

Installation and Operation Guide

BAC-5050

FullBAC BACnet Router



Includes

Installation for Router Configuration Tools

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KMC Controls, Inc.

P.O. Box 497
19476 Industrial Drive
New Paris, IN 46553
U.S.A.
TEL: 1.574.831.5250
FAX: 1.574.831.5252
E-mail: info@kmccontrols.com

Section 1: About the BAC-5050

This section provides a description of the KMC Controls FullBAC router. It also introduces safety information. Review this material before installing or operating the controller.

The KMC Controls BAC-5050 is a multi-port BACnet router. Router highlights are:

- ♦ Easy to install and simple to configure.
- ♦ Routes building automation data between BACnet/IP, BACnet Ethernet and MS/TP networks.
- ♦ Supports BACnet IP tunnel routing.
- ♦ Conforms to ANSI/ASHRAE Standard 135-2001.

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Specifications

Specifications are subject to change without notice.

Communications

LAN connection

10baseT, 10 Mbps RJ-45 connector

BACnet LAN protocols

BACnet 8802-3

BACnet I/P

Four BACnet IP Packet Assembler/Disassembler (PAD) networks

Foreign device registration to a BACnet Broadcast Management Device

BACnet Broadcast Management Device

BACnet Broadcast Management Device with Network Address Translation (Previously Addendum O to ASHRAE Standard 135-2008)

MS/TP

Four MS/TP ports, supports speeds up to 76.8 kilobaud

Connector type is a three-screw terminal block, 12–22 AWG wire.

Point-to-point

- Direct serial or modem connection
- Establishes inbound and outbound links

Serial ports

- Two RS-232 ports, supports speeds up to 115.2 kilobaud
- Connectors are three screw-terminal blocks, 12–22 AWG wire.

Memory**Flash**

- 2 megabytes, nonvolatile, stores operating programs and configuration parameters.

RAM

- 2 megabytes

Regulatory

- UL 916 Energy Management Equipment

- CE

Power Loss

- Power fail with automatic restart.

- On-board real-time clock with 72-hour capacitor backup.

Installation

- International-ready 120/240 volt, 1.35 ampere power supply (included)

- Power-fail with auto restart capabilities

Weight

- 1.8 pounds (816 grams)

Environmental Limits**Operating Temperature**

- 32 to 120° F (0 to 49° C)

Shipping Temperature

- 0 to 140° F (−40 to 60° C)

