

Phoenix Controls Programmable Control Module (PCM) 500 series provides a means of connecting additional inputs and outputs to the Theris® and Traccel® BACnet® room-level network and developing custom control sequences to enhance the control functions already provided. The PCM offers varying numbers of configurable input and output connections, a graphical programming interface for developing custom control applications. The PCM adds tremendous power and flexibility to the Phoenix Controls environmental control system. The graphical programming interface makes developing custom control sequences simple and efficient.

FEATURES

- Interfaces with Theris/Traccel BACnet MS/TP room-level networks
- 6, 10, and 12 universal inputs
- 3, 8, and 12 universal/digital outputs
- Graphical block-oriented programming
- DIN rail mounting
- Separable housing allows removal of controller from wiring base
- Power, Status, and Communication LEDs

SPECIFICATIONS

Enclosure

- ABS type PA-765A tan enclosures with gray connectors

Dimensions

- PCM501—5.7" x 4.7" x 2.0" (144.8 x 119.4 x 50.8 mm)
- PCM502—5.7" x 4.7" x 2.0" (144.8 x 119.4 x 50.8 mm)
- PCM503—7.7" x 4.7" x 2.0" (195.6 x 119.4 x 50.8 mm)

Approximate Weight

- PCM501—0.97lbs (0.44kg)
- PCM502—0.97lbs (0.44kg)
- PCM503—1.17lbs (0.53kg)

Environmental

- Operating temperature 32 °F to 122 °F (0 °C to 50 °C)
- Storage temperature -4 °F to 122 °F (-20 °C to 50 °C)
- Relative humidity 0 to 90% non-condensing

Power Inputs

- 24 Vac ±15%, 50/60 Hz - must be powered by Class 2 power source
- 24 Vdc ±15%
- Power supply polarity must be maintained

Power Consumption

PCM501	14 VA (typical) / 23 VA (maximum)	2.0 A replaceable fuse
PCM502	16 VA (typical) / 33 VA (maximum)	3.0 A replaceable fuse
PCM503	22 VA (typical) / 60 VA (maximum)	3.0 A replaceable fuse

Interoperability

- Communications: BACnet MS/TP
- Baud rates: 9600, 19200, 38400, 76800 bps (autodetect or selectable)
- Addressing: DIP switch (0-127)
- 1/8 unit load. Max devices *recommended*: 50; Max devices *allowed*: 127

General Specifications

Specification	PCM501	PCM502	PCM503
Processor Speed (32-bit ARM)	68 MHz	72 MHz	72 MHz
Application Memory (non-volatile flash)	384 KB	1 MB	1 MB
Storage Memory (non-volatile flash)	1 MB	2 MB	2 MB
RAM	64 KB	96 KB	96 KB



Programmable Control Module (PCM)

General Specifications

- Clock: Real-time clock chip with battery back up (PCM502 and PCM503 only)
- Status indicator:
 - Green LEDs: power status and LAN TX
 - Orange LEDs: service and LAN RX
- Communication Jack: audio jack mono 1/8" (3.5 mm)

Inputs/Outputs

Type and quantity of I/O are determined by model number. For details about I/O, see the *Inputs and Outputs* section on pg. 2.

Agency Compliance

Electromagnetic Compatibility:
CE Emission: EN61000-6-3: 2007; Generic standards for residential, commercial and light-industrial environments.

CE Immunity EN61000-6-1: 2007; Generic standards for residential, commercial and light-industrial environments.

FCC:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

Agency Approvals:

UL Listed (CAN and US) L916 Energy management equipment

Material:
UL94-5VA



TABLE OF CONTENTS

Specifications.....	1
Ordering Guide.....	2
Applications	3
Installation	4
Wiring.....	6
Recommended Cables	10

ORDERING GUIDE

PCM 503 - R04

PRODUCT FAMILY

PCM = Programmable Control Module (BACnet)

SERIES

- 501** = DIN rail or surface mount programmable controller:
6 universal inputs/3 universal outputs/5 digital triac outputs; supports up to 3 optional external DIN rail mounted 8A SPDT relays
- 502** = DIN rail or surface mount programmable controller:
10 universal inputs/8 universal outputs; supports up to 8 optional external DIN rail mounted 8A SPDT relays
- 503** = DIN rail or surface mount programmable controller:
12 universal inputs/12 universal outputs; supports up to 12 optional externally mounted 8A SPDT relays

OPTION

Rnn = Optional externally DIN rail mounted 8A SPDT relay
nn = quantity of relays (universal outputs only); number of relays may not exceed number of universal outputs, single digits entries must be preceded by a zero (0n)

REPLACEMENT RELAY AND BASE

Order PRT-250-321-017

INPUTS AND OUTPUTS

The PCM is offered in a variety of configurations with varying numbers of inputs and outputs. All have universal inputs, offering a wide variety of input configurations which are jumper selectable and software configurable. Each model offers different output configurations to suit the specific application.

