
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)*

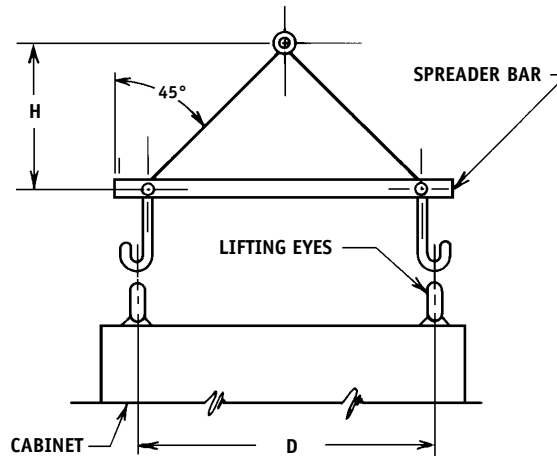


Figure 1

▲ 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	Line and load terminals are located in rear and arranged for bus bar connection.		12	3/0 AWG to 750 MCM
2000			12	3/0 AWG to 750 MCM
3000			12	3/0 AWG to 750 MCM
4000			12	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

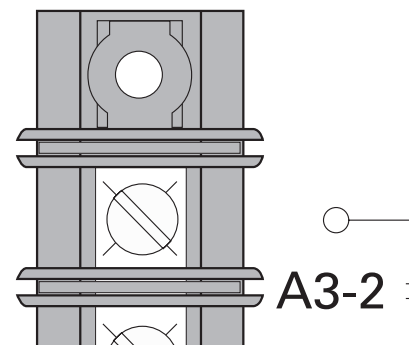


Figure 3

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.

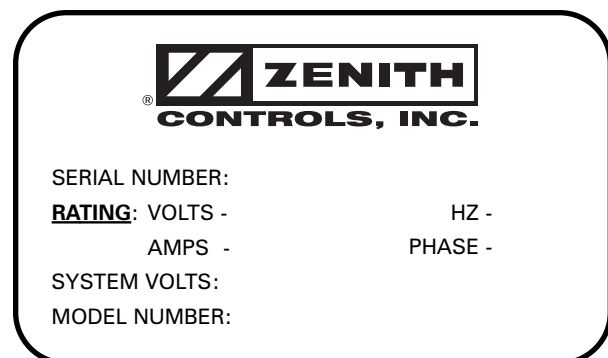


Figure 5

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

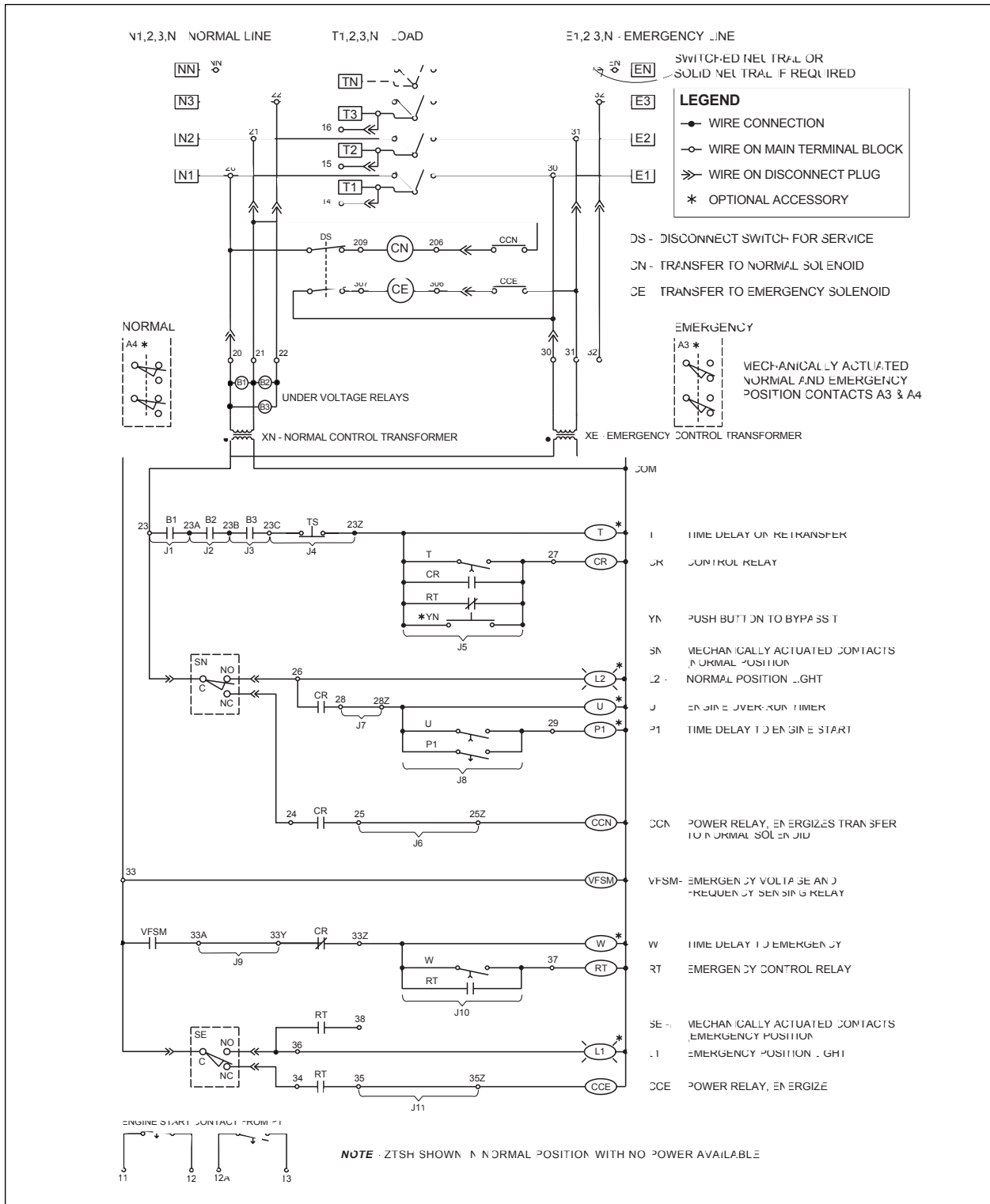


Figure 6

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*.

