



# Active Control User Manual

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## About Active Control

One of the major challenges within data centers today is the alignment of cooling capacity and cooling demand. The constantly changing nature of the data center thermal environment can result in either the over-utilization or under-utilization of cooling resources at any given instant.

### Dynamically Control Cooling Resources

The objective of SynapSense Active Control is to enable data center operators to control cooling resources dynamically to better align capacity and demand. This alignment significantly reduces the potential for over-cooling or under-cooling and therefore enables significant energy savings within the data center. Such energy savings are achieved through significant reductions in the energy used to drive fans and the ability to increase the supply-air temperatures safely throughout the data center.

SynapSense Active Control uses real-time temperature and plenum pressure data to dynamically control data center cooling resources using two main control methods:

- Pressure management via fan-speed, and
- Air temperature management via air temperature setpoint adjustments.

### Increase Energy Efficiency

Since cooling units consume more cooling energy to supply air at lower temperatures, the ability to permit a safe increase in the air temperature setpoint is an important mechanism for improving data center energy efficiency.

Fan motor energy consumption is the cube of fan speed. Consequently, the ability to reduce fan speeds provides existing and potential SynapSense customers with an opportunity for significant energy savings in the day-to-day data center operations. Achieving target environmental performance lowers fan noise and may increase fan/motor life by ensuring that fan speeds typically operate at less than 100% and run only as fast as necessary.

### Increase Reliability

The SynapSense Active Control system provides increased reliability by quickly adapting to dramatic environmental changes that may result from events such as fan failure, floor tile replacement, and increases or decreases in existing IT load.

Further reductions in energy consumption may also be realized as a by-product of reduced cooling demand, by allowing the cooling plant to turn off or bypass entire sub-systems periodically, such as turning off a chiller pump and using evaporative bypass.

In summary, the ability to closely monitor and control the cooling of each instrumented server cabinet throughout the server room, and regionally tailor the climate, allows for significant energy saving opportunities in every segment of the air handling process, while also delivering superior cabinet conditions reporting and control.

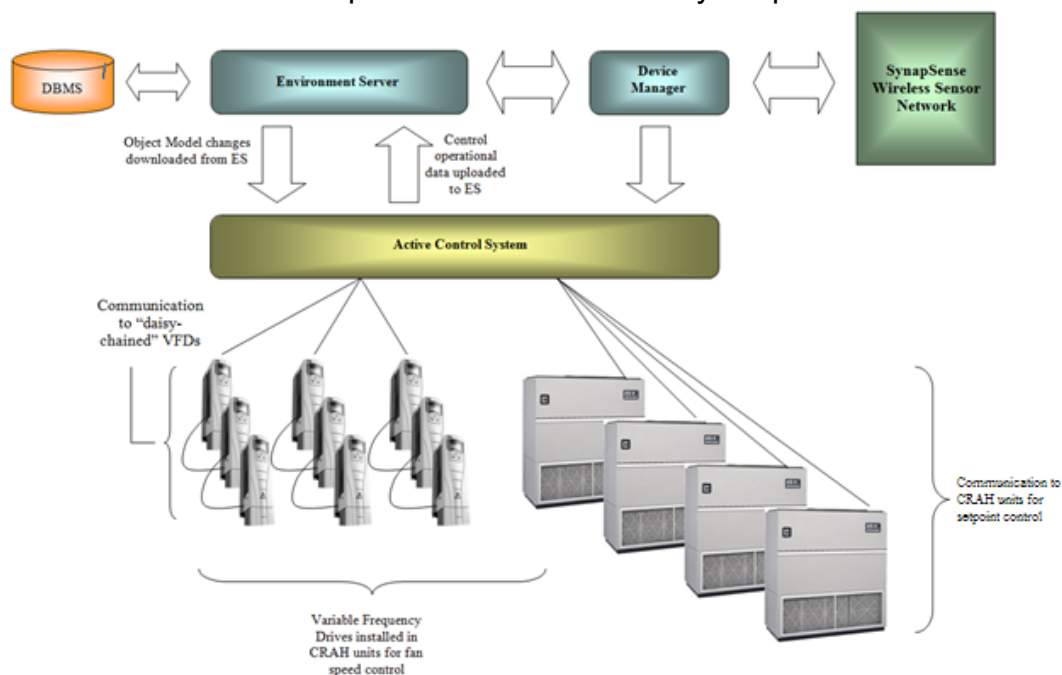
## How the System Works

The SynapSense Active Control system utilizes high-density environmental data acquired by SynapSense Wireless Monitoring and Cooling Control. The data provides the input to software algorithms that control the fan speeds and air temperature setpoints of air handling units. The ability to control these factors ultimately results in maximized cooling energy savings.

### CRAH

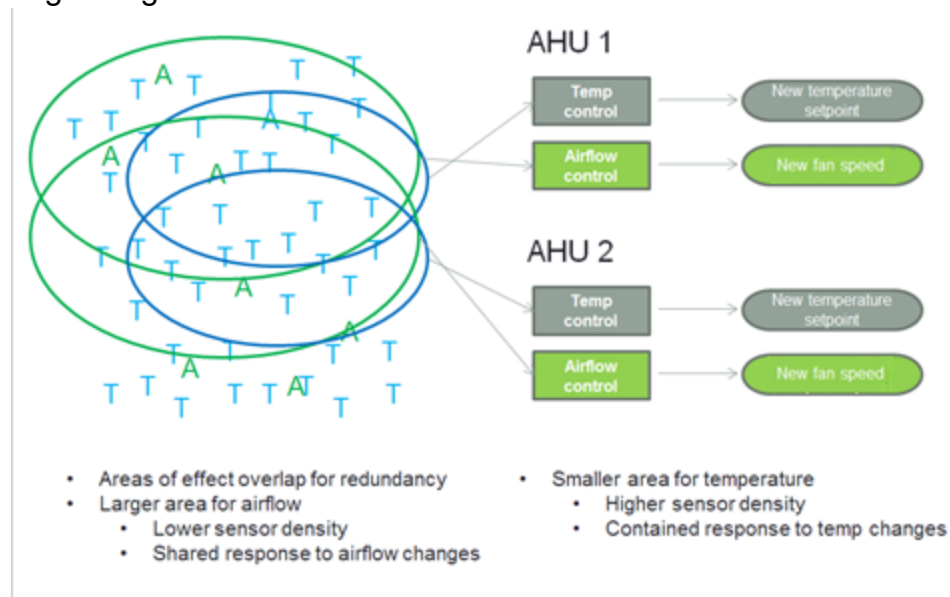
Variable Frequency Drive (VFD) hardware is installed on CRAH fan motors to control their speed. Dynamically controlling the fan speed provides the ability to finely control the pressure (and the resulting volume) of air supplied to server cabinets. Temperature management is achieved via electronic control of CRAH return-air or supply-air temperature settings (the air returning from the server room floor to the CRAH unit, or the air supplied to the server room).

Active Control provides built-in redundancy and fail-over safety mechanisms to mitigate the temperature-control risks associated with fan motor failures, maintenance windows, perforated tile relocations, changes to IT load, and software patches and failures. The system also includes a comprehensive alerts and alarms module that provides notifications to data center operators on a wide variety of operational anomalies.



## Area of Effect

An Area of Effect is a volume of space within the data center where the temperature and pressure is at least partially influenced by one or more air handlers. The Area of Effect is determined dynamically in Active Control based on sensor information and the cooling unit fan speed. In general, areas include all the environmental sensors affected by setting changes made to the controlled devices.



The areas affected by the cooling airflow from each controlled device overlap substantially. Therefore, the Area of Effect created for each cooling unit usually overlap as well. Racks with integrated control input properties are often assigned to a maximum of two Areas of Effect, since the readings from each sensor are important for the control of multiple overlapping regions.

Each Area of Effect is controlled by settings specific to that region. In Automatic Mode, the SynapSense Active Control software algorithm tailors the control setting changes to the type of controlled device to meet the assigned performance expectations (Target Values) for the region. Each Area of Effect individually trends toward achieving its temperature and pressure Target Values.

The first step is to lower the temperature and increase the fan speed or airflow (in each Area of Effect independently) until no component indicates either **too hot** (temperature) or **too low** (pressure) indicated by a red icon in the Web Console. Active Control then seeks to raise the temperature and lower the airflow or pressure settings for all inputs to an acceptable range (indicated by a green icon on the Active Control layer in Web Console).

