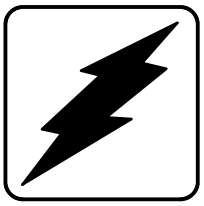
Operation and Installation

Automatic Transfer Switches



Models:

G/GN
GLN/GLS
GTN/GTS

Controller:
S340 Solid State

ISO 9001
KOHLER GENERATORS
INTERNATIONALLY REGISTERED

KOHLER®
POWER SYSTEMS

TP-5993 1/99a

Table of Contents

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***.

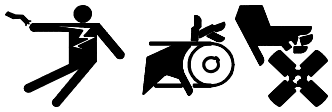
NOTICE

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.

Battery

⚠ WARNING

Sulfuric acid in batteries.
Can cause severe injury or death.

Wear protective goggles and clothing. Battery acid may cause blindness and burn skin.

Battery acid. Sulfuric acid in batteries can cause severe injury or death. Sulfuric acid in the battery can cause blindness and burn skin. Always wear splashproof safety goggles when working near the battery. If battery acid splashes in the eyes or on the skin, immediately flush the affected area for 15 minutes with large quantities of clean water. Seek immediate medical aid in the case of eye contact. Never add acid to a battery after placing the battery in service, as this may result in hazardous spattering of battery acid.

⚠ WARNING

Explosion.
Can cause severe injury or death.
Relays in the battery charger cause arcs or sparks.

Locate the battery in a well-ventilated area. Isolate the battery charger from explosive fumes.

Battery gases. Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flames or sparks to occur near a battery at any time, particularly when it is charging. To prevent burns and sparks that could cause an explosion, avoid touching the battery terminals with tools or other metal objects. Remove wristwatch, rings, and other jewelry before handling the battery. Never connect the negative (–) battery cable to the positive (+) connection terminal of the starter solenoid. Do not test the battery condition by shorting the terminals together. Sparks could ignite the battery gases or fuel vapors. Ventilate the compartments containing batteries to prevent accumulation of explosive gases. To avoid sparks, do not disturb the battery charger connections while the battery is charging. Always turn the battery charger off before disconnecting the battery connections. Remove the negative (–) lead first when disconnecting the battery. Reconnect the negative (–) lead last when reconnecting the battery.

Hazardous Voltage/ Electrical Shock

⚠ WARNING

Hazardous voltage.
Can cause severe injury or death.

Disconnect all power sources before opening the enclosure.

(under 600 volt)

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

(600 volt and above)

⚠ WARNING

Hazardous voltage.
Can cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

(under 600 volt)

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

(600 volt and above)

⚠ 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 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.

Installing the battery charger. Hazardous voltage can cause severe injury or death. An ungrounded battery charger may cause electrical shock. Connect the battery charger enclosure to the ground of a permanent wiring system. As an alternative, install an equipment grounding conductor with circuit conductors and connect it to the equipment grounding terminal or the lead on the battery charger. Install the battery charger as prescribed in the equipment manual. Install the battery charger in compliance with local codes and ordinances.

Connecting the battery and the battery charger. Hazardous voltage can cause severe injury or death. Reconnect the battery correctly, positive to positive and negative to negative, to avoid electrical shock and damage to the battery charger and battery(ies). Have a qualified electrician install the battery(ies).

Hazardous voltage can cause severe injury or death. To prevent electrical shock disconnect the harness plug before installing accessories that will be connected to transformer assembly primary terminals 76, 77, 78, and 79. Terminals are at line voltage. *(Models with E33+, S340, S340+, 340, R340, and R33 controls only)*

Installing accessories to the transformer assembly. Hazardous voltage can cause severe injury or death. To prevent electrical shock disconnect the harness plug before installing accessories that will be connected to the transformer assembly primary terminals on microprocessor logic models. Terminals are at line voltage.

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.

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 wristwatch, rings, and jewelry before servicing the equipment.

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.

Servicing the transfer switch controls and accessories within the enclosure. Hazardous voltage can cause severe injury or death. Disconnect the transfer switch controls at the inline connector to deenergize the circuit boards and logic circuitry but allow the transfer switch to continue to supply power to the load. Disconnect all power sources to accessories that are mounted within the enclosure but are not wired through the controls and deenergized by inline connector separation. Test circuits with a voltmeter to verify that they are deenergized before servicing.

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

Hazardous voltage. Moving rotor.

Can cause severe injury or death.

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

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

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 Kohler® Model GL_/GT_ transfer switches with S340 solid-state electrical controls (logic controller.)

All information in this publication represents data available at time of print. Kohler Co. reserves the right to change this literature and the products represented without incurring obligation.

Read through 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 equipment for future reference.

Equipment service requirements are very important to safe and efficient operation; therefore, inspect parts often and perform required service at the prescribed intervals. An authorized service distributor/dealer should perform required service to keep equipment in top condition.

List of Related Materials

This manual covers operation and installation information for the transfer switch's electrical controls. See the power switching device operation and installation manual to decode the transfer switch part number model code and verify that the transfer switch model and electrical controls matches what is shown on the front cover of this manual before proceeding with operation or installation.

A separate power switching device operation and installation manual that covers information specific to the transfer switch's power switching device completes operation and installation instructions for the transfer switch.

One type of transfer switch power switching device is available with the S340 electrical controls described by this manual. The following table lists the available power switching devices and the related operation and installation manual part numbers.

Power Switching Device	Operation/ Installation Manual
Model GL_/GT_ (Contactor)	TP-5991

Separate manuals cover service and parts information for transfer switch power switching devices and electrical controls The following table lists the available manuals and part numbers.

Electrical Controls	Service Manual
S340 (Solid State)	TP-5612

Service Assistance

Service Information

Please contact a local authorized distributor or dealer for sales, service, or other information about Kohler Generator Division products.

To locate a local authorized distributor or dealer

- Look on the product or the information included with the product
- Consult the Yellow Pages under the heading Generators—Electric
- Visit the Kohler Generator Division web site at www.kohlergenerators.com
- Call 1-800-544-2444 (inside the U.S.A. and Canada) or 920-565-3381 (outside the U.S.A. and Canada)

Product Identification

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.

Part Number _____

Serial Number _____

Accessory Number	Accessory Description

Section 1. Specifications

The following specifications are for the S340 logic controller. See the power switching device operation and installation manual for power switching device specifications and other transfer switch features. See List of Related Materials in the Introduction section in this manual.

1.1 Standard Features

- Solid-state controller for Model GL_/GT_ transfer switches
- Normal source voltage sensing, adjustable from 65% to 130% (factory setting 88%) of nominal for pickup and from 50% to 130% (factory setting 70%) of nominal for dropout. Voltage monitored line-to-line for all phases of 3-phase switches
- Voltage sensing pickup for emergency source, adjustable from 40% to 130% (factory setting 85%) of nominal; monitors one phase only
- LED diagnostic aids to indicate circuit status and monitor function completion
- Two-position test switch to simulate a normal power source failure. Not supplied if optional accessories KA-6 (2- or 3-position) or KA-7 (4-position) test switches are specified
- Time Delay Engine Start (TDES) fixed at 3 seconds
- Time Delay Normal to Emergency (TDNE) adjustable 0.6 to 60 seconds, factory set at 0.6 seconds
- Time Delay Emergency to Normal (TDEN) adjustable 1 to 30 minutes, factory set at 1 minute
- All printed circuit boards conformally coated for environmental protection
- Ambient temperature range
  -40° to 158°F (-40° to 70°C)
- Humidity range 5% to 95% noncondensing

1.2 Optional Features

See Section 3—Accessories for details of optional features selected. The transfer switch nameplate includes a list of factory-installed accessories.

- TDNE adjustable 1 to 30 minutes, factory set at 1 minute.
- TDES with various ranges available from 0.5 to 240 seconds.
- TDEC adjustable 1 to 30 minutes, factory set at 5 minutes.
- Indicators for switch position—normal and emergency
- Indicators for source available—normal and emergency.
- Two-, three-, and four-position test/operation switches.
- Source available auxiliary contacts.
- Main shaft auxiliary contacts: 1 additional closed on normal switch position and 1 additional closed on emergency switch position (600 volt maximum switches only)
- Main shaft auxiliary contacts: 1 or 2 closed on normal switch position and 1 or 2 closed on emergency switch position (250 volt maximum switches only)
- Battery charger, 2-ampere float, 12 and 24 volt.
- Plant exerciser—solid-state, digital display, 7- or 14-day, loaded or unloaded.
- Load shedding contacts.

Notes

⚠ WARNING

Hazardous voltage.
Can cause severe injury or death.

Disconnect all power sources before opening the enclosure.

(under 600 volt)

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

(600 volt and above)

Have preventive maintenance performed on the transfer switch at regular intervals after installation. See Section 4 for preventive maintenance.

Contact an authorized service center to inspect and service the transfer switch when any wear, damage, deterioration, or malfunction of the transfer switch or its components is evident or suspected; *DO NOT ENERGIZE THE SWITCH.*

2.1 Startup

Use this section when power sources have been disconnected to the transfer switch for an extended period after maintenance or service of the standby system, *NOT FOR INITIAL STARTUP.*

For initial startup, follow the instructions in the installation section of the operation and installation manual for the power switching device and Section 5—Installation in this manual.

Follow the following steps to power up the transfer switch and prepare it for automatic operation.

Powerup Procedure

Read and understand all instructions on installation drawings and labels affixed to the switch. Note any accessories installed on the switch and review their operation.

1. Move the generator set master switch to the OFF position to prevent the generator set from starting.
2. Ensure that *BOTH* the normal and emergency power sources are disconnected by opening upstream circuit breakers or switches to the transfer switch.
3. Open the enclosure and check that the wire harnesses for the power switching device and the controller are plugged together at the inline disconnect plug P1. See Figure 5-1.
4. Follow the manual operation procedure to prepare the transfer switch for automatic operation. See the power switching device operation and installation manual for manual operation procedures.
5. Close and lock the transfer switch enclosure door.
6. Prepare the generator set that provides standby power for operation. Check the oil level, coolant level, fuel supply, batteries, and items specified by the generator set installation or operation checklist or manual.
7. Move the generator set master switch to the AUTO position. The generator set should start.
8. When loads can be safely energized, reapply power sources to the transfer switch by closing circuit breakers or switches.

