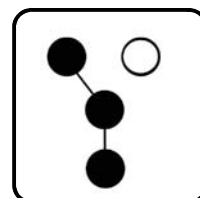


# Installation

## Automatic Transfer Switches



Models:

**RSB**

**ATSR**

## Intelligent Transfer Switch Conversion Kit

150 to 225 Amperes

Electrical Controls:  
MPAC™ 550



**KOHLER**<sup>®</sup>  
POWER SYSTEMS

506091-01

TP-6486 5/08c



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# Safety Precautions and Instructions

IMPORTANT SAFETY INSTRUCTIONS. Electromechanical equipment, including generator sets, transfer switches, switchgear, and accessories, can cause bodily harm and pose life-threatening danger when improperly installed, operated, or maintained. To prevent accidents be aware of potential dangers and act safely. Read and follow all safety precautions and instructions. **SAVE THESE INSTRUCTIONS.**

This manual has several types of safety precautions and instructions: Danger, Warning, Caution, and Notice.

## DANGER

Danger indicates the presence of a hazard that **will cause severe personal injury, death, or substantial property damage.**

## WARNING

Warning indicates the presence of a hazard that **can cause severe personal injury, death, or substantial property damage.**

## CAUTION

Caution indicates the presence of a hazard that **will or can cause minor personal injury or property damage.**

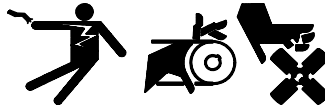
## NOTICE

Notice communicates installation, operation, or maintenance information that is safety related but not hazard related.

Safety decals affixed to the equipment in prominent places alert the operator or service technician to potential hazards and explain how to act safely. The decals are shown throughout this publication to improve operator recognition. Replace missing or damaged decals.

## Accidental Starting

### WARNING



**Accidental starting.**  
**Can cause severe injury or death.**

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

**Disabling the generator set. Accidental starting can cause severe injury or death.** Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

## Hazardous Voltage

### DANGER



**Hazardous voltage.**  
**Will cause severe injury or death.**

Disconnect all power sources before opening the enclosure.

### DANGER



**Hazardous voltage.**  
**Will cause severe injury or death.**

Only authorized personnel should open the enclosure.

### DANGER



**Hazardous voltage.**  
**Will cause severe injury or death.**

This equipment must be installed and serviced by qualified electrical personnel.

**Grounding electrical equipment. Hazardous voltage can cause severe injury or death.** Electrocutation is possible whenever electricity is present. Ensure you comply with all applicable codes and standards. Electrically ground the generator set, transfer switch, and related equipment and electrical circuits. Turn off the main circuit breakers of all power sources before servicing the equipment. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

**Short circuits. Hazardous voltage/current can cause severe injury or death.** Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while making adjustments or repairs. Remove all jewelry before servicing the equipment.

**Making line or auxiliary connections. Hazardous voltage can cause severe injury or death.** To prevent electrical shock deenergize the normal power source before making any line or auxiliary connections.

**Testing live electrical circuits. Hazardous voltage or current can cause severe injury or death.** Have trained and qualified personnel take diagnostic measurements of live circuits. Use adequately rated test equipment with electrically insulated probes and follow the instructions of the test equipment manufacturer when performing voltage tests. Observe the following precautions when performing voltage tests: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Do not touch the enclosure or components inside the enclosure. (4) Be prepared for the system to operate automatically. (600 volts and under)

---

**⚠ WARNING**




**Airborne particles. Can cause severe injury or blindness.**

Wear protective goggles and clothing when using power tools, hand tools, or compressed air.

---

## Heavy Equipment

|   |
|---|
| <b>⚠ WARNING</b>  |
|    |
| <b>Unbalanced weight. Improper lifting can cause severe injury or death and equipment damage.</b><br><br>Use adequate lifting capacity. Never leave the transfer switch standing upright unless it is securely bolted in place or stabilized. |

## Notice

### NOTICE

**Hardware damage.** The transfer switch may use both American Standard and metric hardware. Use the correct size tools to prevent rounding of the bolt heads and nuts.

### NOTICE

**Electrostatic discharge damage.** Electrostatic discharge (ESD) damages electronic circuit boards. Prevent electrostatic discharge damage by wearing an approved grounding wrist strap when handling electronic circuit boards or integrated circuits. An approved grounding wrist strap provides a high resistance (about 1 megohm), *not a direct short*, to ground.

This manual provides instructions for installation of the Kohler® Model RSB or ATSR Intelligent Transfer Switch Conversion Kit into the Square D® Intelligent Load Center QO® Indoor Load Center (Type 1) or QO® Outdoor Load Center (Type 3R). For load center installation, refer to the installation instructions provided with the load center or with the Model RSB or ATSR Intelligent Transfer Switch. See Figure 3 for document part numbers.

The Intelligent Transfer Switch is available in two enclosures, accommodating up to 40 branch circuits (Type 1) or 28 branch circuits (Type 3R) selected by the user for backup power. It is suitable for service entrance or subpanel use.

An optional load shed module, if installed, commands remote control circuit breakers to shed loads when the generator set is in use.

**This equipment must be installed and serviced by qualified electrical personnel.** Read this manual and carefully follow all procedures and safety precautions to ensure proper equipment operation and to avoid bodily injury. Read and follow the Safety Precautions and Instructions section at the beginning of this manual. Keep this manual with the equipment for future reference.

Information in this publication represents data available at the time of print. Kohler Co. reserves the right to change this literature and the products represented without notice and without any obligation or liability whatsoever.

The equipment service requirements are very important to safe and efficient operation. Inspect parts often and perform required service at the prescribed intervals. Obtain service from an authorized service distributor/dealer to keep equipment in top condition.



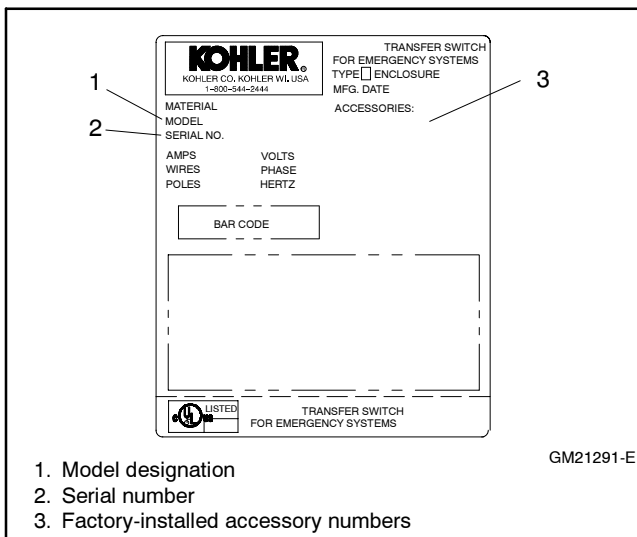
**Figure 1** Intelligent Transfer Switch

## Nameplate

A nameplate attached to the transfer switch includes a model designation, a serial number, ratings, and other information about the transfer switch. See Figure 2.

Check the transfer switch model number from the transfer switch nameplate and verify that it matches the model shown on the front cover of this manual before proceeding with installation.

Copy the model designation, serial number, and accessory information from the nameplate to the spaces provided in the Product Identification Information section located inside the front cover of this manual for use when requesting service or parts. Copy the model designation into the spaces in the Model Code chart and use the chart to interpret the model designation.



**Figure 2** Nameplate

## List of Related Materials

Separate manuals cover the installation of the indoor and outdoor load centers. A separate operation manual explains the use of the transfer switch's electrical controls and accessories. The following table lists the available manuals and part numbers.

| Document  | Part Number |
|---|-------------|
| Installation Instructions, QO Indoor Load Center (Type 1)     | TP-6493     |
| Installation Instructions, QO Outdoor Load Center (Type 3R)   | TP-6494     |
| Operation Manual, Model RSB, ATSR Intelligent Transfer Switch | TP-6487     |

**Figure 3** Related Documents

## FCC Statement

This transfer equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This transfer equipment generates and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

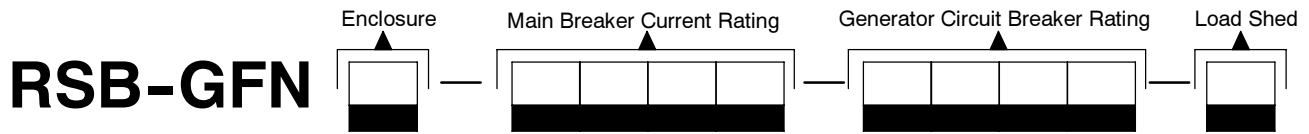
If this transfer equipment does cause harmful interference to radio or television reception, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the transfer equipment and the receiver.
- Connect the receiver into an outlet on a different circuit.
- Consult the receiver dealer or an experienced radio/TV technician for help.
- Do not make changes or modifications to the transfer equipment that are not expressly approved by Kohler Co. Any changes or modifications may result in the loss of authority to operate the equipment.



# Model Code

The transfer switch model designation, shown on the nameplate, defines characteristics and ratings as explained below.



## Kohler® Model Designation Key

This chart explains the Kohler® transfer switch model designation system. The sample model designation shown is for a Model RSB Intelligent Transfer Switch with MPAC™ 550 electrical controls rated at 240 volts/60 Hz, 2 poles, 3 wires, and solid neutral in a Type 1 enclosure with a 200 amp main circuit breaker, a 125 amp generator circuit breaker, and no load shed modules.

## SAMPLE MODEL DESIGNATION

# RSB-GFNA-0200-0125-N

|   |  |
|---|--|
| <b>Model</b><br>R: Kohler®  |  |
| <b>Mechanism</b><br>SB: Intelligent Transfer Switch, Service Entrance Rated   |  |
| <b>Electrical Controls</b><br>G: MPAC™ 550 (Microprocessor ATS Controls)  |  |
| <b>Voltage/Frequency</b><br>F: 240 Volts/60 Hz  |  |
| <b>Number of Poles/Wires</b><br>N: 2-pole, 3-wire, solid neutral  |  |
| <b>Enclosure</b><br>A: Type 1 Complete<br>B: Conversion Kit for Type 1 Indoor Load Center (no enclosure) *<br>C: Type 3R Complete<br>D: Conversion Kit for Type 3R Outdoor Load Center (no enclosure) * |  |
| <b>Main Circuit Breaker Rating, in Amps</b><br>0150      0200      0225      0000 †   |  |
| <b>Generator Circuit Breaker Rating, in Amps</b><br>0050      0070      0090      0125<br>0060      0080      00100   |  |
| <b>Load Shed</b><br>N: No Load Shed Modules<br>S: With Load Shed Module(s)  |  |

\* Order a conversion kit for locations that already have a Square D® Generator-Ready Intelligent Load Center installed.  
 † Conversion kits are available without a main circuit breaker for installations that already include a type QOM main circuit breaker with control taps.  
**Note:** Load centers do not include branch circuit breakers. Obtain Square D® type QO breakers locally as required for the application.

# Service Assistance

---

For professional advice on generator set power requirements and conscientious service, please contact your nearest Kohler distributor or dealer.

- Consult the Yellow Pages under the heading Generators—Electric.
- Visit the Kohler Power Systems website at KohlerPower.com.
- Look at the labels and stickers on your Kohler product or review the appropriate literature or documents included with the product.
- Call toll free in the US and Canada 1-800-544-2444.
- Outside the US and Canada, call the nearest regional office.

## **Headquarters Europe, Middle East, Africa (EMEA)**

Kohler Power Systems  
3 rue de Brennus  
93200 Saint Denis  
France  
Phone: (33) 1 49 178300  
Fax: (33) 1 49 178301

## **Asia Pacific**

Power Systems Asia Pacific Regional Office  
Singapore, Republic of Singapore  
Phone: (65) 6264-6422  
Fax: (65) 6264-6455

## **China**

North China Regional Office, Beijing  
Phone: (86) 10 6518 7950  
(86) 10 6518 7951  
(86) 10 6518 7952  
Fax: (86) 10 6518 7955

East China Regional Office, Shanghai  
Phone: (86) 21 6288 0500  
Fax: (86) 21 6288 0550

## **India, Bangladesh, Sri Lanka**

India Regional Office  
Bangalore, India  
Phone: (91) 80 3366208  
(91) 80 3366231  
Fax: (91) 80 3315972

## **Japan, Korea**

North Asia Regional Office  
Tokyo, Japan  
Phone: (813) 3440-4515  
Fax: (813) 3440-2727

## **Latin America**

Latin America Regional Office  
Lakeland, Florida, USA  
Phone: (863) 619-7568  
Fax: (863) 701-7131

# Section 1 Specifications

| Item                                 | Specifications   |
|--------------------------------------|--|
| Enclosures and ratings               | Type 1 enclosure, 150–225 amp. Maximum rating of generator circuit breaker is 125 amp. For indoor installation, flush or surface mount. Up to 40 branch circuits.  |
|                                      | Type 3R enclosure, 150–200 amp. Maximum rating of generator circuit breaker is 125 amp. For indoor or outdoor installation, padlockable. Up to 28 branch circuits. |
|                                      | 150, 200, and 225 amp models are suitable for service entrance use.  |
| Transfer mechanism                   | Two-pole, single-phase open-transition transfer mechanism.   |
|                                      | 240 VAC 60 Hz.   |
|                                      | Solid neutral.   |
|                                      | Manually operable.   |
| Operating temperature                | –10° to 60° C (14° to 140° F) with derating (see the circuit breaker label for derate information)<br>–10° to 40° C (14° to 104° F) without derating.              |
| Storage temperature                  | –40° to 85° C (–40° to 185° F).  |
| Humidity                             | 5%–95% noncondensing.  |
| Altitude                             | 0–2000 m (0–6560 ft.).   |
| Vibration and shock (shipping)       | ISTA-tested per ASTM 4169-1A.  |
| Certifications, codes, and standards | UL listed per UL 67, Enclosed Panelboards.   |
|                                      | Tested to UL 1008, Standard for Automatic Transfer Switches for Use in Optional Standby Systems.   |
|                                      | NFPA 70, National Electrical Code®, Article 702.   |
|                                      | NEMA Standard IC10-1993, AC Automatic Transfer Switches.   |
| EMI/EMC immunity                     | IEC 61000-4-2, 2001, Electrostatic Discharge, Level 3.   |
|                                      | IEC 61000-4-3, 2002, Radiated Immunity, Level 2.   |
|                                      | IEC 61000-4-4, 2001, EFT/Burst Immunity, Severity Level 3.   |
|                                      | IEC 61000-4-5, 2001, Surge Immunity, Severity Level 4.   |
|                                      | IEC 61000-4-6, 2003, Conducted RF Immunity, Level 2.   |
|                                      | FCC Part 15, Radiated Emissions, Class B.  |
|                                      | FCC Part 15 using CISPR 11 Conducted Emissions, Class B.   |

**Figure 1-1** Specifications

| Enclosure Type | Rating, Amps | Load Center | Weight, kg (lb) | H x W x D, mm (in.)                    |
|----------------|--------------|-------------|-----------------|--|
| Type 1         | 150–225      | 40 circuits | 11.40 (25.0)    | 1000 x 362 x 95 (39.37 x 14.25 x 3.74) |
| Type 3R        | 150–200      | 28 circuits | 19.10 (42.0)    | 858 x 375 x 115 (33.78 x 14.76 x 4.53) |

**Figure 1-2 Weights and Dimensions**

| Cable Sizes              |                            |
|--------------------------|----------------------------|
| Connection               | Range of Wire Sizes, Cu/Al |
| Normal Source, 150–225 A | #4 AWG to 300 kcmil        |
| Emergency Source         | #8 to 2/0 AWG              |
| Neutral                  | #4 AWG to 300 kcmil        |
| Ground                   | #12 to 1/0 AWG             |

**Figure 1-3 Cable Specifications (Al or Cu)**

| Main and Generator Circuit Breaker Ratings *     |              |
|--|--------------|
| Description                                      | Rating, Amps |
| Main circuit breaker<br>Type QOM2-VH8041         | 225          |
|  | 200          |
|  | 150          |
| Generator set circuit breaker<br>Type QO, 2-pole | 125          |
|  | 100          |
|  | 90           |
|  | 80           |
|  | 70           |
|  | 60           |
|  | 50           |
| Remote control circuit<br>breakers †             | 15, 1-pole   |
|  | 20, 1-pole   |
|  | 30, 2-pole   |
|  | 40, 2-pole   |
|  | 50, 2-pole   |
|  | 60, 2-pole   |

\* Main and generator source circuit breakers are included with the transfer switch. Branch circuit breakers are not included. Obtain Square D® type QO and remote control branch circuit breakers locally as required.

† Remote control circuit breakers are not included with the load shed kit. Obtain QO-PLILC breakers through a Kohler distributor/dealer.

**Figure 1-4 Source Circuit Breakers**

# Section 2 Conversion Kit Installation

## 2.1 Load Center Installation

This section contains instructions to install the Conversion Kit into a type 1 (indoor) or type 3R (outdoor) Square D® Intelligent Load Center. For load center installation instructions, refer to the documents provided with the load centers. See the Introduction for document part numbers.

**Note:** Before beginning a wiring installation or addition, read all instructions and safety notices in this bulletin. Consult a local building or electrical inspector for the latest National Electrical Code® (NEC®) requirements and for local wiring codes. A permit may be needed to do electrical work and some areas may require an inspection of the electrical work.

## 2.2 Receipt of Unit

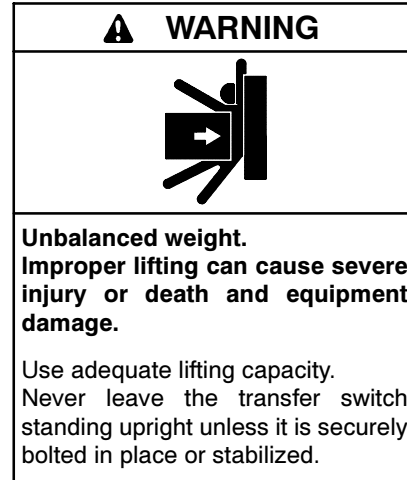
### 2.2.1 Inspection

At the time of delivery, inspect the packaging and components for signs of shipping damage. Unpack the transfer switch as soon as possible and inspect the components for shipping damage. If damage and/or rough handling is evident, immediately file a damage claim with the transportation company.

### 2.2.2 Storage

Store the transfer switch in its protective packing until final installation. Protect the transfer switch at all times from moisture, construction grit, and metal chips. Avoid storage in cold or damp areas where moisture could condense on the unit. See Figure 1-1 for acceptable storage temperatures.

### 2.2.3 Lifting



See Figure 1-2 for the weight of the transfer switch. Close and latch the enclosure door before moving the unit.

### 2.2.4 Unpacking

Allow the equipment to warm to room temperature for at least 24 hours before unpacking to prevent condensation on the electrical apparatus. Use care when unpacking to avoid damaging transfer switch components. Use a vacuum cleaner or a dry cloth to remove dirt and packing material that may have accumulated in the transfer switch or any of its components.

**Note:** Do not use compressed air to clean the switch. Cleaning with compressed air can cause debris to lodge in the components and damage the switch.

Compare the parts with the parts lists and illustrations in Section 7 before starting the installation.

## 2.3 Working Procedures

To maintain the UL listing, observe the following working procedures:

- Route and position the wires as shown in the instructions. Use the wiring harnesses provided with the kit. Do not modify the harnesses.
- Do not wire the load center with other equipment. Install only components provided with the conversion kit or accessories obtained from the manufacturer specifically for the Square D® Intelligent Load Center or Kohler® Intelligent Transfer Switch. Components covered in the load center agency listing are listed on a label on the inside of the load center .
- Use only the fuses specified in Section 2.10, Installing Fuse Holders.
- Mount the kit components only in the enclosure locations specified in the installation procedures.
- Install the generator terminal block insulating cover and the MPAC 550 controller insulator as specified in Section 2.11, Installing Generator Terminal Block, and Figure 2-34.
- Observe the hardware requirements specified in the installation procedures. Do not substitute hardware.
- Mount all covers as specified in the installation procedures.

### NOTICE

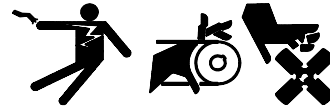
**Hardware damage.** The transfer switch may use both American Standard and metric hardware. Use the correct size tools to prevent rounding of the bolt heads and nuts.

## 2.4 Preliminary Recommendations

Before beginning the installation procedures, read and understand all of the information in this section.

---

### ⚠ WARNING



**Accidental starting.  
Can cause severe injury or death.**

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

---

**Disabling the generator set. Accidental starting can cause severe injury or death.** Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

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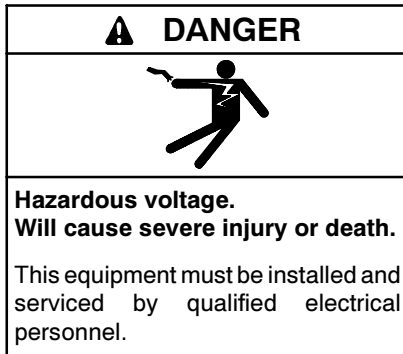
### ⚠ DANGER



**Hazardous voltage.  
Will cause severe injury or death.**

Disconnect all power sources before opening the enclosure.

**Grounding electrical equipment. Hazardous voltage can cause severe injury or death.** Electrocutation is possible whenever electricity is present. Ensure you comply with all applicable codes and standards. Electrically ground the generator set, transfer switch, and related equipment and electrical circuits. Turn off the main circuit breakers of all power sources before servicing the equipment. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.



**Testing live electrical circuits. Hazardous voltage or current can cause severe injury or death.** Have trained and qualified personnel take diagnostic measurements of live circuits. Use adequately rated test equipment with electrically insulated probes and follow the instructions of the test equipment manufacturer when performing voltage tests. Observe the following precautions when performing voltage tests: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Do not touch the enclosure or components inside the enclosure. (4) Be prepared for the system to operate automatically.  
*(600 volts and under)*

**Note:** Do not perform high-potential dielectric testing on the Square D® Intelligent Load Center. Damage to the control electronics may result.

**Note:** Petroleum-based paints, solvents, or sprays can cause plastic to degrade. Do not allow petroleum-based paints, solvents, or sprays to contact the non-metallic parts of this product.

**Note:** This equipment may not be suitable for use in the corrosive environments present in agricultural buildings. See NEC 547 or CEC 2-400.

## 2.4.1 Tools Required

- Multimeter, Fluke model 87, CAT III (or equivalent) with CAT III rated test leads
- Screw driver, 5/16 x 4 in. slotted
- Hex wrenches or hex key: 3/8 in.
- Nut drivers: 5/16 in., 7/16 in.
- Deep well socket, 7/16 in. with ratchet and extension
- Torque wrench, 250 in. lb.
- Driver bits: square (R2), slotted (R2), nut (5/16 in.), magnetic tip Phillips size 2
- Drill, 1/4 in., with drill bit number 28 (0.140 in.)

## 2.4.2 Qualified Personnel

For the protection of personnel and equipment, a qualified person must perform the procedures detailed in this manual. The person should be:

- Able to read, interpret, and follow the instructions and precautions in this manual and the other literature referenced.
- Able to use the required tools listed above in a safe and technically correct manner.
- Able to perform installation, commissioning, and diagnostic procedures while following the safety procedures recommended in ANSI/NFPA 70E.
- Trained on the operation and fundamentals of residential and commercial power distribution apparatus and be familiar with associated hazards.

## 2.4.3 Wiring Notes

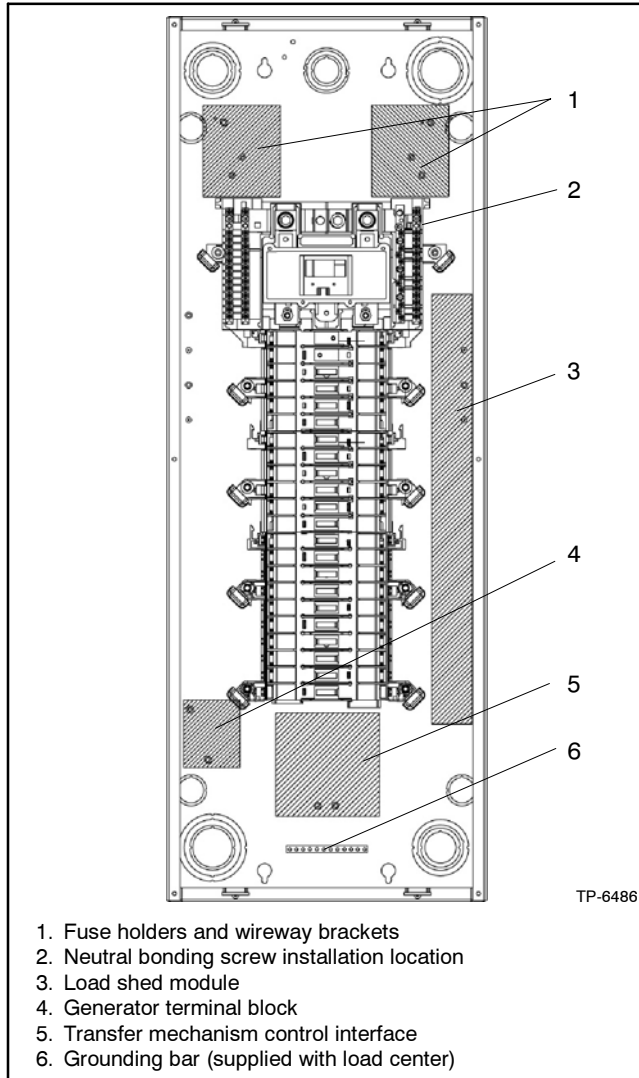
The conversion kit comes with four wire harnesses and two cables. Some harnesses are factory-connected to kit components. Before beginning the installation procedures, read Section 3, Wiring, to familiarize yourself with the wire harnesses and their routing.

Determine the wiring or conduit requirements for the generator circuit as required by applicable electrical codes. See Figure 1-3 for cable sizes. Use separate conduit for AC power wiring and low-voltage DC, control, and communication system wiring.

Select the appropriate cable clamp or use other approved methods for securing the cable or conduit to the enclosure.

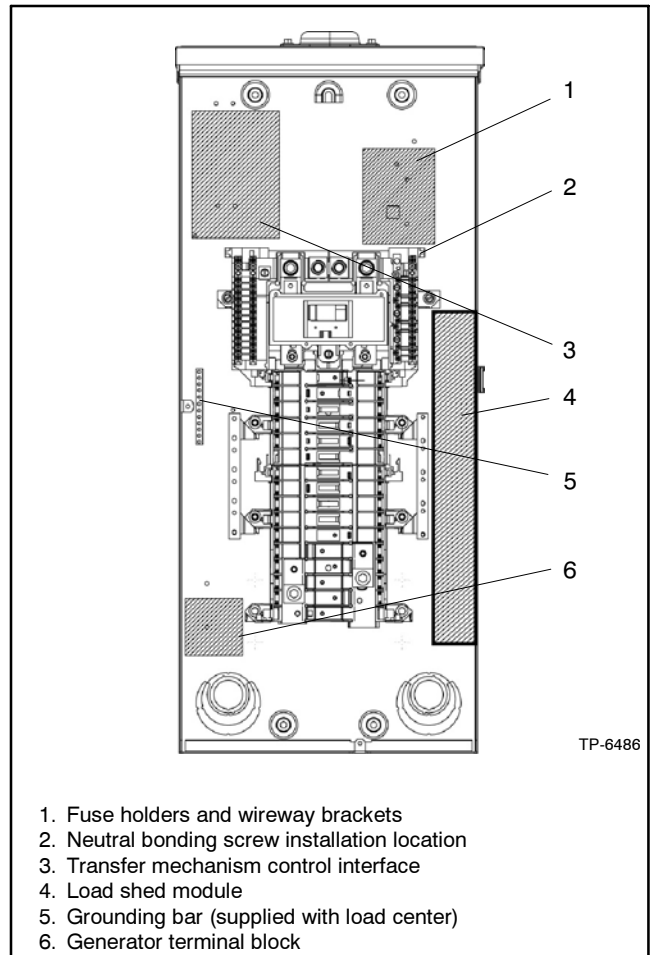
## 2.4.4 Grounding Note

If you are using the load center as a complete subpanel and need additional grounding points, install an additional grounding bar. Kohler® part number GM49129 or Square D® grounding bar kits PK9GTA-PK27GTA are recommended. Install the additional grounding bar according to the instructions provided with the kit, but observe the generator conversion kit component locations illustrated in Figure 2-1 and Figure 2-2 and do not install the grounding bar kit in those areas. Do not remove the existing grounding bar from the load center.



1. Fuse holders and wireway brackets
2. Neutral bonding screw installation location
3. Load shed module
4. Generator terminal block
5. Transfer mechanism control interface
6. Grounding bar (supplied with load center)

**Figure 2-1** Enclosure Component Locations



1. Fuse holders and wireway brackets
2. Neutral bonding screw installation location
3. Transfer mechanism control interface
4. Load shed module
5. Grounding bar (supplied with load center)
6. Generator terminal block

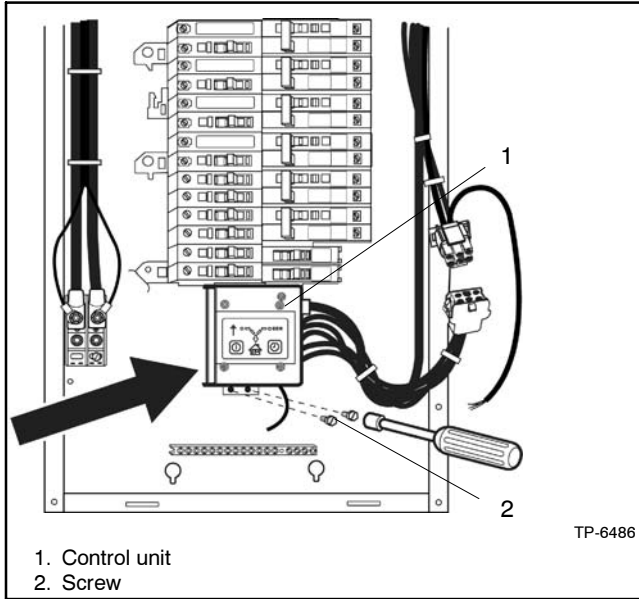
**Figure 2-2** Enclosure Component Locations, Type 3R

## 2.4.5 Enclosure Type Note

Referring to Figure 2-1 and Figure 2-2, familiarize yourself with the component layout of the Type 1 (indoor) and Type 3R (outdoor) enclosures. Because of differences in the layout, not all installation steps are the same for the Type 1 and the Type 3R enclosures. As you are going through the installation procedures, be sure to follow the steps appropriate for your enclosure type.



