



# Installation and Operation Guide



## BAC-5841/5842 UFAD and BAC-5841-16/5842-16 VAV Advanced Application Controllers, 8 x 8

**NOTE:** Download these additional documents from the KMC Controls Partners web site!

- To install and properly address these controllers on a network, see Installation Instructions for MS/TP Automatic MAC Addressing!
- See the appropriate model's data sheet for relevant accessories, specifications, and other important information!
- This document covers installation only for the preconfigured applications and accessories. For custom applications and accessories, see also the installation guide for the standard BAC-5801/5802 for more information.

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**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, and (2) this device must accept any interference received, including interference that may cause undesired operation. This Class A digital apparatus complies with Canadian ICES-003 Class A.

**KMC Controls**

19476 Industrial Drive  
New Paris, IN 46553  
U.S.A.

TEL: 574.831.5250

FAX: 574.831.5252

EMAIL: [info@kmccontrols.com](mailto:info@kmccontrols.com)

WEB: [www.kmccontrols.com](http://www.kmccontrols.com)



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# SECTION 1—Installation (Mounting and Wiring)

This section provides important instructions and guidelines for installing the controller. Carefully review this information before installation.

## Mounting

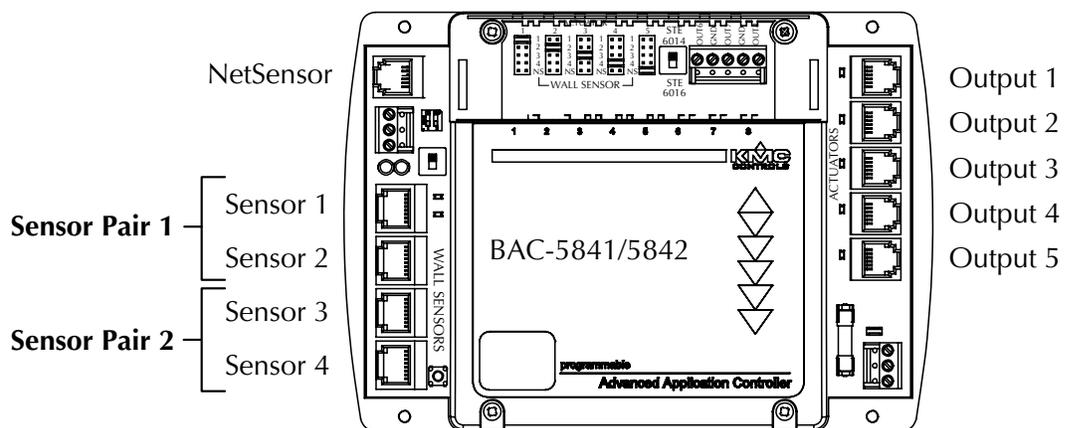
Use the four mounting holes on the top and bottom of the controller to fasten it securely to a flat surface with #6 or #8 (or metric equivalents) hardware. To maintain RF emission specifications, use either shielded connecting cables or enclose all cables in conduit.

## BAC-5841/4542 UFAD

For UFAD (but not VAV) applications, the cooling/heating control sequence is selected by the location and number of the STE-601x sensors connected to the “sensor pairs.”

Sensor Pair	STE-601x Connected to:	H/C Output Mode	Output 1 (3) Controlled by:	Output 2 (4) Controlled by:
1	Sensor 1 and Sensor 2	Outputs 1 and 2 both cooling	Sensor 1	Sensor 2
	Sensor 1 Only	Output 1 cooling and Output 2 heating	Sensor 1	
2	Sensor 3 and Sensor 4	Outputs 3 and 4 both cooling	(Sensor 3)	(Sensor 4)
	Sensor 3 Only	Output 3 cooling and Output 4 heating	(Sensor 3)	

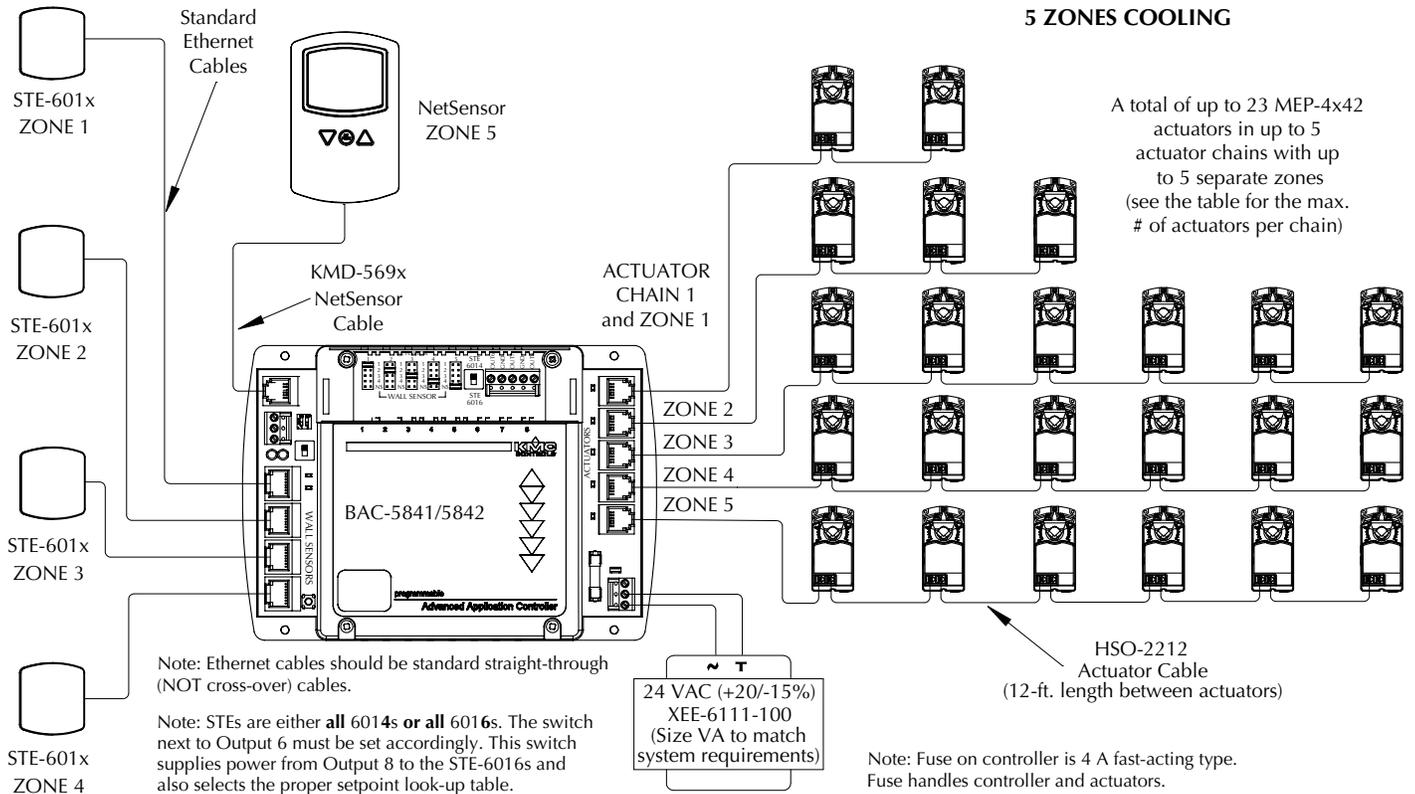
NOTE: This assumes the default jumper positions as shown in Illustration 1 below.