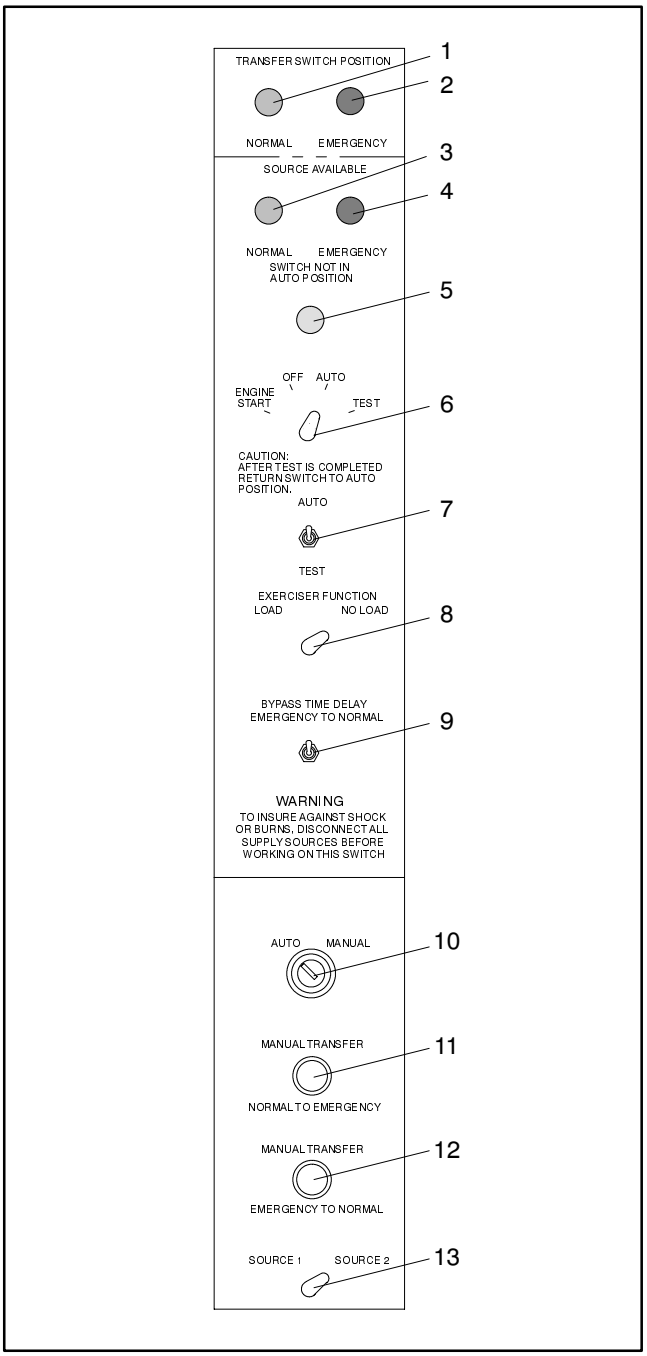
NOTE

When initially applying power to the transfer switch, the engine start contacts remain closed signaling the generator to run until the ATS's Time Delay Engine Cooldown (TDEC), if equipped, ends.

9. Perform an automatic operation test. See Section 5.5.2.

2.2 Controls and Indicators

Most of the control switches and indicators possibly located on the transfer switch enclosure door are optional accessories. See Figure 2-1.



1. **Normal Position (green)** lights when the load is connected to the normal source (optional accessory 12-C).
2. **Emergency Position (red)** lights when the load is connected to the emergency source (optional accessory 12-D).
3. **Normal Source Available (white)** lights when the normal source is available (optional accessory 12-G).
4. **Emergency Source Available (white)** lights when the emergency source is available (optional accessory 12-H).
5. **Switch Not in Auto (white)** lights when the four-position test switch (item 6) is not in the AUTO position, preventing automatic transfer switch operation (optional accessory 7-D, H).
6. **Four-position Test Switch** ENGINE START position signals the generator set to start (unloaded test). OFF position (4-position switch only) prevents automatic transfer switch operation by inhibiting control circuits and opening the engine start circuit. The transfer switch does not start the generator nor does it transfer to an available source if the connected source fails. AUTO position enables automatic transfer switch operation. TEST position simulates a normal source failure (loaded test) (optional accessory 7-D, H).
7. **Two- or Three-position Test Switch** Standard two-position switch shown. AUTO position allows automatic transfer switch operation. TEST WITHOUT LOAD position (three-position switch only) signals generator set to start and run unloaded. TEST or TEST WITH LOAD position simulates a normal power source failure (standard or optional accessory 6-D, F, H, M).
8. **Plant Exerciser Load/No Load Selector Switch** LOAD position exercises the generator set under load. NO LOAD position exercises the generator set unloaded (optional accessory 23-Y).
9. **Bypass Time Delay Switch** Operating bypasses Time Delay Emergency to Normal (TDEN). The transfer switch transfers the load to the normal source immediately when Normal becomes acceptable (optional accessory 8-C).
10. **Automatic/Manual Selector Switch** AUTO position selects automatic transfer switch operation. MANUAL position allows manual operation of transfer switch using the pushbuttons below (optional accessory 29-G, J, P, T).
11. **Manual Transfer, Normal to Emergency Pushbutton** Pressing causes normal-to-emergency transfer if the emergency source is available after any time delay (optional accessory 29-G, T).
12. **Manual Transfer, Emergency to Normal Pushbutton** Pressing causes emergency-to-normal transfer if the normal source is available after any time delay (optional accessory 29-G, J, P, T).
13. **Preferred-source Selector Switch** Selects the power source that the transfer switch transfers to preferentially when the source is available. SOURCE 1 position selects the normal source and the SOURCE 2 position selects the emergency source (optional accessory 10-B or D).

Figure 2-1. Controls and Indicators

2.3 Automatic Operation

Controller circuitry, programming, or accessories determine when a power source is acceptable, has failed, or is restored and operates accordingly. Failure of a power source occurs when the voltage and/or frequency on one or more sensed phases fall below preset levels. A power source is acceptable when the voltage and/or frequency on all sensed phases rise above preset levels. A power source is restored when it becomes acceptable after failing. Typical ATS operation is divided into two sequences.

- **Failure of the normal power source** and the resulting transfer to the emergency source or Emergency.
- **Restoration of the normal power source** and the resulting transfer back to the normal source or Normal.

The following sections explain these automatic sequences of operation for a standard controller with a limited number of accessories that affect the sequence of operation. Installed controller accessories can change the sequence of operation as given here; review the operation of any optional accessories that are present on the transfer switch. See Section 3—Accessories.

2.3.1 Normal Source Failure

The following sequence describes the system response to a normal source failure. See Figure 2-2.

1. **Normal Power Source Fails** Relay NR1 on the controller's main logic board deenergizes when the voltage on any phase of the normal power source falls below the dropout level. See Figure 5-2.
2. **NR Relay Deenergizes and Engine Start Time Delay Starts** When the NR1 relay deenergizes, the NR relay on the relay daughterboard deenergizes. See Figure 5-3. Also, the Time Delay Engine Start (TDES) relay, located on the main logic circuit board, begins its timing cycle. See Figure 5-2. TDES prevents nuisance starting of the generator set during brief power outages. If the normal source voltage on all sensed phases rises above the pickup level before the TDES relay times out, the NR1 and NR relays reenergize and the controller resets all circuits for any future normal source failure.
3. **Generator Signalled to Start** When the TDES relay times out it deenergizes and the engine start contact closes to signal the generator set to start. Controller circuitry monitors the emergency power source for acceptability.
4. **Emergency Source Becomes Acceptable and Starts a Time Delay to Transfer to Emergency** Controller circuitry energizes the emergency voltage/frequency relay (EFR), located on the main logic circuit board, when the voltage and frequency on one sensed phase of the emergency source reach the pickup levels. See Figure 5-2. After EFR energizes, the Time Delay Normal to Emergency (TDNE) starts. TDNE allows emergency source stabilization before load reconnection and prevents nuisance transfers during brief power outages.
5. **Switch Transfers Load to Emergency** When TDNE ends, the Emergency Relay (ER) on the relay daughterboard energizes. When ER energizes, the contactor's solenoid energizes and the contactor transfers the load to the emergency source. The transfer switch is now supplying the load from the emergency source and remains latched in this position until the normal source is restored.

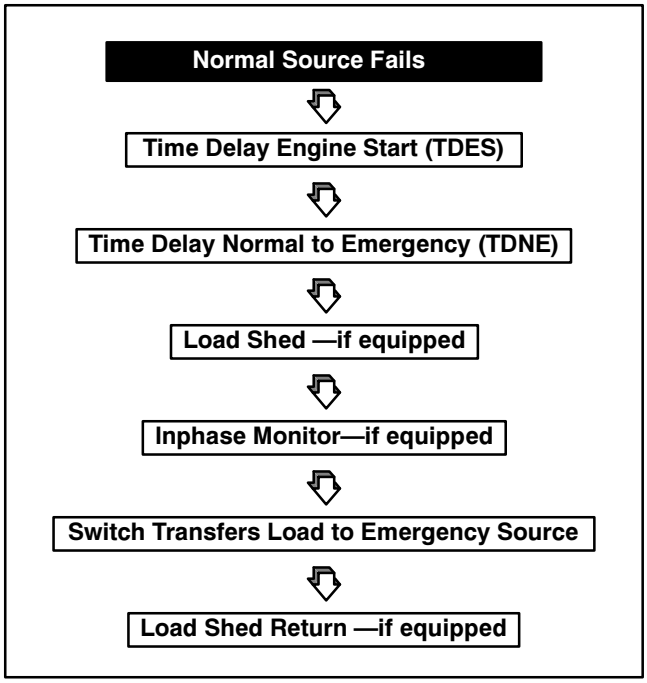


Figure 2-2. ATS Sequence of Operation—Normal Power Failure

2.3.2 Normal Source Restoration

The following sequence describes system response to normal source restoration. See Figure 2-3. In this sequence of operation, if the emergency source fails and the normal source is acceptable, the ATS bypasses all time delays in the sequence and transfers the load immediately to the normal source.

1. **Normal Power Source Returns** Controller circuitry starts the Time Delay Emergency to Normal (TDEN) when the normal source is acceptable. The normal source is acceptable when the voltage level on all sensed phases rises above the voltage pickup level. TDEN allows time for the normal source to stabilize before load reconnection. If the emergency source fails (voltage or frequency on one phase falls below the dropout level) during this timing cycle, the EFR relay deenergizes and the controller signals the contactor to immediately transfer the load to the normal source, if the normal source is acceptable.
2. **Switch Transfers Back to Normal** When TDEN times out, the NR1 relay energizes which, in turn, energizes the NR relay, and the ER relay deenergizes. The contactor solenoid energizes, and the contactor transfers the load back to the normal source.
3. **Generator Set Receives Signal to Shut Down** When the NR1 relay energizes it causes the Time Delay Engine Start (TDES) relay to energize, which signals the generator set to shut down by opening the engine start contacts. All circuits reset for any future normal source failure.

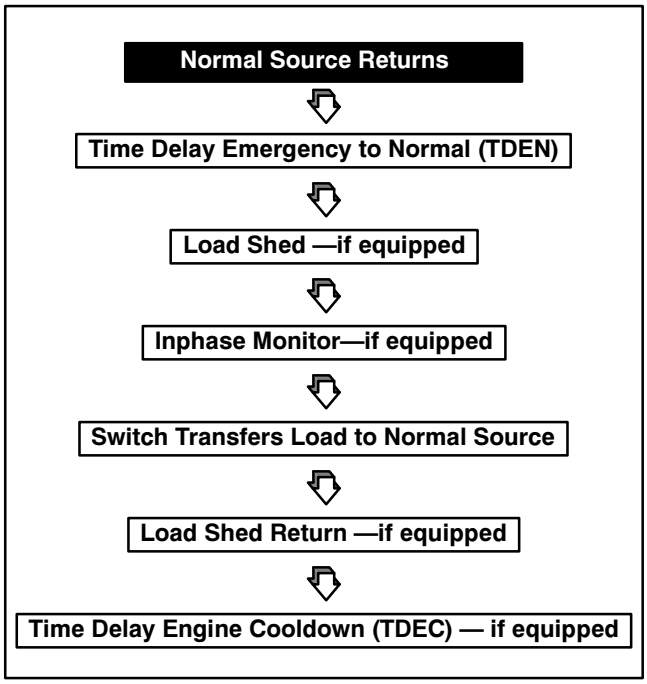
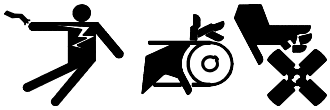


Figure 2-3. ATS Sequence of Operation—Normal Power Restoration

Section 3. Accessories

Determine factory-installed accessories by examining the transfer switch nameplate. This section describes optional accessories available on Model GL_/GT_ transfer switches with the S340 logic controller. All accessories are UL 1008 listed.

⚠ 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.

⚠ WARNING

Hazardous voltage.
Can cause severe injury or death.

Disconnect all power sources before opening the enclosure.

