



# BACnet Protocol Implementation Conformance Statement (PICS)

Version 8.0

Document #IH-ENG-DTS-BAC-006

- BACnet Protocol Implementation Conformance Statement ..... 2
- Object/Property Support Matrix..... 4
- Device Object Description ..... 6
  - System Controller..... 6
  - Exhaust Fans and Auxiliary Airflows ..... 11
  - Hood Controllers ..... 13
  - Virtual Input Module ..... 13
  - Virtual Output Module ..... 14
- Getting Started: Pre-Installation Checklist..... 15
- Configuring the ecosense System ..... 17
  - Configuration through the Touchpad ..... 17
  - Configuration through the Web-Based Configuration..... 18
  - Configuration through a USB Flash Drive ..... 19
- Networking Setup and Configuration ..... 20
- BACnet Setup and Configuration..... 21
- Common BACnet Interfacing Use Cases..... 23
  - Monitoring Fan Speeds..... 23
  - Monitoring Energy Consumption..... 23
  - Setting Time on the System..... 24
- Appendix A: Device List and Device Instance Numbering..... 25
  - Device Object MAC Address ..... 26
  - Example Scenarios..... 26
  - Manual Device Instance Numbering ..... 29
  - Verifying BACnet Device Instance Numbers ..... 30
- Appendix B: Troubleshooting Guide ..... 32
  - Cannot detect any ecosense Device Objects ..... 32
  - Can only detect the System Controller Device Object ..... 32
  - Cannot set the System Time..... 33
  - Virtual Input Module digital inputs and analog inputs keep resetting ..... 34

## BACnet Protocol Implementation Conformance Statement

**Date:** 11-02-2016

**Vendor Name:** Melink Corporation (Vendor ID 654) / ecocanopy

**Product Name:** Intelli-Hood / ecosense

**Product Model Number:** IH3 SC

**Application Software Version:** 2.2

**Firmware Revision:** 0.8.4

**BACnet Protocol Revision:** 12

### **Product Description:**

Melink Intelli-Hood (known as ecosense by ecocanopy) is a demand ventilation product which conserves energy for the commercial kitchen industry. It is particularly used in conjunction with VFDs (Variable Frequency Drives), which control the speed of the kitchen EF (Exhaust Fans) and kitchen MUA (Make-Up Air) units. When smoke is created under normal cooking conditions, the optic sensors signal the exhaust fan VFD to send the exhaust fan motor to full speed until all smoke is removed from the kitchen hood. The temperature sensors measure the heat present and signals the VFD, which in turn modulates the EF between minimum speed and full speed. The MUA works in unison with the EF to maintain balance and conserves energy of conditioned heated or cooled air.

### **BACnet Standardized Device Profile (Annex L):**

BACnet Application Specific Controller (B-ASC)

### **List all BACnet Interoperability Building Blocks Supported (Annex K):**

DS-RP-B, DS-RPM-B, DS-WP-B, DM-DDB-B, DM-DOB-B

### **Segmentation Capability:**

None

**Standard Object Types Supported:**

All objects are statically created based upon device configuration. Create object and delete object are not supported. See object list at the end of this document for more information.

- Analog Value
- Binary Value
- Device

**Data Link Layer Options:**

BACnet IP, (Annex J)

**Device Address Binding:**

Is static device binding supported? (This is currently necessary for two-way communication with MS/TP slaves and certain other devices.)

No

**Networking Options:**

None

**Network Security Options:**

- Non-secure Device - is capable of operating without BACnet Network Security

**Character Sets Supported:**

UTF-8

## Object/Property Support Matrix

The following table summarizes the Object Types/Properties Supported:

Object Name (Value Text)	Object Type		Analog Range or Binary Active/Inactive Text	Present Value Access Type	Object Number
	Binary Value	Analog Value			
<b>System Controller</b>					
Digital Input 1 Status	✓		Closed/Open	Read only	BV0
Digital Input 2 Status	✓		Closed/Open	Read only	BV1
Digital Input 3 Status	✓		Closed/Open	Read only	BV2
Digital Output 1 Status	✓		Energized/De- Energized	Read only	BV3
Digital Output 2 Status	✓		Energized/De- Energized	Read only	BV4
24VDC Out 1 Status	✓		Energized/De- Energized	Read only	BV5
24VDC Out 2 Status	✓		Energized/De- Energized	Read only	BV6
Analog Input Status		✓	0-100%	Read only	AV0
Analog Output Status		✓	0-100%	Read only	AV1
<b>For each Exhaust Fan and Auxiliary Airflow</b>					
Operation Status	✓		Running/Stopped	Read only	BV0
Fault Active	✓		Yes/No	Read only	BV1
Reset VFD Fault	✓		Yes/No	Commandable	BV2
Maximum Output Frequency		✓	0-254 Hz	Read only	AV0
% Commanded Speed		✓	0-100%	Read only	AV1
% Actual Speed		✓	0-100%	Read only	AV2
Output Current <sup>1</sup>		✓	0-32768 A	Read Only	AV3
Output Energy <sup>2</sup>		✓	0-32768 kWh	Read Only	AV4

<sup>1</sup> Output Current is not updated for System VFDs

<sup>2</sup> Output Energy is not updated for System and Allen-Bradley PowerFlex 4/40 VFDs

Object Name (Value Text)	Object Type		Analog Range or Binary Active/Inactive Text	Present Value Access Type	Object Number
	Binary Value	Analog Value			
<b>For each Hood Controller</b>					
Temperature 1		✓	-40°F to 400°F	Read only	AV0
Temperature 2		✓	-40°F to 400°F	Read only	AV1
Temperature 3		✓	-40°F to 400°F	Read only	AV2
Temperature 4		✓	-40°F to 400°F	Read only	AV3
Optics Tripped	✓		Yes/No	Read only	BV0
<b>For each Virtual Input Module</b>					
Digital Input 1	✓		On/Off	Read/Write	BV0
Digital Input 2	✓		On/Off	Read/Write	BV1
Digital Input 3	✓		On/Off	Read/Write	BV2
Digital Input 4	✓		On/Off	Read/Write	BV3
Analog Input 1		✓	0-100%	Read/Write	AV1
Analog Input 2		✓	0-100%	Read/Write	AV2
Analog Input 3		✓	0-100%	Read/Write	AV3
Analog Input 4		✓	0-100%	Read/Write	AV4
<b>For each Virtual Output Module</b>					
Digital Output 1 Status		✓	Energized/De-Energized	Read Only	BV0
Digital Output 2 Status		✓	Energized/De-Energized	Read Only	BV1
Digital Output 3 Status		✓	Energized/De-Energized	Read Only	BV2
Digital Output 4 Status		✓	Energized/De-Energized	Read Only	BV3

## Device Object Description

This section describes in further detail each of the Device Objects in the Object/Property Support Matrix and a brief description of each object associated with each Device Object type.

