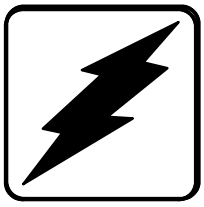
Service and Parts

Automatic Transfer Switches



Models:

S340+

Logic:

Solid-state

ISO 9001
KOHLER GENERATORS
INTERNATIONALLY REGISTERED
U.S.A. Plant ISO Registered

KOHLER®
POWER SYSTEMS

TP-5671 6/94a

Table of Contents

Safety Precautions and Instructions

A transfer switch, like any other electromechanical device, can pose potential dangers to life and limb if improperly maintained or imprudently operated. The best way to prevent accidents is to be aware of the potential dangers and to always use good common sense. In the interest of safety, some general precautions relating to operating of a transfer switch follow. Below are some general precautions relating to the operation of a transfer switch. SAVE THESE INSTRUCTIONS.

DANGER

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

WARNING

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

CAUTION

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

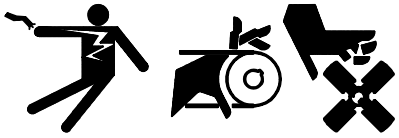
NOTE

Note communicates installation, operation, or maintenance information that is important but not hazard related.

Safety decals are affixed to the transfer switch in prominent places to advise the operator or service technician of potential hazards. The decals are reproduced here to improve operator recognition. For a further explanation of decal information, refer to the safety precautions throughout this manual. Before operating or servicing the transfer switch, be sure you understand the messages of these decals. Replace decals if missing or damaged.

Accidental Starting

⚠ WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect battery cables before working on generator set (negative lead first and reconnect it last).

Accidental starting can cause severe injury or death. Turn generator set master switch to OFF position, disconnect power to battery charger, and remove battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator set. The generator set can be started by automatic transfer switch or remote start/stop switch unless these precautions are followed.

Battery

⚠ WARNING

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

Use protective goggles and clothes. Battery acid can cause permanent damage to eyes, burn skin, and eat holes in clothing.

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

Hazardous Voltage/ Electrical Shock

600 Volt and Above

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Do not open enclosure until all power sources are disconnected.

(600 Volt and above)

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect power sources before servicing. Barrier must be installed after adjustments, maintenance, or servicing.

(600 Volt and above)

Under 600 Volt

⚠ WARNING

Hazardous voltage.
Can cause severe injury or death.

Disconnect power sources before servicing. Barrier must be installed after adjustments, maintenance, or servicing.

(under 600 Volt)

⚠ WARNING

Hazardous voltage.
Can cause severe injury or death.

Do not open enclosure until all power sources are disconnected.

(under 600 Volt)

Hazardous voltage 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 adjustments are made. Remove wristwatch, rings, and jewelry that can cause short circuits.

Hazardous voltage can cause severe injury or death. Whenever electricity is present, there is the hazard of electrocution. Open main circuit breaker on all power sources before servicing equipment. Electrically ground the generator set and electrical circuits when in use. Never come into contact with electrical leads or appliances when standing in water or on wet ground, as the chance of electrocution is increased under such conditions.

Hazardous voltage can cause severe injury or death. To prevent the possibility of electrical shock, disconnect harness plug before installing any accessories involving connection to transformer assembly primary terminals 76, 77, 78, and 79. Terminals are at line voltage!

Hazardous voltage can cause severe injury or death. To prevent the possibility of electrical shock, de-energize the normal power source to be connected to the transfer switch before making any line or auxiliary connections.

Hazardous voltage can cause severe injury or death. Disconnect inner panel harness at in-line connector. This will de-energize circuit board and logic circuitry, but allow transfer switch to continue to supply utility power to necessary lighting and equipment. Hazardous voltage will exist if any accessories mounted to inner panel are NOT wired through the inner panel harness and de-energized by in-line connector separation. Such accessories are at line voltage.

Notes

Charge only lead-acid or nickel-cadmium batteries with battery charger.

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

Hardware Damage! Transfer switch may use both American standard and metric hardware. Use the correct size tools to prevent rounding of bolt heads and nuts.

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

Introduction

This manual covers the operation, troubleshooting, repair, and service parts for the S340+ solid-state logic controller.

Read through this manual and carefully follow all procedures and safety precautions to ensure proper transfer switch operation and to avoid bodily injury. Keep this manual with the transfer switch for future reference.

Service requirements are minimal but are very important to the safe and reliable operation of the transfer switch; therefore, inspect associated parts often. It is recommended that an authorized service distributor perform required servicing to keep the switch in top condition.

All information found in this publication is based on data available at time of printing. The manufacturer reserves the right to make changes to this literature and the products represented at any time without notice and without incurring obligation.

List of Related Manuals

The logic controller covered in this manual is part of a family of related devices. Separate service and parts manuals are available for each group within the overall family. Be sure this manual is the correct manual for the automatic transfer switch.

A power conversion unit is included in each automatic transfer switch. There are three types of power conversion units and each type is covered in a separate service and parts manual. Available power conversion units and the related manual numbers are as follows:

Power Switch Device	Service/ Parts Manual
Mechanically held or electrically held contactors	TP-5667
Molded-case circuit breakers or switch	TP-5666
Standard contactor, programmed transition, and Bypass-Isolation	TP-5668

Service Assistance

For service or information, consult the yellow pages of the telephone directory under the heading GENERATORS—ELECTRIC for the Authorized Spectrum Service Distributor/Dealer.

KOHLER CO., Kohler, Wisconsin 53044
Phone 920-565-3381
Fax 920-459-1646 (North American Sales)
920-459-1614 (International Sales)
For Sales and Service in U.S.A. and Canada
Phone 1-800-544-2444

In communications regarding the automatic transfer switch, please include the PART and SERIAL numbers provided on the nameplate attached to the transfer switch. Enter the numbers in the spaces provided below. This information will enable the authorized service distributor/dealer to supply the correct part or information for your particular model.

Part No. _____

Serial No._____

Notes

Section 1. Specifications

Purpose of Switch

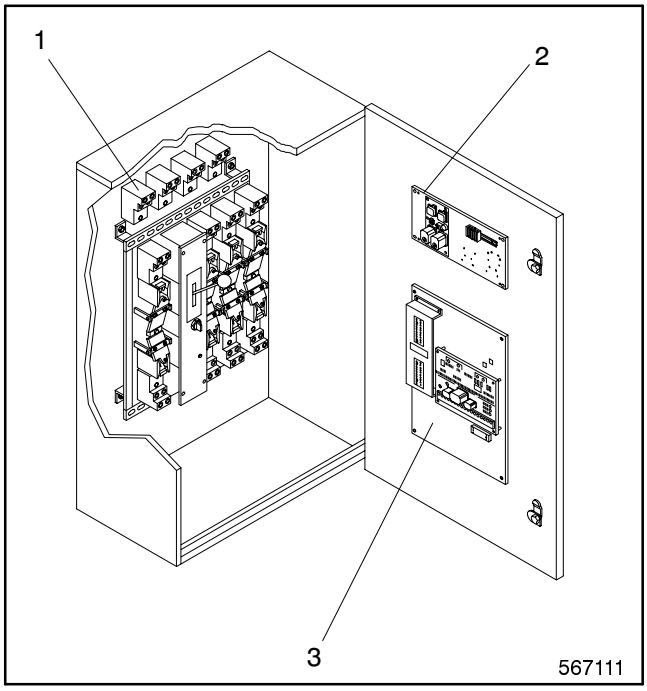
An automatic transfer switch (ATS) is a device used for transferring critical electrical loads from a normal (preferred) source of electrical power to an emergency (standby) source. This transfer occurs automatically when the normal source voltage fails, or is substantially reduced and the emergency sources voltage has reached an acceptable level.

Upon normal source failure, the automatic transfer switch controller signals the generator set(s) to start and transfer to the emergency source. The automatic transfer switch controller continuously senses for an acceptable normal source and will retransfer the load to the normal source after it has been restored to an acceptable level. After retransfer of the load, the generator set start signal is removed and the generator set(s) is allowed to shut down.

Components of Switch

A typical automatic transfer switch includes the actual power switching device and the logic controller to perform power monitoring and transfer sequencing tasks. See Figure 1-1. An interface board is also included to match the controller inputs/outputs to the levels required by a specific switching device.

The three functional units that make up the automatic transfer switch are mounted in an enclosure with a hinged front door. The controller mounts on the back of the front door so its controls and indicators are available to an operator. A signal cable with in-line connectors to facilitate component replacement and door removal connects the controller to the interface board and the switching devices.



1. Power Conversion Unit
2. Interface Panel
3. Logic Controller

Figure 1-1. Transfer Switch Components

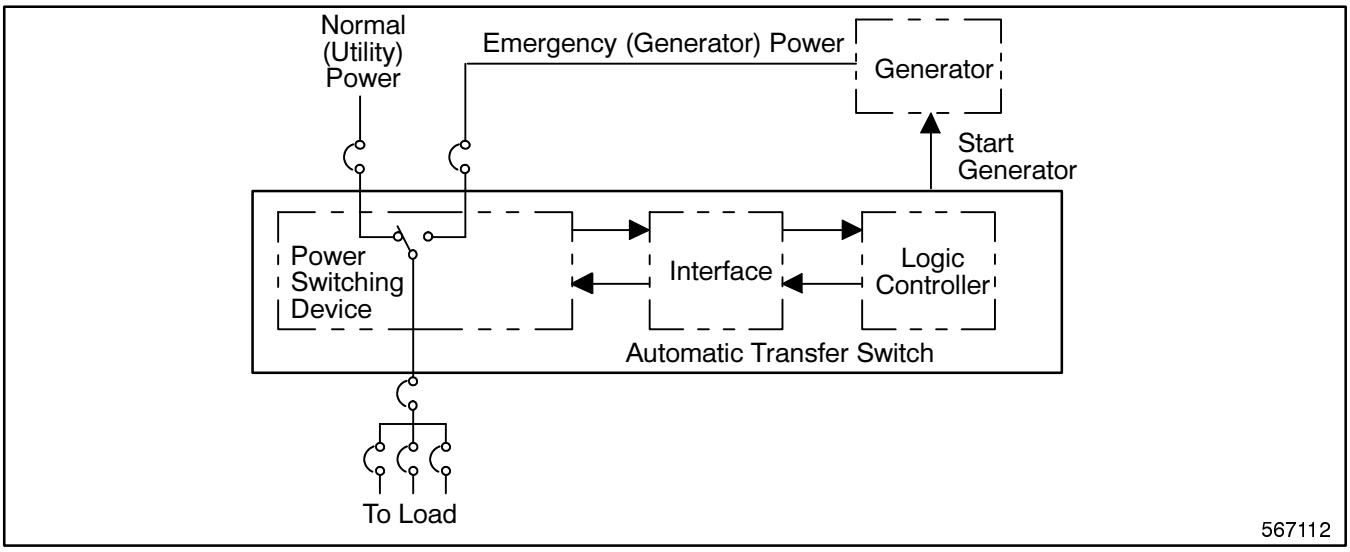


Figure 1-2. Basic Transfer Switch Block Diagram

Ratings

A nameplate is attached to the automatic transfer switch enclosure. See Figure 1-3. The nameplate label includes a factory part number coded to provide characteristic and rating information that affects installation and operation. Copy the part number into the blank spaces provided in the introduction and then use the tables in Figure 1-4 to interpret the part number.

NOTE

Also copy the part number and serial number from the nameplate into the spaces provided in the **Service Assistance** Section of the Introduction for use when requesting service or parts.

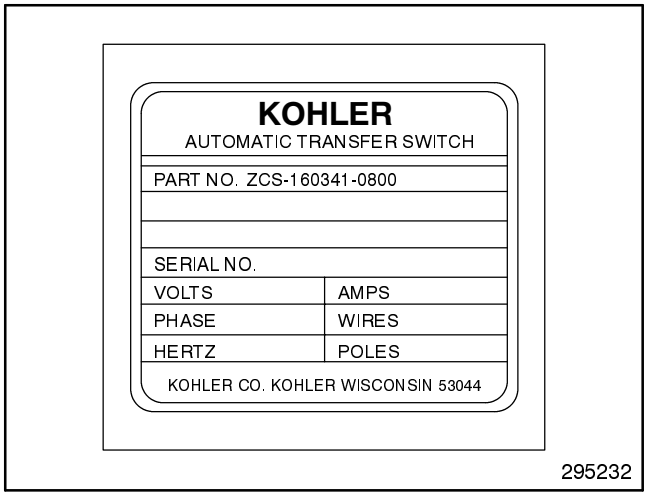
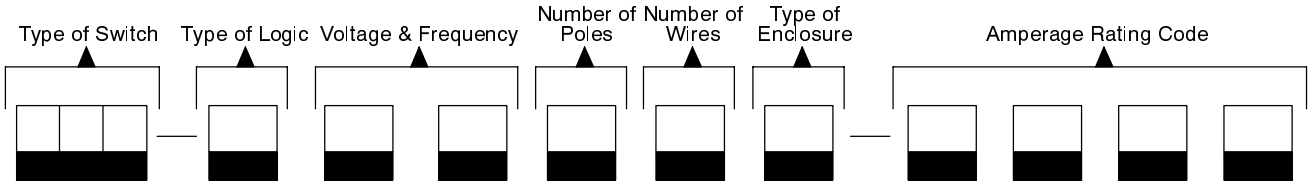


Figure 1-3. Transfer Switch Nameplate

Interpreting a Transfer Switch Part Number

Record the transfer switch part number in the boxes below. The transfer switch part number defines characteristics and ratings as explained in the accompanying chart.



Kohler Part Number Key
This chart explains the Kohler transfer switch part numbering code system. The sample part number shown is for a standard molded-case switch with S340+ logic rated at 480 volts, 60 hertz, 3-phase, 3-pole, and 4 wires in a NEMA 1 enclosure with an amperage rating of 80 amperes.

SAMPLE PART NUMBER

MMS-166341-0080

Classification of Power Switch
M: Switch or Circuit Breaker
T: Electrically & Mechanically Held
Z: Contactor Style

Type of Power Switch
C: Contactor
E: Electrically Held Contactor
L: Mechanically Held Contactor
M: Molded-Case Circuit Breaker
N: Molded-Case Switch (no protection)

Type of Switch
S: Standard

Type of Logic
1: S340+
3: S340+ with programmed transition

Voltage Code

60: 600 Volt, 60 Hz	66: 480 Volt, 60 Hz
62: 120 Volt, 60 Hz	68: 208 Volt, 60 Hz
63: 220 Volt, 50 Hz	71: 380 Volt, 50/60 Hz
64: 240 Volt, 60 Hz	

Number of Poles
2: 2 pole, 1 phase (MM_, MN_, TE_, TL_, devices will be supplied with 3 poles)
3: 3 pole, 3 phase
6: 4 pole, fully rated switched poles (no overlapping neutral)

Number of Wires
2: 2 wire
3: 3 wire
4: 4 wire

Enclosure
1: NEMA type 1

Amperes
Available sizes vary with the type of switch.

Figure 1-4. Transfer Switch Model Description

Specifications

The specifications listed herein are for the S340+ logic controller. See the respective power switching device manual for its specifications.

Standard Features

- Normal source voltage sensing adjustable from 72% to 100% of normal for pickup and 70% to 98% for dropout; monitored line-to-line for all phases of 3-phase switches.
- TDNE (Time Delay Normal to Emergency) adjustable from 0.6 to 60.0 seconds or from 0 to 30 minutes.
- TDES (Time Delay on Engine Starting) fixed at 3.0 seconds.
- TDEN (Time Delay Emergency to Normal) adjustable from 1 to 30 minutes.
- Frequency/voltage sensing for emergency source, nonadjustable, monitors 1 phase only.
- Test switch maintained—simulates a normal source power failure.
- Indicators for switch position—normal and emergency.
- Indicators for source available—normal and emergency.
- Automatic and inhibit transfer positions.

Optional Features

See Section 5. Accessories for details of optional features selected.

- TDES with extended range, 0.6 to 60.0 seconds
- Source available, auxiliary contact
- 4-position switch: AUTO, OFF, ENGINE START, TEST
- Contactor position—auxiliary contact
- Battery charger, 2-ampere float, 12 volt
- Battery charger, 2-ampere float, 24 volt
- Plant exerciser—solid-state, 7-day load-no load selection
- Program Transition (Center off)—time delay during transfer with neither source connected to the load.

Section 2. Operation

Control Switches and Indicators

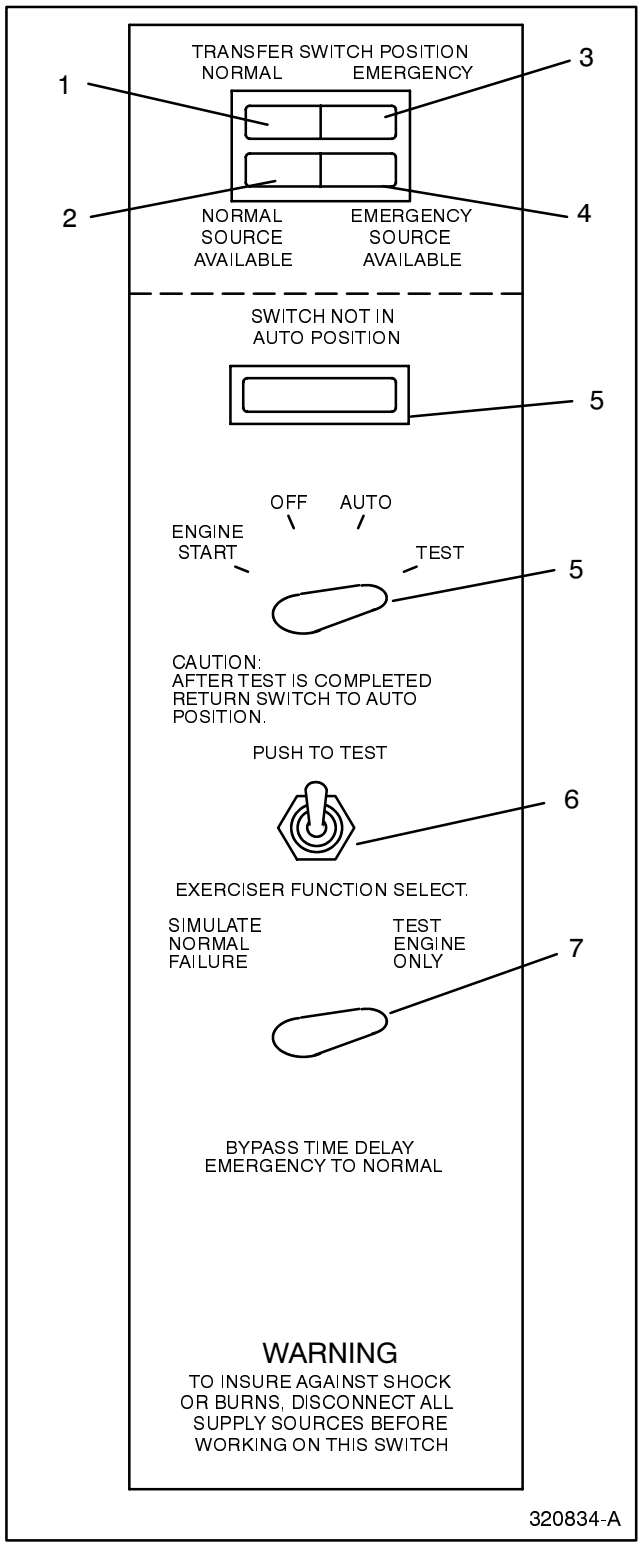


Figure 2-1. Transfer Switch Control Switches & Indicators

Various optional control switches and indicator lamps *may* be present on the transfer switch door. For identification of switches and indicators and an explanation of their function, refer to Figure 2-1 and the following descriptions.

1. **Normal Transfer Switch Position Lamp (green).** Lamp illuminates to indicate that the load is connected to the normal source.
2. **Normal Source Available Lamp (white).** Lamp illuminates to indicate presence of normal source voltage.
3. **Emergency Transfer Switch Position Lamp (red).** Lamp illuminates to indicate that load is connected to the emergency source.
4. **Emergency Source Available Lamp (white).** Lamp illuminates to indicate presence of emergency source voltage.
5. **Four-Position Selector Switch with Lamp (red).** Selects transfer switch mode of operation. *ENGINE-START* position signals the generator set to start. *OFF* position prevents automatic transfer switch operation by de-energizing control circuits and opening the engine-start circuit. *AUTO* position enables automatic transfer switch operation. *TEST* position simulates a normal-source failure. The lamp illuminates to show that the four-position switch is not in *AUTO* position. **Optional accessory DA-07-D**.
6. **Test Switch.** Normal position allows automatic transfer switch operation. *TEST* position signals generator set to start.
7. **Plant Exerciser Selector Switch.** *SIMULATE NORMAL FAILURE* position exercises the generator set under load. *TEST ENGINE ONLY* position exercises the generator set unloaded. **Optional accessory DA-23-V.**

Sequence of Operation

Normal Source Failure

Load transfer to the emergency source automatically begins when the voltage-sensing circuit detects reduced voltage or total loss of the normal source. Relay NR1 located on the main logic circuit board will de-energize whenever the voltage level falls below the preset dropout point of the voltage-sensing circuit. See Figure 2-3.

NR1 relay de-energizes, signalling a failure, and the NR relay located on the logic interface circuit board de-energizes. See Figure 2-4. Also, the time delay engine start relay (TDES) begins its engine start timing cycle. The TDES relay is located on the main logic panel. See Figure 2-3. Standard time delay is factory set at 3.0 seconds. At the same time, TDES relay is a time delay on dropout to override momentary outages. The TDES relay prevents nuisance starting of the generator set. If the normal source voltage returns above the voltage dropout setting before the time delay expires, the NR1 and NR relays energize causing the timing cycle to reset to zero.

TDES relay de-energizes after the time delay and signals the generator set to start. The logic board circuitry monitors the emergency source. The EFR will energize when the emergency source voltage and frequency reach the proper pickup points. See Figure 2-3.

After the EFR is energized the time delay normal to emergency (TDNE) is started. When the TDNE timing cycle is complete, the ER relay is energized. The time delay prevents immediate load transfer to the emergency source. If the program transition function is installed, time delay off-to-normal (TDON) will stop the transition in the off position for an adjustable time. See Figure 2-4.

When the ER relay energizes, the switch transfers load to the emergency source. The transfer switch is then supplying the load from the emergency source and will remain in the emergency position until the normal source is restored.

Normal Source Restoration

The sequence for load transfer to the normal source automatically begins when the voltage-sensing circuit detects restoration of the normal source. The voltage level must rise above the preset pickup point on all monitored phases before the circuit will accept the normal source again.

When the normal source is accepted by the voltage-sensing circuit the time delay emergency to normal (TDEN) is initialized. The TDEN insures that the normal source has stabilized before reconnection of vital loads. If the program transition function is installed, time delay off-to-emergency (TDOE) will stop the transition in the off position for an adjustable time.