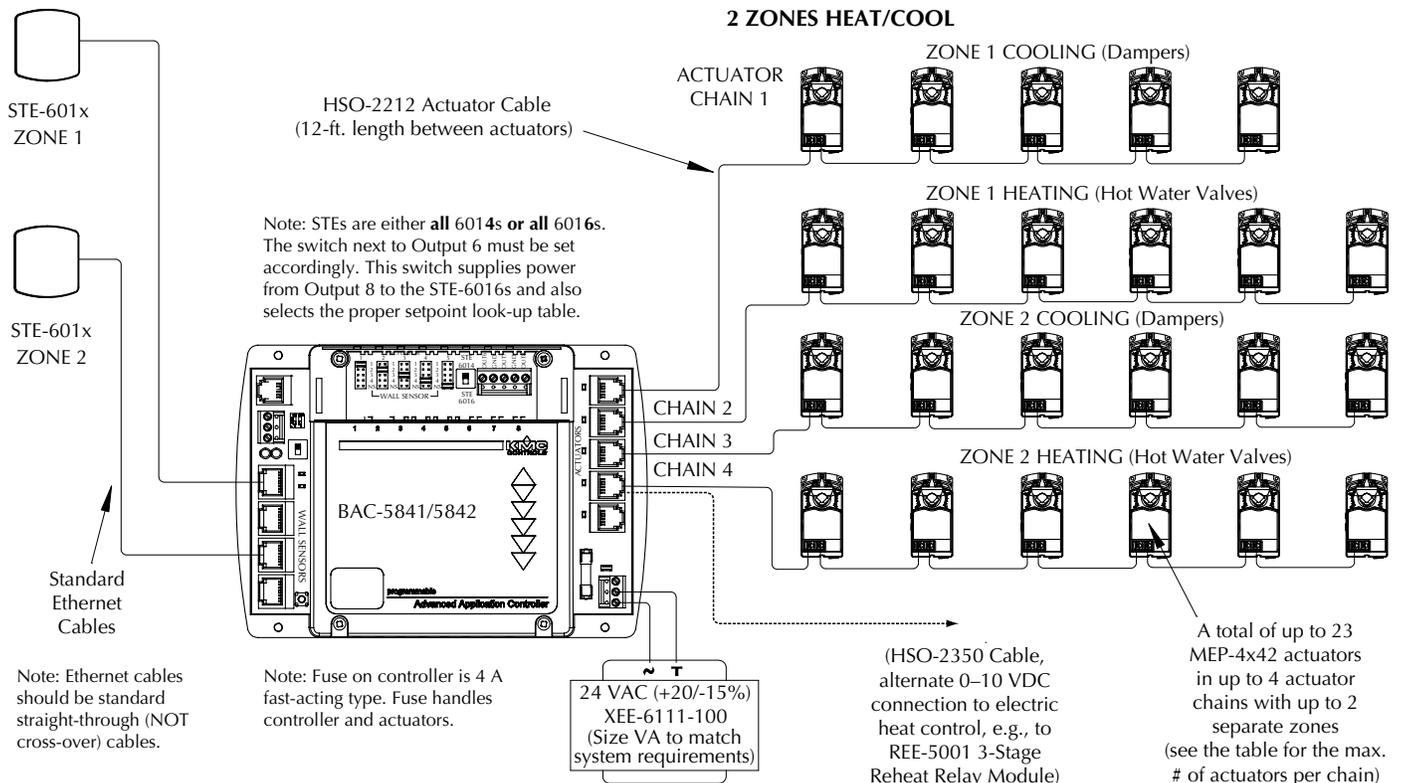
**Illustration 1—Sensor Pairs and Outputs**

Cooling outputs range between 2 and 10 VDC and heating outputs range between 0 and 10 VDC, each mapped to 100% of the associated control loop output.

For sample diagrams for under-floor air distribution applications, see [Illustration 2](#) and [Illustration 3](#) on page 5.



