BAC-9000(A) Series VAV Controller

Installation Guide

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INTRODUCTION

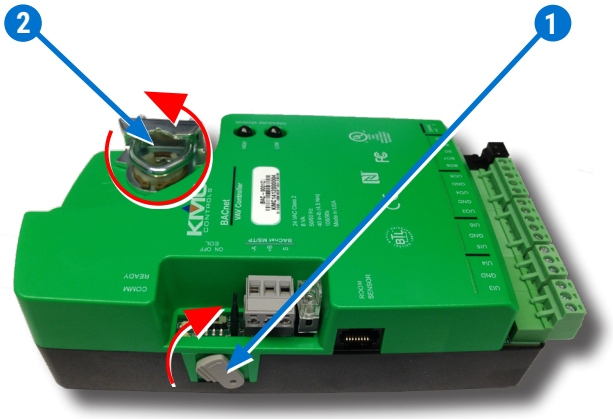
Complete the following steps to install a KMC Conquest™ BAC-9000(A) Series VAV Controller-Actuator. For controller specifications, see the **data sheet** at **kmccontrols.com**. For additional information, see the **KMC Conquest Controller Application Guide**.

SET DRIVE HUB (45/60°) ROTATION LIMIT

NOTE: When shipped from the factory, the drive hub can rotate 90 degrees. However, you can install rotatation limits at 45 or 60 degrees using the included stop screw if required by the VAV box. Complete the steps in this section ONLY IF the VAV damper rotation limit is either 45 or 60 degrees. If the VAV damper rotates 90 degrees, skip this section and go to **Mount Controller on page 2** instead.

NOTE: Damper positions for minimum and maximum air flow are set during the balancing procedure at a later stage.See **Configure/Program the Controller on page 7.**

1. Push and hold the **gear release** 1 and rotate the **drive hub** and **V-clamp** 2 to the left.



NOTE: The **V-clamp nuts** 3 should be on top.

2. Turn the controller over.

3. Remove the **stop screw** 4 from the storage location and clean debris from the threads.

4. Insert the stop screw into the **60** 5 or **45** 6 stop hole position.

5. Tighten the screw until the screw head touches the plastic in the bottom of the recess.

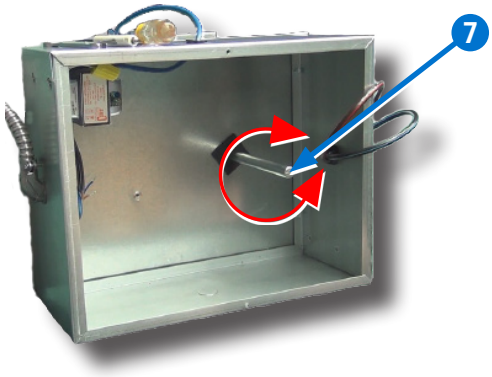
NOTE: Overtightening the screw can cause compression in the case which may interfere with the controller's operation.

MOUNT CONTROLLER

NOTE: Install the controller in a metal enclosure for RF shielding and physical protection.

NOTE: The controller can be installed on a 3/8–5/8 inch (9.5–16 mm) round or 3/8–7/16 inch (99.5–11 mm) square damper shaft with a minimum length of 2 inches (51 mm).

1. Manually rotate the **damper shaft** 7 on the VAV box to fully open the damper.

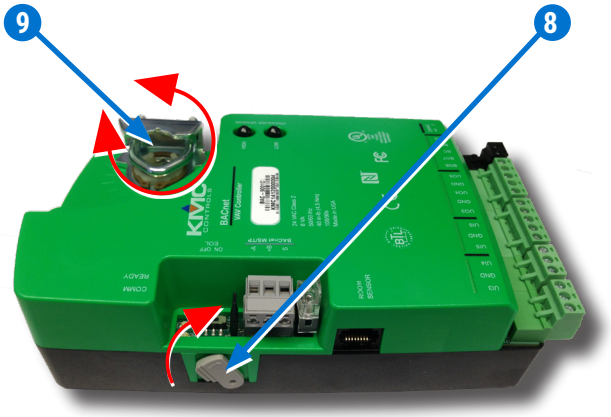


NOTE: The drive hub and V-clamp will be rotated in the same direction in Step 8.