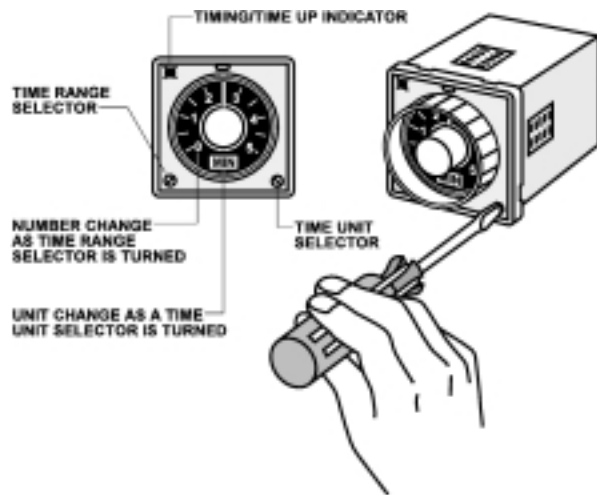


Figure 7

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%

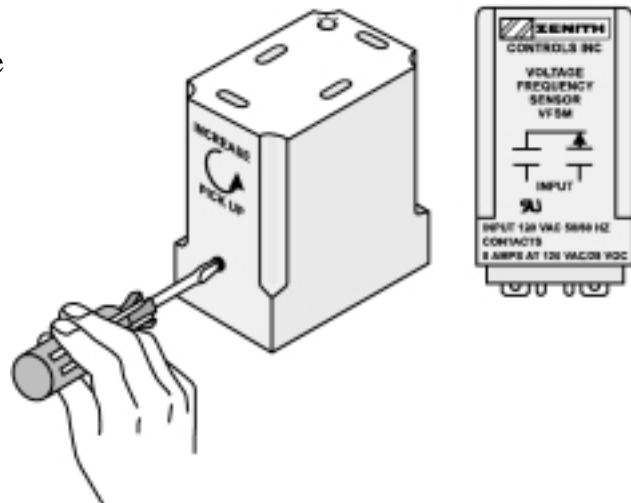


Figure 8

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.

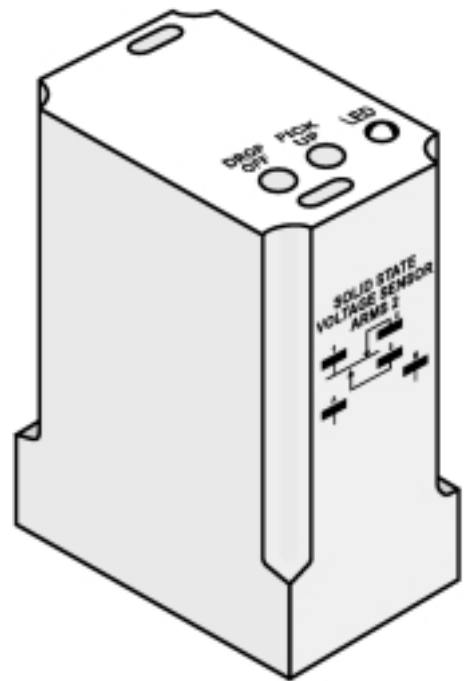


Figure 9

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.

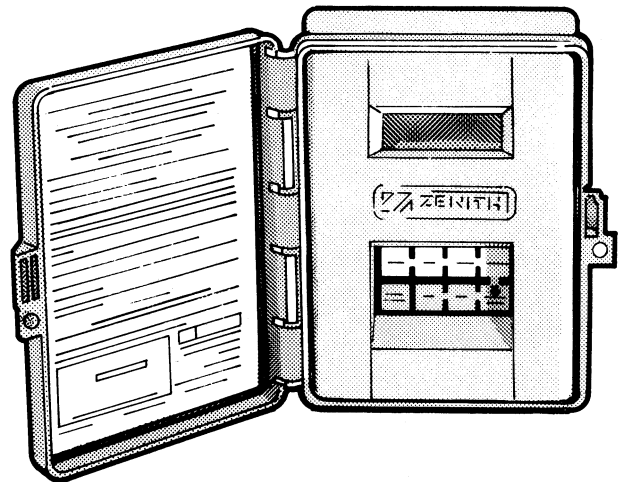


Figure 10

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.

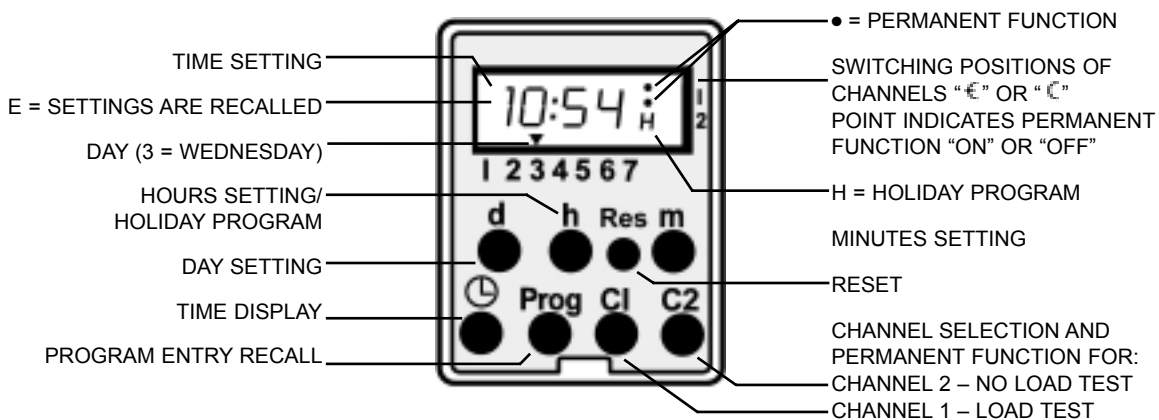



Figure 9

SECTION IV - ADJUSTMENTS AND SETTINGS (Continued)

e. Program Recall/Review

Press "Prog" button repeatedly to recall and review the programmed "C1" and "C2" OFF/ON times. An "E" is displayed either when all 24 program positions are used or if the next available program position is not filled. Press " to return to clock run mode.

