TV-OPT

Installation and Start-up Guide

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Important changes are listed in **Document revision history** at the end of this document.

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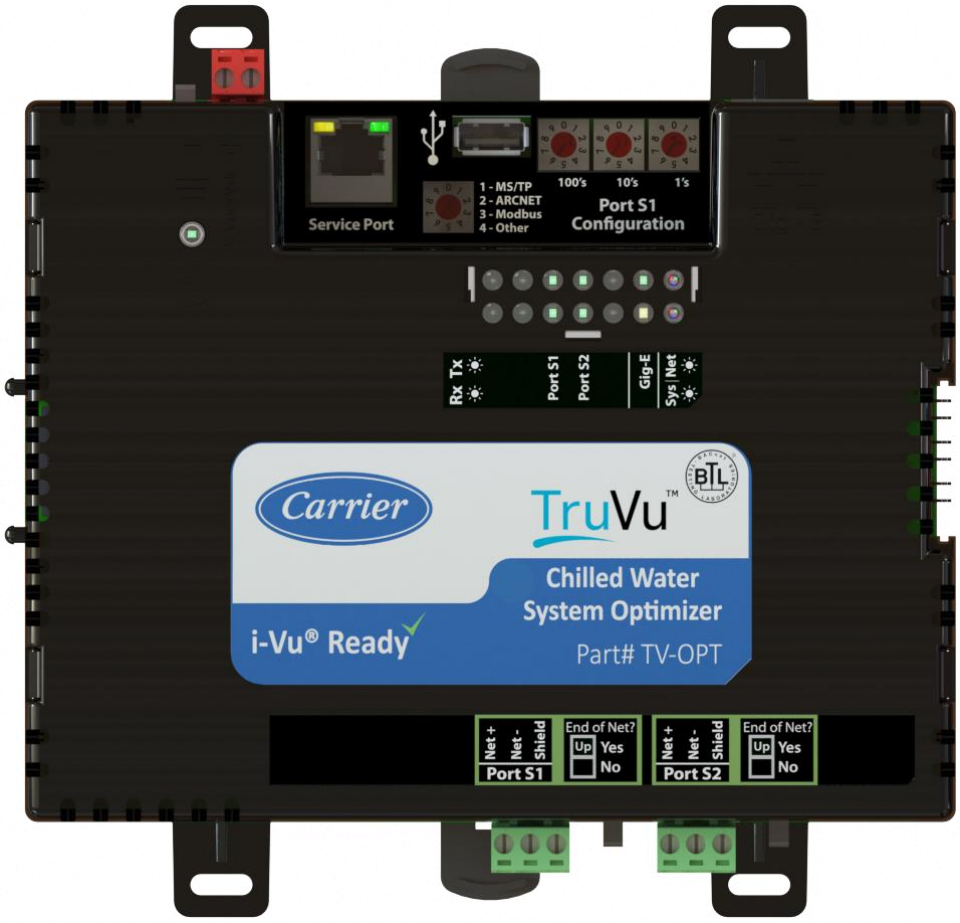
What is the TV-OPT?

The TruVu™ Chilled Water System Optimizer (part no. TV-OPT) provides precise chilled water and condenser water setpoint optimization by carefully balancing the energy use of both the chilled water plant equipment and the chilled water consumers. This results in an overall reduction in energy use and electrical demand.

The TV-OPT is a BACnet router that:

- Provides BACnet routing between any supported BACnet communication types
- Runs the Chilled Water System Optimizer control program
- Can have two BACnet/IP networks communicating on the Gig-E port
- Can serve as a BACnet Broadcast Management Device (BBMD) on each of the BACnet/IP networks
- Supports Foreign Device Registration (FDR)
- Supports DHCP IP addressing
- Has built-in network diagnostic capture functionality for troubleshooting
- Has network statistics that can be viewed numerically or as trend graphs
- Works with the i-Vu® v6.5 or later system with the latest cumulative patch
- Can serve as a gateway that can act as a:
  - Master or slave on a Modbus serial network
  - Server or client on a Modbus TCP/IP network



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The TV-OPT has 4 physical ports for BACnet or Modbus communication:

Port	Port type	For routing this type of communication...	At...
Gig-E	10/100/1000 Mbps Ethernet	BACnet/IP, BACnet/Ethernet, and/or Modbus TCP/IP	10, 100, or 1000 Mbps (1 Gbps)
S1	High-speed EIA-485 port	BACnet/ARCNET or BACnet/MSTP or Modbus Serial	156 kbps 9.6 to 115.2 kbps 9.6 to 115.2 kbps
S2	Electrically isolated EIA-485 port	BACnet/MSTP or Modbus Serial	9.6 to 115.2 Kbps 9.6 to 115.2 kbps
Service Port	10/100 Mbps Ethernet HTTP/IP	BACnet/IP Service Port	10 or 100 Mbps

NOTE The TV-OPT does not support CCN networks.

The TV-OPT also has the following ports:

- USB port for recovery
- Ethernet Service Port for connecting locally to controller setup pages and the TruVu™ ET Display

Critical Product Announcement

Due to the global semiconductor supply chain uncertainty, the TV-OPT does not yet support communication over the ARCNET network. References to ARCNET in this document are for future use and should be ignored at this time.

The TV-OPT's driver properties and controller setup pages only show available communication selection options.

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Specifications

Driver	drv_fwex_< version >.driverx
Maximum number of control programs*	1
Maximum number of BACnet objects*	12000
Third-party BACnet integration points	1500
Third-party Modbus integration points	1000

* Depends on available memory.

Power	24 Vac ±10%, 50–60 Hz, 50 VA 26 Vdc ±10%, 15 W
Gig-E port	10/100/1000 BaseT, full duplex, Ethernet port for BACnet/IP and/or BACnet/Ethernet, or Modbus TCP/IP communication.
Port S1	For communication with either of the following: • A BACnet ARCNET network at 156 kbps • A BACnet MS/TP network at 9600 to 115200 bps • A Modbus serial network at 9600 to 115200 bps This port's **End of Net?** switch can be set to **Yes** to terminate the network segment.
Port S2	For communication with either of the following: • A BACnet MS/TP network at 9600 to 115200 bps • A Modbus serial network at 9600 to 115200 bps This port's **End of Net?** switch can be set to **Yes** to terminate the network segment.
Service Port	Ethernet port at 10 or 100 Mbps for setting up the controller and troubleshooting through a local connection to a computer or connecting to the TruVu™ ET Display
USB port	USB 2.0 host port for device recovery
Microprocessor	32-bit ARM Cortex-A8, 600MHz, processor with multi-level cache memory
Memory	16 GBs eMMC Flash memory and 256 MB DDR3 DRAM (22 MB available to use). User data is archived to non-volatile Flash memory when parameters are changed, every 90 seconds, and when the firmware is deliberately restarted. **NOTE** When you change a parameter, you must wait 30 seconds before turning the power off, in order for the change to be saved.
Real-time clock	Real-time clock keeps track of time in the event of a power failure for up to 3 days.
Protection	Device is protected by a replaceable, fast acting, 250 Vac, 2A, 5mm x 20mm glass fuse. The power and network ports comply with the EMC requirements EN50491-5-2. **CAUTION** To protect against large electrical surges on serial EIA-485 networks, place a PROT485 at each place wire enters or exits the building.

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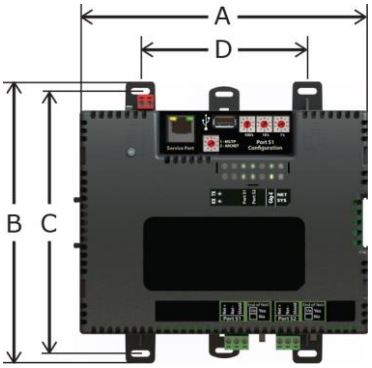
LED status indicators	• Tricolor **NET** LED to show network status
	• Tricolor **SYS** LED to show system status
	• A **TX** (Transmit) and **RX** (Receive) LED for the following ports:
	  • Gig-E
	  • Port S1
	  • Port S2
	See *LED*s (page 40).

Environmental operating range	-40 to 158°F (-40 to 70°C), 10-95% relative humidity, non-condensing **NOTES** • The TV-OPT is suitable for installation inside or outside the building envelope. • Install in a UL Listed enclosure only. • Do not change the position of the power or **End of Net** switch at temperatures below -22°F (-30C) to ensure proper operation and electrical connectivity.
Physical	Fire-retardant plastic ABS, UL94-5VA
Terminal blocks and connectors	Screw-type terminal blocks. 0.2 in (5.08 mm) pitch connectors
Mounting	35mm DIN rail mounting or screw mounting
Overall dimensions	A: 7.1 in. (18.03 cm) B: 6.95 in. (17.65 cm) Depth: 2.09 in. (5.31 cm)
Screw mounting dimensions	C: 6.45 in (16.38 cm) D: 4.1 in. (10.4 cm)
Weight	1 lb. 1 oz. (0.482 kg)
BACnet support	Conforms to the BACnet Building Controller (B-BC) Standard Device Profile as defined in ANSI/ASHRAE Standard 135-2012 (BACnet) Annex L, Protocol Revision 14
Compliance	United States of America: FCC compliant to Title CFR47, Chapter 1, Subchapter A, Part 15, Subpart B, Class A; UL Listed to UL 916, PAZX, Energy Management Equipment
	Canada: Industry Canada Compliant, ICES-003, Class A cUL Listed UL 916, PAZX7, Energy Management Equipment
	Europe: CE Mark, UK: UKCA EN50491-5-2:2009; Part 5-2: EMC requirements for HBES/BACS used in residential, commercial and light industry environment RoHS Compliant: 2015/863/EU REACH Compliant
	Australia and New Zealand: C-Tick Mark, AS/NZS 61000-6-3



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Touchscreen devices

You can connect the TruVu™ ET Display to the TV-OPT's Ethernet Service port to view or change the controller's driver properties. You can also create a custom Touch file to provide a graphic representation of the controlled equipment or to provide access to schedules, view trends and alarms, and more without having to access the system's server.

NOTES

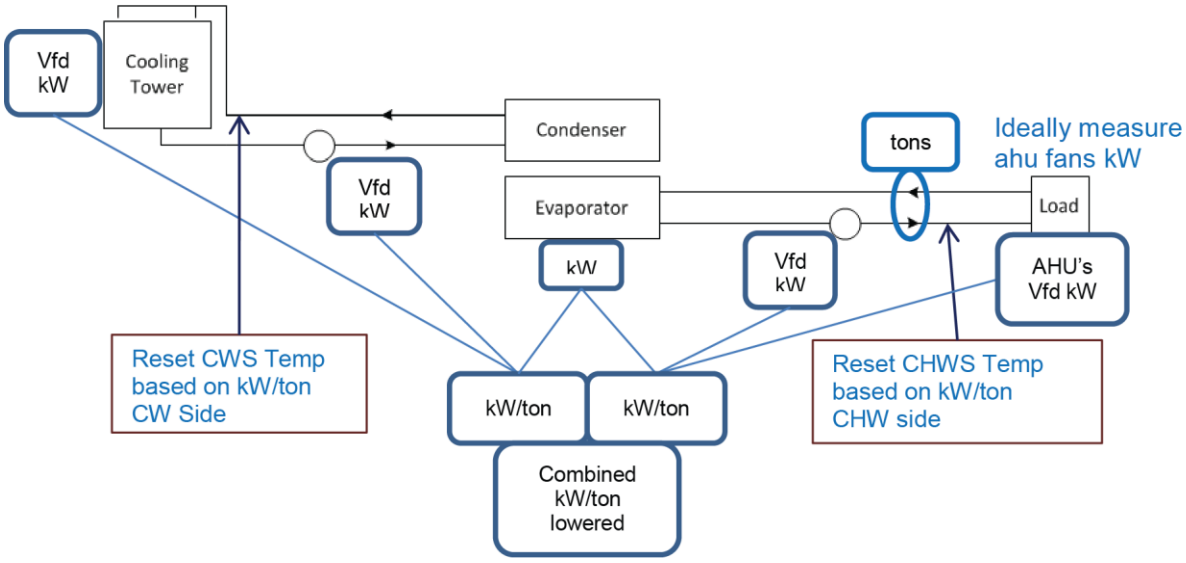
- These touchscreen devices are not powered by the Ethernet port.
- The TruVu™ ET Display requires a 24 Vdc external power source.

CAUTION A touchscreen device can share a power supply with the Carrier controller if:

- The power source shared by the controller and Equipment Touch is AC power.
- The power source shared by the controller and TruVu™ ET Display is DC power.
- You maintain the same polarity.
- You use the power source only for Carrier controllers.

Chiller system configurations

The program is scalable, so it can be applied from a minimal system including only the chiller and chilled water pump components, to a larger system, including condenser water side components and air handling unit fans, as illustrated below.



Even though the controller works with a variety of chilled water system components, it must be used with parallel chiller systems and operates best with variable speed pumps and variable speed fans.

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The TruVu™ Chilled Water System Optimizer works with systems containing any of the following:

- Single chiller or multiple chillers piped in parallel
- Chilled water pumps
- Cooling towers
- Condenser water pumps
- Variable speed air handling unit fans (w/ chilled water coils)
- Chilled water side – when secondary pumps and tertiary pumps are part of the chilled water system, including variable air handling unit fans.
- Condenser water side – systems with multiple cooling towers and condenser water pumps dedicated to their corresponding chiller, or piped in parallel.

CAUTIONS

- The control program can be less effective if the setpoint response is not predictable. For example, when the cooling towers are widely staged to come on above certain temperature thresholds, rather than using modulating VFD fans or pumps for capacity control.
- The TruVu™ Chilled Water System Optimizer is not designed for series arrangements or absorption chillers.

The TruVu™ Chilled Water System Optimizer can be applied to the following chiller system designs:

- **Chilled water supply side**
  - Up to 8 chillers piped in parallel arrangement
    - Centrifugal, scroll type, or screw type chillers
    - Equal-sized or unequal-sized
  - Up to 40 primary, secondary, and/or tertiary variable speed pumps
  - Up to 40 variable speed air handling unit fans serviced by chilled water system

- **Condenser water supply side**
  - Up to 20 condenser water pumps
  - Up to 20 cooling tower variable speed or staged fans

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Installation overview

WARNING This controller only supports a single Chilled Water System Optimizer program and no other control programs.

The TruVu™ Chilled Water System Optimizer collects remote power (kW) values and facility thermal load values residing in other controllers through Network Input points.

The program functions most efficiently and provides increased energy savings if all pumps and fans have variable frequency drives and as more power inputs are measured, however constant volume/constant flow systems are supported.

Control Inputs

- Power Inputs — Sum of power inputs Σ kW
  - Chiller power kW (required)
  - Chilled Water Pump kW (required)
  - Cooling Tower Fan kW (optional, but beneficial)
  - Condenser Water Pump kW (optional, but beneficial)
  - Air Handling Unit Fan kW (optional, but beneficial)
- Load Input — Total Cooling Load

  NOTE This is thermal cooling load in tons, whether calculated from the difference between chilled water supply and return temperatures and the flow rate, or tonnage if it can be read directly.
- Result — kW/Ton (Dividing total kW by the thermal load equals the efficiency benchmark of kW/ton)

Control Outputs – Network Outputs

The optimization program has only two control outputs. They are either Network Outputs or BACnet Analog Values.

- Chilled water supply temperature setpoint
- Condenser water supply temperature setpoint

Safety considerations

WARNING Disconnect electrical power to the TV-OPT before wiring it. Failure to follow this warning could cause electrical shock, personal injury, or damage to the controller.

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To mount the TV-OPT

The TV-OPT must be mounted in a metal enclosure or cabinet which is properly rated for the location where it is being installed.

NOTE We recommend screw mounting when installing in a high temperature and high humidity environment.

DIN rail mount

1 Push down and pull out the center tabs shown below to clear the din rail trough on the back of the controller.

2 Place the controller on the DIN rail so that the rail is in the trough on the back of the controller.

3 Push the center tabs towards the controller until you hear them click.

4 Pull gently on the controller to verify that it is locked in place.

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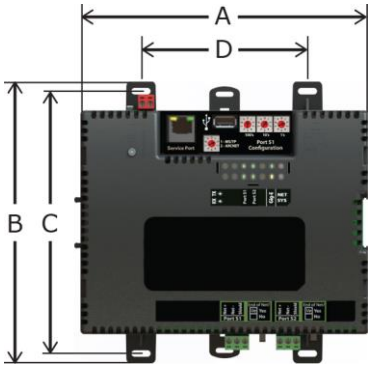
Screw Mount

Leave about 2 in. (5 cm) on each side of the controller for wiring.

Insert #6 screws through the mounting holes. Use no more than 8 in.lbs. torque to secure plastic tab to mounting surface.



A:	7.1 in. (18.03 cm)
B:	6.95 in. (17.65 cm)
C:	6.45 in. (16.38 cm)
D:	4.1 in. (10.4 cm)
Depth:	2.09 in (5.31 cm)

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Wiring for power

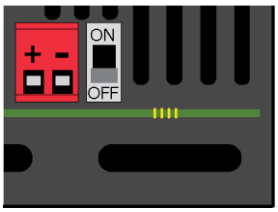
WARNING Do not apply line voltage (mains voltage) to the controller's ports and terminals.

CAUTIONS

- The TV-OPT is powered by a Class 2 power source. Take appropriate isolation measures when mounting it in a control panel where non-Class 2 circuits are present.
- Carrier controllers can share a power supply as long as you:
  - Maintain the same polarity.
  - Use the power supply only for Carrier controllers.

To wire for power

1 Make sure the TV-OPT's power switch is in the **OFF** position to prevent it from powering up before you can verify the correct voltage.



2 Remove power from the power supply.

3 Pull the red screw terminal connector from the controller's power terminals labeled **24 Vac/Vdc** (**+/-**).

4 Connect the power supply's wires to the red screw terminal connector.

5 Connect an 18 AWG or larger wire from the power supply's negative (-) terminal to earth ground. This wire must not exceed 12 in. (30.5 cm).

6 Apply power to the power supply.

7 Measure the voltage at the red screw terminal connector to verify that the voltage is within the operating range of 20 to 30 Vac or 23.4 to 30 Vdc.

8 Insert the red screw terminal connector into the controller's power terminals.

9 To verify the polarity of the wiring, measure the voltage from the negative terminal of the red screw terminal connector to a nearby ground. The reading should be 0V.

10 Turn on the expander's power switch.

11 Verify that the LED on top of the controller is on.

12 Measure the voltage at the red screw terminal connector to verify that the voltage is within the operating range of 20 to 30 Vac or 23.4 to 30 Vdc.

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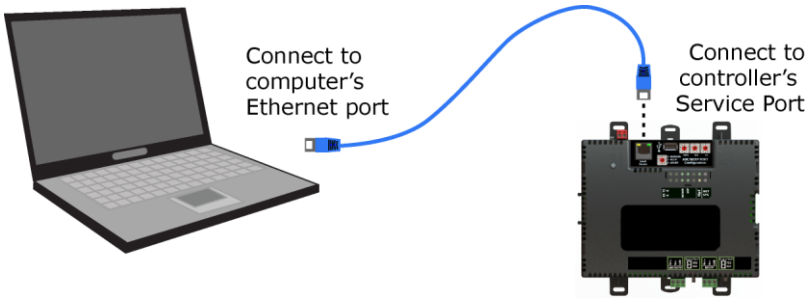
Addressing the TV-OPT

Set this port's address ...	In this location...	See...
IP	Service Port	*To set the IP address* (page 14)
Port S1	On the controller's rotary switches	*To set the Port S1 address and baud rate* (page 16)
Port S2	Service Port	*To set the Port S2 address and baud rate* (page 16)

To access the controller setup through the **Service Port**:

1 Connect an Ethernet cable from a computer to the controller as shown below.



2 Turn off the computer's Wi-Fi if it is on.

3 If your computer uses a static IP address, use the following settings:

- Address: 169.254.1.x, where x is 2 to 7
- Subnet Mask: 255.255.255.248
- Default Gateway: 169.254.1.1

4 If it uses a DHCP address, leave the address as it is.

5 Open a web browser on the computer.

6 Navigate to http://local.access or http://169.254.1.1 to see the Service Port controller setup pages.

See *To set up the controller through the Service Port* (page 35) for general information on using the controller setup pages.

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Rotary switch settings

Rotary switch settings (see example below) are used to determine the following items in your system, so you should plan carefully before setting the switches.

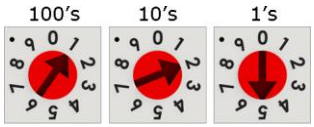
- If you use a **Default IP address**, the final octet is the number created by the three rotary switch settings (must be a unique number from 1 to 253). See *To set the IP address* (page 14).
- If you autogenerate the following:

  Device Instance, the number is automatically set to a number equal to the ((IP network number x 100) + rotary switch settings).

  BACnet Network Number for Port S1, the number is automatically set to a number equal to the ((IP network number + rotary switch settings) x 10).

  Autogenerating is set up through the *controller setup pages* (page 35).
- The rotary switch settings determine the router number in the i-Vu® interface.

EXAMPLE The switches below are set to 125.



CAUTION Do not leave the rotary switches set at 0 (the factory default). The TV-OPT cannot be discovered if the rotary switches are left at 0.

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To set up autobaud

The TV-OPT can automatically receive or establish the baud rate on a serial network. When you configure a device on the network for autobaud and then power it up, the device detects the incoming baud rate on the network and sets its baud to match.

Autobaud does not work unless there is a device on the network, whether Carrier or third party, that has the baud rate already set. You can manually set the baud rate on more than one device, as long as the rate is the same for every device.

NOTES

- The received baud rate stays intact during power cycles.
- We recommend you set the baud rate manually on the router for the network.

MS/TP

MSTP Autobaud can be configured in either the:

- **Service Port** controller setup pages > **BACnet** tab > **Port S1** or **Port S2**

  or

- The i-Vu® interface, right-click your TV-OPT on the navigation tree, and select **Driver Properties** > **BACnet Router Properties** > **MS/TP Configuration** on Port S1 or on Port S2. See *BACnet Router Properties* (page 30).

Modbus

Modbus Serial Autobaud can be configured in either the:

- **Service Port** controller setup pages > **Modbus** tab > **Modbus RS-485** > **Port Configuration**

  or

- The i-Vu® interface, right-click your TV-OPT on the navigation tree, and select to **Driver Properties** > **Communication Status** > **Modbus Serial**

NOTE See the *Modbus Integration Guide*.

NOTE If you set **Autobaud** or make other changes in the controller setup pages, you must upload the changes to the system database the first time you access the controller in the i-Vu® interface. This preserves those settings when you download memory or parameters to the controller.

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To set the IP address

You must define the TV-OPT's IP addressing (IP address, subnet mask, and default gateway) in the Service Port controller setup pages so that the controller can communicate with the i-Vu Server on the IP network.

Use one of the IP addressing schemes described below with the associated instructions that follow.

Use a...	If...
DHCP IP Address generated by a DHCP server	The IP network uses a DHCP server for IP addressing
Custom Static IP Address from your network administrator	You do not use a DHCP server and the answer to any of the following questions is yes. Will the i-Vu® system: • Share a facility's existing IP data network? • Have 254 or more devices with static IP addresses? • Be connected to the Internet? • Have at least one device located on the other side of an IP router? • Have any third-party IP devices?
Default IP Address that your system creates	The answer to all of the above questions is no.

NOTE Carefully plan your addressing scheme to avoid duplicating addresses. If third-party devices are integrated into the system, make sure your addresses do not conflict with their addresses.

To set a DHCP IP address

1. On the controller setup **Modstat** tab, find the controller's **Ethernet MAC address** and write it down.
2. On the **Ports** tab under **IP Port**, select **DHCP**.
3. Click **Save**.
4. Write down the **IP Address**.
5. Give the DHCP network administrator the IP address and Ethernet MAC address and ask him to reserve that IP address for the controller so that it always receives the same IP address from the DHCP server.

To set a custom IP address

1. Obtain the IP address, subnet mask, and default gateway address for the controller from the facility network administrator.
2. On the controller setup **Ports** tab under **IP Port**, select **Custom Static**.
3. Enter the **IP Address**, **Subnet Mask**, and **Default Gateway** addresses that the network administrator gave you.
4. Click **Save**.

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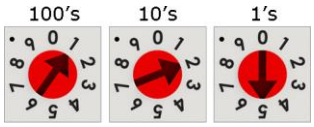
To set a default IP address

Default IP addressing assigns the following to the controller:

- IP address = 192.168.168.**x**
  where **x** is the setting on the rotary switches in the range from 1 to 253
- Subnet Mask = 255.255.255.0
- Default Gateway = 192.168.168.254

1 Set the controller's three rotary switches to a unique address on the network. Set the left rotary switch to the hundreds digit, the middle switch to the tens digit, and the right switch to the ones digit.
EXAMPLE The switches below are set to 125.



