



BENDER[®]
The Power in Electrical Safety

Isolated Power Panels

For healthcare facilities



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1. Introduction

1.1 Isolated Power Panels

Bender isolated power panels provide isolated, ungrounded power to electrical systems in operating rooms and other critical areas in healthcare facilities. Isolated power systems allow for early detection of hazardous current while keeping the system online. The system gives a visual indication of the level of current in milliamperes (mA). When the threshold is reached, a visual and audible alarm is activated.

An isolation transformer serves a single operating room, except when supplying power to equipment requiring 150 VAC or higher. A line isolation monitor (LIM) indicates possible leakage current from all isolated conductors to ground.

This manual provides instructions on installing and operating isolated power panels. Refer to all relevant national and local codes and standards before proceeding

2. Safety Instructions

2.1 General Safety Warning



DANGER

Hazard of Electric Shock, Burn, or Explosion

Only qualified maintenance personnel should operate or service this equipment. These instructions should not be viewed as sufficient for those who are not otherwise qualified to operate or service this equipment. No responsibility is assumed by BENDER for any consequences arising from use of this document.

Turn OFF all sources of electric power before performing any inspections, tests, or service on this equipment. Assume all circuits are live until they have been properly de-energized, tested, grounded, and tagged. Failure to observe these precautions will result in equipment damage, severe personal injury, or death.

Proper operation of this equipment depends on proper installation. Refer to NFPA 70, NFPA 70E, CSA Z462, and other relevant standards and codes for installation standards. Neglecting fundamental installation techniques will result in equipment damage, severe personal injury, or death.

Do not make any modifications to the equipment. Failure to observe this precaution will result in equipment damage or personal injury.

Use only manufacturer's and manufacturer recommended accessories with this equipment. Failure to do so may damage the equipment beyond repair.

2.2 Using This Manual

Read these instructions carefully and become familiar with the equipment before attempting to install, operate, or service it. Throughout this manual, special messages may appear to warn of potential safety hazards or to call attention to information which clarifies instructions or procedures. Observe all safety messages that appear throughout this manual to avoid possible injury or death. An explanation of these symbols is given below.



DANGER: Indicates a hazardous situation which, if not avoided, will result in death or severe injury.



WARNING: Indicates a potentially hazardous situation which, if not avoided, may result in death or injury.



CAUTION: Indicates a potentially hazardous situation which, if not avoided, may result in injury or equipment damage.

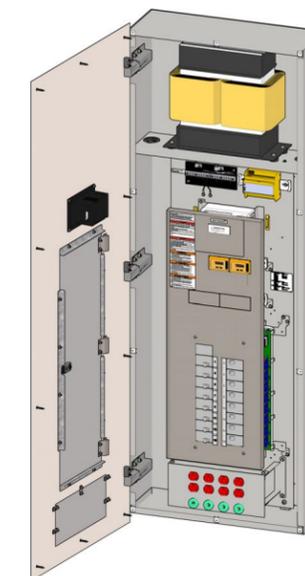


NOTE: Provides additional information to clarify instructions for a product or procedure.

3. Model Types

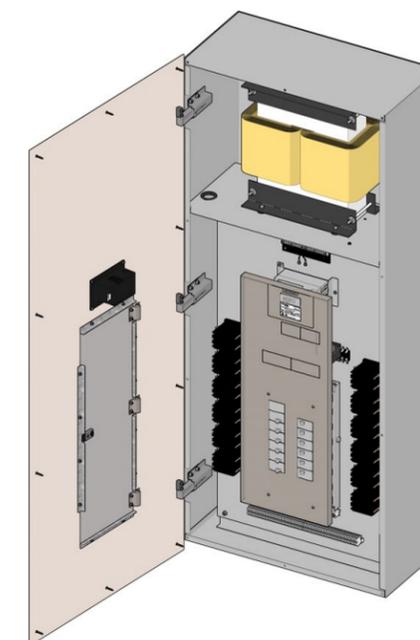
3.1 MIP / MIE Series Isolated Power Panels

Single-system, single-output-voltage isolated power panel. MIP designation is used for panels rated 10 kVA or below. MIE designation is used for panels rated 15 kVA or above.



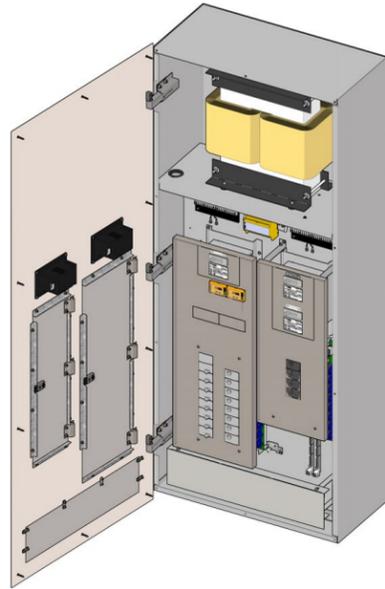
3.2 MIC Series Isolated Power Panels with Circuit Control

Single-system, single-output-voltage (of at least 150 V) isolated power panel. Provides programmable control of up to twelve (12) individual circuits. Commonly used with 208 VAC or 240 VAC portable medical equipment, such as lasers. Circuit control logic is configured at the factory.



3. 3 MID Series Dual Output Voltage Isolated Power Panels

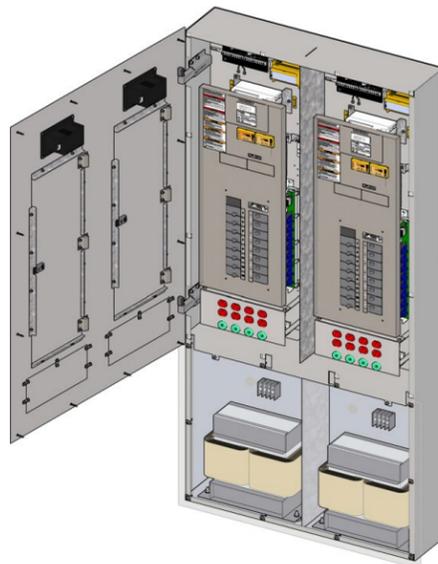
Isolated power panel for a single-input-voltage and dual-output-voltage system. Commonly used to simultaneously supply power to both normal line powered equipment and equipment operating at a voltage greater than 150 VAC (such as portable medical lasers).



3. 4 MIX Series Dual System Isolated Power Panels

Two MIP series interiors installed side-by-side in a common enclosure. In the figure below, the transformer access front trim is translucent for illustration purposes.

Wire is provided with the front trim assembly for ground bus interconnection and transformer terminal block connections to panel board lugs (or sub-feed lugs, if applicable).



4. Components

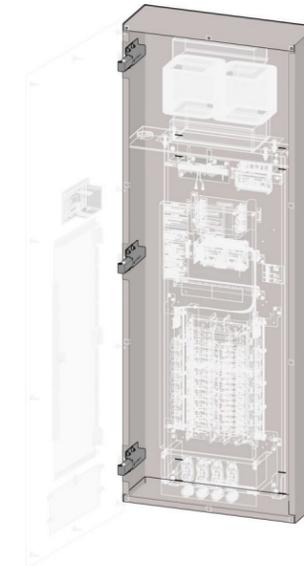
The following sections describe key components of isolated power panels. These components are standard for the United States unless otherwise noted. Ensure equipment conforms to all national and local codes and standards prior to purchasing.

4. 1 Backbox Package

The backbox meet the requirements of NEMA Type 1 according to UL 50. It is fabricated from a minimum 14 GA galvanized steel and is designed for flush (recessed) or surface mounting. Flush mounting is standard. Surface mounted backboxes must be requested during the purchasing process.

Surface mounted backboxes are finished with a coat of hospital grade ivory baked enamel or equivalent.

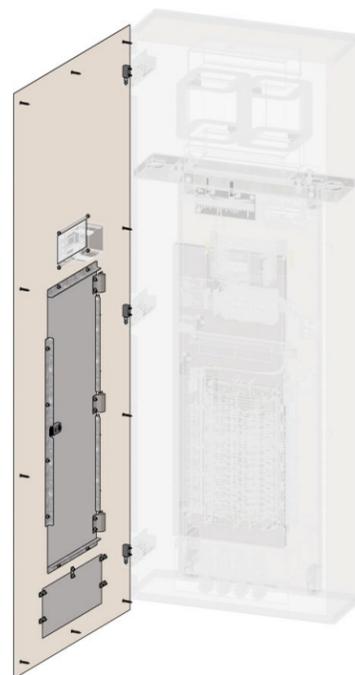
All backboxes include an easy-lift-off hinge assembly to ease front trim installation and system maintenance.



4. 2 Front Trim Package

The front trim is manufactured from a minimum 14 GA, type 304 stainless steel. It contains a door with hidden hinges and flush mounted key lock. The door provides access to circuit breakers and optional fault location (EDS) accessories if equipped. Most front trims are provided with provisions for future field installation of receptacle and/or fault location assembly kits.

Front trims may be used with flush-mounted or surface-mounted backboxes. For flush mounted panels, the front trim extends 1" (25.4 mm) on all sides of the backbox. For surface-mounted panels, the front trim has the same height and width as the backbox.



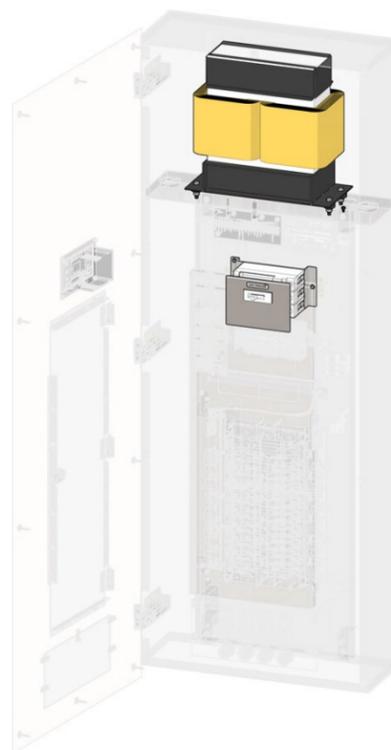
4. 3 Isolation Transformer Kit

The isolation transformer kit contains the following:

- Transformer and mounting hardware
- Primary main circuit breaker and bracket assembly
- Secondary main circuit breakers (where applicable)
- Breaker sub-plate and mounting hardware

Isolation transformers used in isolated power systems are special-purpose, low-voltage, drytype transformers. They are application-specifically designed and fulfill the requirements of UL 5085 and UL 1047.

The primary main breaker, mounting hardware, and sub-plate are included in the isolation transformer kit. For MID series panels (and custom configurations where applicable), the isolation transformer kit will also include secondary main circuit breakers.



4. 5 Circuit Breakers

All panels utilize two-pole, thermal magnetic circuit breakers. Panels ordered with selective coordination may include an electronic trip element added to the primary and/or secondary main circuit breakers to achieve 0.1 second system coordination.

