



Digital Lighting Systems, Inc

Protocol Dimming System

PROTOCOL

System Planning & Hardware



INSTALLER MANUAL

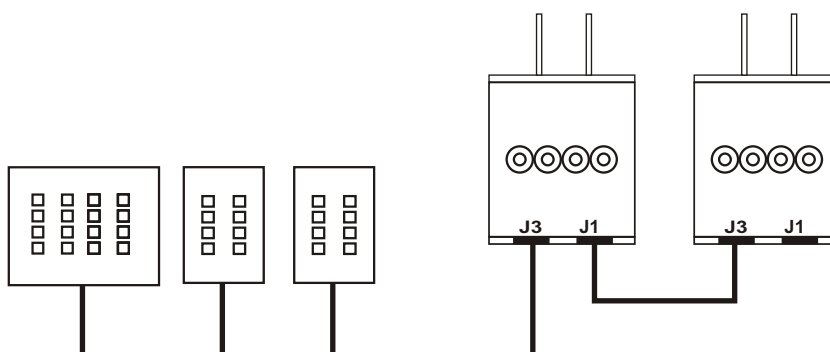


TABLE OF CONTENTS

I- INTRODUCTION	1
II- SYSTEM PLANNING	
A- Features and Capabilities	1
B- PS Series Wall Stations	2
C- PD Series Dimmer and Switch Modules	2
D- DB44 Power and Data Distribution Panel	2
E- RAU-96 Remote Access Unit	3
F- External Modem	3
G- Control Cable and Pigtail Connectors	3
H- DCI-16 Dry Contact Input Interface	3
I- DCO-4 Dry Contact Output Interface	4
J- PTX Patch Panels	4
K- DLC Data Line Conditioning Module	4
L- Custom Accessories and Interface Modules	4
III- HARDWARE INSTALLATION	
A- Component Locations	
1- PD Series Dimmer and Switch Modules	5
2- Control Stations	5
3- DB44 and WT10/30 Low Voltage Transformers	5
4- RAU-96 Remote Access Unit	5
5- External Modem	5
6- DCI-16 and DCO-4 Dry Contact Relay Modules	5
B- Component Low Voltage Wiring	
1- Stations Low Voltage Wiring	6
2- PD Series Dimmer and Switch Module Low Voltage Wiring	6
3- DCI-16 and DCO-4 Low Voltage Wiring	6
4- RAU-96 Low Voltage Wiring	6
5- External Modem Low Voltage Wiring	6
C- Connecting Loads and Power Feeds to PD Dimmer and Switch Modules	7
D- Continuity Check and Final Connections	
1- Checking For Low Voltage Wiring Short Circuits	7
2- Visual Inspection and Final Connections	7
IV- SWITCH FUNCTION AND OPERATION GUIDE	8
V- SYSTEM PROGRAMMING AND TESTING	
A- Powering Up The System	9
B- Connecting To The System Via Modem	9
C- Connecting To The System Via PC/Laptop	9
D- System Check	9
VI- CUSTOMER SUPPORT	9
DRAWINGS	
PHM-001	Protocol System Overview
PHM-002	PD Series Dimmer and Switch Pack Low Voltage Wiring
PHM-003	Low Voltage Wiring of Systems without External Transformer
PHM-004	Control Stations Low Voltage Wiring
PHM-005	Dry-Contact Interface Low Voltage Wiring
PHM-006	DB44 Power and Data Panel Low Voltage Wiring
PHM-007	RAU-96 and Modem Wiring
PHM-008	Device Addressing & Miscellaneous Diagrams
APPENDICES	
Appendix A	Decimal to Hexadecimal Address Table
Appendix B	PD Series Dimmer and Switch Pack Load Schedule Worksheet and Explanation Sheet
Appendix C	Switch Assignment Worksheet and Explanation Sheet
Appendix D	Button Numbers Placement Chart
Appendix E	Control Modules Wire Gauge Chart
Appendix F	New Preset Lock and Unlock Procedure

I- Introduction

The Protocol is a high-tech lighting control and dimming system, designed specifically to meet the demands of today's sophisticated and energy conscious consumers. Its state-of-the-art intelligent electronics, combined with the compact and elegant look of the wall switches, brings both form and function to the fingertips of the user. Whether the Protocol is controlling lighting in a home, office, hospitality area, place of worship, or in any other private or public space, the occupants will have a unique experience with the ease of use, comfort, and convenience that the PROTOCOL dimming system can provide by giving the user total control of lighting and other electrical devices.

CAUTION: DO NOT CONNECT garbage disposals to the PROTOCOL system. Use a conventional wall switch instead.

II- System Planning

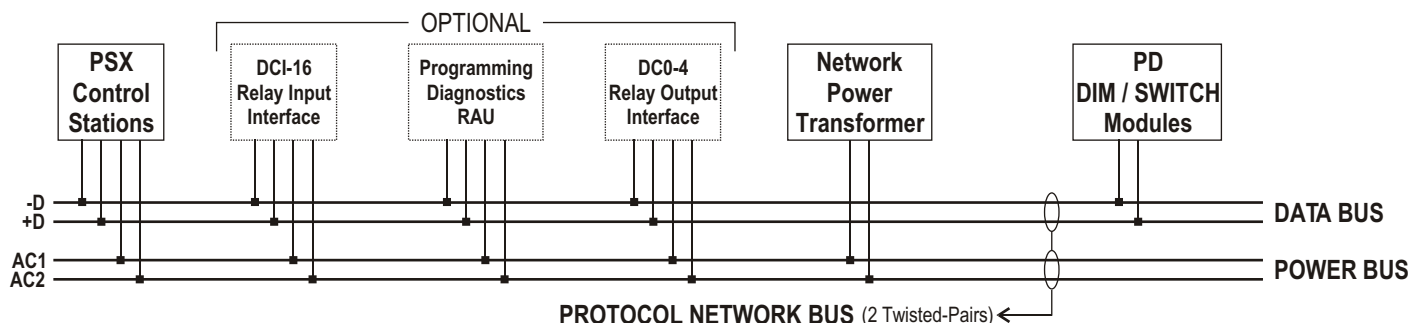
A- Features and Capabilities

The **PROTOCOL** is a powerful and extremely flexible lighting controller. Where and how it is applied is only a function of one's vision and creativity. Here are some of the most powerful features that the Protocol system brings to the user:

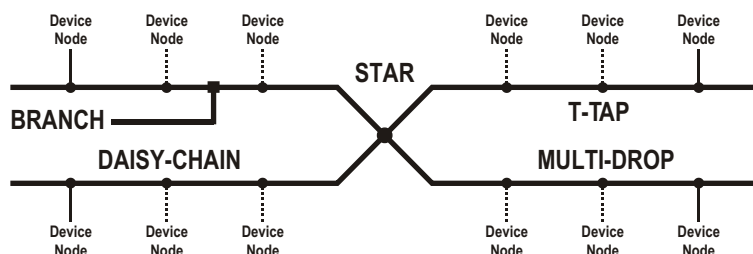
- * Flexibility to control and/or dim a light or a group of lights from any or several different locations.
- * Non-volatile system memory allowing users to store their favorite mood or event-based lighting scenes.
- * Capability to reconfigure the lighting controls quickly and easily before, during, and after installation.
- * Distributed processing which makes total system shut-down virtually impossible. Unlike other systems, each Protocol component communicates with the others without relying on a central unit that may fail and cripple the entire system.
- * Modular design with a minimal amount of circuit components.
- * In-field Programming, Diagnostics and Troubleshooting.
- * On-line Programming, Diagnostics and Troubleshooting. This is particularly useful if help is needed from the factory.
- * Intuitive and Easy to Use Windows-based User Software for programming and setting up the system.

Digital Lighting Systems takes great care in building and fully testing every system prior to release. Understanding the system architecture combined with a little careful planning, at the beginning of the project, will ensure a smooth installation, a trouble-free operation, and an end system that will conform to the expectations of the user. Blank forms which can help in planning and organizing your work are provided with this manual. The following diagram illustrates the architecture and basic elements of the Protocol System.

Protocol System Architecture & Devices



Protocol Network Bus Topology



General Notes

- Basic PROTOCOL Components consist of Stations, Dimmer/Switch Modules, Low Voltage Transformer and a 4-wire Network Bus. No MCU or CCU.
- The Network Bus consist of a Data twisted-pair and a Power twisted-pair.
- The Protocol Low Voltage Network Topology may be a combination of Star, Branch, T-tap, Multi-drop and/or Daisy-Chain.

B- PS Series Wall Stations

PS Series Control Stations are microprocessor based with non-volatile memory and are available with 2 to 16 Switches (Buttons). Each switch may be programmed to be either a Dimmer, Raise, Lower, Toggle, On, Off, Preset, or Momentary. A Switch may be assigned from 1 to 24 loads (zones). Any Switch may be made "Global" to address the entire system with provisions to exclude up to 24 loads (zones). An LED above the switch reflects the status of its loads/Presets. Stations are available with an infrared receiver and can be controlled from a universal IR remote. The stations must be mounted in Grounded masonry boxes or be grounded through the system wiring using the 5th green wire of its pigtail.

A unique address must be set using two hexadecimal rotary selectors on the back of the station. Refer to **Appendix A** for proper address setting. Station addresses must start at 1 and end with the number of the last station used. If DCI-16 input interface modules are used, they are considered as stations by the Protocol and their addresses must not conflict with station addresses. Up to 99 16-button stations can be used per system. A switch (button) in a station is referred to by the configuration software as SS.nn, where SS is the station address and nn is the switch number. For example switch 11.09 represents station #11 - Switch #9. (Refer to **Appendix D**). The stations connect to the Protocol network bus using a 4-wire plug-in pigtail. Appendix E contains a chart for determining the maximum number of stations that can be connected to a single network cable run. Stations derive power from an external low voltage transformer. The DB44 is a power and data distribution panel which can be used to facilitate wiring of stations.

