GENERAC®
POWER SYSTEMS, INC.

"Y-Type" Automatic Transfer Switches

PART 8 "Y-TYPE" AUTOMATIC TRANSFER SWITCHES

STANDBY ELECTRIC POWER SYSTEMS

All Series

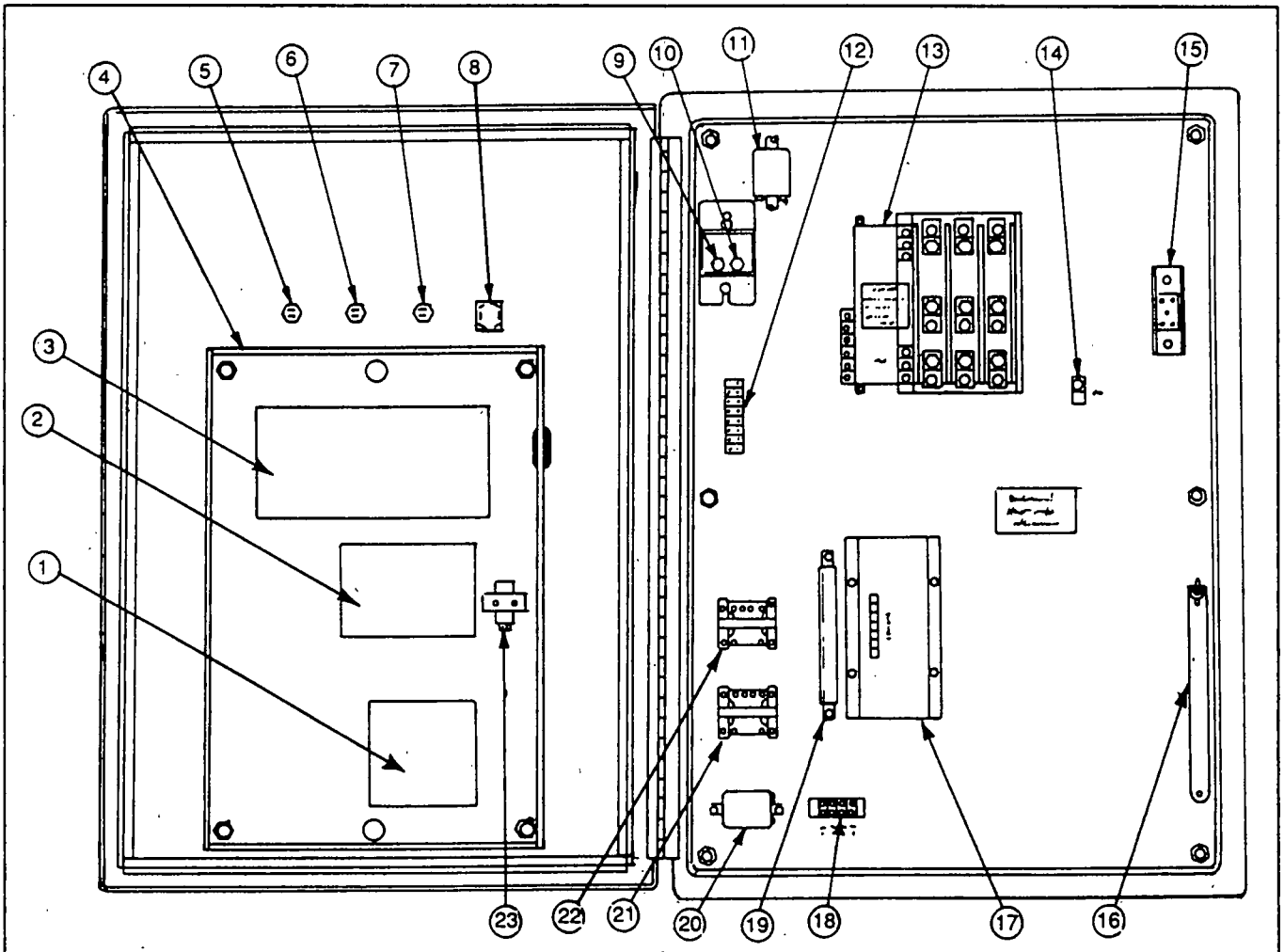
TABLE OF CONTENTS

Section 8.1
TRANSFER SWITCH MAJOR COMPONENTS

Introduction

The purpose of a transfer switch is to transfer critical electrical loads to a "Standby" power source when the "Utility" power supply has failed or dropped below a preset level. A transfer switch is required in all standby electric power systems, to prevent electrical feedback between the two power supplies.

The "Y-Type" automatic transfer switches are rated 250 AC volts and are available in 105 to 420 ampere sizes. Figure 1, below, shows a typical transfer switch with its NEMA 12 enclosure door opened to reveal major components.



ITEM	DESCRIPTION
1 NOTE 1	Utility Voltage Sensor Circuit Board
2 NOTE 1	Exercise Circuit Board
3 NOTE 1	Logic Circuit Board
4	Circuit Board Enclosure
5	Switch Position "Utility" Lamp
6	Switch Position "Emergency" Lamp
7	"Standby Operating" Lamp
8	System Test Mode Switch
9	Time Delay Neutral On-Off Switch
10	Maintenance Disconnect Switch
11	Transfer Relay
12	Terminal Strip

ITEM	DESCRIPTION
13	Transfer Mechanism (3-Pole Shown)
14	Grounding Lug
15	Neutral Block
16	Manual Transfer Handle
17	Utility Voltage Interface Assembly
18	2-Wire Start Terminal Strip
19	Time Delay Neutral Resistor
20	Time Delay Relay
21	Standby Sensing Transformer TR1
22	Load Power Supply Transformer TR2
23	9 Volts Battery (for Exercise Circuit Board)

NOTE 1 - "Logic" type intelligence system is shown.

Figure 1. Major Transfer Switch Components

System Test Switch

INTRODUCTION:

The system test switch provides selection of (a) Automatic Mode, (b) Normal Test Mode, and (c) Fast Test Mode. See Figure 2 below.

AUTOMATIC MODE:

With "Automatic Mode" selected, a utility voltage sensor circuit board will constantly monitor utility power source voltage. Should that source voltage drop below a preset level and remain at such low level for a preset time, circuit board action will initiate generator cranking and startup. Following engine warmup and when generator AC output voltage and frequency have reached a preset level, transfer of electrical looads to the "Standby" power source will occur. The circuit board will continue to monitor utility source voltage and, on restoration of that supply voltage, will initiate retransfer back to "Utility" and generator shutdown.

NORMAL TEST MODE:

This switch position simulates a utility power outage. Generator startup and transfer to "Standby" will occur just as though an actual utility source failure has occured. When the switch is reset back to "Automatic Mode", retransfer and shutdown will occur in the same manner as during automatic operation.

FAST TEST MODE:

When "Fast Test" is selected, the generator engine will crank and start and transfer to "Standby" will occur, with all circuit board timers reduced to a total time of less than five (5) seconds. The switch is spring-loaded out of the "Fast Test" position, must be held there.

"Standby Operating" Advisory Lamp

Lamp turns on when the generator is running. Power for lamp operation is reduced generator output volts.

Switch Position Advisory Lamps

Two lamps indicate the position of the main current carrying contacts in the transfer mechanism. A set of auxiliary contacts in the transfer mechanism will turn one or the other of the lamps on, as follows:

- When the load circuit is connected to the "Utility" source side, the "Utility" lamp will turn on.
- When the load is connected to the "Standby" source side, the "Emergency" lamp will turn on.

NOTE: Utility source power must be available or transfer to that source cannot occur. Standby source power must be available or transfer to that source cannot occur.

Intelligence Circuit Boards

A circuit board compartment is provided in the switch enclosure door. The compartment will house either two or three circuit boards.

- For LOGIC type intelligence systems, the compartment houses three (3) circuit boards. See Part 11.
- For CPU type systems, the compartment houses two (2) circuit boards. See Part 10.

Maintenance Disconnect Switch

When set to its "Manual" position, this switch effectively opens the standby system's 2-wire start circuit (Wires 178/183), as well as the automatic transfer circuit. Thus, when "Manual" is selected, automatic startup and transfer will not be possible.

When set to "Automatic", automatic startup and transfer will occur as programmed in the intelligence circuit.

DANGER: WITH "AUTOMATIC" SELECTED, GENERATOR CAN CRANK AND START WITHOUT WARNING. TO PREVENT INJURY, SET THE SWITCH TO "MANUAL" BEFORE WORKING ON OR AROUND THE GENERATOR.

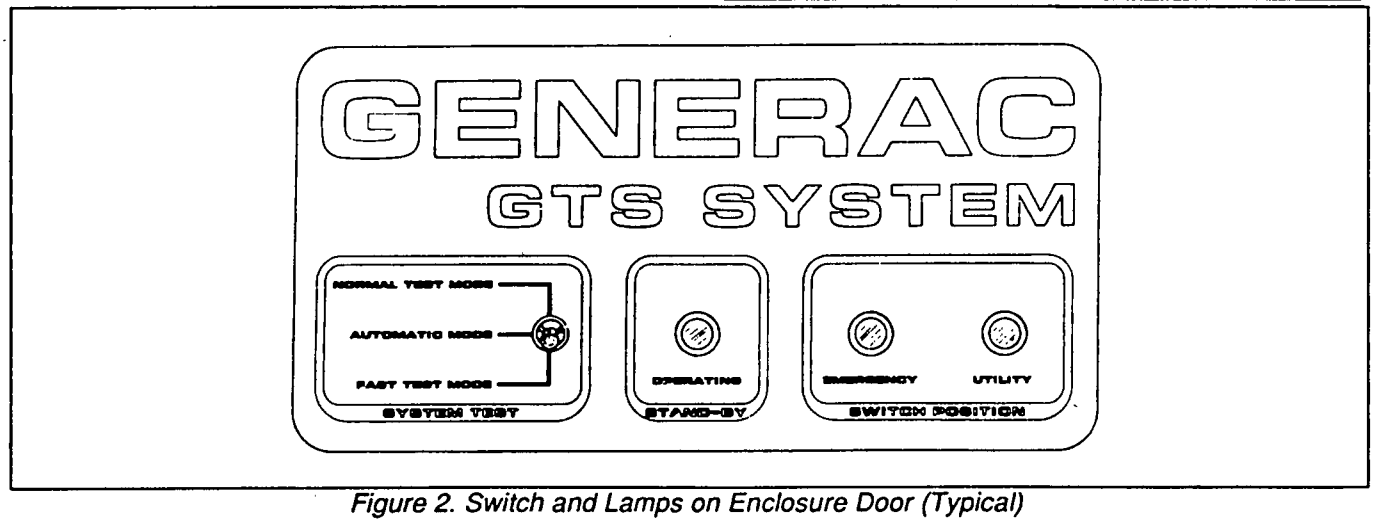


Figure 2. Switch and Lamps on Enclosure Door (Typical)

Optional Time Delay Neutral Switch

Some units may be equipped with an optional time delay neutral switch, usually located adjacent to the maintenance disconnect switch. Setting the switch to "On" activates a "time delay at neutral" function. Also see "Time Delay Relay" in this section.

The time delay neutral feature is a preset time interval during which the transfer switch main contacts will remain disconnected from both the utility and standby source sides.

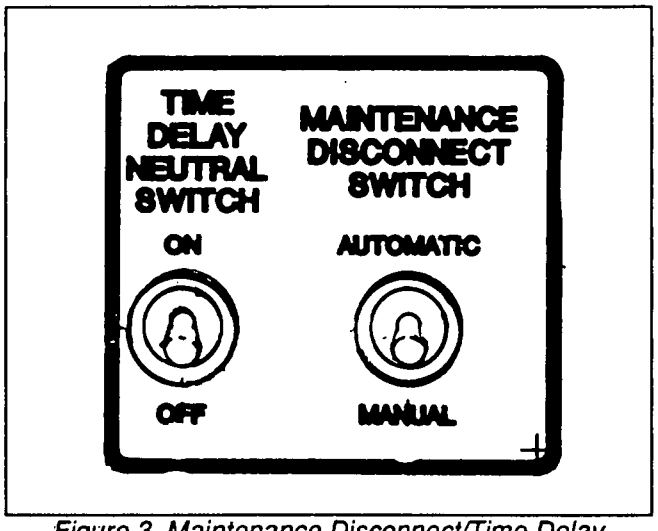


Figure 3. Maintenance Disconnect/Time Delay Neutral Switches

Transfer Relay

When energized by circuit board action, this relay delivers standby source power to the transfer mechanism, to initiate transfer of the main contacts to the "Standby" source side.

When de-energized by circuit board action, the relay actuates to deliver utility source voltage to the transfer mechanism. This initiates re-transfer back to the "Utility" source.

Transfer Mechanism

The transfer mechanism houses the main current carrying contacts. It also houses other electrical and mechanical components needed for switch operation. See Section 8.2.

Neutral Block

Utility, standby and load neutral lines must be connected to the neutral block. Neutral blocks rated 120/150 amps, 200/300 amps, and 420 amps are available.

NOTE: Most standby generators have an "ungrounded" or "floating" neutral. Ground such neutral lines at the main electrical service entrance only. Be sure to comply with appropriate electrical codes.

Grounding Lug

This lug provides a convenient point for connecting the transfer switch to an earth ground.

When conduit is attached to the transfer switch enclosure and such conduit is grounded, the enclosure may be assumed to be grounded. Some installers will simply attach a bare copper wire to the grounding loug and to the conduit.

Manual Transfer Handle

Use this handle for maintenance and testing purposes, to actuate the transfer mechanism main contacts manually.

Terminal Strips TS1 and TS2

Terminal strip TS1 provides a convenient method of interconnecting transfer switch wiring circuits.

Terminal strip TS2 is the "2-wire start" terminal strip, with terminals 178 and 183 identified. Suitable wiring must be connected between these two terminals and an identically numbered terminal strip in the generator's AC connection (lower) panel.

Time Delay Relay

Some transfer switches may be equipped with a "time delay at neutral" feature. This feature extends the disconnect time of the main current carrying contacts beyond the normal disconnect time.

The "neutral" position of the main contacts is that position where the load is disconnected from both power sources. By extending the time at "neutral", residual voltages generated by heavy inductive loads can decay to a safe level before the main contacts are reconnected. The "time delay at neutral" feature provides a measure of protection against blowing of fuses or tripping of circuit breakers that often occurs during rapid transfer of motor and other heavy inductive loads.

Transformer TR1

This step-down transformer may be called the "Standby" transformer, since its primary coil is connected to that power supply. The transformer works as follows:

- Line-to-line standby generator output flows through the transformer's primary winding.
- A reduced voltage is induced into the transformer secondary winding at about 24 volts AC.
- The reduced seoondary winding output is delivered to (a) a "Standby Operating" lamp, and to (b) a logic (or CPU) circuit board. The lamp turns on and the logic (or CPU) board begins to operate.

Transformer TR2

This step-down transformer may be called the "Load-Side" transformer since its primary coil connects to the

Transformer TR2 (Continued)

transfer mechanism's load terminals. Load current, flowing through the transformer's primary windings, induces a voltage into the secondary windings at about 24 volts AC. Secondary winding output is used to operate a timing circuit which starts and exercises the generator once every seven (7) days.

On units with CPU type control system (only two circuit boards), secondary winding output is delivered to the CPU circuit board. The 7-day exercise timing circuit is included in that circuit board.

On units with "logic" type control system (three circuit boards) secondary winding output is delivered to a 7-day exercise circuit board.

NOTE: Reduced load terminal voltage is available to the CPU or exercise board at all times, except during the brief period when the transfer mechanism main contacts are at "Neutral". During this brief period, when the load is disconnected from both power sources, the exercise circuit is powered by a 9 volts battery.

Utility Sensing Interface

This device houses either two or three "step-down" transformers. That is, 1-phase systems use two transformers while 3-phase system require three.

The interface allows several different rated voltages and 1 or 3-phase to "interface" properly with a single utility voltage sensor circuit board.

Utility power source voltage is delivered to terminals N1/N2/N3 of the interface. Reduced secondary winding output is delivered to terminals 224 through 227 and then to the utility voltage sensor board as "sensing" voltage. The voltage step-down ratio is fixed and sensing voltage delivered to the utility voltage sensor circuit board will vary as the utility power supply voltage varies. Figures 4 and 5 at right are schematic representations of (a) a 240 volts, 1-phase interface, and (b) a 208/240 volts, 3-phase interface.

NOTE: Some transfer switches may be equipped with a "multi-voltage" utility sensing interface. The multi-voltage interface allows one transfer switch to be used with several different system voltages and phases. Refer to Section 8.8.

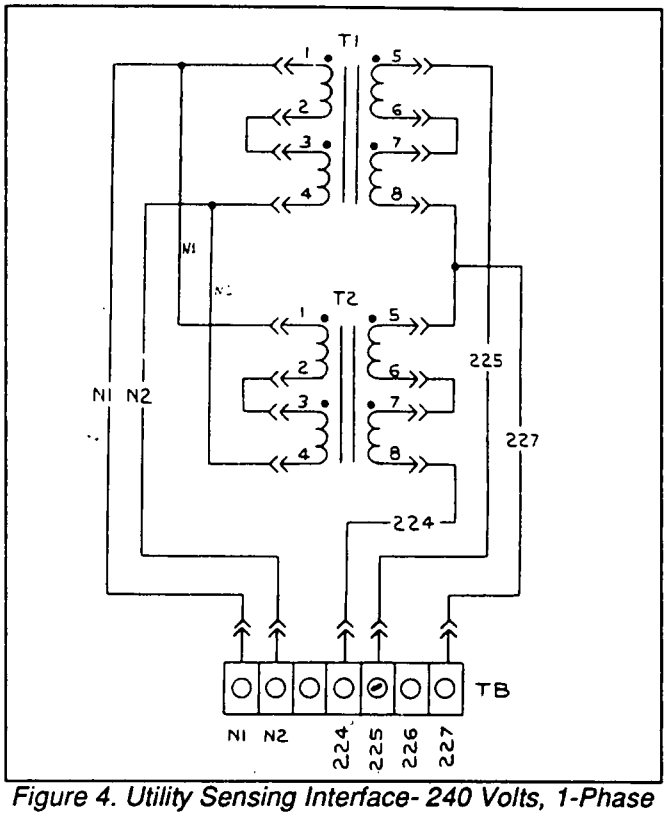


Figure 4. Utility Sensing Interface- 240 Volts, 1-Phase

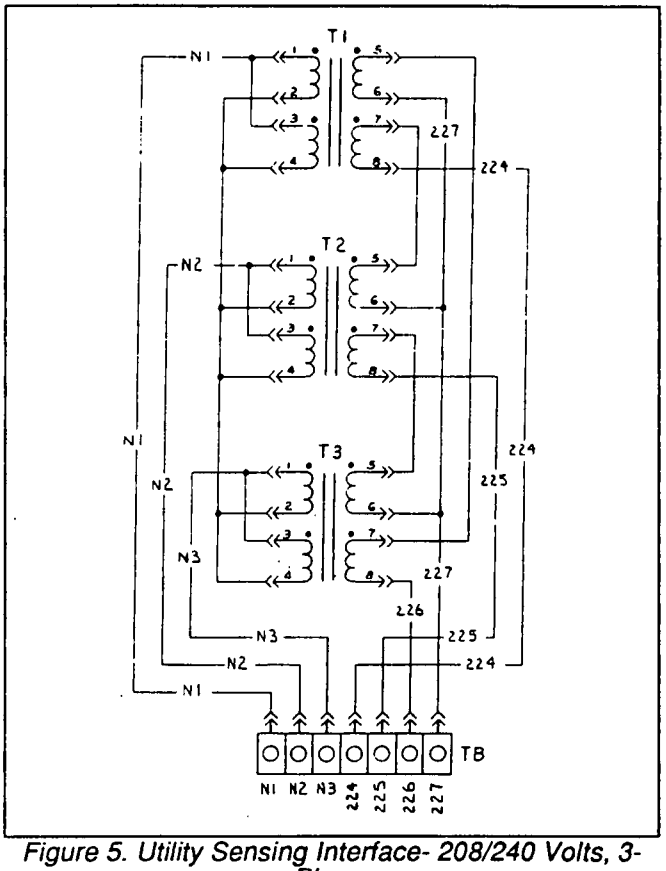


Figure 5. Utility Sensing Interface- 208/240 Volts, 3-Phase

Section 8.2
"Y-TYPE" TRANSFER MECHANISM

General

"Y-Type" automatic transfer switches are rated at not more than 250 volts AC. The mechanisms are available as 2-pole, 3-pole or 4-pole type as shown in Figures 1, 2 and 3.

- The 2-pole unit is for 1-phase applications only.
- The 3-pole units may be used with 3-phase applications or with 1-phase applications in which the "Neutral" line is to be switched during transfer.
- The 4-pole units may be used with 3-phase applications where the 3-phase "Neutral" line is to be switched during transfer.

NOTE: On 1-phase, 3-pole switches where "Neutral" is to be switched, a neutral block may not be provided. On 3-phase, 4-pole switches where "Neutral" is to be switched, a neutral block may not be provided.

Each single pole of the transfer mechanism consists of stationary main contacts and moveable main contacts. The stationary main contacts are retained in the pole assembly, with each pole assembly sandwiched together and retained by two thru-bolts. A single piece moveable contact carrier pivots on a single shaft. Contacts are retained in the moveable contact carrier by a spring.

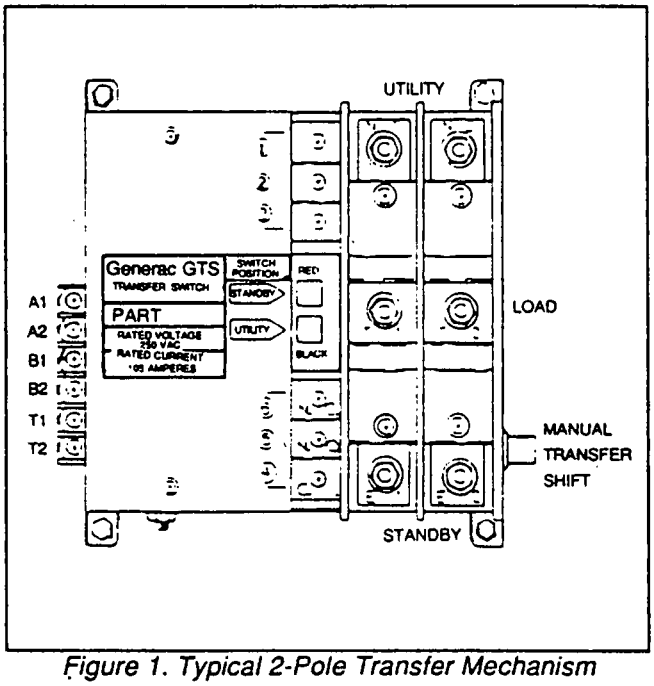


Figure 1. Typical 2-Pole Transfer Mechanism

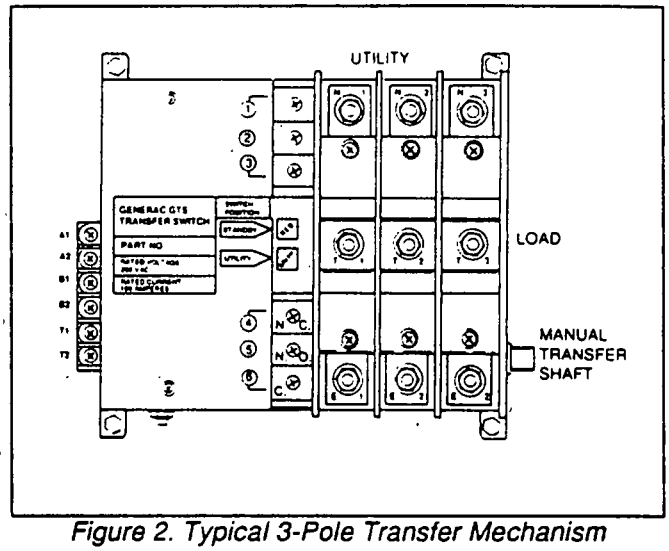


Figure 2. Typical 3-Pole Transfer Mechanism

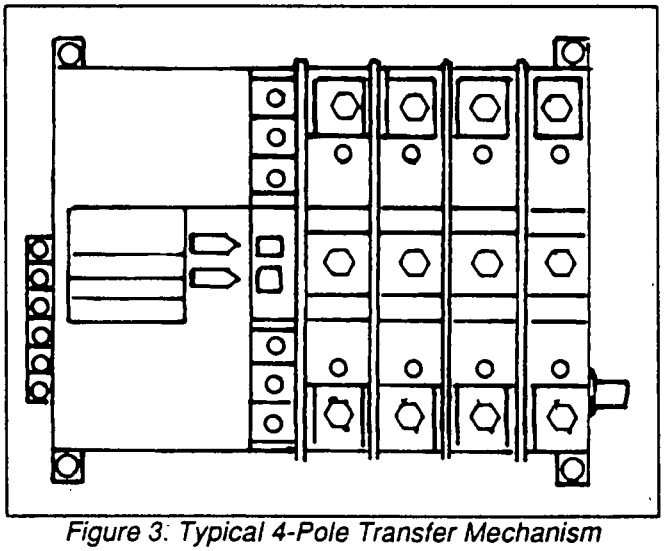


Figure 3. Typical 4-Pole Transfer Mechanism

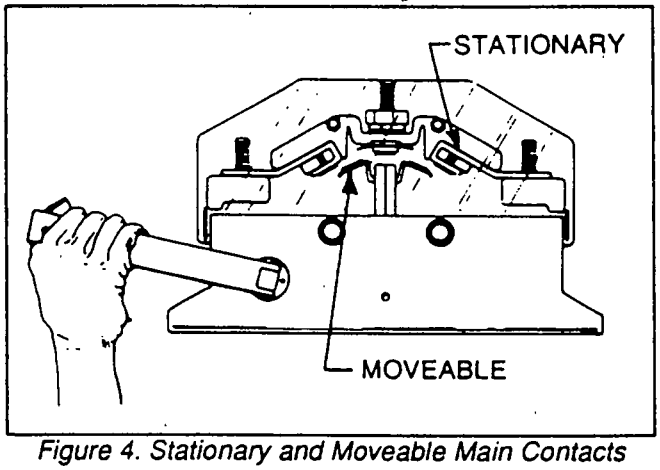


Figure 4. Stationary and Moveable Main Contacts

Main Contacts Operation

The moveable main contacts provide the interconnection between the load and power source terminals. The moveable main contacts are spring-loaded, to ensure proper alignment between the contact surfaces. Figure 5 shows the moveable main contacts at the "Utility" side, i.e., load terminals connected to the utility terminals.

