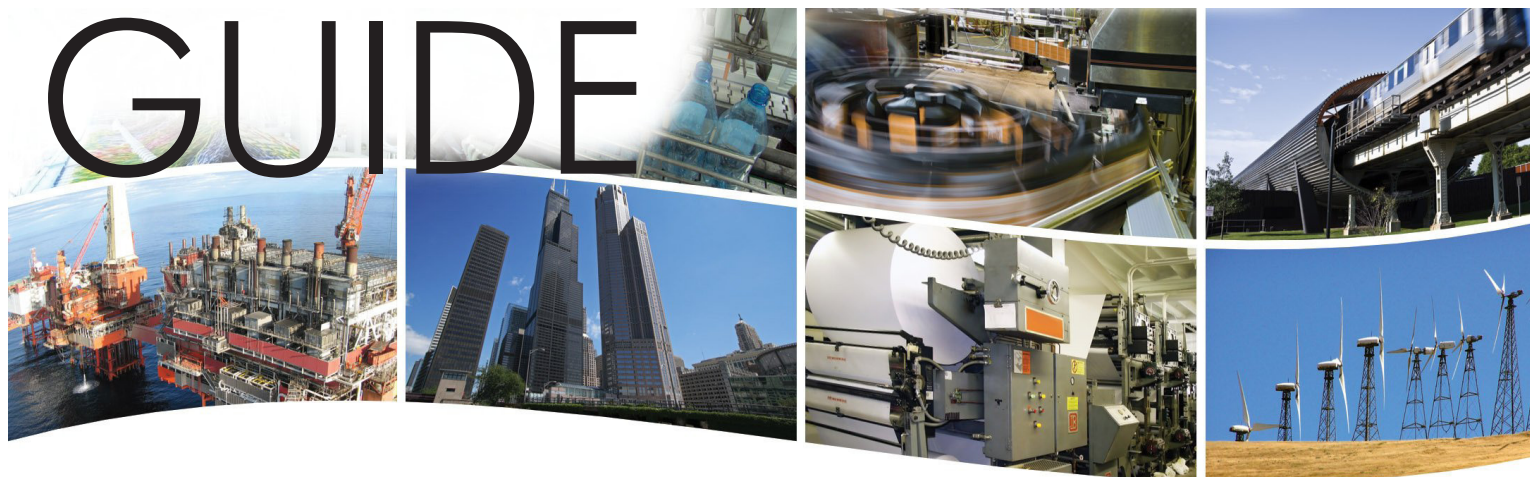


application GUIDE



BAS Router – BACnet® Multi-network Router

The BAS Router provides stand-alone routing between BACnet networks such as BACnet/IP, BACnet Ethernet, and BACnet MS/TP — thereby allowing the system integrator to mix BACnet network technologies within a single

BACnet internetwork. There are two physical communication ports on the BAS Router. One is a 10/100 Mbps Ethernet port and the other an isolated MS/TP port. Configuration is accomplished via a web page.

Versatile Routing Between ...

- BACnet/IP and BACnet MS/TP
- BACnet Ethernet and BACnet MS/TP
- BACnet/IP and BACnet Ethernet
- BACnet/IP and BACnet Ethernet and BACnet MS/TP
- Two BACnet/IP networks

IP Network Support

- Web server for commissioning and troubleshooting
- Communication diagnostic web page
- BACnet/IP Broadcast Management Device (BBMD)
- Foreign Device Registration (FDR)

Flexible Communications

- 10/100 Mbps Ethernet with auto-negotiation and Auto-MDIX
- Optically isolated MS/TP port
- MS/TP baud rates range from 9.6–76.8 kbps
- Jumper-selectable MS/TP bias and termination

Convenient Installation

- 24 VAC/VDC (± 10%), 47–63 Hz input voltage
- Din-rail mounted

The BAS Portable Router has similar features and is ideal for BACnet commissioning tools.



BASautomation™

BAS Router — BACnet® Multi-Network Router

The BAS Router is housed in a metal case that mounts on 35-mm DIN-rail and is powered from a 24 VAC/VDC ($\pm 10\%$) source. The BAS Portable Router is housed in a plastic case and is powered from the USB port on a laptop computer. Both units provide one MS/TP port and one 10/100 Mbps Ethernet port.

