
OPERATION AND MAINTENANCE MANUAL
AUTOMATIC TRANSFER SWITCH
ZTSH SERIES
30 - 4000 AMPS



43R-1000E
1/99

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Introduction

Zenith Transfer Switches are used to provide a continuous source of power for lighting and other critical loads by automatically transferring from the normal source of power to an emergency source of power in the event that the normal source voltage falls below preset limits.

All Zenith transfer switches are designed for use on emergency or standby systems, and are rated for total system or motor loads. Transfer switches are UL Listed under Standard 1008 and CSA Certified under Standard C22.2 No. 178.

This manual provides information on the installation, operation and maintenance of the switch. In addition, a complete information package is supplied with each transfer switch which details the features and accessories provided on that switch. The information package and the instruction manual should be kept in a readily accessible location to provide complete reference information on this critically important piece of equipment.

Installation

▲ DANGER

HAZARDOUS VOLTAGE (Can Cause Severe Injury or Death)

Turn OFF all power before installation, adjustment, or removal of transfer switch or any of its components.

Each Zenith transfer switch is factory wired and tested. A complete information package is furnished with each switch which includes:

- a. Sequence of operation.
- b. Description and operation of all accessories supplied.
- c. Power panel connection diagram and schematic.
- d. Description and identification of all customer field connections.

Installation of Zenith transfer switches includes:

- a. Mounting the transfer switch cabinet.
- b. Connection of all Normal, Emergency, and Load cables or bus bars.
- c. Connection of external control circuits as required.

Equipment Inspection and Storage

Immediately inspect the transfer switch when received to detect any damage which may have occurred during transit. If damage is found or suspected, file claims as soon as possible with the carrier and notify the nearest Zenith representative.

Before installation, it is necessary to store the transfer switch in a clean dry place, protected from dirt and water. Provide ample air circulation and heat, if necessary, to prevent condensation.

Storage Temperature: -30°C to $+85^{\circ}\text{C}$ (-22°F to $+185^{\circ}\text{F}$)

Operating Temperature (Ambient): -20°C to $+75^{\circ}\text{C}$ (-4°F to $+167^{\circ}\text{F}$) [30-260 Amps]
 -20°C to $+40^{\circ}\text{C}$ (-4°F to $+140^{\circ}\text{F}$) [400-800 Amps]

Humidity: 5% to 95% (non-condensing)

Mounting

Adequate lifting means must be used to mount the transfer switch into place. The recommended method for moving the transfer switch using the lifting eyes, where supplied, and a spreader bar is illustrated in *Figure 1*. Enough room should be allowed to open the cabinet doors fully for inspection and servicing of the switch per NEC and local codes.

Before drilling conduit entry holes or any accessory mounting holes, cover and protect the switch and control panel to prevent dirt and metal fragments from entering the mechanical and electrical components. Failure to do so may result in damage and malfunction of the switch.

Installation *(cont'd)*

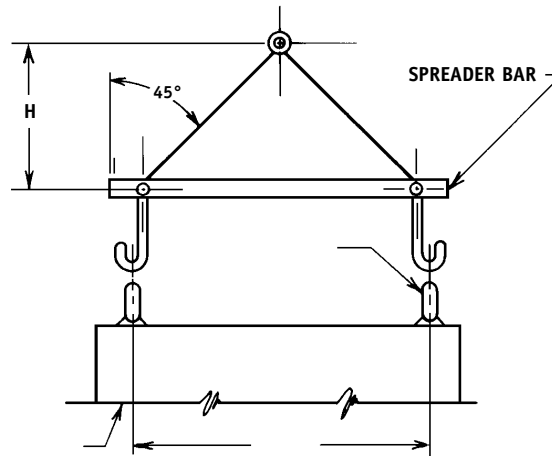


Figure 1

▲ NOTICE

When lifting the switch using a spreader bar, height H must be equal to half of distance D.

Power Connections

Zenith transfer switches are supplied with UL listed solderless screw type terminals as standard for the Normal, Emergency and Load power connections. *Table 1* lists the number and sizes of cable lugs supplied as standard for each switch amp rating.

Connect the Normal, Emergency, and Load conductors to the clearly marked terminals on the transfer switch. Remove surface oxides from cables by cleaning with a wire brush. Verify that all connections are correct before tightening the lugs. All cable lug connections must be tightened to the proper torque values as shown in *Table 2*.

Do not run cables or wiring behind front-connected transfer switches.

In cases where the Normal, Emergency and Load connections are made to a rear connected bus bar, a compression washer, flat washer, and a minimum grade 5 bolt must be used and torqued to the values in *Table 3*.

Tightening Torque for Lugs

| Socket Size Across Flats | Torque | |
|-----------------------------|-----------|-----------|
| | Lb. - In. | Lb. - Ft. |
| 1/8 | 45 | 4 |
| 5/32 | 100 | 8 |
| 3/16 | 120 | 10 |
| 7/32 | 150 | 12 |
| 1/4 | 200 | 17 |
| 5/16 | 275 | 23 |
| 3/8 | 375 | 31 |
| 1/2 | 500 | 42 |
| 9/16 | 600 | 50 |

Table 2

Tightening Torque for Bus Bars

| Bolt Size | Torque Bolt (Grade 5) | |
|-----------|-----------------------|-----------|
| | Lb. - In. | Lb. - Ft. |
| 1/4-20 | 72 | 6 |
| 5/16-18 | 132 | 11 |
| 3/8-16 | 300 | 25 |
| 1/2-13 | 720 | 60 |

Table 3

Installation *(cont'd)*

| Screw Type Terminals for External Power Connections | | | | |
|---|--|---------------------|---|--|
| Switch Size (Amps) | Normal, Emergency & Load Terminals | | Fully Rated Neutral Bar (When Required) | |
| | Cable Per Pole | Range of Wire Sizes | No. of Cables | Range of Wire Sizes |
| 40 | 1 | #8 to 2 AWG | 3 | #8 to 1/0 AWG |
| 80 | 1 | #8 to 1/0 AWG | 3 | #8 to 1/0 AWG |
| 100 | 1 | #8 to 1/0 AWG | 3 | #8 to 1/0 AWG |
| 150 | 1 | #8 to 3/0 AWG | 3 | #6 AWG to 300 MCM |
| 225 | 1 | #6 AWG to 250 MCM | 3 | #6 AWG to 300 MCM |
| 260 | 1 | #6 AWG to 350 MCM | 3 | #6 AWG to 300 MCM |
| 400 | 1 | #4 AWG to 600 MCM | 4 | #2 AWG to 600 MCM |
| 600 | 2 | #2 AWG to 600 MCM | 8 | #2 AWG to 600 MCM |
| 800 | 4 | #2 AWG to 600 MCM | 12 | #2 AWG to 600 MCM |
| 1000 | 4 | #2 AWG to 600 MCM | 12 | #2 AWG to 600 MCM |
| 1200 | 4 | #2 AWG to 600 MCM | 12 | #2 AWG to 600 MCM |
| 1600 2000 3000 4000 | Line and load terminals are located in rear and arranged for bus bar connection. | | 12 12 12 12 | 3/0 AWG to 750 MCM 3/0 AWG to 750 MCM 3/0 AWG to 750 MCM 3/0 AWG to 750 MCM |

Table 1

Control Connections

A complete information package is furnished with each transfer switch including a complete connection diagram and schematic which details all necessary control circuit field connections.

The engine start control wires connect to the terminals specified in the upper left corner of the control panel. *Figure 2* shows the location of these terminals on the standard SSRCP printed circuit board mounted on the steel backplate. These terminals are clearly identified by a pre-printed label attached to the steel control panel. In the case of manual transfer switches, or in other applications not requiring the standard control panel, clearly marked terminal blocks are provided in the upper left corner of the control panel for the engine start control wires.

Terminals for field connections to the A3 Emergency auxiliary contacts and the A4 Normal auxiliary contacts are also provided. These terminals are clearly marked and appear on the side of the power panel. On 400 amp units these terminals appear on the disconnect switch bracket above the operator handle, and are marked as illustrated in *Figure 3*.

ENGINE



Figure 2

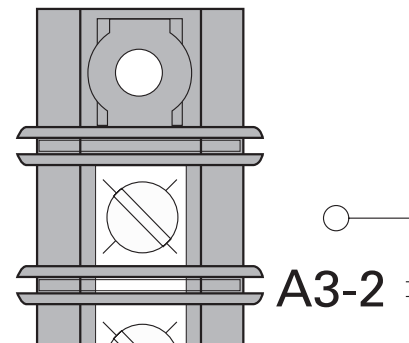


Figure 3

Installation *(cont'd)*

Make all other necessary external control connections to the appropriate terminal blocks located on the control panel. Insure that all connections are tightened to the torque specified in *Figure 4*.

| Control Wire Connections | |
|--------------------------|------------------|
| Wire Size (AWG) | Torque Lb. - In. |
| 18-16 | 19 |
| 14-8 | 19 |
| 6-4 | 36 |

Figure 4

Final Equipment Inspection

Prior to energizing the transfer switch:

- Remove any debris incurred due to shipment or installation. **DO NOT** use a blower since debris may become lodged in the electrical and mechanical components and cause damage. Use of a vacuum is recommended.
- Verify that all cabled connections are correct and that phase rotation of both sources match.
- Check engine start connections and verify the correct connection of all control wires.
- Check settings of all timers and adjust as necessary. Also adjust any optional accessories as required.
- Check the integrity of power connections by verifying actual lug torque values as specified in this manual.
- Make sure that all covers and barriers are installed and properly fastened.

Functional Test

The functional testing of the transfer switch consists of manual and electrical tests described in this section. Before proceeding, refer to the information package supplied with the transfer switch. Read and understand all instructions and review the operation of all accessories provided.

A manual operator handle is provided with the transfer switch for maintenance purposes only. Manual operation of the switch must be checked before it is operated electrically. Both power sources **MUST** be disconnected before manual operation of the switch. Insert the handle and operate the transfer switch between the Normal and Emergency positions. The transfer switch should operate smoothly without binding. Return the switch to the Normal position, remove the handle, and return it to the holder provided.

Before starting the electrical operation test, check the equipment rating nameplate on the transfer switch to verify the correct system voltage. An example of the equipment rating nameplate is shown in *Figure 5*.

First, close the Normal source circuit breaker. The phase relays B1, B2, and B3 will pick up and the LED indicators will be illuminated. Verify the phase to phase voltages at the Normal line terminals.