Humidity

- 0–95% RH, non-condensing

Accessories

HPO-6001 Replacement Ferrite core

KMD-5563 Replacement 120/240 international ready power supply

KMD-5569 External modem

KMD-5672 PC to Controller cable

Illustration 1–1 Dimensions

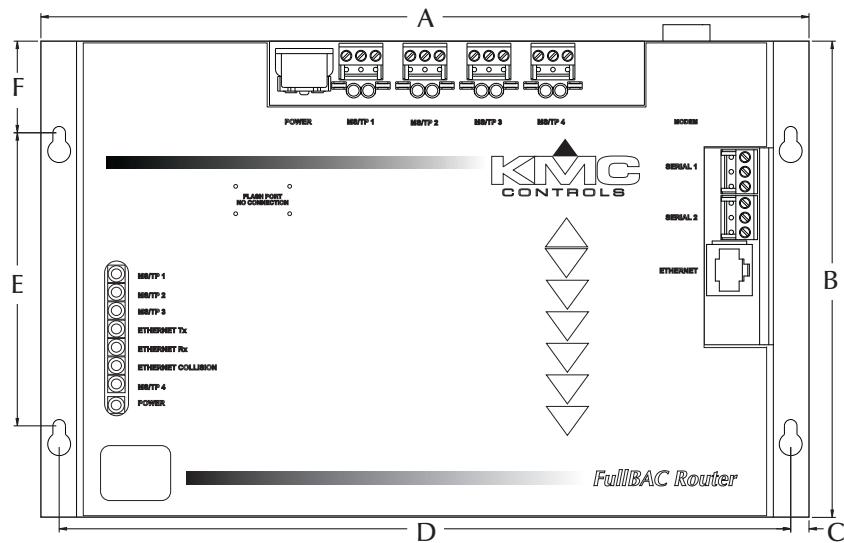
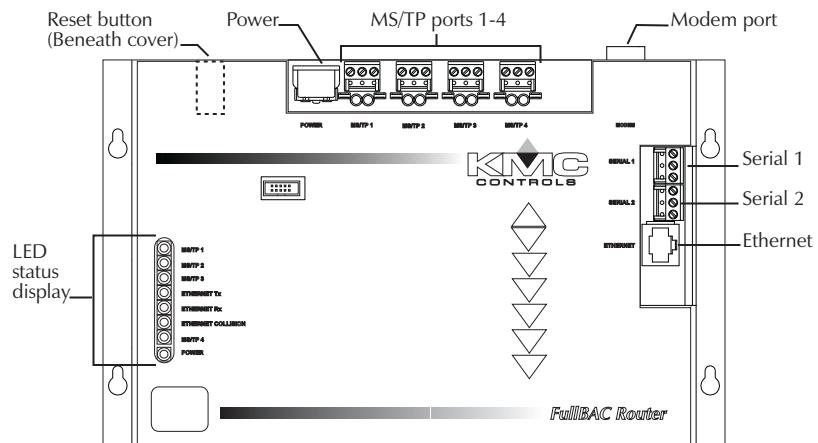


Table 1–1 BAC–5050 Dimensions

A	B	C	D	E	F	Height (not shown)
10.50 in.	6.50 in.	0.25 in.	10.00	4.00 in.	1.25 in.	0.98 in.
267 mm	165 mm	6 mm	254 mm	102 mm	32 mm	25 mm

Illustration 1–2 BAC-5050 Indicators and connectors

Safety considerations

KMC Controls assumes the responsibility for providing you a safe product and safety guidelines during its use. Safety means protection to all individuals who install, operate, and service the equipment as well as protection of the equipment itself. To promote safety, we use hazard alert labeling in this manual. Follow the associated guidelines to avoid hazards.



Caution indicates potential personal injury or equipment or property damage if instructions are not followed.

Note:

Notes provide additional information that is important.

Tip:

A tip provides programing tips and shortcuts that may save time.

Section 2: **Installing the BAC-5050**

This section provides important guidelines for installing a KMC BAC-5050 router. Review this information carefully for proper installation.

Installing a BAC-5050 router includes the following topics in this section.

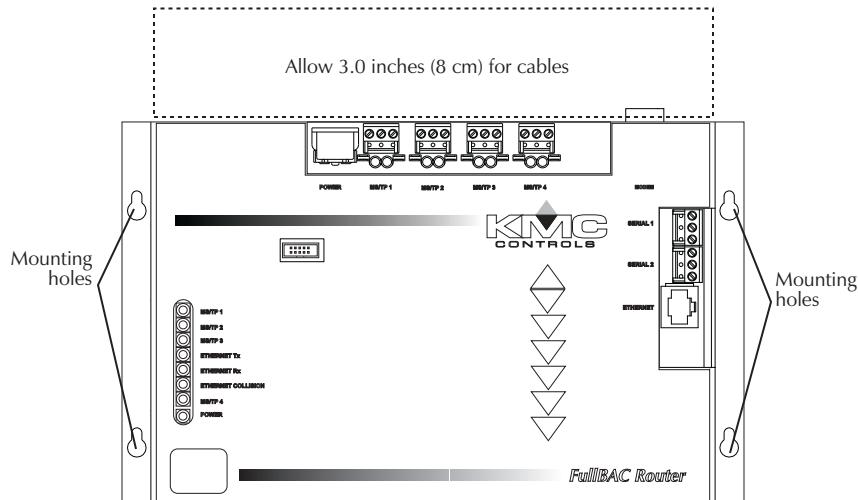
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Mounting

Mount the BAC-5050 router inside of a metal enclosure. KMC Controls recommends a UL-approved Enclosed Energy Management Equipment Panel such as a KMC model HCO-1034, HCO-1035 or HCO-1036. Insert #6 or #8 hardware through the two mounting holes on each side of the router to securely fasten it to a flat surface. See [Mounting details on page 10](#) for mounting hole locations and [Dimensions on page 5](#). To maintain RF emission specifications, use either shielded connecting cables or enclose all cables in conduit.