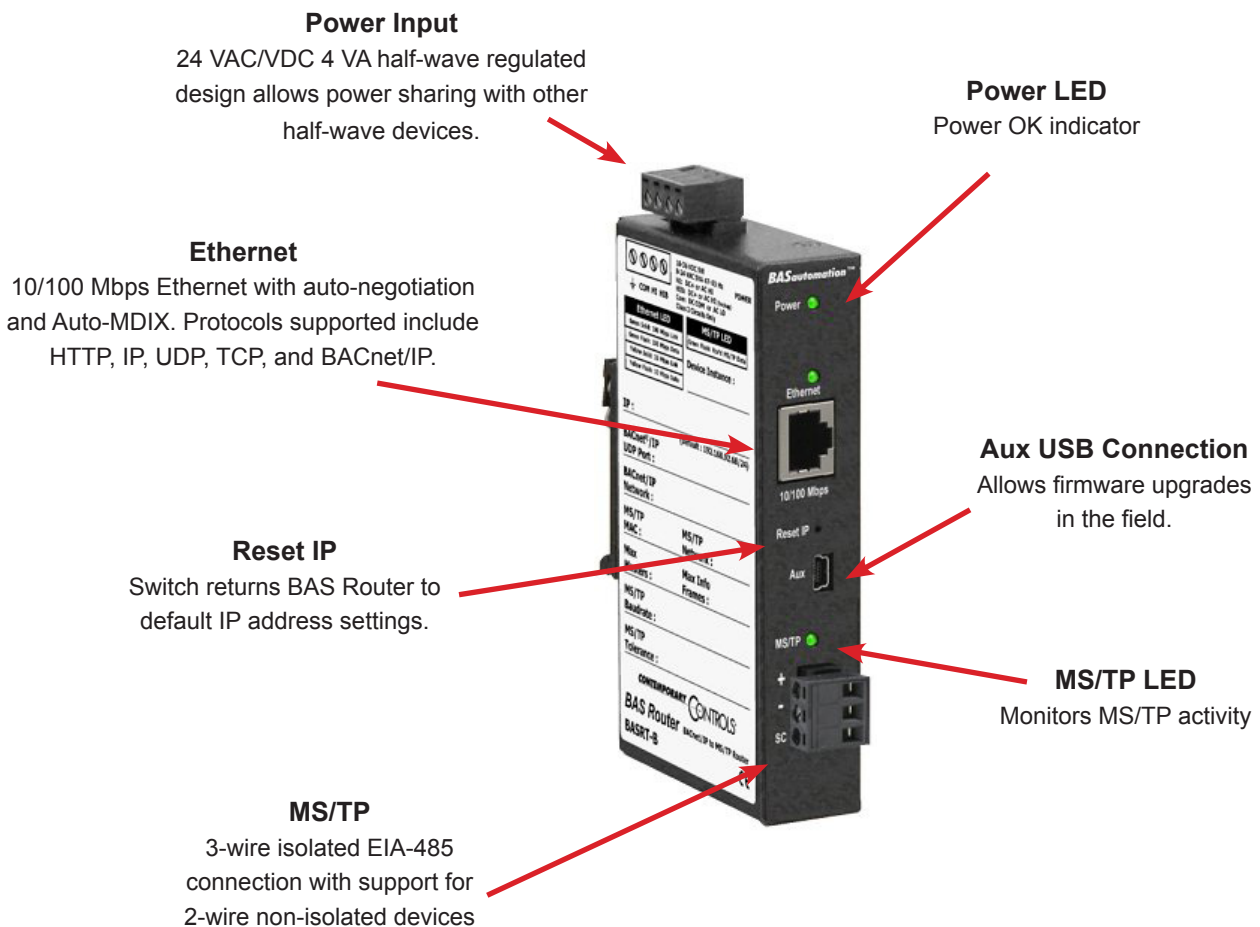
The MS/TP port offers an optically-isolated transceiver. It has a removable 3-pin terminal block for the EIA-485 connection. Logically, 255 devices can be addressed. Physically, the number of devices depends upon device loading.

Up to 31 full-load EIA-485 devices can share the same MS/TP bus segment as the BAS Router. For half-load devices, there can be 62. All MS/TP standard baud rates are supported — from 9.6 to 76.8 kbps.


The Ethernet port offers a shielded RJ-45 connector. Through auto-negotiation and Auto-MDIX, it automatically matches connections to the attached equipment. Therefore, either straight-through or crossover CAT5 cable can be used for hook-up.

A resident web server allows for commissioning, and troubleshooting via a standard web browser. A reset switch is provided on the router to return the unit to the factory default IP address. Three LEDs are provided: The power LED glows green when proper power is provided. A bi-colour Ethernet LED glows green for 100 Mbps operation and yellow for 10 Mbps and indicates activity by flashing. A green LED flashes with MS/TP activity.


Internal MS/TP bias and termination jumpers allow flexible bias and termination options. They can be removed for mid-span installations.




Web Page Configuration




BASRT-B Configuration



Device Instance	<input type="text" value="0"/>	
Ethernet Network	<input type="text" value="0"/>	
BACnet/IP UDP Port 1	<input type="text" value="BAC0"/>	
BACnet/IP Network 1	<input type="text" value="1"/>	
IP Address	<input type="text" value="192.168.92.68"/>	Advanced
IP Subnet	<input type="text" value="24"/>	
IP Gateway	<input type="text" value="192.168.92.1"/>	
MS/TP MAC	<input type="text" value="0"/>	Status
MS/TP Network	<input type="text" value="2001"/>	
Max Masters	<input type="text" value="127"/>	
Max Info Frames	<input type="text" value="100"/>	
MS/TP Baudrate	<input type="text" value="38400"/>	Security
MS/TP Tolerance	<input type="radio"/> Strict <input checked="" type="radio"/> Lenient	
Save Changes		
MAC Address	00-50-DB-00-57-43	
Firmware Revision	2.0.11	



Advanced BASRT-B Configuration



BBMD Enable	<input type="checkbox"/>
BBMD UDP Port	<input type="text" value="Primary"/>
Accept FDR	<input type="checkbox"/>
Broadcast Distribution Table	
Foreign Device Table	
Secondary BACnet/IP UDP Port	<input type="text" value="0000"/>
Secondary BACnet/IP Network	<input type="text" value="0"/>
Public IP Address	<input type="text" value="0.0.0.0"/>
Save Changes	