The primary and secondary (where applicable) main circuit breakers are sized to protect the transformer coil. The primary main circuit breaker is sized at 125% of rated current. Any supplied secondary main circuit breakers are sized at rated coil ampacity.



The quantity and rating of branch circuit breakers varies by panel:

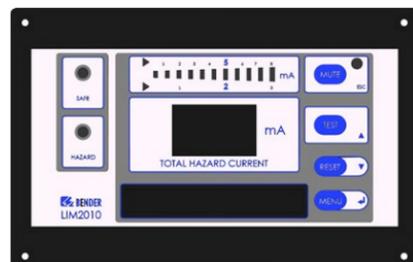
- MIP and MIE series: Provided with sixteen (16) factory-installed 20 A branch circuit breakers (unless otherwise stated).
- MIC series: Quantity and ampacity of branch circuit breakers is provided according to project documents. The maximum allowed is twelve (12). The logic for simultaneously energized branch circuits is configured at the factory per project specifications.
- MID series: Output voltage 1 (designated as the "low side") is provided with sixteen (16) factory-installed branch circuit breakers. Output voltage 2 (designated as the "high side") is provided with either one (1) or two (2) factory-installed branch circuit breakers. Ampacity is per project specifications



NOTE: To maintain compliance with UL 1047, branch breakers must not exceed 60 A.

4. 6 Line Isolation Monitor (LIM)

All panels are supplied with one or more line isolation monitor (LIM). The LIM monitors the system impedance to ground of the entire isolated power system. The impedance to ground is used to calculate the total hazard current (THC), given in units of milliamperes (mA). The factory default THC alarm is set to 5 mA. The value may be changed to 2 mA to meet applicable certification requirements.



The LIM is installed on the front trim in a conspicuously visible location. Refer to LIM user manual for more information on operation and use.

4. 7 Fault Location (EDS) Kit

Panels may include branch circuit fault location as part of an optional accessory kit (EDS kit). The system works together with the LIM2010 to assist in identifying the specific circuit contributing to the total hazard current alarm. Fault location is automated (unless otherwise configured) once the total hazard current alarm is activated.

The EDS kit is installed in the interior assembly and may be installed at the factory or on site. Refer to panel add-on user manual for more information on installation, operation, and use.



4. 8 Receptacle Kit

Panels may include on-board receptacles and ground jacks as part of an optional accessory kit (receptacle kit). The receptacle kit provides NEMA type receptacles and/or hospital grade ground jacks accessible directly from the front trim. Type and quantity is per project specifications.

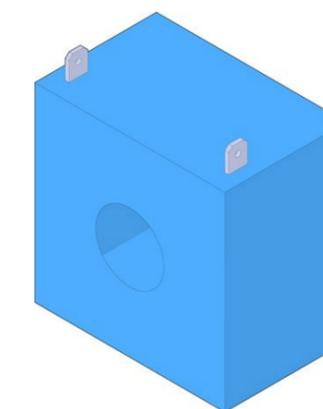
The receptacle kit is installed in the interior assembly and may be installed at the factory or on site. Refer to panel add-on user manual for more information on installation, operation, and use.



4. 9 Load Monitoring

Panels may include one or both of the following load monitoring systems:

- Full system monitoring: The STW3 connects to the line isolation monitor and monitors the current draw of the full system. The LIM can alarm once a set threshold is reached.
- Branch monitoring: Two CMS460 series devices monitor the load current for each individual circuit branch.



4. 10 Accessories Package

Refer to applicable documentation for any additional accessories included with the panel.

5. Receiving, Handling, and Storage

5.1 Receiving

Inspect all equipment immediately upon delivery. If any damage or mishandling has occurred, file a damage claim with Bender and/or the carrier. Verify packing slip details before filing a shortage claim. Isolated power panels are typically packaged and shipped as four (4) separate components:

- Backbox
- Interior assembly
- Transformer kit
- Front trim

These system components may be shipped at different times to accommodate the installer project schedule. In many cases, the backbox and interior assembly arrive first to allow sufficient time for preliminary installation.



NOTE: Do not separate the contents of the isolation transformer kit until ready for installation.

5.2 Handling



WARNING: Due to the heavy load of isolated power equipment, use suitable equipment for lifting and transporting. Failure to do so may result in severe personal injury and damage to equipment.

5.3 Storage

- Do not store equipment in dusty or damp locations.
- Do not stack panels or equipment.
- Do not rest or lean front trims against walls.

6. Pre-Installation Requirements

6.1 General Requirements

Review all code, standards, and project requirements thoroughly before proceeding with installation. Of particular importance is minimizing the cumulative system leakage current in an isolated power system. NFPA 99 mandates an isolated power system's total line-to-ground insulation impedance shall exceed 200 kΩ. Excessive leakage current may result in non-conformance with this requirement.



NOTE: In addition to adhering to all national, local, and project-specific requirements, the installer shall thoroughly review and understand all information within this manual and relevant reference material. Applicable material includes, but is not limited to:

- NFPA 99 - 2012: Healthcare Facilities Code Chapter 6
- NFPA 70: National Electric Code (NEC), Article 517
- (Canada) CSA C22.1: Canadian Electrical Code (CEC, CE-Code), Section 24
- (Canada) CSA Z32: Applications of Electricity in Healthcare

6. 2 Support Requirements

Prior to installation, ensure the proper structural support will be used. Minimum load bearing requirements are listed in the table below. For panels weighing in excess of 500 lb (230 kg), install both horizontal (bottom) and vertical (side) supports.



NOTE: Custom configurations may have special weight and load bearing requirements.

Type	Weight (lb)	Weight (kg)
MIP series	370	168
MIE series	650	295
MIC series	650	295
MID series	675	306
MIX series	700	317

6. 3 Size Requirements

Verify backbox dimensions on label. Ensure the wall space required is available before proceeding with backbox installation. Ensure the mounting style (surface or flush) is correct for the application. For reference, standard backbox sizes are listed in the table below. Dimensions are given in inches (cm).

Model	Height	Width	Depth
B662406(S)	66" (167.6 cm)	24" (61 cm)	6" (15.2 cm)
B662408(S)	66" (167.6 cm)	24" (61 cm)	8" (20.3 cm)
B723012(S)	72" (182.9 cm)	30" (76.2 cm)	12" (30.5 cm)
B723014(S)	72" (182.9 cm)	30" (76.2 cm)	14" (35.6 cm)
B803608(S)	80" (203.2 cm)	36" (91.4 cm)	8" (20.3 cm)

7. Installation

7. 1 Considerations

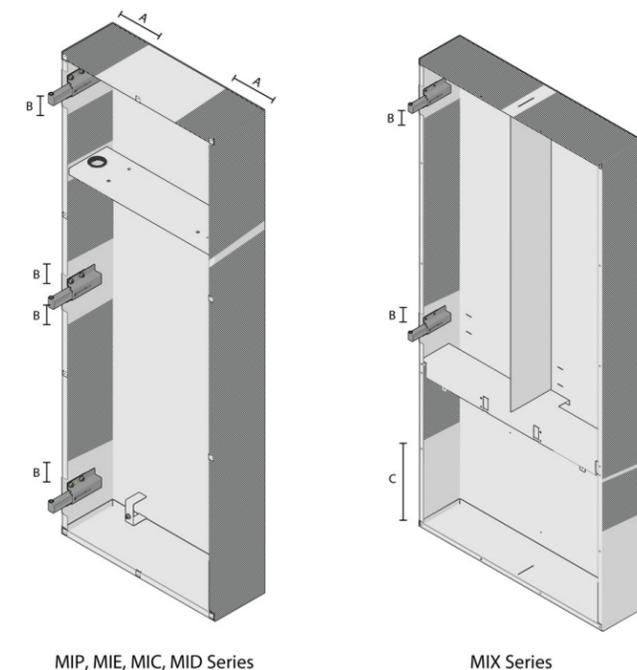
7.1.1 Distance From Finished Floor

Refer to table below for allowable distances between bottom of isolated power panel and finished floor.

Models	Allowable Distance
MIP, MIC, MIE, MID	Minimum 2' (61 cm), maximum 20' (610 cm)
MIX	Minimum 2' (61 cm), maximum 9' (275 cm)

7.1.2 Available Conduit Areas

Refer to figures below. Shaded areas are allowable conduit locations.



A	5" (127 mm)
B	2" (51 mm)
C	16" (405 mm)

7. 2 Mount Backbox



NOTE: Before installing, check the part number to verify the backbox to be installed matches with the appropriate interior, transformer kit, and front trim. Most backboxes are identical in appearance.

The manufacturer recommended mounting method is to secure the backbox to a rigid support structure (strut channel, etc.) using minimum 5/16" commercial grade hardware (not included). Mounting locations are near the four corners of the enclosure sidewalls. Refer to figure on the following page for example location in the top left corner. Note the following requirements for each corner:

- Use two (2) 5/16" fasteners per corner on the side wall of the backbox
- Must be 2" (51 mm) from the top of the backbox
- Must be 2" (51 mm) from the front of the backbox
- Screws must be 2" (51 mm) apart