### System Controller

The System Controller is the main Device Object for the system. It acts as a virtual BACnet router for the other Device Objects populated on the ecosense system. The System Controller Device Object has the following objects which reflect the status of I/O on the System Controller hardware.

#### **Digital Input Status**

These three Binary Values reflect the state of the three physical Digital Inputs located on the System Controller I/O board. These are dry contacts which can be used to command the ecosense system to react to external input. If the digital input is inactive (“Open”), then the physical digital input does not have a completed circuit between the referenced digital input and ground. If the digital input is active (“Closed”), then the physical digital input circuit has been completed and the digital input is commanding the system. The following is the list of possible digital input configurations and how they affect the ecosense system.

#### ***Remote On/Off***

A Remote On/Off digital input is an edge sensitive input. When the digital input changes state from inactive to active, it requests that the fans in the associated Hood Groups turn on. When the digital input changes state from active to inactive, it requests that the fans in the associated Hood Groups turn off. Since a Remote On/Off digital input is edge sensitive, multiple digital inputs (i.e., toggle switches on either end of a kitchen) can be used to turn on and off the same set of fans. Also note that the Remote On/Off command will be ignored if the Hood Group is disabled or in High Temperature Alarm.

#### ***Remote On***

This is similar to the Remote On/Off digital input setting. However, when the digital input changes state from active to inactive, it does not request that the fans turn off.

#### ***Remote On 100%***

This digital input requests that associated fans turn on when the digital input changes state from inactive to active just like the Remote On digital input setting. In addition, when active the digital input requests that associated fans run at full speed.

### ***Remote Enable/Disable***

A Remote Enable/Disable input is a level sensitive input. When the digital input is inactive, the associated Hood Groups are disabled and the fans will not turn on unless a High Temperature Alarm has been reached. When the digital input is active, the associated Hood Groups are enabled and fans can be turned on or off. If there are multiple Remote Enable/Disable digital inputs associated with a Hood Group, all digital inputs need to be active before the fans are allowed to turn on. Note that the Remote Enable/Disable input does not turn any fans on itself.

### ***Remote On/Off with Enable***

A combination of the Remote On/Off and the Remote Enable/Disable digital inputs. This acts as a Remote Enable/Disable digital input as described above. However, it also requests that fans start in the associated Hood Groups.

### ***50% Minimum Speed through 100% Minimum Speed***

A Minimum Speed digital input is a level sensitive input. When active, this digital input dictates that the minimum fan speed for all fans in its associated Hood Group be at least at the digital input's listed minimum. If multiple minimum speed digital inputs are associated with the same Hood Group and they are active at the same time, the highest minimum speed is applied. The minimum speed digital input also needs to be higher than the Exhaust Hood's configured minimum speed to take effect. For example, if one digital input is set for 50% minimum speed and another is set for 80% minimum speed and both digital inputs are associated with the same Hood Groups, then if both digital inputs are active then all fans will have a minimum run speed of 80%. Note that the Minimum Speed digital inputs do not command fans to turn on or off but only set the minimum speed for the fans when they are on.

### ***External Fault***

An External Fault digital input is a level sensitive input. An External Fault input can be used to signal the ecosense system that a fault occurred with some other equipment related to the system. When active, the system will report on the Touchpad and, when fans are running, command the associated Hood Groups to run its fans at full speed. In addition, when the digital input changes state from inactive to active, the External Fault digital input commands the associated Hood Groups to turn on their fans.

### ***Lights On/Off***

A Lights On/Off digital input is an edge sensitive input. Each Touchpad and Auxiliary Touchpad has a Lights button for turning lights on and off, however the Lights On/Off digital input can be used if the user would prefer to use existing toggle switches for turning lights on and off. When this digital input changes state from inactive to active, it commands lights to turn on for associated Hood Groups. If the digital input changes state from active to inactive, it commands lights to turn off for associated Hood Groups. Since this digital input is edge sensitive, multiple digital inputs can be used to turn on and off the same set of lights.

### ***External Alert***

The External Alert digital input is a level sensitive input. This digital input can be used to alert a non-critical failure for equipment that is external to the ecosense system. If this digital input is active, an “External Alert” message is displayed in the title on the main screen on the Touchpad. This digital input does not affect fan speed.

### ***Digital Output and 24VDC Output Status***

The System Controller has two dry contact digital outputs and two 24VDC outputs. If the digital output is active (“Energized”) then the dry contacts are closed or 24VDC is output depending on the digital output. If the digital output is inactive (“De-Energized”) then the dry contact is open or 0VDC is output depending on the digital output. The digital outputs are driven based upon their configuration and the state of the associated Hood Groups. The following is a short description of each digital output configuration option and how the system state affects the digital output.

### ***Temperature Alarm***

Each Exhaust Hood has its own “Temperature Alarm Auto On” parameter which sets at which temperature system should react to a Temperature Alarm. When a Temperature Alarm occurs, all fans in the Hood Group turn on and run at full speed. A Temperature Alarm digital output will be energized if an associated Hood Group is in a Temperature Alarm state.

### ***Smoke***

A Smoke digital output can be used to detect when the fans are triggered to run full speed due to optics being tripped. If the optics on an associated Hood Group detect effluent or have a fault, then the Smoke digital output is energized.

***Fan On***

The Fan On digital output can be used to determine if fans are on or off for an associated Hood Group. If any fan in an associated Hood Group is on, then the Fan On digital output will be energized.

