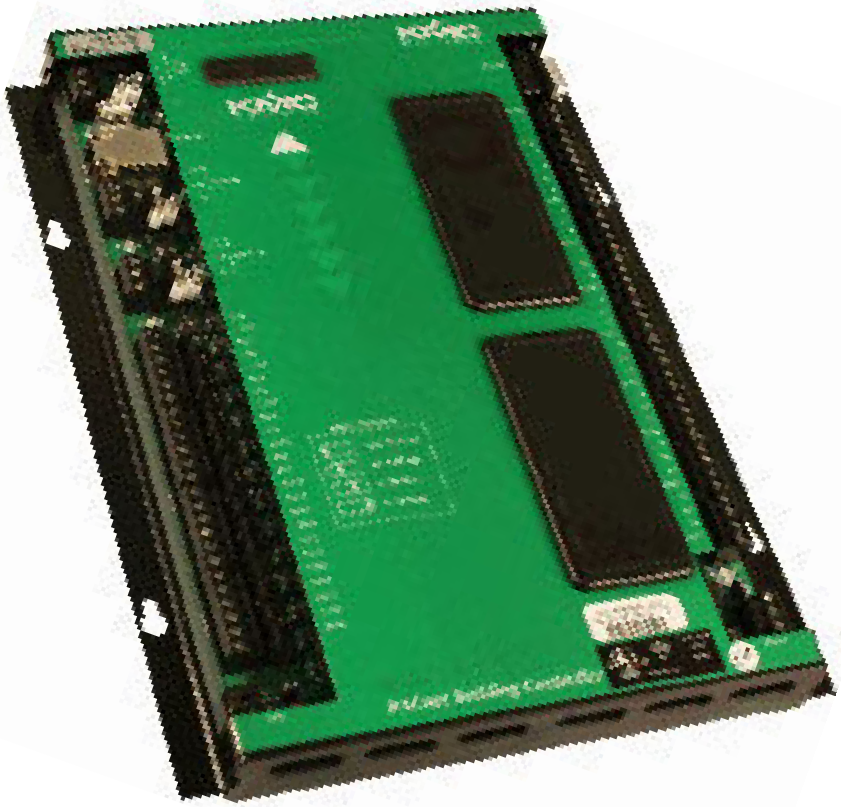
Installation and Operation Guide

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BAC-A1616BC

BACnet Building Controller

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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 B digital apparatus complies with Canadian ICES-003.

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SECTION 1—About the BAC-A1616BC

This section provides a general description of the KMC Controls **BAC-A1616BC BACnet Building Controller (B-BC)**. Review this material before installing or operating the controller.

Introduction

The BAC-A1616BC combines a **high-performance, native BACnet,** direct digital **controller** and a BACnet **router** that is a BACnet (IP) Broadcast Management Device (BBMD). Integrated into this native BACnet device is BACnet router, web server, and expandable I/O capability.

As part of a complete interoperable building automation system, this 16x16 BAC-A1616BC provides precise **monitoring and control** of connected points. **I/O expansion modules** (that can be mounted up to 200 feet away) provide the BAC-A1616BC with a maximum total of 128 inputs and 72 outputs.

As a **web server**, it offers the capability for configuration from a web browser in addition to (via Ethernet) TotalControl. Configure I/Os, set-up objects, and monitor present values via a browser. A custom web graphical interface can be loaded from TotalControl.

As a **router**, the BAC-A1616BC can route traffic between two MS/TP ports, one BACnet PTP (point-to-point) port, four (logical) BACnet IP ports, and one (logical) BACnet Ethernet port (BACnet IP and BACnet Ethernet are logical ports on the Ethernet physical port). It supports BACnet IP foreign device registration and BBMD, supports PTP modem communications, and performs IP packet assembling/disassembling (PAD) routing for up to four BACnet IP PAD networks.

Quick Start

Before using a BAC-A1616BC, the minimum requirements are:

- Mount and make all physical connections. See *SECTION 2—Installation (Mounting and Wiring) on page 11*.
- Configure for network communication with the Router Configuration Tool. See *SECTION 3—Router Configuration Tool Connection/Configuration on page 27*.
- Configure objects with a web browser (see *SECTION 4—Web Browser Configuration and Viewing on page 46*) and/or TotalControl and BACstage.
- See also *Software Tools on page 8*.

NOTE This document reflects **firmware** R2.0.0.5 and later. Certain functions (e.g., internal email server) will also require a license.

Software Tools

The multifunctional BAC-A1616BC requires various software tools for different tasks. This variety of tools and tasks is summarized in the table below. Except for TotalControl and BACstage, all these tools are available at no cost from either KMC (Router Configuration Tool) or other vendors (web browser and terminal emulator).

Software Support Tools	
Function	**Software Tool Needed**
Back-up system files	Router Configuration Tool* (see ***Firmware Update and Backup on page 44***) and TotalControl
Configure BACnet router and device instance	Router Configuration Tool (see ***Connecting for Configuration on page 28***) and/or Router web page (see ***Router Setup (Web) on page 68***)
Configure BACnet objects	Web browser or TotalControl (see ***SECTION 4—Web Browser Configuration and Viewing on page 46***)
Edit/compile/upload Control Basic programs	TotalControl or BACstage (see ***Programs (Control Basic) on page 62***)
Monitor boot-up	HyperTerminal, Tera Term, or a similar terminal emulator (see ***Serial Connection and Debug Monitoring on page 30***)
Publish web pages	TotalControl (see ***Graphics Screens on page 69***)
Update firmware	Router Configuration Tool (see ***Firmware Update and Backup on page 44***)
View/acknowledge alarms	View and acknowledge: Web browser (see ***Alarm (Summary and History) on page 70***) or TotalControl View only: BACstage or email (see ***Notifications, Events, and Alarms on page 60***)
View present values	Web browser or TotalControl (see ***SECTION 4—Web Browser Configuration and Viewing on page 46***)
View trends	TotalControl, BACstage, or (in table format only) a web browser (see ***Trend Logs on page 63***)

For more information about the various software tools, see the relevant sections in this guide and other supporting software documents.

*NOTE: **To download the BAC-A1616BC Building Controller Router Configuration Tool**, log-in to KMC Partners web site (*https://partners.kmccontrols.com/*) and go to Downloads > Software Updates. **The older Router Configuration Tool for the BAC-5050 Router will not work with the BAC-A1616BC.**

Diagram and Dimensions

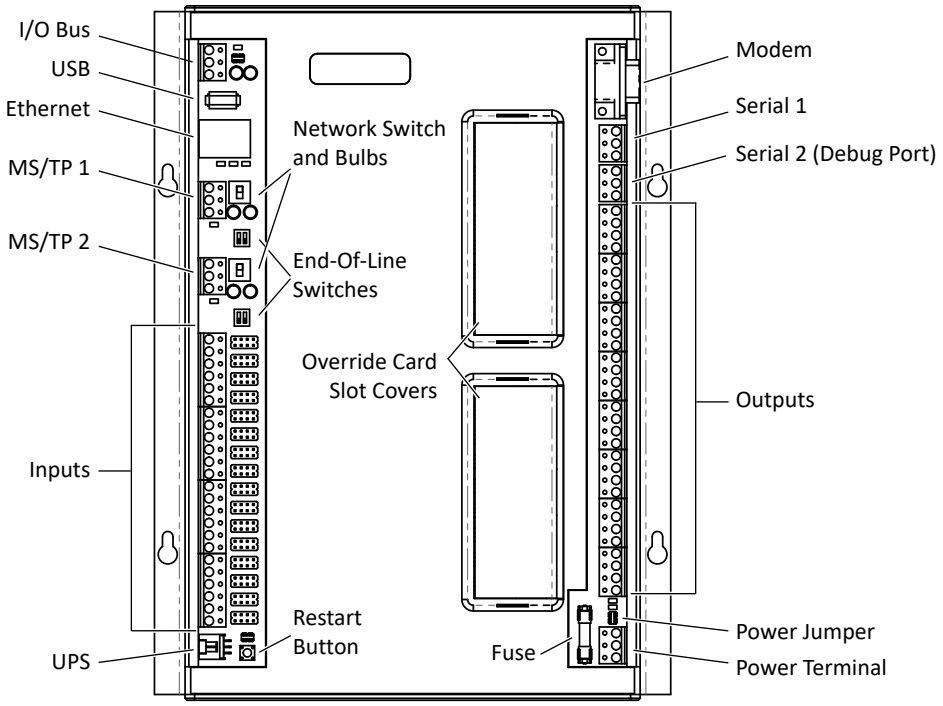
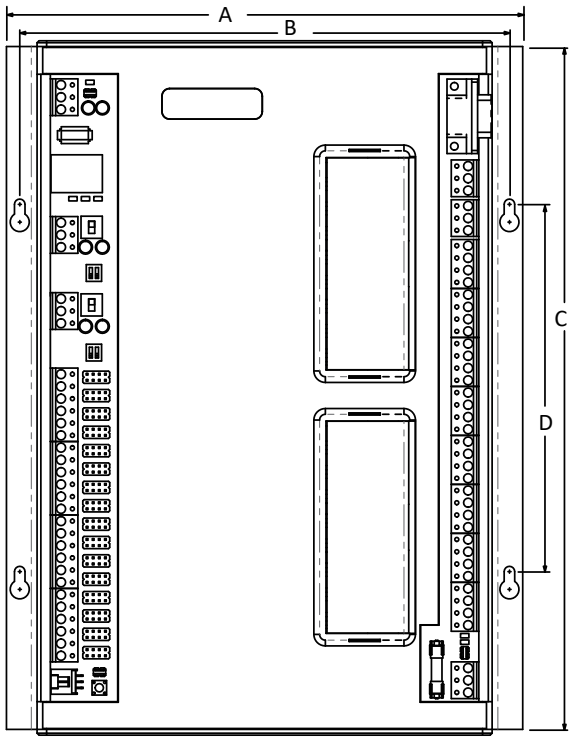


Illustration 1—Indicators and Connectors



A	B	C	D	Depth (not shown)
8.4 in.	8.0 in.	11.2 in.	6.0 in.	1.1 in. (w/o HPO covers), 1.9 in. (with)
214 mm	203 mm	283 mm	152 mm	27 mm, 48 mm

Illustration 2—BAC-A1616BC Dimensions

Accessories

See the **BAC-A1616BC Applications Guide**.

Specifications

See the **BAC-A1616BC Data Sheet**.

Applications and Additional Information

See the **BAC-A1616BC Applications Guide**.

Cautions and Notes

NOTE: In this document, a NOTE provides additional information that is important.

⚠ CAUTION

In this document, a CAUTION indicates potential personal injury or equipment or property damage if instructions are not followed.

SECTION 2—Installation (Mounting and Wiring)

This section provides important instructions and guidelines for installing the BAC-A1616BC. Carefully review this information before installation.

Mounting

Mount the BAC-A1616BC inside of a metal enclosure. KMC Controls recommends using a UL-approved enclosed energy management equipment panel such as a KMC model HCO-1035 or HCO-1036. Insert #6 or #8 (or metric equivalents) hardware through the two mounting holes on each side of the controller to securely fasten it to a flat surface. See *Diagram and Dimensions on page 9* for mounting hole locations and dimensions. To maintain RF emission specifications, use either shielded connecting cables or enclose all cables in conduit.

Connecting Inputs

The BAC-A1616BC has 16 universal inputs. Each input can be configured to receive either analog or binary signals (see *Input and Output Objects on page 55*). After selecting the appropriate jumper position for each input, a variety of active or passive devices may be connected to the inputs. (Active devices have their own external power supply.)

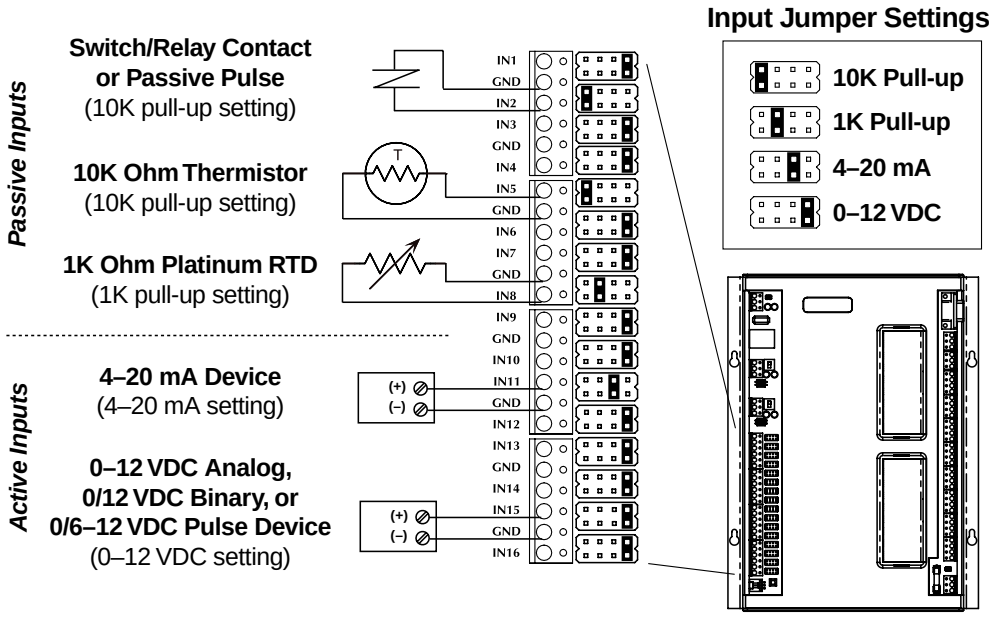


Illustration 3—Typical Inputs and Input Jumper Settings

For inputs to work properly, you must correctly:

- Attach sensors/switches to terminal blocks. See *Connecting Inputs on page 11*.
- Check/change input jumper settings. See *Illustration 3 on page 11* and *Illustration 4 on page 13*.
- Configure input objects. See *Input and Output Objects on page 55*.
- For analog input (AI) objects, check/select/import/configure the relevant look-up table as needed. See *Tables on page 65*.

0–12 VDC inputs

For an active voltage input, set the jumper to the *0–12 VDC* position. See *Illustration 3 on page 11* for the jumper positions. (For active pulse inputs, see below.)

4–20 mA inputs

For a 4–20 mA current loop input, set the jumper to the *4–20 mA* position.

Passive Inputs

Passive input signals, such as thermistors or switch contacts, need a pull-up resistor in the circuit. For KMC thermistors and most other applications set the jumper to the *10K Pull-up* position. For 1K ohm platinum RTDs, use the *1K Pull-up* position. (For troubleshooting inputs with a voltmeter, see *Illustration 4 on page 13*.)

NOTE: For pulse inputs, read the Pulse inputs section below carefully! Active voltage pulses of less than 6 VDC require an external voltage divider.

Pulse Inputs

Connect pulse inputs in the following manner:

- If the pulse input is a **passive** input such as switch contacts, then place the input pull-up in the *10K Pull-up* position.
- If the pulse is an **active** voltage **from 6 VDC up to a maximum of 12 VDC**, then place the input jumper in the *0–12 VDC* position.
- If the pulse is an **active** voltage **LESS than 6 VDC, then remove the input jumper and use an external resistor voltage divider to provide a 3 VDC maximum**. See *Illustration 4 on page 13.*

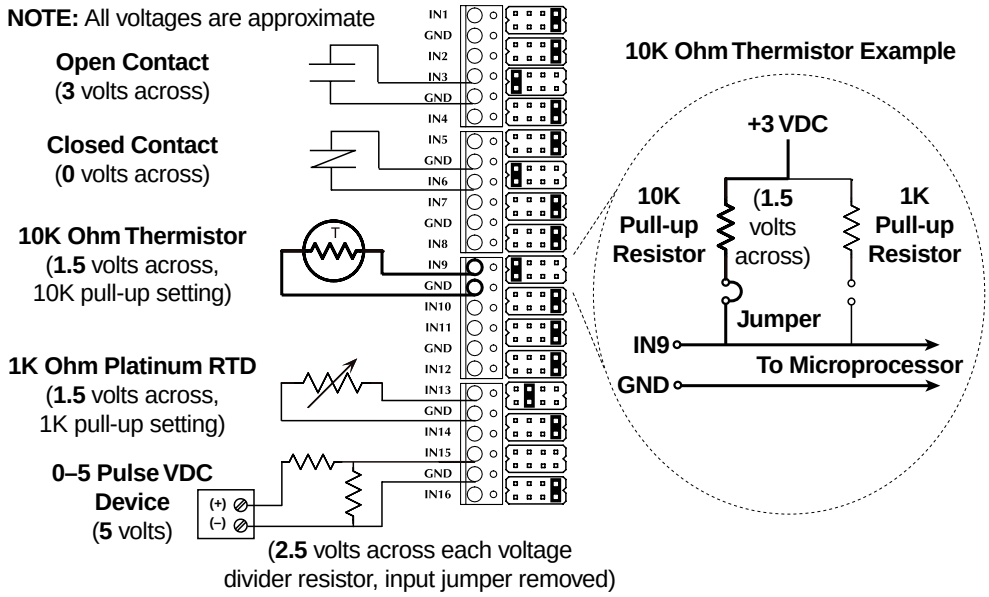


Illustration 4—Input Pull-Up Resistors, Voltage Values, and Resistance Values

Ground Terminals

Input ground terminals are located next to the input terminals. Up to two wires, size 14–22 AWG, can be clamped into each ground terminal. If more than two wires must be joined at a common point, use an external terminal strip to accommodate the additional wires.

NOTE: Input and Output GND terminals are **circuit** grounds and should not be connected to **earth** ground (or ground loops may result).

Connecting Outputs

All 16 onboard outputs are universal, software selectable to produce either analog or binary signals. For loads that exceed the output specifications of the controller, including loads that require AC, use an output override card. See *Installing Override Boards (Optional) on page 14*.

For outputs to work properly, you must correctly:

- Attach output devices to terminal blocks. See *Connecting Outputs on page 13*.
- Configure output objects. See *Input and Output Objects on page 55*.

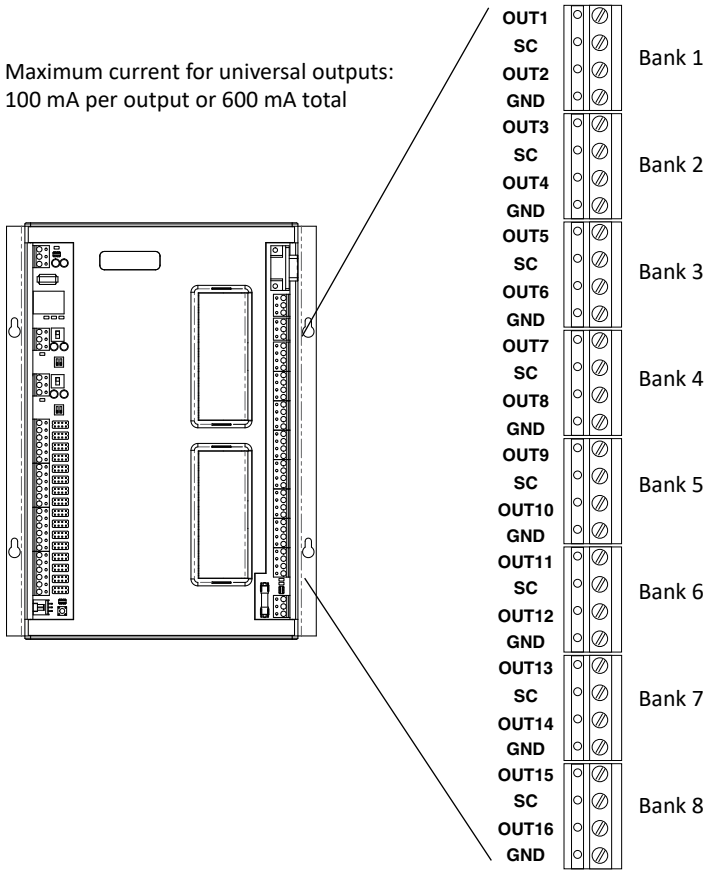


Illustration 5—Output Terminals and Banks

Universal Outputs

Connect the device under control between the output terminal and the ground (GND) terminal on the same bank. Switched common (SC) terminals are only used with some of the output override boards. See *Grounds and Switched (Relay) Commons on page 16*. The universal KMC BACnet controller outputs can be configured as:

- Analog objects—0 **TO** 12 volts DC
- Binary objects—0 **OR** 12 volts DC

For either type of output, the DC voltage signals can—within the specification of the output (**100 mA per output** or **600 mA total)**—connect directly to most equipment.

Installing Override Boards (Optional)

For enhanced output options, such as manual control or using large relays or devices that cannot be powered directly from a standard output, install output override boards (also called "cards"). Output boards have an accessible three-position slide switch for selecting the **"Hand-Off-Auto" functions**. While in the "Hand" position, the output is manually energized, and the controller is provided with a feedback signal to indicate the output has been overridden. While in the "Off" position, the output is manually de-energized, and the controller is provided with a feedback signal to indicate the output has been overridden. While in the "Auto" position, the output is under the command of the controller. Each output

board also has a red LED to indicate when the output is turned On either manually or automatically.

The following output boards are available from KMC Controls.

Output Override Boards	
Model Number	**Output Type**
HPO-6701*	**Triac (AC only):** zero-cross switching, optical isolation, 12 VAC min. and 30 VAC max. voltage, 20 mA min. current and max. current = 1 A for 1 board (0.8 A max. for 2 boards, 0.6 A max. for 3–4 boards, and 0.5 A max. for 5–8 boards per bank at ambient temperature no higher than 122° F or 50° C). At an ambient temperature up to 140° F (60° C), max. current is 0.8 A for 1 board, 0.6 A for 2 boards, 0.5 A for 3–4 boards, and 0.4 A for 5–8 boards (per bank).
HPO-6702	**0–10 VDC analog:** short protection, 100 mA max., adjustable override potentiometer.
HPO-6704	**4–20 mA (@10 VDC) current loop:** short protection, 100 ohm min. and 500 ohm max., adjustable override potentiometer (since the HPO-6704 supplies the power, **it will not work with a 4–20 mA device that also supplies its own power**).
HPO-6703*	**Normally open relay:** 30 VAC/VDC, 2 A max., power factor 0.4.
HPO-6705*	**Normally closed relay:** 30 VAC/VDC, 2 A max., power factor 0.4.
*With the **HPO-6701 triac** and **HPO-6703/6705 relays**, use only the **Switched Common** terminals instead of Ground!	

⚠ CAUTION

Connecting 24 volts AC or other signals that exceed the operation specifications of the controller before the output jumper is removed will damage the controller. Remove the jumper and install the override board before connecting AC or other voltage to output terminals of the controller.

To install the desired output override boards, remove the plastic cover(s) on the right side of the BAC-A1616BC. After installation of the boards, the existing cover needs to be replaced by an HPO-6802 output board cover.

To install the HPO-6700 series override boards:

1. Disconnect the power by removing the power jumper.
2. Remove the relevant cover(s) by lifting the right-hand side of the cover (within the plastic frame) toward you.
3. Remove the jumper from the relevant mounting header. See *Illustration 6 on page 16*.
4. Position the board above the relevant slot with the Hand-Off-Auto selection switch positioned toward the output connections.

NOTE: The slots do not align perfectly with their respective output terminals. Be sure to put the board in the correct slot.

5. Slide it down the integral board tracks onto the header pins.

6. If required, set the selection switch on the override board to the appropriate position. A (Automatic) is the right position of the switch, O (Off) is the middle position, and H ("Hand" or On) is on the left position.
7. Repeat steps 3 through 6 for all desired boards.
8. Remove the necessary label slots for each board location in the HPO-6802 output board cover.
9. Snap the HPO-6802 cover over the boards.
10. Connect output devices to the BAC-A1616BC outputs. See *Grounds and Switched (Relay) Commons on page 16*.
11. Reinstall the power jumper.

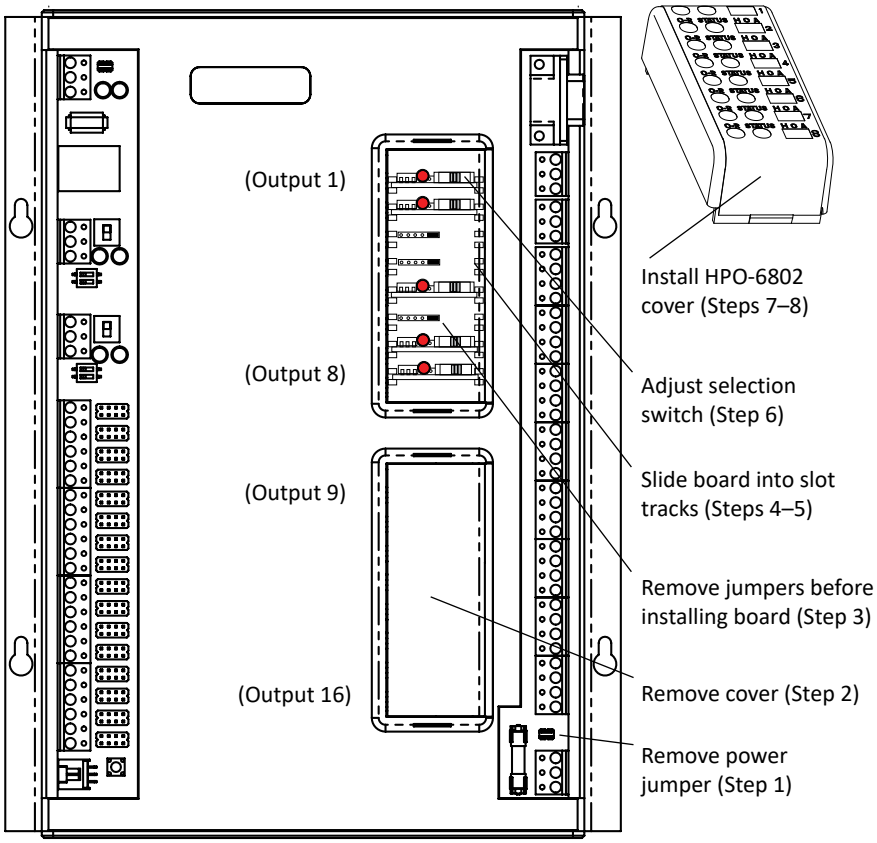


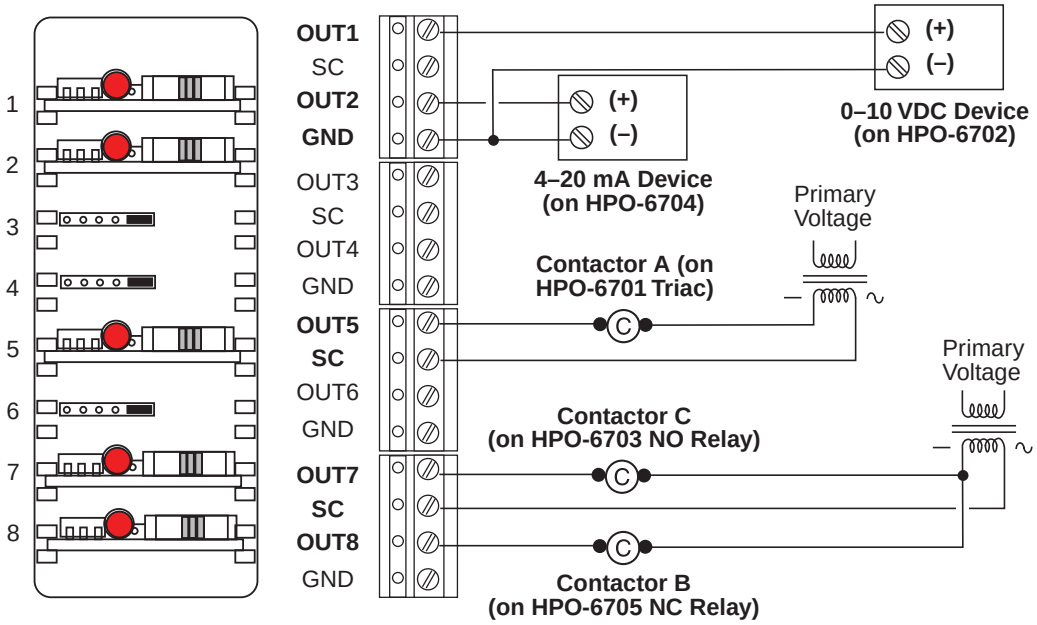
Illustration 6—Override Boards

Grounds and Switched (Relay) Commons

Switched Common (SC) output terminals are unconnected in the controller unless an appropriate relay/triac override output board is installed. **Use only the Switched (relay) Common instead of Ground with the HPO-6701 triac and HPO-6703/6705 relays!** The switched common terminals are isolated from the circuit grounds used for the universal output analog circuitry in the controller. See *Illustration 7 on page 17*. Use the SC terminal in the same output bank as the output terminal. See *Illustration 5 on page 14* for the bank locations.

⚠ CAUTION

Connecting 24 volts to an analog ground will result in improper operation and may result in equipment damage! Use the appropriate Switched (relay) Common terminals instead with the HPO-6701 triac and HPO-6703/6705 relays.



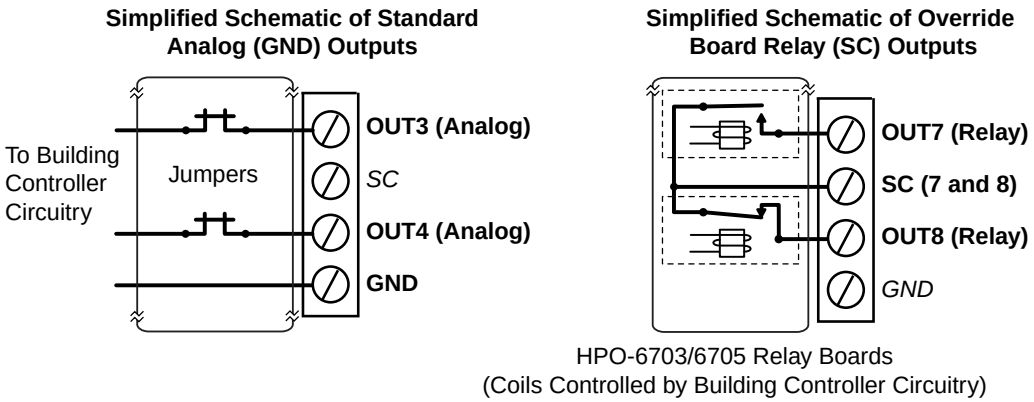


Illustration 7—Output Connections with Override Boards

NOTE: Input and Output GND terminals are **circuit** grounds and should not be connected to **earth** ground (or ground loops may result).

Connecting to an MS/TP Network

Connections and Wiring

The BAC-A1616BC connects to three different types of networks:

- MS/TP
- BACnet IP over Ethernet
- Ethernet 8802-3

Use the following principles when connecting a controller to an **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* terminal in parallel with all other *–A* terminals. (See ***Illustration 8 on page 19***.) Connect the *+B* terminal in parallel with all other *+B* terminals.
- Connect the shields of the cable together at each controller. For KMC BACnet controllers use the S terminal.
- 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.
- 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 Application Note AN0404A, *Planning BACnet Networks* for additional information about installing controllers.

