Carrier Comfort Network

Overview and Configuration Manual

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Manual Revisions

The *Carrier Comfort Network Overview and Configuration Manual* is catalog number 808-534. This is the 8/96 revision of the manual.

The following changes have been made since the last version.

Section/Chapter		Changes
Entire manual		Added information about the Comfort Controller and ComfortWORKS.
Module Wiring	1.	On pages 2-2 and 2-5, added recommendations about using separate, isolated power supplies.
Network Configuration Tool	2.	Deleted

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Introduction
General Information

The Carrier Comfort Network (CCN) is a system of communicating, microprocessor based controls for heating, ventilating and cooling (HVAC) equipment. Communications between the system's devices enables the system to coordinate its activities for greater efficiency, and to simplify the identification of any problems that may arise. Microprocessors incorporated in individual control units enable those units to carry out sophisticated functions on a localized basis.

A CCN system consists of two principal types of controllers, the PIC and the Comfort Controller, supported by a number of other devices that carry out communications functions in the system, and by ComfortWORKS, which provides the main human interface to the system. All CCN devices, termed "system elements," are linked together by the CCN communications bus.

The purpose of the Carrier Comfort Network (CCN) starts with a building. The building's interior is divided into spaces of varying sizes. People in varying numbers occupy those spaces to perform a variety of activities. The exterior of the structure is subject to a number of environmental factors. Notable among the factors are solar heating on different faces as the sun moves through the sky and cooling on the face exposed to the prevailing wind.

Under some conditions one portion of the building may require heating while another requires cooling. More often, one mode of operation prevails for the whole building. Even then, though, the precise amount of heating or cooling required varies from one internal space to another.

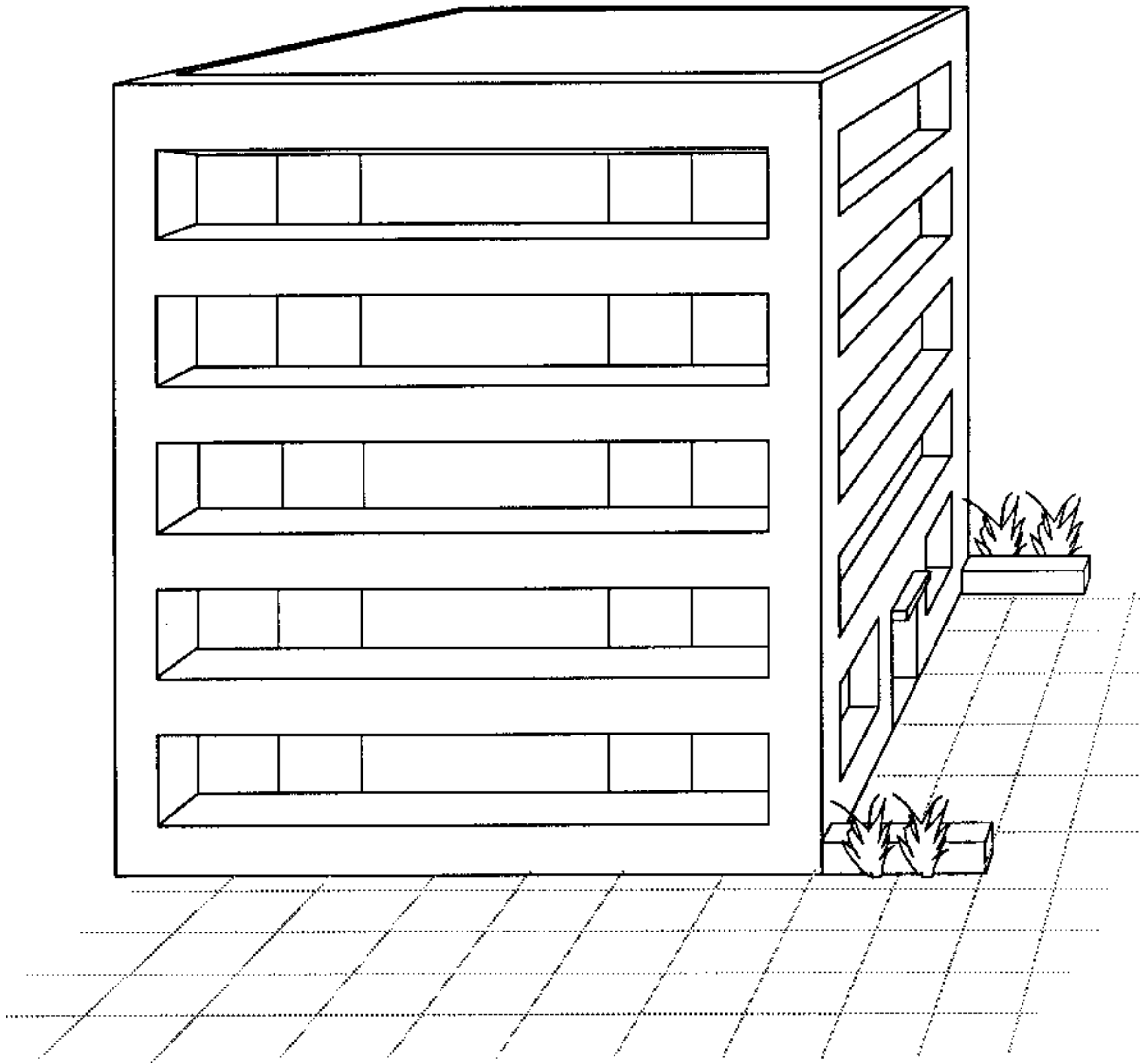

Figure 1-1: Typical Building

A CCN acts to meet a building's varied needs by coordinating the activities of its heating and cooling equipment. A CCN-controlled heating and cooling system for a building such as the one that appears in Figure 1-1 can be viewed as consisting of three layers of subsystems.

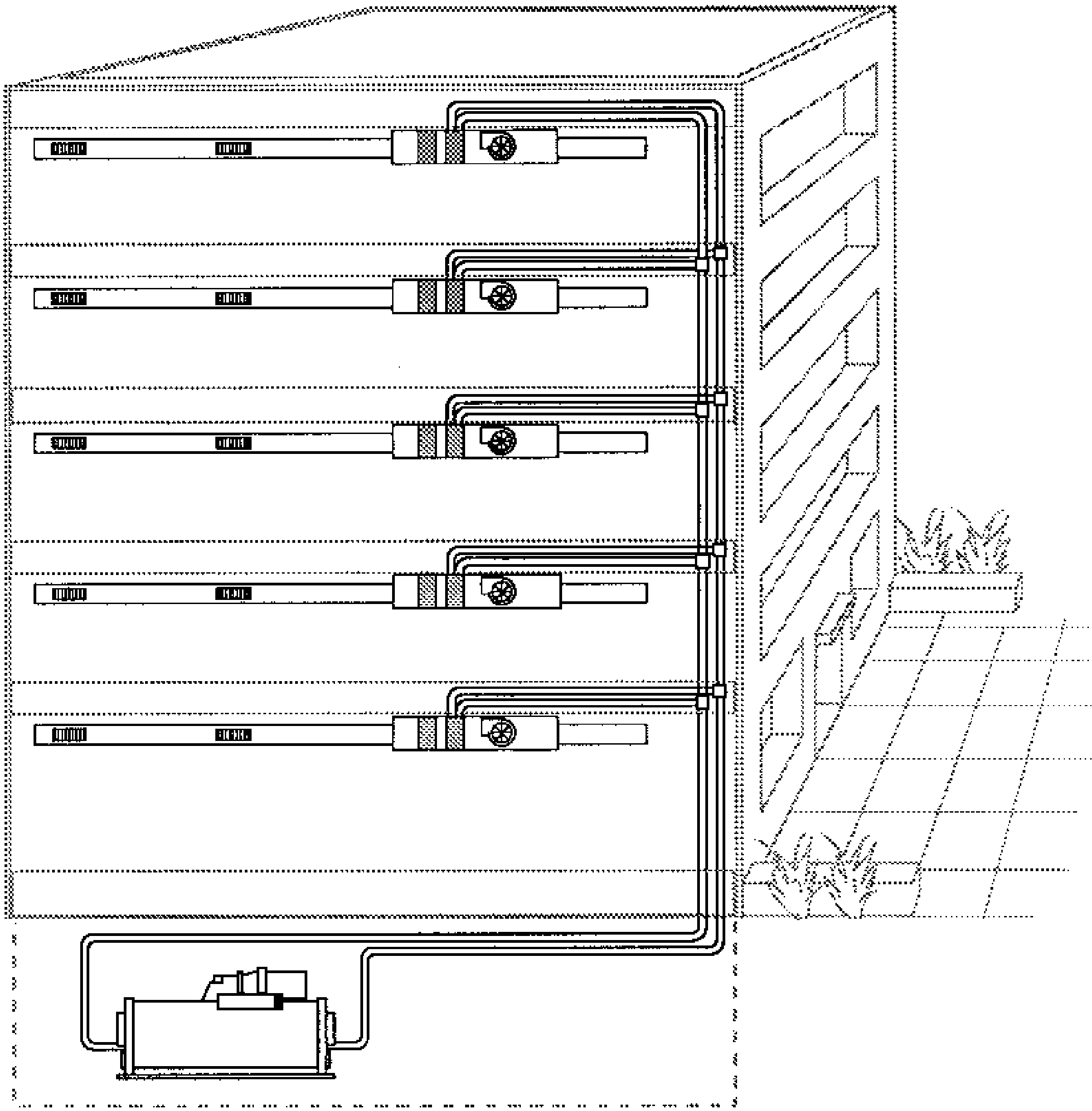

Figure 1-2: Building with Chiller and Air Handlers

The first layer of a CCN-controlled heating and cooling system consists of the heating, ventilating, and air conditioning equipment installed within a building. Its task is to make the building's interior spaces comfortable for occupants despite the influences of external environmental factors. In order to do that, there must be equipment to cool those areas where temperatures may climb and equipment to provide heat for those areas where temperatures threaten to fall below the human comfort range. The building in Figure 1-2, for example, is shown as having a chiller with piping through which it moves chilled water, and an air handler on each floor with associated ductwork for moving heated or cooled air.