f. Change or Clear Program

Press "Prog" button to reach program to be changed or cleared. Change the program by pressing "d", "h" or "m" buttons as required. Clear the entire program by simultaneously pressing "h" and "m".


g. Temporary Override

Each channel state (ON or OFF) can be manually changed before or after the program automatically changes by pressing "C1" or "C2". The next counteracting program cancels the manual override and resumes previous programming.

h. Continuous Override

To continuously override automatic programming, press "m" and "C1" or "m" and "C2". The continuous override "ON" or "OFF" state is preceded by a black dot on the display. To cancel press "m" and "C1" or "C2" until the dot disappears.

i. Holiday Program Override


The holiday program may be set up to 99 days in advance with a program range of 1 to 99 days. While holding down the "h" button, depress the "d" button to enter the number of days before the holiday begins (not including the present day). While holding down the "h" button, depress the "m" button to enter the number of days the holiday will be. During the holiday period the symbol " will be displayed in the upper right hand corner of the display and the channel symbol "C" will be off. To manually cancel the holiday override, the buttons "h", "d" and "m" must be used as described above to reset the holiday program to "00:00". This results in the time switch checking the stored program and implementing the correct switching condition.

j. Programming Examples

EXAMPLE 1


Engine switches "ON" (Channel 1), after simulating normal power failure, at 7:15 a.m. and "OFF" at 7:45 p.m. every day of the week.

1. Press "Prog" once.
2. Press "C1" once (Start "ON" program).

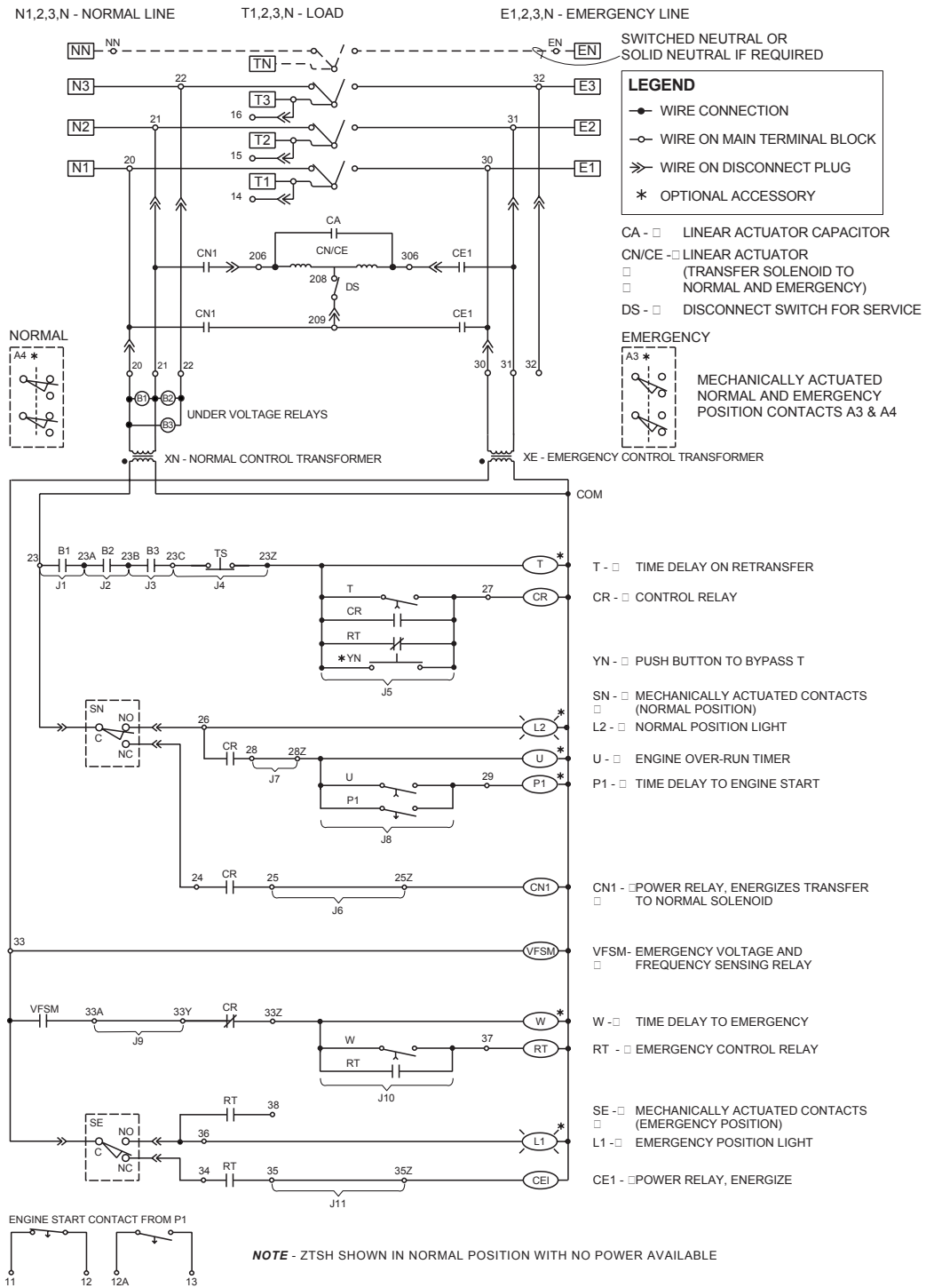
3. Alternatively press "Prog", "d", "Prog", "d", "Prog", "d", "Prog", "d", "Prog", "d", "Prog", "d", "Prog", "d", "Prog", "AGAIN, Seven solid arrows will be displayed over 1 thru 7.
4. Press "h" to 7:00 a.m.
5. Press "m" to 7:15 a.m.
6. Press "prog" to enter the "ON" program into memory.
7. Press "C1" twice (Start "OFF" program).
8. Repeat Step 3.
9. Press "h" to 7:00 p.m.
10. Press "m" to 7:45 p.m.
11. Press "Prog" to enter the "OFF" program into memory.
12. Press " to return to clock run mode.

