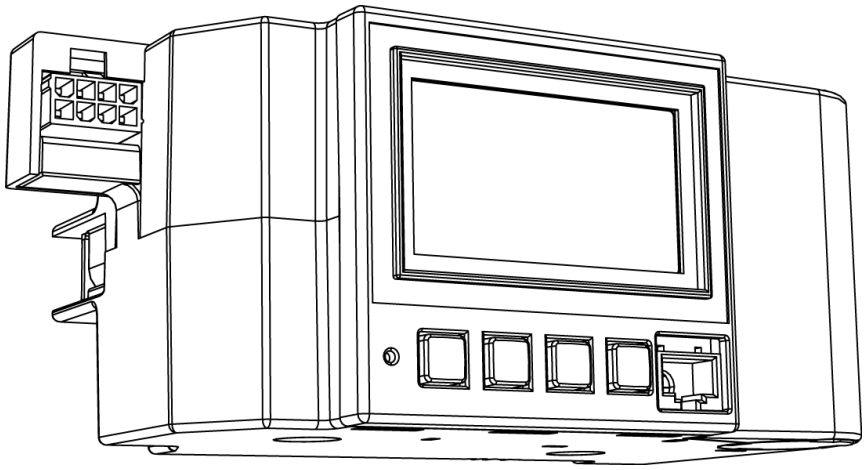
# Installing Powerlink® NF3500G4 Controllers

## for Use with Powerlink Systems

**RETAIN FOR FUTURE USE**



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## Safety Information

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 a hazardous situation which, if not avoided, **will result in** death or serious injury.

**⚠ WARNING**

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

**⚠ CAUTION**

**CAUTION** indicates a hazardous situation which, if not avoided, **could result in** minor or moderate injury.

***NOTICE***

**NOTICE** is used to address practices not related to physical injury.

## Please note

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this manual.

A qualified person is one who has skills and knowledge related to the construction, installation, and operation of electrical equipment and has received safety training to recognize and avoid the hazards involved.

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As standards, specifications and designs change from time to time, please ask for confirmation of the information given in this publication.

## FCC Class B

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

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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.

The user is cautioned that any changes or modifications to this device that are not expressly approved by Schneider Electric could void the user's authority to operate this equipment.

This digital apparatus complies with CAN ICES-3 (B) /NMB-3(B).

## About This Bulletin

This bulletin explains how to install the Powerlink® NF3500G4 Controller, which is used to control the operation of a Powerlink G4 system. The controller uses remotely operated circuit breakers to control up to 336 remotely operated branch circuits. Control signals originate externally from dry-contact inputs, from the internal time scheduler, or from commands received via the communications network. Typical control devices include low voltage pushbutton wall switches, occupancy sensors, photocell controllers, and security and building management systems.

Refer to "Powerlink NF3500G4 Controller User's Guide." for more information about:

- Configuration using the controller's LCD screen navigation
- Installing using LCS software  to a PC for configuration
- The current version firmware

## Before You Begin

Before installing the NF3500G4, inspect it carefully. Verify the catalog number on the box label.

**Table 1: Components**

| Part Number | Description | Quantity |
|---|---|---|
| NF3500G4 | Powerlink® Controller | 1 |
| | Class 2 barrier | 1 |
| | Connector hardware kit<br>- 9 three-terminal connectors<br>- 1 four-terminal connector<br>- 2 two-terminal connector | 1 |
| | Miscellaneous hardware kit (screwdriver, tie wrap, panelboard reference label) | 1 |


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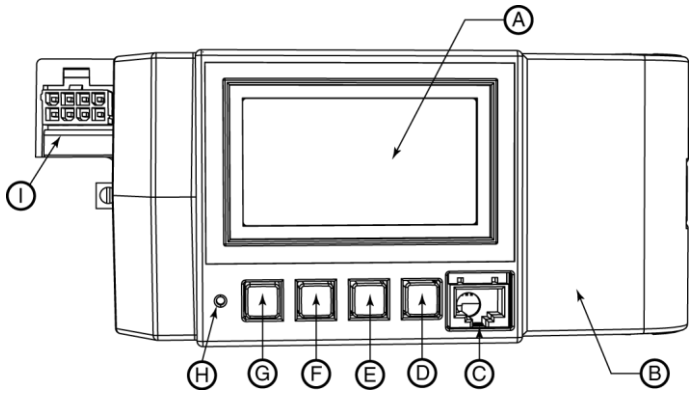
## FRONT PANEL OVERVIEW

The figure below shows the parts of the controller's front panel. A brief description of each part can be found in the following table.

### Figure 1: Components of the Controller

KEY:
A. LCD Screen
B. Wiring compartment
C. Temporary RJ45 communications port
D. Plus key/Enter key
E. Minus key
F. Next key
G. Back key
H. Reset button
I. Power/Communications supply connection (to the power supply)




### Table 2: Features of The Controller Front Panel

| Component | Description |
|---|---|
| A. LCD Screen | The LCD screen displays the information to set up and operate programs for the controller. |
| B.Wiring Compartment Cover | The wiring compartment cover protects the input and communications port terminals located in the Class 2 wiring compartment. To remove and install the compartment cover, see "Installing the Class 2 Barrier" on page 25. See "Wiring Compartment Overview" for an overview of the wiring compartment terminals. |
| C. Temporary RJ45 Communications Port | The temporary RJ45 communications port is used for a temporary connection to a PC. |
| D. Plus Key/Enter Key | The Plus key/Enter key scrolls through the choices for an option on the LCD screen and selects items on the screen. If the cursor is on a numeric field, the Plus key/Enter key increases the value. |
| E. Minus Key | The Minus key scrolls through the choices for an option on the LCD screen and de-selects items on the screen. If the cursor is on a numeric field, the Minus key decreases the value. |
| F. Next Key | The Next key moves the cursor to the next option on the LCD screen. |
| G. Back Key | The Back key moves the cursor to the previous option on the LCD screen. |
| H. Reset Button | The Reset button reboots the controller. |
| I. Power/Communications supply connection | Connects to the power supply. |

### Figure 2: Controller Wiring Compartment Components (See Table 3)

KEY:
A. RJ45 ports
B. RS232 terminals
C. RS485 terminals
D. Input Terminals (1–16)
E. Grounding Terminals

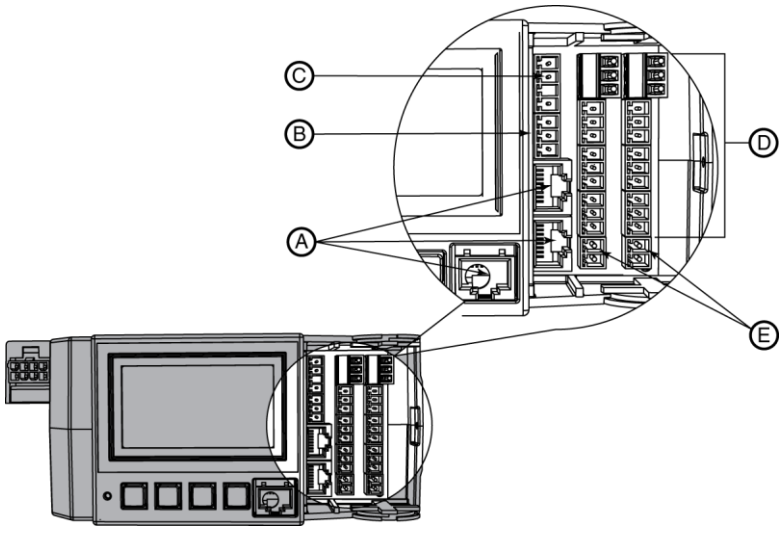



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**Figure 3: Controller Class 2 Communications Terminals Detail**

KEY:
A. RJ45 ports
B. RS232 terminals
C. RS485 terminals

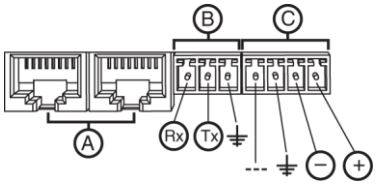


**Table 3: Wiring Compartment Components**

| Component | Description |
|---|---|
| A. RJ45 Ethernet Ports (2) | Use this port to connect the controller to a network. |
| B. RS232 Communications | Use these terminals to connect to external RS-232 communication. |
| C. RS485 Communications Terminals | Use these terminals to connect to external RS-485 communication. |
| D. Input Terminals (See Figure 2.) | (1–16) Use these terminals to connect to an external dry-contact switching device. |

## SAFETY PRECAUTIONS

This section contains important safety precautions that must be followed before attempting to install or maintain electrical equipment. Carefully read and follow the safety precautions below.

