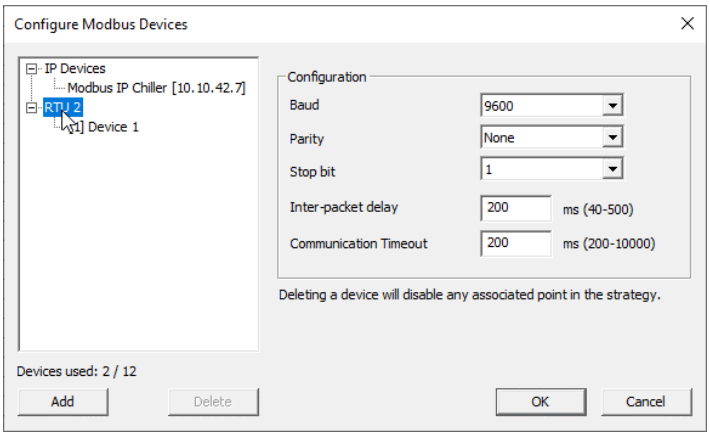
1. a Modbus RTU device connected to the **FBXi**'s RTU port
2. a Modbus IP device
3. a Modbus RTU device connected to a separate IP Router

Connecting directly to a Modbus RTU device

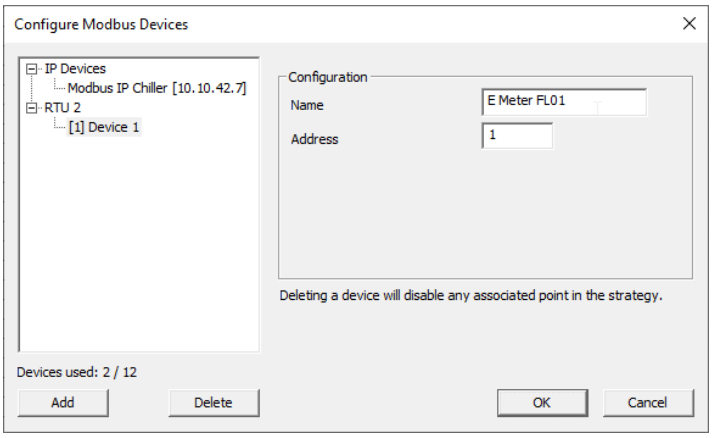
Select **RTU Port** and click **OK**,



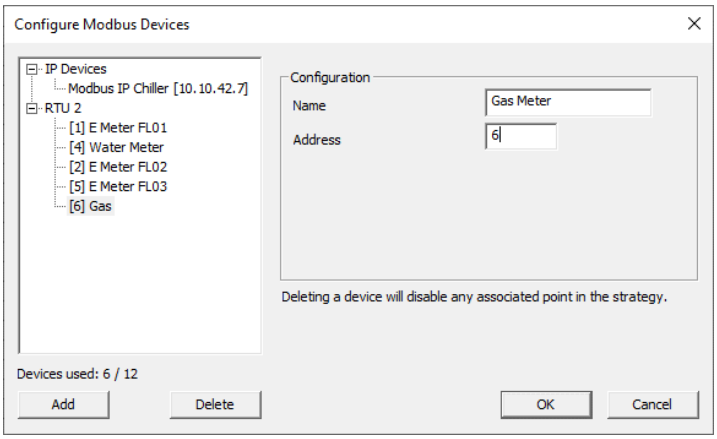
When the first Modbus RTU device is added, an entry for the RTU trunk itself is added. Select this trunk, and set the Baud rate, Parity and Stop Bit to match all other devices on the RS485 trunk:



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



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

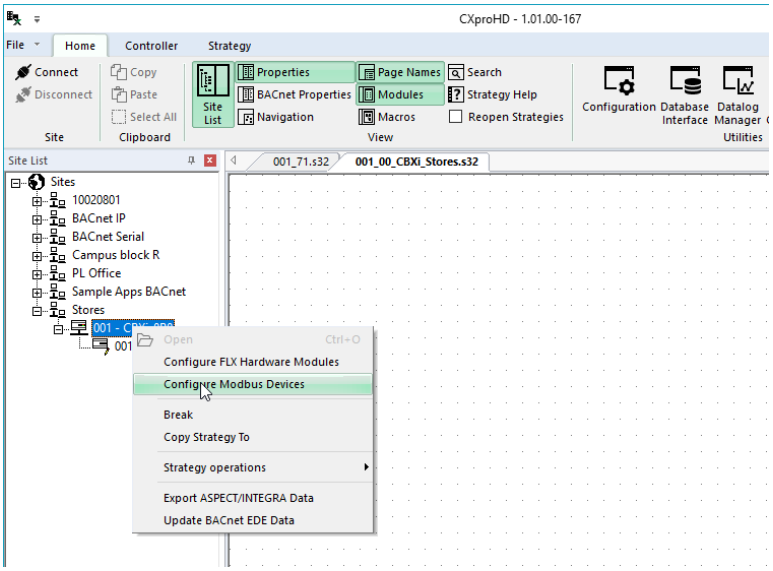


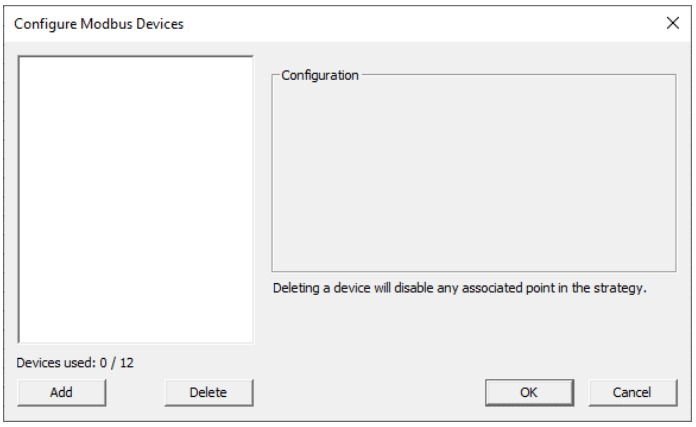
Configuring a Modbus IP connection

If a **Modbus** connection is to be over **IP**,

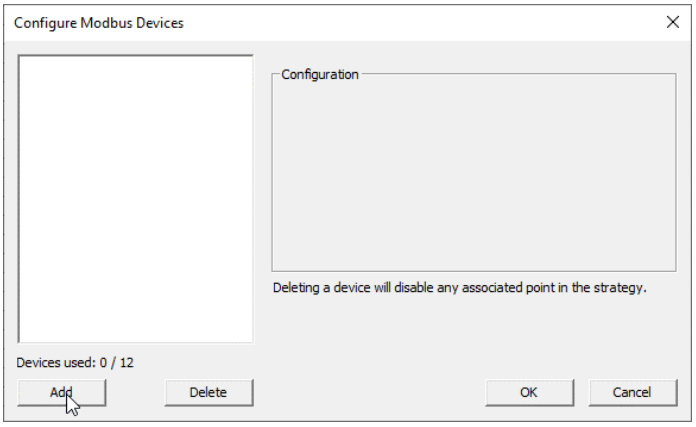
In **CXpro**[HD], open the **Strategy** drawing for the **FBTi**.