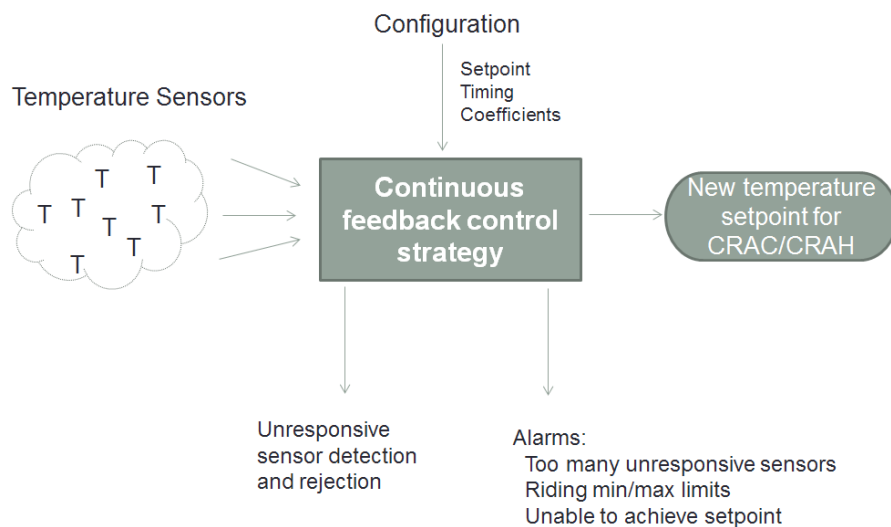


This may, however, cause some sensors to indicate **too cool** or **too much pressure** (indicated by blue icons), which does not harm equipment but does waste energy. Operators can elect to remedy these areas of excessive energy use by adjusting floor tiles, server cabinet location, and other efforts.

## Temperature Control Loop

This is for data centers with raised floor air delivery or freestanding air handling units.

1. Collect temperature readings from sensors assigned to each cooling unit in a defined Area of Effect until a quorum is met or timeout is reached. The quorum size and timeout settings are based on sensor density, reporting interval, criticality of equipment and thermal mass. If the quorum cannot be met within timeout, an alert is issued and failsafe settings are automatically applied.
2. Evaluate sensor readings. For example, sensors flagged for operator attention are those identified as no longer responding to control adjustments. The number of flagged sensors is a configurable limit based upon sensor density and criticality of equipment.



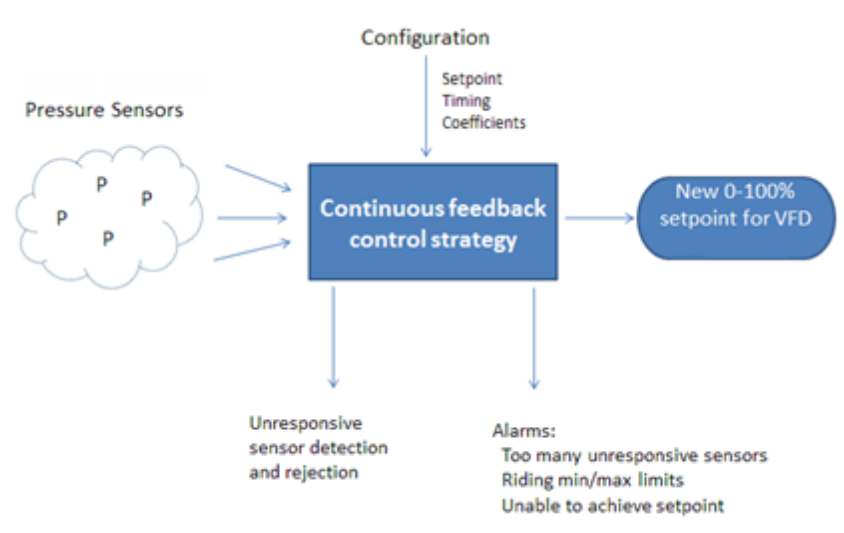
3. Evaluate alert conditions, unresponsive sensors, and failsafe conditions, then flag as required. This includes any failure of physical sensors, wireless nodes, wireless network, gateways, or network infrastructure resulting in loss of sensor data at the controller.
4. Calculate a new Air Temperature setpoint. The setpoint can be written on a configurable timer as a device heartbeat, or set to write on change only. If the calculated adjustment is consistently outside of the configured minimum/maximum constraints, this triggers an alert.

5. Write the new setpoint to the cooling unit. The cooling unit applies the setpoint, modulating water valve or compressor staging according to its local configuration.
6. Allow the new setpoint adjustments time to propagate back to the rack inlet or sub-floor differential sensors and repeat from Step 1.

### Pressure Control Loop

For Raised Floor room types containing sub-floor pressure sensors and installed VFDs in available CRAH units.


1. Collect pressure readings for sensors assigned to each VFD.
2. Evaluate sensor readings. For example, sensors identified as no longer responding to control adjustments are flagged for operator attention. The number of flagged sensors is a configurable limit based upon sensor density and criticality of equipment.



3. Evaluate alert conditions, unresponsive sensors, and failsafe conditions, then flag as required. Any failure of physical sensors, wireless nodes, wireless network, gateways, or network infrastructure resulting in loss of sensor data at the controller results in the application of failsafe settings.
4. Generate a new setpoint for Fan Speed, as indicated.
5. Write the new setpoint to the VFD. The VFD ramps to the new speed.
6. Allow the new adjustments time to propagate back to the sensors and repeat from Step 1.




### Disengaged


 Active Control does not control the units in any way. This mode is typically used when the units are undergoing maintenance.

## Cooling Unit Status


### Disconnected

 Controlled devices that are not responding, have been taken offline for maintenance, or are experiencing communication problems are placed in disconnected state. When the icon displays in red, the device has a pending alert.

### Standby

 Units in Standby state are often in a “soft off” state and not cooling. A cooling unit can be placed in Standby state from the device face-plate or from the cooling unit configuration page in WebConsole. When the icon displays in red, the device has a pending alert.

### Failsafe

 Failsafe Mode means Active Control is getting incorrect values, or it isn't receiving data from the sensors. For these Cooling Units, Active Control moves the temperature set point to the lowest value that the Cooling Unit has had during the past two weeks. For pressure, it will set the fan to the highest fan speed the Cooling Unit has had in the past two weeks. Active Control does this to ensure that the Cooling Units provide the coolest air possible at the highest pressure until communication is restored.

### Standby-Alert

 The unit is in Standby Mode and has a pending alert.

### Automatic-Alert

 The unit is in Automatic Mode and has a pending alert.

### Disconnected-Alert

 The unit is in Disconnected Mode and has a pending alert.

## Disengaged-Alert



The unit is in Disengaged Mode and has a pending alert.

# Configuring Active Control in MapSense

Before adding Active Control to your data center:

- All SynapSense environmental hardware must be installed
- A MapSense project must be created and exported to Web Console
- All functions must work as designed
- The room must be configured in MapSense
- The controlled device must be configured.

## Configuring the Controlled Device

There are two main categories of Controlled Devices: Controlled Devices for cooling units and Controlled Devices for VFDs. Both require an IP Address. Some models may require additional configuration, such as a sitelink port. With this, Active Control can use its model-specific drivers to communicate with and control the hardware.

Generic Controlled Devices are for custom hardware or hardware without a specific driver. In this case, use the component in MapSense to configure how the system should communicate with the physical device. For both the cooling unit and VFD, the component has a series of data points that you configure to either read or write that information from the device.

These data points take the form of configurable expressions. At their simplest, these expressions can be set to read or write a value from a single Modbus register or BACnet object. The expressions are also used to indicate the data type of the value (signed and unsigned 16-bit integers, signed and unsigned 32-bit integers, and 32-bit floating point values.) As 32-bit values require more than one register, the expressions can read from multiple registers and combine their contents. The expressions can also perform scaling, bitmasks, offsets, and equivalency checks.

To configure the controlled device:

1. Go to the **Groupings** tab on the right side of the window and select the Controlled Device with which you want to work.
2. In the Properties Panel, below the Groupings list, fill in the appropriate information for the type of device.
3. Click the ellipsis (...) button to display the Setpoint dialogs for the Read and Write fields. Click **Examples** in the dialog for detailed information about expression configuration.



Use caution when testing the Write field because the test changes the setpoint. A best practice recommendation is to test the Read value and check it, then set the Write value one degree up or down from the actual Read value for the Write value test. Please contact SynapSense Technical Support with any questions or for more information.

See "Appendix A: Configuring Modbus and BACnet data points" on page 44.

## Adding Active Control to a MapSense Environmentals Project

Open the MapSense project file for your data center and perform the following steps to complete control configuration for each controlled device in your data center.

1. Configure the room for Active Control.
2. Select and place the controlled device.
3. Configure the controlled device.
4. Repeat Steps 2 and 3 for each cooling unit and VFD in the room.

### Configure the Room

Configure the room in MapSense.

1. Select the room from the **Groupings** tab.
2. In the Property pane, select the **Room Type** from the drop-down menu.

Property	Value
Name	Room
x	864.9988479614258
y	647.4988708496094
Room Type	<b>Raised Floor</b>
Floor Height	Unspecified
Tile Size	Raised Floor
Tile X Offset	
Tile Y Offset	Slab

- **Unspecified:** These rooms cannot make use of Active Control.
  - **Raised Floor:** These rooms can make full use of Active Control.
  - **Slab:** These rooms can only use remote control. Active Control will not automatically turn Cooling Units on and off or balance pressure throughout the room.
3. Select the **Control Type** from the drop-down menu. This combined with the Room Type determines what Active Control will regulate.

- **None:** No regulation. Typically chosen only for Slab Room Types.
- **Remote Control:** This option is available only when Slab is selected as the Room Type for both CRACs and CRAHs.
- **CRAH Pressure:** Regulates CRAH pressure only.
- **CRAH Pressure and Temperature:** Regulates both CRAH pressure and temperature.
- **DX Temperature:** Regulates DX temperature only.

