C-Bus™ Hardware Installation
C-Bus™ Products Training Course

Training Guide

1250SM0802R10/09

Schneider Electric

HAZARD CATEGORIES AND SPECIAL SYMBOLS

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this bulletin or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of either symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

Danger indicates an immediately hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Warning indicates a potentially hazardous situation which, if not avoided, can result in death or serious injury.

⚠ CAUTION

Caution indicates a potentially hazardous situation which, if not avoided, can result in minor or moderate injury.

CAUTION

Caution, used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, can result in property damage or improper operation.

NOTE: Provides additional information to clarify or simplify a procedure.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. This document is not intended as an instruction manual for untrained persons. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this manual.

FCC CLASS B

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications to this device that are not expressly approved by Schneider Electric could void the user's authority to operate this equipment.

CONTENTS

DISCLAIMER

Electrical equipment should be installed, operated, serviced, and maintained only by qualified electrical maintenance personnel. Training provided by Schneider Electric, in-person, or in a manual, should not be viewed as sufficient instruction for those who are not otherwise qualified to install, operate, service, or maintain the equipment under consideration. Although reasonable care has been taken to provide accurate and authoritative information in presentations and documentation, no responsibility is assumed by Schneider Electric, its employees, or its agents, for any consequences arising out of the use of this material.

SAFETY PRECAUTIONS

Carefully read and follow the safety precautions below before attempting to install or maintain electrical equipment.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- This equipment must be installed and serviced by qualified electrical personnel.
- Turn off all electrical power supplying this equipment before working on or inside the equipment.
- Always use a properly rated voltage sensing device to confirm that power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.

Failure to follow these instructions will result in death or serious injury.

LEARNING OUTCOMES

By the end of this manual, you should have a good enough understanding of C-Bus products and networks to enable you to install them correctly. The following topics are covered:

- C-Bus fundamentals
- line-voltage supply
- guidelines for wiring and cabling, including segregation
- circuit protection
- wire and cable testing
- wiring of C-Bus Relay loads
- wiring of C-Bus Dimmer phase connections
- single and multi-network topologies

SCOPE

The goal of this handbook is to provide the reader with the basic knowledge needed to install C-Bus products. Appropriate licenses and a technical trade background are required.

This handbook is designed for those who wish to install C-Bus hardware, but are not familiar with the technology.

C-BUS FUNDAMENTALS

This section summarizes the fundamental properties of C-Bus networks. These properties affect how C-Bus units are installed. The following fundamentals are covered:

- C-Bus network topology
- C-Bus cable type
- C-Bus voltage
- C-Bus current per network
- maximum C-Bus cable length
- distance between C-Bus units
- maximum number of C-Bus units
- network impedance

C-Bus Installation Rules

There are a number of basic rules that apply to C-Bus networks and units. These rules are listed in the table, “C-Bus Parameters.”

Table 1: C-Bus Parameters

Rule	Description
C-Bus Network Topology	• Daisy Chain, Star, or combination Daisy Chain-Star configurations are used to connect C-Bus units. • Do not wire C-Bus units in a loop configuration.
C-Bus Cable Type	All C-Bus networks use an Unshielded Twisted Pair (UTP), Cat-5 cable as the communications medium.
C-Bus Voltage	The standard C-Bus network voltage should be 34 V DC (this may vary slightly). We recommend 22 V DC as the minimum voltage on the network.
Maximum C-Bus Current per Network	The current on a C-Bus network must not exceed 2 A, which is a limit of the Cat-5 UTP cable.
Maximum Cable Length per C-Bus Network	The total length of Cat-5 cable on a C-Bus network must not exceed 3281 ft (1 km).
Maximum Distance Between all Units on a Network	The total length of Cat-5 cable between all C-Bus units must not exceed 3281 ft (1 km).
Maximum Number of Units per Network	As a rule of thumb, a C-Bus network can incorporate up to 100 units (based on units that draw 18 mA). In practice, the design of a specific network might permit fewer than 100 units. The number of units allowed on a network depends on how much current is being drawn by its C-Bus units.
Network Impedance	The network impedance of the C-Bus network must be between 400 Ohm and 1.4 kOhm. This impedance can be achieved by using a hardware or software Network Burden (one, but only one, per network).

Wiring Overview

The C-Bus line voltage input is wired in accordance with national and local electrical codes. C-Bus cable is run and connected with similar rules that govern data cabling.

Line-Voltage Supply

NOTE: Some C-Bus output units (e.g., Dimmers, Relays) have Local Toggles (Channel Overrides) and also can be equipped with Remote Overrides. ***Do not*** *use either type of override as the method to turn off the power before working on or inside the equipment: Local Toggles and Remote Overrides cannot be locked down.*

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Overrides cannot be locked down and must not be used as the method to turn off the power before working on or inside the equipment—when overrides are used the power can be restored without warning.
- Turn off all electrical power supplying this equipment before working on or inside the equipment.
- Always use a properly rated voltage sensing device to confirm that power is off.

Failure to follow these instructions will result in death or serious injury.

C-Bus Unit Voltage Levels

Some C-Bus units connect to line voltage as well as to the C-Bus network. These types of units may come in one or two voltage levels. The two available line-voltage levels are:

- 277 V AC @ 60 Hz
- 120 V AC @ 60 Hz

The unit's catalog number will indicate its voltage level (see the manual, "C-Bus Hardware," for examples).

When planning a network or ordering C-Bus units, keep in mind that the powered C-Bus units must have the appropriate voltage for the installation where they will be used.

Line-Voltage Waveform

C-Bus units that use line voltage are designed to operate from a sinusoidal line-voltage waveform. Inverter Supplies and Uninterruptible Power Supplies (UPS) can be used with the network, so long as they produce true sinusoidal waveforms.

NOTE: If an Inverter Supply that does not produce a true sinusoidal waveform is used on the network, units that require line voltage may be damaged or they might not operate as expected.

The output voltage and frequency of a true sinusoidal UPS also must meet the requirements of C-Bus units that require line voltage, as follows:

- The output voltage must be between 115–265 V AC or between 250–300 V AC.
- The output frequency must be 60 Hz, ±3 Hz.

An additional requirement applies to a UPS used on a network that includes Dimmers.

- The frequency must vary by less than 3 Hz per minute (C-Bus Dimmers are affected by shifting voltage and frequency.).

CAUTION

HAZARD OF EQUIPMENT DAMAGE

- Only use Inverter Supplies or Uninterruptible Power Supplies (UPS) that meet the following criteria:
- They must produce true sinusoidal waveforms.
- They must meet all the output voltage and frequency requirements of the powered units.

Failure to follow this instruction will result in damage to the C-Bus network.