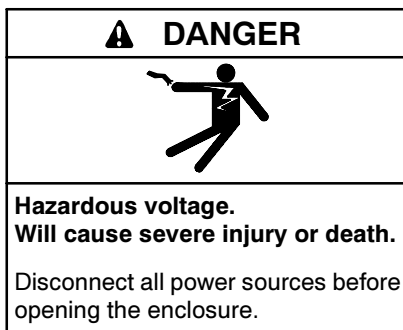
It is permissible to mount the Type 1 enclosure in an inverted position. Doing so does not affect the installation procedures, except in the case of the MPAC 550 controller, which can be mounted 180° from its normal, upright position so that the lettering is right side up when the enclosure is inverted. Refer to Figure 2-3. Do not mount the Type 3R enclosure in an inverted position.



**Figure 2-3** Installing MPAC 550 Controller, Type 1 Enclosures

### 2.4.6 Power Removal

Installation of the generator set conversion kit requires removal of power. Be sure to provide an alternate light source before beginning the installation procedures.



Do not begin the installation procedures until all power is completely removed from the load center. If the load center is installed and wired, ensure that all power is removed from the interior wiring of the load center before installing the conversion kit.

If the load center is already installed and wired:

1. Open the main feeder disconnect supplying power to the load center; or if the installation uses the revenue meter for isolation, arrange for the utility provider to remove the meter. If a main feeder disconnect is not present and the revenue meter cannot be used as an isolation device, contact the utility company for removal of power.
2. Apply appropriate lockouts to the disconnecting means.

## 2.5 Removing Cover

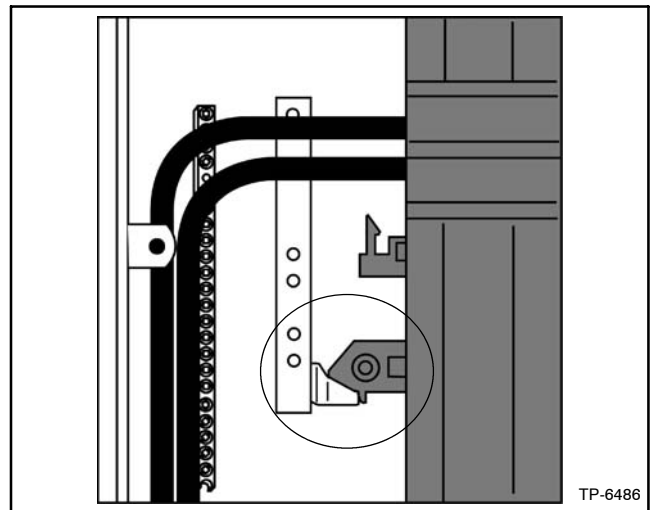
On a Type 1 enclosure, use a slotted or square driver to loosen six screws and remove the front cover of the load center.

On a Type 3R enclosure, open the front door, loosen three screws, and remove the trim.

## 2.6 Inspecting Load Center Interior Assembly

Before proceeding with the installation procedures, inspect the load center interior assembly mounting ears. Ensure that each mounting ear is engaged correctly in its clip or misalignment of the transfer mechanism can occur. See Figure 2-4.

**Note:** Be sure to check all ears in the load center.



**Figure 2-4** Inspecting Load Center Mounting Ears

## 2.7 Installing Main Circuit Breaker

Omit this procedure if a Square D® Intelligent Load Center is already installed and equipped with a main circuit breaker and:

- The current rating of the main circuit breaker is appropriate for the application, and
- The main circuit breaker is equipped with control taps (refer to Section 2.14, Installing Utility Control Tap Connections). Main circuit breakers with part numbers ending in 8041 are equipped with control taps.

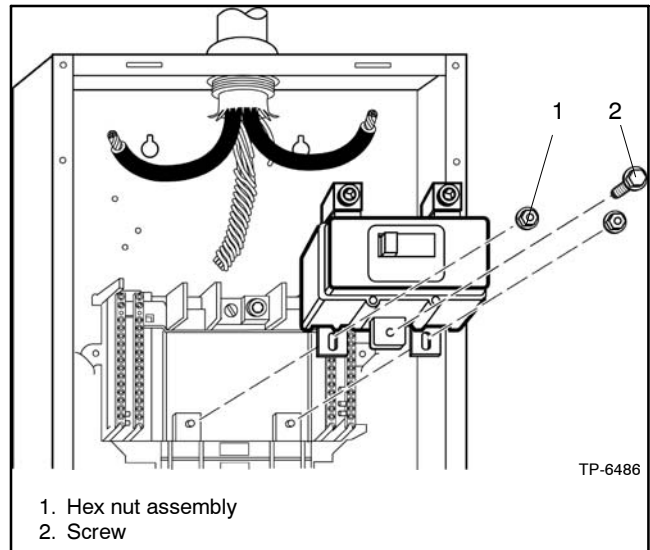
**Note:** See Figure 1-4 for main circuit breaker ratings.

If a Square D® Intelligent Load Center is installed but equipped with a main circuit breaker that is not appropriately rated for the application or does not have control taps, remove the main circuit breaker and replace it as instructed below.

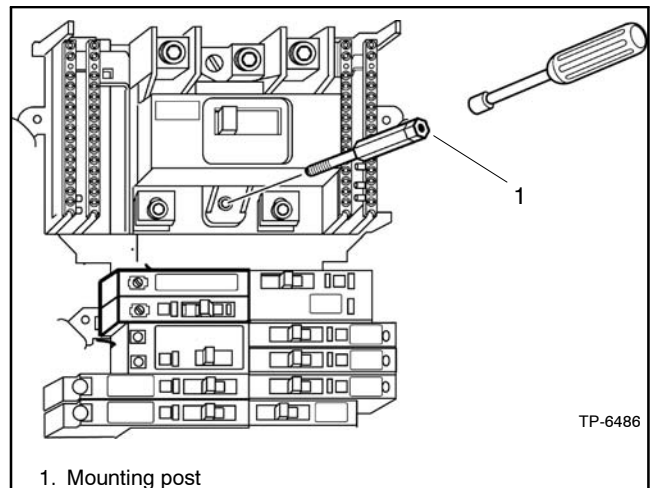
For new installations of complete units (enclosure and conversion kit), install the main circuit breaker as instructed below.

### Main circuit breaker installation:

1. Read Section 2.4.6, Power Removal, and turn off all power supplying this equipment before working on or inside the equipment.
2. If replacing an existing circuit breaker, disconnect the line conductors from the circuit breaker lugs or the main lugs attached to the load center interior assembly. If the load center does not have a main circuit breaker or main lugs, skip to step 5.
3. Using a 5/16 in. nut driver, remove the screw holding the existing circuit breaker in place. See Figure 2-5.
4. Remove the two hex nut assemblies and remove the main circuit breaker.
5. Place the new circuit breaker in the load center by pushing the breaker toward the top end wall until it locks in place.
6. Install the transfer mechanism mounting post using a 5/16 in. nut driver. Torque the post to 3.4 Nm (30 in. lb.). Be careful not to damage the mounting post sleeve during installation. See Figure 2-6.



**Figure 2-5** Installing Main Circuit Breaker



**Figure 2-6** Installing Mounting Post and Generator CB

7. Secure the circuit breaker with two hex nut assemblies using a 7/16 in. nut driver and torque wrench. Torque the fasteners to 6-10 Nm (50-90 in. lb.). Two hex nut assemblies are included in the generator conversion kit for use if no main circuit breaker was present in the load center.

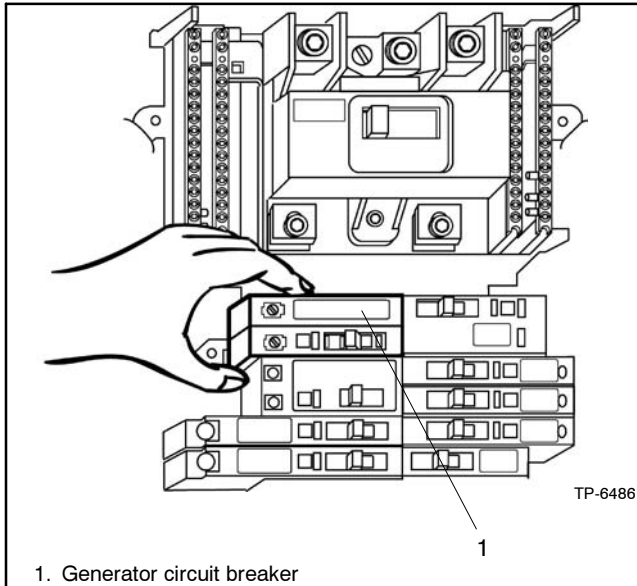
**Note:** Do not install the line conductors at this time.

## 2.8 Installing Generator Circuit Breaker

Refer to Figure 1-4 for the range of QO circuit breakers acceptable for use in the Square D® Intelligent Load Center.

Snap on the generator circuit breaker. See Figure 2-7.

**Note:** If the circuit breaker adjacent to the generator circuit breaker requires a lock off accessory, move it at least one space away from the generator circuit breaker to allow installation of the accessory.



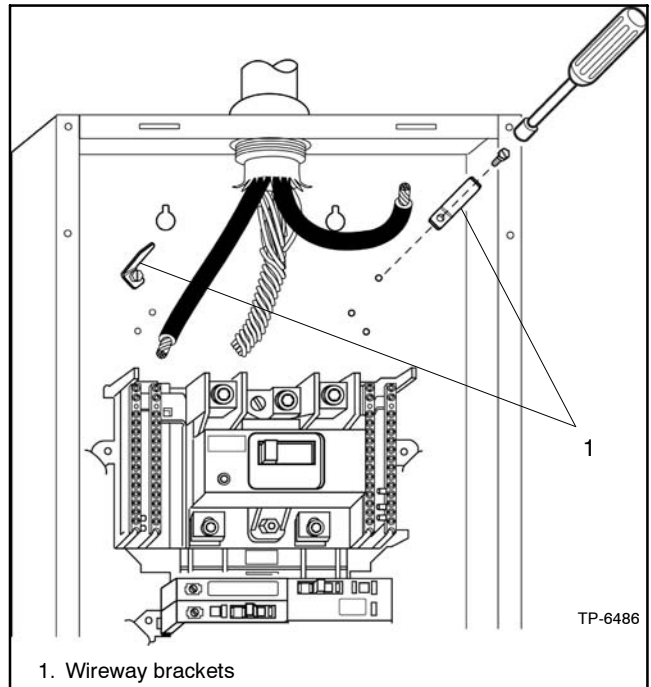
**Figure 2-7** Installing Generator Circuit Breaker

## 2.9 Installing Wireway Brackets

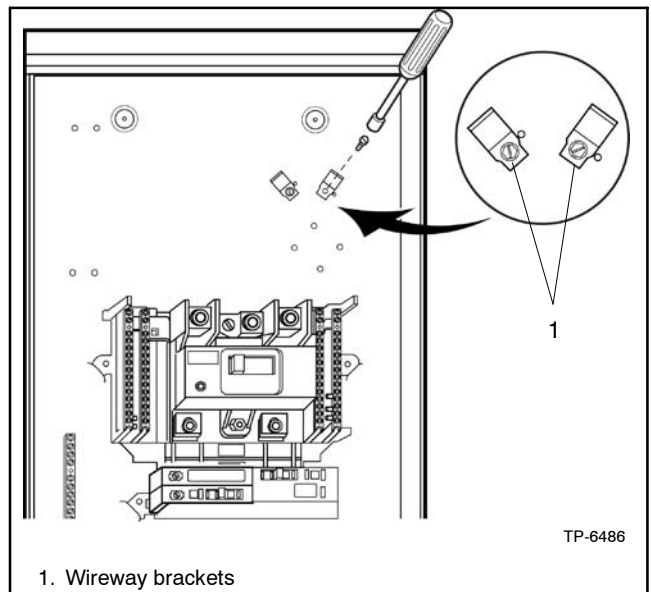
Install the two wireway brackets.

1. Loosely secure each bracket with one 10-32 x 5/16 in. hex head screw using a 5/16 in. nut driver or a flat-blade driver.
2. Before tightening the screws, orient the brackets to a 45° angle. Locating dimples are provided on the back plate of the enclosure as a guide. Refer to Figure 2-8 for Type 1 enclosures and Figure 2-9 for Type 3R enclosures.

3. Torque the screws to 3.4 Nm (30 in. lb.).



**Figure 2-8** Installing Wireway Brackets, Type 1 Enclosures



**Figure 2-9** Installing Wireway Brackets, Type 3R Enclosures

## 2.10 Installing Fuse Holders

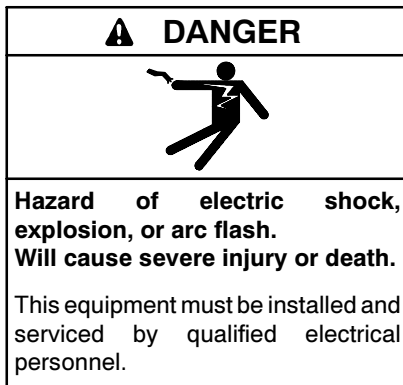
Each fuse holder assembly consists of:

- One fuse clip, GM48746
- Two fuses, GM48749
- One insulating cover, GM48747
- Two mounting screws, 8-32 x 3/8 in. Taptite® cross-recess, pan-head, self-tapping, GM48748

For correct installation of the fuses and fuse holders, you must:

- Install the insulating covers provided with the fuse holders.
- Use the screws supplied with the fuse holder assembly to provide proper spacing between the fuses and mounting screws.
- Use only Bussmann® CC-TRON® FNQ-R-6 fuses (part number GM48749) in the Square D® Intelligent Load Center.

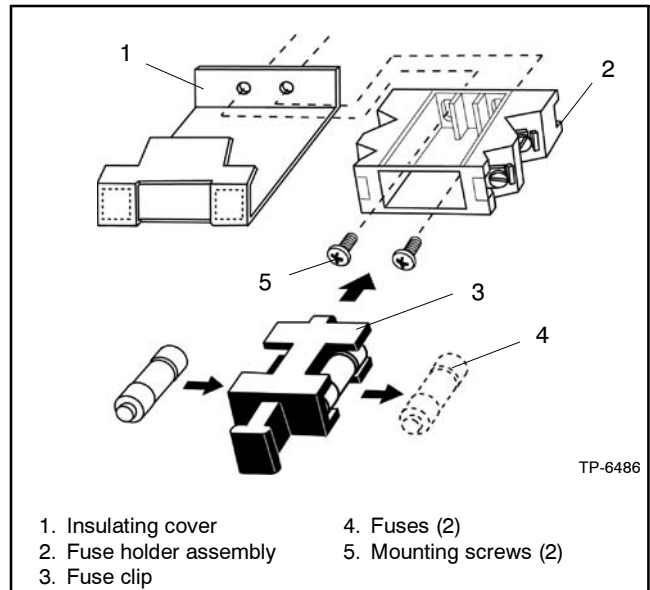
### 2.10.1 Preparing Fuse Holders



Before installing the fuse holders:

1. Pull the fuse clips and fuses out of the fuse holders.
2. Bend the insulating covers to fit around the fuse holders as shown in Figure 2-10.
3. With a magnetic-tip size 2 Phillips driver, insert two mounting screws into the bottom of each fuse holder and through the fuse holder mounting holes.

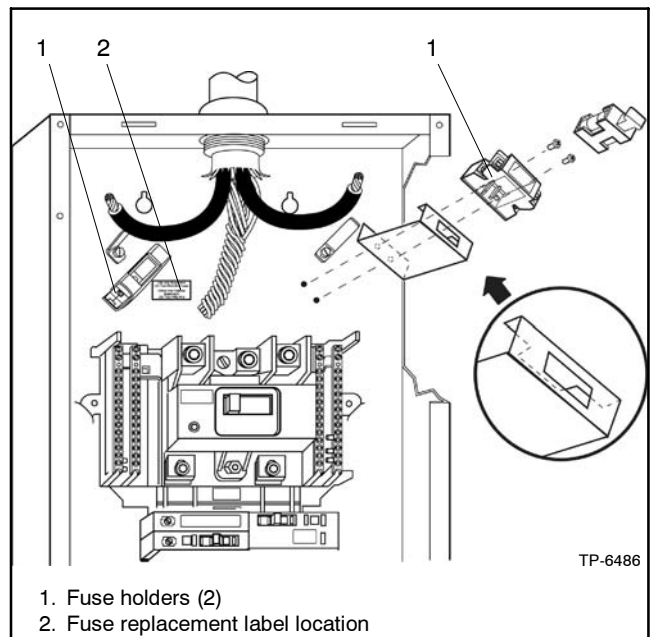
**Note:** To provide proper spacing between the fuses and mounting screws, you must use the screws supplied with the fuse holder assembly.



**Figure 2-10** Preparing Fuse Holders

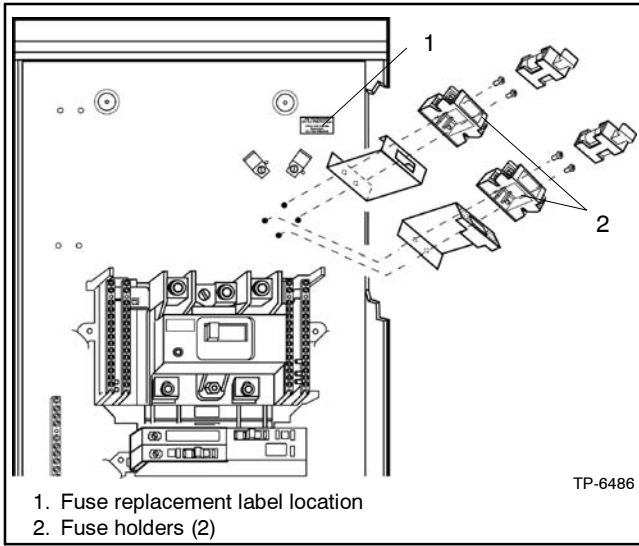
### 2.10.2 Mounting Fuse Holders

1. Install the two fuse holders (GM48746) in the load center cabinet and secure each with two screws (GM48748) using a cross driver. Torque screws to 3.4 Nm (30 in. lb.). Refer to Figure 2-11 for Type 1 enclosures and Figure 2-12 for Type 3R enclosures.

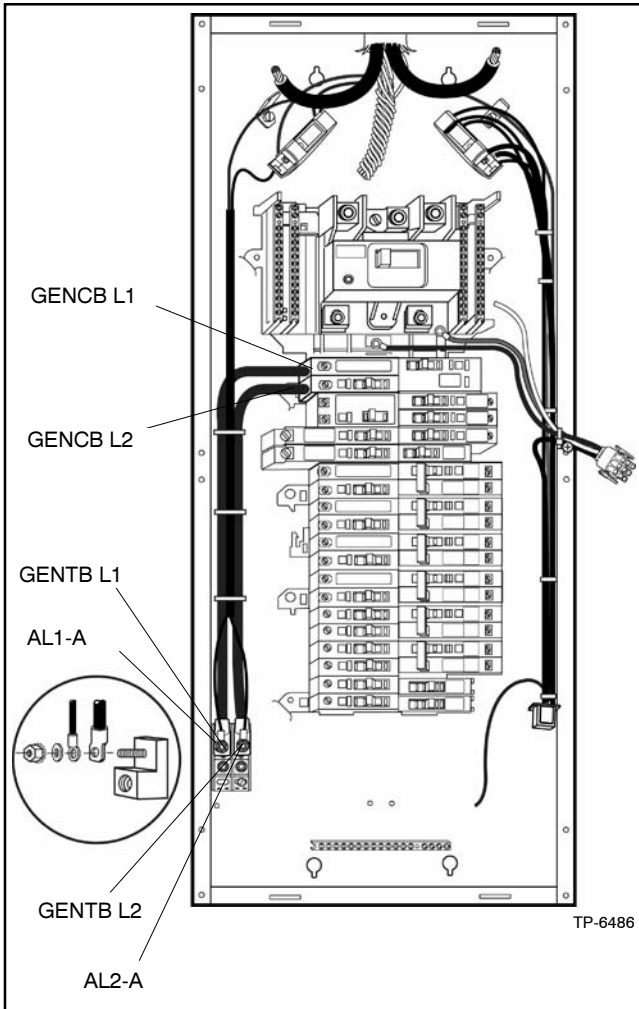


**Figure 2-11** Mounting Fuse Holders GM48746, Type 1 Enclosures

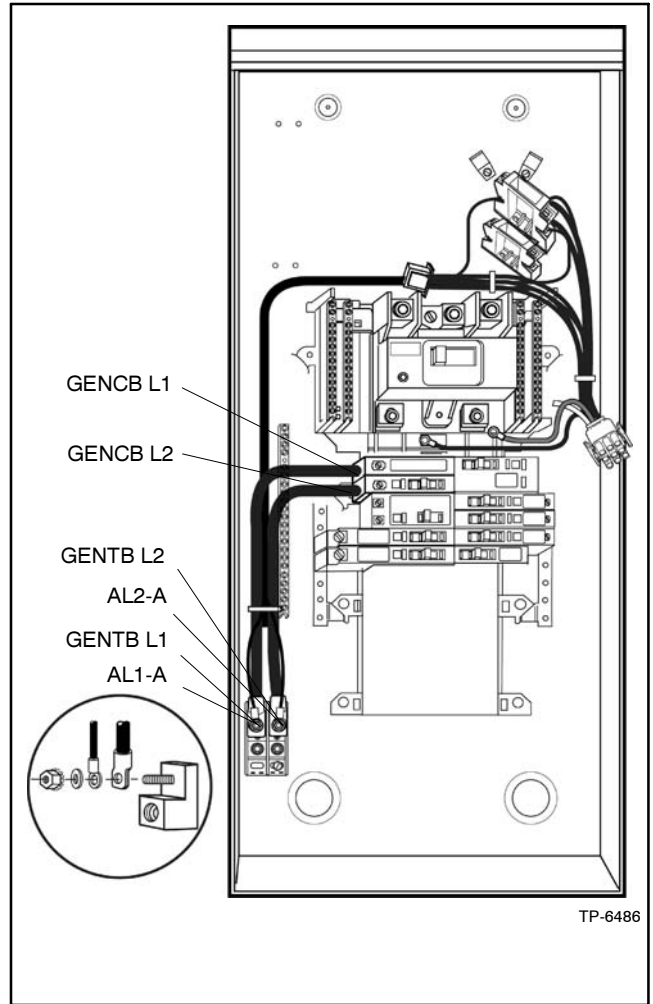
2. Apply the fuse replacement label, GM40861, as shown in Figure 2-11 or Figure 2-12.
3. Route the leads between the fuse holder and the wireway brackets. Refer to Figure 2-13 and Figure 2-14 for lead routing.



**Figure 2-12** Mounting Fuse Holders GM48746, Type 3R Enclosures

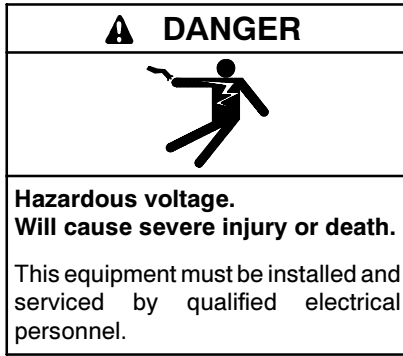


**Figure 2-13** Wire Harness Routing, Type 1 Enclosures



**Figure 2-14** Wire Harness Routing, Type 3R Enclosures

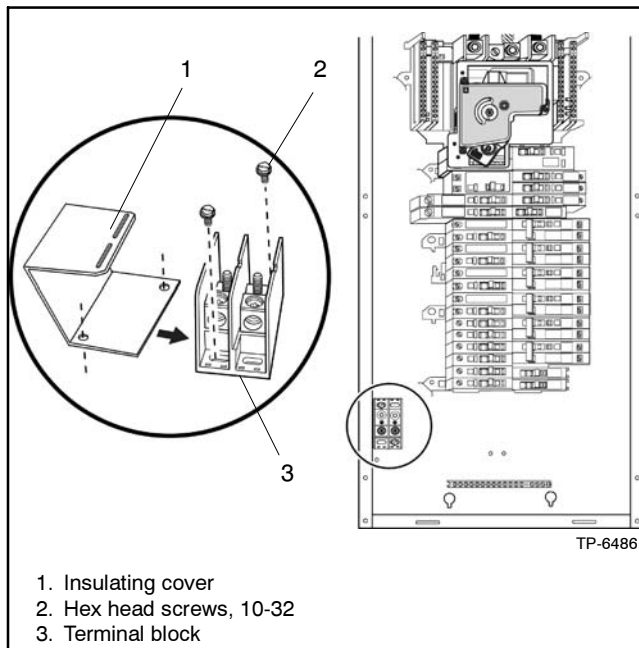
## 2.11 Installing Generator Terminal Block



**Note:** Be sure to install the insulator provided with the terminal block.

**Note:** Installation of the generator terminal block insulator is required for UL compliance.

1. An insulating cover is provided with the generator terminal block. Bend the cover to fit around the terminal block before installing it. See Figure 2-15.



**Figure 2-15** Installing Generator Terminal Block

2. Orient the generator terminal block so that the two studs are at the top and install it in the load center enclosure. Using a 5/16 in. nut driver, secure the terminal block with two 10-32 x 1/2 in. hex head screws. Torque the screws to 3.4 Nm (30 in. lb.).
3. Mount the generator/power harness as follows. Refer to Figure 2-16 for the lead and terminal markings. Refer to Figure 2-13 or Figure 2-14 for terminal locations and hardware stacking detail. Refer to Figure 3-9 or Figure 3-10 for wiring schematics.

**Note:** Connections are polarity-sensitive. **The transfer mechanism will not operate if the connections are reversed.** The leads must be connected as instructed below.

| Lead Marking | From Terminal | To Terminal |
|--------------|---------------|-------------|
| AL1-A        | GENCB* L1     | GENTB† L1   |
| AL2-A        | GENCB L2      | GENTB L2    |
| AL1-A        | Fuse 3A       | GENTB L1    |
| AL2-A        | Fuse 4A       | GENTB L2    |

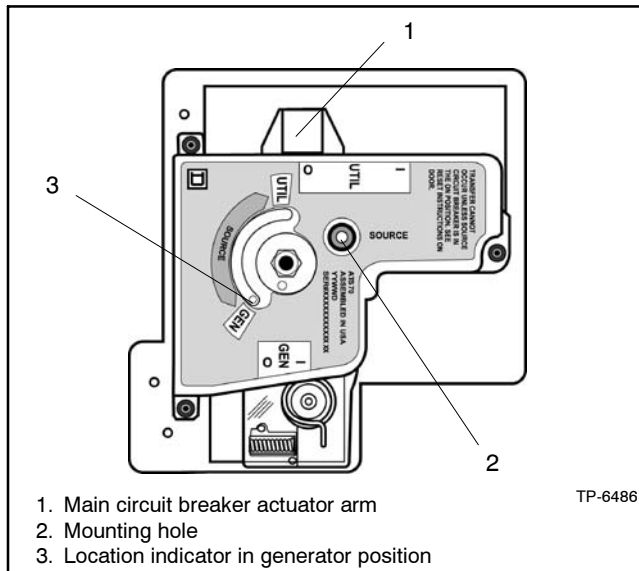
\* GENCB: Generator circuit breaker  
† GENTB: Generator terminal block

**Figure 2-16** Terminal Block Wiring

- a. Connect leads AL1-A and AL2-A (power) to terminals L1 and L2 on the generator circuit breaker. Torque the terminals as follows:  
35–70 A circuit breakers: 5.1 Nm (45 in. lb.)  
80–125 A circuit breakers: 5.7 Nm (50 in. lb.)
- b. Connect leads AL1-A and AL2-A (power) to terminals L1 and L2 on the generator terminal block. Ensure that the barrels of the connectors are turned down so that the control leads and the hardware will seat properly.
- c. Install leads AL1-A and AL2-A (control) on top of the power leads on terminals L1 and L2 of the generator terminal block.
- d. Secure the leads on the generator terminal block studs with a 1/4 x 5/8 in. plain washer and a 1/4-20 x 7/16 in. hex nut washer assembly. Torque the nuts to 6.8 (60 in. lb.).

## 2.12 Installing Automatic Transfer Mechanism

1. If the center screw holding the main circuit breaker in place is present (see Figure 2-5 for location), use a 5/16 in. nut driver to completely remove screw.
2. Install the transfer mechanism mounting post using a 5/16 in. nut driver. Torque the post to 3.4 Nm (30 in. lb.). Be careful not to damage the mounting post sleeve during installation. See Figure 2-6.
3. Check the position of the location indicator on the transfer mechanism. If it is not in the generator position (see Figure 2-17), refer to Section 6, Manual Operation, and manually set the transfer mechanism to the generator position.

