Installation Manual
for
Lighting & Control Systems

by PMMI Lighting LLC

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Warnings – to avoid damaging the system

- Do not run switch cables parallel to and in close proximity to high voltage ROMEX as EMF emissions from high voltage cable can cause signal distortion to switch signals.

- Plug **RED** fixture cables ONLY into LED Driver inputs.

- Plug **GREEN** switch cables ONLY into switch board inputs.

- Plug **YELLOW** motion detector cables ONLY into motion board inputs.

- Install Fixture Termination Plugs ONLY into the OUT connector of light fixtures to end or terminate the channel or daisy chain.

- Never use Fixture Termination Plugs on switches or motion detectors.

"If you let smoke out of the system, there's no way to put it back in."

Important Notes and Procedures

- All components in the PMMI Lighting System interconnect using Cat5, Cat5e or Cat6 cables and corresponding RJ45 connectors.

- Use **ONLY solid copper** Cat5, Cat5e, or Cat6 cable with the PMMI Lighting system. **NEVER** USE COPPER CLAD ALUMINUM WIRE. Use solid copper wire for all custom cables and RJ45 connectors designed for solid copper. You can find links to the proper cable on the website (https://pmmi-lighting.com/monitor-cabling-power/).

- Pre-terminated jumper cables often use stranded copper wire. This is ok if the cables are factory terminated. We do not recommend re-terminating stranded wire, but if it's required, make sure to use RJ45 connectors specifically designed for stranded wire.

- No-Ox connector compound is provided at no cost with each PMMI Lighting order. Apply **No-Ox** to all RJ45 connectors **BEFORE** plugging into the system or any fixtures or switches. (This procedure is shown in the video on the website: https://pmmi-lighting.com/videos/) This is necessary to prevent corrosion in the connectors that can occur over time.

- **Label all cables.** All home run cables, *cables terminating in the control center*, should be **labeled** on each end designating the cable# or the location identifier.

- On fixture daisy chains, **label** all cables designated for the IN or OUT connector on the fixtures at the RJ45 connector. This will allow easy identification when wires are being dropped down a fixture hole and prevent connecting daisy-chain fixtures backwards during installation.

- **After cables are terminated, test EVERY cable with an RJ45 Cat5/CAT6 cable tester before plugging them into the PMMI system. This will ensure continuity on all eight wires in the Cat5/Cat6 cable.**

- **DO NOT connect the tester to a cable that is plugged into the PMMI system as this can damage the tester.**

Cable Color Guide

- **Red Cable** – Light fixture cables
- **Green** - Wall switch cables
- **Yellow** - Motion detectors cables

Using color-coded cable is important to distinguish between the different type cables, and also to distinguish between cable used for the PMMI Lighting System and cables used for computer networks, audio visual, and other purposes. *Plugging PMMI Lighting cables, and especially red fixture cables, into network ports on laptops, routers, or other computing hardware can damage that equipment and/or PMMI Lighting System and components.*

RJ45 Pinout and Cable Termination

All cables should be terminated using RJ45 male connectors using the T568B termination standard. Be sure to leave excess cable at both ends, a minimum of 4 feet extra at the control center and 2 feet extra at the component ends.

RJ45 Pinout
T-568B

1. White Orange   5. White Blue
2. Orange   6. Green
3. White Green   7. White Brown
4. Blue   8. Brown
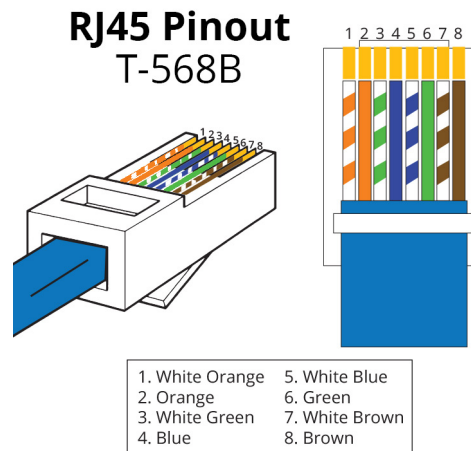
Fixture Daisy Chains

The number of fixtures that can be daisy chained on a channel depends on the V2 voltage and on the voltage drop per fixture. Fixtures can be daisy chained in any combination so long as the total voltage drop across fixtures does not exceed V2.

