

Network Guide

User Guide

DISTECH
CONTROLS™

Innovative Solutions for Greener Buildings

Document Revision History

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2. Version 2.1 - Minor updates
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CHAPTER 1

Introduction

This section provides an overview of the user guide.

Topics

[*Introduction*](#)

[*About This User Guide*](#)

[*Acronyms and Abbreviations*](#)

Introduction

This document describes best practices, specifications, wiring rules, device termination, and application information to implement robust and reliable communications networks.

About BACnet®

The BACnet® ANSI/ASHRAE™ Standard 135-2008 specifies a number of Local Area Network (LAN) transport types. Distech Controls' controllers use both BACnet IP and BACnet Master-Slave/Token-Passing (MS/TP) communications data bus (based on EIA 485) as a local network for internetworking of supervisory controllers and field controllers.

About LONWORKS®

The LONWORKS standard ANSI/CEA-709.1-B specifies a number of Local Area Network (LAN) transport types. Distech Controls' controllers use a twisted pair "free topology" communications data bus operating at 78 kbit/s as a local network for internetworking of supervisory controllers and field controllers.

LONWORKS is one of several network types of the BACnet® ANSI/ASHRAE™ Standard; however, no Distech Controls' controllers are compatible with this network type except for an EC-Net.

About Subnetworks

The Distech Controls' controllers and devices (BACnet and LONWORKS) use the subnetwork data bus to support various expansion / extension modules such as the following: Allure Series sensors, ECx-4XX I/O Extension Module, ECx-Light 4 / ECx-Light 4D / ECx-Light 4DALI, ECx-Blind 4 / ECx-Blind 4LV, and EC-Multi-Sensor series.

About This User Guide

Purpose of the User Guide

This user guide does not provide and does not intend to provide instructions for safe wiring practices. It is the user's responsibility to adhere to the safety codes, safe wiring guidelines, and safe working practices to conform to the rules and regulations in effect in the job site jurisdiction. This user guide does not intend to provide all the information and knowledge of an experienced HVAC technician or engineer.

For BACnet

This User Guide describes the best practices for installing a BACnet MS/TP LAN and reviews the specifications, device limits, BACnet MS/TP LAN cable requirements, best wiring practices, the importance of rigorous grounding practices, 24 volt power supply wiring requirements, BACnet MS/TP data bus termination and shield grounding, setting the MAC address and Device Instance for devices on a BACnet MS/TP LAN, and finally LAN troubleshooting.

This user guide is intended to provide BACnet LAN information to instruct a user to install and configure a BACnet MS/TP LAN. However, this guide is not intended to instruct the user on how configure the devices connected to the LAN, to use network management tool software, to program a device to share points on the network, or the procedure to install a given device. For this information, refer to the device's hardware installation guide and its related programming user guide.

For LONWORKS

This User Guide describes the best practices for installing a LONWORKS LAN and reviews the specifications, device limits, LAN cable requirements, best wiring practices, grounding practices, 24 volt power supply wiring requirements, LONWORKS network termination, and finally LAN troubleshooting.

This user guide is intended to provide LONWORKS LAN information to instruct a user to install and configure a LONWORKS LAN. However, this guide is not intended to instruct the user on how configure the devices connected to the LAN, to use network management tool software, to program a device to share points on the network, or the procedure to install a given device. For this information, refer to the device's hardware installation guide and its related programming user guide.

For Subnetworks

This user guide also describes the best practices for installing the subnetwork used for Distech Controls' expansion / extension modules; for example, the cable requirements, best wiring practices, grounding practices, power supply wiring requirements, data bus termination, and device addressing.

Intended Audience

This user guide is intended for system designers, integrators, electricians, and field technicians who have experience with control systems, and who want to learn about how to make a successful BACnet MS/TP LAN or LONWORKS installation. It is recommended that anyone installing and configuring the devices specified in this user guide have prior training in the usage of these devices.

Referenced Documentation

The following documentation is referenced in this document.

Controller Hardware Installation Guides:

These documents are available on Distech Controls SmartSource website.

[EC-gfxProgram User Guide:](#)

This document is available on Distech Controls SmartSource website.

[Junction Box and Wiring Guideline for Twisted Pair LONWORKS® Networks:](#)

[LONWORKS FTT-10A Free Topology Transceiver User's Guide:](#)

These documents are available on Echelon's website: www.echelon.com

[Open-to-Wireless™ Solution Guide:](#)

This document is available on Distech Controls SmartSource website at the following link:
<http://www.distech-controls.com/smartsource/files/619/>

Conventions Used in this Document

Notes



This is an example of Note text. Wherever the note-paper icon appears, it means the associated text is giving a time-saving tip or a reference to associated information of interest.

Cautions and Warnings



This is an example of Caution or Warning text. Wherever the exclamation icon appears, it means that there may be an important safety concern or that an action taken may have a drastic effect on the device, equipment, and/or network if it is improperly carried out.

Related Documentation

Refer to the Hardware Installation Guide for the devices you are installing.

Acronyms and Abbreviations

Acronym	Definition
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
BACnet®	Building Automation and Control Networking Protocol
B-AAC	BACnet Advanced Application Controller
B-ASC	BACnet Application Specific Controller
B-BC	BACnet Building Controller
BBMD	BACnet/IP Broadcast Management Device
DALI	Digital Addressable Lighting Interface
DI	Device Instance Number
EIA	Electronic Industries Alliance
EOL	End Of Line
ID	Identifier
LAN	Local Area Network
LON®	Local Operation Network (LONWORKS®)
OD	Outside Diameter
MAC	Media Access Control
MS/TP	Master-Slave/Token-Passing

CHAPTER 2

BACnet MS/TP Communication Data Bus Fundamentals

This chapter describes the BACnet MS/TP Communications Data Bus operating principles.

Topics

BACnet MS/TP Data Transmission Essentials
Maximum Number of BACnet MS/TP Devices on a Data Bus Segment and Baud Rate
Data Bus Physical Specifications and Cable Requirements
Data Bus Topology and EOL Terminations
Data Bus Shield Grounding Requirements
Using Repeaters to Extend the Data Bus
Device Addressing
Power Supply Requirements for 24V Controllers
ECx-4XX I/O Extension Module Power Supply Requirements
Typical Device BACnet MS/TP LAN and Power Wiring Diagram

BACnet MS/TP Data Transmission Essentials

The BACnet MS/TP data bus protocol is part of the BACnet® ANSI/ASHRAE™ Standard 135-2008 that uses the EIA-485 (RS-485) physical layer standard for data transmission (herein called the data bus). Multiple data buses can be logically tied together as each BACnet MS/TP data bus is assigned a unique Network Instance that distinguishes it from other data buses in the BACnet MS/TP Local Area Network (LAN). An example of an interconnected BACnet MS/TP data bus is shown in [Figure 22](#).

EIA-485 is a standard that defines the electrical characteristics of the receivers and drivers to be used to transmit data in a differential (balanced) multipoint data bus that provides high noise immunity with relatively long cable lengths which makes it ideal for use in industrial environments. The transmission medium is inexpensive and readily-available twisted pair shielded cable.

While there are many possible LAN topologies for an EIA-485 data bus, only devices that are daisy-chained together are allowed with BACnet MS/TP (see [Figure 5](#)). A spur is only permitted when it is connected to the data bus through a repeater (see [Using Repeaters to Extend the Data Bus](#) on page 28).

End-of-line (EOL) terminations are critical to error-free EIA-485 data bus operation. The impedance of the cable used for the data bus should be equal to the value of the EOL termination resistors (typically 120 ohms). Cable impedance is usually specified by the cable manufacturer.

BACnet MS/TP Data Bus is Polarity Sensitive

The polarity of all devices that are connected to the two-wire BACnet MS/TP data bus must be respected. The markings to identify the polarity can vary by manufacturer. The following table summarizes the most common identification labels for BACnet MS/TP data bus polarity.

Table 1: Common Identification Labels for BACnet MS/TP Data Bus Polarity for Distech Controls' Products


Distech Controls Product	Typical Data Bus Connection Terminals		
	Inverting	Non-inverting	Reference
ECB Series Controllers ECB/ECL-VAVS	NET -	NET +	24V COM
ECB/ECL-VAV	NET -	NET +	 (Ground symbol)
ECB-PTU Series Line-Powered Controllers	NET -	NET +	COM
EC-BOS	-	+	S
Thermostat	-	+	Ref
Repeater	Data- Data1-	Data+ Data1+	N/A

Table 1: Common Identification Labels for BACnet MS/TP Data Bus Polarity for Distech Controls' Products

Distech Controls Product	Typical Data Bus Connection Terminals		
	Inverting	Non-inverting	Reference
BACnet/IP to MS/TP Adapter	RT-	RT+	COM
BACnet/IP to MS/TP Router	-	+	SC



Except for an EC-BOS and ECB-PTU Line-Powered Controllers, never connect the shield of the BACnet MS/TP data bus to the Reference terminal. See [Data Bus Shield Grounding Requirements](#) on page 24 for more information.

Table 2: Common Identification Labels for BACnet MS/TP Data Bus Polarity for other Manufacturers

Device Manufacturer	Typical Data Bus Connection Terminal		
	Inverting	Non-inverting	Reference
Common identification labels for BACnet MS/TP data bus polarity by other Manufacturers	B	A	SC
	-	+	G
	TxD-/RxD-	TxD+/RxD+	GND
	U-	U+	COM
	RT-	RT+	REF
	Sig-	Sig+	
	Data-	Data+	



When interfacing with BACnet MS/TP devices from other manufacturers, refer to the documentation provided with the device to correctly wire the device.

Maximum Number of BACnet MS/TP Devices on a Data Bus Segment and Baud Rate

The following technical parameters limit the number of devices on a BACnet MS/TP Data Bus Segment.

- The BACnet MS/TP Data Bus Segment has a hard limit on the number of devices that can communicate due to the device addressing scheme (the MAC Address Range for BACnet MS/TP Devices). See [Data Bus Segment MAC Address Range for BACnet MS/TP Devices](#) on page 14.
- Each device presents an electrical load on the BACnet MS/TP Data Bus Segment. This is called device loading. The number of devices that can be connected to a BACnet MS/TP Data Bus Segment is limited by the loading of each device. See [Device Loading](#) on page 15.
- Choosing a low baud rate can cause BACnet MS/TP Data Bus congestion that can limit the amount of data that can be efficiently exchanged between devices connected to the BACnet MS/TP Data Bus. For example, at 9600 baud, the maximum number of devices is reduced to 25 due to the increased time it takes for token passing between devices. The recommended baud rate is 38 400. See [Baud Rate](#) on page 16.
- Distech Controls recommends that you connect no more than 50 of our $\frac{1}{8}$ or $\frac{1}{2}$ -load devices on a single BACnet MS/TP Data Bus Segment when a baud rate of 19 200 or higher is used (preferably 38 400 baud). This is to ensure that the BACnet MS/TP Data Bus has enough bandwidth to efficiently communicate network variables between controllers.

These parameters are described in greater detail below.

Data Bus Segment MAC Address Range for BACnet MS/TP Devices

The BACnet MS/TP data bus supports up 255 devices:

- Up to 128 devices (with device MAC addresses in the range of 0 to 127) that are BACnet MS/TP Masters (that can initiate communication).
- Up to 128 devices (with device MAC addresses in the range of 128 to 255) that are BACnet MS/TP Slaves (cannot initiate communication).

However, it is recommended that any given data bus segment have no more than 50 devices, when a baud rate of 19 200 or higher is used for the BACnet MS/TP Data Bus. A repeater counts as a device on each data bus segment to which it is connected.

All Distech Controls' devices are categorized as BACnet MS/TP Masters, that is, their device MAC address can be set in the range of 0 to 127 only.

Device Loading

Each device presents an electrical load on the BACnet MS/TP Data Bus Segment. This is called device loading. The use of full load devices limits the number of devices connected to a BACnet MS/TP Data Bus Segment to 32 devices. Distech Controls' BACnet MS/TP devices are $\frac{1}{8}$ -load devices and $\frac{1}{2}$ -load devices, which allows more devices to be connected to the BACnet MS/TP Data Bus Segment, as compared to full load devices.

Table 3: Device Loading

Manufacturer	Device load on the attached BACnet MS/TP Data Bus
Distech Controls' ECB controllers Distech Controls' ECB-PTU Line-Powered Controllers	$\frac{1}{8}$ -load devices
Distech Controls' BACnet MS/TP Thermostats	$\frac{1}{2}$ -load devices
Other manufacturers	Refer to their documentation

However, if a data bus segment is interoperating with devices that are full-load, $\frac{1}{2}$ -load, $\frac{1}{4}$ -load, or $\frac{1}{8}$ -load, then the device that supports the fewest devices on the same data bus is the one that sets the limit for the maximum total number of devices for that data bus segment. For example, you plan to put on one data bus the following devices:

Table 4: Device Loading Example

Manufacturer	Quantity of devices (example)	Equivalent full-load devices	Maximum devices supported by the manufacturer
Distech Controls' devices ($\frac{1}{8}$ -load devices)	8	1	128 ¹ Maximum 50 recommended
Distech Controls' BACnet MS/TP Thermostats ($\frac{1}{2}$ -load devices)	14	7	64 Maximum 50 recommended
Manufacturer Y (full load devices)	26	26	32
Total Full-Load Devices		34	There are too many devices on the data bus. It is limited to a maximum of 32 devices by Manufacturer's Y devices.

1. This is limited by the maximum number of master devices allowed on a BACnet MS/TP Data Bus.

The solution for the above example is to create two data bus segments connected together by a repeater and then split up the devices between the data bus segments, ensuring again that the maximum number of devices on each separate data bus is not exceeded. See [Using Repeaters to Extend the Data Bus](#) on page 28.

Baud Rate

Most devices will have a range of baud rate settings and possibly an AUTO setting that detects the baud rate of other devices transmitting on the data bus and adjusts the baud rate of the device accordingly. Typical baud rates are 9600, 19 200, 38 400, and 76 800. The baud rate setting determines the rate at which data is sent on the BACnet MS/TP data bus.



At 9600 baud, the maximum number of devices is reduced to 25 due to the increased time it takes for token passing between devices.

All devices on the data bus must be set to the same baud rate. Therefore, the chosen baud rate must be supported by all devices connected to the data bus.

The recommended baud rate for Distech Controls' devices is 38 400.

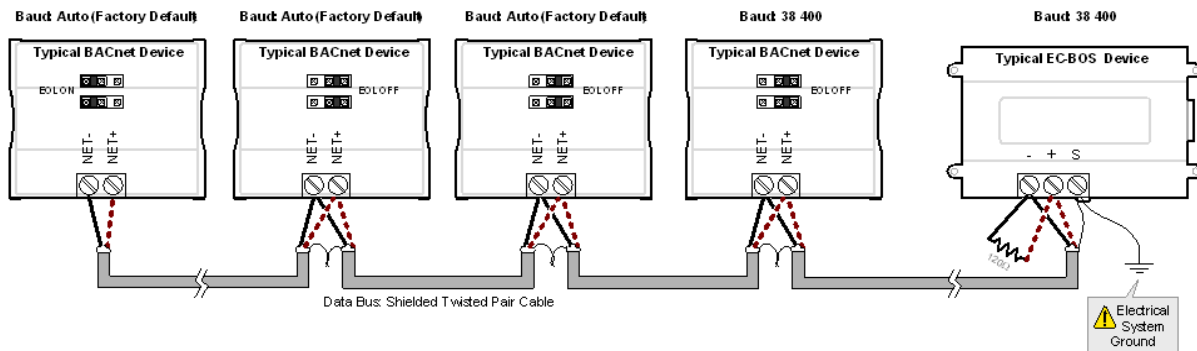
We recommend that you:

- Set the baud rate of two controllers on a BACnet MS/TP Data Bus Segment to the same baud rate to provide failover protection.

For example, set the baud rate of the EC-BOS (if equipped) and one other controller to 38 400 baud. If the EC-BOS becomes unavailable and there is a power cycle, the controller will set the baud rate for the BACnet MS/TP Data Bus.

- Set all other devices to automatically detect the baud rate, if this option is available.

Figure 1: Setting the Baud rate on two Controllers on a BACnet MS/TP Data Bus Segment for Failover Protection



To set the baud rate for ECB series controllers, see [Setting the Baud Rate for ECB-Series Controllers \(optional\)](#) on page 101.

About Setting Built-in EOL Terminations

All controllers use both jumpers or DIP switches to enable the built-in EOL resistors and/or biasing circuitry

Refer to the controller's Hardware Installation Guide for how to identify and set a controller's built-in EOL terminations.

Only a Daisy-Chained Data Bus Topology is Acceptable

Use a daisy-chained BACnet MS/TP data bus topology only. No other data bus topology is allowed.

Data Bus Physical Specifications and Cable Requirements

Cables composed of stranded conductors are preferred over solid conductors as stranded conductor cable better resist breakage during pulling operations. Distech Controls strongly recommends that the following data bus segment cable specifications be respected.

Table 5: BACnet MS/TP Data Bus Segment Physical Specifications and Cable Requirements

Parameter	Details
Media	Twisted pair, 24 AWG (see also Metric Conversions for Wire Gauge on page 133).
Shielding	Foil or braided shield.
Shield grounding	The shield on each segment is connected to the electrical system ground at one point only; see Data Bus Shield Grounding Requirements on page 24.
Characteristic impedance	100-130 Ohms. The ideal is 100-120 Ohms.
Distributed capacitance between conductors	Less than 100 pF per meter (30 pF per foot). The ideal is less than 60 pF per meter (18pF per foot).
Distributed capacitance between conductors and shield	Less than 200 pF per meter (60 pF per foot).
Maximum length per segment	1220 meters (4000 feet).
Data Rate	9600, 19 200, 38 400, and 76 800 baud.
Polarity	Polarity sensitive
Multi-drop	Daisy-chain (no T-connections)
EOL terminations	120 ohms at each end of each segment
Data bus bias resistors	510 ohms per wire (max. of two sets per segment)

Shielded cable offers better overall electrical noise immunity than non-shielded cable. Unshielded cable or cable of a different gauge may provide acceptable performance for shorter data bus segments in environments with low ambient noise.

Table 6: Distech Controls Recommended Cable Types for BACnet MS/TP Data Buses

Cable Type	Part Number	O.D. (Ø)
300 meters (1000 feet), 24 AWG Stranded, Twisted Pair Shielded Cable - FT6, Rated for Plenum Applications	CB-BACN6BL1000	3.75mm (0.148 in.)

Distech Controls BACnet cable offers the best performance over the full range of baud rates, cable lengths, and number of connected devices. This is primarily due to lower conductor-to-conductor capacitance of this cable.

Data Bus Topology and EOL Terminations

Function of EOL Terminations

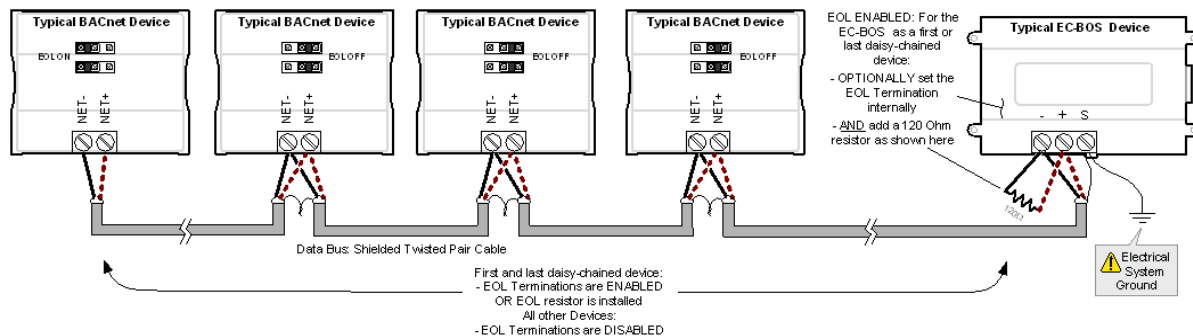
The first and last device on the data bus must have End-of-Line (EOL) termination resistors connected across the two data lines/wires of the twisted pair. These resistors serve the following purposes:

- EOL terminations dampen reflections on the data bus that result from fast-switching (high-speed rising and falling data edges) that otherwise would cause multiple data edges to be seen on the data bus with the ensuing data corruption that may result. The higher the baud rate a data bus is operating at, the more important that EOL terminations be properly implemented. Electrically, EOL terminations dampen reflections by matching the impedance to that of a typical twisted pair cable.
- EIA-485 data bus transmitters are tri-state devices. That is they can electrically transmit 1, 0, and an idle state. When the transmitter is in the idle state, it is effectively offline or disconnected from the data bus. EOL terminations serve to bias (pull-down and pull-up) each data line/wire when the lines are not being driven by any device. When an un-driven data bus is properly biased by the EOL terminations to known voltages, this provides increased noise immunity on the data bus by reducing the likelihood that induced electrical noise on the data bus is interpreted as actual data.

When to Use EOL Terminations

EOL terminations should only be enabled / installed on the two devices located at either end of the data bus. All other devices must not have the EOL terminations enabled/installed.

Figure 2: EOL Terminations Must be Enabled at Both the First and Last Device on the Data Bus



Devices with built-in EOL terminations are factory-set with the EOL termination disabled by default.



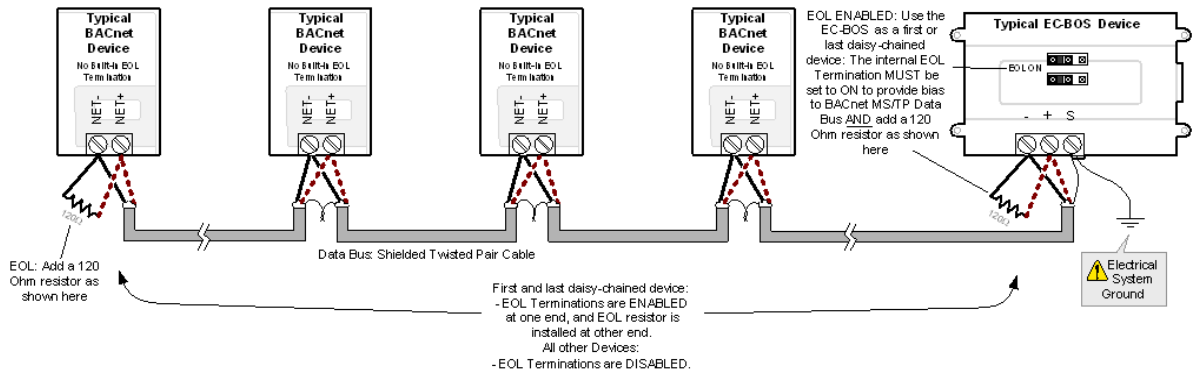
The BACnet/IP to MS/TP Adapter does not have EOL Termination (and BACnet MS/TP Data Bus biasing) capabilities to be used at the end of a BACnet MS/TP data bus. Instead, use the BACnet/IP to MS/TP Router for this application.

When to use EOL Terminations with BACnet MS/TP Thermostats

BACnet MS/TP thermostats support external EOL termination resistors only. When a BACnet MS/TP thermostat is the first or last daisy-chained device, add a 120 Ohm resistor across the - and + BACnet MS/TP data bus connections.

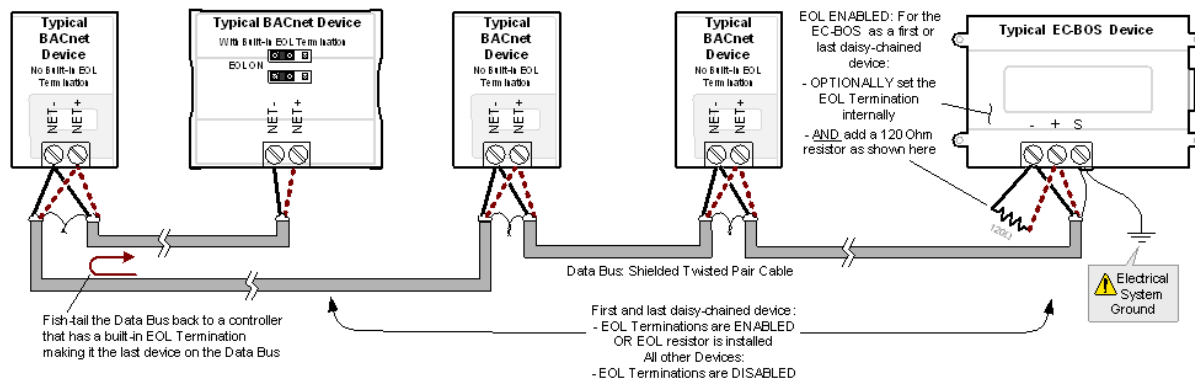
The BACnet MS/TP data bus must be biased. This bias can only be provided by built-in EOL termination resistors (ones set with jumpers or DIP switches - refer to the controller's Hardware Installation Guide for how to identify and set a controller's built-in EOL terminations). If a BACnet MS/TP data bus has a BACnet MS/TP thermostat at one end of the BACnet MS/TP data bus and an EC-BOS at the other end, you must set the built-in EOL termination in the EC-BOS so that proper biasing is provided to the BACnet MS/TP data bus.

Figure 3: Typical EOL Terminations with BACnet MS/TP Thermostats with Biasing Provided by the EC-BOS Built-in EOL Termination set to ON



When a BACnet MS/TP data bus has a BACnet MS/TP thermostat at one end of the BACnet MS/TP data bus and an EC-BOS at the other end without its built-in EOL termination enabled, fish-tail the BACnet MS/TP data bus back to a controller in which the built-in EOL termination can be set. This will provide the necessary biasing to the BACnet MS/TP data bus.

Figure 4: Fish-tailing the BACnet MS/TP Data Bus to use a Controller with Built-in EOL Termination that will Provide Biasing to the BACnet MS/TP Data Bus



About Setting Built-in EOL Terminations

ECB-PTU Series Line-Powered Controllers use DIP switches (found alongside those DIP switches used to set the MAC address) to enable the build-in EOL resistors and biasing circuitry.

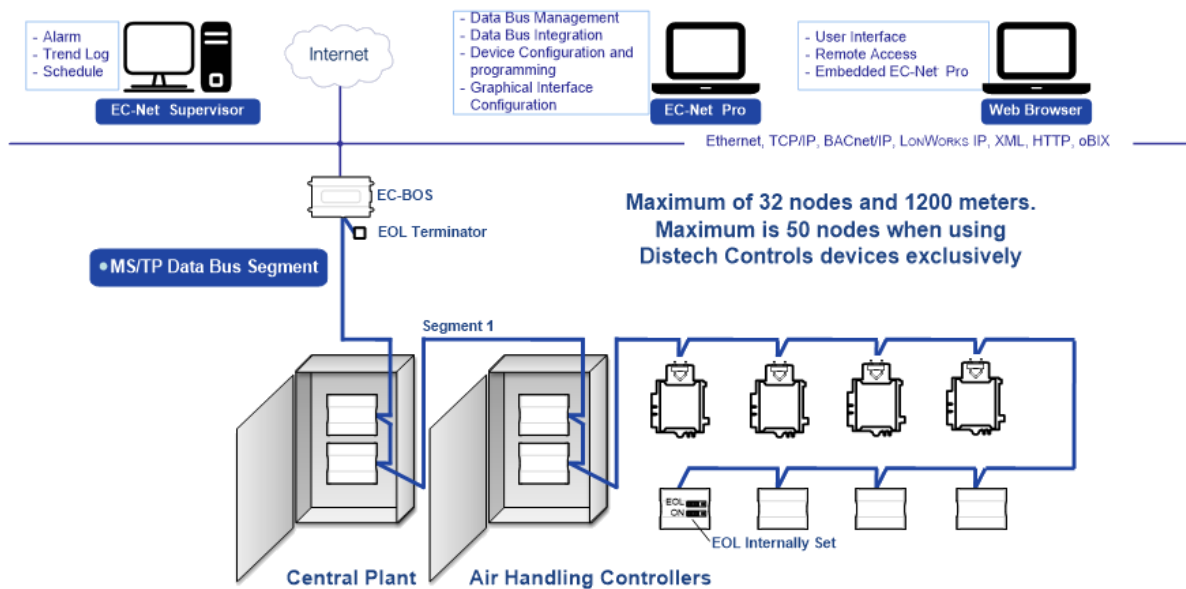
ECB 24V Powered Controllers have built-in EOL terminations. These Controllers use jumpers to enable the EOL resistors and biasing circuitry.

Refer to the controller's Hardware Installation Guide for how to identify and set a controller's built-in EOL terminations.

Only a Daisy-Chained Data Bus Topology is Acceptable

Use a daisy-chained BACnet MS/TP data bus topology only. No other data bus topology is allowed.

Figure 5: Typical BACnet MS/TP LAN Topology Showing How Devices are Daisy-Chained Together to Form One Data Bus Segment

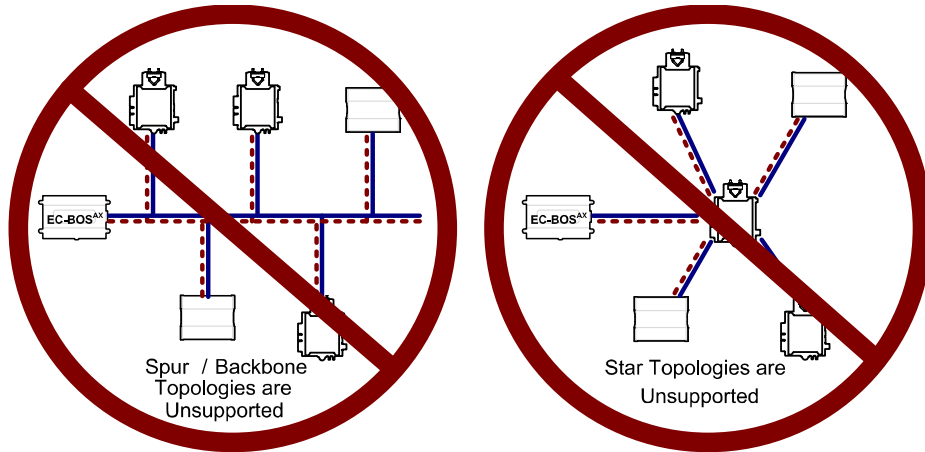


Only linear, daisy-chained devices provide predictable data bus impedances required for reliable data bus operation.

Only a daisy-chained data bus topology should be specified during the planning stages of a project and implemented in the installation phase of the project.

A spur is only permitted when it is connected to the data bus through a repeater (See [Using Repeaters to Extend the Data Bus](#) on page 28.).

Figure 6: Unsupported BACnet MS/TP LAN Topologies



Data Bus Shield Grounding Requirements

The EIA-485 data bus standard requires that the data bus must be shielded against interference. A BACnet MS/TP data bus must also be properly grounded.

For ECB 24V-Powered Controllers: The data bus' cable shields must be twisted together and isolated with electrical tape at each device. Note that for ECB 24V-Powered Controllers, the power supply transformer's secondary that is connected to the 24V COM terminal is grounded. This provides the ground reference for the data bus (see [BACnet MS/TP is a Three-Wire Data Bus](#) on page 41). If the controller is at the end of the BACnet MS/TP data bus, simply isolate the data bus shield with electrical tape.

For ECB-PTU Line-Powered Controllers: The data bus' cable shields must be twisted together and connected to the COM terminal at each ECB PTU Line-Powered Controller. Keep the cable shield connections short and take steps at each device to isolate the cable shield from touching any metal surface by wrapping them with electrical tape, for example. Note that for ECB-PTU Line-Powered Controllers, the data bus' cable shield provides the ground reference for the data bus (see [BACnet MS/TP is a Three-Wire Data Bus](#) on page 41). If the controller is at the end of the BACnet MS/TP data bus, simply connect the data bus shield to the COM terminal (see [Figure 15](#)).



Grounding the shield of a data bus segment in more than one place will more than likely reduce shielding effectiveness.

ECB 24V Powered Controller Data Bus Shield Grounding Requirements

The shield on each data bus segment must be connected to the electrical system ground at one point only, for example, at the Data Bus Master (Building Controller) if there is one, as shown below in [Figure 7](#) and [Figure 8](#). On data bus segments without a Data Bus Master, the ideal point to ground the shield is in the middle of the data bus segment as shown in [Figure 9](#).