Model Number	Universal Inputs	Universal Outputs 1	Triac Outputs 2	Options
PCM501	6	3	5	R01 to R03
PCM502	10	8	—	R01 to R08
PCM503	12	12	—	R01 to R12

Universal Inputs (software configurable)	
Input Types	
• Voltage	0 to 10 Vdc (up to 40K Ω input impedance) 0 to 5 Vdc (greater than 40K Ω input impedance)
• Current	4 to 20 mA with 249 Ω resistor: PCM501 requires an external resistor wired in parallel PCMs 502 and 503 have an internal resistor jumper selected
• Digital	Dry contact
• Pulse	Dry contact: 500 ms minimum ON/OFF — UI1 to UI4 on PCMs 502 and 503 will accept pulses up to 50 Hz (10 mSec ON/10 mSec OFF)
Resistors	
• Thermistor	10K Ω Type 2, 3 (10K Ω @ 77 °F/25 °C) — Range -40 °F to 302 °F (-40 °C to 150 °C)
• Platinum	Pt1000 (1K Ω @ 32 °F/0 °C) — Range -40 °F to 302 °F (-40 °C to 150 °C)
• Nickel	Ni1000 (1K Ω @ 32 °F/0 °C or @ 69.8 °F/21 °C) — Range -40 °F to 302 °F (-40 °C to 150 °C)
• Potentiometer	0 to 350K Ω
Input Resolution	16-bit analog/digital converter

Outputs	
<ul style="list-style-type: none"> Digital (PCM501 only) 	<ul style="list-style-type: none"> 24 Vac Triac, digital (on/off), floating², or PWM (software configurable) <ul style="list-style-type: none"> .5A continuous 1A @ 15% duty cycle for 10 minute periods PWM control: adjustable period from 2000 to 65,535 mSec Floating control requires two consecutive outputs: <ul style="list-style-type: none"> Min. pulse on/off: 500 msec Adjustable drive time period External power supply required
<ul style="list-style-type: none"> Universal 	<ul style="list-style-type: none"> Software configurable 0-10 Vdc digital 0-12 Vdc (on/off), floating or PWM PWM control: adjustable period from 2000 to 65,535 mSec Floating control: requires two consecutive outputs <ul style="list-style-type: none"> Min. pulse on/off: 500 msec. Adjustable drive time period 60 mA max. @ 12 Vdc 140 °F (60 °C) Minimum resistance 200 Ω for 0 to 10 Vdc or 0/12 Vdc outputs Minimum resistance 500 Ω for 0 to 20 mA output - PCMs 502 and 503 only Auto-reset fuse <ul style="list-style-type: none"> 60 mA @ 140 °F (60 °C) 100 mA @ 68 °F (20 °C)
Output Resolution	10-bit analog/digital converter
Power Supply	15 Vdc; maximum current: 120 mA (PCM501), 200 mA (PCM502), 240 mA (PCM503)
DC Relay Kit	
Relay	<ul style="list-style-type: none"> Coil Characteristics: <ul style="list-style-type: none"> Rated voltage: 12 Vdc Rated current: 33.3 mA Resistance: 360 Ω Minimum operating voltage: 8.4 V Operating Temperature: -40°F to 185°F (-40°C to 85°C) Storage Temperature: -40°F to 221°F (-40°C to 105°C) Agency Approvals: VDE, RU, CSA, RoHS Contact Characteristics: <ul style="list-style-type: none"> Maximum power rating: 2500 VA Rated current: 10A Rated voltage: 250 Vac Standard contact material: Silver-nickel 90/10 Type of Duty: Continuous Mechanical life expectancy: 1x10⁶ operations Weight: 10 grams Dimensions (L x W x H): 3.0" x .62" x 2.42" (76.2 mm x 15.8 mm x 61.5 mm)