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





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

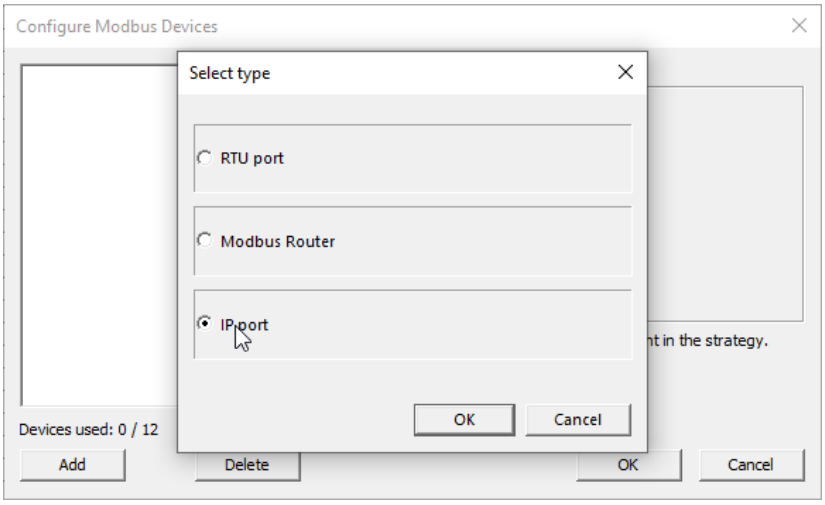


In **FBTi** controllers, each time you add a **Modbus** device you are offered the choice of adding

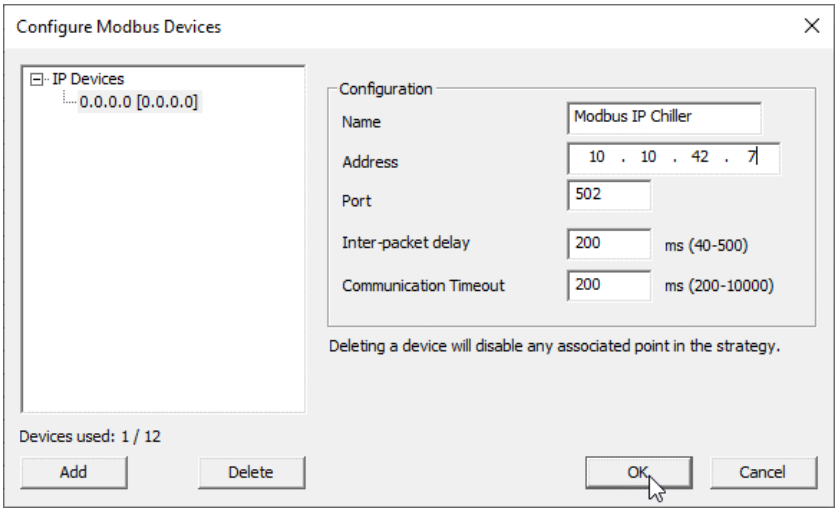
1. a Modbus RTU device connected to the **FBXi**'s RTU port
2. a Modbus IP device
3. a Modbus RTU device connected to a separate IP Router

Connecting directly to an IP Modbus device

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

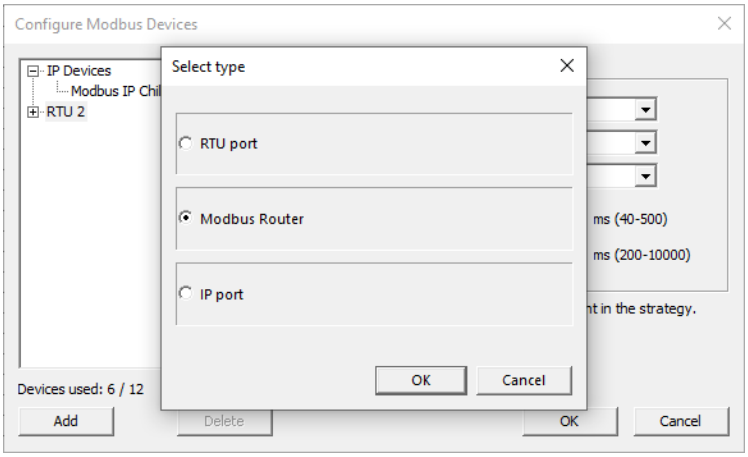


Set the `Name` and `IP Address` for the device and Click `OK`

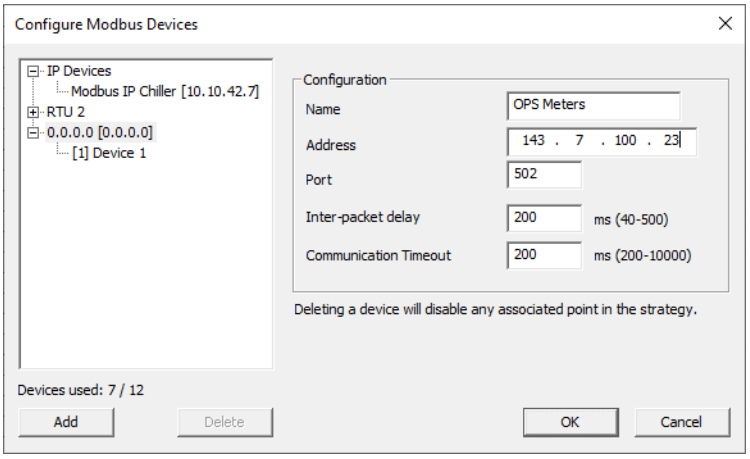


Connecting to a remote Modbus RTU device through an IP router

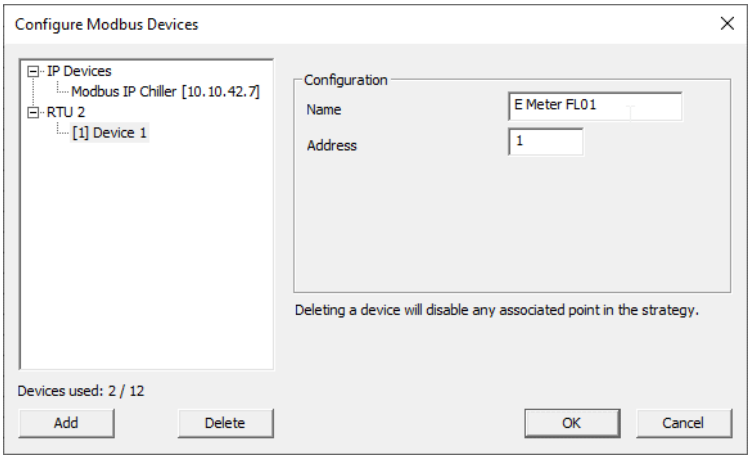
Select Modbus Router



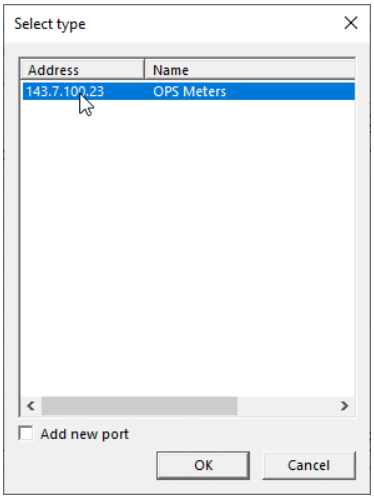
Set a Name, IP address and IP Port for the Router



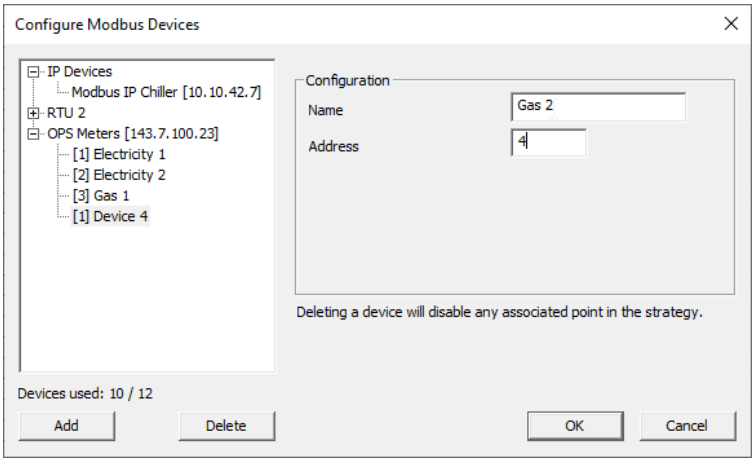
Set a name and Modbus address for the RTU device that was added along with the Router



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:



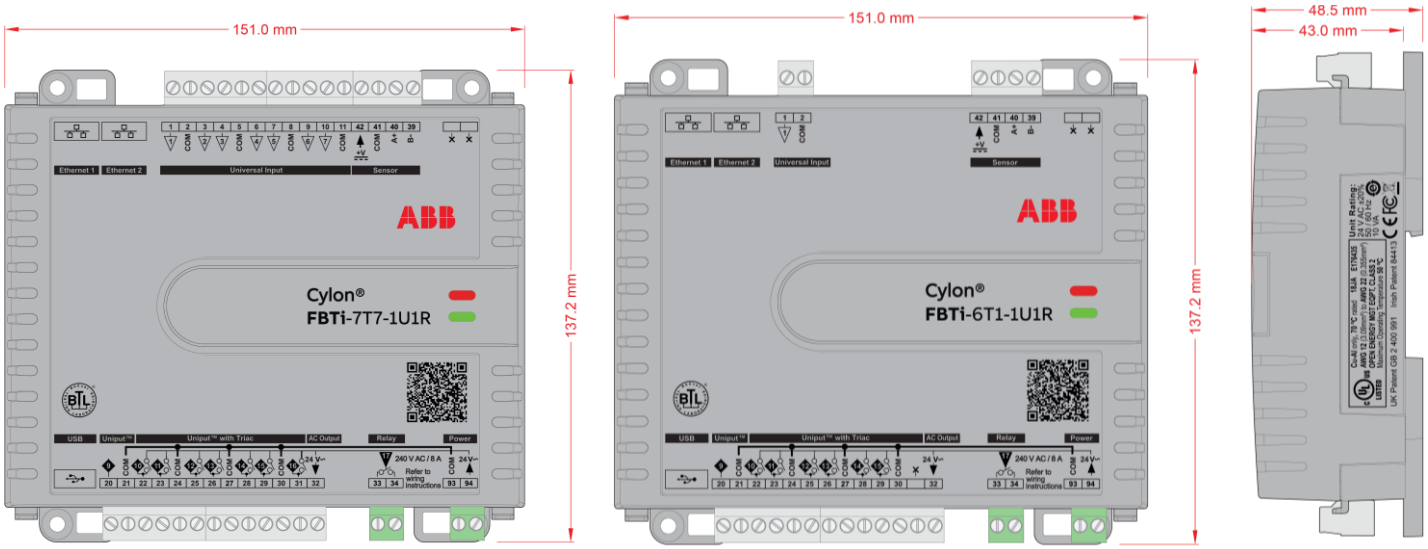
and specify a name and RTU address.



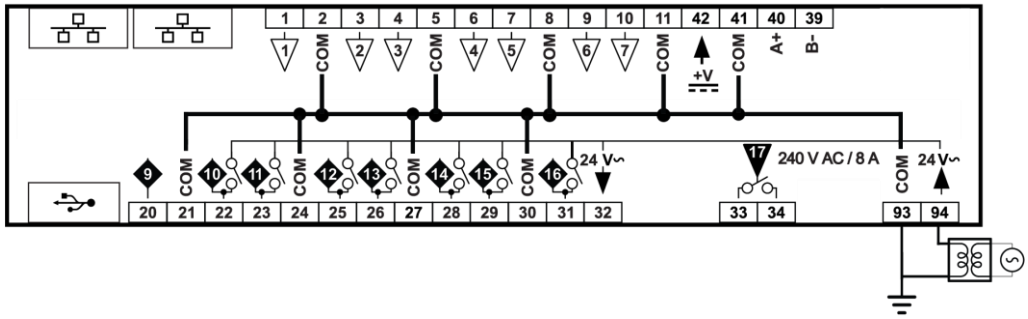
Click OK when Modbus device configuration is complete.

6 Cylon® FBTi Series Operation

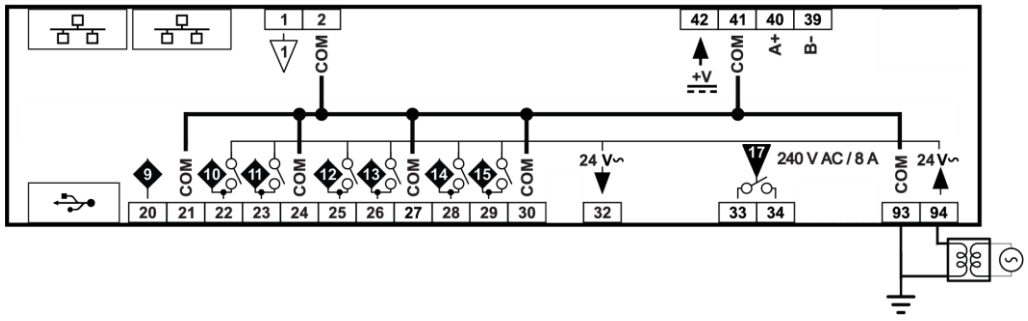
PHYSICAL LAYOUT



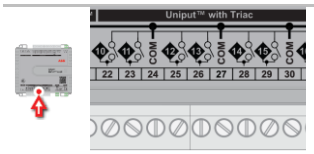
FBTi-7T7-1U1R:



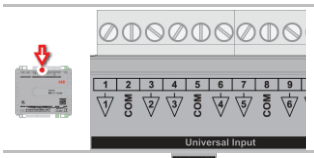
FBTi-6T1-1U1R:



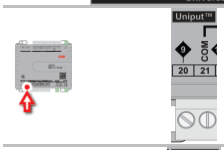
⏚	Ground
COM	Common
✱	Terminal is Not Connected
10 4 16	Point Numbers
25 26	Terminal Numbers



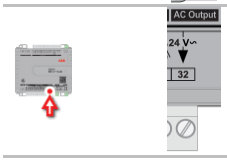
22 … 30 UniPuts™ with Triac



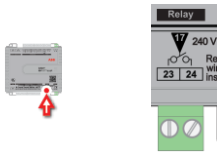
1 … 9 Universal Inputs



20, 21 UniPuts™

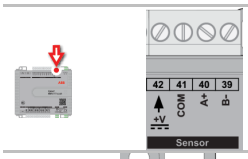


32 24 V AC output

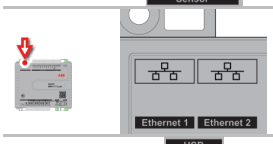


33, 34 Relay digital output 240 V AC,
Maximum Load: 240 V AC / 8 A Max

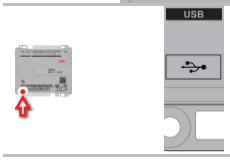
WARNING: HAZARDOUS VOLTAGES.
DISCONNECT SUPPLY TO MAINS RELAYS AND 24 V AC TO UNIT BEFORE WIRING.



39 … 42 Sensor Port



Ethernet



USB Port

Indicator LEDs

	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

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

(Unconnected terminals, for use on future product variants)

INPUTS AND OUTPUTS

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

INPUT MODES

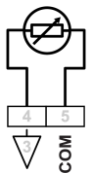
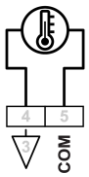
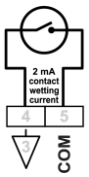
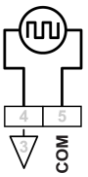
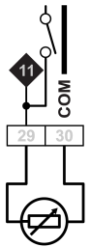
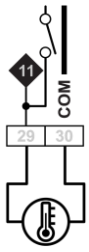
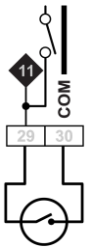
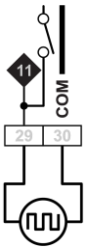
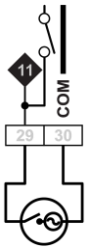
Universal Input terminals and UniPut™ terminals can be configured as inputs in almost identical fashion:

Measurement Mode	Universal Input	UniPut™ as Input:
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)	
	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.

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					

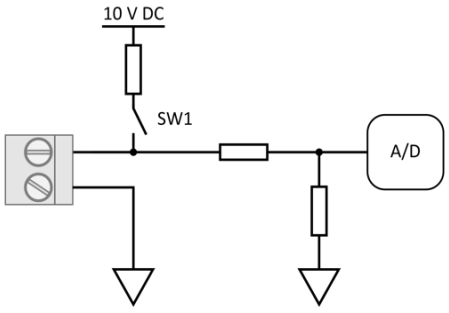
These all require a current supplied by the **FLX** terminal so that this resistance can be measured.

The passive sensor types supported by the **FBTi** 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 **FBTi**.