Note: Allow a minimum of 3 inches (8 cm) of clearance at the top edge of the controller for the power and network connectors.

Illustration 2–1 Mounting details



Installing the ferrite core

To maintain RF emission specifications for regulatory agency listings, attach the included ferrite core to the Ethernet or serial cable inside the enclosure:

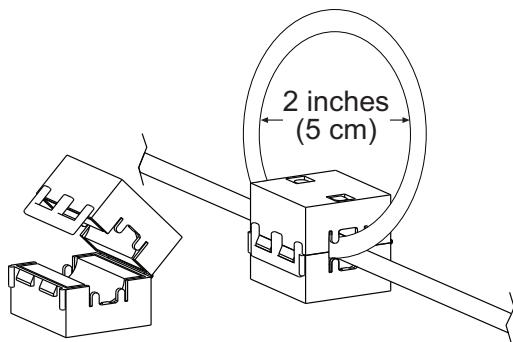
1. Locate the locking tab on one side of the core and pull the hinged cover open. For core details, see See "Ferrite core installed on Ethernet cable" on page 11.
2. Make a loop in the cable near the end that plugs into the router.
 - Make the loop at least two inches (5 centimeters) in diameter to avoid damaging the cable.
 - Position the loop with enough slack in the cable to plug it into the Ethernet port.
3. Lay the crossed section of the cable loop on one half of the core and snap the core closed.s

If a serial port is connected and not the Ethernet port, then attach the core to the serial cable. If both ports are connected, order an additional ferrite core and attach cores to both cables.

Note:

Never leave an unterminated cable—either serial or Ethernet—connected to the router. High frequency communications cables can act as antennas if left unterminated.

Illustration 2–2 Ferrite core installed on Ethernet cable



Network connections

The FullBAC router connects to three different types of networks.

- ◆ MS/TP
- ◆ BACnet IP
- ◆ BACnet 8802-3



Caution

Placing a router on a network without proper configuration and assigning the correct IP address could cause disruption to the Ethernet LAN network service. Review the section [Setting up and troubleshooting the BAC-5050 on page 19](#) and the applications note AN0404A *Planning BACnet Networks* before connecting a router to a network.

BACnet 8802-3 and BACnet IP

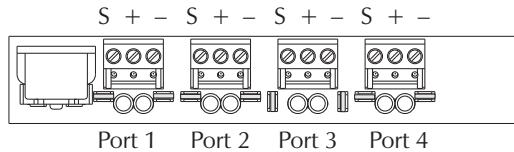
The BAC-5050 connects to the Ethernet LAN in the same manner as other Ethernet devices.

1. Install the ferrite core on the network cable. See [Installing the ferrite core on page 11](#) for details.
2. Connect a standard CAT 5 Ethernet cable from the Ethernet port on the router to a network router or hub.

MS/TP networks

Use approved shielded cable and 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 50 picofarads per foot for all MS/TP network wiring. Belden cable model #82760 meets the cable requirements.
- ◆ Connect no more than 128 BACnet addressable devices to one MS/TP network. The devices can be any mix of controllers or routers.
- ◆ 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 controller. For KMC BACnet controllers use the S terminal.
- ◆ Connect the shield to an earth ground at one end only.
- ◆ Use a repeater between every 31 MS/TP devices or if the cable length will exceed 4000 feet (1220 meters). Generally, use no more than four repeaters per MS/TP network.
- ◆ Place a KMD-5567 surge suppressor in the cable where it exits a building.

Illustration 2–3 MS/TP connections

On routers manufactured prior to 1 August 2005, the plus (+) and minus (−) terminals for MS/TP Port 4 are reversed from the connections shown in Illustration 2–3. The date the router was manufactured is located on a silver label on the front of the router. If this is a replacement router, verify which version of the router you are installing before wiring MS/TP Port 4.

