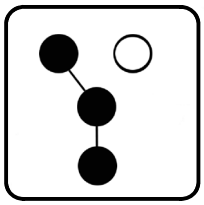
Operation and Installation

Automatic Transfer Switches



Model:

SE-ILC

Service Entrance-Rated Transfer Switch
with Integrated Load Center
GM39766-SA1

200 Amps

Electrical Controls:
MPAC™ 500

ISO 9001
KOHLER POWER SYSTEMS
NATIONALLY REGISTERED

KOHLER®
POWER SYSTEMS

TP-6378 7/05

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 _____

Accessory Number	Accessory Description

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

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

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

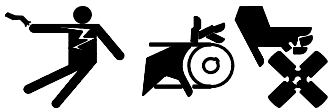
NOTICE

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

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

Accidental Starting

⚠ WARNING



Accidental starting.
Can cause severe injury or death.

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

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

Hazardous Voltage/ Electrical Shock

⚠ 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. Electrocution is possible whenever electricity is present. Open the main circuit breakers of all power sources before servicing the equipment. Configure the installation to electrically ground the generator set, transfer switch, and related equipment and electrical circuits to comply with applicable codes and standards. 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. Open 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.

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.

Moving Parts

⚠ WARNING

Airborne particles.
Can cause severe injury or blindness.

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

Notice

NOTICE

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

NOTICE

When replacing hardware, do not substitute with inferior grade hardware. Screws and nuts are available in different hardness ratings. To indicate hardness, American Standard hardware uses a series of markings, and metric hardware uses a numeric system. Check the markings on the bolt heads and nuts for identification.

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 Kohler® Model SE-ILC service entrance rated automatic transfer switches with MPAC™ 500 electrical controls.

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.

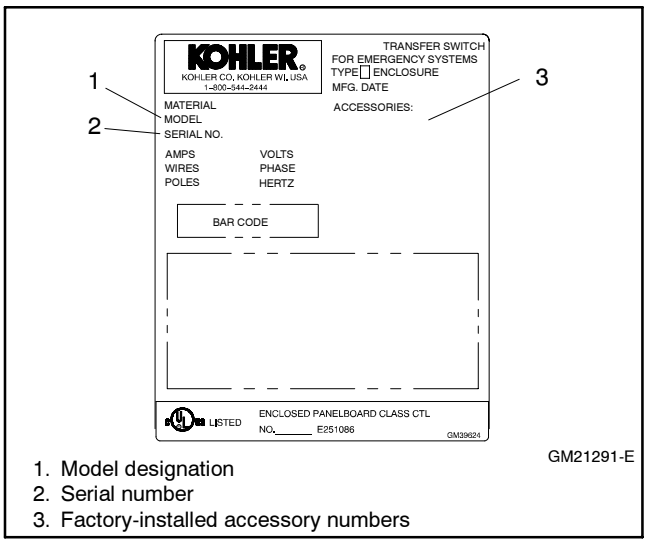
The equipment service requirements are very important to safe and efficient operation. Inspect parts often and perform required service at the prescribed intervals. Obtain service from an authorized service distributor/ dealer to keep equipment in top condition.

Nameplate

A nameplate attached to the inside of the enclosure cover includes a model designation, a serial number, ratings, and other information about the transfer switch. See Figure 1.

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

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



1. Model designation
2. Serial number
3. Factory-installed accessory numbers

Figure 1 Typical Transfer Switch Nameplate

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 KohlerPowerSystems.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
ZI Senia 122
12, rue des Hauts Flouviers
94517 Thiais Cedex
France
Phone: (33) 1 41 735500
Fax: (33) 1 41 735501

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

1.1 Transfer Switch Operation

An automatic transfer switch (ATS) transfers electrical loads from a normal source of electrical power to an emergency source when the normal source voltage or frequency falls below an acceptable level. The normal source is typically utility power. The emergency source is usually a generator set.

When the normal source fails, the ATS signals the emergency source generator set to start. When the emergency source reaches acceptable levels and stabilizes, the ATS transfers the electrical load to the emergency source.

The ATS continuously monitors the normal source and transfers the load back when the normal source returns and stabilizes. After transferring the load back to the normal source, the ATS removes the generator start signal, allowing the generator set to shut down.

Figure 1-1 shows a typical installation block diagram.

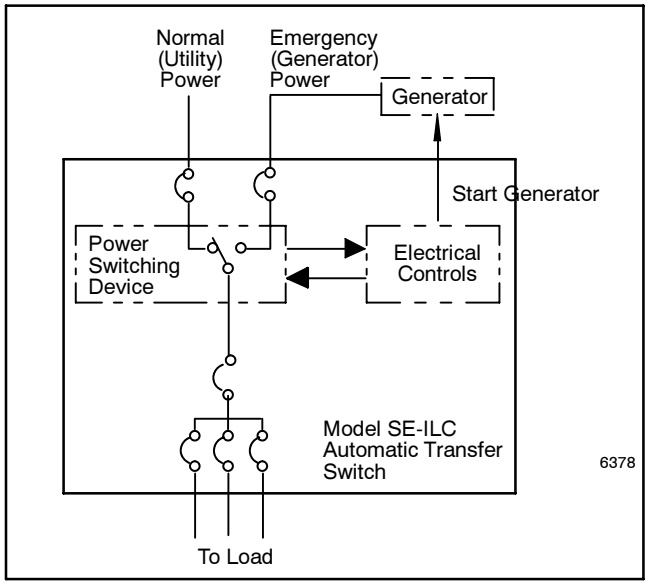


Figure 1-1 Typical ATS Block Diagram

1.2 Load Centers

Model SE-ILC 200 amp transfer switches are equipped with Square D 42-circuit type QO load centers.

Loads. Verify that the generator set and transfer switch are adequately rated to supply all of the connected loads.

Circuit breakers. The ATS load center requires Square D type QO breakers. Because the size and number of circuit breakers required will vary with each application, circuit breakers are not provided with the transfer switch load center. Verify that the total rating for all of the breakers used in the load center does not exceed the rating of the transfer switch.

1.3 Surge Protection

Two transient voltage surge suppression (TVSS) modules provide 100 kA protection for both the normal and emergency sources.

1.4 Service Disconnect

Two 250-Amp circuit breakers provide the service disconnect for the normal and emergency sources.

Notes

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, and verify that the installation complies with applicable codes and standards. Protect the switch against damage before and during installation.

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 Storage

Store the transfer switch in its protective packing until final installation. Protect the transfer switch at all times from moisture, construction grit, and metal chips. Avoid storage in cold or damp areas where moisture could condense on the unit. See Figure 2-1 for acceptable storage temperatures.

2.2.3 Lifting

⚠ 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.

See Figure 2-2 or the dimension drawing for the 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.

2.2.4 Unpacking

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

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

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

Figure 2-1 Environmental Specifications

Weight, kg (lb.)	Dimensions, mm (in.)		
	H	W	D
41 (90)	1299 (51.1)	610 (24.0)	178 (7.0)

Figure 2-2 Transfer Switch Weight and Dimensions

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.

NOTICE

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

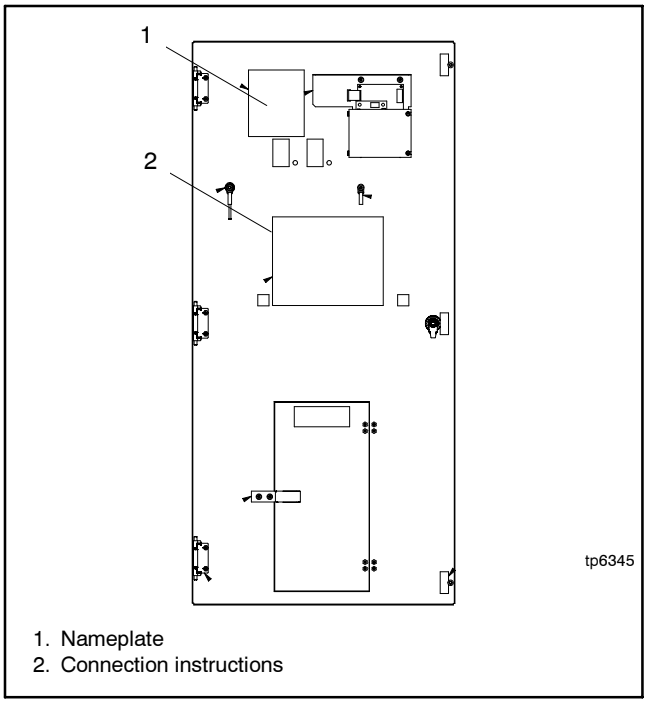
Check the system voltage and frequency. Compare the voltage and frequency shown on the transfer switch nameplate to the source voltage and frequency. See Figure 2-3. Do not install the transfer switch if the voltage and frequency are different from the normal (utility) source voltage and frequency or the emergency source voltage and frequency shown on the generator set nameplate.

Plan the installation. Use the dimensions given on the enclosure dimension (ADV) drawings in Section 6. 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 open the enclosure and service the switch.

Mounting. Cover or remove the transfer switch's internal components to protect them from drill chips or debris during installation. Mount the transfer switch to a wall or other rigid vertical supporting structure. Clearance holes through the back of each enclosure are provided for mounting. Use shims to plumb the enclosure.

Use a vacuum cleaner to remove debris from the enclosure. Reinstall any internal components that were removed and tighten the mounting screws to 2.9 Nm (26 in. lbs.).

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



1. Nameplate
2. Connection instructions

Figure 2-3 Nameplate Location, Enclosure Door (inside)

2.4 Manual Operation Check

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

Check the manual operation before energizing the transfer switch. Verify that the contactor operates smoothly without binding. Do not place the transfer switch into service if the contactor does not operate smoothly.

After checking the manual operation, place the contactor in the Normal (utility) position.

Note: Never manually operate the transfer switch when the power is connected. Disconnect both power sources before manually operating the switch.

Manual Operation Procedure

1. Move the handle up to place the transfer switch in the Normal Source position and down to place the contactor in the Emergency Source position. See Figure 2-4.

