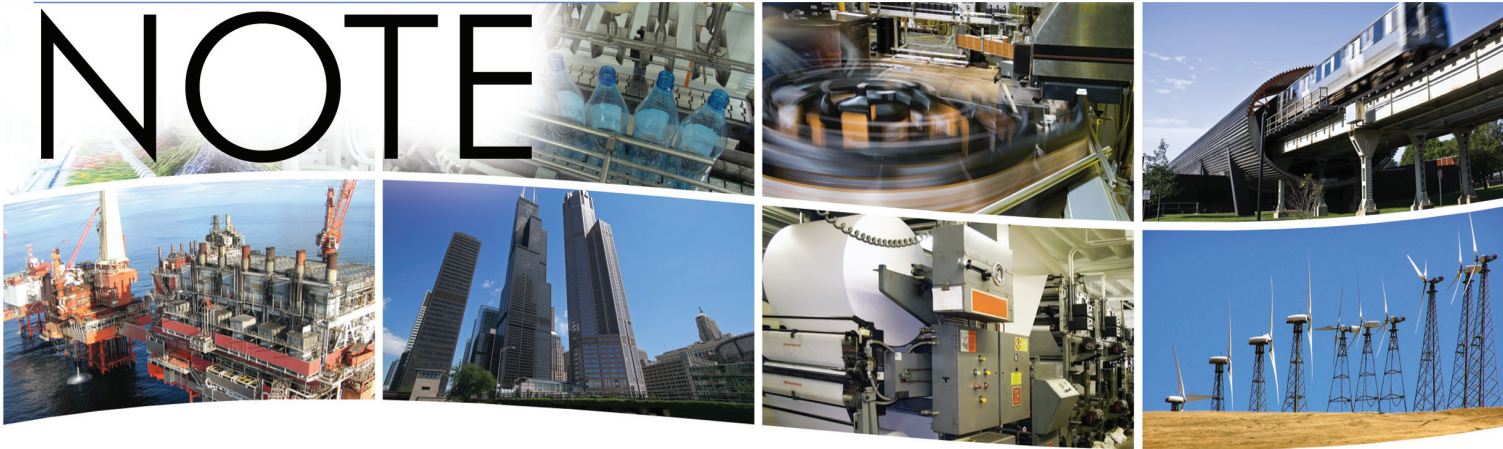


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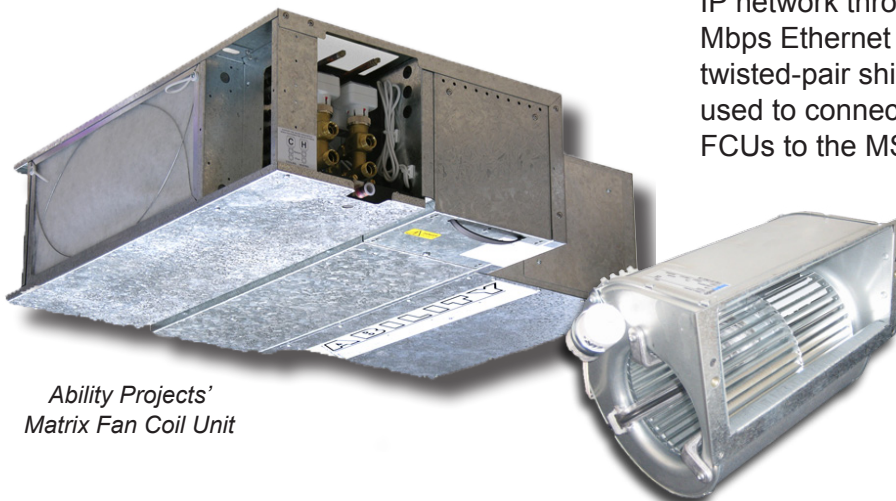
Interfacing Ability Projects' Matrix Fan Coil Units to a BACnet/IP Network

Introduction

The Matrix Fan Coil System from Ability Projects offers building owners higher energy efficiency, reduced noise levels and easier air balancing from conventional fan coil units (FCUs). Temperature control is accomplished by first modulating the hot and cold water supply values and then by modulating the speeds of the individual fans. An Alerton BACnet MS/TP compliant controller is the primary source of control within each FCU. Numerous FCUs would be distributed on each floor of the building with shielded twisted-pair cable connecting the individual units. In order to connect the BACnet MS/TP bus to a BACnet/IP network, a BACnet/IP to MS/TP router is needed such as Contemporary Controls' BAS Router.

BAS Router

The BAS Router can be DIN-rail mounted having a single 10/100 Mbps Ethernet port and a single optically-isolated MS/TP port. BACnet messages are routed between the two networks. Power is derived from a 24 V transformer with the LO side of the transformer tied to earth. The Ethernet port supports auto-negotiation and auto-MDIX and needs to be connected to a BACnet/IP network through a 10/100 Mbps Ethernet switch. A twisted-pair shielded cable is used to connect a network of FCUs to the MS/TP port on the BAS Router.