2. Push and hold the **gear disengagement lever** 8 on the side of the controller.

3. Rotate the **drive hub and V-clamp** 9 in the same direction that opened the damper.

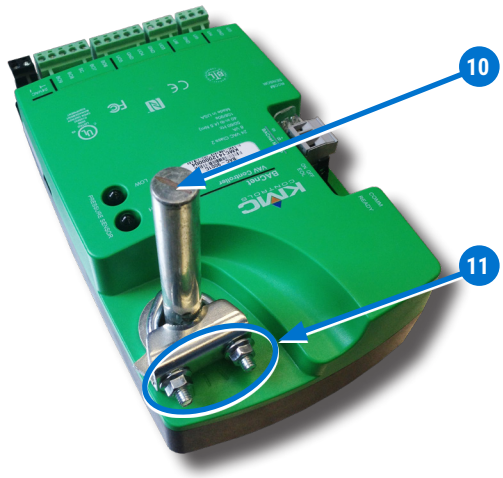
NOTE: Continue to rotate the drive hub and V-clamp until they reach a stop.



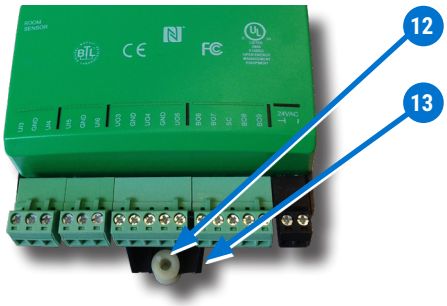
4. Position the controller over the **damper shaft** 10 so that the color-coded **terminal blocks** are easy to access for wiring.

NOTE: The black terminals are for power. The green terminals are for inputs and outputs. The gray terminals (if present) are for MS/TP communication.

5. Finger-tighten the **V-clamp nuts** 11 to position the damper shaft in the drive hub.



6. Center the **mounting bushing** 12 in the **mounting tab** 13.



7. Attach the controller to the VAV box with a **#8 sheet metal screw** through the **mounting bushing** 12.

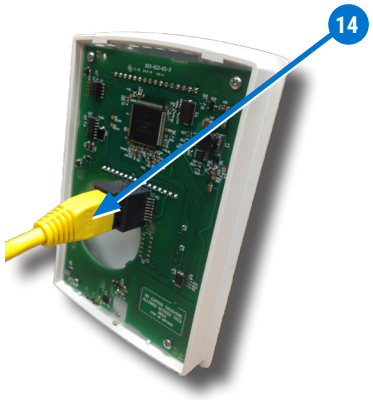
8. Evenly tighten the **V-clamp nuts** 11 on the drive hub to 30–35 in-lb.

CONNECT SENSORS AND EQUIPMENT

NOTE: For more information, see **Sample (BAC-9001A) Wiring on page 8** and **Input/Output Objects/Connections on page 9**. See also the BAC-9000 series videos in the **KMC Conquest Controller Wiring** playlist.

NOTE: A digital **STE-9000 Series NetSensor** can be used for configuring the controller (see **Configure/Program the Controller on page 7**). After the controller has been configured, an **STE-6010**, **STE-6014**, or **STE-6017** analog sensor can be connected to the controller in place of the NetSensor. See the relevant installation guide for additional details.

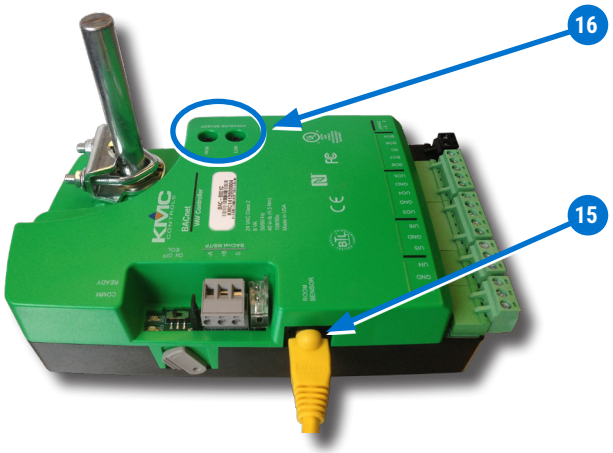
1. Plug an **Ethernet patch cable** 14 connected to an STE-9xxx or STE-6010/6014/6017 sensor into the controller's (**yellow** 22) **ROOM SENSOR** 15 port.