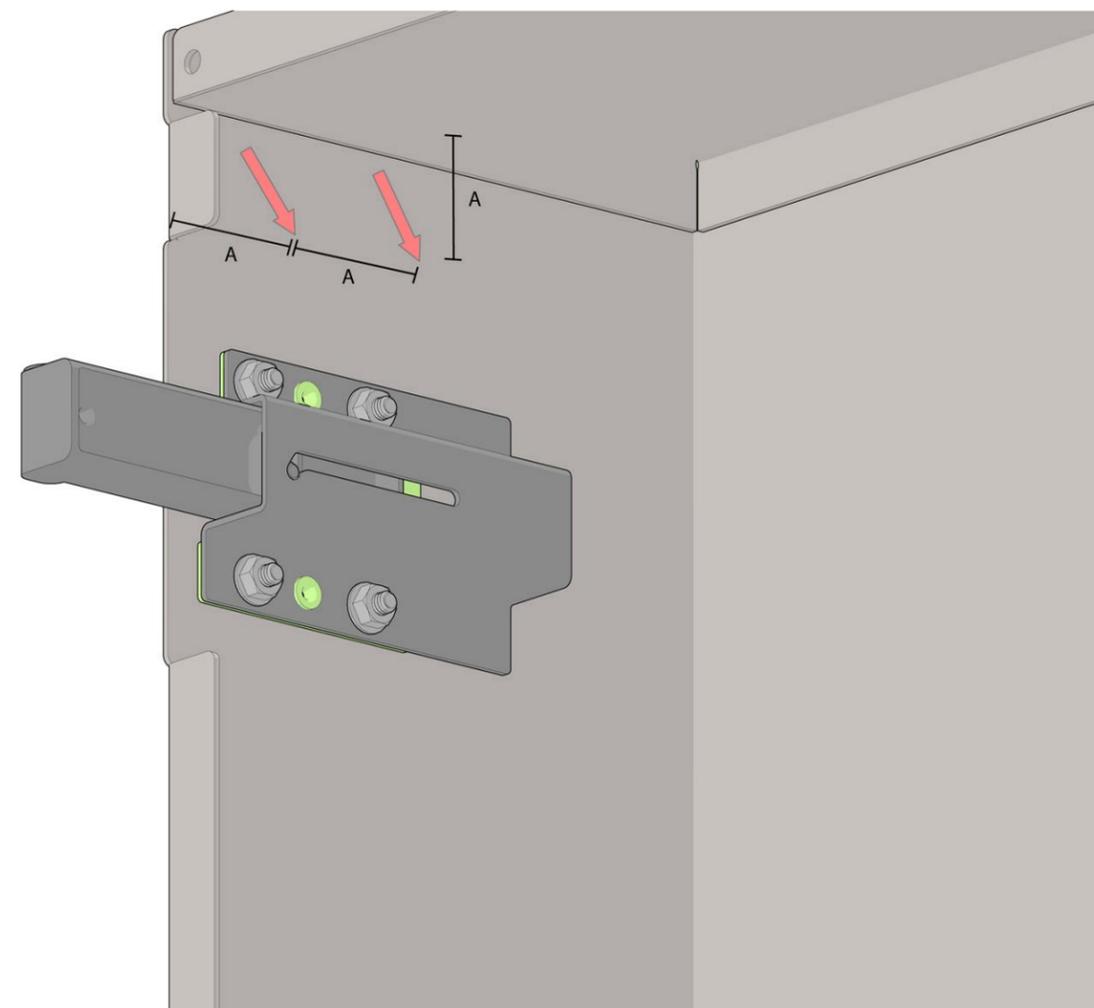


CAUTION: Do not over-tighten the mounting hardware. Over-tightening will cause distortion, misalignment of the front trim, and improper hinge functionality. Use shims to mitigate distortion as needed.

For flush-mounted enclosures, install flush with finished wall or recessed no more than 1/8" (3 mm).



NOTE: Recessing enclosure more than 1/8" (3 mm) will impede hinge functionality.



7.3 Install Conduit



NOTE: Knock-outs or holes for conduit are not provided by the factory.

Before installing conduit, Refer to Section 7.1.2 for available areas. Conduit must be metallic type per NEC Article 517.13, and itself must qualify as an equipment ground conductor per NEC Article 250.118.

- Install conduit properly. Use hubs and ring connectors to protect cables and prevent condensation from entering the panel.
- If top entry, use independent conduit support. Do not use the top of the panel as a weight support.
- Ground all conduit, stubs, and ring connectors to the panel with approved electrical connections.
- Conduit runs for branch circuits shall be as short as possible to minimize cumulative system leakage current.



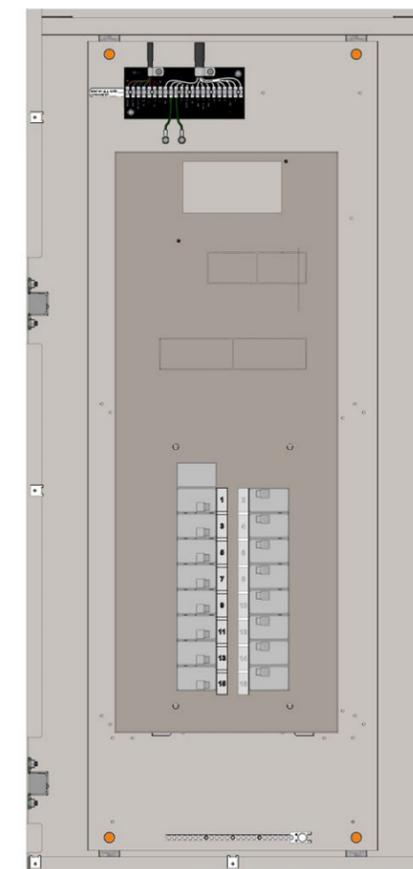
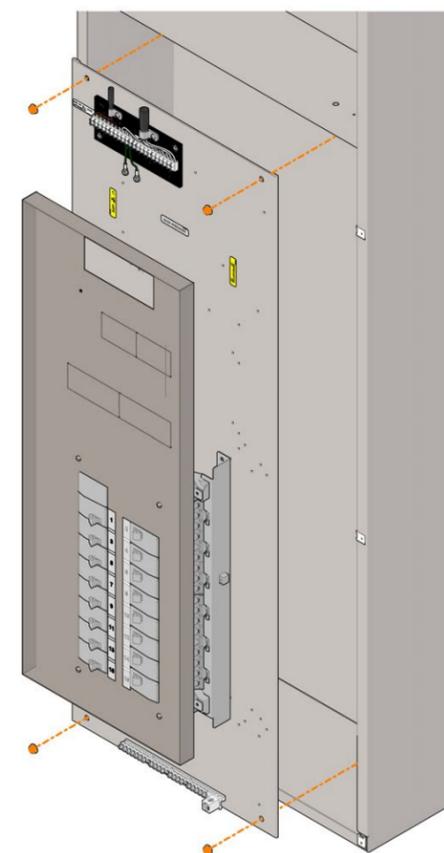
NOTE: For Canadian applications, refer to Canadian Electrical Code, section 24-204(2)(f).

7.4 Install Interior

All interior assemblies have minimum four (4) mounting slots that fasten to the threaded studs on the rear of the backbox. To install, align the mounting holes to the lower studs, then align to the upper studs. Using a 5/16" hex drive, secure the interior assembly to the studs using the provided hardware. Use 125 to 129 lb-in tightening torque. Refer to figure below.

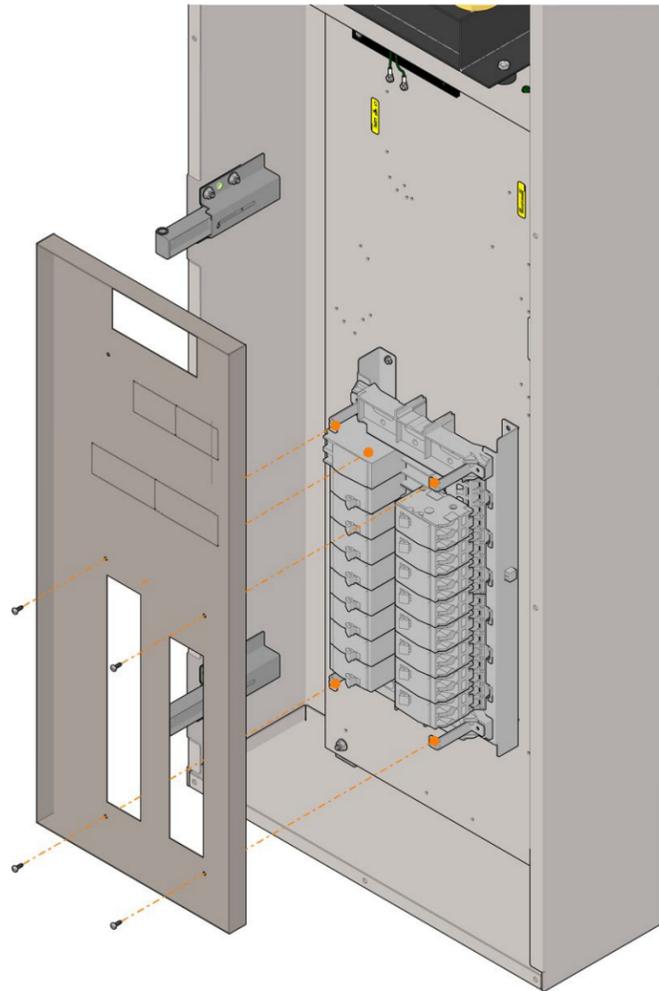


NOTE: For MIX series panels, the left-side (hinge-side) system must be installed at an angle. With the interior at a 30 degree angle, align the interior with the leftmost studs, then to the studs on the right. The rightside interior may be installed as shown below.



7. 5 Remove Interior Deadfront

Remove the four interior deadfront screws as shown in the figure below. Retain the deadfront and mounting hardware.



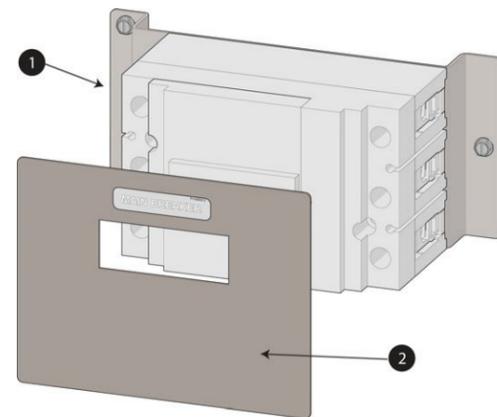
7. 6 Install Breaker Kit

Skip this section if breaker kit was installed at the factory.

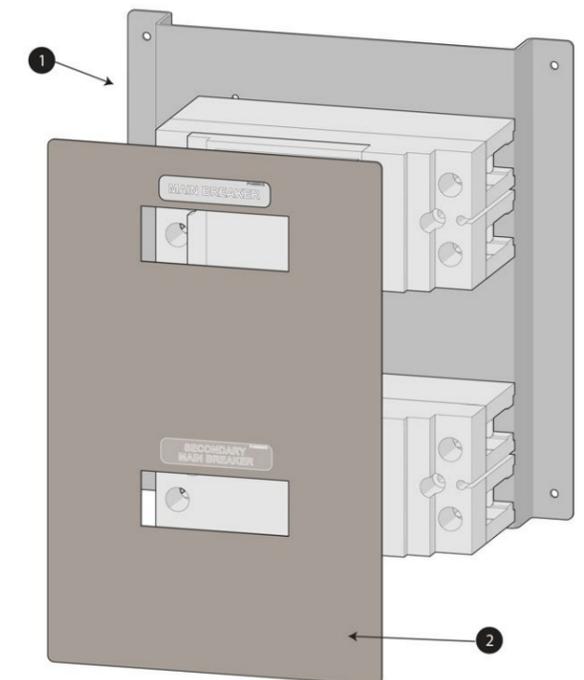


CAUTION: Do not separate breaker from sub-plate until ready to install. Ensure model on breaker sub-plate label matches the model number on the isolation transformer label.