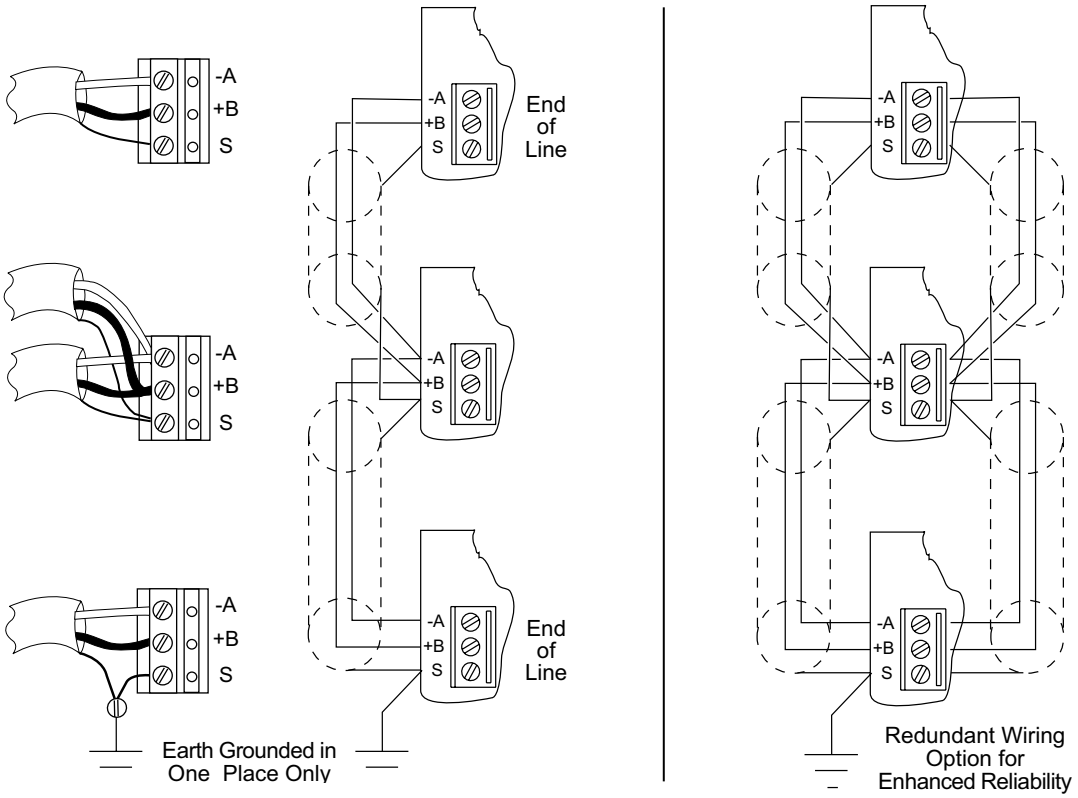


Illustration 8—MS/TP Network Wiring (Standard and Redundant Wiring)

NOTE: The BAC-A1616BC's EIA-485 terminals 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. When connecting to controllers from other manufacturers, verify the shield connection is not connected to ground.

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 9 on page 20*** and ***Illustration 10 on page 20***.

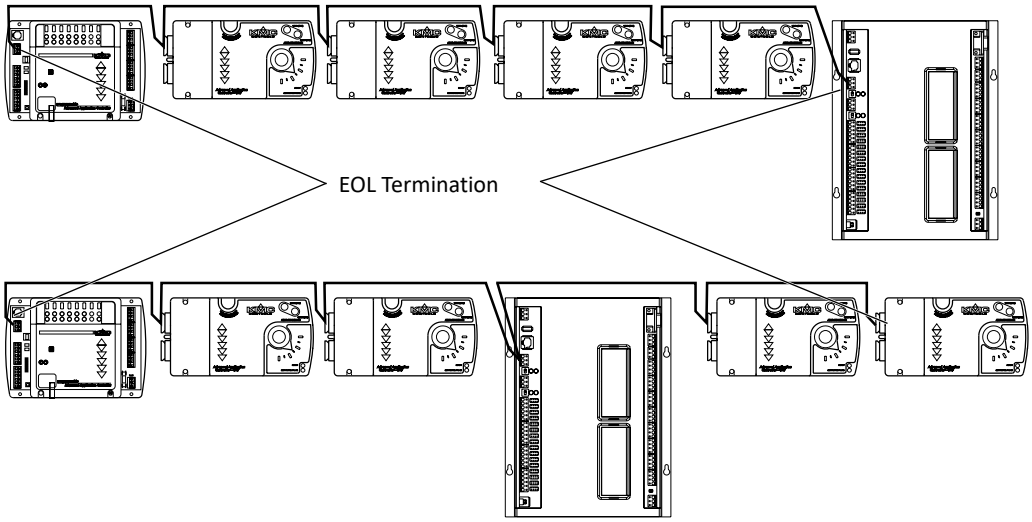


Illustration 9—End-of-Line Termination

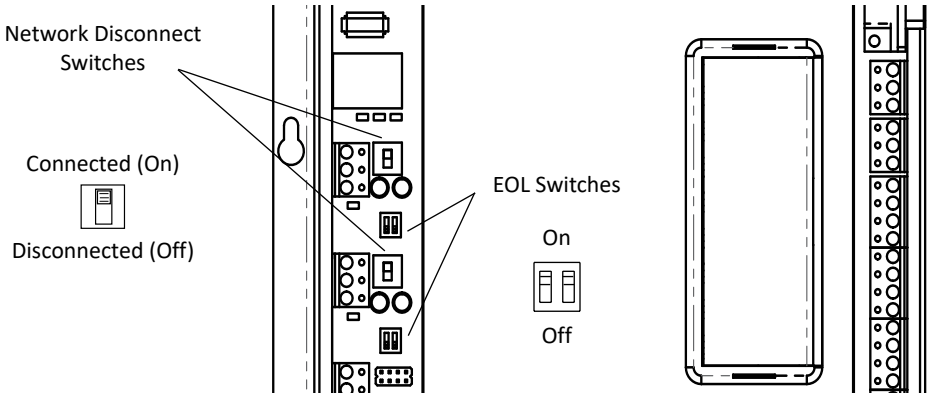


Illustration 10—Location of Network Disconnect and EOL Switches

Connecting to an Ethernet Network

⚠ CAUTION

Placing the BAC-A1616BC on an Ethernet network without proper configuration and assigning the correct IP address could cause disruption to the Ethernet LAN network service. Review *SECTION 3—Router Configuration Tool Connection/ Configuration on page 27* and the applications note AN0404A *Planning BACnet Networks* before connecting a BAC-A1616BC or router to a network.

The BAC-A1616BC connects to the Ethernet LAN in the same manner as other Ethernet devices. Connect a standard CAT 5 or CAT 6 Ethernet cable from the Ethernet port on the router to a network router, switch, or hub.

Connecting for Point-to-Point Operation

Introduction

BACnet point-to-point (PTP) links are established between two BACnet half-routers. Each half-router may be:

- Part of a hardware router (built into the BAC-A1616BC or BAC-5050).
- A feature of a software driver in a computer.

In the BAC-A1616BC, either the modem connector or the Serial 1 port may be used to establish PTP links. See *Illustration 11 on page 22* and *Illustration 12 on page 22*.

Use the KMC Router Configuration Tool to configure the router function for point-to-point operation. You will need all or part of the information in the following list to configure the router for PTP:

- The desired baud range that will be established between two remote modems (e.g., 9.6K to 33.6K).
- The baud between the modem and the BAC-A1616BC or between the BAC-A1616BC and a directly connected half-router. The maximum baud rate between the BAC-A1616BC and the modem (link "A" in *Illustration 12 on page 22*) must be higher than the baud rate between the two modems ("B"). The default Building-Controller-to-modem baud rate is 38400, which requires a 36.6K or less modem-to-modem setting.
- The passwords used by the remote half-router.
- At least one BACnet network that is known to the remote half-router (required for outbound connections only).

Debug Port Connection

To aid in troubleshooting, use a KMD-5672 PC-to-Controller cable and connect it to the *Serial 2 Debug port*. See ***Illustration 11 on page 22*** and ***Serial Connection and Debug Monitoring on page 30***. (This is the same connection method used to connect to the currently not-supported *Serial 1* port, which is reserved for a future upgrade.)

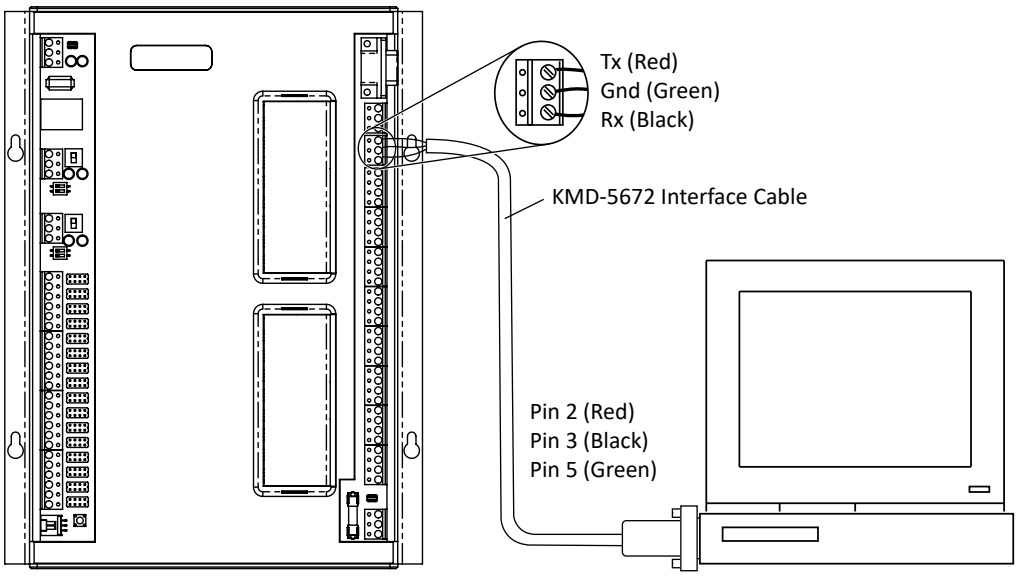


Illustration 11—Debug EIA-232 Serial Port Connection

Modem Connection for Point-to-Point

The point-to-point method is the only standard BACnet method for a dial-up connection.

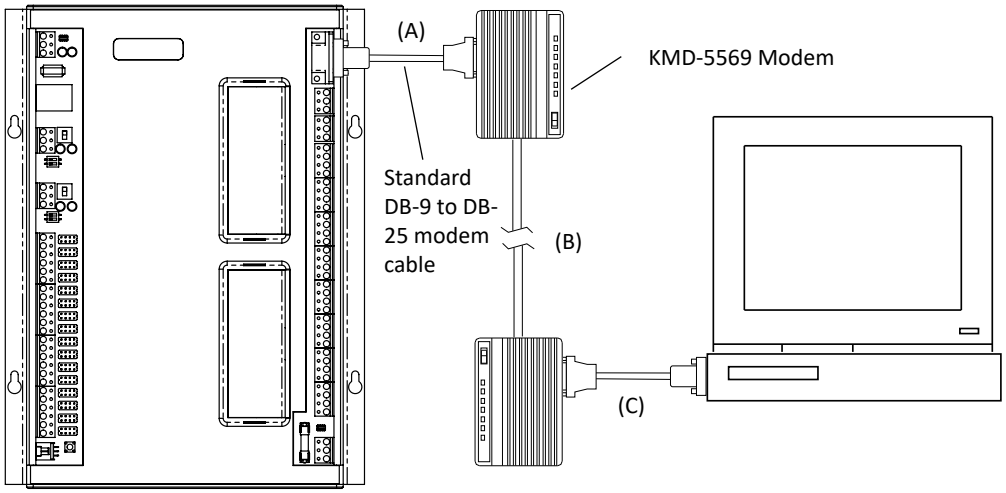


Illustration 12—Point-to-Point Modem Connection

NOTE: When using the BAC-A1616BC with a modem, power the modem before applying power to the controller.

To install a modem:

1. Connect a standard DB-9 to DB-25 computer-to-modem cable between the KMD-5569 modem and the *Modem* connector on the BAC-A1616BC. This cable is available from computer supply sources.
2. Connect the modem to a telephone line dedicated to the network system.
3. Verify the configuration switches on the back of the KMD-5569 modem are in the following positions.

KMD-5569 Modem Switch Settings		
Switch Number	**Switch Position**	**Function***
1	Up	DTR normal
2	Up	Verbal result codes
3	Down	Display error results
4	Down	Suppress command echo
5	Down	Modem does not auto answer
6	Up	Normal carrier detect
7	Up	Load non-volatile ram defaults
8	Down	Smart mode, processes AT commands

*NOTE: Refer to the instructions supplied with the modem for additional details about each switch function.

Or if another modem is used (not recommended), configure the modem for the functions shown in the table below (see the instructions supplied with the modem).

Generic Modems
Functions (refer to the instructions supplied with the modem)
Normal Data Terminal Ready
Normal Carrier Detect
Ignore Request To Send
Disable modem flow control
Verbal result codes
Display error result codes
Suppress command echo
Modem does not auto answer
Load non-volatile RAM defaults
Smart mode, processes AT commands

NOTE: KMC Controls does not guarantee compatibility with any modem other than the KMD-5569.

4. After the modem is configured, turn it on.
5. Connect power to the BAC-A1616BC. (The BAC-A1616BC must be powered up **after** the modem.)
6. Use the Router Configuration Tool to enable and configure the router for PTP routing. See *SECTION 3—Router Configuration Tool Connection/Configuration on page 27*.

NOTE: When using the BAC-A1616BC with a modem, power the modem before applying power to the router. If the power to the modem is ever cycled, power to the BAC-A1616BC must then also be cycled.

The maximum baud rate between the BAC-A1616BC and the modem (link "A" in *Illustration 12 on page 22*) must be higher than the baud rate between the two modems ("B"). The default router-to-modem baud rate is 38,400, which requires a 36.6K or less modem-to-modem setting.

When the BAC-A1616BC powers up, it configures the modem by using modem initialization strings, and it initializes the modem (using settings for a U.S. Robotics 56K Faxmodem or true compatible) to support any baud rate between 9600 and 33600. To use a higher modem-to-modem baud rate (e.g., 56K) or a different type of modem, you would need to adjust the router's modem initialization strings in the router using the Router Configuration Tool. (See *SECTION 3—Router Configuration Tool Connection/Configuration on page 27*.) If modifying initialization strings from the defaults, connect to the router from the PC using a program such as HyperTerminal to test the new initialization strings.

The default settings for the Modem and Serial 1 ports are 38,400 baud, 8 data bits, no parity bits, and 1 stop bit. The Serial 2 port defaults are the same except for a speed of 115,200 baud. In the General Settings tab of Router Configuration Tool menu, **Serial 1 Baud Rate sets the baud for both the Serial 1 and Modem ports**, and Serial 2 Baud Rate sets the baud for the Serial 2 ports.

Controller-to-Controller over Null Modem Cable

Use a standard DB-9 to DB-9 null modem cable to connect two BAC-A1616BCs with a PTP link. Use the Router Configuration Tool to configure the BAC-A1616BCs for point-to-point operation.

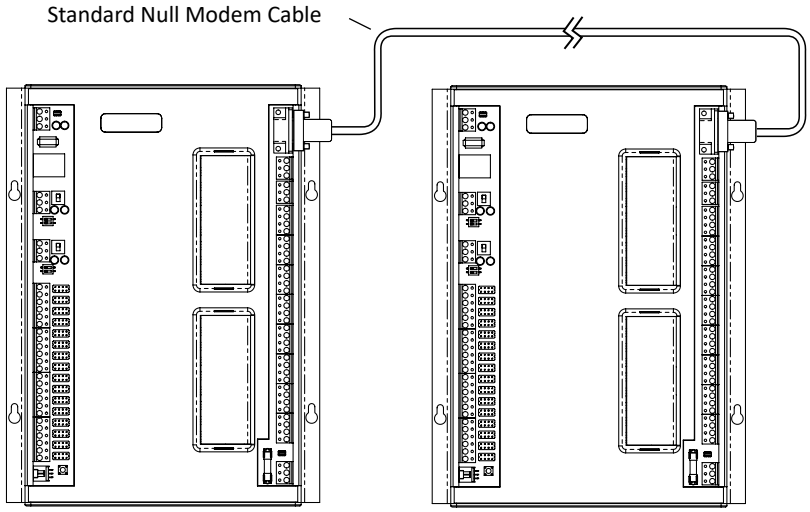


Illustration 13—Point-to-Point Link with Null Modem Cable

Connecting to Expansion I/O Modules

The onboard 16 inputs and 16 outputs can be expanded up to a total of 128 inputs and 72 outputs by using up to 7 expansion I/O modules installed up to 200 feet away. See *SECTION 6—CAN-A168EIO Expansion Module on page 85*.

Connecting USB and UPS Ports (Future Upgrades)

The USB 2.0 port and the UPS port are included for future enhancements. See *Illustration 14 on page 25*. For example, when the UPS port would be connected to an appropriate Uninterruptible Power Supply with a signal cable, a power failure would cause the UPS shutdown circuitry to signal the BAC-A1616BC to back up the data in the memory to the nonvolatile flash memory and power down.

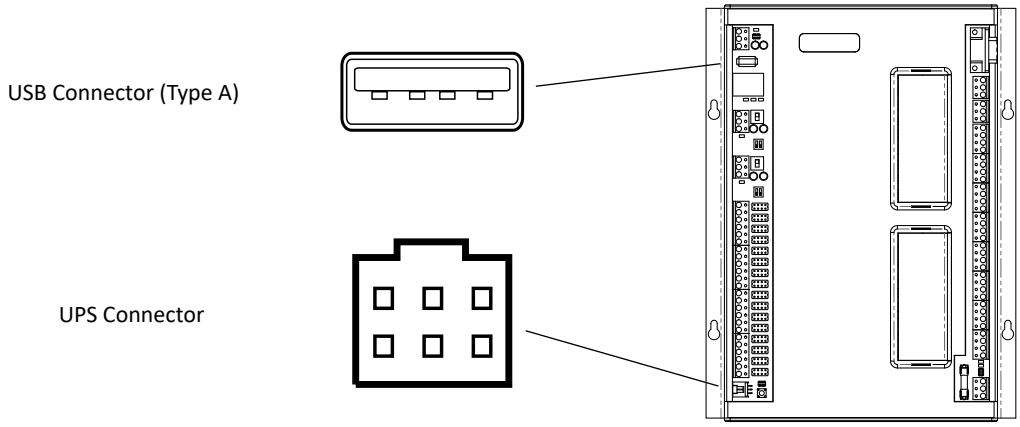


Illustration 14—Location of USB and UPS Connectors

Connecting Power

The BAC-A1616BC 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. 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.
- (For future release reference, the transformer must be powered by the same UPS as is connected to the Building Controller's UPS communications port.)

Connect the 24 volt AC power supply to the power terminal block on the lower right side of the controller near the power jumper. **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 plugged in and the power jumper is in place.

Connect an **earth** ground to the *E* terminal. This terminal grounds the USB and Ethernet connector shields, but it is not circuit/signal ground (–). It does **not** ground the input GND terminals, output GND terminals, or S terminals on the MS/TP connectors.

NOTE: If a CAN-A168EIO expansion module is being used, see the important notes on powering **both** in *Inputs, Outputs, and Power on page 88*.

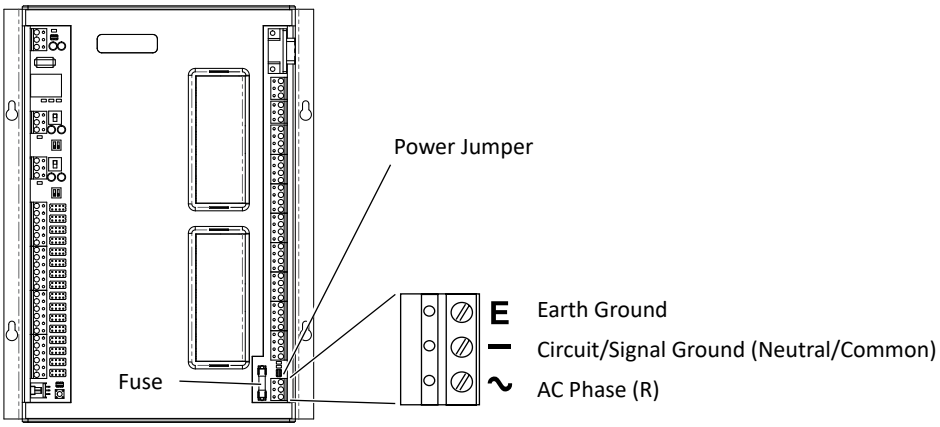


Illustration 15—Power Terminal and Jumper

⚠ CAUTION

Do not mistakenly connect 24 VAC to an analog output ground. This is not the same as a relay's switched common.

SECTION 3—Router Configuration Tool Connection/Configuration

This section provides important guidelines for configuring the BAC-A1616BC before it is placed on a network. Review this information carefully for proper installation.

Before You Begin

Before initializing the BAC-A1616BC, review Application Note AN0404A, *Planning BACnet Networks*. Also refer to the TotalControl documentation for complete details of network configuration.

Before the BAC-A1616BC can communicate on a network, it must be configured with the supplied Router Configuration Tool. Configuring prepares the controller with the following:

- MS/TP MAC address.
- Device instance number.
- Baud rate.
- IP address.

In addition to the Router Configuration Tool software, you will need the following information before you can initialize the router function of the BAC-A1616BC.

From the system designer:

- Network numbers for each of the networks to which the BAC-A1616BC will connect.
- A MAC address for each MS/TP port that will be enabled in the router function.
- The highest MAC address used on each of the MS/TP networks to which the BAC-A1616BC will connect.
- The baud rate for each of the enabled MS/TP networks.
- The address and port for a PAD router or BBMD to which the BAC-A1616BC router function will connect.

From the system administrator:

- The IP address for the BAC-A1616BC.
- The UDP port numbers.
- The IP subnet mask for the Ethernet LAN to which the BAC-A1616BC will connect.

NOTE: The Setup > Router web page has many of the same functions as the Router Configuration Tool in a graphical format.. See ***Router Setup (Web) on page 68*****.**

Connecting for Configuration

Connecting with Ethernet

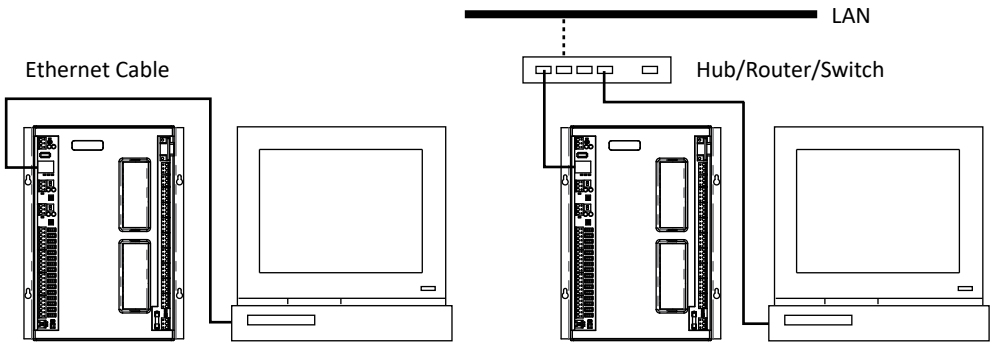


Illustration 16—Ethernet Configuration Connections

Configure the BAC-A1616BC router functions before connecting it to a BACnet internetwork. To perform initialization with the Router Configuration Tool (see *Router Configuration Tool (RCT) on page 30*) via Ethernet, you will need a computer with an Ethernet port and one of the following connection methods.

- Connect directly to the BAC-A1616BC with an Ethernet (cross-over or straight-through) cable.
- Connect the BAC-A1616BC and computer together with a router/hub/switch. (For example, a Linksys or D-Link router in standard configuration should work.)

Verify that address conflicts will not occur (see *Resolving PC and B-BC IP Address Conflicts* below).

NOTE: **Before connecting an uninitialized BAC-A1616BC to an existing LAN, verify that addressing conflicts will not occur and that they will be on the same subnet.** The default IP address for the BAC-A1616BC is **192.168.1.254**. The default subnet mask is **255.255.255.**0. The default gateway is 255.255.255.255.

NOTE: The **existing (unknown) IP address** for a BAC-A1616BC can be viewed in a terminal program (such as Hyperterminal). It will appear on a line part-way through a restart. To optionally monitor the boot-up, a KMD-5672 computer-to-router serial cable is needed. See *Serial Connection and Debug Monitoring on page 30*.

Resolving PC and B-BC IP Address Conflicts

To communicate on the same subnet as the BAC-A1616BC after making physical Ethernet connections, the IP address of the computer will probably have to be temporarily changed. One way of doing so is the following procedure.

1. Determine the computer's IP address and subnet mask by running ipconfig from a command prompt (*Start* button > select *Run* > type in `cmd` and hit *Enter* > at the prompt, type in `ipconfig`). Write the address numbers down for future reference. (See *Illustration 17 on page 29*.)

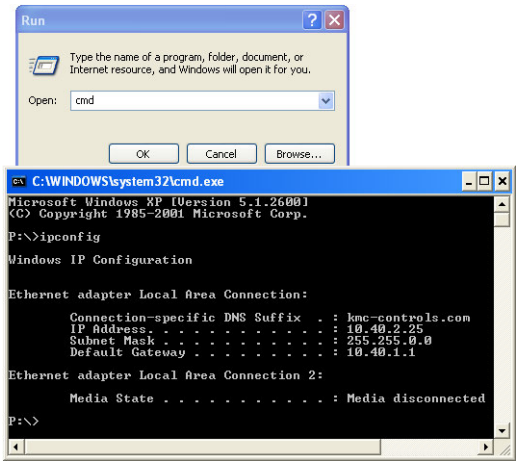


Illustration 17—Default PC IP Address and Subnet Mask

2. From the Start menu, right-click *My Network Places* and select *Properties*. (These instructions are for Windows XP. For Windows 7, start in the Control Panel > Network and Sharing Center.)
3. Right-click (left-click in Windows 7) the relevant *Local Area Connection* and select *Properties*. (See *Illustration 18 on page 29*.)
4. Highlight *Internet Protocol (TCP/IP)* or *Internet Protocol Version 4 (TCP/IPv4)* and click *Properties*.
5. If it is not already selected, click on the radio button in front of *Use the following IP address*.
6. Enter the following numbers (***with the last three digits of the IP address any number between 1 and 253) into the appropriate field. (These numbers should be the same as in the BAC-A1616BC's default except for the last set of the IP address.)

IP address	**192.168.1.*** ** (where the last digits are any number between 1 and 253 since the BAC-A1616BC is 254)
Subnet mask	**255.255.255.0**
Gateway	**Leave blank** (or if that does not work, use 192.168.1.***, where the last digits are different than the IP address in the computer or BAC-A1616BC)

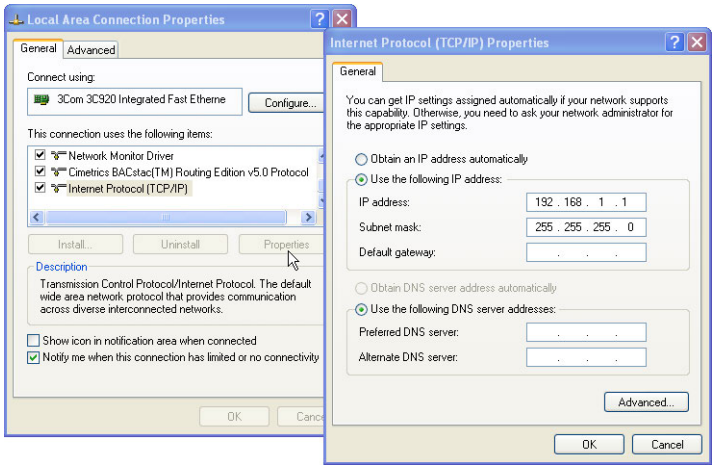


Illustration 18—IP Properties

7. Click *OK* and *Close*.
8. In the Router Configuration Tool (see *Router Configuration Tool (RCT) on page 30*), change the BAC-A1616BC's IP address (same as the PC's except at least one digit must be different in the last set) and subnet mask (same as the PC) as needed to be compatible with the PC.
9. Save changes and restart the BAC-A1616BC. (See *Illustration 20 on page 32*.)
10. Repeat steps 2 through 4 above.
11. Select *Obtain an IP address automatically* (or, if appropriate, leave *Use the following IP address* selected and reenter the computer's old numbers) and then click *OK*.
12. Click *Close*.

Serial Connection and Debug Monitoring

Serial 2 is a standard EIA-232 port for connecting a PC directly to the BAC-A1616BC. Make the connection using a KMD-5672 PC to serial port cable. See *Illustration 11 on page 22*.

The **Serial 2 "Debug" port** allows monitoring of the BAC-A1616BC's boot-up process. Most of the debug information is only useful to KMC engineers, but the current device number, IP address, and subnet mask can be viewed. Also, **during the boot-up, there will be a two-second window to halt the process by hitting any key** (but the terminal program must have sending keystrokes enabled). Use HyperTerminal, Tera Term or equivalent. **In HyperTerminal**, change the default Port Settings to the following:

Bits per second	**115200**
Data Bits	8
Parity	None
Stop bits	1
Flow control	**None**

While boot-up is paused, firmware may be reloaded using the Router Configuration Tool (e.g., if a problem in a firmware upgrade has caused the BAC-A1616BC to continuously reboot). To connect to that default IP address, the computer's IP address may need to be temporarily changed. See *Resolving PC and B-BC IP Address Conflicts on page 28* information about communicating with that IP address.

Router Configuration Tool (RCT)

NOTE: The Setup > Router web page has many of the same functions as the Router Configuration Tool in a graphical format.. See *Router Setup (Web) on page 68*.

NOTE: Illustrations in Section 3 show sample screen shots of versions 2.x.x.x of the RCT. Later RCT versions show the information somewhat differently.

To initialize the BAC-A1616BC (or upgrade the firmware), use the Router Configuration Tool (RCT). To install the tool, insert the CD into the computer's CD drive

(or double-click the downloaded EXE file) and follow the on-screen installation directions. A typical installation of the RCT places it in the KMC Controls program group in the Startup menu. After the installation:

1. When the BAC-A1616BC and computer are connected, start the RCT. See *Illustration 19 on page 31*.
2. Click *Add Device*, double-click on the first blank line under IP Address, and type in the default BAC-A1616BC IP address (`192.168.1.254`). (Click ***Add Device*** even when reconnecting later to one already added.)
3. Double-click on the first blank line under *Description* and name the connection (such as B-BC default). (You may rename it later.)
4. Click *Connect*.