**⚠ DANGER**

**HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E in the USA, CSA Z462, or applicable local standards.
- This equipment must be installed and serviced by qualified electrical personnel.
- Turn off all power supplying this device and the equipment in which it is installed before working on the device or 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.
- Before energizing panelboard, all unused spaces must be filled with blank fillers.

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


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## INSTALLING AND REMOVING THE CONTROLLER

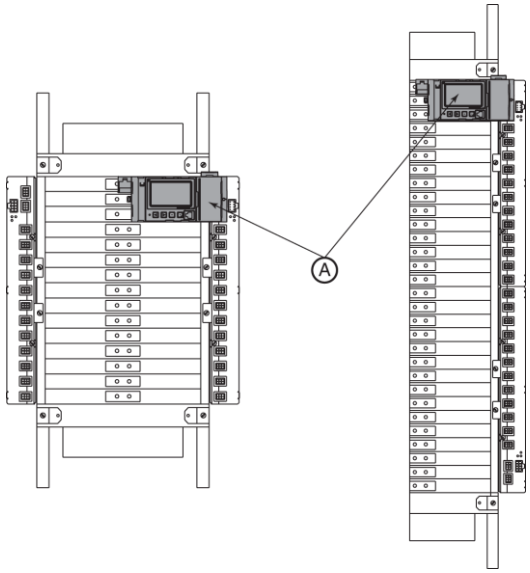
Follow the instructions and safety precautions to install and remove the controller from the panelboard.

### Installing the Controller

Follow these steps to install the controller in an NF panelboard.

**Figure 4: Controllers On Standard and Column-width Panelboards**

KEY:
A. Controller location




1. Turn off all power supplying this device and the equipment in which it is installed. Verify that the power is off using a properly rated voltage sensing device.
2. Remove the panelboard cover and deadfront.
3. Insert the controller's two bus connectors into the vertical bus connections on the right control bus. See the figure, "Controllers On Standard and Column-width Panelboards."

   *NOTE: If you are using a standard NF panelboard, the controller is installed at the top of the right control bus. If you are using a column- width NF panelboard, the controller is installed at the top of the panelboard. See the figure, "Controllers On Standard and Column-width Panelboards."*
4. Push the controller onto the control bus until the mounting feet snap onto the panelboard interior. A captive screw on the left side of the controller is lined up with a hole on the panelboard interior. Use a screwdriver to secure the screw. Torque to 20–30 in-lbs.

   *NOTE: If not already installed, install the power supply according to its instruction bulletin.*
5. Push the power supply connector plug into the power connection on the controller. See the figure, "Controller Front Panel."

   *NOTE: If you are using a column-width NF panelboard, the column-width controller cable NFCWG3 is required to connect the power supply and controller.*

### Removing the Controller

To remove the controller, follow these steps:

1. Turn off all power supplying this device and the equipment it is installed. Verify that power is off using a properly rated voltage sensing device.
2. Remove the panelboard cover and deadfront.
3. Unplug the controller's power supply connector from the power supply.
4. Loosen the controller's captive screw from the panelboard interior.
5. Grasping the controller by the edges, lift straight out until the controller disengages.

   *NOTE: Powerlink G3 control buses include a mode where all Powerlink G3 circuit breakers are turned ON approximately 10 minutes after communication is lost with a controller as long as the control buses are still receiving power.*

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## INPUT WIRING

Powerlink G4 controllers provide a local set of Class 2 terminals for wiring to external control devices such as wall switches, photocells, occupancy sensors, relays, and pilot lights.

### Terminal Connection Points

These terminals provide the following connection points:

- Input terminals — Powerlink G4 controllers provide 16 input connection points and eight 24 Vdc source voltage points so that the dry-contacts of an external control device can act as a control source for an associated zone. These input terminals are designed to work with two-wire and three-wire switching devices. Eight of these terminals are bi-directional and are shared with the output function, described below. See “Physical vs. Communications” below for a comparison between physical inputs and communication inputs.
- Outputs — Powerlink G4 controllers provide eight status outputs that can be used to operate pilot lights or relays. The output terminal is bi-directional and is not available for use as an output when it is used as an input connection. The total current for all outputs combined is 160mA. This limits the current available for each output to a total of 20mA, if all eight outputs are used. Choose devices that are capable of operating within these parameters. The output voltage rating is 24 Vdc.
- Analog Terminals — Terminals 1-4 are universal inputs. Configuration options are Analog or digital. Analog option are (0-5V), (0-10V), (4-20mA).
- Communication Inputs — The controller provides 256 communication inputs. These inputs do not exist physically, but are control points that receive commands from the communications network. ON or OFF commands may be written to controller by any device that supports the industry standard Modbus open protocol. Typical devices with Modbus capability are Building Automation Systems (BAS) and programmable logic controllers (PLC). See “Physical vs. Communications” below for a comparison between physical inputs and communication inputs.

### Physical and Communication Inputs

The controller supports up to 16 physical inputs and up to 256 communication inputs. Physical inputs receive their signals to turn ON or OFF from dry-contact type switches (such as wall switches and occupancy sensors) that are wired to a controller’s input terminals. Communications inputs do not exist physically, rather they receive commands to turn ON or OFF across the communications network. For example, a building management system can send a command (by writing to a specific register in the controller) to turn a communication input ON or OFF across Ethernet, RS-232 or RS-485 communications.

All inputs (1-256) can be controlled via the communications network — both manually, from the switch, and automatically via commands from the network. For example, even though a wall switch wired to input 1 is ON, you can use the controller or Powerlink software to turn input 1 OFF via communications.

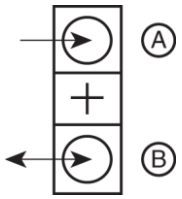
Because inputs 17–256 do not exist physically, no input type configuration is available. However, input timers, input override capabilities, and the “default action on comms loss” feature are available for all inputs.

### Input Wiring Connections

A connector plug is provided for each of the eight sets of terminals. The wiring compartment label identifies each terminal as shown in the figure below.

**Figure 5: Input/Output Connector**

KEY:
A. Input terminal
B. Bi-directional Input/Output (I/O) Terminal





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## External Device Wiring

External control devices, such as wall switches, photocells, occupancy sensors, and relays can be easily connected to the controller's input terminals. Most of these devices have a single set of contacts that provide a control signal, requiring two wires for connection . Some devices use two sets of contacts to provide a control signal, requiring three wires for connection . See the figure "2- and 3-Wire Input Connections."

The contact closure activity is monitored by the controller and is interpreted according to an input type configuration setting that is appropriate for the external device. The bi-directional terminal is used as an input when a 3-wire device is used. It also can be used as an independent input. See the figure "2-wire Input Connection to a Bi-directional Terminal".

**Figure 6: 2- and 3-wire Input Connections**

KEY:
A. 2-wire device
B. 3-wire device

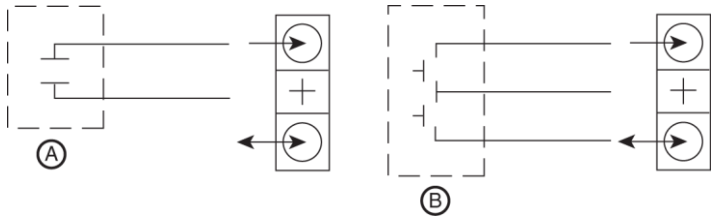
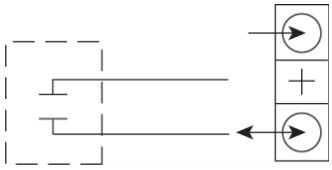
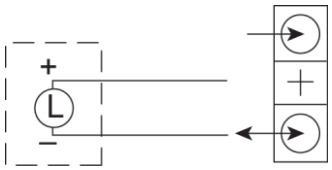



**Figure 7: 2-wire Input Connection to a Bi-directional Terminal**



A pilot light, relay, or other device that requires an output from the controller uses the bi-directional terminal as an output. The output function, shown in the figure "Output connection", is only available if the bi-directional terminal is not being used as an input. Use this connection to obtain a powered signal representing the zone status of the input located on the same 3-terminal connector.

**Figure 8: Output Connection**

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Controller Input Terminals

The diagram below illustrates the position of each connector in a controller. Numbered terminals are input terminals. Numbered terminals in parenthesis can be used as either input or output terminals, allowing for up to 16 inputs.

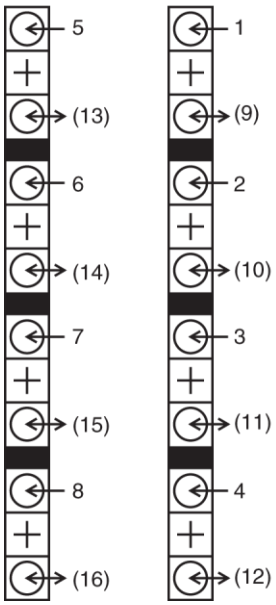
The diagram on the LEFT shows the input terminals in the wiring compartment. The diagram on the RIGHT shows an example of connector terminal usage.