Figure 7: Typical Cable-Shield Grounding Requirements for a BACnet MS/TP Data Bus Segment with a Building Controller located at the End of the Data Bus

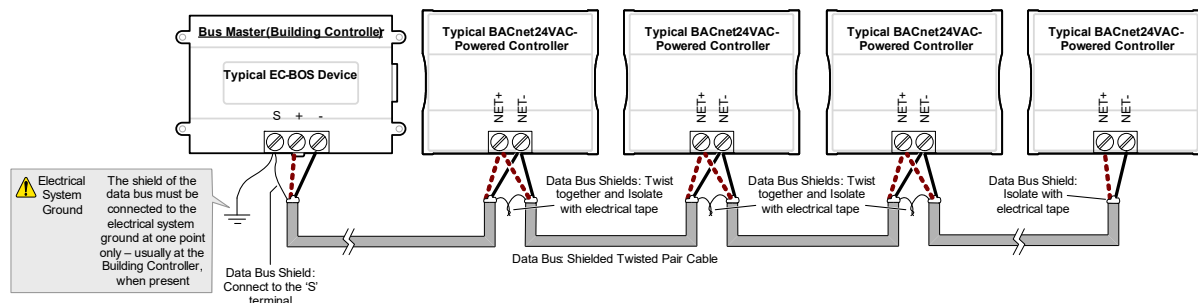


Figure 8: Typical Cable-Shield Grounding Requirements for a BACnet MS/TP Data Bus Segment with a Building Controller located in the Middle of the Data Bus

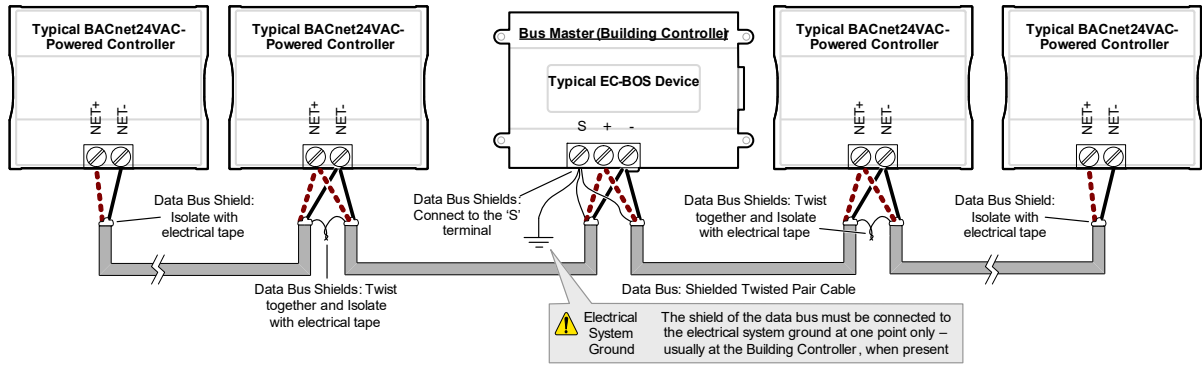
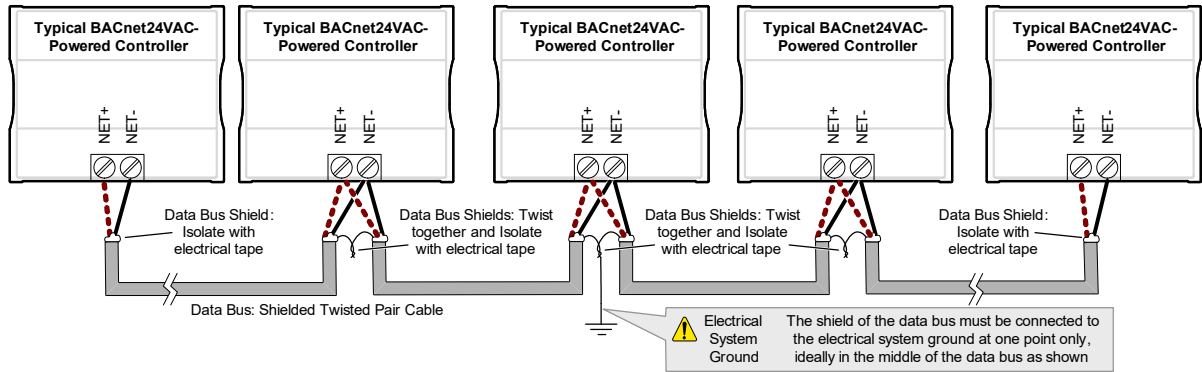


Figure 9: Typical Cable-Shield Grounding Requirements for a BACnet MS/TP Data Bus Segment without a Building Controller



ECB-PTU Line-Powered Data Bus Controller Shield Grounding Requirements

The shield on each data bus segment must be connected to the electrical system ground at one point only, for example, at the Data Bus Master (Building Controller) if there is one, as shown below in [Figure 10](#) and [Figure 12](#). On data bus segments without a Data Bus Master, the ideal point to ground the shield is in the middle of the data bus segment as shown in [Figure 13](#).

Figure 10: Typical Cable-Shield Grounding Requirements for a BACnet MS/TP Data Bus Segment with a Building Controller located in the End of the Data Bus

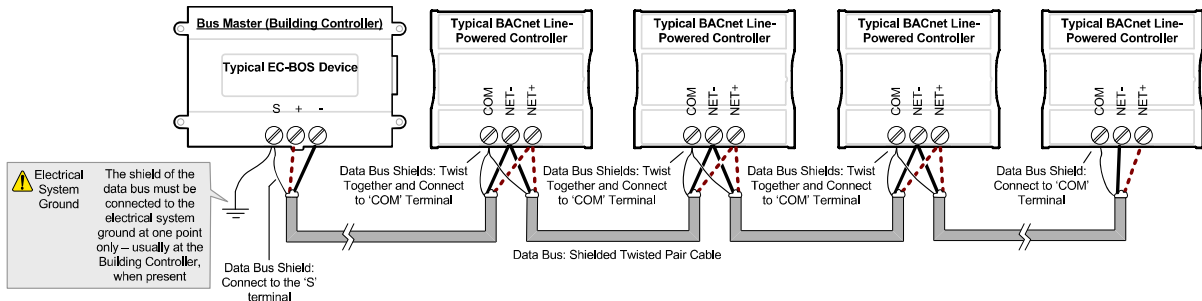


Figure 11: Typical Cable-Shield Grounding Requirements for a BACnet MS/TP Data Bus Segment with a Building Controller located in the Middle of the Data Bus

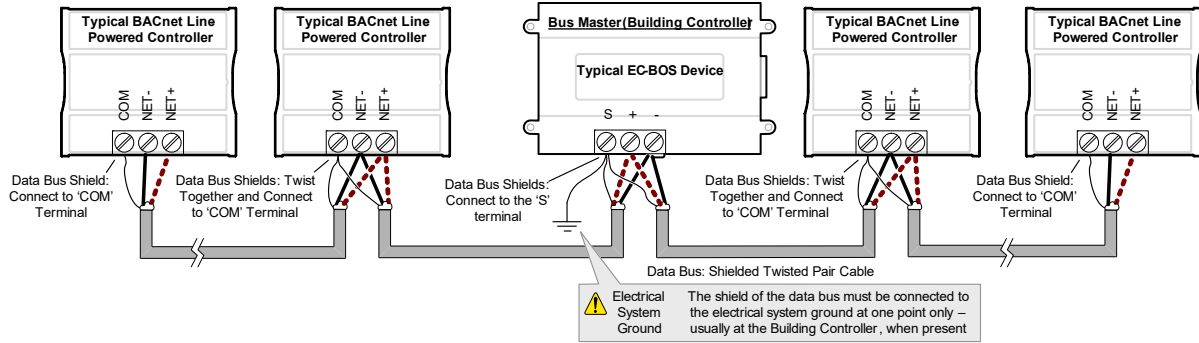
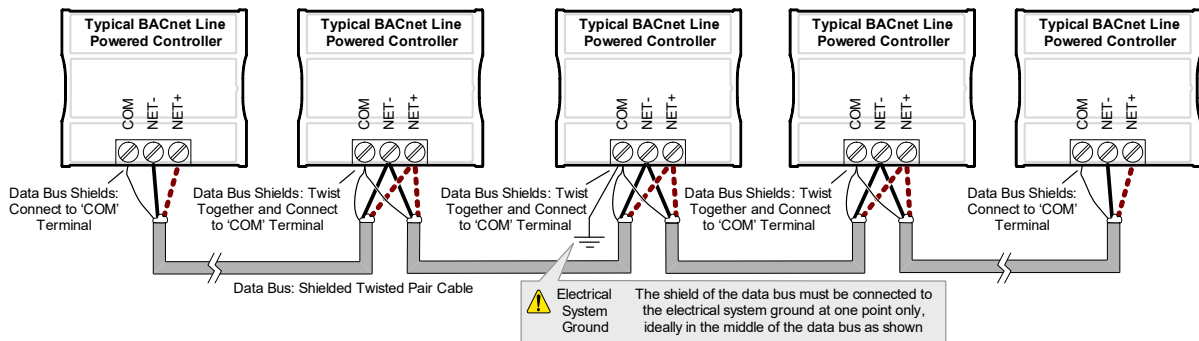


Figure 12: Typical Cable-Shield Grounding Requirements for a BACnet MS/TP Data Bus Segment without Building Controller



Data Bus Shield Grounding Requirements When Mixing Both ECB 24V-Powered Controllers and ECB-PTU Line-Powered Controllers

The shield on each data bus segment must be connected to the electrical system ground at one point only, for example, at the Data Bus Master (Building Controller) if there is one, as shown below in [Figure 13](#) and [Figure 14](#). On data bus segments without a Data Bus Master, the ideal point to ground the shield is in the middle of the data bus segment as shown in [Figure 15](#).

Figure 13: Typical Cable-Shield Grounding Requirements for a BACnet MS/TP Data Bus Segment with a Building Controller located in the End of the Data Bus

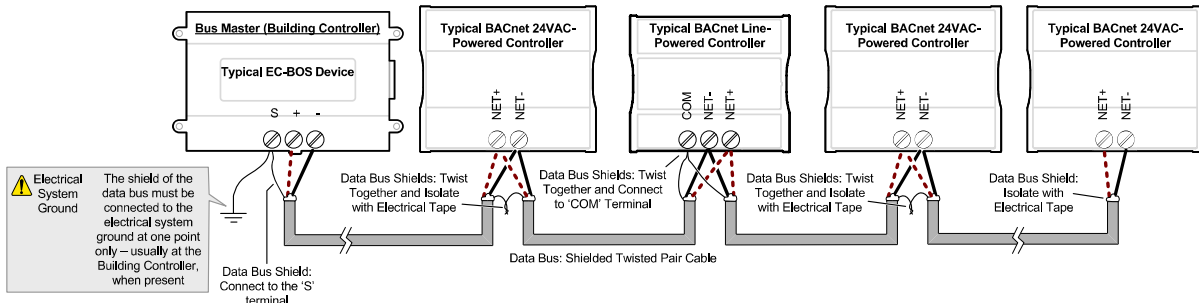


Figure 14: Typical Cable-Shield Grounding Requirements for a BACnet MS/TP Data Bus Segment with a Building Controller located in the Middle of the Data Bus

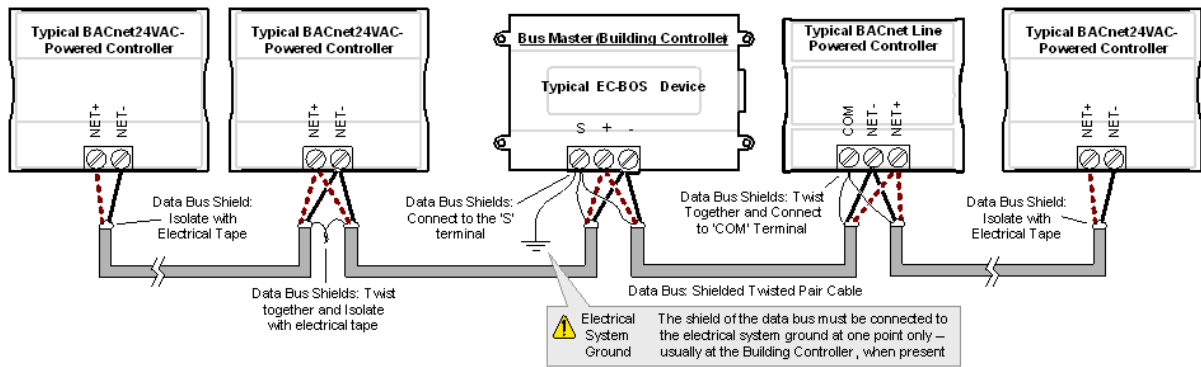
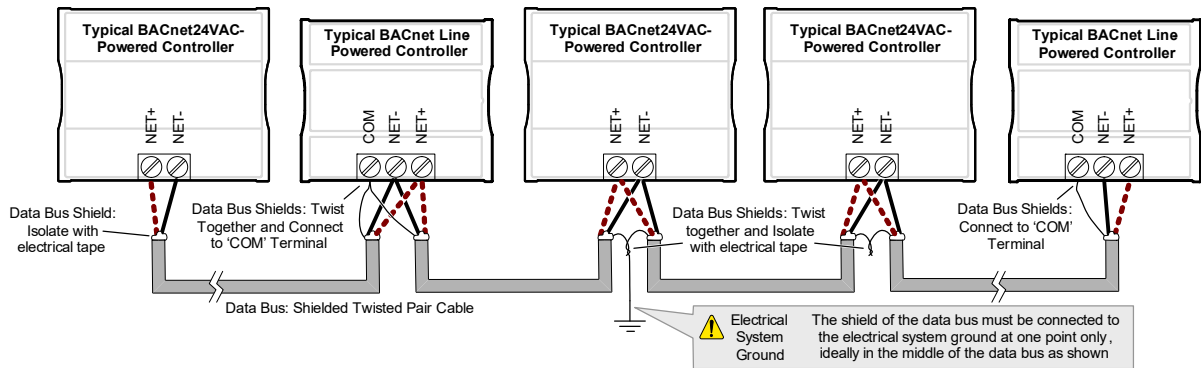


Figure 15: Typical Cable-Shield Grounding Requirements for a BACnet MS/TP Data Bus Segment without Building Controller



Using Repeaters to Extend the Data Bus

A BACnet MS/TP data bus segment can be up to 1220 meters (4000 feet) long with up to a maximum of 50 devices. When a greater length is required, a solution is to use a repeater. A repeater increases the maximum total length of the data bus.

Using an EC-BOS to Increase the Number of Connected Devices

If your BACnet MS/TP network has an EC-BOS, it may be more cost effective to add one or two MS/TP network cards to the EC-BOS in place of an MS/TP Repeater. A standard EC-BOS can support up to four MS/TP networks when equipped with two optional MS/TP network cards. Furthermore, network performance is increased as each MS/TP network will have lower communication latency since each MS/TP network has its own token to pass between devices. See [BACnet MS/TP Data Bus Token-Passing Overview](#) on page 32.

With up to 50 devices per MS/TP network, this allows up to a total of 200 devices to be connected to an EC-BOS. See [Figure 22](#).

Using a Repeater to Extend the Length of the BACnet MS/TP Data Bus

Repeaters can be used to extend a BACnet MS/TP data bus up to 3660 meters (12 000 feet) maximum total length. Do not use more than two repeaters on a BACnet MS/TP LAN.

A BACnet MS/TP repeater is a bi-directional device that regenerates and strengthens the electrical signals that pass through it. It creates two electrically-isolated BACnet MS/TP data bus segments that transparently enable devices on one side of the repeater to communicate with any device on the other side. The two BACnet MS/TP data bus segments have the same requirements of an ordinary BACnet MS/TP data bus segment; that is, each BACnet MS/TP data bus segment:

- Can be up to 1220 meters (4000 feet) long.
- Must have End-of-Line (EOL) termination resistors connected across the two data lines/wires of the twisted pair at the first and last device on the data bus.
- Must respect the maximum limit for [Device Loading](#) on page 15.
- Will have the same network number as they remain part of the same network or LAN.

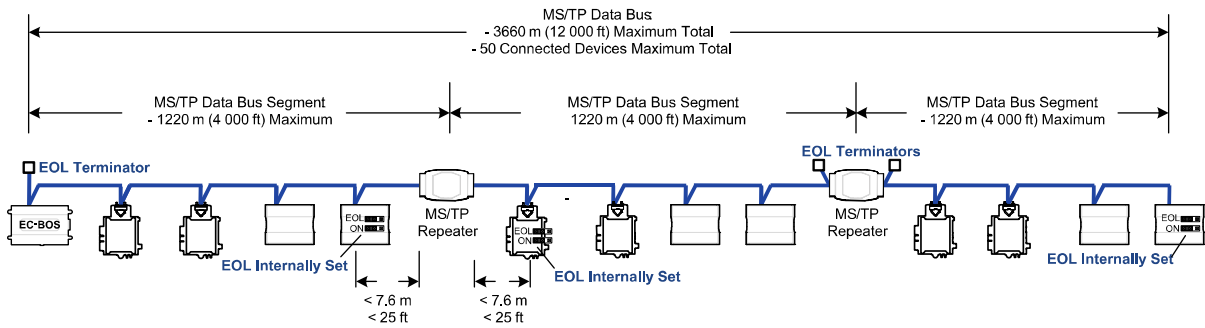
Distech Controls recommends that you connect no more than 50 of our 1/8 or 1/2-load devices on all BACnet MS/TP Data Bus repeater segments when a baud rate of 19 200 or higher is used (preferably 38 400 baud). This is to ensure that the BACnet MS/TP Data Bus has enough bandwidth to efficiently communicate network variables between controllers.



Do not use more than two repeaters on a BACnet MS/TP data bus. A repeater can only connect two BACnet MS/TP data bus segments even if it has ports to support more than two BACnet MS/TP data bus segments.

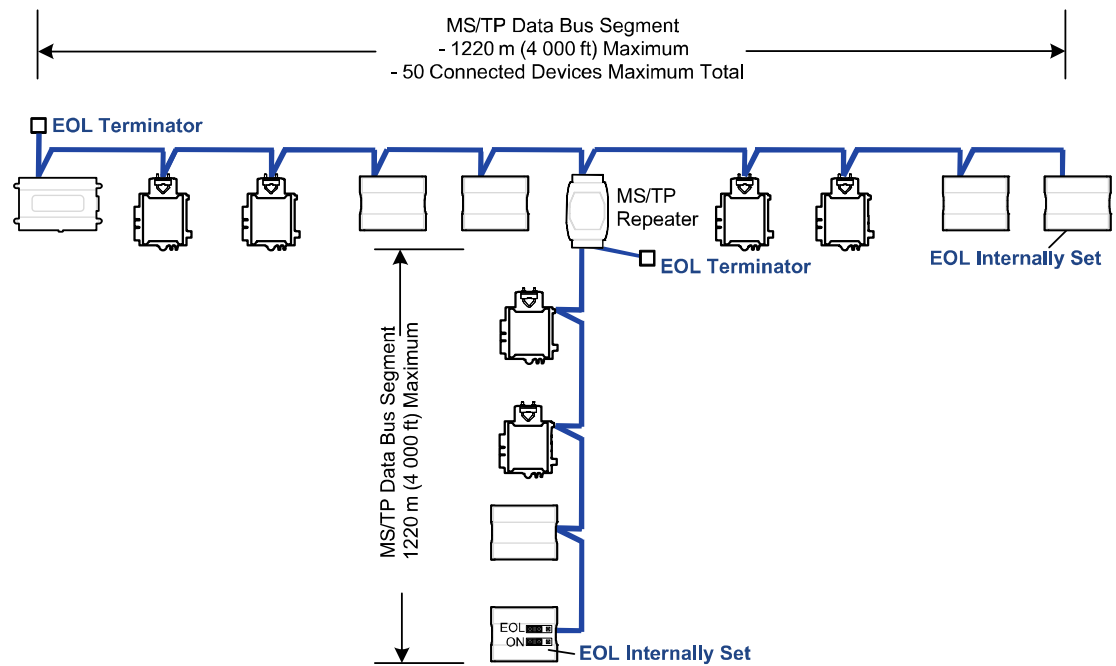
A repeater can be added anywhere to a data bus segment including the end of the segment as shown below.

Figure 16: Using a Repeater to Extend the Range of the LAN



A repeater can be used to create a spur as shown below.

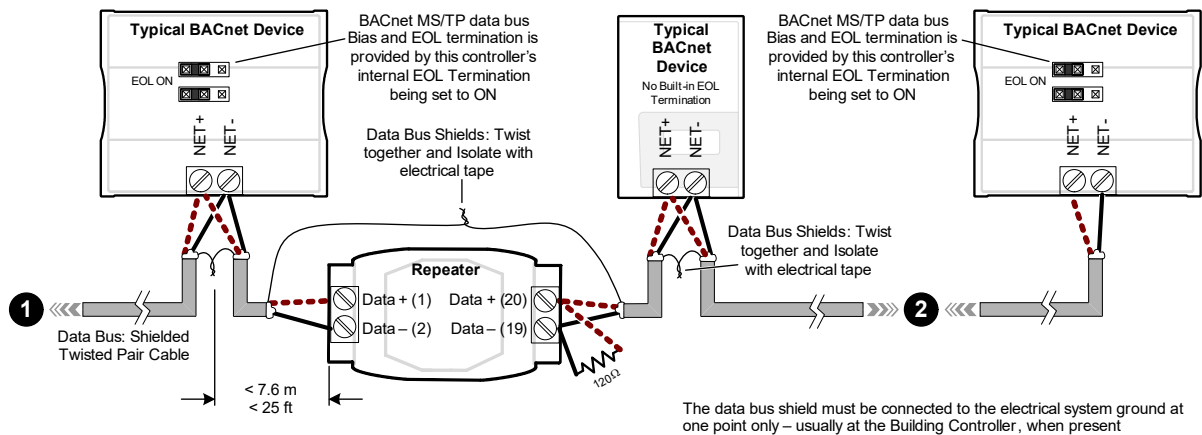
Figure 17: Adding a Spur by Using a Repeater



A repeater is counted as a device on each data bus to which it is connected.

When third party devices are connected to a data bus segment, the number of devices that can be connected to that data bus segment may be reduced. See [Device Loading](#) on page 15.

Figure 18: Repeater Connections when it is the First or Last Device on its Respective Data Bus Segment



The BACnet MS/TP Data Bus must be biased. This bias can only be provided by built-in EOL termination resistors (ones set with a jumper or DIP switch). When a repeater is the first or last device on its respective data bus segment, use the following methods to provide MS/TP Data Bus biasing and EOL termination as applicable to your situation:

1. On the BACnet MS/TP data bus segment ❶ shown in [Figure 18](#), bias and EOL termination is provided by a controller's built-in EOL termination being set to ON. In this case the connection to the repeater cannot be more than 7.6 meters (25 feet) from this controller.
2. On the BACnet MS/TP data bus segment ❷ shown in [Figure 18](#), a 120Ω EOL Termination resistor is added to the repeater's terminals. Biasing for this BACnet MS/TP data bus segment is provided by the built-in EOL termination being set to ON at the last controller at the other end of this data bus.

See [When to Use EOL Terminations](#) on page 20 for more information. The shield of one data bus must be grounded at one point as specified in see [Data Bus Shield Grounding Requirements](#) on page 24. The shields of the two data buses must be connected together and isolated with electrical tape as shown in [Figure 18](#). Refer to the controller's Hardware Installation Guide for how to identify and set a controller's built-in EOL terminations.

Device Addressing

Device addressing allows the coordinated transfer of messages between the intended devices on the BACnet MS/TP data bus and with devices connected to the internetwork. For this, each device connected to the BACnet MS/TP data bus is identified by a MAC address, a Device Instance number, and a Network Number:

- The MAC Address uniquely identifies a device on a Network (identified by a Network Number). Devices on another Network can have the same MAC Address as messages are not passed at the internetwork level using the MAC Address. The MAC Address also defines the devices on the data bus that are Masters and Slaves, among other categories (see [Table 7](#)). The MAC Address is also used to share data bus bandwidth between devices through token passing between Master devices.
- The Device Instance uniquely identifies a device across the BACnet internetwork. The Device Instance is any number between 0 and 4 194 303. It is with the Device Instance that messages are exchanged between BACnet devices. The Device Instance is also used by routers to forward messages to devices located elsewhere in the internetwork. Unlike a MAC Address, a Device Instance cannot be reused elsewhere in the BACnet internetwork (it must be unique for the entire network).
- The Network Number is any number between 1 and 65 534. A network number identifies a LAN for routing purposes.

Both the MAC Address and the Device Instance must be set for each device and are essential for proper BACnet LAN operation.

For an example of how MAC address, Device Instance number, and Network Number apply to a typical BACnet network, see [Figure 22](#).

About the MAC Address

The MAC Address is a number from 0 to 255; however we recommend reserving some MAC Addresses for common commissioning and maintenance tasks. For example, when a portable adaptor is set to use one of these reserved MAC Addresses, it can be temporarily connected with certainty to any BACnet MS/TP data bus of any site without conflicting with other devices already connected to the BACnet MS/TP data bus. We strongly recommend that the MAC address of each MS/TP port of an EC-BOS be always set to 0.

MAC Addresses should be used as shown in the following table.

Table 7: Recommended BACnet MS/TP Bus MAC Address Values / Ranges for BACnet MS/TP Data Bus Devices

MAC Address Value / Range	Usage	Devices
0	Data Bus Master (Building Controller)	EC-BOS This address is invalid for Distech Controls' ECB devices

Table 7: Recommended BACnet MS/TP Bus MAC Address Values / Ranges for BACnet MS/TP Data Bus Devices

MAC Address Value / Range	Usage	Devices
1	Temporary commissioning connection	Portable adaptor MAC Address for a temporary commissioning and maintenance connection
2	Reserved	Other
3-127	Master Range	Master devices: All Distech Controls' devices are master devices and should be in this MAC Address range
128-254	Slave Range	Slave devices and network sensors
255	Broadcast	Do not apply address 255 to any device

BACnet MS/TP Data Bus Token-Passing Overview

The BACnet MS/TP data bus protocol is a peer-to-peer, multiple-master protocol that shares data bus bandwidth by passing a token between Master devices on the data bus that authorizes the device that is holding the token to initiate communications on the data bus. Once the device has completed its request(s), it closes the communications channel, passes the token to the next Master device (making it the current Master), and liberates the data bus.

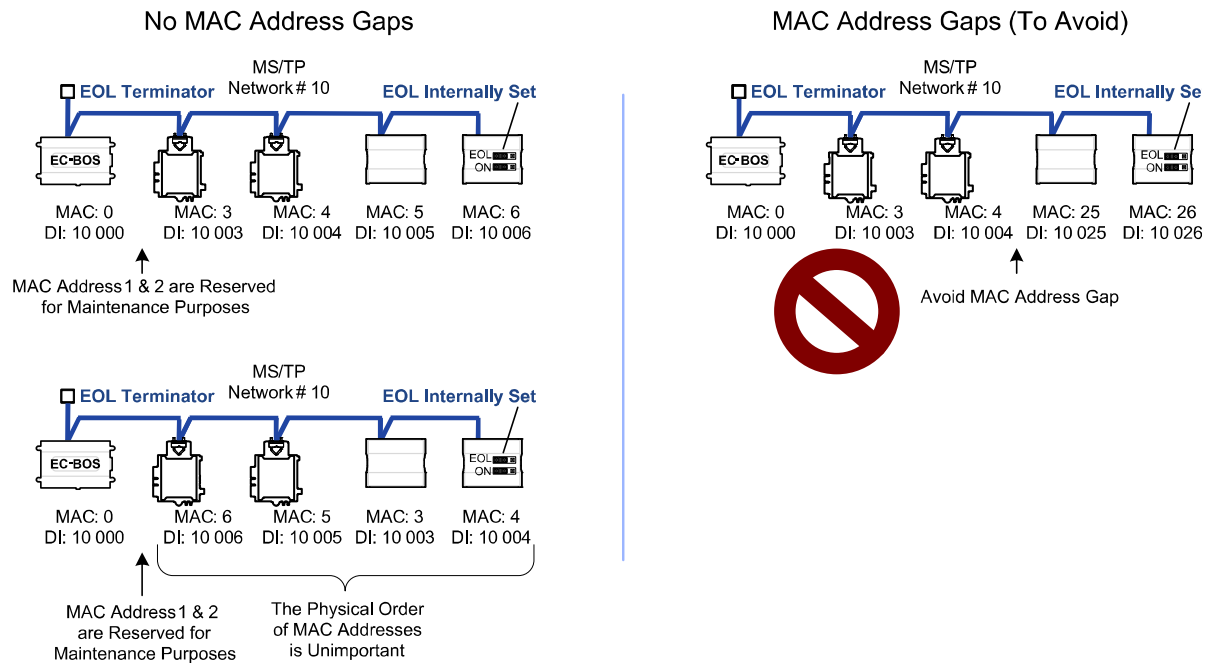
The token is passed through a short message from device to device on the BACnet MS/TP data bus in consecutive order starting from the lowest MAC address (MAC Address = 0) to the next MAC Address.

Gaps or pockets of unassigned device MAC Addresses should be avoided as this reduces data bus performance. Once a master has finished making its requests, it must poll for the next master that may exist on the Data Bus. It is the timeout for each unassigned MAC Address that slows down the data bus.

The way MAC Addresses are assigned is not a physical requirement: Devices can be daisy-chained on the data bus in any physical order regardless of their MAC Address sequence. The goal is to avoid gaps in the device MAC Address range.

Slave devices cannot accept the token, and therefore can never initiate communications. A Slave can only communicate on the data bus to respond to a data request addressed to it from a Master device. Gaps in slave device MAC Addressing have no impact on BACnet MS/TP data bus performance.

Figure 19: Setting the Max Master on the Data Bus Master (Building Controller) to the Highest MAC Address Used on the BACnet MS/TP Data Bus



About Tuning the Max Info Frames Parameter

Once a device has the token, it can make a number of information requests to other devices on the BACnet intranetwork. The maximum number of requests is limited by the **Max Info Frames** parameter. Once the device has made the maximum number of requests it is permitted to make according to the **Max Info Frames** parameter, the device passes the token to the following device with the next higher MAC address. This makes the BACnet MS/TP Data Bus more reactive for all devices by preventing a device from hanging on to the token for too long. Ordinary BACnet MS/TP devices should have the Max Info Frames parameter set to between 2 and 4. The Data Bus Master (Building Controller) should have the **Max Info Frames** parameter set to 20.

About Tuning the Max Master Parameter

To prevent the passing of the token to unused MAC Addresses situated after the final Master device, the Max Master parameter must be set. By default, the Max Master for the Data Bus Master (Building Controller) is set to 127 which allows for the theoretical maximum of 127 devices besides the Data Bus Master to be connected to the data bus.

In practice, the actual number of devices connected to a data bus is far less, resulting in a gap between the highest MAC Address of any device connected to the data bus and the value set for Max Master. This gap unnecessarily slows-down the data bus with Poll for Master requests.

When commissioning a BACnet MS/TP Data Bus, it is useful to start with the Max Master set to 127 so as to be able to discover all devices connected to the data bus. Then, once all devices have been discovered and the MAC Addressing is finalized by eliminating any gaps in the address range, set the Max Master (maximum MAC Address) in the EC-BOS (Building

Controller) to the highest Master device's MAC Address number to optimize the efficiency of the data bus.

Setting the Max Master and Max Info Frames

The Max Master and Max Info Frames are parameters used to optimize a BACnet MS/TP Data Bus. This is set in the Data Bus Master (EC-BOS Building Controller) for the MS/TP port of the Data Bus Master and for each BACnet MS/TP device connected on that port.

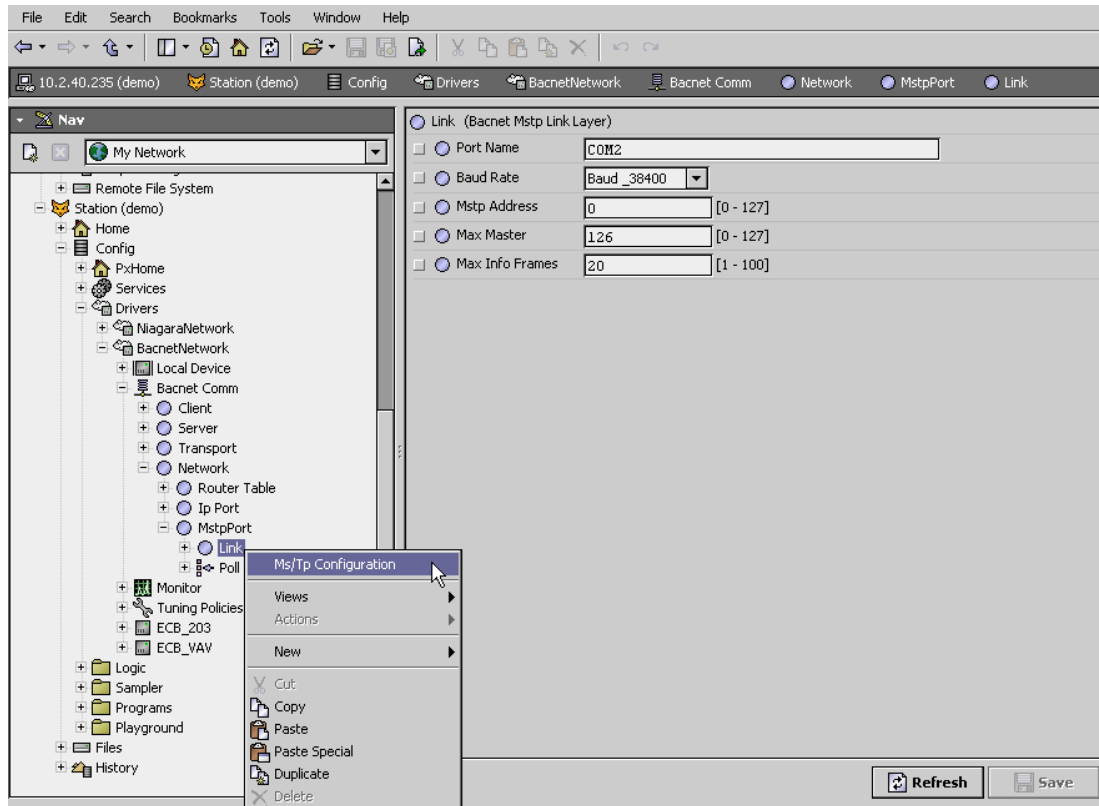
A Configure MS/TP Devices tool is available to automate this task. This tool:

- Can only be used with a live database during commissioning. If you add more devices to the data bus, you must run this tool again.
- Automatically calculates the value for the Max Master by finding the highest Master device MAC Address on the connected BACnet MS/TP data bus plus 1.
- Sets the Max Master for all master devices including the Data Bus Master (EC-BOS).
- Sets the Max Info Frames for all master devices excluding the Data Bus Master (EC-BOS).

For the Data Bus Master (EC-BOS), set the **Max Info Frames** to 20 in the screen shown in [Figure 21](#) as this is a device that will make more requests for service from other devices on the network. In general, according to the way a device is programmed, the **Max Info Frames** may have to be set to a higher value than for other devices. For example, when Roof Top Unit Controllers are used with VAV controllers that use gfxApplications code, they should also have their **Max Info Frames** set to a higher value such as 5, as Roof Top Unit Controllers will poll many VAV controllers for information.

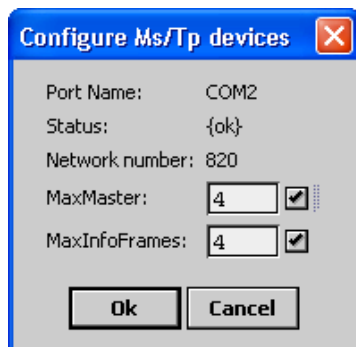
Set the Max Master and Max Info Frames as follows.