If the emergency source fails during TDOE, the EFR relay drops out, and the load is immediately transferred to the normal source, if available.

After the TDEN is complete, the NR1 relay energizes which in turn energizes the NR relay and de-energizes the ER relay. The switch transfers load back to the normal source. The transfer switch is in the normal position.

The NR1 relay energizes the TDES relay which signals the generator set to shut down. The time delay engine cooldown (TDEC) time keeps the engine running without load until the time has expired. All circuits are reset for any future normal source failure.

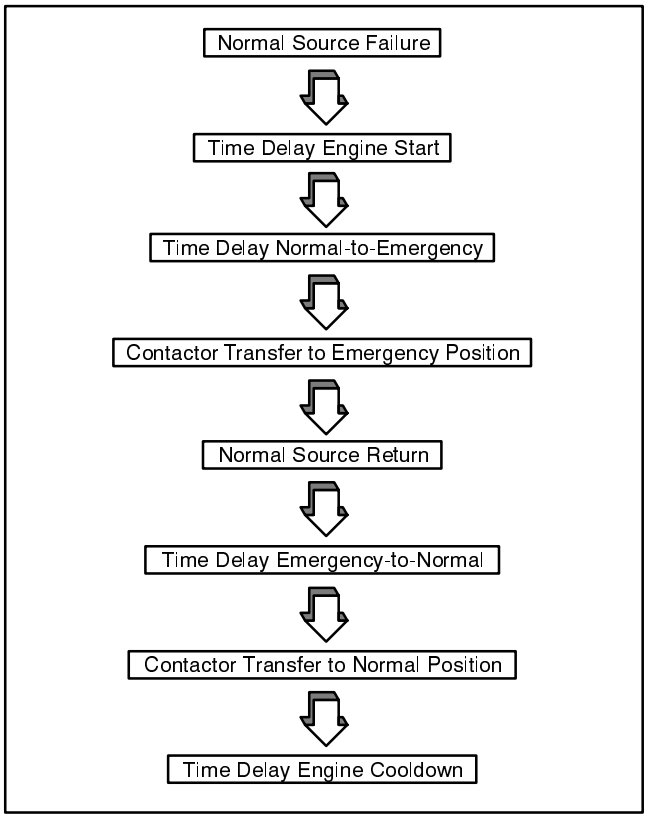
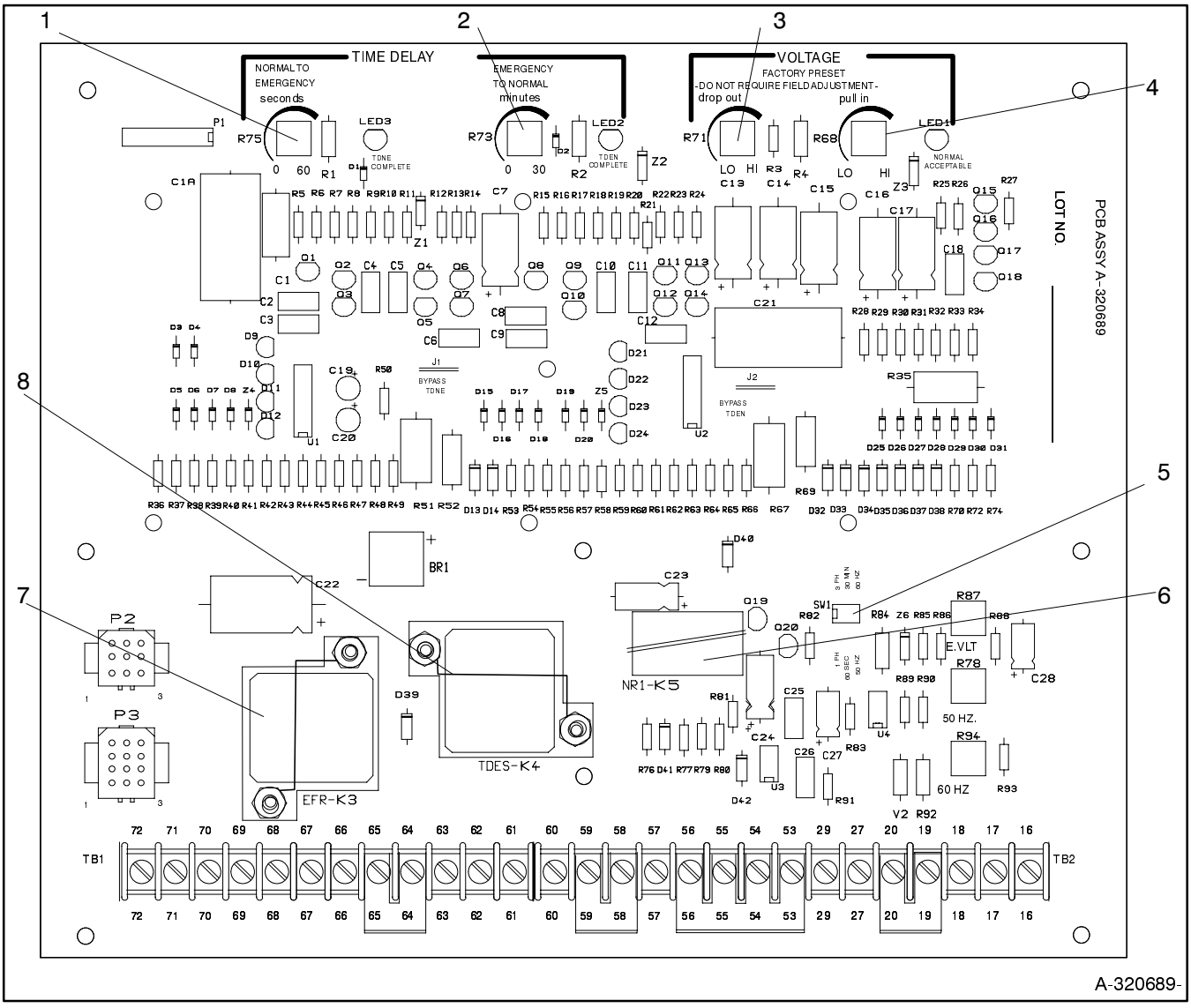
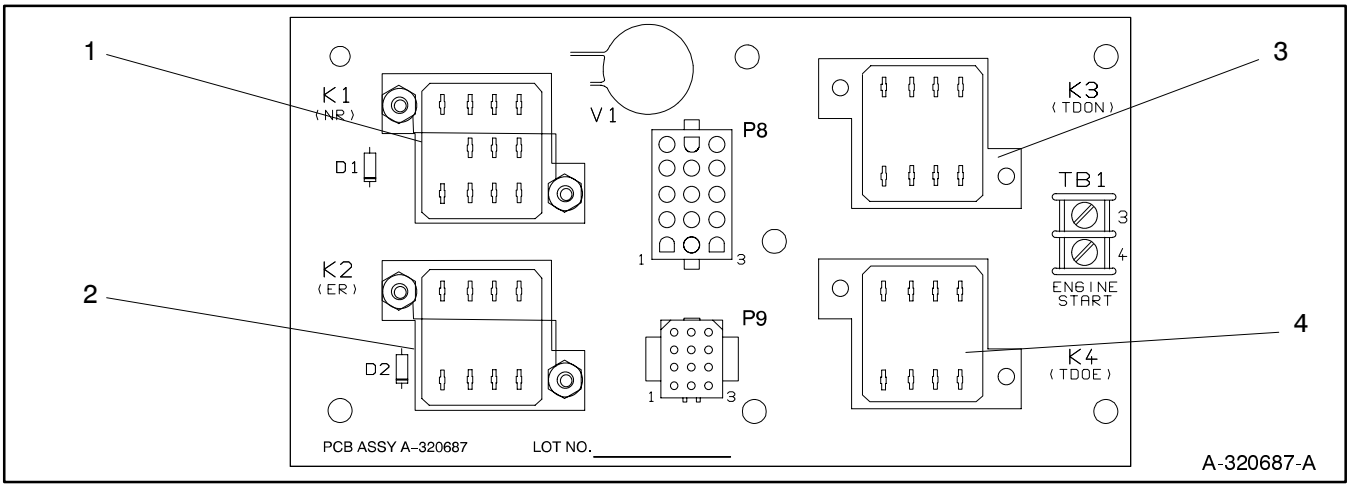


Figure 2-2. Logic Board Operation



1. TDEN Adjustment Pot
2. TDNE Adjustment Pot
3. Voltage Dropout Adjustment Pot
4. Voltage Pickup Adjustment Pot
5. DIP Switch
6. NR1 Relay
7. EFR Relay
8. TDES Relay

Figure 2-3. Main Logic Circuit Board



1. NR Relay
2. ER Relay
3. TDON Relay
4. TDOE Relay

Figure 2-4. Interface Circuit Board

Voltage Checks

⚠ WARNING

Hazardous voltage.
Can cause severe injury or death.

Disconnect power sources before servicing. Barrier must be installed after adjustments, maintenance, or servicing.

(under 600 Volt)

Hazardous voltage can cause severe injury or death. Disconnect inner panel harness at in-line connector. This will de-energize circuit board and logic circuitry, but allow transfer switch to continue to supply utility power to necessary lighting and equipment. Hazardous voltage will exist if any accessories mounted to inner panel are NOT wired through the inner panel harness and de-energized by in-line connector separation. Such accessories are at line voltage.

To Disconnect The P1 Plug

1. If the transfer switch is in the normal position, place the generator set start switch in the OFF position. Then open the emergency-source circuit breaker.
2. If the transfer switch is in the emergency position, open the normal-source circuit breaker. Place the generator set start switch in the TEST position.

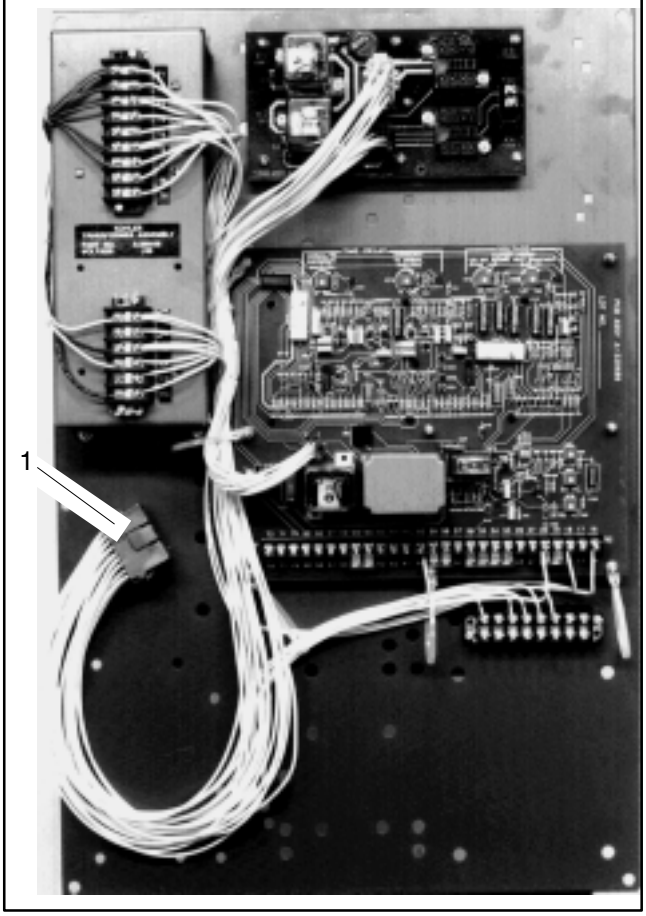
NOTE

Separating the in-line disconnect plug on transfer switches with TES power conversion units will cause the available source contactor to open, removing power from the load.

3. Separate the in-line disconnect plug by grasping and squeezing the plug. Do NOT pull on the wires. See Figure 2-5.

To Reconnect The P1 Plug

1. Engage the in-line disconnect plug by grasping the connectors and pressing together.
2. If the transfer switch is in the normal position, place the generator set start switch in the AUTO position. Then close the emergency-source circuit breaker.
3. If the transfer switch is in the emergency position, close the normal-source circuit breaker. The load will automatically retransfer to the normal source, if it is available, after a time delay. For immediate retransfer, open and then reclose the emergency-source circuit breaker. Place the generator set start switch in the AUTO position.



1. In-Line Disconnect Plug (P1)

Figure 2-5. In-line Disconnect Plug

⚠ WARNING

Hazardous voltage.

Moving rotor.

Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

⚠ WARNING

Hazardous voltage 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 adjustments are made. Remove wristwatch, rings, and jewelry that can cause short circuits.

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

NOTE

Perform voltage checks in the order given to avoid damaging the switch.

First, check the rated voltage on the transfer switch nameplate. It should be the same as normal line voltage and emergency line voltage (as indicated on the generator set nameplate).

1. Be sure power is off; then separate the power switch device control in-line disconnect plug (P1) if you have not already done so. See Figure 2-5.
2. Close the normal source line circuit breaker.
3. Use an accurate voltmeter to check for rated phase-to-phase, and phase-to-neutral voltages, and phase rotation at the power switching device's normal-source terminals.
4. Close the emergency source line circuit breaker.
5. Manually start the generator set using the engine control switch on the generator set controller.
6. Use an accurate voltmeter to check for rated phase-to-phase, and phase-to-neutral voltages, and phase rotation at the contactor's emergency-source terminals.
7. If necessary, adjust the generator voltage regulator following the generator set manufacturer's instructions. The automatic transfer switch will respond only to rated voltage and frequency specified on the nameplate. Check phase rotation; it should be the same as that of the normal source.
8. Shut down the generator set using the engine control switch on the generator set controller. Disconnect the normal source; then reconnect the power switch device control in-line disconnect plugs. See Figure 2-5. Wait until the time delay engine cooldown (TDEC, if equipped) has completed timing per the factory setting. After the TDEC has completed timing, the generator set controller's engine control switch can be placed in the AUTO position.

Electrical Operation Test

Place the transfer switch to in the Normal position. Use following procedure to check the electrical operation of the automatic transfer switch.

1. Place the exerciser function selector switch in the TEST position (if so equipped). See Figure 2-1.
2. Move the door-mounted test switch to TEST. The generator set should start and run after the time delay engine start (TDES) has completed timing.
3. The transfer switch will transfer to the emergency position. The transfer will occur after the normal-to-emergency time delay (TDNE) has completed timing.
4. Move the door-mounted test switch back to the normal position. The transfer switch will retransfer to normal after the emergency-to-normal time delay has completed timing.
5. Time delay engine cooldown (TDEC) allows the engine to continue running for an additional unloaded running time. The transfer switch TDEC will complete timing before any TDEC function in the generator set controller begins timing.
6. Close load circuit breaker(s) when loads may be safely energized.

NOTE

Connecting the transfer switch in-line disconnect plugs (P1) together when the generator controller's master switch is in the AUTO position will cause the generator set to IMMEDIATELY start and run until the generator set controller's cooldown timer has completed timing.

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

Notes

Section 3. Main Circuit Board Adjustments

⚠ WARNING

Hazardous voltage.
Can cause severe injury or death.

Disconnect power sources before servicing. Barrier must be installed after adjustments, maintenance, or servicing.

(under 600 Volt)

Hazardous voltage can cause severe injury or death. Disconnect inner panel harness at in-line connector. This will de-energize circuit board and logic circuitry, but allow transfer switch to continue to supply utility power to necessary lighting and equipment. Hazardous voltage will exist if any accessories mounted to inner panel are NOT wired through the inner panel harness and de-energized by in-line connector separation. Such accessories are at line voltage.

Voltage Adjustments

The main circuit board contains a normal source undervoltage circuit. To adjust, proceed as follows. The adjustments are the same for single- and three-phase systems. See Figure 3-1.

NOTE

Disconnect normal and emergency sources. Use a 3-phase variable AC power supply to establish voltage levels. Connect the 3-phase variable AC power supply to the power conversion unit at the normal and emergency power lugs.

1. Set dropout pot (R71) to maximum counterclockwise.
2. Set pull-in pot (R68) to maximum counterclockwise.
3. Set line voltage to desired dropout value (normally 70% of rated). LED1 will illuminate.
4. Rotate dropout pot (R71) clockwise until LED 1 goes OFF.
5. Rotate pull-in pot (R68) to maximum clockwise.
6. Increase line voltage to desired pickup value (normally 90% of rated).
7. Rotate pull-in pot (R68) counterclockwise until LED 1 illuminates.
8. Recheck pull-in and dropout values by varying the input voltage fom 50% to 100% of rated voltage. LED 1 will illuminate when the input voltage is between 70% and 100%.

Circuit Board Switch Settings

The SW1 switch (See Figure 3-1) is a circuit board-mounted switch that contains individual switches for three different control variables. The control variables that SW1 controls are as follows:

- Number of normal phases sensed
- TDEN range
- Emergency frequency (Emergency frequency setting must match the system frequency.)

If a three-phase system is used, set switch 1 of SW1 to the 3 PH position. If a single-phase system is used, then set switch 1 of SW1 to the 1 PH position.

Switch 2 of SW1 selects the time delay range for the transfer from normal to emergency. The ranges are 0-60 seconds or 0-30 minutes.

Switch 3 of SW1 selects the frequency sensing for the emergency source. Set the switch to the correct setting for your system, 50 Hz or 60 Hz.

Circuit Board Calibration

NOTE

These adjustments need to be set only when a new circuit board is install.

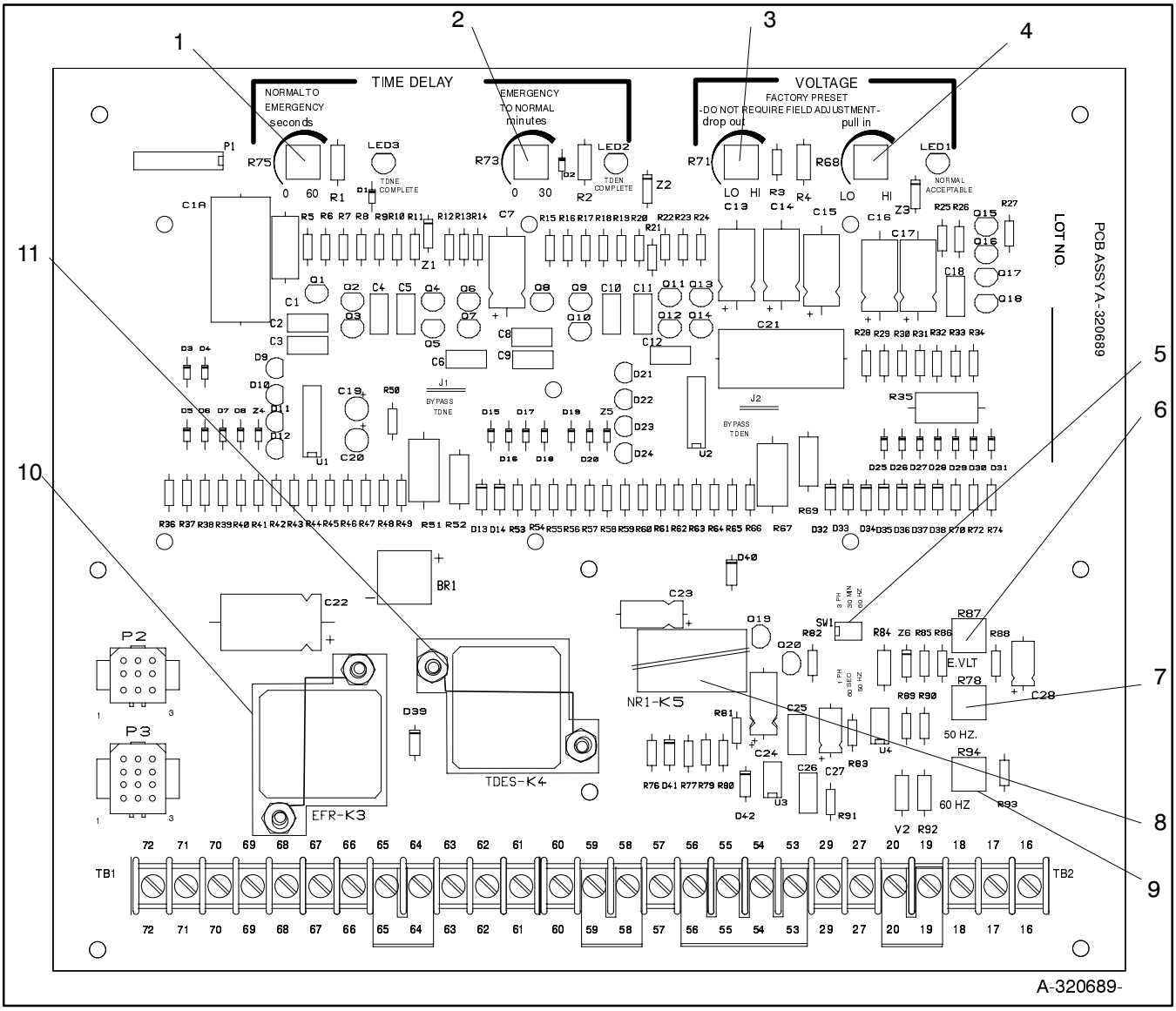
NOTE

Disconnect the normal source and use a variable AC voltage and frequency power supply to establish voltage and frequency levels, i.e., a generator set. Calibration of the S340+ circuit board will require adjusting pots R78, R87, and R94. The indicator for these adjustments will be the EFR relay (K3). You must watch the armature of K3 for movement to determine a change in state of the relay. See Figure 3-1.

1. Set switch 3 of SW1 to the 50 Hz setting. See Figure 3-1.
2. Carefully rotate pots R78, R87, and R94 completely clockwise. See Figure 3-1. Do not force pots beyond their internal stops.
3. Adjust the emergency source voltage to 85% of the normal operating voltage. Refer to power supply (generator) manufacturer's literature for information on how to adjust output voltage.
4. Adjust the emergency source frequency to rated frequency. Refer to power supply (generator) manufacture's literature for information on how to adjust output frequency. K3 will energize.
5. Rotate pot R87 (E VLT) fully counterclockwise. K3 will de-energize.
6. Rotate pot R87 (E VLT) slowly clockwise until K3 energizes.
7. Adjust the emergency voltage source to rated voltage. Refer to power supply (generator) manufacture's literature for information on how to adjust output voltage. K3 will de-energize.
8. Adjust the emergency frequency source to 47.5 Hz. Refer to power supply (generator) manufacturer's literature for information on how to adjust output frequency. K3 will energize.
9. Rotate pot R78 (50 Hz) slowly counterclockwise until K3 de-energizes.
10. Increase the emergency frequency source to 57 Hz. Move switch 3 of SW1 to the 60 Hz position. K3 will energize.
11. Rotate pot R94 (60 Hz) slowly counterclockwise until K3 de-energizes.
12. Check that switch 3 of SW1 is set to the correct frequency (50 or 60 Hz) for your system.

