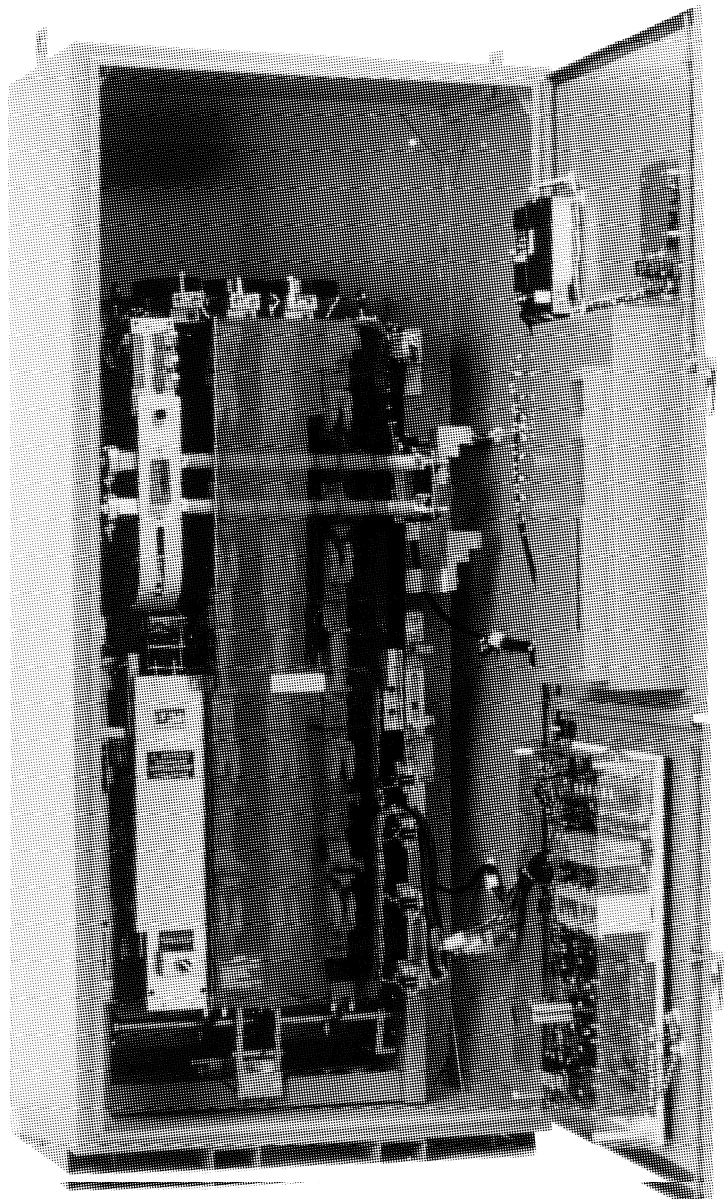
ZENITH CONTROLS, INC.

OPERATION AND MAINTENANCE MANUAL
ZBTSCTH SERIES POWER PANEL
100 - 4000 AMPS



ISO 9001

46R-7000D
Rev 8/97

INTRODUCTION

Zenith Bypass-Isolation Closed Transition Transfer Switches provide Zenith's most comprehensive load power protection during standard operation, maintenance and testing procedures.

Closed Transition Transfer Switches parallel two available sources of power during test procedures to enable transfer without interrupting power to the load (make-before-break). Paralleling of the two sources occurs within a predefined window of synchronization and the initial source is then disconnected. If the primary source falls below preset voltage limits and the second source is available, the transfer switch defaults to open transition (break-before-make) mode. In this mode, the transfer switch uses the power from the available source to open the switch from the "dead source" first, before closing the switch into the second source. When in the Bypass-Isolation mode, the switch acts as a manual transfer switch, enabling testing, repair and even removal of the automatic transfer switch.

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.

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SECTION I - 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.

1. REQUIREMENTS

⚠ DANGER

Closed transition transfer switches typically require momentary paralleling of utility and generator sources. The customer should obtain approval from their utility before using a closed transition transfer switch.

The following requirements must be met to use a closed transition transfer switch:

a. Isochronous governor with a frequency range of 60 ± 0.2 Hz.
b. Shunt trip breaker on the genset with a response time not exceeding 50 milliseconds.

2. 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 + 65 C (-22 F to +149 F)

Operating Temperature (Ambient):
-20 C to +75 C (-4 F to +167 F) [40-260 Amps]
-20 C to +40 C (-4 F to +104 F) [400-3000 Amps]

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

3. 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 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.

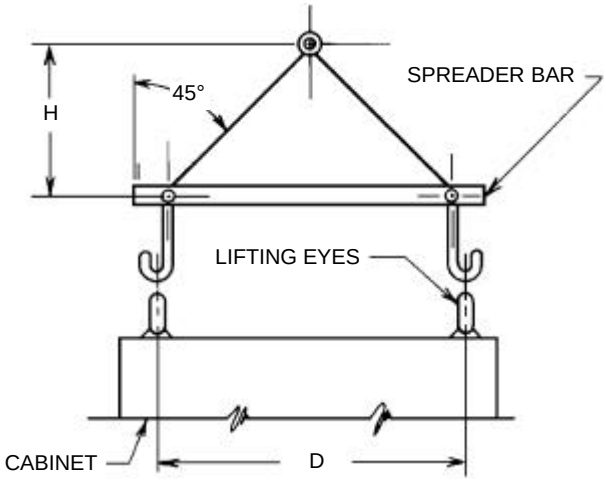


Figure 1

⚠ NOTICE

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

4. 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 the 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*.

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	Number of Cables	Number of Cables
100	1	#14 to 1/0 AWG	3	#14 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	#6 AWG to 300 MCM
600	2	#2 AWG to 600 MCM	8	#2 AWG to 600 MCM
800 1000 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	3/0 AWG to 750 MCM

Table 1

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

5. 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 right corner of the bypass cabinet. 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 left side of the ATS power panel. *Figure 2* below shows the location of these terminals.

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 *Table 4*.

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

Table 4

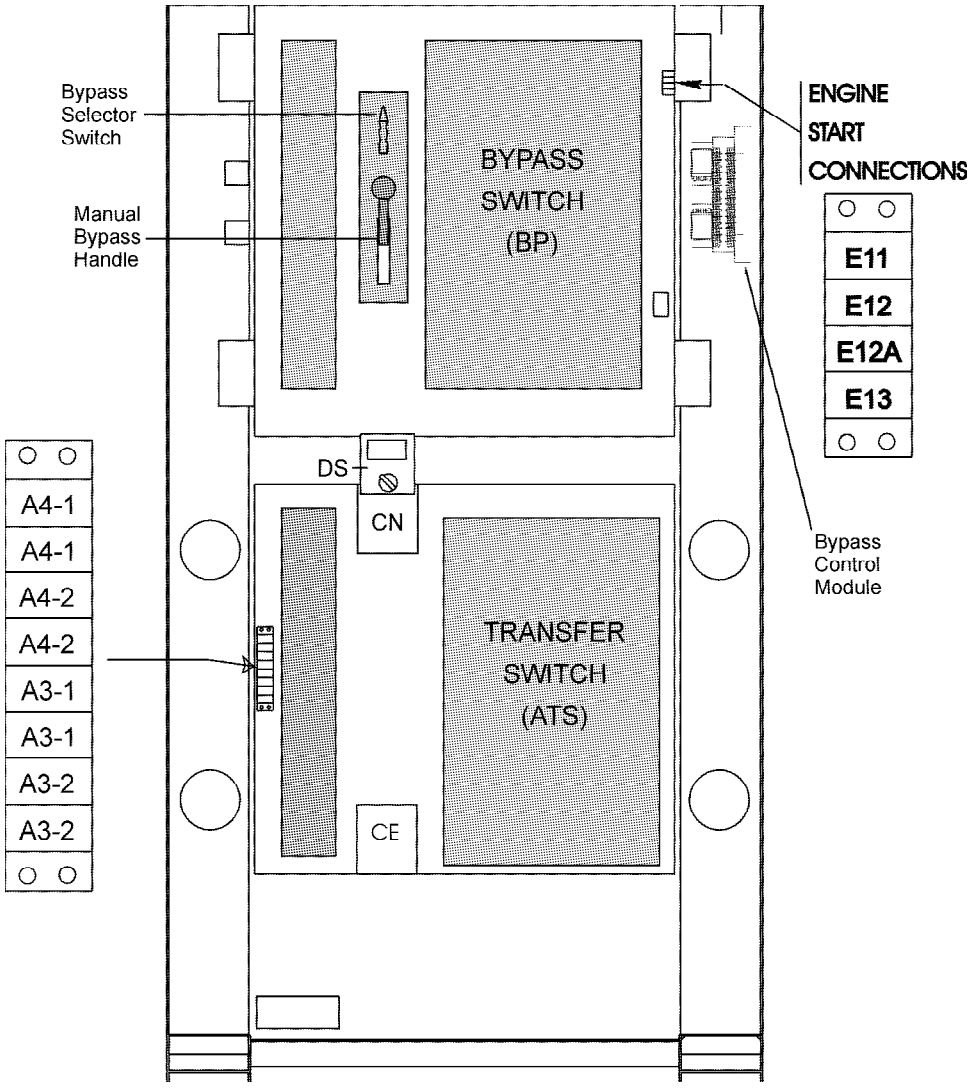


Figure 2

6. FINAL EQUIPMENT INSPECTION

Prior to energizing the transfer switch:

a. 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.
b. Verify that all cabled connections are correct and that phase rotation of both sources match.
c. Check engine start connections and verify the correct connection of all control wires.
d. Check settings of all timers and adjust as necessary. Also adjust any optional accessories as required. [See MX200 manual (50R-2000) for instructions on timer and option adjustments.]
e. Check the integrity of power connections by verifying actual lug torque values as specified in this manual.
f. Make sure that all covers and barriers are installed and properly fastened.

7. FUNCTIONAL TEST

The functional testing of the transfer switch consists of 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.

