



CX-Router

USER GUIDE

New Release

Form 450.24-NOM5 (804)

# CX-Router



# IMPORTANT!

## READ BEFORE PROCEEDING!

### GENERAL SAFETY GUIDELINES

This equipment is a relatively complicated apparatus. During installation, operation, maintenance or service, individuals may be exposed to certain components or conditions including, but not limited to: refrigerants, oils, materials under pressure, rotating components, and both high and low voltage. Each of these items has the potential, if misused or handled improperly, to cause bodily injury or death. It is the obligation and responsibility of operating/service personnel to identify and recognize these inherent hazards, protect themselves, and proceed safely in completing their tasks. Failure to comply with any of these requirements could result in serious damage to the equipment and the property in which it

is situated, as well as severe personal injury or death to themselves and people at the site.

This document is intended for use by owner-authorized operating/service personnel. It is expected that this individual possesses independent training that will enable them to perform their assigned tasks properly and safely. It is essential that, prior to performing any task on this equipment, this individual shall have read and understood this document and any referenced materials. This individual shall also be familiar with and comply with all applicable governmental standards and regulations pertaining to the task in question.

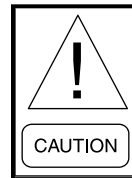
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### SAFETY SYMBOLS

The following symbols are used in this document to alert the reader to areas of potential hazard:



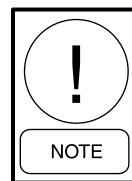
***DANGER*** indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



***CAUTION*** identifies a hazard which could lead to damage to the machine, damage to other equipment and/or environmental pollution. Usually an instruction will be given, together with a brief explanation.



***WARNING*** indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



***NOTE*** is used to highlight additional information which may be helpful to you.

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## CHANGEABILITY OF THIS DOCUMENT

In complying with YORK's policy for continuous product improvement, the information contained in this document is subject to change without notice. While YORK makes no commitment to update or provide current information automatically to the manual owner, that information, if applicable, can be obtained by contacting the nearest YORK Sales, Service and Authorized Distributor offices.

It is the responsibility of operating/service personnel as to the applicability of these documents. If there is any question in the mind of operating/service personnel as to the applicability of these documents, then, prior to working on the equipment, they should verify with the owner whether the equipment has been modified and if current documentation is available.

## SUMMARY OF CHANGES

804 Original Release

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## REFERENCE INSTRUCTIONS

DESCRIPTION	FORM NO.
CX-Router Specifications	450.24-S6
PICS/BIBBS Statement	450.24-TD6

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# SECTION 1

## GENERAL INFORMATION

### Overview

The CX-Router is a BACnet® device that links separate BACnet networks together to form an internetwork. The CX-Router connects to Ethernet (10Base-T), MS/TP (RS485), and PTP (RS232) networks. All three network types function simultaneously.

As a router, the CX-Router repacketizes messages destined for devices on other networks based on the destination address within the packet. The message is only passed across the router when the destination device is located on another network. If the receiving device is within the originating network, the message is not passed through the CX-Router, reducing network traffic.

Additional capabilities can be accessed within the CX-Router when connected to the ConneXsys Operator WorkStation. As a BACnet device, the CX-Router contains Objects which can be manipulated and controlled. Communication parameters, such as modem strings, network names, IP addresses, etc., can be configured and controlled. This also allows messages, such as alarm notifications, to be forwarded to other devices. Recipients of these messages can be cell phones, pagers, or e-mail addresses.

The CX-Router is configured to function with the ISN ConneXsys line of control products from YORK International. However, as a native BACnet device, it is capable of communicating with other, third-party BACnet devices.

### ConneXsys Network

The full range of ISN ConneXsys control products (CX-UDC, CX-TDCE, CX-IDC, etc.) are able to reside on a common network structure with full peer-to-peer communications.

The controllers operate on an MS/TP data link layer using RS485. If repeaters are used, a maximum of 96 devices, including the repeaters, can reside on a network. Networks are connected using CX-Routers that operate using Ethernet ISO 8802-3 connections.

The CX-Router also allows Point-to-Point (PTP) data transfer via modems using RS232 connections.

Within the MS/TP network, each controller receives a token, which is passed around the network with packetized data. As the token is received by the next device, the device reads the packet to determine if it needs to receive the data. If it does, it copies the data and forwards the token to the next device. Otherwise, the controller simply passes the token to the next device.

Each controller is daisy-chained along the RS485 network with terminator modules at each end. To connect different networks, CX-Routers are connected in a “star” configuration through one or more Ethernet hubs. Using this structure, local messages remain contained within the network “behind” the router unless addressed to a controller on another network. Full internetwork communications is then limited to only the data relevant to the other subnetworks, greatly reducing the network traffic.

The BACnet network is a peer-to-peer network without a master, eliminating the need for a high-powered processor to manage network communications.

### Setup

The CX-Router requires the ISN ConneXsys OWS to program the router to do "special" things. However, the CX-Router can be set using the on-board DIP switches and jumpers when only a minimal setup is required.

*BACnet is a registered trademark of ASHRAE*

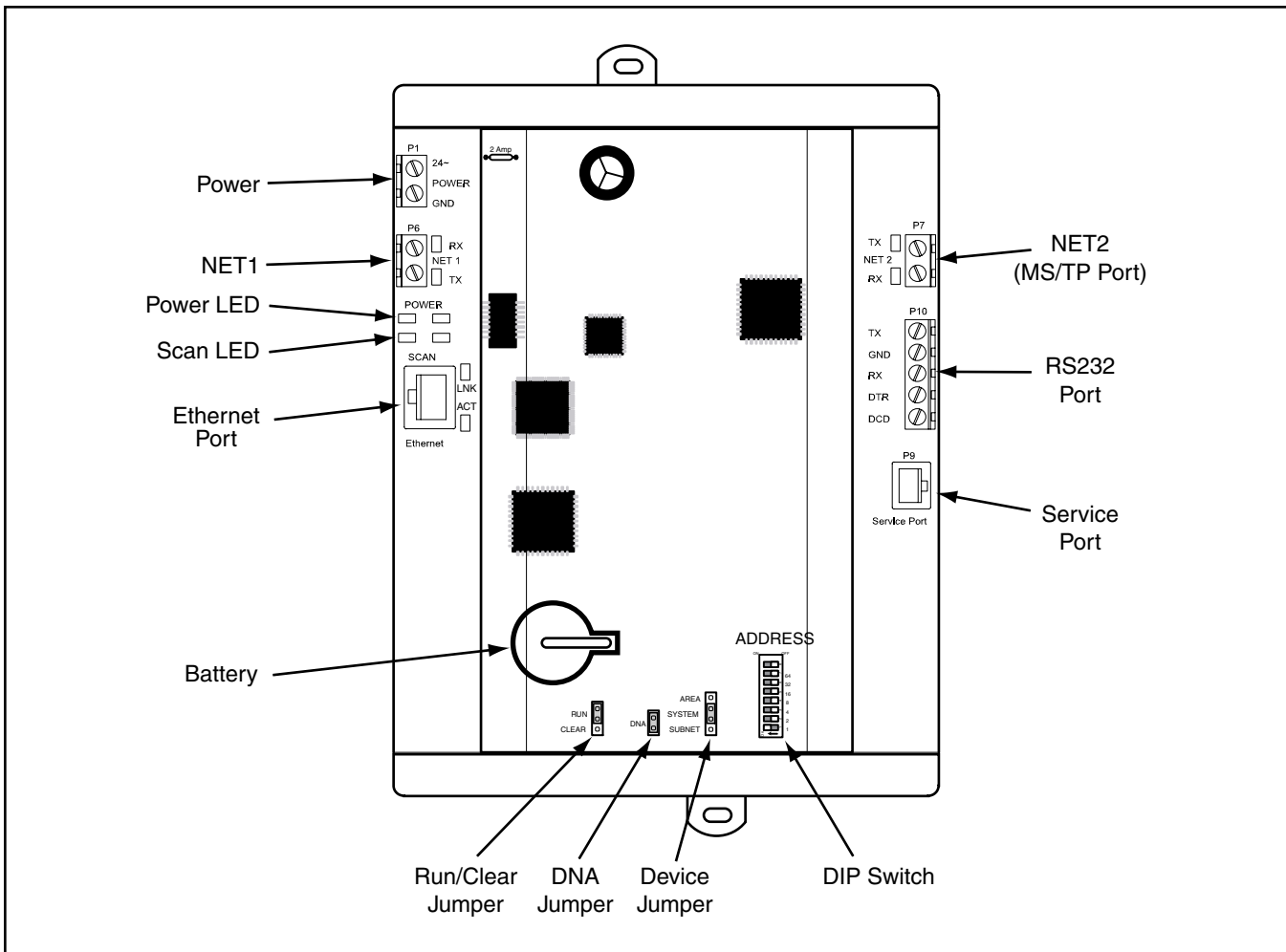


Figure 1. CX-Router

**Functionality**

The CX-Router requires a 24 VAC isolated transformer for power. A modular housing with swing-open door provides easy mounting and access to DIP switches and jumpers.