Time Delay Adjustments

The main circuit board also contains normal-to-emergency and emergency-to-normal time delay circuits. Each time delay is adjusted by turning the potentiometer clockwise to increase and counterclockwise to decrease the time (TDNE .6-60 sec.; TDEN 1-30 min.). When the time delay is complete, the corresponding LED will turn on.



1. TDEN Adjustment Pot
2. TDNE Adjustment Pot
3. Voltage Dropout Adjustment Pot
4. Voltage Pickup Adjustment Pot
5. SW1 Switch
6. Emergency Voltage Pullin (E. VLT)
7. Emergency 50Hz Adjustment Pot
8. NR1 Relay (K5)
9. Emergency 60Hz Adjustment Pot
10. EFR Relay (K3)
11. TDES Relay (K4)

Figure 3-1. Main Circuit Board Adjustments

Notes

Section 4. Controller Troubleshooting

The following section will assist in solving common problems with the S340+ controller. Note any optional accessories that may have been furnished on this switch and review their operation in Section 5, Accessory Troubleshooting.

Logic Board Troubleshooting

Normal Power to the System

Step	Test Procedure	Yes Action	No Action
A1	Is the normal source available at the power conversion unit?	Proceed to A2	Check normal power source line circuit breaker or incoming feed lines
A2	Is there line-to-line voltage between NA and NB, NA and NC, NB and NC?	Proceed to A4	Proceed to A3
A3	Is the in-line disconnect plug plugged all the way in and are all the pins free of any physical damage?	Replace wiring harness from power conversion unit to transformer assembly	Replace wiring harness from power conversion unit to transformer assembly
A4	Are there 12 vac between T1 and each of the following: T2, T3, T4, and T5?	Proceed to A5	Replace transformer assembly
A5	Remove power from the system. Unplug P2 from the logic board and test the continuity of the wiring from the transformer assembly to the logic board. See Figure 4-1 for connections. Is the harness wired according to Figure 4-1?	Replace logic board.	Replace wiring harness from the transformer assembly to the logic board.

Emergency Power to the System

Step	Test Procedure	Yes Action	No Action
B1	Is the emergency source available at the power conversion unit?	Proceed to B2	Check emergency power source line circuit breaker or generator feed lines
B2	Is there line-to-line voltage between EA and EC	Proceed to B4	Proceed to B3
B3	Is the in-line disconnect plug plugged all the way in, and are all the pins free of any physical damage?	Replace wiring harness from power conversion unit to transformer assembly	Replace wiring harness from power conversion unit to transformer assembly
B4	Are there 12 vac between T1, T6, and T7?	Proceed to B5	Replace transformer assembly
B5	Remove power from the system. Unplug P2 from the logic board and test the continuity of the wiring from the transformer assembly to the logic board. See Figure 4-1 for connections. Is the harness wired according to Figure 4-1?	Replace logic board.	Replace wiring harness from the transformer assembly to the logic board.

Transformer terminals	P2 plug pin number	Continuity
T1	1	Yes
T2	3	Yes
T3	4	Yes
T4	7	Yes
T5	6	Yes
T6	5	Yes
T7	2	Yes
T8	8	Yes
T9	9	Yes

Figure 4-1. Terminal Connections

Generator set will not start when power fails or when the test switch is depressed.

Step	Test Procedure	Yes Action	No Action
C1	Verify that the generator set master switch is in the AUTO position and the generator set is not running. Jumper the remote generator set leads 3 and 4 on the contactor. Does generator set start?	Proceed to Step C3	Check generator and wiring to generator controller.
C2	Verify that the generator set master switch is in the AUTO position and the generator set is not running. Jumper terminals 57 and 58 on the logic board. Does generator set start?	Proceed to Step C3	Check wiring harness from the main logic board to contactor
C3	Verify that the generator set master switch is in the AUTO position and the generator set is not running. Jumper terminals 57 and 59 on the logic board. Does generator start?	Proceed to Step C4	Proceed to Step C5
C4	Remove TDES and wait 30 sec. Is there continuity between terminals 1 and 7 on the TDES relay?	Replace main logic board.	Replace TDES relay.
C5	Is there a jumper installed between terminals 58 and 59?	Bad connection on jumper. Reconnect or replace.	Proceed to Step C6
C6	Are there any options installed on terminals 58 and 59?	See Figure 4-2, there must be continuity between termninals 58 and 59 on the logic board for the engine to start. Check any options that are connected to terminals 58 and 59 and verify that they are working correctly.	Add jumper between terminals 58 and 59 on the logic board.

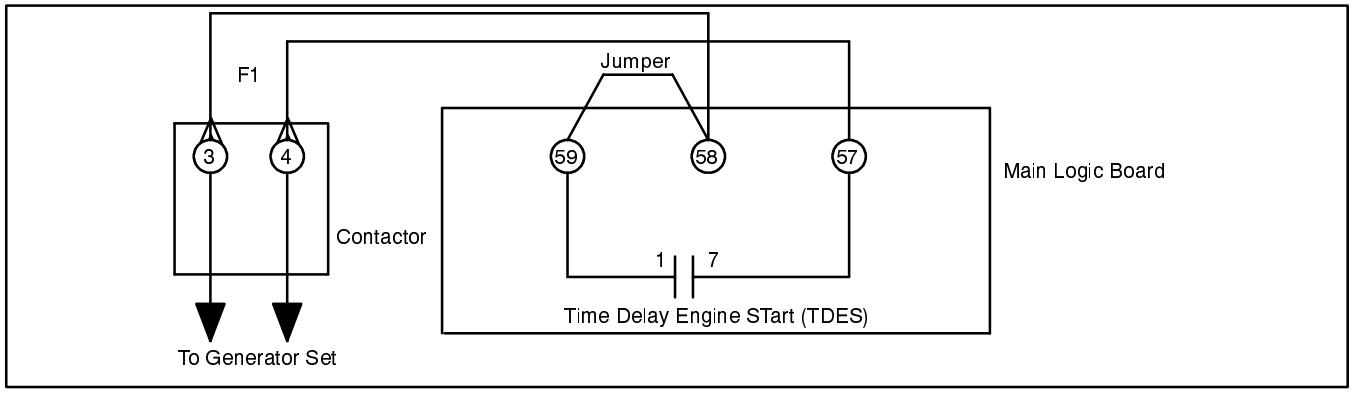


Figure 4-2. Basic Engine Start Circuit

Generator set runs, but transfer switch does not transfer load to the emergency source during power failure or with the test switch depressed.

NOTE

There is an adjustable time delay for transfer to emergency. Make sure the DIP switch and potentiometer settings are correct.

Step	Test Procedure	Yes Action	No Action
D1	Is the TDNE LED on and the other LEDs off on the logic board (after the time delay normal to emergency has timed out)?	Proceed to Interface Relay Board Test (page 4-5)	Proceed to Step D2
D2	Is the generator set adjusted for the correct voltage and frequency for the ATS?	Proceed to Step D3	Check and adjust generator. See generator set operation manual.
D3	Is the voltage at the emergency transformer primaries correct? See Figure 4-3.	Proceed to Step D4	Check and repair or replace wiring as necessary.
D4	Is the voltage at the emergency transformer secondaries correct? See Figure 4-3.	Proceed to Step D5	Proceed to Step D7
D5	Test voltage at main logic board. See Figure 4-4. Is the voltage correct?	Proceed to Step D9	Repair or replace wiring harness from transformer to main logic board.
D6	Turn off the emergency source and disconnect the wires from the emergency transformer's secondaries. Turn on the emergency source. Retest the emergency transformer's secondary voltage. Is the voltage correct?	Proceed to Step D7	Replace the transformer assembly.
D7	Turn off the emergency source. Reconnect the leads going to the emergency transformer's secondaries except for the wires going to the interface relay board. Turn on the emergency source. Retest the emergency transformer's secondary voltage. Is the voltage correct?	Reconnect all wires and proceed to the interface relay board test.	Reconnect all wires and proceed to Step D8
D8	Are there any options connected to the emergency transformer's secondaries?	Proceed to Step D10	Proceed to Step D9
D9	Are all of the jumpers on the logic board correct?	Replace main logic board.	Repair or replace jumpers.
D10	Are the options that are wired to the transformers's secondaries wired correctly? See Section 5, Accessory Troubleshooting for wiring diagrams of accessory.	Replace main logic board.	Repair or replace options wiring.

With Normal Power Energized	
Terminals	VAC
NA-NC	Line to Line
NB-NC	Line to Line
NC-NA	Line to Line
T2-T3	25.75-26.25
T1-T2	12.75-13.25
T1-T3	12.75-13.25
T1-T4*	12.75-13.25
T1-T5*	12.75-13.25
With Emerency Power Energized	
Terminals	VAC
EA-EC	Line to Line
EA-EB**	Line to Line
EB-EC**	Line to Line
T6-T7	25.48-26.52
T1-T6	12.74-13.26
T1-T7	12.74-13.26
T1-T8**	12.74-13.26
T1-T9**	12.74-13.26

* Only on units with three-phase sensing
** Only on units with three-phase emergency sensing option.

Figure 4-3. ATS Transformer Voltage Data

Terminals	VAC ± 10%
19-56	24
19-63	12
56-63	12
20-53	24
20-63	12
53-63	12

Figure 4-4. Main Logic Board Terminal Voltage

Transfer switch will not transfer back to normal.

Step	Test Procedure	Yes Action	No Action
E1	Does the main logic board have 26 vac between terminals 62 and 60?	Proceed to Step E2	See transformer test. Figure 4-3.
E2	Measure the voltage on the main logic board between the following terminals: 61-62=26 vac ±10% 64-62=26 vac ±10% 65-62=26 vac ±10% 60-63=13 vac ±10% 62-63=13 vac ±10% 64-63=13 vac ±10% 65-63=13 vac ±10% Are all of the voltages correct?	Proceed to Step E4	Proceed to Step E3
E3	Check the jumper between terminals 60 and 65. Is the jumper present between 60 and 65?	Proceed to Step E4	Replace the main logic board.
E4	Is LED1 (Normal Acc) on?	Proceed to Step E6	Proceed to Step E5
E5	Readjust the pull-in and drop-out pots. Is LED1 (Normal Acc) on?	Proceed to Step E6	Replace the main logic board.
E6	Is LED2 on?	Proceed to Step E7	Replace the main logic board.
E7	Is NR1 relay energized?	Proceed to interface relay board test.	Replace the main logic board.

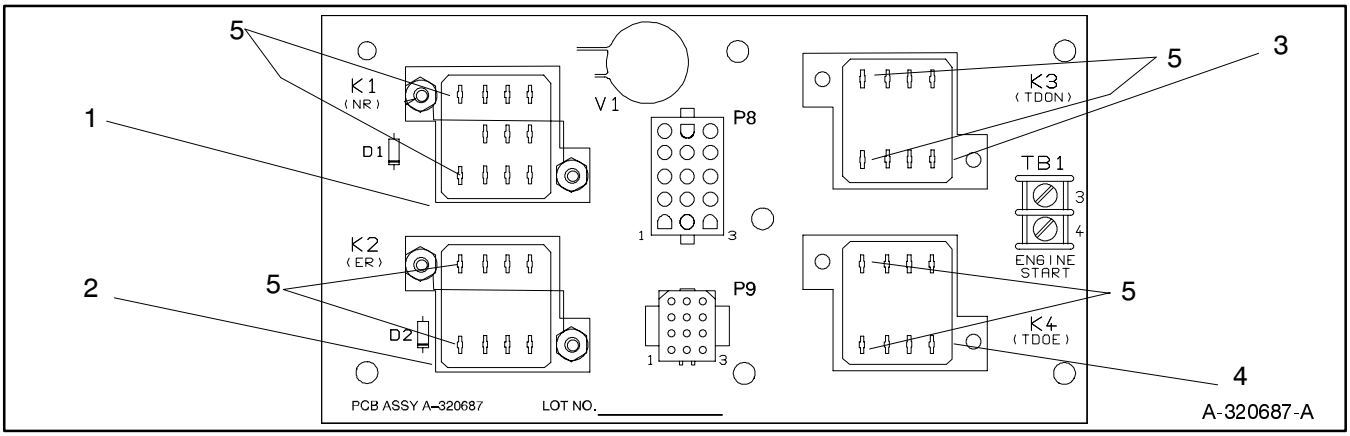
Interface Relay Board Troubleshooting

Transfer switch will not transfer to emergency.

NOTE

Before proceeding with the interface relay board troubeshooting, perform the test outlined in the nontransfer flowchart.

Step	Test Procedure	Yes Action	No Action
A1	Is the voltage at the emergency transformers correct? See Figure 4-3.	Proceed to Step A2	Proceed to Step A10
A2	Does the E.R. relay (K2) pull-in?	Proceed to Step A3	Proceed to Step A8
A3	Does the ATS disconnect the load from the normal source?	Proceed to Step A4	Proceed to Step A6
A4	Remove the TDOE relay (K4). Is there 25.5 to 26.5 vac on the coil contacts? See Figure 4-5.	Proceed to Step A5	Reinstall TDOE relay (K4) and proceed to Step A10
A5	Replace the TDOE relay and retest. Is the transfer switch working?	Troubleshooting complete.	Proceed to Step A11
A6	Disconnect plug P8 on the interface relay board. Is there continuity between pins P8-1 and P8-2?	Proceed to Step A7	Replace interface relay board.
A7	Is the wiring harness from the interface relay board to the power switch wired correctly and free from physical damage?	Refer to the power switch troubleshooting section of the switch's troubleshooting manual.	Repair or replace wiring harness from interface relay board to the power switch.
A8	Remove ER relay (K2). Is there 12 vdc across the coil contacts in the relay socket? See Figure 4-5.	Replace the ER relay.	Proceed to Step A9
A9	Is the wiring correct from the logic board to the interface relay board?	Replace main logic board.	Repair of replace wiring harness from logic board to interface relay board.
A10	Disconnect plugs P8 and P9 from the interface relay board. Is the voltage between pins P8-6 to P9-6, 25.5 to 26.5 vac?	Proceed to Step A11	Test the voltage at the transformer's assembly. Repair or replace as necessary.
A11	Is the any damage to the interface relay board (burn traces, resistors, etc.)?	Replace the interface relay board.	Proceed to Step A12
A12	Is the TDOE relay functioning properly?	Replace the interface relay board.	Replace the TDOE relay.



1. NR Relay
2. ER Relay
3. TDON Relay
4. TDOE Relay
5. Coil Contacts

Figure 4-5. Interface Relay Board

Transfer switch will not transfer to normal.

NOTE

Before proceeding with the interface relay board troubeshooting, perform the test outlined in the nontransfer flowchart.

Step	Test Procedure	Yes Action	No Action
B1	Is the voltage at the emergency transformers correct? See Figure 4-3.	Proceed to Step B2	Proceed to Step B10
B2	Does the N.R. relay (K1) pull in?	Proceed to Step B3	Proceed to Step B8
B3	Does the ATS disconnect the load from the emergency source?	Proceed to Step B4	Proceed to Step B6
B4	Remove the TDON relay (K3). Are there between 25.5 to 26.5 vac at the coil contacts? See Figure 4-5.	Proceed to Step B5	Reinstall TDON relay (K3) and proceed to Step B10
B5	Replace the TDON relay (K3) and retest. Is the transfer switch working correctly?	Troubleshooting complete.	Proceed to Step B7
B6	Disconnect P8 on the interface relay board. Is there continuity between pins P8-1 and P8-2?	Proceed to Step B7	Replace interface relay board.
B7	Is the wiring harness from the interface relay board to the power switch wired correctly and free of any physical damage?	Refer to the power switch troubleshooting section of the switch's troubleshooting manual.	Repair or replace wiring harness from interface relay board to the power switch.
B8	Remove NR relay (K1). Are there 12 vdc across the coil contacts in the relay socket? See Figure 4-5.	Replace the NR relay.	Proceed to Step B9
B9	Is the wiring correct from the logic board to the interface relay board?	Replace main logic board.	Repair or replace wiring harness from logic board to interface relay board.
B10	Disconnect plugs P8 and P9 from the interface relay board. Is the voltage between pins P8-7 to P9-7, 25.5 to 26.5 vac?	Proceed to Step B11	Test the voltage at the transformer's assembly. Repair or replace as necessary.
B11	Is there any damage to the interface relay board (burn traces, resistors, etc.)?	Replace the interface relay board.	Proceed to Step B12
B12	Is the TDON relay functioning properly?	Replace the interface relay board.	Replace the TDON relay.

Section 5. Accessory Troubleshooting

600 Volt and Above

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Do not open enclosure until all power sources are disconnected.

(600 Volt and above)

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect power sources before servicing. Barrier must be installed after adjustments, maintenance, or servicing.

(600 Volt and above)

Hazardous voltage can cause severe injury or death. Whenever electricity is present, there is the hazard of electrocution. Open main circuit breaker on all power sources before servicing equipment. Electrically ground the generator set and electrical circuits when in use. Never come into contact with electrical leads or appliances when standing in water or on wet ground, as the chance of electrocution is increased under such conditions.

Hazardous voltage 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 adjustments are made. Remove wristwatch, rings, and jewelry that can cause short circuits.

Hazardous voltage can cause severe injury or death. To prevent the possibility of electrical shock, disconnect harness plug before installing any accessories involving connection to transformer assembly primary terminals 76, 77, 78, and 79. Terminals are at line voltage!

Standard Features

STD	(TDNE) Time Delay on Transfer from Normal to Emergency (adjustable 0.6 to 60 seconds). TDNE delays transfer of the switch from the normal source to the emergency source. This overrides momentary power outages or fluctuations that may occur on the system if the emergency source is utility or allows the emergency source to stabilize before accepting the load if the emergency source is a generator set. The timer begins timing when the emergency source appears but will not transfer to it until the time delay setting has elapsed.
STD	(TDES) Time Delay on Engine Starting (fixed at 3 seconds). TDES delays initiation of the engine-start circuit in order to ignore momentary power outages or fluctuations. This timer begins timing when the normal source fails. It is intended for use when the emergency source is an engine generator and does not affect the transfer switch's ability to transfer from normal to emergency.
STD	(TDEN) Time Delay on Transfer from Emergency to Normal (adjustable 1 to 30 minutes) TDEN delays retransfer from emergency to normal in order to permit stabilization of the normal power source before retransfer or to allow a minimum generator run time. This timer begins timing when the normal source appears. If the standby source fails while this timer is timing and the normal source is available, the switch will immediately transfer to normal, overriding the TDEN time delay.
STD	Main shaft auxiliary contact, one closed on normal, one closed on emergency. (For 600-volt maximum switches only; not available for 240-volt switches.)
STD	Frequency voltage relay for emergency source, nonadjustable. Monitors 1 phase only.
STD	Test switch for testing the emergency source. The momentary test switch will interrupt power to the normal source relay and simulate a power failure on normal as long as the switch is held in the test position. (Omitted if accessory DA-07 is selected.)
STD	Pilot light normal supply, enclosure door mounted. Green lamp indicates transfer switch in normal position and normal power supplying load.
STD	Pilot light emergency supply, enclosure door mounted. Red lamp indicates transfer switch in emergency position and emergency power supplying load.
STD	Pilot light normal supply, enclosure door mounted. White lamp indicates normal power is present.
STD	Pilot light emergency supply, enclosure door mounted. White lamp indicates emergency power is present.
STD	Inhibit switch to prevent transfer in either direction for enclosure mounting. Also opens engine-start circuit. Not UL listed.

Optional Accessories

Time Delays	
DA-02-F	(TDES) Time Delay on Engine Starting (adjustable from 0.6 to 60.0 seconds). TDES delays initiation of the engine-start circuit in order to ignore momentary power outages or fluctuations. The TDES timer begins timing when the normal source fails. It is intended for use when the emergency source is an engine generator and does not affect the transfer switch's ability to transfer from normal to emergency.
Test Switches	
DA-07-D	Four-position selector switch (selector switch with white light, installed on enclosure door). Permits four modes of switch operation: Test, Auto, Off and Engine Start. The Off position de-energizes the control circuitry and opens the engine-start circuit. The transfer switch will not operate nor will the engine start on power failure. The Test position simulates a normal power failure. The Auto position returns the transfer switch to automatic operation. The Engine Start position closes the engine-start circuit. The switch will transfer only if the normal source fails. A white lamp will light in all except the Auto position (accessory DA-06 is omitted if accessory DA-07 is selected). NEMA Type 1 only.
Auxiliary Contacts	
DA-14-C	Relay auxiliary contacts (normal source 2 NO and 2 NC). Relay coil is energized when normal power is available.
DA-14-D	Relay auxiliary contact (emergency source 2 NO and 2 NC). Relay coil is energized when emergency power is available. Suitable for use in operating louvers.
DA-15-E	One additional closed on normal, for switches 30-150 and 600-800 amperes.
DA-15-F	One additional closed on emergency, for switches 30-150 and 600-800 amperes.
Plant Exercisers	
DA-23-T	Solid-state plant exerciser for periodic no-load exercising of the emergency generator set. Timer is adjustable over 7-day period in any time increment.
DA-23-U	Solid-state plant exerciser for periodic exercising under load. Timer is adjustable over 7-day period in any time increment. Includes override circuit to provide immediate retransfer to normal if emergency fails.
DA-23-V	Solid-state plant exerciser with a two-position selector switch that permits either operation. Timer is adjustable over 7-day period in any time increment (desired). Includes override circuit to provide immediate retransfer to normal if emergency fails.
Battery Chargers	
DA-24	Solid-state battery charger. Two-ampere maximum charge rate with automatic adjustable float. For 12 or 24 vdc.

Use grid in Figure 5-1 when troubleshooting an accessory to refer to accessories that may cause transfer switch failure.

Option	Option Description	Affects Transfer Normal to Emergency	Transfer Emergency to Normal	Engine Starts	Engine Shutdown
STD	TDNE (0.6-60 sec)	X			
STD	TDES (fixed 3 sec)			X	X
02-F	TDES (0.6-60 sec)			X	X
STD	TDEN (1-30 min)		X		
STD	TDEC (1-30 min)				X
07-D	4-Position Selector Switch With Lamp	X	X	X	X
STD	Inhibitor Switch	X	X		
23-T	Plant Exerciser			X	X
23-U	Plant Exerciser	X	X		
23-V	Plant Exerciser	X	X	X	X
40-A	External Manual Operator	X	X		

Figure 5-1. Accessory Troublshooting Grid

Standard Features Troubleshooting

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Do not open enclosure until all power sources are disconnected.

(600 Volt and above)

Hazardous voltage can cause severe injury or death. To prevent the possibility of electrical shock, disconnect harness plug before installing any accessories involving connection to transformer assembly primary terminals 76, 77, 78, and 79. Terminals are at line voltage!