Before starting the 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 3.*

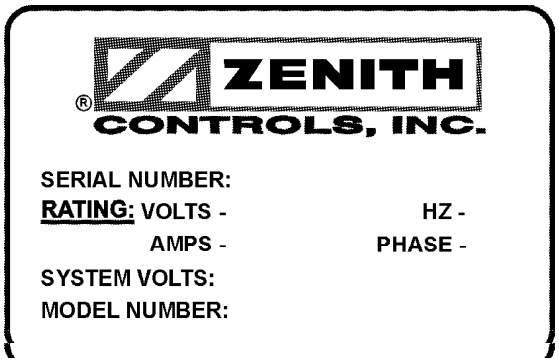


Figure 3

To begin the test, close the Normal source circuit breaker. Phase relays B1, B2, and B3 will pick up and the LED indicators will illuminate. Verify the phase to phase voltages at the Normal line terminals.

Next, close the Emergency source breaker and start the engine generator. The VFSM relay will pick up and the LED indicator will illuminate. 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 test switch (TS). This de-energizes the engine start relay. The transfer switch closes into Emergency only after the sync-check relay ensures the proper phase relationship of both sources. After the transfer switch closes into Emergency, the SE limit switch becomes activated to de-energize the CCE relay and energize the CCNO relay. This opens the transfer switch out of Normal. When the transfer switch has opened out of Normal, the SNO-2 limit switch activates to de-energize the CCNO relay. The transfer switch has now closed into Emergency power without interrupting the load.

Turning the TS to AUTO initiates re-transfer to Normal. The transfer switch closes into Normal only after the sync-check relay ensures the proper phase relationship of both sources. After the transfer switch closes into Normal, the SN limit switch becomes activated (de-activated in 400 Amp units) to de-energize the CCN relay and energize the CCEO relay; the transfer switch opens out of Emergency. Then the SEO-2 limit switch activates to de-energize the CCEO relay. The transfer switch has now closed back into Normal power without interrupting the load.

The transfer switch defaults to an open transition transfer when the Normal source fails. Closed transition transfer is not possible with one source available. Open transition transfer for testing can be selected via the transition mode selector switch. (For a description of the Open Transition sequence of operation, refer to Section II - Operation and Features, page 6.)

A 24 VDC circuit is supplied to control the alarm and warning indicators. To ensure continuous power to this circuit, a constant 24 VDC can be supplied by the customer from the engine start battery.

⚠ NOTICE

A periodic test of the transfer switch under load conditions is recommended to insure proper operation.

SECTION II - OPERATION AND FEATURES

1. SEQUENCE OF OPERATION

Figure 4 is a typical schematic diagram of a Zenith closed transition transfer switch. The information supplied with the transfer switch includes a schematic diagram and description of operation of all accessories provided.

Transfer of the load 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 solid state phase relays B1, B2, B3.

The phase relays drop out, de-energizing the Normal control relays CR & CR2, 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 phase relays' pickup setting, the P1 timing cycle is reset to zero by re-energizing 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 transfer to the Emergency source and timer W begins it timing cycle. The W timer provides an adjustable transfer delay to the Emergency source as required.

When the W time is completed, the Emergency control relay RT energizes and picks up the CCNO relay. The CNO solenoid is then energized to open the transfer switch from normal position to neutral position. The switch remains in the neutral position for the duration of the DW time delay. After the DW time delay is completed, the CCE relay energizes the CE solenoid to close the transfer switch into the emergency source. The SE limit switch activates to de-energize the CCE relay.

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, B1, B2, B3.

When the Normal source restores and if the transition mode selector switch is in CT (Closed Transition), the transfer switch will return to the Normal source in a make-before-break sequence (this is described in the Testing section of this manual).

If the transition mode selector switch is in OT (Open Transition), the transfer switch will return to the normal source in a break-before-make sequence. When the Normal source restores, the solid state phase relays, B1, B2, B3 pick up and switching to the Normal source is initiated by energizing timer T, beginning its timer cycle. The T timer provides an adjustable delay to insure that the Normal source has stabilized before reconnection to the load. If the Normal source fails before the T time delay completes, 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 CCEO. This energizes the CEO solenoid opening the transfer switch out of the emergency source. The SEO-1 limit switch activates to energize the DT time delay and de-energize the CCEO relay. After the DT time delay is completed, the CCN relay energizes the CN solenoid to retransfer the switch into the normal source. The SN limit switch activates to de-energize the CCN relay. The SN limit switch also energizes the engine over-run timer U and begins its timing cycle. This timer provides a period of time for the engine generator to run without load and cool down before shutdown. After the U time delay is completed, the P1 timer is energized and the engine generator is shutdown.

NOTES:

1. The transition mode selector switch on the front door enables the user to operate the unit in Open Transition mode, if so desired.
2. When in Closed Transition mode, if the transfer switch does not open the first source within 100 milliseconds, an alarm will sound, the transfer switch will open the last source it closed in to and will lock out the control circuit from any transfer operation. After the condition has been corrected the control circuit should be reset by turning the Failed to Open Lockout Reset switch to the right.
3. The controls will provide a signal to shunt trip the generator breaker if the transfer switch remains closed into both sources for more than 325 ms. The load will then be fed by the utility source. The maximum time that the two sources would be parallel, under these conditions, is less than 0.5 sec. Before operating the closed transition transfer switch the condition must be corrected and the shunt trip reset. Refer to the procedure for servicing the switch after shunt tripping occurs. The shunt trip reset switch is provided on the front door. Alarm and lights on the front door provide indication of failure conditions.

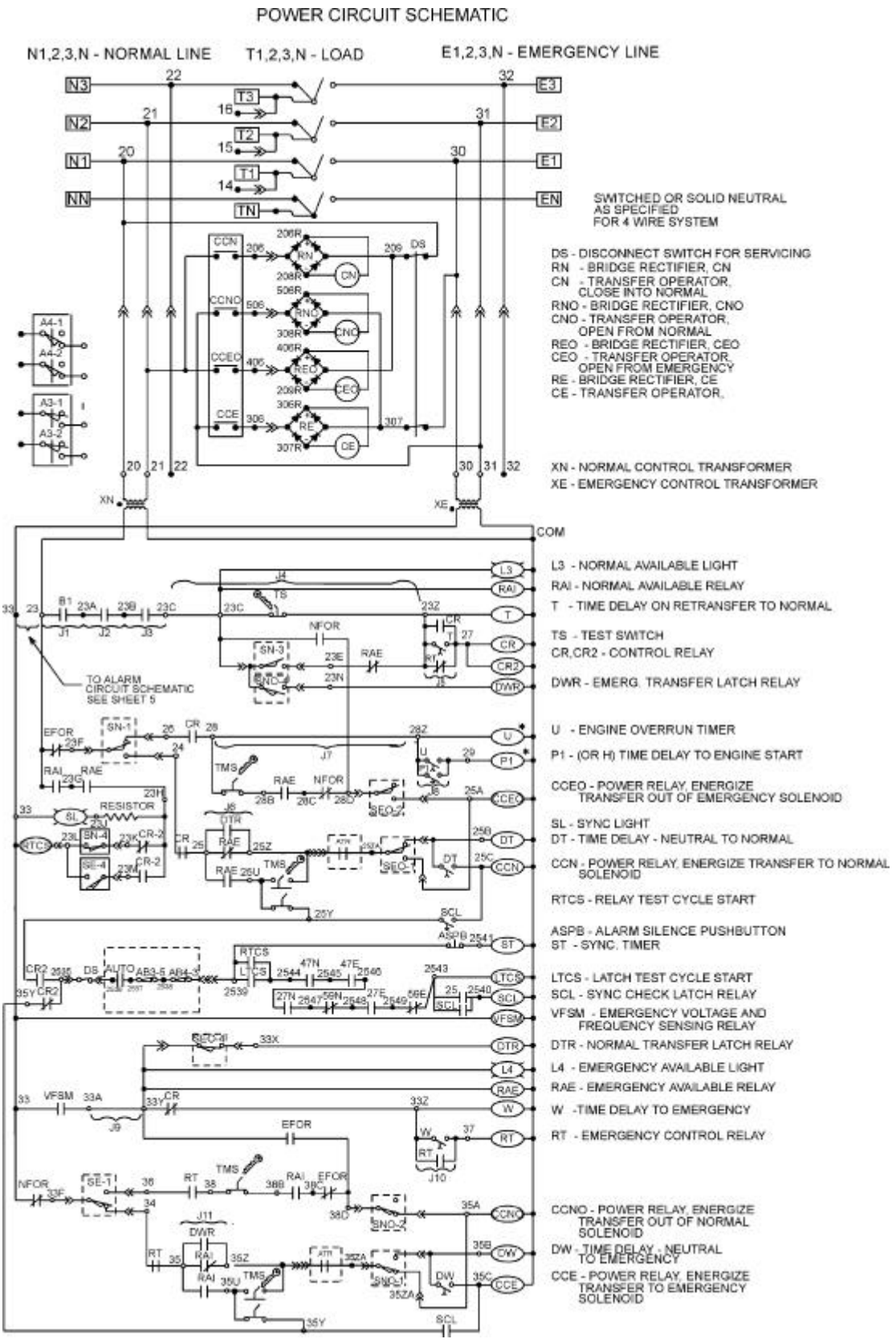

POWER CIRCUIT SCHEMATIC
N1,2,3,N - NORMAL LINE
T1,2,3,N - LOAD
E1,2,3,N - EMERGENCY LINE
SWITCHED OR SOLID NEUTRAL AS SPECIFIED FOR 4 WIRE SYSTEM
DS - DISCONNECT SWITCH FOR SERVICING
RN - BRIDGE RECTIFIER, CN
CN - TRANSFER OPERATOR, CLOSE INTO NORMAL
RNO - BRIDGE RECTIFIER, CNO
CNO - TRANSFER OPERATOR, OPEN FROM NORMAL
REO - BRIDGE RECTIFIER, CEO
CEO - TRANSFER OPERATOR, OPEN FROM EMERGENCY
RE - BRIDGE RECTIFIER, CE
CE - TRANSFER OPERATOR.
XN - NORMAL CONTROL TRANSFORMER
XE - EMERGENCY CONTROL TRANSFORMER
COM
L3 - NORMAL AVAILABLE LIGHT
RAI - NORMAL AVAILABLE RELAY
T - TIME DELAY ON RETRANSFER TO NORMAL
TS - TEST SWITCH
CR,CR2 - CONTROL RELAY
DWR - EMERG. TRANSFER LATCH RELAY
U - ENGINE OVERRUN TIMER
P1 - (OR H) TIME DELAY TO ENGINE START
CCEO - POWER RELAY, ENERGIZE TRANSFER OUT OF EMERGENCY SOLENOID
SL - SYNC LIGHT
DT - TIME DELAY - NEUTRAL TO NORMAL
CCN - POWER RELAY, ENERGIZE TRANSFER TO NORMAL SOLENOID
RTCS - RELAY TEST CYCLE START
ASPB - ALARM SILENCE PUSHBUTTON
ST - SYNC. TIMER
LTCS - LATCH TEST CYCLE START
SCL - SYNC CHECK LATCH RELAY
VFSM - EMERGENCY VOLTAGE AND FREQUENCY SENSING RELAY
DTR - NORMAL TRANSFER LATCH RELAY
L4 - EMERGENCY AVAILABLE LIGHT
RAE - EMERGENCY AVAILABLE RELAY
W -TIME DELAY TO EMERGENCY
RT - EMERGENCY CONTROL RELAY
CCNO - POWER RELAY, ENERGIZE TRANSFER OUT OF NORMAL SOLENOID
DW - TIME DELAY - NEUTRAL TO EMERGENCY
CCE - POWER RELAY, ENERGIZE TRANSFER TO EMERGENCY SOLENOID
TO ALARM CIRCUIT SCHEMATIC SEE SHEET 5