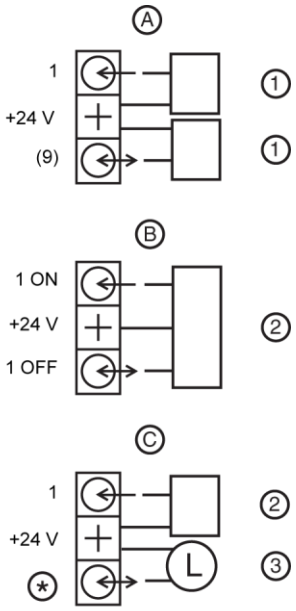
**Figure 9: Wiring Compartment Terminal Diagram**

KEY:
Example of connector terminal usage (RIGHT):
A. All single contact inputs
1. 2-wire device

B. Dual momentary inputs
2. 3-wire device

C. Status outputs
1. 2-wire device
3. Pilot light




In the figure above, a connector can be used three different ways:

1. Single contact inputs: A device is connected to input 1, and/or a second device is connected to the bi-directional I/O terminal. The bi-directional I/O terminal is used by the controller as input 9. If the second connector was used, input 2 and/or input 10 also would be single contact inputs.
2. Dual momentary inputs: A three-wire device is connected to the connector. The bi-directional I/O terminal is not available for configuration as an independent input or status output.
3. Status outputs: The bi-directional I/O terminal is used as an output terminal for a status output, such as an LED pilot light. Input 1 is used to connect an input, and input 9 is configured to provide a status output.
4. Analog Inputs: Analog terminal 1-4 are used as input terminal with three configuration types (0-5V, 0-10V, 4-20mA)

   *NOTE: In order to operate as intended, the input type must be set up. See the instruction bulletin, "Powerlink NF3500G4 Controller User's Guide."*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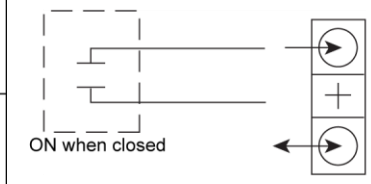
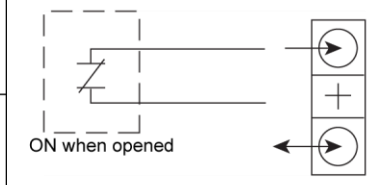
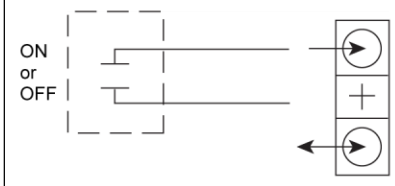
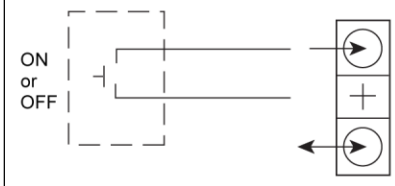
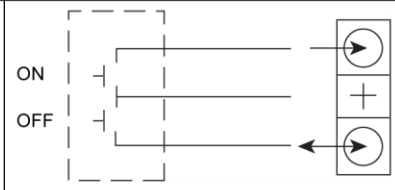
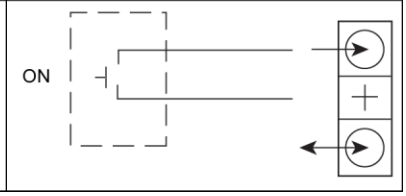
## Common Input Types

| Input Type | Application | Operation | Connection Diagram |
|---|---|---|---|
| Maintained Normally Open | External control devices such as photocells, time clocks and occupancy sensors that contain a normally open contact. | The input state is commanded ON when the contacts are closed and is commanded OFF when the contacts are opened. |  |
| Maintained Normally Open with Blink | Notifies an occupant when the lights are about to turn OFF. | Same as above. Associated breakers will blink (if configured with Blink Type) in response to an OFF command. | |
| Maintained Normally Closed | External control devices such as photocells, time clocks and occupancy sensors that contain a normally closed contact. | The input state is commanded OFF when the contacts are closed and is commanded ON when the contacts are opened. |  |
| Maintained Normally Closed With Blink | Notifies an occupant when the lights are about to go OFF. | Same as above. Associated breakers will blink (if configured with Blink Type) in response to an OFF command. | |
| Maintained Toggle | Maintained switches used to switch lights ON and OFF | The input state alternates between ON and OFF each time the switch changes position. |  |
| Momentary Toggle | Pushbutton switches used to switch lights ON and OFF. | The input state alternates between ON and OFF each time the contacts are closed. |  |
| Dual Momentary | Dual pushbutton or return-to-center momentary switches in which one contact is used to turn lights ON and the other is used to turn lights OFF. | The input state is commanded ON or OFF depending on which contacts are closed. (3-wire device.) |  |
| Momentary ON | Pushbutton switches used with a timer to switch lights ON for a preset period. | The input state is commanded ON when the contacts are closed. Typically used with a timer. |  |

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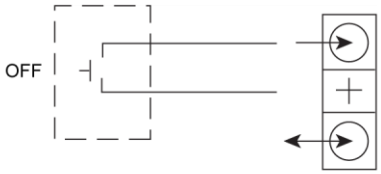
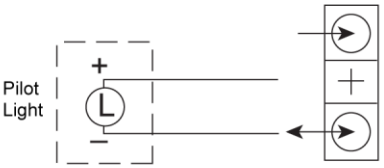
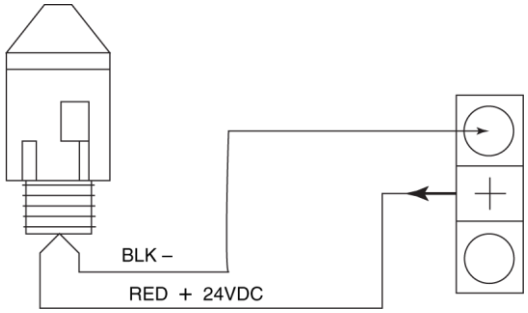
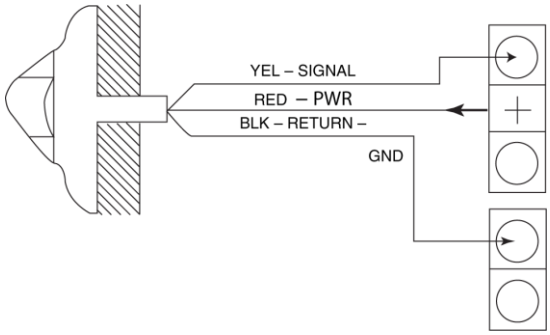
**Common Input Types (continued)**

| Input Type | Application | Operation | Connection Diagram |
|---|---|---|---|
| Momentary OFF | Pushbutton switches used with a timer to switch lights OFF for a preset period. | The input state is commanded OFF when the contact is closed. Typically used with a timer. |   |
| Status Output | Used to annunciate the ON/OFF state of the lights when they are not visible from the position of the control device. | The bi-directional terminal provides a status output voltage for use with a pilot light or relay. |   |

Terminal inputs 1–16 of the controller can be configured for any input type from the front panel. Terminal inputs 9–16 are limited to 2-wire input types and are not available if the other input on the same connector plug is configured as dual momentary. To use any of the bi-directional terminals as an output it must be specifically configured for status output. This terminal will then provide a powered signal representing a selected status. The output status can be reconfigured to represent any input, schedule, zone, or remote source in the controller.

**Analog Input Types**

| Input Type | Application | Operation | Diagram |
|---|---|---|---|
| Analog 4-20mA | External analog control devices such as photocells and light level sensors that delivers a 4-20mA analog signal. | The input state is commanded ON/OFF when the terminal's analog signal reach High Event threshold set in configuration and is commanded ON/OFF when the terminal's analog signal reach Low Event threshold set in configuration. |   |
| Analog 0-5V | External analog control devices such as photocells and light level sensors that delivers 0-5V analog signal. | The input state is commanded ON/OFF when the terminal's analog signal reach High Event threshold set in configuration and is commanded ON/OFF when the terminal analog signal reach Low Event threshold set in configuration. |   |
| Analog 0-10V | External analog control devices such as photocells and light level sensors that delivers 0-10V analog signal. | The input state is commanded ON/OFF when the terminal's analog signal reach High Event threshold set in configuration and is commanded ON/OFF when the terminal analog signal reach Low Event threshold set in configuration. | |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### Input Timers

Any input can be configured with a timer that will automatically turn OFF or ON the input after a period of time. The duration of the input timer can be set for up to 18 hours. See the table below for a description of the available timer types.