1. Right-click the **Link** node in the **Nav** tree and select **Ms/Tp Configuration**.



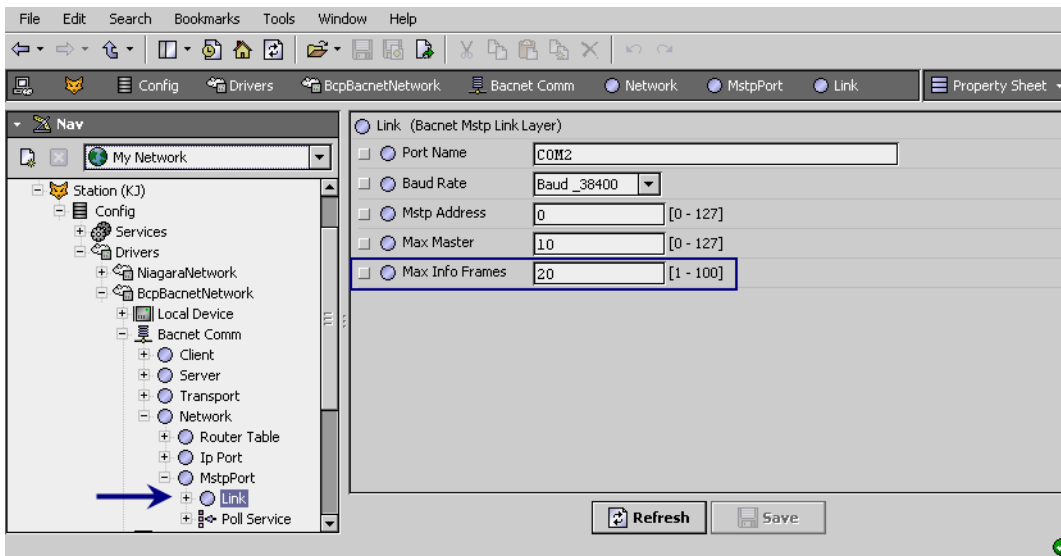
2. The **Configure Ms/Tp devices** dialog box is displayed. The network must be live; the **Status** shown in **Configure Ms/Tp devices** window must be **{ok}**.

Figure 20: Setting the Max Master on the Data Bus Master (EC-BOS) to the Highest MAC Address Used on the BACnet MS/TP Data Bus



3. A confirmation message is shown.
4. Set the **Max Info Frames** to 20 for the Data Bus Master (EC-BOS) as shown in the screen below.

Figure 21: Setting the Max Info Frames on the Data Bus Master (EC-BOS)



Default Device Instance Number Numbering System for Distech Controls' controllers

By default, controllers from Distech Controls automatically self-assign a Device Instance number generated from the unique MAC Address assigned to the controller during installation. The Device Instance number is calculated as follows:

$$\text{Device Instance number} = 364 \times 1000 + \text{MAC Address}$$

Where 364 is Distech Controls unique BACnet Manufacturer ID.

This Numbering system is sufficient for a BACnet network that has only one Building Controller. For larger BACnet networks that have more than one Building Controller (to form a BACnet intranetwork), set the MAC Addresses, Device Instance Numbers and Network Numbers according to the numbering scheme below.

Adopting a Numbering System for MAC Addresses, Device Instance Numbers, and Network Numbers

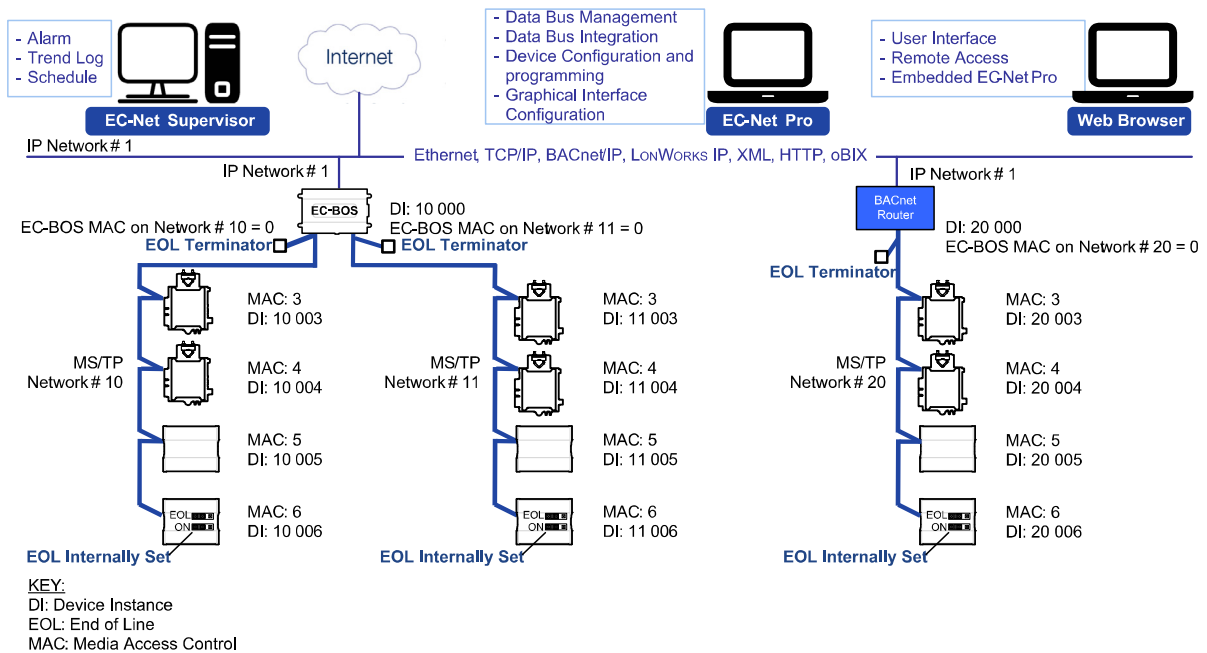
Good network planning requires a well thought-out numbering scheme for device MAC Addresses, Device Instance Numbers (DI), and Network Numbers. We recommend the following scheme, as it reuses the MAC Address and Network Number in the Device Instance number to make it easier for a network administrator to know where a device is located in the network. This is shown below.

Table 8: Recommended Numbering Scheme for MAC Addresses, Instance Numbers, and Network Numbers

Description	Range	Example
BACnet/IP Network Number	0 to 65 534	1
Building Controller BACnet/IP Device Instance Numbers: Multiples of 10 000	10 000 to 4 190 000	10 000 20 000
BACnet MS/TP Network Number: Building Controller BACnet/IP Device Instance Number/1000 + 0,1,2,3,4 (for each LAN)	10 to 4190	10 11 12
BACnet MS/TP Device Instance Number = EC-BOS BACnet MS/TP Network Number * 1000 + MAC Address	10 000 to 4 190 256	10 006 where MAC = 6

An example of this numbering system is shown below.

Figure 22: BACnet MS/TP Numbering System for MAC Addresses, Device Instance Numbers, and Network Numbers



When discovering devices with an EC-BOS which has the routing option configured, it will discover all BACnet devices connected to all EC-BOS controllers. Make sure to add only the devices connected to the MS/TP port of the specific EC-BOS being configured. Using this numbering system will greatly help to identify those devices that should be added to a given EC-BOS.

Setting the Controller's MAC Address

The controller's MAC address can be set as follows:

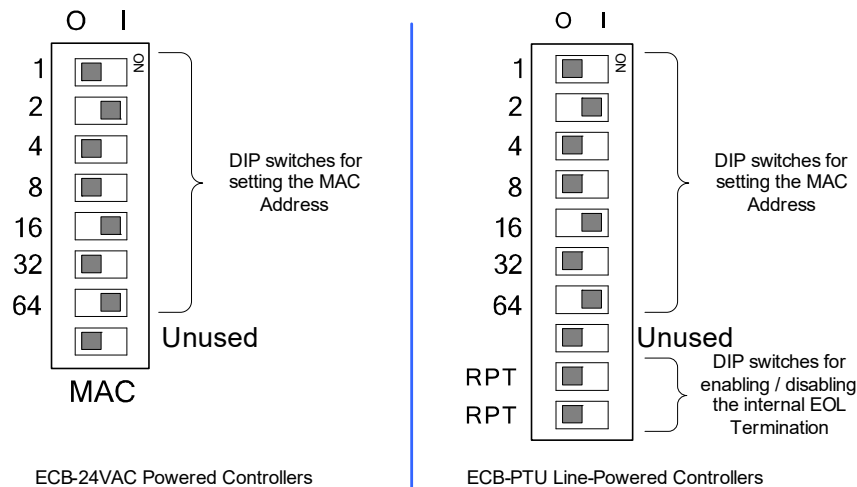
- Through a DIP switch located on its faceplate or under the cover.
- Through a password-protected menu of a connected Allure EC-Smart-View sensor.
- Through the controller's color LCD screen (50 Series controller).

Setting the Controller's MAC Address Through a DIP Switch

The MAC address on most devices can be set through a DIP switch located on its faceplate or under the cover (in the case of an ECB-103 or ECB-VAV series controller - when equipped). This can be done before the controller is installed or powered up.

An example of how to set the device's MAC address DIP switch is shown below for a Distech Controls' ECB 24V-powered controller on the left, and for a Distech Controls' ECB-PTU 208 controller on the right.

Figure 23: Typical Device MAC Address DIP Switch Set to 82



The address is the sum of the numbers set to ON. For example, if the second (2), fifth (16), and seventh (64) DIP switches are set to ON (or to the right position), the device MAC address is 82 (2 + 16 + 64). Addresses from 3 to 127 are recommended to be used (see [Table 7](#)). See also [How to Set a Dip Switch](#) on page 131.

The controller must be power cycled after the MAC address DIP switch setting has been changed for the new MAC address setting to take effect.

For more information about how to set the device's MAC address, refer to the device's hardware installation guide.

Setting the Controller's MAC Address Through a Connected Allure EC-Smart-Vue Sensor

To commission a controller that has a MAC Address DIP switch located on the faceplate or under the cover (in the case of an ECB-103 or ECB-VAV Series controller - when equipped) with an Allure EC-Smart-Vue sensor, first set all the MAC address DIP switches to 0 (this is the factory default). Connect an Allure EC-Smart-Vue sensor to the controller to then set the MAC address. See [Commissioning Controllers](#) on page 99 for this procedure. If the MAC Address is set with an Allure EC-Smart-Vue sensor, the change is made immediately without any need to power cycle the controller.

Setting the Controller's MAC Address Through the color LCD Screen of a 50 Series Controller

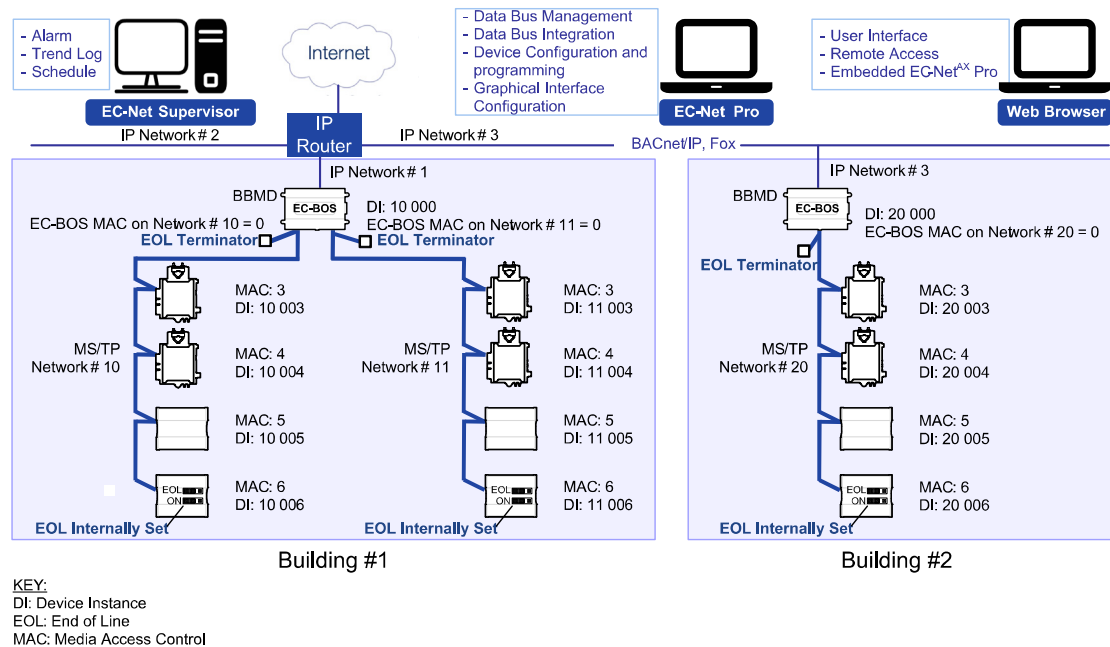
To commission a controller through its color LCD screen, first set all the MAC address DIP switches to 0 (this is the factory default). Through the color LCD Screen, set the MAC address in the Options menu. Refer to the [50 Series User Guide](#) for more information.

If the MAC Address is set with through the color LCD Screen, the change is made immediately without any need to power cycle the controller.

Inter-Building BACnet Connection

BACnet network connections between buildings must be made using BACnet/IP or FOX as shown below.

Figure 24: Typical Inter-Building Connection Using BACnet/IP or FOX



BACnet/IP Broadcast Management Device Service

Though BACnet/IP or FOX uses IP protocol to communicate, a standard IP router does not forward broadcast messages which are important in BACnet to identify services that are available within the BACnet internetwork.

When two Building Controllers communicate to each other over a standard IP connection that is separated by an IP router, both Building Controllers need the BACnet/IP Broadcast Management Device (BBMD) service to be configured and operational.

The BBMD service identifies BACnet messages on the BACnet MS/TP network that are intended for a device located on another BACnet network. The BBMD service encapsulates these messages into an IP message to the appropriate BBMD service of the other BACnet MS/TP network(s). The BBMD service on these networks strips out the encapsulation and sends the BACnet message on to the appropriate devices.

When sending BACnet messages across a standard IP connection that has an IP router, there must be one BBMD service running on each BACnet MS/TP network.

Power Supply Requirements for 24V Controllers

BACnet MS/TP is a Three-Wire Data Bus

Even though data is transmitted over a 2-wire twisted pair, all EIA-485 transceivers interpret the voltage levels of the transmitted differential signals with respect to a third voltage reference common to all devices connected to the data bus (signal reference). In practice, this common signal reference is provided by the building's electrical system grounding wires that are required by electrical safety codes worldwide. Without this signal reference, transceivers may interpret the voltage levels of the differential data signals incorrectly, and this may result in data transmission errors.



Note: ECB/ECL-VAV controllers are insulated devices and therefore may not be grounded. When not grounded, the reference for the BACnet MS/TP data bus is made by connecting the shield of the BACnet MS/TP data bus to the controller's COM terminal to provide a signal reference. This shield is grounded at one point only - see [Figure 13](#).



ECB-PTU line-powered controllers are double-insulated devices and therefore are not grounded. The reference for the BACnet MS/TP data bus is made by connecting the shield of the BACnet MS/TP data bus to the controller's COM terminal to provide a signal reference. This shield is grounded at one point only - see [ECB-PTU Line-Powered Data Bus Controller Shield Grounding Requirements](#) on page 25.

Avoid Ground Lift

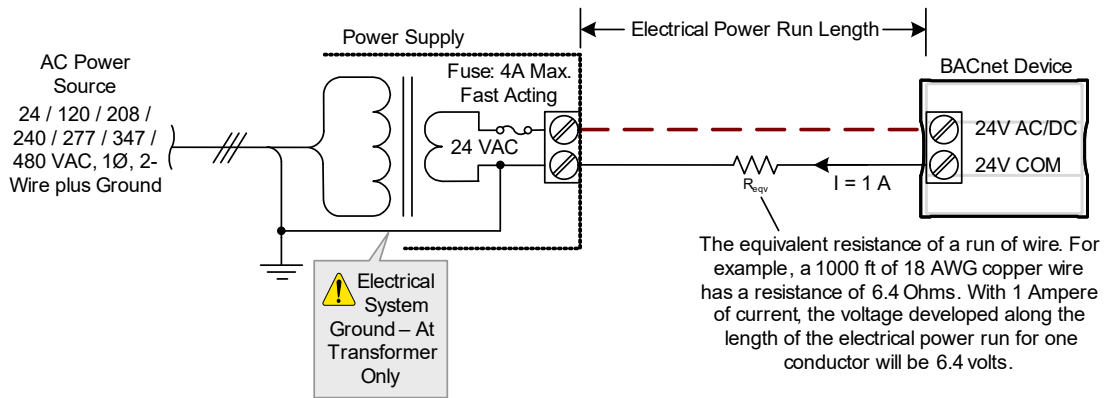
24V Power wiring runs should not be too long, nor have too many devices connected to it. Wiring used to supply power to devices has a resistance that is proportional to the length of the wiring run (see [Table 9](#)).

Table 9: Resistance of Common Copper Wire Sizes

AWG	Diameter (Ø)		Area		Copper wire resistance	
	(inch)	(mm)	(kcmil)	(mm ²)	(Ω/km)	(Ω/1000ft)
14	0.0641	1.628	4.11	2.08	8.286	2.525
16	0.0508	1.291	2.58	1.31	13.17	4.016
18	0.0403	1.024	1.62	0.823	20.95	6.385

If the power run from the power supply is relatively long and it supplies power to many devices, a voltage will develop over the length of wire. For example, a 1000 ft of 18 AWG copper wire has a resistance of 6.4 Ohms. If this wire is supplying 1 Ampere of current to connected devices (as shown in [Figure 25](#)), the voltage developed across it will be 6.4 volts. This effect is called ground lift.

Figure 25: Ground Lift from a Long Power Run with a 24VAC Device



If the 24V COM terminal is the signal reference point for the data bus, ground lift offsets the data bus voltage reference that is used to interpret valid data levels sent on the data bus. If the ground lift is more than 7 volts peak, there is a risk of data corruption and offline events due to the device being incapable of correctly reading data signals from the data bus. Thus it is important to keep the power supply (transformer) as close to the controller as possible.

Techniques to Reduce Ground Lift

Reduce the impact of ground lift as follows:

- Use a heavier gauge wire.
- Use a 3-wire power connection when available.
- Add more wire runs. Connect these wire runs to the power supply in a star pattern.
- For controllers that accept DC power (that is, models without triac outputs): Specify a 24VDC power supply. The continuous and even voltage of a DC power supply makes more efficient use of the power handling capabilities of a power run. A 24VDC power supply eliminates the 2.5 multiplication factor associated with the peak AC current being 2.5 times the average RMS AC current. See below.

About External Loads

When calculating a controller's power consumption to size the 24VAC transformer, you must also add the external loads the controller is going to supply, including the power consumption of any connected subnet module (for example, for Allure Series sensors). Refer to the respective module's datasheet for related power consumption information.

A controller can support a maximum of two Allure Series sensor models equipped with a CO₂ sensor. See [Subnetwork Module Compatibility and Supported Quantity Charts](#) on page 71 for how many Allure EC-Smart-Vue sensors are supported by a given controller model. The remaining connected Allure Series sensor models must be without a CO₂ sensor.

For the ECB-VAV model, see the room device calculator spreadsheet available for download from our website to determine the power requirements and supported quantities of connected subnet modules: [VAV-Smart Room Control Device Calculator.xlsm](#)

Peak Current

Particular attention should be paid to the peak current absorbed by devices that are powered by an AC circuit. Most Distech Controls 24VAC devices use half-wave rectifiers to supply their onboard electronics (this is common with most controls manufacturers). With this configuration, the peak AC current is approximately 2.5 times the average RMS AC current. The ECB/ECL-VAV controllers are isolated full-wave rectified with power factor correction. The peak AC current is approximately 1.4 times the average RMS AC current.

Transformer Selection and Determining the Maximum Power Run Length



Distech Controls' 24V-powered devices are Class 2 Products. To conform to Class 2 installation requirements, only use transformers of 100VA or less to power the device(s).

It is recommended to wire only one controller per 24VAC transformer.

When calculating a controller's power consumption to size the 24VAC transformer, you must also add the external loads the controller is going to supply, including the power consumption of any connected subnet module (for example, Allure™ Series Communicating Sensors).

If only one 24VAC transformer is available, determine the maximum number of daisy-chained VAV controllers that can be supplied on a single power cable supplied by a 100 VA transformer, according to the controller's expected power consumption including external loads, the cable's wire gauge, and the total cable length from the following figures ([Figure 26](#) and [Figure 27](#)). Any installation condition that is outside of the parameters of the following graph should be avoided.

To maximize daisy-chaining performance, the transformer should be installed as close as possible to the first VAV. If this is not possible, then use 14 AWG wire to power the first VAV which can help reduce a voltage drop at the end of the daisy-chain.



The recommended minimum peak input voltage is 27.2V_p

Figure 26: Maximum number of VAV Devices on a Daisy-Chain at Evenly Spaced Intervals

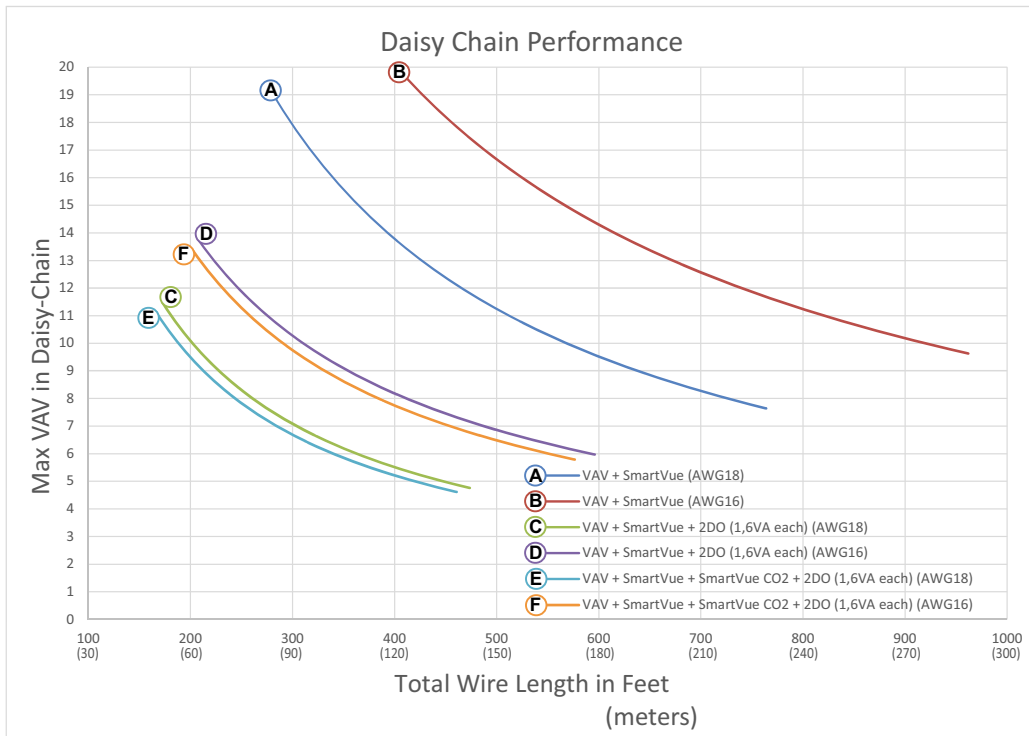
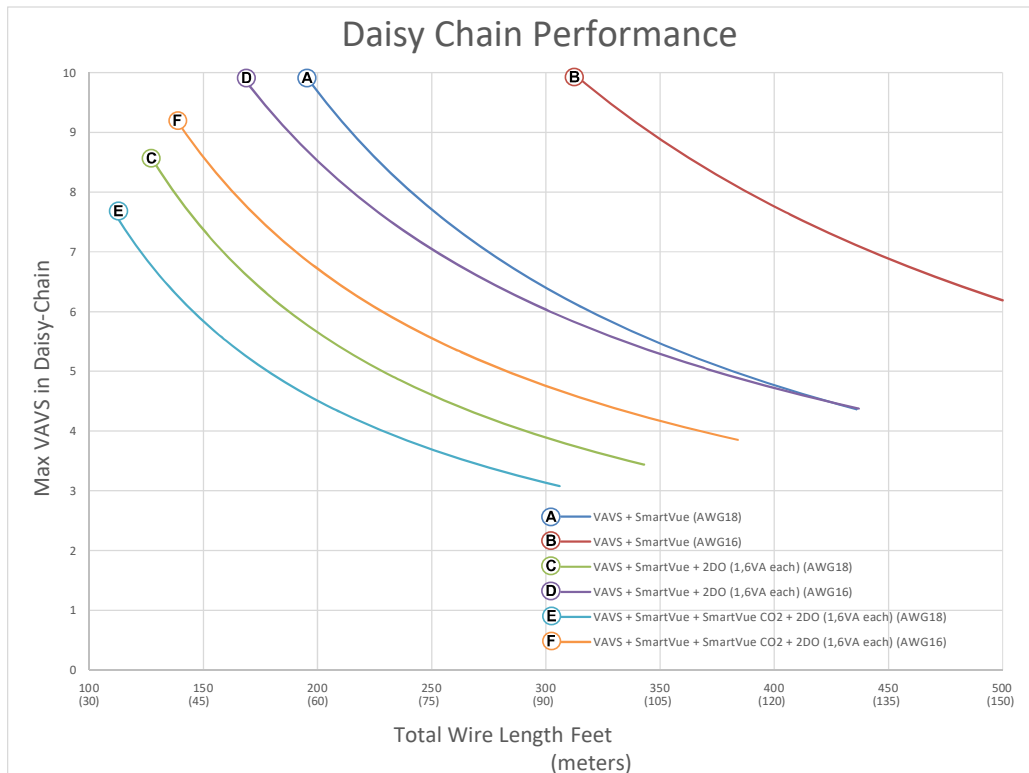


Figure 27: Maximum Number of VAVS Devices on a Daisy-Chain at Evenly Spaced Intervals





Laboratory testing conditions for the above graph are as follows:

- Distance between each VAV is evenly spaced along the entire wire length
- Transformer specification: 100VA (120/24VAC)
- Tested at room temperature with low voltage line conditions: 108VAC (50Hz)

For non-VAV devices, determine the appropriate size transformer for the job as follows:

1. Add up the power requirements of all devices plus all external loads (see [About External Loads](#) on page 42). Multiply the total power needed by a multiplier of 1.3, as a security margin. For example, to power five devices (15 VA each), the total load is 75 VA multiplied by 1.3 is 98 VA. Choose a size of transformer just over this amount: For example, a 100 VA model.
2. When the total load of a number of devices requires a transformer with a rating greater than 100 VA, use two or more transformers. Ensure that the load to be connected to each transformer follows the guideline of Step 1 above.



Always use a separate transformer for each ECL-600 series controller and for each of its associated I/O Extension Modules. See [ECx-4XX I/O Extension Module Power Supply Requirements](#) on page 47.

Recommended 24V Power Cable

The table below lists Distech Controls' recommended power cable.

Table 10: Distech Controls Recommended 24V Power Cable

Cable Type AWG - Number of Conductors	Non-Plenum Applications (FT4)		Plenum Applications (FT6)	
	Part Number	O.D. (Ø)	Part Number	O.D. (Ø)
18-2	CB-W181P-1002	5.0mm / 0.20in.	CB-W181P-2051-	5.0mm / 0.20in.
16-2	CB-W161P-1031	4.8mm / 0.19in.	CB-W161P-2062	4.8mm / 0.19in.
14-2	CB-W141P-1081	7.2mm / 0.29in.	CB-W141P-2013	7.2mm / 0.29in.

24VAC Power Supply Connection

Use an external fuse on the 24VAC side (secondary side) of the transformer, as shown in [Figure 28](#), to protect all controllers against power line spikes.

Maintain consistent polarity when connecting controllers and devices to the transformer, as shown in [Typical Device BACnet MS/TP LAN and Power Wiring Diagram](#) on page 49. That is, the 24V COM terminal of each controller and each peripheral must be connected to the same terminal on the secondary side of the transformer. This transformer terminal must be connected to the building's ground. This ensures that the reference terminals of all devices connected to any BACnet MS/TP data bus in the building are at the same potential.

Most Distech Controls devices use the 24V COM terminal as the signal reference point for the data bus (see [Table 1](#) and [Figure 3](#)) for common device terminal labels). As a consequence, you must wire the power supply (for any given number of devices) as shown in [Figure 28](#), such that the transformer's secondary that is connected to 24V COM / C terminals is connected to the building's ground at the power supply. This ensures that the 24V COM / C terminals of all devices connected to any BACnet MS/TP data bus in the building are at the same electrical potential.

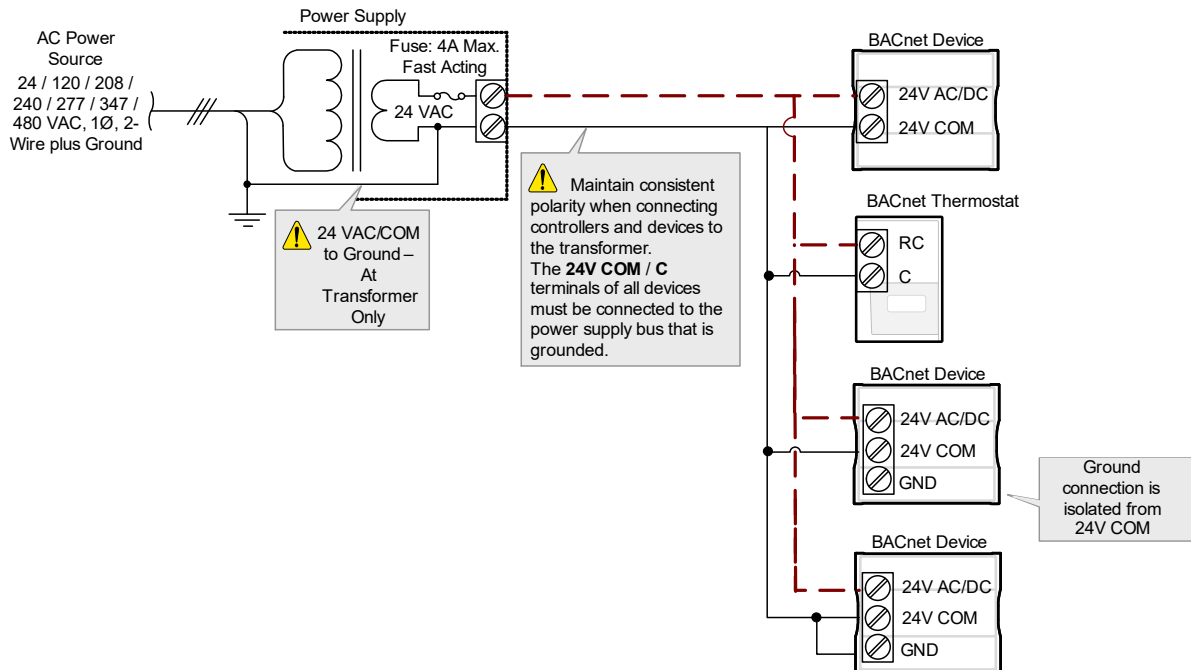


As specified by electrical safety codes worldwide, the building's protective ground network must not be used to conduct electrical current under normal conditions. Such current can lift the reference voltage sensed at a controller's 24V COM terminal, thus resulting in data transmission errors.

A mechanical ground is unacceptable: Do not use a pipe, conduit, or duct work for a ground. The power supply must have a dedicated ground wire that comes from the main electrical supply panel.

Any connection between buildings cannot be made with BACnet MS/TP. For inter-building connections, it is recommended to use a BACnet/IP or FOX network connection. See [Inter-Building BACnet Connection](#) on page 39.

Figure 28: Power Wiring diagram

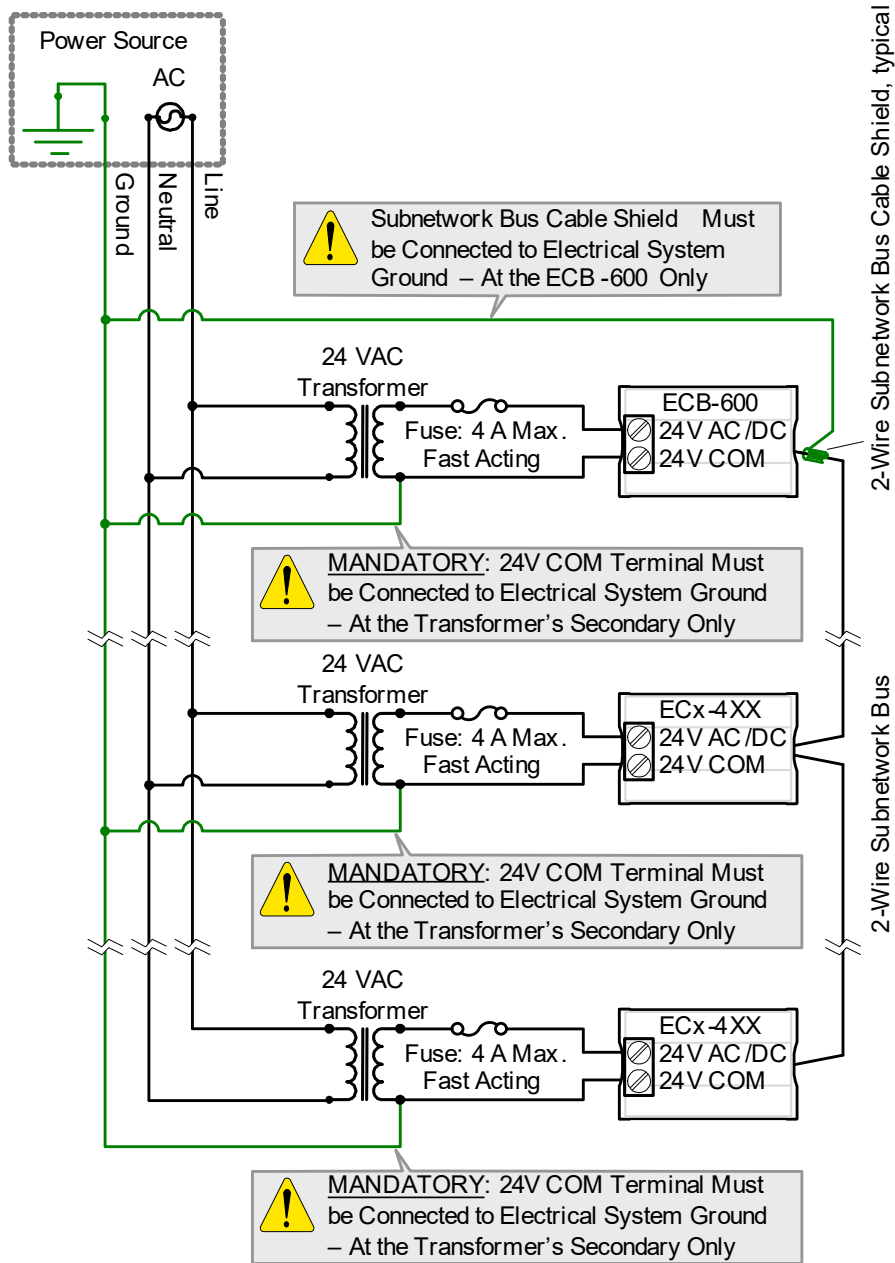


ECx-4XX I/O Extension Module Power Supply Requirements

When an ECB-600 is used with one or more ECx-4XXs (I/O Extension Modules), always use a separate transformer for each ECB-600 series controller and for each of its associated I/O Extension Modules. See [Transformer Selection and Determining the Maximum Power Run Length](#) on page 43 for how to choose an appropriate transformer. One terminal on the secondary side of each of these transformers must be connected to the building's ground and to the respective controller's or I/O Extension Modules' **24V COM** terminal. See [Figure 29](#).