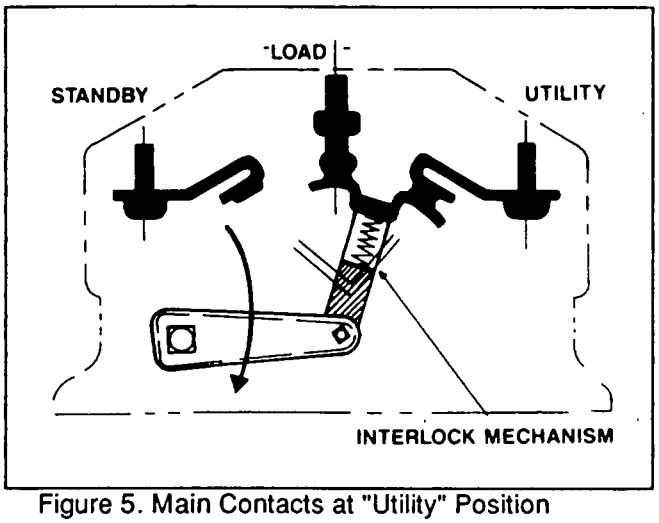


Figure 5. Main Contacts at "Utility" Position

Figure 6 shows the moveable main contacts at their "Neutral" position, with the load terminals disconnected from both power supplies. During automatic operation, the main contacts will remain at "Neutral" as long as the actuating coil remains energized.

NOTE: Some units may be equipped with a "time delay at neutral" feature. See "Time Delay Relay" on Page 8.1-3. This feature holds the main contacts actuating coil energized for a preset time interval during any transfer action. The main contacts remain at "Neutral" as long as that coil stays energized.

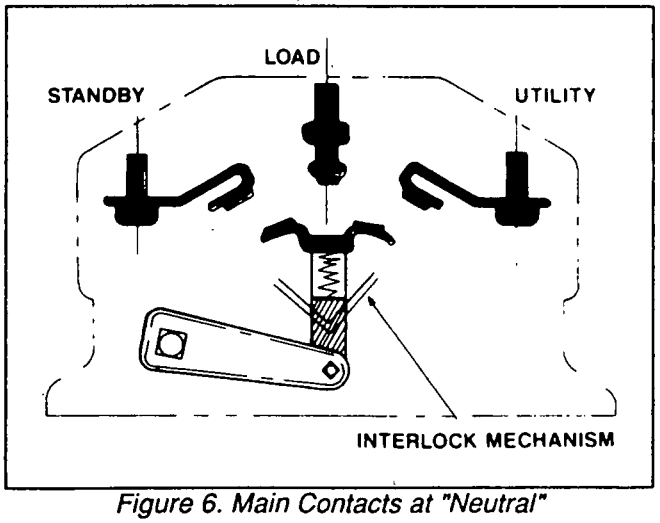


Figure 6. Main Contacts at "Neutral"

Figure 7 shows the main contacts at their "Standby" position, i.e., load terminals are connected to the standby terminals.

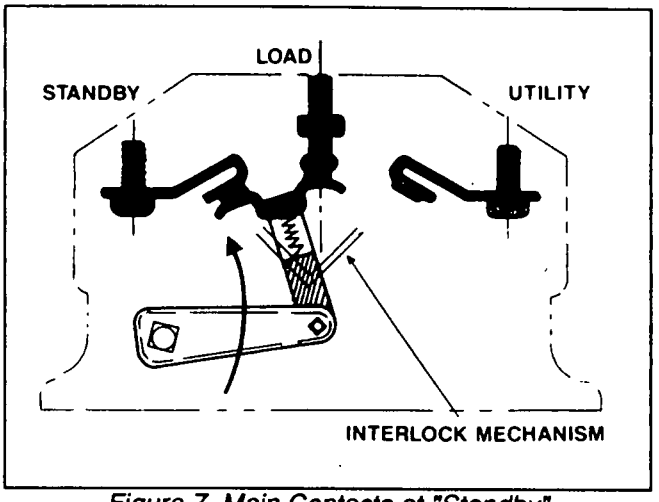


Figure 7. Main Contacts at "Standby"

Auxiliary Contacts

The transfer mechanism mounts two sets of auxiliary contacts. One set, numbered 1-2-3, is already in use for operation of switch position lamps on the enclosure door. The second set of contacts (4-5-6) are available for use by the customer. One possible use of the auxiliary contacts might be to turn remote-mounted switch position advisory lamps off and on.

The auxiliary contacts are rated 15 amps at 125, 250 or 480 volts; or 1/2 amp at 125 volts DC; or 1/4 amp at 250 volts DC. DO NOT EXCEED THE RATED AMPS OF THE CONTACTS.

Contacts consist of a common, normally-closed and normally-open contacts as listed in the following chart.

AUXILIARY CONTACTS TERMINAL	NAME	MAIN CONTACTS POSITION	
		UTILITY	STANDBY
4	Common		
5	Normally Open	Open	Closed
6	Normally Closed	Closed	Open

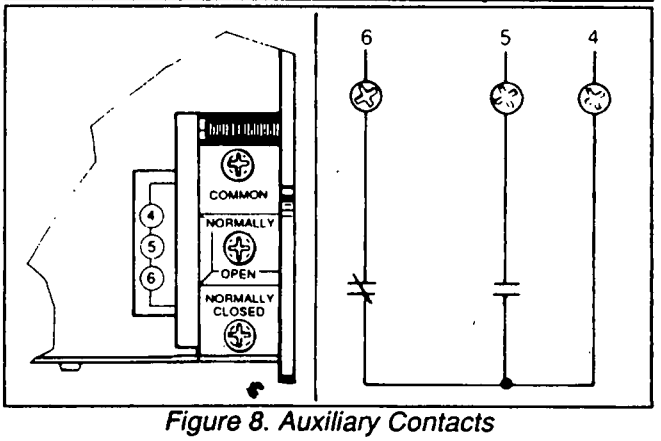


Figure 8. Auxiliary Contacts

Electrical Components

Transfer mechanism electrical components are shown in Figure 9. Included in the illustration are (a) a solenoid coil, (b) a terminal strip, (c) a bridge rectifier, (d) limit switches LS1 and LS2, and (e) limit switch LS3.

SOLENOID COIL:

Flow of electrical current through this coil creates a magnetic field which actuates a plunger. Plunger movement then actuates the main contacts to either their "Utility" or "Standby" side. The coil is energized by rectified DC power from the power source to which the load terminals are being connected. The following facts apply to actuating coil operation:

- The solenoid coil is operated by direct current from either the "Utility" or the "Standby" power source.
- Rectified "Standby" source power is used to actuate the plunger and main contacts to their "Standby" source side.
- Rectified "Utility" source power is used to actuate the plunger and main contacts to their "Utility" source side.
- With the solenoid coil energized, plunger movement will actuate the main contacts to their "Neutral" position. They will remain at "Neutral" as long as the solenoid coil remains energized.
- The coil is normally de-energized by the action of a "Neutral" limit switch (LS3), to allow the main contacts to complete the transfer action.

TERMINAL STRIP:

Terminal numbers and their functions are listed in the following chart:

TERMINALS	FUNCTION
A1, A2	Actuating command to the "Utility" power source side from the utility power supply.
B1, B2	Actuating command to the "Standby" power source side from standby power supply.
T1, T2	Time delay at neutral circuit.

BRIDGE RECTIFIER:

The solenoid coil requires direct current (DC) for its operation. The bridge rectifier changes the power source alternating current (AC) to direct current (DC).

LIMIT SWITCHES LS1/LS2:

During transfer to either power source side, a mechanical interlock actuates these limit switches. The two limit switches function to ensure that the solenoid coil can be energized only by the active power source side.

On transfer to "Standby", LS1 and LS2 will actuate to close the terminals A1/A2 circuit and open the B1/B2

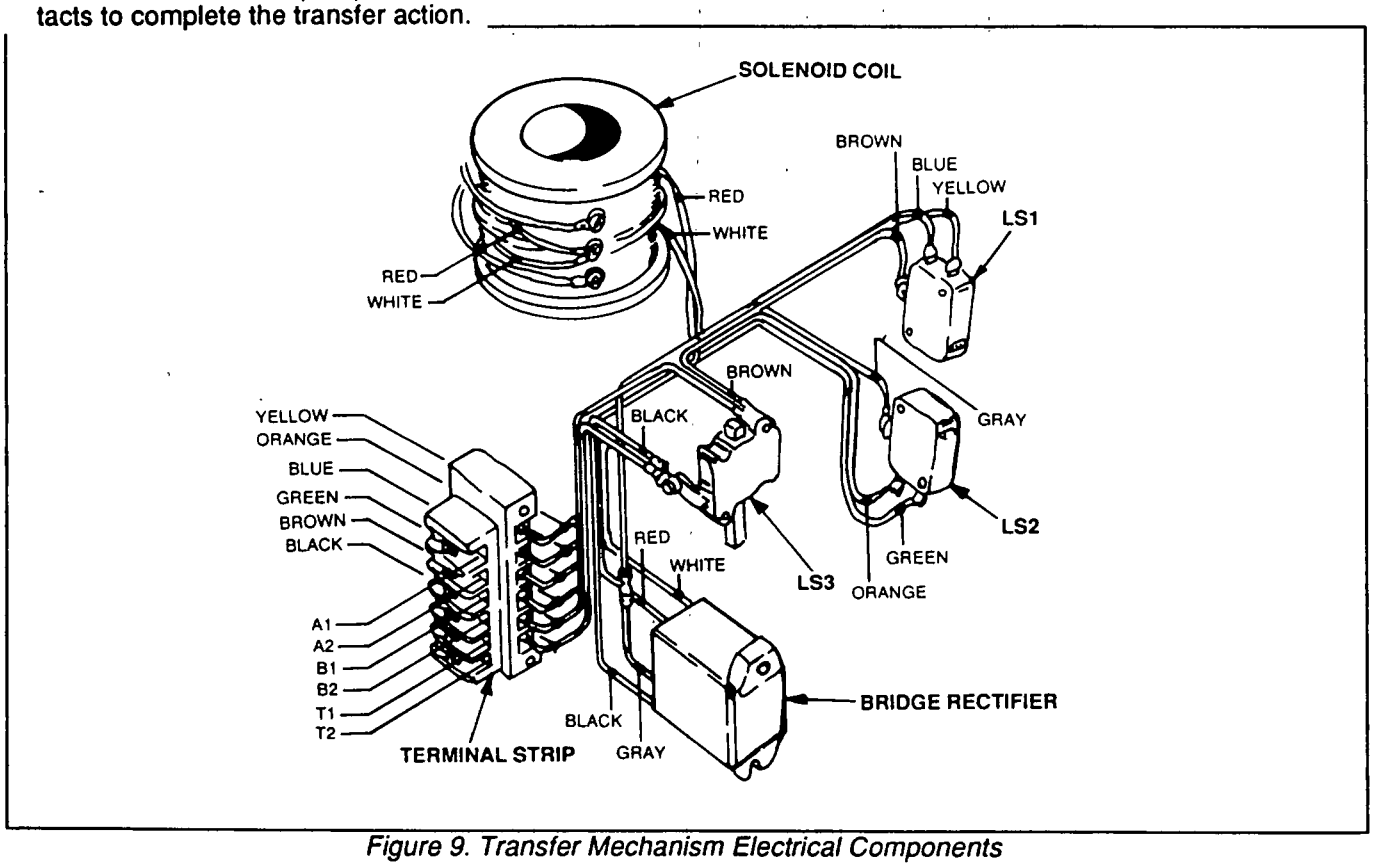


Figure 9. Transfer Mechanism Electrical Components

Electrical Components (Continued)

circuit. Thus, with the load connected to the standby source, the A1/A2 circuit is "armed" and ready for retransfer back to "Utility".

On re-transfer back to "Utility", limit switch action will open the terminals A1/A2 circuit and close the B1/B2 circuit. With circuit B1/B2 closed, the transfer mechanism is ready for transfer to the "Standby" source.

NEUTRAL LIMIT SWITCH LS3:

This switch is opened by a mechanical interlock when the main contacts reach their "Neutral" position. Opening of LS3 opens the circuit to the solenoid coil. The coil will then de-energize and the transfer action will be completed.

NOTE: The main contacts will remain at "Neutral" as long as the solenoid coil is energized. Opening of LS3 de-energizes the solenoid coil and spring force, acting on an "over-center" mechanism, will complete the transfer action.

NOTE: On units equipped with the optional "time delay at neutral" feature, LS3 is bypassed during a transfer action by the T1/T2 circuit. The T1/T2 circuit will hold the solenoid coil energized for a pre-set time interval. The main contacts will then remain at "Neutral" for that pre-set time.

Section 8.3
TRANSFER MECHANISM DISASSEMBLY

Transfer Mechanism Removal

To remove the transfer mechanism from the transfer switch enclosure, proceed as follows:

1. On the generator control console, set the auto-manual-off switch to "Off". Then, place a "DO NOT OPERATE" tag on or near the console.
2. As a safety measure, to prevent generator startup, disconnect the cables from the generator battery.
3. Turn OFF all power voltage supplies to the transfer switch using whatever means provided (such as the "Utility" and "Standby" main line circuit breakers).

DANGER: DO NOT PROCEED UNTIL ALL POWER VOLTAGE SUPPLIES TO THE TRANSFER SWITCH HAVE BEEN POSITIVELY TURNED OFF. FAILURE TO TURN OFF POWER VOLTAGE SUPPLIES WILL RESULT IN HAZARDOUS AND POSSIBLY LETHAL ELECTRICAL SHOCK. BOTH THE "UTILITY" AND "STANDBY" POWER SUPPLIES TO THE TRANSFER SWITCH MUST BE DISCONNECTED OR TURNED OFF.

4. Disconnect all wires from transfer mechanism terminal lugs N1, N2, N3. Also disconnect wires T1, T2, T3 and E1, E2, E3 from their terminal lugs on the transfer mechanism.
5. Disconnect wiring from transfer mechanism terminal strip (A1, A2, B1, B2, T1, T2).
6. Remove the capscrews, lockwashers and flatwashers that retain the transfer mechanism in the transfer switch enclosure.
7. Remove the transfer mechanism.

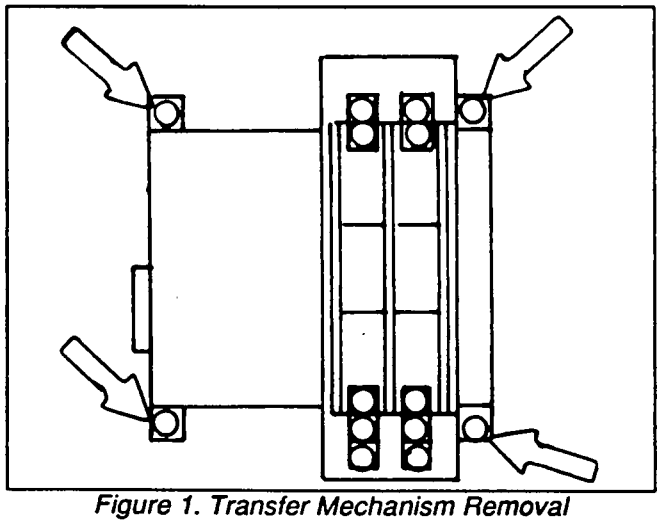


Figure 1. Transfer Mechanism Removal

Electrical Section Disassembly

1. See Figure 2. Remove two (2) screws that retain the outer cover to the transfer mechanism.

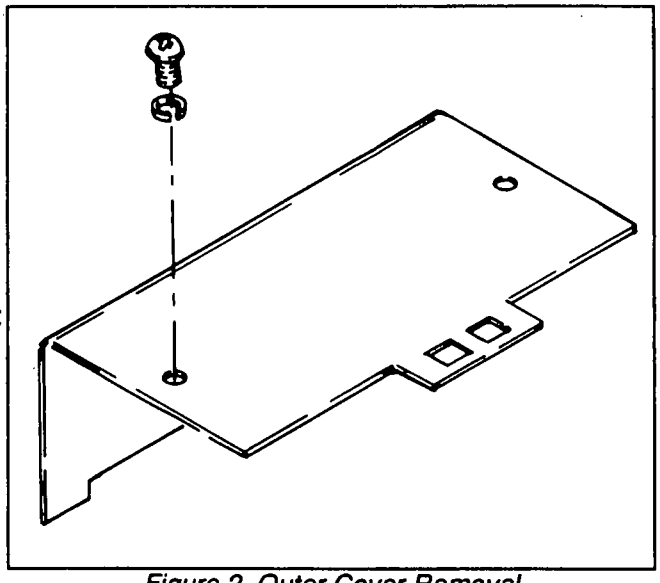


Figure 2. Outer Cover Removal

2. See Figure 3. Remove four (4) screws that retain the inner cover.

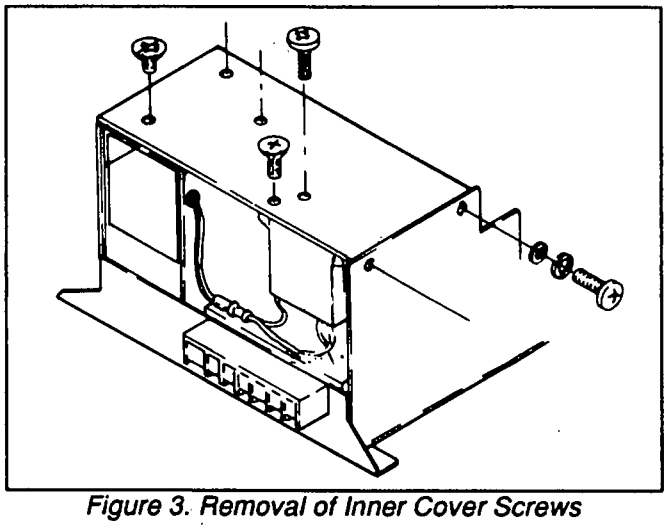


Figure 3. Removal of Inner Cover Screws

3. Limit switch LS3 is retained to the inner cover by two long screws with countersunk head (see Figure 4) and a retaining bar with threaded holes. Lift up on the cover slightly and remove the two long screws.
4. Remove the inner cover and the limit switch retaining bar. Also remove limit switch actuating lever bracket, limit switch actuating lever, and an actuating lever spring.

NOTE: Keep all limit switch parts together in a safe place, such as a container. These parts are small and are easily lost.

Electrical Section Disassembly (Continued)

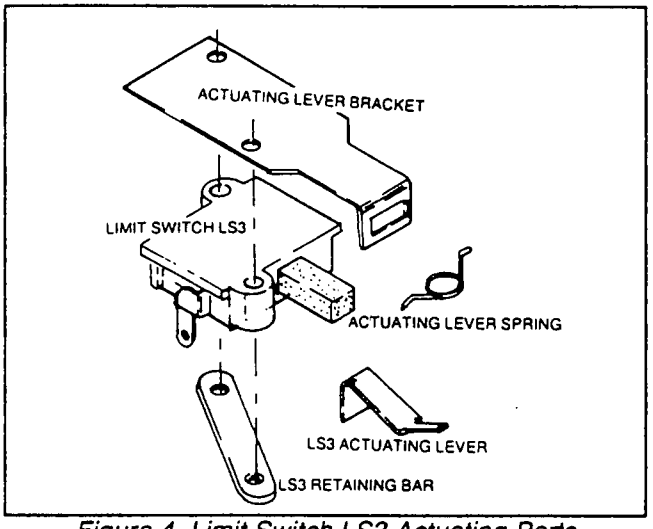


Figure 4. Limit Switch LS3 Actuating Parts

LIMIT SWITCH LS3 REMOVAL:

1. The limit switch retaining screws and bar were previously removed during removal of the inner cover.
2. Disconnect all wires from limit switch LS3 and completely remove the switch from the transfer mechanism.

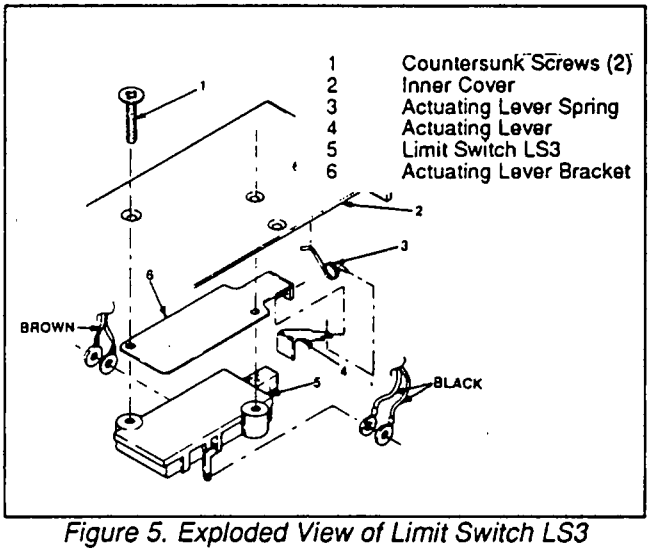


Figure 5. Exploded View of Limit Switch LS3

TERMINAL STRIP REMOVAL:

1. See Figure 6. Remove two (2) screws that retain the terminal strip to the transfer mechanism.
2. Loosen- do not remove- the wire retaining screws at back of terminal strip. Remove all wires and remove the terminal strip.

SOLENOID COIL REMOVAL:

1. See Figure 7. Remove four capscrews that retain the coil backing plate.
2. Remove the capscrew that retains the solenoid coil to the backing plate.
3. Rotate the coil slightly to allow access to the coil terminal screws. Remove the terminal screws and disconnect the coil's red and white wires.
4. Remove the solenoid coil along with the coil cylinder.

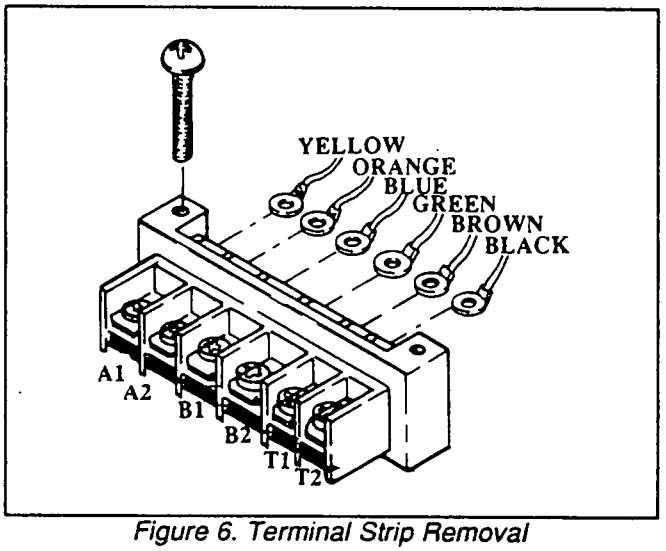


Figure 6. Terminal Strip Removal

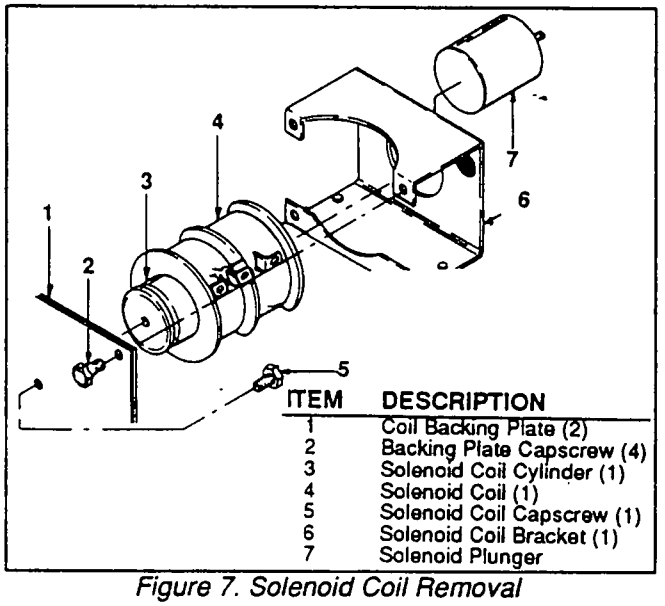


Figure 7. Solenoid Coil Removal

BRIDGE RECTIFIER REMOVAL:

Guide the bridge rectifier wires out through the protective rubber grommet. Remove the bridge rectifier. See Figure 8.

SOLENOID COIL BRACKET REMOVAL:

Remove two screws that retain the bracket to the base. Then, remove the coil bracket. See Figure 9.