2. Move the handle up to place the transfer switch in the Normal Source position for normal operation.

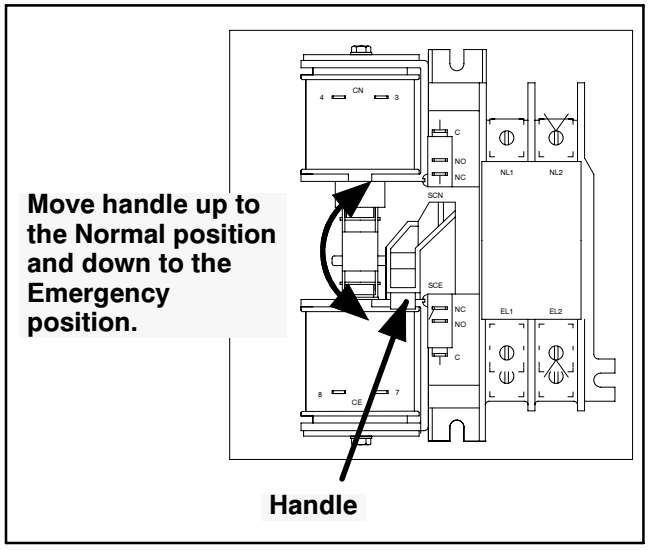


Figure 2-4 Manual Operation

2.5 Electrical Wiring

All wiring must comply with applicable national, state, and local electrical codes. Use separate conduit for AC power wiring and low-voltage DC, control, and communication system wiring.

Refer to the connection diagrams on the transfer switch enclosure door (see Figure 2-3) and the wiring diagrams in Section 6 during installation.

⚠ 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. Electrocution is possible whenever electricity is present. Open the main circuit breakers of all power sources before servicing the equipment. Configure the installation to electrically ground the generator set and related equipment and electrical circuits to comply with applicable codes and standards. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

2.5.1 Load Center Circuit Breakers

The ATS load center uses Square D type QO breakers. Obtain and install Square D type QO circuit breakers as required for the application. Install cover plates over any vacant positions in the load panel.

Verify that the total rating for all of the breakers used in the load center does not exceed 200 Amps (the transfer switch rating).

2.5.2 AC Power Connections

Determine the cable size. Refer to the table in Figure 2-5 to determine the cable size required for the transfer switch.

Screw-Type Terminals for External Power Connections			
Switch Size, Amps	Range of Wire Sizes, Al/Cu		
	Disconnect Breakers	Neutral	Ground
200	(1) #4 AWG to 300 MCM	(1) #4 AWG to 250 MCM	(1) #14 AWG to #4 AWG

Figure 2-5 Cable Sizes

Conduit. Use separate conduit for AC power wiring and low-voltage DC, control, and communication system wiring.

Connect the sources. 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.

The transfer switch lugs are factory-wired to the service disconnect circuit breakers and the load panel. Field connections to the transfer switch lugs are not required.

Refer to Figure 6-2 (ADV-7042B) for source, neutral, and ground connection points. Connect the normal source (typically the utility power) to the Normal Disconnect circuit breaker. Connect the emergency source (typically the generator set) to the Emergency Disconnect circuit breaker.

Note: The neutral connection is required for transfer switch operation.

Connect the normal source neutral, emergency source neutral, and load neutral to the neutral lug in the ATS enclosure. The neutral connection is required for sensing and control. If the neutral is lost, the transfer switch will not operate.

Grounding. Ground the transfer switch and generator set in accordance with the NEC and local codes.

Connect the load leads. Connect the load leads to the circuit breakers in the load center. Check that the load does not exceed the rating for each breaker.

Connect the load neutral to the neutral lug in the ATS enclosure.

Verify that all connections are consistent with drawings before tightening. Tighten all cable connections to the torque values shown on the labels on the switch and breakers. Carefully wipe off any excess joint compound after tightening.

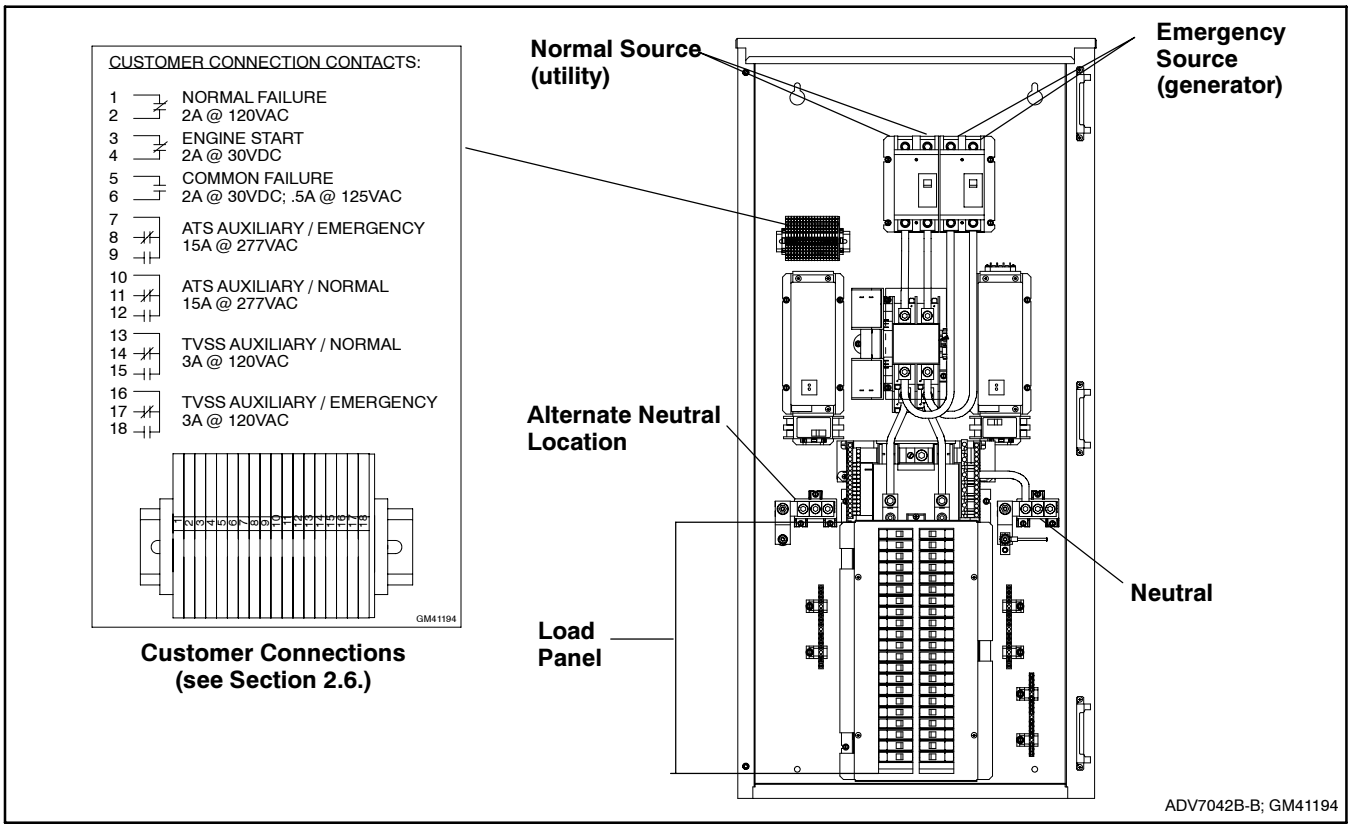


Figure 2-6 Connections

2.6 Customer Connections

The customer connection terminal block shown in Figure 2-6 allows connection of the generator set engine start leads and customer-supplied equipment for remote indication of normal source failure, common faults, transfer switch position, and TVSS module status.

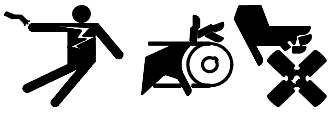
Wire Size. Use wire size #12–18 AWG for connections to the customer connection terminal block.

Contact	Contact State	Condition
Normal Fail	Open	Normal source present
	Closed	Normal source lost
Engine Start	Open	Normal source present
	Closed	Normal source lost
Common Failure	Open	No fault
	Closed, latched	Fault

Figure 2-7 Contact Operation

2.6.1 Engine Start Connections

⚠ 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.

The engine start contact is held open by the normal source. The contact closes when the normal source is lost, signalling the generator set to start and run. When the normal source returns, the contact remains closed until the ATS transfers back to normal and the engine cooldown time delay expires.

Connect the engine start leads from the generator set to terminals 3 and 4 on the customer connection terminal block. See Figure 2-6 for the location of the engine start contacts.

2.6.2 Normal Failure Contact

The normal failure contact closes when the normal source is lost. Connect customer-supplied equipment to the normal failure contact terminals on the customer connection terminal strip, if desired. See Section 3.3.1 for source sensing information.

2.6.3 Common Failure Contact

The normally open (NO) common failure contact closes and latches on the following fault conditions:

- Failure to acquire emergency source
- Failure to transfer
- Position-indicating auxiliary contact fault

Connect customer-supplied equipment such as an indicator lamp or alarm horn to the common fault connections on the customer connection terminal strip, if desired. See Section 3.4 for fault information.

The faults must be reset to open this contact after a fault condition. See Section 3.5 for instructions to reset faults.

2.6.4 Auxiliary Contacts

Standard auxiliary contacts provide one set of contacts that close when the transfer switch is in the Normal position and another set that close when the transfer switch is in the Emergency position. See Figure 2-6 for contact ratings.

Connect the auxiliary contact terminals on the customer connection terminal strip to customer-supplied alarms, remote indicators, or other devices, if desired.

2.6.5 TVSS Auxiliary Connections

The TVSS provides for remote monitoring via a normally open (NO) or normally closed (NC) contact. The contact changes state when the TVSS module needs to be replaced. The circuit is rated for 3 amps at 120 VAC. See Figure 2-6 and the wiring diagram in Section 6.

Connect customer-provided indicators or alarms to the TVSS auxiliary contact terminals on the customer connection terminal strip to provide remote indication when the TVSS needs to be replaced, if desired. See Section 5 for more information about TVSS modules.