Refer to Drawing **#PHM-004** for additional information.

C- PD Series Dimmer and Switch Modules (PD MODULES or PD's)

The **PD Series Dimmer and Switch Modules** are microprocessor based with non-volatile memory. They control between 2 and 8 individual loads and are available in dimmer and a switch version for non-dim loads. Dimmer versions may also switch. **PD Modules** are all fed in the same manner, by two 20A circuit breakers on the same electrical phase. **PD Modules** come in a surface mount aluminum enclosure. The **PD Module** dimensions are 11-5/8"(H) x 8-1/2"(W) x 4-1/4"(D). They have three 1/2" or 1/3" knockouts for electrical conduit at the top of the enclosure and one on each side.

PD216/-S controls 2 x 16 Amp loads (2 x 1920 W @ 120 V), **PD408/-S** controls 4 x 8 Amp loads (4 x 960 W @ 120V), **PD804/-S** controls 8 x 4 Amp loads (8 x 480 W @ 120 V). Units are available in 12v, 24v, 120v, 220v versions.

PD Modules may be mounted near the breaker panel or close to the loads to minimize line-voltage wire runs. The area must be well ventilated and the ambient temperature must not exceed 110 °F (43.3 °C) for full load operation. Allow 4" side clearance for proper air circulation. **PD Modules** may create some buzzing noise and should not be located where this will be objectionable.

A unique address must be set using two hexadecimal rotary selectors on the front panel (**PD804** has two sets of rotary selectors and is treated by the system as two **PD'S**). Refer to **Appendix A** for proper address setting. **PD** addresses must start at 1 and end with the number of the last one used. If **DCO-4** output interface modules are used, they are considered as **PD's** by the **PROTOCOL** and their addresses must not conflict with other **PD** addresses. Up to 63 master **PD's** and 3 slave **PD's** per master can be used in a system. The front panel has four LED's which mimic the status of the high-voltage outputs (the **PD804** has eight LED's, four for each set of four circuits). An output (channel) in a **PD** unit is referred to by the configuration software as PP.c, where PP is the **PD** address and c is the output number. For example output 14.2 represents **PD** #14 – Output #2.

The **PD Dimmer** derives low voltage power from its built-in transformer. Generally, a 2-wire data only connection with the Protocol network bus is necessary. Pre-terminated cables and pigtails are available from the factory for daisy-chaining several **PD Dimmer Modules**.

Special Case

Protocol systems with 3 control modules (stations, **DCI-16's**, **DCO-4's**, **RAU-96's**...) or less can use a **PD Module** to supply low voltage to the network. The external network power transformer is not required.

Refer to the **PD Module** User Manuals and Drawings **#PHM-002** and **#PHM-003** for more details.

D- DB44 Power and Data Distribution Panel

The **DB44** panel provides a convenient way for splicing Protocol network bus branches. It also supplies wall stations and other control devices with interruptible power from an external low voltage transformer. The **DB44** also has a socket to connect the **RAU-96** for system programming, control, and diagnostics. The transformer is supplied by the factory and its output capacity is determined by the number of stations in the system. The **DB44** does not perform any system control or processing functions. The **DB44** panel mounts in a 2-gang masonry box and may be installed along with the external transformer near the distribution panel or the **PD Dimmers**.

Refer to **DB44** specifications sheets and Drawing **#PHM-006** for additional information.

E- RAU-96 Remote Access Unit (Optional)

The Remote Access Unit (**RAU-96**) interfaces the Protocol system (stations, dimmers, etc...) to a personal computer (PC) or to a stand-alone modem for on-line access from a remote PC. The **RAU-96** features a simple to use menu-driven user interface that allows the user to perform three basic functions:

- Configure and/or modify the configuration of system components (stations, dimmers, etc...).
- Perform diagnostics and help with troubleshooting.
- Perform direct control of the loads via DLS's **SOFTPRO** or third party software interfaces.

The **RAU-96** comes in a plastic table top box measuring 4.25" x 6.125" x 1.625". It connects to the system network bus via a special socket in the **DB44** panel, using a special cable (**RAU-CC**). Another special cable (**RS232-CC**) is used to connect the RAU to the PC or to the modem.

Usually Protocol systems are pre-configured at the factory as required by the end user. If changes are required later, they may be performed at the job site or remotely and downloaded to the system via modem. The **RAU-96** operating instructions are provided in the PROTOCOL's software manual.

Refer to **RAU-96** specifications sheets and Drawing **#PHM-007** for more information.

F- 9600 BAUD External Modem (Optional)

The external modem is used when the system is being accessed from an off-site personal computer. It is a simple, Hayes Compatible, analog data modem operated at 9600 BAUD. It connects to the **RAU-96** using the (**RS232-CC**) cable. The modem must be connected to a direct Fax/PC telephone line using a standard RJ11 cable (**TEL-CC**). Upon power-up, the RAU initializes the modem with the proper communications parameters.

Refer to **RAU-96** specifications sheets and Drawing **#PHM-007** for more information.

G- Control Cable and Pigtail Connectors

The Protocol network bus cable consists of a data twisted-pair (-D / +D) and a low voltage twisted-pair (AC1 / AC2). The data pair carries system commands and information and must be connected to all Protocol devices. The low voltage pair is used to supply power to all low voltage Protocol control devices. **PD Modules** contain individual transformers and do not connect to the network power bus. An additional earth ground wire may be required for applications using plastic or improperly grounded masonry boxes.

The Protocol network bus may follow a combination of star, branch, T-tap or daisy-chain topologies. The network cable may be Carol Cable #C3362 or equivalent, unless otherwise required. Several network cable runs may be used and spliced together inside the **DB44** panel. Refer to **Appendix E** to determine maximum length of cable runs. Pre-terminated cables, pigtails and cable jumpers are available to facilitate network connections and splicing. In order to minimize wiring errors and facilitate troubleshooting. It is advisable to maintain the same cable color coding scheme shown in drawings.

Refer to Drawings **#PHM-002** through **#PHM-004** for more information.

H- DCI-16 Dry Contact Input Interface (OPTIONAL)

The **DCI-16** is a dry contact input interface module that can be used to link other systems, such as A/V, alarm, time clocks, and energy management to the Protocol system. The **DCI-16** may be viewed as a control station with 16 "phantom" button inputs. A relay closure from an external device connected to the **DCI-16** is interpreted in the same way as a button press on a control station. Switch input functions and control channel assignment are programmed and loaded into the **DCI-16**, as if it were a control station, by means of PROTOCOL programming software. The **DCI-16** address is set similarly to a station address and must not conflict with any station address in the system. Up to 99 input devices may be installed in any one system (**DCI-16's**, **PS Series Stations**, etc...).

Normally, the inputs of the **DCI-16** are programmed as "Preset" functions. An external system is then able to recall up to 16 system presets by momentarily closing and releasing relays connected to the inputs. Relay closures must be maintained for a period of (0.5 +/- 20%) second.

The **DCI-16** comes in an open-frame circuit module that can be integrated into existing system cabinets. It is also available installed inside a 12" x 8" x 4" NEMA enclosure. the **DCI-16** connects to the network bus using a 4-wire pigtail connector.

Refer to Drawing **#PHM-005** for more information.

I- DCO-4 Dry Contact Output Interface (OPTIONAL)

The **DCO-4** is a dry contact output interface module that can be used to link the Protocol to other systems, such as Audio-Visual systems, alarm systems, energy management systems, etc. The **DCO-4** may be viewed as a **PD Module** with "ON/OFF" dry contact outputs. Setting the **DCO-4's** address is similar to setting the **PD's** address. The address used must not conflict with any **PD's** address in the system.

Combining the **DCI-16** input interface module and the **DCO-4** output interface module can provide a simple closed loop communication scheme between the Protocol and other systems. For example, a **DCO-4** relay closure can trigger the alarm system or provide a positive feedback to an external system that initiated a preset recall through the **DCI-16** input interface module.

The **DCO-4** comes in an open-frame circuit module that can be integrated into existing system cabinets. It is also available installed inside a 12" x 8" x 4" NEMA enclosure. the **DCO-4** connects to the network bus using a 4-wire pigtail connector.

Refer to Drawing #PHM-005 for more information.

J- PTX Patch Panels (Special Application)

The PROTOCOL digital patch panels are designed for applications requiring the ability to patch control stations as room configurations change. Common applications of the PROTOCOL digital patch panels include hotel meeting rooms, ballrooms, restaurant banquet areas or other installations that employ moveable partitions. All PROTOCOL patch panels are thin profile and feature front covers with no visible mounting hardware.

The **PTP04** is a digital patch panel with a single gang faceplate that can digitally link control stations up to four partitionable rooms. The **PTP12**, with a double gang faceplate, can digitally link control stations up to 12 partitionable rooms. Typically, each of the rooms in these installations has the same lighting design, and it is recommended to maintain the same lighting design and control functions as the partition is removed. When rooms are combined and control stations are digitally linked, control stations in each of the combined rooms will have full control of programmed button functions. Each room may have up to three additional control stations with the same button configuration, for multi-point control within each room. The **PTP Series** can patch rooms in any possible combinations by simply selecting the rooms using the individual room buttons and saving the selection in nonvolatile memory with a simple push of a button.