(under 600 volt)

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

(600 volt and above)

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.

Installing the battery charger. Hazardous voltage can cause severe injury or death. An ungrounded battery charger may cause electrical shock. Connect the battery charger enclosure to the ground of a permanent wiring system. As an alternative, install an equipment grounding conductor with circuit conductors and connect it to the equipment grounding terminal or the lead on the battery charger. Install the battery charger as prescribed in the equipment manual. Install the battery charger in compliance with local codes and ordinances.

Connecting the battery and the battery charger. Hazardous voltage can cause severe injury or death. Reconnect the battery correctly, positive to positive and negative to negative, to avoid electrical shock and damage to the battery charger and battery(ies). Have a qualified electrician install the battery(ies).

Hazardous voltage can cause severe injury or death. To prevent electrical shock disconnect the harness plug before installing accessories that will be connected to transformer assembly primary terminals 76, 77, 78, and 79. Terminals are at line voltage. *(Models with E33+, S340, S340+, 340, R340, and R33 controls only)*

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.

⚠ WARNING

Hazardous voltage.
Can cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

(under 600 volt)

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

(600 volt and above)

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 wristwatch, rings, and jewelry before servicing the equipment.

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.

Servicing the transfer switch controls and accessories within the enclosure. Hazardous voltage can cause severe injury or death. Disconnect the transfer switch controls at the inline connector to deenergize the circuit boards and logic circuitry but allow the transfer switch to continue to supply power to the load. Disconnect all power sources to accessories that are mounted within the enclosure but are not wired through the controls and deenergized by inline connector separation. Test circuits with a voltmeter to verify that they are deenergized before servicing.

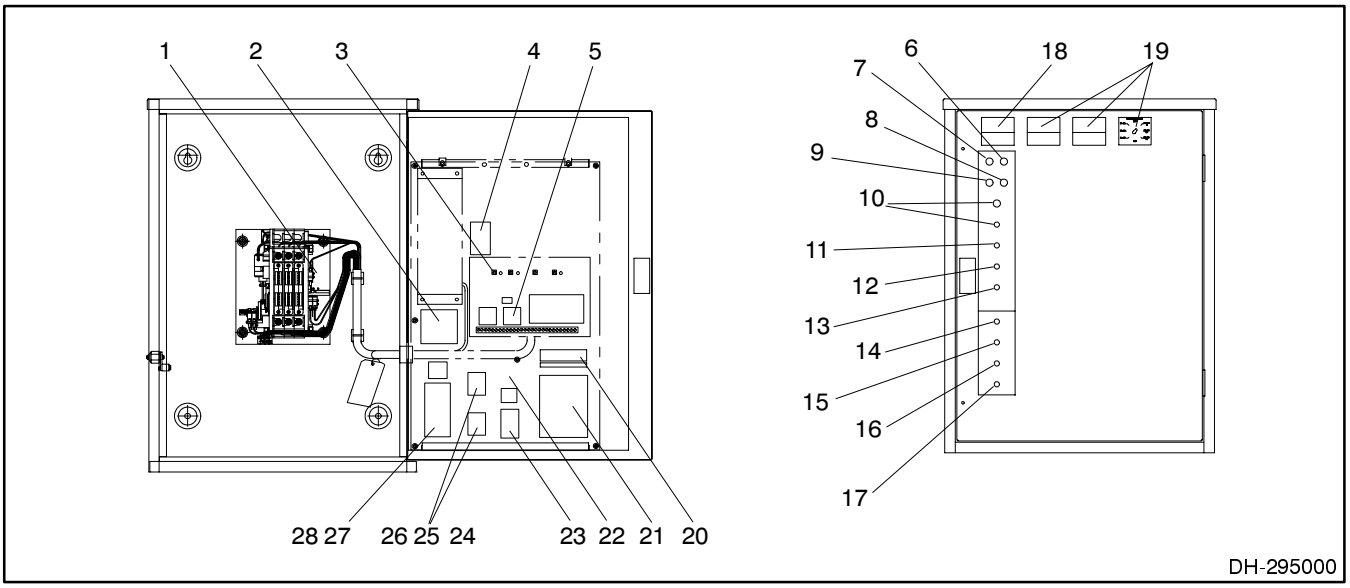
NOTICE

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.

3.1 Typical Mounting Locations

See Figure 3-1 for the typical mounting locations for accessories. The mounting locations of accessories may vary when the transfer switch has multiple accessories. See Figure 2-1 for a closeup view of controls and indicators on the front of the enclosure.

The following sections describe the operation of each accessory. The operations of some accessories are interdependent when certain combinations of accessories are installed.



1. KA-15—Main shaft auxiliary contacts
2. KA-34-B—Sync check relay
3. KA-1—TDNE adjustment on logic board
4. KA-4-D—TDEC relay
5. KA-2—TDES relay
6. KA-12-D—Panel lamp, contactor in normal position
7. KA-12-C—Panel lamp, contactor in emergency position
8. KA-12-H—Panel lamp, normal source available
9. KA-12-G—Panel lamp, emergency source available
10. KA-7—Four-position test switch with lamp
11. KA-6—Two- or three-position test switch
12. KA-23-Y—Plant exerciser Load/No Load selector switch
13. KA-8-C—Bypass TDNE switch
14. KA-29—Automatic/Manual selector switch
15. KA-29-G and T—Manual Transfer to Emergency pushbutton
16. KA-29—Manual Transfer to Normal pushbutton
17. KA-10-B, D—Preferred-source selector switch
18. KA-18-G—Frequency meter
19. KA-18-J—Voltage and current meters and selector switch
20. Accessory terminal strip TB6 (terminals 74–81)
21. KA-24—Battery charger
22. KA-10—Preferred-source switch engine start terminal strip
23. KA-23—Plant exerciser timer
24. KA-26—Area protection relay
25. KA-29—Manual operation relay circuit board
26. KA-14—Auxiliary contact, source available relays
27. KA-34-A—Inphase monitor
28. KA-35-G—Load shedding contacts

Figure 3-1. Typical Accessory Mounting Locations

3.2 KA-1 through KA-4—Time Delays

Time delays work automatically in the transfer switch sequence of operation. See Section 2.3—Automatic Operation. The table below summarizes the adjustment ranges for the various time delays. See Figure 3-2.

NOTE

When initially applying power to a transfer switch with accessory KA-4 installed, the engine start contacts remain closed until the ATS's Time Delay Engine Cooldown (TDEC) ends. To avoid starting the generator set, move the generator set master controller switch to the OFF position and disconnect the generator starting batteries before applying power to the transfer switch.

Time Delay	Accessory	Adjustment Range	Factory Default
Normal to Emergency (TDNE)	*	0.6–60 sec.	0.6 sec.
	KA-1-B	1–30 min.	1 min.
Engine Start (TDES)	KA-2-A	5–20 sec.	5 sec.
	*	Fixed 3 sec	3 sec.
	KA-2-F	20–240 sec.	20 sec.
	KA-2-G	0.5–5 sec.	0.5 sec.
Emergency to Normal (TDEN)	*	1–30 min.	1 min.
Engine Cooldown (TDEC)	KA-4-D	1–30 min.	5 min.

* Standard feature

Figure 3-2. Time Delay Ranges and Factory Default Settings

The time delay adjustment range depends upon the presence of accessories. See Figure 3-2 for a time delay summary.

TDES When accessory KA-2-A, F, or G is present on the transfer switch the TDES relay on the main controller circuit board is adjustable. See Figure 5-2.

TDNE and TDEN Adjustment pots for TDNE and TDEN are located on the main controller circuit board. See Figure 5-2.

TDEC Accessory KA-4-D includes a separate adjustable time-delay relay and is located on the inner panel. See Figure 3-1.

Time Delay Adjustment Procedure

1. Prevent the generator set, which provides the emergency power source to the transfer switch, from starting by moving the generator set master switch to the OFF position; disconnecting power to the generator engine start battery charger, if installed; and disconnecting all generator engine start batteries, negative (–) leads first.
2. Disconnect *BOTH* the normal and emergency power sources by opening upstream circuit breakers or switches to the transfer switch.
3. Adjust time delays by turning the adjustment clockwise to increase the time delay and counterclockwise to decrease the time delay.
4. Reinstall barriers removed to access adjustments.
5. Close and lock the transfer switch enclosure door.
6. Reconnect power supplies to the transfer switch.

NOTE

When initially applying power to the transfer switch, the engine start contacts remain closed signaling the generator to run until the ATS's Time Delay Engine Cooldown (TDEC), if equipped, ends.

7. Reconnect generator engine start battery cables, negative (–) leads last; reconnect power to the generator engine start battery charger, if installed; and move the generator set master switch to the AUTO (automatic) position. The generator may start and run for a while.

3.3 KA-6, 7—Test Switches

NOTE

If a test switch is in the TEST, TEST WITH LOAD, or OFF position, the transfer switch does not transfer to the normal source even when the emergency source fails.

The standard test switch and accessories KA-6-D, F, and H are two-position test switches mounted on the transfer switch enclosure door select one of two operation modes. All three switches have a have a maintained AUTO (automatic) position. The standard test switch and accessory KA-6-have a momentary TEST position. Accessories KA-6-D and H have a maintained TEST position. Accessories KA-6-F and H are key-operated.

Two-position Switch (standard and KA-6-D, F, H)

- **Automatic** Transfer switch works automatically as described in Section 2.3—Automatic Operation.
- **Test** Simulates a normal source failure. The transfer switch operates as described in Section 2.3—Automatic Operation when Normal fails.

Accessory KA-6-M is a three-position test switch mounted on the enclosure door that selects one of three operation modes: momentary TEST WITH LOAD position, maintained AUTO (automatic) and TEST WITHOUT LOAD positions.

Three-position Switch (KA-6-M)

- **Automatic** Transfer switch works automatically as described in Section 2.3—Automatic Operation.
- **Test With Load** Simulates a normal source failure. The transfer switch operates as described in Section 2.3—Automatic Operation when Normal fails.
- **Test Without Load** Signals the generator set to start and run unloaded.

Accessories KA-7-D and H, four-position test switches with lamp mounted on the enclosure door, select one of four operation modes. The lamp lights when the switch is not in the AUTO position. The switches have a momentary TEST and maintained AUTO, OFF, and ENGINE START positions.

Four-position Switch (KA-7-D, H)

- **Engine Start** Signals the generator set to start and run unloaded.
- **Off** Prevents automatic transfer switch operation by inhibiting control circuits and opening the engine start circuit. The transfer switch does not start the generator nor does it transfer to an available source if the connected source fails.
- **Automatic** Transfer switch works automatically as described in Section 2.3—Automatic Operation.
- **Test** Tests transfer switch by simulating a normal source failure. The transfer switch operates as described in Section 2.3—Automatic Operation when Normal fails.

3.4 KA-8—Bypass Time Delay Switch

Accessory KA-8-C is a two-position switch mounted on the enclosure door. Moving this switch to the BYPASS TIME DELAY EMERGENCY TO NORMAL (momentary) position overrides the Time Delay Emergency to Normal (TDEN) timer by simulating an Emergency failure, causing the switch to immediately transfer to the normal source, if acceptable.

3.5 KA-10—Preferred-source Switches

A two-position selector switch or a programmable timer allows selection of either the normal or emergency power source as the preferred power source. Engine start connections located on the inner panel rather than the contactor assembly allow the controller to start and run the corresponding generator constantly when it is a preferred source and as an emergency source when the preferred source fails.

Accessory KA-10-B and D Accessory KA-10-B is for use when there are either two commercial (utility) power sources or one commercial (utility) power source and one engine generator. Accessory KA-10-D is for use when both power sources are engine generators. A selector switch mounted on the enclosure door selects the preferred source. The SOURCE 1 position selects the normal source as the preferred source and the SOURCE 2 position selects the emergency source as the preferred source.