Five communication ports are available.

NET1 – This port is not used.

NET2 – This 2-pin connector communicates using RS485 and connects to the MS/TP network. It operates at 9.6, 19.2, 38.4, or 76.8 kbaud.

Ethernet – This RJ-45 connector attaches to the Ethernet network. It uses the 10Base-T physical layer.

RS232 – This 5-pin connector is a serial port, communicating via the RS232 layer. This port is ideally suited for connecting to a modem. The RS232 port is capable of 9.6, 19.2, and 38.4 kbaud transmission.

Service Port – This RJ-45 connector is used as a service port. Used in conjunction with the RS232 to RS485 converter, it connects a PC to the MS/TP network without removing the network connection on NET2.

An 8-way DIP switch sets the router's MAC Address. The MAC Address must be between 1 and 99. The MAC Address is also used to establish a network number.

LEDs at the network ports indicate when a port is transmitting (green TX) or receiving (red RX). The Ethernet port has two LEDs. The green LNK LED indicates a successful Ethernet connection. The green ACT LED indicates communication across the Ethernet port.

Two additional LEDs indicate power and scan rate.

Several jumpers are used to provide further configuration of the CX-Router.

The Device Type jumper sets how the CX-Router functions within the system.

The DNA jumper sets how the network number is derived.

The RUN/CLEAR jumper enables the battery to maintain the SRAM. When in the CLEAR position and the battery is removed, the database is cleared. This is also the recommended position for long-term storage.

### **Interoperability**

BACnet conforms to a standard written and maintained by a consortium of manufacturers and is managed by ASHRAE. While many devices meet the standard, there are varying levels of conformance which may limit the exchange of data between devices.

As part of the BACnet standard, every manufacturer of a BACnet device must provide a PICS Statement. This PICS statement outlines the Conformance

Classes, Services, and Objects provided by each device, as well as several other items.

In addition to the PICS Statement, a BIBBs document is often included by a manufacturer. The BIBBs document provides additional detail into the abilities of a devices to operate with one another.

YORK, as a BACnet device manufacturer, has available PICS/BIBBs Statements which can be obtained from Technical Publications or from the YORK Library by York personnel. At the front of this manual is a list of related documents, including the PICS/BIBBs Statement.

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## **SECTION 2**

### **NETWORK TOPOLOGY**

#### **General**

A CX-Router is used to connect different networks together. A network allows the transfer of data collected by one controller to other controllers. Data may also be passed to the ISN ConneXsys Operator Work Station to allow a User to view data graphically.

Networks can be connected to one another using routers to form an internetwork. The internetwork can consist of a building or complex to form a Building Automation System (BAS) or Building Management System (BMS). The internetwork can also be expanded beyond the BAS through the use of modems or web servers.

The native protocol for ISN ConneXsys controllers from YORK is BACnet MS/TP protocol from ASHRAE. The controllers utilize RS485 as the physical layer while the CX-Router utilizes Ethernet (8802.3), RS485, and RS232.

ISN ConneXsys controllers function as Client/Servers. This allows data to be exposed to any other BACnet client. Clients can also retrieve data from slave devices.

#### **Devices**

As an open protocol, BACnet devices from other manufacturers may also be placed on the same network along with YORK devices. While these devices can communicate, not all data is exposed to all BACnet devices. As a minimum, the DE and FI Objects must be exposed. Network exposure of other objects in the controller is the decision of the Application Engineer.

YORK provides all the devices which are necessary for a BACnet network. Some of these devices are:

- **Controllers:** CX-UDC, CX-IDC, and CX-TDCE controllers allow monitoring and control of various devices through the use of voltage, resistance, pulse, and current inputs and voltage and digital relay outputs.
- The CX-Repeater amplifies the network signal to extend the physical length and/or the number of controllers within a network.

- The CX-Router connects networks to form an internetwork. The CX-Router connects MS/TP (RS485), Ethernet (10Base-T), and serial (RS232) devices such as modems.
- ISN ConneXsys Operator Work Station (OWS) provides a graphical interface of the system, allowing monitoring of data and control of setpoints.
- ISN ConneXsys Web Server provides the ability to expose data from the system across the internet to be viewed by any standard web browser.

#### **Network Architecture**

BACnet allows a variety of “technologies” to be used in its implementation. YORK uses several different types of data link layer to communicate between devices.

At the Management level, standard Ethernet is used. Devices that operate at the Management level include the ISN ConneXsys Operator Work Station, routers, and some controllers. When exposing information through a web browser, Ethernet/IP can be used.

The Automation level includes various building controllers, such as the Solution controller. At this level, Ethernet may be used as well as RS485.

At the Field level are the terminal controllers. These almost always operate on an RS485 network.

#### Ethernet

An Ethernet network is arranged in a star network with all devices connecting to hubs. Many buildings have existing Ethernet networks which may be utilized by HVAC devices.

Existing Ethernet networks are typically not managed by maintenance/HVAC personnel. Therefore, it is required that permission to utilize these networks be obtained prior to design of the network.

A separate network may be setup for the HVAC devices to utilize Ethernet. Along with the Ethernet cabling, additional issues must be resolved. While Ethernet is a physical layer similar to RS485, there are a variety of types of Ethernet, each with its own