7. 6.1 Components



MIP, MIE, MIC, MIX series: Primary main CB
MID series: Secondary main CB, low voltage side

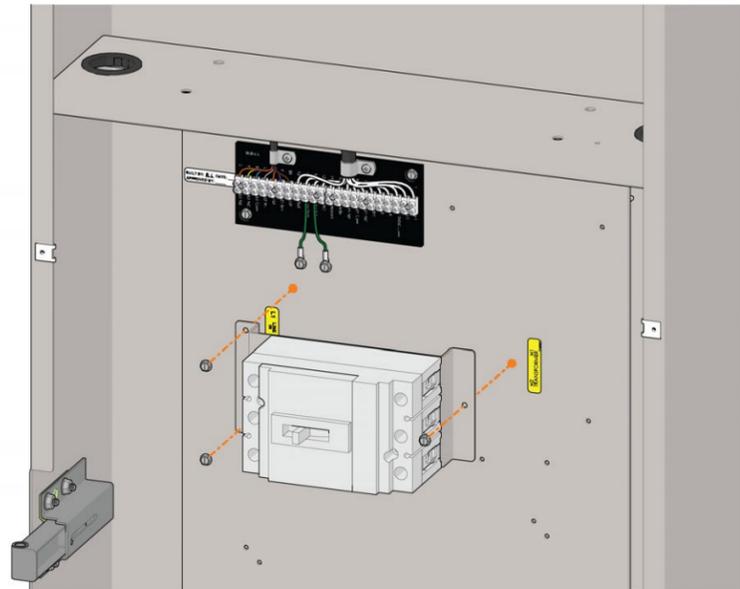


MID Series: Primary main CB (top)
Secondary main CB, high voltage side (bottom)

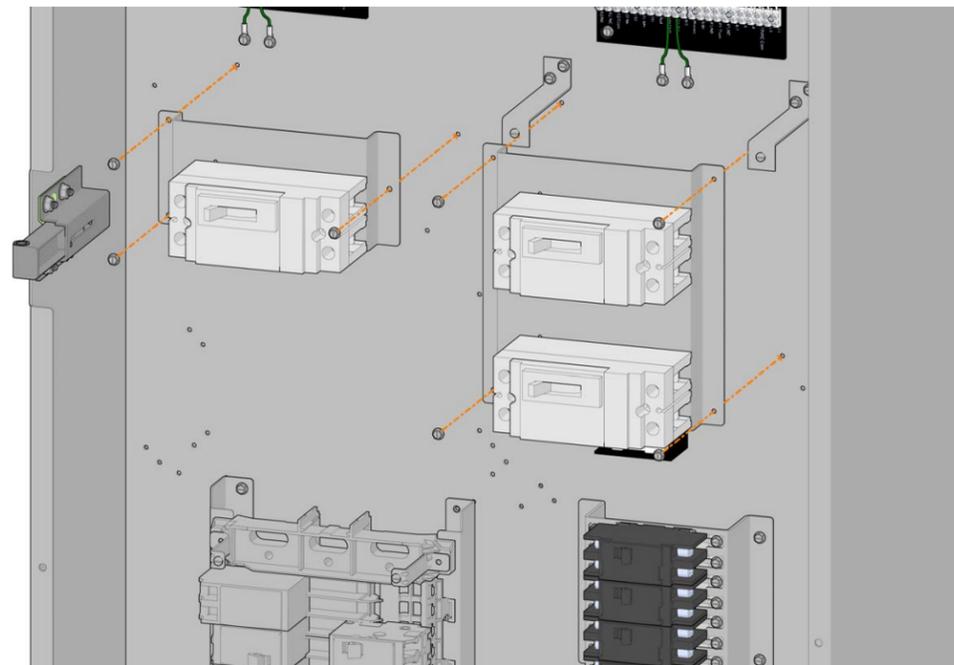
Component	Description
1	Breaker bracket assembly: Breaker(s) affixed to mounting bracket
2	Breaker sub-plate: Filler plate with system rating label and mounting hardware

7.6.2 Install Breaker Bracket Assembly

Locate the breaker bracket assembly's mounting points on the interior assembly backplate. Using a 5/16" hex drive, remove the #10-16 screws located in the mounting holes. Using the same holes and hardware, attach the assembly to the interior backplate. Use 35 to 45 lb-in tightening torque. Refer to appropriate figure below.



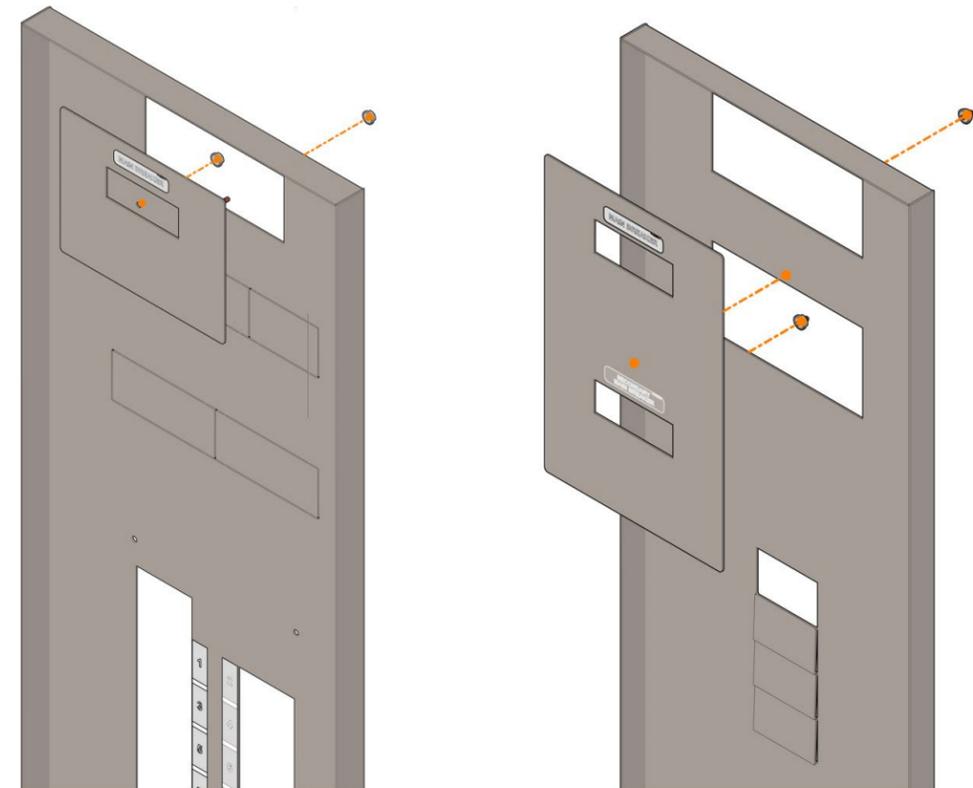
MIP, MIE, MIC, MIX series



MID Series

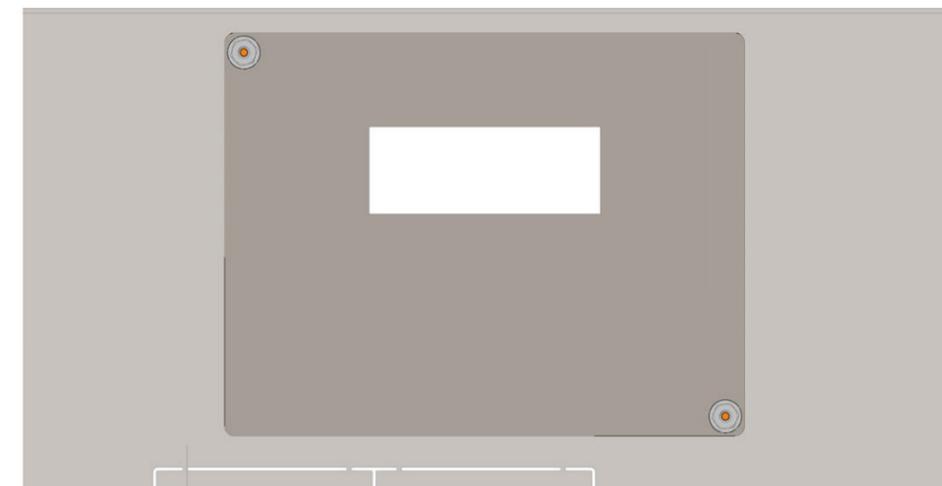
7.6.3 Install Breaker Sub-Plate

Fasten the breaker sub-plate to the interior deadfront using the #6-32 flange nuts provided in the breaker hardware kit. Use 8 to 9 lb-in tightening torque. Refer to appropriate figure below.



All Models

MID Series - High Side Deadfront

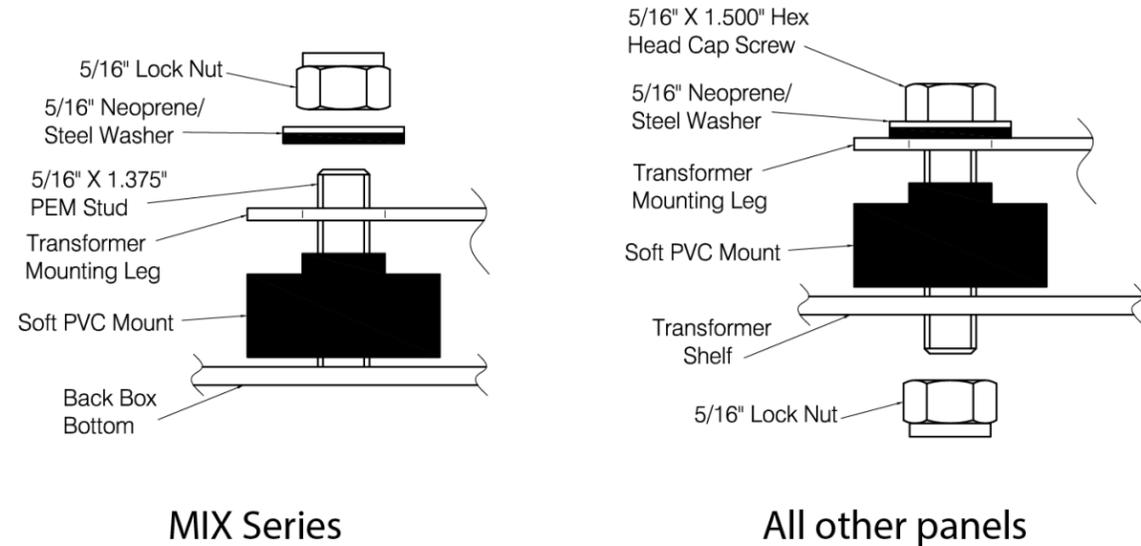


Rear view of deadfront

7.7 Install Transformer

7.7.1 Vibration Pads and Mounting Hardware

Mounting hardware and vibration pads are included with each transformer. Install hardware according to the appropriate figure below. Do not compress the vibration pads. Tighten until hardware no longer freely moves. figure below.



MIX Series

All other panels

7.7.2 Mounting

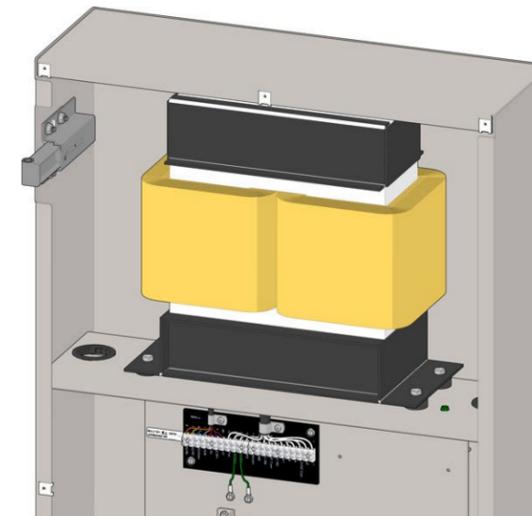


WARNING: Isolation transformers can weigh in excess of 650 lb (295 kg). Use suitable equipment for lifting, transporting, and installing. Failure to do so may result in personal injury and damage to equipment.