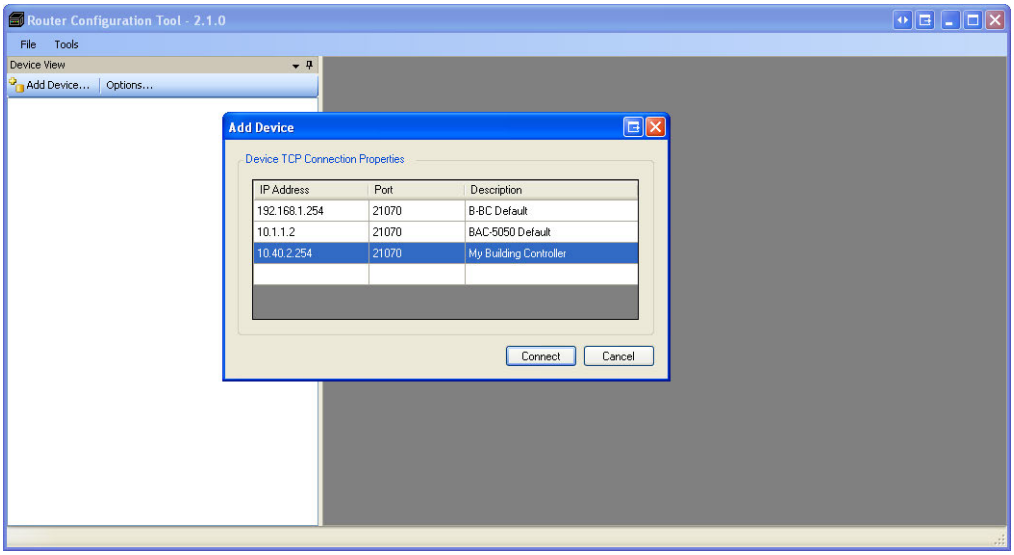


Illustration 19—RCT Add (Connection to) Device Screen

5. Double-click the top-level line to go to the *General Settings* tab. See *Illustration 21 on page 32*. Alternately, right-click the line and select *Configure Device* from the context-sensitive menu. See *Illustration 20 on page 32*. (Other functions can also be performed from this menu.)
6. Type in the new IP Address, Subnet Mask, and/or Gateway in the fields as needed and click *Save Changes*. (Clicking *Refresh* restores fields to the last saved values from the controller.) See *Illustration 21 on page 32*.
7. If necessary, restore the computer's IP address and repeat steps 1 through 4 with the new IP settings.
8. Double-click the lines for IP, MS/TP, Ethernet, and/or PTP Routing Networks as desired to configure those items.

NOTE: The **Home Port** determines to which network the BAC-A1616BC appears to be connected.

NOTE: **Be very careful about setting the baud rate** on the controllers on the MS/TP network. They should all match. The BAC-A1616BC does not (yet) autobaud. For example, if other controllers are set to 38400 with autobaud turned on while the BAC-A1616BC is set to 9600 baud, and if power to all devices is temporarily lost, the other controllers may cycle first and lock

in 38400 baud before the BAC-A1616BC has a chance to send any MS/TP traffic. Such a situation would cause the BAC-A1616BC and the MS/TP bus to be nonresponsive until the other controllers are restarted or the baud rate on the BAC-A1616BC is changed.

9. **Restart the BAC-A1616BC for the changes to take effect.** A convenient method for doing so is to right-click the top-level line and select Restart Device from the context-sensitive menu. See *Illustration 20 on page 32*.

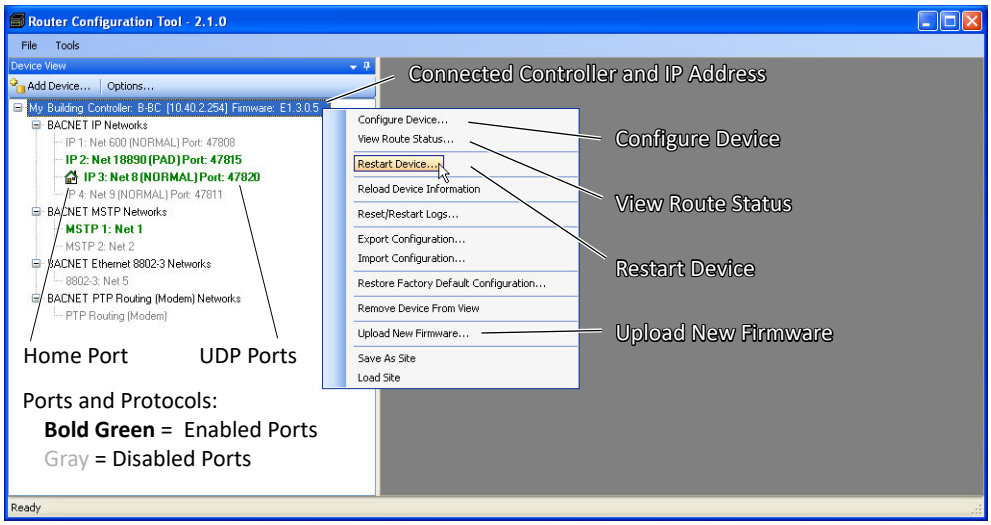


Illustration 20—RCT Ports and Context Sensitive Menu

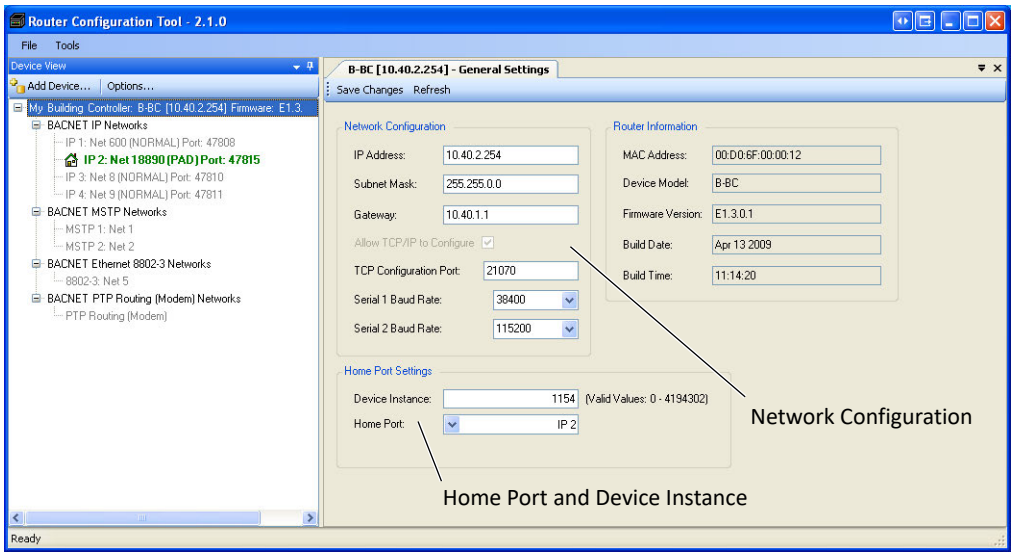


Illustration 21—RCT General Settings Screen

Route Status (RCT)

Introduction

Route Status (selectable from the context-sensitive menu by right-clicking the B-BC line) is a diagnostic tool that displays a list of all networks of which the Building Controller's router function is aware. The Route Status tab displays status of both direct and remote networks.

NOTE: Direct (or local) networks are networks that connect directly to the router, and remote networks are networks that are on the other side of one or more remote routers. The path to a remote network always includes at least one directly connected network. If a directly connected network is shown to have a problem, the remote networks that connect to it will also show problems. Correct directly connected network problems before troubleshooting remote network problems.

Route status can be used to troubleshoot network problems (such as a duplicate network number indicated by the D-in-a-circle icon in *Illustration 22 on page 33*).

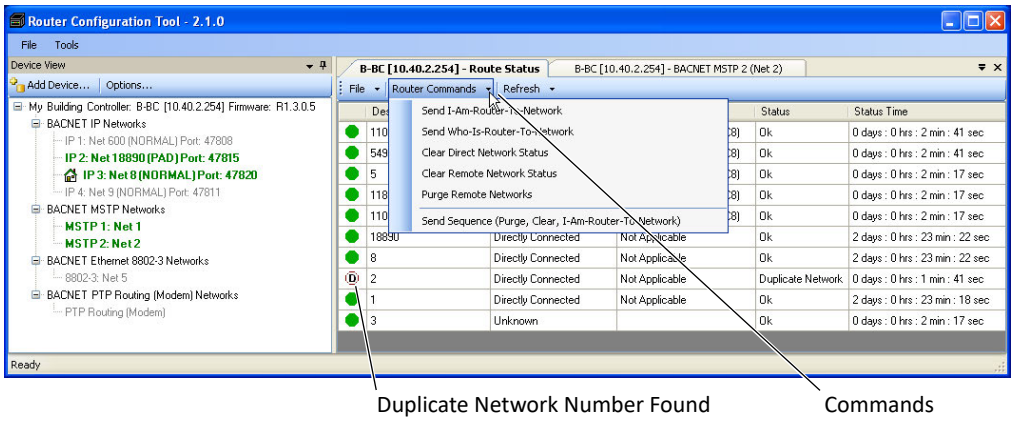


Illustration 22—Route Status (RCT)

To change the order in which network information is displayed, click the header at the top of the column.

NOTE: Route Status is also available in the Setup > Router web configuration page. See *Router Setup (Web) on page 68* **and** *Illustration 56 on page 68*.

Network Information

- **Destination Network** displays the networks to which the router will send messages. The networks can be directly connected to the router or connected to a remote router.
- **Next Router Network** displays each of the networks connected to the ports that will be used to route a message to the next router.
- **Next Router Address** displays the decoded MAC (or bus) address of the next router.
- **Status Time** displays the elapsed time since the status update.

- **Status** displays an icon and network status (see chart below for details).

Icon	Status	Description	Action
	OK	The network is functioning correctly and capable of passing traffic.	None required.
	Busy	The amount of network traffic is high enough that no new traffic can be accepted.	Usually a temporary condition that does not require operator intervention.
 or 	Down or Gone	Something is impeding the traffic to that network. Usually this means the directly connected network is in a “traffic halted” state.	Will probably require manual intervention. Conditions that cause a network to be down may include both LAN or BACnet router problems. However, PTP can be “down” and not require manual intervention. Directly connected networks are almost never “down” but will have another “traffic halted” status.
	No Status	The router is searching for the network.	Usually a temporary condition that does not require operator intervention.
	Duplicate Network	The internetwork is configured with networks using the same network number. A router cannot pass traffic on a duplicated network.	Usually requires intervention to locate and redesignate the router with the duplicate network number. Multiple duplicate networks are usually an indication of network loop.
	Duplicate MAC	The router has detected another MS/TP device using the MAC address assigned to the router. Traffic is not routed.	Change the MST/TP MAC address in either the router or the device that contains the duplicate number.
	Sole Master	The router is not detecting any master devices on the local MS/TP networks. Slave devices however, may be present. (The network switch might be Off.)	Requires corrective action if master devices are known to be connected to the local MS/TP network and the network switch is turned On.
	BBMD: Unknown	Indicates the router is receiving BBMD traffic from a BBMD that is not in its table. This does **not** stop traffic from routing.	If appropriate, add the unknown BBMD to the local BDT. A possible cause of unknown traffic is an address issue because of network address translation.
	BBMD: Multiple	Indicates the router has detected another BBMD servicing the same subnet **AND** port. (Some configurations may have two BBMDs in the same subnet but operating on **different** ports.) This stops traffic from being routed.	Remove a BBMD from the network.
	Foreign Device NAK (Negative AcKnowl-edge-ment)	The foreign device server is preventing this router’s request to distribute messages. Initially, this condition will not block. However, as each request is received, attempts to registration speed up until traffic is stopped.	The foreign device table in the remote foreign device server is full and cannot register additional devices, commonly caused by the max FDT entries not being set high enough. Increase the value of Max FDT Entries in the remote server or register with a different server. Foreign device support might also be disabled.

Router Commands

- **Send I-Am-Router-To-Network** initiates a broadcast to all known networks that this router is on the network. This can trigger internetwork-wide updates.
- **Send Who-Is-Router-to-Network** initiates a query to all other routers which results in the discovery of other networks. Other routers will respond with an I-am-router-to-network message.
- **Clear Direct Networks** forces the status of all local networks to OK. If a problem continues with a direct network, it will return to a status other than OK.
- **Clear Remote Status** forces the status of all remote networks to OK. If a problem continues with a remote network, it will return to a status other than OK.
- **Purge Remote Networks** removes all remote routes from the network table.
- **Send Sequence** broadcasts the three commands *Purge Remote Networks*, *Clear Remote Status*, and *Send I-Am-Router-To-Network* sequentially.

NOTE: After configuration changes, it may be helpful to select *Send Sequence* and wait for the entire network to refresh traffic from active controllers and routers (which may take a minute or more for large networks).

RCT and Sample Network Configurations

BACnet Over MS/TP

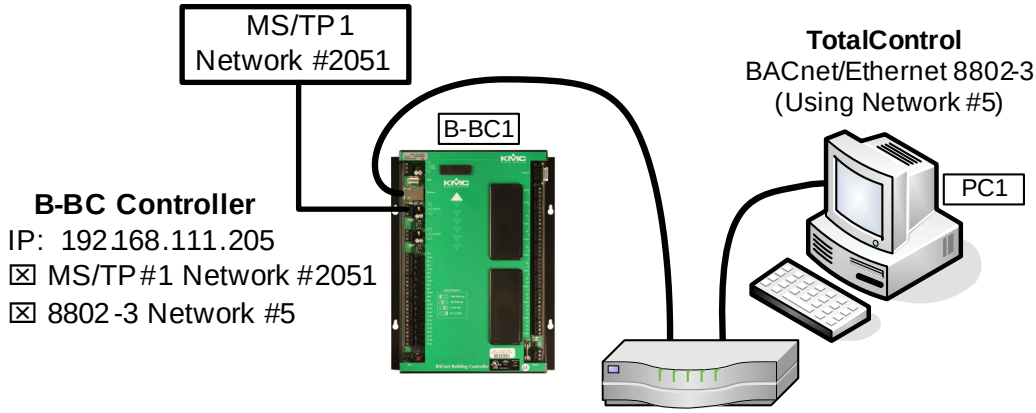


Illustration 23—Basic MS/TP Connections

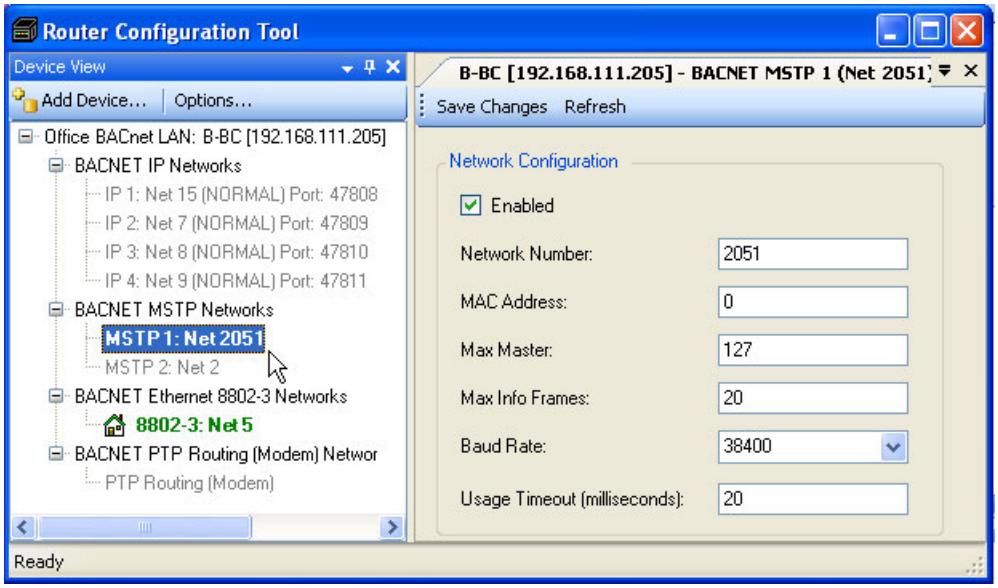


Illustration 24—RCT Settings for MS/TP

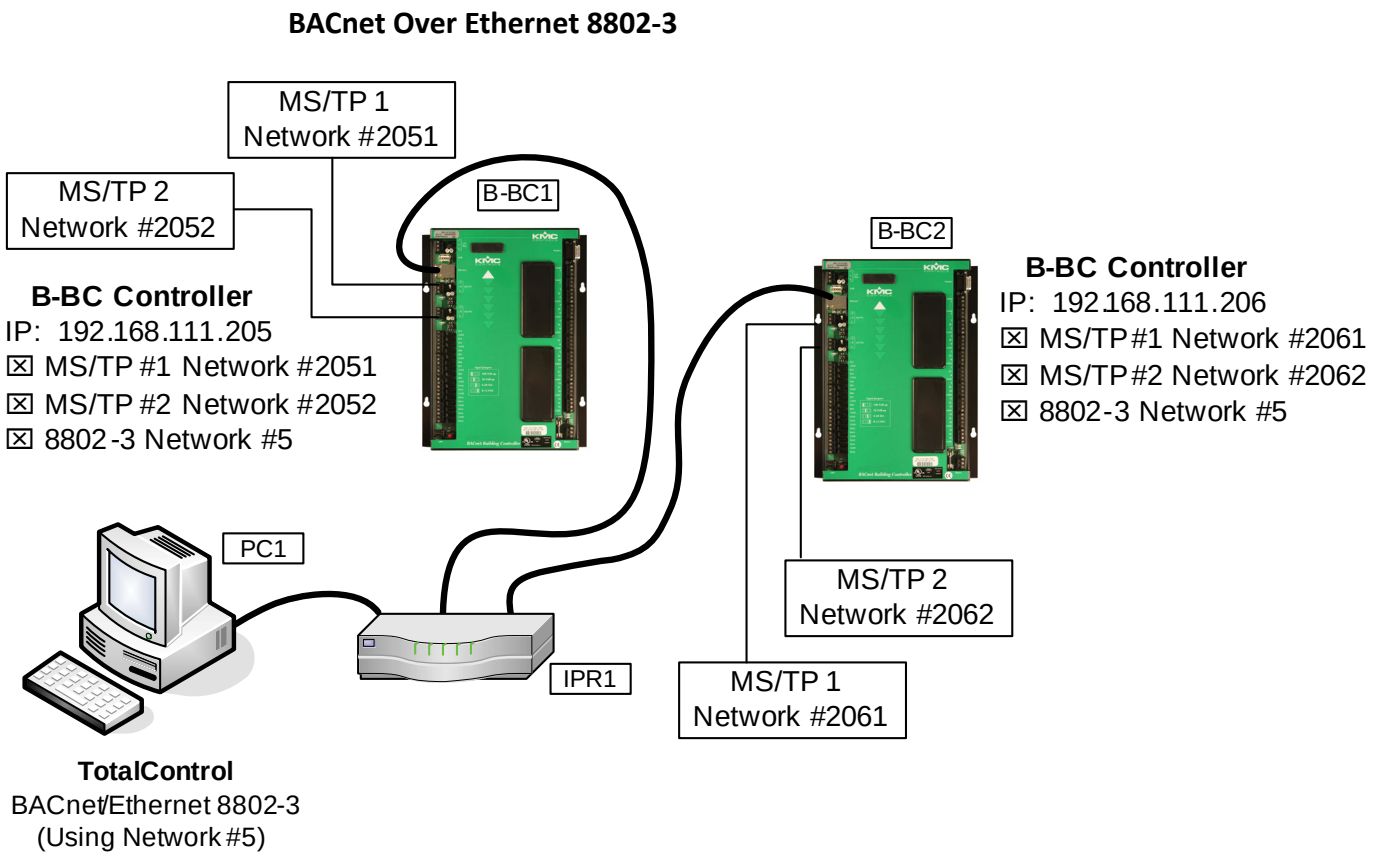


Illustration 25—BACnet Over Ethernet Connections

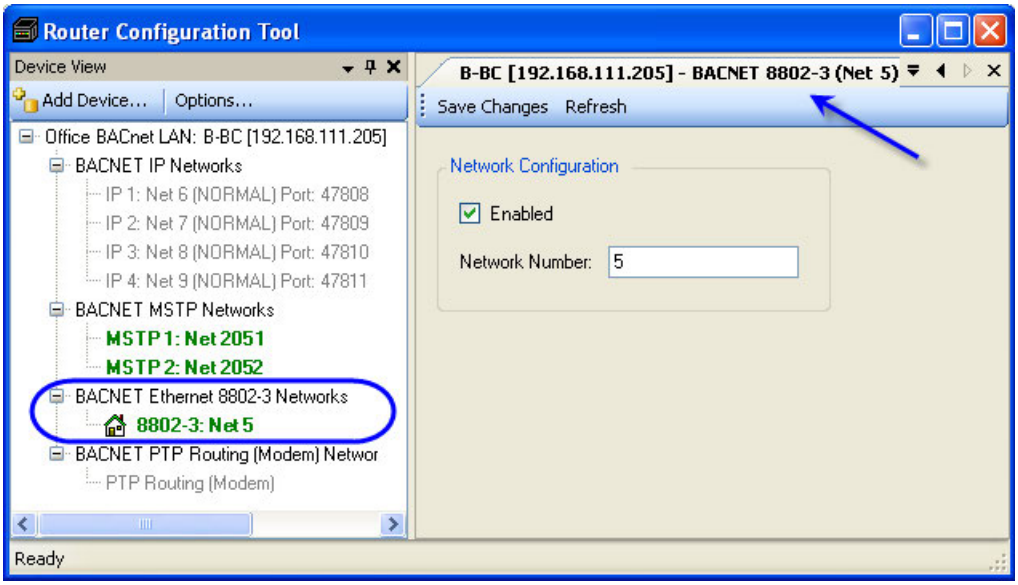


Illustration 26—RCT Settings for BACnet Over Ethernet

BACnet Over IP (Normal Mode)

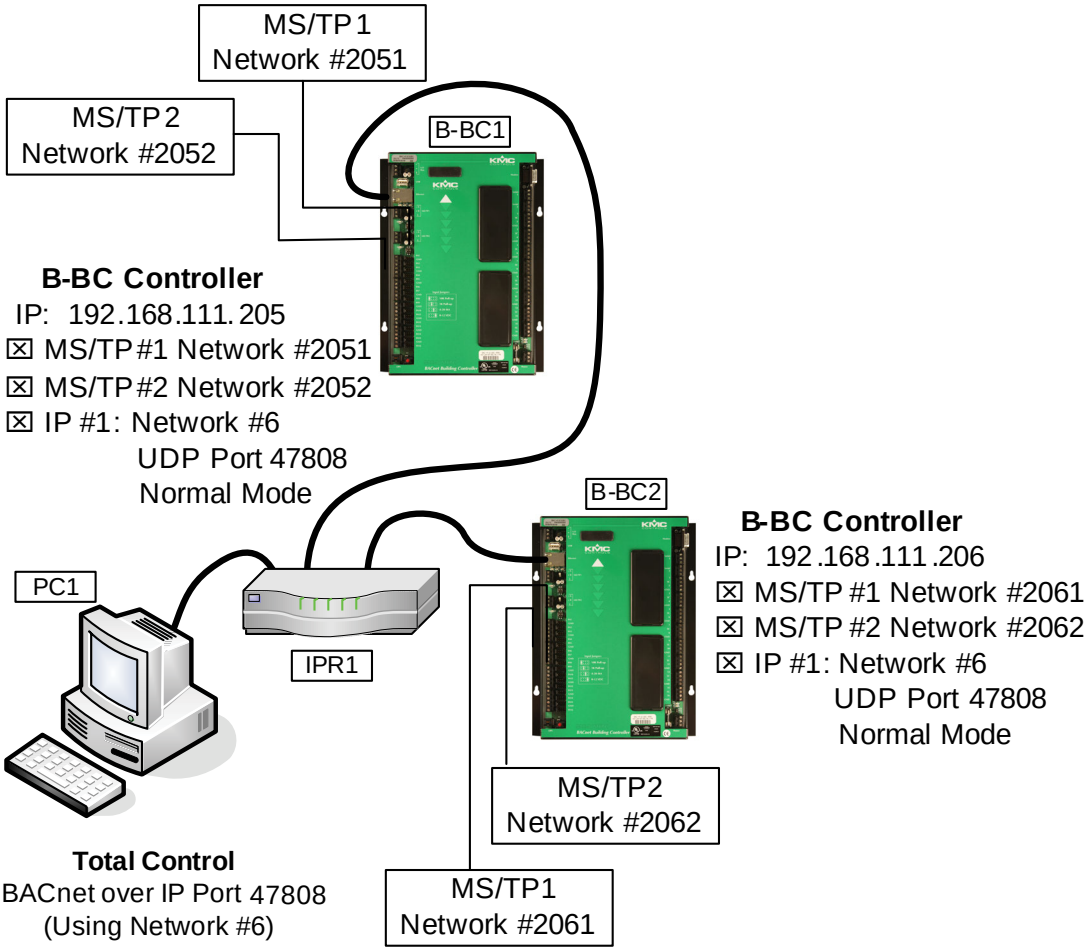


Illustration 27—BACnet Over IP Connections (Normal Mode)

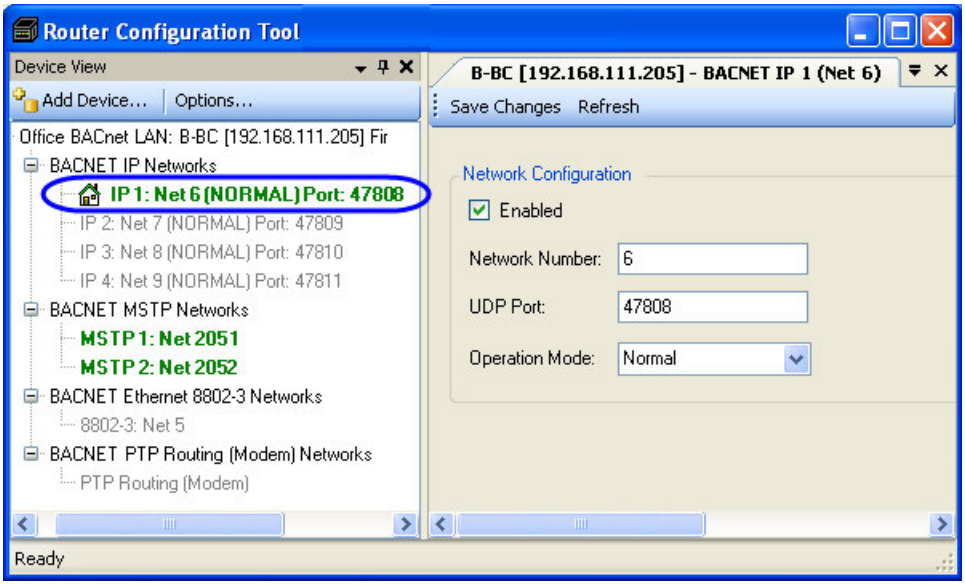


Illustration 28—RCT Settings for BACnet Over IP (Normal Mode)

See also *BACnet Over IP, Using PAD (Packet Assembler/Disassembler) on page 39* and *BACnet Over IP, Using BBMD and Foreign Device on page 41.*

BACnet Over IP, Using PAD (Packet Assembler/Disassembler)

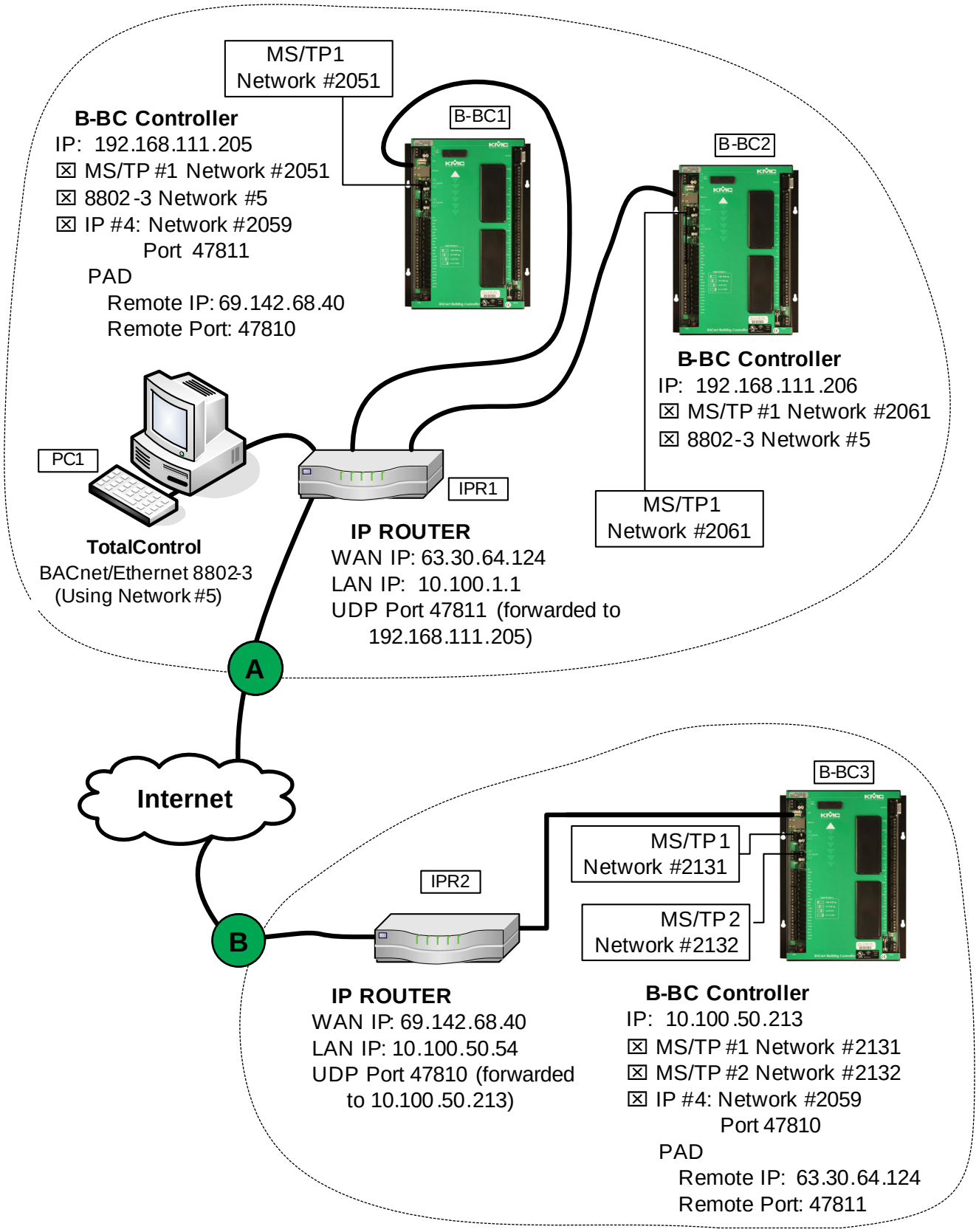


Illustration 29—BACnet Over IP Connections (PAD)

A PAD (Packet Assembler/Disassembler) can be used to join BACnet networks through the Internet. PAD enables the transporting of BACnet packets across IP routers to join two separate IP subnets.

NOTE: The routing might or might not involve NAT (Network Address Translation), which is a (fixed/static or dynamic) process of network address translation involving rewriting the source and/or destination addresses of IP packets as they pass through a router or firewall. NAT is often used to enable multiple hosts on a private network to access the Internet through a single public IP address.