2.7 Accessory Board Connections

The optional accessory board is mounted on top of the MPAC 500 controls main logic board, on the inside of the enclosure door.

The following input and output connections are available. See Figure 2-8.

Remote Test Input. Connect an optional remote switch to this input for remote starting and stopping of a loaded test, if desired. DIP switch 3 on the accessory board affects the operation of this switch. See Section 3.6.4, Accessory Board DIP Switches.

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

Connect input and output leads to connector P9. see Figure 2-9. Refer to the label on the enclosure cover or Figure 2-8 for the connections. Use #12–18 AWG wire and tighten the connections to 0.5 Nm (4.4 in. lb.).

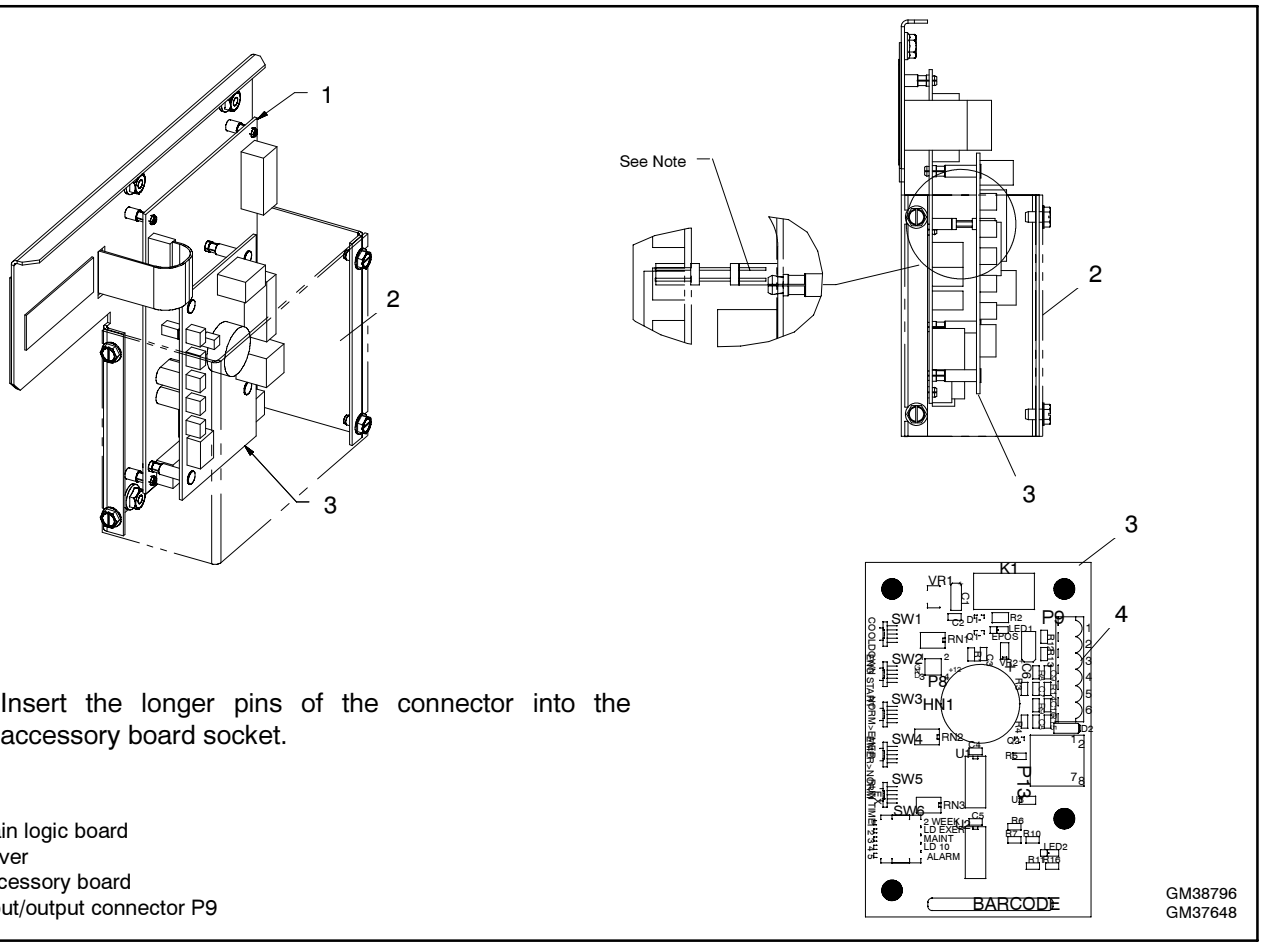
Note: The ATS main logic board has a similar green 6-pin connector. Do not interchange the black and green mating connectors.

DIP Switches and Time Delays. Check the DIP switches and time delay settings and set them to the desired values. See Section 3.6.

Note: Replace the cover before energizing the transfer switch controls.

Terminals, Connector P9	Function
1 - 2	Generator Set Supplying Load Output Contact rated 10 amps @ 120VAC
3 - 4	Not used
5 - 6	Remote Test Input

Figure 2-8 Accessory Board Inputs and Outputs



Note: Insert the longer pins of the connector into the accessory board socket.

1. Main logic board
2. Cover
3. Accessory board
4. Input/output connector P9

Figure 2-9 Accessory Board Installation and Connection

2.8 Automatic Operation Test

Use the test procedure below to check the transfer switch's automatic control system. Loaded or unloaded test sequences can be run. The test sequence simulates a loss of the normal source, starts the generator set, and, for a loaded test, transfers the load to the emergency source, executing all time delays that are set up to operate during a loss of the normal source. When the test ends, the transfer switch transfers the load back to the normal source and removes the engine start signal, executing all appropriate programmed time delays.

Refer to Section 3.3 for a description of the transfer switch sequence of operation.

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

Note: Transfer switches equipped with the accessory board may use different time delays than the factory settings shown in the test procedure. See Figure 2-10.

Note: If the generator set fails during a test, the ATS will immediately attempt to transfer to the normal (utility) source.

Time Delays			
		Adjustment with Accessory Board*	
Time Delay	Factory Setting	Range	Increment
Engine Start	3 sec.	1–10 sec.	1 sec.
Transfer from Normal to Emergency	3 sec.	1–10 sec.	1 sec.
Retransfer from Emergency to Normal	6 min.	3–30 min.	3 min.
Engine Cooldown	5 min.	1–10 min.	1 min.
Failure to Acquire Emergency	78 sec.†	NA	
Exercise Time Duration	20 min.	5–50 min.	5 min.
Undervoltage Dropout Time	0.5 sec.	NA	
Underfrequency Dropout Time	3 sec.	NA	

* Optional accessory board required for time delay adjustments. NA = not adjustable

† Allows for three 15 sec. crank attempts separated by two 15 sec. rest periods.

Figure 2-10 Time Delays

Automatic Operation Test Procedure

1. Check the controller LED indicators to verify that the Utility Source Available and Utility Source Position indicators are lit. See Figure 3-1.

2. Verify that the generator set master switch is in the AUTO position.

3. Run a loaded or an unloaded test as described below:

   a. **Loaded Test:** Press and hold the TEST button on the controller for 6 seconds to start a loaded test. The GEN Source and Position LEDs flash to indicate that the ATS controller is set up to transfer the load during the test.

   b. **Unloaded Test:** To start the generator set without transferring the load, hold the TEST button for 3 to 5 seconds. The GEN Position LED flashes to indicate an unloaded test.

4. After the 3-second engine start delay, the generator set engine starts. The GEN Available LED flashes.

5. For a loaded test, after 3 seconds the switch transfers the load to the emergency source (generator set). Verify that the Utility Source Position LED goes out and the GEN Position LED lights.

6. Push the Test button to end the test.

7. After 6 minutes, the switch transfers the load to the normal (utility) source. Verify that the GEN Position LED goes out and the Utility Position LED lights.

   Note: The 6-minute retransfer time delay does not operate during an unloaded test.

8. After a 5-minute engine cooldown time delay, the generator set shuts down.

   Note: The generator set may have an additional engine cooldown time delay that causes the engine to run after the transfer switch engine start signal is removed.

2.9 Exerciser Setup

Follow the instructions below to set the exercise timer to automatically start and run the generator set for 20 minutes every week. The exerciser can be set for loaded or unloaded exercise runs. The factory settings for the exerciser are summarized in Figure 2-11.

Pressing and holding the Exercise button will start an exercise run and set the exercise timer as described below. The exercise time and day are set to the time that the Exercise button is pushed. The exerciser will run at the same time on the same day each week.

While the generator set is running during an exercise period, the exercise can be ended early by pressing and holding the exercise button for 2 seconds. Ending the current exercise period early does not affect future exercise runs.

Unloaded exercise. The generator set runs, but the electrical load is not transferred. Press and hold the Exercise button for approximately 3 seconds until the GEN Available LED flashes to start an unloaded exercise and set the time and date of the next exercise run. The GEN available LED continues to flash throughout the exercise run to indicate an unloaded exercise.

Exerciser	
Parameter	**Setting**
Frequency	Weekly
Duration	20 minutes
Type	Loaded: Hold Exercise button for 3–5 seconds Unloaded: Hold Exercise button for 6+ seconds

Figure 2-11 Exerciser Settings

Loaded Exercise. The generator set runs and the ATS transfers the electrical load to the generator set. Hold the Exercise button for at least 6 seconds until the GEN available and GEN position LEDs flash to start a loaded exercise and set the time and date of the next exercise run. The GEN available and GEN position LEDs continue to flash throughout the exercise run to indicate a loaded exercise.

Resetting the Exerciser. After the exerciser has been set, pressing and holding the Exercise button to start an exercise run at a different time resets the exerciser to that new time and day. Resetting the controller by pressing and holding both the Exercise and Test buttons for at least 6 seconds clears the exercise setting.

2.10 Warranty Registration

Complete the Startup Notification Form and the Extended Warranty Registration Form and submit to the manufacturer within 60 days of the initial startup date.