2 On the controller setup **Ports** tab under **IP Port**, select **Default IP Address**.

3 Click **Save**.

CAUTIONS

- The Default IP address range is 1 to 253. Setting the rotary switches to 0 will set the Default IP address to 1. Setting the switches to 255 will set the Default IP to 253. Do not set the switches to 254.
- If you set the Default IP address on the controller setup **Ports** tab and then change the rotary switches, you must do one of the following to correct the IP address in the controller:
  - Go to the controller setup **Ports** tab and click the **Update IP Address**.
  - Cycle the controller's power.

  You will then need to correct the IP address in the i-Vu® application using **Find Devices** and **Upload All Content**. See the i-Vu® Help for more information.

NOTE The default address is an intranet address. Data packets from this address are not routable to the Internet.

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To set the Port S1 address and baud rate

The address should be in one of the following ranges based on the port's use.

Port address

- For ARCNET, the range is 1 to 254.
- For MS/TP, the range is 0 to 127.
- For Modbus, the range is 1 to 247.

For MS/TP, set up autobaud or the port's baud rate

1 On the controller setup **BACnet** tab under **Port S1**, select the **MSTP Baud Rate** or select **Yes** for **MSTP Autobaud**. The default is 76,800 bps.

NOTES

- See *To set up autobaud* (page 13) for details.
- If not using autobaud, enter the identical baud rate for all devices on the same MS/TP network segment.

2 Click **Save**.

Modbus

For Modbus, see the *Modbus Integration Guide*.

To set the Port S2 address and baud rate

For MS/TP, set up autobaud or the port's baud rate

1 On the controller setup **BACnet** tab under **Port S2**, type the address in the **MSTP Address** field. The address must be in the range 0 to 127.

2 Select the **MSTP Baud Rate** or select **Yes** for **MSTP Autobaud**. The default is 76,800 bps.

NOTES

- See *To set up autobaud* (page 13) for details.
- If not using autobaud, enter the same baud rate for all devices on the MS/TP network.

3 Click **Save**.

Modbus

For Modbus, see the *Modbus Integration Guide*.

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Configuring BACnet Device Instance and network number

The TV-OPT controller must have a unique Device Instance and Name. These BACnet addresses are automatically generated and usually do not require modification. However, sometimes you need to override the automatic addressing assignments.

Autogenerated addressing scheme:

The TV-OPT's rotary address setting determines the automatic BACnet addressing scheme for the connected Open network.

Legend

16 = Carrier's BACnet Vendor ID
xxx = TV-OPT's rotary switch address (See NOTES below.)
yy = Controller's rotary switch address (ARCNET/MSTP MAC address)

For the TV-OPT:

- BACnet Device Instance Number = (IP network number x 100) + rotary switch address
- BACnet Device Instance Name = the name "device" + the Device Instance
- BACnet IP Network Number = 1600
- BACnet ARC/MSTP Port S1 Network Number = ((IP network number + rotary switch address) x 10)
- Port S1 MSTP MAC Address = 0 by default (user configurable)
- Port S1 ARCNET Address = 254 by default (user configurable)
- BACnet MSTP Port S2 Network Number = ((IP network number + rotary switch address) x 10) +3
- Port S2 MSTP MAC Address = 0 by default (user configurable)

For the Open controllers connected to the TV-OPT

- BACnet MSTP Device Instance Number = BACnet MSTP Network Number + yy
- BACnet ARCNET Device Instance Number = BACnet ARCNET Network Number +yy
- BACnet MSTP Device Instance Name = the name "device" + Device Instance
- BACnet ARCNET Device Instance Name = the name "device" + Device Instance
- BACnet MSTP or ARCNET MAC Address = yy
- BACnet MSTP Network Number = 161xx (learned from the router, defaults to 16101 if no TV-OPT is operating)

NOTES

- Do not configure the rotary switches on the TV-OPT to a number greater than 127 unless Port S1 is enabled for ARCNET. Doing so will not allow the i-Vu® server to discover the TV-OPT.
  If you change the TV-OPT's switches or jumpers, you must cycle its power for the changes to take effect.
- If the BACnet automatic settings need to be changed, see *To communicate through the Local Access port* (page 35).

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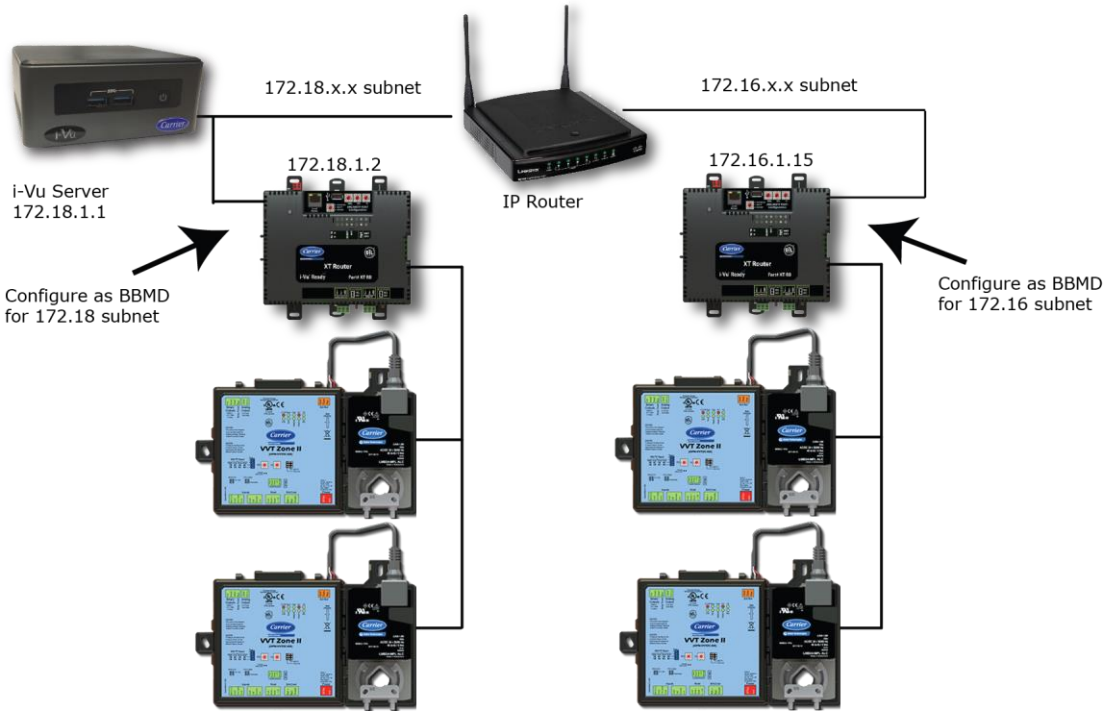
To set up BACnet Broadcast Management Devices (BBMDs)



If your system has multiple routers that reside on different IP subnets, you must set up one router on each IP subnet as a BACnet/IP Broadcast Management Device (BBMD).

Every subnet with a router must have a BBMD configured in order for broadcasts from routers on that subnet to reach the rest of the routers on the network.

NOTES

- The i-Vu® Standard or Plus application - If the i-Vu® web server is on a separate subnet than the rest of the routers, the internal router must be assigned a routable IP address and configured as a BBMD.
- The i-Vu® Pro application - If the i-Vu® Pro server is on a separate subnet than the rest of the routers, you must register it as a foreign device to a router acting as a BBMD device.

Use the **BBMD Configuration Tool** to:

- Write/read the **Broadcast Distribution Table** (BDT) of each BBMD device
- Allow controllers on one subnet to communicate with controllers on other subnets
- Enable the i-Vu® application to see, upload, or configure controllers on different subnets

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To set up BBMDs using the BBMD Configuration Tool

1 Assign an IP address, subnet mask, and default gateway for each TV-OPT on the IP network. See *Addressing the TV-OPT* (page 11).

2 Acquire the **BBMD Configuration Tool** from the Tech Tools USB drive or from either of the *Carrier Control Systems Support Sites http://www.hvacpartners.com/*. This is a stand-alone executable file and no installation is necessary.

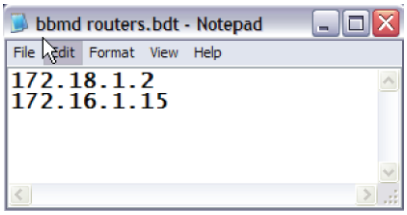
3 Make a list of the IP addresses for each router that will function as a BBMD in your system.

In the above illustration, the Carrier router, address 172.18.1.2, must be configured as a BBMD for the 172.18 subnet, while the Carrier router, address 172.16.1.15, must be configured as a BBMD for the 172.16 subnet.

CAUTIONS

- Define only one BBMD per subnet. Multiple BBMDs on an IP subnet disrupt network communications.
- Unless explicitly modified, the UDP Port for BACnet/IP is 0xBAC0 (47808). Do not change this parameter unless you made a change in the router.

4 In a text editor such as Notepad, create a list of the routers that will be BBMDs. List each IP address on a separate line. (Maximum of 50 IP addresses per file)



5 Save the file to your folder of choice with a .bdt, .bbmd, or .text extension instead of .txt.

6 Open the **BBMD Configuration Tool**.

7 In the **IP Address** or **Host Name** field, type the IP address of the router that functions as the BBMD (BACnet Broadcast Management Device) for its subnet.

8 To check if the router has an existing BBMD table, click the **Broadcast Distribution Table Read** button.

9 If the **Broadcast Distribution Table** contains IP addresses that are not in your file, verify that they are valid BBMDs and, if so, add them to your file.

NOTES

- The BDTs in each BBMD should be identical. Repeat this entire process whenever a BBMD is added.
- If needed, disable the checkbox next to **Show Broadcast** to limit the amount of scrolling text that is displayed.

10 Click the **Broadcast Distribution Table Browse** button and select the file that you made in step 4.

11 Verify that the appropriate IP address is still in the **IP Address** or **Host Name** field.

12 Click the **Broadcast Distribution Table Write** button.

13 Click **Read** again to verify that the new file was written to the router. See example below.

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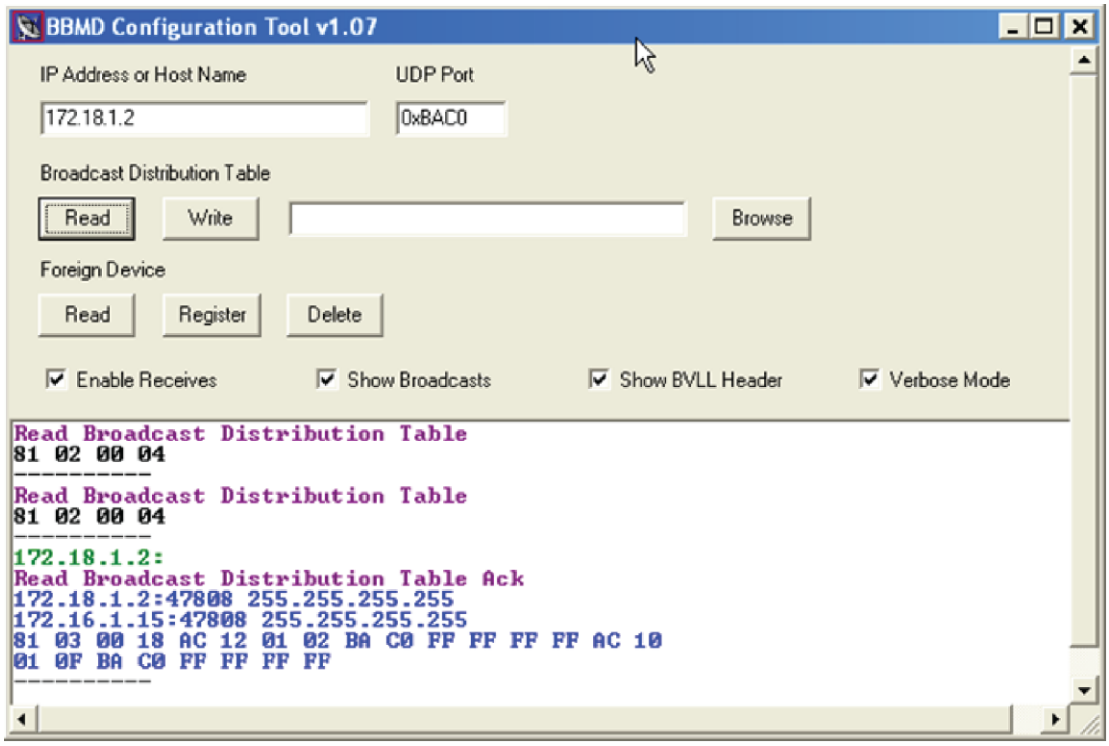
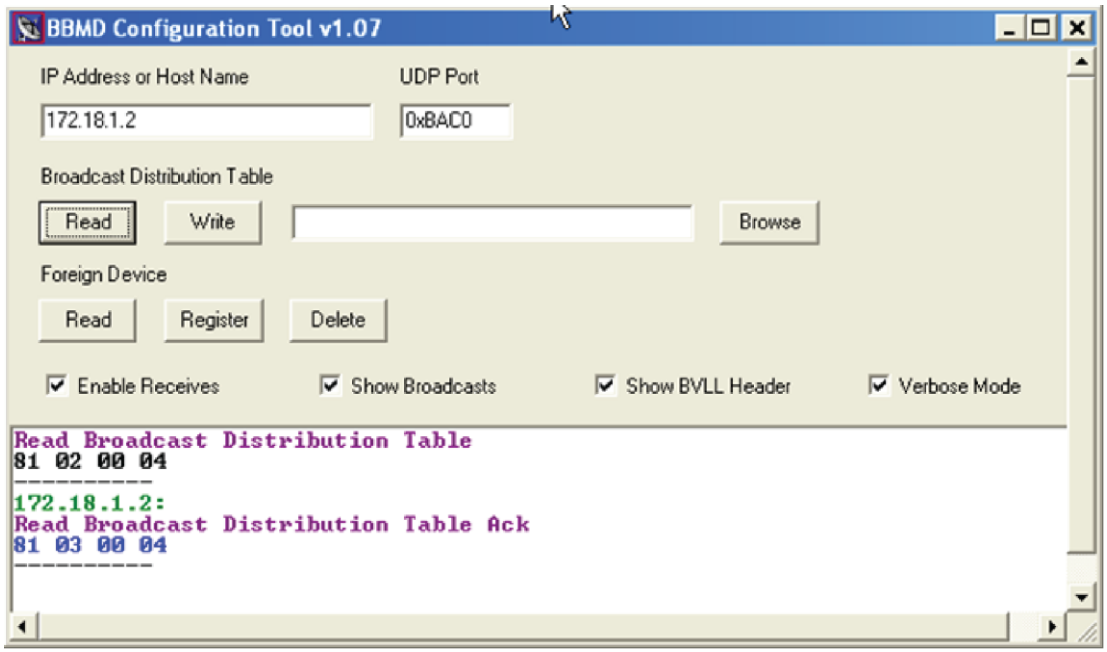
NOTE If you have a large BDT, you may have to re-size the **BBMD Configuration Tool** window to see the **Broadcast Distribution Table**.



14 Using the next IP address in the file, repeat steps 7 through 14 until every file has been updated.

NOTE To clear the BBMD entries from a router, follow the steps above using an empty (blank) file. A cleared BBMD table contains just the router's IP address without entries in the BBMD table, as shown below.



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Wiring for communications

The TV-OPT communicates on the following ports.

Port	Protocol	Port type(s)	Speed(s)
Gig-E	BACnet/IP, BACnet/Ethernet, and/or Modbus TCP/IP	Ethernet	10, 100, or 1000 Mbps (1 Gbps)
Port S1 [1]	BACnet/ARCNET	EIA-485	156 kbps
Port S1 [1] or **Port S2**	BACnet/MSTP Modbus Serial	EIA-485	9.6 to 115.2 kbps [2] 9.6 to 115.2 kbps [2]
Service Port [3]	HTTP/IP	Ethernet	10 Mbps 100 Mbps
USB Port	USB2.0	USB	

[1] Set the **Port S1 Configuration** rotary switch to:
0 if port is not used
1 for MS/TP
2 for ARCNET
3 for Modbus
4 is for future use

[2] Default for MS/TP is 76.8 kbps.
Default for Modbus is 38.4 kbps.

[3] See To set up the controller through the Service Port.

Wiring specifications

For...	Use...	Maximum Length
BACnet/IP Ethernet	Cat5e or higher Ethernet cable	328 feet (100 meters)
MS/TP* ARCNET*	22 AWG, low-capacitance, twisted, stranded, shielded copper wire *	2000 feet (610 meters)

* For details see the *Open Controller Network Wiring Guide*.

WARNING Do not apply line voltage (mains voltage) to the controller's ports and terminals.

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To connect the TV-OPT to the Ethernet

Connect an Ethernet cable to the Gig-E Ethernet port.

If your system has multiple routers that reside on different IP subnets, you must set up one router on each IP subnet as a BACnet/IP Broadcast Management Device (BBMD).

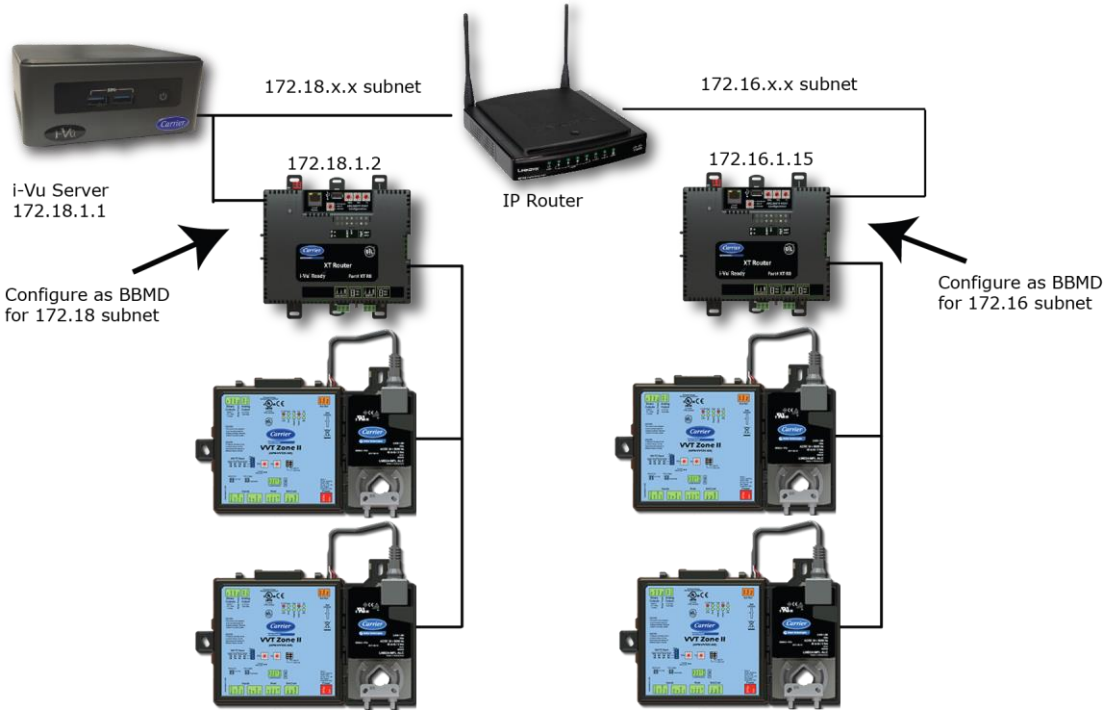
Every subnet with a router must have a BBMD configured in order for broadcasts from routers on that subnet to reach the rest of the routers on the network.

NOTES

- The i-Vu® Standard or Plus application - If the i-Vu® web server is on a separate subnet than the rest of the routers, the internal router must be assigned a routable IP address and configured as a BBMD.
- The i-Vu® Pro application - If the i-Vu® Pro server is on a separate subnet than the rest of the routers, you must register it as a foreign device to a router acting as a BBMD device.

Use the **BBMD Configuration Tool** to:

- Write/read the **Broadcast Distribution Table** (BDT) of each BBMD device
- Allow controllers on one subnet to communicate with controllers on other subnets
- Enable the i-Vu® application to see, upload, or configure controllers on different subnets



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To wire to a BACnet/ARCNET network

1. Turn **off** the TV-OPT's power.
2. Check the communications wiring for shorts and grounds.
3. Connect the communications wiring to **Port S1**'s screw terminals labeled **Net +**, **Net -**, and **Shield**.

   NOTE Use the same polarity throughout the network segment.
4. If the controller has a **Port S1 Configuration** rotary switch, set it to 2.
5. If the TV-OPT is at either end of a network segment, set the port's **End of Net** switch to **Yes**.

   NOTE The controller's **End of Net** switch applies network termination and bias. See the *Open Controller Network Wiring Guide.*
6. Turn on the controller's power.
7. To verify communication with the network, get a Module Status report in the i-Vu® interface for a controller on the ARCNET network.

   NOTE This step requires that you have discovered and uploaded the controller in the i-Vu® application.

To wire to a BACnet MS/TP network

An MS/TP network can be wired to either **Port S1** or **Port S2**.

1. Turn **on** the TV-OPT's power.
2. Check the communications wiring for shorts and grounds.
3. Connect the communications wiring to the **Port S1** or **Port S2** screw terminals labeled **Net +**, **Net -**, and **Shield**.

   NOTE Use the same polarity throughout the network segment.
4. If you are using **Port S1**, and the controller has a **Port S1 Configuration** rotary switch, set it to 1.

   NOTE If **Port S1** is not being used for any network, set this rotary switch to 0.
5. If the TV-OPT controller is at either end of a network segment, set the port's **End of Net?** switch to **Yes**.

   NOTE The controller's **End of Net** switch applies network termination and bias. See the *Open Controller Network Wiring Guide.*
6. Turn on the controller's power.
7. To verify communication with the network, get a Module Status report in the i-Vu® interface for a controller on the MS/TP network.

   NOTE This step requires that you have discovered and uploaded the controller in the i-Vu® application.

To wire a third-party device

BACnet: You can wire a third-party BACnet device to the TV-OPT's **Gig-E** port, **Port S1**, or **Port S2**. See the *BACnet Integration Guide* for the TV-OPT.

Modbus: You can wire a third-party Modbus TCP/IP device (client or server) to the TV-OPT's **Gig-E** port or a Modbus master or slave device to **Port S1** or **Port S2**. See *Modbus Integration Guide* for the TV-OPT.

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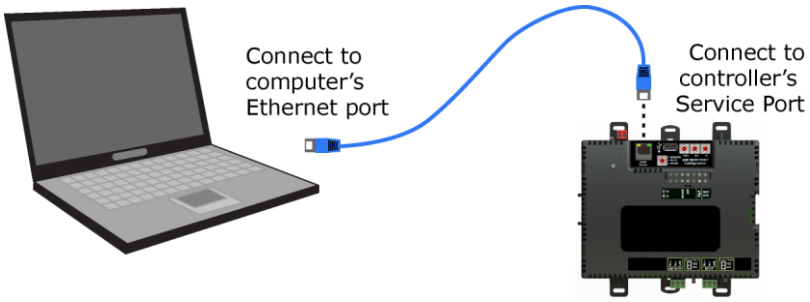
To communicate through the BACnet/IP Service Port network

You can connect to the Service Port to access your network through:

- Field Assistant
- The Carrier touchscreen device

1 Connect an Ethernet cable from a computer to the controller as shown below.



2 Turn off the computer's Wi-Fi if it is on.

3 Launch Field Assistant.

4 Select a **System Name.**

5 If you need to create a new **System Name**, click . Enter the **System Name**, then click **Create**. The **System Name** cannot:

- Begin with a number.
- Contain special characters other than a dash or an underscore.
- Exceed 40 characters.
- Contain capital letters or spaces. Use an underscore or dash between words.

6 Under **Communications**, select **BACnet/IP Service Port**.

7 Click to start your system. This opens a new browser window.

8 On the **Devices** page > **Manage** tab, click **Find Devices** to discover your routers.

9 Once routers are found, select one router at a time in the left-hand navigation tree and click **Upload**. Use **Ctrl+click**, **Shift+click**, or both to select multiple items.

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Find and upload in the i-Vu® interface

1. In the i-Vu® interface, select the System level in the navigation tree.
2. On the **Devices** page > **Manage** tab, click **Find Devices** to discover your routers and their drivers, graphics, and touch files.
3. Once routers are found, select one or more routers in the list on the **Manage** tab and click **Upload All Content** to upload to the i-Vu® application. Use **Ctrl+click**, **Shift+click**, or both to select multiple items.
4. Click **OK** when you see the message **This will upload all content for the controller. Are you sure you want to do this?**. When complete, a check mark under **Status** indicates a successful upload.