***MUA Damper***

If the Make-Up Air unit has a damper that closes when the Make-Up Air unit is not running, then the damper needs to be opened before the fan should run. A MUA Damper digital output is then used to signal the damper to open. If there is any input which requests an associated Hood Group to turn on its fans (Fans button from either the Touchpad or Auxiliary Touchpad, Schedule, Remote On/Off digital input), then a MUA Damper digital output is energized. This can then trigger the damper to open and allow fan operation.

***Temperature Fault***

A Temperature Fault digital output will be energized if there is a fault with any temperature probe in any associated Hood Group.

***Optic Fault***

An Optic Fault digital output will be energized if there is a fault with any optics in any associated Hood Groups.

***VFD Fault***

A VFD Fault digital output will be energized if there is any VFD Fault (lost communication or VFD tripped due to a fault) on any VFD in any associated Hood Group.

***System Fault***

A combination digital output that will be energized on multiple fault situations. A System Fault digital output will be energized if there is either a Temperature Fault, Optic Fault, VFD Fault, or an active External Fault digital input on any associated Hood Group.

***24/7***

A 24/7 digital output is energized whenever the ecosense system is powered up and has begun normal operation.

### **Analog Input Status**

The is one physical analog input on the System Controller. The analog input can be configured in either 0-10VDC or 0-20 mA operation and can affect any Hood Group in the system. The Analog Input Status reports the current value of the system's physical analog input as a percentage. The following is a short description of the different modes of operation for the analog input.

#### ***Highest***

The affected Exhaust Fans and Auxiliary Airflows either run at the calculated fan speed or the percent speed governed by this analog input, whichever is highest.

#### ***Add***

The analog input percentage is added to the calculated fan speed for the Exhaust Fans and Auxiliary Airflows.

#### ***Average***

The fan speed for the Exhaust Fans and Auxiliary Airflows is first calculated and then is averaged with the analog input value.

#### ***Aux. Highest***

The affected Auxiliary Airflows either run at the calculated fan speed or the percent speed governed by this analog input, whichever is highest. Exhaust Fans are not affected.

#### ***Aux. Add***

The analog input percentage is added to the calculated fan speed for the Auxiliary Airflows. Exhaust Fans are not affected.

#### ***Aux. Average***

The fan speed for the Auxiliary Airflows is first calculated and then is averaged with the analog input value. Exhaust Fans are not affected.

### **Analog Output Status**

There is one physical analog output on the System Controller. The analog output can be configured in either 0-10VDC or 0-20mA operation and can be associated with any Auxiliary Airflows in the system. The Analog Output Status reports the current value of the system's physical analog output as a percentage.

## Exhaust Fans and Auxiliary Airflows

Each Exhaust Fan and Auxiliary Airflow can be configured to be present on the BACnet interface or not. By default all Exhaust Fans and Auxiliary Airflows are enabled on the BACnet interface and will populate as a separate Device Object with a DNET matching the configured “BACnet DNET” for the system. The Exhaust Fans and the Auxiliary Airflows have the same Object list. Below is a description of each fan’s Objects.

### Operation Status

The Operation Status is a Binary Value that reports whether the fan is running or stopped. If the Binary Value is active, then the fan is running.

### Fault Active

The Fault Active reports whether there is an active VFD fault on the VFD used for this fan. If this value is active, then the VFD has tripped due to a fault and is not running.

### Clear VFD Fault

If the situation resulting in a VFD fault has been resolved, the VFD still will need its VFD fault cleared before the VFD will power a fan. The Clear VFD Fault Binary Value can be used to attempt to clear a VFD Fault. If the Clear VFD Fault Binary Value is set to 1 (active), then the system will attempt to clear the fault on the associated VFD. Reading the Clear VFD Fault will always return inactive.

**NOTE:** Clearing a VFD fault when the problem responsible for the VFD fault has not been resolved can lead to VFD, motor or fan damage.

### Maximum Output Frequency

The Maximum Output Frequency lists the maximum speed the fan is allowed to run in Hertz. This can be used in conjunction with the % Commanded Speed and % Actual Speed to determine the commanded and actual speed in Hertz.

### % Commanded Speed

This is the speed at which the system is commanding the fan to run as a percentage.

### % Actual Speed

This is the speed at which the fan is currently running as a percentage. Note there will be a difference between % Commanded Speed and % Actual Speed during normal operation due to the ramp up and ramp down timing for the VFD.

**Output Current**

The instantaneous output current reading as reported by the VFD. The output current is not available on all VFD models; be sure it is available on your VFD if you would like to monitor this value.

**Output Energy**

The reported kWh counter of the VFD. The kWh counter is not available on all VFD models; be sure it is available on your VFD if you would like to monitor this value. Note that the system does not internally track this number and that the kWh counter does eventually roll over on all VFDs. If the Output Energy is being monitored, it is suggested to account for any counter rollover.

## **Hood Controllers**

Each Hood Controller houses up to four temperature sensors and one set of optics for temperature and effluent detection. By default there is not a Device Object present for each Hood Controller, but the system can be configured to do so. Below is a list of the Hood Controller Objects.

### **Temperature 1 through Temperature 4**

Each Hood Controller has one Analog Value that represents the current temperature of the related temperature probe in Fahrenheit. The temperature readings are updated once every 30 seconds.

### **Optics Tripped**

The Optics Tripped Binary Value is active if the Hood Controller's optics have detected effluent or if there is an optic fault. If the Optics Tripped value is active, then any associated fans that are on will be running full speed.

## **Virtual Input Module**

A Virtual Input Module is a virtual device to provide a means to add digital inputs to the system that can be controlled via BACnet. Below is a list of the Objects available on the Virtual Input Module.

### **Digital Input 1 through Digital Input 4**

The Virtual Input Module has four digital inputs that mimic the operation of the physical digital inputs on the System Controller. See the "Digital Input Status" section under the System Controller on page 6 for a description of the different digital input configurations. The ecosense system has a BACnet Watchdog timeout that is used to reset the Virtual Input Module's digital inputs if no BACnet communication has been received in a given amount of time. See the BACnet Watchdog description on page 21 for more details on this configuration parameter.