The voltage drop for common PMMI fixtures are:

- Standard and Low Profile Down lights – 6V
- Gimbal Lights – 9V
- Double Floods – 24V
- 24W Strips – 24V
- 48W Strip Lights – 48V

So, for example, using a 48V (V2) system, eight down lights (6x8=48) OR four down lights and one double flood (4x6 + 24=48) OR five gimbals (5x9=45) can be daisy chained together.

Internet Connectivity

The PMMI Lighting supports Internet connectivity via Ethernet cable or WiFi. Since the system is contained in a metal cabinet WiFi usually will not work, so Ethernet is preferred. For security purposes, an Ethernet cable run between the router/firewall and the Control Center is recommended. When connected, PMMI Lighting LLC can provide diagnostic support and system updates.

Installation Process

Overview

The suggested order of installation is as follows.

1) Decide on the location for the Control Center.
2) Install fixture (channel) cables.
    a. Home run cables between the first light fixture on a chain and the control center and jumper cables between fixtures on a chain.
    b. Use **RED** cable for all **FIXTURE** cables.
    c. **Label as you go.**
3) Install switch cables.
    a. Home run cables between the first switch on each switch chain and the control center, and jumper cables between each switch location on the chain.
    b. Use **GREEN** cable for all **SWITCH** cables.
    c. **Label as you go.**
4) Install motion detector cables.
    a. Home run cables between each motion detector and the control center.
    b. Use **YELLOW** cable for all **MOTION DETECTOR** cables.
    c. **Label as you go.**
5) Install Ethernet cable for Internet connectivity.
    a. Run a cable between the control center and the location or intended location of the LAN router.
    b. Use any color you choose except red, green, or yellow to distinguish the Ethernet cable from PMMI Lighting system cables.
6) Install Light Control and AC Interface Cabinets in the Control Center area.
7) Route all cables into Control Center cabinets.
8) Organize cables in the cabinets according to cable number or area. Organize channel, switch, and motion detector cables separately.
9) Terminate Cables at both ends, leaving enough cable slack to adjust as necessary.
10) Test EVERY cable with a Cat5/6 cable tester

a. Testing cables at this time prevents discovery of a bad cable after insulation and sheetrock are installed or cables are otherwise covered up.

b. This not only confirms continuity on all 8 wires but also is an opportunity to verify labeling.

c. It's possible that cables can be damaged after testing and during construction. If a cable does not appear to behave properly at that time, retest the cable and repair as necessary.

11) Tape over all connectors in the living space to prevent damage and prevent paint, texture, or other material from contacting the connectors.

12) Install and test fixtures according to the procedure outlined below.

13) Install and test switches according to the procedure outlined below.

14) Install and test motion detectors according to the procedure outlined below.

Cable Installation

- During rough in, leave plenty of extra cable (nominally 3-4 feet) extra at each end

- Once cables are plugged into boards or components, don't pull on cables without releasing the terminator clasp. Damage can occur with excessive stress.

- Do not run switch cables parallel to and in close proximity to high voltage ROMEX as EMF emissions from high voltage cable can cause signal distortion to switch signals.

Control Center Installation

Mounting

The Control Center is typically installed in a utility closet or mechanical room. **For ease of working on your system and restarting/rebooting your system, it is recommended that a power switch or breaker box be located near the control center.**

Mounting tips:

- These lighting control cabinets are typically flush mounted between studs but may also be surface mounted to a piece of plywood.
- Mounting cabinets at eye level when standing or sitting on a stool is recommended as the installer will need to easily read all the markings on the circuit boards.
- A multitude of cable will be terminated in the control center, so allow room for organizing cables.

Ethernet

Install Ethernet cable for Internet connectivity. The PMMI Lighting supports Internet connectivity via Ethernet cable or WiFi. Since the system is contained in a metal cabinet WiFi usually will not work, so Ethernet is preferred. For security purposes, an Ethernet cable run between the router/firewall and the Control Center is recommended. When connected, PMMI Lighting LLC can provide diagnostic support and system updates.