Figure 4

2. BYPASS-ISOLATION OPERATION - 100-400 AMP

a. Automatic
1) Manually operated bypass switch contacts (BN/BE) are open and ATS is supplying load.
2) Disconnect Switch (DS) is in Auto.

b. To Bypass ATS
1) Open bottom cabinet door and turn DS to Inhibit.
2) Position Manual Bypass Handle (MBH) to same power source as ATS.

c. To Test ATS
1) Bypass per above instructions.
2) Move ATS Location Handle (ALH) to Test location.
3) Turn DS to Auto.
4) Test Switch (TS) on bottom cabinet door will allow electrical operation of ATS.

d. To Isolate ATS
1) Bypass per above instructions.
2) Move ALH to Isolate location.

e. To Remove ATS
1) Bypass and isolate per above instructions.
2) Move ALH to Release location.
3) Disconnect multipin plugs.
4) Lift ATS out of drawer.

f. To Reconnect ATS
1) Place ATS into drawer slots (front rollers first).
2) Turn DS to Inhibit.
3) Manually position ATS into same source as bypass switch.
4) Reconnect multipin plugs and external connections to ATS.
5) Push ATS inward to engage carriage.
6) Move ALH to Test location (as indicated by light).
7) Turn DS to Auto and use TS to electrically operate ATS.
8) Turn DS to Inhibit.
9) Move ALH to Auto location.
10) Turn DS to Auto and open bypass with MBH.
11) ATS is now fully automatic.

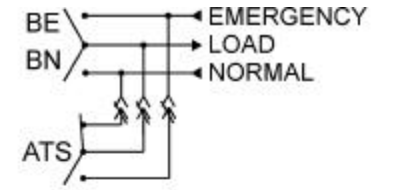


FIG. 1 BP IS OPEN WITH ATS IN NORMAL

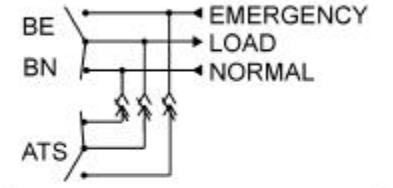


FIG. 2 BP IN NORMAL WITH ATS IN NORMAL

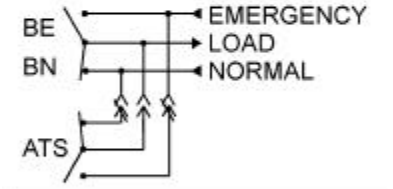


FIG. 3 BP IN NORMAL WITH ATS IN TEST (LOAD CONNECTIONS ARE OPEN)

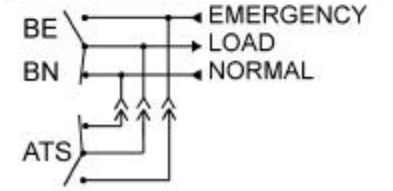


FIG. 4 BP IN NORMAL WITH ATS ISOLATED

Notes:

1. DS in Inhibit will prevent ATS electrical operation.
2. Do not use excessive force on mechanical handles.
3. Figures depict Bypass Normal. Sequence is the same for Bypass Emergency.
4. When ATS is in Test or Isolate, bypass switch is manual; transfer switch to either available source (indicated on light panel).
5. To operate bypass switch when ATS is in Test or Isolate, position MBH to available power source.

Legend:

1. BP - bypass switch (indicated by contacts BN/BE) is a three position switch.
2. ATS - Automatic Transfer Switch.

3. BYPASS-ISOLATION OPERATION - 600-1200 AMP

a. Automatic
1) Manually operated bypass switch contacts (BN/BE) are open and ATS is supplying load.
2) Disconnect Switch (DS) is in Auto.

b. To Bypass ATS
1) Open bottom cabinet door and turn DS to Inhibit.
2) Turn Bypass Selector Switch (BSS) to same power source as ATS.
3) Move the Manual Bypass Handle (MBH) upward.

c. To Test ATS
1) Bypass per above instructions.
2) Rotate crank mechanism counterclockwise until ATS Test light is illuminated.
3) Turn DS to Auto.
4) Test Switch (TS) on bottom cabinet door will allow electrical operation of ATS.

d. To Isolate ATS
1) Bypass per above instructions.
2) Rotate crank mechanism counterclockwise until ATS Isolated light is illuminated.

e. To Remove ATS
1) Bypass and isolate per above instructions.
2) Disconnect multipin plugs and external connections to ATS.
3) Rotate four power panel latches to vertical position, slide ATS forward and lock mechanism in place.
4) ATS can now be removed from cabinet.

f. To Reconnect ATS
1) Place ATS in slide mechanism.
2) Unlock slide mechanism. Slide ATS over power panel latches and rotate latches to horizontal position.
3) Turn DS to Inhibit.
4) Manually position ATS into same source as bypass switch.
5) Reconnect multipin plugs and external connections to ATS.
6) Rotate crank mechanism clockwise until ATS Test light is illuminated.
7) Turn DS to Auto and use TS to electrically operate ATS.
8) Turn DS to Inhibit.
9) Move ALH to Auto location.
10) Turn DS to Auto and open bypass with MBH.
11) ATS is now fully automatic.

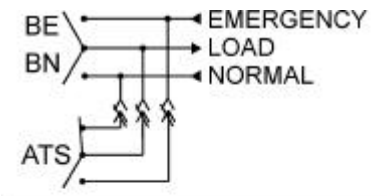


FIG. 1 BP IS OPEN WITH ATS IN NORMAL

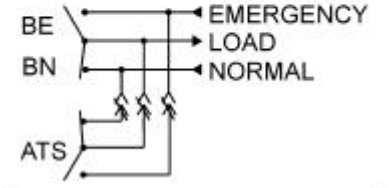


FIG. 2 BP IN NORMAL WITH ATS IN NORMAL

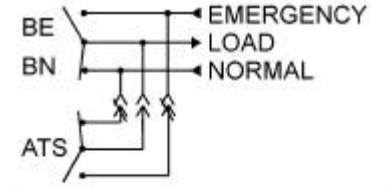


FIG. 3 BP IN NORMAL WITH ATS IN TEST (LOAD CONNECTIONS ARE OPEN)

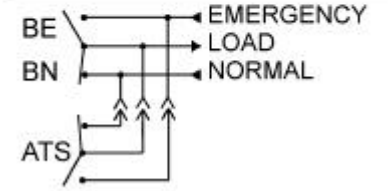


FIG. 4 BP IN NORMAL WITH ATS ISOLATED

Notes:
1. DS in Inhibit will prevent ATS electrical operation.
2. Do not use excessive force on mechanical handles.
3. Figures depict Bypass Normal. Sequence is the same for Bypass Emergency.
4. When ATS is in Test or Isolate, bypass switch is manual transfer switch to either available source (indicated on light panel).
5. To operate bypass switch when ATS is in Test or Isolate:
   a) Move MBH downward (to open open Bypass Contacts BN/BE).
   b) Turn BSS to opposite power source.
   c) Move MBH upward to close into selected power source.

Legend:
1. BP - Bypass Switch (indicated by contacts BN/BE) is a three posi tion switch.
2. ATS - Automatic Transfer Switch.

4. BYPASS-ISOLATION OPERATION - 1600-4000 AMP

a. Automatic
1) Manually operated bypass switch contacts (BN/BE) are open and ATS is supplying load.
2) Disconnect Switch (DS) is in Auto.

b. To Bypass ATS
1) Open bottom cabinet door and turn DS to Inhibit.
2) Turn Bypass Selector Switch (BSS) to same power source as ATS.
3) Move the Manual Bypass Handle (MBH) upward.

c. To Test ATS
1) Bypass per above instructions.
2) Rotate crank mechanism counterclockwise until ATS Test light is illuminated.
3) Turn DS to Auto.
4) Test Switch (TS) on bottom cabinet door will allow electrical operation of ATS.

d. To Isolate ATS
1) Bypass per above instructions.
2) Rotate crank mechanism counterclockwise until ATS Isolated light is illuminated.

e. To Remove ATS
1) Bypass and isolate per above instructions.
2) Disconnect multipin plugs and external connections to ATS.
3) Slide four corner latches of ATS to innermost position.
4) ATS can now be removed from cabinet.

f. To Reconnect ATS
1) Roll cart back into cabinet.
2) Slide four corner latches of ATS to outermost position.
3) Turn DS to Inhibit.
4) Manually position ATS into same source as bypass switch.
5) Reconnect multipin plugs and external connections to ATS.
6) Rotate crank mechanism clockwise until ATS Test light is illuminated.
7) Turn DS to Auto and use TS to electrically operate ATS.
8) Turn DS to Inhibit.
9) Rotate crank mechanism clockwise until ATS location pointer is aligned with Auto mark on location indicator (ATS must be in same source as bypass).
10) Turn DS to Auto and open bypass with MBH.
11) ATS is now fully automatic.