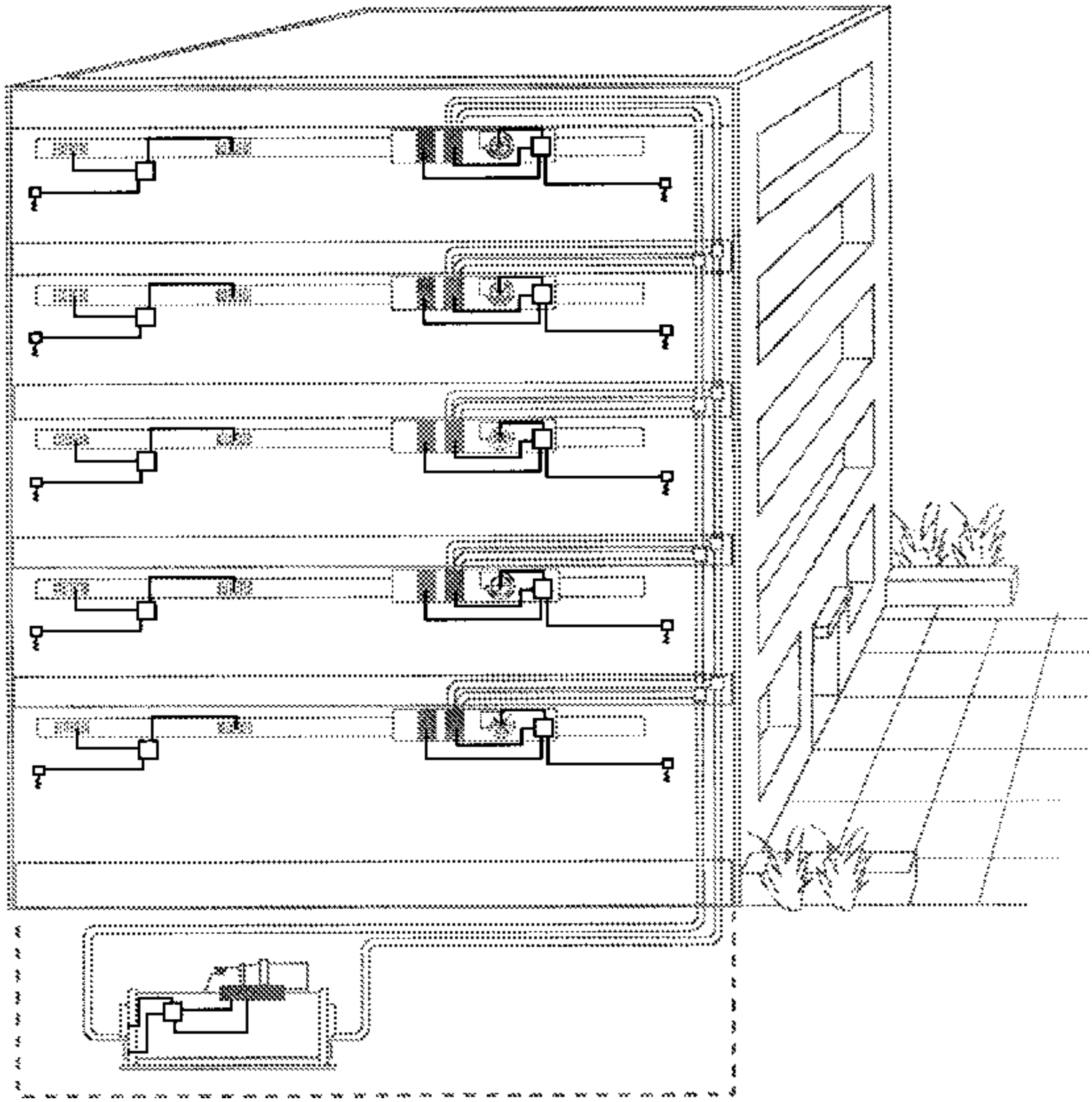

Figure 1-3: Building with Controllers Added to HVAC Equipment

The second layer of a CCN-controlled HVAC system consists of the controllers that regulate the HVAC equipment. Figure 1-3 uses boxes to represent controllers added to the equipment. Each controller uses sensors to monitor conditions in the space being served and in the equipment, and actuators to control the equipment. The sensors and actuators are wired to I/O modules at the controller. Two types of CCN controllers are available for the direct control of equipment: PICs and Comfort Controllers.

Both types of controllers, as well as a number of other CCN devices, are described later in this section of the manual. The generic term for a CCN device is "system element."

PICs and Comfort Controllers are also thoroughly documented in manuals of their own.

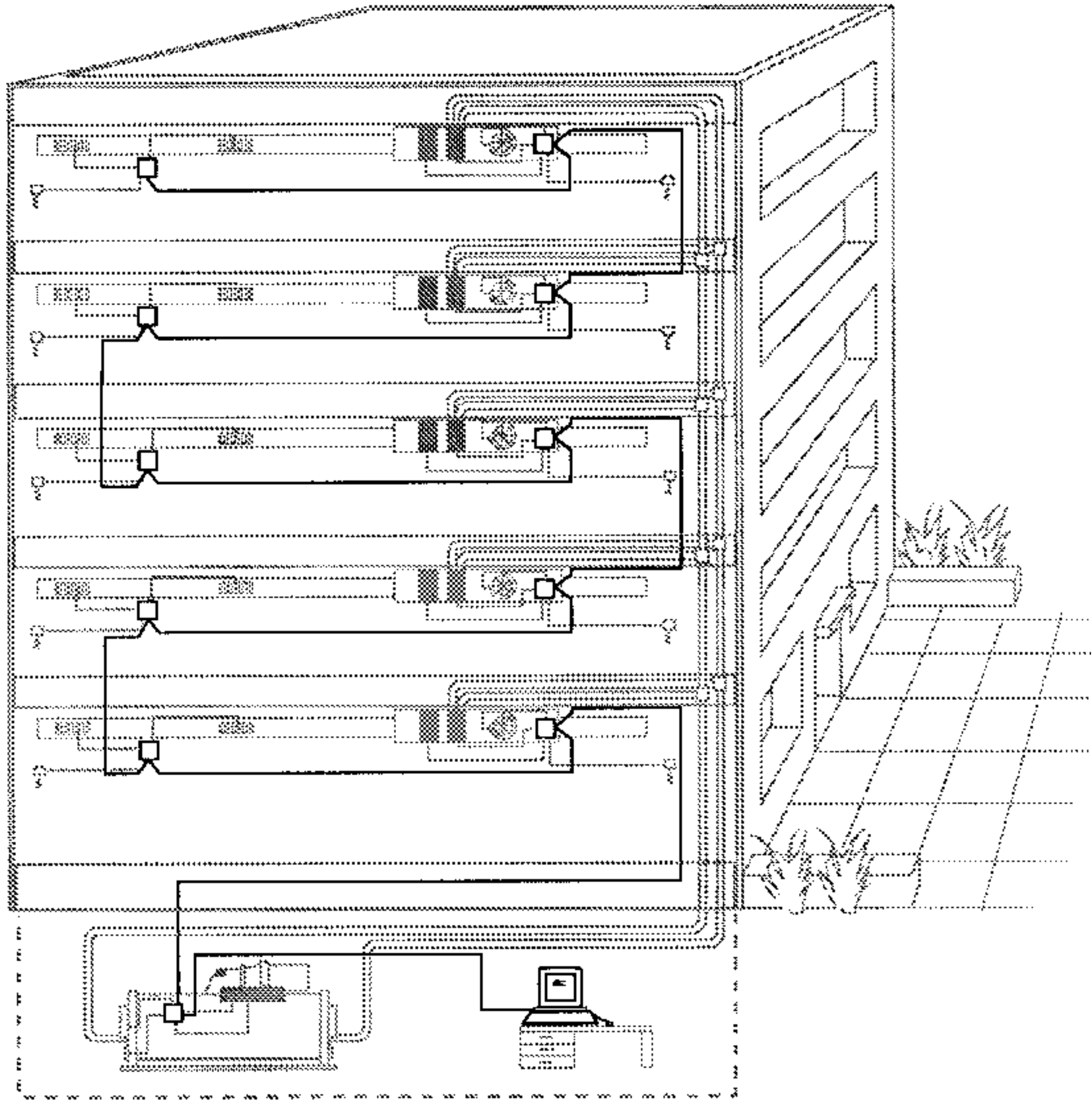

Figure 1-4: Building with CCN Bus and ComfortWORKS Added

The CCN's third layer is the one with which this manual is most concerned. It consists of the communications capability that enables controllers to function together. It is communication that ties the system elements of a CCN into a network. By exchanging information between themselves, CCN controllers can act in a coordinated fashion to operate a building's HVAC equipment in the most efficient manner.

Communications in a CCN take place over a CCN Communications Bus. There can be multiple buses in one network, with one bus designated as the primary bus and other, secondary, buses connected to it through CCN Bridges. A bus, either primary or secondary, can consist of up to four bus segments connected together by CCN Repeaters.

The communications bus also enables system elements to communicate with a CCN ComfortWORKS. This software is the means by which the user interfaces with the CCN. It makes it possible for a user to interact with all controllers in a CCN from one location. Figure 1-4 shows a ComfortWORKS added to the CCN and a communication bus linking the CCN's system elements.

Like PICs and Comfort Controllers, ComfortWORKS is thoroughly covered in its own documentation.

CCN Communications Bus

The CCN communications bus conveys commands, data, and alarms between the CCN system elements. Transmissions on the bus are performed by the techniques specified in EIA RS-485. Any system element connected to the bus may communicate with any other system element, regardless of their physical locations.