- Run a cable between the control center and the location or intended location of the LAN router.
- Use any color you choose except red, green, or yellow to distinguish the Ethernet cable from PMMI Lighting system cables.
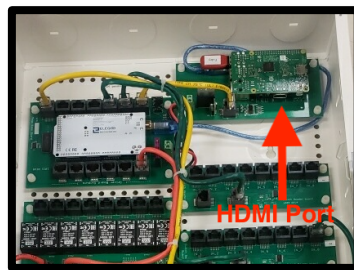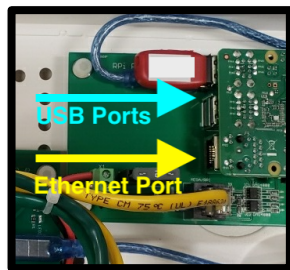
Monitor, Keyboard, Mouse

Monitors are not a necessity for the functionality of the **Multi Board** and **Single Board Lighting & Control Systems**, however, hooking one up to the HUB/Raspberry Pi makes viewing the system activity, and controlling your system effortless. The HUB/Raspberry Pi has an HDMI input for the monitor and USB ports that allow a keyboard and mouse to be connected.

A/C Interface (aka Relay Panel)

If your system has an A/C Interface, the A/C Interface should be installed by an electrician and located in the PMMI Control Center next to the Control Panel Cabinet.

Each relay can accommodate 120 or 240V loads and up to 10A per relay. The relays are used to switch AC loads (on/off only, no dimming) based on low-voltage current input to each relay coming from drivers on LED driver boards. Typically, the high leg from 120/240V breakers are routed to the relays as a source of power, and output from the relays go to the intended loads.

Power Supplies

Every installation will have a 12V DC power supply to power computers and supporting electronics, and a separate DC power (V2) supply for fixtures. V2 can be 12V, 24V, 36V, or 48V and must provide enough power to drive the all fixtures in the system simultaneously, or at least all fixtures that will be operated simultaneously.

AC/DC power supplies tie into the breaker panel and should be installed by an electrician. Depending on the power supply selected, power input is typically 120 or 240 VAC and 50 or 60Hz.

Where multiple power supplies are used, all must be connected to a common ground.

Some power supplies have a switch to select input voltage. BE SURE TO SELECT INPUT VOLTAGE CONSISTENT WITH LINE VOLTAGE OR DAMAGE CAN OCCUR.

DC output should be connected to the lighting console panels using connector lugs for 12VDC, 48VDC, etc. and grounded properly.

Verify LED Drivers are Working Correctly

Once the control center is installed and powered, and **before** fixture cables are connected to driver boards in control center, test the LED Drivers.

For LED driver testing and fixture installation and testing purposes, each Multi Board System has a one-button switch installed in the cabinet and connected to Switch Board 1, Input 1. Button one is pre-configured to TOGGLE all drivers/lights ON and OFF.

In Single Board Systems, the one button switch is provided but not installed as to allow that input to be used for switch cabling later. When testing the Single Board System Plug the One Button Switch into SW 1. Button one is pre-configured to TOGGLE all drivers/lights ON and OFF.

- With **NO** LIGHT CHANNEL CABLES CONNECTED to the system, observe that all Channel Driver Indicator LEDs **LIGHT UP** when **Button One** is toggled. *LEDs are located between LED driver and RJ45 channel socket on Driver Boards and Single Board.*

- If all Driver LED indicators light up, the LED drivers are working correctly.

Fixture Installation

Mounting Holes: Standard LED Recessed Down Light Fixture

The standard recessed down light is a light weight, flush mounted fixture that can be installed directly into sheet rock, artificial ceiling, or other ceiling material with no physical mounting to the ceiling joist.

- Locate and mark fixture location on the ceiling or mounting surface being careful to locate fixtures clear of ceiling joists or other obstructions.
- Using a 3 3/4″ hole saw, cut a hole through the ceiling material at the fixture location. A carbide saw will be required for cement-based ceiling material.
- Marking and cutting holes should be done when raw ceiling material is in place. We recommend ceiling finish (float, texture, paint, etc.) be done after holes have been cut.