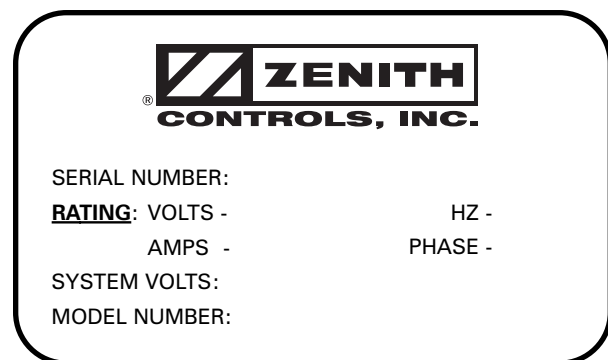


Figure 5

Installation *(cont'd)*

Next, close the Emergency source breaker and start the engine generator. The VFMSM relay will pick up and the LED indicator will be illuminated. Check the phase to phase voltages at the Emergency line terminals. Also, verify that the phase rotation of the Emergency source is the same as the phase rotation of the Normal source.

After the sources have been verified, shut down the engine generator, and put the starting control in the automatic position. Complete the visual inspection of the transfer switch, and close and lock the cabinet door.

Initiate the electrical transfer test by activating the TS test switch. The CR control relay will drop out and the P1 engine start timer will start its timing cycle.

After the P1 timer has completed its timing cycle, the engine start contact will close and signal the engine generator to start. The VFMSM relay will energize. The switch will transfer to the Emergency source after the time delay of the W timer.

Deactivating the test switch will start retransfer to the Normal source. The switch will retransfer to the Normal source after the time delay of the T timer. The U engine over-run timer allows the engine generator to run unloaded for a preset cool down time period.

▲ NOTICE

**A periodic test of the transfer switch under load conditions is recommended to insure proper operation.
(See National Electric Code articles 700 and 701).**

Operation and Features

Sequence of Operation

Figure 6 is a typical schematic diagram of a Zenith transfer switch with a Module 9 accessory package. The information package supplied with the transfer switch includes a schematic diagram and description of operation of all accessories provided.

The sequence for load transfer to the Emergency source begins automatically when any phase of the Normal source falls below the preset dropout point and this undervoltage failure condition is detected by the solid state phase relays B1, B2, B3.

The phase relays drop out, de-energizing the normal control relay CR, and engine start timer P1 begins its timing cycle. The P1 time delay is provided to override momentary outages and to prevent nuisance starting of the engine generator. If the Normal source voltage returns above the pickup setting of the phase relays, the P1 timing cycle is reset to zero by the re-energization of the CR relay.

If the normal source voltage does not return before the P1 time delay is completed, the P1 timer drops out and sends a starting signal to the engine generator. An emergency voltage and frequency sensing relay VFSM monitors the voltage and frequency of the Emergency source. When both the voltage and the frequency of the Emergency source reach the preset pickup points, the VFSM relay initiates the transfer to the Emergency source and timer W begins its timing cycle. The W timer provides an adjustable transfer delay to the Emergency source as required.

When the W time delay is completed, the Emergency control relay RT energizes and picks up the power relay, CE1 or CCE. The power relay connects voltage from the Emergency source to the Emergency switch operating circuit causing the switch to transfer its main contacts to the Emergency source. The switch is mechanically locked in the Emergency position. The power relay and Emergency operator are de-energized when the SE limit switch is activated by the operator. The SN limit switch is deactivated at the same time, readying the Normal control circuit for retransfer when the Normal source is restored.

The sequence for retransfer to the Normal source begins automatically when the voltage on all phases of the Normal source reach the preset pickup point and this condition is detected by the solid state phase relays.

When the Normal source restores, the solid state phase relays B1, B2, B3 pick up and initiate retransfer of the switch to the Normal source by energizing timer T and beginning its timing cycle. The T timer provides an adjustable delay to ensure that the Normal source has stabilized before reconnection to the load. If the Normal source fails before the T time delay is completed, the phase relays drop out and the T timing cycle is reset to zero.

When the T time delay is completed, the Normal control relay CR energizes and picks up the power relay, CN1 or CNN. The power relay connects voltage from the normal source to the Normal switch operating circuit causing the retransfer of the main switch contacts to the normal source. The switch is mechanically locked in the Normal position. The power relay and the Normal operator are de-energized when the SN limit switch is activated by the operator. The SN limit switch also energizes the engine over-run timer U and begins its timing cycle. The timer provides a period of time for the engine generator to run without load and cooldown before shutdown. After the U time delay is completed, the P1 timer is energized and the engine generator is shutdown.

Operation and Features *(cont'd)*

Typical Schematic Diagram

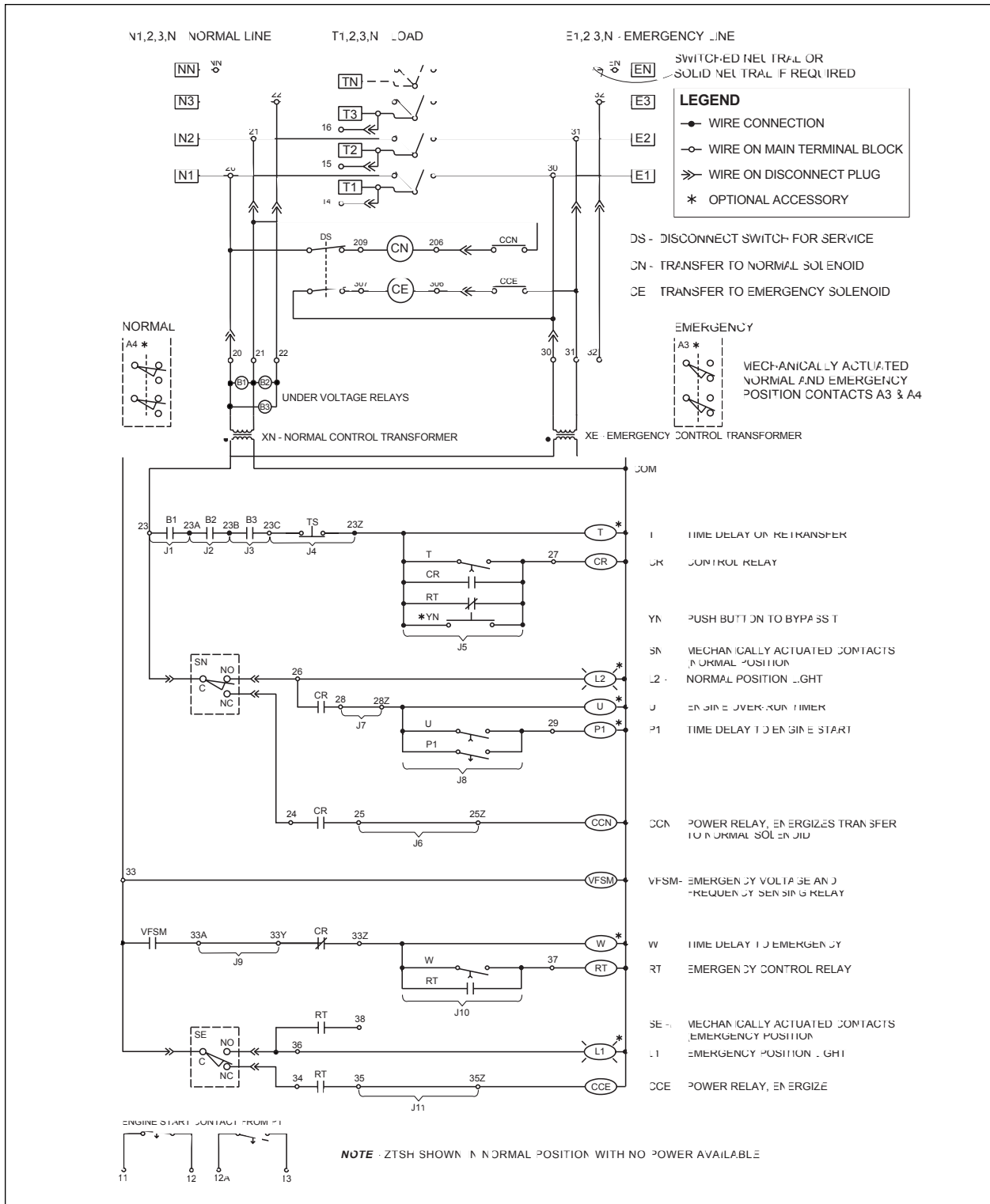


Figure 6

Operation and Features *(cont'd)*

Zenith Module 9 Accessory Package

The Zenith Module 9 Accessory package includes nine of the commonly specified accessories. These accessories are:

- A Auxiliary Contacts:
 - A3 Closed when switch is in emergency position
- L Indicating LED Pilot Lights:
 - L1 Indicates switch in emergency position
 - L2 Indicates switch in normal position
- P1 Time Delay - Engine Start: Adjustable 0.5 to 6 seconds
- T200 Time Delay on Retransfer to Normal: To delay retransfer to normal source (immediate retransfer on generator set failure); standard setting 30 minutes, adjustable 0-60 minutes.
- T100 Time Delay on Retransfer to Normal: To delay retransfer to normal source (immediate retransfer on generator set failure); standard setting 30 min., adjustable 0-30 min.
- T3/W3 Time Delays - Presignal for Auxiliary Control: Prior to transfer between two live sources in either direction, provides an adjustable (factory set at 20 second) presignal contact closure
- U200 Time Delay for Engine Cooldown: Allows engine to run unloaded after switch retransfers to normal. Standard setting 5 min., adjustable 0-60 minutes.
- U100 Time Delay for Engine Cooldown: Allows engine to run unloaded after switch retransfer to normal; standard setting 5 min., adjustable 0-5 min.
- W200 Time Delay on Transfer to Emergency: To delay transfer to emergency after normal source failure; standard setting 1 sec., adjustable 0-5 minutes.
- W100 Time Delay on Transfer to Emergency: To delay transfer to emergency after verifying emergency source available; standard setting 1 sec., adjustable 0-15 sec.