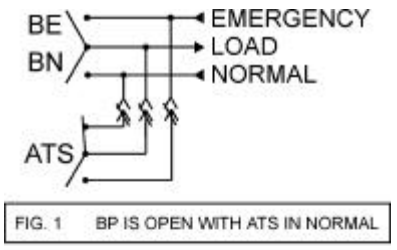


FIG. 1 BP IS OPEN WITH ATS IN NORMAL

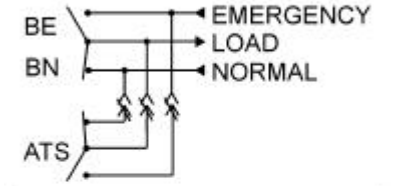


FIG. 2 BP IN NORMAL WITH ATS IN NORMAL

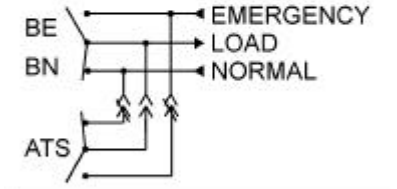


FIG. 3 BP IN NORMAL WITH ATS IN TEST (LOAD CONNECTIONS ARE OPEN)

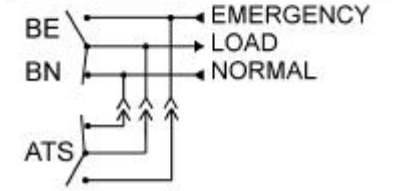


FIG. 4 BP IN NORMAL WITH ATS ISOLATED

Notes:
1. DS in Inhibit will prevent ATS electrical operation.
2. DO NOT use excessive force on mechanical handles.
3. Figures depict Bypass Normal. Sequence is the same for Bypass Emergency.
4. When ATS is in Test or Isolate, bypass switch is a manual transfer switch to either available source (indicated on light panel).
5. To operate bypass switch when ATS is in Test or Isolate:
   a) Move MBH downward (to open Bypass Contacts BN/BE)
   b) Turn BSS to opposite power source.
   c) Move MBH upward to close into selected power source.

Legend:
1. BP - Bypass Switch (indicated by contacts BN/BE) is a three position switch.
2. ATS - Automatic Transfer Switch.

5. ZENITH STANDARD PACKAGE

The Zenith Closed Transition Switch comes with the following standard features:

A3 Auxiliary contact closes when the switch is in the Emergency position.

A4 Auxiliary contact closes when the switch is in the Normal position.

DT Adjustable time delay before closing into Normal source from open position (Open Transition Mode only).

DW Adjustable time delay before closing into Emergency source from open position (Open Transition Mode only).

E Engine start contact closes to start the engine generator when the Normal source fails. 1 N.O., 1 N.C. contact.

P1 Solid state adjustable timer with range from 0.5 to 6.0 seconds. The contact closes to start the engine generator.

T Adjustable time delay to transfer out of Emergency source and into open position after Normal source is restored.

U Adjustable time delay for engine cool down after engine generator is signaled to shut down.

W Adjustable time delay to transfer out of Normal source and into open position after Normal source failure.

6. ZENITH OPTIONAL ACCESSORIES

Many control accessories are available to meet specific and special requirements. **Your drawings indicate which accessories were ordered with your switch.**

SECTION III - 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:

1. INSPECTION AND CLEANING

⚠ DANGER

HAZARDOUS VOLTAGE
(Can Cause Severe Injury or Death)

Turn OFF all power before installation, adjustment, or removal of transfer switch or

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 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 pitted or worn excessively, they should be replaced. A general inspection of mechanical integrity should be made to include loose, broken or badly worn parts.

2. 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.

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.

3. TESTING

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. This de-energizes the engine start relay. The transfer switch closes into Emergency only after the sync-check relay ensures the proper phase relationship of both sources. After the transfer switch closes into Emergency, the SE limit switch becomes activated to de-energize the CCE relay and energize the CCNO relay. This opens the transfer switch out of Normal. When the transfer switch has opened out of Normal, the SNO-2 limit switch activates to de-energize the CCNO relay. The transfer switch has now closed into emergency power without interrupting the load.

Turning the TS to AUTO initiates re-transfer to Normal. The transfer switch closes into Normal, only after the sync-check relay ensures the proper phase relationship of both sources. After the transfer switch closes into Normal, the SN limit switch becomes activated to de-energize the CCN relay and energize the CCEO relay; the transfer switch opens out of Emergency. Then the SEO-2 limit switch activates to de-energize the CCEO relay. The transfer switch has now closed back into normal power without interrupting the load.

The transfer switch defaults to an open transition transfer when the Normal source fails. Closed transition transfer is not possible with one source available. Open transition transfer for testing can be selected via the transition mode selector switch.

A 24 VDC circuit is supplied to control the alarm and warning indicators. To insure continuous power to this circuit, a constant 24 VDC can be supplied by the customer from the engine start battery.

⚠ NOTICE

A periodic test of the transfer switch under load conditions is recommended to insure proper operation.

4. 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 Section II of this manual, Operation and Features.

CONDITION	ITEMS TO BE CHECKED
a. Engine-Generator Does Not Start when Normal source fails or Test Switch (TS) is activated.	1) Verify the setting of the time delay P1. 2) Make sure timer P1 drops out and the engine-start contact closes after time delay is completed. 3) Make sure the starting battery is charged and connected to the engine-generator. 4) Generator controls in Automatic mode. 5) Verify wiring of the engine-start contact If the generator does not start, contact the generator dealer.
b. Does Not Transfer To Emergency after generator starts.	1) If in Closed Transition Mode: a) Verify that the phase angle difference between Normal and Emergency is < 5° (@ 0.1 Hz f). b) Verify that the frequency difference between Normal and Emergency is < 0.2 Hz (0.1 Hz is recommended). Also verify that the frequency difference is not 0 Hz. c) Verify that the voltage difference between Normal and Emergency is < ±5% of nominal. d) Verify that the phase sequence is the same for Normal and Emergency. 2) Emergency source breaker should be closed. 3) Emergency source voltage and frequency should meet the preset pickup values of the VFSM relay. 4) Make sure Emergency control relay RT picks up after time delay W.
c. Does Not Retransfer To Normal when Normal source restores or Test Switch (TS) is deactivated.	1) If in Closed Transition Mode: a) Verify that the phase angle difference between Normal and Emergency is < 5° (@ 0.1 Hz f). b) Verify that the frequency difference between Normal and Emergency is < 0.2 Hz (0.1 Hz is recommended). Also verify that the frequency difference is not 0 Hz. c) Verify that the voltage difference between Normal and Emergency is < ±5% of Nominal. d) Verify that the phase sequence is the same for Normal and Emergency. 2) Normal source voltage should meet the preset pickup value of the phase relays. 3) Make sure Normal control relay CR picks up after time delay T. 4) Verify the circuit connections from the power relay, CN1 or CCN, to the Normal switch operating circuit. 5) Verify the circuit connections from the power relay, CE1 or CCE, to the Emergency switch operating circuit.
d. Engine-Generator Does Not Shutdown after retransfer to Normal.	1) Verify the setting of engine overrun time delay U. 2) Make sure timer P1 picks up and the engine-start contact has opened. 3) Generator controls in Automatic mode. 4) Verify wiring of the engine-start contact.

5. EMERGENCY SERVICE PROCEDURE FOR EXTENDED PARALLEL TIME

a. Auto Location:

Removal of closed transition transfer switch after Emergency breaker shunt trip.

1) Disconnect all power sources from bypass-isolation transfer switch.
2) Open the bottom cabinet door and turn the Disconnect Switch (DS) to the OFF position.
3) Remove the service access cover on the left hand side of the transfer switch.
4) The manual operator and the manual handle will now be exposed. Insert the handle into the Emergency side manual operator. Open the Emergency side contacts.
5) Close bottom cabinet door.
6) Energize Normal power.
7) Close the bypass contacts (BN) as described in Section II of this manual.
8) Isolate the transfer switch as described in Section II.
9) Remove the transfer switch from the bypass-isolation transfer switch as indicated on the bypass instruction label to inspect and repair.
10) Re-install the transfer switch after maintenance with contacts closed to the same source as the bypass switch. Re-install the manual handle in its holder and the service access cover on the left side of the transfer switch.
11) Re-connect the transfer switch to AUTO, as described in Section II.

b. Auto Location:

Removal of the closed transition transfer switch if Normal and Emergency contacts remain open.

1) Turn the BSS to an available source. Close the bypass switch into the available source as described in Section II of this manual.
2) Turn the DS to INHIBIT. Remove the transfer switch service access cover. Close the transfer switch into the same source as the bypass switch. (Incorrect sequencing is prevented by the interlocks while the transfer switch is in AUTO only.)
3) Remove the transfer switch from the bypass-isolation transfer switch as indicated in Section II to inspect and repair.

c. Test Location:

Removal of the closed transition transfer switch if both Normal and Emergency contacts remain open.

1) Close the bypass switch contacts (BN) as indicated on the bypass instruction label on the cabinet door.
2) Disconnect all power sources from bypass-isolation closed transition transfer switch.
3) Open bottom cabinet door. Turn the Disconnect Switch (DS) to the OFF position.
4) Remove the service access cover on the left side of the transfer switch.
5) The manual operator and the manual handle will not be exposed. Insert the handle into the Normal side and close the Normal contacts.
6) Close the bottom cabinet door.
7) Energize Normal power.
8) Remove the automatic transfer switch from the bypass-isolation transfer switch as indicated in Section II.
9) Re-install the transfer switch after maintenance with contacts closed to the same source as the bypass switch. Re-install the manual handle in its holder and the service ccess cover on the left side of the transfer switch.
10) Re-connect the transfer switch to AUTO, as indicated in Section II.