Accessory KA-10-F is for use when both sources are engine generators and uses the same exerciser timer used in accessory KA-23 to cycle between the two sources alternately on a programmed schedule. Accessory KA-10-F selects the normal source as the preferred source during the exerciser on period and the emergency source during the exerciser off period. See Section 3.10 for programming the timer.

Engine start connections for accessory KA-10 use terminals 3, 3A, 4, and 4A on a terminal strip located on the inner panel, *not the engine start terminals 3 and 4 located on the power switching device assembly.* When there is only one generator connect the engine start circuit from the generator to engine start terminals 3 and 4 on the inner panel. When there are two generator sets connect the engine start circuit from the generator whose output connects to the normal power source terminals to engine start terminals 3 and 4 and connect the engine start circuit from the generator whose output connects to the emergency power source terminals to engine start terminals 3A and 4A on the inner panel.

3.6 KA-12—Panel Lamps

All accessory 12 panel lamps are mounted on the enclosure door. The following table summarizes panel lamp function. See Figure 3-3.

Accessory	Panel Lamp	
	Color	Lights When
12-C	Green	Contactor in Normal position
12-D	Red	Contactor in Emergency position
12-G	White	Normal source available
12-H	White	Emergency source available

Figure 3-3. Panel Lamp Summary

3.7 KA-14—Auxiliary Relay Contacts

Auxiliary relays are located on the left-hand side of the inner panel mounted on the enclosure door and energize when phase A-C of the normal or emergency source is available. Each relay has three sets of isolated SPDT form C contacts. See Figure 3-4 for auxiliary relay contact ratings.

Auxiliary Relay Contact Ratings, Maximum Current
10 A @ 28 vdc
10 A @ 120 vac, 0.8 PF
6 A @ 240 vac, 0.8 PF
3 A @ 480/600 vac

Figure 3-4. Auxiliary Relay Contact Ratings

Accessory KA-14-C relay energizes when the normal source is available and is labeled NR2. See Figure 3-5 for connections.

Accessory KA-14-D relay energizes when the normal source is available and is labeled ER2. See Figure 3-6 for connections.

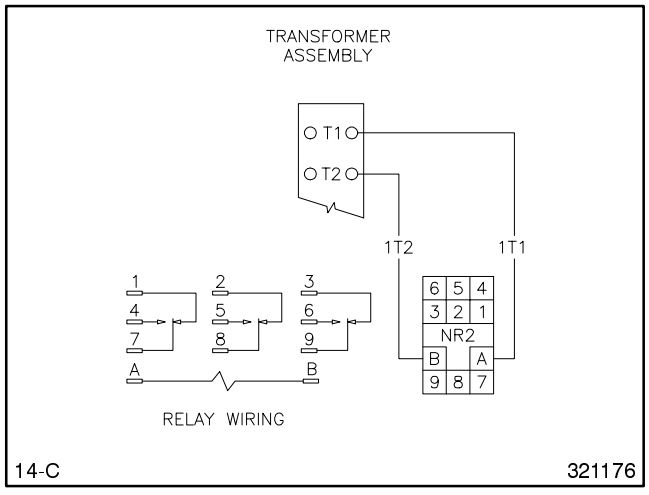


Figure 3-5. Accessory KA-14-C Connections

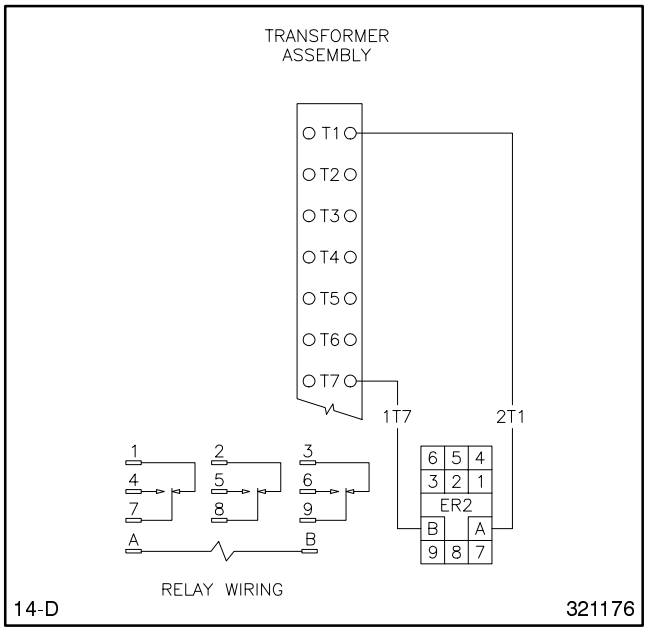


Figure 3-6. Accessory KA-14-D Connections

3.8 KA-15—Main Shaft Auxiliary Contacts

All main shaft auxiliary contacts are mounted on the power switching device and operate with the transfer switch main contacts to provide a positive indication of switch position. See the power switching device operation and installation manual for details. See List of Related Materials in the Introduction section in this manual.

Accessory KA-15-N and P provides one additional isolated contact closed when the load is connected to the normal source and one additional isolated contact closed when the load is connected to the emergency source.

Accessory KA-15-R provides two additional isolated contacts closed when the load is connected to the normal source and two additional isolated contacts closed when the load is connected to the emergency source.

3.9 KA-18—Meters

Analog meters are mounted on the enclosure door.

Accessory KD-18-G is an analog frequency meter that displays the emergency power source frequency in hertz.

Accessory KD-18-J is an analog AC rms average voltage and current meter with a selector switch that allows display of each load line current in amperes or each phase voltage of Normal or Emergency.

3.10 KA-23—Plant Exercisers

A plant exerciser contains a timer that periodically runs the emergency source generator set. The exerciser timer is mounted below the main logic circuit board on the inner panel of the enclosure door.

Plant exercisers run the generator set in one of two modes, loaded or unloaded.

Plant Exerciser Modes

- **Unloaded** The plant exerciser closes the engine start contacts directly. The transfer switch only transfers to the emergency source if the normal source fails during the exercise period.
- **Loaded** The plant exerciser simulates a normal source failure and the transfer switch goes through an automatic sequence of operation that closes the engine start contacts and transfers the load to the emergency source during the exercise period.

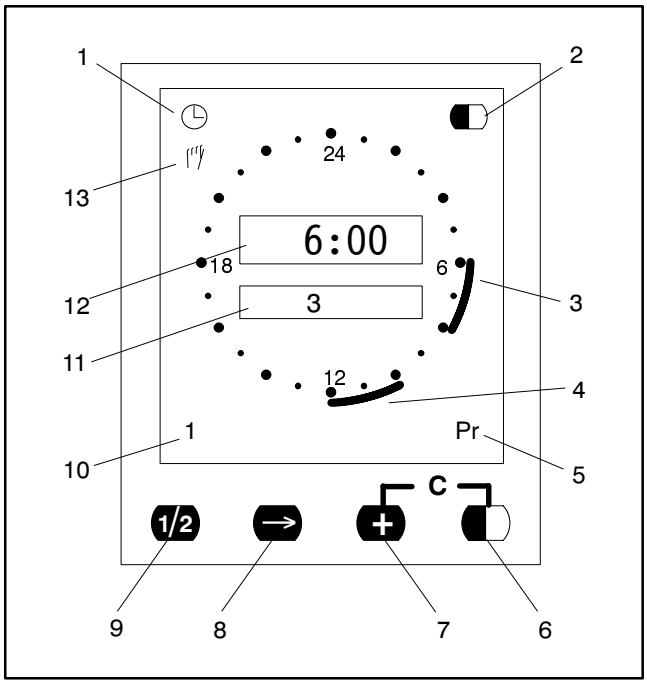
See Figure 3-7 for a summary of each exerciser accessory.

Accessory	Exercises The Generator Set
23-W	Unloaded
23-X	Loaded
23-Y	Loaded or unloaded set by the position of the Load/No Load selector switch

Figure 3-7. Plant Exerciser Summary

Exercising the generator set under load once a week for a minimum of 30 minutes helps to maximize the reliability of the emergency power system.

The plant exerciser has a Liquid Crystal Display (LCD) panel that shows various exerciser information and four pushbuttons to enter information. See Figure 3-8. The following sections detail how to set the exerciser.



1. Blinking clock symbol = set time of day
   Constant clock symbol = time switch running
2. Generator start contact state, half shaded = on, no shading = off
3. Segment display of first program, 1 segment = 15 min.
4. Segment display of second program, 4 programs per day max
5. Symbol of program input or interrogation
6. Set button stores the programs to memory. Also used to override program
7. Plus button increments time for programming
8. Arrow button changes from day to hour:minute. Copy start and shutdown times from one day to the next
9. Week button alternates between week one and week two
10. Displays week one or week two
11. Actual day of the week or program day
12. Real time, set start time or set shutdown time
13. Hand symbol—blinking = continuous manual operating
    constant = manual override

Figure 3-8. Exercise Timer

3.10.1 Resetting the Clock

1. Lift bottom flap of timer front cover to open.
2. Simultaneously press and hold the ARROW (→), PLUS (+), and SET (◐) buttons for 10 seconds. See Figure 3-8.
3. Continue to depress the ARROW (→) button and simultaneously release the PLUS (+) and SET (◐) buttons.
4. Release the ARROW (→) button when all segments of the LCD display appear.

3.10.2 Initial Setup (Time and Day)

Use the following procedure to set the current day and time.

1. Press the ARROW (→) button once. The clock symbol and the program day flash.
2. Press and release the PLUS (+) button until the current day of the week displays. Monday is day 1, Sunday is day 7.
3. Press the ARROW (→) button once when the current day displays.
4. Press and release the PLUS (+) button to increase the hour. Press the ARROW (→) button once to enter the hour. Timer runs from 1 to 24 hours, not am/pm.
5. Press and release the PLUS (+) button to increase the minutes. Hold the PLUS (+) button to increase the minutes by 5.
6. Press the ARROW (→) button once to enter the minute. After the minute has been entered, PR (program) flashes on the exerciser's display, and the number 1 in the display's lower left corner indicates the week.

3.10.3 Programming the Plant Exercise and Shutdown Times

1. Press and release the ARROW (→) button to advance to the desired exercise day. If the exercise day is in week 1, proceed to step 2. If the exercise day is in week 2, continue with step 1a.
   a. Press and release the ARROW (→) button to advance to day 7.
   b. Press the ARROW (→) button once.
   c. Press the WEEK (1/2) button once. The number 2 in the display's lower left corner indicates the week.
   d. Press and release the ARROW (→) button four times to advance to the desired exercise day.
2. Press or hold the PLUS (+) button to set the exercise start time.
3. Press the SET (◐) button to save the exercise start time.
4. Press or hold the PLUS (+) button to set the exercise shutdown time. Bar segments fill the display to identify the start time.
5. Press the SET (◐) button to save the exercise shutdown time.
6. Press the ARROW (→) key to advance to the next exercise day.
7. Press the PLUS (+) and SET (◐) buttons simultaneously to clear the setting if the exercise start and shutdown times are different from the previous day or do not apply to the current day. Repeat steps 2–6 to set the exercise start and shutdown times for each day of the week.
8. Press the ARROW (→) button once to complete programming when day 7 of week 1 or week 2 displays. The program is complete and ready to run when the clock icon is in the upper left corner of the exerciser's display.

3.10.4 Resetting the Time

Use the following procedure to reset the time.

1. Perform Initial Setup steps 1 to 5.
2. Press and release the ARROW (→) button eight times until the clock icon appears.