**Table 4: Input Timer Types**

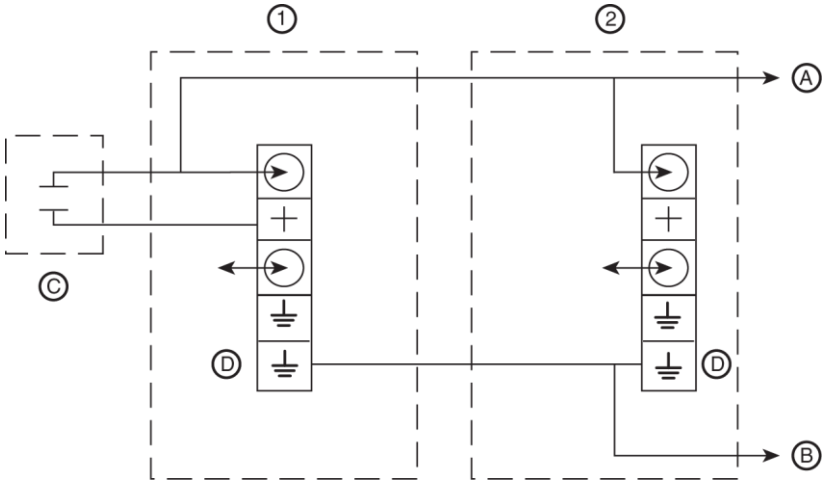
| Timer Type | Operation |
|---|---|
| No Timer | The input is not affected by the timer. |
| Timed ON | The timer countdown starts or restarts whenever the input is turned ON. The input is commanded OFF when the timer value reaches zero. |
| OFF Delay | The timer countdown starts or restarts whenever the input is commanded OFF, but the input remains ON until the timer reaches zero. |
| ON-Delay | The timer countdown starts or restarts whenever the input is commanded ON, but the input remains OFF until the timer reaches zero. |

## CONNECTING AN EXTERNAL DEVICE TO MULTIPLE CONTROLLERS

An external device may be wired to multiple controllers. It is recommended that the source voltage be provided to the external device by one controller. The input signal from the external device and the circuit common terminal on the common ground connector are connected to the other controllers.

**Figure 10: Connecting External Devices to Multiple Controllers**

KEY:
1. Controller 1
2. Controller 2
A. To next controller
B. To next controller
C. External device
D. Controller common ground terminal

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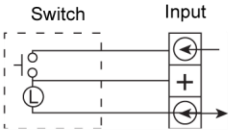
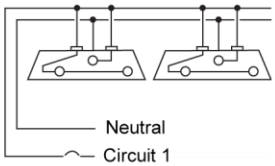
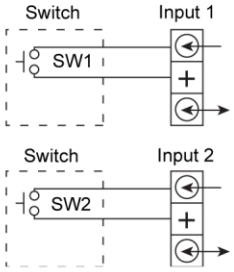
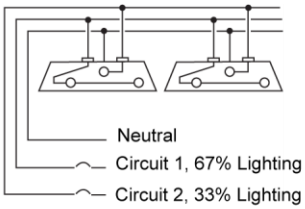
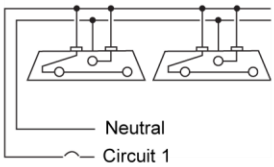
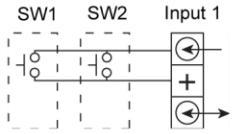
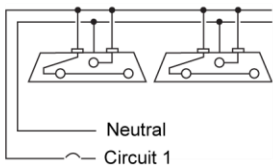
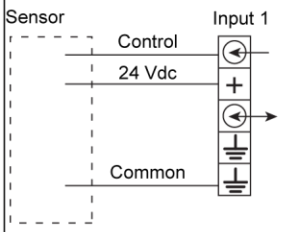
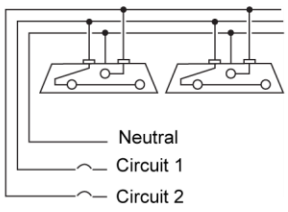
## APPLICATIONS FOR COMMON INPUT TYPES

The following table shows how the input configuration types can be used in common applications.

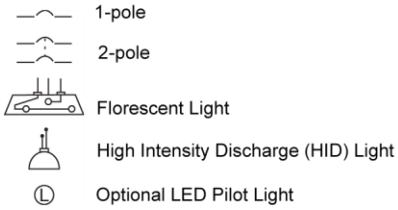
### Common Input Applications

| Application | Switch Type/Input | Switch Diagram | Branch Circuit Diagram① | Action |
|---|---|---|---|---|
| ON/OFF wall switch | Momentary Switch<br>(configured for momentary toggle) |  |  | Switch toggles lights ON and OFF. |
| Multi-level switching | Momentary Switch<br>Input 1: Momentary Toggle<br>Input 2: Momentary Toggle |  |  | SW1 is mapped to Circuit 1 for 67% level lighting. Successive presses of SW1 will switch Circuit 1 ON and OFF.<br>SW2 is mapped to Circuit 2 for 33% level lighting. Successive presses of the SW2 will switch Circuit 2 ON and OFF.<br>Use SW1 and SW2 to turn ON both circuits for 100% lighting. |
| Time clock with wall switch override | Internal time clock with logic type set to OR<br>Momentary switch wired to Input (configured for momentary toggle with timer) | |  | Zone 1 is programmed with a schedule. Lights will remain ON during programmed time periods.<br>Zone 1 is mapped to Circuit 1. Toggling SW1 has no control during scheduled ON periods, However, during OFF periods, SW1 will toggle lights ON/OFF. A timer on SW1 will switch lights OFF after preset period, unless they are manually toggled OFF. |
| Two switches controlling the same group of lights (such as typical 3-way line voltage switch arrangement) | Two momentary switches (configured for momentary toggle) |  |  | Either switch SW1 or SW2 will toggle lights ON and OFF. |
| Occupancy sensor controlling a group of circuit breakers | Occupancy-rated sensor wired to Input 1 (configured for maintained N.O.)<br>Control power supplied by auxiliary power supply. |  |  | Input 1 is mapped to Circuit 1 and Circuit 2. When motion is detected, the occupancy sensor contact will close, causing circuit breakers 1 and 2 to close. |

① Circuit numbers are based on circuit numbering in a panelboard.

N.O. = Normally Open

N.C. = Normally Closed





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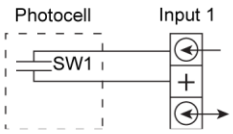
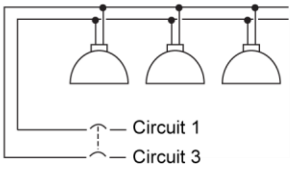
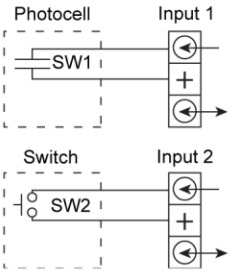
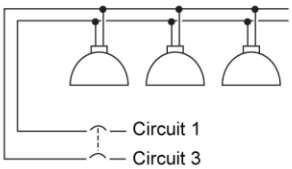
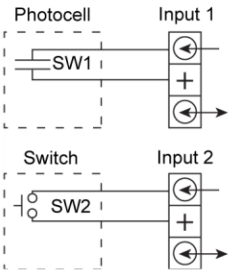
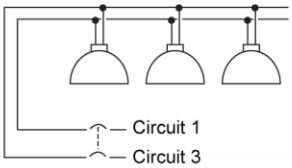
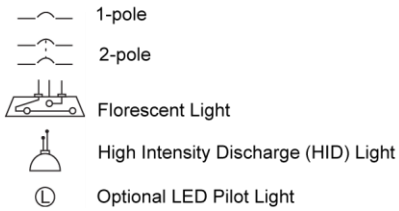
**Common input Applications (continued)**

| Application | Switch Type/Input | Switch Diagram | Branch Circuit Diagram① | Action |
|---|---|---|---|---|
| Photo sensor | Photo controller contact N.O. wired to Input 1 (configured for maintained N.O.) |  |  | When SW1 closes, the circuit breaker that feeds circuits 1 and 3 will switch ON and remain ON until SW1 contact opens. |
| Photo sensor with manual override and timer | Photo controller contact N.O. wired to Input 1 (configured for maintained N.O.)<br>Momentary Switch wired to Input 2 (configured for momentary toggle with timer) |  |  | When SW1 closes, the circuit breaker that feeds circuits 1 and 3 will switch ON and remain ON until SW1 contact opens.<br>Override SW2 is provided to switch lights ON for periods when photo controller has open contact. Timer prevents override from remaining ON indefinitely. |
| Photo sensor with clock override | Internal time clock with logic type set to AND, and with Input 1 wired to a N.O. photo controller (configured for maintained N.O.)<br>Momentary switch wired to Input 2 (configured for momentary toggle with timer) |  |  | Internal time clock prevents photo cell from switching lights ON during preset scheduled periods.<br>SW2 provides a timed override. |

① Circuit numbers are based on circuit numbering in a panelboard.