Test Selector Switch

Feature has a two-position, momentary switch. This switch selects one of two modes of operation:

Automatic mode enables automatic transfer switch operation depending upon the source available.

Test mode simulates a normal source failure for as long as the switch is held or remains in the TEST position. See Figure 5-2 for connections.

NOTE

While selector switch is in the TEST position, no transfer to the normal source will occur even if emergency source fails or is unacceptable.

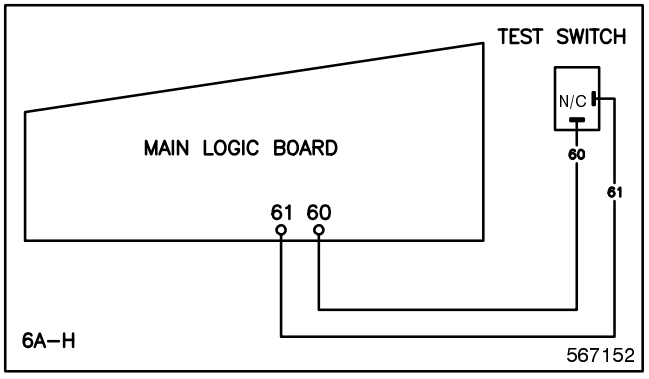


Figure 5-2. Test Switch Connection

Test Switch Has No Affect on the System

Step	Test Procedure	Yes Action	No Action
A1	Remove leads 60 and 61 from terminals 60 and 61 on the logic board. Does the generator start?	Proceed to A2	Check wiring connections from logic board to the contactor for opens or shorts.
A2	Remove leads 60 and 61 from the test switch. Does the generator start?	Replace the test switch	Replace leads 60 and 61 from the main logic board to the test switch.

Pilot Lights

All panel lamps are mounted on the transfer switch enclosure door.

The normal-position lamp lights when the transfer switch is connected to the normal source. See Figure 5-3 for connections.

The emergency-position lamp lights when the transfer switch is connected to the emergency source. See Figure 5-4 for connections.

The normal-source lamp lights when the normal source is available. See Figure 5-5 for connections.

The emergency-source lamp lights when the emergency source is available. See Figure 5-6 for connections.

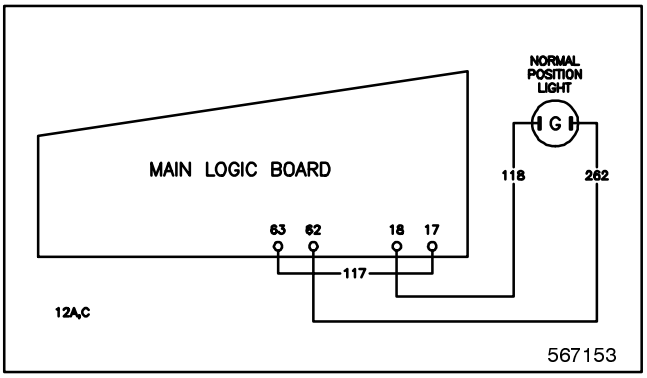


Figure 5-3. Normal-Position Lamp Connections

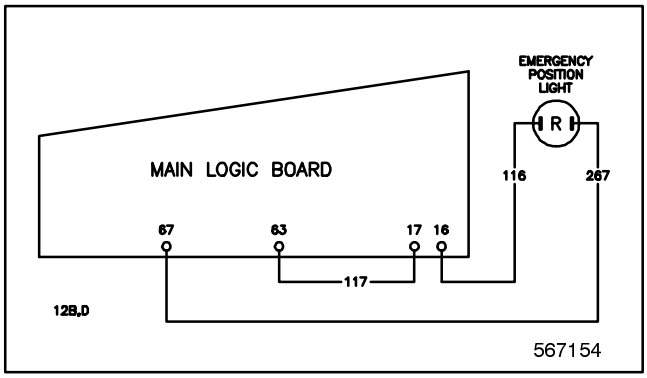


Figure 5-4. Emergency- Position Lamp Connections

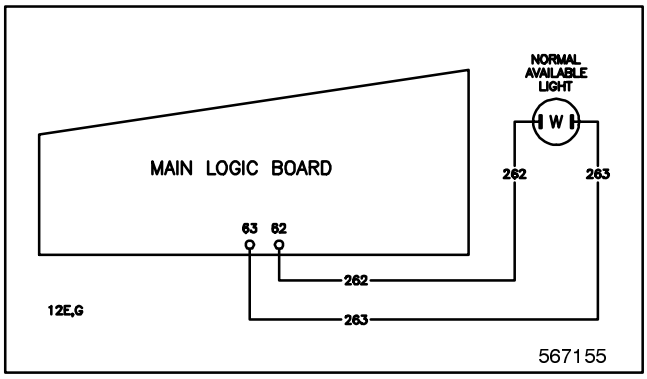


Figure 5-5. Normal-Available Lamp Connections

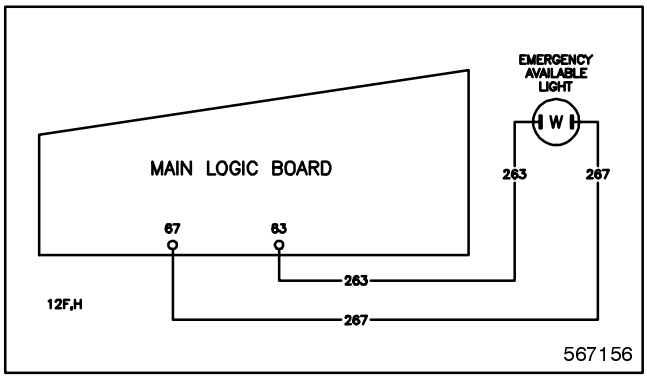


Figure 5-6. Emergency-Available Lamp Connections

Normal-Position Lamp Will Not Illuminate

Step	Test Procedure	Yes Action	No Action
A1	Are the power conversion unit in the normal position?	Proceed to A2	Lamp will not illuminate unless the power conversion unit is in the normal position
A2	Are there 12 vdc between terminal 62 and 63 of the logic board?	Proceed to A3	Refer to Section 4, Power to the System troubleshooting
A3	Are there 12 vdc between the terminals of the normal position lamp?	Replace normal-position lamp	Proceed to A4
A4	Are there 12 vdc between terminals 18 and 62 of the main logic board?	Replace leads from terminals 18 and 63 on the logic board to the normal position lamp.	Proceed to A5
A5	Are there 12 vdc between terminals 17 and 62 of the logic board?	Check leads from terminals 17 and 18 to the auxiliary contacts on the power conversion unit for an open.	Replace jumper from terminals 17 to 63 on the logic board

Emergency-Position Lamp Will Not Illuminate

Step	Test Procedure	Yes Action	No Action
B1	Is the power conversion unit in the emergency position?	Proceed to B2	Lamp will not illuminate unless the power conversion unit is in the emergency position
B2	Are there 12 vdc between terminals 63 and 67 of the logic board?	Proceed to B3	Refer to Section 4, Power to the System troubleshooting
B3	Are there 12 vdc between the terminals on the emergency-position lamp?	Replace emergency-position lamp	Proceed to B4
B4	Are there 12 vdc between terminals 16 and 67 of the logic board?	Replace leads from terminals 16 and 67 on the logic board to the emergency-position lamp.	Proceed to B5
B5	Are there 12 vdc between terminals 17 and 67 of the logic board?	Check leads from terminals 16 and 17 to the auxiliary contacts on the power conversion unit for an open.	Replace jumper from terminals 17 to 67 on the logic board

Normal-Source-Available Lamp Will Not Illuminate

Step	Test Procedure	Yes Action	No Action
C1	Is the normal source available?	Proceed to C2	Lamp will not illuminate unless the normal source is available
C2	Are there 12 vdc between terminals 62 and 63 of the logic board?	Proceed to C3	Refer to Section 4, Power to the System troubleshooting
C3	Are there 12 vdc between the terminals of the normal-source-available lamp?	Replace normal-source-available lamp	Replace leads from terminals 62 and 63 of the logic board to the normal-source-available lamp

Emergency-Source-Available Lamp Will Not Illuminate

Step	Test Procedure	Yes Action	No Action
D1	Is the emergency source available?	Proceed to D2	Lamp will not illuminate unless the emergency source is available
D2	Are there 12 vdc between terminals 63 and 67 of the logic board?	Proceed to D3	Refer to Section 4, Power to the System troubleshooting
D3	Are there 12 vdc between the terminals of the emergency-sorce-available lamp?	Replace emergency-sorce-available lamp	Replace leads from terminals 63 and 67 on the logic board to the emergency-sorce-available lamp

Optional Features Troubleshooting

Accessory 7: Operation Mode Selector Switch with Lamp

Accessory 7-D uses a four-position test switch with a lamp to select one of the four operation modes. The lamp lights to show that the switch is not in the Auto position. These troubleshooting procedures check only the wiring between the four-position test switch and the logic board. See Figure 5-7 for connections.

Accessory 7 Engine Start Position

Engine start closes the engine-start circuit to test-run the generator set. The transfer switch will not transfer unless the normal source fails.

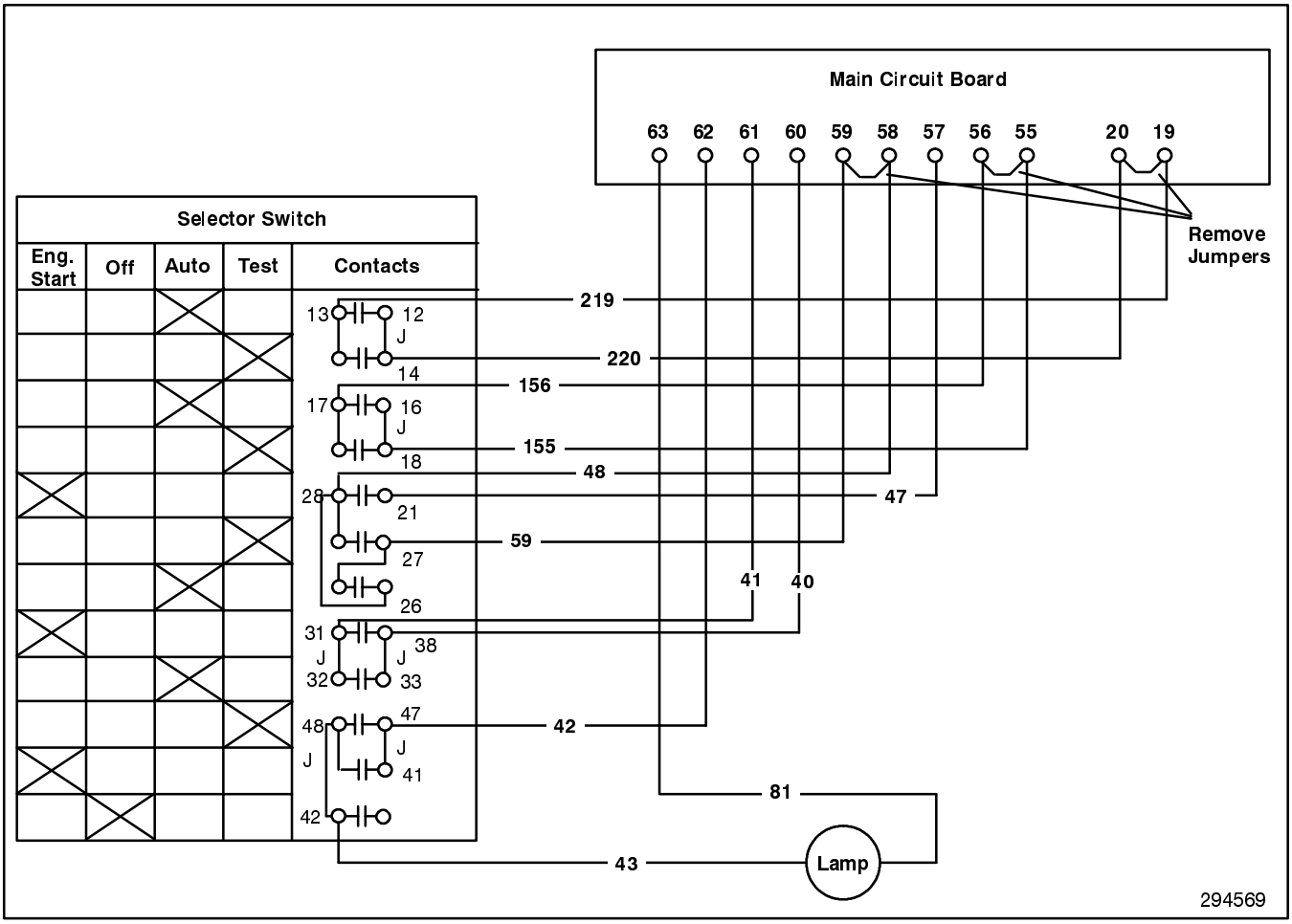


Figure 5-7. Four-Position Switch Connection

NOTE

Be sure to connect all eight switch contact jumpers. Remove standard auto-test switch.

Engine will not start when the four-position test switch is placed in the start position

Step	Test Procedure	Yes Action	No Action
A1	Jumper terminals 3 and 4 of the power conversion unit (see power conversion operation and installation manual for location). Does the generator set start?	Proceed to A2	Refer to the generator set service manual for starting troubleshooting.
A2	Jumper terminals 57 and 58 of the logic board. Does the generator set start?	Proceed to A3	Verify that the wiring harness from the logic board to the power conversion unit does not have an open circuit.
A3	Jumper terminals 47 and 48 of the four-position test switch. Does the generator set start?	Replace four-position test switch	Replace leads 47 and 48 from the four-position test switch to the logic board.

Accessory 7 Off Position

Off mode de-energizes the control circuits and opens the engine-start circuit.

Engine start when the four-position test switch is placed in the off position

Step	Test Procedure	Yes Action	No Action
B1	Remove leads 219 and 220 from terminals 19 and 20 of the logic board. Is there continuity between terminals 19 and 20 of the logic board?	Proceed to B2	Proceed to B3
B2	Is there a jumper between terminals 19 and 20 on the logic board?	Remove jumper between terminal 19 and 20 of the logic board.	Replace the logic board.
B3	With leads 219 and 220 removed from the logic board, is there continuity between leads 219 and 220?	Proceed to 4B	Proceed to B5
B4	Remove leads 219 and 220 from the four-position test switch. Is there continuity between terminals 12 and 13 or 13 and 14 of the four-position test switch?	Replace the four-position test switch	Replace leads 219 and 220 from the logic board to the four-position test switch.
B5	Remove leads 155 and 156 from terminals 55 and 56 of the logic board. Is there continuity between terminals 55 and 56 of the logic board?	Proceed to B6	Proceed to B7
B6	Is there a jumper between terminals 55 and 56 of the logic board?	Remove jumper between terminal 55 and 56 of the logic board.	Replace the logic board.
B7	With leads 155 and 156 removed from the logic board, is there continuity between leads 155 and 156?	Proceed to B8	Proceed to B9
B8	Remove leads 155 and 156 from the four-position test switch. Is there continuity between terminals 16 and 17 or 17 and 18 of the four-position test switch?	Replace the four-position test switch	Replace leads 155 and 156 from the logic board to the four-position test switch.
B9	Remove leads 47, 48, and 59 from terminals 57, 58, and 59 of the logic board. Is there continuity between terminals 58 and 59 of the logic board?	Proceed to B10	Proceed to B11
B10	Is there a jumper between terminals 58 and 59 of the logic board?	Remove jumper between terminals 58 and 59 of the logic board.	Proceed to B11.
B11	Is there continuity between terminals 57 and 58 of the logic board?	Replace the logic board.	Proceed to B12
B12	With leads 47, 48, and 59 removed from the logic board, is there continuity between leads 47 and 48 or 48 and 59?	Proceed to B13	Proceed to B14
B13	Remove leads 47, 48, and 59 from the four-position test switch. Is there continuity between terminals 21 and 28 or 28 and 59 of the four-position test switch?	Replace the four-position test switch	Replace wiring from the logic board to the four-position test switch.
B14	Remove leads 40 and 41 from terminals 60 and 61 of the logic board. Is there continuity between terminals 60 and 61 of the logic board?	Replace the logic board	Proceed to B15
B15	With leads 40 and 41 disconnected from the logic board, is there continuity between leads 40 and 41?	Proceed to B16	Replace the logic board
B16	Remove leads 40 and 41 from the four-position test switch. Is there continuity between terminals 31 and 38 or 31 and 33 of the four-position test switch?	Replace the four-position test switch	Replace leads 40 and 41 from the logic board to the four-position test switch.

Accessory 7 Auto Position

Auto mode enables automatic transfer switch operation.

NOTE

For additional troubleshooting see Section 4, controller troubleshooting earlier in the manual.

Switch will not transfer when the four-position test switch is placed in the Auto position

Step	Test Procedure	Yes Action	No Action
C1	Is there continuity between terminals 19 and 20 of the logic board?	Proceed to C3	Proceed to C2
C2	Remove leads 219 and 220 from the four-position test switch. Is there continuity between terminals 12 and 13 of the four-position test switch?	Replace leads 219 and 220 from the logic board to the four-position test switch	Replace the four-position test switch
C3	Is there continuity between terminals 55 and 56 of the logic board?	Proceed to C5	Proceed to C4
C4	Remove leads 155 and 156 from the four-position test switch. Is there continuity between terminals 16 and 17 of the four-position test switch?	Replace leads 155 and 156 from the logic board to the four-position test switch	Replace the four-position test switch
C5	Is there continuity between terminals 58 and 59 of the logic board?	Proceed to C7	Proceed to C6
C6	Remove leads 48 and 59 from the four-position test switch. Is there continuity between terminals 28 and 27 of the four-position test switch?	Replace leads 48 and 59 from the logic board to the four-position test switch	Replace the four-position test switch
C7	Is there continuity between terminals 60 and 61 of the logic board?	Replace the logic board	Proceed to C8
C8	Remove leads 40 and 41 from the four-position test switch. Is there continuity between terminals 31 and 33 of the four-position test switch?	Replace leads 40 and 41 from the logic board to the four-position test switch	Replace the four-position test switch

Accessory 7 Test Position

Test mode simulates normal source failure.

See Accessory 23 troubleshooting.

The **Not-In-Auto** lamp will illuminate when the four-position test switch is not in the auto position.

Not-In-Auto lamp will not illuminate

Step	Test Procedure	Yes Action	No Action
D1	Is the four-position test switch in the auto position?	Lamp illuminates only when switch is not in the auto position.	Proceed to D2
D2	Are there 120 vac at terminals 62 and 63 of the logic board?	Proceed to D3	Source voltage is not available.
D3	Jumper leads 42 to 43 on the logic board. Does the not-in-auto lamp illuminate?	Replace the four-position test switch.	Replace the not-in-auto lamp.

Accessory 14: Auxiliary Relay Contacts

These relay contacts operate from the voltage source and are energized as soon as normal or emergency power is available. They are located on the left-hand side of the inner panel mounted on the door. Contacts are rated for 10 amperes, 1/3 HP at 120 vac.

Accessory 14-C has three sets of contacts on the normal side. See Figure 5-8 for connections.

Accessory 14-D has three sets of contacts on emergency side. See Figure 5-9.

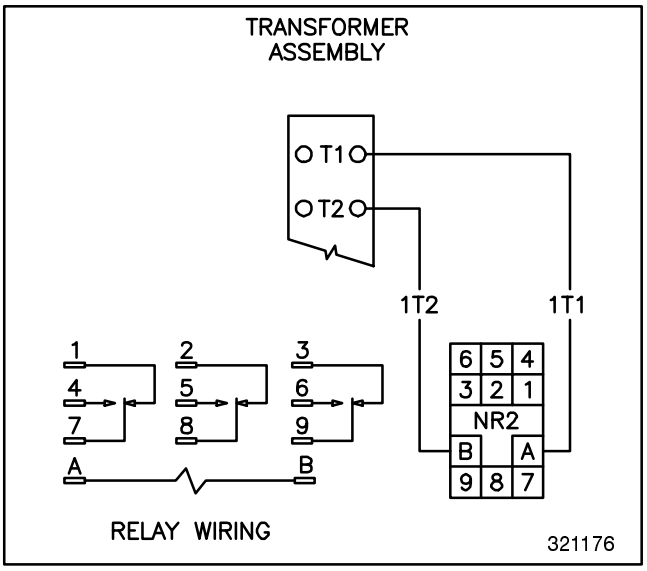


Figure 5-8. Accessory 14-C Connections

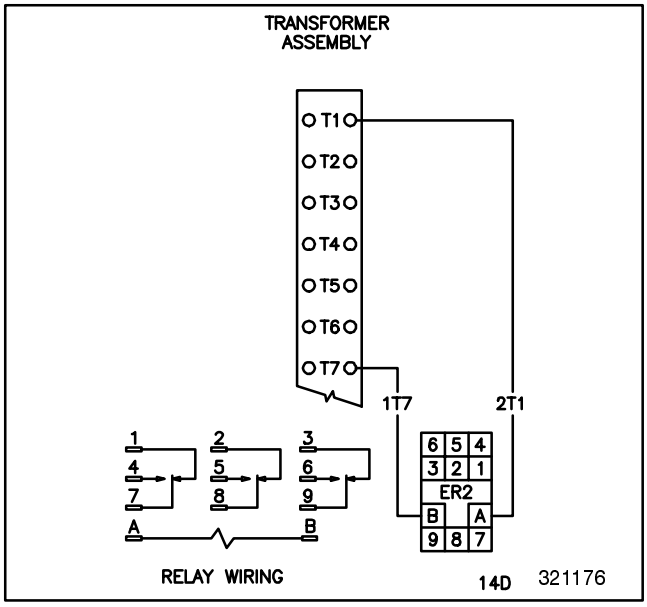


Figure 5-9. Accessory 14-D Connections

Normal Source Auxiliary Contacts Do Not Function Correctly

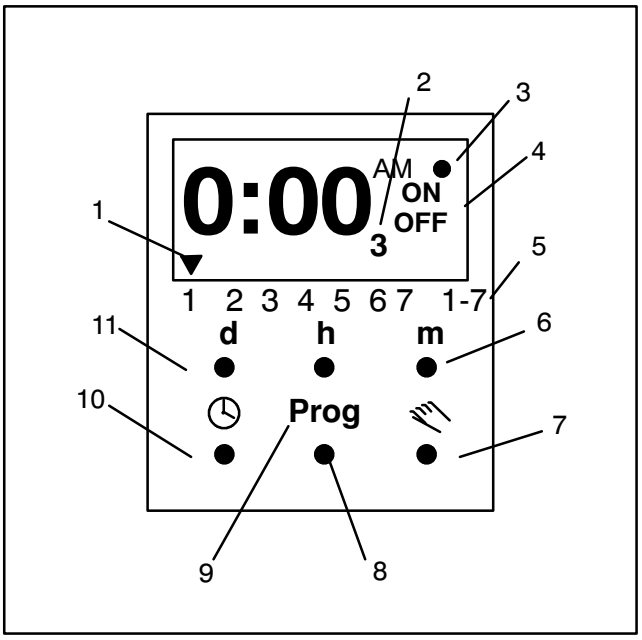
Step	Test Procedure	Yes Action	No Action
A1	Is the normal power source available?	Proceed to A2	Accessory 14-C functions only when the normal source is available
A2	Are there 12 vac between terminals T1 and T2 of the transformer assembly?	Proceed to A3	Refer to Section 4, power to the system troubleshooting.
A3	Are there 12 vac between terminals A and B of the NR2 relay?	Replace the NR2 relay	Replace leads 1T2 and 1T1 from the transformer assembly to the NR2 relay

Emergency Source Auxiliary Contacts Do Not Function Correctly

Step	Test Procedure	Yes Action	No Action
B1	Is the emergency power source available?	Proceed to B2	Accessory 14-D functions only when the emergency source is available
B2	Are there 12 vac between terminals T1 and T7 of the transformer assembly?	Proceed to B3	Refer to Section 4, power to the system troubleshooting.
B3	Are there 12 vac between terminals A and B of the ER2 relay?	Replace the ER2 relay	Replace leads 1T7 and 2T1 from the transformer assembly to the ER2 relay

Accessories 23-P: 7-Day, Solid-State Exercise Timer

Accessory 23-P signals the generator set to run unloaded for the set time period. Timer does not simulate a normal source failure. The transfer switch is not affected.