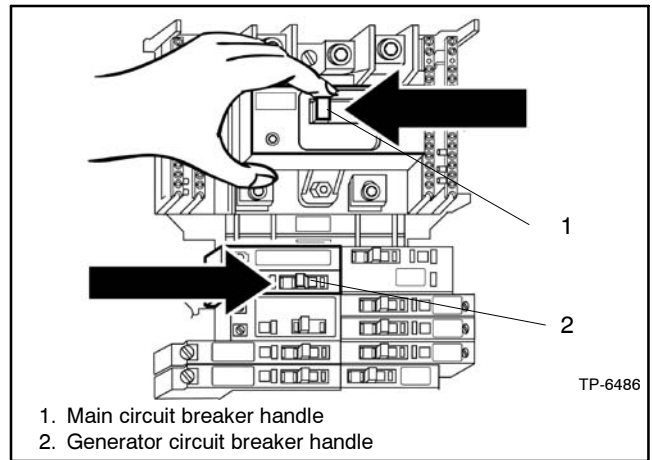


**Figure 2-17** Transfer Mechanism

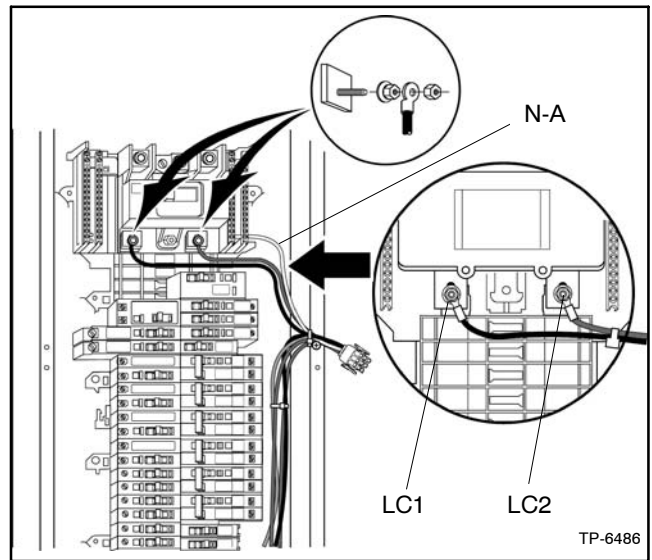
4. Set the main circuit breaker handle to the OFF position and the generator set circuit breaker handle to the ON position. See Figure 2-19.
5. Install leads LC1-A and LC2-A of the long control harness onto the bus bar studs as follows. Refer to Figure 2-18 for the lead and terminal markings. Refer to Figure 2-20 and Figure 2-21 for terminal locations and hardware stacking. Refer to Figure 3-2 or Figure 3-3 for wiring schematics.

| Lead Marking | Bus Bar Terminal |
|--------------|------------------|
| N-A          | NEUT             |
| LC1-A        | Stud             |
| LC2-A        | Stud             |

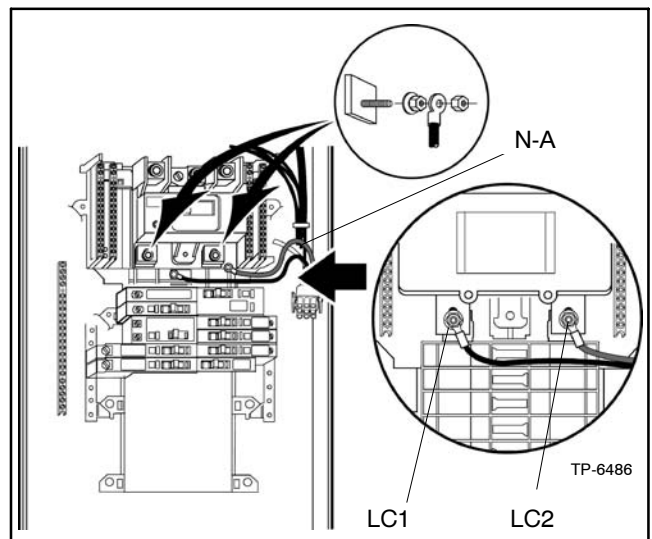
**Figure 2-18** Bus Bar and Neutral Wiring



**Figure 2-19** Set Main CB and Generator CB Switch Handles



**Figure 2-20** Bus Bar and Neutral Connections, Type 1 Enclosures

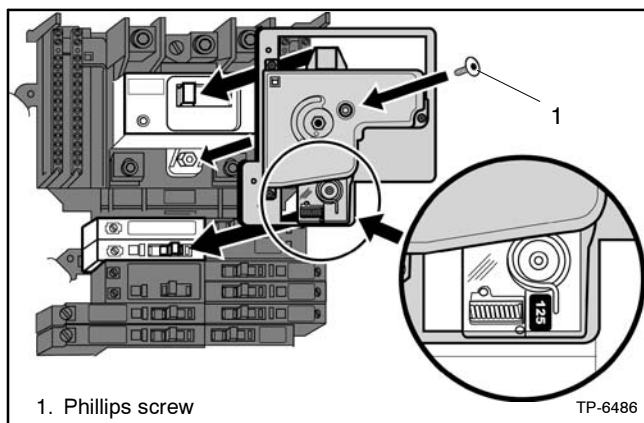


**Figure 2-21** Bus Bar and Neutral Connections, Type 3R Enclosures

**Note:** Connections are polarity-sensitive. **The transfer mechanism will not operate if the connections are reversed.** The leads must be connected as instructed below.

**Note:** Ensure that wiring harnesses are routed as illustrated in Figure 2-20 and Figure 2-21. The transfer mechanism will not seat properly if leads are not corrected routed.

- a. Connect lead LC1-A to terminal LC1. Orient the barrel of the ring lug toward the load center interior assembly.
  - b. Connect lead LC2-A to terminal LC2. Orient the barrel of the ring lug toward the load center interior assembly.
  - c. Secure both connections with a 1/4-20 x 7/16 in. hex nut assembly. Using a 7/16 in. deep well socket, torque the nuts to 5.7–8.5 Nm (50–75 in. lb.).
6. Connect lead N-A of the long control harness to the load-center neutral with a flat-blade or a square driver. Torque the terminals to 2.3 Nm (20 in. lb.). See Figure 2-20 or Figure 2-21.
  7. Mount the transfer mechanism, ensuring that the actuator spring is on the right side of the generator circuit breaker handle. Refer to Figure 2-22. Then secure it with one 8-32 x 1/2 in. Phillips screw. Torque the screw to 1.7 Nm (15 in. lb.).



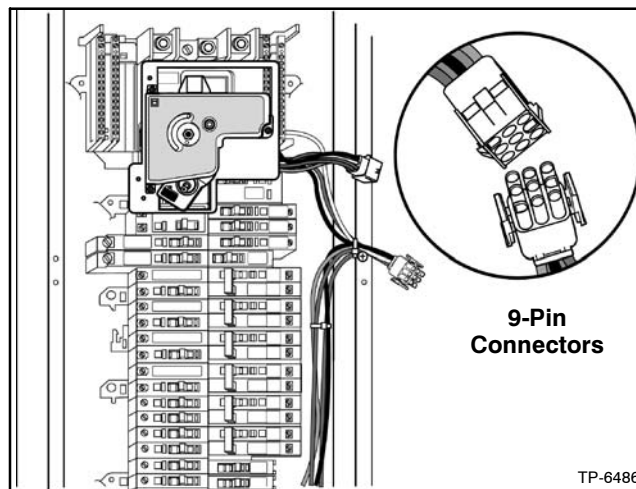
**Figure 2-22** Mounting Transfer Mechanism

**Note:** Refer also to Section 4.1, step 14, and Figure 4-2 for additional information on mounting the transfer mechanism.

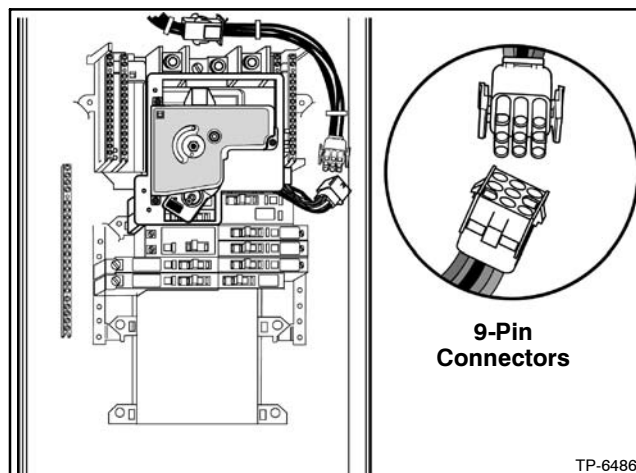
8. If a Spanish label is required, apply the Spanish hazard label on top of the English hazard label.

## 2.13 Connecting Control Harness 9-Pin Plugs

Connect the 9-pin control harness segment to the long control harness. Ensure that the plugs are fully engaged. See Figure 2-23 and Figure 2-24.



**Figure 2-23** Connecting Control Harnesses, Type 1 Enclosures



**Figure 2-24** Connecting Control Harnesses, Type 3R Enclosures



## 2.14 Installing Utility Control Tap Connections

Install two utility control tap connections on the tab terminals of the main circuit breaker. Refer to Figure 2-25 for the lead and terminal markings. Refer to Figure 3-2 or Figure 3-3 for wiring schematics.

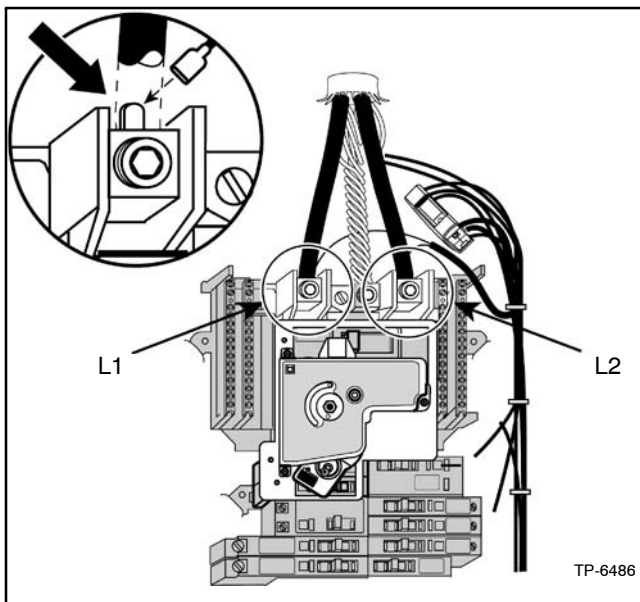
**Note:** Connections are polarity-sensitive. **The transfer mechanism will not operate if connections are reversed.** The leads must be connected as instructed below.

| Lead Marking | Main CB Terminal |
|--------------|------------------|
| NL1-2        | QOM2* L1         |
| NL2-A        | QOM2 L2          |

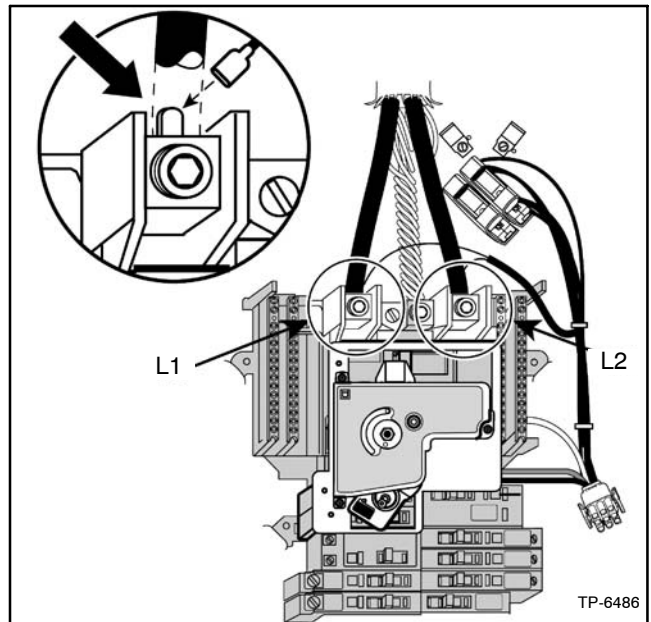
\* QOM2: Main circuit breaker

**Figure 2-25** Control Tap Connections

1. Connect lead NL1-A to terminal L1 on the main circuit breaker. See Figure 2-26 or Figure 2-27.
2. Connect lead NL2-A to terminal L2 on the main circuit breaker.



**Figure 2-26** Utility Control Tap Connections, Type 1 Enclosures



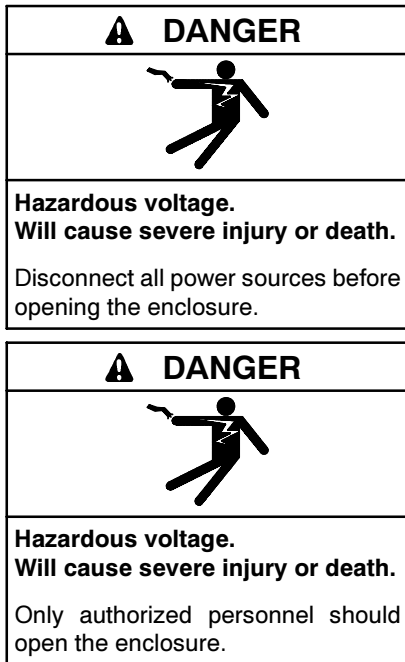
**Figure 2-27** Utility Control Tap Connections, Type 3R Enclosures

## 2.15 Terminating Line Conductors

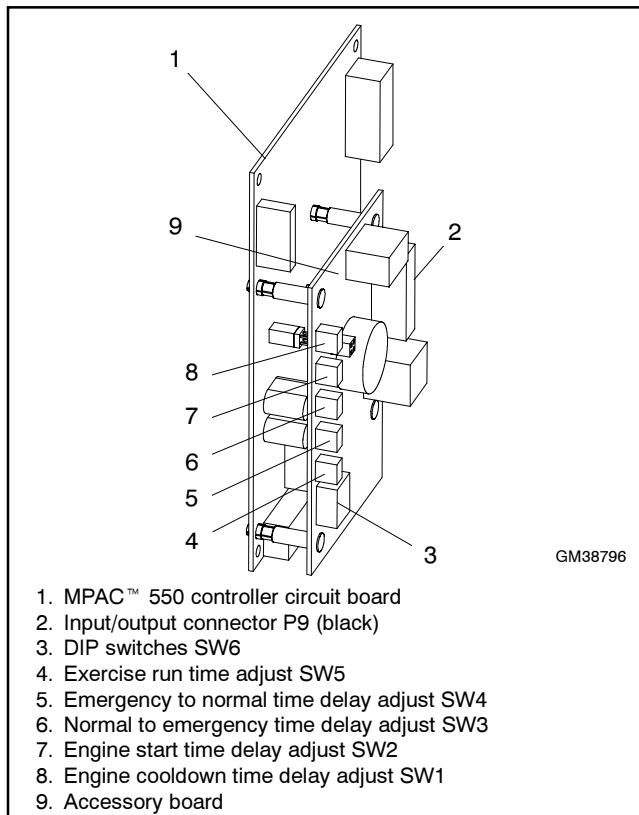
If the load center is installed and wired, reconnect the line conductors to the line-side terminals of the main circuit breaker following step 1. If other power lead connections have been removed during the installation of the generator conversion kit, perform steps 1 to 4.

1. Install the line conductors at terminals L1 and L2 and secure the terminals with a 3/8 in. hex wrench or hex key. Torque the terminals to 28 Nm (250 in. lb.). See Figure 2-26 or Figure 2-27.
2. Verify that the main neutral lead is properly terminated on the neutral terminal of the load center.
3. Verify that the service ground or equipment grounding conductor, or both, as required by local electrical code, are present and correctly terminated in the load center.
4. Verify that a green neutral bonding screw is present in the hole in the neutral plate if required by local code. Refer to Figure 2-1.

## 2.16 Connecting Optional Accessory Board



The transfer switch may be equipped with an optional accessory board mounted on the MPAC™ 550 controls as shown in Figure 2-28. Connect inputs, adjust time delays, and set the DIP switches on the accessory board as described in the following sections.



**Figure 2-28** Optional Accessory Board

### 2.16.1 Accessory Board Input and Output Connections

The black 6-pin connector P9 on the accessory board provides the following input and output connections. See Figure 2-28 and Figure 2-29.

| Terminals, Connector P9 | Function  |
|-------------------------|---|
| 1 - 2                   | Generator set supplying load output<br>Contact rated 10 amps @ 120VAC |
| 3 - 4                   | Not used  |
| 5 - 6                   | Remote test input   |

**Figure 2-29** Accessory Board Inputs and Outputs

**Generator Set Supplying Load Output.** This output provides a closed contact to indicate that the generator set is supplying the load when the transfer switch is in the Emergency position and the GEN source is available.

**Remote Test Input.** Connect a remote switch to this input for remote starting and stopping of a loaded test.

**Note:** DIP switch 3 affects the operation of this input. See Section 2.16.3, Accessory Board DIP Switches.

#### Connection Procedure

1. Use #12–24 AWG lead to connect input and output leads to connector P9. See Figure 2-29 for the connections.
2. Tighten the connections to 0.5 Nm (4.4 in. lb.).

**Note:** Always replace the cover before energizing the transfer switch controls.

### 2.16.2 Accessory Board Time Delay Adjustment Switches

The 10-position rotary switches allow adjustment of the time delays shown in Figure 2-30. Use a small screwdriver or other small tool to increase or decrease the time delays within the range shown in the table. The rotary switch positions range from 1 to 10, with position 10 labeled 0 (zero).

The factory settings are the same as the controller time delays without the accessory board.

| Time Delay                          | Switch | Factory Setting |                 | Adjustment   |           |
|-------------------------------------|--------|-----------------|-----------------|--------------|-----------|
|                                     |        | Setting         | Switch Position | Range        | Increment |
| Engine Cooldown                     | SW1    | 5 minutes       | 5               | 1-10 minutes | 1 minute  |
| Engine Start                        | SW2    | 3 seconds       | 3               | 1-10 seconds | 1 second  |
| Transfer from Normal to Emergency   | SW3    | 3 seconds       | 3               | 1-10 seconds | 1 second  |
| Retransfer from Emergency to Normal | SW4    | 6 minutes       | 2               | 3-30 minutes | 3 minutes |
| Exercise Run Time                   | SW5    | 20 minutes      | 4               | 5-50 minutes | 5 minutes |

**Figure 2-30** Accessory Time Delay Adjustment Switches

### 2.16.3 Accessory Board DIP Switches

DIP switches on the accessory board control the exercise, remote test, and load control functions. The DIP switch location is shown in Figure 2-28. The DIP switch functions are summarized in Figure 2-31. Check the DIP switch settings and adjust if necessary for the application.

**Switch 1: 1 Week/2 Week Exercise.** This switch controls the time interval for exercise runs that are set by pressing the Exercise button on the ATS controller. If the setting is changed after the exerciser has been set, the new schedule becomes effective *after* the next exercise.

**Switch 2.** This switch is not used.

| Switch | OFF (Open)      | ON (Closed)    | Notes         |   |
|--------|-----------------|----------------|---------------|---|
| 1      | 2 Week Exercise | 1 week         | 2 Weeks       | For the exercise button on the controller's user interface.           |
| 2      | —               | —              | —             | Not used.   |
| 3      | Maintained Test | Momentary      | Maintained    | For an optional remote test (start/stop) switch.                      |
| 4      | —               | —              | —             | Not used.   |
| 5      | Alarm enable    | Alarm Disabled | Alarm Enabled | For the alarm horn on the accessory board (inside the ATS enclosure). |

**Figure 2-31** Accessory Board DIP Switches

**Switch 3: Maintained/Momentary Test.** Set this switch for a maintained or momentary remote test (start/stop) switch, as follows:

- ON (maintained) position: Close a remote test switch or contact to start and run the generator set. Open the remote contact to end the test and signal the generator set to stop.
- OFF (momentary) position: Close the remote test switch momentarily (at least 1 second) and then open to start a test. To stop the test and signal the generator set to stop, momentarily close the test switch again.

**Switch 4.** This switch is not used.

**Switch 5: Alarm Enable.** Enables or disables the alarm horn on the accessory board. If this switch is changed while the horn is sounding, allow several seconds for the change to register and the horn to stop.

Install the front panel(s) or close and lock the enclosure door before energizing the transfer switch.

## 2.17 Installing MPAC 550 Controller

### 2.17.1 Factory Connections

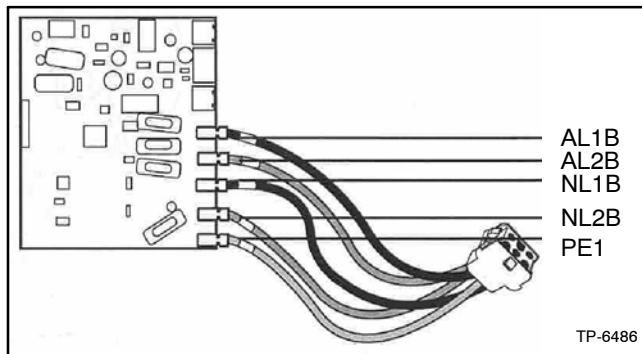
The 6-pin control harness (GM49971) is factory-connected to the MPAC 550 controller. Connections are shown here for reference only. Refer to Figure 2-32 for the lead and terminal markings. Refer to Figure 2-33 for the location of the connections. Refer to Figure 3-2 or Figure 3-3 for wiring schematics.

**Note:** For Type 1 enclosures, install the insulator provided with the MPAC 550 controller.

| Lead Marking | MPAC 550 Controller Terminal |
|--------------|------------------------------|
| NL1B         | TSC* NL1-B                   |
| NL2B         | TSC NL2-B                    |
| AL1B         | TSC AL1-B                    |
| AL2B         | TSC AL2-B                    |
| PE1          | TSC PE1                      |

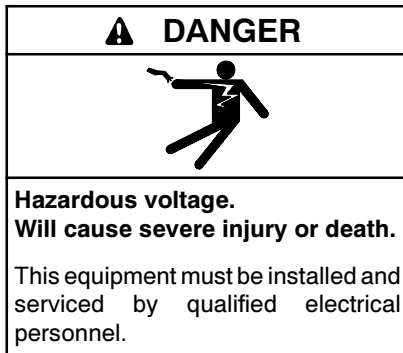
\* TSC: MPAC 550 transfer switch controller

**Figure 2-32** MPAC 550 Controller Wiring

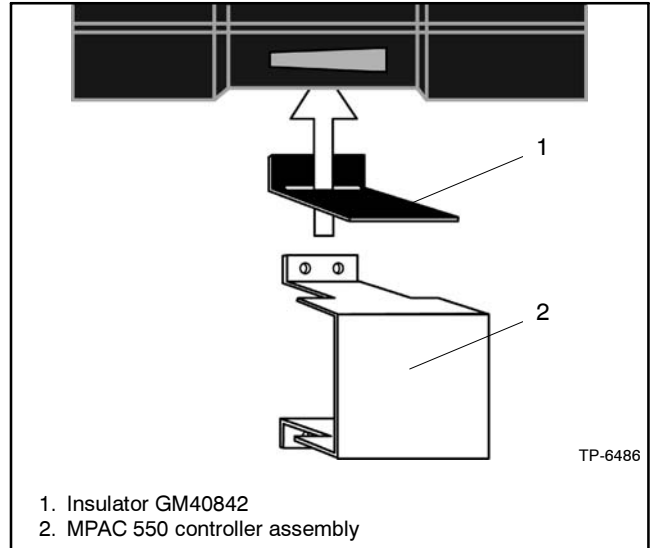


**Figure 2-33** Controller Wire Harness GM49971 Connections (factory-connected)

### 2.17.2 Install Controller



- For Type 1 enclosures only, install the insulator over the top mounting foot of the MPAC 550 controller. Refer to Figure 2-34.



**Figure 2-34** Installing Insulator, Type 1 Enclosures Only

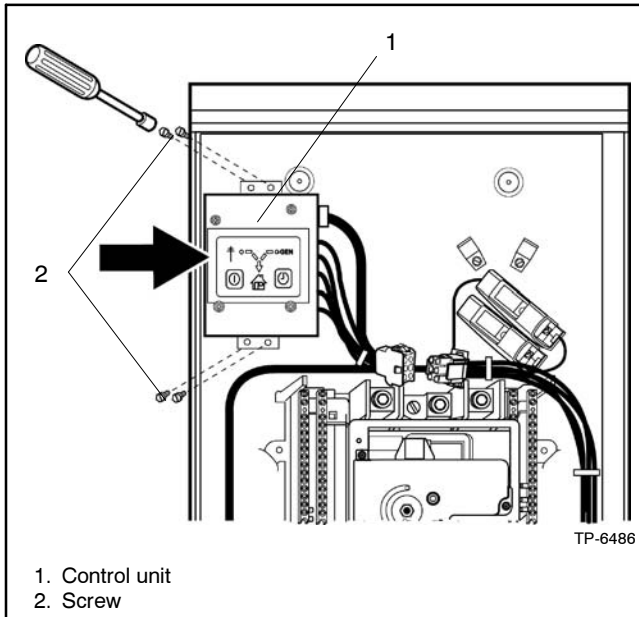
- Install the MPAC 550 controller in the load center enclosure. Ensure that the insulator is positioned between the load center interior assembly and the upper mounting foot of the MPAC 550 controller.

**Note:** Installation of insulator GM40842 is required for UL compliance.

For Type 1 enclosures, secure the control unit with two 10-32 x 5/16 in. screws using a 5/16 in. hex driver. Torque the screws to 3.4 Nm (30 in. lb.). See Figure 2-3.

**Note:** The wiring harness is long enough to permit the MPAC 550 controller to be mounted upright when the Type 1 load center is mounted in an inverted position.

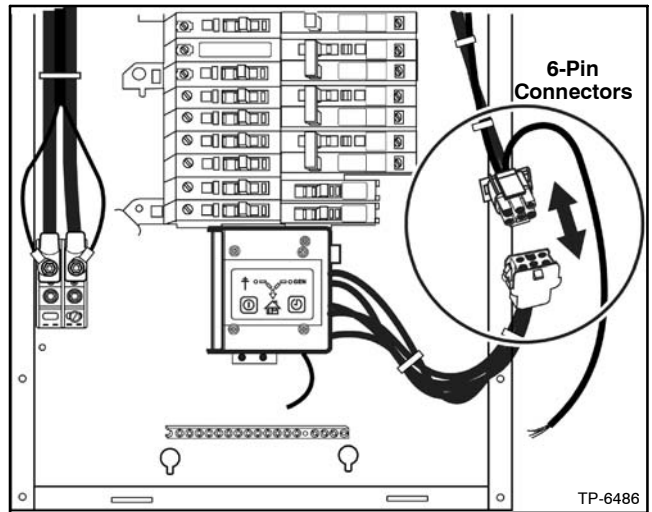
For Type 3R enclosures, secure the control unit with four 10-32 x 5/16 in. screws using a 5/16 in. hex driver. Torque the screws to 3.4 Nm (30 in. lb.). See Figure 2-35.



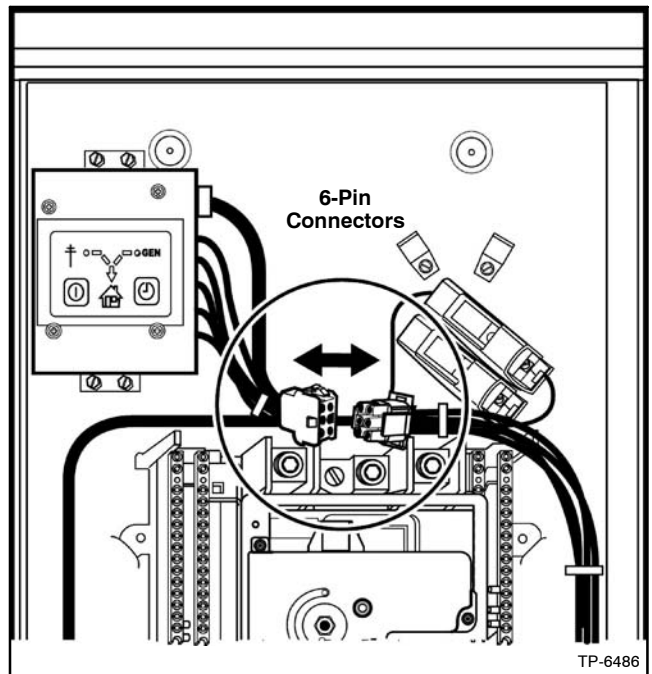
**Figure 2-35** Installing MPAC 550 Controller, Type 3R Enclosures

### 2.17.3 Connecting Control Harness 6-Pin Plugs

Connect the 6-pin control harness segment to the long control harness. Ensure that the plugs are fully engaged. See Figure 2-36 and Figure 2-37.



**Figure 2-36** Connecting Control Harnesses, Type 1 Enclosures

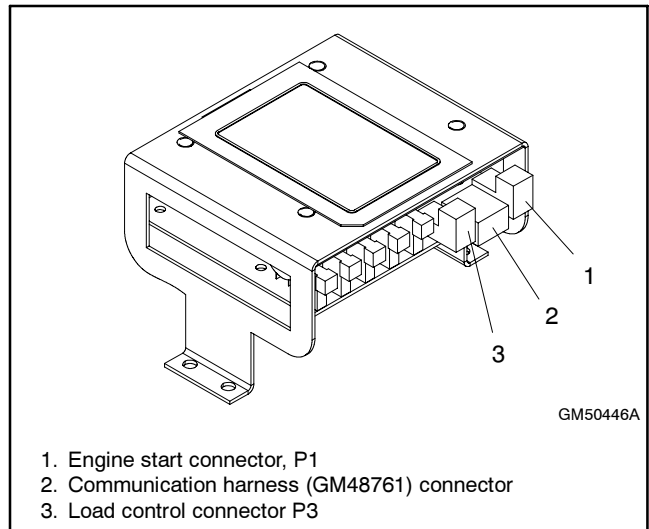


**Figure 2-37** Connecting Control Harnesses, Type 3R Enclosures

## 2.17.4 Connecting Engine Start and Optional Load Control Circuits

Connect the generator set engine start leads to 2-pin connector P1 on the MPAC 550 controller. See Figure 2-38 and Figure 2-39. When the utility power is lost, or a test or exercise sequence is started, the engine start contacts close to signal the generator set to start.

Optional: Connect the load control circuit to 2-pin connector P3 on the MPAC 550 controller. See Figure 2-38 and Figure 2-39. The load control contact opens when the utility source is lost. The load connected to the load control circuit is not supplied by the standby source when the normal source is not available. Refer to TP-6487, Model RSB, ATSR Transfer Switch Operation Manual, for more information on load control operation.



**Figure 2-38** Engine Start and Load Control Connections

| Description  | Connector | Contact Rating  | Wire Size  | Tightening Torque  |
|--------------|-----------|---|------------|--------------------|
| Engine Start | P1        | 0.5 A @ 125 VAC;<br>2 A @ 30 VDC<br>SPST normally closed (NC) | #12-24 AWG | 0.8 Nm (7 in. lb.) |
| Load Control | P3        | 10 A @ 120 VAC<br>SPST normally open (NO)                     | #12-24 AWG | 0.8 Nm (7 in. lb.) |

**Figure 2-39** Controller Field Connection Specifications

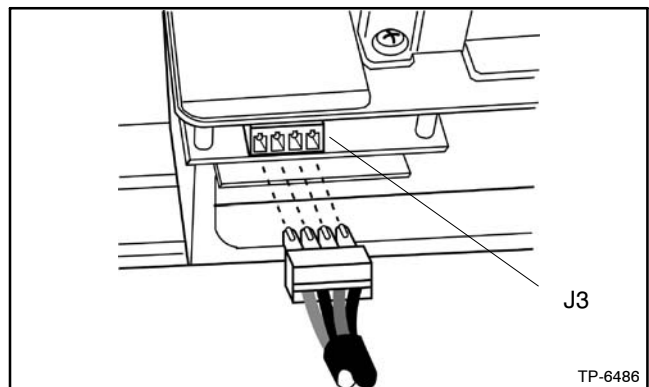
## 2.18 Installing Communication Wire Harness

**Note:** If you are installing a load shed module, omit this procedure and skip to Section 2.19, Installing Load Shed Module.

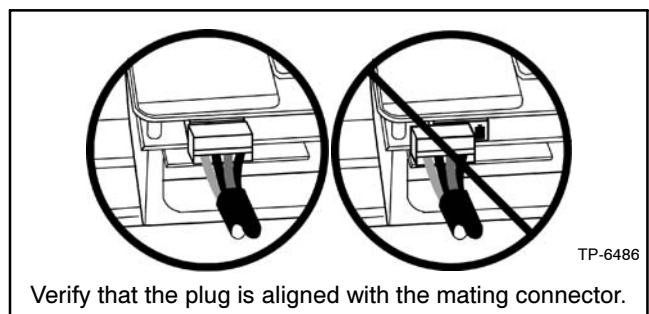
### 2.18.1 Install Communication Harness

If you are not installing a load shed module, install communication harness GM48761 as follows.