EXAMPLE 2

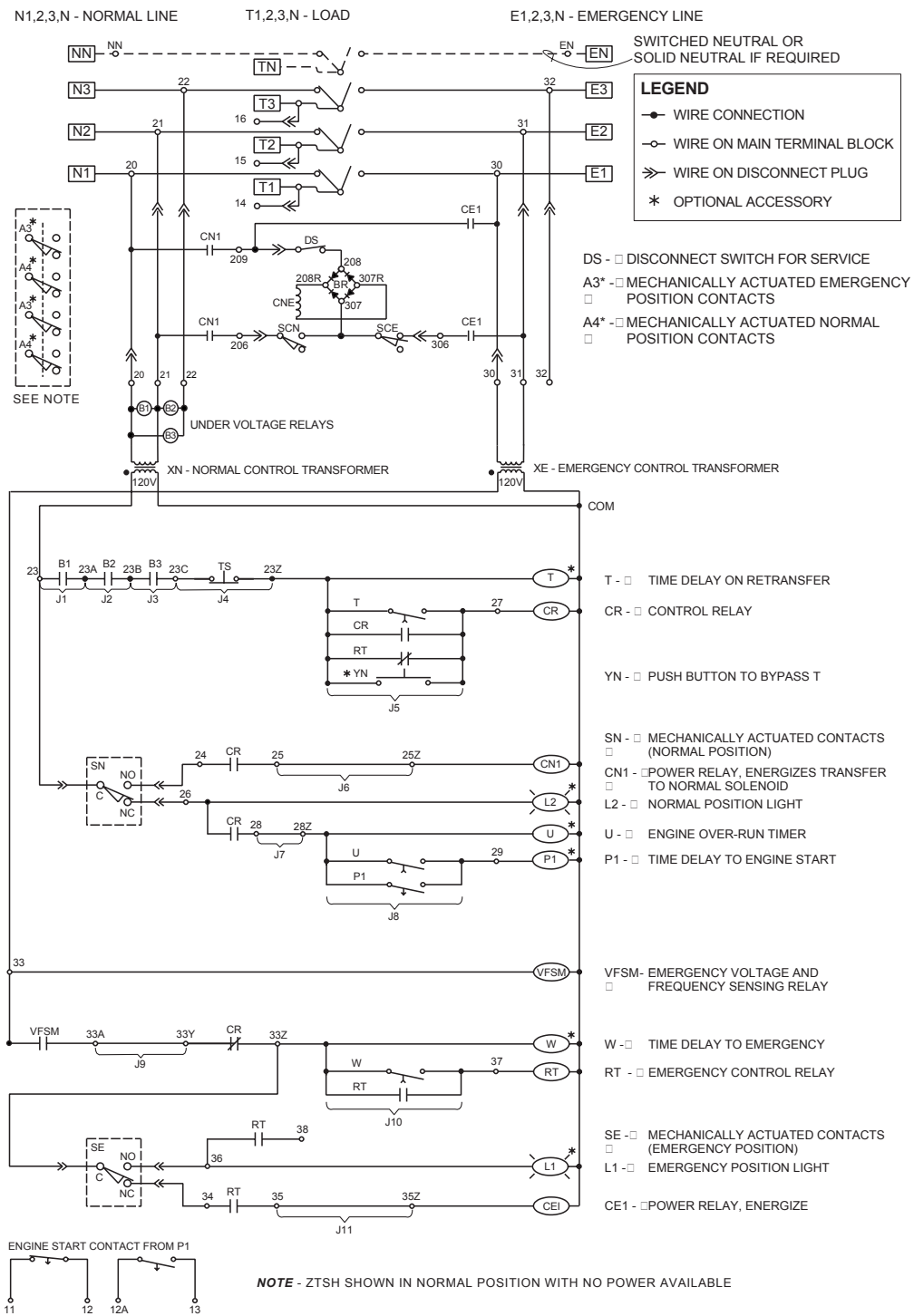
Engine switches "ON" (Channel C2) at 5:00 p.m. and "OFF" at 5:30 p.m. Monday thru Friday (no load test). Engine switches "ON" (Channel 1) after simulating normal power failure at 9:00 a.m. and "OFF" at 9:30 a.m. Saturday and Sunday.

1. Press "Prog" once.
2. Press "C2" once (Start CH2 "ON" PGM).
3. Alternately press "Prog", "d", "Prog", "d", "Prog", "d", "Prog", "d", "Prog", Five solid arrows should be displayed over 1 thru 5.
4. Press "h" to 5:00 p.m.
5. Press "Prog" to enter C2 "ON" program into memory.
6. Press C2 twice (Start CH2 "OFF" PGM).
7. Repeat Step 3.
8. Press "h" to 5:00 p.m.
9. Press "m" to 5:30 p.m.
10. Press "Prog" to enter C2 "OFF" PGM into memory.
11. Press "Prog" once.
12. Press "C1" once (Start CH1 "ON" PGM).
13. Press "d" five times, (blinking arrow over 6, Saturday).
14. Press "Prog", "d", "Prog", (two solid arrows over 6 and 7).
15. Press "h" to 9:00 a.m.
16. Press "Prog" to enter C1 "ON" PGM into memory.
17. Press "C1" twice (Start C1 "OFF" PGM).
18. Repeat Step 13.
19. Repeat Step 14.
20. Press "h" to 9:00 a.m.
21. Press "m" to 9:30 a.m.
22. Press "Prog" to enter C1 "OFF" PGM into memory.
23. Press " to return to clock run mode.