End-of-line termination

Each MS/TP network segment requires end-of-line termination for proper operation of the network. Proper termination prevents signal degradation and EMI type interference with other system wiring. Termination jumpers are located on both sides of each EIA-485 connector (one each for the -A and +B terminals; see Illustration 2–4.)

To activate the end-of-line termination, leave the jumpers in place. If termination is not required, position the jumpers so they only cover one pin on the header.

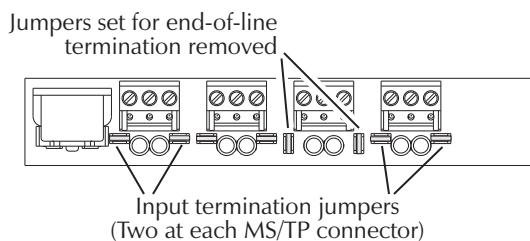
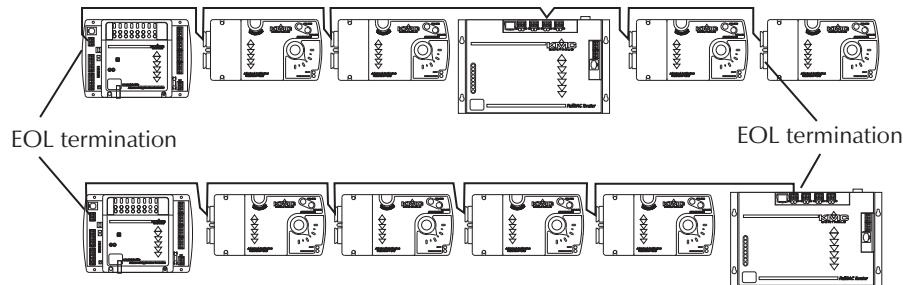
Illustration 2–4 End-of-line Termination Jumpers

Illustration 2–5 End of line termination

Connecting for point-to-point operation

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

- ◆ Part of a hardware router or
- ◆ A feature of a software driver in a computer.

In the BAC-5050 either the modem connector or the port *Serial 1* may be used to establish PTP links.



Do not use *Serial 1* and the *Modem* connectors at the same time. If devices are connected to both connectors, neither device will operate correctly.

Use the *BACnet Router Tool* to configure the router for point-to-point operation. If a modem is connected and configuration is to be performed through the *Serial 1* connector, temporarily disconnect the modem during configuration. You will need all or part of the information in the following list to configure the router for PTP.

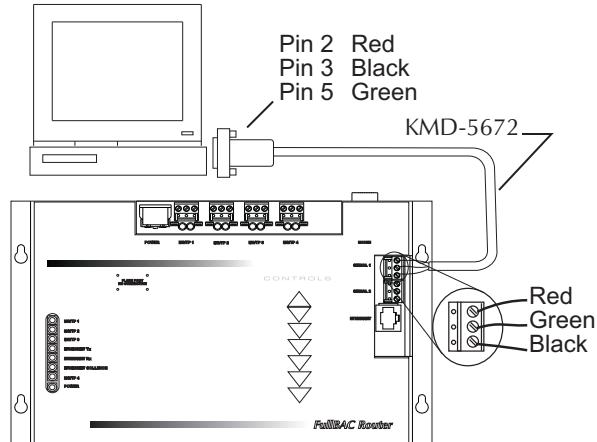
- ◆ The highest expected baud that will be established between two remote modems.
- ◆ The baud between the modem and the BAC-5050 or between the BAC-5050 and a directly connected half-router.
- ◆ The passwords used by the remote half-router.
- ◆ At least one BACnet network that is known to the remote half-router (Required for outbound connections only).

Direct serial port connection

To establish a serial cable point-to-point link between a BAC-5050 and half-router on a PC, use a KMD-5672 PC-to-Controller cable. Refer to [Direct](#)

[serial port connection on page 15](#). This is the same connection method used to connect to the router for configuring the router with *BACnet Router Tool* software.