APPLICATIONS

The Phoenix Controls PCM is a programmable input/output module that may be used as:

- A standalone controller — Physical sensors and switches may be connected to the PCM, which then performs the desired control by using built-in functions (see section below) to switch or modulate PCM outputs.
- An input/output (I/O) expansion module — Physical sensors, switches and actuators may be connected to the PCM and values passed across the room-level network to a Theris or Traccel valve-mounted controller for use in its control sequence. Data from the PCM may also be passed across the building-level network to the BMS for monitoring purposes.
- A controller integrated into the Theris or Traccel system — Data may be passed between the valve mounted controllers and PCM on the room-level network to supplement the control functions of either device. An example might be interlocking door locks between an anteroom and a space under control so that doors may not be opened until the pressure stabilizes or a certain number

of air changes have occurred. The PCM may also be used to implement virtually any room-level control sequence that relies on inputs from physical sensors, switches or network based variables to develop the desired control output, function or interlock. Typical control applications include:

- Lighting
- Temperature (spaces adjacent to controlled spaces)
- Access

Built-in Features

Built-in features refer to any room-level control sequence relying on inputs from physical sensors, switches, or network-based variables that can be defined using the programming language tool which includes comparators, constants and variables, VAV, time, math, logic, I/Os, HVAC, and others.

See the following tables for available BACnet controllers and BACnet objects.

BACnet PCM Controllers			
Features	PCM501	PCM502	PCM503
Points	14	18	24
Universal hardware inputs	6	10 ^{1.}	12 ^{1.}
15 Vdc Power Supply	X	X	X
Digital (triac) outputs	5	—	—
Universal outputs	3	8	12

1. The first four inputs are software configurable for pulse counting up to 50 Hz and compatible with an SO rated (optically isolated output).

BACnet Objects List			
Object	PCM501	PCM502	PCM503
Calendar	1	2	2
Schedule	2	10	10
PID Loop	8	40	30
BV Objects:			
Commandable	10	15	20
Non-Commandable	40	60	55
MSV Objects:			
Commandable	10	15	20
Non-Commandable	40	60	55
AV Objects			
Commandable	25	35	35
Non-Commandable	75	100	115

INSTALLATION

1. Choose a location where the operating conditions may be maintained within the specified environmental limits:
 - The device is not subject to shock and vibration.
 - Cable lengths are kept to a minimum.
 - The device is protected from dripping or spraying liquids, airborne dust and metallic particles.
2. When mounting the device:
 - Mount vertically with the ventilation slots on top.
 - Mount on a smooth, flat surface using 35mm DIN rail mounting screws.
 - Allow two-inch clearance on all sides for proper ventilation, routing of cables.
3. In some cases, it may be necessary to remove the PCM cover to access the mounting screw slots.