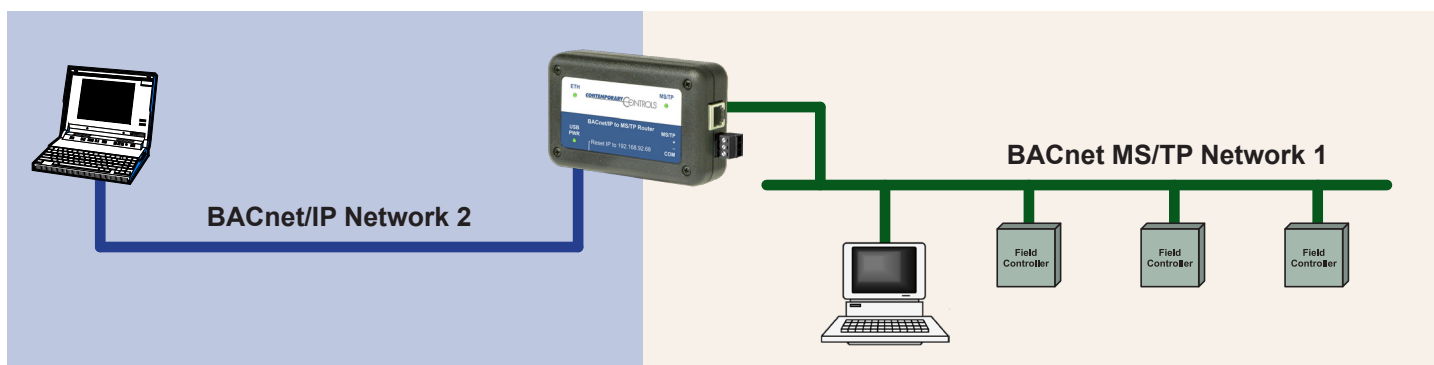
BAS Router Parameters

<i>Device Parameter</i>	<i>Default Value</i>	<i>Description</i>
Device Instance	0	The router device instance is a 22-bit decimal value (0–4,194,302). Each BACnet device has a unique device instance.
BACnet Ethernet Parameter		
<i>BACnet Ethernet Parameter</i>	<i>Default Value</i>	<i>Description</i>
BACnet Ethernet Network	0	16-bit decimal value (1–65534). Each BACnet network, regardless of technology, must have a unique network number. By retaining the default value of 0, BACnet Ethernet routing is disabled.
BACnet/IP Parameters		
<i>BACnet/IP Parameters</i>	<i>Default Value</i>	<i>Description</i>
BACnet/IP UDP Port	BAC0	16-bit hex value (0–FFFF) is set to BAC0 as the default value and should be used. All BACnet/IP devices on the same BACnet network must have the same UDP port assignment. For other assignments choose ports in the range from BAC1 to BACF while verifying that these ports are available.
BACnet/IP Network	1	16-bit decimal value (1–65534). Each BACnet network, regardless of technology, must have a unique network number. It is recommended that all subnets of the same BACnet/IP network be given the same BACnet network number as well.
IP Address	192.168.92.68	IP address in dotted decimal format. Select a valid address in the range from 0.0.0.1 through 255.255.255.254.
IP Subnet	24	Decimal value (0–30) in the “slash” notation is the number of bits with a “1” in the mask. The default value of 24 corresponds to 255.255.255.0 in the dotted decimal format. All devices on the same subnet which communicate via BACnet/IP should use the same subnet mask.
IP Gateway	192.168.92.1	IP Gateway address in dotted decimal format. Select a valid address in the range from 0.0.0.1 through 255.255.255.254.
MS/TP Parameters		
<i>MS/TP Parameters</i>	<i>Default Value</i>	<i>Description</i>
MS/TP MAC Address	0	Decimal value (0–127) represents the MAC address of the router’s MS/TP port. Lower MAC address numbers are preferred.
MS/TP Network	2001	16-bit decimal value (1–65534). Each BACnet network, regardless of technology, must have a unique network number.
Max Masters	127	This 8-bit decimal value (1–127) represents the highest master MAC address in the MS/TP network. If the highest value MAC address is unknown or if additional devices are to be added in the future above the current highest MAC address, use the default setting of 127.
Max Info Frames	100	This is the maximum number of messages (1–100) that can be routed onto the MS/TP network by the router per token pass. Values above 20 are typical.
MS/TP Baud Rate	38400	The baud rate of the MS/TP network can be 9600, 19200, 38400 or 76800 bps. All MS/TP devices on the same MS/TP network must use the same baud rate. Auto-bauding devices will set their baud rates to that of the BAS Router.
MS/TP Tolerance	Lenient	Affects the degree to which interoperability with devices is successful. Lenient option causes less efficient traffic but optimises interoperability.

Application #1 Commissioning BACnet MS/TP using a Laptop Computer

Some BAS commissioning software was developed for a BACnet/IP environment but could be used to commission BACnet MS/TP devices if the proper connection is made. The BAS Portable Router is a perfect fit for this application. The BACnet/IP port on the portable router connects to the laptop's Ethernet port using CAT5 cable while the MS/TP port connects to the target BACnet MS/TP network. Power for the portable router is derived from one of the laptop's USB ports using a USB cable. However, no communication occurs over the USB port. Using

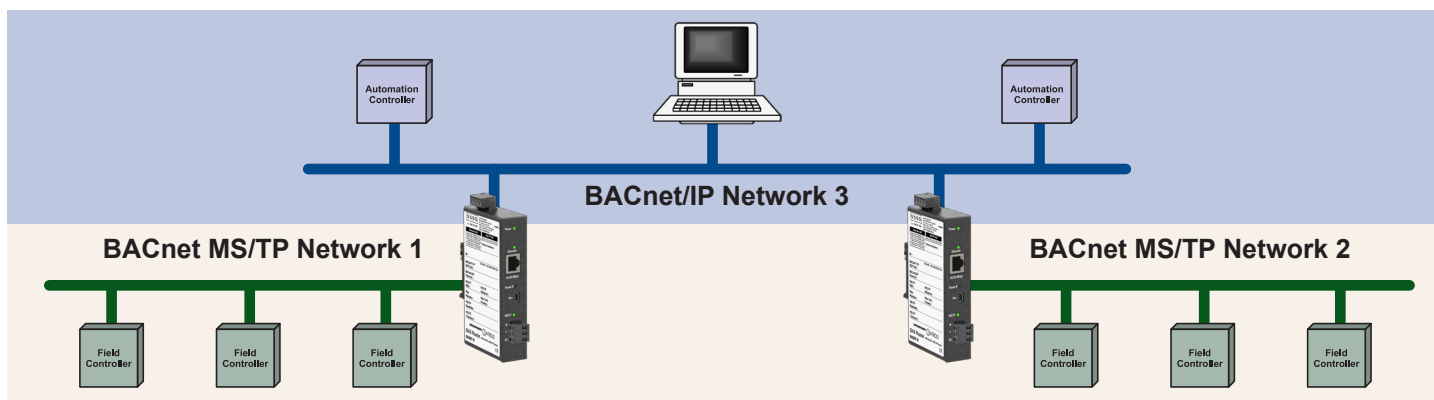
the portable router's web page, the baud rate of the MS/TP port is set to correspond to the baud rate of the MS/TP network. There is no auto-bauding option with the portable router. The target MS/TP must be assigned a unique BACnet network address from that of the BACnet/IP network created with the laptop connection. There is nothing to preclude the use of multiple BAS Routers on the same MS/TP network as long as unique BACnet network assignments are made to each created network.