NOTE: The Ethernet patch cable should be a maximum of 150 feet (45 meters).

⚠ CAUTION

On Conquest "E" models, do NOT plug a cable meant for Ethernet communications into the Room Sensor port! The Room Sensor port powers a NetSensor, and the supplied voltage may damage an Ethernet switch or router.



NOTE: Auxiliary VAV equipment such as fans, heaters, reheat valves, and discharge air temperature sensors can be connected to the controller.

2. Connect auxiliary VAV equipment to the input and output **green terminal blocks** 17. See **Sample (BAC-9001A) Wiring on page 8**.

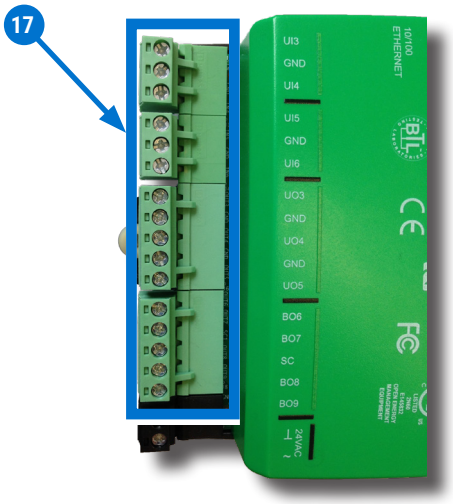
⚠ CAUTION

Do NOT connect 24 VAC to the analog outputs (UO3–UO5 and GNDs)!

NOTE: Use 24 V**AC** (only) with triac outputs (BO6–BO9 with SC).

NOTE: Wire sizes 12–24 AWG can be clamped in each terminal.

NOTE: No more than two (16 AWG) wires can be joined at a common point.



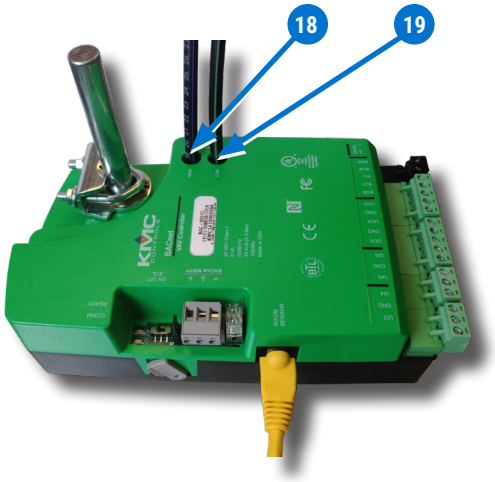
CONNECT (OPTIONAL) PRESSURE SENSOR

NOTE: Complete the steps in this section to connect an air flow sensor to the controller.

NOTE: Only the BAC-9021 controller does not have PRESSURE SENSOR ports. For that model, skip this section.

NOTE: Use 1/4 inch (6.35 mm) FR (Flame Retardant) tubing. Tubing should not be longer than 20 feet (6 meters).

1. Remove the **black shipping plugs** 16 from the PRESSURE SENSOR ports.
2. Connect the high pressure tube from the pressure flow sensor to the **HIGH** 18 port on the controller.
3. Connect the low pressure tube from the pressure flow sensor to the **LOW** 19 port on the controller.



