

# ESSENTIALS

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## Applying BACnet® Routers in the Field

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When we promote the concept of **Raising BACnet to the Next Level**, we are talking about having all BACnet devices accessible from an IP infrastructure. However, the majority of BACnet devices are not IP-ready — with the most popular being BACnet MS/TP. Master-slave/token-passing is only one of the several data link technologies BACnet supports. The others being Ethernet, ARCNET, Point-to-Point and LonTalk. In order to communicate between these different data links or between one of these data links and BACnet/IP, a BACnet router is required.

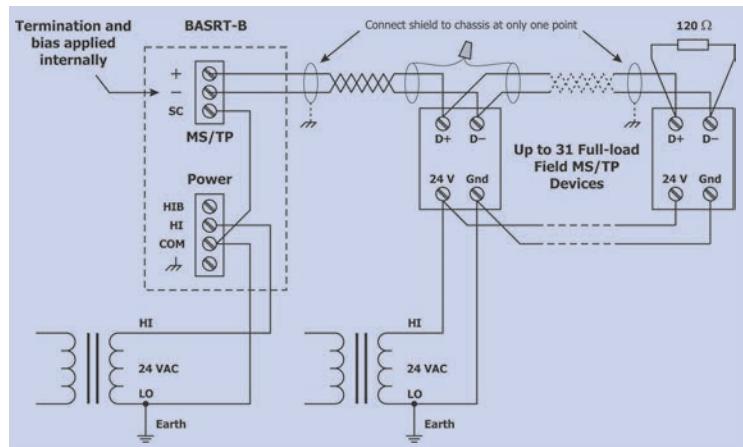
BACnet routing is available in higher-end BACnet controllers and stand-alone BACnet routers such as those available from Contemporary Controls. The BASRT-B BAS Router is intended for fixed installations requiring BACnet®/IP to BACnet MS/TP routing, while the BASRTP-B is a portable equivalent for commissioning and troubleshooting. What follows are some tips to ensuring a successful installation of either of these products.

### MS/TP Physical Layer Issues

With MS/TP, one octet is provided for source and destination addresses with address 255 reserved for the broadcast destination address. Addresses 0–127 can be either master or slave addresses, while all valid addresses above 127 can only be slaves. Although logically you can have 255 nodes passing the token, there are physical restrictions that limit the number of nodes per segment. Since the EIA-485 physical layer is used with MS/TP, the maximum number of loads that can occupy one physical segment is 32. Each EIA-485 transceiver must be capable of driving 32 unit-loads (including itself) plus two 120-ohm terminating resistors at each end of the segment. The transceivers used in the BAS Routers represent one unit-load. Some MS/TP equipment utilizes half-load

or quarter-load transceivers which can be mixed along a single segment.

In theory, one BAS Router can co-exist with 62 half-load devices or 124 quarter-load devices assuming no local bias on attached devices. Termination of 120 ohms should be applied at each end of the segment.



For 2-wire MS/TP devices, the SC pin on the BAS Router must be tied to earth if no common connection exists.



The BASRT-B BAS Router can be DIN-rail mounted and is intended for fixed installations.

In order to attach more MS/TP devices beyond the EIA-485 limit, EIA-485 repeaters are frequently used. This could be tricky — especially when auto-bauding MS/TP devices are involved. Repeaters are baud rate sensitive and with MS/TP's ability to operate over several baud rates, communication could be compromised. Large systems force all traffic through a single router, thereby reducing performance. Instead of using repeaters, Contemporary Controls recommends the use of additional BAS Routers — thereby creating multiple MS/TP segments. This topology change could actually reduce MS/TP wiring, improve performance, and aid in isolating trouble nodes.

In the BACnet specification there is one more requirement. If the MS/TP segment spans two or more buildings, 1500 V isolation is required between signal conductors and ground.

In order to comply with the isolation requirement, both BAS routers utilize 3-wire isolated EIA-485 transceivers with field connections labelled +, -, and SC. The SC pin is NOT for a shield connection. It represents the signal common of the isolated EIA-485 transceiver and it must be connected to the other EIA-485 signal commons. If all the MS/TP devices are isolated, simply connect three wires to the corresponding pins. A two-pair twisted-pair would do. One pair would be dedicated to the +, - signals while a second pair would have its conductors shorted together and tied to each of the SC pins. A shield wire would be attached to earth or chassis at one point along the MS/TP bus.

What should you do if you are connecting to 2-wire non-isolated EIA-485 transceivers like the Alerton VLCs? In this case, the EIA-485 transceivers are referenced to the controller's common ground. The power supply input has a common connection that should be referenced to earth which will serve as the reference point for all EIA-485 devices on the MS/TP bus. Under these circumstances, the BAS Router MUST have its SC pin connected to the power supply common.

The other issue is with bias and termination. Contemporary Controls elects to combine bias and termination so the effective impedance is 120 ohms. On the fixed BAS Router the effective termination is applied at the factory but can be disabled in the field. For the portable BAS Router, no termination is applied.

### Power Supply Issues

There really are no power supply issues. The BASRT-B incorporates a half-wave rectifier and therefore can share the same power supply with other half-wave rectified devices. The unit can also be powered from a DC source. The BASRTP-B derives its power from a USB port on a laptop computer.

### Configuration

Both BAS Routers can be configured through a simple web page. It will be necessary to set the **IP Address**, **IP Subnet** and **IP Gateway** address like any other IP device. Note that "slash" notation is assumed for the **IP Subnet**. For example, a 24 represents 255.255.255.0 in dotted decimal notation. There are only a few other parameters worthy of note.

The **Max Masters** parameter defines the highest MS/TP master address that will participate in the token-passing. If you are not sure of the number, use the default value of 127. **Max Info Frames** indicates the largest number of frames that will be sent by a station before it releases the token. Adhering to a customer request, we have increased that number from 40 to 100. This would improve router performance by allowing the BAS Router to purge accumulated messages quickly once it receives the token again. The BAS Router needs both a Device Instance to be



The BASRTP-B Portable BAS Router derives its power from laptop computers.

assigned as well as an **MS/TP MAC address**. Practice dictates that routers should be assigned MAC address 0.

### Router Enhancements

The original Portable BAS Router was intended as a low-cost solution for laptops running BACnet/IP configuration programs needing access to MS/TP devices. A companion product was then made for fixed installations. However, instead of customers attaching just a couple of isolated MS/TP devices to a convenient point on an IP infrastructure, we noticed much larger MS/TP networks being attached. To meet this need we increased the Ethernet buffer size, and improved the MS/TP token-passing over the wide range of baud rates. We will continue to make improvements as customers find novel ways of using our products.

### Additional Reading

Visit our web site at: <http://www.ccontrols.com/basautomation/basrouters.htm> to learn more about BACnet routers. In the Learning Center, there are numerous articles on BACnet including our white paper **Raising BACnet to the Next Level**.