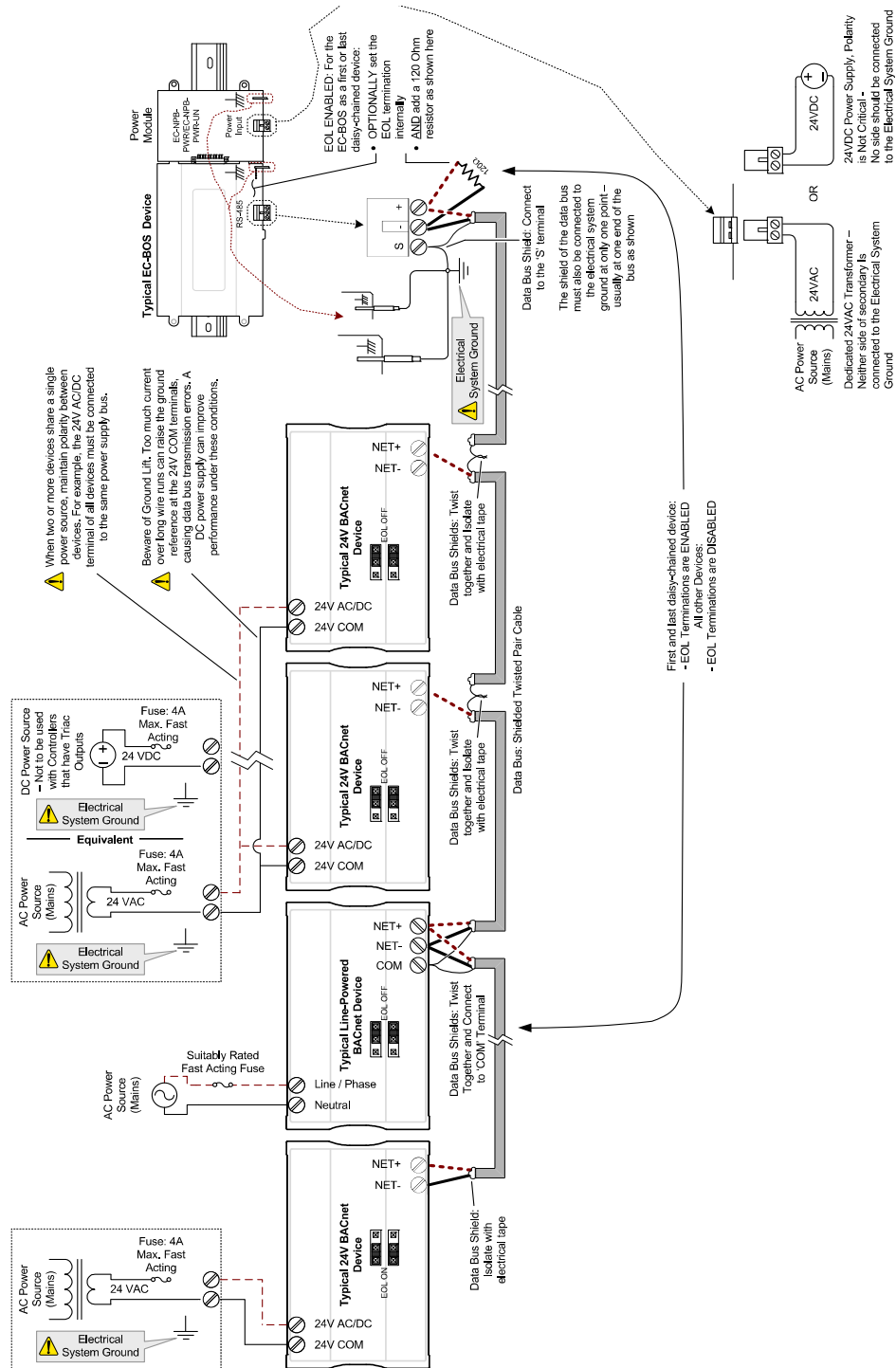
Note that the shield of the 2-Wire subnetwork data bus cable must also be grounded, preferably at the ECB-600. See also [2-Wire Subnetwork Data Bus Shield Grounding Requirements](#) on page 94.

Figure 29: Power wiring - AC for ECB-600 with ECx-4XXs: The 24V COM Terminal of all Devices must be Connected to Ground



Typical Device BACnet MS/TP LAN and Power Wiring Diagram

An overview of the BACnet MS/TP LAN and power wiring is shown below.



CHAPTER 3

LONWORKS Communication Bus Fundamentals

This chapter describes the LONWORKS Communications Bus operating principles.

Topics

Network Architecture

TP/FT 10 Network Topologies

Extending the Network

Grounding a Network

Power Supply Requirements for 24V Controllers

ECx-4XX I/O Extension Module Power Supply Requirements

Network Architecture

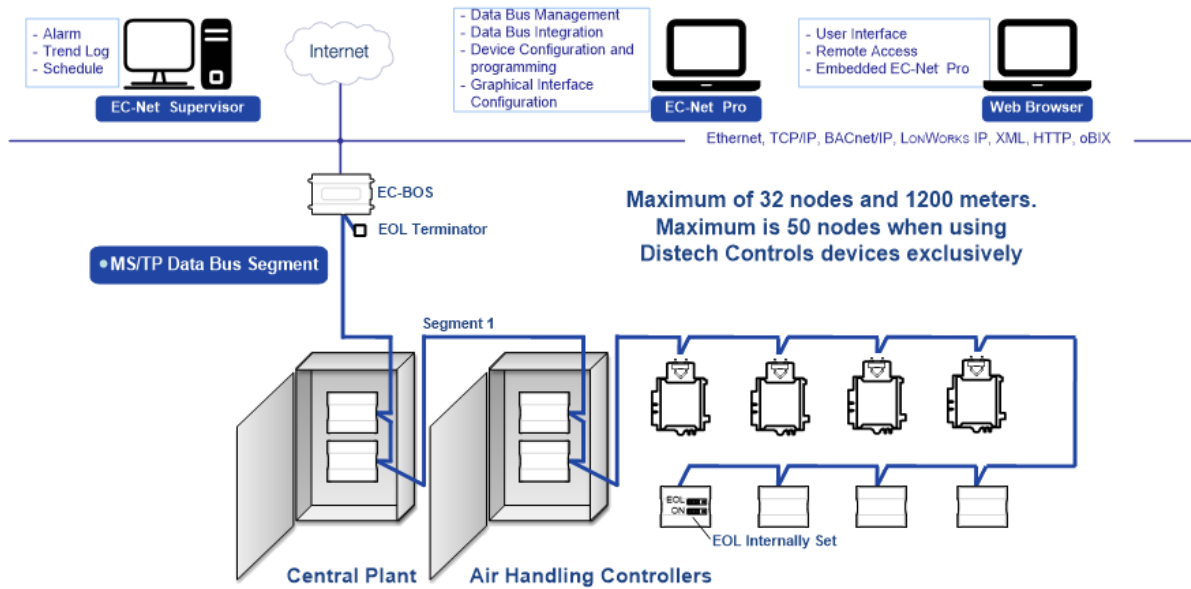
EC-Net Network Architecture

The following EC-Net architecture diagrams show the typical network connections for LONWORKS controllers.

Single-Segment EC-Net Network

A single-segment EC-Net Network shown with EC-Net Supervisor and EC-Net Pro.

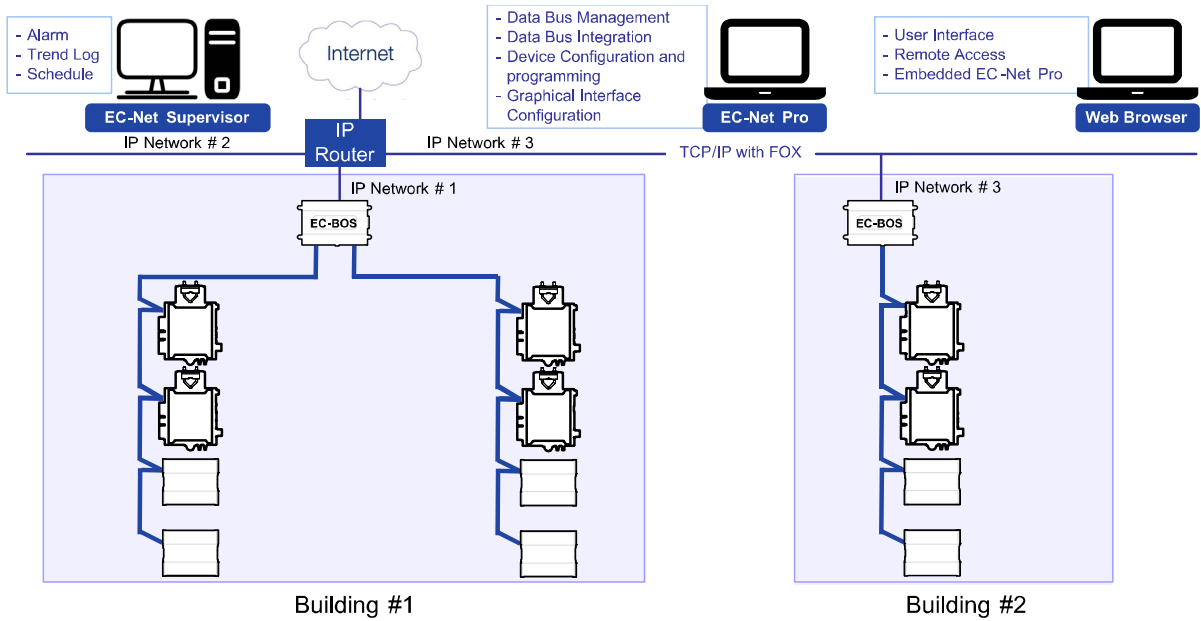
Figure 30: Single-Segment EC-Net Network



Inter-Building LONWORKS Connection

LONWORKS network connections between buildings must be made using TCP/IP with FOX as shown below.

Figure 31: Typical Inter-Building Connection Using IP/FOX



TP/FT 10 Network Topologies

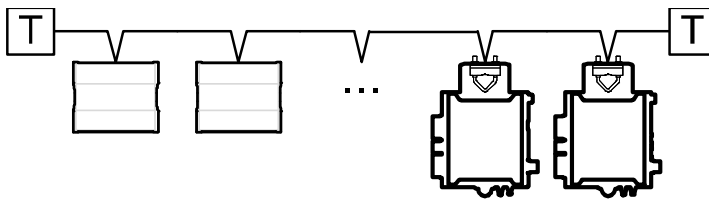
The physical routing of the communication channel defines the network topology. The channel and transceiver types define the requirements and limitations of each wiring topology.

TP/FT 10 network segments require termination for proper data transmission performance. Free topology and bus network topology differ in their termination requirements. The following sections describe the various network topologies, their terminator types and termination procedures.

Bus Topology

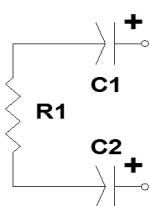
A bus topology is a physical routing of the communication channel that includes a distinct beginning and end. It is also known as a daisy-chain topology.

Figure 32: Figure 3 3: Bus Topology



TP/FT 10 Bus Topology Network Termination

For bus topology type networks, use the following terminators at each end of the bus topology channel (2 terminators per channel in total):



R1 = 105Ω, ±1%, 1/8W

C1 = 100μF, ≥50V

C2 = 100μF, ≥50V

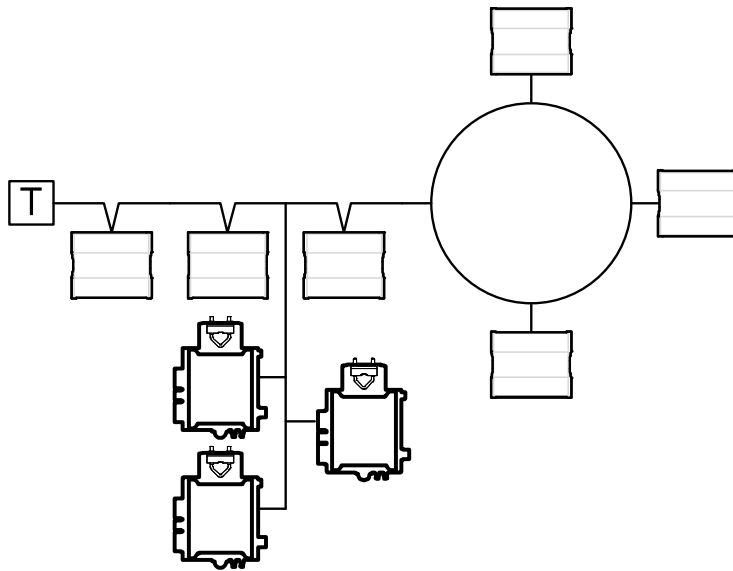


It is recommended to use a bus topology when designing a network. Bus topologies are the easiest to troubleshoot and the maximum wiring length in a bus topology is greater than that for a free topology. See [Network Cables](#) on page 55 for detailed information about wiring lengths and network cable considerations.

Free Topology

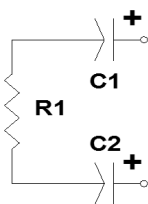
Free topology is a flexible wiring structure for communication channels that include ring, star, loop and/or combination wiring structures. A free topology does not have restrictions such as branching restrictions, stub length limits, device separation requirements or strict termination guidelines. The free topology transmission specification only has two requirements that must be met for proper system operation. The distance from each transceiver to all other transceivers and to the termination must not exceed the maximum node-to-node distance. If multiple paths exist (i.e. a loop topology) then the longest path should be used for calculations. The maximum total wire length is the total length of wire within a segment. See [Network Cables](#) on page 55 for detailed information about wiring lengths and network cable considerations.

Figure 33: Free Topology



TP/FT 10 Free Topology Network Termination

For free topology type networks (TP/FT 10 only), use the terminator shown below for each free topology channel. It is recommended to always place the terminator near the router for consistency.



$R1 = 52.3\Omega, \pm 1\%, \frac{1}{8}W$
 $C1 = 100\mu F, \geq 50V$
 $C2 = 100\mu F, \geq 50V$

Network Cables

The following section identifies the type of cabling that may be used in a TP/FT 10 twisted pair LONWORKS network. The recommendations presented herein are intended to assist network integrators and OEMs and are provided for informational purposes only.

For more information and detailed explanations on network topology and wire length restrictions refer to the [Junction Box and Wiring Guideline for Twisted Pair LONWORKS® Networks](#). These guides can be downloaded from Echelon's web site at www.echelon.com.



- As a general rule, the TP/FT 10 channel communication cables should not be run close to high voltage power cables.
- All wiring must comply with applicable national, state and local wiring electrical codes, ordinances, and regulations.

Table 11: TP/FT 10 Channel Attributes

Parameter	Details
Nickname	Free Topology
Raw Bit rate	78kbps
Packets per second	144/168
Peak traffic	180/210
Topology	Free, Bus
Termination	-One per segment in free topology -Two per segment in bus topology
Maximum number of devices per segment	64 Note: A maximum of 128 devices per channel can be installed on a TP/FT 10 when a router or repeater is used. See Extending the Network on page 59 for more information.

TP/FT 10 Cable Specifications

Two types of cable are recommended for TP/FT 10 channel installations.

Type 1:

22 AWG (Ø0.65mm), 1 twisted pair (1P), stranded conductor (STR), tinned copper (TNC), PVC insulation, PVC jacket, unshielded, plenum FT6, CSA 600V, UL 300V.

Table 12: TP/FT 10 Type 1 Cable Attributes

Parameter	Details
Conductor Gauge (AWG)	22 AWG (see also Metric Conversions for Wire Gauge on page 133).
Conductor Count	2 Conductors (twisted pair)
Conductor Type	Stranded conductor
Material	Tinned copper
Plenum	Plenum rated

Table 12: TP/FT 10 Type 1 Cable Attributes

Parameter	Details
NEC Rating	UL listed art 800 plenum
CSA	Flame rated



Untwisted wires or cables containing flat or parallel untwisted conductors must not be used on an LONWORKS twisted pair channel. The use of these wires/cables may result in improper network operation and could, in certain circumstances, result in damage to nodes connected to such a channel.

In a **bus** topology, the maximum wire length is 1400 meters (4593 feet). The maximum stub length on a TP/FT 10 channel is 3 meters (10 feet). A stub is a section of unterminated transmission line that branches off the main transmission line of interest. The branch line is terminated as an open circuit.

In a **free** topology, the maximum length is 400 meters (1312 feet) node-to-node and 500 meters (1640 feet) total wire length.



In the event that the limits on the number of transceivers or total wire distance are exceeded, then one FTT physical layer repeater can be added to interconnect two segments and double the overall system capability.

Type 2:

16 AWG (Ø1.3mm), 1 twisted pair (1P), stranded conductor (STR), tinned copper (TNC), PVC insulation, PVC jacket, unshielded, plenum FT6, CSA 600V or UL 300V.

Table 13: TP/FT 10 Type 2 Cable Attributes

Parameter	Details
Conductor Gauge (AWG)	16 AWG (see also Metric Conversions for Wire Gauge on page 133).
Conductor Count	2 Conductors (twisted pair)
Conductor Type	Stranded conductor
Material	Tinned copper
Plenum	Plenum rated
NEC Rating	UL listed art 800 plenum
CSA	Flame rated

In **bus** topology, the maximum wire length is 2700 meters (8858 feet). The maximum stub length on a TP/FT 10 channel is 3 meters (10 feet).

In **free** topology, the maximum length is 500 meters (1640 feet) node-to-node and 500 meters (1640 feet) total wire length.



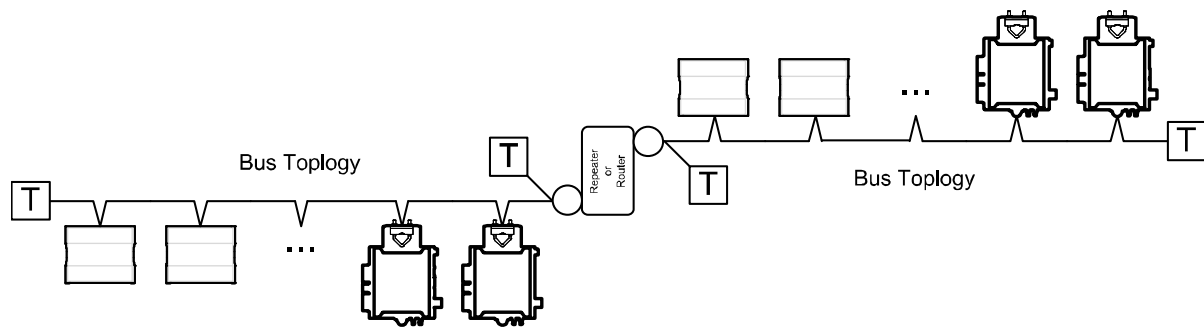
For more information about extending the network to a sensor, see [Connecting to the LAN through an Allure EC-Smart-View Sensor](#) on page 102.

Extending the Network

In the event that the limits on the number of transceivers or total wire distance are exceeded, then one repeater or a router can be added to interconnect two segments and double the overall system capability.

A maximum of 128 devices per channel can be installed on a TP/FT 10. However, after 64 devices you must add a repeater in order to add more devices up to the 128 device limit. Alternately, once you have 64 devices on an FT 10 channel you can add a router instead of a repeater. However the router will create a new channel for your new devices. A router is recommended for optimal performance.

Figure 34: Repeater or Router

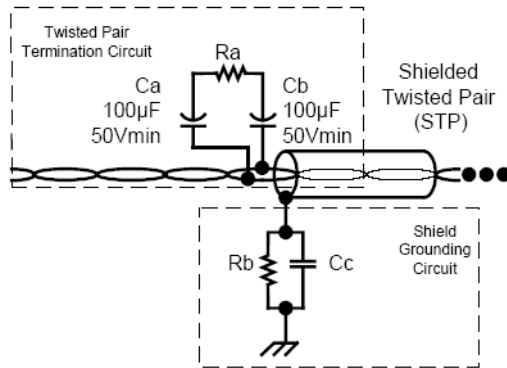


Grounding a Network

Grounding Shielded Twisted Pair Cable

When using Shielded Twisted Pair, terminate the twisted pair and ground the cable shield, as shown in the following figure.

Figure 35: Grounding Shielded Twisted Pair Cable



It is recommended to use shielded cable only when the network cable is outside of the building since it will be subjected to electromagnetic interference (EMI).

The twisted pair is terminated according to the guidelines listed in the previous sections. The cable shield should be grounded using a capacitor to tie the shield to earth ground and a large value resistor should be used to bleed off any static charge on the shield.

Tie the shield to earth ground through a capacitor, instead of with a direct connection. This prevents DC and 50/60 Hz ground paths from forming through the shield. Typical values for C_c and R_b are as follows:

- $C_c = 0.1 \mu\text{F}$, 10%, Metalized Polyester, $\geq 100\text{V}$
- $R_b = 470\Omega$, 1/4W, $\pm 5\%$

The cable shield should be grounded at least once per segment, and preferably at each node. Grounding the shield at every node (using the shield grounding circuit shown in [Figure 35](#)) will assist in suppressing 50/60Hz standing waves.

Building Entrance Protection

Use shielded twisted pair wire for networks, or portions of networks, that are run outside of buildings. The shield should be connected to earth at each building entry point via a data-line lightning/surge arrester, to conduct lightning strike energy or power surges directly to ground and prevent their entry into the building via the control systems network. Data-line lightning/surge arresters should also be used at each building entrance and should be connected to the network data lines. Refer to the LONWORKS FTT-10A Free Topology Transceiver User's Guide available from Echelon, for more information about building entrance protection.

Power Supply Requirements for 24V Controllers

About External Loads

When calculating a controller's power consumption to size the 24VAC transformer, you must also add the external loads the controller is going to supply, including the power consumption of any connected subnet module (for example, for Allure Series sensors). Refer to the respective module's datasheet for related power consumption information.

A controller can support a maximum of two Allure Series sensor models equipped with a CO₂ sensor. See [Subnetwork Module Compatibility and Supported Quantity Charts](#) on page 71 for how many Allure Series sensors are supported by a given controller model. The remaining connected Series sensor models must be without a CO₂ sensor.

For the ECL-VAV model, see the room device calculator spreadsheet available for download from our website to determine the power requirements and supported quantities of connected subnet modules: [VAV-Smart Room Control Device Calculator.xlsm](#)

Transformer Selection and Determining the Maximum Power Run Length



Distech Controls' 24V-powered devices are Class 2 Products. To conform to Class 2 installation requirements, only use transformers of 100VA or less to power the device(s).

It is recommended to wire only one controller per 24VAC transformer.

When calculating a controller's power consumption to size the 24VAC transformer, you must also add the external loads the controller is going to supply, including the power consumption of any connected subnet module (for example, Allure™ Series Communicating Sensors).

If only one 24VAC transformer is available, determine the maximum number of daisy-chained VAV controllers that can be supplied on a single power cable supplied by a 100 VA transformer, according to the controller's expected power consumption including external loads, the cable's wire gauge, and the total cable length from the following figures ([Figure 36](#) and [Figure 37](#)). Any installation condition that is outside of the parameters of the following graph should be avoided.

To maximize daisy-chaining performance, the transformer should be installed as close as possible to the first VAV. If this is not possible, then use 14 AWG wire to power the first VAV which can help reduce a voltage drop at the end of the daisy-chain.



The recommended minimum peak input voltage is 27.2V_p

Figure 36: Maximum number of VAV Devices on a Daisy-Chain at Evenly Spaced Intervals

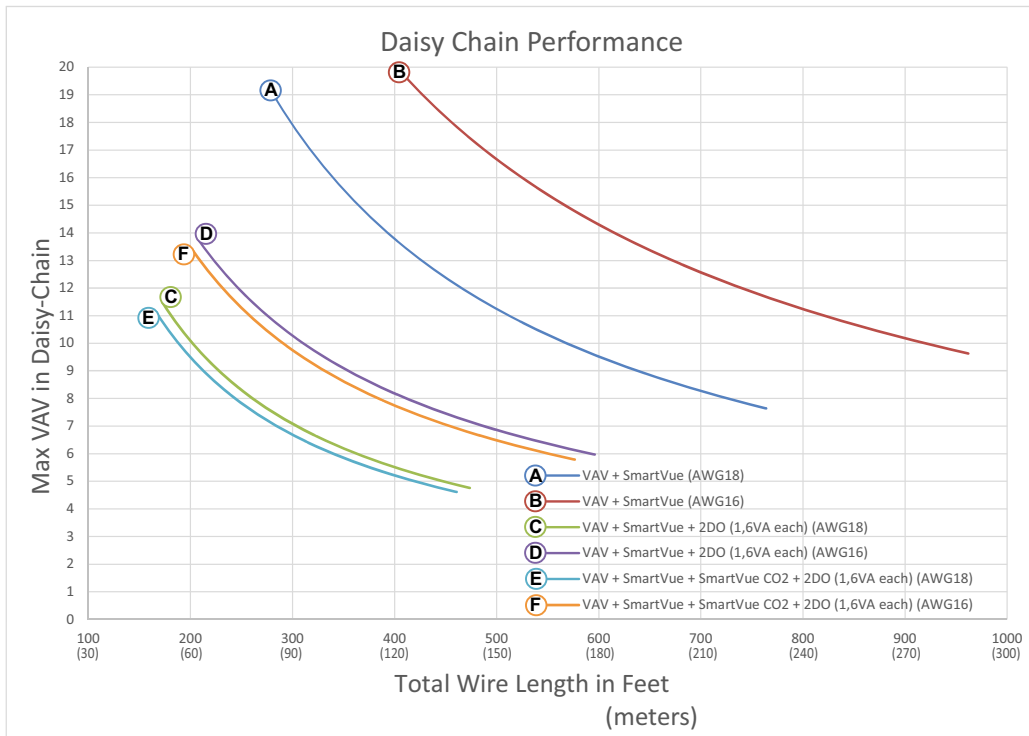
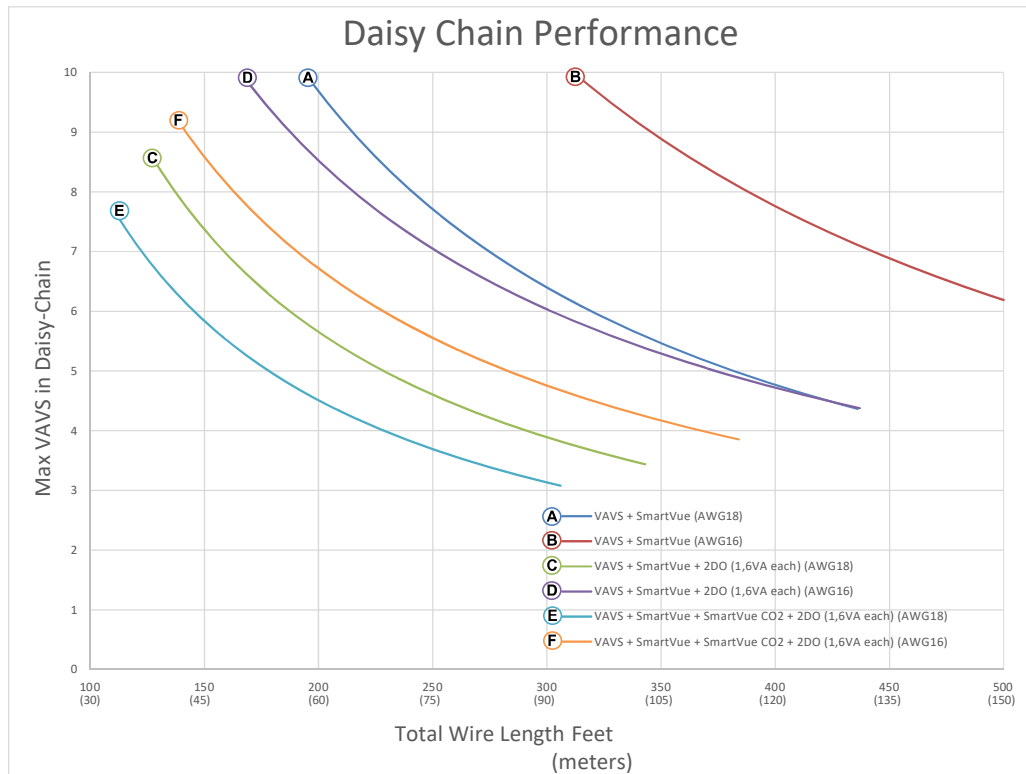


Figure 37: Maximum Number of VAVS Devices on a Daisy-Chain at Evenly Spaced Intervals



Laboratory testing conditions for the above graph are as follows:

- Distance between each VAV is evenly spaced along the entire wire length
- Transformer specification: 100VA (120/24VAC)
- Tested at room temperature with low voltage line conditions: 108VAC (50Hz)

For non-VAV devices, determine the appropriate size transformer for the job as follows:

- Add up the power requirements of all devices plus all external loads (see [About External Loads](#) on page 61). Multiply the total power needed by a multiplier of 1.3, as a security margin. For example, to power five devices (15 VA each), the total load is 75 VA multiplied by 1.3 is 98 VA. Choose a size of transformer just over this amount: For example, a 100 VA model.
- When the total load of a number of devices requires a transformer with a rating greater than 100 VA, use two or more transformers. Ensure that the load to be connected to each transformer follows the guideline of Step 1 above.



Always use a separate transformer for each ECL-600 series controller and for each of its associated I/O Extension Modules. One terminal on the secondary side of each of these transformers must be connected to the building's ground and to the respective controller's or I/O Extension Modules' 24V COM terminal. See [ECx-4XX I/O Extension Module Power Supply Requirements](#) on page 66.

Maintain consistent polarity when connecting controllers and devices to the transformer. That is, the 24V COM terminal of each controller and each peripheral **may** be connected to the same terminal on the secondary side of the transformer. This transformer terminal must be connected to the building's ground.

Recommended 24V Power Cable

The table below lists Distech Controls' recommended power cable.

Table 14: Distech Controls Recommended 24V Power Cable

Cable Type AWG - Number of Conductors	Non-Plenum Applications (FT4)		Plenum Applications (FT6)	
	Part Number	O.D. (Ø)	Part Number	O.D. (Ø)
18-2	CB-W181P-1002	5.0mm 0.20in.	CB-W181P-2051	5.0mm 0.20in.
16-2	CB-W161P-1031	4.8mm / 0.19in.	CB-W161P-2062	4.8mm / 0.19in.
14-2	CB-W141P-1081	7.2mm / 0.29in.	CB-W141P-2013	7.2mm / 0.29in.

24V Power Supply Connection

Use an external fuse on the 24VAC side (secondary side) of the transformer or DC power supply, as shown in [Figure 38](#) and [Figure 39](#), to protect all controllers against power line spikes.

For any given number of devices, wire the power supply as shown in [Figure 38](#) and [Figure 39](#). Maintain consistent polarity when connecting controllers and devices to the transformer. That is, the 24V COM terminal of each controller and each peripheral should be connected to the same terminal on the secondary side of the transformer.



Connecting the power source to Electrical System Ground is not a requirement for proper system operation. However it is good installation practice to do so in order to maintain the same potential between all controllers and Protective Earth.