One bus can accommodate connection of up to 239 addressed system elements. Each of those is identified for communications purposes by a unique system address. A system address consists of the number of the bus to which the system element is connected and a system element number between 1 and 239. That address is sometimes expressed in documentation as bus number/system element number.

Physically, the communications bus consists of shielded three conductor cable. Connections to the bus are made in a parallel daisy-chain fashion. That is, a system element's main communication port is usually connected to two cables, each going to a different system element. Only a system element at the end of a bus or a Repeater being used to extend a bus has a single cable connected to its main communication port.

System elements must be connected directly to the bus without the use of T-taps or spurs. T-tap or spur connections might cause excessive reflected noise on the network.

A CCN system of no more than 239 system elements may perform all of its communications by means of a single primary bus. The primary bus is always assigned bus number 0. Larger networks, or those with special requirements, may make use of one or more secondary buses. A secondary bus is connected to the primary bus by a system element called a NDS/Bridge. The Bridge and the numbering scheme for secondary buses are described below.

Each CCN bus is served by a Network Directory Services (NDS) software module that maintains a directory of system elements on the bus. A NDS also performs diagnostic functions to determine whether the bus's system elements are functioning correctly. The NDS for a primary bus is installed in a CIO Module dedicated to that purpose. It is also available packaged along with the Autodial Gateway. The NDS for each secondary bus is installed in the NDS/Bridge that connects the secondary bus to the primary bus.

System Elements

PIC

A PIC (Product Integrated Control) is the CCN controller for use with Carrier-built, CCN-compatible HVAC equipment. It consists of a processor module, and may include one or more I/O modules. All the modules that make up a PIC are installed in the HVAC equipment during manufacture.

The processor module contains a microprocessor connected to 12 inputs and six outputs. There is also provision for connecting the processor module to I/O modules that support additional inputs and outputs. The microprocessor executes algorithms, computer software that determines how the PIC controls the equipment. The processor module is also the PIC component that performs communications functions on the CCN communications bus.

Sensors to monitor both the equipment's operation and conditions in the space served by the equipment are connected to inputs at the PIC. Outputs from the PIC serve to control the equipment's operation.

Each PIC is customized according to the needs of the equipment in which it is installed. The customization involves selection of the modules that make up a given PIC, and selection of the software loaded in the PIC's processor module to determine its control functions.

Comfort Controller

The Comfort Controller product family gives the CCN the capability to control non-Carrier equipment and Carrier HVAC equipment not equipped with PICs. The Comfort Controller product family provides general purpose HVAC control and monitoring capability in a stand-alone or network environment using closed-loop, direct digital control. This product family can control and monitor equipment such as lighting, pumps, and cooling towers.

The two types of Comfort Controllers, the 6400 and the 1600, provide the following functions:

- HVAC control
- proportional, integral, and derivative (PID) loop control
- scheduling
- custom programming

You configure the Comfort Controller to contain a database of the algorithms, points, schedules, alarms, and system functions necessary to control and monitor the equipment at your site.

FID

A FID (Field Installed Device) is a CCN controller for use with HVAC equipment built by manufacturers other than Carrier. It may also be used in retrofit applications to control earlier Carrier equipment that does not have a PIC. A FID consists of an enclosure that contains a power supply, a processor module, and one or more I/O modules.

The processor module contains a microprocessor. The microprocessor executes the algorithms that determine how the FID controls the equipment. The processor module is also the FID component that performs communications functions on the CCN communications bus.

Sensors to monitor both the equipment's operation and conditions in the space served by the equipment are connected to inputs at the I/O module(s). Outputs from the I/O module(s) serve to control the equipment's operation.

A FID is customized for the equipment to which it is connected by selection of varying combinations of I/O modules. FID software, however, is more "general purpose" than that used in a PIC. The user must configure FID software on-site to suit each specific application.

CIO Module

A CIO (Communications Input/Output) Module serves as a standalone processor module in the CCN. It does not act to control a specific piece of equipment as does a PIC or a FID. Instead, CIO Modules are used to carry out functions that relate to communications and the way that CCN system elements work together.

A CIO Module may be installed in a CCN system to act as the processor responsible for providing an option function such as Loadshed or Data Collection. Or it may be equipped with specific communications software that enables it to act as a NDS/Bridge, an Autodial Gateway, or a VVT Gateway. Although they all employ the same CIO Module hardware, each of those applications is treated as a unique system element because each has different operating characteristics and wiring requirements. Descriptions of the three system elements appear below.

NDS/Bridge

An NDS/Bridge consists of a CIO Module equipped with software that enables it to function as the interface between the CCN primary bus and a secondary bus. A secondary bus is isolated from the primary bus and subordinate to it.

An NDS/Bridge may be assigned any of the 239 system element numbers on a primary bus. Each secondary bus takes as its bus number the system element number of the Bridge that connects it to the primary bus.

A Bridge may not be used on a secondary bus to create a third level bus.

Each NDS/Bridge contains Network Directory Services (NDS) software that maintains a directory of system elements on the Bridge's secondary bus. NDS also performs diagnostic functions to determine whether the secondary bus's system elements are functioning correctly.

There is a section in this manual devoted to the NDS. There is no section devoted to the Bridge function of the NDS/Bridge because there is no user interaction with a Bridge after it is placed in service.

Autodial Gateway

An Autodial Gateway consists of a CIO Module equipped with software that enables it to function as the interface between a CCN communications bus using RS-485 signalling and an external autodial modem using EIA RS-232 signalling. An Autodial Gateway must be connected to the primary bus of its CCN.

It is possible to set up a CCN site at which the only equipment is a ComfortWORKS or Building Supervisor connected through an Autodial Gateway to an autodial modem. An operator working at that system can use the Autodial Gateway to "dial-in" to CCN systems that contain Autodial Gateways. When the telephone connection is established the operator has complete access to the CCN system, just as if the ComfortWORKS or Building Supervisor were connected to it directly.

A CCN with an Autodial Gateway can be configured in such a way that certain alarms will cause the Autodial Gateway to automatically initiate a call to another site. The alarms can then be reported to a ComfortWORKS or Building Supervisor at the second site.

VVT Gateway

A VVT Gateway consists of a CIO Module equipped with software that enables it to function as the interface between a CCN communications bus and a VVT system communications bus. An operator working at a ComfortWORKS or Building Supervisor in a CCN system that is connected to a VVT system by a VVT Gateway can configure and control the VVT system's communicating thermostats. The operator can also display VVT diagnostic information on the ComfortWORKS or Building Supervisor screen.

Repeater

The Repeater is a special purpose hardware module that has two applications in the CCN system. It may be used as a bus extender to connect together two bus segments, or it may be used as a protocol converter to interface a RS-232 device to the CCN's RS-485 communications bus.

A Repeater is the one system element that is not assigned a system address. That is because it is neither the source nor the destination of any communications on the bus.

The bus extender function, in which it links two RS-485 bus segments, is the most common application for a Repeater module. In this application the Repeater performs bi-directional signal regeneration that is transparent to the system elements connected to the bus segments.

All buses, both primary and secondary, are composed of bus segments. A bus segment may be up to 1000 feet in length and can accommodate connection of up to 60 addressed system elements. Up to three Repeaters may be used to form one bus, consisting of four segments and able to accommodate up to 239 addressed system elements.

The Repeater's second, less common, application is its use as a protocol converter. In that application it serves as an interface device for connecting a device that communicates by EIA RS-232 signals to the CCN communications bus, which employs EIA RS-485 signals.

A Repeater may be used as the protocol converter that connects a CCN ComfortWORKS or Building Supervisor to the bus. However, the use of other protocol converters is also permitted for that purpose.

There is not a section devoted to the Repeater in this manual because the user has no interaction with it once it is installed and set in operation.

ComfortWORKS

ComfortWORKS software is the primary human interface to the CCN. It is designed to run on a variety of IBM® and IBM-compatible microcomputers using the Microsoft® Windows NT™ Workstation or Server operating system.

ComfortWORKS provides tools for monitoring, configuring, and analyzing a facility's daily HVAC operations. It provides an environment from which you can perform the following tasks:

- Configure operating parameters such as time schedules, setpoints, and point configuration
- Downline load data to and upline load data from controllers
- Override the state or value of selected input and output points
- View, print, and acknowledge alarms from the network
- Display dynamic data in both text and graphic modes
- Create dynamic trend plots of data from one or multiple controllers
- Customize graphics and create custom links from graphic to graphic
- Generate reports from system data

Building Supervisor

A CCN Building Supervisor is a human interface device for a CCN system. It consists of an IBM PC computer or an IBM PC compatible computer equipped with software that enables it to act as a system element in the CCN.

An operator working at a Building Supervisor can configure, command, or monitor any system element in the CCN. When a Data Collection option is installed in the CCN, the Building Supervisor stores the information accumulated by Data Collection and formats it into Reports that can be printed by an associated printer. The Building Supervisor also serves to store and display any alarms that occur on the CCN system.

More than one Building Supervisor may be present in a CCN system, but all Building Supervisors must be connected to the primary bus. In a CCN system that includes more than one building it is not mandatory to have a Building Supervisor located in each building.

A Building Supervisor may be connected to the communications bus by means of the computer's RS-232 port. A protocol converter such as the CCN Repeater is required in order to make connection to the RS-485 CCN bus.

Lightning Suppressors

Any cable in the CCN system that exits from a building and/or enters a building from the outside must be equipped with a lightning suppressor. The lightning suppressor is not considered a CCN system element.

Lightning suppressors are required on communications bus, sensor, and device cables. A lightning suppressor must be mounted inside the last PIC or FID enclosure that a cable exits from before exiting a building, or the first enclosure it enters upon entering a building.

CCN Options

A CCN system may have one or more options installed in it to perform functions that enhance network operations.

Each option consists of special purpose algorithms and communications software that provide a function for the entire CCN system or a designated portion of the CCN system. Some options consist of two parts, a supervisory part and an equipment part.