### **Analog Input 1 through Analog Input 4**

The Virtual Input Module has four analog inputs that mimic the operation of the physical analog input on the System Controller. See the "Analog Input Status" section under the System Controller on page 10 for a description of the different analog input configurations. The ecosense system has a BACnet Watchdog timeout that is used to reset the Virtual Input Module's analog inputs if no BACnet communication has been received in a given amount of time. See the BACnet Watchdog description on page 21 for more details on this configuration parameter.

## **Virtual Output Module**

A Virtual Output Module is a virtual device to provide a means to add digital outputs to the system that can be monitored via BACnet. Below is a list of the Objects available on the Virtual Input Module.

### **Digital Output 1 through Digital Output 4**

The Virtual Output Module has four digital outputs that mimic the operation of the physical digital outputs on the System Controller. See the “Digital Output Status” section under the System Controller on page 8 for a description of the different digital output configurations.

## Getting Started: Pre-Installation Checklist

Before connecting the ecosense system in your BACnet network, the system needs its network and BACnet specific configuration to be setup correctly. If these settings are known prior to delivery, ecocanopy can configure the ecosense system's network and BACnet settings for you so it is ready when the system is installed. Below is a quick checklist of settings that could be determined prior to installation. Contact ecocanopy prior to installation with the following configuration settings (either fill in by hand or copy details in some other manner) and these can be configured on your system prior to installation.

### Network Settings

DHCP Enabled: Yes No  
Static IP: \_\_\_\_\_  
Netmask: \_\_\_\_\_  
DNS Server 1: \_\_\_\_\_  
DNS Server 2: \_\_\_\_\_

### System Controller BACnet Settings

BACnet Device Instance ID: \_\_\_\_\_  
BACnet Auto Number: Yes No  
BACnet Port: \_\_\_\_\_  
BACnet DNET: \_\_\_\_\_

### Exhaust Fan 1 BACnet Settings

BACnet Device Instance ID: \_\_\_\_\_  
BACnet Enabled: Yes No

### Exhaust Fan 2 BACnet Settings

BACnet Device Instance ID: \_\_\_\_\_  
BACnet Enabled: Yes No

### Exhaust Fan 3 BACnet Settings

BACnet Device Instance ID: \_\_\_\_\_  
BACnet Enabled: Yes No

### Exhaust Fan 4 BACnet Settings

BACnet Device Instance ID: \_\_\_\_\_  
BACnet Enabled: Yes No

**Auxiliary Airflow 1 BACnet Settings**

BACnet Device Instance ID: \_\_\_\_\_  
BACnet Enabled: Yes No

**Auxiliary Airflow 2 BACnet Settings**

BACnet Device Instance ID: \_\_\_\_\_  
BACnet Enabled: Yes No

**Auxiliary Airflow 3 BACnet Settings**

BACnet Device Instance ID: \_\_\_\_\_  
BACnet Enabled: Yes No

**Auxiliary Airflow 4 BACnet Settings**

BACnet Device Instance ID: \_\_\_\_\_  
BACnet Enabled: Yes No

**Hood Controller 1 BACnet Settings**

BACnet Device Instance ID: \_\_\_\_\_  
BACnet Enabled: Yes No

**Hood Controller 2 BACnet Settings**

BACnet Device Instance ID: \_\_\_\_\_  
BACnet Enabled: Yes No

**Hood Controller 3 BACnet Settings**

BACnet Device Instance ID: \_\_\_\_\_  
BACnet Enabled: Yes No

**Hood Controller 4 BACnet Settings**

BACnet Device Instance ID: \_\_\_\_\_  
BACnet Enabled: Yes No

If you are unsure of how many Exhaust Fans, Auxiliary Airflows or Hood Controllers your system will have, contact ecocanopy and we can let you know how many of each are scheduled to be included in your system. **NOTE:** Actual number of Exhaust Fans, Auxiliary Airflows, and Hood Controllers is dependent upon the configuration of the ecosense system. Four of each are shown here for illustrative purposes, but this is not definitive or a limit.

## Configuring the ecosense System

There are three different methods in which the user can configure the ecosense system. It can be configured through the Touchpad, directly over the network using the web-based configuration, or a configuration file can be uploaded through a USB Flash drive. This section describes how to configure the system in each of these methods.

### Configuration through the Touchpad

Refer to Section 5 in the Operation Manual for general tips on navigating the Touchpad. The remainder of this document refers to Touchpad buttons as described in the Operator's Manual.

Follow these steps to unlock configuration.

1. From the Touchpad's Main Screen, press the "Menu" softkey to go to the Main Menu.
2. While on the Main Menu, option 2 titled "System Configuration" is red to indicate that configuration is locked. Press the Up and Down buttons at the same time and hold the buttons down for ten seconds. "System Configuration" should change from red to blue to indicate that configuration is unlocked. Release the Up and Down buttons at this point.
3. Use the Down arrow to highlight the "System Configuration" option and press "Enter" to navigate to the System Configuration.

For general navigation, the right softkey is used to navigate down into a new screen, the Up and Down arrows are used to navigate options on a screen and the left softkey is used to go back up one level.

### Network Configuration through the Touchpad

If network settings need to be changed on-site, you most likely will need to change these settings through the Touchpad as you may not be able to access the ecosense system to perform web-based configuration. To navigate to the network settings:

1. Unlock configuration as described previously.
2. From the Main Menu, go to System Configuration->System to get to the general system settings.
3. Navigate down to the network configuration settings. Changes are applied as soon as each item is changed.

### **BACnet Configuration through the Touchpad**

There are system level BACnet configuration settings as well as BACnet configuration settings specific to each Exhaust Fan, Auxiliary Airflow and Hood Controller in the system. This describes how to get to each of these settings through the Touchpad.

1. Unlock configuration as described previously.
2. To get to the system level BACnet configuration settings from the Main Menu, go to System Configuration->System to get to the general system settings. Navigate down to find the system level BACnet configuration settings.
3. To get to the Exhaust Fan BACnet configuration settings from the Main Menu, go to System Configuration->Exhaust Fans to get to the Exhaust Fans' configuration. Select the Next button to select which Exhaust Fan you would like to configure. Once you are on the screen for the Exhaust Fan you would like to configure, navigate down to get to the Exhaust Fan's BACnet configuration settings.
4. To get to the Auxiliary Airflow BACnet configuration settings from the Main Menu, go to System Configuration->Auxiliary Airflows to get to the Auxiliary Airflows' configuration. Select the Next button to select which Auxiliary Airflow you would like to configure. Once you are on the screen for the Auxiliary Airflow you would like to configure, navigate down to get to the Auxiliary Airflow's BACnet configuration settings.
5. To get to the Hood Controller BACnet configuration settings from the Main Menu, go to System Configuration->Hood Controllers to get to the Hood Controllers' configuration. Select the Next button to select which Hood Controller you would like to configure. Once you are on the screen for the Hood Controller you would like to configure, navigate down to get to the Hood Controller's BACnet configuration settings.