The **PTA Series** patch panels are similar in functionality to the **PTP Series**. They feature programmable buttons that can be preset to specific room combinations. These can be programmed at the factory and later modified using the Protocol programming software to accommodate the changing requirements of the application. Users are able to combine or separate rooms by pressing a single button on the panel.

The patch panels are physically and aesthetically identical to **PS Series** control stations. They are addressed similarly to control stations starting at 1 and ending with the last patch panel number in the system. Up to 7 patch panels may be present per system. Patch panel addresses do not conflict with station addresses.

The **PT** patch panels connect to the Protocol network bus using a 4-wire pigtail plug

Refer to **PATCH PANEL** specifications sheets and Drawing #PHM-004 for more information.

K- DLC Data Line Conditioning Module (Special Application)

This module may be required only in environments with unusually high EMI and RFI electrical interference. It may also be needed when network cable lengths exceed fifteen hundred feet. The **DLC** module consists of a circuit board with passive elements. It can be mounted in a single-gang masonry box and connected to the **DB44** panel. Contact factory for more information

L- Custom Accessories and Interface Modules (Special Application)

Digital Lighting Systems can supply application-specific PROTOCOL interface devices. Custom devices include RS232 to PROTOCOL data interface, DMX-512 to PROTOCOL data interface, and 0 - 10 VDC to PROTOCOL interface. All interfaces may be either simplex or half-duplex and are designed and built upon request. Applications include interfacing to touch screens and other input-output devices.

Contact our technical support team with your specific requirements for an estimate on cost and delivery.

III- HARDWARE INSTALLATION

A- Component Locations

Note: Components Locations & Wiring may be indicated in a Job Submittal Document from the factory or from your factory representative.

1- PD Dimmer and Switch Modules

- Select suitable location(s) for the dimmer packs where the ambient temperature does not exceed 110 °F (43.3 °C) for full load operation. **PD Modules** may be located near electrical distribution panels or close to their respective loads.
- Surface mount the dimmer packs in a well ventilated area. Allow 4" of side clearance for proper air circulation. Installation clearance shall meet local and/or NEC code requirements. Enclosures may be attached to the wall or other mounting surface by holes in the heat sink flanges.
- Conduit shall be pulled to the top of the dimmer packs.
- In general, **PD Modules** require connections to the data twisted-pair only.

Refer to the **PD216/PD408/PD804** User Manuals for more information.

2- Control Stations

- As with any other light switches and dimmers, stations should be located in logical places to provide the user with convenient access and natural operation. Station locations should be strategically planned to take full advantage of the preset capabilities of the Protocol system. While creating and storing lighting scenes the user should be able to visually adjust the lighting levels. Stations which are mainly used to recall lighting scenes should be placed in strategic locations, such as main entrances, exits and night tables.
- Locations of stations with IR receiver should be selected so that the IR station is as close as possible to a direct line of sight with the IR transmitter.
- Install a properly grounded masonry box or ground wire for each station. **DO NOT INSTALL** the stations at this point.
- Stations require connections to both twisted-pairs of the network bus. Depending on the total number of stations in the system, several network cable runs may be required. Refer to the stations wiring section in the manual for more details.

Refer to Drawing **#PHM-004** for the proper wall box dimensions.

3- DB44 and WT10/30 Low Voltage Transformers

- The most logical location for the **DB44** and external transformer is next to the largest cluster of **PD Modules**. The **DB44** serves as a home base for all low-voltage cable runs from/to various Protocol system components.
- The **DB44** mounts in a double-gang masonry box.
- The transformer requires a standard 120 VAC wall outlet and should be located next to the **DB44** low voltage distribution panel.
- Protocol network cables may be connected inside the **DB44** panel with or without plug-in pigtails.
- **DO NOT CONNECT** the low voltage secondary of the transformer to TB5 at this time.

Refer to **DB44** specifications sheets and Drawing **#PHM-006** for more information.

4- RAU-96 Remote Access Unit

- The most logical location for the **RAU-96** is next to the **DB44** panel.
- The **RAU-96** comes in a table top box and may sit on a small shelf or on the floor for temporary use.
- Two special cables are supplied with the **RAU-96**. The **RAU-CC** connects it to the a socket on the front of the **DB44** panel. The **RS232-CC** is used to connect the **RAU-96** to a PC or to an external modem.

Refer to Drawing **#PHM-007** for more information.

5- XM-96 External Modem

- The most logical location for the external modem is next to the **DB44** panel.
- The external modem may be set on a small shelf next to the **RAU-96** or on the floor for temporary use.
- The modem requires a standard 120 VAC wall outlet for its external transformer.

Refer to Drawing **#PHM-007** for more information.

6- DCI-16 and DCO-4 Dry Contact Relay Modules

- Both types of components have the same physical specifications. They are available in open-frame for integration into existing systems enclosures or in NEMA enclosures for stand-alone installations.
- These components require connections to both twisted-pairs of the network bus. They may be connected at the **DB44** panel or anywhere on the Protocol network bus cables using a 4-wire pigtail included with each unit.

Refer to Drawing **#PHM-005** for more information.

B- Component Low Voltage Wiring

Note: Components Locations & Wiring may be indicated in a Job Submittal Document from the factory or from your factory representative.

1- Stations Low Voltage Wiring

- ☐ Refer to **Appendix E** to determine the number of separate cable runs needed for the stations.
- ☐ Pull a network bus cable (2 pairs for data & power) for each group of stations as determined in the previous step. For each group of stations, begin at the farthest station from the **DB44** panel and pull the cable in and out of each box leaving a 12" loop in the box. Terminate the cable for each group at the **DB44** panel leaving a 12" lead. For existing installations with plastic or non-grounded metal boxes, a ground wire must be pulled alongside the control cable. No line-voltage or other high-voltage wires are allowed to be closer than 7" from the control cable.
- ☐ At each wall box, splice a **PSXX-PT** pigtail to the cable. Leave enough excess cable to allow the station to be easily pulled out of the box and unplugged.
- ☐ Wire the stations home run cables inside the **DB44**. Connect each cable (-D, +D, AC1 and AC2) to the corresponding terminal of Terminal Blocks TB1 through TB4 (observe conductors color code and/or label). If there are more than four home runs, you may connect two or more home runs to the same terminal block (TB).
- ☐ **DO NOT** plug-in the stations pigtails at this time.

Refer to Drawing **#PHM-004** for more information.

2- PD Series Dimmer and Switch Modules Low Voltage Wiring

- ☐ The **PD Modules** are normally daisy-chained in groups of 32 or less with supplied pre-terminated low voltage cables (31 x **W2J8J10** daisy-chain cables and 1 x **W2J8J8** home run cable to the **DB44** panel for each group of 32).
- ☐ Plug-in all home run cables (**W2J8J8**) into any one of the J1-J4 sockets in the **DB44**, or if a twisted-pair cable (-D, +D) is used, connect it to terminals marked -D and +D, respectively, on Terminal Blocks TB1-TB4 (observe conductors color code and/or label).
- ☐ **DO NOT** plug-in the **PD Modules'** data cables at this time.

Refer to Drawings **#PHM-002** and **#PHM-003** for more information.

3- DCI-16 and DCO-4 Low Voltage Wiring

- ☐ The low voltage wiring of these components is identical to **PS Series** Control Stations Wiring using **PSXX-PT** pigtails.. Refer to paragraph III-B Section 1 above for instructions.
- ☐ **DO NOT** plug-in the components pigtails at this time.

Refer to Drawing **#PHM-005** for more information.

4- RAU-96 Low Voltage Wiring

- ☐ The **RAU-96** is supplied with a factory pre-terminated network cable (RAU-CC).
- ☐ Plug-in the **RAU-CC** cable into the front of the **DB44** panel.
- ☐ **DO NOT** plug the **RAU-CC** into the **RAU-96** at this time.

Refer to Drawing **#PHM-007** for more information.

5- External Modem Low Voltage Wiring

- ☐ For permanent installation, provide a standard RJ11 telephone line outlet for the modem.
- ☐ The RJ11 outlet must be connected directly to an incoming phone line before the PBX switch box (if any).
- ☐ If the modem is to be used temporarily, provide an extension from an existing Fax/PC telephone line to the modem.
- ☐ Plug the modem into the telephone line using the **TEL-CC** cable.

Refer to Drawing **#PHM-007** for more information.

C- Connecting Loads and Power Line Feeds to PD Series Dimmers and Switch Modules

- ☐ Refer to the **PD Module** User Manuals and Specifications Sheets before proceeding.
- ☐ Test each load individually by direct wiring to a breaker protected hot line feed before proceeding to next step.
- ☐ Connect each load to its respective output of each **PD Module**. Use the Job Submittal Document and/or the building plans for the proper location of each load.
- ☐ Connect one or two (as required) 20 Amp. Breakers from the same phase to **H1 & H2** terminals of each **PD Module**.
- ☐ Make sure all breakers feeding the **PD Modules** are turned **OFF** at this time.

CAUTION

Do not connect garbage disposals or any equipment that can cause harm if turned on unexpectedly to the PROTOCOL dimming system. Use conventional mechanical air-gap switches instead. In general, electronic control systems are prone to false turn-on or latching due to voltage spikes and other uncontrollable elements such as lightning strikes.

The PROTOCOL system must be installed by qualified personnel in accordance with all NEC and local codes.

D- Continuity Check And Final Connections

This procedure must be observed to insure that all network data and power cable runs are wired properly and to avoid any possible damage to Protocol components that may result from short-circuits or polarity reversal on any of the network bus wires. This check is performed inside the **DB44** panel.

None of the control stations, interface modules, or PD data cables should be plugged-in at this time.

1- Checking For Low Voltage Wiring Short Circuits

Set your OHM-Meter to "continuity check" and select any one of terminal blocks (TB1-4) for this test.