Cable Segregation

Many C-Bus units have connections to Class 1 (120/277 V AC) and Class 2 (15–36 V DC
C-Bus) rated wires. The Class 1 and Class 2 wires must be adequately separated according to national and local electrical codes. See the section, “General C-Bus Wiring Guidelines,” for basic Square D guidelines. Each unit’s installation bulletin has more specific wiring guidelines for that unit or type of unit.

General C-Bus Wiring Guidelines

Square D offers this set of guidelines for installing and working with C-Bus networks. The guidelines presume that those who work with our products are qualified and know and follow industry regulations and best industry practices.

The first guideline refers to electrical regulations, as they take precedence and can determine the specific manner you will perform the installation.

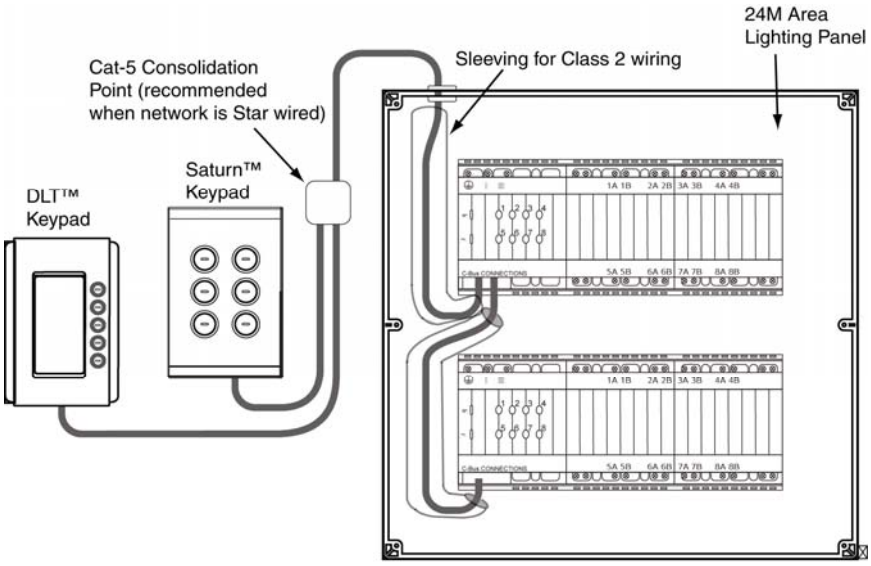
- Always follow national and local electrical codes.

The following guidelines are consistent with best practices and provide the best immunity to noise. Unless otherwise noted, these guidelines apply to units located around an installation as well as to C-Bus DIN units in an enclosure or panel.

- In panels and enclosures, sleeve and securely anchor C-Bus network cable and securely anchor electrical power lines. A length of Class 2 rated barrier (for sleeving) is included with Clipsal enclosures.
- Wherever possible, consolidate multiple C-Bus network Cat-5 cables outside a panel or enclosure so that only one C-Bus cable connects into it.
- Insulate any consolidation of multiple C-Bus network cables inside panels and enclosures.
- (The following guideline applies to the wiring outside an enclosure or panel.) Even though Cat-5 cable has superior noise immunity, where electrical power lines and C-Bus network Cat-5 cable run parallel to each other, it is important to maintain at least 6 in. (152 mm) isolation between them.
- Cross C-Bus network cable and electrical power lines at an angle of 90°, and where they cross, separate the two types of wire by at least 2.5 in. (64 mm).
- Limit the current on a C-Bus network to 2 A or less.
- Limit the total length of Cat-5 cable on a single C-Bus network to 3281 ft (1 km).
- Seal-off unused RJ-45 ports with rubber terminal plugs to prevent wire cuttings, loose wires, and debris from entering the DIN units.
- Refer to a unit's installation bulletin for specific information about wiring diagrams, wire types, torque, and so on.

Examples of cable consolidation (outside an enclosure) and cable sleeving (inside an enclosure) are shown in the figure, "C-Bus Network Cable Consolidation and Sleeving."

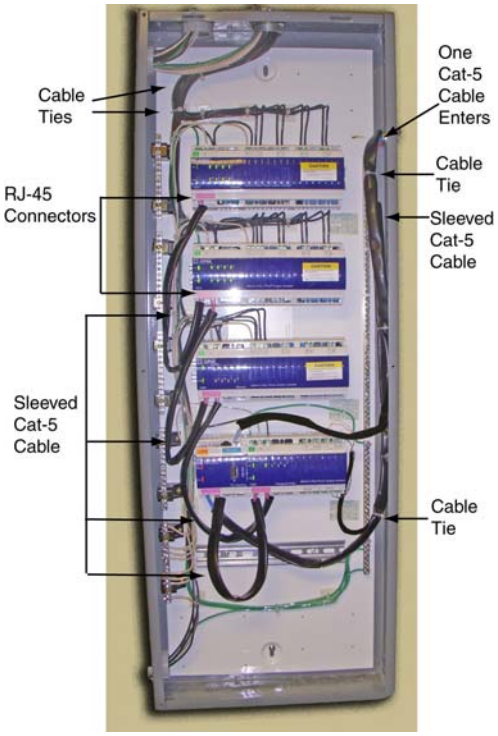
Figure 1: C-Bus Network Cable Consolidation and Sleeving



Background

A method for maintaining separation between wires rated as Class 1 (120/277 V AC line voltage) and Class 2 (15–36 V DC C-Bus) is especially important in the case of C-Bus DIN units, which are used in the confined area of panels and enclosures. Panels and enclosures contain connections to both line-level voltage and C-Bus network voltage, but the wires cannot be separated by 6 in. (152 mm). Sleeves and anchoring are used to help prevent contact between loose electrical power conductors and the C-Bus network cable.

Figure 2: Example of a Properly Wired Lighting Control Panel



Instead of bringing multiple C-Bus network cables into an enclosure, we recommend consolidating them outside the enclosure and bringing only one inside to an RJ-45 port on one DIN unit. The 15.75 in. (400 mm) Cat-5 patch leads supplied with Clipsal DIN units would then be used to interconnect any other DIN units in the enclosure, beginning with the C-Bus unit that receives the external connection. This method reduces the amount of wiring in the enclosure and makes it easier to maintain separation between the Class 1 and Class 2 wires.

In the event multiple Cat-5 cables cannot be consolidated outside the enclosure, effectively insulate any consolidation of Cat-5 cables inside the enclosure so that there are no exposed terminal screws, no loose wires, and so on.

Some C-Bus units are connected to both line-level voltage and C-Bus network voltage, which can lead to noise on the network. You can prevent the noise by separating the C-Bus Cat-5 cable and the 120 V AC and/or 277 V AC lines by least 6 in. (152 mm).