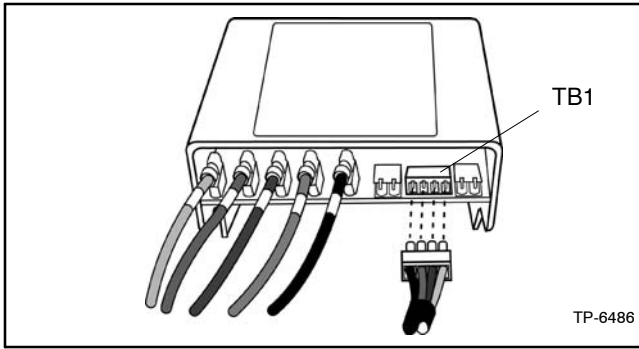
1. Install the green pluggable connector into terminal J3 on the transfer mechanism. See Figure 2-40. Refer to Figure 2-41 for the correct position of the cable.



**Figure 2-40** Communication Terminal J3 on Transfer Mechanism

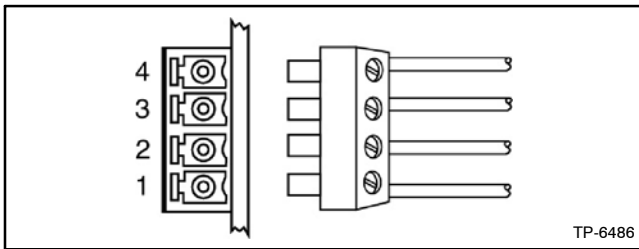


**Figure 2-41** Connecting Communication Cable



**Figure 2-42** Communication Terminal TB1 on MPAC 550 Controller

- Then install the green plugable connector at the other end of the cable into terminal TB1 on the MPAC 550 controller. See Figure 2-42.



**Figure 2-43** Communication Connector Pin-Out

| Pin | Name   | Description                 |
|-----|--------|-----------------------------|
| 4   | B      | Inverting data line         |
| 3   | A      | Non-inverting data line     |
| 2   | Ground | DC control power ground     |
| 1   | Power  | 24 VDC control power source |

**Figure 2-44** Communication Connector Pin-Out

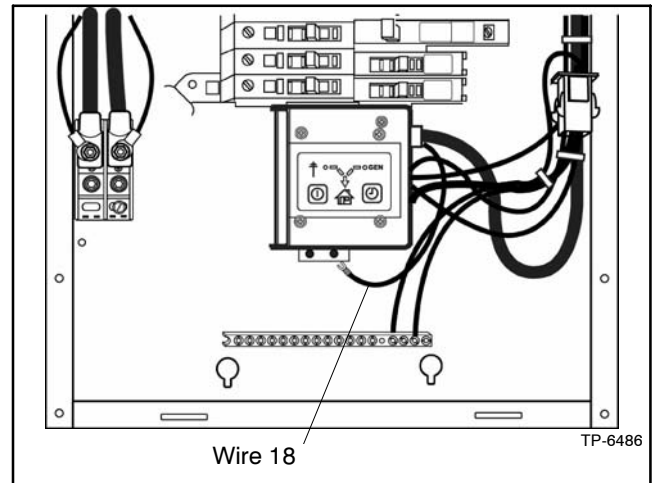
| Lead Marking | Transfer Mechanism Terminal | MPAC 550 Controller Terminal |
|--------------|-----------------------------|------------------------------|
| 4            | TM* J34                     | TSC† J34                     |
| 3            | TM J33                      | TSC J33                      |
| 2            | TM J32                      | TSC J32                      |
| 1            | TM J31                      | TSC J31                      |

\* TM: Automatic transfer mechanism  
 † TSC: MPAC 550 transfer switch controller

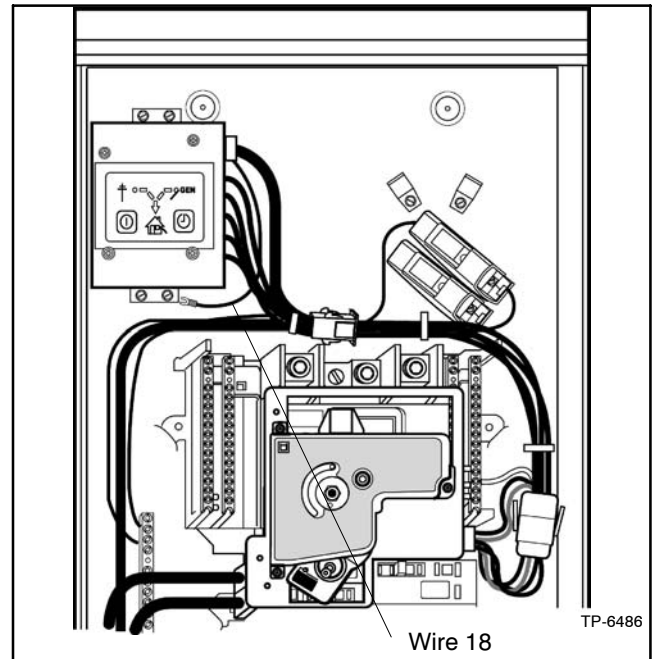
**Figure 2-45** Communication Harness Connections

## 2.18.2 Connect Communication Cable Shield Wire

- Slide the spade connector of wire 18 (shield wire for the communication cable) between the mounting screw of the generator control unit and the control unit housing as shown in Figure 2-46 (Type 1 enclosures) or Figure 2-47 (Type 3R enclosures). Secure the mounting screw, taking care not to crush the shield wire connector.
- Skip to Section 2.21, Installing Grounding Leads.



**Figure 2-46** Communication Cable Shield, Type 1 Enclosures

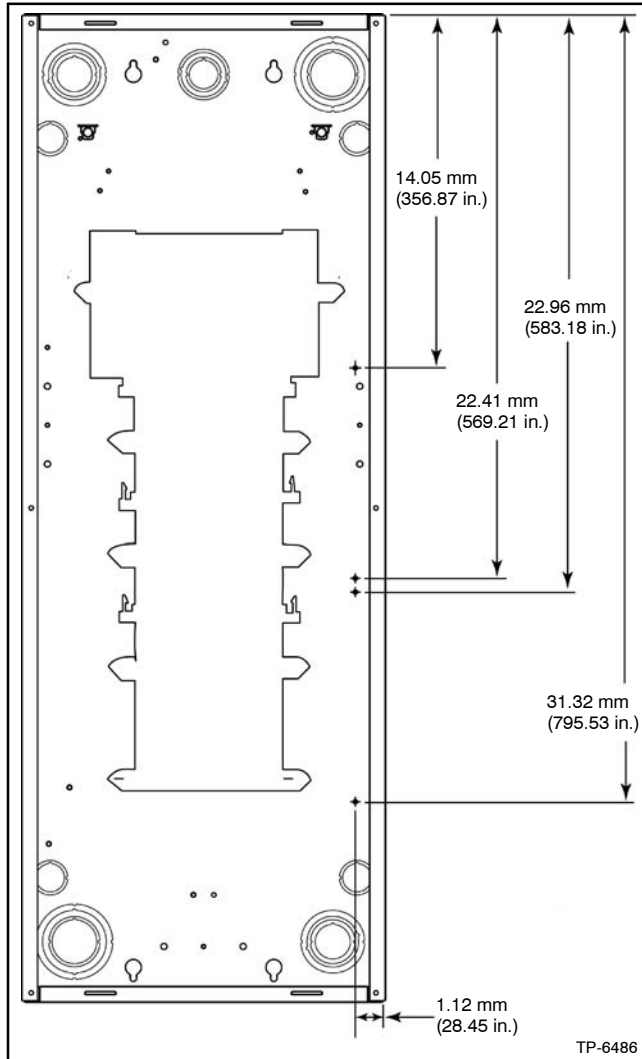


**Figure 2-47** Communication Cable Shield, Type 3R Enclosures

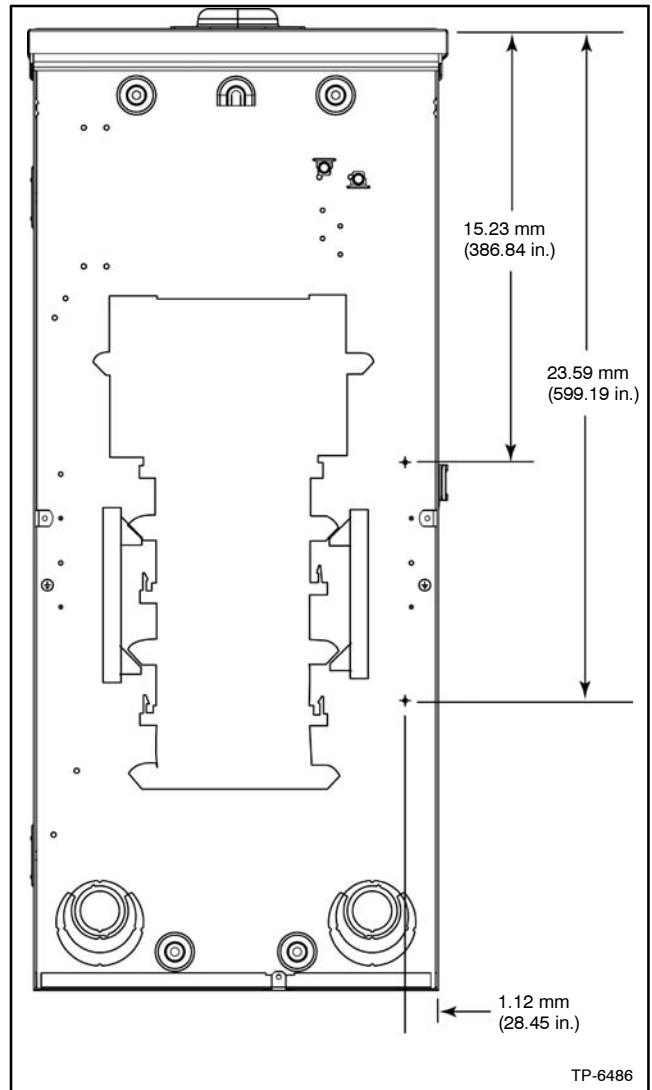
## 2.19 Installing Load Shed Module

**Note:** If you are not installing a load shed module, omit this procedure and skip to Section 2.21, Installing Grounding Leads.

1. If the load center does not have predrilled mounting holes, using a drill and a number 28 (0.140 in.) drill bit, drill the appropriate number of mounting holes for the installation. Refer to Figure 2-48 or Figure 2-49 for the drill pattern.



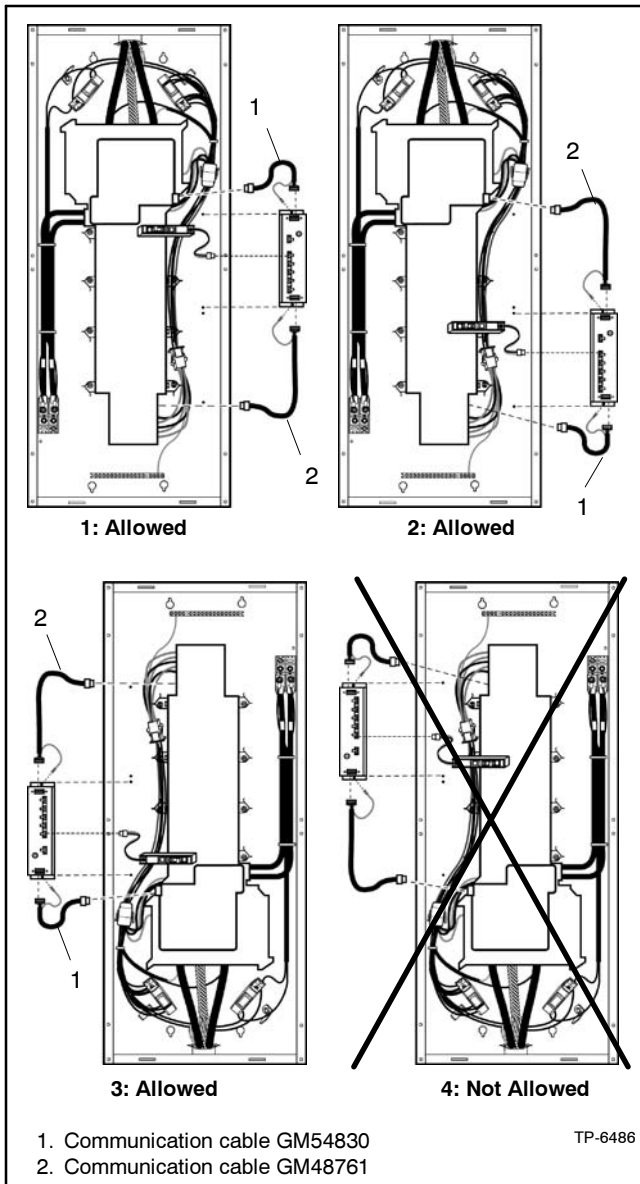
**Figure 2-48** Drill Pattern, Type 1 Enclosures



**Figure 2-49** Drill Pattern, Type 3R Enclosures

**Note:** You can install one or two modules in the Type 1 load center. If you are installing one module and the load center is not inverted (see Section 2.4.5), install the module in either the top or bottom mounting locations. See positions 1 and 2 in Figure 2-50. If you are installing one module and the load center is inverted, you must install the module in position 3 as shown in Figure 2-50. Communication cable A is not long enough to install the module in position 4.





**Figure 2-50** Correct Load Shed Module Installation

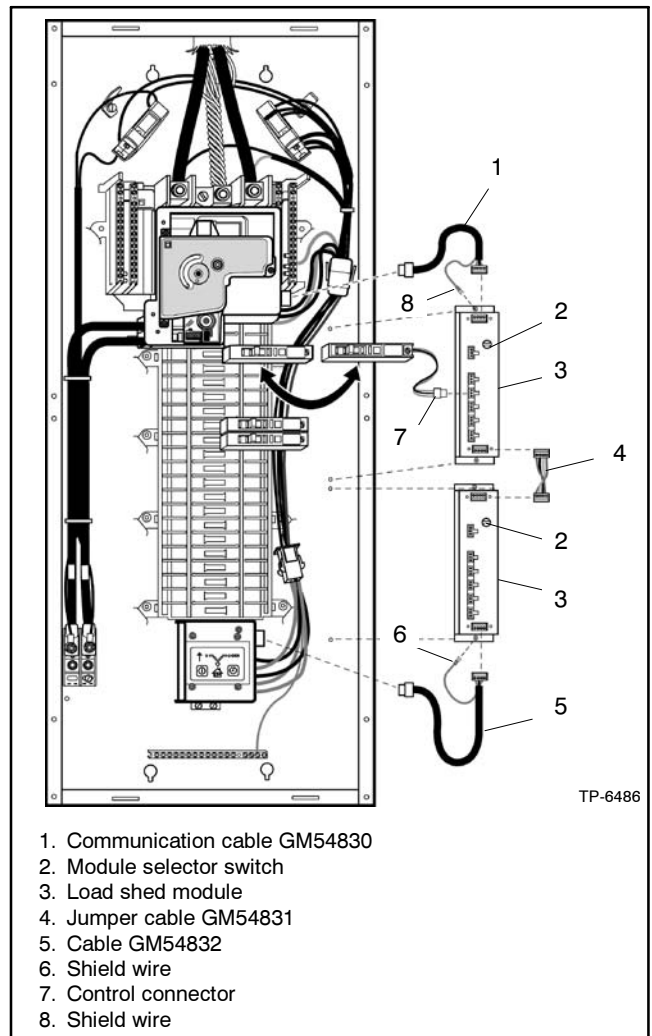
- Place the load shed module in the load center as shown in Figure 2-52 or Figure 2-53 and loosely secure it with the two captive screws provided.

| Cable No. | Cable Length, mm (in.) |
|-----------|------------------------|
| GM54830   | 152.4 (6)              |
| GM54831   | 76.2 (3)               |
| GM54832   | 406.4 (16)             |
| GM48761   | 899.0 (35)             |

**Figure 2-51** Load Shed Module Cables

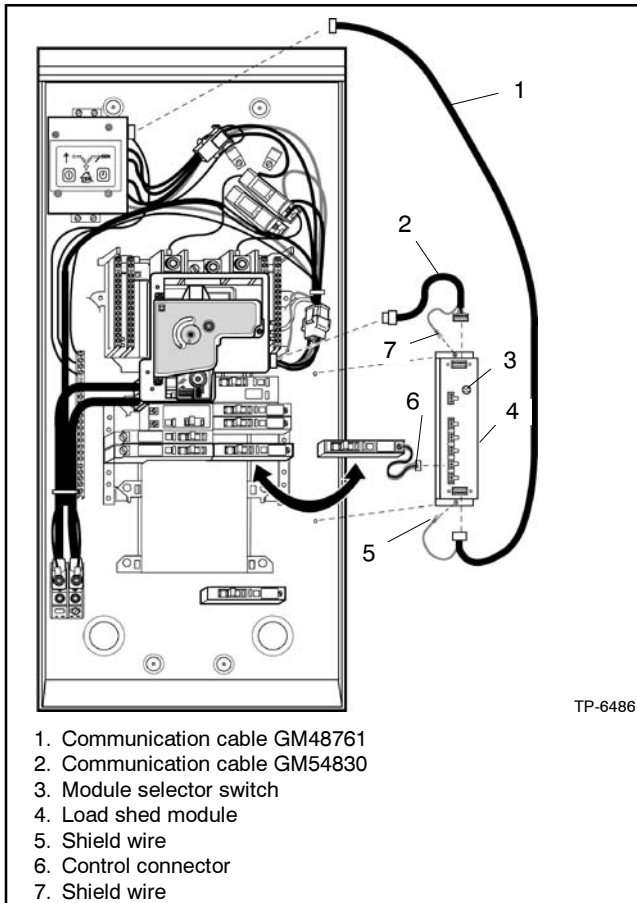
- Referring to Figure 2-52 or Figure 2-53, install the communication cables provided with the load shed module:

- Slide the spade connector of the shield wire (Figure 2-52, item 6, or Figure 2-53, item 5) for cable GM54832 (Type 1) or cable GM48761 (Type 3R) between the mounting screw of the load shed module and the module housing as shown in Figure 2-52 or Figure 2-53. Secure the mounting screw, taking care not to crush the shield wire connector. Connect cable GM54832 (Type 1) or cable GM48761 (Type 3R) to the bottom connector of the load shed module and to terminal TB1 on the generator control unit.



**Figure 2-52** Load Shed Module Installation, Type 1 Enclosures

- b. Slide the spade connector of the shield wire (Figure 2-52, item 8, or Figure 2-53, item 7) for communication cable GM54830 between the mounting screw of the load shed module and the module housing. Secure the mounting screw, taking care not to crush the shield wire connector. Connect cable GM54830 to the top terminal of the load shed module and to terminal J3 on the automatic transfer mechanism.



**Figure 2-53** Load Shed Module Installation, Type 3R Enclosures

- c. If you installed two load shed modules in the Type 1 load center:

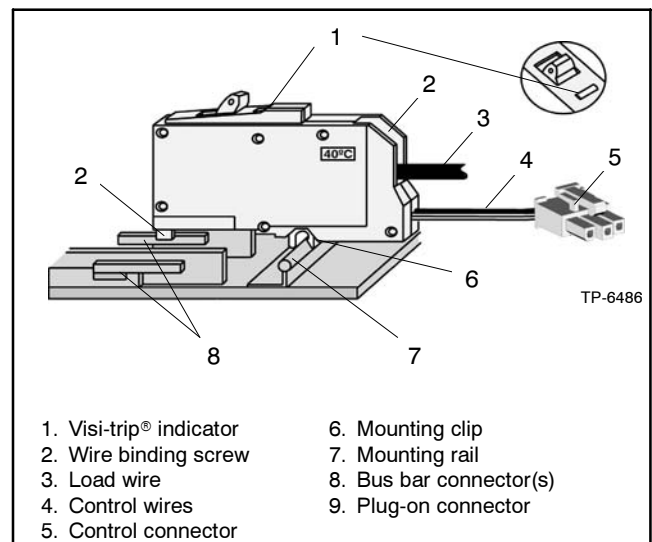
- Install the jumper cable GM54831 between the two modules.
- Set the module selector switches to two different settings.

## 2.20 Installing Remote Control Circuit Breakers

One load shed module can control a maximum of six remote control circuit breakers. A Type 1 installation with two load shed modules can control a maximum of twelve remote control circuit breakers.

Install the required number of remote control circuit breakers in the Square D® Intelligent Load Center as follows. Refer to Figure 1-4 for circuit breaker ratings. When refitting an existing circuit in an Intelligent Load Center, always select a remote control circuit breaker whose rated current is the same as the circuit breaker being replaced.

1. Before installing the circuit breaker, turn the circuit breaker handle to the OFF (O) position.
2. Position the mounting clip of the circuit breaker onto the mounting rail of the Intelligent Load Center, and snap the plug-on connector onto the bus bar connector. Refer to the instruction bulletin provided with the circuit breaker for complete installation instructions and operational checks.
3. Plug the remote control circuit breaker control connectors into the load shed module (see item 7 in Figure 2-52 or Figure 2-53).

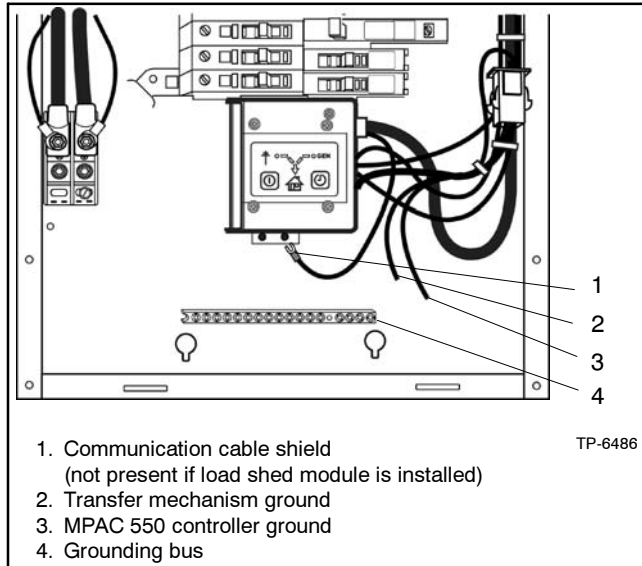


**Figure 2-54** Circuit Breaker

## 2.21 Installing Grounding Leads

Install the grounding leads to grounding bus as follows:

1. Slide the spade connector of the shield wire for the communication cable between the mounting screw of the generator control unit and the control unit housing as shown in Figure 2-55 (Type 1 enclosures) and Figure 2-56 (Type 3R enclosures). Secure the mounting screw, taking care not to crush the shield wire connector.

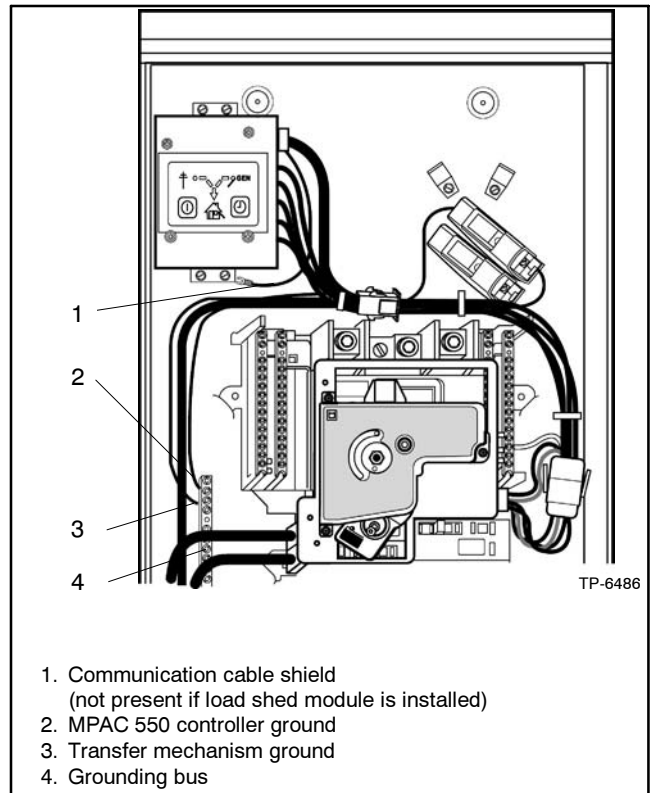


**Figure 2-55** Installing Grounding leads, Type 1 Enclosures

2. For the following connections, loosen the screw at the appropriate terminals, install the wires, and torque the screws to 2.3 Nm (20 in. lb.). Refer to Figure 2-55 and Figure 2-56 for grounding bus location. Refer to Figure 2-57 for the lead and terminal markings. Refer to Figure 3-2, Figure 3-3, Figure 3-5, and Figure 3-7 for wiring schematics.

- Connect grounding lead PE1 from the MPAC 550 controller to the grounding bus.
- Connect grounding lead PE1 from the transfer mechanism to the grounding bus.
- Connect grounding lead PE1 from the communication harness to the grounding bus.

**Note:** If you installed a load shed module, the shield wire will not be present.



**Figure 2-56** Installing Grounding Leads, Type 3R Enclosures

| Lead Marking | From Terminal              | To Terminal |
|--------------|----------------------------|-------------|
| PE1          | TM* PE_1                   | GND Bus     |
| PE1          | TSC† PE1                   | GND Bus     |
| PE1          | Communication cable shield | GND Bus     |

\* TM: Automatic transfer mechanism  
† TSC: MPAC 550 transfer switch controller

**Figure 2-57** Grounding Bus Wiring

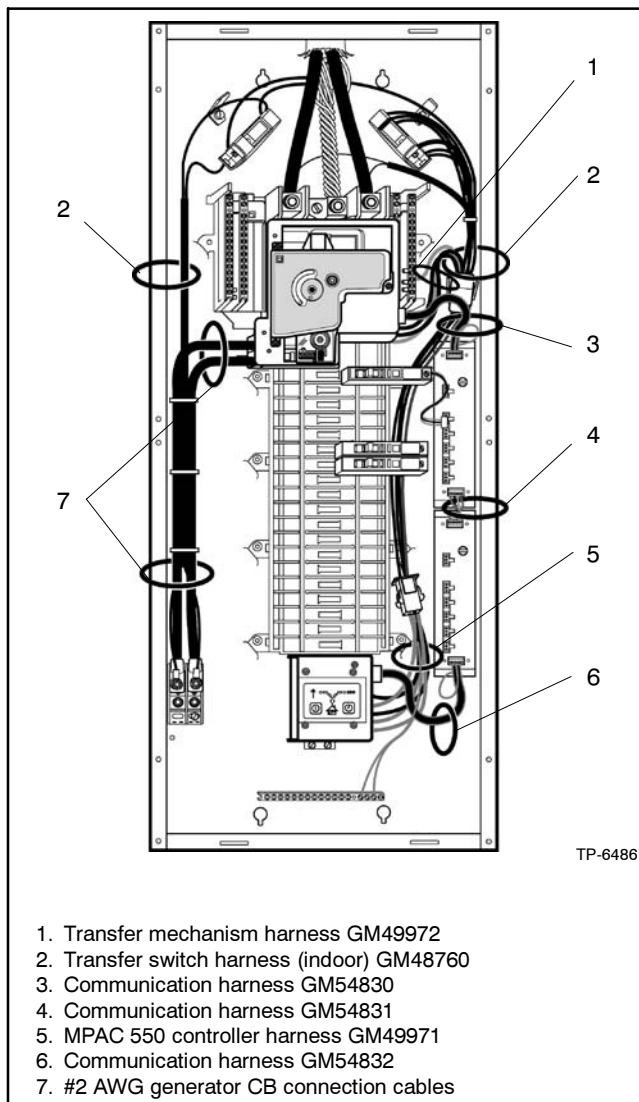
## 2.22 Installing Fuses

Use only Bussmann® CC-TRON® FNQ-R-6 fuses in the Square D® Intelligent Load Center. To install fuses, refer to Figure 2-10.

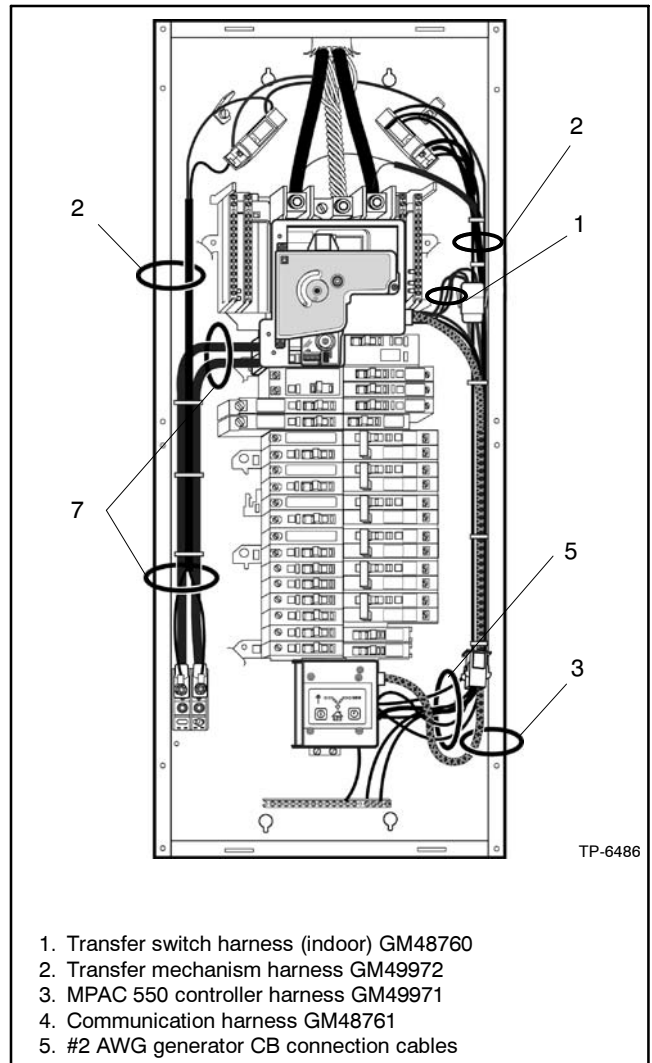
1. Insert the fuses into the fuse clip. Note that the fuses will only fit into the fuse holder one way.
2. Insert the fuse clip into the fuse holder.