Ability Projects'
Matrix Fan Coil Unit

Installation

Figure 1 depicts a typical installation. It is recommended that a single BAS Router be relegated to each floor of a building and be positioned at one end of a MS/TP segment. All the FCU's on that floor would then tie into the MS/TP port on the BAS Router using a bussed connection. The recommended maximum limit of FCUs per MS/TP segment is 40 and a terminating resistor needs to be applied at the last controller. Contact Ability Projects if a larger number of FCUs are to be connected to the same segment. Each device on the MS/TP network must be assigned a unique MAC address from 0 to 127. It is not necessary that the BAS Router be located on each floor – it can be mounted anywhere within the 4000' distance limit of MS/TP cable.

On the Ethernet side, the BAS Router must connect

to a 10/100 Mbps Ethernet switch. Category 5 or better cable up to 100 meters in length can be used with either RJ-45 screened or non-screened connectors. One port on the switch is then connected to a BACnet/IP network where building controllers and operator works stations reside. Notice that each of the five networks depicted in figure 1 must have unique BACnet network addresses in order to operate within one BACnet internetwork.

Each Matrix FCU is mains-powered. Included in each unit is a 24 V transformer for powering the Alerton controllers. The common side of the secondary of this transformer must be tied to earth to ensure successful communication over the MS/TP network.

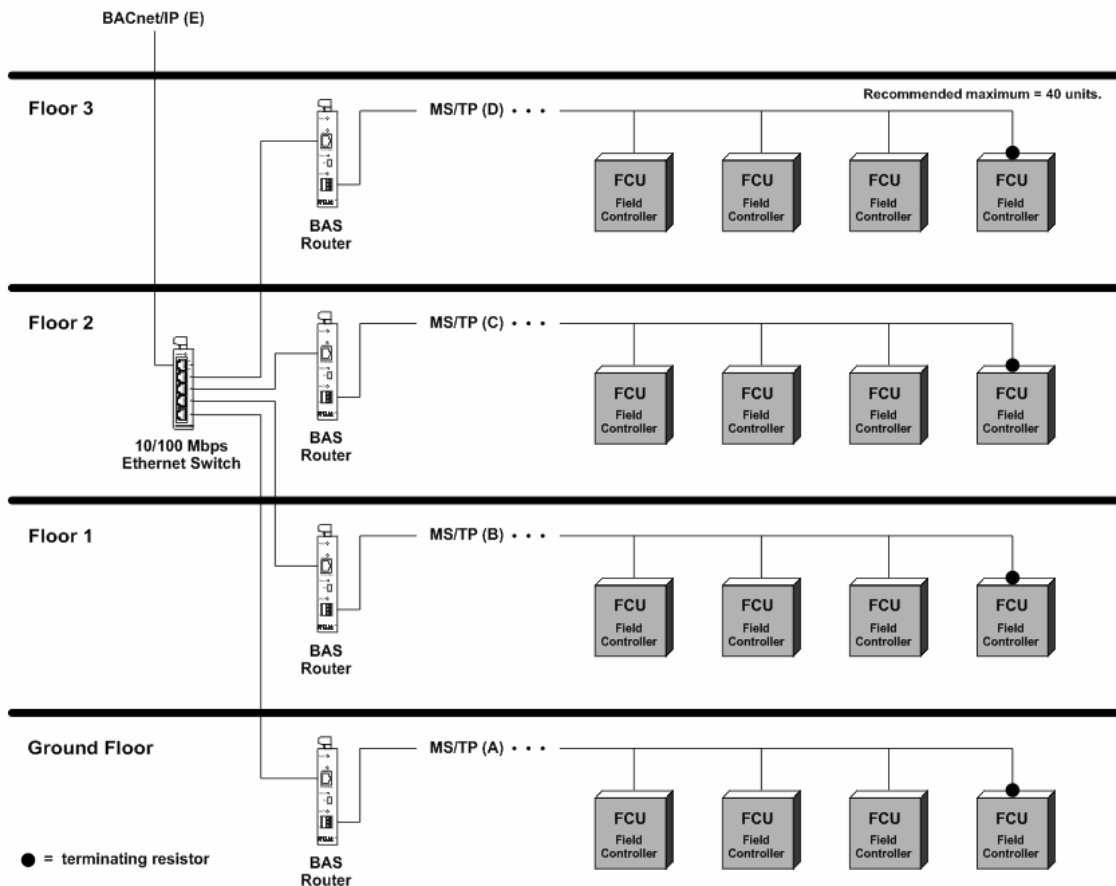


Figure 1 – Four MS/TP networks are being routed to one BACnet/IP network. Each of the five networks (A, B, C, D, and E) must be assigned unique BACnet network addresses. Within each MS/TP network, each FCU and BAS Router must have unique MAC addresses. It is recommended that the BAS Router be assigned MAC address 0. MAC addresses can be repeated on different MS/TP networks.