Startup Notification Form. A Startup Notification Form is included with generator sets and covers all equipment in the standby system. Standby systems not registered within 60 days of startup are automatically registered using the manufacturer's ship date as the startup date.

2-Year Extended Warranty. Complete and submit the Extended Warranty Registration Form with the Startup Notification Form to register the 2-year extended warranty. There is no charge for the 2-year extended warranty for Model SE-ILC transfer switches.

3.1 Introduction

Red and green LEDs on the transfer switch controls indicate which sources are available, show which source is connected to the load, and flash to indicate fault conditions. Pushbuttons allow you to start and stop the generator set and set the exercise timer. See Figure 3-1.

The transfer switch uses fixed settings for time delays, voltage and frequency pickup and dropout, and other system settings. An optional Accessory Board allows changes to the time delays and exerciser settings and provides selected input and output connections. See Section 3.6 for information on the Accessory Board.

3.2 Controls

The controller's user interface panel is accessible through an opening in the transfer switch enclosure door. Figure 3-1 explains the operation of the controller pushbuttons and LED indicators.

The LEDs light steadily or flash to indicate different ATS conditions as shown in Figure 3-6. See Section 3.4 for more information on fault conditions.

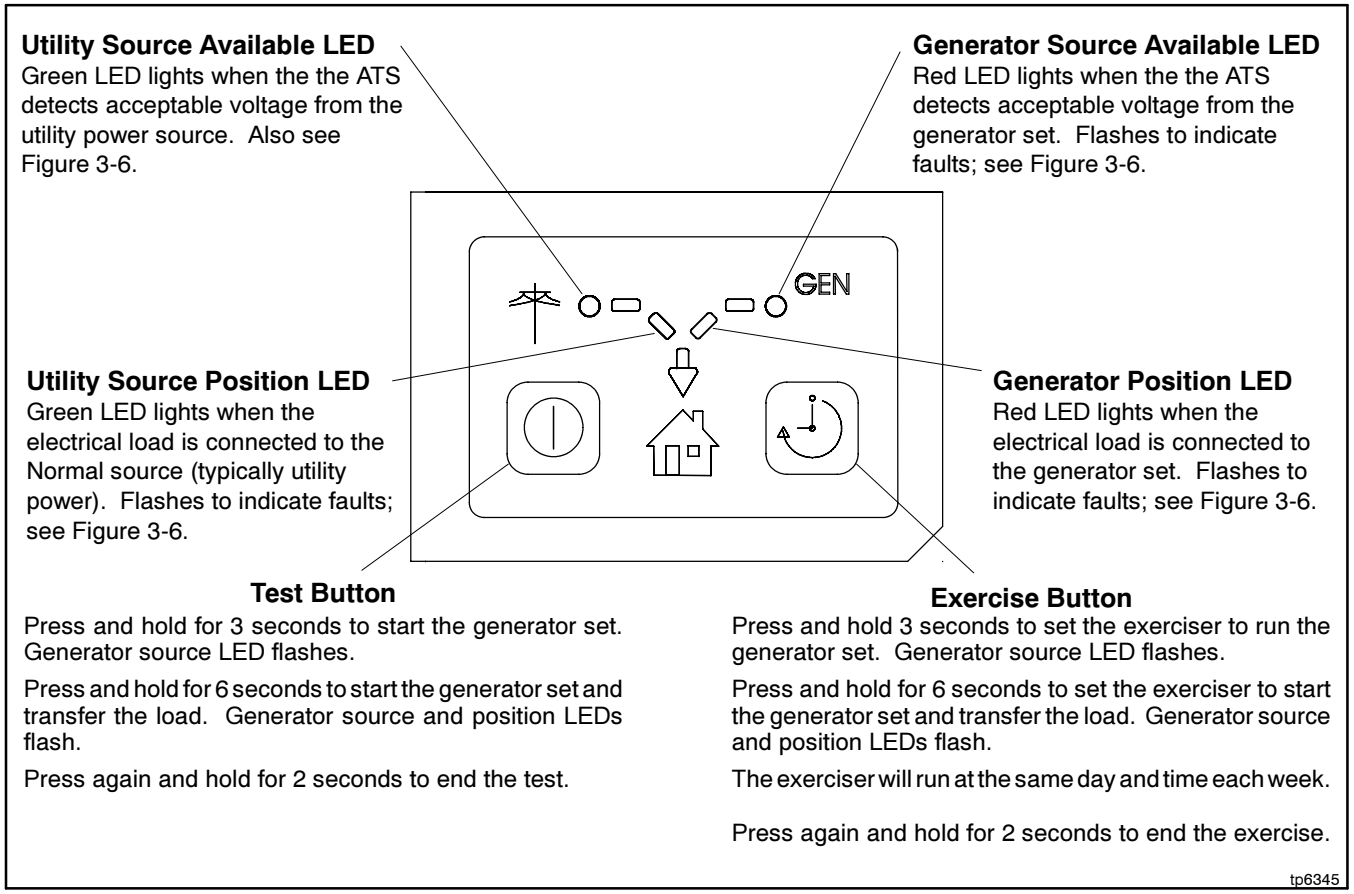


Figure 3-1 User Interface Panel

3.3 Sequence of Operation

3.3.1 Source Sensing

The transfer switch controller monitors the utility power source voltage, and initiates the transfer sequence if the source voltage falls below the voltage dropout setting. Retransfer is initiated when the utility source rises above the voltage pickup settings and remains stable for at least 6 minutes. See Figure 3-2.

- Single-phase voltage sensing on both sources, ±5%
- Line-to-line frequency sensing on emergency (GEN) source, ±2%

Source Sensing	
Undervoltage dropout	80%
Undervoltage pickup	85%
Underfrequency dropout *	90%
Underfrequency pickup *	96%
* Emergency (GEN) source only	

Figure 3-2 Source Sensing

3.3.2 Transfer Sequence

Figure 3-3 illustrates the transfer sequence when the normal source fails, and Figure 3-4 illustrates the sequence when it returns. Time delays before load transfer prevent nuisance transfers during brief power interruptions. See Figure 3-5. Events such as the failure of the generator set to start can change the sequence of operation.

If the emergency source fails and the normal source is not available, the transfer switch controller powers down until one of the sources returns.

The optional Accessory board allows time delay adjustments. See Section 3.6.

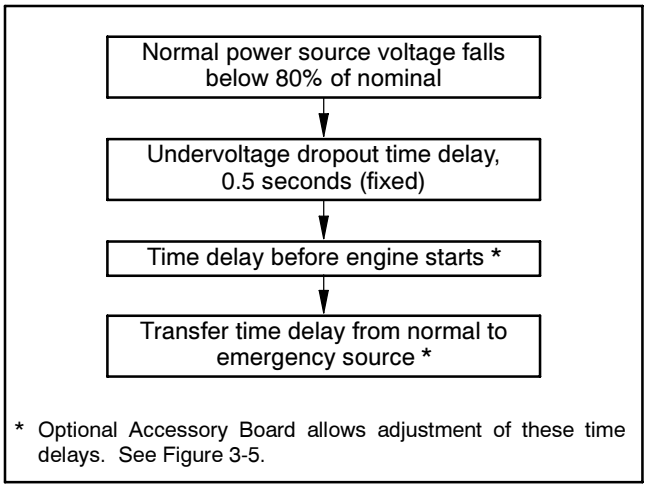


Figure 3-3 ATS Sequence of Operation, Transfer to Emergency

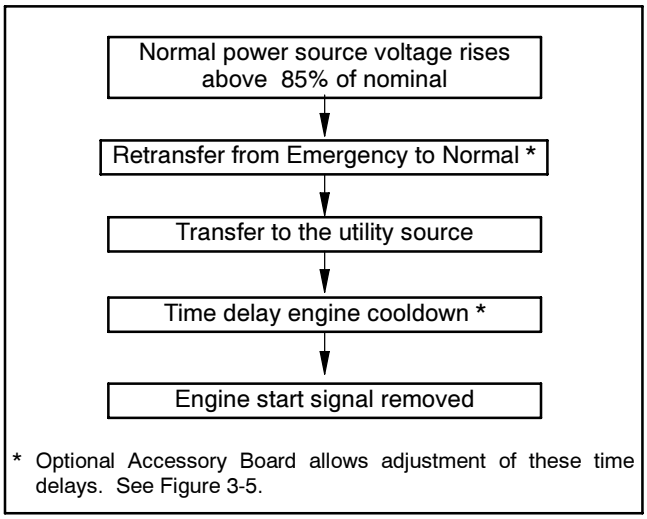


Figure 3-4 ATS Sequence of Operation, Retransfer to Normal

Time Delays	
Time Delay	**Factory Setting**
Failure to Acquire Emergency	78 sec.
Undervoltage Dropout Time	0.5 sec.
Underfrequency Dropout Time	3 sec.
Engine Start	3 sec. *
Transfer from Normal to Emergency	3 sec. *
Retransfer from Emergency to Normal	6 min. *
Engine Cooldown	5 min. *
Exercise Time Duration	20 min. *
* Optional accessory board allows time delay adjustments. See Section 3.6.	

Figure 3-5 Time Delays

3.4 Faults

The LEDs on the controller's user interface flash as shown in Figure 3-6 to indicate various fault conditions. Contact an authorized distributor/dealer for service if the fault persists.

3.4.1 Failure to Acquire Emergency Source Warning

The Failure to Acquire Emergency Source fault occurs if the transfer switch does not sense voltage from the generator set within 78 seconds after signalling the generator set to start. Check the generator set operation and the connections from the generator set to the ATS in the case of this fault.

The Failure to Acquire Emergency Time Delay is set for 78 seconds to allow for three 15-second engine cranking cycles plus 15 seconds rest between starting attempts.

The fault clears when the system acquires the emergency source.

3.4.2 Failure to Transfer Warning

The Failure to Transfer warning occurs if a signal to transfer is sent to the contactor and the position-indicating contacts do not indicate a complete transfer.

The controller will attempt to transfer three times before indicating the fault. If the transfer switch is in the Normal position, the Engine Cooldown time delay is executed and then the engine start contacts open to stop the generator set.

Reset the controller to clear the fault condition. See Section 3.5.