### **Configuration through the Web-Based Configuration**

If the ecosense system's networking configuration is set up, you can configure the system through its web-based interface. To configure the system through the web-based interface:

1. Connect any device with an up-to-date web browser up to the same network as the system. We suggest using either Firefox or Chrome for a web browser. Please note that at this time MS Internet Explorer does not work properly.
2. On your device's web browser, go to <http://<IP address of ecosense system>/ih3-configurator>, where <IP address of ecosense system> is replaced with the IP address the ecosense system is using.
3. On the left side of the screen is a list of devices in the ecosense configuration. To setup system-level network and BACnet configuration, select the "System Controller" device from the list on the left. On the right, the system-level configuration parameters are shown. All networking and BACnet configuration settings are at the end of the list.

4. To setup Exhaust Fan, Auxiliary Airflow or Hood Controller BACnet configuration, select the appropriate Exhaust Fan, Auxiliary Airflow or Hood Controller device from the list on the left. On the right, the device's configuration will be shown.
5. After changing configuration, click "Save Configuration" to save any configuration changes.

## Configuration through a USB Flash Drive

Every time the configuration is saved, the ecosense system saves a backup of up to the last 30 configurations to a USB flash drive if it is installed. Backups are stored in the directory "last\_logs" on the USB flash drive with the one titled "ConfigurationFiles.zip" containing the latest configuration. It is suggested that you keep a backup of the system configuration in a safe location in case you need to revert the configuration for some reason. You can also obtain a copy of the configuration if you need to revert configuration to match how it was configured when it originally shipped.

To apply a new configuration from the USB flash drive:

1. Remove the USB flash drive from the system.
2. Copy the configuration zip file to the root directory on the USB flash drive.
3. Power off the system.
4. Insert the USB flash drive into the system.
5. Power on the system. During bootup, the system reads and applies the new configuration.

## Networking Setup and Configuration

There are a limited number of network configuration parameters for the system. This section describes each in detail.

### Use DHCP

Tells the system whether it should use DHCP to obtain an IP address or not. The system defaults to “Yes.”. If you are able to use DHCP, then the system may be able to determine the rest of the following network settings from your DHCP server.

### Static IP

If the system will not use DHCP to obtain an IP address, you need to fill in a valid static IP address. If DHCP is enabled, then this value is ignored.

### Netmask

Specify the netmask for the subnet on which the system resides. You can set this if DHCP is enabled but it may be overridden by the DHCP server.

### Gateway

Specify the IP address of the Gateway if the system needs to communicate with devices on another network. This is generally not needed unless you are setting up the system for remote access. You can set this if DHCP is enabled but it may be overridden by the DHCP server.

### DNS Server 1 and DNS Server 2

Specify the IP address of the DNS servers for the system. This is not needed unless you are setting up the system for remote access. You can set this if DHCP is enabled but it may be overridden by the DHCP server. If you are setting up the system for remote access, we suggest using 8.8.8.8 and 8.8.4.4 for DNS servers.

### Time Zone

Although this is not a network-related configuration parameter, it is useful so the system displays the correct time throughout the year. This defaults to New York, US (UTC -5, DST).

When any of the networking configuration parameters change, the system restarts the networking interface with the updated settings. This takes about 10 to 15 seconds after the settings have changed.

## **BACnet Setup and Configuration**

The system has separate system-level, Exhaust Fan, Auxiliary Airflow and Hood Controller specific BACnet configuration parameters. This section describes each in detail.

### **System Controller BACnet Device Instance ID**

This specifies the Device Instance ID that will be used by the System Controller. The System Controller's Device Instance ID defaults to 654000. Change this number as needed based on available Device Instance IDs on your BACnet network.

### **System Controller BACnet Auto Number**

Since the system is a virtual BACnet router with each Exhaust Fan, Auxiliary Airflow and Hood Controller present as a separate Device Object, each one needs to have a unique Device Instance ID. If you plan to sequentially number the Device Instance IDs for the virtual Device Objects, the system can auto number the virtual Device Objects for you. If "BACnet Auto Number" is set to "Yes", each Exhaust Fan, Auxiliary Airflow and Hood Controller will be assigned a unique Device Instance ID sequentially after the System Controller's Device Instance ID. See Appendix A if you need specific details on how the automatic Device Instance Numbering works.

If you cannot use a sequential set of Device Instance IDs, then set this parameter to No and statically assign each Device Instance ID.

### **System Controller BACnet Port**

This specifies the UDP Port that the system uses for BACnet communication. This defaults to 47808 (0xBAC0).

### **System Controller DNET**

This is the destination network (DNET) number for the virtual Device Objects. This needs to be unique on your BACnet network or you will have communication issues to the system. This defaults to 654.

### **System Controller BACnet Watchdog**

This is the watchdog timeout for resetting the Virtual Input Module's digital inputs. This guards against the system being stuck in a state due to loss of communication. If the system receives no BACnet communication that is addresses for the system for the communication timeout period, then all digital inputs on all Virtual Input Modules are reset. This can be set to between 0 and 600 seconds. Setting this parameter to 0 seconds disables the watchdog. This defaults to 300 seconds.

**Exhaust Fan, Auxiliary Airflow, Hood Controller, Virtual Input Module and Virtual Output Module Device Instance ID**

This is the statically assigning the Device Instance ID for each Exhaust Fan, Auxiliary Airflow, Hood Controller, Virtual Input Module and Virtual Output Module. If “BACnet Auto Number” is set to “Yes,” these numbers are ignored. These all default to 0. Note that if you are statically assigning Device Instance IDs that they all need to be unique on the BACnet network.