### Configure Pressure (VFD) Control Device

1. In MapSense, select a CRAH that has been placed on the floor plan.
2. In the Property table, click the ... button next to **Air Volume Table** to open the VFD Air Volume table. Enter the fan speed percentages and the corresponding CFM for each percentage, based on the manufacturer's specifications for the unit. For percentages that the manufacturer's specifications do not address, Active Control will automatically interpolate the CFM based on what you have entered. At a minimum, the table needs at least two points. The more data you can enter, the more accurate the Area of Effect calculations will be.

Fan Speed	Air Volume
20	2800 CFM
30	4200 CFM
40	5600 CFM
50	7000 CFM
60	8400 CFM
70	9800 CFM
80	11200 CFM
90	12600 CFM
100	14000 CFM

3. From the VFD Control Device drop-down menu, select the fan type: ACH550, Generic BACnet, or Generic Modbus. ACH550 units have a specific Modbus mapping. Users do not have to configure register values when selecting this option.



Property	Value
Name	CRAH Temp/Hum 1
Rotation	0
Depth	72
Width	36
x	204
y	358
MAC ID	01000B0B8C43EC84
Sampling Interval (min)	5
Location	
Sensible Cooling Table	(Table)
Air Volume Table	(Table)
VFD Control Device	Generic Modbus
IP Address	Select A Device
Device ID	ACH500
Device Write Timer (sec)	Generic BACnet
Device Read Timer (sec)	Generic BACnet
Setpoint Write	Generic Modbus

4. For Modbus, specify the IP address for the VFD on the CRAH and the Modbus Device ID.
5. In the **Device Write Timer** and **Device Read Timer** fields, specify how often (in seconds) Active Control will read information (for example, setpoint of the CRAH, fan speed, power levels, alarms) from the CRAH and write (the setpoint) information to the CRAH.
6. Click **Setpoint Write** to open the VFD: Setpoint Write dialog box.

VFD: Setpoint Write (WRITE) X

☒ Simple

Register: 40011

Data Type: Int16

Action: None

Action Modifier: 10

Action Modifier Base: 10

☐ Advanced

write\_register16(40011, Value )

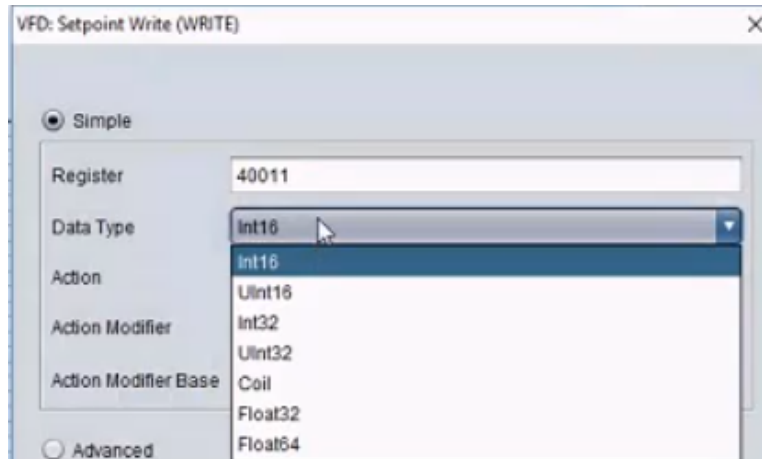
Syntax OK! Examples

Test Write Value

Test Result

Test Currently Invalid OK Cancel

7. Enter the **Register** to determine where the unit setpoint will be written.
8. Click **Data Type** and select an option from the drop-down menu.



9. If advanced calculations need to be performed, click **Advanced** radio button and enter an expression. Click the **Examples** button for assistance.
10. Enter a **Test Write Value**. (For example, enter "60.0" to set the fan speed to 60%.)
11. Click the **Test** button. The Test Result displays.



12. Click **Setpoint Read** to open the **VFD: Setpoint Read** dialog box.

VFD: Setpoint Read (READ)

Disabled Active

☒ Simple

Register: 40012

Data Type: Int16

Action: None

Action Modifier: 10

Action Modifier Base: 10

☐ Advanced

read\_int16(40012)

Syntax OK! Examples

Test Result

Test Currently Valid OK Cancel

13. Configure the Read expression.
14. Click **Test**. If successful, it will read the setpoint specified as the Test Write Value above.
15. Click **Comm Read** to verify that communication with the CRAH (or Building Management System (BMS)) is functioning properly.
16. The rest of the fields are optional for a VFD.

VFD Control Device	Generic Modbus
IP Address	10.136.202.12
Device ID	1
Device Write Timer (sec)	30
Device Read Timer (sec)	60
Setpoint Write	write_register16(40011, V...
Setpoint Read	read_int16(40012)
Power Read	read_int16(40013)
Local Override Read	read_int16(40014)
Comm Read	read_int16(40015)
Over Current Alarm	read_int16(40016)
Over Voltage Alarm	read_int16(40017)
Under Voltage Alarm	read_int16(40018)
Over Temperature Alarm	read_int16(40019)
General Alarm	read_int16(40020)
Write Clear Alarm	read_int16(40021)

Configure CRAHs - BACnet

- 1. For BACnet, you need to specify the VFD BACnet Network and a BACnet Device ID. Users get these network values from the data center's Facilities department.

Property	Value
MAC ID	01000B0B8C43EC84
Sampling Interval (min)	5
Location	
Sensible Cooling Table	(Table)
Air Volume Table	(Table)
VFD Control Device	Generic BACnet
IP Address	0
BACnet Network	0
BACnet Device	0
Device Write Timer (sec)	30
Device Read Timer (sec)	60
Setpoint Write	!!
Setpoint Read	
Power Read	
Local Override Read	
Comm Read	
Over Current Alarm	
Over Voltage Alarm	
Under Voltage Alarm	
Over Temperature Alarm	
General Alarm	
Write Clear Alarm	
Temperature Control Device	Generic Modbus
IP Address	10.136.202.12
Device ID	1

- 2. Click **Setpoint Write** to open the VFD: Setpoint Write dialog box.

VFD: Setpoint Write (WRITE)

☒ Simple

Object Instance: 5

Object Type: Analog Output

Property Id: present-value (85)

Action: None

Action Modifier: 10

Action Modifier Base: 10

☐ Advanced

write\_ao( 0, 85, ( Value ) )

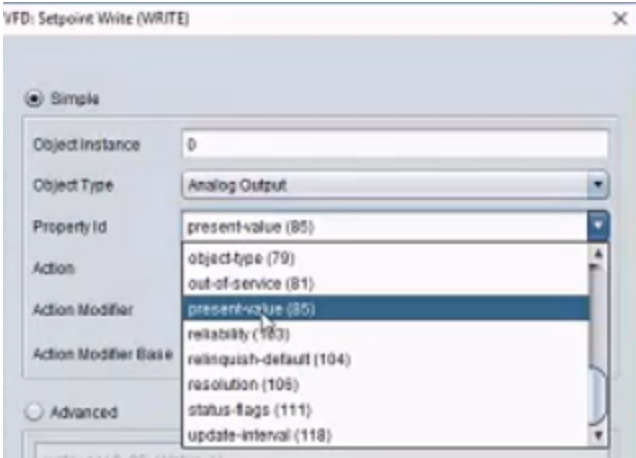
Syntax OK! Examples

Test Write Value

Test Result

Test Currently Invalid OK Cancel

3. Enter the **Object Instance**.
4. Select **Object Type** that will be read.
5. Select the **Property ID** from the drop-down menu. This is specified by the CRAH. Check the unit's user manual.

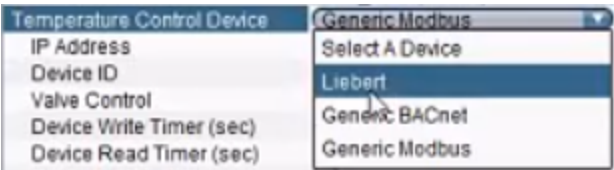


6. If advanced calculations need to be performed, select the **Advanced** radio button and enter an expression. Click the **Examples** button for assistance.
7. Enter a **Test Write Value**. (For example, enter "60.0" to set the fan speed to 60%.)
8. Click the **Test** button. The Test Result displays.

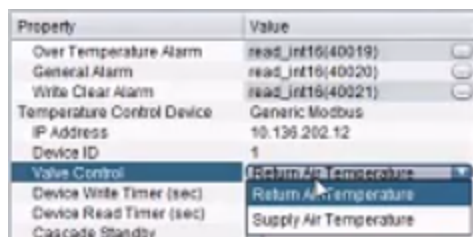


## Configure Temperature Control Device

1. Choose the **Temperature Control Device** from the drop-down menu: Liebert, Generic BACnet, or Generic Modbus. Liebert has a siteport that must be configured by the data center's IT or Facilities department.



2. Specify whether the valve control is regulating temperature based on the Return Air (hot side) Temperature or the Supply Air (cold side) Temperature. Review the manufacturer's specifications to see what is regulated.