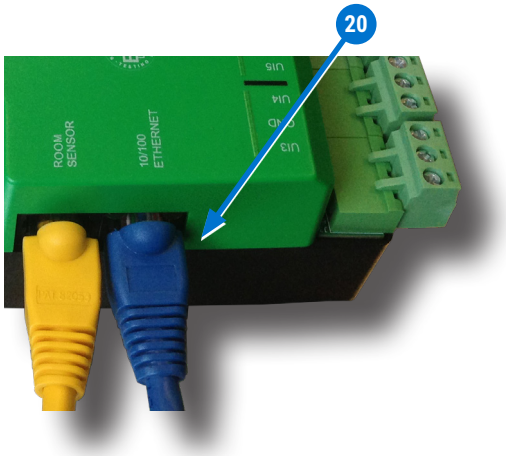
CONNECT (OPT.) ETHERNET NETWORK

1. For a BAC-9001(A)C**E** (only), connect an **Ethernet patch cable** 20 to the **10/100 ETHERNET** port 21.

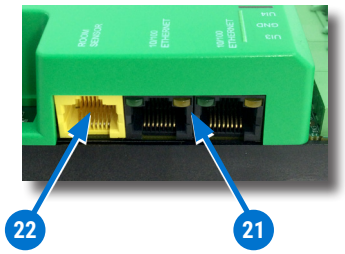
⚠ CAUTION

On Conquest "E" models, do NOT plug a cable meant for Ethernet communications into the Room Sensor port! The Room Sensor port powers a NetSensor, and the supplied voltage may damage an Ethernet switch or router.

NOTE: Before May 2016, BAC-9001CE models had a **single** Ethernet port 20. They now have **dual** Ethernet ports 21, enabling daisy-chaining of controllers. See the **Daisy-Chaining Conquest Ethernet Controllers Technical Bulletin** for more information.



NOTE: Also on the newer models, the Room Sensor port is **yellow** 22 instead of black to help differentiate it from the black Ethernet ports.

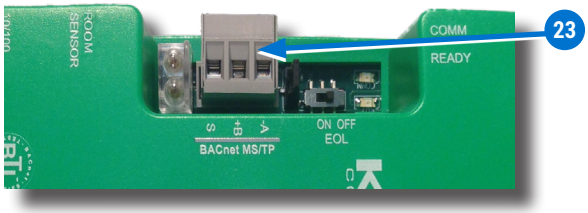


NOTE: The Ethernet patch cable should be T568B Category 5 (or better) and a maximum of 328 feet (100 meters) between devices.

CONNECT (OPTIONAL) MS/TP NETWORK

1. For a BAC-9001 or BAC-9021, connect the network to the gray **BACnet MS/TP network terminal block** 23.

   NOTE: Use 18 gauge AWG shielded twisted pair cable with maximum capacitance of 51 picofarads per foot (0.3 meters) for all network wiring (Belden cable #82760 or equivalent).



   A. Connect the **–A** terminals in parallel with all other **–A** terminals on the network.

   B. Connect the **+B** terminals in parallel with all other **+B** terminals on the network.

   C. Connect the **shields** of the cable together at each device using a wire nut or the **S** terminal in KMC BACnet controllers.

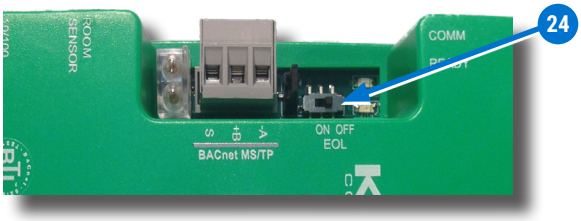
2. Connect the cable shield to a good earth ground at **one end only**.

   NOTE: For principles and good practices when connecting an MS/TP network, see **Planning BACnet Networks (Application Note AN0404A)**.

   NOTE: The EOL switch is shipped from the factory in the OFF position.

3. If the controller is at either end of a BACnet MS/TP network (only one wire under each terminal), turn the **EOL switch** 24 to **ON**.

   NOTE: For more information, see **Sample (BAC-9001A) Wiring on page 8** and the BAC-9000 series videos in the **KMC Conquest Controller Wiring** playlist.