Mounting Holes: Low Profile LED Recessed Down Light Fixture

- The low profile recessed down light is designed for use where a wiring cavity exists between the base of the cabinet and interior cabinet floor. Low profile fixtures are 3/4″ thick as measured from the back of the face plate. So if 1/4″ material is used for the base, a minimum 1/2″ cavity is required to accommodate the fixture.
- The installation procedure is the same for low-profile recessed fixtures as standard recessed fixtures. Use caution however when drilling 3 3/4″ hole through the base to avoid drilling into the floor of the cabinet.
- This fixture is also perfect for use in walls, like pantries and closets to allow horizontal lighting where low profile is necessary.
- Perfect for above cabinets, this fixture can be placed on top with no installation within the cabinet itself. The flat bottom allows the fixture to lay flat. This allows the homeowner to move around fixtures if desired to feature an above cabinet item.

Mounting Holes: Gimbal LED Recessed Down Light Fixture

VERIFY the required mounted hole size for YOUR fixture. PMMI has two different gimbals, one requires a 3 ½" hole, the other a 3 ¾" hole. VERIFY the hole size needed for the gimbal in your possession BEFORE cutting a hole.

The installation procedure is the same for gimbal recessed fixtures as for the standard recessed fixtures.
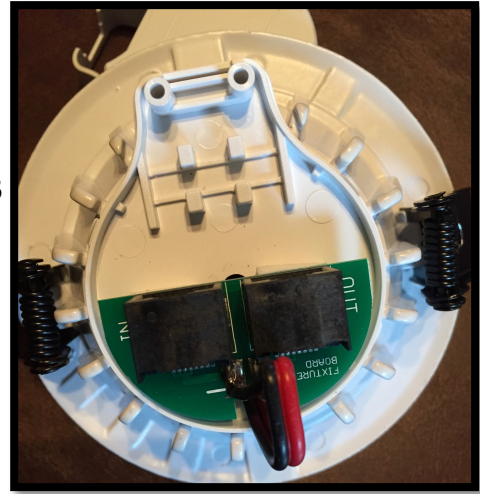
Testing as you go - Verify Single Fixture Operation on a Channel

Fixtures should be tested as they are installed to verify the viability of the cable and fixture. Instructions to test each fixture as you create channels is as follows:

- Each channel has one Cat5, Cat5e or Cat6 cable with RJ45 connectors that home run to the control panel and plugs into a LED driver output.

- **Label all cables.** All home run cables, *cables terminating in the control center*, should be **labeled** on each end designating the cable# or the location identifier.

- Apply **No-Ox** to all RJ45 connectors **BEFORE** plugging into the system or any fixtures or switches. (This procedure is shown in the video on the website: www.pmmi-lighting.com/installation) This is necessary to prevent corrosion in the connectors that can occur over time.

- Turn on all light channels using the switch described in the previous section.

- Plug one end of the home run cable into the appropriate LED driver output in the control panel.

- Plug the other end into the IN socket on a fixture. *On fixture daisy chains, **label** all cables designated for the IN or OUT connector on the fixtures at the RJ45 connector. This will allow easy identification when wires are being dropped down a fixture hole and prevent connecting daisy-chain fixtures backwards during installation.*

- Plug a **fixture terminator plug** into the OUT connector on that fixture.

- This verifies proper channel operation.

- **IF this is the last fixture in the chain skip to the "Installing in Ceiling" section.** If it is NOT the last fixture in the daisy chain, continue to the next step and the next fixture.

Complete the Daisy Chain by Connecting Multiple Fixtures

To connect multiple light fixtures to that same channel:

- Remove the fixture termination plug from the OUT of fixture one.
- Apply **No-Ox** to all RJ45 connectors BEFORE plugging into the system or any fixtures or switches.
- Plug a new Cat5, Cat5e or Cat6 cable into the OUT connector on fixture one
- Plug the other end of that cable into the IN connector on fixture two. *On fixture daisy chains, **label** all cables designated for the IN or OUT connector on the fixtures at the RJ45 connector. This will allow easy identification when wires are being dropped down a fixture hole and prevent connecting daisy-chain fixtures backwards during installation.*
- Plug the fixture termination plug into the OUT connector on fixture two.
- Fixtures one and two should light up when button one is pressed.
- Repeat this process for all fixtures on the channel/daisy-chain.
- All fixtures on the channel/daisy-chain should light up.
- Leave the fixture termination plug in the last fixture of the daisy chain.