Wiring

Figure 2 provides detail on how to wire up the equipment. The BAS Router represents one unit-load to the MS/TP network and a total of 32 unit loads can exist on a single segment. Since the Alerton controllers represent fractional loads, up to 62 Alerton devices can be connected. However, communication throughput will drop with increasing number of devices so Ability Projects recommend limiting the number of FCUs per network to 40.

Either a Belden 88102 (2-pair/24AWG) or a Belden 9841 (1-pair/24AWG) cable is recommended. Both are screened cables but the screen must be tied to earth at only one endpoint. There is no provision on the Alerton controllers for tying together screens so use a wire nut instead. A 120 ohm termination resistor needs to be applied at the last FCU on a segment. The BAS Router has internal bias and

termination applied so do not apply any additional termination at the BAS Router end. Maintain the proper polarity of the MS/TP connections since they are polarized.

The BAS Remote utilizes an isolated 3-wire MS/TP transceiver which includes a signal reference connection SC which must be tied to the transceiver signal reference of any attached devices. The Alerton controllers utilize a 2-wire non-isolated MS/TP transceiver which uses the power supply common as a reference point. In order to provide a common reference between all devices on the MS/TP segment, an earth connection is required at the common of all transformer secondaries. Make a short jumper connection between the SC pin and COM on the BAS Remote. The SC pin is NOT TO BE USED AS A SCREEN CONNECTION.

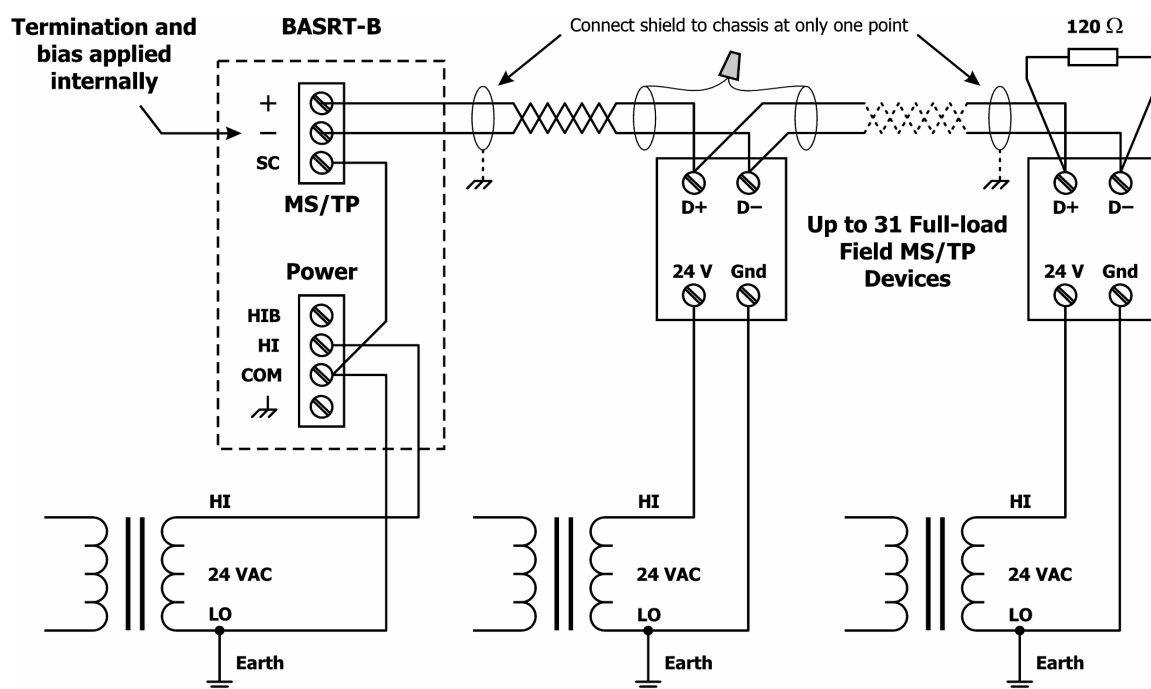


Figure 2 – The Alerton controllers provide a non-isolated two-wire MS/TP connection while the BAS Router provides an isolated 3-wire connection. Therefore the SC (transceiver common) pin on the BAS Router must be referenced to earth in order to have the same signal reference as the Alerton devices. There is no tie point for the screens of the twisted-pair cable. Use a wire nut to maintain a continuous screen but only tie one end of the screened cable to earth or chassis.