   NOTES

   - If an error message appears, click on the message to view an explanation.
   - For details, see the i-Vu® Help.

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Adjusting the TV-OPT driver properties

After you find and upload the TV-OPT in the i-Vu® interface, you may want to customize the TV-OPT's settings for your applications. You can change settings on the **Driver Properties** page.

1 In the i-Vu® interface, right-click the TV-OPT in the navigation tree and select **Driver Properties**.

2 Adjust the driver as desired.

Driver

The **Driver** page provides the following information plus the items described in the table below:

- The date/time of last parameter change or the last time the database was archived
- If control programs, properties, and schedules were successfully stored in memory
- Undelivered Alarm Status

TouchScreen Control	
TouchScreen Schedule Edit Enable	Check this field to allow a user to edit this controller's schedules from an Equipment Touch or System Touch Schedules screen. **NOTE** Schedules edited on an Equipment Touch or System Touch are not uploaded to the i-Vu® application. This could result in the controller operating on a schedule that differs from the one you see in the i-Vu® interface.
Controller Clock	
Clock Fail Date and Time	Date and time the controller uses when its real-time clock is invalid.
Time Synch Sensitivity (seconds)	When the controller receives a time sync request, if the difference between the controller's time and the time sync's time is greater than this field's value, the controller's time is immediately changed. If the difference is less than this field's value, the controller's time is slowly adjusted until the time is correct.
Network Microblocks	
BACnet third party integration points capacity, **integration points requested**, and **integration points active**	Shows how many third-party BACnet points the TV-OPT allows (capacity), how many points are in the control program (requested), and how many are currently active (not disabled in i-Vu®). For example, if the controller allows 400 points, the control program has 350 points, and you disabled 30 points in i-Vu®, you would see: Integration points capacity: 400 Integration points requested: 350 Integration points active: 320
Modbus integration points capacity and **integration points active**	Shows how many Modbus points the TV-OPT allows (capacity) and how many are currently active.
Number of poll retries before Network Input Microblocks indicate failure	The maximum number of retries after the initial attempt that a Network microblock will attempt to communicate with its target device. If unsuccessful, the point will transition to an idle state for 30 seconds before attempting to communicate again. Change this field only if directed by Technical Support.

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Periodic rebinding interval	If a microblock uses a wildcard in its address, this timer determines how often the microblock will attempt to find the nearest instance of its target. For example, if an outside air temperature address uses a wildcard, a VAV application will look for the outside air temperature on the same network segment or on the nearest device containing that object.
BACnet COV Throttling	
Enable COV Throttling	Under normal circumstances, COV Throttling should be enabled to prevent excessive network traffic if an object's COV Increment is set too low. See EXCEPTION below. When enabled, if an object generates excessive COV broadcasts (5 updates in 3 seconds), the driver automatically throttles the broadcasts to 1 per second. Also, if the object's value updates excessively for 30 seconds, an alarm is sent to the i-Vu® application listing all objects that are updating excessively. A Return-to-normal alarm is sent only after all objects have stopped updating excessively. EXCEPTION: In rare circumstances, such as process control, a subscribing object may require COV updates more frequently than once per second. For these situations, clear this checkbox, but make sure that your network can support the increased traffic. You will also need to disable the **Excessive COV** alarms under the driver's **Common Alarms**.
Trend Sampling	
Collect a daily midnight sample for all points in this controller that are sampling on COV	For values that change infrequently, select to verify at midnight daily that the point is still able to communicate trend values.
Local Network Configuration	
Allow Local Network Configuration from other devices on the local network for 24 hours	You can unlock a device for 24 hours to make IP address changes.
Locator LED	
Blink	Click the **Blink** button to prompt the Net and Sys LEDs to blink on a device, allowing you to verify the physical location.
Debug	
Enable Debug Messages	Enable only if directed by Carrier Controls System Support.

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Device

The **Device** page provides the following information plus the items described in the table below:

- BACnet device object properties for the TV-OPT
- The character sets supported by this device for BACnet communication

Configuration	
BACnet System Status	The current state of the controller: Operational Download in Progress Download Required Backup in Progress Non-Operational
The following fields refer to all networks over which the TV-OPT communicates.	
APDU Timeout	How many milliseconds the device will wait before resending a message if no response is received.
APDU Segment Timeout	How many milliseconds the device will wait before resending a message segment if no response is received.
Number of APDU Retries	The number of times the device will resend a message.
Controller Clock	
Time Broadcaster will synchronize time every ____	If you have third-party BACnet devices on one of the router's networks, you can have the router send a BACnet time sync to those devices at the interval you define in this field.
Time Synchronization Recipients	To define third-party BACnet devices as Time Synchronization Recipients: **1** Click **Add**. **2** Select **Device ID, Address**, **Local Broadcaster**, or **Global Broadcaster** in the **Recipient Type** field. **3** If you selected **Device ID** or **Address**, enter the information. **4** Click **Accept**.

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Notification Classes

A BACnet alarm's Notification Class defines:

- Alarm priority for Alarm, Fault, and Return to Normal states
- Options for BACnet alarm acknowledgment
- Where alarms should be sent (recipients)

Alarms in the i-Vu® application use Notification Class #1. The i-Vu® application is automatically a recipient of these alarms.

Priorities	**NOTE** BACnet defines the following Network message priorities for Alarms and Events.	
	Priority range	**Network message priority**
	00–63	Life Safety
	64–127	Critical Equipment
	128–191	Urgent
	192–255	Normal
Priority of Off-Normal	BACnet priority for Alarms.	
Priority of Fault	BACnet priority for Fault messages.	
Priority of Normal	BACnet priority for Return-to-normal messages.	
Ack Required for Off-Normal, Fault, and Normal	Specifies whether alarms associated with this Notification Class require a BACnet Acknowledgment for Off-Normal, Fault, or Normal alarms. **TIP** You can require operator acknowledgment for an Alarm or Return-to-normal message (stored in the i-Vu® database). In the i-Vu® interface on the **Alarm** > **Enable/Disable** tab, change the acknowledgment settings for an alarm source or an alarm category.	
Recipient List		
Recipients	The first row in this list is from the i-Vu® application. Do not delete this row. Click **Add** if you want other BACnet devices to receive alarms associated with this Notification Class. **NOTE** Additional entries in this table may be lost after a download.	
Recipient Description	Name that appears in the **Recipients** table.	
Recipient Type	Use **Address** (static binding) for either of the following: • Third-party BACnet device recipients that do not support dynamic binding • When you want alarms to be broadcast (you must uncheck **Issue Confirmed Notifications**). This use is rare.	
Days and times	The days and times during which the recipient will receive alarms.	
Recipient Device Object Identifier	Type the **Device Instance** from SiteBuilder (or from the network administrator for third-party devices) in the **#** field.	
Process Identifier	Change for third-party devices that use a BACnet Process Identifier other than 1. The i-Vu® application processes alarms for any 32-bit Process Identifier.	
Issue Confirmed Notifications	Select to have a device continue sending an alarm message until it receives delivery confirmation from the recipient.	
Transitions to Send	Uncheck the types of alarms you do not want the recipient to get.	

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Calendars

Calendars are provided in the driver for BACnet compatibility only. Instead, use the **Schedules** feature in the i-Vu® interface.

Common and Specific Alarms

On these pages, you can enable/disable, change BACnet alarm properties, or set delays for the following BACnet alarms:

Common alarms:

- All Programs Stopped
- Excessive COV
- Program Stopped
- Locked I/O
- Controller Halted
- Control Program
- Duplicate Address

Specific alarm:

- Dead Controller Timeout

NOTE To set up alarm actions for controller generated alarms, see *Setting up alarm actions* in the i-Vu® Help.

Controller Generated Alarm	
Description	Short message shown on the **Alarms** page or in an alarm action when this type of alarm is generated.
Events	
Alarm Category and Alarm Template	See *Setting up an alarm source in the i-Vu® interface* in i-Vu® Help.
Enable	Clear these checkboxes to disable Alarm or Return to normal messages of this type from the TV-OPT.
Notification Class	In a typical i-Vu® system, the Notification Class is 1; however, if needed, you can associate a different notification class with the alarm. See *Notification Classes* (page 29) to set up alarm delivery options for a specific Notification Class.

BACnet Router Properties

CAUTION Do not change the settings on this page as it will result in communication failure. Use *the controller setup pages* (page 35) to change settings and then resolve mismatches in the i-Vu® application.

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BACnet Firewall

If this IP controller is accessible from the Internet, you can increase security by enabling its BACnet firewall. When enabled, this feature prevents the controller from responding to BACnet messages from unidentified sources and allows communication only with IP addresses that you define. These can be all private IP addresses and/or a list of IP addresses. Follow the instructions in the i-Vu® interface to set up the BACnet firewall.

Network Diagnostics - Statistics

This page shows the network statistics for each of the TV-OPT's ports that are in use. This same information is provided in a *Module Status report* (page 42).

Click the **Error Rate Trend** or **Packet Rate Trend** link at the bottom of each section to see the statistics displayed as trend graphs. You can also access these trends by clicking on the driver in the network tree, and then selecting **Trends** > **Enabled Points** > and the desired trend graph.

Click a port's **Reset** button to set all of the numbers to zero so the counting can start over.

Router Statistics	
Error Counters	**Dropped Packets**—Data packets that could not be delivered. **Route Not Found**—Packets that could not be delivered because the requested network does not exist. **Route Unreachable**—These are routed packets whose destination network is either busy or offline.
Network Activity	Shows the number of incoming and outgoing unicast and broadcast packets for each of the TV-OPT's networks.
Router Sourced Packets	Shows the number of packets initiated by the TV-OPT that are not in response to a request from another device. The numbers in this table will also appear in the appropriate columns in the **Network Activity** tab.
Trends	**Error Rate Trend**—Shows the total number of errors within the trend sampling interval. **Packet Rate Trend**—Shows the total number of packets transmitted and received within the trend sampling interval.
Gig-E Port Statistics	
BACnet/IP Statistics	**BACnet/IP Rx Unicast Packets**—BACnet/IP packets received from a single BACnet device. **BACnet/IP Tx Unicast Packets**—BACnet/IP packets transmitted to a single BACnet device. **BACnet/IP Rx Broadcast Packets**—BACnet/IP broadcast packets received by the TV-OPT. **BACnet/IP Tx Broadcast Packets**—BACnet/IP broadcast packets transmitted by the TV-OPT. **Whitelist Rejections** (if *BACnet Firewall* (page 31) is enabled)—Messages blocked by the BACnet Firewall because the IP address that sent the message was not in the whitelist.

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Ethernet Statistics	**Ethernet Rx packets**—All packets (including non-BACnet packets such as a ping) received by the TV-OPT. **Ethernet Tx packets**—All packets (including non-BACnet packets such as a ping) transmitted by the TV-OPT. **Receive Errors (total)**—All errors related to received packets such as CRC errors, FIFO errors, frame errors, length errors, missed errors, and overrun errors. **Transmit Errors (total)**—All errors related to transmitted packets such as aborted errors, carrier errors, dropped errors, FIFO errors, heartbeat errors, and window errors. **Dropped Packets**—Packets dropped by the TV-OPT's Ethernet interface.
Trends	**Error Rate Trend**—Shows the total number of errors within the interval time. **Packet Rate Trend**—Shows the total number of packets transmitted and received within the trend sampling interval.

Network Diagnostics - Packet Capture

This page allows you to capture network communication on a port and then download the capture file for troubleshooting. Choose one of the following capture options:

- **Start/Stop** - Define the start and stop criteria, and then click **Start** and **Accept** to begin the capture. When the capture stops, the capture file is generated.
  NOTE If a Start/Stop capture is running on any other port, the **Get capture file** button will be disabled until all Start/Stop captures have completed.
  - **Start capture:** - When you check **At (mm/dd/yyyy hh:mm AM/PM)**, enter the time and date, and click **Start**, the packet capture begins at the date and time you specified.

    NOTE The hours field is validated from 0 to 12, and minute field is validated from 0 to 59.
  - **Continuous** - Click **Start** and **Accept** to begin the capture. Click **Save** to momentarily stop the capture and create the capture file. The capture will automatically resume. Click on the **Start/Stop** option to end the **Continuous** capture.
  - If the port is set up for MS/TP, select an option in the **Capture** section.

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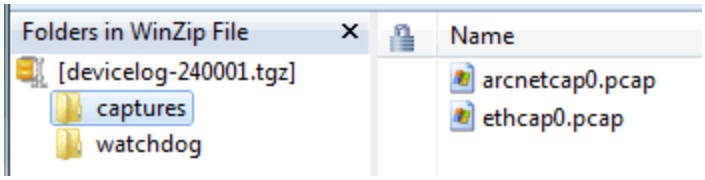
To download the capture file

Capture files are Wireshark files that are added to the Device Log Archive .tgz file. Do the following to view the files.

1. If you do not have Wireshark installed on your computer, download the latest version from the *Wireshark website* (*http://www.wireshark.org*).
2. Run the install program, accepting all defaults. Include WinPcap in the installation.
3. On the i-Vu® **Packet Capture** page, click **Get capture file** to download the .tgz file. The message appears "Retrieving the file, this may take a little while". Click **OK**.

   NOTE If the size of the .tgz is large, there could be a considerable delay (for example, over 2 minutes) after you click **Get capture file** until your browser begins the download.
4. Open the .tgz file. The files are in the **captures** folder.



   Capture file names are based on the ports.

   NOTE Clicking **Get capture file** generates the port's .pcap file. If the port has a .pcap file from a previous capture, that file will be overwritten.
5. Extract the .pcap file from the .tgz file.
6. Open the .pcap file in Wireshark.

Communication Status

The **Communication Status** page shows the status of the protocols currently running on the TV-OPT's ports.

Standalone Controller Detection

You can use the fields on this page with a binary input in your control program to detect when the controller does not receive a write request from the selected network within the specified amount of time. The input remains OFF as long as write requests are received, but switches to ON if the controller does not receive a request within the specified time. The binary input must have the Expander number and Input number set to **99** and the I/O Type set to **Special**.

Modbus Serial, Modbus TCP/IP, and Modbus Error Definitions pages

If the controller will be used with Modbus devices, see the *Modbus Integration Guide* for information on using these pages.

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To set up Network Statistic trends

PREREQUISITE To view Network Statistic trends, you must have a i-Vu® v6.5 or later system with the latest cumulative patch.

To view the *Network Statistics* (page 31) as trend graphs, select the controller in i-Vu®'s navigation tree and go to one of the following:

- On the **Driver Properties** > **Network Diagnostics** > **Statistics** page, click a **Trend** link at the bottom of each section.
- Click the **Trends** drop-down button, select **Enabled Points** and then the graph you want.

You can define:

- How the graph looks on the trend's **Configure** tab.
- How you want trend samples to be collected on the **Enable/Disable** tab. See table below.

Field	Notes
Sample every _:_:_ (hh:mm:ss)	(Recommended method) To record the value at a regular time interval, enter hh:mm:ss in this field.
Sample on COV (change of value)	To record the value only when the value changes by at least the amount of the **COV Increment**, set the **Sample every** field to 0:00:00 and enter a value in the **COV Increment** field.
Max samples	Network Statistic trends have a non-configurable maximum trend log buffer size of 1440. **NOTE** Trending consumes memory in the controller. Click **Reset** to delete all samples currently stored in the controller.
Stop When Full	Check this field to stop trend sampling when the maximum number of samples is reached.
Enable trend log at specific times only	Collects trend data for the specific period of time you define in the time and date fields.
Enable Trend Historian	Archives trend data to the system database.
Store Trends Now	Writes all trend data in the controller to the system database without having to enable trend historian.
Write to historian every __ trend samples	Writes all trend data in the controller to the system database each time the controller collects the number of samples that you enter in this field. This number must be greater than zero and less than the number entered in the Max samples field. The number of trends specified must be accumulated at least once before the historical trends can be viewed. **NOTE** Any trends not stored in the historian will be lost if the controller loses power.
Trend samples accumulated since last notification	Shows the number of samples stored in the controller since data was last written to the database.
Last Record Written to Historian	Shows the number of trend samples that were last written to the database.
Keep historical trends for __ days	This is based on the date that the sample was read. Select the first option to use the system default that is defined on the **System Options** > **System Settings** > **General** tab. Select the second option to set a value for this trend only.

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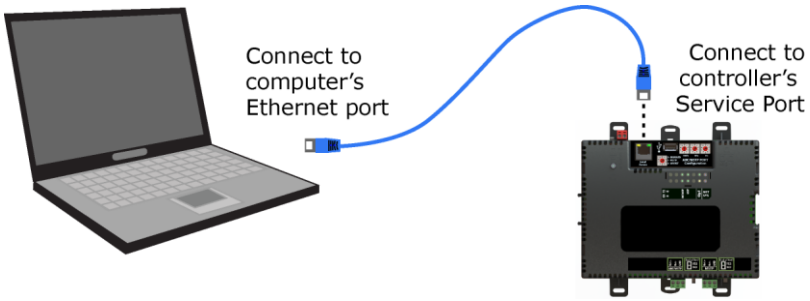
To set up the controller through the Service Port

Using a computer and an Ethernet cable, you can communicate with the TV-OPT through a web browser to:

- View the controller's Module Status report
- View/change controller and network settings. Changes take effect immediately.
- Troubleshoot
- Use BACnet/IP Service Port to access the i-Vu® application or a touchscreen device. See To communicate through the BACnet/IP Service Port network.

1 Connect an Ethernet cable from a computer to the controller as shown below.



2 Turn off the computer's Wi-Fi if it is on.

3 If your computer uses a static IP address, use the following settings:

- Address: 169.254.1.x, where x is 2 to 7
- Subnet Mask: 255.255.255.248
- Default Gateway: 169.254.1.1

4 If it uses a DHCP address, leave the address as it is.

5 Open a web browser on the computer.

6 Navigate to http://local.access or http://169.254.1.1 to see the Service Port controller setup pages.

NOTE The first time you access the controller in the i-Vu® interface after you have changed settings through the Service Port, be sure to upload the changes to the system database. This will preserve those settings when you download memory or parameters to the controller.

ModStat tab

This tab provides the controller's Module Status report that gives information about the controller and network communication status. See *Appendix - Module Status field descriptions* (page 64).

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Device tab

BACnet Object	
Device Instance	**Autogenerated**—(Default) The Device ID is automatically set to a number equal to the (IP network number) x 100 + rotary switch address. **Assigned**—Lets you enter a specific number that is unique on the BACnet network.
Device Name	**Autogenerated**—(Default) The Device Name is automatically set as the word device + the Device Instance. For example, device2423911. **Assigned**—Lets you enter a specific name that is unique on the BACnet network.
Device Location	You can enter an intuitive location for the device in the i-Vu® interface.
Device Description	You can enter an intuitive description for the device in the i-Vu® interface.
Configuration	
APDU Timeout	How many milliseconds the device will wait before resending a message if no response is received.
APDU Segment Timeout	How many milliseconds the device will wait before resending a message segment if no response is received.
APDU Retries	The number of times the device will resend a message.
Controller Information	
Clear Counts/Logs	Clears Reset counters and the three message history fields from the Module Status.
Data Backup and Restore	
Backup	Displays time of the last backup. Click button to backup the controller's control programs, properties, and schedules.
Restore	Displays time of the last restore. Click button to restore the most recent backup of the controller's control programs, properties, and schedules.
Network Factory Defaults	
Reset	Resets the controller to network factory default settings.

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Ports tab

IP Port	
IP Addressing	Select the type of addressing the controller is to use. See *Addressing the TV-OPT* (page 11).
Ethernet Port	
Address	A factory assigned Ethernet MAC Address for the **Gig-E** port.
Port S1	
End of Network	Indicates status of the controller's **End of Net?** switch.
Active Protocol	Indicates status of the controller's **Port S1 Configuration** rotary switch. 0=Disabled 1=MS/TP 2=ARCNET 3=Modbus
Port S2	
End of Network	Indicates status of the controller's **End of Net?** switch.
Protocol	Change active protocol, if needed.
Active Protocol	Indicates if Port S2 is enabled for Modbus.

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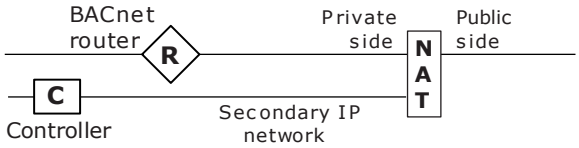
BACnet tab

IP Port	
BACnet Network Number	**Disable Routing**—Select if the IP port is not used. **Autogenerated**—The BACnet/IP network number is automatically set to 1600. **Assigned**—Lets you enter a specific number.
BACnet UDP Port	The port that the i-Vu® application will use for BACnet communication.
Enable NAT Routing	**For future use.** Check if the TV-OPT is behind a NAT router (firewall).
BACnet Secondary IP Net Number	If the TV-OPT has two BACnet/IP networks communicating on the Gig-E port, enter the second IP network number in this field. If the TV-OPT is behind a NAT router and there is a second network with BACnet/IP devices behind the NAT router, enter the second network number in this field to logically connect the TV-OPT to the devices on the second network. 
BACnet Secondary UDP Port	If the TV-OPT has two BACnet/IP networks communicating on the Gig-E port, enter the port number that the i-Vu® application will use for BACnet communication. This port must be different than the **BACnet UDP Port**.
Ethernet Port	
BACnet Network Number	Specify a number for the BACnet/Ethernet network or set to 0 if the port is not used.
Port S1	
Active Protocol	Indicates status of the controller's Port S1 rotary switch. 0=Disabled 1=MS/TP 2=ARCNET 3=Modbus
Port S2	
Active Protocol	Shows one of the following: • **Modbus** if enabled on the **Modbus** tab • **BACnet/MSTP** if you enter a **BACnet Network Number** below for an MS/TP network • **Disabled** if neither of the above have been done
Home Network	This is typically the network that is communicating with the building automation system's application. This sets the BACnet Address of the Device object.

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Modbus tab

If the controller will be used with Modbus devices, see the *Modbus Integration Guide* for information on using this tab.

Security tab

BACnet Firewall	If your BACnet Firewall configuration in the i-Vu® interface did not include the i-Vu® server IP address, thus blocking communication with the i-Vu® server, you can disable the controller's BACnet Firewall on the controller setup **Security** tab. **NOTE** You can enable the BACnet Firewall only in the i-Vu® interface.

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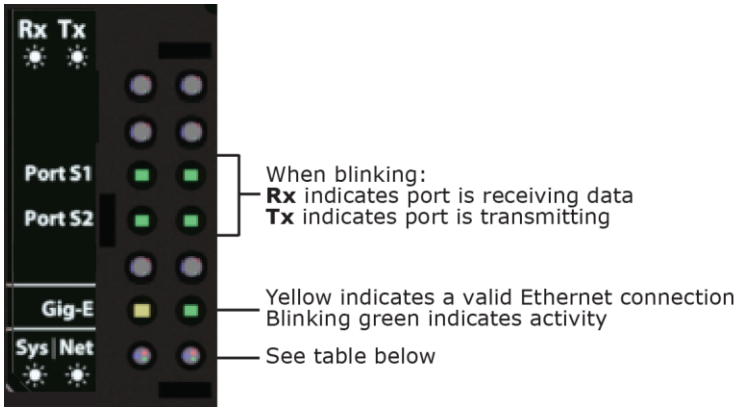
Troubleshooting

If you have problems mounting, wiring, or addressing the TV-OPT, contact Carrier Controls System Support.