A supervisory part installed in a CIO Module is present in every option. It contains the algorithms that administer the option's function and the software that enables the option to communicate with the CCN system's PICs, Comfort Controllers, and FIDs to influence their operation.

Some options require processing to be carried out by each system element affected by the option. Comfort Controllers and FIDs possess the capability to do that processing as part of their general purpose software. A PIC that is required to do "local" processing for an option function must have an equipment part for that option installed in its processor module.

Each CCN option is described in its own Overview and Configuration Manual.

About This Manual

The following sections of this manual present information that the user will need when dealing with communications aspects of the CCN.

Section 2 - *Module Wiring* presents wiring instructions for the Repeater and the CIO Module in their various applications. Wiring instructions for PICs, Comfort Controllers, FIDs, ComfortWORKS, and Building Supervisors are not included here, but may be found in their respective manuals.

Section 3 - *Network Directory Services* describes the function of the Network Directory Services (NDS) software module that must be present on each CCN bus. The section includes instructions for configuring the diagnostic portion of NDS.

Module Wiring
General Information

This section of the manual contains information on how two types of modules, the Repeater and the CIO Module, are connected in the CCN.

Two ways of connecting a Repeater are shown. The first is for its more common use as a bus extender. The second is for its use as a RS-232 to RS-485 protocol converter. The Repeater can be used as a protocol converter to interface the PC containing the Building Supervisor to the CCN.

Four ways of connecting a CIO Module to a CCN are shown in this section. The four types of connection correspond to applications that a CIO Module can serve in a CCN:

- Standalone processor to run an option, controller, or primary bus NDS.
- NDS/Bridge, connecting a secondary CCN Communication Bus to the primary CCN Communication Bus.
- Interface device using the RS-232 COMM2 connector.
- Interface device using the RS-485 COMM2 connector.

Each Repeater or CIO Module application has its own special connection requirements as described below.

Repeater

A CCN Repeater module has two connectors for power, labelled PWR1 and PWR2, and three communication connectors. Two communication connectors are four-position Phoenix-type connectors, labelled COMM1 and COMM2. Both these connectors are provided for connection to the RS-485 CCN Communication Bus. The COMM2 designation is also shared by the third connector, a 25-position D shell connector provided for RS-232 signalling. Only one of the two COMM2 connectors may be in use at a time.

The two power connectors correspond to the two communication connectors, PWR1 to COMM1 and PWR2 to whichever COMM2 is in use. Because communication signals are optically isolated as they pass through the Repeater, it provides complete electrical isolation when its two power connectors are attached to different power sources.

When installing a Repeater or CCN Bridge, you should install separate, isolated power supplies at PWR1 and PWR2. This provides maximum noise prevention and ground loop protection. Failing to do so could connect COMM1 and COMM2 electrically.

Caution: Failing to install separate, isolated power supplies could result in intermittent or failed CCN communications.

When a Repeater is used as a bus extender, a CCN Communication Bus segment is connected to it at each of its Phoenix-type RS-485 connectors. In this application, only one three-wire bus cable is attached to each of the Repeater's connectors.

When a Repeater is used as a protocol converter, an RS-232 device such as a Building Supervisor is connected to the D shell COMM2 connector and the COMM1 connector is attached to the CCN Communication Bus. In this application, two three-wire cables may be attached to the Repeater's COMM1 connector.

Figures 2-1 and 2-2 on the following two pages illustrate how a Repeater is connected for each of its two applications.

