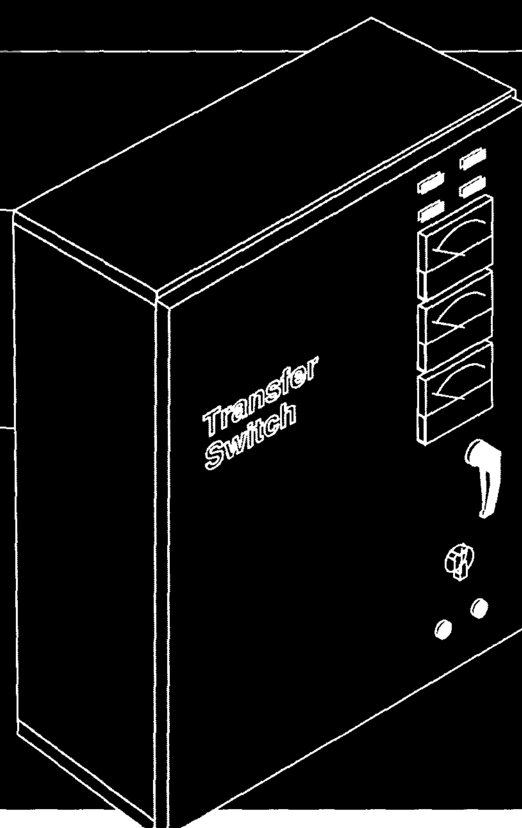
Onan

Service Manual

OT III

Transfer Switch
40 to 1000 Amperes



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⚠WARNING

INCORRECT SERVICE OR REPLACEMENT OF PARTS CAN RESULT IN DEATH, SEVERE PERSONAL INJURY, AND/OR EQUIPMENT DAMAGE. SERVICE PERSONNEL MUST BE QUALIFIED TO PERFORM ELECTRICAL AND/OR MECHANICAL SERVICE.

Safety Precautions

This manual includes the following symbols to indicate potentially dangerous conditions. Read the manual carefully and know when these conditions exist. Then take the necessary steps to protect personnel and the equipment.

DANGER ***This symbol warns of immediate hazards that will result in severe personal injury or death.***

WARNING ***This symbol refers to a hazard or unsafe practice that can result in severe personal injury or death.***

CAUTION ***This symbol refers to a hazard or unsafe practice that can result in personal injury or product or property damage.***

High voltage in OT transfer switch components presents serious shock hazards that can result in severe personal injury or death. Read and follow these suggestions.

Keep the transfer switch cabinet closed and locked. Make sure only authorized personnel have the cabinet and operational keys.

Due to the serious shock hazard from high voltages within the cabinet, all service and adjustments to the transfer switch must be performed only by an electrician or authorized service representative.

If the cabinet must be opened for any reason:

1. Move the operation selector switch on the generator set or Stop/Auto/Handcrank switch on the automatic transfer switch (whichever applies) to Stop.
2. Disconnect the starting batteries of the generator set (remove the ground [–] lead first).
3. Remove AC power to the automatic transfer switch. If the instructions require otherwise, use extreme caution due to the danger of shock hazard.

Place rubber insulative mats on dry wood platforms over metal or concrete floors when working on any electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surfaces to be damp when handling any electrical equipment.

Jewelry is a good conductor of electricity and should be removed when working on the electrical equipment.

Do not work on this equipment when mentally or physically fatigued, or after consuming alcohol or any drug that makes the operation of equipment unsafe.

1. Introduction

ABOUT THIS MANUAL

This manual contains service procedures for an OT transfer switch. Sections 1, 2, 3, and 4 cover the utility-to-generator set automatic transfer switch.

Although much of the information on theory of operation, Power Sentry® calibration, and troubleshooting in sections 1, 2, and 3 is applicable to generator set-to-generator set, utility-to-utility, and nonautomatic/remote configurations; there are several significant differences.

Refer to section 5 for an overview of the generator set-to-generator set transfer switch.

Refer to section 6 for an overview of the utility-to-utility transfer switch.

Refer to section 7 for an overview of the non-automatic/remote transfer switch.

Refer to the schematic and wiring diagram package that was shipped with the transfer switch for specific information about its configuration.

Section 4 of this manual covers transfer switch assembly service procedures for all configurations.

Use normal and necessary safety precautions before starting any service procedures. Identify all hazards by referring to the Safety Precautions printed inside the front cover and observe all warnings and cautions within the manual. Whenever troubleshooting, remember that the generator set, transfer switch, and utility power source are all interdependent.

TRANSFER SWITCH APPLICATION

Transfer switches are an essential part of a building's standby or emergency power system. The Normal power source, commonly the utility line, is backed up by an Emergency power source, often a generator set. The transfer switch supplies the electrical load with power from one of these two power sources.

The load is connected to the common of the transfer switch (Figure 1-1). Under normal conditions, the load is supplied with power from the Normal source (as illustrated). If the Normal power source is interrupted, the load is transferred to the Emergency power source. When Normal power returns, the load is retransferred to the Normal power source. The transfer and retransfer of the load are the two most basic functions of a transfer switch.

Power Sentry is a registered trademark of Onan Corporation.

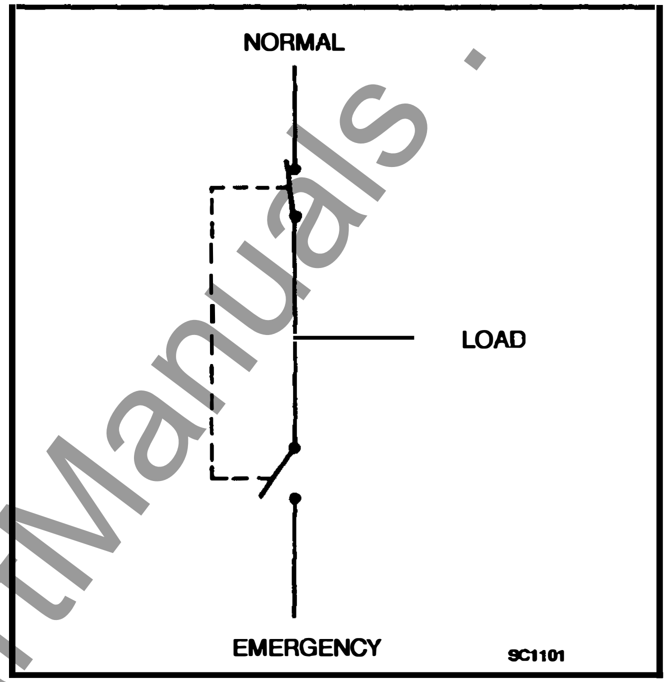


FIGURE 1-1. LOAD TRANSFER SWITCH (TYPICAL FUNCTION)

AUTOMATIC TRANSFER SWITCHES

Automatic transfer switches, capable of automatic operation without operator involvement, perform the following basic functions:

1. Sense the interruption of the Normal power source.
2. Send a start signal to the generator set (Emergency power source).
3. Transfer the load to the Emergency power source.
4. Sense the return of the Normal power source.
5. Retransfer the load to the Normal power source.
6. Send a stop signal to the generator set.

MODEL IDENTIFICATION

Identify your model by referring to the Model and Specification number as shown on the nameplate. Electrical characteristics are shown on the lower portion of the nameplate, which is located on the cabinet door. Refer to the last page of this section for a list of feature/option codes.

If it is necessary to contact a dealer or the factory regarding the transfer switch, always give the complete Model, Specification, and Serial number as listed on the nameplate. This information is necessary to properly identify your unit among the many types manufactured.

CABINET

The standard cabinet meets the requirements of the National Electrical Manufacturers Association (NEMA) for a UL Type 1 cabinet. This type is designated as a general-purpose, indoor cabinet. The door of a typical utility-to-generator set cabinet is shown in Figure 1-2.

Refer to section 5, 6, or 7 if applicable.

Indicator Lamps

There are four indicator lamps on the cabinet door. The Normal Available and Emergency Available lamps are lit whenever their corresponding power sources (utility or generator set) are producing power. These two lamps can be lit simultaneously.

The Normal Connected and Emergency Connected lamps indicate which power source is connected to the load. Only one of these two lamps can be lit.

Test/Normal/Retransfer Switch

This switch has three positions. In the Normal position, the transfer switch is set for automatic operation. Moving the switch to Test sends a start signal to the generator set. After the transfer time delay, the generator set will assume the load—provided that the Test With/Without Load switch (Figure 1-3) is in the With Load position.

Moving the switch to Normal causes the load to transfer to the Normal power source after the retransfer time delay. To avoid the delay and cause a fast retransfer of load to the Normal power source, move the switch to the Retransfer position.

Optional Meter Package

The optional meter package includes an AC ammeter, an AC voltmeter, a frequency meter, and a phase selector switch.

AC Voltmeter: The voltmeter measures line-to-line voltage of the selected power source.

AC Ammeter: The ammeter measures the line currents of the load.

Frequency Meter: This meter measures the output frequency of the selected power source in hertz.

Phase Selector Switch: This switch is used to select the source and phase to be measured.

On transfer switches with an AC ammeter, the load wires must each pass through a current transformer.

Optional Auto/Manual Switch (Utility-to-Generator Set)

The Auto/Manual switch is used to enable or disable the automatic retransfer function. This switch has two positions. In the Auto position, normal automatic retransfer is enabled. In the Manual position, automatic retransfer (from a functioning generator set back to utility power) is disabled; only manual retransfer (using the Test/Normal/Retransfer switch) is possible. In the event of generator set failure, however, the Power Sentry control logic will ignore the Auto/Manual switch and initiate retransfer to utility power.

Refer to section 6 for a description of the optional Auto/Manual switch on utility-to-utility transfer switches.

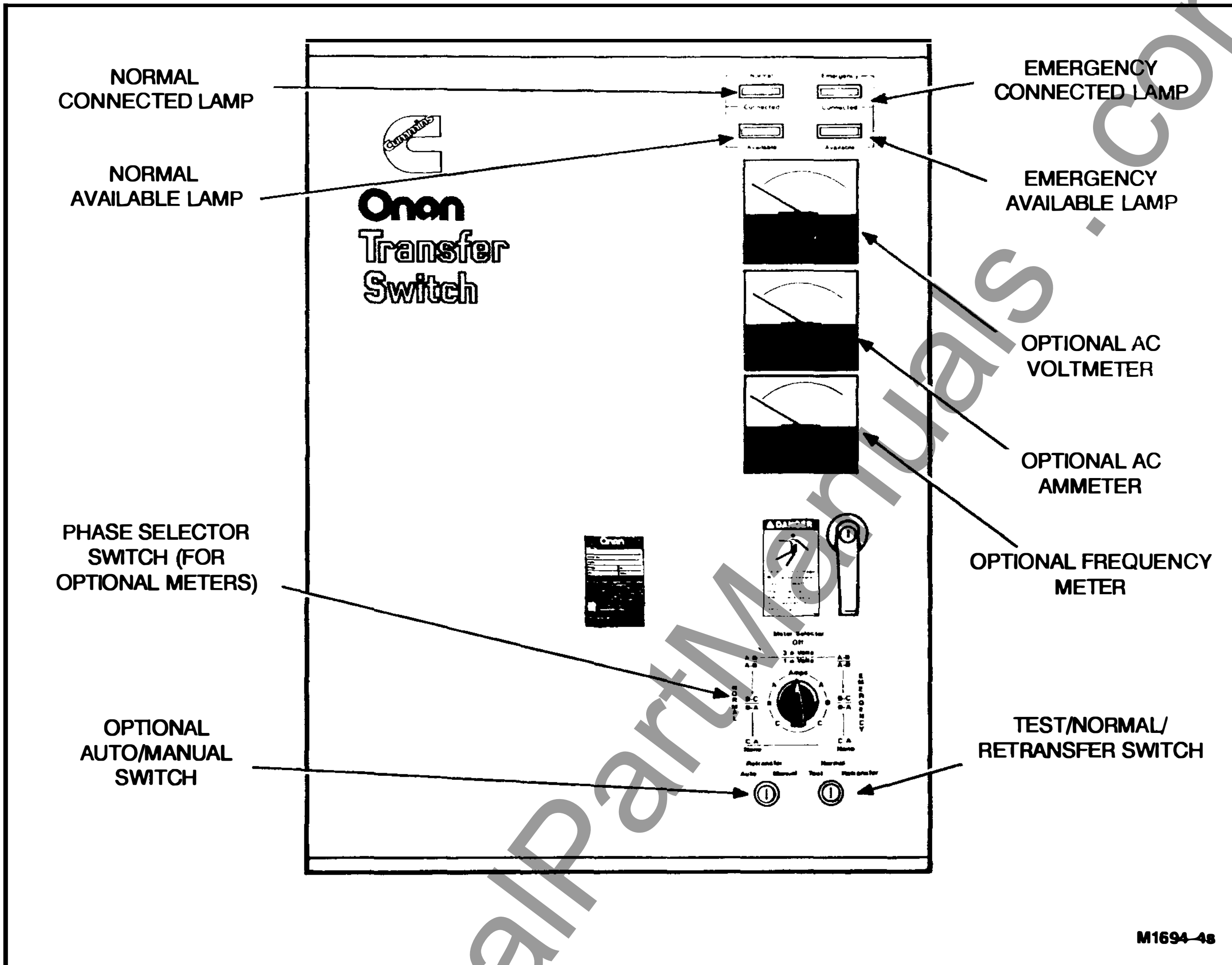


FIGURE 1-2. UTILITY-TO-GENERATOR SET TRANSFER SWITCH CABINET EXTERIOR

TRANSFER SWITCH ASSEMBLY

The transfer switch (Figure 1-3) opens and closes the contacts that transfer the load between Normal and Emergency power. The transfer switch is mechanically interlocked to prevent simultaneous closing to both power sources. The main parts of the transfer switch discussed here are the contact assemblies, linear actuator, capacitor(s), Motor Disconnect switch, auxiliary switches, and auxiliary contacts. Transfer switch assembly maintenance procedures are described in Section 4.

Contact Assemblies

The transfer switch either has three or four poles. Three pole transfer switches are provided with a neutral bar. The contact assemblies make and break the current flow. When closed to either the Normal or the Emergency power source, the contacts are mechanically held. A mechanical interlock prevents them from closing to both power sources at the same time.

Linear Actuator

The linear actuator is a linear induction motor that moves the contact assemblies between the Normal power source and the Emergency power source. Linear actuator operation is initiated automatically with automatic transfer switches. Manual operation of the transfer switch is also possible. Refer to Manual Operation.

Capacitor(s)

Either one or two capacitors (refer to Section 4) provide the phase shift necessary to drive the linear motor. If the capacitor is faulty, the linear motor does not operate.

Motor Disconnect Switch

The Motor Disconnect toggle switch, on the accessory control panel, enables and disables the linear actuator circuit. Place the switch in the Auto position to enable the linear actuator. Place the switch in the Off position to disable the linear actuator.

Auxiliary Switches

Eight auxiliary switches are configured to respond to the position of the transfer switch. When the transfer switch is in the Normal position, switches S2, S3, S4, and S5 are actuated. When the transfer switch is in the Emergency position, switches S6, S7, S8, and S9 are actuated. Refer to Section 2 and to the schematic and wiring diagram package for more information on the functions of the individual switches.

The schematic and wiring diagram package is shipped with the transfer switch. Contact your distributor if you do not have a set of drawings. Refer to Section 4 for a description of auxiliary switch maintenance procedures.

Auxiliary Contacts

Auxiliary contacts are provided on the Normal (switch S2) and Emergency (switch S6) sides of the transfer switch. They are actuated by operation of the transfer switch during transfer and retransfer.

The Normal side auxiliary contact switch is actuated when the transfer switch is in the Normal position. The Emergency side auxiliary contact switch is actuated when the transfer switch is in the Emergency position.

The auxiliary contacts have current ratings of 10 amperes at 250 VAC.

ELECTRONIC CONTROL

Figure 1-3 shows the interior of a 125-ampere utility-to-generator set transfer switch. Due to differences in cabinet sizes, the location of some of the optional modules in your transfer switch may not be the same as shown here.

Refer to section 5, 6, or 7 if applicable.

The most important component of the electronic control system is the Power Sentry Control. The Power Sentry includes voltage sensing circuits, time delay circuits and control relays. There are also several adjustment potentiometers and indicator lamps on the Power Sentry. The adjustments must be performed only by qualified service personnel.

Power Sentry Time Delays

Start Time Delay: This delay is adjustable from 0 to 15 or (optionally) 0 to 90 seconds. This brief time delay prevents generator set starting during power interruptions of short duration. Timing starts the moment of Normal (utility) power interruption. If the duration of the interruption exceeds the delay time, the control system signals the generator set to start.

Stop Time Delay: This delay is adjustable from 0 to 10 minutes. It begins timing when the load is retransferred to the Normal power source. At the end of the delay, the stop signal is sent to the generator set. This time delay allows the generator set to cool down at no load before stopping.

Transfer Time Delay: This delay begins when generator voltage and frequency reach the settings of the control. After the delay, the transfer switch transfers the load to the Emergency power source. This brief time delay allows the generator set to stabilize before the load is applied. It has an adjustable range of 0 to 120 seconds.

Retransfer Time Delay: This delay begins the moment Normal line voltage and frequency return. After the delay, the transfer switch can retransfer the load to the Normal source. The delay allows the Normal source to stabilize before retransfer. It has an adjustable range of 0 to 30 minutes.

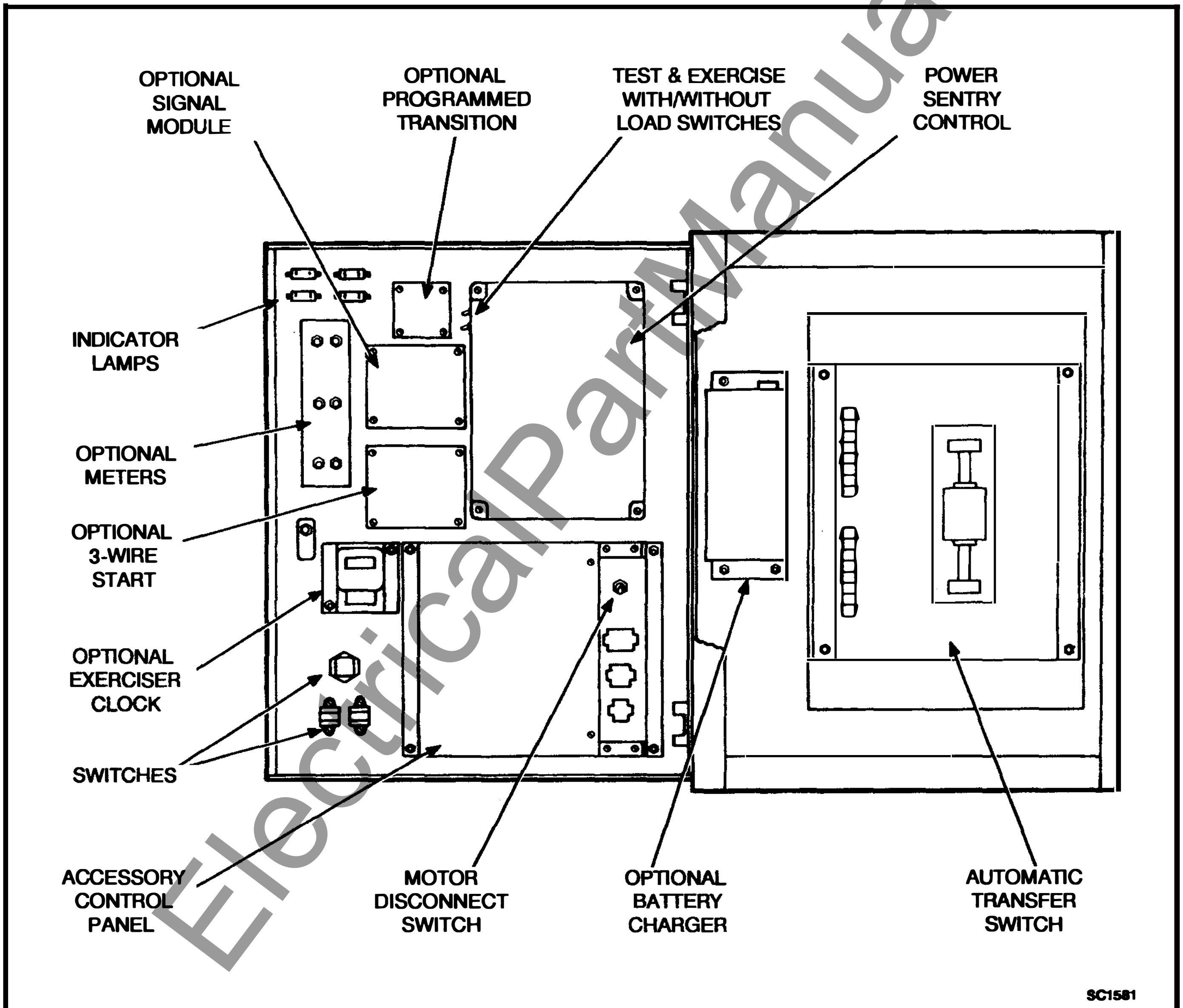


FIGURE 1-3. UTILITY-TO-GENERATOR SET TRANSFER SWITCH INTERIOR COMPONENTS

Undervoltage Sensing

Two voltage sensors, one for the Normal side and one for the Emergency side, monitor source voltages for an undervoltage condition and generate signals, which are sent to the time delay module. If, for example, an undervoltage condition is sensed on the Normal source, the voltage sensor module sends a signal to the time delay module that initiates and controls the timing for generator set start and the transfer of load.

The standard transfer switch has undervoltage sensing for all phases of the Normal and Emergency power sources.

Overvoltage and Frequency Sensing Option

Overvoltage and frequency sensing are available as a single option.

Overvoltage Sensing: With optional overvoltage sensing, the Normal and Emergency sources are monitored for an overvoltage condition.

As with the standard undervoltage sensing, the voltage sensors signal the time delay module, which controls the transfer or retransfer sequence.

An adjustable time delay overrides momentary overshoots in voltage.

Frequency Sensing: With optional frequency sensing, the Normal and Emergency sources are monitored for variations in frequency. The sensors detect whether or not the source is within an adjustable bandwidth.

As with the standard undervoltage sensing, the frequency sensors signal the time delay module, which controls the transfer or retransfer sequence.

An adjustable time delay allows the control to ignore momentary dips or rises in frequency.

Two-Wire Starting

The starting circuit is a basic supervisory function of the electronic control. Water-cooled generator sets use a two-wire start control.

Although the logic is more involved, the two-wire starting circuit can be thought of as a single-pole, single-throw switch. A closed switch signals the generator set to start. An open switch signals the electric generator set to stop.

Three-Wire Starting Option

The optional three-wire starting control (available only on 40- to 125-ampere units) enables the transfer switch to start and stop a three-wire start generator set. Three-wire starting logic is similar to a single-pole, double-throw switch. A common is closed to one side to send a start signal, and to the opposite side to send a stop signal. In addition to start and stop functions, the control has an overcrank relay, a preheat relay, two Timing lamps, a Lockout lamp, a Reset switch, a preheat delay On/Off switch, and an Auto/Stop/Handcrank switch.

Programmed Transition Option

The optional Program Transition module is used to introduce a pause during transition. Programmed transition allows the transfer switch to assume a midtransition position for an adjustable interval of time. In this position, the load is **not** connected to either power source (Normal or Emergency). This feature allows residual voltage from inductive loads to decay to an acceptable level before transfer is completed.

Signal Module Option

The main function of the optional Signal Module is to delay transfer (or retransfer) for a preset time while operating a signal contact to give warning that a transfer (or retransfer) is about to occur. This option is typically used in elevator applications.

Float Battery Charger Option

The optional float-charge battery charger regulates its charge voltage to continuously charge without damage to the battery. As the battery approaches full charge, the charging current automatically tapers to zero amperes or to steady-state load on the battery. The battery charger has an ammeter for indication of charging current and has a fuse for protection of the battery charger circuit.

Auxiliary Relays Option

Optional auxiliary relays provide contacts for energizing external alarms, remote indicators, and control equipment such as louver motors and water pumps.

Exerciser Clock Option

The optional exerciser clock initiates generator set start/run cycles at programmable intervals and for programmable durations. It is a 7-day, 24-hour clock that can store and execute up to ten start/stop programs (exercise cycles).

Load Shed Option

The optional Load Shed function is used to disconnect the load from an available Emergency source in order to reduce the power consumed from that source. The Load Shed function (when activated by a customer-supplied signal) moves the transfer switch from the Emergency position to the neutral position.

Alarm Module Option

The optional alarm module provides an audible indication that the transfer switch has transferred to the emergency power source.

Phase Sequence/Balance Monitor Option

The optional phase sequence/balance monitor senses A, B, and C phases of utility power. If there is an over- or undervoltage, a phase reversal, a loss of one phase, or an unbalanced voltage condition; a normally energized relay drops out, initiating the generator set start/transfer of load sequence.

Standby Set Start Sequencer Option

The optional standby set start sequencer is available only on a generator set-to-generator set transfer switch. The standby set start sequencer responds to a remote start signal from the utility-to-generator set transfer switch by directing a start signal from the generator set-to-generator set transfer switch to the RMT start input of the generator set that is selected as the preferred source.

Refer to Section 2 and to Section 5, if applicable.

Area Protection/ Remote Test Transfer

The transfer switch can be wired with a remote test transfer switch. Closure of a set of contacts across the remote test transfer inputs (terminals 7 and 8 of TB2) causes the transfer switch to sense a (simulated) utility power failure and send a start/run signal to the generator set. The load is transferred to the generator set when generator set power becomes available.

On 300-3090 mother boards, the With/Without Load switch must be in the With Load position. On 300-3953 mother boards, this input is NOT dependent upon the position of With/Without Load switch .

Transfer Inhibit

Removal of the jumper across terminals 5 and 6 of TB2 prevents the transfer switch from operating. This jumper may be removed when the transfer switch is used in a paralleling system. If applicable, refer to the interconnection drawings that are furnished with paralleling switchgear.

OPERATION

Automatic Operation

The utility-to-generator set automatic transfer switch is set for automatic operation by placing control switches in the positions given below. The generator set must also be set for automatic operation.

Refer to section 5, 6, or 7 if applicable.

Test/Normal/Retransfer switch:
Normal position.

Motor Disconnect switch:
Auto position.

Operation selector switch (engine control):
Remote position. (Two-wire start for water-cooled generator sets only.)

Stop/Auto/Handcrank switch:
Auto position. (Three-wire start for air-cooled generator sets only.)

Manual Operation

The transfer switch has operator handles for manually transferring the load. Use the following procedure:

WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts whenever the cabinet door is open.***

If possible, remove all AC power to the transfer switch before manually operating the switch. If it is necessary to perform manual operation with AC power connected, follow the "Safety Related Work Practices" listed in NFPA 70E.

1. Open the cabinet door of the automatic transfer switch.
2. Move the Motor Disconnect switch to the Off position.
3. **Transfer - from the Normal to the Emergency power source:**
   A. Pull the upper manual operator handle down.
   B. Push the lower manual operator handle down.

   Retransfer - from the Emergency to the Normal power source:
   C. Pull the lower manual operator handle up.
   D. Push the upper manual operator handle up.
4. Before moving the Motor Disconnect switch back to the Auto position, remember the trans-

fer switch will transfer load to the active power source (if both power sources are available, it will transfer the load to the Normal source).

WARNING ***Automatic transfer switch operation results in rapid movement of the manual operator handles and presents a hazard of severe personal injury. Keep hands clear of handles when switching back to automatic operation.***

5. Move the Motor Disconnect switch to the Auto position.
6. Close the cabinet door.

Generator Set Exercise

Run the generator set for at least 30 minutes once each week, with at least 50 percent load (if possible). If you do not have an optional exerciser, use the Test/Normal/Retransfer switch to test the generator set each week.

The optional exerciser has preselected exercise periods and exercises the generator set automatically with or without load depending on the position of the Exercise With/Without Load switch. If the Normal power source has an interruption while the generator set is exercising without load, the automatic transfer switch will transfer the load to the generator set.

Generator Set Start Test

WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts whenever the cabinet door is open.***

1. Place the Test With/Without Load selector switch, on the Power Sentry control, in the Without Load position.

   The Test With/Without Load selector switch must be in the Without Load position.

2. Close the cabinet door.

   WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Close the cabinet door.***

3. Move the Test/Normal/Retransfer switch to Test. The generator set should start and run.
4. At the end of the test period, move the Test/Normal/Retransfer switch to the Normal position. The generator will stop.
5. In anticipation of scheduled or automatic generator set exercise, check that the With/Without Load selector switches are in the desired positions. Refer to *Generator Set Exercise*.
6. Close and lock the cabinet door.

With-Load Standby System Test

WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts whenever the cabinet door is open.***

1. Place the Test With/Without Load selector switch, on the Power Sentry control, in the With Load position.

   The Test With/Without Load selector switch must be in the With Load position in order to test with load.

2. Close the cabinet door.

   WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Close the cabinet door.***

3. Move the Test/Normal/Retransfer switch to Test. The generator set should start and assume the load after the transfer time delay.
4. At the end of the test period, move the Test/Normal/Retransfer switch to the Normal position if you want to retransfer load back to the Normal power source after the retransfer time delay. To bypass the retransfer time delay and cause immediate load retransfer, move the Test/Normal/Retransfer switch to Retransfer and release (the switch will return to Normal). The generator will stop after the stop time delay.
5. In anticipation of scheduled or automatic generator set exercise, check that the With/Without Load selector switches are in the desired positions. Refer to *Generator Set Exercise.*
6. Close and lock the cabinet door.

Overcrank Reset

An overcrank condition exists when the generator set fails to start within the time limit. When this condition occurs, the Lockout lamp on the 3-Wire Start module will light. To restore the automatic starting circuit:

1. Correct the engine starting problem.
2. Push the Overcrank Reset button and release.

PREVENTIVE MAINTENANCE

Performing the yearly preventive maintenance procedures in Table 1-1 will result in operational reliability of the transfer switch.

WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. In addition, incorrect installation, service, or parts replacement can result in severe personal injury, death, and/or equipment damage. Therefore, all corrective service procedures must only be performed by technically qualified personnel, following the procedures provided in this manual.***

WARNING ***The transfer switch presents a shock hazard that can cause severe personal injury or death unless all AC power is removed. Be sure to move the generator set operation selector switch to Stop, disconnect AC line power, disconnect the battery charger from its AC power source, and disconnect the starting battery (negative [–] lead first) before servicing.***

WARNING ***Ignition of explosive battery gases can cause severe personal injury. Do not smoke or cause any spark, arc, or flame while servicing batteries.***

TABLE 1-1. ANNUAL PREVENTIVE MAINTENANCE

1. **DISCONNECT ALL SOURCES OF AC POWER:**

   Disconnect both AC power sources from the transfer switch before continuing. If a generator set provides Emergency power, turn the operation selector switch to Stop. (The selector switch is located on the generator set control panel.) ***If there is an external battery charger, disconnect it from its AC power source.*** Then disconnect the set starting battery (negative [–] lead first).
2. **CLEAN**
   a. Thoroughly dust and vacuum all controls, meters, switching mechanism components, interior buswork, and connecting lugs.
   b. Close the cabinet door and wash **exterior** surfaces with a damp sponge (mild detergent and water). ***Do not allow water to enter the cabinet, especially at meters, lamps, and switches.***
3. **INSPECT**
   a. Check buswork and supporting hardware for carbon tracking, cracks, corrosion, or any other types of deterioration. If replacement is necessary, call your dealer or distributor.
   b. Check stationary and movable contacts. If contact replacement is necessary, the procedures are described in section 4 of this manual.
   c. Check system hardware for loose connections. Tighten as indicated in step 4.
   d. Check all control wiring and power cables (especially wiring between or near hinged door) for signs of wear or deterioration.
   e. Check all control wiring and power cables for loose connections. Tighten as indicated in step 4.
   f. Check the cabinet interior for loose hardware. Tighten as indicated in step 4.
4. **PERFORM ROUTINE MAINTENANCE**
   a. Tighten buswork, control wiring, power cables, and system hardware, as necessary. Hardware torque values are given in section 4 of this manual. Retorque all cable lug connections. Lug torque requirements are listed in Table 1-2.
   b. Service or replace the batteries.
5. **CONNECT AC POWER AND CHECK OPERATION**
   a. Connect the set starting battery (negative [–] lead last). Connect the normal AC power source, enable the backup power source. If applicable, connect power to the battery charger.
   b. Verify proper operation of the battery charger.
   c. Test system operation as described in this section. Close and lock the cabinet door.

REMOVING AND REPLACING ELECTRONIC CONTROL COMPONENTS

⚠WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Disconnect connector J1/P1 before working on the electronic control system.***

Disconnecting J1/P1 removes all power to the door **except for customer-introduced power at the Signal Module.** Be sure to remove all power before replacing components.

No special tools are required to remove and replace control system components.

The mother board and transformer assembly are held in place by several screws and will not fall when the four screws that secure the Power Sentry cover are removed. Be sure to use all of the hardware when remounting components.

TABLE 1-2. LUG TIGHTENING REQUIREMENTS

SET SCREW SOCKET SIZE (ACROSS FLATS)	MINIMUM TORQUE FOR PROPER OPERATION
3/16 IN	80 IN-LBS (9 N•m)
1/4 IN	200 IN-LBS (23 N•m)
5/16 IN	275 IN-LBS (31 N•m)
3/8 IN	375 IN-LBS (43 N•m)
1/2 IN	500 IN-LBS (57 N•m)
9/16 IN	600 IN-LBS (68 N•m)

FEATURE DESCRIPTION	FEATURE OPTION
Poles	
3 Poles	A028
4 Poles	A029
Application	
Appl – Utility to Genset	A035
Appl – Utility to Utility	A036
Appl – Genset to Genset	A037
Appl – Nonautomatic	A038
Agency Approvals	
Listing – UL	A046
Certification – CSA	A047
Listing – Not Applicable	A048
Frequency	
60 Hertz	A044
50 Hertz	A045
Voltage	
120 VAC	R020
208 VAC	R021
220 VAC	R022
240 VAC	R023
380 VAC	R024
416 VAC	R025
480 VAC	R026
600 VAC	R027
Phase	
System – 1 Phase, 2-W or 3-W	A041
System – 3 Phase, 3-W or 4-W	A042
Control Options	
Start Time Delay – 90 Sec	C015
Control – OV & O/U Hz,Source 2	C016
Control – OV & O/U Hz,Source 1	C017
Meters	
Meters – None	D001
Meters – Door Mounted	D002
Program Transition	
Program Transition – 0–7.5 Sec	J021
Program Transition – 0–60 Sec	J022

FEATURE DESCRIPTION	FEATURE OPTION
Battery Chargers	
Battery Charger – 2A,12/24V	K001
Battery Charger – 10A,12V	K002
Battery Charger – 10A,24V	K003
Auxiliary Relays	
Aux Relay – 24 VAC Coil	L001
Aux Relay – Emergency Position	L002
Aux Relay – Normal Position	L003
Aux Relay – Emergency Source	L004
Aux Relay – Normal Source	L005
Aux Relay – 24 VDC Coil	L101
Aux Relay – Emergency Position	L102
Aux Relay – Normal Position	L103
Aux Relay – Genset Start	L104
Aux Relay – 12 VDC Coil	L201
Aux Relay – Emergency Position	L202
Aux Relay – Normal Position	L203
Aux Relay – Genset Start	L204
Miscellaneous	
Clock – 7 Day Exerciser	J001
Module – Signal	M001
Module – 3-Wire Start	M002
Terminal Block – 30 Points	M003
Monitor – Phase Seq/Bal	M004
Sequencer – Stdby Set Start, 12V	M006
Load Shed – From Emergency	M007
Module – Alarm	M008
Sequencer – Stdby Set Start, 24V	M010
Switch – Auto/Manual Change	N001
Term Block – Batt Chrg Alarms	N002
Term Block – Source1/2 Rmt Signal	N005
Power Connect – Bus Stabs	N009
Cabinet	
Cabinet – Type 1	B001
Cabinet – Type 3R	B002
Cabinet – Type 4	B003
Open Construction	B004

2. Electronic Control System

INTRODUCTION

The electronic control system includes:

1. The voltage sensing and start, stop, transfer, and retransfer timing circuitry of the Power Sentry control.
2. The transformers, relays, switch, and connectors of the accessory control panel.
3. The optional control modules and accessories.
4. The position-sensing switches that monitor and control the operation of the automatic transfer switch.
5. The standard and optional lamps, meters, and switches that are mounted on the cabinet door. These components are described in Section 1. They are also referenced in this section, when applicable.

POWER SENTRY CONTROL

The Power Sentry control (Figure 2-1) consists of the following major components:

- Transformer assembly
- Mother board
- Voltage sensor modules
- Time delay module

All components of the Power Sentry control are mounted within a single enclosure.

The timing, sensitivity, and calibration potentiometers and LED control lamps are visible and accessible through holes on the control cover (Figure 2-1).

The following text provides a general description of each component and how it functions.

Transformer Assembly

The transformer assembly is mounted in the control as shown in Figure 2-1. The assembly includes four transformers, a terminal block, and a ribbon cable connector. The transformers step down the line voltage to approximately 18 VAC. The output from the transformers is supplied to the mother board rectifier bridges.

The transformer assemblies are not the same for every control, even though they may appear identical. Each transformer assembly must be used with the correct line voltage and phase or the control can be damaged when power is applied. For this reason, the transformer assemblies from different controls are not necessarily interchangeable.

When replacing a transformer assembly, note that the transformer input leads are wired with a line-to-line or line-to-neutral configuration, and with jumper wires across some of the TB11 terminals. The wiring and jumper wire configurations are voltage and phase dependent. Refer to sheet 3 of 5 in your schematic and wiring diagram package.

Mother Board Assembly

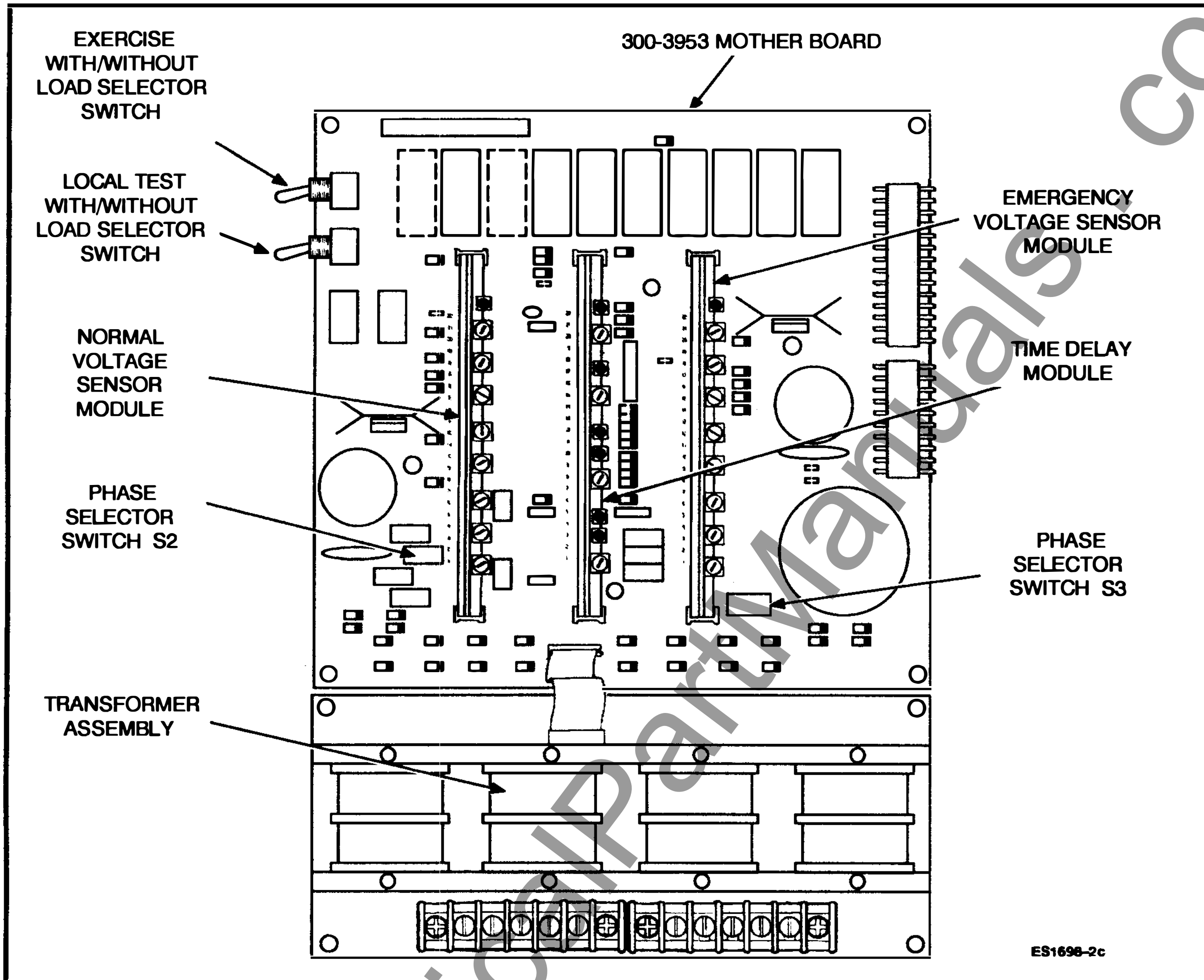
The mother board assembly is a printed circuit board that serves as a central terminal for all the input and output signals that flow through the control. It also provides a mounting point for the voltage sensing and time delay modules and several control relays, including K11, the two-wire run relay. Connections to the mother board are made through five mating/locking pin connectors (J4, J5, J6, J7, and J8) and three circuit board edge connectors (J1, J2, and J3).

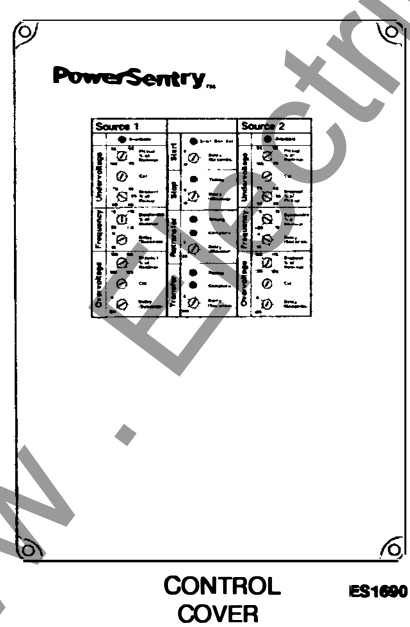
There are three different mother boards. Utility-to-generator set transfer switches may be equipped with mother board 300-3953 or mother board 300-3090. Utility-to-utility and generator set-to-generator set transfer switches are equipped with mother board 300-3267.

Mother board Identification: Mother board 300-3090 has one With/Without Load switch. Mother board 300-3953 has two With/Without Load switches. Mother board 300-3267 does **not** have a With/Without Load switch.

The schematics of the various mother boards appear in Section 8. Significant differences are pointed out in this section.

J1, J2, and J3 Edge Connectors: Connectors J1 and J3 provide a mechanical/electrical connection point for the voltage sensor modules. Connector J1 corresponds to the Source 1 (Normal) power source and J3 corresponds to the Source 2 (Emergency) power source. Connector J2 provides a mechanical/electrical connection point for the time delay module.





The schematic of the 300-3953 mother board is on page 8-3. The schematic of the 300-3267 mother board is on page 8-4. The schematic of the 300-3090 mother board is on page 8-5.

FIGURE 2-1. POWER SENTRY CONTROL

Mother Board Circuitry: The mother board circuitry serves several functions that are essential for control operation.

A series of rectifier bridges receive the AC output from the transformer assembly (connector J6) and rectify it. The rectified voltage (15 to 25 VDC) is used as a reference input for the voltage sensors and as a power source for the control electronics. The circuitry for the rectifier bridges is shown in the schematics in Section 8.

Separate voltage regulator circuits receive the output from the Normal and Emergency side rectifier bridges and regulate the voltages to a constant value (12 $\pm$0.5 VDC). These circuits provide power for the control relays, display lamps, voltage sensor modules, and time delay module.

Capacitor C1 is large enough (0.1 or 0.47 farads) to provide power to the time delay module from the time Normal power is lost until Emergency power is available. Refer to Control System Operation.

Additional inputs to the utility-to-generator set mother board include:

- Test/exercise inputs
- Manual retransfer input
- Transfer inhibit input
- Instant retransfer input
- (Delayed) transfer and retransfer inputs

The test/exercise inputs (from the Test/Normal/Retransfer switch and from the optional exerciser clock) are used to start the generator set. Their function is described under Control System Operation in this section.

Closure of a set of contacts across the remote test transfer inputs (terminals 7 and 8 of TB2) causes the transfer switch to sense a (simulated) utility power failure and send a start/run signal to the generator set. The load is transferred to the generator set when generator set power becomes available.

On 300-3090 mother boards, the With/Without Load switch must be in the With Load position. On 300-3953 mother boards, this input is NOT dependent upon the position of With/Without Load switch.

The manual retransfer input (from the optional Auto/Manual switch) blocks automatic retransfer and permits only manually initiated retransfer.

The Transfer Inhibit input, when open, prevents Emergency power from being sensed. This input is at terminals 5 and 6 of TB2.

The Instant Retransfer input (from the Test/Normal/Retransfer switch) is optically coupled to the time delay module to override the retransfer time delay.

On all versions of the mother board, the transfer and retransfer inputs are used in conjunction with the optional signal module relay board. Refer to Optional Control Modules in this section.

Utility-to-utility and generator set-to-generator set mother boards include Source 1 and Source 2 select inputs. These inputs are wired to the Source Selector switch on the cabinet door. Refer to section 5 or 6.

Generator set-to-generator set mother boards may include an optional change-over clock input. Refer to section 5.

Switches: There are three switches on the 300-3090 mother board and four switches on the 300-3953 mother board.

On the 300-3090 mother board, Switch S1 is the With/Without Load selector. When the switch is in the With Load position, test and exercise functions include the transfer of load to the Emergency side. When S1 is in the Without Load position, test and exercise functions start and run the generator set, but do not transfer the load.

On the 300-3953 mother board, Switch S1 is the Exercise With/Without Load selector. When this switch is in the With Load position, the exercise function includes the transfer of load to the Emergency side. When S1 is in the Without Load position, the exercise function starts and runs the generator set, but does not transfer the load.

On the 300-3953 mother board, there is a Switch S4. S4 is the Test With/Without Load selector. When this switch is in the With Load position, the local test function (using the Test switch on the cabinet door) includes the transfer of load to the Emergency side. When S4 is in the Without Load position, the test function starts and runs the generator set, but does not transfer the load.

The With/Without Load switch(es) is (are) included only on the utility-to-generator set transfer switch.

Switches S2 and S3 are used to select single- or three-phase operation.

Relays: There are six relays on the 300-3090 mother board and eight relays on the 300-3953 mother board. Three are used to send primary control signals, and the others are used to control logic functions on the mother board itself.

Relays K10 and K18 are included only on the 300-3953 mother board. These two relays are critical to the operation of with load test and exercise. Refer to *Control System Operation.*

The K11 two-wire run relay responds to a signal from the time delay module. When this normally energized relay is de-energized, K11 contacts 3 and 2 close to send a two-wire start signal. Note: Output connections for two-wire starting are made at TB2 on the transfer switch assembly.

There are 2 two-wire start relays on the generator set-to-generator set mother board.

The K12 source 2 available relay is energized only when the source 2 sensor determines that Emergency power is acceptable. The opening of K12 contacts 4 and 2 (in conjunction with test or exercise with load signals) helps simulate a loss of Normal power for test and exercise purposes. If Emergency power fails during a test or exercise, the closing of these contacts initiates retransfer to the Normal power source.

The K12 relay is included only on the utility-to-generator set mother board.

On the 300-3090 mother board, the K13 test/exercise relay is energized by a signal at one of the test/exercise inputs. When K13 is energized, its contacts 3 and 2 open. This action de-energizes K11, starting the generator set.

On the 300-3953 mother board, the K13 test/exercise relay is energized by a signal at one of the test/exercise inputs only when the corresponding With/Without Load switch is in the Without Load position. When K13 is energized, its contacts 3 and 2 open. This action de-energizes K11, starting the generator set.

The K13 relay is included only on the utility-to-generator set mother board.

The K14 and K15 transfer and retransfer relays are energized by signals from the time delay module. When energized, their contacts 3 and 4 close to provide power to one of the interposing relays. K14 drives the K2 transfer relay. K15 drives the K1 retransfer relay. K1 and K2 are located on the accessory control panel.

The K16 run interlock relay is energized whenever the transfer switch is in the Emergency position. When energized, its contacts 2 and 4 are open. This functions to prevent generator shut off until retransfer to the Normal side occurs.

There are two run interlock relays on the generator set-to-generator set mother board.

Additional outputs from the mother board include:

- Start Genset outputs
- Source 1 and 2 Available outputs
- Transfer and Retransfer outputs
- Backup Source Failure outputs

Start Genset and Source 2 Available outputs are available for connection to the optional 3-Wire Start module.

The generator set-to-generator set mother board includes a Start Genset 1 output and a Start Genset 2 output. These two outputs, as well as Source 1 and Source 2 Available outputs, are available for connection to the (two) optional 3-Wire Start modules.

Start Genset, Source 1 Available, Source 2 Available, Transfer, Retransfer, and Backup Source Failure outputs are available for connection to the optional Signal Module relay board.

Voltage Sensor Modules

The voltage sensors are plug-in modules that fit into the J1 and J3 edge connectors on the mother board. The voltage sensors monitor the voltage sources (single or three phase) and provide an output signal (Source Available) when the source is within predetermined limits. Depending on the options selected, the sensors test for undervoltage, overvoltage and under/overfrequency. The Source Available output signal is latched on when all of the pickup requirements for voltage and frequency are satisfied. The Source Available output signal remains on until the voltage or frequency goes beyond the dropout limits for longer than the corresponding dropout time delay.

Undervoltage sensing is accomplished by sensing all voltage phases, but responding only to the lowest one. Thus, all phases must be above the undervoltage pick-up point before undervoltage pickup will occur; while undervoltage dropout will occur when any of the phase voltages fall below the dropout point. A fixed dropout time delay (0.5 seconds) elapses before the Source Available output responds to an undervoltage condition. The sensor is calibrated and the undervoltage pickup and dropout points are adjusted with potentiometers (refer to *Adjusting Power Sentry Modules* in this section). The pickup adjustment range is 85% to 100% of the nominal voltage. The dropout adjustment range is 75% to 98% of the pickup setting.

Overvoltage sensing is accomplished by monitoring the peak of the combined phase voltages so that the sensor essentially responds to the highest phase. The sensor is calibrated and the overvoltage limit is adjusted with potentiometers (refer to *Adjusting Power Sentry Modules* in this section). The overvoltage adjustment range is 105% to 135% of the nominal voltage. The pickup point is fixed at 5% below the overvoltage limit point and is not adjustable. A time delay is also included and is adjustable from 0 to 120 seconds.

Over/underfrequency sensing is accomplished by sensing the source frequency and detecting when it is within a specific band. The pickup bandwidth is adjusted with a potentiometer (refer to *Adjusting Power Sentry Modules* in this section). The pickup adjustment range is 5% to 20% of the nominal frequency. The dropout bandwidth is fixed at 5% wider than the pickup band. The pickup and dropout bands are centered about the nominal frequency. A time delay is also included and is adjustable from 0 to 15 seconds.

Time Delay Module

The time delay module plugs into the J2 edge connector on the mother board. The time delay module contains the timing circuits and associated logic that provide time delays for generator starting, load transfer, load retransfer, and generator stopping.

The Source Available output signals are received from the voltage sensors. If the Source 1 Available signal is interrupted, the start time delay begins timing out.