Operation and Features *(cont'd)*

Zenith Optional Accessories

Many control accessories are available to meet specific requirements. Some of the more commonly specified accessories are:

- A Auxiliary Contacts:
 - A6 Deenergizes external motor control circuit 5 seconds (adjustable) prior to transfer in either direction.
- C Plant Exerciser (no load): Automatically starts the generator to run unloaded at selected intervals
- C/D Plant Exerciser (Load/no load): Allows the generator to start and run unloaded or to simulate a power failure, start generator and run under load. Specify weekly, bi-weekly or calendar schedule
- L Indicating LED Pilot Lights:
 - L3 Indicates normal source available
 - L4 Indicates emergency source available
- P2 Time Delay - Engine Start: Adjustable 0.5 to 300 seconds
- Q2 Peak Shave/Remote Load Test: Input for peakshave or remote load test; includes automatic return to normal if emergency source fails and normal is present; 120 VAC or 24 VDC
- R4 In-Phase Monitor: Prevents transfer until two sources are in relative synchronism
- R43 In-Phase Monitor: Prevents transfer until two sources are in relative synchronism
- S1 Four-position selector switch (Stop - Hand Crank - Test - Automatic)
- S2 Disconnect switch in series with accessory E to disconnect engine-starting circuit
- S3 Source selector switch circuit; to select either source as primary
- T3/W3 Time Delays - Presignal for Auxiliary Control: Prior to transfer between two live sources in either direction, provides an adjustable (factory set at 20 second) presignal contact closure
- W100 Time Delay on Transfer to Emergency: To delay transfer to emergency after verifying emergency source available; standard setting 1 sec., adjustable 0-15 sec.
- YEN Pushbutton Bypass of T&W Timers

Maintenance and Testing

A preventive maintenance program will insure high reliability and long life for the transfer switch. The preventive maintenance program for the transfer switch should include the following items:

▲ DANGER

HAZARDOUS VOLTAGE (Can Cause Severe Injury or Death)

Turn OFF all power before installation, adjustment, or removal of transfer switch or any of its components.

Inspection and Cleaning

Before doing any work on the transfer switch, de-energize all sources of power. The switch should be inspected for any accumulation of dust, dirt, or moisture, and should be cleaned by vacuuming or wiping with a dry cloth or soft brush. **DO NOT** use a blower since debris may become lodged in the electrical and mechanical components and cause damage.

Remove the transfer switch barriers or arch chutes and check the condition of the contacts. Any surface deposits must be removed with a clean cloth (**DO NOT USE EMERY CLOTH OR A FILE**). If the contacts are worn excessively, they should be replaced. A general inspection of mechanical integrity should be made to include loose, broken or badly worn parts.

Servicing

All worn or inoperative parts must be replaced using Zenith recommended replacement parts. Appendix B at the back of this manual includes replacement part information for typical power and control panel configurations. When ordering parts provide the model number or serial number from the transfer switch rating nameplate.

Please refer to the Replacement Parts manual for specific part information and ordering procedures. Please contact the Zenith Technical Services Department for the Replacement Parts manual.

The operating mechanism of the transfer switch is lubricated with Lubriplate 105. The lubricant applied at the factory provides adequate lubrication for the lifetime of the switch. Should debris contaminate the mechanism, clean and apply additional Lubriplate.

Zenith can provide complete preventative maintenance services. Please contact the Zenith Technical Services Department for additional information.

Maintenance and Testing *(cont'd)*

Testing

A manual operator handle is provided with the transfer switch for maintenance purposes only. Manual operation of the switch must be checked before it is operated electrically. Both power sources **MUST** be disconnected before manual operation of the switch. Insert the handle and operate the transfer switch between the Normal and Emergency positions. The transfer switch should operate smoothly without binding. Return the switch to the Normal position, remove the handle, and return it to the holder provided.

After completing the inspection, cleaning and servicing of the transfer switch, reinstall the switch cover, and close and lock the cabinet door. Reclose the circuit breakers feeding the utility and generator sources to the switch.

Initiate the electrical transfer test by activating the TS test switch. P timer will time out and the microcontroller will send an engine start signal. When the W time has elapsed, the switch will complete its transfer by closing into the Emergency source.

Deactivating the test switch will start retransfer to the Normal source. The switch will complete its retransfer to Normal after the time delay of the T timer. The U engine overrun timer allows the engine generator to run unloaded for a preset cool down period.

▲ NOTICE

**A periodic test of the transfer switch under load conditions is recommended to insure proper operation.
(See National Electric Code articles 700 and 701).**

Maintenance and Testing *(cont'd)*

Troubleshooting

Before beginning any troubleshooting activity, refer to the information package supplied with the transfer switch and review the description and operation of all accessories supplied. Also refer to the Installation section of this manual.

Engine Does Not START

| Annunciation | Possible Cause | Corrective Action |
|-----------------------------|--|--|
| Emergency Available LED off | Engine start wires not terminated properly | Check Engine Start Connections |
| | Generator in "OFF" position | Investigate why Engine Control Switch was turned off |

Engine Does Not STOP

| Annunciation | Possible Cause | Corrective Action |
|--|---|---|
| Delay to Engine Stop LED on | U timing cycle not complete | Check U Timer setting |
| Normal Available, Normal Position, and Emergency Available LEDs on | Engine start wires not terminated correctly | Check Engine Start Connections |
| | Generator in "Manual" | Investigate why the Engine Control Switch was put in manual |

ATS Will Not Transfer To EMERGENCY

| Annunciation | Possible Cause | Corrective Action |
|---|---|--|
| Emergency Available LED off | Emergency voltage or frequency not within acceptable parameters | Check Engine Start Connections, Generator Breaker, Generator output, and Engine Control Switch |
| None | Power supply harness unplugged | Plug in harness |
| Normal Position and Emergency Position flashing | Limit switch harness unplugged | Plug in harness |
| Delay to Open Normal LED on | W timing cycle not complete | Check W Timer setting |

ATS Will Not Transfer To NORMAL

| Annunciation | Possible Cause | Corrective Action |
|--|--|------------------------------------|
| Normal Available LED off | Normal voltage or frequency not within acceptable parameters | Check utility and utility breakers |
| None | Power supply harness unplugged | Plug in harness |
| Normal Position and Emergency Position LEDs flashing | Limit switches harness unplugged | Plug in harness |
| Delay to Open Emergency LED on | T timing cycle not complete | Check T Timer setting |

Maintenance and Testing *(cont'd)*

Adjustments and Settings

Solid State Timers

Solid state timers are adjustable from 0.1 second to 100 hours. The red timing indicator in the upper left corner flashes as the timer progresses through the timing cycle. When the timing cycle is completed, the indicator remains illuminated. A flathead screwdriver is required to change the setting, as shown in *Figure 7*.

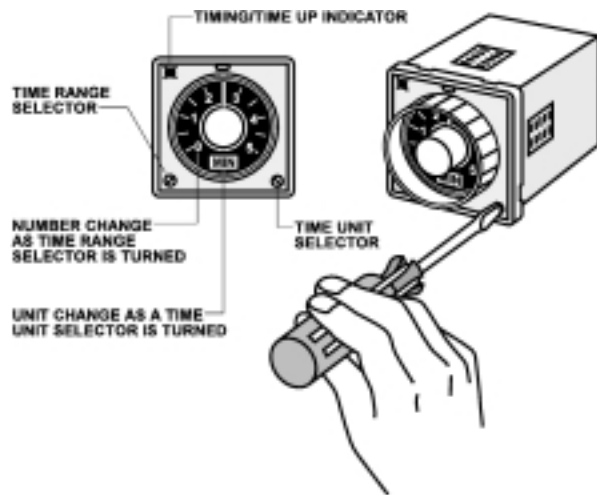


Figure 7

The time unit is selected by turning the rotary switch at the lower right of the timer. Four selections are available: “Seconds”, “Minutes”, “Hours”, “10 Hours”. The time unit selected is displayed in the window below the time setting dial.

The time range is selected by turning the rotary switch at the lower left of the timer. Four ranges are available: “0-0.5”, “0-1.0”, “0-5.0”, “0-10.0”. The dial digits appear in the windows around the time setting knob.

▲ CAUTION

Do NOT change the setting while the timer is energized. Timer malfunction or damage may occur.

The factory setting of the solid state timers used in the Zenith standard package are shown in *Table 4*.

| Timer | Factory Setting |
|-------|-----------------|
| T | 30 minutes |
| U | 5 minutes |
| W | 1 second |

Table 4

Voltage/Frequency Sensor (VSFM)

The pickup point may be adjusted by rotating the adjustment screw as shown in *Figure 8* below. Counter-clockwise rotation increases the pickup voltage.

Pickup Voltage (at 100% Frequency)

Adjustable: 80% to 95%

Factory Set: 90%

Pickup Frequency

Adjustable: 80% to 100%

Factory Set: 95%

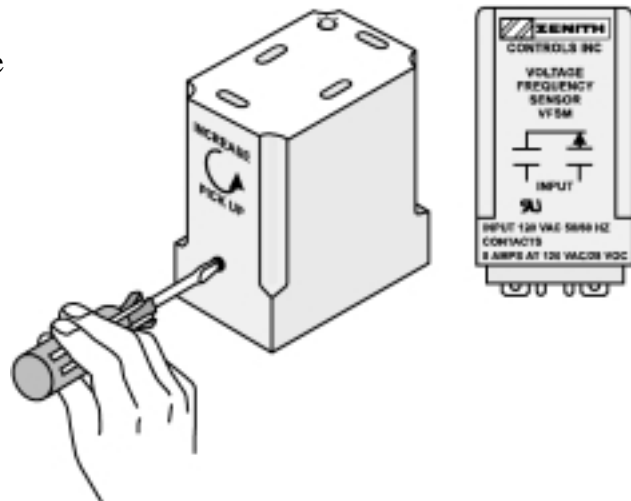


Figure 8

Adjustments and Settings *(cont'd)*

Solid State Phase Relay (ARSM)

The pickup and dropout points may be adjusted by using the following procedure. Use of a variable voltage supply (Variac) is required. The relay is illustrated in *Figure 9* below.

1. Turn the pickup adjustment fully clockwise.
2. Turn the dropout adjustment fully counter-clockwise.
3. Set Variac to the desired pickup voltage.
4. Rotate the pickup adjustment counterclockwise very slowly until the relay picks up. The LED will illuminate.
5. Set Variac to the desired dropout voltage.
6. Rotate the dropout adjustment clockwise very slowly until the relay drops out. The LED will go out.
7. Verify the setting by raising the voltage until the relay picks up and lowering the voltage until the relay drops out.