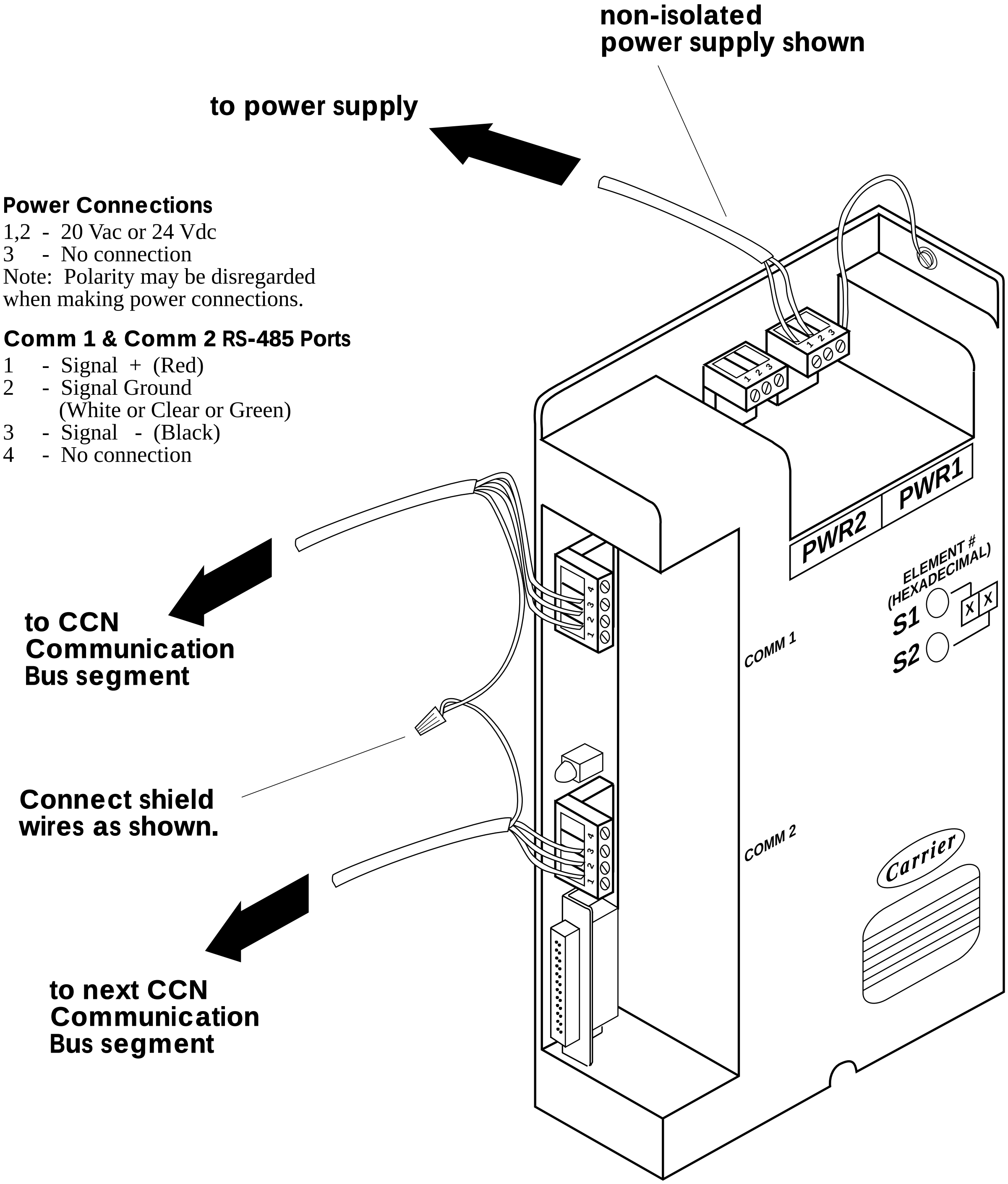

Figure 2-1: Connections for Repeater Used as Bus Extender

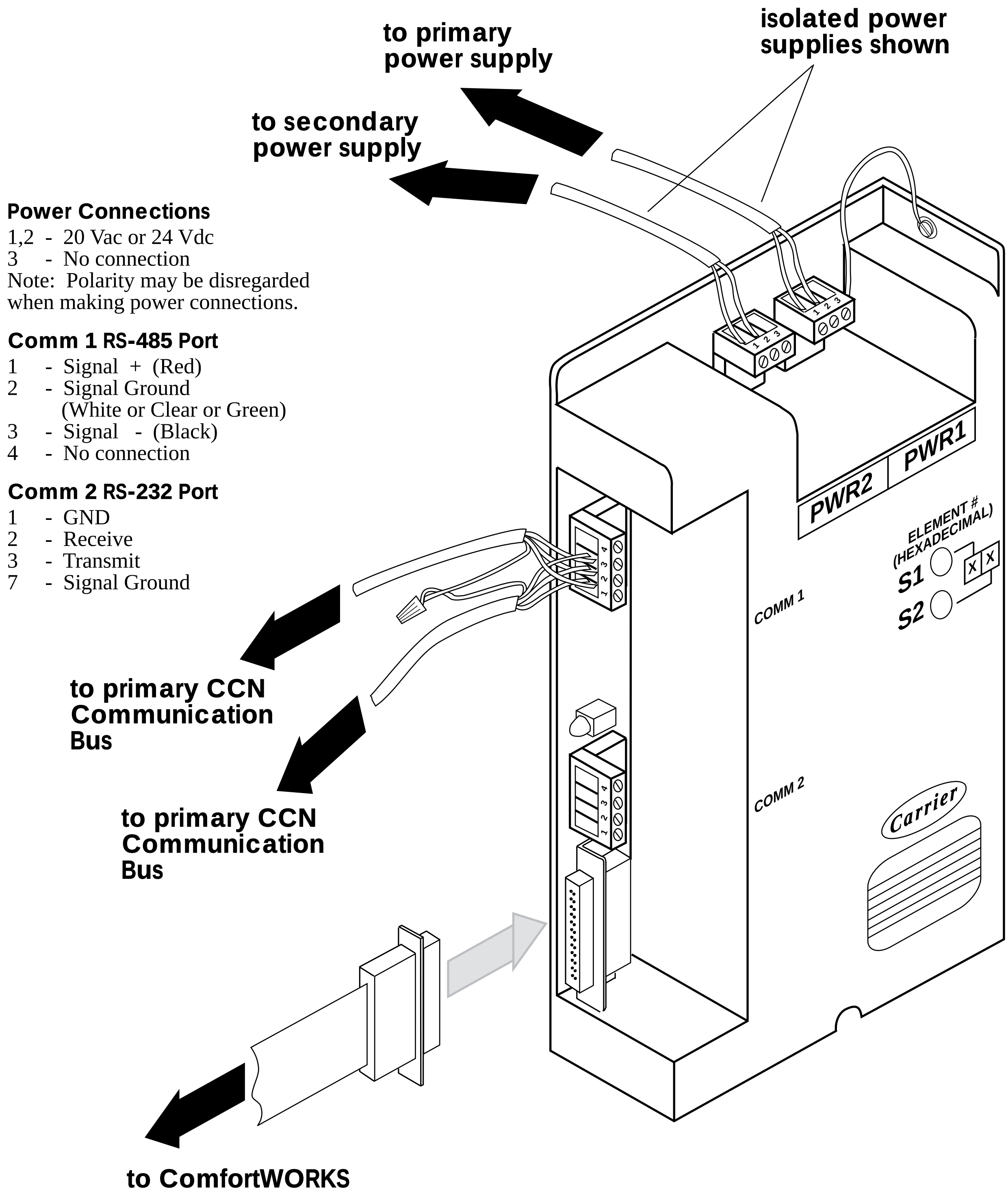

Figure 2-2: Connections for Repeater Used as Protocol Converter

CIO Module

A CIO Module has two connectors for power, labelled PWR1 and PWR2, and three communications connectors. Two communication connectors are four-position Phoenix-type connectors, labelled COMM1 and COMM2. COMM1 is always used for connection to an RS-485 CCN bus. It is the only communication connection when the module is being used as a standalone processor on either a primary or secondary CCN Communication Bus.

When the module is used as an NDS/Bridge, COMM1 connects to the primary CCN Communication Bus and the four-position COMM2 connector connects to a secondary CCN Communication Bus. Some CCN controllers, such as the Terminal System Manager and the HydroSource System Manager, are NDS/Bridges in addition to their other control functions.

When the module is used as an interface device to another type of four-wire control bus, connection to the non-CCN bus is made at the four-position COMM2 connector. This type of connection is used for the VVT Gateway and the 32MP Gateway. When the CIO Module is used as an interface to a non-CCN four-wire bus, the module can be installed on either a primary or secondary CCN Communication Bus.

The COMM2 designation is also shared by the third connector, a 25-position D shell connector provided for RS-232 signalling. Only one of the two COMM2 connectors may be in use at a time.

When the module is used as an Autodial Gateway, the 25-position COMM2 connector is used for connection to a modem. When the module is used as a DATAPORT, the 25-position COMM2 connector can be used for connection to a modem, a terminal, or any other RS-232 device. When the CIO Module is used as an interface to an RS-232 device, it must be installed on the primary CCN Communication Bus.

The two power connectors correspond to the two communication connectors, PWR1 to COMM1 and PWR2 to whichever COMM2 is in use. Because communication signals are optically isolated as they pass through the CIO Module, it provides complete electrical isolation when its two power connectors are attached to different power sources.

When installing an NDS/Bridge or any other system element that functions as a bridge (for example, an Autodial or VVT Gateway, a Terminal System Manager, or an Alarm Printer Interface), you should install separate, isolated power supplies at PWR1 and PWR2. This provides maximum noise prevention and ground loop protection. Failing to do so could connect COMM1 and COMM2 electrically.

Caution: Failing to install separate, isolated power supplies could result in intermittent or failed CCN communications.

In all applications, there may be two three-wire cables attached to a CIO Module's COMM1 connector to connect it to the CCN bus.

Figures 2-3 through 2-6 on the following four pages illustrate how a CIO Module is connected for each of its four applications.

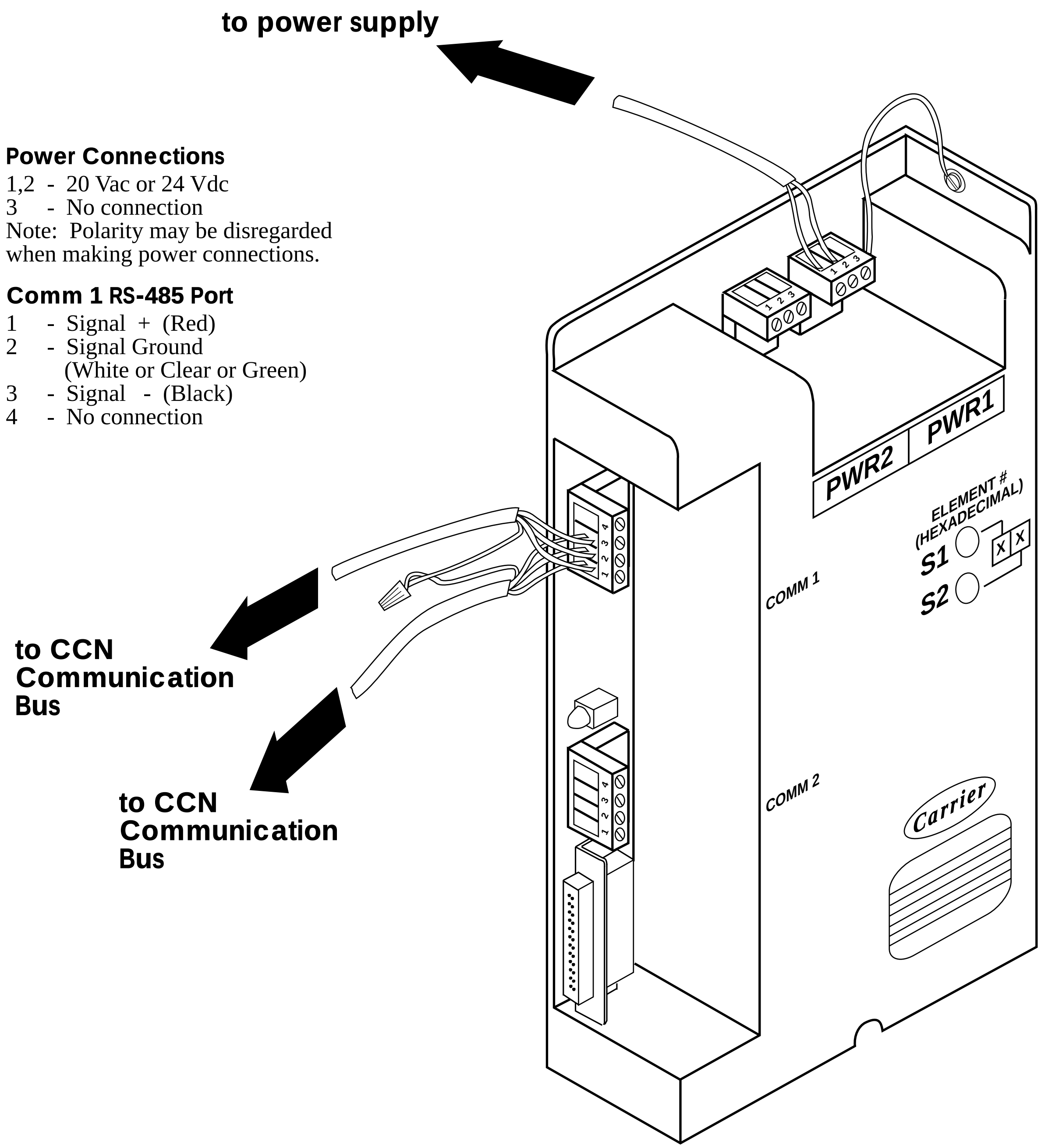

Figure 2-3: Connections for CIO Module Used as a Proccessor for an Option or a Primary Bus NDS