The figure, “Example of a Properly Wired Lighting Control Panel,” highlights the following recommended procedures:

all line cables are fixed using cable ties

a single C-Bus cable enters the enclosure

all C-Bus connections inside the panel are made with RJ-45 connectors

Circuit Protection

All C-Bus output units consist of electronic components that can be damaged by surges, short circuits, and overvoltage conditions.

Overvoltage Protection

We recommend using overvoltage protection in the main breaker panel. If the C-Bus Cat-5 cable is routed between buildings or used in an outdoor installation, also use overvoltage protection on the C-Bus cable.

To protect the line-voltage wire, an overvoltage protection device should be installed across each active C-Bus Power Supply on each C-Bus output unit (e.g., Relay, Dimmer). Contact your local Schneider Electric sales representative for more information about our full line of Transient Voltage Surge Suppression (TVSS) products.

Cable Testing

We recommend checking both the line-voltage wires (Megger® testing) and C-Bus network cables (fault tests) before you connect the C-Bus units to the network cable. This will ensure that the wiring and cabling are sound and eliminate possible sources of problems.

Meggerâ Testing Line-Voltage Wire

Megger test the insulation of the line-voltage wire before you connect any C-Bus units to it.

If you must Megger test line-voltage wiring after C-Bus units have been connected to it, first disconnect the C-Bus units. Otherwise, the electronic components in the C-Bus units could affect the readings and they will not be correct.

Do not Megger test C-Bus data cabling or terminals, as it can damage the C-Bus network.

CAUTION

HAZARD OF EQUIPMENT DAMAGE

Do not Megger test C-Bus data cabling or terminals as it can degrade the performance of the C-Bus network.

Failure to follow this instruction can result in damage to the C-Bus network.

Testing C-Bus Network Cable

We recommend performing basic fault tests (resistance and short-circuit) of the C-Bus network Cat-5 cable before the C-Bus units have been installed, but after the cable has been run throughout the site. By testing at this time, you can easily detect and repair any wire crimps, shorts, or breaks that might have occurred during the cabling process. This prevents future problems that might be very difficult to diagnose.

The two tests use a multimeter and are described in the following sections, along with possible results and interpretations.

Resistance Test

Test each installed length from one switch-plate location to the next, as follows:

1. Working with one positive conductor at a time, connect the multimeter probes to its two ends (the positive conductors are the blue wires and the orange wires).
2. Perform the same procedure with the negative conductors (the negative conductors are the blue-white wires and the orange-white wires). Interpretations of the readings are the same as for the positive conductors.

Interpreting the Results

- Readings in the range of 0.05 Ohm/39.37 in. (0.05 Ohm/m) or less indicate that a conductor has no breaks.
- Readings higher than 1 Ohm/39.37 in. (1 Ohm/m) indicate there could be cable breaks or another type of damage. You should inspect this length of cable.

Short-Circuit Test

Perform the short-circuit test at one end of each length of the installed C-Bus cable, as follows:

1. Connect one multimeter probe to one end of a positive conductor (blue wire and orange wire).
2. Connect the other probe to a negative conductor (blue-white wire and orange-white wire) at the same end.

Interpreting the Results

- Readings greater than 2 MOhm indicate that there is no short circuit between that set of wires.
- Readings of less than 2 MOhm suggest that the positive and negative conductors have been shorted or partially shorted—inspect that length of cable for signs of damage, such as a nail or screw cutting through the cable.

C-Bus Network Cabling

The Cat-5 UTP cable used for the C-Bus network has a number of characteristics that help optimize network communications.

- Cat-5 UTP minimizes the coupling of external magnetic fields onto the cable, thus reducing interference on the C-Bus network.
- Its electrical characteristics include low capacitance, which allows communications over long distances.
- The twisted pairs inside Cat-5 UTP also provide high immunity to noise, making it ideal for wiring a C-Bus network.

NOTE: Where possible, we recommend using a color-coding system for the cables at an installation. This will make it easy to distinguish the C-Bus network cable from information system cables (e.g., data, fire, telephone).

C-Bus Network Connections

Each connection to a C-Bus unit uses two conductors, that is, two conductors for each positive connection to a C-Bus unit and two conductors for each negative connection. A connection made with two conductors has several advantages over a connection made with only one conductor:

- A termination is more secure when it is made with two conductors instead of one.
- Using two wires for each of the positive and negative rails of the C-Bus cable decreases the wire's resistance compared to using one wire for each rail. This then decreases the potential voltage drop that can occur over long lengths of cable.

C-Bus-Specific Wiring (Polarity and Pairing)

C-Bus network communications occur over the standard Cat-5 cable, but it is critical to note that C-Bus networks use wire pairs differently than the standard TCP/IP twisted-pair assignments. The wiring approach also differs for units that have terminals and for those that have RJ-45 ports (e.g., DIN units). However, you will see that the same connections are ultimately made.

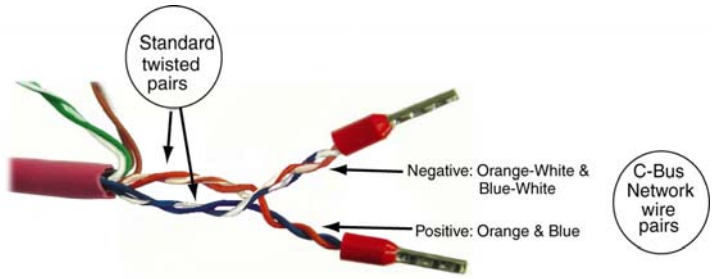
Wiring for C-Bus Units with Screw Terminals

When you connect to C-Bus units that have terminals—e.g., Neo Keypads—you will
re-arrange the wire pairs at the end of the cable to use "opposite" colors, as follows:

- Positive supply: Orange and blue wires
- Negative supply: Orange-white and blue-white wires

Wire pairs for connecting to units with terminals are illustrated in the figure, "C-Bus Network Wire Pairs." You will note that the original mutual twist has also been retained. This wiring strategy maintains immunity to noise.

Figure 3: C-Bus Network Wire Pairs



*NOTE: **Only use the C-Bus-specific wire pairs to connect to** C-Bus units that have terminal connectors (e.g., screw terminals). Other wire pairs could short out the bus. See the manual, "Introduction to C-Bus Networks," for more information about the differences between C-Bus-specific wire pairs and standard Cat-5 TCP/IP twisted-pair assignments.*

The remaining four wires (green, green-white, brown, and brown-white) are available for “Remote Override” connections (see the figure, “C-Bus Network Cable/RJ-45 Conductor Assignments”). Remote Overrides can be used to manually override C-Bus operations. Remote Override connections use the standard Cat-5 UTP twisted-pair assignments:

- Remote Override ON: Green and green-white wires are connected to C-Bus negative via a mechanical switch.
- Remote Override OFF: Brown and brown-white wires are connected to C-Bus negative via a mechanical switch.