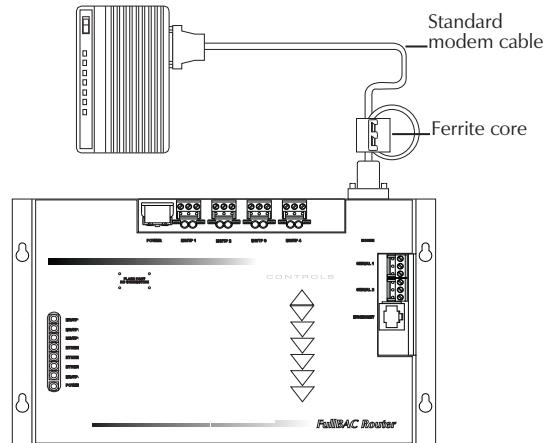
Illustration 2–6 Direct serial port connection



Modem connection for point-to-point

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

Illustration 2–7 Point-to-point modem connection



Note: When using the BAC-5050 with a modem, power the modem before applying power to the router.

To install a modem do the following:

1. Connect a standard DB-9 to DB-25 computer-to-modem cable between the KMD-5569 modem and the *Modem* connector on the router. This cable is available from computer supply sources.
2. If the modem is located outside of the enclosure in which the router is mounted, add a ferrite core to the cable. For details on the ferrite core, see *Installing the ferrite core on page 11*.
3. Connect the modem to a telephone line dedicated to the network system.
4. Verify the configuration switches on the back of the KMD-5569 modem are in the following positions.

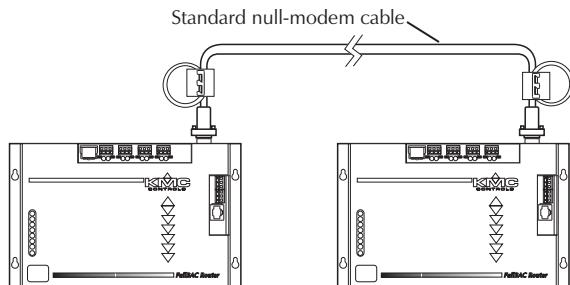
Table 2–1 KMD-5569 modem switch settings

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

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

Router-to-router

Use a standard DB-9 to DB-9 null modem cable to connect two routers with a PTP link. Use *BACnet Router Tool* to configure the routers for point-to-point operation. If the configuration is performed through port *Serial 1*, temporarily disconnect the null-modem cable during configuration.

Illustration 2–8 Router-to-router PTP link

Connecting power

Each BAC-5050 router requires a KMD-5563 power supply for operating power. Mount the power supply in a convenient location near the router and route the supply cable to the BAC-5050.

The router does not use a power switch and will automatically power on when the power connection is complete.

Note:

When using the BAC-5050 with a modem, apply power to the modem before applying power to the router.

Lights and indicators

The network isolation bulbs and LED indicators display system status and can help with understanding network problems.

Network isolation bulbs

The two network isolation bulbs, located next to the MS/TP terminal blocks, serve three functions:

- ◆ Removing the bulbs opens the EIA-485 circuit and isolates the router 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 router is not the same as the controllers on the network.
- ◆ If the voltage or current on the network exceeds safe levels, the bulbs operate as fuses and may protect the router from damage.

LED indicators

Eight LEDs on the front of the router display system status. Use the LEDs to confirm proper operation or as an aid when troubleshooting.

MS/TP 1-4 Flashes briefly when MS/TP port has the token

Ethernet Tx Blinks green when Ethernet traffic is being transmitted.

Ethernet Rx Blinks green when Ethernet traffic is being received.

Ethernet Collision Momentarily blinks red when a collision occurs in Ethernet traffic.

Power Blinks green during normal operation. The normal cycle is one second on and one second off.

When power is first applied to the router, the first three LEDs and last two LEDs will flash briefly starting with the MS/TP 1 LED. When the start-up sequence is complete the power LED will continue to flash at a one-second rate. If any LED glows steady it is an indication of a problem in the router. Contact KMC Controls technical support.