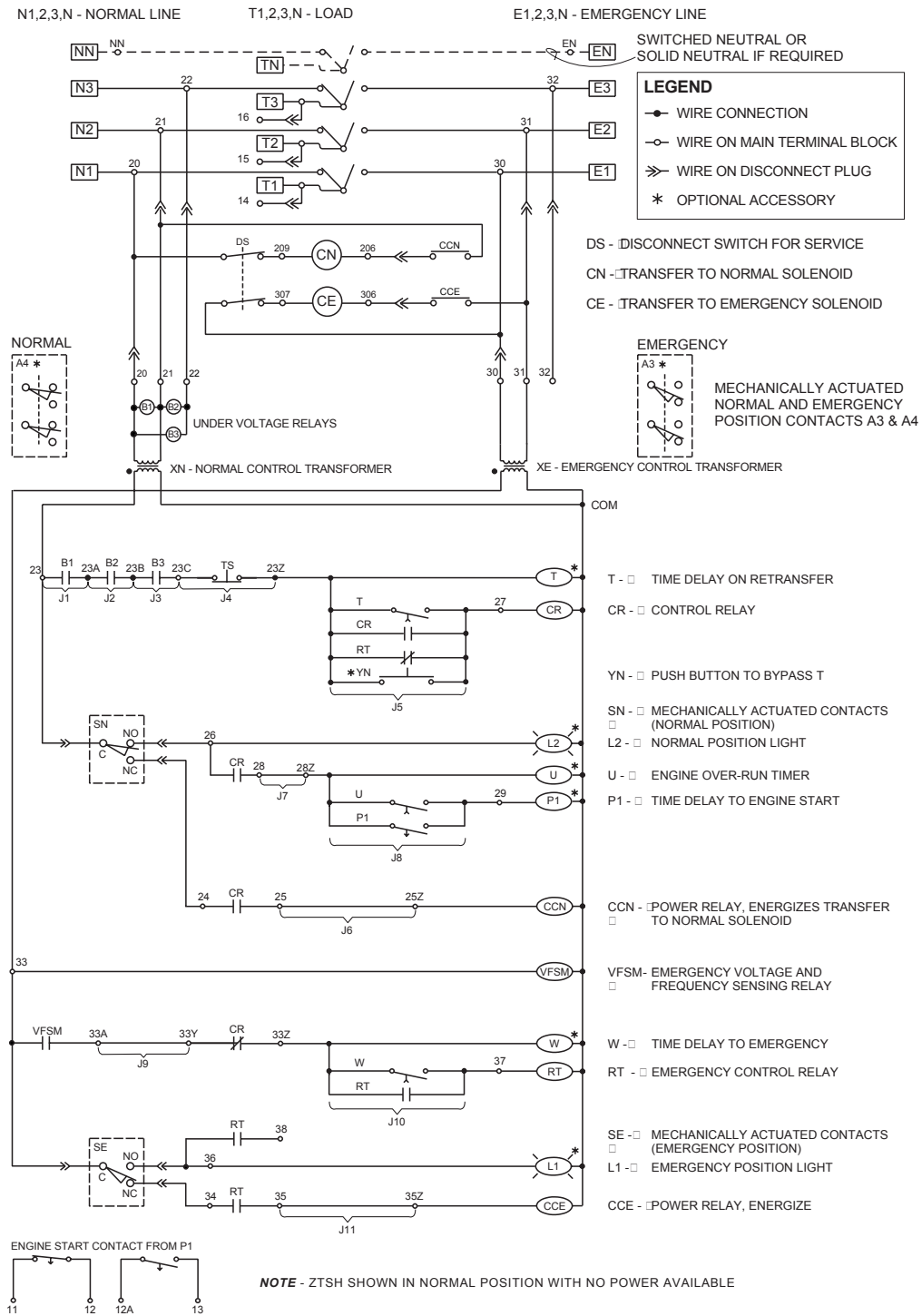
APPENDIX A - TYPICAL SCHEMATIC DIAGRAM 40 - 260 AMPS



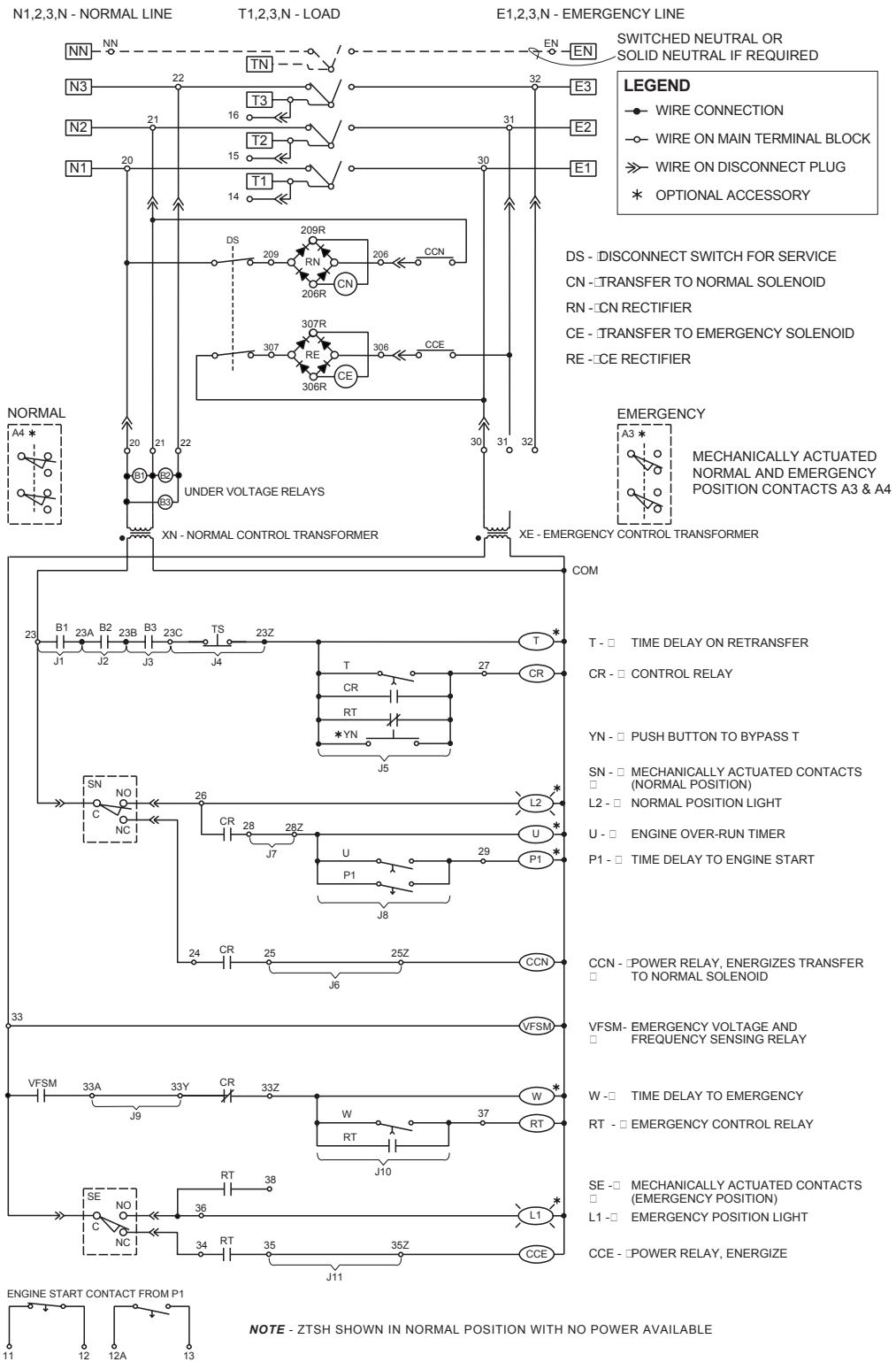
APPENDIX A - TYPICAL SCHEMATIC DIAGRAM 40 - 260 AMPS