NOTE: Remote Overrides cannot be locked down, so they must not be used to turn off the power before working on or inside the equipment.

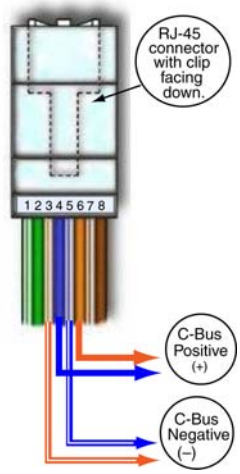
Wiring for C-Bus Units with RJ-45 Ports

RJ-45 connectors are used for network connections to units with RJ-45 ports, such as C-Bus DIN units. These connectors are wired as a standard patch lead with the pin assignments shown in the table, “C-Bus Network Cable/RJ-45 Conductor Assignments.” The individual wires are paired into the C-Bus positive and negative supplies inside the DIN units, so the connections are the same as those made to a unit that has a terminal (see the section, “Wiring for C-Bus Units with Screw Terminals”).

NOTE: Remember to use the assignments given in the table if you need to make a patch lead or attach an RJ-45 type connector to the network cable.

Table 2: C-Bus Network Cable/RJ-45 Conductor Assignments

RJ Pin	C-Bus Network Connection	Wire Color
1	Remote ON	Green-White
2	Remote ON	Green
3	C-Bus Neg (–)	Orange-White
4	C-Bus Pos (+)	Blue
5	C-Bus Neg (–)	Blue-White
6	C-Bus Pos (+)	Orange
7	Remote OFF	Brown-White
8	Remote OFF	Brown



Importance of the C-Bus Supply Connections

Remember three key points about the C-Bus supply connections.

- All Clipsal C-Bus products are designed to use the orange and blue conductors for the positive connection and the orange-white and blue-white conductors for the negative connection.
- The C-Bus range of DIN units comes with Cat-5 patch leads. The connectors on these patch leads have the appropriate wiring for the C-Bus network. In the event you must make a patch lead, remember to use the pin assignments listed in the table, “C-Bus Network Cable/RJ-45 Conductor Assignments.”
- The C-Bus-specific wire pairs (and the mutual twist of the wires) increase the network's immunity to electromagnetic interference.

CAUTION

HAZARD OF IMPROPER OR UNSTABLE OPERATION

- Only use the C-Bus-specific wire pairs for network connections.
- Standard Cat-5 UTP twisted-pairs will short out the bus.

Failure to follow these instructions can result in improper C-Bus network operation.

Terminating C-Bus Conductors

Each conductor in Cat-5 cable is typically single strand 0.24 mm^2 copper. C-Bus network connections to C-Bus units are made to screw terminals or to an RJ-45 port.

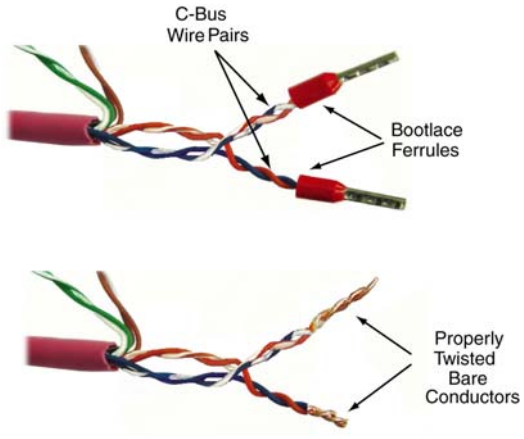
C-Bus Units with Screw Terminals

We recommend two termination methods for connections to units with screw terminals:

- Cap the end of each wire pair with a bootlace ferrule. Depending on the size of the ferrule, several can be inserted into a terminal.
- Twist together the ends of the wires in each pair. When twisting the wires together, take care to ensure that all core wires are secure and the wires do not break.

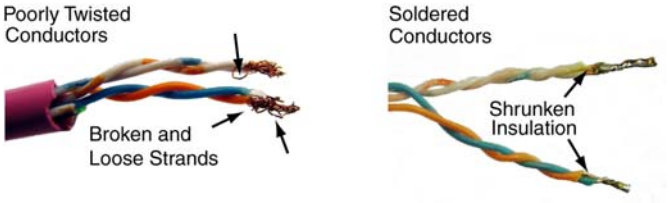
The figure, “Recommended Methods for Terminating C-Bus Conductors Used with Screw Terminals,” shows wires capped with bootlace ferrules and properly twisted bare conductors.

Figure 4: Recommended Methods for Terminating C-Bus Conductors Used with Screw Terminals



Soldering is **not** recommended, as it can cause "cold flow." Soldering the conductors together shrinks back the insulation, making short circuits between conductors more likely. Over time solder will cold flow away from the point of pressure, causing an intermittent or high resistant joint. The figure, “Problematic Wiring Terminations,” shows examples of soldered wires and wires with frayed ends, which can cause short circuits.

Figure 5: Problematic Wiring Terminations



C-Bus Units with RJ-45 Ports

RJ-45 type connectors are used for network connections to units with RJ-45 ports, such as C-Bus DIN units. See the section, “Wiring for C-Bus Units with RJ-45 Ports,” for a full description.

Wiring of Relay Loads

It is important not to mix Class 1 and Class 2 output voltages on the channels of a C-Bus Relay. The AC and DC voltages for each class are given below:

- Class 1: 100 V AC–600 V AC
- Class 2: 0 V AC–100 V AC

The ranges above reflect the standards at the time this document is published; always check the appropriate standards for the date and your locale.

Voltage Connections

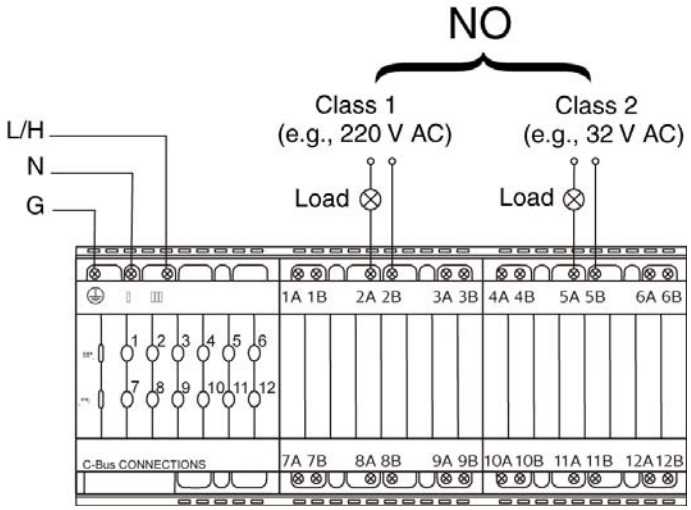
When you wire loads to a C-Bus Relay, use only one voltage class (Class 1 or Class 2) on each channel.