1. Day of Week
   1 = Monday
   2 = Tuesday
   3 = Wednesday
   4 = Thursday
   5 = Friday
   6 = Saturday
   7 = Sunday
2. Response Time Number for the weekday indicated (1 ON, 1 OFF, 2 ON, 2 OFF, etc.) ☰ OFF Holiday program
3. Dot indicates permanent override control ON or OFF
4. Switch Position ON or OFF
5. Programmed Daily display, 1-7
6. Minute Setting
7. Override and Permanent Control
8. Program Entry/Recall
9. Hours/Holiday Setting
10. Time Setting
11. Weekday Setting

Figure 5-10. Plant Exerciser Features

Adjustment

See Figure 5-10 for operational information. Remove the transparent timer cover when making adjustments. Replace the cover when adjustment is complete.

NOTE

The display will remain for about 40 seconds after an entry is interrupted (postponed) or finished. Then it will switch to normal automatic operation.

To Reset & Clear Memory:

1. The power supply must be connected to the plant exerciser before setting the clock timer. Check to see that the in-line disconnect plug attaching the contactor to the logic panel is connected.
2. Press he following four keys simultaneously to reset the timer's programming. This will clear the memory and permit new programming. Press the **d**, 🕓 , **m** and 🖐 buttons.

Setting Day of Week and Time

1. During the day and time setting procedure, hold down the 🕓 button.

NOTE

This timer may be set as either a seven-day or a one-day timer. To set the generator set to run during certain hours of every day, refer to Entering Daily Time Periods, following.

2. Press the **d** button to select the weekday. The arrow on the display will move to indicate the day of the week selected (1-7).
3. Set the time by pressing the **h** button or the **m** button, for hours or minutes. If the button is depressed for more than one second, the quick sequence will start allowing faster time change. When nearing the desired time, release the button to use the slow sequence so the desired time is not passed.

NOTE

Some earlier models may use a 24-hour clock. Use military time when setting.

4. After the time- and day-setting procedure is complete, release the 🕓 button.

Daylight Savings Time Adjustment

If this semiannual time change applies in the area, use the following procedure to conveniently set the hour without having to completely reset the timer.

1. To add 1 hour, press the **d** and the **h** buttons simultaneously.
2. To subtract 1 hour, press the **d** and the **m** buttons simultaneously.

Setting Exercise Start and Stop Times

A maximum of four time periods (four start and four stop times) is programmable for each day of the week. A maximum of 28 time periods (28 start and 28 stop times) is possible. For exercising the generator set, only one start and stop period per week is usually necessary.

1. Decide upon a convenient day and time to test run the generator set that will not disturb usual work or living routines. It is recommended that exercising be done when observation by a responsible person is possible.

   NOTE

   If the setting procedure is interrupted, postponed, or finished, the display will show the actual time after approximately 40 seconds. The system will then switch to normal automatic operation.

2. Press the **Prog** button once. Press the **d** button. The display will show an arrow above 1 which indicates Monday (2 = Tuesday, 3 = Wednesday, etc.). Press the **d** button until the arrow is above the decided weekday. Press the button to store the selected day. Start/stop commands can now be entered for the selected day.
3. When ON is indicated on the right-hand side of the display, set the START time by pressing the **h** button and/or the **m** button.
4. Store the START time command by pressing the **Prog** button. This command places the program in the OFF mode.
5. When OFF is indicated on the right side of the display, press the **d** button until the arrow is above the decided weekday. Press the button to store the selected day. Set the STOP time by pressing the **h** button and/or the **m** button.
6. Store the STOP time command by pressing the **Prog** button. This command places the program in the ON mode for the next set of response times.
7. Now set periods 2, 3, and 4 of the same weekday using the same procedure, if required. To override/cancel this function and go to another weekday, press the **d** button until the required weekday is shown.
8. If programming is complete, press the button. The timer is now set to function as programmed.

Entering Daily Time Periods

The timer may be set to run the generator set during certain hours of every day.

After the timer's memory has been reset and cleared, the timer can be set as a one-day timer. Up to six time periods (6 start and 6 stop times) can be set in this mode.

To use the daily-program mode, do not set a current day of the week. Rather, leave the day pointer above the **1-7**. Set the ON/OFF times following steps 3-8 in section Setting Exercise Start and Stop Times, preceding.

Program Recall/Check

1. To check or verify the programmed START/ON and STOP/OFF times, simultaneously press the **Prog** button and **d** button for each respective day. Press the **Prog** button to display START/ON and STOP/OFF response times. Daily response times are displayed for each day following the normal program locations (1 ON, 1 OFF, 2 ON, 2 OFF, 3 ON, 3 OFF).
2. On days where a daily response time has been entered and a normal display occurs such as 3 ON with an arrow appearing above **1-7**, press the button to finish the recall procedure.

Program Change

1. To change one or more previously programmed START or STOP times without clearing the entire memory press the **Prog** button and **d** button until the required weekday is shown. Press to store the selected day.
2. Change the 1 ON time by pressing the **h** button or the **m** button. Press the **Prog** button to advance to the next time setting. Clear the program by pressing **h** and **m** buttons simultaneously.
3. Press the **Prog** and **d** buttons to advance to the next program requiring a change.
4. When all changes are complete, press . The timer is now set to function as programmed.

Vacation/Holiday Setting

The Vacation/Holiday Setting suspends the automatic program sequence from 1 to 45 days.

1. During the vacation/holiday setting procedure, press and hold the **h** button.
2. Press ☜ for the number of nonexercising days desired. After 45 days the display returns to zero. The vacation/holiday program starts at 12:00 a.m. the next day and is indicated on the display by ≡ OFF.

NOTE

The vacation/holiday setting places the exercise cycle (plant exerciser) on hold only. Should failure of the utility/normal power source occur, the transfer switch will start the generator set and transfer to the emergency/generator power source when voltage/frequency conditions are met. When utility/normal power is restored, the transfer switch will return to the utility/normal power position.

3. To recall/check the remaining vacation/ holidays, press **h**. The display will momentarily show the number of days.
4. To change the number of vacation/holidays, press and hold **h** while pressing ☜ each time until the desired number of vacation/holidays is displayed.

Temporary Program Override

1. Press ☜ to alternate between the ON and OFF modes. To bypass the present programmed mode and place the plant exerciser in the ON or OFF mode (as displayed on the readout). **Changing the OFF mode will signal the generator set to start.** The plant exerciser will remain in this position until the next programmed mode changes it.
2. If override is no longer required, press ☜ to place plant exerciser in normal automatic mode.

Permanent Program Override

Press ☜ and **m** simultaneously to switch between modes ON ● and OFF ●. The automatic normal programmed mode bypasses the present programmed mode and places the plant exerciser in one of the other two modes. The plant exerciser will remain in the ON ● or OFF ● position until the permanent override is manually changed.

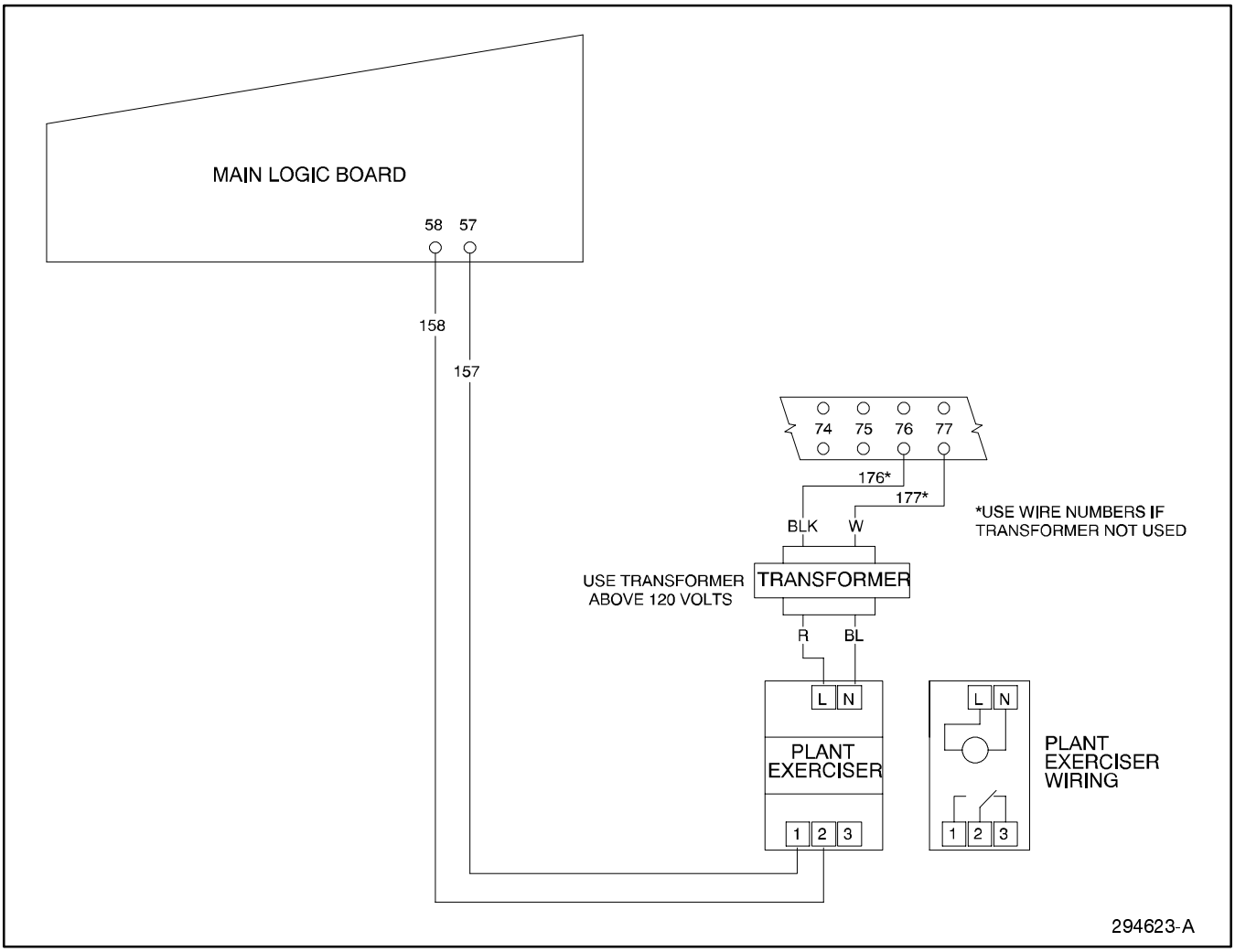


Figure 5-11. Timer Connection Schematic

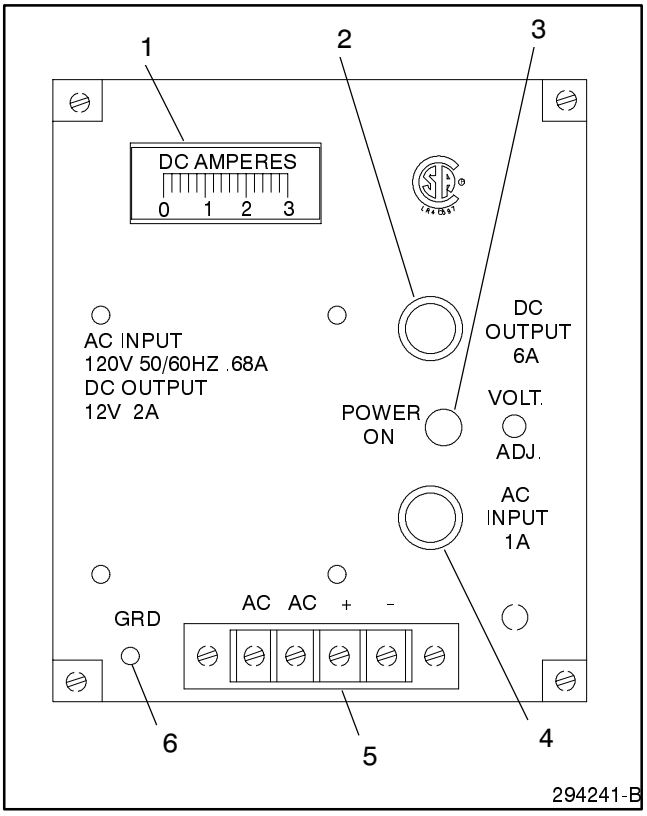
Plant Exerciser does not function correctly

Step	Test Procedure	Yes Action	No Action
A1	Is there rated line-to-line voltage between terminals 76 and 77 on terminal block TB-6?	Proceed to A2	Source voltage is not available. Refer to Section 4
A2	Are there 120 vac between terminals L and N of the plant exerciser?	Proceed to A3	Proceed to A6
A3	Is the plant exerciser display on?	Proceed to A4	Replace the plant exerciser
A4	Place a jumper between terminals 1 and 2 of the plant exerciser. Does the generator set start?	Proceed to A5	Proceed to A8
A5	Is the plant exerciser programmed correctly? See TP-5664 for programming information.	Replace the plant exerciser	Reprogram the plant exerciser
A6	Is there a transformer wired between terminal block TB-6 and the plant exerciser?	Proceed to A7	Replace the leads from TB-6 to the plant exerciser
A7	Is there rated line voltage on the primary windings of the transformer?	Replace the transformer assembly	Replace the leads from TB-6 to the transformer
A8	Place a jumper between terminals 9 and 10 of TB-1. Does the generator set start?	Replace leads 157 and 158 between TB-1 and the plant exerciser	Proceed to A9
A9	Does the generator set start manually from the test switch?	Replace the logic board	Refer to the engine service manual

Accessory 24-XX-A,B Battery Charger

Specifications

The automatic battery charger is designed to maintain lead-acid automotive-type batteries in a fully charged state without any manual intervention. The charger output provided by the power transformer is controlled by the circuit board. The control board provides the charger with 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 state of charge. Refer to Figure 5-12 for component identification. The battery chargers are factory adjusted to maintain the battery at the proper float voltages. The 12-volt battery charger will maintain a lead-acid (6-cell) battery without adjustment. The 24-volt battery charger will maintain a lead-acid (12-cell) battery without adjustment.



1. DC Ammeter
2. DC Output Fuse
3. "Power On" Lamp
4. AC Input Fuse
5. Terminal Block
6. Ground Terminal

Figure 5-12. Battery Charger Components

Features

Current Limiting

The battery charger is protected from overload by its current-limiting circuitry. This circuitry continuously monitors the charger output current and is set to limit the current to 2 amps from full load to short circuit. Therefore, no crank disconnect is required when the plant is exercised.

Reverse Polarity Protection

When the battery charger is connected to the battery, the reverse polarity protection circuit determines if the positive lead from the battery charger is connected to the positive terminal on the battery, and the negative lead from the battery charger is connected to the negative terminal on the battery. If the polarity is incorrect, the charger will not turn on when AC input is connected.

Automatic Float Operation

When the battery charger is connected to the battery and AC power is applied to the charger, the charger operates in the constant-current mode until the battery voltage rises to the preset float level. At the preset float level, the charger will switch to the constant-voltage float mode. The charger will operate in constant-voltage float mode until AC input power is lost or the current required to maintain the battery at the float voltage setting exceeds 2 amps.

The battery charger will provide temperature compensation of -2 mV/°C per cell over the ambient temperature range from -40°C (-40°F) to +60°C (+140°F). This feature will automatically adjust the float voltage setting to prevent the battery from being overcharged at high ambient temperatures and undercharged at low ambient temperatures.

AC Input Fuse

When AC input is applied, the AC input fuse will open to protect the power transformer from damage caused by a short circuit. The fuse may also open if it is subjected to vibration. Replace the fuse to restore charger operation.

DC Output Fuse

The DC output fuse will open and protect the power transformer from damage if the current limit setting has been disabled or set to its maximum. It will also open if the charger output leads are shorted together.

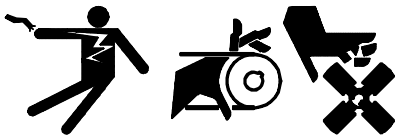
Power On Lamp

The Power On lamp is connected across the power transformer's primary winding and indicates when AC power is present.

⚠ CAUTION

Hazardous voltage can cause severe injury or death. De-energize both normal and emergency power sources before proceeding. Move generator set master switch on controller to OFF position and disconnect battery negative (–) before working on transfer switch! Turn the transfer switch selector switch to the OFF position.

⚠ WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect battery cables before working on generator set (negative lead first and reconnect it last).

Accidental starting can cause severe injury or death. Turn generator set master switch to OFF position, disconnect power to battery charger, and remove battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator set. The generator set can be started by automatic transfer switch or remote start/stop switch unless these precautions are followed.

⚠ WARNING

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

Locate in a well-ventilated area. Keep explosive fumes away.

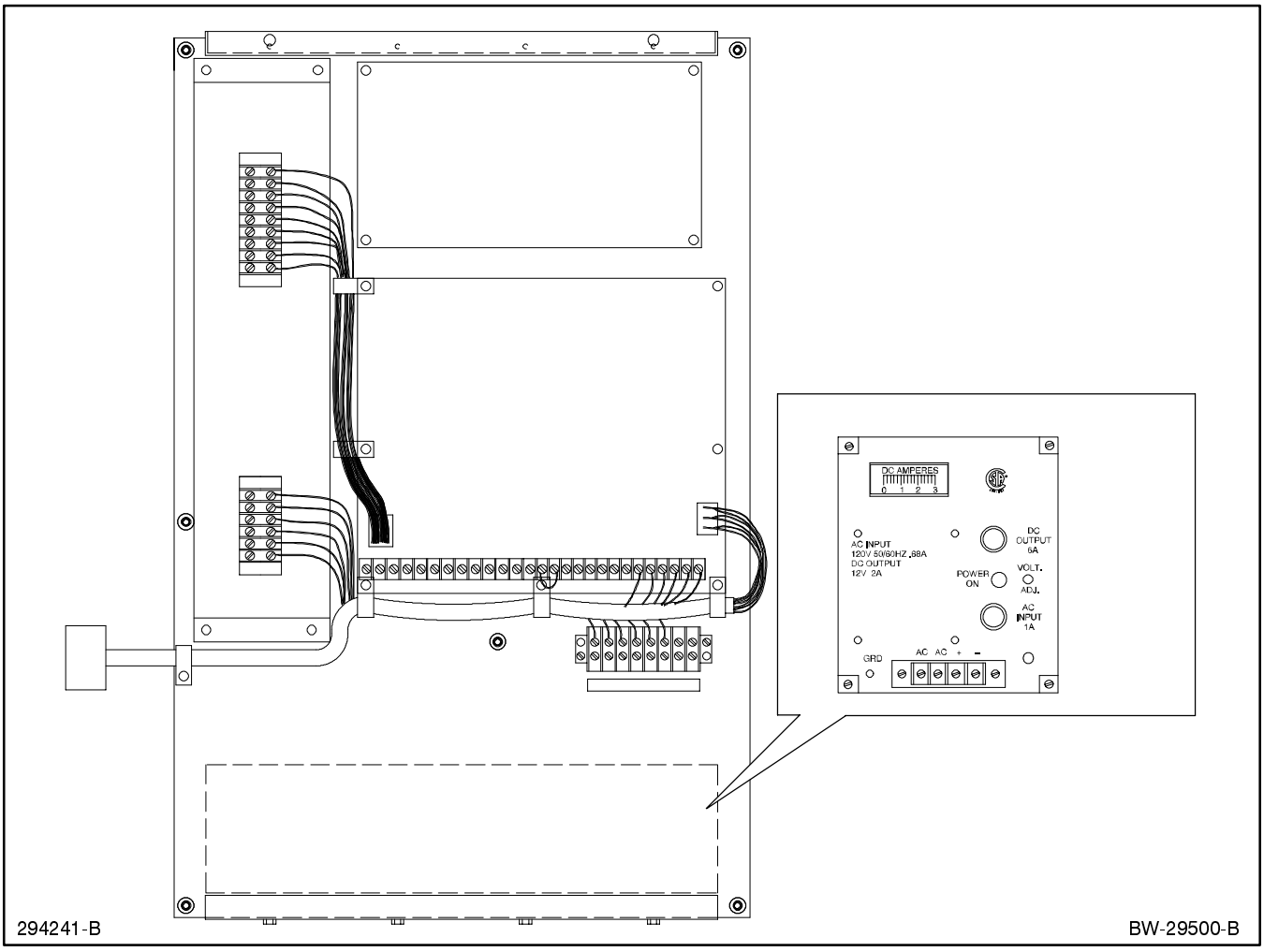


Figure 5-13. Battery Charger Location on S340+ **Inner Panel—Solid-State Transfer Switch**

To Disconnect Charger (When Replacing or Servicing Battery)

1. Move generator master switch to OFF position.
2. Remove AC power supply from battery charger.
3. Remove charger leads from battery, negative lead first.

Battery Charger Operation

Charging Lead-Acid Batteries

Charge 6- or 12-cell lead-acid batteries according to the following procedure.