The start time delay, adjustable from 0 to 15 seconds, begins timing if the input signal from the Source 1 voltage sensor is interrupted. If the signal returns during the timing out period, the timer is reset. If the signal does not return by the end of the delay period, the timer signals for the generator set to start. The purpose of this delay is to prevent generator set start-up when power interruptions of very short duration occur. An optional time delay module, with a 0 to 90 second start time delay range, is also available.

The utility-to-utility transfer switch has no start time delay.

The transfer time delay, adjustable from 0 to 120 seconds, begins timing as soon as the Source 2 voltage sensor signals that power is available. At the end of the delay, the timer signals for the load to transfer to the generator set. The purpose of the delay is to allow the generator set to stabilize before the load is applied.

When the Source 1 power returns and Source Available signals are received from both voltage sensors, the time delay module will respond to the preferred source. In utility-to-generator installations, Source 1 is recognized as the preferred source. In utility-to-utility or generator-to-generator installations, the preferred source is selected by setting an externally mounted selector switch.

The retransfer time delay, adjustable from 0 to 30 minutes, begins timing as soon as the input signal from Source 1 voltage sensor is sent to the time delay module. At the end of the delay, the timer signals for the load to transfer to the normal source. The purpose of the delay is to allow the normal power source to stabilize before the load is applied.

The stop time delay, adjustable from 0 to 10 minutes, begins timing as soon as the retransfer timer signals for the load to transfer to the normal source. At the end of the delay, the timer signals for the generator set to stop. The purpose of the delay is to allow the generator set to cool while running at no load.

On the utility-to-utility transfer switch, stop time delay is not applicable.

Refer to *Adjusting Power Sentry Modules* in this section for the time delay adjustment procedures.

Indicator Lamps

Mounted at the edges of the voltage sensor and time delay modules, and visible through holes in the Power Sentry cover, are eight indicator lamps. Refer to Table 2-1.

TABLE 2-1. POWER SENTRY CONTROL INDICATOR LAMPS

LAMP	INDICATES
Source 1 Available	Source 1 voltage is available and within the voltage and frequency settings of the voltage/frequency sensor.
Source 2 Available	Source 2 voltage is available and within the voltage and frequency settings of the voltage/frequency sensor.
Start Gen Set	The control is signaling the generator set to run. This lamp is dimly lit (or off) when both sources are off.
(Stop) Timing	The control is timing out the generator stop delay. At the end of this delay, a stop signal is sent to the generator set and the Start Gen Set and (Stop) Timing lamps go out.
(Retransfer) Timing	Control is timing out for retransfer to Source 1 power. At the end of the timing period, the lamp goes out and the Retransfer Complete lamp turns on.
(Retransfer) Complete	Control is signaling for retransfer to Source 1 power. The Source 1 Available lamp is also on.
(Transfer) Timing	Control is timing out for transfer to Source 2 power. At the end of the timing period, the lamp goes out and the Transfer Complete lamp turns on.
(Transfer) Complete	Control is signaling for retransfer to Source 2 power. The Source 2 Available lamp is also on.

ACCESSORY CONTROL PANEL AND TERMINAL BLOCKS

The accessory control panel (Figure 2-2) includes:

- T1 and T2 transformers
- T3 optional transformer
- K1 and K2 interposing relays
- K3 and K4 optional relays
- Motor Disconnect Switch S1
- Connectors J1, J2, and J3
- TB4 terminal block

Not included on the accessory control panel, but related in function, are terminal blocks TB1, TB2, and TB3 (Figure 2-3).

Transformers

Transformers T1 and T2 provide 24 VAC power for the cabinet door display lamps; relays K1, K2, and K16; and the optional exerciser clock. (K16 is on the mother board.) Refer to sheets 2, 3, and 4 in your schematic and wiring diagram package.

Transformer T3 is used with the optional voltage and frequency meters on units that are rated at more than 300 volts. Refer to sheets 2 and 5 in your schematic and wiring diagram package.

Relays

Interposing relays K1 and K2 are used to transfer line power to the linear actuator motor (M1). The closing of K1 contacts causes retransfer to the Normal side. The closing of K2 contacts causes transfer to the Emergency side. K1 is energized by the closing of K15 contacts. K2 is energized by the closing of K14 contacts. (K15 and K14 are on the mother board.) Refer to sheets 2, 4, and 5 of your schematic and wiring diagram package.

Optional programmed transition relay K3 is used to open the circuit that drives the linear actuator motor (M1) for a time determined by the setting of the Program Transition module. Refer to sheets 2 and 5 of your schematic and wiring diagram package, and to *Optional Control Modules and Accessories* in this section.

Optional load shed relay K4 (not shown) is driven by a customer-supplied signal and is used to drive the linear actuator motor (M1) from the emergency position to the neutral position. Refer to sheets 1, 2, and 5 of your schematic and wiring diagram package, and to *Optional Control Modules and Accessories.*

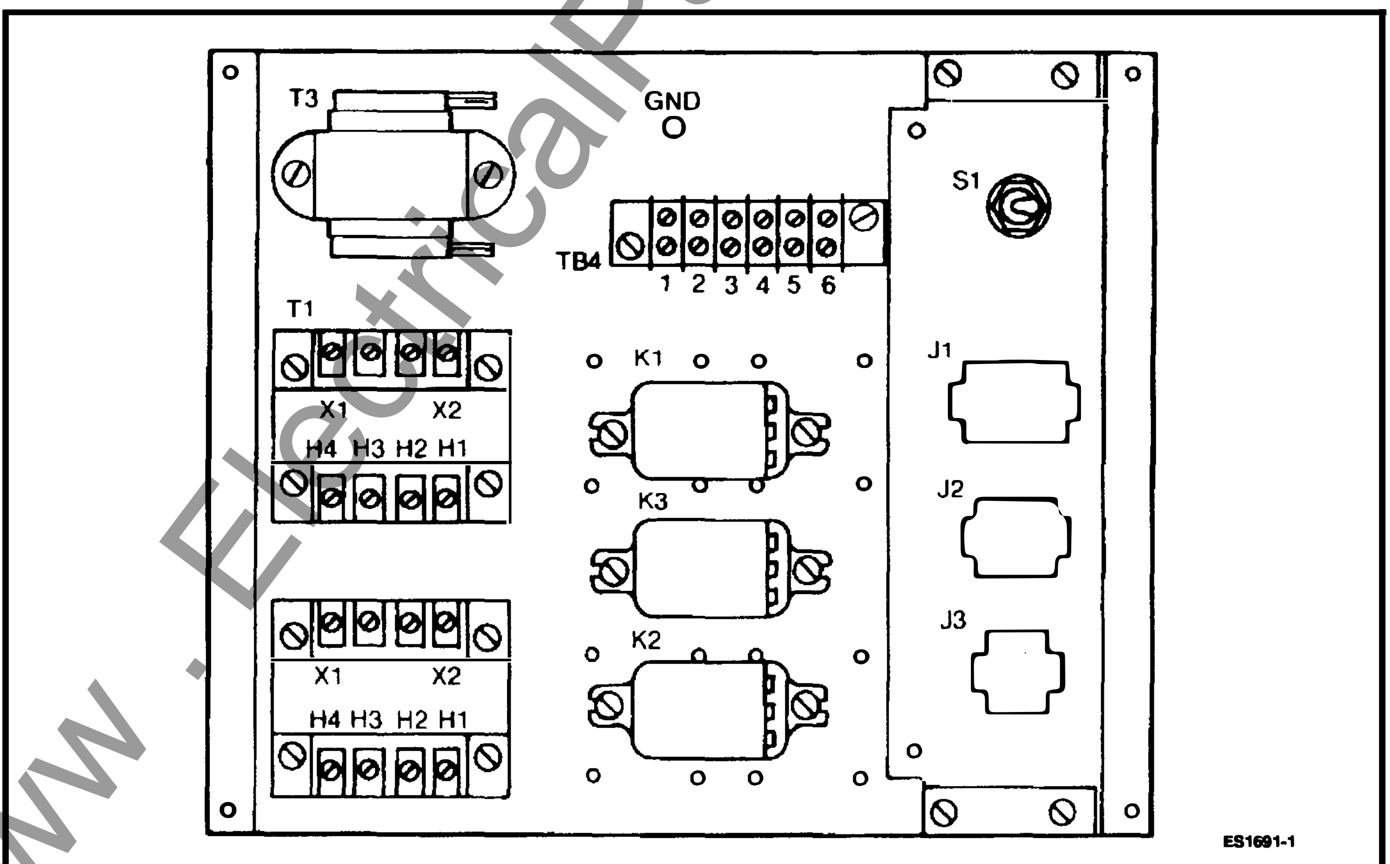


FIGURE 2-2. ACCESSORY CONTROL PANEL

Motor Disconnect Switch S1

Motor Disconnect Switch S1 is used to disable the linear actuator motor. In the Off position, the switch is open. In the Auto position, the switch is closed. Refer to sheets 2 and 4 of your schematic and wiring diagram package.

Connectors

Accessory control panel connectors J1, J2, and J3 are used to connect the electronic control system to the power terminals, auxiliary switch contacts, linear motor, and the terminals of TB2. Disconnecting J1 disconnects all line power from the door. Refer to sheets 2 and 4 in your schematic and wiring diagram package.

Terminal Blocks

Terminal block TB4 provides six AC connection terminals. Refer to sheets 2, 4, and 5 of your schematic and wiring diagram package.

Terminal block TB1 (Figure 2-3) provides the connection terminals for form C auxiliary switch contacts. Refer to sheet 1 of your schematic and wiring diagrams package.

Terminal block TB2 (on the utility-to-generator transfer switch) provides the connection terminals for two-wire start, transfer inhibit and remote test. Refer to sheet 1 of your schematic and wiring diagram package.

Refer to section 5, 6, or 7 if applicable.

Terminal block TB3 (Figure 2-3) provides the connection terminals for the 3-Wire Start, Load Shed, battery charger alarm contacts, and Signal Module options. Refer to sheet 1 of your schematic and wiring diagram package, and to Optional Control Modules and Accessories.

Open Construction

On open construction configurations, indicator lamps and key switches are connected to TB3. Refer to sheet 1 of your schematic and wiring diagram package and to the *Open Construction Wiring Diagrams* sheet in Section 8.

OPTIONAL CONTROL MODULES AND ACCESSORIES

Optional Control Modules include:

- 3-Wire Start
- Program Transition
- Signal Module
- Exerciser clock (utility-to-generator set transfer switch)
- Change-over clock (generator set-to-generator set transfer switch)
- Phase Sequence/Balance Monitor
- Standby Set Start Sequencer (generator set-to-generator set transfer switch)

Optional accessories include:

- Battery charger
- Auxiliary relays
- Load Shed function
- Meter package
- Auto/Manual switch
- 600 Volt adapter transformer T4
- Alarm Module

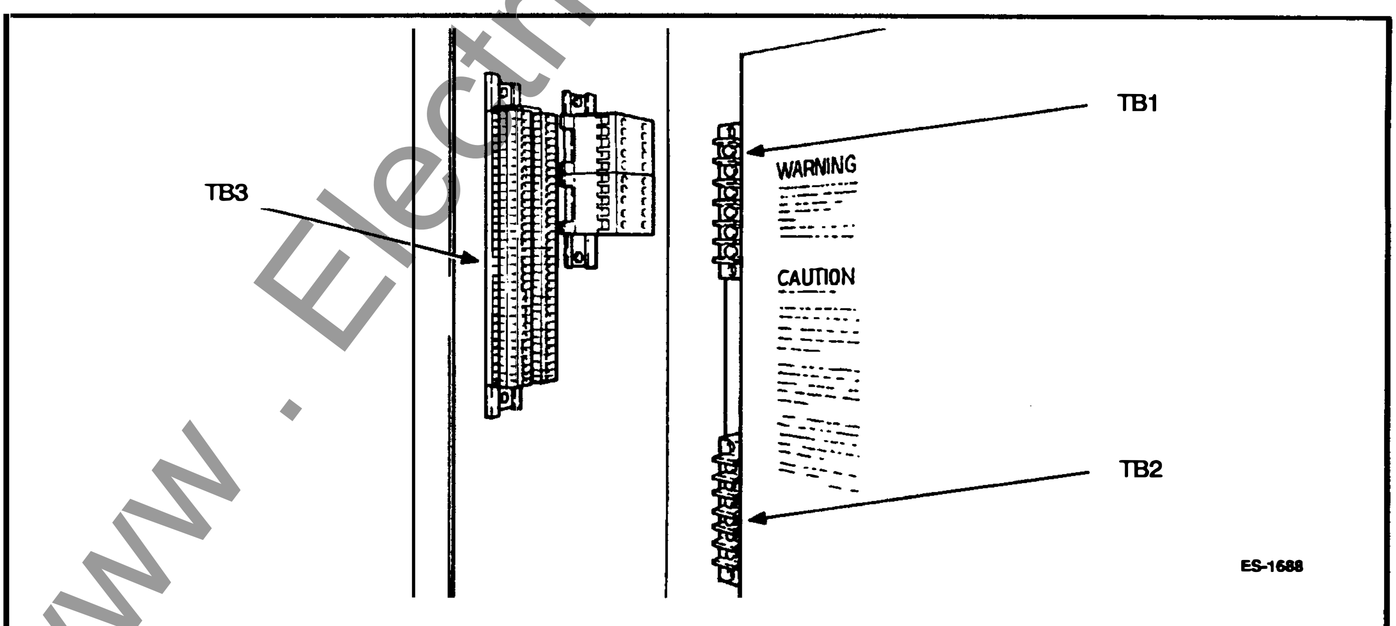


FIGURE 2-3. TERMINAL BLOCKS

Three-Wire Start

The 3-Wire Start module (Figure 2-4) provides start/stop signals and a preheat signal for a three-wire start system. It includes a preheat timer, an overcrank timer, an overcrank reset switch, an Auto/Handcrank/Stop switch, and three indicator lamps. The 3-Wire Start module may be equipped with a preheat timer On-Off switch.

If used, the preheat timer delays the start signal (0 to 60 seconds) while a preheat output is energized. The Preheat Timing lamp is on during this delay.

The overcrank timer limits the time the engine starter motor is engaged. If the generator set does not start within the adjustable time limit (0 to 120 seconds), a relay opens the starting circuit. During cranking the Overcrank Timing lamp is on. If the overcrank timer opens the circuit, a Lockout lamp is lit. After a starting problem is corrected, press the Overcrank Reset switch to reset the timer. It cannot be reset by any other method.

The Auto/Handcrank/Stop switch has three positions that function as follows:

Auto: Allows the generator set to start and assume the load if a power outage occurs. **This is the normal operating position.**

Stop: Shuts down the generator set and prevents it from starting. **Use this position when servicing the generator set.**

Handcrank: Prevents the automatic transfer switch from starting the generator set, but allows starting and stopping at the set. **Use this position for generator set maintenance.**

Connections for the optional 3-Wire Start module are made at TB3.

Generator set-to-generator set transfer switches can be equipped with two 3-Wire Start modules. Refer to section 5.

Refer to sheets 1 and 5 of your schematic and wiring diagram package.

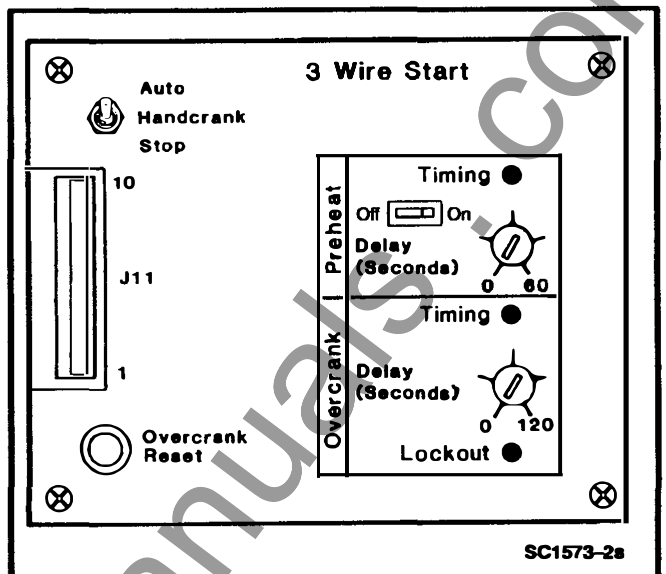


FIGURE 2-4. 3-WIRE START

Programmed Transition

The optional Program Transition module (Figure 2-5) is used to introduce a pause during transition. Programmed transition allows the transfer switch to assume a midtransition position for an adjustable interval of time. In this position, the load is **not** connected to either (Normal or Emergency) power source. This feature allows residual voltage from inductive loads to decay to an acceptable level before transfer is completed.

The length of time that the transfer switch is in the midposition can be adjusted from 0 to 7.5 seconds or 0 to 60 seconds, depending on the timer option. The proper adjustment is a function of the load decay time.

A Delay/No Delay switch permits bypassing the timer delay (if it is not needed or if the timer has failed).

The timing circuit is triggered by the same signal that is used to drive K1 or K2. The output of the timing circuit is used to energize K3. Contacts K3-6/K3-9 and contacts K3-4/K3-7, acting in conjunction with auxiliary switches S9 and S5 respectively, control the linear actuator circuit. When the normally open contacts of K3 close, the linear actuator circuit is completed and the switch contacts are moved from the neutral position to their original destination.

Refer to sheets 2 and 5 of your schematic and wiring diagram package.

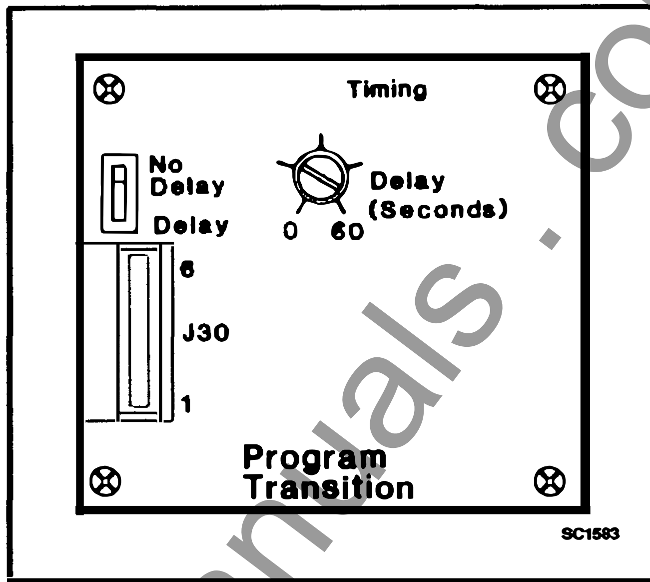


FIGURE 2-5. PROGRAM TRANSITION MODULE

Signal Module

The optional Signal Module (Figure 2-6) has one adjustable timer. The Elevator Signal delay controls the timing of two events. It delays transfer/retransfer and energizes the Elevator Transfer Signal relay during the delay period. This time delay is adjustable over a range of 0 to 50 seconds.

A Delay/No Delay switch permits bypassing the timer delay (if it is not needed).

The timing circuit is started by a transfer or a retransfer signal from the time delay module on the Power Sentry mother board.

If the transfer switch includes the Signal Module, resistors R10 and R11 on the mother board (schematic in section 8) are removed. Because these resistors are removed, the transfer and retransfer signals from the time delay module do not have a direct path to relays K14 and K15. Instead, these signals are directed to the Signal Module and are returned to drive the relays after the elevator time delay has elapsed.

While the timer is timing, the (form C) Elevator Signal relay is energized and the Timing lamp on the Signal Module is lit. At the end of the time delay, the Elevator Signal relay is de-energized and the switch is allowed to transfer.

When installed on a utility-to-generator set transfer switch, there are four other Signal Module relays with form-C contacts:

- Source 1 Available
- Source 2 Available
- Test/Exercise
- Backup Source Available

These relays are not affected by the Elevator Signal delay. They respond directly to signals from the Power Sentry.

The Source 1 and Source 2 Available relays are energized whenever their respective power sources are producing power.

In utility-to-generator set applications, the Source 2 Available and Backup Source Available relays operate identically.

The Test/Exercise relay is energized whenever the system is in test or exercise mode.

Refer to section 5 or 6 for a description of generator set-to-generator set or utility-to-utility signal modules.

All relay contact connections are made at TB3. Refer to sheet 1 of your schematic and wiring diagram package.

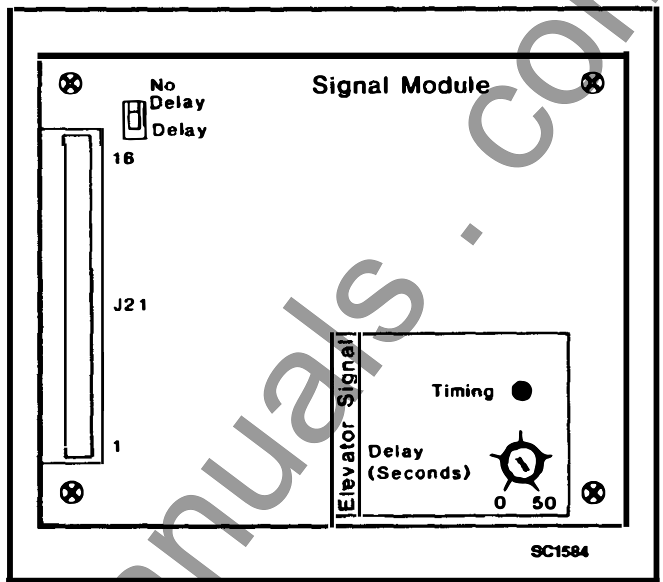


FIGURE 2-6. SIGNAL MODULE

Exerciser Clock

The optional exerciser clock (Figure 2-7) initiates generator set start/run cycles at programmable intervals and for programmable durations. It is a 7-day, 24-hour clock that can store and execute up to ten start/stop programs (exercise cycles).

Instead of an exerciser clock, generator set-to-generator set transfer switches may include an optional change-over clock. Refer to section 5 if applicable.

Programming the exerciser clock requires setting the time of day and entering the exercise start and stop times. This procedure is described under *Adjusting Optional Control Modules.*

The output of the exerciser clock is a set of normally open contacts that, when closed, provide a ground to the Power Sentry mother board (schematic in section 8) input J7-8. This signal energizes test/exercise relay K13 on the mother board.

The Exercise With/Without Load switch provides the option of transferring or not transferring the load during the exercise periods.

The three-position switch in the lower left corner of the clock can be used to override the program. To test the exercise function (close the output contacts), place the switch in the "I" position. To disable the exercise function (hold the output contacts in the open position), place the switch in the "Off" position. For normal operation (output contacts under program control), place the switch in the center (clock) position.

The exerciser clock is powered by the 24 VAC output of T1. An internal nickel cadmium battery (not replaceable) maintains time and program information for 150 hours (minimum) without external power. However, the clock does not initiate exercise periods when it is under battery power.

Refer to sheets 2 and 5 of your schematic and wiring diagram package.

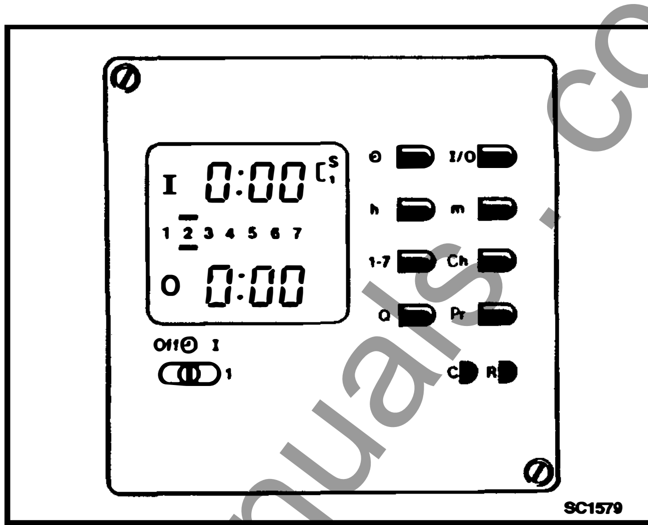


FIGURE 2-7. EXERCISER CLOCK

Phase Sequence/Balance Monitor

The optional phase sequence/balance monitor (Figure 2-8) is connected to A, B, and C phases of utility power. If there is an over- or undervoltage, a phase reversal, a loss of one phase, or an unbalanced voltage condition; a normally energized relay drops out, closing a set of contacts. These relay contacts are wired to the remote test input terminals (7 and 8) of TB2. When the contacts across terminals 7 and 8 of TB2 close, the generator set start/transfer of load sequence is initiated.

Five LEDs indicate normal operation or fault conditions. The Relay Energized LED is lit during normal operation. Three potentiometers permit setting the percent of voltage unbalance, the normal system voltage, and the relay dropout time delay.

The relay dropout delay applies only to over/undervoltage and voltage unbalance. In the event that a phase reversal or loss of one phase is sensed, relay dropout occurs within 100 milliseconds (maximum). There is NO relay dropout delay when a phase reversal or loss of phase is sensed.

- Overvoltage dropout occurs at normal voltage +10% (±2%).
- Undervoltage dropout occurs at normal voltage –10% (±2%).
- Dropout time delay range is 2 to 20 seconds.
- Percent voltage unbalance range is 2 to 6% on 240- and 480-volt units.
- Percent voltage unbalance range is 2 to 8% on 380-volt units.

Standby Set Start Sequencer

The optional standby set start sequencer (Figure 2-9) is available (and applicable) only on a generator set-to-generator set transfer switch. In dual standby applications, the power cables from two generator sets are connected to the source 1 and source 2 lugs of a generator set-to-generator set transfer switch, which in turn provides power to the generator set source lugs on a utility-to-generator set transfer switch.

The function of the standby set start sequencer is to respond to a remote start signal from the utility-to-generator set transfer switch by directing a start signal from the generator set-to-generator set transfer switch to the RMT start input of the generator set that is selected as the preferred source. The standby set start sequencer permits normal backup set operation if the preferred/active set fails. The sequencer also permits normal change-over clock-initiated operation.

Refer to section 5 and to the system interconnection drawings, if applicable.

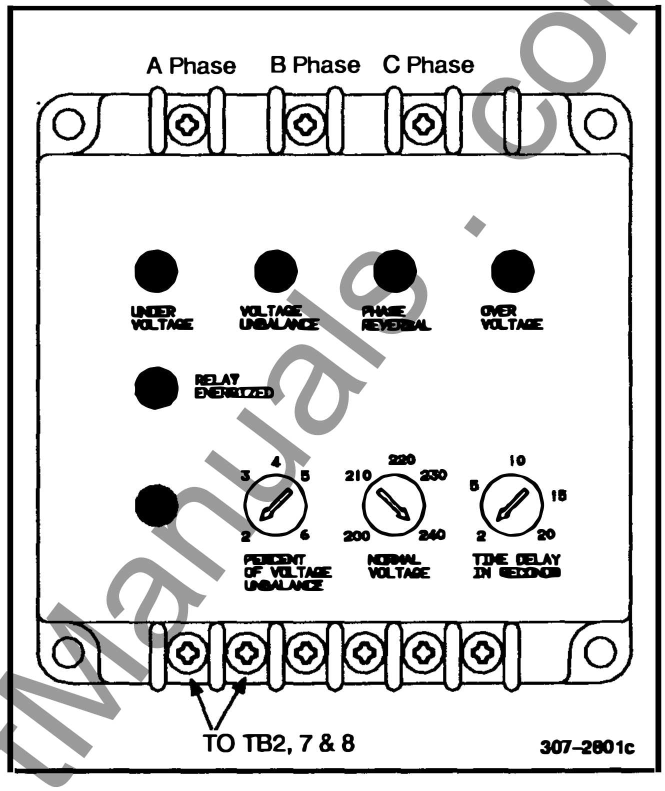


FIGURE 2-8. PHASE SEQUENCE BALANCE MONITOR

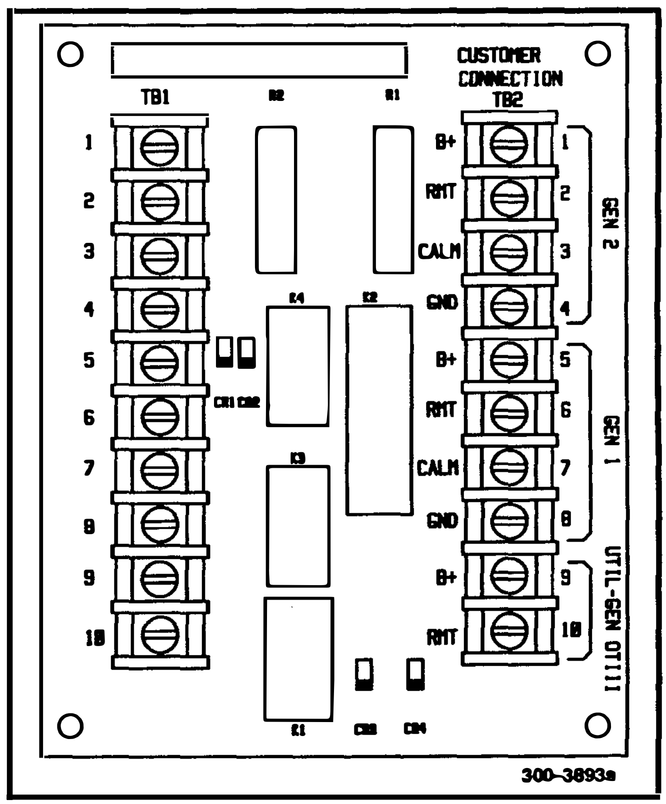


FIGURE 2-9. STANDBY SET START SEQUENCER OPTION

Float Battery Charger

The optional float-charge battery charger (Figure 2-10) regulates its charge voltage to continuously charge the battery. As the battery approaches full charge, the charging current automatically tapers to zero amperes or to steady-state load on the battery.

There are two chargers available. One battery charger is rated for 10 amperes at 12 or 24 VDC. The other battery charger is rated for 2 amperes at 12 or 24 VDC.

Power to the battery charger is supplied directly from the Normal source through connector J1/P1 on the Accessory Control Panel. The output of the battery charger is connected to the GND and B+ terminals of TB2 (or TB3 if the 3-Wire Start module is used). Refer to the drawing referenced on sheet 3 of your schematic and wiring diagram package.

The 2-ampere battery charger has an ammeter to indicate charging current and a fuse to protect the battery charger circuit.

The 10-ampere battery charger has three fuses (two on the AC input and one on the DC output), three fault display LEDs, and an ammeter for indication of charging current.

On the 10-ampere charger, three sets of (form C) alarm contacts (corresponding to the three fault LEDs) are also available. These contacts can be wired by the installer to activate other audible or visual alarms. (An optional harness and contact block is required.)

Under normal operating conditions, the Low Bat and AC Fail relays are energized and the High Bat relay is de-energized. In response to a Low Bat or AC Fail condition, the appropriate normally energized relay (Low Bat or AC Fail) drops out. In response to a High Bat condition, the normally de-energized High Bat relay is energized.

The alarm contacts are rated for 4 amperes at 120 VAC or 30 VDC. Connections to these contacts are made at terminals 41-42-43 (AC failure), 44-45-46 (high battery voltage), and 47-48-49 (low battery voltage) of TB3 (Figure 2-11).

The high and low alarm and float voltage adjustments are set at the factory. Adjustment procedures are described later in this section.

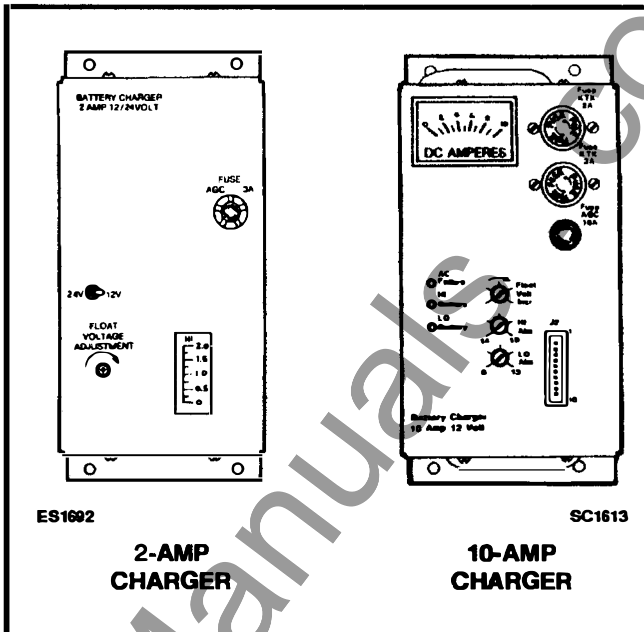


FIGURE 2-10. BATTERY CHARGER

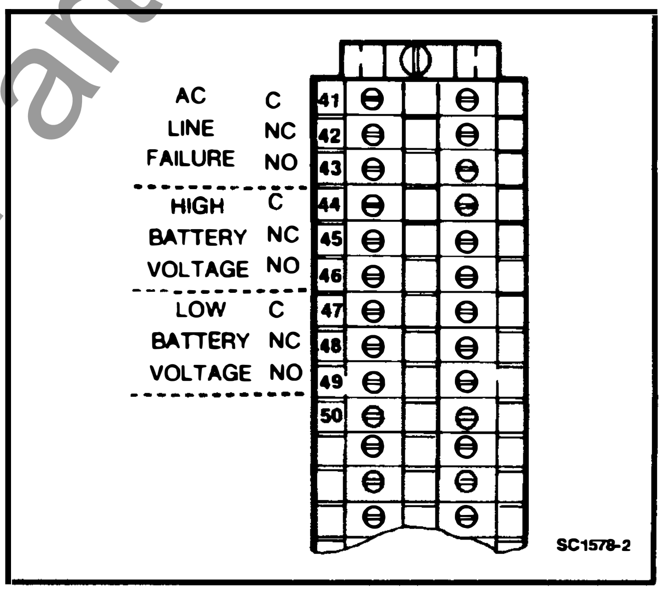


FIGURE 2-11. 10-AMPERE BATTERY CHARGER ALARM CONTACTS

Auxiliary Relays

Optional auxiliary relays (Figure 2-12) provide contacts for energizing external alarms, remote indicators, and control equipment such as louver motors and water pumps.

There are three types of auxiliary relay coils (12 VDC, 24 VDC, and 24 VAC).

DC relay coils are powered by B+ voltage. AC relay coils are powered by the 24 VAC outputs of T1 and T2.

All relays have two normally open and two normally closed contacts that are rated for 6 amperes at 600 VAC.

Table 2-2 is a partial list of the auxiliary relay options.

The AC relays are energized by the same signals that power the corresponding indicator lamps on the cabinet door.

The Emergency and Normal DC relays are energized to indicate transfer switch position. The Genset Run DC relay is energized only when the 2-wire start signal is present at the RMT terminal of TB2.

Refer to sheet 1 and to the drawings referenced on sheet 3 of your schematic and wiring diagram package.

Load Shed

The optional Load Shed function is used to disconnect the load from an available Emergency source in order to reduce the power consumed from that source. The Load Shed function (when activated by a customer-supplied signal) moves the transfer switch from the Emergency position to the neutral position.

Load Shed signal relay K4 is energized by the closing of a switch across terminals TB3-29 and TB3-30. When K4 is energized, four sets of K4 contacts act (in conjunction with auxiliary switch S8 and relay K2) to drive the linear actuator and move the transfer switch from the Emergency position to the neutral position.

When load shedding is in effect, a return of Normal utility power will cause retransfer to the Normal power source immediately.

If the load shed signal is removed before Normal power returns, the switch will transfer back to the Emergency side.

Refer to section 7 for a description of the non-automatic transfer switch Load Shed option.

Refer to sheets 1, 2, and 5 of your schematic and wiring diagram package.

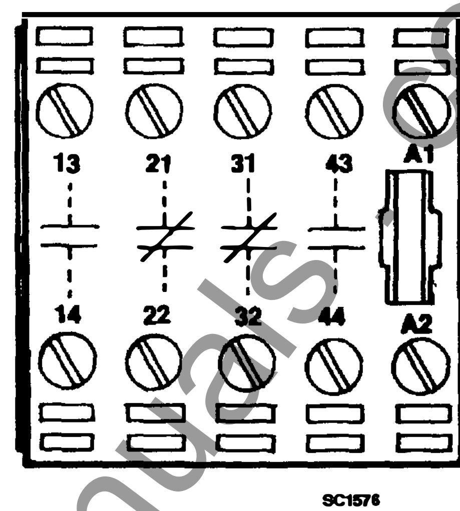


FIGURE 2-12. AUXILIARY RELAYS

TABLE 2-2. AUXILIARY RELAY OPTIONS

24 VAC Coil	Installed, Not Wired
24 VAC Coil	Emergency Connected Relay
24 VAC Coil	Normal Connected Relay
24 VAC Coil	Emergency Source Available Relay
24 VAC Coil	Normal Source Available Relay
24 VDC Coil	Installed, Not Wired
24 VDC Coil	Emergency Relay
24 VDC Coil	Normal Relay
24 VDC Coil	Genset Run Relay
12 VDC Coil	Installed, Not Wired
12 VDC Coil	Emergency Relay
12 VDC Coil	Normal Relay
12 VDC Coil	Genset Run Relay

Meter Package

The optional meter package includes an AC ammeter, an AC voltmeter, a frequency meter, and a phase selector switch.

AC Voltmeter: The voltmeter measures line-to-line voltages of the selected power source.

AC Ammeter: The ammeter measures the line currents of the load.

Frequency Meter: This meter measures the output frequency of the selected power source in hertz.

Phase Selector Switch: This switch is used to select the source and phase to be measured.

Power to the voltage and frequency meters is supplied from the connector lugs, through connector J1/P1 on the accessory control panel, and through the phase selector switch (S13). On switches rated for more than 300 VAC, transformer T3 is used between S13 and the meters to step down the voltage.

Power to the ammeter is supplied from current transformers, through switch S13 and directly to the ammeter. Cables from the source are passed once through the current transformers.

Refer to sheets 2 and 5 of your schematic and wiring diagram package.

Auto/Manual Switch

The optional Auto/Manual switch is used to enable or disable the automatic retransfer function. This switch has two positions. In the Auto position, normal automatic retransfer is enabled. In the Manual position, automatic retransfer is disabled—only manually initiated retransfer is possible.

In the Manual position, the switch closes and provides a ground at J7-3 on the Power Sentry mother board. This signal is optically coupled to the time delay module where it overrides the automatic retransfer timer.

Refer to the Power Sentry mother board schematic (Section 8) and to sheet 3 of your schematic and wiring diagram package.

600 VAC Adapter Transformer

On 600 VAC switches, transformer T4 is connected between phase A and B sources and the linear actuator to step down the AC voltage. A special pair of interposing relays (K1 and K2), equipped with a mechanical interlock, allow only one source (Normal or Emergency) to be connected to the transformer at a time.

Refer to sheets 2 and 4 of your schematics and wiring diagram package.

Alarm Module Option

The optional alarm module (Figure 2-13) provides an audible indication that the transfer switch has transferred to the emergency power source.

A push button on the alarm module provides a means to silence the horn.

The Alarm lamp indicates that the transfer switch is in the Emergency Connected position. If the horn is silenced, the Horn Silenced lamp will also light. Both lamps will stay lit until the transfer switch moves from the Emergency Connected position to the disconnected (neutral) or Normal Connected position.

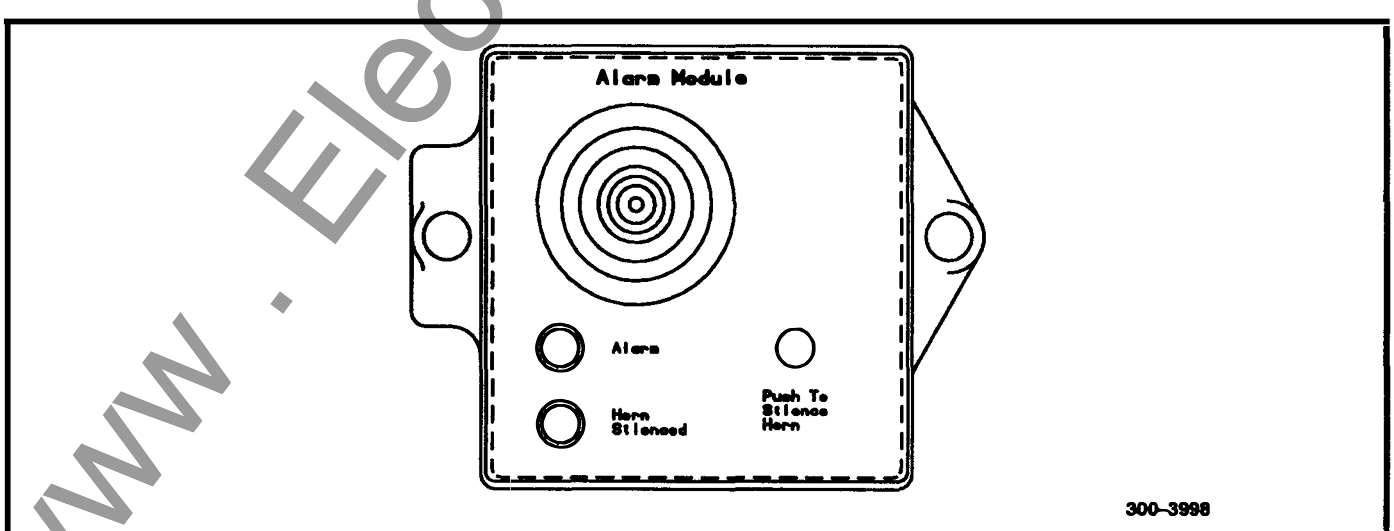


FIGURE 2-13. ALARM MODULE

CONTROL SYSTEM OPERATION

The following text covers the operation of the electronic control system in a utility-to-generator set installation. Source 1 is designated as the normal power source and Source 2 is designated as the emergency power source. The following situations and control responses are described:

- **Normal Power Source Connected to Load**
- **Normal Power Source Interrupted**
- **Emergency Power Source Connected to Load**
- **Normal Power Source Restored**
- **Test/Exercise With/Without Load Mother Board 300-3090**
- **Test/Exercise With/Without Load Mother Board 300-3953**

Some of the control commands can be verified by observing the indicator lamps on the Power Sentry Control. The mother board schematic (Section 8) and your schematic and wiring diagram package will help you follow the operation descriptions.

Normal Power Source Connected to Load

On the Power Sentry Control: The Source 1 Available lamp is on to indicate that the normal power source is within the voltage and frequency settings of the voltage sensor. The Retransfer Complete lamp is on to indicate that the control is signaling for the load to be connected to the normal power source (retransfer). No other Power Sentry indicator lamps are on.

The normally energized start relay (K11) and the retransfer relay (K15) are energized.

Normal Power Source Interrupted

An interruption in power can be defined as not only the complete loss of power but also as any situation where the voltage or frequency are outside the settings of the voltage sensor. The voltage sensor responds to all power interruptions by blocking the Source 1 Available signal.

Source 1 Voltage Sensor: The undervoltage sensor begins timing if the source fails or if the voltage falls below the dropout setting. The undervoltage dropout time delay is factory set for 0.5 seconds and is not adjustable. Unless power is lost completely, both the Source 1 Available lamp and the Retransfer Complete lamp remain on during the timing period. If the voltage returns during the 0.5 second delay, the sensor resets itself. This short delay prevents the time delay module from responding during momentary dips in voltage.

The optional overvoltage sensor begins timing if the source voltage rises above the dropout setting. The overvoltage dropout time delay is adjustable from 0 to 120 seconds. The Source 1 Available and Retransfer Complete lamps remain on during the timing period. If the voltage returns to normal during the timing period, the sensor resets itself.

The optional over/underfrequency sensor begins timing if the source frequency rises above or falls below the dropout setting. The frequency dropout time delay is adjustable from 0 to 15 seconds. Unless power is lost completely, both the Source 1 Available lamp and the Retransfer Complete lamp remain on during the timing period. If the frequency returns to normal during the timing period, the sensor resets itself.

Start Time Delay: If the Normal power source is still faulty after the voltage sensor has timed out, all indicator lamps go out and the start time delay begins timing. The start time delay is adjustable from 0 to 15 seconds (or, optionally, from 0 to 90 seconds). All lamps stay out while the start time delay is timing. The start time delay prevents generator set startup when a power interruption of very short duration occurs. If the Normal power source returns during the timing period, the start time delay is reset.

Capacitor C1 (on the mother board) provides power to the time delay module during this timing period. Because the generator set start signal is initiated by de-energizing a relay, a complete discharge of C1 produces a start signal.

After the start time delay has timed out, a signal from the time delay module de-energizes the normally energized two-wire start relay (K-11), lights the Start Gen Set lamp (dimly), and (if applicable) sends a start signal to the 3-Wire Start module.

On two-wire start systems, K11 contacts close and signal the generator set to run. On three-wire start systems, a relay in the 3-Wire Start module signals the generator set to run. The Start Gen Set lamp remains lit as long as the control is signaling the generator set to run.

Source 2 Voltage Sensor: The Source 2 voltage sensor monitors the voltage output from the generator set. When the voltage rises above the pickup setting, the sensor signals that the Emergency power source is available. The Source 2 Available lamp lights and stays on as long as the Emergency power source is within the voltage and frequency settings of the voltage sensor.

Transfer Time Delay: The transfer time delay begins timing as soon as the voltage sensor signals that source 2 voltage is available. The transfer time delay is adjustable from 0 to 120 seconds. The Transfer Timing lamp lights to indicate that the transfer time delay is timing. This pause before transferring the load to the generator is to allow the generator set to stabilize.

Transfer of Load: After the transfer time delay has timed out, the time delay module sends out a transfer signal. If the optional Signal Module is not used, the transfer signal energizes the transfer control relay K14.

If the Signal Module is used, the transfer signal is delayed for a preset time (0-50 seconds). During this delay, the Signal Module energizes an Elevator Signal relay to announce that a transfer is about to occur.

When K14 is energized (with or without the Signal Module delay), its normally open contacts close and energize transfer relay K2. When K2 is energized, its contacts direct Emergency power to the linear actuator, transferring the load to the Emergency source.

Without programmed transition, the linear actuator circuit path includes K2 contacts, circuit breaker CB1, Motor Disconnect switch S1, and auxiliary switch S8. Capacitor(s) C1 provides the phase shift necessary to drive the linear actuator.

If the Program Transition module is used, there is a pause (0 to 60 or 0 to 7.5 seconds) at the neutral position. The timing of this pause is controlled by the Program Transition module. The linear actuator drive circuit is controlled by K2, K3, and auxiliary switch S5.

With programmed transition, the circuit path provided by the normally closed contacts of K3 and auxiliary switch S5 allows the switch to move from the Normal side to the neutral position. Switch S5 then breaks the linear actuator drive circuit—forcing the switch to wait for the Program Transition module to time out. After the normally open K3 contacts (on the Program Transition module) close, the circuit path to the linear actuator is completed and the switch is transferred to the Emergency side.

The Transfer Complete lamp lights and stays on as long as the control is signaling for the load to be connected to the Emergency power source.

Auxiliary switches S6, S7, S8, and S9 are actuated when the transfer switch is in the Emergency position. Switch S8 acts as a limit switch to break the circuit path to the linear actuator. Switch S7 breaks the circuit path to the coil of relay K2 and lights the Emergency Connected lamp on the door.

Emergency Power Source Connected to Load

The Source 2 Available lamp is on to indicate that the Emergency power source is within the voltage and frequency settings of the voltage sensor. The Transfer Complete lamp is on to indicate that the control is signaling for the load to be connected to Emergency power source. The Start Gen Set lamp is on to indicate that the control is signaling for the generator set to run.

When the transfer switch is in the Emergency position (and the Emergency source is energized), K16 is energized by the action of position-sensing auxiliary switch S7. When K16 is energized, its run interlock contacts K16-2/K16-4 are open, preventing K11 from being re-energized. This prevents the control from stopping the generator set as long as it is still powering the load.

Normal Power Source Returns

The time delay module is programmed to identify the Normal power source as the preferred power source. The return of Normal power initiates several control responses that eventually cause the load to retransfer to the Normal side.

Source 1 Voltage Sensor: The Source 1 voltage sensor monitors the Normal power source. When the voltage and frequency satisfy the pickup setting requirements, the sensor signals that Source 1 voltage is available. The Source 1 Available lamp lights and stays on as long as the Normal source voltage is within the voltage and frequency settings of the voltage sensor.

Retransfer Time Delay: The retransfer time delay begins timing as soon as the voltage sensor signals that Source 1 voltage is available. The retransfer time delay is adjustable from 0 to 30 minutes. The Retransfer Timing lamp lights while the retransfer time delay is timing. This delay allows the line voltage to stabilize before retransferring to the Normal power source.

Retransfer of Load: After the retransfer time delay has timed out, the time delay module generates a retransfer signal. If the optional Signal Module is not used, the retransfer signal energizes the retransfer control relay K15.

If the Signal Module is used, the retransfer signal is delayed for a preset time (0 to 50 seconds). During this delay, the Signal Module energizes an Elevator Signal relay to announce that a retransfer is about to occur.

When K15 is energized (with or without the Signal Module delay), its normally open contacts close and energize retransfer relay K1. When K1 is energized, its contacts direct Normal power to the linear actuator, retransferring the load back to the Normal power source.

Without programmed transition, the linear actuator circuit path includes K1 contacts, circuit breaker CB1, Motor Disconnect switch S1, and auxiliary switch S4. Capacitor(s) C1 provides the phase shift necessary to drive the linear actuator.

If the Program Transition module is used, there is a pause (0 to 60 or 0 to 7.5 seconds) at the neutral position. The timing of this pause is controlled by the Program Transition module. The linear actuator drive circuit is controlled by K1, K3, and auxiliary switch S9.

With programmed transition, the circuit path provided by the normally closed contacts of K3 and auxiliary switch S9 allows the switch to move from the Emergency side to the neutral position. Switch S9 then breaks the linear actuator drive circuit—forcing the switch to wait for the Program Transition module to time out. After the normally open K3 contacts (on the Program Transition module) close, the circuit path to the linear actuator is completed and the switch is transferred to the Normal side.

The Retransfer Complete lamp lights and stays lit as long as the control is signaling for the load to be connected to the Normal power source.

Auxiliary switches S2, S3, S4, and S5 are actuated when the transfer switch is in the Normal position. Switch S4 acts as a limit switch to break the circuit path to the linear actuator. Switch S3 breaks the circuit path to the coil of relay K1 and lights the Normal Connected lamp on the door.

Stop Time Delay: The stop time delay begins timing as soon as the Retransfer Complete lamp lights. The stop time delay is adjustable from 0 to 10 minutes. The Stop Timing lamp lights while the stop time delay is timing. This delay allows the generator set to cool down while running at no load. When the stop time delay has timed out (provided that K16 is de-energized), the time delay module energizes the two-wire start relay (K11), turns off the Start Gen Set lamp, and (if applicable) sends a stop signal to the 3-Wire Start module.

On two-wire start systems, K11 contacts open, removing the generator set run signal. On three-wire start systems, a relay in the 3-Wire Start module signals the generator set to stop. After the generator set stops, the Source 2 Available lamp goes out.

Test/Exercise With/Without Load Mother Board 300-3090

To follow this description of Power Sentry control of generator set test and exercise functions, refer to the schematic of mother board 300-3090 (in section 8). On the schematic, locate switch S1 and relays K11, K12, K13 and K16. Locate the Test/Normal/ Retransfer switch, S12, on sheet 2 of the schematic and wiring diagram package.

Signal to Test/Exercise: The signals that initiate test or exercise enter the mother board at:

- Local Test input J7-9 (from the Test/Normal/ Retransfer switch, S12-3/S12-4),
- Optional Exerciser Clock input J7-8, or
- Remote Test input J8-7.

The signal consists of a switch closing to ground. A ground at K13-8 energizes K13—the test/exercise relay.