Relay Wiring Examples

The figure, “Incorrect Application of Mixed Voltages,” shows a Relay that is being used to switch 32 V AC (which is Class 2) and 240 V AC (which is Class 1).

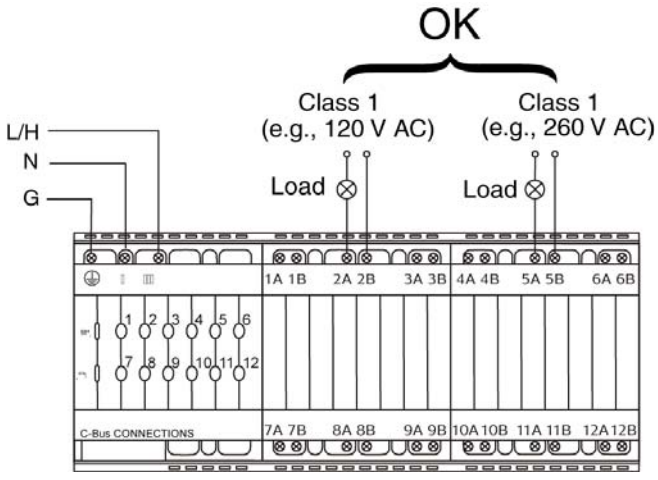
This is not the correct wiring for a single Relay unit, because the loads are different voltage classes. We strongly recommend using a separate Relay unit for each voltage class that is to be switched.

Figure 6: Incorrect Application of Mixed Voltages



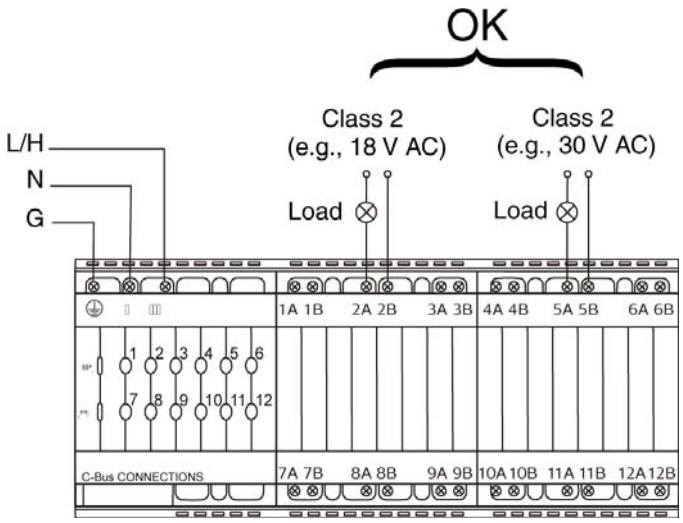
One example of a correctly wired C-Bus relay is shown in the figure, “Correct Application of Mixed Class 1 Voltages.” Although two different voltages are being switched by two relay channels, they are both Class 1.

Figure 7: Correct Application of Mixed Class 1 Voltages



Another example of a correctly wired C-Bus Relay is shown in the figure, “Correct Application of Mixed Class 2 Voltages.” Again, two different voltages are being switched by two Relay channels, but it is appropriate, because they are both Class 2.

Figure 8: Correct Application of Mixed Class 2 Voltages



Wiring OF C-Bus Dimmers

C-Bus wired Dimmers are leading-edge phase-control Dimmers for incandescent and
low-voltage lighting applications (iron core and electronic transformer).

NOTE: Electronic transformers must be suitable for leading-edge dimming technology.

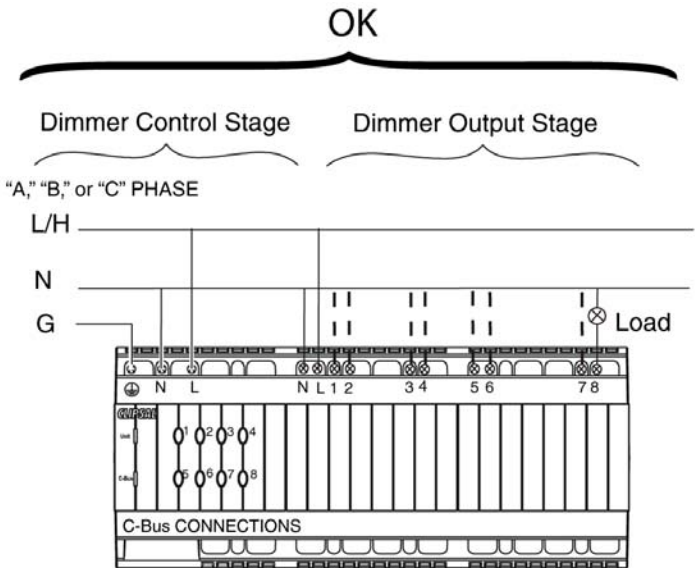
Dimmer Phase Connections

Line-voltage supply to the Control and Output Stages of the C-Bus DIN-rail Dimmers are not internally connected. Therefore, both must be wired from the same voltage phase. Do not cross the neutral connections.

Dimmer Wiring Examples

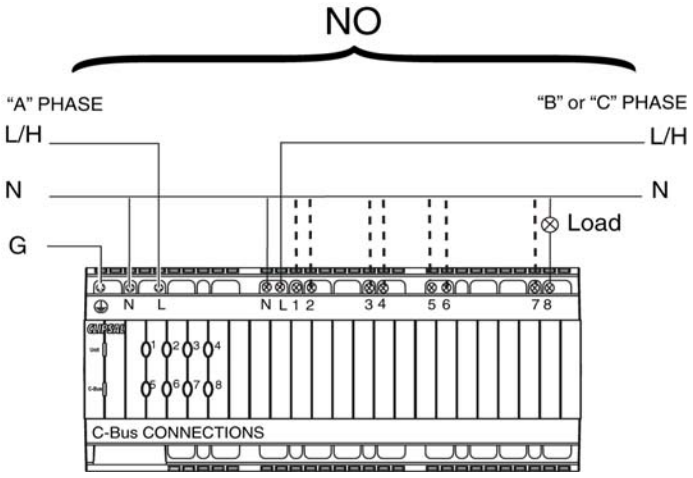
Correct wiring of a C-Bus DIN-rail Dimmer is shown in the figure, “Correct Wiring of Dimmer Control and Output Stages,” with the same phase being looped between the Control Stage and the Output Stage.