See also *BACnet Over IP (Normal Mode) on page 38* and *BACnet Over IP, Using BBMD and Foreign Device on page 41.*

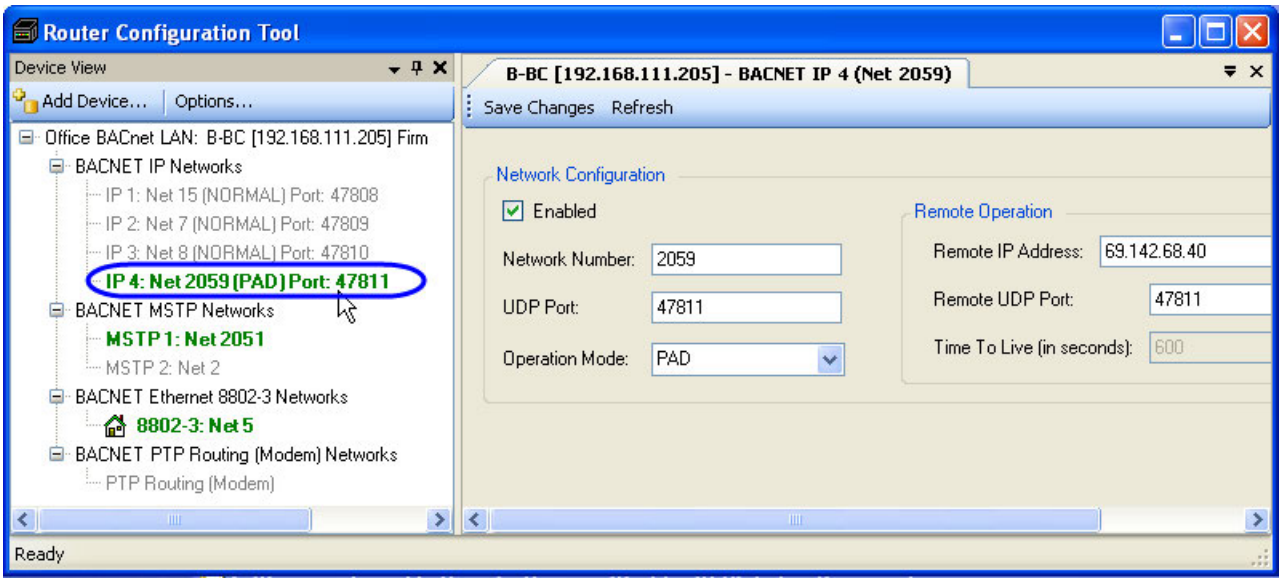


Illustration 30—RCT Settings for BACnet Over IP (PAD)

BACnet Over IP, Using BBMD and Foreign Device

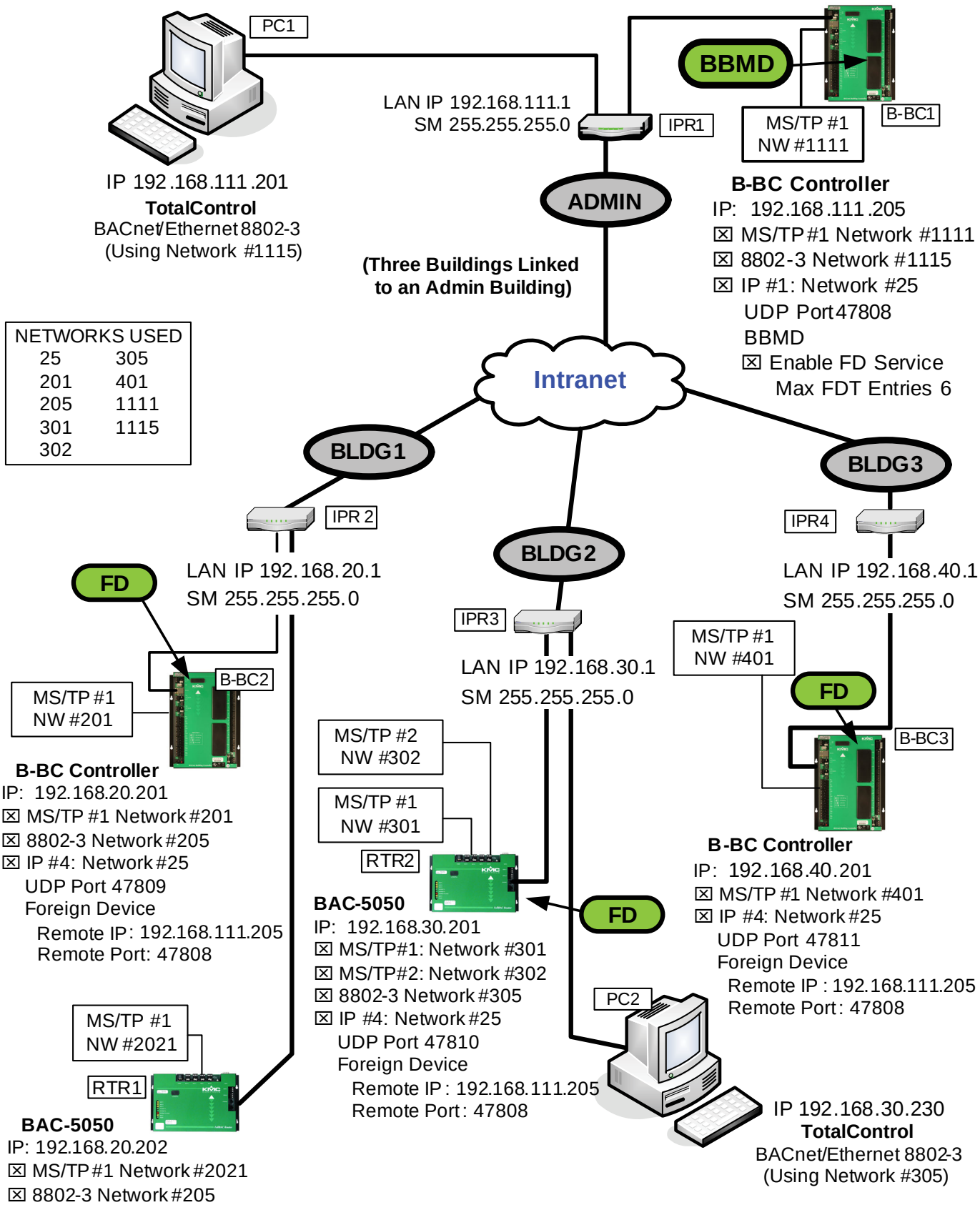


Illustration 31—BACnet Over IP Connections (BBMD and Foreign Device)

FDs (Foreign Devices) report to the BBMD (BACnet Building Management Device) to tunnel through IP Routers. However, as the BACnet standard was written, this form of tunneling cannot deal with NAT (Network Address Translation) in IP Routers. This form of tunneling is recommended only in an intranet (see *Illustration 31 on page 41*), VLAN environment, or as a temporary connection over a VPN. FDs and a BBMD cannot use NAT to cross the Internet except through a VPN connection.

Addendum O of the BACnet standard now allows communication across the Internet with the addition of a public IP address of the router (see the BBMD_ADDENDUM O selection in *Illustration 32 on page 42*). (This requires Router Configuration Tool version 2.1.0.13 or later and BAC-A1616BC firmware R1.6.0.11 or later.)

If communication with FDs on both an (internal) intranet and across the Internet is required, two different networks must be set up. One network is configured as a BBMD for the FDs on the intranet, and the other is configured as a BBMD ADDENDUM O for the FDs on the Intranet.

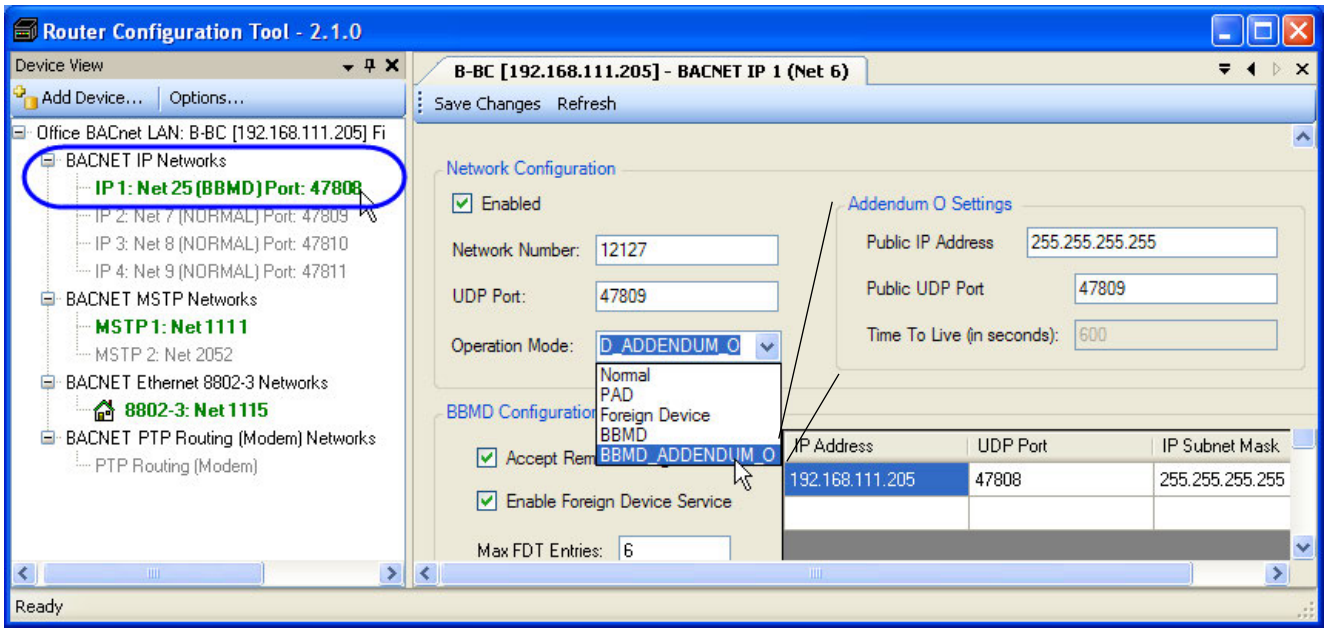


Illustration 32—RCT Settings for BACnet Over IP (BBMD, B-BC1)

The Foreign Devices in this example (mixed between BAC-A1616BCs and BACnet routers) register with the BBMD over BACnet IP UDP Port 47808, Network #25, and they become four networks joined as a single BACnet internetwork. PC1 joins the BACnet network using BACnet/Ethernet 8802-3 on the local subnet.

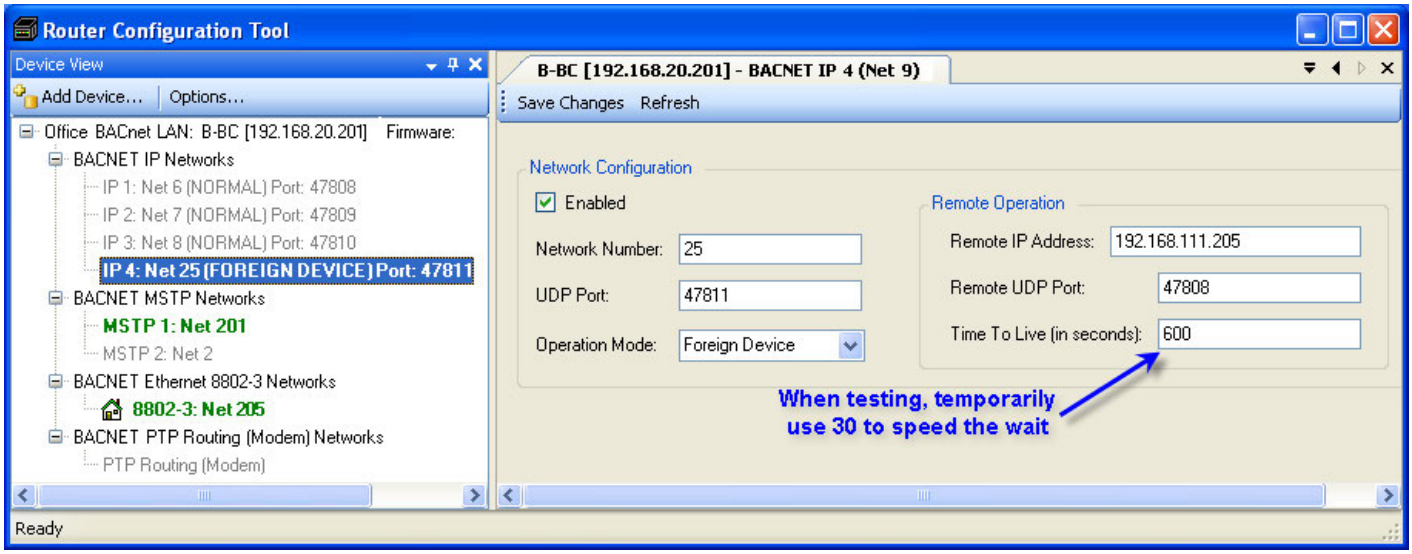


Illustration 33—RCT Settings for BACnet Over IP (Foreign Device, B-BC2)

Firmware Update and Backup

The current firmware version number can be viewed on the Device web page as well as the top right of most screens. (See *Illustration 42 on page 53*.)

The BAC-A1616BC firmware can be updated through the Router Configuration Tool (ver. 2.1.0.14 or later). The BAC-A1616BC can also be backed up using the Router Configuration Tool or TotalControl. (For backing up using TotalControl, refer to the documentation with that software.)

⚠ CAUTION

To update to R2.0.0.5 firmware, firmware R1.8.0.1 (from October 2012) MUST ALREADY BE INSTALLED! Earlier firmware must first be upgraded to R1.8.0.1, and then upgraded from R1.8.0.1 to R2.0.0.5.

The Router Configuration Tool (RCT) 3.0.0.18 (released in September 2013) or later MUST be used to upgrade from R1.8.0.1 to R2.0.0.x! Do NOT use an earlier version of the RCT or your BAC-A1616BC may become unusable!

Back up the BAC-A1616BC before starting the firmware update either through TotalControl or as part of the firmware update process in the Router Configuration Tool.

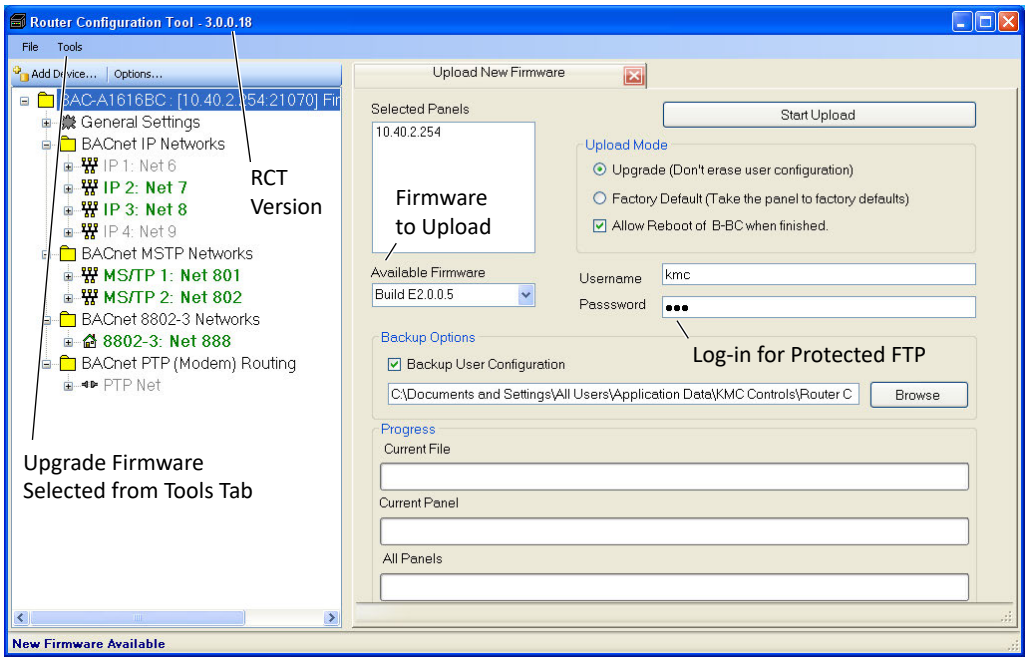


Illustration 34—Upgrade Firmware Screen

To update the BAC-A1616BC, perform the following procedure:

1. Under *Device View*, click the line at the BAC-A1616BC's top level (not networks or ports), click the *Tools* tab at the top left, and select *Upgrade Firmware*. See *Illustration 34 on page 44*.
2. For backing up the user configuration, check the box before continuing.
3. Ensure the desired firmware version and panel(s) are selected. (If multiple BAC-A1616BCs are on the network, they can all be selected and have the firmware upgraded at the same time.)

4. Click *Start Upload*.

NOTE: With firmware R1.6.0.12 or later installed, to update the BAC-A1616BC's firmware, FTP Access on the System screen must be set to *Protected* (which requires an admin log-in on the RCT) or *Anonymous*. (See *Illustration 39 on page 50*.) If FTP is configured for *No Access*, it must be temporarily changed to *Protected* or *Anonymous*.

Reset (warm start) the BAC-A1616BC to make the changes take effect. (Leaving the Allow Reboot of B-BC when finished option checked will automatically reset the controller when the upgrade is done.) To reset it manually, see *Resetting (Reinitializing) the BAC-A1616BC on page 82*.

⚠ CAUTION

During the upgrade process, avoid stopping the upload unless absolutely necessary. Stopping the process may result in some files being updated and not others. As a result, the BAC-A1616BC may become unusable.

If the BAC-A1616BC keeps rebooting itself or becomes unusable after the firmware update, halt the boot-up via the debug port and reload the last working version of the firmware. See *Serial Connection and Debug Monitoring on page 30*.

If the BAC-A1616BC will not connect with the Router Configuration Tool because of a boot-up problem, firmware can still be uploaded. From the *Tools* tab, select *Upgrade Firmware*, double-click inside the Selected Panels box, and manually type in the IP address of the BAC-A1616BC. See *Illustration 35 on page 45*. Upload the appropriate firmware and restart the BAC-A1616BC.

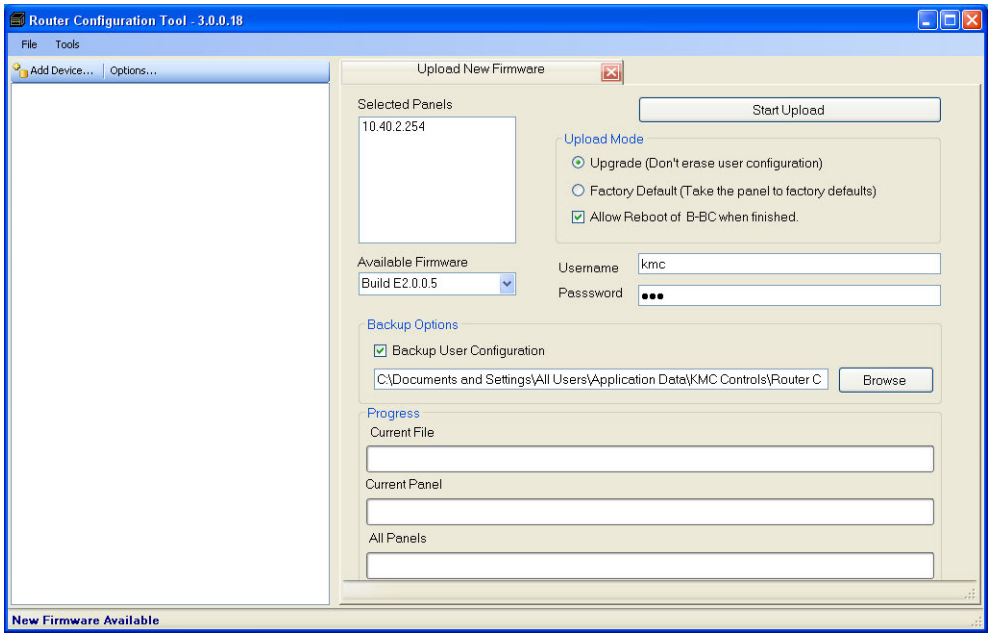


Illustration 35—Upgrading Firmware from Typed-in IP Address

Choosing to restore to Factory Default during the upgrade might resolve problems with the configuration. The BAC-A1616BC would then need to be reconfigured.

NOTE: See also Service Bulletin SB1111A Back-up and Restore Issues concerning unconfigured event enrollment objects and checksum errors on NIC cards.

SECTION 4—Web Browser Configuration and Viewing

This section explains how to connect to and configure the BAC-A1616BC using a web browser. It assumes the user has a good working knowledge of BACnet. **See the TotalControl documentation for more information about setting up the various values for the device and objects.**

Through the embedded HTTP server in the BAC-A1616BC, a web browser can view and make changes to the following functions in the controller.

BAC-A1616BC View and Change Functions	
Function	**Control**
Alarms	Configure (via event enrollment and notification class) and acknowledge and delete (via alarm viewer)
Device	Change device object configuration
System	Change time, restart system, configure email, import expansion module firmware
Inputs	Change values and configuration (via objects and/or relevant viewers)
Outputs	
Analog Values	
Binary Values	
Multi-state Values	
Calendar	
Schedule	
Loop	
Event Enrollment	
Notification Class	
Program	
Router	
Trend Log	Change values and configuration, view log buffer
Table	Change values and configuration, import tables in CSV format

Browsers and Screen Refresh

The BAC-A1616BC's web interface is fully compatible with recent versions of Microsoft Internet Explorer and Mozilla Firefox web browsers. Other browsers may not be fully compatible.

After logging in, to view a current present value, click the *Refresh* button (or *Save* button if any of the values in the editable fields have been deliberately changed).

If problems with the browser display occur:

- Click the browser's *Refresh* button (or press function key F5 on the keyboard).
- Clear the browser's history cache of temporary Internet files.
- Close the browser and restart it.

Log-in, Security, and Permissions (Setup > Admin)

To access the BAC-A1616BC's home page with a web browser, enter the BAC-A1616BC's IP address (default is 192.168.1.254) in the browser's address bar. See *Illustration 36 on page 47*.

- Use the internal IP address (in the format **http://192.168.1.254** or equivalent if the default has been changed) if you are connected to the same network as the BAC-A1616BC.
- Use the IP address assigned for viewing with a browser if you are connecting to the BAC-A1616BC through an Internet service or network firewall.

NOTE: The IP address in the BAC-A1616BC may be changed from the default by using the Router Configuration Tool. When changing the IP address, be careful not to lose or forget the new address. If it is lost, the only way to recover it is by reading the IP address in the output of the debug port (Serial 2) during boot up. The debug port can be viewed with HyperTerminal, Tera Term, or a similar terminal emulator. See *Serial Connection and Debug Monitoring on page 30*.

When the home page is open, enter your user name and password. Only assigned operators can view or make changes to the BAC-A1616BC.

NOTE: To see the web pages correctly, upgrade the BAC-A1616BC to the latest firmware. Alternately, add "**/index.htm**" to the address (e.g., mybbc.mysite.com**/index.htm**) for the home page if there is a problem accessing the log-in screen.

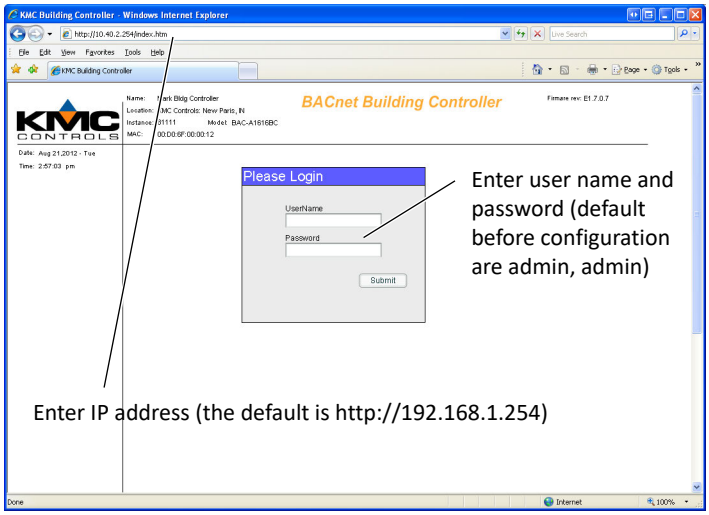


Illustration 36—Log-in Screen

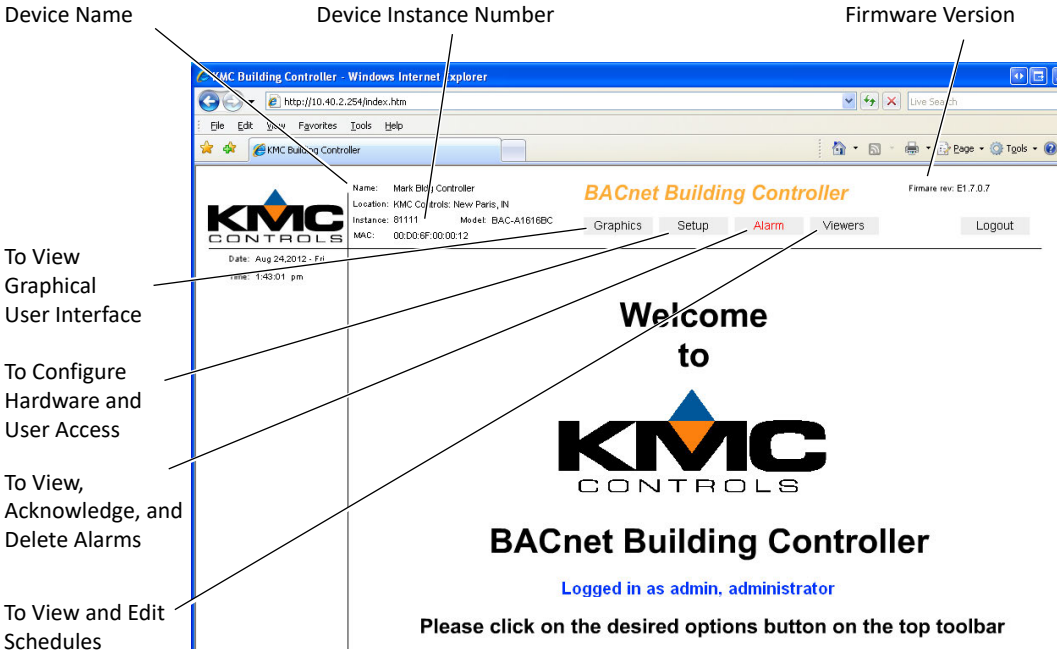


Illustration 37—Welcome Screen

Security levels are assigned in the Admin screen. Only a person with Administrator rights can click the Admin button and change users, passwords, permissions, and opening (graphic) pages. (See *Illustration 38 on page 49*.) After editing the list, click the *Save* button.

The **Graphic_page column** optionally changes the web page that automatically loads after the user's log-in. (For example, *Illustration 57 on page 69* loads rather than the "none" or default *Illustration 37 on page 48*.) For this option, graphic pages must first be published to the BAC-A1616BC from TotalControl Design Studio (ver. 1.7 or higher).

What a user sees and options that are available will depend on user permissions, licensed options for the BAC-A1616BC (e.g., web graphics pages), and configuration.

User Rights	
Operator Level	**Permission***
1 View Only	User can view graphics but cannot change values
2 Operator	User can also change element values, such as a setpoint
3 Senior Operator	User can also change the controller configuration
4 Administrator	User can also change users, passwords, and rights
*For the Scheduler, permissions for viewing, enabling, overriding, and weekly per each schedule are individually selectable for each user and are turned off as a default.	

NOTE: To enhance security, delete the default admin/admin user AFTER at least one other user with Administrator rights has been assigned. You may also change the Inactivity Logout Time value to a desired amount.

To enable the custom graphical interface, internal email "server" notifications, and trend graphs, an appropriate license will need to be obtained from KMC Controls and enabled in your configuration. After the **(*.dat) license file** (based on the individual BAC-A1616BC's MAC address) is obtained, click the *Upload* button, locate the file, and click *Open*. (See *Illustration 38 on page 49*.) After the file has uploaded, reset the BAC-A1616BC (using the Controller Restart button at the bottom of the page) and log off of the web page. After the BAC-A1616BC has rebooted, log back into the web page. (See also *Resetting (Reinitializing) the BAC-A1616BC on page 82*.)

For user access to the **Schedule Viewer** (see *Schedule Viewer (Viewers > Schedule) on page 71*), enable/disable scheduler access, select which schedules can be viewed, and select whether the user can also edit weekly schedules, override schedules, and/or enable/disable schedules in the **Permissions** pop-up screen. When selections are complete, click the *Save and Close* button and then click the *Save* button above the User Access List.

NOTE: Administrators do not have complete schedule access by default. Access must be configured for all users and administrators.

NOTE: Be sure to save changes before navigating to another screen.

To log out, click the *Logout* button and close the browser window.

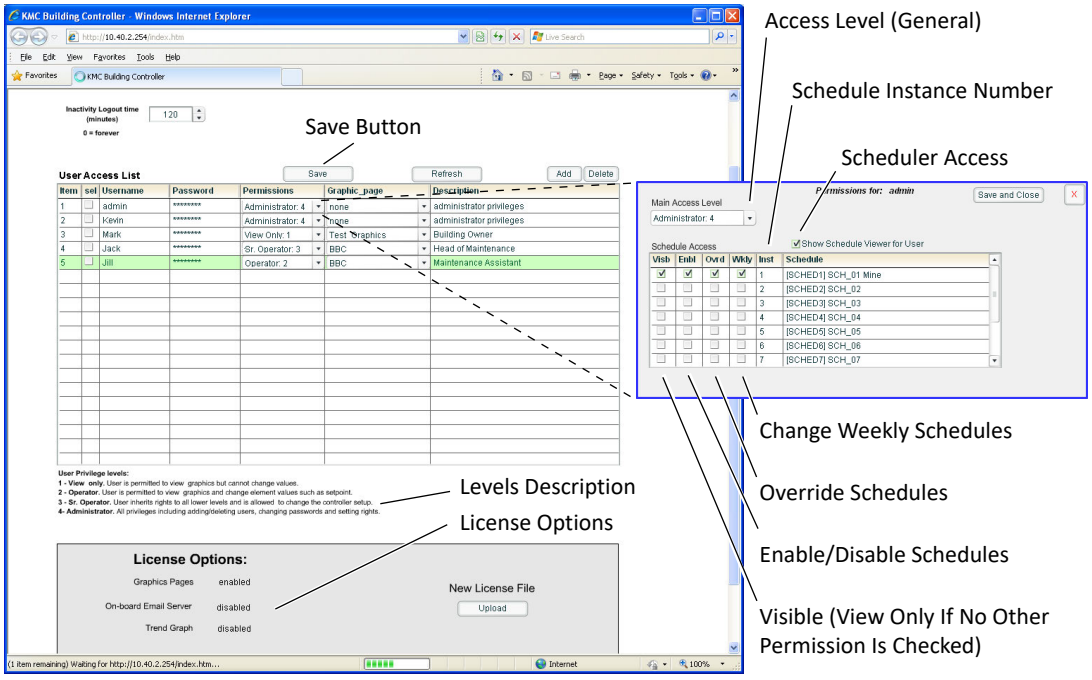


Illustration 38—Administration Screen

Device and System Screens (Setup > Objects)

After a logging in and clicking the *Setup* button, the Device page displays a list of available devices and objects. It also displays the current web page and firmware versions. (See *Illustration 42 on page 53*.) See more information about the Device screen in *Viewing & Editing BACnet Objects (Setup > Objects) on page 53* and *Device Object on page 54*.

The System page offers the ability to change the system time, reinitialize (restart) the BAC-A1616BC from the browser, set up email notifications, and control FTP access.