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:

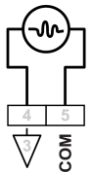
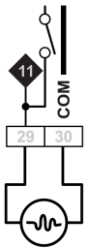


Note: The reference voltage can be pulsed or continuous, using the solid state switch.
A pulsed reference gives optimum accuracy by eliminating self-heating in the sensor, and this is the default setting.

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)

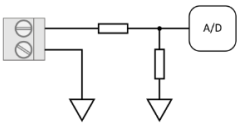
Universal Input	Uniput
	

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

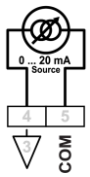
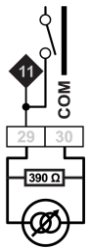
The 0 … 10 V input is used for Active analog and digital measurements. 'Active' means that there is no current supplied by the FLX for the sensor, as the signal is generated completely by the Sensor.

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:

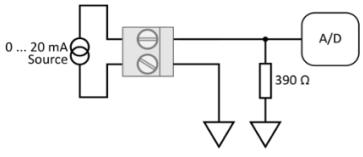


Current Input mode (Active Input)

Universal Input	Uniput
	

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

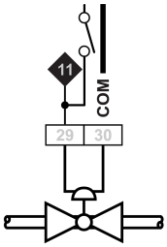
`4 ... 20 mA` scaling can easily be achieved using CXpro[HD] by entering range values in the Point Module '`Advanced`' parameters.



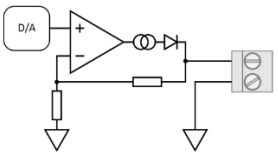
OUTPUT MODES

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
- Analog 0 … 10 V output mode

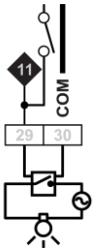


In `Analog 0 ... 10 V output` Mode, the Uniputs configure themselves like this:

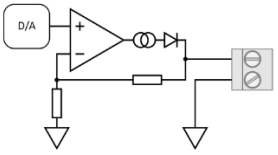


where the D/A is the digital to analog converter. All circuitry is fully protected against 24 V AC.

Digital 0 … 10 V output mode

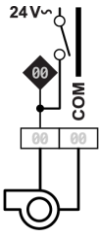


In `Digital 0 ... 10 V output` Mode, the Uniputs configure in the same way as for analog:



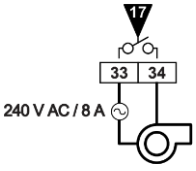
In this mode the output toggles between the voltages defined as "`ON`" and "`OFF`".

Triac Mode



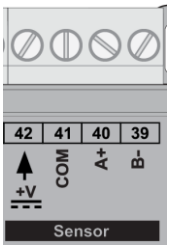
RELAY OUTPUT

- Relay Contacts with ability to switch up to 240 V AC
- Maximum Load: 240 V AC / 8 A max



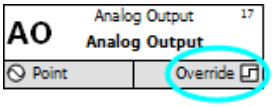
USING A KEYPAD WITH THE CYLON® FBTI SERIES

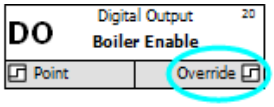
A FusionAir Smart Sensor can be connected to the controller at the Sensor port.



Note: FusionAir Smart Sensor can not be used to balance a VAV box.

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





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.

7 Configuring the Fan Coil Strategy

SETTING FAN COIL UNIT CONFIGURATION CODES

The configuration options for the FBTi Fan Coil unit strategy inputs and strategy options can be set with CXProHD BACnet Commissioning tool. If this isn't available, the following will explain how to set up the unit only using BACnet points.

These codes are the same for all the different output setups available for the fan coil unit series. Any setpoints that are specific to each strategy will be covered under each strategy section.

INPUTS

Standard input setups:

- **UI-1** Will always be used for supply air temperature.
- **UI-9** This input is set for fan status as the default. Other options are a digital safety input, or as a digital filter status.
- **UI-10** This input is used as a digital safety input as the default. Other options are a 10k pipe temperature, a digital input for summer/winter changeover, or as a digital fan status.

OUTPUTS

Standard output setup for ANALOG OUTPUT CONTROL (Strategy ID 10121500 (US) and 10101500 (Metric))

- **AO-11** is configured for an analog fan command.
- **DO-12** is configured for digital electric heat.
- **AO-13** is configured for an analog heating or analog 2-pipe valve.
- **AO-14** is configured for an analog cooling valve.
- **AO-15** is configured for an analog damper.
- **DO-17** is configured for a digital fan on/off command.

Standard output setup for DIGITAL/FLOATING OUTPUT CONTROL (Strategy ID 10131500 (US) and 10111500 (Metric))

- **AO-11** is configured for an analog fan command.
- **DO-12** is configured for digital electric heat, floating open hot water, or floating open 2-pipe valve.
- **DO-13** is configured for a digital open/close heating valve, floating closed hot water or floating closed 2-pipe valve.
- **DO-14** is configured for a digital open/close cooling valve or floating open cooling valve.
- **DO-15** is configured for a digital open/close damper or floating closed cooling valve.
- **DO-17** is configured for a digital fan on/off command.

The FBTi with Fan Coil Unit Strategy may have several pre-loaded strategies to choose from that are designed to be configurable for a variety of Fan Coil Unit (FCU) sequences.

The setup can be selected by writing a value to configurable BACnet setpoints that are within the strategy. There are multiple ways to configure the FBTi for a specific sequence. Users can set these configuration values through CXpro^{HD}, NBPro, or a BACnet interface.

The preset configuration variables from the factory are:

- tempControlConfig = `0`
- unitConfig = `0`
- UI9Config = `0`
- UI10Config = `0`

TEMP CONTROL CONFIGURATION CODE

The type of temperature control for the Fan Coil Unit strategy are selected using tempControlConfig

There are multiple options which can be selected for each input. Adding these together will result in the final code for the tempControlConfig

Supply Air Temp Control – `0` is the default for supply temperature control. The supply air temperature setpoint will reset based on the zone temperature demand. Based on ASHRAE recommendations. The heating and cooling control will be based on the deviation from supply air temperature from supply air temperature setpoint.

Zone Temp Control –`1` is the default for zone temperature control. The cooling and heating demand will be based on the zone temperature deviation from heating and cooling setpoints. Does not use supply air temperature setpoint.

Heat Only– If `2` is added, the unit will only operate when there is a heating demand. Cooling will not be enabled.

Cool Only – If `4` is added, the unit will only operate when there is a cooling demand. Heating will not be enabled.

Electric Heat Enabled If `8` is added, the electric heat will be used for heating. Electric heating will be based on zone temperature control only. If Electric heat has been configured, analog heating will be disabled.

Free Cooling – If `16` is added, the outside air damper will modulate based on cooling demand. An outdoor air temperature is required to be sent to the unit.

Note: A FusionAir sensor is required for 9-point controllers, it will use the sensor for space temp, humidity if available, CO_2 if available, setpoint adjust and temporary occupancy. Setpoint adjustments are made by pressing the up and down arrows on the FusionAir. Temporary occupancy is achieved by touching the face of the FusionAir.

UNIT CONFIGURATION CODE

The different basic sequence options that are available to all fan coil unit configurations are selected using unitConfig

There are multiple options which can be selected for each. Adding these together will result in the final code for the unitConfig

- **Not Set** – `0` is the default, no additional configuration. Basic operation.
- **Slave Mode –** If `1` is added, the unit will be set to Slave mode.
- **Master Mode** – If `2` is added, the unit will be set to Master mode.
- **Demand Control Ventilation** – If `4` is added, the outdoor air damper will modulate based on CO_2 levels.
- **Occ Sensor –** If `8` is added, the occ sensor wired to the FusionAir Sensor digital input will be used to determine occupancy. Occupancy = `closed`, Standby = `open`.
- **Window Contact –** If `16` is added, the window contact wired to the FusionAir Sensor digital input will be used to determine window status. Window closed = `closed`, Window open = `open`.
- **Fan Cycling Off** – If `32` is added, when the unit is in ventilation mode, the fan will shut off. When heating or cooling, the fan will be enabled.
- **Fan Cycling Deadband** – If `64` is added, when the unit is in ventilation mode, the fan will run at deadband speed.
- **Remote 2-Pipe Changeover** – If `128` is added, if 2-pipe control is needed, but cannot utilize UI10, the strategy will use the remoteSummerWinterTemp analog setpoint.