Remaining Channels

- Repeat this procedure for every channel/daisy-chain in the system.
- Once completed, every light in the system should turn ON and OFF with the TOGGLE button installed in the control center.

Fixture Can Installation

Because the fixtures operate at low voltage and low temperature (100°F), use of a "fixture can" behind the ceiling material is optional. Cans are available from PMMI Lighting, and are recommended if insulation is used around fixtures.

- If fixture cans are used, installation should be done before ceiling insulation is installed.
- This process works best with one person located above the ceiling to install cans at the same time as fixtures from below.
- Following the same instructions for fixture installation, the person above the ceiling should run the cables through the plastic bushing in the side of the fixture can and then pass them down through the hole in the ceiling.
- Once RJ45 cable connections are made, the person located above the ceiling should hold the can tight against the ceiling over the hole while the person below the ceiling installs the fixture and clips.
- The clips will serve to both hold both the fixture in place and the can tight against the ceiling from above.

Switch Installation

Switch Cables

Every system delivered by PMMI Lighting is pre-configured. This configuration was created from the Planning Document done at the time of the order. Plugging cables into proper inputs consistent with the pre-configuration allows the system to operate correctly from the start. Switch set up can be found on the Switch Tab in the configuration spreadsheet.

No Ox must be applied to all cable ends **BEFORE** plugging into switches.

Multi Board Systems: Connecting Switch Chains in the Control Center

Switch Reader Boards are installed in the Control Center, and are labeled Switch Board 1, 2, 3, etc. Each Switch Reader Board has eight RJ45 switch cable connectors (inputs 1-8).

In the configuration spreadsheet, switches tab, each switch is associated with a board number, switch number, and cable number in the first three columns of the spreadsheet. Notice that cables 1-8 correspond to board 1, inputs 1-8. Cables 9-16 correspond to board 2, inputs 1-8, and so forth. Cables should be labeled with the cable number an/or location identifier according to configuration spreadsheet.

- Route the **green** cable labeled with cable#2 and/or location identifier into the Control Center and plug that cable into the IN port on Switch Reader Board that corresponds with that cable# or location identifier on the switch page of the configuration file.
- Repeat this for all remaining switch cables.

Single Board Systems: Connecting Switch Chains in the Control Center

- Simply plug switch cables 1 and 2 into ports on the Single Board labeled SW 1 and SW 2, respectively.

Switch Jumpers

Note in the configuration spreadsheet that each cable allows for seven separate functions to be defined. Cable 1 for example, defines buttons 1-7. Cable 2 defines buttons 8-14. And so forth. Regardless of the physical order of switches on a chain, each button will access one function on that chain.

- Four and Six Button Switches

    - There are no jumpers on four and six button switches

    - Buttons automatically trigger functions 1-4 or 1-6 that have been specified in the configuration spreadsheet.

- One, Two, and Three Button Switches

    - The function for each button is manually set using jumpers on the back of the switch.

    - For example, for a one-button switch, you might set the one button to function 7. To do this you place the jumper between 1 and 7.

    - In another example, on a 3-button switch, you might set buttons 1, 2, and 3 to trigger functions 5, 6, and 7. To do this jumper 1 to 4, 2 to 5, and 3 to 6.

Understanding Chaining Switches

- Wall switches are connected in a daisy-chain manner using Cat5, Cat5e or Cat6 cable.

- Each switch cable has one common wire and seven active wires, allowing seven unique signals to be processed on each cable. Each of these seven signals are associated with the seven functions identified for that cable in the configuration file.

- Each button triggers one function defined by jumper settings as previously described.

- Any number of switches can be daisy chained in any combination and in any order as long as the
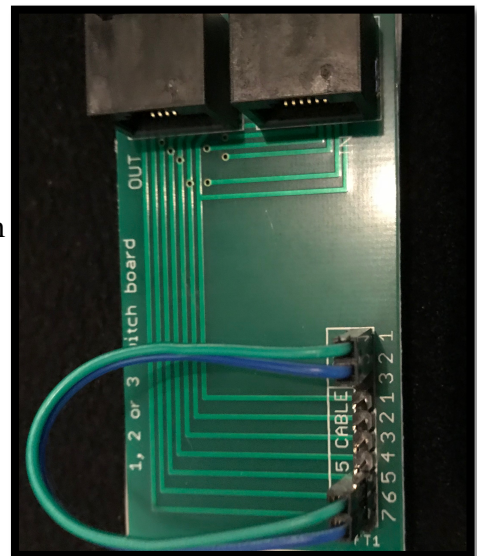
total number of unique functions does not exceed seven.