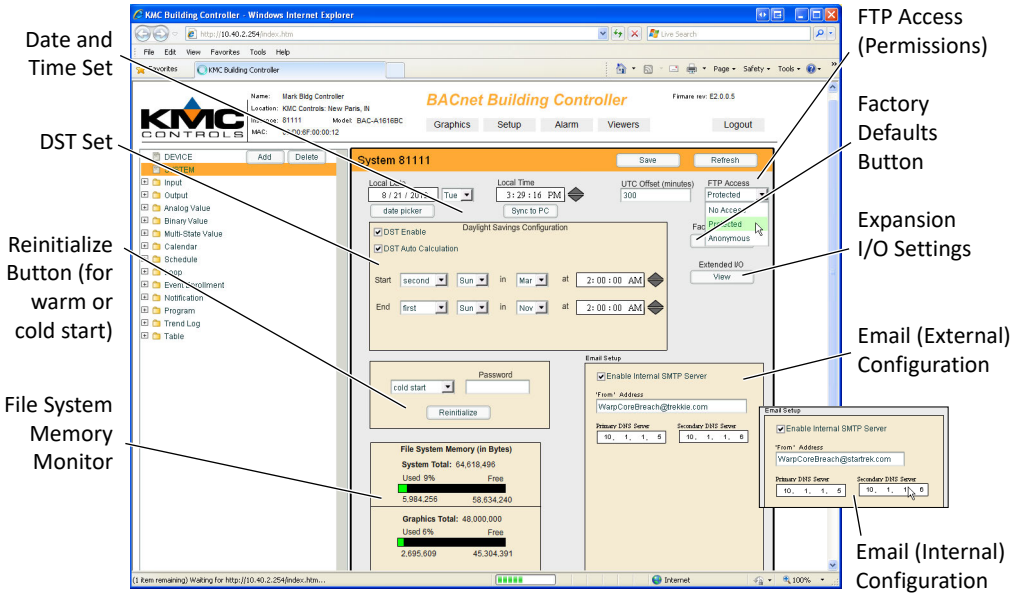


Illustration 39—System Screen (with External and Internal Email)

Email may be configured to be sent via an external (or internal with license) SMTP server. Consult with the network administrator about the appropriate address and authentication settings.

The "From" address is entered in the System Screen. "To" email addresses are entered in the appropriate Notification Class screen. (See *Notifications, Events, and Alarms on page 60*.)

Email sent from the optional internal SMTP "server" requires a license. (See *Log-in, Security, and Permissions (Setup > Admin) on page 47*.) For the internal SMTP "server" (or restricted closed SMTP relay that is dedicated solely to forwarding emails internally generated by the BAC-A1616BC), the values of the DNS numbers can by determined from a PC on the same network:

1. Select the *Start* button
2. Select *Run*
3. Type in `cmd` and hit *Enter*
4. At the prompt, type in `ipconfig /all`. (See *Illustration 40 on page 51*.)

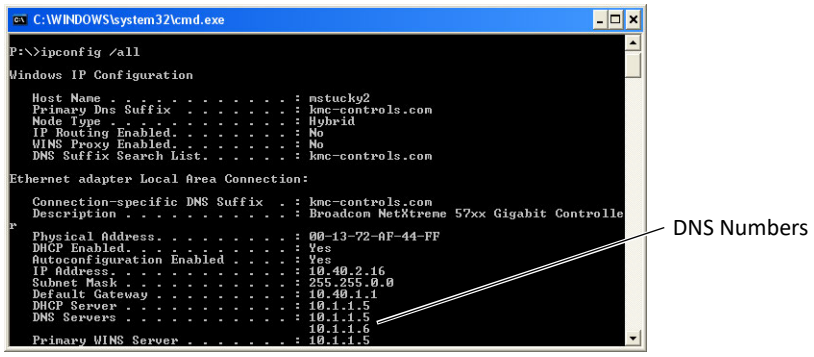


Illustration 40—Determining DNS Numbers for Internal Email

When powered up after losing the RTC (Real Time Clock) time, the **time and date** will revert to the default and must be set manually or by Sync to PC. (See *Illustration 39 on page 50*.)

For areas that observe **DST (Daylight Saving Time)**, check DST Enable and DST Auto Calculation. The DST period is currently the second Sunday of March through the first Sunday of November, but these rules can be changed in the menu if the official period changes or if the installed location needs a schedule adjustment for better operation.

NOTE: If DST is enabled but Auto Calculation is not, the actual calendar dates (instead of using the general rules) will need to be entered every year.

If **UTC (Coordinated Universal Time)** synchronization is used on the network, set the UTC Offset value. The UTC Offset value is in minutes and corresponds to the distance of the local time zone to the zero degree meridian. In stand-alone operation or networks that do not have UTC broadcasts, setting this value is not necessary.

UTC Offset and Time Zones	
Sample Time Zones	**Offset to Equal UTC**
Alaska	9 hours = **540** minutes
USA/Canada Pacific Standard Time	8 hours = **480** minutes
USA/Canada Mountain Standard Time	7 hours = **420** minutes
USA/Canada Central Standard Time	6 hours = **360** minutes
USA/Canada Eastern Standard Time	5 hours = **300** minutes
Bolivia, Chile	4 hours = **240** minutes
Argentina, Uruguay	3 hours = **180** minutes
United Kingdom, Portugal	0 hours = **0** minutes
Europe (most countries)	–1 hours = **–60** minutes
Egypt, Israel, Turkey	–2 hours = **–120** minutes
Kuwait, Saudi Arabia	–3 hours = **–180** minutes
United Arab Emirates	–4 hours = **–240** minutes
India, Sri Lanka	–5.5 hours = **–330** minutes
China, Mongolia	–8 hours = **–480** minutes
Korea, Japan	–9 hours = **–540** minutes
New Zealand	–12 hours = **–720** minutes

NOTE: The BACnet standard for this offset value is: "The time zones to the west of the zero degree meridian shall be positive values, and those to the east shall be negative values." The value is in minutes, not hours.

You can set **FTP** access/permissions to *Anonymous* (not recommended), *No Access*, or *Protected* (accessible using any administrator log-in currently set-up in the BAC-A1616BC). Backing up is better done through the Router Configuration Tool or TotalControl (see ***Firmware Update and Backup on page 44***), but to use Internet Explorer to back up the BAC-A1616BC via FTP, perform the following procedure.

1. In the address bar, type `ftp://192.168.1.254/` (or use the current IP address if it has been changed) and hit *Enter*. (You should then see the root directory of the BAC-A1616BC web server.)
2. From the Menu bar, select *View > Open FTP Site in Windows Explorer*.
3. In the password dialog box, type the following (assuming FTP permissions are not set for No Access):
   - User: `anonymous` (or an administrator user name for Protected Access)
   - Password: `user@server.com` (or the administrator password)
4. To back up the BAC-A1616BC from the resulting window, drag and drop all the files and folders from its root directory to a storage device. (This may take quite some time.)

⚠ CAUTION

Using FTP to delete or edit the wrong files can potentially render the BAC-A1616BC inoperable and unable to properly control objects!

This setting also affects **TotalControl's** access from the Building Controller Site Manager and **ability to publish web pages**:

- To publish web pages with a **Protected** FTP setting, after starting TotalControl's Building Controller Site Manager, log into the BAC-A1616BC with any valid Administrative log-in.
- With a **No Access** FTP setting, TotalControl will be unable to publish web pages to the BAC-A1616BC at all—to publish, temporarily change FTP access to another setting.

The **File System Memory** monitor shows used and available memory. (See ***Illustration 39 on page 50***.) If free space becomes too limited, use TotalControl to delete unused graphics pages and consolidate/rework needed pages. Avoid resizing standard graphic elements since that increases the file size.

Viewing & Editing BACnet Objects (Setup > Objects)

Objects are the means by which a BACnet device represents information that can be observed or changed. An object may represent a physical point such as an input or output or a logical grouping of data such as a PID loop, schedule, or variable. Objects are a method of organizing and accessing data in a way that corresponds to real-world inputs and values. The BACnet standard strictly defines available objects, their properties, and the acceptable values for each property.

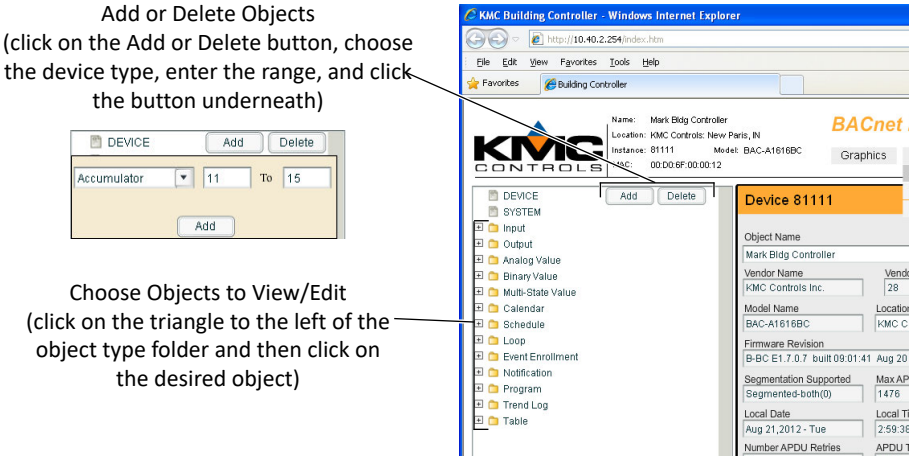


Illustration 41—Selecting, Adding, and Deleting Objects

These instructions assumes the user has a good working knowledge of BACnet. For more information about BACnet objects and their configuration, consult the TotalControl documentation.

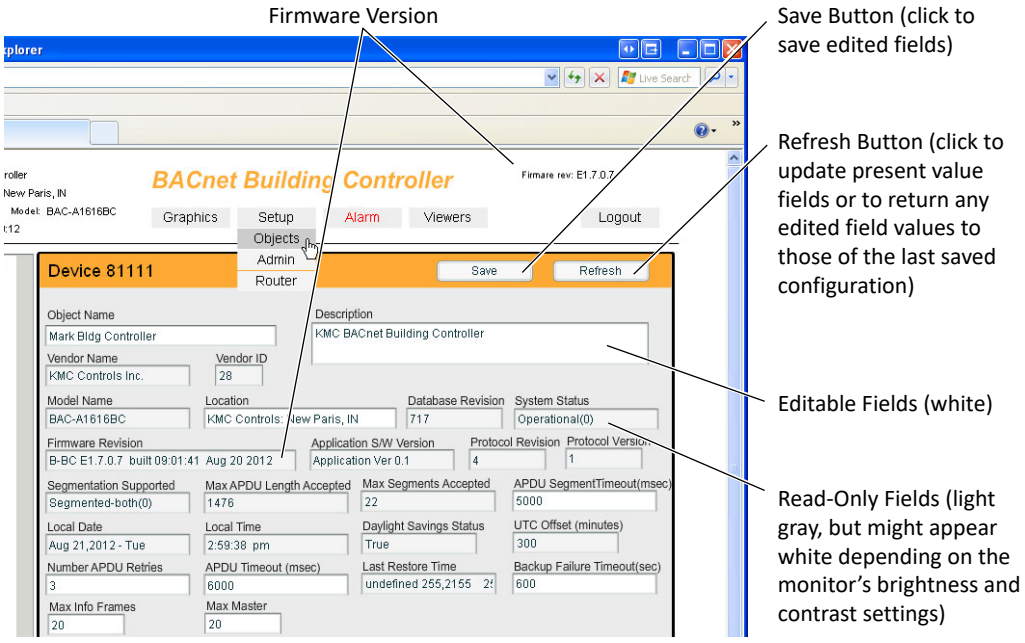


Illustration 42—Device Screen

Choose to view/edit a desired object's properties by clicking on the triangle to the left of the object type "folder" and then clicking on the desired object. Add or delete a desired object (except the default device object) by clicking on the *Add* or

Delete buttons and selecting/entering the object type and range of numbers (e.g., **Binary Input, 12 to 15**, but **not Binary Input, BI12 to BI15**).

NOTE: The default configuration has a default number of objects, but objects (except Device) can be added to a maximum amount. Unneeded objects can be deleted. To change an object (e.g., AI to BI), delete the object and then add an object.

Any "light gray" field (but might appear "white" depending on the monitor's brightness and contrast settings) on a screen may be viewed only and cannot be changed in the web browser. The Router Configuration Tool and TotalControl Design Studio can edit some of those settings and labels, but some cannot be changed. (See *Illustration 42 on page 53*.)

Settings in the white fields may be changed as needed. **Click the *Save* button to save the new configuration to the BAC-A1616BC**.

NOTE: Unless the Save button is clicked, switching to a different screen will cause all changes to be lost.

⚠ CAUTION

After the *Save* button is pressed in the web browser a one minute time-out period exists before changes are written to flash memory. (To reduce the number of writes to and provide longer life for the flash memory.) If the red reset button is pushed or power is removed during the time-out period, all changes will be lost. If the red reset button is pushed or power is removed during the time-out period, all changes will be lost.

Click the *Refresh* button (prior to clicking the *Save* button) to **return any edited field values to those of the last saved configuration**. The *Refresh* button erases any changes in editable fields since the last save. It also updates present value fields.

NOTE: If monitoring present values, click the *Refresh* button periodically to view the latest value.

NOTE: For more information about object types and configurations, see the TotalControl documentation.

Device Object

The BAC-A1616BC supports one device object. (See *Illustration 42 on page 53*.) The Device Name and Max Master are edited here. Choose to view/edit the device object properties by clicking on the device name.

NOTE: The Device Instance Number can be changed in the Router Configuration Tool but not in the web interface.

NOTE: The Max Master is the highest MAC address a device will attempt to locate when polling for master devices on the MS/TP network. The lowest Max Master number that still incorporates all the installed MAC addresses will increase network traffic efficiency.

Input and Output Objects

The BAC-A1616BC supports the following:

- 16 default and up to 128 (with expansion I/O modules) analog, binary, or accumulator (for pulse inputs) **input** objects.
- 16 default and up to 72 (with expansion I/O modules) analog or binary **output** objects.

Input and output objects are managed the same as described in *Viewing & Editing BACnet Objects (Setup > Objects) on page 53*.

NOTE: Be sure the appropriate Device Type, Units, Multiplier, Offset, Lookup Table, and/or Polarity are selected. **Select Device Type first since it may automatically configure other settings.**

NOTE: Tables for **Type II and III thermistors** contain Celsius values. Displaying **Celsius** readings requires a **multiplier of 1 and an offset of 0**. Displaying **Fahrenheit** readings requires a **multiplier of 1.8 and an offset of 32**.

NOTE: Tables for the STE-6000 series of temperature sensors/transmitters are downloadable from the KMC web site. See *Tables on page 65*.

NOTE: The Offset can be altered for calibration purposes. Add or subtract the error value from the default value.

NOTE: To change an Analog, Binary, or Accumulator object to one of the other types, delete the object, and add a new object in its place.

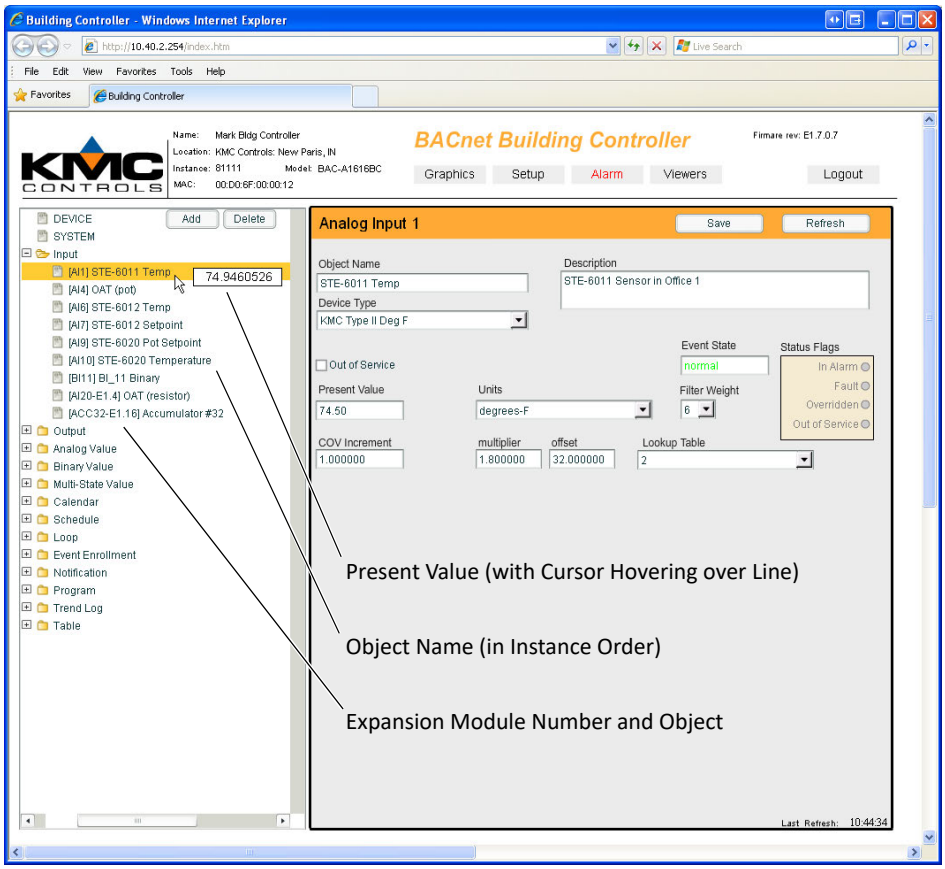


Illustration 43—Inputs (Analog) Screen

Value Objects (Variables)

The BAC-A1616BC supports the following:

- 100 default and up to 1,000 analog value objects.
- 100 default and up to 1,000 binary value objects.
- 10 default and up to 256 multi-state value objects (with up to 16 states each).

Value objects represent variables. **Analog values (AV) store a floating-point value, binary values (BV) store a Boolean value (true or false), and multi-state values (MSV) store up to 16 discrete states.**

Value objects are managed the same as described in *Viewing & Editing BACnet Objects (Setup > Objects) on page 53*.

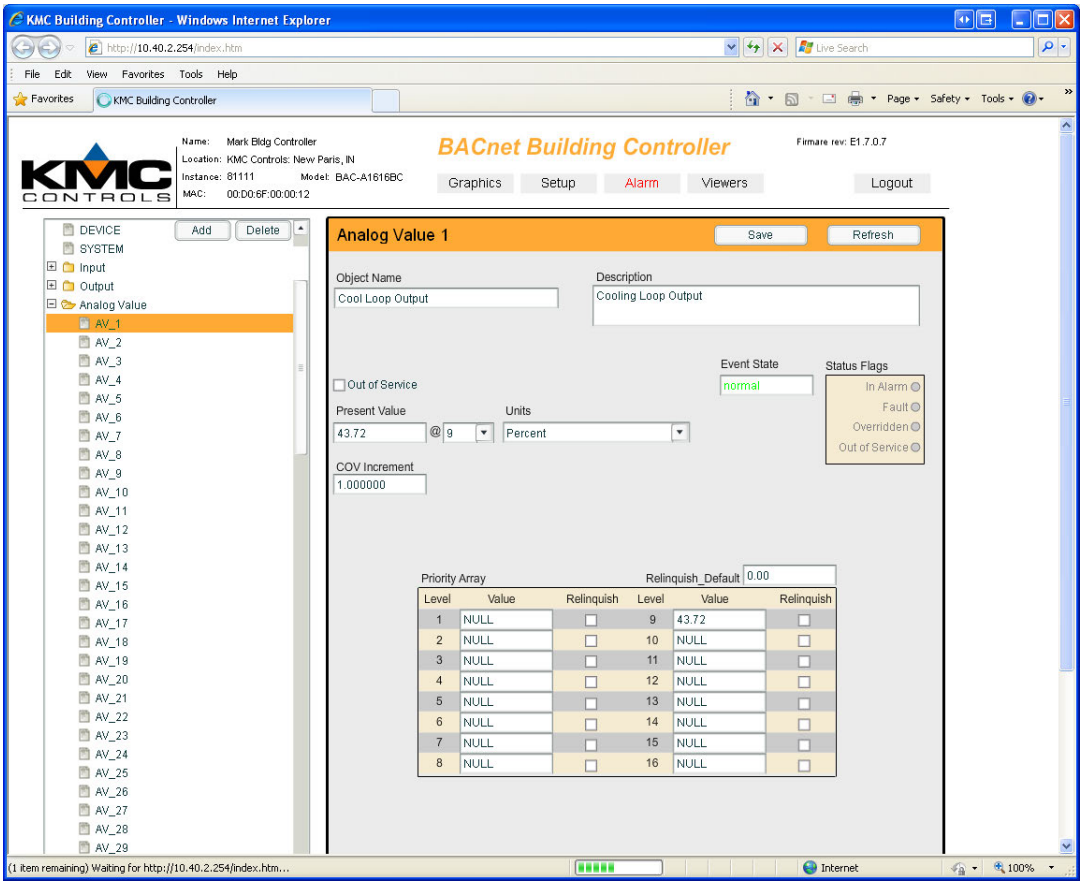


Illustration 44—Values (Analog) Screen

NOTE: The BAC-A1616BC was the first KMC controller to support MSV (Multi-State Value) objects. MSVs are used to show changes of state, such as OFF, LOW, MEDIUM, and HIGH for fan speed. Other potential uses include stages, ranges, positions, and alarm messages. MSV states are numbered consecutively, starting with 1 and going up to 16. Text (up to 32 characters) can accompany each state. The current state text (e.g., MEDIUM) displays as the MSV's present value.

Calendar and Schedules

NOTE: See also *Schedule Viewer (Viewers > Schedule) on page 71.*

The BAC-A1616BC supports the following:

- 10 default and up to 100 schedule objects.
- 10 default and up to 32 calendar objects.

Use a **schedule** object dialog to enter and manage a **periodic** schedule that may recur during a range of dates. Schedules can control objects in the BAC-A1616BC and other controllers as well. Schedules are divided into days, of which there are two types:

- Normal days are defined by the weekly schedule. See *Illustration 45 on page 58.*
- Exception days are defined by exception schedules (and calendars). See *Illustration 46 on page 58.*

Use a **calendar** object to enter and manage a list of **special** dates. These special dates may be holidays, special events, or other days that require special attention on a schedule.

The method for editing a weekly schedule is described in *Viewing & Editing BACnet Objects (Setup > Objects) on page 53*.

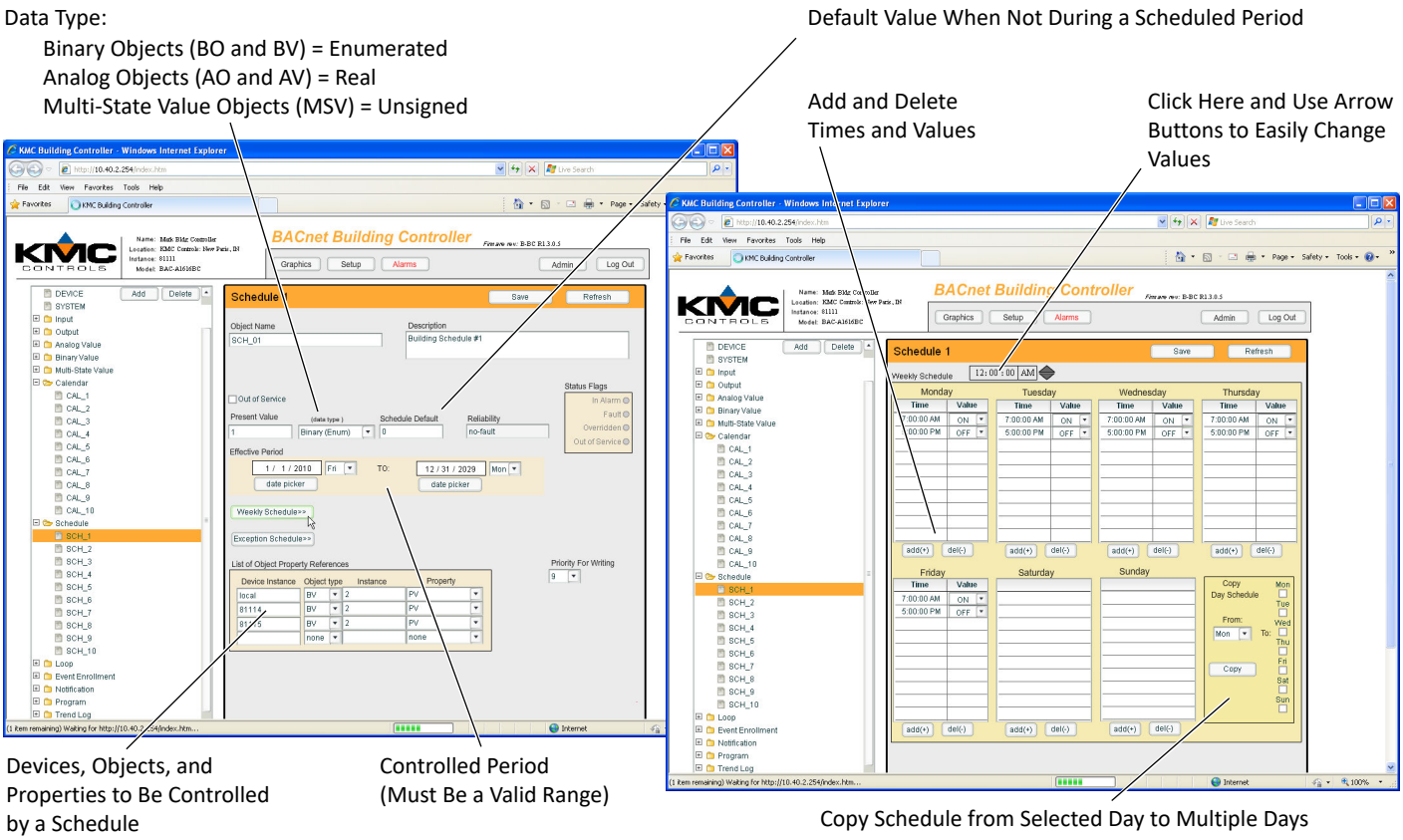


Illustration 45—Schedules (Main) and Weekly Schedules Screens

NOTE: Be sure to first specify the correct **data type** according to the controlled object. See *Illustration 45 on page 58*. If the wrong data type is saved, the schedule object may need to be deleted, and a new one added in its place.

NOTE: Schedule Default is the value used during times not covered during the schedule (e.g., at night).

NOTE: The second **"Instance"** is the object number, not the Device Instance.

NOTE: To retain any changes on the main Schedule screen, click the *Save* button **before** clicking the *Weekly Schedule* button, *Exception Schedule* button, or any other object in the tree list.

NOTE: If time is typed in using 24-hour "military" time, the time will automatically convert to the equivalent 12-hour "PM" format.

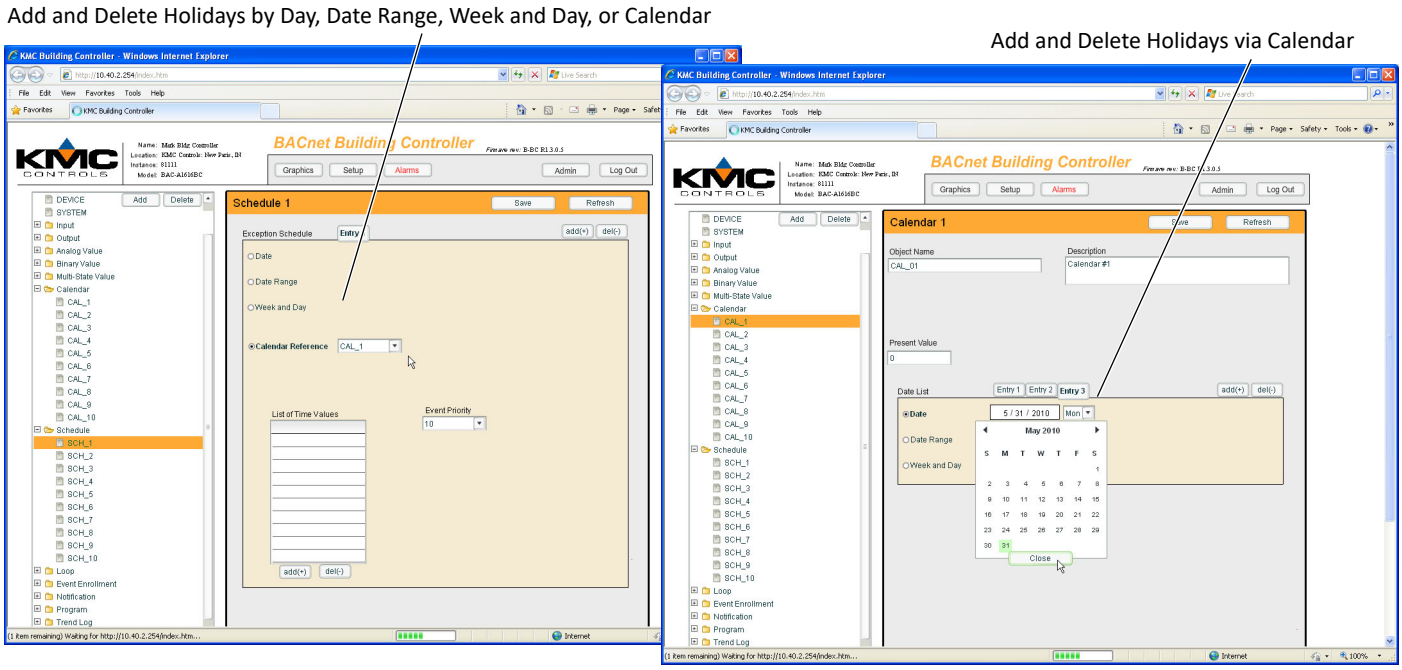


Illustration 46—Exception Schedules and Calendar Screens

NOTE: Exceptions can be entered in a variety of ways: by date, by date range, by week and day, or by calendar reference.

Loop Objects (PID Controllers)

The BAC-A1616BC supports 16 default and up to 32 PID loop objects.

A PID loop is a mathematical function that calculates the analog output required to maintain a process at or near a setpoint. The output of the loop object directly controls the present value of either an analog output or analog value object.

The Setpoint Reference (e.g., desired temperature) is compared to the Controlled Variable Reference (e.g., actual temperature), and the difference controls the Manipulated Variable Reference according to the other screen settings. PID loops are used with Control Basic programs. For more information about PID loops, see the Help files in TotalControl or BACstage.

Loop objects are managed the same as described in *Viewing & Editing BACnet Objects (Setup > Objects) on page 53*.

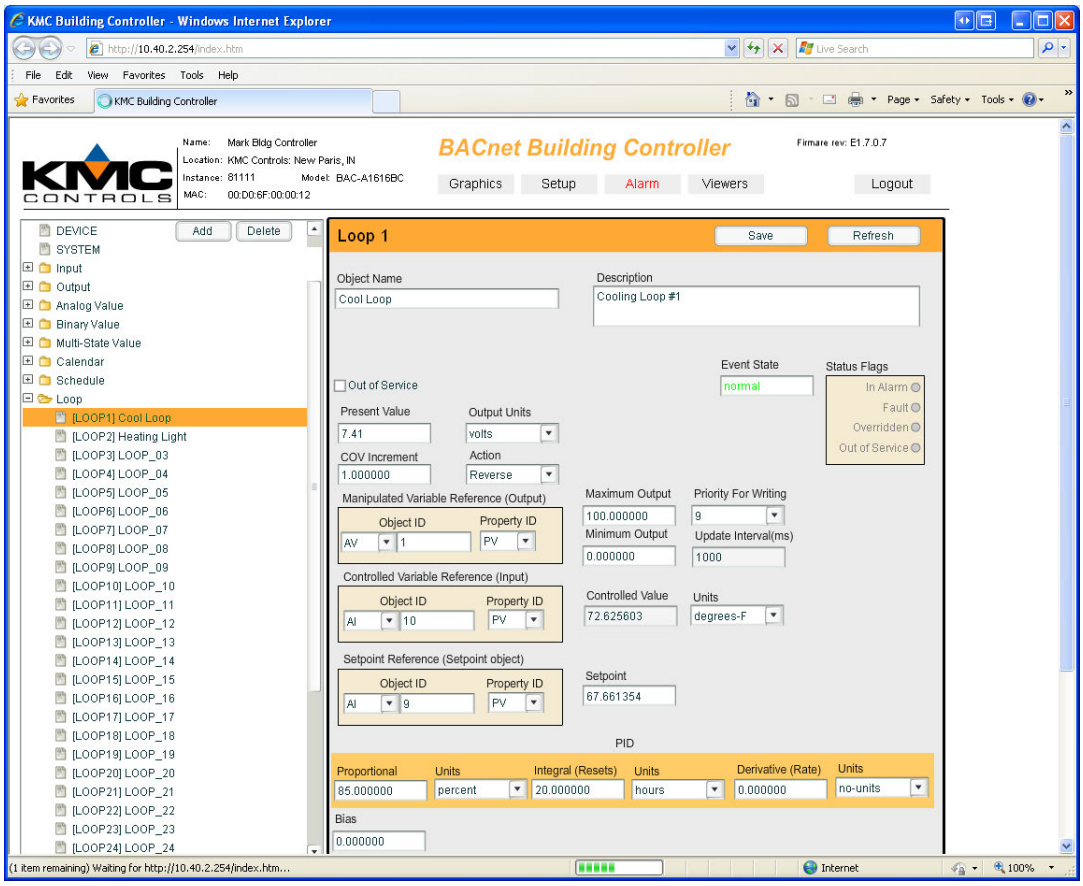


Illustration 47—PID Control Loop Screen

Notifications, Events, and Alarms

To have the BAC-A1616BC send out notifications (to the Alarms viewer on the web interface, to BACstage or TotalControl, or to email addresses), the specified event or alarm is setup and enrolled in a particular notification class.