UI9 CONFIGURATION CODE

The different universal input options that are available on UI9 to all fan coil unit configurations are selected using UI9Config

There are multiple options which can be selected for each. Adding these together will result in the final code for the UI9Config

- **Fan Status –** `0` is the default, no additional configuration. UI9 will be used as a digital status of the unit fan.
- **Safety –** If `1` is added, UI9 will be used as a digital status of a combination of smoke, freeze or water pan alarm.
- **Filter Status –** If `2` is added, UI9 will be used as a digital status of the unit filter.

UI10 CONFIGURATION CODE

The different universal input options that are available on UI10 to all fan coil unit configurations are selected using UI10Config

There are multiple options which can be selected for each. Adding these together will result in the final code for the UI10Config

- **Safety –** `0` is the default, no additional configuration. UI10 will be used as a digital status of a combination of smoke, freeze or water pan alarm.
- **2-Pipe temperature sensor –** If `1` is added, UI10 will be used as a 10k water temperature sensor to determine heating or cooling season.
- **2-Pipe digital changeover –** If `2` is added, UI10 will be used as a digital input to determine heating or cooling season.
- **Fan Status –** If `4` is added, UI10 will be used as a digital status of the unit fan.

HEAT DIGITAL OUTPUT CONFIGURATION

Strategy ID 10131500 (US) and 10111500 (Metric)

The different heating digital output options that are available on digital fan coil unit configurations are selected using HeatDOConfig

- 0 is the default, no additional configuration.
  - DO12 Electric Heat On/Off
  - DO13 Hot Water On/Off
- `1`
  - DO12 Electric Heat On/Off
  - DO13 2-Pipe On/Off
- `2`
  - DO12 Float Open Hot Water
  - DO13 Float Close Hot Water
- `4`
  - DO12 Float Open 2-Pipe
  - DO13 Float Close 2-Pipe

Note: If setting your digital outputs to 2-pipe control, remember to set either unitConfig to remote (software) changeover or UI10Config for a hardwired connection. The hardwired options are either a 10k pipe temperature sensor or a dry contact closure.

COOL DIGITAL OUTPUT CONFIGURATION

Strategy ID 10131500 (US) and 10111500 (Metric)

The different cooling digital output options that are available on digital fan coil unit configurations are selected using CoolConfigDO

- `0` is the default, no additional configuration.
    - DO14 Chilled Water On/Off
    - DO15 Damper On/Off
- `1`
    - DO14 Float Open Chilled Water
    - DO15 Float Closed Chilled Water

Note: To manually reset the floating-point position if it gets disjoined from the valve position, manually close the valve, then set the unit to unoccupied mode while not in cooling or heating mode. This will reset automatically as well.

8 FBTi Fan Coil Sequences of Operation

This section provides details of the basic control sequences used for all Fan Coil Unit (FCU) applications.

OCCUPANCY SEQUENCE

Occupancy can be achieved in 4 different ways:

- ***Internal Schedule***: When intScheduleEnb is ON, the Fan Coil unit will be commanded to the occupied mode when the BACnet schedule returns a `True` value. Otherwise the Fan Coil unit will be in unoccupied mode.
- ***External schedule thru an analog command***: When the point OccCmd is set to `1`, the Fan Coil unit will be commanded to the occupied mode. If it is set to `0`, the fan coil will be in the unoccupied mode. If it is set to `2`, the fan coil will be in the standby mode.
- ***Occupancy Override:*** If the unit is unoccupied, when the face of the FusionAir Sensor is touched, the unit will go into a temporary occupied mode. Temporary occupancy time will be defined by the configuration occOvrTime in minutes.

FUSION AIR SENSOR

Some optional settings are available thru setpoints:

- FusionStatStptEnb – Set to FALSE to disable users from changing the setpoint.
- Fusion_Offset – Set the allowable range for users to change the setpoints
- Fusion_Increment – Set the amount of temperature setpoint change for each press of the button.
- alt_CO2input – If there is a remote sensor used for CO2 sensing, by sending that value to this analog setpoint will show the remote sensor value on the FusionAir Sensor.

FAN SEQUENCE

Some optional settings are available thru setpoints:

- FusionStatStptEnb – Set to FALSE to disable users from changing the setpoint.
- Fusion_Offset – Set the allowable range for users to change the setpoints
- Fusion_Increment – Set the amount of temperature setpoint change for each press of the button.
- alt_CO2input – If there is a remote sensor used for CO2 sensing, by sending that value to this analog setpoint will show the remote sensor value on the FusionAir Sensor.

TEMPERATURE CONTROL

There are two options to control space temperature:

The default method is supply air temperature control. When the zone temperature calls for cooling or heating, the supply air temperature setpoint will reset between the maxSupplyAirStpt and minSupplyAirStpt setpoints. Then the heating and cooling control will be based on the deviation from supply air temperature from supply air temperature setpoint. (ASHRAE recommendation).

PI TUNING FOR SUPPLY AIR CONTROL:

To tune the reset between the supply air setpoint temperature setpoints, use PIDSupplyResetGain and PIDSupplyResetInt. To tune the heating and cooling demand based on the supply air temperature setpoint and actual supply air temperature, use supplyAirGain and supplyAirIntegration.

The unit can also control based on zone temperature. The cooling and heating demand will be based on the zone temperature deviation from heating and cooling setpoints. Does not use supply air temperature setpoint.

PI TUNING FOR ZONE AIR CONTROL:

To tune the zone temperature to the zone temperature setpoints, use PIDTuneGain and PIDTuneInt.

Note: If there is a supply air temperature fault, the unit will automatically change over to zone air temperature control.

COOLING CALCULATION

When the zone space temperature rises above the current cooling setpoint, the Fan Coil unit will switch into cooling mode. If the unit has been selected as a heating only unit, this will not apply.

In an OCCUPANCY state, on a rise in zone temperature above the occCoolStpt, the cooling demand will rise from `0` to `100`%. On a fall in zone temperature below the occCoolStpt, the cooling demand will fall from `100`% to `0`.

The occCoolStpt setpoint can be affected by shed or standby modes. The active cooling setpoint will be reflected by the activeCoolStpt.

In an UNOCCUPANCY state, on a rise in zone temperature above the unoccCoolStpt, the cooling demand will rise from `0` to `100`%. The unit will be in **Setup Mode**. On a fall in zone temperature below the unoccCoolStpt, the cooling demand will fall from `100`% to `0`.

HEATING CALCULATION

When the zone space temperature falls below the current heating setpoint, the Fan Coil unit will switch into heating mode. If the unit has been selected as a cooling only unit, this will not apply.

In an OCCUPANCY state, on a fall in zone temperature below the unoccHeatStpt, the heating demand will rise from 0-100%. If heat is available, the stages of heat will be enabled. On a rise in zone temperature above the unoccHeatStpt, the heating demand will fall from 100%-0.

The unoccHeatStpt setpoint can be affected by shed or standby modes. The active heating setpoint will be reflected by the activeHeatStpt.

If the digital electric heat option was selected from tempControlConfig, once the heating demand has risen about 50%, the electric heating coil will be enabled. Once the heating demand falls below 45%, the electric heat will be disabled.

In an UNOCCUPANCY state, on a fall in zone temperature below the unoccHeatStpt (A126), the heating demand will rise from `0` to `100`%. If heat is available, the stages of heat will be enabled, and the unit will be in **Setback Mode**. On a rise in zone temperature above the unoccHeatStpt (A126), the heating demand will fall from `100`% to `0`.

Note: If the user tries to set the cooling setpoint occCoolStpt lower than the heating setpoint unoccHeatStpt, the heating setpoint will be automatically lowered. If the user tries to set the heating setpoint unoccHeatStpt higher than the cooling setpoint occCoolStpt, the heating setpoint will not change.

MORNING WARMUP

If the HVACModeCmd analog setpoint has been set to `1` for Morning Warm-up, or the slave FCU has been sent a signal from the master FCU, the unit will change to **Occupied Mode** and maintain the occupied heating setpoint.