Figure 38: Power wiring – 24VAC: Maintain Consistent Polarity with all Controllers' Power Connections

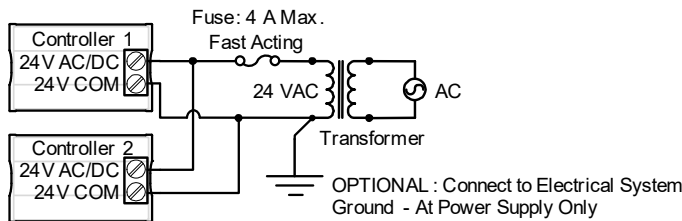


Figure 39: Power wiring - 24VDC: Maintain Consistent Polarity with all Controllers' Power Connections

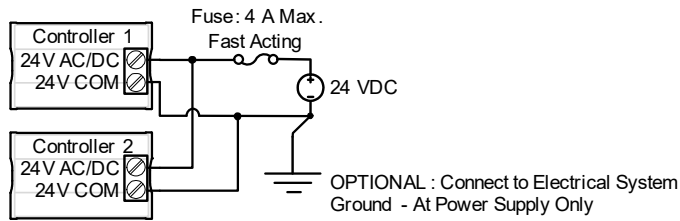
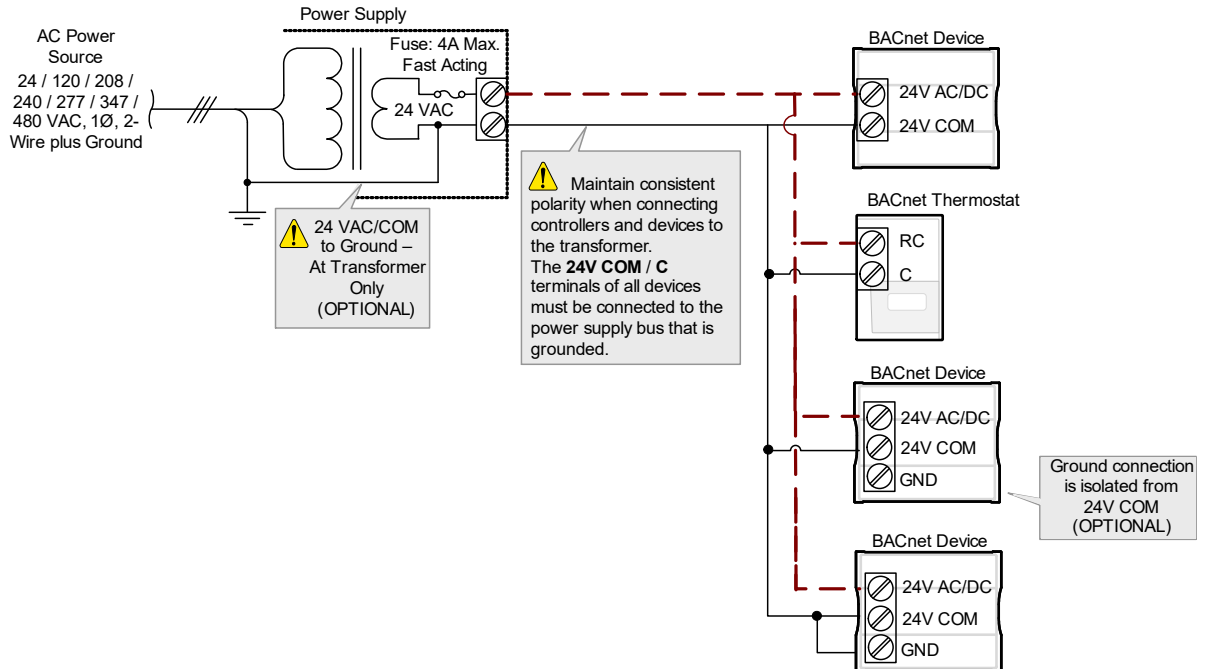


Figure 40: Power Wiring example

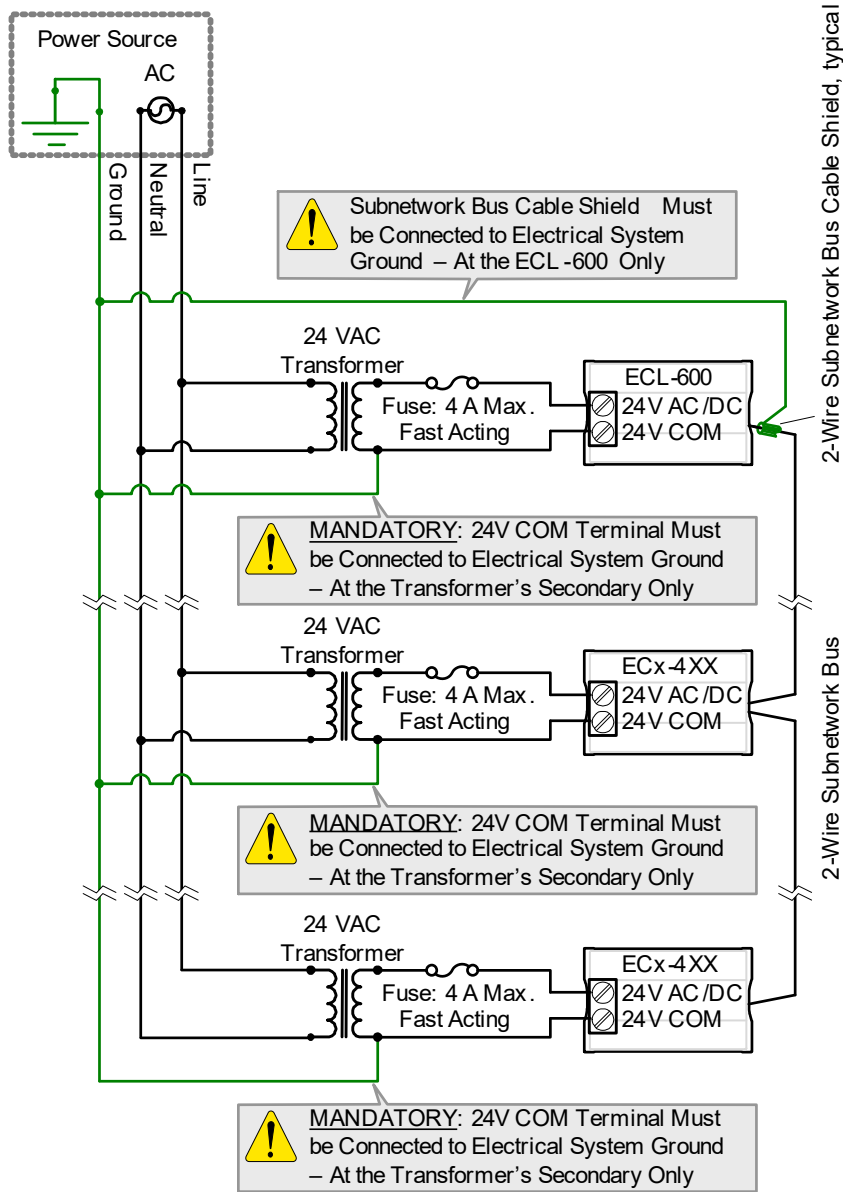


ECx-4XX I/O Extension Module Power Supply Requirements

When an ECL-600 is used with one or more ECx-4XXs (I/O Extension Modules), always use a separate transformer for each ECL-600 series controller and for each of its associated I/O Extension Modules. See [Transformer Selection and Determining the Maximum Power Run Length](#) on page 61 for how to choose an appropriate transformer. One terminal on the secondary side of each of these transformers must be connected to the building's ground and to the respective controller's or I/O Extension Modules' 24V COM terminal. See [Figure 41](#).

Note that the shield of the 2-wire subnetwork bus cable must also be grounded, preferably at the ECL-600. See also [2-Wire Subnetwork Data Bus Shield Grounding Requirements](#) on page 94.

Figure 41: Power wiring - AC for ECL-600 with ECx-4XXs: The 24V COM Terminal of all Devices must be Connected to Ground



CHAPTER 4

Subnetwork Installation Guidelines

This chapter describes the subnetwork installation guidelines. This subnetwork supports a range of expansion / extension modules.

Topics

[*About the Subnetwork Data Bus*](#)

[*Cat 5e Cable Subnetwork Data Bus*](#)

[*Setting the Allure EC-Smart-Air and EC-Smart-Comfort Communicating Sensor Series' Subnet ID Address*](#)

[*Setting the EC-Multi-Sensor Series' Subnet ID Address*](#)

[*Setting the ECx-Light and ECx-Blind Series' Subnet ID Address*](#)

[*2-Wire Subnetwork Data Bus*](#)

About the Subnetwork Data Bus

ECL and ECB Distech Controls' controllers use the subnetwork data bus to support various optional modules that add extra inputs, outputs, sensor inputs (temperature, humidity, CO2, motion, receive wireless commands from a remote control), and interactive screen menus for user control. The subnetwork data bus uses the EIA-485 (Electronic Industries Alliance) standard for data transmission.

Subnetwork Connection Method

Connection to the subnetwork data bus can be made as follows:

- All ECB and ECL series controllers are equipped with an RJ-45 Subnet Port to quickly connect expansion modules and sensors in a daisy-chained fashion to the subnetwork using a Cat 5e cable (standard straight Ethernet patch cable). Any device that connects to a controller's Subnet Port is collectively referred to as room devices.
- In addition, the ECB-600 and ECL-600 Series controllers can be connected to one or two ECx-4XX I/O Extension Modules using the same subnetwork data bus, however the connection is made through the controller's Subnet+ and Subnet screw-type terminal block connectors using a 2-wire twisted-pair shielded cable.

This is summarized in the table below.

Table 15: Subnetwork Connection Method

Subnetwork Room Device or Extension Module	Type	Connection Method
Allure EC-Smart-View series	Room Device: Sensors	Cat 5e cable with RJ-45 connectors - See Cat 5e Cable Subnetwork Data Bus on page 79.
Allure EC-Smart-Comfort series		
Allure EC-Smart-Air sensor series		
EC-Multi-Sensor series		
ECx-Light-4 / ECx-Light-4D / ECx-Light-4DALI	Room Device: Application specific expansion modules	
ECx-Blind-4 / ECx-Blind-4LV		
ECx-Display	Colour LCD display	
ECx-4XX Series I/O Extension Module	Extension Module	2-wire twisted-pair shielded cable - See 2-Wire Subnetwork Data Bus on page 92.

Subnetwork Module Compatibility and Supported Quantity Charts

Not all subnetwork modules work with all controller models: The subnetwork module compatibility for an individual controller is shown in the table below along with the maximum supported quantity of room devices and extension modules. The Subnet ID address of all subnet devices must be set to be within the shown addressing range.



Adding devices to the subnetwork decreases system responsiveness which may cause delays executing commands needing a fast response such as lighting and shades/sunblind commands.

Table 16: Subnetwork Module Compatibility and Maximum Supported Quantity Chart

Controller Model	Subnetwork Data Bus Device	Permitted Subnet ID Addressing Range ¹	Maximum Quantity Allowed
ECL-VAV ECB-VAV	Allure EC-Smart-View series	1 to 4	See below ^{2, 4}
	Allure EC-Smart-Comfort series	1 to 4	
	Allure EC-Smart-Air sensor series		
	EC-Multi-Sensor series	1 to 4	
	ECx-Light-4 / ECx-Light-4D / ECx-Light-4DALI	1 to 4	
	ECx-Blind-4 / ECx-Blind-4LV		
	ECx-4XX I/O Extension Modules	-	Not Supported
	ECx-Display	-	Not Supported
ECL-VAVS ECL-VAV-N ECB-VAVS ECB-VAV-N	Allure EC-Smart-View series	1 to 4	4 ³
	Allure EC-Smart-Comfort series	1 to 4	
	Allure EC-Smart-Air series		
	EC-Multi-Sensor series	-	Not Supported
	ECx-Light-4 / ECx-Light-4D / ECx-Light-4DALI	-	Not Supported
	ECx-Blind-4 / ECx-Blind-4LV	-	Not Supported
	ECx-4XX I/O Extension Modules	-	Not Supported
	ECx-Display	-	Not Supported

Table 16: Subnetwork Module Compatibility and Maximum Supported Quantity Chart

Controller Model	Subnetwork Data Bus Device	Permitted Subnet ID Addressing Range ¹	Maximum Quantity Allowed	
ECL / ECB-PTU Series	Allure EC-Smart-Vue series	1 to 4	4 ⁴	
	Allure EC-Smart-Comfort series	1 to 4		
	Allure EC-Smart-Air series			
	EC-Multi-Sensor series	1 to 4		
	ECL / ECB-103 ECL / ECB-203 Series	ECx-Light-4 / ECx-Light-4D / ECx-Light-4DALI	1 to 4	2 ⁵
		ECx-Blind-4 / ECx-Blind-4LV		2 ⁵
		ECx-4XX I/O Extension Modules	-	Not Supported
		ECx-Display	-	Not Supported
ECL / ECB-203 Models Only	Allure EC-Smart-Vue series	1 to 4	4 ³	
	Allure EC-Smart-Comfort series	1 to 4		
	Allure EC-Smart-Air series			
	EC-Multi-Sensor series	-	Not Supported	
	ECx-Light-4 / ECx-Light-4D / ECx-Light-4DALI	1 to 4	2 ⁵	
	ECx-Blind-4 / ECx-Blind-4LV		2 ⁵	
	ECx-4XX I/O Extension Modules	-	Not Supported	
ECL / ECB-300 Series ECL / ECB-400 Series	ECx-Display	Not Applicable	1	
ECL / ECB-300 Models Only ECL / ECB-400 Models Only	Allure EC-Smart-Vue series	1 to 12	12 ³	
	Allure EC-Smart-Comfort series	1 to 6		
	Allure EC-Smart-Air series			
	EC-Multi-Sensor series	-	Not Supported	
	ECx-Light-4 / ECx-Light-4D / ECx-Light-4DALI	1 to 4	2 ⁵	
	ECx-Blind-4 / ECx-Blind-4LV		2 ⁵	
	ECx-4XX I/O Extension Modules	-	Not Supported	
ECL / ECB-300 Models Only ECL / ECB-400 Models Only	ECx-Display	Not applicable	1	

Table 16: Subnetwork Module Compatibility and Maximum Supported Quantity Chart

Controller Model	Subnetwork Data Bus Device	Permitted Subnet ID Addressing Range ¹	Maximum Quantity Allowed
ECL / ECB-600 Series	Allure EC-Smart-Vue series	1 to 12	12 ³
	Allure EC-Smart-Comfort series	1 to 6	
	Allure EC-Smart-Air series		
	EC-Multi-Sensor series	-	Not Supported
	ECx-Light-4 / ECx-Light-4D / ECx-Light-4DALI	1 to 4	2 ⁵
	ECx-Blind-4 / ECx-Blind-4LV		2 ⁵
	ECx-4XX I/O Extension Modules	1 to 7	2
ECL / ECB-600 Models Only	ECx-Display	Not applicable	1

1. The indicated addressing ranges group together the permitted addressing ranges for those devices.



The following devices use different Subnet address ranges so that the same Subnet ID of one device will not conflict with that of another device that is on a different Subnet address range:

- 1 address range for Allure EC-Smart-Vue sensors
- 1 address range for Allure EC-Smart-Comfort and Allure EC-Smart-Air sensors
- 1 address range for EC-Multi-Sensors
- 1 address range for ECx-Light/Blind expansion modules
- 1 address range for ECx-Display

For example, an Allure EC-Smart-Vue sensor and an Allure EC-Smart-Air sensor can have the same Subnet ID, but an Allure EC-Smart-Air sensor and an Allure EC-Smart-Comfort sensor must have a different Subnet ID. Consequently, you cannot set both an ECx-Light-4 and an ECx-Blind-4 to have a Subnet ID as 1.

2. See the room device calculator spreadsheet available for download from our website to know the permitted quantities for these controller models: [VAV-Smart Room Control Device Calculator.xlsm](#)
3. A controller can support a maximum of two (2) Allure Series sensor models equipped with a CO₂ sensor. Any remaining connected Allure Series sensor models must be without a CO₂ sensor.
4. These models support a recommended maximum of 4 sensors (Allure Series sensor series and EC-Multi-Sensor series) combined in total. Each Allure Series sensor model equipped with a CO₂ sensor counts as 2 sensors (for example, you cannot connect any other sensors if you connect two Allure Series sensor models equipped with a CO₂ sensor or you can connect up to two other non-CO₂ sensors if you connect one Allure Series sensor models equipped with a CO₂ sensor). When a longer system response time is acceptable, up to 4

- Allure Series sensor series (no more than 2 of which are equipped with a CO₂ sensor) and up to 4 EC-Multi-Sensor series can be connected in total.
- Up to 8 light and 8 blind/shade outputs total, provided by a maximum of 2 × ECx-Light and 2 × ECx-Blind room devices.

Subnetwork Module Connection

The following sections will provide further information needed to connect and configure the subnetwork devices such as cable type, cable length, wiring, data bus termination, device addressing, and more.

Figure 42: Subnetwork Module Connection to ECB-600 / ECL-600 Series Controllers Example

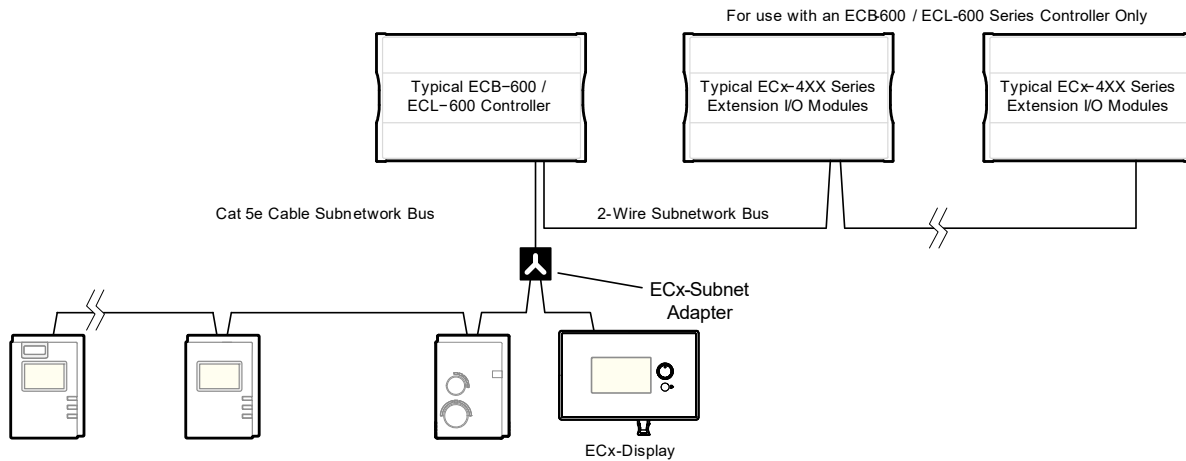
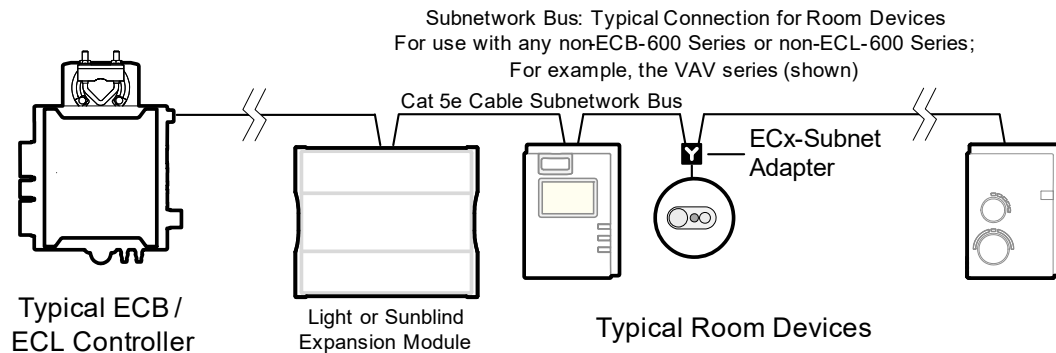


Figure 43: Subnetwork Module Connection to ECB/ECL Series¹ Controllers Example



- This includes the following models only: ECB/ECL-VAV Series, ECB-PTU / ECL-PTU Series, ECB/ECL-103, ECB/ECL-203 Series, ECB/ECL-300 Series, ECB/ECL-400 Series



When the Allure EC-Smart-Vue sensor is used with certain controller models, the subnetwork data bus can extend the LAN to the Allure EC-Smart Vue sensor to provide convenient network access. See [Connecting to the LAN through an Allure EC-Smart-Vue Sensor](#) on page 102.

Subnetwork Data Bus Length

The length of the subnetwork data bus varies according to the type of controller and the types of connected subnetwork modules as follows:

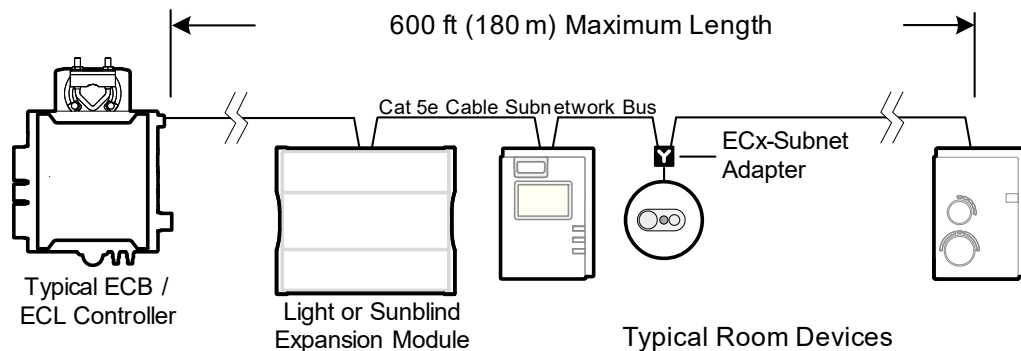
For all controllers that do not support the 2-Wire subnetwork data bus, the maximum length of the Cat 5e cable subnetwork data bus is 600 ft (180 m). See [Figure 44](#).

For ECB-600 or ECL-600 Series controllers:

- When no ECx-4XX I/O Extension Module is connected to the controller, the maximum length of the Cat 5e subnetwork data bus is 600 ft (180 m). See [Figure 44](#).
- When no Cat 5e subnetwork extension module is connected to the controller, the maximum length of the 2-Wire subnetwork data bus is 1 000 ft (300 m). See [Figure 46](#).
- When both ECx-4XX I/O Extension Modules (using the 2-wire subnetwork data bus) and subnetwork extension modules (using the Cat 5e cable subnetwork data bus) are connected, the total maximum length of all subnetwork data buses is 1 000 ft (300 m), of which the length of the Cat 5e subnetwork data bus can be no more than 600 ft (180 m). See [Figure 47](#).

See below:

Figure 44: Maximum Length of the Cat 5e Cable Subnetwork Data Bus, ECB/ ECL² Series Controllers



2. This includes the following models: ECB/ECL-VAV Series, ECB/ECL-103, ECB/ECL-203 Series, ECB/ECL-300 Series, ECB/ECL-400 Series, ECB/ECL-PTU-107, ECB/ECL-PTU-207, ECB/ECL-PTU-208, ECB/ECL-PTU-307, ECB/ECL-PTU-308

For ECB/ECL-PTU Series controllers, the maximum length between two consecutive devices on the subnetwork data bus is 100 ft (30 m).

For controllers that support an ECx-Display, the maximum length of the Cat 5e cable subnetwork data bus used to connect a controller to an ECx-display as a stub is 6.5 ft. (2m). The maximum total length of the Cat 5e cable subnetwork data bus remains 600 ft. (180 m).

When other subnetwork devices are used, use an ECx-Subnet Adapter to connect to those devices.

Figure 45: Subnetwork Module Connection with an ECx-Display Connected as a Stub Example

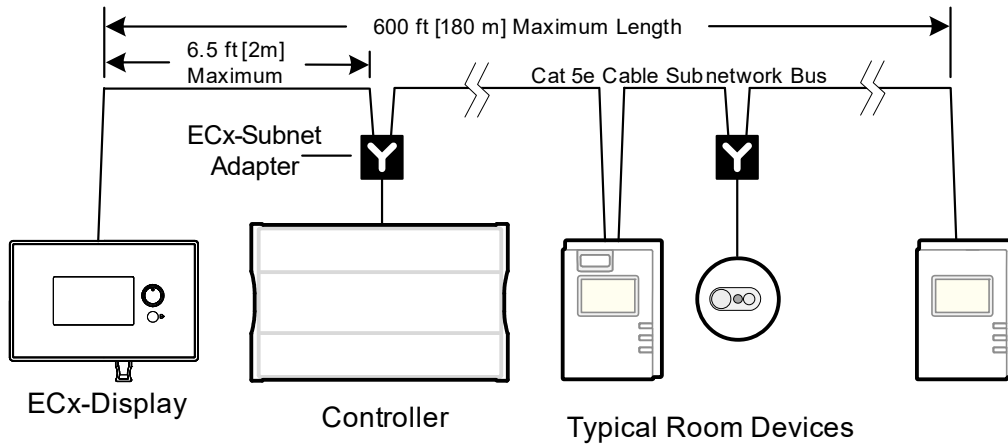
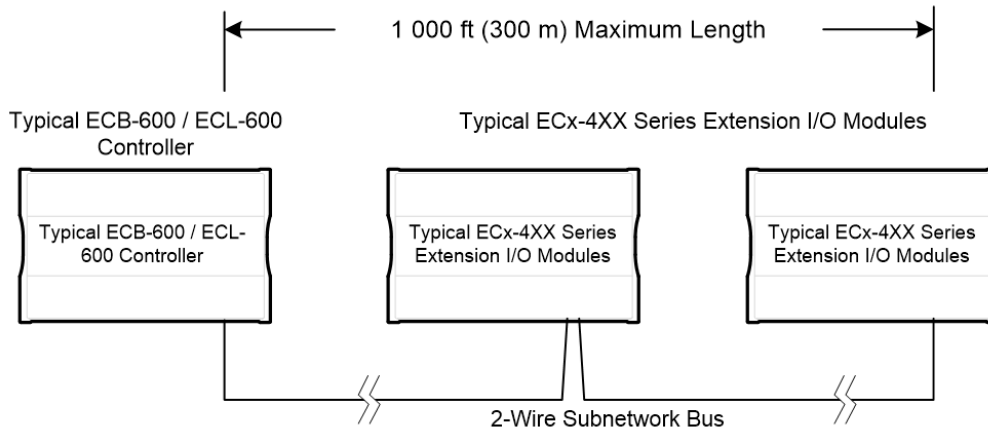


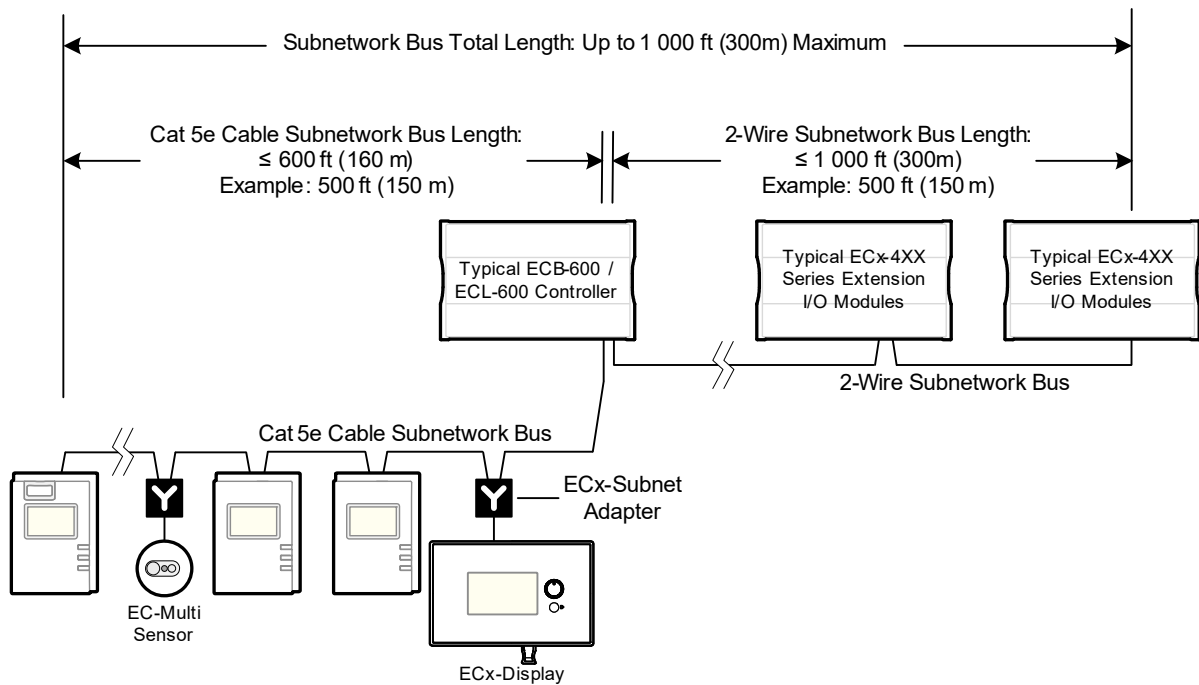
Figure 46: Maximum Length of the 2-Wire Subnetwork Data Bus, ECB-600 / ECL-600 Series Controllers



When both ECx-4XX Series Extension I/O Modules and any Cat 5e subnetwork expansion module are used with an ECB-600 or ECL-600 Series controller, the total maximum length of all subnetwork data buses is 1 000 ft (300 m). That is, any length of the Cat 5e cable subnetwork data bus will reduce the maximum length of the 2-Wire Subnetwork Data Bus.

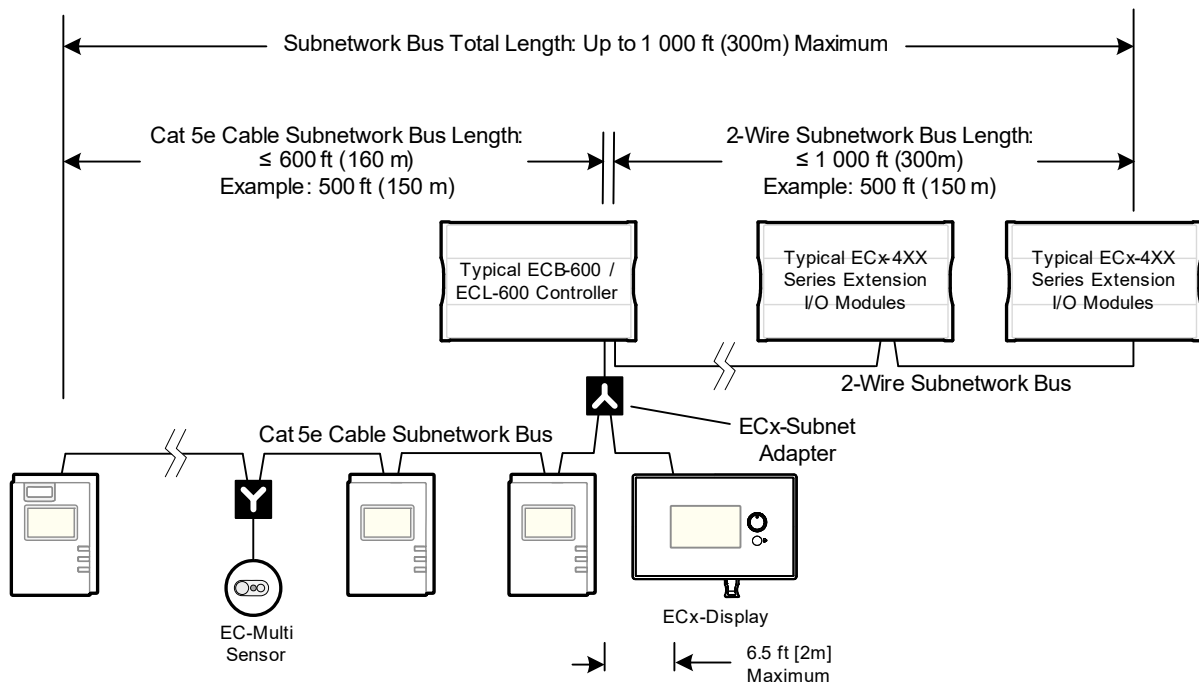
The example below shows that if the length of the Cat 5e Cable Subnetwork Data Bus (used to connect to the Allure Series sensors) is 500 ft (150 m) then the length of the 2-Wire Subnetwork Data Bus (used to connect to the ECx-4XXs Series) can only be a maximum of 500 ft (150 m), for a maximum 1 000 ft (300 m) total length.

Figure 47: Example of the Distribution of the Total Subnetwork Data Bus Length Example



The maximum length of the Cat 5e cable subnetwork data bus used to connect a controller to an ECx-display as a stub is 6.5 ft. (2m). The maximum total length of the Cat 5e cable subnetwork data bus remains 1 000 ft. (300 m). When other Cat 5e cable subnetwork devices are used, use an ECx-Subnet Adapter to connect to those devices.

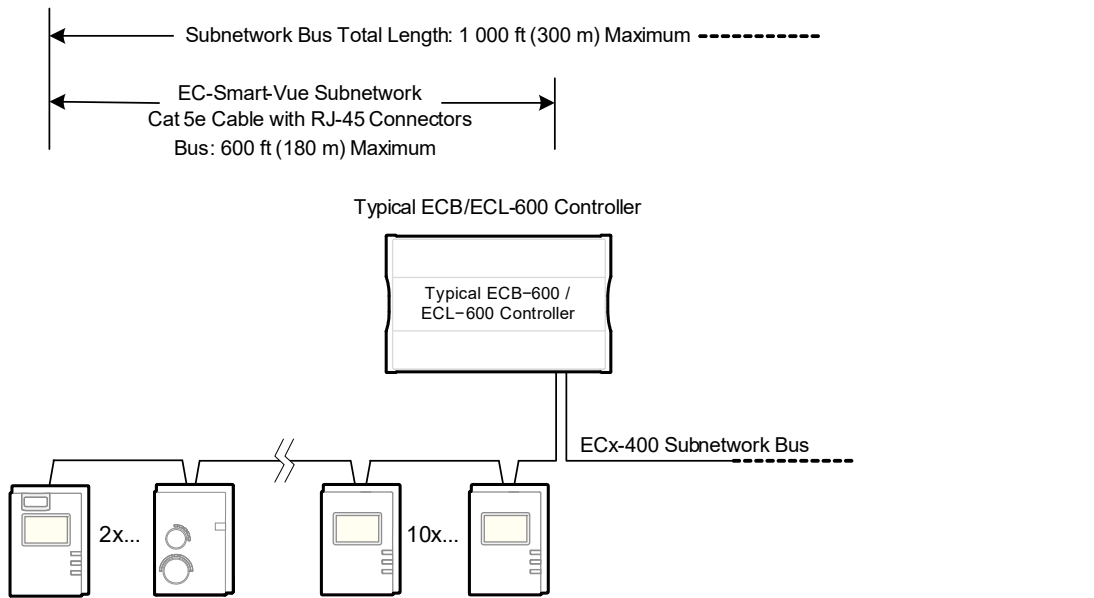
Figure 48: Example of the Distribution of the Total Subnetwork Data Bus Length with an ECx-Display Connected as a Stub Example



A controller can support a maximum of two (2) Allure Series sensor models equipped with a CO₂ sensor; the remaining connected models must be without a CO₂ sensor. See [Subnetwork Module Compatibility and Supported Quantity Charts](#) on page 71 for the quantity of room devices supported by each controller model.