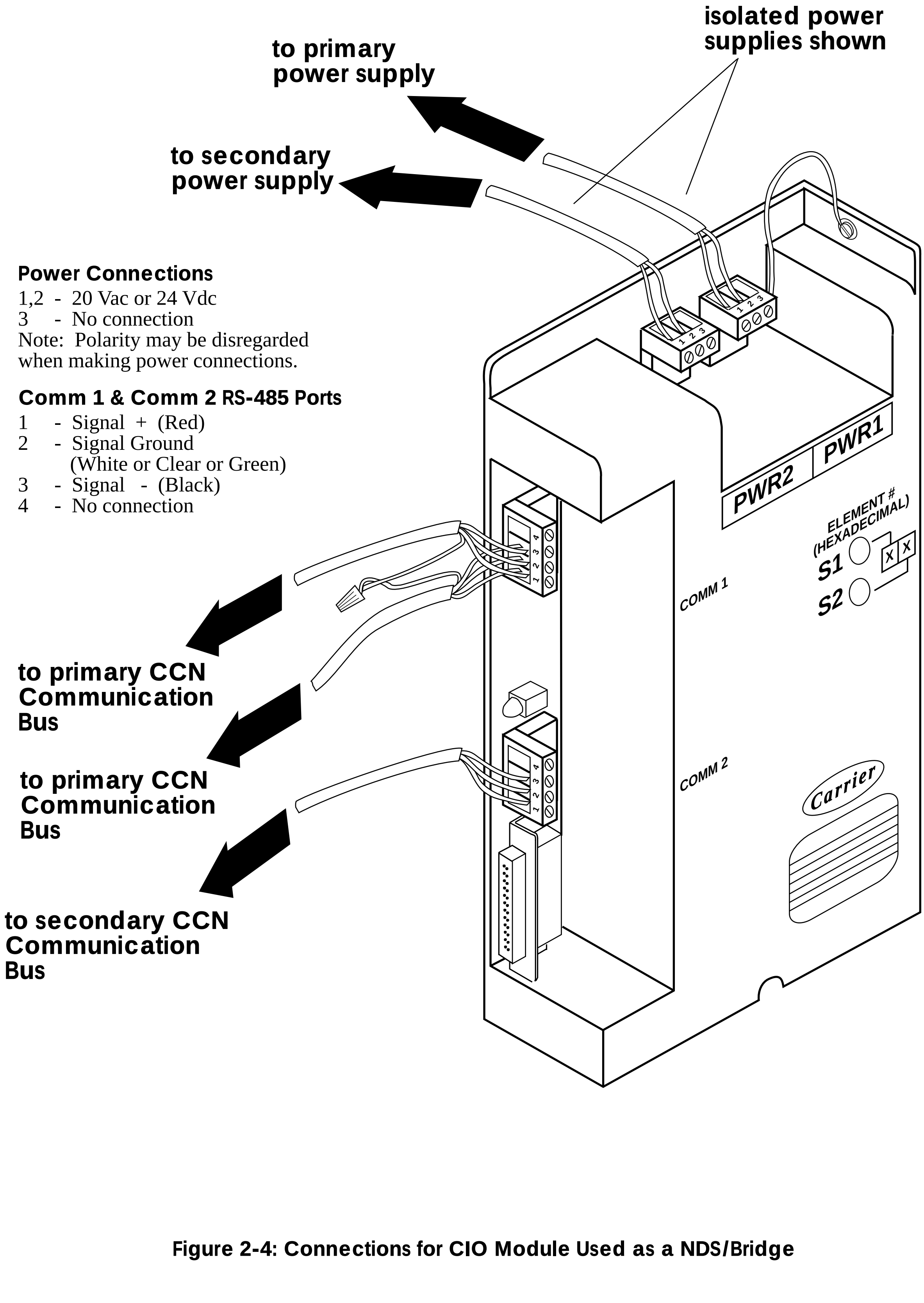

Figure 2-4: Connections for CIO Module Used as a NDS/Bridge

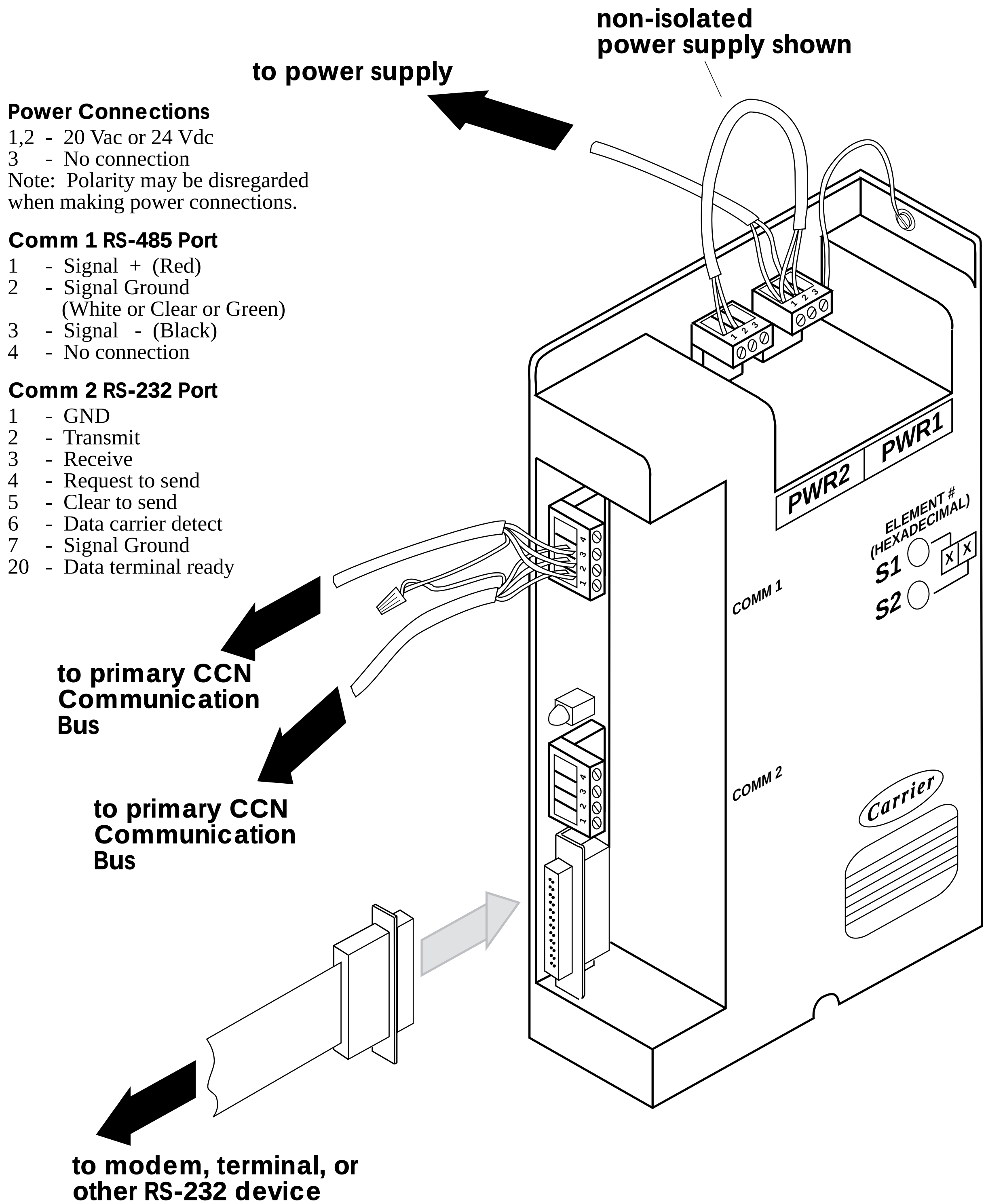

Figure 2-5: Connections for CIO Module Used as an Interface to an RS-232 Device

Power Connections
1,2 - 20 Vac or 24 Vdc
3 - No connection
NOTE: Polarity may be disregarded when making power connections.

Comm 1 & COMM2 RS-485 Ports
1 - Signal (+) (Red)
2 - Signal Ground (White or Clear or Green)
3 - Signal (-) (Black)
4 - No connection

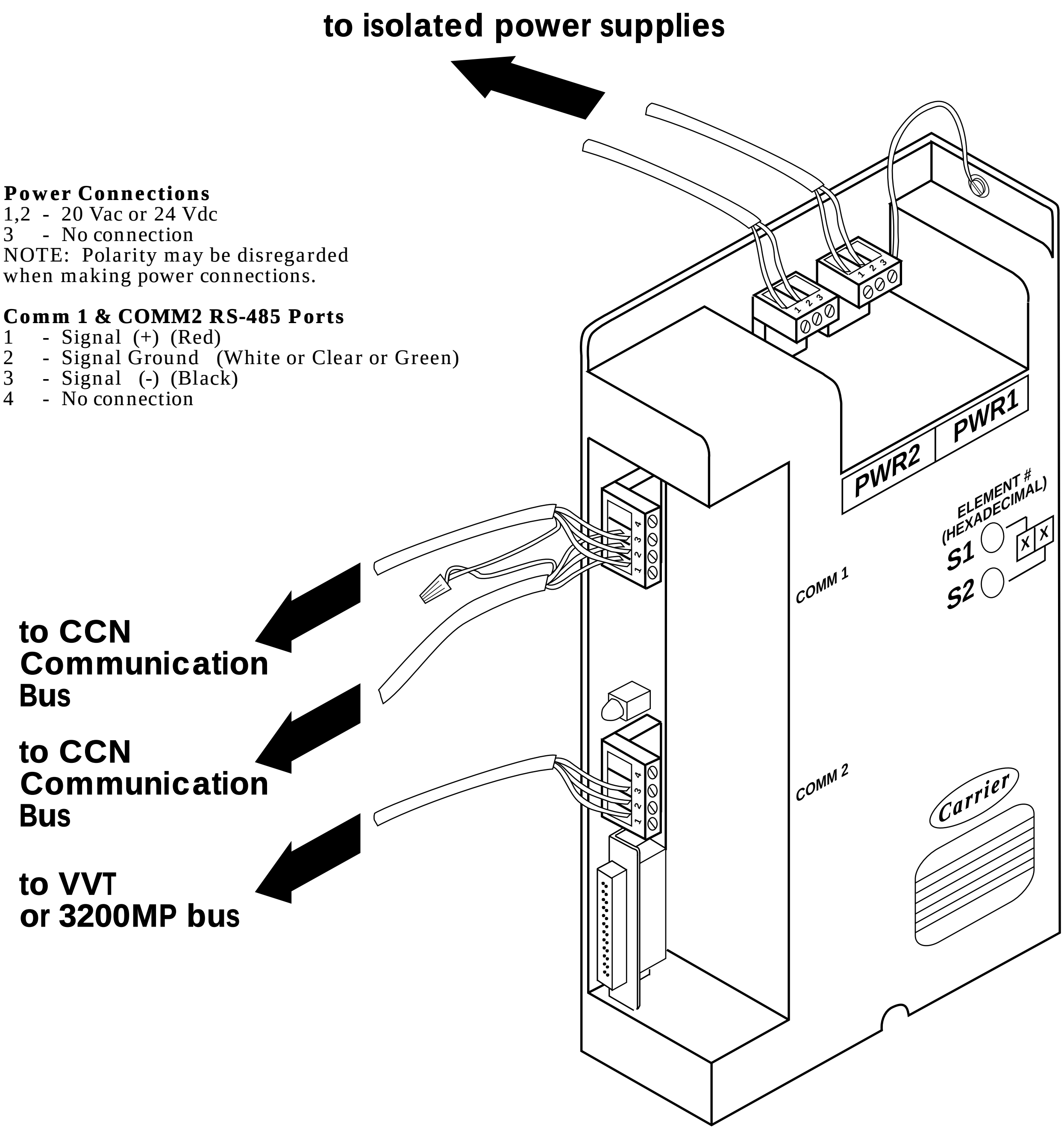

Figure 2-6: Connections for CIO Module Used as an Interface to a Non-CCN Four-Wire Bus

Network Directory Services
Introduction

This manual section concerns the Network Directory Services (NDS) software module for the CCN. It contains descriptions of the NDS's purpose and functions, as well as instructions for configuring the portion of an NDS that requires user-specified decisions.