Property	Value
Over Temperature Alarm	read_int16(40019)
General Alarm	read_int16(40020)
Write Clear Alarm	read_int16(40021)
Temperature Control Device	Generic Modbus
IP Address	10.136.202.12
Device ID	1
Value Control	Return Air Temperature
Device Write Timer (sec)	
Device Read Timer (sec)	
Cascade Standby	

3. In the **Device Write Timer** and **Device Read Timer** fields, specify how often (in seconds) Active Control will read the return or supply air temperature from the Cooling Unit and write the setpoint for the return or supply air to the Cooling Unit.
4. For **Setpoint Write** and **Setpoint Read**, follow the instructions above for configuring the Cooling Unit, based on the protocol used (BACnet or Modbus).
5. In the **Cascade Standby** field, choose whether the Standby setting is cascaded to the VFD. If it is cascaded, when the Cooling Unit goes into Standby mode (not cooling), the VFD also goes into Standby mode.
6. Click **Comm Read** to verify communication with a BMS or Cooling Unit unit.

### Test All

In the Property table, control points displayed in red have not been validated. When you run an export, you will get a warning for each of these control points.

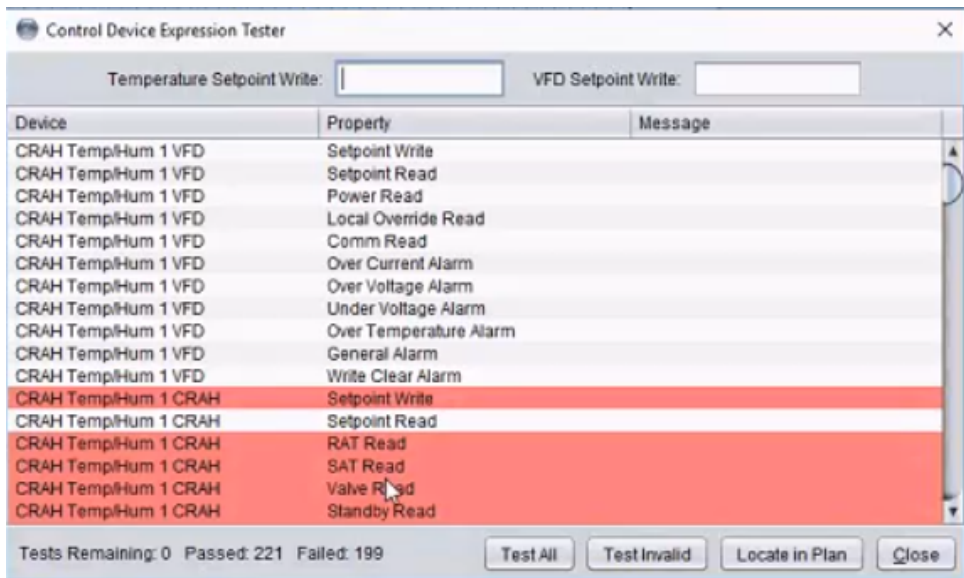


Cascade Standby	
Setpoint Write	write_register16(40001)
Setpoint Read	read_int16(40002)
RAT Read	read_int16(40003)
SAT Read	read_int16(40004)
Valve Read	read_int16(40005)
Standby Read	read_int16(40006)
Comm Read	read_int16(40007)
Change Filters Alarm	read_int16(40008)
General Alarm	read_int16(40009)
Clear Alarm	read_int16(40010)

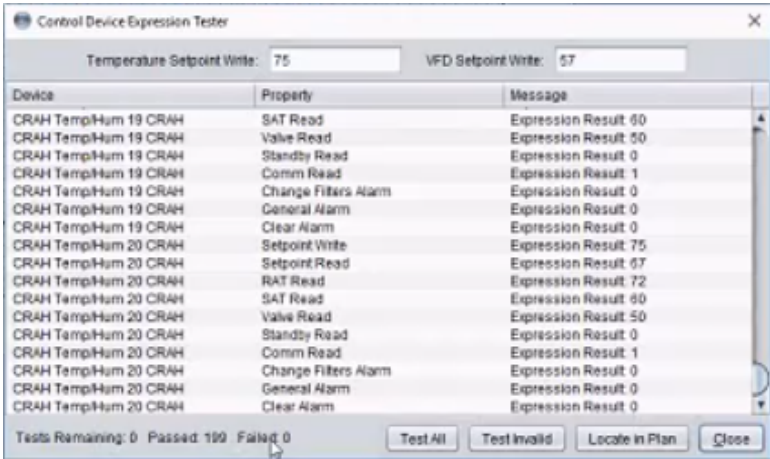
You can test all the unvalidated control points at once by using the Test All feature.

1. Click **Export** and select **Test Device Expressions** from the drop-down menu. The Control Device Expression Tester window opens.





2. Enter values in the **Temperature Setpoint Write** and **VFD Setpoint Write** text fields.
3. Click **Test Invalid** to test current invalid expressions (highlighted in red) or **Test All** to test all expressions.
4. The test results display the number of tests remaining, the number passed, and the number failed.



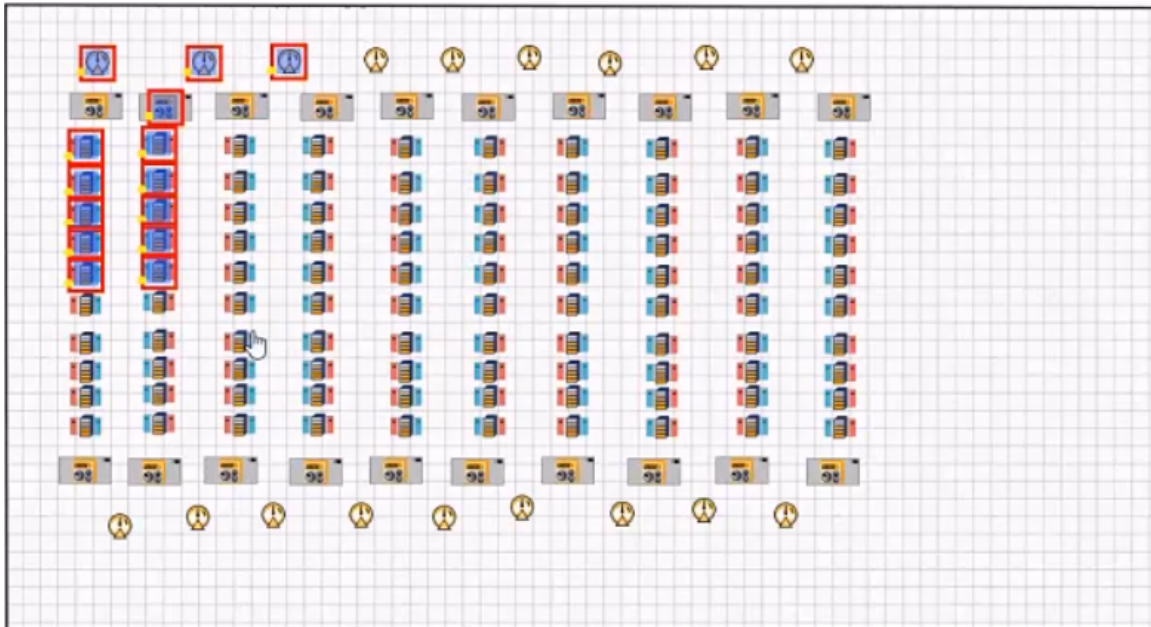
5. If any of the control points failed validation, you can right-click it. Select **Locate in Plan**, and adjust the control point as needed.

## Area of Effect

An Area of Effect is a region of sensors noticeably affected by a specific Cooling Unit. These regions overlap across the data center because the cooling effect of Cooling Unit

overlaps. Active Control calculates each Cooling Unit's Area of Effect automatically. These calculations cannot be manually overridden. In most cases, a sensor will be assigned to two Areas of Effect, but never more than two.

An Area of Effect calculation uses the fan's pressure (CFM output) to determine how far the air will travel and which pressure nodes and temperature nodes will detect the air. The calculation takes into account any obstructions (walls, etc.).

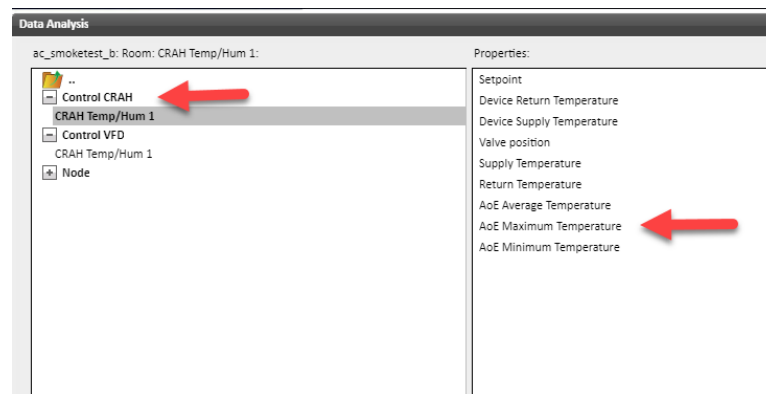


## Data Analysis

There are new standard metrics for Active Control systems. The metrics are available in WebConsole under Data Analysis.