Once the room has met the occupied heating setpoint, the HVACModeCmd will reset to 0, disabling morning warm up for that unit.

STANDBY MODE

This mode will be enabled only when occupancy sensors are used or on network command. Whenever the scheduled occupancy is OCCUPIED, and the occupancy sensor detects no occupants, this will offset the occupied heating and cooling setpoints for energy conservation. Once an occupant has been detected in the zone, the occupied heating and cooling setpoints will return to normal operation. Standby Mode can also be set manually by toggling analog setpoint occCmd **= 2**.

Occupancy sensors need to be wired to `dry contact 1` on the **FusionAir Sensor**, and unitConfig set for occupancy sensors if not using the OccCmd analog setpoint.

Standby setpoints are calculated as an offset from the occupied heating and cooling setpoints. standbyOffset is used to set the offset amount.

- For example, the standbyOffset is set to 3 deg, and the cooling setpoint is 72F(22C) and the heating setpoint is 70(20C). When no occupancy is detected by the occupancy sensor, the activeCoolStptwill change by +3 deg and change to 75F(25C). The activeHeatStpt will change by -3 deg and change to 67F(17C). Once there is occupancy detected, the cooling and heating setpoints will revert to their occupied setpoints.
- occSensor StandbyTimeDelay will allow an additional delay time if needed before the system will go to Standby Mode. For example, if an office needs to maintain room temperature over lunch, set this setpoint for an hour in addition to any occ sensor dip switch settings.

WINDOW CONTACT

If unitConfig has been set to monitor a window contact, and the window contact input detects an open, the fan coil unit will shut down. The supply fan will be disabled, the damper shall close, and all cooling and heating outputs will be closed or off. If the window contact closes, the fan coil unit shall be enabled to run.

Window contacts need to be wired to `dry contact 2` on the **FusionAir Sensor.**

FIRE SHUTDOWN

If HVACModeCmd has been set to `16`, or a signal has been sent from the master fan coil unit to the slave fan coil unit, the fan coil will shut down. The supply fan will be disabled, the damper shall close, and all cooling and heating outputs will be closed or off. If the fire signal has been disabled, the fan coil unit shall be enabled to run.

LOAD SHEDDING

If a value other than 0 is entered into shedDemand the occupied setpoints will offset toward the standby offsets.

- Shed cooling setpoint = (Standby cooling setpoint - Occupied Cooling setpoint) * Shedding%/100
- Shed heating setpoint = (Standby heating setpoint - Occupied Heating setpoint) * Shedding%/100

COMM FAIL/HEARTBEAT

The BACnet heartbeat is disabled by default. To enable the digital heartbeat, toggle enableHeartbeat to true.

The heartbeatPulse will need to toggle from false to true, or true to false within the heartbeatTimer time (default is `10 minutes`). If heartbeatPulse fails to change state within the set time, a communication alarm will be set. A communication alarm will cause the unit to go into occupied mode.

DEMAND VENTILATION

Analog output control strategy only.

This sequence requires an analog damper to be part of the I/O configuration.

In Occupied Mode:

On a rise in space carbon dioxide above setpoint, set at CO2_Stpt (default is `800 ppm`), the damper shall modulate open. On a fall in space carbon dioxide below setpoint, the damper shall modulate to minimum position, damperMinPosition (default is `20%`).

In Unoccupied Mode, the damper will be closed.

FREE COOLING

Analog output control strategy only.

This sequence requires an analog damper to be part of the I/O configuration. Add `16` to tempControlConfig to enable.

In Occupied Mode:

An outdoor air temperature is required to be set at outdoorAirTemp. If the outdoor air temperature is within the minOATStpt and maxOATStpt, the outdoor air damper will modulate open based on the cooling demand.

- If the outdoor air temperature is within range, the first stage of cooling will be the damper, the second stage of cooling will enable the cooling valve.
- If the outdoor air temperature is out of range, the damper will not modulate. The cooling valve will be used for the cooling signal.

In Unoccupied Mode, the damper will be closed.

2-PIPE CONTROL

2-pipe control can be achieved in 3 different ways:

- **2-Pipe temperature sensor** – If `1` is added to UI10Config, UI10 will be used as a 10k water temperature sensor to determine heating or cooling season.
- **2-Pipe digital changeover** – If `2` is added to UI10Config, UI10 will be used as a digital input to determine heating or cooling season. Open = Winter, Closed = Summer.
- **Remote 2-Pipe Changeover** – If `128` is added to unitConfig, if 2-pipe control is needed, but cannot utilize UI10, the strategy will use the remoteSummerWinterTemp analog setpoint. This value should use the hot water plant loop temperature. For example, if the loop temp rises above setpoint, the system will be in winter mode. If the loop temperature falls below setpoint, the system will switch to summer mode.

The 2-pipe valve should be wired to **AO-13** if the strategy is for an analog control, **DO12** if the strategy is for digital control, or **DO12/DO13** for floating control.

If the 2-pipe temperature sensor source is above changeOverStpt, the unit will be set to WinterMode. If the temperature sensor is below the changeOverStpt, the unit will be set to SummerMode. TwoPipe Offset will offset the difference between summer and winter loop temperature setpoints.

MASTER/SLAVE MODE

In applications where more than one unit serves an area, one unit can serve as master and the others as slaves to maintain coordinated control.

Add `2` to unitConfig to set the unit as the master.

Add `1` to unitConfig to set the unit as a slave to the master.

The master unit will distribute the following to the slave units:

- Zone Temperature
- Active cooling setpoint
- Active heating setpoint
- Occupancy command
- HVAC command

ALARMS/MONITORING

- Fan Alarm – If either UI9 or UI10 are set to use a fan status, on a loss of fan status for more than 30 seconds, a BACnet alarm called fanAlarm will be generated.
- Fan Runtime – Fan runtime is calculated in hours. Runtime can be reset by setting fanRuntimeReset to `true`.
- Maintenance Alarm – Maintenance runtime is calculated in hours. If the runtime exceeds the amount set at maintAlarmStpt, an alarm will be generated at maintAlarm. Runtime can be reset by setting maintAlmReset to `true`.
- Zone Temperature Alarm – If the **FusionAir Sensor** temperature is out of range, a zoneTempFailure BACnet alarm will be generated.
- Supply Temperature Alarm – If the supply air temperature is out of range, a supplyTempFault BACnet alarm will be generated.
- Safety Alarm – If UI9 or UI10 are set for a digital safety alarm, and the contact closes, a safetyAlarm BACnet alarm will be generated.
- Low and High Zone Temperature Alarms – If the **FusionAir Sensor** temperature is above the active cooling setpoint for more than 5 minutes, a highZoneTempAlarm will be generated. If the **FusionAir Sensor** temperature is below the active heating setpoint for more than 5 minutes, a lowZoneTempAlarm will be generated.