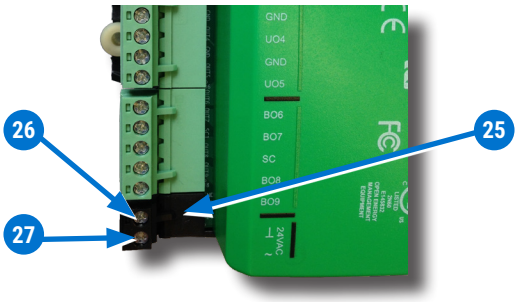
CONNECT POWER

NOTE: Follow all local regulations and wiring codes.

1. Connect a 24 VAC, Class-2 transformer to the **black power terminal block** 25 of the controller.

   A. Connect the neutral side of the transformer to the controller's **common terminal ⊥** 26.

   B. Connect the AC phase side of the transformer to the controller's **phase terminal ~** 27.



NOTE: Connect only one controller to each transformer with 12–24 AWG copper wire.

NOTE: Use either shielded connecting cables or enclose all cables in conduit to maintain RF emissions specifications.

NOTE: For more information, see **Sample (BAC-9001A) Wiring on page 8** and the BAC-9000 series videos in the **KMC Conquest Controller Wiring** playlist.

POWER AND COMMUNICATION STATUS

The **status LEDs** indicate power connection and network communication. The descriptions below describe their activity during **normal operation** (at least 5 to 20 seconds **after** power-up/initialization or restart).

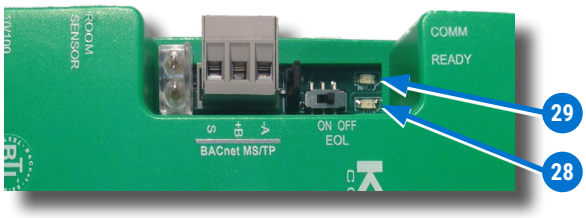
> **NOTE:** If both the green READY LED and the amber COMM LED remain OFF, check the power and cable connections to the controller.

Green READY LED 28

After controller power-up or restart is complete, the READY LED flashes steadily about once per second, indicating normal operation.

Amber (BACnet MS/TP) COMM LED 29

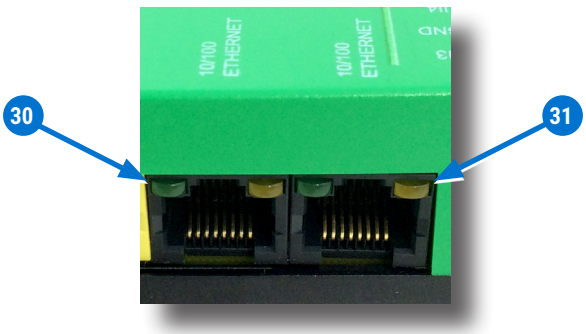
- During normal operation, the COMM LED flickers as the controller receives and passes the token over the BACnet MS/TP network.
- When the network is **not** connected or communicating properly, the COMM LED flashes more slowly (about once a second).



Green ETHERNET LED 30

> **NOTE:** The Ethernet status LEDs indicate network connection and communication speed.

- The green Ethernet LED stays ON when the controller is communicating with the network.
- The green Ethernet LED is OFF when the (powered) controller is **not** communicating with the network.

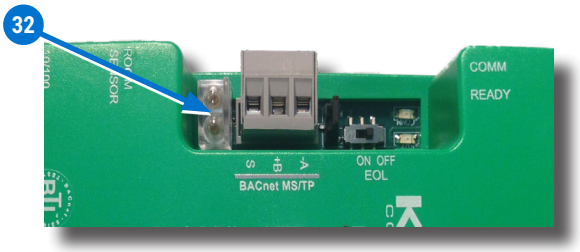


Amber ETHERNET LED 31

- The amber Ethernet LED flashes when the controller is communicating with a 100BaseT Ethernet network.
- The amber Ethernet LED remains OFF when the (powered) controller is communicating with the network at only 10 Mbps (instead of 100 Mbps).

> **NOTE:** If both the green and amber Ethernet LEDs remain OFF, check the power and network cable connections.