Start with the black meter lead at position 1 and the red lead at positions 2, making sure that the meter shows an open-circuit. Repeat with the red lead at positions 3, 4 & 5.

Move the black lead to positions 2 and repeat above steps, making sure that the meter always shows an open-circuit. Repeat above with the black lead at positions 3 then 4, etc...

If at any point you encounter a short-circuit between any of the conductors, check all your cables and repeat previous steps 1-3 until all connections show an open-circuit.

2- Visual Inspections & Final Connections

- ☐ Perform a visual inspection to make sure that -Data & +Data are not reversed anywhere in the cables or pigtails.
- ☐ Make sure the **DB44** power toggle is in the Off position.
- ☐ Connect the Secondary of the external transformer to TB5 at positions 1 & 2. Polarity is not critical.
- ☐ Plug the **RAU-CC** cable into the RJ45 network port of the **RAU-96**.
- ☐ If you are planning to use a personal computer to communicate with the system, plug-in connector (P) into the desired COM port (COM Port 1-4) of your PC. Leave connector (M) unplugged. Flip the **RAU-96's** mode switch to the PC position and leave the **RAU-96** Off at this time.
- ☐ If you are planning to dial into the system from a remote site, plug-in connector (M) into the modem's DB-25 female connector. Leave connector (P) unplugged. Flip the **RAU-96's** mode switch to the MODEM position and leave the **RAU-96 OFF** at this time.
- ☐ If not pre-set at the factory, set the station addresses according to the building plans. Determine the specific location of each station according to its address or label. Plug the respective pigtail into the back of the station and secure the station to its wall box. (If address is not pre-set at the factory, refer to **Appendix A.**)
- ☐ If not pre-set at the factory, set the **DCI-16** and the **DCO-4** address according to the building plans. Plug-in their respective pigtails. (If address is not pre-set at the factory, refer to **Appendix A.**)
- ☐ If not pre-set at the factory, set the **PD Modules** addresses according to the building plans. Plug-in their respective pigtails. (If address is not pre-set at the factory, refer to **Appendix A.**)

IV- Switch Function And Operation Guide

The switches (buttons) in the control station operate in different ways depending on the function that they were assigned during system configuration using the PROTOCOL Software. The switch function and the loads associated with it may be changed at any time. For example, a button on a particular station may be programmed as a RAISE Switch for loads 1.1, 1.4, 4.4, 5.3 and 6.1. At a later time, its function and/or loads may be modified by connecting the **RAU-96** to the system and downloading a new station file. Following is a description of available functions and their use:

TOGGLE Switch

The Toggle function works alternately. When the switch is pressed, its load(s) will turn ON if previously OFF or will turn ON if previously On. The associated LED mimics the status of the load(s) If any of the loads is On, the LED will light, else it will extinguish. This type of switch should be used for relays, motors, or other non-dimmable fixtures.

DIMMER Switch

This type of switch combines dimming and toggling. About 0.5 sec. after the switch is pressed and held, the lighting level starts to increase until maximum trim is reached. After 1.5 sec., if the switch remains pressed, the lighting level starts to decrease until minimum trim is reached. This up-down ramping continues until switch is released. At this point the last level reached is stored in memory. Momentarily pressing the switch toggles the lighting level between Off and the last stored level. The LED associated with this switch mimics the status of the load. It will light if the level is greater than 0% and will extinguish otherwise.

ON Switch

Momentarily pressing the switch turns the lights to the level that was specified during switch configuration. The default value is 100%. If a 90% level is programmed, then the lights will turn on to 90% every time this switch is pressed. The LED associated with this switch mimics the status of the load. It will light if the level is greater than 0% and will extinguish otherwise.

OFF Switch

Momentarily pressing the switch will always turn the lights Off. The LED associated with this switch mimics the status of the load. It will light if the level is greater than 0% and will extinguish otherwise.

RAISE Switch

Pressing the switch will increase the light level for as long as the switch is pressed. When the desired level is reached release the switch. If the level reaches 100%, no further action is taken. The LED associated with this switch mimics the status of the load. It will light if the level is greater than 0% and will extinguish otherwise.

LOWER Switch

Pressing the switch will decrease the light level for as long as the switch is pressed. When the desired level is reached release the switch. If the level reaches 0%, no further action is taken. The LED associated with this switch mimics the status of the load. It will light if the level is greater than 0% and will extinguish otherwise.

MOMENTARY Switch

As the name implies this type of switch turns a load on for as long as it is pressed and turns the load off when released. It is useful for controlling curtains and screens. The LED associated with this switch turns on only while the switch is pressed.

PRESET Switch

This switch is used to store or recall lighting scenes for a single load or group of loads. A group of loads may have several Preset Switches. Each switch must be assigned a different preset number, unless you want a duplicate preset on another station.

Storing a PRESET Scene

Adjust the lights to desired levels using their individual dimming switches. Press and hold the Preset switch until LED's on the station flash (after 4 seconds). The lighting levels are now stored. See **APPENDIX F** for more information.

Recalling a PRESET Scene

Momentarily press the switch. Upon release, all loads associated with the switch will return to their previously stored levels. Dimmed-loads will go through a gradual level change. Non-dimmed loads will return to either full on or full off, depending on their previous state during the store operation. The associated LED turns on during recall and remains on until another Preset switch for the same group of loads or a Global (All loads) Preset is recalled. The **RAU-96** provides a way to lock and unlock the Store Preset function on any station to prevent inadvertent overriding of stored scenes. In a new feature, this locking and unlocking feature is now also available from the station itself.

Please see Appendix F for information on locking and unlocking station to allow setting of preset scenes.

V- SYSTEM PROGRAMMING AND TESTING

A- Powering Up the System

Turn the **DB44** panel on.

Observe the LED's on the wall stations. They should flash for a few seconds and stop.

Energize the **PD Modules** by turning on their respective breakers.

If configuration files have been previously generated and downloaded to the various PROTOCOL devices, proceed to the system check, **Section D**. If you are accessing the system from a PC follow the steps in **Section C**, otherwise follow the steps in **Section B** for accessing the system via modem.

B- Connecting to the system Via XM-96 Modem

- * Connect the **RS232-CC** cable between the **RAU-96** and the **XM-96** external modem.
- * Connect the modem to the phone line.
- * Plug-in the **RAU-CC** cable into the RJ45 network port on the **RAU-96**.
- * Flip the **RAU-96** PC/MODEM toggle switch to MODEM.
- * Turn the **XM-96** Modem on by energizing its wall adapter. Some of the LED's on the modem panel should be lit indicating that the modem is powered up.
- * Turn the **RAU-96** on and observe the Tx & Rx Led's on the modem. After about 8 seconds they should flicker indicating that the **RAU-96** has initialized the modem and the modem is ready to answer a call from a remote computer.
- * Refer to the **Protocol Software / RAU-96 User Guide** for programming instructions.
- * After downloading the system configuration files proceed to **Section D**.

C-Connecting to the system Via PC/Laptop

- * Connect the **RS232-CC** cable between the **RAU-96** and an available COM port on the PC.
- * Plug-in the **RAU-CC** cable into the RJ45 network port on the RAU.
- * Flip the **RAU-96** PC/MODEM toggle switch to PC.
- * Turn the **RAU-96** On.
- * Refer to the **Protocol Software / RAU-96 User Guide** for programming instructions.
- * After downloading the system configuration files proceed to **Section D**.

D- System Check

Using the station configuration worksheets (**Appendix C**), determine the station number of the nearest station. The switch functions and loads are listed next to each switch number on the worksheet. Using the switch function guide in **Section IV**, activate each button and check the response of its respective loads. For example if switch #1 is shown as a TOGGLE for Load 6.4, pressing the switch should turn on or off output #4 of dimmer module #6. Check the remainder of the stations for proper operation. Follow the guide in **Section IV** for storing scene presets. If you encounter problems, use the **RAU-96** to perform system diagnostics and troubleshooting.

If you need assistance contact our technical support department at the numbers listed below.

VI- CUSTOMER SUPPORT

For help with planning, specifications, installation, and troubleshooting, please contact your local factory representative or our technical support department at:

Tel: 305-264-8391 or Toll free: 1-877-264-8391

We can be reached by e-mail at the following address:
or by filling out the Message Form posted on our web site at:

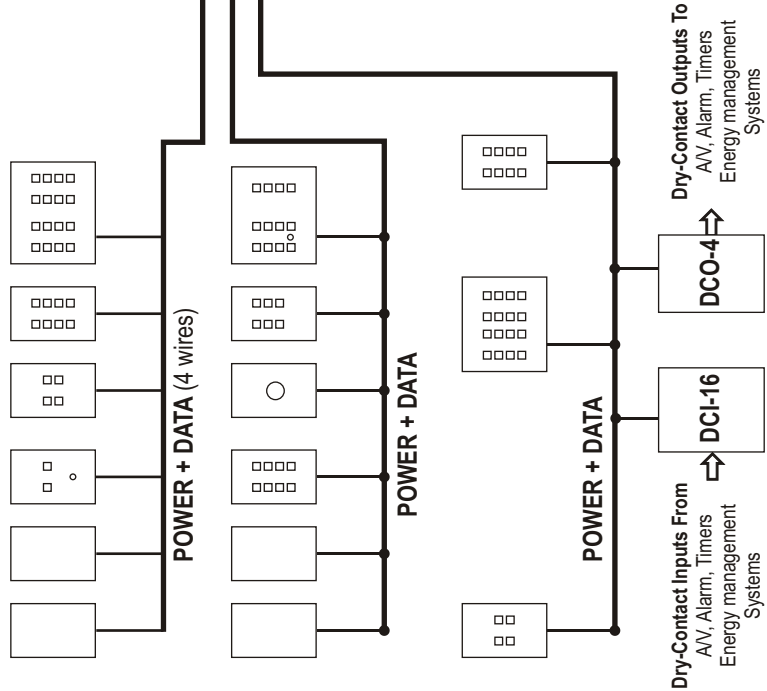
info@digitallighting.com
www.digitallighting.com