The NDS has two main functions. First, it maintains a directory that lists all system elements, other than ComfortWORKS or Building Supervisors, connected to one CCN bus and any options installed in those system elements. Second, an NDS performs diagnostic polling operations that check whether the system elements in its directory are functioning and able to communicate on the CCN bus. The user can configure operating parameters for the diagnostic polling process.

A separate NDS software module must be present on each CCN bus. An NDS for the primary bus is included in the same CIO Module as the Autodial Gateway II and III. If there is more than one Autodial Gateway II or III in a system, every primary bus NDS but one must be configured with its Activate decision set to *No.*

For systems that do not include an Autodial Gateway, or use the earlier version of the gateway, NDS for a primary bus is available in a dedicated CIO Module. The Activate decision does not appear in the configuration table of the NDS installed in a dedicated module.

The NDS for each secondary bus is installed in the NDS/Bridge that connects the secondary bus to the primary bus. An NDS/Bridge containing an NDS cannot be used to provide NDS functions for a primary bus.

Those restrictions are the only difference between a primary bus NDS and a secondary bus NDS. Operating characteristics and user configuration are the same whether an NDS is used on a primary bus or a secondary bus.

NDS Directory

An NDS's directory feature stores information about the system elements on its bus. The system elements are identified in the directory's list by eight-character names and system element numbers. The listed system elements are those that are classified as controllers in the ComfortWORKS Controller List or the Building Supervisor's Carrier Controls List – PICs, Comfort Controllers, FIDs, and CIO Module-based devices. The directory does not list ComfortWORKS or Building Supervisors.

An NDS acquires information for its directory by polling the 239 possible system element numbers on its bus. The NDS records a directory entry for each controller from which it receives a response. Each entry consists of a controller's system element number, its eight-character name, its device type, and a list of any CCN options that the controller contains.

The polling process takes place in response to an Update Poll command issued by an operator at a ComfortWORKS or Building Supervisor. In ComfortWORKS, that command is accessed in the Carrier Network Manager CCN Tools menu. In Building Supervisor, that command is on the menu that appears when Directory is selected from the Carrier Controls menu.

If a system element that is already in the NDS directory fails to respond when polled, its entry still remains in the directory. The only way that an entry can be removed from a directory is by removing the corresponding controller from the ComfortWORKS Controller List or Building Supervisor's Carrier Controls List. When that is done, the system automatically deletes the controller's entry from the NDS directory.

An operator using a ComfortWORKS or Building Supervisor can access an NDS directory by using the Cold Call command from the Carrier Network Manager CCN Tools Menu or the Directory menu of the Carrier Controls function. Cold Call creates or updates a controls list for a CCN by interrogating NDS directories on each bus in the CCN. Information can also be retrieved from the directory by a Building Supervisor's Reports function.

A Building Supervisor Carrier Controls List constructed by means of a Cold Call contains a separate entry for each option that is present in the CCN. Option entries are identified in the controller list by an "O" preceding the option's name. The option's name is an eight-character abbreviation of the option type, rather than the user-specified name of the controller that contains the option. The user can access a controller that contains an option by selecting either the controller's entry or the option's entry in the Carrier Controls List.

A Building Supervisor can generate reports based on information received from NDS directories. For more information on Update-Poll, Cold Call, and the Building Supervisor's directory reports, consult the *ComfortWORKS Operation Manual* or the *Building Supervisor III Operation Manual*.

NDS Diagnostics

Each NDS performs diagnostic checks on the controllers connected to its bus. Diagnostics determine whether controllers are able to communicate on the bus and check each controller's clock as an indicator of normal operation. Unlike the NDS's directory function, NDS diagnostics provide configuration decisions that the user can employ to govern how diagnostics operate.

Each NDS does diagnostic checks on its bus's controllers at user-specified intervals. The user specifies two intervals for checking, designated as the Standard Priority and High Priority Test Intervals. When a diagnostic check indicates that a malfunction exists in a controller, the NDS sends an error message to the ComfortWORKS or Building Supervisor. Configuration by the user determines what type of error message – alarm or alert – is sent in response to each of the different error conditions for which the NDS checks.

NDS diagnostics take the form of regularly scheduled polling of a bus's system elements. Each NDS polls the system elements of the bus it is responsible for. The directory function of the NDS determines the system element numbers to be polled. Each controller is contacted with a message requesting it to transmit the current time and day of week back to the system element that contains the NDS. How an NDS interprets the responses it receives is described below under the heading Diagnostic Polling Results.

Diagnostic Configuration

There are two categories of polling for NDS diagnostics: standard priority and high priority.

All system elements are treated as standard priority system elements. The Standard Priority Test Interval can be configured for polling to occur from once each hour to once every twelve hours in one-hour increments.

The user can configure up to twenty-four system elements to also be high priority system elements. As such, those system elements are polled at the user-configured High Priority Test Interval. High priority diagnostic polling can be configured to occur from once every two minutes to once every sixty minutes.

The user can disable either type of scan by configuring it with a test interval of zero.

Diagnostic Polling Results

Four possible responses can result from a polling request for time and day of week from a controller:

- Successful return transmission of the requested information. The NDS takes no further action in regard to that system element.
- No response from the polled system element. The NDS considers the system element unable to communicate and transmits a communication alarm or alert message to that effect.

- Reception by the polling system element of the requested information, but with a difference of more than 10 minutes between the received time and day of week and the time and day of week according to the NDS system element's clock. The NDS considers the error a malfunction in the system element being polled and transmits a clock error alarm or alert message to that effect.

- Reception by the NDS system element of a message that indicates the polled system element received the request but is unable to respond with the desired information. The NDS interprets this response as a successful poll of a system element that does not contain a clock and therefore the NDS takes no further action.

Diagnostic Error Messages

When configuring NDS diagnostics, the user can specify either an alarm or an alert as the result for each of four types of errors: high priority communication error, high priority clock error, standard priority communications error, and standard priority clock error. The terms high priority and standard priority do not appear in NDS error messages displayed by a ComfortWORKS or Building Supervisor.

The NDS stores a record in a buffer of each alarm or alert that it transmits. When a subsequent scan shows that an error condition has been corrected, the NDS transmits a return to normal message and clears the record of the error from its buffer.

In alarms, alerts, and return to normal messages that result from NDS diagnostic polling, the source of the message appears as NETDIAG followed by the full address, bus number and system element number of the controller that contains the NDS. The controller with the error condition is specified in messages by its name and system element number.

Each error condition detected by an NDS is reported only once. A condition that persists through repeated scans without returning to normal does not cause a new alarm on each scan.

NDS Alarm Conditions

The two remaining types of errors that can be reported by an NDS result from conditions that occur in the NDS itself.

An alarm buffer full error condition is reported when the NDS has twenty errors that have not yet returned to normal stored in its buffer. When that condition exists, the NDS cannot generate any further polling error messages until one or more of the stored errors returns to normal. The NDS does, however, continue to perform diagnostic polling while the alarm buffer full condition exists.

A directory not available error occurs if an operator uses the Building Supervisor's Reports function to command a diagnostic poll while an Update-Poll is still in progress. An NDS cannot perform a diagnostic poll while a directory update is in progress because it must access the directory to get the valid system element numbers required for the diagnostic polling operation. To avoid creating this error condition, the operator simply has to wait at least ten minutes after issuing an Update-Poll before commanding a diagnostic poll.

Regularly scheduled diagnostic polls do not generate *directory not available* errors. When a scheduled diagnostic poll cannot take place for lack of directory access, the NDS reschedules it to occur a minute later and tries again at that time. The NDS continues to reschedule the diagnostic poll until the directory is available.

The Building Supervisor's Reports function enables the user to generate reports concerning NDS diagnostic activities. It also provides the means for manually initiating a diagnostic poll.

For more information on Alarms and Building Supervisor NDS Reports, consult the *ComfortWORKS Operation Manual* or the *Building Supervisor III Operation Manual*.

Configuration

The user configures the operation of the NDS's diagnostic portion by means of the decisions that appear in the NDS configuration table. This table is identified as NDSCONFG in the list of tables for the controller in which it is installed. You access this table in ComfortWORKS in the same manner as you access any other configuration table. You access the screen on the Building Supervisor either by means of the Select-Modify-Controller menu selections in Carrier Controls or by selecting Modify in Reports and then Network Services from the resulting list. When the table is displayed, the name that appears at the top of the screen is DIRCTnnS, where "nn" is the number, in hexadecimal, of the bus with which it is associated. A decimal to hexadecimal conversion table is included at the end of this section as Table 3-1.

The NDS itself inserts the correct bus number into the table name. It does so by reading the information from its controller's configured address when the controller is powered on.

The NDS configuration table is shown below in Figure 3-1. The illustration is followed by an explanation for each of the decisions. Each explanation includes the purpose of the decision, the values that it will accept as input, and the default value that will be employed if not changed by the user.

```
Save  Upload  Download  Copy  Edit  Quit


      DESCRIPTION               STATUS              POINT
___________________________   ______________________   _________

Activate                          No

Standard test interval             6     hours       STD-INTR

Hi-priority test intervl          30     min         HI-INTR
1st Hi-prty element#               0                 1-ELMNT
2nd Hi-prty element#               0                 2-ELMNT
3rd Hi-prty element#               0                 3-ELMNT
        .                          .                    .
        .                          .                    .
        .                          .                    .
22nd Hi-prty element#              0                 22-ELMNT
23rd Hi-prty element#              0                 23-ELMNT
24th Hi-prty element#              0                 24-ELMNT

(Type 0=alarm, 1=alert)
Std comm error type                1                 STCM-TYP
Std clock error type               1                 STCL-TYP
Hi comm error type                 0                 HICM-TYP
Hi clock error type                1                 HICL-TYP
Alarm buffer full type             0                 BUFR-TYP
Dir not available type             1                 DRNA-TYP

                               Reports          13:07:15  03/30/90
```

Figure 3-1: NDS Diagnostics Configuration Screen

Activate

This decision is used to enable or disable the operation of the NDS software. There should be only one active NDS on each CCN communications bus. In that NDS this decision must be set to Yes. In any other NDS that may be present on the same bus, this decision must be set to No.