Application #2 Connecting Together BACnet's Automation and Field Levels

One advantage of BACnet is that the same protocol can operate at both the automation level, and the field level where the field controllers are operating. The automation devices are BACnet/IP compatible operator workstations (B-OWS) and building controllers (B-BC) while the field devices are application specific controllers (B-ASCs). In order to interconnect these two levels, a BAS Router is needed. On the BACnet/IP side, the BAS Router can operate up to 100 Mbps while supporting both auto-negotiation and Auto-MDIX. On the MS/TP side,

baud rates up to the 76.8 kbps limit are supported. Notice that multiple BAS Routers can reside within the same BACnet internetwork. A cluster of MS/TP devices located at distant parts of a building can be connected to the same BACnet/IP network but at different locations using separate BAS Routers. This could be a more convenient solution than using EIA-485 repeaters to extend MS/TP networks especially if the MS/TP devices cannot all operate at the same baud rate. Using repeaters with auto-bauding MS/TP devices can also be tricky.

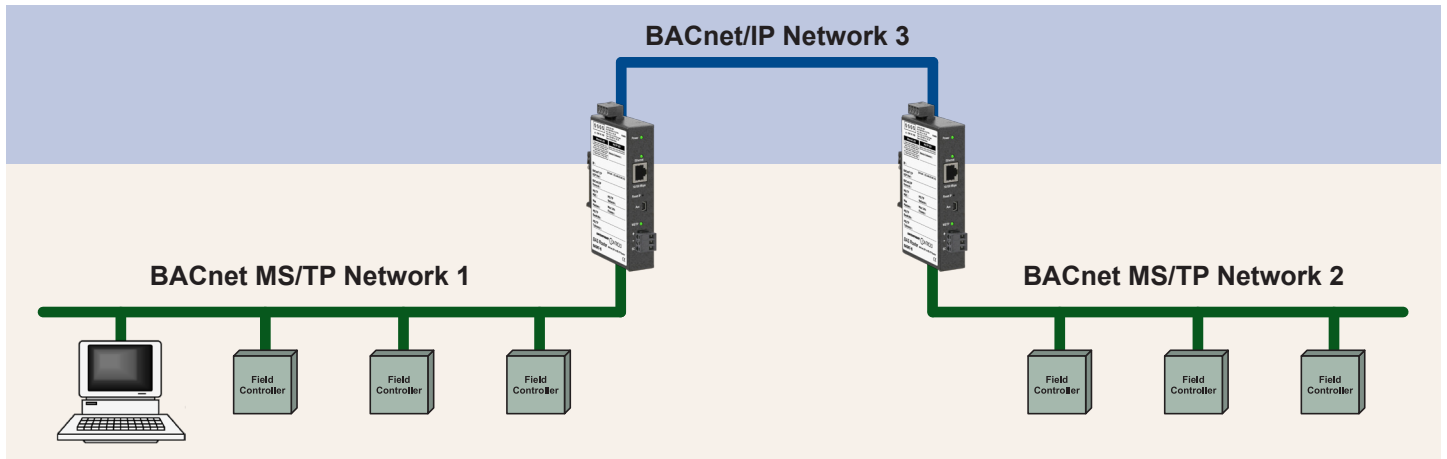


Application #3 Tunneling over BACnet/IP

In a tunneling application, a lower speed technology uses a high speed technology to pass data between two lower speed segments without any change in the end-to-end protocol. With this approach, minimal understanding of the high speed protocol is required. In this example, two BACnet MS/TP networks located in separate buildings need to be connected together but no fieldbus wiring exists between the two buildings. Instead, it is desired to utilize the buildings' existing Ethernet cabling. This can be accomplished with the use of two BAS Routers. The result is three cable segments each requiring a unique BACnet network number. This solution is not limited to just two MS/TP segments. Additional segments each with

a BAS Router can be added together through the use of an Ethernet switch. Once the data is tunneled onto Ethernet, advantage can be taken of all the Ethernet connectivity products that are available. For example, the cabling between buildings could be fiber optics thereby providing the ultimate in electrical isolation.

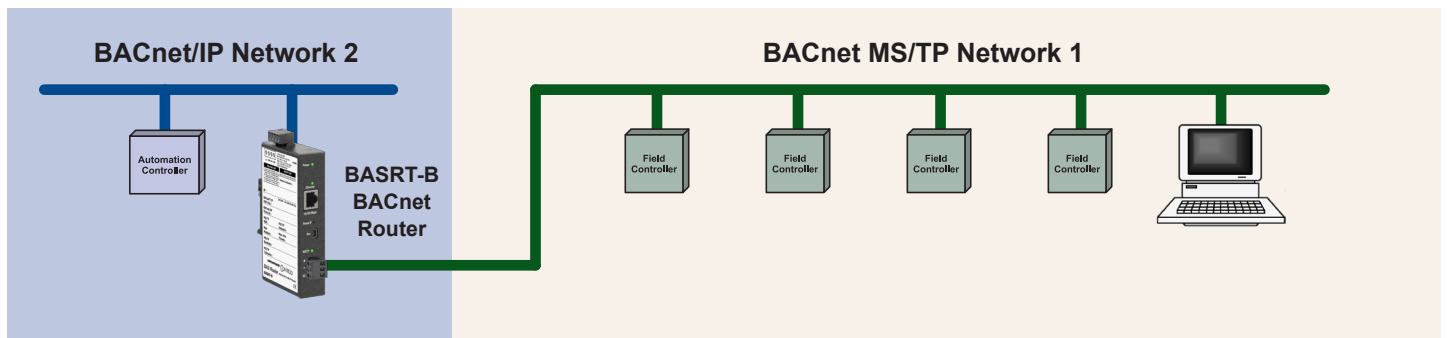
Using a high-speed BACnet/IP tunnel for two low-speed networks is acceptable but the inverse of using two high speed networks using a low speed MS/TP tunnel is not. With a low-speed tunnel like MS/TP, the maximum message size is still too short for the longer sized messages of BACnet/IP. This should be avoided.