Electrical Section Disassembly (Continued)

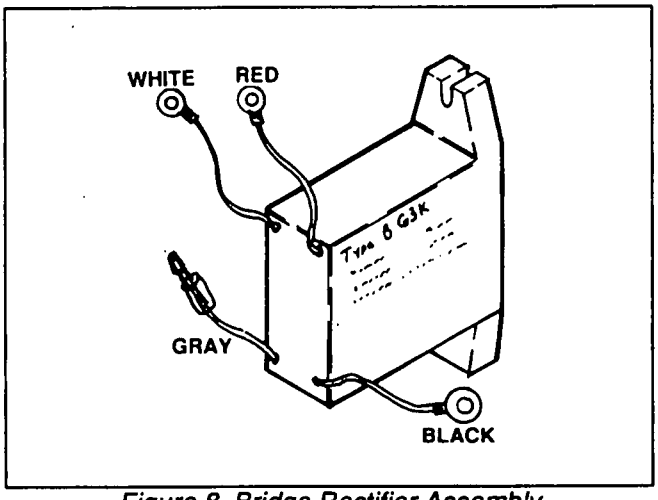


Figure 8. Bridge Rectifier Assembly

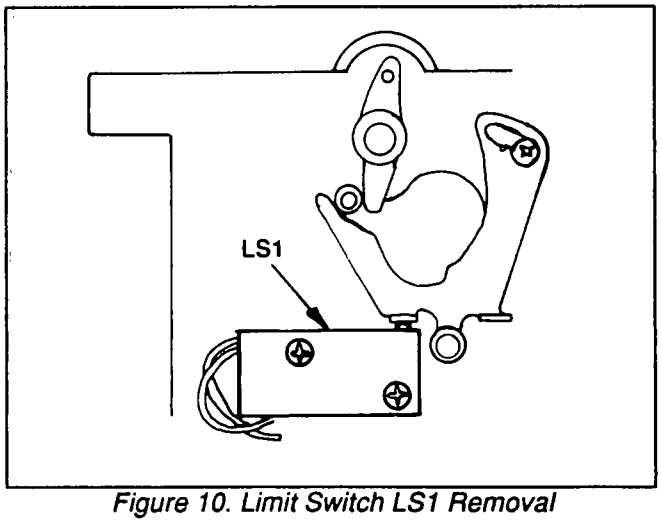


Figure 10. Limit Switch LS1 Removal

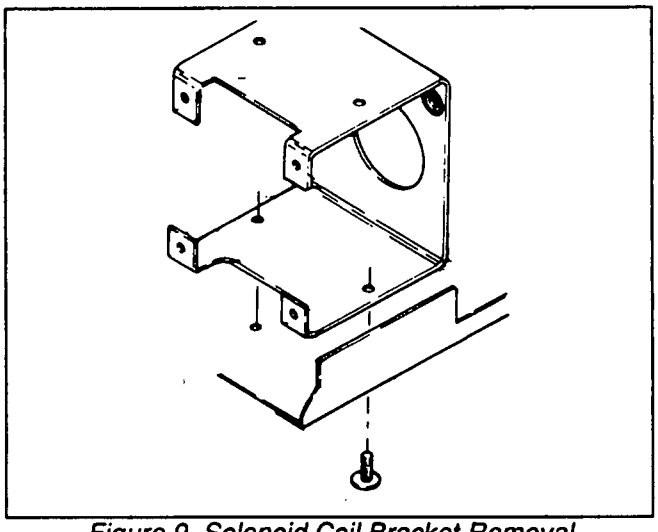


Figure 9. Solenoid Coil Bracket Removal

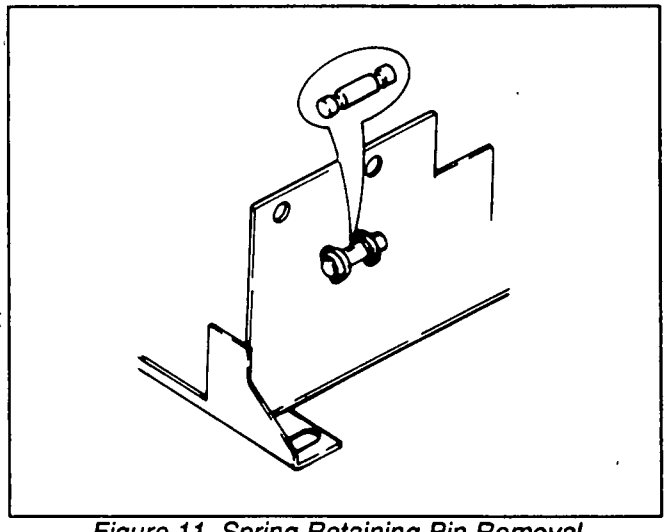


Figure 11. Spring Retaining Pin Removal

LIMIT SWITCH LS1 REMOVAL:

See Figure 10. With the solenoid coil removed, limit switch LS1 is accessible. Remove two (2) screws, then remove LS1 along with two insulator strips. Wires on switch LS1 are soldered connections.

LIMIT SWITCH LS2 REMOVAL:

1. See Figure 11. Remove the spring retaining pin.
2. See Figure 12. Remove two (2) screws that retain the actuating link assembly to the transfer mechanism base.
3. You should be able to lift the actuating link assembly high enough to remove two (2) screws that retain limit switch LS2 to its support. Remove the two screws.
4. Remove limit switch LS2 along with two insulator strips. Switch wires have soldered connections.

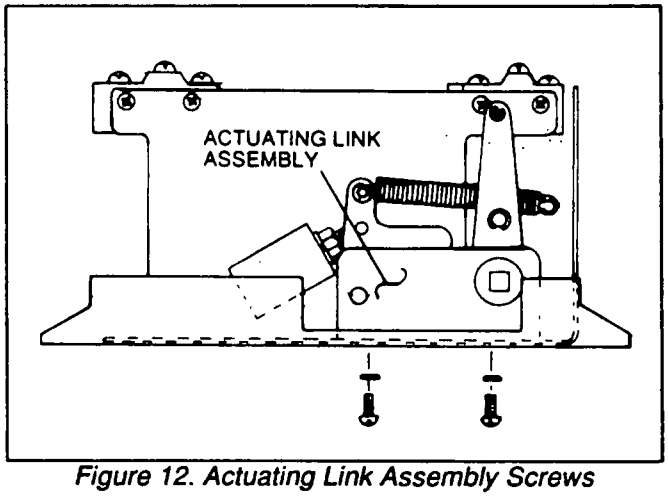


Figure 12. Actuating Link Assembly Screws

Electrical Section Disassembly (Continued)

AUXILIARY CONTACTS REMOVAL:

Refer to Figure 13. Remove two screws that retain one set of auxiliary contacts and remove the contacts. The second set of auxiliary contacts can be removed in the same manner.

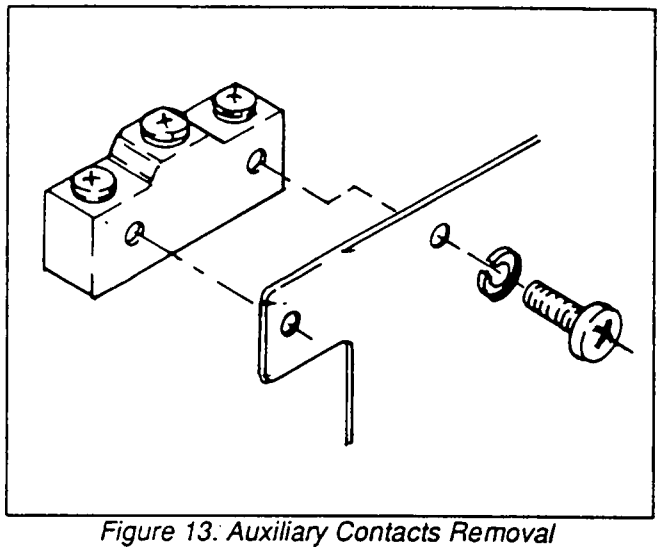


Figure 13. Auxiliary Contacts Removal

Stationary Main Contacts Removal

Remove the two long thru-bolts that retain the stationary main contacts assembly. Carefully remove the stationary main contacts.

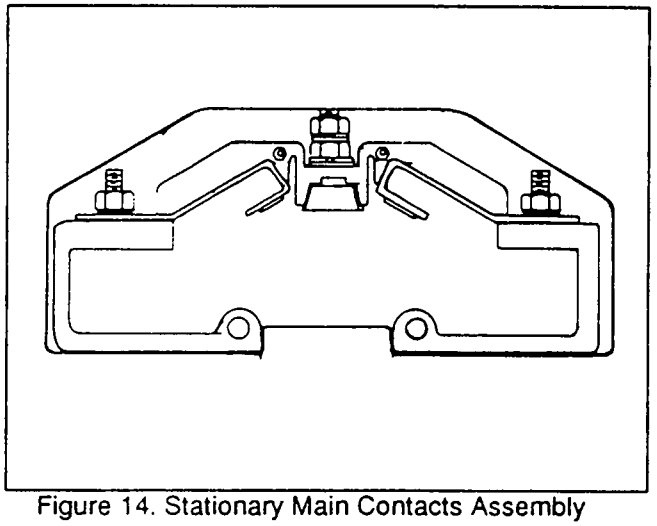


Figure 14. Stationary Main Contacts Assembly

Moveable Main Contacts

The moveable main contacts are now exposed and may be inspected, removed or replaced as necessary. The main contacts assembly consists of (a) a moveable contact carrier, (b) contact spring, and (c) contact.

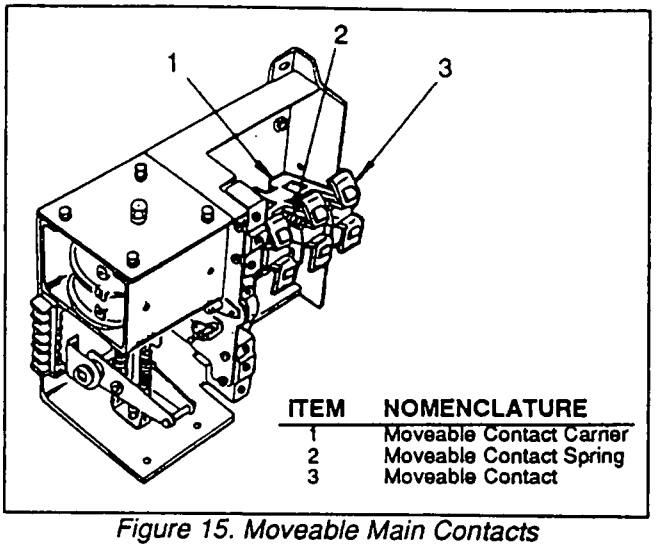


Figure 15. Moveable Main Contacts

Testing and Inspection

Inspect the stationary and moveable main contacts closely. Inspect springs, linkage, retaining pins, etc., for damage, wear. Replace any damaged or defective parts.

Switches may be tested using a volt-ohm-milliammeter (VOM). Replace any defective switch.

NOTE: Test procedures for most switches, the bridge rectifier and the solenoid coil are discussed in Section 8.10, "Diagnostic Tests".

Reassembly

Reassemble the transfer mechanism in the reverse order of disassembly.

Following reassembly, the transfer mechanism should be tested thoroughly before it is placed into service. Before applying electrical power, actuate the main contacts manually several times (using the manual transfer handle). When you are certain that manual operation is correct, electrical power may be applied. Test electrical operation of the transfer switch.

Section 8.4
TRANSFER SWITCH INSTALLATION

Introduction

Generac "GTS" transfer switches have been factory wired and tested. Installation at the standby electric system site consists of the following:

- Mounting the transfer switch.
- Connection of power source and load lines.
- Connection of the 2-wire start circuit.
- Installation of any options and accessories.
- Functional tests and adjustments.

Mounting the Transfer Switch

For enclosure mounting dimensions, refer to the appropriate Owner's Manual. Typically, the transfer switch enclosures are wall mounted. However, some units with higher amperage ratings may be self-supporting, floor-mounted units.

The enclosure should be mounted vertically to a strong, rigid supporting structure. All mounting points should be level. If necessary, install flatwashers behind the mounting holes to prevent distortion.

CAUTION: Handle the transfer switch assembly carefully. Protect the unit against impact. Also protect the unit against construction grit, metal chips, lint, dust, dirt, etc. Never install a transfer switch that has been damaged.

CAUTION: The transfer switch will respond only to its correct rated voltage and phase. Transfer switch rated voltage and phase must be compatible with the voltage and phase of the "Utility" and "Standby" power supplies. Also see Section 8.8. "Multi-Voltage Transfer Switches".

Power Source and Load Line Connections

DANGER: TURN OFF ALL POWER VOLTAGE SUPPLIES BEFORE ATTEMPTING TO CONNECT POWER SOURCE AND LOAD LINES TO THE TRANSFER SWITCH TERMINAL LUGS. EXTREMELY HIGH AND DANGEROUS VOLTAGES ARE PRESENT IN POWER SOURCE LINES. FAILURE TO TURN OFF OR DISCONNECT POWER VOLTAGE SUPPLIES MAY RESULT IN HAZARDOUS AND POSSIBLY FATAL ELECTRICAL SHOCK.

Power source and load line connections are made at solderless, screw-type terminal lugs on the transfer mechanism. See Section 8.2. "Y-Type Transfer Mechanism". In most cases, the switch enclosure will include a neutral block for attachment of power source and load neutral lines.

All power cables should enter the switch enclosure adjacent to the appropriate terminal lugs. Conductors must be (a) properly supported, (b) protected by approved conduit, (c) of approved insulative qualities, and (d) of the correct wire gauge size to handle the maximum current load that will be applied. All applicable electrical codes and regulations must be strictly complied with. Maintain proper electrical clearance between live metal parts and grounded metal, as follows:

- Allow at least one-half inch of clearance for 100-400 amp circuits.
- Allow at least one inch of clearance for circuits over 400 amps.

Remove surface oxides from stripped ends of power source and load conductors with a wire brush. If aluminum conductors are used, apply joint compound to the conductor's stripped end. Insert stripped end of conductor into the correct terminal lug, then tighten the terminal to its specified torque. Finally, wipe away excess joint compound.

Recommended torques of terminal lugs are as follows:

Units rated 100 amps = 50 inch-pounds (6 N-m)
All Other Units = 250 inch-pounds (26 N-m)

Connecting 2-Wire Start Circuit Leads

Connect suitable, approved wiring to terminals 178 and 183 in the transfer switch enclosure. These wires must be routed to and interconnected with identically numbered terminals in the generator's AC connection (lower) panel.

The 2-wire start wiring must be routed through conduit that is separate from circuits of any other source. Closure of the Wires 178/183 circuit must result in engine cranking and startup.

NOTE: A "3-wire" start system is also available as an option. If a generator having a 3-wire start system is to be installed, use a transfer switch equipped with a 3-wire start system.

NOTE: Some very early production standby generators were equipped with a "9-wire" start system. The optional "3-wire" transfer switch system can be used with the "9-wire" generator system by installing a Model 8815 "Start Control Interface".

Connection of 2-Wire Start Leads (Continued)

Recommended wire gauge sizes for the 2-wire start circuit are given in the following chart:

WIRE LENGTH	WIRE GAUGE SIZE
Up to 460 feet (140m)	No. 18 AWG
461-730 feet (223m)	No. 16 AWG
731-1160 feet (354m)	No. 14 AWG
1161-1850 feet (565m)	No. 12 AWG

Auxiliary Contacts

The transfer mechanism includes a set of auxiliary contacts. See Figure 1. Contacts identified as 1, 2 and 3 have been factory connected to switch position advisory lamps on the transfer switch enclosure door. Contacts 4, 5 and 6 are available for customer use, if desired. Refer to "Auxiliary Contacts" on Page 8.2-2.

Post Installation Tests and Adjustments

Following installation, the transfer switch and other parrts of the standby electric system must be tested and adjusted. See Section 8.6, "Functional Tests". Never place a standby system into operation until all operational tests and adjustments have been properly completed.

Section 8.5
OPERATING INSTRUCTIONS

Normal Automatic Operation

To select normal automatic operation, proceed as follows:
1. On the transfer switch enclosure door, check that the "Switch Position-Utility" lamp is ON.

NOTE: The "Switch Position-Utility" lamp MUST be lighted before proceeding. The lamp indicates that (a) utility power source voltage is available to the transfer switch, and (b) the transfer mechanism main contacts are at their "Utility" position (loads are connected to the utility power supply). If necessary, manually actuate the main contacts to their "Utility" side and turn on the utility power supply to the transfer switch.

2. Inside the transfer switch enclosure, set the maintenance disconnect switch to "Automatic" position.
3. If so equipped, set the generator's auto-manual-off switch to "Auto".
4. On the transfer switch enclosure door, set the system test switch to its "Automatic Mode" position.

The system is now set for fully automatic operation. Should utility source voltage drop below a preset level, the generator engine will crank and start. Following generator startup, an "engine warmup timer" on the logic (or CPU) circuit board will start timing. When that timer has timed out and when generator AC output voltage and frequency have reached preset levels, transfer of loads to the "Standby" source will occur. On restoration of utility source voltage above a preset level, retransfer back to "Utility" and generator shutdown will occur.

NOTE: Timers and sensors which control automatic operation are located on circuit boards in the transfer switch enclosure door. Two different types of circuit board systems are currently in use. The "CPU" type system utilizes two circuit boards. The "logic" system has three circuit boards. For more detailed information on automatic operating parameters, sequences and times, see Part 10, "The CPU Type Intelligence System" and Part 11, "The Logic Type Intelligence System".

Manual Transfer to "Standby"

To manually transfer loads to the "Standby" source and to start the generator manually, proceed as follows:
1. Inside the transfer switch enclosure, set the maintenance disconnect switch to "Manual".
2. If so equipped, set the generator's auto-manual-off switch to "Manual".
3. Turn OFF all power voltage supplies to the transfer switch.

DANGER: DO NOT ATTEMPT MANUAL TRANSFER SWITCH OPERATION UNTIL ALL POWER VOLTAGE SUPPLIES HAVE BEEN POSITIVELY TURNED OFF. FAILURE TO TURN POWER OFF MAY RESULT IN DANGEROUS OR DEADLY ELECTRICAL SHOCK.

4. Remove the manual transfer handle from its storage place in the transfer switch enclosure.
5. Place open end of manual transfer handle over the square shaft on the transfer mechanism. See Figure 1. Then, actuate the handle as follows:
   a. Move the handle upward. Movement will stop when the main contacts reach their "Neutral" position (load disconnected from both power supplies).
   b. When handle movement stops at "Neutral", return the handle to its original position and actuate again.
6. Observe the changeover display on the transfer mechanism.
   a. If "Utility" arrow is aligned with the green band, load is connected to the "Utility" power supply.
   b. If the "Standby" arrow is aligned with the green band, load is connected to the "Standby" power supply.
7. If necessary, repeat Steps 5 and 6 until the "Standby" arrow points to the green band, i.e., loads are connected to the "Standby" source.
8. Remove the manual transfer handle from the square shaft and store the handle in the place provided.
9. Crank and start the generator manually, using the start/stop switch on the generator console. Refer to appropriate Owner's Manual.
10. Let the engine stabilize and warm up. Then, turn ON the "Standby" power supply to the transfer switch using whatever means provided.
    a. The "Standby Operating" lamp on switch enclosure door should illuminate.
    b. The "Switch Position-Emergency" lamp on switch enclosure door should turn on.

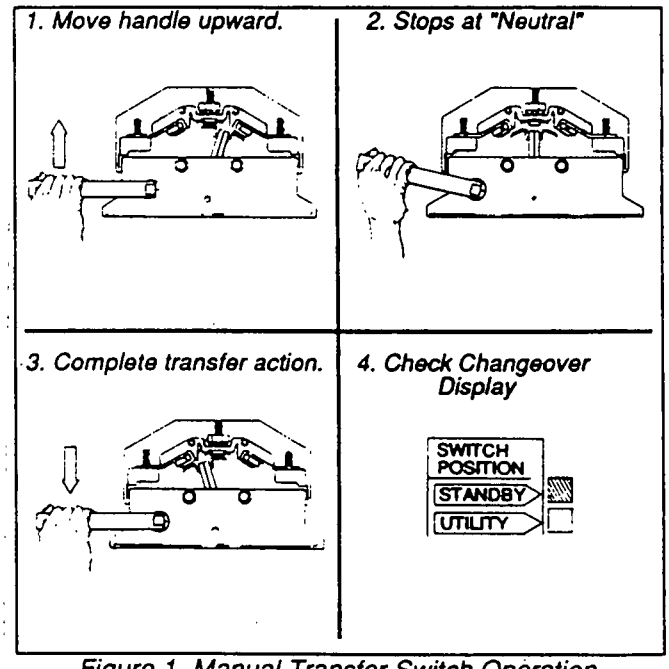


Figure 1. Manual Transfer Switch Operation

Manual Retransfer Back to "Utility"

To retransfer loads back to the "Utility" power source and shut the generator down, proceed as follows:

1. Turn OFF all power voltage supplies to the transfer switch, using whatever means provided (such as the utility and standby main line circuit breakers).

DANGER: DO NOT PROCEED UNTIL ALL POWER VOLTAGE SUPPLIES TO THE TRANSFER SWITCH ARE POSITIVELY TURNED OFF. FAILURE TO TURN OFF POWER VOLTAGE SUPPLIES MAY RESULT IN EXTREMELY HAZARDOUS AND POSSIBLY FATAL ELECTRICAL SHOCK.

2. Remove the manual transfer handle from its place of storage.
3. Place open end of manual handle over the square shaft on transfer mechanism. Actuate the handle as follows:
   a. Move the handle upward. Movement will stop when the main contacts reach their "Neutral" position.
   b. When movement stops at "Neutral", return the handle to its original position and actuate again.
4. Observe the "Changeover Display" on the transfer mechanism.
   a. If the "Utility" arrow is aligned with the green band, load is connected to the "Utility" power supply.
   b. If the "Standby" arrow is aligned with the green band, load is connected to the "Standby" power supply.
   c. If necessary, repeat Steps 3 and 4 until the "Utility" arrow is aligned with the green band (load connected to "Utility" source).
5. Turn ON the "Utility" power supply to the transfer switch using whatever means provided.
   a. Check that the "Switch Position-Utility" lamp is lighted, indicating that utility power is available and the main contacts are at their "Utility" position.
   b. The "Standby Operating" lamp will still be on since the generator is running.
6. In the transfer switch enclosure, set the maintenance disconnect switch to its "Automatic" position.
7. If so equipped, set the generator's auto-manual-off switch to "Auto".
8. Shut the generator engine down.

Section 8.6
FUNCTIONAL TESTS

Introduction

Following installation of a standby electric power system and before placing the system into service, the entire system should be thoroughly inspected and tested. All applicable codes, standards and regulations must be strictly complied with.

When the installer is absoultely certain that the installation is correct and complete, a "functional test" of the system should be performed. Perform these functional tests in the exact order they are presented here or damage to the transfer switch might result.

Manual Transfer Switch Operation

Use the manual transfer handle to actuate the main contacts to "Standby" and to "Utility" several times. When certain that the switch is operating normally, return the main contacts to their "Utility" position (load connected to the "Utility" source). See Section 8.5, "Operating Instructions".

Remove the manual handle from the square shaft and store in the place provided.

IMPORTANT; THE LOAD MUST BE CONNECTED TO THE "UTILITY" SOURCE BEFORE PROCEEDING.

Voltage Checks

Check the transfer switch DATA PLATE for rated voltage and phase. The DATA PLATE voltage and phase must be fully compatible with the rated voltage and phase of both power sources.

NOTE: Also see Section 8.8, "Multi-Voltage Transfer Switches".

DANGER: DURING THE FOLLOWING VOLTAGE CHECKS, THE TRANSFER SWITCH WILL BE ELECTRICALLY HOT. PROCEED WITH CAUTION. AVOID CONTACT WITH LIVE WIRES, TERMINALS, ETC.

Perform voltage checks as follows:

1. In the transfer switch enclosure, check that the maintenance disconnect switch is set to "Manual".
2. Check that the load is connected to the "Utility" power supply.
   a. Observe "Changeover Display" on transfer mechanism. The "Utility" arrow should point to the green band.
   b. The "Switch Position-Utility" lamp on enclosure door should be ON. Light on indicates that (a) utility power is available and (b) load is connected to "Utility" source.
3. On the utility voltage sensor circuit board, check that the "Utility On" lamp is lighted. LAMP MUST BE ON BEFORE PROCEEDING.
4. Use an AC voltmeter to check line-to-line (phase-to-phase) and line-to-neutral (phase-to-neutral) voltages across transfer mechanism terminal lugs N1, N2, N3 and the "Neutral" block. Supplied voltages must be compatible with transfer switch rated voltage.

NOTE: If the transfer switch is a "multi-voltage" type, installer selection of a compatible voltage and phase is possible. Refer to Section 8.8, "Multi-Voltage Transfer Switches".

NOTE: The "sensing" voltage that is delivered to the utility voltage sensor circuit board will vary as the utility source voltage varies. It may be necessary to calibrate the utility voltage sensor board to match the "Utility" voltage. See Part 10 or Part 11 as appropriate.

5. Refer to the appropriate generator Owner's Manual. Make sure the generator engine has been properly serviced and is ready for use.
6. When certain that it is ready for use, start the engine manually. Let the engine stabilize and warm up for a few minutes.
7. Use an AC voltmeter to test line-to-line (phase-to-phase) and line-to-neutral (phase-to-neutral) voltage across transfer mechanism terminal lugs E1, E2, E3 and the neutral block. Supplied voltages must be compatible with transfer switch rated voltage.
8. Shut the generator engine down.

Normal Test

Perform a "Normal Test" of the standby system as follows:

1. On the transfer switch enclosure door, check that the "Switch Position-Utility" lamp is lighted.
2. In the transfer switch enclosure, set the maintenance disconnect switch to "Automatic".
3. If so equipped, set the generator's auto-manual-off switch to "Auto".
4. On the transfer switch enclosure door, set the system test switch to "Normal Test Mode". The generator should crank and start and transfer to "Standby" should occur, just as though an actual utility source outage has occured.
5. When test is complete, return the switch to "Automatic Mode". Retransfer back to the "Utility" source followed by generator shutdown should occur.

NOTE: The sequence of events that occur during "Normal Test" are exactly the same as the sequences during an actual utility power failure. Sequences and times are controlled by timers and sensors on transfer switch circuit boards. See Parts 10 or 11 of this manual, as appropriate.

Fast Test

Hold the system test switch at "Fast Test Mode". Generator startup and transfer to "Utility" should occur very quickly, with all timers reduced to less than five (5) seconds. Switch is spring loaded, must be held at "Fast Test Mode".

Circuit Board Sensor and Timer Adjustments

The installer or customer may wish to change the timer and sensor settings on the transfer switch circuit boards. This can be done quickly and easily. Lamps (LED's) are provided on the circuit boards which will turn on during the operation of each sensor and/or timer.

For transfer switches with "CPU" type intelligence systems, see Part 10, "The CPU Type Intelligence System".

For units equipped with a "Logic" type intelligence system, refer to Part 11, "The Logic Type Intelligence System".

Section 8.7
OPERATIONAL ANALYSIS

Introduction

This section will familiarize the reader with the electrical operation of a typical "Y-Type" transfer switch having a "Logic" type intelligence system. The "Logic" system uses three circuit boards (utility voltage sensor, 7-day exercise, and logic boards).

"CPU" type intelligence systems feature only two circuit boards (utility voltage sensor and CPU board). Except for the number and functions of the circuit boards, operation of the two systems is nearly identical. On the CPU type system, the CPU circuit board handles the functions of both the logic board and the 7-day exerciser board.