1. Inspect battery for defective cables, loose posts, and loose terminals. Battery terminals and battery charger clips must be tight and cleaned of all corrosion for efficient charging.
2. Check the fluid level in each cell. If fluid level is low, add distilled water until fluid level is full. (No maintenance is required for maintenance-free batteries.) When using a dry-charge battery, give the battery a conditioning charge immediately after adding the electrolyte fluid. An automatic charger will not charge a dry-charge battery unless it has been given a conditioning charge. Follow the battery manufacturer's recommendations for length of charge.
3. The charge rate the charger is delivering to the battery is indicated on the ammeter. The charger control circuit limits the maximum charging current to 2 amps. No cranking disconnect is required because of the current-limit protection feature. A battery is almost fully charged when one of the following occurs:

- **Charging rate tapers to zero.** As a battery becomes charged, 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 charged.
- **Specific gravity reading (using a hydrometer) is between 1.250 and 1.285 at an electrolyte temperature of 80°F (26.7°C).**
- **Bubbles appear at the surface of the battery fluid.** Bubbles indicate a battery is from 80 to 85% charged. Vigorous bubbling occurs when the battery is near full charge.

Checking Specific Gravity (Lead-Acid Batteries)

Use a battery hydrometer to check the specific gravity of the electrolyte in each battery cell. While holding the hydrometer vertically, read the number on the glass bulb at the top of the electrolyte level. The battery is fully charged if the specific gravity is 1.260 at an electrolyte temperature of 80°F (26.7°C). The difference between specific gravities of each cell should not exceed 0.01. The battery should be charged if the specific gravity is below 1.215 at an electrolyte temperature of 80°F (26.7°C). **The temperature of the battery electrolyte will affect the specific gravity reading and must be considered when checking battery specific gravity. If the hydrometer used does not have a temperature correction table, use the table shown in Figure 5-14.**

Charging Nickel-Cadmium Batteries

Since charging recommendations vary between manufacturers of nickel-cadmium batteries, specific nickel-cadmium battery charging instructions are not provided in this manual. Contact the manufacturer of the nickel-cadmium battery for specific 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 distributor for information on adjusting the battery charger.

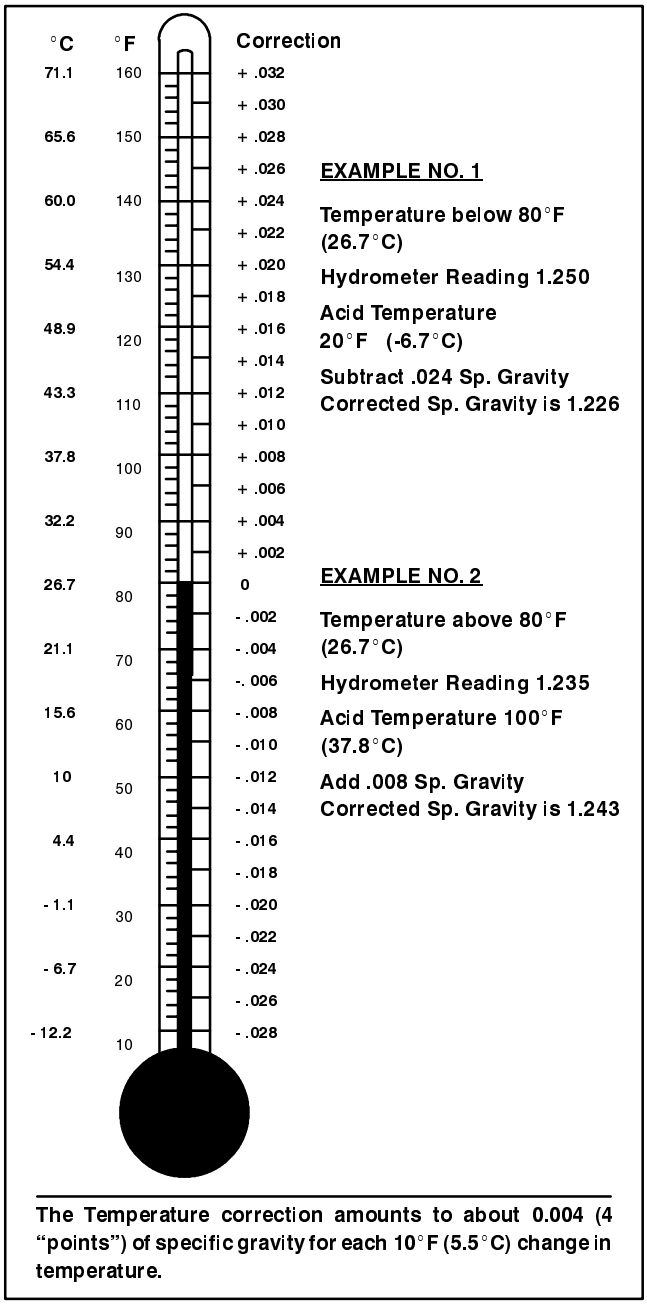


Figure 5-14. Specific Gravity Temperature Correction

Charger Voltage Adjustment

The battery charger's output settings are factory set and normally require no customer adjustment. If adjustment is required, contact an authorized dealer/distributor for service or service literature. The factory settings are listed below.

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

Figure 5-15. Factory Output Settings

Charger and Battery Maintenance

1. Check battery terminals and charger connectors for clean contact surfaces. Clean battery terminals and charger connectors as necessary with a mild baking soda/water solution. If battery charger does not work, see Troubleshooting section below.
2. Check battery fluid level regularly; maintain battery fluid at the full level.

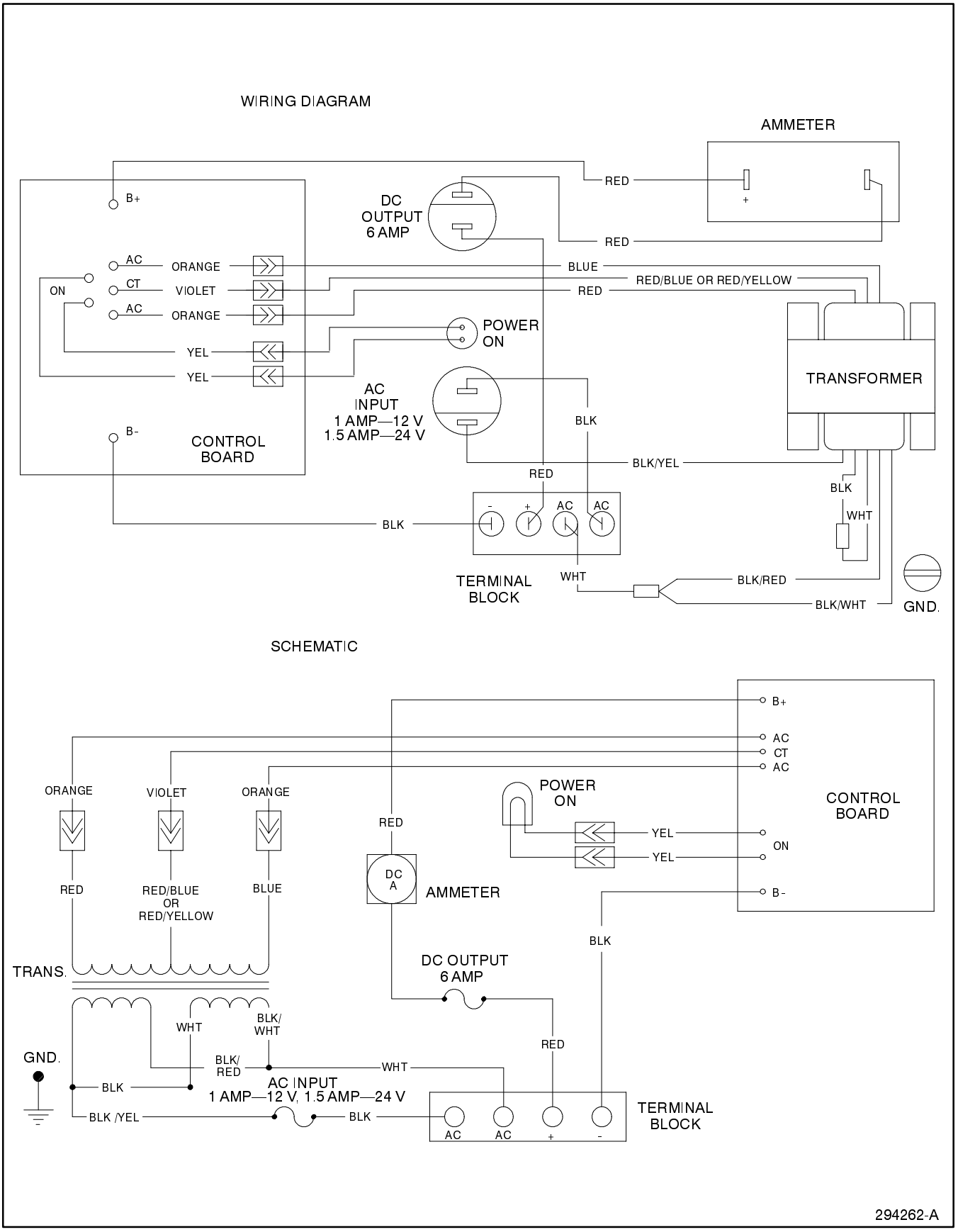
No Ammeter Reading on Battery Charger

Step	Test Procedure	Yes Action	No Action
A1	Check the battery charger connections to the battery for correct polarity: positive lead from battery charger to positive terminal on battery, negitive lead from battery charger to negitive terminal on battery. Is the polarity correct?	Proceed to A2	Reverse battery charger leads to battery
A2	Turn off AC supply to the battery charger. Are the battery terminals clean and tight?	Proceed to A3	Clean and tighten the battery terminals
A3	Is there line-to-line voltage at the AC input terminals of the battery charger?	Proceed to A5	Proceed to A4
A4	Is there line-to-line voltage at terminals 78 and 79 on terminal block TB-6?	Replace leads from terminal block TB-6 to battery charger.	Power is not available. Check wiring harness to contactor for an open.
A5	Check the AC input and DC output fuses. Are the fuses blown?	Replace fuse	Replace battery charger

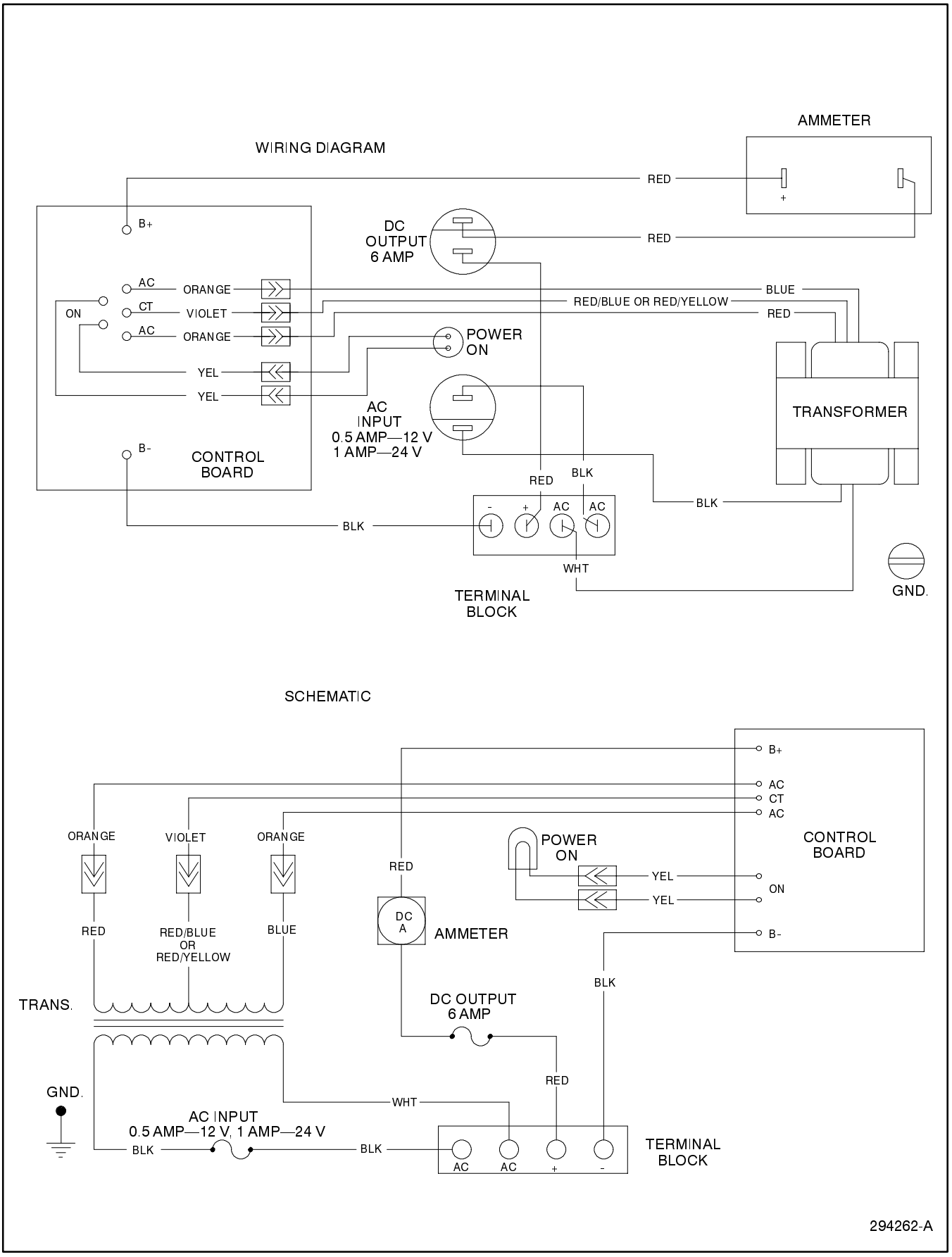
Ammeter Remains at 2 Amps Indefinitely

Step	Test Procedure	Yes Action	No Action
B1	Is the battery charger output voltage the same as the battery(s) voltage?	Proceed to B2	Replace battery charger to match battery voltage
B2	Disconnect the battery charger from the batteries. Does the ammeter on the battery charger go the zero?	Proceed to B3	Replace battery charger.
B3	Do the batteries have any shorted cells?	Replace batteries	Proceed to B4
B4	Are the batteries severely discharged?	Remove battery charger leads from batteries and connect a heavy duty battery charger to charge the batteries.	Replace battery charger

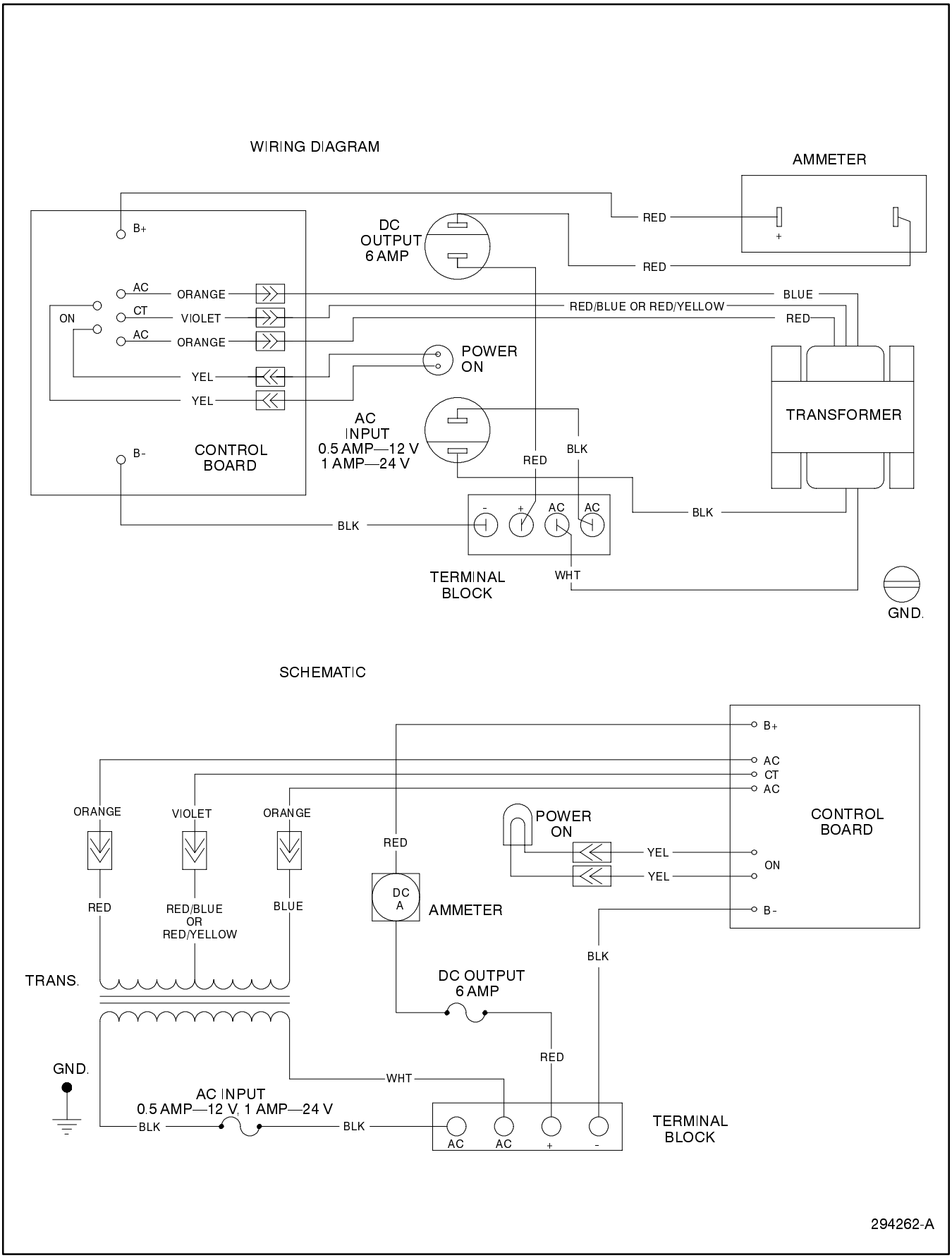
Battery Charger Wiring Diagrams



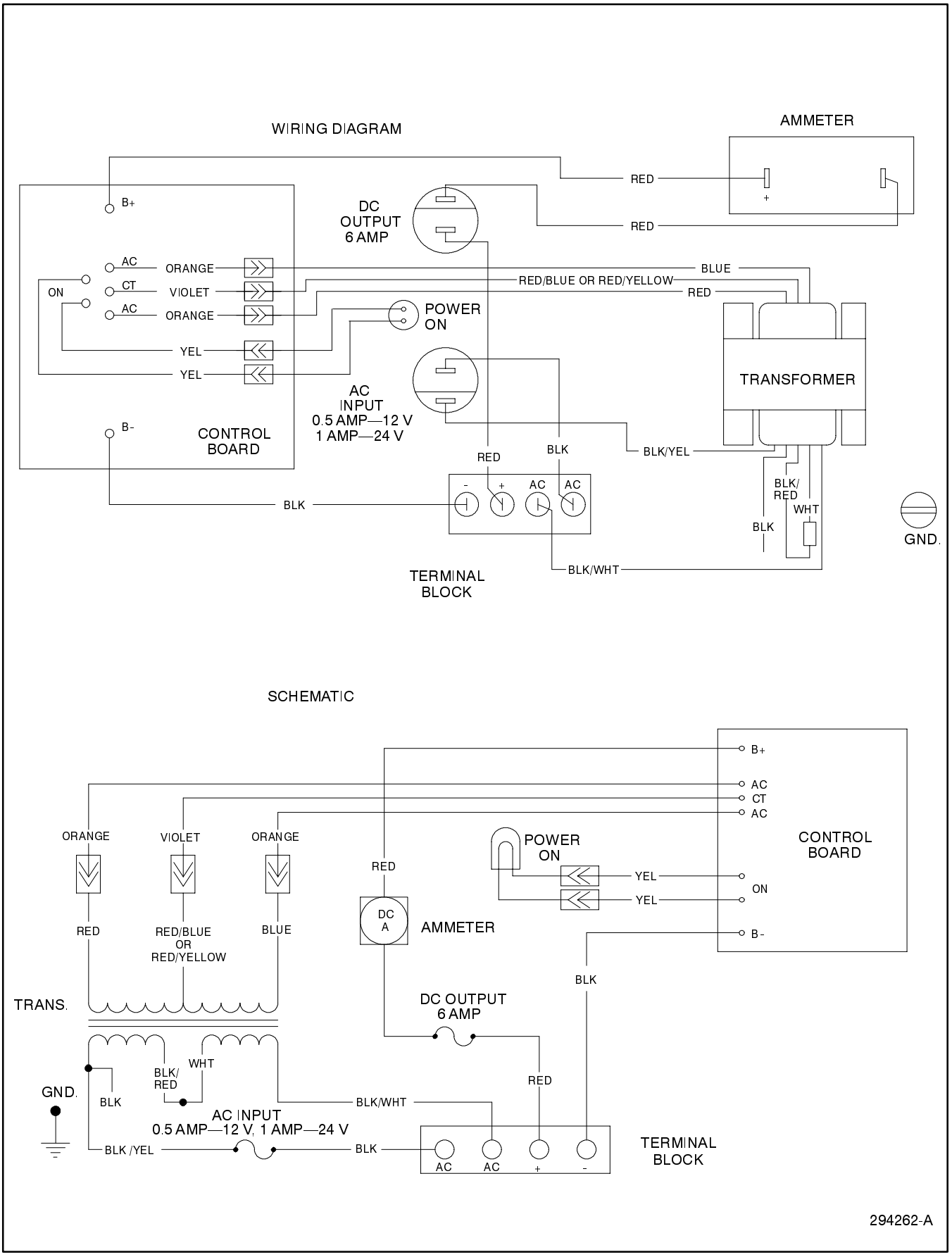
Wiring Diagram, Schematic—120-Volt Battery Charger