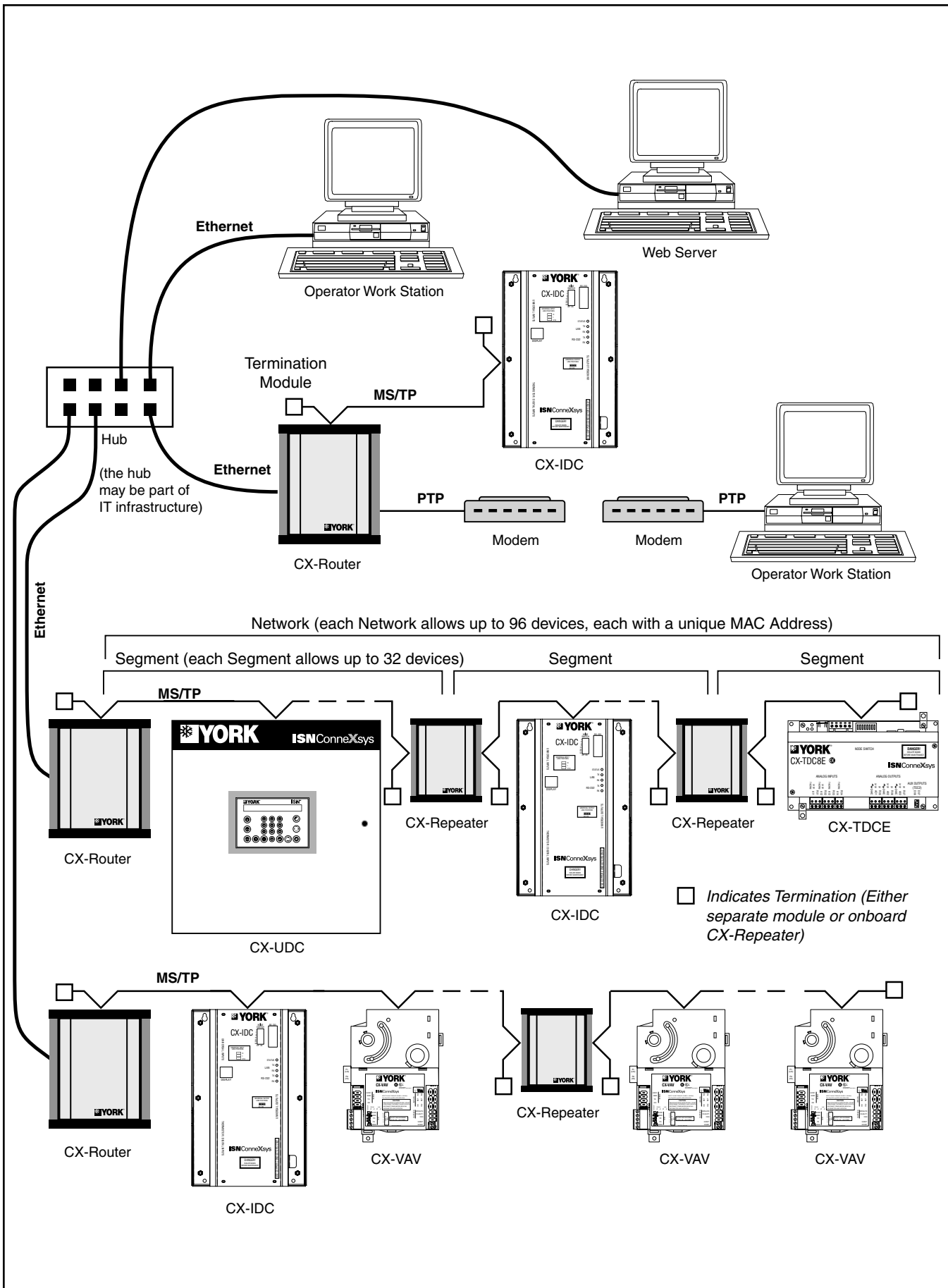
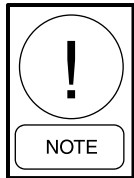


Figure 2. Typical Network Configuration with CX-Repeaters in Series

set of standards and rules which are managed by the IEEE under standard 802.3. Some of the issues in setting up an Ethernet network include different media (10Base-T, 10Base-2, 100Base-TX, Fiber Optic, etc.) and speeds (10 Mbps, 100 Mbps, 1 Gbps) and the accompanying devices (hubs, repeaters, transceivers, etc.).

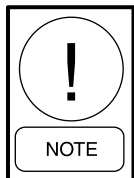


**NOTE:** *It is recommended that, when installing an Ethernet network, an experienced Ethernet subcontractor be consulted. The subcontractor will be equipped with the supporting devices, special tools, and testing equipment required for installation of an Ethernet network.*

A typical Ethernet network for the Management level of a YORK control system consists of Category 5 twisted-pair cabling (10Base-T) using RJ-45 connectors and an 8-port hub. If distances are greater than 330 ft. (100 m), Ethernet repeaters must be used.

RS485

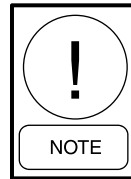
The RS485 standard is a multi-drop system with devices daisy-chained together. Typically, twisted-pair, shielded cabling is used as the transfer media. The shield reduces the effects of electrical and magnetic noise and is typically grounded at some point on each segment. Termination modules are utilized at each end of the segment to balance and “center” the + and – communication signals. The termination module also provides a method of grounding the shielding.



**NOTE:** *The CX-Repeater has selectable termination on board.*

The maximum length of an RS485 segment is 4000 ft. (1200 m). This can be extended with the use of repeaters. A repeater amplifies the signal to allow another segment to be added. Two repeaters placed in series creates a network of three segments (Figure 2). Three repeaters can also be used to create three parallel segments (Figure 3).

The network signal will also degrade as it passes through each node or device connection. This is known as a physical load. This limitation is 32 loads for each segment with maximum of 96 loads on a network.



**NOTE:** *Network devices, such as repeaters and routers, must be included when summing devices on a network. Repeaters typically consume 2 loads, a router consumes a single load.*

In a parallel repeater arrangement, the repeaters are daisy-chained to the router, creating a “header” cable, i.e., between the router and repeaters. This header cable must be under 4000 ft. (1200 m) and must not contain any devices other than the CX-Repeaters. Each segment can then connect 32 devices, including the repeater.

**Communication Method**

BACnet allows a variety of physical connection types. At the controller level, the controllers are connected using RS485 through twisted-pair (2-core) shielded cable. This cable is daisy-chained between the controllers and repeaters. The data link is MS/TP.

The routers connect to the RS485 network and convert the packets to Ethernet (IEEE 802.3) or to RS232 for Point-to-Point (PTP) for dial-up, asynchronous communication.

As an MS/TP network, each controller receives a token, which is passed around the network with packetized data. As the token is received by the next device, the device reads the packet to determine if it needs to receive the data. If it does, it copies the data and forwards the token to the next device.

If an empty token is received, the controller places data in it, if it has any, and forwards it along the network. If the controller has no data to forward, the token is passed along “empty” to the next device.

BACnet uses standard services, or commands, to manipulate standard or proprietary objects. Some services require return of an acknowledgement, others do not.

If a response to a service is required and the device does not respond, the sending device will automatically resend the request. If a response is not received