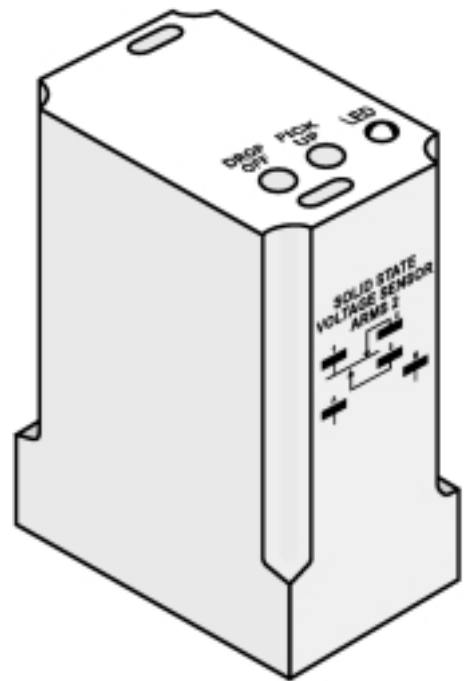


Figure 9

Pickup Voltage: 75% to 115% of Nominal
Factory Set: 90% of Nominal

Dropout Voltage: 55% to 105% of Nominal
Factory Set: 80% of Nominal

Electronic Time Switch Z1000-1A

This time switch is used for either the C or C/D option (See page 7). Instructions for programming the switch are located inside the cover of the switch. An indicating light will appear in the left side of the display to indicate the time switch is in operation. If the time switch has a flashing display, it indicates that a power outage has occurred. To restore the display, press the clock key and check the time of day. The battery should be checked and replaced if necessary.

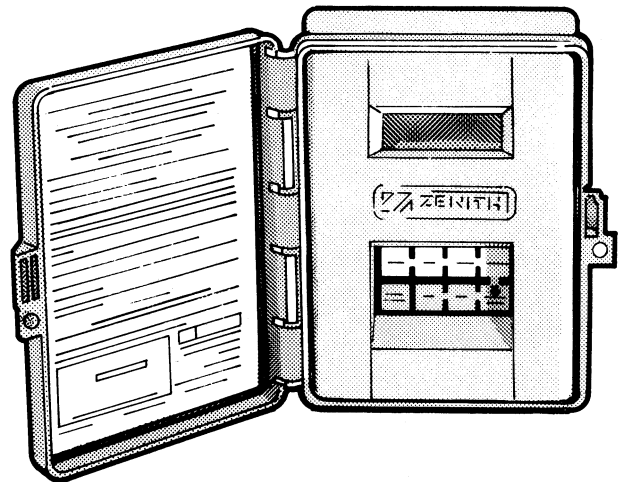


Figure 10

Due to the 10-year memory retention feature, cutting the power to the time switch will not erase the user's program. The user's settings can be changed or cleared at any time. This feature eliminates the need for having to reprogram the time switch after long power outages.

The time switch will keep the clock running if power is lost by the installation of a 9 volt battery. It will not perform any of the programmed operations during a power outage.

5. ELECTRONIC TIME SWITCH Z2000-2A

This time switch is used for the C/D option (see page 7). Time switch Z2000-1A is used for the C option.

a. Setting Time and Day:

Press and hold “E” button during the Following adjustments:

- 1) Press “d” to set day pointer to correct day:
1 = Monday...7 = Sunday
- 2) Press “h” to set the hour. The time of day is expressed in 24-hour military time:
04:00 = 4 a.m.....20:00 = 8 p.m.
- 3) Press “m” to set minutes
- 4) Release “E” button. Clock is running

b. Programming:

Twenty-four total ON or OFF settings are available on one, several, or all days of the week.

- 1) Press Prog button. The blank program entry field will appear with two flashing points: “_:_”
- 2) Press either C1 or C2 depending on which channel you wish to program.
- 3) Next, select either ON or OFF by pressing C1 or C2 which toggles the ON/OFF mode.
- 4) You will now see the pointer flashing above 1 for Monday. To lock in Monday, press Prog. If you want to enter further days, press d then Prog to lock them in. Solid pointers must be displayed over each day that the switching command is required.