**Illustration 2—Sample 5 Zones Cooling UFAD Application (BAC-5841/5842)**

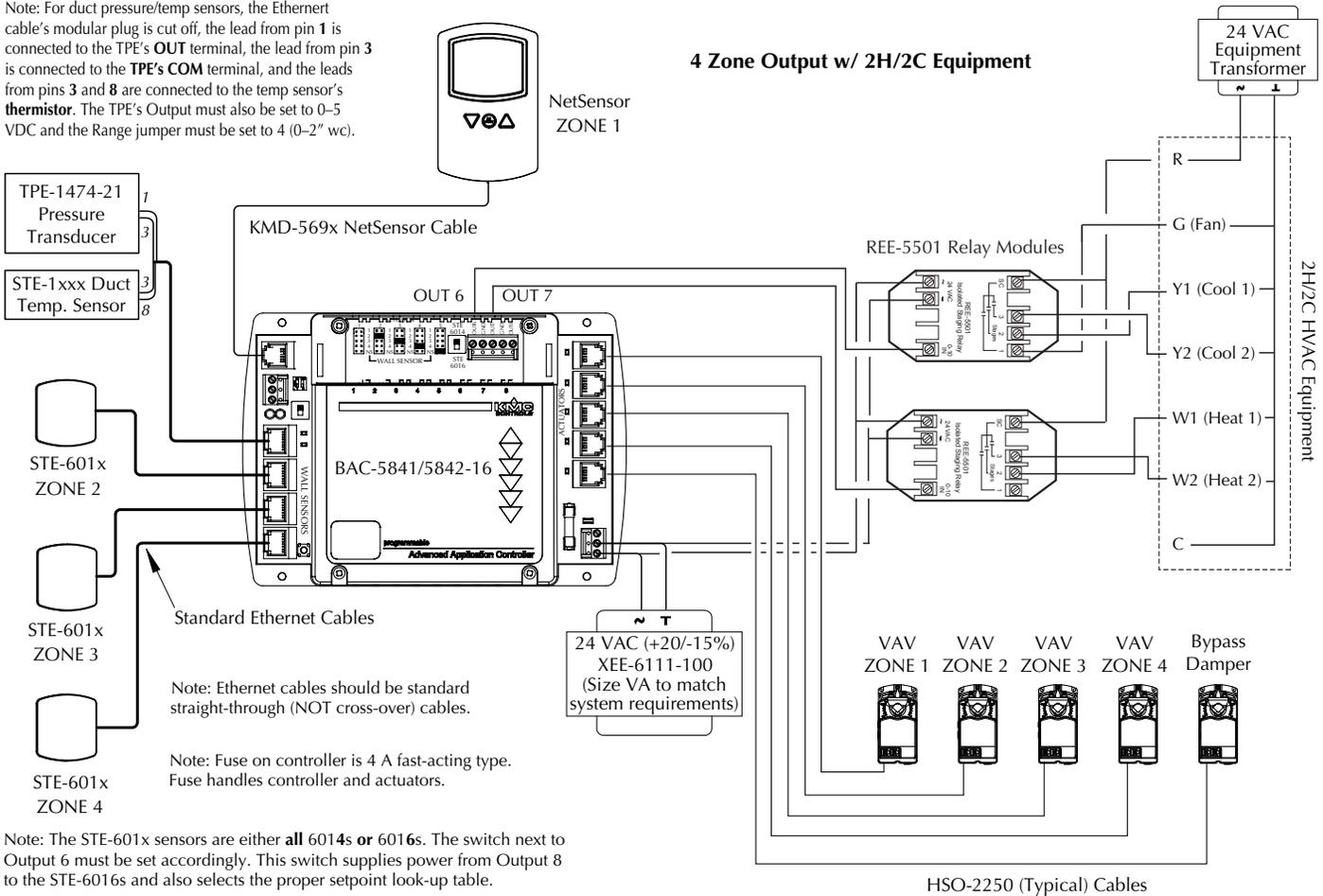


**Illustration 3—Sample 2 Zones Heat/Cool UFAD (BAC-5841/5842)**

# BAC-5841-16/5842-16 VAV

For a sample diagram of a Variable Air Volume application, see *Illustration 4*.

Note: For duct pressure/temp sensors, the Ethernet cable's modular plug is cut off, the lead from pin 1 is connected to the TPE's **OUT** terminal, the lead from pin 3 is connected to the **TPE's COM** terminal, and the leads from pins 3 and 8 are connected to the temp sensor's **thermistor**. The TPE's Output must also be set to 0–5 VDC and the Range jumper must be set to 4 (0–2" wc).