Starting the Generator Set: When K13 is energized, its normally closed contacts open. When contacts K13-2/K13-3 open, K11, the normally energized two-wire start relay is de-energized and a start signal (if applicable) is sent to the 3-Wire Start module. When contacts K13-6/K13-7 open, one of three paths to the phase A/B Normal side bridge rectifier (at CR16/CR17) is opened.

Generator Set Starts: As the generator set runs and produces power (at an acceptable voltage and frequency), the Source 2 Available lamp lights and the source 2 available relay (K12) is energized. When contacts K12-2/K12-4 open, the second of three paths to the phase A/B Normal side bridge rectifier is opened. These contacts close to initiate retransfer to Normal power if the generator set fails during test or exercise.

With/Without Load: With K12 (source 2 available relay) and K13 (test/exercise relay) energized, the only path for phase A/B power to the bridge rectifiers is through switch S1 (the With/Without Load switch).

If S1 is closed (Without Load position), the Power Sentry senses that both sources are available. In utility-to-generator set applications, the Power Sentry is configured to prefer Source 1. No transfer of load occurs.

If S1 is open (With Load position), there is no path for phase A/B power to the bridge rectifier. A power failure (although simulated) is sensed and transfer of load timing begins. After the transfer timer times out, the time delay module signals relay K14 and transfer of load (as described above) occurs.

When the transfer switch is in the Emergency position (and the Emergency source is energized), K16 is energized by the action of position-sensing auxiliary switch S7. When K16 is energized, its run interlock contacts K16-2/K16-4 are open, preventing K11 from being re-energized. This prevents the control from stopping the generator set as long as it is still powering the load.

End of Test/Exercise: The test/exercise period is stopped by removing the ground from K13-8. This is done by moving the Test/Normal/Retransfer switch to Normal, by opening the remote test switch, or (automatically) by the opening of contacts in the exerciser clock.

When ground is removed from K13-8, its normally closed contacts close. If the test/exercise was conducted without load, then the closure of contacts K13-2/K13-3 energizes two-wire start relay K11 (which removes the two-wire start signal) and (if applicable) sends a stop signal to the 3-Wire Start module.

If the test/exercise was conducted with load, then the closure of contacts K13-6/K13-7 provide a path for A/B phase power to the bridge rectifiers. This allows the source 1 sensor to sense Normal power and begin retransfer timing.

Meanwhile, the closure of K13-2/K13-3 contacts does not energize K11 because contacts K16-2/K16-4 are open and because there is no stop signal being sent from the time delay module (J2-13). K16 stays energized and its contacts stay open as long as the transfer switch is in the Emergency position.

After the retransfer delay has timed out, the time delay module signals relay K15 and retransfer to the Normal power source occurs. After retransfer, K16 is de-energized and contacts K16-2/K16-4 close. The closure of these contacts completes the circuit to K11. After the stop time delay times out, the time delay module sends out a stop signal (J2-13) that passes through contacts K13-2/K13-3 and K16-2/K16-4. This signal terminates both two-wire and three-wire start signals.

Instant Retransfer: When testing with load, you can bypass the retransfer delay by moving the Test/Normal/Retransfer switch to the Retransfer position. This sends a signal to J7-12, which is optically coupled to the time delay module where it overrides the retransfer timer. In response to this signal, the time delay module signals K15 and retransfer occurs without delay.

For Normal operation the Test/Normal/Transfer switch must be in the Normal position.

Test/Exercise With/Without Load Mother Board 300-3953

To follow this description of Power Sentry control of generator set test and exercise functions, refer to the schematic of mother board 300-3953 (in section 8). On the schematic, locate switches S1 and S4, and relays K10, K11, K12, K13, K16 and K18. Locate the Test/Normal/ Retransfer switch, S12, on sheet 2 of the schematic and wiring diagram package.

Signal to Test/Exercise: The signals that initiate test or exercise enter the mother board at:

- Local Test input J7-9 (from the Test/Normal/ Retransfer switch, S12-3/S12-4),
- Exerciser Clock input J7-8, or
- Remote Test input J8-7.

These signals consist of a switch closing to ground.

The Exerciser Clock and Local Test inputs each have a corresponding With/Without Load switch, labeled S1 and S4, respectively. If a switch is in the With Load position, a local test or exercise signal will energize K18. If a switch is in the Without Load position, a local test or exercise signal will energize K13.

The Remote Test input has no corresponding With/Without Load switch. This input is connected directly to relay K18.

Without Load Test: If the appropriate With/Without Load switch (S1 or S4) is in the Without Load position, a local test or exercise signal will energize K13. When K13 is energized, its normally closed contacts open. When contacts K13-2/K13-4 open, K11, the normally energized two-wire start relay, is de-energized. When K11 is de-energized, a start signal is sent to the generator set. If applicable, a start signal is sent to the 3-Wire Start module.

With Load Test: Locate contacts K10-2/K10-4 and K18-2/K18-4. These two sets of contacts, along with a set of K12 contacts, provide the two circuit paths for the phase A/B Normal side bridge rectifier (at CR16/CR17). The bridge rectifier, in turn, provides a sampling voltage to the Normal side voltage sensor.

Whenever the transfer switch is connected to the Normal (source 1) source, relay K10 is energized and contacts K10-2/K10-4 are open. Under these conditions, contacts K18-2/K18-4 provide the only circuit path for Normal phase A/B power to the bridge rectifier.

If the appropriate With/Without Load switch (S1 or S4) is in the With Load position, a local test or exercise signal will energize K18. (Because the Remote Test input is connected directly to relay K18, a Remote Test signal will also energize that relay.) When K18 is energized, its normally closed contacts open. When contacts K18-2/K18-4 open, Normal phase A/B power to the bridge rectifier is cut off, and a (simulated) power failure is sensed.

With Normal phase A/B power to the Normal side voltage sensor interrupted, generator set start timing begins. When the generator set starts and the source 2 voltage sensor senses generator set voltage, transfer of load timing begins. After the transfer timer times out, the time delay module sends a signal to relay K14 and transfer of load occurs.

When the transfer switch is in the Emergency position (and the Emergency source is energized), K16 is energized by the action of position-sensing auxiliary switch S7. When K16 is energized, its run interlock contacts K16-2/K16-4 are open, preventing K11 from being re-energized. This prevents the control from stopping the generator set as long as it is still powering the load.

As the generator set runs and produces power (at an acceptable voltage and frequency), the Source 2 Available lamp lights and the source 2 available relay (K12) is energized, opening contacts K12-2/K12-4. If the generator set fails during test or exercise, these contacts close to initiate retransfer to Normal power. (Note that with the transfer switch in the Emergency position, contacts K10-2/K10-4 are closed.)

End of Test/Exercise: The test/exercise period is stopped by removing the test or exercise signal. This is done by moving the Test/Normal/Retransfer switch to Normal, by opening the remote test switch, or (automatically) by the opening of contacts in the exerciser clock.

If the test/exercise was conducted without load, then the removal of the ground signal from K13 causes K13 to be de-energized, closing contacts K13-2/K13-4. The closure of these contacts energizes two-wire start relay K11 (which removes the two-wire start signal) and (if applicable) sends a stop signal to the 3-Wire Start module.

If the test/exercise was conducted with load, then the removal of the ground signal from K18 causes K18 to be de-energized, closing its normally open contacts. The closure of contacts K18-2/K18-4 provides a circuit path for A/B Normal phase power to the bridge rectifiers. This allows the source 1 sensor to sense Normal power and begin retransfer timing.

After the retransfer delay has timed out, the time delay module signals relay K15 and retransfer to the Normal power source occurs. After retransfer, K16 is de-energized, closing contacts K16-2/K16-4. The closure of these contacts completes the circuit to K11. After the stop time delay times out, the time delay module sends a stop signal from J2-13, through contacts K13-2/K13-4 and K16-2/K16-4, to the coil of K11. This signal terminates the start signal.

Instant Retransfer: When testing with load, you can bypass the retransfer delay by moving the Test/Normal/Retransfer switch to the Retransfer position. The closing of contacts S12-1/S12-2 sends a signal to J7-12, which is optically coupled to the time delay module, where it overrides the retransfer timer. In response to this signal, the time delay module signals K15 and retransfer occurs without delay.

For Normal operation the Test/Normal/Transfer switch must be in the Normal position.

ADJUSTING POWER SENTRY MODULES

WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause serious personal injury or death. Use extreme caution to avoid touching electrical contacts when the cabinet door is open.***

CAUTION ***Incorrect setting of the calibration (Cal) adjustments will result in abnormal operation of the transfer switch.***

All adjustments to the sensor modules are made by turning potentiometers with a screwdriver.

Access to the potentiometers is made through openings in the cover of the Power Sentry control (Figure 2-14).

A separate voltage sensor is used for each power source. They are located one on each side of the time delay module. The Source 1 sensor monitors the Normal (utility) power source. The Source 2 sensor monitors the Emergency (generator set) power source.

Disable the Linear Motor

WARNING ***Accidental actuation of the linear motor can cause severe personal injury. Disable the motor, as described below, before making adjustments.***

Place the Motor Disconnect Switch (on the accessory control panel) in the Off position when making adjustments. Return the switch to the Auto position after adjustments are completed.

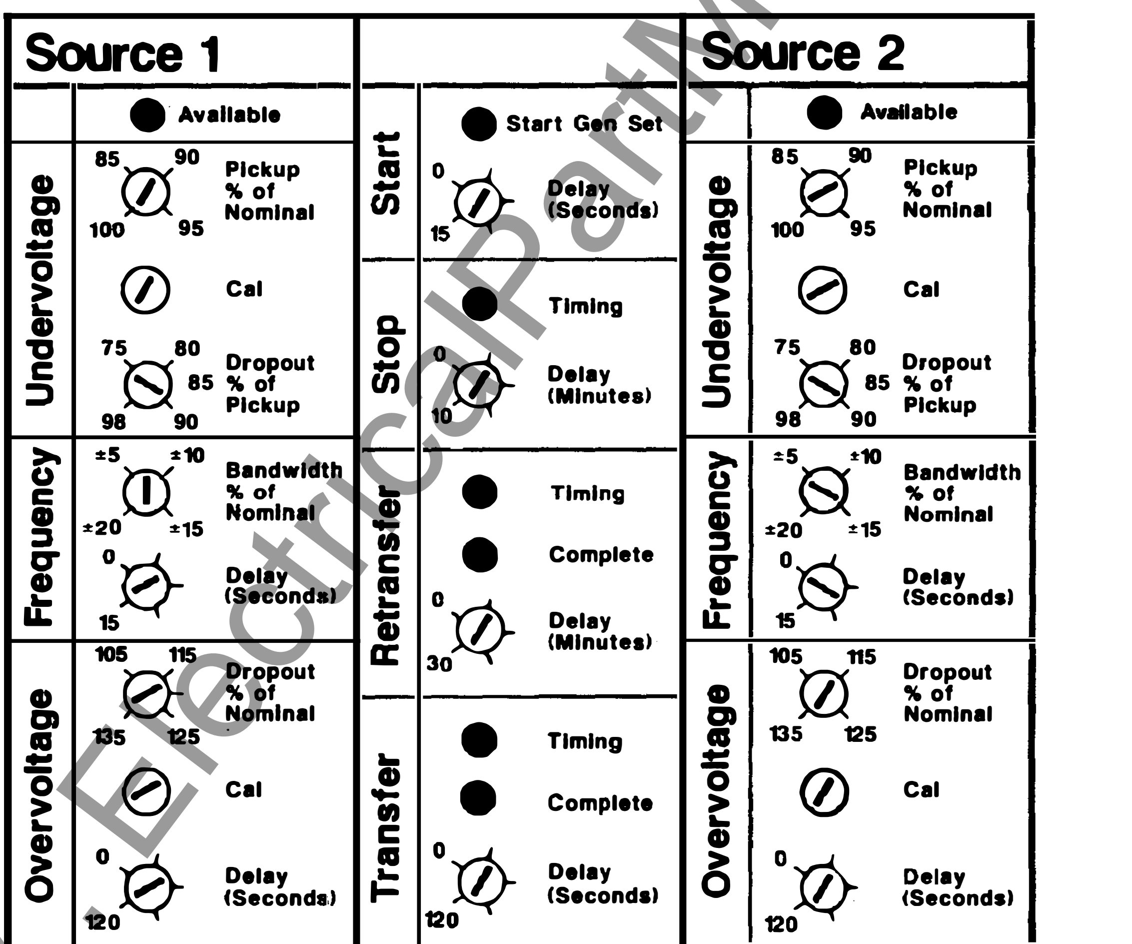


FIGURE 2-14. POWER SENTRY ADJUSTMENTS

⚠WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts when the cabinet door is open.***

Undervoltage Sensor Calibration

The standard voltage sensor modules monitor the Normal and Emergency power sources for an undervoltage condition. To calibrate the undervoltage sensors:

1. Check that nominal voltage is present on all phases of the source being calibrated (Normal or Emergency). On voltage sensors with the frequency sensing option, the source frequency must be within the limits set by the Frequency Bandwidth potentiometer.
2. Turn the Undervoltage Pickup and Dropout potentiometers on the voltage sensor fully clockwise.
3. Turn the Undervoltage calibration (Cal) potentiometer fully clockwise. The Source Available lamp that corresponds to the source sensor being calibrated should be on. If the Source Available lamp fails to come on, and the voltage sensor has an overvoltage sensing option, turn the overvoltage Dropout and Cal potentiometers fully clockwise.
4. Turn the Undervoltage Cal potentiometer counterclockwise until the Source Available lamp turns off.
5. Slowly turn the Undervoltage Cal potentiometer clockwise until the Source Available lamp just turns on again.
6. The undervoltage sensor is now calibrated. If the overvoltage sensor was adjusted in Step 3, then recalibrate it by using the overvoltage sensor calibration procedure.

Undervoltage Pickup and Dropout Adjustments

Undervoltage dropout occurs when an undervoltage condition is sensed. Pickup occurs when an acceptable voltage is sensed. Undervoltage dropout and pickup are adjustable over the following ranges:

Function	Adjustment Range
Pickup	85% to 100% of nominal voltage
Dropout	75% to 98% of pickup voltage

To set the pickup and dropout percentages, align the slots on the potentiometers with the desired markings on the Power Sentry cover (Figure 2-14).

Overvoltage Sensor Calibration

The optional overvoltage sensor monitors the source voltage for an overvoltage condition. To calibrate the overvoltage sensor:

If the undervoltage sensor has not been calibrated, do so before proceeding.

1. Check that nominal voltage is present on all phases of the source being calibrated (Normal or Emergency). On voltage sensors with the frequency sensing option, the source frequency must be within the limits set by the Frequency Bandwidth potentiometer.
2. Turn the Overvoltage Dropout and Delay potentiometers fully counterclockwise.
3. Turn the Overvoltage Cal potentiometer fully clockwise. The Source Available lamp for the selected source should light.
4. Turn the Overvoltage Cal potentiometer counterclockwise until the Source Available lamp turns off.
5. Slowly turn the Overvoltage Cal potentiometer clockwise until the Source Available lamp just turns on again.

Overvoltage Dropout and Time Delay Adjustments

The overvoltage sensor has an adjustable dropout and time delay. Dropout occurs when an overvoltage condition is sensed. The dropout time delay allows the control to ignore momentary voltage overshoots. Pickup is fixed at five percent below the dropout setting. Overvoltage dropout and time delay are adjustable over the following ranges:

Function	Adjustment Range
Dropout	105% to 135% of nominal voltage
Delay	0 to 120 seconds

To set the dropout percentage and time delay, align the slots on the potentiometers with the desired markings on the Power Sentry cover (Figure 2-14).

Frequency Sensor Adjustments

The optional frequency sensor monitors the source frequency. When the source frequency is outside the acceptable band, dropout occurs. (The band is centered about the nominal system frequency - 50 or 60 hertz.) The dropout bandwidth is 2.5% wider (on each end) than the pickup bandwidth. The pickup bandwidth is adjustable.

An adjustable dropout time delay allows the control to ignore momentary dips or rises in frequency.

Frequency sensor pickup bandwidth and time delay are adjustable over the following ranges:

Function	Adjustment Range
Bandwidth	±5% to ±20% of nominal
Delay	0 to 15 seconds

To set the pickup bandwidth and time delay, align the slots on the potentiometers with the desired markings on the Power Sentry cover (Figure 2-14).

Time Delay Module Adjustments

The time delay module controls the following functions:

- Start time delay
- Stop time delay
- Transfer time delay
- Retransfer time delay

The time delays on the standard time delay module are adjustable over the following ranges:

Delay	Adjustment Range
Start	0 to 15 seconds
Stop	0 to 10 minutes
Transfer	0 to 120 seconds
Retransfer	0 to 30 minutes

An optional time delay module has an adjustable start delay range of 0 to 90 seconds.

To set the time delays, align the slots on the potentiometers with the desired markings on the Power Sentry cover (Figure 2-14).

WARNING ***Automatic transfer switch operation results in rapid movement of the manual operator handles and presents a hazard of severe personal injury. Keep hands clear of handles when switching back to automatic operation.***

If there are no optional control modules to adjust, place the Motor Disconnect Switch in the Auto position and close the cabinet door.

ADJUSTING OPTIONAL CONTROL MODULES AND ACCESSORIES

WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts when the cabinet door is open.***

The transfer switch can be equipped with one or more optional control modules. The 3-Wire Start, Program Transition, and Signal modules have adjustable time delays that must be set. The exercise clock must be programmed.

Disable the Linear Motor

WARNING ***Accidental actuation of the linear motor can cause severe personal injury. Disable the motor, as described below, before making adjustments.***

Place the Motor Disconnect Switch (on the accessory control panel) in the Off position when making adjustments. Return the switch to the Auto position after adjustments are completed.

Three-Wire Start

The 3-Wire Start module has two adjustable timers.

The Preheat timer delays the start signal to allow preheating the generator set. The Preheat timer's range of adjustment is 0 to 60 seconds.

If the module has a Preheat On-Off switch, make sure that it is in the correct position.

The Overcrank timer limits the time that the generator set starter is allowed to operate. The Overcrank timer's range of adjustment is 0 to 120 seconds.

To set the timers, align the slots on the potentiometers with the desired markings on the faceplate.

Program Transition

The Program Transition module has one adjustable timer. The Program Transition time delay holds the transfer switch in the neutral position before allowing it to complete a transfer to the other source.

This module is available with two adjustment ranges; 0 to 7.5 seconds or 0 to 60 seconds.

To set the time delay, align the slot on the potentiometer with the desired marking on the faceplate.

If a time delay is desired, make sure that the Delay/No Delay switch is in the Delay position.

Signal Module

The Signal Module has one adjustable timer. The Elevator Signal delay controls the timing of two events. It delays transfer/retransfer and energizes the Elevator Transfer Signal relay during the delay period.

This time delay is adjustable over a range of 0 to 50 seconds.

To set the time delay, align the slot on the potentiometer with the desired marking on the faceplate.

If a time delay is desired, make sure that the Delay/No Delay switch is in the Delay position.

Exerciser Clock

The exerciser clock initiates generator set start/run cycles at programmable intervals and for programmable durations. It is a 7-day, 24-hour clock that can store and execute up to ten start/stop programs (exercise cycles).

Programming the exerciser clock requires setting the time of day and entering the exercise start and stop times.

Refer to the circled numbers in Figure 2-15 when reading the following instructions.

To set the time of day:

1. If you are performing installation and setup, press the R button (9) with the tip of a ball point pen to reset all memory. Do not press the R button if you are only changing the time of day.
2. Press the clock button (1).
3. Press the h button (3) to set the hour of the day. The clock uses 24-hour (military) time.
4. Press the m button (4) to set the minutes of the hour.
5. Press the 1-7 button (5) to advance the indicator bar over the desired day number. (Use the 1 to represent Sunday.)
6. Press the Pr button (8) to enter the time.

To set the exercise start time:

1. Slide the output selector switch (16) to the center position. The output selector switch has three positions. The Off position overrides the program and causes an exercise stop. The I position overrides the program and causes an exercise start. The center position selects program control.
2. Press the I/O button (2). An "I" (12) appears in the upper display window. The "I" is a symbol for start time.
3. Press the h button (3) to set the start hour.

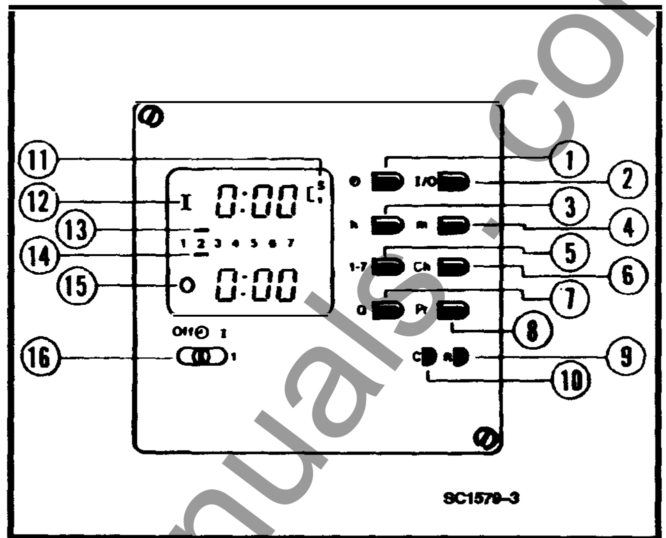


FIGURE 2-15. EXERCISER CLOCK

4. Press the m button (4) to set the start minute.
5. Press the 1-7 button (5) to advance the indicator bar (13) from 1 to 7 and back to 1. For each day to be selected for exercise, press the Q button (7) when the indicator is over the desired day number. (1 represents Sunday.)

To set the exercise stop time:

1. Press the I/O button (2). An "O" (15) appears in the lower left display window. The "O" is a symbol for stop time.
2. Press the h button (3) to set the stop hour.
3. Press the m button (4) to set the stop minute.
4. Press the 1-7 button (5) to advance the indicator bar (14) from 1 to 7 and back to 1. For each start time (selected in step 5 above), there must be a corresponding stop time. A program can start on day 2, pass through midnight, and stop on day 3 (for example); but there must be a stop time for every start time. Press the Q button (7) when the indicator is under the desired day number.
5. To enter the complete start/stop program, press the Pr button (8). If all program requirements have been satisfied, the display returns to the time of day. If the program requirements are not met, the display of the section that needs correction flashes on and off.

To enter more programs, repeat the two 5-step procedures. A maximum of ten programs can be entered. (The same ten programs can be repeated each day.)

The word "Full" appears in the display when the memory is full.

If the I/O button (2) is pressed and no program is to be entered, press the Ch button (6) and then the Pr button (8) to get out of the program mode.

To check the programs:

1. Press the Ch button (6). An "I" (12) and an "O" (15) are displayed.
2. Press the Ch button (6) again. The start and stop information for the first program is displayed.
3. Continued pressing of the Ch button (6) causes the display to sequence through all of the programs in memory. If ten programs have been entered, the word "Full" appears after the tenth program display.
4. Press the Pr button (8) to return to the time-of-day display.

To change (edit) a program:

1. Press the Ch button (6) until the program you want to change appears in the display window.
2. Press the I/O button (2) to select start or stop time.
3. Press the h (3), m (4), or 1-7 (5) and Q (7) buttons to change the hour, minute, or day.
4. Press the Pr button (8) to enter the edited program and return to the time-of-day display.

To erase (clear) a program:

1. Press the Ch button (6) until the program to be erased is displayed.
2. Press the C button (10) with a ball point pen to clear the program.
3. Press the Pr button (8) to return to the time-of-day display.

Battery Charger Float Voltage

The float voltage is set at the correct value at the factory and should not require adjustment. However, if the battery shows signs of being overcharged or undercharged, the float voltage can be adjusted. A high specific gravity, bubbling of electrolyte, and loss of water indicate a high float voltage. A low specific gravity indicates a low float voltage.

WARNING ***Ignition of explosive battery gases can cause severe personal injury. Do not smoke or cause any spark, arc, or flame while servicing batteries.***

To change the float voltage, a fully charged battery, a hydrometer, a small screwdriver, and an accurate voltmeter (0.5% accuracy) are needed. Use the following procedures to adjust the float voltage.

CAUTION ***Attempting to adjust or test the battery charger with a deeply discharged battery can lead to the false conclusion that the charger is malfunctioning. Always use a fresh, fully charged battery when adjusting or testing the charger.***

CAUTION ***Always disconnect the battery charger from its AC source (remove the charger's AC input fuses) before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage DC control circuits.***

1. Turn the operation selector for the generator set to Stop and disconnect the starting battery (negative [–] lead first). The selector switch is located on the generator set control panel on two-wire start systems and on 3-Wire Start module on three-wire start systems.
2. Connect the fully charged battery (negative [–] lead last) to the generator set and verify the charge condition with the hydrometer. A fully charged lead-acid battery will have a specific gravity of 1.260 at 77° F (25° C).
3. Connect the voltmeter directly to the battery terminals and measure the voltage.
4. Compare the voltage reading with the value shown in Table 2-3. If the voltage is above or below the recommended float voltage, open the cabinet door and adjust as specified in step 5. If the voltage is correct, proceed to step 7.

TABLE 2-3. BATTERY FLOAT VOLTAGES

Lead-Acid Batteries	
Battery Voltage	**Float Voltage**
12	13.3
24	26.6

Nickel-Cadmium Batteries
Float Voltage Charge Per Cell
1.38 to 1.45 volts
Example: Float charge for 10 cell battery should be 13.8 to 14.5 volts.

5. Use a small screwdriver to turn the adjustment potentiometer (located on charger panel) counterclockwise to decrease the float voltage and clockwise to increase the float voltage. Adjust in small steps and wait five minutes for the voltage to stabilize before making additional adjustments.

   WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use care when making adjustments to avoid touching electrical contacts.***
6. When adjustments are complete, close and lock the transfer switch cabinet door.
7. Disconnect the voltmeter from the battery terminals and disconnect the test battery (negative [–] lead first) from the generator set.
8. Reconnect the generator set starting battery (negative [–] lead last) and place the operation selector switch in the Auto (three-wire start) or Remote (two-wire start) position.

10-Amp Charger Alarm Settings

If the battery voltage rises above the HI alarm setting or drops below the LO alarm setting for 90 seconds, the corresponding (HI or LO) battery alarm LED is lit and a corresponding (optional) set of form C relay contacts is activated.

WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts whenever the cabinet door is open.***

The high and low alarm adjustments are set at the factory. The ranges and factory settings are:

12-volt charger

9 VDC to 13 VDC (LO Alarm)
Factory Setting: 12.5 VDC

14 VDC to 19 VDC (HI Alarm)
Factory Setting: 14.5 VDC

24-volt charger

18 VDC to 25 VDC (LO Alarm)
Factory Setting: 25 VDC

27 VDC to 36 VDC (HI Alarm)
Factory Setting: 29 VDC

WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution when making adjustments to avoid touching electrical contacts.***

1. Open the cabinet door.
2. Use a small screwdriver to turn the HI Alm or LO Alm adjustment potentiometers on the charger panel counterclockwise to decrease the alarm voltage and clockwise to increase the alarm voltage. The graduations on the adjustment potentiometers are approximate (± 1 volt).
3. When finished, close and lock the cabinet door.

When you have finished the adjustments of the optional control modules, place the Motor Disconnect Switch (on the accessory control panel) in the Auto position and close and lock the cabinet door.

WARNING ***Automatic transfer switch operation results in rapid movement of the manual operator handles and presents a hazard of severe personal injury. Keep hands clear of handles when switching back to automatic operation.***

3. Troubleshooting Electronic Control System

This section covers troubleshooting procedures for the utility-to-generator set automatic transfer switch.

Although some of the information is applicable to generator set-to-generator set, utility-to-utility, and nonautomatic/remote configurations, there are several significant differences.

Refer to section 5 for an overview of generator set-to-generator set transfer switch troubleshooting.

Refer to section 6 for an overview of utility-to-utility transfer switch troubleshooting.

Refer to section 7 for an overview of nonautomatic/remote transfer switch troubleshooting.

Refer to the (five sheet) schematic and wiring diagram package that was shipped with the transfer switch for specific information about its configuration.

WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts when the cabinet door is open. Remove power to the door by disconnecting connector J1/P1 (on the accessory control panel) before removing and replacing components. The following procedures are to be performed only by technically qualified personnel.***

WARNING ***Improper operation of the generator set presents a hazard that can cause severe personal injury or death. Observe all safety precautions in your generator set manuals.***

This troubleshooting procedure asks questions that can be answered with a YES or a NO. The numbers in the YES and NO columns direct you to the next appropriate step. An "X" in the column means that the step should reveal or correct the problem.

In this procedure, you are instructed to measure voltages at specific diodes. The cathode is the end with the black band. The anode is the end without the black band.

When taking voltage measurements, be sure that the probe penetrates the conformal coating on the boards.

To perform the following procedures, you will need to refer to the mother board schematic (Section 8) and to the schematic and wiring diagram package (shipped with the transfer switch).

TROUBLE **PAGE**

AWARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. The following procedures are to be performed only by technically qualified personnel. Use extreme caution to avoid touching electrical contacts when the cabinet door is open. Remove power to the door by disconnecting connector J1/P1 (on the accessory control panel) before removing and replacing components.***

AWARNING ***Improper operation of the generator set presents a hazard that can cause severe personal injury or death. Observe all safety precautions in your generator set manuals.***

AWARNING ***Automatic transfer switch operation results in rapid movement of the switch mechanism and presents a hazard of severe personal injury. Keep hands clear of the switch handles when switching to automatic operation.***

TROUBLESHOOTING 3-1

Transfer Switch Does Not Retransfer When Normal Voltage Returns After A Power Outage

	YES	NO
This procedure is to be performed with the generator set running and Normal voltage on line. MAKE SURE THAT THE MOTOR DISCONNECT SWITCH IS IN THE AUTO POSITION.		
NOTE: If the Program Transition module is used and transfer switch only moves to the mid-transition (disconnected) position, the trouble may be in Program Transition module or relay K3. Place the Delay/No Delay switch in the No Delay position. If retransfer occurs, replace the Program Transition module. If retransfer does not occur, replace K3.		
When taking voltage measurements, be sure that the probe penetrates the conformal coating on the boards.		
1. Is the Retransfer Timing lamp on the time delay board lit?	9	2
2. Is the Retransfer Timing Complete lamp lit?	10	3
3. Is the Source Available lamp on the Source 1 voltage sensor lit?	5	4
4. Refer to Source 1 voltage sensor troubleshooting.	X	X
5. If the unit is equipped with the Auto/Manual Retransfer selector switch (located on the door), is the switch in the Auto position? If the unit doesn't have the switch, then go to Step 8.	8	6
6. Place the Auto/Manual Retransfer switch in the Auto position. Does the Retransfer Timing lamp on the time delay board come on?	7	8
7. Does the transfer switch retransfer after the retransfer time delay?	X	1
8. Replace the time delay board.	X	X
9. Turn the retransfer delay pot (on the time delay board) to minimum (counterclockwise). If the Retransfer Timing Complete lamp doesn't come on within a minute, then replace the time delay board. If the Retransfer Timing Complete lamp does come on, but the transfer switch still doesn't retransfer, then go to Step 10.	X	X
10. Is the Motor Disconnect Switch (on the accessory control panel) in the Auto position?	12	11
11. Place the Motor Disconnect Switch in the Auto position. If the transfer switch does not retransfer, then go to Step 12.	X	X

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TROUBLESHOOTING 3-1 (Continued)

Transfer Switch Does Not Retransfer When Normal Voltage Returns After A Power Outage

	YES	NO
This procedure is to be performed with the generator set running and Normal voltage on line.		
12. If the Signal Module is used, check that the ribbon cable from J4 (on the mother board) to the Signal Module is connected properly. If the cable is OK, then place the Delay/No Delay switch (on the Signal Module) in the No Delay position. Does the transfer switch retransfer?	13	14
13. Replace the Signal Module.	X	X
14. Place the elevator signal Delay/No Delay switch back in the Delay position. Go to Step 15.	X	X
15. Is there approximately 24 VAC between J7-6 (on the mother board) and ground?	23	16
16. Is there approximately 24 VAC between J7-7 (on the mother board) and ground?	17	18
17. Replace the mother board and recalibrate the voltage sensors.	X	X
18. Is there approximately 24 VAC between TI-X1 and TI-X2 (on the accessory control panel)?	19	20
19. Either switch S3 (on the transfer switch) is defective or there is an open in the wiring from T1-X1 to J7-7 (on the mother board).	X	X
20. Is the correct line voltage present on the primary side of T1 (on the accessory control panel)?	21	22
21. Either the connection at transformer T1 is bad or the transformer itself is bad. Replace the transformer or repair the wiring, as required.	X	X
22. If there is line voltage at the Normal lugs of the transfer switch, then there is an open in the wiring from the Normal lugs (Phase A and B) to the primary side of T1. Find it and repair it.	X	X
23. Unplug P2 while watching K1. Does the relay drop out?	25	24
24. Either relay K1 (on the accessory control panel) could be defective or there could be an open in the wiring from J7-6 to K1.	X	X
25. There may be an open between K1-9 or K1-7 and the linear motor. The circuit breaker (CB1) could be open or defective, or the linear motor (M1) could be defective. CB1 and M1 are located on the transfer switch.	X	X

⚠WARNING AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. The following procedures are to be performed only by technically qualified personnel. Use extreme caution to avoid touching electrical contacts when the cabinet door is open. Remove power to the door by disconnecting connector J1/P1 (on the accessory control panel) before removing and replacing components.

TROUBLESHOOTING 3-2

Source 1 Voltage Sensor Does Not Sense Voltage

	YES	NO
Place the Test With/Without Load switch in the Without Load position.		
When taking voltage measurements, be sure that the probe penetrates the conformal coating on the boards.		
1. Are the proper line voltages present at the Normal lugs of the transfer switch?	2	X
2. Are the proper line voltages present at transformer assembly terminal block A1-TB11 (located below the mother board)? Refer to sheet 3 of 5 in your schematic and wiring diagram package.	3	8
3. Is there 15 to 25 VAC on the mother board between: CR20 Cathode and CR24 Cathode? CR22 Cathode and CR26 Cathode? CR16 Cathode and CR18 Cathode?	4	10
4. Is there approximately 12 VDC between the CR5 anode (on the mother board) and ground?	5	9
5. With the voltage sensor removed from slot J1 (on the mother board), is there 15 to 25 VDC between J1-14/J1-15/J1-16 and ground and 20 to 30 VDC between J1-17 and ground? If voltages are OK, put the board back in slot J1.	6	9
6. If the sensor module is equipped with frequency sensing, is frequency within limits?	7	X
7. Recalibrate the sensor module, if it can't be calibrated, then replace the sensor module and calibrate the new one.	X	X
8. Find and repair an open in the wiring between the Normal lugs on the transfer switch and the transformer assembly terminal block (located below the mother board).	X	X
9. Replace the mother board and calibrate the voltage sensors.	X	X
10. Perform these steps in the following sequence: A. Replace the transformer board-to-mother board ribbon cable. B. If the source 1 voltage is not sensed, replace the transformer assembly and recalibrate the sensors. C. If the source 1 voltage is not sensed, replace the mother board and recalibrate the voltage sensors.	X	X

⚠WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. The following procedures are to be performed only by technically qualified personnel. Use extreme caution to avoid touching electrical contacts when the cabinet door is open. Remove power to the door by disconnecting connector J1/P1 (on the accessory control panel) before removing and replacing components.***

⚠WARNING ***Improper operation of the generator set presents a hazard that can cause severe personal injury or death. Observe all safety precautions in your generator set manuals.***

⚠WARNING ***Automatic transfer switch operation results in rapid movement of the switch mechanism and presents a hazard of severe personal injury. Keep hands clear of the switch handles when switching to automatic operation.***

TROUBLESHOOTING 3-3

Transfer Switch Does Not Transfer During a Power Failure, Test, or Exercise

	YES	NO
This procedure is to be performed with the generator set running and the Test switch in the Test position. MAKE SURE THAT THE MOTOR DISCONNECT SWITCH IS IN THE AUTO POSITION. **NOTE: If the Program Transition module is used and transfer switch only moves to the mid-transition (disconnected) position, the trouble may be in Program Transition module or relay K3. Place the Delay/No Delay switch in the No Delay position. If transfer occurs, replace the Program Transition module. If transfer does not occur, replace K3.** **When taking voltage measurements, be sure that the probe penetrates the conformal coating on the boards**		
1. Is the Transfer Timing lamp lit?	6	2
2. Is Source 2 Available lamp lit?	4	3
3. Go to the Source 2 voltage sensor troubleshooting section.	X	X
4. Is the Transfer Timing Complete lamp on?	7	5
5. Replace the time delay board.	X	X
6. Turn the transfer delay potentiometer, on the time delay board, to minimum (fully counterclockwise). If the Transfer Timing Complete lamp does not come on within two minutes, then replace the time delay board. **If the Transfer Timing Complete lamp does come on, but the transfer switch still doesn't transfer, then go to Step 7.**	X	X
7. Is the Motor Disconnect switch (on the accessory control panel) in the Auto position.	9	8
8. Place the Motor Disconnect switch in the Auto position. Does the transfer switch transfer?	X	9
9. If the optional Signal Module is used, check that the ribbon cable from the mother board to the option board is connected properly. If the cable is OK, then place the Delay/No Delay switch (on the option board) in the No Delay position. Does the switch transfer?	10	11
10. Replace the Signal Module.	X	X

AWARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. The following procedures are to be performed only by technically qualified personnel. Use extreme caution to avoid touching electrical contacts when the cabinet door is open. Remove power to the door by disconnecting connector J1/P1 (on the accessory control panel) before removing and replacing components.***

TROUBLESHOOTING 3-3 (Continued)

Transfer Switch Does Not Transfer During a Power Failure, Test, or Exercise

	YES	NO
This procedure is to be performed with the generator set running and the Test switch in the Test position.		
11. Place the Signal Module Delay/No Delay switch back in the Delay position. Go to step 12.	X	X
12. Is there approximately 24 VAC between J7-4 (on the mother board) and ground?	20	13
13. Is there approximately 24 VAC between J7-5 (on the mother board) and ground?	14	15
14. Replace the mother board and recalibrate the voltage sensors	X	X
15. Is there approximately 24 VAC between T2-X1 and and T2-X2 (located on the accessory control panel)?	16	17
16. Either switch S7 (located on transfer switch assembly) is defective or there is an open in the wiring from transformer T2-X1 to J7-5 (on the mother board).	X	X
17. Is there line voltage on the primary side of T2 (on the accessory control panel)?	18	19
18. Either the connection at transformer T2 is bad or the transformer itself is bad. Replace the transformer or repair the wiring.	X	X
19. If there is generator voltage at the Emergency lugs of the transfer switch, then there is an open in the wiring from the Emergency lugs (Phase A and B) to the primary side of T2.	X	X
20. Unplug P2 while watching K2. Does the relay drop out?	22	21
21. Either relay K2 (on the accessory control panel) is defective or there is an open in the wiring from J7-4 to K2-A.	X	X
22. There may be an open between K2-9 or K2-7 and the linear motor. The circuit breaker (CB1) can be open or defective, or the linear motor could be defective. Both are located on the transfer switch.	X	X

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WARNING ***Improper operation of the generator set presents a hazard that can cause severe personal injury or death. Observe all safety precautions in your generator set manuals.***

TROUBLESHOOTING 3-4

Source 2 Voltage Sensor Does Not Sense Voltage

	YES	NO
This procedure is to be performed with the generator set running. When taking voltage measurements, be sure that the probe penetrates the conformal coating on the boards.		
1. Is there a jumper or some kind of a closed circuit connected between TB2-5 and TB2-6?	3	2
2. Install a jumper between TB2-5 and TB2-6. If the voltage sensor is still inoperative go to Step 3.	X	X
3. Are the proper generator voltages present at the Emergency lugs of the transfer switch?	4	X
4. Are the proper generator voltages present at transformer assembly terminal block A1-TB11 (located below the mother board)? Refer to sheet 3 of 5 in your schematic and wiring diagram package.	5	10
5. Is there 15 to 25 VAC on the mother board between: CR29 Cathode and CR33 Cathode? CR31 Cathode and CR35 Cathode? CR37 Cathode and CR39 Cathode?	6	12
6. Is there approximately 12 VDC between the CR28 anode (on the mother board) and ground?	7	11
7. With the voltage sensor removed from slot J3 (on the mother board), is there 15 to 25 VDC between J3-14/J3-15/J3-16 and ground and 20 to 30 VDC between J3-17 and ground? If voltages are OK, put the board back in slot J3.	8	11
8. If the sensor module is equipped with frequency sensing, is the frequency within limits?	9	X
9. Recalibrate the sensor. If it can't be calibrated, then replace the sensor and calibrate the new one.	X	X
10. Find and repair an open in the wiring between the Emergency lugs on the transfer switch and the transformer assembly terminal block (located below the mother board).	X	X
11. Replace the mother board and recalibrate the voltage sensors.	X	X
12. Perform these steps in the following sequence: A. Replace the ribbon cable. B. If source 2 voltage is not sensed, replace the transformer assembly and recalibrate the voltage sensors. C. If source 2 voltage is not sensed, replace the mother board and recalibrate the voltage sensors.	X	X

WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. The following procedures are to be performed only by technically qualified personnel. Use extreme caution to avoid touching electrical contacts when the cabinet door is open. Remove power to the door by disconnecting connector J1/P1 (on the accessory control panel) before removing and replacing components.***

WARNING ***Improper operation of the generator set presents a hazard that can cause severe personal injury or death. Observe all safety precautions in your generator set manuals.***

WARNING ***Ignition of explosive battery gases can cause severe personal injury or death. Do not smoke or cause any spark or flame while servicing batteries.***

TROUBLESHOOTING 3-5

Generator Does not Crank for a Power Failure, Test or Exercise, Using a Two-Wire Starting System

	YES	NO
This procedure is to be performed with the Normal voltage available and the Test/Normal/Retransfer switch in the Test position. **When taking voltage measurements, be sure that the probe penetrates the conformal coating on the boards.**		
1. Does the generator set crank using the generator set Start switch?	3	2
2. Check the battery voltage. If the battery is low, then charge it or replace it. If battery is OK, then there is a problem with the generator set. Consult the generator set manual.	X	X
3. Check the wiring from the battery to the transfer switch.	X	X
4. Is there a jumper or closed circuit between TB2-B+ and TB2-2? There should NOT be a jumper between TB2-GND and TB2-2.	6	5
5. Install a jumper between TB2-B+ and TB2-2. If the generator set does not crank, then go to Step 6.	X	X
6. Is there 12 (or 24) VDC between TB2-RMT and ground?	7	9
7. Are the wires from the generator set starting circuit to TB2-B+ and TB2-RMT connected properly?	9	8
8. Connect wires from the generator set starting circuit to TB2-3 and TB2-4. If the set still does not crank, then go to Step 9.	X	X
9. With the Test/Normal/Retransfer switch in the Test position, is there 12 (or 24, if applicable) VDC between J7-10 (on the mother board) and ground?	10	12
10. Is there 12 (or 24, if applicable) VDC between J8-3 (located on the mother board) and ground?	11	13
11. There is an open in the wiring from J8-3 (on the mother board) to TB2-4 (on the transfer switch). Find and repair it.	X	X
12. There is an open in the wiring from TB2-2 (on the transfer switch) to J7-10 (on the mother board). Find and repair it.	X	X
13. Replace the mother board and recalibrate the voltage sensors.	X	X

AWARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. The following procedures are to be performed only by technically qualified personnel. Use extreme caution to avoid touching electrical contacts when the cabinet door is open. Remove power to the door by disconnecting connector J1/P1 (on the accessory control panel) before removing and replacing components.***

AWARNING ***Improper operation of the generator set presents a hazard that can cause severe personal injury or death. Observe all safety precautions in your generator set manuals.***

AWARNING ***Ignition of explosive battery gases can cause severe personal injury or death. Do not smoke or cause any spark or flame while servicing batteries.***

TROUBLESHOOTING 3-6

Generator Set Does not Crank for a Power Failure, Test or Exercise, Using a Switching Ground Three-Wire Starting System

	YES	NO
This procedure is to be performed with the line voltage available and the Test/Normal/Retransfer switch in the Test position.		
When taking voltage measurements, be sure that the probe penetrates the conformal coating on the boards.		
1. Is the battery voltage at approximately 12 VDC?	3	2
2. Charge or replace the battery.	X	X
3. Is the Auto/Handcrank/Stop switch on the 3-Wire Start module in the Auto position?	5	4
4. Place the Auto/Handcrank/Stop switch in the Auto position. If the generator set does not crank, go to Step 5.	X	X
5. With the Auto/Handcrank/Stop switch in the Handcrank position, can the generator set be started from the generator set control?	7	6
6. There is a problem with the generator set, consult the generator set service manual.	X	X
7. Place the Auto/Handcrank/Stop switch in the Auto position. Is there a jumper from TB2-GND to TB2-2? There should NOT be a jumper from TB2-2 to TB2-B+.	9	8
8. Install a jumper from TB2-GND to TB2-2. If generator set still does not start, then go to step 9.	X	X
9. Is there approximately 12 VDC between TB3-1 (located on the left side of the cabinet) and ground?	11	10
10. Connect the starter battery to TB3-1.	X	X
11. Is there B+ voltage (12 VDC) at TB3-4?	13	12
12. There is an open in the wiring between TB3 and the generator set. Find and repair it.	X	X
13. Is the Overcrank Lockout lamp lit?	14	21

WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. The following procedures are to be performed only by technically qualified personnel. Use extreme caution to avoid touching electrical contacts when the cabinet door is open. Remove power to the door by disconnecting connector J1/P1 (on the accessory control panel) before removing and replacing components.***

TROUBLESHOOTING 3-6 (Continued)

Generator Set Does not Crank for a Power Failure, Test or Exercise, Using a Switching Ground Three-Wire Starting System

	YES	NO
This procedure is to be performed with the line voltage available and the Test/Normal/Retransfer switch in the Test position.		
14. Press and release the Overcrank Reset button. Does the Preheat lamp light?	15	21
15. After the preheat time delay, does the Overcrank Timing lamp light?	16	23
16. Does the generator set crank?	17	18
17. If the generator set cranks, but does not start, there is a generator set problem.	X	X
18. Is there 0 VDC at TB3-4?	19	20
19. There is a generator set problem.	X	X
20. There is an open between TB3-4 and J11-8 or the 3-WireStart module is bad.	X	X
21. Is there 9 to 12 VDC between the anode of CR2 (on the mother board) and ground?	22	24
22. There is a bad connection in the ribbon cable between the mother board and the 3-Wire Start module.	X	X
23. The 3-Wire Start module is bad and must be replaced.	X	X
24. Replace the mother board and recalibrate the voltage sensors.	X	X

4. Transfer Switch Assembly

GENERAL

This section covers the removal and replacement procedures for the transfer switch assembly. There are four separate switch assemblies. Each assembly corresponds to a particular ampere range. The four ampere range groups are: 40-70-100-125 amperes, 150-225-250-260 amperes, 300-400-600 amperes, and 800-1000 amperes.

For servicing purposes, each transfer switch assembly can be separated into the following components:

- **Linear Actuator**
- **Block and Crossbar Assembly**
- **Auxiliary Switches**

A separate section covers the removal and replacement procedures for each major component within a particular range.

DISCONNECT AC POWER

Before beginning any service procedure:

- If a generator set provides Emergency power, turn the operation selector switch to Stop. (The selector switch is located on the generator set control panel.)
- **Disconnect all sources of AC power from the transfer switch.**
- If there is an external battery charger, disconnect it from its AC power source. Then disconnect the set starting battery (negative [–] lead first).

WARNING ***The transfer switch presents a shock hazard that can cause severe personal injury or death unless all AC power is removed. Disconnect all sources of AC power from the transfer switch before servicing. Be sure to move the generator set operation selector switch to Stop, disconnect the battery charger from its AC power source, and disconnect the starting battery (negative [–] lead first).***

RECONNECTING AC POWER (When Finished)

After all service procedures are completed:

- If a generator is the Emergency power source, connect the negative (–) battery cable to the starting battery. If applicable, connect the battery charger to its AC power source.
- Reconnect the Normal power source and Emergency power source.
- Place the operation selector switch in the Remote position.

WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts whenever the cabinet door is open.***

LINEAR ACTUATOR REMOVAL AND REPLACEMENT (40 to 125 Amperes)

If a generator set provides Emergency power, turn the operation selector switch to Stop. (The selector switch is located on the generator set control panel.) **Disconnect both the Normal and Emergency power sources from the transfer switch.** If there is an external battery charger, disconnect it from its AC power source. Then disconnect the set starting battery (negative [–] lead first).

WARNING ***AC power within the cabinet presents an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

The following procedures cover the removal and replacement of the linear actuator for 40- to 125-ampere switches.

Removing Actuator

1. Open the transfer switch cabinet door.
2. Loosen and remove the four machine screws (with flat washers) that secure the plastic switch cover to the switch base, and lift off the cover.
3. Separate the actuator lead wires from the rest of the wiring harness. Remove wire ties as required.

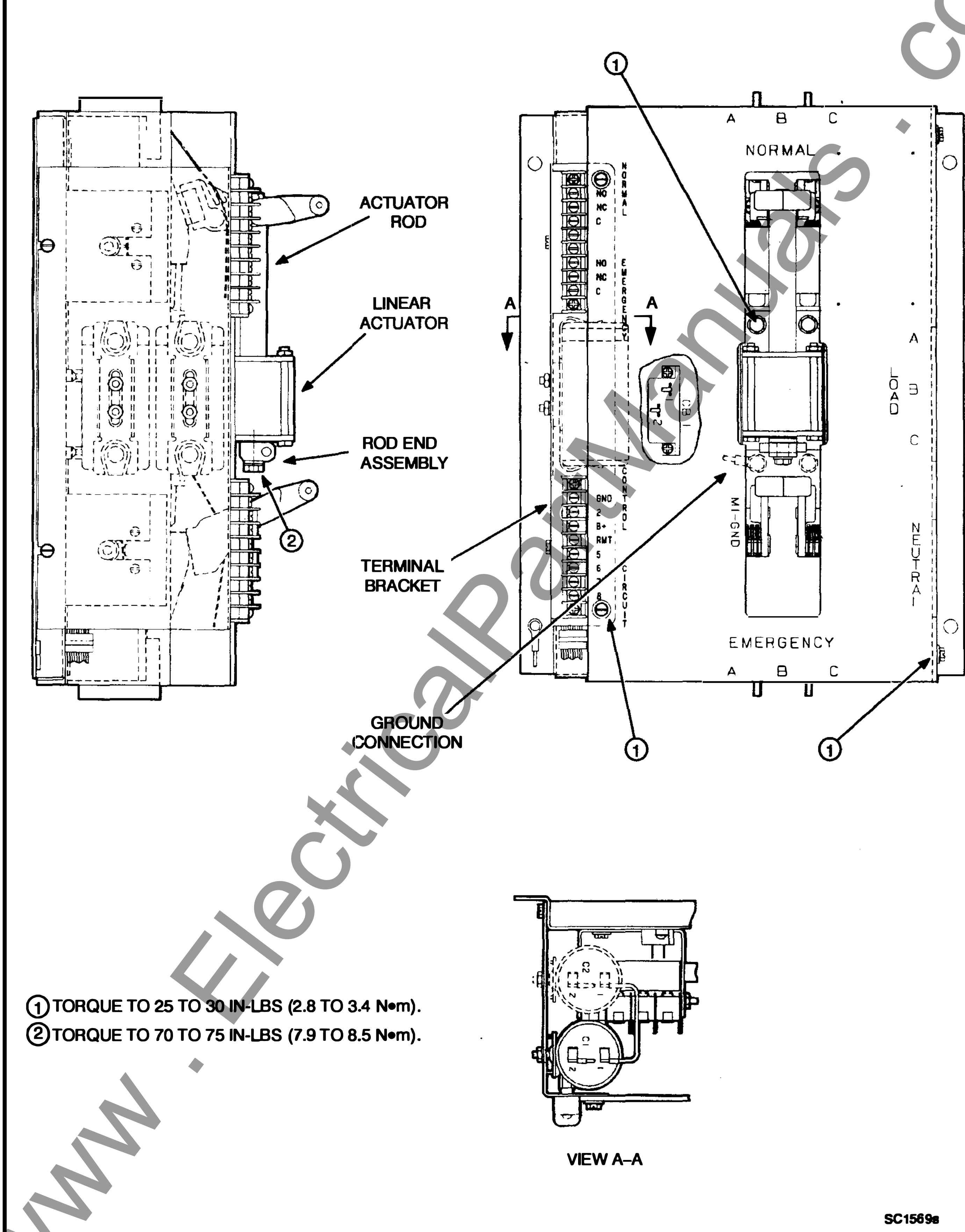


FIGURE 4-1. TRANSFER SWITCH COVER (40 TO125 AMPERES)

4. Pry the capacitor(s) loose from the bracket. Remove the end cap and disconnect the red and white actuator leads from the capacitor and the black lead from circuit breaker. Note the lead connections to the capacitor terminals.
5. Remove the socket head capscrews and lock washers that secure the actuator to the block assemblies (Figure 4-1). Note the ground wire connection to the lower left capscrew.
6. Disengage the actuator rod from the switch handle and remove the actuator from the block assembly.
7. Remove one of the hex head capscrews and lock washers that secure the rod end assembly to the actuator rod.
8. Remove the rod end assembly from the actuator rod (Figure 4-2) and slide the rod out of the actuator.