NOTES

[illegible]

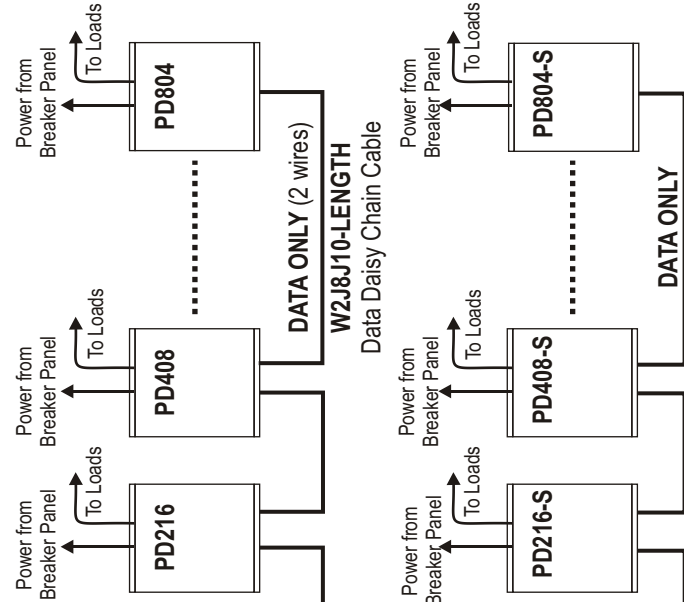
Protocol Control Modules

Stations, Patch Panels, DCI-16's, DCO-4's ...



Control Modules Notes

- Protocol control modules consist of wall stations, patch panels, **DCI-16** dry-contact input interfaces, **DCO-4** dry-contact output interfaces and the **RAU-96**.
- DCI-16** modules are viewed as stations by the Protocol system software and should not have conflicting addresses with any station in the system.
- Station/**DCI-16** addresses must start at 1 and be sequentially incremented up to a maximum of 99.
- Patch panel addresses must start at 1 and be sequentially incremented up to a maximum of 7.
- Protocol Network Topology may be a combination of Star, T-tap, Multi-Drop, Daisy-Chain or Branch.
- Control Modules require a 4-wire connection (both Data & Power).
- Several Home Runs may be used, as required.
- Different types of control modules may be mixed on a home run.
- Maximum number of modules on a single run, as well as the wire size, may be determined from the chart in appendix E.
- Systems with 3 control modules or less do not require the external transformer and the **DB44** Panel. (Refer to Drawing **#PHM-003**.)



PD Dimmer/Switch Module Notes

- Several Data home runs may be used as required.
- PD Modules** require a 2-wire connection to the Data bus only.
- Suggested Maximum number of **PD Modules** on a single home run is 32.
- DCO-4** modules are viewed as "switch-only" **PD Switch Modules** by the Protocol system software and should not have conflicting addresses with any **PD** in the system.
- PD/DCO-4** addresses must start at 1 and be sequentially incremented up to a maximum of 63.
- Pre-terminated cables are available from the factory for daisy-chaining dimmer modules. (Refer to Drawing **#PHM-002**)
- Various PD408 low voltage wiring methods are shown in Drawings **#PHM-002** and **#PHM-003**.

Date	8/02
Drawn By	SAS
Appd. By	EMK
Scale	Sheet 1 Of 1

Digital Lighting Systems

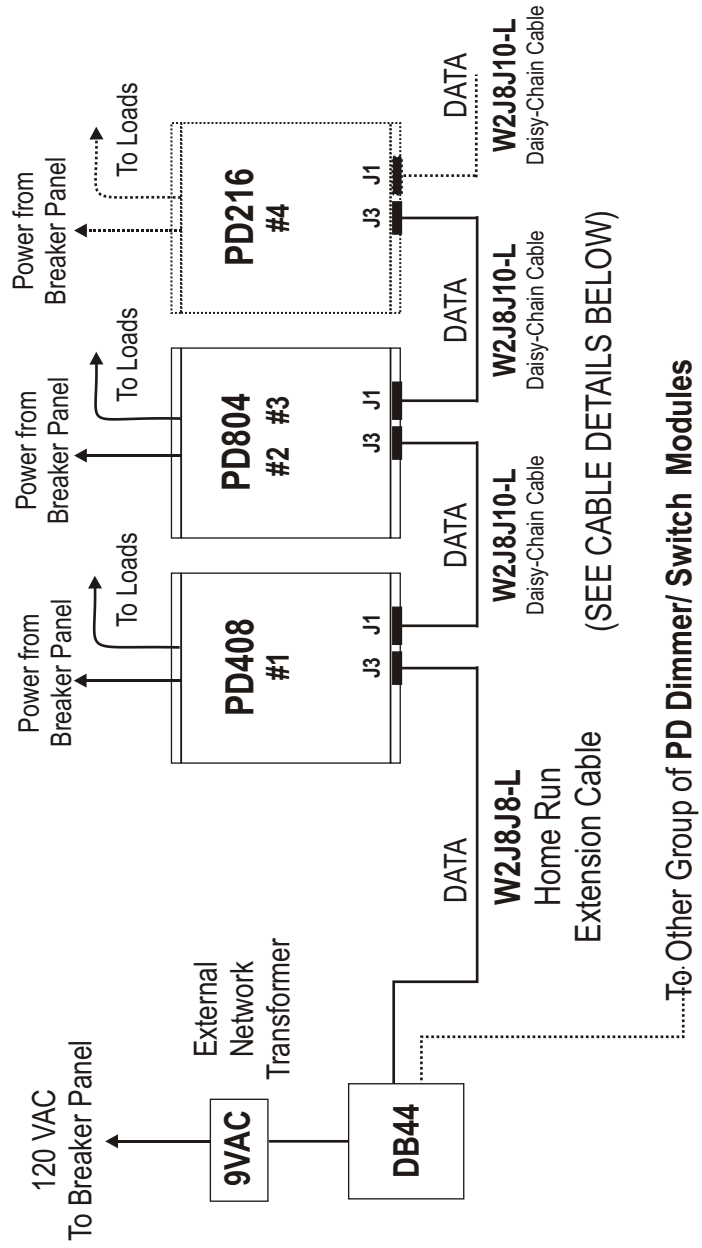
7588 NW 8th Street, Miami, FL 33126 (305) 264-8391

Description

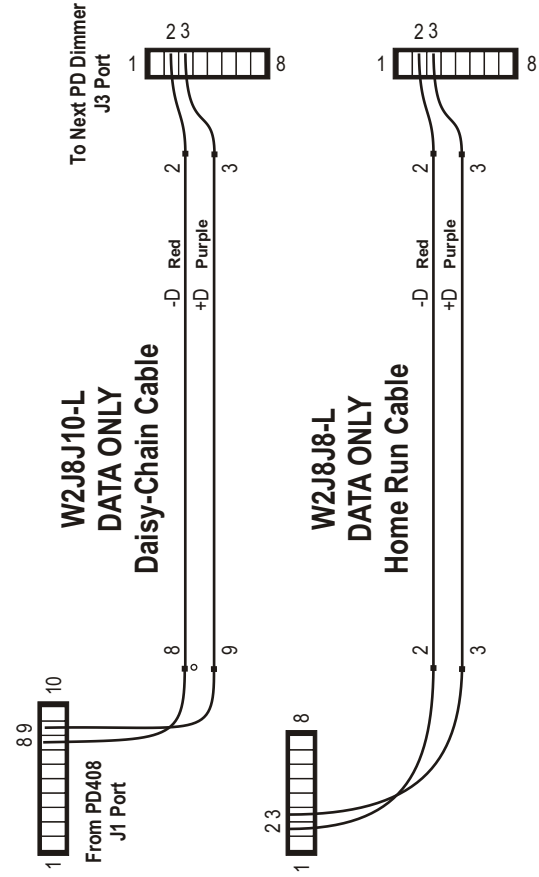
Protocol System Overview

Drawing No.	PHM-001
Part No.	Revision C

PD Module Low Voltage Wiring Using Daisy-Chain Cables



(SEE CABLE DETAILS BELOW)

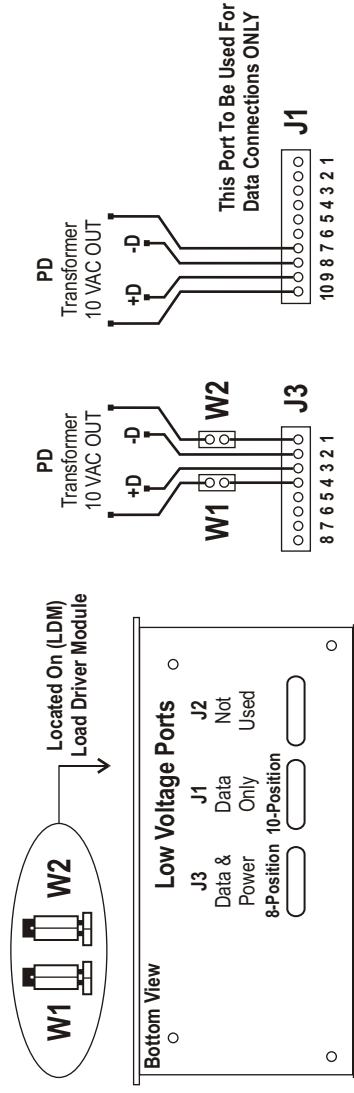


- Notes:**
- 1- Conductors colors may vary.
 - 2- Signal names always correspond to position numbers indicated.
 - 3- Up to 32 PD Modules may be daisy-chained on a single home run.