Figure 9: Correct Wiring of Dimmer Control and Output Stages



Incorrect wiring of a C-Bus DIN-rail Dimmer is shown in the figure, “Incorrect Wiring of Dimmer Control and Output Stages,” with different phases being used on the Control Stage and the Output Stage.

Figure 10: Incorrect Wiring of Dimmer Control and Output Stages

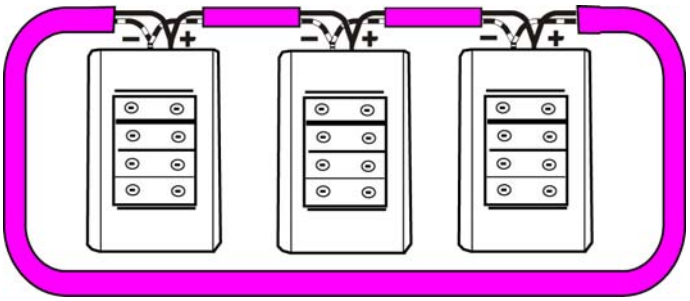


Topologies

Single Network Topologies

C-Bus units can be wired together in a number of different ways. Typical topologies are "Daisy Chain," “Star,” and a Daisy Chain-Star combination. Ultimately all conductor connections are parallel. We **do not** recommend using a Closed Loop (Ring) topology for C-Bus networks, as it can cause erratic behavior.

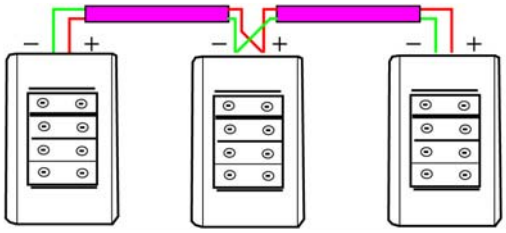
Figure 11: Inappropriate Closed Loop Topology



Daisy Chain

The Daisy Chain wiring configuration is a run of units connected with the positive and negative terminals in parallel (see the figure, “Single Network Daisy Chain Topology”).

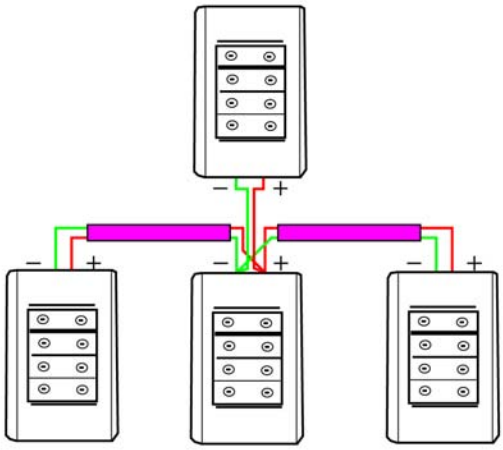
Figure 12: Single Network Daisy Chain Topology



Star

A Star configuration is a run of units connected with multiple wires to the positive and negative terminals in parallel. If a network has two or more cable runs branching off from a single point, it is referred to as a Star configuration (see the figure, “Single Network Star Topology”).

Figure 13: Single Network Star Topology



Multi-Network Topologies

When a C-Bus system reaches a certain size, it is expanded by using a C-Bus Network Bridge to create another electrically isolated network, each with its own Power Supply and Network Burden (see “Introduction to C-Bus” for more information on multi-network installations). Up to 255 C-Bus networks can be connected using C-Bus Network Bridges.

The same connection topologies are used for multi-network installations as for single network installations:

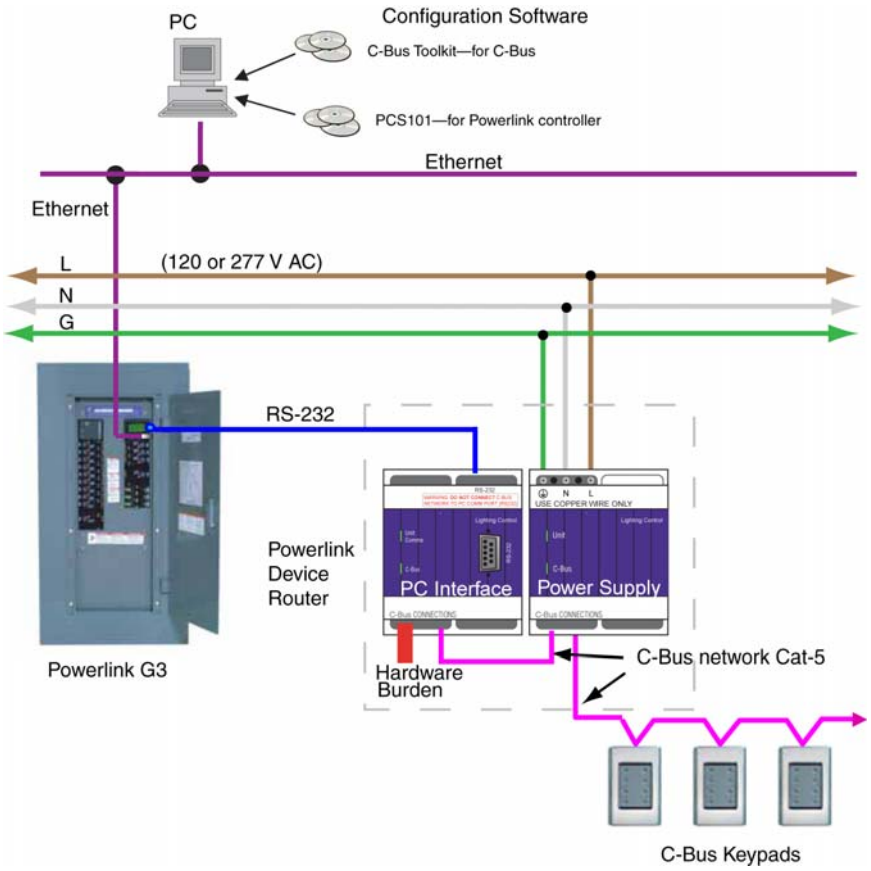
- Daisy Chain
- Star
- Daisy Chain-Star combination

Again, the Closed Loop (Ring) topology must **not** be used.

INTEGRATING A C-BUS NETWORK WITH POWERLINK

This section provides instructions for connecting a C-Bus network to a Powerlink® NF3000G3C Controller. The figure, “A C-Bus Network Integrated with a Powerlink NF3000G3C Controller,” illustrates this type of system.