APPENDIX A - TYPICAL SCHEMATIC DIAGRAM 40 - 260 AMPS

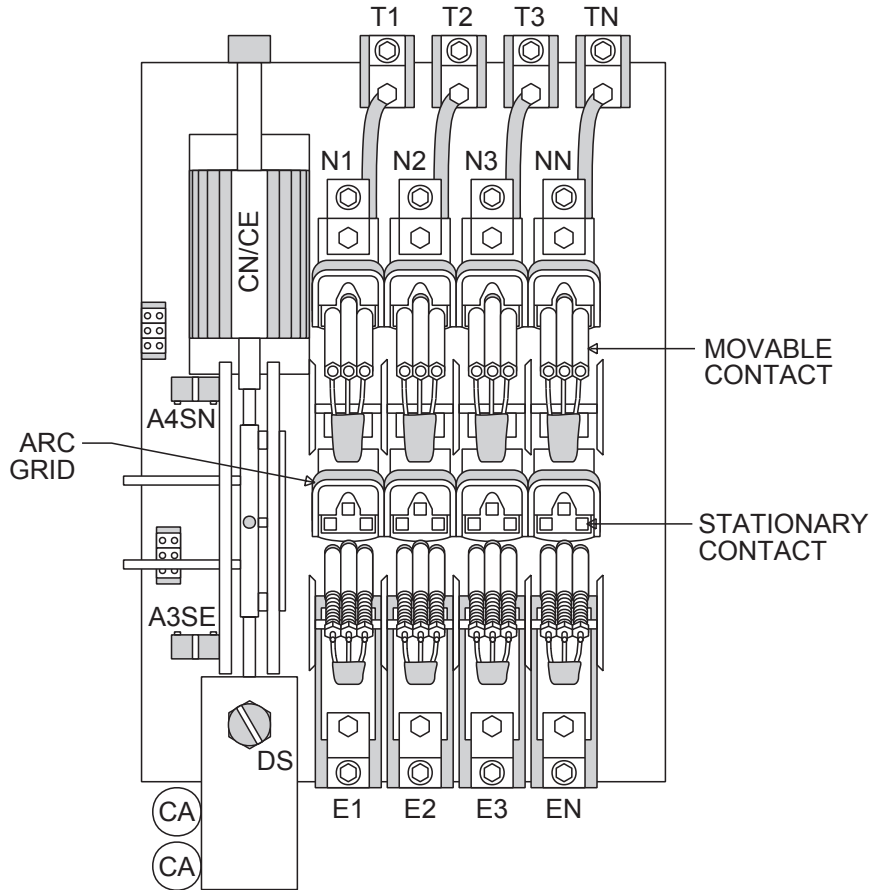


APPENDIX A - TYPICAL SCHEMATIC DIAGRAM 40 - 260 AMPS



APPENDIX B - REPLACEMENT PARTS

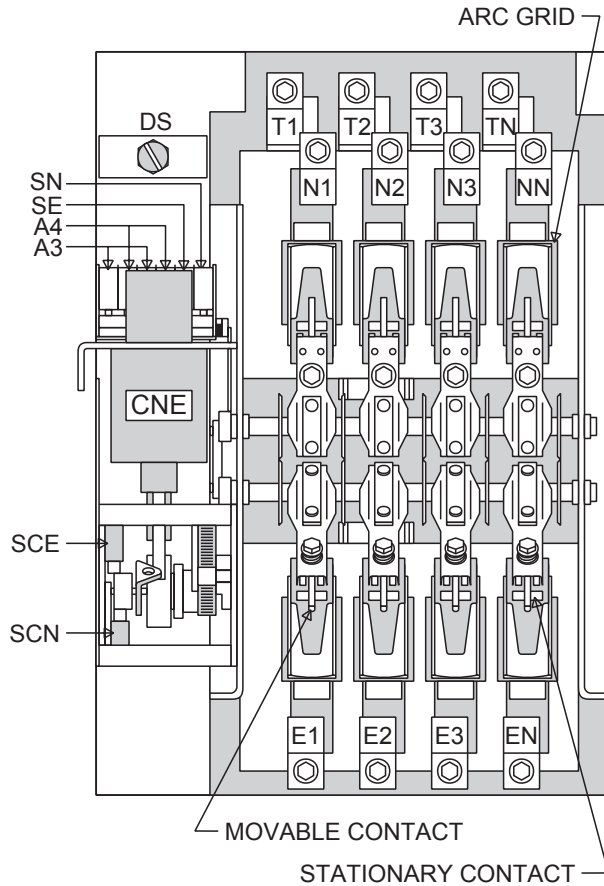
1. POWER PANEL - 40 TO 260 AMPS



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				Quantity	Part	mf
	120	2	K-2104PN	1	PS-4007	340-408	
	240	2	K-2105PN	1	PS-4016	108-130	
		3					
	208	3	K-2141PN	1	PS-4084	145-174	
		4	K-2142PN	1	PS-4084	145-174	
	575/600	3	K-2198PN	2S	PS-4083	36-43	
		4	K-2197PN	2S	PS-4083	36-43	
	480	3	K-2119PN	2S	PS-4008	72-86	
		4	K-2111PN	2S	PS-4008	72-86	