## 2.23 Harness Routing

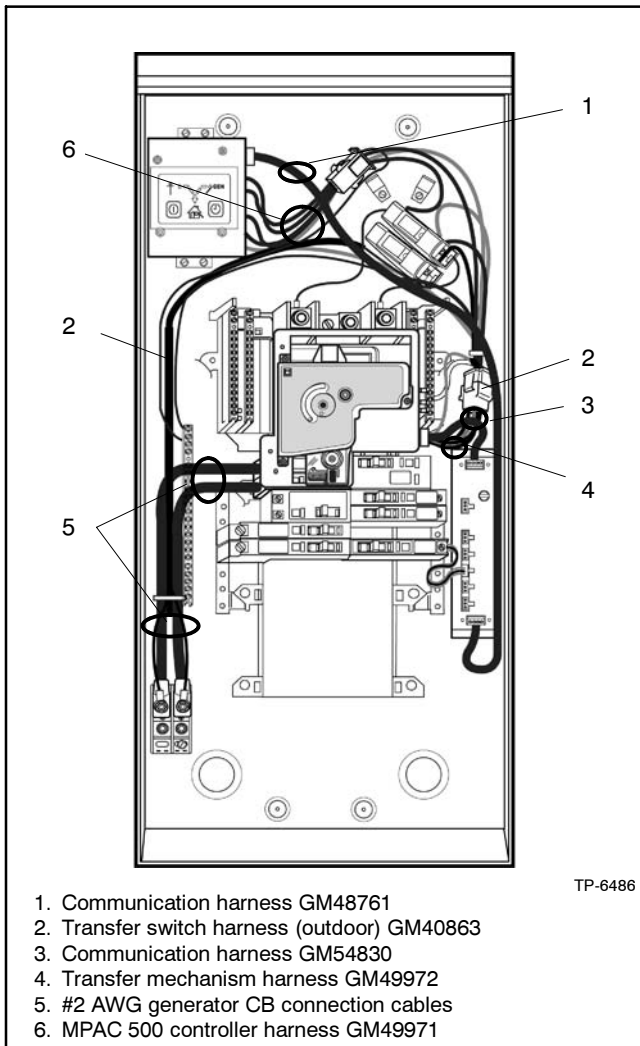
Route the harnesses and leads as shown in Figure 2-58 through Figure 2-61. Keep the harnesses against the left and right sidewalls of the enclosure. Do not reroute or alter the wiring harnesses.



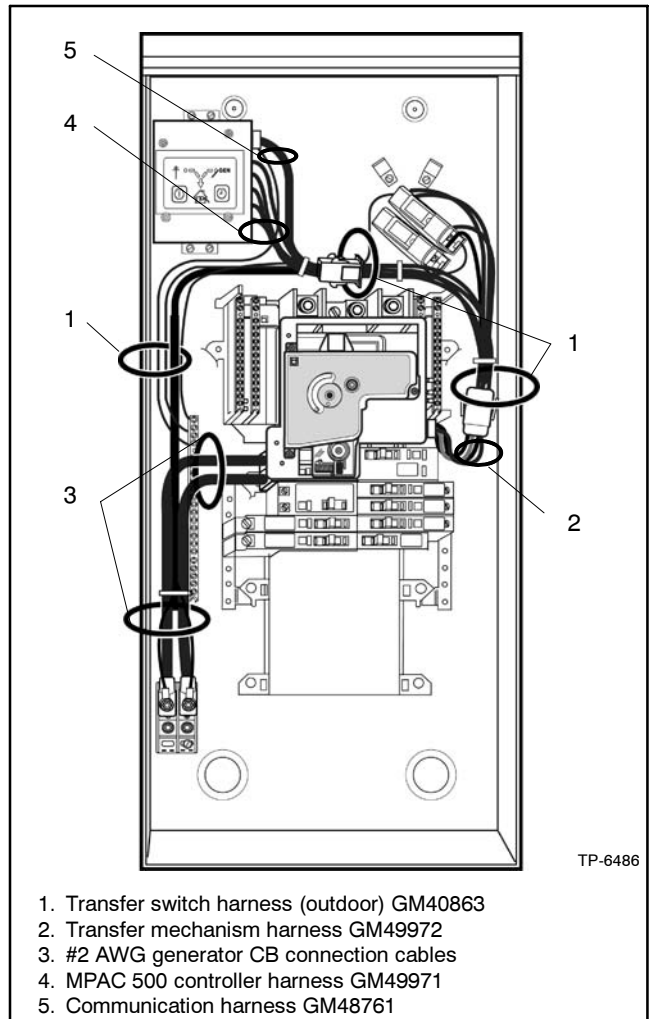
**Figure 2-58** Enclosure Harness Routing, Type 1 With Load Shed Module



**Figure 2-59** Enclosure Harness Routing, Type 1 Without Load Shed Module



**Figure 2-60** Enclosure Harness Routing, Type 3R  
With Load Shed Module



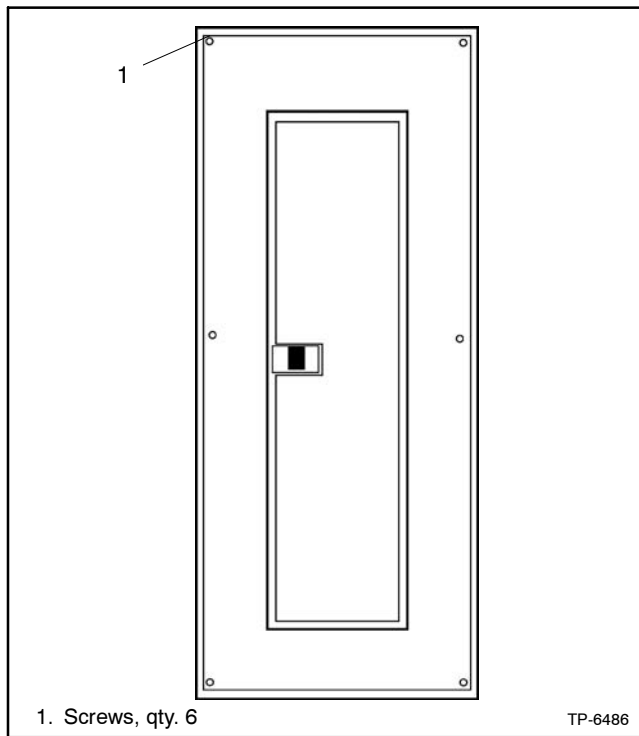
**Figure 2-61** Enclosure Harness Routing, Type 3R  
Without Load Shed Module

## 2.24 Installing Covers

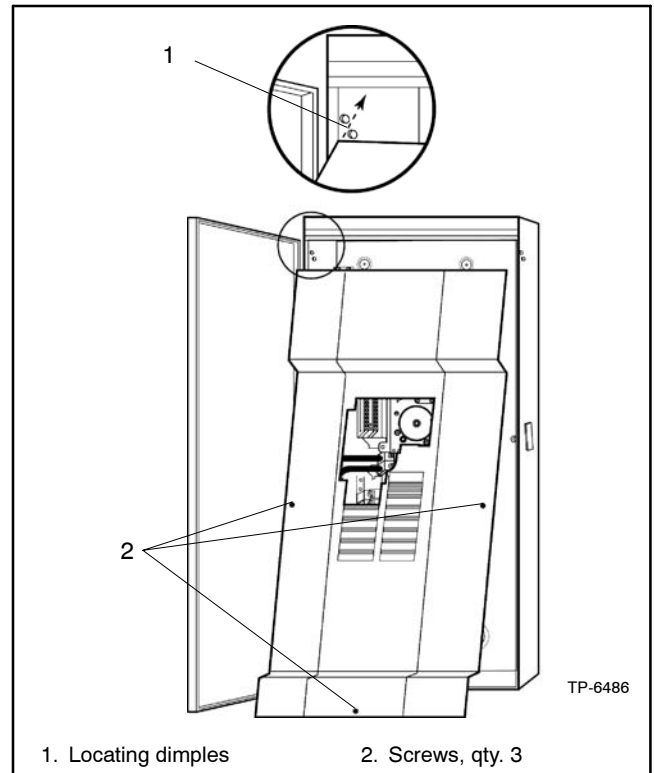
For Type 1 enclosures, install the cover provided with the generator conversion kit and secure it with six screws using a slotted or square driver. Refer to Figure 2-62.

For Type 3R enclosures, install the interior cover provided with the conversion kit as follows:

- Slide the top left edge of the cover between the locating dimples on the back plane of the enclosure and into place. Refer to Figure 2-63.
- Secure the cover with three screws using a slotted or square driver.



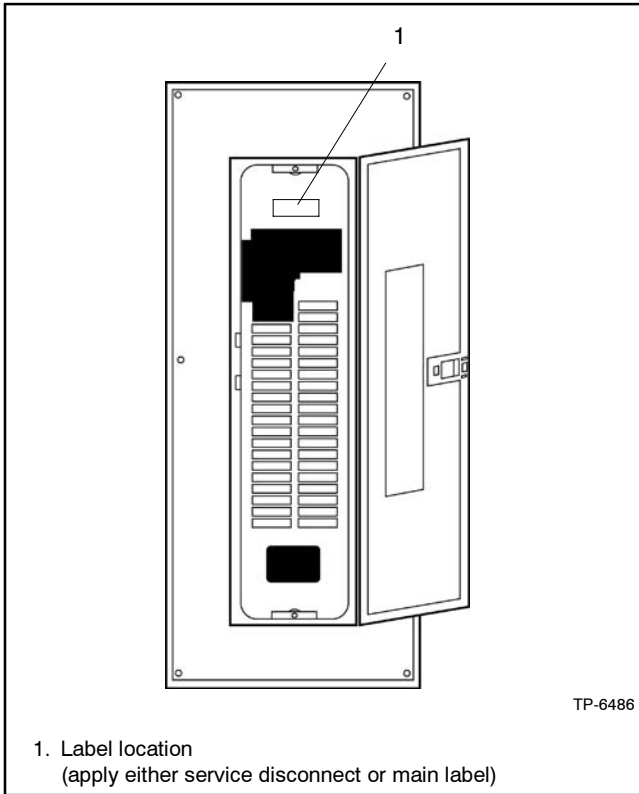
**Figure 2-62** Front Cover, Type 1 Enclosure



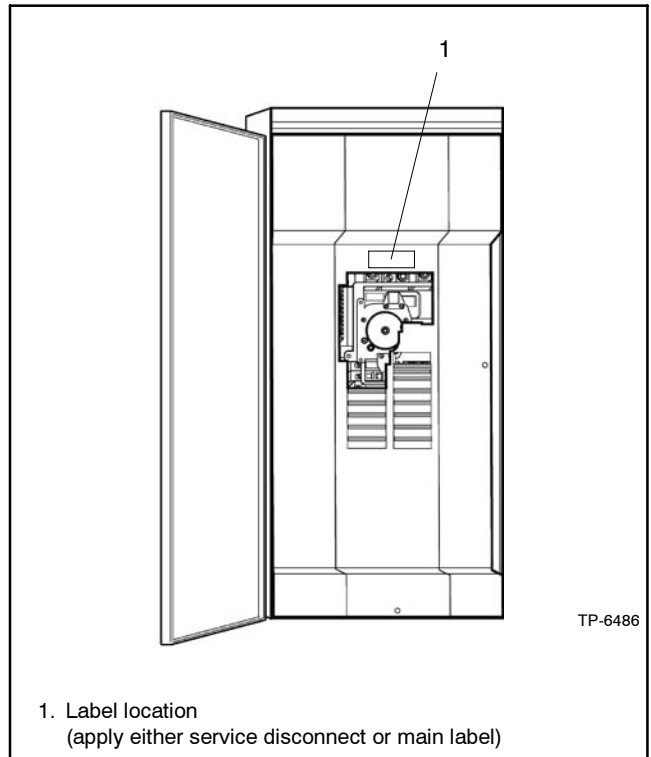
**Figure 2-63** Front Cover, Type 3R Enclosure

## 2.25 Main Circuit Breaker or Service Disconnect Label

Two labels are provided with the load center identifying the main circuit breaker as either a service disconnect or a main circuit breaker. For service equipment, apply the service disconnect label; otherwise, apply the main label. See Figure 2-64 or Figure 2-65 for the label location. Unless the specific application of the load center is known before installation, apply the appropriate label during installation of the load center.



**Figure 2-64** Front Cover, Type 1 Enclosures



**Figure 2-65** Inside Cover, Type 3R Enclosures

# Notes



## Section 3 Wiring

| Wire Harness   | For Schematic, Refer To |             | Wire Marking | From: Device and Terminal | To: Device and Terminal | Wire Size (AWG) |
|--|-------------------------|-------------|--------------|---------------------------|-------------------------|-----------------|
|  | Type 1                  | Type 3R     |              |                           |                         |                 |
| Control  | Figure 3-2              | Figure 3-3  | NL1-A        | QOM2 L1                   | Fuse 1A                 | #14             |
|  |                         |             | NL2-A        | QOM2 L2                   | Fuse 2A                 | #14             |
|  |                         |             | AL1-A        | GENTB L1                  | Fuse 3A                 | #14             |
|  |                         |             | AL2-A        | GENTB L2                  | Fuse 4A                 | #14             |
| 9-Pin Control Harness Segment  |                         |             | NL1-B        | Fuse 1B                   | TM NL1 B                | #14             |
|  |                         |             | NL2-B        | Fuse 2B                   | TM NL2 B                | #14             |
|  |                         |             | AL1-B        | Fuse 3B                   | TM AL1 B                | #14             |
|  |                         |             | AL2-B        | Fuse 4B                   | TM AL2 B                | #14             |
|  |                         |             | N-A          | LC NEUT                   | TM N A                  | #14             |
|  |                         |             | LC1-A        | LC Stud                   | TM LC1 A                | #14             |
|  |                         |             | LC2-A        | LC Stud                   | TM LC2 A                | #14             |
|  |                         |             | PE1          | GND BUS                   | TM PE 1                 | #14             |
| 6-Pin Control Harness Segment  |                         |             | NL1-B        | Fuse 1B                   | TSC NL1-B               | #14             |
|  |                         |             | NL2-B        | Fuse 2B                   | TSC NL2-B               | #14             |
|  |                         |             | AL1-B        | Fuse 3B                   | TSC AL1-B               | #14             |
|  |                         |             | AL2-B        | Fuse 4B                   | TSC AL2-B               | #14             |
|  | PE1                     | GND BUS     | TSC PE1      | #14                       |                         |                 |
| Communication Cable  | Figure 3-5              | Figure 3-7  | PE1          | GND BUS                   | Cable Shield            | #18             |
|  |                         |             | 1 ORG        | TM J3-1                   | TSC TB1-1               | #18             |
|  |                         |             | 2 BLU        | TM J3-2                   | TSC TB1-2               | #18             |
|  |                         |             | 3 BLK        | TM J3-3                   | TSC TB1-3               | #18             |
|  |                         |             | 4 RED        | TM J3-4                   | TSC TB1-4               | #18             |
| Generator Power Cables   | Figure 3-9              | Figure 3-10 | AL1-A        | GENTB L1                  | GENCB L1                | #2              |
|  |                         |             | AL2-A        | GENTB L2                  | GENCB L2                | #2              |
| Legend:<br>TSC      Transfer switch controller (MPAC™ 550)<br>GENCB   Generator circuit breaker<br>GENTB   Generator terminal block<br>LC        Load center<br>QOM2    Main circuit breaker<br>TM        Automatic transfer mechanism |                         |             |              |                           |                         |                 |

**Figure 3-1** Wiring

# 3.1 Control Harness Wiring

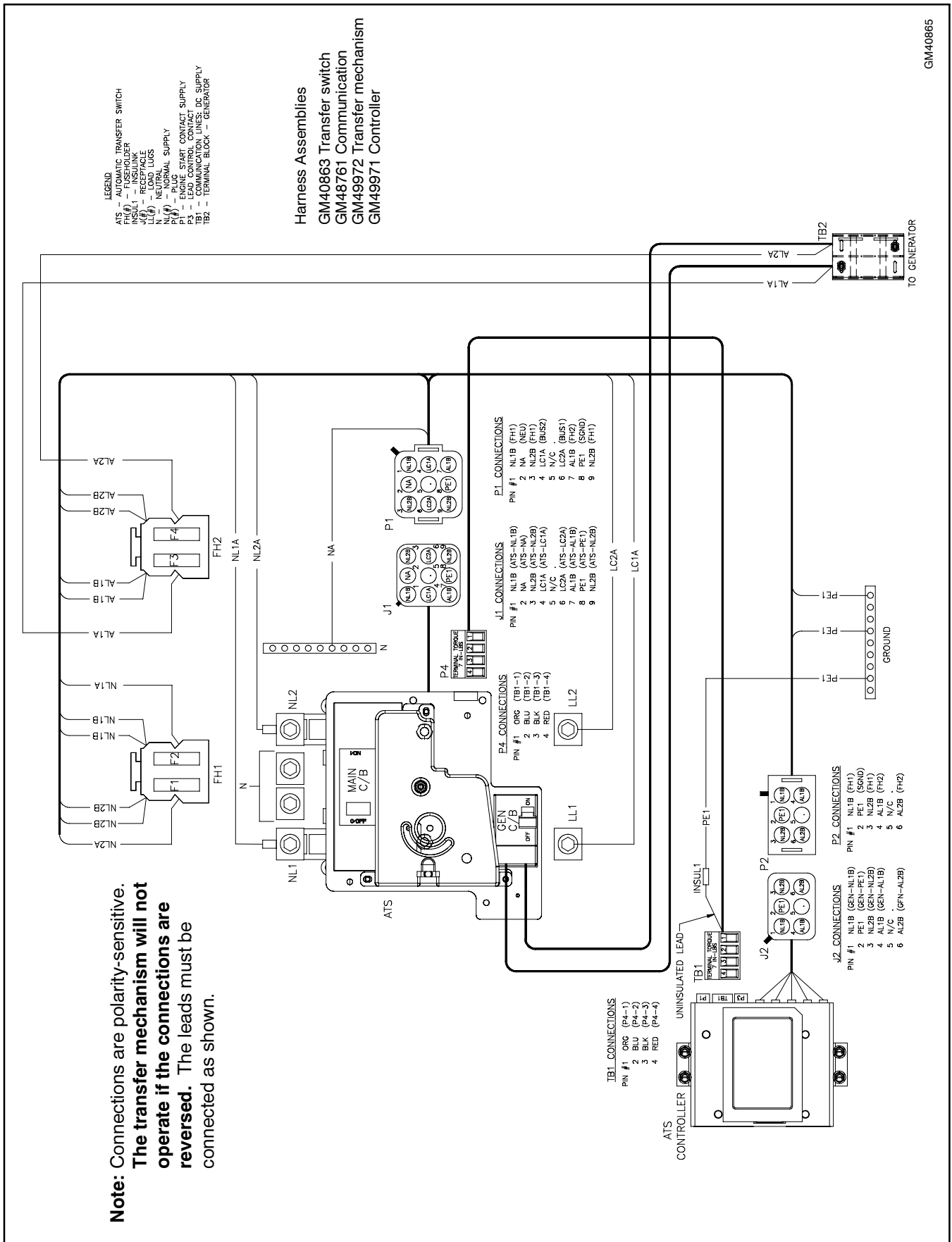
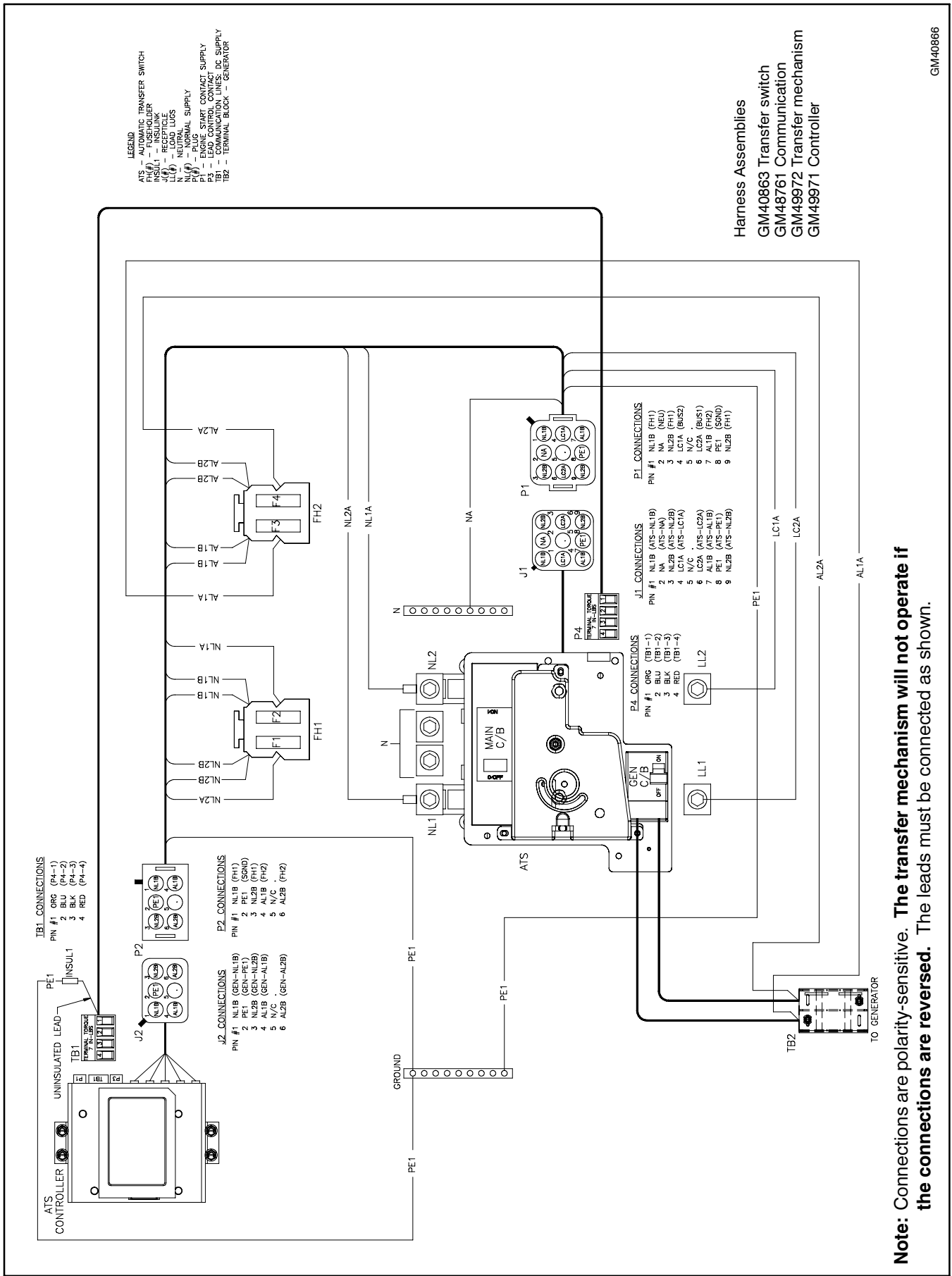


Figure 3-2 Wiring Diagram, Type 1 Enclosures



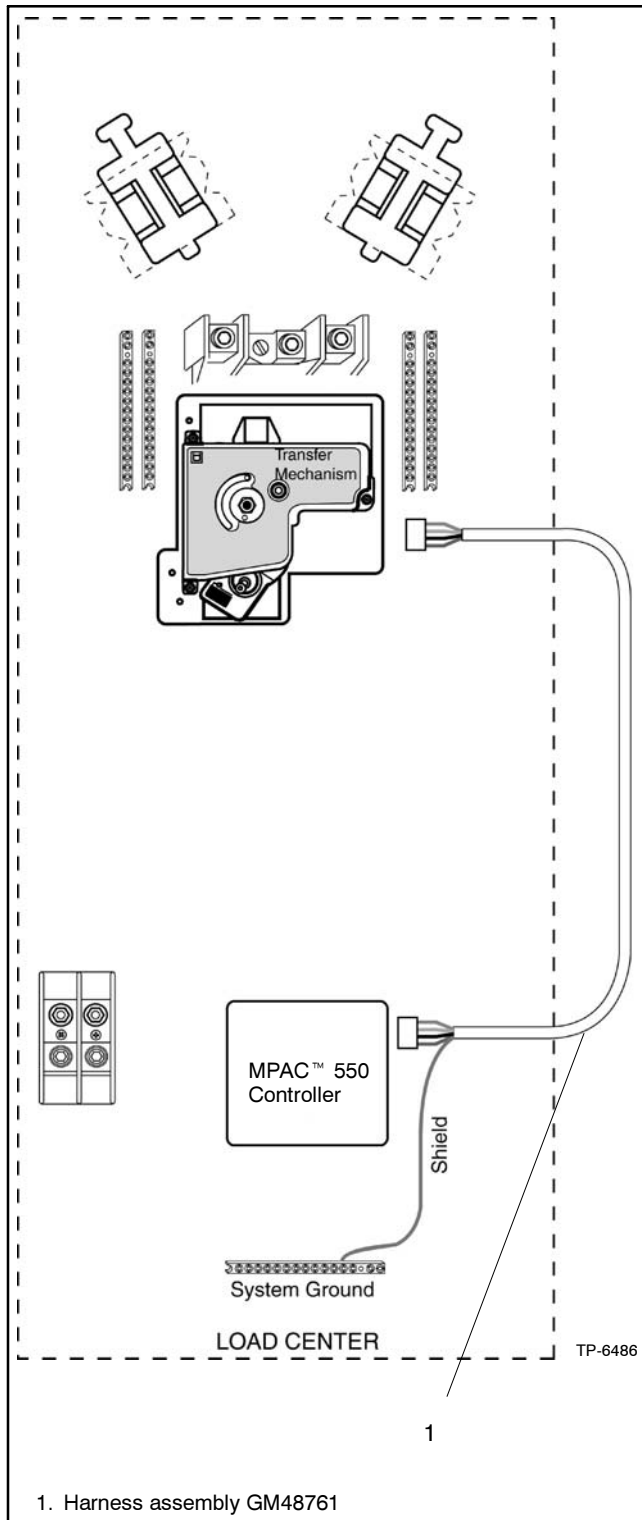
Harness Assemblies  
 GM40863 Transfer switch  
 GM48761 Communication  
 GM49972 Transfer mechanism  
 GM49971 Controller

**Note:** Connections are polarity-sensitive. The transfer mechanism will not operate if the connections are reversed. The leads must be connected as shown.

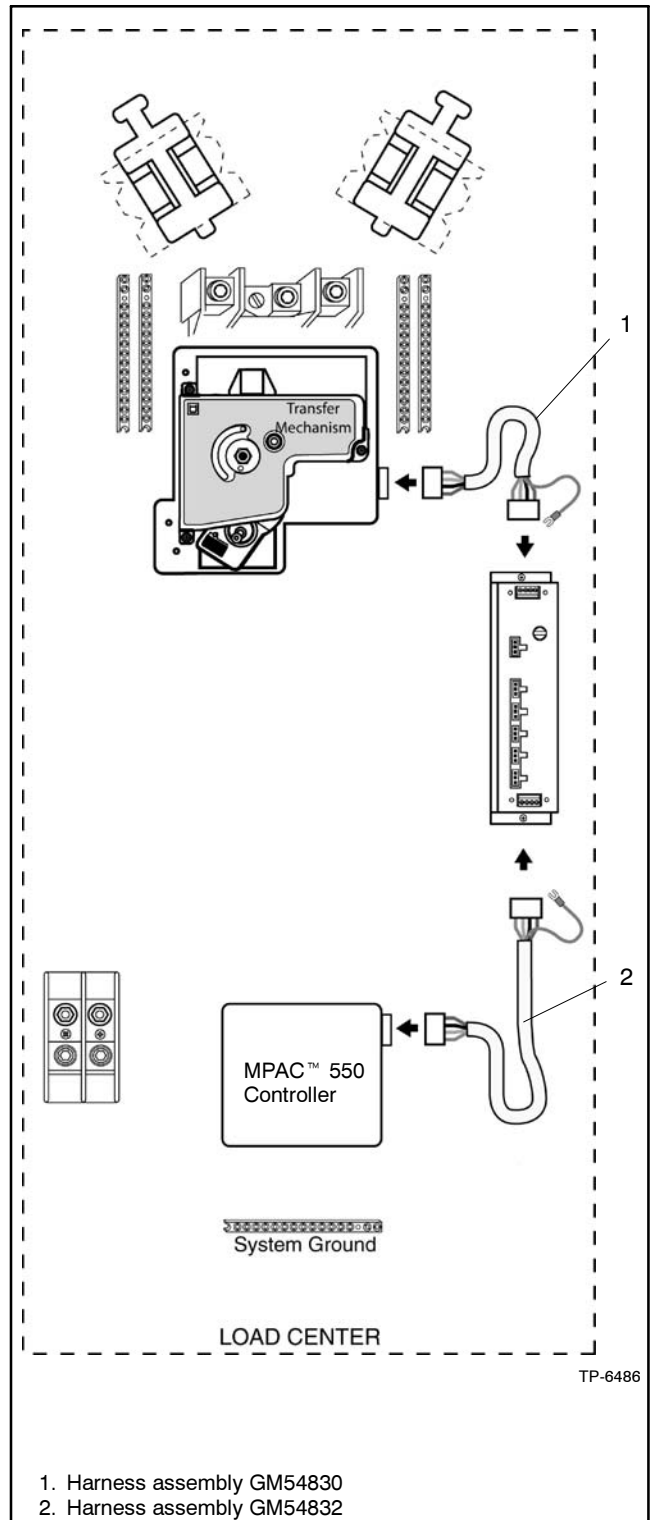
GM40866

Figure 3-3 Wiring Diagram, Type 3R Enclosures

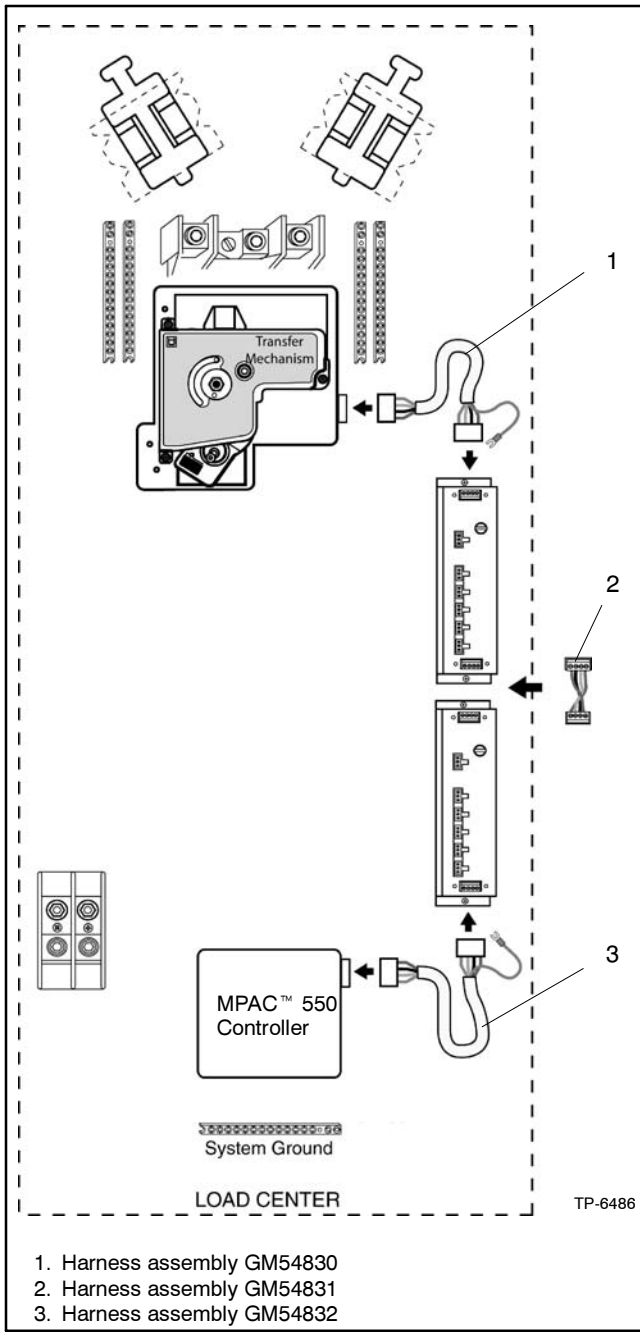
### 3.2 Communication Harness Wiring



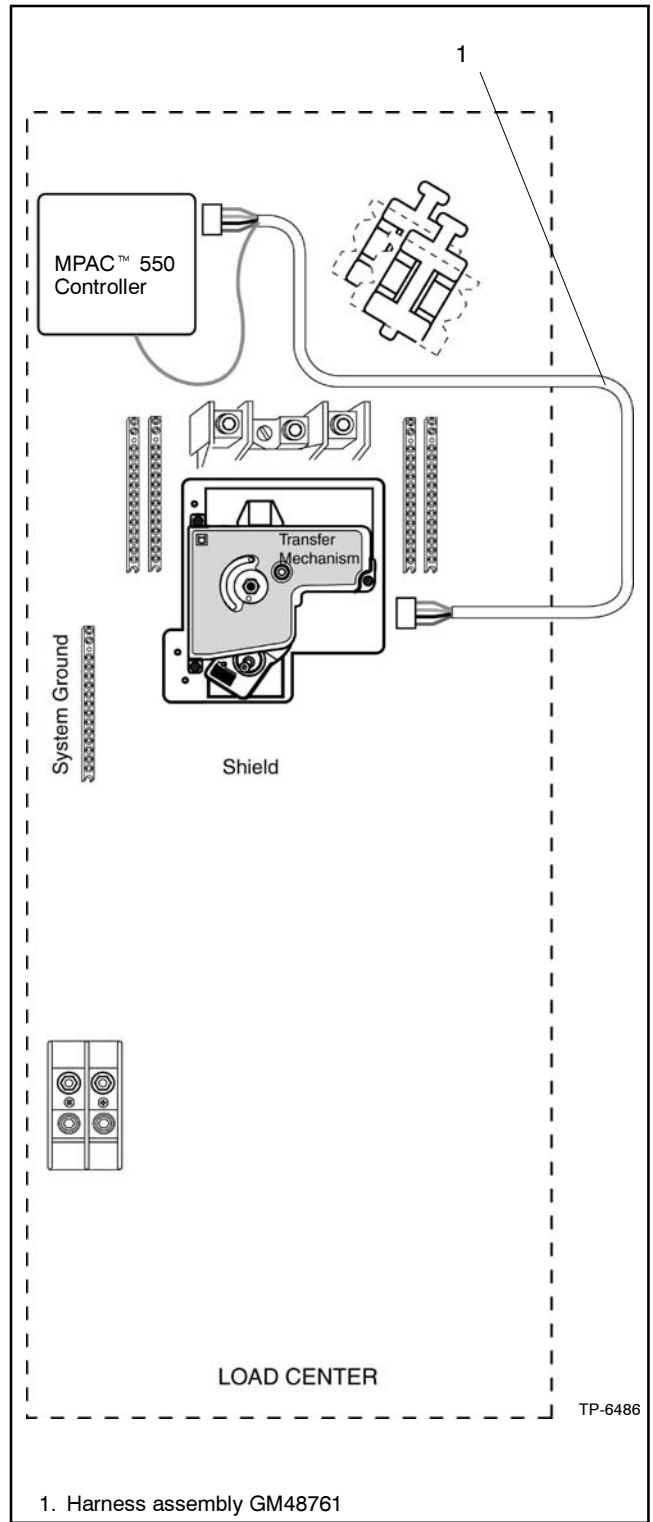
**Figure 3-4** Communication Harness Wiring Without Load Shed Module, Type 1 Enclosures