Figure 1. PCM501/PCM502 Programmable Control Module

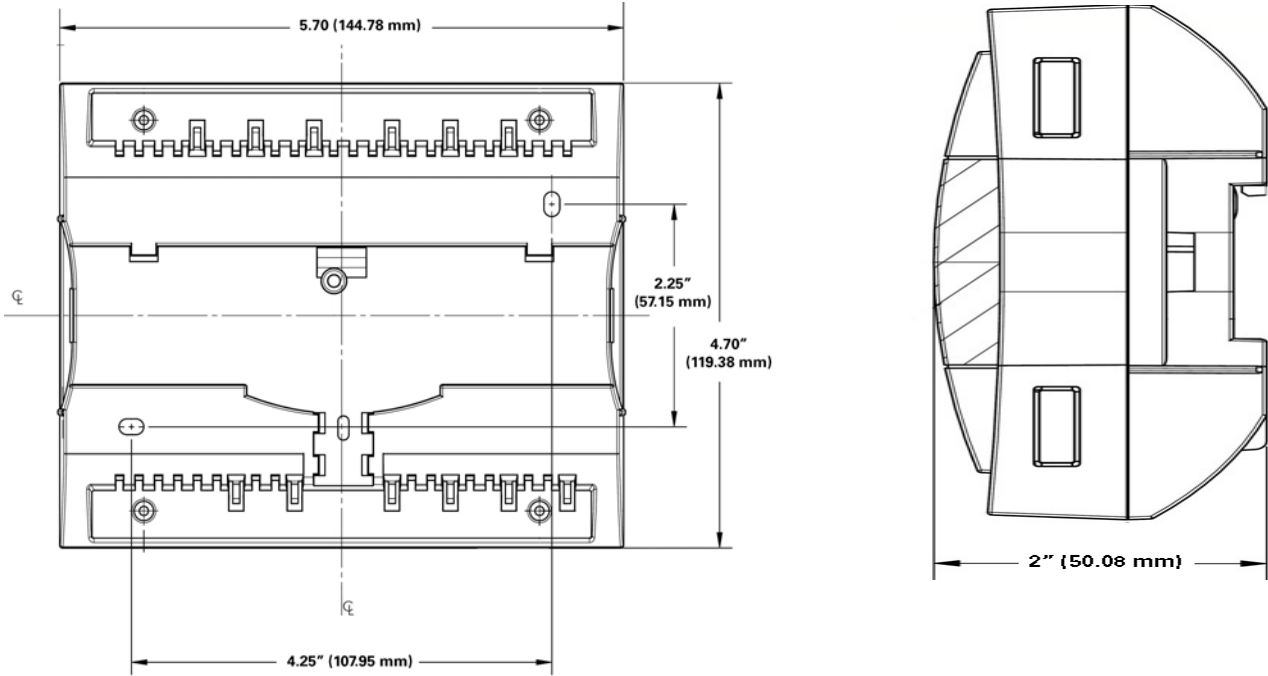


Figure 2. PCM503 Programmable Control Module

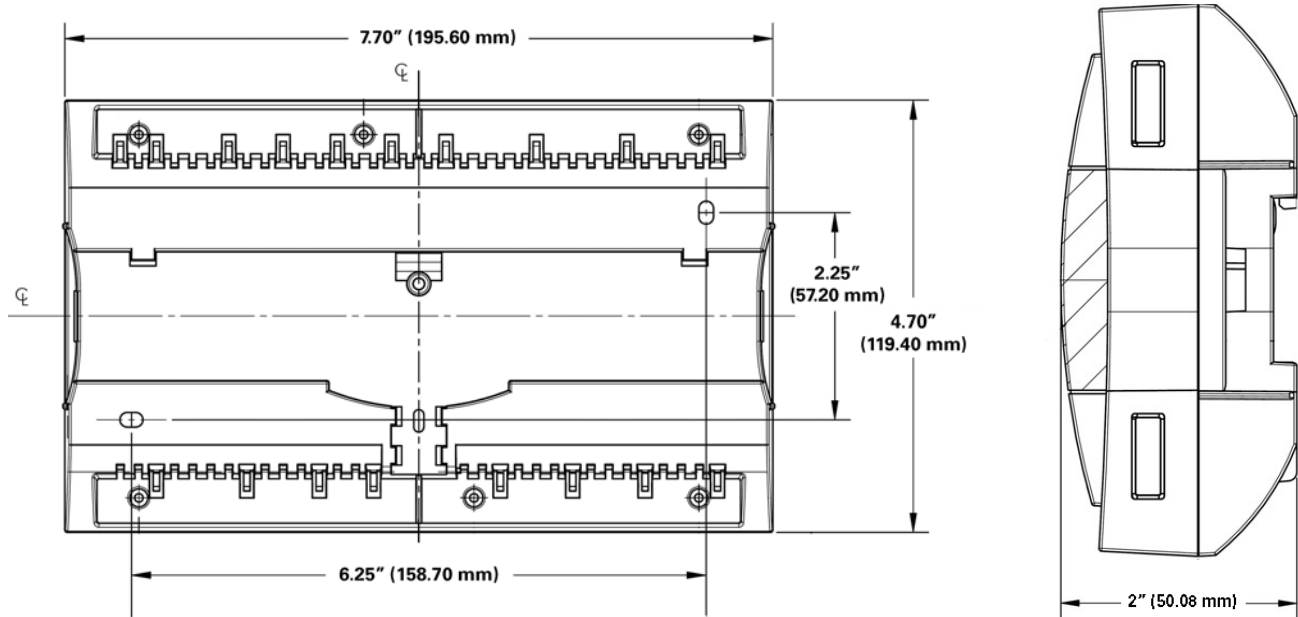


Figure 3. Relay Kit Dimensions

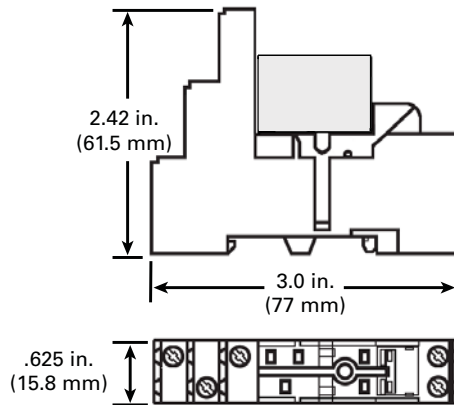
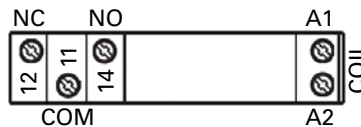


Figure 4. Relay Kit Connections



WIRING

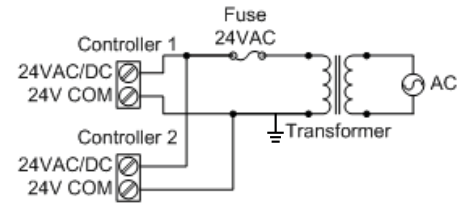
All wiring connections are via terminal blocks on the base plate that will accommodate wire sizes from 22 to 12 AWG (0.65 to 2.1 mm). Multiple conductors may be placed under one terminal, providing the cumulative diameter does not exceed 0.1" (2.5 mm).

Phoenix Controls Wiring Recommendations

- All circuits must conform to the requirements of an NEC Class 2 (dry) circuit.
- Use multiple transformers instead of larger transformers when more than 100 VA is required.
- Each pressurization zone should have either a dedicated single-phase primary circuit, or a secondary circuit disconnect
- Use appropriate cable sizes between 22 and 12 AWG (0.65 to 2.1 mm).
- Use stranded wire for ease of installation.
- Follow good wiring practices:
 - Locate cables away from sources of electrical interference (EMI/RFI).
 - Do not run signal or communication cable in the same conduit or wire way as power cables.
 - If signal cable must cross power cables place these at a 90-degree angle.
 - Shield or drain wires, if required, should be wrapped with insulating tape to prevent contact with exposed conductors or contacts.
 - Maintain a consistent color code or polarity all the way through the wiring system.
 - Power supply and signal isolation on I/O devices vary from manufacturer to manufacturer. Verify the wiring device manufacturer's recommendations for isolating power and signal common connections and maintain polarity.
 - Local and national electrical codes take precedence.
- Strip 0.25" (6.4 mm) of insulation from each conductor, twist the strands, insert the conductor fully into the terminal block, and tighten the terminal.
- Test the wire connection by pulling on each conductor.
- See *Phoenix Recommended Cables* for approved cable manufacturers and wire types.

Power Connections

- The PCM may be powered by either 24 Vac or 24 Vdc. When locating the device, consider the location of the transformers/ power supplies, cable runs, and connected load to ensure proper operating voltage.
- The secondary of the transformer must be grounded.
- Power connections are on the top left side of the control module (see figure).
- An external fuse is recommended to protect the outputs and other equipment powered by the transformer.
- To calculate the required transformer power:
 - Add the power requirements of all of the controllers and peripheral devices.
 - Add the largest starting power of the group.
 - Multiply this value by 1.3.
 - This value is the required transformer power.