For instance, if the subnetwork for the controller model supports a subnetwork with 12 Allure Series sensors in total, then 10 Allure Series sensor models must be without a CO₂ sensor and the remaining two (2) Allure Series sensor models can be equipped with a CO₂ sensor. To ensure proper operation, it is recommended to distribute the sensors throughout the length of the subnetwork.

Figure 49: Allure Series Sensors Subnetwork Length and Distribution



Cat 5e Cable Subnetwork Data Bus

The Cat 5e Cable subnetwork data bus is used to connect compatible room devices ([Table 15](#)) to any Distech Controls ECB/ECL series controller. See [Subnetwork Module Compatibility and Supported Quantity Charts](#) on page 71 for a list of compatible extension / expansion modules.



Never connect an IP (Ethernet) network to the SUBNET PORT connector of a controller or RJ 45 connector of a room device. Equipment damage may result.

Cat 5e Cable Subnetwork Data Bus Cable Requirements

The Cat 5e Cable subnetwork data bus uses commonly available Cat 5e structural cabling fitted with RJ 45 connectors. If you make your own patch cable, use Category 5e cable and crimp the RJ 45 connectors at both ends of the cable either as T568A or T568B.

Table 17: Cat 5e Cable Subnetwork Data Bus Physical Specifications and Cable Requirements

Parameter	Details
Maximum number of room devices	See Subnetwork Module Compatibility and Supported Quantity Charts on page 71. See also the controller's datasheet.
Subnet ID Addressing Configuration	See Setting the Subnet ID Addressing for Room Devices on page 84.
Media	Cat 5e Patch Cable with RJ-45 Connectors (standard straight patch cable)
RJ-45 Pin Configuration	Four (4) pairs required. Straight-through wiring. Crimp connectors as per T568A or T568B (both cable ends must be crimped the same way).
Characteristic impedance	100-130 Ohms
Distributed capacitance	Less than 100 pF per meter (30 pF per foot)
Maximum total length of the Cat 5e Cable subnetwork data bus plus the 2-Wire subnetwork data bus	300 m (1 000 ft.) Maximum – See Subnetwork Data Bus Length on page 75.
Maximum length of the Cat 5e Cable subnetwork data bus	180 m (600 ft.) Maximum – See Subnetwork Data Bus Length on page 75.
Polarity	Polarity sensitive

Table 17: Cat 5e Cable Subnetwork Data Bus Physical Specifications and Cable Requirements

Parameter	Details
Multi-drop	Daisy-chain (no T-connections) Most room devices have two RJ-45 female pass-through connectors to facilitate the daisy-chain connection of room devices. For the EC-Multi-Sensor: An optional ECx-Subnet Adapter (Y-splitter) is available to facilitate the daisy-chain connection of room devices. The ECx-Subnet Adapter must be connected directly to the EC-Multi-Sensor and its length cannot be extended.
EOL terminations	Must be set / enabled on the last room device only. This does not apply to the ECx-Display.
Shield grounding	Not applicable

Distech Controls recommends the Cat 5e cables shown below. Cables fitted with connectors are crimped as T568B.

Table 18: Distech Controls Recommended Cable Types to use for the Cat 5e Cable Subnetwork Data Bus

Cable Type	Non-Plenum Applications (Use in Conduit - FT4)		Plenum Applications (FT6)	
	Part Number	O.D. (Ø) ¹	Part Number	O.D. (Ø) ¹
0.3m (1 ft.), Cat 5e Cable fitted with RJ-45 Connectors	CB-CAT5PC4WH0001	4.6mm (0.18in.)	CB-CAT5PC6WH0001	4.6mm (0.18in.)
4.6m (15 ft.), Cat 5e Cable fitted with RJ-45 Connectors	CB-CAT5PC4WH0015	4.6mm (0.18in.)	CB-CAT5PC6WH0015	4.6mm (0.18in.)
9m (30 ft.), Cat 5e Cable fitted with RJ-45 Connectors	CB-CAT5PC4WH0030	4.6mm (0.18in.)	CB-CAT5PC6WH0030	4.6mm (0.18in.)
15m (50 ft.), Cat 5e Cable fitted with RJ-45 Connectors	CB-CAT5PC4WH0050	4.6mm (0.18in.)	CB-CAT5PC6WH0050	4.6mm (0.18in.)
22m (75 ft.), Cat 5e Cable fitted with RJ-45 Connectors	CB-CAT5PC4WH0075	4.6mm (0.18in.)	CB-CAT5PC6WH0075	4.6mm (0.18in.)
30m (100 ft.), Cat 5e Cable fitted with RJ-45 Connectors	CB-CAT5PC4WH0100	4.6mm (0.18in.)	CB-CAT5PC6WH0100	4.6mm (0.18in.)
300 m (1000 feet), Cat 5e Cable – Without Connectors	CB-W244P-1446WHTB	4.6mm (0.18in.)	CB-W244P-2176WHTB	4.6mm (0.18in.)
100 Crimp RJ-45 Connectors	CB-W5506E	N/A	CB-W5506E	N/A

1. Outer cable diameter – This does not take into account the RJ-45 connector.

Cat 5e Cable Subnetwork Bus Topology and End-of-Line Terminations

The EOL termination settings for the Cat 5e Cable subnetwork data bus will vary depending on the type of controller the room device or extension module is connected to. By default, all

room devices and ECx-4XX Series I/O Extension Module EOL terminations are factory set to OFF (except for the EC-Multi-Sensor).



For the Cat 5e Cable subnetwork data bus, only a daisy-chain topology is acceptable and T-connections are not allowed. For the EC-Multi-Sensor and ECx-Display, an optional ECx-Subnet Adapter (Y-splitter) is available to facilitate the daisy-chain connection of these devices. The male-end of the ECx-Subnet Adapter must be connected directly to the device and its length cannot be extended.

Figure 50: An ECx-Subnet Adapter (Y-Splitter)



The ECx-Subnet Adapter is also used with a controller to connect to an ECx-Display and to one or more room devices. See [Figure 47](#). In this scenario, the male-end of the ECx-Subnet Adapter must be connected directly to the controller's **Subnet Port** and its length cannot be extended.

EOL Terminations for the ECB/ECL-VAV Series, ECB/ECL-103 to -400 Series, and ECB/ECL-PTU Series Controllers

When one or more room devices are connected to the Subnet Port of an ECB/ECL-VAV series, ECB/ECL-103 to -400 Series, or ECB/ECL-PTU Series controllers, only the EOL terminations of the last room device is set to ON. All other room devices on the subnetwork data bus must have their EOL terminations set to OFF. The controller must be the first device on the Cat 5e Cable Subnetwork data bus as its internal EOL termination is permanently enabled. The ECx-Display does not have any EOL terminations to be set and as such should not be installed as the last device on the subnetwork bus. See [Figure 47](#).

Figure 51: Setting the EOL Terminations on the Cat 5e Cable Subnetwork Data Bus for the ECB/ECL-VAV Series and ECB/ECL-103 to -400 Controllers

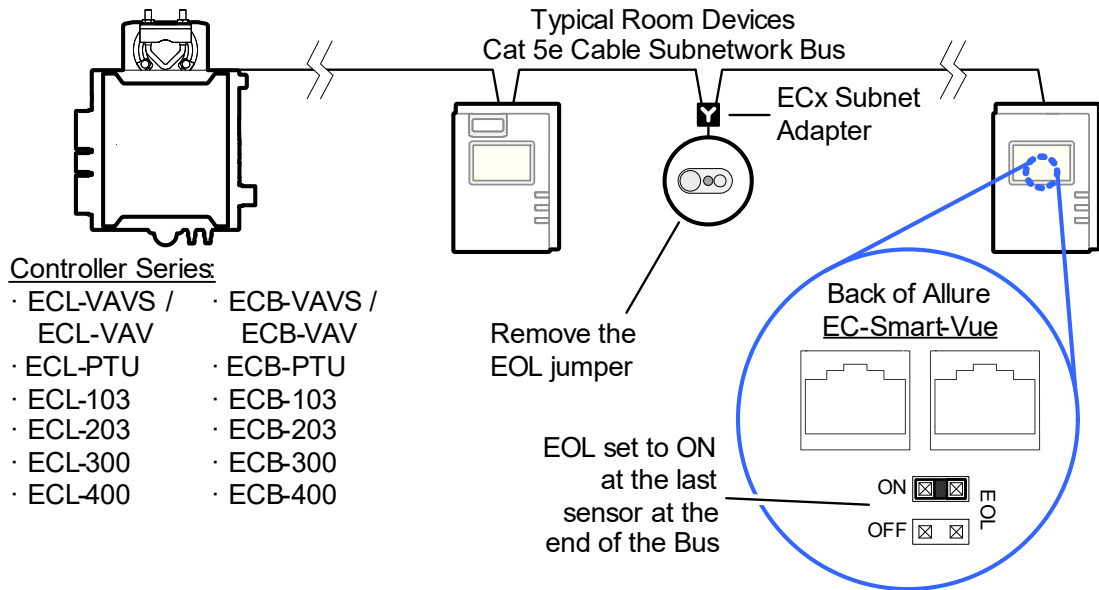


Figure 52: Setting the EOL Terminations on the Cat 5e Cable Subnetwork Data Bus for the ECB/ECL-VAV Series and ECB/ECL-103 to -400 Controllers (Allure EC-Smart-Comfort)

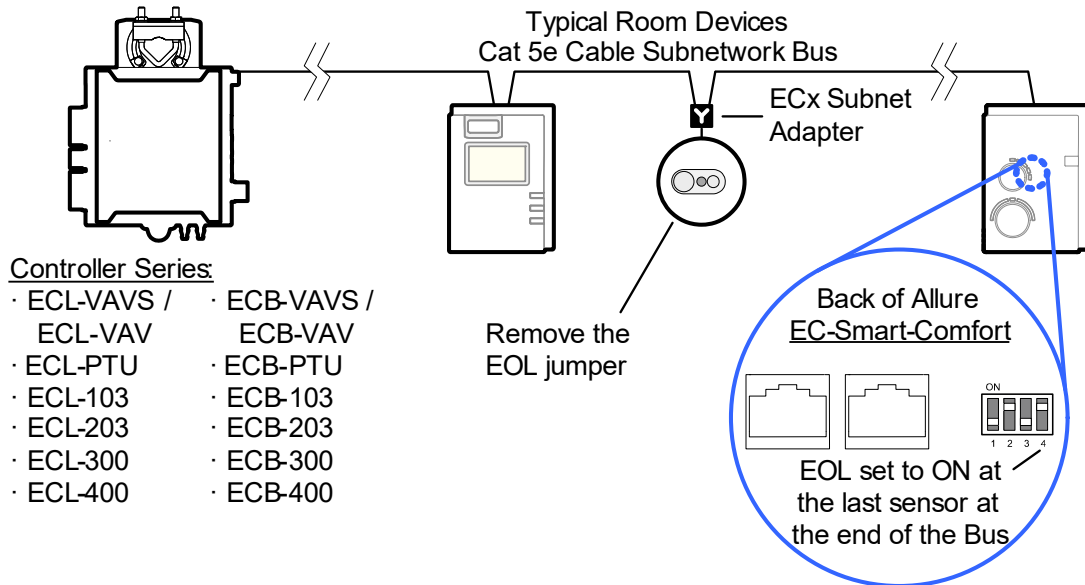
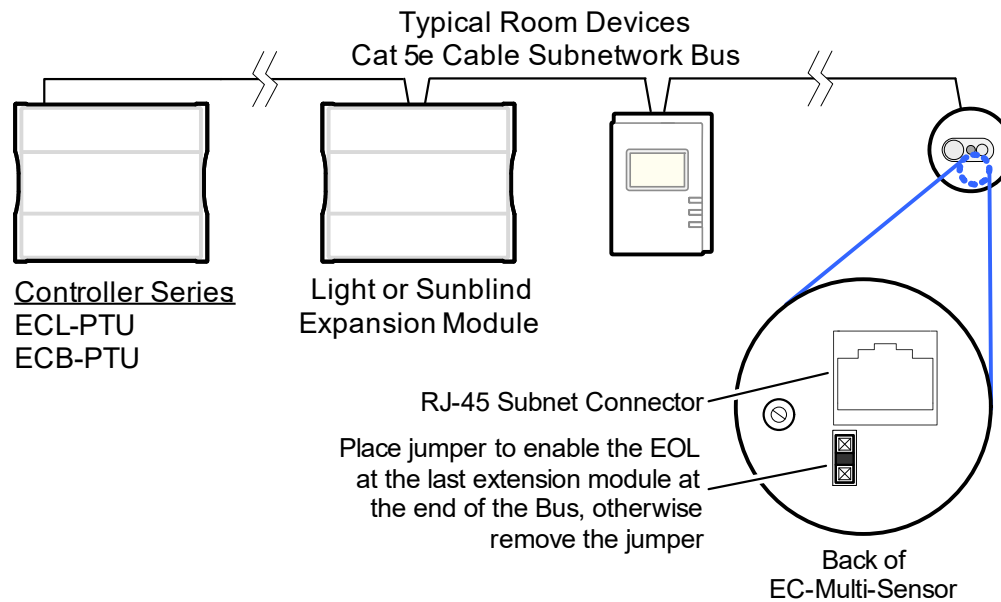


Figure 53: Setting the EOL Terminations on the Cat 5e Cable Subnetwork Data Bus for the ECB/ECL-PTU Series Controllers

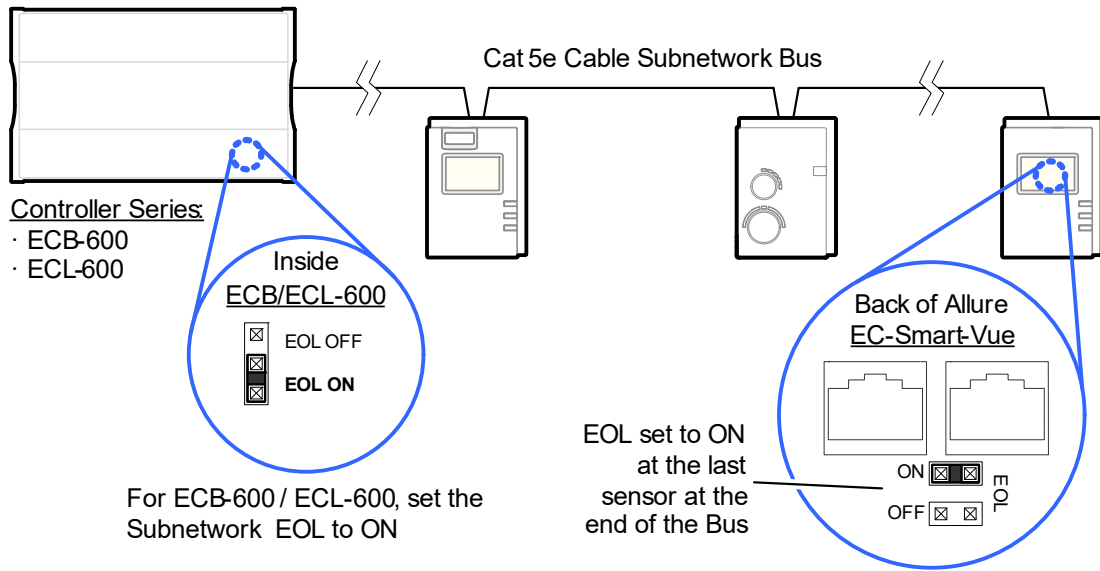


Depending on the type of expansion module, the subnetwork data bus EOL may be set by configuring jumpers or DIP switches. Refer to the expansion module's hardware installation guide for how to identify and set a room devices' built-in EOL terminations.

EOL Terminations for the ECB/ECL-600 Series Controllers

When one or more Allure Series sensors are installed with an ECB/ECL-600, only the EOL terminations of the ECB/ECL-600 and the last Allure Series sensor are set to ON. All other Allure Series sensors must have their EOL terminations set to OFF. This is shown below:

Figure 54: Setting the EOL Terminations on the Allure Series sensor Subnetwork Data Bus for the ECB/ECL-600



If an ECx-4XX Series I/O Extension Module is used with both a Cat 5e room device and an ECB/ECL-600 controller, see [2-Wire Subnetwork Data Bus](#) on page 92 for how to set the EOL terminations.

Setting the Subnet ID Addressing for Room Devices

Each type of room device connected to a controller's Subnet Port must be set to a unique subnet ID address. The permitted subnet ID addressing range according to controller model is shown in [Table 16](#). The method to use to set a room device's subnet ID address is shown in the table below.

Table 19: Subnetwork Module Compatibility and Maximum Supported Quantity Chart

Room Device Type	Configuration Method	See
Allure EC-Smart-Vue series	Configured in an on-screen menu.	Setting the Allure EC-Smart-Vue Sensor's Subnet ID Address on page 98.
Allure EC-Smart-Comfort series	Dip Switch located next to the RJ-45 subnet connectors	Setting the Allure EC-Smart-Air and EC-Smart-Comfort Communicating Sensor Series' Subnet ID Address on page 86
Allure EC-Smart-Air series		
EC-Multi-Sensor series	Rotary selector located next to the RJ-45 subnet connector	Setting the EC-Multi-Sensor Series' Subnet ID Address on page 88.

Table 19: Subnetwork Module Compatibility and Maximum Supported Quantity Chart

Room Device Type	Configuration Method	See
ECx-Light-4 / ECx-Light-4D / ECx-Light-4DALI ECx-Blind-4 / ECx-Blind-4LV	DIP switch located next to Subnet Port connectors	Setting the ECx-Light and ECx- Blind Series' Subnet on page 75

Setting the Allure EC-Smart-Air and EC-Smart-Comfort Communicating Sensor Series' Subnet ID Address

Each Allure EC-Smart-Air or EC-Smart-Comfort communicating sensor connected to a controller's Subnet Port must be set to a unique subnet ID address. This address should correspond to the block number of the associated Subnet Extension block in EC-*gfx*Program. The address is set through a DIP switch located inside the sensor near the RJ-45 connectors.



Allure EC-Smart-Comfort and EC-Smart-Air communicating sensor series share the same Subnet ID range: the same address cannot be assigned concurrently to an Allure EC-Smart-Comfort communicating sensor series and to an Allure EC-Smart-Air communicating sensor series.

Figure 55: Setting the Allure EC-Smart-Air or EC-Smart-Comfort communicating sensor's Subnet ID Address

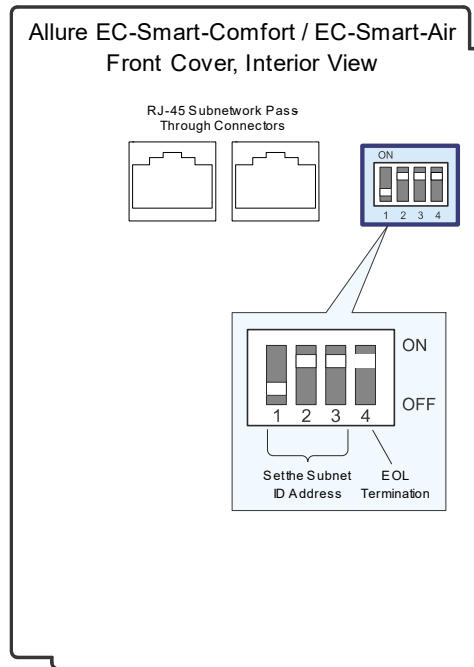


Table 20: Allure EC-Smart-Air or EC-Smart-Comfort communicating sensor's Subnet ID Address DIP Switch Settings

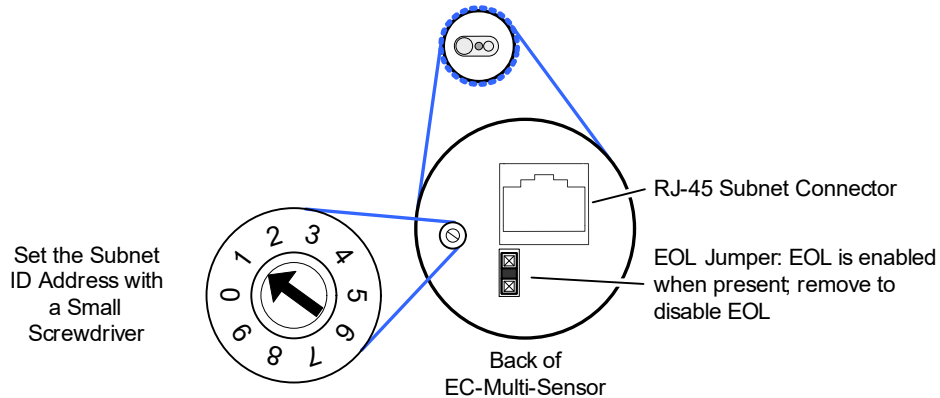
Switch Position				Allure EC-Smart-Air or EC-Smart-Comfort communicating sensor's Subnet ID Address
1	2	3	4	
OFF	OFF	OFF	OFF: EOL disabled ON: EOL enabled	1
ON	OFF	OFF		1
OFF	ON	OFF		2
ON	ON	OFF		3
OFF	OFF	ON		4
ON	OFF	ON		5
OFF	ON	ON		6

Figure 55 shows an example of how to set the Allure EC-Smart-Air or EC-Smart-Comfort communicating sensor's Subnet ID address DIP switch to 6 and how to set the EOL termination to ON.

Setting the EC-Multi-Sensor Series' Subnet ID Address

Each EC-Multi-Sensor connected to a controller's Subnet Port must be set to a unique subnet ID address. This address should correspond to the block number of the associated Multi Sensor block in EC-*gfx*Program. The address is set through the rotary selector located next to the Subnet Port connector.

Figure 56: Setting the EC-Multi-Sensor Series' Subnet ID Address



Use a small screwdriver (for example, a precision or jeweler's screwdriver) to set the selector. [Figure 56](#) shows an example of how to set the EC-Multi-Sensor Series' Subnet ID address DIP switch to 1 and the EOL termination is ON.



Once an EC-Multi-Sensor is installed, the following tip can be used during system commissioning to verify if the EC-Multi-Sensor is set to the correct subnet ID address for the zone in which it is physically located.

Run EC-*gfx*Program in debug mode for the controller with 4 Multi Sensor block instances, 1 to 4. Set a remote control to zone ID 0, then aim it at the EC-Multi-Sensor and press a command (fan speed button for example). In EC-*gfx*Program, see which block instance shows an output (RemoteFanSpeed).

Usually it is easier to reassign Multi Sensor block numbers in EC-*gfx*Program code than it is to change the Subnet ID Address of an installed EC-Multi-Sensor.

Setting the ECx-Light and ECx-Blind Series' Subnet ID Address

Each ECx-Light and ECx-Blind Series' connected to a controller's Subnet Port must be set to a unique subnet ID address. The address is set through the DIP switch located next to the Subnet Port connectors.

Figure 57: Setting the ECx-Light and ECx-Blind Series' Subnet ID Address (Typical)

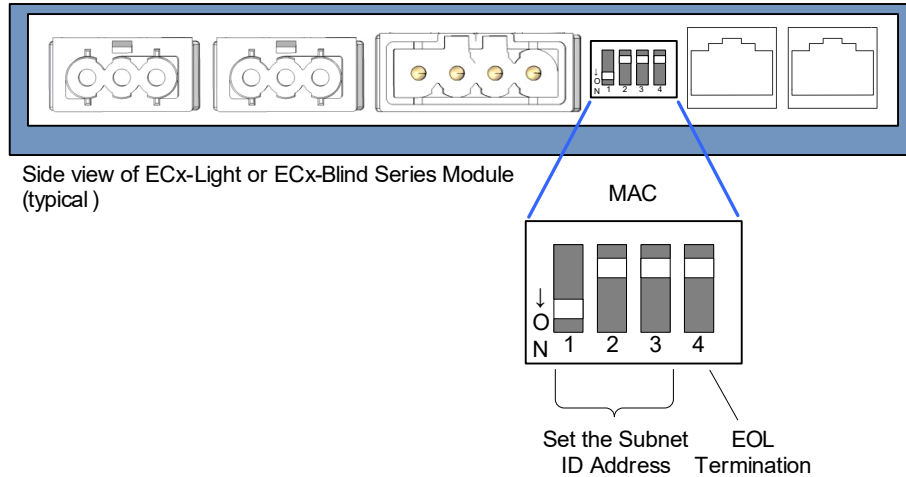


Table 21: ECx-Light and ECx-Blind Series' Subnet ID Address DIP Switch Settings

Switch Position				Expansion Module's Subnet ID (MAC) Address
1	2	3	4	
OFF	OFF	OFF	OFF	See Table 22
ON	OFF	OFF	OFF	1
OFF	ON	OFF	OFF	2
ON	ON	OFF	OFF	3
OFF	OFF	ON	OFF	4

[Figure 57](#) shows an example of how to set the ECx-Light and ECx-Blind series' Subnet ID address DIP switch to 1 and how to set the EOL termination to OFF.

Auto-assigned Subnet ID Address for Light and Blind Expansion Modules

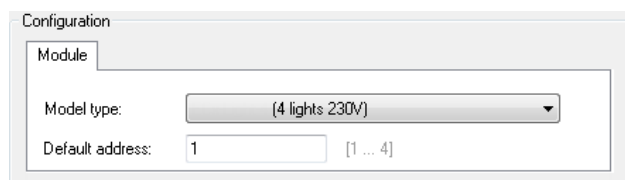
Often only one type of expansion module is connected to the controller; for example, one ECx-Light-4 and one ECx-Blind-4 model. By leaving the Subnet ID address DIP switch at 0 (factory default position) for these two expansion modules, the ECx-Light and ECx-Blind room device sets its own Subnet ID Address according to its model type so no configuration is necessary.

Table 22: ECx-Light and ECx-Blind Series' Automatic Subnet ID Address when the DIP Switch is set to 0

Expansion Module Model Type	Auto-assigned Subnet ID Address when the expansion modules' MAC DIP Switch is set to 0 (factory default position)			
	1	2	3	4
ECx-Light-4 (4 lights 230V)	x			
ECx-Light-4DALI (4 DALI buses)	x			
ECx-Light-4D (4 dimming lights)		x		
ECx-Blind-4 (4 blinds/shades 230V)			x	
ECx-Blind-4LV (4 blinds/shades 24V)				x

If you connect a second expansion module of the same type to the controller's subnetwork data bus, you must set at least one of the two expansion modules' MAC DIP switch to a unique (that is, unused) subnet ID (MAC) address and then set the same value in Default address in EC-gfxProgram. See "Manage Light and Sunblind Module Instances" in the [EC-gfxProgram User Guide](#).

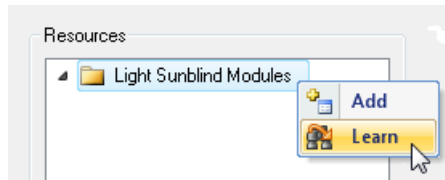
Figure 58: In EC-gfxProgram: Default Address: Setting an Expansion Modules' Subnet ID (MAC) Address for this Expansion Module Instance



Auto Learn Light and Blind/Shade Expansion Modules in EC-gfxProgram

In EC-gfxProgram, when the connection status for the controller is Connected, this scans the controller's subnetwork data bus for connected expansion modules, when each expansion module has a unique subnet ID (MAC) address on the controller's subnetwork data bus. Using this feature will delete any previously configured expansion modules. See "Manage Light and Sunblind Module Instances" in the [EC-gfxProgram User Guide](#).

Figure 59: Light and Blind/Shade Modules Tree Options



Learn is only available after 2 minutes of the controller having been powered up. This information is no longer available after 30 minutes. Reboot the controller if Learn is unable to find the connected modules (in Project Synchronization, select Download to device and Reboot controller only).

2-Wire Subnetwork Data Bus

The 2-Wire subnetwork data bus is used to connect ECx-4XX Series I/O Extension Modules to an ECB-600 or ECL-600 controller. The specifications for this cable are shown in [Table 23](#).

2-Wire Subnetwork Data Bus is Polarity Sensitive

The polarity of the 2-wire subnetwork data bus must be respected as shown in [Figure 62](#). All terminals identified as SUBNET+ must be connected to the same conductor. Likewise, all terminals identified as SUBNET- must be connected to the same conductor.

2-Wire Subnetwork Data Bus Physical Specifications and Cable Requirements

Cables composed of stranded conductors are preferred over solid conductors as stranded conductor cable better resist breakage during pulling operations. Distech Controls strongly recommends the following 2-wire subnetwork data bus cable specifications be respected.

Table 23: Cat 5e Cable Subnetwork Data Bus Physical Specifications and Cable Requirements

Parameter	Details
Maximum number of ECx-4XX Series I/O Extension Modules	2
Subnet ID Addressing Configuration	DIP switch located on faceplate. ECx-4XX I/O Extension Module Addressing on page 95.
Media	Shielded, twisted pair
Characteristic impedance	100-130 Ohms
Distributed capacitance	Less than 100 pF per meter (30 pF per foot)
Maximum total length of the Cat 5e Cable subnetwork data bus plus the 2-wire subnetwork data bus	300 m (1 000 ft.) Maximum – See Subnetwork Data Bus Length on page 75.
Polarity	Polarity sensitive
Multi-drop	Daisy-chain (no T-connections, no routers)
EOL terminations	Built-in. Must be set / enabled on the last ECx-4XX Series I/O Extension Module only.
Shield grounding	See 2-Wire Subnetwork Data Bus Shield Grounding Requirements on page 94.

Distech Controls recommends the cable shown below.

Table 24: Distech Controls Recommended Cable Types for the 2-Wire Subnetwork Data Bus

Cable Type	Part Number	O.D. (Ø)
300 meters (1000 feet), 24 AWG Stranded, Twisted Pair Shielded Cable - FT6, Rated for Plenum Applications	CB-BACN6BL1000	3.75mm (0.148 in.)

2-Wire Subnetwork Data Bus Topology and End-of-Line (EOL) Terminations

The EOL termination settings for the 2-wire subnetwork data bus will vary depending on whether any Allure Series sensors are connected to the controller's Subnet Port or not. By default, the EOL termination on the ECx-4XX devices and Allure Series sensors are factory-set to OFF.

When ECx-4XX I/O Extension Modules are connected to an ECB-600 / ECL-600 controller's Subnet+ and Subnet connectors, only the EOL terminations of the ECB-600 / ECL-600 and the last ECx-4XX are set to ON. All other ECx-4XX I/O Extension Modules must have their EOL terminations set to OFF. This is shown below.


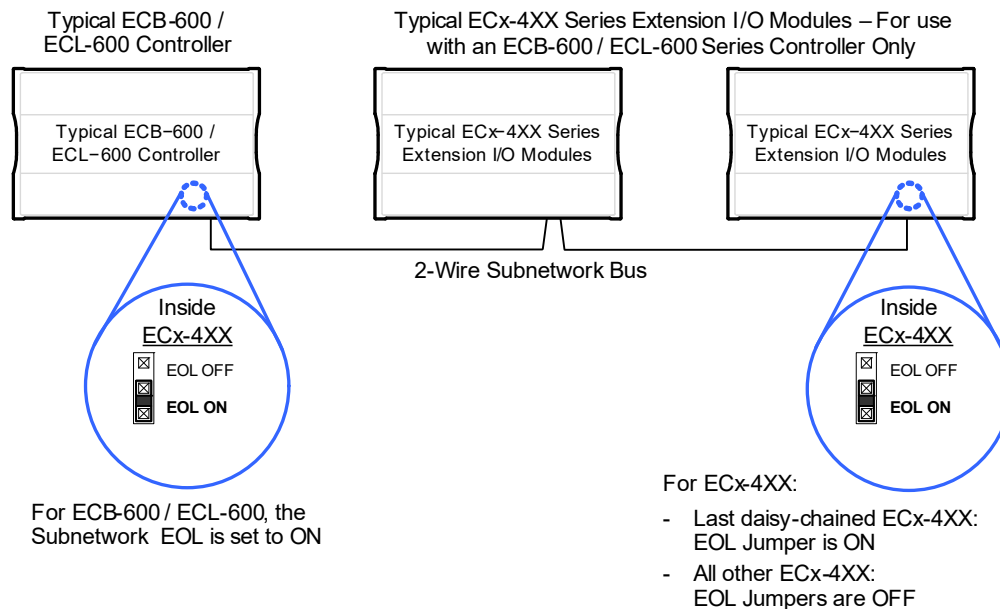
 For the 2-wire subnetwork data bus, only a daisy-chain topology is acceptable and T-connections and routers are not allowed.

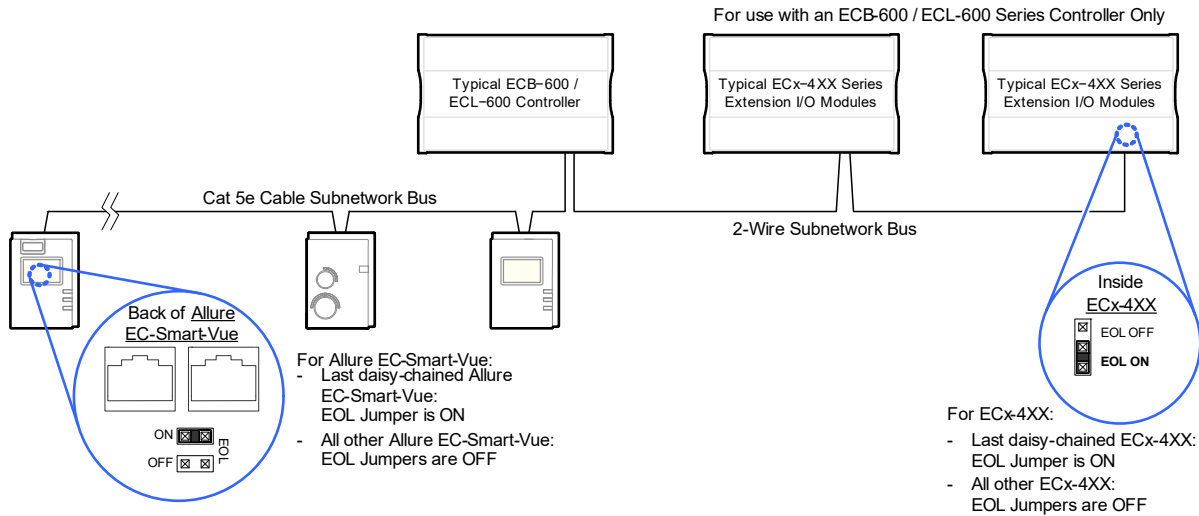
Figure 60: Setting the EOL Terminations on the ECx-4XX Subnetwork Data Bus



When ECx-4XX I/O Extension Modules are connected to an ECB-600 / ECL-600 controller's Subnet+ and Subnet connectors and with one or more Allure Series sensor(s) are connected to the controller's Subnet Port, only the EOL terminations of the last ECx-4XX and the last

Allure Series sensor are set to ON. All other ECx-4XX I/O Extension Modules and Allure Series sensors must have their EOL terminations set to OFF. This is shown below.