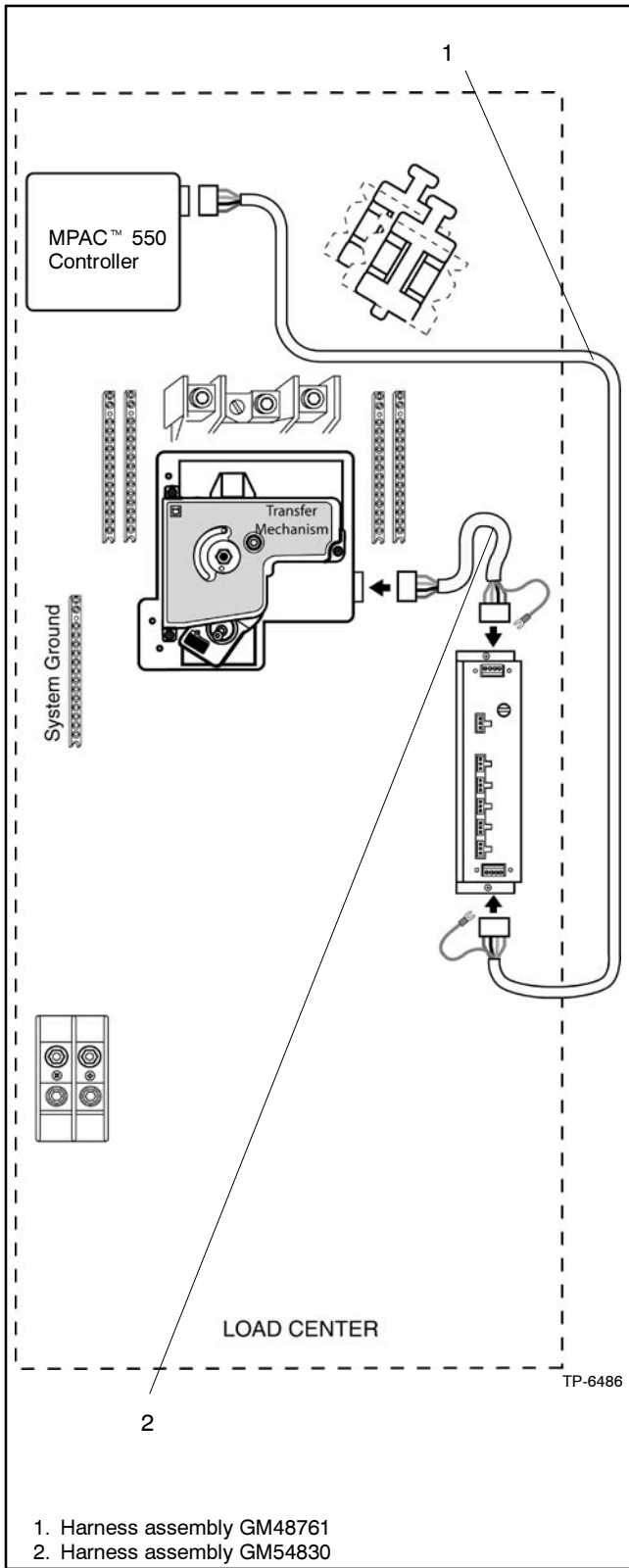
**Figure 3-5** Communication Harness Wiring With One Load Shed Module, Type 1 Enclosures



**Figure 3-6** Communication Harness Wiring With Two Load Shed Modules, Type 1 Enclosures

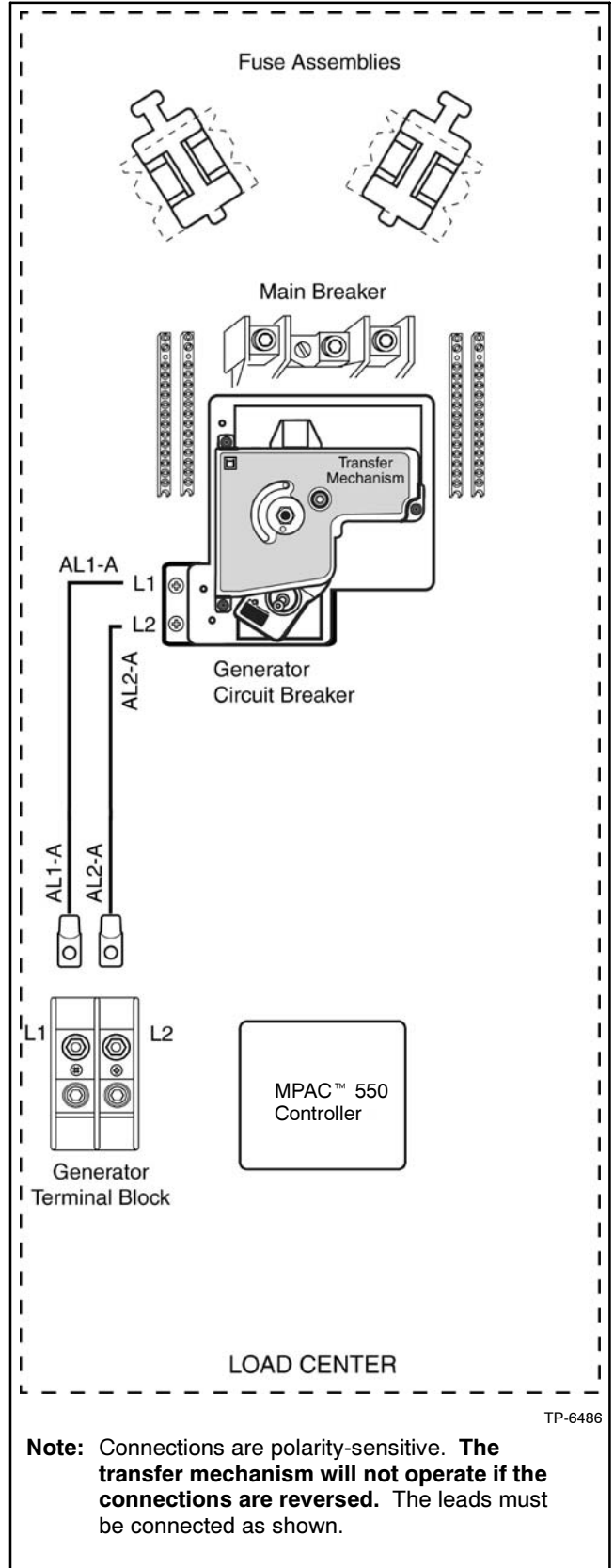


**Figure 3-7** Communication Harness Wiring Without Load Shed Module, Type 3R Enclosures

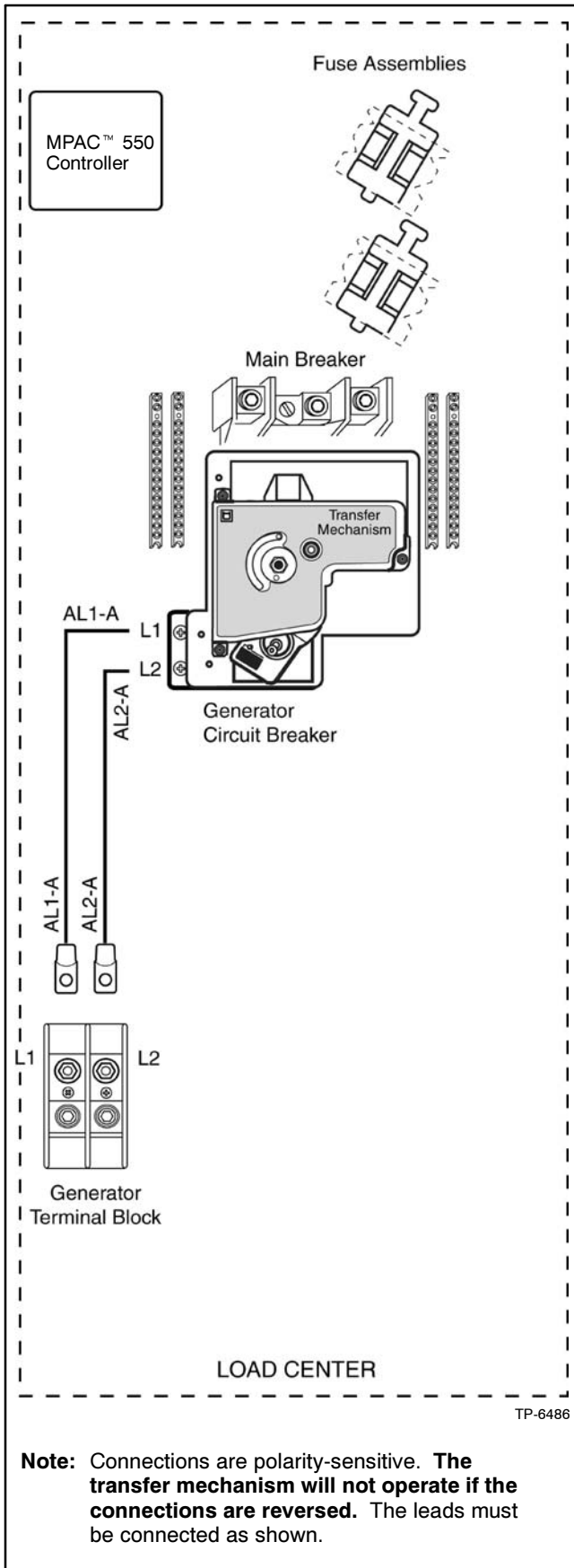


**Figure 3-8** Communication Harness Wiring With Load Shed Module, Type 3R Enclosures

### 3.3 Generator/Power Harness Wiring

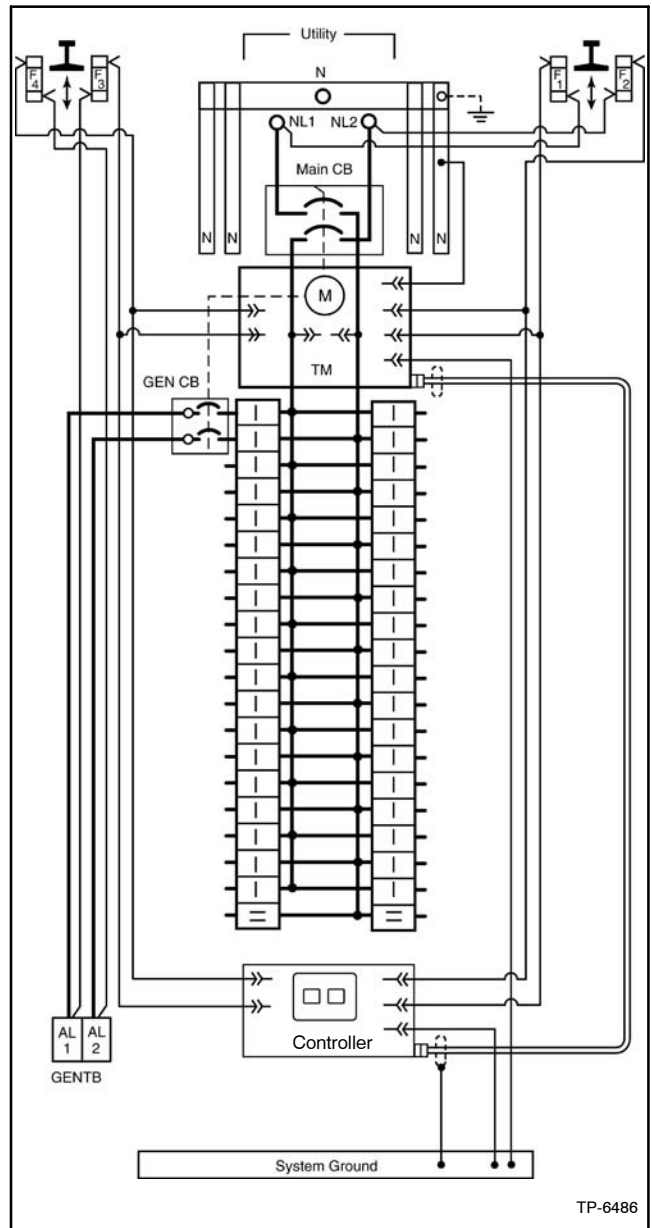


**Figure 3-9** Generator/Power Harness Wiring, Type 1 Enclosures

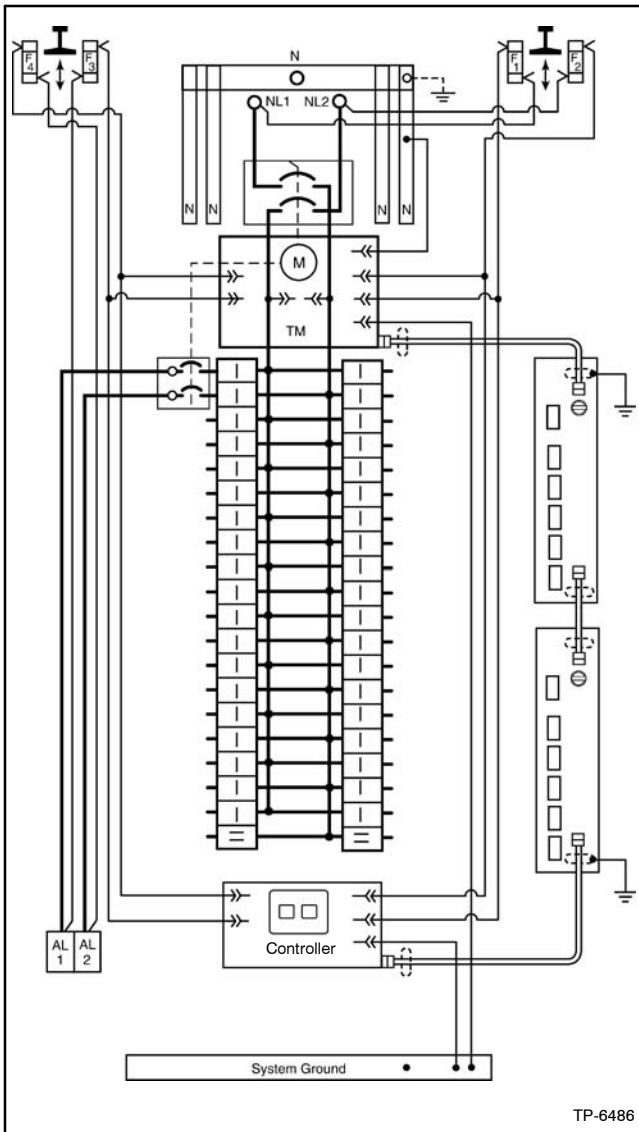


**Figure 3-10** Generator/Power Harness Wiring, Type 3R Enclosures

### 3.4 Power Wiring



**Figure 3-11** Intelligent Load Center Schematic Without Load Shed Module, Type 1 Shown



**Figure 3-12** Intelligent Load Center Schematic With Load Shed Module, Type 1 Shown



## Section 4 Commissioning

After the conversion kit parts have been assembled into the load center, verify that the mechanism is functioning correctly.

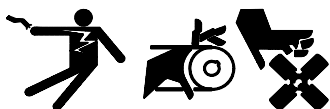
The procedures in this section are intended to verify that the conversion kit wiring, transfer mechanism, and mechanism control electronics are properly installed and functional.

These procedures are not intended to verify that the optional standby power system is operating properly or that the MPAC 550 controller and associated generator are set up and operating properly. Refer to the literature supplied with the generator set for installation, test, and troubleshooting information for the standby generator set.

### 4.1 Checking Mechanical Installation

Follow this procedure to verify that the mechanical portion of the conversion kit has been correctly installed.



#### WARNING





**Accidental starting.  
Can cause severe injury or death.**

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

**Disabling the generator set. Accidental starting can cause severe injury or death.** Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

|  |
|--|
|  <b>DANGER</b>  |
|   |
| <b>Hazard of electric shock, explosion, or arc flash.<br/>Will cause severe injury or death.</b><br><br>This equipment must be installed and serviced by qualified electrical personnel. |

|  |
|--|
|  <b>DANGER</b>                                  |
|   |
| <b>Hazardous voltage.<br/>Will cause severe injury or death.</b><br><br>Disconnect all power sources before opening the enclosure. |

**Servicing the transfer switch. Hazardous voltage can cause severe injury or death.** Deenergize all power sources before servicing. Turn off the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (-) leads first. Reconnect negative (-) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

#### WARNING

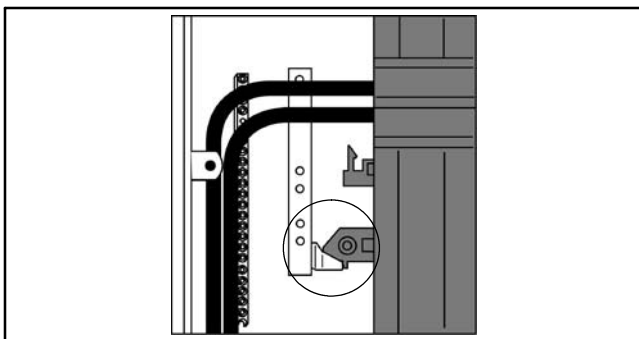


**Hazardous voltage.  
Can cause severe injury or death.**

Close and secure the enclosure door before energizing the transfer switch.

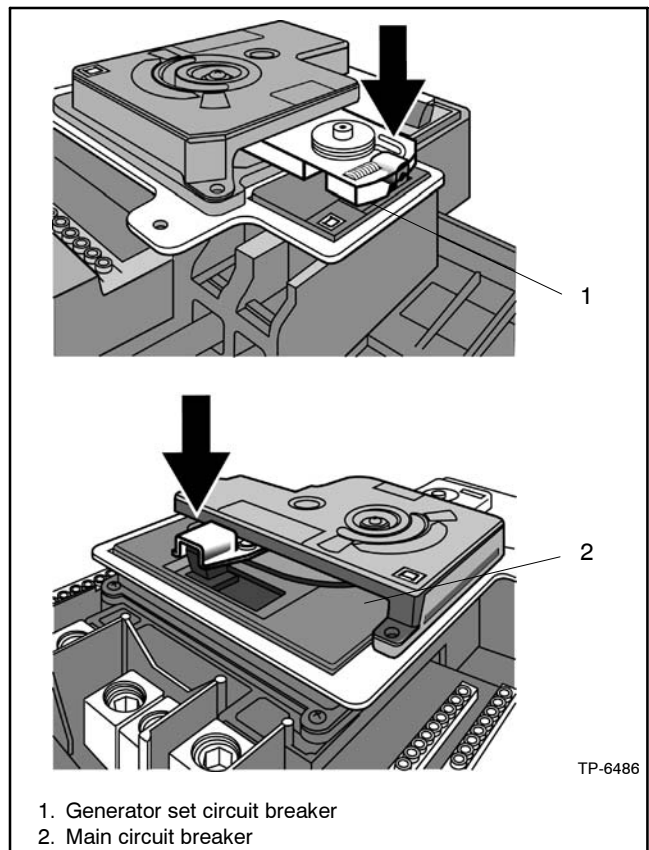
**Note:** Do not perform high-potential dielectric testing on the Intelligent Load Center. Damage to the control electronics may result.

1. Mechanical verification of the conversion kit requires removal of all power from the load center. Provide an alternate light source before beginning the procedure.
2. If the load center is already installed and wired, open the generator disconnect at the generator, and lockout the generator from starting and running. Apply the appropriate lockouts to the disconnect means.
3. If the load center is already installed and wired, open the main feeder disconnect supplying power to the load center. If the installation uses the revenue meter for isolation, arrange for the utility provider to remove the meter. Apply the appropriate lockouts to the disconnecting means. If a main feeder disconnect is not present and the revenue meter cannot be used as an isolation device, do not continue with this procedure. Implementation of this procedure requires complete removal of power!
4. Remove the front cover of the load center:  
  
Type 1 (indoor) enclosures: Using a slotted or square driver, loosen the six screws and remove the front cover. See Figure 2-62 for screw location.  
  
Type 3R (outdoor) enclosures: Open the front enclosure door, loosen the three screws, and remove the front cover. See Figure 2-63 for screw location.
5. Referring to Figure 4-1, inspect the load center interior assembly mounting ears to ensure proper engagement in the back surface slots of the enclosure. All mounting ears must be engaged with their respective slots or misalignment of the transfer mechanism can occur.
6. Inspect the load center interior for the presence of construction and wire-stripping debris. Vacuum the interior to remove any debris. Do not use compressed air.
7. Verify that the fuse insulating covers (see Figure 2-11 and Figure 2-12) and the generator terminal block insulating cover (see Figure 2-15) are installed.
8. Verify that the insulator between the load center interior assembly and the MPAC 550 controller mounting bracket is installed. See Figure 2-34.
9. Verify that the conversion kit wire harnesses have been installed and routed as shown in Figure 2-58 and Figure 2-60.
  - a. Ensure that the harnesses are routed against the left and right sidewalls of the enclosure.
  - b. Ensure that the harnesses are bundled together with wire ties as shown in Figure 2-58 and Figure 2-60.
  - c. Ensure that the wire harnesses have not been altered or rerouted.
10. Verify that all wire ends of the harnesses supplied with the generator conversion kit have been terminated.
  - a. Verify that the three green grounding wires from the harnesses are connected to the grounding bar in the enclosure and that all wire strands are captured in the wire clamps.
  - b. Verify that the white neutral wire from the harness is connected to the neutral bar and that all wire strands are captured in the wire clamps.
  - c. Ensure that all spade terminals are properly oriented and captured under the pressure wire terminals of the fuse assemblies.
  - d. Verify that the tab terminals on the line side of the main circuit breaker are completely seated onto their mating stab.
  - e. Gently pull on each wire end to verify that it is securely anchored in the terminal.



**Figure 4-1** Inspecting Load Center Mounting Ears

11. Verify that the 6-pin connector joining the control harness and the MPAC 550 controller is engaged. See Section 2.17.3, Connecting Control Harness 6-Pin Plugs. Verify that the 9-pin connector joining the control harness and the automatic transfer mechanism is engaged. See Section 2.13, Connecting Control Harness 9-Pin Plugs.
12. Referring to table and drawings in Section 3, verify that all wiring is terminated on the correct component terminals.
13. Referring to Figure 2-11 and Figure 2-12, verify that the fuses installed in the fuse assemblies are of the manufacturer and type listed in Section 2.22, Installing Fuses.
14. Referring to Figure 4-2, verify that the transfer mechanism frame is properly seated on the front of the generator and main circuit breakers. Ensure that:
  - a. The front of both circuit breakers slightly protrudes past the front edge of the transfer mechanism metal frame.
  - b. Both circuit breaker handles are engaged under the actuation arms of the mechanism.
  - c. The actuator arm of the transfer mechanism is on the correct side of the generator circuit breaker handle. See Figure 4-2.
  - d. The transfer mechanism is parallel to the rear of the enclosure and sufficiently recessed from the front of the main and generator circuit breakers so that it does not prevent the front cover trim plate from seating properly.
15. Referring to Figure 2-17, inspect the position of the transfer mechanism location indicator to verify that it is in the Generator position.
  - a. When the location indicator is in the Generator position, the handle of the generator circuit breaker can be moved from the open to the closed position, and back to the open position. Verify that the generator set circuit breaker handle can be operated. Leave the generator set circuit breaker in the OFF position.
  - b. When in the Generator position, the transfer mechanism prevents the main circuit breaker handle from moving to the ON position. Verify that the main circuit breaker handle is blocked from moving to the ON position.



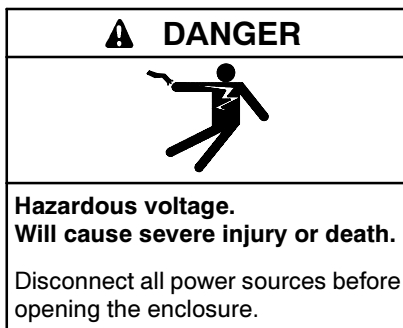
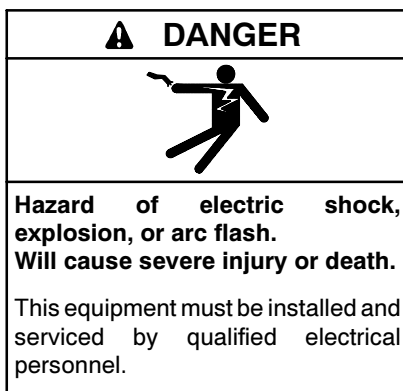
**Figure 4-2** Transfer Mechanism Seating

16. Referring to Figure 2-22, verify that the transfer mechanism mounting screw is installed and securely fastened to the torque value found in step 7 of Section 2.12, Installing Automatic Transfer Mechanism.
17. For Intelligent Load Centers equipped with a load shed module, verify that the communication cable and remote control circuit breaker connections are terminated.
  - a. Verify that the communication cables are properly terminated on the load shed modules. Refer to Figure 2-52 and Figure 2-53 for the location of these connections.
  - b. Verify that the remote control circuit breaker connectors are plugged into the load shed modules.
  - c. For Intelligent Load Centers with two load shed modules, verify that the selector switches are not both set to the same position. See the module selector switch location in Figure 2-52 and Figure 2-53.

18. Replace the load center front cover and secure the cover screws. Close the enclosure door of Type 3R enclosure load centers.
19. If the load center is already installed and wired, restore the generator disconnect and the generator to the state they were in before starting this procedure.

## 4.2 Testing MPAC 550 Controller and Initializing Automatic Transfer Mechanism

Once the mechanical integrity checks have been completed, check the operation of the automatic transfer mechanism. This requires application of power to the load center.



**Servicing the transfer switch. Hazardous voltage can cause severe injury or death.** Deenergize all power sources before servicing. Turn off the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (-) leads first. Reconnect negative (-) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

---

### **⚠ WARNING**



**Hazardous voltage.  
Can cause severe injury or death.**

Close and secure the enclosure door before energizing the transfer switch.

---

1. If you are testing the load center before installing and wiring it, provide a test power source. A 240 V, 3-wire, single-phase, 60 Hz power feed capable of supplying a continuous current of 5 A is sufficient. Connect the load center to the power source as follows:
  - a. Deenergize the test power source.
  - b. Remove the front cover:
 

Type 1 enclosures: Using a slotted or square driver, loosen the six screws and remove the front cover. See Figure 2-62 for screw location.