N.O. = Normally Open

N.C. = Normally Closed

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## COMMUNICATIONS WIRING

The controller communicates primarily through MODBUS protocol. It can also be configured to use DMX512, BACnet, and C-Bus communications protocols. Refer to,"Powerlink NF3500G4 Controller User's Guide." for more information about using the controller with these protocols.

MODBUS

The controllers includes MODBUS communications as a standard feature. ASCII and RTU slave modes are supported as well as TCP/IP. A computer or building automation system (BAS) may be connected to a controller in one of the following ways:

- A temporary local connection using the front panel RJ45 TCP/IP port.
- A permanent connection, either to a local computer or to a remote computer via modem that is wired into the wiring compartment's RS-232 or RS-485 serial port.

DMX512

The controllers include DMX512 communication protocol as a standard feature.

*NOTE: Potential communication errors may occur if multiple computers access any controller's serial port at the same time.*

BACnet

The Powerlink controller models listed in the table below provide native BACnet communication capability. They can be integrated into a BACnet system in one of two ways:

- Ethernet (BACnet/IP)
- RS-485 (MS/TP)

*BACnet/IP*

Powerlink controllers can be connected directly to an Ethernet backbone so that the BAS front-end software communicates to each controller temporarily. BAS controllers with Ethernet capability can read status and perform control tasks, such as overriding Powerlink zones On/Off, by communicating on the Ethernet network to each controller. Refer to the "BACnet IP Screen" and "Configuring BACnet/IP" for more information.

*Master-Slave/Token Passing (MS/TP)*

Powerlink controllers can be connected to a BACnet BAS on an RS-485 network. The BACnet BAS front-end software communicates with the BAS controller directly via Ethernet, which in turn, can communicate to a network of Powerlink controllers via serial communications.

Powerlink controllers operate as a master node on a MS/TP network (device address 0-127).

C-Bus

Serial communications wiring terminals for permanent connections are located in the low-voltage wiring compartment of the controller. Connect a serial communications cable to the 3-pin RS232 port which is found in this compartment. Connect the other end of the cable to the C-Bus network interface device. The connector legend is found on the wiring compartment cover.

See the figure, "Controller Class 2 Communications Terminals Detail" in the "Automation Network Communications" section.


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**Figure 11: C-Bus Communications Cable Diagram**

KEY:
A. Controller COM1 connector
B. RJ45 male plug
C. Front view pin orientation

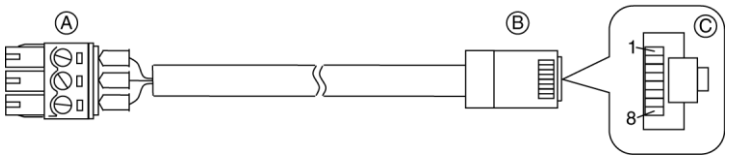



**Table 5: C-Bus Cable-RJ45 Pin Reference**

| Controller COM1 Connector | RJ45 Pin Number | Designation | Description |
|---|---|---|---|
| | 1 | DSR/RI | Data set ready/ring indicator |
| | 2 | DCD | Data carrier detect |
| | 3 | DTR | data terminal ready |
| | 4 | SGND | Signal ground |
| GRD | 5 | RD | Receive data |
| TX | 6 | SD | Send data |
| RX | 7 | CTS | Clear to send |
| | 8 | RTS | Ready to send |

## Communications Overview

The Powerlink G4 system contains two levels of communication networks, subnet and automation (see the figure below).

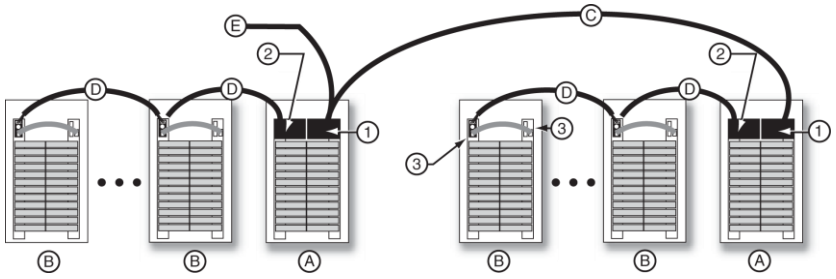
The first level of communications is the device-level network called the subnetwork, or subnet. The subnet connects these Powerlink G4 components.

Up to 16 control buses, which can be located in multiple panelboards, can be controlled from a single controller. The subnet carries command signals from the controller to the appropriate control bus, which in turn, instructs the proper circuit breakers to remotely switch. Through the subnet, the controller also polls the control buses for the status of the remotely operated circuit breakers. In addition to providing the communications path to the control buses, the subnet wiring also provides a 24 Vdc source for powering the control buses and providing power to operate the remotely operated circuit breakers.

The second level of the communication network connects the system (one or more controllers) to devices such as personal computers, modems, or a building management system with the appropriate interface drivers. This communication network is referred to as the automation network.

**Figure 12: Typical Automation and Subnet Communications Network**

KEY:
1. Controller
2. Power supply
3. Control bus
A. Master panel
B. Slave Panel
C. Automation network
D. Subnet communications
E. To PC, Modem, or BAS

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## Subnet Communications

A subnet communications network is necessary whenever two or more panels are to be controlled from a single controller.

### Subnet Components

In a subnet network, the master panel contains the controller and power supply. Other panels connected to the controller are referred to as slave panels.

The components of the subnet communications wiring are the controller, power supply, control buses, slave address selectors, and slave bus interconnect cable.

**Figure 13: Subnet System Communications Wiring**

KEY:
1. Controller
2. Power supply
3. Control bus
4. Slave address inter connect cable (NF2HG3)

A. Master panel
B. Slave panels
C. 4-wire, 18AWG, Class 1 cable, subnet cable (e.g. General Cable 236100, Belden Cable 27326)

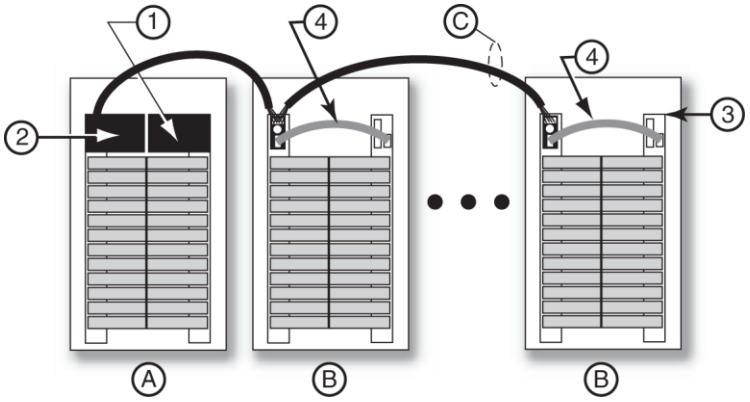
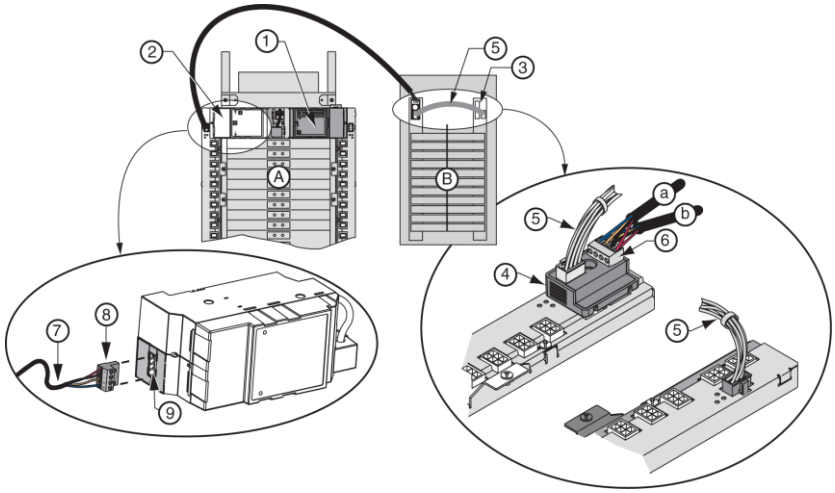



**Figure 14: Subnet Communications Component Wiring**

KEY:
A. Master panel
B. Slave panel
1. Controller
2. Power supply
3. Control bus
4.Slave address selector
5. Slave address interconnect cable (NF2HG3)
   a. To master power supply
   b. To next panel
6. Subnet connector
7. 4-wire, 18AWG subnet cable form the subnetwork
8. Subnet connector plug
9. Mating connection





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## Subnet Wiring

The power supply, located in the master panel, is connected to each slave address selector in a daisy chain. See the figure below. Only one slave address selector is required for each slave panel.