**Illustration 4—Sample 4 Zone VAV w/ 2H/2C Equipment (BAC-5841-16/5842-16)**

## Connecting Inputs and Outputs

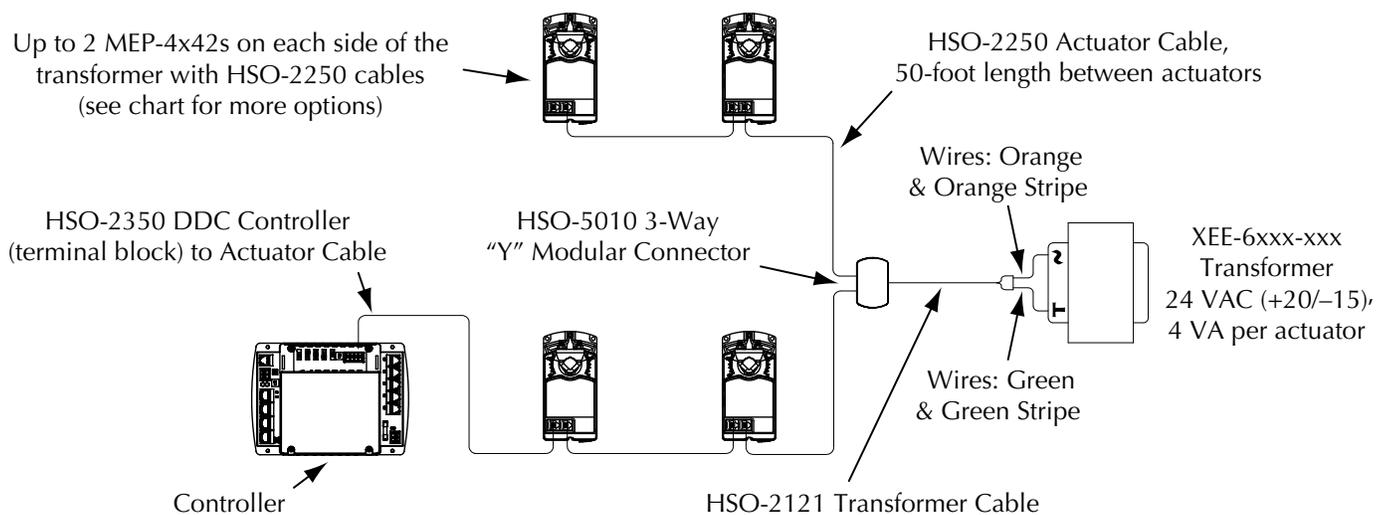
Each of the modular input connectors is preconfigured to receive analog signals from temperature sensors and setpoint controls. Plug standard (not cross-over) Ethernet cables into the input connectors and the corresponding STE-6014 or STE-6016. Select the corresponding position on the sensor selection switch at the top of the controller. See *Illustration 13 on page 13*.

For outputs, use HSO-22xx cables to connect to MEP-4x42 actuators, using the modular connectors.

Cable P/N	Cable Length	Max. # of Daisy-Chained MEP-4x42s	
		WithOUT HSO-5010	With HSO-5010*
HSO-2203	3 feet	8	8
HSO-2206	6 feet	8	8
HSO-2212	12 feet	6	8
HSO-2220	20 feet	4	8
HSO-2250	50 feet	2	4

\*For examples of the HSO-5010 3-way “Y” modular connector in use with the actuators, see *Illustration 5 on page 7*.

The HSO-2350 can also provide a connection to the terminal block. See *Illustration 5 on page 7*.



**Illustration 5—Sample HSO-2350 and HSO-5010 Application**

For output connections to devices other than MEP-4x42 actuators, use 14–22 AWG wire to the terminal block for Outputs 6–8. See *Illustration 4 on page 6*.

The maximum allowable output current is **100 mA per output OR 350 mA total**.

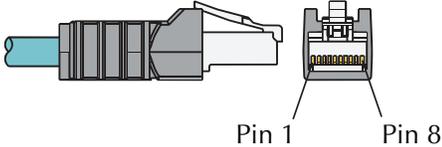
**NOTE:** To change which input controls which output, adjust the sensor input to actuator output mapping selection jumpers as needed. See *Illustration 13 on page 13*.

NOTE: Room temperature sensor models cannot be mixed. Room temperature sensors must **all be STE-6014s** (with rotary setpoint dial) **OR all be STE-6016s** (with LCD display and up/down setpoint buttons) and the switch by Output 6 must be set accordingly. However, duct sensors may be used in the place of one of the room temperature sensors (see [Illustration 4 on page 6](#)).

NOTE: Ethernet cables should be standard **straight-through** (NOT cross-over) cables. To use a standard straight-through Ethernet cable with **duct** sensors:

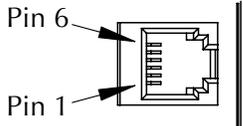
1. Cut off one modular plug.
2. Strip the wires connected to pins **1, 3, and 8**. See [Illustration 6](#).
3. Connect those wires to the duct sensors as noted in [Illustration 4 on page 6](#).
4. Tape back or cut off all other wires.

Ethernet Cable Connector Pins	Input Function
1	Setpoint
3	Ground
6	12 VDC Supply for STE-6016
8	Temperature Sensor



**Illustration 6—Ethernet Cable Pins (for Modular Inputs)**

Connector Pins	Function
1 and 6	~ 24 VAC (phase side)
2 and 5	Common
3	No Connection on BAC-584x (but 17.4 VDC out @ 10 mA Max. on MEP-4x42 actuators for powering CTE-5201-16)
4	Signal (2–10 VDC)



**Illustration 7—Modular Output Connector Pins**

See also [Application Configuration with a NetSensor on page 12](#).