3.10.5 Reviewing the Program

Continue to press and release the ARROW (→) button to review the programmed start and shutdown times.

3.10.6 Modifying an Existing Program

Use one of the following procedures to reprogram a previously entered program.

1. Reprogramming procedure 1.
   a. Press the WEEK (1/2) button to choose week 1 or week 2.
   b. Press the ARROW (→) key four times.
   c. Perform the procedure listed under Programming the Plant Exercise and Shutdown Times.
   d. Cancel the entered program for every day by pressing the PLUS (+) and SET (◐) buttons simultaneously.
   e. Enter the new program for every day.
2. Reprogramming procedure 2.
   a. Reset the clock as described under Resetting the Clock.
   b. Perform the steps listed under Initial Setup.

3.10.7 Manual Override

Use the following procedure to manually override the exercise timer and start or stop the generator.

1. Press the SET (◐) button and release once. The generator start contact changes state.
2. Press and release the SET (◐) button again to end manual override. The generator start contact changes state. If manual override is not ended, the timer automatically continues with the program at the next preset on or off time.

3.10.8 Continuous Manual Operation

Use the following steps for continuous manual operation of the generator.

1. Press the SET (◐) button for two seconds until the hand icon (☟) flashes.

   If the generator start contact is on (◐), the segmented display appears. If the generator start contact is off (○), the segmented display does not appear.

2. Press and release the SET (◐) button to cause the generator start contact to change state.

3.10.9 Ending Continuous Manual Operation

Press the SET (◐) button for two seconds until the clock icon appears in the display to end continuous manual operation.

3.11 KA-24—Battery Charger

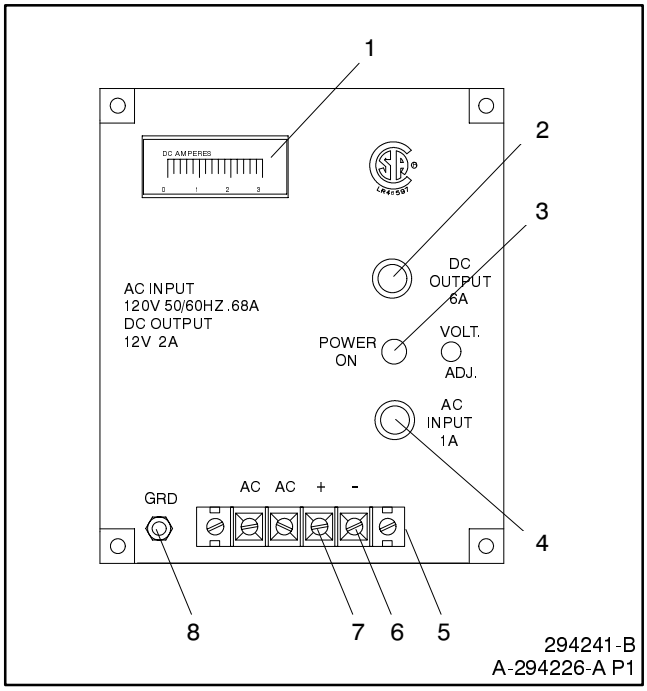
Automatic, adjustable-float battery chargers are mounted below the main circuit board on the inner panel of the enclosure door. See Figure 3-9 for component identification.

KA-24-xxA 12-volt Charger
KA-24-xxB 24-volt Charger

Where xx refers to the line voltage and is coded to match the transfer switch model number voltage code.

3.11.1 Specifications

The automatic battery charger automatically charges and maintains the charge on lead-acid automotive-type batteries. Circuits on the control circuit board regulate and limit the output of the battery charger to provide current-limiting, AC line compensation, reverse-polarity protection, ambient-temperature compensation, and a constant-voltage charging mode. The control circuit board continuously monitors the battery and load conditions to maintain the battery's proper state of charge. The charger is factory adjusted to maintain the battery at the proper float voltages. The 12-volt charger maintains a 6-cell lead-acid battery and requires no user adjustment. The 24-volt charger maintains a 12-cell lead-acid battery and requires no user adjustment.



1. Ammeter
2. DC output fuse
3. POWER ON lamp
4. AC input fuse
5. Terminal block
6. DC negative (–) output terminal
7. DC positive (+) output terminal
8. Ground terminal

Figure 3-9. Typical Battery Charger Components

NOTE

The battery chargers included in the transfer switch covered by this manual are designed strictly for use in the transfer switch and conform with UL and CSA listing requirements where specified. Read instructions before using battery charger.

3.11.2 Installation Connections

NOTE

Charger Damage! Connect battery charger only to a battery with the same DC voltage as the battery charger output rating.

Wire Type Use #10 AWG stranded copper wire, 600 V, 105°C vinyl plastic insulation UL style 1015, CSA type TEW for the DC output leads from the battery charger to the battery.

Wire Length See Figure 3-10 for the maximum distance of leads from the battery charger to the battery. Greater distances may result in excessive voltage drop, particularly when a battery ages and requires more current to maintain a float charge. Excessive voltage drop results in an undercharging condition that can lead to battery damage and/or failure of the generator to start.

Battery Voltage	Maximum Distance *, Ft. (m)
12	150 (45)
24	300 (90)

* Based on #10 AWG stranded copper wire, 0.1/0.2 volt maximum voltage drop on each lead to the battery on 12/24 volt systems, output current 0.5 amps maximum, and ambient temperature 167°F (75°C) maximum.

Figure 3-10. Maximum Distance from Battery Charger to Battery

Grounding Ensure that the metal frame or ground terminal of the battery charger is connected to a grounded, metal, permanent wiring system or an equipment-grounding conductor. Ensure that all battery charger connections comply with all applicable electrical codes and standards.

Charger Installation Connection Procedure

1. Prevent the generator set, which provides the emergency power source to the transfer switch, from starting by moving the generator set master switch to the OFF position and disconnecting all generator engine start batteries, negative (–) leads first.
2. Disconnect *BOTH* the normal and emergency power sources to the transfer switch by opening upstream circuit breakers or switches. The POWER ON lamp on the battery charger should turn off.
3. Battery leads are not provided due to the variety of generator installations. Install, prepare, and connect leads as follows.
   a. Install a red wire for the positive (+) lead and a black wire for the negative (–) lead from the battery charger to the battery. Do not exceed the maximum distance given in Figure 3-10.
   b. Strip the insulation from both ends of both leads.
   c. Install a ring terminal on one end of the positive (+) lead and connect to the generator set at a location that is connected to the positive (+) terminal of the battery, typically at the engine starter solenoid (direct connection to the battery terminal can lead to corrosion problems.) Connect the other end of the red lead to the DC positive (+) terminal on the battery charger's terminal block and secure by tightening the lock screw.
   d. Install a ring terminal on one end of the negative (–) lead and connect to the generator set in a location that is connected to the negative (–) terminal of the battery, typically the engine block. Connect the other end of the black lead to the DC negative (–) terminal on the battery charger's terminal block and secure by tightening the lock screw.
   e. Reinstall the barrier on the battery charger's terminal strip.
4. Reconnect power supplies to the transfer switch. The POWER ON lamp on the battery charger should light.

NOTE

When initially applying power to the transfer switch, the engine start contacts remain closed signaling the generator to run until the ATS's Time Delay Engine Cooldown (TDEC), if equipped, ends.

5. Reconnect generator engine start battery cables, negative (–) leads last; reconnect power to the generator engine start battery charger, if installed; and move the generator set master switch to the AUTO (automatic) position. The generator may start and run for a while.

3.11.3 Disconnecting the Charger Before Replacing or Servicing the Battery

Charger Disconnection Procedure

1. Prevent the generator set, which provides the emergency power source to the transfer switch, from starting by moving the generator set master switch to the OFF position and disconnecting all generator engine start batteries, negative (-) leads first.
2. Disconnect *BOTH* the normal and emergency power sources to the transfer switch by opening upstream circuit breakers or switches. The POWER ON lamp on the battery charger should turn off.
3. Remove lead leads from the battery charger terminal block, black lead from the negative (-) terminal first and wrap each of the charger connection leads with electrically-insulating tape.
4. Reconnect power supplies to the transfer switch. The POWER ON lamp on the battery charger should light.

NOTE

When initially applying power to the transfer switch, the engine start contacts remain closed signaling the generator to run until the ATS's Time Delay Engine Cooldown (TDEC), if equipped, ends.

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5. Reconnect generator engine start battery cables, negative (-) leads last; reconnect power to the generator engine start battery charger, if installed; and move the generator set master switch to the AUTO (automatic) position. The generator may start and run for a while.

3.11.4 Reconnecting the Charger After Replacing or Servicing the Battery

Charger Reconnection Procedure

1. Prevent the generator set, which provides the emergency power source to the transfer switch, from starting by moving the generator set master switch to the OFF position and disconnecting all generator engine start batteries, negative (-) leads first.
2. Disconnect *BOTH* the normal and emergency power sources to the transfer switch by opening upstream circuit breakers or switches. The POWER ON lamp on the battery charger should turn off.
3. Reconnect the lead wires to the battery charger terminal block, black lead to the negative (-) terminal last.
4. Reconnect the power supplies to the transfer switch. The POWER ON lamp on the battery charger should light.

NOTE

When initially applying power to the transfer switch, the engine start contacts remain closed signaling the generator to run until the ATS's Time Delay Engine Cooldown (TDEC), if equipped, ends.

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5. Reconnect generator engine start battery cables, negative (-) leads last; reconnect power to the generator engine start battery charger, if installed; and move the generator set master switch to the AUTO (automatic) position. The generator may start and run for a while.

3.11.5 Charging Lead-acid Batteries

Charge 6- or 12-cell (12- or 24-volt) lead-acid batteries according to the following procedure.

Battery Charging Procedure

1. Inspect the battery for defective cables, loose posts, and loose terminals. Ensure that the battery terminals and battery charger connectors are tight and clean of all corrosion for efficient charging.
2. If the battery is not sealed check the fluid level in each cell. If the fluid level is low, add distilled water to bring the fluid level up to the battery manufacturer's recommended level.
3. An automatic charger does not operate properly on dry-charge batteries not given a conditioning charge. Give a dry-charge battery a conditioning charge immediately after adding electrolyte fluid. *This battery charger cannot provide the voltage and current required to provide a conditioning charge.* Follow the battery manufacturer's recommendations for length of the conditioning charge and required charger specifications.
4. Reconnect the power supplies to the transfer switch. The POWER ON lamp on the battery charger should light.

5. The ammeter indicates the charge current the charger delivers to the battery. The charger control circuit limits the maximum charging current to 2 amps. A generator set does not require a cranking disconnect because the charger output is overload-protected. A battery in good condition is nearly fully charged when the following occurs.

   - **Charging current approaches zero** as a battery becomes charged and the battery voltage approaches the control voltage setting. The ammeter needle may fluctuate, indicating a continuous supply of pulsating current that automatically keeps the battery in a charged condition.
   - **The specific gravity of the battery electrolyte is between 1.250 and 1.285 corrected to a temperature of 80°F (26.7°C).** See the generator set or engine operation manual for the procedure to measure the specific gravity of battery electrolyte.
   - **Bubbles appear at the surface of the battery fluid.** Bubbles indicate a battery that is 80 to 85% charged. Vigorous bubbling occurs when the battery nears full charge.

3.11.6 Charging Nickel-cadmium Batteries

Charging recommendations vary between manufacturers of nickel-cadmium batteries. Contact the manufacturer of the nickel-cadmium battery for charging and maintenance instructions. If the voltage setting recommended by the battery manufacturer is different from the battery charger's factory setting, contact an authorized service center to adjust the battery charger.

