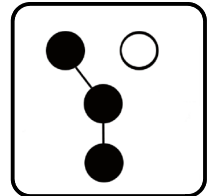


Operation and Installation

Automatic Transfer Switches



Models:

KSS/KSP

40 to 1000 Amperes

KOHLER[®]
Power Systems

ISO 9001
KOHLER
POWER SYSTEMS
NATIONALLY REGISTERED

TP-6834 4/14

Product Identification Information

Product identification numbers determine service parts. Record the product identification numbers in the spaces below immediately after unpacking the products so that the numbers are readily available for future reference. Record field-installed kit numbers after installing the kits.

Transfer Switch Identification Numbers

Record the product identification numbers from the transfer switch nameplate.

Model Designation _____

Serial Number _____

Accessories

- Alarm Board
- Battery Module
- Controller Disconnect Switch
- Digital Meter
- Heater
- I/O Module, Standard (max. 4) qty: _____
- I/O Module, High Power (max. 4) qty: _____
- Load Shed
- Line-Neutral Monitoring
- Seismic Certification
- Supervised Transfer Switch
- Surge Protection Device (SPD)
- _____
- _____
- _____
- _____
- _____
- _____

Controller Identification

Record the controller description from the generator set operation manual, spec sheet, or sales invoice.

Controller Description _____

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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.**

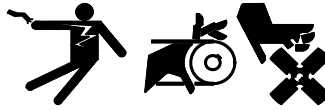
NOTICE

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.

(Decision-Maker® 3+ and 550 Generator Set Controllers)

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or equipment connected to the set, disable the generator set as follows: (1) Press the generator set off/reset button to shut down the generator set. (2) Disconnect the power to the battery charger, if equipped. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent the starting of the generator set by the remote start/stop switch.

(RDC, DC, RDC2, DC2, Decision-Maker® 3000, 3500 and 6000 Generator Set Controllers)

Hazardous Voltage/ Moving Parts

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.

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.

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.

(Decision-Maker® 3+ and 550 Generator Set Controllers)

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) Press the generator set off/reset button to shut down the generator set. (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.

(RDC, DC, RDC2, DC2, Decision-Maker® 3000, 3500 and 6000 Generator Set Controllers)

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

⚠ WARNING



Unbalanced weight. Improper lifting can cause severe injury or death and equipment damage.

Use adequate lifting capacity. Never leave the transfer switch standing upright unless it is securely bolted in place or stabilized.

Notice

NOTICE

Improper operator handle usage. Use the manual operator handle on the transfer switch for maintenance purposes only. Return the transfer switch to the normal position. Remove the manual operator handle, if used, and store it in the place provided on the transfer switch when service is completed.

NOTICE

Foreign material contamination. Cover the transfer switch during installation to keep dirt, grit, metal drill chips, and other debris out of the components. Cover the solenoid mechanism during installation. After installation, use the manual operating handle to cycle the contactor to verify that it operates freely. Do not use a screwdriver to force the contactor mechanism.

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 operation and installation instructions for the following Kohler® Automatic Transfer Switches (ATS):

- Model KSS standard-transition specific breaker ATS equipped with the Decision-Maker® MPAC 750 controller.
- Model KSS standard-transition specific breaker ATS equipped with the Decision-Maker® MPAC 1200 controller.
- Model KSP programmed-transition specific breaker ATS equipped with the Decision-Maker® MPAC 1200 controller.

A separate manual provided with the transfer switch covers the transfer switch controller operation. See List of Related Materials for the document part number.

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.

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.

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

List of Related Materials

A separate manual covers the transfer switch controller and related accessories. Separate manuals contain service and parts information for transfer switch power switching devices and electrical controls.

The following table lists the part numbers for related literature.

| Literature Item | Part Number |
|---|-------------|
| Specification Sheet, Decision-Maker® MPAC 750 Controller | G11-126 |
| Specification Sheet, Decision-Maker® MPAC 1200 Controller | G11-127 |
| Specification Sheet, Model KSS/KSP | G11-130 |
| Operation Manual, Decision-Maker® MPAC 750 Controller | TP-6865 |
| Operation Manual, Decision-Maker® MPAC 1200 Controller | TP-6866 |
| Parts Catalog, Transfer Switch and Controller | TP-6433 |
| Service Manual, Model KSS/KSP/KGS/KGP | TP-6921 |

Service Assistance

For professional advice on generator 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 Netherlands B.V.
Kristallaan 1
4761 ZC Zevenbergen
The Netherlands
Phone: (31) 168 331630
Fax: (31) 168 331631

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 Product Description

1.1 Purpose

An automatic transfer switch (ATS) transfers electrical loads from a normal (preferred) source of electrical power to an emergency (standby) source when the normal source falls outside the acceptable electrical parameters.

When the normal (preferred) source fails, the ATS signals the emergency (standby) source generator set to start. When the emergency (standby) source reaches acceptable levels and stabilizes, the ATS transfers the load from the normal (preferred) source to the emergency (standby) source. The ATS continuously monitors the normal (preferred) source and transfers the load back when the normal (preferred) source returns and stabilizes. After transferring the load back to the normal (preferred) source, the ATS removes the generator start signal, allowing the generator set to shut down.

Figure 1-2 shows a typical installation block diagram.

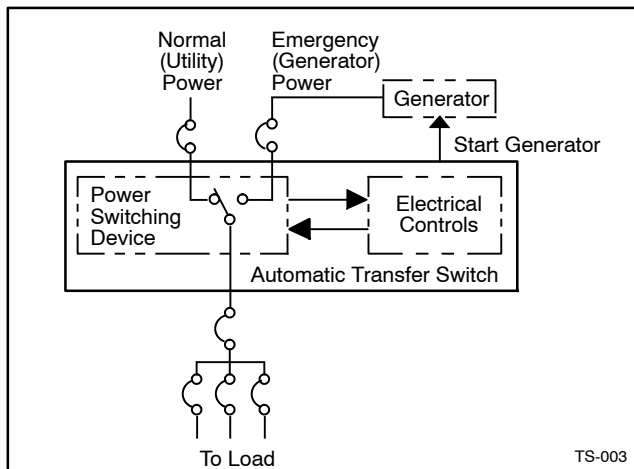


Figure 1-2 Typical ATS Block Diagram

1.2 Nameplate

A nameplate attached to the controller cover on the inside of the enclosure door includes a model designation, a serial number, ratings, and other information about the transfer switch. See Figure 1-3. The serial number is also shown on a label inside the transfer switch enclosure.

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

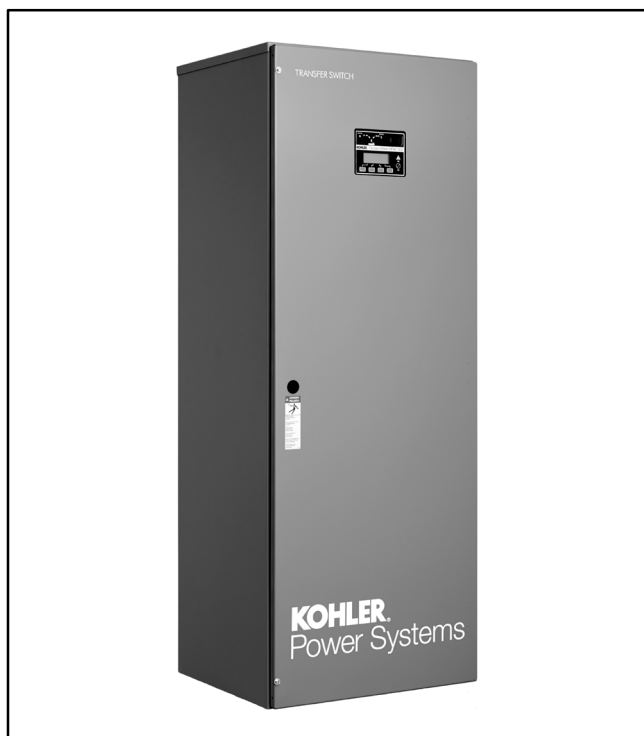


Figure 1-1 Automatic Transfer Switch

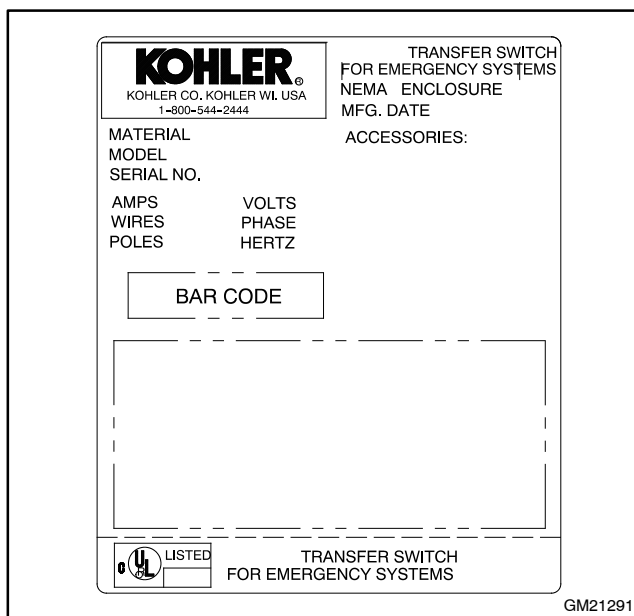
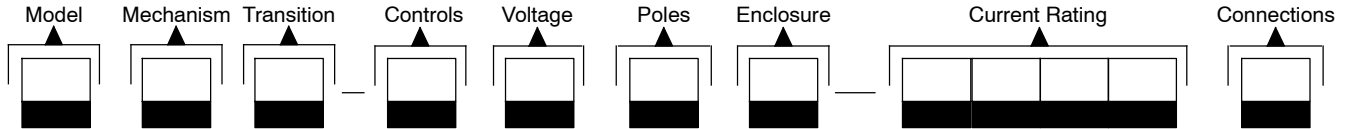


Figure 1-3 Typical Transfer Switch Nameplate

1.3 Model Designation



Record the transfer switch model designation in the boxes. The transfer switch model designation defines characteristics and ratings as explained below.

Sample Model Designation: KSS-JCNA-0100S

Model

K: Kohler

Mechanism

S: Standard (Specific-Breaker)

Transition

S: Standard

P: Programmed

Controller

A: Decision-Maker® MPAC 1200, Automatic

B: Decision-Maker® MPAC 1200, Non-Automatic

J: Decision-Maker® MPAC 750, Automatic

Voltage/Frequency

C: 208 Volts/60 Hz

J: 416 Volts/50 Hz

D: 220 Volts/50 Hz

K: 440 Volts/60 Hz

F: 240 Volts/60 Hz

M: 480 Volts/60 Hz

G: 380 Volts/50 Hz

P: 380 Volts/60 Hz

H: 400 Volts/50 Hz

R: 220 Volts/60 Hz

Number of Poles/Wires

N: 2 Poles/3 Wires, Solid Neutral

T: 3 Poles/4 Wires, Solid Neutral

V: 4 Poles/4 Wires, Switched Neutral

Enclosure

A: NEMA 1

D: NEMA 4

B: NEMA 12

F: NEMA 4X

C: NEMA 3R

G: Open Unit

Current, Amps

0040 0200 600

0080 0225 800

0100 0260 1000

0150 0400

Connections

S: Standard

Note: Some selections are not available for every model. Contact your Kohler distributor for availability.

2.1 Introduction

Kohler® transfer switches are shipped factory-wired, factory-tested, and ready for installation. Have the equipment installed only by trained and qualified personnel. Verify that the installation complies with applicable codes and standards. Installation includes the following steps:

- Unpack and inspect the transfer switch upon receipt.
- Verify that the transfer switch voltage and frequency ratings match the voltages and frequencies of the sources.
- Install the transfer switch.
- Check the manual operation.
- Connect the controller harness and ground lead.
- Connect the generator set engine start leads.
- Connect the normal power source (utility), emergency power source (generator set), and load circuits.
- Connect accessories, if provided.
- Check voltages and operation.

Protect the switch against damage before and during installation.

Note: An approved protective device such as a molded-case circuit breaker or fused disconnect switch **MUST** be installed on both sources of incoming power for circuit protection and used as a disconnect device.

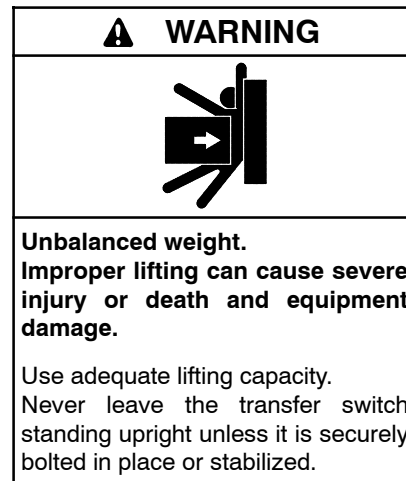
The functional tests in Section 4 are a necessary part of the installation. Be sure to perform the functional tests, which include voltage checks and operation tests, before putting the transfer switch into service.

2.2 Receipt of Unit

2.2.1 Inspection

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

2.2.2 Lifting



See Figure 2-1 or the dimension drawing for the approximate weight of the transfer switch. Use a spreader bar to lift the transfer switch. Attach the bar only to the enclosure's mounting holes or lifting brackets; do not lift the unit any other way. Close and latch the enclosure door before moving the unit.

| Model | Amps | Weight kg (lb.) | | |
|-------|---------|-----------------|-----------|-----------|
| | | 2-Pole | 3-Pole | 4-Pole |
| KSS | 40-225 | 28 (62) | 30 (65) | 31 (68) |
| | 260-400 | 52 (115) | 56 (123) | 59 (131) |
| | 600 | 179 (395) | 183 (403) | 186 (410) |
| | 800 | N/A | 226 (498) | 236 (520) |
| | 1000 | N/A | 231 (509) | 241 (531) |
| KSP | 100-200 | 52 (115) | 56 (123) | 59 (131) |
| | 400 | 52 (115) | 56 (123) | 59 (131) |
| | 600 | 179 (395) | 183 (403) | 186 (410) |

Figure 2-1 Approximate Transfer Switch Weights, NEMA Type 1 and 3R Enclosures

2.2.3 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 low-temperature and high-humidity areas where moisture could condense on the unit. See Figure 2-2 for acceptable storage temperatures.

| Item | Specification |
|-----------------------|--------------------------------|
| Storage temperature | -40°C to 70°C (-40°F to 158°F) |
| Operating temperature | -20°C to 85°C (-4°F to 185°F) |
| Humidity | 5% to 95% noncondensing |

Figure 2-2 Environmental Specifications

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. 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.

2.3 Installation

NOTICE

Foreign material contamination. Cover the transfer switch during installation to keep dirt, grit, metal drill chips, and other debris out of the components. Cover the solenoid mechanism during installation. After installation, use the manual operating handle to cycle the contactor to verify that it operates freely. Do not use a screwdriver to force the contactor mechanism.

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.

Check the system voltage and frequency. Compare the voltage and frequency shown on the transfer switch nameplate to the source voltage and frequency. Do not install the transfer switch if the system voltage and frequency are different from the nominal normal (utility) source voltage and frequency or the nominal emergency source voltage and frequency shown on the generator set nameplate.