1. AoE Average Temperature: Displays the average reading for temperature sensors in particular AoE.
2. AoE Maximum Temperature: Displays the maximum temperature reading from a sensor in a particular AoE.
3. AoE Minimum Temperature: Displays the minimum temperature reading from a sensor in a particular AoE.
4. AoE Average Pressure: Displays the average reading for pressure sensors in a particular AoE,
5. AoE Maximum Pressure: Displays the maximum pressure reading from a sensor in a particular AoE.
6. AoE Minimum Pressure: Displays the minimum pressure reading from a sensor in a particular AoE.

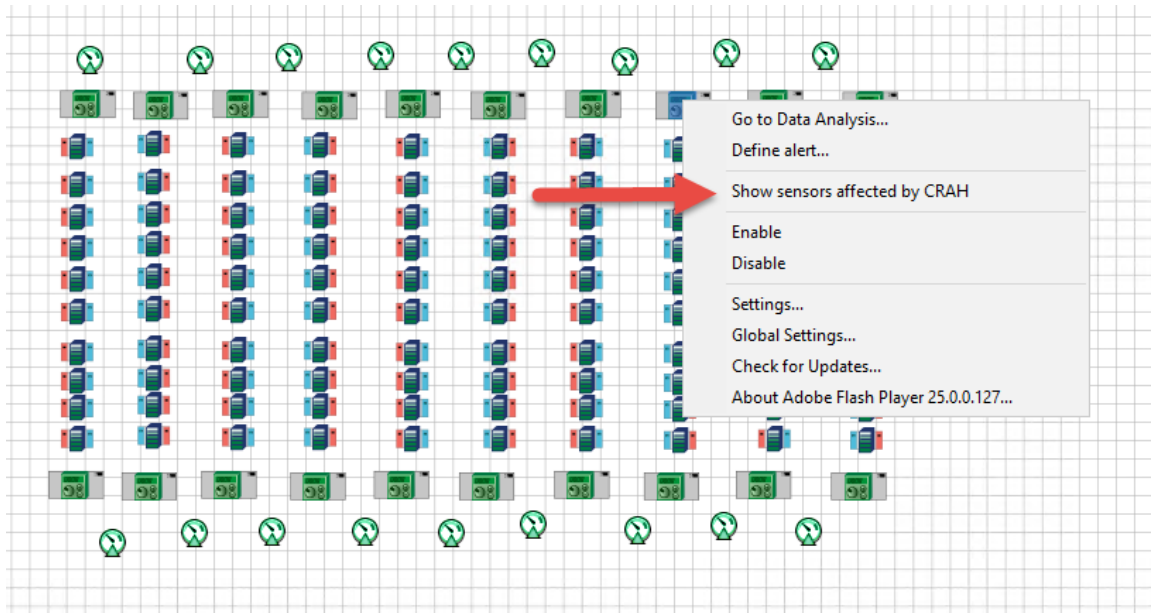
These metrics are specific to Active Control systems. The metrics are applicable to a Room but they are accessible through **Cooling Unit** objects. Pressure under **Control VFD** and temperature under **Control CRAH**.



## Viewing an Area of Effect

After establishing Active Control for components, you can view the Area of Effect and everything in it.

To view an Area of Effect, go to the **Floorplans** tab in Web Console, right-click a CRAH, and select **Show sensors affected by CRAH** from the drop-down menu.




**Note:** If you right-click a cooling unit and select **Show sensors affected**, Web Console not only highlights sensors in a cooling unit's AoE, it also selects the component, making the component susceptible to subsequent operations. Other right-click operations after a Show sensors affected operation impact all components.

# Icons and Alerts







## Controlled Device Icons

This icon represents Active Control elements that display sensor readings and settings regarding the controlled device itself. Active Control uses this data to control the region, including the temperature or pressure to the air handling unit and fan speed and power data.

In addition, these device icons also indicate the operation mode of the components (for example, Automatic or Manual mode), whether it is online, in standby, or disconnected, and whether alerts are pending.

 CRAC or CRAH Icon – Displays the air temperature setpoint as well as the current air temperature sensors on the cooling unit.

In addition to the device icons, there are status icons that append to the device icon to give a broader picture of current conditions. Definitions of these icons display on the CRAH Configuration page.

Status Icon	Description
	Disconnected Mode
	Disengaged Mode
	Failsafe Mode
	Online in Automatic and Manual Mode
	Standby Mode
	Override Mode

## Default Alerts

Active Control provides six default alerts. Create additional alerts for your facility using the manage alerts features provided in the Web Console. Device icons on the floor plan change to indicate an alert was triggered.

Name	Description
Critical System	CRAC or CRAH in Standby, sensor crossed alarm threshold
Communication Error	All CRAC or CRAH/VFD communication errors: cannot connect to Modbus gateway, Device not responding, invalid register, etc.
Overcooling	Control setpoints at minimum cooling for three adjustment periods but all control points remain overcooled
Undercooling	Control setpoints at maximum cooling for three adjustment periods but one or more control points remain undercooled
Sensors Not Reporting	The number of non-reporting sensors has exceeded the configured threshold.
CRAC or CRAH Off	The air handler is not powered on and not disabled.

In addition to these default alerts, create a variety of Custom Alerts to meet the needs of the data center configuration. See the Web Console User Guide for information.

### Alarm Relay

Active Control can relay a subset of alarms from CRAC, CRAH, and VFD units to the SynapSense alerting module. When fully integrated, for Active Control, the SynapSense system has access to many of the alarms triggered that display on the faceplate.

#### CRAC Alarms Relayed

- High Head Pressure – Triggered when compressor head pressure exceeds the safe operating range.
- Low Suction Pressure – Triggered when cooling unit detects a low suction pressure.
- Compressor Overload – Triggered when cooling unit detects a compressor overload condition.
- Short Cycle – Triggered when a compressor cycles repeatedly within a given time-frame.
- Change Filters – Triggers when a cooling unit indicates that the air filter needs replacing.
- General Alert – Triggered when an uncategorized alarm condition is present.

#### CRAH Alarms Relayed

- Change Filters – Triggers when a cooling unit indicates that the air filter needs replacing.
- General Alert – Triggered when an uncategorized alarm condition is present.

## **VFD Alarms Relayed**

- Over Current – Triggered when an over current condition is detected.
- Over Voltage – Triggered when an over voltage condition is detected.
- Under Voltage – Triggered when an under voltage condition is detected.
- Over Temperature – Triggered when an over temperature condition is detected.
- General Alert – Triggered when an uncategorized alarm condition is present.

## **Heartbeat Monitor**

The Heartbeat Manager informs other 3rd-party systems (usually an intermediate BMS) that Active Control is connected and running. It has no internal or user-controlled states like other device drivers. It begins running as soon as the object model is processed following a MapSense export, and it continues running as long as the room is running. Comm errors do not cause mode changes and are not reported through the Alerting service. Heartbeat Managers are optional and limited to at most 1 per controlled room.

## Active Control Pages in Web Console

1. Click a Room with Active Control to view its floor plan.
2. Right-click the Room in the Location Tree and select **Room Configuration**.

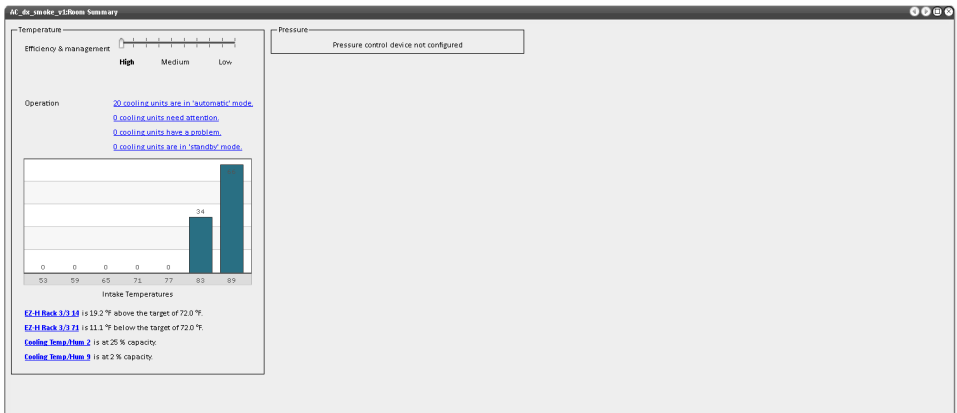


The Active Control Room Configuration page opens. The example below shows a CRAH Configuration Page, which displays both temperature and pressure data.



The following example shows a CRAC configuration, which displays temperature but not pressure data.