Section 3:

Setting up and troubleshooting the BAC-5050

This section provides important guidelines for configuring a KMC BAC-5050 router before it is placed on a network. Review this information carefully for proper installation.

The following topics in this section will help you set up the router and diagnose typical installation problems.

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Before you begin

Before initializing a router, review the document *Planning BACnet Networks*. In addition to the *BACnet Router Tools* software, you will need the following information before you can initialize a router.

From the system designer:

- ♦ Network numbers for each of the networks to which the router will connect.
- ♦ A MAC address for each MS/TP port that will be enabled in the router.
- ♦ The highest MAC address used on each of the MS/TP networks to which the router 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 router will connect.

From the system administrator:

- ◆ The IP address for the router.
- ◆ The Ethernet port number.
- ◆ The IP subnet mask for the Ethernet LAN to which the router will connect.

You will also need one of the following connecting cables or cable sets

- ◆ A KMD-5672 computer-to- router serial cable. This is the same cable used with the KMD-5210 LAN Controller
- ◆ An Ethernet CAT 5 cross-over cable
- ◆ Two standard Ethernet cables and a small Ethernet hub.

Connecting for configuration

Configure the FullBAC router before connecting it to a BACnet internetwork. You may connect to the router with either Ethernet or a direct computer connection.

You will need the correct version of the program *BACnet Router Tools* to set up the router.

- ◆ For firmware versions 1.6 and later, use *BACnet Router Tools* version 1.6.
- ◆ For firmware versions earlier than 1.6 use the version of *BACnet Router Tools* that matches the version of the firmware in the router. Only the first two digits in the version number need match. For example, use *Router Configuration Tools 1.5.0.0* with firmware 1.5.0.1.

Note:

To set up the router as a BACnet Broadcast Management Device with network address translation, you will need to use the *Router Configuration Tool* which is also used to set up the BAC-A1616BC building controller. The *Router Configuration Tool* is available from partners.kmccontrols.com.

Connecting with Ethernet

To perform initialization with *BACnet Router Tools* via Ethernet you will need a computer with an Ethernet port and one of the following connection methods.

- ◆ Connect directly to the router with an Ethernet cross-over cable.
- ◆ Connect the router and computer together with a hub that is not connected to a LAN.
- ◆ Verify that address conflicts will not occur and connect both the router and computer to an Ethernet LAN.

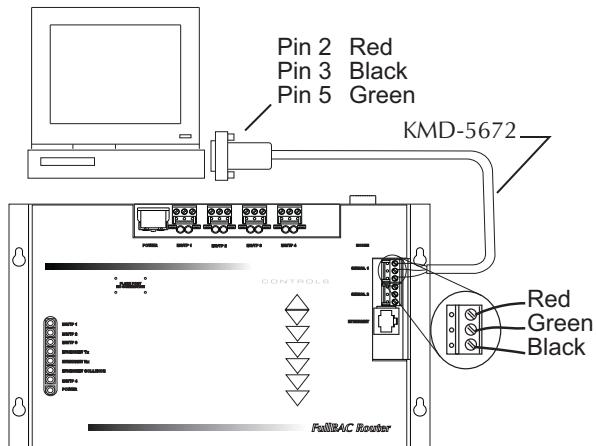


Before connecting an uninitialized router to an existing LAN, verify that addressing conflicts will not occur. The default IP address for the router is 10.1.1.2. The default subnet mask is 255.255.255.0.

Direct serial port connection

Two RS-232 ports are provided on the controller for connecting a PC directly to the controller. Connect the PC to the router using a KMD-5672 PC to Controller cable. Refer to Illustration 3-1.

Illustration 3-1 Direct serial port connection



Do not use *Serial 1* and the modem port at the same time. If devices are simultaneously connected to both ports, neither port will operate correctly.