Type 3R enclosures: Open the front enclosure door, loosen the three screws and remove the front cover. See Figure 2-63 for screw location.
  - c. Connect the test power source to the L1, N, and L2 power terminals of the load center. The power terminals are located on the line side of the main circuit breaker. Refer to Figure 2-26 and Figure 2-27 for the terminal locations.
 

**Note:** The minimum wire size of the power terminals is #4 AWG. If smaller conductors are used to connect the test power source to the load center, provide a means of filling the power terminal to its minimum capacity to ensure that the electrical connection is made to the main circuit breaker. For example, add a short stub of #4 AWG or larger conductor into the terminal along with the power supply conductor.
  - d. Connect a grounding wire from the test power source to the grounding bar of the load center. Refer to Section 2.21, Installing Grounding Leads, for the location of the grounding bar.
  - e. Replace the load center front cover and secure the cover screws. Close the enclosure door of Type 3R enclosure load centers.
  - f. After the power source is connected, go to step 3.

2. If you are testing the load center after installing and wiring it, you may use the 240 V, 3-wire, single-phase utility feeder power to test the MPAC 550 controller, provided that the load center and its power wiring have already been inspected, approved, and subsequently powered up. Do not power up an installed load center that has not been inspected and approved.
3. If the load center is already installed and wired, open the generator disconnect at the generator and lock out the generator set from starting.
4. Referring to Figure 2-17, inspect the position of the transfer mechanism location indicator to verify that it is in the Generator position. If not, refer to Section 6, Manual Operation, and manually set the transfer mechanism to the Generator position.
5. Ensure that the generator circuit breaker is set to the ON position.
6. Open all the branch circuit breakers in the load center. If the load center is already installed and wired, provide an alternate light source before beginning the procedure.
7. For uninstalled load centers, energize the test power source. If the load center is already installed, wired, and being used as a subpanel, close the disconnect switch to energize the load center.
8. Check the MPAC 550 controller for response. The MPAC 550 controller should acknowledge the presence of mains power and the absence of generator power. Refer to TP-6487, Model RSB, ATSR Operation Manual, for operation of the MPAC 500 controller. The transfer mechanism will transfer to utility power (its location indicator will move from the Generator position to the Utility position; see Figure 2-17). During the transfer, the generator circuit breaker will open and the main circuit breaker will close.
9. If the mechanism does not move or does not complete the movement, refer to the troubleshooting section of the MPAC 550 controller manufacturer's documentation and Section 5, Diagnostics and Troubleshooting.
10. If you are testing the load center before installing and wiring it, this is a sufficient check of the transfer mechanism. Deenergize the test power source. Once test power is removed, disconnect the test power source and grounding conductor. Refer to Steps 1.b. and 1.e. of Section 4.2 for access and closure of the load center.

If you are testing the load center after installing and wiring it, close the generator disconnect at the generator and proceed to step 11.

**Note:** The remaining procedures require operation of the generator. Refer to the documentation provided by the generator manufacturer for starting and operating the generator.

11. From the MPAC 550 controller, issue a command to the automatic transfer mechanism to transfer to generator. Follow the instructions in TP-6487, Model RSB, ATSR Intelligent Transfer Switch Operation Manual, to start a loaded test.

When the command is received, the transfer mechanism will transfer to generator power (its location indicator will move from the Utility position to the Generator position. See Figure 2-17. During the transfer, the main circuit breaker will open and the generator circuit breaker will close.

If the mechanism does not move or does not complete the movement, refer to Section 5, Diagnostics and Troubleshooting, and to TP-6487, Operation Manual.

12. This step applies power to branch circuits. Confirm that the load center branch circuits have been inspected, approved, and subsequently powered-up. Do not power up any branch circuits that have not been inspected and approved. Verify that the application of power to any load connected to the branch circuits will not result in a hazard when the load is energized. Follow appropriate lockout/tagout procedures as described in NFPA 70E for all loads.
  - a. Place the QO-PLILC branch circuit breakers in the ON position.
  - b. Verify that no power is present at the loads controlled by the QO-PLILC circuit breakers. If power is present, refer to Section 5.4, Troubleshooting.
  - c. From the MPAC 550 controller, issue a command to the automatic transfer mechanism to transfer to the utility. Once the automatic transfer mechanism begins to move, you should hear a clicking sound from the QO-PLILC circuit breakers as the circuit breaker contacts close.
  - d. Verify that power is present at the loads controlled by the QO-PLILC circuit breakers. If no power is present, refer to Section 5.4, Troubleshooting.

- e. Check each branch circuit as follows:
  - (1) Move the handle of each QO-PLILC circuit breaker to the OFF position and verify that power is removed from the associated branch circuit.
  - (2) If power is still present, refer to Section 5.4, Troubleshooting.
  - (3) After checking each branch circuit, set the handle of each QO-PLILC circuit breaker to the ON position.
- f. From the MPAC 550 controller, issue a command to the automatic transfer mechanism to transfer to the generator set. Once the automatic transfer mechanism begins to move, you should hear a clicking sound from the QO-PLILC branch circuit breakers as the circuit breaker contacts open
- g. Verify that no power is present at the loads controlled by the QO-PLILC circuit breakers. If power is still present, refer to Section 5.4, Troubleshooting.

- 13. Shut down the generator set. Refer to the instructions provided by the generator set manufacturer for stopping the generator.
- 14. Close all branch circuit breakers opened in step 6 above. Restore the load center main circuit breaker to the state it was in before starting this procedure.
- 15. Restore the generator disconnect and the generator to the state they were in before starting this procedure.

Upon completion of this procedure, refer to the literature provided by the generator set manufacturer for additional commissioning requirements for the optional standby power system.

### 4.3 Operation

Refer to TP-6487, Model RSB, ATSR Intelligent Transfer Switch Operation Manual, for controller operation instructions.

# Section 5 Diagnostics and Troubleshooting

## 5.1 Terminology

Throughout this document, the term *source* indicates the power source selected by the position of the automatic transfer mechanism. The selected power source is identified by the position of the location indicator on the front of the transfer mechanism. See Figure 2-17.

## 5.2 Diagnostics

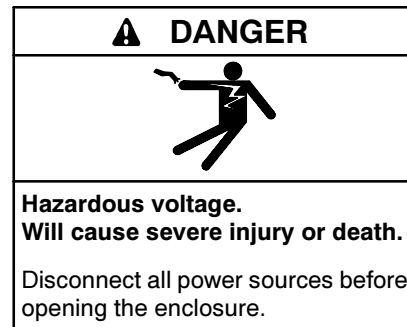
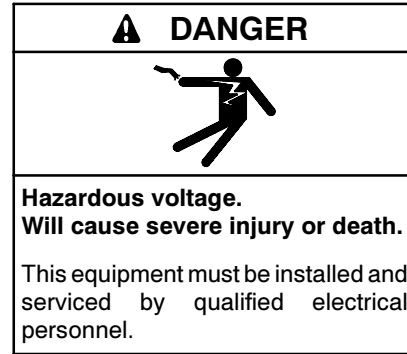
The diagnostic information in this section is intended to support the mechanical verification, installation, initialization, and operation of the conversion kit wiring, mechanisms, and mechanism control electronics used in the Intelligent Transfer Switch. This section is not intended for diagnostic support of the overall optional standby power system that uses the transfer switch. Refer to the literature supplied with the generator set for installation, test, and troubleshooting information for the standby generator set.

## 5.3 Checking Fuses

There are four removable fuses in the Intelligent Transfer Switch. The fuses are housed in two fuse holder assemblies that can function as the disconnecting means for the control circuits of the load center.

The fuses protect the control wiring, and prevent load center damage should a component breakdown occur in the control electronics. The fuses may also operate if the load center is subjected to severe, repeated overvoltage, such as occurs when lightning strikes in the vicinity of the utility or generator feeder to the residence.

**Note:** Fuse operation is usually the result of component breakdown in the load center. If one or more fuses have opened their circuits, replace the fuses only after the circuits have been examined and the damaged components have been replaced. Repeated replacement of a fuse on a damaged circuit may result in further damage to the load center.



**Servicing the transfer switch. Hazardous voltage can cause severe injury or death.** Deenergize all power sources before servicing. Turn off the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (-) leads first. Reconnect negative (-) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

Do not allow petroleum-based paints, solvents, or sprays to contact the nonmetallic parts of this product.

This equipment may not be suitable for use in corrosive environments present in agricultural buildings. See NEC 547 or CEC 2-400.

**Note:** Do not perform high-potential dielectric testing on the Intelligent Transfer Switch. Damage to the control electronics may result.

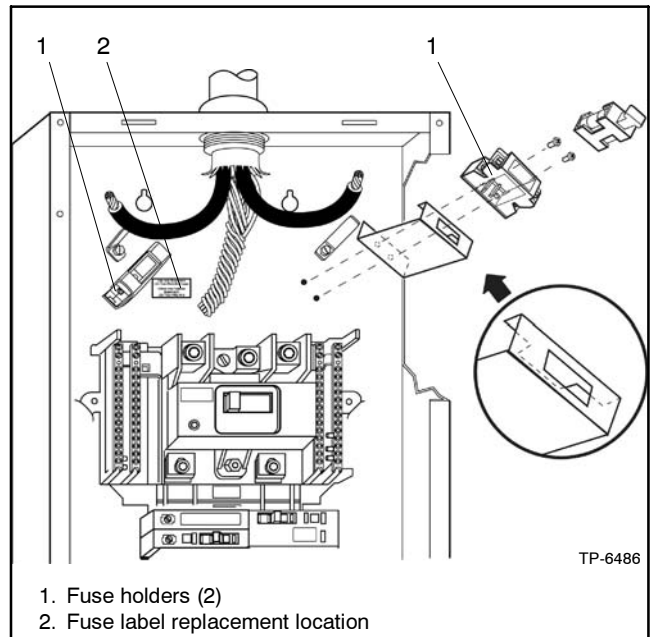
## Procedure to Check the Fuses

1. Checking the fuses requires the removal of all power from the load center. Be sure to provide an alternate light source before beginning the procedure.
2. Open the generator disconnect at the generator and lockout the generator from starting and running. Apply appropriate lockouts to the disconnecting means.
3. Open the main feeder disconnect supplying power to the load center. If the installation uses the revenue meter for isolation, arrange for the utility provider to remove the meter. Apply appropriate lockouts to the disconnecting means. If a main feeder disconnect is not present and the revenue meter cannot be used as an isolation device, the line side of the main circuit breaker and fuse holders will remain energized. Wear appropriate Personal Protective Equipment (PPE) and use isolation/access barriers when working on this equipment.
4. Generator circuit breaker should now be in the open position.
5. Remove the front cover:

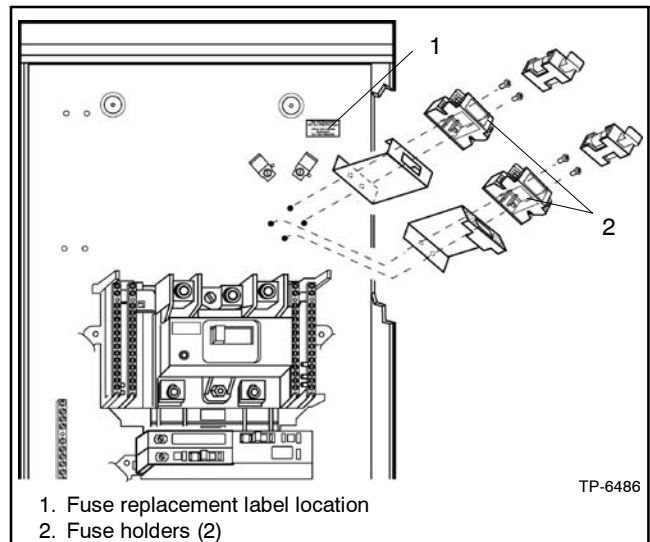
Type 1 enclosures: Using a slotted or square driver, loosen six screws and remove the front cover.

Type 3R enclosures: Open the front enclosure door, loosen three screws, and remove the front cover. Refer to Figure 2-62 and Figure 2-63 for cover screw locations.

6. Referring to Figure 5-1 and Figure 5-2, locate the fuse holders in the load center. Pull the fuse clips from both fuse holders.
7. There are two fuses in each fuse clip. Check condition of each fuse using an ohmmeter. If the fuse has operated, this indicates that other components may be damaged. Only repair personnel authorized by the manufacturer of the standby power system should check and repair the load center components.
8. If the fuses have opened or the transfer mechanism is to be operated manually, remove all fuses from each fuse clip. Reinstall all fuse clips into their respective fuse holders.



**Figure 5-1** Mounting Fuse Holders, Type 1 Enclosures



**Figure 5-2** Mounting Fuse Holders, Type 3R Enclosures

9. Replace the load center front cover and replace the attachment screws. Close the enclosure door of Type 3R enclosure load centers.
10. Close the source circuit breaker.
11. Once all lockouts are cleared, close the generator disconnect.
12. Once all lockouts are cleared, close the main feeder disconnect.



## 5.4 Troubleshooting

If expected operation is not achieved during mechanical validation, commissioning, or operation, refer to Figure 5-3 through Figure 5-5 for troubleshooting information.

Always check for blown fuses and loose connections before replacing parts.

| Symptom  | Probable Cause  | Troubleshooting Procedure  |
|--|---|--|
| The load center trim plate will not fit on the front of the load center.                     | An incorrect front trim plate is being installed.   | Ensure that the trim plate is seated around transfer mechanism and that blank circuit breaker covers (twistouts) are removed for the installed circuit breakers. |
|  | The load center interior assembly mounting ears are not engaged with the enclosure slots.   | Ensure that the load center ears are engaged on rear wall of panel. Refer to Figure 2-4.   |
| The automatic transfer mechanism will not seat onto the main and generator circuit breakers. | The automatic transfer mechanism was not set to the Generator position before assembly.   | Refer to Section 6, Manual Operation, and manually set the transfer mechanism to the Generator position.   |
|  | The automatic transfer mechanism circuit breaker handle actuators are not engaged with the main or generator circuit breaker handles. | The main circuit breaker handle may need to be pushed slightly to the left to ensure proper seating of the actuators.  |
|  | The hardware stackup on the bus stud connections behind the automatic transfer mechanism is incorrect.                                | Ensure that the hardware on terminals LC1 and LC2 is correctly stacked and installed. Refer to Figure 2-20 and Figure 2-21.                                      |
|  | The bus voltage tap wiring is not seated between the load center interior assembly ribs.  | Ensure that the wires are routed as shown in Figure 2-20 and Figure 2-21.  |
|  | The automatic transfer mechanism frame is bent.   | Replace the transfer mechanism. An authorized service representative must perform replacement.   |

**Figure 5-3** Mechanical Validation

| Symptom  | Probable Cause   | Troubleshooting Procedure   |
|--|--|---|
| The automatic transfer mechanism will not move when initially commanded to move from generator source to utility source.   | The automatic transfer mechanism was not initially set to the Generator position.  | Refer to Section 6, Manual Operation, and manually set the transfer mechanism to the Generator position.  |
|  | The generator circuit breaker is OFF or Tripped.   | Reset the generator circuit breaker to the ON position.   |
|  | Test or utility power is not present.  | Provide the correct power to the circuit. The MPAC 550 controller should indicate the presence of at least one source.  |
|  | The generator control circuit fuses (F3/F4) are not installed or are open.   | If the fuses are not installed, install the correct type of fuses. If the fuses are open, determine and correct the cause, then replace the fuses with correct type. Refer to Section 5.3NO TAG,, Checking Fuses. |
|  | The control wiring is not correct.   | Review the Installation Procedures in Section 2.  |
|  | No transfer command has been issued by the MPAC 550 controller.  | Reissue the transfer command. Refer to MPAC 550 controller Operation Manual TP-6486 for instructions to test controller operation.  |
| The automatic transfer mechanism starts to move, but does not complete movement, when it is initialized.   | The mechanism circuit breaker handle actuators are not engaged with the main or generator circuit breaker handles.   | Ensure that the circuit breaker handles are properly engaged. Refer to Figure 2-22.   |
|  | The mechanism is mechanically obstructed or loose on its mounting.   | Check the mechanism for loose hardware or obstructions in the gearing.  |
|  | The control wiring is not correct.   | Review Figure 3-1 and the wiring diagrams. Review the installation procedures in Section 2. Check for reversed connections.   |
| The MPAC 550 controller does not acknowledge the presence of test or utility power, but power is present.  | For installed and wired load centers, the Utility feeder disconnect is open.   | Check for the presence of source power and ensure that the circuit breakers are on. Ensure that the Modbus cable is properly installed. Refer to Section 2.18, Installing Communication Wire Harness.             |
|  | The utility control circuit fuses (F1/F2) are not installed or are open.   | If the fuses are not installed, install the correct type of fuses. If the fuses are open, determine and correct the cause, then replace the fuses with correct type. Refer to Section 5.3NO TAG, Checking Fuses.  |
|  | The control wiring is not correct.   | Review Figure 3-1 and the wiring diagrams. Review the installation procedures in Section 2.   |
|  | The MPAC 550 controller is inoperative.  | Replace the MPAC 550 controller. An authorized service representative must perform replacement.   |
| The remote control circuit breaker(s) installed in the Intelligent Load Center cannot be switched to the ON state when the automatic transfer mechanism is set to utility source.  | Control wiring is not correct.   | Review the installation procedures in Section 2.  |
|  | The module selector switches are incorrectly set on load shed module.  | Set the module selector switches. Refer to Section 2.19, Installing Load Shed Module.   |
|  | The remote control circuit breakers are shipped with the internal control mechanism set to the open position. The internal control mechanism must be in the closed position for the handle to close the circuit. | Cycle the automatic transfer mechanism from utility to generator set, and back to generator set.  |
|  | The remote control circuit breaker is inoperative.   | Replace the remote control circuit breaker.*  |
|  | The load shed module is inoperative.   | Replace the load shed module.*  |
| The remote control circuit breaker(s) installed in the Intelligent Load Center do not switch to the OFF state when the automatic transfer mechanism moves to the generator source. | The control wiring is not correct.   | Review the Installation Procedures in Section 2.  |
|  | The module selector switches are incorrectly set on the load shed module.  | Set the module selector switches. Refer to Section 2.19, Installing Load Shed Module.   |
|  | The remote control circuit breaker is inoperative.   | Replace the remote control circuit breaker.*  |
|  | The load shed module is inoperative.   | Replace the load shed module.*  |
| Branch circuits controlled by the remote control circuit breakers do not switch ON or OFF properly when the automatic transfer mechanism changes state.                            | The branch circuit is not connected to remote control circuit breaker.   | Verify that the branch circuit is connected to the correct remote control circuit breaker.  |
|  | The branch circuit is incorrectly wired.   | Have an authorized service representative correct the wiring.   |
|  | The remote control circuit breaker is inoperative.   | Replace the remote control circuit breaker.*  |
|  | The load shed module is inoperative.   | Replace the load shed module.*  |

\* An authorized service representative must replace the circuit breaker or load shed module.

**Figure 5-4** Commissioning

| Symptom  | Probable Cause   | Troubleshooting Procedure   |
|--|--|---|
| The MPAC 550 controller does not acknowledge the presence of power, yet utility or generator power is present.   | Either or both the Utility feeder disconnect or the Generator are open.                            | Check for the presence of source power and ensure that the circuit breakers are on. Ensure that the Modbus cable is properly installed. Refer to Section 2.18, Installing Communication Wire Harness.   |
|  | The utility control circuit fuses (F1/F2) or the generator control circuit fuses (F3/F4) are open. | If the fuses are not installed, install the correct type of fuses. If the fuses are open, determine and correct the cause, then replace the fuses with correct type. Refer to Section 5.3NO TAG, Checking Fuses.  |
|  | The control wiring is not correct.   | Review Figure 3-1 and the wiring diagrams. Review the installation procedures in Section 2.   |
|  | The source voltage and/or frequency are not within the acceptable range.                           | Contact an authorized service representative to check the source voltage and frequency and to service the generator set, if necessary.  |
|  | The MPAC 550 controller is inoperative.  | The MPAC 550 controller must be replaced. An authorized service representative must perform replacement.  |
| The automatic transfer mechanism will not move when commanded by the MPAC 550 controller.  | The source circuit breaker is not in the ON position.  | Set proper breaker to the ON position.  |
|  | No command has been issued by MPAC 550 controller.   | Reissue the command. Refer to TP-6487.  |
|  | A utility to generator source transfer was commanded, but the generator set did not start.         | Ensure that the generator is running and that the generator disconnects are in the ON position.   |
| The automatic transfer mechanism does not transfer to utility when the presence of utility source is indicated by the MPAC 550 controller.   | The retransfer time delay is running.  | Allow sufficient time after the utility source has been restored before a transfer.<br><br>Refer to TP-6487, Operation Manual, for minimum transfer times.<br><br><b>Note:</b> The optional accessory board allows time delay adjustments.  |
|  | A test or exercise sequence is running.  | Check the MPAC 550 controller LEDs for indication that a test or exercise sequence is running.<br><br>Refer to TP-6487, Operation Manual, for LED indication and instructions.  |
| The MPAC 550 controller continues to indicate the presence of generator source after transferring to utility.  | The engine cooldown time delay is running.   | Allow sufficient time for the generator to cool down.<br><br>Refer to TP-6487, Operation Manual, for cooldown time. The optional accessory board allows adjustment of the cooldown time.<br><br>Some generator set controllers may also execute an engine cooldown time delay before shutting down. |
| The remote control circuit breaker(s) installed in the Intelligent Load Center cannot be switched to the ON state when the automatic transfer mechanism is set to utility source.  | The remote control circuit breaker is inoperative.   | Replace the remote control circuit breaker.   |
|  | The load shed module is inoperative.   | Replace the load shed module.*  |
| The remote control circuit breaker(s) installed in the Intelligent Load Center do not switch to the OFF state when the automatic transfer mechanism moves to the generator source. | The remote control circuit breaker is inoperative.   | Replace the remote control circuit breaker.   |
|  | The load shed module is inoperative.   | Replace the load shed module.*  |

\* An authorized service representative must replace the circuit breaker or load shed module.

**Figure 5-5** Operation

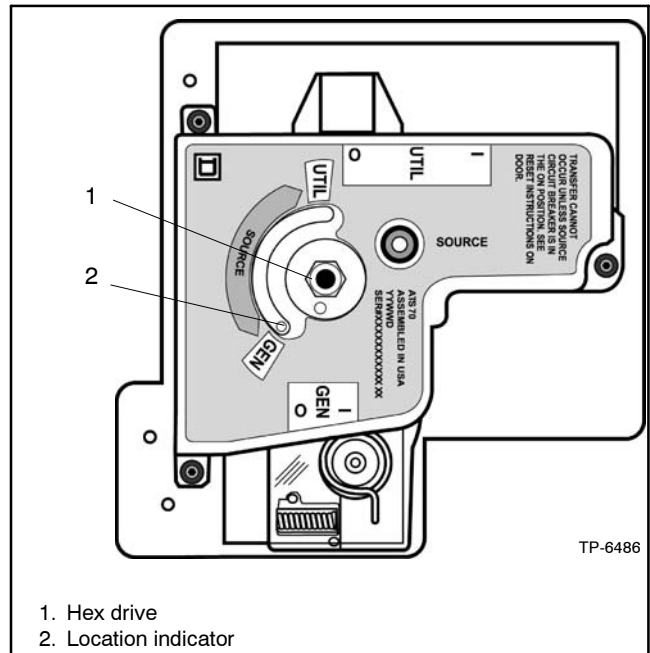
# Notes

## Section 6 Manual Operation

To manually move the transfer mechanism from one power source to another, follow this procedure.

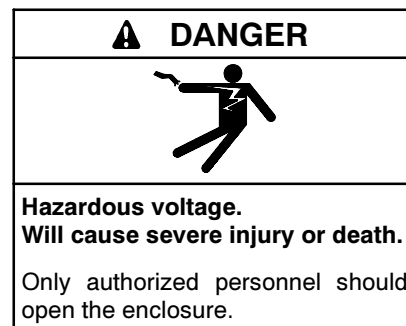
1. Before attempting to manually move the transfer mechanism, use the controller's Test button to try to initiate transfer. Refer to TP-6487, Model RSB, ATSR Operation Manual, for instructions to initiate a loaded or an unloaded test.
2. Before moving the mechanism, verify that the generator power source, utility power source, and the positions of the branch load circuit breakers in the load center are in a state that supports the desired transfer.
  - a. Verify that neither of the sources breakers is tripped. A tripped breaker locks the mechanism, preventing transfer.
  - b. Verify that the selected source breaker is in the ON position. If the source circuit breaker is OFF, the mechanism locks, preventing transfer.
  - c. Verify that the generator set is running before transferring the load to the Emergency source.
3. To manually transfer between power sources, use a 7/16 in. socket and driver to move the hex drive so that the location indicator is set to the desired power source. See Figure 6-1. Rotate the hex drive fully counterclockwise to transfer from Utility to Generator power source. Rotate the hex drive fully clockwise to transfer from Generator to Utility power source. Upon completion of transfer, the desired source circuit breaker should close.

**Note:** Transfer cannot occur unless the source circuit breaker is in the ON position. Do not exceed 1.3 Nm (100 in. lb.) when manually operating the transfer mechanism.



**Figure 6-1** Main Circuit Breaker Actuator Arm Location

If the transfer mechanism automatically moves while a manual transfer is being performed, or if the mechanism will not stay in the desired position once a manual transfer has been completed, disable the transfer mechanism.



To disable the transfer mechanism and prevent unintended operation, remove the control power fuses from their holders using the procedure in Section 5.3, Checking Fuses. After removing the fuses, follow steps 2 and 3 to manually move the automatic transfer mechanism to the desired source.

# Notes

# Section 7 Parts

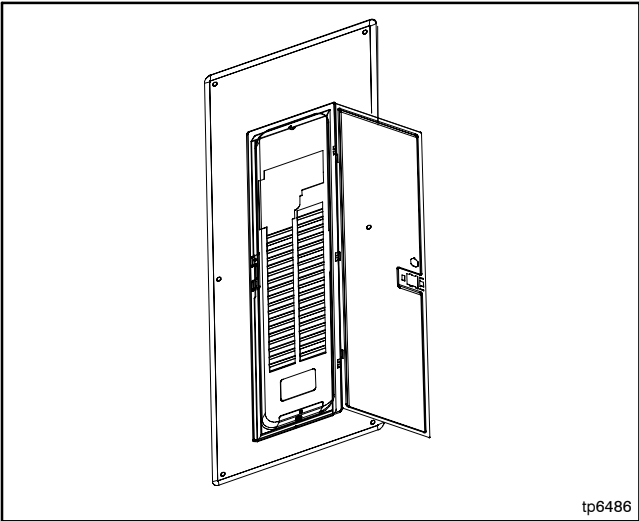
Verify that all parts for your kit are included before proceeding. Refer to Figure 7-1 and then compare the kit parts to the illustrations indicated for your unit.

Conversion kit parts are shipped in a multi-purpose package. Some spaces in the package may be empty, as shown in Figure 7-6 and Figure 7-7.