Transfer Mechanism Operation

Figure 1 is a schematic representation of A 3-pole "Y-Type" transfer mechanism, shown with the LOAD connected to the STANDBY power supply. Operation of the transfer mechanism may be briefly described as follows:

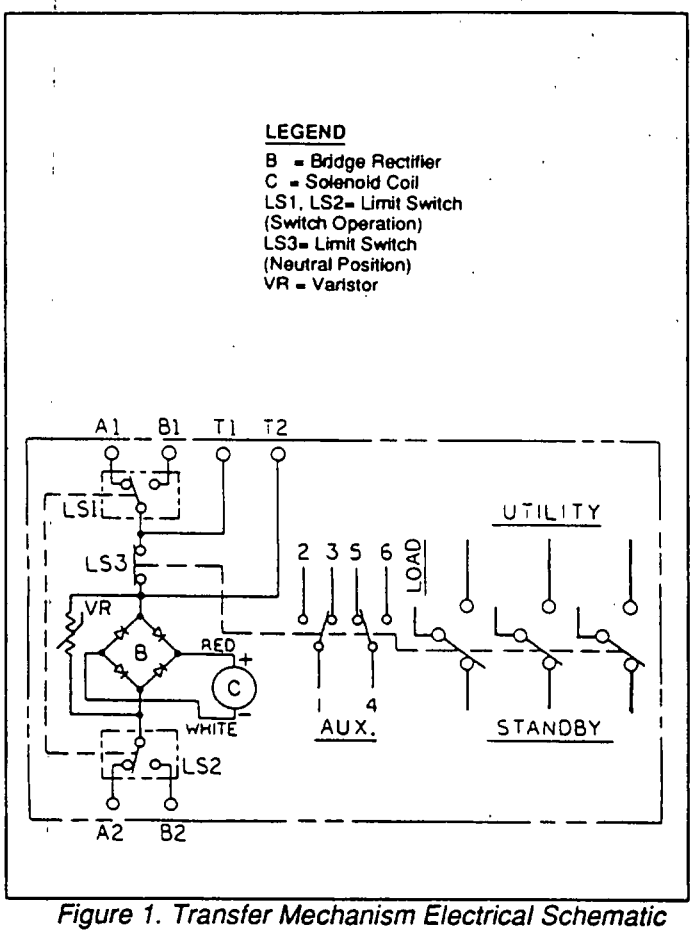


Figure 1. Transfer Mechanism Electrical Schematic

LOAD POWERED BY STANDBY SOURCE:

1. Generator AC output is delivered to transfer mechanism terminal lugs E1/E2/E3, across the main contacts, to load terminals T1/T2/T3, and to the load circuits.
2. Limit switches LS1 and LS2 are closed to the terminals A1/A2 side (utility power source side).
3. Limit switch LS3 is closed.
4. A transfer relay has been energized by logic (or CPU) board action and standby source AC voltage is available to terminals B1/B2. However, that circuit is held open by LS1/LS2 action and the solenoid coil (C) is de-energized.
5. Auxiliary contacts terminal 1 is connected to terminal 3; terminal 4 to terminal 5.

RETRANSFER BACK TO UTILITY:

1. When utility power is restored, the action of a logic (or CPU) circuit board de-energizes a transfer relay. That relay's normally-closed contacts then deliver utility source voltage to terminals A1/A2.
2. The utility source voltage is delivered to solenoid coil (C), via terminals A1/A2, limit switches LS1/LS2/LS3, and a bridge rectifier (B).
3. Solenoid coil (C) energizes to actuate the main contacts to their "Neutral" position (load isconnected from both power sources). Main contacts will remain at "Neutral" as long as solenoid coil (C) remains energized.
4. When the main contacts reach "Neutral", interlock action opens limit switch LS3 and solenoid coil (C) de-energizes. Spring force then completes the movement to the "Utility" source side (load connected to the "Utility" power supply).
5. Limit switches LS1/LS2 actuate to the terminals B1/B2 side. The auxiliary contacts are repositioned.

TRANSFER TO STANDBY:

1. When utility source voltage drops below a preset level and remains at such low level for a preset time, utility voltage sensor circuit board action will close the 2-wire start circuit (178/183). Generator will crank and start.
2. Logic (or CPU) board action will energize a transfer relay. Standby source power will then be delivered to terminals B1/B2 and to the solenoid coil (C) via LS1/LS2/LS3 and a bridge rectifier (B). The solenoid coil (C) energizes and actuates the main contacts to "Neutral".
3. When main contacts reach "Neutral", LS3 opens. Solenoid coil (C) de-energizes and main contacts complete the transfer action to the "Standby" source side.
4. Limit switches LS1/LS2 are actuated to the terminals A1/A2 terminals side, to "prepare" the circuit for retransfer back to "Utility".
4. The auxiliary contacts (AUX) are repositioned by a mechanical interlock mechanism.

Circuit Condition- Utility Power Available

Refer to Figure 2 on facing page. The dark and heavy lines indicate circuits that are electrically hot while normal "Utility" power is available to the transfer switch. Circuit condition may be briefly described as follows:

1. Utility source voltage is available to transfer mechanism terminal lugs N1/N2/N3, through the closed main contacts, and to load terminals T1/T2/T3.
2. Utility source voltage is available to transfer mechanism terminals A1 and A2. However, limit switches LS1 and LS2 have actuated to the terminals B1/B2 side and this circuit is open.
3. From load terminals T1/T2, utility source voltage is delivered to the primary winding of a load side transformer (TR2). This is a "step-down" transformer, which will provide a voltage reduction of approximately 10 to 1. The reduced voltage is delivered to a 7-day exercise circuit board, via Wires 185 and 0. The step-down voltage is used to operate the timing circuit (clock) that starts and exercises the generator at regular weekly intervals.
4. From terminal lugs N1/N2/N3, utility source power is delivered to a utility sensing interface. Step-down transformers in that interface reduce the utility voltage to a value that is compatible with a utility voltage sensor circuit board.
5. As long as the utility voltage sensor board reads a normal utility source voltage, the system takes no action.

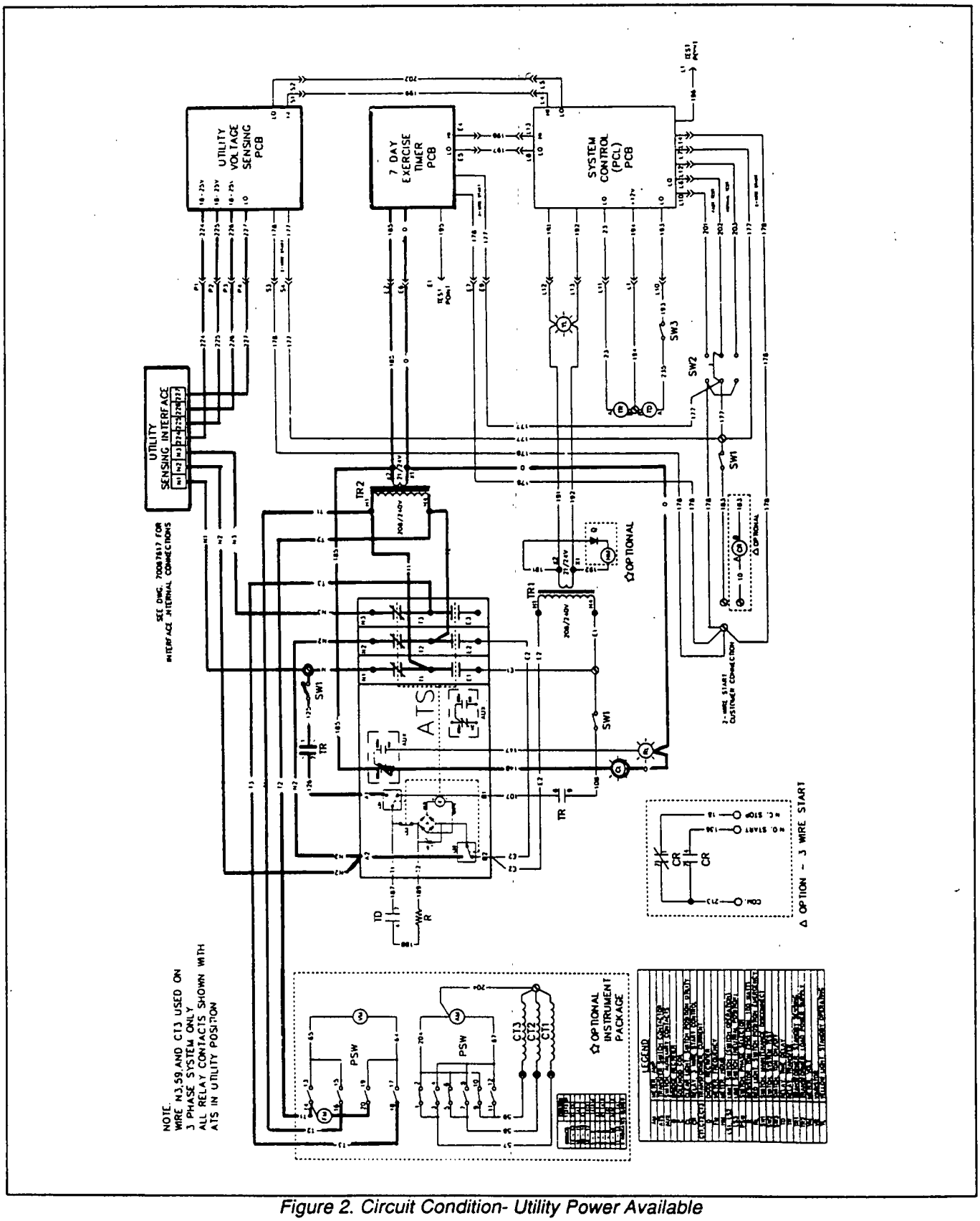


Figure 2. Circuit Condition- Utility Power Available

Circuit Condition- Utility Power Source Dropout

1. A "voltage dropout sensor" on the utility voltage sensor circuit board constantly monitors utility power source voltage. Should that source voltage drop below a preset level, a "line interrupt delay timer" will start timing. If utility voltage is still low when that timer has timed out, the circuit board will (a) close the 2-wire start circuit which consists of terminals and wires 178 and 183, and (b) open the wires 199 and 202 circuit between the utility voltage sensor board and the system control (logic) board.

2. Closure of the 178/183 circuit energizes components in the generator's DC control/latch-crank circuit board and the engine cranks cyclically. That is, the engine will crank for about eight (8) seconds, rest for about eight (8) seconds, crank for eight (8) seconds, and so on.

3. When the generator starts, standby source power is delivered to the transfer mechanism terminals E1/E2/E3, and to a sensing transformer (TR1). The transformer's secondary coil delivers a "step-down" voltage to (a) a "Standby Operating" lamp and (b) to the system control (Logic) circuit board. The "Standby Operating" lamp illuminates. The System Control (Logic) board starts operating.

4. A "minimum run timer" and an "engine warmup timer" on the system control (logic) board both start timing.

NOTE: During the time that power is not available to the 7-Day Exercise board, the board is operated by a 9 volts battery. On units with a CPU type system (only two circuit boards), secondary winding output from transformer TR2 is delivered to the CPU circuit board. When power to TR2 is lost, the CPU board is powered by a 9 volts battery.

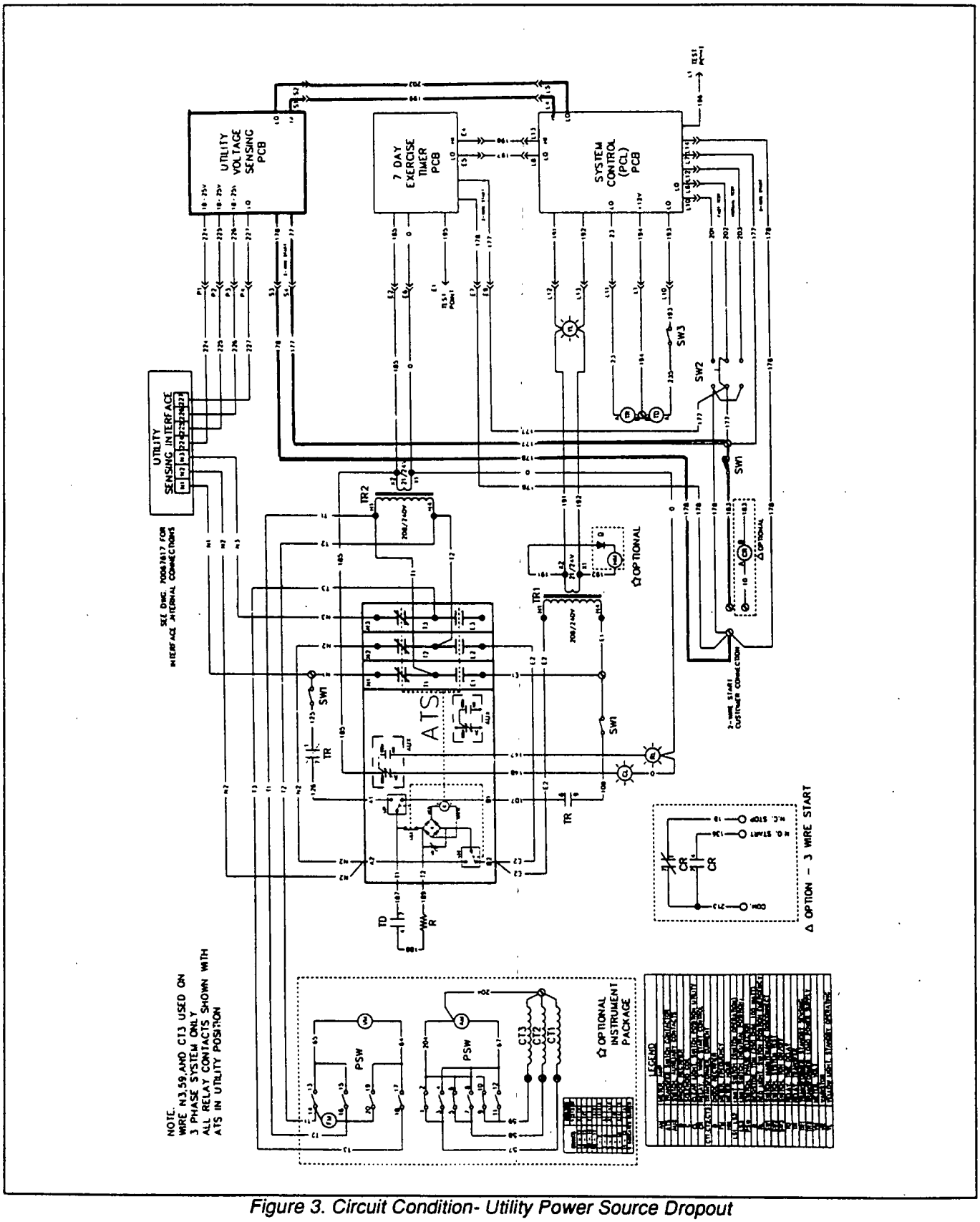


Figure 3. Circuit Condition- Utility Power Source Dropout

Circuit Condition- Standby Generator Running

1. Standby generator AC output is delivered to transfer mechanism terminal lugs E1/E2/E3 via customer supplied conductors.

2. From terminals E1/E2/E3, generator AC output is delivered to the primary winding of step-down transformer TR1. A reduced voltage is induced into the transformer's secondary coil, at about a 10 to 1 ratio. Secondary coil output is then delivered to (a) a "Standby Operating" lamp, and to (b) the system control (logic) circuit board.
   a. The "Standby Operating" lamp turns on.
   b. The system control (logic) board turns on. A "minimum run timer" and an "engine warmup timer" on the logic board start timing. The circuit board delivers a 12 volts DC output to the transfer relay (TR) coil, via Wire 194 and back to the circuit board via Wire 23. However, circuit board action holds the Wire 23 circuit open and the transfer relay (TR) is de-energized.
   c. If so equipped, the DC output from the circuit board is delivered to the actuating coil of a time delay relay (TD) and back to the circuit board via Wire 193. However, circuit board action holds the time delay relay de-energized at this time.

3. Standby source power is available to transfer mechanism terminal B2 and to the normally-open contacts of the transfer relay (TR). However, TR is de-energized and the circuit is held open.

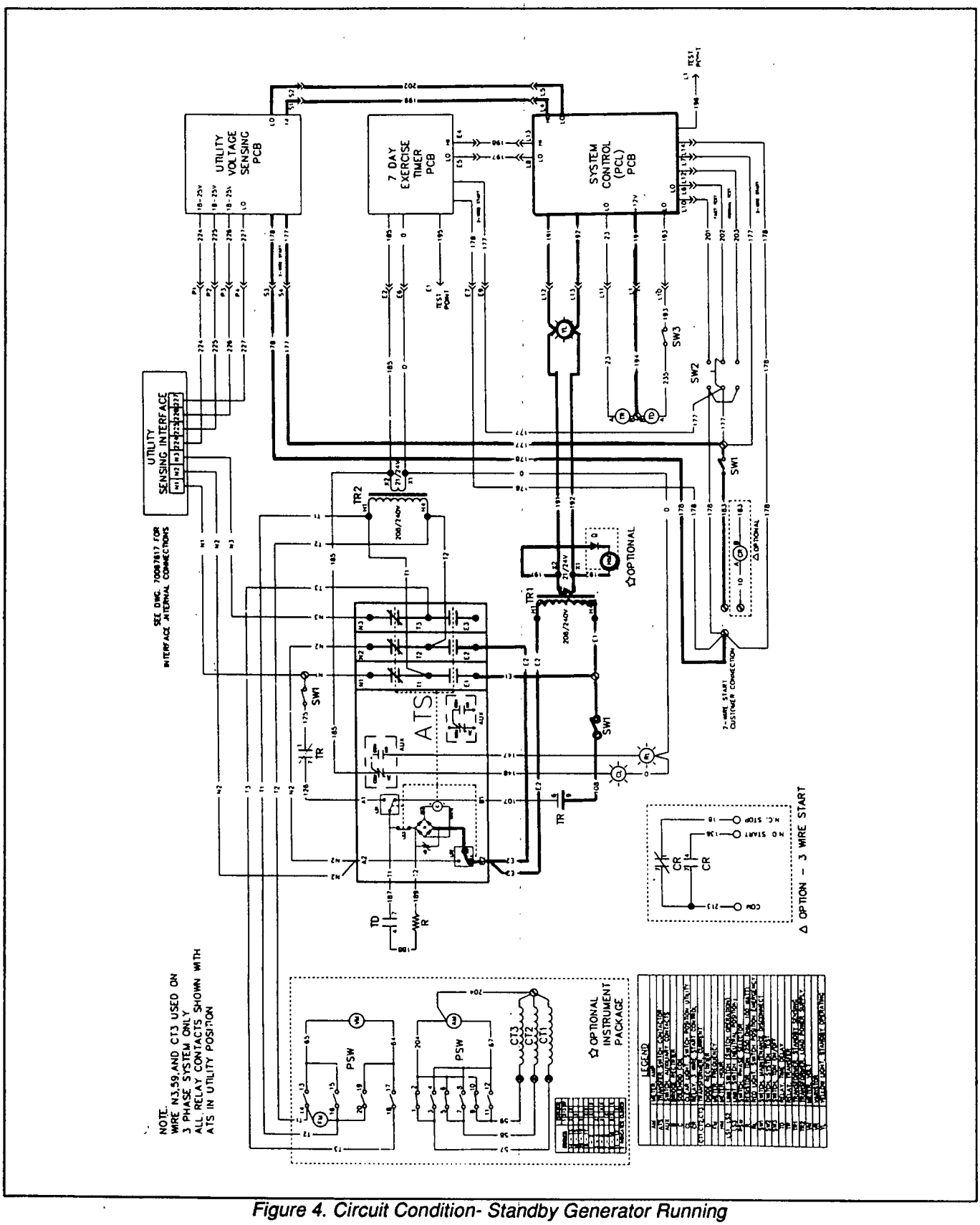


Figure 4. Circuit Condition- Standby Generator Running

Circuit Condition- Transfer to Standby

When an "engine warmup timer" on the system control (logic) board has timed out, and when standby frequency and voltage have reached the settings of a "standby frequency sensor" and a "standby voltage sensor" on that board, circuit board action will complete the Wires 23 and 193 circuits to ground. The transfer relay will energize and (if so equipped) a time delay relay will also energize.

1. The transfer relay's normally-open contacts close to deliver standby power to transfer mechanism terminals B1 and B2.

2. From the B1/B2 terminals standby power is delivered to a bridge rectifier and to the solenoid coil (C). The solenoid coil energizes to actuate the main contacts to their "Neutral" position.

3. **Units without Time Delay Neutral:** As the main contacts reach "Neutral", limit switch LS3 opens. On units without the time delay neutral feature, the main contacts will then complete their movement to the standby power source side.
Units with Time Delay Neutral: Limit switch LS3 is bypassed by the time delay circuit which consists of the time delay relay (TD), a resistor (R), and Wires 187 and 189. The solenoid coil (C) will then remain energized as long as the time delay relay (TD) remains energized. When TD is de-energized by system control board action, solenoid coil (C) will de-energize and main contacts will complete their movement to the standby side.

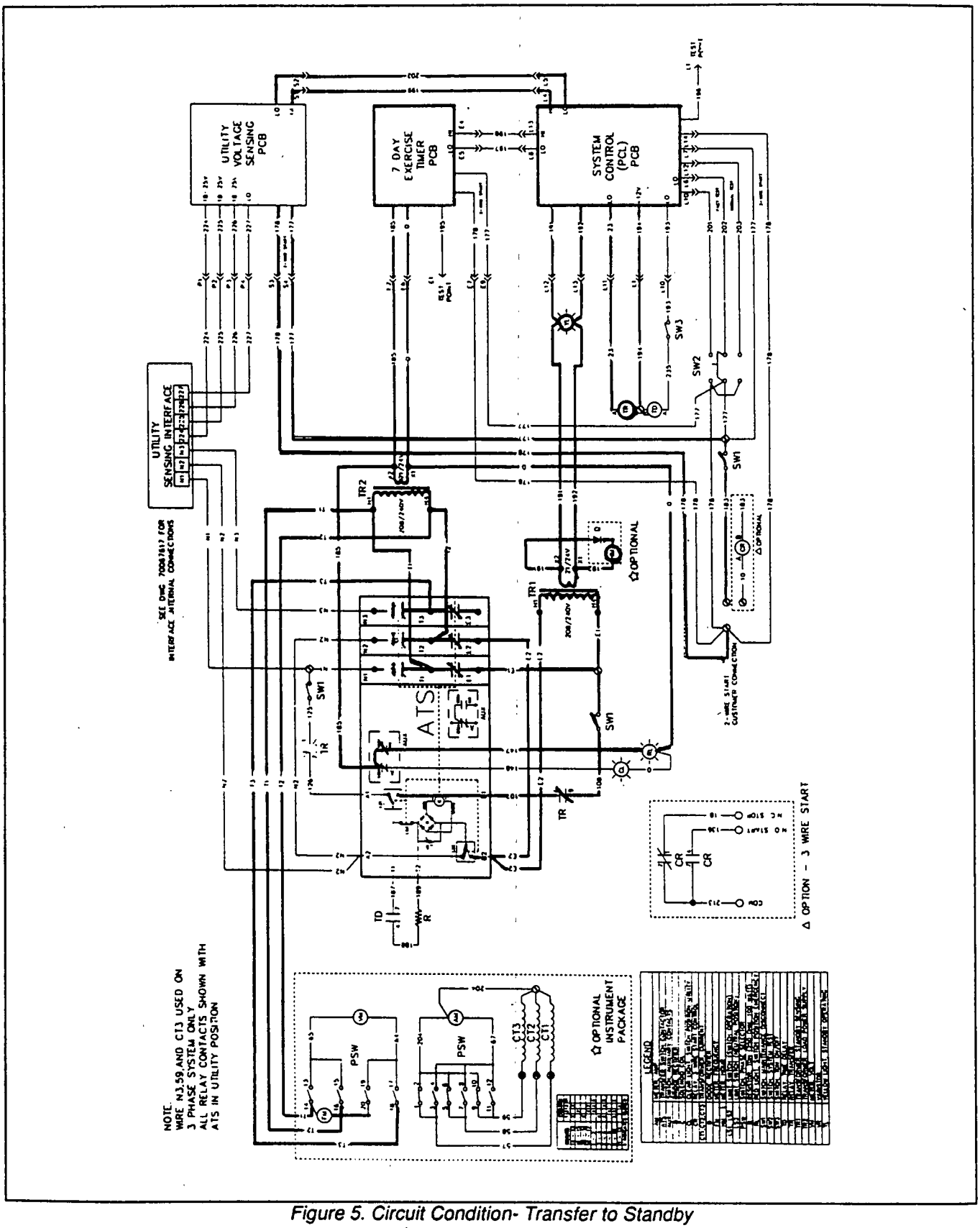


Figure 5. Circuit Condition- Transfer to Standby

Circuit Condition- Utility Source Voltage Restored

On restoration of utility source voltage, that source voltage is delivered to the utility sensing interface via terminals and wires N1, N2, N3. Reduced utility sensing interface voltage is then available to the utility voltage sensor circuit board via Wires 224-227.

If the utility voltage is above the setting of a "voltage pickup sensor" on the utility voltage sensor board, circuit board action will close the Wires 199/202 circuit. Closure of the 199/202 circuit will signal the system control (logic) board that utility voltage is now restored. A "return to utility timer" on the system control board then starts timing. When the timer has timed out, retransfer back to the utility source will be initiated.