**Exhaust Fan, Auxiliary Airflow, and Hood Controller Active on BACnet**

Given the number of Device Objects that are possible with the system, some sites may not need to monitor all devices and may want to limit the number of Device Objects on their BACnet network. If you do not want to monitor a particular Exhaust Fan, Auxiliary Airflow or Hood Controller then you can use this parameter to remove that particular device from the BACnet interface. If a devices “Active on BACnet” parameter is set to “No”, then there will not be a Device Object created for that device. This setting defaults to “Yes” for the Exhaust Fans and Auxiliary Airflows. This setting defaults to “No” for the Hood Controllers.

## Common BACnet Interfacing Use Cases

This section describes some common use cases for BACnet interaction with the ecosense system and how to accomplish such tasks.

### Monitoring Fan Speeds

The most common usage is to monitor the fan speed. There are several points that are useful for monitoring fan speed.

#### Maximum Output Frequency

Each Exhaust Fan and Auxiliary Airflow reports the Maximum Operating Frequency as Analog Value 0. This typically is only changed at the VFD during installation. Depending on how you need to translate your data, you may want to check this value for each fan during initial setup so you can convert fan speed to Hz.

#### % Actual Speed

Each Exhaust Fan and Auxiliary Airflow reports % Actual Speed as Analog Value 2. This is the fan speed as reported by the VFD as a percentage.

#### Fault Active

Each Exhaust Fan and Auxiliary Airflow reports Fault Active on Binary Value 1. If there is a fault at the VFD or if the system has lost communication to the VFD, then Fault Active is set for that fan. This may be useful to monitor to detect problems with the fans when they occur.

### Monitoring Energy Consumption

In addition to fan speed, you can also monitor the energy consumption of the fans controller by the system.

#### Output Energy

This is the reported kWh usage from the VFD. This is present on Analog Value 4 on each Exhaust Fan and Auxiliary Airflow. Whether this value is updated or not depends on the VFDs installed. See the Object/Property Support Matrix to see if the VFDs installed in your system have a kWh counter available.

Note that the kWh counter does eventually rollover on each VFD. How long it takes to rollover is dependent upon the VFD being used and how much energy it consumes. If you are using the kWh counter to track energy usage, we suggest you read this value often enough to detect when the kWh count rolls over on the VFDs.

## **Setting Time on the ecosense System**

There are several system functions, such as Schedules, that are most useful if the system is set for the correct time. The system can synchronize time using the Network Time Protocol. However, typical installations will segregate the BACnet network from outside internet access. In these instances you can set the system's time from your Operator's Workstation.

The system supports the UTC Time Synchronization service. Follow your Operator Workstation's instructions on how to set a Device Object's time using UTC Time Synchronization. The system has a separate configuration parameter for its time zone, so there is no need to update the UTC offset through the Operator's Workstation.

If you are setting the system's time in this manner, it is suggested that the time be updated often to keep the system's time in sync. Setting the time once per day should be sufficient.

## Appendix A: Device List and Device Instance Numbering

The System Controller is a scalable device that can control up to 64 VFDs. The items listed in the Object/Property Support Matrix list the points available from the system at this time. As such, the system's BACnet interface is implemented as a virtual router. The System Controller is the main Device Object and the router; each Exhaust Fan, Auxiliary Airflow, Hood Controller, Virtual Output Module and Virtual Input Module is populated at separate Device Objects behind the router. From the user's perspective each Exhaust Fan, for example, will appear to be a separate physical device on the system. This implementation means that another Exhaust Fan or Auxiliary Airflow can be added to the system without changing how the previous points are accessed. By default, the system will auto-number the Device Instance Numbers for the System Controller, Exhaust Fans, Auxiliary Airflows, Hood Controllers, Virtual Output Modules and Virtual Input Modules to reduce the number of items that need to be configured for the system. This section summarizes how the user can determine the Device Instance Number and the Device Object MAC address for each virtual device when the System Controller auto-assigns the Device Instance Numbers.

The System Controller Device Object is Device Instance Number defaults to 654000 (Vendor ID x 1000). Each Exhaust Fan, Auxiliary Airflow, Hood Controller, Virtual Output Module and Virtual Input Module is then numbered after the System Controller in the following manner:

1. Exhaust Fans, Auxiliary Airflows, Hood Controllers, Virtual Output Modules and Virtual Input Modules are numbered immediately after the System Controller. With the default settings, they will start with Device Instance Number 654001.
2. Exhaust Fans and Auxiliary Airflows are sorted before being assigned a Device Instance Number. They are sorted first by its configured name, then by its Modbus address, then by an internal Universally Unique Identifier (UUID) to ensure a consistent sort order.
3. Hood Controllers are numbered immediately after the last Exhaust Fan or Auxiliary Airflow.
4. Hood Controllers are sorted before being assigned a Device Instance Number. They are sorted first by its configured name, then by its Hood Network address, then by an internal UUID to ensure a consistent sort order.
5. Virtual Output Modules are numbered immediately after the Hood Controllers.
6. Virtual Output Modules are sorted before being assigned a Device Instance Number. They are sorted first by its configured name, then by its address, then by an internal UUID to ensure a consistent sort order.

7. Virtual Input Modules are numbered immediately after the Virtual Output Modules.
8. Virtual Input Modules are sorted before being assigned a Device Instance Number. They are sorted first by its configured name, then by its address, then by an internal UUID to ensure a consistent sort order.

This Device Instance Numbering scheme ensures that, for a given system configuration, all Device Objects maintain a consistent numbering.

The Object Instances associated with each Device Object are as shown in the Object/Property Support Matrix. The Exhaust Fan Device Objects, for example, contain the Object instances listed under the “For each Exhaust Fan and Auxiliary Airflow” section. For each Device Object, its Objects will be in the ordered listed. For example, Operation Status will always be Binary Value 0 for each Exhaust Fan or Auxiliary Airflow.

### **Device Object MAC Address**

The MAC address for each Device Object is based upon the IP address of the System Controller. The System Controller Device Object will match the System Controller IP address and it uses the standard BACnet UDP port 47808 (0xBAC0) by default. For the rest of the device objects, the IP address is reversed and the last octet is set to 1 for the first additional Device Object. The last octet is then incremented for each additional Device Object.