Wiring the controller to the subnet is not necessary. The connection between the controller and the power supply provides the subnet communications for the controller.

**Figure 15: Subnet Wiring Detail**

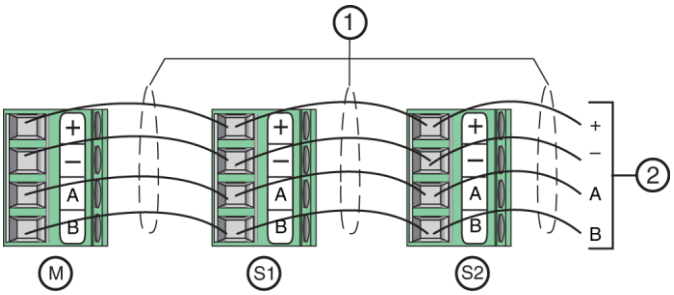
KEY:

1. 4-wire, 18AWG, Class 1 cable, subnet cable (e.g. General Cable 236100, Belden Cable 27326)
2. To next slave address selector

M. Power supply in master panel

S1. Slave address selector in slave panel 1

S2.Slave address selector in slave panel 2




## Slave Address Selector

The slave address selector enables you to set the address of the slave panel. A dial switch on the face of the selector is labeled 0 –7, with each number representing a unique address. Address 0 is reserved for the master panelboard. If the power supply or controller is plugged into any control bus on the subnet, address 0 should not be used as a slave address.

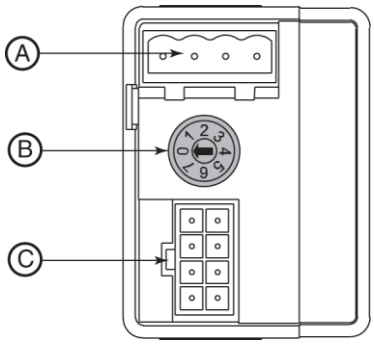
**Figure 16: Slave Address Selector**

KEY:

A. Subnet cable to master panel power and next panel subnet connector

B. Address setting dial

C. Slave address interconnect cable (NF2HG3)




Only two control buses may be connected to a slave address selector. If a second control bus is located in the same slave panelboard, a slave bus interconnect cable is required for connecting the slave address selector to the second bus. For proper operation of the system, always install the slave address selector on the left control bus. Each slave address selector must also have its own unique address. If two or more selectors contain the same address, improper operation may result.

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**Figure 17: Slave Address Selector Assembly**

KEY:

A. Slave address selector

B. Slave bus interconnect cable connections

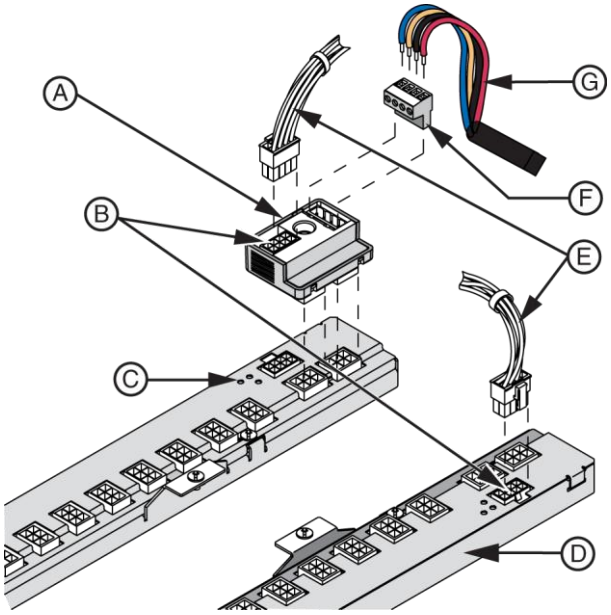
C. Left control bus

D. Right control bus

E. Slave bus interconnect cable (NF2HG3 or NF4HG3)

F. Subnet connector

G. 4-wire, 18AWG subnet cable




## Subnet Conductors

The National Electrical Code (NEC) classifies the Powerlink G4 subnet communications wiring as a Class 1 circuit. Thus, the conductors must be sized and insulated from the line voltage of the panelboard. To meet Class 1 requirements, conductors should be 18 AWG and installed in conduit or an appropriate raceway.

Four conductors are required for the subnet. Two conductors carry 24 Vdc power to the control buses, while the other two are used for the data path. Approved cables are 4-wire, 18 AWG, Class 1 subnet cables such as General Cable236100, Belden 27326, or equivalent.

The total distance of the conductor length from the power supply to the farthest control bus depends on the power supply voltage. The table below list maximum wiring distances based on nominal voltages.

**Table 6: Maximum Wiring Distances**

| Nominal Voltage* | Power Supply Part Number | Maximum Cable Length |
|---|---|---|
| 120 | NF120PSG3 | 400 ft (122 m) |
| 220 | NF240PSG3 | 100 ft (30 m) |
| 240 | NF240PSG3 | 400 ft (122 m) |
| 277 | NF277PSG3 | 400 ft (122 m) |

*Phase to neutral voltage

*NOTE: If the Master Panel is in the middle of the subnet daisy chain network, the subnet distance limits above apply to each direction of the subnet. Star connections are not recommended.*

With the exception of setting the slave address selectors, no additional setup is required for commissioning the subnet communications network.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## Automation Network Communications

The Powerlink G4 controllers feature an automation network for communicating with other controllers. Three communication ports are available on the controller: RS-232, RS-485, and Ethernet.

There are three RJ485 ports on the controller. One RJ45 port is located externally on the front of the controller. This port is used to temporarily connect multiple NF3500 controllers to a PC for configuration with LCS software. Two RJ485 ports are located inside the class 2 wiring compartment and are used for permanent ethernet communications wiring connection.

**Figure 18: Controller Wiring Compartment Components**

KEY:
A. RJ45 ports
B. RS232 terminals
C. RS485 terminals
D. Input Terminals
E. Earthing (Ground) Terminals

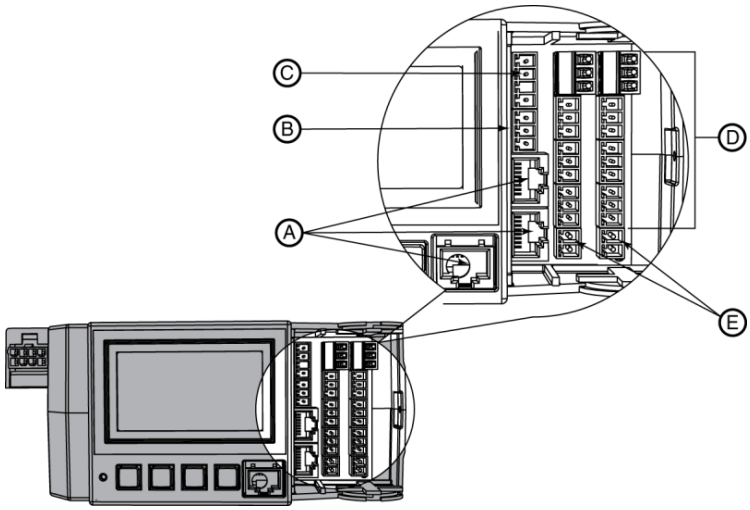
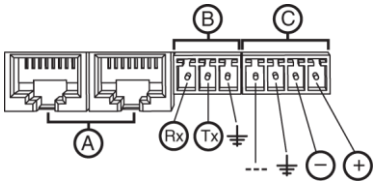



**Figure 19: Controller Class 2 Communications Terminals Detail**

KEY:
A. RJ45 ports
B. RS232 terminals
C. RS485 terminals




RS-485

Multiple controllers can be networked together by wiring the system using the RS-485 port on the controllers. The figure below shows a typical configuration where three master panels are shown (each controlling its own independent subnet.)

A maximum of 247 controllers can be connected together. Use a line repeater for each group of 32 controllers. The maximum cable distances at various baud rates are listed in following table.