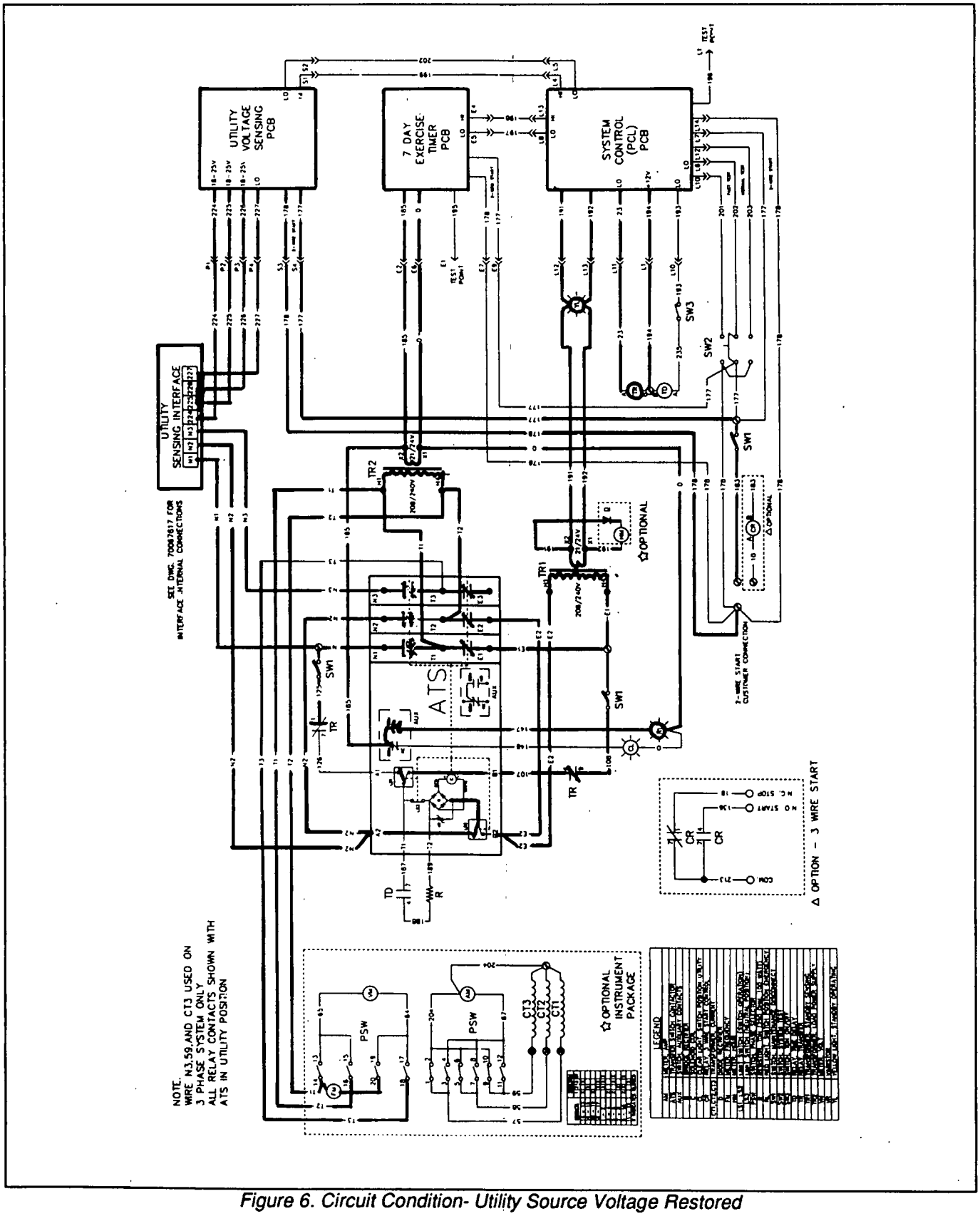


Figure 6. Circuit Condition- Utility Source Voltage Restored

Circuit Condition- Retransfer to Utility

When the system control (logic) board's "return to utility timer" has timed out, circuit board action opens the Wire 23 circuit. The transfer relay (TR) de-energizes. Circuit board action also closes the Wire 193 circuit and time delay relay (TD) energizes. If so equipped, a "time delay neutral timer" on the circuit board starts timing. The following actions then occur:

1. Utility source voltage is delivered to transfer mechanism terminals A1/A2 and to the solenoid coil (C).

2. Solenoid coil (C) energizes to actuate the main contacts to their "Neutral" position.

3. When the main contacts reach "Neutral", limit switch LS3 opens. On units without the time delay neutral feature, solenoid coil (C) will then de-energize and spring force will complete the main contacts movement back to the utility side.

4. On units with the time delay neutral feature, solenoid coil (C) will remain energized as long as the time delay relay (TD) stays energized. Main contacts will remain at "Neutral" as long as the solenoid coil (C) is energized.

5. Following retransfer, an "engine cooldown timer" on the system control (logic) baord will start timing. When that timer has timed out, circuit board action will open the 178/183 circuit and the generator will shut down.

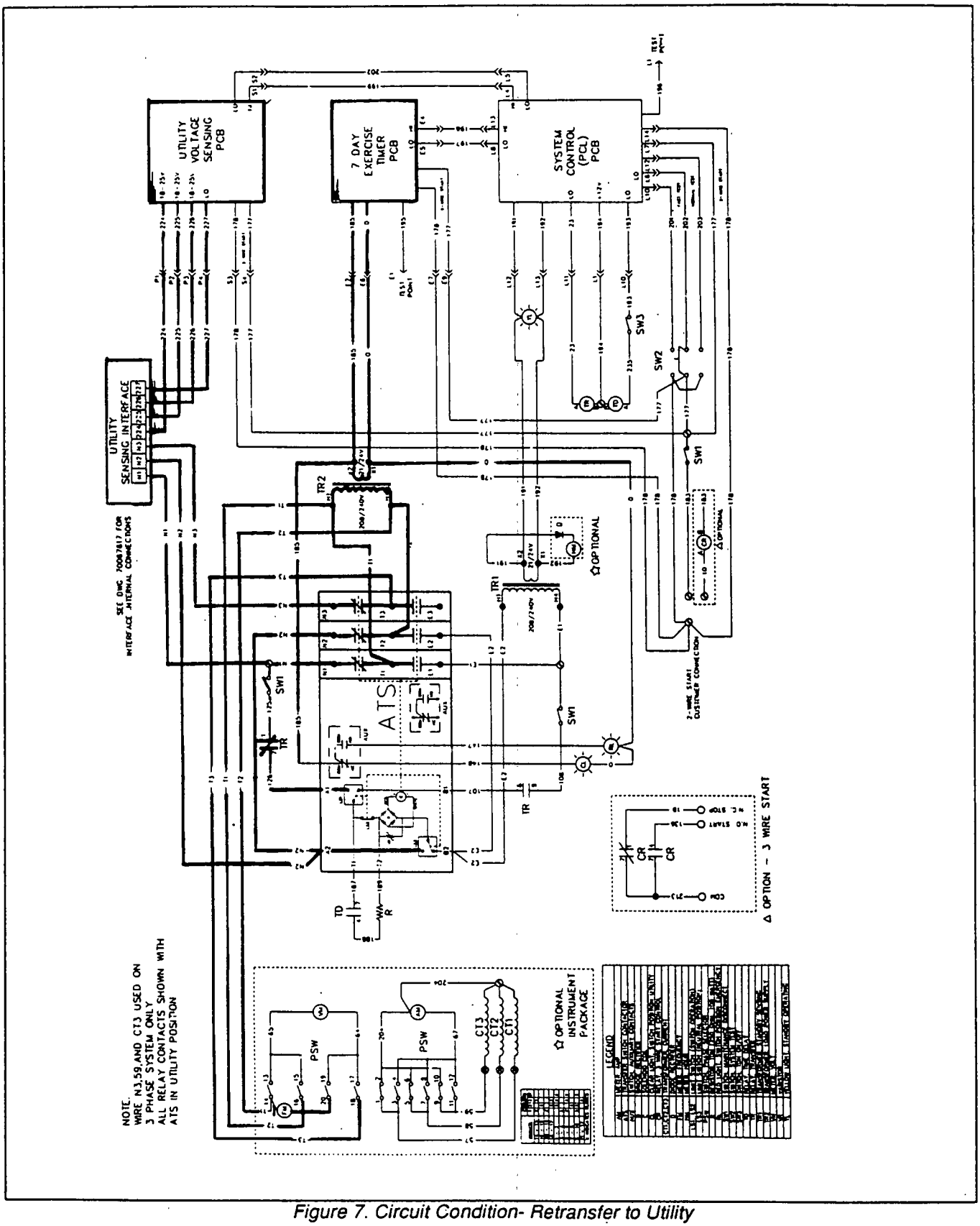


Figure 7. Circuit Condition- Retransfer to Utility

Section 8.8
MULTI-VOLTAGE TRANSFER SWITCHES

General

Standard "Y-Type" transfer switches must be installed and used in conjunction with power source voltages that are compatible with the rated voltage and phase of the specific transfer switch and as stated on the transfer switch data plate.

Use of a multi-voltage type transfer switch allows greater flexibility since it permits several different voltage/phase selections to be made by the installer. Thus, a single transfer switch may be installed in any one of several applications having different power source voltages.

Voltage selections are made by means of a "multi-voltage interface panel" and a "voltage selector switch" on the utility voltage sensor circuit board. VOLTAGE SELECTIONS ON THE INTERFACE PANEL MUST MATCH THE RATED UTILITY POWER SOURCE PHASE AND VOLTAGE.

Voltage Selections

See Figure 1. The multi-voltage interface panel shown permits the installer to match the transfer switch phase and voltage to the utility power source phase and voltage. Simply plug the interface connector into the interface panel receptacle identified with the correct phase and voltage. Then, set the selector switch on the utility voltage sensor circuit board to match the interface voltage and phase.

Using 3-Pole Transfer Mechanisms in 1-Phase Applications

A special procedure may be required when connecting a 1-phase power source to a 3-pole transfer mechanism (in multi-voltage applications). The procedure used will vary depending on whether the neutral block is to be used or whether the 1-phase neutral line will be switched.

If the Neutral Block Is to Be Used: When utility, standby and load "Neutral" lines are to be connected to the transfer switch neutral block ("Neutral" is not to be switched), connect lines as follows:

1. Connect utility hot line 1 to terminal lug N1; utility hot line 2 to terminal lug N3. Connect the utility service neutral line to the neutral block.
2. Connect generator line E1 to terminal lug E1; generator line E3 to terminal lug E3. Connect the generator neutral line (00) to the neutral block.
3. Connect the load hot lines 1 and 2 to terminal lugs T1 and T3, respectively. Connect the load neutral line to the transfer switch terminal block.

This concludes 1-phase connections where the "Neutral" block is to be used, i.e., "Neutral" will NOT be switched during transfer.

If the 1-Phase Neutral Line Will Be Switched: If a 3-pole transfer switch is to be used in a 1-phase system and it is desireable to switch the "Neutral" during a transfer action, comply with the following instructions:

1. Disconnect Wire N2 from terminal lug N2 of the transfer mechanism and from terminal A2 of the transfer mechanism terminal strip. Completely remove the disconnected Wire N2.

CAUTION: Wire N2 that must be removed is a factory installed wire that is usually routed from transfer mechanism terminal N2 to terminal A2 of the transfer mechanism terminal strip. If Wire N2 is not removed, the switched "Neutral" line will be connected to hot line E3 in the multi-voltage interface panel. This will result in serious problems and possible damage to the system.

2. Connect utility power source line 1 to transfer mechanism terminal N1. Connect utility line 2 to transfer mechanism terminal lug N3. Connect the utility source "Neutral" line to transfer mechanism terminal lug N2.
3. Connect generator line E1 to transfer mechanism terminal lug E1. Connect 1-phase generator lead E3 to terminal lug E3. Connect the generator "Neutral" line to transfer mechanism terminal lug E2.
4. Connect load line 1 to transfer mechanism terminal lug T1; load line 2 to terminal lug T3. Connect the load "Neutral" line to terminal lug T2.

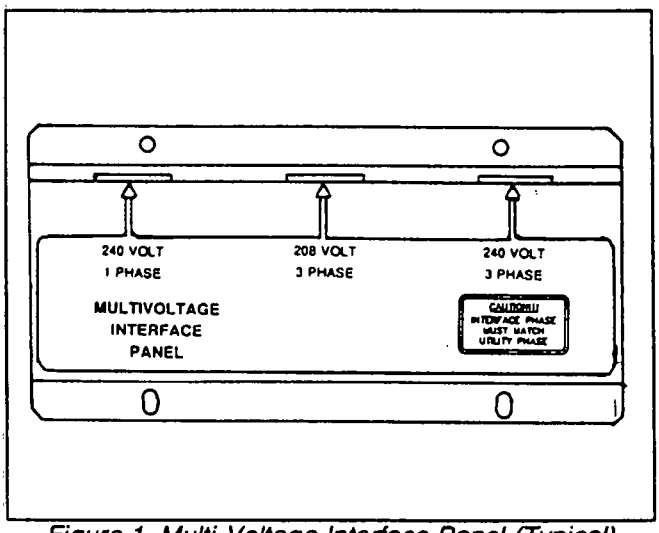


Figure 1. Multi-Voltage Interface Panel (Typical)

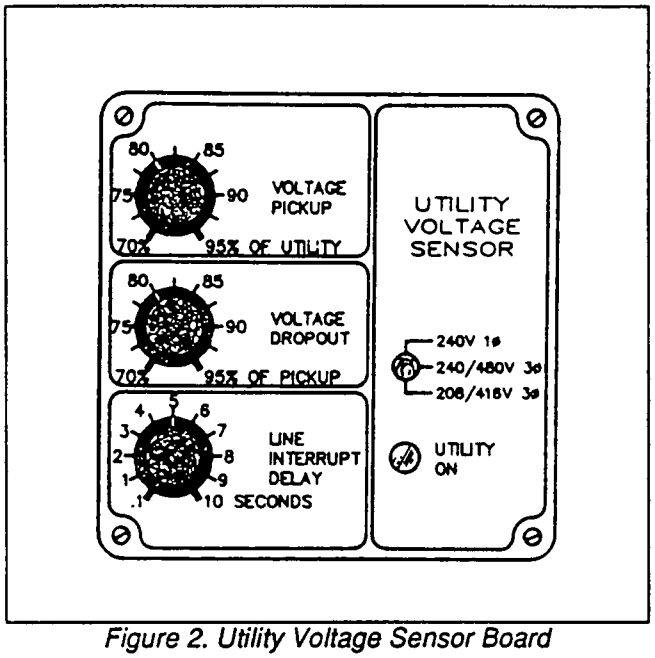


Figure 2. Utility Voltage Sensor Board

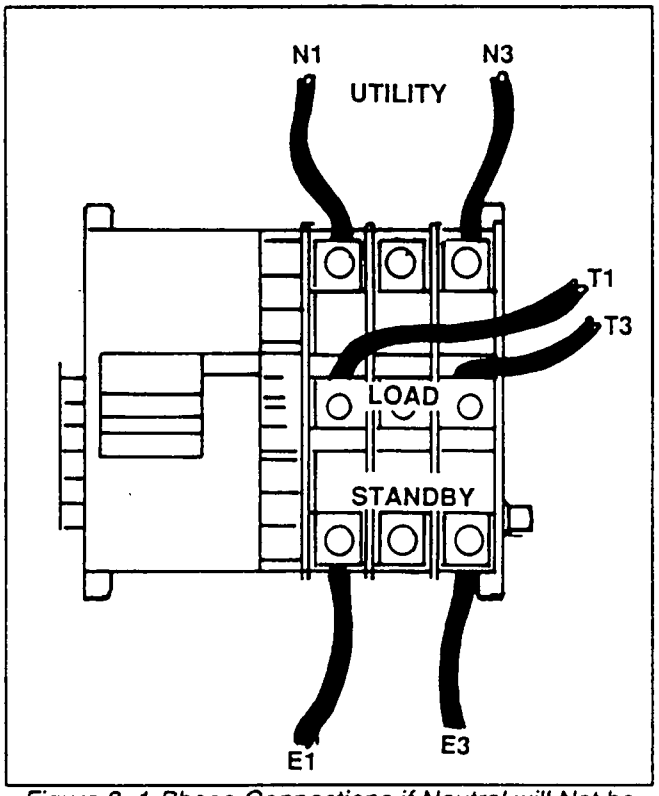


Figure 3. 1-Phase Connections if Neutral will Not be Switched

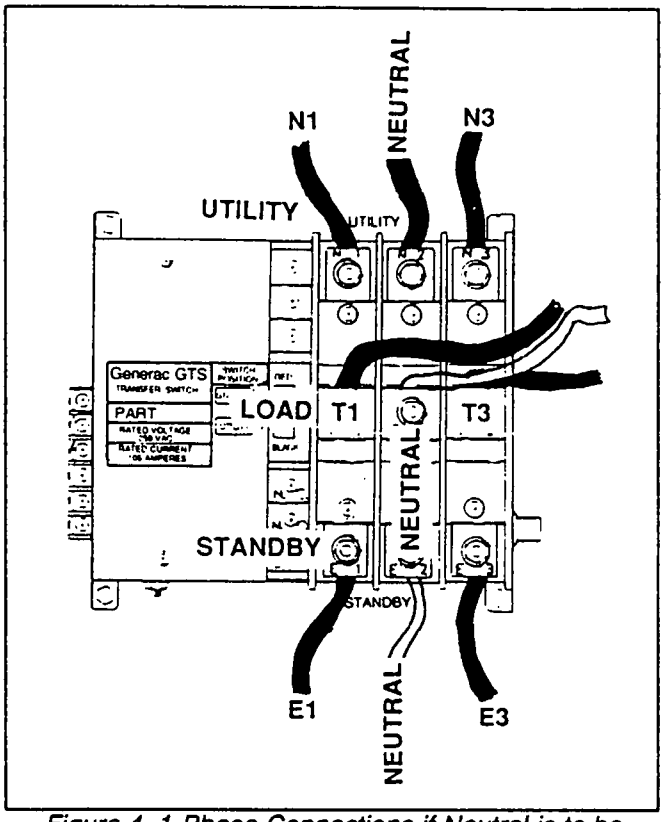


Figure 4. 1-Phase Connections if Neutral is to be Switched

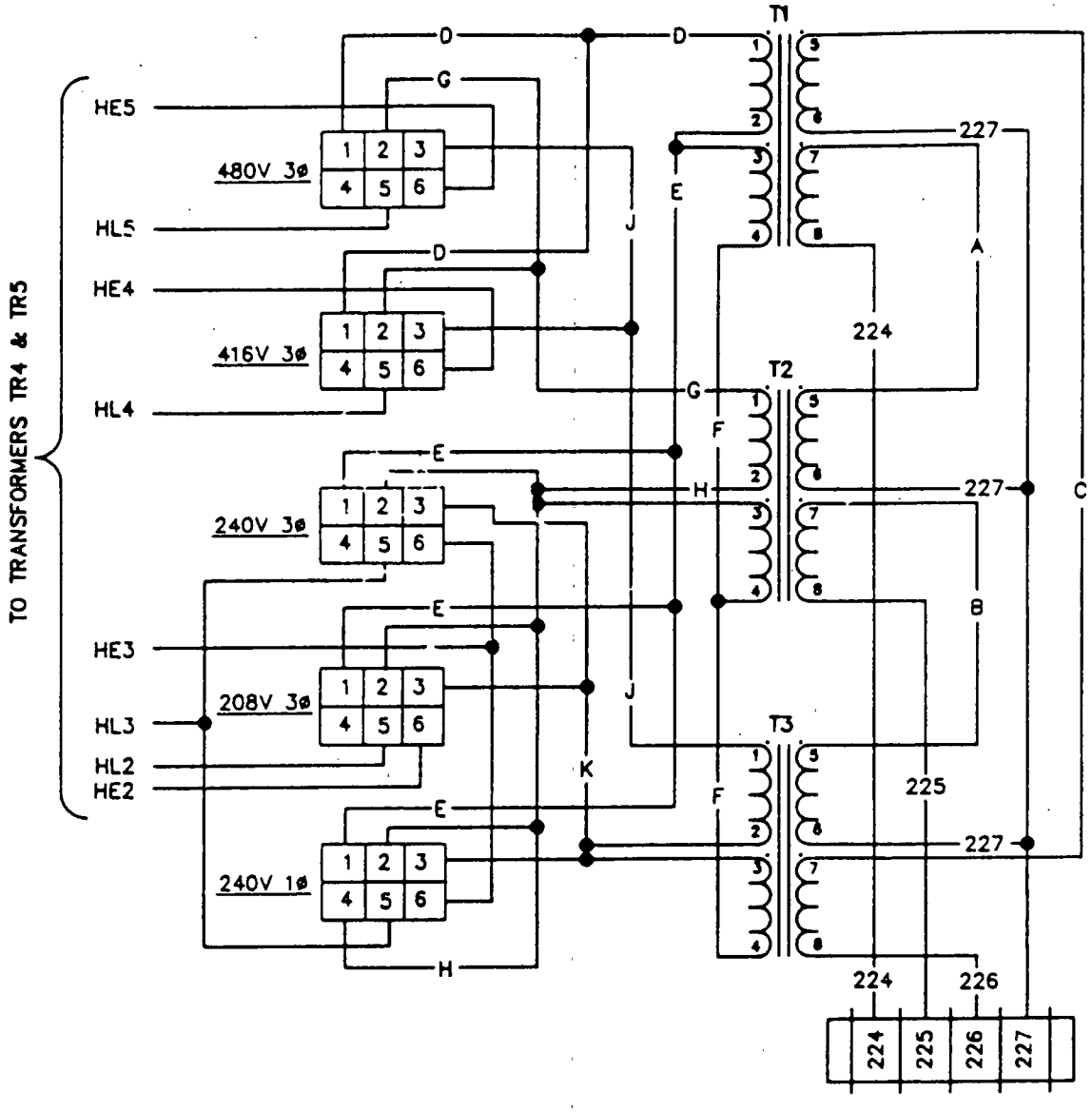


Figure 5. Schematic Diagram- Typical Multi-Voltage Interface Panel

Section 8.9
TROUBLESHOOTING FLOW CHARTS

Introduction

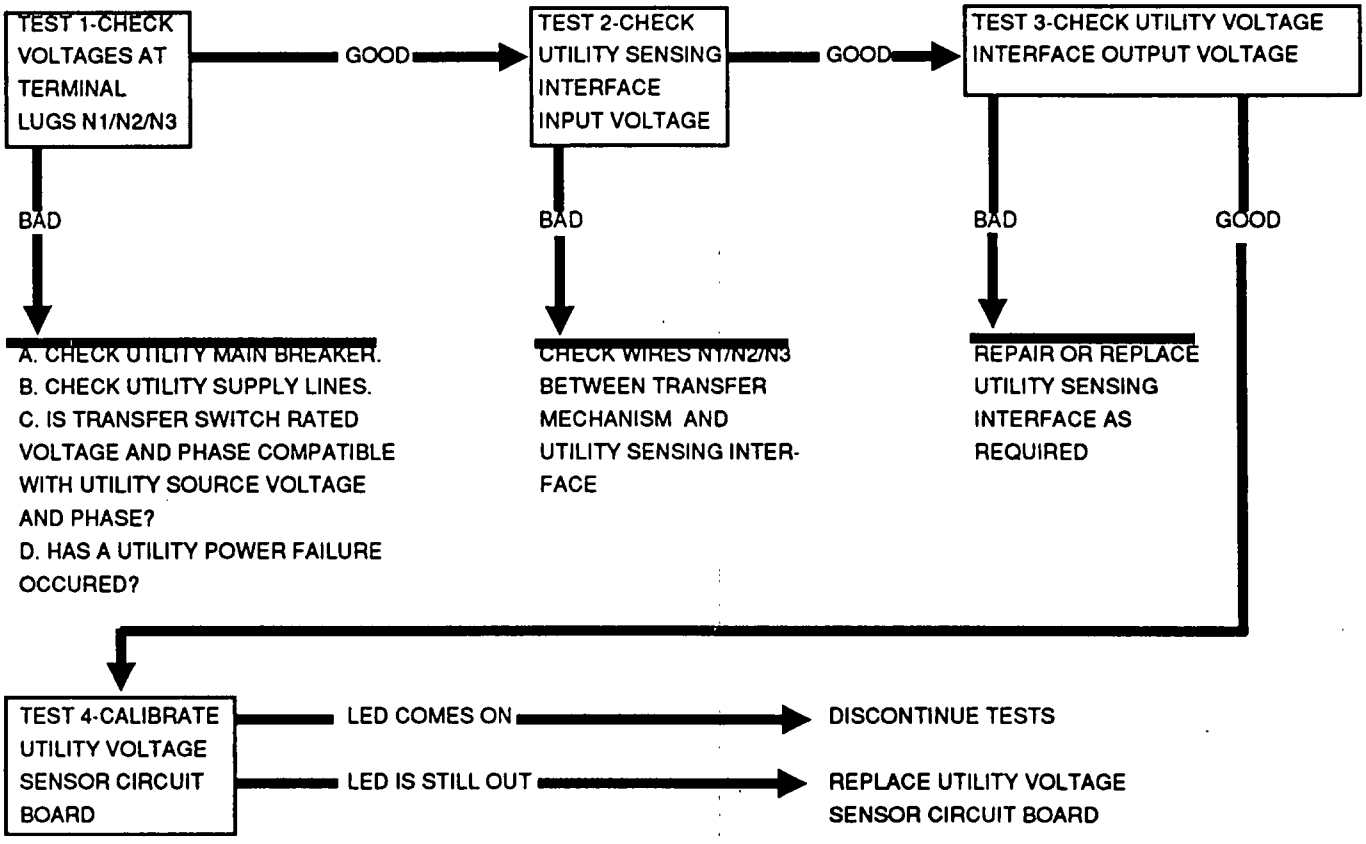
The "Flow Charts" in this section are sequenced in logical order. To use the flow charts, first identify the specific problem you have encountered. Once that is done, locate the description of that problem on the following pages. Then, accomplish each test under that problem in the exact order the tests are presented.

DANGER: USE EXTREME CARE WHEN PERFORMING TESTS ON THE TRANSFER SWITCH. SOME TESTS MAY BE PERFORMED WHILE HIGH AND DANGEROUS VOLTAGES ARE PRESENT AT TRANSFER SWITCH TERMINALS. CONTACT WITH LIVE TERMINALS WILL RESULT IN EXTREMELY DANGEROUS AND POSSIBLY LETHAL ELECTRICAL SHOCK. BE ALERT AT ALL TIMES. IF A TEST CAN BE PERFORMED WITH POWER VOLTAGE SUPPLIES TURNED OFF, THEN TURN VOLTAGE SUPPLIES OFF BEFORE PERFORMING THE TEST.

Problem 1- Circuit Board "Utility On" Lamp Does Not Turn On

The "Utility On" lamp (LED) is located on the utility voltage sensor circuit board. Following installation, the LED should illuminate within 10 seconds after the utility power supply to the transfer switch is turned on. A "lamp out" condition generally means that (a) utility sensing voltage is not available to the circuit board, or (b) utility sensing voltage is below the setting of a "voltage dropout sensor" on the circuit board. When the maintenance disconnect switch is set to "Automatic", a "lamp out" condition will usually result in generator startup and transfer of loads to the "Standby" power supply. However, if the maintenance disconnect switch is set to "Manual", the system will take no action.

NOTE: Early production utility voltage sensor boards were "phase sensitive". These early production boards had a green "Utility On" lamp. Later production boards have a red lamp and are NOT phase sensitive.