Plan the installation. Use the dimensions given on the enclosure dimension (ADV) drawings. Select a mounting site that complies with local electrical code restrictions for the enclosure type. Mount the transfer switch as close to the load and power sources as possible. Allow adequate space to fully open the enclosure and to service the switch. Provide cable bending space and clearance to live metal parts.

Outdoor installations. Transfer switches with NEMA 3R, 4, or 4X enclosures can be installed outdoors. In locations with very high ambient temperatures, installation in a shaded area or a location with the enclosure door facing away from direct sunlight is recommended.

Prepare the foundation. Ensure that the supporting foundation for the enclosure is level and straight. For bottom cable entry, if used, install conduit stubs in the foundation. Refer to the enclosure dimension drawing for the conduit stub locations. When pouring a concrete floor, use interlocking conduit spacer caps or a wood or metal template to maintain proper conduit alignment.

Installation of seismically certified transfer switches. See Section 2.4 and the transfer switch dimension (ADV) drawings for additional installation requirements.

Install the ATS. Mount 40- through 400-amp transfer switches to a wall or other rigid vertical supporting structure. Clearance holes through the back of each enclosure are provided for mounting. Level the enclosure and use shims if needed to plumb the enclosure. Verify that the door hinges are vertical to avoid distortion of the enclosure or door.

Bolt 600- through 1000-amp automatic transfer switches directly to floor mounting pads. Use shims if needed to plumb the enclosure. Verify that the door hinges are vertical to avoid distortion of the enclosure or door.

2.4 Seismic Certification

Automatic transfer switches with seismic certification must be installed according to the instructions in this section. Also refer to the Certificate of Compliance and the installation drawings for the transfer switch.

Abbreviations:

ACI: American Concrete Institute

IBC: International Building Code®

S_{DS} : Design spectral response acceleration at short period, as determined in Section 1615.1.3 of the IBC

R_p : Equipment response modification factor

I_p : Equipment importance factor

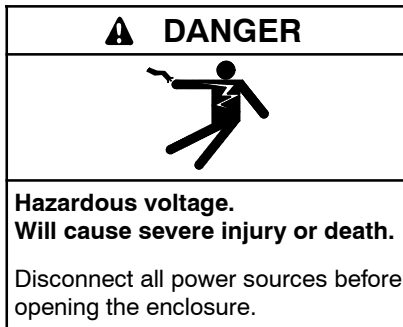
a_p : In-structure equipment amplification factor

Refer to the International Building Code® for more information.

General Seismic Installation Notes:

1. Anchors used for seismic installation must be designed in accordance with ACI 355.2-04. Suggested manufacturers include Simpson, Ramset, and Hilti.
2. Anchors must be installed to a minimum embedment of 8x the anchor diameter.
3. Anchors must be installed in minimum 4000 psi compressive strength normal weight concrete. Concrete aggregate must comply with ASTM C33. Installation in structural lightweight concrete is not permitted unless otherwise approved by the structural engineer of record.
4. Anchors must be installed to the required torque specified by the anchor manufacturer to obtain maximum loading.
5. Anchors must be installed with spacing and edge distance required to obtain maximum load unless otherwise approved by the structural engineer of record.
6. Anchors used for seismic installation must be designed and rated to resist seismic loading in accordance with ACI 355.2-04 and documented in a report by a reputable testing agency (ex. the Evaluation Service Report issued by the International Code Council).
7. Wide washers must be installed at each anchor location between the anchor head and equipment for tension load distribution. See applicable ADV drawing for specific anchor information and washer dimensions.
8. Equipment installed on a housekeeping pad requires the housekeeping pad thickness to be at least 1.5x the anchor embedment depth.
9. All housekeeping pads must be seismically designed and dowelled or cast into the building structure as approved by the structural engineer of record.
10. Rebar reinforcing in the housekeeping pad is required for all installations.
11. Rebar reinforcement in concrete must be designed in accordance with ACI 318-05.
12. Wall mounted equipment must be installed to a rebar reinforced structural concrete wall that is seismically designed and approved by the engineer of record to resist the added seismic loads from components being anchored to the wall.
13. Floor mounted equipment (with or without a housekeeping pad) must be installed to a rebar reinforced structural concrete floor that is seismically designed and approved by the engineer of record to resist the added seismic loads from components being anchored to the floor.
14. When installing to a floor or wall, rebar interference must be considered.
15. Equipment attached to any structural floor other than those constructed of structural concrete and designed to accept the seismic loads from the mounted equipment are beyond the scope of this specification.
16. Installation to light-weight concrete over steel decking is beyond the scope of this specification.
17. Installation to concrete block or cinder block walls is beyond the scope of this specification.

2.5 Manual Operation



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) Press the generator set off/reset button to shut down the generator set. (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.

NOTICE

Improper operator handle usage. Use the manual operator handle on the transfer switch for maintenance purposes only. Return the transfer switch to the normal position. Remove the manual operator handle, if used, and store it in the place provided on the transfer switch when service is completed.

A manual operation handle is provided with the transfer switch *for maintenance purposes only*. Use the manual operation handle to check the manual operation before energizing the transfer switch. Use the following manual operation procedures to verify that the contactor operates smoothly without binding.

Note: A contactor in normal and serviceable condition operates smoothly without binding. Do not place the transfer switch into service if the contactor does not operate smoothly; contact an authorized distributor/dealer to service the contactor.

2.5.1 Manual Operation, Model KSS Standard-Transition Switches

Note: Never use the maintenance handle to transfer the load with the power connected. Disconnect both power sources before manually operating the switch.

1. Disable the generator set to prevent starting and disconnect all power sources before manually operating the transfer switch.
2. Remove the maintenance handle from its storage location inside the enclosure. See Figure 2-3 through Figure 2-5.
3. Attach the maintenance handle:
 - a. 40–600 Amp switches: Insert the maintenance handle into the hole in the shaft on the left side of the operator as shown in Figure 2-3 or Figure 2-4.
 - b. 800–1000 Amp switches: Slide the maintenance handle over the square shaft on the left side of the operator as shown in Figure 2-5.
4. Move the maintenance handle up or down as shown in the corresponding figure to manually operate the transfer switch. It should operate smoothly without any binding. If it does not, check for shipping damage or construction debris.
5. Return the transfer switch to the Normal position.
6. Remove the maintenance handle and return it to the storage location.

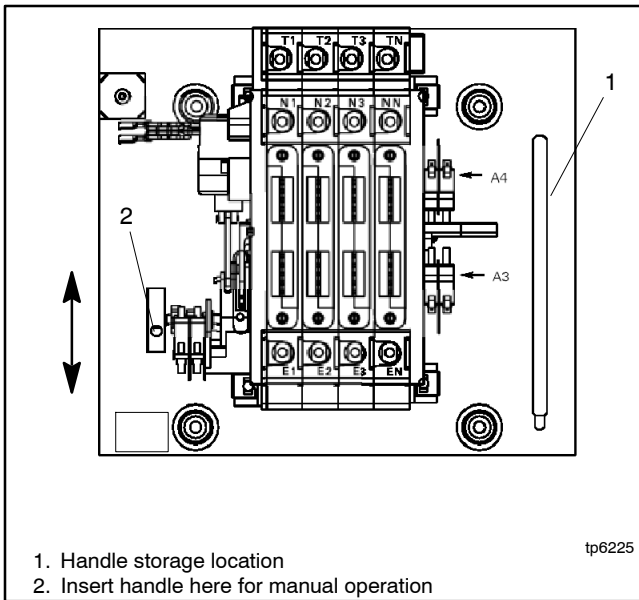


Figure 2-3 Manual Operation, 40–260 Amp Standard-Transition Switches

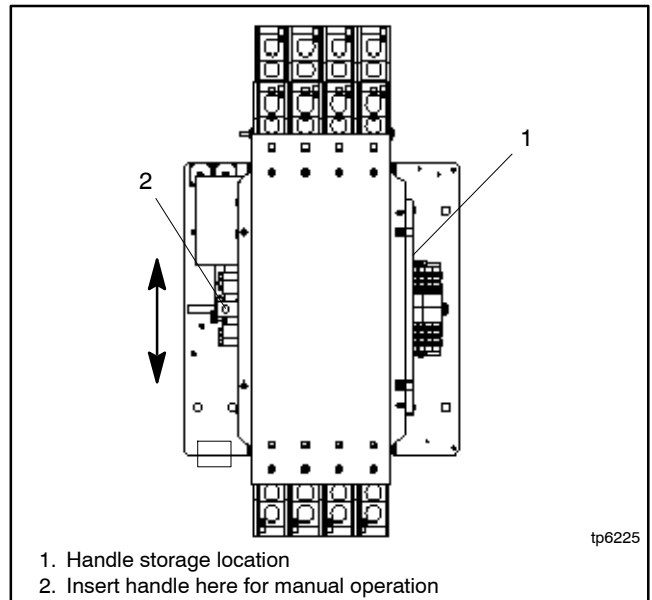


Figure 2-4 Manual Operation, 400–600 Amp Standard-Transition Switches

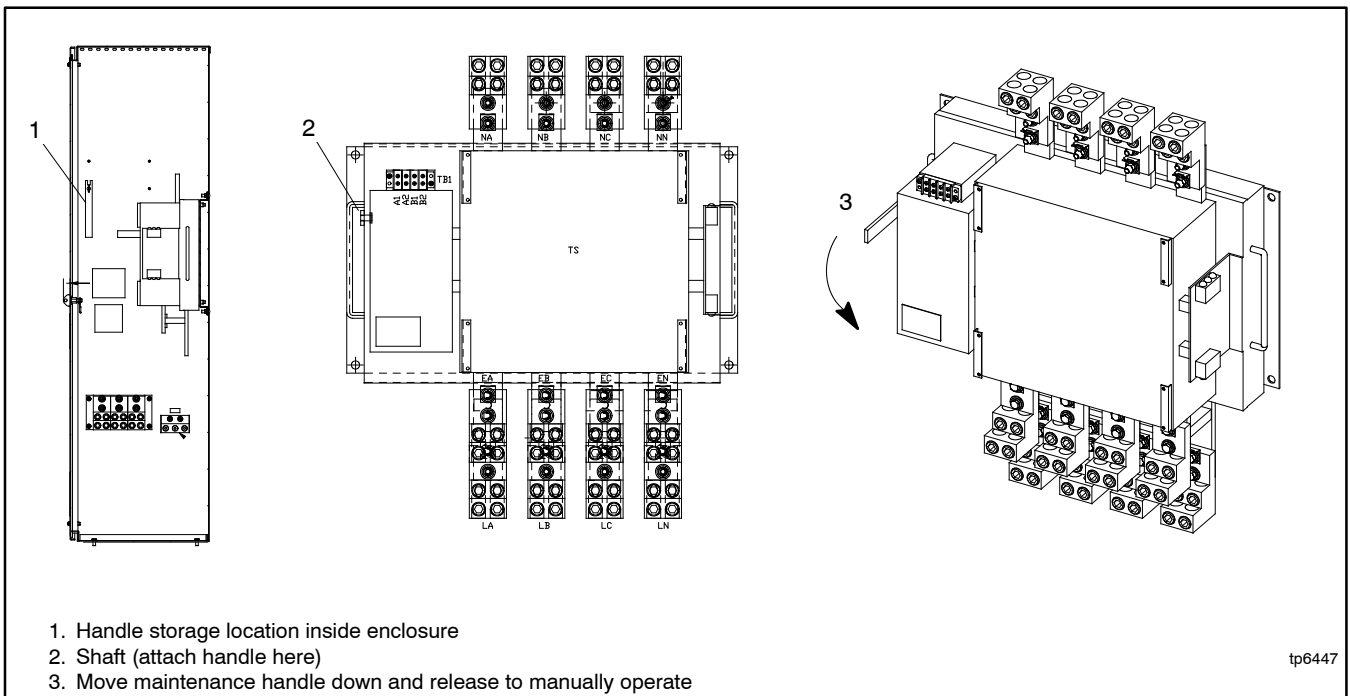


Figure 2-5 Manual Operation, 800–1000 Amp Standard-Transition Switches

2.5.2 Manual Operation, Model KSP Programmed-Transition Switches

Note: Never use the manual operation handle to transfer the load with the power connected. Disconnect both power sources before manually operating the switch.

1. Disable the generator set to prevent starting and disconnect all power sources before manually operating the transfer switch.
2. Check the contactor position, indicated by the A and B position indicators. See Figure 2-6. One position indicator will display ON to indicate the source position. If both indicators display OFF, the transfer switch is in the OFF position.

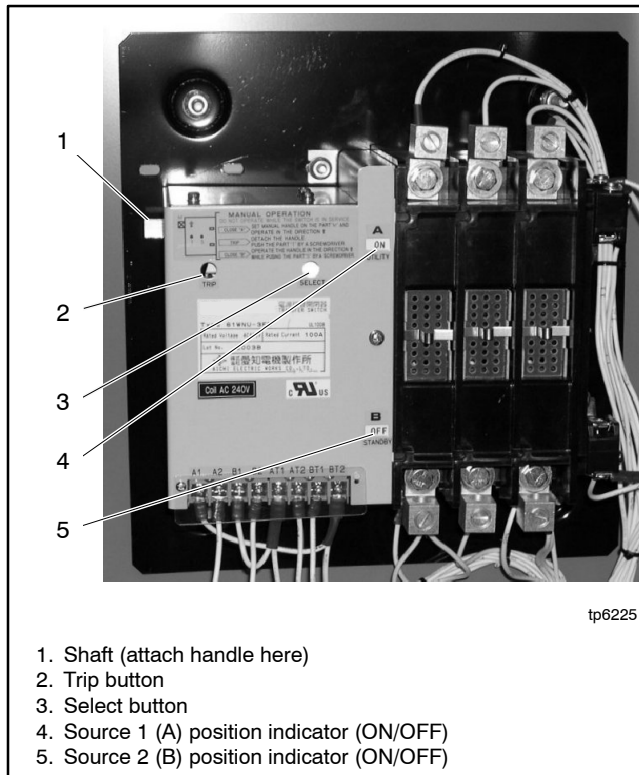


Figure 2-6 Manual Operation, Programmed-Transition Switches (handle not shown)

3. If the transfer switch is not in the OFF position, use a screwdriver or other tool to push the TRIP button.

See Figure 2-6. Check that both position indicators display OFF.

4. Slide the manual operating handle (provided with the switch) over the shaft on the left side of the switch. See Figure 2-6.
5. Move the switch to the A (Source 1) or B (Source 2) position as follows:
 - a. To move the switch to position A (Source 1), move the manual operation handle up and then release the handle. Verify that the A position indicator displays ON.
 - b. To move the switch to position B (Source 2), use a screwdriver or other tool to push the SELECT button. Hold the SELECT button in and move the manual operation handle up and then release the handle. Verify that the B position indicator displays ON.

Note: Always move the manual operation handle UP and then release it.