Application #4 Adding BACnet/IP automation equipment to a MS/TP network

Usually when you think of adding a router you think of BACnet/IP at the automation level and BACnet MS/TP at the field level. However, it is quite possible to have an MS/TP network with both clients and servers functioning successfully at only the field level and finding out that the field equipment that needs to be added has only a BACnet/IP interface.

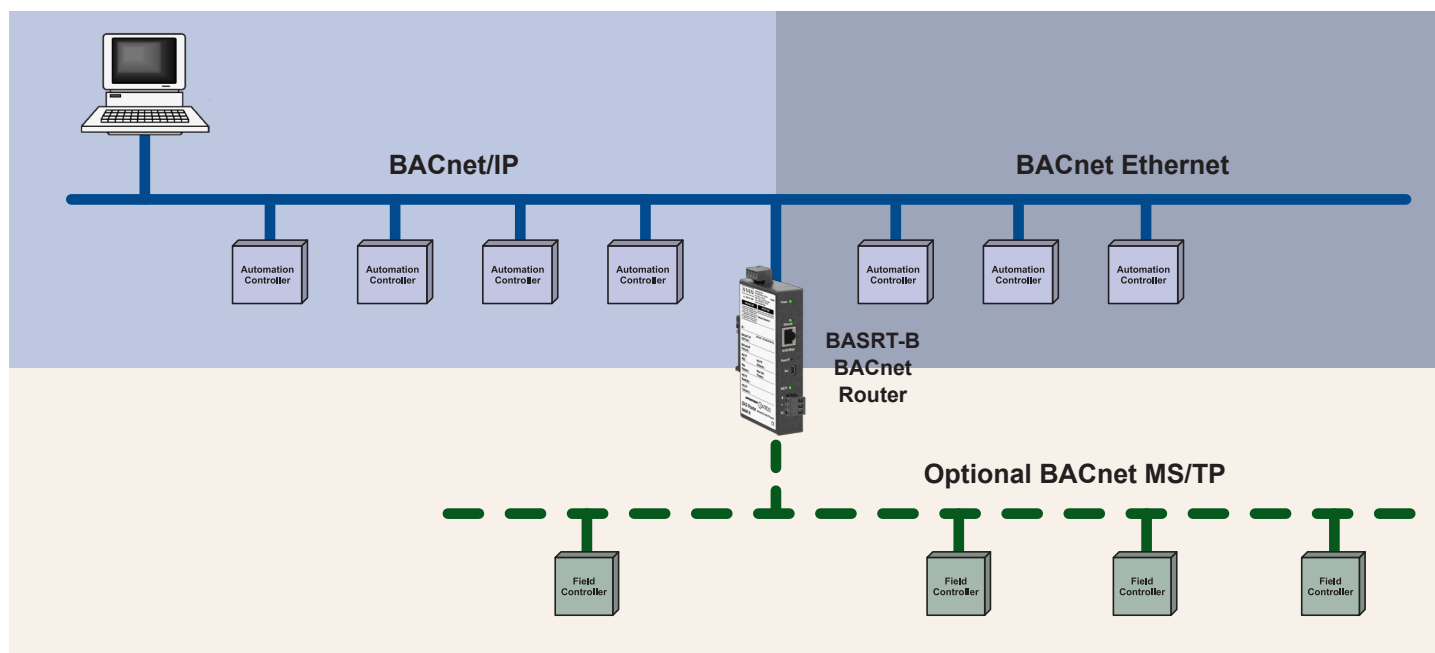
The BAS Router will work fine in this application as well. Simply connect the BAS Router between the BACnet MS/TP network and the BACnet/IP device. There will be no speed improvement to the overall internetwork, but the new equipment will be connected.



Application #5 One-armed router

Not only do the BAS Router and the BAS Portable Router support BACnet/IP to BACnet MS/TP routing, BACnet Ethernet can be added to the mix in support of three-way routing. Do not confuse BACnet/IP and BACnet Ethernet. BACnet Ethernet uses Ethernet as its data link technology and MAC addresses for station addressing. BACnet/IP does not need to use Ethernet at all. However, if Ethernet is being used with a BACnet/IP device, the device must be accessed by its IP address and not just its MAC address. BACnet/IP to BACnet Ethernet routing is

possible with either of the BAS Router products. In such a case, there would be no connection to the MS/TP port on the BAS Router. There would only be the one connection to the Ethernet port on the BAS Router. This is called “one-armed routing” since there is only one connection. If routing to MS/TP is still desired, a connection could be made accordingly to achieve three-way routing. The BAS Router can simultaneously route between MS/TP, BACnet/IP, and BACnet Ethernet.



BACnet Ethernet to BACnet MS/TP

Before BACnet/IP became popular, BACnet Ethernet was used at both the automation and field levels. It is still used today — so routing between BACnet Ethernet and BACnet MS/TP is required. Both the BAS Router and the BAS Portable Router route between BACnet Ethernet