Problem 2- Loss of Timing on 7-Day Exercise (or CPU) Circuit Board

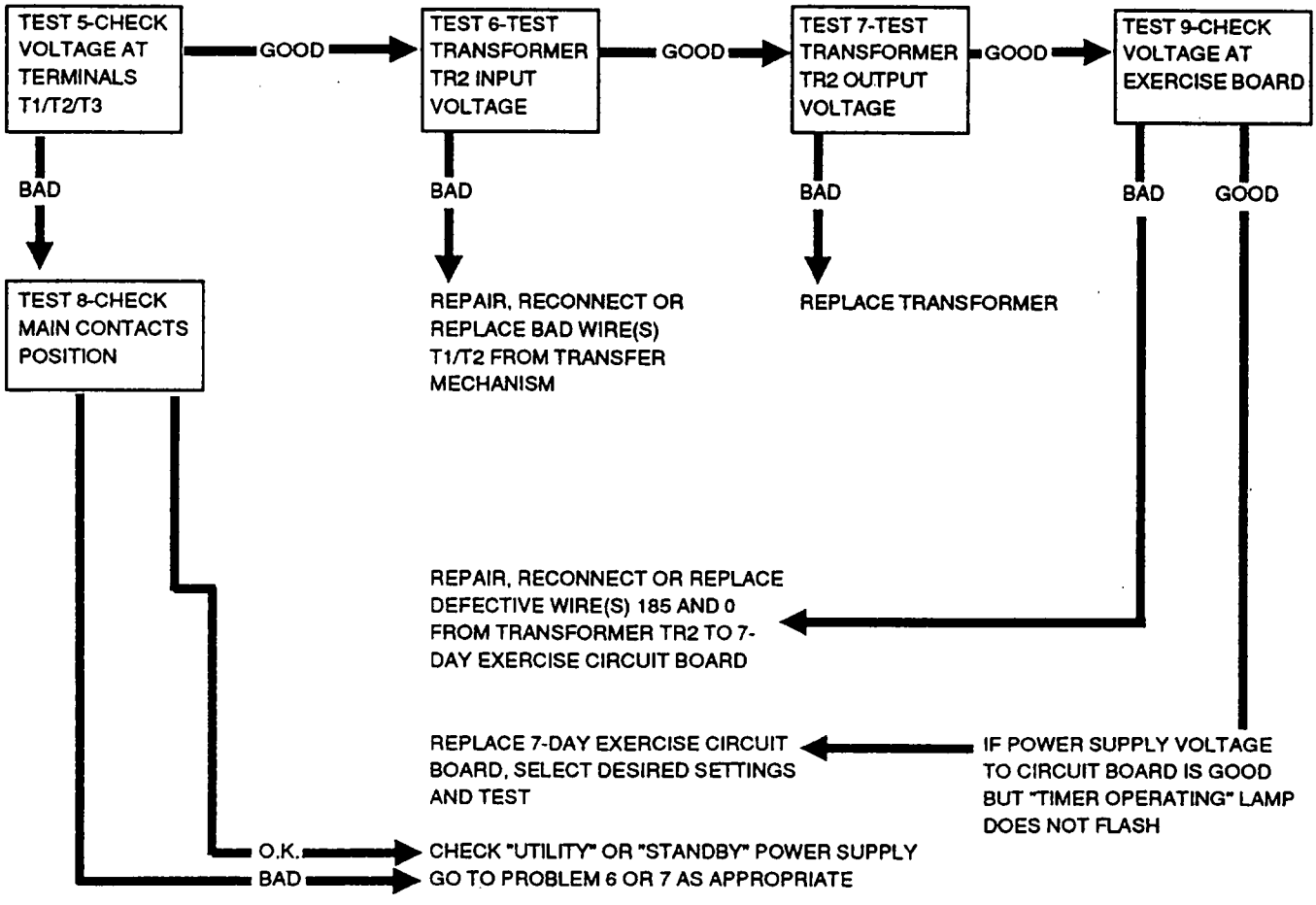
The 7-day exercise circuit board is operated by transformer reduced voltage from the transfer switch load terminals. Load terminal voltage is delivered to the primary winding of step-down transformer TR2. A reduced voltage is then induced into the transformer's secondary winding, at a 10-to-1 ratio. Transformer secondary winding output is delivered to the 7-day exercise board via Wires 185 and 0.

When the 7-day exercise board's timer is operating, a "timer operating" lamp on the circuit board should be flashing. Loss of power to the board or a timer failure will cause the LED to stop flashing.

During any transfer action, the load terminals will be disconnected from a power source while the transfer mechanism's main contacts are at "Neutral", i.e., load disconnected from both power supplies. During this brief period, the "Timer Operating" lamp will stop flashing and a 9 volts transistor battery will prevent the pre-set exercise time and day from becoming "scrambled". The standard 7-day exercise board will lose the amount of timing count that power is disconnected and, if power is lost indefinitely, the battery will eventually discharge. The exercise time and day will then become scrambled.

NOTE: The optional DELUXE EXERCISE BOARD also uses a 9 volts battery to prevent the preset time and day of exercise from becoming "scrambled". Timing count on this board will also be lost during the time the main contacts are at "Neutral". However, on restoration of the board's power syupply, the deluxe board will automatically reset itself to the proper time.

If the "Timer Operating" lamp on the exercise circuit board is not flashing, troubleshoot the system as follows:

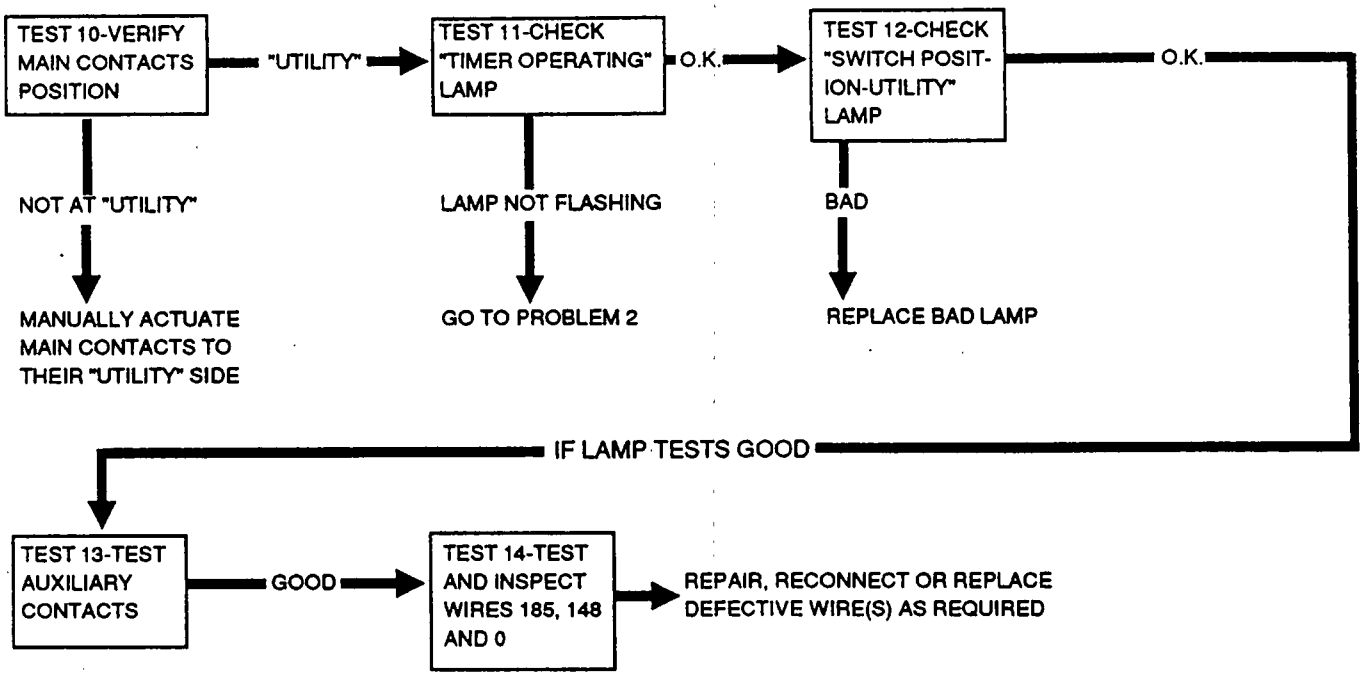


Problem 3- "Switch Position Utility" Lamp Does Not Come On

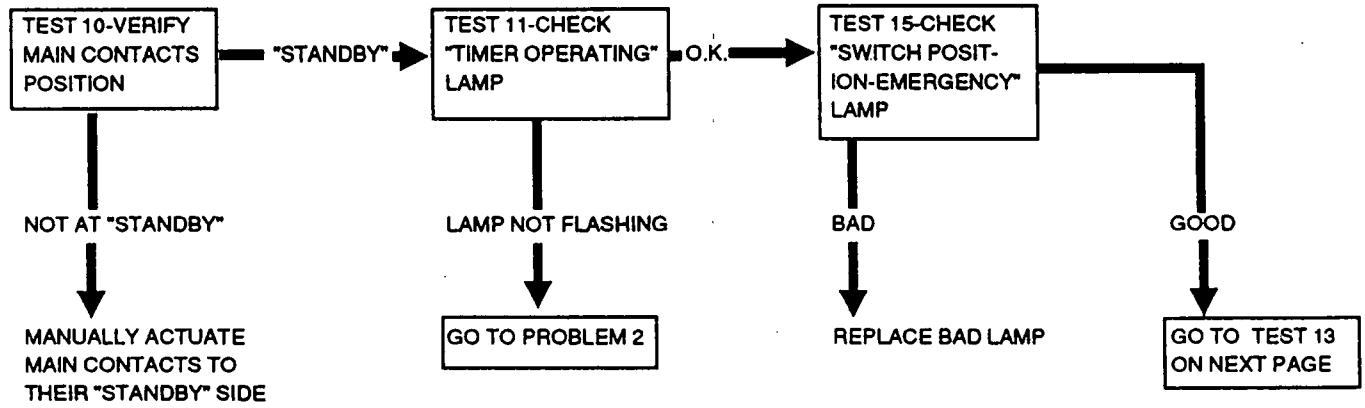
Following installation and before placing the system into service, the installer should verify that the transfer mechanism main contacts have been actuated to their "Utility" position (load connected to the utility power source side). Similarly, before the system is set for normal automatic operation, the operator should verify that the main contacts are at their "Utility" position. When the main contacts have been actuated to their "Utility" power source side and the "Utility" power supply to the transfer switch has been turned on, a "Switch Position-Utility" lamp on the switch enclosure door should illuminate.

The same transformer reduced voltage that operates the 7-day exercise board is used to operate the "Switch Position-Utility" lamp. That voltage is delivered to the lamp via a set of auxiliary contacts only when the main contacts have been actuated to their "Utility" power source side.

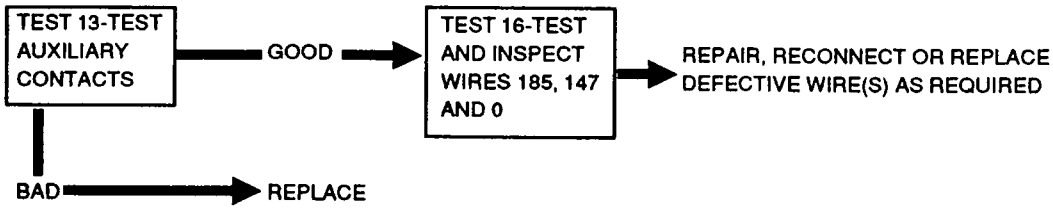
If the main contacts have been positioned to their "Utility" side, "Utility" power to the transfer switch is turned on, and the "Switch Position-Utility" lamp does not turn on, test the system as follows:



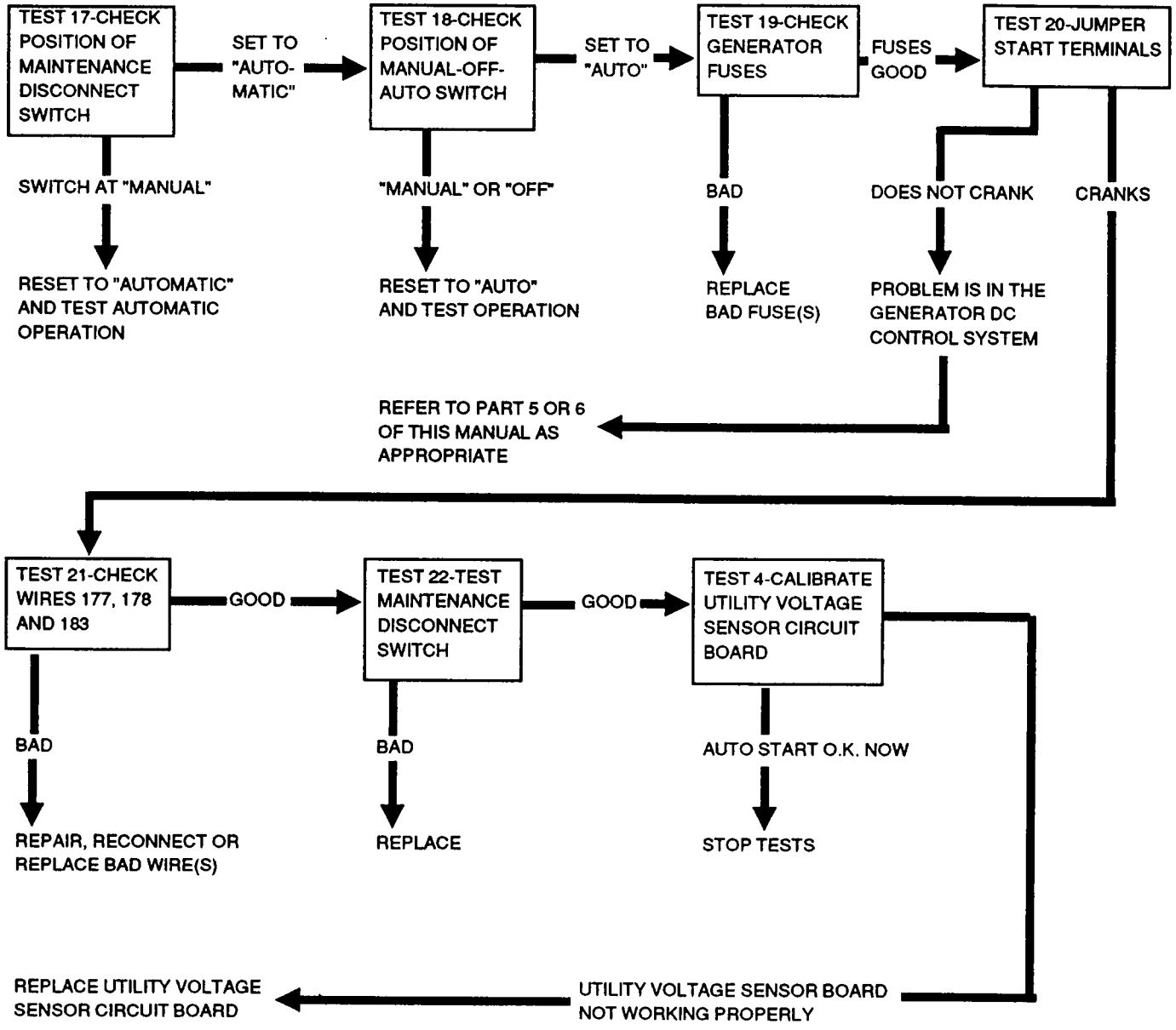
Problem 4- "Switch Position-Emergency" Lamp Does Not Come On



Problem 4- "Switch Position-Emergency" Lamp Does Not Come On (Continued)



Problem 5- Generator Engine Does Not Crank in Automatic Mode

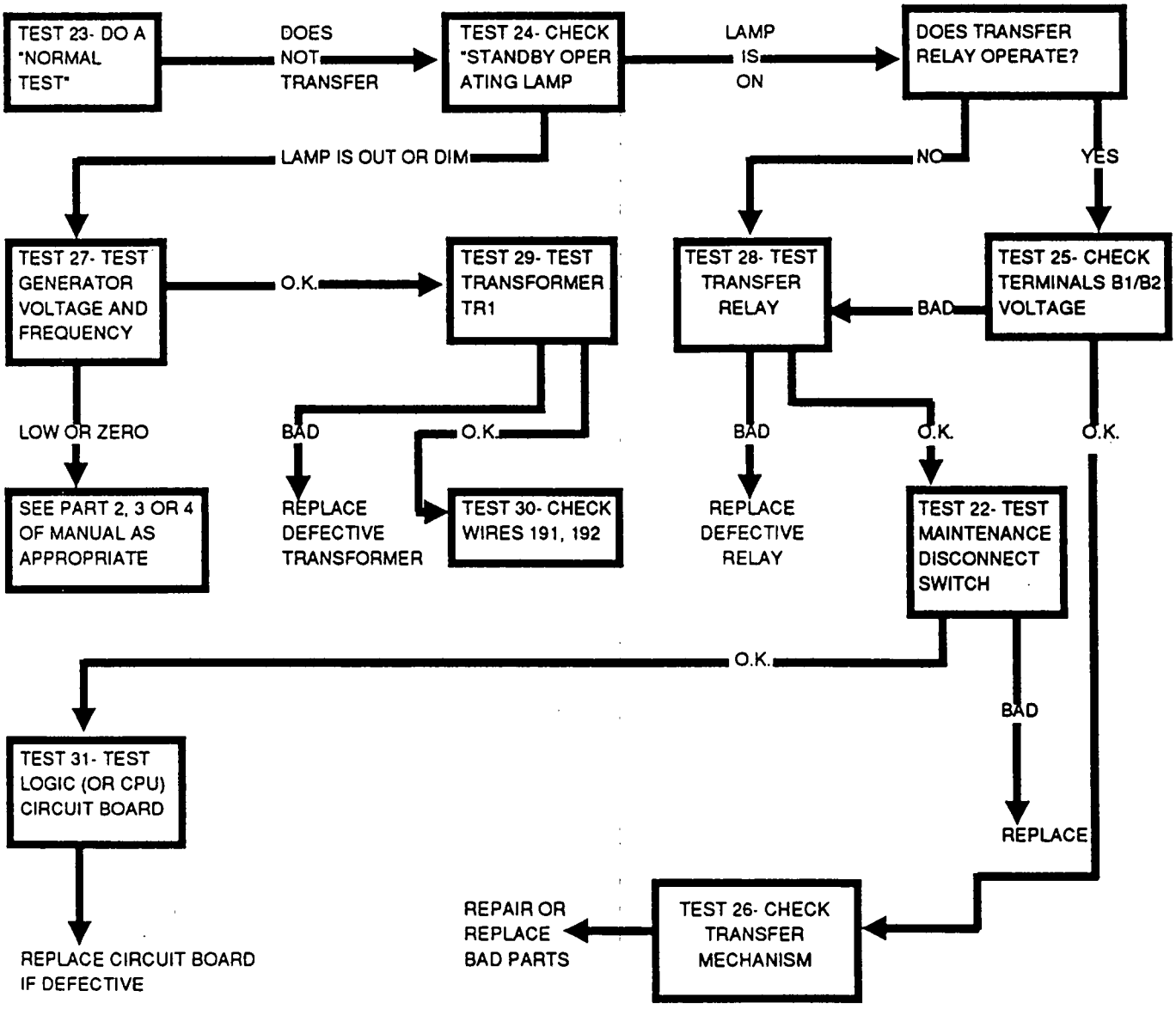


NOTE: If engine does not crank in automatic mode, try testing the system as outlined in Part 5, "Options A and B Control Consoles"; or in Part 6, "Option C Control Consoles".

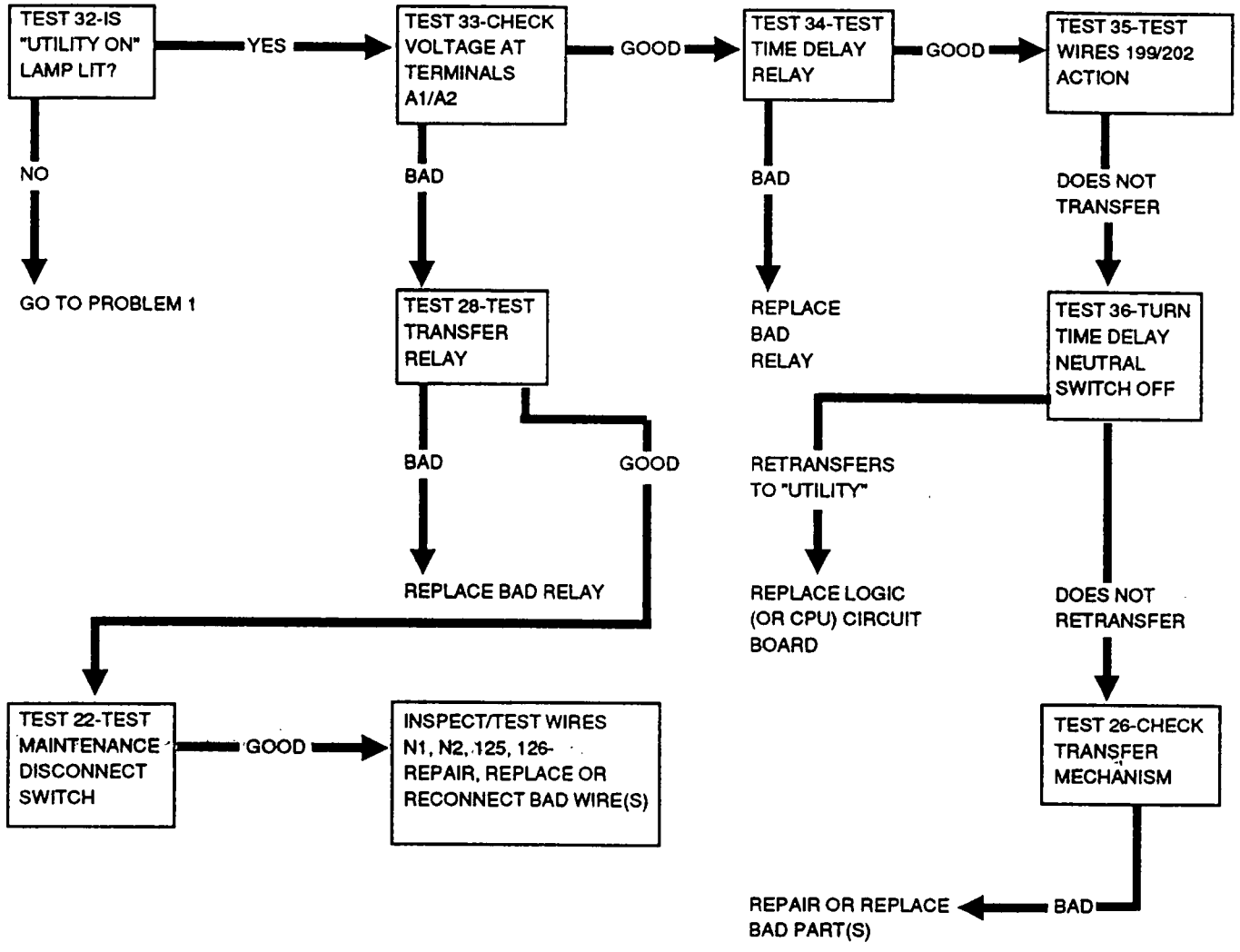
Problem 6- No Transfer to "Standby" in Automatic Mode

During operation in automatic mode, the utility voltage sensor board monitors transformer reduced "Utility" power source voltage. Should that source voltage drop below the setting of a "voltage dropout sensor" on the circuit board, closure of the 2-wire start circuit (178/183) will occur. On closure of that circuit, the generator's DC control/latch-crank board initiates engine cranking and startup. At the same time, the utility voltage sensor board opens a Wire 199/202 circuit between itself and the system control (Logic) board. With the generator running, transformer reduced "Standby" source voltage is delivered to the system control board and to a "Standby Operating" lamp on the transfer switch enclosure door. An "engine warmup timer" on the system control board starts timing. When that timer has timed out and if "Standby" source voltage and frequency have reached the settings of voltage and frequency sensors on the system control board, the system control board will complete a Wire 23 circuit to ground. A transfer relay will then energize and, on closure of the relay's normally-open contacts, power will be delivered to transfer mechanism terminals B1/B2. The transfer mechanism's solenoid coil should then energize and transfer to "Standby" should occur.

If the generator engine starts normally in automatic mode, but transfer to "Standby" does not occur, troubleshoot the system as follows:



Problem 7- In Automatic Mode, No Retransfer Back to "Utility"



Section 8.10
DIAGNOSTIC TESTS

Introduction

Use the "Diagnostic Tests" in conjunction with the "Troubleshooting Flow Charts" of Section 8.9. Test numbers in this section correspond to the numbered tests in the "Flow Charts".

To find the cause of a problem, first define the problem. Then, locate the defined problem in Section 8.9. Perform the tests under that problem in the exact order indicated by the flow chart.

Test 1- Check Voltages at Terminals N1/N2/N3

DISCUSSION:

Utility power source voltage must be available to terminal lugs N1 and N2 (2-pole units) or N1, N2 and N3 (3-pole units). In addition, the applied voltage must be compatible with the rated voltage and phase of the transfer switch. If correct rated voltage is not available to the transfer switch, the following will result:

- The "Switch Position-Utility" lamp on the transfer switch enclosure door will not turn on.
- The "Utility On" lamp (LED) on the utility voltage sensor circuit board will not illuminate.
- If the utility voltage is lower than the setting of the utility voltage sensor board's "voltage dropout sensor", generator startup and transfer to the standby power source will occur.
- Retransfer back to the utility power supply will not occur.

DANGER: THE POWER VOLTAGES DELIVERED TO TRANSFER MECHANISM TERMINALS N1/N2/N3 IS EXTREMELY HIGH AND DANGEROUS. CONTACT WITH POWER VOLTAGE TERMINALS WILL RESULT IN EXTREMELY HAZARDOUS AND POSSIBLY DEADLY ELECTRICAL SHOCK.

PROCEDURE:

1. Turn on the utility power supply to the transfer switch using whatever means available (such as the utility power source main line circuit breaker).
2. Use an AC voltmeter to check the line-to-line and line-to-neutral voltages applied to terminal lugs N1, N2, N3 and the neutral block in the transfer switch. The meter must indicate correct rated voltage and must be compatible with transfer switch rated voltage.

RESULTS:

1. If utility supply voltage is not available, check the utility main line circuit breaker. Also make sure that a utility power source outage has not occured.
2. If the utility voltage supply to transfer mechanism terminal lugs is good, go on to Test 2.

Test 2- Check Utility Sensing Interface Input Voltage

DISCUSSION:

Utility power source voltage is not delivered directly to the utility voltage sensor board. Instead, utility source voltage is delivered to a utility voltage sensing interface. Transformers in the interface reduce the voltage. It is this reduced voltage that is delivered to the utility voltage sensor circuit board.

PROCEDURE:

Use an AC voltmeter to measure the utility source voltage across terminals N1, N2 and N3 of the utility voltage sensing interface. Correct rated utility source voltage (line-to-line) should be indicated.

RESULTS:

1. If voltage readings are good, go on to Test 3.
2. If voltage readings are bad but readings in Test 1 were good, inspect and test Wires N1/N2/N3 (between the transfer mechanism and the utility sensing interface). Repair, reconnect or replace any bad wire(s).

Test 3- Check Utility Voltage Interface Output Voltage

DISCUSSION:

The utility voltage sensing interface will reduce the utility source voltage at a fixed ratio. This test, in conjunction with Test 2, will indicate whether a fault exists in the utility sensing interface.