LEDs



NET (Network Status) Tricolor LED

Color	Pattern	Condition	Message in Module Status	Possible Solutions
Red	On	Ethernet connection problem	No Ethernet Link	• Connect Ethernet Cable • Check other network components
Red	1 blink	One of the following BACnet/IP (Ethernet) DLL reporting issue: • Unable to create tasks • Unable to open socket for BACnet port	BACnet/IP error	Cycle power
Red	2 blink	Current default IP address does not match the current rotary switch setting	Default IP address mismatch	• Use the controller setup **Ports** tab to set the IP address • Cycle power to accept new IP address • Change rotary switches to match current default IP address

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NET (Network Status) Tricolor LED

Color	Pattern	Condition	Message in Module Status	Possible Solutions
Blue	On	One of the following issues: • Port communication firmware did not load properly • Port communication firmware is not running • Invalid protocol selected	ARCNET/MSTP firmware error	• Change rotary switch to select valid protocol • Cycle power
Blue	1 blink	Invalid address selected for protocol	Invalid address selection for ARCNET/MSTP	Change rotary switch to valid address
Blue	2 blink	Router has same MAC address as another connected device	Duplicate address on ARCNET/MSTP	Change rotary switch to unique address
Blue	3 blink	Router is the only device on the network	No other devices detected on ARCNET/MSTP	• Check that network cable is connected properly • Check that baud rate is correct
Blue	4 blink	Excessive errors detected over 3 second period	Excessive communication errors on ARCNET/MSTP	• Check that network cable is connected properly • Check that baud rate is correct
Blue	5 blink	ARCNET traffic overload possibly due to circular router or excessive COVs (change of values)	Event System Error - FPGA RX FIFO full	• Check the network configuration for a circular route • Increase the time between COVs to reduce excessive COV traffic
Green	On	All enabled networks are functioning properly	No errors	No action required

SYS (System Status) Tricolor LED

Color	Pattern	Condition	Message in Module Status	Possible Solution
Red	2 blink	Restarting after an abnormal exit	Auto restart delay due to system error on startup	After 5 minute delay has expired, if condition occurs again then cycle power
Red	4 blink	Firmware image is corrupt	Firmware error	Download driver again
Red	Fast blink	Firmware error has caused the firmware to exit and restart	Fatal error detected	No action required
Green	1 blink	No errors	Operational	No action required
Green	2 blink	Download of driver is in progress	Download in progress	No action required

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SYS (System Status) Tricolor LED

Color	Pattern	Condition	Message in Module Status	Possible Solution
Green	3 blink	BACnet Device ID is not set	Download required	Download the controller
Green	Fast blink	Installation of recently downloaded driver is occurring	N/A	No action required
Blue	On	Router is starting up	N/A	No action required
Blue	Slow blink	Linux (operating system) is starting up	N/A	No action required
Blue	Fast blink	Linux is running but it could not start the firmware application	N/A	Download driver

To get a Module Status report

A Module Status report provides information about the controller and verifies proper network communication with the controller. You can get this report:

- In the i-Vu® application—Right-click the controller on the navigation tree, then select **Module Status**.
- In the Field Assistant application—Right-click the controller in the navigation tree and select **Module Status**.
- On the controller setup **ModStat** tab—See *To set up the controller through the Service Port* (page 35).

See Module Status field descriptions in the Appendix.

To get a Device Log

If Carrier Controls System Support instructs you to get the controller's Device Log containing diagnostic information for troubleshooting:

1 Select the TV-OPT in the i-Vu® navigation tree.

2 On the **Properties** page, click **Device Log**.

NOTE You can click **Device Log Archive** to download a file containing multiple Device Logs to your computer. This also contains any network packet captures that have been run from the *Network Diagnostics - Packet Captures* (page 32) driver page.

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To get the TV-OPT's serial number

If you need the controller's serial number when troubleshooting, the number is on:

- A Module Status report (Modstat).
- A laser-etched number and QR code on the circuit board inside the controller.
- Some controllers have a sticker on the front with the serial number, MAC address, and a QR code.

See *To get a Module Status report* (page 42).

To replace the TV-OPT's fuse

If you turn on the controller's power switch and the LED is not lit, the fuse that protects the controller may be blown. Remove the fuse and use a multimeter to check it.

The fuse is a fast acting, 250Vac, 2A, 5mm x 20mm glass fuse that you can purchase from one of the following vendors:

Manufacturer	Mfr. Model #
Littelfuse	0217002.HXP
Bussmann	S500-2-R
Belfuse	5SF 2-R
Optifuse	FSD-2A

Before replacing the fuse, try to determine why the fuse blew. Check the power wiring polarity of the TV-OPT and any other devices that share the power supply. Use the same polarity for all of them.

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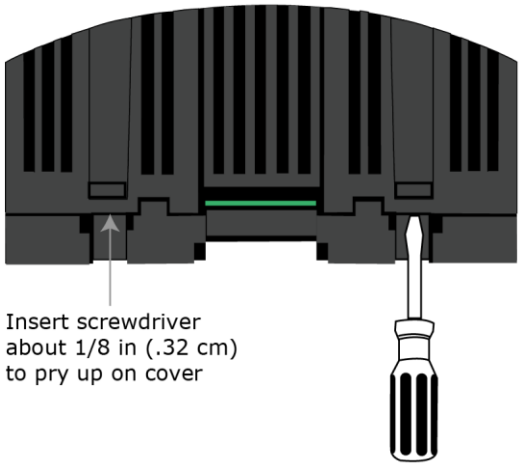
To replace the fuse:

1 Turn off the controller's power.

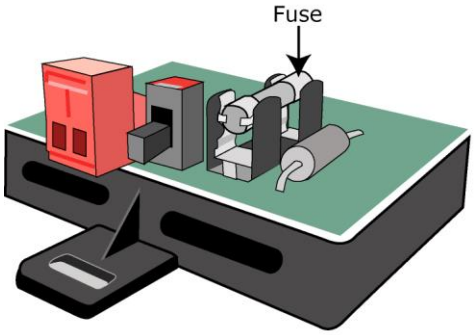
2 Remove the red power connector.

3 On both ends of the controller, insert a small flathead screwdriver as shown below, and then gently pry up the cover until it is released from the base.



4 Remove the cover from the base.

5 The fuse labeled **F1** is located near the power connector. Use a fuse puller to remove the fuse.



6 Use the fuse puller to snap the new fuse into the fuse holder.

7 Replace the controller's cover.

8 Replace the power connector.

9 Turn on the controller's power switch.

10 Verify that the ⏻ LED on top of the controller is on.

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To take the TV-OPT out of service

If needed for troubleshooting or start-up, you can prevent the i-Vu® application from communicating with the TV-OPT by shutting down communication from the TV-OPT to the i-Vu® application. When **Out of Service**, i-Vu® no longer communicates properties, colors, trends, etc.

1 On the i-Vu® navigation tree, select the TV-OPT.

2 On the **Properties** page, check **Out of Service**.

3 Click **Accept**.

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Start-up and Commissioning

The chilled water system optimization program gathers input values over the network, applies logic, and then outputs a chilled water temperature setpoint and a condenser water temperature setpoint. The new setpoints are designed to lower the chiller lift to save energy, while balancing it with increased energy consumed by the pumps and tower fans.

NOTE The program does not support any hardware points.

Network Points

Network Inputs

On the **Properties** page > **Network Points** tab:

- Verify that all input connections are linked, valid, and error-free.
- Set all remote inputs as **Network Visible**.
- Set all network input refresh times to low polling rates or to COV (change of value). If the response times are too slow, the program may lag in its calculations.
- We recommend you use kW instead of amperage whenever possible. If the equipment power is in amperage, use the appropriate formula based on voltage, phase, and power factor inputs.
- The links to each **Chiller ON** BNI2 should indicate the actual chiller run status, from either the chiller manager (if using the Carrier® ChillerVu™ controller) or the incumbent chiller control program (if in a third-party environment), to determine when the chiller is actually running.

Control Output – Chilled Water Supply Setpoint Value

- Link the Analog Network Input in the chiller program to the BACnet Analog Value Status in the optimization program.

  NOTE The chilled water supply setpoint signal is read and used by the chiller program. The Chilled Water Setpoint Value in the optimization program is exposed as a BACnet Analog Value Status.

- The chiller program, which is located in a separate controller, must retrieve the **Chilled Water Supply Setpoint Value** information. The program managing the chiller operation must verify the accuracy and integrity of the received chilled water supply setpoint value.
- Each chiller must have setpoint adjustment available, enabled, and working on each chiller.
- Obtain an approximation of the setpoint adjust response time by locking the optimization chilled water setpoint signal **Optimized Chilled Water Supply Setpoint AV**, under Chilled Water Temperature Optimizer Reset to a 40 to 50°F reset value, and then verify response in the chiller manager program and each controlled chiller.
- Each operating chiller should recognize the signal and respond to find the new setpoint.
- You may need to tune the chiller program properties and chiller setpoint ramp rates to get proper response.

  NOTE It is important that the chilled water setpoint be reset predictably and quickly enough for the optimizer to work reliably. Good response is essential and the actual response is subject to the system limits.

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Control Output – Condenser Water Supply Setpoint Signal

- Link the Analog Network Input in the tower program to the BACnet Analog Value Status in the optimization program.

  NOTE This is the condenser water supply setpoint signal that is read by the cooling tower program. The condenser water setpoint is exposed as a BACnet Analog Value Status.

- The tower program, in a separate controller, must retrieve the condenser water setpoint information. Verify accuracy of the condenser water setpoint signal.
- Obtain an approximation of the response time by locking the condenser water setpoint signal. See **Optimized Condenser Water Supply Setpoint AV (wetb + approach)**, under *Condenser Water Temperature Optimizer Reset* (page 101) to set a condenser water setpoint value, and then verify response in the tower manager program.
- You may need to tune PID properties and tower ramp rates.

  NOTE It is important that the condenser water setpoint be reset predictably and quickly enough for the optimizer to work reliably. Good response is essential, though the actual response is still subject to the system and engineering judgment.

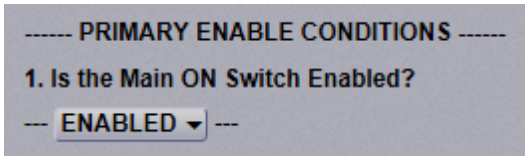
General conditions and status

After you complete network point checkout, run a sequence checkout. The chiller plant must be on and running in mechanical mode. The chillers and chilled water pumps must be running in order to check out the chilled water optimization program.

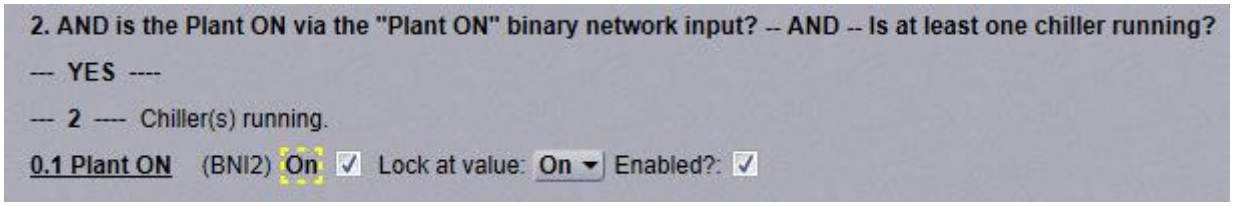
After they have been running for a sufficient time to stabilize, expand **Properties** > **General Conditions & Status** and verify the following:

Section 1 - Optimizer – Primary Enable Conditions (page 78)

1 **Is the Main ON Switch Enabled?**



2 **Plant is ON** when the **0.1 Plant ON** binary network input is **On**, indicating chiller plant is running normally and the number of operating chillers is correctly detected.



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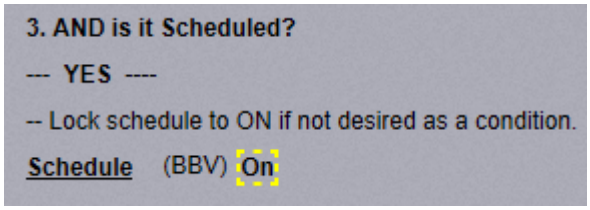
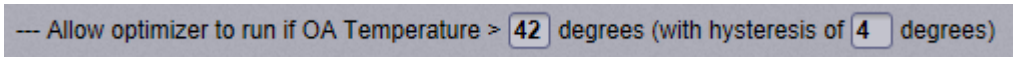
3 Optimization program is either scheduled or the **Schedule** present value is locked to **On**.

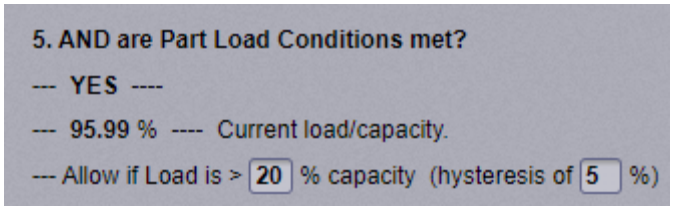


NOTE In order to lock the Schedule microblock from the **Properties** page, you must select **Show Service Config** view.

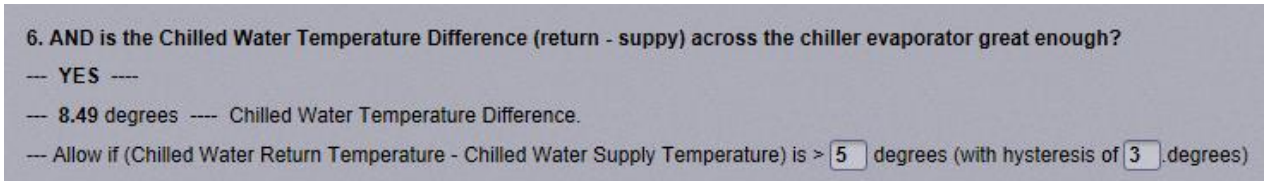
4 Verify the outdoor air conditions are met. OAT must be greater than the configured value.



5 The part load conditions are met.



6 The current chilled water delta temperature is greater than the configured limit.



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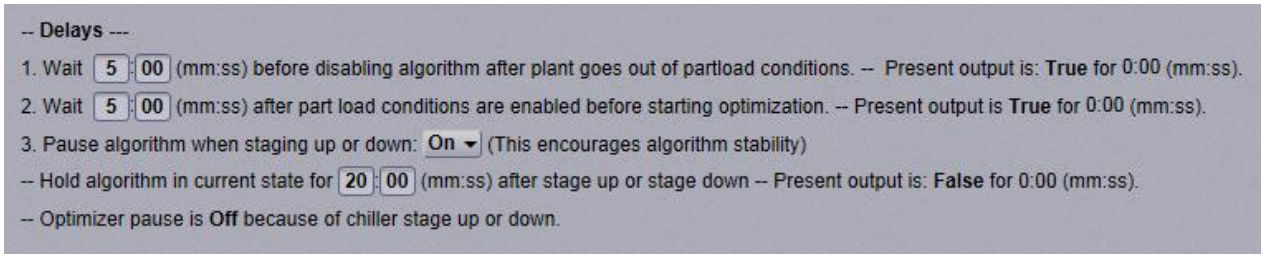
7 Verify all delays are sufficient.



NOTE We highly recommended that you set **Pause algorithm when staging up or down** to **On** when the plant has multiple chillers. We recommend you initially set the **Hold algorithm** delay time to between 15 and 20 minutes. Adjust as required. Delay time should allow enough time for the plant to stabilize after a chiller is started or stopped.

CAUTION Even though the plant is now ready to be enabled, do **not** enable it yet.

Section 2 - Chiller System Power, Efficiency, and Thermal Load Input and Status (page 81)

- Verify all the power inputs are displaying proper values for all available devices - chiller(s), pump(s) and AHU fan(s).
- Verify all running chiller(s) are showing the appropriate statuses (Off/On).

Section 3 - Stagger Reset – Enable Conditions (page 84)

Verify **Lead / Lag - Stagger routine for optimization is: Off**.

NOTE Stagger reset should only be **On** after both the **Chilled Water Optimizer Reset** and the **Condenser Water Optimizer Reset** are commissioned and enabled.

Section 4 – Optimizer Setpoint Change Mode (page 85)

- Select **Optimizer is in: AUTOMATIC mode** to enable automatic setpoint change.
- Select **Optimizer is in: MANUAL mode** to enable only manual setpoint change.

  NOTE Use **MANUAL** mode with caution and only if you thoroughly understand its operation.

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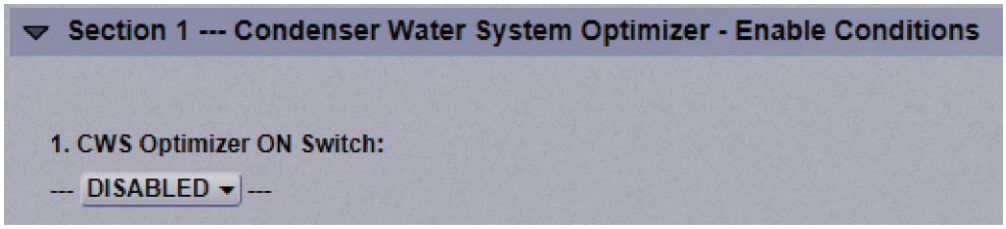
Chilled water temperature optimizer reset

After you have completed the sequence specified in the General Conditions and Status section, then commission the *Chilled Water Temperature Optimizer Reset* (page 87).

1 Before commissioning the **Chilled Water Temperature Optimizer Reset**, verify that **Condenser Water Temperature Optimizer Reset** > **Section 1 - Condenser Water System Optimizer - Enable Conditions** > **CWS Optimizer ON Switch** (page 78) is set to **DISABLED**.



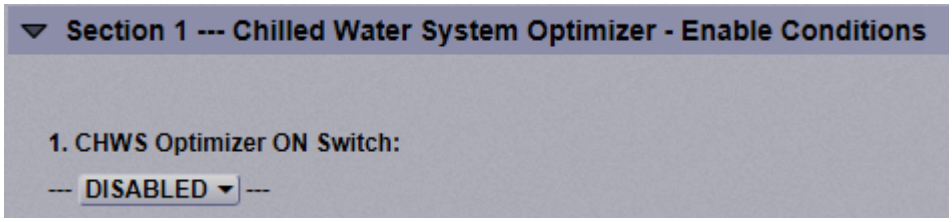
2 Verify the condenser water temperature setpoint is held constant.

Sequence

Expand **Chilled Water Temperature Optimizer Reset** for the following:

Section 1 - Chilled Water System Optimizer – Enable Conditions (page 88)

Verify **CHWS Optimizer ON Switch** is set to **DISABLED**.



Section 2 - Automatic Overrides of Chilled Water Reset (page 89)

Verify the following:

1 **Automatic "Pause & Hold"** override conditions have been set appropriately to match the system's operating requirements.

2 The pause status displays: **Pause & Hold is: OFF**. If it is on, then determine which condition is causing it to display **ON** and correct as necessary.

3 **Automatic "Quick Cool Down"** conditions have been set appropriately to match the system's operating requirements. We suggest you utilize the default values initially unless changes are required.

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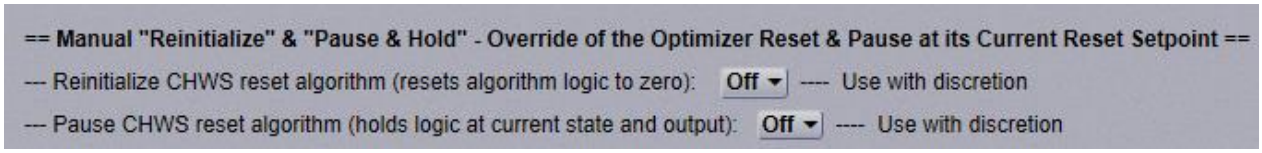
4 The cool down status displays **Quick Cool Down is: OFF**. If it is on, then determine which condition is causing it to display **ON** and correct as necessary.

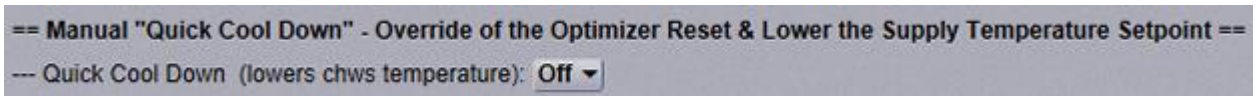
Section 3 - Manual Overrides of Chilled Water Reset – and other Settings

Verify the following:

1 **Manual** "**Reinitialize" & "Pause & Hold"** are both **Off**.



2 **Quick Cool Down:** is **Off**.



3 **Quick Cool Down incremental drop: __**(deg) is the value used for each interval when quick cool down is required. Use the default value initially and adjust as required.

4 Initially use the default value 1.25 (deg) for the **First Reset**. Adjust after observing the response. This value should be between 0.7 and 2.0 (deg).

5 Input Smoothing is reasonable

NOTE You should start with the default of 50 and then fine tune it according to your system after it has been running for a while.

6 **System Response Time in minutes** is set to the default initial response time of 15 minutes.

NOTE Start with 10 / 15 minute value for a small / medium commercial building.

7 Set **Minimum and Maximum Reset Increments & Algorithm Reset Gains**, starting with:

- Minimum Reset = 1 (deg)
- Maximum Reset = 2 (deg)
- Reset Increment Coarse Gain = 5
- Reset Increment Fine Gain = 0

NOTE Adjust if required.

8 **Bias for reset of CHWS temperature setpoint for warmer temperatures** are off at this time.

9 **Reset Output** is setup for the actual setpoint range of the desired chilled water supply temperature. Use the default range of 42 degrees to 52 degrees as a start, or fine tune to your system requirements.

10 Select **NO** for the **Current Setpoint Input** > **Use the chilled water supply temperature (CURR STPT IN) as the optimizer starting setpoint?**.

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Chilled water optimizer reset - Start-up

After you have completed the check out and verification of both the **General Conditions & Status** and the **Chilled Water Temperature Optimizer Reset**, enable the optimizer.

To Start & Run the Optimizer

General Conditions & Status > **Section 1 - Optimizer – Primary Enable Conditions** (page 78)

1 All the enable conditions must be **On**.

2 Set the **Main ON Switch** to **ENABLED**.

NOTE This switch ONLY enables the program, but not the individual reset functions. Continue below to enable the chilled water reset function.

Chilled Water Temperature Optimizer Reset > **Section 1- Chilled Water System Optimizer – Enable Conditions** (page 81)

Set the **CHWS Optimizer ON Switch** to **ENABLED**.

NOTES

- This switch enables the chilled water reset portion of the program.
- You can observe the changing supply water temperature setpoint as the program searches for a lower energy consumption point.

Chilled Water Temperature Optimizer Reset > **Section 3 - Manual Overrides of Chilled Water Reset - and other Settings**

1 First response period — first reset
   - After one response period, the temperature is raised by the amount specified in **First Reset**.
   - The program waits for the second response period. During the second response, the program measures whether the first reset reduced the power consumption.

2 Second response period — second reset
   - After the second response period, the program resets the temperature again by a calculated amount.
   - If the first reset lowered power demand, then the program recognizes it is resetting in the correct direction. Since the first reset raised the supply temperature, then the second reset will again raise the chilled water supply temperature.
   - If the first reset increased power demand, then the program recognizes it is resetting in the wrong direction. Since the first reset raises the supply temperature, then the second reset lowers the chilled water supply temperature.

3 Third and successive responses — The program will repeat the above process and continue to reset the chilled water supply temperature by a new calculated amount. The program continually searches for the chilled water supply temperature that maximizes energy savings at the chiller with any increased energy use at the pumps and fans.

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Chilled water optimizer reset - Tuning

One of the most important settings in the program is the time it takes for the chilled water system to respond after the optimization program resets the chilled water supply temperature setpoint.

The program needs to recognize if the system is using less energy after the setpoint has changed. The response time is the period that it takes the system to achieve and stabilize at a new setpoint and allow enough time for the total system power to stabilize at its new demand level.

Adequate response depends on each reset increment being large enough for the chilled water system to react. The system may not recognize increments that are too small. To make the increment large enough, start the minimum increment between 1° to 1.5°F and the maximum increment at least 1°F above that.

It is difficult to approximate the response time. If the response time is too small, the optimization program does not get an accurate measurement of the new energy use because the demand is still changing.

NOTE It is always better to be high rather than low when setting the response time.

You can trend various points (i.e., chiller leaving supply temperature, pump speeds, chilled water valve positions) to get a better estimate of the response time.

NOTE The nominal response time is between 15 and 20 minutes. For smaller water loops in small or medium-sized commercial buildings, it may be lowered, but only after the timing is verified. Otherwise, unstable operation may occur.

You can get an approximation of the response time by locking the chilled water reset signal in **Chilled Water Temperature Optimizer Reset** (page 87) > **Optimized Chilled Water Supply Setpoint AV** to a value between 40 and 50°F and 3°F higher than the current value, then verifying response in the chiller manager program. The response time will be larger than the time it takes to achieve the temperature rise of 3°F. It includes the total time it takes for everything below to occur:

- The time it takes for the chilled water supply temperature to reach the new temperature
- The time it takes after the water temperature has stabilized for the air handling unit valves to open or close, based on new chilled water temperature
- The pumps have reached their new speed in response to valves opening
- The air handler supply air temperature has risen or dropped (if applicable)

All the changes in consumption (kW) above result from the chilled water setpoint change. The effect of this change must propagate through all the devices in the system until it is stable. You may need to tune some chiller programs or properties to get a proper response. It is important that the chilled water setpoint be reset predictably and quickly enough for the optimization program to work reliably. Good response is essential and the actual response time depends on the system.

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Make adjustments

Section 3 - Manual Overrides of Chilled Water Reset - and other Settings > **Minimum & Maximum Reset Increments & Algorithm Reset Gains**

After the program has been running awhile, adjust the **Minimum Reset Increment** and **Maximum Reset Increment** as shown below, if necessary.