- 5) Once the days are selected, press h button to enter the desired hour and press m to enter the desired minutes. To enter the program into the time switch, press Prog. When the programming is complete, press “E” to return the clock run mode. If the “E” button is not depressed, it will switch to the clock run mode after 60 seconds.

c. Installation and Start-Up with Automatic Summer/Winter Time Adjustment

- 1) After applying A.C. power, press the “Res” button.
- 2) Press “C1” until dot 3 appears (see Table 1).
- 3) Press “Prog” to display 1997, press “d” until appropriate year is displayed.
- 4) Press “Prog” to display 01.01. month and day.
- 5) Press “m” to set the month and “d” to set the day. Then press the “Prog” button.
- 6) Press and hold the “E” button during the following adjustments:
To set day, press “d” to position “▼” over correct day, (1=Monday,...7=Sunday).
To set hour, press “h” to correct hour (AM or PM).
To set minutes, press “m” to correct minute.
Release “E” button. Clock is now running.

d. Programming

24 total “ON” and “OFF” settings are available on one, several or all days of the week. Press “Prog” button, see _:_ _ display with two flashing points. This is the blank program entry field. Press “C1” or “C2” depending on which channel you will program first. Assume, for example, “C1” first. Select either “C1”, “ON” or “OFF” by again pressing “C1” which toggles the ON/OFF mode. You will now see the pointer “▼” flashing above 1(Monday). If you wanted to enter a program starting Monday you would now press “Prog” to lock in Monday. If you wanted further days press “d” then “Prog” to lock them in. If the switching command was required Monday thru Friday, five solid pointers must be displayed over 1 thru 5; for the entire week, 1 thru 7. Once days are selected, press “h” to enter desired switching hour, then press “m” to enter desired switching minutes. Now to enter the program into the timer press “Prog”. When programming is finished press “E” to return to clock run mode. If the “E” button is not pressed, the timer will switch to clock run mode after 60 seconds. After programming, recheck and reset the time of day, if necessary.

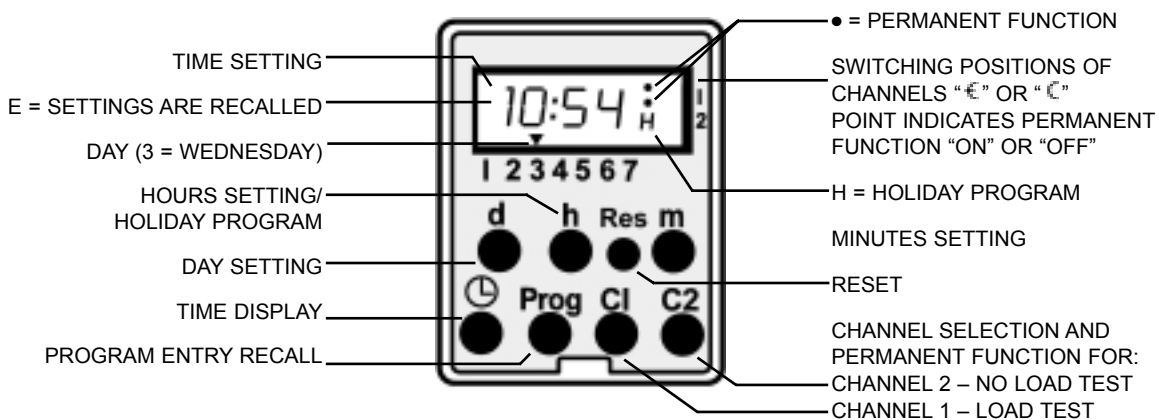
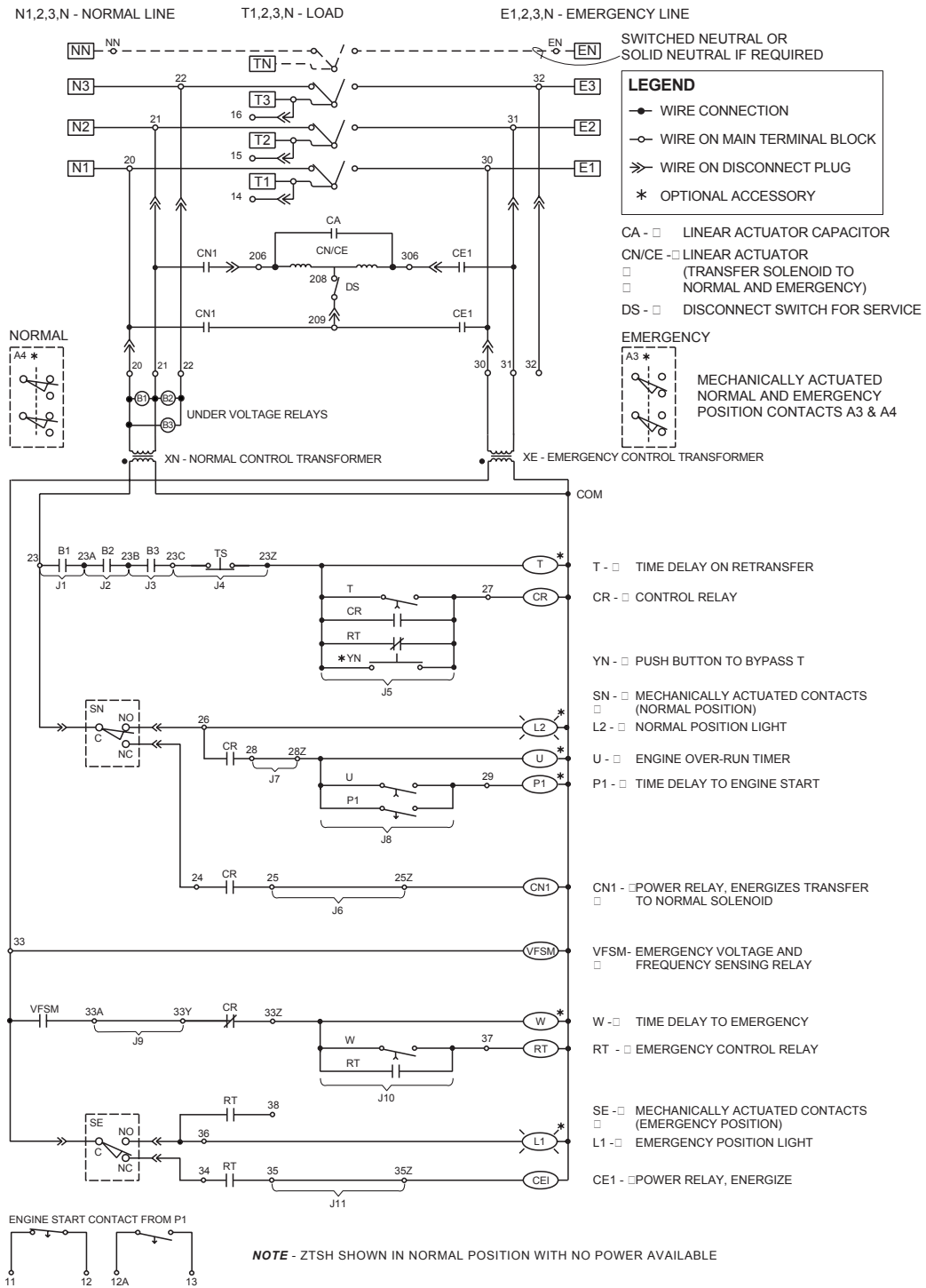
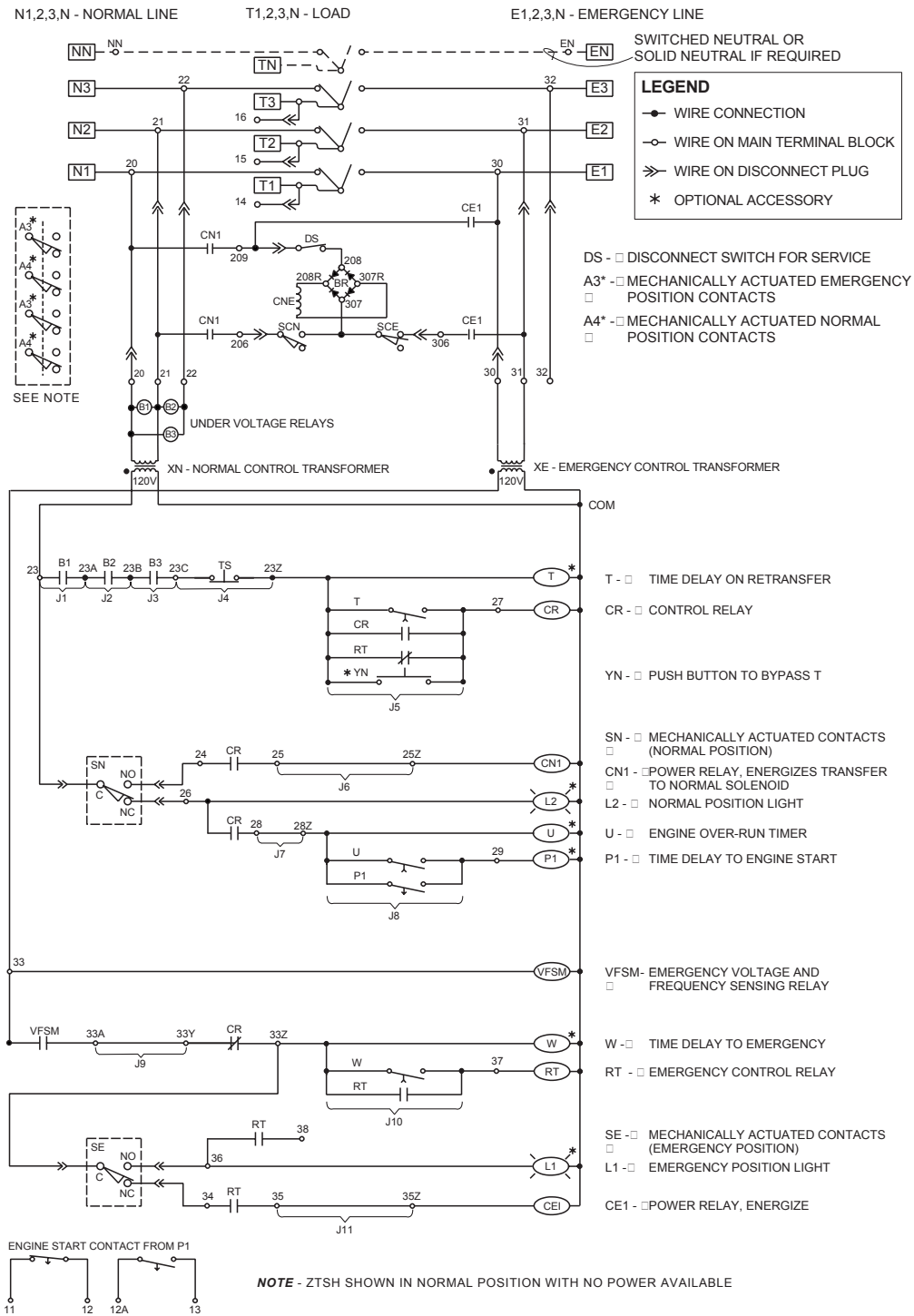