PROCEDURE:

Use an AC voltmeter to test for correct interface output voltage across interface terminals 224 through 227. Test connections and acceptable interface output voltages are listed in the following chart.

Test 3- Check Utility Voltage Interface Output Voltage (Continued)

TEST ACROSS TERMINALS	224-225 225-226 224-226	224-227 225-227 226-227
LINE-TO-LINE RATED VOLTS	OUTPUT VOLTS	
600 Volts AC	40-43 VAC	22.5-25 VAC
480 Volts AC	40-43 VAC	22.5-25 VAC
400 Volts AC	40-43 VAC	22.5-25 VAC
240 Volts AC	40-43 VAC	22.5-25 VAC
208 Volts AC	36.5-39 VAC	20.5-23 VAC

RESULTS:

1. If voltage readings in Test 3 are bad, but readings taken in Test 2 were good, replace the utility sensing interface.
2. If readings taken in both Test 2 and Test 3 were good, go on to Test 4.

Test 4- Calibrate Utility Voltage Sensor Circuit Board

DISCUSSION:

The utility sensing interface reduces utility source voltage at a fixed ratio. Thus, if utility voltage varies from the nominal, sensing voltage to the circuit board will also vary. For that reason, calibration of the circuit board to match system voltage may be required.

CAUTION: The installed transfer switch must be rated at a voltage and phase that is compatible with the utility and standby power supplies. DO NOT attempt to calibrate any utility voltage sensor board on a non-compatible unit in an attempt to make the unit compatible.

Once the circuit board has been properly calibrated, the voltage that was present during calibration establishes 100 percent utility voltage for "pickup" and "dropout" settings. Utility source voltage must be available to the transfer switch during calibration.

PROCEDURE:

1. In the transfer switch enclosure, set the maintenance disconnect switch to "Manual".
2. On the utility voltage sensor circuit board, locate Test Points "TP3" and "TP4" (Figure 1). Connect a jumper wire across these two test points.
3. Locate the small potentiometer "R10". Turn the potentiometer fully counterclockwise.
4. Now, turn the "R10" potentiometer SLOWLY clockwise until the "Utility On" lamp (LED) just turns on.
5. Remove the jumper wire from "TP3" and "TP4".
6. Reset the maintenance disconnect switch to "Automatic".

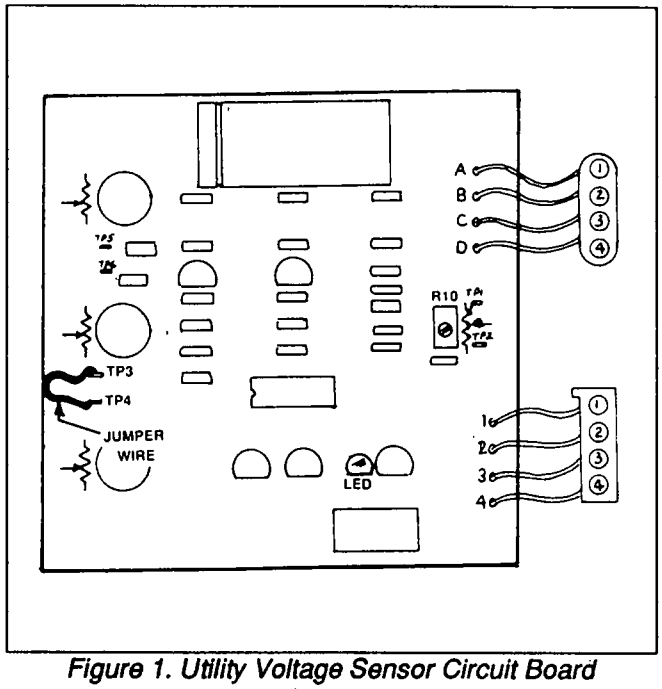


Figure 1. Utility Voltage Sensor Circuit Board

RESULTS:

1. If the "Utility On" lamp (LED) does NOT turn on as described under "Procedure", replace the utility voltage sensor board. Calibrate the new board and perform a "Normal Test" of the system.
2. If the "Utility On" lamp turns on, discontinue tests.

Test 5- Check Voltage at Terminals T1/T2/T3

DISCUSSION:

Terminals T1, T2 and T3 are the "load side" terminals of the transfer mechanism. Either "Utility" or "Standby" voltage is always available to the "Load" terminals, unless (a) the main contacts are at their "Neutral" position, or (b) one or both of the supply voltage sources has failed. If power is not available to the load terminals, the 7-day exercise timer will not function. In addition, neither of the "Switch Position" lamps on the switch enclosure door will operate.

Test 5- Check Voltage at Terminals T1/T2/T3 (Continued)

PROCEDURE:

Use an AC voltmeter to test for correct rated AC voltage across terminal lugs T1, T2 and T3 and across each terminal lug and the neutral block.

RESULTS:

1. If correct rated line-to-line and line-to-neutral AC voltages are indicated, go on to Test 6.
2. If correct rated voltages are not indicvated, go on to Test 8.

Test 6- Test Transformer TR2 Input Voltage

DISCUSSION:

Transformer TR2 is the "load side" transformer. Its function is to reduce the Line 1 (T1) to Line 2 (T2) load voltage at a ratio of about 10 to 1. Thus, a line-to-line AC input voltage of 240 volts will be reduced to about 24 volts AC by transformer action. This transformer reduced voltage is delivered to the 7-day exercise circuit board for operation of the exercise timer. As long as the reduced voltage is available to the board and the timer is operating, a "Timer Operating" lamp on the board will flash.

PROCEDURE:

Use an AC voltmeter to test for correct rated line-to-line voltage across transformer TR2 terminals H1 and H4 (see Figure 2). Normal rated line to line load terminal voltage should be indicated.

RESULTS:

1. If normal rated line to line load voltage is not indicated, but normal volts was indicated in Test 5, inspect and test Wires T1 and T2 between the transformer and the transfer mechanism. Repair, reconnect or replace any defective wire(s) as required.
2. If normal rated line to line load voltage is indicated, go on to Test 7.

Test 7- Check Transformer TR2 Output Voltage

DISCUSSION:

In Test 6, input voltage to the primary winding of transformer TR2 was checked. To determine if the transformer is functioning properly, the output voltage from the transformer's secondary winding must be checked.

PROCEDURE:

Use an AC voltmeter to check the voltage across terminals X1 and X2 of transformer TR2. The indicated voltage should be about 21 volts AC for a 208 volts system; about 24 volts AC for a 240 volts system.

RESULTS:

1. If correct line to line voltage was indicated in Test 6, but correct step-down voltage was not indicated in Test 7, replace transformer TR2.
2. If the reduced voltage reading across transformer terminals X1 and X2 is correct, go on to Test 8.

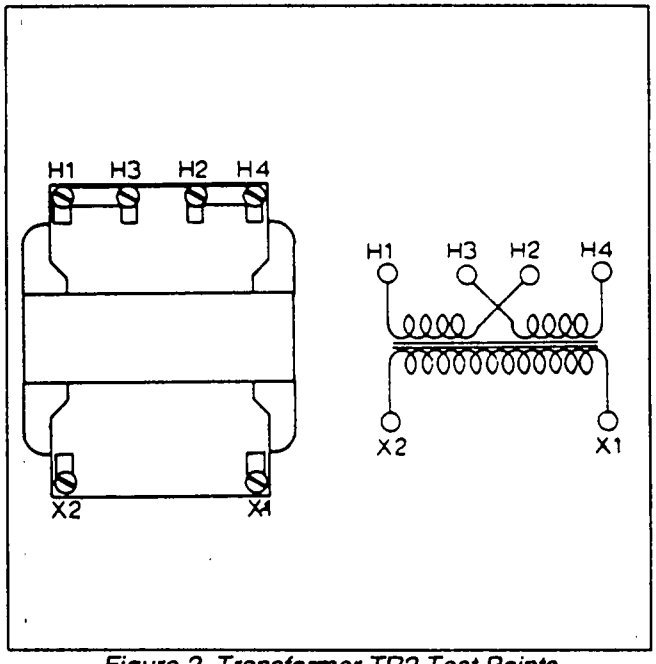


Figure 2. Transformer TR2 Test Points

Test 8- Check Main Contacts Position

DISCUSSION:

During operation in automatic (electrical) mode, the transfer mechanism main contacts will remain at "Neutral" as long as the solenoid coil remains energized. Normally, limit switch LS3 will be opened to de-energize the solenoid coil and allow spring force to complete the transfer action. On units with the "time delay at neutral" feature, a time delay relay wil be de-energized by circuit board action to de-energize the solenoid coil.

While the main contacts are at "Neutral", the load terminals (T1, T2, T3) are disconnected from both power sources and the 7-day exerciser circuit will not operate.

Test 8- Check Main Contacts Position (Continued)

PROCEDURE:

1. Observe the "Switch Position" advisory lamps on the transfer switch enclosure door. Either the "Utility" or "Emergency" lamp should be on.
2. Visually observe the main contacts through the clear plastic cover on side of transfer mechanism. The switch position can be seen (Figure 3).

NOTE: The "Changeover Display" on front of transrfer mechanism will indicate whether the main contacts are at "Utility" or "Standby". It does not provide a valid indication should the main contacts be held at "Neutral".

RESULTS:

1. If main contacts are at "Utility" and the "Switch Position-Utility" lamp is not on, check the "Utility" power supply to the transfer switch (Test 1).
2. If the main contacts are at "Standby" and the "Switch Position-Emergency" lamp is not on, check the "Standby" power supply to the transfer switch.

Test 9- Check Voltage at Exercise Board

DISCUSSION:

You should have already determined that transformer TR2 output voltage is good. That voltage must be available to the 7-day exercise board, for operation of the exercise timer circuit. This test (Test 9) will determine (a) if an open or shorted condition exists between transformer TR2 and the exercise (or CPU) board, and (b) if the exercise (or CPU) board is defective.

You may wish to review Part 10, "The CPU Type Intelligence System" and/or Part 11, "The Logic Type Intelligence System".

PROCEDURE:

Units with System Control (Logic) Board: Locate Pins 2 and 6 of the 7-day exercise board's connector plug, to which Wires 185 and 0 connect. Use an AC voltmeter to check the voltage reading across these two pins and wires. The meter should read about 21 volts for a 208 volts system; about 24 volts for a 240 volts system.

Units with CPU Circuit Board: Locate Pins 14 and 15 of the CPU board connector, to which Wires 185 and 0 connect. Use an AC voltmeter to check the voltage across these two pins and wires. Readings should be about 21 volts for a 208 volts system; about 24 volts for a 240 volts system.

RESULTS:

1. If voltage reading is bad, repair, reconnect or replace Wires 185 or 0, between transformer TR2 and the circuit board.
2. If the voltage reading is good but the "Timer Operating" lamp (LED) on the circuit board does not flash, replace the 7-day exercise board. (Lamp on CPU board does not flash.)

Test 10- Verify Main Contacts Position

DISCUSSION:

If the "Switch Position-Emergency" lamp on the transfer switch enclosure door does not come on, the first step in troubleshooting is to verify the position of the main contacts. That lamp will illuminate only if (a) the main contacts are at "Standby" and (b) if generator AC output power is available to the transfer switch.

PROCEDURE:

Refer to Test 8.

RESULTS:

1. If the main contacts are at "Standby" but lamp is not on, go to Test 11.
2. If the main contacts are NOT at "Standby", manually actuate them to the "Standby" position. Then, recheck the "Switch Position-Emergency" lamp.

Test 11- Check "Timer Operating" Lamp

DISCUSSION:

The "Timer Operating" lamp on the 7-day exercise board is powered by the same voltage source that operates the two "Switch Position" lamps. If either of the "Switch Position" lamps do not turn on, a check of the "Timer Operating" lamp will indicate whether the required step-down voltage is available for lamp operation.

PROCEDURE:

Visually check the "Timer Operating" lamp (LED) on the circuit board. The lamp should be flashing.

RESULTS:

1. If the lamp is NOT flashing, go to Problem 2.
2. If the lamp IS flashing and the "Switch Position-Utility" lamp does not come on, go to Test 12.
3. If the lamp IS flashing and the "Switch Position-Emergency" lamp does not light, go to Test 15.

Test 12- Check "Switch Position-Utility" Lamp

DISCUSSION:

With "Utility" source power available to the transfer switch and the main contacts at their "Utility" position, the "Switch Position-Utility" lamp should be ON.

Test 10 verified the position of the main contacts. Test 11 verified that power is available to operate the "Timer Operating" lamp (LED) on the 7-day exercise board. You will now want to check the "Switch Position-Utility" lamp itself.

PROCEDURE:

1. Make sure the main contacts are at "Utility" and that "Utility" source power is available to the transfer switch.
2. Connect an AC voltmeter across the two terminals of the "Switch Position-Utility" lamp, inside the transfer switch enclosure door. The meter should read about 24 volts for 240 volts systems; or 21 volts for 208 volts systems.

RESULTS:

1. If the meter reads normal step-down voltage but the lamp is out, replace the lamp.
2. If voltage is not indicated, go to Test 13.

Test 13- Test Auxiliary Contacts

DISCUSSION:

Two sets of auxiliary contacts are provided on the transfer mechanism. See "Auxiliary Contacts" on Page 8.2-2. The contacts with terminals numbered 4, 5 and 6 are for customer use. Contacts numbered 1, 2 and 3 operate the "Switch Position" lamps on the transfer switch enclosure door. Thus, a defective auxiliary contacts switch can mean that the "Switch Position" lamp(s) will not turn on.

PROCEDURE:

Before attempting to test the auxiliary contacts, first turn OFF all power voltage supplies to the transfer switch. Then, test the auxiliary contacts as follows:

DANGER: DO NOT PROCEED UNTIL BOTH THE "UTILITY" AND "STANDBY" POWER SUPPLIES TO THE TRANSFER SWITCH HAVE BEEN TURNED OFF. FAILURE TO TURN OFF ALL POWER VOLTAGE SUPPLIES MAY RESULT IN DANGEROUS AND POSSIBLE FATAL ELECTRICAL SHOCK.

1. Turn OFF all power voltage supplies to the transfer switch, using whatever means provided (such as the "Utility" or "Standby" main line circuit breakers.
2. Use the manual transfer handle to actuate the main contacts to their "Standby" position, i.e., load connected to the "Standby" source. See Section 8.5 for manual operating instructions.

a. Set a VOM to its "Rx1" scale and zero the meter. Connect the VOM test leads across auxiliary contacts terminals 1 (common) and 3 (normally-open). Meter should read as indicated in chart below.

b. Now, connect the VOM test leads across auxiliary contacts terminals 1 (common) and 2 (normally-closed). The VOM should read as indicated in chart below.

3. Use the manual transfer handle to actuate the main contacts to their "Utility" position. See Section 8.5 for manual transfer procedures.

a. Connect the VOM test leads across terminal 1 (common) and 3 (normally-open). See chart below for correct reading.

b. Connect the VOM test leads across terminal 1 (common) and 2 (normally-closed). See chart for correct reading.

AUXILIARY CONTACTS TERMINALS	MAIN CONTACT POSITION	METER READING
1 and 3	Standby	Continuity
1 and 2	Standby	Infinity
1 and 3	Utility	Infinity
1 and 2	Utility	Continuity

RESULTS:

1. Replace auxiliary contacts, if bad.
2. If auxiliary contacts are good, go to Test 14.

Test 14- Test and Inspect Wires 185, 148 and 0

DISCUSSION:

An open condition in Wires 185, 148 or 0 will result in a failure of the "Switch Position-Utility" lamp to light.

PROCEDURE:

Refer to appropriate wiring diagram. Inspect and test Wires 185, 148 and 0 for an open, shorted or grounded condition.

RESULTS:

Repair, reconnect or replace defective wire(s) as necessary.

Test 15- Check "Switch Position-Emergency" Lamp

DISCUSSION:

When the main contacts are at "Standby" and the generator is running, the "Switch Position-Emergency" lamp should be on. You should have already checked the "Timer Operating" lamp on the exercise board (Test 11) and that lamp should be flashing. This test (Test 15) will determine if the "Switch Position-Emergency" lamp is out.

PROCEDURE:

1. With the main contacts at "Standby" and with "Standby" power available to the transfer switch (generator running), use an AC voltmeter to check voltage across the two lamp terminals. Wires 147 and 0 connect to the two terminals.
2. The meter should read about 24 volts for a 240 volts system; about 21 volts for a 208 volts system.

RESULTS:

1. If meter indicates normal step-down voltage but lamp does not light, replace the lamp.
2. If normal step-down voltage is not available to the lamp, go on to Test 13.

Test 16- Test and Inspect Wires 185, 147 and 0

DISCUSSION:

If any of these wires are open, shorted or grounded, the "Switch Position-Emergency" lamp will not function.

PROCEDURE:

Carefully inspect Wires 185, 147 and 0. Use a VOM to test wires for an open or grounded condition.

RESULTS:

Repair, reconnect or replace any defective wire(s).

Test 17- Check Position of Maintenance Disconnect Switch

DISCUSSION:

On dropout of "Utility" source voltage below a preset level and if that source voltage remains at such a low level for a preset time, closure of the 2-wire start circuit should result. Closure of the 2-wire start circuit should also result during a "Normal Test". When the 2-wire start circuit closes, engine cranking and startup should occur. If the engine does not crank in automatic mode, perhaps the maintenance disconnect switch is set to "Manual". The switch must be at "Automatic" or cranking will not occur.

PROCEDURE:

Inside the transfer switch enclosure, check that the maintenance disconnect switch is set to "Automatic".

RESULTS:

1. If the switch is at "Automatic" but engine does not crank in automatic mode, go to Test 18.
2. If switch is at "Manual", reset it to "QAutomatic" then test automatic operation.

Test 18- Check Position of Auto-Manual-Off Switch

DISCUSSION:

An auto-manual-off switch is located on the generator control console (if so equipped). The switch must be set to "Auto" position for normal automatic operations.

PROCEDURE:

On the generator control console, check that the auto-manual-off switch is set to "Auto" (if so equipped).

RESULTS:

1. If the switch is set to "Auto" but engine will not crank in automatic mode or during a "Normal Test", go to Test 19.
2. If the switch is set to "Manual" or "Off", reset it to "Auto". Then test automatic operation.

Test 19- Check Generator Fuses

DISCUSSION:

A 30 amp fuse is mounted on the generator console. A 14 amp in-line fuse is located inside the control console housing. If either of these fuses has blown, neither automatic or manual engine cranking will be possible.

PROCEDURE:

Refer to Part 5 or 6 of this manual as appropriate.

RESULTS:

1. If both fuses are good but engine will not crank, go to Test 20.
2. Replace any blown fuse(s). Then, test automatic operation.

Test 20- Jumper Start Terminals

DISCUSSION:

Automatic engine cranking normally begins when transfer switch circuit board action closes the 2-wire start circuit (Wires 178/183). This action can be simulated by using a jumper to physically close that circuit. If engine will not crank in automatic mode, this test will isolate the problem to either the generator or the transfer switch.

Test 20- Jumper Start Terminals (Continued)

PROCEDURE:

Test the system's 2-wire start capability as follows:

DANGER: THE GENERATOR ENGINE WILL CRANK AND START DURING THIS PROCEDURE. MAKE SURE ALL PERSONNEL ARE CLEAR OF THE GENERATOR BEFORE PERFORMING THIS TEST.

CAUTION: The generator must have been properly serviced and ready for use before this test is performed. Failure to properly prepare the engine-generator for use will result in damage to the unit.

1. On the generator console, set the auto-manual-off switch to "Auto".
2. On the transfer switch enclosure door, set the system test mode switch to "Automatic Mode".
3. In the transfer switch enclosure, set the maintenance disconnect switch to "Automatic".
4. In the transfer switch enclosure, locate the terminal strip with terminals 178 and 183 identified.
5. Connect a jumper wire across terminals 178 anf 183. The engine should crank and start.
6. Disconnect the jumper wire. The engine should shut down.

RESULTS:

1. If the engine does not crank when the jumper wire is connected across terminals 178/183, the problem is in the generator's DC control system. Refer to Part 5 or 6 as appropriate.
2. If the engine cranks when the jumper wire is connected across terminals 178/183, but does not crank during normal automatic operation, go to Test 21.

Test 21- Check Wires 177, 178 and 183

DISCUSSION:

Refer to appropriate transfer switch wiring diagram. An open condition in the Wires 177/178/183 circuit will prevent closure of the 2-wire start circuit. If that circuit cannot close, automatic startup will not be possible.

PROCEDURE:

Inspect and test Wires 177, 178 and 183 for an open or grounded condition.

RESULTS:

1. Repair, reconnect or replace any defective wire(s).
2. If all wires are good, go to Test 22.

Test 22- Test Maintenance Disconnect Switch

DISCUSSION:

An internal failure in the maintenance disconnect switch can result in a permanently open condition in the 2-wire start circuit. Such an open condition will result in failure of the engine to crank in automatic mode.

PROCEDURE:

1. On the generator console, set the auto-manual-off switch to "Off" (if so equipped).
2. In the transfer switch enclosure, set the maintenance disconnect switch to "Manual".
3. Turn OFF all power voltage supplies to the transfer switch using whatever means provided (such as the "Utility" and "Standby" main line circuit breakers).
4. Disconnect all wires from the maintenance disconnect switch, to prevent interaction.
5. Use an ohmmeter to test the switch. The meter should read either "infinity" or "continuity" as listed in the chart below.

RESULTS:

1. Replace the maintenance disconnect switch, if defective.
2. If switch tests good but engine will not crank in automatic mode, go to Test 4.

SWITCH POSITION	METER TEST POINTS	READING
"AUTOMATIC"	Terminals 1 and 2	Continuity
	Terminals 2 and 3	Infinity
	Terminals 4 and 5	Continuity
	Terminals 5 and 6	Infinity
	Terminals 7 and 8	Continuity
	Terminals 8 and 9	Infinity
	Terminals 10 and 11	Continuity
	Terminals 11 and 12	Infinity
"MANUAL"	Terminals 1 and 2	Infinity
	Terminals 2 and 3	Continuity
	Terminals 4 and 5	Infinity
	Terminals 5 and 6	Continuity
	Terminals 7 and 8	Infinity
	Terminals 8 and 9	Continuity
	Terminals 10 and 11	Infinity
	Terminals 11 and 12	Continuity

Test 23- Do a "Normal Test"

DISCUSSION:

Performing a "Normal Test" simulates automatic operation. When the system test mode switch is set to "Normal Test", engine will crank and start followed by transfer to the "Standby" source, just as though an actual "Utility" source failure has occured. Thus, if you

Test 23- Do a "Normal Test" (Continued)

wish to test normal automatic operation (including cranking, startup, running, transfer, etc.), the "Normal Test" method is a good way to do just that.

PROCEDURE:

Perform a "Normal Test" as outlined in Section 8.6, "Functional Tests". The generator engine should crank and start just as though a "Utility" power outage has occured. On system control (Logic) type circuit boards, LED's can be monitored during the test. These LED's turn on to indicate that various timers are operating.

When the "Normal Test" is completed, reset the switch back to "Automatic Mode". Retransfer back to the "Utility" source and generator shutdown should occur as programmed.

NOTE: For a description of automatic operating sequences and times, see Part 10 ("The CPU Type Intelligence System") or Part 11 ("The Logic Type Intelligence System"). These sequences and times can be monitored by observing LED's on the CPU or system control (logic) board.

RESULTS:

1. If generator startup and transfer to standby occurs as programmed, system operation is good.
2. If the engine does not crank, go to Problem 5.
3. If the engine cranks and starts but no transfer to "Standby" occurs, go to Test 24.
4. If startup and transfer to "Standby" are normal, but when switch is reset to "Automatic Mode", retransfer back to "Utility" does not occur, go to Problem 7.

Test 24- Check "Standby Operating" Lamp

DISCUSSION:

Transfer to either power source cannot occur unless that power supply is available to the transfer switch. For example, transfer to "Standby" cannot occur unless that power supply is available. One quick way of checking for "Standby" power is to observe the "Standby Operating" lamp on the transfer switch door. If the lamp is ON, you may assume that generator power is available.

PROCEDURE:

Perform a "Normal Test" (Test 23, above). If transfer to "Standby" does not occur, check the "Standby Operating" lamp.

RESULTS:

1. If the "Standby Operating" lamp is ON, but transfer to "Standby" did not occur, go to Test 25.
2. If the "Standby Operating" lamp is OUT or DIM, go to Test 27.

NOTE: During an actual "Utility" power outage, utiolity sensor board action will open the Wires 199/202 circuit to the system control or CPU circuit board. Opening of that circuit "tells" the system control (or CPU) board that utility voltage has dropped out. The system control (or CPU) board will then initiate transfer to the "Standby" source side. If an acceptable preset voltage is available, the 199/202 circuit will not be opened and transfer to "Standby" will not occur. During a "Normal Test", the 199/202 circuit is bypassed and transfer to "Standby" will occur even if "Utility" voltage is available. If transfer to "Standby" occurs during a "Normal Test" but not during an actual "Utility" source outage, try replacing the utility voltage sensor circuit board. On new installations with this problem, first verify that the transfer relay has been wired correctly.

Test 25- Check Terminals B1/B2 Voltage

DISCUSSION:

Following engine startup in "Automatic" or "Normal Test" mode, an engine warmup timer on the system control (or CPU) circuit board will start timing. A "Standby Voltage" and a "Standby Frequency" sensor on that circuit board will check for an acceptable (preset) generator AC output voltage and frequency. After the engine warmup timer has timed out and providing standby voltage and frequency are above a preset level, system control (or CPU) board action will energize a transfer relay. When the transfer relay energizes, its normally-open contacts will close to deliver generator output voltage to transfer mechanism terminals B1 and B2. With standby voltage available to B1/B2, transfer to the "Standby" source should occur. This test will determine if the transfer relay has energized and if generator AC output is available to terminals B1/B2.

NOTE: On units equipped with the optional time delay at neutral feature, a time delay relay will be energized at the same time as the transfer relay.

PROCEDURE:

1. Perform a "Normal Test".
2. After the engine has started, wait for the "engine warmup timer" to time out. Transfer to "Standby" should then occur.
3. If transfer does not occur, use an AC voltmeter to check for "Utility" voltage across terminals B1 and B2. Generator rated AC voltage should be indicated.

Test 25- Check Terminals B1/B2 Voltage (Continued)

RESULTS:

1. If generator rated voltage is indicated at terminals B1/B2, but transfer to "Standby did not occur, the problem is in the transfer mechanism. Go to Test 26.
2. If generator rated voltage is NOT indicated at terminals B1/B2, go to Test 28.