Date	8/02	Digital Lighting Systems	
Drawn By	SAS	7588 NW 8th Street, Miami, FL 33126 (305) 264-8391	
Appd. By	EMK	Description	
Scale		PD Module Low Voltage Wiring	
Sheet	1	Drawing No.	PHM-002
Of	1	Part No.	Revision
			C

Refer to the PD Dimmer/ Switch Module User Manuals for Line Feed & Load Wiring Instructions.

PD Dimmer/Switch Module Network Ports and W1-W2 Jumpers



Using the PD Modules to Supply Network Power

In small systems with 3 control modules or less, one of the **PD Modules** may be used to supply low voltage network power. This eliminates the need for the external transformer used in larger systems.

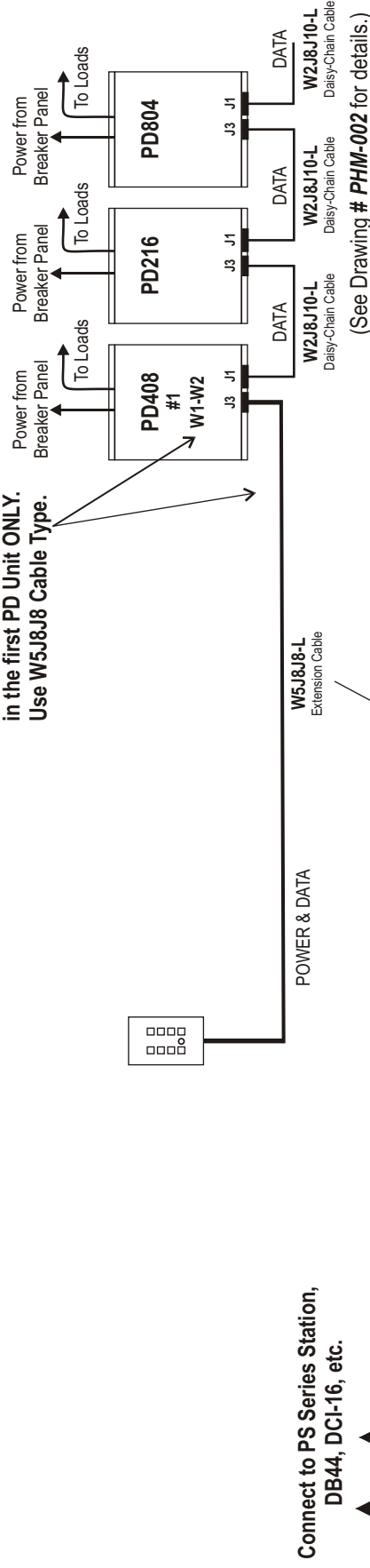
Installing Jumpers W1 & W2 connects the **PD's** internal transformer secondary to pins 1 & 4 (AC1 & AC2) of J3 which in turns supplies power to the network bus.

CAUTION

Install the W1 & W2 jumpers **ONLY** in one **PD** per system.
Special factory supplied cables must be used.

Typical Wiring of Small Systems Powered by a PD Module

**Install W1 & W2 Jumpers
in the first PD Unit ONLY.
Use W5J8J8 Cable Type.**



Refer to the PD Module User Manuals for Line Feed & Load Wiring Instructions.

Date		08-02		<div><div><div>Digital Lighting Systems</div><div>7588 NW 8th Street, Miami, FL 33126 (305) 264-8391</div></div><div><div>Low Voltage Wiring Of Systems</div><div>Without An External Transformer</div></div></div>		Revision	
Drawn By		SAS				Part No.	
Appd. By		AMK		Drawing No.		PHM-003	
Scale							
Sheet		1		Of		1	

Notes:

- 1- Conductors colors may vary.
2- Conductors must not be reversed on any plug.

PSxx-PT Pigtails



Power & Data Network Cable

Power Twisted-Pair

Numbers Preceding Colors
Refer to Wire Positions
In the Pigtail Connector.

- 1- Black ← 10 VAC
- 4- Yellow ← 10 VAC
- 2- Red ← - DATA
- 3- Purple ← + DATA

Data Twisted-Pair

6- Green ← Earth Gnd
Additional Earth Ground
(Use #18 AWG or Better)

Splice Pigtail
Inside J-Box

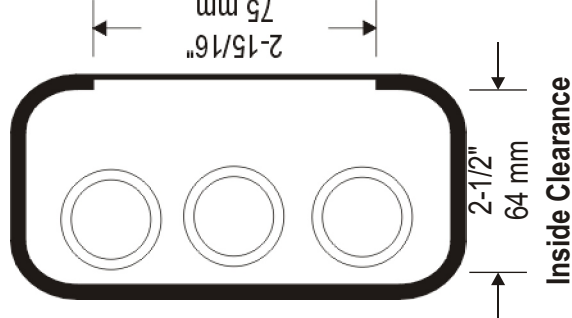
Masonry Boxes
Must Be Grounded

If required, several home runs may be used
and interconnected at the DB44 panel.
Refer to **Appendix E**.

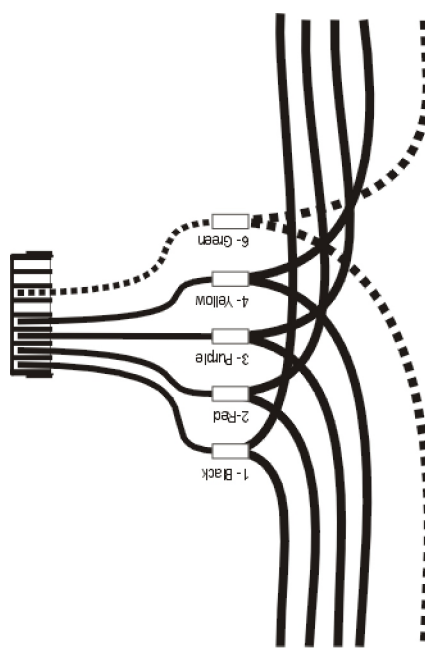
Wiring Notes

1. All wiring between the control stations, dimmer/switch modules, and other system accessories (network bus) is low voltage (NEMA Class 2) and may be run with two twisted pair # 18 AWG wire. Refer to **Appendix E**, for number of modules and maximum wire length per home run.
2. Do not run Network Bus cable in the same conduit with non-class 2 circuits.
3. Network Bus wire may be run in any combination of daisy chain (T-tap), home run, star, and/or branch.
4. Observe Correct Signal and Polarity with all network bus connections.
5. All Splices must be properly insulated and mechanically secure.
6. Use Grounded Metal Boxes Only (Refer to inside dimensions shown at left).
7. Installation must conform to local and/or NEC code requirements.

Single and Multi Gang Metal Masonry Boxes Inside Clearance Dimensions



PSxx-PT Typical Wiring And Recommended Splicing Method For Stations, Patch Panels, DCI's and DCO's Use Crimp Connectors or Wire Nuts



Digital Lighting Systems

7588 NW 8th Street, Miami, FL 33126 (305) 264-8391

Description

Control Stations Low Voltage Wiring

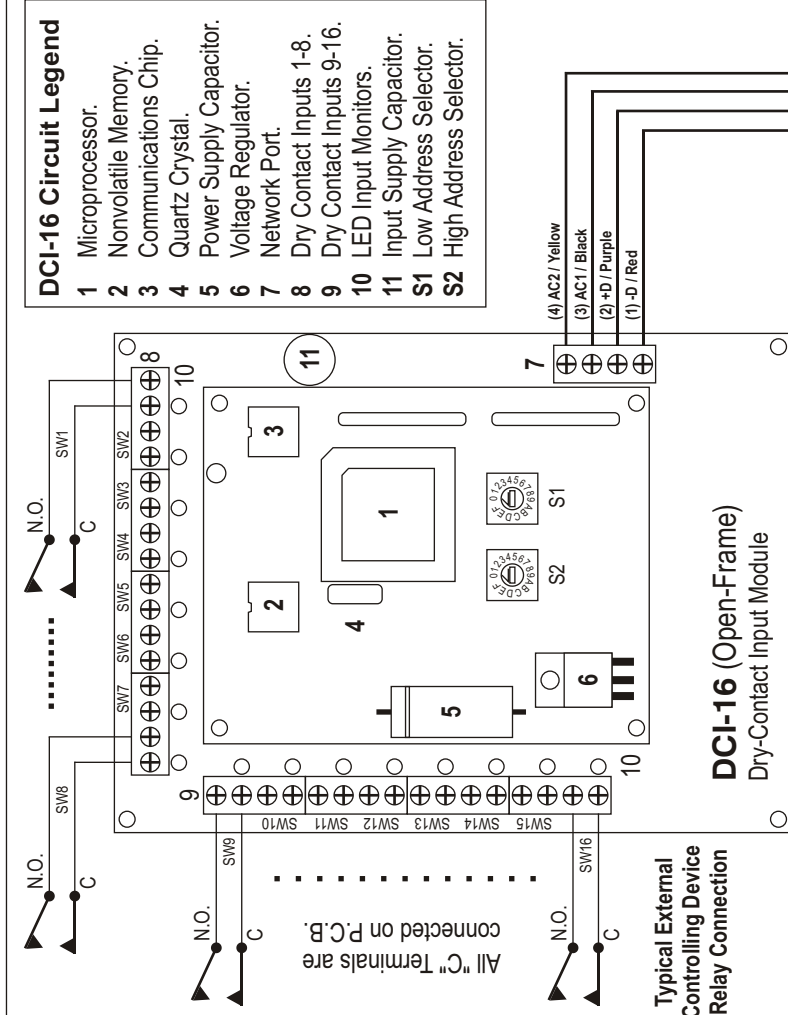
Date	8/02
Drawn By	SAS
Appd. By	AMK
Scale	None
Sheet	1 of 1

Drawing No.