Replacing Actuator

1. Insert the actuator rod into the replacement actuator motor from the side opposite the ground brush (Figure 4-2). Install the rod end assembly and tighten the capscrew to 70 to 75 in-lbs (7.9 to 8.5 N•m).
2. Position the actuator motor on the block assemblies so the load wires are at the bottom, and fit the rod assembly into the handle of the closed switch assembly.
3. Secure the actuator motor to the block assemblies using socket head capscrews (4) and lock washers (4). Be sure to reconnect the ground wire to the lower left screw (Figure 4-1). Tighten capscrews to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.

⚠CAUTION ***Do not overtighten screws or the switch can be damaged.***

4. Connect the black actuator lead wire to the circuit breaker, and connect the red and white actuator lead wires to the following capacitor terminals:

   Red Lead Wire - Connect to capacitor C1, Terminal 1.

   White Lead Wire - If one capacitor, connect to capacitor C1, Terminal 2. If two capacitors, connect to capacitor C2, Terminal 2.

   Transfer switches for voltage ranges 347, 380/416, 440/480 and 480 use two capacitors (C1 and C2) wired together in series. A single jumper wire is placed between terminal 2 on C1 and Terminal 1 on C2.
5. Replace the capacitor end cap(s) and install the capacitor(s) in the bracket(s). Use wire ties to hold actuator lead wires in place.
6. Check the operation of the transfer switch and alignment of the actuator rod by manually opening and closing both the Normal and Emergency switch assemblies.
7. Place the plastic switch cover in position and secure with machine screws (4) and flat washers (4). Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
8. If a generator set is the Emergency power source, connect the starting battery (negative [–] lead last). If applicable, connect the battery charger to its AC power source. **Reconnect the Normal power source and the Emergency power source.** Place the operation selector switch in the Auto (or Remote) position.
9. Test the switch for proper operation and close the cabinet.

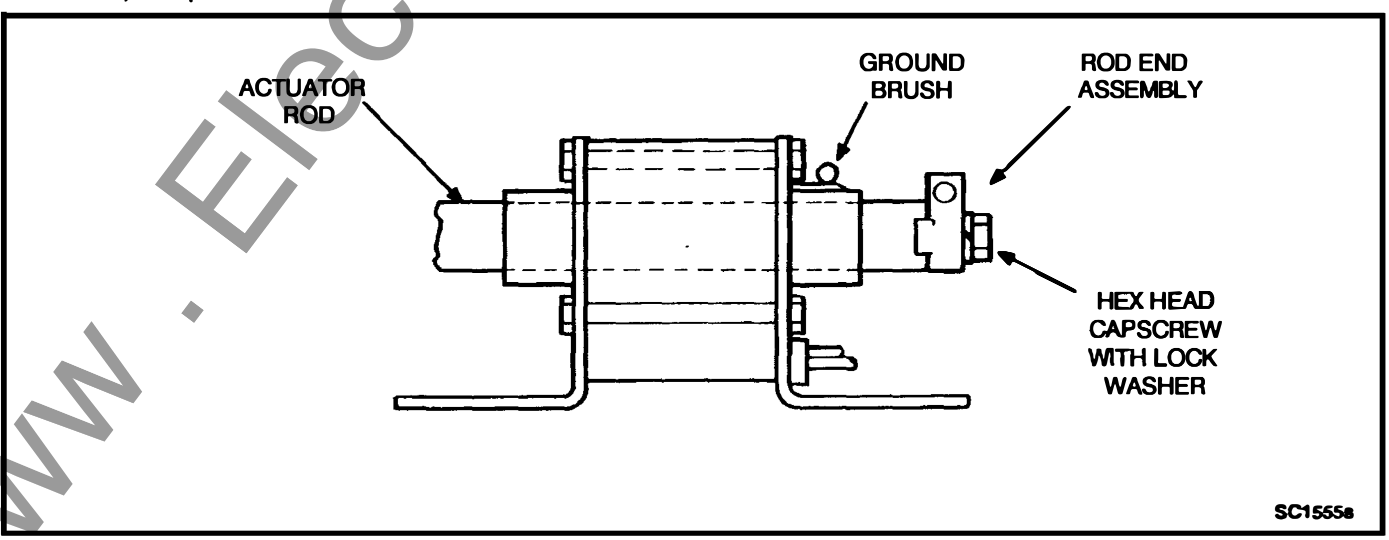


FIGURE 4-2. LINEAR ACTUATOR (40 TO 125 AMPERES)

BLOCK AND CROSS-BAR ASSEMBLY REMOVAL AND REPLACEMENT (40 to 125 Amperes)

If a generator set provides Emergency power, turn the operation selector switch to Stop. (The selector switch is located on the generator set control panel.) **Disconnect both the Normal and Emergency power sources from the transfer switch**. If there is an external battery charger, disconnect it from its AC power source. Then disconnect the set starting battery (negative [–] lead first).

⚠WARNING ***AC power within the cabinet presents an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

The following procedures cover the removal and replacement of the block and crossbar assemblies for 40- to 125-ampere switches.

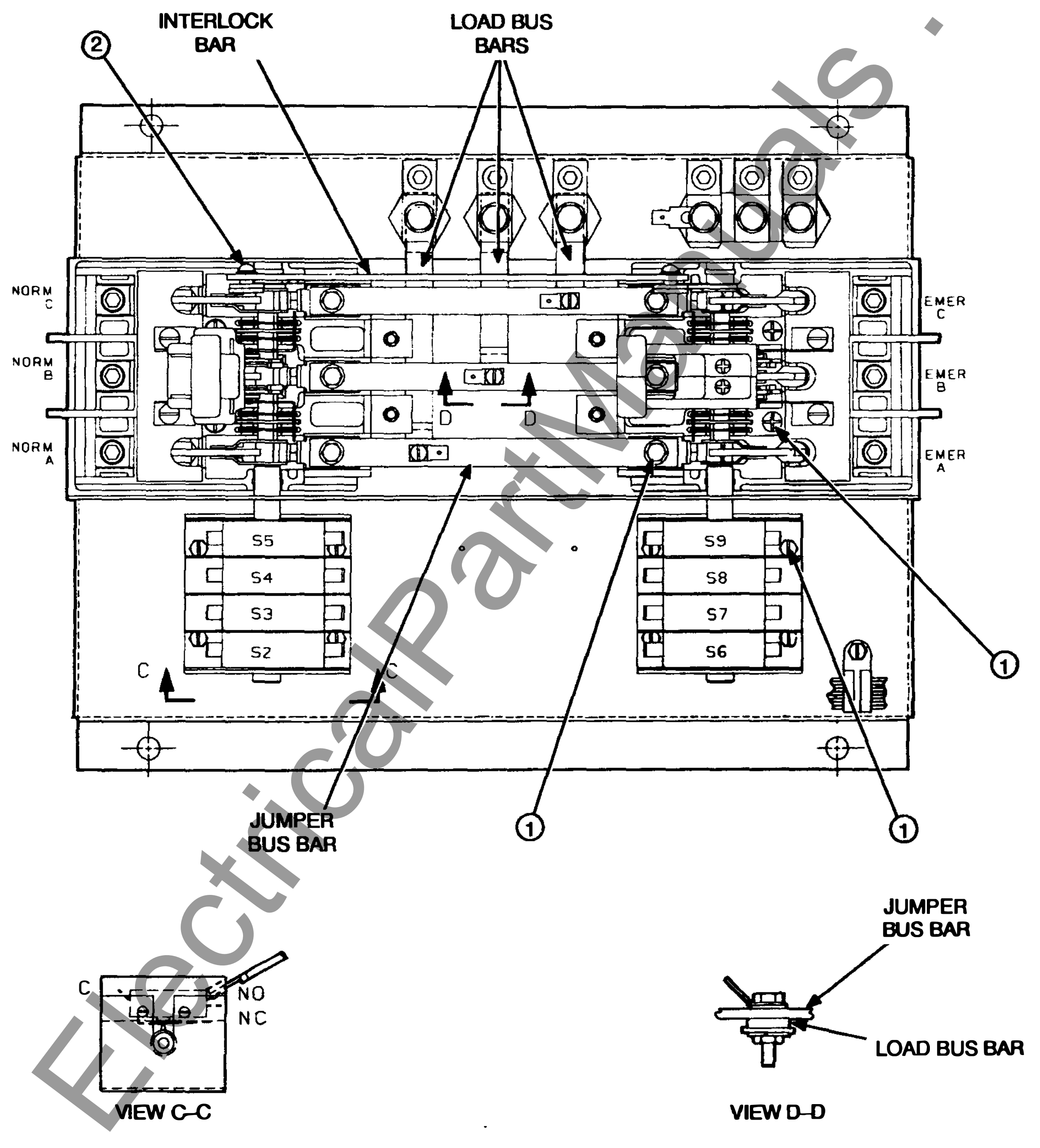
Removing the Block and Cross-Bar Assembly (Normal or Emergency)

1. Remove the linear actuator as described in the *Linear Actuator Removal and Replacement* section for 40- to 125-ampere switches. Follow steps 1-6 in the Removing Actuator section.
2. Remove the round head machine screws and flat washers that secure the interlock bar to the interlock arms (see Figure 4-3) and remove the interlock bar.
3. Disconnect the control wiring leads from the jumper bus bars.
4. Remove the hex head machine screws, ring terminals, flat washers, lock washers, and nuts that secure the jumper bus bars (see Figure 4-3) to the load bus bars.
5. Remove the hex head machine screws and spring washers that secure the jumper bus bars to the block assemblies, and lift off the jumper bus bars.
6. Remove the control wiring leads from the power source terminals (Figure 4-4).
7. Loosen the lug terminal screws and remove the power source supply wires from the lug terminals.
8. Remove the two round head machine screws, lock washers, and flat washers that secure the block assembly to the base; and carefully remove the assembly.

⚠CAUTION ***Use care when removing the block and cross-bar assembly from the base. Carefully disengage the cross bar from the auxiliary switch lever to avoid cracking the switch lever.***

Replacing the Block and Cross-Bar Assembly

1. Clean all current-carrying surfaces with a wire brush.
2. Hold the block assembly in position on the base and check the alignment of the auxiliary switch lever. When the main switch contacts are closed, the auxiliary switch lever must be aligned vertically, as shown in Figure 4-3. Move the auxiliary switch lever as required to get correct alignment.
3. Secure the block assembly to the base with round head machine screws (2), lock washers (2), and flat washers (2). Tighten the screws to 25 to 30 in-lbs(2.8 to 3.4 N•m).
4. Install the power source supply wires and securely tighten the lug terminals.
5. Connect the control wiring leads to the corresponding power source terminals. Control wires are marked NORM A,B,C or EMER A,B,C for identification.
6. Apply a thin coat of electric joint compound between the mating surfaces of the jumper bus bars, braided strap connector, and load bus bars.
7. Install the jumper bus bars and secure to the switch assemblies with hex head machine screws and spring washers. Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
8. Secure the jumper bus bars to each load bus bar using a hex head machine screw, ring terminal, flat washer, lock washer, and nut. Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
9. Connect the control wiring leads to the corresponding jumper bus bar terminal. Control wires are marked LOAD A,B,C for identification.



(1) TORQUE TO 25 TO 30 IN-LBS (2.8 TO 3.4 N•m).

(2) TORQUE TO 15 TO 20 IN-LBS (1.7 TO 2.3 N•m).

FIGURE 4-3. SWITCH ASSEMBLY (40 TO 125 AMPERES)

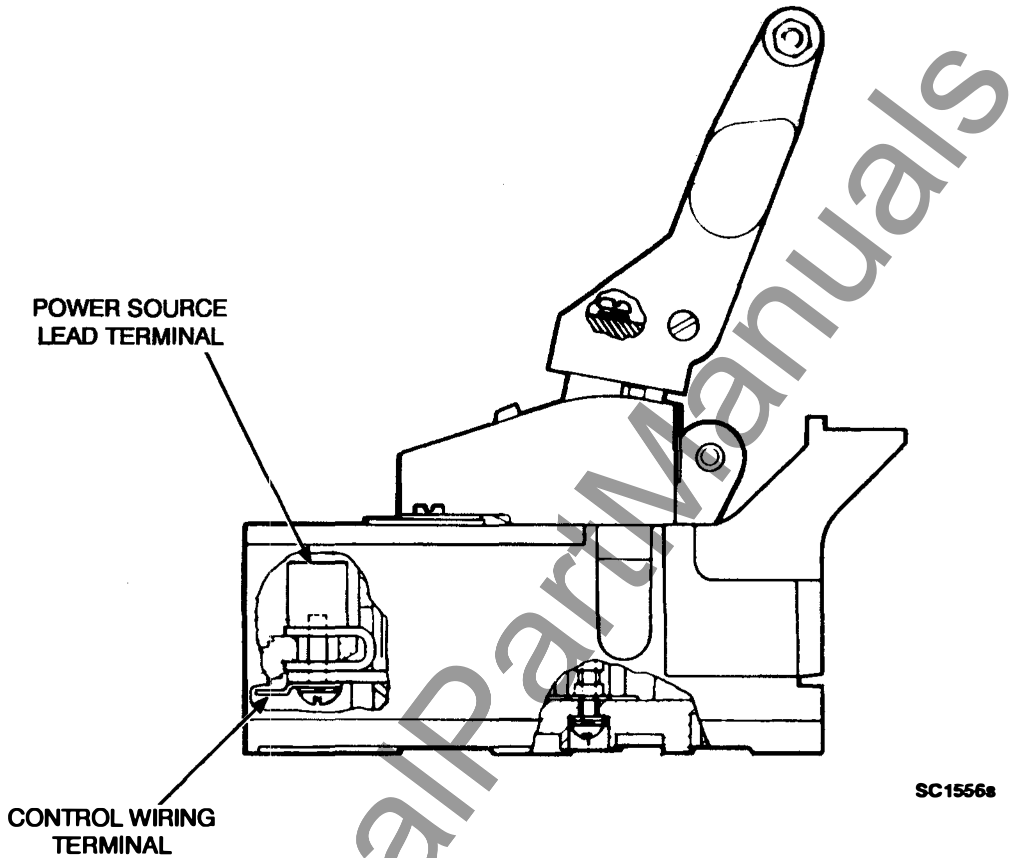


FIGURE 4-4. CONTROL WIRING TERMINALS (40 TO 125 AMPERES)

10. Apply thread sealant (blue Loctite 242, Onan part number 518-0309 is recommended) to the threads of the interlock bar machine screws. Install the interlock bar and secure to each interlock arm with a round head machine screw and flat washer. Tighten to 15 to 20 in-lbs (1.7 to 2.3 N•m) torque.
11. Attempt to close both sides of the transfer switch. The interlock assembly must hold one side open so that only one side closes at at time.
12. Replace the linear actuator as described in *Linear Actuator Removal And Replacement* section for 40- to 125-ampere switches. Follow steps 2 through 8 in the *Replacing Actuator* section. Apply a thin coat of lubricant (Onan part number 524-0157) to the slot in the handle.
13. Test the switch for proper operation and close the cabinet.

AUXILIARY SWITCH REMOVAL AND REPLACEMENT (40 to 125 Amperes)

If a generator set provides Emergency power, turn the operation selector switch to Stop. (The selector switch is located on the generator set control panel.) **Disconnect both the Normal and Emergency power sources from the transfer switch**. If there is an external battery charger, disconnect it from its AC power source. Then disconnect the set starting battery (negative [–] lead first).

⚠WARNING ***AC power within the cabinet presents an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

The following procedures cover the removal and replacement of the auxiliary switch for 40- to 125-ampere switches.

Removing Auxiliary Switch Assembly

1. Open the transfer switch cabinet door.
2. Loosen and remove the four machine screws (with flat washers) that secure the plastic switch cover to the switch base, and lift off the cover.
3. Loosen the two machine screws that secure the terminal bracket to the base. Move the terminal bracket to allow access to the auxiliary switches.
4. Remove the control wiring leads from the auxiliary switch terminals (Figure 4-5).
5. Remove the hex head machine screws that secure the auxiliary switch assembly bracket to the base.
6. Disengage the auxiliary switch lever from the transfer switch crossbar and lift out the auxiliary switch assembly.

   ⚠CAUTION ***Use care when disengaging the switch lever from the crossbar to avoid cracking the switch lever.***

7. Remove the hex head machine screws and nuts that secure the auxiliary switches to the bracket (Figure 4-5); and lift out the four auxiliary switches, insulating barriers, and switch lever.

Replacing Auxiliary Switch Assembly

1. Place the auxiliary switch lever in the bracket as shown in Figure 4-5. Note that the end of the lever with the octagonal hole must engage the transfer switch cross bar when the auxiliary switch assembly is installed.
2. Install the auxiliary switches (4) and insulating barriers (5) in the bracket, and secure with hex head machine screws (2) and nuts (2).Tighten to 10 to 15 in-lbs(1.1 to 1.7 N•m) torque. Note that each switch must be assembled so the side with two terminals (Figure 4-5) is facing inward, toward the other auxiliary switch assembly.
3. Manually close the contacts that will be coupled to the auxiliary switch lever.
4. Hold the auxiliary switch assembly in position on the base and check the alignment of the auxiliary switch lever. When the transfer switch assembly is closed, the auxiliary switch must be aligned as shown in Figure 4-5. Move the auxiliary lever as required to get the correct alignment.
5. Secure the bracket to the base using the hex head machine screws and tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
6. Install control wiring leads on the corresponding switch terminals.Leads are marked with the terminal numbers (S2/N0, S7/NC, S9/C, etc.) for identification. Refer to Figure 4-5 for identification of the auxiliary switch terminals.
7. Place the terminal bracket in position on the base and secure it with the hex head machine screws.Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m).
8. Place the plastic switch cover in position and secure with machine screws (4) and flat washers (4). Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
9. If a generator set is the Emergency power source, connect the starting battery (negative [–] lead last). If applicable, connect the battery charger to its AC power source. **Reconnect the Normal power source and the Emergency power source.** Place the operation selector switch in the Remote position.
10. Test the switch for proper operation and close the cabinet.

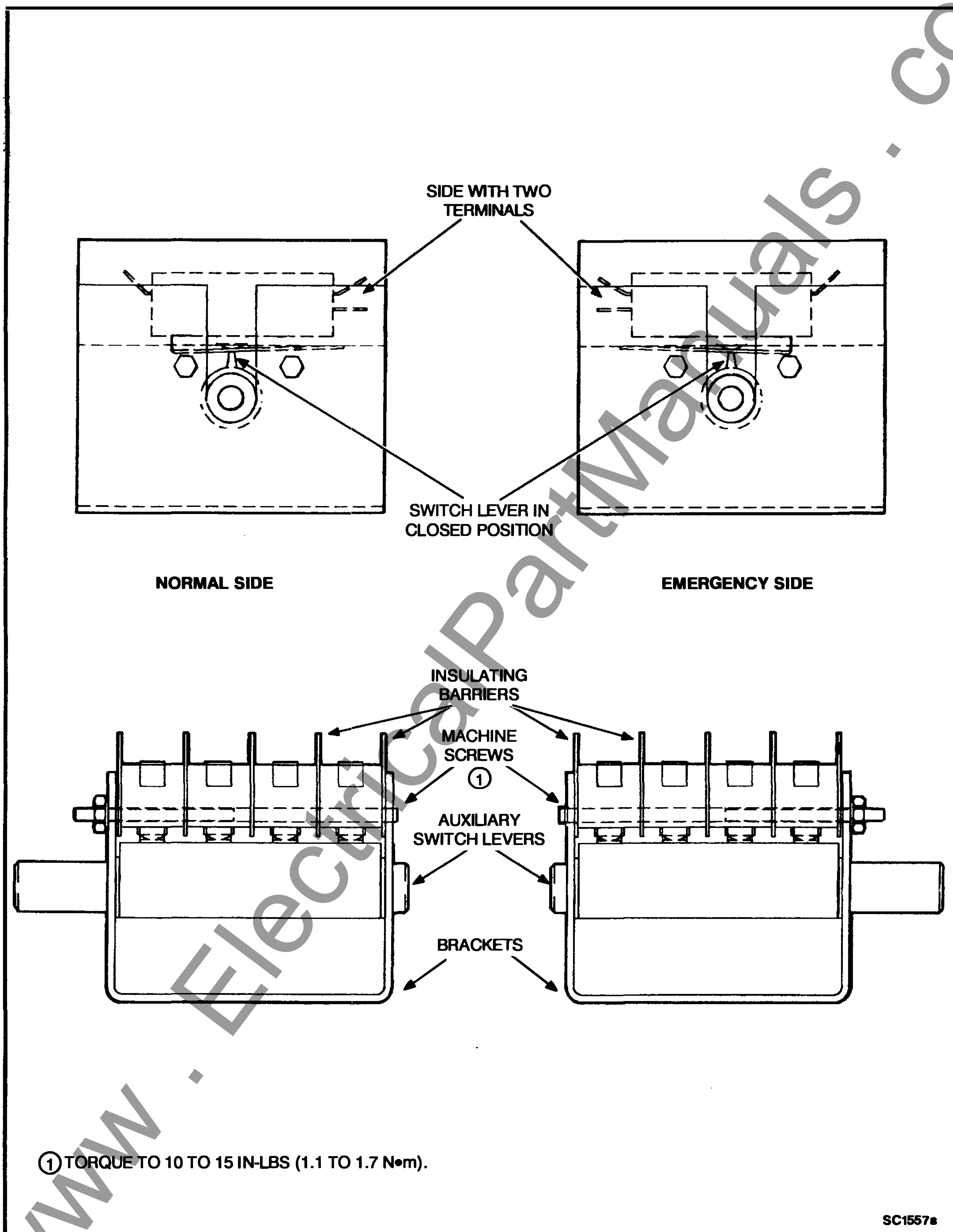


FIGURE 4-5. AUXILIARY SWITCHES (40 TO 125 AMPERES)

LINEAR ACTUATOR REMOVAL AND REPLACEMENT (150 to 260 Amperes)

If a generator set provides Emergency power, turn the operation selector switch to Stop. (The selector switch is located on the generator set control panel.) **Disconnect both the Normal and Emergency power sources from the transfer switch**. If there is an external battery charger, disconnect it from its AC power source. Then disconnect the set starting battery (negative [–] lead first).

⚠WARNING ***AC power within the cabinet presents an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

The following procedures cover the removal and replacement of the linear actuator for 150- to 260-ampere switches.

Removing Actuator

1. Open the transfer switch cabinet door.
2. Loosen and remove the two self- locking nuts and the two machine screws (with flat washers) that secure the plastic switch cover to the switch base, and lift off the cover. (Figure 4-6.)
3. Separate the actuator lead wires from the rest of the wiring harness; remove wire ties as required.
4. Pry the capacitor(s) loose from the bracket. Remove the end cap and disconnect the red and white actuator lead wires from the capacitor terminals.
5. Disconnect the black actuator wire from the circuit breaker and disconnect the ground wire from the end of the actuator.
6. Remove the hex head capscrews, flat washers, and lock washers that secure the actuator to the switch assemblies (Figure 4-6), and lift out the spacers (4) and barriers (2).
7. Disengage the actuator rod from the switch handle and remove the actuator from the switch assembly.
8. Remove one of the hex head capscrews and lock washers that secure the rod end assembly to the end of the actuator rod.
9. Remove the rod end assembly from the actuator rod (Figure 4-6) and slide the rod out of the actuator motor.

Replacing Actuator

1. Insert the actuator rod into the replacement actuator motor (Figure 4-7). Hold the actuator ground brush up slightly to allow passage of the actuator rod.Install the rod end assembly and tighten the capscrew to 70 to 75 in-lbs (7.9 to 8.5 N•m).
2. Hold the actuator motor in position over the switch assemblies so the lead wires are at the bottom, and fit the rod assembly into the handle of the closed switch assembly.
3. Secure the actuator motor to the switch assemblies using hex head capscrews (4), lock washers (4), flat washers (4), barriers (2), and spacers (4). Tighten the capscrews to 45 to 50 in-lbs (5.1 to 5.7 N•m).
4. Connect the black actuator lead wire to the circuit breaker, and the red and white actuator lead wires to the following capacitor terminals:

   Red Lead Wire - Connect to capacitor C1 - Terminal 1.

   White Lead Wire - If one capacitor, connect to capacitor C1 - Terminal 2. If two capacitors, connect to capacitor C2 - Terminal 2.

   Transfer switches for voltage ranges 347,380/416, and 440/480 use two capacitors (C1 and C2) wired together in series. A single jumper wire is placed between terminal 2 on C1 and terminal 1 on C2.

5. Replace the capacitor end cap(s) and install the capacitor(s) in the bracket(s).

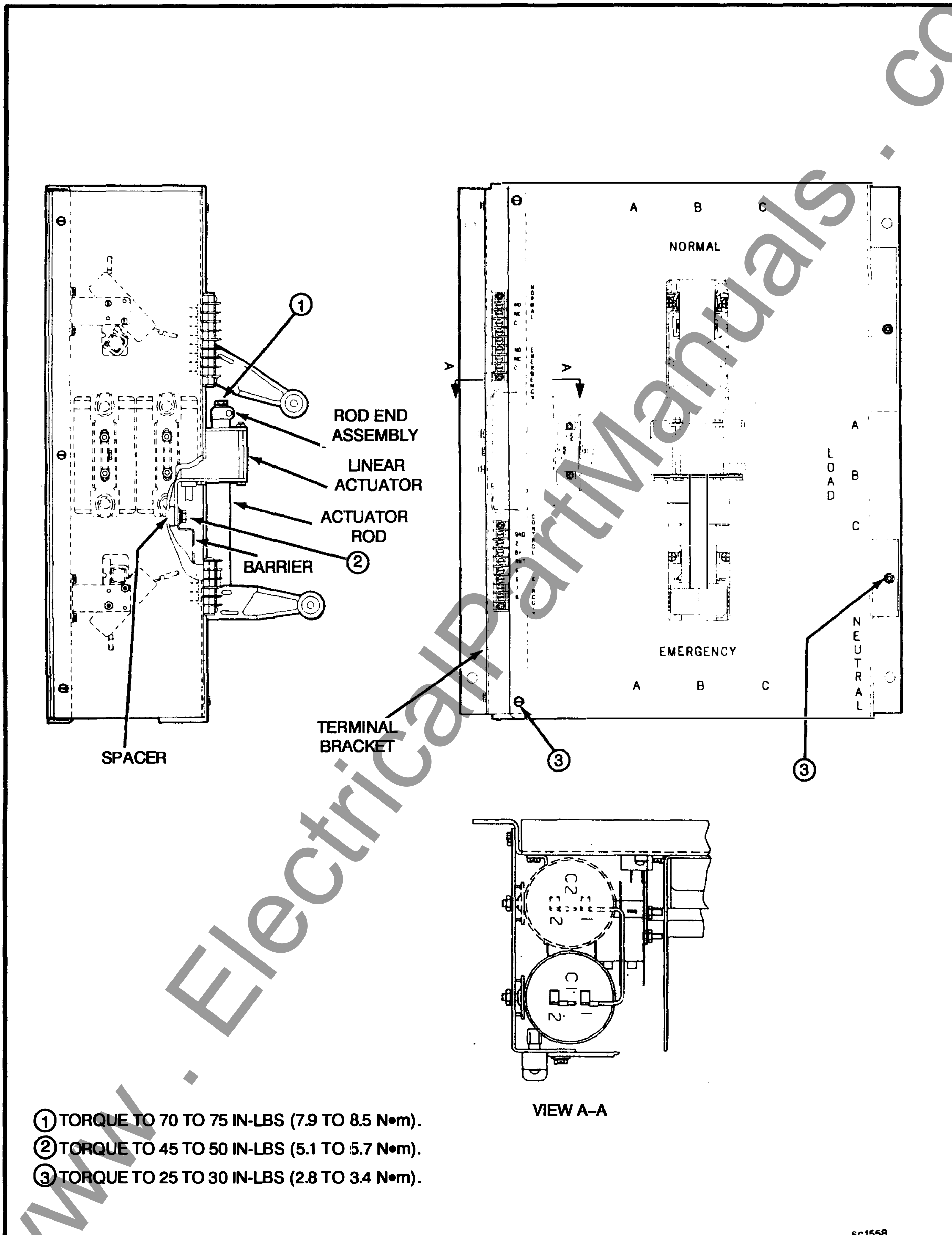


FIGURE 4-6. TRANSFER SWITCH COVER (150 TO 260 AMPERES)

6. Connect the ground wire to the end of the actuator. Use wire ties to hold the actuator lead wires in place with the rest of the wiring harness.
7. Check operation of the transfer switch and alignment of the actuator rod by manually opening and closing both the Normal and emergency switch assemblies.
8. Place the plastic switch cover in position and secure with machine screws (2), flat washers (2), and self-locking nuts (2). Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
9. If a generator set is the Emergency power source, connect the starting battery (negative [–] lead last). If applicable, connect the battery charger to its AC power source. **Reconnect the Normal power source and the Emergency power source.** Place the operation selector switch in the Remote position.
10. Test the switch for proper operation and close the cabinet.

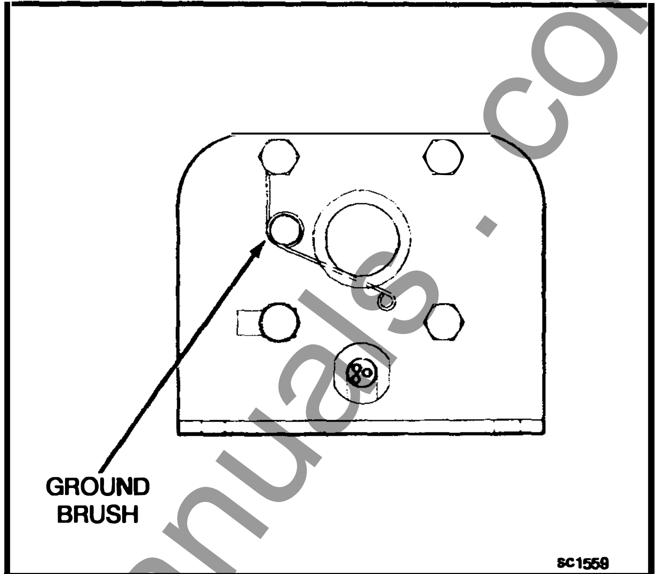


FIGURE 4-7. LINEAR ACTUATOR (150 TO 260 AMPERES)

BLOCK AND CROSS-BAR ASSEMBLY REMOVAL AND REPLACEMENT (150 to 260 Amperes)

If a generator set provides Emergency power, turn the operation selector switch to Stop. (The selector switch is located on the generator set control panel.) **Disconnect both the Normal and Emergency power sources from the transfer switch.** If there is an external battery charger, disconnect it from its AC power source. Then disconnect the set starting battery (negative [–] lead first).

WARNING ***AC power within the cabinet presents an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

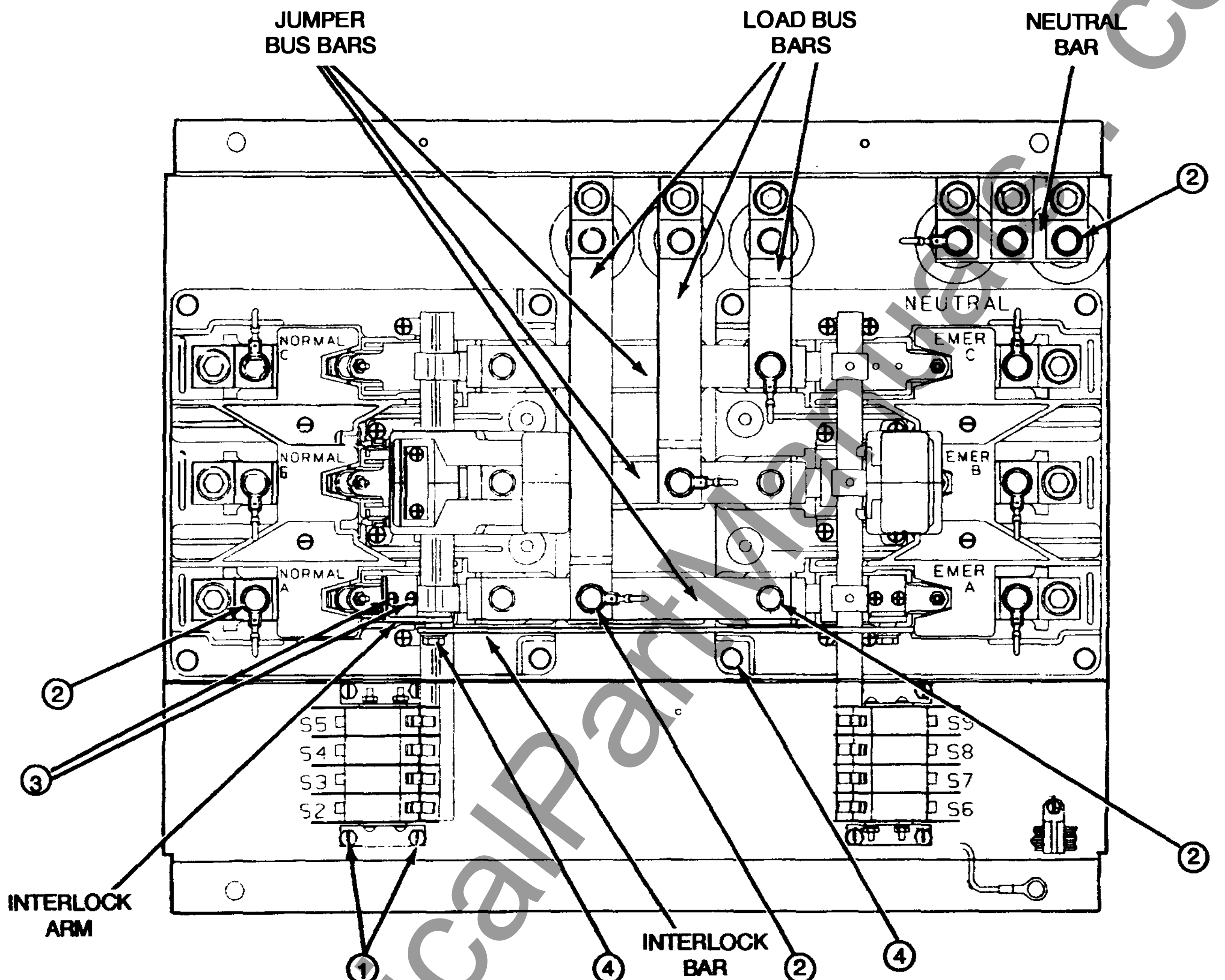
The following procedures cover the removal and replacement of the block and cross-bar assemblies for 150- to 260-ampere switches.

Removing the Block and Cross-Bar Assembly (Normal or Emergency)

1. Loosen the lug terminal screws and remove the power source supply wires from the lug terminals.
2. Remove the linear actuator as described in the *Linear Actuator Removal and Replacement* section for 150- to 260-ampere switches. Follow steps 1 through 7 in the Removing Actuator section.
3. Remove the hex head capscrews, lock washers, and flat washers that secure the interlock bar to the interlock arms (Figures 4-8 and 4-9), and remove the interlock bar.
4. Remove the round head machine screws and mounting plate that secure the handle assembly to the switch assembly, and lift off the handle assembly.
5. Disconnect the control wiring leads from the jumper bus bars.
6. Remove the hex head capscrews and spring washers that secure the A, B, and C jumper bus bars to the block and cross-bar assemblies. Remove the two Phillips head screws and the two hex head capscrews that secure the load lug support block. Carefully remove the jumper bus bar/load bus bar/load lug support block assembly.
7. Remove the control wiring leads from the power source terminals.
8. **On 4-pole switches (Figure 4-9):** Before the block and cross-bar assembly can be removed, the neutral block assembly must be loosened and pivoted slightly out of the way.
   A. Remove the two machine screws that secure the arc chute cover. Remove the cover and the arc chute.
   B. Remove the hex head capscrew, terminal ring, spring washer, and load lug that secure the neutral jumper bus bar. Remove the neutral jumper bus bar.
   C. Remove the two Phillips screws and the spacer that secure the source lug side of the neutral block.
   D. Pivot the neutral block slightly away from the block and cross-bar assembly.

CAUTION ***Use care when removing the block and cross-bar assembly from the base. Carefully disengage the cross-bar from the auxiliary switch assembly to avoid cracking the switches.***

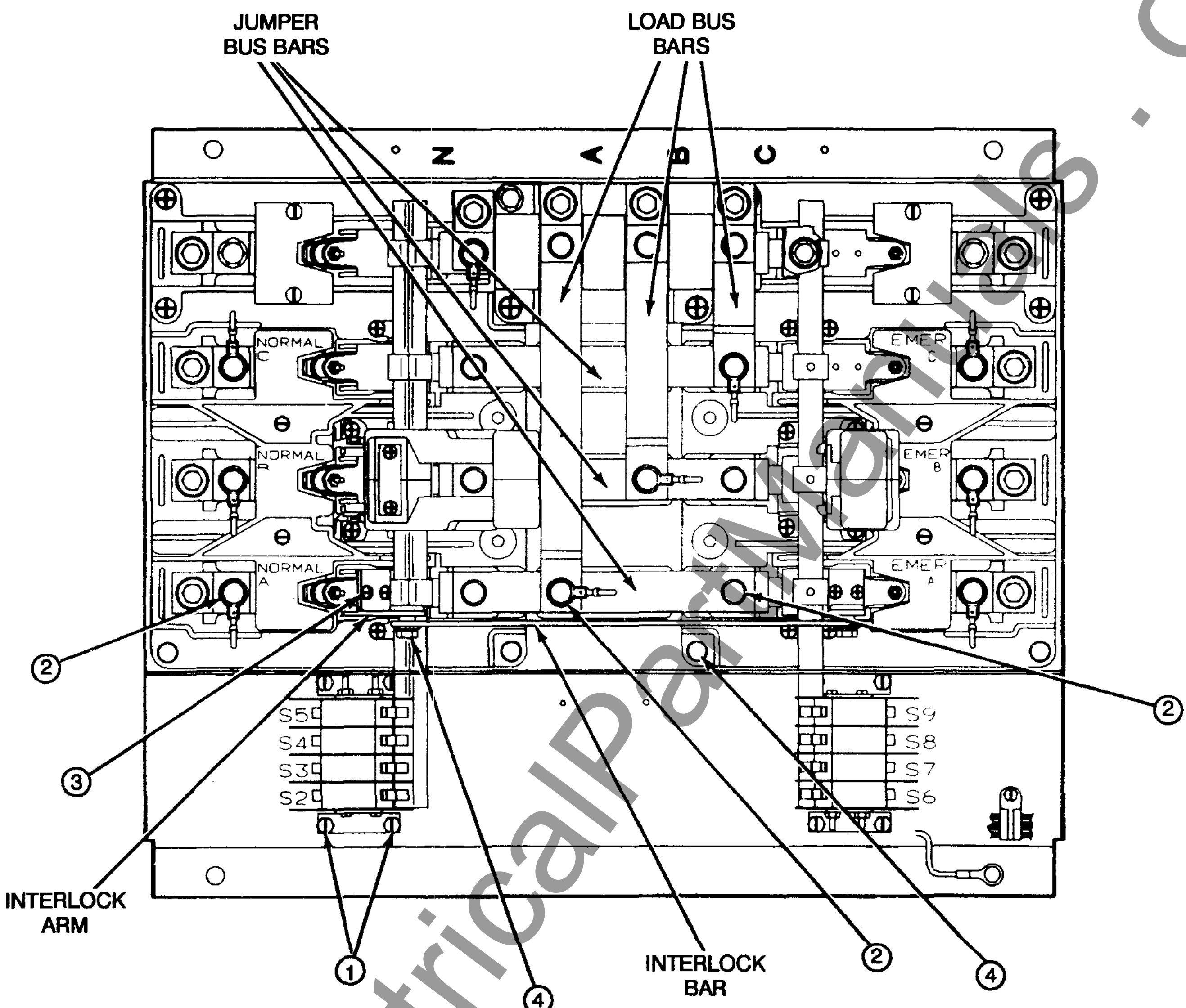
9. Remove the remaining hex head capscrews that secure the block and cross-bar assembly to the base, and carefully remove the assembly.
10. Remove the two threaded hex spacers from the back of each block assembly and save for reuse.
11. **On 4-pole switches (Figure 4-9):** With a screwdriver, dig the glue out of the cavity in the base of the neutral block. Remove the machine screw that secures the neutral block, and remove the neutral block.
12. Remove the two round head machine screws that secure the interlock arm to the block and cross-bar assemblies, and lift off the interlock arm.
13. Remove the hex head capscrews, ring terminals, spring washers, and lug terminals from the block and cross-bar assembly.



(1) TORQUE TO 25 TO 30 IN-LBS (2.8 TO 3.4 N•m).
(2) TORQUE TO 10 TO 12 FT-LBS (13.6 TO 16.3 N•m).
(3) TORQUE TO 15 TO 20 IN-LBS (1.7 TO 2.3 N•m).
(4) TORQUE TO 70 TO 75 IN-LBS (7.9 TO 8.5 N•m).

ac1560

FIGURE 4-8. 3-POLE SWITCH ASSEMBLY (150 TO 260 AMPERES)



① TORQUE TO 25 TO 30 IN-LBS (2.8 TO 3.4 N•m).
② TORQUE TO 10 TO 12 FT-LBS (13.6 TO 16.3 N•m).
③ TORQUE TO 15 TO 20 IN-LBS (1.7 TO 2.3 N•m).
④ TORQUE TO 70 TO 75 IN-LBS (7.9 TO 8.5 N•m).

FIGURE 4-9. 4-POLE SWITCH ASSEMBLY (150 TO 260 AMPERES)

Replacing Block and Cross-Bar Assembly

1. Install the lug terminals on the block and cross-bar assembly and secure with hex head capscrews, ring terminals, and spring washers. Tighten to 10 to 12 ft-lbs (13.6 to 16.3 N•m) torque.
2. Install the interlock arm and secure with the two round head capscrews. Tighten the screws to 15 to 20 in-lbs (1.7 to 2.3 N•m) torque.
3. Install the two threaded hex spacers in the back of the block and cross-bar assembly.
4. **On 4-pole switches (Figure 4-9):** Secure the neutral block with the machine screw that was removed from the center hole. Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque. Fill the cavity in the block with adhesive silicone to completely cover the screw head. Pivot the neutral block to permit placement of the block and cross-bar assembly.
5. Secure the block and cross-bar assembly to the base with the hex head capscrews. Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque.
6. **On 4-pole switches (Figure 4-9):**
   A. Pivot the neutral block back to its correct position.
   B. Secure the neutral block with the two Phillips screws and the spacer. Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque.
   C. Secure the neutral jumper bus bar with the hex head capscrew, terminal ring, spring washer, and load lug. Tighten to 10 to 12 ft-lbs (13.6 to 16.3 N•m) torque.
   D. Position the neutral block arc chute and cover. Secure the arc chute cover with the two machine screws. Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
7. Connect the control wiring leads to the corresponding power source terminals. Control wires are marked NORM A,B,C,N or EMER A,B,C,N for identification.
8. Clean the current-carrying surfaces of the jumper bus bars and load bus bars with a wire brush.
9. Install the A, B, and C jumper bus bar/load bus bar/load lug support block assembly. Secure to the block and cross-bar assemblies with hex head capscrews and spring washers. Tighten to 10 to 12 ft-lbs (13.6 to 16.3 N•m) torque. Secure the load lug support block with the four screws. Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque.
10. Connect the control wiring leads to the corresponding jumper bus bar terminals. Control wires are marked LOAD A,B,C,N for identification.
11. Place the handle assembly in position on the block and cross-bar assembly and secure with the two machine screws and mounting plate. Tighten to 15 to 20 in-lbs (1.7 to 2.3 N•m) torque. Apply a thin coat of lubricant (Onan part number 524-0157) to the slot in the handle.
12. Apply thread sealant (blue Loctite 242, Onan part number 518-0309 is recommended) to the threads of the interlock bar capscrews. Install the interlock bar and secure to each interlock arm with a hex head capscrew, lock washer, and flat washer. Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque.
13. Attempt to close both sides of the transfer switch. The interlock assembly must hold one side open so that only one side closes at a time.
14. Replace the linear actuator as described in the *Linear Actuator Removal and Replacement* section for 150- to 260-ampere switches. Follow steps 2 through 9 in the *Replacing Actuator* section.
15. Install the power source supply wires and securely tighten the lug terminals to the torque value specified on the plastic cover.
16. Test the switch for proper operation and close the cabinet.

AUXILIARY SWITCH REMOVAL AND REPLACEMENT (150 to 260 Amperes)

If a generator set provides Emergency power, turn the operation selector switch to Stop. (The selector switch is located on the generator set control panel.) **Disconnect both the Normal and Emergency power sources from the transfer switch.** If there is an external battery charger, disconnect it from its AC power source. Then disconnect the set starting battery (negative [–] lead first).

⚠WARNING ***AC power within the cabinet presents an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

The following procedures cover the removal and replacement of the auxiliary switch assembly for 150- to 260-ampere switches.

Removing Auxiliary Switch Assembly

1. After disconnecting all sources of AC power, open the transfer switch cabinet door.
2. Loosen and remove the two self- Locking nuts and the two machine screws (with flat washers) that secure the plastic switch cover to the switch base, and lift off the cover.
3. Remove the three machine screws that secure the terminal bracket (Figure 4-6) to the base. Move the terminal bracket to allow access to the auxiliary switches.
4. Remove the control wiring leads from the auxiliary switch terminals (Figure 4-10).
5. Remove the hex head machine screws that secure the auxiliary switch assembly bracket to the base.
6. Lift out the auxiliary switch assembly.
7. Remove the hex head capscrews and nuts that secure the auxiliary switches to the brackets (Figure 4-10), and lift out the four auxiliary switches and insulating barriers.

Replacing Auxiliary Switch Assembly

1. Install the insulating barriers (5) and auxiliary switches (4) in the brackets and secure with hex head machine screws (2) and nuts (2). Tighten to 10 to 15 in-lbs (1.1 to 1.7 N•m). Note that each switch must be assembled so the side with two terminals faces inward (Figure 4-10) when the auxiliary switch assembly is installed on the base.
2. Hold the auxiliary switch assembly in position on the base (the side with two terminals must face inward) and secure the bracket to the base using the hex head machine screws. Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
3. Install the control wiring leads on the corresponding switch terminals.Leads are marked with the terminal numbers (S2/NO, S5/NC, S7/C, etc.) for identification. Refer to Figures 4-8, 4-9, and 4-10 for identification of auxiliary switch terminals.
4. Place the terminal bracket in position on the base and secure it with the hex head machine screws.Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
5. Place the plastic switch cover in position and secure with machine screws, flat washers, and self-locking nuts. Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
6. If a generator set is the Emergency power source, connect the starting battery (negative [–] lead last). If applicable, connect the battery charger to its AC power source. **Reconnect the Normal power source and the Emergency power source.** Place the operation selector switch in the Remote position.
7. Test the switch for proper operation and close the cabinet.

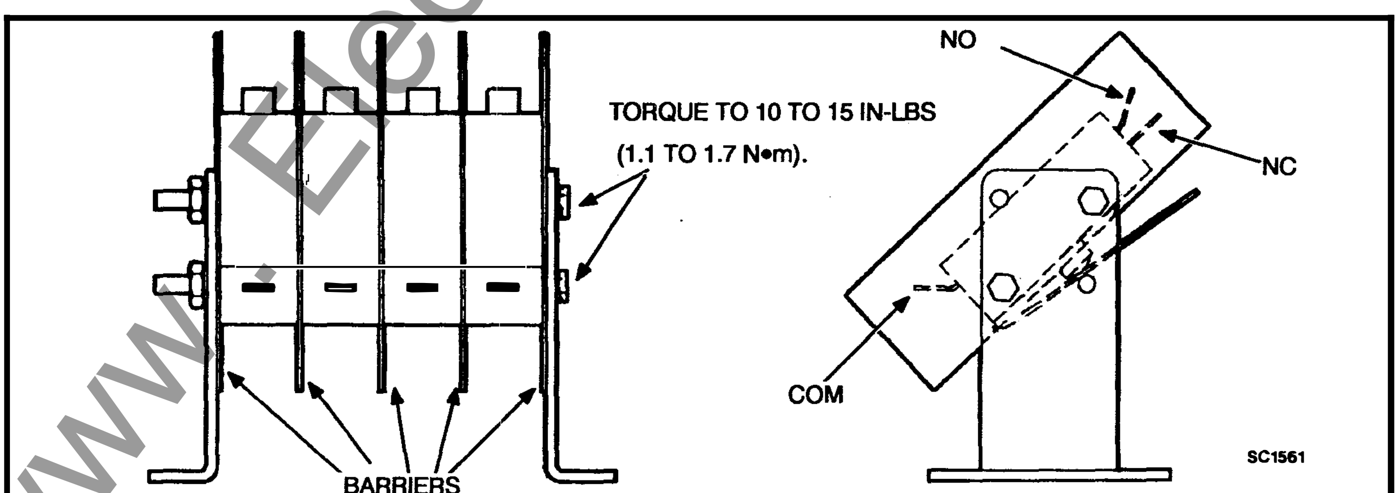


FIGURE 4-10. AUXILIARY SWITCH (150 TO 260 AMPERES)

LINEAR ACTUATOR REMOVAL AND REPLACEMENT (300 to 600 Amperes)

If a generator set provides Emergency power, turn the operation selector switch to Stop. (The selector switch is located on the generator set control panel.) **Disconnect both the Normal and Emergency power sources from the transfer switch.** If there is an external battery charger, disconnect it from its AC power source. Then disconnect the set starting battery (negative [–] lead first).

⚠WARNING ***AC power within the cabinet presents an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

The following procedures cover the removal and replacement of the linear actuator for 300- to 600-ampere switches.

Removing Actuator

1. Open the transfer switch cabinet door.
2. Loosen and remove the four machine screws that secure the plastic switch cover to the transfer switch, and lift off the cover (Figure 4-11).
3. Separate the actuator lead wires from the rest of the wiring harness; remove wire ties as required.
4. Pry the capacitor(s) loose from the bracket. Remove the end cap and disconnect the red and white actuator lead wires from the capacitor terminals.
5. Disconnect the black actuator lead from the circuit breaker and the ground wire from the end of the actuator.
6. Remove the hex head capscrews, flat washers, and lock washers that secure the actuator to the switch assemblies (Figure 4-11).
7. Disengage the actuator rod from the switch handle and remove the actuator from the switch assembly.
8. Remove one of the hex head capscrews and lock washers that secure the rod end assembly to the end of the actuator rod.
9. Remove the rod end assembly (Figure 4-11) and slide the actuator rod out of the actuator motor.