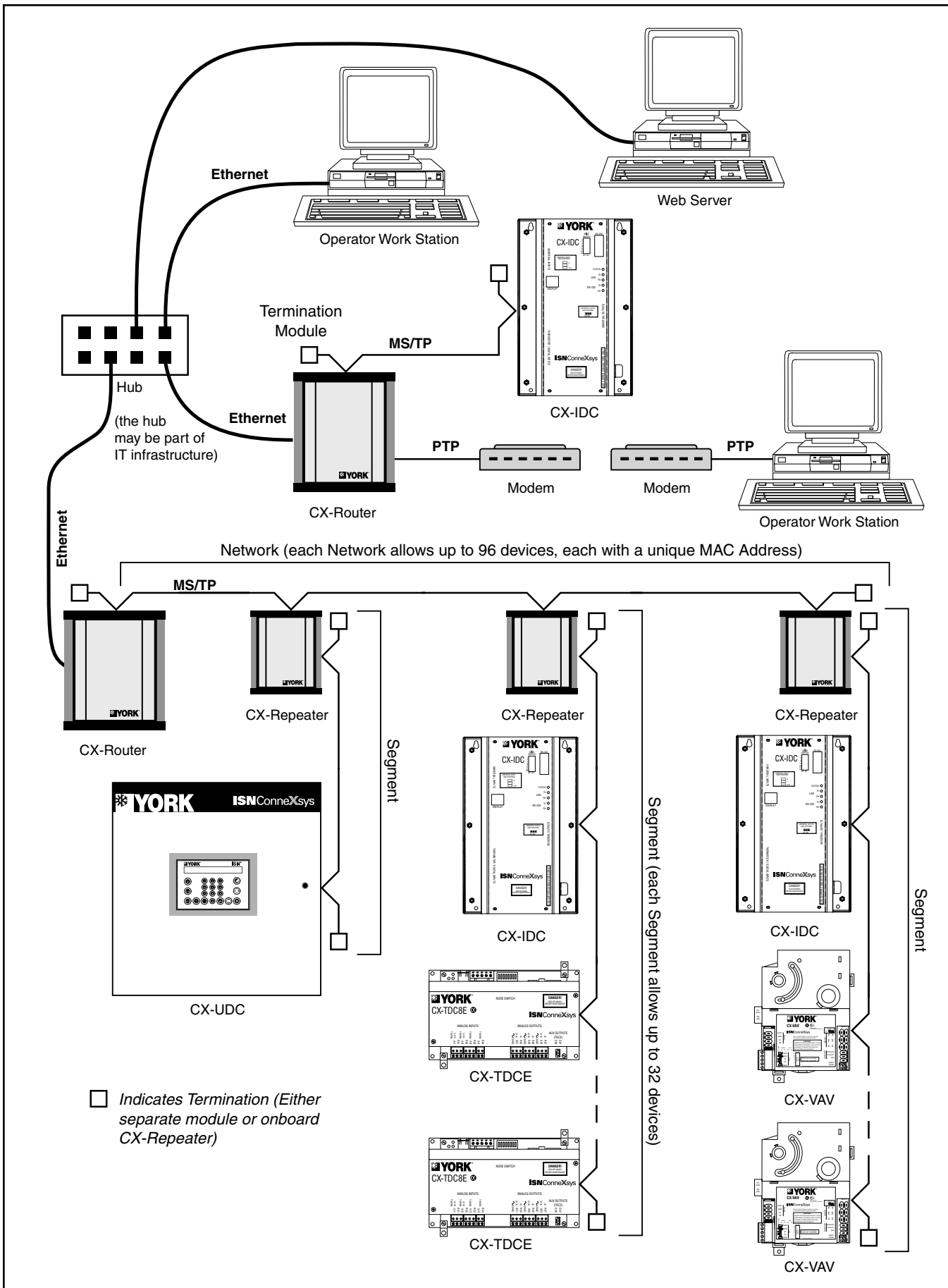


Figure 3. Typical Network Configuration with CX-Repeaters in Parallel

after the retry, the sending controller starts to increase the amount of time between transmissions. Retransmission of the message then occurs automatically every hour until receipt is acknowledged.

The CX controllers support 9.6, 19.2, and 38.4 kbaud. The CX-Router and CX-Repeater also support 76.8 kbaud. All the devices on the network must be set to the same transfer speed.

### Summary of Network Restrictions

- The maximum RS485 network length is 12,000 ft. (3600 m). This is obtained using 2 repeaters to combine 3 segments.
- The maximum RS485 segment length is 4000 ft. (1200 m).
- A load is created for every device connected to the network. Each segment can contain up to 32 nodes. A CX-Repeater creates a load on each port.
- The maximum number of loads on an MS/TP network is 96. To connect segments CX-Repeaters must be used. If connected to a CX-Router for internetwork connectivity, the router must also be counted as a load.
- The CX-Router communicates on MS/TP, PTP and Ethernet layers.
- When the network is extended between different buildings, the ground/earth voltage of the buildings must be at the same potential. If this cannot be guaranteed, two separate routers should be used to create two networks isolated by the Ethernet network. If a single network is used, the repeater must be powered by two separate transformers to provide 500 volt isolation between the segments.
- The maximum length of Ethernet 10Base-T cable is 330 ft. (100 m). If additional distance is required, an Ethernet repeater must be used.

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## SECTION 3

### INSTALLATION

#### Installation Guidelines

This manual assumes the installer is competent in environments with moving machinery, and is able to recognize and protect against any inherent hazards, such as, but not limited to, refrigerants, oil, corrosive chemicals or gases, materials under pressure, rotating parts, and both high and low voltages. Each of these items has the potential, if misused or handled improperly, to cause bodily injury or death.

It is the obligation and responsibility of the operating/service personnel to identify and recognize inherent hazards, protect themselves, and proceed safely in completing their tasks. Failure to comply with any of these requirements could result in serious damage to the equipment, as well as severe personal injury or death. In addition to following standard local, state and country codes and procedures, it is recommended that a lockout procedure be used to prevent inadvertent start up of equipment during installation and maintenance procedures.

All wiring should be carried out in a safe and neat manner and should always comply in all respects to the latest edition of any local, state or country codes that may be applicable. The wiring should be installed in a manner that does not cause a hazard and is protected against electrical and mechanical damage.

Care should also be taken when mounting the enclosure so access to other equipment within the vicinity is not restricted.

#### Environment

The CX-Router must be installed in an environment that is protected from the direct influence of the elements and is within the following:

Temperature: 32 to 122° F (0 to 50° C).

Humidity: 10% to 95% non-condensing.

The unit should never be mounted outside the confines of a building. If this cannot be avoided, it may be mounted inside an enclosure rated at IP65/NEMA 4X or greater. In addition to protection against the elements, the enclosure must be capable of maintaining the circuit boards at the required

temperature and humidity. This may require the addition of a fan or heater to maintain the temperature and humidity inside the enclosure.



***WARNING: Never install the components in an element that does not meet the minimum environmental requirements.***

#### Electrical

Use a suitably sized wire (refer to the table titled “Recommended Cable Specifications”) to connect the line voltage feed to the CX-Router. The line voltage power source should be “clean”, separately fused (for 24 VAC), and isolated, (using a control transformer) from other equipment in the plant room that may generate EMI interference.

#### Electrical Noise

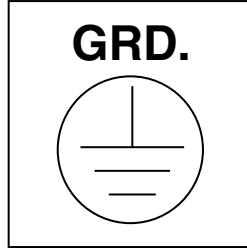
As with all electrical equipment, the CX-Router controller may be affected by external electrical noise. This noise may take the form of Radio Frequency Interference (RFI) or Electro-Magnetic Interference (EMI). To minimize the affects of electrical noise, choose a mounting location where the controller is removed from all possible RFI and EMI sources. These include high voltage cables, high voltage transformers, breakers, and high frequency drives.

Keep line voltage switching loads a minimum of 6 in. (152 mm) away. Any high voltage equipment, such as transformers, high horsepower electric motors or high frequency drives, should be kept a minimum of 30 ft. (9.1 m) away.

All high voltage wiring (>75 volts) must be run in conduit and kept separate from low voltage communications wiring. This will greatly reduce network communication problems.

## Ground/Earth

All YORK control products are designed to use the building ground (earth) as a reference point. This electrical orientation helps maintain all electronic components communicating to the controller within their specified voltage limits.



***CAUTION: The device must connect to a true building ground. Failure to do so may cause equipment damage and will void all warranty claims.***

Electrical grounding also protects the controller from the effects of lightning strikes. When lightning strikes near a building, it alters the potential of the building's ground. If the controller has been properly grounded, it will respond to this change much faster than if the ground connection is inadequate. Controllers that are poorly grounded provide a lower resistance path through their signal or power connections than the actual ground of the building. Under these circumstances large surge currents may flow through the controller and result in component failure.

An example of a poor ground would be a galvanized steel cold water pipe. As the pipe corrodes it no longer acts as a true ground. The corrosion acts as an insulator, raising the potential of the pipe with respect to earth ground.

YORK strongly recommends that the building's ground be checked prior to the start of the installation. The power distribution panel should be checked to ensure that it is not connected to a corroded or galvanized pipe. As a minimum, it must be connected with 14 AWG wire.

The CX-Router must also be connected to the power distribution's ground connection using a 14 AWG copper wire as a minimum.

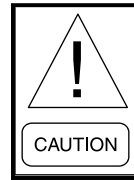
## Protection of Communication Ports

The most common circuits damaged are communication components, such as RS485 and RS232 drivers.

When using RS485 technology it is possible that electrical disturbances, such as voltage spikes, can damage a circuit board.

## Cable Specifications

### Power Cables



***CAUTION: Aluminum wire is absolutely not acceptable.***

The power cable should be at least a 18 AWG copper wire rated for 10 amps per core at 250 volt AC. If the power cable uses three conductors, the ground conductor must be, as a minimum, the same size with the same current carrying capacity as the live and neutral conductors.

The controller should be wired to a non-switched, fused spur to prevent the power from being turned off accidentally. The supply spur should be protected with either a suitable fuse or an approved power breaker. The input line supply voltage should be fused. Use a 10-amp fuse or breaker.

The fuse or breaker should be located within a reasonable distance to the controller so the power can be turned off any time the unit is serviced.

### Network and Sensor Cables

Cables come in many types. A balance between cost of the wire and the simplicity of the project determines the variety of wires used. Quite often a single type of wire or cable may be used for nearly all wiring on a project, even though it greatly exceeds the requirements for a particular sensor or application.