Test 26- Check Transfer Mechanism

DISCUSSION:

If generator AC output voltage is available to transfer mechanism terminals B1/B2, but transfer to "Standby" does not occur, the most obvious cause of the problem is a defective transfer mechanism.

This test will outline procedures for completion of "preliminary tests" of the transfer mechanism. These tests are those that can be performed with little or no disassembly of the mechanism. If the tests indicate a defective component, further disassembly and testing may be required.

DANGER: BEFORE PERFORMING PRELIMINARY TESTS, TURN OFF ALL POWER VOLTAGE SUPPLIES TO THE TRANSFER SWITCH. FAILURE TO TURN OFF ALL POWER VOLTAGE SUPPLIES MAY RESULT IN EXTREMELY HAZARDOUS AND POSSIBLY FATAL ELECTRICAL SHOCK.

PROCEDURE:

A. Test Limit Switch LS1: Test limit switch LS1 in the transfer mechanism as follows:

1. Set the maintenance disconnect switch to "Manual". This will prevent automatic operation when the "Utility" power supply is turned off.
2. Turn OFF all power voltage supplies to the transfer switch. Both the "Utility" and "Standby" power supplies must be turned off.
3. Use the manual transfer handle to actuate the main contacts to their "Standby" position.
   a. Check the changeover display on the transfer mechanism.
   b. The "Standby" arrow should point to the green band; the "Utility" arrow to the red band.
4. Set a volt-ohm-milliammeter (VOM) to its "Rx1" scale and zero the meter.
5. Connect one VOM test lead to terminal A1; the other to terminal T1. The meter should read "continuity".
6. Connect the VOM test lerads across terminals B1 and T1. The meter should read "Infinity".
7. Manually actuate the main contacts to their "Utility" power source side.

a. Check the changeover display on transfer mechanism.
b. The "Utility" arrow should point to the green band; the "Standby" arrow to the red band.

8. Connect the VOM test leads across terminals A1 and T1. The meter should read "Infinity".
9. Connect the VOM test leads across terminals B1 and T1. The meter should read "Continuity".

LEGEND
B = Bridge Rectifier
C = Solenoid Coil
LS1, LS2= Limit Switch (Switch Operation)
LS3= Limit Switch (Neutral Position)
VR = Varistor

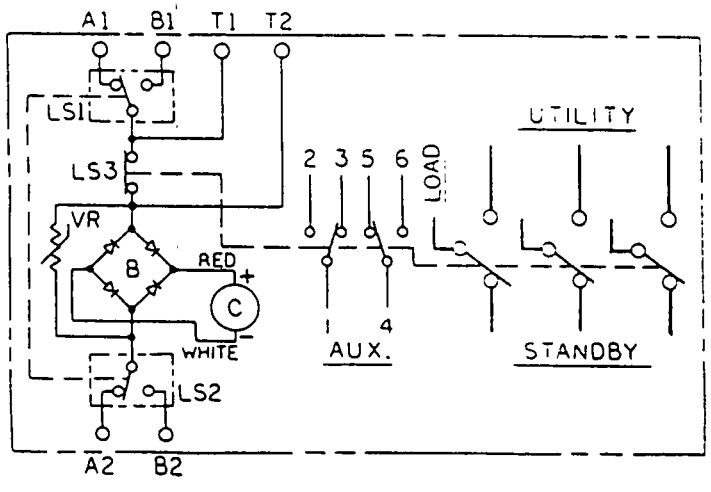


Figure 3. Transfer Mechanism Schematic Diagram

Test 26- Check Transfer Mechanism (Continued)

B. Testing Limit Switch LS2:

1. Turn OFF all power voltage supplies to the transfer switch.
2. Set the maintenance disconnect switch to "Manual" and main contacts at their "Utility" side.
3. **IMPORTANT: Use a digital meter and set the meter to its "diode test" position.**
4. Read across transfer mechanism terminals A2 and T2- meter should read "infinity".
5. Read across B2 and T2- some resistance should be read, i.e., the resistance of the varistor.
6. Manually actuate the main contacts to "Standby" and then read across A2 and T2- varistor resistance should be read.
7. Read across B2 and T2- meter should read "infinity".

C. Testing Limit Switch LS3:

1. Set the maintenance disconnect switch to "Manual".
2. Turn off all power voltage supplies to the transfer switch.
3. Set a VOM to its "Rx1" scale and zero the meter.
4. Connect the VOM test leads across transfer mechanism terminals T1 and T2.
5. Manually actuate the main contacts to "Standby" and to "Utility" several times. Check the VOM reading with the contacts at "Utility", with the contacts at "Standby", and with the contacts at "Neutral".
   a. With main contacts at "Neutral", VOM should read "Infinity".
   b. At "Utility", the VOM should read "Continuity".
   c. At "Standby", the VOM should indicate "Continuity".

D. Testing the Bridge Rectifier:

1. Set the maintenance disconnect switch to "Manual".
2. Turn OFF all power voltage supplies to the transfer switch.
3. On the transfer mechanism, locate the solenoid coil cover. Remove the cover to expose the coil terminals. Cover may display a "Tap Change of Coil" diagram.
   a. A RED wire indicates the positive (+) side of coil.
   b. A WHITE wire indicates negative (-) side of coil.
4. To prevent interaction, disconnect the red and white wires from the far left and far right coil terminals (red wire at left, white wire at right).
5. Manually actuate the main contacts to their "Standby" position ("Standby" arrow next to the green color band).
6. Set a VOM to its "Rx1" scale and zero the meter.
7. Connect the VOM positive (+) test lead to the terminal end of red wire at far left.
8. Connect the common (-) VOM test lead to transfer mechanism terminal A2. Observe the meter reading.
9. Now, reverse the test leads. That is, connect the common (-) test lead to terminal end of red wire and the positive (+) test lead to terminal A2. Observe the meter reading.
   a. The forward resistance of a bridge rectifier diode should be indicated at one polarity only.
   b. At opposite polarity, VOM should read "Infinity".
10. Now, connect the VOM positive (+) test lead to terminal end of white wire and the common (-) test lead to terminal A2. Observe the meter reading.
11. Reverse the test leads. Again, observe the meter reading.
   a. At one polarity, the meter should indicate the forward resistance of a bridge rectifier diode.
   b. At the opposite polarity, the VOM should read "Infinity".
12. Connect the positive (+) VOM test lead to terminal A1; the common (-) test lead to the red wire. Note the meter reading. Reverse the test leads and again note the meter reading.
   a. At one polarity, the VOM should read the forward resistance of a diode.
   b. At the opposite resistance, the meter should read "Infinity".
13. Finally, connect the positive (+) VOM test lead to terminal A1; the common (-) test lead to the white wire. Note the reading. Then, reverse the test leads and again note the reading.
   a. At one polarity, the VOM should read diode resistance.
   b. At the opposite polarity, the meter should read "Infinity".

NOTE: When reconnecting the red and white wires to the actuating coil, be sure to follow the "Tap Change of Coil" diagram.

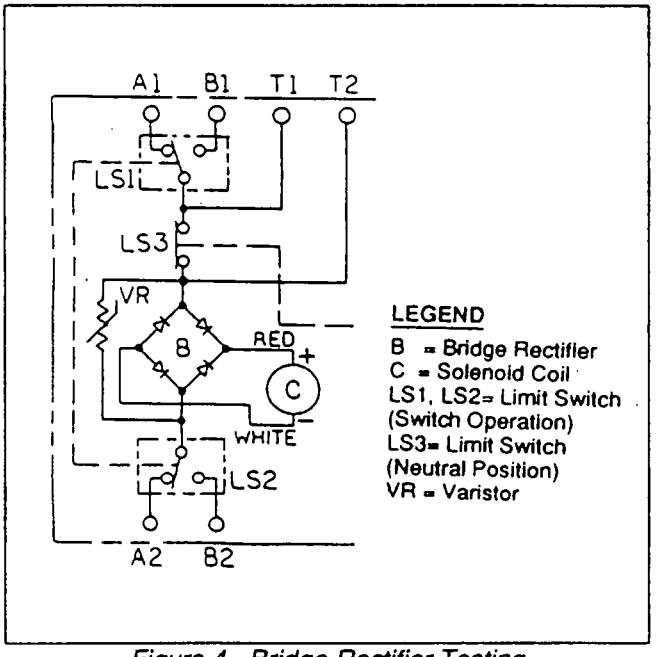


Figure 4. Bridge Rectifier Testing

E. Testing the Actuating Coil:

Test the transfer mechanism's actuating coil as follows:

1. Set the maintenance disconnect switch to "Manual".
2. Turn OFF power voltage supplies to transfer switch.

Test 26- Check Transfer Mechanism (Continued)

3. Remove outer cover and plastic actuating coil cover.
4. Disconnect the red and white wires from the actuating coil.
5. Use a VOM to measure actuating coil resistance as follows:

a. From the red wire to outer terminal, about 34-36 ohms.

b. From the white wire to the outer terminal, about 34-36 ohms.

Test 27- Test Generator Voltage and Frequency

DISCUSSION:

Transfer to the "Standby" source will not occur in automatic mode until after (a) the engine has started, (b) an engine warmup timer has timed out, and (c) generator AC output frequency and voltage have reached preset minimum values. This test will determine if generator AC output voltage and frequency are high enough to permit a "transfer to standby" operation.

PROCEDURE:

1. Refer to Test 1 in this section. Check voltage at terminals N1/N2/N3 as outlined in that test. Normal rated voltage of the system should be indicated.
2. Use an AC frequency meter to test the frequency at the "Utility" terminal lugs (N1/N2). Normal rated AC frequency should be indicated.

RESULTS:

1. If voltage and frequency check good, go to Test 29.
2. If voltage/frequency are low or zero, troubleshoot the AC generator systems as outlined in Part 2, 3 or 4 of this manual as appropriate.

Test 28- Test Transfer Relay

DISCUSSION:

During automatic operation, system control (or CPU) circuit board action should energize the transfer relay to initiate automatic transfer to the "Standby" power source (providing utility voltage sensor board action has opened the Wires 199/202 circuit).

When "Utility" power has been restored, utility voltage sensor board action will open the Wires 199/202 circuit. System control (or CPU) board action will then open the transfer relay circuit. The transfer relay will de-energize, its normally-closed contacts will close, and retransfer back to "Utility" will be initiated.

Failure of the transfer relay can mean (a) no transfer to "Standby", or (b) no retransfer back to "Utility".

PROCEDURE:

Test the transfer relay as follows:

1. Set the maintenance disconnect switch to "Manual", to prevent automatic startup when power voltage supplies are turned off.
2. Turn OFF all power voltage supplies to the transfer switch, using whatever means provided (such as the "Utility" and "Standby" main line circuit breakers).
3. Disconnect all wires from the transfer relay terminals (see Figure 5). Note wire numbers and the relay terminals to which they connect.
4. Connect the positive (+) post of a 12 volts battery to relay terminal B. Connect the battery negative (-) post to relay terminal A. The relay should energize.
5. With the relay energized, connect the test leads of a VOM across relay terminals 6 and 9, then across terminals 1 and 7. In each case, note the meter resistance readings.
6. Disconnect the battery posts from relay terminals A and B. The relay should de-energize.
7. With the relay de-energized, connect the VOM test leads across relay terminals 1 and 7; also across terminals 6 and 9. Again, note the meter readings.

Correct readings in each case are listed in the chart below.
Be sure to reconnect all wires to the relay terminals before proceeding.

TRANSFER RELAY CONDITION	ACROSS TERMINALS	DESIRED READING
ENERGIZED	1 and 7	Infinity
ENERGIZED	6 and 9	Continuity
ENERGIZED	4 and 7	Continuity
DE-ENERGIZED	1 and 7	Continuity
DE-ENERGIZED	6 and 9	Infinity
DE-ENERGIZED	4 and 7	Infinity

Test 28- Test Transfer Relay (Continued)

RESULTS:

1. Replace transfer relay if it is defective.
2. If transfer relay is good, perform Test 22, "Test Maintenance Disconnect Switch". If maintenance disconnect switch is good, complete Test 31.

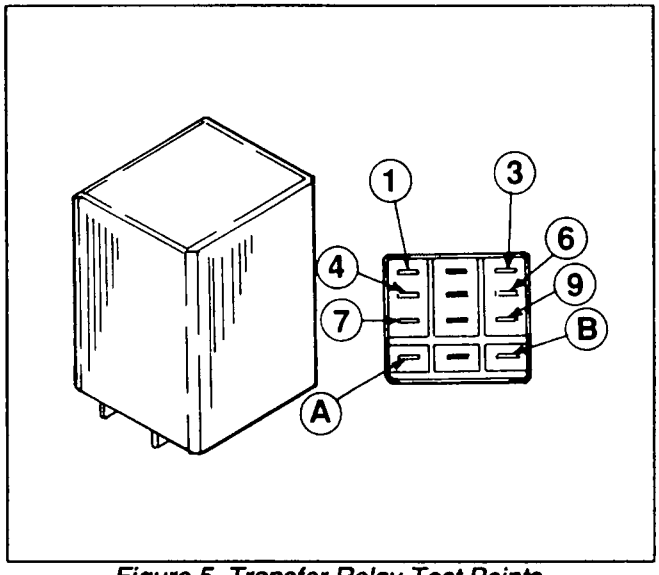


Figure 5. Transfer Relay Test Points

Test 29- Test Transformer TR1

DISCUSSION:

Power for system control (or CPU) circuit board operation is taken from the secondary winding of transformer TR1. Secondary winding output from that transformer also operates the "Standby Operating" lamp on the transfer switch enclosure door. Without the reduced output of transformer TR1, the system control (or CPU) circuit board will not operate and transfer to "Standby" will not occur.

PROCEDURE:

A. Check TR1 Primary Winding Input

1. With the standby generator running and its main line circuit breaker closed, use an AC voltmeter to check for correct voltage across transformer terminals H1 and H4.
2. Normal rated generator AC output voltage should be indicated.

B. Check TR1 Secondary Winding Output

1. With the generator still running, check for correct step-down voltage across transformer terminals X1 and X2.
2. For a system rated 208 volts, reading should be 21 volts.
3. For a 240 volts system, reading should be about 24 volts.

NOTE: The step-down ratio of transformer TR1 is fixed at a ratio of approximately 10-to-1. For that reason, the secondary winding output voltage will vary as the standby generator voltage varies.

RESULTS:

1. If primary winding input voltage is zero or low, but generator voltage and frequency reading in Test 27 was good, test Wires E1 and E2 between the transfer mechanism and the trransformer. Repair, reconnect or replace any bad wire(s).
2. If primary winding input voltage is good, but secondary winding output voltage is bad, replace the transformer TR1.
3. If input voltage to primary winding is good and output from secondary winding is also good, go to Test 30.

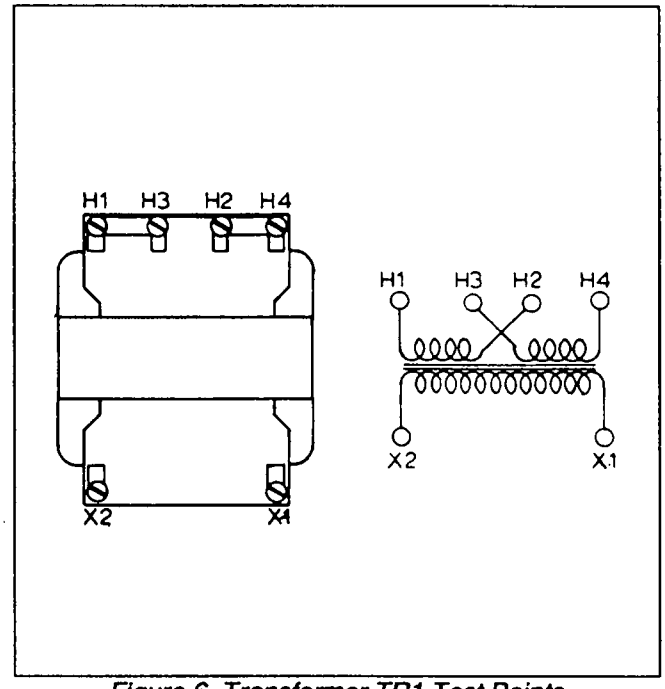


Figure 6. Transformer TR1 Test Points

Test 30- Check Wires 191, 192

DISCUSSION:

The step-down voltage from transformer TR1 secondary windings is delivered to (a) the "Standby Operating" lamp, and (b) the system control (or CPU) circuit board, via Wires 191 and 192.

PROCEDURE:

Inspect and test Wires 191/192, between transformer TR1 and the "Standby Operating" lamp and between the "Standby Operating" lamp and the system control (or CPU) circuit board.

Test 30- Check Wires 191, 192 (Continued)

RESULTS:

Repair, reconnect or replace defective wire(s), as necessary.

Test 31- Test Logic (or CPU) Circuit Board

DISCUSSION:

During operation in automatic mode, system control (or CPU) circuit board action may be briefly described as follows:

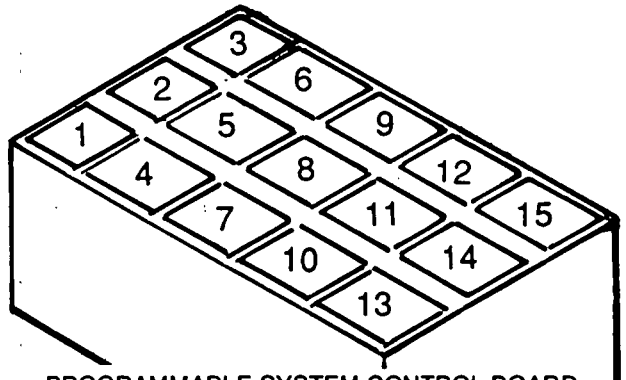
1. The circuit board is turned on by step-down voltage from the secondary winding of transformer TR1. This is transformer reduced "Standby" source voltage.
2. When turned on, an "engine warmup timer" starts timing.
3. The board delivers 12 volts to a transfer relay coil via Wire 194. From the relay coil, the circuit is completed back to the circuit board via Wire 23. However, circuit board action will hold the Wire 23 circuit open until the following requirements are met:
   a. Utility voltage sensor board action must have opened the Wires 199/202 circuit due to a "Utility" voltage dropout below a preset level.
   b. The "engine warmup timer" must have finished timing.
   c. "Standby" voltage must be at or above the setting of a "standby voltage" sensor on the circuit board.
   d. "Standby" frequency must be at or above the setting of a "standby frequency" sensor on the circuit board.
4. When all of the above conditions have been met, circuit board action will complete the Wire 23 circuit to ground.
   a. The transfer relay will then energize.
   b. Transfer to "Standby" will be initiated as the normally-open contacts of the transfer relay close to deliver "Standby" source power to transfer mechanism terminals B1/B2.

PROCEDURE:

1. Perform a "Normal Test" of the system. See Section 8.6, "Functional Tests".
2. During the "Normal Test", observe lamps on the transfer switch doorand on the system control board (not on the CPU board) as follows:
   a. Check that the "Standby Operating" lamp on the transfer switch enclosure door is lighted.
   b. Check that the "Engine Warmup Timer" lamp (LED) on the circuit board turns on and goes out when the timer has finished timing.
   c. Check that the "Standby Voltage Sensor" lamp (LED) on the circuit board turns on.
   d. Check that the "Standby Frequency Sensor" lamp (LED) on the circuit board turns on.
3. If transfer to "Standby" does not occur, proceed as follows with the generator running.
   a. Locate Pin 11 of the system control (or CPU) circuit board connector, to which Wire No. 23 connects. Also locate Pin 2 of the circuit board connector, to which Wire 202 connects.
   b. Connect a jumper wire from Pin 11 (Wire No. 23) and to Pin 2 (Wire No. 202).
   c. When the jumper wire is connected across Pins 11 and 2 (Wires 23 and 202), the transfer relay should energize and transfer to "Standby" should occur.

RESULTS:

If transfer to "Standby" occurs when the jumper wire is connected, but does not occur normally, replace the system control (or CPU) circuit board. Then, retest automatic operation.



PROGRAMMABLE SYSTEM CONTROL BOARD PLUG IS SHOWN. FOR "CPU" BOARD CONNECTOR CONFIGURATION, SEE APPROPRIATE WIRING DIAGRAM.

Figure 7. System Control (CPU) Board Connector

Test 32- Is "Utility On" Lamp Lit?

DISCUSSION:

The "Utility On" lamp is located on the utility voltage sensor circuit board. The lamp (LED) should illuminate when "Utility" source voltage is above the setting of a "voltage dropout sensor". Check condition of this lamp if retransfer back to the "Utility" source does not occur in automatic mode.

PROCEDURE:

Simply observe the lamp (LED). If the LED is lighted, "Utility" source sensing voltage is available to the utility voltage sensor board.

RESULTS:

1. If lamp is ON, but retransfer does not occur, go to Test 33.
2. If lamp is OUT, go to Problem 1.

Test 33- Check Voltage at Terminals A1/A2

DISCUSSION:

Transfer mechanism terminals A1/A2 are the "retransfer back to utility" terminals. These two terminals are powered by "Utility" source voltage when the transfer relay de-energizes, to initiate the retransfer action. This test will determine if the transfer relay has de-energized to deliver "Utility" source voltage to terminals A1 and A2.

PROCEDURE:

Perform a "Normal Test". Wait for the generator engine to start and wait for transfer to "Standby" to occur. Then, set the system test mode switch back to its "Automatic Mode" position. Let the circuit board timers time out and then determine if retransfer back to the "Utility" source has occured ("Switch Position-Utility" lamp comes on). If retransfer back to "Utility" does not occur, use an AC voltmeter to check voltage across terminals A1 and A2. Normal rated "Utility" voltage should be indicated.

RESULTS:

1. If "Utility" source voltage is NOT indicated, go to Test 28 (see Problem 7 on Page 8.9-6).
2. If voltage reading at A1/A2 is good but retransfer back to "Utility" does not occur, go to Test 34.

Test 34- Test Time Delay Relay

DISCUSSION:

Some transfer switches may be equipped with the "time delay at neutral" feature. That feature functions to hold the transfer mechanism's solenoid coil energized for a preset time period. The main contacts will remain at "Neutral" as long as the solenoid coil is energized.

The time delay relay is normally energized by system control (or CPU) circuit board action during any transfer operation. When the relay is energized, its normally-open contacts will close to bypass limit switch LS3 and allow the solenoid coil to remain energized for a preset time. A time delay resistor limits current flow to the coil. After a "time delay neutral timer" on the system control (or CPU) board has finished timing, circuit board action will de-energize the time delay relay. The relay's contacts will then open and the solenoid coil will de-energize. Spring force will then complete the transfer action.

A defective time delay relay can (a) prevent transfer by keeping the main contacts at "Neutral", or (b) result in immediate transfer without occurence of the "time delay at neutral" function.

PROCEDURE:

See Test 28. Test the time delay relay in the same manner as the transfer relay.

RESULTS:

1. Replace time delay relay if defective.
2. If time delay relay tests good, go to Test 35.

Test 35- Test Wires 199/202 Action

DISCUSSION:

During a utility power source dropout, utility voltage sensor board action should open the Wires 199/202 circuit, to "tell" the system control (or CPU) board that a utility power source failure has occured. If the circuit is not closed, the system control (or CPU) board will not initiate transfer to the "Standby" side.

When utility source voltage has been restored, the utility voltage sensor board must re-close the Wires 199/202 circuit. If the circuit is not re-closed, retransfer back to "Utility" will not occur.

PROCEDURE:

Perform a "Normal Test". Wait for the standby generator to start and wait for transfer to the "Standby" side. Then, proceed as follows:

1. **System Control (Logic) Circuit Boards Only:** Reset the system test mode switch back to "Automatic Mode" and observe the "return to utility timer" lamp (LED) on the circuit board. That lamp should turn on as soon as the system test mode switch is reset back to "Automatic Mode". Retransfer should occur when the timer has timed out.
CPU Circuit Boards: This circuit board is not equipped with a "return to utility timer" lamp. The board's "return to utility timer" has a fixed (non-adjustable) setting of 30 seconds. Reset the system test mode switch back to "Automatic Mode" and wait for 30 seconds. Retransfer back to "Utility" should occur when the timer has timed out.
2. If retransfer back to "Utility" does not occur, test the Wires 199/202 action as follows (see Figure 8):
   a. Insert a jumper wire into Pins 1 and 2 of the utility voltage sensor board's connector plug. Wires 199 and 202 attach to these pins.
   b. Wait about a minute to see if retransfer back to "Utility" occurs.

RESULTS:

1. If retransfer occurs when Wires 199/202 are jumpered, but does not occur otherwise, replace the utility voltage sensor board. Calibrate the new board (Test 4) and perform a "Normal Test".

Test 35- Test Wires 199/202 Action

2. If retransfer does not occur when the wires are jumpered, go to Test 36.

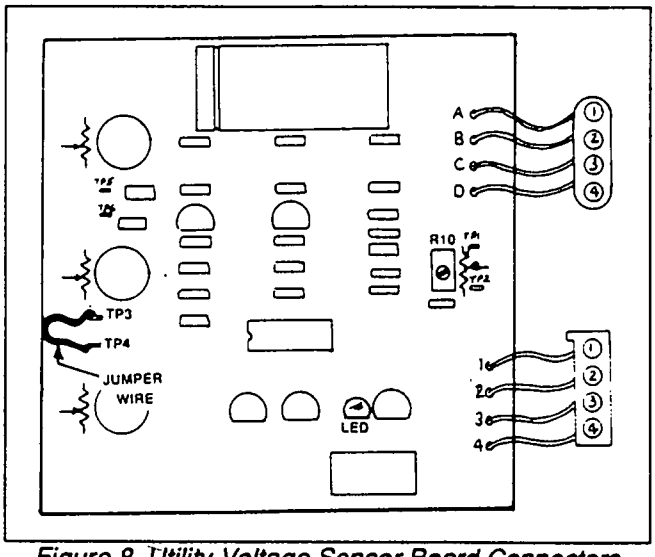


Figure 8. Utility Voltage Sensor Board Connectors

Test 36- Turn Time Delay Neutral Switch Off

DISCUSSION:

This test is a continuation of Test 35. If system control (or CPU) board has failed to de-energize the time delay relay, transfer will not occur. By turning the time delay neutral switch "Off", the relay circuit is broken and the relay must de-energize.

PROCEDURE:

Turn the time delay neutral switch to "Off" and observe transfer switch action.

RESULTS:

1. If retransfer back to "Utility" occurs when the switch is reset to "Off", replace the system control (or CPU) circuit board.
2. If retransfer back to "Utility" does not occur, perform Test 26.