Install Router Configuration Tools

To set up the BAC-5050 use *Router Configuration Tools* which is supplied on a flash drive. A typical installation of *Router Configuration Tools* places it in the KMC program group in the Startup menu. You must install *Router Configuration Tools* from the USB flash drive onto a computer hard disk; *Router Configuration Tools* will not run from the flash drive.

You will need the correct version of the program *BACnet Router Tools* to set up the router.

- ♦ For firmware versions 1.6 and later, use *BACnet Router Tools* version 1.6.
- ♦ For firmware versions earlier than 1.6 use the version of *BACnet Router Tools* that matches the version of the firmware in the router. Only the first two digits in the version number need match. For example, use *Router Configuration Tools 1.5.0.0* with firmware 1.5.0.1.

Note:

To set up the router as a BACnet Broadcast Management Device with network address translation, you will need to use the *Router Configuration Tool* which is also used to set up the BAC-A1616BC building controller. The *Router Configuration Tool* is available from partners.kmccontrols.com.

To start the BACnet Router Tool installation wizard, do the following:

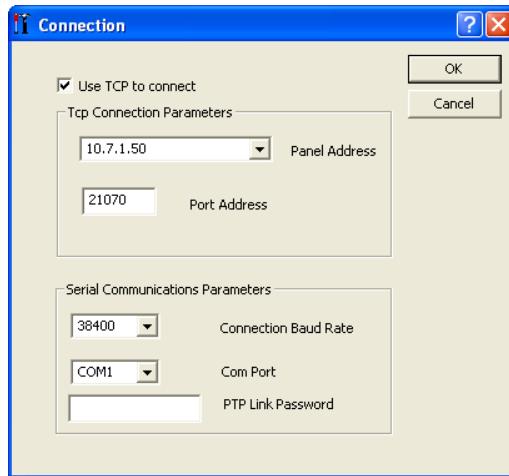
1. Insert the flash drive into any USB port.
2. Use Windows Explorer to locate and open the flash drive. The flash drive is labeled Removable Disk.
3. On the flash drive double-click the SETUP icon.
4. Follow the on-screen installation instructions.
5. When prompted, choose a location for the program. KMC Controls recommends the default location.
6. When installation is complete, remove the flash drive and store it in a safe location.

Router Configuration Tools installs with a complete help system. A printable version of the help system, *RouterToolsReference.PDF*, formatted in Adobe Acrobat is included also on the flash drive.

Starting Router Configuration Tools

When the router and computer are connected, start *Router Configuration Tools*. The connection dialog opens:

Illustration 3–2 Router Configuration Tools connection dialog



Initializing a BAC–5050 over Ethernet

To connect to the router via over the Ethernet, the computer must be connected to the same Ethernet LAN subnet that connects to the router.

Use TCP to connect Check *Use TCP to connect* box to connect over Ethernet. This is the recommended setting.

Panel Address and Port Address The first time you connect to the router over Ethernet use the default settings.

Table 3–1 Ethernet connection default settings

IP address	10.1.1.2
Port Address	21070
Subnet mask	255.255.255.0

Once connected the IP address, subnet mask and port number can be changed in the *General Settings* tab.

Connecting to a BAC–5050 with a direct serial port connection

To connect to the router with a direct serial connections use a KMD–5672 PC-to-Controller [serial cable](#). Connect the cable between a serial COM port on the computer and *Serial 1* on the router.

Use TCP to connect Uncheck the *Use TCP to connect* box to connect by direct serial connection.

Com Port Select the COM port on the computer to which the router is connected. Only the serial ports available on the computer are listed.