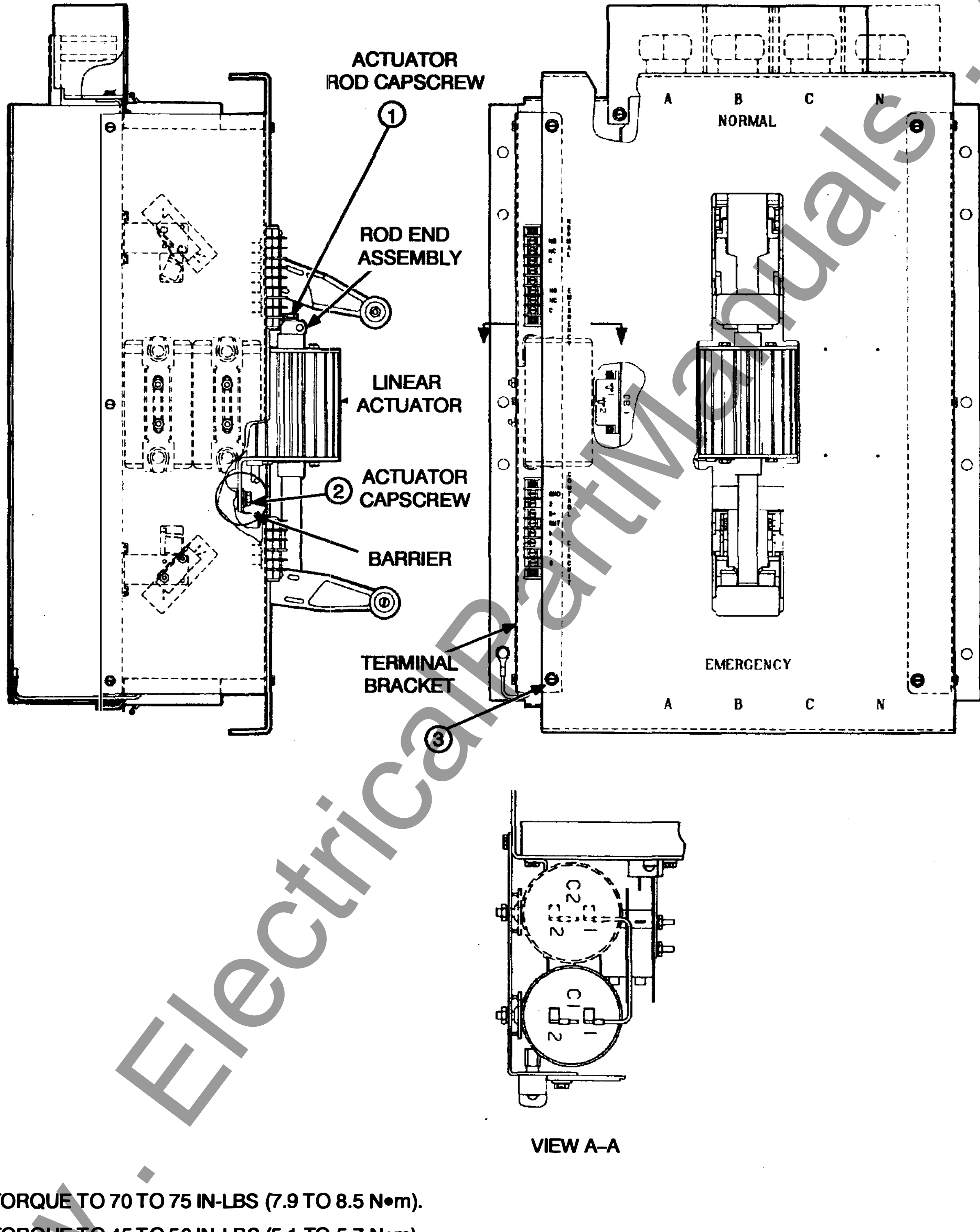
Replacing Actuator

1. Insert the actuator rod into the replacement actuator motor (Figure 4-12). Hold the actuator ground brush up slightly to allow passage of the actuator rod. Install the rod end assembly and tighten the capscrew to 70 to 75 in-lbs(7.9 to 8.5 N•m).
2. Hold the actuator motor in position over the switch assemblies so the lead wires are at the bottom and fit the rod assembly into the handle of the closed switch assembly.
3. Secure the actuator motor to the switch assemblies using hex head capscrews (4), lock washers (4), flat washers (8), and spacers (4). Tighten capscrews to 45 to 50 in-lbs (5.1 to 5.7 N•m).
4. Connect the black actuator lead wire to the circuit breaker, and the red and white actuator lead wires to the following capacitor terminals:

   White Lead Wire -
   If one capacitor, connect to C1 - Terminal 2.
   If two capacitors, connect to C2 - Terminal 2.

   Red Lead Wire - Connect to C1 - Terminal 1.

   Transfer switches for voltage ranges 347, 380/416, and 440/480 use two capacitors (C1 and C2) wired together in series. A single jumper wire is placed between terminal 2 on C1 and terminal 1 on C2.
5. Replace the capacitor end cap(s) and install the capacitor(s) in the bracket(s).
6. Connect the ground wire to the end of the actuator. Use wire ties to hold the actuator lead wires in place with the rest of the wiring harness.



(1) TORQUE TO 70 TO 75 IN-LBS (7.9 TO 8.5 N•m).
(2) TORQUE TO 45 TO 50 IN-LBS (5.1 TO 5.7 N•m).
(3) TORQUE TO 25 TO 30 IN-LBS (2.8 TO 3.4 N•m).

FIGURE 4-11. TRANSFER SWITCH COVER (300 TO 600 AMPERES)

7. Check the operation of the transfer switch and the alignment of the Actuator rod by manually opening and closing both the Normal and emergency switch assemblies.

8. Install the plastic switch cover on the switch with the four screws. Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m).

9. If a generator set is the Emergency power source, connect the starting battery (negative [–] lead last). If applicable, connect the battery charger to its AC power source. **Reconnect the Normal power source and the Emergency power source.** Place the operation selector switch in the Remote position.

10. Test the switch for proper operation and close the cabinet.

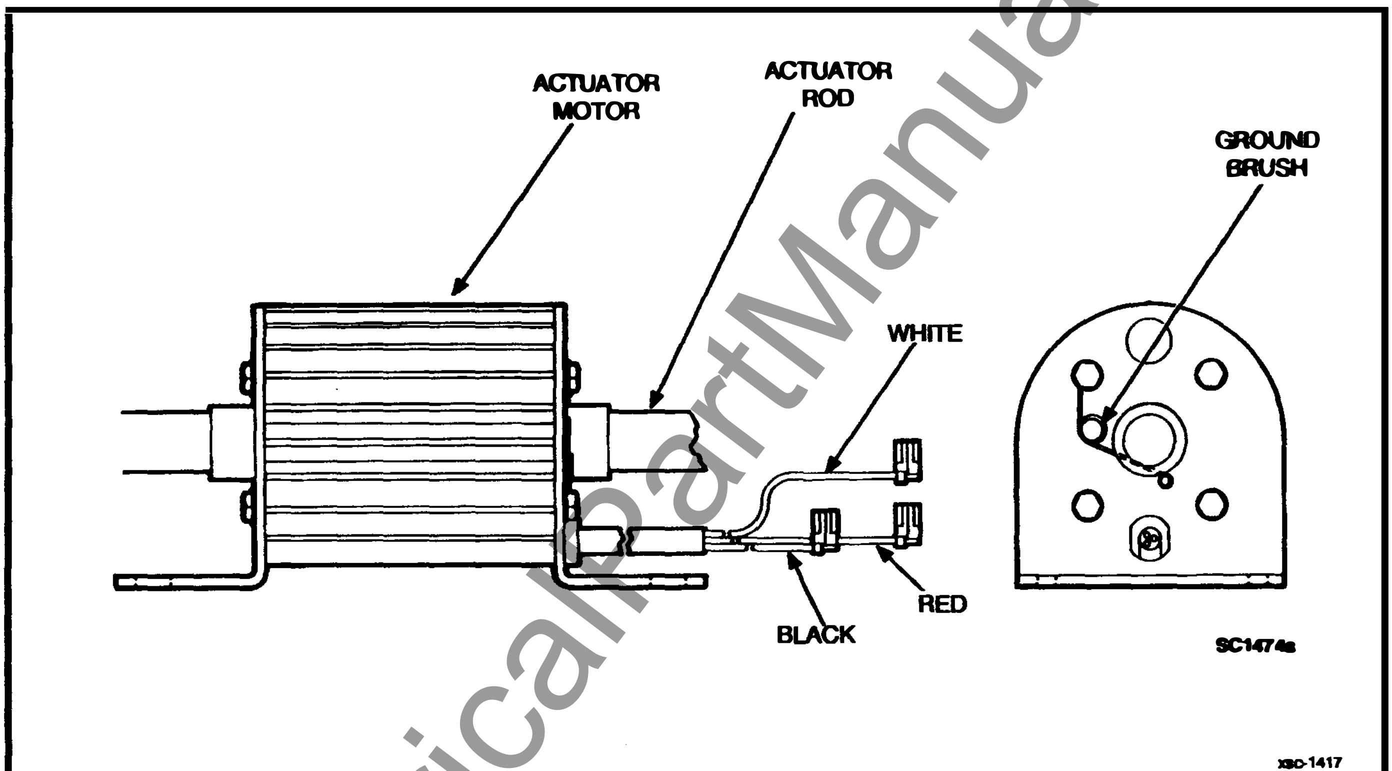


FIGURE 4-12. LINEAR ACTUATOR (300 TO 600 AMPERES)

BLOCK AND CROSS-BAR ASSEMBLY REMOVAL AND REPLACEMENT (300 to 600 Amperes)

If a generator set provides Emergency power, turn the operation selector switch to Stop. (The selector switch is located on the generator set control panel.) **Disconnect both the Normal and Emergency power sources from the transfer switch.** If there is an external battery charger, disconnect it from its AC power source. Then disconnect the set starting battery (negative [–] lead first).

WARNING ***AC power within the cabinet presents an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

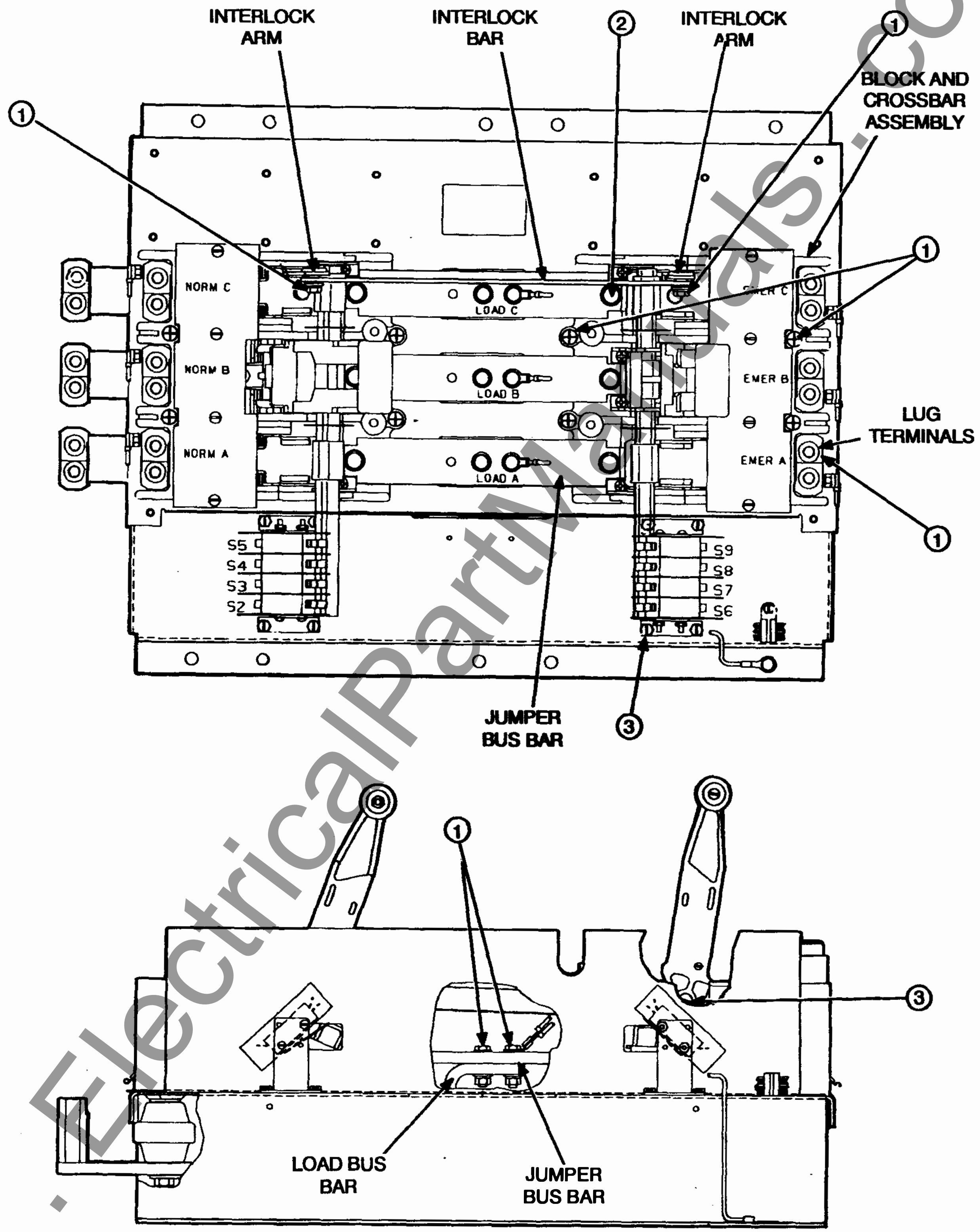
The following procedures cover the removal and replacement of the block and cross-bar assemblies for the 300- to 600-ampere switches.

Removing the Block and Cross-bar Assembly (Normal or Emergency)

1. Remove the linear actuator as described in the *Linear Actuator Removal and Replacement* section for 300- to 600-ampere switches.
2. Remove the hex head capscrews, lock washers, and flat washers that secure the interlock bar to the interlock arm (Figures 4-13 and 4-14), and remove the interlock bar.
3. Disconnect the control wiring leads from the jumper bus bars.
4. Remove the round head shoulder screws and lock washers that secure the handle assembly to the block and cross-bar assembly, and lift off the handle assembly.
5. Remove the control wiring leads from the power source terminals.
6. Remove the lug terminal screws and the power supply wires from the lug terminals. Remove the lug mounting screws and then remove the solder-less lugs from the switch assemblies.
7. Remove the hex head capscrews, ring terminals, spring washers, flat washers, lock washers, and nuts that secure the jumper bus bars to the load bus bars.
8. Remove the hex head capscrews and spring washers that secure the jumper bus bars to the block assemblies, and lift off the jumper bus bars.
9. Remove the four screws, lock washers, and flat washers that secure the block and cross-bar assembly to the base. **On 4-pole switches,** remove the screw that secures the small bearing bracket to the neutral block (Figure 4-14). Remove the block and cross-bar assembly. Save the bearing bracket and screw for reuse.

CAUTION ***Use care when removing the block and cross-bar assembly from the base. Carefully disengage the crossbar from the auxiliary switch assembly to avoid cracking the switches.***

10. **On 4-pole switches (Figure 4-14):** Remove the four screws that secure the block and contact assembly to the base, and lift off the block and contact assembly.
11. Remove the hex head capscrew and lock washer that secure the interlock arm assembly to the block assembly and lift off the interlock arm.



① TORQUE TO 70 TO 75 IN-LBS (7.9 TO 8.5 N•m).
② TORQUE TO 10 TO 12 FT-LBS (13.6 TO 16.3 N•m).
③ TORQUE TO 25 TO 30 IN-LBS (2.8 TO 3.4 N•m).

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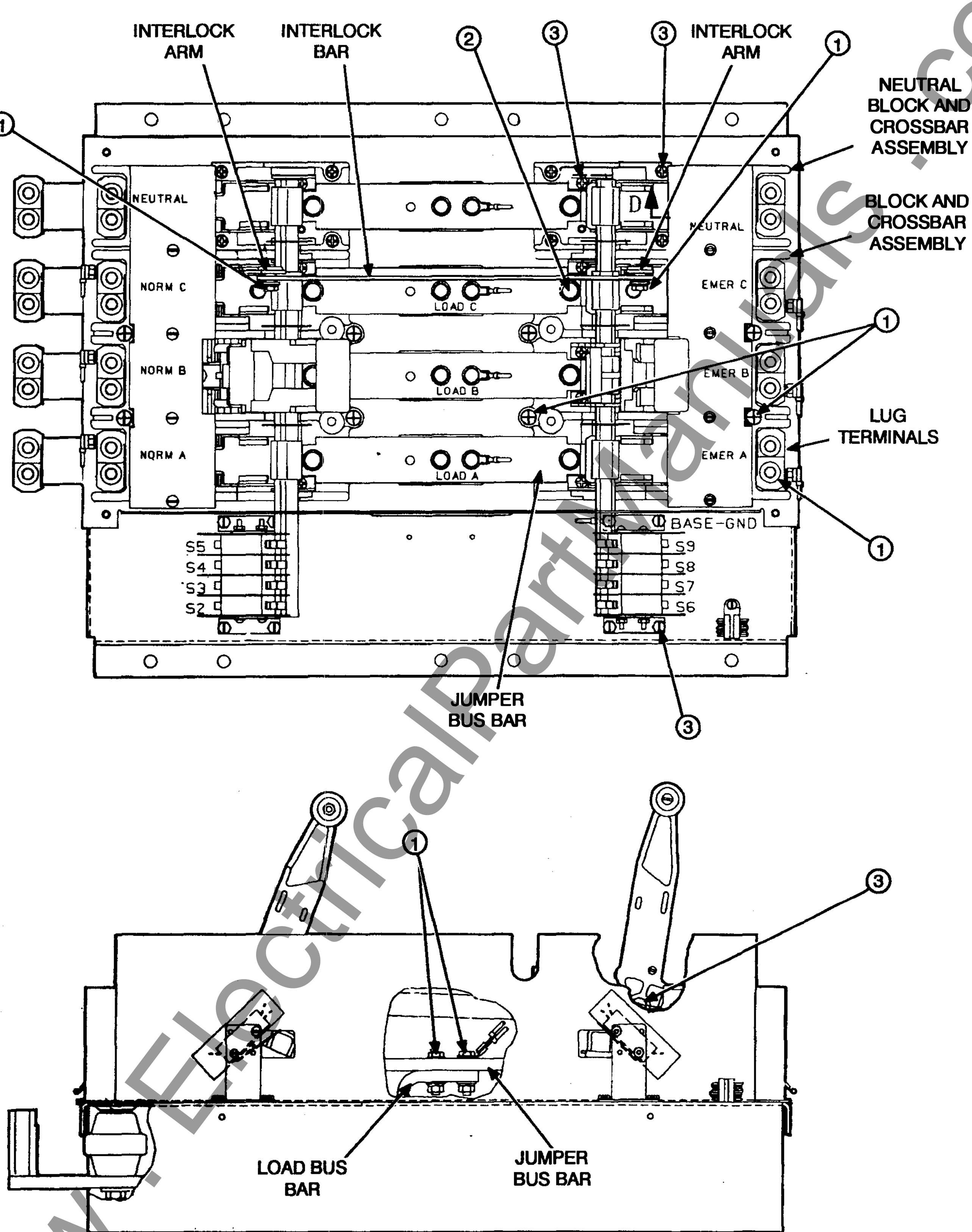
FIGURE 4-13. 3-POLE SWITCH ASSEMBLY (300 TO 600 AMPERES)



① TORQUE TO 70 TO 75 IN-LBS (7.9 TO 8.5 N•m).

② TORQUE TO 10 TO 12 FT-LBS (13.6 TO 16.3 N•m).

③ TORQUE TO 25 TO 30 IN-LBS (2.8 TO 3.4 N•m).

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FIGURE 4-14. 4-POLE SWITCH ASSEMBLY (300 TO 600 AMPERES)

Replacing the Block and Cross-bar Assembly (Normal or Emergency)

1. Install the interlock arm on the block assembly using the capscrew and lock washer (Figures 4-13 and 4-14). Torque to 70 to 75 in-lbs (7.9 to 8.5 N•m).
2. **On 4-pole switches (Figure 4-13):** Secure the block and contact assembly to the base using the four screws removed in step 10 above. Tighten the screws to 25 to 30 in-lbs (2.8 to 3.4 N•m). Place the bearing bracket (removed in step 9) in position on the end of the cross-bar assembly.
3. Install the block and cross-bar assembly on the transfer switch base (with the screws, lock washers, and flat washers), carefully engaging the auxiliary switches. Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m). On 4-pole switches, tighten the bearing bracket screw to 25 to 30 in-lbs (2.8 to 3.4 N•m).
4. Clean the current-carrying surfaces of the block assembly and the lug terminals with a wire brush. Install the lug terminals with the round head screws and lock washers. Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m).
5. Secure the jumper bus bars to the block assembly with the capscrews and spring washers. Make sure the mating surfaces have a coating of electrical joint compound. Tighten the capscrews 10 to 12 ft-lbs (13.6 to 16.3 N•m).
6. Secure the load bus bars to the jumper bus bars with the capscrews, lock washers, flat washers, spring washers, ring terminals, and nuts (Figure 4-13 and 4-14). Be sure to apply a thin coat of electrical joint compound between the current-carrying surfaces. Tighten 70 to 75 in-lbs (7.9 to 8.5 N•m).
7. Install the actuator handle on the block assembly with the shoulder screws and lock washers. Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m). Apply a thin coat of lubricant (Onan part number 524-0157) to the slot in the handle.
8. Connect the power source supply wires to the lug terminals. Tighten the lug terminals to the torque value silkscreened on the transfer switch cover.
9. Connect the control wiring leads to the power source terminals. Control wires are marked NORM A,B,C or EMER A,B,C for identification.
10. Connect the control wiring leads to the jumper bus bars. Control wires are marked LOAD A,B,C for identification.
11. Apply thread sealant (blue Loctite 242, Onan part number 518-0309 is recommended) to the threads of the interlock bar capscrews. Install the interlock bar and secure to each interlock arm with a hex head capscrew, lock washer, and flat washer. Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m).
12. Attempt to close both sides of the transfer switch. The interlock assembly must hold one side open so that only one side closes at at time.
13. Replace the linear actuator as described in the *Linear Actuator Removal and Replacement* section for 300- to 600-ampere switches. Follow steps 2 through 9 in the *Replacing Actuator* section.
14. Test the switch for proper operation and close the cabinet.

AUXILIARY SWITCH REMOVAL AND REPLACEMENT (300 TO 600 Amperes)

If a generator set provides Emergency power, turn the operation selector switch to Stop. (The selector switch is located on the generator set control panel.) **Disconnect both the Normal and Emergency power sources from the transfer switch.** If there is an external battery charger, disconnect it from its AC power source. Then disconnect the set starting battery (negative [–] lead first).

⚠WARNING ***AC power within the cabinet presents an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

The following procedures cover the removal and replacement of the auxiliary switch assembly for 300- to 600-ampere switches.

AWARNING ***AC power within the cabinet presents an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

Removing Auxiliary Switch Assembly

1. After disconnecting all sources of AC power, open the transfer switch cabinet door.
2. Loosen and remove the four machine screws that secure the plastic switch cover to the transfer switch, and lift off the cover.
3. Loosen and remove the four machine screws that secure the terminal bracket (Figure 4-11) to the base. Move the terminal bracket to allow access to the base.
4. Remove the control wiring leads from the auxiliary switch terminals (Figure 4-15).
5. Close the transfer switch to the side you are working on and remove the hex head machine screws that secure the auxiliary switch assembly bracket to the base.
6. Lift out the auxiliary switch assembly.
7. Remove the hex head machine screws and nuts that secure the auxiliary switches to the bracket (Figure 4-15) and lift out the auxiliary switches and insulating barriers.

Replacing Auxiliary Switch Assembly

1. Install the insulating barriers (5) and auxiliary switches (4) in the brackets, and secure with hex head machine screws (2) and nuts (2). Tighten to 10 to 15 in-lbs (1.1 to 1.7 N•m).

   Note that each switch must be assembled so the side with two terminals faces inward (Figures 4-13, 4-14, and 4-15) when the auxiliary switch assembly is installed on the base.
2. Hold the auxiliary switch assembly in position on the base (the side with two terminals must face inward) and secure the bracket to the base with the hex head machine screws. Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m).
3. Install the control wiring leads on the corresponding switch terminals. Leads are marked with the terminal numbers (S2/N0, S5/NC, S7/C, etc.) for identification. Refer to figures 4-13, 4-14, and 4-15 for identification of the auxiliary switch terminals.
4. Place the terminal bracket in position on the base and secure it with the hex head machine screws. Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m).
5. Place the plastic cover in position and secure with the hex head screws and flat washers. Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m).
6. If a generator set is the Emergency power source, connect the starting battery (negative [–] lead last). If applicable, connect the battery charger to its AC power source. **Reconnect the Normal power source and the Emergency power source.** Place the operation selector switch in the Remote position.
7. Test the transfer switch for proper operation and close the cabinet.

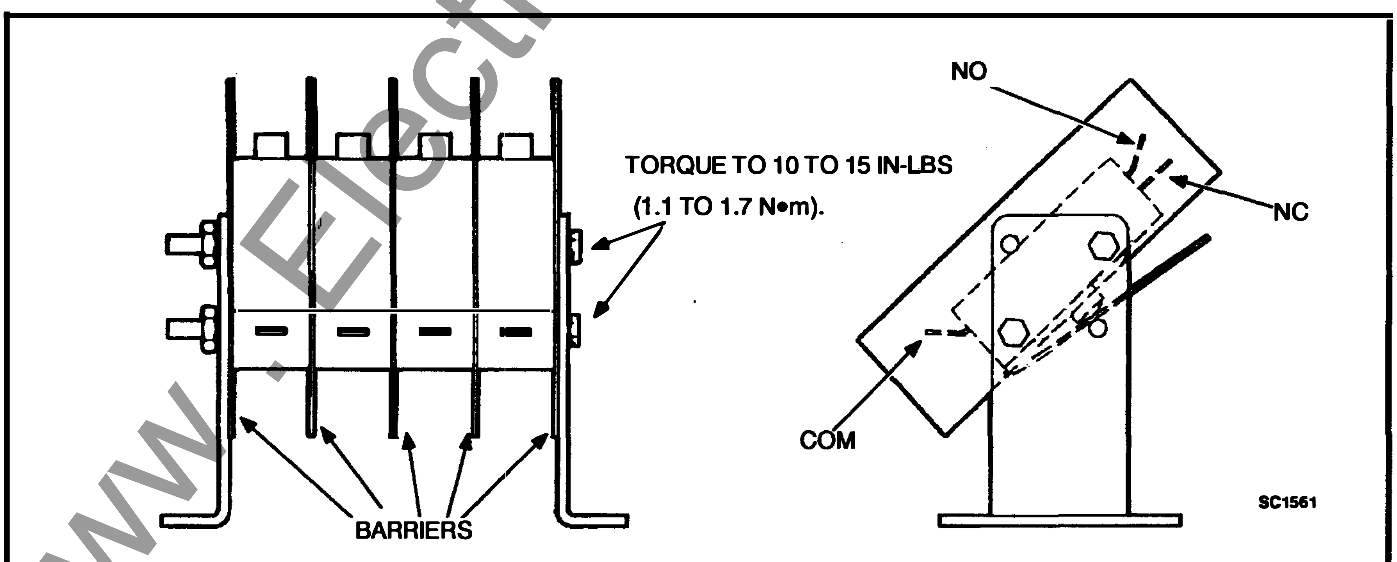


FIGURE 4-15. AUXILIARY SWITCH (300 TO 600 AMPERES)

LINEAR ACTUATOR REMOVAL AND REPLACEMENT (800 and 1000 Amperes)

If a generator set provides Emergency power, turn the operation selector switch to Stop. (The selector switch is located on the generator set control panel.) **Disconnect both the Normal and Emergency power sources from the transfer switch.** If there is an external battery charger, disconnect it from its AC power source. Then disconnect the set starting battery (negative [–] lead first).

⚠WARNING ***AC power within the cabinet presents an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

The following procedures cover the removal and replacement of the linear actuator for 800- and 1000-ampere switches.

Removing Actuator

1. Open the transfer switch cabinet door.
2. Remove a hex head capscrew, flat washer, and lock washer that secures one of the rod end assemblies to the end of the actuator rod.
3. Remove the rod end assembly (Figure 4-16) and slide the actuator rod out of the actuator motor.
4. Loosen and remove the twelve machine screws (with flat washers) that secure the three plastic switch covers to the switch base, and lift off the switch covers (Figure 4-16).
5. Separate the actuator lead wires from the rest of the wiring harness; remove the wire ties as required.
6. Pry the capacitors loose from the brackets. Remove the end cap and disconnect the red and white actuator lead wires from the capacitor terminals.
7. Disconnect the black actuator lead wire from the circuit breaker and the ground wire from the end of the actuator.
8. Remove the hex head capscrews, flat washers, and lock washers that secure the actuator to the switch assemblies (Figure 4-16) and lift out the spacers and actuator motor.

Replacing Actuator

1. Hold the actuator motor and spacers (4) in position over the switch assemblies with the lead wires at the bottom.
2. Secure the actuator motor to the switch assemblies using hex head capscrews (4), lock washers (4), and flat washers (4). Tighten the capscrews to 70 to 75 in-lbs (7.9 to 8.5 N•m).
3. Connect the black actuator lead wire to the circuit breaker, and the red and white actuator lead wires to the following capacitor terminals:

   Red Lead Wire - Connect to capacitor C1 - Terminal 1.

   White Lead Wire - Connect to capacitor C2 - Terminal 2.

   Transfer switches for voltage ranges 347, 380/416, and 440/480 use two capacitors (C1 and C2) wired together in series. A single jumper wire is placed between terminal 2 on C1 and terminal 1 on C2.

   Transfer switches for voltage ranges 115, 190/200, 208, and 220/240 use two capacitors (C1 and C2) wired in parallel. Two jumper wires are used. One is placed between terminal 1 on C1 and terminal 1 on C2. The other is placed between terminal 2 on C1 and terminal 2 on C2.
4. Replace the capacitor end cap(s) and install the capacitor(s) in the bracket(s).
5. Connect the ground wire to the end of the actuator. Use wire ties to hold the actuator lead wires in place with the rest of the wiring harness.
6. Place the plastic switch covers in position and secure with machine screws and flat washers. Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.

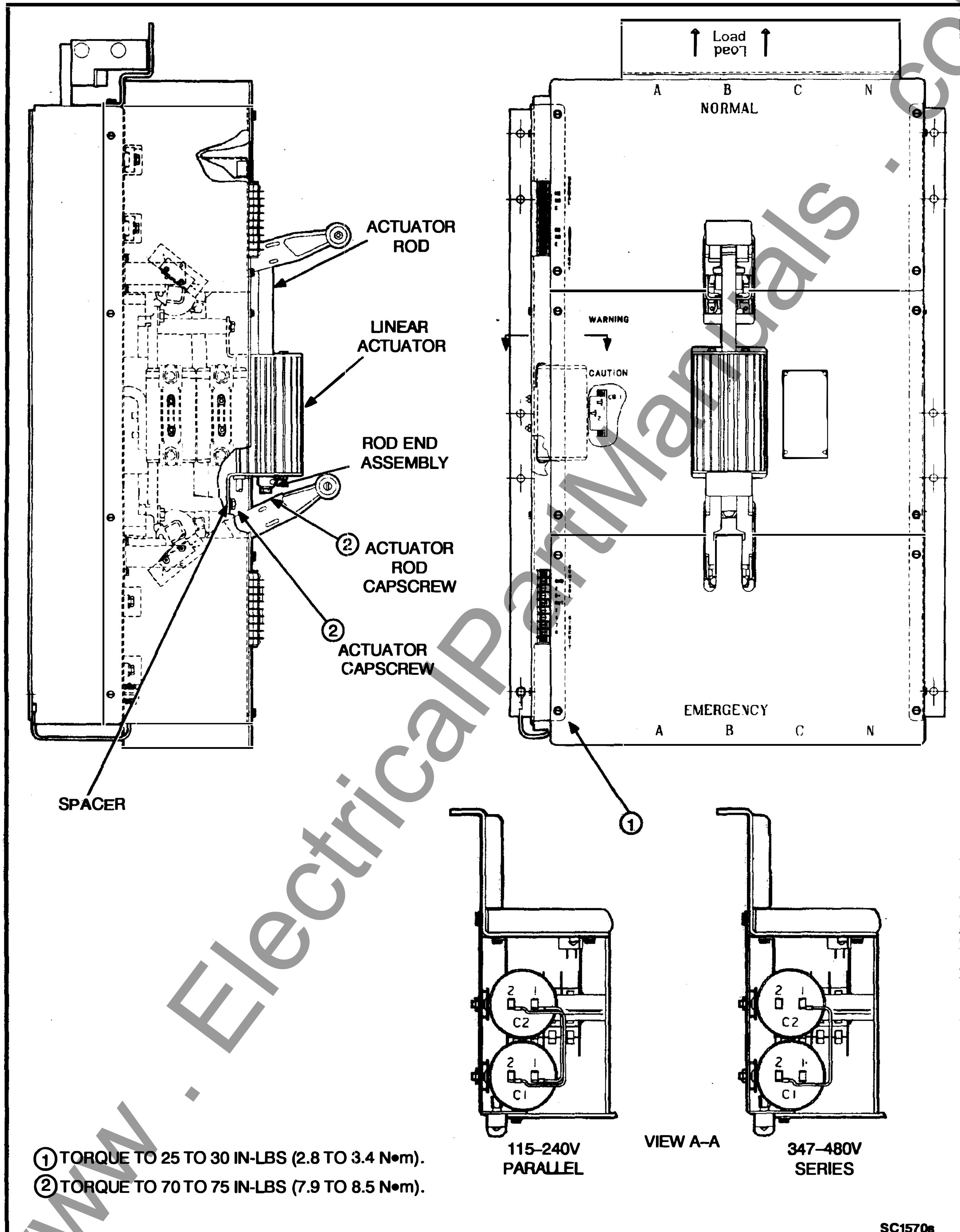


FIGURE 4-16. TRANSFER SWITCH COVER (800 - 1000 AMPERES)

7. Insert the actuator rod into the replacement actuator motor (Figure 4-17). Hold the actuator ground brush up slightly to allow passage of the actuator rod.

8. Secure the rod end assembly to the actuator rod with the hex head capscrew, flat washer, and lock washer. Tighten the capscrew to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque. Fit the rod assembly into the handle of the closed switch assembly.

9. Check the operation of the transfer switch and the alignment of the actuator rod by manually opening and closing both the Normal and Emergency switch assemblies.

10. If a generator set is the Emergency power source, connect the starting battery (negative [–] lead last). If applicable, connect the battery charger to its AC power source. **Reconnect the Normal power source and the Emergency power source.** Place the operation selector switch in the Remote position.

11. Test the switch for proper operation and close the cabinet.

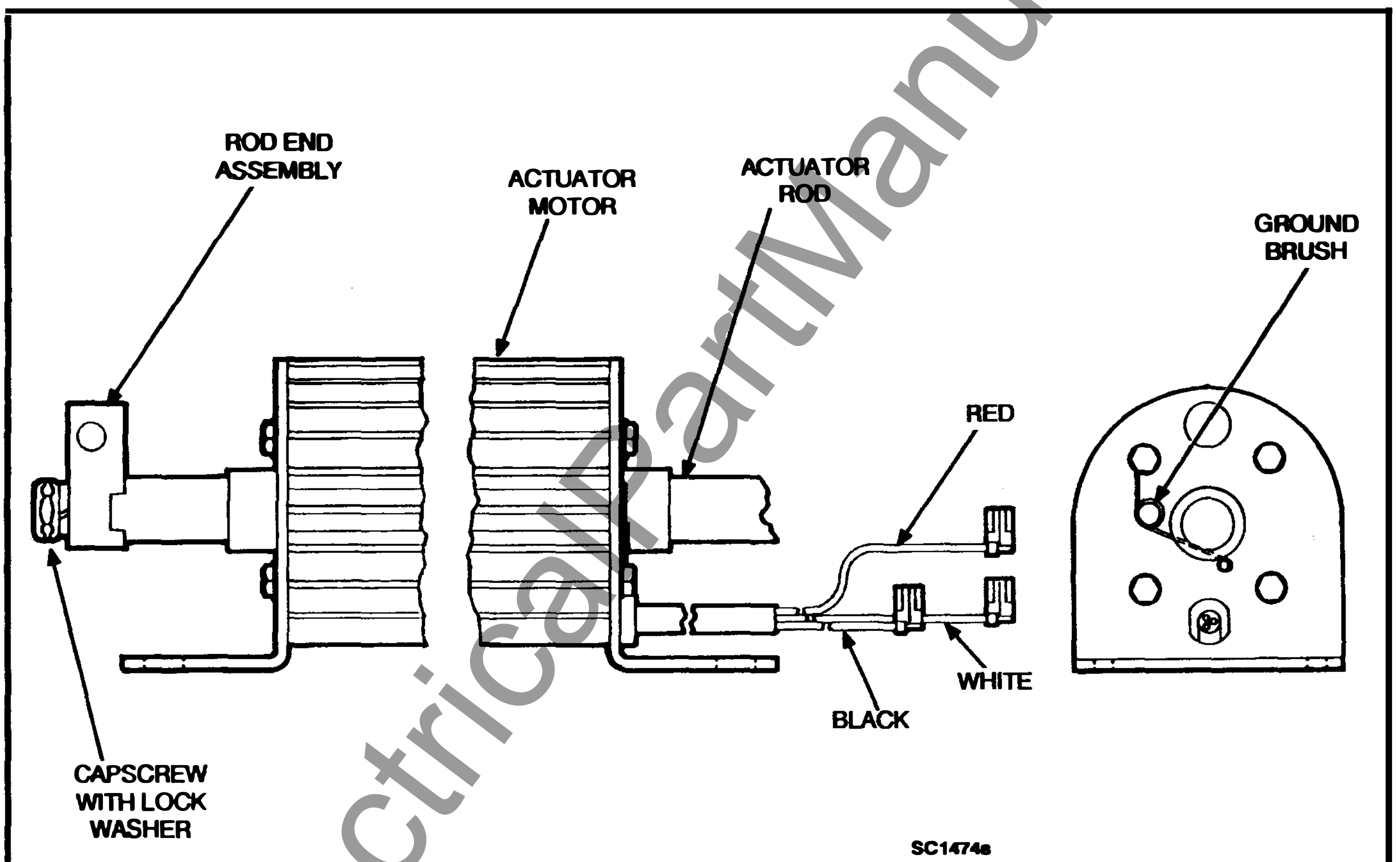


FIGURE 4-17. LINEAR ACTUATOR (800 - 1000 AMPERES)

BLOCK AND CROSS-BAR ASSEMBLY REMOVAL AND REPLACEMENT (800 and 1000 Amperes)

If a generator set provides Emergency power, turn the operation selector switch to Stop. (The selector switch is located on the generator set control panel.) **Disconnect both the Normal and Emergency power sources from the transfer switch.** If there is an external battery charger, disconnect it from its AC power source. Then disconnect the set starting battery (negative [–] lead first).

WARNING ***AC power within the cabinet presents an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

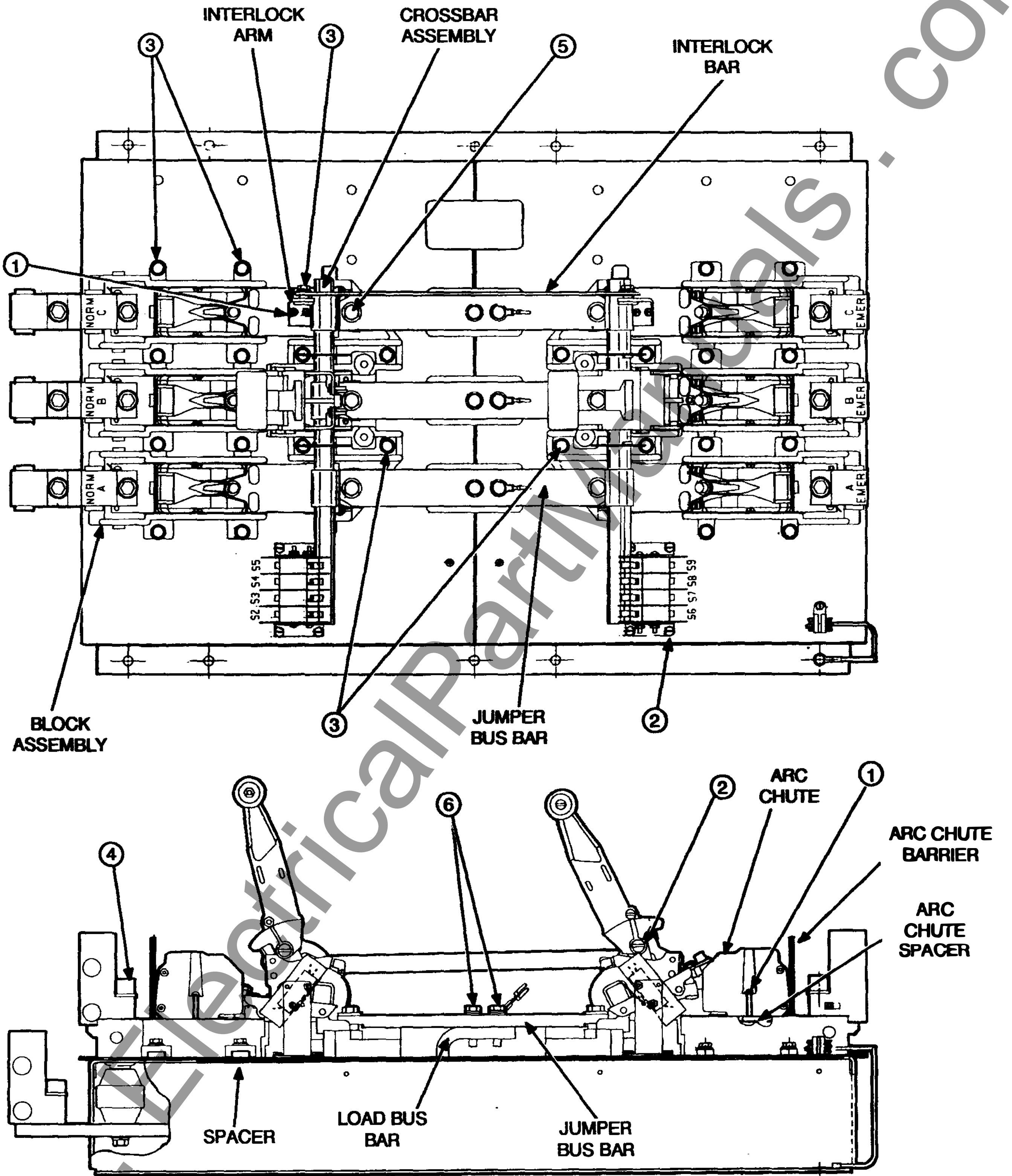
The following procedures cover the removal and replacement of the block and cross-bar assemblies for 800- and 1000-ampere switches.

Removing the Block and Cross-bar Assembly (Normal or Emergency)

1. Remove the linear actuator as described in the *Linear Actuator Removal and Replacement* section for 800- and 1000-ampere switches.
2. Lift the arc chute covers off the arc chutes.
3. Remove the hex head capscrews, lock washers, and flat washers that secure the interlock bar to the interlock arm (Figures 4-18 and 4-19); and remove the interlock bar.
4. Disconnect the control wiring leads from the jumper bus bars.
5. Remove the hex head capscrews, ring terminals and spring washers that secure the jumper bus bars (Figures 4-18 and 4-19) to the load bus bars.
6. Remove the hex head capscrews, spring washers, and bushings that secure the jumper bus bars to the switch assemblies. Lift off the jumper bus bars. (The neutral pole on the 4-pole switches does not have a bushing at this connection.)
7. Remove the control wiring leads from the power source terminals.
8. Loosen the lug terminal screws and remove the power source supply wires from the lug terminals.
9. With a screwdriver, dig the glue out of the insulator cups that cover and insulate the block assembly mounting screws.
10. Remove the hex head capscrews and flat washers that secure the block assemblies (Figures 4-18 and 4-19) to the base, and lift off the block assemblies (note where spacers are used).
    - **On 3-pole switches, the A-phase block on the Normal side and the C-phase block on the Emergency side have a spacer under their outer mounting tabs. On 4-pole switches, the A-phase block on the Normal side and the neutral block on the Emergency side have this spacer. Make certain that you install new block assemblies with the spacers in their original positions.**
    - **The block assemblies are not identical. The A- and C-phase blocks, and the neutral block on 4-pole switches, are different than the B-phase block. Refer to the parts manual and the part numbers stamped on the replacement block assemblies to make certain that you install new block assemblies in their correct positions.**
11. Remove the round head machine screws, lock washers, and flat washers that secure the arc chutes (Figures 4-18 and 4-19) to the block assemblies; and lift out the arc chutes, arc chute barriers, and arc chute spacers. Discard the arc chute barriers, and spacers.
12. Remove the allen head capscrews and lug terminals from the block assemblies.
13. Remove the hex head capscrews and flat washers that secure the cross-bar assembly to the base, and lift off the cross-bar assembly.

    CAUTION ***Use care when removing the block and cross-bar assembly from the base. Carefully disengage the crossbar from the auxiliary switch assembly to avoid cracking the switch.***

14. Remove the shoulder screws and self-locking nuts that secure the two halves of the handle assembly together. Remove the shoulder screws and lock washers that secure the handle assembly to the block and cross-bar assembly. Slide the two halves of the handle apart and remove them.
15. Remove the two round head machine screws that secure the interlock arm to the cross-bar assembly, and lift of the interlock arm.



(1) TORQUE TO 15 TO 20 IN-LBS (1.7 TO 2.3 N•m).

(2) TORQUE TO 25 TO 30 IN-LBS (2.8 TO 3.4 N•m).

(3) TORQUE TO 70 TO 75 IN-LBS (7.9 TO 8.5 N•m).

(4) TORQUE TO 28 TO 33 FT-LBS (40.0 TO 44.7 N•m).

(5) TORQUE TO 18 TO 20 FT-LBS (24.4 TO 27.1 N•m).

(6) TORQUE TO 10 TO 12 FT-LBS (13.6 TO 16.3 N•m).

SC1567s

FIGURE 4-18. 3-POLE SWITCH ASSEMBLY (800 - 1000 AMPERES)

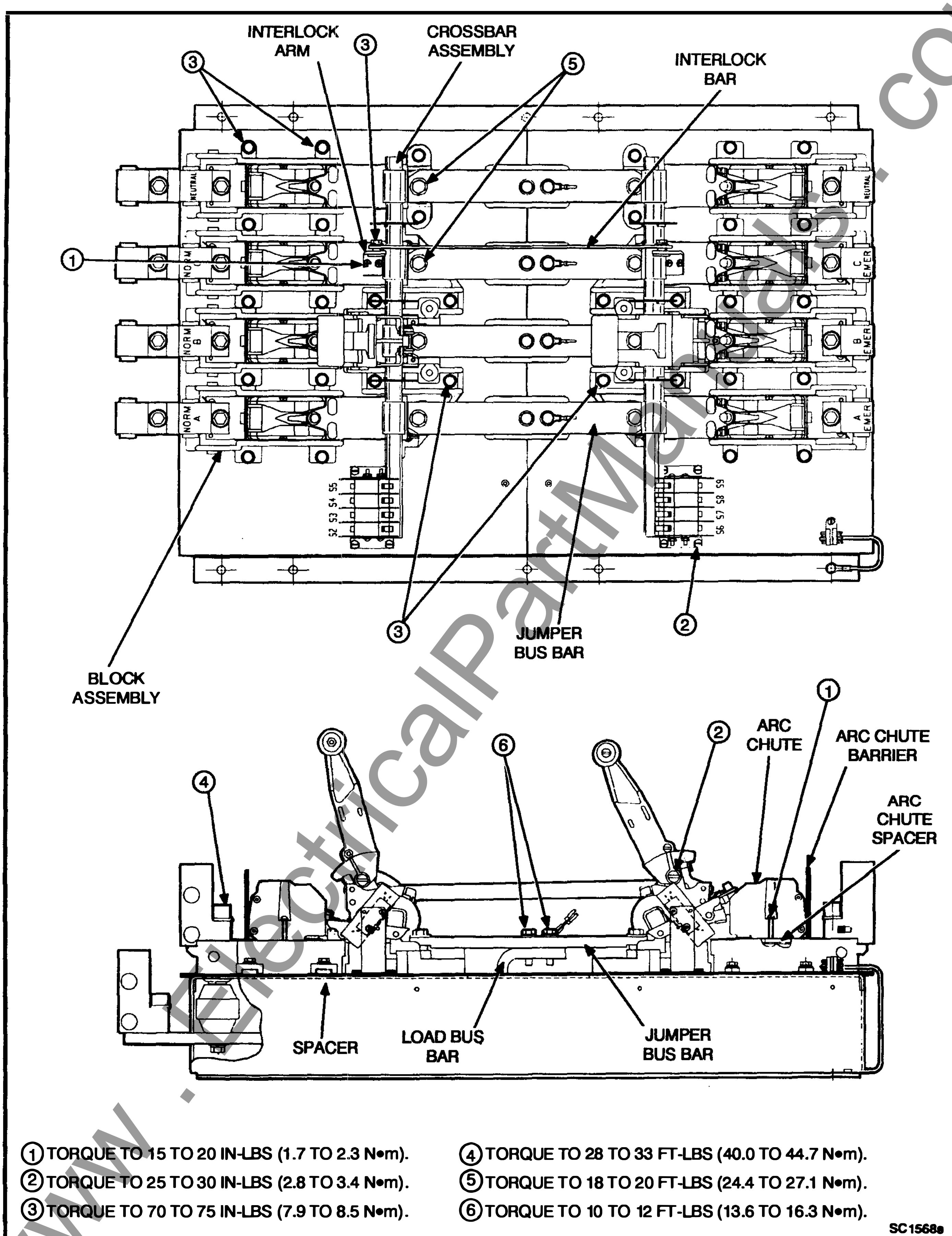


FIGURE 4-19. 4-POLE SWITCH ASSEMBLY (800 - 1000 AMPERES)

Replacing the Block and Cross-bar Assembly (Normal or Emergency)

1. Install the interlock arm on the cross-bar assembly and secure with the round head machine screws. Tighten the screws to 15 to 20 in-lbs (1.7 to 2.3 N•m) torque.
2. Apply a thin coat of lubricant (Onan part number 524-0157) to the slot in the handle. Place the handle assembly in position on the switch assembly and secure with the shoulder screws, lock washers, and locknuts. Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m).
3. Secure the cross-bar assembly to the base with the hex head capscrews (4), lock washers (4), and flat washers (4). Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque.
4. Apply a thin coat of glyptol between the arc chute spacers and the arc chute barrier. Place the arc chute spacers (2), arc chute barrier, and arc chute in position on each block assembly; and secure with round head machine screws (2), lock washers (2) and flat washers (2). Tighten to 15 to 20 in-lbs (1.7 to 2.3 N•m) torque.
5. Apply a thin coat of electrical joint compound between the mating surfaces of the block assembly and the lug terminals. Install the lug terminals on the block assemblies and secure with the allen head capscrews. Tighten to 28 to 33 ft-lbs (40.0 to 44.7 N•m) torque.
6. Place each block assembly in position on the base and secure with the hex head capscrews and flat washers. Refer to Figures 4-18 and 4-19 to determine where the spacers are required. Tighten the capscrews to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque.
   - **On 3-pole switches, the A-phase block on the Normal side and the C-phase block on the Emergency side have a spacer under their outer mounting tabs. On 4-pole switches, the A-phase block on the Normal side and the neutral block on the Emergency side have this spacer. Make certain that you install new block assemblies with the spacers in their original positions.**
   - **The block assemblies are not identical. The A- and C-phase blocks, and the neutral block on 4-pole switches, are different than the B-phase block. Refer to the parts manual and the part numbers stamped on the replacement block assemblies to make certain that you install new block assemblies in their correct positions.**
7. Fill the insulator cups that cover and insulate the block assembly mounting screws with adhesive silicone to completely cover the washers and screw heads.
8. Install the power source supply wires and securely tighten the lug terminals to 10 to 12 ft-lbs (13.6 to 16.3 N•m) torque.
9. Connect the control wiring leads to the power source terminals. Control wires are marked NORM A,B,C or EMER A,B,C for identification.
10. Apply a thin coat of electric joint compound between the mating surfaces of the jumper bus bars, the braided strap connectors, and load bus bars.
11. Install the jumper bus bars and secure to the switch assemblies with hex head capscrews, spring washers, and bushings. (The neutral pole on 4-pole switches does not have a bushing at this connection.) Tighten to 18 to 20 ft-lbs (24.4 to 27.1 N•m) torque.
12. Secure the jumper bus bars to the load bus bars with hex head capscrews, ring terminals, and spring washers. Tighten to 10 to 12 ft-lbs (13.6 to 16.3 N•m) torque.
13. Connect the control wiring leads to the jumper bus bars. Control wires are marked LOAD A,B,C for identification.
14. Apply thread sealant (blue Loctite 242, Onan part number 518-0309 is recommended) to the threads of the interlock bar capscrews. Install the interlock bar and secure to each interlock arm with a hex head capscrew, lock washer, and flat washer. Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m).
15. Place the arc chute covers in position over the arc chutes.
16. Attempt to close both sides of the transfer switch. The interlock assembly must hold one side open so that only one side closes at at time.
17. Replace the linear actuator as described in the *Linear Actuator Removal and Replacement* section for 800- and 1000-ampere switches. Follow steps 2 through 10 in the *Replacing Actuator* section.
18. Test the switch for proper operation and close the cabinet.