The table titled *Recommended Cable Specifications* provides a guide to one major wire manufacturer's product line. These are the minimum requirements. Use them as a guide. If questions arise, most wire supply companies can cross-reference between manu-

Table 1 – Recommended Cable Specifications

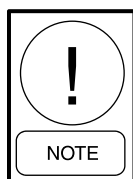
	Digital Outputs	Analog, Digital, Pulse Inputs and Analog Outputs	RS485 (BACnet MS/TP & York Talk 2 Networks)	RS232 (Serial Devices; York Talk 1 & 3 Networks)	Line Voltage Power Supply
Number of Cores	2 (or n for multicore)	2 (or n for multicore)	2 Twisted	3	3 w/Outer Sheath 0.31- 0.41 in. (7.8-10.3 mm) dia.
Minimum Conductor Gauge – AWG (CSA)	22 (0.34 mm <sup>2</sup> )	22 (0.34 mm <sup>2</sup> )	24 (0.25 mm <sup>2</sup> )	22 (0.34 mm <sup>2</sup> )	18 (0.80 mm <sup>2</sup> )
Conductor Material	Tinned Copper	Tinned Copper	Tinned Copper	Tinned Copper	Plain Copper
Strand/Strand gauge AWG (CSA)	7/30 (7/0.2 mm)	7/30 (7/0.2 mm)	7/32 (16/0.2 mm)	7/30 (7/0.2 mm)	N.A.
Voltage Rating – U <sub>o</sub> /U	300	300	300	300	300/600
Shield	Unshielded	100% Overall Beldfoil	100% Overall Beldfoil or 90% Braid	100% Overall Beldfoil	N.A.
Conductor Insulation	Round PVC	Round PVC	Round PVC Teflon*	Round PVC	PVC
Core Insulation	PVC	PVC	PE	PE	PVC
Nominal Capacitance between Conductors – pF/m	N.A.	80	42	75	N.A.
Characteristic Impedance – ohms	N.A.	N.A.	120	N.A.	N.A.
Maximum Run Length – ft (m)	1000 (305)	1000 (305)	Refer to Section 2	32 (10)	N.A.
Belden Number	8442	8761	9841 89841*	9533	N.A.

\* Teflon insulation must be used to meet plenum application requirements.

N.A. – Not applicable.

NOTE: Whenever possible, use cabling which meets or exceeds the equivalent of the Belden specification.

facturers and help determine if a particular wire will meet the requirements.



**NOTE: Be sure cables are securely attached without tensile load.**

### Summary of Mounting Recommendations

- **Always** mount the controller inside the confines of a building or inside an enclosure suitably rated for exposure to weather.
- **Never** mount the controller under or beside pipes carrying water or chemicals.

- **Never** mount the controller near high voltage cables, high voltage transformers or breakers, or close to high frequency drives.
- **Never** mount the controller in a location where the environment could be outside the specified operating specifications.
- **Never** mount the controller on a vibrating surface without first employing some form of mechanical dampening.

CX-Router controller if desired. In addition to protecting the unit against liquid and particle ingress, it also aids in shielding the unit from EMI.



**WARNING:** Under no circumstances should a CX-Router controller be installed in close proximity to high voltage wiring. This configuration will result in unreliable operation.

## Mounting



**CAUTION:** Never install the CX-Router outside the confines of a building unless mounted within another enclosure rated at IP65/ NEMA 4X or higher.

A CX-Router controller can be mounted on any smooth, nonvibrating surface using screw fasteners. An enclosure can be used to protect the

Take care not to restrict access to other equipment in the installation area.

## Panel Mounting

After a suitable location has been determined:

1. Use the dimensions show in Figure 4 or hold the CX-Router in position as a template to mark the mounting holes in the CX-Router.

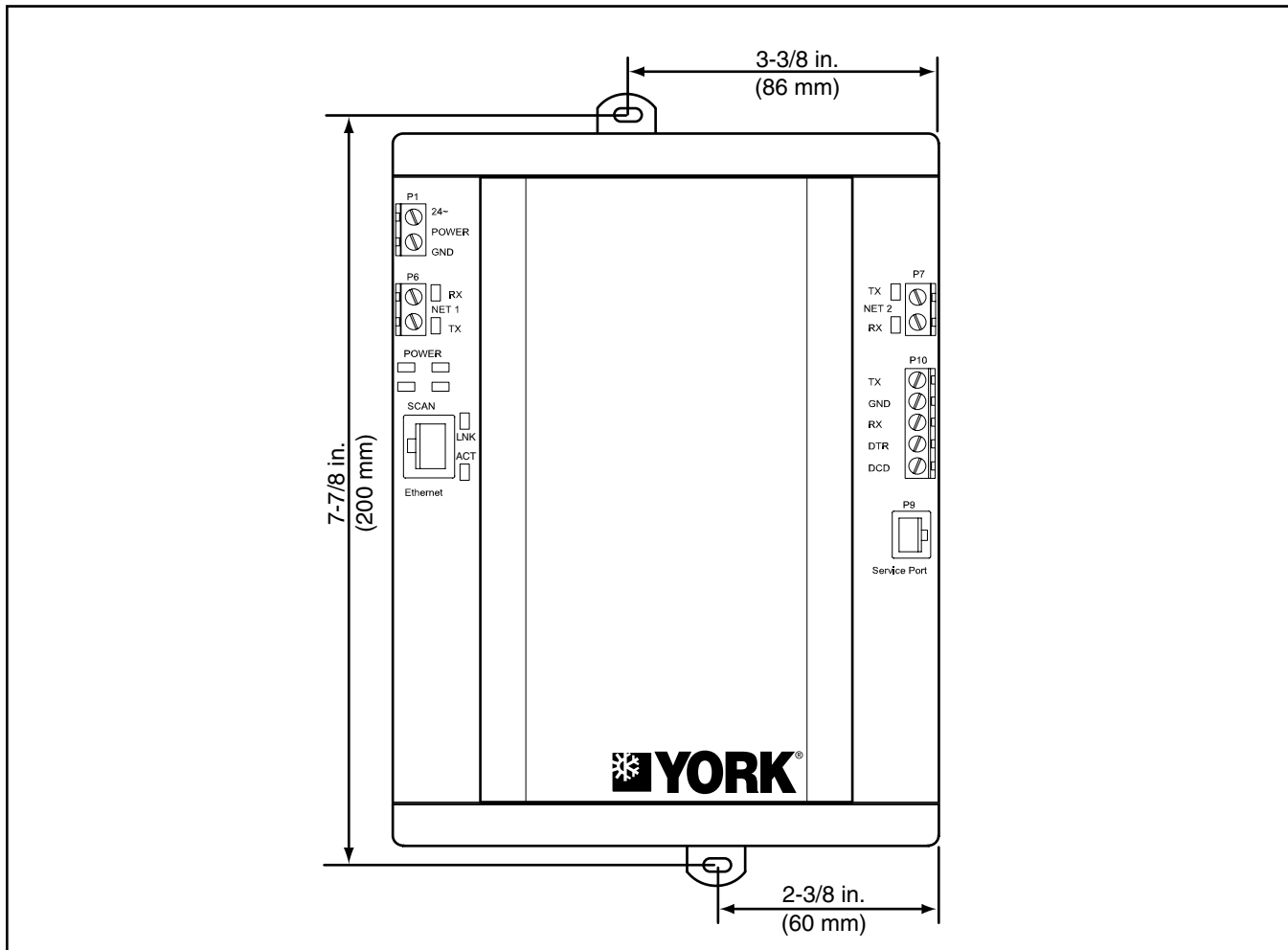


Figure 4. Dimensions



**WARNING:** Do not allow chips or dirt to fall onto the CX-Router boards or connectors when using the CX-Router as a template.

2. Remove the CX-Router and drill the appropriate sized holes at the marks for the mounting method to be used. Mounting methods depend upon the type of surface the device is mounted on or in. For concrete surfaces use lag bolts, for dry wall or gypsum board use anchors, for wood use wood screws or bolts, etc.
3. Install the CX-Router using the appropriate style of mounting screws into the holes drilled in step 2.

**Connecting Power**

The CX-Router requires a Class 2 power transformer supplying an isolated 24 VAC nominal line voltage with a minimum rating of 40 VA at 60 Hz. A properly color-coded wire must be obtained locally to conform to all local, state and country regulations as well as NEC recommendations.