The BAC-A1616BC supports 10 default and up to 64 notification (alarm/event) objects as well as 10 default and up to 512 event enrollment objects.

Use the **notification class** object to manage the distribution and processing of alarms and events. The notification object:

- Maintains a list of destination devices such as a BACnet operator workstation or an email address.
- Sets the prioritization of TO-OFFNORMAL and TO-NORMAL events by the destination device. (TO-FAULT is not currently supported in the BAC-A1616BC.)
- Designates if the event notification requires an acknowledgement. (TO-FAULT is not currently supported in the BAC-A1616BC.)
- Designates the process a recipient device should perform upon the receipt of an event.

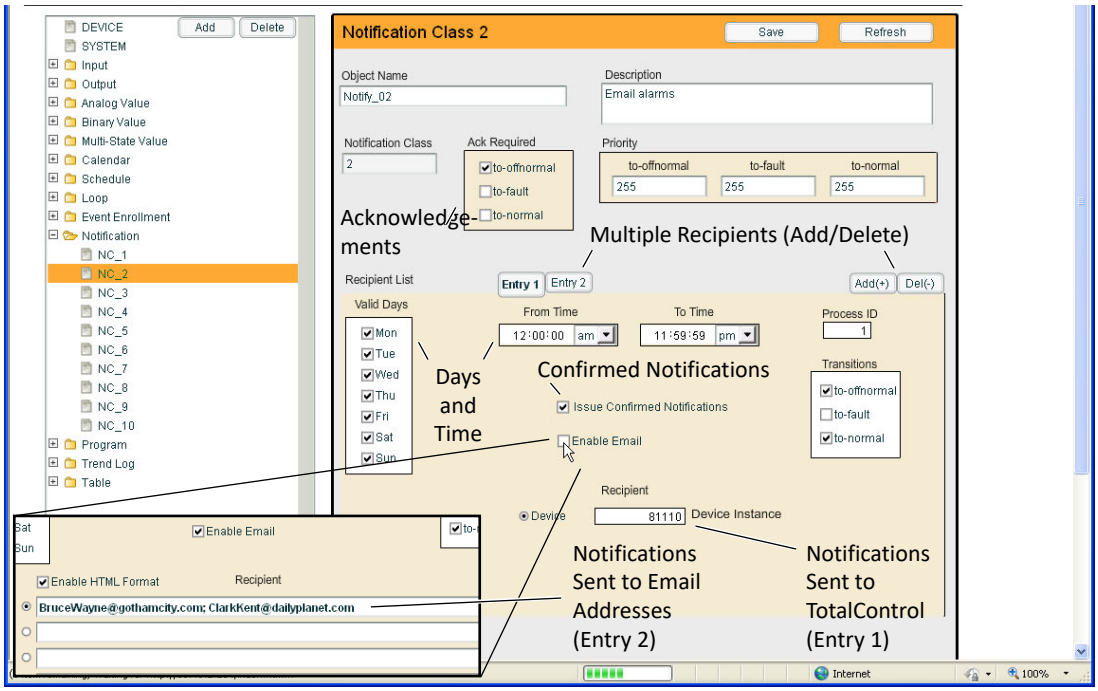


Illustration 48—Notification Class Screen (Two Options)

If using email, configure email in the System Screen first. See *Device and System Screens (Setup > Objects) on page 50*. In the Notification Class screen, be sure a line is selected and filled in with at least one address for each desired entry. (Different entries may have different email lines as well as different valid date/time ranges selected.) Use semicolons between email addresses on the selected line to notify multiple people from a single event. (Each email address line is limited to 115 characters.)

Use the **event enrollment object** to specify the criteria for generating an alarm/event for a specified object such as change of bitstring, change of state, change of

value, command failure, floating limit, out of range, buffer ready, and unsigned range as desired.

The method for editing event enrollment and notification class is described in *Viewing & Editing BACnet Objects (Setup > Objects) on page 53*.

NOTE: The one or more events designated as Notification Class *x* will be monitored by the correspondingly numbered Notification object.

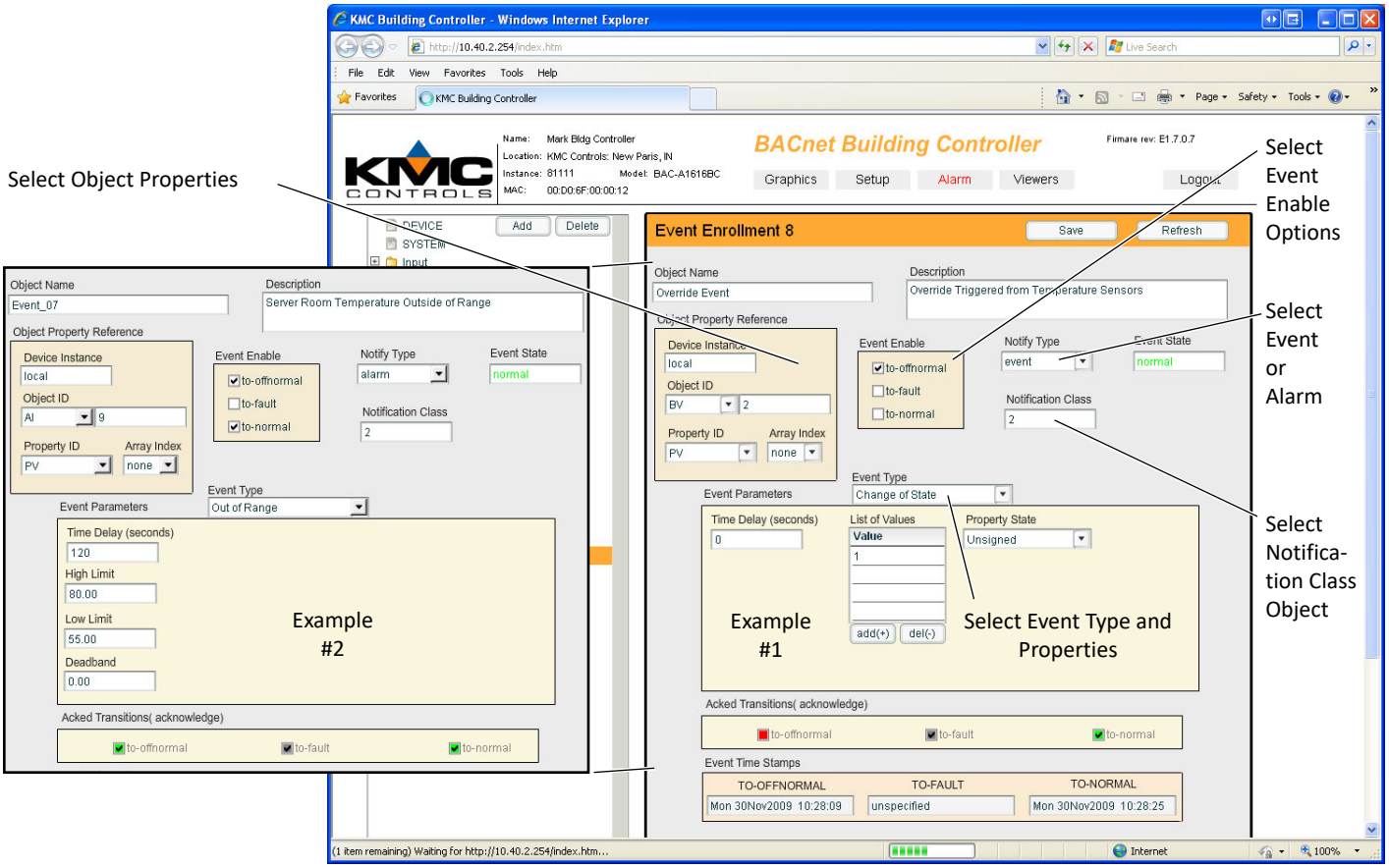


Illustration 49—Event Enrollment Screen (Two Options)

NOTE: *Illustration 49 on page 61* shows alternate examples of (1) an event triggered by a change of state in a binary variable and (2) an alarm triggered by an analog input value being out of range.

NOTE: An **unsigned** property state means having no negative sign in front of the integer (e.g., 0, 1, or 70, but neither –1 nor 70.34).

NOTE: Under Acknowledged Transitions, a check in a green box indicates that the event and notification was triggered and an acknowledgment was received. A solid red box indicates no acknowledgement was received but acknowledgment was required by the Notification Class.

NOTE: Time stamps at the bottom of the screen verify whether an event is triggered.

NOTE: In the Notification Class screen, Issue Confirmed Notifications should be checked. (See *Illustration 48 on page 60*.)

NOTE: In the Notification Class screen, Ack (Acknowledged) Required transitions must be left unchecked for trends.

NOTE: The To-Fault option is not currently supported in the BAC-A1616BC.

NOTE: **Unused event enrollment objects should not be left unconfigured.** Delete or or configure them for possible future use. See Service Bulletin SB1111A Back-up and Restore Issues concerning unconfigured event enrollment objects.

Programs (Control Basic)

The BAC-A1616BC supports 32 program objects.

Program objects allow the corresponding Control Basic program to be loaded, run, halted, restarted, or unloaded using the browser. These programs are the method by which automation is added to controllers.

A Control Basic program cannot be created or edited directly in the browser. TotalControl or BACstage is required to load Control Basic programs. The BAC-A1616BC uses **Next Generation** Control Basic. See the Help files in TotalControl or BACstage for more information about creating and loading programs.

The method for using the web browser to edit the Control Basic program configuration is described in *Viewing & Editing BACnet Objects (Setup > Objects) on page 53*.

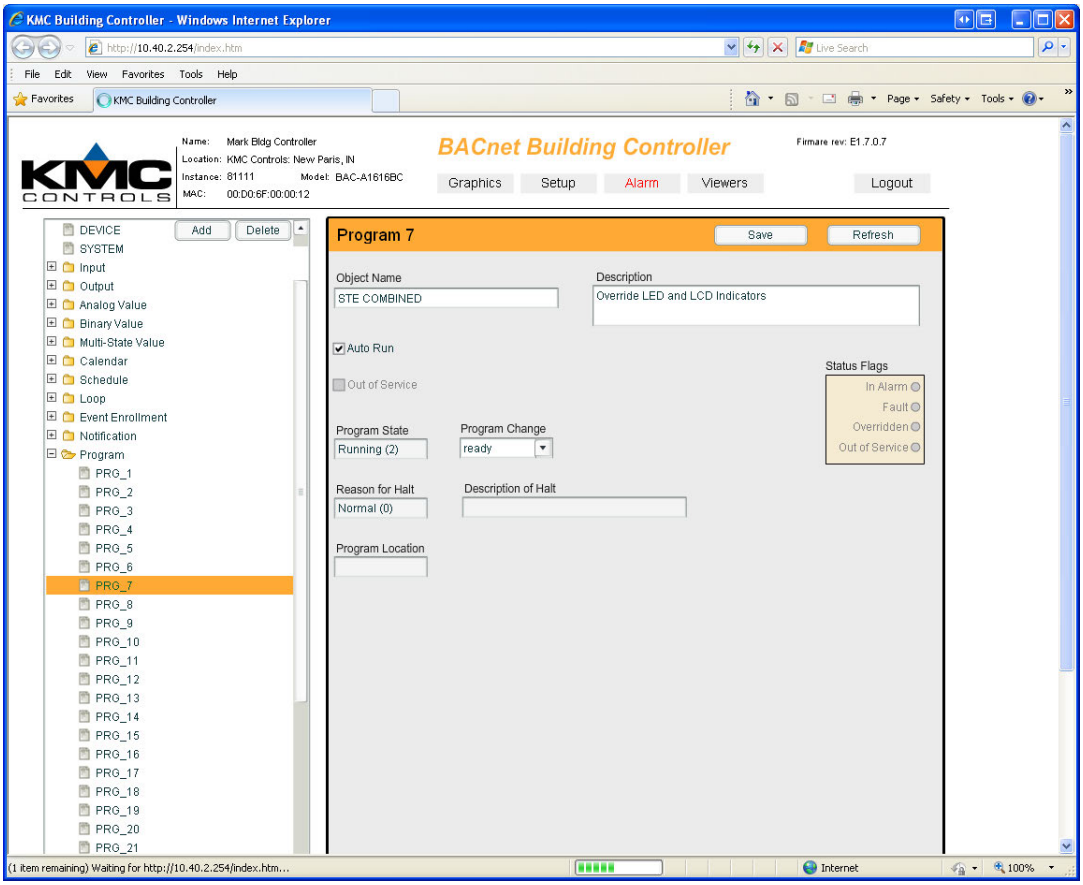


Illustration 50—Programs Screen

Trend Logs

The BAC-A1616BC supports 64 default and up to 256 trend objects, each of which holds up to 256 samples.

A trend log can monitor the present value of one object. Each trend log periodically saves the data record along with a timestamp and relevant status information at the time the controller saved the record to a trend log. Trend log objects can be configured in the browser and viewed in a graph (by clicking on the *Log Buffer View: Graph* button) or table format (by clicking on the *Log Buffer View: Tabular* button). TotalControl and BACstage can also view the record as a graph.

NOTE: The Graph view of trend logs became available in firmware R2.0.0.5. For details, see the **BAC-A1616BC Applications Guide**.

NOTE: To **clear** a trend log **buffer**, click the Reset Buffer button (or change *Record Count* to 0 and click *Save*).

For trends:

- **A trend object defines the object to be sampled** (see *Illustration 51 on page 64*).
- **An event enrollment object enrolls the trend object as an event** (see *Illustration 52 on page 64*).
- **And a notification class object determines what device to contact and report the event** (see *Illustration 48 on page 60*).

All three objects must be configured properly. The method for editing these objects is described in *Viewing & Editing BACnet Objects (Setup > Objects) on page 53*.

NOTE: The **Log Interval is in units of 0.01 seconds**, and, for example, 6000 intervals equals one minute.

NOTE: Be sure the Start and Stop date range is valid.

NOTE: In the Notification Class screen (see *Illustration 48 on page 60*), Ack (Acknowledged) Required transitions must be left unchecked for trends.

NOTE: Trends from external device instances are not yet supported.

Using **Change of Value (COV)** instead of polling for trends reduces network traffic. Plus, for binary objects, such as a fan status switch, it provides the exact times the switch opens and closes. To configure a trend for one of the BAC-A1616BC's objects:

- The trend's Log Interval must be set to *0* and Client COV Increment set to *null* (see *Illustration 51 on page 64*).
- Configure the COV Increment in the object being trended to an appropriate desired value (usually 1 for binary objects). See *Illustration 43 on page 55* and *Illustration 44 on page 56*.

See the TotalControl Help system for information about subscribing to a COV from TotalControl as well as more information about COVs.

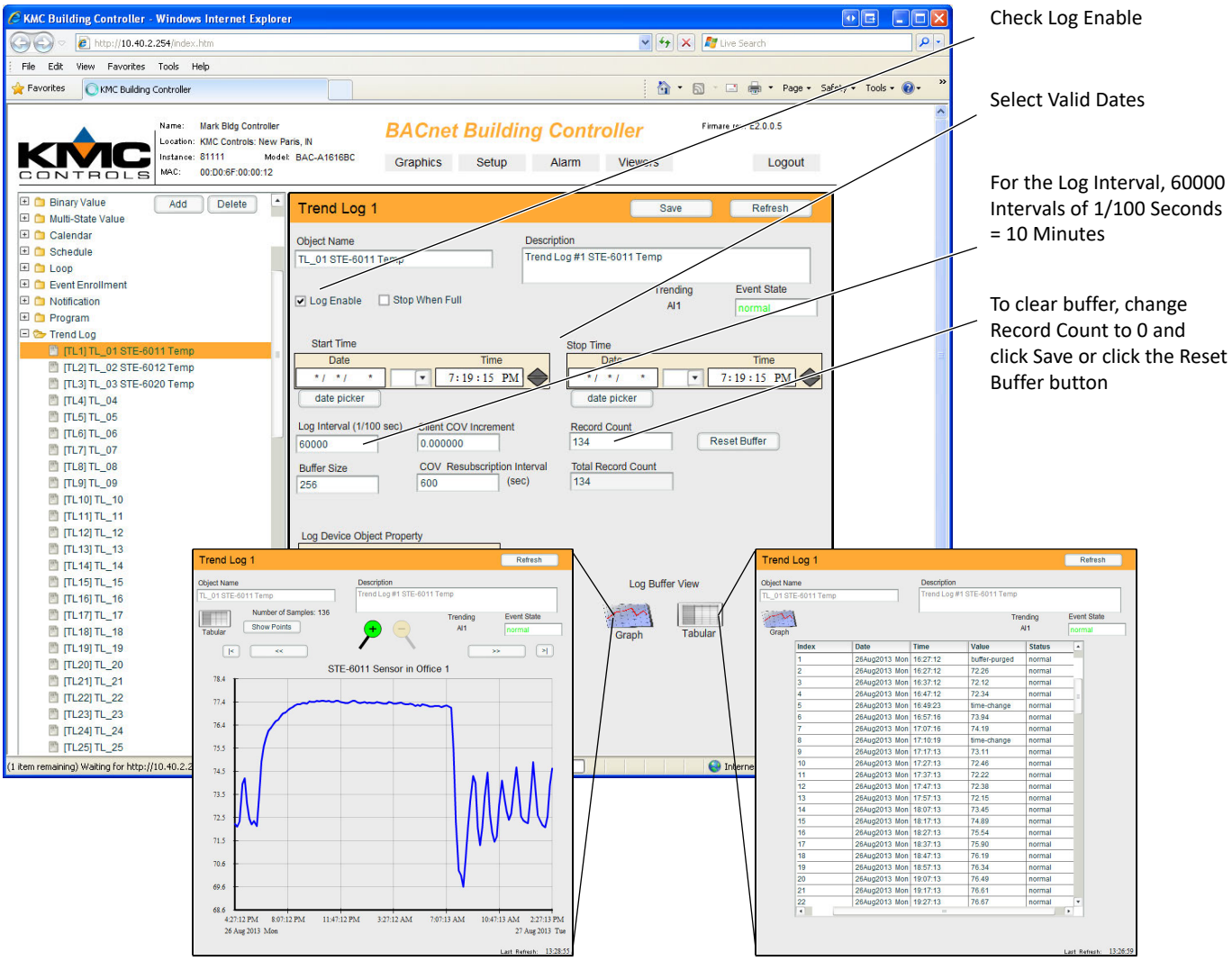


Illustration 51—Trend Log Main and Buffer View Screens

NOTE: For details on using the Graph view of trend logs, see the **BAC-A1616BC Applications Guide**.

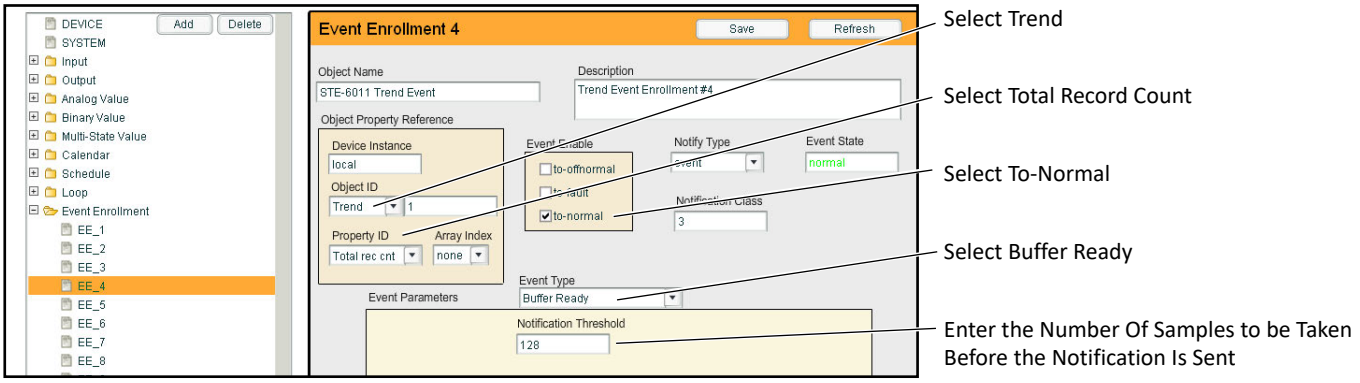


Illustration 52—Event Enrollment for Trends

Tables

Look-up tables are used when the value of an expression is nonlinear (such as the temperature response of a thermistor) or requires a complex calculation to arrive at the proper value. The two types of supported tables are:

- (Up to 16) **InTbl_x input** tables that determine the present value based on the voltage input (e.g., x VDC = y° F). The 128 values in the table span the range of the input voltage to the BAC-A1616BC's processor.
- (Up to 8) **CbTbl_x Control Basic** tables that are used to chang values according to another value (e.g., resetting setpoints according to outside air temperature). The 32 x:y value pairs have 0:0 as defaults. The CB table in *Illustration 53 on page 65* would work with the Control Basic code `AV4 = TBL( AI3, 1 )`. An outside air temperature (OAT) of 60° F or above would cause the hot water to reset to 140° F, and an OAT of –10° or below would reset the hot water to 180°, and any OAT between –10° and 60° would cause the hot water temperature to be linearly adjusted somewhere between 140° and 180°. Since the adjustment is linear, only two x:y value pairs are needed in the table (besides the default zeros).

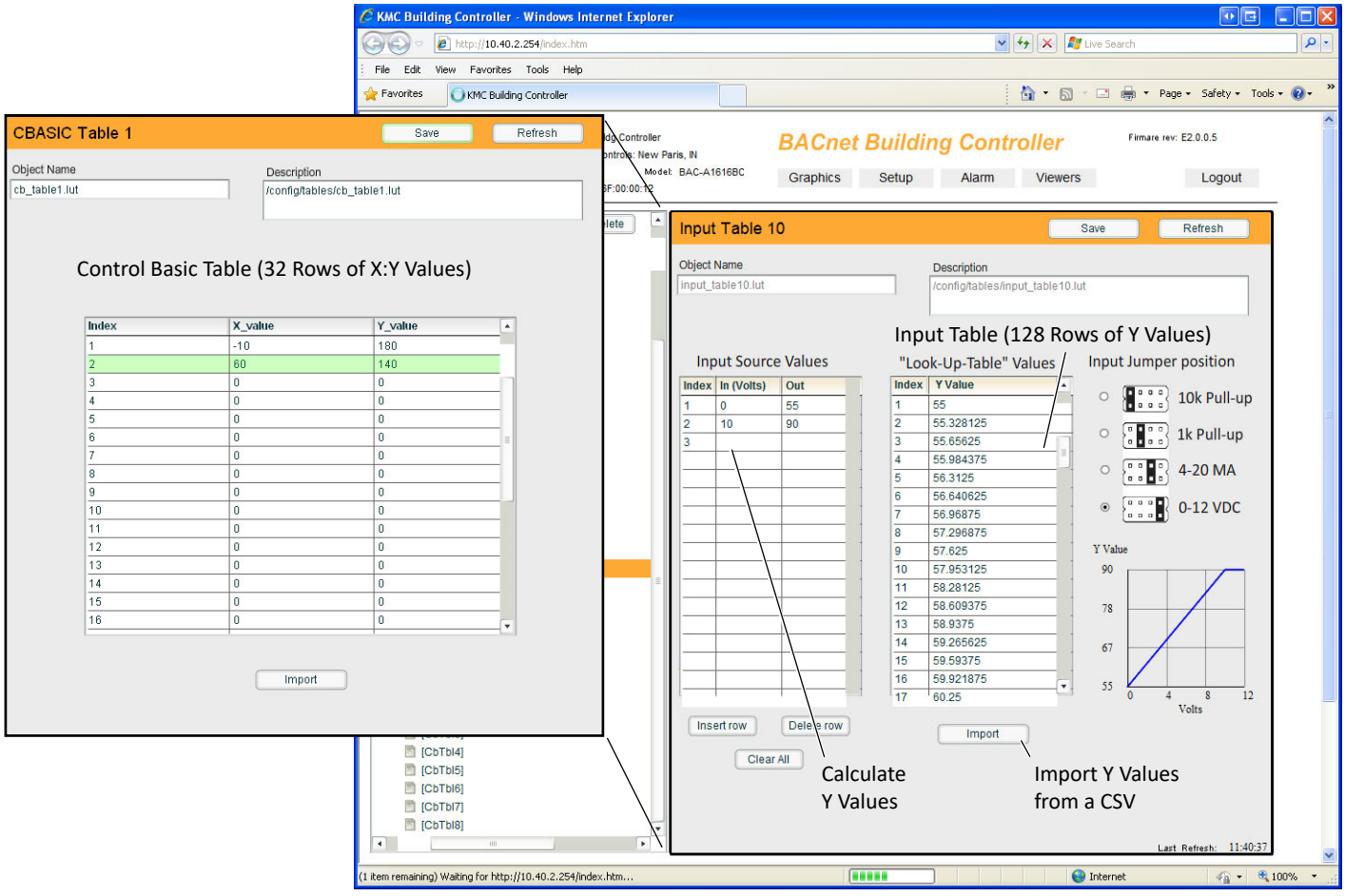


Illustration 53—Tables (Input) Screen

Tables can be added or replaced through three methods:

- Entering each Y value manually in each of the rows (via mouse and keyboard).
- Calculating the Y value table from the Input Source Values table (see *Illustration 53 on page 65*). To calculate a custom table, select the correct Input Jumper Position (as well as Volts vs. Ohms if applicable) and enter the ("In") input voltage/resistance with the corresponding desired ("Out") AI present value. For details and examples, see the **BAC-A1616BC Applications Guide**.
- Importing a (*.CSV) file by clicking the Import button. (See instructions below.)

Because the BAC-A1616BC has a 0–12 VDC total input range, different tables are required than in other (0–5 VDC) KMC controllers. Reserve Input Table 2 for Type II sensor input values and Input Table 3 for Type III sensor input values.

Input tables are required for the **STE-6012/6016** room temperature and setpoint transmitters and for the **STE-6014/6017/6019/6018/6020 rotary dial setpoints**. **To set up the correct tables for these devices by downloading and importing CSV files**:

1. Download the CSV table files from the KMC Partners web site and unzip the compressed file. (Log-in to *https://partners.kmccontrols.com/* and go to Downloads > Tables or the BAC-A1616BC product pages.)
2. Click the *Import* button near the bottom of the Tables screen. (See *Illustration 53 on page 65*.)
3. Locate the appropriate file and click *Open*.
4. At the "Upload Complete" reminder, click *OK*.
5. Click *Save* **before** exiting to another screen.
6. Record which device/function corresponds to each table.

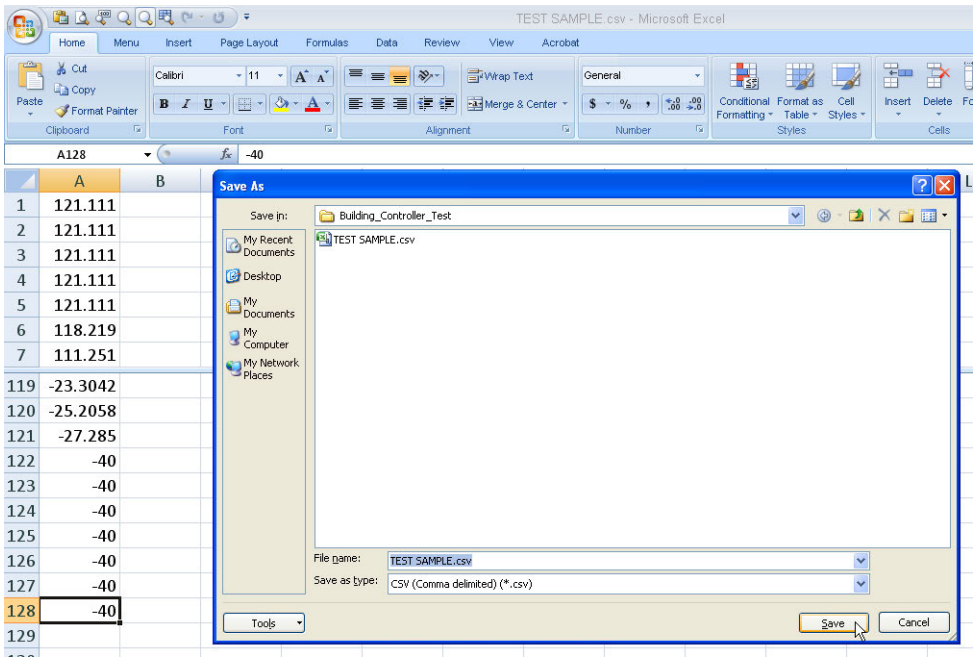


Illustration 54—Exporting a CSV Table File from Excel

NOTE: Custom CSV files can be easily created in Microsoft Excel. (See *Illustration 54 on page 66*.) For an input table, fill in 128 values, and save the file as a CSV (Comma Delimited) file type.

NOTE: The **input table** import function imports the **first 128 values** from the CSV file even if there are more values in the file. Input tables must have 128 values even if many of them are 0. Likewise, the The **Control Basic table** import function imports the **first 32 values** from the CSV file. All indexes in all tables must have values, which default to 0.

NOTE: Downloadable KMC BAC-A1616BC tables have Celsius values. Fahrenheit values are calculated via a multiplier (1.8) and offset (32) on the input configuration screens. (See *Illustration 43 on page 55*.)

Router Setup (Web)

The Setup > Router web page has many of the same functions as the Router Configuration Tool in a graphical format.

Clicking the *Route Status* button reveals a diagnostic tool that displays a list of all networks of which the Building Controller's router function is aware. See ***Route Status (RCT) on page 33*** for an explanation of those functions. Icons (e.g., ● and ⓘ below) on the Router page preview the route status condition for that port.