AUXILIARY SWITCH REMOVAL AND REPLACEMENT (800 and 1000 Amperes)

If a generator set provides Emergency power, turn the operation selector switch to Stop. (The selector switch is located on the generator set control panel.) **Disconnect both the Normal and Emergency power sources from the transfer switch.** If there is an external battery charger, disconnect it from its AC power source. Then disconnect the set starting battery (negative [–] lead first).

⚠WARNING ***AC power within the cabinet presents an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

The following procedures cover the removal and replacement of the auxiliary switch assembly for 800- and 1000-ampere switches.

Removing Auxiliary Switch Assembly

1. Open the transfer switch cabinet door.
2. Remove the hex head capscrew, flat washer, and lock washer that secure one of the rod end assemblies to the end of the actuator rod.
3. Remove the rod end assembly (Figure 4-16) and slide the actuator rod out of the actuator motor.
4. Loosen and remove the twelve machine screws (with flat washers) that secure the three plastic switch covers to the switch base, and lift off the switch covers (Figure 4-16).
5. Remove the hex head machine screws that secure the terminal bracket to the base. Move the bracket to the side to allow access to the auxiliary switch terminals.
6. Remove the control wiring leads from the auxiliary switch terminals (Figure 4-20).
7. Close the transfer switch to the side you are working on and remove the hex head machine screws that secure the auxiliary switch assembly brackets to the base. Lift out the auxiliary switch assembly.
8. Remove the round head machine screws, Flat washers, and nuts that secure the auxiliary switches to the bracket (Figure 4-20); and lift out the auxiliary switches and insulating barriers.

Replacing Auxiliary Switch Assembly

1. Install the insulating barriers and auxiliary switches in the brackets and secure with hex head capscrews (2) and nuts (2). Note that each switch must be assembled so the side with two terminals faces inward (Figure 4-20) when the auxiliary switch assembly is installed.
2. Install the auxiliary switch assembly on the base and secure the bracket to the base using the hex head machine screws. Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
3. Install the control wiring leads on the switch terminals. The leads are marked with the terminal numbers (S2/NO, S5/NC, S7/C, etc.) for identification. Refer to figures 4-18, 4-19, and 4-20 for identification of the auxiliary switch terminals.
4. Place the terminal bracket in position on the base and secure it with the hex head machine screws (4). Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
5. Place the plastic covers in position and secure them with machine screws and flat washers. Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
6. Insert the actuator rod into the replacement actuator motor. Hold the actuator ground brush up slightly to allow passage of the actuator rod.
7. Secure the rod end assembly to the actuator rod with the hex head capscrew, flat washer, and lock washer. Tighten the capscrew to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque. Fit the rod assembly into the handle of the closed switch assembly.
8. If a generator set is the Emergency power source, connect the starting battery (negative [–] lead last). If applicable, connect the battery charger to its AC power source. **Reconnect the Normal power source and the Emergency power source.** Place the operation selector switch in the Remote position.
9. Test the transfer switch for proper operation and close the cabinet.

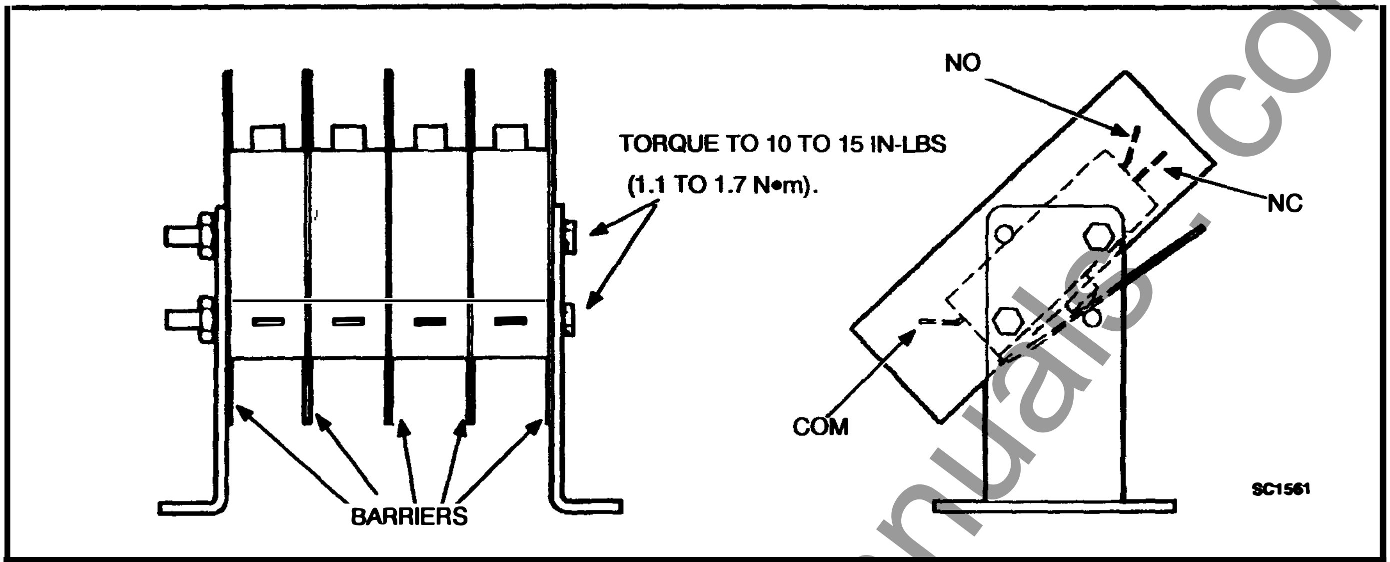


FIGURE 4-20. AUXILIARY SWITCH (800 - 1000 AMPERES)

5. GenSet-to-GenSet

INTRODUCTION

This section provides information for a transfer switch with an automatic generator set-to-generator set control.

Much of the information on theory of operation, Power Sentry calibration, and troubleshooting in sections 1, 2, and 3 is applicable. Refer to this section (5) for an overview of the generator set-to-generator set transfer switch. Refer to the (five sheet) schematic and wiring diagram package that was shipped with the transfer switch for specific information about its configuration.

Section 4 of this manual covers transfer switch assembly service procedures for all configurations.

Transfer Switch Application

This transfer switch enables two generator sets, running at alternate times, to provide power to a load. The transfer and retransfer of the load are the two most basic functions of a transfer switch.

The transfer switch may be equipped with an optional change-over clock, which is programmed to alternately run (and connect) one generator set for a selected time and then to run (and connect) the other generator set for a selected time.

If one of the generator sets fails to operate within a selected range of voltage and (optionally) frequency, the transfer switch automatically starts and connects the other generator set.

Figure 5-1 shows generator set number 1 connected to the load.

Automatic transfer switches control transfer of the load to the Normal (source 1) power source or to the Emergency (source 2) power source, without operator involvement.

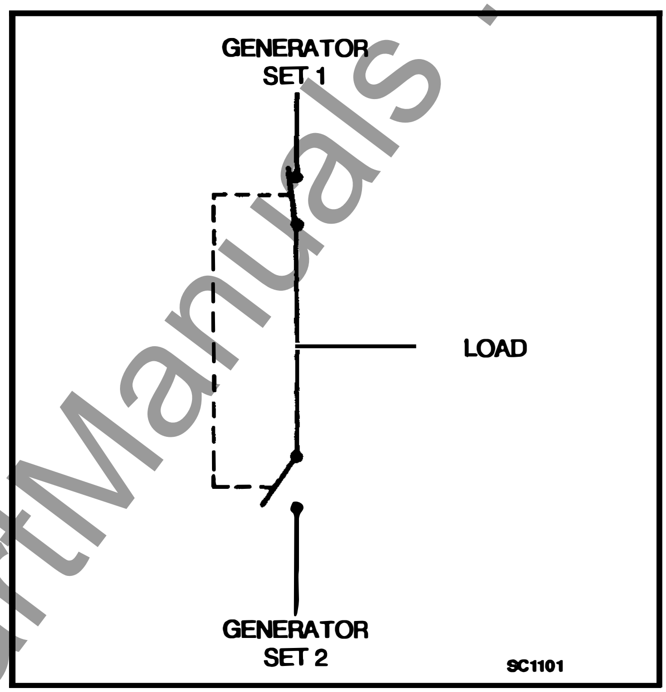


FIGURE 5-1. LOAD TRANSFER SWITCH (TYPICAL FUNCTION)

CABINET

The standard cabinet meets the requirements of the National Electrical Manufacturers Association (NEMA) for a UL Type 1 cabinet. This type is designated as a general-purpose, indoor cabinet. Items on the door of a typical cabinet are shown in Figure 5-2.

Indicator Lamps

There are four indicator lamps on the cabinet door. The Source 1 Available and Source 2 Available lamps are lit whenever their corresponding power sources are producing power. These two lamps can be lit simultaneously.

The Source 1 Connected and Source 2 Connected lamps indicate which power source is connected to the load. Only one of these two lamps can be lit.

Source Selector Switch

This is a three-position switch.

In the Auto position, the optional change-over clock determines which generator set has priority to run and assume load. Transfer and retransfer are controlled by the change-over clock and (in the event of a generator set fault) the voltage sensing and timing components of the electronic control system.

In the Source 1 position, the source 1 generator set has priority to run and assume load. The load remains connected to source 1 unless a source 1 failure is sensed.

In the Source 2 position, the source 2 generator set has priority to run and assume load. The load remains connected to source 2 unless a source 2 failure is sensed.

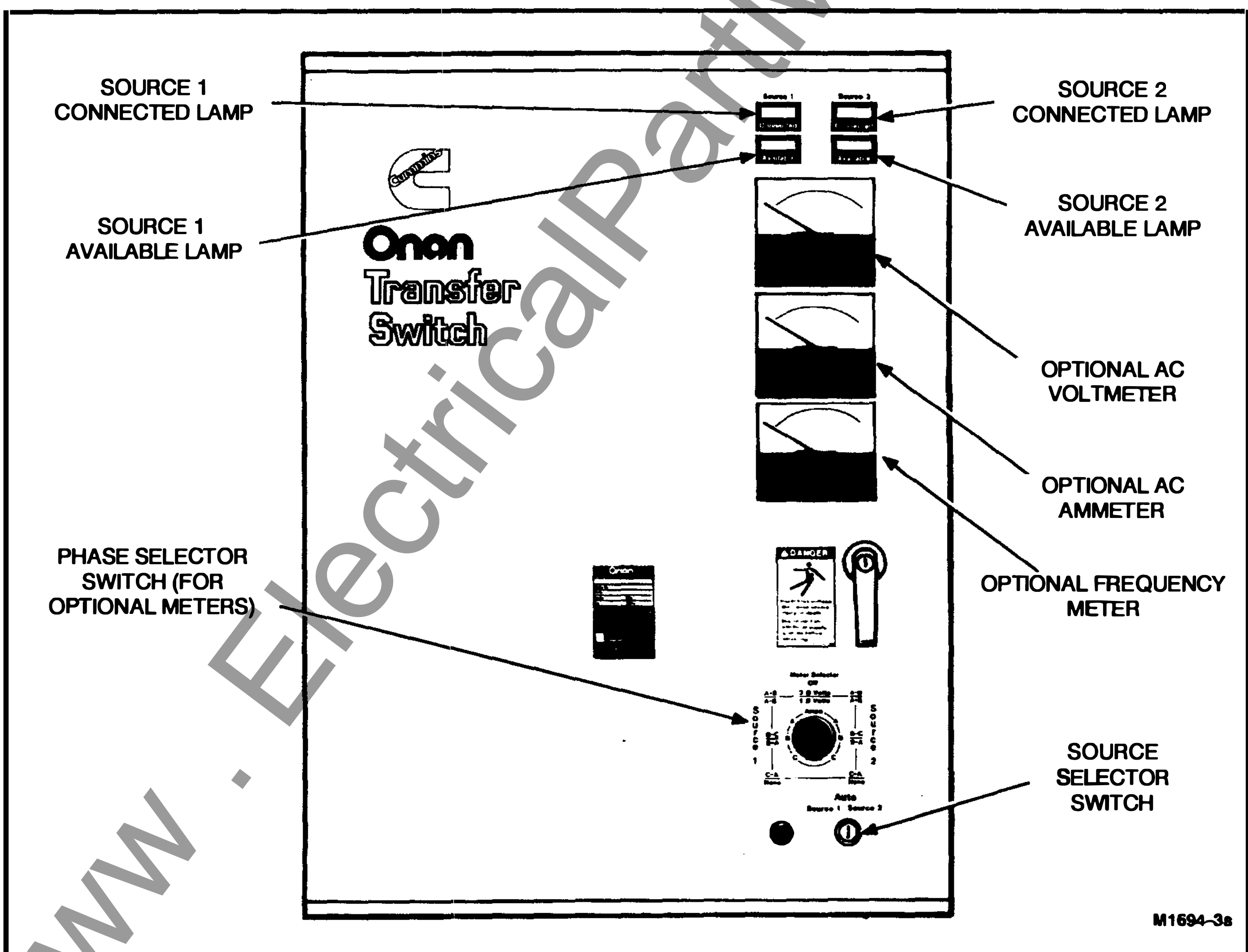


FIGURE 5-2. GENERATOR SET-TO-GENERATOR SET TRANSFER SWITCH CABINET WITH OPTIONS

Optional Meter Package

The optional meter package includes an AC ammeter, an AC voltmeter, a frequency meter, and a phase selector switch.

AC Voltmeter: The voltmeter measures line-to-line voltage of the selected power source.

AC Ammeter: The ammeter measures the line currents of the load.

Frequency Meter: This meter measures the output frequency of the selected power source in hertz.

Phase Selector Switch: This switch is used to select the source and phase to be measured.

On transfer switches with an AC ammeter, the load wires must each pass through a current transformer.

TRANSFER SWITCH

The transfer switch (Figure 5-3) opens and closes the contacts that transfer the load between source 1 and source 2 generator sets. The transfer switch is mechanically interlocked to prevent simultaneous closing to both power sources. The main parts of the transfer switch discussed here are the contact assemblies, linear actuator, Motor Disconnect switch, and auxiliary contacts.

Contact Assemblies

The automatic transfer switch has either three or four poles. Three pole transfer switches are provided with a neutral bar. The contact assemblies make and break the current flow. When closed to either the source 1 or the source 2 generator set, the contacts are mechanically held. A mechanical interlock prevents them from closing to both generator sets at the same time.

Linear Actuator

The linear actuator is a linear induction motor that moves the contact assemblies between the Normal (source 1) side and the Emergency (source 2) side. Linear actuator operation is initiated automatically with automatic transfer switches. Manual operation of the transfer switch is also possible. Refer to Manual Operation in the Operation section.

Motor Disconnect Switch

The Motor Disconnect toggle switch, on the accessory control panel, enables and disables the linear actuator. Place the switch in the Auto position to enable the linear actuator. Place the switch in the Off position to disable the linear actuator.

Auxiliary Contacts

Auxiliary contacts are provided on the Normal (source 1) and Emergency (source 2) sides of the transfer switch. They are actuated by operation of the transfer switch during transfer and retransfer. The Normal side auxiliary contact switch is actuated when the transfer switch is in the Normal position. The Emergency side auxiliary contact switch is actuated when the transfer switch is in the Emergency position. The auxiliary contacts have current ratings of 10 amperes at 250 VAC. Connections for the auxiliary contacts are made on terminal block TB1. Refer to sheet 1 of your schematic and wiring diagram package.

ELECTRONIC CONTROL SYSTEM

This section describes the standard and optional components of the electronic control system.

⚠WARNING ***Improper calibration or adjustment of electronic control modules can cause death, severe personal injury, and equipment or property damage. Calibration and adjustment of these components must be performed by technically qualified personnel only.***

Power Sentry calibration and adjustment procedures are described in section 2.

The most important component of the electronic control system is the Power Sentry control (Figure 5-3). The Power Sentry includes voltage sensing circuits, time delay circuits and control relays. There are also several adjustment potentiometers and indicator lamps on the Power Sentry. The adjustments must be performed only by qualified service personnel.

⚠WARNING ***Accidental actuation of the linear motor can cause severe personal injury. Disable the motor, as described below, before making any adjustments.***

Place the Motor Disconnect Switch (Figure 5-3) in the Off position when making adjustments. Return the switch to the Auto position after adjustments are completed.

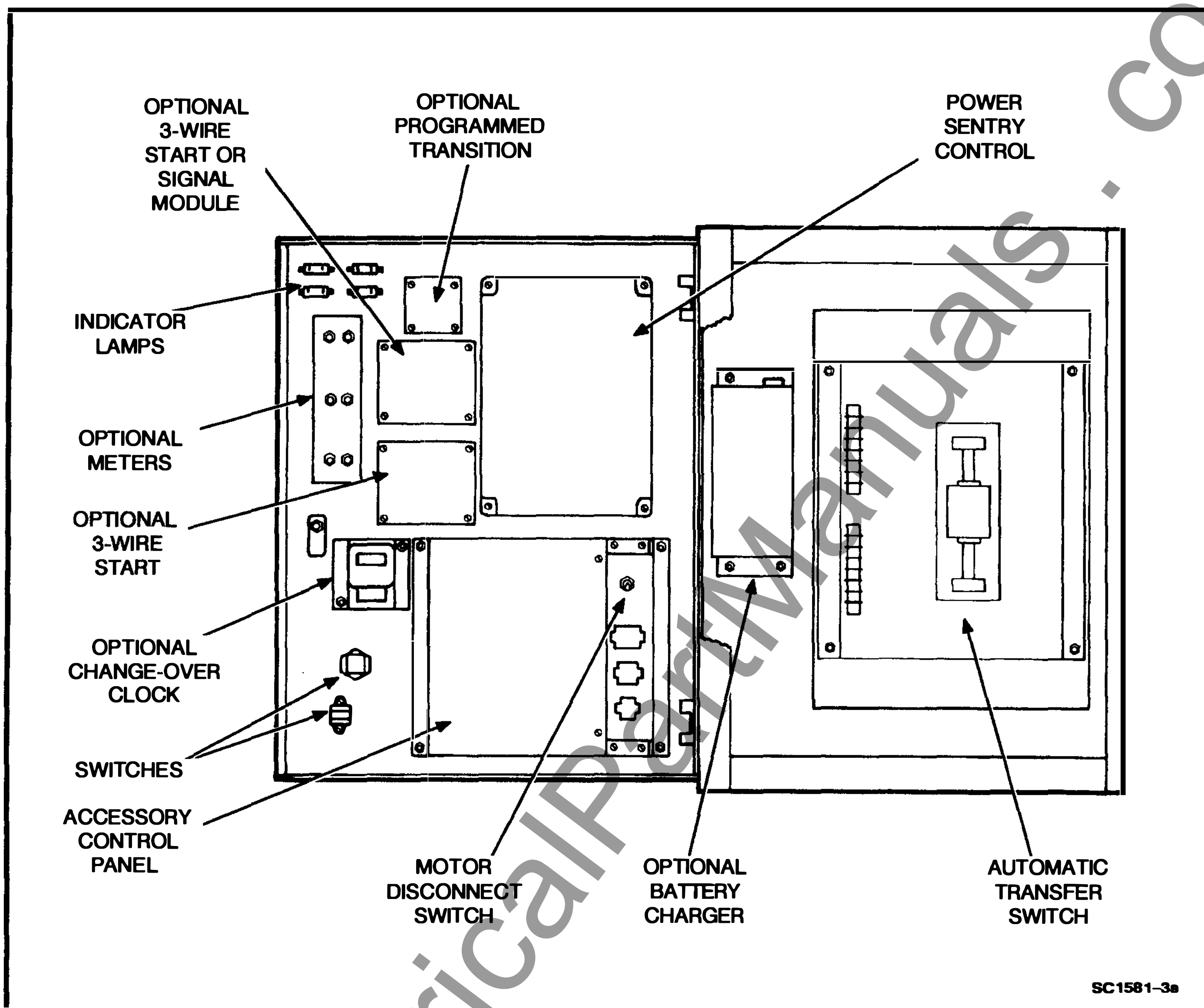


FIGURE 5-3. GENERATOR SET-TO-GENERATOR SET TRANSFER SWITCH CABINET INTERIOR

Power Sentry Time Delays

Start Time Delay: This delay is adjustable from 0 to 15 seconds. This brief time delay prevents generator set starting during power interruptions of short duration. Timing starts the moment of power interruption. If the duration of interruption exceeds the delay time, the control system signals the other generator set to start.

To set this time delay, align the slot on the potentiometer with the desired marking on the Power Sentry cover.

Stop Time Delay: This delay is adjustable from 0 to 10 minutes. It begins timing when the load is retransferred to the other generator set. At the end of the delay, the stop signal is sent to the generator set that is no longer connected. This time delay allows the generator set to cool down at no load before stopping.

To set this time delay, align the slot on the potentiometer with the desired marking on the Power Sentry cover.

Transfer Time Delay: This delay begins when generator voltage and frequency reach the settings of the control. After the delay, the transfer switch transfers the load to the generator set. This brief time delay allows the generator set to stabilize before the load is applied. It has an adjustable range of 0 to 120 seconds.

To set this time delay, align the slot on the potentiometer with the desired marking on the Power Sentry cover.

Retransfer Time Delay: This delay begins the moment the preferred source voltage and frequency return. After the delay, the transfer switch can retransfer the load to the preferred source. The delay allows the preferred source to stabilize before retransfer. It has an adjustable range of 0 to 30 minutes.

To set this time delay, align the slot on the potentiometer with the desired marking on the Power Sentry cover.

Undervoltage Sensing

Two voltage sensors, one for the source 1 side and one for the source 2 side, monitor source voltages for an undervoltage condition and generate signals, which are sent to the time delay module. If, for example, an undervoltage condition is sensed on the priority source, the voltage sensor module sends a signal to the time delay module that initiates and controls the timing for generator set start and the transfer of load.

The standard transfer switch has undervoltage sensing for all phases of the source 1 and source 2 power sources.

Undervoltage adjustment and calibration procedures are described in section 2.

Overvoltage and Frequency Sensing Option

Overvoltage and frequency sensing are available as a single option.

Overvoltage Sensing: With optional overvoltage sensing, the sources are monitored for an overvoltage condition.

As with the standard undervoltage sensing, the voltage sensors signal the time delay module, which controls the transfer or retransfer sequence.

An adjustable time delay (0 to 120 seconds) overrides momentary overshoots in voltage.

To set this time delay, align the slot on the potentiometer with the desired marking on the Power Sentry cover.

Overvoltage adjustment and calibration procedures are described in section 2.

Frequency Sensing: With optional frequency sensing, the sources are monitored for variations in frequency. The sensors determine whether the source is within an adjustable bandwidth.

As with the standard undervoltage sensing, the frequency sensors signal the time delay module, which controls the transfer or retransfer sequence.

An adjustable time delay (0 to 15 seconds) allows the control to ignore momentary dips or rises in frequency.

To set this time delay, align the slot on the potentiometer with the desired marking on the Power Sentry cover.

Change-over Clock Option

The optional change-over clock initiates generator set starting and operation at programmable intervals. When the source selector switch on the cabinet door is in the Auto position, the change-over clock determines which generator set has priority.

Programming the Change-over Clock

The change-over clock initiates generator set changeover at programmable intervals. It is a 7-day, 24-hour clock that can store and execute up to ten changeovers a week.

Programming the change-over clock requires setting the time of day and selecting the change-over times.

The change-over clock must be programmed to close its (normally open) contacts, hold the contacts closed long enough to allow the generator set to start, and then open the contacts.

Refer to the circled numbers in Figure 5-4 when reading the following instructions.

To set the time of day:

1. If you are performing installation and setup, press the R button (9) with the tip of a ball point pen to reset all memory. Do not press the R button if you are only changing the time of day.
2. Press the clock button (1).
3. Press the h button (3) to set the hour of the day. The clock uses 24-hour (military) time.
4. Press the m button (4) to set the minutes of the hour.
5. Press the 1-7 button (5) to advance the indicator bar over the desired day number (Use the 1 to represent Sunday.)
6. Press the Pr button (8) to enter the time.

To set the change-over time:

1. Slide the output selector switch (16) to the center position. The output selector switch has three positions. The Off position overrides the program and holds the contacts open. The I position overrides the program and holds the contacts closed. The center position selects program control.

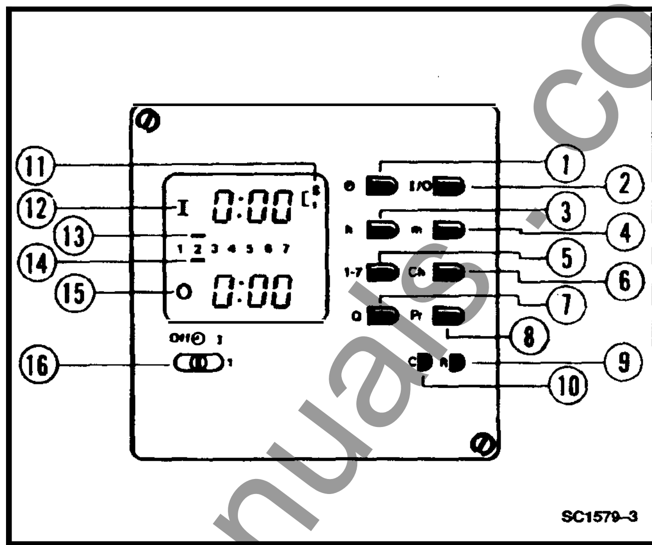


FIGURE 5-4. CHANGE-OVER CLOCK

2. Press the I/O button (2). An "I" (12) appears in the upper display window. The "I" is a symbol for closing contacts.
3. Press the h button (3) to set the change-over hour.
4. Press the m button (4) to set the change-over minute.
5. Press the 1-7 button (5) to advance the indicator bar (13) from 1 to 7 and back to 1. For each day to be selected for changeover, press the Q button (7) when the indicator is over the desired day number. (1 represents Sunday.)

   For each contact-closure time (selected in steps 1 to 5 above), there must be a corresponding contact-opening time. Program the change-over clock to hold the contacts closed for five minutes.

6. Press the I/O button (2). An "O" (15) appears in the lower left display window. The "O" is a symbol for opening contacts.
7. Press the h button (3) to set the hour.
8. Press the m button (4) to set the minute.
9. Press the 1-7 button (5) to advance the indicator bar (14) from 1 to 7 and back to 1. Press the Q button (7) when the indicator is under the desired day number.
10. To enter the complete program, press the Pr button (8). If all program requirements have been satisfied, the display returns to the time of day. If the program requirements are not met, the display of the section that needs correction flashes on and off.

    To enter more programs, repeat the ten-step procedure. A maximum of ten programs can be entered.

    The word "Full" appears in the display when the memory is full.

    If the I/O button (2) is pressed and no program is to be entered, press the Ch button (6) and then the Pr button (8) to get out of the program mode.

To check the programs:

1. Press the Ch button (6). An "I" (12) and an "O" (15) are displayed.
2. Press the Ch button (6) again. The contact closing and contact opening information for the first program is displayed.
3. Continued pressing of the Ch button (6) causes the display to sequence through all of the programs in memory. If ten programs have been entered, the word "Full" appears after the tenth program display.
4. Press the Pr button (8) to return to the time-of-day display.

To change (edit) a program:

1. Press the Ch button (6) until the program you want to change appears in the display window.
2. Press the I/O button (2) to select contact closing or contact opening time.
3. Press the h (3), m (4), or 1-7 (5) and Q (7) buttons to change the hour, minute, or day.
4. Press the Pr button (8) to enter the edited program and return to the time-of-day display.

To erase (clear) a program:

1. Press the Ch button (6) until the program to be erased is displayed.
2. Press the C button (10) with a ball point pen to clear the program.
3. Press the Pr button (8) to return to the time-of-day display.

Two-Wire Starting

The starting circuit is a basic supervisory function of the electronic control.

Although the logic is more involved, the two-wire starting circuit can be thought of as a single-pole, single-throw switch. A closed switch signals the generator set to start. An open switch signals the electric generator set to stop.

The two-wire start circuit uses terminals B+, GND (ground), and RMT of terminal block TB2 (Figure 5-5). There are two B+ and two RMT terminals on TB2. The upper B+ and RMT terminals are connected to like terminals on unit 2. The lower B+ and RMT terminals are connected to like terminals on unit 1. The TB2 GND terminal is connected to the GND terminals on both units. In some applications, the jumpers between terminals 2 and (upper) B+ and between 7 and (lower) B+ are removed. Refer to the generator set control schematic and to the interconnection wiring diagram.

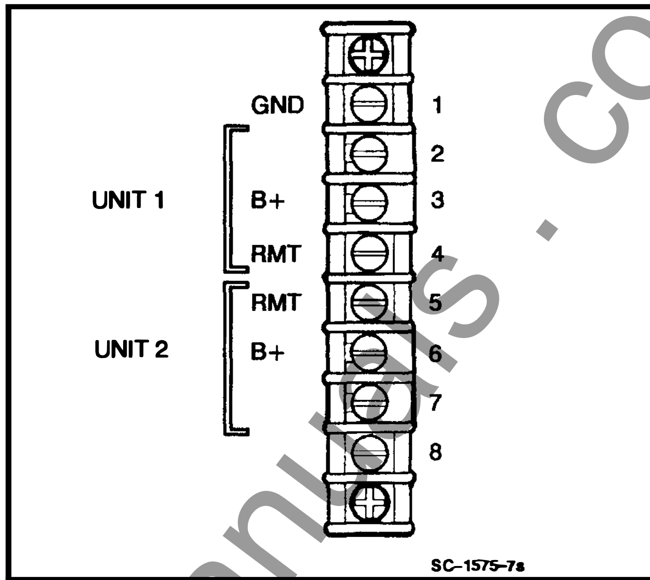


FIGURE 5-5. TWO-WIRE START CONNECTIONS

Three-Wire Starting Option

The optional three-wire starting control (available on 40- to 125-ampere switches only) enables the transfer switch to start and stop a three-wire start generator set. Three-wire starting logic is similar to a single-pole, double-throw switch. A common is closed to one side to send a start signal, and to the opposite side to send a stop signal. In addition to start and stop functions, the control has an overcrank relay, a preheat relay, two Timing lamps, a Lockout Lamp, a Reset Switch, and a Auto/Stop/Handcrank Switch (Figure 5-6). The 3-Wire Start module may be equipped with a preheat timer On-Off switch.

Overcrank occurs when the generator set does not start within the adjustable time limit. In order to protect the starter motor, overcrank relay contacts open the starting circuit and light the Lockout lamp. After a starting problem is corrected, pressing the Overcrank Reset switch resets the circuit. Refer to the Operation Section.

A set of overcrank alarm contacts are also provided. The contacts can be used to energize an external overcrank alarm.

The 3-Wire Start module has two adjustable timers.

The Preheat timer delays the start signal to allow preheating the generator set. The Preheat timer's range of adjustment is 0 to 60 seconds.

If the module has a Preheat On-Off switch, make sure that it is in the correct position.

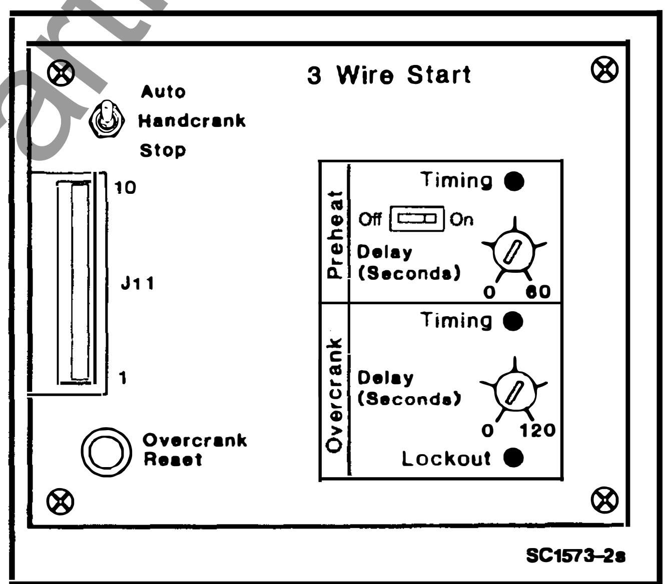


FIGURE 5-6. THREE-WIRE START MODULE

The Overcrank timer limits the time that the generator set starter is allowed to operate. The Overcrank timer's range of adjustment is 0 to 120 seconds.

To set the timers, align the slots on the potentiometers with the desired markings on the faceplate (Figure 5-6).

The Auto/Stop/Handcrank Switch is located on the 3-Wire Start module. This switch is the operation selector switch for a three-wire start generator set. The three positions, Auto, Stop, and Handcrank, function as follows:

Auto: Allows the generator set to start and assume the load if a power outage occurs. **This is the normal operating position.**

Stop: Shuts down the generator set and prevents it from starting. **Use this position when servicing the generator set.**

Handcrank: Prevents the automatic transfer switch from starting the generator set, but allows starting and stopping at the set. **Use this position for generator set maintenance.**

The three-wire start circuit uses TB3 terminals 1, 2, 3, 4, and 5 (for unit 2) and terminals 31, 32, 33, 34, and 35 (for unit 1). See Figure 5-7.

TB3 terminals 1, 2, 3, and 4 are connected to terminals on the source 2 generator set as shown in Figure 5-7. With diesel sets that use the preheat circuit, terminal 5 on TB3 is connected to terminal H on the source 2 generator set control.

TB3 terminals 31, 32, 33, and 34 are connected to terminals on the source 1 generator set as shown in Figure 5-7. With diesel sets that use the preheat circuit, terminal 35 on TB3 is connected to terminal H on the source 1 generator set control.

TB3 terminals 6, 7, and 8 (unit 2) and 36, 37, and 38 (unit 1) are for connection to the overcrank alarm contacts. See Figure 5-7. These (form C) contacts are rated for 4 amperes at 125 VAC or 3 amperes at 30 VDC and are provided for customer use.

TB3 terminals 7, 9, and 10 (unit 2) and 37, 39, and 40 (unit 1) are for connection to the generator running contacts. (Terminals 7 and 37 are common to both overcrank alarm and generator running relay contacts.) See Figure 5-7. These (form C) contacts are rated for 4 amperes at 125 VAC or 3 amperes at 30 VDC and are provided for customer use. Refer to sheet 1 of the schematic and wiring diagram package that was shipped with the transfer switch.

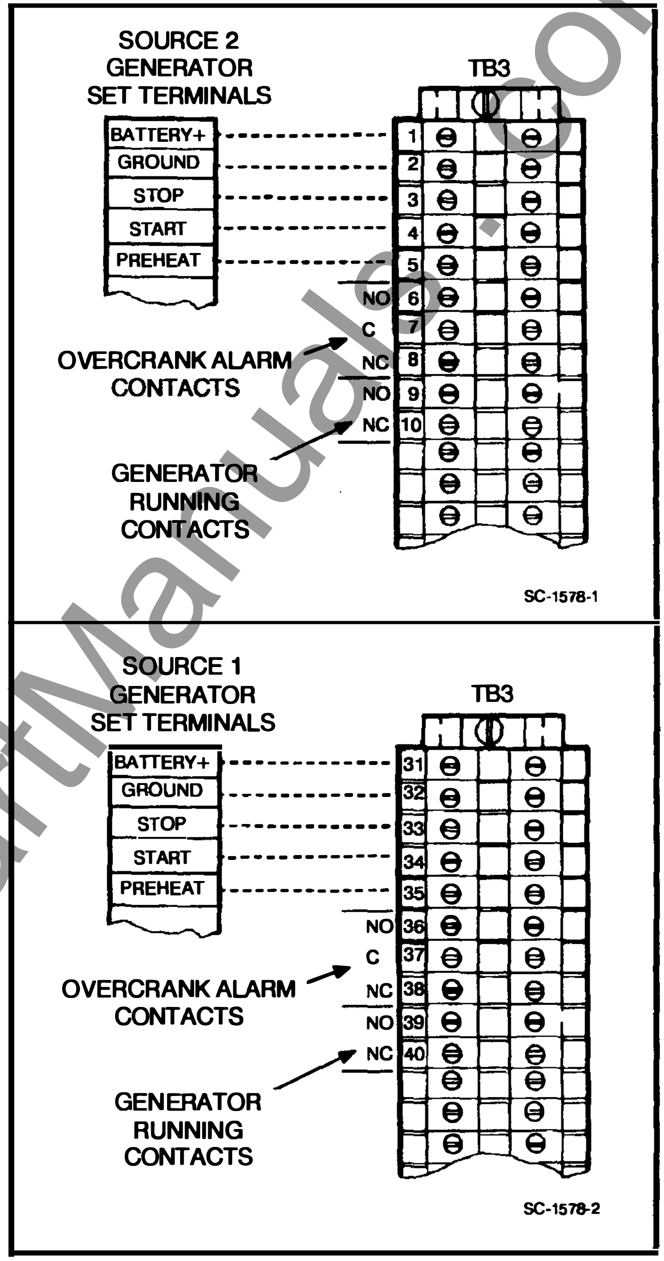


FIGURE 5-7. THREE-WIRE START CONNECTIONS

Programmed Transition Option

The optional Program Transition module (Figure 5-8) is used to introduce a pause during transition. Programmed transition allows the transfer switch to assume a mid-transition position for an adjustable interval of time. In this position, the load is **not** connected to either power source. This feature allows residual voltage from inductive loads to decay to an acceptable level before transfer is completed.

The length of time that the transfer switch is in the midposition can be adjusted from 0 to 7.5 seconds or 0 to 60 seconds, depending on the timer option. The proper adjustment is a function of the load.

To set the time delay, align the slot on the potentiometer with the desired marking on the faceplate (Figure 5-8).

If a time delay is desired, make sure that the Delay/No Delay switch is in the Delay position.

Refer to sheets 2 and 5 of your schematic and wiring diagram package.

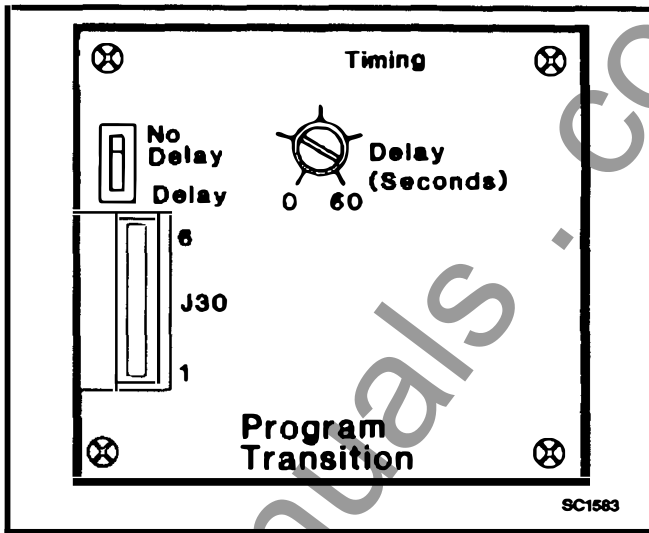


FIGURE 5-8. PROGRAM TRANSITION MODULE

Signal Module Option

The optional Signal Module (Figure 5-9) has one adjustable timer. The Elevator Signal delay controls the timing of two events. It delays transfer/retransfer and energizes the Elevator Transfer Signal relay during the delay period. This time delay is adjustable over a range of 0 to 50 seconds.

A Delay/No Delay switch permits bypassing the timer delay (if it is not needed).

The timing circuit is started by a transfer or a retransfer signal from the time delay module on the Power Sentry mother board.

While the timer is timing, the (form C) Elevator Signal relay is energized and the Timing lamp on the Signal Module is lit. At the end of the time delay, the Elevator Signal relay is de-energized and the switch is allowed to transfer (or retransfer).

There are two other relays (with form C contacts) on the Signal Module:

Genset 1 Running
Genset 2 Running

These relays are not affected by the Elevator Signal delay. They respond directly to signals from the Power Sentry.

The Genset 1 and Genset 2 Running relays are energized when their respective power sources are producing adequate power.

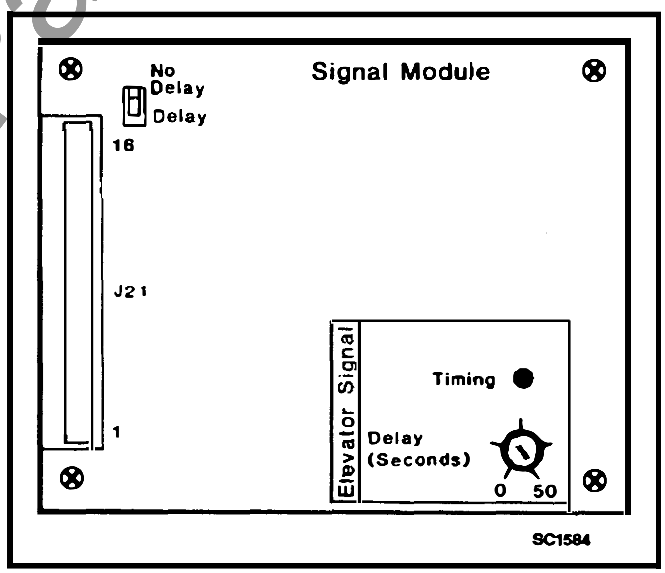


FIGURE 5-9. SIGNAL MODULE

All relay contact connections are made at TB3. Refer to sheet 1 of your schematic and wiring diagram package.

To set the time delay, align the slot on the potentiometer with the desired marking on the faceplate (Figure 5-9).

If a time delay is desired, make sure that the Delay/No Delay switch is in the Delay position.

The Signal Module option is not available on transfer switches that are equipped with 3-Wire Start modules.

Float Battery Charger Option

The optional float-charge battery charger (Figure 5-10) regulates its charge voltage to continuously charge the battery. As the battery approaches full charge, the charging current automatically tapers to zero amperes or to steady-state load on the battery.

There are two chargers available. One battery charger is rated for 10 amperes at 12 or 24 VDC. The other battery charger is rated for 2 amperes at 12 or 24 VDC.

The 2-ampere battery charger has an ammeter to indicate charging current and a fuse to protect the battery charger circuit.

The 10-ampere battery charger has three fuses (two on the AC input and one on the DC output), three fault display LEDs, and an ammeter for indication of charging current.

On the 10-ampere charger, three sets of (form C) alarm contacts (corresponding to the three fault LEDs) are also available. These contacts can be wired by the installer to activate other audible or visual alarms.

Under normal operating conditions, the Low Bat and AC Fail relays are energized and the High Bat relay is de-energized. In response to a Low Bat or AC Fail condition, the appropriate normally energized relay (Low Bat or AC Fail) drops out. In response to a High Bat condition, the normally de-energized High Bat relay is energized.

The alarm contacts are rated for 4 amperes at 120 VAC or 30 VDC. Connections to these contacts are made at terminals 41-42-43 (AC failure), 44-45-46 (high battery voltage), and 47-48-49 (low battery voltage) of TB3 (Figure 5-11).

Refer to sheet 2 of the schematic and wiring diagram package.

The high and low alarm and float voltage adjustments are set at the factory. Adjustment procedures are described in section 2.

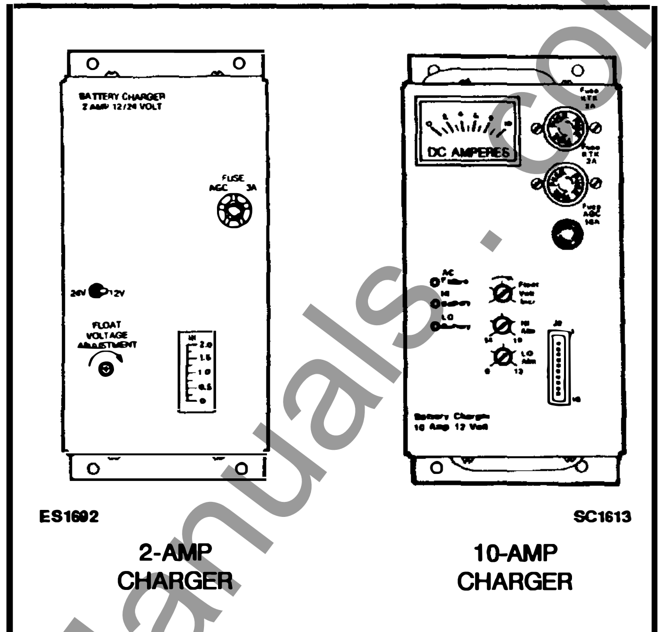


FIGURE 5-10. BATTERY CHARGER

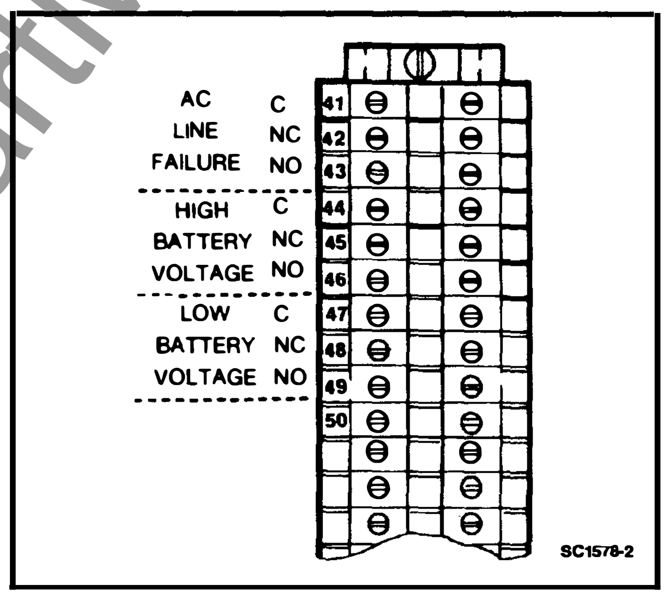


FIGURE 5-11. 10-AMP CHARGER ALARM CONTACTS

Auxiliary Relays Option

Optional auxiliary relays provide contacts for energizing external alarms, remote indicators, and control equipment such as louver motors and water pumps.

Connections to the auxiliary relays are made directly to the relay terminals. The terminals accept wire sizes from one 18 AWG wire to two 12 AWG wires.

There are three types of auxiliary relay coils (12 VDC, 24 VDC, and 24 VAC).

Table 5-1 lists several auxiliary relay options.

All relays have two normally open and two normally closed contacts that are rated for 6 amperes at 600 VAC (Figure 5-12).

The AC relays are energized by the same signals that power the corresponding indicator lamps on the cabinet door.

The Emergency and Normal DC relays are energized to indicate transfer switch position. The Genset Run DC relay is energized only when the 2-wire start signal is present at the RMT terminal of TB2.

Refer to sheet 1 and to the drawings referenced on sheet 3 of your schematic and wiring diagram package.

TABLE 5-1. AUXILIARY RELAY OPTIONS

24 VAC Coil	Installed, Not Wired
24 VAC Coil	Emergency Connected Relay
24 VAC Coil	Normal Connected Relay
24 VAC Coil	Emergency Source Available Relay
24 VAC Coil	Normal Source Available Relay
24 VDC Coil	Installed, Not Wired
24 VDC Coil	Emergency Relay
24 VDC Coil	Normal Relay
24 VDC Coil	Genset Run Relay
12 VDC Coil	Installed, Not Wired
12 VDC Coil	Emergency Relay
12 VDC Coil	Normal Relay
12 VDC Coil	Genset Run Relay

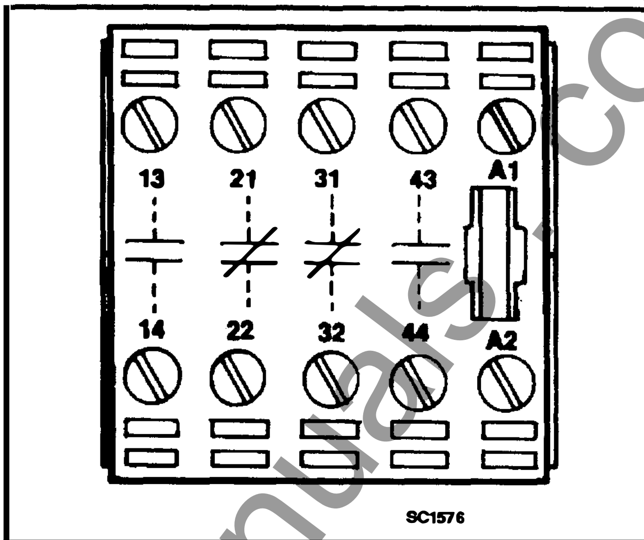


FIGURE 5-12. AUXILIARY RELAYS

Alarm Module Option

The optional alarm module (Figure 5-13) provides an audible indication that the transfer switch has transferred to the source 2 power source.

A push button on the alarm module provides a means to silence the horn.

The Alarm lamp indicates that the transfer switch is in the Source 2 Connected position. If the hom is silenced, the Hom Silenced lamp will also light. Both lamps will stay lit until the transfer switch moves from the Source 2 Connected position to the disconnected (neutral) or Source 1 Connected position.

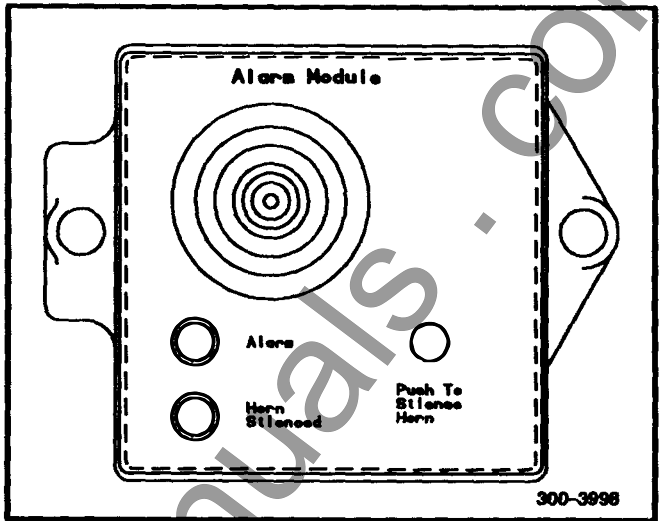


FIGURE 5-13. ALARM MODULE

Standby Set Start Sequencer Option

The optional standby set start sequencer (Figure 5-14) is available (and applicable) only on generator set-to-generator set transfer switches. In dual standby applications, the power cables from two generator sets are connected to the source 1 and source 2 lugs of a generator set-to-generator set transfer switch, which in turn provides power to the generator set source lugs on a utility-to-generator set transfer switch.