Power Connection and Fuse

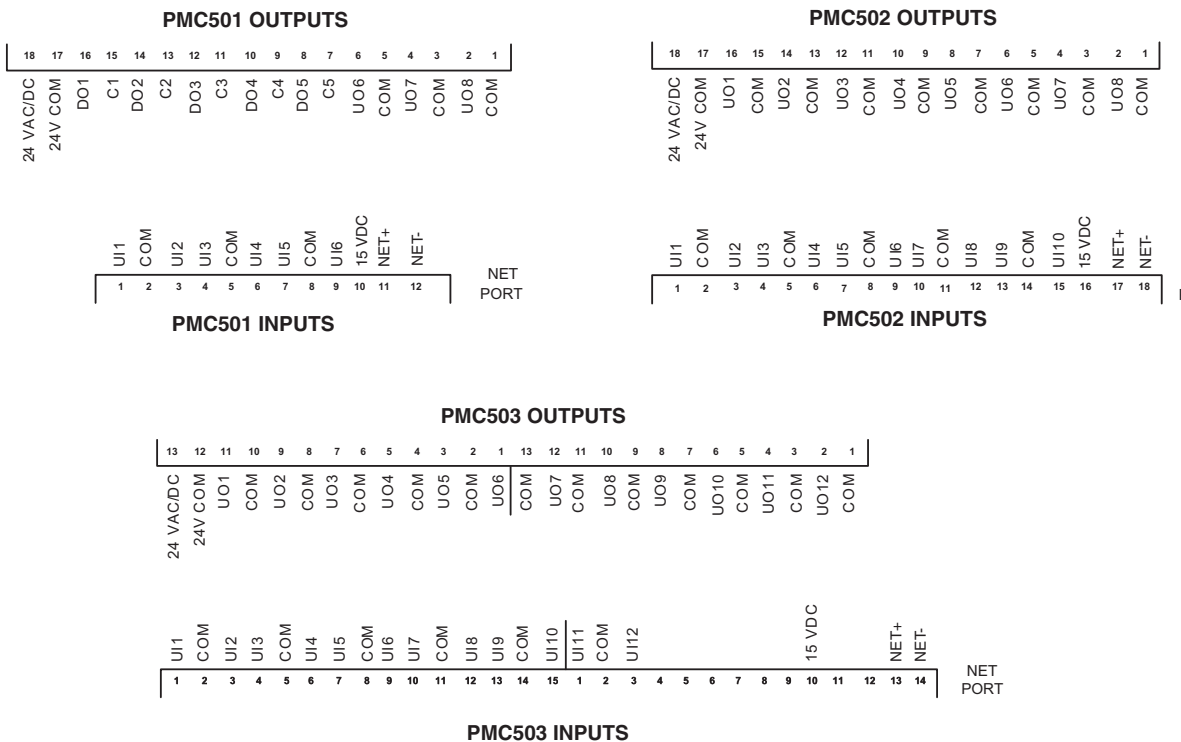
Note: Failure to maintain proper polarity may cause damage to the control module.

Input and Output Connections

- The PCM supports a wide variety of universal inputs and analog and digital outputs.
- Signal input types are either jumper or software selectable; then defined and scaled using the PCM Programming Tool.
- If a shield is used, it should be connected to the signal common (-) terminal.
- Power for inputs must be externally supplied. The PCM will not provide a power source for 4-20 mA input devices.
- Input connections are on the bottom side of the control module.
- Output connections are on the top side of the control module.
- The Common (-) is shared between the two adjacent inputs. Choose the appropriate wire size.

Note: Multiple power sources may be present. Insure that all power is removed before handling bare conductors.

Network Connections



Network Wiring (Room-level Network)

The quality of the cable and the cable installation, the number of devices, and the amount of data to be passed influence the practical cable length and communications speed (baud rate). Cabling has the greatest influence on the quality of communications. Depending on the quality of the installation, it may be necessary to reduce the baud rate to avoid intermittent communications. Using a larger gauge wire will not allow you to exceed the maximum recommended cable length.

Layout:

Bus topology.

Cabling:

Three-conductor, stranded, twisted-shield cable with the following electrical characteristics:

- Impedance between 100 and 130 Ω .
- Distributed capacitance between conductors less than 30 pF/ft (100 pF/m).
- Distributed capacitance between conductors and shield less than 60 pF/ft (200 pF/m).
- Phoenix Controls recommends 22 AWG (.65 mm) cable. Alternate wire sizes which meet these specifications may be used, but will not extend the maximum cable length per segment.

Segment Length:

4000 ft. (1219 m) maximum per segment using recommended wire.

Devices per Segment:

A maximum of 50 devices is recommended.

Repeaters:

Repeaters are required when making runs longer than 4000 ft (1219 m). Available from other vendors.