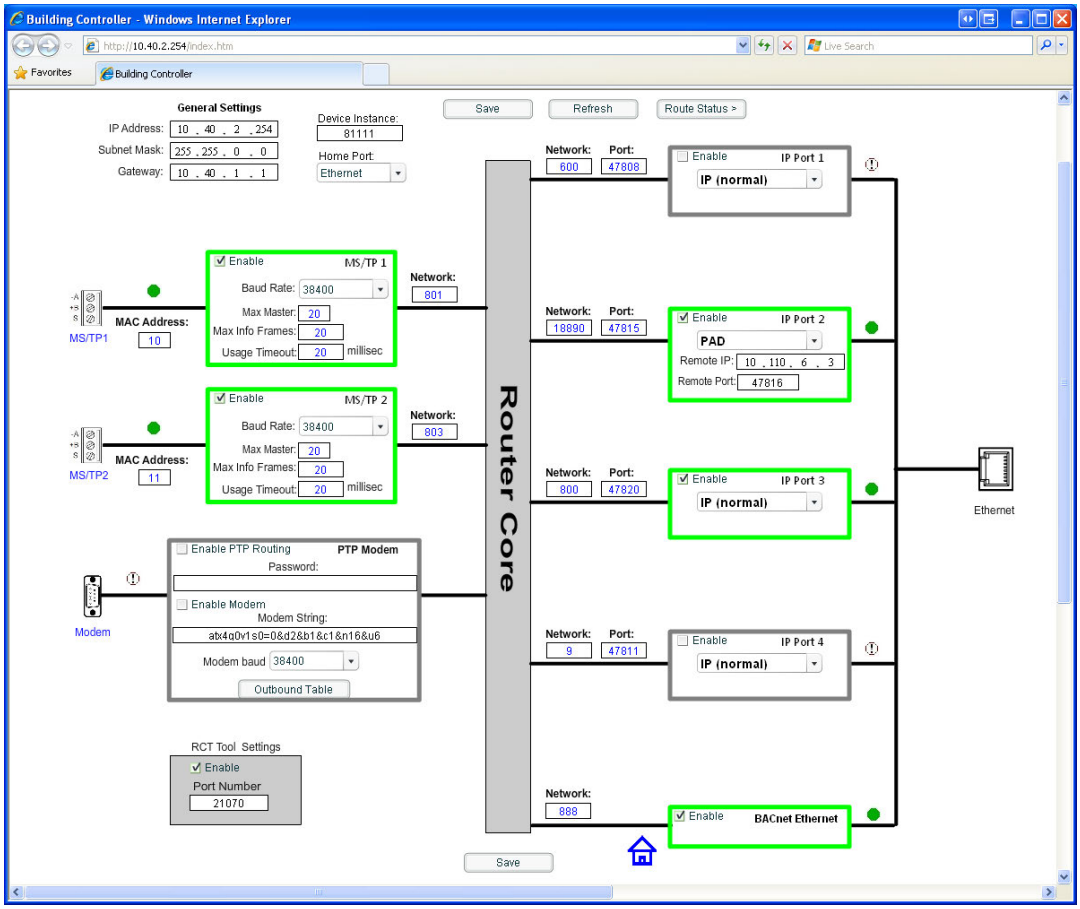


Illustration 55—Router Setup (Web)

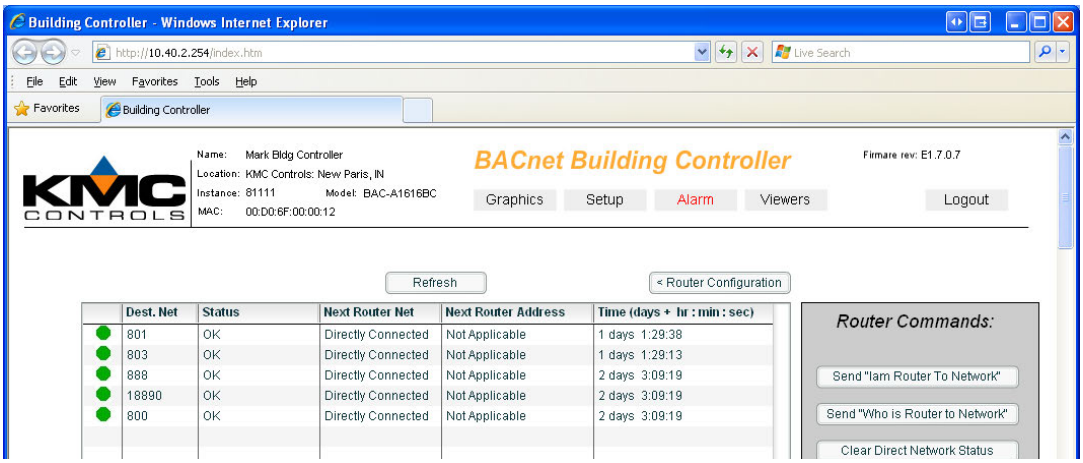


Illustration 56—Route Status (Web)

Graphics Screens

If custom graphics interface images have been published to the BAC-A1616BC from TotalControl Design Studio (ver. 1.7 or higher), after log-in, click the *Graphics* button and select the appropriate screen. **See the TotalControl documentation for information about page creation and publication.**

The custom graphic interface requires a license. See *Log-in, Security, and Permissions (Setup > Admin) on page 47*.

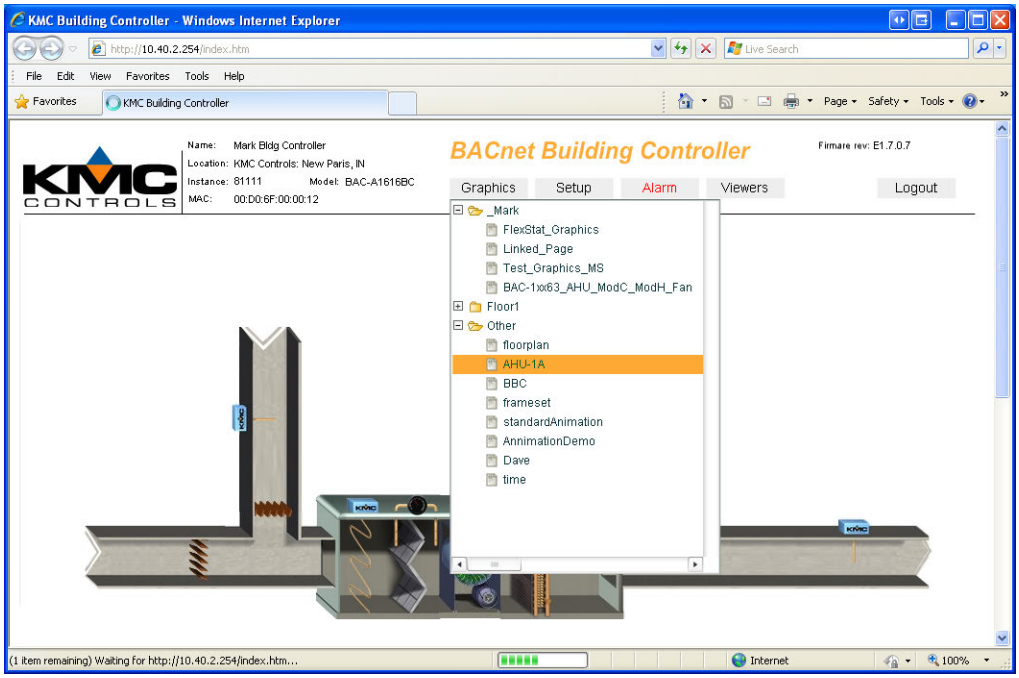


Illustration 57—Graphics Screen and Menu

NOTE: An administrator can control which graphics page a user will see upon log-in. (For example, *Illustration 57 on page 69* rather than the default *Illustration 37—Welcome Screen on page 48*.) See *Log-in, Security, and Permissions (Setup > Admin) on page 47*.

NOTE: When publishing pages from TotalControl to the BAC-A1616BC, publishing to the IP address (rather than device instance or name) often works best.

NOTE: For information about means of navigating between the pages, see the **BAC-A1616BC Applications Guide**.

Alarm (Summary and History)

Alarms can be viewed, acknowledged, and deleted from the Alarms screen. The (upper) Alarm Summary shows the present status of any alarms. The Individual Alarm History shows a history of changes in the status of an alarm.

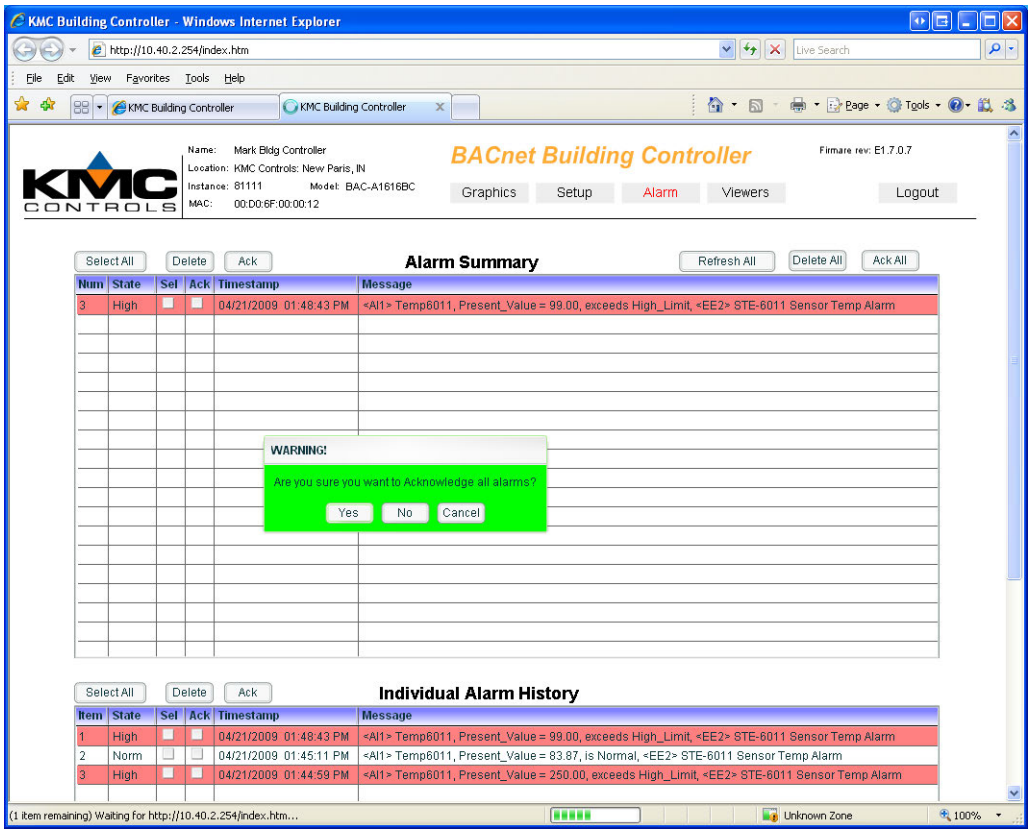


Illustration 58—Alarms Screen

Schedule Viewer (Viewers > Schedule)

Overview

Schedules can be created or modified either through the Schedule Viewer via the Schedules button (in firmware R1.6.0.11 and later) and/or through the Calendar and Schedule objects under the Setup button. See *Calendar and Schedules on page 57*.

NOTE: Linking the schedule to desired object properties must be done under "List of Object Property References" on the Schedule page (not Schedule Viewer). See *Illustration 45 on page 58*. An administrator must also define which schedules can be viewed and configured by which users. See *Log-in, Security, and Permissions (Setup > Admin) on page 47*.

The Schedule Viewer has two separate views: Weekly and Holiday. The Weekly view shows a full week of day-to-day settings with an override provision. The Holiday view shows a full calendar year of designated holidays.

The schedule object's name can be changed by clicking the name field near the top of the screen and typing in a new name.

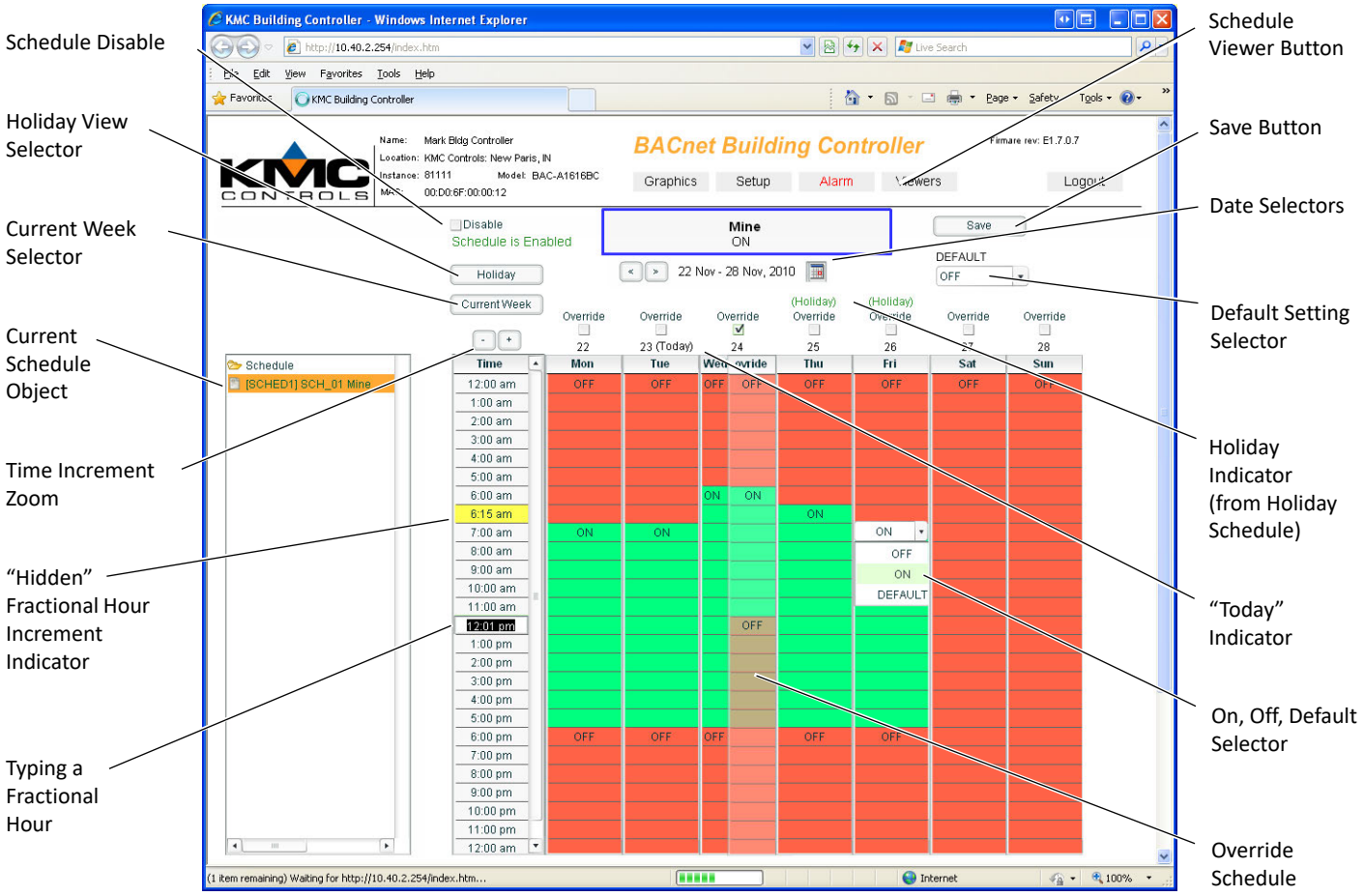


Illustration 59—Weekly View in the Schedule Viewer

User Access and Permissions

An administrator defines which schedules can be viewed and configured by which users (including administrators) by clicking on the Admin button and configuring the user profiles. See *Log-in, Security, and Permissions (Setup > Admin) on page 47*.

Weekly View

The weekly view shows the time and values (On, Off, or Null) assigned to a particular schedule on a weekly basis. To **add** a value to a particular day, double-click the desired time slot for the day. A default value will appear and can be edited to the desired value. To resize a value block, click on the top or bottom of the block and drag the block up or down. See *Illustration 59 on page 71*.

Time slot increments can be "zoomed" from one hour each to 15 minutes each by clicking the **+/–** buttons above the time column. If the time is "zoomed out" any increments smaller than the the rest will be highlighted in yellow. Time increments with values as small as one minute can also be created directly by double-clicking in a slot in the time column and typing in the desired time. The schedule's On/Off must also be adjusted for this to have an affect.

To **copy** the schedule for one day to another, click the day name at the top of the column (e.g., "Mon"), drag the day to the desired day, release the button over the new column, and click *Yes*.

An **override** is an exception that **takes precedence over the weekly and holiday values for that day only**. An override exception can be added to any day by clicking on the *Override* check box located above the desired day of the week. Once checked, a translucent copy of the weekly day will be seen over the column. Value blocks can then be adjusted by clicking on the override grid and adjusting just as in the weekly view. If an override for a particular day is no longer wanted, uncheck the override box. **A total of up to five overrides are available per schedule, and overrides in the past disappear (freeing them for use on other days) if needed for a new day. (A sixth override may be available if no holidays are used.)**

Navigate to different weeks by clicking on the Right or Left arrow buttons located at the top of the weekly view. Alternately, click the calendar icon to select a month view and click on the week desired. The weekly schedule is the same for all the viewable weeks, but some weeks may have overrides and holidays that affect only those particular days.

To **disable or enable** the schedule, check or uncheck the "Disable" box at the upper left of the screen. The status of the schedule being viewed is shown by a green "Schedule is Enabled" message or a flashing red "Schedule is Disabled" message. **When a schedule is disabled, that schedule object's present value will persist unchanged until the schedule is enabled again.**

Holiday View

To set up holidays:

1. Click on the *Holiday* button in the upper left of the screen.
2. Click the *Edit Mode* button to toggle it On. See *Illustration 60 on page 73*.
3. Click on desired individual days (turning them green).
4. In the Time/Override column on the left, adjust each block by clicking and dragging just as in the weekly view. Value changes are automatically saved.

NOTE: **All** holidays for the year use the same schedule values.

5. When done adding holidays, click on the Edit button to disable the edit mode. Changes are automatically saved. Navigate to other schedule holiday views, if desired, by clicking on the desired schedule in the Schedule tree.

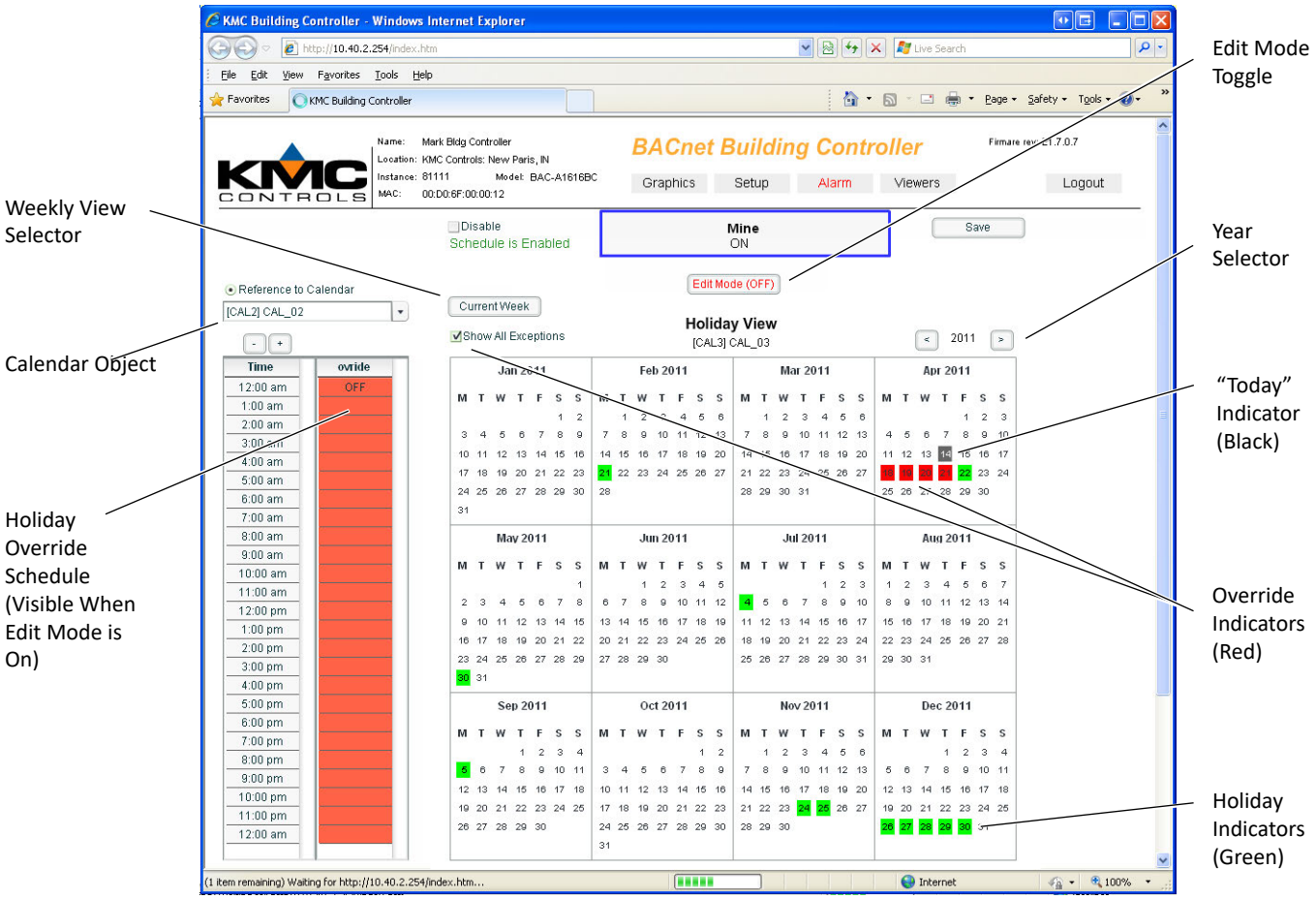


Illustration 60—Holiday View in the Schedule Viewer

NOTE: Up to 20 unique holidays can be included on a particular year, and consecutive days (e.g., Thursday and Friday) count as a single holiday. "Holidays" can be legal holidays, special events, and any other days that need an exception schedule for that day.

Check the "Show All Exceptions" box to highlight overrides currently configured on the Weekly schedule. If there are conflicts in scheduling, weekly Overrides take priority over both Weekly values and Holiday values.

NOTE: At midnight the schedule restarts with the schedule default if no value is set. If a (default) value on the schedule is **null** (see *Illustration 59 on page 71*), objects commanded by the schedule will be relinquished at their set priority for writing (see *Illustration 45 on page 58*). For example, a schedule writing to BO1 @ priority 8 will normally command 0 or 1 and write to the BO1's priority array @ 8. However, if the schedule default is set to null and neither the weekly nor the holiday schedules are controlling, BO1's present value will become null, and BO1 will be relinquished @ level 8 in its priority array.

NOTE: **Priorities** of the different BACnet values are:

1. Exceptions: overrides (@ priority 15) and holidays (@ priority 16)
2. Weekly
3. Schedule Default

You can view holidays in various years by clicking on the left or right arrow buttons.

SECTION 5—Operation and Troubleshooting

This section provides a brief overview of operating and troubleshooting the BAC-A1616BC. Once configured, programmed and powered up, the BAC-A1616BC requires very little user intervention.

Controls and Indicators

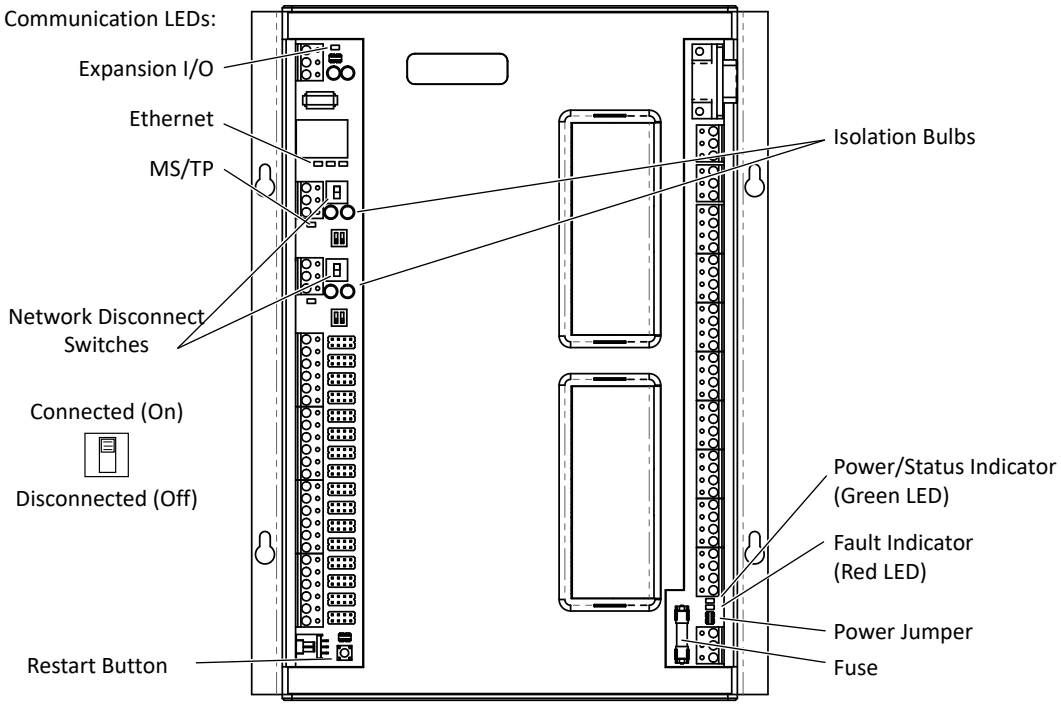


Illustration 61—Controls and Indicators

Network Disconnect Switches

The network disconnect switches are located on the left side of the controller. Use these switches to enable or disable the MS/TP network connections. 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 Indicators

Expansion I/O Communications (Amber)

This amber LED flashes when there is I/O communications bus activity. The LED is off when there is no activity.

Ethernet Communications (Amber)

Three amber LEDs indicate Ethernet communications. The left LED illuminates when the BAC-A1616BC has power. The middle LED illuminates whenever it detects an Ethernet connection. The right LED flashes at a rate in accordance to Ethernet traffic. Under normal conditions the left and center LEDs are illuminated continuously and the right LED is blinking.

MS/TP 1/2 Communications (Amber)

When the BAC-A1616BC is powered up (but not communicating on the MS/TP port), these amber LEDs will flash slowly, about once per second. When the MS/TP port establishes communications with the network, the amber LED for that MS/TP port will flash rapidly as it receives and passes the token.

Power/Status (Green)

About 30 seconds after power is applied, this (upper green LED by the power jumper) indicator flashes about once per second when the BAC-A1616BC is operating normally.

Fault (Red)

This (lower red LED by the power jumper) indicator will illuminate for approximately 30 seconds after the BAC-A1616BC has been reset/reinitialized or powered-up.

- It will glow dimly (along with the green power/status LED) after power has been first applied or restored after an outage (and both LEDs will go out briefly before the green LED starts flashing normally).
- It will glow brightly (by itself) during a commanded warm or cold start.

If it stays illuminated after boot-up or illuminates at a later time, this indicates a problem in the BAC-A1616BC.

Isolation Bulbs (HPO-0054)

Two isolation bulbs are located near each network switch. These bulbs serve three functions:

- Removing the bulbs will open the MS/TP or expansion I/O network and isolate the BAC-A1616BC 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.

Troubleshooting

Back-up and Restore Issues

- See *Firmware Update and Backup on page 44*.

CAN-A168EIO Expansion Module Issues

- See *Troubleshooting (CAN-A168EIO) on page 94*.

Communication Issues

- For the **internal** email server to be enabled, a license is required. See *Log-in, Security, and Permissions (Setup > Admin) on page 47*.
- For **Ethernet** and **IP** issues, review *Connecting to an Ethernet Network on page 21*, *Connecting for Configuration on page 28*, and *Route Status (RCT) on page 33*.
- For **point-to-point** issues, review *Connecting for Point-to-Point Operation on page 21* and *Route Status (RCT) on page 33*.
- For **MS/TP** issues, see *LED Indicators and Isolation Bulbs Issues on page 78* and *Route Status (RCT) on page 33*.

NOTE: **Be very careful about setting the baud rate** on the controllers on the MS/TP network. They should all match. The BAC-A1616BC does not (yet) autobaud. For example, if other controllers are set to 38400 with autobaud turned on while the BAC-A1616BC is set to 9600 baud, and if power to all devices is temporarily lost, the other controllers may cycle first and lock in 38400 baud before the BAC-A1616BC has a chance to send any MS/TP traffic.

Firmware Update or FTP Access Does Not Work or Requires a Log-in

- With firmware R1.6.0.12 and later, access to the BAC-A1616BC through FTP can be selected as *Anonymous* (not recommended during general use), *Protected* (requires an administrator log-in), and *No Access*. (See *Device and System Screens (Setup > Objects) on page 50*.) With a *Protected* FTP setting, the FTP connection or firmware update through the Router Configuration Tool requires an Administrative log-in. With a *No Access* FTP setting, neither connection is possible—to connect, temporarily change FTP access to another setting.

Firmware Update Causes BAC-A1616BC to Become Unstable

- See *Reboots Repeatedly or Becomes Unusable on page 80*.
- See also *Firmware Update or FTP Access Does Not Work or Requires a Log-in on page 77*

Inputs or Outputs Are Not Working

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

- Check wiring. See *Connecting Inputs on page 11* and *Connecting Outputs on page 13*.
- For inputs, check input jumper setting. See *Illustration 3 on page 11* and *Illustration 4 on page 13*.
- Check object configuration. See *Input and Output Objects on page 55*.
- For AI objects, check/select/import/configure the relevant look-up table. See *Tables on page 65*.
- For outputs, check Control Basic programs (*Programs (Control Basic) on page 62*), loop objects (*Loop Objects (PID Controllers) on page 59*), and schedules (*Calendar and Schedules on page 57*).

LED Indicators and Isolation Bulbs Issues

Power/Status LED (Green) Issues

About 30 seconds after power is first applied, the green Power/Status LED will begin flashing about once a second if the device is functioning normally. See *Controls and Indicators on page 75*.

- If it is **not illuminated**, check the (1.6 A, fast-acting, 5 x 20 mm) fuse, power, and connections to the BAC-A1616BC (see *Illustration 15 on page 26*).
- If it **stays illuminated continuously (without flashing)**, check the Ethernet connection and restart the BAC-A1616BC (see *Resetting (Reinitializing) the BAC-A1616BC on page 82*).

Fault LED (Red) Issues

The red Fault LED will illuminate for approximately 30 seconds after the BAC-A1616BC has been reset/reinitialized or powered-up. If it **stays illuminated after boot-up or illuminates at a later time**, this indicates a problem in the BAC-A1616BC:

- Check the Ethernet connection.
- Restart the BAC-A1616BC (see *Resetting (Reinitializing) the BAC-A1616BC on page 82*).
- If it continues to stay illuminated, contact KMC Controls technical support.

Ethernet LEDs (Amber) Issues

The Ethernet connection has three amber LEDs below it.

- The left LED illuminates when the BAC-A1616BC has power.
- The middle LED illuminates whenever it detects an Ethernet connection.
- The right LED will blink at a rate in accordance to Ethernet traffic. **If the middle and right LEDs are not illuminated**, check the Ethernet connection.

MS/TP LEDs (Amber) Issues

Each **MS/TP** network has an **amber LED** that flickers as it receives and passes the token during communication with the network. When the BAC-A1616BC is powered up (but not communicating on the MS/TP port), these amber LEDs will flash slowly, about once per second. When the MS/TP port establishes communications with the network, the amber LED for that MS/TP port will flash rapidly as it receives and passes the token. If it is **not flashing rapidly**:

- Check the position of the network switch. See *Network Disconnect Switches on page 75*.
- Check the isolation bulbs. See *Isolation Bulbs (HPO-0054) on page 76*.
- Check network connections and configuration. See *Connecting to an MS/TP Network on page 18* and *Router Configuration Tool (RCT) on page 30*.
- Restart the BAC-A1616BC. See *Resetting (Reinitializing) the BAC-A1616BC on page 82*.