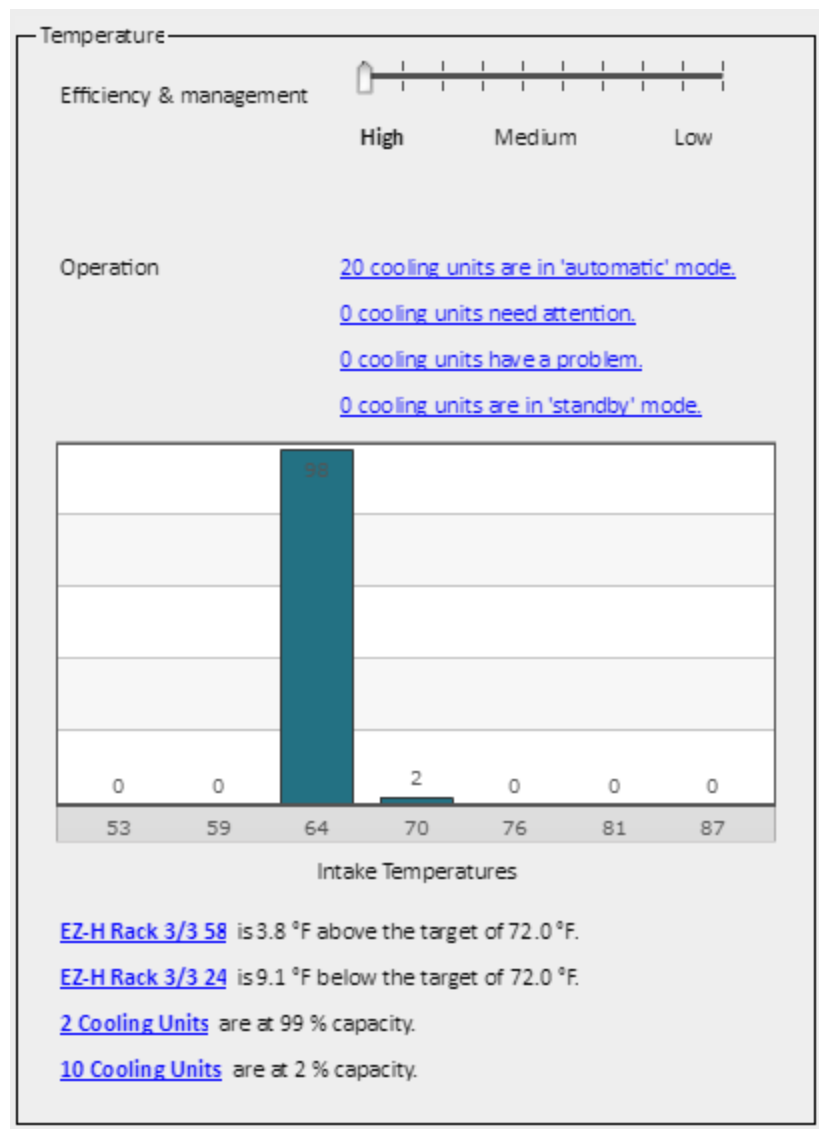




3. The Efficiency & Management settings display for Temperature and/or pressure.



The Operations section shows how many of the room's Cooling Units are in specific mode, how many need attention, and how many have a problem.

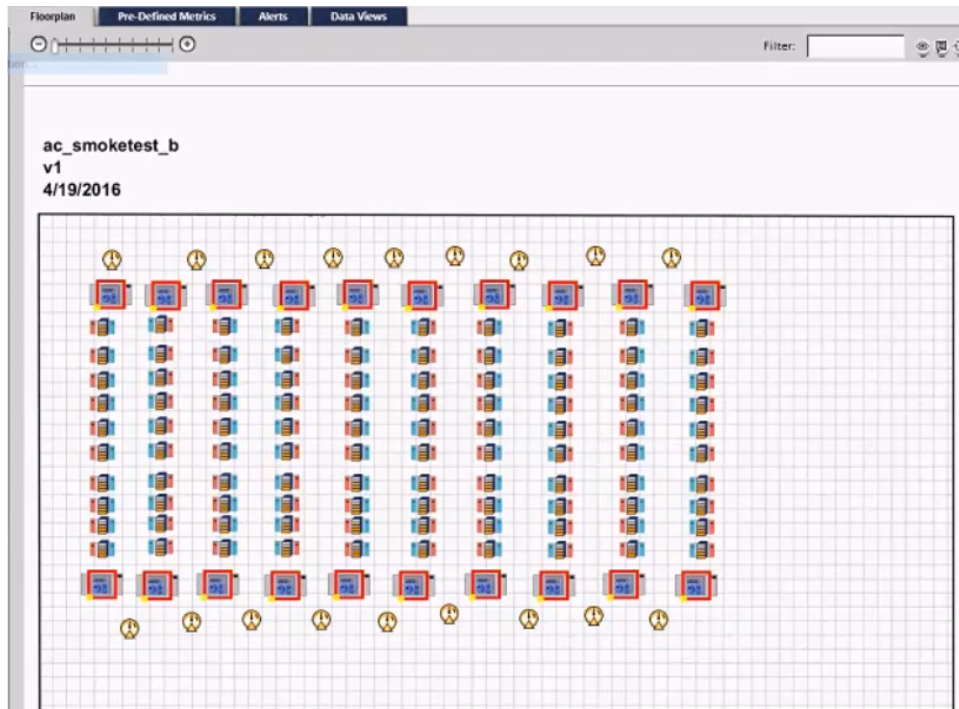


- **Automatic mode:** Cooling units in automatic mode.
- **Need Attention** (applies to units in manual, standby, local override, or disengaged mode).
- **Have a Problem** (applies to units in Failsafe or Disconnected Mode. Failsafe Mode means Active Control is getting incorrect values, or it isn't receiving data from the sensors. For these Cooling Units, Active Control moves the temperature setpoint to the lowest value that the Cooling Unit has had during the past two weeks. For pressure, it will set the fan to the highest fan speed the Cooling Unit has had in the past two weeks. Active Control does this to ensure that the Cooling Units provide the coolest air possible at the highest pressure. Click on the links to see the Cooling Units that need attention or are in failsafe

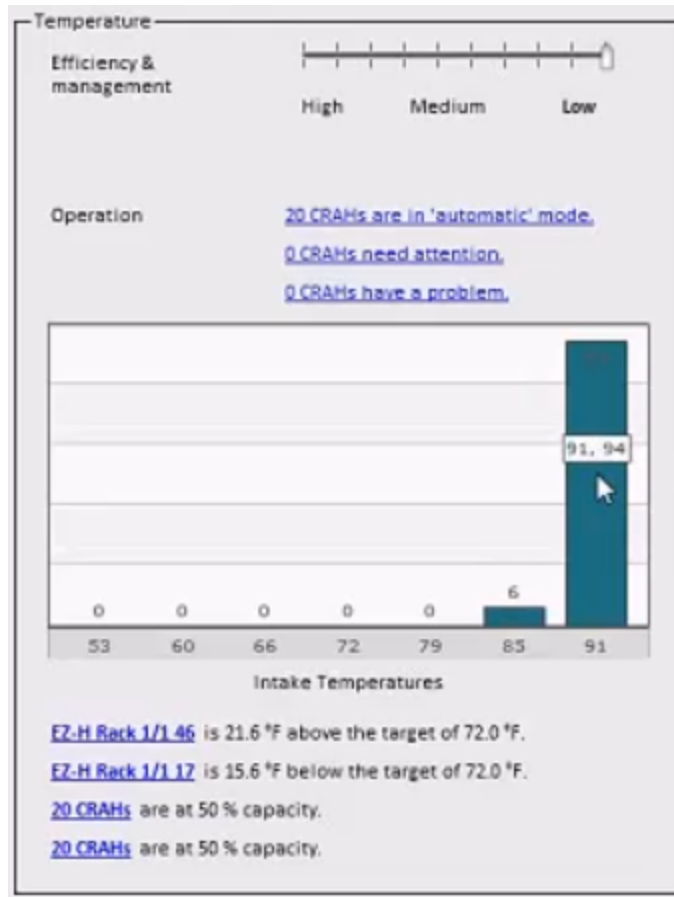
mode.

- **Standby Mode:** The Cooling Units have been put in Standby mode by Active Control.

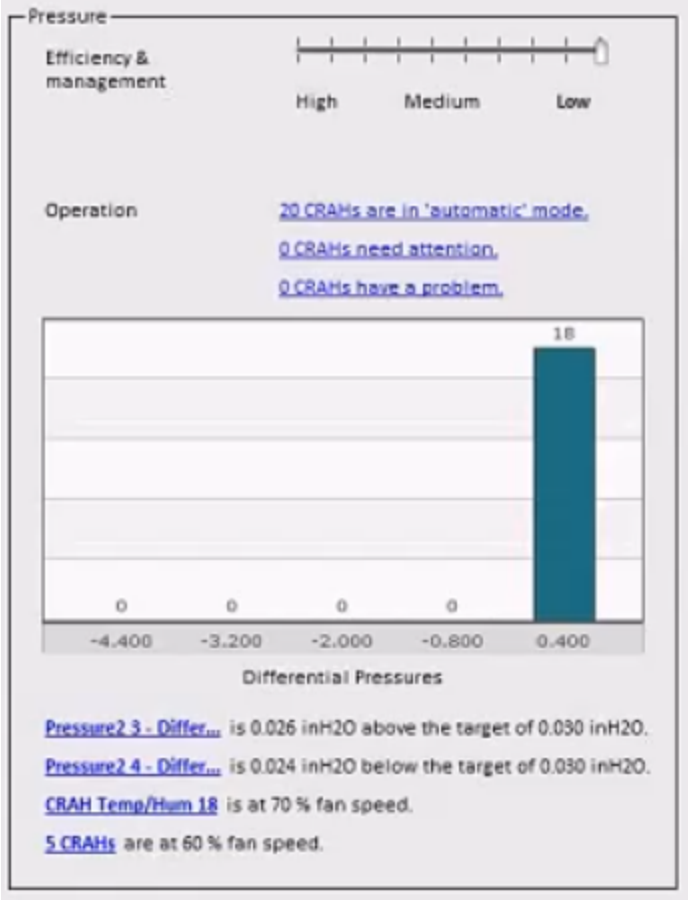
4. Click the any of the mode links to view the Cooling Units that are in that mode.