416	3	K-2190PN	2S	PS-4008	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)

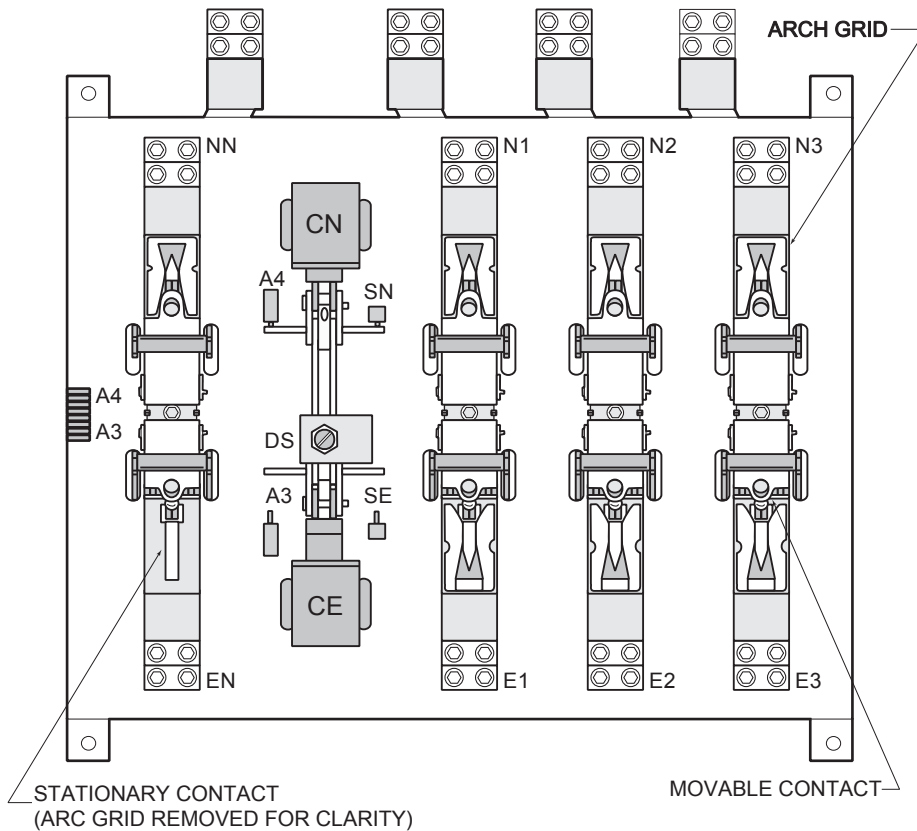
2. POWER PANEL - 400 AMPS



TAG	DESCRIPTION		PART NUMBER	
N 1,2,3, N E 1,2,3, N T 1,2,3, N	Normal	Cable Connection Lugs #4-600 MCM	PS1815F	
	Emergency			
	Load			
	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	
DS	ATS Solenoid Disconnect Switch		L-4018 L-1029	
	Operator 2 - Position Maintain			
	Contact Block N.C. (1)			
BR	Rectifier		PS-5076	

APPENDIX B - REPLACEMENT PARTS (Continued)

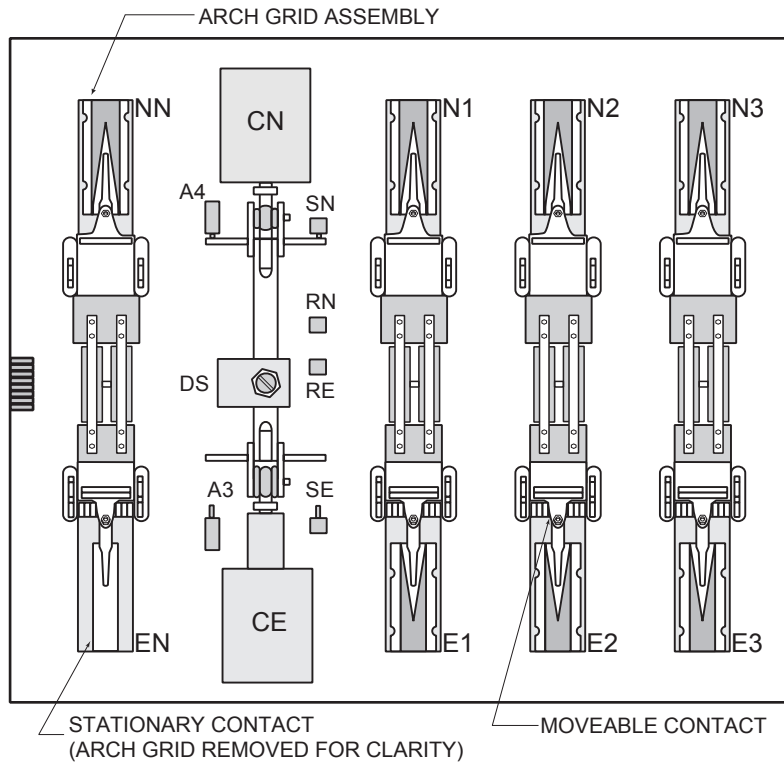
4a. POWER PANEL - 600-1200 AMPS



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)