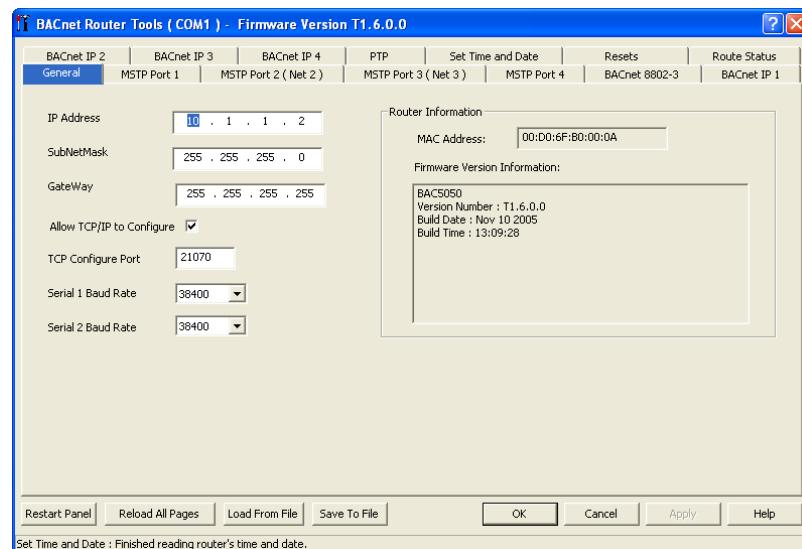
Baud Baud sets the connection speed between the router and serial port on the computer running Router Configuration Tools.

The default connection baud is 38,400 baud. Once connected, the baud can be changed in *General Settings* tab.

Configure the router

When *Router Configuration Tools* connects to the router, the *General Settings* tab is on top.

Illustration 3–3 General Settings tab



As required, choose additional tabs to configure router network settings. Each of the tabs includes help that fully explains the functions in each tab.

Troubleshooting the router

This topic offers suggestions for diagnosing problems with the router.

See also the following topics.

- ◆ [Returning to the factory settings](#) on page 26
- ◆ [Reset logs](#) on page 25
- ◆ [Restarting the router](#) on page 26

LED indicators

When power is first applied to the router, the first three LEDs and last two LEDs will briefly flash sequentially starting with the top LED. When the start-up sequence is complete, the power LED will continue to flash at a one-second rate. See [Lights and indicators](#) on page 17. If any LED glows steadily, this indicates a problem in the router. Contact KMC Controls technical support.

Serial port conflicts

Do not use Serial 1 and the Modem connectors at the same time. If devices are connected to both connectors, neither device will operate correctly. If the Modem port is being used, the Serial 2 port may also be used.

Note:

In the [General Settings tab](#) of *BACnet Router Tools* menu, Serial 1 Baud Rate sets the baud for both the Serial 1 and Modem ports.

Point-to-point difficulties

See the help topic *Setting the router for Point-to-Point operation* in the program *BACnet Router Tools*.

Other configuration, network, or hardware difficulties

See the help in the program *BACnet Router Tools*.

Reset logs

There are two logs in the Reset tab that can help diagnose problems with the router.

- ◆ Restarts are controlled results caused by the error handling such as recovering from corrupted memory or user requests such as clicking Restart Panel.
- ◆ Resets are restarts caused by external events such as power cycles or internal errors including the restarts mentioned previously. See the topic *Viewing the Restart and Reset logs* section in the *Router Configuration Tools* help.

Restarting the router

At the bottom of the *BACnet Router Tools* window, is a Restart Panel button. Selecting this button restarts the router's processor and places an entry into the restart logs. If you are connected to BACnet Router Tools over a LAN with IP, the connection will be terminated. All changes not applied will also be lost. When connected by a direct serial port connection, you may need to click Reload current page to view up-to-date information. The router may take up to two minutes before reconnecting to *BACnet Router Tools*.

If the router appears to be operating incorrectly or is not responding to commands, the router may need to be returned to the factory settings.

Note:

Momentarily pushing the red reset button while the router remains powered will have no effect on the router.

Returning to the factory settings

Note:

Momentarily pushing the red reset button while the router remains powered will have no effect on the router.



In the following procedure, do not remove power unless it is part of the procedure. Damage may result to the router if this happens.

Do the following to restore the router to the original factory settings:

1. Remove power from the router by unplugging the power supply.
2. Press and hold the reset button while reestablishing power to the router. See the illustration *BAC-5050 Indicators and connectors* on page 6 for the location of the reset button.
3. Continue to hold the reset button until the power LED illuminates.
4. Release the reset button.