### **Example Scenarios**

Below are some example configurations to show how the Device Object numbering and the MAC addressing works with the default configuration options.

Scenario 1:

System Controller IP Address: 142.51.5.36

Exhaust Fan 1: KEF-02, Modbus Address 2

Exhaust Fan 2: KEF-05, Modbus Address 5

Auxiliary Airflow 1: MUA-41, Modbus Address 41

Hood Controller 1: HC-01, Hood Network Address 1

Virtual Output Module 1: VOM-01, address 1

## Resulting Device Object List:

Device Instance Number	Device Object MAC Address	Device Object Name
654000	142.51.5.36:0xBAC0	System Controller
654001	36.5.51.1:0xBAC0	KEF-02
654002	36.5.51.2:0xBAC0	KEF-05
654003	36.5.51.3:0xBAC0	MUA-41
654004	36.5.51.4:0xBAC0	HC-01
654005	36.5.51.5:0xBAC0	VOM-01

## Scenario 2:

System Controller IP Address: 10.20.21.100

Exhaust Fan 1: Fryer EF, Modbus Address 1

Exhaust Fan 2: Island EF, Modbus Address 2

Exhaust Fan 3: Grill EF, Modbus Address 3

Exhaust Fan 4: Banquet EF, Modbus Address 4

Auxiliary Airflow 1: West Supply, Modbus Address 41

Auxiliary Airflow 2: East Supply, Modbus Address 42

Auxiliary Airflow 3: 0-10VDC, Modbus Address 43

Hood Controller 1: HC-01, Hood Network Address 1

Hood Controller 2: HC-02, Hood Network Address 2

Hood Controller 3: HC-03, Hood Network Address 3

Hood Controller 4: HC-04, Hood Network Address 4

## Resulting Device Object List:

Device Instance Number	Device Object MAC Address	Device Object Name
654000	10.20.21.100:0xBAC0	System Controller
654001	100.21.20.1:0xBAC0	0-10VDC
654002	100.21.20.2:0xBAC0	Banquet EF
654003	100.21.20.3:0xBAC0	East Supply
654004	100.21.20.4:0xBAC0	Fryer EF
654005	100.21.20.5:0xBAC0	Grill EF
654006	100.21.20.6:0xBAC0	Island EF
654007	100.21.20.7:0xBAC0	West Supply
654008	100.21.20.8:0xBAC0	HC-01
654009	100.21.20.9:0xBAC0	HC-02
654010	100.21.20.10:0xBAC0	HC-03
654011	100.21.20.11:0xBAC0	HC-04

## Manual Device Instance Numbering

Prior to June 25, 2014, only automated Device Instance Numbering was supported. The FW2014.06.25 firmware release added support for static Device Instance Numbering. This section describes how to statically set the Device Instance Numbers.

The System Controller defaults its Device Instance Number to 654000. This can be changed to any valid BACnet Device Instance Number (0-4194302). From the Touchpad, this configuration item is under *Menu->System Configuration->System->BACnet Instance ID*. This is the Device Instance Number that will be used for the System Controller.

The System Controller can also be set to auto number the remaining devices under *Menu->System Configuration->System->BACnet Auto Number*. This can be useful if you need to set the Device Instance Numbers to be within a certain range but do not care what the Device Instance Number is for a particular device.

The following is a modification to the previous example in which only the System Controller's BACnet Device Instance Number is modified in the configuration.

Scenario 2a:

System Controller IP Address: 10.20.21.100

System Controller BACnet Device Instance Number: 500

System Controller BACnet Auto Number: Yes

Exhaust Fan 1: Fryer EF, Modbus Address 1

Exhaust Fan 2: Island EF, Modbus Address 2

Exhaust Fan 3: Grill EF, Modbus Address 3

Exhaust Fan 4: Banquet EF, Modbus Address 4

Auxiliary Airflow 1: West Supply, Modbus Address 41

Auxiliary Airflow 2: East Supply, Modbus Address 42

Auxiliary Airflow 3: 0-10VDC, Modbus Address 43

Hood Controller 1: HC-01, Hood Network Address 1

Hood Controller 2: HC-02, Hood Network Address 2

Hood Controller 3: HC-03, Hood Network Address 3

Hood Controller 4: HC-04, Hood Network Address 4

**Resulting Device Object List:**

Device Instance Number	Device Object MAC Address	Device Object Name
500	10.20.21.100:0xBAC0	System Controller
501	100.21.20.1:0xBAC0	0-10VDC
502	100.21.20.2:0xBAC0	Banquet EF
503	100.21.20.3:0xBAC0	East Supply
504	100.21.20.4:0xBAC0	Fryer EF
505	100.21.20.5:0xBAC0	Grill EF
506	100.21.20.6:0xBAC0	Island EF
507	100.21.20.7:0xBAC0	West Supply
508	100.21.20.8:0xBAC0	HC-01
509	100.21.20.9:0xBAC0	HC-02
510	100.21.20.10:0xBAC0	HC-03
511	100.21.20.11:0xBAC0	HC-04

If, however, on your network you need to manually assign each Device Instance Number, that option is also available. Each Exhaust Fan, Auxiliary Airflow, Hood Controller, Virtual Input Module and Virtual Output Module in the system has a BACnet Device Instance Number configuration option. When BACnet Auto Number is set to “Yes”, the system ignores these configuration values for the Exhaust Fans, Auxiliary Airflows, Hood Controllers, Virtual Input Modules and Virtual Output Modules and auto numbers these devices. When BACnet Auto Number is set to “No”, the configured BACnet Device Instance Number for each device is used. Note that these values will be used regardless of collision; if all Exhaust Fans and Auxiliary Airflows in a system are configured to use Device Instance Number 0, then that is how the system will operate. Take care to use unique values when statically assigning the BACnet Device Instance Numbers.

### **Verifying BACnet Device Instance Numbers**

When the system is in operation, there are several ways you can verify the Device Instance Numbers that were assigned. Depending on your building configuration and your operator workstation, the simplest method may be to send a Who-Is request to the expected Device Instance Numbers. If the system is on your network and properly configured, then your operator workstation should discover all the devices. If this did not work, you can verify from the Touchpad which Device Instance Numbers were assigned to all devices.