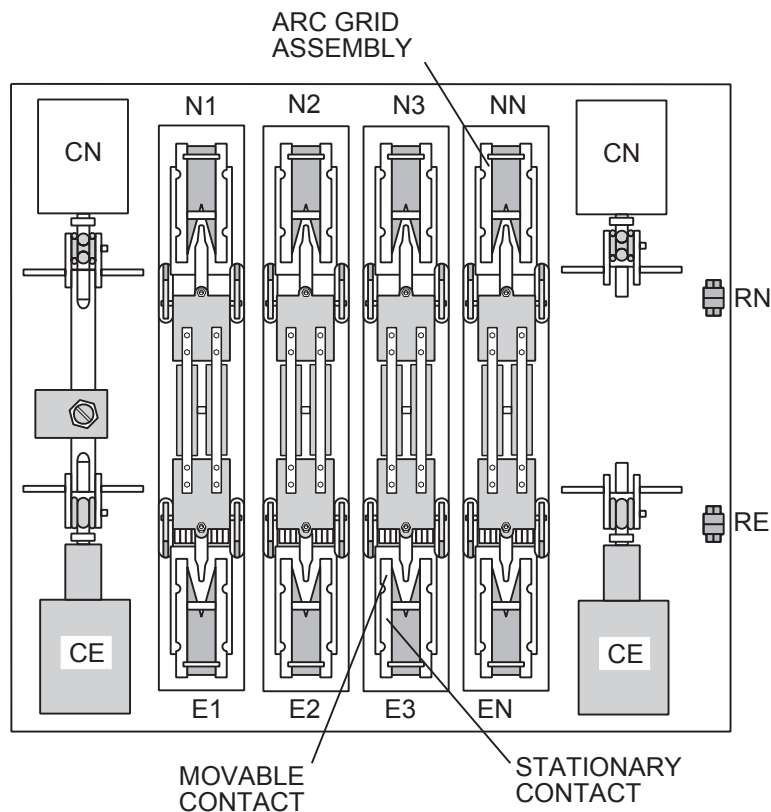
4a. POWER PANEL - 1600-3000 AMPS



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)

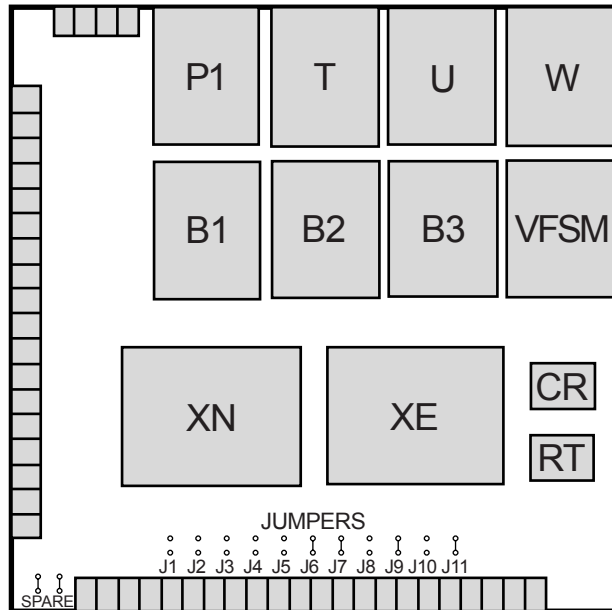
4a. POWER PANEL - 4000 AMPS



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	240	3	K-2219
			4	K-2219
		208	3	K-2226
			4	K-2226
		575/600	3	K-2221
			4	K-2221
		480	3	K-2218
			4	K-2218
		416	3	K-2220
		SN	CCN Cut-out Switch	
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)

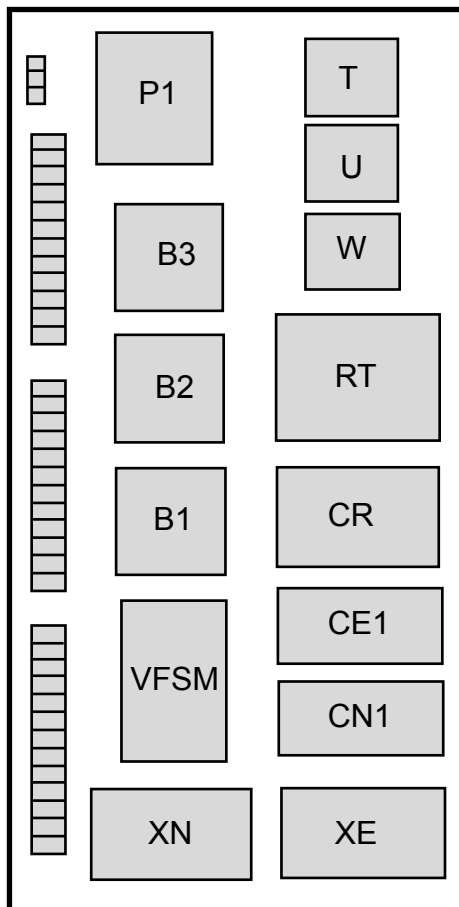


JUMPER	CONNECTS POINTS	REMOVE WHEN ACCESSORIES USED
J1	23, 23A	B1
J2	23A, 23B	B2
J3	23B, 23C	B3
J4	23C, 23Z	JIN, TS, C/D
J5	23Z, 27	T, YN
J6	25, 25Z	T3, R4
J7	28, 28Z	S1, C, C/D
J8	28Z, 29	P1 & U
J9	33A, 33Y	ER1, 2, 3, J1E
J10	33Z, 37	W
J11	35, 35Z	R4, W3

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
VFMS	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.

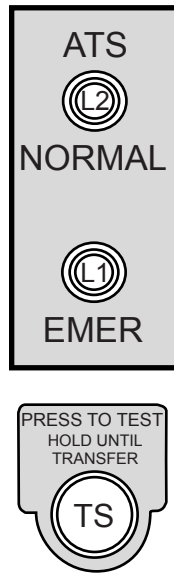
6. OPTIONAL CONTROL PANEL



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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