Configuring the BAS Router

Consult the BAS Router Installation Guide for detailed instructions on configuring the BAS Router. Configuration is accomplished through a web page on the unit which can be accessed by a web browser pointing to the BAS Router's default IP address of 192.168.92.68 with a subnet mask of 255.255.255.0. Make sure your web browser resides on the same subnet as the BAS Router. Once configured, the router IP address can be changed but note the change in your records.

A basic review of BACnet network topology would aid in the understanding on how best to configure each BAS Router.

- Each BACnet device attaches to some medium such as twisted-pair cable. A continuous length of this medium is called a *physical segment*. Physical segments can be interconnected by *repeaters*. While BACnet devices are assigned addresses, repeaters are not.
- A BACnet network, referred to as a *local area network (LAN)*, can consist of several physical segments with all connected BACnet devices assigned unique *medium access control (MAC)* addresses. BACnet supports several types of LANs with different MAC assignment schemes.
- The various types of LANs are interconnected through the use of *routers* thereby forming a single BACnet *internetwork*.

The BAS Router connects BACnet/IP networks to BACnet MS/TP networks. All BACnet devices attached to the MS/TP side of the router must have a unique MAC address from other devices connected to the same MS/TP network. In addition, all BACnet devices regardless of location must be assigned a unique *device instance* in order to reside within the same BACnet internetwork. Since either side of the BAS Router connects to a separate network – each side must be assigned a unique BACnet network address.

With the above understanding, configuring each BAS Router will be easier. Remember that the BAS Router is treated just like other BACnet device in that it must have a unique device instance within

the BACnet internetwork and have a unique MAC address within its LAN.

Device Parameter

Device Instance (Default Value = 0)

The router's device instance is a 22-bit value (0–4,194,302). Each BACnet device within the same BACnet inter-network must have a unique device instance. One must be assigned to the BAS Router. Do not use device instance 4,194,303 since this instance is reserved.

BACnet/IP Parameters

BACnet/IP UDP Port (Default Value = 0xBAC0)

This 16-bit hex value (BAC0–BACF) is set to BAC0 by default. Usually, this default value should not be changed. In a typical installation, each BAS Router will be assigned the same UDP port.

BACnet/IP Network (Default Value = 1)

The BACnet/IP network number is a 16-bit value (1–65534). Each network within the BACnet internetwork must have a unique number. This includes the BACnet/IP and MS/TP sides of the BAS Router. Do not use addresses 0 or 65535 since these addresses are reserved.

IP Address (Default Value = 192.168.92.68)

The IP address of the router can be 0.0.0.1–255.255.255.254. A private IP address is usually assigned to the router.

IP Subnet (Default Value = 24)

This 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 (Default Value = 192.168.92.1)

The default gateway for the IP stack is a dotted decimal number in the range of 0.0.0.0–255.255.255.254. This will be the IP address of your local IP router — if one exists.

MS/TP Parameters

MS/TP MAC (Default Value = 0)

This is the unique 8-bit (0–127) MAC address of the router's MS/TP port, in decimal. Lower MAC address numbers are preferred with the default value recommended. It is further recommended that all other BACnet devices attached to the same MS/TP network be assigned consecutive MAC addresses beginning with 1 without allowing for any gaps in addressing.

MS/TP Network (Default Value = 2001)

This 16-bit decimal network number (1–65534) must be unique for all BACnet networks within the BACnet internetwork. No other networks, regardless of type, can have the same network number. Do not use addresses 0 or 65535 since these addresses are reserved.

Max Masters (Default Value = 127)

Only master nodes participate in the MS/TP token-passing process. The highest master MAC address (in decimal) in the MS/TP network is 127 and you should use 127 if you are unsure of other MS/TP device addresses. Each MS/TP device should use this same value. For a value in this field to be proper, it must equal or exceed the highest MAC address for any master on the network. Optimum performance occurs when this value:

1. **equals** the highest MAC address of any master, and
2. all masters use **sequential** MAC addresses starting with 1

Since many BACnet devices do not allow this parameter to be changed, leave the BAS Router at the default value. The Alerton controllers are factory set to a Max Master's value of 127.

Max Info Frames (Default Value = 40)

This is the maximum number of messages that can be routed onto the MS/TP network by the router per token pass. Its range is 1–100, and typical values are 20–40. Smaller values provide less access to the MS/TP network from the BACnet/IP network because they give native MS/TP messages higher priority than those passed by the router from BACnet/IP. The default value usually provides good performance.

MS/TP Baud Rate (Default Value = 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. On power up the router checks for other masters; if finding none, it begins *poll for master* — at which point auto-bauding devices attached to the MS/TP network will adjust to the router's baud rate.

MS/TP Tolerance (Default Selection = Lenient)

This setting determines the degree to which interoperability with devices is successful. The Lenient option is less efficient for traffic flow but optimizes interoperability. A slight improvement in performance will be realized by selecting the Strict setting.

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