- **Minimum Reset Increment**
  - If the chilled water system is not responding to each supply temperature increment, it could be the minimum reset increment is too small. If so, increase it by 0.5 (deg) above its current value.
  - If the system is still not responding to each temperature increment, increase it by another 0.5 (deg).

    NOTE Setting the minimum reset increment to more than 1.75 (deg) may cause overshoot. Set the minimum to match your system and chiller type, as some chillers require a larger minimum increment.
- **Maximum Reset Increment**
  - If the chilled water system is responding too much for each supply temperature increment, the maximum reset increment is too high. Decrease it by 0.5 (deg) below its current property value.
  - If the system is still responding too much for each temperature increment, decrease it by another 0.5 (deg). It is preferable to have the **Maximum Reset Increment** at least 1.5 (deg) above the **Minimum Reset Increment**.

Reset Gain

Reset Gain and the **Minimum and Maximum Reset Increments** are interdependent and you might need to adjust both more than once. The reset gain determines the reset increment and the chilled water supply temperature.

After the program has been running a while and if each increment is often at either the minimum or maximum, then you can adjust the Reset Gain.

- Each reset increment should fall **between** the minimum and maximum limits
- The reset increment frequently increases over a response period, which is normal
- If most often at the **Minimum Reset Increment**, then raise the reset gain
- If most often at the **Maximum Reset Increment**, then lower the reset gain

Optional - Bias for warmer Chilled Water Supply Temperatures

After the program has been running a while, the chilled water temperature could be running cooler than expected. This could be any one of the following reasons:

- It is the best temperature for optimum energy use
- The system power, flows, or tonnage inputs are turbulent and fluctuate irregularly
- There is a piping or design issue
- The program calculations could be misconfigured

NOTE Smoothing can help address the problem caused by turbulence or fluctuations in measurements.

If you are concerned about cooler temperatures:

- Add smoothing and give a bias toward warmer supply temperatures and energy savings at the chiller(s) by turning each Bias switch to On.
- Fine tune the Bias, for lower energy savings at the chiller versus lower "system wide" energy savings.

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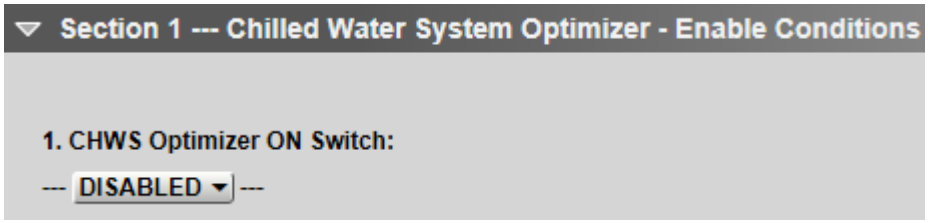
Condenser water optimizer reset

Before starting this section, you must have already completed the sequence specified in General conditions and status and completed the Chilled water optimizer reset.

Before commissioning the **Condenser Water Temperature Optimizer Reset**, verify the **Chilled Water Temperature Optimizer Reset** > **Section 1. Chilled Water System Optimizer - Enable Conditions** (page 88) > **CHWS Optimizer ON Switch** is set to **DISABLED**.

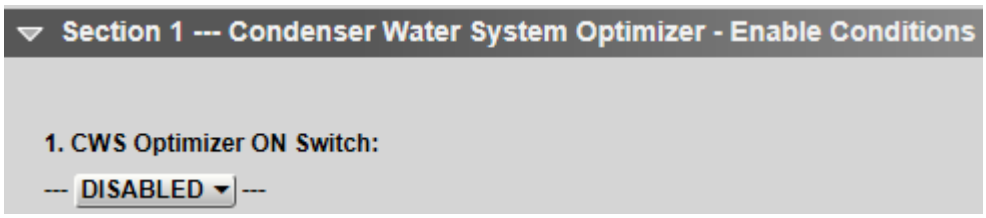


Sequence

Expand **Condenser Water Temperature Optimizer Reset** for the following:

Section 1 - Condenser Water System Optimizer – Enable Conditions (page 103)

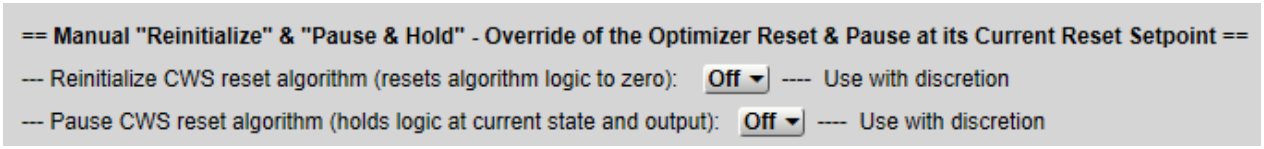
Verify **CWS Optimizer ON Switch** is set to to **DISABLED.**



Section 2 - Manual Overrides of Condenser Water Reset (page 104)

Verify the following:

1 **Manual "Reinitialize" & "Pause & Hold"** are both **Off**.



2 **Manual "Quick Warm Up"** conditions have been set appropriately to match the system's operating requirements. We recommend that you use the default values initially unless changes are required.

3 The quick warm up status displays **Quick Warm Up is: OFF**. If it is on, then determine which condition is causing it to display ON and correct as necessary.

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4 Configure the **First Reset** by initially using the default value of 6 (deg). Adjust after observing the response.

NOTE This value should be between 4.0 and 8.0 (deg).

EXAMPLE Your default **Resting** temperature (**Condenser Water Optimizer Operation Overview - Notes** > **Condenser Water Supply Setpoint Range - Based on OA Wet Bulb Temperature** (the condenser water supply temperature setpoint when the optimizer is off) is set to 8 degrees above wet bulb. Your **First Reset** priming temperature might be 7 degrees above wet bulb. This first reset would lower the condenser water supply temperature by 1 degree (from 8 degrees to 7 degrees above wet bulb). This would result in the fans running slightly faster (increasing energy use at the fans) and lowering the lift slightly at the chiller (reducing energy demand at the chiller). This **First Reset** starts the optimization program in its search for lower energy use and balancing lower energy demand at the chiller with higher energy demand at the tower fans (and any variable flow pumps).

5 Initially start with a default Input Smoothing value of 50 and then fine tune it according to your system.

6 **System Response Time in minutes:** is set to the initial response time.

NOTE Start with 5 minutes for a facility where the cooling towers are near the chiller, and 8 to 10 minutes for a facility where they are remote.

7 Set **Minimum and Maximum Reset Increments & Program Reset Gains**:, starting with:

- Minimum Reset = 1 (deg)
- Maximum Reset = 2 (deg)
- Reset Increment Gain = 5
- Reset Increment Fine Gain = 0

NOTE You may need to change these later.

8 Ensure your **Bias for reset of CWS temperature setpoint for cooler temperatures** are off at this time. You can always turn them on later.

Section 3 - Condenser Water Setpoint Reset – Output & Limit Settings (page 104)

1 Configure the **Condenser Water Supply Setpoint Range – Based on OA Wet Bulb Temperature**, starting with:

- **Maximum: Wet Bulb Approach:** 11 degrees — Setpoint at lowest reset (warmest condenser water temperature) when the tower fans run the slowest.
- **Resting: Wet Bulb Approach:** 8 degrees — Setpoint when the optimizer is off.
- **Minimum Wet Bulb Approach:** 5 degrees — Setpoint at highest reset (coolest condenser water temperature) when the tower fans are running faster.

NOTE You may need to change these later.

- Configure the **Condenser Water Supply Temperature – High Limits** appropriate for your chiller. You may need to adjust the defaults .
- Configure the **Condenser Water Supply Temperature – Low Limits** appropriate for your chiller. You may need to adjust the defaults .

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Condenser water optimizer reset - Start-up

After you have completed the check out and verification of both **General Conditions and Status** and **Condenser Water Temperature Optimizer Reset**, enable the optimizer.

To start and run the TruVu™ Chilled Water System Optimizer

General Conditions & Status > Section 1 - Optimizer – Primary Enable Conditions (page 78)

- All the enable conditions must be **On**.
- Set the **Main ON Switch** to **ENABLED**.

  NOTE This switch ONLY enables the program, but not the individual reset functions. Continue below to enable the condenser water reset function.

Condenser Water Temperature Optimizer Reset > **Section 1- Condenser Water System Optimizer – Enable Conditions** (page 103)

Set the **CWS Optimizer ON Switch** to **ENABLED**.

NOTE This switch enables the condenser water reset portion of the program.

You can observe the changing condenser water temperature setpoint as the program searches for a lower energy consumption point.

Condenser Water Temperature Optimizer Reset > **Section 2 - Manual Overrides of Condenser Water Reset - and other Settings** (page 104)

1 First response period **–** first reset
   - After one response period, the temperature is raised by the amount specified in **First Reset**.
   - The condenser water temperature should be lower than the **Resting Wet Bulb Approach** defined in **Section 3 - Condenser Water Setpoint Rest - Output & Limit Settings** > **Condenser Water Optimizer Operation Overview - Notes** > **Resting Wet Bulb Approach**.>
   - The program waits for the second response period. During the second response, the program measures whether the First Reset temperature reduced the power consumption.

2 Second response period – second reset
   - After the second response period, the program resets the temperature again by a calculated amount.
   - If the first reset lowered power demand, then the program continues resetting in the same direction.
   - If the first reset increased power demand, then the program recognizes it is resetting in the wrong direction. Since the first reset lowers the supply temperature, then the second reset raises the condenser water supply temperature.

3 Third and successive responses — The program will repeat the above process and continue to reset the condenser water temperature setpoint by a new calculated amount. The program continually searches for the condenser water temperature that best balances energy savings at the chiller with increased energy use at the condenser water pumps and tower fans.

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Condenser water optimizer reset - Tuning

One of the most important settings in the program is the time it takes for the condenser water system to respond after the optimization program resets the temperature.

The program needs to recognize if the system is using less energy after the setpoint has changed. The response time is the period that it takes the system to achieve and stabilize at a new setpoint and allow enough time for the total system power to stabilize at its new demand level.

Adequate response depends on each reset increment being large enough for the condenser water system to react. The system may not recognize increments that are too small. To make the increment large enough, start the minimum increment between 1° to 1.5°F and the maximum increment at least 1° to 1.25°F above that.

It is difficult to approximate the response time. If the response time is too small, the optimization program does not get an accurate measurement of the new energy use because the demand is still changing.

NOTE It is always better to be slightly high rather than low when setting the response time.

You can trend various points (i.e., condenser water supply temperature, tower fan, and pump speeds) to get a better estimate of the response time.

NOTE For chilled water facilities where the towers are close to the chillers, the response time may be between 4 and 8 minutes. For other facilities, where the towers are more remote, the response time may be higher.

You can get an approximation of the response time by locking the condenser water reset signal **Condenser Water Temperature Optimizer Reset** > **Optimized Condenser Water Supply Temperature AV (wetb + approach)** to a value 3°F higher or cooler than current setpoint and then verifying response in the tower manager program. This should result in a temperature change of 3°F. It also includes the total time it takes for everything below to occur:

- The time it takes for the condenser water supply temperature to reach the new temperature setpoint
- The time it takes for the tower fans to settle to a new speed based on the new condenser water temperature setpoint
- The condenser water pumps (if variable flow) have reached their new speed in response to the new temperature

All the changes in consumption (kW) are due to the condenser water setpoint change. The effects of the setpoint change must propagate through the entire condenser water system until all devices in the system become stable. You may need to tune certain tower or pump program properties, such as PID control loop gains and ramp rates to get proper response. It is important that the condenser water setpoint be reset predictably and quickly enough for the optimizer to work reliably. Good response is essential and the actual response time depends on the system.

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Adjustments - Minimum & Maximum Increments and Reset Gain

After the program has been running a while, adjust the Minimum Increment and Maximum Increment as shown below, if necessary.

Minimum Reset Increment

- If the condenser water system is not responding to each incremental temperature setpoint change, it could be the minimum reset increment is too small. If so, increase it by 0.5 (deg) above its current property value.
- If the system is still not responding to each incremental change, increase it by another 0.5 (deg).

  NOTE Never set the reset increment to more than 1.75 (deg). Values above this may cause overshoot.

Maximum Reset Increment

- If the condenser water system is responding too much for each incremental change, the maximum reset increment is too high. Decrease it by 0.5 (deg) from its current value.
- If the system is still responding too much for each temperature increment, decrease it by another 0.5 (deg). It is preferable to have the **Maximum Reset Increment** be at least 0.5 (deg) above the **Minimum Reset Increment**.

Reset Gain

Reset Gain and the **Minimum and Maximum Reset Increments** are interdependent and you might need to adjust both more than once.

The reset gain determines the reset increment and, consequently, the condenser water supply temperature.

After the program has been running a while and if each increment is often at either the minimum or maximum, then you can adjust the Reset Gain.

- Each reset increment should fall **between** the minimum and maximum limits
- The reset increment frequently increases over a response period, which is normal
- If most often at the Minimum Increment, then raise the reset gain
- If most often at the Maximum Increment, then lower the reset gain

Optional - Add Bias for cooler Condenser Water Supply Temperatures

After the program has been running a while, the condenser water temperature could be running warmer than expected. This could be any one of the following reasons:

- It is the best temperature for optimum energy use
- The system power, flows, or variable fan speed drives are turbulent or fluctuate irregularly
- There is a piping or design issue
- The program calculations could be misconfigured

NOTE Smoothing can help address the problem, but may not completely remove the impact on the calculations.

If you are concerned about warmer temperatures:

- Add smoothing and give a bias toward cooler water and energy savings at the chiller(s), turn each Bias switch to On.
- Fine tune the Bias, for lower energy savings at the chiller versus lower "system wide" energy savings.

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Device Address Binding

Device Address Binding (DAB) allows the TruVu™ Chilled Water System Optimizer to send and receive data to and from other controllers when they are connected to a BAS network. The data transfer takes the form of DAB, which you must configure.

Currently, the controller implements DAB for the following variables:

- **0.1 Plant ON**
- **1 CH1 kW**
- **1 CH1 ON**
- **2 CH2 kW**
- **3 CH3 kW**
- **3 CH3 ON**
- **4 CH4 kW**
- **4 CH4 ON**
- **5 CH5 kW**
- **6 CH6 kW**
- **6 CH6 ON**
- **7 CH7 kW**
- **7 CH7 ON**
- **8 CH8 kW**
- **8 CH8 ON**
- **9 CHW Pump kW**
- **10 AHU VAV Fan kW**
- **11 CWP kW**
- **12 CW Tower Fan kW**
- **13 CHW Flow**
- **13 CHWR Temp**
- **13 CHWS Temp**
- **13 Cooling Load**
- **15 Building Relative Humidity**
- **16 CHWS STPT TEMP (REMOTE INPUT)**
- **16 CHWS TEMP (REMOTE INPUT)**
- **16 Curr Stpt IN**
- **16 Optimized CHWS Reset Heartbeat ANO Minutes**

  NOTE Recommended, but not required

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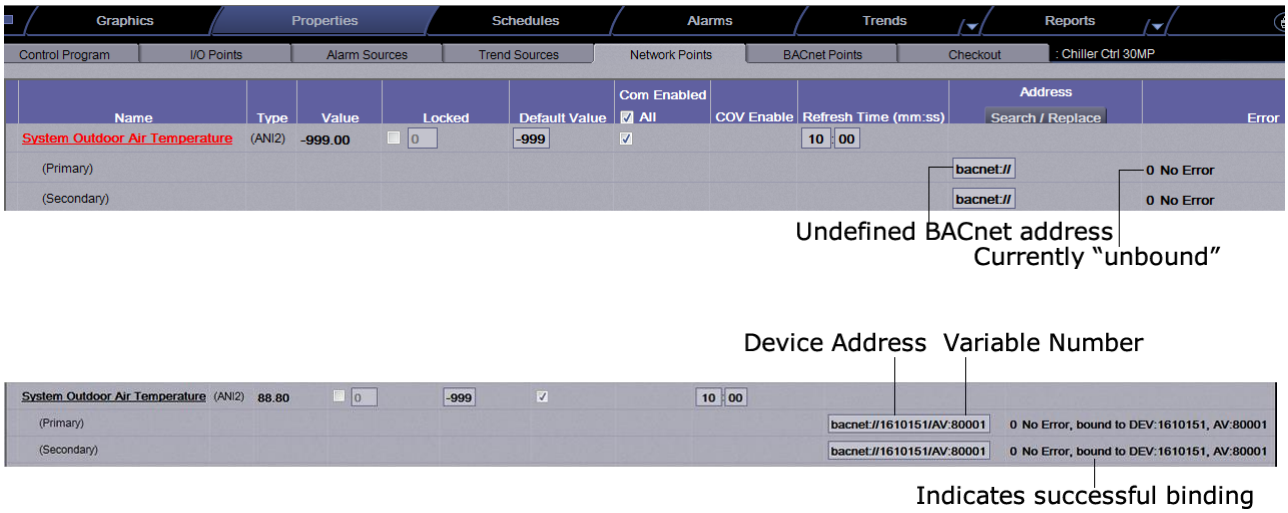
- **17 CWS FLOW (REMOTE INPUT)**
- **17 CWR TEMP (REMOTE INPUT)**
- **17 CWS STPT TEMP (REMOTE INPUT)**
- **17 CWS TEMP (REMOTE INPUT)**
- **17 Optimized CWS Reset Heartbeat ANO Minutes**

  NOTE Recommended, but not required
- **Outdoor Air Humidity**
- **Outdoor Air Temperature**

You can implement DAB on network points with an undefined BACnet address, displayed in Field Assistant and the i-Vu® interface on the **Properties** page > **Network Points** tab. See example below.



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Configuring the TruVu™ Chilled Water System Optimizer's Properties page

In the i-Vu® interface, on the controller's **Properties** page, you can select 4 different options to view and configure properties and points.

You can select from the following views:

- **Status only** — Displays the current values or state of points and properties applicable to monitoring the TV-OPT.
- **Service Config** — For making basic user changes to configuration.
- **Commissioning** — For commissioning and start-up.
- **Commissioning+Notes** — Incorporates explanations added to the Commissioning view.

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Compliance

FCC Compliance

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1 This device may not cause harmful interference.

2 This device must accept any interference received, including interference that may cause undesired operation.

NOTE This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy, and if it is not installed and used in accordance with this document, it may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

CAUTION Any modifications made to this device that are not approved by Carrier will void the authority granted to the user by the FCC to operate this equipment.

CE and UKCA Compliance

WARNING This is a Class B product. In a light industrial environment, this product may cause radio interference in which case the user may be required to take adequate measures.

Industry Canada Compliance

This Class A digital apparatus complies with Canadian ICES-003.
Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

BACnet Compliance

Compliance of listed products to requirements of ASHRAE Standard 135 is the responsibility of BACnet International. BTL® is a registered trademark of BACnet International.

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Appendix: Module Status field descriptions

Field	Description
Date/Time	Date and time the Modstat was run
CM	The controller's rotary switch address (MAC address)
Model Name	Identifies the Product Type
Device Instance	A unique ID assigned to the controller
Driver built	When the driver was built
Downloaded by	When and where the last download was performed
Application Software Version	The name of the first control program that is downloaded
Data Partition Version	Data Partition identifies the clipping used when the product was manufactured. **NOTE** This field will say **None** except for a Carrier product from the factory. If a Carrier product is subsequently downloaded in the field, then this field will say **None**.
# PRGs initialized # PRGs running	If applicable, the number of control programs that were downloaded vs. the number that are running. If these numbers are not the same, the controller has a problem such as lack of memory.
Driver version	The name, version, and date of the driver, as well as all the bundles and versions.
Reset Counters:	The number of times each of the following events have occurred since the last time the controller was commanded to clear the reset counters. See **NOTE** below this table.
Power failures	Interruption of incoming power
Commanded boots	Includes commands issued from the i-Vu® interface such as the zap manual command, plus commands issued during a memory download.
System errors	Error in the controller's firmware or hardware
S/W Watchdog timeouts	Watchdog is firmware that monitors the application firmware for normal operation. If the watchdog firmware detects a problem, it restarts the application firmware.
H/W Watchdog timeouts	H/W Watchdog will restart the controller if it detects a severe problem with the controller's operating system
System status	Gives the current status of the controller's operation. See *LED*s (page 40) for all possible conditions.
Network status	Gives the current status of the controller's networks. See *LED*s (page 40) for all possible conditions.
System error message history	High-severity errors since the last memory download. Shows the most recent 10 messages. See **NOTE** below this table.

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Field	Description
Warning message history	Low-severity errors and warning messages since the last memory download. Shows the most recent 10 messages. See **NOTE** below this table.
Information message history	Information-only messages since the last memory download. Shows the most recent 10 messages. See **NOTE** below this table.
Core and Base board hardware	Gives the following information about the controller's boards: • Type and board numbers that are used internally by Carrier. • The manufacture date and serial number.
Number of BACnet Objects	Indicates the number of BACnet objects that were created in the device and the number of those objects that are network visible
Database Partition	**Non-Volatile** partition (16 MB maximum) contains data that needs to be preserved through a power cycle and archived to flash such as parameters and trend data. **Volatile** partition (6 MB maximum) contains data that does not need to be preserved through a power cycle such as status values that are calculated during runtime.
IP Networks - BBMDs	Shows the following information for each active IP network: **BBMD Active** shows whether the BACnet Broadcast Management Device is currently active (1) or inactive (0). **BBMD Entries**—the number of entries in the BBMD table (500 maximum). **FDT Entries**—the number of entries in the Foreign Device Table (500 maximum).
Third party integration points	Shows number of points used.
Modbus integration points	Shows number of points used.
Network Information	The various network addresses for the controller. The **Current** and **Assigned** addresses will be the same unless the **Enable IP configuration changeover** on the **BACnet Router Properties** page is being implemented.
Statistics and Network Activity	Shows network communication statistics to assist with troubleshooting. See *Network Diagnostics - Statistics* (page 31) for more information.
Route Information Port Number	BACnet networks that a router is currently routing traffic to. The list changes as BACnet routers are added or removed from the system.

NOTE If you want to clear the Reset counters and the three message history fields, click the **Clear Counts/Logs** button on the controller's **Properties** page in the i-Vu® application or in the controller setup **Device** tab.

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Appendix A: The TruVu™ Chilled Water System Optimizer — Status only view of the Properties page

The following properties and points show only the current value or state. For more information, select the **Service Config** or **Commissioning** view.

See *Appendix B* (page 76) for a list of default values and ranges for the properties.

At the top of the Properties page, there is a quick overview of system statuses

ENABLED/DISABLED — Optimizer

ENABLED/DISABLED — Chilled Water Supply Reset

__.__ degrees = Setpoint

__.__ degrees = Supply Temperature

__.__ degrees = Return Temperature

ENABLED/DISABLED — Condenser Water Supply Reset

__.__ degrees = Setpoint

__.__ degrees = Temperature

__.__ degrees = Outdoor Air Temperature

__.__ degrees = Outdoor Air Wet Bulb

__.__ degrees = Total Demand

__.__ degrees = Load

__.__ degrees = Efficiency

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General Conditions & Status

Navigation: i-Vu® **Properties** > **Control Program** > **General Conditions & Status**

Point Name/Description
Optimizer Enable — Displays ENABLED or DISABLED status.
Outdoor Air Temperature— Allows this controller to use an outdoor temperature value from another controller over the network. The remote controller must be equipped with a network-accessible sensor value. Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.
Outdoor Air Humidity — Allows using another controller's relative humidity value over the network. The remote controller must be equipped with a network-accessible value. Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.
Outdoor Air Wet Bulb Temperature — Displays the calculated value based on the OA temperature and OA humidity values.
Total Chilled & Condenser Water System kW — Displays the current value of all the monitored energy loads.
Total Building Cooling Load Tons — Displays the current value of all the monitored chilled water system thermal load
Total Chilled & Condenser Water System kW/ton — Displays the current value of all the monitored energy loads as a function of the operating thermal load of the plant.

Section 1 - Optimizer - Primary Enable Conditions

Navigation: i-Vu® **Properties** > **Control Program** > **General Conditions & Status** > **Section 1 - Optimizer - Primary Enable Conditions**

Point Name/Description
Chilled Water System Optimizer Allowed to Run under the Following "Primary Enable Conditions"
PRIMARY ENABLE CONDITIONS
1. Is the Main ON Switch Enabled? — Displays the status of the master switch that enables the entire optimization program.