- It is not necessary to use all seven functions on a switch chain.

Installing / Chaining Switches

Switch should be mounted in a standard single or multi-gang electrical box.

- Switch should be mounted with the **CONNECTORS on TOP.**

- Buttons are numbered from left to right, top to bottom, so if installed upside down, this can cause confusion.

- **No Ox** must be applied to all cable ends **BEFORE** plugging into switches.

- After the switch jumpers have been set properly (see explanation above), plug the green cables at the switch locations into the RJ45 connectors on the back of the switch.

- For switches in the middle of a switch chain, two cables are present.

  - **One** from the preceding fixture on the chain or from the home run from the control center

  - A **second** to the next fixture on the chain

- Plug one of those cables into the RJ45 connector labeled IN and the other into the connector labeled OUT. Unlike the light fixtures where a certain order has to be followed, on the switch it is not important which cable goes to which connector.

- If the switch is the final switch on a switch chain, **only one cable** is present.

- Plug the cable into either one of the RJ45 connectors on the switch and leave the other connector empty.

- **DO NOT use light fixture terminator in switches.**
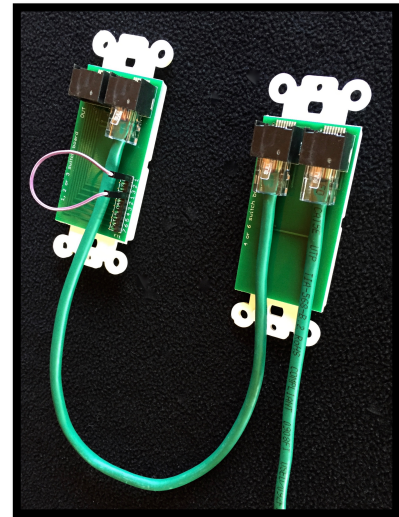
Motion Detector Installation

Location and Orientation

PMMI Motion Detectors have a 90-degree detection cone from the axis of the motion sensor (45 degrees on each side) and a range of about 15 feet. In most cases, a ceiling mount works best. For special applications, make sure the detection cone covers the area in which motion detection is desired.

Motion Detector Cables

Motion detector cables carry 12V DC to power the motion detectors and signal wires to return detection signals to the lighting controller in the control center.

The system has a configuration file that corresponds with the planning document. Plugging cables into proper inputs allows the system to access data correctly from the start of installation. Motion Detector set up can be found on the Triggers Tab in the configuration spreadsheet.

- **No Ox** should be applied to all cable ends **BEFORE** plugging into motion detectors or boards.
- **NO Chaining**. Motion detectors each have their own cable from the motion detector to Motion Reader Boards located in the control center.
- Motion detector should be mounted in a standard single or multi-gang electrical box.

Multi Board System: Connecting Motion Detector Cables in the Control Center

Motion Reader Boards are installed in the Control Center, and are labeled Motion Board 1 and 2. Each Switch Motion Board has eight RJ45 switch cable connectors. Inputs 1-8 are on Motion Reader Board 1, and 9-16 on Motion Reader Board 2. In the configuration spreadsheet, triggers tab, motion triggers can be setup on motion ports 1-16.

- Route the **yellow** cable labeled with cable#1 and/or location identifier into the Control Center and plug that cable into the IN port on Motion Reader Board that corresponds with that cable# or location identifier on the triggers page of the configuration file.

- Repeat this for all remaining motion detector cables.

Single Board System: Connecting Motion Detector Cables in the Control Center

In the configuration file, Triggers tab, motion triggers can be setup on motion ports 1 or 2.

- Plug the **yellow** cables 1 and 2 into ports on the Single Board Controller labeled MOT1 and MOT2 that correspond with the port number designated on the triggers tab of the configuration spreadsheet.