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**Figure 20: RS485 Automation Communications Wiring**

KEY:

A. Master panel
B. Slave panel
C. PC or modem
D. RS232 to RS485 converter
E. Power supply
F. Controller
G. RS485 Daisy chain, 2-wire, twisted pair Belden 9841 or equivalent

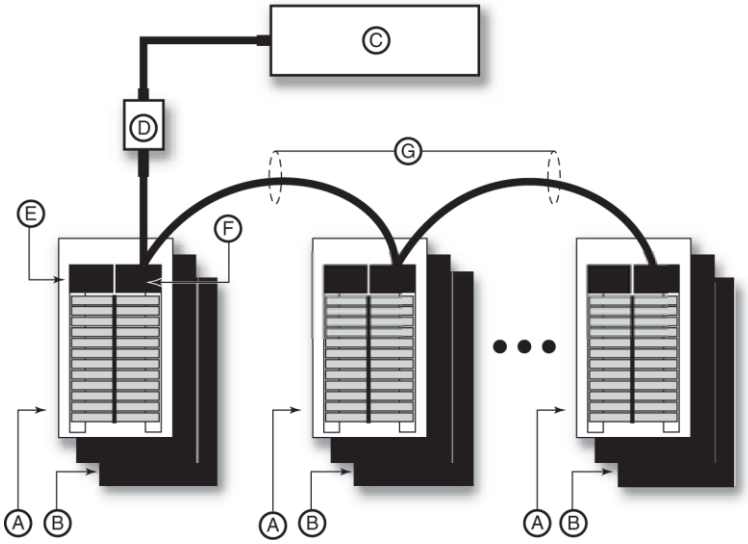


**Table 7: Maximum Communication Cable Distances**

| Baud Rate | Maximum Distances | | |
|---|---|---|---|
| | 1–8 Controllers | 9–16 Controllers | 17–32 Controllers |
| 115,200 | 3,000 ft (914m) | 3,000 ft (914 m) | 2,000 ft (609 m) |
| 76,800 | 4,000 ft (1,219 m) | 4,000 ft (1,219 m) | 3,000 ft (914 m) |
| 38,400 | 4,000 ft (1,219 m) | 4,000 ft (1,219 m) | 3,000 ft (914 m) |
| 19,200 | 5,000 ft (1,524 m) | 4,000 ft (1,219 m) | 4,000 ft (1,219 m) |
| 9,600 | 5,000 ft (1,524 m) | 5,000 ft (1,524 m) | 4,000 ft (1,219 m) |
| 4,800 | 5,000 ft (1,524 m) | 5,000 ft (1,524 m) | 4,000 ft (1,219 m) |
| 2,400 | 5,000 ft (1,524 m) | 5,000 ft (1,524 m) | 4,000 ft (1,219 m) |
| 1,200 | 5,000 ft (1,524 m) | 5,000 ft (1,524 m) | 4,000 ft (1,219 m) |

RS485 Controller Connections Using a RS232/485 Converter

Connection from the network to a personal computer, modem, or a building management system with the appropriate interface drivers often requires the use of a converter that will convert the RS485 signal to an RS232 signal. When the automation network is connected to the serial port (comms port) on the computer, the Powerlink Controller Software can be used. A female DB9 to female DB9 cable is required for the connection from the computer serial port to the converter.

Schneider Electric offers a standard RS232/485 converter kit that includes the converter, power supply, and serial cable (6382RS485G3KIT). Typical connection of this kit to the automation network is shown in the figure below. The communication wires are daisy-chained from one controller RS485 port to the next in the following manner:

- Positive to positive (+ to +)
- Negative to negative (– to –)
- Shield to shield


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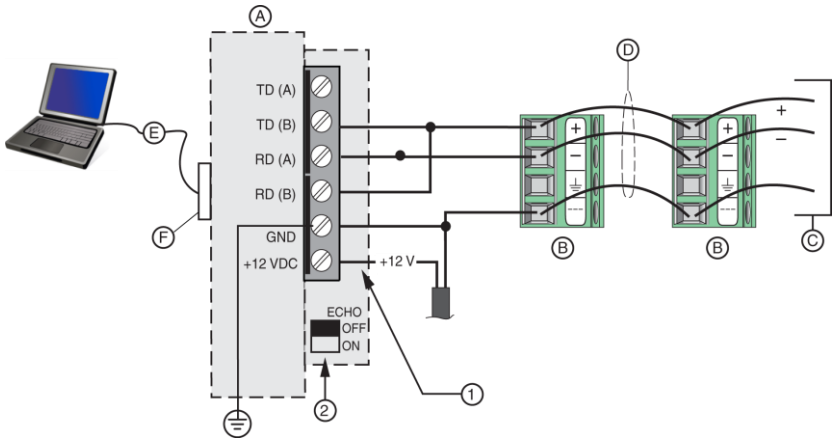
**Figure 21: 2-Wire, RS485 Connection Using a Converter Kit**

KEY:
A. RS485 converter communications terminal
B. Controller RS485 connection
C. To next controller master panel
D. RS-485 daisy chain, 2-wire, twisted pair, Belden 9841 or equivalent
E. Serial cable (RS232 DB-9)
F. RS232 female DB-9 terminal
1. Black/white stripe wire to power supply
2. Jumper on ECHO OFF
NOTE: Ground shield in one location only




RS485 Controller Connections Using DMX512

A DMX512 master may be connected to the controller via the internal RS485 port. Refer to the wiring setup table below. See the instruction bulletin, "Powerlink NF3500G4 Controller User's Guide." for more information on using the controller with DMX512 systems.

**Table 8: DMX512 Communications Wiring Setup**

| Use | 5 Pin XLR PIN # | DMX512 Function | Controller |
|---|---|---|---|
| Cross reference | 1 | Data Link Common | COM 1: shield |
| Primary Data Link | 2 | Data 1 - | COM 1: NEG ( –) |
| | 3 | Data 1 + | COM 1: POS (+) |
| Secondary Data Link (Optional) | 4 | Data 2- | Not used |
| | 5 | Data 2 + | Not used |

Automation Communications Wiring Specifications

The National Electric Code (NEC) classifies automation communications wiring as a Class2 circuit. Conductors may range in size from 24 to 18 AWG and consist of a single set of twisted pair conductors with a shield (Belden 9841 or equivalent). Maximum wiring distance should not exceed 5000 ft (1524 m) at 19,200 baud for eight controllers. See table "Maximum Communication Cable Distances " for more information about maximum communication cable distances at various baud rates.

Shielding and Grounding

The automation network shield should be grounded in one place only, typically at the RS232/485 converter as shown in the figure, "Alternate Controller Communications Wiring Detail for 3-wire, RS-485 Systems".

The controller circuitry and associated Class 2 wiring is electrically isolated from all system voltages and earth ground. Maintaining the integrity of this isolation is important for proper operation and performance.

The controller’s input terminals and auxiliary power source are part of the Class 2 circuitry. External devices connected to the controller must meet the isolation requirements and other Class 2 wiring standards. Do not connect the controller to external voltage sources or earth ground.

The RS485 network communications circuit is also part of the Class 2 circuitry. In most applications, the shield of each communications cable will be interconnected at the center terminal of the communications connector. This connection ensures networked controllers are tied together to a common reference potential. The shield must be grounded at only one point in the system. Grounding the shield at multiple points will create a “ground loop” that may disrupt communications or cause damage to the controller circuitry.

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## Alternate RS485 Wiring

An alternate RS485 wiring scheme that uses a third reference wire is preferred in certain applications:

- When you cannot avoid connecting the Class 2 input circuitry to earth/ground.
- When an external device's isolation from ground is minimal.
- When the controller is installed on a network with non-isolated devices.

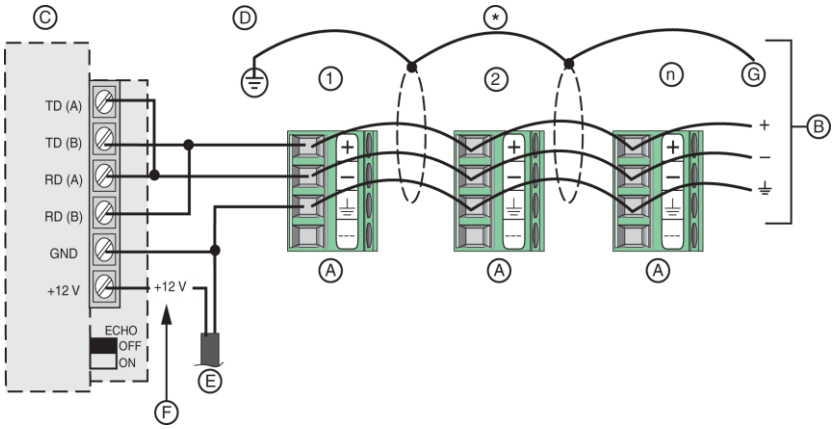
This 3-wire method uses a separate reference wire, or pair of wires, to interconnect the center terminal of all communications connectors See figure "Alternate Controller Communications Wiring Detail for 3-wire, RS-485 Systems."

The shield should remain isolated from the controller and should not be connected to this point. Instead, interconnect the shields using a wire nut.