3.11.7 Charger Voltage Adjustment

The battery charger's output settings are factory set and normally require no customer adjustment. If the battery charger requires adjustment, contact an authorized service center to adjust the battery charger. See Figure 3-11 for factory output settings.

Charger Voltage	Float Voltage	Current Limit (Amps)
12	13.2	2
24	26.4	2

Figure 3-11. Factory Output Settings

3.11.8 Charger and Battery Maintenance

See the operation manual for the generator set or engine for battery maintenance details. Include the following items when maintaining the system.

Important Charger and Battery Maintenance Items

- Check the battery terminals and charger connectors for clean contact surfaces. Clean corroded battery terminals and charger connectors with a mild baking soda/water solution.
- Check battery fluid level regularly and maintain battery fluid to battery manufacturer's recommended level by adding distilled water (nonsealed batteries only).

3.12 KA-26—Area Protection Relay

Accessory KA-26-D allows a remote contact to cause the transfer switch to signal the generator set to start and transfer to the emergency source when the contact is opened. KA-26-D also includes an override circuit to transfer to the normal source if the emergency source fails. The area protection relay is mounted on the inner panel of the enclosure door. Connection terminals are on the TB6 terminal strip. Operating voltage is 12 vac, maximum external customer circuit resistance approximately 12 ohms. See Figure 3-12 for connections.

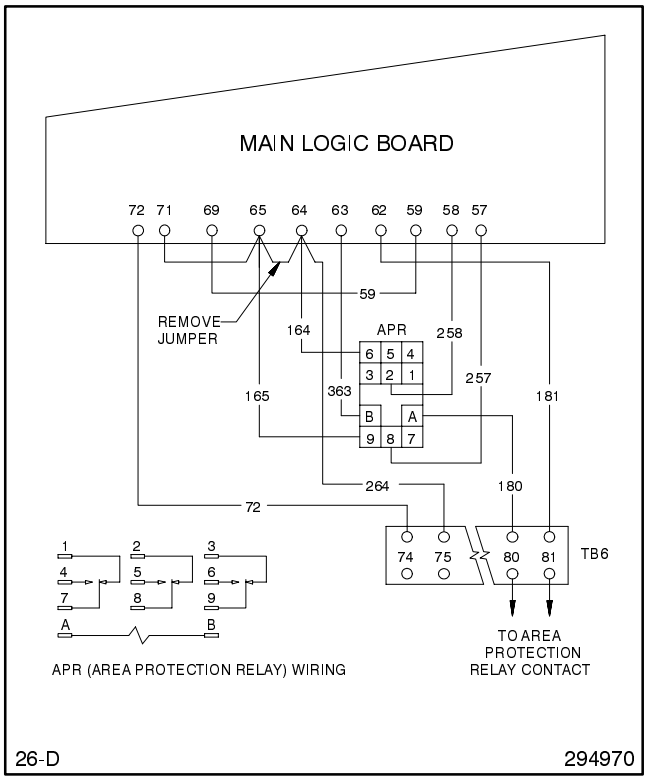


Figure 3-12. Accessory KA-26-D Connections

3.13 KA-28—Logic Protection Fuses

Accessory KA-28-A logic protection fuses for nonessential circuitry work with accessories KA-7-C, D; 12-C, D, G, H; and 23-W, X, Y. The fuse holders are mounted on the inner panel of the enclosure door.

3.14 KA-29—Manual Operation Switches

Manual operation switches are located on the enclosure door. Accessories KA-29-G and P allow manual transfer to the emergency source only. Accessories KA-29-J and T allow manual transfer to the normal or emergency source. A key-operated Automatic/Manual selector switch provides the following modes of operation.

- **Automatic** Transfer switch works automatically as described in Section 2.3—Automatic Operation. No manual transfer is allowed.
- **Manual** Operate the transfer switch by pressing a pushbutton to transfer to Emergency or Normal. The manual transfer is available after the TDEN or TDNE has timed out. The transfer switch allows manual transfer only to an acceptable source. Accessories KA-29-P and T have an override circuit that allows the transfer switch to automatically transfer to an acceptable source when the manually selected source becomes unacceptable.

To manually operate the transfer switch, set the Automatic/Manual selector switch to MANUAL and then press the Manual Transfer to Emergency or Manual Transfer to Normal pushbutton after the TDEN or TDNE has timed out.

3.15 KA-34—Inphase Monitor and Synchronism Check Relay

Accessory KA-34 controls the transfer of loads to prevent inrush currents from exceeding normal starting currents and tripping circuit breakers, and to prevent damage to loads. Monitors one phase of the normal and emergency power sources and permits transfer only when power sources are near synchronism.

If the voltage of the power source supplying the load drops below a bypass pickup setting, accessory KA-34 allows immediate transfer to the alternate power source. If both power source voltages fall below a pickup prevention setting, accessory KA-34 inhibits transfer to prevent transfer to an unacceptable power source.

3.15.1 KA-34-A—Inphase Monitor

Accessory KA-34-A inphase monitor permits transfer when power source voltage waveforms have a phase difference within ±15 degrees and a frequency difference within ±3.0 Hz. The inphase monitor causes the contactor solenoid to energize at the precise moment to close in phase with the alternate source.

An inhibit circuit prevents transfer when sources are moving away from synchronism.

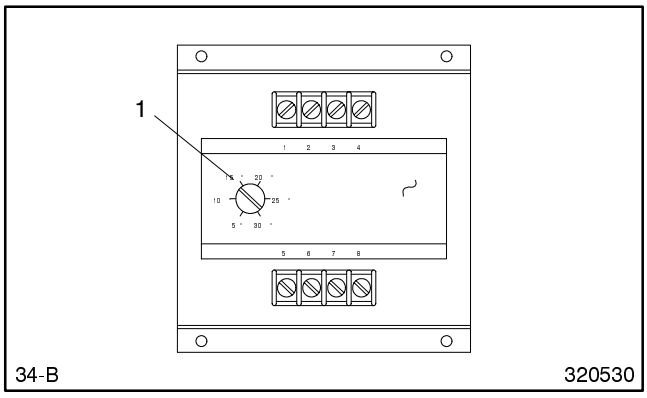
When power is first applied to the inphase monitor, an approximate 2.0 second time delay occurs before the inphase monitor starts the sampling mode. Disconnecting the enabling input automatically resets the monitor.

The bypass pickup and pickup prevention settings are 70% of nominal.

3.15.2 KA-34-B—Synchronism Check Relay

Accessory KA-34-B is a synchronism check (sync check) relay with an adjustable phase difference. KA-34-B permits transfer when the power source voltage waveforms have a phase angle difference below a phase angle setting for approximately 50 milliseconds. The phase angle setting is adjustable from ±5 to ±30 degrees, factory setting ±10 degrees. Use a slotted screwdriver to set the phase angle adjustment located on the front of the sync check relay assembly. See Figure 3-13.

The bypass pickup setting is 71–75% of nominal. The pickup prevention setting is 68–72% of nominal. The inhibit time is approximately 35 milliseconds.



1. Phase angle adjustment

Figure 3-13. Accessory KA-34-B—Sync Check Relay Assembly

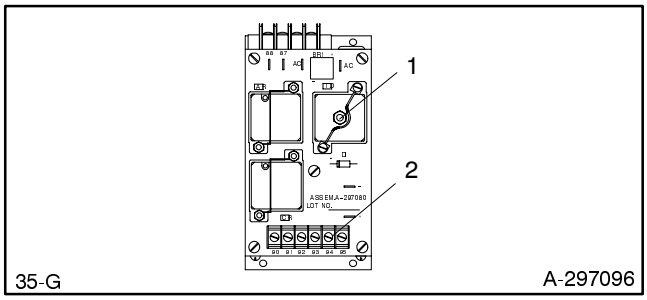
3.16 KA-35—Load Shedding Contacts

Accessory KA-35-G load shedding contacts allows the controller to disconnect loads prior to transfer in either direction. Two isolated SPDT form C relay contacts operate an adjustable time (0.6 to 60 seconds) before transfer in either direction and reset immediately after transfer and are located on a load shed relay circuit board mounted on the inner panel of the enclosure door. A terminal strip is located at the bottom of the assembly for customer connections. See Figure 3-15. See Figure 3-14 for load shedding contact ratings. See Figure 3-16 for connections.

An adjustment screw is located on the top of one of the three relays on the load shed relay circuit board. To adjust the time delay before transfer, turn the adjustment screw. See Figure 3-15.

Load Shedding Contact Ratings
10 A Max. @ 28 VDC
10 A Max. @ 120 VAC, 0.8 PF;
6 A @ 240 VAC, 0.8 PF;
3 A @ 480/600 VAC, 0.8 PF.

Figure 3-14. Load Shedding Contact Ratings



1. Time delay adjustment
2. Customer connections terminal strip

Figure 3-15. Accessory KA-35-G

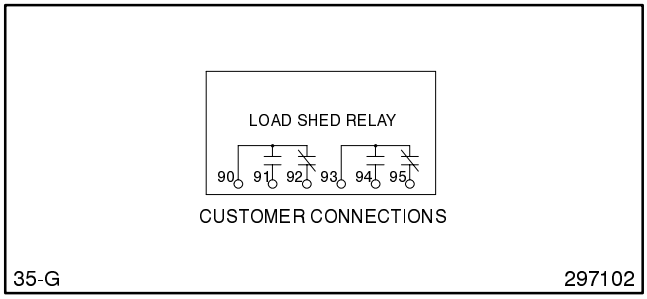


Figure 3-16. Accessory KA-35-G Connections

Scheduled 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.

A local authorized distributor/dealer (authorized service center) can provide complete preventive maintenance and services to keep the transfer switch in top condition. Contact a local distributor/dealer for additional information. See the Service Assistance section in this manual for how to locate a local distributor/dealer.

Read this entire section carefully before attempting any maintenance or service. Unless otherwise specified, have maintenance or service performed by an authorized service center that has trained and qualified personnel who follow all applicable codes and standards.

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.

⚠ WARNING

Hazardous voltage.
Can cause severe injury or death.

Disconnect all power sources before opening the enclosure.

(under 600 volt)

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

(600 volt and above)

⚠ WARNING

Hazardous voltage.
Can cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

(under 600 volt)

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

(600 volt and above)

⚠ 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 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 wristwatch, rings, and jewelry before servicing the equipment.

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.

Servicing the transfer switch controls and accessories within the enclosure. Hazardous voltage can cause severe injury or death. Disconnect the transfer switch controls at the inline connector to deenergize the circuit boards and logic circuitry but allow the transfer switch to continue to supply power to the load. Disconnect all power sources to accessories that are mounted within the enclosure but are not wired through the controls and deenergized by inline connector separation. Test circuits with a voltmeter to verify that they are deenergized before servicing.

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

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.

4.1 Inspection and Service

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

4.1.1 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, noise, 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. *Do not use compressed air to clean the switch because it can cause debris to lodge in the components and cause damage.* Replace any worn, missing, or broken external components with manufacturer-recommended replacement parts. Contact a local authorized service center for specific part information and part ordering. Tighten loose external hardware.

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 service center to inspect and service the transfer switch if any of the following conditions are found inside the transfer switch.

- Accumulations of dirt or 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 power interruption required to perform an internal inspection is unacceptable in the application, have an internal inspection performed by an authorized service center.

4.1.2 Other Inspections and Service

Contact an authorized service center to perform scheduled maintenance, service, and other maintenance that ensures the safe and reliable operation of the transfer switch. See Section 4.3—Service Schedule for the recommended maintenance items and service intervals.

Have an authorized service center repair or replace components inside the transfer switch enclosure with manufacturer-recommended replacement parts.