Figure 9

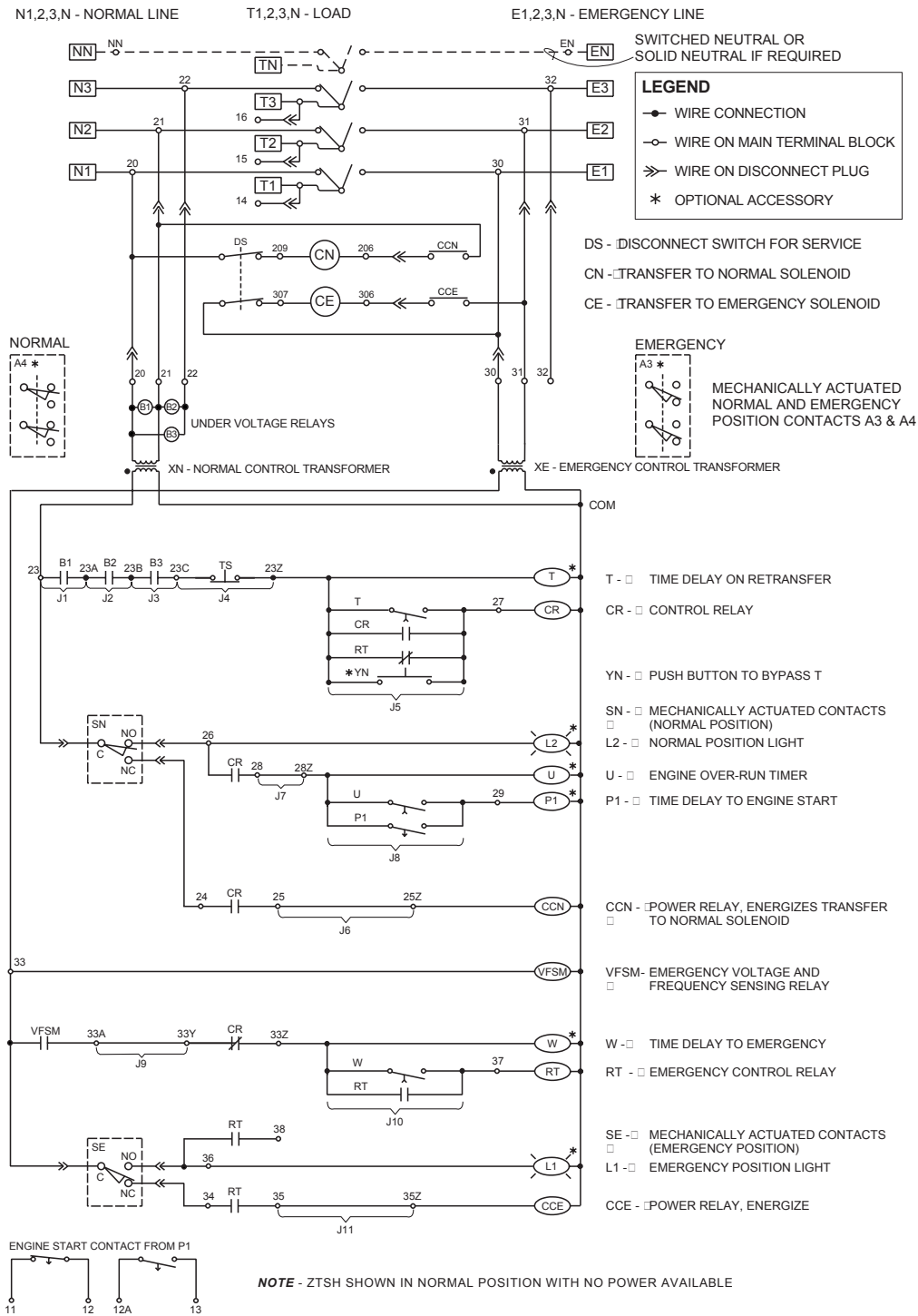
APPENDIX A - TYPICAL SCHEMATIC DIAGRAM 40 - 260 AMPS



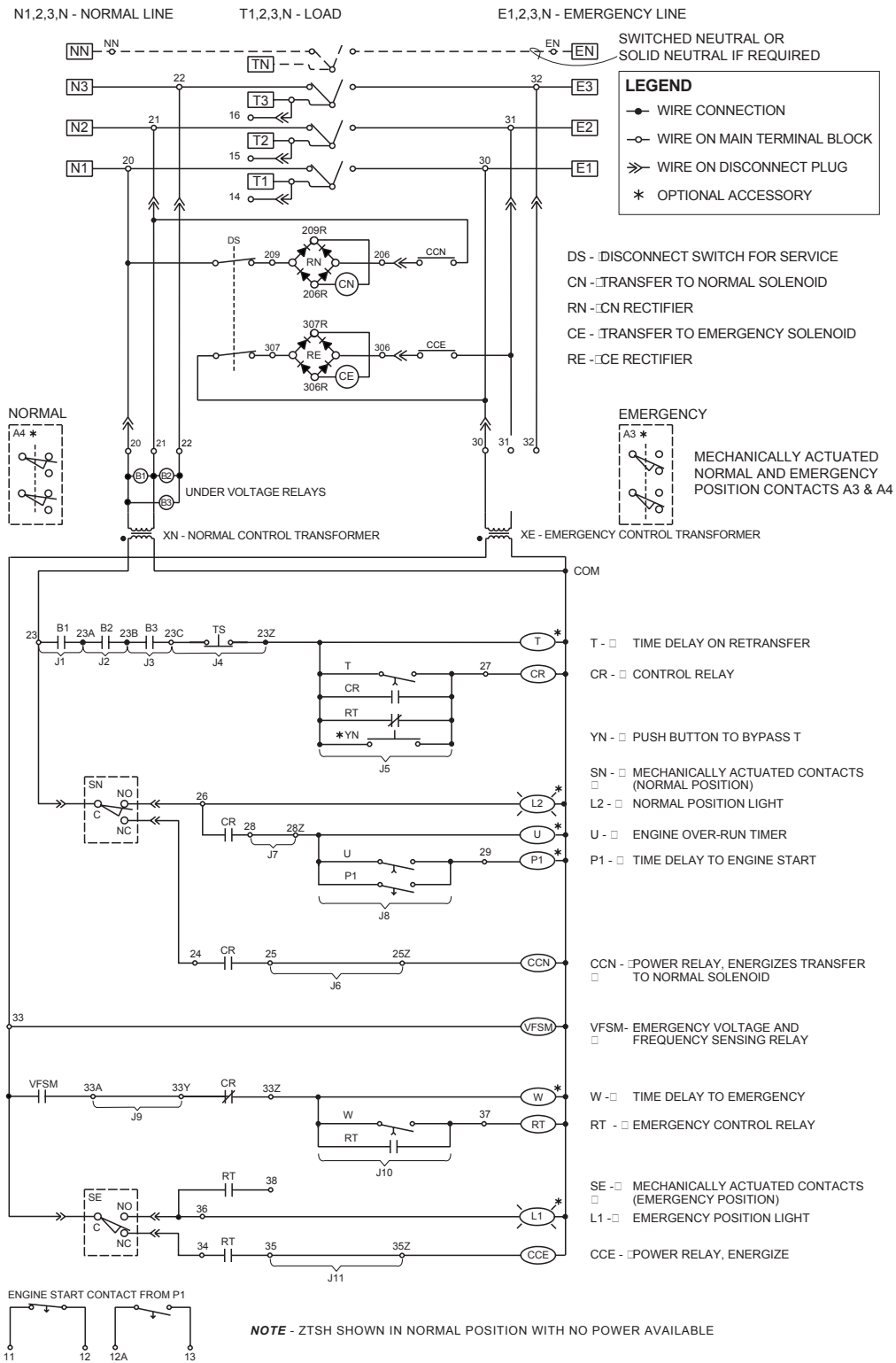
APPENDIX A - TYPICAL SCHEMATIC DIAGRAM 40 - 260 AMPS



APPENDIX A - TYPICAL SCHEMATIC DIAGRAM 40 - 260 AMPS

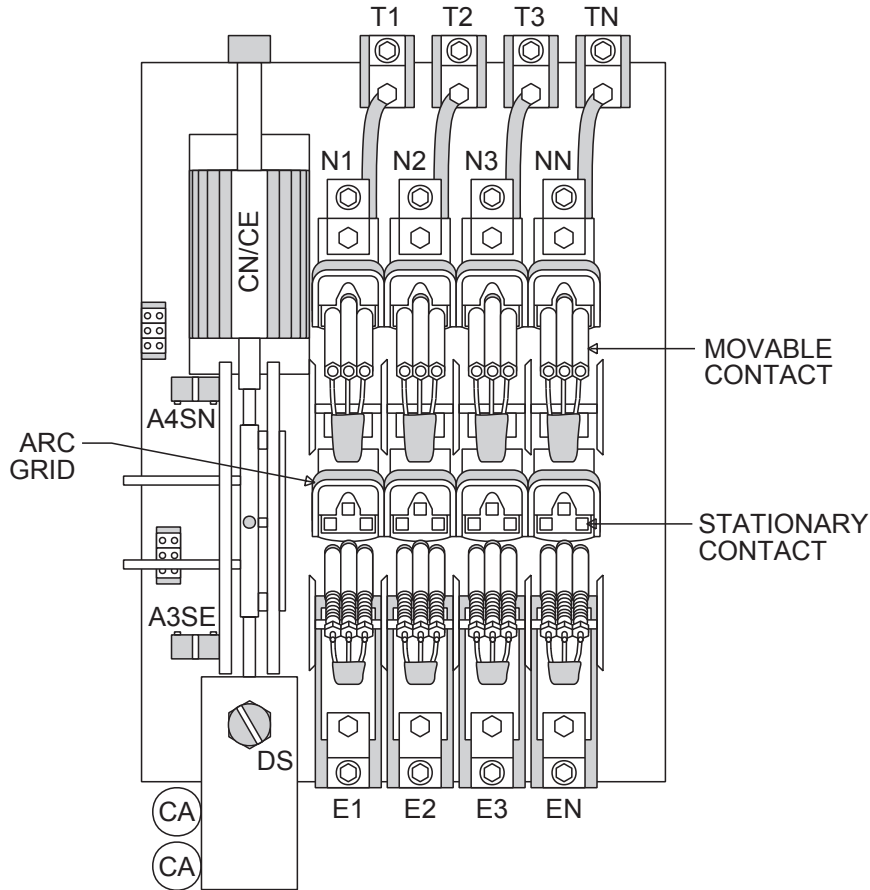


APPENDIX A - TYPICAL SCHEMATIC DIAGRAM 40 - 260 AMPS



APPENDIX B - REPLACEMENT PARTS

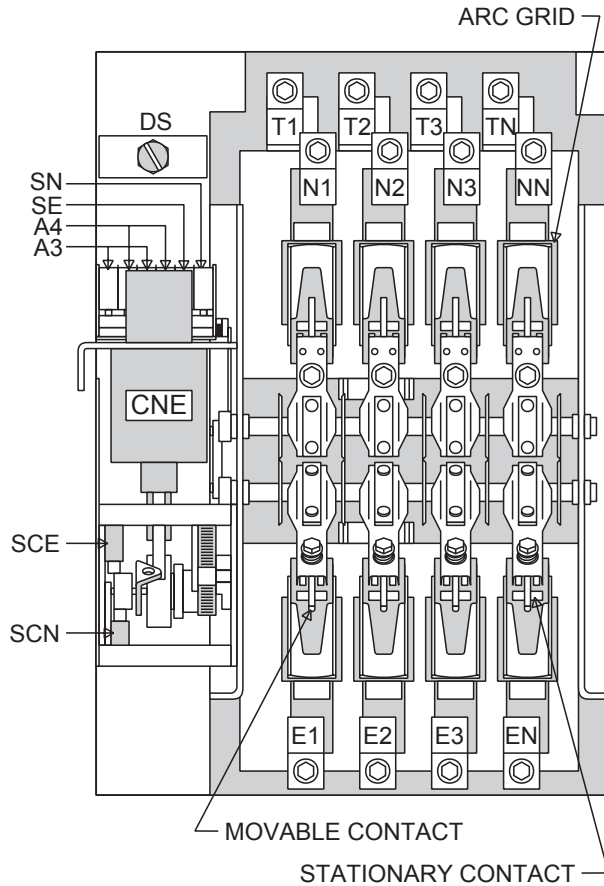
1. POWER PANEL - 40 TO 260 AMPS



| TAG | DESCRIPTION | STOCK NUMBERS BY AMPERAGE | | | | | |
|---|--------------------------------------|---------------------------------------|----------|----------|---------------|------------------|------------------|
| | | 40 | 80 | 100 | 150 | 225 | 260 |
| N 1,2,3, N E 1,2,3, N T 1,2,3, N | Cable Connection Lug | PS-4419 | PS-4423 | PS-4423 | 27P-1128 | 27P-1126 | 27P-1127 |
| | Wire Size | #14-2 | #14-1/0 | #14-1/0 | #8-3/0 | #6 to 250 MCM | #6 to 350 MCM |
| | Stationary Contact Assembly Kit | 27P-1141 | 27P-1141 | 27P-1141 | 27P-1111 | 27P-1111 | 27P-1111 |
| | Stationary Load Contact Assembly Kit | 27P-1140 | 27P-1140 | 27P-1140 | 27P-1109 | 27P-1109 | 27P-1109 |
| | Arc Grid Assembly Kit | 27P-1014 | 27P-1014 | 27P-1014 | 27P-1014 | 27P-1014 | 27P-1014 |
| | Movable Contact Assembly Kit | 27P-1036 | 27P-1036 | 27P-1036 | 27P-1037 | 27P-1037 | 27P-1037 |
| CN/CE, CA | Linear Actuator and Capacitors | | | CN/CE | CA (See Note) | | |
| Note: 2S denotes two capacitors wired in series | Coil Volts | 120 | 240 | 208 | 575/600 | 480 | 416 |
| | Poles | 2 | 2 3 | 3 4 | 3 4 | 3 4 | 3 |
| | | | | K-2104PN | K-2105PN | K-2141PN | K-2142PN |
| | Quantity | 1 | 1 | 1 | 2S | 2S | 2S |
| | Part | PS-4007 | PS-4016 | PS-4084 | PS-4083 | PS-4008 | PS-4008 |
| | mf | 340-408 | 108-130 | 145-174 | 36-43 | 72-86 | 72-86 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| SN | CN1 Cut-out Switch | L-5022 | | | | | |
| SE | CE1 Cut-out Switch | L-5022 | | | | | |
| A3 | Emergency Position Auxiliary Contact | SPDT, L-5022; DPDT, L-5021 | | | | | |
| A4 | Normal Position Auxiliary Contact | SPDT, L-5022; DPDT, L-5021 | | | | | |
| DS | Disconnect Switch | Operator I-4018; Contact Block L-1028 | | | | | |

APPENDIX B - REPLACEMENT PARTS (Continued)