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Point Name/Description
2. AND Is the Plant Is ON via the "Plant ON" binary network input? — This input runs the optimization program only when the plant is appropriately enabled and running. **AND is at least one chiller running?** - Displays YES or NO status. **Chiller(s) running** - Number of running chillers
3. AND is it Scheduled? — Link to a BACnet Binary Value that indicates the chiller manager (or chiller, if single chiller only) is running. Displays YES or NO status.
4. AND are outdoor air conditions met? — Set the outside air temperature enable conditions to stabilize the program when the weather is warm enough for the chiller plant to stabilize. - Displays YES or NO status.
__ degrees — Outdoor Air Temperature — Displays current OAT
5. AND are Part Load Conditions met? — Set the part load conditions to fit your chiller plant. The program defaults to run when the chiller plant is operating above 20%. If the reset is applied at very low load conditions, the plant may cycle off more frequently when on low load or low delta temperature. The program starts to cool down to lowest chilled water supply temperature when the load is below the low threshold. - Displays YES or NO status.
_.___% Current load/capacity — Displays value.
6. AND Is the Chilled Water Temperature Difference (return-supply) across the chiller evaporator great enough? — Set a minimum allowed temperature across the evaporator so the temperature difference will not drop too low. This prevents the chiller from cycling off on low load too often and helps to stabilize chiller operation. The optimization program will not start until the temperature drop across the evaporator is large enough. - Displays YES or NO status. **Chilled Water Temperature Difference** — Displays delta temperature in degrees
Loss of Communications Lockout Conditions
Loss of Network Communications Conditions **Optimizer __ latched off due to comm loss** — Displays status.
Time since loss of comm _:__ (mm:ss) — Displays status.
Number of comm losses this period __ — Displays value.
Time since first loss of comm _:__ (mm:ss) — Displays value.
Alarm(s): **COMMLOSS (BALM) Loss of Comm Alarm** — Displays Off/On communication alarm status.
SENSOR (BALM) **__ Sensor Out of Range** — Displays Off/On status.

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Section 2 - Chiller System Power, Efficiency, and Thermal Load Input Status

Navigation: i-Vu® **Properties** > **Control Program** > **General Conditions & Status** > **Section 2 - Chiller System Power, Efficiency and Thermal Load Input Status**

- Verify network connections are operating. See *Device Address Binding* (page 60).
- Input the nominal chiller capacities (tons) required to determine part load conditions.
- Select whether the power input is actual kW or amperage.
- Select load input type using temperatures and flow or cooling load input.

Point Name/Description
The following are status displays from the linked network points. See *Device Address Binding* (page 60). **Total Chiller kW** — Displays value.
Total Chilled Water Pump kW — Displays value.
Total Condenser Water Pump kW — Displays value.
Total Cooling Tower Fan kW — Displays value.
Total Airside Fan kW — Displays value.
Total System kW (Chillers + CHWPs + CWPs + CTs + Fans) — Displays value.
Total Building Cooling Load Tons — Displays value.
Total System kW/ton — Displays value.

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Section 3 - Stagger Reset - Enable Conditions

Navigation: i-Vu® **Properties** > **Control Program** > **General Conditions and Status** > **Section 3 - Stagger Reset - Enable conditions**

Stagger Reset is only enabled when both Chilled Water Reset and Condenser Water Reset are running

Stagger Reset alternates between the chilled water reset and the condenser water reset calculations. When on, the program first resets the chilled water supply temperature and calculates its impact on decreasing energy demand. It then resets the condenser water temperature and calculates its impact on decreasing energy demand. This is a lead-lag approach.

If both chilled water and condenser water optimizer reset calculations are done simultaneously, the program would not know whether the chilled water reset alone decreased energy demand, or the condenser water reset decreased energy demand. Temperatures might be reset in the wrong direction.

Point Name/Description
Lead / Lag - Stagger routine for optimization is: __ — Displays On/Off status. **Condenser Water Optimization Reset is now ___ in the stagger routine.** — Displays Held off or Running status. **Chilled Water Optimization Reset is now ___ in the stagger routine.** — Displays Held off or Running status.

Chilled Water Temperature Optimizer Reset

Navigation: i-Vu® **Properties** > **Control Program** > **Chilled Water Temperature Optimizer Reset**

Point Name/Description
Optimizer Chilled Water Supply Reset Enable — Displays status.
Optimized Chilled Water Supply Setpoint AV — Displays status.
Total Chiller kW/ton — Displays value.
Total Chilled Water Pump kW/ton — Displays value.
Total Airside Fan kW/ton — Displays value.
Total Chilled Water System kW/ton — Displays value.

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Section 1 - Chilled Water System Optimizer - Enable conditions

Navigation: i-Vu® **Properties** > **Control Program** > **Chilled Water Temperature Optimizer Reset** > **Section 1 - Chilled Water System Optimizer - Enable Conditions**

	Point Name/Description
	1. CHWS Optimizer ON Switch: — Displays Disabled/Enabled status.

Section 2 - Automatic Overrides of Chilled Water Reset

Navigation: i-Vu® **Properties** > **Control Program** > **Chilled Water Temperature Optimizer Reset** > **Section2 - Automatic Overrides of Chilled Water Reset**

Point Name/Description
Automatic Pause & Hold of Chilled Water Reset - Status
Pause & Hold is: __ — Displays OFF/ON status.
Automatic Quick Cool Down of Chilled Water Supply - Status:
Quick Cool Down is: ___ — Displays OFF/ON status.

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Section 3 - Manual Overrides of Chilled Water Reset - and other Settings

Navigation: i-Vu® **Properties** > **Control Program** > **Chilled Water Temperature Optimizer Reset** > **Section 3 - Manual Overrides of Chilled Water Reset - and other Settings**

Point Name/Description
Manual Pause & Hold of Chilled Water Reset
Pause & Hold is:___ — Displays OFF or ON status.
Manual Quick Cool Down of Chilled Water Supply
Quick Cool Down is: __ — Displays OFF or ON status.

Condenser Water Temperature Optimizer Reset

Navigation: i-Vu® **Properties** > **Control Program** > **Condenser Water Temperature Optimizer Reset**

Point Name/Description
Optimizer Condenser Water Supply Reset Enable — Displays ENABLED or DISABLED status.
Optimized Condenser Water Supply Setpoint AV (wetb + approach) (BAV) **—** Displays value.
Outdoor Air Wet Bulb Temperature — Displays value.
Optimized Condenser Water Supply Setpoint (calculated approach) (BAV) — Displays value.
Total Chiller kW/ton — Displays value.
Total Condenser Water Pump kW/ton — Displays value.
Total Cooling Tower Fan kW/ton — Displays value.
Total Condenser Water System kW/ton — Displays value.

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Section 1 - Condenser Water System Optimizer - Enable Conditions

Navigation: i-Vu® **Properties** > **Control Program** > **Condenser Water Temperature Optimizer Reset** > **Section 1 - Condenser Water System Optimizer - Enable Conditions**

Point Name/Description
1. CWS Optimizer ON Switch: — Select ENABLED or DISABLED.

Section 2 - Manual Overrides of Condenser Water Reset - and other Settings

Navigation: i-Vu® **Properties** > **Control Program** > **Condenser Water Temperature Optimizer Reset** > **Section 2 - Manual Overrides of Condenser Water Reset - and other Settings**

Point Name/Description
Manual Pause & Hold of Condenser Water Reset
Pause & Hold is __ — Displays OFF or ON status.
Manual Quick Warm Up of Condenser Water Supply
Quick Warm Up is: — Displays OFF or ON status.

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Section 3 - Condenser Water Setpoint Reset - Output & Limit Settings

Navigation: i-Vu® **Properties** > **Control Program** > **Condenser Water Temperature Optimizer** > **Section 3 - Condenser Water Setpoint Reset - Ouput & Limit Settings**

Point Name/Description
Current Limits, Approach, Setpoints, and CWS Temperature Setpoint **Current High Limit is:** — Displays value. **Current High Approach is:** — Displays value. **Current Setpoint is:** — Displays value. **Current Low Approach is:** — Displays value. **Current Low Limit is:** — Displays value.

Electric Metering - Combined kW of Monitored Equipment

Navigation: i-Vu® **Properties** > **Control Program** > **Electric Metering - Combined kW of Monitored Equipment**

Point Name/Description
Meter Input
Instantaneous Demand: __ kW — Displays value of the instantaneous demand read by meters.
Peak Demand History Displays the historical peak kW demand values recorded for various periods. Each period also indicates the time, date, and day of the occurrence *since the beginning of the evaluation period*. The following time period values are displayed in this format: ___.__ Kw on ___ (hh:mm) on __/__/__ (mm/dd/yy) / day of the week **since** __:__ (hh:mm) on __/__/__ (mm/dd/yy) / day of the week
Daily Peak Demand **Today** — Displays values and times in the above format. **Previous Day** — Displays values and times in the above format.
Monthly Peak Demand **Month-To-Date** — Displays values and times in the above format. **Previous Month** — Displays values and times in the above format.

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Point Name/Description
Yearly Peak Demand **Year-To-Date** — Displays values and times in the above format. **Previous Year** — Displays values and times in the above format.
Usage History Displays the historical accumulated energy usage values recorded for various periods as shown below.
Daily Usage **Today** — Displays values. **Previous Day** — Displays values.
Monthly Usage **Month-To-Date** — Displays values. **Previous Month** — Displays values.
Yearly Usage **Year-To-Date** — Displays values. **Previous Year** — Displays values.

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Appendix B: The TruVu™ Chilled Water System Optimizer Commissioning view of the Properties page

NOTE Engineering units shown in this document in the defaults and ranges are strictly for reference. You must enter an integer only.

CAUTION You must disable the following before commissioning:

1 **General Conditions & Status**

Section 1: **Set Main ON Switch** to **DISABLED**.

2 **Chilled Water Temperature Optimizer Reset**

Section 1: Set the **CHWS Optimizer ON Switch** to **DISABLED**.

3 **Condenser Water Temperature Optimizer Reset**

Section 1: Set the **CWS Optimizer ON Switch** to **DISABLED**.

At the top of the Properties page, there is a quick overview of system statuses

ENABLED/DISABLED — Optimizer

ENABLED/DISABLED — Chilled Water Supply Reset

__.__ degrees = Setpoint

__.__ degrees = Supply Temperature

__.__ degrees = Return Temperature

ENABLED/DISABLED — Condenser Water Supply Reset

__.__ degrees = Setpoint

__.__ degrees = Temperature

__.__ degrees = Outdoor Air Temperature

__.__ degrees = Outdoor Air Wet Bulb

__.__ degrees = Total Demand

__.__ degrees = Load

__.__ degrees = Efficiency

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General Conditions & Status

Navigation: i-Vu® **Properties** > **Control Program** > **General Conditions & Status**

Point Name/Description	Range
Optimizer Enable — Displays ENABLED or DISABLED status.	
Outdoor Air Temperature— Allows this controller to use an outdoor temperature value from another controller over the network. The remote controller must be equipped with a network-accessible sensor value. Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.	D: Unlocked (checked) D: Enabled (checked)
Outdoor Air Humidity — Allows using another controller's relative humidity value over the network. The remote controller must be equipped with a network-accessible value. Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.	D: Unlocked (checked) D: Enabled (checked)
Outdoor Air Wet Bulb Temperature — Displays the calculated value based on the OA temperature and OA humidity values.	
Total Chilled & Condenser Water System kW — Displays the current value of all the monitored energy loads.	
Total Building Cooling Load Tons — Displays the current value of all the monitored chilled water system thermal load.	
Total Chilled & Condenser Water System kW/ton — Displays the current value of all the monitored energy loads as a function of the operating thermal load of the plant.	R: 0 to 5 kW/Ton

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Section 1 - Optimizer - Primary Enable Conditions

Navigation: i-Vu® **Properties** > **Control Program** > **General Conditions & Status** > **Section 1 - Optimizer - Primary Enable Conditions**

Point Name/Description	Range
Chilled Water System Optimizer Allowed to Run under the Following "Primary Enable Conditions"	
PRIMARY ENABLE CONDITIONS	
1. Is the Main ON Switch Enabled? — Displays the status of the master switch that enables/disables the entire optimization program. **NOTES** • For initial setup, set to **DISABLED**. • The chilled water supply reset and condenser water supply reset have their own enable switch. **CAUTIONS** • Only select **ENABLED** after the program is set up and ready to run • This switch must be enabled in order for the Chilled Water System Optimizer to be enabled.	D: DISABLED R: ENABLED/DISABLED
2. AND is the Plant ON via the "Plant ON" binary network input? — This input runs the optimization program only when the plant is appropriately enabled and running. **AND is at least one chiller running? —** Displays YES or NO status. **Chiller(s) running** - Displays number of running chillers	R: YES/NO
0.1 Plant ON (BNI2)Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.	
3. AND is it Scheduled? — Link to a BACnet Binary Value that indicates the chiller manager (or chiller, if single chiller only) is running. — Displays YES or NO status. **NOTE** Use only a schedule that is coordinated with the chiller plant operation.	R: YES/NO
Lock schedule to ON if not desired as a condition:	
Schedule (BBV) — Displays Off or On status.	R: Off/On
4. AND are outdoor air conditions met? — Set the outside air temperature enable conditions to stabilize the program when the weather is warm enough for the chiller plant to stabilize. — Displays YES or NO status.	R: YES/NO

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Point Name/Description	Range
__ degrees — Outdoor Air Temperature — Displays current OAT	D: 65°F R: 50 to 70°F
Allow optimizer to run if OA Temperature > __ degrees.	R: Disallow/Allow
(with hysteresis of __ degrees)	D: 4°F R: 2 to 5°F
____ optimizer enable if OA Temperature is invalid.	D: Allow R: Disallow/Allow
Delays **Wait __:__ (mm:ss) after chiller plant is enabled before checking part load conditions and further enabling optimization.** **Present output is True for 0:00 (mm:ss)** — Displays status.	D: 00:10 (mm:ss) R: 0:00 to 10:00 (mm:ss)
5. AND are Part Load Conditions met? — Set the part load conditions to fit your chiller plant. The program defaults to run when the chiller plant is operating above 20%. If the reset is applied at very low load conditions, the plant may cycle off more frequently when on low load or low delta temperature. The program starts to cool down to lowest chilled water supply temperature when the load is below the low threshold. — Displays YES or NO status.	R: YES/NO
_.___% Current load/capacity — Displays value.	R: 0 to 100%
Allow Optimizer Reset if Load is < __% of capacity	D: 90% R: 60 to 90%
hysteresis of __%	D: 5% R: 5 to 10%
6. AND is the Chilled Water Temperature Difference (return-supply) across the chiller evaporator great enough? — Set a minimum allowed temperature across the evaporator so the temperature difference will not drop too low. This prevents the chiller from cycling off on low load too often and helps to stabilize chiller operation. The optimization program will not start until the temperature drop across the evaporator is large enough. — Displays YES or NO status. **Chilled Water Temperature Difference** — Displays delta temperature in degrees	
Allow if (Chilled Water Return Temperature - Chilled Water Supply Temperature) is > __ degrees	D: 5°F R: 3 to 10°F
with hysteresis of __ degrees	D: 3°F R: 1 to 5°F
Delays	
1. Wait __ : __ (mm:ss) before disabling algorithm after plant goes out of part load conditions. Present output is: True/False for 0:00 (mm:ss) — Displays status.	D: 5:00 (mm:ss) R: 0:00 to 10:00 (mm:ss)

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Point Name/Description	Range
2. Wait __ : __ (mm:ss) after part load conditions are enabled before starting optimization. Present output is : True/False for 0:00 (mm:ss) — Displays status.	D: 5:00 (mm:ss) R: 0:00 to 10:00 (mm:ss)
3. **Pause algorithm when staging up or down: —** This encourages algorithm stability.	D: On R: Off/On
Hold algorithm in current state for __ : __ (mm:ss) after stage up or stage down Present output is : True/False for ___ (mm:ss) — Displays status. **Optimizer pause is ___ because of chiller stage up or down**. — Displays Off or On status.	D: 20:00 (mm:ss) R: 10:00 to 60:00 (mm:ss)
Loss of Communications Lockout Conditions	
Allow Optimizer Lockout on loss of communications?	D: Off R: Off/On
Loss of Network Communications Conditions	
Network communications is considered lost if not valid for _:__ (mm:ss) (output is True/False for _:__ (mm:ss). — Displays status and value.	D: 5:00 (mm:ss) R: 1 to 10 (mm:ss)
Optimizer **IS/IS NOT** latched off due to comm loss — Displays status.	R: IS/IS NOT
Latch optimizer operation OFF	
1. If the comm is lost for _:__ (mm:ss) or more. Time since loss of comm _:__ (mm:ss) — Displays status.	D: 1:00 (mm:ss) R: 0:00 to 5:00 (mm:ss)
2. **OR if __ or more comm losses occur**	D: 3 R: 2 to 5
within a period of _:__ (mm:ss) **Number of comm losses this period __** — Displays value. **Time since first loss of comm _:__ (mm:ss)** — Displays value.	D: 10:00 (mm:ss) R: 0 to 20:000 (mm:ss)
Clear latch out and restore optimizer operation	
1. If the comm is restored lost for _:__ (mm:ss) or more. **Time since restored comm** _:__ **(mm:ss)** — Displays value.	D: 5:00 (mm:ss) R: 0:00 to 10:00 (mm:ss)
2. Or manually reset and clear the latch out and restore operation.	D: Off R: Off/Reset and Clear

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Point Name/Description	Range
Alarm(s): **COMMLOSS (BALM) Loss of Comm Alarm** — Displays communication alarm status.	R: Off/On
Alarm and stop the optimizer if the Cooling Load, CHW Flow, CHWR Temp or CHWS Temp sensor values indicate sensor is out of range and invalid. **Alarm if signal indicates sensor out of range for _:__ (mm:ss)**	D: 1:00 (mm:ss) R: 0:00 to 4:00 (mm:ss)
with output of False for _:__ (mm:ss)?	D: YES R: YES/NO
SENSOR (BALM) **__ Sensor Out of Range** — Displays Off or On status.	R: Off/On

Section 2 - Chiller System Power, Efficiency, and Thermal Load Input Status

Navigation: i-Vu® **Properties** > **Control Program** > **General Conditions & Status** > **Section 2 - Chiller System Power, Efficiency and Thermal Load Input Status**

1 Verify network connections are operating. See *Device Address Binding* (page 60).

2 Input the nominal chiller capacities (tons) required to determine part load conditions.

3 Select whether the power input is actual kW or amperage.

4 Select load input type using temperatures and flow or cooling load input.

5 Enter voltage and power factors from the equipment's specifications.

Point Name/Description	Range
The following are statuses displayed from the linked network points. See *Device Address Binding* (page 60). **Total Chiller kW** — Displays value.	
Total Chilled Water Pump kW — Displays value. **If "Amp" network inputs are used for CHWP kW determination, then:** **The voltage is ___ volts** — Enter value. **The Power Factor is __.** — Enter value.	

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Point Name/Description	Range
Total Condenser Water Pump kW — Displays value. **If "Amp" network inputs are used for CWP kW determination, then:** **The voltage is ___ volts** — Enter value. **The Power Factor is __.** — Enter value.	
Total Cooling Tower Fan kW — Displays value. **If "Amp" network inputs are used for Cooling Tower Fan kW determination, then:** **The voltage is ___ volts** — Enter value. **The Power Factor is __.** — Enter value.	
Total Airside Fan kW — Displays value. **If "Amp" network inputs are used for AHU VAV Fan kW determination, then:** **The voltage is ___ volts** — Enter value. **The Power Factor is __.** — Enter value.	
Total System kW (Chillers + CHWPs + CWPs + CTs + Fans) — Displays value.	
Total Building Cooling Load Tons — Displays value.	
Total System kW/ton — Displays value.	
CHILLER POWER INPUTS AND CAPACITIES	
Are the Chiller Normal Capacities (below) in Tons or kW? (Default is tons.)	D: tons R: tons/kW
CHILLER 1*	
1 CH1 ON (BNI2) — Displays status. Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.	D: Unlocked (unchecked) R: Enabled (checked)
1 CH1 kW (BAV) — Displays value.	
1 CH1 kW (ANI2) — Displays value. Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.	D: Unlocked (unchecked) R: Enabled (checked)
Is the CH1 power input above in Amps OR kW? (Default is kW.)	D: kW R: Amps/kW
If Amps: The chiller voltage is ___ volts — Enter value **If Amps: Power Factor is ___** — Enter value	

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Point Name/Description	Range
CH1 Nominal Capacity is: ___ tons — Enter value.	D: 225 R: Chiller capacity
*Continue the same settings as above up to **CHILLER 8**	
COOLING LOAD, TEMPERATURES & FLOW INPUTS	
13 Cooling Load (ANI2) — Displays value. Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.	D: Unlocked (unchecked) R: Enabled (checked)
Use Cooling Load Input (above) OR use the Temperatures & Flow (below) to calculate the cooling load?	D: Cooling Load Input R: Cooling Load Input Temperatures & Flow
If using the ___ — Displays status. **Is the Load in Tons OR kW?** (Default is tons.) — Enter value.	D: tons R: tons/kW
13 CHWR Temp (ANI2) — Displays value. Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.	D: Unlocked (unchecked) R: Enabled (checked)
13 CHWS Temp (ANI2) — Displays value. Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.	D: Unlocked (unchecked) R: Enabled (checked)
13 CHW FLOW (ANI2) — Displays value. Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.	D: Unlocked (unchecked) R: Enabled (checked)

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Section 3 - Stagger Reset - Enable Conditions

Navigation: i-Vu® **Properties** > **Control Program** > **General Conditions and Status** > **Section 3 - Stagger Reset - Enable conditions**

Stagger Reset is only enabled when both Chilled Water Reset and Condenser Water Reset are running

Stagger Reset alternates between the chilled water reset and the condenser water reset calculations. When on, the program first resets the chilled water supply temperature and calculates its impact on decreasing energy demand. It then resets the condenser water temperature and calculates its impact on decreasing energy demand. This is a lead-lag approach.

If both chilled water and condenser water optimizer reset calculations are done simultaneously, the program would not know whether the chilled water reset alone decreased energy demand, or the condenser water reset decreased energy demand. Temperatures might be reset in the wrong direction.

Point Name/Description	Range
Lead / Lag - Stagger routine for optimization is: __ — Displays On/Off status. **Condenser Water Optimization Reset is now ___ in the stagger routine.** — Displays Held off or Running status. **Chilled Water Optimization Reset is now ___ in the stagger routine.** — Displays Held off or Running status.	D: On R: Off/On

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Section 4 - Optimizer Setpoint Change Mode

Navigation: i-Vu® **Properties** > **Control Program** > **General Conditions & Status** > **Section 4 - Optimizer Setpoint Change Mode**

Optimizer Setpoint Change Mode determines if the optimizer resets the setpoints automatically or requires manual intervention and entry. The default is **AUTOMATIC** mode. During each response period, the optimizer determines a new setpoint that best lowers energy consumption.

Modes:

- **AUTOMATIC** – The optimizer calculates the new setpoint and then automatically changes it. It repeats every response period. No operator is required.
- **MANUAL** – The optimizer calculates the new setpoint, and requires an operator to change it. It repeats every response period. An operator must continually monitor and change the setpoint.

  Each response period, when the optimizer finishes its calculation, the optimizer instructs the operator to change to the new setpoint, which should be changed within 2 minutes after each new setpoint is determined. If the operator delays changing the setpoint, then the optimizer begins losing effectiveness in saving energy.

  The optimizer calculates the next setpoint only after the operator changes it. The process repeats itself each response period.