**CAUTION:** Aluminum wire is absolutely not acceptable.

Power Connection



**CAUTION:** Do not apply power to the CX-Router until all components have been installed and commissioning checks have been completed.



**DANGER:** Disconnect any line voltage power supply at the source before attaching wiring to prevent possible electrocution.

The line voltage power supply should be wired to a non-switched fused spur to prevent the power from being turned OFF accidentally. A fuse or breaker rated at 10 amps should protect the controller from overload.

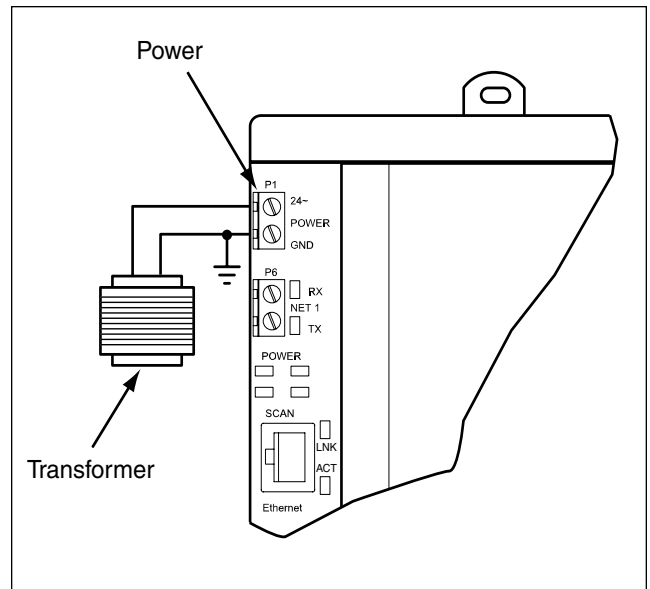


Figure 5. Power Connection

It is recommended that the line voltage supply cable be installed within suitable conduit. Ensure that all wiring meets local, state and country codes, as well as follows NEC recommendations.

Connect the wiring as shown in the Figure 5. If a single transformer powers multiple devices, ensure that the devices are wired within the same phase.

**Network Communications**

The CX-Router can interface with four different types of BACnet networks through 3 different connectors (ports); MS/TP (NET2 port), Ethernet and BACnet IP (Ethernet Port), and PTP (RS232 port). The three individual ports can all be connected simultaneously to provide the router capabilities.

The CX-Router repacketizes information from one network protocol to the other, forwarding data only to the appropriate network. Separate networks connect to each port and, once connected, become part of a BACnet internetwork.

Ethernet Port

The CX-Router uses an RJ-45 connector and Cat 5 cable to connect to Ethernet networks. Through this connection, the CX-Router can connect to the Internet, other Ethernet networks (WAN), or simply connect different MS/TP networks together. This port is also used to connect to the ISN ConneXsys OWS running on a PC.

The Ethernet port defaults to 10 Mbps and uses 10Base-T Cat 5 cable.



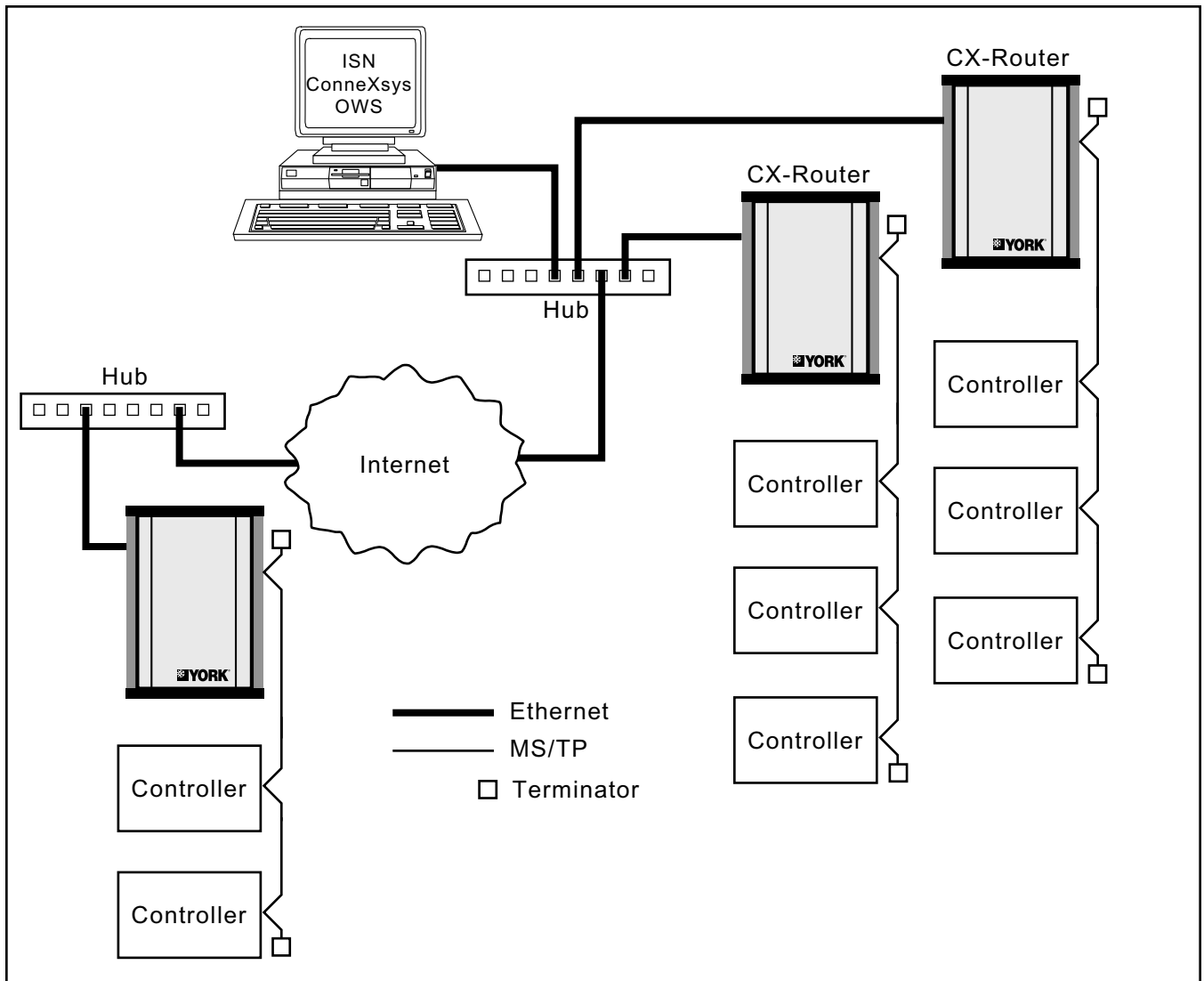


Figure 7. Typical Internet Connectivity

The distance limitation of 10Base-T Ethernet is 330 ft. (100 m).

Depending upon the usage, two different types of wiring can be used.

Standard Patch Cable – This cable is used when connecting devices through a hub. Refer to Figure 8.

Crossover Patch Cable – This cable is used when connecting devices directly. Refer to Figure 8.

RS485 Cable

The distance limitation of RS485 is 4000 ft. (1200 m) per segment. Three segments can be connected using CX-Repeaters for a maximum distance of 12000 ft. (3600 m).

Refer to Table 1 for specific cable recommendations. Note that, for installation within a plenum, teflon insulation must be used.

When connecting the MS/TP devices using RS485, termination is required at the end of each segment. Separate termination modules are available or CX-Repeaters include an onboard termination capability. Refer to Figure 9 for an example of cable connections on an MS/TP network.