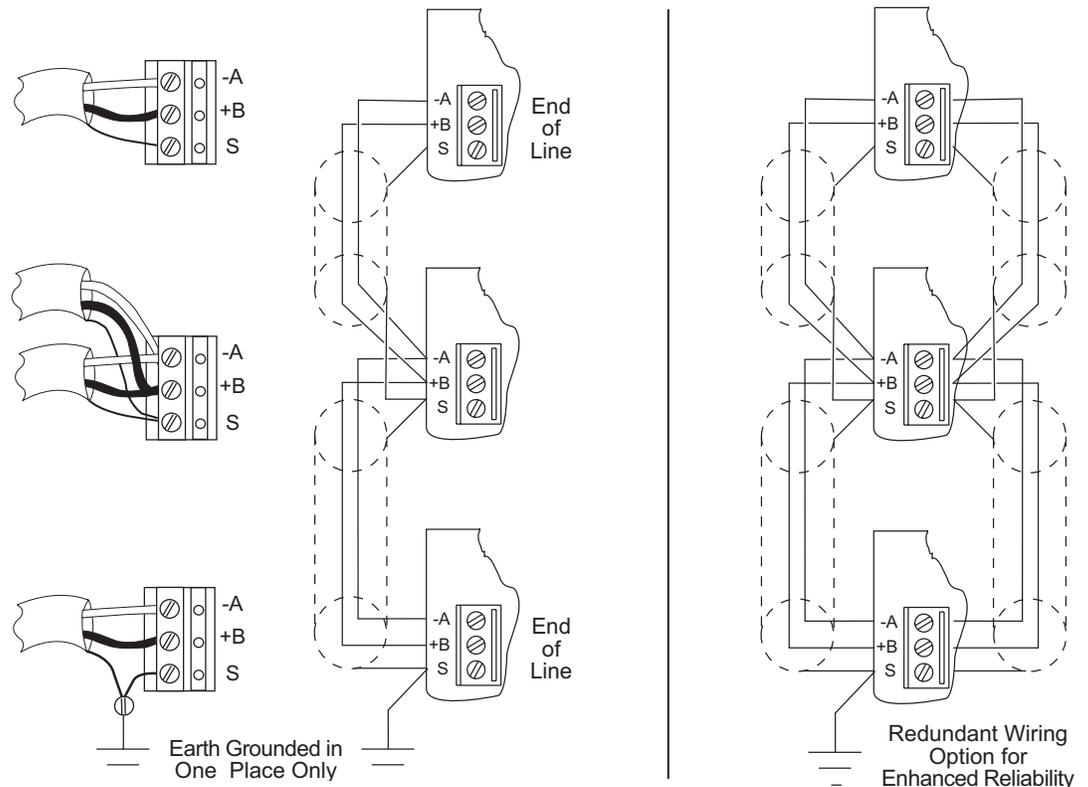
NOTE: Unlike standard BAC-580x controllers, these BAC-584x controllers do **not** support the use of HPO-67xx output override boards.

# Connecting to an MS/TP Network

## Connections and Wiring

Use the following principles when connecting a controller to an EIA-485 (formerly RS-485) MS/TP network:

- Use 18 gauge, twisted-pair, shielded cable with capacitance of no more than about 50 picofarads per foot for all network wiring. Belden cable model #82760 meets KMC requirements.
- **Connect the –A terminals in parallel with all other –A terminals and the +B terminals in parallel with all other +B terminals. The EIA-485 terminals on most KMC controllers are labeled –A, +B, and S. The S terminal is provided as a connecting point for the shield. The terminal is not connected to the ground of the controller. (See *Illustration 8.*) When connecting to controllers from other manufacturers, verify the shield connection is not connected to ground.**
- Connect the shields of the cable together at each controller. For KMC BACnet controllers use the S terminal or a wire nut. Connect the shield to an earth ground **at one end only**.
- To maintain communications in case of an open conductor on the network cable, redundant wiring routed separately enhances reliability.



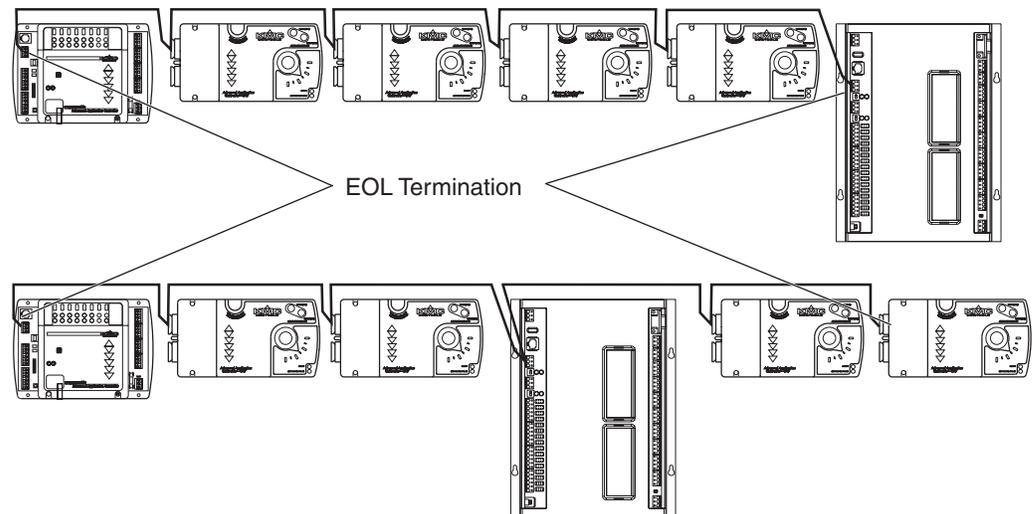
**Illustration 8—MS/TP Network Wiring (Standard and Redundant Wiring)**

- Connect no more than 128 addressable BACnet master devices (total) to one MS/TP network. The devices can be any mix of controllers or routers. (Up to 127 slave devices can also be connected.)

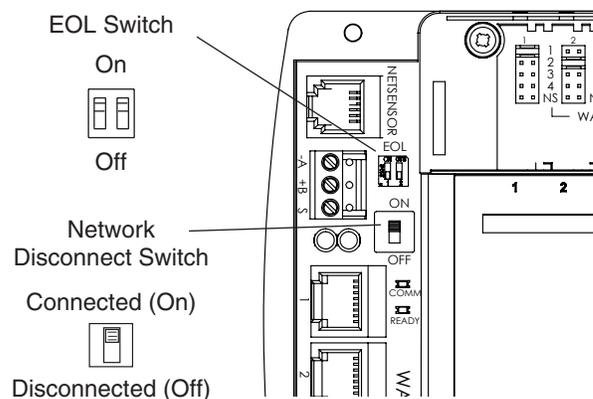
- Limiting the MS/TP network size to no more than about 60 BAC-A1616BC, BAC-5800, and BAC-7000 series controllers will optimize network performance.
  - Use a KMC KMD-5575 repeater after every 31 MS/TP devices or if the cable length exceeds 4,000 feet (1,220 meters). Generally, use no more than **four** repeaters per MS/TP network. Do not connect the cable shield to the circuit GND terminal on the KMD-5575. For each network segment, connect the shields to a good earth ground at only one end of the segment; tape back the shield ground at the other end.
  - Place a KMC KMD-5567 surge suppressor in the cable where it exits a building.
- See also Application Note AN0404A, *Planning BACnet Networks* for additional tips.