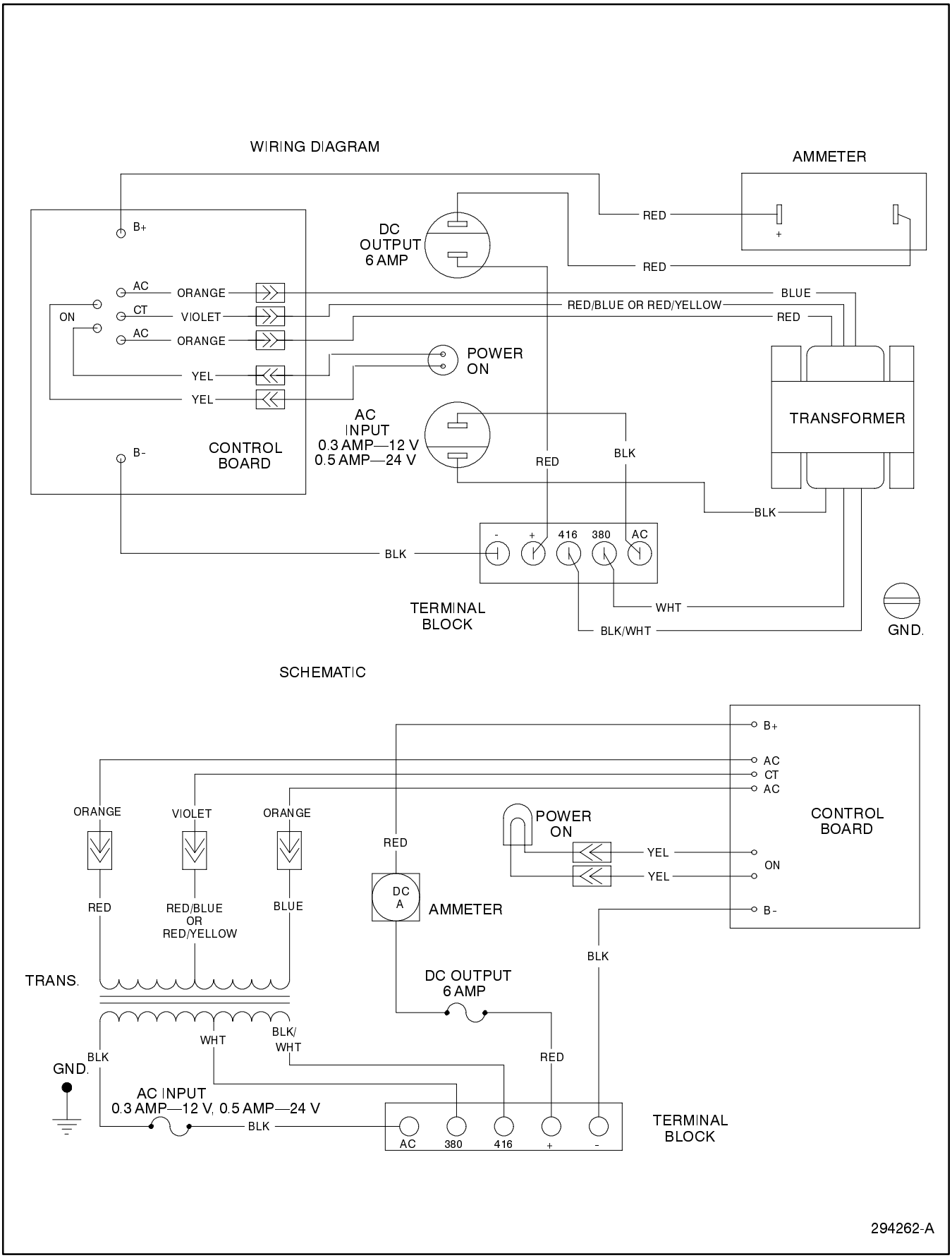
Wiring Diagram, Schematic—208-Volt Battery Charger



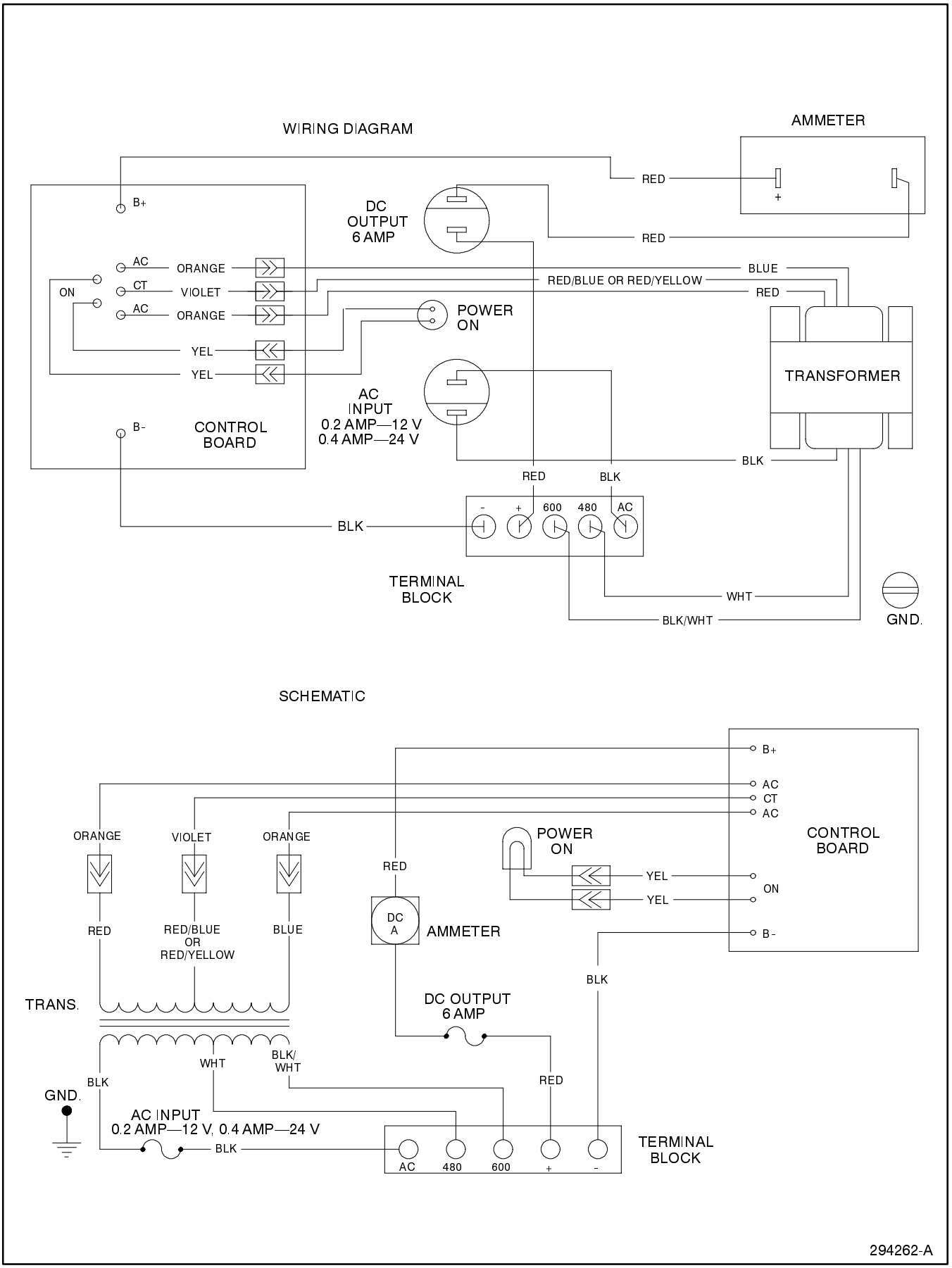
Wiring Diagram, Schematic—220-Volt Battery Charger



Wiring Diagram, Schematic—240-Volt Battery Charger



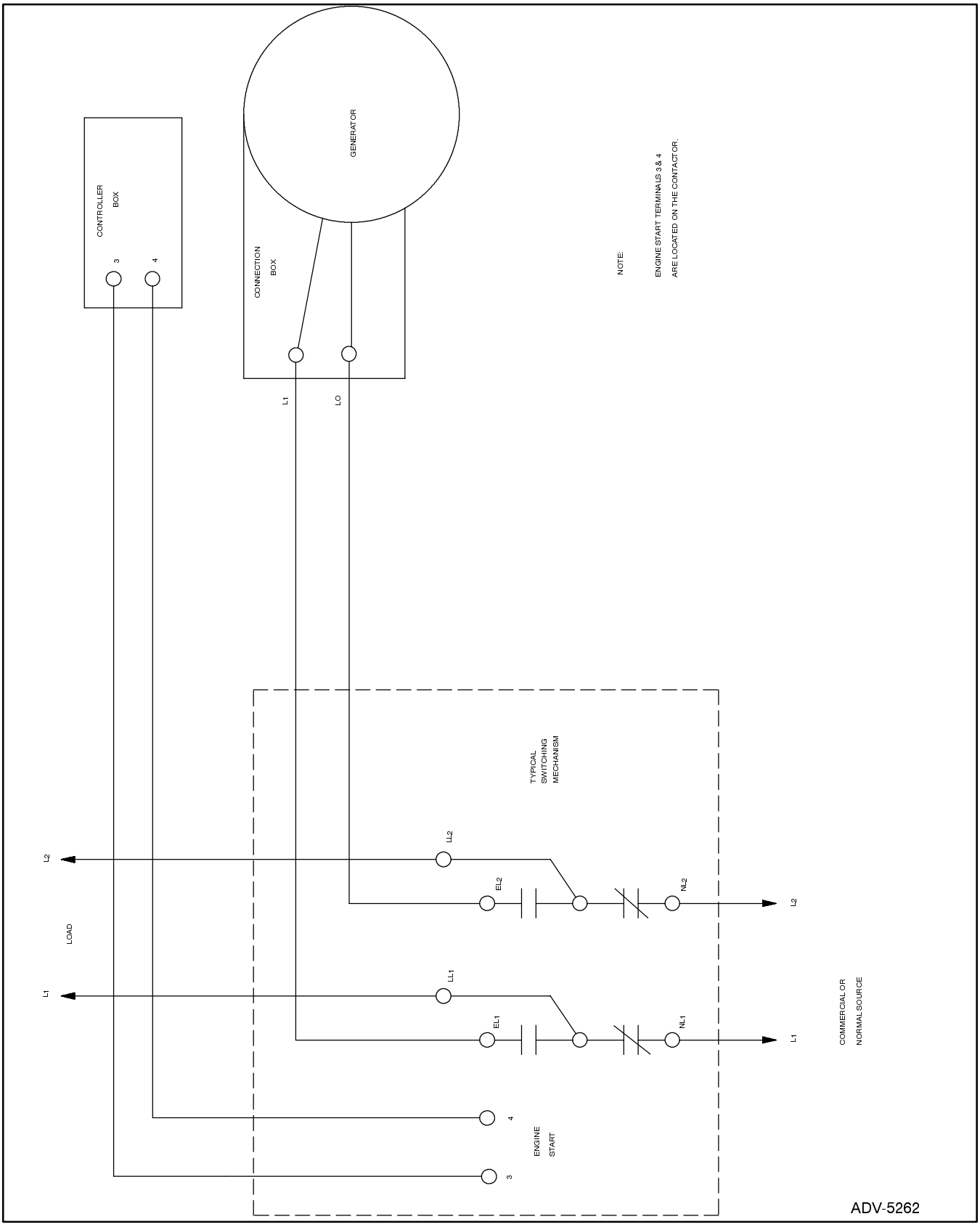
Wiring Diagram, Schematic—380/416-Volt Battery Charger



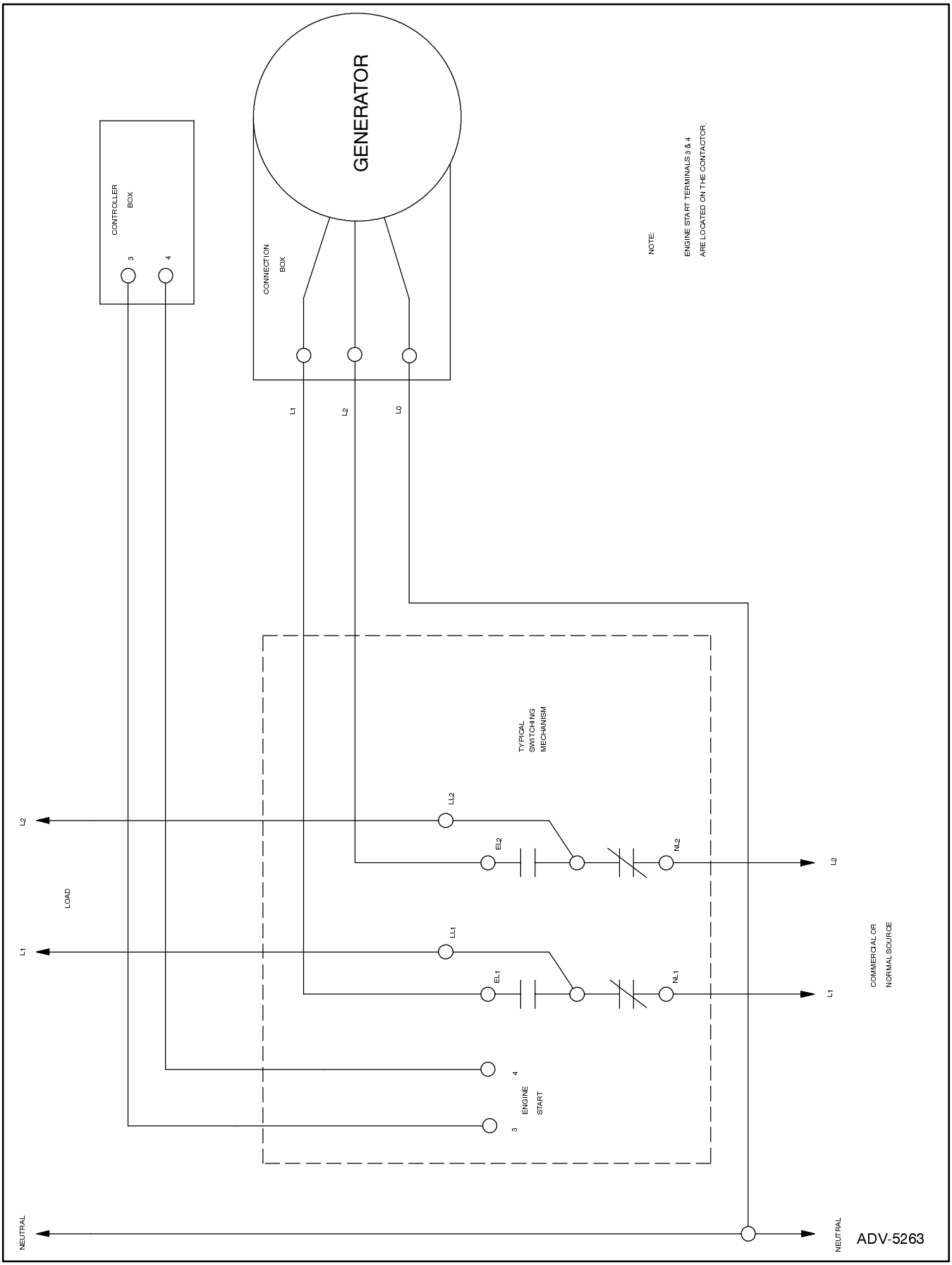
Wiring Diagram, Schematic—480/600-Volt Battery Charger

Notes

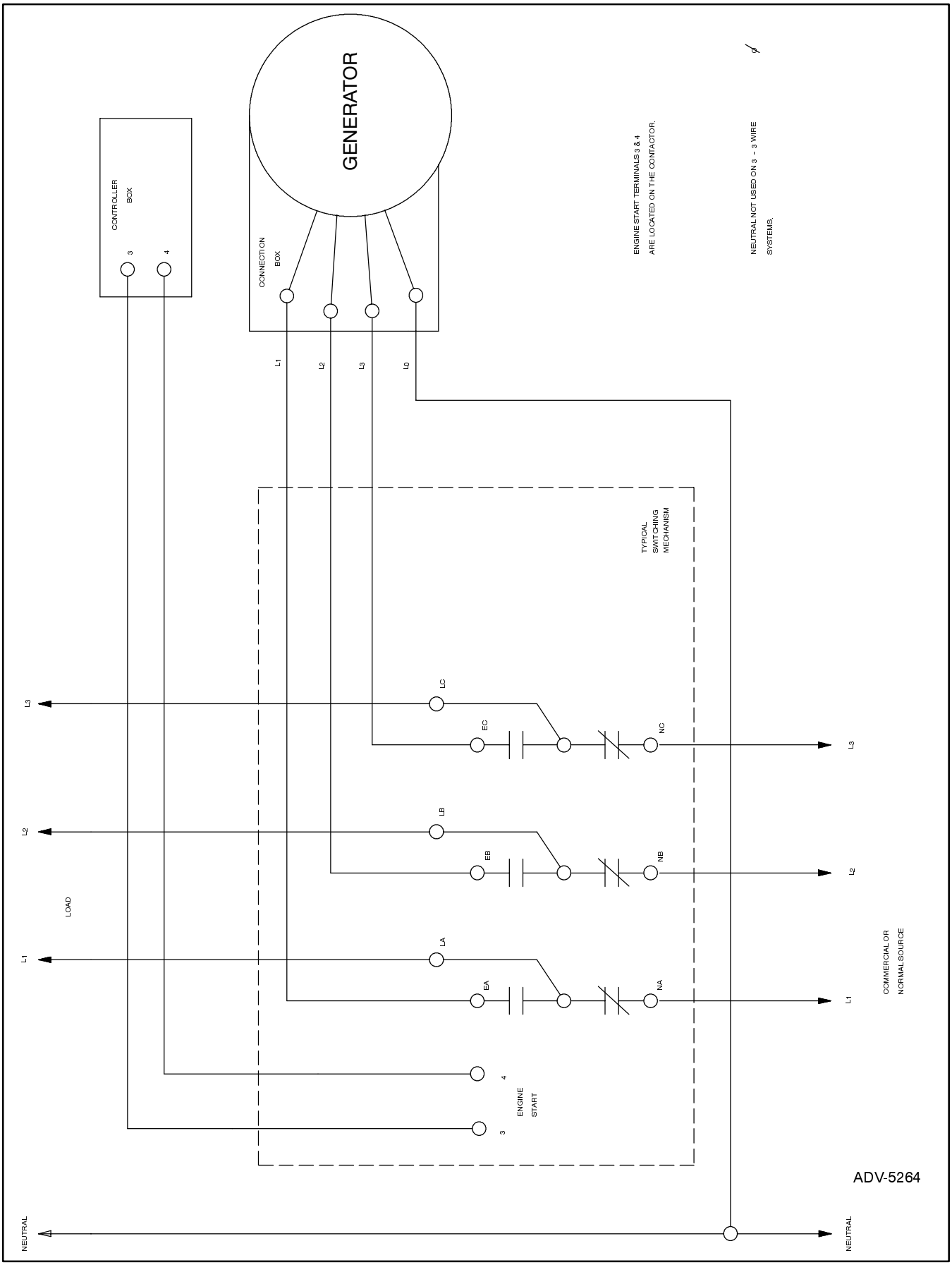
Section 6. Wiring Diagrams



Generator/ATS Interconnect 1-Phase, 2 Wire



Generator/ATS Interconnect, 1-Phase, 3 Wire



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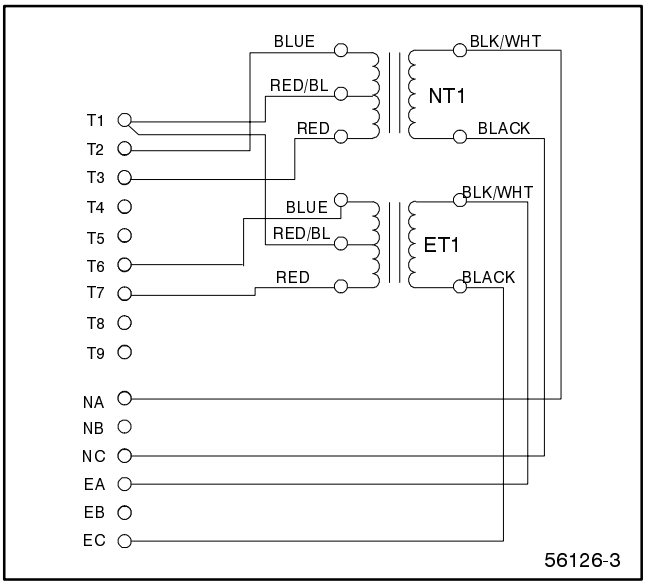
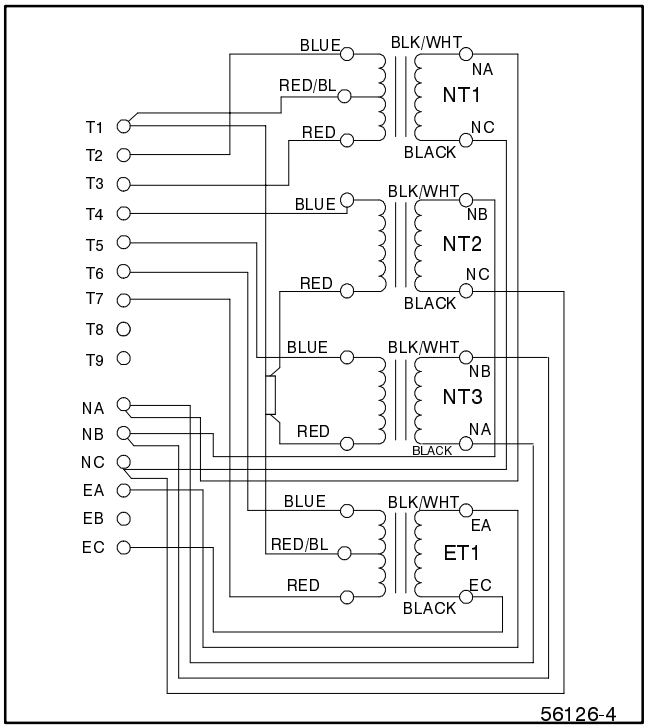
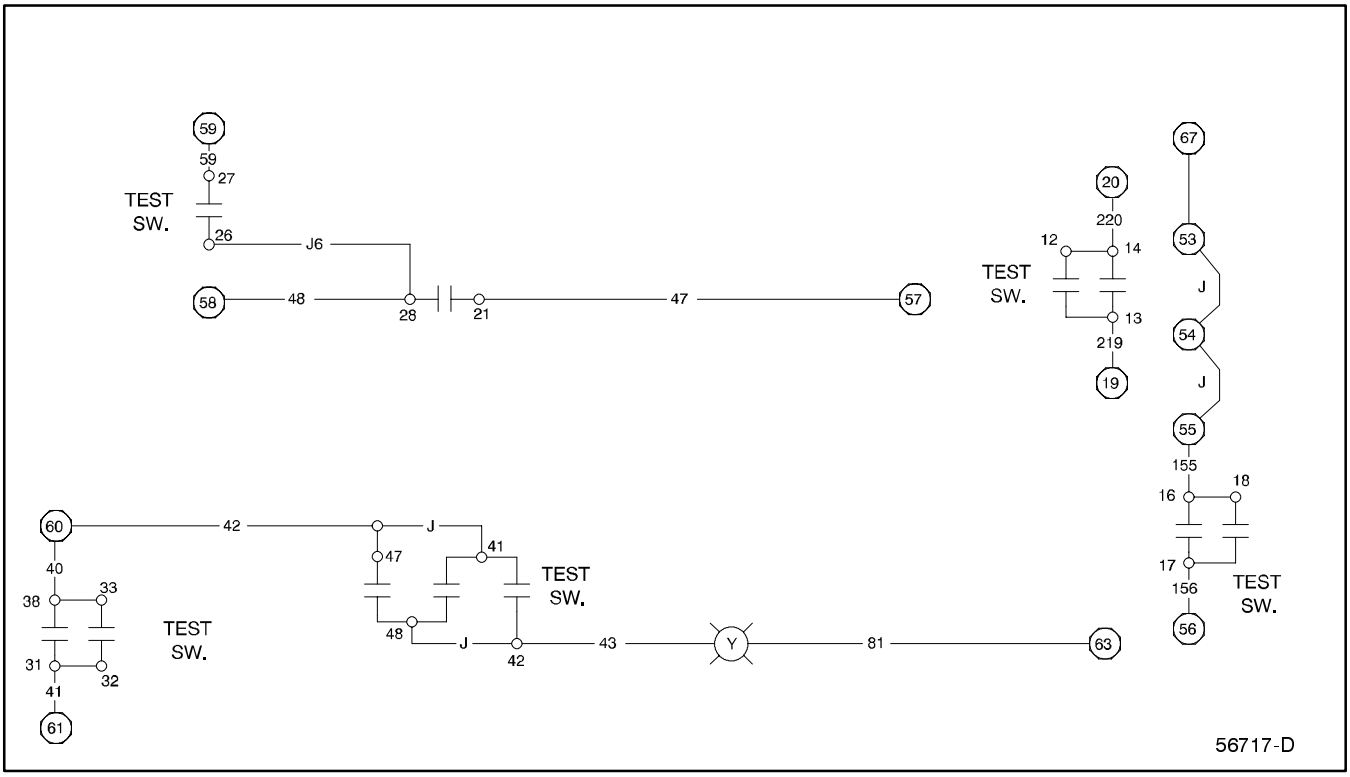