FIELD NOTES

Model Number _____

Serial Number _____

Date Shipped _____

Start-Up Date _____

Drawings Supplied _____

Test And Maintenance Notes			
Date	**Tested**	**Observations**	**Notes**

1. PARALLELING RELAY SETTINGS

25, 27/59N & 27/59E are factory set to allow paralleling of the sources only when these conditions have been met:

a. Phase Angle Differences < 5° (@ 0.1 Hz f)
b. Frequency Difference < 0.2 Hz
c. Voltage Difference < ±5% Nominal

NOTES:

1. This system requires an isochronous governor with an operating frequency of 60 ± 0.2 Hz.
2. Requires a shunt trip breaker on generator set with a response time not exceeding 50 ms.

2. 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 5* below.

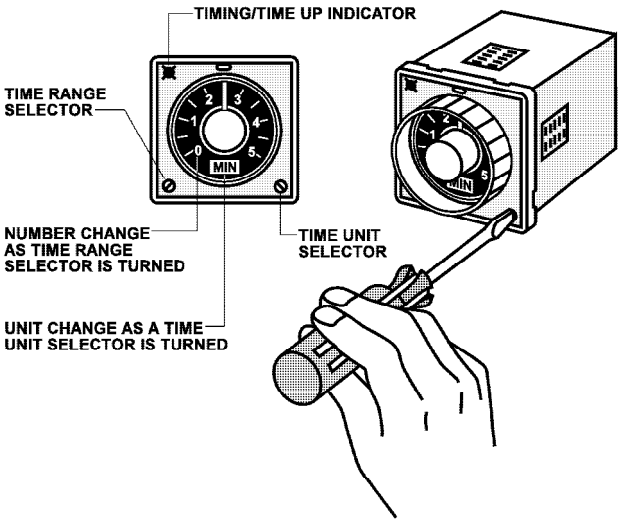


Figure 5

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

The factory setting of the solid state timers used in the Zenith standard package are shown in Table 5 below.

Timer	Factory Setting
T	30 minutes
U	5 minutes
W	1 second
DT	5 seconds
DW	5 seconds
ST	1 second
PART	0.002 sec,
OLC	0.275 sec.
ETT	0.420 sec.

Table 5

3. VOLTAGE/FREQUENCY SENSOR (VFSM)

The pickup point may be adjusted by rotating the adjustment screw as shown in *Figure 6* below. Counter-clockwise rotation increases the pickup voltage.

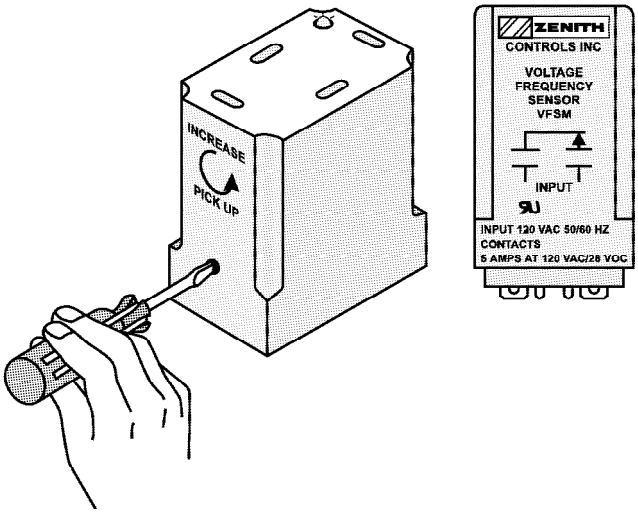


Figure 6

Pickup Voltage (at 100% Frequency)
Adjustable: 80% to 95%
Factory Set: 90%
Pickup Frequency
Adjustable: 80% to 100%
Factory Set: 95%

4. 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 7* below.

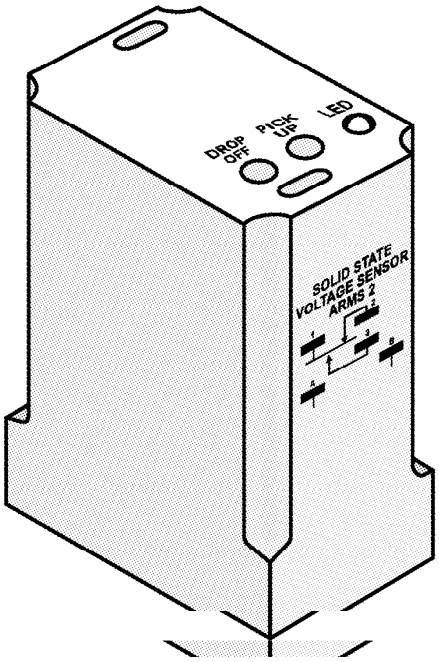


Figure 7

a. Turn the pickup adjustment fully clockwise.
b. Turn the dropout adjustment fully counter-clockwise.
c. Set Variac to the desired pickup voltage.
d. Rotate the pickup adjustment counterclock-wise very slowly until the relay picks up. The LED will illuminate.
e. Set Variac to the desired dropout voltage.
f. Rotate the dropout adjustment clockwise very slowly until the relay drops out. The LED will go out.
g. Verify the setting by raising the voltage until the relay picks up and lowering the voltage until the relay drops out.

Pickup Voltage:	75% to 115% of Nominal
Factory Set:	90% of Nominal
Dropout Voltage:	55% to 105% of Nominal
Factory Set:	80% of Nominal

5. PARALLELING WINDOW UNDER-OVERVOLTAGE SENSING RELAY

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 8.*

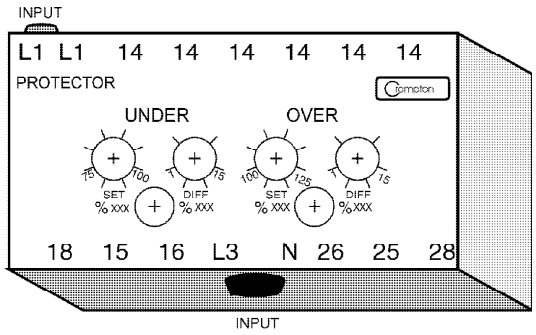


Figure 8

a. Turn both DIFF adjustments fully counter-clockwise.
b. Undervoltage sensing - Use lowest phase to phase relationship on Variac to set the relay. Set Variac voltage to desired undervoltage setting. Turn undervoltage SET adjustment fully clockwise, then slowly counterclockwise until the LED illuminates.
c. Overvoltage sensing - Use the highest phase to phase voltage relationship on Variac to set the relay. Set Variac voltage to desired overvoltage. Turn overvoltage SET adjustment fully clockwise, then counterclockwise until LED illuminates.

Undervoltage:	75-100% of 120V
Factory Set:	95%
Overvoltage:	100-125% of 120V
Factory Set:	105%

6. ELECTRONIC TIME SWITCH Z2000-2A

This time switch is used for the C/D option. Time switch Z2000-1A is used for the C option.

a. Setting Time and Day:

Press and hold " ⏲ " 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 " ⏲ " button. Clock is running

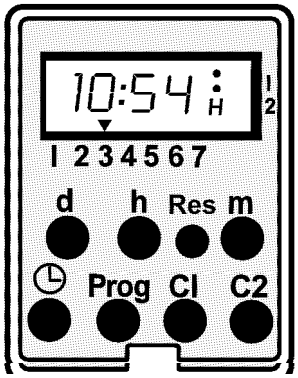


Figure 9

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 " ⏲ " to return the clock run mode. If the " ⏲ " button is not depressed, it will switch to the clock run mode after 60 seconds.

c. Program Review and Change:

Press Prog button to recall and review the C1 and"C2 On/Off times. An E is displayed if all 24 positions are used or if the next available position is not filled. To change or clear a program, press Prog button to find the program to be changed or cleared. Change by pressing d, h or m buttons as required. Clear the entire program by simultaneously pressing "h" and "m". Press " ⏲ " to return to the clock run mode.

d. Program Override:

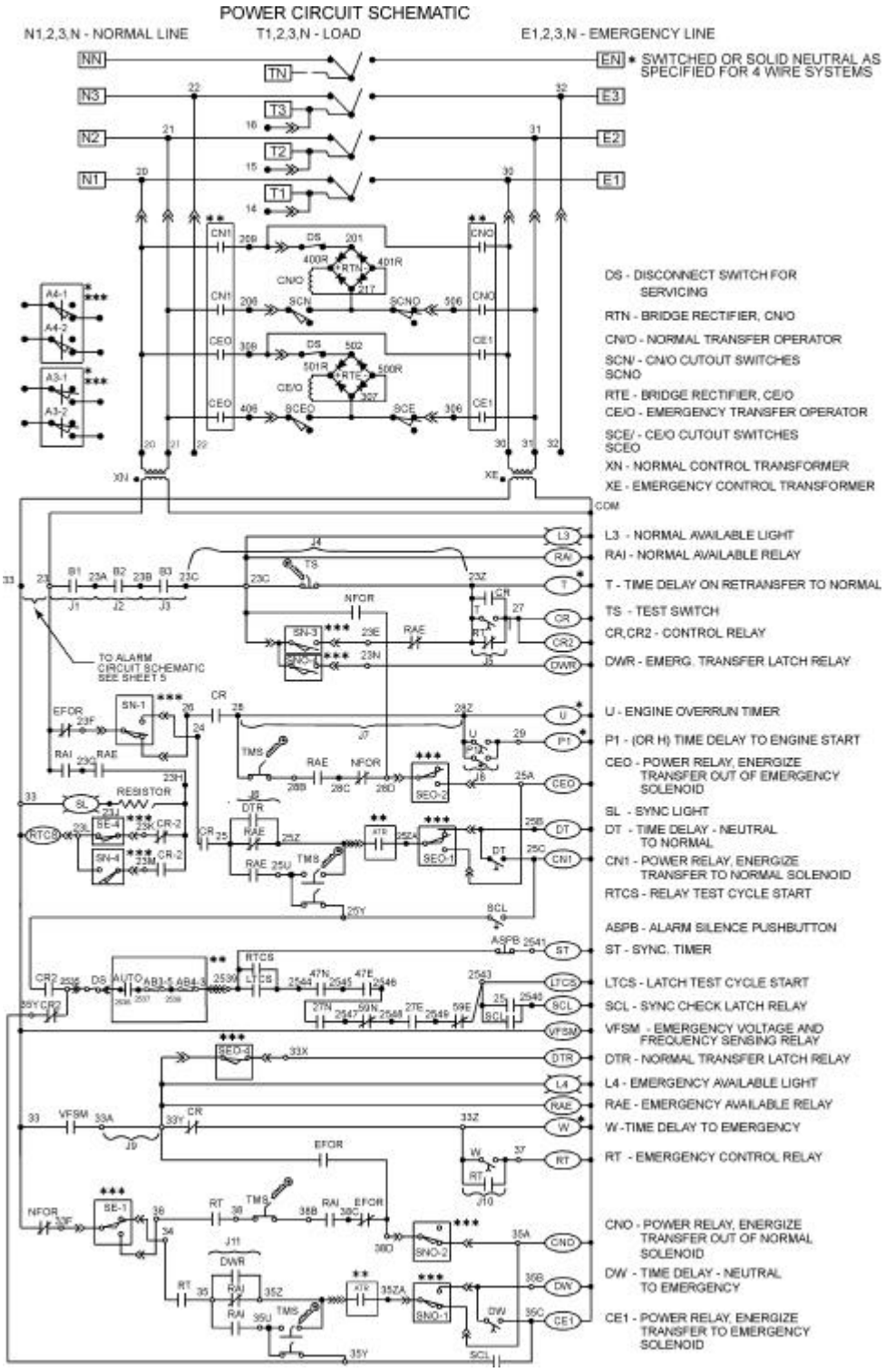
Each On/Off state can be manually changed by pressing C1 or C2. The next counteracting program cancels the manual override and resumes previous programming.