6. Remove the manual operation handle and store it in a convenient location.

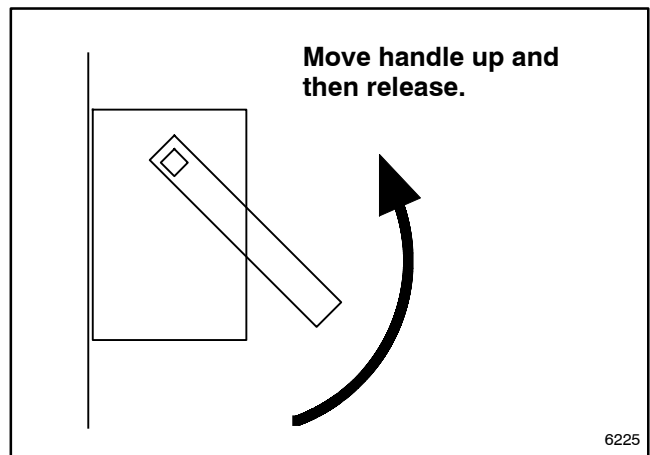
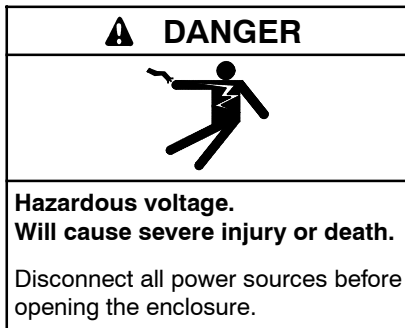


Figure 2-7 Manual Operating Handle, Programmed-Transition Switches

2.6 Controller Connections



NOTICE

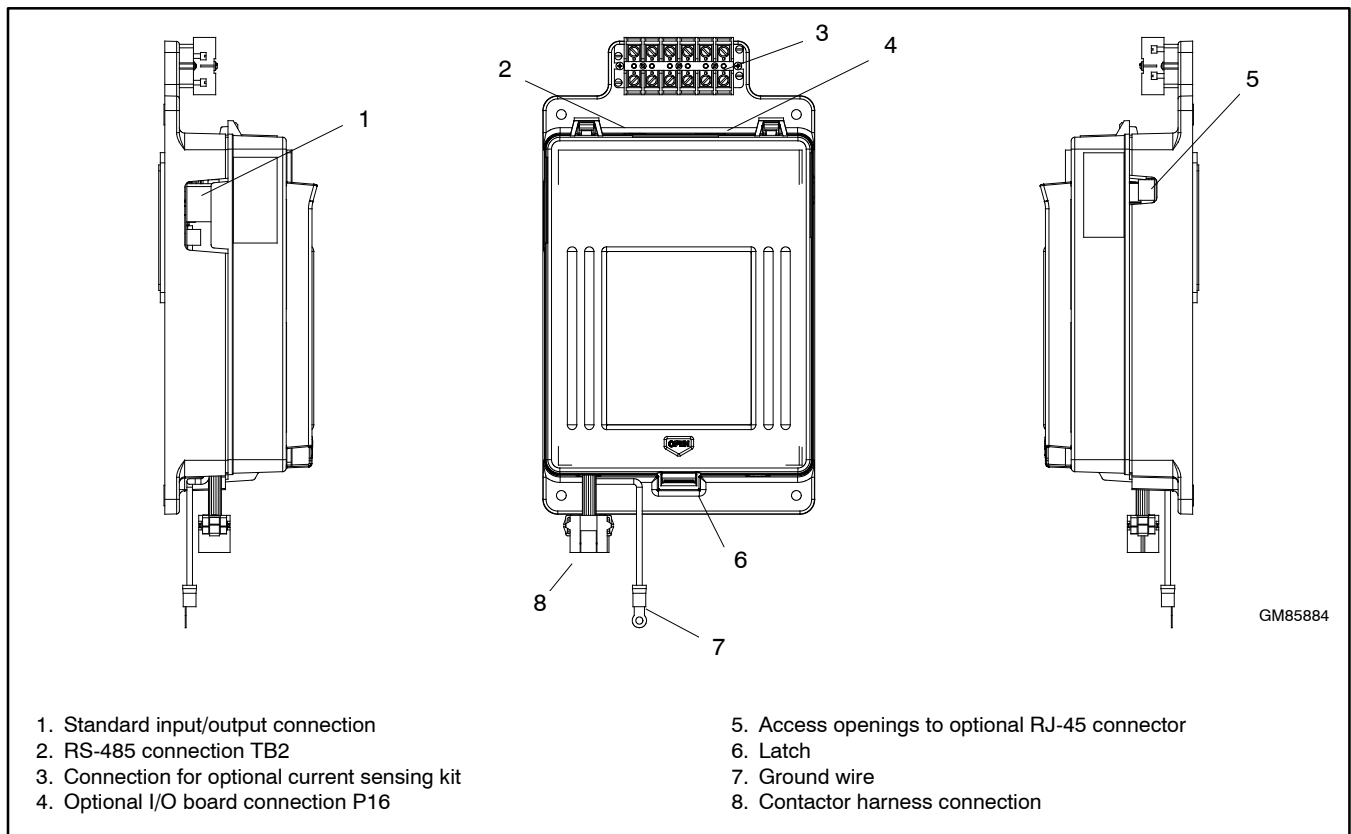
Electrostatic discharge damage. Electrostatic discharge (ESD) damages electronic circuit boards. Prevent electrostatic discharge damage by wearing an approved grounding wrist strap when handling electronic circuit boards or integrated circuits. An approved grounding wrist strap provides a high resistance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

The controller is mounted in a plastic housing on the inside of the transfer switch enclosure door.

Figure 2-8 shows the locations of the connectors on the controller. It is not necessary to open the cover to access the Ethernet, Modbus®, and input/output connectors.

Opening the cover. If necessary, open the plastic housing by pushing up on the latch on the bottom of the cover and swinging the cover up and out. The cover is hinged at the top. Lift the cover off the hinges to remove it completely, if necessary.

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



1. Standard input/output connection
2. RS-485 connection TB2
3. Connection for optional current sensing kit
4. Optional I/O board connection P16

5. Access openings to optional RJ-45 connector
6. Latch
7. Ground wire
8. Contactor harness connection

Figure 2-8 Controller

2.6.1 Controller Input and Output Connections

The controller provides connections for two programmable inputs and two programmable outputs. See Figure 2-8 for the connector location.

Each input has a signal and a return connection. The outputs are C form contacts with ratings of 500 mA @ 120 VAC. See Figure 2-10 for connections. Use #12-24 AWG wire and tighten the connections to 0.5 Nm (4.4 in. lbs.).

See the transfer switch controller operation manual for instructions to assign inputs and outputs.

Transfer switches equipped with the MPAC 750 controller may also include the optional programmable exerciser. This accessory uses one input connection, which must be assigned to Remote Test. Refer to the instructions provided with the exerciser kit for more information.

Transfer switches equipped with the MPAC 1200 controller can use optional input/output modules for additional input and output connections. See Section 3.3 for instructions.

| Main Board I/O Specifications | |
|-------------------------------|------------------------------------|
| Output contact type | Isolated form C (SPDT) |
| Output contact rating | 1 amp @ 30 VDC, 500 mA @120 VAC |
| I/O terminals wire size | #12-24 AWG |

Figure 2-9 Main Board I/O Specifications

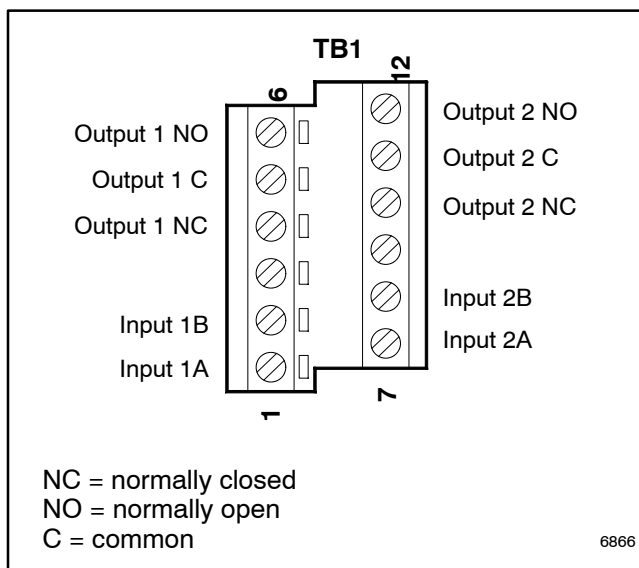


Figure 2-10 Input and Output Connections

2.6.2 Harness Connection

Verify that the contactor harness is connected at the controller base (or at the controller disconnect switch, if equipped). See Figure 2-11.

Note: Verify that the power is disconnected before connecting or disconnecting the contactor harness.

2.6.3 Controller Ground

Verify that the grounding wire is connected from the controller's lower left mounting stud to the enclosure. This connection provides proper grounding that does not rely upon the door hinges.

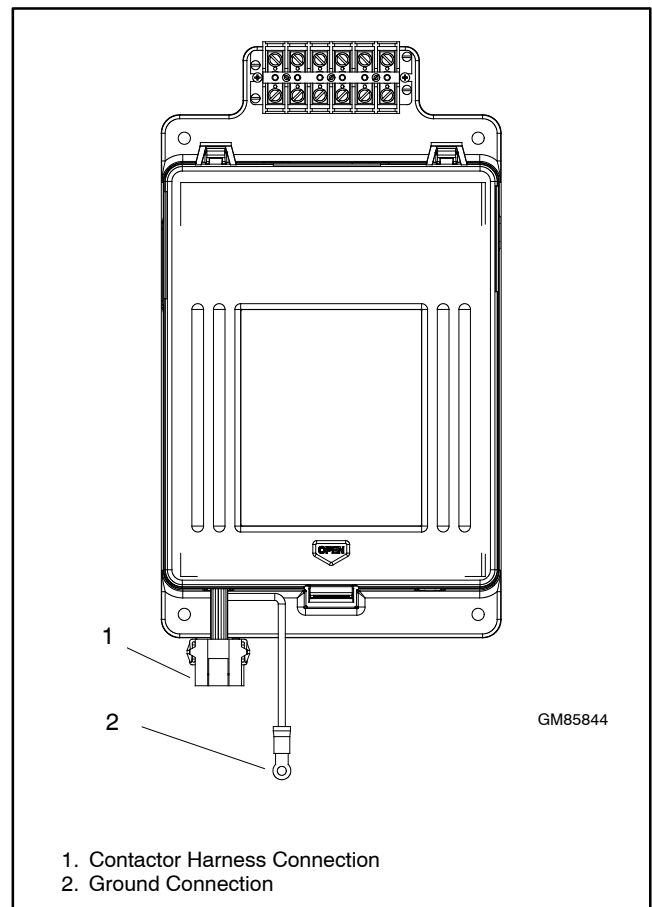


Figure 2-11 Contactor Harness and Controller Ground Connections

2.7 Electrical Wiring

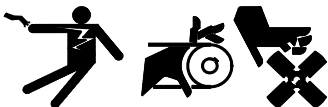
The transfer switch is factory-wired and tested. Field installation includes connecting the sources, loads, generator start circuit(s), and auxiliary circuits, if used.

Note: An approved protective device such as a molded-case circuit breaker or fused disconnect switch **MUST** be installed on both sources of incoming power for circuit protection and used as a disconnect device.

Refer to the wiring diagrams provided with the transfer switch. Observe all applicable national, state, and local electrical codes during installation.

Install DC, control, and communication system wiring in separate conduit from AC power wiring.


⚠ 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.

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) Press the generator set off/reset button to shut down the generator set. (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.

| |
|---|
| ⚠ DANGER |
|  |
| Hazardous voltage. Will cause severe injury or death. |
| Disconnect all power sources before opening the enclosure. |

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.

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 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.

NOTICE

Foreign material contamination. Cover the transfer switch during installation to keep dirt, grit, metal drill chips, and other debris out of the components. Cover the solenoid mechanism during installation. After installation, use the manual operating handle to cycle the contactor to verify that it operates freely. Do not use a screwdriver to force the contactor mechanism.

2.7.1 Source and Load Connections

Determine the cable size. Refer to the transfer switch dimension drawing to determine the size and number of conductors that can be used. Make sure that the cables are suitable for use with the transfer switch lugs. Watertight conduit hubs may be required for outdoor use.

Drill the entry holes. Cover the internal components of the ATS to protect them from metal chips and construction grit. Then drill entry holes for the conductors at the locations shown on the enclosure drawings. Remove debris from the enclosure with a vacuum cleaner.

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.

Install and test the power cables. Leave sufficient slack in the power leads to reach all of the power connecting lugs on the power switching device. Test the power conductors before connecting them to the transfer switch. Installing power cables in conduit, cable troughs and ceiling-suspended hangers often requires considerable force. Pulling cables can damage insulation and stretch or break the conductor's strands.

Test the cables after pulling them into position and *before* they are connected to verify that they are not defective and that they were not damaged during installation.

Connect the cables. Be careful when stripping insulation from the cables; avoid nicking or ringing the conductor. Clean cables with a wire brush to remove surface oxides before connecting them to the terminals. Apply joint compound to the connections of any aluminum conductors.

Refer to the wiring diagram provided with the switch. The connection points on the contactor are labeled Normal, Emergency, and Load. Be sure to follow the phase markings (A, B, C, and N). For single-phase systems, connect to A and C.

Note: Connect the source and load phases as indicated by the markings and drawings to prevent short circuits and to prevent phase-sensitive load devices from malfunctioning or operating in reverse.

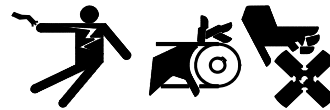
Tighten the lugs. Verify that all connections are consistent with drawings before tightening the lugs. Tighten all lug connections to the torque values shown in Figure 2-12. Carefully wipe off any excess joint compound after tightening the terminal lugs.

| Socket Size Across Flats, in. | Bolt Torque | |
|-------------------------------|-------------|---------|
| | Nm | Ft. lb. |
| 1/8 | 5 | 4 |
| 5/32 | 11 | 8 |
| 3/16 | 14 | 10 |
| 7/32 | 16 | 12 |
| 1/4 | 23 | 17 |
| 5/16 | 31 | 23 |
| 3/8 | 42 | 31 |
| 1/2 | 57 | 42 |
| 9/16 | 68 | 50 |

Figure 2-12 Tightening Torque for Lugs

2.7.2 Engine Start Connection

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 equipment connected to the set, disable the generator set as follows: (1) Press the generator set off/reset button to shut down the generator set. (2) Disconnect the power to the battery charger, if equipped. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent the starting of the generator set by the remote start/stop switch.

Prevent the generator set from starting by pressing the OFF button on the generator controller; disconnecting power to the generator engine start battery charger, if installed; and disconnecting all generator engine start battery cables, negative (-) leads first.

Connect the generator set remote starting circuit to the engine start terminals located on the transfer switch contactor assembly. See Figure 2-14 through Figure 2-19 for the locations of the engine start terminals, which are labeled on the unit with a red decal. Refer to the generator set installation manual for wire size specifications.

The engine start contact ratings are shown in Figure 2-13.

2.7.3 Auxiliary Contacts

Connect the auxiliary contacts to customer-supplied alarms, remote indicators, or other devices. Auxiliary contacts provide contacts that close when the transfer switch is in the Normal position and contacts that close when the transfer switch is in the Emergency position.

Refer to the schematic diagram provided with the transfer switch to identify which auxiliary contacts are closed on Normal and which are closed on Emergency.