Figure 14: A C-Bus Network Integrated with a Powerlink NF3000G3C Controller



Overview

The Powerlink NF3000G3C Controller (see the figure, “Powerlink NF3000G3C Controller”) provides a data interface to C-Bus networks. Devices operating on the C-Bus network are logically interconnected via groups. An NF3000G3C Controller input is simply assigned to a C-Bus network group for operation.

NOTE: The NF3000G3C Controller is the only Powerlink Controller model that can be integrated with C-Bus networks. The NF500, NF1000, NF2000, NF 3000, and so on, can not be integrated with C-Bus networks.

Figure 15: Powerlink NF3000G3C Controller

A unique attribute of the NF3000G3C Controller is the ability to act as both an input and output device to a C-Bus network. For example, the Controller can accept input signals from a C-Bus network keypad to control remotely operable circuit breakers. A Controller schedule can trigger output commands to a C-Bus group to set a dimming scene.

Requirements

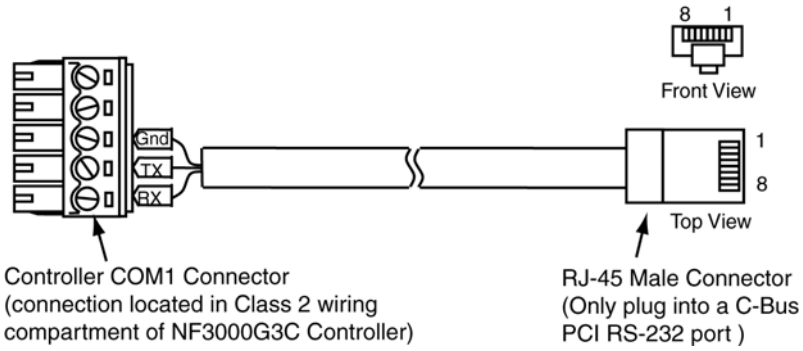
Hardware

C-Bus is a powered, two-wire network, so the Controller does not connect directly to the
C-Bus network. A serial C-Bus PC Interface (SLC5500PC) is required to convert serial messages to C-Bus network messages. A C-Bus network Power Supply [SLC5500TPS (120 V AC); SLC5500HPS (277 V AC)] is also required to provide DC voltage to devices connected to the C-Bus network.

The C-Bus network Power Supply and PC Interface (PCI) are available separately or as a Powerlink Device Router (refer to the figure, “A C-Bus Network Integrated with a Powerlink NF3000G3C Controller”). The Device Router consists of a DIN-mounted PC Interface (PCI) and a DIN-mounted Power Supply mounted in a Clipsal 8M enclosure [NFDR120G3C (120 V AC model) or NFDR277G3C (277 V AC model)]. The Device Router package also includes a hardware Network Burden and a serial RS-232 communications cable with an RJ-45 connector and a Phoenix connector (see the figure, “Serial RS-232 Communications Cable for Connecting an NF3000G3C Controller to a C-Bus Network via a C-Bus PC Interface”).

NOTE: A hardware Network Burden is pre-installed in the Device Router. Do not remove the hardware Burden unless a software Network Burden has been enabled on one of the C-Bus network units. (Remember that a C-Bus network should have one, but only one, Network Burden).

Figure 16: Serial RS-232 Communications Cable for Connecting an NF3000G3C Controller to a C-Bus Network via a C-Bus PC Interface



Software

The NF3000G3C is fully compatible with PCS101 configuration software. PCS v. 5.5 or higher is required for access to the C-Bus features.

Communications

The PCS software uses Modbus serial or Ethernet communications to interact with the Controller. We strongly recommend using Ethernet—the Controller has only one serial port, which is used for both Modbus serial and C-Bus network communications. Also, an Ethernet connection will allow you to configure the system remotely or monitor the system over a network.

CAUTION

HAZARD OF IMPROPER OR UNSTABLE OPERATION

- Make only one serial communication connection to the PC Interface at any given time. Use either the DB-9 (9 pin) type serial connector or an RJ-45 (8 pin) connector.
- Do not Megger® test C-Bus or RS-232 data cabling or terminals.

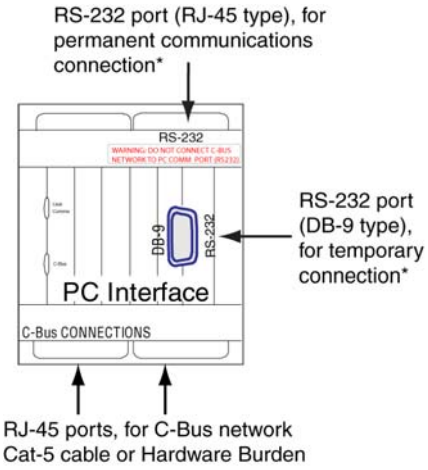
Failure to follow these instructions can result in improper C-Bus network operation.

Connecting the NF3000G3C Controller to a C-Bus Network

Location of Connection Ports

The permanent C-Bus-side serial communications wiring terminals are at the top of the PCI (see the figure, “C-Bus PC Interface Communications Terminals”).

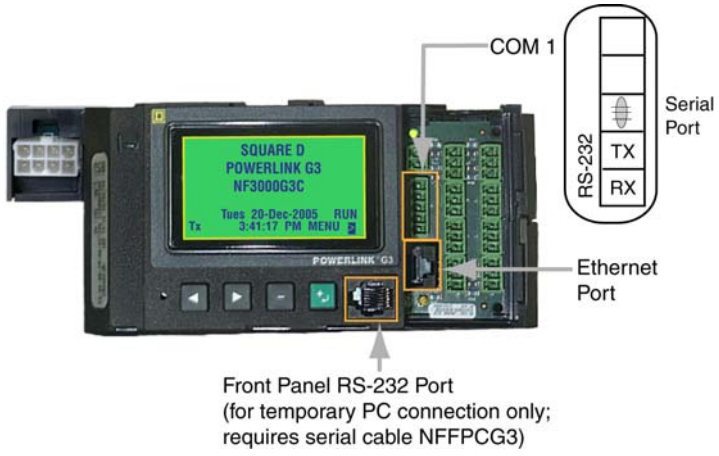
Figure 17: C-Bus PC Interface Communications Terminals



*Use *only* one RS-232 Serial port at any time.

The permanent Controller-side serial communications wiring terminals are located in the Class 2 low-voltage wiring compartment of the NF3000G3C Controller. The figure, “NF3000G3C Controller Communications Terminals,” shows that area with the Class 2 cover removed.