9 APPENDIX: List of FBTi Points

COMMON ANALOG POINTS

SETPOINTS

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	DEFAULT	UNITS
1	Analog	*occCmd*	Network occupancy command: 0 = Unoccupied Mode 1 = Occupied Mode 2 = Standby Mode	1	no-units
2	Analog	*HVACModeCmd*	Network HVAC Mode command: 0 = Auto 1 = Morning Warm Up 4 = Heat Only 8 = Cool Only 16 = Fire 32 = Purge System will go into occupied mode if set to 1,4,8,32 Purge will open the damper 100% and the fan will run at 100%	0	no-units
6	Analog	*occSensor StandbyTimeDelay*	Additional delay time before system goes into Standby Mode when using an occupancy sensor.	5	min
22	Analog	*minHeatSpeed*	Minimum speed of fan during heating demand.	20	%
25	Analog	*minCoolSpeed*	Minimum speed of fan during cooling demand.	20	%
26	Analog	*deadbandSpeed*	Speed of fan during ventilation mode, set at unitConfig	10	%
27	Analog	*maxHeatSpeed*	Maximum speed of fan during heating demand.	50	%
28	Analog	*maxCoolSpeed*	Maximum speed of fan during cooling demand.	100	%
29	Analog	*minSupplyAirStpt*	Minimum temperature supply air will control to.	52/11	°F/°C
30	Analog	*maxSupplyAirStpt*	Maximum temperature supply air will control to.	90/32	°F/°C
35	Analog	*CO2_Stpt*	Carbon Dioxide setpoint.	800	ppm
36	Analog	*alt_CO2input*	Alternative carbon dioxide point that can be used by 3rd party CO2 sensors over the BACnet network. Will be shown on the Fusion Sensor.	0	ppm
45	Analog	*tempControlConfig*	Configuration of Temperature Control: 0 = Supply Air Temp Control 1 = Zone Temp Control 2 = Heat Only 4 = Cool Only 8 = Aux Electric Heat Enabled 16 = Free Cooling	0	no-units
61	Analog	*MaxChange*	Value for regulating ramp speed of fan (Digital output Strategy)	0.5	no-units
62	Analog	*MaxChange*	Value for regulating ramp speed of fan (Analog output strategy)	0.5	no-units
68	Analog	*unitConfig*	Configuration of unit control options: 0 = NotSet 1 = Slave 2 = Master 4 = DemandControlVentilation 8 =OccSensor 16 =WindowSensor 32 = Fan Cycling Off 64 = Fan Cycling Deadband 128 = Remote2-PipeChangeover	0	no-units
69	Analog	*shedDemand*	The amount of setpoint shedding from 0-100%, ranges from occupied setpoints to standby setpoints.	0	%
79	Analog	*damperMinPosition*	Minimum damper position during occupied mode.	20	%
80	Analog	*damperMaxPosition*	Maximum damper position during occupied mode.	100	%
81	Analog	*HeatDOConfig*	0 = DO12 Electric Heat On/Off DO13 On/Off HW 1 = DO12 Electric Heat On/Off DO13 On/Off 2 Pipe 2 = DO12 Float Open HW DO13 Float Close HW 4 = DO12 Float Open 2-Pipe DO13 Float Close 2-Pipe	0	no-units
82	Analog	*CoolDOConfig*	0 = DO14 On/Off CHW DO15 Damper 1 = DO14 Float Open CHW DO15 Float Close CHW	0	no-units

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	DEFAULT	UNITS
86	Analog	*UI9Config*	Configuration of UI9: 0=FanStatus 1=Safety 2=FilterStatus	0	no-units
87	Analog	*UI10Config*	Configuration of UI10: 0=Safety 1=10k 2-Pipe Temp 2=Digital changeover 2 -Pipe 4=FanStatus	0	no-units
100	Analog	*outdoorAirTemp*	Network provided outdoor air temperature	0	°F/°C
101	Analog	*maxOATStpt*	Maximum outdoor air temperature setpoint to allow free cooling.	60/15	°F/°C
102	Analog	*minOATStpt*	Minimum outdoor air temperature setpoint to allow free cooling.	50/10	°F/°C
104	Analog	*changeOverStpt*	Used with 2-pipe system. When pipe temperature rises above setpoint, system goes into winter mode. When pipe temperature falls below setpoint, system goes into summer mode.	68/20	°F/°C
108	Analog	*remoteSummerWinterTemp*	Used with 2-pipe system. Used as a network variable to set pip temperature if UI10 is not available.	0	°F/°C
121	Analog	*TwoPipe Offset*	Temperature difference between the heating and cooling system for a 2-pipe system. (Digital output strategy)	60/15	°F/°C
123	Analog	*occCoolStpt*	Occupied cooling setpoint.	72/22	°F/°C
124	Analog	*occHeatStpt*	Occupied heating setpoint.	70/20	°F/°C
125	Analog	*unoccCoolStpt*	Unoccupied cooling setpoint.	80/26	°F/°C
126	Analog	*unoccHeatStpt*	Unoccupied heating setpoint.	65/18	°F/°C
131	Analog	*HWLowAOValue*	Low voltage range amount for output. (Analog output strategy)	2	volts
132	Analog	*HWHiAOValue*	High voltage range amount for output. (Analog output strategy)	10	volts
133	Analog	*TwoPipe Offset*	Temperature difference between the heating and cooling system for a 2-pipe system. (Analog output strategy)	60/15	°F/°C
137	Analog	*FanLowAOValue*	Low voltage range amount for output. (Digital output strategy)	2	volts
138	Analog	*FanHiAOValue*	High voltage range amount for output. (Digital output strategy)	10	volts
144	Analog	*CHWLowAOValue*	Low voltage range amount for output.	2	volts
146	Analog	*standbyOffset*	Offset between the standby heating and cooling setpoints.	3	°F/°C
158	Analog	*CHWHiAOValue*	High voltage range amount for output. (Analog output strategy)	10	volts
169	Analog	*DamperLowAOValue*	Low voltage range amount for output. (Analog output strategy)	2	volts
170	Analog	*DamperHiAOValue*	High voltage range amount for output. (Analog output strategy)	10	volts
176	Analog	*HWactuatorDegrees*	Damper angle travel range for floating point control	90	deg
177	Analog	*HWactuatorDriveTime*	Damper actuator travel time for floating point control	95	sec
180	Analog	*occOvrTime*	Amount of time unit will be in occupied override once the Fusion Sensor is touched.	160	min
193	Analog	*maintAlarmStpt*	Amount of time unit needs to run until a maintenance alarm is triggered.	2160	hours
195	Analog	*supplyAirGain*	PI Gain tuning value for supply air control of heating or cooling	10	no-units
196	Analog	*supplyAirIntegration*	PI Integration tuning value for supply air control of heating or cooling	80	no-units
200	Analog	*Fusion_Offset*	Allowable offset amount of user entered setpoint from Fusion Sensor.	3	°F/°C
201	Analog	*PIDTuneGain*	PI Gain tuning value for zone air control of heating or cooling	3	no-units
202	Analog	*PIDTuneInt*	PI Integration tuning value for zone air control of heating or cooling	60	no-units
203	Analog	*PIDSupplyResetGain*	PI Gain tuning value for supply air setpoint reset	30	no-units
204	Analog	*PIDSupplyResetInt*	PI Integration tuning value for supply air setpoint reset	60	no-units
218	Analog	*Fusion_Increment*	Amount of temperature increase or decrease of temperature setpoint when user presses up or down arrow on Fusion Sensor.	0.5	°F/°C
222	Analog	*HWLowAOValue*	Low voltage range amount for output. (Analog output strategy)	2	volts
223	Analog	*HWHiAOValue*	High voltage range amount for output. (Analog output strategy)	10	volts
225	Analog	*CHWactuatorDegrees*	Damper angle travel range for floating point control (Digital output strategy)	90	deg
226	Analog	*CHWactuatorDriveTime*	Damper actuator travel time for floating point control. (Digital output strategy)	95	sec
245	Analog	*FanLowAOValue*	Low voltage range amount for output. (Analog output strategy)	2	volts
247	Analog	*FanHiAOValue*	High voltage range amount for output. (Analog output strategy)	10	volts
408	Analog	*heartbeatTimer*	If the heartbeat has not changed within this timeframe, trigger an alarm.	10	min