PHM-004

Part No.

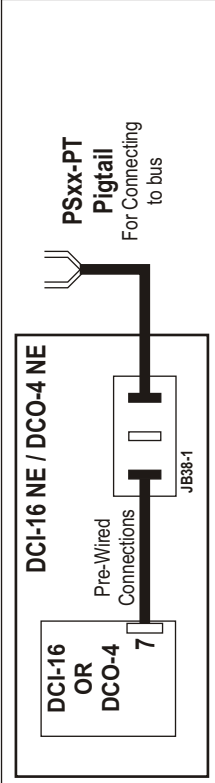
Revision
C



Protocol System Network Bus



DCI-16NE and DCO-4NE Modules in NEMA Enclosure

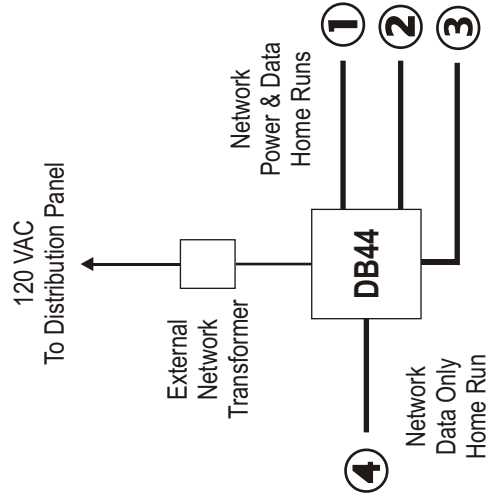


NOTES

- The DCI-16 and the DCO-4 dry-contact interfaces may be connected to the system network bus at any point.
- Both types of units are open-frame circuit modules (top drawing) and may be integrated in existing cabinets.
- DCI-16NE and DCO-4NE come pre-installed and pre-wired inside an 8" x 12" x 4" NEMA enclosure.
- DCI-16 switch terminals labeled "C" are connected together on the printed circuit board.
- DCI-16 Input signal closure must be momentarily maintained for a period of 0.5 second, +/- 20%.
- Contact Rating for DCO-4 relays: Max. 2 A at 48 VDC, Max. 5 A at 125 VAC.

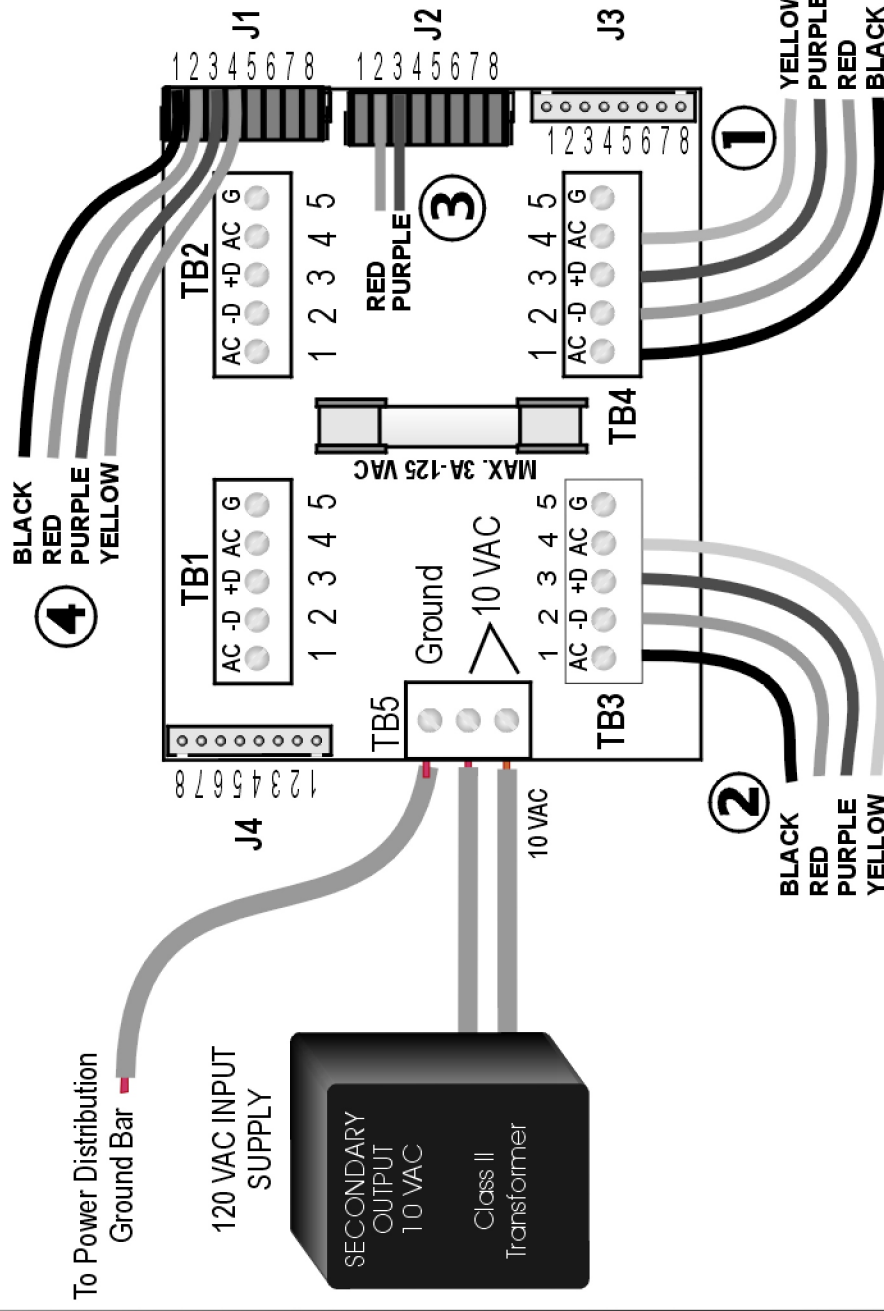
Date	6/01	Digital Lighting Systems		Revision	C
Drawn By	SAS	Description		7588 NW 8th Street, Miami, FL 33126 (305) 264-8391	
Appd. By	AMK	Dry-Contact Interface		Low Voltage Wiring	
Scale	None	Drawing No.		Part No.	
Sheet	1	Of 1		PHM-005	

TYPICAL APPLICATION DETAILS



SIGNAL COLOR CONNECTOR POSITION

AC1	Black	TB1-TB4, J1-J4	1
-Data	Red	TB1-TB4, J1-J4	2
+Data	Purple	TB1-TB4, J1-J4	3
AC2	Yellow	TB1-TB4, J1-J4	4
GND ^{AC1}	Green	TB1-TB4	5
GND ^{AC2}	Green	J1-J4	6
GND ^{-D}	Green	TB5	3
GND ^{+D}	Black	TB5	1
AC1	Yellow	TB5	2



Notes:

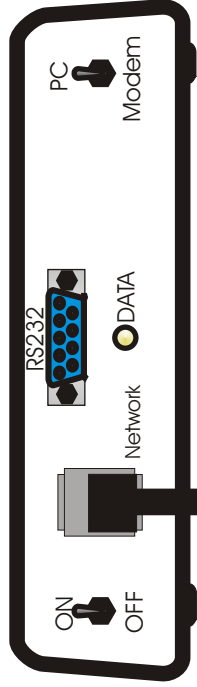
- The continuity check must be performed, before connecting transformer to TB5, to insure all signals are short-circuit free.
- All modules must be unplugged from the network bus to prevent sneak circuits.
- Perform the continuity check on just one of the TB's terminals since they are all interconnected.
- Using a simple Ohm-meter check continuity between all terminals.
- Maximum Fuse Rating: 3A - 125 VAC.
- Terminal Blocks TB1 to TB4 are identical and may be used interchangeably.
- Connectors J1 to J4 are identical and may be used interchangeably.

Date	6/01	Digital Lighting Systems	
Drawn By	SAS	7588 NW 8th Street, Miami, FL 33126 (305) 264-8391	
Appd. By	AMK	DB44 Power & Data Panel	
Scale	None	Low Voltage Wiring	
Sheet	1	Of	1
Drawing No.	PHM-006	Part No.	Revision
			C

RAU-96

Power Switch

Mode Switch



RAU-CC Cable

RS232-CC Cable



Network Bus Tap
Alternative Connection to
System also available upon request

- 1-Black
- 2-Red
- 3-Purple
- 4-Yellow

PC COM Port

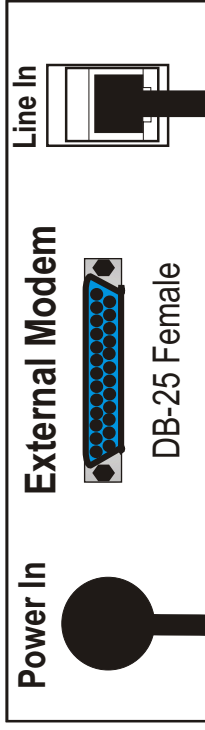
Plug into PC
For On-Site
Access



CAUTION
Plug into Either
Modem Or PC
But Not Both



Plug into Modem
For Access from Remote Site
Via Telephone



TEL-CC
Standard
RJ11
Cable



Plug into
Phone Line



Installation and Operating Instructions

- * Install a Switched Wall Receptacle for the Modem Wall Adapter.
- * With receptacle de-energized plug the modem Wall Adapter into the outlet.
- * Connect the modem Wall Adapter cable to the Modem.
- * Connect the modem to a fax or PC phone line.
- * Make sure the RAU Power Switch is in the OFF position.
- * Install the RAU-CC cable between the DB44 box and the RAU.
- * Plug connector (R) from the RS232-CC cable into the RAU.