The auxiliary contact ratings are shown in Figure 2-13. Figure 2-14 through Figure 2-19 show the locations of the auxiliary contacts for different models.

| Contacts | Resistive Load | Inductive Load | Motor Load | |
|-------------------------------------|----------------|----------------------------------|---|--|
| | | | NC | NO |
| Engine Start Contacts | 2 A @ 30 VDC | N/A | N/A | N/A |
| Auxiliary Contacts, KSS (40-600A) | 15 A @ 250 VAC | N/A | N/A | N/A |
| Auxiliary Contacts, KSS (800-1000A) | 15 A @ 480 VAC | 15 A @ 250 VAC; 6 A @ 500 VAC | 5 A @ 125 VAC; 3 A @ 250 VAC; 1.5 A @ 500 VAC | 2.5 A @ 125 VAC; 1.5 A @ 250 VAC; 0.75 A @ 500 VAC |
| Auxiliary Contacts, KSP | 15 A @ 480 VAC | 15 A @ 250 VAC; 6 A @ 500 VAC | 5 A @ 125 VAC; 3 A @ 250 VAC; 1.5 A @ 500 VAC | 2.5 A @ 125 VAC; 1.5 A @ 250 VAC; 0.75 A @ 500 VAC |

Figure 2-13 Contact Ratings

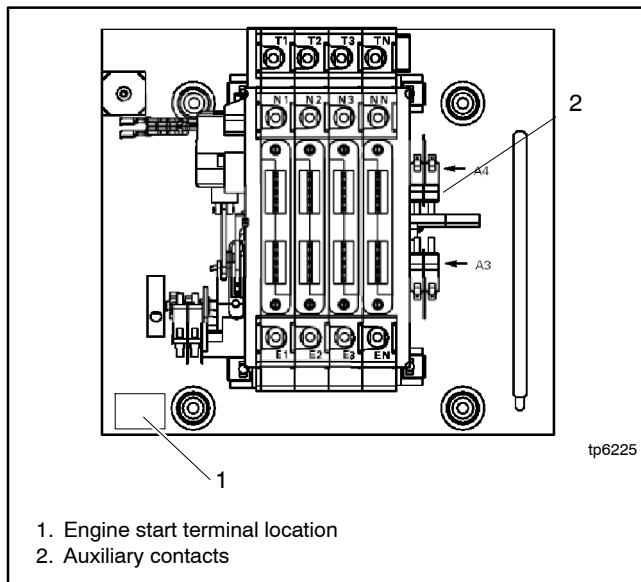


Figure 2-14 Engine Start and Auxiliary Contact Locations, 40-225 Amp Standard-Transition Switches

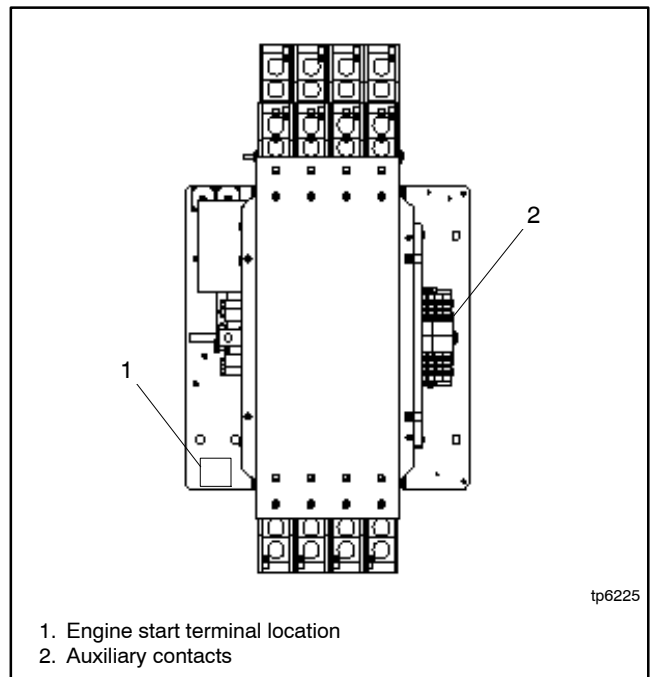


Figure 2-15 Engine Start and Auxiliary Contact Locations, 400-600 Amp Standard-Transition Switches

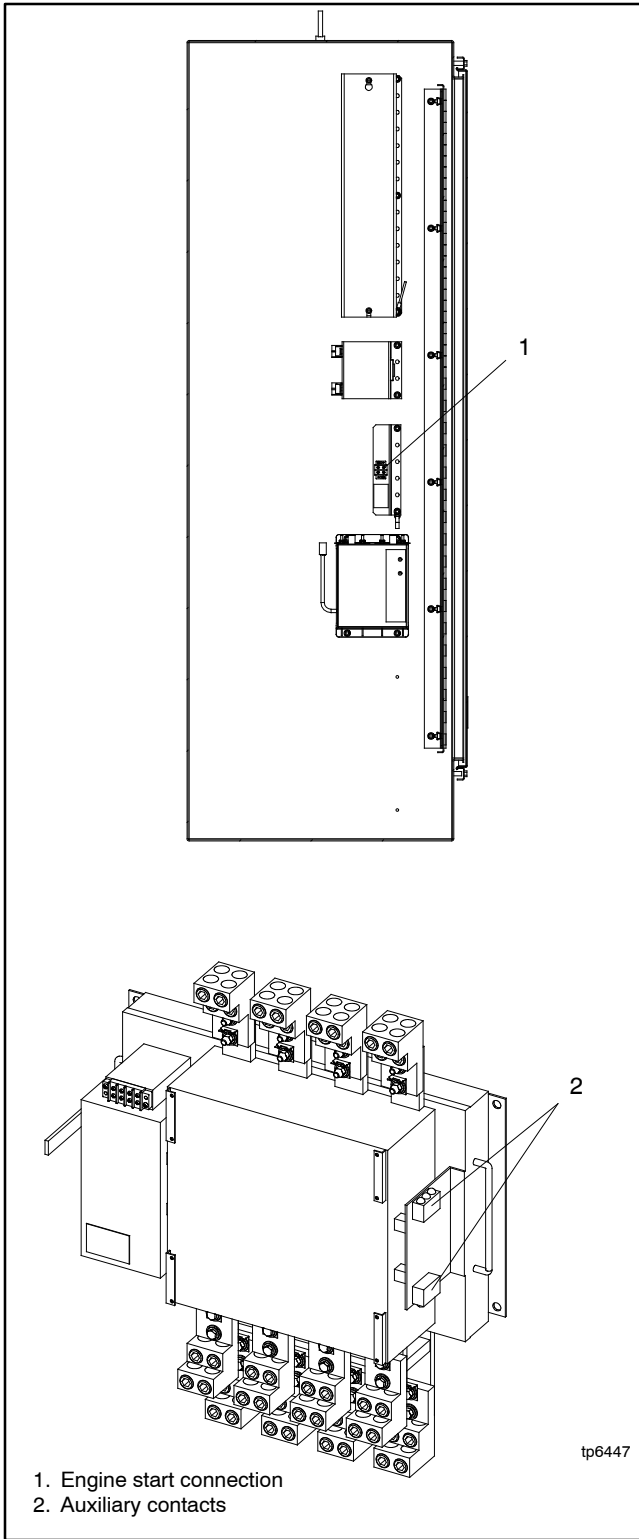


Figure 2-16 Engine Start and Auxiliary Contact Locations, 800-1000 Amp Standard-Transition Switches

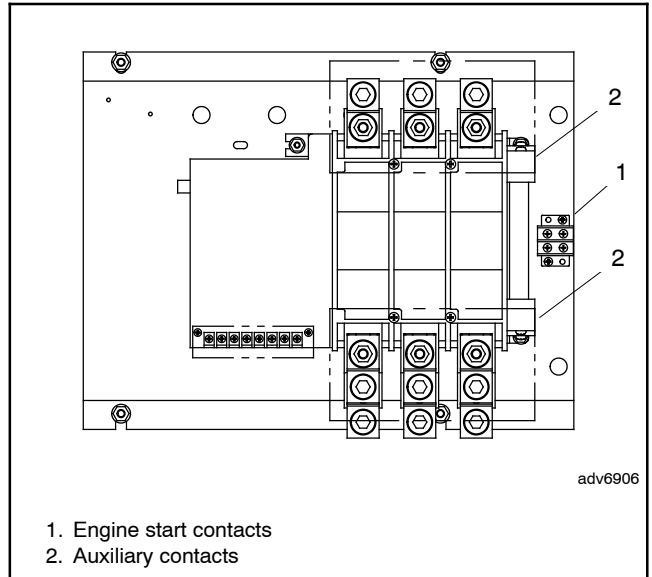


Figure 2-17 Engine Start and Auxiliary Contact Locations, 100-200 Amp Programmed-Transition Switches

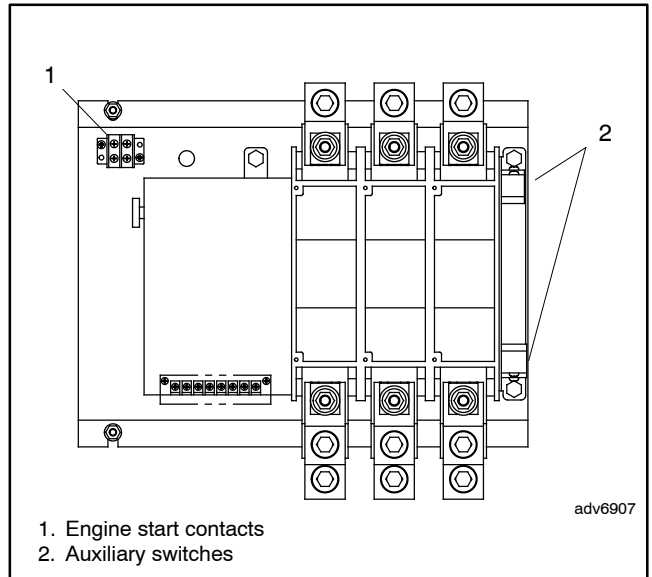


Figure 2-18 Engine Start and Auxiliary Contact Locations, 400 Amp Programmed-Transition Switches

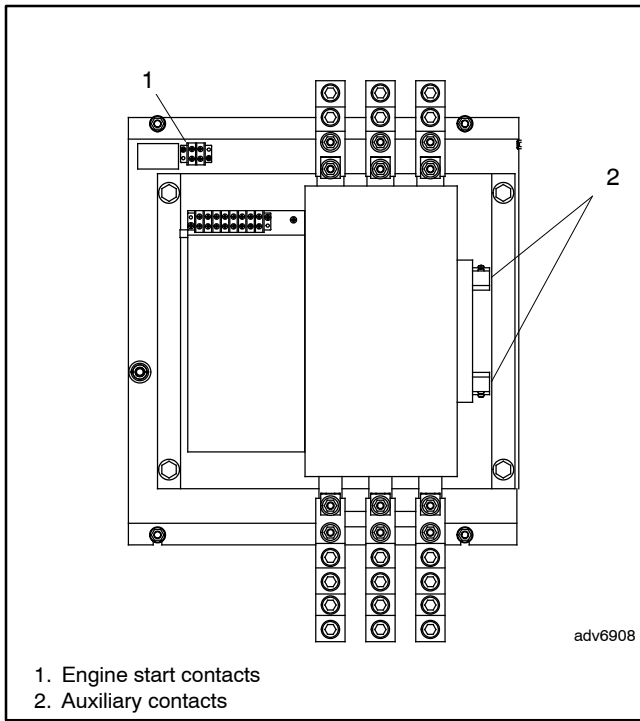


Figure 2-19 Engine Start and Auxiliary Contact Locations, 600 Amp Programmed-Transition Switches

2.8 Communication and Accessory Connections

See Section 3 for accessory and communication connection instructions.

2.9 Functional Tests

After completion of the mechanical installation and all electrical connections, perform the functional tests described in Section 4. The procedures in Section 4 are required to complete the installation and startup of the transfer switch.

Notes

Section 3 Communication and Accessory Connections

3.1 Introduction

This section explains the connection of communication cables and factory-installed accessories.

Also refer to the following documentation for instructions to install, connect, and operate optional accessories.

- Transfer switch wiring diagrams.
- Installation instructions or diagrams provided with loose accessory kits.

3.2 Communication Connections

The Decision-Maker® MPAC 750 and MPAC 1200 controllers are equipped with a USB port and a Modbus port with an RS-485 connector. An Ethernet communication board is optional.

3.2.1 USB Port SiteTech Connection

A personal computer and Kohler® SiteTech™ software can be used for changing controller settings. Use a USB cable to connect the controller to a personal computer.

See Figure 3-1 for the USB port location on the front of the controller assembly. Remove the small port cover and use a USB cable with a mini-B connector to connect the controller's USB port to the computer.

See TP-6701, SiteTech Software Operation Manual, for instructions to use the software. Disconnect the USB cable from the controller and replace the port cover when finished.

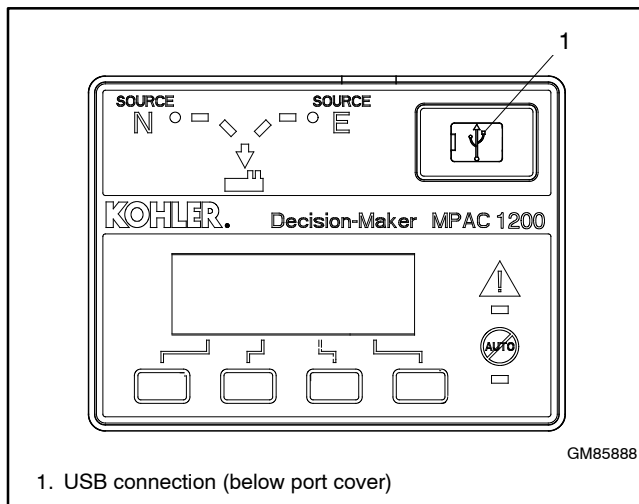
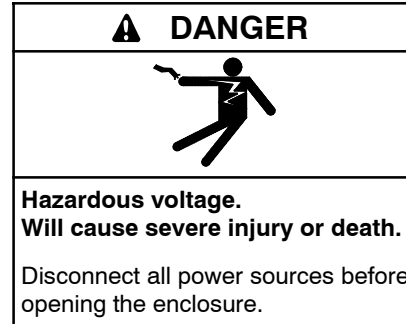


Figure 3-1 USB Connection for SiteTech (MPAC 1200 controller shown)

3.2.2 Modbus Connection



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) Press the generator set off/reset button to shut down the generator set. (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.

See Figure 3-2 for the RS-485 Modbus connector location.

Use serial connections to TB2 on the controller to connect the transfer switch to a personal computer for system monitoring, the optional remote annunciator, or a Modbus network. See Figure 3-4.

Notice that a 121 ohm terminating resistor is recommended on the last device in a network. If there is only one device, a terminating resistor may be required depending on the cable distance and communication speed. Long cables and high speeds will increase the need for a terminating resistor.

The serial port is an isolated RS-485 port with connection speeds of 9.6, 19.2, and 57.6 kbps. Use shielded twisted-pair cable to connect to the RS-485 connectors on the controller's terminal strip TB2 for serial connections. For connection to a PC, use a USB to RS-485 converter.