Figure 61: Setting the EOL Terminations on the Subnetwork Data Bus when Cat 5e Room Devices are used

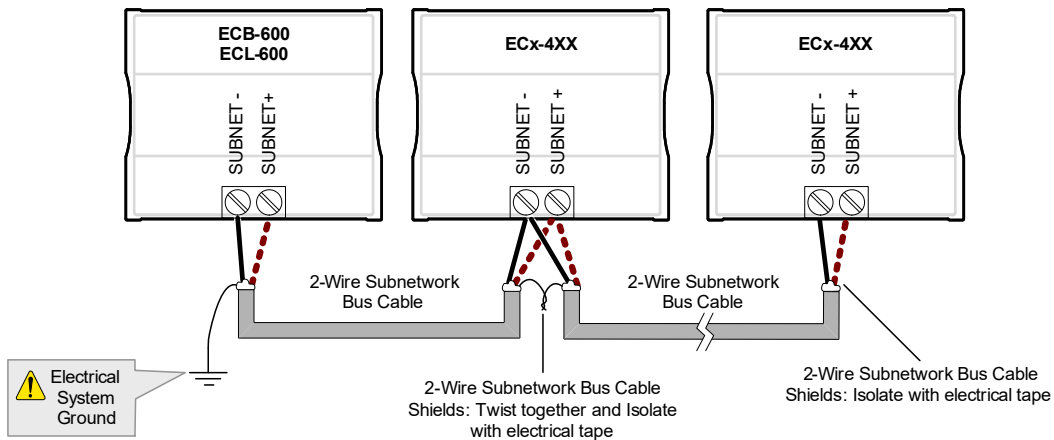


2-Wire Subnetwork Data Bus Shield Grounding Requirements

The 2-Wire subnetwork data bus is a three-wire bus that has specific installation requirements. The best protection against interference is to use properly grounded shielded cable for the 2-Wire subnetwork data bus. For this, the ECx-4XX I/O Extension Modules on the 2-Wire subnetwork data bus must be daisy-chained together with the cable shield twisted together and isolated with electrical tape at each ECx-4XX I/O Extension Module.

The shielding of the 2-Wire subnetwork data bus cable must be connected to the electrical system ground at one point only, preferably at the ECB-600/ECL-600 as shown below.

Figure 62: ECB-600/ECL-600 - 2-Wire Subnetwork Data Bus Shielding



For more information about 2-Wire subnetwork data bus grounding, see:

- [ECx-4XX I/O Extension Module Power Supply Requirements](#) on page 47 for ECB-600 controllers.
- [ECx-4XX I/O Extension Module Power Supply Requirements](#) on page 66 for ECL-600 controllers.

ECx-4XX I/O Extension Module Addressing

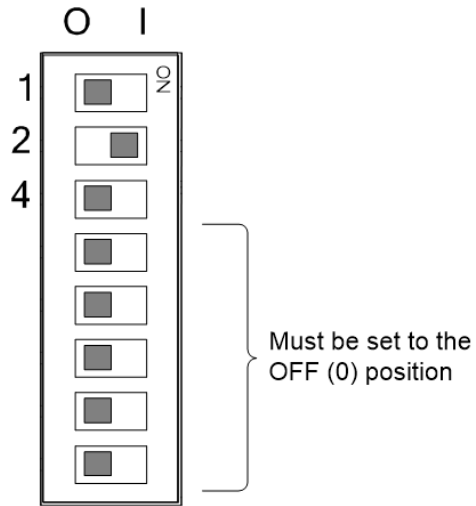
Each ECx-4XX I/O Extension Module on a 2-Wire subnetwork data bus needs to be set to a unique address. The address is set through the DIP switch located on the ECx-4XX I/O Extension Module's faceplate. The range of valid addresses is 1 to 7.

Table 25: ECx-4XX I/O Extension Module Address DIP Switch Settings

Switch Position			Value
1	2	4	
OFF	OFF	OFF	Invalid
ON	OFF	OFF	1
OFF	ON	OFF	2
ON	ON	OFF	3
OFF	OFF	ON	4
ON	OFF	ON	5
OFF	ON	ON	6
ON	ON	ON	7

An example of how to set an ECx-4XX I/O Extension Module address DIP switch is shown below.

Figure 63: Typical ECx-4XX I/O Extension Module Address DIP Switch Set to 2



Power Supply Requirements

The ECB-600/ECL-600 and each associated ECx-4XX I/O Extension Module must have their own dedicated power supply. To size the power supply transformer, see:

- [Transformer Selection and Determining the Maximum Power Run Length](#) on page 43 for ECB-600 controllers.
- [Transformer Selection and Determining the Maximum Power Run Length](#) on page 61 for ECL-600 controllers.

CHAPTER 5

Controller Installation and Maintenance Tasks with an Allure EC-Smart-View Sensor

This chapter describes how to use an Allure EC-Smart-View sensor to perform installation and maintenance tasks including commissioning a controller.

Topics

[*Commissioning a Controller with an Allure EC-Smart-View Sensor*](#)

Commissioning a Controller with an Allure EC-Smart-Vue Sensor


Commissioning a controller with an Allure EC-Smart-Vue sensor involves the following tasks:

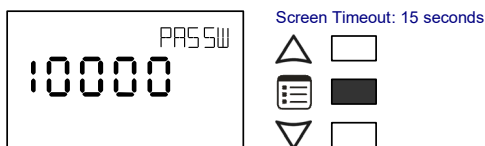
- Set the Allure EC-Smart-Vue sensor's Subnet ID.
- For BACnet controllers: Optionally set the controller's MAC address.
- For controllers that support preloaded applications: Select the controller's preloaded application to use. See the ECL-VAV or ECB-VAV Preloaded Application User Guide for more Information.
- For BACnet controllers: Set the controller's baud rate, if necessary.
- For maintenance and troubleshooting purposes, the Allure EC-Smart-Vue sensor can be used to temporarily connect to the LAN.


Setting the Allure EC-Smart-Vue Sensor's Subnet ID Address

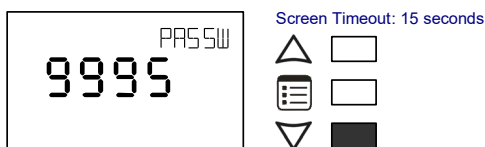
An Allure EC-Smart-Vue sensor's Subnet ID corresponds to the ComSensor block instance programmed in the controller with EC-*gfx*Program. The Allure EC-Smart-Vue sensor's Subnet ID can be set in the procedure below.


ECB and ECL Series controllers can be commissioned with an Allure EC-Smart-Vue sensor. The default Subnet ID for an Allure EC-Smart-Vue sensor is 1. To commission an ECB / ECL Series controller, the Allure EC-Smart-Vue sensor's Subnet ID must be set to 1. If the Allure EC-Smart-Vue sensor's Subnet ID has been set to another value (for example, the display flashes error code 1 with the Bell icon when the Allure EC-Smart-Vue sensor is connected to a controller for commissioning), change the Subnet ID to 1 as follows:

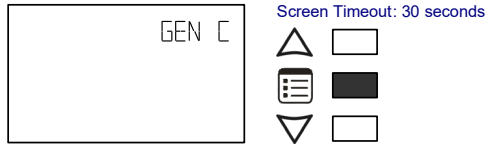
1. Connect an Allure EC-Smart-Vue sensor to the controller with a Cat 5e patch cable. Wait for the Bell icon and the number 1 to flash on the display.
2. Press and hold the **Menu** button  for 5 seconds to enter the password menu. 10000 is shown on the display.





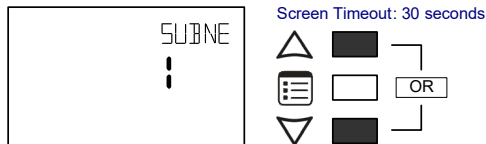
3. Use the down button  to set the number to **9995** (this is the default password).







4. Press the **Menu** button  to submit the password. Upon submitting the password, the GEN CFG menu appears on the display.



5. Press the down button  once to enter the GEN CFG submenu
6. Press the Menu button  several times until SUBNET ID appears on the display. The current controller's Subnet ID is shown.



7. For commissioning purposes, use the up and down buttons   to set the controller's Subnet ID to 1. Tip: Hold down either the up or down button to fast-advance the display value. Otherwise use the up and down buttons to set the controller's Subnet ID to the ComSensor block instance value programmed in the controller with EC-gfxProgram.
8. Press the Menu button  once to apply the value.
9. Press and hold the Menu button  for 5 seconds to exit the configuration menu.

The Allure EC-Smart-Vue sensor can now be used to go from one ECB/ECL Series controller to the next for commissioning purposes.


When the controller has been programmed, each connected Allure EC-Smart-Vue's Sensor must be assigned a unique Subnet ID.

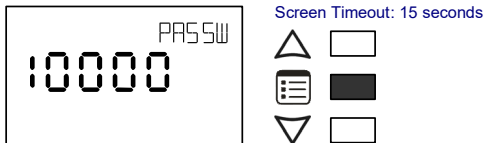
Commissioning Controllers


To commission a controller with a MAC Address DIP switch located on the faceplate or under the cover (in the case of an ECB-103 or ECB-VAV Series controller - when equipped), first set the DIP switch to 0 (all off - this is the factory default setting when the controller is shipped). When using an Allure EC-Smart-Vue sensor for commissioning a controller (before code is downloaded to the controller from EC-gfxProgram), connect an Allure EC-Smart-Vue sensor to the controller with its Subnet ID set to 1.

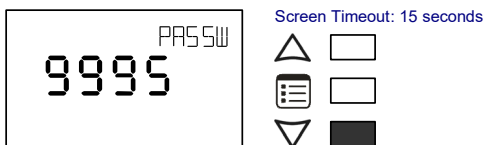
For ECB-VAV and ECL-VAV Series controllers, commissioning can be used to perform application selection if needed. Applications are preloaded programs that enable the ECB-VAV and ECL-VAV to control a typical VAV box. See the ECL-VAV or ECB-VAV Preloaded Application User Guide for more Information.


For ECB Series controllers only, during commissioning, the Allure EC-Smart-View sensor is used to set the controller's BACnet® MAC Address. Set the connected ECB Series controller's MAC Address as follows:

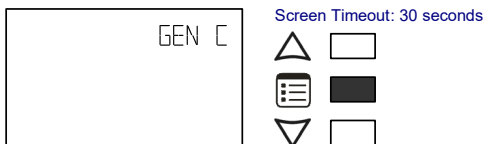
1. Connect an Allure EC-Smart-View sensor to the controller with a Cat 5e patch cable. Wait for the display to show the room temperature.
2. Press and hold the Menu button  for 5 seconds to enter the password menu. 10000 is shown on the display.




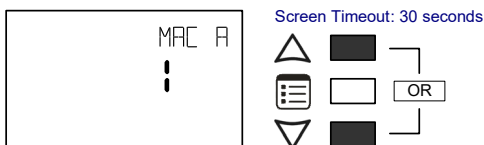
3. Use the down button  to set the number to 9995 (this is the default password).





4. Press the Menu button  to submit the password. Upon submitting the password, the **GEN CFG** menu appears on the display.



5. Press the down button  once to enter the **GEN CFG** submenu. The **MAC ADDRESS** menu is shown with the current controller's BACnet MAC Address.



6. Use the up and down buttons to set the controller's MAC Address. Only addresses from 1 to 127 are recommended to be used.
7. Press the **Menu** button  once to apply the value.
8. Press and hold the **Menu** button  for 5 seconds to exit the configuration menu.

Once the controller's communication network is operational, the controller can be programmed with EC-gfxProgram. For each Allure EC-Smart-View sensor, set its Subnet ID number to the block number of its associated **CommSensor** block in EC-gfxProgram. This is done in the Allure EC-Smart-View sensor's **GEN CFG** menu under **SUBNET ID**.

Setting the Baud Rate for ECB-Series Controllers (optional)

For information about what the BACnet MS/TP network baud rate should be set to, see [Maximum Number of BACnet MS/TP Devices on a Data Bus Segment and Baud Rate](#) on page 14.


By default, the baud rate for the controller is factory set to automatically detect the current communication baud rate of the connected BACnet MS/TP network (AUTO setting). This is the preferred setting for a controller. However, at least one controller on the BACnet MS/TP network data bus must have its baud rate set to act as the master for setting the baud rate on the BACnet MS/TP network. The preference is to set the building controller's baud rate (if present). Otherwise, set the baud rate on one controller that will set the baud rate for all other controllers.

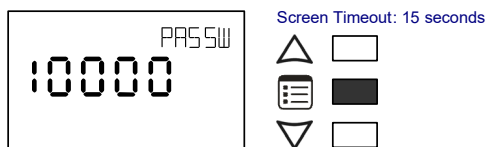



When the baud rate is set to AUTO, the controller cannot initiate any communication until it has detected the baud rate of the BACnet MS/TP network. If all controllers on the BACnet MS/TP network are set to AUTO, then all controllers will not communicate.

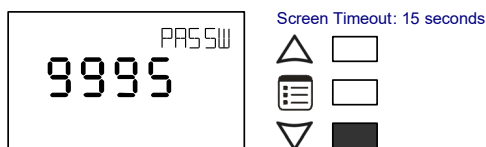
A method to increase the availability of the BACnet MS/TP network is to also set the baud rate of a second controller on the BACnet MS/TP network so that it can provide failover service. In this scenario, should the first controller that is to set the baud rate fail or should it take longer than usual to boot after a power failure, this second "failover controller" will set the baud rate of all other controllers on the BACnet MS/TP network, thereby allowing all other controllers to establish communications with each other. This provides redundancy and helps to eliminate a single point of failure. See [Baud Rate](#) on page 16.


Set the connected controller's baud rate as follows:

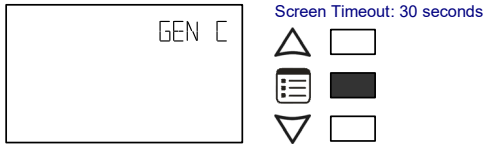
1. Connect an Allure EC-Smart-View sensor to the controller with a Cat 5e patch cable. Wait for the display to show the room temperature.
2. Press and hold the **Menu** button  for 5 seconds to enter the password menu. 10000 is shown on the display.





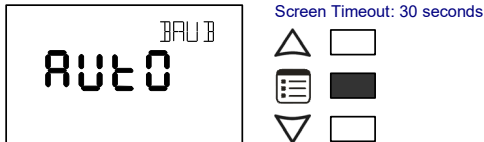
3. Use the down button  to set the number to 9995 (this is the default password).





4. Press the **Menu** button  to submit the password. Upon submitting the password, the **GEN CFG** menu appears on the display.



5. Press the down button  once to enter the **GEN CFG** submenu.
6. Press the **Menu** button  several times until **BAUD RATE** appears on the display. The current controller's baud rate is shown.



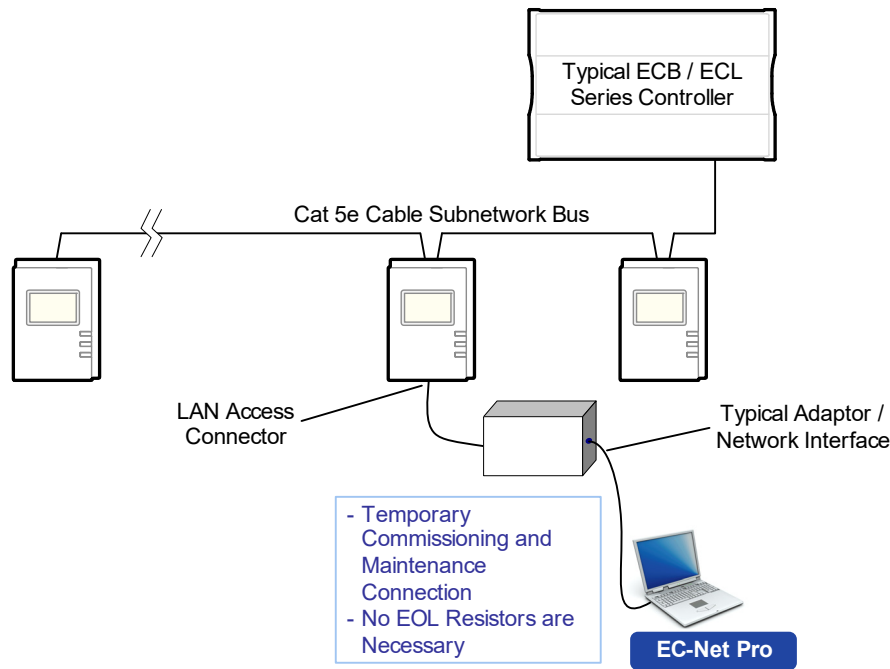
7. Use the up and down buttons to set the controller's baud rate. **AUTO** detects and uses the baud rate currently being used by the BACnet MS/TP network.
8. Press the **Menu** button  once to apply the value.
9. Press and hold the **Menu** button  for 5 seconds to exit the configuration menu.

Connecting to the LAN through an Allure EC-Smart-Vue Sensor

The Cat 5e Cable subnetwork data bus extends the LAN to the Allure EC-Smart-Vue sensor to provide convenient network access for maintenance and troubleshooting purposes.

The next sections explain how to bring to the LONWORKS network and BACnet network to the Allure EC-Smart-Vue sensor. Both are handled slightly differently since there can only be a limited number of enabled controllers on a LONWORKS network, whereas BACnet has no limitations.

Figure 64: Overview of the Allure EC-Smart-View sensor Subnetwork Data Bus with LAN Access



Certain controller models support the ability to bring the LAN to the Allure EC-Smart-View sensor, while other controller models do not.

Table 26: LAN through an Allure EC-Smart-View Sensor Feature Compatibility

Controller Model	Supported	See
ECL-VAV Series ECL-103 ECL-203 Series ECL-300 Series ECL-400 Series ECL-600 Series	Yes	LAN through an Allure EC-Smart-View Sensor for a LONWORKS Network on page 60
ECB-VAV Series ECB-103 ECB-203 Series ECB-300 Series ECB-400 Series ECB -600 Series	Yes	LAN through an Allure EC-Smart-View Sensor for a BACnet Network on page 60
ECB/ECL-PTU Series ECB/ECL/AVS	No	-

LAN through an Allure EC-Smart-Vue Sensor for a LONWORKS Network

To provide LAN access for a LONWORKS network, jumpers, or DIP switches on both the controller and Allure EC-Smart-Vue sensor must be enabled.

All LONWORKS controllers have Net to Subnet Port Settings jumpers which when enabled will bring down the LONWORKS network to the Allure EC-Smart-Vue sensor (for jumper locations see [Figure 66](#) and [Figure 67](#)).

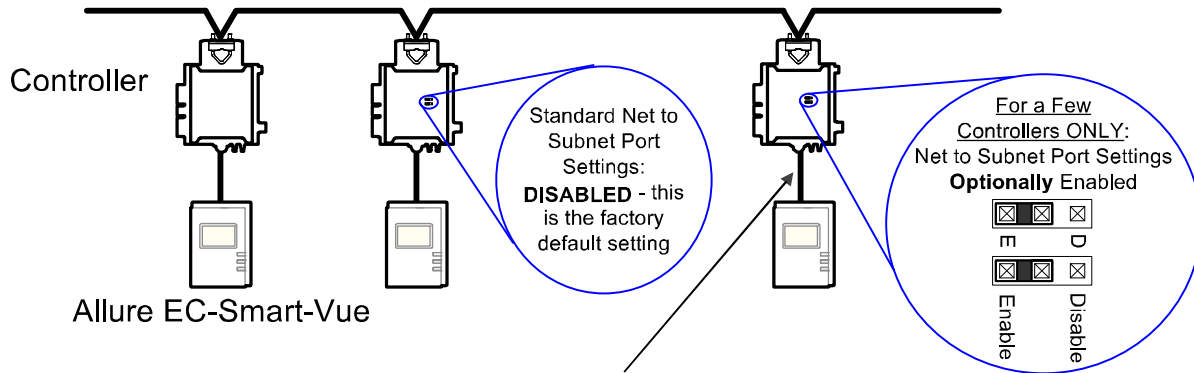


Recommendation: Only a limited number of controllers on a LONWORKS network segment should have their Net to Subnet Port Settings jumpers enabled. Enabling too many Allure EC-Smart-Vue sensors with network access may cause network communication issues. If there are any network communication problems, refer to the LONWORKS Troubleshooting section on page 60.

The image below shows a typical LONWORKS network data bus topology with only a few controllers enabled for LAN access at the Allure EC-Smart-Vue sensor.

Figure 65: LONWORKS Network Data Bus Topology

Bus Network Topology: 22AWG (0.65mm) Unshielded Twisted Pair Network Cable



Cat 5e Cable Subnetwork Bus Provides:

- Room Device Data communication
- LONWORKS Network when **Net to Subnet Port Settings** jumpers are Enabled

For maximum cable lengths and cable specifications for a LONWORKS network data bus topology, refer to [Network Cables](#) on page 55.

The length of the Allure EC-Smart-Vue sensor subnetwork data bus must also comply with the restrictions shown in [Subnetwork Data Bus Length](#) on page 75.

Enabling the Net to Subnet Port Jumper

To connect the main LONWORKS network to the Cat 5e Cable subnetwork data bus, set the two Net to Subnet Port Settings jumpers inside the ECL series controller to Enable. The factory-set default is disabled. Refer to the controller's Hardware Installation Guide for how to identify and set a controller's Net to Subnet Port jumpers.

Figure 66: Jumpers Set to Enabled on an ECL Series Controller

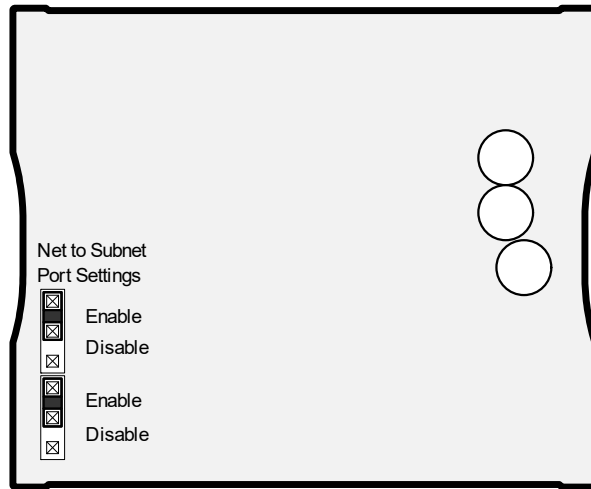
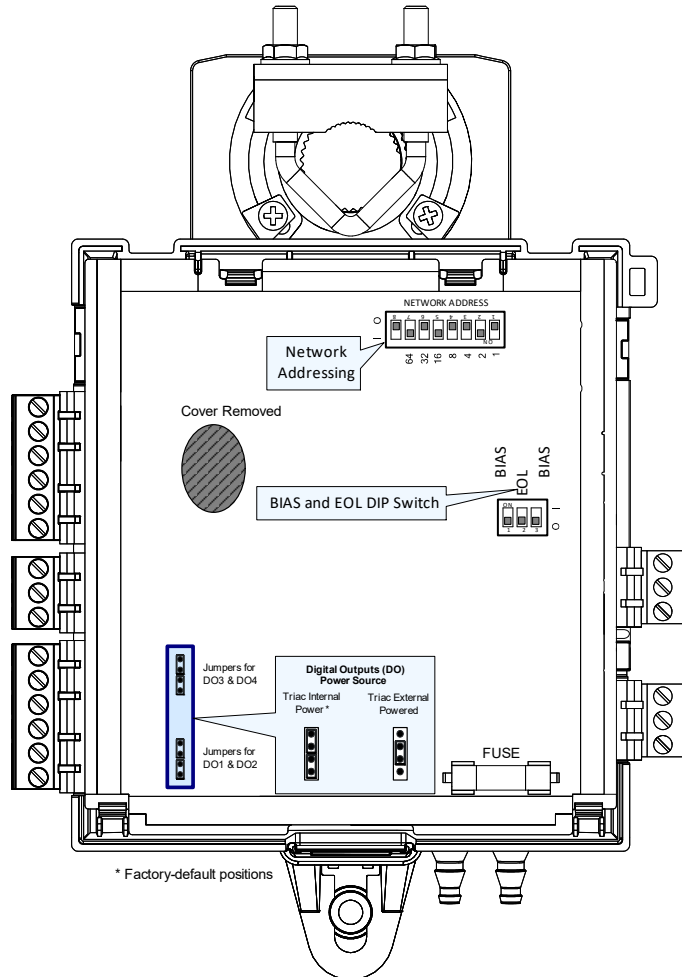


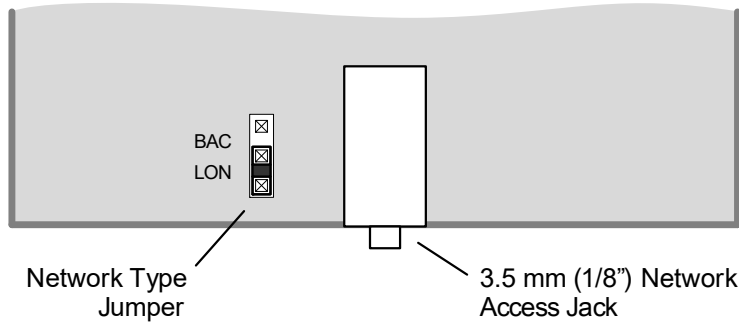
Figure 67: Figure 5 4: Dip Switch and Jumper Identification and Configuration



Configuring the Allure EC-Smart-Vue Sensor

On each Allure EC-Smart-Vue sensor, make sure that the BAC/LON jumper is set to the LON position. This should be done for all Allure EC-Smart-Vue sensors, in case you wish to enable network access in the future.-

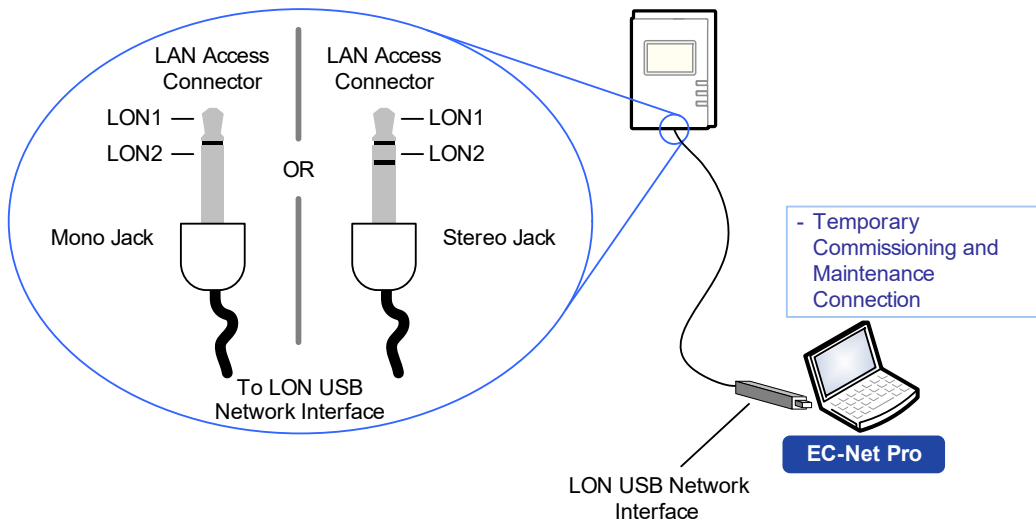
Figure 68: Allure EC-Smart-Vue Sensor BAC/LON Jumper is Set to LON



Connecting to the LON USB Network Interface

To temporarily access the LONWORKS LAN for commissioning and maintenance purposes, connect a LONWORKS USB Network Interface to the stereo audio plug port located on the lower edge of the Allure EC-Smart-Vue sensor. Then wire a standard 3.5 mm (1/8") three-conductor (stereo jack) or two-conductor (mono jack) as shown below.

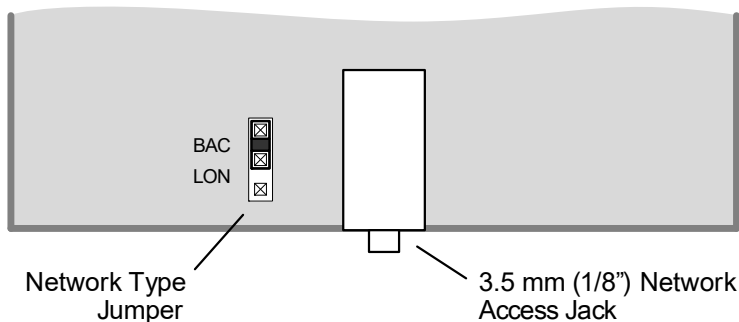
Figure 69: 1/8" (3.5 mm) Stereo or Mono Jack Connection for a LONWORKS Network Interface



LAN through an Allure EC-Smart-Vue Sensor for a BACnet Network

For a BACnet network, by default, all Allure EC-Smart-Vue sensors provide LAN access. First, ensure that the BAC/LON jumper in the Allure EC-Smart-Vue sensor is set to the BAC (BACnet) position (this is the factory-set default jumper position).

Figure 70: BAC/LON Jumper Set to the BAC Position



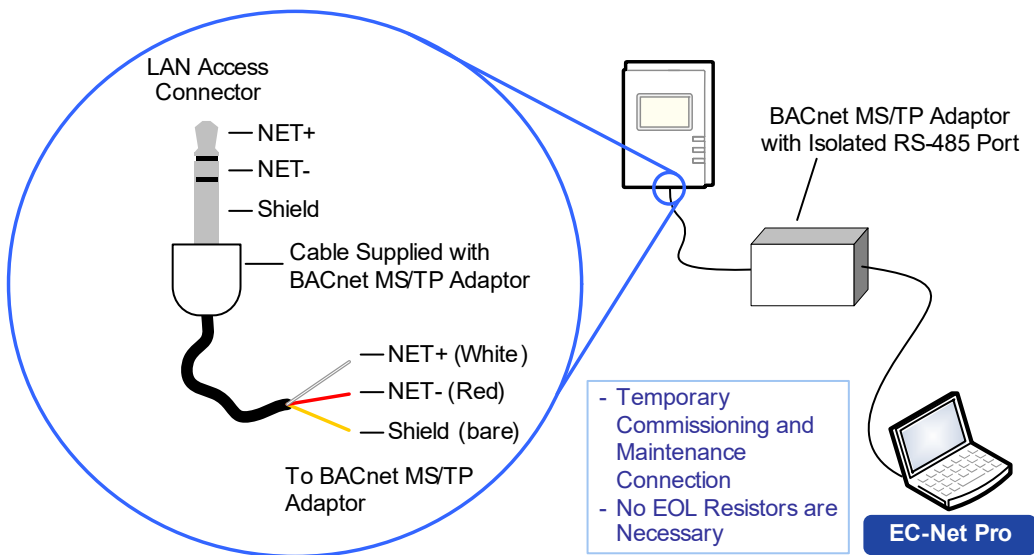
To temporarily access the LAN for commissioning and maintenance purposes, connect a portable adaptor to the stereo audio plug located on the lower edge of the Allure EC-Smart-View sensor.



The BACnet MS/TP adaptor must have an electrically-isolated RS-485 port. Otherwise a ground path from the BACnet network will be made through the computer that will disrupt BACnet network communications.

Wire a standard three-conductor 3.5 mm (1/8 inch) stereo jack as shown below.

Figure 71: 1/8" (3.5 mm) Stereo Jack Connection for a Portable Adapter



The following BACnet MS/TP adaptor is available from Distech Controls: BACnet/IP to MS/TP Adaptor, part number NC-BASRTPBXX.

CHAPTER 6

BACNET TROUBLESHOOTING

You can use this Troubleshooting Guide to help detect and correct issues that you may encounter.

Table 27: Troubleshooting ECB Device Symptoms

Symptom	Possible Cause	Solution
Controller is powered but does not turn on	Fuse has blown (for 24V controllers)	Disconnect the power. Check the fuse integrity. Reconnect the power.
	Power supply polarity	Verify that consistent polarity is maintained between all controllers and the transformer. Ensure that the COM terminal of each controller is connected to the same terminal on the secondary side of the transformer. See Power Supply Requirements for 24V Controllers on page 41.
	The device does not have power / poor-quality power (for 24V controllers)	Verify that the transformer used is powerful enough to supply all controllers. See Power Supply Requirements for 24V Controllers on page 41.