Connect the shield to ground at only one point.

**Figure 22: Alternate RS485 Wiring**

KEY:
A. RS485 port on controller
1. Controller comms terminal in master panel 1
2. Controller comms terminal in master panel 2
n. Controller comms terminal in master panel (n)
B. To next controller
C. RS485 converter
D. Earth/ground shield in one place only
E. Power supply
F. Black/White stripe conductor to 12
G. Shield

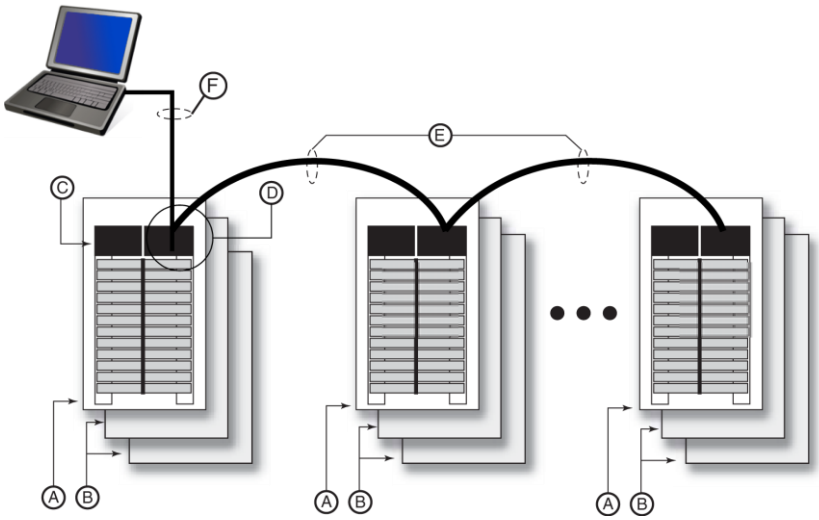



## RS232 Serial Communications

In addition to the RS-485 communications port, the controller has an RS-232 port for direct connection to personal computers, modems, or other devices that support MODBUS ASCII or RTU communications as shown in the figure below. Because it is a direct RS-232 connection, no converter is required. However, the total length of the RS-232 wiring should not exceed 50 ft (15 m).

**Figure 23: RS232 Controller Serial Connections**

KEY:
A. Master panels
B. Slave panels
C. Power supply
D. Controller RS232 connection (Refer to the figure "RS232 Controller Serial Connection Detail"
E. RS485 daisy chain, 2-wire, twisted pair Belden 9841 or equivalent, up to 5000 ft (1524 m)
F. RS232 Serial Cable up to 50 ft (15 m)





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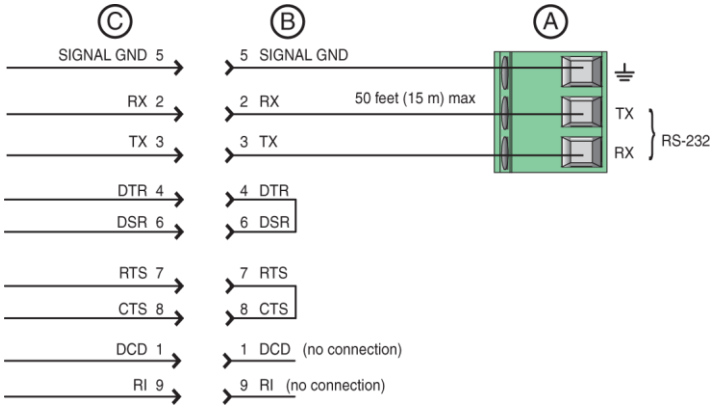
RS232 Connection to a Personal Computer

To make the serial communications connection using the RS232 port of the controller, use a standard RS232, 9-pin DB-9 connector and serial cable. Refer to the figure below for wiring connection information.

**Figure 24: Serial Communication Connections Using the RS232 COMMS Port of the Controller**

KEY:
A. Controller terminal
B. Cable - DB9 (female)
C. PC serial connection DB9 (male)




**Installing the Class 2 Barrier**

All connections to the wiring compartment of the controller are classified as Class 2 circuits. As such, these circuits must be separated from Class 1, electric light, and power circuits. There are two ways to separate the wiring. The first is to maintain a minimum amount of spacing between the circuits. The second is to install a Class 2 barrier.

A flexible barrier is provided with the controller. The barrier provides circuit separation in situations where maintaining minimum spacing is not practical.

No fittings are required to attach the class 2 barrier to the controller.

Follow the safety precautions and instructions below to install the Class 2 barrier.

**⚠ DANGER**

**HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E in the USA, CSA Z462, or applicable local standards.
- This equipment must be installed and serviced by qualified electrical personnel.
- Turn off all power supplying this device and the equipment in which it is installed before working on the device or 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.
- Before energizing panelboard, all unused spaces must be filled with blank fillers.

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

1. Turn off all power supplying this device and the equipment it is installed. Verify that the power is off using a properly rated voltage sensing device.
2. Remove the wiring compartment cover by pressing on the retaining tab (or use a small screwdriver), then slide the cover up and away from the controller (See the figure, "Installing the Class 2 Barrier").
3. Remove the conduit plug by pulling down and out on the conduit plug.

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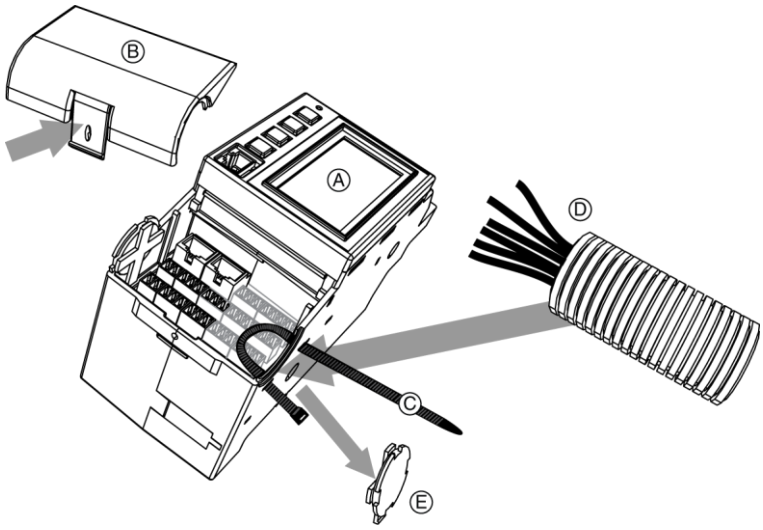
**Figure 25: Installing the Class 2 Barrier**

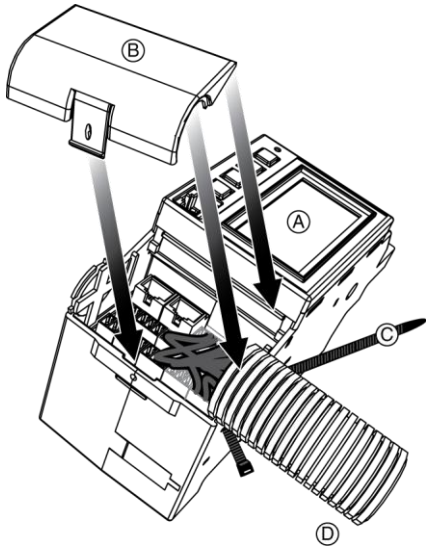
KEY:
A. Controller
B. Wiring compartment cover
C. Cable tie
D. Class 2 conduit
E. Class 2 conduit knockout




4. Thread the optional tie wrap (supplied) through the holes on the controller as shown below.

**Figure 26: Securing the Class 2 Barrier**

KEY:
A. Controller
B. Wiring compartment cover
C. Cable tie
D. Class 2 conduit




5. Locate and remove a knockout on the top of the panelboard near the controller. If not using a conduit, apply a fitting where the knockout was removed. This will protect the wires coming into the panelboard.
6. Pull the Class 2 wires into the panelboard through the hole in the panelboard.
7. Determine the length of the barrier by measuring the distance from where the wires enter the panelboard to the controller wiring compartment.
8. Cut the barrier slightly longer than the measured length to allow enough of the barrier to enter the wiring compartment.
9. Thread the wires into the barrier and slide the barrier up to the hole in the panelboard.
10. Cut the wires to length and terminate them according to the input wiring and communication wiring requirements described in the "Input Wiring" and "Subnet Wiring"sections.
11. Optional: Close the tie wrap around the barrier to secure the wires and barrier to the controller.
12. Position the cover over the wiring compartment and snap it into place.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## CUSTOMER SUPPORT AND SERVICE

Contact your local Schneider Electric service representative for repairs or service to your network.

You may also find helpful information on our web site at www.schneider-electric.com.

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