Connect the Modbus input and output to the terminals shown in Figure 3-3. Use #12-24 AWG shielded, twisted-pair wire. Belden cable #9841 or equivalent is recommended. Connect one end of the shield to ground. Leave the other end of the shield disconnected. Tighten the connections to 0.5 Nm (4.4 in. lb.).

Use Modbus RTU (remote terminal unit) protocol for communication through the serial port. A map of the Modbus codes for this controller is available. Contact your local distributor/dealer.

Note: Modbus® applications require a Modbus software driver written by a trained and qualified systems programmer.

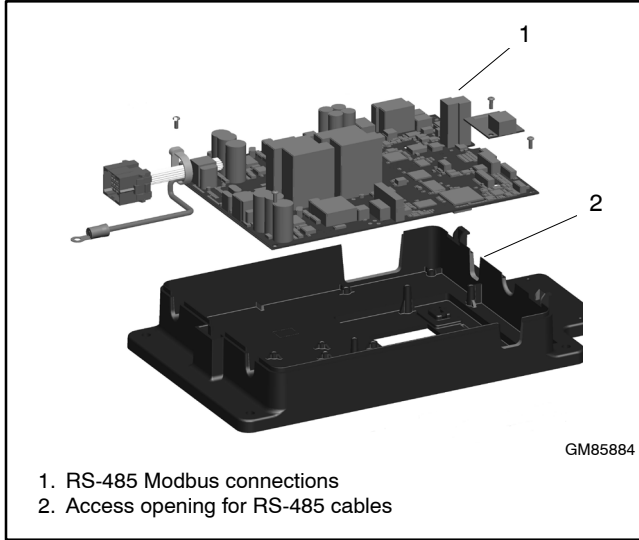


Figure 3-2 Modbus Connections (controller cover removed for illustration only)

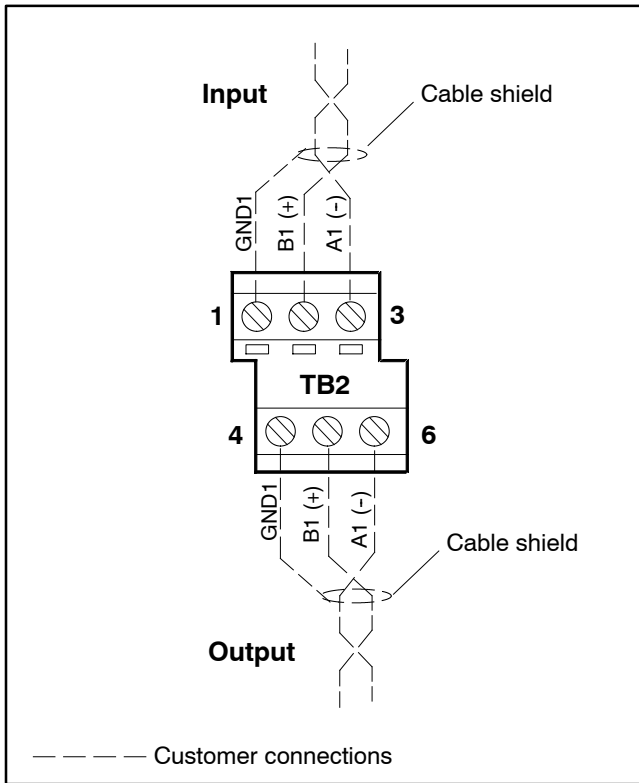


Figure 3-3 Modbus RS-485 Connections

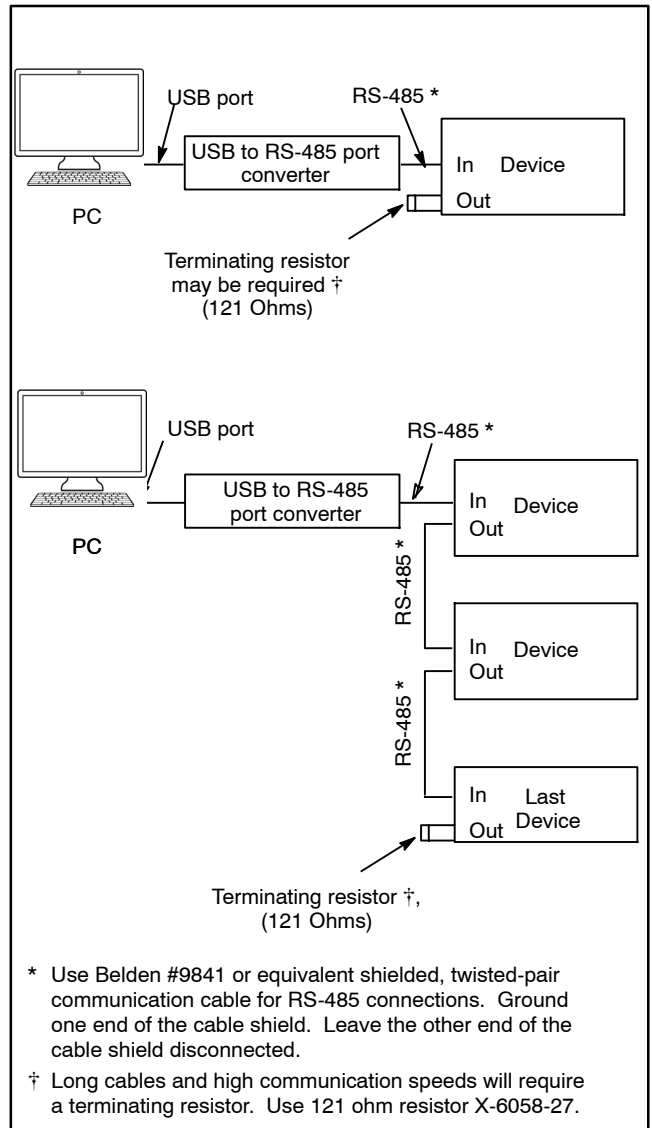
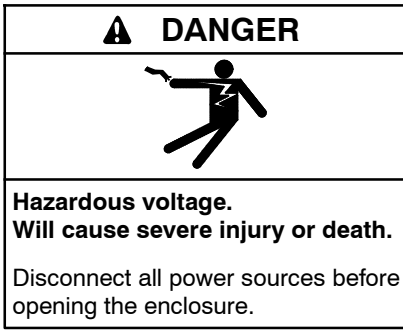


Figure 3-4 Serial Connections

* Use Belden #9841 or equivalent shielded, twisted-pair communication cable for RS-485 connections. Ground one end of the cable shield. Leave the other end of the cable shield disconnected.

† Long cables and high communication speeds will require a terminating resistor. Use 121 ohm resistor X-6058-27.

3.2.3 Ethernet Connection



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) Press the generator set off/reset button to shut down the generator set. (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.

The Ethernet communication accessory board is required for connection to the Ethernet. The Ethernet communication board is an optional accessory for the MPAC 750 and MPAC 1200 controllers. The communication board connects to the controller board as shown in Figure 3-5.

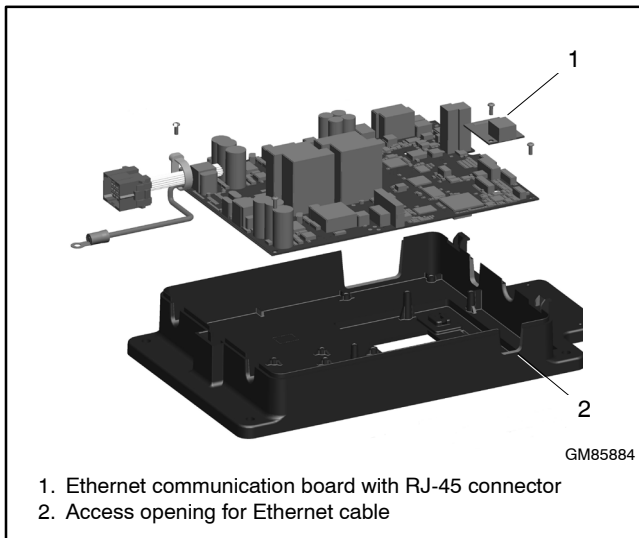


Figure 3-5 Ethernet Board (controller cover removed for illustration only)

The Ethernet communication accessory board allows the transfer switch to be connected to a building's Ethernet network to communicate with personal computers connected to the same subnet.

Note: For an ethernet connection, obtain an IP address and subnet mask number from the local system administrator.

Ethernet Port. The ethernet port is a standard RJ-45 jack. See Figure 3-5 for the location of the Ethernet port. Use Category 5e or better cable to connect the controller to the building's network.

Use the controller's Setup menus or a personal computer connected to the controller's USB port and Kohler SiteTech software to set the communication parameters. The Ethernet communication board may have a default IP address assigned at the factory for test purposes. See Figure 3-6. **Change the IP address to an address owned by the user.** See the controller operation manual for instructions to set the communication parameters.

The transfer switch controller does not operate as a Modbus-to-Ethernet converter for other devices in a network. For multiple device networks connected to the personal computer through the Ethernet, use a Modbus-to-Ethernet converter for the other devices in the network. See Figure 3-7 and instruction sheet TT-1405, provided with the converter, for connection instructions.

The controller can communicate with up to five (5) simultaneous TCP/IP (ethernet) connections. These five connections do not include the RS-485 serial port. In the extreme case, five users may be communicating with the controller via TCP/IP network connections and another may be communicating through the serial port, for a total of six (6) communication channels. As the controller is asked to communicate with more and more outside devices, the communication will slow down.

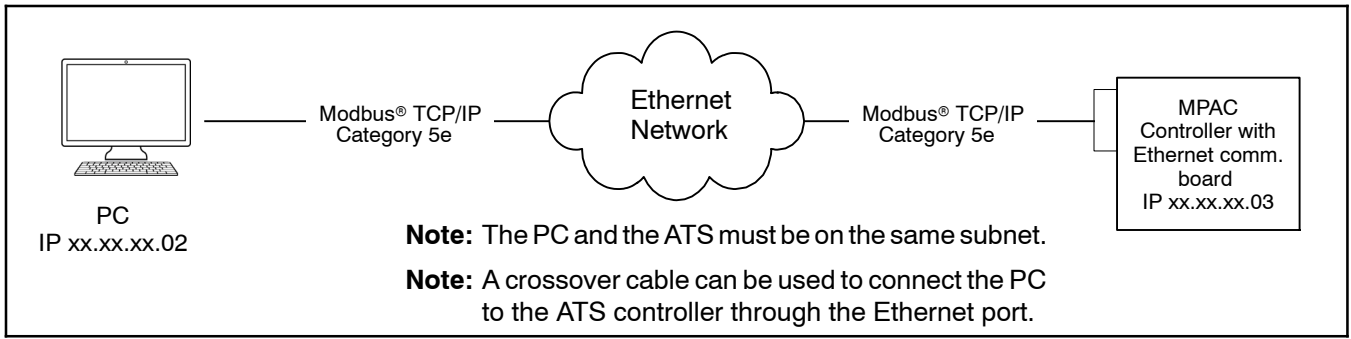


Figure 3-6 Remote Network (Ethernet) Connection

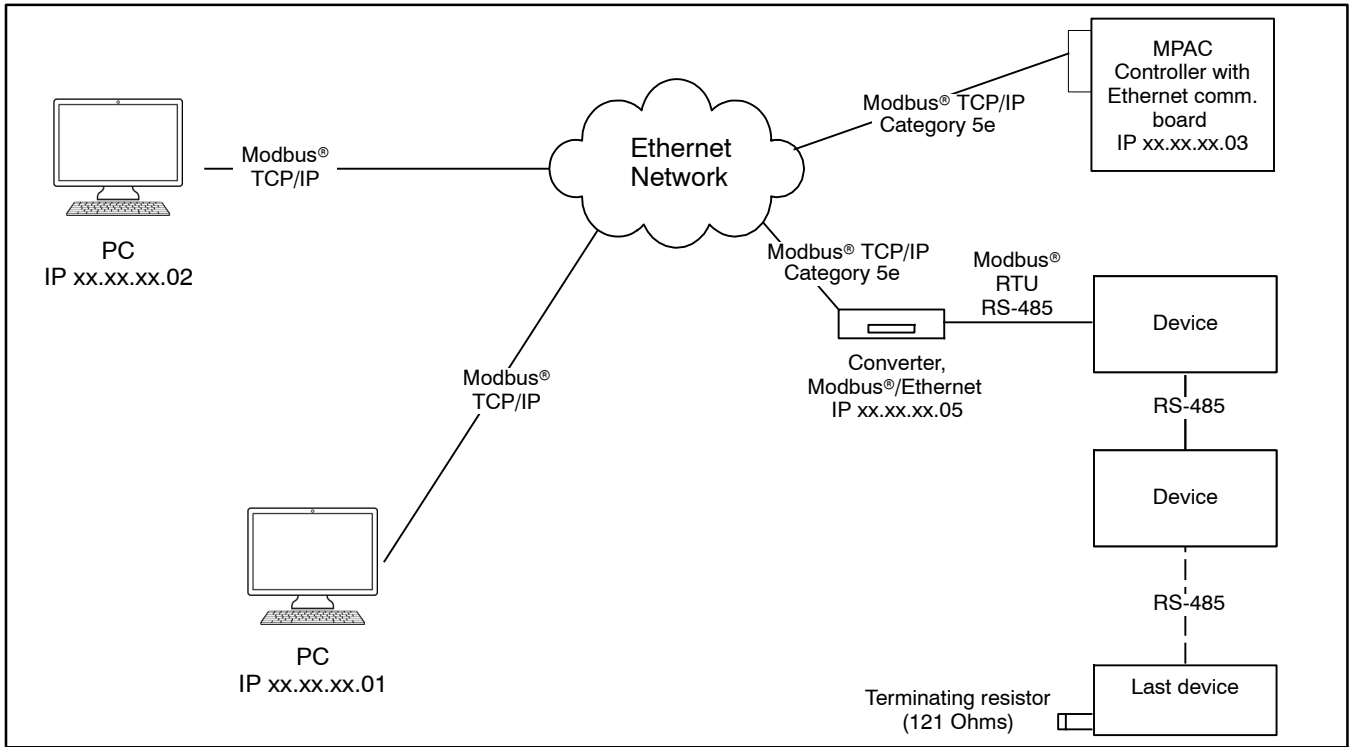
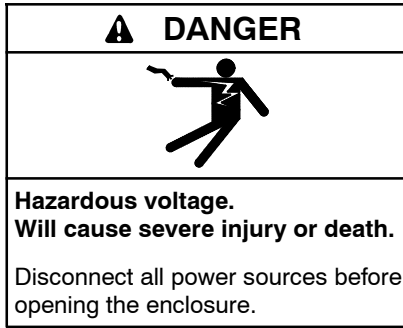


Figure 3-7 Ethernet Connections to Multiple-Device Network

3.3 Accessory Modules (MPAC 1200 only)



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) Press the generator set off/reset button to shut down the generator set. (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.

Accessory modules are available with the MPAC 1200 controller. This section provides specifications and field connection information for factory-installed accessory modules. If the modules are not factory-installed, follow the instructions provided with the kits to install the mounting assembly and modules.

The transfer switch uses a standard bus system for connecting accessory modules to the controller. This bus incorporates a standard serial communication interface for passing data back and forth between the main logic board and the assemblies on the expansion bus.