VALUES

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	RANGE	UNITS
5	Analog	*activeCoolStpt*	Current active cooling setpoint that unit is controlling to.	varies	°F/°C
7	Analog	*Fusion_CO2*	FusionAir sensor carbon dioxide reading	0 … 2000	ppm
12	Analog	*standbyCoolStpt*	Standby cooling setpoint used for internal calculations	varies	°F/°C
13	Analog	*standbyHeatStpt*	Standby heating setpoint used for internal calculations	varies	°F/°C
14	Analog	*shedCoolStpt*	Shed cooling setpoint for internal calculations	varies	°F/°C
15	Analog	*shedHeatStpt*	Shed heating setpoint for internal calculations	varies	°F/°C
23	Analog	*activeHeatStpt*	Current active heating setpoint that unit is controlling to.	varies	°F/°C
41	Analog	*supplyAirTempStpt*	Calculated supply air temperature setpoint if unit is controlling off supply air temperature. This will equal zone supply air temperature if in ventilation mode, or unit is controlling to zone temperature only.	varies	°F/°C
46	Analog	*coolDemand*	The analog demand signal sent to the cooling outputs	0 … 100	%
47	Analog	*heatDemand*	The analog demand signal sent to the heating outputs	0 … 100	%
57	Analog	*Fusion_Humidity*	FusionAir sensor humidity reading	0 … 100	%RH
65	Analog	*fanSpeedCmd*	Current fan speed command from 0-100%	0 … 100	%
67	Analog	*Fusion_Temp*	FusionAir sensor zone temperature reading	varies	°F/°C
76	Analog	*fanRuntime*	Current fan runtime in hours.	varies	hours
83	Analog	*damperCmd*	Current damper command from 0-100% for analog control output (Analog output strategy)	0 … 100	%
88	Analog	*activeZoneTemp*	Current active zone temperature the unit is controlling to.	varies	°F/°C
189	Analog	*occStatus*	Current occupancy status. Enumerations are: 0=Unocc 1=Occ 3=Standby 4=SetbackMode 8=SetupMode	varies	no-units
190	Analog	*unitStatus*	Current unit status. Enumerations are: 1=CoolMode 2=VentMode 4=HeatMode	varies	no-units
191	Analog	*HVACModeStatus*	Current HVACMode status. Enumerations are: 0 = Auto 1 = Morning Warm Up 4 = Heat Only 8 = Cool Only 16 = Shed 32 = Fire 64 = Purge	varies	no-units
213	Analog	*terminalLoad*	Single PI signal to determine heating or cooling load. Cooling 0 to 100 Heating 0 to -100	0 … 100 -0 … -100	%
220	Analog	*StrategyVer*	Strategy versioning	varies	No-units
222	Analog	*FloatHWPosition*	Calculated damper position for floating valve	0 … 100	%
227	Analog	*HWPosition*	Current valve position from 0-100%. Rescaled from voltage output.	0 … 100	%
247	Analog	*FloatCHWPosition*	Calculated damper position for floating valve	0 … 100	%
251	Analog	*fanPosition*	Current fan position from 0-100%. Rescaled from voltage output.	0 … 100	%
335	Analog	*DamperPosition*	Current damper position from 0-100%. Rescaled from voltage output.	0 … 100	%
336	Analog	*CHWPosition*	Current valve position from 0 … 100%. Rescaled from voltage output.	0 … 100	%

COMMON DIGITAL POINTS

SETPOINTS

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	UNITS 0/OFF	UNITS 1/ON
1	Digital	*intScheduleEnb*	Internal schedule, enable if unit is to use a stand-alone schedule.	disabled	enabled
98	Digital	*reverseDO13*	Reverse the output from low to high voltage -> high to low voltage (digital/floating control)	disabled	enabled
98	Digital	*reverseAO13*	Reverse the output from low to high voltage -> high to low voltage (analog control)	disabled	enabled
99	Digital	*reverseDO14*	Reverse the output from low to high voltage -> high to low voltage (digital/floating control)	disabled	enabled
99	Digital	*reverseAO14*	Reverse the output from low to high voltage -> high to low voltage (analog control)	disabled	enabled
100	Digital	*reverseDO15*	Reverse the output from low to high voltage -> high to low voltage (digital/floating control)	disabled	enabled
100	Digital	*reverseAO15*	Reverse the output from low to high voltage -> high to low voltage (analog control)	disabled	enabled
101	Digital	*reverseAO11*	Reverse the output from low to high voltage -> high to low voltage	disabled	enabled
102	Digital	*reverseDO12*	Reverse digital output control from closed = ON to open = ON	disabled	enabled
103	Digital	*reverseDO17*	Reverse digital output control from closed = ON to open = ON	disabled	enabled
124	Digital	*FusionStatStptEnb*	Enables the user to adjust the temperature setpoint on a Fusion Sensor.	disabled	enabled
162	Digital	*Fusion_OvrReset*	Resets any overrides currently running on a Fusion Sensor. (Analog output strategy)	disabled	enabled
165	Digital	*Fusion_OvrReset*	Resets any overrides currently running on a Fusion Sensor. (Digital output strategy)	disabled	enabled
164	Digital	*maintAlmReset*	Resets the maintenance runtime alarm. (analog output strategy)	disabled	enabled
166	Digital	*fanRuntimeReset*	Resets the fan runtime.	disabled	enabled
168	Digital	*maintAlmReset*	Resets the maintenance runtime alarm. (Digital output strategy)	disabled	enabled
181	Digital	*HWReverse*	Reverse floating point operation	disabled	enabled
191	Digital	*CHWReverse*	Reverse floating point operation	disabled	enabled
306	Digital	*heartbeatPulse*	Enable if using the Heartbeat feature. If there is a loss of comm, system will go into occupied mode.	disabled	enabled
307	Digital	*enableHeartbeat*	Enables the heartbeat macro.	disabled	enabled

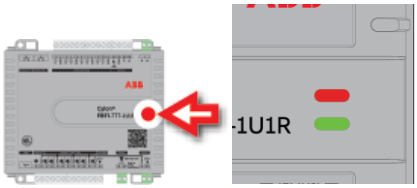
VALUES

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	UNITS 0/OFF	UNITS 1/ON
2	Digital	*ScheduleOccCmd*	Status of the internal schedule.	off	on
3	Digital	*commAlarm*	Communication alarm. Enabled when the heartbeat macro has been enabled.	off	on
6	Digital	*Fusion_TempOK*	Fusion Sensor temperature reading is valid	off	on
10	Digital	*occMode*	Shows occupancy mode status. On = Occupied. Off = unoccupied.	off	on
11	Digital	*unoccCallForHeat*	If the zone temperature falls below the unoccupied heating setpoint, the unit will be enabled to run.	off	on
12	Digital	*unoccCallForCool*	If the zone temperature rises above the unoccupied cooling setpoint, the unit will be enabled to run.	off	on
29	Digital	*occSensor*	Occupancy sensor status. Occupancy = Closed Standby = Open	off	on
30	Digital	*windowSensor*	Window sensor status. Window Closed = Closed Window Open = Open	off	on
32	Digital	*shedMode*	Shed Mode status.	off	on
37	Digital	*supplyTempFault*	Supply Temperature fault alarm.	off	on
38	Digital	*maintAlarm*	Maintenance Alarm.	off	on
42	Digital	*highZoneTempAlarm*	High zone temperature alarm.	off	on
43	Digital	*lowZoneTempAlarm*	Low zone temperature alarm.	off	on
45	Digital	*zoneTempFailure*	Zone temperature failure alarm.	off	on
60	Digital	*fanStatus*	If a digital fan status is wired to an input, closed = running.	off	on
62	Digital	*filterStatus*	If a digital filter status is wired to an input, closed = dirty.	off	on
65	Digital	*standbyMode*	Standby Mode status.	off	on
69	Digital	*unitShutdown*	If unit has been shutdown due to safety, fire or window contact, unitShutdown = ON.	off	on
79	Digital	*freeCoolingActive*	If free cooling is active, this will be ON.	off	on
81	Digital	*damperCmd*	Damper position command, digital control only (Digital output strategy)	off	on
83	Digital	*safetyAlarm*	If a safety contact has closed at UI9 or UI10, this will show ON.	off	on
85	Digital	*SummerMode*	Summer mode status for 2-pipe system	off	on
86	Digital	*WinterMode*	Winter mode status for 2-pipe system	off	on
107	Digital	*coolMode*	Cooling mode status	off	on
108	Digital	*heatMode*	Heating mode status	off	on
110	Digital	*ventMode*	Ventilation mode status	off	on
121	Digital	*Fusion_HumidityOK*	Fusion Sensor humidity reading is valid	off	on
123	Digital	*OccOvr*	If Fusion Sensor has been touched and is in occupied override, this will be ON	off	on
141	Digital	*fanAlarm*	If the unit is set up to monitor a fan status at UI9 or UI10 and there is no status when fan is commanded on, this will be ON.	off	on
142	Digital	*Fusion_CO2OK*	Fusion Sensor CO2 reading is valid	off	on

10 APPENDIX: Troubleshooting

CONTROLLER STATE

LED LIGHT INDICATORS



	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

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

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