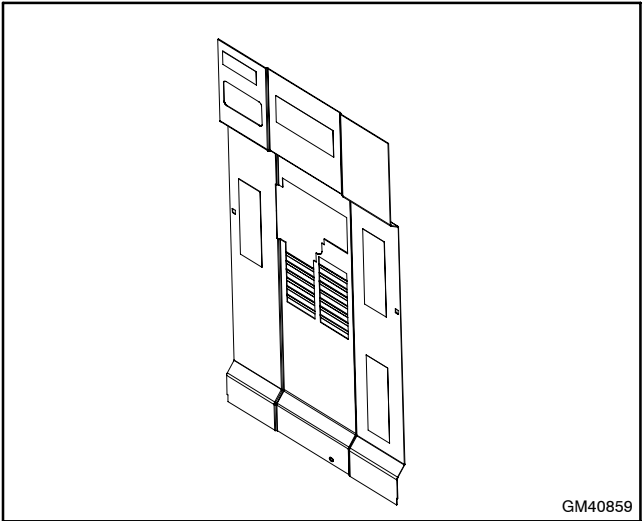
See Figure 7-10 for the optional accessory board, kit GM49179-KA1.

| Description                    | Cover      | Load Center | Conversion Kit | Conversion Kit with Load Shed Kit |
|--------------------------------|------------|-------------|----------------|-----------------------------------|
| Type 1 Indoor Conversion Kit   | Figure 7-2 | None        | Figure 7-6     | Figure 7-8 or Figure 7-9          |
| Type 1 Indoor Complete Unit    | Figure 7-2 | Figure 7-3  | Figure 7-6     | Figure 7-8 or Figure 7-9          |
| Type 3R Outdoor Conversion Kit | Figure 7-4 | None        | Figure 7-7     | Figure 7-8                        |
| Type 3R Outdoor Complete Unit  | Figure 7-4 | Figure 7-5  | Figure 7-7     | Figure 7-8                        |

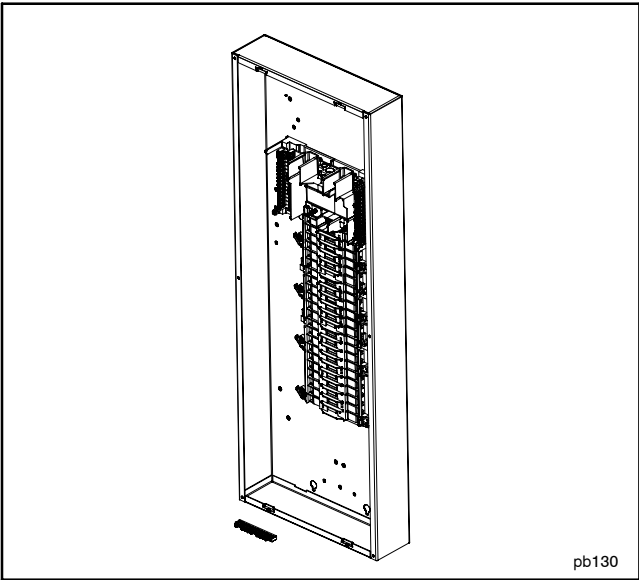
**Figure 7-1** Kit Reference



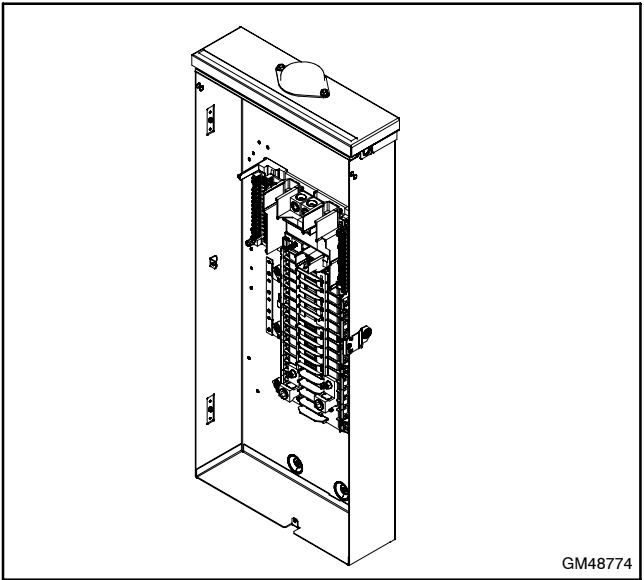
**Figure 7-2** Type 1 (Indoor) Cover



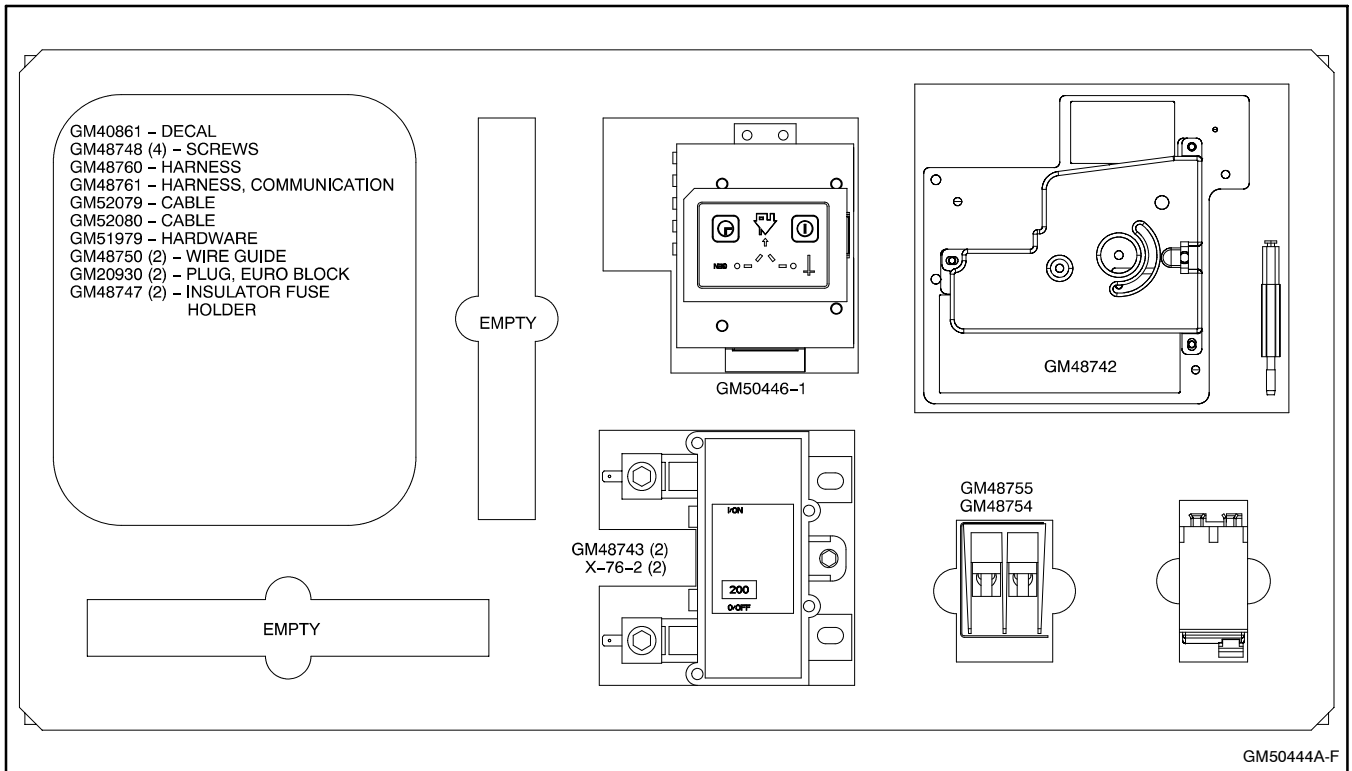
**Figure 7-4** Type 3R (Outdoor) Cover



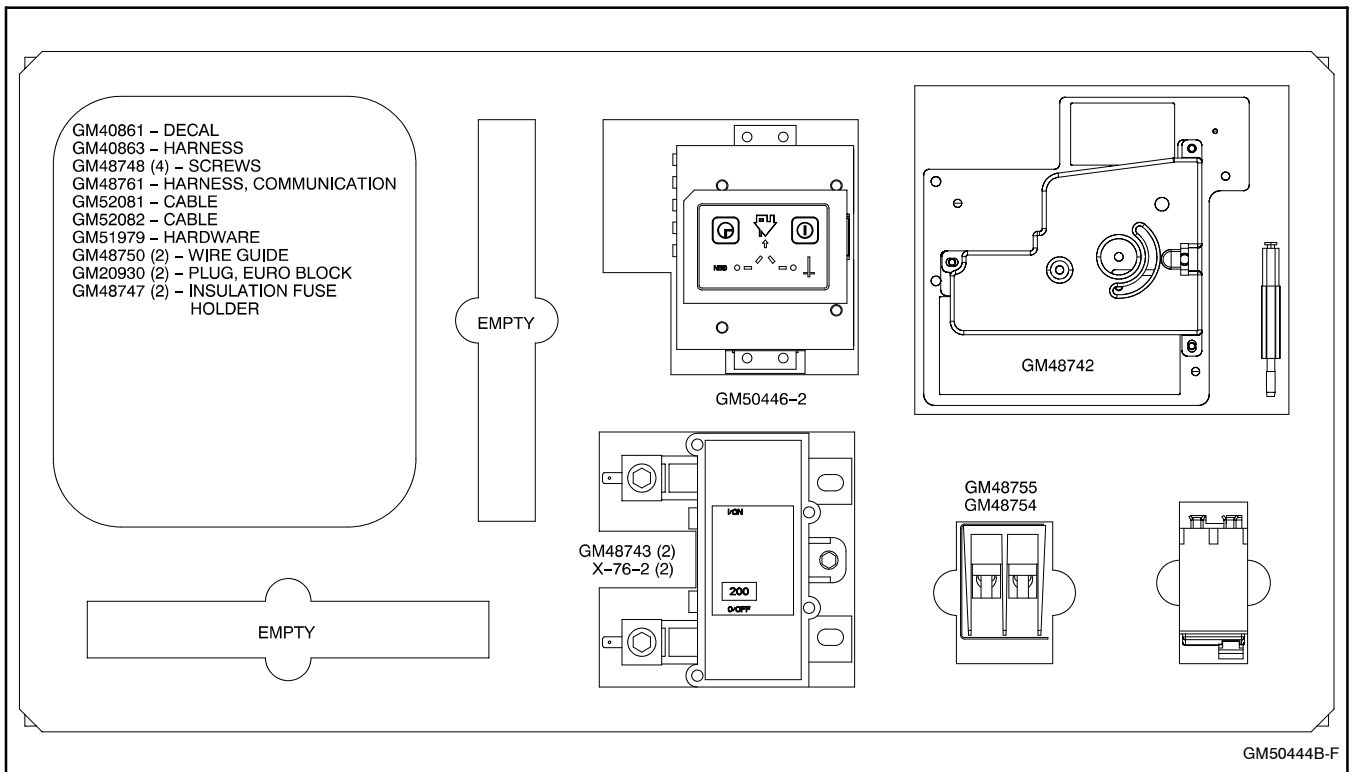
**Figure 7-3** Type 1 (Indoor) Load Center



**Figure 7-5** Type 3R (Outdoor) Load Center

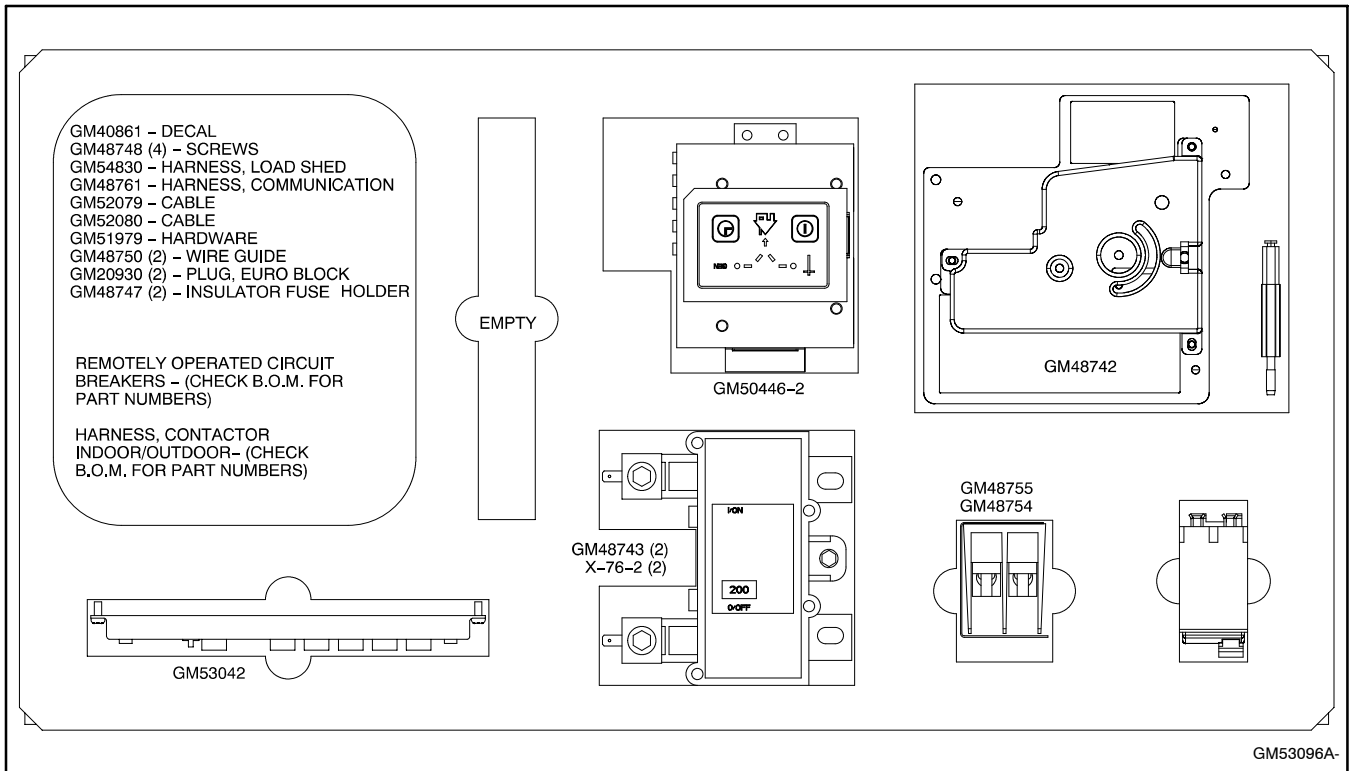


**Figure 7-6** Type 1 (indoor) Conversion Kit Parts

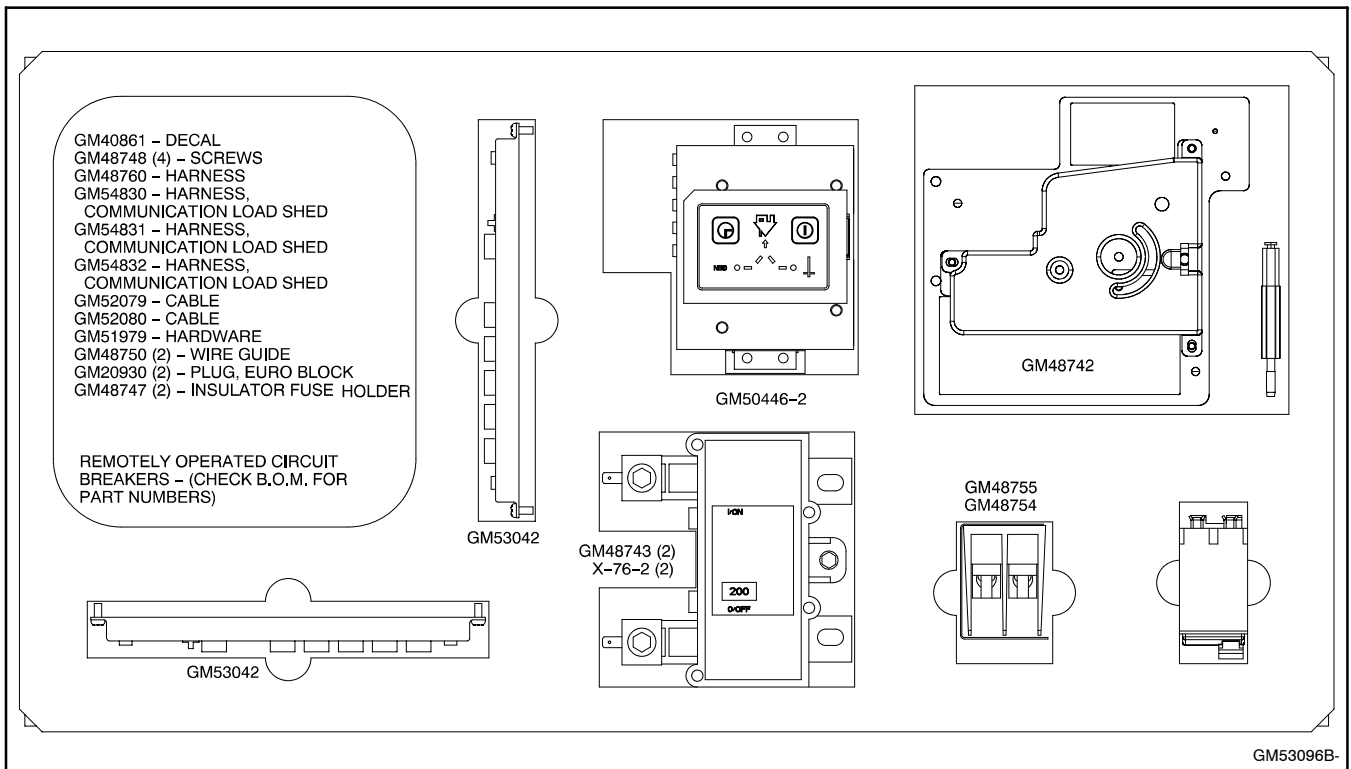


**Figure 7-7** Type 3R (Outdoor) Conversion Kit Parts

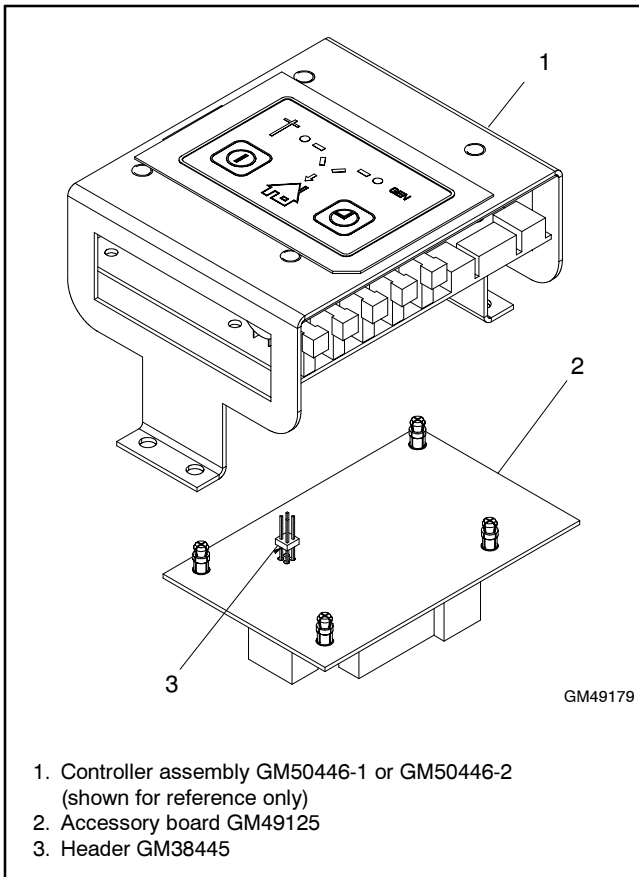




**Figure 7-8** NEMA 1 and NEMA 3R Enclosure with One Load Shed Module



**Figure 7-9** NEMA 1 Enclosure with Two Load Shed Modules



**Figure 7-10** Accessory Board Kit GM49179-KA1

# Appendix A Abbreviations

The following list contains abbreviations that may appear in this publication.

|           |  |          |  |                      |  |
|-----------|--|----------|--|----------------------|--|
| A, amp    | ampere   | cfm      | cubic feet per minute  | est.                 | estimated  |
| ABDC      | after bottom dead center   | CG       | center of gravity  | E-Stop               | emergency stop                                       |
| AC        | alternating current  | CID      | cubic inch displacement  | etc.                 | et cetera (and so forth)                             |
| A/D       | analog to digital  | CL       | centerline   | exh.                 | exhaust  |
| ADC       | advanced digital control;<br>analog to digital converter                                   | cm       | centimeter   | ext.                 | external   |
| adj.      | adjust, adjustment   | CMOS     | complementary metal oxide<br>substrate (semiconductor)                               | F                    | Fahrenheit, female                                   |
| ADV       | advertising dimensional<br>drawing   | cogen.   | cogeneration   | fglass               | fiberglass   |
| Ah        | amp-hour   | com      | communications (port)  | FHM                  | flat head machine (screw)                            |
| AHWT      | anticipatory high water<br>temperature   | coml     | commercial   | fl. oz.              | fluid ounce  |
| AISI      | American Iron and Steel<br>Institute   | Coml/Rec | Commercial/Recreational  | flex.                | flexible   |
| ALOP      | anticipatory low oil pressure  | conn.    | connection   | freq.                | frequency  |
| alt.      | alternator   | cont.    | continued  | FS                   | full scale   |
| Al        | aluminum   | CPVC     | chlorinated polyvinyl chloride   | ft.                  | foot, feet   |
| ANSI      | American National Standards<br>Institute (formerly American<br>Standards Association, ASA) | crit.    | critical   | ft. lb.              | foot pounds (torque)                                 |
| AO        | anticipatory only  | CRT      | cathode ray tube   | ft./min.             | feet per minute                                      |
| APDC      | Air Pollution Control District   | CSA      | Canadian Standards<br>Association  | ftp                  | file transfer protocol                               |
| API       | American Petroleum Institute   | CT       | current transformer  | g                    | gram   |
| approx.   | approximate, approximately   | Cu       | copper   | ga.                  | gauge (meters, wire size)                            |
| AQMD      | Air Quality Management District  | cUL      | Canadian Underwriter's<br>Laboratories   | gal.                 | gallon   |
| AR        | as required, as requested  | CUL      | Canadian Underwriter's<br>Laboratories   | gen.                 | generator  |
| AS        | as supplied, as stated, as<br>suggested  | cu. in.  | cubic inch   | genset               | generator set  |
| ASE       | American Society of Engineers  | cw.      | clockwise  | GFI                  | ground fault interrupter                             |
| ASME      | American Society of<br>Mechanical Engineers  | CWC      | city water-cooled  | GND, ⊕               | ground   |
| assy.     | assembly   | cyl.     | cylinder   | gov.                 | governor   |
| ASTM      | American Society for Testing<br>Materials  | D/A      | digital to analog  | gph                  | gallons per hour                                     |
| ATDC      | after top dead center  | DAC      | digital to analog converter  | gpm                  | gallons per minute                                   |
| ATS       | automatic transfer switch  | dB       | decibel  | gr.                  | grade, gross   |
| auto.     | automatic  | dB(A)    | decibel (A weighted)   | GRD                  | equipment ground                                     |
| aux.      | auxiliary  | DC       | direct current   | gr. wt.              | gross weight   |
| avg.      | average  | DCR      | direct current resistance  | H x W x D            | height by width by depth                             |
| AVR       | automatic voltage regulator  | deg., °  | degree   | HC                   | hex cap  |
| AWG       | American Wire Gauge  | dept.    | department   | HCHT                 | high cylinder head temperature                       |
| AWM       | appliance wiring material  | DFMEA    | Design Failure Mode and<br>Effects Analysis  | HD                   | heavy duty   |
| bat.      | battery  | dia.     | diameter   | HET                  | high exhaust temp., high<br>engine temp.             |
| BBDC      | before bottom dead center  | DI/EO    | dual inlet/end outlet  | hex                  | hexagon  |
| BC        | battery charger, battery<br>charging   | DIN      | Deutsches Institut fur Normung<br>e. V. (also Deutsche Industrie<br>Normenausschuss) | Hg                   | mercury (element)                                    |
| BCA       | battery charging alternator  | DIP      | dual inline package  | HH                   | hex head   |
| BCI       | Battery Council International  | DPDT     | double-pole, double-throw  | HHC                  | hex head cap   |
| BDC       | before dead center   | DS       | disconnect switch  | HP                   | horsepower   |
| BHP       | brake horsepower   | DVR      | digital voltage regulator  | hr.                  | hour   |
| blk.      | black (paint color), block<br>(engine)   | E, emer. | emergency (power source)   | HS                   | heat shrink  |
| blk. htr. | block heater   | ECM      | electronic control module,<br>engine control module                                  | hsg.                 | housing  |
| BMEP      | brake mean effective pressure  | EDI      | electronic data interchange  | HVAC                 | heating, ventilation, and air<br>conditioning        |
| bps       | bits per second  | EFR      | emergency frequency relay  | HWT                  | high water temperature                               |
| br.       | brass  | e.g.     | for example ( <i>exempli gratia</i> )  | Hz                   | hertz (cycles per second)                            |
| BTDC      | before top dead center   | EG       | electronic governor  | IC                   | integrated circuit                                   |
| Btu       | British thermal unit   | EGSA     | Electrical Generating Systems<br>Association   | ID                   | inside diameter, identification                      |
| Btu/min.  | British thermal units per minute   | EIA      | Electronic Industries<br>Association   | IEC                  | International Electrotechnical<br>Commission         |
| C         | Celsius, centigrade  | EI/EO    | end inlet/end outlet   | IEEE                 | Institute of Electrical and<br>Electronics Engineers |
| cal.      | calorie  | EMI      | electromagnetic interference   | IMS                  | improved motor starting                              |
| CAN       | controller area network  | emiss.   | emission   | in.                  | inch   |
| CARB      | California Air Resources Board   | eng.     | engine   | in. H <sub>2</sub> O | inches of water                                      |
| CB        | circuit breaker  | EPA      | Environmental Protection<br>Agency   | in. Hg               | inches of mercury                                    |
| cc        | cubic centimeter   | ES       | engineering special,<br>engineered special   | in. lb.              | inch pounds  |
| CCA       | cold cranking amps   | ESD      | electrostatic discharge  | Inc.                 | incorporated   |
| ccw.      | counterclockwise   |          |  | ind.                 | industrial   |
| CEC       | Canadian Electrical Code   |          |  | int.                 | internal   |
| cert.     | certificate, certification, certified  |          |  | int./ext.            | internal/external                                    |
| cfh       | cubic feet per hour  |          |  | I/O                  | input/output   |
|           |  |          |  | IP                   | iron pipe  |
|           |  |          |  | ISO                  | International Organization for<br>Standardization    |
|           |  |          |  | J                    | joule  |
|           |  |          |  | JIS                  | Japanese Industry Standard                           |

|                      |  |           |   |         |  |
|----------------------|--|-----------|---|---------|--|
| k                    | kilo (1000)  | MTBO      | mean time between overhauls                         | rms     | root mean square   |
| K                    | kelvin   | mtg.      | mounting  | rnd.    | round  |
| kA                   | kiloampere   | MTU       | Motoren-und Turbinen-Union                          | ROM     | read only memory   |
| KB                   | kilobyte (2 <sup>10</sup> bytes)                     | MW        | megawatt  | rot.    | rotate, rotating   |
| KBus                 | Kohler communication protocol                        | mW        | milliwatt   | rpm     | revolutions per minute   |
| kg                   | kilogram   | μF        | microfarad  | RS      | right side   |
| kg/cm <sup>2</sup>   | kilograms per square centimeter                      | N, norm.  | normal (power source)                               | RTU     | remote terminal unit   |
| kgm                  | kilogram-meter                                       | NA        | not available, not applicable                       | RTV     | room temperature vulcanization   |
| kg/m <sup>3</sup>    | kilograms per cubic meter                            | nat. gas  | natural gas   | RW      | read/write   |
| kHz                  | kilohertz  | NBS       | National Bureau of Standards                        | SAE     | Society of Automotive Engineers  |
| kJ                   | kilojoule  | NC        | normally closed                                     | scfm    | standard cubic feet per minute   |
| km                   | kilometer  | NEC       | National Electrical Code                            | SCR     | silicon controlled rectifier   |
| kOhm, kΩ             | kilo-ohm   | NEMA      | National Electrical Manufacturers Association       | s, sec. | second   |
| kPa                  | kilopascal   | NFPA      | National Fire Protection Association                | SI      | <i>Systeme internationale d'unites</i> , International System of Units |
| kph                  | kilometers per hour                                  | Nm        | newton meter  | SI/EO   | side in/end out  |
| kV                   | kilovolt   | NO        | normally open                                       | sil.    | silencer   |
| kVA                  | kilovolt ampere                                      | no., nos. | number, numbers                                     | SN      | serial number  |
| kVAR                 | kilovolt ampere reactive                             | NPS       | National Pipe, Straight                             | SNMP    | simple network management protocol                                     |
| kW                   | kilowatt   | NPSC      | National Pipe, Straight-coupling                    | SPDT    | single-pole, double-throw  |
| kWh                  | kilowatt-hour  | NPT       | National Standard taper pipe thread per general use | SPST    | single-pole, single-throw  |
| kWm                  | kilowatt mechanical                                  | NPTF      | National Pipe, Taper-Fine                           | spec    | specification  |
| kWth                 | kilowatt-thermal                                     | NR        | not required, normal relay                          | specs   | specification(s)   |
| L                    | liter  | ns        | nanosecond  | sq.     | square   |
| LAN                  | local area network                                   | OC        | overcrank   | sq. cm  | square centimeter  |
| L x W x H            | length by width by height                            | OD        | outside diameter                                    | sq. in. | square inch  |
| lb.                  | pound, pounds  | OEM       | original equipment manufacturer                     | SS      | stainless steel  |
| lbm/ft <sup>3</sup>  | pounds mass per cubic feet                           | OF        | overfrequency                                       | std.    | standard   |
| LCB                  | line circuit breaker                                 | opt.      | option, optional                                    | stl.    | steel  |
| LCD                  | liquid crystal display                               | OS        | oversize, overspeed                                 | tach.   | tachometer   |
| ld. shd.             | load shed  | OSHA      | Occupational Safety and Health Administration       | TD      | time delay   |
| LED                  | light emitting diode                                 | OV        | overvoltage   | TDC     | top dead center  |
| Lph                  | liters per hour                                      | oz.       | ounce   | TDEC    | time delay engine cooldown   |
| Lpm                  | liters per minute                                    | p., pp.   | page, pages   | TDEN    | time delay emergency to normal   |
| LOP                  | low oil pressure                                     | PC        | personal computer                                   | TDES    | time delay engine start  |
| LP                   | liquefied petroleum                                  | PCB       | printed circuit board                               | TDNE    | time delay normal to emergency   |
| LPG                  | liquefied petroleum gas                              | pF        | picofarad   | TDOE    | time delay off to emergency  |
| LS                   | left side  | PF        | power factor  | TDON    | time delay off to normal   |
| L <sub>wa</sub>      | sound power level, A weighted                        | ph., ∅    | phase   | temp.   | temperature  |
| LWL                  | low water level                                      | PHC       | Phillips® head Crimptite® (screw)                   | term.   | terminal   |
| LWT                  | low water temperature                                | PHH       | Phillips® hex head (screw)                          | THD     | total harmonic distortion  |
| m                    | meter, milli (1/1000)                                | PHM       | pan head machine (screw)                            | TIF     | telephone influence factor   |
| M                    | mega (10 <sup>6</sup> when used with SI units), male | PLC       | programmable logic control                          | TIR     | total indicator reading  |
| m <sup>3</sup>       | cubic meter  | PMG       | permanent magnet generator                          | tol.    | tolerance  |
| m <sup>3</sup> /hr.  | cubic meters per hour                                | pot       | potentiometer, potential                            | turbo.  | turbocharger   |
| m <sup>3</sup> /min. | cubic meters per minute                              | ppm       | parts per million                                   | typ.    | typical (same in multiple locations)                                   |
| mA                   | milliampere  | PROM      | programmable read-only memory                       | UF      | underfrequency   |
| man.                 | manual   | psi       | pounds per square inch                              | UHF     | ultrahigh frequency  |
| max.                 | maximum  | psig      | pounds per square inch gauge                        | UL      | Underwriter's Laboratories, Inc.                                       |
| MB                   | megabyte (2 <sup>20</sup> bytes)                     | pt.       | pint  | UNC     | unified coarse thread (was NC)   |
| MCCB                 | molded-case circuit breaker                          | PTC       | positive temperature coefficient                    | UNF     | unified fine thread (was NF)   |
| MCM                  | one thousand circular mils                           | PTO       | power takeoff                                       | univ.   | universal  |
| meggar               | megohmmeter  | PVC       | polyvinyl chloride                                  | US      | undersize, underspeed  |
| MHz                  | megahertz  | qt.       | quart, quarts                                       | UV      | ultraviolet, undervoltage  |
| mi.                  | mile   | qty.      | quantity  | V       | volt   |
| mil                  | one one-thousandth of an inch                        | R         | replacement (emergency) power source                | VAC     | volts alternating current  |
| min.                 | minimum, minute                                      | rad.      | radiator, radius                                    | VAR     | voltampere reactive  |
| misc.                | miscellaneous  | RAM       | random access memory                                | VDC     | volts direct current   |
| MJ                   | megajoule  | RDO       | relay driver output                                 | VFD     | vacuum fluorescent display   |
| mJ                   | millijoule   | ref.      | reference   | VGA     | video graphics adapter   |
| mm                   | millimeter   | rem.      | remote  | VHF     | very high frequency  |
| mOhm, mΩ             | milliohm   | Res/Coml  | Residential/Commercial                              | W       | watt   |
| MOhm, MΩ             | megohm   | RFI       | radio frequency interference                        | WCR     | withstand and closing rating   |
| MOV                  | metal oxide varistor                                 | RH        | round head  | w/      | with   |
| MPa                  | megapascal   | RHM       | round head machine (screw)                          | w/o     | without  |
| mpg                  | miles per gallon                                     | rly.      | relay   | wt.     | weight   |
| mph                  | miles per hour                                       |           |   | xfrm    | transformer  |
| MS                   | military standard                                    |           |   |         |  |
| ms                   | millisecond  |           |   |         |  |
| m/sec.               | meters per second                                    |           |   |         |  |
| MTBF                 | mean time between failure                            |           |   |         |  |

# Notes

# Notes



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