The function of the standby set start sequencer is to respond to a remote start signal from the utility-to-generator set transfer switch by directing a start signal from the generator set-to-generator set transfer switch to the RMT start input of the generator set that is selected as the preferred source. The standby set start sequencer permits normal backup set operation if the preferred/active set fails. The sequencer also permits normal changeover clock-initiated operation.

Refer to the system interconnection drawings, if applicable.

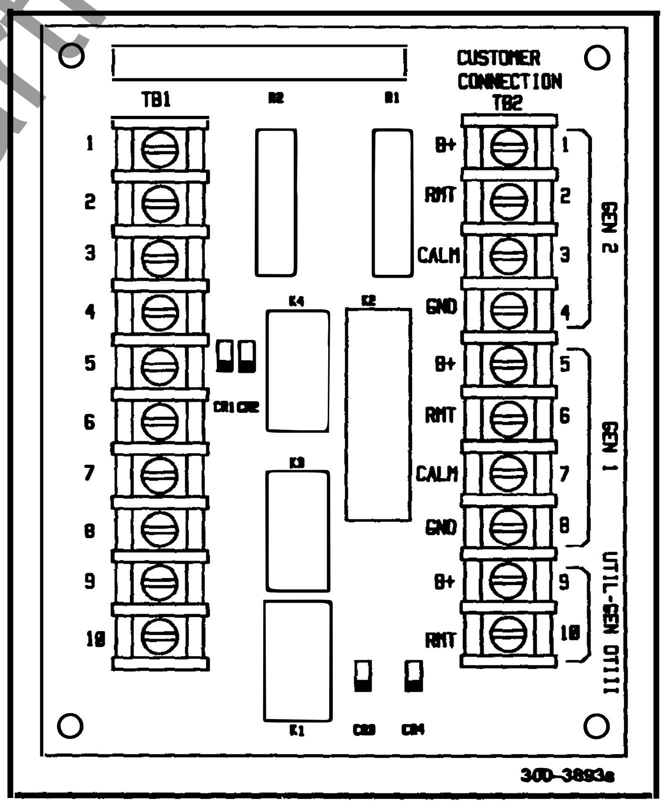


FIGURE 5-14. STANDBY SET START SEQUENCER OPTION

OPERATION

Automatic Operation

The automatic transfer switch is set for automatic operation by placing control switches in the positions given below. The generator set must also be set for automatic operation.

Motor Disconnect Switch (on the Accessory Control Panel) – Auto position.

Source selector switch (on the cabinet door) – Auto position.

Stop/Auto/Handcrank switch (three-wire start) – Auto position.

Operation selector switch on engine control (two-wire start) – Remote position.

Manual Operation

The transfer switch has operator handles for manually transferring the load. Use the following procedure:

WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts whenever the cabinet door is open.***

If possible, remove all AC power to the transfer switch before manually operating the switch. If it is necessary to perform manual operation with AC power connected, follow the "Safety Related Work Practices" listed in NFPA 70E.

1. Open the cabinet door of the automatic transfer switch.
2. Move the Motor Disconnect switch to the Off position.
3. **Transfer - from the Normal (source 1) to the Emergency (source 2) power source:**
   A. Pull the upper manual operator handle down.
   B. Push the lower manual operator handle down.

   Retransfer - from the Emergency (source 2) to the Normal (source 1) power source:
   C. Pull the lower manual operator handle up.
   D. Push the upper manual operator handle up.
4. Before moving the Motor Disconnect switch back to the Auto position, remember the transfer switch will transfer load to the active power source. (If both power sources are available, it will transfer the load to the priority source).

   WARNING ***Automatic transfer switch operation results in rapid movement of the manual operator handles and presents a hazard of severe personal injury. Keep hands clear of the handles when switching back to automatic operation.***
5. Move the Motor Disconnect switch to the Auto position.
6. Close and lock the cabinet door.

Overcrank Reset (3-Wire Start Only)

An overcrank condition exists when the generator set fails to start within the overcrank time limit. When this condition occurs, the Lockout lamp on the 3-Wire Start module will light. To restore the automatic starting circuit:

1. Correct the engine starting problem.
2. Push the Overcrank Reset button inward and release to reset the overcrank relay.

TROUBLESHOOTING

The following procedures describe preliminary troubleshooting checks.

Priority Generator Set Fails, But Backup Generator Set Does Not Start

1. ***Two-wire starting only:*** Check the generator set. The operation selector switch on the generator set control panel should be in the Remote position. Check for fault indicators on the generator set control.

   WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. For this reason; do not touch or allow clothing, tools, or jewelry to contact exposed electrical terminals whenever the cabinet door is open. Make sure you are standing on a dry, insulating surface.***

2. ***Three-wire starting only:*** The Auto/Stop/Handcrank switch on the 3-Wire Start modules should be in the Auto position. Check for overcrank condition. (See Operation Section).
3. Start the generator set using its start-stop controls. (The Auto/Stop/Handcrank switch on the 3-Wire Start module must be in the Handcrank position.) If it does not crank, check the starting battery. If it cranks but does not start, check the fuel supply.

   WARNING ***Ignition of explosive battery gases can cause severe personal injury. Do not smoke or cause any spark or flame while servicing batteries.***

   WARNING ***Ignition of fuel can cause severe personal injury or death by fire or explosion. Do not permit any flame, cigarette, spark, pilot light, arcing equipment, or other possible source of ignition near the fuel system.***

Generator Set Starts When Not Scheduled

1. ***Two-wire starting only:*** The operation selector switch on the generator set control panel should be in the Remote position.

   WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. For this reason; do not touch or allow clothing, tools, or jewelry to contact exposed electrical terminals whenever the cabinet door is open. Make sure you are standing on a dry, insulating surface.***

2. ***Three-wire starting only:*** The Auto/Stop/Handcrank switch on the 3-wire start module should be in the Auto position.
3. Check the source selector switch (on the cabinet door) to make sure it is in the Auto position.
4. Check the change-over clock to verify the change-over schedule. The procedure for checking the change-over program is described under Programming the Change-over Clock.

   If a change-over is incorrectly programmed, refer to the change-over clock programming procedure.

5. Momentary voltage dips can cause voltage sensors to initiate generator set starting.

Generator Set Does Not Start When A Change-over Is Scheduled

1. ***Two-wire starting only:*** The operation selector switch on the generator set control panel should be in the Remote position.

   WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. For this reason; do not touch or allow clothing, tools, or jewelry to contact exposed electrical terminals whenever the cabinet door is open. Make sure you are standing on a dry, insulating surface.***

2. ***Three-wire starting only:*** The Auto/Stop/Handcrank switch on the 3-Wire Start module should be in the Auto position.
3. Check the change-over clock to verify the change-over schedule. The procedure for checking the change-over program is described under Programming the Change-over Clock.

   If a change-over is incorrectly programmed, refer to the change-over clock programming procedure.

4. Start the generator set using its start-stop controls. (The Auto/Stop/Handcrank switch on the 3-Wire Start module must be in the Handcrank position.) If it does not crank, check the starting battery. If it cranks but does not start, check the fuel supply.

WARNING ***Ignition of explosive battery gases can cause severe personal injury. Do not smoke or cause any spark or flame while servicing batteries.***

WARNING ***Ignition of fuel can cause severe personal injury or death by fire or explosion. Do not permit any flame, cigarette, spark, pilot light, arcing equipment, or other possible source of ignition near the fuel system.***

Generator Set Scheduled For Duty Cycle Starts But Does Not Assume Load

1. Has the transfer/retransfer time delay expired?
2. Check the generator set output voltage by observing the voltmeter on the generator set or the optional voltmeter on the automatic transfer switch.
3. Open the cabinet door and check to see if the Motor Disconnect switch is in the Auto position.

WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. For this reason; do not touch or allow clothing, tools, or jewelry to contact exposed electrical terminals whenever the cabinet door is open. Make sure you are standing on a dry, insulating surface.***

4. Check the appropriate Source Available lamp on the Power Sentry.
5. Manually transfer the switch (see Operation).

Generator Set Continues To Run After Completing Duty Cycle

1. Check the position of the generator set operation selector switch. It should be in the Auto (3-wire start) or Remote (2-wire start) position.
2. The stop time delay function may not have expired. Check the Stop Timing lamp on the Power Sentry. If the timer is defective, stop the generator set with its Start/Stop switch.

Battery Charger Fails To Charge

Check the battery charger fuses. Replace, if necessary, with fuses of the correct rating. Fuse Ampere ratings are shown on the charger faceplate.

WARNING ***Ignition of explosive battery gases can cause severe personal injury. Do not smoke or cause any spark or flame while servicing batteries.***

Battery Loses Water

The battery charger float voltage could be too high.

Battery Loses Charge

Battery charger float voltage could be too low.

6. Utility-to-Utility

INTRODUCTION

This section provides information for a transfer switch with an automatic utility-to-utility control. The utility-to-utility control automatically directs transfer of the load from one utility power source to another, providing nearly continuous power.

Much of the information on theory of operation, Power Sentry calibration, and troubleshooting in sections 1, 2, and 3 is applicable. Refer to this section (6) for an overview of the utility-to-utility transfer switch. Refer to the (five sheet) schematic and wiring diagram package that was shipped with the transfer switch for specific information about its configuration.

Section 4 of this manual covers transfer switch assembly service procedures for all configurations.

Transfer Switch Application

Transfer switches are an essential part of a building's standby or emergency power system. The Normal power source (source 1) is backed up by an Emergency power source (source 2). A transfer switch supplies the electrical load with power from one of these two power sources. The load is connected to the common of the transfer switch (Figure 6-1). Under normal conditions, the load is supplied with power from the Normal source (as illustrated). If the Normal power source is interrupted, the load is transferred to the Emergency power source. When Normal power returns, the load is retransferred to the Normal power source. The transfer and retransfer of the load are the two most basic functions of a transfer switch.

Utility-to-Utility Transfer Switches

Utility-to-utility transfer switches, capable of automatic operation without operator involvement, perform the following basic functions:

1. Sense the interruption of the Preferred power source.
2. Transfer the load to the Backup power source.
3. Sense the return of the Preferred power source.
4. Retransfer the load to the Preferred power source.

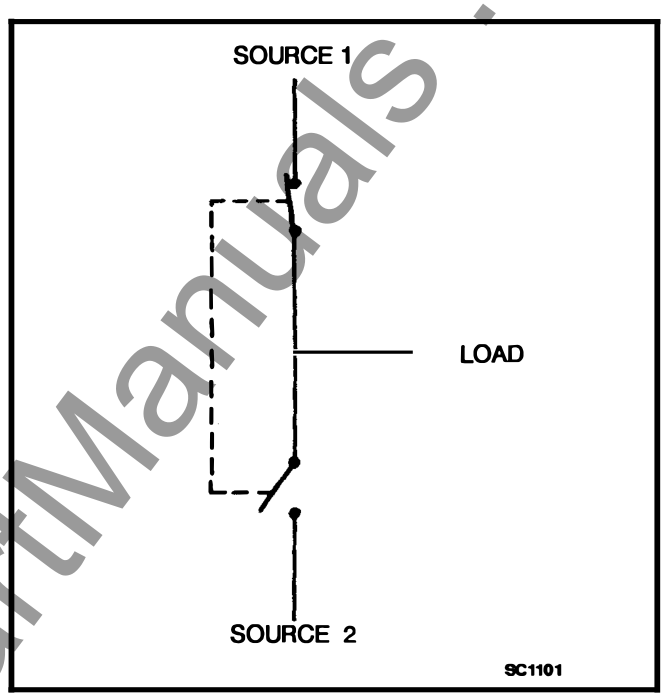


FIGURE 6-1. LOAD TRANSFER SWITCH (TYPICAL FUNCTION)

CABINET

The standard cabinet meets the requirements of the National Electrical Manufacturers Association (NEMA) for a UL Type 1 cabinet. This type is designated as a general-purpose, indoor cabinet. Items on the door of a typical cabinet are shown in Figure 6-2.

Indicator Lamps

There are four indicator lamps on the cabinet door. The Source 1 Available and Source 2 Available lamps are lit whenever their corresponding power sources are producing power. These two lamps can be lit simultaneously.

The Source 1 Connected and Source 2 Connected lamps indicate which power source is connected to the load. Only one of these two lamps can be lit.

Source Selector Switch

This two-position switch is used to select which source is preferred and which source is the backup.

In the Source 1 position, the Normal power source supplies the load power until a power interruption occurs.

In the Source 2 position, the Emergency power source supplies the load power until a power interruption occurs.

Optional Auto/Manual Switch

The optional Auto/Manual switch is used to enable or disable the automatic retransfer function. This switch has two positions. In the Auto position, normal automatic retransfer is enabled. In the Manual position, automatic retransfer (from the non-preferred source back to the preferred source) is disabled; only manual retransfer (using the Preferred Source Selector switch) is possible. In the event of power source failure, however, the Power Sentry control logic will ignore the Auto/Manual switch and initiate retransfer to the other source.

When the optional Auto/Manual switch is installed, the standard Source Selector Switch is replaced with a three-position, spring-return-to-center switch.

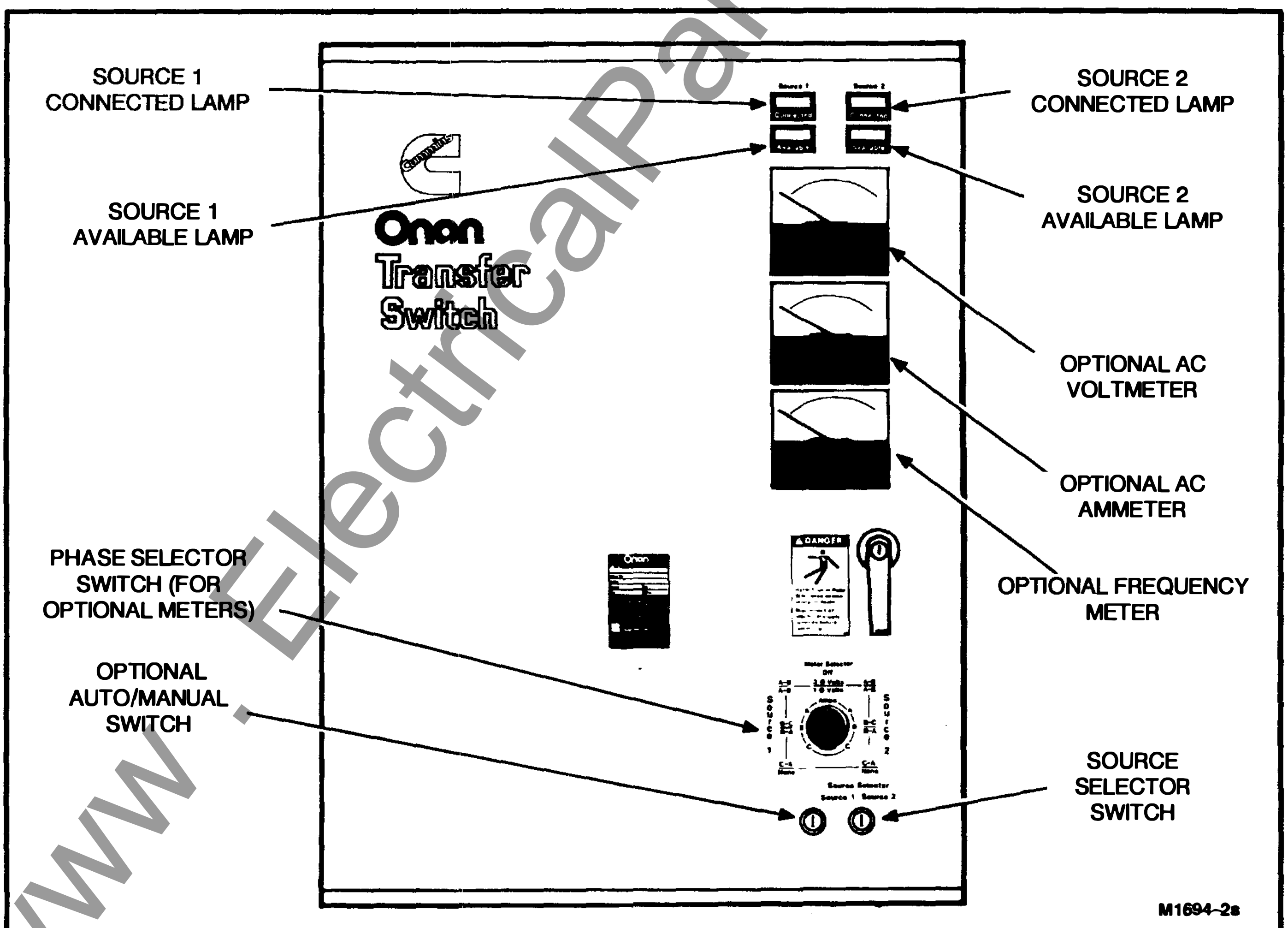


FIGURE 6-2. UTILITY-TO-UTILITY CABINET WITH OPTIONS

Optional Meter Package

The optional meter package includes an AC ammeter, an AC voltmeter, a frequency meter, and a phase selector switch.

AC Voltmeter: The voltmeter measures line-to-line voltage of the selected power source.

AC Ammeter: The ammeter measures the line currents of the load.

Frequency Meter: This meter measures the output frequency of the selected power source in hertz.

Phase Selector Switch: This switch is used to select the source (1 or 2) and phase to be measured.

On transfer switches with an AC ammeter, the load wires must each pass through a current transformer.

TRANSFER SWITCH

The transfer switch (Figure 6-3) opens and closes the contacts that transfer the load between source 1 and source 2 power. The transfer switch is mechanically interlocked to prevent simultaneous closing to both power sources. The main parts of the transfer switch discussed here are the contact assemblies, linear actuator, Motor Disconnect switch, and auxiliary contacts.

Contact Assemblies

The automatic transfer switch has either three or four poles. Three pole transfer switches are provided with a neutral bar. The contact assemblies make and break the current flow. When closed to either the Normal or the Emergency power source, the contacts are mechanically held. A mechanical interlock prevents them from closing to both power sources at the same time.

Linear Actuator

The linear actuator is a linear induction motor that moves the contact assemblies between the Normal (source 1) power source and the Emergency (source 2) power source. Linear actuator operation is initiated automatically with automatic transfer switches. Manual operation of the transfer switch is also possible. Refer to Manual Operation in the *Operation* section.

Motor Disconnect Switch

The Motor Disconnect toggle switch, on the accessory control panel, enables and disables the linear actuator. Place the switch in the Auto position to enable the linear actuator. Place the switch in the Off position to disable the linear actuator.

Auxiliary Contacts

Auxiliary contacts are provided on the Normal and (source 1) and Emergency (source 2) sides of the transfer switch. They are actuated by operation of the transfer switch during transfer and retransfer. The Normal side auxiliary contact switch is actuated when the transfer switch is in the Normal position. The Emergency side auxiliary contact switch is actuated when the transfer switch is in the Emergency position. The auxiliary contacts have current ratings of 10 amperes at 250 VAC. Connections for the auxiliary contacts are made on terminal block TB1. Refer to sheet 1 of your schematic and wiring diagram package.

ELECTRONIC CONTROL SYSTEM

This section describes the standard and optional components of the electronic control system.

WARNING ***Improper calibration or adjustment of electronic control modules can cause death, severe personal injury, and equipment or property damage. Calibration and adjustment of these components must be performed by technically qualified personnel only.***

Power Sentry calibration and adjustment procedures are described in section 2.

The most important component of the electronic control system is the Power Sentry control (Figure 6-3). The Power Sentry includes voltage sensing circuits, time delay circuits and control relays. There are also several adjustment potentiometers and indicator lamps on the Power Sentry. The adjustments must be performed only by qualified service personnel.

WARNING ***Accidental actuation of the linear motor can cause severe personal injury. Disable the motor, as described below, before making any adjustments.***

Place the Motor Disconnect switch (Figure 6-3) in the Off position when making adjustments. Return the switch to the Auto position after adjustments are completed.

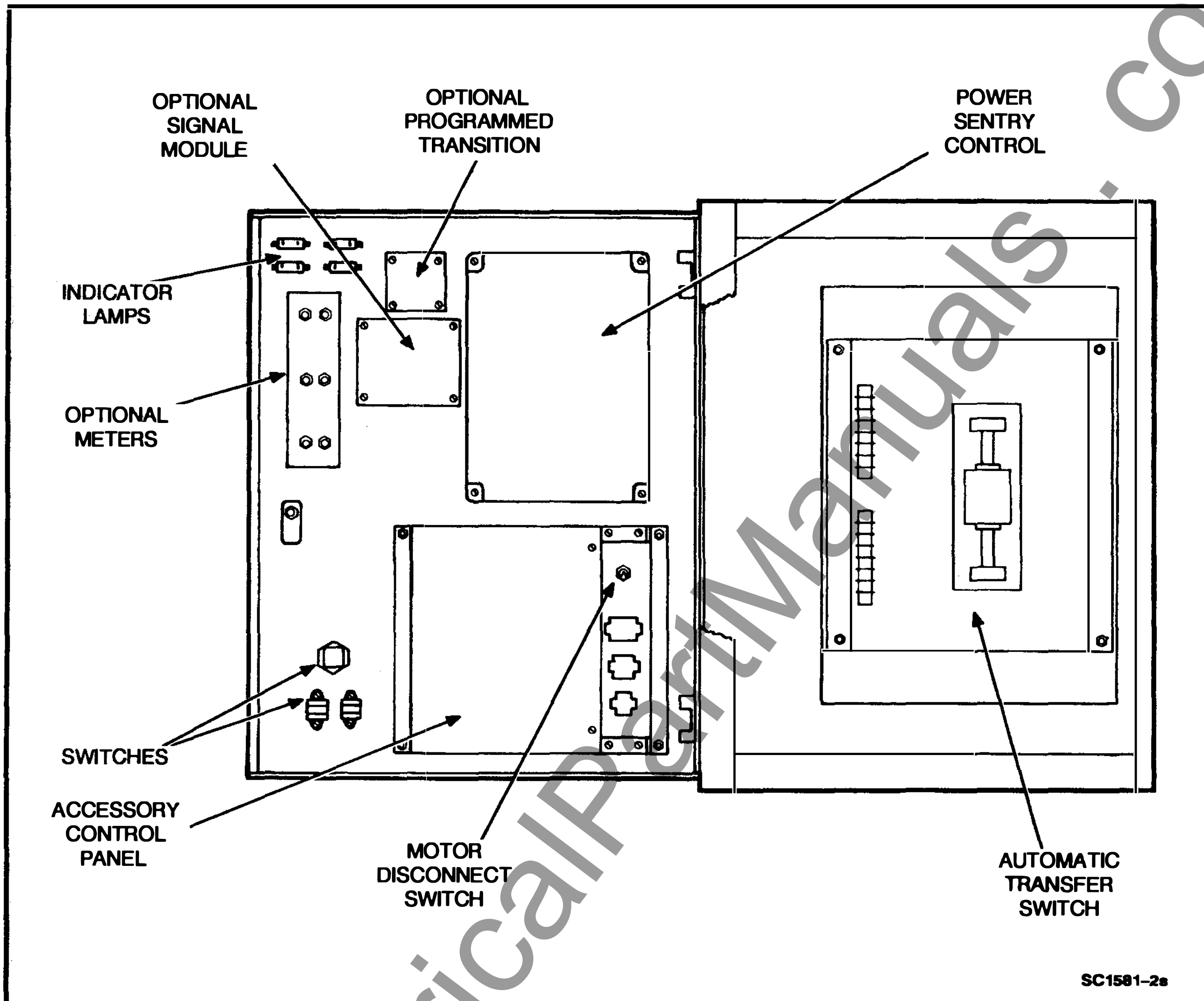


FIGURE 6-3. UTILITY-TO-UTILITY CABINET INTERIOR

Power Sentry Time Delays

Transfer Time Delay: This delay prevents "nuisance" transfers to the backup power source caused by brief line fluctuations. After the delay, the transfer switch transfers the load to the backup power source. It has an adjustable range of 0 to 120 seconds.

To set this time delay, align the slot on the potentiometer with the desired marking on the Power Sentry cover.

Retransfer Time Delay: This delay begins when the preferred source voltage and frequency return. After the delay, the transfer switch can retransfer the load to the preferred source. The delay allows the preferred source to stabilize before retransfer. It has an adjustable range of 0 to 30 minutes.

To set this time delay, align the slot on the potentiometer with the desired marking on the Power Sentry cover.

Undervoltage Sensing

Two voltage sensors, one for the Normal side and one for the Emergency side, monitor source voltages for an undervoltage condition and generate signals, which are sent to the time delay module. If, for example, an undervoltage condition is sensed on the Normal source, the voltage sensor module sends a signal to the time delay module that initiates and controls the transfer of load.

The standard transfer switch has undervoltage sensing for all phases of the Normal and Emergency power sources.

Undervoltage adjustment and calibration procedures are described in section 2.

Overvoltage and Frequency Sensing Option

Overvoltage and frequency sensing are available as a single option.

Overvoltage Sensing: With optional overvoltage sensing, the Normal and Emergency sources are monitored for an overvoltage condition.

As with the standard undervoltage sensing, the voltage sensors signal the time delay module, which controls the transfer or retransfer sequence.

An adjustable time delay (0 to 120 seconds) overrides momentary overshoots in voltage.

To set this time delay, align the slot on the potentiometer with the desired marking on the Power Sentry cover.

Overvoltage adjustment and calibration procedures are described in section 2.

Frequency Sensing: With optional frequency sensing, the Normal and Emergency sources are monitored for variations in frequency. The sensors determine whether the source is within an adjustable bandwidth.

As with the standard undervoltage sensing, the frequency sensors signal the time delay module, which controls the transfer or retransfer sequence.

An adjustable time delay (0 to 15 seconds) allows the control to ignore momentary dips or rises in frequency.

To set this time delay, align the slot on the potentiometer with the desired marking on the Power Sentry cover.

Programmed Transition Option

The optional Program Transition module (Figure 6-4) is used to introduce a pause during transition. Programmed transition allows the transfer switch to assume a mid-transition position, for an adjustable interval of time, when the load is neither connected to the Normal power source nor to the Emergency power source.

This feature allows residual voltage from inductive loads to decay to an acceptable level before transfer is completed. The length of time that the transfer switch is in the midposition can be adjusted from 0 to 7.5 seconds or 0 to 60 seconds, depending on the timer option. The proper adjustment is a function of the load.

To set the time delay, align the slot on the potentiometer with the desired marking on the faceplate (Figure 6-4).

If a time delay is desired, make sure that the Delay/No Delay switch is in the Delay position.

Refer to sheets 2 and 5 of your schematic and wiring diagram package.

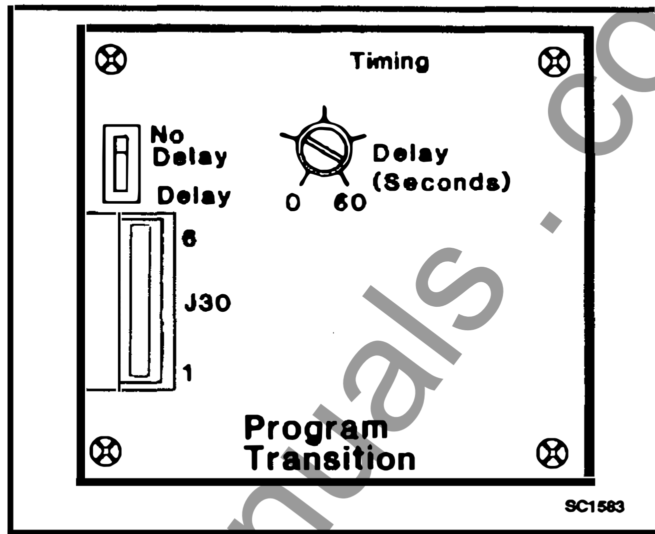


FIGURE 6-4. PROGRAM TRANSITION MODULE

Signal Module Option

The optional Signal Module (Figure 6-5) has one adjustable timer. The Elevator Signal delay controls the timing of two events. It delays transfer/retransfer and energizes the Elevator Transfer Signal relay during the delay period. This time delay is adjustable over a range of 0 to 50 seconds.

A Delay/No Delay switch permits bypassing the timer delay (if it is not needed).

The timing circuit is started by a transfer or a retransfer signal from the time delay module on the Power Sentry mother board.

While the timer is timing, the (form C) Elevator Signal relay is energized and the Timing lamp on the Signal Module is lit. At the end of the time delay, the Elevator Signal relay is de-energized and the switch is allowed to transfer (or retransfer).

There are three other relays (with form-C contacts) on the Signal Module:

Source 1 Available
Source 2 Available
Backup Source Available

These relays are not affected by the Elevator Signal delay. They respond directly to signals from the Power Sentry.

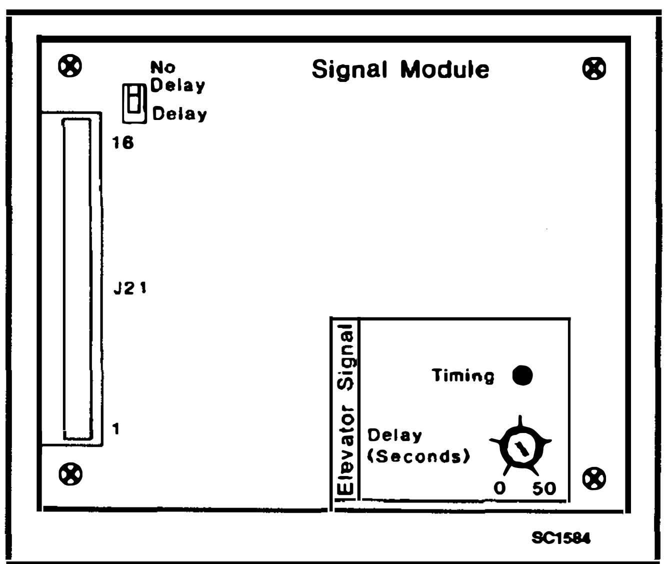


FIGURE 6-5. SIGNAL MODULE

The Source 1 and Source 2 Available relays are energized when their respective power sources are producing adequate power.

In utility-to-utility applications, the Backup Source Available relay is energized whenever the designated backup source is producing adequate power.

All relay contact connections are made at TB3. Refer to sheet 1 of your schematic and wiring diagram package.

To set the time delay, align the slot on the potentiometer with the desired marking on the faceplate (Figure 6-5).

If a time delay is desired, make sure that the Delay/ No Delay switch is in the Delay position.

Auxiliary Relays Option

Optional auxiliary relays provide contacts for energizing external alarms, remote indicators, and control equipment such as louver motors and water pumps.

Connections to the auxiliary relays are made directly to the relay terminals. The terminals accept wire sizes from one 18 AWG wire to two 12 AWG wires.

Table 6-1 lists several auxiliary relay options.

All relays have two normally open and two normally closed contacts that are rated for 6 amperes at 600 VAC (Figure 6-6).

The AC relays are energized by the same signals that power the corresponding indicator lamps on the cabinet door.

Refer to sheet 1 and to the drawings referenced on sheet 3 of your schematic and wiring diagram package.

Alarm Module Option

The optional alarm module (Figure 6-7) provides an audible indication that the transfer switch has transferred to the source 2 power source.

A push button on the alarm module provides a means to silence the horn.

The Alarm lamp indicates that the transfer switch is in the Source 2 Connected position. If the horn is silenced, the Horn Silenced lamp will also light. Both lamps will stay lit until the transfer switch moves from the Source 2 Connected position to the disconnected (neutral) or Source 1 Connected position.

TABLE 6-1. AUXILIARY RELAY OPTIONS

24 VAC Coil	Installed, Not Wired
24 VAC Coil	Emergency Connected Relay
24 VAC Coil	Normal Connected Relay
24 VAC Coil	Emergency Source Available Relay
24 VAC Coil	Normal Source Available Relay

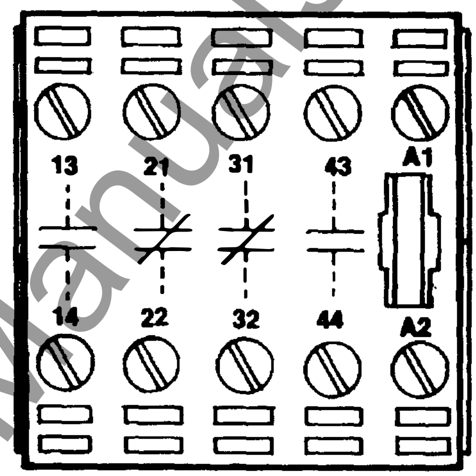


FIGURE 6-6. AUXILIARY RELAYS

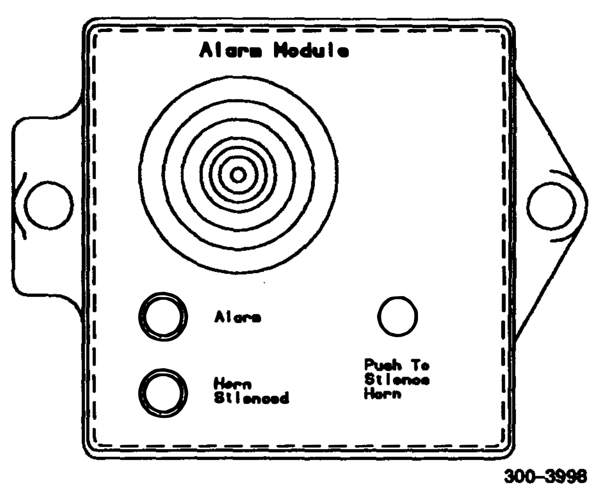


FIGURE 6-7. ALARM MODULE

OPERATION

Automatic Operation

The automatic transfer switch is set for automatic operation by placing the Motor Disconnect switch (on the Accessory Control Panel) in the Auto position.

Place the Source Selector switch in the desired position.

Manual Operation

The transfer switch has operator handles for manually transferring the load. Use the following procedure:

⚠WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts whenever the cabinet door is open.***

If possible, remove all AC power to the transfer switch before manually operating the switch. If it is necessary to perform manual operation with AC power connected, follow the "Safety Related Work Practices" listed in NFPA 70E.

1. Open the cabinet door of the automatic transfer switch.
2. Move the Motor Disconnect switch to the Off position.
3. ***Transfer - from the Normal to the Emergency power source:***
   A. Pull the upper manual operator handle down.
   B. Push the lower manual operator handle down.

   Retransfer - from the Emergency to the Normal power source:

   C. Pull the lower manual operator handle up.
   D. Push the upper manual operator handle up.
4. Before moving the Motor Disconnect switch back to the Auto position, remember the transfer switch will transfer load to the active power source (if both power sources are available, it will transfer the load to the preferred source).

   ⚠WARNING ***Automatic transfer switch operation results in rapid movement of the manual operator handles and presents a hazard of severe personal injury. Keep hands clear of handles when switching back to automatic operation.***
5. Move the Motor Disconnect switch to the Auto position.
6. Close and lock the cabinet door.

TROUBLESHOOTING

The following procedures describe preliminary troubleshooting checks.

⚠WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. For this reason; do not touch or allow clothing, tools, or jewelry to contact exposed electrical terminals whenever the cabinet door is open. Make sure you are standing on a dry, insulating surface.***

Transfer Switch Does Not Transfer Automatically

1. Check the Motor Disconnect switch. It should be in the Auto position.
2. Is the Source Selector switch in the correct position?
3. Has the transfer time delay expired?
4. Has the programmed transition time delay (if equipped) expired?
5. Is backup source voltage sufficient to trigger the backup source voltage sensor?

Transfer Switch Does Not Retransfer Automatically

1. Check the Motor Disconnect switch. It should be in the Auto position.
2. Is the Source Selector switch in the correct position?
3. Has the retransfer time delay expired?
4. Has the programmed transition time delay (if equipped) expired?
5. Is preferred source voltage sufficient to trigger the preferred source voltage sensor?

7. Nonautomatic/Remote

INTRODUCTION

This section provides information for a transfer switch with a nonautomatic/remote control.

Some of the information on theory of operation and troubleshooting in sections 1, 2, and 3 is applicable. Refer to this section (7) for an overview of the nonautomatic/remote transfer switch. Refer to the (five sheet) schematic and wiring diagram package that was shipped with the transfer switch for specific information about its configuration.

Section 4 of this manual covers transfer switch assembly service procedures for all configurations.

Transfer Switch Application

Transfer switches are an essential part of a building's standby (or emergency) power system. The Normal power source, commonly the utility line, is backed up by a Standby power source, often an electric generating set. A transfer switch supplies the electrical load with power from one of these two power sources. The load is connected to the common of the transfer switch (Figure 7-1). Under normal conditions, the load is supplied with power from the Normal source (as illustrated). If the Normal power source must be interrupted, the load is transferred to the Standby power source. When Normal power returns, the load should be retransferred to the Normal power source. The transfer and retransfer of the load are the two most basic functions of a transfer switch.

Operation of a nonautomatic/remote transfer switch is initiated either by an operator at the transfer switch or by an external signal from a remote source.

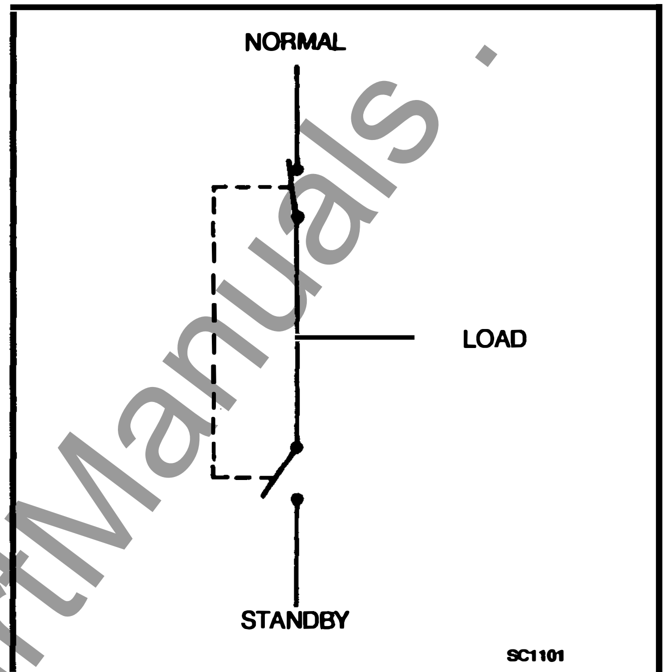


FIGURE 7-1. LOAD TRANSFER SWITCH (TYPICAL FUNCTION)

CABINET

The standard cabinet meets the requirements of the National Electrical Manufacturers Association (NEMA) for a UL Type 1 cabinet. This type is designated as a general-purpose, indoor cabinet. Items on the door of a typical cabinet are shown in Figure 7-2.

Indicator Lamps

There are four indicator lamps on the cabinet door. The Normal Available and Standby Available lamps are lit whenever their corresponding power sources are producing power. These two lamps can be lit simultaneously.

The Normal Connected and Standby Connected lamps indicate which power source is connected to the load. Only one of these two lamps can be lit.

Normal/Standby Switch

This three-position (spring return to center) switch is used to electrically select which source is connected to the load. The Normal position causes the Normal source to be connected. The Standby position causes the Standby source to be connected.

Under electrical control, the transfer switch will connect to a source only if voltage is present at that source.

The Normal/Standby switch controls transfer switch position only when the Local/Remote switch is in the Local position.

Local/Remote Switch

The Local/Remote switch is used to enable the Normal/Standby switch (Local position) or the remote control inputs at TB2 (Remote position).

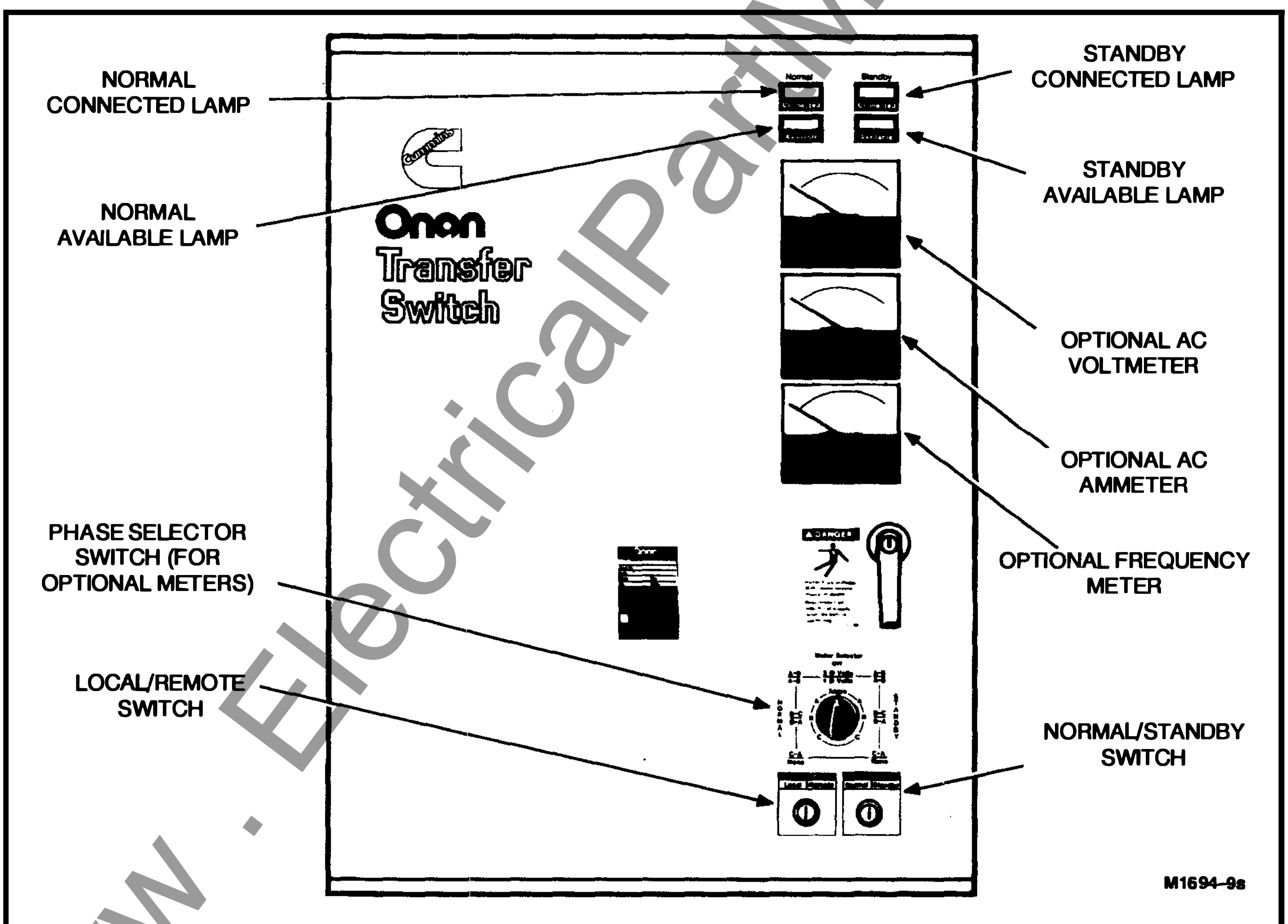


FIGURE 7-2. NONAUTOMATIC/REMOTE CABINET WITH OPTIONS

Optional Meter Package

The optional meter package includes an AC ammeter, an AC voltmeter, a frequency meter, and a phase selector switch.

AC Voltmeter: The voltmeter measures line-to-line voltage of the selected power source.

AC Ammeter: The ammeter measures the line currents of the load.

Frequency Meter: This meter measures the output frequency of the selected power source in hertz.

Phase Selector Switch: This switch is used to select the source and phase to be measured.

On transfer switches with an AC ammeter, the source wires must each pass through a current transformer.

TRANSFER SWITCH

The transfer switch (Figure 7-3) opens and closes the contacts that transfer the load between Normal and Standby power. The transfer switch is mechanically interlocked to prevent simultaneous closing to both power sources. The main parts of the transfer switch discussed here are the contact assemblies, linear actuator, Motor Disconnect switch, and auxiliary contacts.

Contact Assemblies

The automatic transfer switch has either three or four poles. Three pole transfer switches are provided with a neutral bar. The contact assemblies make and break the current flow. When closed to either the Normal or the Standby power source, the contacts are mechanically held. A mechanical interlock prevents them from closing to both power sources at the same time.

Linear Actuator

The linear actuator is a linear induction motor that moves the contact assemblies between the Normal power source and the Standby power source. Normally, linear actuator operation is initiated electrically. Manual operation of the transfer switch is also possible. Refer to Manual Operation in this section.

Motor Disconnect Switch

The Motor Disconnect toggle switch, on the accessory control panel, enables and disables the linear actuator. Place the switch in the Off position for manual operation and in the Auto position for electrical (local/remote) operation.

Auxiliary Contacts

Auxiliary contacts are provided on the Normal and Emergency (Standby) sides of the transfer switch. They are actuated by operation of the transfer switch during transfer and retransfer. The Normal side auxiliary contact switch is actuated when the transfer switch is in the Normal position. The Emergency side auxiliary contact switch is actuated when the transfer switch is in the Emergency position. Connections for the auxiliary contacts are made on terminal block TB1. The contacts have ratings of 10 amperes at 250 VAC. Refer to sheet 1 of your schematic and wiring diagram package.

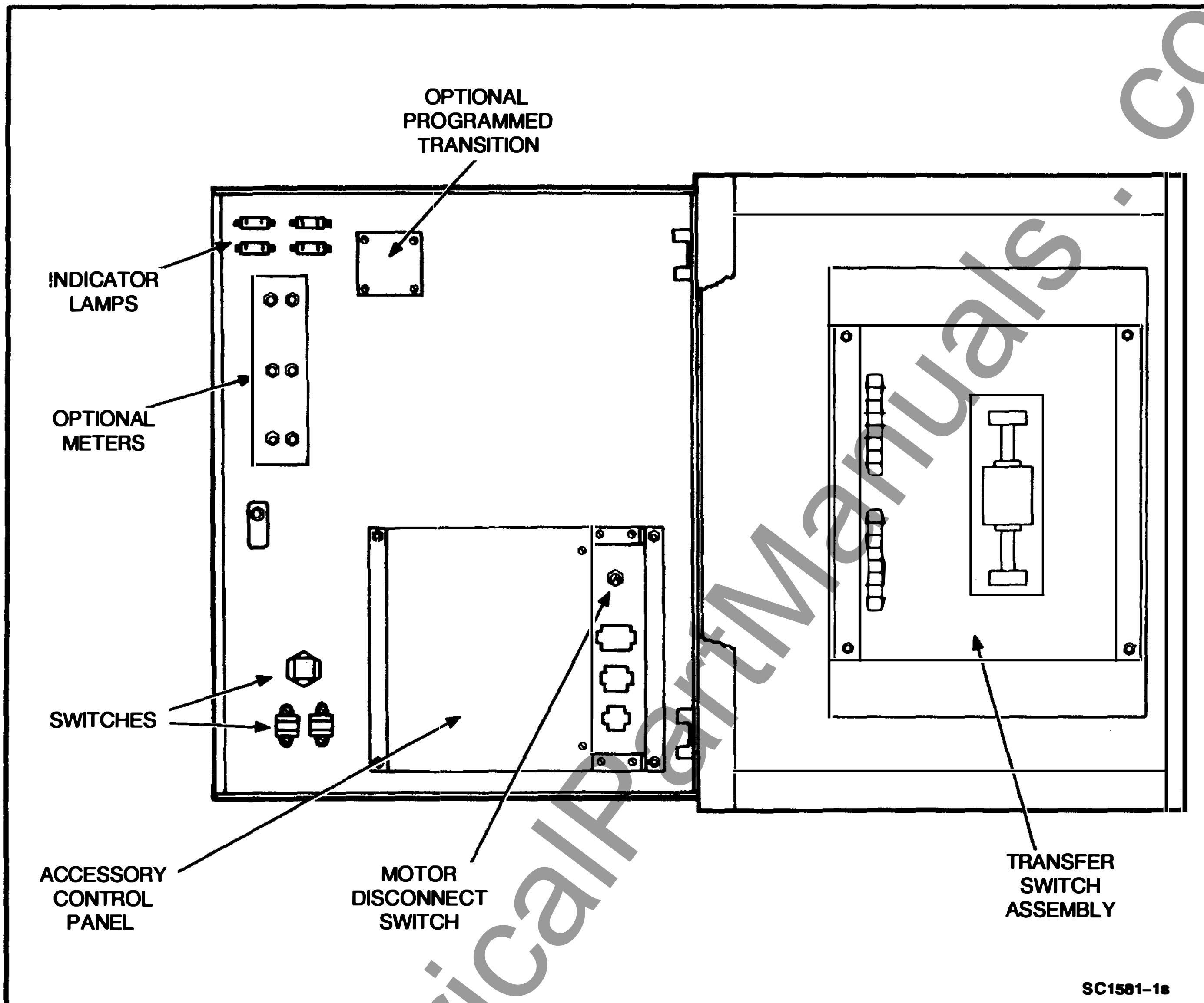


FIGURE 7-3. NONAUTOMATIC/REMOTE CABINET INTERIOR

OPTIONAL CONTROL COMPONENTS

Remote Control Circuit Connections

Remote control circuit connections are made at terminals 1, 2, and 3 of TB2 (Figure 7-4). Closing the contacts across terminals 1 and 2 causes transfer to the Normal source. Closing the contacts across terminals 1 and 3 causes transfer to the Standby source.

Terminal 4 of TB2 is not used. Terminals 5 and 6 of TB2 are used for the transfer inhibit input (with paralleling systems only). For normal operation, there is a jumper across terminals 5 and 6.

Load Shed

The Load Shed function is used to disconnect the load from an available Standby source in order to reduce the power consumed from that source. When the load shed function is initiated, the transfer switch is moved to the neutral position.

The load shed function is initiated by closing a set of normally open contacts across terminals 7 and 8 of TB2.

If the load shed signal is removed, the switch will transfer back to the Standby source if the Standby source is available.

When load shedding is in effect, local or remote selection of Normal power will cause retransfer to the Normal power source if the Normal power source is available.

Refer to sheets 1, 2, and 5 of your schematic and wiring diagram package.

Auxiliary Relays Option

Optional auxiliary relays provide contacts for energizing external alarms, remote indicators, and control equipment such as louver motors and water pumps.

Connections to the auxiliary relays are made directly to the relay terminals. The terminals accept wire sizes from one 18 AWG wire to two 12 AWG wires.

All relays have two normally open and two normally closed contacts that are rated for 6 amperes at 600 VAC (Figure 7-5).

Table 7-1 lists several auxiliary relay options.

The relays are energized by the same signals that power the corresponding indicator lamps on the cabinet door.

Refer to sheet 1 and to the drawings referenced on sheet 3 of your schematic and wiring diagram package.