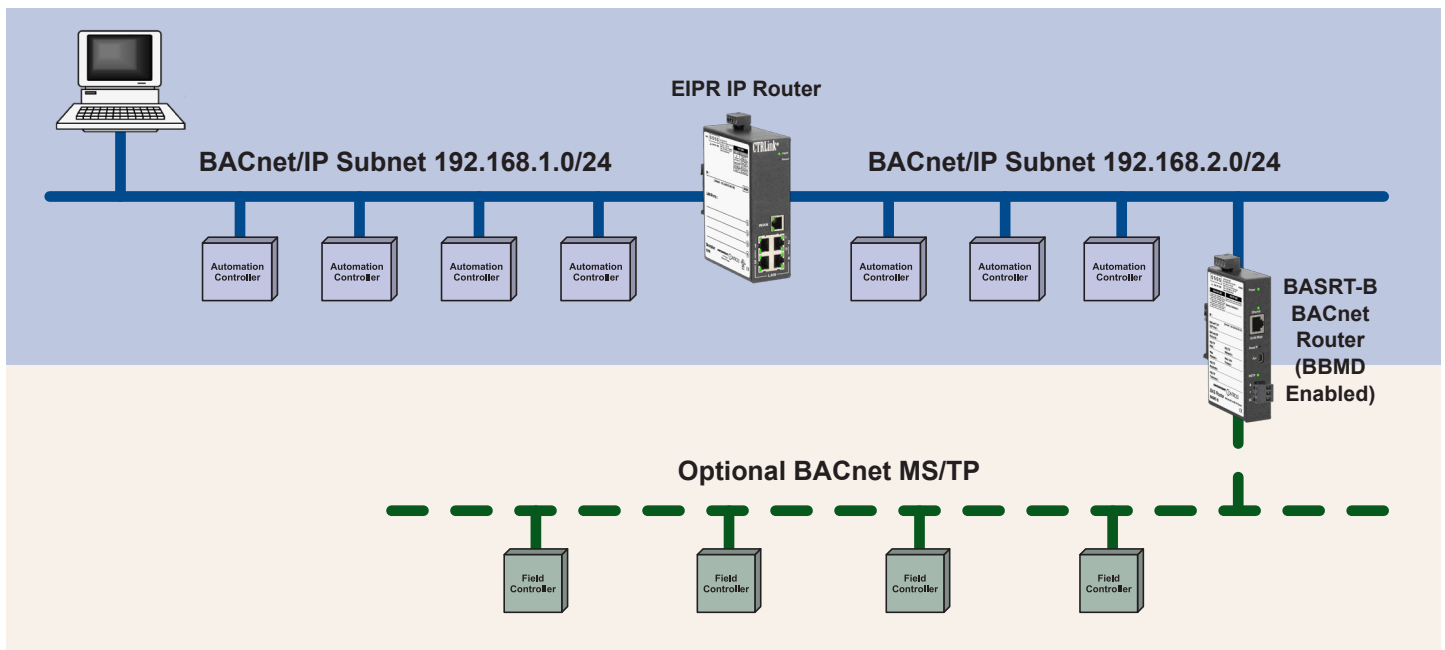
and BACnet MS/TP. To enable BACnet Ethernet routing, you must configure the BAS Router web page such that a unique non-zero network number is assigned to the Network parameter for BACnet Ethernet. The same applies to the Network parameter for BACnet MS/TP.

Application #6 BBMD server

When attaching BACnet devices to IP networks it is possible that the IP network has been sub-netted through the use of IP routers. Most IP routers will not pass broadcast messages which are crucial to BACnet's operation. The solution is to incorporate BACnet/IP Broadcast Management Device (BBMD) functionality within the BACnet internetwork.

The BBMD concept requires that a broadcast message originating on one subnet be encapsulated into a directed message and sent to all remote subnets since these directed messages will pass through IP routers. Once the encapsulated messages are received on the remote subnets, a

BBMD device will decode the message and resend it on its local subnet as a broadcast message. Therefore it would appear that a BBMD device must be present on each subnet in order to provide this encoding and decoding function. However, this is not the case if all the BACnet/IP devices support Foreign Device Registration (FDR). At a minimum, one BBMD device is required to be located on one of the subnets with FDR devices registering to this one BBMD. This is what is shown in the example with a BAS Router providing BBMD functionality while allowing for foreign devices registration. Notice that connecting to a BACnet MS/TP network is an option.



Enabling BBMD

Before the BAS Router can function as a BBMD it must be configured. A BBMD setup page is accessed by clicking the Advanced button on the BAS Router's main web page. On the Advanced screen, BBMD is enabled by checking a box. There are two choices for the BBMD UDP port. Normally, the BACnet/IP UDP value matches that on the main web page, but an alternate port can be chosen. An Accept FDR box (checked by default) allows foreign devices to register with the BBMD. But if BBMD is not enabled, FDR is ignored.

Another button accesses the Broadcast Distribution Table (BDT). On this table, the locations of up to five BBMDs can be entered by specifying their IP addresses and subnet masks. Note that all BBMDs must all be on the same BACnet/IP network as the BAS Router.

Finally, another button gives access to the Foreign Device Table (FDT) which displays all the foreign devices that have registered with the BBMD.

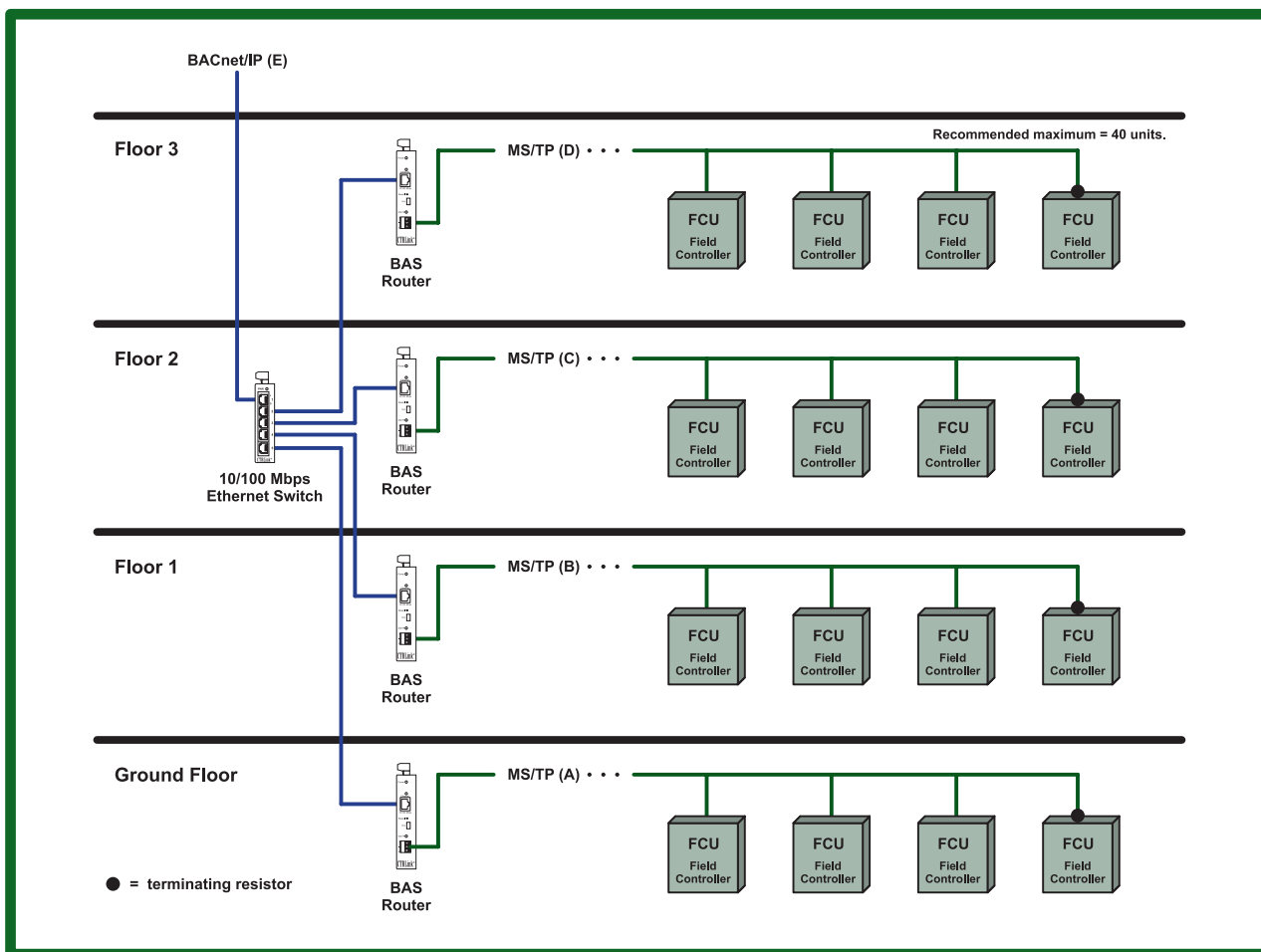
Application #7 Connecting Field Devices on Multiple Floors