5. Back at the Room Summary page, the histograms display temperature and pressure distributions from the sensor inputs. The Temperature chart shows how many racks are at a given bandwidth of temperature, represented by the height of each bar. Mouse over the bar to see a tool tip that displays the actual number of racks at that temperature. (Ideally, all Cooling Units will be within the same band.) In the chart below, the tool tip indicates that there are 94 racks with a temperature of 91 degrees.



The Pressure chart shows the pressure differentials.



6. You can double-click within the Temperature table outside the bands to see the intakes for the control and their temperatures.

Status	Name	Actual value	Target value	Position	Resource
🚩	EZ-H Rack 1/1 90 - Intal	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 70 - Intal	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 50 - Intal	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 10 - Intal	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 30 - Intal	x	72.00	Top	temperature
🚩	Pressure2 15 - Differen	x	0.03		pressure
🚩	Pressure2 4 - Differen	x	0.03		pressure
🚩	EZ-H Rack 1/1 51 - Intal	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 31 - Intal	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 91 - Intal	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 71 - Intal	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 11 - Intal	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 28 - Intal	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 8 - Intalx	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 48 - Intal	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 87 - Intal	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 27 - Intal	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 7 - Intalx	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 67 - Intal	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 47 - Intal	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 29 - Intal	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 49 - Intal	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 9 - Intalx	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 89 - Intal	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 69 - Intal	x	72.00	Top	temperature
🚩	Pressure2 9 - Differen	x	0.03		pressure
🚩	Pressure2 3 - Differen	x	0.03		pressure
🚩	EZ-H Rack 1/1 68 - Intal	x	72.00	Top	temperature
🚩	EZ-H Rack 1/1 88 - Intal	x	72.00	Top	temperature

7. The Intake Temperature chart bars identify the rack(s) with the highest and lowest readings, relative to *target temperature*. Click on the link to go to the floor plan, where that rack is highlighted. Also shows Cooling Units and their capacity.
8. Differential Pressures on Summary page: Shows the Pressure Nodes that are most above the target and most below the target. Also shows highest fan speed and lowest fan speed. Double click on the Cooling Units running at lowest speed link as an example to view the Cooling Unit summary page.
9. Temperature pane shows:
  - Unit Setpoint: This is the current setpoint of the unit. Active Control reads this value from unit
  - Active Control Setpoint - this is the setpoint calculated by Active Control. This value is written and set onto the unit at a specified interval.
  - Last Adjustment: Last time the temperature was adjusted and the amount of adjustment.
  - Supply/return temp: The supply air temperature and the return air temperature read from the unit.
  - Valve Position: Percentage at which the valve is open.
  - Failsafe: These are setpoints used when Cooling Units go into failsafe mode. For temperature, this is lowest reading over over the last two weeks. For pressure, it is highest reading over the last two weeks.
10. Temperature Input Summary: Actual intake temperature represented by bar, current target represented by black line. You can move this line to set a new target. A

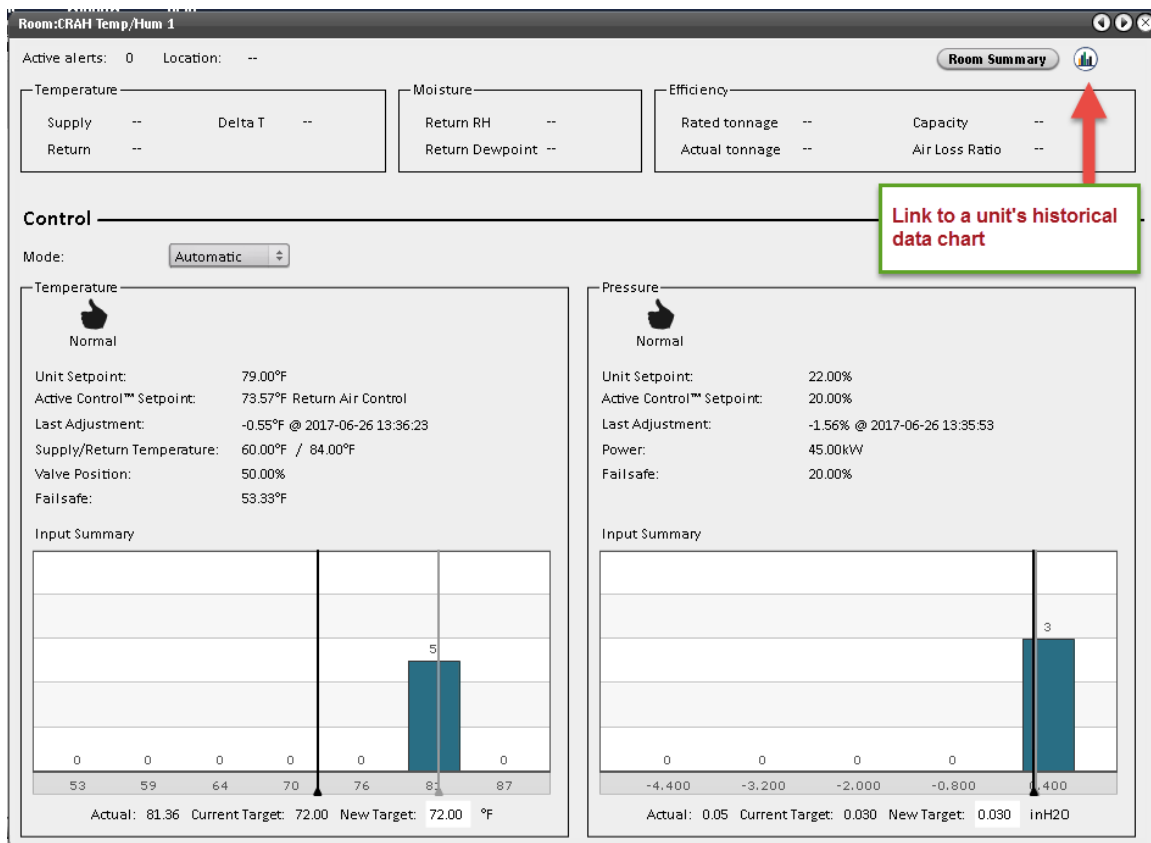
dialog box will open, asking whether you want to set all sensor targets to the new value or whether you want each target sensor to change by the amount you've changed for the new value, so that the sensor targets may have different values but increased/decreased by the same amount. You also can type in the new value in the text field below the table.

11. Pressure Input Summary: Same as temperature. The pressure target can also be adjusted in units of inches-of-water.
12. Arrows at top allow you to move from one Cooling Unit to the next (from left to right).
13. Click Room Summary button at the top to see the information for the room containing the Cooling Unit.
14. Exit the window to return to the floor plan. Double-click on a Pressure Node to set the individual target pressure if it has high pressure or low pressure because something is blocking it, make it lower so that Active Control doesn't keep trying to adjust it when the sensor can't meet the target.
15. For racks that have just a top intake sensor, or ones that have top and bottom, click to open the Rack Environmentals Summary. Choose which sensor you want to use when calculating the rack temperature. (Typically, the top sensor is used.) The change will be made in Active Control automatically.

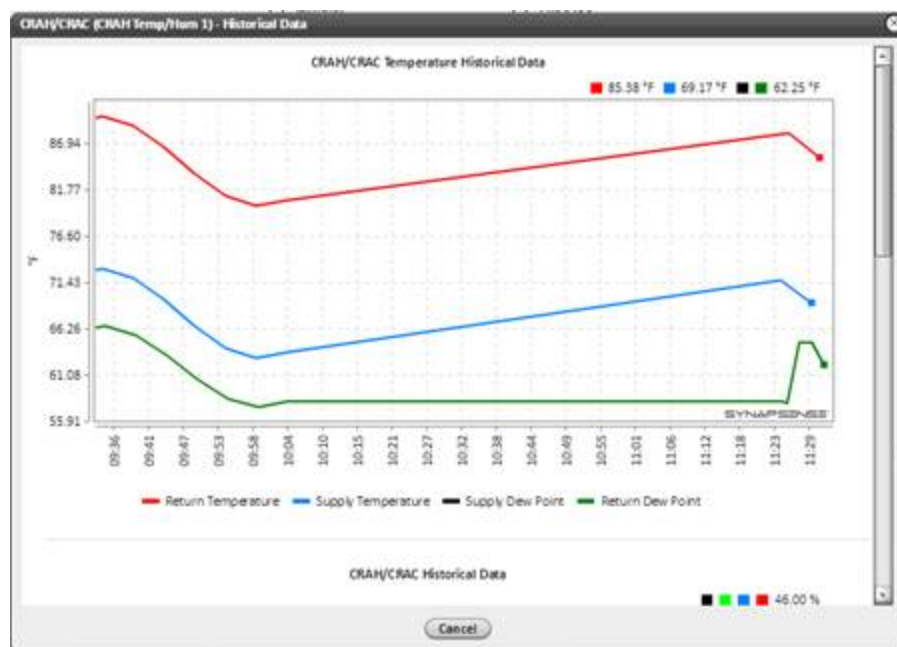
**Note:** If you click the Target Intake Temperature value multiple times, it will only change once. It waits a half second before it makes a change.