Point Name/Description	**Range**
Optimizer is in: ___ mode— Select desired mode.	D: AUTOMATIC R: AUTOMATIC MANUAL
Optimizer is in MANUAL mode	
CHILLED WATER SETPOINT - OPTIMIZATION	
Optimizer Status — Displays the following statuses: ○ **PRE-START UP** – Optimizer doing pre-start calculations when first initiated ○ **FIRST RESET** – Optimizer ready for first reset ○ **CALCULATING** – Optimizer calculating next setpoint ○ **NEW SETPOINT** – Optimizer has new setpoint and is ready for acceptance ○ **WAITING TURN** – Setpoint calculation in waiting when stagger is ON ○ **PAUSE IS ON** – Displays when pause is ON ○ **COOL DOWN IS ON** – Displays when cool down is ON ○ **AUTOMATIC** – Displays when in AUTOMATIC mode	R: OFF PRE-START UP FIRST RESET CALCULATING NEW SETPOINT WAITING TURN PAUSE IS ON COOL DOWN IS ON AUTOMATIC
Countdown until "New Setpoint" is determined: — Displays value.	R: (minutes:seconds)

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Point Name/Description	Range
Optimizer Instructions — Displays status.	R: NO ACTION NEEDED WAIT FOR RESULT SETPOINT AVAILABLE
Elapsed time since "New Setpoint" is determined: ___ — Displays value.	R: (minutes:seconds)
New Setpoint: ___ degrees — Displays value.	R: degrees
Setpoint was changed? — Enter status. **NOTE** Change setting only when **SETPOINT AVAILABLE** displays in **Operator Instructions:**.	D: NO R: NO/YES
Current Optimizer Setpoint: ___ degrees — Displays value.	R: degrees
Current Chiller Setpoint: ___ degrees — Displays value.	R: degrees
CONDENSER WATER SETPOINT - OPTIMIZATION	
Optimizer Status: — Displays status. ○ **PRE-START UP** – optimizer doing pre-start calculations when first initiated. ○ **FIRST RESET** – optimizer is ready for first reset. ○ **CALCULATING** – optimizer is calculating next setpoint ○ **NEW SETPOINT** – optimizer has new setpoint and is ready for acceptance. ○ **WAITING TURN** – setpoint calculation is waiting when stagger is ON ○ **PAUSE IS ON** – displays when pause is ON. ○ **WARM UP IS ON** – displays when warm up is ON. ○ **AUTOMATIC** – displays when in AUTOMATIC mode.	R: OFF PRE-START UP FIRST RESET CALCULATING NEW SETPOINT WAITING TURN PAUSE IS ON WARM UP IS ON AUTOMATIC
Countdown until "New Setpoint" is determined: Displays value	R: (minutes:seconds)
Operator Instructions: — Displays status.	R: NO ACTION NEEDED WAIT FOR RESULT SETPOINT AVAILABLE
Elapsed time since "New Setpoint" is determined: ___ — Displays value.	R: (minutes:seconds)
New Setpoint: ___ degrees — Displays value.	R: degrees
Setpoint was changed? — Enter status. **NOTE** Change setting only when **SETPOINT AVAILABLE** displays in **Operator Instructions:**.	D: NO R: NO/YES
Current Optimizer Setpoint: **___ degrees** — Displays value.	R: degrees
Current Condenser Setpoint: ___ degrees — Displays value.	R: degrees

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Chilled Water Temperature Optimizer Reset

Navigation: i-Vu® **Properties** > **Control Program** > **Chilled Water Temperature Optimizer Reset**

Point Name/Description	Range
Optimizer Chilled Water Supply Reset Enable — Displays status.	R: Disabled/Enabled
Optimized Chilled Water Supply Setpoint AV — Displays status.	D: Off
Lock the CHWS temperature setpoint output __	R: Off/On
To __ (Final setpoint, e.g., 44 degrees F)	D: 44°F
CAUTION Bypasses optimizer calculations.	R: 40 to 50°F
16 CHWS STPT TEMP (REMOTE INPUT) — Displays value.	D: Unlocked (checked)
Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.	D: Enabled (checked)
16 CHWS TEMP (REMOTE INPUT) — Displays value.	D: Unlocked (checked)
Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.	D: Enabled (checked)
CHWR RETURN TEMP — Displays value.	
Total Chiller kW/ton — Displays value.	
Total Chilled Water Pump kW/ton — Displays value.	
Total Airside Fan kW/ton — Displays value.	
Total Chilled Water System kW/ton — Displays value.	
16 Optimized CHWS Reset Heartbeat ANO Minutes — Displays value.	D: Unlocked (unchecked)
Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.	D: Enabled (checked)
16 Optimized CHWS Setpoint ANO — Displays value.	D: Unlocked (unchecked)
Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.	D: Enabled (checked)

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Section 1 - Chilled Water System Optimizer - Enable conditions

Navigation: i-Vu® **Properties** > **Control Program** > **Chilled Water Temperature Optimizer Reset** > **Section 1 - Chilled Water System Optimizer - Enable Conditions**

	Point Name/Description	Range
	1. CHWS Optimizer ON Switch: — Displays Disabled/Enabled status. **CAUTIONS** • You must set this to **DISABLED** until the system is set up and ready to run. • The **Main ON Switch** in *Section 1 - Optimizer - Primary Enable Conditions* (page 78) must also be enabled for the CHWS Optimizer to be enabled.	D: DISABLED R: DISABLED/ENABLED

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Section 2 - Automatic Overrides of Chilled Water Reset

Navigation: i-Vu® **Properties** > **Control Program** > **Chilled Water Temperature Optimizer Reset** > **Section2 - Automatic Overrides of Chilled Water Reset**

The chilled water reset is automatically overridden by:

- Automatic "Pause & Hold"
- Automatic "Quick Cool Down"

You must configure the following properties to balance chiller stability.

Automatic "Pause & Hold"

In **Automatic "Pause & Hold"**, the reset pauses its operation and holds the supply temperature at its current setpoint under any one of the 5 following conditions:

1 **The chilled water return temperature gets too cold.**

This indicates a low load condition, or low temperature difference across the air handling unit cooling coils, which could cause the chiller to cycle off. The chiller could be held on longer and operate under more stable conditions, if the supply temperature is not reset any higher. Input the preferred low temperature trip point and the delay that best fits your system.

2 **The temperature difference across the evaporator gets too cold.**

This can happen as the chilled water supply temperature rises faster than the chilled water return temperature. This could create low load conditions across the chiller and could cycle off too often. The chiller could stay on longer if the chilled water is not reset any higher. This allows time for the return water temperature to rise, and the load across the chiller to remain high enough for it to continue to run. Input the preferred low temperature trip point and delay that best fits your system.

3 **The building relative humidity gets too high**.

The program has the option to monitor relative humidity (up to 20 sensors) throughout the building. If the user-configurable average or maximum RH rises above a predefined threshold, the program holds its chilled water reset. If the humidity continues to rise, then the program lowers the chilled water supply temperature setpoint as described below.

4 **The thermal load gets too high.**

The program has the option to pause if the thermal load to capacity rises above a certain threshold. If the thermal load to capacity rises above a predefined threshold (in percentage), the program holds its chilled water reset. If it continues to rise, then the program lowers the chilled water supply temperature setpoint as described below.

5 **The remote pause is enabled.**

The program has the option to pause if there is a remote BACnet pause signal. If the remote pause input is enabled, the program holds its chilled water reset.

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Automatic " Quick Cool Down"

Configure the **Automatic "Quick Cool Down"** function for the chilled water reset to enable the optimization program to balance comfort with energy savings. When in automatic cool down, the chilled water optimization reset overrides its operation and drops the supply temperature under any one of the 6 following conditions:

1 **The building is too warm and the incoming cooling requests rise above threshold**

When this happens, the optimization program is overridden and the chilled water temperature resets downward by a predetermined adjustable rate until the building cools down and no longer needs cooling. Input your preferred threshold number of requests, that are needed before cool down occurs, and delay.

2 **The chilled water return temperature gets too warm**

The chilled water return temperature can act as an indicator of the facility warming up and exceeding occupant comfort. Input your preferred high chilled water return temperature trip point that is needed before cool down occurs, and delay.

3 **The temperature difference across the evaporator gets too cold**

Like Automatic Pause, the chiller could stay on longer if the load across the chiller remains high enough for it to continue to run. If the temperature difference drops below the pause threshold, then you may want to actually lower the chilled water supply temperature to increase the load. Dropping the chilled water supply temperature raises the temperature difference and encourages chiller stability. Input your preferred low temperature trip point and delay.

NOTE This low temperature trip point should be below the pause trip point since the pause is the first step in preventing excessive cycling. If the temperature drops below the pause trip point, then lowering the temperature would be the second step.

1 **The building relative humidity rises above a threshold (user-configurable)**

Like Automatic Pause, this is a response to rising humidity levels. The Automatic Pause is the first step and, if the humidity levels continue to rise, the second step is lowering the chilled water supply temperature. The setpoint continues to drop each response interval until the relative humidity conditions drop to an acceptable level.

2 **The chilled water temperature setpoint rises above a predefined high limit**
This is another measure to prevent high humidity conditions, especially when you have chilled beams and the dewpoint is a problem. Enter the high chilled water supply setpoint limit and the setpoint drops if the limit is exceeded.

3 **IF the "Remote Quick Cool Down" BBV receives a binary ON signal**

This is for those systems which, for any reason, need to cool down the supply temperature. It is activated by a remote BACnet binary write signal.

During automatic cool down, the temperature drops immediately by the cool down temperature increment (which you define in **Quick Cool Down Incremental drop**, Section 3 - Manual Overrides of Chilled Water Resets), and then the program cools down by the same amount each Response Period.

In conditions above, you may select to cool down more quickly, as an **"Emergency Cool Down"**, rather than the **"Quick Cool Down"** settings in Section 3 Manual Overrides of Chilled Water Reset - and other Settings. If so, you may configure **"Emergency Cool Down Incremental Drop"** settings in this section.

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Point Name/Description	Range
Automatic "Pause & Hold" Override of the Optimizer Reset & Pause at its Current Reset Setpoint	
1. **Pause Reset if CHWRT is >__ degrees**	D: 46°F R: 45 to 50°F
with hysteresis of __	D: 1°F R: 1 to 3°F
for __:__ (mm:ss) Present output is False for __:__ (mm:ss). — Displays value.	D: 4:00 (mm:ss) R: 2:00 to 10:00 (mm:ss)
2. **OR Pause Reset if CHWRT-CHWST is <__degrees**	D: 6°F R: 2 to 7°F
with hysteresis of __	D: 1°F R: 1 to 3°F
for __:__ (mm:ss) Present output is False for __:__ (mm:ss). — Displays value.	D: 4:00 (mm:ss) R: 2:00 to 10:00 (mm:ss)
3. **OR Pause Reset if Building Relative Humidity is > __%**	D: 60% R: 50 to 100%
with hysteresis of __	D: 2% R: 2 to 10%
for __:__ (mm:ss) Present output is False for __:__ (mm:ss). — Displays value.	D: 20:00 (mm:ss) R: 10:00 to 60:00 (mm:ss)
Use the __ building relative humidity from networked sensor values to determine if it is too high. Current Building Relative Humidity is __.__% — Displays value.	D: Average R: Average/Maximum
4. **OR Pause Reset if Load is > __% capacity**	D: 90% R: 70 to 100%
with hysteresis of __%	D: 5% R: 2 to 10%
__(Pause is default, Algorithm will Cool Down otherwise)	D: Pause R: Pause/Cool Down
5. **OR Pause Reset, for a remote condition, if the "Remote Pause" BBV receives a binary ON signal**	D: 60% R: 50 to 100%
for __:__ (mm:ss) Present output is False for __:__ (mm:ss). — Displays value.	D: 20:00 (mm:ss) R: 10:00 to 60:00 (mm:ss)
Automatic Pause & Hold of Chilled Water Reset - Status	

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Point Name/Description	Range
Pause & Hold Is: OFF — Displays status.	
Pause & Hold Criteria — Displays statuses and values.	
Automatic "Quick Cool Down" - Override of the Optimizer Reset & Lower the Supply Temperature Setpoint	
1. Drop chws temperature if building gets too warm due to increasing requests for cooling **In the Occupied Mode: Drop chws temperature if more than __ cooling requests**	D: 3
hysteresis __, are received	D: 1
In the Unoccupied Mode: Drop chws temperature if more than __ cooling requests	D: 6
hysteresis __, are received	D: 1
for __:__ (mm:ss) Present output is False for __:__ (mm:ss). — Displays value.	D: 1:00 (mm:ss) R: 1:00 to 3:00 (mm:ss)
Building Occupancy Status: ___ Mode — Displays status. **Total Cool Request:_.__** — Displays value.	
2. OR Drop chws temperature if chilled water return temperature is > __ degrees	D: 58°F R: 54 to 60°F

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Point Name/Description	Range
with a hysteresis of __	D: 2°F R: 1 to 3 °F
for __:__ (mm:ss) Present output is False for __:__ (mm:ss). — Displays value.	D: 8:00 (mm:ss) R: 1:00 to 10:00 (mm:ss)
3. OR Drop chws temperature if chilled water return - supply temperature is < __ degrees	D: 5°F R: 5 to 8°F
with a hysteresis of __	D: 0.5°F R: 0.25 to 1°F
for __:__ (mm:ss) Present output is False for __:__ (mm:ss). — Displays value.	D: 8:00 (mm:ss) R: 1:00 to 10:00 (mm:ss)
4. OR Drop chws temperature if building relative humidity is > __%	D: 65% R: 50 to 100%
with a hysteresis of __	D: 2% R: 2 to 10%
for __:__ (mm:ss) Present output is False for __:__ (mm:ss). — Displays value. **Current Building Relative Humidity is _.__%** — Displays value.	D: 20:00 (mm:ss) R: 10:00 to 60:00 (mm:ss)
5. OR Drop chws temperature for humidity & dewpoint control, if chws setpoint rises above __ degrees — Displays value.	
with a hysteresis of __	D: 2°F
High CHWS Setpoint Limit for RH Control __°F — Displays value. **Default Value:** __	D: 70°F R: 50 to 70°F
Lock at value __	D: Unlocked (unchecked)
6. OR Drop chws temperature, for a remote condition, if the "Remote Quick Cool Down" BBV receives a binary ON signal	
for __:__ (mm:ss) Present output is False for __:__ (mm:ss). — Displays value.	D: 8:00 (mm:ss) R: 3:00 to 60:00 (mm:ss)

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Point Name/Description	Range
Remote Quick Cool Down (BBV) — Displays value. **Default Value: __**	D: Off R: Off/On
Lock at value __	D: Unlocked (unchecked)
"Emergency Cool Down Response" Time in Minutes (3=min to 30=max): __ minutes **Current interval time is _.__ minutes and _.__ seconds** — Displays values.	
Use "Emergency Cool Down Response" Time? __ **NOTE** You can use this instead of the default "System Response Time" of __ minutes, set in Section 3.	D: No R: No/Yes
Emergency Cool Down Incremental Drop __ (deg) - Drop per Response Interval	D: 1.5 R: 1 to 4
Use "Emergency Cool Down Incremental Drop"? __ **NOTE** You can use this instead of the default "Quick Cool Down Incremental Drop" of __ (deg) per response interval, set in Section 3. — Displays value.	D: No R: No/Yes
Automatic Quick Cool Down of Chilled Water Supply - Status:	
Quick Cool Down is: ___ — Displays OFF/ON status.	
Quick Cool Down Criteria: — Displays statuses and values.	
Chilled Water Temperature Alarms	
Alarm(s): **Enable Chilled Water Temperature alarms after the optimizer has been enabled for __:__ mm:ss**	D: 30 (mm:ss) R: 10:00 to 60:00 (mm:ss)
CHRT HI (BALM) **___ —** Displays status. **Alarm if chilled water return temperature is > __ degrees**	D: 62°F R: 50 to 70°F
hysteresis of __	D: 2°F R: 0.5 to 3°F
for __:__ (mm:ss) Present output is False for __:__ (mm:ss). — Displays value.	D: 10:00 (mm:ss) R: 2:00 to 20:00 (mm:ss)

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Point Name/Description	Range
CHDT LO (BALM) **___ —** Displays status. **Alarm if (chilled water return - supply temperature) is > __ degrees**	D: 4°F R: 3 to 8°F
hysteresis of __	D: 2°F R: 0.5 to 3°F
for __:__ (mm:ss) Present output is False for __:__ (mm:ss). — Displays value.	D: 10:00 (mm:ss) R: 2:00 to 20:00 (mm:ss)

Section 3 - Manual Overrides of Chilled Water Reset - and other Settings

Navigation: i-Vu® **Properties** > **Control Program** > **Chilled Water Temperature Optimizer Reset** > **Section 3 - Manual Overrides of Chilled Water Reset - and other Settings**

The program outputs a reset signal in the range of 0 - 10 (deg). This reset signal is not the actual temperature reset, because the 0-10 (deg) reset is ultimately converted to a signal used by the equipment.

NOTE The (deg) designation does not indicate actual degrees, but the 0-10 output range of the algorithm that is converted into an actual temperature

EXAMPLE The 0 - 10 (deg) reset range might be converted to 42 - 50°F reset signal used for a chilled supply temperature setpoint. Therefore, the 0 - 10 (deg) reset signal is converted to a range of 0 - 8°F. Each reset increment of 1 (deg) would actually be a 0.8°F increment.

Reset settings such as **First Reset**, **Full Load Drop**, **Quick Cool Down**, and any other temperature reset settings, are always based on 0 - 10 (deg) program output, not the final output.

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Point Name/Description	Range
Manual "Reinitialize" & "Pause & Hold" - Override of the Optimizer Reset & Pause at it Current Reset Setpoint	
Reinitialize CHWS reset algorithm (resets algorithm logic to zero): To manually reinitialize and reset the chilled water optimization, turn on by selecting **REINITIALIZE**. After a few moments, this returns the program back to its initial zero state. Turn the reinitialize switch to **Off** to allow the program to operate again from its zero state. **CAUTION** This setting drops the setpoint back to its default temperature and restarts the program from state zero.	D: Off R: Off/REINITIALIZE
Pause CHWS reset algorithm (holds logic at current state and output): — To manually pause the chilled water supply, select **PAUSE**. When you no longer need the pause, select **OFF** and the application begins again from its holding pattern.	D: Off R: Off/PAUSE
Pause & Hold is:___ — Displays OFF or ON status..	R: OFF/ON
Alarm if the "Pause CHWS reset algorithm" above is on longer than _:__ (mm:ss)	D: 30:00 (mm:ss) R: 10:00 to 60:00 (mm:ss)
with output of ____ for _:__ (mm:ss) — Displays status and value.	
CHW MAN PAUSE ALARM (BALM) __ — Displays Off or On status.	
Manual "Quick Cool Down" - **Override of the Optimizer Reset & Lower the Supply Temperature Setpoint**	
Quick Cool Down (lowers chws temperature): — A manual override to drop chilled water supply temperature. This is a manual cool down of the chilled water supply temperature used to override the chilled water optimization and to cool down the facility. Turn the switch to **Quick Cool Down** and the temperature drops immediately by the cool down temperature increment (defined below), and then the temperature cools down by the same amount each **Response Time** (set in the following section). The cool down continues until minimum reset is reached. To turn off **Quick Cool Down**, select **Off** and the program begins again, starting from the current reset temperature.	D: Off R: Off/QUICK COOL
Quick Cool Down incremental drop: __ (deg) - Drop per Response Interval — This is the incremental amount the chilled water supply temperature is dropped (initially and each response period) when in **Quick Cool Down**. Input your desired amount and its response time. This incremental drop also applies to: Automatic cool down described in *Section 2 - Automatic Overrides of Chilled Water Resets* (page 89) Cool down to default low temperature when not in part load conditions described as Step 5 in *Section 1 - Optimizer - Primary Enable Conditions* (page 78)	D: 1 (deg) R: 0.5 to 2 (deg)

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Point Name/Description	Range
Quick Cool Down is: __ — Displays OFF or ON status.	
First Reset	
First Reset - Raise Temperature initially by: __(deg) — The first reset should be large enough for the system to register the reset temperature and respond to it, but not so large that it creates instability. If the temperature increment is too small, then the system won't experience enough temperature change to determine if it saves energy. The program measures the decrease (or possible increase) in kW/ton from this first reset. It then determines what the next reset should be. We recommend no more than 2 (deg), though it can be a maximum of 4 (deg).	D: 1.25 (deg) R: 0.7 to 2.0 (deg)
Allow 50% of previous day's average reset as a first increment? — The program keeps a running average of the previous day's reset values. This value can be used as a first reset, which is closer to the optimal reset temperature for the most efficient operation. However, this calculated value is limited to 4°F. Even though the average temperature of the most efficient operation is close to the same on subsequent days, it may not always be the most efficient temperature at the beginning of the day. If set to **ON**, the program takes the highest of **First Reset** (configured above) or **Previous day's average reset**.	D: Off R: Off/On
Input Smoothing and System Response Time	
Input Smoothing (0=min : 100=max): This setting "smooths" the (kW/Ton) input and removes erratic signals. This smoothing is more complex and subtle than most. It does not smooth the signal excessively and it adjusts without shifting the output too much. Input settings: 0 - no smoothing 1 - automatic minimal smoothing Up to 100 (maximum smoothing or dampening)	D: 50 R: 0 to 100

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Point Name/Description	Range
System Response time in minutes (3=min to 30=max): __ minutes Current interval time is: __minutes and __.__ seconds. — Displays values. **CAUTION** Critical setting. This setting defines the time it takes for the chilled water system to respond after the optimization program resets the temperature. The program needs to know if the system is using less energy after the setpoint has changed and after the system has settled to the new setpoint. The following must occur at the completion of one response time period: Chiller supply temperature reaches the new setpoint temperature Pumps reach their new speed in response to valves opening Air handling unit valves open (or close) based on new chilled water temperature (if applicable) Air handler supply air temperature reaches steady state value Air handling unit fan speeds up or slows down, due to supply air temperature change (VAV systems) The response time is difficult to approximate. You will need to initially monitor the entire system to determine when the above conditions have been achieved. Start with the 20 minute default value and adjust as required based on the actual system response.	D: 15 minutes R: 3 to 30 minutes
Minimum and Maximum Reset Increments & Program Reset Gain Each response period, the program determines the next reset signal that lowers energy demand most effectively. The program outputs a reset signal between 0 and 10 (deg) (0 (deg) is no reset or coolest temperature, 10 (deg) is the maximum or warmest temperature). **EXAMPLE** The program is producing a 5.4 (deg) reset signal. The next time it resets, in order to minimize energy use, it either adds to the signal, by raising the temperature, or subtracts from the signal, by lowering the temperature. Each reset increment falls between the minimum and maximum allowed reset increment. The actual reset value is based on the reset gains and program measurements of the curve profile. If the program is currently producing a 5.4 (deg) reset, and the next reset increment is determined to be 1.1(deg), thenthe next reset output will be (5.4 (deg) +1.1 (deg)) = 6.5 (deg). This will be converted to the actual setpoint in the chiller program. **NOTE** The reset increment should be large enough for the system to register the reset temperature and react to it – but not so large that it creates instability. If the temperature increment is too small, the system won't experience enough temperature change to determine if it saves energy.	
Minimum Reset Increment: __ (deg) (output units: 0-10) — The minimum allowed output increment for each response interval. **EXAMPLE** If you set this value to 1.0 (deg), the program resets no less than that for each increment. This does not necessarily equal the actual reset at the chiller, which may have a range of 42 to 54°F. Unless the 0 - 10 (deg) signal is exactly the 10°F temperature range, the minimum increment may not equal the actual temperature increment. With a range of 42 to 54°F, each reset degree is (54 - 42°F)/10 = 1.2°F.	D: 1 (deg) R: 0.5 to 1.2 (deg)

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Point Name/Description	Range
Current reset increment is: __ — Displays value.	
Maximum Reset Increment: __ (deg) (output units) — The maximum allowed output increment for each response interval. **EXAMPLE** If you set it to 1.5 (deg), the program resets no more than 1.5 (deg) for each increment. As described above, this does not necessarily equate to the actual reset at the chiller.	D: 2 (deg) R: 1.5 to 2.5 (deg)
Reset Increment Coarse Gain — (1=min to 10=max) Determines how large each reset increment will be. The program applies the gain to various measurements of the efficiency curve, and determines the next increment size. The larger the gain, the larger the increment. However, no matter how small or large the gain, the increment can be no less than the minimum increment and no more than the maximum increment.	D: 5 R: 1 to 10
Reset Increment Fine Gain — (0=min to 10=max) A fine gain that is added to each increment. It can be combined with the above gain to configure the best gain applied to each increment. More is described about how to set up the gain in the *Start-up and Commissioning* (page 46) section.	D: 0 R: 0 to 10
Bias for reset of CHWS temperature setpoint for warmer temperatures The program works as intended without applying bias. However, there are times that the kW/ton input can be erratic. Adding bias toward warmer temperatures promotes energy savings at the chiller, even though the chilled water reset temperatures are not necessarily the most effective supply temperature for the system. **EXAMPLE** The program is very close to resetting toward a warmer temperature, but not close enough, and still wants to reset for cooler temperatures. This bias shifts the decision slightly toward resetting for warmer temperatures. Energy savings are biased toward the chiller rather than the towers. **NOTE** Bias is not required.	
Add a small bias for reset toward warmer CHWS temps? — Turn On for a bias for warmer temperatures.	D: Off R: Off/On
Add an additional small bias for reset toward warmer CHWS temps? — This adds a fine adjustment to the small bias (above). Turn **On** to increase bias for warmer CHWS temperatures and adjust the gain between 0 and 10.	D: Off R: Off/On
Fine gain for bias for reset toward warmer CHWS temps (0=min to 10=max) — This adds another fine adjustment to the small bias above, increases bias for warmer temperatures, and adjusts the gain between 0 and 10.	D: 5 R: 0 to 10

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Point Name/Description	Range
Reset Output Expected chilled water supply setpoint temperature. The programmed "0 - 10 (deg)" output is converted to the chilled water temperature setpoint signal compatible with your system, feeding directly to the chiller setpoint adjust, either in your chiller manager or each chiller program. The chiller setpoint adjust requires an actual temperature range, such as 42 to 52°F. If the chiller setpoint adjust requires a 0 - 10 input signal, then you must still convert the above (i.e. 42 to 52°F) to a 0 - 10 signal in the chiller manager or each chiller program. This is not done in the optimization program.	
Vary chilled water supply temperature from __ degrees — Defines the minimum allowable chilled water temperature	D: 42°F R: 42 to 46°F
to __ degrees. Defines the maximum allowable chilled water temperature	D: 52°F R: 48 to 54°F
Current Setpoint Input	
Use the current chilled water setpoint (CURR STPT IN) as the optimizer's starting setpoint? — The optimizer's beginning setpoint when first enabled.	D: NO R: NO/YES
16 CURR STPT IN (ANI2) — Displays value. Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.	D: Unlocked (unchecked) R: Unlocked (unchecked) Locked (checked)

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Condenser Water Temperature Optimizer Reset

Navigation: i-Vu® **Properties** > **Control Program** > **Condenser Water Temperature Optimizer Reset**

Overall operation

Like the Chilled Water Temperature Optimizer Reset section, the condenser water reset searches for the condenser water supply temperature that best lowers the kW/ton on the condenser water side. The reset lowers condenser water supply temperature for the approach temperature that balances energy savings at the chiller with energy increases at the tower fans and condenser water pumps.