3.4.3 Auxiliary Switch Fault

An Auxiliary Switch fault occurs if the position-indicating contacts indicate that the ATS position changed when no transfer was called for. If the transfer switch is in the Normal position, the Engine Cooldown time delay is executed and then the engine start contacts open to stop the generator set.

An Auxiliary Switch fault also occurs if both auxiliary switches are open or closed so that the controller is unable to determine the transfer switch position.

Reset the controller to clear the fault condition. See Section 3.5.

Condition	LED Indication
Utility source power available	Utility Source Available LED lights steadily.
Load connected to utility power	Utility Source Position LED lights steadily.
Generator set power available	GEN Source Available LED lights steadily.
Load connected to the generator set	GEN Position LED lights steadily.
Loaded test	GEN Available and GEN Position LEDs flash on 1 second, off 1 second.
Unloaded test	GEN Available LED flashes on 1 second, off 1 second.
Loaded exercise	GEN Available and GEN Position LEDs flash on 0.5 second, off 2 seconds.
Unloaded exercise	GEN Available LED flashes on 0.5 second, off 2 seconds.
Failure to acquire standby source fault	GEN Available LED flashes 2 times/second.
Failure to transfer fault	GEN or Utility Source Position LED flashes 2 times/second.
Auxiliary switch failure fault	GEN Position and Utility Source Position LEDs flash alternately 2 times/second.

Figure 3-6 LED Indication

3.5 Resetting the Controller

3.5.1 Fault Reset

Always identify and correct the cause of a fault condition before resetting the ATS controller. Press and hold the Exercise and Test buttons for approximately 3 seconds until the LEDs flash to clear faults and warnings. Warnings reset automatically with a change in the source availability or a signal to transfer.

Note: The Common Fault output remains closed until the faults are reset. See Section 2.6.2.

3.5.2 Controller Reset

Press and hold both buttons for 6 seconds to reset the controller to its original state at powerup.

Note: Resetting the controller clears the exerciser setting. Set the exercise time and day as described in Section 2.9 after resetting the controller.

3.5.3 Alarm Silence

If the transfer switch is equipped with an optional Accessory Board, pressing both buttons will also silence the alarm horn.

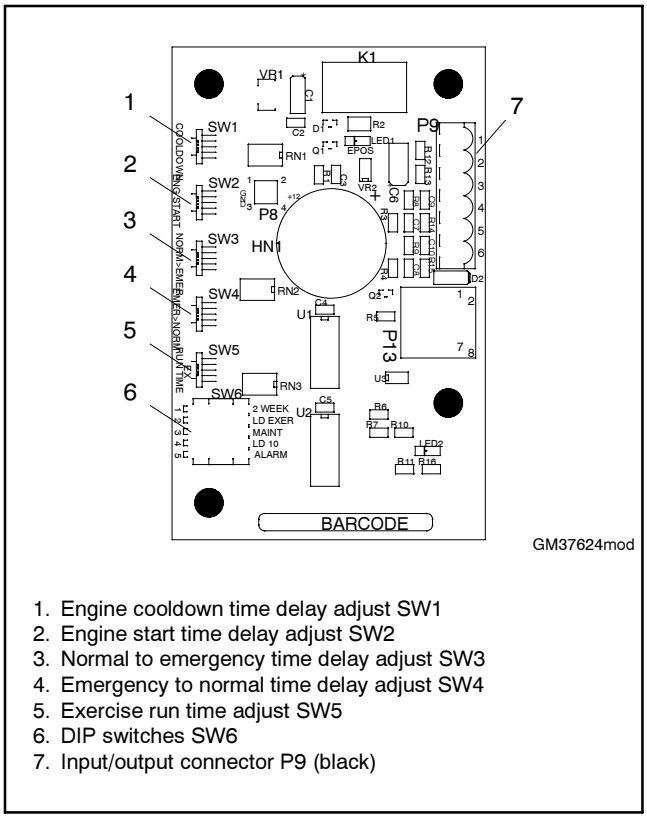
3.6 Accessory Board

The optional Accessory board is mounted over the controller's main logic board. The Accessory board kit is available factory-installed or as a loose kit. See Figure 2-9 for the accessory board location.

The Accessory board contains the following components. See Figure 3-7 for component locations.

- Audible alarm on system faults
- Rotary switches for time delay adjustments
- DIP switches for exercise, remote test switch operation, and audible alarm enable/disable
- Connector for remote test input and generator set supplying load output

Note: Before opening the transfer switch enclosure to access the accessory board, open the circuit breakers to disconnect the power to the transfer switch.



1. Engine cooldown time delay adjust SW1
2. Engine start time delay adjust SW2
3. Normal to emergency time delay adjust SW3
4. Emergency to normal time delay adjust SW4
5. Exercise run time adjust SW5
6. DIP switches SW6
7. Input/output connector P9 (black)

Figure 3-7 Accessory Board Component Locations

3.6.1 Audible Alarm

The audible alarm sounds on the fault conditions shown in Section 3.4.

Always identify and correct the cause of the fault condition before resetting the controller. Press and hold the test and exercise pushbuttons on the controller to clear the fault and silence the alarm.

3.6.2 Accessory Board Time Delay Adjustment Switches

The 10-position rotary switches allow adjustment of the time delays shown in Figure 3-8. Use a small screwdriver or other small tool to increase or decrease the time delays within the range shown in the table. The rotary switch positions range from 1 to 10, with position 10 labelled 0 (zero).

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

3.6.3 Accessory Board Input and Output

A remote test switch can be connected to the black 6-pin connector P9 on the accessory board. Connector P9 also includes an output connection for optional customer-supplied equipment. See Section 2.7 for connections.

Remote Test Input. Connect an optional remote switch to this input for remote starting and stopping of a loaded test, if desired. Use DIP switch 3 on the accessory board to set the operation of this switch for a maintained or momentary contact closure. See Section 3.6.4, Accessory Board DIP Switches.

Generator Set Supplying Load Output. This output provides a closed contact to indicate that the generator set is supplying the load when the transfer switch is in the Emergency position and the GEN source is available. The contact is rated 10 amps @ 120VAC.

3.6.4 Accessory Board DIP Switches

DIP switches on the optional Accessory board control the exercise and remote test functions. The DIP switch location is shown in Figure 3-7. The DIP switch functions are summarized in Figure 3-9. Check the DIP switch settings and adjust if necessary for the application.

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

Switch 2. Not used.

Switch 3. Maintained/Momentary Test.

- With DIP switch 3 in the ON (maintained) position, close a remote test switch or contact to start and run the generator set. Open the remote contact to end the test and signal the generator set to stop.
- With DIP switch 3 in the OFF (momentary) position, hold the test switch for 1 second and release to start a test. The remote switch must be held closed for at least 1 second. Press the test switch again to stop the test and signal the generator set to stop. Use this setting for the External Alarm Module.

Note: Some generator sets may continue to run for an engine cooldown time period after receiving the remote stop signal.

Switch 4. Not used.

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

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

	Factory Setting		Adjustment with Optional Accessory Board	
Time Delay	Setting	Switch Position (1-0)	Range	Increment
Engine Cooldown	5 minutes	5	1-10 minutes	1 minute
Engine Start	3 seconds	3	1-10 seconds	1 second
Transfer from Normal to Emergency	3 seconds	3	1-10 seconds	1 second
Retransfer from Emergency to Normal	6 minutes	2	3-30 minutes	3 minutes
Exercise Run Time	20 minutes	4	5-50 minutes	5 minutes

Figure 3-8 Accessory Board Time Delay Adjustments

Switch		Off (open)	On (closed)	Notes
1	2 WEEK	1 week	2 Weeks	For the exercise button on the controller's user interface.
2	LD EXER	—	—	Not used.
3	MAINT	Momentary	Maintained	For an optional remote test switch.
4	LD 10	—	—	Not used.
5	ALARM	Alarm Disabled	Alarm Enabled	For the alarm horn on the accessory board (inside the ATS enclosure). Does not affect the alarm horn on the External Alarm Module.

Figure 3-9 Accessory Board DIP Switches

Notes

4.1 Introduction

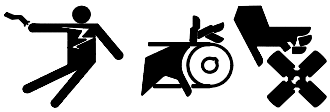
Regular preventive maintenance ensures safe and reliable operation and extends the life of the transfer switch. Preventive maintenance includes periodic testing, cleaning, inspection, and replacement of worn or missing components. Section 4.4 contains a service schedule for recommended maintenance tasks.

A local authorized distributor/dealer can provide complete preventive maintenance and service to keep the transfer switch in top condition. Unless otherwise specified, have maintenance or service performed by an authorized distributor/dealer in accordance with all applicable codes and standards. See the Service Assistance section in this manual for how to locate a local distributor/dealer.

Keep records of all maintenance or service.

Replace all barriers and close and lock the enclosure door after maintenance or service and before reapplying power.

⚠ 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.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

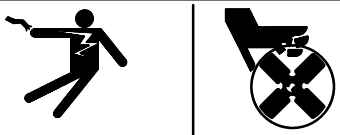
Disconnect all power sources before opening the enclosure.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

⚠ WARNING



Hazardous voltage. Moving rotor.
Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

Grounding the transfer switch. Hazardous voltage can cause severe injury or death. Electrocution is possible whenever electricity is present. Open main circuit breakers of all power sources before servicing equipment. Configure the installation to electrically ground the transfer switch and related equipment and electrical circuits to comply with applicable codes and standards. Never contact electrical leads or appliances when standing in water or on wet ground, as the chance of electrocution increases under such conditions.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Open 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.

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.

NOTICE

When replacing hardware, do not substitute with inferior grade hardware. Screws and nuts are available in different hardness ratings. To indicate hardness, American Standard hardware uses a series of markings, and metric hardware uses a numeric system. Check the markings on the bolt heads and nuts for identification.

NOTICE

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

NOTICE

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

4.2 Testing

4.2.1 Weekly Generator Set Exercise

Use the exerciser or a manual test to start and run the generator set under load once a week to maximize the reliability of the emergency power system. See Section 2.8 for test instructions, and Section 2.9 for instructions to set the exerciser.