## **History Data Link**

This is a link to a sensor's historical data located on the CRAH Summary page.



Below are examples of charts you can view when you click the link.



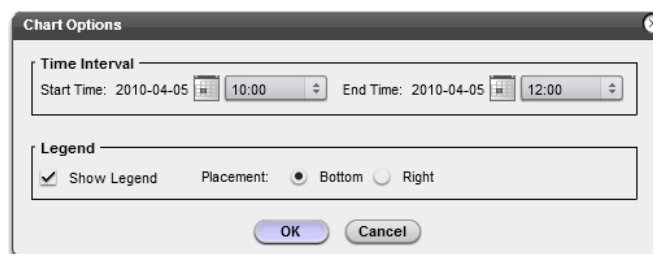




**Note:** Displayed data will not update automatically. Data will refresh upon Zoom In, Zoom Out or upon exiting the Chart Options Dialog Box.

- Time (horizontal axis) – Initially set to show the preceding two hours of operational history (at default zoom). Clicking inside the graph allows zooming with the mouse wheel to show a longer or shorter time span (can also be changed via the Start Time and End Time settings in the Chart Options Dialog Box). In addition, users can scroll the chart data right or left with the arrow keys.
- Return Air Temperature Set Point (uses the vertical axis on left) – Shows Return Air Temperature Set point settings made by Active Control in Automatic Mode, or by the operator in Manual Mode, over the time span currently displayed.
- Fan Speed (uses the vertical axis on right) – Shows Fan Speed settings, as a percentage of its maximum capable speed, made by Active Control in Automatic Mode, or by the operator in Manual Mode, over the time span currently displayed.
- Valve Position (uses the vertical axis on right) – Shows valve position setting, as a percentage of its maximum, made by Active Control in Automatic Mode, or by the operator in Manual Mode, over the time span currently displayed.

1. Right-click inside the graph area to display a context menu.
2. Select Chart Options.



- Chart Options - allows users to change the span of time shown on the graph and whether or not the Legend displays on the graph with a choice of location.
- Time Interval – Click the Calendar icons to choose the starting and ending times displayed in the chart. Use the drop-down lists to choose the month and year. A small “X” in the upper-right corner closes the calendar dialog.
- Legend – Select the Show legend checkbox to show or hide the Legend properties. Use the Placement radio buttons to determine whether the Legend displays below or to the right of the chart.
- Mode – To change the operation mode for a region, click and drag the handle to Manual, Automatic, or Disengaged. The current mode will change to the new selection when you click Apply or OK. Disengaged mode is used when the controlled device should not be subject to Active Control. For example, when the unit is off or undergoing maintenance.
- Constraints – Displays setpoints from the respective tab (Temperature, Airflow, or Pressure) for Minimum Setpoint, Maximum Setpoint, and Fallback. To make a change, click to activate the field, then enter a new value.

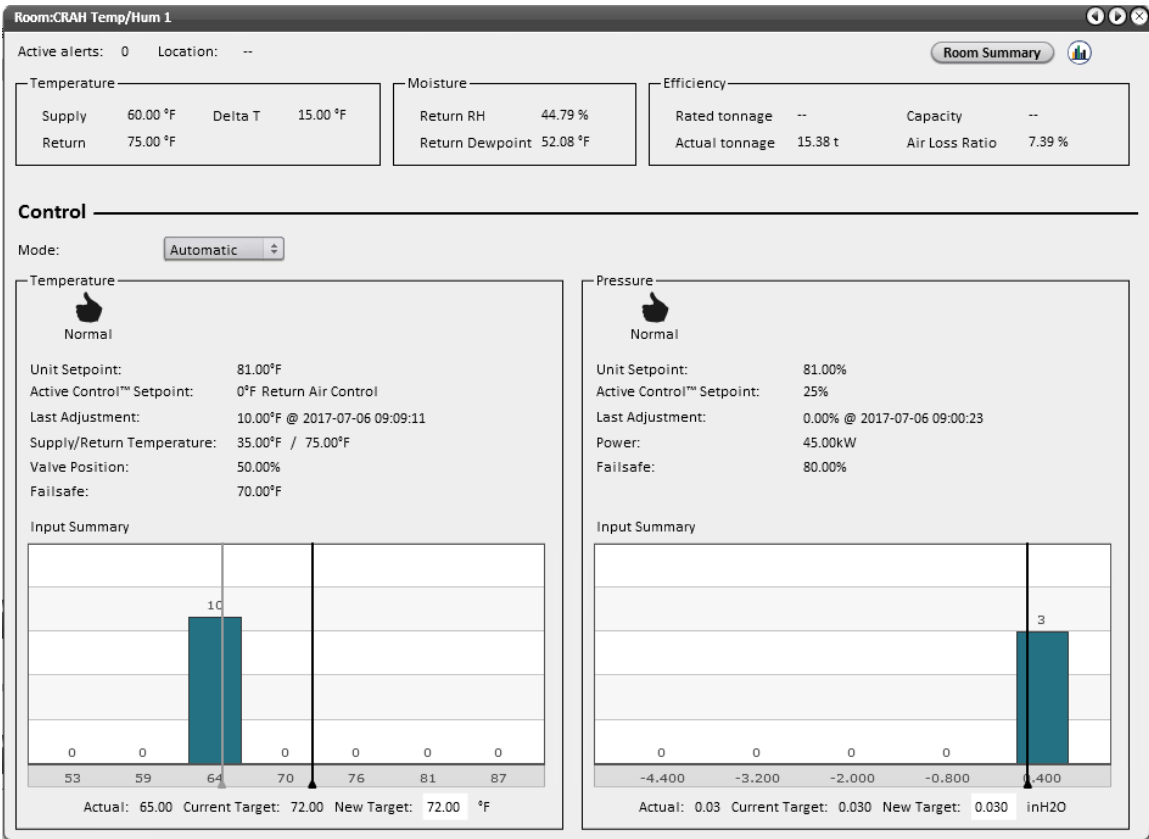
**Note:** You must click **OK** or **Apply** for the changes to take effect.

## Changing Operation Mode

Normally, operators will keep the entire data center in Automatic mode and monitor system performance over time, to ensure satisfactory operating conditions. However, there are several circumstances where Manual mode may be employed, such as when floor tiles are temporarily removed during maintenance or cable installations. This prevents the Automatic mode algorithms from making unnecessary temperature and fan speed changes while the server room environment is undergoing maintenance.

To adjust a CRAH's operation mode:

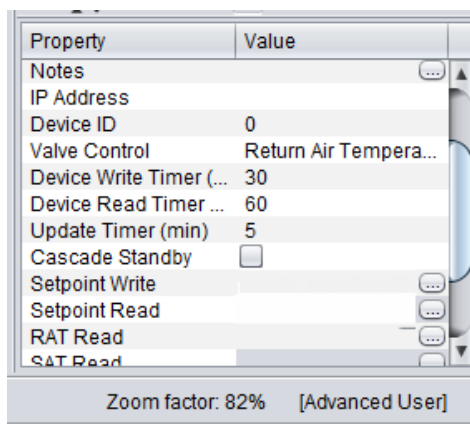
- Double-click a CRAH on the **Floorplan** tab in Web Console to open the CRAH Summary page for the unit. Here, you can change the mode from Automatic to Manual or Disengaged.



## Appendix A: Configuring Modbus and BACnet data points

To configure Modbus and BACnet data points:

1. When the Generic Controlled Devices are placed on the floor plan, view the Properties Editor panel.



2. Set up the properties on this panel, using the table below.

Field Name	Data Type	Required	Description
Set point Read	°F	Yes	Read the device setpoint
Setpoint Write	°F	Yes	Set the device setpoint
Valve Position Read	%	No	Read the position of the water valve. This is a required field if Temperature Priority is attached to the controlled VFD.
Return Air Temperature Read	°F	If Return-Air Controlled	The value of the device's RAT sensor
Supply Air Temperature Read	°F	If Supply-Air Controlled	The value of the device's SAT sensor
Standby Read	True/False	No	If the device is in standby
Comm Read	True/False	No	If there is end-to-end communication with the device, as opposed to only

Field Name	Data Type	Required	Description
			Modbus communication
Change Fil- ters	True/False	No	When a cooling unit indicates filter replacement is needed.
General Alert	True/False	No	Any uncategorized alarm condition.