MS/TP NETWORK ISOLATION BULBS



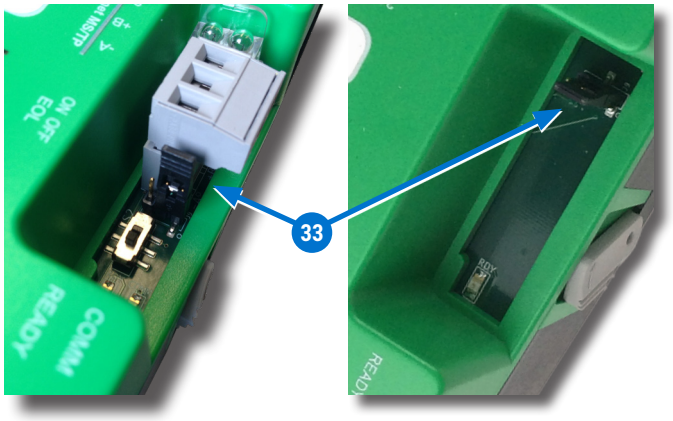
The two **network isolation bulbs** 32 serve three functions:

- Removing the (**HPO-0055**) bulb assembly opens the MS/TP circuit and isolates the controller from the network.
- If one or both bulbs are ON, the network is improperly phased. This means the ground potential of the controller is not the same as other controllers on the network. If this happens, fix the wiring. See **Connect (Optional) MS/TP Network on page 5**.
- If the voltage or current on the network exceeds safe levels, the bulbs blow, opening the circuit. If this happens, fix the problem and replace the bulb assembly.

WATCH DOG JUMPER

The **watch dog jumper** 33 resets the controller if there is a power failure or a communication timeout between the controller and the network.

Never remove the jumper (from the two outer pins).



CONFIGURE/PROGRAM THE CONTROLLER

See the table (in the column to the right) for the most relevant KMC Controls tools for configuring, programming, and/or creating graphics for the controller. See the tools' documents or Help systems for more information.

NOTE: After the controller has been configured, an STE-6010/6014/6017 series analog sensor can be connected to the controller in place of an STE-9000 series digital NetSensor.

NOTE: A BAC-9001(A)C**E** can be configured by connecting an HTML5-compatible web browser to the controller's default IP address (192.168.1.251). See the **Conquest Ethernet Controller Configuration Web Pages Application Guide** for more information about the built-in configuration web pages.

NOTE: To configure a VAV controller, enter the correct **K factor** for the VAV box. Typically, this is supplied by the manufacturer of the VAV unit. If this information is unavailable, use an approximate K factor from the chart in the Appendix: K Factors for VAV section in the **KMC Conquest Controller Application Guide**.

For instructions on **VAV balancing**:

- With an **STE-9000** series NetSensor, see the VAV Airflow Balancing with an STE-9xx1 section of the **KMC Conquest Controller Application Guide**.
- With a **BAC-5051E Router**, see its **application and installation guide**.
- With **KMC Connect** or **TotalControl**, see the Help system of the software.

SETUP PROCESS			KMC CONTROLS TOOL
Configuration	Programming (Control Basic)	Web Page Graphics*	
✓			Conquest NetSensor
✓			Internal configuration web pages in Conquest Ethernet "E" models**
✓			KMC Connect Lite™ (NFC) app***
✓	✓		KMC Connect™ software
✓****	✓****	✓	TotalControl™ software
✓	✓		KMC Converge™ module for Niagara Workbench
		✓	KMC Converge **GFX** module for Niagara Workbench

*Custom graphical user-interface web pages can be hosted on a remote web server, but not in the controller.