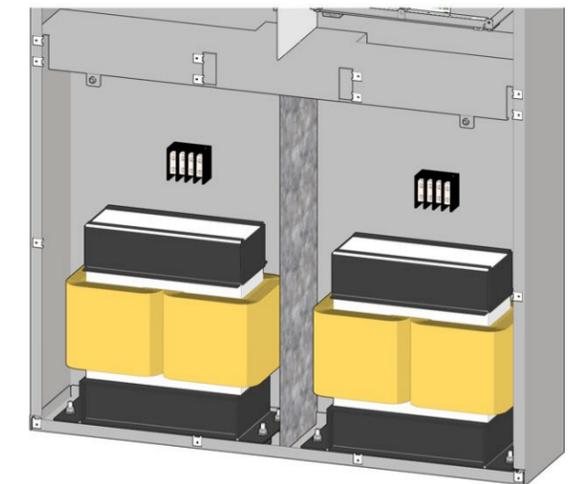
Depending on panel model, transformer(s) are installed in either the top half or bottom half of the enclosure. Refer to figures below and approved submittal drawings for specific locations.

If located on the top half of the enclosure, place transformer on provided transformer shelf. For transformers located in the bottom half of the enclosure, place the transformer on the provided studs.

Orient the transformer(s) in the enclosure to allow the leads to extend from the front to facilitate wiring the primary circuit breaker and panel board lugs.



MIP, MIE, MIC, MID series



MIX Series

7.8 Wiring

7.8.1 General Instructions



HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

This equipment must only be installed and serviced by qualified electrical personnel. Disconnect all power before servicing. Observe all local, state, and national codes, standards and regulations when installing this equipment.

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

This section provides general information for wiring isolated power panels. After reading this section and ensuring all requirements will be met, locate the appropriate wiring diagram in Section 7.9 and make all necessary electrical connections.

7.8.2 Transformer and Incoming Power Wiring

Isolated power systems require a three-wire incoming power feed (hot/hot/ground or hot/neutral/ground). Standard building construction wire (THHN or equivalent) is acceptable.

- Verify the incoming voltage corresponds with the primary voltage (H1/H2) listed on the transformer nameplate and breaker sub-panel label.
- The incoming power conductors (hot/hot or hot/neutral) are connected to the line side (L1/L2) terminals of the primary main circuit breaker.
- The incoming ground conductor is terminated to the reference ground bus in the panel.
- The transformer's primary leads (H1/H2) are connected to the load side (H1/H2) of the primary main circuit breaker. For MIX panels, first terminate the transformer leads to the terminal block located in the backbox.
- The transformer's secondary leads (X1/X2) are connected to the panel board lugs (or sub-feed lug if applicable). For MIX panels, first terminate the transformer leads to the terminal block located in the backbox.
- Using the provided #10-32 grounding screw, terminate the transformer's ground lead to the threaded hole labeled "Transformer Grounding Point" located in the backbox.

7.8.3 Branch Circuit Wiring



NOTE: Ensure any isolated power system conductors are kept separate from other system circuits (isolated or grounded). Do not include them in a common conduit or raceway.



NOTE: To minimize the cumulative system leakage current, ensure the length of any branch circuit conductors is as short as possible.

The manufacturer recommended wire for all branch-circuit, current-carrying conductors is a cross-linked, polyethylene wire with a dielectric constant of 3.5 or less. XHHW and XHHW-2 type wire is a commonly available example. Avoid wire with high carbon fiber filler, as it can contribute to increased system leakage current.

For all panels except MIC series, terminate connections at the circuit breaker. For MIC series panels, terminate connections at the appropriate contactor.

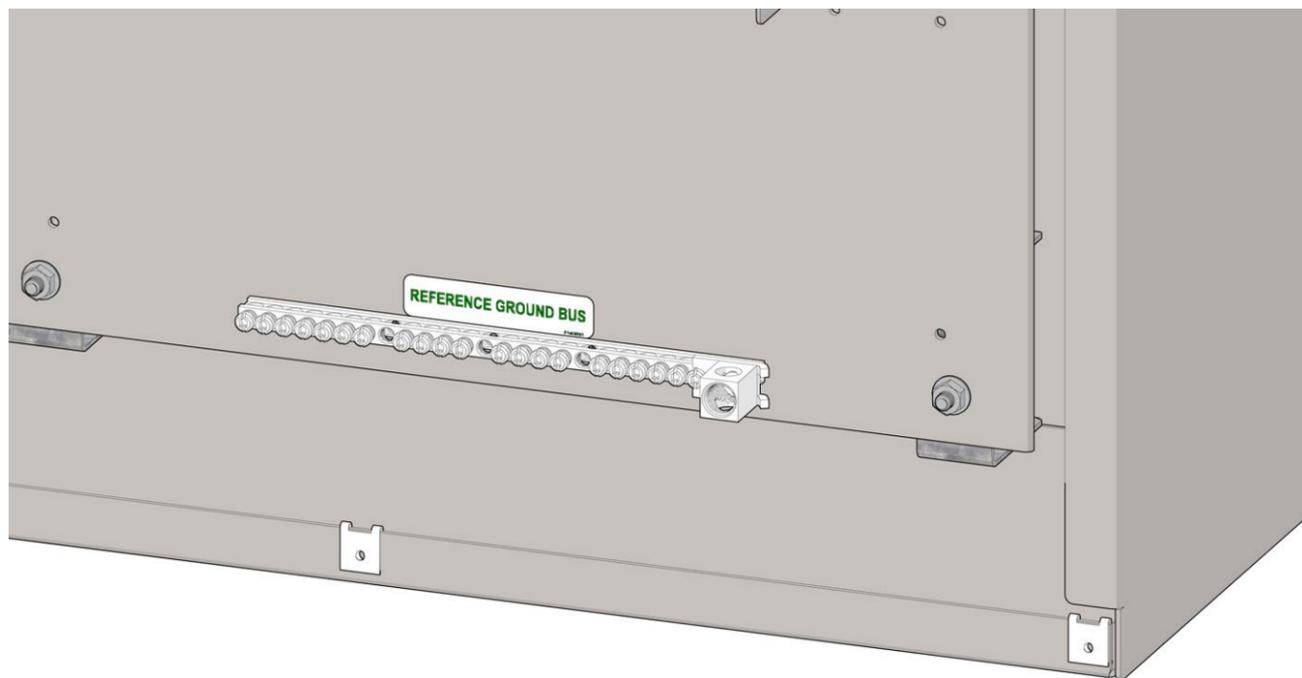
Do not use wire pulling compounds to lubricate conduit.

Identification and location of secondary circuit conductors shall be in accordance with NEC Article 517:

Type	Identification and Connection Location
Isolated conductor 1	Orange with at least one distinctive color stripe OTHER THAN white, green or gray along the entire length of the conductor. Terminated to the upper pole of the branch breaker and to the silver screw of each NEMA rated receptacle.
Isolated conductor 2	Brown with at least one distinctive color stripe OTHER THAN white, green or gray along the entire length of the conductor. Terminated to the lower pole of the branch breaker and to the brass screw of each NEMA rated receptacle.
Equipment grounding conductor	Green with or without yellow stripe.

7.8.4 Grounding

As defined by NEC Article 517, the ground bus in the isolated power system is the reference grounding point for the room. Refer to figure below for typical appearance and location.



- Connect all ground conductors from the equipment and receptacles in the area served by the isolated power system to the panel's ground bus.
- If more than one isolated power system is serving the same area, bond them together using a minimum AWG 10 insulated equipment bonding conductor per NEC Article 517.14.

7.8.5 Accessories / Add-On Kit Wiring

Refer to the respective installation manual(s) for installing additional equipment.