### End of Line Termination Switches

The controllers on the physical ends of the EIA-485 wiring segment must have end-of-line termination installed for proper network operation. In the end controllers, set the end-of-line termination to *On* using the EOL switches. See *Illustration 8 on page 9*, *Illustration 9*, and *Illustration 10*.



**Illustration 9—End-of-Line Termination**



**Illustration 10—Location of Network Disconnect and EOL Switches**

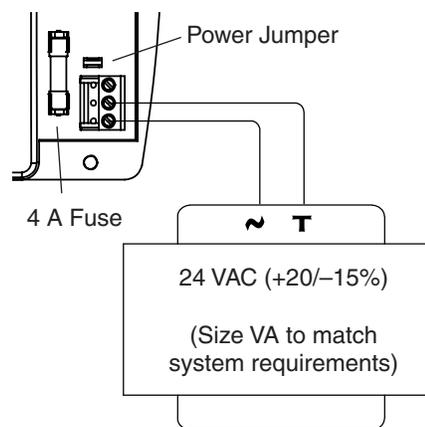
These controllers feature an automatic network addressing feature. See *Installation Instructions for MS/TP Automatic MAC Addressing* for additional information about installing these controllers on a BACnet network!

## Connecting Power

The controller requires an external, 24 volt, AC power source. Use the following guidelines when choosing and wiring transformers.

- Use a KMC Controls Class-2 transformer of the appropriate size to supply power to the controllers. **See the data sheets for all connected devices to calculate the required VA rating of the transformer.**
- KMC Controls recommends powering only one controller from each transformer.
- When installing a controller in a system with other controllers, you may power multiple controllers with a single transformer as long as the total power drawn from the transformer does not exceed its rating and phasing is correct.
- If several controllers are mounted in the same cabinet, you can share a transformer between them provided the transformer *does not exceed* 100 VA or other regulatory requirements.
- Do not run 24 volt, AC power from within an enclosure to external controllers.

Connect the 24 volt AC power supply to the power terminal block on the lower right side of the controller near the power jumper. See [Illustration 11](#). **Connect the neutral lead from the transformer to the – terminal (middle terminal of the block) and the AC phase to the ~ (phase) terminal.** Power is applied to the controller when the transformer is powered and the power jumper is in place.



**Illustration 11—Power Terminal and Jumper**

## SECTION 2—Operation and Troubleshooting

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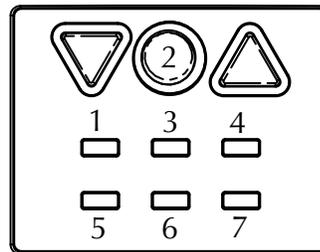
This section provides a brief overview of operating and troubleshooting the controller. Once set-up and powered, the controller requires very little user intervention.

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### Application Configuration with a NetSensor

A KMD-1x6x/1x8x/12x1 NetSensor is connected to the controller via a KMD-569x cable.

If both a NetSensor is connected and an STE-601x is connected to the Sensor 1 port, then Output 5 will provide a cooling output. If no STE-601x is connected to the Sensor 1 port, then the connected NetSensor will control Sensor 1 values.



**Illustration 12—NetSensor Buttons**

Functions of the NetSensor buttons (under the hinged cover) are:

- Button 1 = AV1 = Temperature (Not Adjustable)
- Button 2 = AV2 = Setpoint
- *Button 3 = AV3 = OAT (Unused)*
- Button 4 = BV4 = Override (UFAD); Standby Offset (VAV)
- Button 5 = AV5 = Setpoint Minimum Limit
- Button 6 = AV6 = Setpoint Offset
- Button 7 = AV7 = Setpoint Maximum Limit

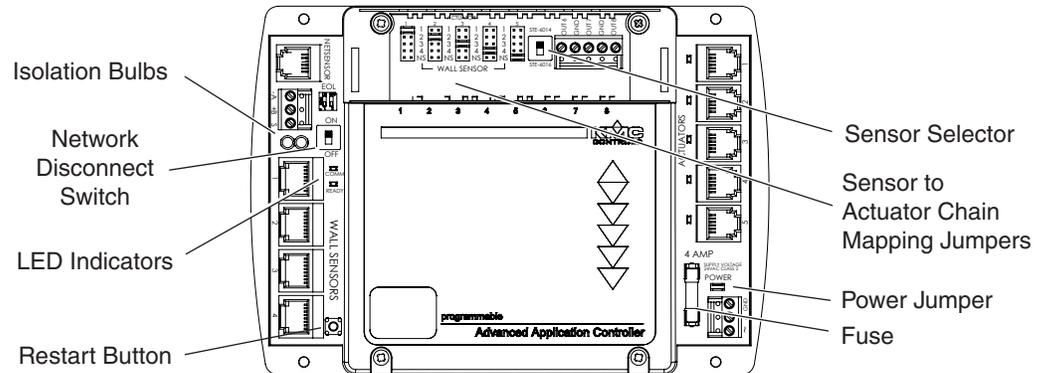
**NOTE:** If power to the controller is lost, all user adjustments will be returned to their default values.