The module mounting kit holds up to five optional modules. Add the current draw for all modules installed to determine the total current draw. See Figure 3-8. The total current drawn by all modules must not exceed 300 mA. If an External Battery Module is installed and connected to a battery, there is no current restriction. The External Battery Module, if used, must be the last board on the bus.

| Module Current Draw Specifications, mA | |
|--|-----|
| Alarm Module | 75 |
| Standard I/O Module | 75 |
| High Power I/O Module | 100 |
| Note: EBSM required if total current is higher than 300 mA. | |

Figure 3-8 Module Current Requirements

3.3.1 Accessory Module Mounting

Mount the accessory modules on the module mounting plate. Starting at the end of the module mounting assembly nearest the cable connection, install any I/O modules first, then install the alarm board, if used. The external battery module, if used, must be the last module. See Figure 3-9. The alarm board has a fixed Modbus address = 5.

Note: Some models may have the I/O module assembly installed with the cable connection end pointing to the side or the bottom. Regardless of the actual orientation of the assembly, the I/O modules must be installed closest to the cable connection, followed by the alarm module and then the external battery module, if used.

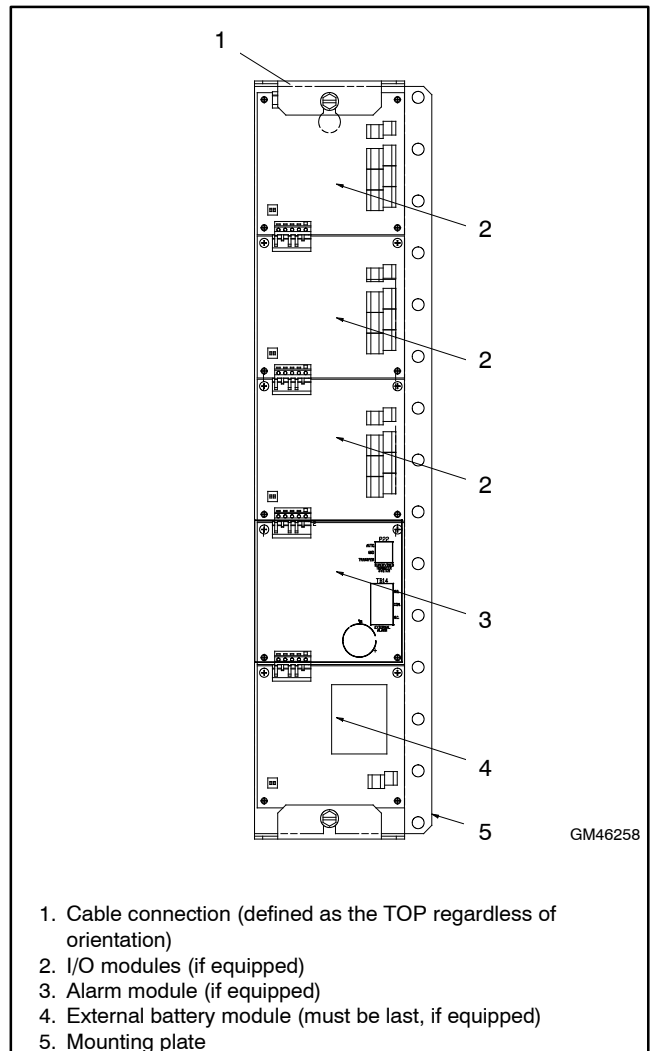


Figure 3-9 Module Mounting

3.3.2 Input/Output (I/O) Modules

Two types of input/output modules are available. The standard I/O Module has two inputs and six outputs. The high-power I/O module has two inputs and three outputs. See Figure 3-10 through Figure 3-13 for I/O module illustrations and specifications.

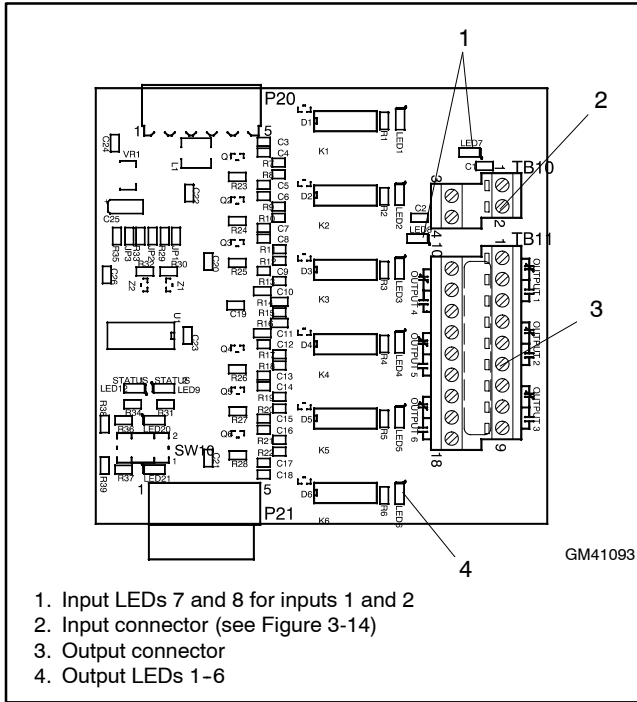


Figure 3-10 Standard Input/Output Module

| Inputs | |
|------------------------|----------------------------------|
| Available Inputs | 2 |
| Input Definition | Contact Closure |
| Current | 5 mA Max |
| Connection Type | Terminal Strip |
| Wire Size | #14-24 AWG |
| Max Distance | 700 feet |
| Outputs | |
| Outputs Available | 6 |
| Contact Type | Form C (SPDT) |
| Contact Voltage Rating | 2 A @ 30 VDC 500 mA @ 125 VAC |
| Connection Type | Terminal Strip |
| Wire Size | #14-24 AWG |

Figure 3-11 Standard I/O Module Specifications

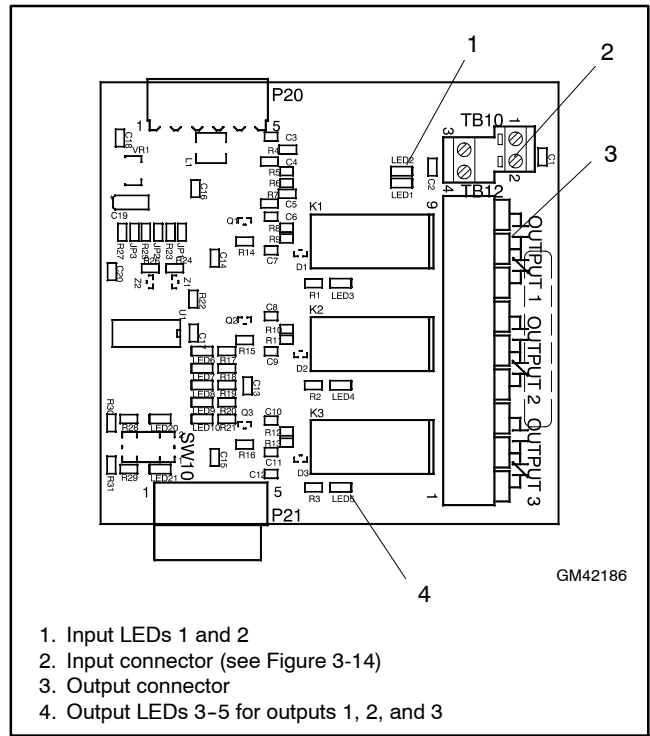


Figure 3-12 High-Power Input/Output Module

| Inputs | |
|------------------------------|--|
| Available Inputs | 2 |
| Input Definition | Contact Closure |
| Current | 5 mA Max |
| Connection Type | Terminal Strip |
| Wire Size | #14-24 AWG |
| Max Distance | 700 feet |
| Outputs | |
| Outputs Available | 3 |
| Contact Type | Form C (SPDT) |
| Contact Voltage Rating | 12 A @ 24 VDC 12 A @ 250 VAC 10 A @ 277 VAC 2 A @ 480 VAC |
| Connection Type | Terminal Strip |
| Wire Size | #14-24 AWG |
| Environmental Specifications | |
| Temperature | -40°C to 85°C (-40°F to 185°F) |
| Humidity | 35% to 85% noncondensing |

Figure 3-13 High-Power I/O Module Specifications

Use 14-24 AWG cable to connect to inputs and outputs. See Figure 3-14.

LEDs on the module circuit board light to indicate that each input or output is active.

Note: Each I/O module must have unique address.

Use the address DIP switches on the I/O module to assign a unique (different) address to each module as shown in Figure 3-15. Assign addresses in order from 1 to 4. An LED for each DIP switch lights to indicate that the switch is closed.

The alarm module's fixed address is 5. The battery module's fixed address is 6.

See the controller operation manual for instructions to assign functions to each input and output. Inputs and outputs can also be assigned using a personal computer with Kohler® SiteTech™ software or over Modbus. See TP-6701, SiteTech Operation Manual, or TP-6113, Modbus Protocol Manual.

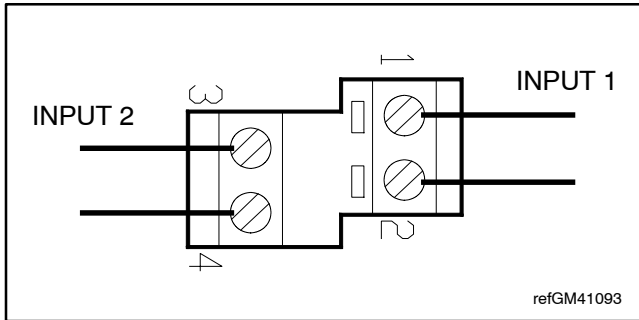
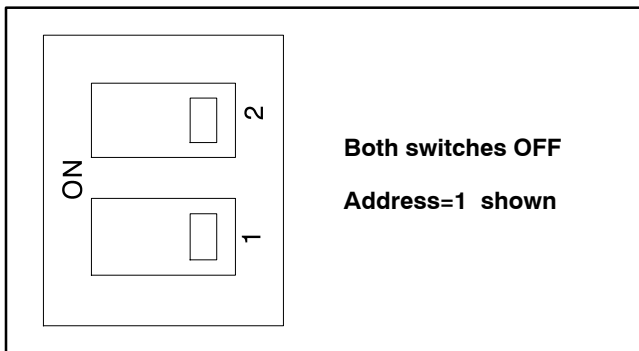


Figure 3-14 I/O Module Input Connections (TB1 or TB10)



| DIP Switch | | Address |
|------------|-----|---------|
| 1 | 2 | |
| Off | Off | 1 |
| On | Off | 2 |
| Off | On | 3 |
| On | On | 4 |

Figure 3-15 Address DIP Switch Settings

3.3.3 External Battery Supply Module (EBSM)

The external battery supply module kit allows connection to the generator set engine start battery(ies) or other batteries to provide 12 VDC power to the ATS controller. The external battery supply module kit is required for the following applications:

- **Systems using extended engine start time delays.** The EBSM provides power to the ATS controller during extended time delays longer than 15 seconds, when neither the Normal nor the Emergency source is available.
- **Installations with frequent utility power outages.** The EBSM provides power to the ATS controller when neither source is available, preserving the controller's backup battery.
- **Transfer switches equipped with multiple accessory modules that require a total of more than 300 mA current.** See Figure 3-8.

The EBSM produces 2 amps at 12 VDC with 9–36 VDC input. The EBSM input is reverse-polarity protected. The EBSM outputs a low battery voltage signal when the external battery voltage falls below 11 VDC for a 12-volt system or 22 VDC for a 24-volt system. The module is shown in Figure 3-16.

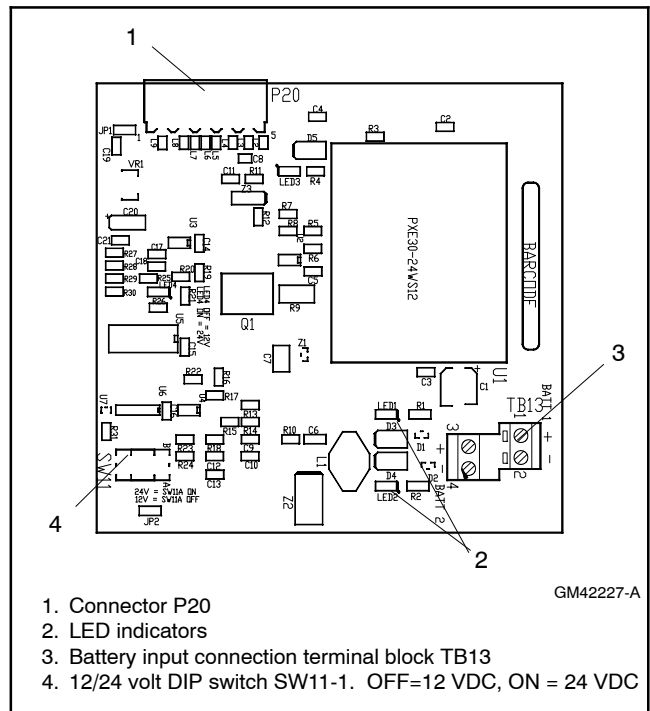


Figure 3-16 External Battery Supply Module

The external battery supply module kit includes one external battery supply circuit board and the circuit board mounting components. A module mounting kit is required for installation of the external battery supply module. See Section 3.3.1. Obtain a module mounting kit if one is not already installed and follow the instructions provided with the kits to install the mounting assembly and modules.

The battery voltage selection DIP switch SW11-1 allows selection between 12-volt and 24-volt systems for low battery voltage sensing and indication. Connect one or two batteries to the external battery supply module. Use a battery charger to maintain the battery(ies) connected to the EBSM.

| DIP Switch SW11-1 Setting | Battery Voltage |
|---------------------------|-----------------|
| OFF | 12 VDC |
| ON | 24 VDC |

Figure 3-17 Battery Voltage Selection

EBSM Connection and Voltage Setting

1. Use #14-28 AWG wire to connect one or two batteries to terminal block TB13. (A second battery can be connected but is not required.) Follow the marking on the board for the positive (+) and negative (-) connections. See Figure 3-16 and Figure 3-17.

Note: If the battery connections are reversed, red LED1 or LED2 will light. See Figure 3-16.

2. Set voltage selector switch SW11-1 to 12 or 24VDC. See Figure 3-16 and Figure 3-17. Switch SW11-2 is not used.

Note: The EBSM has no address switches but must be the last board on the bus.

3.3.4 Alarm Module

See Figure 3-18 for the optional alarm module. A module mounting kit is required for installation of the alarm module. See Section 3.3.1.

The functions provided by this board are:

- 90 dB Audible alarm (any alarm function can be programmed to trigger the audible alarm)
- Chicago alarm operation
- Preferred source selection
- Supervised transfer control (supervised transfer control switch required)
- Connection for external alarm

The alarm board has a fixed address = 5.