Optional accessories allow adjustment of the exercise schedule. See Section 3.6. Refer to the generator set Operation Manual for exercise recommendations.

4.2.2 Monthly Automatic Control System Test

Test the transfer switch's automatic control system monthly. See Section 2.8 for the test procedure.

- Verify that the expected sequence of operations occurs as the switch transfers the load to the emergency source when a preferred source failure occurs or is simulated.
- Observe the indicator LEDs included on the transfer switch to check their operation.
- Watch and listen for signs of excessive noise or vibration during operation.
- After the switch transfers the load to the standby source, end the test and verify that the expected sequence of operations occurs as the transfer switch retransfers to the preferred source and signals the generator set to shut down after a cooldown period.

4.3 Inspection and Service

Contact an authorized distributor/dealer to inspect and service the transfer switch annually and also when any wear, damage, deterioration, or malfunction of the transfer switch or its components is evident or suspected.

4.3.1 General Inspection

External Inspection. Keep the transfer switch clean and in good condition by performing a weekly general external inspection of the transfer switch for any condition of vibration, leakage, excessive temperature, contamination, or deterioration. Remove accumulations of dirt, dust, and other contaminants from the transfer switch's external components or enclosure with a vacuum cleaner or by wiping with a dry cloth or brush.

Note: Do not use compressed air to clean the transfer switch because it can cause debris to lodge in the components and damage the switch.

Tighten loose external hardware. Replace any worn, missing, or broken external components with manufacturer-recommended replacement parts. Contact a local authorized distributor/dealer for specific part information and ordering.

Internal Inspection. Disconnect all power sources, open the transfer switch enclosure door, and inspect internal components monthly or when any condition noticed during an external inspection may have affected internal components.

Contact an authorized distributor/dealer to inspect and service the transfer switch if any of the following conditions are found inside the transfer switch.

- Accumulations of dirt, dust, moisture, or other contaminants
- Signs of corrosion
- Worn, missing, or broken components
- Loose hardware
- Wire or cable insulation deterioration, cuts, or abrasion
- Signs of overheating or loose connections: discoloration of metal, melted plastic, or a burning odor
- Other evidence of wear, damage, deterioration, or malfunction of the transfer switch or its components.

If the application does not allow a power interruption for the time required for the internal inspection, have an authorized distributor/dealer perform the internal inspection.

4.3.2 TVSS Inspection

At intervals not exceeding two months, check the following items on the transient voltage surge suppressors:

- Status indication light (green)
- Condition of connecting cables

4.3.3 Other Inspections and Service

Have an authorized distributor/dealer perform scheduled maintenance, service, and other maintenance that ensures the safe and reliable operation of the transfer switch. See Section 4.4, Service Schedule, for the recommended maintenance items and service intervals.

Have an authorized distributor/dealer repair or replace damaged or worn internal components with manufacturer-recommended replacement parts.

4.4 Service Schedule

Follow the service schedule below for the recommended service intervals. Have all service performed by an authorized distributor/dealer except for activities designated by an X, which may be performed by the switch operator.

System Component or Procedure	See Section	Visually Inspect	Check	Adjust, Repair, Replace	Clean	Test	Frequency
Electrical System							
Check for signs of overheating or loose connections: discoloration of metal, melted plastic, or a burning odor	4.3.1	X	X				Y
Check the contactor's external operating mechanism for cleanliness; clean and relubricate if dirty *	4.3.1	X			D (clean and lube)		
Inspect wiring insulation for deterioration, cuts, or abrasion. Repair or replace deteriorated or damaged wiring	4.3.1	X	D	D			
Tighten control and power wiring connections to specifications	2.5		D			D	
Check the transfer switch's main power switching contacts' condition; clean or replace the main contacts or replace the contactor assembly as necessary	4.3.3	D		D	D		
Control System							
Exercise the generator set under load	2.9					X	W
Test the transfer switch's automatic control system	2.8	X				X	M
Test all indicators (LEDs) and all remote control systems for operation	3.2	D	D	D		D	Y
TVSS Modules							
Check status indication light		X		X			Every 2 months
Check condition of connecting cables		X		D			
General Equipment Condition							
Inspect the outside of the transfer switch for any signs of excessive vibration, leakage, high temperature, contamination, or deterioration *	4.3.1	X			X		M
Check that all external hardware is in place, tightened, and not badly worn	4.3.1	X	X	X			
Inspect the inside of transfer switch for any signs of excessive vibration, leakage, high temperature, contamination, or deterioration *	4.3.3	D	D		D		Y
Check that all internal hardware is in place, tightened, and not badly worn	4.3.3	X	D	D			

* Service more frequently if the transfer switch is operated in dusty or dirty areas.

See Section: Read these sections carefully for additional information before attempting maintenance or service.

Visually Inspect: Examine these items visually.

Check: Requires physical contact with or movement of system components, or the use of nonvisual indications.

Adjust, Repair, Replace: Includes tightening hardware and lubricating the mechanism. May require replacement of components depending upon the severity of the problem.

Clean: Remove accumulations of dirt and contaminants from external transfer switch's components or enclosure with a vacuum cleaner or by wiping with a dry cloth or brush. *Do not use compressed air to clean the switch because it can cause debris to lodge in the components and cause damage.*

Test: May require tools, equipment, or training available only through an authorized distributor/dealer.

Symbols used in the chart:

X=The transfer switch operator can perform these tasks.
D=An authorized distributor/dealer must perform these tasks.
W=Weekly
M=Monthly
Q=Quarterly
S=Semiannually (every six months)
Y=Yearly (annually)

Section 5 Transient Voltage Surge Suppression (TVSS) Modules

5.1 Introduction

Transient Voltage Surge Suppression (TVSS) modules on the utility and emergency source sides protect the system from voltage spikes and surges.

Refer to specification sheet G11-99 for TVSS specifications.

5.2 Diagnostic Indication

Red and green indicators on each Transient Voltage Surge Suppression (TVSS) module indicate connected power and protected status. See Figure 5-1.

Note: All wires must be connected and power applied for the LEDs to illuminate.

An audible alarm provides notification when the TVSS module needs replacement. See Figure 5-1. Remote status indication is also available.

5.3 Remote Status Indication

Each TVSS provides for remote monitoring via a normally open (NO) or normally closed (NC) circuit. The contact changes state when the TVSS module needs replacement. See Figure 5-1.

Connect customer-provided indicators or alarms to the TVSS auxiliary contact terminals (Normal and Emergency) on the customer connection terminal strip to provide remote indication when the TVSS needs to be replaced. The circuit is rated for 3 amps at 120 VAC. See Section 2.6.5 for connection information.

Green LED	Red LED	Status
ON	OFF	AC power is present and protection is provided.
OFF	ON	AC power is present but the TVSS module needs replacement. An audible alarm sounds and the remote indication changes state.
OFF	OFF	AC power or ground is missing: Verify that wire connections are correct. Make sure that circuit breaker is engaged. Check panel for power.

Figure 5-1 Diagnostic Indication

5.4 TVSS Replacement

The green indicator light goes out if the suppressor capability is exceeded or if there is an internal safety component failure in the TVSS module. See Figure 5-1. Replace the module if the green indicator is off and the red indicator is on. Follow the replacement procedure in this section and see Figure 5-2.

Note: The normal and emergency side TVSS modules are not identical. See Figure 5-2 for part numbers.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

⚠ DANGER

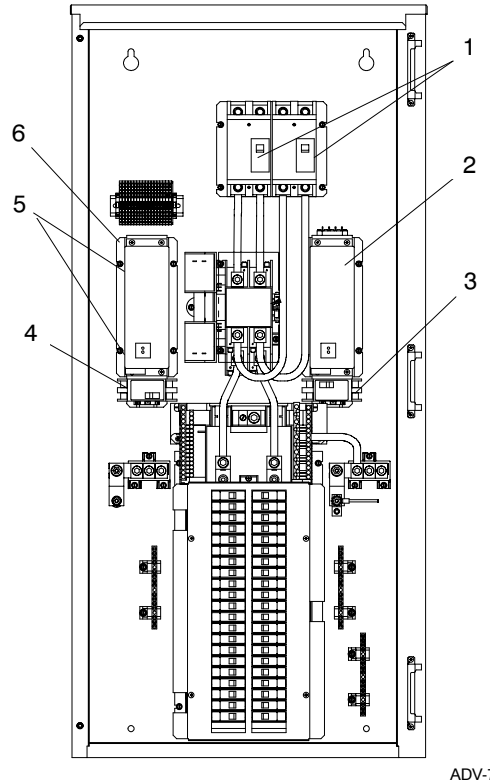
Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Open 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.

Replacement Procedure

1. Disconnect power sources to the ATS before opening the enclosure door.
2. Open the Normal and Emergency service disconnect circuit breakers.
3. Open the circuit breaker located directly below the TVSS module to be replaced.
4. Note connections and disconnect the TVSS leads to the circuit breaker, ground, and neutral. Disconnect the TVSS red, yellow, and blue leads from the customer connection terminal block (normal side) or terminal block TB2 (emergency side). See the wiring diagram in Section 6.
5. Loosen the 4 TVSS mounting screws. Remove 2 mounting screws on one side to remove the module.
6. Install the new module and tighten the mounting screws to 3 Nm (26 in.lbs.).
7. Connect the TVSS leads using the connections noted in step 4 and the wiring diagram in Section 6.
8. Close the TVSS circuit breaker.
9. Close the Normal and Emergency service disconnect circuit breakers.
10. Close and lock the ATS enclosure door.
11. Reconnect power.