Table 27: Troubleshooting ECB Device Symptoms

Symptom	Possible Cause	Solution
Device does not communicate on the BACnet MS/TP network	Absent or incorrect supply voltage (for 24V controllers)	<ol style="list-style-type: none"> 1. Check if the device is showing the 'Poor- Quality Power' status code (for 24V controllers). See Table 30 for a list of fault codes. 2. Check power supply voltage between 24VAC/DC $\pm 15\%$ and 24V COM pins and ensure that it is within acceptable limits (for 24V controllers). 3. Check for tripped fuse or circuit breaker.
	Overloaded power transformer (for 24V controllers)	<ol style="list-style-type: none"> 1. Check if the device is showing the 'Poor- Quality Power' status code. See Table 30 for a list of fault codes. 2. Verify that the transformer used is powerful enough to supply all controllers. See Transformer Selection and Determining the Maximum Power Run Length on page 43.
	Network not wired properly	Double check that the wire connections are correct.
	Absent or incorrect network termination	Check the network termination(s).
	Max Master parameter	Configure the Max Master to the highest MAC Address of any device on the MS/TP data bus. See Setting the Max Master and Max Info Frames on page 34.
	There is another controller with the same MAC Address on the BACnet MS/TP data bus	Each controller on a BACnet MS/TP data bus must have a unique MAC Address. Look at the MAC Address DIP switch on the faceplate of each controller. If it is set to 0 (all off), use an Allure EC-Smart-Vue sensor to check the MAC Address.
	There is another controller with the same Device ID on the BACnet intranetwork	Each controller on a BACnet intranetwork (the entire BACnet BAS network) must have a unique Device ID. Use an Allure series communicating sensor to check the Device ID of each controller. See Adopting a Numbering System for MAC Addresses, Device Instance Numbers, and Network Numbers on page 36.
	BACnet data bus polarity is reversed.	Ensure the polarity of the BACnet data bus is always the same on all devices. See BACnet MS/TP data bus is polarity sensitive on page 146.
	Cut or broken wire.	Isolate the location of the break and pull a new cable.
	The BACnet data bus has one or more devices with the same MAC Address.	See Adopting a Numbering System for MAC Addresses, Device Instance Numbers, and Network Numbers on page 167.
	The baud rate for all devices are set to AUTO	At least one device must be set to a baud rate, usually the data bus master. See Setting the Baud Rate for ECB-Series Controllers (optional) on page 101.
	The device is set to a MAC Address in the range of 128 to 255.	<p>See if the STATUS LED on the device is showing a fault condition. See Table 28 for a list of fault codes.</p> <p>This range is for slave devices that cannot initiate communication. All Distech Controls' devices are master devices and must their MAC Address set accordingly. See Device Addressing on page 164.</p>
The maximum number of devices on a data bus segment has been exceeded.	Use a repeater to extend the BACnet data bus. See Maximum Number of BACnet MS/TP Devices on a Data Bus Segment and Baud Rate on page 148.	

Table 27: Troubleshooting ECB Device Symptoms

Symptom	Possible Cause	Solution
The STATUS LED is blinking	The device has auto-diagnosed a fault condition	See Table 28 for a list of fault codes.
Controller communicates well over a short network, but does not communicate on large network	Network length	Check that the total wire length does not exceed the specifications of the Network Guide. See Data Bus Physical Specifications and Cable Requirements on page 151.
	Wire type	Check that the wire type agrees with the specification of the Network Guide: See Data Bus Physical Specifications and Cable Requirements on page 151.
	Network wiring problem	Double check that the wire connections are correct.
	Absent or incorrect network termination	Check the network termination(s). Incorrect or broken termination(s) will make the communication integrity dependent upon a controller's position on the network.
	Number of controllers on network segment exceeded	The number of controllers on a channel should never exceed 50. Use a router or a repeater: See Data Bus Segment MAC Address Range for BACnet MS/TP Devices on page 148.
	Max Master parameter	Configure the maximum number of master device on the MS/TP network in all devices to the controller's highest MAC address used on the MS/TP trunk. BACnet MS/TP Data Bus Token-Passing Overview on page 165.
Hardware input is not reading the correct value	Input wiring problem	Check that the wiring is correct according to the module's hardware installation manual and according to the peripheral device's manufacturer recommendations.
	Open circuit or short circuit	Using a voltmeter, check the voltage on the input terminal. For example, for a digital input, a short circuit shows approximately 0V and an open circuit shows approximately 5V. Correct wiring if at fault.
	Configuration problem	Using the controller configuration wizard, check the configuration of the input. Refer to the controller's user guide for more information.
	Over-voltage or over-current at an input	An over-voltage or over-current at one input can affect the reading of other inputs. Respect the allowed voltage / current range limits of all inputs. Consult the appropriate datasheet for controller input range limits.
Hardware output is not operating correctly	Fuse has blown (Auto reset fuse, for 24V controllers)	Disconnect the power and outputs terminals. Then wait a few seconds to allow the auto-reset fuse to cool down. Check the power supply and the output wiring. Reconnect the power.
	Output wiring problem	Check that the wiring is correct according to the module's hardware installation manual and according to the peripheral device's manufacturer.
	Configuration problem	With <i>EC-gfxProgram</i> , check the configuration of the output; for example, is it enabled? Refer to the EC-gfxProgram User Guide for more information.
	0-10V output, 24VAC powered actuator is not moving	Check the polarity of the 24VAC power supply connected to the actuator while connected to the controller. Reverse the 24VAC wire if necessary.

Table 27: Troubleshooting ECB Device Symptoms

Symptom	Possible Cause	Solution
Wireless devices not working correctly	Device not associated to controller	Using the device configuration wizard, check the configuration of the input. Refer to the controller's device's user guide for more information.
	Power discharge	1. Recharge device with light (if solar-powered) or replace battery (if battery-powered). 2. Ensure sufficient light intensity (200lx for 4 hours/day).
	Device too far from the Wireless Receiver	Reposition the device to be within the range of the Wireless Receiver. For information on typical transmission ranges, refer to the Open-to-Wireless™ Solution Guide .
	Configuration problem	With EC-gfxProgram, check the configuration of the input; for example, is it enabled? Refer to the EC-gfxProgram User Guide for more information

Refer to the controller's Hardware Installation Guide for how to identify and set a controller's configuration jumpers and switches.

Table 28: LED Fault Condition Interpretation for ECB Devices

ECB Device LED Interpretation	Description	Solution
RX LED not blinking	Data is not being received from the BACnet MS/TP data bus.	If there is no communication, See Table 27 .
TX LED not blinking	Data is not being transmitted onto the BACnet MS/TP data bus.	
POWER constant on	Power is available at the device. However this does not mean that the quality of supplied power is good. See Power Supply Requirements for 24V Controllers on page 41.	If not lit, see See Power Supply Requirements for 24V Controllers on page 41 for the power requirements.
STATUS blinking	See following table.	-

Table 29: STATUS LED Interpretation for Normal Operation with ECB Devices

Device STATUS LED blink patterns	Status	Description
One fast blink ●	Initialization	The device is starting up.
Fast blink continuous: ● ● ● ● ● (150ms On, 150ms Off, continuous)	Firmware upgrade in progress	Controller operation is temporarily unavailable. The new firmware is being loaded into memory. This takes a few seconds. Do not interrupt power to the device during this time.
The STATUS LED is always OFF (Not applicable to ECB-PTU Series)	No anomaly	Normal operation.

Table 29: STATUS LED Interpretation for Normal Operation with ECB Devices

Device STATUS LED blink patterns	Status	Description
The STATUS LED is always ON (ECB PTU Series only)	No anomaly	Normal operation.

Table 30: STATUS LED Fault Condition Interpretation for ECB Devices



Device STATUS LED blink patterns - every 2 seconds (highest priority shown first)	Possible Cause	Corrective Action
Long Long Long blink  (800ms On, 300ms Off, 800ms On, 300ms Off, 800ms On)	Offline	The device has not received a BACnet token, and therefore cannot communicate on the network: Verify that the controller's MAC Address is unique on the BACnet MS/TP Data Bus - see About the MAC Address on page 31. Make sure the controller's baud rate is the same as the BACnet MS/TP Data Bus' baud rate (see Maximum Number of BACnet MS/TP Devices on a Data Bus Segment and Baud Rate on page 14). Verify that the Max Master is set high enough to include this controller's MAC Address (see Setting the Max Master and Max Info Frames on page 34).
Short Short Long blink  (150ms On, 300ms Off, 150ms On, 300ms Off, 800 ms On)	Poor-quality power. The device has browned-out (for 24V controllers)	The voltage at the 24VAC/DC and 24VCOM terminals was not at an acceptable level during power up.
Short Long blink (150ms On, 300ms Off)	Invalid MAC address	The device's MAC address is set to zero (0) or is set to an address higher than the Max Master. See BACnet MS/TP Data Bus Token-Passing Overview on page 32.

Table 31: Verify that the Following Recommendations have been Carried Out Before Calling Technical Support

Recommendation	Description
Properly terminate the BACnet MS/TP data bus	EOL terminations must be enabled / installed at either end of the data bus only. See Figure 71 .
Avoid duplicate MAC Addresses	Verify that no device has a duplicate MAC Address by checking the MAC Address DIP switch settings on all devices on the data bus, including segments connected by a repeater. If necessary, isolate devices from the data bus to narrow-down the number of devices that may be at fault.
All devices must be set to the same baud rate	When all devices are set to AUTO baud rate, at least one device must be set to a baud rate, usually the data bus master. See Maximum Number of BACnet MS/TP Devices on a Data Bus Segment and Baud Rate on page 148.

Table 31: Verify that the Following Recommendations have been Carried Out Before Calling Technical Support

Recommendation	Description
The data bus is polarity sensitive	Ensure that the polarity of all data bus wiring is consistent throughout the network. See BACnet MS/TP data bus is polarity sensitive on page 146.
Do not overload the data bus with Change of Value (COV) reporting	COV reports create the most traffic on the BACnet MS/TP data bus. Set the COV report rate to the largest value that provides acceptable performance. Only map COV reports for values that are necessary. For mapped analog points that are continuously changing, try increasing the COV increment on these points or set the COV minimum send time flag to true to send the value at a regular frequency.
Do not leave address holes in the device's MAC Address range	Assign MAC Address to device starting at 3, up to 127. Do not skip addresses. Set the maximum MAC Address in the ECY Series Controller to the final MAC Address number actually installed. NOTE: The physical sequence of the MAC Address of the devices on the data bus is unimportant: For example, the MAC Address of devices on the data bus can be 5, 7, 3, 4, 6, and 8.
Only daisy-chained devices are acceptable	Eliminate T-taps and star configurations. Use a router to connect a data bus spur.
Connect no more than five devices to a power supply transformer (for 24V controllers)	BACnet MS/TP devices require good power quality. See Power Supply Requirements for 24VAC-Powered Controllers on page 171.

CHAPTER 7

LONWORKS TROUBLESHOOTING

You can use this Troubleshooting Guide to help detect and correct issues that you may encounter.

Table 32: Troubleshooting ECL Device Symptoms

Symptom	Possible Cause	Solution
Device does not communicate on the LONWORKS MS/TP network	The device does not have power / poor-quality power.	See Power Supply Requirements for 24V Controllers on page 61.
	Cut or broken wire.	Isolate the location of the break and pull a new cable.
	The maximum number of devices on a data bus segment has been exceeded.	Use a repeater to extend the BACnet data bus. See Network Cables on page 55.
	Absent or incorrect supply voltage	<ol style="list-style-type: none"> 1. Check if the device is showing the 'Poor Power Quality' status code (for 24V controllers). See Table 35 for a list of fault codes. 2. Check power supply voltage between 24VAC/DC $\pm 15\%$ and 24V COM pins and ensure that it is within acceptable limits (for 24V controllers). 3. Check for tripped fuse or circuit breaker.
	Overloaded power transformer (for 24V controllers)	<ol style="list-style-type: none"> 1. Check if the device is showing the 'Poor Power Quality' status code. See Table 35 for a list of fault codes. 2. Verify that the transformer used is powerful enough to supply all controllers. See Transformer Selection and Determining the Maximum Power Run Length on page 61.
	Network not wired properly	Double check that the wire connections are correct.
	Absent or incorrect network termination	Check the network termination(s).
	Too many Allure EC-Smart-View sensors are providing network access	Disable the Net to Subnet Port Settings jumpers on all controllers. If communications are re-established, re-enable only a few Allure EC-Smart-View sensors to have network access.
The STATUS LED is blinking	The device has auto-diagnosed a fault condition	See Table 33 for a list of fault codes.
Controller is powered but does not turn on	Fuse has blown (for 24V controllers)	Disconnect the power. Check the fuse integrity. Reconnect the power.

Table 32: Troubleshooting ECL Device Symptoms

Symptom	Possible Cause	Solution
	Power supply polarity	Verify that consistent polarity is maintained between all controllers and the transformer. Ensure that the COM terminal of each controller is connected to the same terminal on the secondary side of the transformer. See Power Supply Requirements for 24V Controllers on page 61.
Controller communicates well over a short network, but does not communicate on large network	Network length	Check that the total wire length does not exceed the specifications of the Network Guide. See Data Bus Physical Specifications and Cable Requirements on page 151.
	Wire type	Check that the wire type agrees with the specification of the Network Guide: See Data Bus Physical Specifications and Cable Requirements on page 151.
	Network wiring problem	Double check that the wire connections are correct.
	Absent or incorrect network termination	Check the network termination(s). Incorrect or broken termination(s) will make the communication integrity dependent upon a controller's position on the network.
	Extra capacitance	Make sure that no extra capacitance is being connected to the network other than the standard FTT circuit, and a maximum of a 3 meter stub (in bus topology).
	Number of controllers on network segment exceeded	The number of controllers on a channel should never exceed 50. Use a router or a repeater: See Data Bus Segment MAC Address Range for BACnet MS/TP Devices on page 148.
	Network traffic	Query node statistic to check errors. Use a LON protocol analyzer to check network traffic.
Hardware input is not reading the correct value	Input wiring problem	Check that the wiring is correct according to the module's hardware installation manual and according to the peripheral device's manufacturer recommendations.
	Open circuit or short circuit	Using a voltmeter, check the voltage on the input terminal. For example, for a digital input, a short circuit shows approximately 0V and an open circuit shows approximately 5V. Correct wiring if at fault.
	Configuration problem	Using the controller configuration wizard, check the configuration of the input. Refer to the controller's user guide for more information.
	Over-voltage or over-current at an input	An over-voltage or over-current at one input can affect the reading of other inputs. Respect the allowed voltage / current range limits of all inputs. Consult the appropriate datasheet for controller input range limits.
Hardware output is not operating correctly	Fuse has blown (Auto reset fuse, for 24V controllers)	Disconnect the power and outputs terminals. Then wait a few seconds to allow the auto-reset fuse to cool down. Check the power supply and the output wiring. Reconnect the power.
	Output wiring problem	Check that the wiring is correct according to the module's hardware installation manual and according to the peripheral device's manufacturer.
	Configuration problem	With EC-gfxProgram, check the configuration of the output; for example, is it enabled? Refer to the EC-gfxProgram User Guide for more information.

Table 32: Troubleshooting ECL Device Symptoms

Symptom	Possible Cause	Solution
	0-10V output, 24VAC powered actuator is not moving	Check the polarity of the 24VAC power supply connected to the actuator while connected to the controller. Reverse the 24VAC wire if necessary.
Wireless devices not working correctly	Device not associated to controller	Using the device configuration wizard, check the configuration of the input. Refer to the controller's device's user guide for more information.
	Power discharge	1. Recharge device with light (if solar-powered) or replace battery (if battery-powered). 2. Ensure sufficient light intensity (200lx for 4 hours/day).
	Device too far from the Wireless Receiver	Reposition the device to be within the range of the Wireless Receiver. For information on typical transmission ranges, refer to the Open-to-Wireless™ Solution Guide.
	Configuration problem	With EC gfxProgram, check the configuration of the input; for example, is it enabled? Refer to the EC gfxProgram User Guide for more information

Refer to the controller's Hardware Installation Guide for how to identify and set a controller's configuration jumpers and switches.

Table 33: LED Fault Condition Interpretation for ECB Devices

ECB Device LED Interpretation	Description	Solution
RX LED not blinking	Data is not being received from the BACnet MS/TP data bus.	If there is no communication, see Table 32 .
TX LED not blinking	Data is not being transmitted onto the BACnet MS/TP data bus.	
POWER constant on	Power is available at the device. However this does not mean that the quality of supplied power is good. See Power Supply Requirements for 24V Controllers on page 61.	If not lit, see Power Supply Requirements for 24V Controllers on page 61 for the power requirements.
STATUS blinking	See following table.	-

Table 34: STATUS LED Interpretation for Normal Operation with ECB Devices

Device STATUS LED blink patterns	Status	Description
One fast blink ●	Initialization	The device is starting up.
Fast blink continuous : ● ● ● ● ● (150ms On, 150ms Off, continuous)	Firmware upgrade in progress	Controller operation is temporarily unavailable. The new firmware is being loaded into memory. This takes a few seconds. Do not interrupt power to the device during this time.

Table 34: STATUS LED Interpretation for Normal Operation with ECB Devices

Device STATUS LED blink patterns	Status	Description
The STATUS LED is always OFF (Not applicable to ECB-PTU Series)	No anomaly	Normal operation.
The STATUS LED is always ON (ECB PTU Series only)	No anomaly	Normal operation.

Table 35: STATUS LED Fault Condition Interpretation for ECL Devices






Device STATUS LED blink patterns - every 2 seconds (highest priority shown first)	Possible Cause	Corrective Action
Long blink continuous:  (1s On, 1s Off, continuous)	The controller is unconfigured	Commission the controller
Long Long Long blink  (800ms On, 300ms Off, 800ms On, 300ms Off, 800ms On)	The controller is offline	Set the controller Online
Long Short Short Short blink  (800ms On, 300ms Off, 150ms On, 300ms Off, 150ms On, 300ms Off, 150ms On)	The controller is in bypass mode	Set the controller Online
Short Short Long blink  (150ms On, 300ms Off, 150ms On, 300ms Off, 800 ms On)	Poor-quality power; The device has browned-out (for 24V controllers)	The voltage at the 24VAC/DC and 24VCOM terminals has gone below the device's acceptable limit during power up.
Fast blink 12x:  (80ms On, 80ms Off, 12x)	Wink	The wink function is used to identify a device.

Table 36: Verify that the Following Recommendations have been Carried Out Before Calling Technical Support

Recommendation	Description
Properly terminate the BACnet MS/TP data bus	EOL terminations must be enabled / installed at either end of the data bus only. See TP/FT 10 Free Topology Network Termination on page 55.
Connect no more than five devices to a power supply transformer (for 24V controllers)	LonWorks devices require good power quality. See TP/FT 10 Free Topology Network Termination on page 55.

CHAPTER 8

ECx-4XX Series I/O Extension Module Specific Troubleshooting

For general troubleshooting of an ECx-4XX Series I/O Extension Module, first follow the troubleshooting for a controller - see [BACnet Troubleshooting](#) on page 109 and [LonWorks Troubleshooting](#) on page 115. Then follow the troubleshooting tips shown below.

Table 37: Troubleshooting ECx-4XX Series I/O Extension Module Device Specific Symptoms

Symptom	Possible Cause	Solution
Device does not communicate on the BACnet MS/TP network	Absent or incorrect supply voltage	1. Check power supply voltage between 24VAC/DC $\pm 15\%$ and 24V COM pins and ensure that it is within acceptable limits (for 24V controllers). 3. Check for tripped fuse or circuit breaker.
	Cut or broken wire.	Isolate the location of the break and pull a new cable.
	Overloaded power transformer	Verify that the transformer used is powerful enough to supply all controllers. See ECx-4XX I/O Extension Module Power Supply Requirements on page 47.
	Network not wired properly	Double check that the wire connections are correct.
	Absent or incorrect network termination	Check the network termination(s). See 2-Wire Subnetwork Data Bus Topology and End-of-Line (EOL) Terminations on page 93.
	There is another controller with the same Subnet ID on the subnetwork data bus	Each I/O Extension Module on the subnetwork data bus must have a unique Subnet ID. Look at the Subnet ID DIP switch on the faceplate of each I/O Extension Module. See ECx-4XX I/O Extension Module Addressing on page 95.
	Network length	Check that the total wire length does not exceed the specifications of the Network Guide. See About the Subnetwork Data Bus on page 70.
	Wire type	Check that the wire type agrees with the specification shown in 2-Wire Subnetwork Data Bus Physical Specifications and Cable Requirements on page 92.

CHAPTER 9

Allure EC-Smart-Vue Sensor Troubleshooting

Table 38: Allure EC-Smart-Vue Sensor Normal Operation

Symptom	Status	Description
When the Allure EC-Smart-Vue sensor is connected to a Controller, the LCD display on the Allure EC-Smart-Vue sensor is blank with the backlight ON for about 30 to 45 seconds	Firmware upgrade in progress	Wait for the upgrade to complete. Do not disconnect the Allure EC-Smart-Vue sensor from the controller as the upgrade will only restart once it is reconnected.

Table 39: Troubleshooting Allure EC-Smart-Vue Sensor Symptoms

Symptom	Possible Cause	Solution
Allure EC-Smart-Vue sensor screen is blank & backlight is off	Is the Allure EC-Smart-Vue sensor connected to the controller?	Verify that the Allure EC-Smart-Vue sensor is connected to the controller and that the patch cables are plugged-in to the connectors. See Cat 5e Cable Subnetwork Data Bus on page 79 for more information.
	Is power being supplied to the controller?	There may be no power being supplied from the controller. Check if the controller has power or if the controller's internal fuses have blown or tripped.
	Is the cable connected to the controller and Allure EC-Smart-Vue sensor?	Verify wiring.
	Was the patch cable made onsite?	Verify that the RJ-45 crimp connectors were installed on the cable correctly. See Cat 5e Cable Subnetwork Data Bus Cable Requirements on page 79.

Symptom	Possible Cause	Solution
Device is not communicating with controller	Is the address correctly set to a unique address?	Each Allure EC-Smart-View sensor must be set to a unique address for each controller. See Commissioning a Controller with an Allure EC-Smart-View Sensor on page 98.
	Is the device too far from controller?	Verify the distance between the device and the controller. See Subnet-work Data Bus Length on 75.
	Is there a configuration problem?	With EC-gfxProgram, check the configuration of the sensor, for example, is it enabled? Refer to the EC-gfxProgram User Guide for more information.
	Have the subnetwork EOL settings been correctly set?	Only the last module on the subnetwork data bus must have its EOL termination set to ON. See Figure 51 , Figure 53 , and Figure 54 . When one or more ECx-400 Series IO Extension modules are connected to the controller, only the last ECx-400 must have its EOL termination set to ON. See Figure 61 .
Controller cannot communicate on the LONWORKS network (ECL controllers only)	Too many Allure EC-Smart-View sensors are providing network access	Disable the Net to Subnet Port Settings jumpers on all controllers (for jumper location, see LAN through an Allure EC-Smart-View Sensor for a LonWorks Network on page 104). If communications are re-established, re-enable only a few Allure EC-Smart-View sensors to have network access.
Allure EC-Smart-View sensor motion detector window indicator is always ON	Does the connected controller have Allure EC-Smart-View sensor firmware that supports the motion and CO ₂ sensor?	When the Allure EC-Smart-View sensor is connected to a controller, its firmware is loaded from the controller. In this case, the controller has an earlier version of Allure EC-Smart-View sensor firmware that does not support the motion or CO ₂ sensor. To upgrade to the latest Allure EC-Smart-View sensor firmware, download the firmware from SmartInstaller and refer to the firmware upgrade procedure in the EC-gfxProgram User Guide .
The Motion or CO ₂ output of the associated ComSensor block always reads NULL in EC-gfxProgram		
The CO ₂ sensor readings are too high, too low, or inconsistent between sensors	Immediately after installing the Allure EC-Smart-View sensor with CO ₂ sensors, are the CO ₂ sensor readings incoherent?	If the CO ₂ sensor readings seem unusual or show inconsistencies between sensors in the same building right after installation, the following reasons should be taken into consideration: <ul style="list-style-type: none"> - Concentration levels in each space may be different - The installer may have unintentionally blown into the sensor while installing it. - The sensor may have been dropped or mishandled during shipment causing a minor shift in the original factory calibration. Allow up to 14 days of operation (without power interruptions) for the sensor to calibrate itself according to its new environment.

Table 40: Error code Interpretation for Allure EC-Smart-View Sensor Symptoms

Symptom	Possible Cause	Corrective Action
Clock icon flashing for 15 seconds	Cannot communicate with controller.	Wait for the communication link to the controller to be established. Verify wiring.
After 15 seconds: Error code 1 with Bell icon		Verify that all Allure EC-Smart-View sensor's Subnet IDs are unique for this controller. See Setting the Allure EC-Smart-View Sensor's Subnet ID Address on page 98.
Error code 2 with Bell icon	Invalid configuration.	In EC-gfxProgram, resynchronize the code with the controller. Contact Distech Controls customer support.

Symptom	Possible Cause	Corrective Action
Error code 3 with Bell icon	Allure EC-Smart-Vue sensor is not properly configured in the controller	With EC-gfxProgram, check the configuration of the sensor, for example, is the ComSensor block enabled? Refer to the EC-gfxProgram User Guide for more information.

CHAPTER 10

ECx-Light/Blind Series Troubleshooting

Table 41: Troubleshooting ECx-Light / Blind Series Symptoms

Symptom	Possible Cause	Solution
Allure EC-Smart-View sensor screen is blank & back light is off	Is the Allure EC-Smart-View sensor connected to the controller?	Verify that the Allure EC-Smart-View sensor is connected to the controller and that the patch cables are plugged-in to the connectors. See Cat 5e Cable Subnetwork Data Bus on page 79 for more information.
	Is power being supplied to the controller?	There may be no power being supplied from the controller. Check if the controller has power or if the controller's internal fuses have blown or tripped.
	Is the cable connected to the controller and Allure EC-Smart-View sensor?	Verify wiring.
	Was the patch cable made onsite?	Verify that the RJ-45 crimp connectors were installed on the cable correctly. See Cat 5e Cable Subnetwork Data Bus Cable Requirements on page 79.
Expansion module is not communicating with controller	Is the address correctly set to a unique address?	Each expansion module must be set to a unique address for each controller. See Commissioning a Controller with an Allure EC-Smart-View Sensor on page 98.
	Is the device too far from controller?	Verify the distance between the device and the controller. See Subnetwork Data Bus Length on 75.
	Is there a configuration problem?	With EC-gfxProgram, check the configuration of the sensor, for example, is it enabled? Refer to the EC-gfxProgram User Guide for more information.
	Have the subnetwork EOL settings been correctly set?	Only the last module on the subnetwork data bus must have its EOL termination set to ON. See Figure 51 , Figure 53 , and Figure 54 . When one or more ECx-400 Series IO Extension modules are connected to the controller, only the last ECx-400 must have its EOL termination set to ON. See Figure 61 .

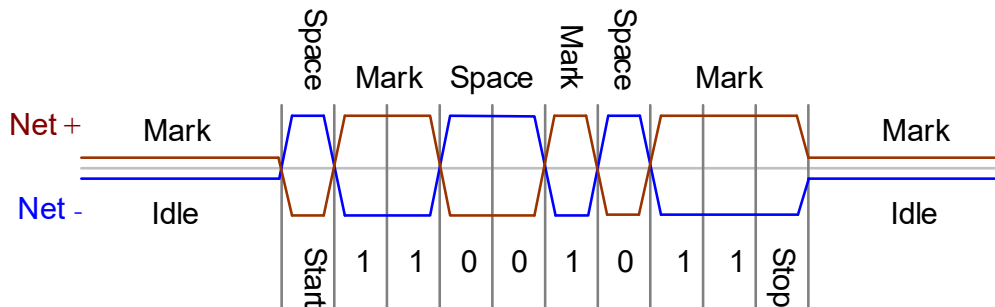
Symptom	Possible Cause	Solution
Hardware input is not reading the correct value	Input wiring problem	Check that the wiring is correct according to the module's hardware installation manual and according to the peripheral device's manufacturer.
	Open circuit or short circuit	Using a voltmeter, check the voltage on the input terminal. For example, for a digital input, a short circuit shows approximately 0V and an open circuit shows approximately 3.3V. Correct wiring if at fault.
	Configuration problem	With EC-gfxProgram, check the configuration of the input; for example, is it enabled? Refer to the EC-gfxProgram User Guide for more information.
	Over-voltage or over-current at an input	An over-voltage or over-current at one input can affect the reading of other inputs. Respect the allowed voltage / current range limits of all inputs. Consult the appropriate datasheet for controller input range limits.
Hardware output is not reading the correct value	Output wiring problem	Check that the wiring is correct according to the module's hardware installation manual and according to the peripheral device's manufacturer.
	Configuration problem	With EC-gfxProgram, check the configuration of the output; for example, is it enabled? Refer to the EC-gfxProgram User Guide for more information.

APPENDIX A

Typical BACnet EIA-485 Data Bus Transmission Example

The graph below shows electrical signals for the transmission of one byte of data (hexadecimal D3, least significant bit first). Note that when idle, the BACnet MS/TP data bus is biased such that the Net + connection is positive with respect to the Net - connection.

Figure 72: Example of a Typical EIA-485 Data Bus Transmission



The permitted voltage levels of an EIA-485 transmitter and receiver are shown below.

Figure 73: Typical EIA-485 Data Bus Operating Signal Levels

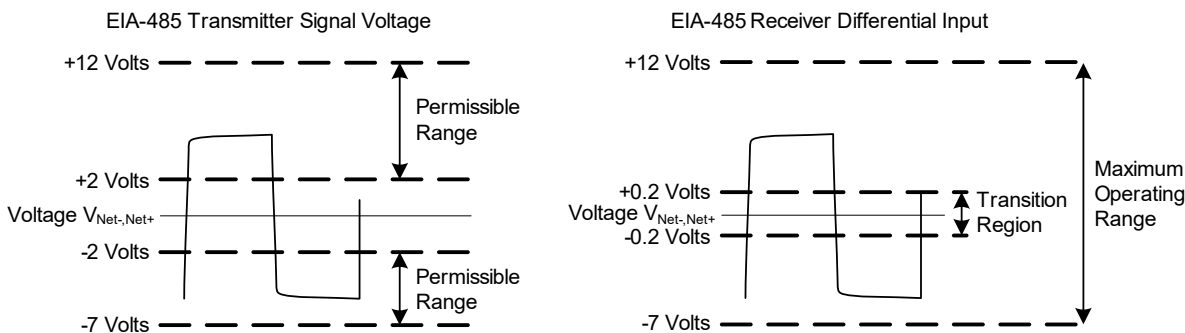


Table 42: EIA-485 Signal Specifications

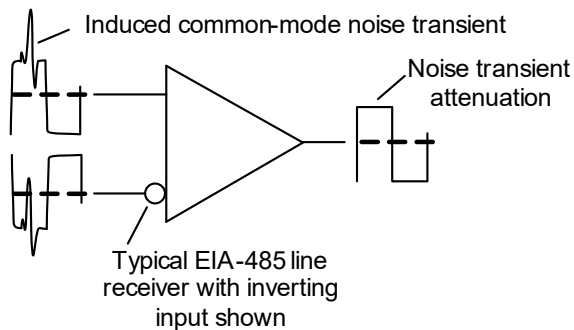
Parameter	Conditions	Min	Max	Units
Differential Driver Output Voltage - Open Circuit			6	V
Driver Output Voltage - Loaded	$R_{LOAD} = 27\Omega$	1.5	5	V
		-1.5	-5	V
Driver Common Mode (CM) Voltage	$R_{LOAD} = 54\Omega$	-1	3	V
Receiver Sensitivity	$-7 \leq V_{cm} \leq +12$	± 0.2		V
Receiver Common-Mode Voltage Range		-7	+12	V
Receiver Input Resistance		96K		Ω

The receiver is also protected against the temporary application of 24VAC and against transients. However, such events will interrupt data reception.

Common Mode Noise Rejection

Noise induced onto the conductors of the data bus cable will be common to both Net + and Net - data bus wires - that is to say, the noise will be of the same amplitude and polarity as the conductors in the cable are so close together. For this reason the EIA-485 data bus is differential data bus. The receiver nulls out common mode induced noise picked up on the data bus wire by subtracting the negative input from the positive input. This greatly reduces the impact that induced noise has on the data bus.

Figure 74: Common-Mode Noise is Significantly Attenuated by a Differential EIA-485 Line Receiver



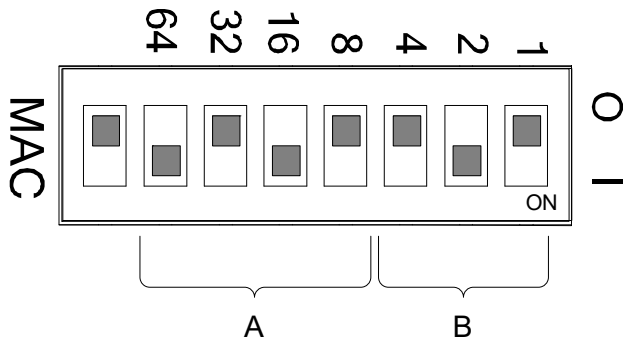
APPENDIX B

How to Set a Dip Switch

DIP switches are used to set the address of a device. In the following table, A & B represent the binary ON / OFF setting for the DIP switch required for a given decimal value shown in the table.

A \ B	000	001	010	011	100	101	110	111
0000	0	1	2	3	4	5	6	7
0001	8	9	10	11	12	13	14	15
0010	16	17	18	19	20	21	22	23
0011	24	25	26	27	28	29	30	31
0100	32	33	34	35	36	37	38	39
0101	40	41	42	43	44	45	46	47
0110	48	49	50	51	52	53	54	55
0111	56	57	58	59	60	61	62	63
1000	64	65	66	67	68	69	70	71
1001	72	73	74	75	76	77	78	79
1010	80	81	82	83	84	85	86	87
1011	88	89	90	91	92	93	94	95
1100	96	97	98	99	100	101	102	103
1101	104	105	106	107	108	109	110	111
1110	112	113	114	115	116	117	118	119
1111	120	121	122	123	124	125	126	127

Figure 75: Example of How to Set a DIP Switch to 82



For example
82 = A: 1010 & B: 010

APPENDIX C

Metric Conversions for Wire Gauge

The following table provides information about metric wire equivalents for wire gauge.

AWG	Diameter (\emptyset)		Area		Approximate stranded metric equivalents
	Inch	mm	kcmil	mm ²	
10	0.1019	2.588	10.4	5.26	
12	0.0808	2.053	6.53	3.31	
14	0.0641	1.628	4.11	2.08	
16	0.0508	1.291	2.58	1.31	
18	0.0403	1.024	1.62	0.823	24/0.2
20	0.0320	0.812	1.02	0.518	16/0.2
22	0.0253	0.644	0.642	0.326	7/0.25
24	0.0201	0.511	0.404	0.205	1/0.5, 7/0.2, 30/0.1