### Motion Sensing with a KMD-12x1 NetSensor

KMD-1261/1281 NetSensors have an integral motion sensor. If one of these models is used and no motion is detected for 30 minutes, the controller goes into **standby** mode until motion is detected again. In standby mode, the setpoint is raised by 3° for cooling or lowered by 3° for heating.

## Controls and Indicators

The following topics describe the controls and indicators found on the controller. Additional information for automatic addressing functions are described in the guide *MS/TP Automatic MAC Addressing Installation Instructions* that is available from the KMC Controls Partners web site.



**Illustration 13—Controls and Indicators**

### Network Disconnect Switch

The network disconnect switch is located on the left side of the controller. See [Illustration 13](#). Use this switch to enable or disable the MS/TP network connection. When the switch is ON the controller can communicate on the network; when it is OFF, the controller is isolated from the network.

Alternately, you may remove the isolation bulbs to isolate the controller from the network.

### LED Indicator: Ready (Green)

The green Ready LED indicates the state of the controller. **This includes automatic addressing functions that are fully described in the guide *Installation Instructions for MS/TP Automatic MAC Addressing*.**

### Power Up

During controller initialization, the Ready LED is continuously illuminated for 5 to 20 seconds. Once initialization is complete, the Ready LED begins flashing to indicate normal operation.

### Normal Operation

During normal operation, the Ready LED flashes a repeating pattern of one second on and then one second off.

### Restart Button Acknowledge

The Restart button (see [Illustration 13 on page 13](#)) includes several functions for automatic addressing that are acknowledged with the Ready LED. When the Restart button is pressed, the Ready LED illuminates continuously until either of the following take place:

- The Restart button is released.
- The Restart button time-out period is reached and a restart operation is complete. Restart button operations are listed in the following table.

Ready LED Patterns for Restart Button Operations	
Controller State	LED Pattern
The controller is set as an automatic addressing anchor, and the MAC in the controller is set to 3	A rapid repeating pattern of a short flash followed by a short pause
The controller has sent the automatic addressing lock command to the network	Two short flashes followed by a long pause, and the pattern repeats until the restart button is released
No restart operation	Ready LED remains unlit until the restart button is released

### LED Indicator: MS/TP Communications (Amber)

The yellow Communications LED indicates how the controller is communicating with other controllers on the network. **This includes automatic addressing functions that are fully described in the guide *Installation Instructions for MS/TP Automatic MAC Addressing*.**

#### Sole Master

Repeating pattern of a long flash and a short pause that repeats once a second. It indicates that the controller has either generated the token or is a sole MS/TP master and has yet to establish communications with other MS/TP devices.

#### Token Passing

A short flash each time the token is passed. The frequency of the flash is an indication of how often the device receives the token.

#### Nomad Patterns

There are three Communications LED patterns that indicate that the controller is an automatic addressing nomad controller that is receiving valid MS/TP traffic.

Automatic Addressing Nomad Patterns	
Controller State	LED Pattern
Lost nomad	A long flash
Wandering nomad	A long flash followed by three short flashes
Assigned nomad	Three short flashes followed by a long pause

### LED Indicator: Error Conditions

Error conditions are indicated with a combination of the Ready and Communications LEDs.

- If the Ready LED and Com LED are both unlit, check the fuse, power, and connections to the controller.
- If the Ready LED alternates with the Com LED at a one-half-second rate, there is an error in the controller's memory. Restoring the controller to factory default settings will typically resolve the problem.

## Isolation Bulbs (HPO-0054)

Two isolation bulbs are located near the network switch. (See *Illustration 13 on page 13*.) These bulbs serve three functions:

- Removing the bulbs will open the MS/TP network and isolate the controller from the network.
- If one, or both, bulbs are lit, it indicates the network is improperly phased. This means that the ground potential of the controller is not the same as other controllers on the network.
- If the voltage or current on the network exceeds safe levels, the bulbs operate as fuses and may protect the controller from damage.

## Replacing the Fuse

KMC controllers do not require routine maintenance. If a fuse opens, investigate the cause, and then replace the fuse. To replace the fuse:

1. Remove the power jumper located near the fuse. See *Illustration 11 on page 11*.
2. Carefully pull out the open fuse from the fuse holder.
3. Carefully snap an identical 4 A, fast-acting, 5 x 20 mm fuse into the fuse holder.
4. Reinstall the power jumper.

NOTE: This is a different fuse than the 1 A fuses in BAC-580x controllers.

## Viewing the Firmware Version

The controller's firmware is viewable with either BACstage or TotalControl. To view the controller's firmware version with BACstage:

1. Start BACstage and select System List from under the Access menu.
2. Click the # of the appropriate network and enter the appropriate user name and password.
3. Select the appropriate controller from the Device List.
4. Select Device from under the Objects menu, and that controller's firmware version will be displayed in the middle of the Device Object/Parameters dialog box.

To view the controller's firmware version with TotalControl:

1. Log on to the site with Design Studio.
2. Expand the Network Manager list to reveal the device.
3. Point to the device.
4. TotalControl displays a Tool Tip with the model number and firmware build revision.

## Real-Time Clock and Time Updates

The BAC-5841 and BAC-5841-16 have a hardware real-time (RTC) clock and the BAC-5842-16 and BAC-5842-16 have a software-based clock. Both the real-time clock and software-based clocks are updated by time synchronization messages from a time master device, such as a computer with BACstage or TotalControl connected to the network.

Controllers with an RTC are guaranteed to maintain accurate time for 72 hours without power being supplied to the controller.