Figure 18: NF3000G3C Controller Communications Terminals



NOTE: The permanent RS-232 connection in the Class 2 low-voltage wiring compartment is shared with the RS-232 port on the Controller’s front panel. If you need to use the front panel RS-232 port, you must first disconnect the serial cable between the Controller and the C-Bus PCI.

Connection Steps

The following steps describe how to make the connection.

1. Connect the RJ-45 end of the serial cable to one of the RS-232 ports on the PCI (see the figure, “C-Bus PC Interface Communications Terminals”). **Do not** connect this cable to a port labeled “C-Bus Connections.”

CAUTION

HAZARD OF IMPROPER OR UNSTABLE OPERATION

- Verify that all connections to C-Bus units are being made to the correct port.
- Only connect an RS-232 serial cable to a port labeled RS-232; an Ethernet cable to a port labeled Ethernet; and a C-Bus network cable to a port labeled C-Bus.

Failure to follow these instructions can result in improper C-Bus network operation, damage to the computer or C-Bus network equipment, or both.

2. Route the unterminated end of the cable to the Class 2 compartment of the NF3000G3C Controller. Observe the National Electrical Code and any local electrical codes regarding Class 2 circuits.
3. Cut the cable to the desired length and remove 1–1.5 in. of the outer sheath. Discard any unused cable.
4. Strip 0.5 in. of insulation from the blue, white/blue, and green wires (see the table, “NF3000G3C Controller to PCI Cable Wiring Reference”). Cut the other wires back to the cable sheath.

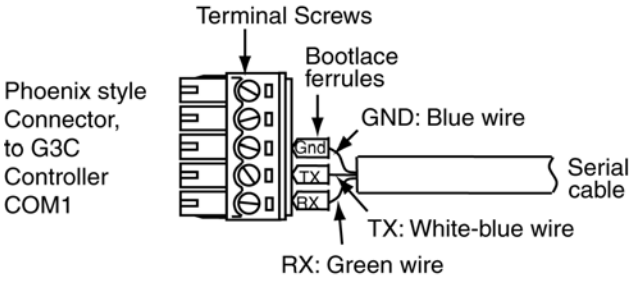
NOTE: The NF3000G3C Controller has an RS-485 port, but it does not function. Do not make any connections to these terminals.

Table 3: NF3000G3C Controller to PCI Cable Wiring Reference

Phoenix-style connector (to Controller COM 1 Connection)		**RJ-45 Connector (to PCI)**	
Terminal	**Wire Color**	**RJ-45 PIN**	**Description**
Not used	N/A	1	Data set ready/ring indicator (DSR/RI)
Not used	N/A	2	Data carrier detect (DCD)
Not used	N/A	3	Data terminal ready (DTR)
Gnd	Blue	4	Signal ground (SGND)
TX	White-blue	5	Receive data (RD)
RX	Green	6	Send data (SD)
Not used	N/A	7	Clear to send (CTS)
Not used	N/A	8	Ready to send (RTS)

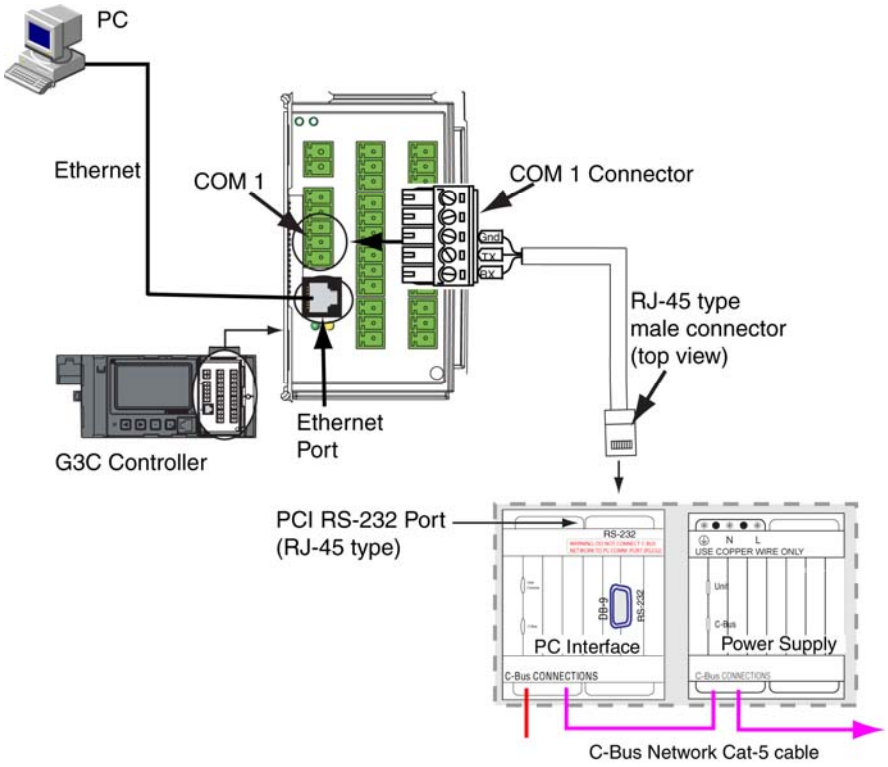
5. Crimp a bootlace ferrule onto the end of each stripped wire, then insert the wires into the appropriate terminals of the Phoenix-style connector (see the figure, “Wiring to the Phoenix-Style Connector”).

Figure 19: Wiring to the Phoenix-Style Connector



6. Tighten the terminal screws until each wire is secure.
7. Plug the connector into the serial (COM1) port of the NF3000G3C Controller (refer to the figure, “Connecting the Powerlink NF3000G3C Controller to a C-Bus Network”). The connector legend is on the wiring compartment cover.

Figure 20: Connecting the Powerlink NF3000G3C Controller to a C-Bus Network



More Resources

More complete information about the NF3000G3C Controller—including safety and installation instructions, hardware, wiring, software, and programming—can be found in the following two instruction bulletins:

- 63249-401-209, “Powerlink® G3 Controller, NF3000G3C, for use with Powerlink G3 Systems: Addendum to Controller Instruction Bulletin 63249-410-205”
- 63249-401-205, “Powerlink® G3 Controller, NF2000G3 and NF3000G3, for use with Powerlink G3 Systems, Class 1210.”

The documents can be downloaded from the Schneider Electric website:

http://www.schneider-electric.us/

Support and Service

Contact the Customer Information Center for technical support by phone at 1-888-778-2733 or e-mail at lightingcontrol.support@us.schneider-electric.com.

Contact your local Schneider Electric service representative or C-Bus™ system certified installer for repairs or service to your network.

You may also find helpful information on our web site at www.Schneider-Electric.us.

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