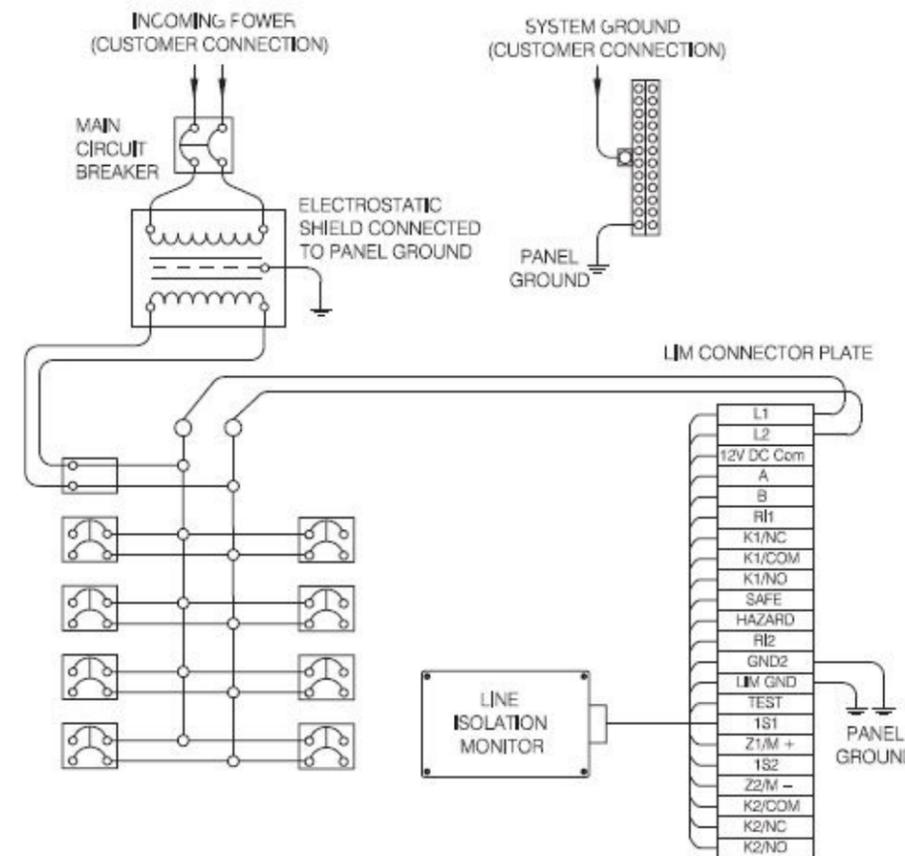
7.9 Wiring Diagrams



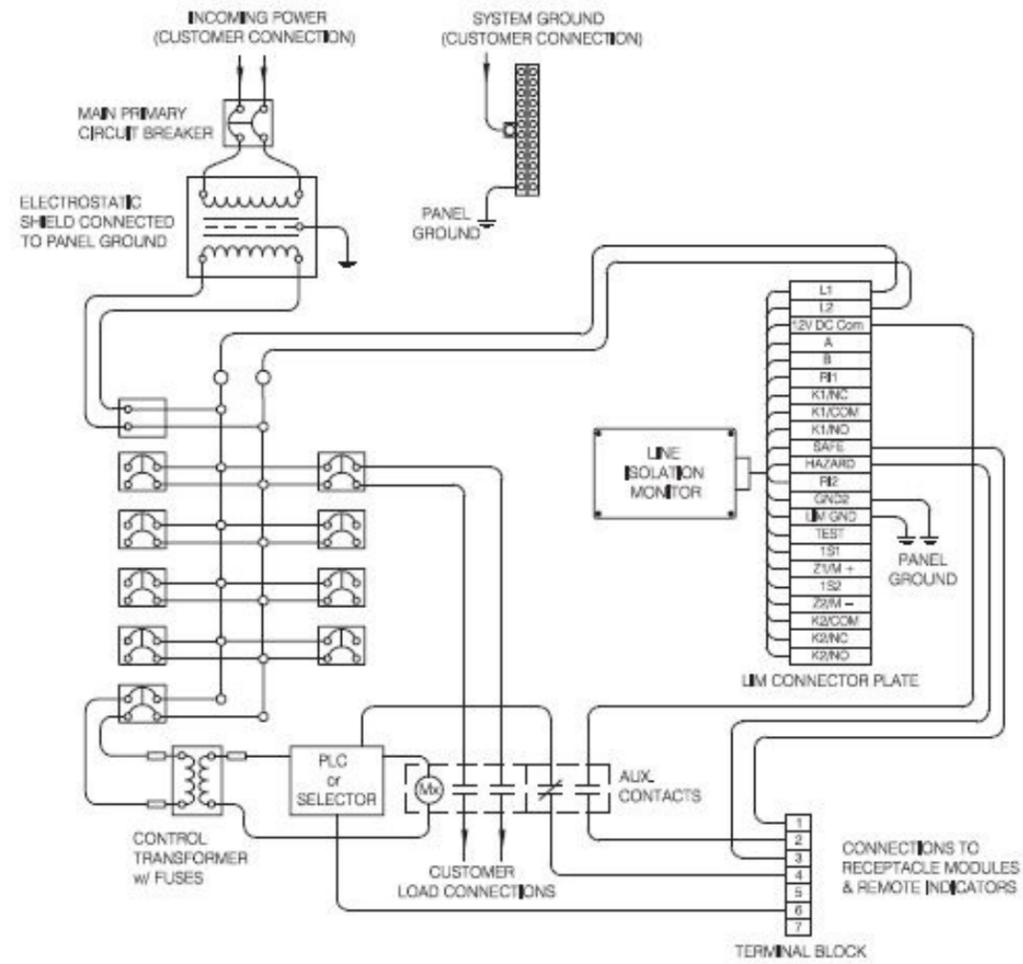
NOTE: The wiring diagrams in this section do not include connections for accessories or add-on options, such as remote indicators, EDS kits, or receptacle kits. Refer to the respective installation manual for information on wiring additional equipment.

7.9.1 MIP, MIE, and MIX Series

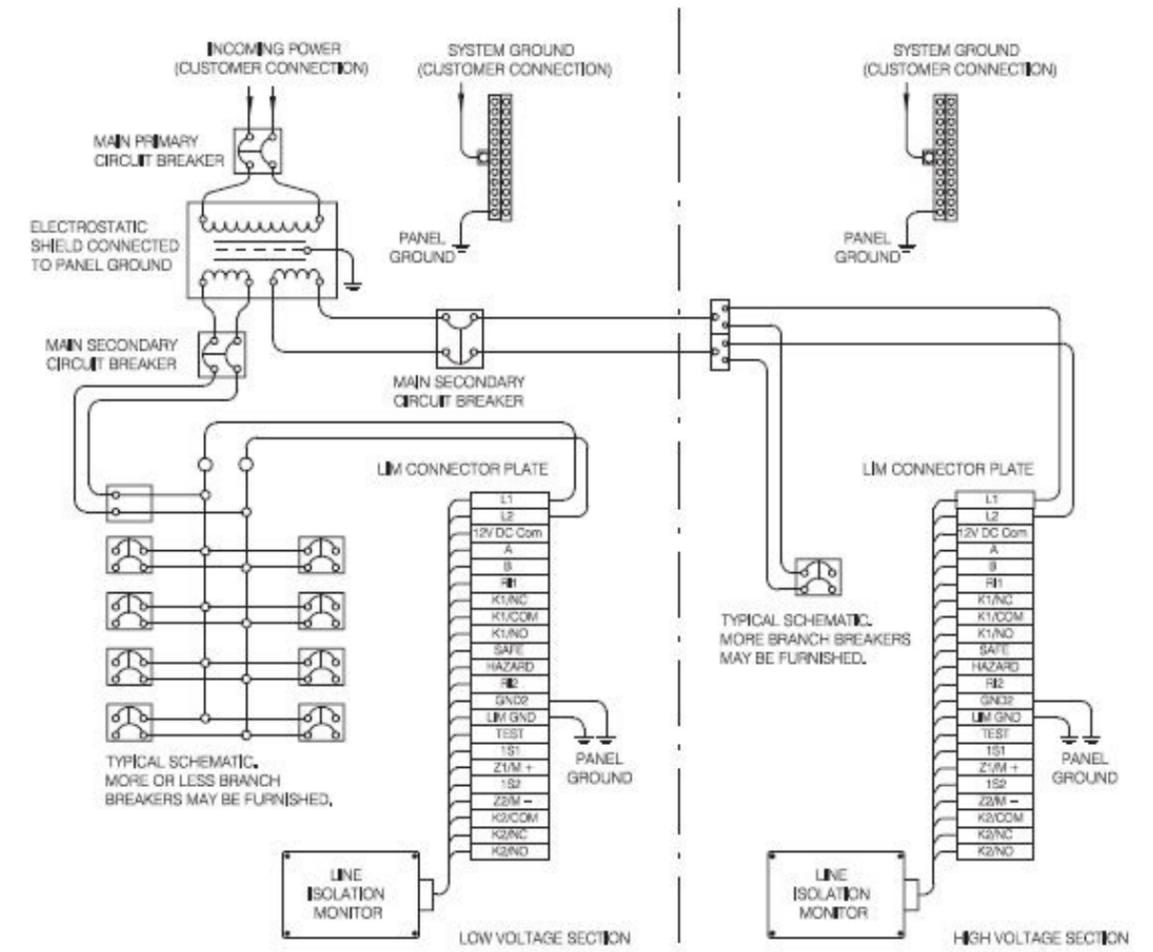
For MIX series dual system panels, wiring schematic shown is for each system.



7.9.2 MIC Series

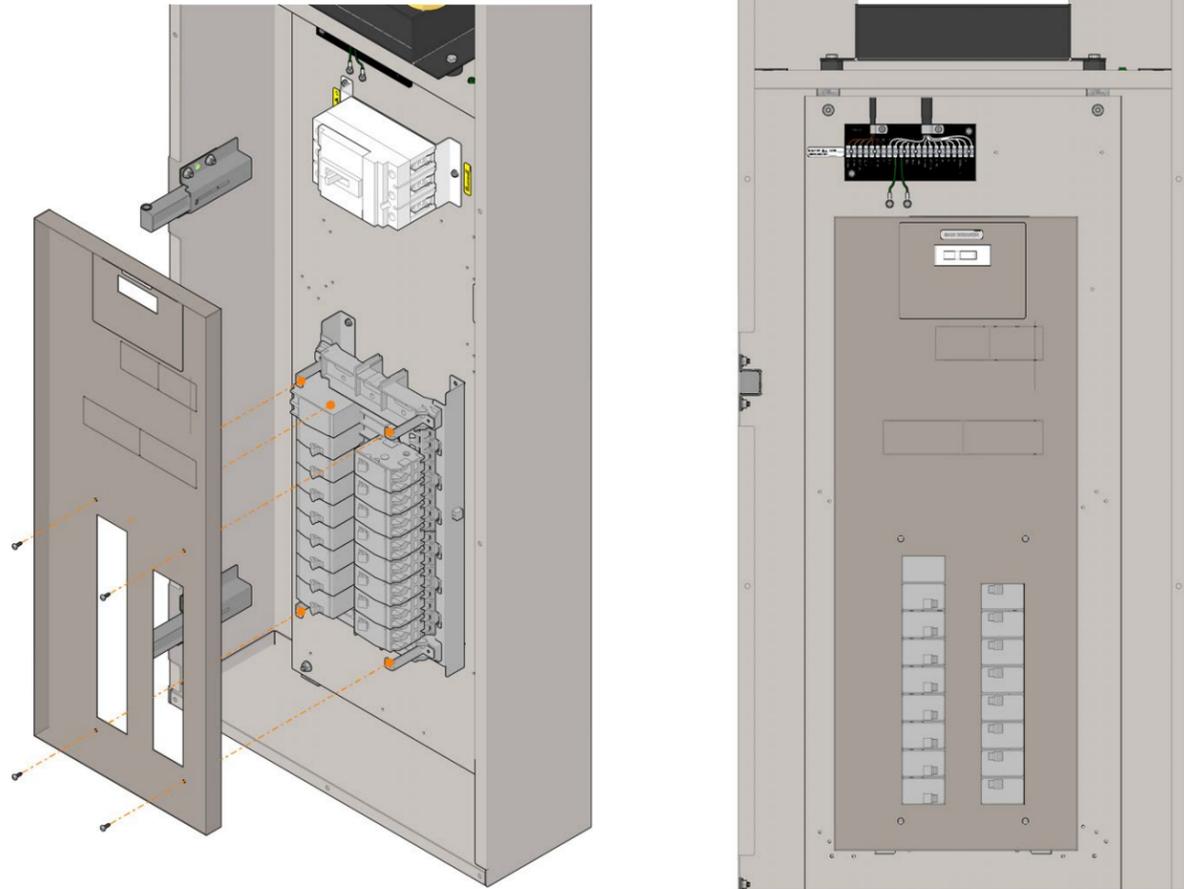


7.9.3 MID Series



7. 10 Reinstall Interior Deadfront

Align and mount the interior deadfront. Refer to figure below.



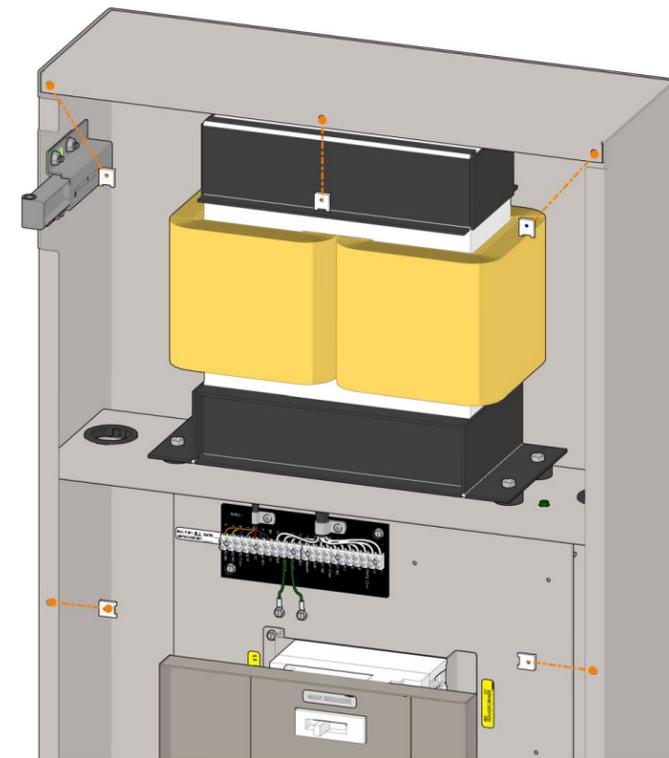
7. 11 Install Front Trim

A stainless steel front trim is provided for each isolated power panel. Certain models may have a front trim comprised of more than one section. Before installing, verify the front trim model is compatible with the installed backbox.