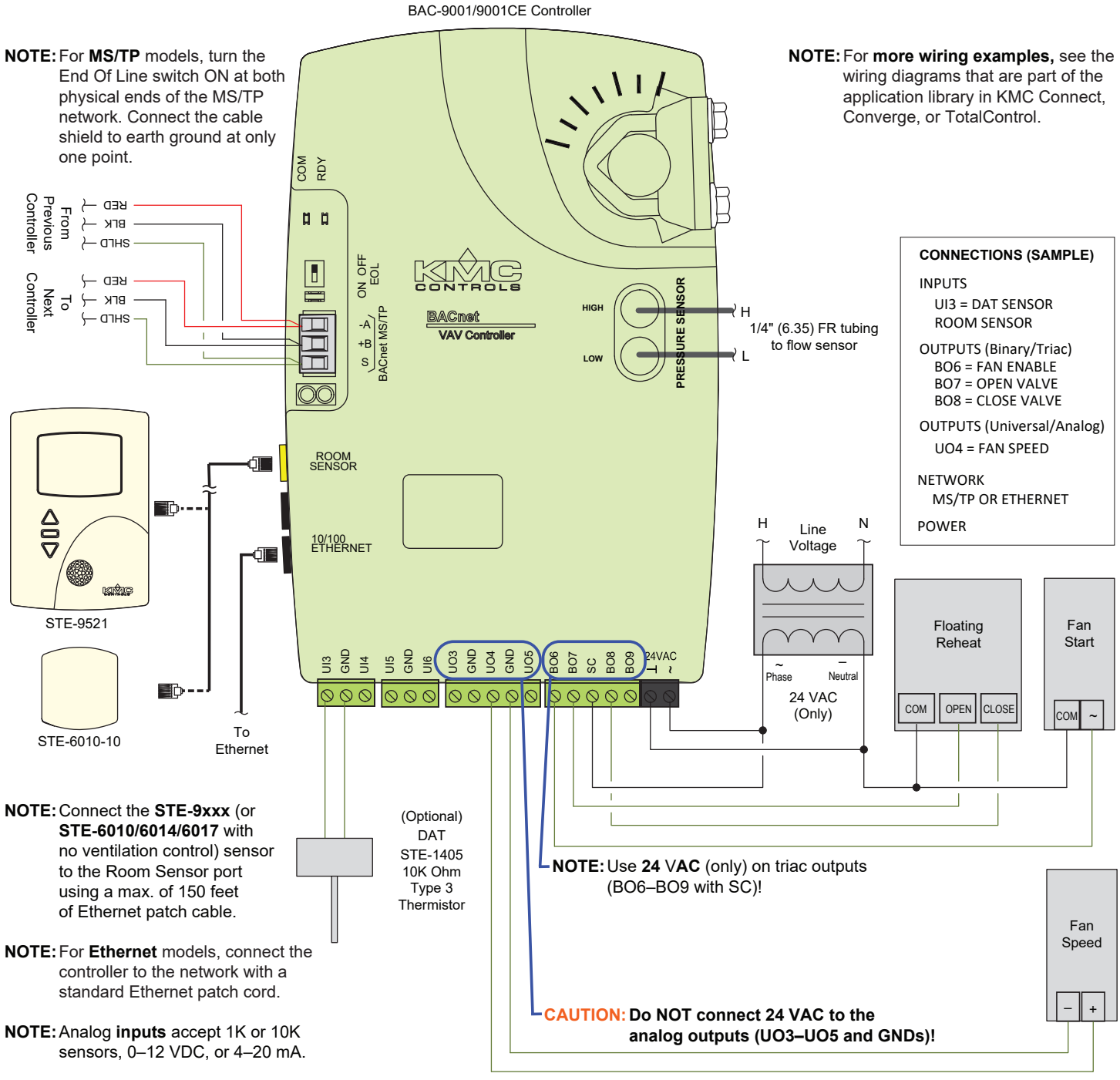
Conquest Ethernet-enabled "E" models with the latest firmware can be configured with an HTML5 compatible web browser from pages served from within the controller. For information, see the **Conquest Ethernet Controller Configuration Web Pages Application Guide.

***Near Field Communication via enabled smart phone or tablet running the KMC Connect Lite app.

****Full configuration and programming of KMC Conquest controllers is supported starting with TotalControl ver. 4.0.

SAMPLE (BAC-9001A) WIRING

(Single Duct VAV, Series Fan Powered with Floating Reheat and Vent Control)