1. Normal and Emergency service disconnect circuit breakers
2. TVSS, emergency side, GM42272
3. TVSS circuit breaker, emergency side
4. TVSS circuit breaker, normal side
5. TVSS mounting screws, qty. 4
6. TVSS, normal source, GM42270

Figure 5-2 TVSS Module Replacement

Section 6 Diagrams and Drawings

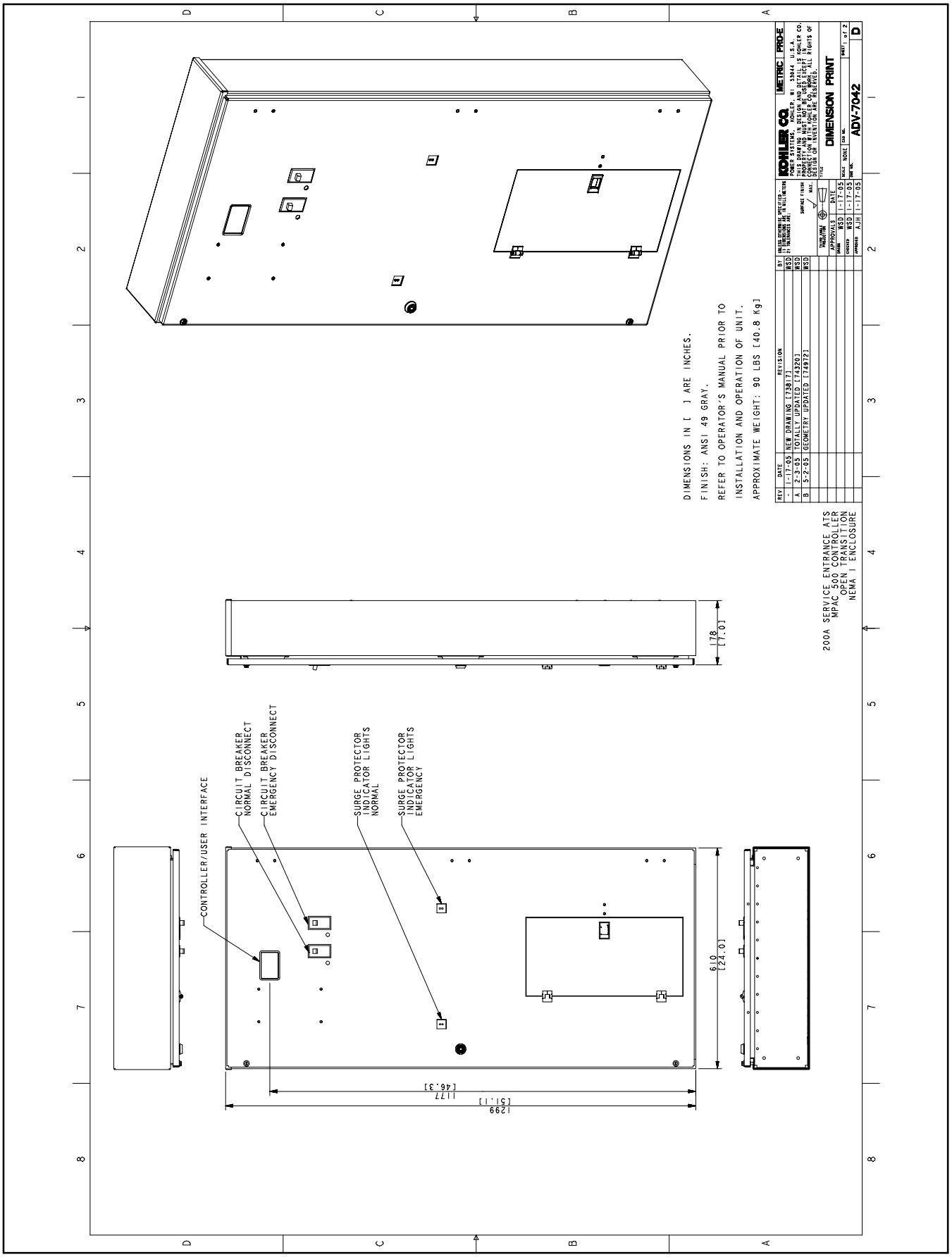


Figure 6-1 Dimension Drawing, Sheet 1, ADV-7042A-B

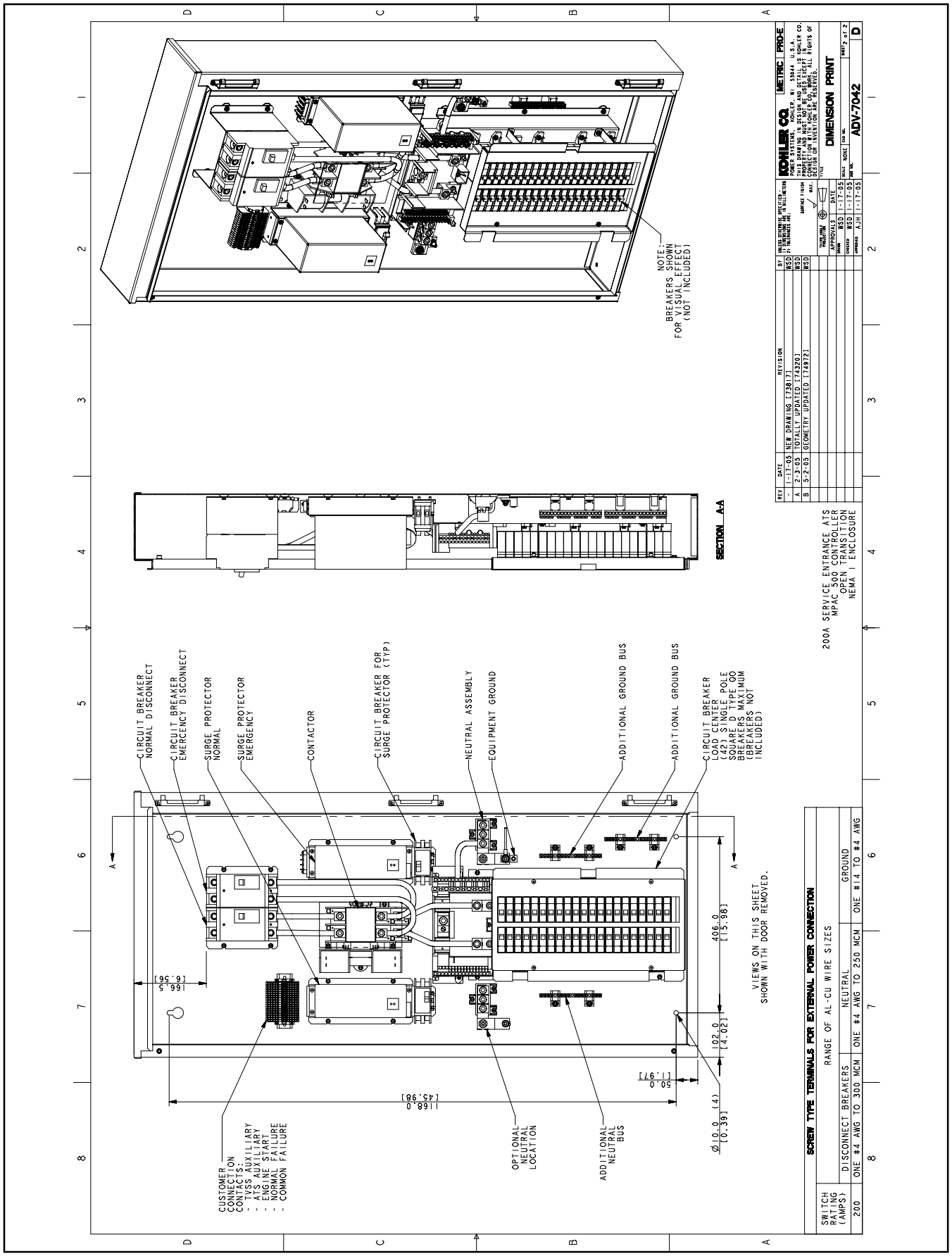


Figure 6-2 Dimension Drawing, Sheet 2, ADV-7042B-B

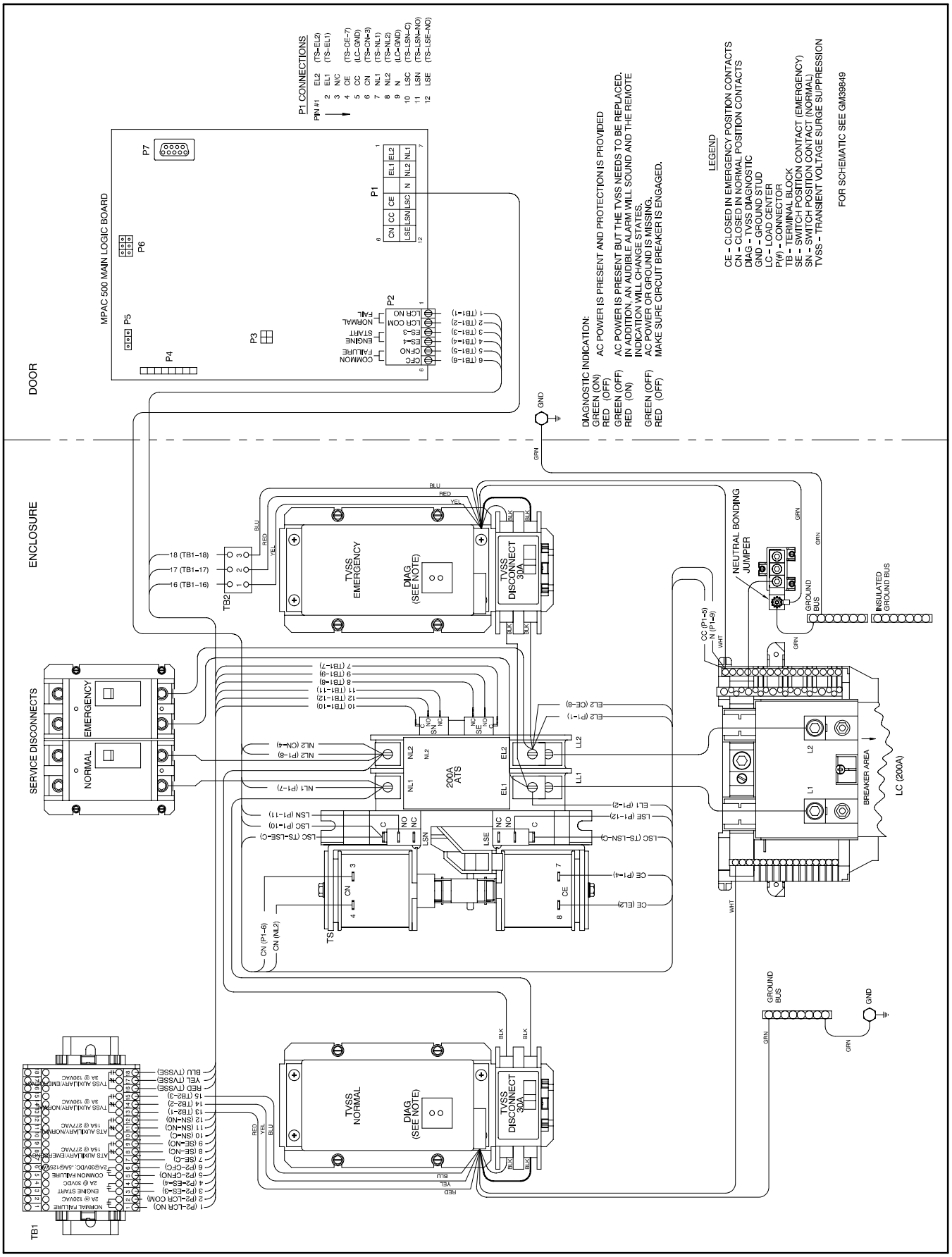


Figure 6-3 Wiring Diagram, GM39848-B

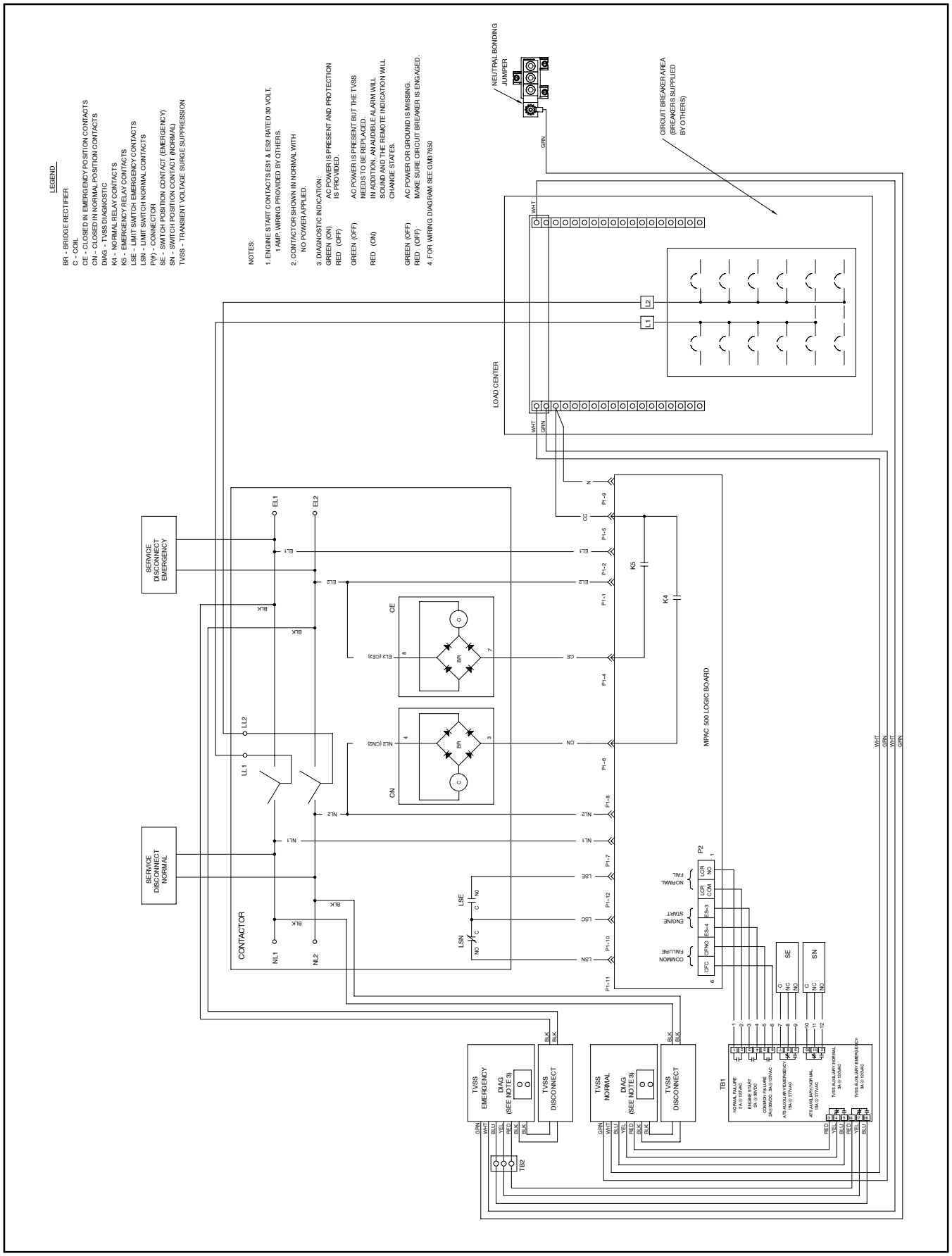


Figure 6-4 Schematic Diagram, GM39849-A

Notes

Appendix A Abbreviations

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

A, amp	ampere
ABDC	after bottom dead center
AC	alternating current
A/D	analog to digital
ADC	analog to digital converter
adj.	adjust, adjustment
ADV	advertising dimensional drawing
AHWT	anticipatory high water temperature
AISI	American Iron and Steel Institute
ALOP	anticipatory low oil pressure
alt.	alternator
Al	aluminum
ANSI	American National Standards Institute (formerly American Standards Association, ASA)
AO	anticipatory only
API	American Petroleum Institute
approx.	approximate, approximately
AR	as required, as requested
AS	as supplied, as stated, as suggested
ASE	American Society of Engineers
ASME	American Society of Mechanical Engineers
assy.	assembly
ASTM	American Society for Testing Materials
ATDC	after top dead center
ATS	automatic transfer switch
auto.	automatic
aux.	auxiliary
A/V	audiovisual
avg.	average
AVR	automatic voltage regulator
AWG	American Wire Gauge
AWM	appliance wiring material
bat.	battery
BBDC	before bottom dead center
BC	battery charger, battery charging
BCA	battery charging alternator
BCI	Battery Council International
BDC	before dead center
BHP	brake horsepower
blk.	black (paint color), block (engine)
blk. htr.	block heater
BMEP	brake mean effective pressure
bps	bits per second
br.	brass
BTDC	before top dead center
Btu	British thermal unit
Btu/min.	British thermal units per minute
C	Celsius, centigrade
cal.	calorie
CARB	California Air Resources Board
CB	circuit breaker
cc	cubic centimeter
CCA	cold cranking amps
ccw.	counterclockwise
CEC	Canadian Electrical Code
cfh	cubic feet per hour
cfm	cubic feet per minute
CG	center of gravity
CID	cubic inch displacement
CL	centerline
cm	centimeter
CMOS	complementary metal oxide substrate (semiconductor)
cogen.	cogeneration
COM	communications (port)
conn.	connection
cont.	continued
CPVC	chlorinated polyvinyl chloride