Each front trim includes a hardware kit attached to the rear of the front trim. Remove this hardware kit and retain for installation.

7.11.1 Install U-Type Retaining Nuts

Place u-type retaining nuts over each mounting hole in the backbox (more unuts are provided than needed). Refer to figure below.



7.11.2 Mount Front Trim

Remove tape protecting backbox hinge and fully extend. Lift the front trim, align, and mate the hinge fittings. Refer to figure below.



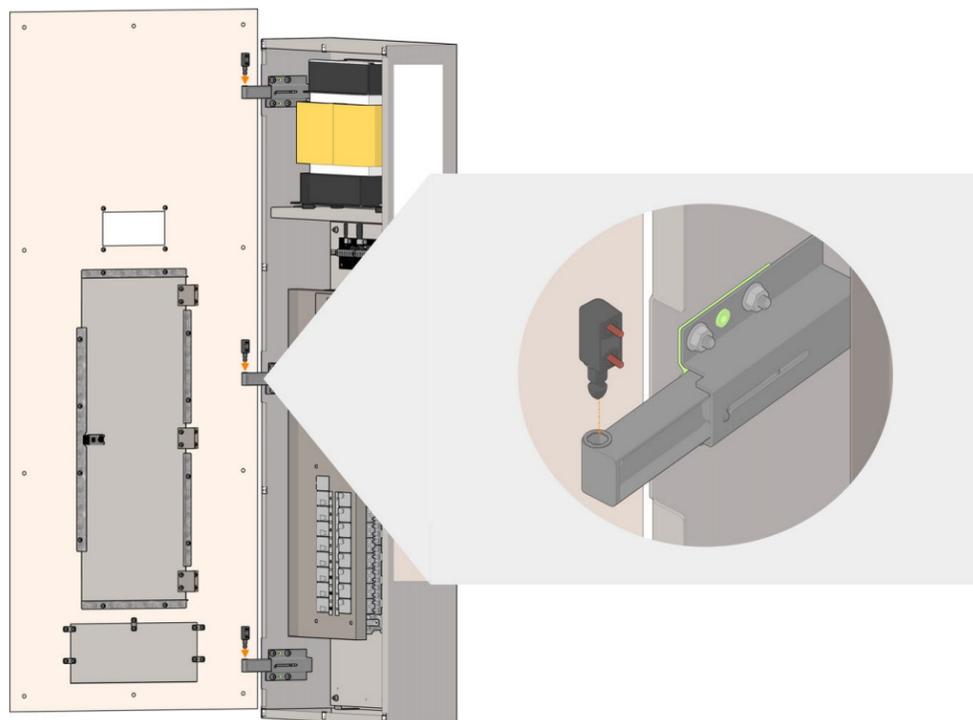
NOTE: Lifting the front trim from the breaker door opening may provide additional leverage and control. The breaker door key is included with the front trim hardware kit.



NOTE: MIX series front trims are divided into two pieces. The upper half uses two hinges. The bottom half is secured using hex screws. Instructions for installing the lower half trim are in a later section.



CAUTION: Front trims may have sharp edges. Use appropriate PPE when handling. Failure to do so may result in personal injury or damage to equipment.

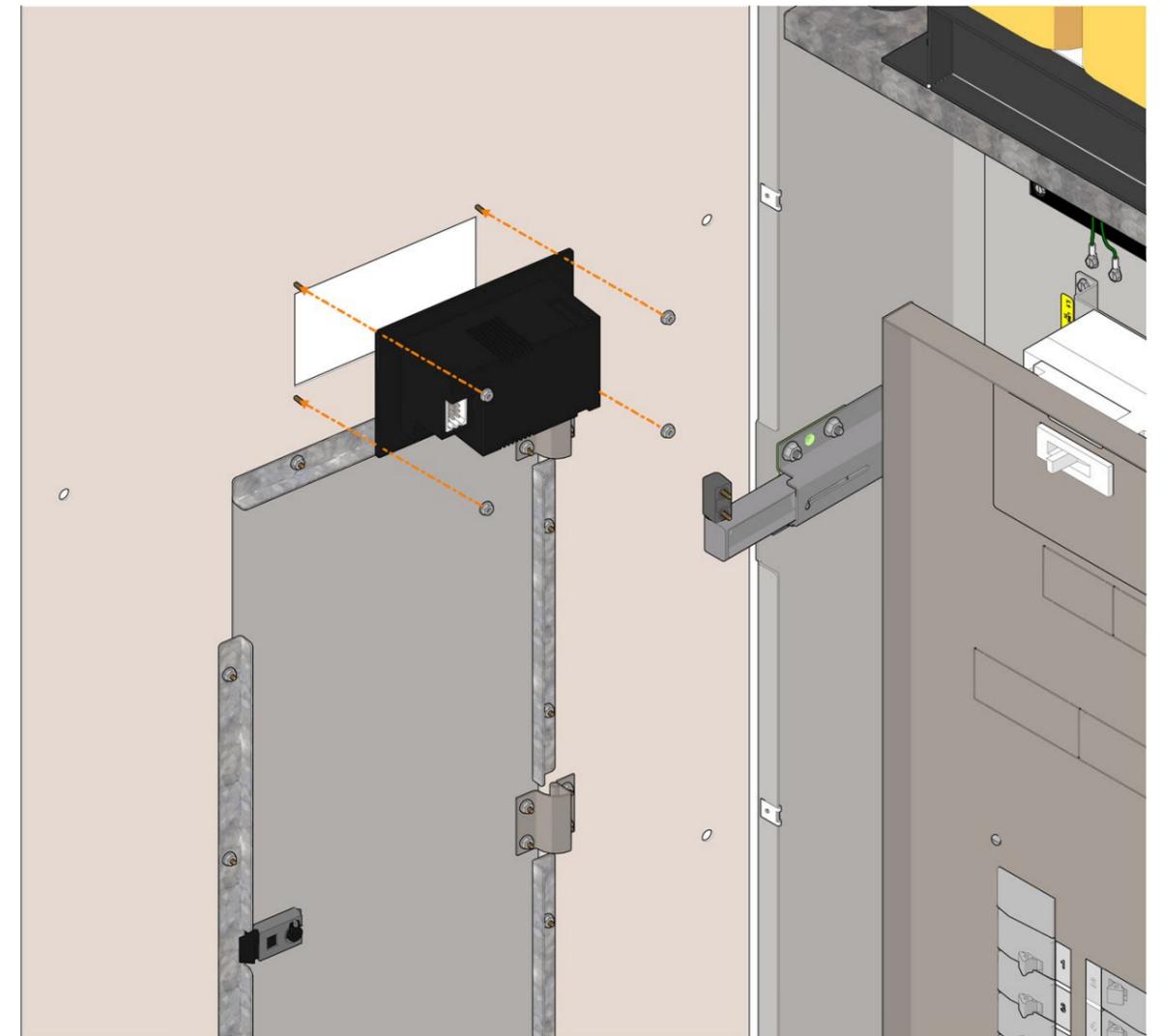


7.11.3 Install Line Isolation Monitor



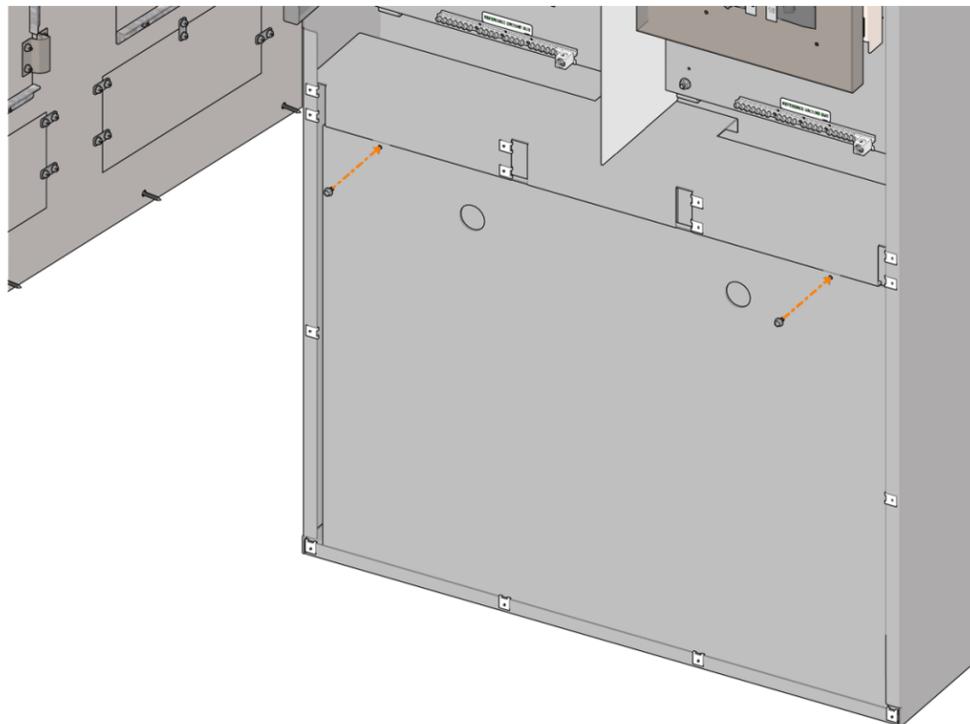
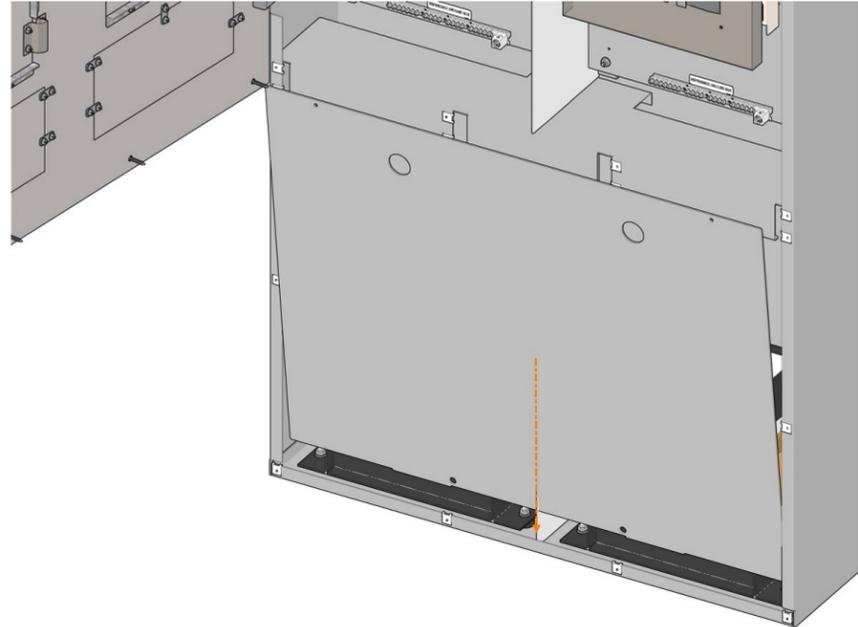
NOTE: The line isolation monitor is packaged with the interior assembly. The LIM hardware kit is packaged with the line isolation monitor.