INPUT/OUTPUT OBJECTS/CONNECTIONS

BAC-9001 SINGLE DUCT	
Inputs (Objects/Terminals)	
AI1	Space Sensor (on Room Sensor port)
AI2	Space Setpoint Offset (on port)
AI3/UI3	Discharge Air Temperature
AI4/UI4	Analog Input #4
AI5/UI5	Analog Input #5
AI6/UI6	Analog Input #6
AI7	Primary Duct Pressure (internal sensor)
AI8	Primary Damper Position (internal sensor)
Outputs (Objects/Terminals)	
AO3/UO3	Analog Heat*
AO4/UO4	Fan Speed
AO5/UO5	Analog Output #5
BO1	Primary Damper CW (internal actuator)
BO2	Primary Damper CCW (internal actuator)
BO6	Fan
BO7	Heating Stage 1*
BO8	Heating Stage 2*
BO9	Heating Stage 3*
*NOTE ABOUT REHEAT: • When staged heating is configured (on MSV3), BO7, BO8, and BO9 activate in sequence. • When floating (tri-state) heating is configured, BO7 opens and BO8 closes (BO9 is not used). • When time proportional heating is configured, BO7 is the controlling output (BO8 and BO9 are not used). • AO3 is always active (and a voltage test on it always reflects the heating PID loop value even when AO3 is not the controlling output). When modulating heating is configured, AO3 is the controlling output (BO7, BO8, and BO9 are not used).	
BAC-9021 PRESSURE DEPENDENT	
Inputs	
AI1	Space Sensor (on Room Sensor port)
AI2	Space Setpoint Offset (on port)
AI3/UI3	Discharge Air Temperature
AI4/UI4	Analog Input #4
AI5/UI5	Analog Input #5
AI6/UI6	Analog Input #6
	(No internal pressure sensor in this model)
AI8	Primary Damper Position (internal sensor)
Outputs	
AO3/UO3	Analog Heat*
AO4/UO4	Analog Output #4
AO5/UO5	Analog Output #5
BO1	Primary Damper CW (internal actuator)
BO2	Primary Damper CCW (internal actuator)
BO6	Binary Output #6
BO7	Heating Stage 1*
BO8	Heating Stage 2*
BO9	Heating Stage 3*
*See NOTE ABOUT REHEAT above.	

BAC-9001 DUAL DUCT	
Inputs	
AI1	Space Sensor *(on Room Sensor port)*
AI2	Space Setpoint Offset *(on port)*
AI3/UI3	Discharge Air Temperature
AI4/UI4	Analog Input #4
AI5/UI5	Secondary Duct Pressure
AI6/UI6	Secondary Damper Position
AI7	Primary Duct Pressure *(internal sensor)*
AI8	Primary Damper Position *(internal sensor)*
Outputs	
AO3/UO3	Analog Output #3
AO4/UO4	Analog Output #4
AO5/UO5	Analog Output #5
BO1	Primary Damper CW *(internal actuator)*
BO2	Primary Damper CCW *(internal actuator)*
BO6	Binary Output #6
BO7	Secondary Damper CW
BO8	Secondary Damper CCW
BO9	Binary Output #9

NOTE: For more information, see **Sample (BAC-9001A) Wiring on page 8** and the BAC-9000 series videos in the **KMC Conquest Controller Wiring** playlist.

NOTE: Universal Input (UIx) terminal = Analog Input (AIx) object. Universal Output (UOx) terminal = Analog Output (AOx) object.

NOTE: Universal (analog) inputs and outputs can be configured to emulate binary (on/off or voltage/no-voltage) objects. They are used with GND terminals.

NOTE: Binary Output (BOx) terminals are triacs and are used with SC terminals instead of GND terminals.

REPLACEMENT PARTS

HPO-0055	Replacement Network Bulb Module for Conquest Controllers, Pack of 5
HPO-9901	Conquest Hardware Replacement Parts Kit

NOTE: HPO-9901 includes the following:

Terminal Blocks	DIN Clips
(1) Black 2 Position	(2) Small
(2) Grey 3 Position	(1) Large
(2) Green 3 Position	
(4) Green 4 Position	
(2) Green 5 Position	
(2) Green 6 Position	

NOTE: See the **Conquest Selection Guide** for more information about replacement parts and accessories.

IMPORTANT NOTICES

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The KMC Connect Lite™ app for NFC configuration is protected under United States Patent Number 10,006,654. Pat: **https://www.kmccontrols.com/patents/**.

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