MS/TP Isolation Bulbs Issues

Each **MS/TP** network also has **two isolation bulbs** located near each network switch. (See *Illustration 61 on page 75*.) 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.

Log-in Does Not Work or Is Required Unexpectedly

- Review *Log-in, Security, and Permissions (Setup > Admin) on page 47*.
- See *Firmware Update or FTP Access Does Not Work or Requires a Log-in on page 77* and *Web Pages Can't Be Published from TotalControl on page 81*.

Memory Becomes Full

- Monitor the memory status before it reaches a critical level. See *Illustration 39 on page 50*.
- Use TotalControl to delete unused graphics pages and consolidate/rework needed pages. Avoid resizing standard graphic elements since that increases the file size.

Objects Lose Changed Values

- Click *Save* before changing screens. See *Illustration 42 on page 53*.
- Review *Viewing & Editing BACnet Objects (Setup > Objects) on page 53*.

Reboots Repeatedly or Becomes Unusable

- See *LED Indicators and Isolation Bulbs Issues on page 78*.
- Halt the boot-up via the debug port and reload the last working version of the firmware. See *Serial Connection and Debug Monitoring on page 30* and *Firmware Update and Backup on page 44*. See also *Router Configuration Tool (RCT) on page 30*.

Router Configuration Tool Firmware Upgrade/Backup Issues

- See *Firmware Update and Backup on page 44*.

Schedules Cannot Be Viewed or Changed

- To use the Schedule Viewer, check that *Show Schedule Viewer for User* is checked and appropriate permissions are selected in the Administration screen. Review *Schedule Viewer (Viewers > Schedule) on page 71* and see *Illustration 38 on page 49.*
- In Holiday view, check that Edit Mode is turned on. See *Illustration 60 on page 73*.

Schedules Do Not Operate Properly

- Check for valid dates, data type and other values. See *Illustration 45 on page 58*.
- Check the BAC-A1616BC's time. See *Illustration 39 on page 50*.
- Review *Calendar and Schedules on page 57*.

Temperature Is Not Controlled Properly

- Check inputs and outputs. See *Inputs or Outputs Not Working on page 94*.
- Check schedules. See *Schedules Do Not Operate Properly on page 80*.

Time and/or Date Are Not Correct

NOTE: When powered up after losing the RTC (Real Time Clock) time, the time and date will revert to the default and must be set manually or by Synch to PC.

- Set time and date in the System screen. See *Device and System Screens (Setup > Objects) on page 50*.
- Check the DST (Daylight Saving Time) settings.
- Check the UTC Offset (if applicable).

Trends Do Not Work

- Check that the Start and Stop times are valid.
- Review *Trend Logs on page 63*.

Web Browser Does Not Respond as Expected or Can't View Web Pages

- Review *Browsers and Screen Refresh on page 46*.
- Review *Log-in, Security, and Permissions (Setup > Admin) on page 47*.

Web Pages Can't Be Published from TotalControl

NOTE: Access to the BAC-A1616BC through FTP can be selected as *Anonymous* (not recommended during general use), *Protected* (requires an administrator log-in), and *No Access*. (See *Device and System Screens (Setup > Objects) on page 50*.) This setting affects TotalControl's access from the Building Controller Site Manager.

- With a *Protected* FTP setting, after starting TotalControl's Building Controller Site Manager, log into the BAC-A1616BC with an Administrative log-in.
- With a *No Access* FTP setting, TotalControl will be unable to publish web pages to the BAC-A1616BC at all—to publish, temporarily change FTP access to another setting.
- For graphics pages to be enabled, a license is required. See *Log-in, Security, and Permissions (Setup > Admin) on page 47*.

Other Configuration, Network, or Hardware Issues

- Thoroughly check appropriate connections, wiring, and settings.
- Use Route Status to check for duplicate network numbers and other issues. See *Route Status (RCT) on page 33* and *Router Setup (Web) on page 68*.
- Reset the BAC-A1616BC (see *Resetting (Reinitializing) the BAC-A1616BC on page 82*).
- Consult with the network administrator for proper network and email settings.
- Contact KMC Controls technical support.

Resetting (Reinitializing) the BAC-A1616BC

⚠ CAUTION

To protect against equipment damage and loss of data, read ALL the information in this section before proceeding! Before resetting the BAC-A1616BC, shut down or manually override all controlled equipment that might be damaged by abrupt changes in operation.

Types of Reset

If the BAC-A1616BC appears to be operating incorrectly or is not responding to commands, it may need to be reset (reinitialized). After initiating, the restart process **takes at least half a minute to complete and return the Building Control to normal operation**. 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 BAC-A1616BC 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) before continuing.

After the Save button is pressed in the web browser a one minute time-out period exists before changes are written to flash memory (to reduce the number of writes to and provide longer life for the flash memory). If the red restart button is pushed or power is removed during the time-out period, all changes will be lost.

Performing a WARM Start

A warm start does the following in the BAC-A1616BC:

- **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, programming, trend data, and IP address intact.

⚠ CAUTION

In the unlikely event that the checksum test in RAM fails during the warm start, the BAC-A1616BC 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 (see *Illustration 61 on page 75*).
- Through the Reinitialize button on the built-in configuration System web page (see *Illustration 39 on page 50*).
- 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.

A cold start can be performed:

- By pushing (for about one second) the red restart button (see *Illustration 61 on page 75*). (The red Fault light will turn on several seconds later.)
- Through the Router Configuration Tool (see *Illustration 20 on page 32*).
- Through the Reinitialize button on the System web page (see *Illustration 39 on page 50*).
- Through the Controller Restart button on the Admin web page (see *Illustration 38 on page 49*).
- Through TotalControl or BACstage (see the software documentation).

Restoring Factory Defaults of Controller Functions

NOTE: See also *Restoring Factory Defaults of Router Functions on page 84*.

⚠ 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.

Restoring **controller** functions to the **WEB INTERFACE** factory defaults:

- Restores the object database/configuration to the defaults.
- Does **NOT** remove tables and Control Basic programs, but fills in missing numbers to the default numbers.

- Does **NOT** restore **IP address and router functions** to their defaults. See *Restoring Factory Defaults of Router Functions on page 84*.

To restore the BAC-A1616BC to factory defaults (through the web browser):

1. Back up the BAC-A1616BC. (See *Firmware Update and Backup on page 44*.)
2. Connect to the BAC-A1616BC via a web browser.
3. Go to the System page.
4. Click the Factory Defaults *Restore* button (see *Illustration 39 on page 50*) and *Yes* to the prompts.
5. After the BAC-A1616BC restarts, restore desired configuration and programming through the Router Configuration Tool, TotalControl, and/or the built-in configuration web pages.

Restoring Factory Defaults of Router Functions

NOTE: See also *Restoring Factory Defaults of Controller Functions on page 83*.

⚠ CAUTION

Restoring router factory defaults erases configuration. You must then configure the BAC-A1616BC to establish normal communications and operation.

Restoring BAC-A1616BC router functions to the **ROUTER CONFIGURATION TOOL** factory defaults:

- Restores the **IP address,** the **device instance**, and other settings seen in the General Settings tab of the RCT to the defaults.
- Does **NOT** restore **objects and programs** to their defaults. See *Restoring Factory Defaults of Controller Functions on page 83*.

To restore the BAC-A1616BC to factory defaults (through the RCT):

1. Back up the BAC-A1616BC. (See *Firmware Update and Backup on page 44*.)
2. In the RCT, right-click on the BAC-A1616BC line and select *Restore Factory Default Configuration*.
3. Click *Yes* to "Would you like to immediately save the factory default configuration to the device after restoring?"
4. Restart the BAC-A1616BC.
5. Reconfigure the network configuration and home port settings. See *Connecting for Configuration on page 28*.

SECTION 6—CAN-A168EIO Expansion Module

This section provides a brief overview of adding from one to seven expansion modules to the BAC-A1616BC. Review this material before you do so.



Specifications

Inputs	16 universal inputs, software selectable as analog, binary, or accumulator
Overvoltage protection	24 VAC, continuous on inputs
Pulse counting	Up to 16 Hz
Binary inputs	0 or 12 VDC (on/off)
Analog inputs	Configurable via jumper for 1K or 10K ohms with pull-up resistors (for unpowered contacts or devices), 0–12 VDC, or 4–20 mA
A/D conversion	16-bit analog-to-digital conversion
Connectors	Removable screw terminal blocks, wire size 14–22 AWG
Outputs	8 universal outputs, software selectable as analog or binary
Output current	**100 mA per output** (at 0–12 VDC) **or 450 mA total** for all outputs, short-circuit protected
Output override	8 slots for output override cards (e.g., triac, relay, 4–20 mA) for large relays or devices that cannot be powered from a standard universal output
D/A conversion	12-bit digital-to-analog conversion
Connectors	Removable screw terminal blocks, wire size 14–22 AWG

Communications, Indicators, Fuses, and Jumpers	
Serial I/O	One serial bus connection (terminal block) for daisy-chaining I/O expansion modules to the BAC-A1616BC
LED indicators	Expansion I/O Communication and Ready/Status
Network bulbs	Two for reversed polarity and overload protection/ indication
Fuse	1.6 A, fast-acting, 5 x 20 mm
Jumpers	Power, input type selectors, I/O bus end of line, outputs (removed for output override boards), WD (watch dog—not to be removed)
Installation	
Dimensions	8.4 x 8.2 x 1.1 (w/o HPO output card covers or 1.9 w/ covers) inches (283 x 207 x 27/48 mm)
Weight	1.6 lb. (0.7 kg)
Supply voltage	24 VAC (–15%, +20%), Class 2 only
Supply power	19 VA @ 28.8 VAC
Case material	Black powder-coated steel
Environmental Limits	
Operating temperature	32 to 140° F (0 to 60° C)
Shipping temperature	–40 to 160° F (–40 to 71° C)
Humidity	0 to 95% relative humidity, noncondensing
Regulatory	
	UL 916 Energy Management Equipment
	CE compliant
	FCC Class B, Part 15, Subpart B
	Complies with Canadian ICES-003

Accessories

See the **BAC-A1616BC Applications Guide**.

Diagram and Dimensions

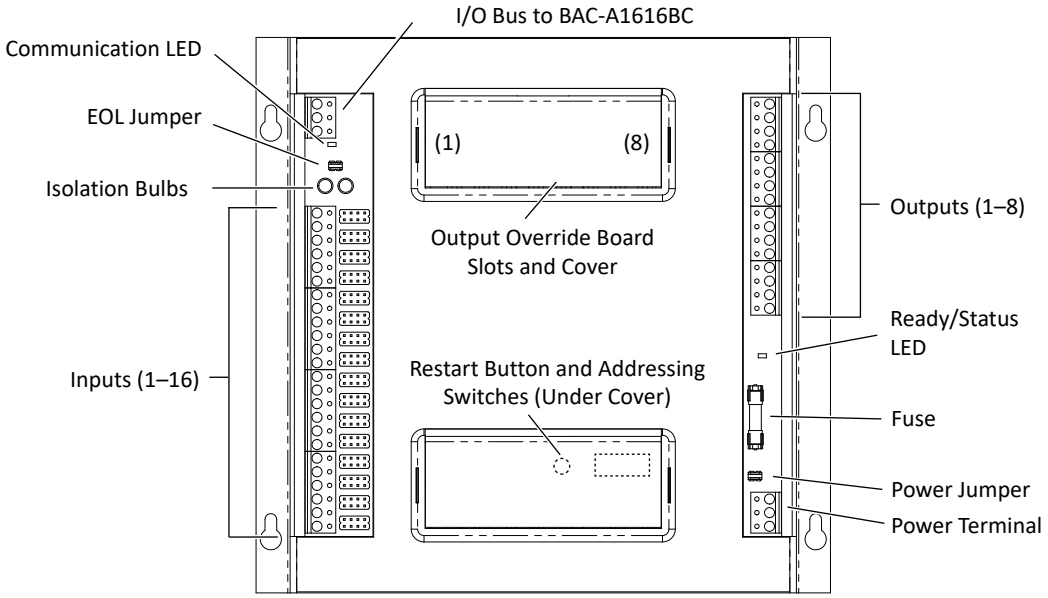
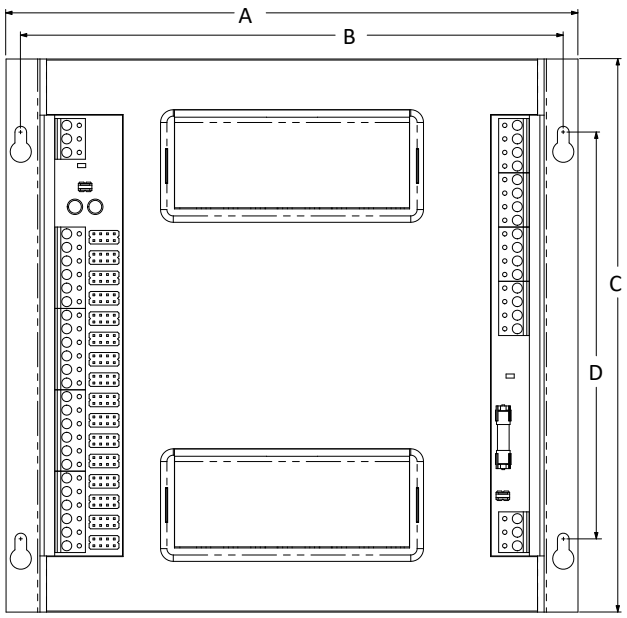


Illustration 62—CAN-A168EIO Overview



A	B	C	D	Depth (not shown)
8.4 in.	8.0 in.	8.2 in.	6.0 in.	1.1 in. (w/o HPO covers), 1.9 in. (with)
214 mm	203 mm	207 mm	152 mm	27 mm, 48 mm

Illustration 63—CAN-A168EIO Dimensions

Mounting

Mount the CAN-A168EIO inside of a metal enclosure in the same manner as the BAC-A1616BC. See *Mounting on page 11*.

Inputs, Outputs, and Power

Connect the CAN-A168EIO **inputs and outputs** in the same manner as the BAC-A1616BC. See *Connecting Inputs on page 11* and *Connecting Outputs on page 13*.

NOTE: The maximum output current is **100 mA per output** (at 0–12 VDC) or **450 mA total** for all outputs.

Connect the CAN-A168EIO **power** in the same manner as the BAC-A1616BC. See *Connecting Power on page 26*.

NOTE: The CAN-A168EIO is controlled by the BAC-A1616BC. If they are on separate electrical circuits, the possibility exists that power could fail to the BAC-A1616BC but remain on to the CAN-A168EIO. If this occurs, the outputs of the CAN-A168EIO would remain in their current state until (at least) the BAC-A1616BC has its power restored. Having the BAC-A1616BC and all expansion modules on the same electrical circuit is recommended.

⚠ CAUTION

If the CAN-A168EIO will control a device that has a minimum required "off" time (e.g., a large compressor), for proper operation after a power failure, power the CAN-A168EIO from the same electrical circuit as the BAC-A1616BC. The CAN-A168EIO should restart at the same time as the BAC-A1616BC after a power failure.

I/O Bus

Connect the **I/O Bus connector** of the CAN-A168EIO to the I/O Bus connector of the BAC-A1616BC. The modules can be installed up to 200 feet away (of total wiring) using standard twisted-pair wiring on the serial I/O bus. Use the following principles when connecting the BAC-A1616BC to one or more expansion modules:

- 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.
- The total wire length from the BAC-A1616BC to the CAN-A168EIO should be **no more than 200 feet**. If there is a daisy chain of multiple modules, the total, combined wire length to the farthest CAN-A168EIO from the BAC-A1616BC should be no more than 200 feet.
- Connect the – terminal in parallel with all other – terminals.
- Connect the + terminal in parallel with all other + terminals.
- Connect the shields of the cable together at each module using the *S* terminal.

- Connect the shield to an earth ground at one end only.

The devices on the physical **ends** of the I/O bus network must have **end-of-line termination jumpers** installed/on (default) for proper network operation. (See *Illustration 64 on page 89*.) If one expansion module is installed, it and the BAC-A1616BC must both have the jumper installed. If multiple expansion modules are installed, the devices **not** on the ends must have the jumper removed/off (reinsert the jumper on one pin only for possible future use).

NOTE: The BAC-A1616BC does not need to be on an end.

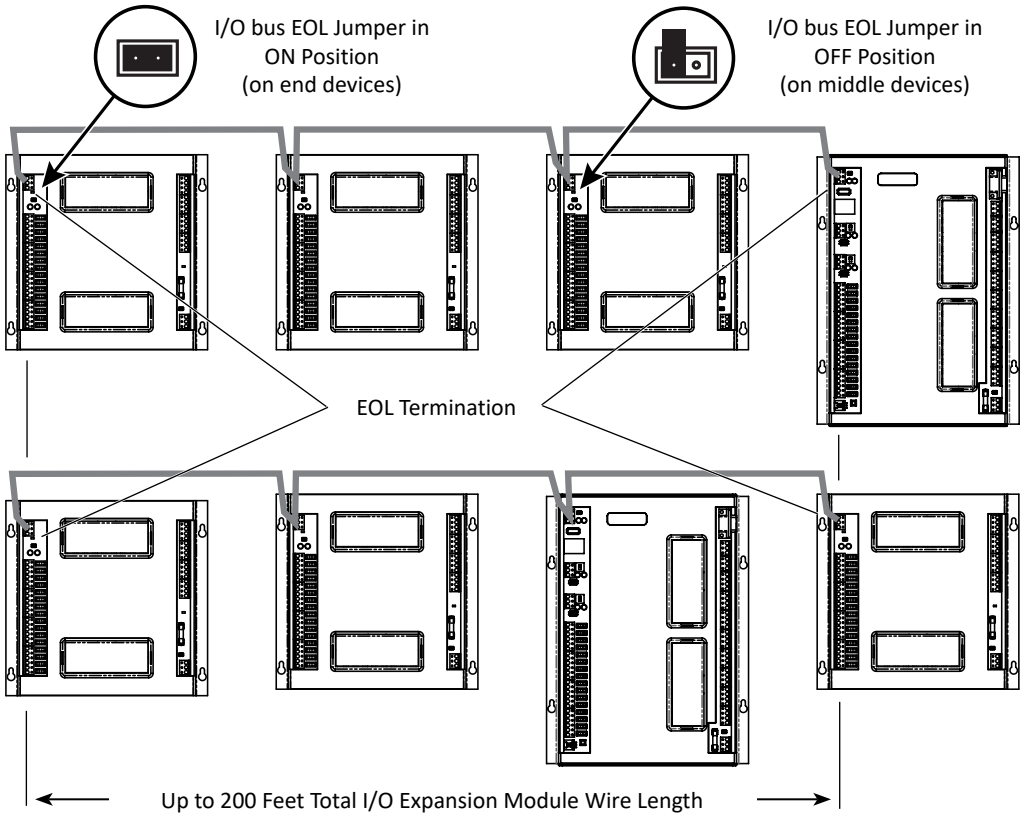


Illustration 64—End-Of-Line Termination and Maximum Wire Length

Addresses

The expansion modules must each be addressed to identify the inputs and outputs. Under the lower cover are four DIP switches used for addressing. See *Illustration 65 on page 90* and *Illustration 62 on page 87*.

Inputs and Outputs Addresses			
Module	**Inputs**	**Outputs**	**Address**
B-BC	1–16	1–16	0
EIO_1	17–32	17–24	1
EIO_2	33–48	25–32	2
EIO_3	49–64	33–40	3
EIO_4	65–80	41–48	4
EIO_5	81–96	49–56	5
EIO_6	97–112	57–64	6
EIO_7	113–128	65–72	7

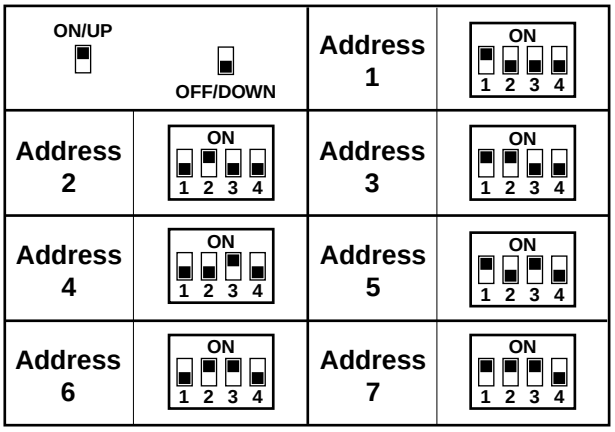


Illustration 65—Expansion Module Address Switch Positions

NOTE: Switch 4 is always down, and at least one switch of 1 through 3 must be up.

NOTE: Input and output numbers must correspond with the appropriate module number set by the address switches.

NOTE: If the EIO modules are not addressed in consecutive order, gaps will exist between the input and output objects. For example, B-BC, EIO_1, and EIO_3 (only) would have Inputs 1–32, 49–64 and Outputs 1–24, 33–40. B-BC and EIO_2 (only) would have Inputs 1–16, 33–48 and Outputs 1–16, 25–32.

Override Boards (Optional)

Optional output override boards are installed in the same manner as in the BAC-A1616BC with the exception of the horizontal instead of vertical orientation.

On the selection switch on the override board, *A* (Automatic) is the top position of the switch, *O* (Off) is the middle position, and *H* ("Hand" or On) is on the bottom position. Output 1 slot is on the left, and Output 8 slot is on the right.

See *Illustration 62 on page 87*, *Installing Override Boards (Optional) on page 14*, *Illustration 6 on page 16*, and *Illustration 7 on page 17.*

Indicators

LED Indicators

Communication (by I/O Bus)

This amber LED flashes quickly when there is I/O communications bus activity. The LED will be off when there is no activity. (In contrast, the BAC-A1616BC's I/O LED will also flash quickly when there is I/O communications activity, but it flashes slowly when there is no activity.)

Ready (by Power Jumper)

This green LED flashes about once per second when the controller is operating normally.

Isolation Bulbs (HPO-0054)

Two isolation bulbs are located near I/O bus connector. These bulbs serve three functions:

- Removing the bulbs will open the I/O bus circuit and isolate the CAN-A168EIO from the BAC-A1616BC and any other daisy-chained CAN-A168EIOs. (This can also be done by pulling the connector from the pins on the board.)
- If one, or both, bulbs are lit, it indicates the bus is improperly phased.
- If the voltage or current on the bus exceeds safe levels, the bulbs operate as fuses and may protect the expansion module from damage.

Web Configuration Page

The **State column** on the Extended I/O configuration screen (see *Illustration 66 on page 92* and *Illustration 68 on page 95*) indicates the current conditions of attached expansion modules:

- **Running**—module connected, objects configured, and operating normally.
- **Silent**—module has been silenced.
- **Intermediate**—module is rebooting (click the Refresh button to see) or is connected but not configured properly (see *Illustration 65 on page 90*).
- **Inactive**—no module properly connected and configured.

Firmware Update (CAN-A168EIO)

Firmware for the expansion modules may be included as part of the firmware for the BAC-A1616BC. If so, after updating the firmware in the BAC-A1616BC (see *Firmware Update and Backup on page 44*), a new firmware version will appear in the Expansion I/O screen. See *Illustration 67 on page 93*. Follow Steps 5 through 8 (only) to also update the expansion module.

Expansion module patches might also be available separately. In that case, follow Steps 1 through 4 and then 5 through 8.

1. Download the updated firmware file from the KMC web site to a convenient location on your computer.
2. From the System screen, click on the *Extended I/O View* button. (See *Illustration 66 on page 92*.)

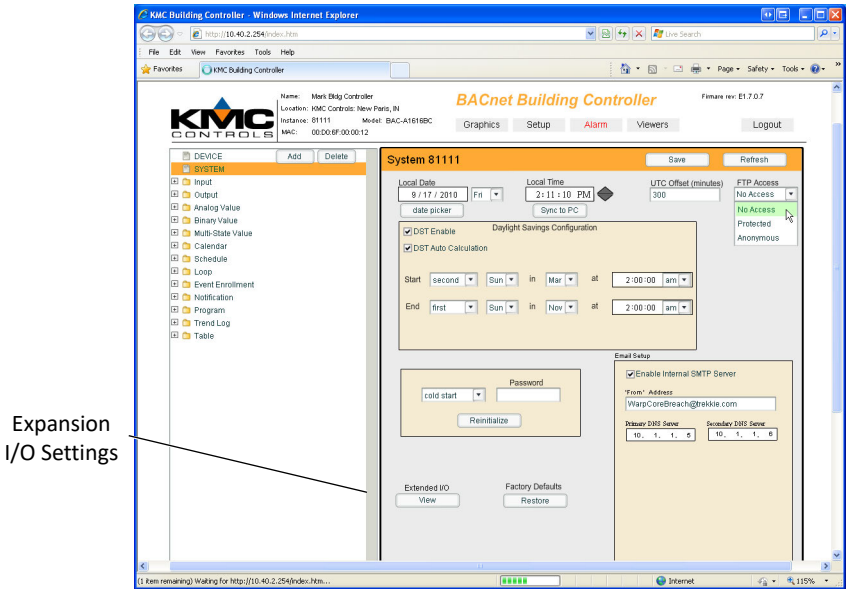


Illustration 66—Accessing the Expansion I/O Settings

3. Click the *Import* button. See *Illustration 67 on page 93*.

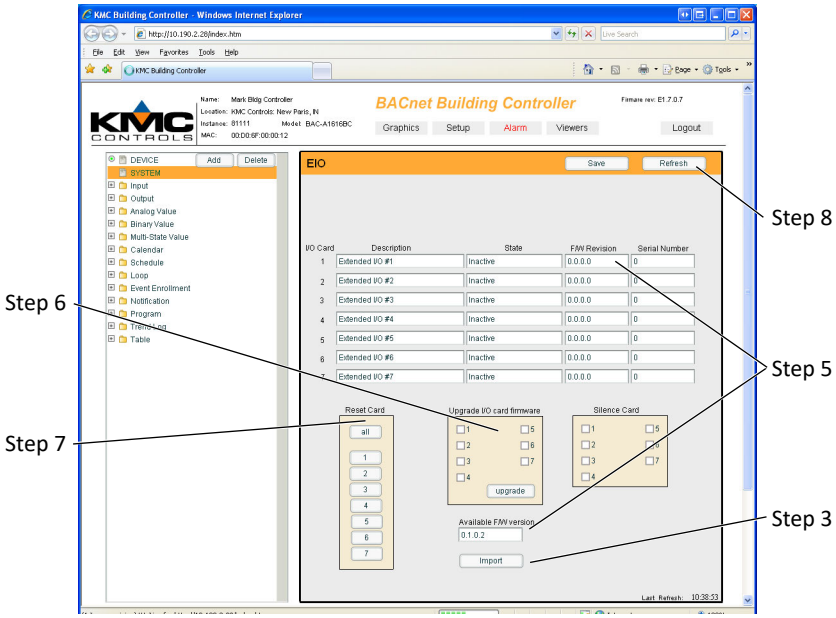


Illustration 67—Expansion I/O Screen

4. Navigate to where the new firmware file is located, select the file, and click *Open*.
5. The version of the new firmware will display in the Available F/W version field. (The current firmware versions in each module are shown in the upper section of the screen.)
6. Under Upgrade I/O card firmware, check the appropriate boxes and click the *Upgrade* button.
7. When "Upgrade Complete" appears in the State field of the appropriate expansion module, restart the module by clicking the appropriate number under Reset Card.
8. Click the *Refresh* button to verify that the module is "Running."

Troubleshooting (CAN-A168EIO)

Ready LED

The CAN-A168EIO green Ready LED flashes about once per second if the device is functioning normally. If it is **not illuminated**:

- Check the (1.6 A, fast-acting, 5 x 20 mm) fuse.
- Check the power connection.
- Check the connection to the BAC-A1616BC.

Communication Issues

- The CAN-A168EIO amber Communications LED flashes quickly when there is I/O communications bus activity. The LED will be off when there is no activity. If there is **no indication of activity** when there should be, check the I/O bus connection.
- If the CAN-A168EIO inputs appear "frozen" and outputs are not controlled even though correct values appear in the web interface or TotalControl, check the I/O communications bus wiring and connections.

Inputs or Outputs Not Working

- Input and output numbers must correspond with the appropriate module number set by the address switches. See *Illustration 65 on page 90*
- If inputs are "frozen" and outputs do not respond to commands, check that the Communications LED is flashing and that the I/O bus connection is wired correctly.
- See *Inputs or Outputs Are Not Working on page 78*.

Other Difficulties

- Thoroughly check appropriate connections, wiring, and settings.
- Check that the EOL jumpers are set correctly. See *Illustration 64 on page 89*.
- Remove the CAN-A168EIO.
- Reset the BAC-A1616BC. See *Resetting (Reinitializing) the BAC-A1616BC on page 82*.
- Contact KMC Controls technical support.

Resetting and Silencing the CAN-A168EIO

⚠ CAUTION

A cold start returns object values to their relinquished defaults. 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.

The expansion module can be **reset (cold start)** by any of three methods:

- On the Expansion I/O screen (see *Illustration 68 on page 95*), click on the desired button under Reset Card. Single or multiple expansion modules (cards) can be reset remotely.
- Remove the lower cover and push the reset button. See *Illustration 62 on page 87*.
- Remove the power jumper for a few seconds and reinstall. See *Illustration 62 on page 87*.

To facilitate troubleshooting, one or more of the expansion modules can be **"silenced"** from the Expansion I/O screen. To prevent a particular module from transmitting on the MS/TP network, check the appropriate number under Silence Card and click the *Save* button. See *Illustration 68 on page 95*. **Remember to uncheck it when resuming normal operation.**

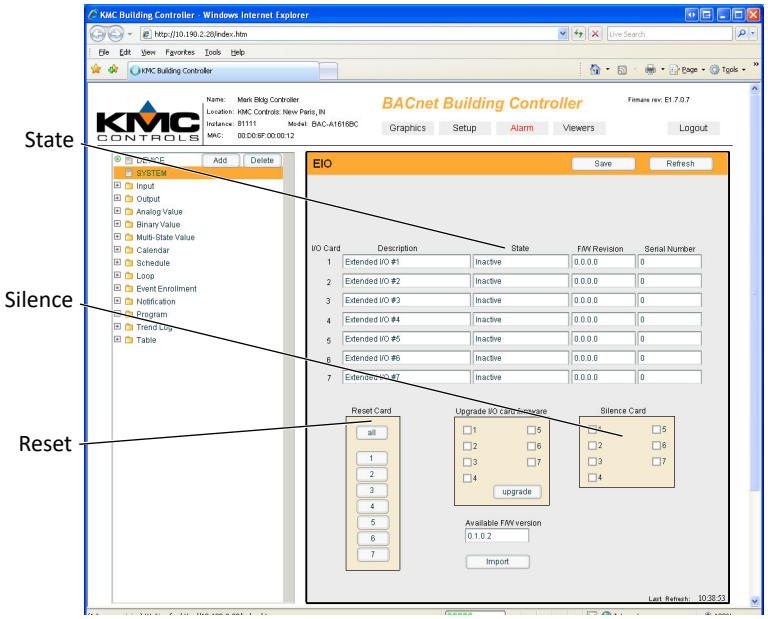


Illustration 68—Resetting or Silencing the CAN-A168EIO

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