From the rear of the front trim, position the LIM display through the front trim cutout while aligning the line isolation monitor's four mounting holes to the #6-32 threaded studs. Secure the LIM to the front trim by tightening the four #6-32 flange nuts. Use 8 to 9 lb-in tightening torque. Refer to figure below.



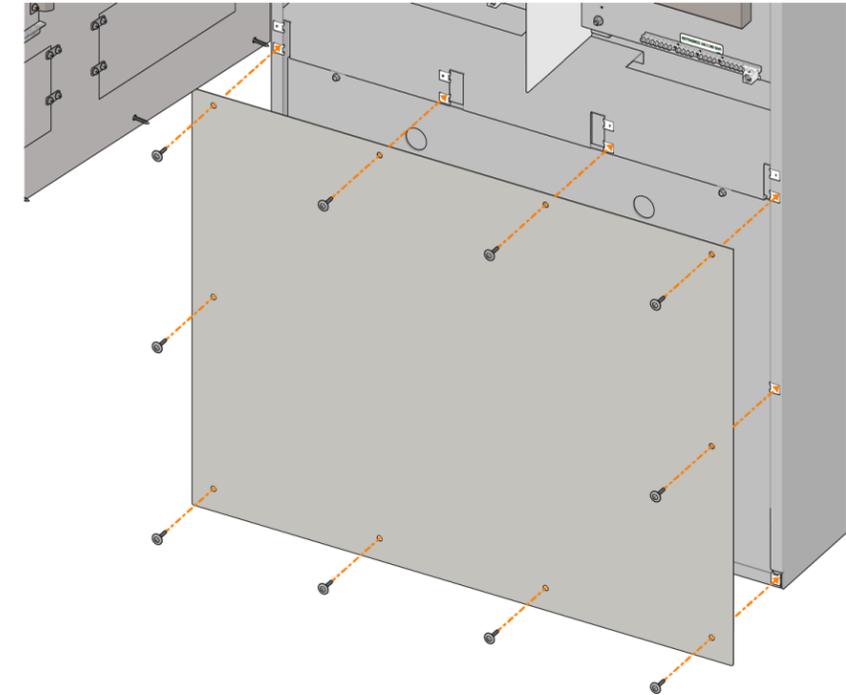
7.11.4 Install Transformer Heat Shield (MIX Series Only)

Dual system panels include a heat shield and additional front trim piece. Slide the heat shield into the two slots on the bottom of the backbox. Secure to backbox using the provided #10-32 hex screws. Use 25 to 30 lb-in tightening torque.



7.11.5 Install Lower Front Trim (MIX Series Only)

Align the lower front trim to the mounting holes and secure using the provided #2 phillips-head front trim panel screws. Use 10 to 12 lb-in tightening torque.



7.11.6 Install Restraining Lanyard (MIX series only)



A lanyard is included with one end preinstalled into the front trim. This lanyard must be attached to the backbox to prevent accidental damage to the LIM harness when opening the front trim.

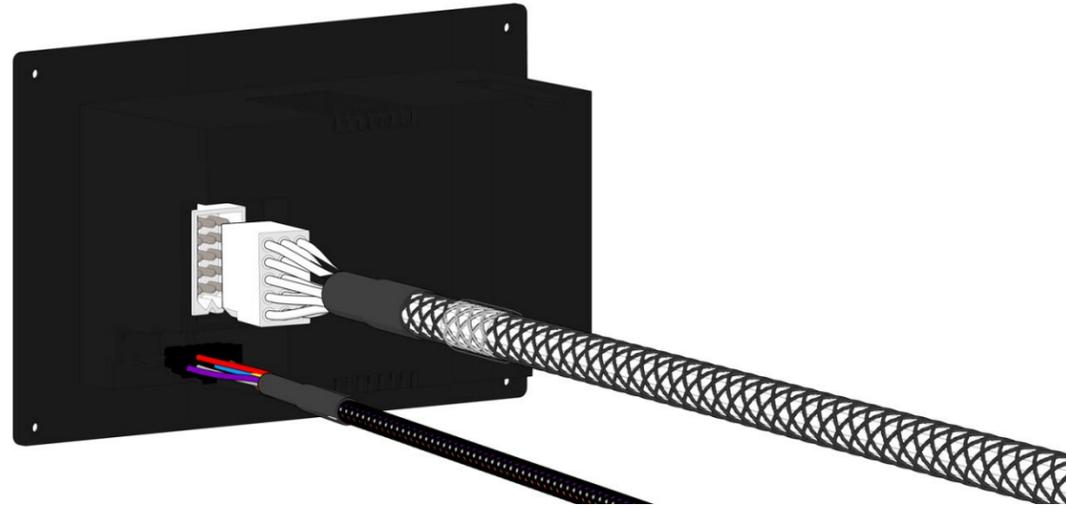
Locate the connection point on the backbox, which is a preinstalled screw above the lower front trim. Remove the screw, place the open lanyard end above the hole, and reinstall the screw.



CAUTION: The lanyard must be removed from the backbox prior to fully opening the MIX series front trim. Failure to do so may result in damage to equipment.

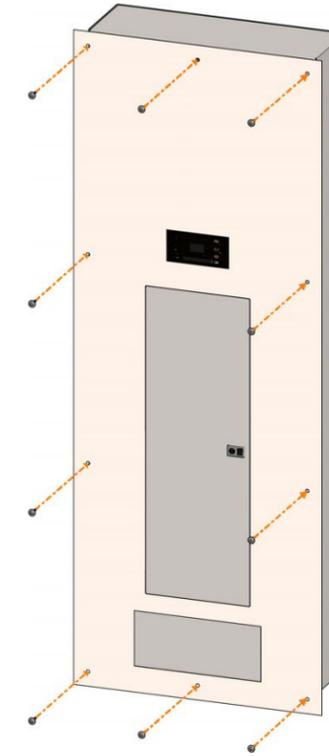
7.11.7 Connect Line Isolation Monitor Harness

Once complete, pivot the front trim to a 45 degree angle relative to the backbox. Connect the 15-pin and 12-pin LIM wire harness from the connector plate to the LIM.



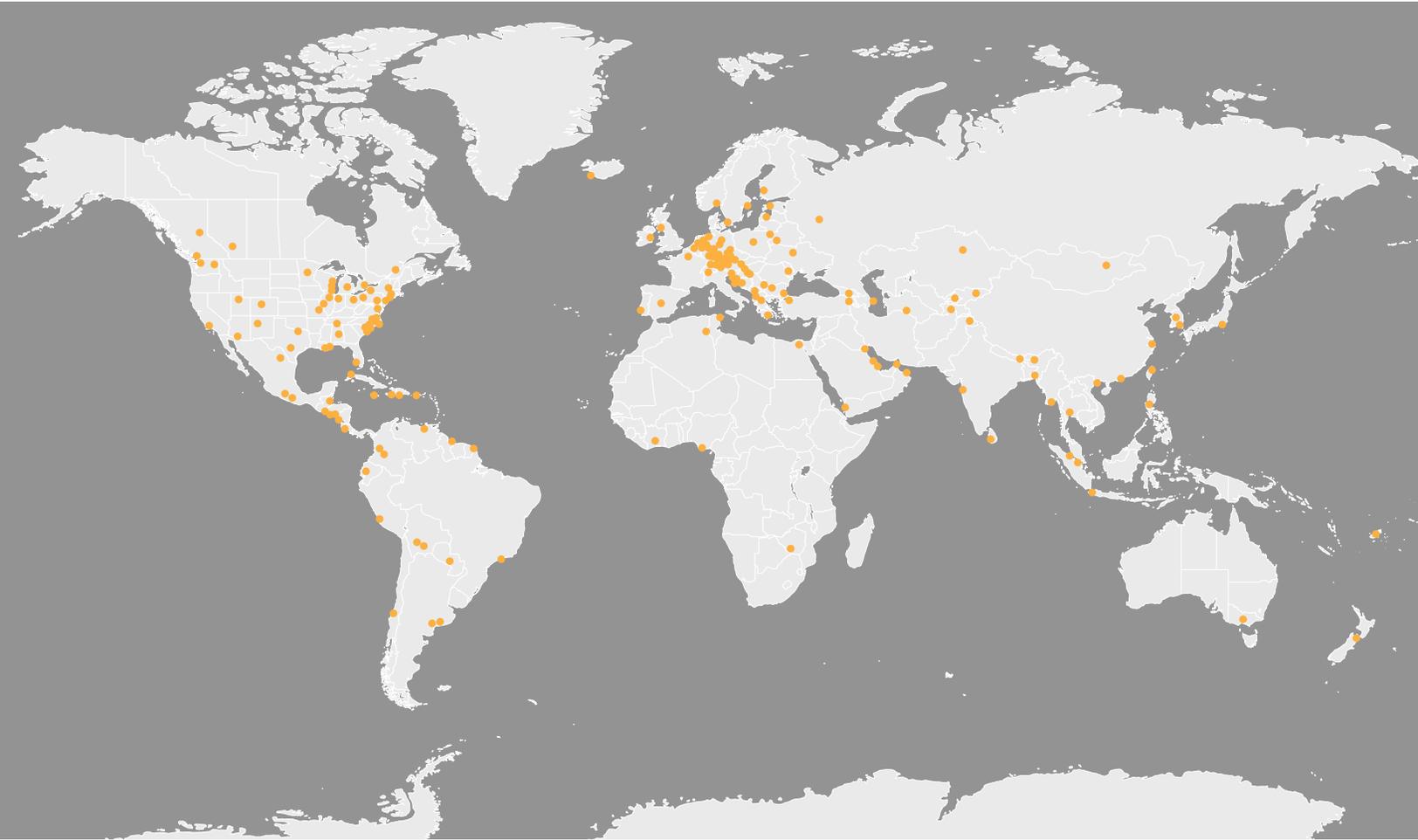
7.11.8 Close Front Trim

Fully close front trim and secure to backbox using the provided 1/4-20x1" Phillips truss-head stainless-steel screws. Use #2 Phillips-head bit to fasten. Loosely install all screws by hand then tighten in a star pattern. Refer to figure below.





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