crit.	critical
CRT	cathode ray tube
CSA	Canadian Standards Association
CT	current transformer
Cu	copper
cu. in.	cubic inch
cw.	clockwise
CWC	city water-cooled
cyl.	cylinder
D/A	digital to analog
DAC	digital to analog converter
dB	decibel
dBA	decibel (A weighted)
DC	direct current
DCR	direct current resistance
deg., °	degree
dept.	department
dia.	diameter
DI/EO	dual inlet/end outlet
DIN	Deutsches Institut fur Normung e. V. (also Deutsche Industrie Normenausschuss)
DIP	dual inline package
DPDT	double-pole, double-throw
DPST	double-pole, single-throw
DS	disconnect switch
DVR	digital voltage regulator
E, emer.	emergency (power source)
EDI	electronic data interchange
EFR	emergency frequency relay
e.g.	for example (*exempli gratia)*
EG	electronic governor
EGSA	Electrical Generating Systems Association
EIA	Electronic Industries Association
EI/EO	end inlet/end outlet
EMI	electromagnetic interference
emiss.	emission
eng.	engine
EPA	Environmental Protection Agency
EPS	emergency power system
ER	emergency relay
ES	engineering special, engineered special
ESD	electrostatic discharge
est.	estimated
E-Stop	emergency stop
etc.	et cetera (and so forth)
exh.	exhaust
ext.	external
F	Fahrenheit, female
fglass.	fiberglass
FHM	flat head machine (screw)
fl. oz.	fluid ounce
flex.	flexible
freq.	frequency
FS	full scale
ft.	foot, feet
ft. lbs.	foot pounds (torque)
ft./min.	feet per minute
g	gram
ga.	gauge (meters, wire size)
gal.	gallon
gen.	generator
genset	generator set
GFI	ground fault interrupter
GND, ⏚	ground
gov.	governor
gph	gallons per hour
gpm	gallons per minute
gr.	grade, gross
GRD	equipment ground
gr. wt.	gross weight
H x W x D	height by width by depth
HC	hex cap
HCHT	high cylinder head temperature
HD	heavy duty
HET	high exhaust temperature
hex	hexagon
Hg	mercury (element)
HH	hex head
HHC	hex head cap
HP	horsepower
hr.	hour
HS	heat shrink
hsg.	housing
HVAC	heating, ventilation, and air conditioning
HWT	high water temperature
Hz	hertz (cycles per second)
IC	integrated circuit
ID	inside diameter, identification
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IMS	improved motor starting
in.	inch
in. H_2O	inches of water
in. Hg	inches of mercury
in. lbs.	inch pounds
Inc.	incorporated
ind.	industrial
int.	internal
int./ext.	internal/external
I/O	input/output
IP	iron pipe
ISO	International Organization for Standardization
J	joule
JIS	Japanese Industry Standard
k	kilo (1000)
K	kelvin
kA	kiloampere
KB	kilobyte (2^{10} bytes)

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

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