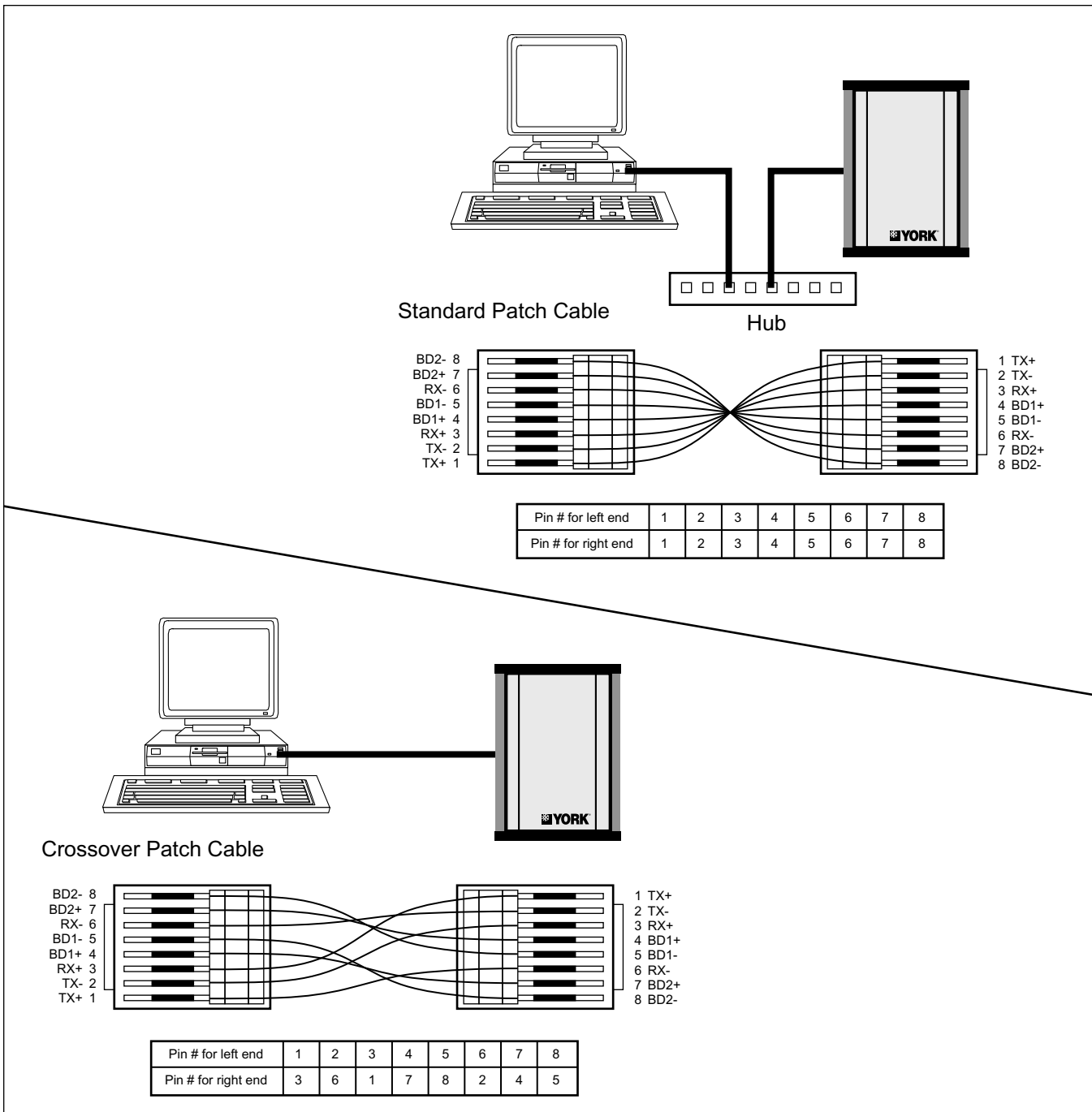
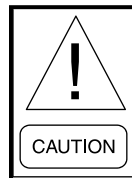


Figure 8. Patch Cables

RS232 Cable

YORK control devices can use null modem cables with full handshake ability or can function using the simple, 3-wire connection. The maximum distance limitation is 50 ft. (15 m) but can sometimes be longer, dependent upon signal strength and cable quality. Refer to Table 1 for specific cable recommendations.



**CAUTION: Partial handshake null modem cables do not work with YORK control products and must be avoided.**

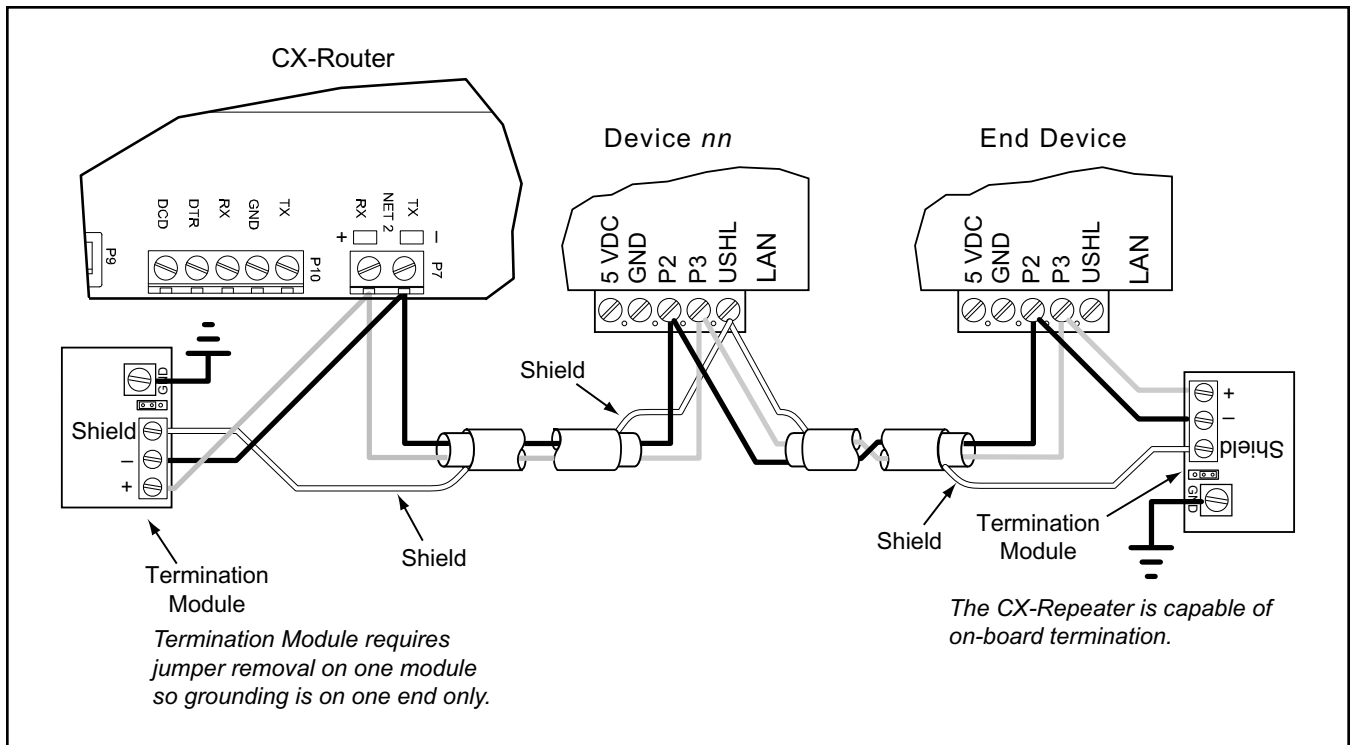


Figure 9. MS/TP Wiring Details

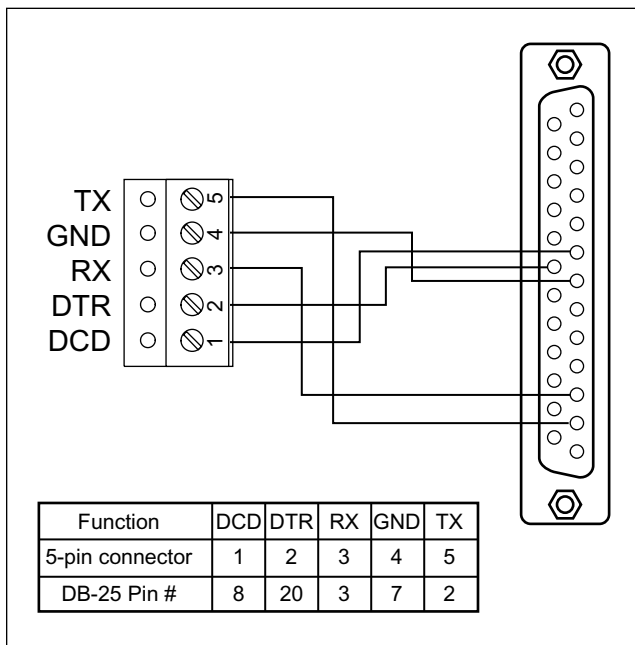
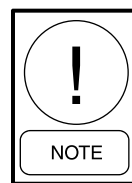


Figure 10. RS232 Modem Cable

### Switch Settings

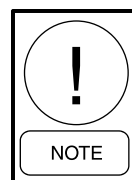
Several jumpers and an 8-way DIP switch are located on the CX-Router board.