To Access the system using a PC or Automation System:

- * Plug connector (P) into your PC or Automation System's COM Port and leave connector (M) unplugged
- * Flip the RAU's MODE SWITCH to PC and turn the RAU Off then On.
- * System is ready to be accessed by the PROTOCOL or other software.

To Access the system via Modem:

- * Plug connector (M) at the modem. Leave connector (P) unplugged.
- * Flip the RAU's MODE SWITCH to MODEM.
- * First, energize the modem's wall receptacle. Second, turn the RAU Off then On. (Above Power-Up sequence must be observed for proper operation).
- * System is ready for a call from a remote PC.

Date	8/02	Description		Part No.		Revision
Drawn By	SAS					
Appd. By	AMK	Drawing No.		PHM-007		C
Scale	None					
Sheet	1	Of		1		

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RAU-96 & Modem Wiring

**Provide a Switched
Power Receptacle**

Setting Device Addresses

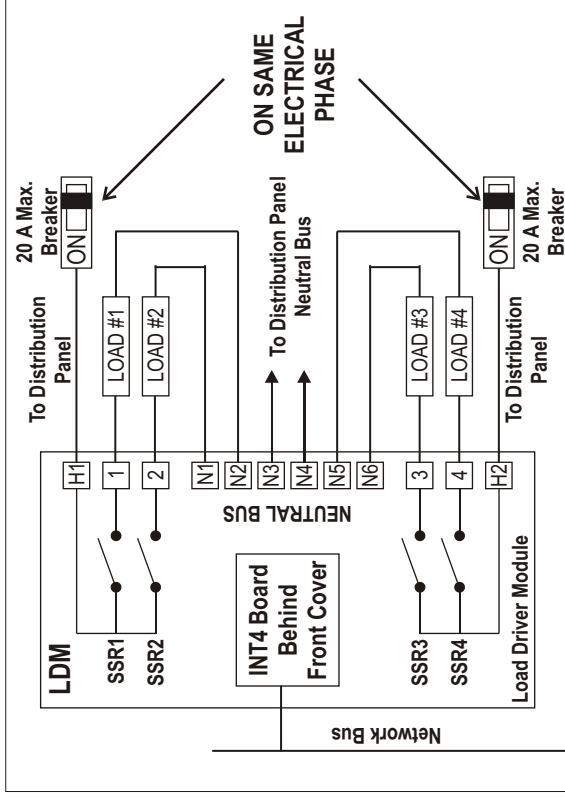
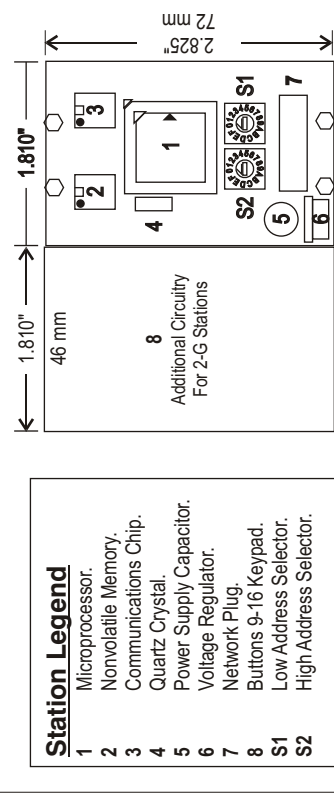
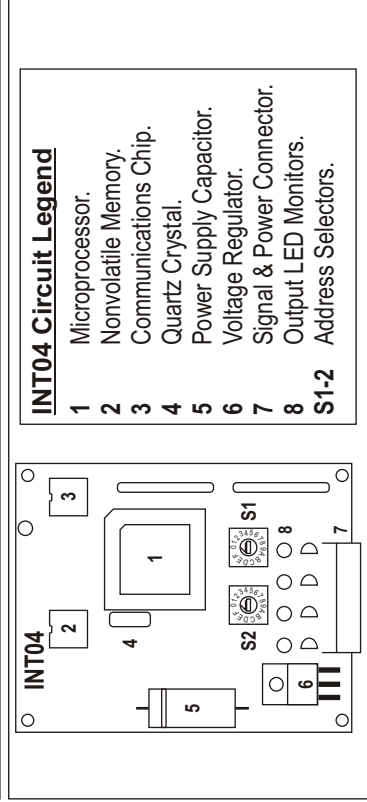
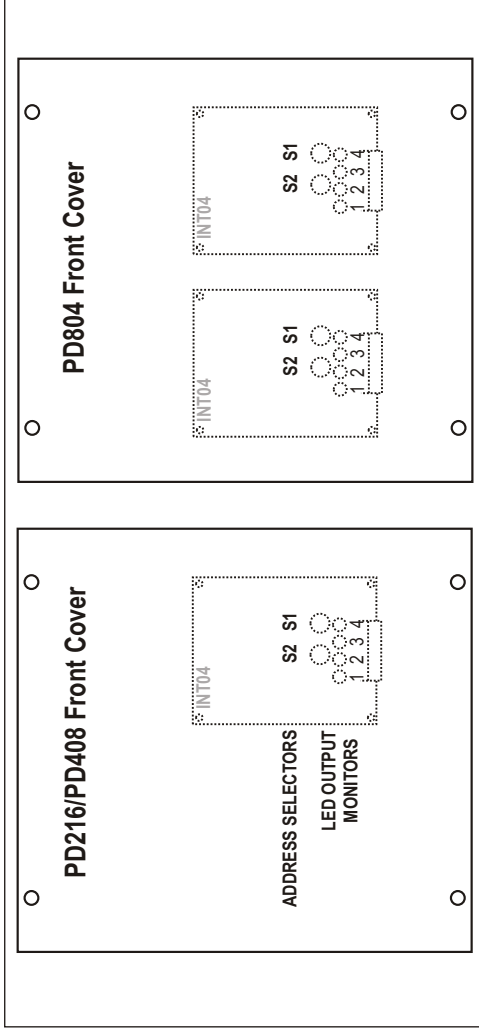
- Each Protocol device must have a unique decimal address.
- The address is set in Hexadecimal format using two rotary selectors found on each device. Refer to Appendix A for properly setting [S2, S1] to the desired decimal address.
- All devices must be RESET each time an address is modified by temporarily powering them off and back on.
- Valid station addresses begin at 1 and end at 99. The DCI-16 is considered like a station and cannot have an address taken by a station in the system.
- Valid **PD Module** addresses begin at 1 and end at 63. The PD804 is considered by the system as two **PD Modules** and will have two separate addresses. The DCO-4 is considered as a **PD SWITCH Module** and cannot have an address taken by a **PD Module** in the system.

Hexadecimal to Decimal Equation

Decimal Address = $S2 \times 16 + S1$. S1 & S2 may be set to 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, or F.
(A=10, B=11, C=12, D=13, E=14 and F=15).

Example

If [S2, S1] are set to [2, A], the decimal address is equal to $2 \times 16 + 10$, or 42.



PD408 Functional Diagram

Other PD Modules have inputs wired in the same manner. PD216 has one output per input and PD804 has 4 outputs per input. Refer to PD216/408/804 User Manuals for exact line and load wiring instructions for each dimmer.

Date	6/01
Drawn By	SAS
Appd. By	AMK
Scale	None
Sheet	1 Of 1

Digital Lighting Systems	
7588 NW 8th Street, Miami, FL 33126 (305) 264-8391	
Description	
Device Addressing	
Miscellaneous Block Diagrams	
Drawing No.	Part No.
PHM-008	
Revision	6/01



LIMITED WARRANTY

Digital Lighting Systems, warrants to the purchaser that its products have been carefully manufactured and inspected and are warranted to be free from defects of workmanship and materials when used as intended. Any abuse or misuse contrary to normal operation shall void this warranty.

Digital Lighting Systems' obligation under this warranty shall be limited to replacement or repair of any units as shall within two years of date of invoice from **Digital Lighting Systems**, prove defective; and **Digital Lighting Systems** shall not be liable for any other damages, whether direct or consequential. **The implied warranties of merchantability and fitness for a particular purpose are limited to the duration of the expressed warranty.** Some states do not allow the exclusion of the limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, you may also have other legal rights which vary from state to state.

Defective merchandise may be returned to **Digital Lighting Systems**, prepaid, after prior notification has been given and approval obtained for the return. To obtain prior approval for the return of the defective items, contact your local Digital Lighting Systems distributor, representative, or:

Digital Lighting Systems, Inc.

Attn: Customer Service Department
7588 NW 8th Street
Miami, FL 33126
(305) 264-8391

Upon request, replacement unit(s) will be shipped as soon as available. Unless immediate shipment of replacement merchandise is requested, **Digital Lighting Systems** will not ship replacement merchandise until defective merchandise is received, inspected, and determined to be defective.

No labor charges in connection with warranty problems will be reimbursed by Digital Lighting Systems without prior written approval from the factory.

Digital Lighting Systems distributors and representatives have no authority to change this warranty without written permission.

Digital Lighting Systems reserves the right to determine the best method of correcting warranty problems.





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