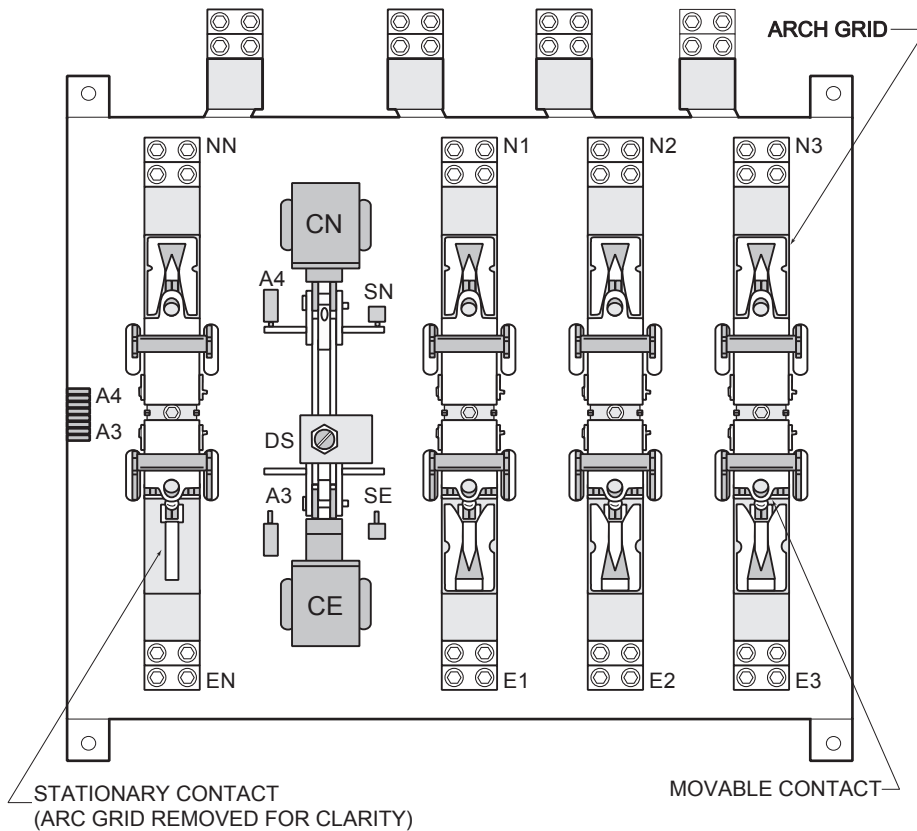
2. POWER PANEL - 400 AMPS



| TAG | DESCRIPTION | | | PART NUMBER |
|--|--------------------------------------|-----------------------|-------|-------------|
| N 1,2,3, N E 1,2,3, N T 1,2,3, N | Normal | Cable Connection Lugs | | PS1815F |
| | Emergency | #4-600 MCM | | |
| | Load | | | PS1815 |
| | Stationary Contact Assembly Kit | | | |
| | Stationary Load Contact Assembly Kit | | | 46P-1100E |
| | Arc Grid Assembly Kit | | | 46P-1101E |
| | Movable Contact Assembly Kit | | | 46P-1102E |
| | Linear Actuator and Capacitors | | | 46P-1103E |
| | Linear Actuator and Capacitors | | | 46P-1140 |
| CNE | Main ATS Operating Coils | Coil Volts | Poles | |
| | | 120 | 2 | K-2178 |
| | | 240 | 3,4 | K-2189 |
| | | 208 | 3,4 | K-2177 |
| | | 575/600 | 3,4 | K-2196 |
| | | 480 | 3,4 | K-2176 |
| | | 416 | 3,4 | K-2188 |
| 380 | 3,4 | K-2188 | | |
| SN | CN1 Limit Switch | | | L-5021 |
| SE | CE1 Limit Switch | | | |
| A3 | ATS Emergency Position Switch | | | |
| A4 | ATS Normal Position Switch | | | |
| SCN/SCE | CNE Limit Switches | | | L-3079 |
| | ATS Solenoid Disconnect Switch | | | |
| DS | Operator 2 - Position Maintain | | | L-4018 |
| | Contact Block N.C. (1) | | | L-1029 |
| | | | | |
| BR | Rectifier | | | PS-5076 |

APPENDIX B - REPLACEMENT PARTS (Continued)

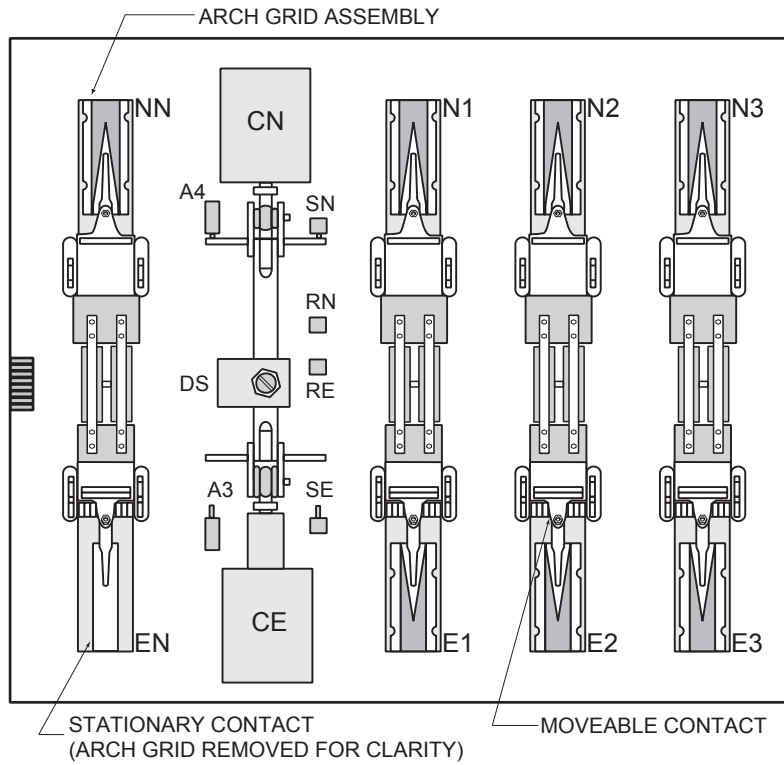
4a. POWER PANEL - 600-1200 AMPS



| TAG | DESCRIPTION | STOCK NUMBERS BY AMPERAGE | | | | | |
|--|---------------------------------|---|---------------|---------------|---------------|---------|---------|
| | | 600 | 800 | 1000 | 1200 | | |
| N 1,2,3, N E 1,2,3, N T 1,2,3, N | Cable Connection Lug | S1393F (2) | S1392F (4) | S1392F (4) | S1392F (4) | | |
| | Wire Size | #2-600 MCM | #2-600 MCM | #2-600 MCM | #2-600 MCM | | |
| | Stationary Contact Assembly Kit | Consult Factory | | | | | |
| | Arc Grid Assembly Kit | 23P-1366 | | | | | |
| | Movable Contact Assembly Kit | Consult Factory | | | | | |
| CN/CE | Main Operating Coils | Coil Volts | Poles | | | | |
| | | 120 | 2 | K-2090F | K-2073F | K-2073F | K-2073F |
| | | | 2 | K-2092F | K-2070F | K-2070F | K-2070F |
| | | 240 | 3 | K-2078F | K-2070F | K-2070F | K-2070F |
| | | | 4 | K-2091F | K-2074F | K-2074F | K-2074F |
| | | 208 | 3,4 | K-2091F | K-2074F | K-2074F | K-2074F |
| | | 575/600 | 3,4 | K-2095 | K-2155 | K-2155 | K-2155 |
| | | 480 | 3 | K-2080F | K-2071F | K-2071F | K-2071F |
| | | | 4 | K-2079F | K-2071F | K-2071F | K-2071F |
| | | 416 | 3 | K-2080F | K-2071F | K-2071F | K-2071F |
| SN | CCN Cut-out Switch | 23P-1333 | | | | | |
| SE | CCE Cut-out Switch | 23P-1327 | | | 23P-1452 | | |
| A3 | Emergency Position Aux Contact | (Qty 1) 23p-1327 (Qty 2) 23p-1328 (Qty 3) 23p-1334 (Qty 4) 23p-1336 | | | | | |
| A4 | Normal Position Aux Contact | (Qty 1) 23p-1333 (Qty 2) 23p-1334 (Qty 3) 23p-1328 (Qty 4) 23p-1330 | | | | | |
| DS | Disconnect Switch | Operator L-4009; ; Contact Block L-1020 | | | | | |

APPENDIX B - REPLACEMENT PARTS (Continued)

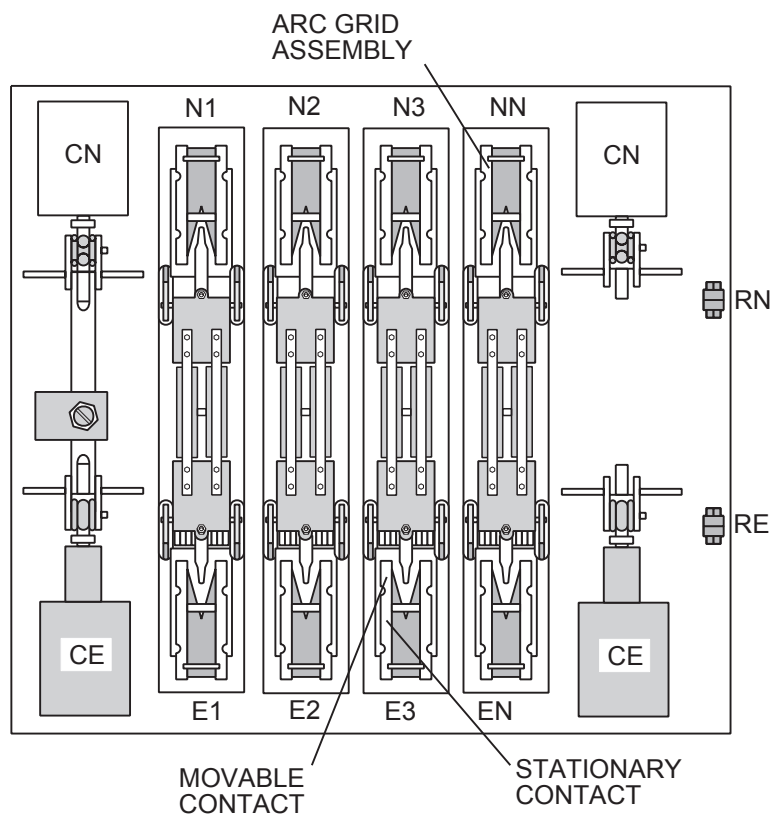
4a. POWER PANEL - 1600-3000 AMPS



| TAG | DESCRIPTION | | | STOCK NUMBERS BY AMPERAGE | | |
|--|---------------------------------|------------|---|---------------------------|------------------------|------------------------|
| | | | | 1600 | 1600 | 1600 |
| N 1,2,3, N E 1,2,3, N T 1,2,3, N | Cable Connection Lug | | | S1126F (2) Optional | S1126F (2) Optional | S1126F (2) Optional |
| | Wire Size | | | (8) #2-600 MCM | (8) #2-600 MCM | (8) #2-600 MCM |
| | Stationary Contact Assembly Kit | | | 23P-1594 | 23P-1594 | 23P-1594 |
| | Arc Grid Assembly Kit | | | 23P-1171 | 23P-1171 | 23P-1171 |
| | Movable Contact Assembly Kit | | | 23P-1400 | 23P-1400 | 23P-1400 |
| CN/CE | Main Operating Coils | Coil Volts | Poles | | | |
| | | 120 | 2 | SPO | SPO | SPO |
| | | 240 | 2,3 | K-2123F | K-2123F | K-2123F |
| | | | 4 | K-2127F | K-2127F | K-2127F |
| | | 208 | 3 | K-2125F | K-2125F | K-2125F |
| | | | 4 | K-2128F | K-2128F | K-2128F |
| | | 575/600 | 3 | K-2153F | K-2153F | K-2153F |
| | | | 4 | K-2154F | K-2154F | K-2154F |
| | | 480 | 3 | K-2120F | K-2120F | K-2120F |
| 4 | K-2130F | | K-2130F | K-2130F | | |
| | 416 | 3 | K-2126F | K-2126F | K-2126F | |
| SN | CCN Cut-out Switch | | 23P-1352 | | | |
| SE | CCE Cut-out Switch | | 23P-1356 | | | |
| A3 | Emergency Position Aux Contact | | (Qty 1) 23p-1356 (Qty 2) 23p-1357 (Qty 3) 23p-1353 (Qty 4) 23p-1355 | | | |
| A4 | Normal Position Aux Contact | | (Qty 1) 23p-1352 (Qty 2) 23p-1353 (Qty 3) 23p-1357 (Qty 4) 23p-1359 | | | |
| DS | Disconnect Switch | | Operator L-4009; ; Contact Block L-1020 | | | |
| RN, RE | Rectifier | | 23P-1473 (Up to 240V); 23P-1582 (Up to 600V) | | | |