Controllers with a software-based clock can be updated (in addition to the time master device) by a controller with an RTC through the unconfirmed private transfer (UPT) time synchronization method. Without supplied power, the value of a software-based clock will be retained for at least six hours (but not maintaining current time). When power is off for longer than six hours, the time and date may reset to the default values (1/1/2000 12:00:00 a.m.). After power is restored, the controller with a software-based clock will automatically send out a Time\_Request message to each controller on the network (starting with address MAC 1) until it receives a valid Time\_Announce message or a time synchronization service. Until then, it will remain behind by the amount of time the power was off or (if longer than six hours) start over at the default values.

# Troubleshooting

## Communication Issues

- For MS/TP issues, see *LED Indicator: MS/TP Communications (Amber) on page 14*.

NOTE: **Be very careful about setting the baud rate** on the controllers on the MS/TP network. They should all match.

## Inputs or Outputs Not Working

NOTE: **Faulty wiring on one input can potentially cause fluctuating input values on all inputs.**

- Check wiring. See *Connecting Inputs and Outputs on page 7*.
- For inputs, check the input selectors.

## LED Indicators and Isolation Bulbs Issues

### Ready LED (Green) Issues

After power is first applied, the green Power/Status LED will begin operating as described in *Controls and Indicators on page 13* if the device is functioning normally. If it is **not illuminated**, check the (4 A, fast-acting, 5 x 20 mm) fuse, power, and connections to the controller. See *Replacing the Fuse on page 15*.

### MS/TP Network Communication LED (Amber) Issues

The **amber LED flickers** to indicate the state of its communication with the network as described in *Controls and Indicators on page 13*. If it is not operating as it should:

- Check the position of the network switch. See *Network Disconnect Switch on page 13*.
- Check the isolation bulbs. See *Isolation Bulbs (HPO-0054) on page 15*.
- Check network connections and configuration. See *Connecting to an MS/TP Network on page 9*.
- Restart the controller. See *Resetting (Reinitializing) the Controller on page 19*.

### MS/TP Network Isolation Bulbs Issues

The network also has **two isolation bulbs** located near the network switch. (See *Illustration 13 on page 13*.) Normally they are not illuminated.

- **If one or both bulbs is illuminated**, it indicates the network is improperly phased (the ground potential of the controller is not the same as other controllers on the network). Remove power and check the MS/TP and power connections.
- **If one or both bulbs is blown**, it indicates the voltage or current on the network exceeded safe levels. Correct the conditions and replace the bulbs.

**Temperature Is Not Controlled Properly**

- Check inputs and outputs. See *Inputs or Outputs Not Working on page 17*.
- Check sensor selection and mapping jumpers. See *Illustration 13 on page 13*.

**Other Configuration, Network, or Hardware Issues**

- Thoroughly check appropriate connections, wiring, and settings.
- Reset the controller. See *Resetting (Reinitializing) the Controller on page 19*.
- Contact KMC Controls technical support.

## Resetting (Reinitializing) the Controller

### ⚠ CAUTION

To protect against equipment damage and loss of data, read **ALL** the information in this section before proceeding! Before resetting the controller, shut down or manually override (unplug connectors) all controlled equipment that might be damaged by abrupt changes in operation.

### Types of Reset

If the controller appears to be operating incorrectly or is not responding to commands, it may need to be reset (reinitialized). Three types of controller reset exist:

- A **warm start** is the option least disruptive to the network and should usually be tried first.
- If problems persist, then try a **cold start**.
- If problems still persist, restoring all settings to their **factory defaults** (and reconfiguring and reprogramming the controller) may be required.

### ⚠ CAUTION

When any of the three types of reset are initiated, the controller will immediately reboot. It will **NOT** back up data in the memory to the nonvolatile flash memory before restarting. If needed, back up current information (using TotalControl or BACstage) before continuing.

### Performing a WARM Start

A warm start does the following in the controller:

- **Keeps present values at their last known values until the Control Basic programs update them** (in contrast to a cold start).
- Restarts the controller's Control Basic programs.
- Leaves configuration and programming intact.

### ⚠ CAUTION

In the unlikely event that the checksum test in RAM fails during the warm start, the controller will automatically perform a cold start. During a cold start, object values are returned to their relinquished defaults, which may abruptly change the state of connected equipment.

A warm start can be performed:

- By removing the power jumper for a few seconds and then reinstall it (see *Illustration 11—Power Terminal and Jumper on page 11*).
- Through TotalControl or BACstage (see the software documentation).

**NOTE:** If power is off for less than about six hours **and** the RAM checksum test passes, a warm start will occur after reboot. If power is off for longer than that or if the RAM checksum test fails, a cold start will occur after reboot.

## Performing a COLD Start

A cold start performs the same functions as a warm start except for retaining last known present values. Instead, a cold start **returns all object values back to their relinquished defaults** until they are updated by the controller (usually within a few seconds).

### ⚠ CAUTION

**Returning object values to their relinquished defaults may abruptly change the state of connected equipment during the cold start. Before performing a cold start, manually override equipment as needed.**

To perform a cold start:

1. While the controller is powered, press and hold the red Restart button. (See *Illustration 13 on page 13.*)
2. Remove the power jumper.
3. Release the red button before replacing the power jumper.

## Restoring Factory Defaults of Controller Functions

### ⚠ CAUTION

**Restoring factory defaults in the controller erases object configuration. You must then reconfigure the controller to establish normal operation.**

**Returning object values to their relinquished defaults may abruptly change the state of connected equipment during the cold start. Before restoring factory defaults, disconnect, turn off, and/or manually override controlled equipment as needed.**

To restore the controller to factory defaults:

1. If possible, use BACstage or TotalControl to back up the controller.
2. Remove the power jumper. (See *Illustration 11—Power Terminal and Jumper on page 11.*)
3. Press and hold red Restart button.
4. Replace the power jumper while continuing to hold the Restart button.
5. After the controller restarts, restore desired configuration and custom programming through BACstage or TotalControl.

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