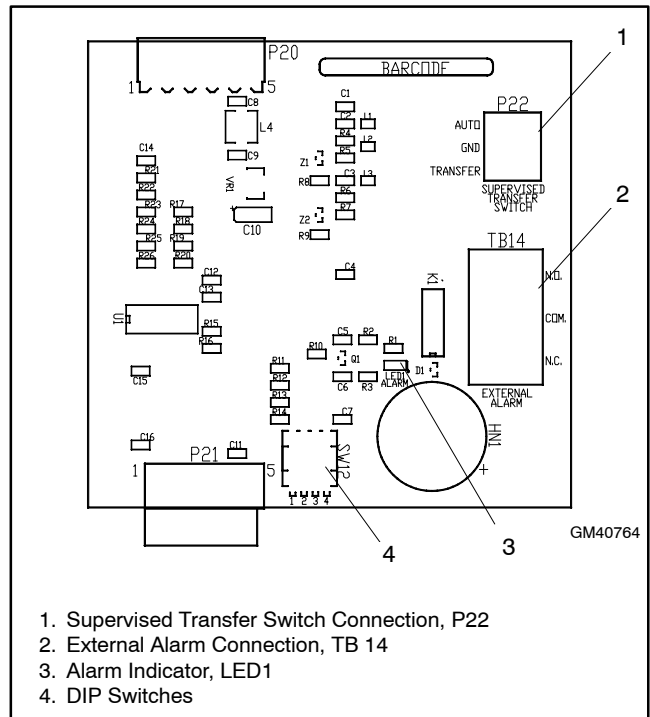


Figure 3-18 Alarm Module

Alarm Board DIP Switches

There are four DIP switches on the alarm module board. Some of the switches are not used. See Figure 3-19. To enable the preferred source selection, set DIP switch 1 to ON. If the supervised transfer switch is installed on the ATS, set DIP switch 2 to ON.

| DIP Switch | Function |
|------------|----------------------------|
| 1 | Preferred source selection |
| 2 | Supervised transfer enable |
| 3 | Not used |
| 4 | Not used |

Figure 3-19 Alarm Board DIP Switches

Preferred Source Selection

The alarm module is required for preferred source selection. To enable the preferred source selection, set DIP switch 1 to ON. Then see the controller operation manual for instructions to select Source N or Source E as the preferred source.

External Alarm

A customer-supplied external alarm horn can be connected to the alarm module at terminal block TB14. Connect to the normally open or normally closed contact as recommended by the alarm manufacturer's instructions. See Figure 3-20.

| Item | Specification |
|------------------------|------------------|
| Wire Size | #12-22 AWG Cu |
| Contact Voltage Rating | 500 mA @ 120 VAC |
| | 250 mA @ 240 VAC |

Figure 3-20 External Alarm Connection Specifications

Audible Alarm Setup

The alarm board is equipped with a 90 dB audible alarm. The audible alarm can be set to sound under selected fault conditions. Use the Common Alarms Setup menu to assign functions to the audible alarm. See the controller operation manual for instructions to set Audible Alarm: Y for each function that should trigger the alarm.

Alarm Operation, Normal Mode

In Normal Mode, the horn sounds anytime a fault event happens in the system. The horn continues to sound unless the alarm silence button is pressed. When the fault is cleared, the alarm silence is ended and reset for the next alarm.

Alarm Operation, Chicago Alarm Mode

Chicago Alarm mode requires the horn to sound and a lamp or LED to light when the switch is in the emergency (non-preferred) position. The horn continues to sound unless the alarm silence button is pressed. When the fault is cleared, the alarm silence is ended and reset for the next alarm.

For Chicago Alarm Mode, use the Common Alarm Setup menu to assign the necessary faults and conditions to the audible alarm. See the controller operation manual for instructions to assign common faults. Be sure to assign the Contactor in Standby condition to trigger the audible alarm.

A remote alarm or indicator light can also be connected to the alarm board to indicate the alarm condition, as described previously. See External Alarm.

Alarm Silence Mode

In Alarm Silence Mode, the horn is disabled. Alarm Silenced appears on the display and the system alert LED lights.

The Alarm Silenced condition can be assigned to a programmable output. See the controller operation manual for instructions to assign outputs.

Instructions to Silence the Alarm in Normal and Chicago Alarm Modes

When the alarm is activated, the word Alarm appears on the main display menu above the first button. See Figure 3-21. Press the Alarm button to open the Reset menu. Then press the button labeled Reset to silence the alarm.

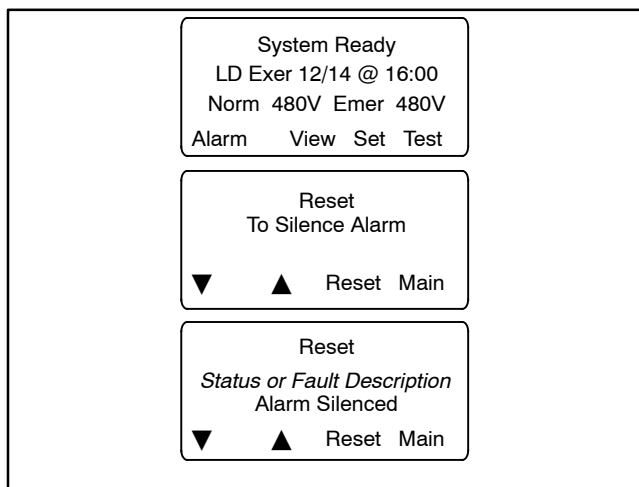
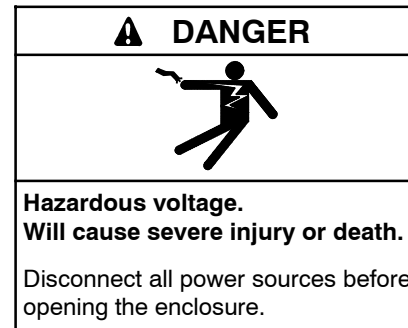


Figure 3-21 Alarm Silence

3.4 Heater



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) Press the generator set off/reset button to shut down the generator set. (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.

An anti-condensation heater kit is available. The strip heater is controlled by a hygrostat to raise the temperature inside the enclosure above the dew point to prevent condensation. Figure 3-22 shows a typical location of the heater kit components inside the enclosure.

The installer must connect 120 VAC power to the terminal block near the hygrostat. See Figure 3-23 and Figure 3-24. The heater and hygrostat are connected to power through a 15-amp circuit breaker.

The relative humidity setting on the hygrostat is adjustable from 35% to 95%. A setting of 65% is recommended.

Because of space limitations in the smaller enclosures, 30–225 Amp Model KSS switches can include either an enclosure heater or a surge protection device (SPD), but not both.

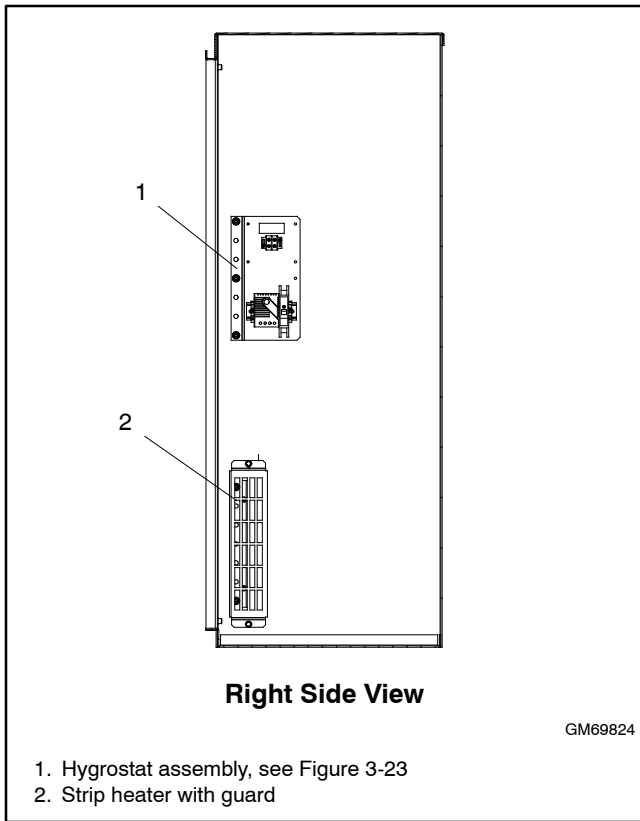


Figure 3-22 Heater Location, Typical

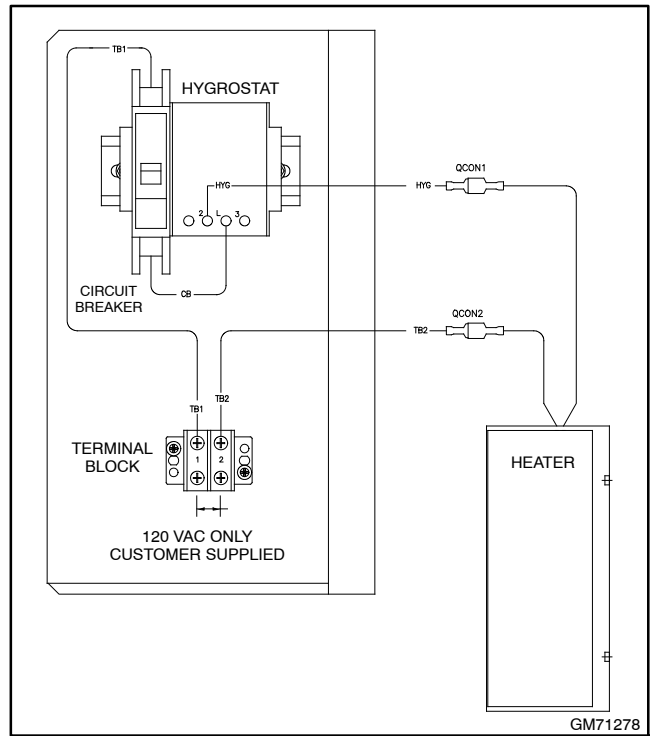


Figure 3-24 Heater Connections

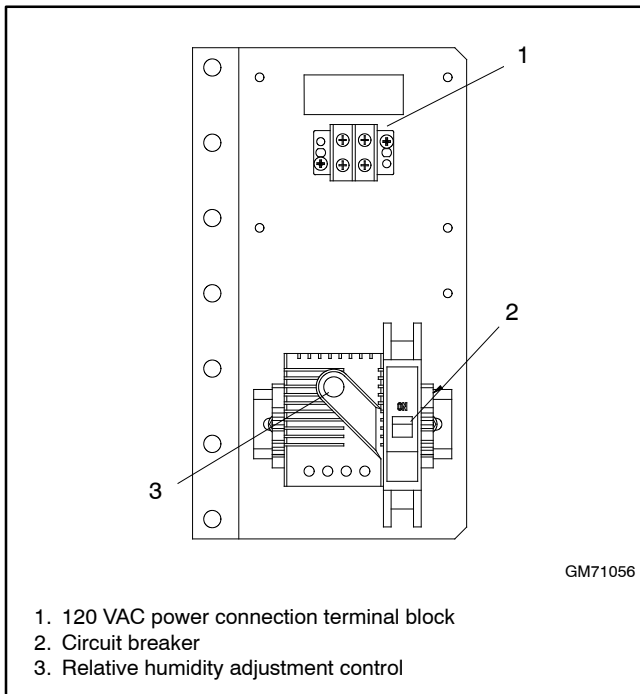
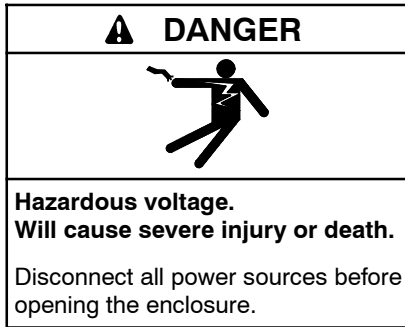


Figure 3-23 Hygrostat Assembly, Typical

3.5 Load Shed (Forced Transfer to OFF, KSP with MPAC 1200 only)



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) Press the generator set off/reset button to shut down the generator set. (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.

The load shed (forced transfer to OFF) accessory must be factory-installed. The load shed accessory is available only on programmed-transition transfer switches with the MPAC 1200 controller. See Figure 3-25 for an illustration of the load shed accessory.

The load shed function requires an external signal (contact closure) to initiate transfer to the OFF position.

Connect the external contact to input #1 (if available) or input #2 on connector TB1 on the main logic board. See Figure 3-26. Use #12-24 AWG wire and tighten to 0.5 Nm (4.4 in. lb.).

Use the Input/Output setup menu or Kohler SiteTech software to assign the connected input (Main Board Input #1 or #2) to the forced transfer to off function. If the external contact is connected to a different input connection on an optional I/O module, assign the forced transfer to off function to that input.

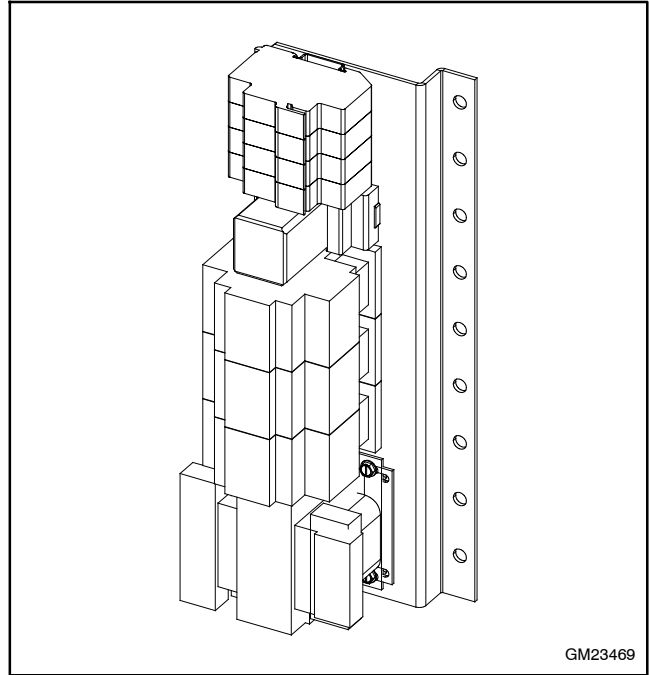


Figure 3-25 Load Shed Accessory (for identification)

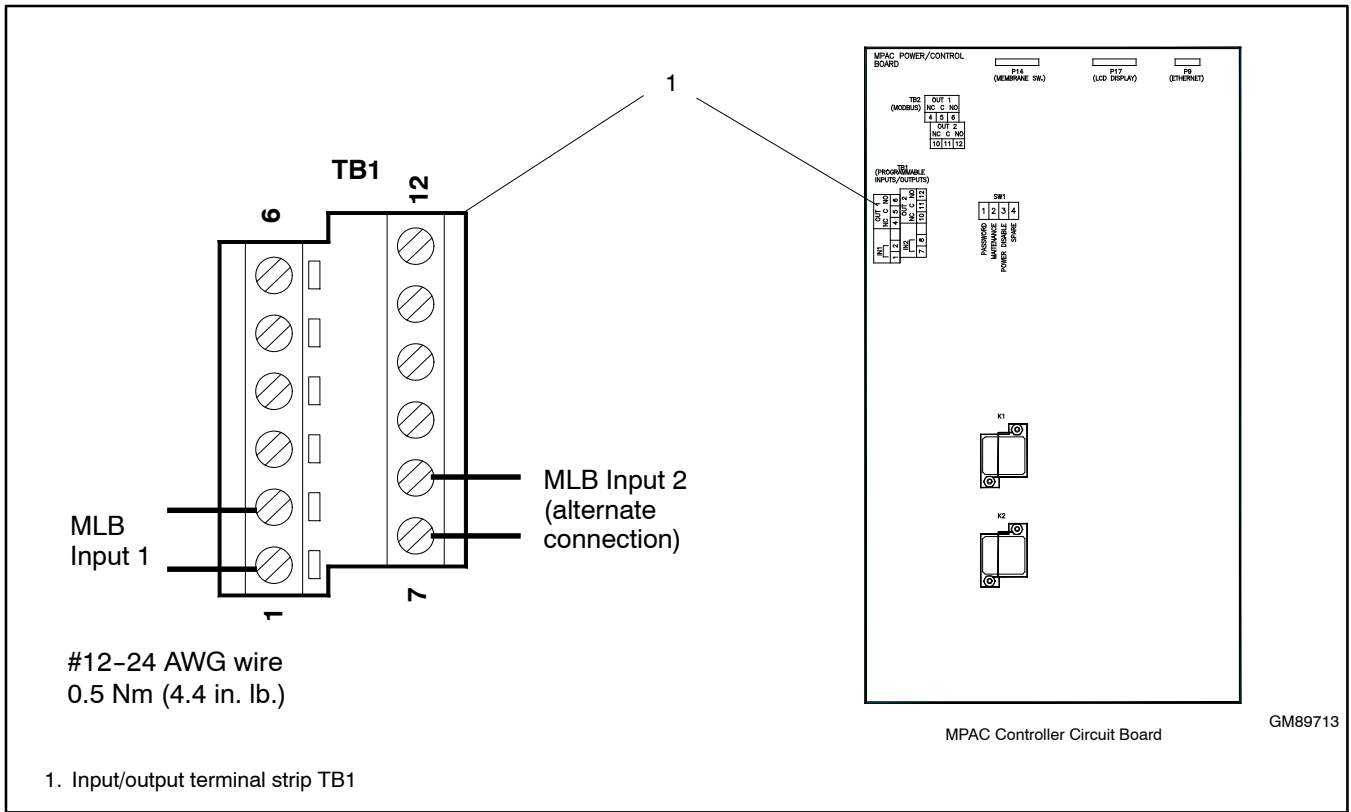


Figure 3-26 Forced Transfer to Off Input Connection (for factory-installed load shed kits)

3.6 Programmable Exerciser

An optional programmable exerciser is available for transfer switches equipped with the Decision-Maker® MPAC 750 controller.