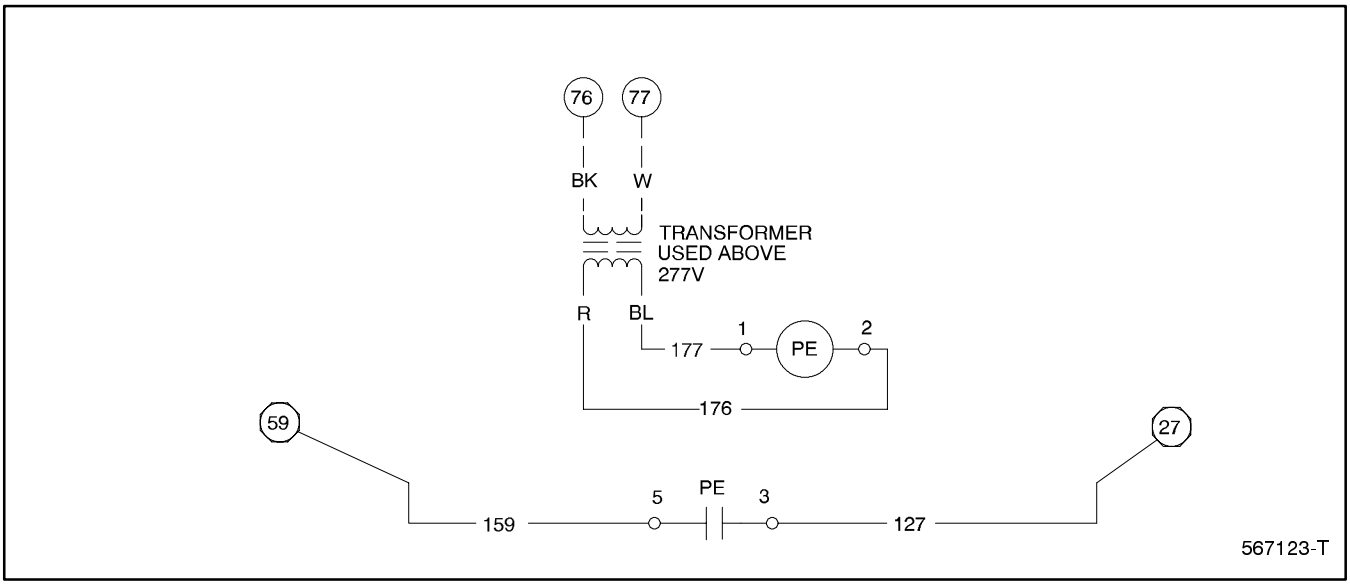
1-Phase ATS Transformer



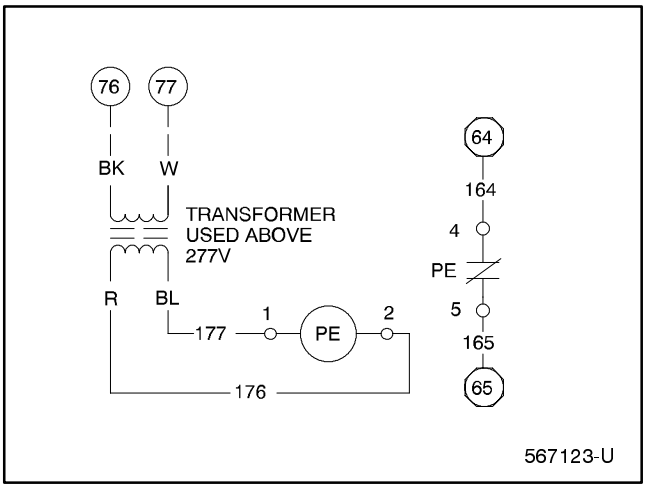
3-Phase ATS (Standard) Transformer



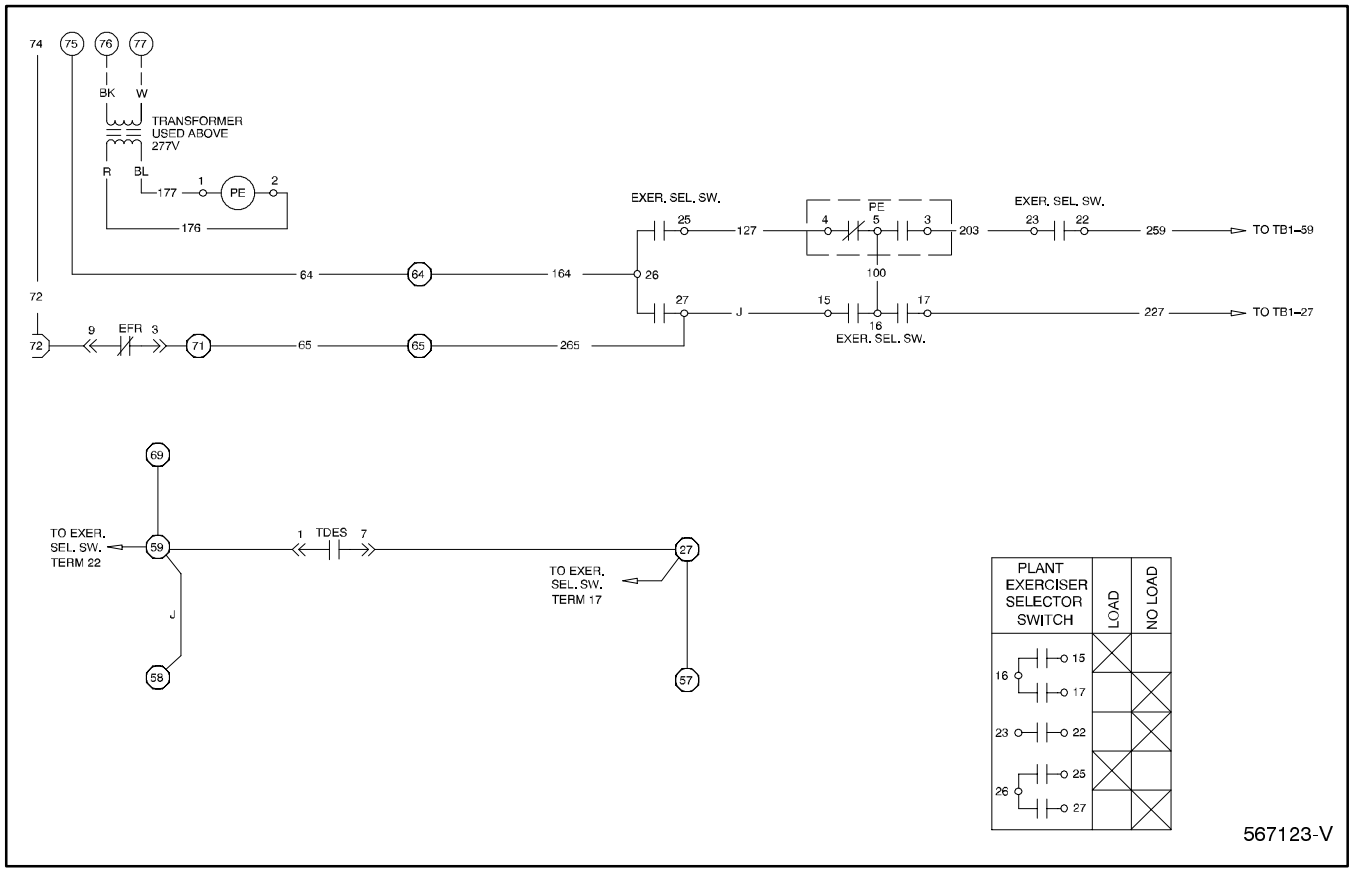
Accessory DA-7-D



Accessory DA-23-T



Accessory DA-23-U

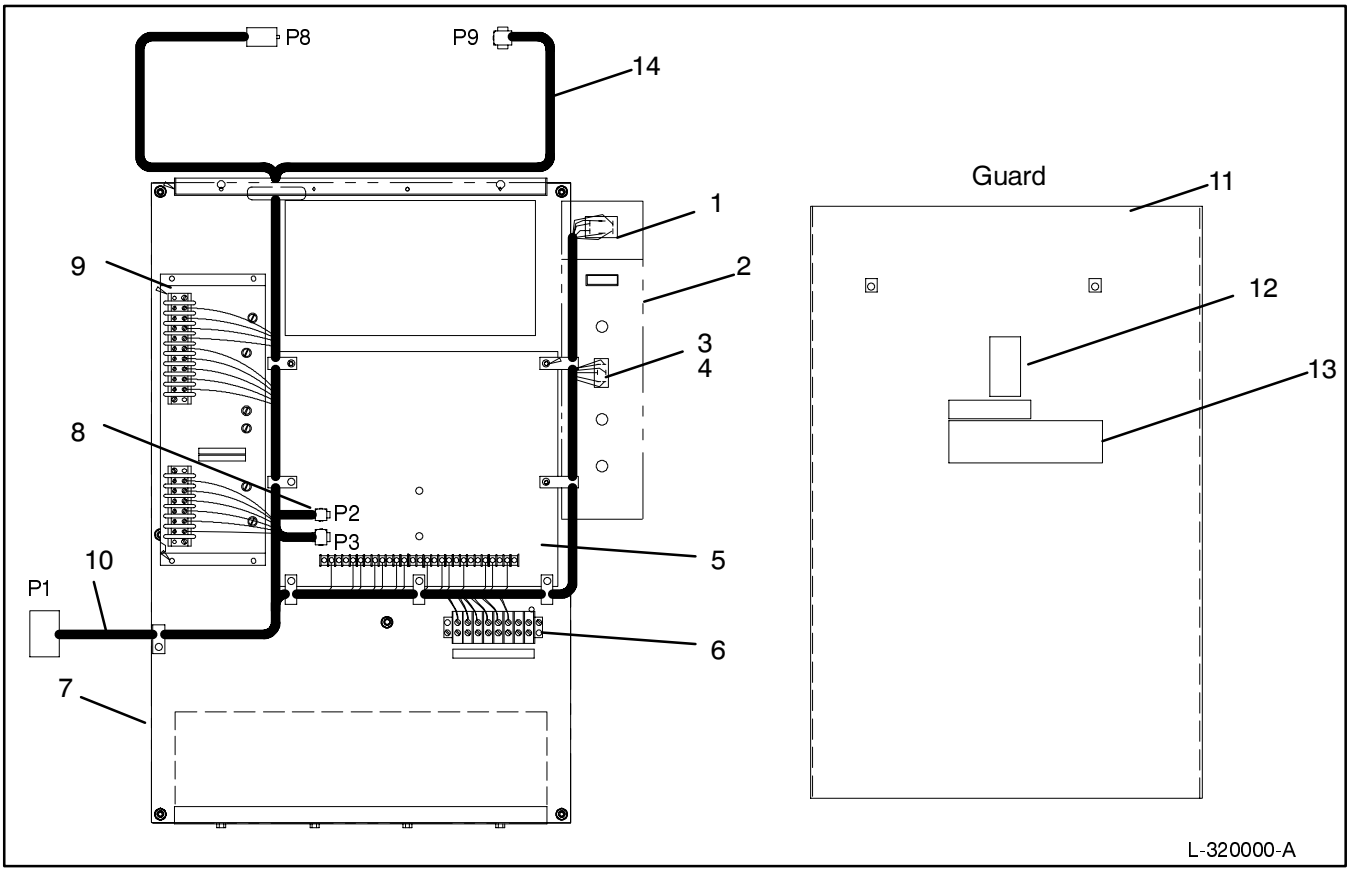


Accessory DA-23-V

Notes

Section 7. Service Parts

Inner Panel



Item	Qty.	Description	Part No.
1	1	Light Assembly, four-light	320827
2	1	Decal (outside of door)	320834
3	1	Switch, toggle (momentary)	295068
4	1	Switch, toggle (maintained)	268015
5	1	Circuit Board Assembly	B-320689
6	1	Block, terminal	295266
7	1	Panel, inner	295005
8	1	Wiring Harness (Transfomer)	Figure 7-1
9	1	Transformer Assembly	Figure 7-1
10	1	Harness, logic/interface to power conversion unit	Figure 7-2
11	1	Guard	321017
12	1	Decal	295328
13	1	Decal	295261
14	1	Harness, logic to interface	Figure 7-2

Voltage	Phase	Item 9 Transformer Assembly	Item 8 Wiring Harness
120	1	A-320919	321156
208	1	A-320921	321156
240	1	A-320919	321156
480	1	A-320922	321156
600	1	A-320923	321156
120/208	3	A-320911	321155
120/240	3	A-320912	321155
277/480	3	A-320913	321155
347/600	3	A-320914	321155
110 or 120	3	A-320915	321155
220/380	3	A-320916	321155
240/416	3	A-320917	321155

Figure 7-1. Transformer Part Numbers

Switch	Item 14 Logic to Interface	Item 10 Logic/Interface to Power Conversion Unit
TES, TLS		
25-180 amp standard and programmed transition	320958	321119
25-180 amp standard and programmed transition	320961	321280
MNS, MMS		
40-160 amp standard and programmed transition	320958	321174
250-1200 amp standard and programmed transition	320961	321164
1600-4000 Amp standard and programmed transition	320960	321164
ZCS		
150-225 amp standard and programmed transition	320961	321081
260-1200 amp standard and programmed transition	320961	321083
800-1200 (4-pole) amp standard	320961	321079
800-1200 (4-pole) amp programmed transition	320961	321083
1600-4000 amp standard and programmed transition	320961	321083
ZCBZCS		
100-400 amp standard	321455	321463
100-400 amp programmed transition	321455	321466
600-1200 amp standard	321455	321464
600-1200 amp programmed transition	321455	321467
1600-3000 amp standard	320961	321464
1600-3000 amp programmed transition	320961	321467

Figure 7-2. Wirng Harness Part Numbers

Accessories

Time Delay

Accessory	Description	Part Number
02-F	Relay, Time Delay	295974

Test Switch

Accessory	Description	Part Number
07-D	Decal Block, Contact Switch, Pushbutton Switch, 4 Position Contact Assembly	294686 294651 294653 294695 298049

Auxiliary Contacts—Relay

Accessory	Description	Part Number
14-C	Relay Socket, Relay Tab, Identification Clamp, Relay Hold Down	295254 295034 201620-157 295189
14-D	Relay Socket, Relay Tab, Identification Clamp, Relay Hold Down	295254 295034 201620-158 295189
15-E	Relay Socket, Relay Tab, Identification Clamp, Relay Hold Down	295254 295034 201620-159 295189
15-F	Relay Socket, Relay Tab, Identification Clamp, Relay Hold Down	295254 295034 201620-160 295189

Plant Exercisers

Accessory	Description	Part Number
23-TA	Clock, Time	294541
23-TB	Clock, Time Transformer	294541 295354
23-TC	Clock, Time Transformer	294541 295355
23-TD	Clock, Time Transformer	294541 295301
23-TE	Clock, Time Transformer	294541 295302
23-TF	Clock, Time Transformer	294541 295299
23-UA	Clock, Time	294541
23-UB	Clock, Time Transformer	294541 295354

Plant Exercisers, continued

Accessory	Description	Part Number
23-UC	Clock, Time Transformer	294541 295355
23-UD	Clock, Time Transformer	294541 295301
23-UE	Clock, Time Transformer	294541 295302
23-UF	Clock, Time Transformer	294541 295299
23-VA	Clock, Time Switch, Selector	294541 295322
23-VA3	Clock, Time Switch, Operator Block, Contact Block, Contact Contact, Assembly	294541 298039 298051 298052 298054
23-VB	Clock, Time Transformer Switch, Selector	294541 295354 295322
23-VB3	Clock, Time Transformer Switch, Operator Block, Contact Block, Contact Contact, Assembly	294541 295354 298039 298051 298052 298054
23-VC	Clock, Time Transformer Switch, Selector	294541 295355 295322
23-VC3	Clock, Time Transformer Switch, Operator Block, Contact Block, Contact Contact, Assembly	294541 295355 298039 298051 298052 298054
23-VD	Clock, Time Transformer Switch, Selector	294541 295301 295322
23-VD3	Clock, Time Transformer Switch, Operator Block, Contact Block, Contact Contact, Assembly	294541 295301 298039 298051 298052 298054
23-VE	Clock, Time Transformer Switch, Selector	294541 295302 295322
23-VE3	Clock, Time Transformer Switch, Operator Block, Contact Block, Contact Contact, Assembly	294541 295302 298039 298051 298052 298054
23-VF	Clock, Time Transformer Switch, Selector	294541 295299 295322
23-VF3	Clock, Time Transformer Switch, Operator Block, Contact Block, Contact Contact, Assembly	294541 295299 298039 298051 298052 298054

Battery Chargers

Accessory	Description	Part Number
24-60A	Charger Assembly, Battery Fuse, 6.0 amp Fuse, 0.2 amp	A-294236 226520 226527
24-60B	Charger Assembly, Battery Fuse, 6.0 amp Fuse, 0.4 amp	A-294237 226520 226528
24-62A	Charger Assembly, Battery Fuse, 6.0 amp Fuse, 1.0 amp	A-294226 226520 226525
24-62B	Charger Assembly, Battery Fuse, 6.0 amp Fuse, 1.5 amp	A-294227 226520 291207
24-63A	Charger Assembly, Battery Fuse, 6.0 amp Fuse, 0.5 amp	A-294230 226520 226521
24-63B	Charger Assembly, Battery Fuse, 6.0 amp Fuse, 1.0 amp	A-294231 226520 226525
24-64A	Charger Assembly, Battery Fuse, 6.0 amp Fuse, 0.5 amp	A-294232 226520 226521
24-64B	Charger Assembly, Battery Fuse, 6.0 amp Fuse, 1.0 amp	A-294233 226520 226525
24-66A	Charger Assembly, Battery Fuse, 6.0 amp Fuse, 0.2 amp	A-294236 226520 226527
24-66B	Charger Assembly, Battery Fuse, 6.0 amp Fuse, 0.4 amp	A-294237 226520 226528
24-68A	Charger Assembly, Battery Fuse, 1.0 Fuse,	A-294229 226525 239298
24-68B	Charger Assembly, Battery Fuse, 1.0 Fuse	A-294229 226525 239298
24-71A	Charger Assembly, Battery Fuse, 6.0 amp Fuse, 0.3 amp	A-294234 226520 226526
24-71B	Charger Assembly, Battery Fuse, 6.0 amp Fuse, 0.5 amp	A-294235 226520 294552
24-73A	Charger Assembly, Battery Fuse, 6.0 amp Fuse, 0.3 amp	A-294234 226520 226526
24-73B	Charger Assembly, Battery Fuse, 6.0 amp Fuse, 0.5 amp	A-294235 226520 294552

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.

Abbreviation	Description
AC	alternating current
AHWT	anticipatory high water temp.
ALOP	anticipatory low oil pressure
AM	amplitude modulation
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
assy.	assembly
ASTM	American Society for Testing Materials
ATDC	after top dead center
ATS	automatic transfer switch
aux.	auxiliary
AWG	American Wire Gauge
AWM	appliance wiring material
bhp	brake horsepower
bmep	brake mean effective power
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
C.S.A.	Canadian Standards Association
cu. in.	cubic inch, cubic inches
cyl.	cylinder
dBA	decibels
DC	direct current
DCR	direct current resistance
deg.	degree
dept.	department
dia.	diameter
e.g.	example given
EMI	electromagnetic interference
etc.	etcetera, (and so forth)
ext.	external
°F	Fahrenheit degree
fl. oz.	fluid ounce, fluid ounces
FM	frequency modulation
fs	full scale
ft.	foot, feet
ft. lbs.	foot pound, foot pounds
ga.	gauge
gal., gals.	gallon, gallons
gal./hr.	gallons per hour
gph	gallons per hour
gpm	gallons per minute
gr.	grade
grd.	ground
HCHT	high cylinder head temperature
HET	high exhaust temperature
Hg	mercury (element)
H_2O	water
hp	horsepower
hr, hrs	hour
HWT	high water temperature
Hz	hertz (cycles per second)
ID	inside diameter
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)
km	kilometer, kilometers

Abbreviation	Description
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, LEDs	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
LWT	low water temperature
m	meter, meters
m^3	cubic meter, cubic meters
max.	maximum
MCM	one thousand circular mils.
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
mph	miles per hour
MS	military standard
mW	milliwatt, milliwatts
MW	megawatt, megawatts
N/A	not available
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

Abbreviation	Description
	thread per general use
N/R	not required
OC	overcrank
OD	outside diameter
OEM	original equipment manufacturer
OS	overspeed, oversize
OV	overvoltage
oz.	ounce, ounces
PF	power factor
pot.	potentiometer
ppm	parts per million
psi	pounds per square inch
pt., pts.	pint, pints
qt., qts.	quart, quarts
qty.	quantity
ref.	reference
RFI	radio frequency interference
rms	root mean square
rpm	revolutions per inch
SAE	Society of Automotive Engineers
sec.	second, seconds
SCR	silicon controlled rectifier
spec, specs	specification
sq.	square
sq. cm	square centimeters
sq. in.	square inch, square inches
tach	tachometer
TDC	top dead center
temp.	temperature
TIF	telephone influence factor
turbo	turbocharger
UNC	Unified coarse thread (was NC)
UNF	Unified fine thread (was NF)
UL	Underwriter's Laboratories, Inc.
US	undersize
V	volt, volts
VAC	Volts alternating current
VDC	volts direct current
W	watt, watts

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