From the Touchpad, go to *Menu->Status->VFDs*. Status on each Exhaust Fan and Auxiliary Airflow is available with the BACnet Device Instance Number shown as the last item. Select *Next* to go to the next device in the list. If the Device Instance Number for an Exhaust Fan or an Auxiliary Airflow is not what you expected, then check the configuration for that device. Similarly, you can find the assigned Device Instance Numbers for all Hood Controllers by navigating to *Menu->Status->Hood Controllers*. The Device Instance Number for each Hood Controller is shown as the last item. Select *Next* to go to the next device in the list. Navigate to *Menu->Status->Virtual Input Modules* and *Menu->Status->Virtual Output Modules* to find the Device Instance Numbers for the Virtual Input Modules and Virtual Output Modules respectively.

## Appendix B: Troubleshooting Guide

This section describes possible solutions to some common problems when connecting to the ecosense system.

### Cannot detect any Device Objects

Problem:

The system cannot be discovered from the Operator's Workstation. Device discovery yields no results for the expected Device Objects. Search for specific points under specific Device Objects also yields no results.

Diagnosis:

Validate network connectivity is working and configured correctly for the system. See the section "Networking Setup and Configuration" and review the steps and validate that the system can be seen on the network.

If you are doing a ranged Device discovery, validate that the system is configured for the correct Device Instance Numbers. See the section "BACnet Setup and Configuration" and review the settings for the system.

ecocanopy sells a standard System Controller and a Lite System Controller. The Lite System Controller does not support BACnet communication. To determine if you have a standard or Lite System Controller, either go to *Menu->About* from the Touchpad or look at the label on the inside door of the System Controller enclosure. If the serial number starts with "V3", for example "V300012" then you have a standard System Controller and BACnet communication is available. If the serial number starts with "V4", for example "V400020", then you have a Lite System Controller and BACnet communication is not available. If you do have a Lite System Controller, contact ecocanopy on how to obtain a standard System Controller.

### Can only detect the System Controller Device Object

Problem:

The Operator's Workstation can detect the System Controller Device Object and its points, but it does not discover the Exhaust Fan, Auxiliary Airflow or the Hood Controller Device Objects.

### Diagnosis:

The most common cause for this problem is due to how most Operator Workstations perform Device discovery. Most will send a Who-Is message that is formatted such that it does not get broadcast through BACnet routers. This is intentional by the Operator Workstation in order to speed up Device discovery. Each Operator Workstation's interface is different, but these are the general steps to follow in order to discover the virtual Device Objects:

1. Through the Operator Workstation, discover the BACnet routers in the network. This option is usually called "BACnet Discovery" or "Network Discovery" on the Operator Workstation.
2. After the BACnet routers are discovered, you should see a BACnet router that matches the DNET configured for the system. Select that BACnet router on your Operator Workstation.
3. After selecting the BACnet router, perform Device discovery again. You should now see the virtual Device Objects.

Another common cause is if the system's DNET is configured for the same DNET as a different BACnet router or BBMD on the network. To diagnose this problem:

1. Validate the DNET for the system is configured correctly. See the section "BACnet Setup and Configuration" for details on how to validate the DNET is configured correctly.
2. If the DNET is configured as intended, verify that there isn't another BACnet router or BBMD that is incorrectly configured for the same DNET. To do so, unplug the system from the network and then attempt to discover the BACnet networks ("Network Discovery" or "BACnet Discovery" as described above). If you discover a device that is setup with the Intelli-Hood's DNET, then determine whether to change the system's DNET or the other device's DNET.

It is also possible that all Exhaust Fans, Auxiliary Airflows and Hood Controllers are configured with incorrect Device Instance Numbers or are configured to not be visible through the BACnet interface. See the section "BACnet Setup and Configuration" and validate the Exhaust Fans, Auxiliary Airflows and Hood Controllers have correct BACnet configuration.

## Cannot set the system time

### Problem:

Through the Operator Workstation, you are attempting to set the system time using either Time Synchronization or UTC Time Synchronization. The system is responding, but the system's time is not changing.

### Diagnosis:

There was an issue with Time Synchronization and UTC Time Synchronization in system firmware FW2015.09.16 and earlier. If this is the case, then contact ecocanopy about obtaining a firmware upgrade for your system.

## **Virtual Input Module digital inputs and analog inputs keep resetting**

### **Problem:**

The Virtual Input Module's digital inputs are set through the Operator's Workstation and the system reacts to the change in state. After several minutes, all the digital inputs on the Virtual Input Module are reset.

### **Diagnosis:**

Check the BACnet Watchdog configuration settings. The system will reset all the digital inputs and analog inputs on all Virtual Input Modules if the system receives no BACnet communication for the time specified by the BACnet Watchdog parameter (default setting of five minutes). Any BACnet communication directed toward the system, including reading data points, will restart the watchdog timeout. Either extend the BACnet Watchdog timeout or query the system often enough to reset the watchdog timeout.

## Revision History

Version	Date	Description
1.0	8-15-2013	Initial document release
2.0	2-6-2013	-Corrected Firmware Revision and Application Software Revision -Updated and expanded detail in Object Property Support Matrix -Added description for Device Instance numbering and Device Object MAC Address numbering
2.1	5-29-2014	Update formatting
3.0	9-16-2014	-Updated firmware revision -Removed unused points -Added description for static Device Instance Numbering
4.0	9-25-2015	-Updated formatting to clarify device operation -Removed references to BBMD and Foreign Device support
5.0	10-21-2015	-Updated the Object Property Support Matrix to include the currently supported points -Added detail on the new Hood Controller points -Added sections for system configuration -Add section for common use cases -Added troubleshooting section -Correct language in regard to BACnet Device Instance numbering
6.0	4-4-2016	-Added detailed descriptions for each Device type. -Added description of the Digital Input and Digital Output configuration options. -Added the Virtual Input Module -Added the Virtual Output Module
7.0	9-16-2016	-Updated formatting -Added analog input support
8.0	11-2-2016	-Updated the Object Property Support Matrix to include the currently supported points -Added 'Remote On' and 'Remote On 100%' digital input option descriptions -Minor formatting changes