Terminating Resistors:

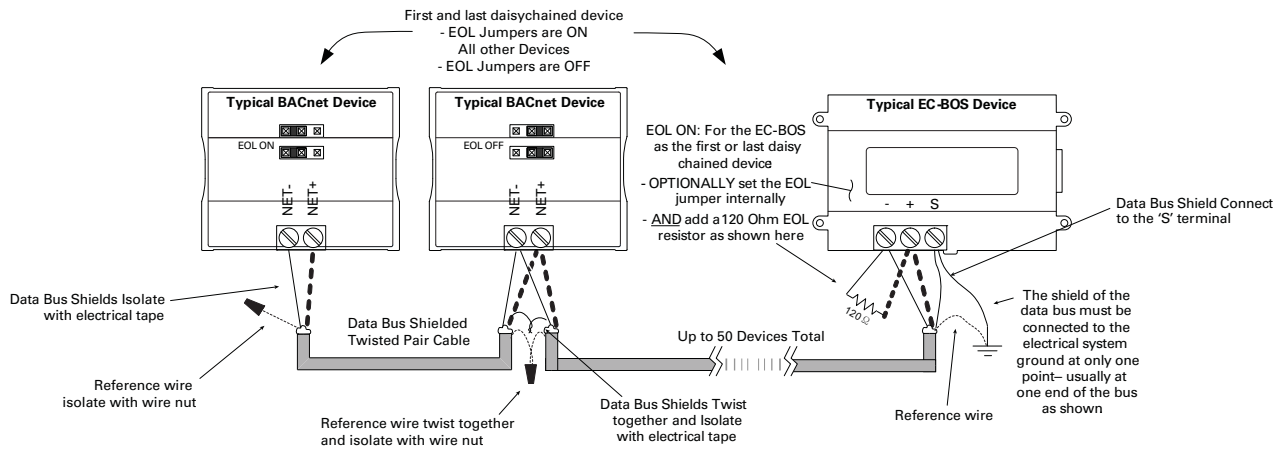
Matched resistors required at each end of segment bus wired across (+) and (-). Use matched resistors rated 120 ohm 1/4W +/-5%.

Shield Grounding:

Ground shield drain wire at single point earth (panel) ground, and not the TBC ground. Tape off shield drain wire at other end. Tie shield drain wire through at each TBC.

- Each controller counts as a 1/8 unit, up to 127 controllers can be on a single segment. Phoenix Controls recommends not placing more than 50 devices on a single physical network segment.
- At the last device on each end of the MS/TP segment, matched terminating resistors wired across Data+ and Data- are required for signal integrity. The resistors are not included.
- For more detailed information, refer to *Phoenix Recommended Cables* on page 10.

Example Wiring Diagram



PHOENIX RECOMMENDED CABLES

Cable Type	Plenum Rated	Function	Wire Gauge	Primary Vendor/Part #	Alternate Vendor/Part #	Color Code	Notes
2C Round	No	24 Vac power	18	Belden 9409		1: Red 2: Black	Must be stranded
			14	Belden 9411			
2C Round	Yes	24 Vac power	18	Belden 82740	Windy City NP002360	1: Red 2: Black	Must be stranded
			14	Windy City NP007960			
TSP	No	I/O signal wiring	22	Belden 9501		1: Black&Red	Twisted Shielded Pair
2 TSP	No	I/O signal wiring	22	Belden 9502		1: Black&Red 2: Black&White	Two Twisted Pair, Shielded
3C Round	No	Signal	22	Belden 8443		1: Red 2: Black 3: Green	Must be stranded
3C or 4C Round	Yes	Signal	22	Belden 88444	Windy City 004380	1: Red 2: Black 3: Green 4: White (not used as 3C)	Must be stranded
4C Round	No	Signal	22	Belden 8444	Manhattan M13304	1: White 2: Green 3: Black 4: Red	Must be stranded
5C Round	No	Signal	22	Belden 8445	Manhattan M13305	1: White 2: Brown 3: Black 4: Red 5: Green	Must be stranded
8C	No	Signal	22	Belden 9421	Manhattan M13308	1: White 2: Orange 3: Black 4: Red 5: Green 6: Yellow 7: Blue 8: Brown	No substitutes
8C	Yes	Signal	22	Comtran 4956		1: White 2: Orange 3: Black 4: Red 5: Green 6: Yellow 7: Blue 8: Brown	No substitutes
3C MS/TP	No	Shielded	22	Belden 3106A (120 ohm)		1: White with Orange stripe 2: Orange with White stripe 3: Blue with White stripe	Shielded with drain
3C MS/TP	Yes	Shielded	22	Connect-Air W223C-2060YPC		1: Black 2: White 3: Red	Foil shield with drain wire