**NOTE:** Network transfer speeds are set in the firmware. Ensure that the specified speed is consistent in all devices on the network.

### DIP Switch

The DIP switch sets the MAC Address or the CX-Router on the MS/TP network. The MAC Address must be between 1 and 99.

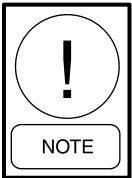


**NOTE:** The address on the Ethernet network is set via software.

## Run/Clear Jumper

The Run/Clear jumper is used to clear the SRAM which stores the BACnet Objects, history data, and Real Time Clock.

In the RUN position, the battery maintains the SRAM even when 24 VAC power is removed. In the CLEAR position the SRAM is erased when power is disconnected. This jumper is normally in the RUN position.



**NOTE:** *The jumper should be placed in the RUN position before power is applied.*

## DNA Jumper

The DNA jumper simplifies the network addressing of the CX-Router. When enabled, the network address is derived from higher level devices on the network. When disabled, the network numbering is derived from defaults. Network numbers are modifiable from within the software using the ISN ConneXsys OWS. This jumper is normally in the enabled position.

## AREA/SYSTEM/SUBNET Jumper

The Area/System/Subnet jumper sets the type of device that the CX-Router operates as. Along with the DNA jumper, it determines how the network and DE are set.

When set to AREA, the CX-Router operates as an area device.

When set to SYSTEM, the CX-Router operates as a system device.

When set to SUBNET, the CX-Router operates as a subnet device.

## **Service Port**

Located on the CX-Router is an RJ-11 connector which can be used as a Service Port. The Service Port allows a PC using VT100 Terminal Emulation software to be connected directly to the MS/TP network through the use of an RS232 to RS485 converter.

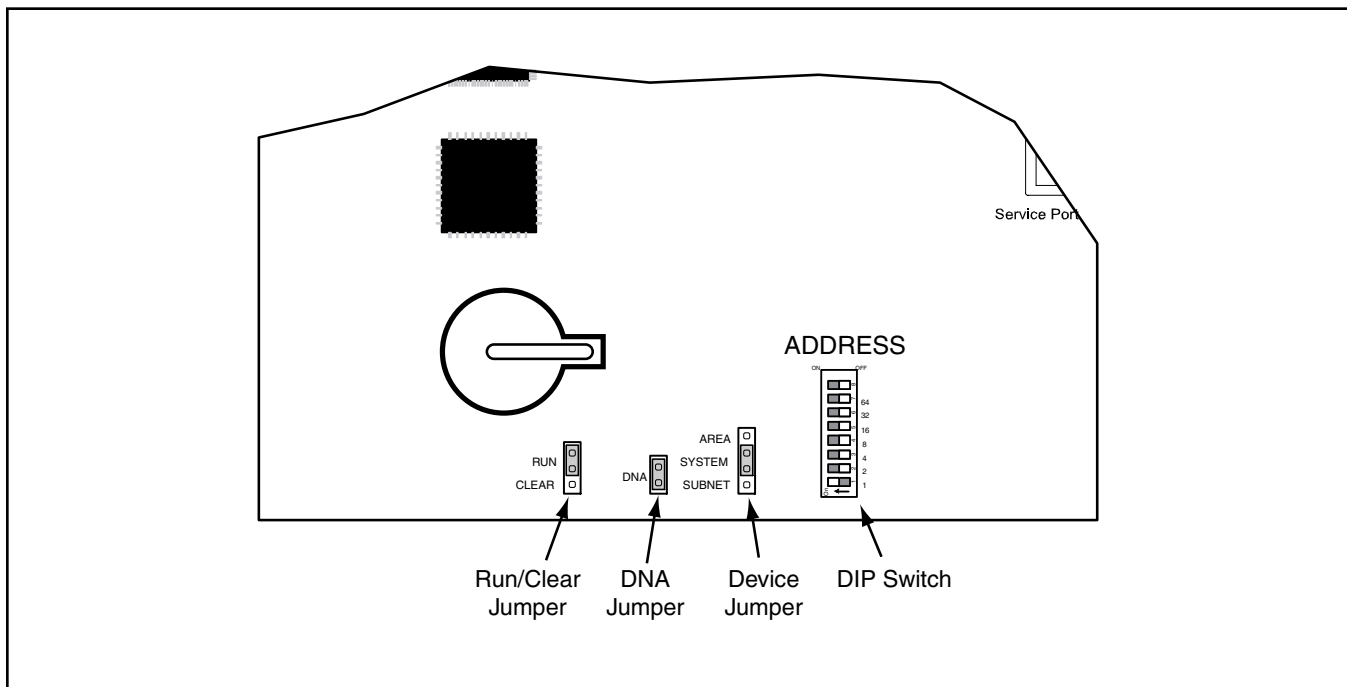


Figure 11. DIP Switch and Jumper Locations

## SECTION 4

### MAINTENANCE

#### LEDs

The CX-Router is equipped with LEDs to aid in troubleshooting the operation and communication functions. LEDs are located on the board next to the appropriate connector.

#### Power LED

The amber Power LED indicates the presence of 24 VAC power. If not lit, the power supply is off or a fuse is blown.

#### SCAN LED

The SCAN LED flashes at different rates to indicate the scan rate of the CX-Router.

#### NET1 LEDs

This port is not used.

#### NET2 LEDs

The green NET2 TX LED flashes to indicate data is being transmitted across the MS/TP network. The red NET2 RX LED flashes to indicate data is being received from the MS/TP network.

#### LINK LED

The LINK LED indicates that the CX-Router is connected to an Ethernet network. If not illuminated, either the Ethernet cable is not connected correctly or not working properly.

#### ACT LED

The ACT LED flashes on for one second to indicate Ethernet transmitting or receiving activity.

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## APPENDIX

## Specifications

**General**

Power Source	24 VAC (Transformer Required)
Power Consumption	40 VA
Operating Environment	32 to 131° F (0 to 55° C) 10 to 95% non-condensing
Size (H x W x D)	5.8 x 8.3 x 2.3 in. (168 x 102 x 48 mm)
Weight	0.75 lb. (342 g)

**Technology**

Processor	32 bit
SRAM Memory	512 kbytes
FLASH Memory	1 Mbytes w/10 year retention
Battery Backup	Lithium Ion, Backups RTC and SRAM
Real Time Clock	Yes

**Interface**

Ports	RS485 (2), RS232, 10Base-T
Connection	10Base-T – RJ-45; RS485 – 2-pin screw terminals; RS232 – 5-pin screw terminals
Protocols	BACnet Ethernet, MS/TP, PTP
Ethernet Speeds	10 Mbps
MS/TP Speeds	9.6, 19.2, 38.4 and 76.8 kbaud
PTP Speeds	9.6, 19.2, and 38.4 kbaud
Switch Selections	Address, Run/Clear, DNA Jumper, Area/System
LEDs	Power Status; LAN Communication
Programming	ISN ConneXsys OWS

**Compliance**

UL916 Listed
FCC Part 15 Class A
CE Directives EN55022:1994, EN50082-1:1997

**Ordering Information**

CX-Router	371-04475-000
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