The optional programmable exerciser is a 7-day timer that allows programming of up to 8 on/off events per day. See Figure 3-27. Use the exercise timer to schedule weekly loaded or unloaded exercise runs in addition to the exercise time set through the ATS controller. The timer is installed inside the ATS enclosure.

The programmable exerciser uses the Remote Test input to the transfer switch controller. Refer to the instruction sheet provided with the exerciser for installation, connection, loaded/unloaded test selection, and programming instructions. See Section 2.6.1 for input connection information.

A personal computer and Kohler® SiteTech™ software are required to set up the remote exerciser. SiteTech software is available to Kohler-authorized distributors and dealers.



Figure 3-27 Programmable Exerciser

3.7 Other Accessories

Refer to the following documentation for instructions to install, connect, and operate optional accessories.

- Transfer switch wiring diagrams.
- Installation instructions provided with loose accessory kits.
- Controller Operation Manual. See List of Related materials in the Introduction section of this manual for document numbers.

Section 4 Functional Tests and Setup

4.1 Introduction

Be sure to perform all of the functional tests described in this section before putting the transfer switch into operation.

The functional tests include the following checks:

- Manual Operation Test
- Voltage Checks
- Automatic Operation Test

Note: Perform these checks in the order presented to avoid damaging the ATS.

Read all instructions on the labels affixed to the automatic transfer switch before proceeding.

To complete the installation, follow the instructions in this section to:

- Set the time, date, and exercise schedule on the controller.
- Perform the system startup procedures listed on the startup form.
- Register the unit using the Kohler® online Warranty Processing System.

4.2 Manual Operation Test

If you have not already done so, test the contactor manual operation before proceeding to the voltage check and electrical operation test.

Note: Disable the generator set and disconnect the power by opening the circuit breakers or switches for both sources before manually operating the transfer switch.

Follow the instructions in the Installation Section to check the transfer switch manual operation.

A contactor in normal and serviceable condition transfers smoothly without binding when operated manually. Do not place the transfer switch into service if the contactor does not operate smoothly without binding; contact an authorized distributor/dealer to service the contactor.

4.3 Voltage Check

The voltage, frequency, and phasing of the transfer switch and the power sources must be the same to avoid damage to loads and the transfer switch. Compare the voltage and frequency ratings of the utility source, transfer switch, and generator set, and verify that the ratings are all the same.

Use the voltage check procedure explained in this section to verify that the voltages and phasing of all power sources are compatible with the transfer switch before connecting the power switching device and controller wire harnesses together.

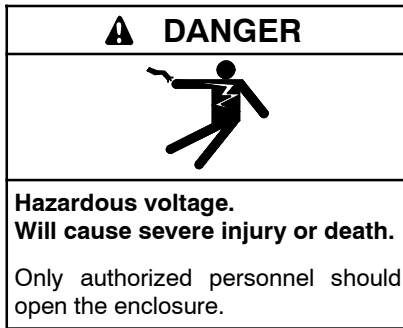
Follow the instructions provided with the generator set to prepare the generator set for operation.

Read and understand all instructions on installation drawings and labels on the switch. Note any optional accessories that have been furnished with the switch and review their operation.

Note: Source N is the source connected to the normal side of the contactor. Source E is the source connected to the emergency side of the contactor. Verify that the source leads are connected to the correct lugs before proceeding.

The voltage check procedure requires the following equipment:

- A digital voltmeter (DVM) with electrically insulated probes capable of measuring the rated voltage and frequency
- A phase rotation meter



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)

Voltage Check Procedure

1. If Source N is a generator set, move the generator set master switch to the RUN position. The generator set should start.
2. Close the Source N circuit breaker or switch.
3. Use a voltmeter to check the Source N (normal) phase-to-phase and phase-to-neutral (if applicable) terminal voltages and frequency.
 - a. If Source N is the utility and the measured input does not match the voltage and frequency shown on the transfer switch nameplate, **STOP!** Do not proceed further in installation because the transfer switch is not designed for the application—call your distributor/dealer to order the correct transfer switch.
 - b. If Source N is a generator set and the generator set output voltage and frequency do not match the nominal system voltage and frequency shown on the transfer switch nameplate, follow the manufacturer's instructions to adjust the generator set. The automatic transfer switch will only function with the rated system voltage and frequency specified on the nameplate.

4. Use a phase rotation meter to check the phase rotation at the Source N (normal) terminals. Rewire the transfer switch Source N terminals to obtain the correct phase sequence if necessary.

Note: The default setting for the phase rotation on the controller is ABC. If the application uses a phase rotation of BAC, refer to the controller Operation Manual for instructions to change the phase rotation setting on the controller.

5. If the source is a generator set, stop the generator set by moving the master switch to the OFF position.
6. Disconnect Source N by opening upstream circuit breakers or switches.
7. Repeat steps 1 through 5 for Source E. Then proceed to step 8.
8. Disconnect both sources to the transfer switch by opening the circuit breakers or switches.
9. Close and lock the transfer switch enclosure door.
10. Reconnect both power sources by closing the circuit breakers or switches.
11. Move the generator set master switch to the AUTO position.

Note: If the engine cooldown time delay setting is not set to zero (default setting), the generator set may start and run until the Engine Cooldown Time Delay ends.

12. Perform the lamp test and then proceed to the automatic operation test.

4.4 Automatic Operation Test

Check the transfer switch's automatic control system immediately after the voltage check. Refer to the controller Operation Manual for instructions to run the automatic operation test.

Note: Close and lock the enclosure door before starting the test procedure.

4.5 System Setup

Set the controller's current time and date. See the controller Operation Manual for instructions.

The transfer switch is factory-set with default settings for time delays and other parameters. See the controller Operation Manual for instructions to view and change settings, if necessary.

Note: Use caution when changing transfer switch settings. The source voltage and frequency settings must match the values shown on the transfer switch nameplate.

4.6 Exerciser Setup

Set the exerciser to start and run the generator set at least once a week. See the controller Operation Manual for instructions.

Transfer switches equipped with the Decision-Maker® MPAC 750 controller may also use the optional programmable exerciser. Refer to the instructions provided with the exerciser to schedule additional loaded or unloaded exercise runs.

4.7 User Interface Cover

The gasket-sealed, hinged user interface cover prevents unauthorized access to the transfer switch controls and protects the user interface from harsh environmental conditions. The cover is available as an optional accessory for NEMA 1 enclosures. NEMA 3R enclosures include the cover as standard equipment.

Use a customer-supplied padlock to lock the cover.

4.8 Startup Notification

Perform the system startup procedure explained on the Startup Notification Form. The Startup Notification Form covers all equipment in the power system. Complete the Startup Notification Form and register the power system using the Kohler® online Warranty Processing System.

Notes

Appendix A Abbreviations

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

| | | | | | |
|-----------|--|-----------------------------|--|----------------------|--|
| A, amp | ampere | cfm | cubic feet per minute | exh. | exhaust |
| ABDC | after bottom dead center | CG | center of gravity | ext. | external |
| AC | alternating current | CID | cubic inch displacement | F | Fahrenheit, female |
| A/D | analog to digital | CL | centerline | FHM | flat head machine (screw) |
| ADC | advanced digital control; analog to digital converter | cm | centimeter | fl. oz. | fluid ounce |
| adj. | adjust, adjustment | CMOS | complementary metal oxide substrate (semiconductor) | flex. | flexible |
| ADV | advertising dimensional drawing | com | communications (port) | freq. | frequency |
| Ah | amp-hour | coml | commercial | FS | full scale |
| AHWT | anticipatory high water temperature | Coml/Rec | Commercial/Recreational connection | ft. | foot, feet |
| AISI | American Iron and Steel Institute | conn. | connection | ft. lb. | foot pounds (torque) |
| ALOP | anticipatory low oil pressure | cont. | continued | ft./min. | feet per minute |
| alt. | alternator | CPVC | chlorinated polyvinyl chloride | ftp | file transfer protocol |
| Al | aluminum | crit. | critical | g | gram |
| ANSI | American National Standards Institute (formerly American Standards Association, ASA) | CSA | Canadian Standards Association | ga. | gauge (meters, wire size) |
| AO | anticipatory only | CT | current transformer | gal. | gallon |
| APDC | Air Pollution Control District | Cu | copper | gen. | generator |
| API | American Petroleum Institute | cUL | Canadian Underwriter's Laboratories | genset | generator set |
| approx. | approximate, approximately | CUL | Canadian Underwriter's Laboratories | GFI | ground fault interrupter |
| APU | Auxiliary Power Unit | cu. in. | cubic inch | GND, ⊕ | ground |
| AQMD | Air Quality Management District | cw. | clockwise | gov. | governor |
| AR | as required, as requested | CWC | city water-cooled | gph | gallons per hour |
| AS | as supplied, as stated, as suggested | cyl. | cylinder | gpm | gallons per minute |
| ASE | American Society of Engineers | D/A | digital to analog | gr. | grade, gross |
| ASME | American Society of Mechanical Engineers | DAC | digital to analog converter | GRD | equipment ground |
| assy. | assembly | dB | decibel | gr. wt. | gross weight |
| ASTM | American Society for Testing Materials | dB(A) | decibel (A weighted) | H x W x D | height by width by depth |
| ATDC | after top dead center | DC | direct current | HC | hex cap |
| ATS | automatic transfer switch | DCR | direct current resistance | HCHT | high cylinder head temperature |
| auto. | automatic | deg., ° | degree | HD | heavy duty |
| aux. | auxiliary | dept. | department | HET | high exhaust temp., high engine temp. |
| avg. | average | dia. | diameter | hex | hexagon |
| AVR | automatic voltage regulator | DI/EO | dual inlet/end outlet | Hg | mercury (element) |
| AWG | American Wire Gauge | DIN | Deutsches Institut für Normung e. V. (also Deutsche Industrie Normenausschuss) | HH | hex head |
| AWM | appliance wiring material | DIP | dual inline package | HHC | hex head cap |
| bat. | battery | DPDT | double-pole, double-throw | HP | horsepower |
| BBDC | before bottom dead center | DPST | double-pole, single-throw | hr. | hour |
| BC | battery charger, battery charging | DS | disconnect switch | HS | heat shrink |
| BCA | battery charging alternator | DVR | digital voltage regulator | hsg. | housing |
| BCI | Battery Council International | E ² PROM, EEPROM | electrically-erasable programmable read-only memory | HVAC | heating, ventilation, and air conditioning |
| BDC | before dead center | E, emer. | emergency (power source) | HWT | high water temperature |
| BHP | brake horsepower | ECM | electronic control module, engine control module | Hz | hertz (cycles per second) |
| blk. | black (paint color), block (engine) | EDI | electronic data interchange | IBC | International Building Code |
| blk. htr. | block heater | EFR | emergency frequency relay | IC | integrated circuit |
| BMEP | brake mean effective pressure | e.g. | for example (<i>exempli gratia</i>) | ID | inside diameter, identification |
| bps | bits per second | EG | electronic governor | IEC | International Electrotechnical Commission |
| br. | brass | EGSA | Electrical Generating Systems Association | IEEE | Institute of Electrical and Electronics Engineers |
| BTDC | before top dead center | EIA | Electronic Industries Association | IMS | improved motor starting |
| Btu | British thermal unit | EI/EO | end inlet/end outlet | in. | inch |
| Btu/min. | British thermal units per minute | EMI | electromagnetic interference | in. H ₂ O | inches of water |
| C | Celsius, centigrade | emiss. | emission | in. Hg | inches of mercury |
| cal. | calorie | eng. | engine | in. lb. | inch pounds |
| CAN | controller area network | EPA | Environmental Protection Agency | Inc. | incorporated |
| CARB | California Air Resources Board | EPS | emergency power system | ind. | industrial |
| CAT5 | Category 5 (network cable) | ER | emergency relay | int. | internal |
| CB | circuit breaker | ES | engineering special, engineered special | int./ext. | internal/external |
| CC | crank cycle | ESD | electrostatic discharge | I/O | input/output |
| cc | cubic centimeter | est. | estimated | IP | internet protocol |
| CCA | cold cranking amps | E-Stop | emergency stop | ISO | International Organization for Standardization |
| ccw. | counterclockwise | etc. | et cetera (and so forth) | J | joule |
| CEC | Canadian Electrical Code | | | JIS | Japanese Industry Standard |
| cert. | certificate, certification, certified | | | k | kilo (1000) |
| cfh | cubic feet per hour | | | K | kelvin |
| | | | | kA | kiloampere |
| | | | | KB | kilobyte (2 ¹⁰ bytes) |
| | | | | KBus | Kohler communication protocol |
| | | | | kg | kilogram |

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

Notes

Notes

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KOHLER[®] Power Systems

KOHLER CO. Kohler, Wisconsin 53044
Phone 920-457-4441, Fax 920-459-1646
For the nearest sales/service outlet in the
US and Canada, phone 1-800-544-2444
KOHLERPower.com

Kohler Power Systems
Asia Pacific Headquarters
7 Jurong Pier Road
Singapore 619159
Phone (65) 6264-6422, Fax (65) 6264-6455