To continuously override automatic programming, press m and C1 or C2. The continuous override On/Off stat is preceded by a black dot on the display. To cancel, press m and C1 or C2 until the dot disappears.

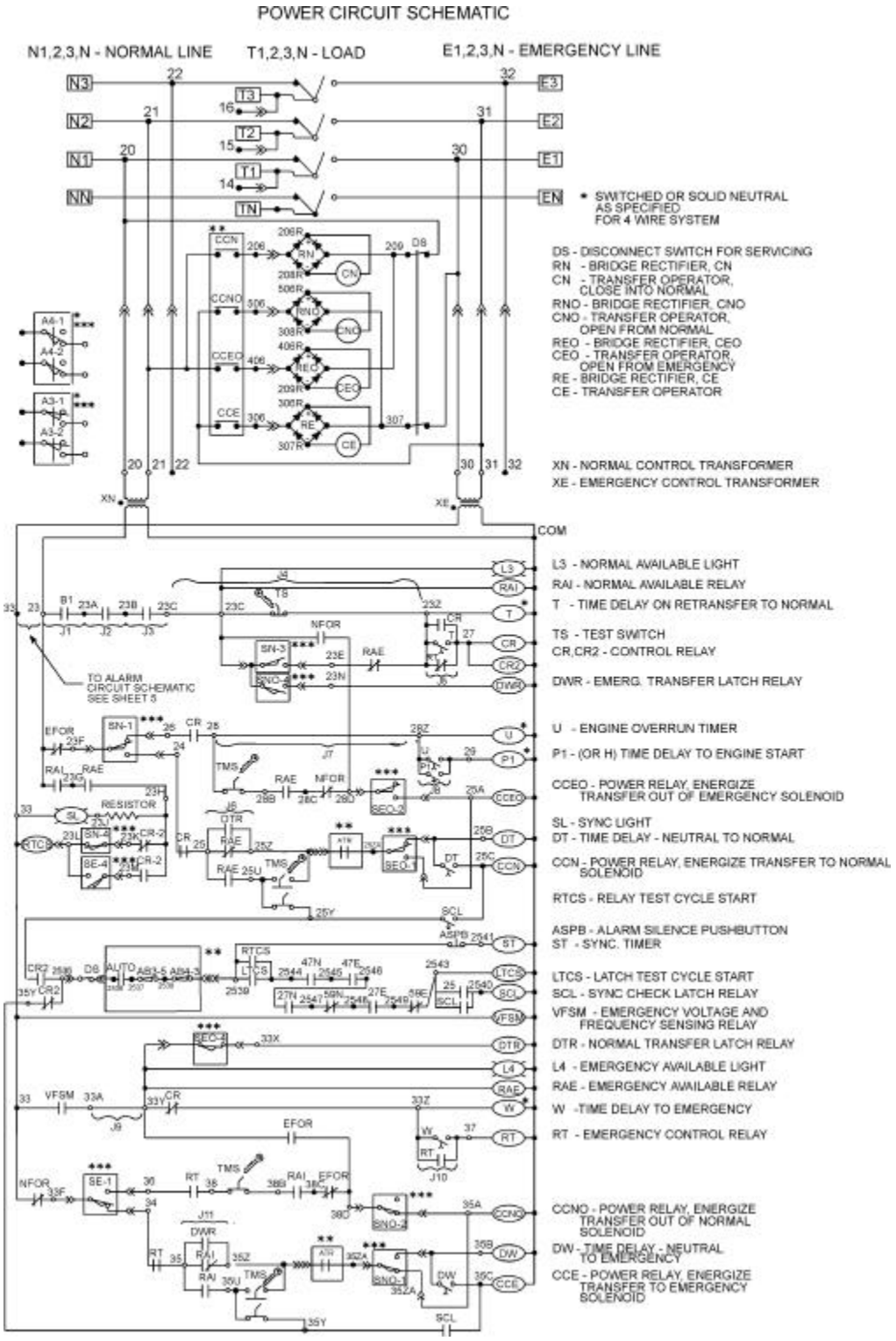
The automatic program can be continuously overridden up to 47 days by pressing and holding h while pressing C1 or C2 until the display shows the number of days desired. Starting the following day at "0:00", the display will show a "0:00", both C1 and C2 off, and an H in the lower right hand corner.

APPENDIX A - TYPICAL SCHEMATIC DIAGRAMS

1. 100-400 AMPS

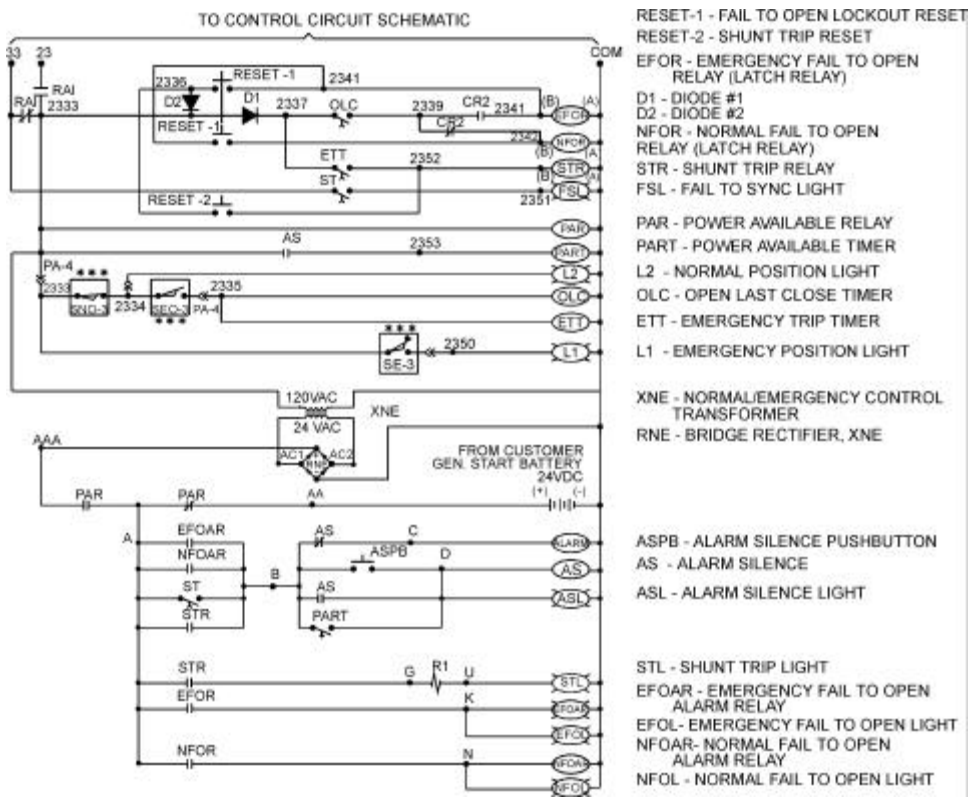


2. 600-3000 AMPS

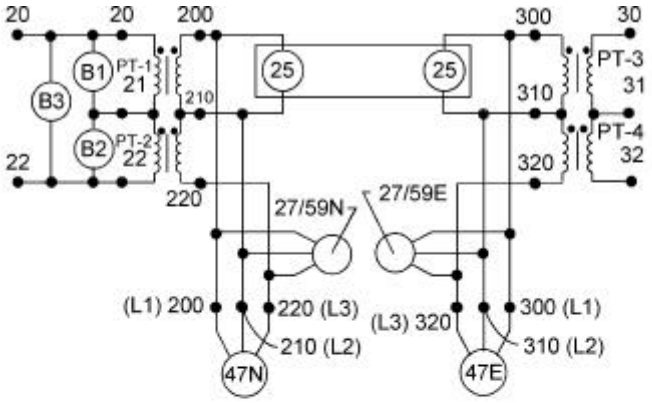


APPENDIX A - TYPICAL SCHEMATIC DIAGRAMS (Continued)

3. ALARM CIRCUIT SCHEMATIC



4. 3f CONTROL SENSING SCHEMATIC



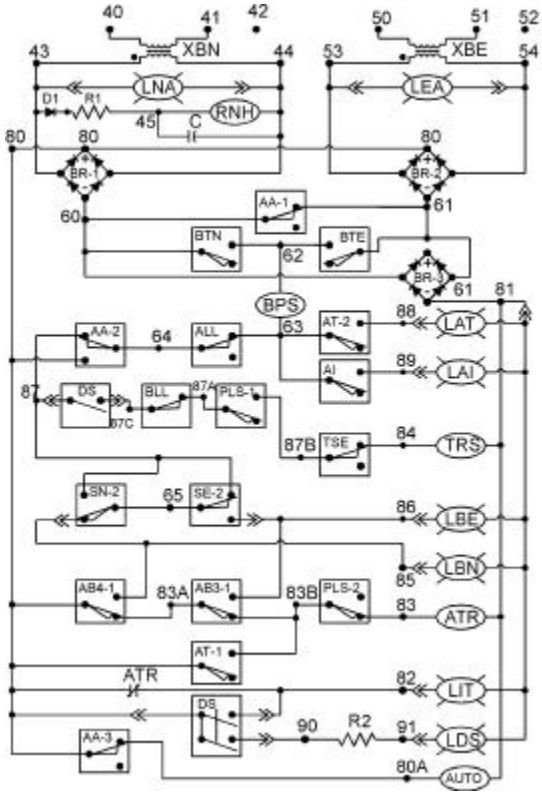
DRAWING SHOWS 47N/47E CONNECTION FOR A-B-C PHASE ROTATION SEQUENCE. (PARENTHESIS = DEVICE TERMINAL #'s)
IF PHASE ROTATION SEQUENCE IS A-B-C SWAP
L2 & L3 TERMINAL INPUTS ON EACH 47 RELAY.