This decision is not included when NDS is installed in a dedicated CIO Module.

Allowable Entries

Yes/No

Default Value

No

Standard Test Interval

This decision is used to specify the amount of time, in hours, that will elapse between diagnostic polls of standard priority system elements. Standard priority system elements are all those that are not assigned to the high priority list.

An entry of 0 in this decision disables all diagnostic polling by the NDS.

Allowable Entries

0
1-12 hours

Default Value

6

High-priority Test Interval

This decision is used to specify the amount of time, in minutes, that will elapse between diagnostic polls of high priority system elements. A system element is assigned to high priority by the entry of its system element number in one of the twenty-four High-Priority Element Number decisions.

An entry of 0 in this decision disables diagnostic polling of high priority system elements.

Allowable Entries

0
2-60 minutes

Default Value

30

1st-24th High-priority Element Number

Each of these decisions is used to specify the system element number of one high priority system element. The system elements specified in these decisions will be polled by the diagnostic routine at the High Priority Test Interval. Problems detected by the polling will be reported using the configured High Communication Error Type and High Clock Error Type.

Unused High-Priority Element Number decisions should be set to 0.

Allowable Entries

0-239

Default Value

0

Standard Communication Error Type

This decision specifies whether an alert or an alarm will be sent when diagnostic polling of a standard priority system element results in a communications error. A communications error is judged to have occurred when the NDS receives no response from a system element to which it has transmitted a polling message.

Allowable Entries

0 = alarm
1 = alert

Default Value

1

Standard Clock Error Type

This decision specifies whether an alert or an alarm will be sent when diagnostic polling of a standard priority system element results in a clock error. A clock error is judged to have occurred when the day of week and time received by the NDS in response to a diagnostic poll differs from that at the NDS by more than 10 minutes.

Allowable Entries

0 = alarm
1 = alert

Default Value

1

High Communication Error Type

This decision specifies whether an alert or an alarm will be sent when diagnostic polling of a high priority system element results in a communications error. A communications error is judged to have occurred when the NDS receives no response from a system element to which it has transmitted a polling message.

Allowable Entries

0 = alarm
1 = alert

Default Value

0

High Clock Error Type

This decision specifies whether an alert or an alarm will be sent when diagnostic polling of a high priority system element results in a clock error. A clock error is judged to have occurred when the day of week and time received by the NDS in response to a diagnostic poll differs from that at the NDS by more than 10 minutes.

Allowable Entries

0 = alarm
1 = alert

Default Value

1

Alarm Buffer Full Type

This decision specifiies whether an alert or an alarm will be sent when the alarm buffer of the NDS contains twenty alarms or alerts that have not returned to normal. When that occurs the NDS cannot generate any new alarms or alerts until one or more of those in its buffer return to normal.

Allowable Entries

0 = alarm
1 = alert

Default Value

0

Directory Not Available Type

This decision specifies whether an alert or an alarm will be sent when the NDS is unable to perform diagnostic polling because of an inability to access the directory portion of the NDS. That inability is most often a transient condition resulting from an attempt to access the directory while it is being updated.

Allowable Entries

0 = alarm
1 = alert

Default Value

1

Controller Name:___________________________ Bus #______ Element #______

Table Description: ____ Table Name: DIRCT_ _S

NETWORK DIRECTORY SERVICES (NDS) CONFIGURATION SHEET			
DESCRIPTION	LIMITS	UNITS	VALUE
Activate	**Yes/No**		
Standard Test Interval	**0,1-12**	**Hours**	
Hi-Priority Test Intervl	**0,2-60**	**Minutes**	
1st Hi-Prty Element #	**0,1-239**	**SE #'s**	
2nd Hi-Prty Element #	**0,1-239**	**SE #'s**	
3rd Hi-Prty Element #	**0,1-239**	**SE #'s**	
4th Hi-Prty Element #	**0,1-239**	**SE #'s**	
5th Hi-Prty Element #	**0,1-239**	**SE #'s**	
6th Hi-Prty Element #	**0,1-239**	**SE #'s**	
7th Hi-Prty Element #	**0,1-239**	**SE #'s**	
8th Hi-Prty Element #	**0,1-239**	**SE #'s**	
9th Hi-Prty Element #	**0,1-239**	**SE #'s**	
10th Hi-Prty Element #	**0,1-239**	**SE #'s**	
11th Hi-Prty Element #	**0,1-239**	**SE #'s**	
12th Hi-Prty Element #	**0,1-239**	**SE #'s**	
13th Hi-Prty Element #	**0,1-239**	**SE #'s**	
14th Hi-Prty Element #	**0,1-239**	**SE #'s**	
15th Hi-Prty Element #	**0,1-239**	**SE #'s**	
16th Hi-Prty Element #	**0,1-239**	**SE #'s**	

Controller Name:____________________________ Bus #______ Element #______

Table Description:
____ Table Name: DIRCT_ _S

NETWORK DIRECTORY SERVICES (NDS) CONFIGURATION SHEET			
DESCRIPTION	LIMITS	UNITS	VALUE
17TH Hi-Prty Element #	**0,1-239**	**SE #'s**	
18TH Hi-Prty Element #	**0,1-239**	**SE #'s**	
19TH Hi-Prty Element #	**0,1-239**	**SE #'s**	
20TH Hi-Prty Element #	**0,1-239**	**SE #'s**	
21st Hi-Prty Element #	**0,1-239**	**SE #'s**	
22nd Hi-Prty Element #	**0,1-239**	**SE #'s**	
23rd Hi-Prty Element #	**0,1-239**	**SE #'s**	
24th Hi-Prty Element #	**0,1-239**	**SE #'s**	
(Type 0=Alarm, 1=Alert)			
Std Comm Error Type	**0/1**	**Alarm/Alert**	
Std Clock Error Type	**0/1**	**Alarm/Alert**	
Hi Comm Error Type	**0/1**	**Alarm/Alert**	
Hi Clock Error Type	**0/1**	**Alarm/Alert**	
Alarm Buffer Full Type	**0/1**	**Alarm/Alert**	
Dir Not Available Type	**0/1**	**Alarm/Alert**	

Table 3 -1: Decimal to Hexadecimal Conversion Chart

DEC	HEX	DEC	HEX	DEC	HEX	DEC	HEX
1	0 1	61	3 D	121	7 9	181	B 5
2	0 2	62	3 E	122	7 A	182	B 6
3	0 3	63	3 F	123	7 B	183	B 7
4	0 4	64	4 0	124	7 C	184	B 8
5	0 5	65	4 1	125	7 D	185	B 9
6	0 6	66	4 2	126	7 E	186	B A
7	0 7	67	4 3	127	7 F	187	B B
8	0 8	68	4 4	128	8 0	188	B C
9	0 9	69	4 5	129	8 1	189	B D
10	0 A	70	4 6	130	8 2	190	B E
11	0 B	71	4 7	131	8 3	191	B F
12	0 C	72	4 8	132	8 4	192	C 0
13	0 D	73	4 9	133	8 5	193	C 1
14	0 E	74	4 A	134	8 6	194	C 2
15	0 F	75	4 B	135	8 7	195	C 3
16	1 0	76	4 C	136	8 8	196	C 4
17	1 1	77	4 D	137	8 9	197	C 5
18	1 2	78	4 E	138	8 A	198	C 6
19	1 3	79	4 F	139	8 B	199	C 7
20	1 4	80	5 0	140	8 C	200	C 8
21	1 5	81	5 1	141	8 D	201	C 9
22	1 6	82	5 2	142	8 E	202	C A
23	1 7	83	5 3	143	8 F	203	C B
24	1 8	84	5 4	144	9 0	204	C C
25	1 9	85	5 5	145	9 1	205	C D
26	1 A	86	5 6	146	9 2	206	C E
27	1 B	87	5 7	147	9 3	207	C F
28	1 C	88	5 8	148	9 4	208	D 0
29	1 D	89	5 9	149	9 5	209	D 1
30	1 E	90	5 A	150	9 6	210	D 2
3I	1 F	91	5 B	151	9 7	211	D 3
32	2 0	92	5 C	152	9 8	212	D 4
33	2 1	93	5 D	153	9 9	213	D 5
34	2 2	94	5 E	154	9 A	214	D 6
35	2 3	95	5 F	155	9 B	215	D 7
36	2 4	96	6 0	156	9 C	216	D 8
37	2 5	97	6 1	157	9 D	217	D 9
38	2 6	98	6 2	158	9 E	218	D A
39	2 7	99	6 3	159	9 F	219	D B
40	2 8	100	6 4	160	A 0	220	D C
41	2 9	101	6 5	161	A 1	221	D D
42	2 A	102	6 6	162	A 2	222	D E
43	2 B	103	6 7	163	A 3	223	D F
44	2 C	104	6 8	164	A 4	224	E 0
45	2 D	105	6 9	165	A 5	225	E 1
46	2 E	106	6 A	166	A 6	226	E 2
47	2 F	107	6 B	167	A 7	227	E 3
48	3 0	108	6 C	168	A 8	228	E 4
49	3 1	109	6 D	169	A 9	229	E 5
50	3 2	110	6 E	170	A A	230	E 6
51	3 3	111	6 F	171	A B	231	E 7
52	3 4	112	7 0	172	A C	232	E 8
53	3 5	113	7 1	173	A D	233	E 9
54	3 6	114	7 2	174	A E	234	E A
55	3 7	115	7 3	175	A F	235	E B
56.	3 8	116	7 4	176	B 0	236	E C
57	3 9	117	7 5	177	B 1	237	E D
58	3 A	118	7 6	178	B 2	238	E E
59	3 B	119	7 7	179	B 3	239	E F
60	3 C	120	7 8	180	B 4		

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