In a typical HVAC installation, many Fan Coil Units (FCU) or Variable-Air-Volume (VAV) terminal units will be installed in the ceiling on each floor of a multi-storey office building. Frequently, these units contain BACnet MS/TP controllers all sharing one EIA-485 bus. Depending on the rating of the EIA-485 transceivers, 32, 64 or 128 devices are allowed on the same bus. Having a large number of devices on the same bus over several floors with concealed wiring makes troubleshooting much more difficult. Adding EIA-485 repeaters compounds the problem.

A better approach has all the terminal control units on each floor bused together with one end connected to the MS/TP port on the BAS Router and the far end terminated with a 120 ohm resistor. The BAS Router is shipped with EIA-485 bias and termination applied so there is no need for an external terminator on the near side. The BAS Router Ethernet port is then tied to a 10/100 Mbps Ethernet Switch and then a cable connection is brought up through risers to the

centrally-located building or automation controllers that operate over BACnet/IP. On each floor will be installed a BAS Router dedicated to the field devices on that floor. If the building supports structured wiring, the BAS Router Ethernet wiring can share this system. With this approach, there is no need to carry EIA-485 wiring between floors. By having a fewer number of field devices on one MS/TP segment, network traffic on that segment is reduced.

Many MS/TP field controllers support auto-bauding so it is only necessary to set the baud rate on the BAS Router to the desired setting and all the field controllers will follow suit. The maximum number of MS/TP devices on each segment is often arbitrary. Assuming that half-load EIA-485 transceivers exist on the field controllers, a reasonable limit would be about 40. Each MS/TP segment is treated as a separate BACnet network so each segment must be assigned a unique network number including the BACnet/IP network.



BACnet Protocol Implementation Conformance Statement (PICS)



BAS Router

BACnet Multi-network Router

BACnet Protocol Implementation Conformance Statement (Annex A)

Date: 16 December 2009
Vendor Name: Contemporary Controls
Product Name: BAS Remote
Product Model Number: BASRT-B
Applications Software Version: **Firmware Revision:** 2.0 **BACnet Protocol Revision:**

Product Description: Device to route between BACnet/IP, ISO 8802-3 and MS/TP networks.

BACnet Standardized Device Profile (Annex L):

- BACnet Operator Workstation (B-OWS)
- BACnet Building Controller (B-BC)
- BACnet Advanced Application Controller (B-AAC)
- BACnet Application Specific Controller (B-ASC)
- BACnet Smart Sensor (B-SS)
- BACnet Smart Actuator (B-SA)

List all BACnet Interoperability Building Block Supported (Annex K):

NM-RC-B (Network Management-Router Configuration-B) DM-DDB-B Device Management — Dynamic Device Binding – B
 DS-RP-B Data Sharing — ReadProperty – B

Segmentation Capability:

- Able to transmit segmented messages Window Size:
- Able to receive segmented messages Window Size:

Standard Object Types Supported:

Object Type Supported	Can Be Created Dynamically	Can Be Deleted Dynamically
Device	No	No

No optional properties are supported. NOTE: The above object is directed supported on the router. The router will pass to the appropriate network all BACnet communications not directed to the router.

Data Link Layer Options:

- BACnet IP, (Annex J)
- BACnet IP, (Annex J), Foreign Device
- ISO 8802-3, Ethernet (Clause 7)
- ANSI/ATA 878.1, EIA-485 ARCNET (Clause 8), baud rate(s):
- MS/TP master (Clause 9), baud rate(s): 9600; 19,200; 38,400; 76,800
- MS/TP slave (Clause 9), baud rate(s):
- Point-To-Point, EIA 232 (Clause 10), baud rate(s):
- Point-To-Point, modem, (Clause 10), baud rate(s):
- LonTalk, (Clause 11, medium:
- Other:

Device Address Binding:

Is static device binding supported? (This is currently necessary for two-way communication with MS/TP slaves and certain other devices.) Yes No

Networking Options:

- Router, Clause 6 — routing between BACnet/IP, ISO 8802-3, and MS/TP
- Annex H, BACnet Tunnelling Router over IP
- BACnet/IP Broadcast Management Device (BBMD)
 Does the BBMD support registrations by Foreign Devices? Yes No

Character Sets Supported:

Indicating support for multiple character sets does not imply that they can all be supported simultaneously.