Approach temperature

The approach temperature is the difference between condenser water supply temperature and current wet bulb temperature (cws temp – oa wb). The rated approach temperature equates to the lowest condenser water temperature that the tower is likely to produce. A 7°F approach rating is common for most cooling towers, although more efficient towers can go down to a 5°F degree approach, or less, in a few cases.

Condenser water reset function

After the program is enabled, the algorithm begins its optimizing routine with **Section 2 - Manual Overrides of Condenser Water Reset - and other Settings** (page 104) > **First Reset**. Each response period, the program determines the next reset signal that best lowers energy demand. The 0-10 (deg) output is converted to a condenser water supply approach to wet-bulb temperature, which is a setpoint between the maximum and minimum approach. Since the wet bulb temperature varies during the day, the actual condenser water supply setpoint also varies within the approach window (maximum approach – minimum approach). See example setpoint chart below (assuming a very efficient tower with a minimum 5 degree approach.

No Reset of 0	= 12 degree (max approach, adj.)	Warmer Condenser Supply Temp
Full Reset of 10	= 5 degree (min approach, adj.)	Cooler Condenser Supply Temp

EXAMPLE The current outside air wet-bulb temperature is 70°F.

- The program calculates an optimal approach setpoint of 6°F.
  - The condenser water setpoint will be 70°+ 6°=76°F (based on current wet bulb)
  - If the tower is rated at a 7°F approach, then this is a cooler approach temperature with tower fans likely running at or near 100%. But the chiller would experience lower lift and possibly greater energy savings at such a low approach temperature.
- The program attempts to find the balance of energy saved at the chiller and energy expended at the fans through a calculated approach temperature. So the approach temperature setpoint would likely change throughout the day in a constant search for the optimal temperature.

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Point Name/Description	Range
You can use one of the following to link to the tower or pump condenser water setpoint control. • BACnet ANO2, which writes to a remote Setpoint Analog Value • BACnet Analog value, which is read by a remote Setpoint ANI **NOTE** If using a BAV, link the **Optimized (Final) CWS Reset Setpoint** BAV to the remote cooling tower logic reset BACnet Analog Input. This output is a temperature setpoint signal and when fed through the condenser water logic, should override the current CWS temperature setpoint. The BACnet Analog Input should go through its own safeties and ramps before setting the CWS temperature setpoint. The Heartbeat may be used to communicate a healthy signal to the receiving program. Use if required or desired, but not necessary.	
Optimizer Condenser Water Supply Reset Enable — Displays status.	R: DISABLED / ENABLED
Optimized Condenser Water Supply Setpoint AV (wetb + approach) (BAV) **—** Displays value.	
Lock the CWS temperature setpoint output — Locks above setpoint to a specific value.	D: Off R: Off/On
To __ degrees (realistic condenser water supply temperature setpoint) **NOTE** Bypasses optimizer calculations - but not lower and upper limits. Use with caution.	D: 0°F R: 70 to 80°F
Outdoor Air Wet Bulb Temperature — Displays value.	
Optimized Condenser Water Supply Setpoint (calculated approach) (BAV) — Displays value.	
17 CWS STPT TEMP (REMOTE INPUT) — Displays value. Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.	D: Unlocked (unchecked) D: Enabled (checked)
17 CWS TEMP (REMOTE INPUT) — Displays value. Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.	D: Unlocked (unchecked) D: Enabled (checked)
17 CWR TEMP (REMOTE INPUT) — Displays value. Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.	D: Unlocked (unchecked) D: Enabled (checked)
17 CW TEMP (REMOTE INPUT) — Displays value. Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.	D: Unlocked (unchecked) D: Enabled (checked)
Total Chiller kW/ton — Displays value.	
Total Condenser Water Pump kW/ton — Displays value.	
Total Cooling Tower Fan kW/ton — Displays value.	

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Point Name/Description	Range
Total Condenser Water System kW/ton — Displays value.	
17 Optimized CWS Setpoint Heartbeat ANO Minutes — Displays value. Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.	D: Unlocked (unchecked) D: Enabled (checked)
17 Optimized CWS Setpoint ANO — Displays value. Allows lockout if **Lock at value:** is checked. Allows communication if **Enabled?:** is checked.	D: Unlocked (unchecked) D: Enabled (checked)

Section 1 - Condenser Water System Optimizer - Enable Conditions

Navigation: i-Vu® **Properties** > **Control Program** > **Condenser Water Temperature Optimizer Reset** > **Section 1 - Condenser Water System Optimizer - Enable Conditions**

Point Name/Description	Range
1. CWS Optimizer ON Switch: You must set this to **DISABLED** until the system is setup and ready to run. This enables the **Condenser Water Supply Temperature Setpoint Reset** portion of the program. **NOTE** Only turn the set to **ENABLED** after the program is setup and ready to run. The **Main ON Switch** in *Section 1 - Optimizer - Primary Enable Conditions* (page 78) must also be enabled for the CWS Optimizer to be enabled.	D: DISABLED R: DISABLED/ENABLED

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Section 2 - Manual Overrides of Condenser Water Reset - and other Settings

Navigation: i-Vu® **Properties** > **Control Program** > **Condenser Water Temperature Optimizer Reset** > **Section 2 - Manual Overrides of Condenser Water Reset - and other Settings**

Point Name/Description	Range
Manual "Reinitialize" & "Pause & Hold" - Override of the Optimizer Reset & Pause at it Current Reset Setpoint	
Reinitialize CWS reset algorithm (resets algorithm logic to zero): Select **REINITIALIZE** to manually reinitialize and reset the condenser water optimization. After a few moments, the program returns back to its initial zero state. Select **Off** to allow the program to operate again from its zero state. **CAUTION** This setting drops the setpoint back to its default "resting" temperature and restarts the program from state zero.	D: Off R: Off/REINITIALIZE
Pause CWS reset algorithm (holds logic at current state and output): Select **PAUSE** to manually pause the condenser water supply reset. When you no longer need the pause, select **OFF** to begin the program from its holding pattern. **Pause & Hold is __** — Displays status. **Pause is __ due to low limit.** — Displays status.	D: Off R: Off/Pause
Alarm if the "Pause CWS reset algorithm" above is on longer than _:__ (mm:ss)	D: 30:00 mm:ss R: 10:00 to 60:00 mm:ss
with output of ____ for _:__ (mm:ss) — Displays status and value.	
CW MAN PAUSE ALARM __ — Displays status.	
Manual "Quick Warm Up" - **Override of the Optimizer Reset & Raise the Supply Temperature Setpoint** When on, the setpoint is still limited to its high and low limit settings.	
Optimizer CWS Temp - Quick Warm Up: — Manual override to the program to raise condenser water supply temperature.	D: Off R: Off / QUICK WARM
Quick Warm Up incremental rise __ (deg) — Rise per Response Interval **NOTE** The Quick Warm Up (deg) rise applies to warm up when condenser water temperature is considered too cold and a limit is imposed. **Quick Warm Up is:** — Displays status. **Quick Warm up is __ due to CWS temperature below low limit.** — Displays status.	D: 0.5 (deg) R: 0.5 to 1.5 (deg)

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Point Name/Description	Range
First Reset	
First Reset - Lower Temperature initially by: __ (deg) — The program requires a priming reset when it is first turned on. The reset occurs after the program has first been enabled in **General Conditions & Status** and **Section 1 - Optimizer - Primary Enable Conditions**. For the condenser water optimization, this determines the initial approach temperature. The first reset, or priming reset, should be large enough for the system to register the reset temperature and respond to it, but not so large that it creates instability. If the temperature increment is too small, then the system won't experience enough temperature change to determine if it saves energy. The program measures the decrease (or possible increase) in kW/ton from this first reset. It then determines what the next reset should be. For the condenser water reset, the greater the value, the lower the temperature. We recommend you set this value between 5 (deg) and 7(deg) for setup. The first reset must be different from your resting approach temperature described in *Section 3 Condenser Water Setpoint Reset* (page 108).	D: 6 (deg) R: 4 to 8 (deg)
Input Smoothing and System Response Time	
Input Smoothing (0=min : 100=max): — This setting smooths the (kW/Ton) input and removes erratic signals. This smoothing is more complex and subtle than most. It does not overly smooth the signal, but rather adjusts without shifting the output too much. Input settings: 0 - no smoothing 1 - automatic minimal smoothing Up to 100 (maximum smoothing or dampening)	D: 50 R: 0 to 100

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Point Name/Description	Range
System Response time in minutes (3=min to 30=max): __ minutes The response time period of the building to react to each reset temperature change. If set to less than the actual system response time, then the reset could search and not be accurate. Current interval time is: __:__ minutes and _.__ seconds. — Displays values. **CAUTION** Critical setting. You set the time it takes for the condenser water system to respond after the optimization program resets the temperature. The program must perceive if the system is using less energy after the setpoint has changed and after the system has settled to the new setpoint. The following occur during the response time: Condenser water temperature reaches the new temperature Cooling tower fans stabilize Pumps reach their new speed The response time is difficult to approximate. If you have access to the entire system, you can trend various points to approximate time. **NOTES** Remote towers (for example, if they are on the roof) response time may be between 5 and 10 minutes. Towers next to the mechanical room may be between 3 and 5 minutes.	D: 8 minutes R: 3 to 30 minutes
Minimum and Maximum Reset Increments & Algorithm Reset Gain Each response period, the program determines the next reset signal that lowers energy demand most effectively. The program outputs a reset signal between 0 and 10 (deg) (0 (deg) = no reset or warmest condenser water temperature, 10 (deg) = the maximum or coolest temperature). **EXAMPLE** The program is producing a 5.4 (deg) reset signal. The next time it resets, in order to minimize energy use, it either adds to the signal, by lowering the condenser water temperature, or subtracts from the signal, by raising the temperature. Each reset increment falls between the allowed minimum and maximum. The actual reset value is based on the reset gains and measurements of the curve profile. If the program is currently producing a 5.4 (deg) reset, and the next reset increment is determined to be 1.1 (deg), then the next reset output will be (5.4 (deg) + 1.1 (deg)) = 6.5 (deg). This is converted to the actual condenser water approach setpoint. **NOTE** The reset increment should be large enough for the system to register the reset temperature and react to it – but not so large that it creates instability. If the temperature increment is too small, the system won't experience enough temperature change to determine if it saves energy.	
Adjust Reset Increments below:	

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Point Name/Description	Range
Minimum Reset Increment: __ (deg) (output units: 0-10) — The minimum allowed output increment for each response interval. Current reset increment is: __ — Displays value. **EXAMPLE** If you set this value to 1.0 (deg), the program resets no less than that for each increment. This does not necessarily equal the actual reset at the chiller, which may have a range of 42°F to 54°F. Unless the 0-10 (deg) signal is exactly the 10°F temperature range, the minimum increment may not equal the actual temperature increment. With a range of 42°F to 54°F, each reset degree is (54°-42°F)/10 = 1.2°F degrees.	D: 1 R: 0.75 to 1.25
Maximum Reset Increment: __ (deg) (output units: 0-10) — The maximum allowed output increment for each response interval. **EXAMPLE** If you set it to 1.5 (deg), it resets no more than 1.5 (deg) for each increment. This does not necessarily equal the actual condenser water approach temperature.	D: 2 R: 1.25 to 2.0
Adjust Reset Gains below:	
Reset Increment Coarse Gain (1=min to 10=max) — Determines how large each reset increment will be. The program applies the gain to various measurements of the efficiency curve, and determines the next increment size. The larger the gain, the larger the increment. However, no matter how small or large the gain, the increment can be no less than the minimum increment and no more than the maximum increment.	D: 5 R: 1 to 10
Reset Increment Fine Gain (0=min to 10=max) — A fine gain that is added to each increment. It can be combined with the above reset increment to configure the best gain applied to each increment. More is described about how to set up the gain in the *Start-up and Commissioning* (page 46) section.	D: 0 R: 0 to 10
Bias for reset of CWS temperature setpoint for cooler temperatures - (only if desired, not a requirement) The program functions without applying bias. However, there are times that the kW/ton input can be erratic. Adding bias toward cooler condenser water temperatures promotes energy savings at the chiller even though the condenser water reset temperatures may not be the most effective supply temperature for the system. **EXAMPLE** The program is very close to resetting toward a cooler temperature, but not close enough, and still wants to reset for warmer temperatures. The bias shifts the decision slightly toward resetting for cooler temperatures. Energy savings are biased toward the chiller rather than the towers. **NOTE** Bias is not a required setting.	
Add a small bias for reset toward cooler CWS temps? — Turn On for a bias for cooler temperatures.	D: Off R: Off/On
Add an additional small bias for reset toward cooler CWS temps: — Adds a fine adjustment to the small bias (above). Turn **On** to increase bias for cooler temperatures and adjust the gain between 0 and 10.	D: Off R: Off/On
Fine gain for bias for reset toward cooler CWS temps (0=min to 10=max) — Adds another fine adjustment to the small bias above, increases bias for cooler temperatures, and adjusts the gain between 0 and 10.	D: 5 R: 0 to 10

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Section 3 - Condenser Water Setpoint Reset - Output & Limit Settings

Navigation: i-Vu® **Properties** > **Control Program** > **Condenser Water Temperature Optimizer** > **Section 3 - Condenser Water Setpoint Reset - Ouput & Limit Settings**

Point Name/Description	Range
Condenser Water Supply Setpoint Range – Based on OA Wet Bulb Temperature	
Maximum Wet Bulb Approach __ degrees — The approach when the reset is at its lowest - equivalent to the tower fans running slower as the condenser water temperature setpoint is warmer.	D: 12°F R: 9 to 12°F
Resting Wet Bulb Approach __ degrees — The default approach, or base condenser water temperature setpoint, when the optimization program is off. The general default is set close to, but not below, the tower design efficiency. It can be any value between the maximum and minimum approach. **EXAMPLE** The resting approach may be 7°F above wet bulb temperature, which is appropriate, since it is between a high of 12°F and a low of 5°F.	D: 8°F R: 7 to 9°F
Resting: Use CWS Setpoint: __ degrees — The default temperature or resting condenser water temperature setpoint, when the optimization program is off.	D: 75°F R: 72 to 78°F
Instead of the "Resting Wet Bulb Approach" above?	D: NO R: NO/YES
Minimum Wet Bulb Approach __ degrees — The approach when the reset is at its highest. This is the same as tower fans running faster as the condenser water temperature setpoint is coolest.	D: 5°F R: 4 to 7°F
Condenser Water Supply Temperature – High Limits To prevent chiller surge and other high condenser water temperature issues, high temperature limits are established by the following: • Outside Air Ratio — As the outside air wet bulb temperature rises, set a ratio to limit the condenser water supply temperature • Simple high temperature limit — Do not allow the condenser water temperature to rise above a specific setpoint. **NOTE** These safeties are not meant to work as primary high limit safeties. You also need high limit safeties at the cooling tower or the facility's local cooling tower program.	
Vary condenser water supply temperature high limit based on outdoor air wet bulb temperature	
As outdoor air wet bulb temperature rises (from __ degrees...	D: 78°F R: 70 to 80°F
...**to __ degrees)**	D: 85°F R: 80 to 90°F
Limit condenser water supply temperature (from __ degrees...	D: 79°F R: 76 to 82°F

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Point Name/Description	Range
...to __ degrees)	D: 75°F R: 72 to 77°F
Allow condenser water temperature setpoint to rise no higher than __ degrees	D: 79°F R: 75 to 84°F
Condenser Water Supply Temperature – Low Limits —This program will apply the highest of the following methods: **NOTES** • To help prevent oil migration, minimum pressure across the orifice plate, and other low-lift issues, the condenser water temperature is given low temperature limits. • These safeties are not meant to work as primary low-limit safeties. You still need low limit safeties at the cooling tower or the facility's local cooling tower program • The condenser water supply temperature will not drop below the highest of the lowest limits. So, the highest limit is the governing limit.	
Method 1 There are 3 low limit temperatures based on chiller capacity: Low limit temperature at 20%, 50%, and 100% of chiller operating capacity. The temperatures are linearly interpolated between these points. If the low limit temperature profile is not known, set the same low limit temperature for each.	
Low CWS Temp. Setpoint limit at 20% Chiller capacity: __ degrees	D: 57°F R: 55 to 78°F
Low CWS Temp. Setpoint limit at 50% Chiller capacity: __ degrees	D: 56°F R: 55 to 80°F
Low CWS Temp. Setpoint limit at 100% Chiller capacity: __ degrees	D: 58°F R: 55 to 80°F
Method 2 The condenser water temperature low limit varies based on chiller operating capacity and chilled water supply temperature setpoint. The goal is to have enough pressure across the orifice plate (expansion mechanism) to maintain sufficient refrigeration. This is accomplished by maintaining a low minimum delta temperature between chilled water supply and condenser water supply (condenser water supply temperature – chilled water supply temperature setpoint). The delta temperature varies according to capacity. • Low Load – Optimizer running at minimum allowable load 20% default – CWS Setpoint = CHWS Setpoint + 10°F (adj) • High Load – Optimizer running at maximum allowable load 90% default – CWS Setpoint = CHWS Setpoint + 30°F (adj) The delta temperature varies with the square of capacity between these points. If the low limit temperature profile is unknown, input the default. If the profile is unknown, you can keep the defaults. If you want to disable this feature, enter 0°F for both.	

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Point Name/Description	Range
Low CWS Temp. Setpoint limit at Low Load = CHWS Setpoint + __ degrees	D: 10°F R: 10 to 30°F
Low CWS Temp. Setpoint limit at High Load = CHWS Setpoint + __ degrees	D: 30°F R: 20 to 40°F
Method 3 — This is a simple low limit.	
Allow condenser water temperature setpoint to drop no lower than: __ degrees	D: 55°F R: 53 to 75°F
Current Limits, Approach, Setpoints, and CWS Temperature Setpoint **Current High Limit is:** — Displays value. **Current High Approach is:** — Displays value. **Current Setpoint is:** — Displays value. **Current Low Approach is:** — Displays value. **Current Low Limit is:** — Displays value.	

Electric Metering - Combined kW of Monitored Equipment

Navigation: i-Vu® **Properties** > **Control Program** > **Electric Metering - Combined kW of Monitored Equipment**

Point Name/Description	Range
Meter Input	
Instantaneous Demand: __ kW — Displays value of the instantaneous demand read by meters.	
Alarm: **IN FAIL —** Displays the status of the meter input based on the criteria selected below **Send Alarm if meter input** < **x** with hysteresis of **y** for greater than **_:__** mm:ss Where: • x = alarm threshold in Kw • y = hysteresis amount • **_:__** mm:ss = delay time in minutes and seconds	D: 30:00 mm:ss R: 10:00 to 60:00 mm:ss
Reset History **Reset ALL values to zero?** — Provides the ability to reset all meter data and history	D: No R: No/Yes

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Point Name/Description	Range
Peak Demand History — Displays the historical peak kW demand values recorded for various periods. Each period also indicates the time, date, and day of the occurrence *since the beginning of the evaluation period*. The following time period values are displayed in this format: ___.__ Kw on ___ (hh:mm) on __/__/__ (mm/dd/yy) / day of the week **since** __:__ (hh:mm) on __/__/__ (mm/dd/yy) / day of the week	
Daily Peak Demand **Today** — Displays values and times in the above format. **Previous Day** — Displays values and times in the above format.	
Monthly Peak Demand **Month-To-Date** — Displays values and times in the above format. **Previous Month** — Displays values and times in the above format.	
Yearly Peak Demand **Year-To-Date** — Displays values and times in the above format. **Previous Year** — Displays values and times in the above format.	
Usage History — Displays the historical accumulated energy usage values recorded for the following periods.	
Daily Usage **Today** — Displays kWh values. **Previous Day** — Displays kWh values.	
Monthly Usage **Month-To-Date** — Displays kWh values. **Previous Month** — Displays kWh values.	
Yearly Usage **Year-To-Date** — Displays kWh values. **Previous Year** — Displays kWh values.	

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Appendix C: Network Points List for TruVu™ Chilled Water System Optimizer

Equipment	Data point description	Option (O) or Required (X)	Description	Point Type	Comment
Chilled Water Plant					
	Tons of cooling	O	Calculated Cooling Tons	ANI	If available, can be read from a BTU meter. If not, Optimizer will calculate Tons using CHW flow & delta T
	Chiller system on/off	X	System CHW Plant Start/Stop	BNI	
	Chilled water flow rate	X	Total System CHW Flow	ANI	On Pri/Sec systems, use Sec Loop Flow
	Condenser water flow rate	O	Total System CW Flow	ANI	Optional. Can be used for system analysis.
	System CHW Setpoint	X	System CHW Setpoint	ANO	This value is optimized CHW setpoint value and is pushed down to the incumbent control system.
	CHW Setpoint Heartbeat	O	CHW setpoint comm verification signal to incumbent BAS	ANO	Optional. This value is used to confirm communications between the Optimizer and the base control system. It is available in the base control system if using TruVu ChillerVu control logic, or modified i-Vu® logic. Third party usage will require modification to the third party control logic.
	System CW Setpoint	X	System CW Setpoint	ANO	This value is optimized CW setpoint value and is pushed down to the incumbent control system.
	CW Setpoint Heartbeat	O	CW setpoint comm verification signal to incumbent BAS	ANO	Optional. This value is used to confirm communications between the Optimizer and the base control system. It is available in the base control system if using TruVu ChillerVu control logic, or modified i-Vu® logic. Third party usage will require modifying to the third party control logic.
	Chilled water supply temperature set point	O	System CHW Setpoint	ANI	Optional. Can be used to monitor the effective CHW setpoint, or can be used by the Optimizer such that it starts its setpoint calculations from current setpoint.
	Chilled water supply temperature	X	Loop CHW Supply Water Temp	ANI	On Pri/Sec systems, use Sec Loop Temps
	Chilled water return temperature	X	Loop CHW Return Water Temp	ANI	On Pri/Sec systems, use Sec Loop Temps
	Condenser water supply temperature	O	Common CW Supply Temp	ANI	
	Condenser water return temperature	O	Common CW Return Temp	ANI	
	Condenser water supply temperature set point	O	System CW Setpoint	ANI	Optional. Can be used to monitor the effective CW setpoint.
Chillers (Max 8)					

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Equipment	Data point description	Option (O) or Required (X)	Description	Point Type	Comment
	Chiller power	X	Power input per chiller	ANI	Inputs can be either amps of kW
	Chiller status	X	Chiller run status	BNI	
Chilled water pumps (Max 20)					
	CHW pump power	X	Power per pump	ANI	Optimizer supports a maximum of 20 kW inputs, and 20 amp inputs Total of ALL CHW pumps (max number is the sum of all pumps; primary, secondary, tertiary)
Condenser water pumps (Max 20)					
	CW pump power	X	Power per pump	ANI	Optimizer supports a maximum of 10 kW inputs, and 10 amp inputs
Cooling tower fans (Max 20)					
	Cooling tower fan power	X	Power per tower	ANI	Optimizer supports a maximum of 10 kW inputs, and 10 amp inputs
Air handler units (Max 40)					
	AHU fan power	X	Power per fan	ANI	Optimizer supports a maximum of 20 kW inputs, and 20 amp inputs
	Return air humidity or area relative humidity	O	RARH from each of the 20 AHUs or representative area relative humidity values	ANI	Optimizer supports up to 20 RH Inputs
Weather					
	Outside air temperature	X		ANI	
	Outside air relative humidity	X		ANI	

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Document revision history

Important changes to this document are listed below. Minor changes such as typographical or formatting errors are not listed.

Date	Topic	Change description	Code*
		No changes yet.	

* For internal use only

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