LEGEND: PT- 1,2 - NORMAL POTENTIAL TRANSFORMERS
PT- 3,4 - EMERGENCY POTENTIAL TRANSFORMERS
B1,2,3 - UNDER VOLTAGE RELAYS
27/59N - NORMAL UNDER/OVER VOLTAGE RELAY
27/59E - EMERGENCY UNDER/OVER VOLTAGE RELAY
47N - PHASE SEQUENCING NORMAL
47E - PHASE SEQUENCING EMERGENCY
25 - SYNC CHECK RELAY

APPENDIX A - TYPICAL SCHEMATIC DIAGRAMS (Continued)

5. BYPASS CONTROL CIRCUIT

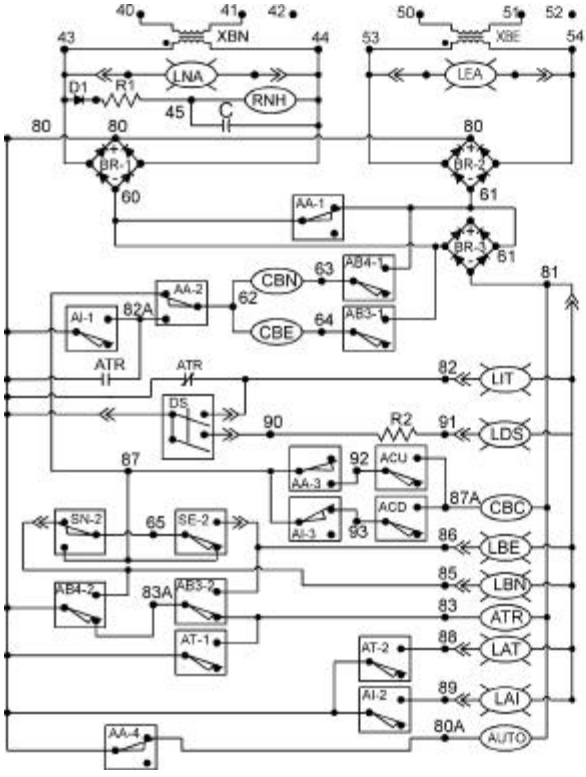
a. 100-400 Amp



LNA - NORMAL AVAILABLE LIGHT
LEA - EMERGENCY AVAILABLE LIGHT
RNH - NORMAL VOLTAGE RELAY
D1 - DIODE
R1 - RESISTOR, RNH
C - CAPACITOR, RNH
BR-1,2,3 - BRIDGE RECTIFIER

AA-1 - LIMIT SWITCH, ATS AUTO LOCATION
BTN - LIMIT SWITCH, BYPASS TRANSFER NORMAL
BTE - LIMIT SWITCH, BYPASS TRANSFER EMERGENCY
BPS - BYPASS SOLENOID
AA-2 - LIMIT SWITCH, ATS IN AUTO
ALL - LIMIT SWITCH, ATS LOCK LOCATION
AT-2 - LIMIT SWITCH, ATS IN TEST
LAT - ATS TEST LOCATION
AI - LIMIT SWITCH, ATS IN ISOLATE
LAI - ATS ISOLATE LIGHT
BLL - LIMIT SWITCH, BYPASS LOCK LOCATION
PLS-1 - PERMISSIVE LIMIT SWITCH
TSE - LIMIT SWITCH, TRANSFER SWITCH ENGAGED
TRS - SOLENOID, TRANSFER RELEASE
NA-4 - LIMIT SWITCH, ATS IN NORMAL
EA-3 - LIMIT SWITCH, ATS IN EMERGENCY
LBE - BYPASS EMERGENCY
LBN - BYPASS NORMAL LIGHT
AB4 - LIMIT SWITCH, BYPASS NORMAL
AB3-1 - LIMIT SWITCH, BYPASS EMERGENCY
PLS-2 - PERMISSIVE LIMIT SWITCH
AT-1 - LIMIT SWITCH
ATR - AUTO/TEST RELAY
LIT - ATS INHIBIT LIGHT
DS - ATS DISCONNECT SWITCH
R2 - RESISTOR, LDS
LDS - LIGHT, DISCONNECT SWITCH INHIBIT POSITION

b. 600-3000 Amp



LNA - NORMAL AVAILABLE LIGHT
LEA - EMERGENCY AVAILABLE LIGHT
RNH - NORMAL VOLTAGE RELAY
D1 - DIODE
R1 - RESISTOR, RNH
C - CAPACITOR, RNH
BR-1,2,3 - BRIDGE RECTIFIER

AA-1 - LIMIT SWITCH

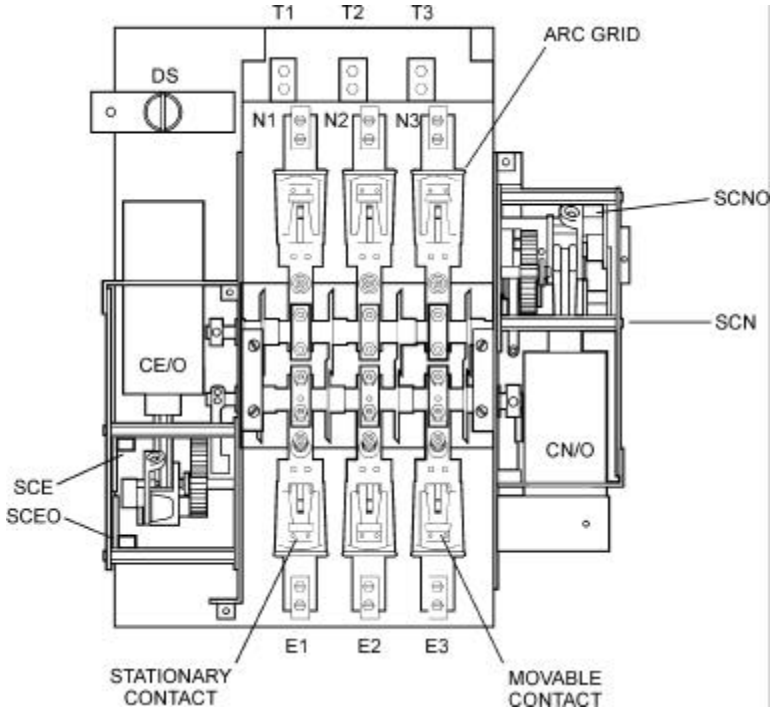
AB4-1- LIMIT SWITCH, BYPASS NORMAL
CBN - NORMAL TRANSFER OPERATOR
AA-2 - LIMIT SWITCH, ATS IN AUTO
AB3-1- LIMIT SWITCH, BYPASS EMERGENCY
CBE - EMERGENCY TRANSFER OPERATOR
LIT - ATS INHIBIT LIGHT
AI-1 - LIMIT SWITCH, ATS IN ISOLATE
LDS - DISCONNECT SWITCH
DS - ATS DISCONNECT SWITCH
R2 - RESISTOR, LDS
ACU - LIMIT SWITCH, CRANK HANDLE ENGAGED
CBC - CRANK SOLENOID
AA-3 - LIMIT SWITCH, ATS IN AUTO
ACD - LIMIT SWITCH, CRANK HANDLE ENGAGED
AI-3 - LIMIT SWITCH, ATS IN ISOLATE
LBE - BYPASS EMERGENCY
LBN - BYPASS NORMAL LIGHT
AB4-2- LIMIT SWITCH, BYPASS NORMAL
AB3-2- LIMIT SWITCH, BYPASS EMERGENCY
AT-1 - LIMIT SWITCH
ATR - AUTO/TEST RELAY
LAT - ATS TEST LOCATION
AT-2 - LIMIT SWITCH, ATS IN TEST
LAI - ATS ISOLATE LIGHT
AI-2 - LIMIT SWITCH, ATS IN ISOLATE
AA-4 - LIMIT SWITCH, ATS AUTO LOCATION

APPENDIX B - REPLACEMENT PARTS

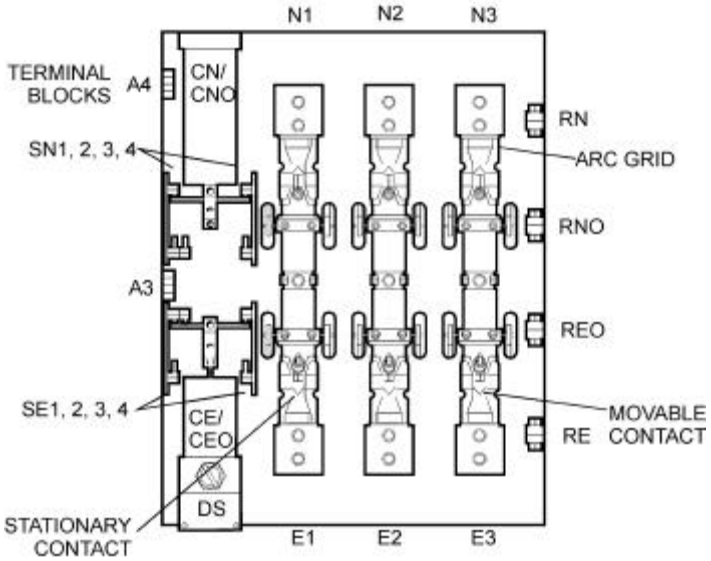
⚠ NOTICE

Model number and serial number of switch must be included with all orders for replacement parts. Specify line voltages, drawing numbers and date of installation. When ordering parts not shown on the parts list, refer to this part by its legend description in the wiring diagrams.