4.2 Testing

4.2.1 Weekly Generator Set Exercise

Use a plant exerciser or manual test to start and run the generator set under a load once a week to maximize the reliability of the emergency power system. See Section 3.10 for plant exerciser information. See Section 3.3 for information on test switches.

4.2.2 Monthly Automatic Operation Test

Test the transfer switch's automatic control system monthly. See Section 5.5.2. Verify that the expected sequence of operations occurs as the switch transfers the load to the emergency source when a normal source failure occurs or is simulated. Observe the indicators (incandescent lamps and LEDs) included on the transfer switch to check their operation. When the switch transfers the load to the emergency source, end the test and verify that the expected sequence of operations occurs as the transfer switch retransfers to the available normal source and signals the generator set to shut down after a cooldown period.

4.3 Service Schedule

Follow the service schedule below for the recommended service intervals. Have all service performed by an authorized service center except for activities limited to the items designated by an X.

System Component or Procedure	See Section	Visually Inspect	Check	Change	Clean	Test	Frequency
ELECTRICAL SYSTEM							
Check for signs of overheating or loose connections: discoloration of metal, melted plastic, or a burning odor	4.1.1	X	X				M
Check the contactor's external operating mechanism for cleanliness and clean and relubricate if dirty *	4.1.1	X		D, R (lubricant)	D		M
Check wiring insulation for deterioration, cuts, or abrasion and repair or replace wiring to regain the properties of the original wiring	4.1.1	X		D, R (wiring)			M
	4.1.2	D	D				Q
Check the transfer switch's main power switching mechanisms' mechanical operation and integrity	4.1.2	D	D			D	Y
Tighten control and power wiring connections to specifications	4.1.2, P		D			D	Y
Check the transfer switch's main power switching contacts' condition and clean or replace the main contacts or replace the contactor assembly as necessary	4.1.2	D		D, R	D		Y
Perform a thermal scan or millivolt drop test to check for high contact resistances on power circuits. Tighten connections, clean main contacts, adjust or replace main contacts or contactor assembly to eliminate high contact resistances	4.1.2		D	D, R	D	D	Y
Test wire and cable insulation for electrical breakdown	4.1.2					D	Every 3 Years
Check calibration of voltage-sensing circuitry and setpoints, and recalibrate circuitry as necessary	4.1.2		D			D	Every 5 Years
CONTROL SYSTEM							
Exercise the generator set under load	4.2.1					X	W
Test the transfer switch's automatic control system	4.2.2	X				X	M
Test all indicators (incandescent lamps and LEDs) and all remote control systems for operation		D	D	D, R		D	Y
GENERAL EQUIPMENT CONDITION							
Inspect the outside of the transfer switch for any condition of vibration, leakage, noise, temperature, contamination, or deterioration to keep the transfer switch clean and in good condition *	4.1.1	X			X		W
Check that all external hardware is in place, tightened, and not badly worn	4.1.1	X	X	R			W
Inspect the inside of transfer switch for any condition of vibration, leakage, noise, temperature, contamination, or deterioration to keep the inside of the transfer switch clean, dry, and in good condition *	4.1.1	X	X		D		M
	4.1.2	D	D		D		Y
Check that all internal hardware is in place, tightened, and not badly worn	4.1.2	X	D				M

* Service more frequently if 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.

Change 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 service center.

L See the transfer switch logic controller operation and installation manual for more information.

P See the transfer switch power switching device operation and installation manual for more information.

D Have service performed by an authorized service center.

X Operator action.

R May require replacement of components.

W=Weekly
M=Monthly
Q=Quarterly
S=Six Months
Y=Yearly

Kohler® automatic transfer switches are shipped factory wired and tested, ready for installation. Installation of the switch consists of the following.

- Unpacking and inspectiing the switch upon receipt.
- Protecting the switch against damage before and during installation.
- Wiring of normal source (utility), emergency source (generator) and load power circuits.
- Wiring of control connections such as generator start signals and accessories.
- Checking voltages and functions.
- Connecting and initializing the controller.

Use this section for controller installation details. Begin installation by following the installation section in the power switching device operation and installation manual packed with the transfer switch. The power switching device operation and installation manual contains information on mechanical installation, electrical ratings, power connection details, and other power switching device details. See List of Related Materials in the Introduction section in this manual.

5.1 Upon Receipt of Unit

5.1.1 Inspection

At time of delivery, inspect the transfer switch for signs of shipping damage. If damage and/or rough handling is evident, file a damage claim immediately with the transportation company and promptly notify the distributor/dealer.

5.1.2 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.

The power switching device operation and installation manual lists the approximate weight of each transfer switch. Use a spreader bar to lift. Attach the bar only to the enclosure's mounting holes or lifting brackets; do not lift the unit at any other points. Replace, close, and latch the enclosure door before moving or mounting the unit.

5.1.3 Unpacking

Unpack the transfer switch immediately after receipt and inspect it for shipping damage. Failure to perform an immediate inspection impedes recovery of losses caused by shipping damage. Use care when unpacking to avoid damaging the transfer switch components. Remove all dirt and packing material that may have accumulated in the transfer switch or any of its components.

If the equipment has been stored at cold temperatures, allow equipment to warm to room temperature for 24 hours (minimum) before unpacking to prevent condensation on the electrical apparatus.

5.1.4 Storage

Store the transfer switch in its protective packing until ready for final installation. Protect the automatic transfer switch at all times from excessive moisture, construction grit, and metal chips. Avoid storage in low temperature and high humidity areas where condensation could occur on the unit.

5.2 Mechanical Installation

Check the System Voltage and Frequency Do not install the transfer switch if the system voltage and frequency shown on the transfer switch nameplate is different from the nominal normal (utility) source voltage and frequency and the nominal emergency (standby) source voltage and frequency shown on the generator set nameplate.

All enclosed switches have the logic controls mounted on the enclosure door. The transfer switch enclosure is either mounted on the wall or floor depending on the switch type and size. Refer to the power switching device operation and installation manual for mounting information.

5.3 Check Manual Operation

Follow the procedure in the power switching device operation and installation manual to manually operate the power switching device to verify that it operates smoothly without binding and prepare it for automatic operation. If the power switching device does not operate smoothly without binding, *STOP!* Call an authorized service center to service the power switching device before proceeding.

5.4 Electrical Wiring

The factory prewires all internal electrical connections. The only wiring necessary to install the transfer switch is to connect the automatic transfer switch to external devices and power sources.

Observe all applicable national, state, and local electrical codes during installation.

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

The power switching device operation and installation manual provides schematic diagrams and enclosure drawings.

⚠ 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.

⚠ WARNING

Hazardous voltage.
Can cause severe injury or death.

Disconnect all power sources before opening the enclosure.

(under 600 volt)

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

(600 volt and above)

⚠ WARNING

Hazardous voltage.
Can cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

(under 600 volt)

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

(600 volt and above)

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.

Installing the battery charger. Hazardous voltage can cause severe injury or death. An ungrounded battery charger may cause electrical shock. Connect the battery charger enclosure to the ground of a permanent wiring system. As an alternative, install an equipment grounding conductor with circuit conductors and connect it to the equipment grounding terminal or the lead on the battery charger. Install the battery charger as prescribed in the equipment manual. Install the battery charger in compliance with local codes and ordinances.

Connecting the battery and the battery charger. Hazardous voltage can cause severe injury or death. Reconnect the battery correctly, positive to positive and negative to negative, to avoid electrical shock and damage to the battery charger and battery(ies). Have a qualified electrician install the battery(ies).

Hazardous voltage can cause severe injury or death. To prevent electrical shock disconnect the harness plug before installing accessories that will be connected to transformer assembly primary terminals 76, 77, 78, and 79. Terminals are at line voltage. *(Models with E33+, S340, S340+, 340, R340, and R33 controls only)*

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.

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.

5.4.1 AC Power Connections

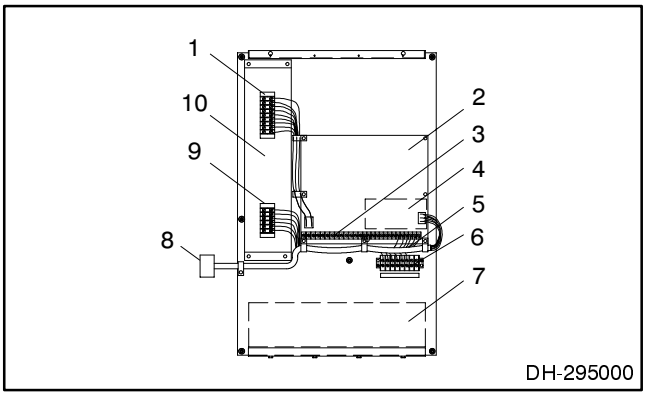
See the power switching device operation and installation manual for power connection information and ratings.

5.4.2 Controller Logic

The S340 electrical control system (logic controller) is mounted on the inside of the enclosure door. See Figure 5-1.

The power switching device and the logic controller each has its own wire harness that terminates with an inline disconnect plug. See Figure 5-1. The factory sends the transfer switch with the inline disconnect plugs disconnected.

Do not connect the controller to the power switching device until a voltage check is performed. See Section 5.5.1.



1. Transformer secondary terminal strips
2. Main controller circuit board
3. Terminal strips TB1 and TB2 (terminals 16–72)
4. Relay daughterboard
5. Wiring harness
6. Accessory terminal strip TB6 (terminals 74–81)
7. Accessory mounting area
8. Inline disconnect plug P1
9. Transformer primary terminal strip
10. Power sensing transformer assembly

Figure 5-1. S340 Inner Panel Electrical Controls

The main controller circuit board provides the standard features listed in Section 1—Features. It also provides a terminal strip and connectors that allow connection to the system using a wiring harness.

The relay daughterboard is mounted on the main controller circuit board and contains the relays that energize the contactor solenoid.

Terminal strips TB1 and TB2, located on the main controller circuit board, provide connection terminals for the system and various accessories.

Accessory terminal strip TB6 provides connection terminals for various accessories.

The power sensing transformer assembly has power transformers that power the controller and allow power source sensing. The number of transformers required depends upon the number of phases and the accessories requested. A terminal strip on the assembly connects the primaries of the transformers to the emergency and normal sources through the wiring harness. Another terminal strip connects the outputs of transformer secondaries and connects to controller inputs through the wiring harness.

5.4.3 Accessory and Control Connections

NOTE

If accessory KA-10—Preferred Source Switch is installed on the transfer switch, the generator set engine start connections are made to a terminal strip on the inner panel, not to the engine start terminals on the power switching device assembly. See Section 3.5.

Make the generator engine start signal connections. See the power switching device operation and installation manual for details.

Note optional accessories installed on the switch and make connections to those accessories. See Section 3—Accessories.

5.5 Functional Tests

5.5.1 Voltage Check

Follow the instructions in the power switching device operation and installation manual for the voltage check procedure to complete installation of the power switching device. See Figure 5-1 to locate the controller's inline disconnect plug.

5.5.2 Automatic Operation Test

The following test verifies the transfer switch's electrical control system operation.

Start the test with the normal power source available, load connected to the normal source, normal and emergency source circuit breakers or switches closed. Close circuit breakers or switches only when loads can be safely energized. Observe indicators and time delays during the sequences of operation and compare them to expected operation. See Section 2.3—Automatic Operation.