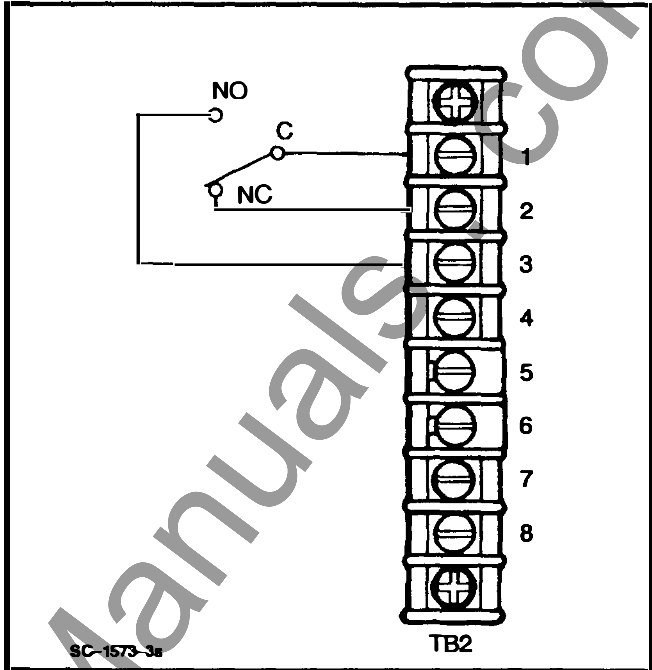


FIGURE 7-4. REMOTE CONTROL CONNECTIONS

TABLE 7-1. AUXILIARY RELAY OPTIONS

24 VAC Coil	Installed, Not Wired
24 VAC Coil	Emergency Connected Relay
24 VAC Coil	Normal Connected Relay
24 VAC Coil	Emergency Source Available Relay
24 VAC Coil	Normal Source Available Relay

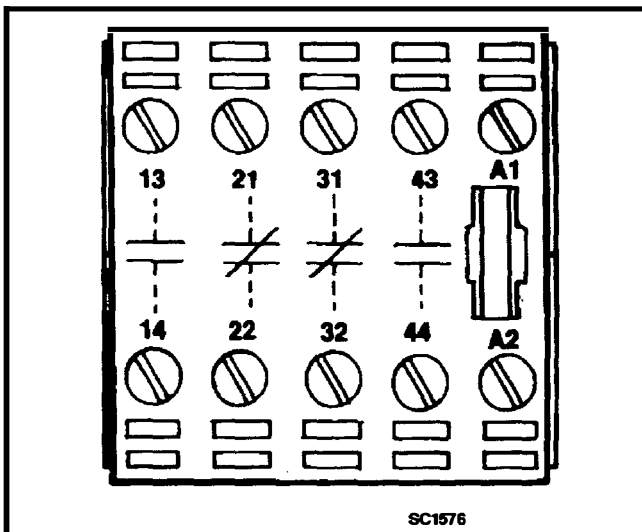


FIGURE 7-5. AUXILIARY RELAYS

Programmed Transition Option

The optional Program Transition module (Figure 7-6) is used to introduce a pause during transition. Programmed transition is the capability of the transfer switch to assume a mid-transition position, for an adjustable interval of time, when the load is neither connected to the Normal power source nor to the Standby power source.

This feature allows residual voltage from motor loads to decay to an acceptable level before transfer is completed. The length of time that the transfer switch is in the midposition can be adjusted from 0 to 7.5 seconds or 0 to 60 seconds, depending on the timer option. The proper adjustment is a function of the motor and its connected load.

To set the time delay, align the slot on the potentiometer with the desired marking on the faceplate. If a time delay is desired, make sure that the Delay/ No Delay switch is in the Delay position.

Refer to sheets 2 and 5 of your schematic and wiring diagram package.

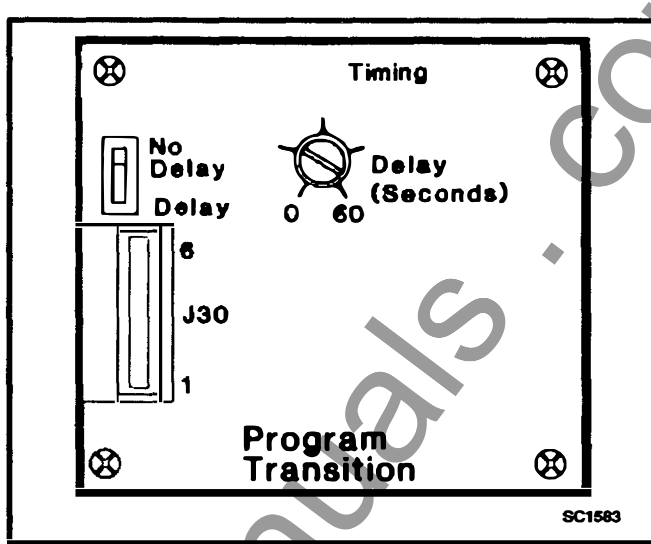


FIGURE 7-6. PROGRAM TRANSITION MODULE

Alarm Module Option

The optional alarm module (Figure 7-7) provides an audible indication that the transfer switch has transferred to the Standby power source.

A push button on the alarm module provides a means to silence the horn.

The Alarm lamp indicates that the transfer switch is in the Standby Connected position. If the horn is silenced, the Horn Silenced lamp will also light. Both lamps will stay lit until the transfer switch moves from the Standby Connected position to the disconnected (neutral) or Normal Connected position.

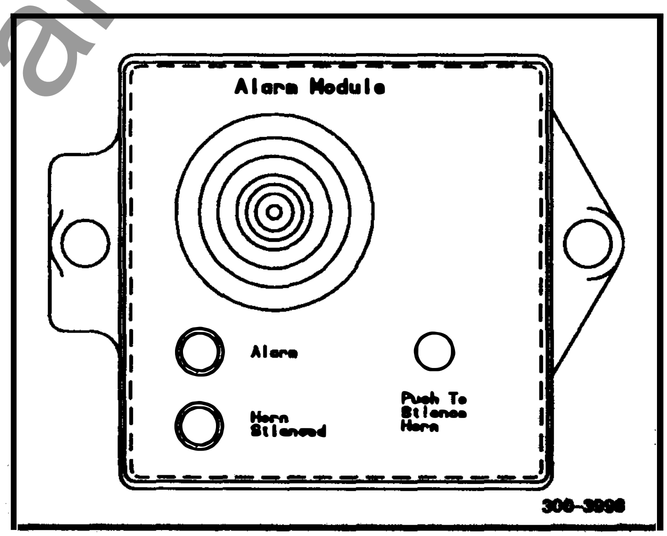


FIGURE 7-7. ALARM MODULE

OPERATION

Local Operation

WARNING ***Transfer switch operation results in rapid movement of the manual operator handles and presents a hazard of severe personal injury. Keep the cabinet door closed.***

To set the transfer switch for local operation:

1. Place the Local/Remote switch in the Local position.
2. Place the Motor Disconnect switch (on the Accessory Control Panel) in the Auto position.

To transfer the load to the Standby source:

1. Check that the Standby Available lamp is lit. (The transfer switch will only permit transfer to the Standby source if the Standby source voltage is available.)
2. Move the Normal/Standby switch to the Standby position and hold it there until the Standby Connected lamp is lit.

To transfer the load to the Normal source:

1. Check that the Normal Available lamp is lit. (The transfer switch will only permit transfer to the Normal source if the Normal source voltage is available.)
2. Move the Normal/Standby switch to the Normal position and hold it there until the Normal Connected lamp is lit.

Remote Operation

WARNING ***Transfer switch operation results in rapid movement of the manual operator handles and presents a hazard of severe personal injury. Keep the cabinet door closed during remote operation.***

To set the transfer switch for remote operation:

1. Place the Local/Remote switch in the Remote position.
2. Place the Motor Disconnect switch (on the Accessory Control Panel) in the Auto position.
3. Close and lock the cabinet door.

Remotely controlled transfer to the Standby source is accomplished by closing a set of normally open contacts that are connected across terminals 1 and 3 of TB2.

The contacts must be held closed until transfer is complete.

Remotely controlled retransfer to the Normal source is accomplished by closing a set of normally open contacts that are connected across terminals 1 and 2 of TB2.

The contacts must be held closed until transfer is complete.

As with local operation, the transfer switch permits transfer and retransfer only when the selected source voltage is present.

Manual Operation

The transfer switch has operator handles for manually transferring the load. Use the following procedure:

WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts whenever the cabinet door is open.***

If possible, remove all AC power to the transfer switch before manually operating the switch. If it is necessary to perform manual operation with AC power connected, follow the "Safety Related Work Practices" listed in NFPA 70E.

1. Place the Local/Remote switch in the Local position.
2. Open the cabinet door of the transfer switch.
3. Move the Motor Disconnect switch to the Off position.
4. ***Transfer - from the Normal to the Standby power source:***
   A. Pull the upper manual operator handle down.
   B. Push the lower manual operator handle down.

   Retransfer - from the Emergency to the Normal power source:

   C. Pull the lower manual operator handle up.
   D. Push the upper manual operator handle up.

   WARNING ***Transfer switch operation results in rapid movement of the manual operator handles and presents a hazard of severe personal injury. Keep hands clear of handles when switching back to Auto.***
5. To return to electrical operation, move the Motor Disconnect switch to the Auto position.
6. Close and lock the cabinet door.
7. If remote control operation is being used, place the Local/Remote switch in the Remote position.

TROUBLESHOOTING

The following procedures describe preliminary troubleshooting checks.

⚠WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. For this reason; do not touch or allow clothing, tools, or jewelry to contact exposed electrical terminals whenever the cabinet door is open. Make sure you are standing on a dry, insulating surface.***

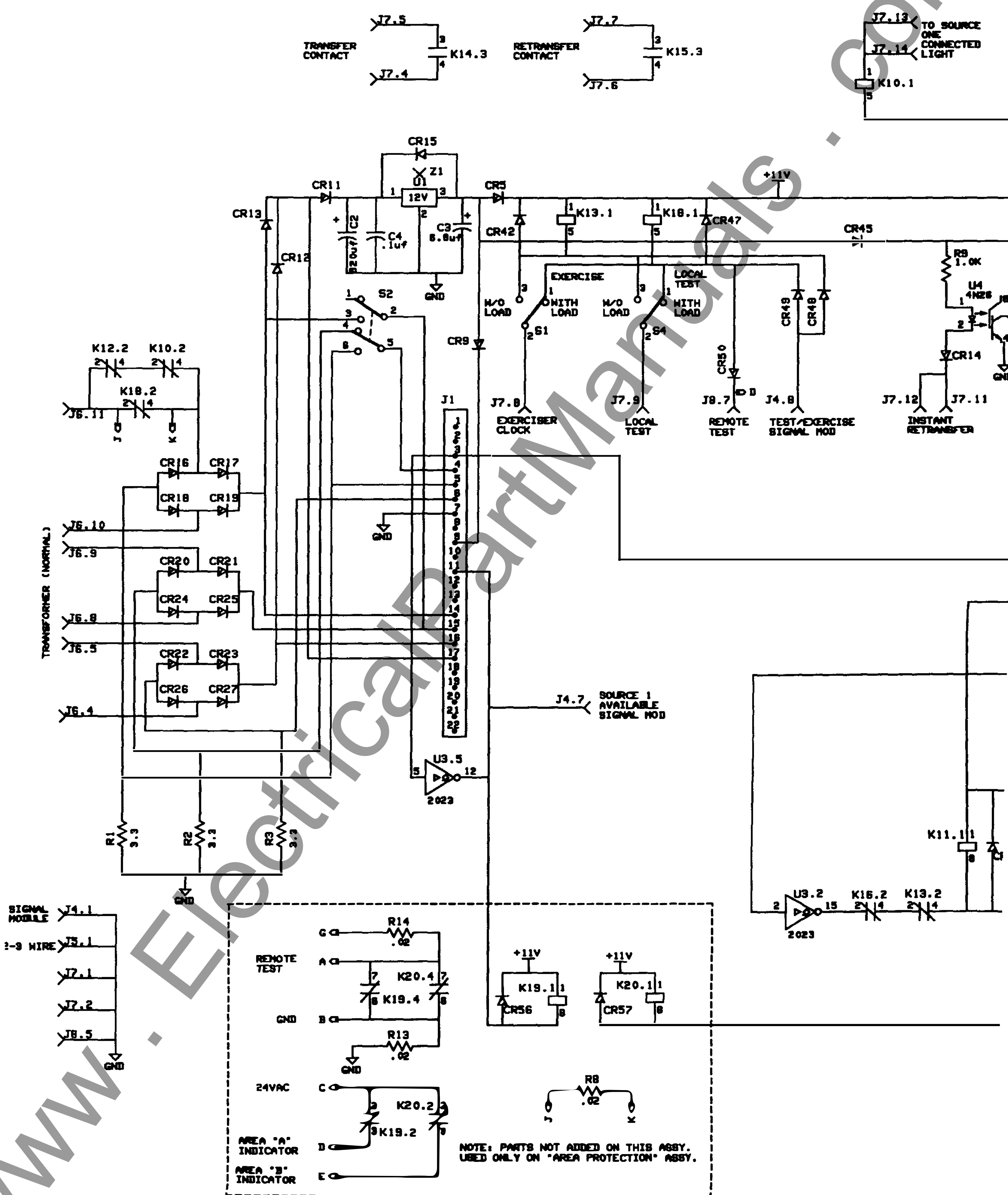
Transfer Switch Does Not Transfer To The Standby Source

1. Check the Motor Disconnect switch. It should be in the Auto position.
2. Are the Local/Remote and Normal/Standby switches in the correct positions?
3. Has the programmed transition time delay (if equipped) expired?
4. Is the Standby source voltage present? Check the Standby Available lamp. Check the Standby source voltage.
5. Manually transfer the switch (see Operation).

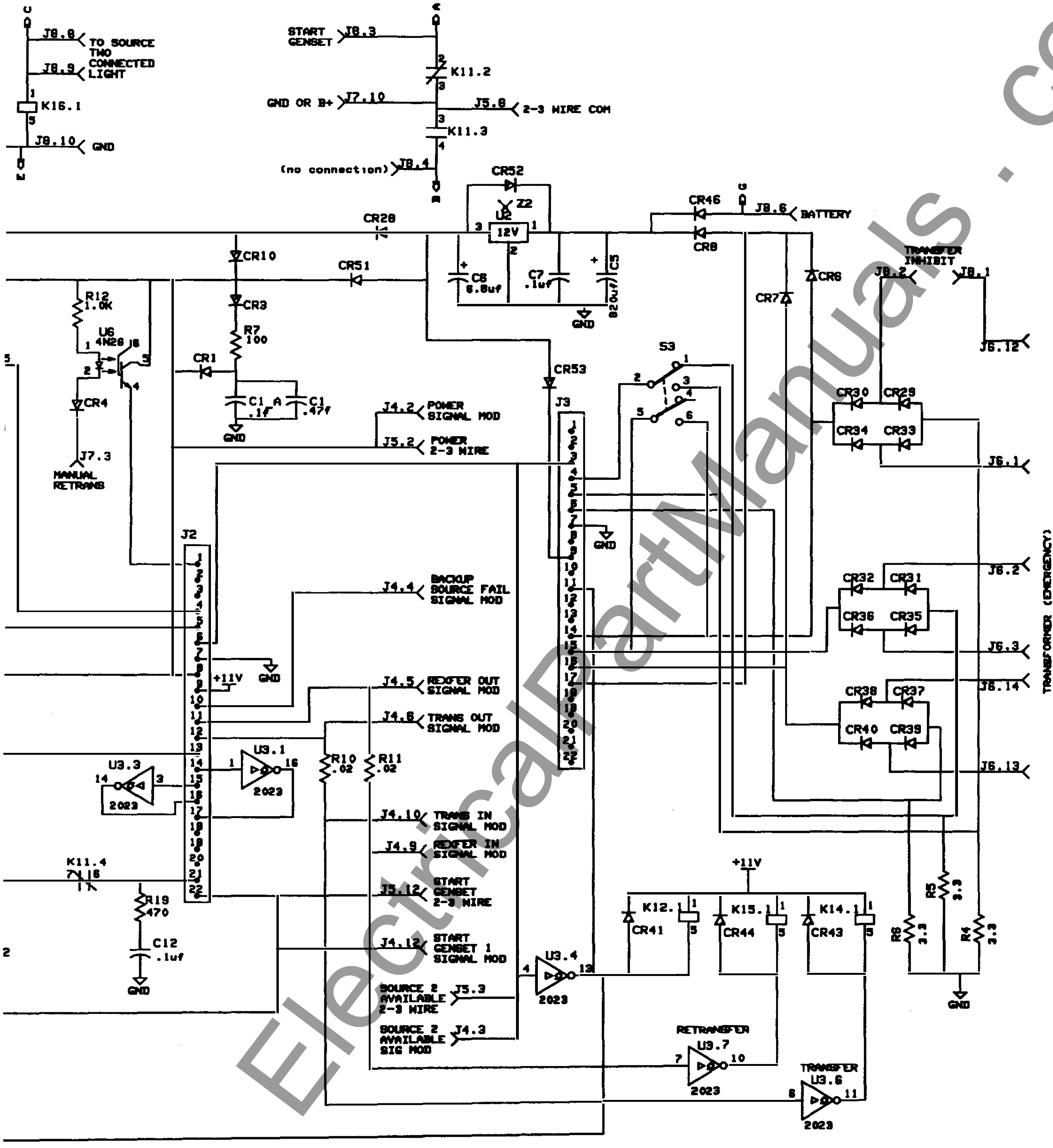
Transfer Switch Does Not Retransfer To The Normal Source

1. Check the Motor Disconnect switch. It should be in the Auto position.
2. Are the Local/Remote and Normal/Standby switches in the correct positions?
3. Has the programmed transition time delay (if equipped) expired?
4. Is the Normal source voltage present? Check the Normal Available lamp. Check the Normal source voltage.
5. Manually retransfer the switch (see Operation).

8. Schematics



SCHEMATIC OF MOTHERBOARD 300-3953 (UTILITY-TO-GENERATOR SET)



300-3953

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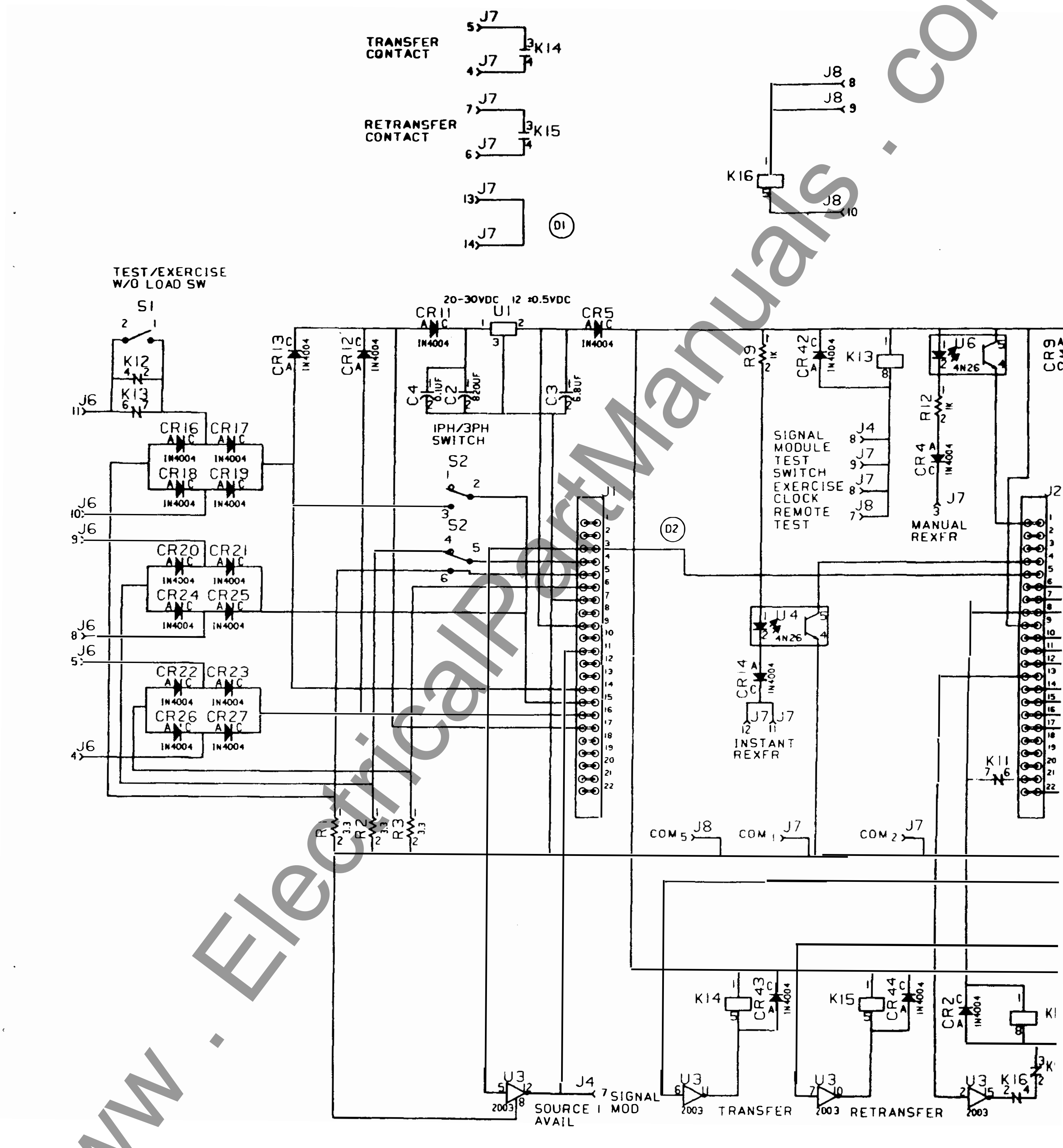
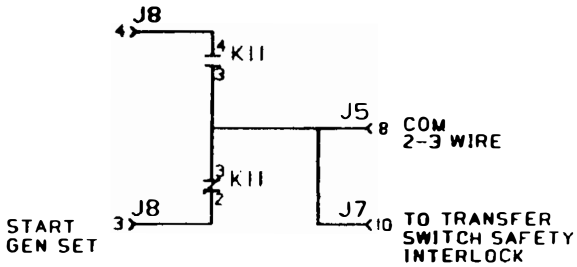


SCHEMATIC OF MOTHER BOARD 300-3090 (UTILITY-TO-GENERATOR SET)



300-3090

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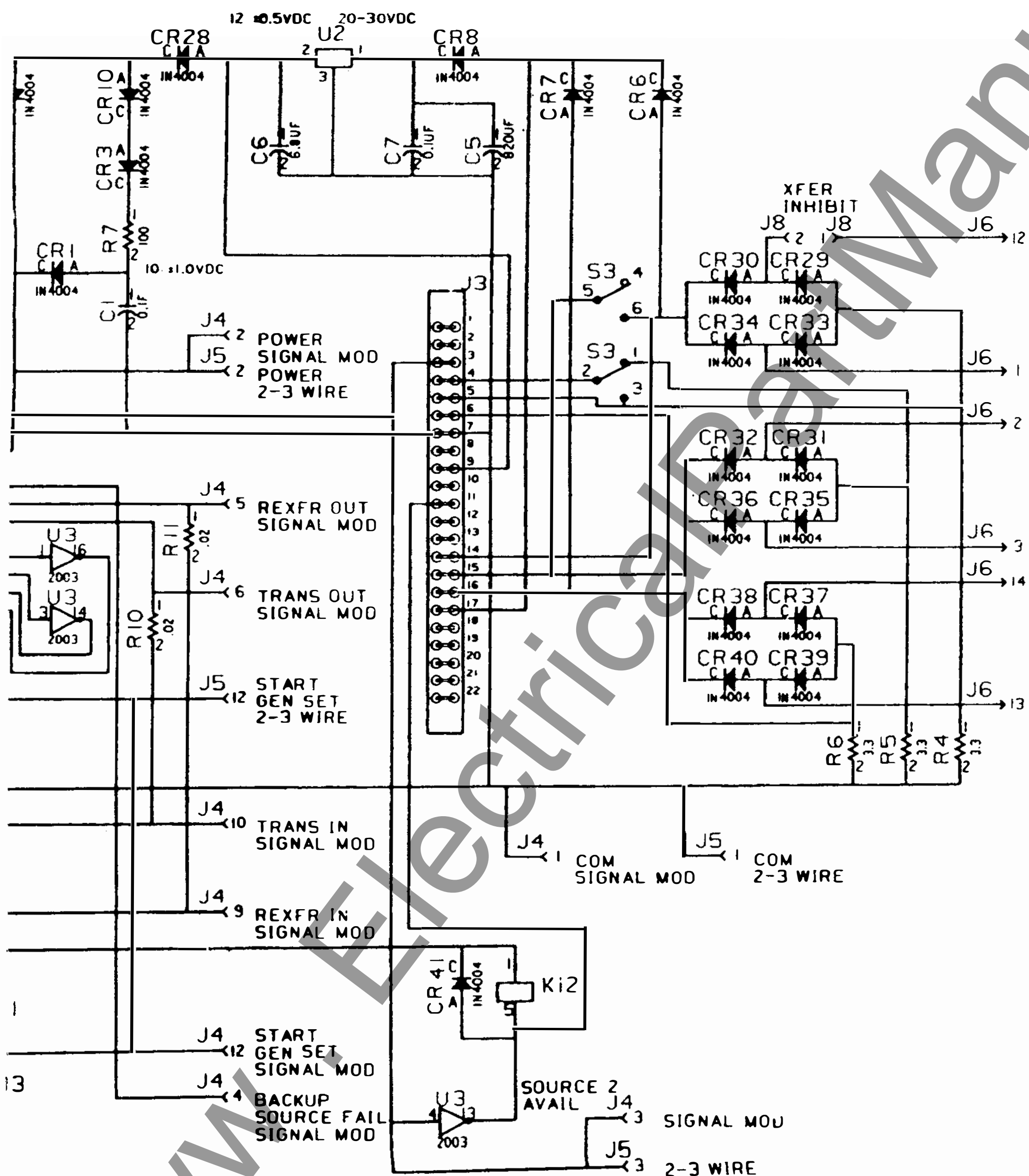
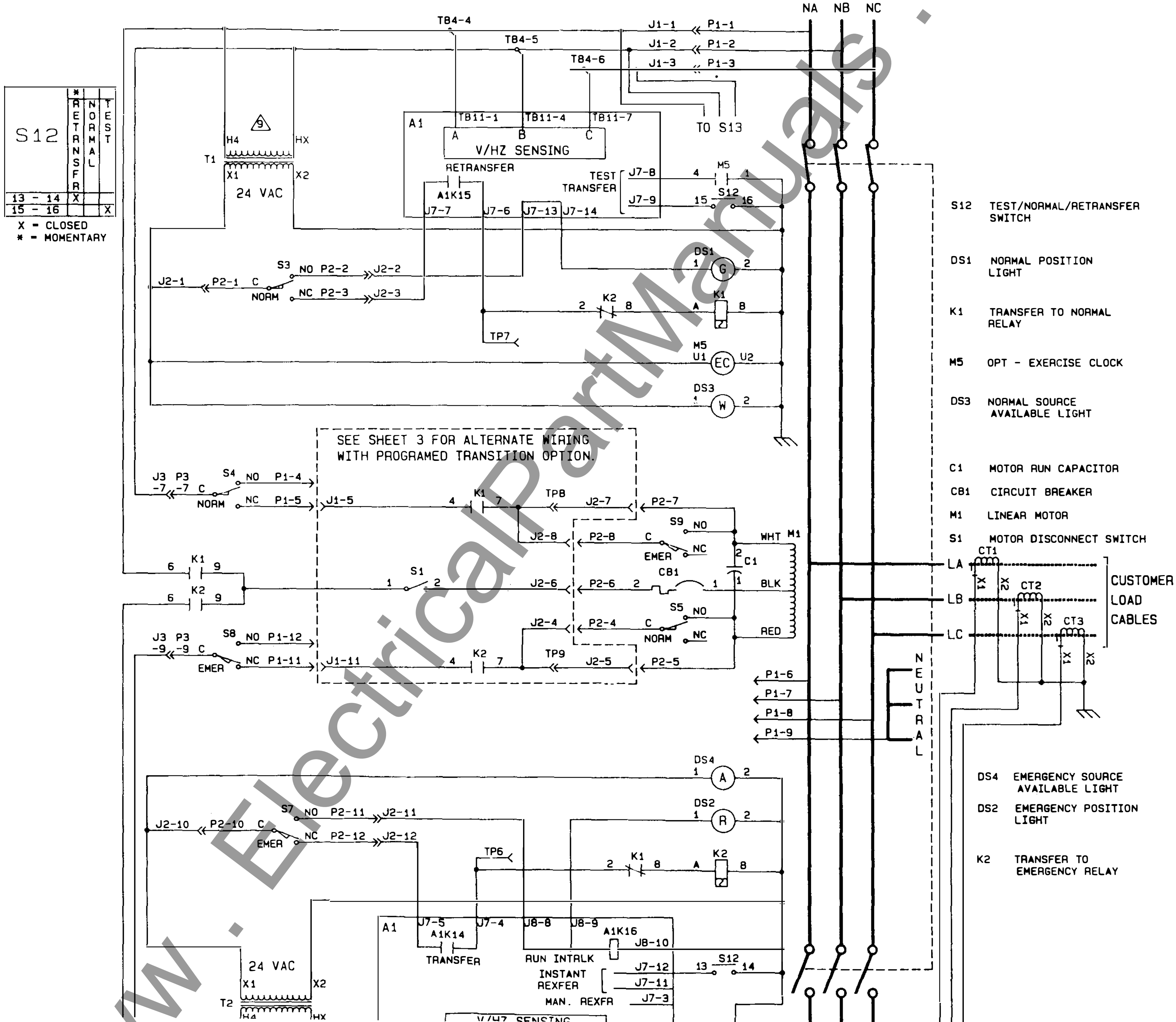
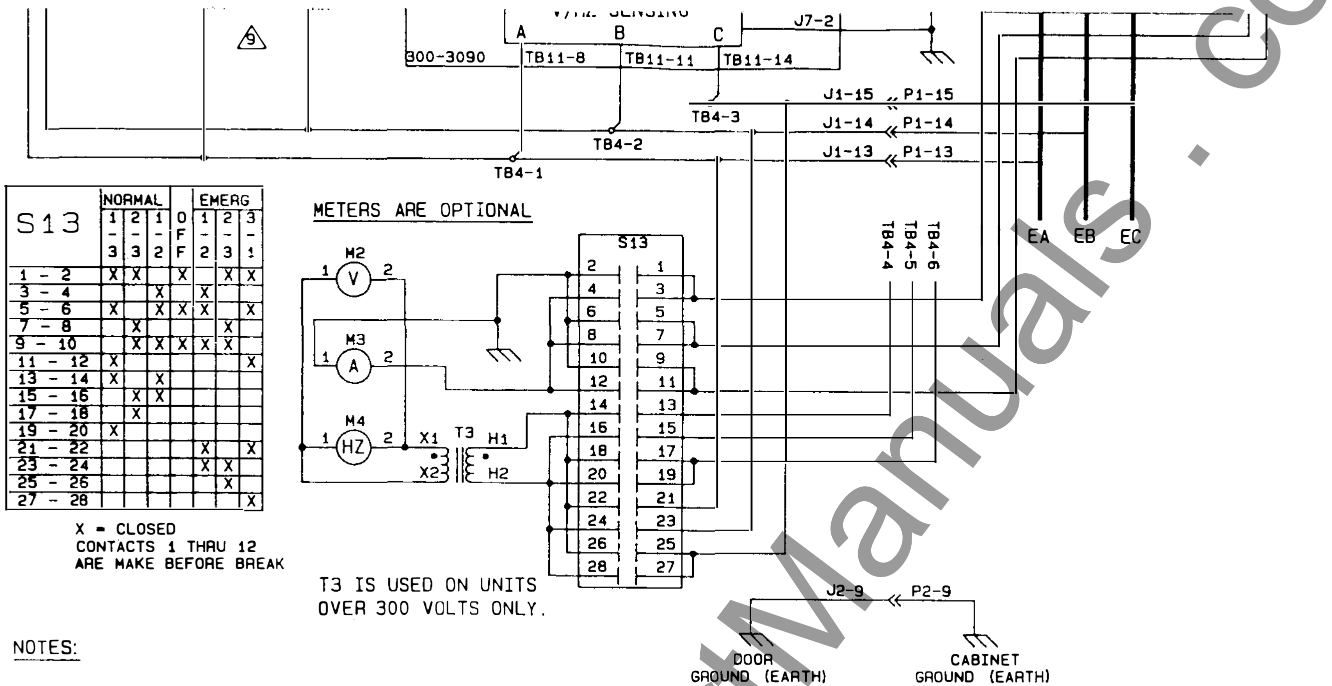


ES1973s


S12
RETRANSFR*
NORMAL
TEST
13 - 14
15 - 16
X = CLOSED
* = MOMENTARY
SEE SHEET 3 FOR ALTERNATE WIRING WITH PROGRAMED TRANSITION OPTION.
S12 TEST/NORMAL/RETRANSFER SWITCH
DS1 NORMAL POSITION LIGHT
K1 TRANSFER TO NORMAL RELAY
M5 OPT - EXERCISE CLOCK
DS3 NORMAL SOURCE AVAILABLE LIGHT
C1 MOTOR RUN CAPACITOR
CB1 CIRCUIT BREAKER
M1 LINEAR MOTOR
S1 MOTOR DISCONNECT SWITCH
CUSTOMER LOAD CABLES
NEUTRAL
DS4 EMERGENCY SOURCE AVAILABLE LIGHT
DS2 EMERGENCY POSITION LIGHT
K2 TRANSFER TO EMERGENCY RELAY
V/HZ SENSING
24 VAC
TO S13
RETRANSFER
TEST TRANSFER
TRANSFER
RUN INTRLK
INSTANT REXFER
MAN. REXFR



S13	NORMAL 1-3	NORMAL 2-3	NORMAL 1-2	OFF	EMERG 1-2	EMERG 2-3	EMERG 3-1
1 - 2	X	X		X		X	X
3 - 4			X		X		
5 - 6	X		X	X	X		X
7 - 8		X				X	
9 - 10		X	X	X	X	X	
11 - 12	X						X
13 - 14	X		X				
15 - 16		X	X				
17 - 18		X					
19 - 20	X						
21 - 22					X		X
23 - 24					X	X	
25 - 26						X	
27 - 28							X

X = CLOSED
CONTACTS 1 THRU 12
ARE MAKE BEFORE BREAK

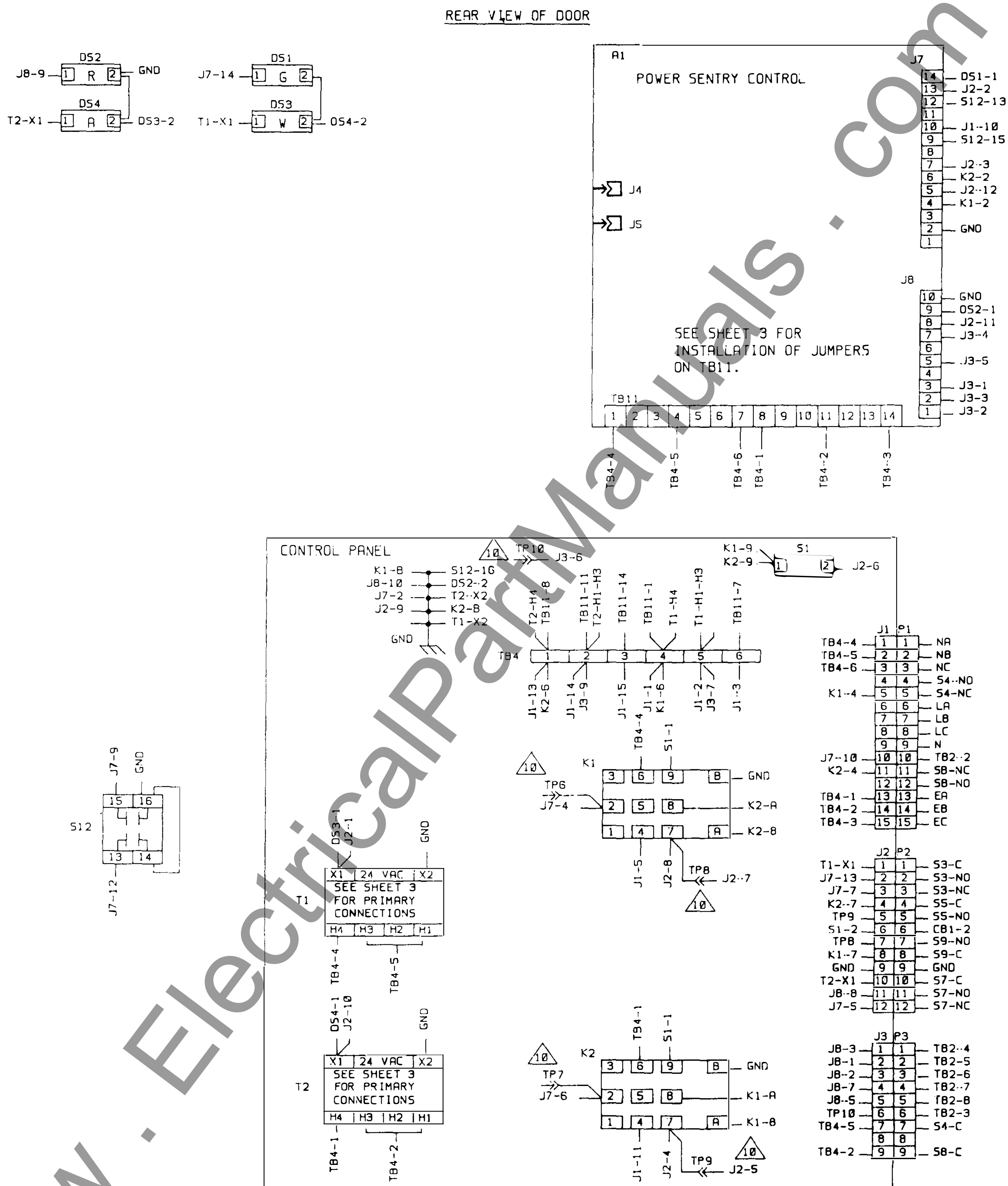
NOTES:

B. ALL DEVICES ARE SHOWN DE-ENERGIZED AND WITH THE TRANSFER SWITCH CLOSED TO NORMAL.

9 SEE SHEET 3 FOR PRIMARY CONNECTIONS.

THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC / WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE 5-SHEET SCHEMATIC AND WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR TRANSFER SWITCH.

626-1762
sh 2 of 5
MODIFIED



NOTES:

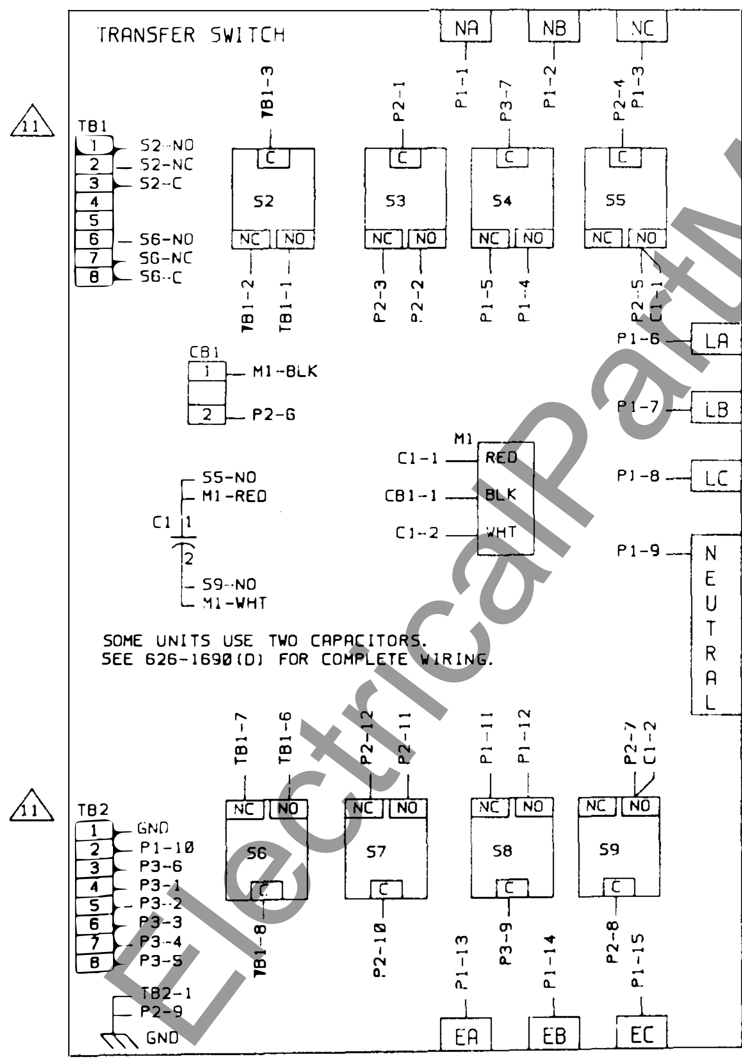
10. TP6 THRU TP10 ARE .25 INCH INSULATED FASTON TERMINALS FOR ACCESSORY CONNECTIONS.

11. CUSTOMER CONNECTION TERMINAL BLOCK. SEE SHEET 1 FOR DETAILS.

626-1762 SHEET 4 OF 5

THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC / WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE 5-SHEET SCHEMATIC AND WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR TRANSFER SWITCH.

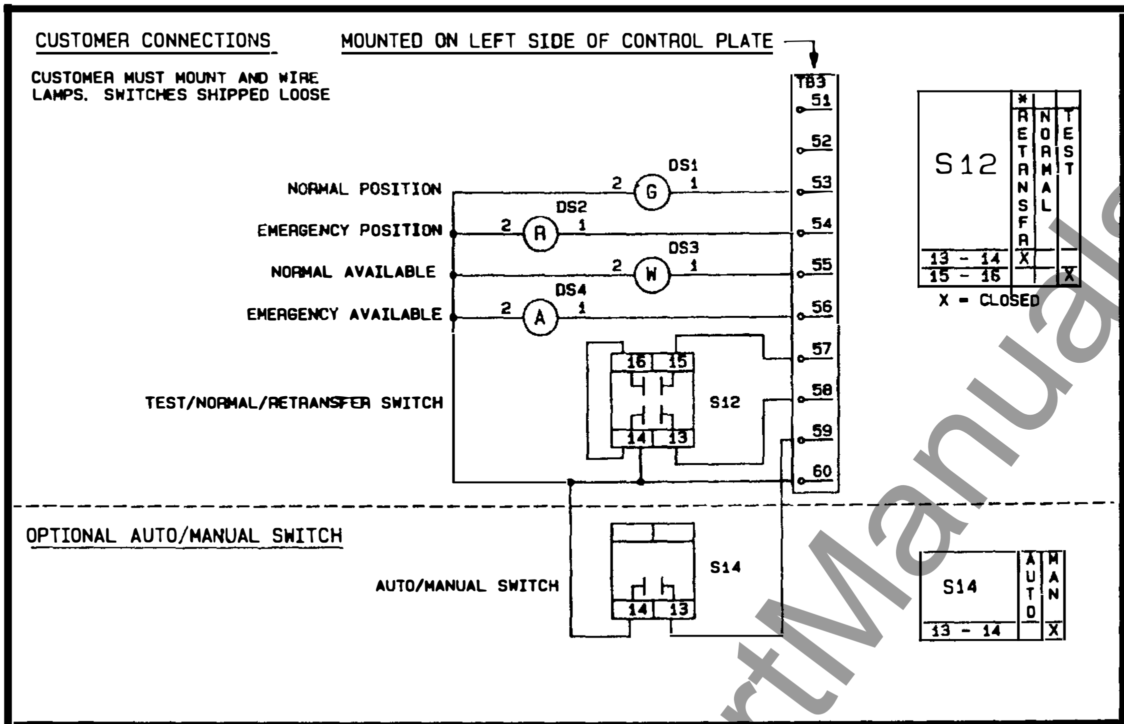
REAR WALL OF CABINET



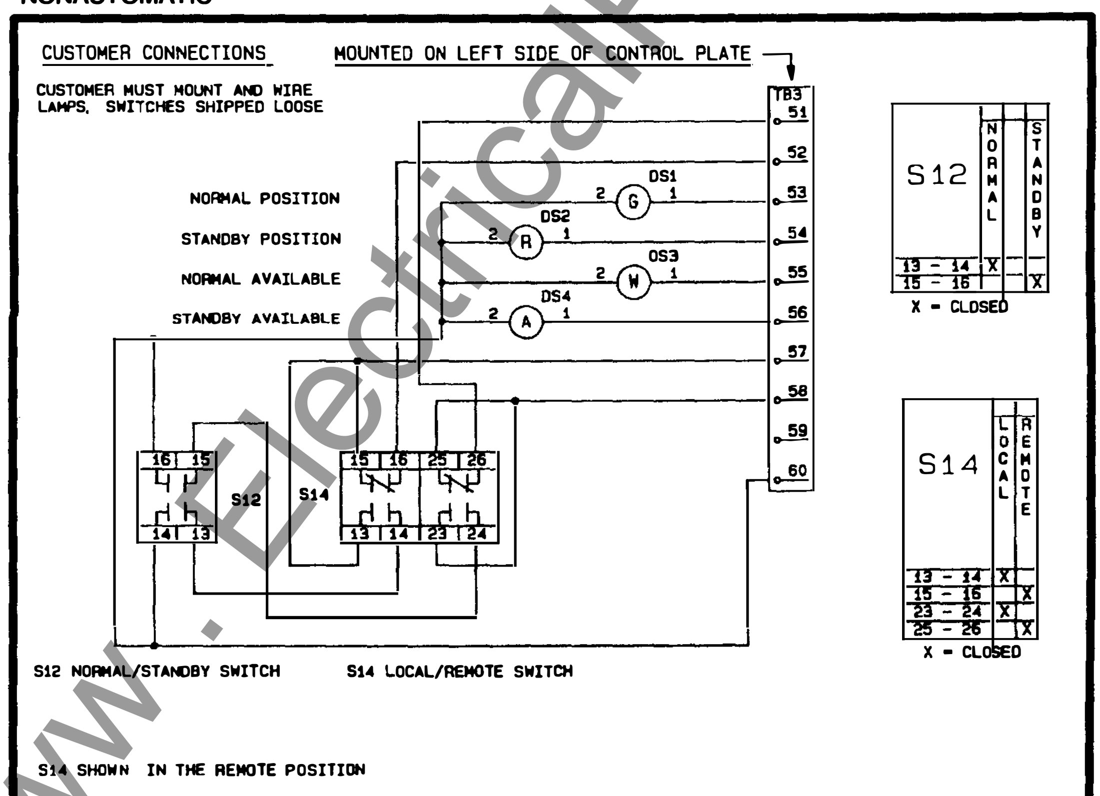
STANDARD WIRING

626-1762
sh 4 of 5
MODIFIED

UTILITY TO GENERATOR SET

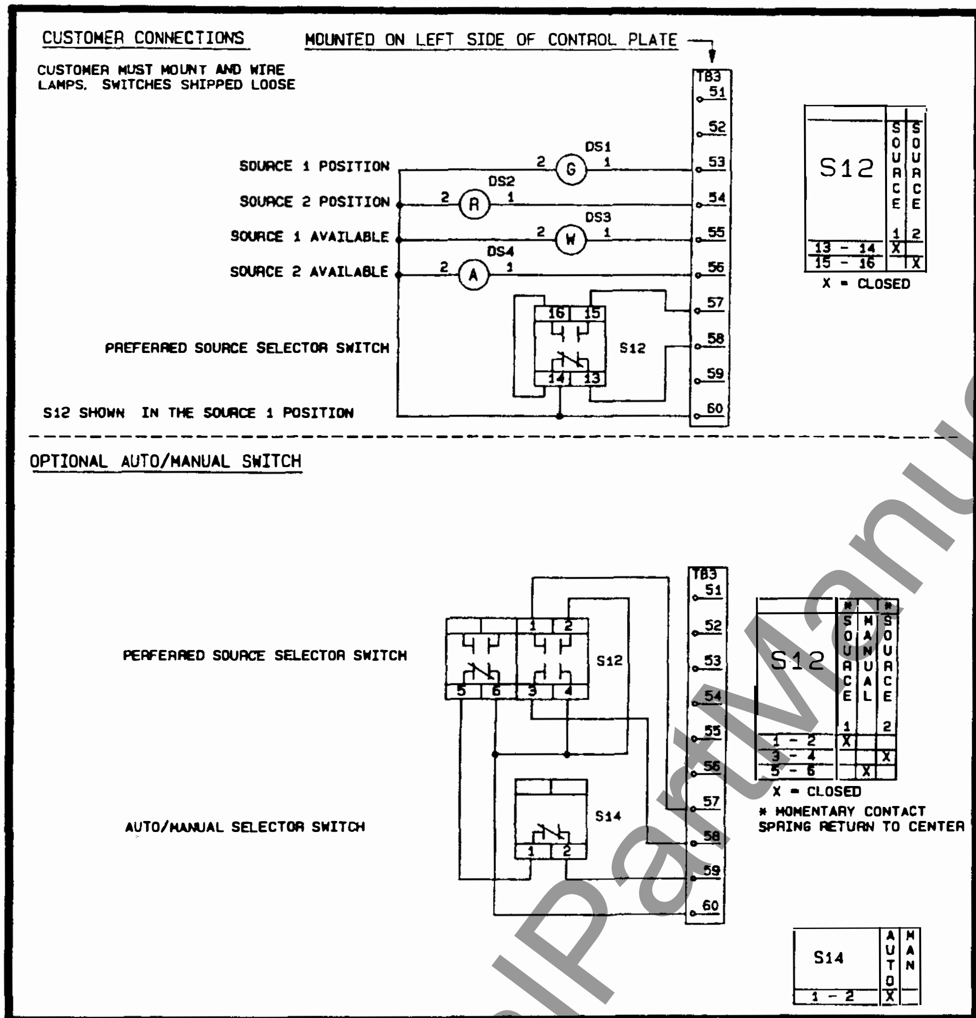


NONAUTOMATIC

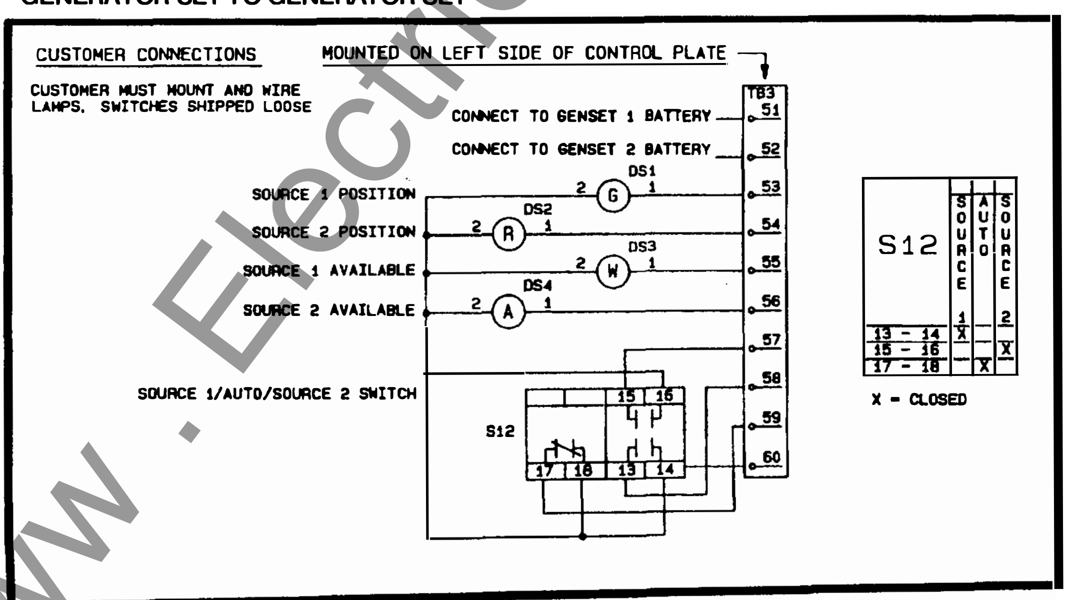


OPEN CONSTRUCTION WIRING DIAGRAMS

UTILITY TO UTILITY



GENERATOR SET TO GENERATOR SET



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