APPENDIX B - REPLACEMENT PARTS (Continued)

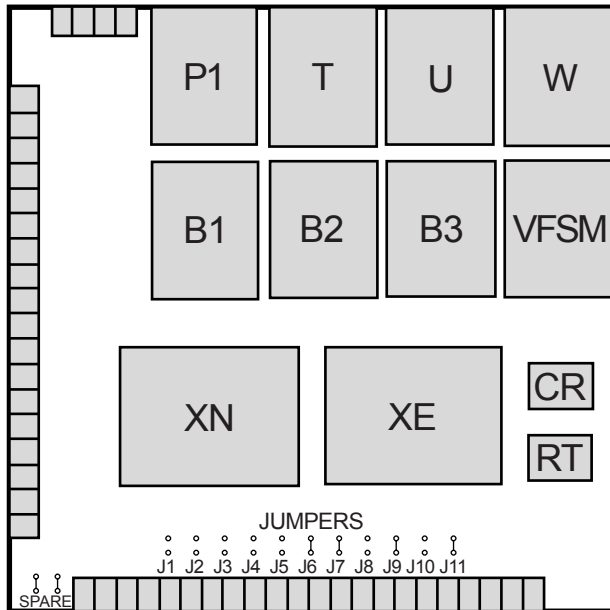
4a. POWER PANEL - 4000 AMPS



| TAG | DESCRIPTION | | | STOCK NUMBERS | |
|--|---------------------------------|------------|--|------------------------|---|
| N 1,2,3, N E 1,2,3, N T 1,2,3, N | Cable Connection Lug | | | S1511F (3) Optional | |
| | Wire Size | | | (12) #2-600 MCM | |
| | Stationary Contact Assembly Kit | | | 23P-1655 | |
| | Arc Grid Assembly Kit | | | 23P-1171 | |
| | Movable Contact Assembly Kit | | | 23P-1640 | |
| CN/CE | Main Operating Coils | Coil Volts | 240 | 3 4 | K-2219 K-2219 |
| | | | 208 | 3 4 | K-2226 K-2226 |
| | | 575/600 | | 3 4 | K-2221 K-2221 |
| | | | 480 | 3 4 | K-2218 K-2218 |
| | | 416 | | 3 | K-2220 |
| | | SN | CCN Cut-out Switch | | 23P-1352 |
| | | SE | CCE Cut-out Switch | | 23P-1356 |
| | | A3 | Emergency Position Aux Contact | | (Qty 1) 23p-1356 (Qty 2) 23p-1357 (Qty 3) 23p-1353 (Qty 4) 23p-1355 |
| | | A4 | Normal Position Aux Contact | | (Qty 1) 23p-1352 (Qty 2) 23p-1353 (Qty 3) 23p-1357 (Qty 4) 23p-1359 |
| | | DS | Disconnect Switch | | Operator L-4009; ; Contact Block L-1020 |
| RN, RE | Rectifier | | 23P-1473 (Up to 240V); 23P-1582 (Up to 600V) | | |

APPENDIX B - REPLACEMENT PARTS (Continued)

5. STANDARD CONTROL PANEL (SSRCP)

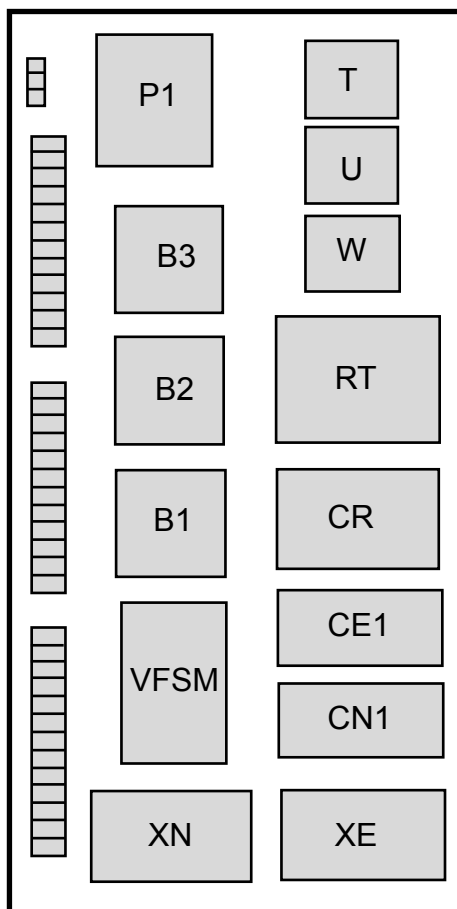


| JUMPER | CONNECTS POINTS | REMOVE WHEN ACCESSORIES USED |
|--------|-----------------|------------------------------|
| J1 | 23, 23A | B1 |
| J2 | 23A, 23B | B2 |
| J3 | 23B, 23C | B3 |
| J4 | 23C, 23Z | JIN, TS, C/D |
| J5 | 23Z, 27 | T, YN |
| J6 | 25, 25Z | T3, R4 |
| J7 | 28, 28Z | S1, C, C/D |
| J8 | 28Z, 29 | P1 & U |
| J9 | 33A, 33Y | ER1, 2, 3, J1E |
| J10 | 33Z, 37 | W |
| J11 | 35, 35Z | R4, W3 |

| TAG | DESCRIPTION | VOLTAGE 50/60 HZ | | PART NUMBER |
|-------------------------|---|-----------------------------------|-------|-------------|
| XN, XE | Control Transformers (See Note 1) | 120 V | | K-3068 |
| | | 208 V | | K-3070 |
| | | 240 or 480 V | | K-3071 |
| | | 416 V | | K-3089 |
| B 1, 2, 3 | Phase Relays Solid State (See Note 1) | 120 V | | K-1185 |
| | | 208 or 240 V | | K-1186 |
| | | 480 V | | K-1186 |
| VFSM | Voltage Frequency Sensor | 120 V | | K-1192 |
| CR | Control Relay | 120 V | | K-1204 |
| RT | Bypass T Relay | 120 V | | K-1204 |
| CN1, CE1 or CCN, CCE | Transfer Relays (Mounted below SSRCP) | ZTSH 4-40, ZTSH 160-300 | 120 V | K-1120 |
| | | ZTSH 60-120 | 120 V | K-1095 |
| T | Time Delay-to-Normal, Timer Solid State | 0.1 sec. to 100 hours; adjustable | 120 V | K-1230 |
| U | Engine Cool Down, Timer Solid State | 0.1 sec. to 100 hours; adjustable | 120 V | K-1230 |
| W | Time Delay Emergency, Timer Solid State | 0.1 sec. to 100 hours; adjustable | 120 V | K-1230 |
| P1 | Time Delay Engine Start Timer | 0.5 sec. to 6 sec.; adjustable | 120 V | K-1201 |
| P2 | Optional (Mounted below SSRCP) | 0.5 sec. to 300 sec.; adjustable | 120 V | K-1061 |
| J1 - J11 | Jumpers | | | PS-5067 |

NOTES: 1. If -6 voltage system (575/600V is supplied, then XN, XE is K-3087 and B1, 2, 3 is K-1185 (120V) supplied with XB (575-600V/120V) 3 phase transformer assembly.

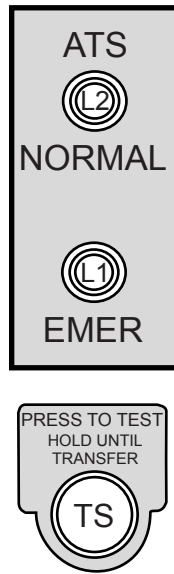
6. OPTIONAL CONTROL PANEL



| TAG | DESCRIPTION | VOLTAGE 50/60 HZ | | PART NUMBER |
|-------------------------|---|-----------------------------------|-------|-----------------|
| XN, XE | Control Transformers (See Note 1) | 120 V | | K-3068 |
| | | 208 V | | K-3053 |
| | | 240 or 480 V | | K-3041 |
| | | 416 V | | K-1055 (K-1185) |
| B 1, 2, 3 | Phase Relays Electro-Mechanical-Standard Solid State (See Note 1) | 120 V | | K-1056 (K-1186) |
| | | 208 or 240 V | | K-1058 (K-1188) |
| | | 480 V | | K-1186 |
| VFSM | Voltage Frequency Sensor | 120 V | | K-1192 |
| CR | Control Relay | 120 V | | Y-260002 |
| RT | Bypass T Relay | 120 V | | Y-260002 |
| CN1, CE1 or CCN, CCE | Transfer Relays | ZTSH 4-40, ZTSH 160-300 | 120 V | K-1120 |
| | | ZTSH 60-120 | 120 V | K-1095 |
| T | Time Delay-to-Normal, Timer Solid State | 0.1 sec. to 100 hours; adjustable | 120 V | K-1230 |
| U | Engine Cool Down, Timer Solid State | 0.1 sec. to 100 hours; adjustable | 120 V | K-1230 |
| W | Time Delay Emergency, Timer Solid State | 0.1 sec. to 100 hours; adjustable | 120 V | K-1230 |
| P1 | Time Delay Engine Start Timer | 0.5 sec. to 6 sec.; adjustable | 120 V | K-1201 |
| P2 | Optional | 0.5 sec. to 300 sec.; adjustable | 120 V | K-1061 |

NOTES: 1. If -6 voltage system (575/600V is supplied, then XN, XE is K-3059 and B1, 2, 3 is K-1155 (120V) supplied with XB (575-600V/120V) 3 phase transformer assembly.

6. OPTIONAL CONTROL PANEL



| TAG | DESCRIPTION | PART NUMBER |
|----------|--|--|
| L1 L2 | ATS Emergency Position Indicator ATS Normal Position Indicator Lens (Normal) Lens (Emergency) Bulb Socket Emergency Bulb Normal Bulb | PS-5048 (Green) PS-5047 (Red) PS-5046 (Incandescent) PS-5105 (Incandescent) PS-5105 (Incandescent) |
| TS | Test Switch Operator, Momentary Contact Block N.C. Contact Mounting Base | L-1025 L-1029 PS-3473 |



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