Automatic Operation Test Procedure

1. Move the generator set master switch on the generator set that provides the emergency power source to the transfer switch to the AUTO (automatic) position. The generator set may start.
2. If the generator set is still running, wait until it shuts down. After normal power is applied to the transfer switch the generator set should not run longer than the transfer switch TDEC and the generator set controller cooldown period.
3. Move or push the transfer switch test switch to select the test mode and hold it in that position if the test switch has a momentary test position. The generator set should start and run after TDES completes timing. The load should transfer to the emergency source after TDNE completes timing.
4. Move or release the transfer switch test switch to select the automatic mode. The transfer switch retransfers the load to the normal source after the TDEN completes timing. TDEC, if equipped, allows the generator engine to continue running for an additional unloaded running time. The transfer switch TDEC completes timing before any cooldown function in the generator set controller begins timing.

This completes functional tests of the transfer switch. Leave the generator set master switch in the AUTO (automatic) position.

5.6 Controller Setup

The main circuit board of the controller contains undervoltage, time delay, and underfrequency circuits. These circuits are factory-set and may require adjustment to the application at installation, but normally will not require readjustment. See Section 1 for factory default values.

⚠ WARNING

Hazardous voltage.
Can cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

(under 600 volt)

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

(600 volt and above)

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 wristwatch, rings, and jewelry before servicing the equipment.

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.

Servicing the transfer switch controls and accessories within the enclosure. Hazardous voltage can cause severe injury or death. Disconnect the transfer switch controls at the inline connector to deenergize the circuit boards and logic circuitry but allow the transfer switch to continue to supply power to the load. Disconnect all power sources to accessories that are mounted within the enclosure but are not wired through the controls and deenergized by inline connector separation. Test circuits with a voltmeter to verify that they are deenergized before servicing.

Time Delays See Section 3.2 for time delay adjustments.

Normal Undervoltage The dropout level is the minimum acceptable source voltage or frequency. Below this level, the controller determines that the source is unacceptable. The pickup level is the voltage or frequency at which all sensed phases must rise above before the controller determines that the source is acceptable.

To adjust the undervoltage circuit for the normal source proceed as follows. See Figure 5-2.

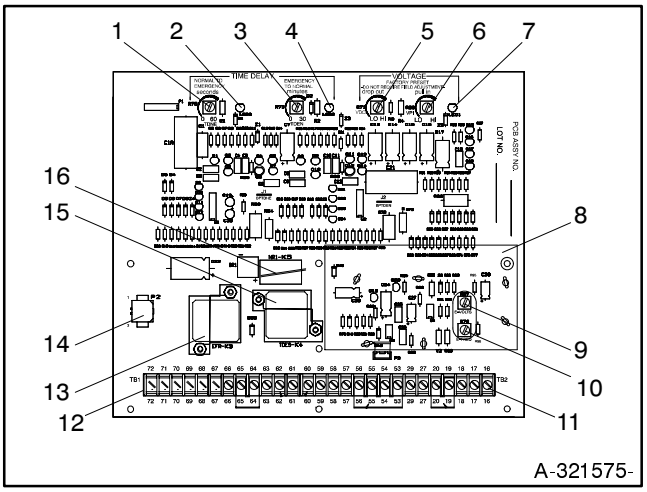
Normal Undervoltage Adjustment Procedure

1. Prevent the generator set, which provides the emergency power source to the transfer switch, from starting by moving the generator set master switch to the OFF position; disconnecting power to the generator engine start battery charger, if installed; and disconnecting all generator engine start batteries, negative (-) leads first.
2. Disconnect *BOTH* the normal and emergency power sources by opening upstream circuit breakers or switches to the transfer switch.
3. Disconnect the power switching device and the controller at the inline disconnect plug P1.
4. Connect a variable AC power supply to the normal source transformer primaries (terminals NA-NC on single-phase switches, each of the three phases to NA-NB, NB-NC, and NC-NA respectively on three-phase switches) to establish line voltage levels from 65% to 130% of nominal voltage. Observe the variable AC power supply voltage during adjustments using test equipment of 1% minimum accuracy.
5. Set dropout pot maximum counterclockwise.
6. Set pickup pot maximum counterclockwise.
7. Increase the line voltage to the desired dropout level (factory setting is 70% of nominal voltage). The Normal Acceptable LED should light.
8. Rotate dropout pot clockwise until LED turns off.
9. Rotate pickup pot maximum clockwise. LED is off.
10. Increase line voltage to the desired pickup level (factory setting is 88% of nominal). LED is off.
11. Rotate pickup pot counterclockwise until LED lights.
12. Verify pickup and dropout points by varying the voltage and observing the voltages at which the Normal Acceptable LED changes state.
13. Remove the variable AC power source from the transformer primaries.
14. Reinstall barriers removed to access adjustments.
15. Reconnect the power switching device to the controller.
16. Close and lock the transfer switch enclosure door.
17. Reconnect power supplies to the transfer switch.

NOTE

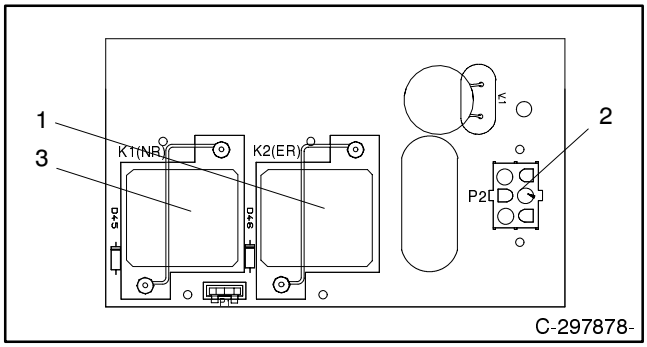
When initially applying power to the transfer switch, the engine start contacts remain closed signaling the generator to run until the ATS's Time Delay Engine Cooldown (TDEC), if equipped, ends.

18. Reconnect generator engine start battery cables, negative (-) leads last; reconnect power to the generator engine start battery charger, if installed; and move the generator set master switch to the AUTO (automatic) position. The generator may start and run for a while.



1. Time Delay Normal to Emergency (TDNE) adjustment
2. TDNE timing complete LED
3. Time Delay Emergency to Normal (TDEN) adjustment
4. TDEN timing complete LED
5. Normal undervoltage dropout adjustment pot
6. Normal undervoltage pickup adjustment pot
7. Normal Acceptable LED
8. Relay daughterboard
9. Emergency undervoltage pickup adjustment pot
10. Emergency underfrequency pickup adjustment pot
11. Terminal strip TB2 (terminals 16-60)
12. Terminal strip TB1 (terminals 61-72)
13. EFR relay
14. Plug P2
15. Time Delay Engine Start (TDES) relay
16. NR1 relay

Figure 5-2. Main Logic Circuit Board



1. ER relay
2. Plug P2
3. NR relay

Figure 5-3. Relay Daughterboard

Notes

Appendix A. Glossary of Abbreviations

Abbreviations are used throughout this manual. Normally in the text they will appear in complete form with the abbreviation following in parenthesis the first time they are used. After that they will appear in the abbreviated form. The commonly used abbreviations are shown below.

AC	alternating current
AISI	American Iron and Steel Institute
Amp	ampere
Amps	amperes
ANSI	American National Standard Institute
API	American Petroleum Institute
approx.	approximate, approximately
A/R	as required, as requested
A/S	as supplied, as stated, as suggested
ASA	American Standards Association
ASME	American Society of Mechanical Engineers
assy.	assembly
ASTM	American Society for Testing Materials
ATDC	after top dead center
aux.	auxiliary
AWG	American Wire Gauge
AWM	appliance wiring material
BBDC	before bottom dead center
BDC	before dead center
BHP	brake horsepower
bmep	brake mean effective pressure
Btu	British thermal unit
°C	Celsius degree
cc	cubic centimeter
CCA	cold cranking Amps.
CEC	Canadian Electrical Code
cfh	cubic feet per hour
cfm	cubic feet per minute
CID	cubic inch displacement
cm	centimeter, centimeters
cmm	cubic meters per minute
co.	company
cont'd.	continued
CSA	Canadian Standards Association
CT	current transformer
cu. in.	cubic inch, cubic inches
cyl.	cylinder
dB	decibel
dBA	decibels (A weighted)
DC	direct current
DCR	direct current resistance
deg.	degree
dept.	department
dia.	diameter
e.g.	example given
EIA	Electronic Industries Association
EMI	electromagnetic interference
EPA	Environmental Protection Agency
etc.	et cetera (and so forth)
ext.	external
°F	Fahrenheit degree
fl. oz.	fluid ounce, fluid ounces
FM	frequency modulation
ft.	foot, feet
ft. lbs.	foot pound, foot pounds
ga.	gauge (meters, wire size)
gal./ gals.	gallon, gallons
gph	gallons per hour
gpm	gallons per minute
gr.	grade
gnd.	ground
HCHT	high cylinder head temperature
HET	high exhaust (or engine) temperature
Hg	mercury (element)
H_2O	water
HP	horsepower
hr, hrs	hour
Hz	hertz (cycles per second)
ID	inside diameter
IEEE	Institute of Electrical and Electronic Engineers
in.	inch(es)
inc.	incorporated
in. lbs.	inch pounds
int.	internal
int.-ext.	internal-external
ISO	International Standards Organization
J	joule, joules
JIS	Japanese Industry Standard
kg	kilogram, kilograms
kg/cm^2	kilograms per square centimeter
kgm	kilogram meter(s)
kJ	kilojoules (btu cal)
km	kilometer, kilometers
kPa	kiloPascal, kiloPascals
kph	kilometers per hour
kV	kilovolt
kVA	kilovolt amperes
kW	kilowatt, kilowatts
kWH	kilowatt hour
L	liter, liters
LxWxH	length x width x height
LED(s)	light emitting diode
lb., lbs.	pound, pounds
L/hr.	liter per hour, liters per hour
L/min.	liter(s) per minutes
LOP	low oil pressure
LP	liquefied petroleum
m	meter, meters
m^3	cubic meter, cubic meters
max.	maximum
MCM	one thousand circular mils.
meggar	megohmmeter
MHz	megahertz
mi.	mile, miles
mil	one one-thousandth of an inch
min.	minimum
mJ	millijoule, millijoules
MJ	mega joule, mega joules
mm	millimeter, millimeters
m^3/min	cubic meters per minute
MPa	megaPascal
mW	milliwatt, milliwatts
MW	megawatt, megawatts
N/A	not available or not applicable
NBS	National Bureau of Standards
N.C.	normally closed
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
Nm	Newton meter, Newton meters
no., nos	number, numbers
NPT	National Standard taper pipe thread per general use
N/R	not required
OC	overcrank
OD	outside diameter
OEM	original equipment manufacturer
OS	overspeed, oversize
O/S	oversize
OSHA	Occupational Safety and Health Act
OV	overvoltage
oz.	ounce, ounces
PF	power factor
PMG	permanent magnet generator
pot.	potentiometer
ppm	parts per million
psi	pounds per square inch
pt., pts.	pint, pints
PVC	polyvinyl chloride
qt., qts.	quart, quarts
qty.	quantity
ref.	reference
RFI	radio frequency interference
r.h.m.	round-head machine (screw)
rms	root mean square
RPM	revolutions per minute
RTV	room temperature vulcanization
SAE	Society of Automotive Engineers
SCR	silicon-controlled rectifier
sec.	second, seconds
spec.	specs, specification
sq.	square
sq. cm	square centimeters
sq. in.	square inch, square inches
tach	tachometer
TDC	top dead center
tech. pub.	technical publications
temp.	temperature
TIF	telephone influence factor
TP, TPs	technical publications
turbo	turbocharger
UHF	ultrahigh frequency
UNC	Unified coarse thread (was NC)
UNF	Unified fine thread (was NF)
UL	Underwriter's Laboratories, Inc.
U/S	undersize
U.S.A.	United States of America
V	volt, volts
vac	volts alternating current
vdc	volts direct current
VHF	very high frequency
W	watt, watts

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