- ANSI X3.4 IBM/ MicrosoftDBCS ISO 8859-1
- ISO 10646 (UCS-2) ISO 10646 (UCS-4) JIS C 6226

If this product is a communication gateway, describe the types of non-BACnet equipment/network(s) that the gateway supports:

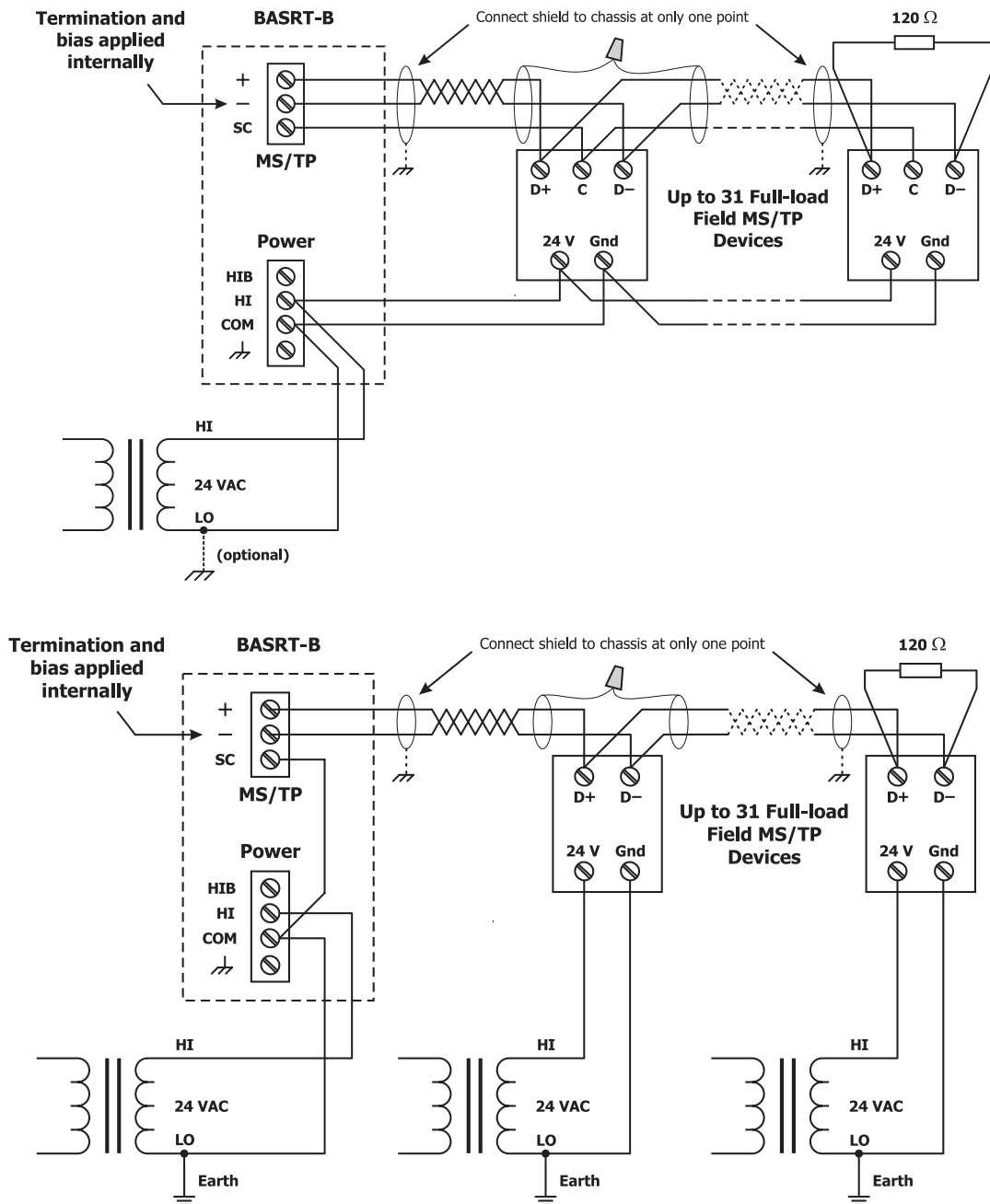
No gateway support.

Wiring Diagram




Since the BAS Router incorporates a half-wave rectifier circuit, it can share the same 24 VAC power with other half-wave rectified devices. It can also be powered from a 24 VDC source. A redundant power connection exists for back-up power schemes.

The BAS Router incorporates a 3-wire optically-isolated EIA-485 interface for the MS/TP connection, allowing better circuit protection and noise immunity. To connect to other 3-wire devices simply make a

one-to-one connection to the other devices. But when connecting to 2-wire non-isolated devices, the signal common (SC) on the BAS Router must share the reference used by the 2-wire devices. This is accomplished by tying the SC pin to COM on the BAS Router and by grounding the low-side of each power supply on all connected devices. In this way all EIA-485 transceivers share the same earth reference. Notice that the SC pin is signal common and not a shield pin.



Specifications

Power Requirements	24 VDC \pm 10% 2 W	or	24 VAC \pm 10% 4 VA 47–63 Hz
Operating Temperature	0°C to 60°C		
Storage Temperature	–40°C to 85°C		
Relative Humidity	10–95%, non-condensing		
Protection	IP30		
Ethernet Communications	IEEE 802.3 10/100 Mbps data rate 10BASE-T, 100BASE-TX physical layer 100 m (max) CAT5 cable length		
MS/TP Communications	ANSI/ASHRAE 135 (ISO 16484-5) 9600, 19200, 38400, 76800 bps data rate EIA-485 physical layer 1200 m (max) cable length		
LEDs	Power	Green = power OK	
	Ethernet	Green = 100 Mbps Yellow = 10 Mbps Flash = activity	
	MS/TP	Flashing Green = receive activity	
Regulatory Compliance	CE Mark; CFR 47, Part 15 Class A; RoHS		 

Ordering Information

Model	RoHS	Description
BASRT-B		BAS Router BACnet multi-network router DIN-rail mount

United States

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Fax: +1 630 963 0109

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www.ccontrols.com

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