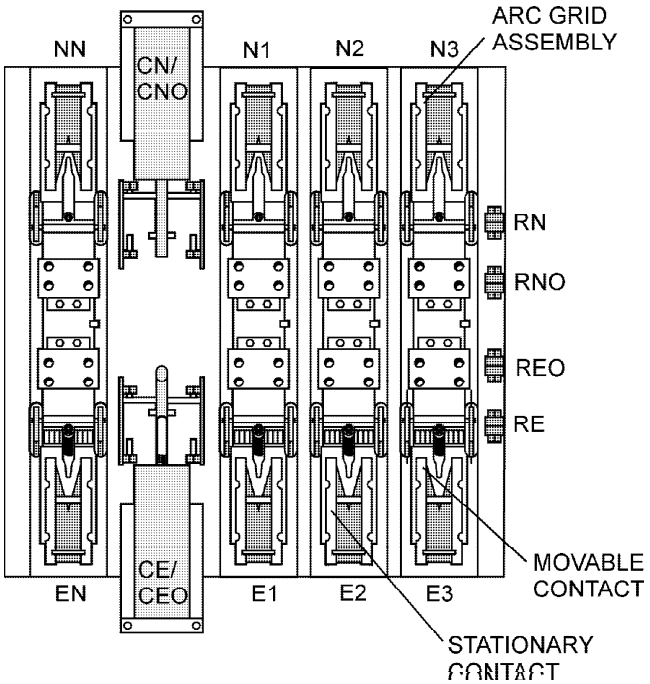
1. POWER PANEL 100-400 AMPS



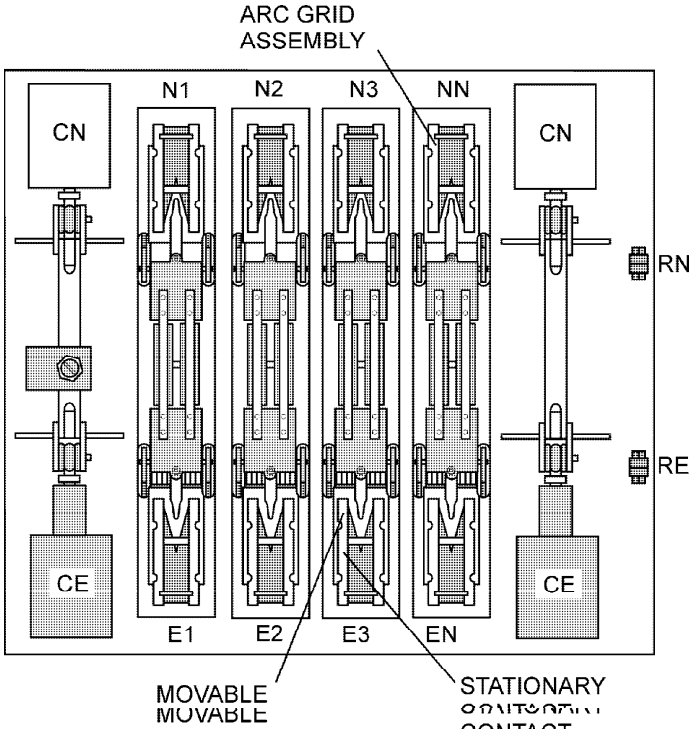
2. POWER PANEL 600-1200 AMPS



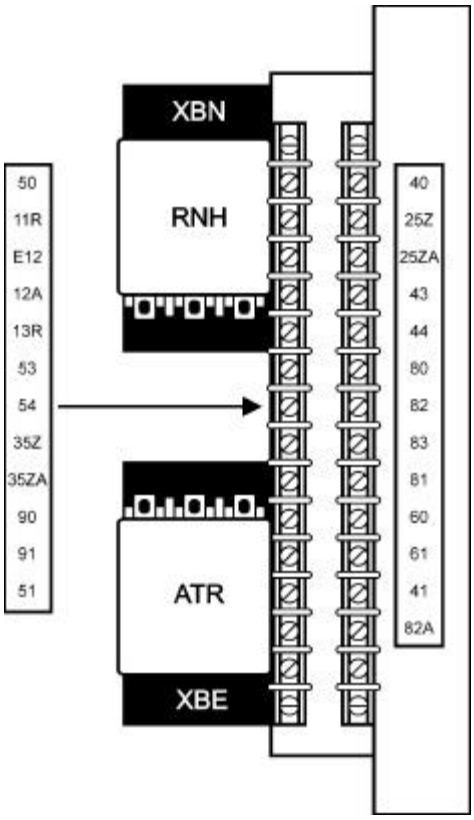
3. POWER PANEL 1600-3000 AMPS



4. POWER PANEL 4000 AMPS



5. BYPASS SUBPANEL



APPENDIX B - REPLACEMENT PARTS (Continued)

Power Panel Replacement Parts List 100-400 Amps								
Tag	Description				100A	150A	225A	260A	400A
NL1,2,3 EL1,2,3 T1,2,3 NLN, ELN, TN	Cable Connection Lug, CU Wire				PS-4418	PS-4418	PS-4418	S-1422	S-1422
Bypass Contact Assembly (Movable and Stationary)									
N1,2,3	Normal				46P-1104A	46P-1104B	46P-1104C	46P-1104D	46P-1104E
N	(Sw. Neutral Normal)				46P-1105A	46P-1105B	46P-1105C	46P-1105D	46P-1105E
E1,2,3	Emergency				46P-1106A	46P-1106B	46P-1106C	46P-1106D	46P-1106E
E	(Sw. Neutral Emergency)				46P-1107A	46P-1107B	46P-1107C	46P-1107D	46P-1107E
ATS Contact Assembly (Movable and Stationary)									
NL1,2,3	Normal				46P-1100A	46P-1100B	46P-1100C	46P-1100D	46P-1100E
N	(Sw. Neutral Normal)				46P-1101A	46P-1101B	46P-1101C	46P-1101D	46P-1101E
EL1,2,3	Emergency				46P-1102A	46P-1102B	46P-1102C	46P-1102D	46P-1102E
N	(Sw. Neutral Emergency)				46P-1103A	46P-1103B	46P-1103C	46P-1103D	46P-1103E
Arc Grid Assy.					46P-1099				
XBN, XBE	Bypass Step-Down Transformer Secondary 24V				**Voltage**		**Part No.**		
					120/240		K-3061		
					208/416		K-3063		
					220/440		K-3064		
					240/480		K-3062		
					380		K-3067		
					575		K-3065		
					600		K-3066		
Main ATS Operating Coils									
	No.	Volts	Ph	Wire	Coil Volts	Poles	Part No.		
CN/O & CE/O	-1	120	1	2	120	2	K-2178		
	-2	120/240	1	3	240	2, 3	K-2189		
	-3	240	3	3	240	3			
	-38	120/240	3	4	240	3, 4			
	-4	120/208	3	4	208	3, 4	K-2177		
	-5	480	3	3	480	3	K-2176		
	-6	575/600	3	3	575/600	3	SPO		
	-7	277/480	3	4	480	3, 4	K-2176		
	-9	240/416	3	4	416	3, 4	SPO		
	-91	220/380	3	4	380	3, 4	K-2188		
SN/SEO SE/SEO A3 A4	Normal Position Limit Switch Emergency Position Limit Switch ATS Emergency Position Switch ATS Normal Position Switch						L-3002		
SCN/O & SCE/O	CN/O & CE/O Limit Switches						L-3079		
AA AE1,2 PLS1,2	ATS Auto Location Switch ATS Isolate/Remove Location Switch Position Lever Switch						L-3071		
AI AT1,2	ATS Isolate Location Switch ATS Test Location Switch						L-3070		
AB3/ABE AB4/ABN NA4 EA3	Bypass Emergency Position Switch Bypass Normal Position Switch Normal TRS Limit Switch Emergency TRS Limit Switch						L-5021		
BTE BTN TSE BLL ALL	Bypass Emergency Position Switch Bypass Normal Position Switch ATS Engaged Switch Bypass Lock Location Switch ATS Lock Location Switch						L-3054		
DS	ATS Solenoid Disconnect Switch: Operator 2-Position Maintain						L-4018		
	Contact Block N.C. (3)						L-1029		
	Contact Block N.O. (2)						L-1028		
	Contact Block Mounting Plate						PS-3473		
BPS TRS	Bypass Interlock Solenoid Transfer Release Solenoid						K-2180		

APPENDIX B - REPLACEMENT PARTS (Continued)

Power Panel Replacement Parts List 600-1200 Amps									
Tag	Description						600A	800A	1000A	1200A
N 1,2,3,N	Normal Connections CU/AL Cable Lugs						S-2119 (2) 600MCM-2	S-2131 (3) 600MCM-2	S-2132 (4) 600MCM-2	S-2132 (4) 600MCM-2
E 1,2,3,N	Emergency Connections CU/AL Cable Lugs						S-1393F (2) 600MCM-2	S-1391F (3) 600MCM-2	S-1392F (4) 600MCM-2	S-1392F (4) 600MCM-2
T 1,2,3,N	Load Connections CU/AL Cable Lugs						S-1393F (2) 600MCM-2	S-1391F (3) 600MCM-2	S-1392F (4) 600MCM-2	S-1392F (4) 600MCM-2
STAT (BP)	Stationary Contact Assembly Bypass						26P-1144	26P-1126	26P-1126	26P-1126
STAT (ATS)	Stationary Contact Assembly ATS						26P-1144	26P-1126	26P-1126	26P-1126
ARC	Arc Grid Assembly Kit						23P-1366			
MOV	Movable Contact Assembly						23P-1157	23P-1125	26P-1125	26P-1125
	Movable Contact (Switched Neutral)						23P-1157	26P-1231	26P-1231	26P-1231

		Voltage	Part No.
XBN, XBE	Bypass Step-Down Transformer 25VA, Secondary 24V	120/240	K-3061
		208/416	K-3063
		220/440	K-3064
		240/480	K-3062
		380	K-3067
		575	K-3065
		600	K-3066

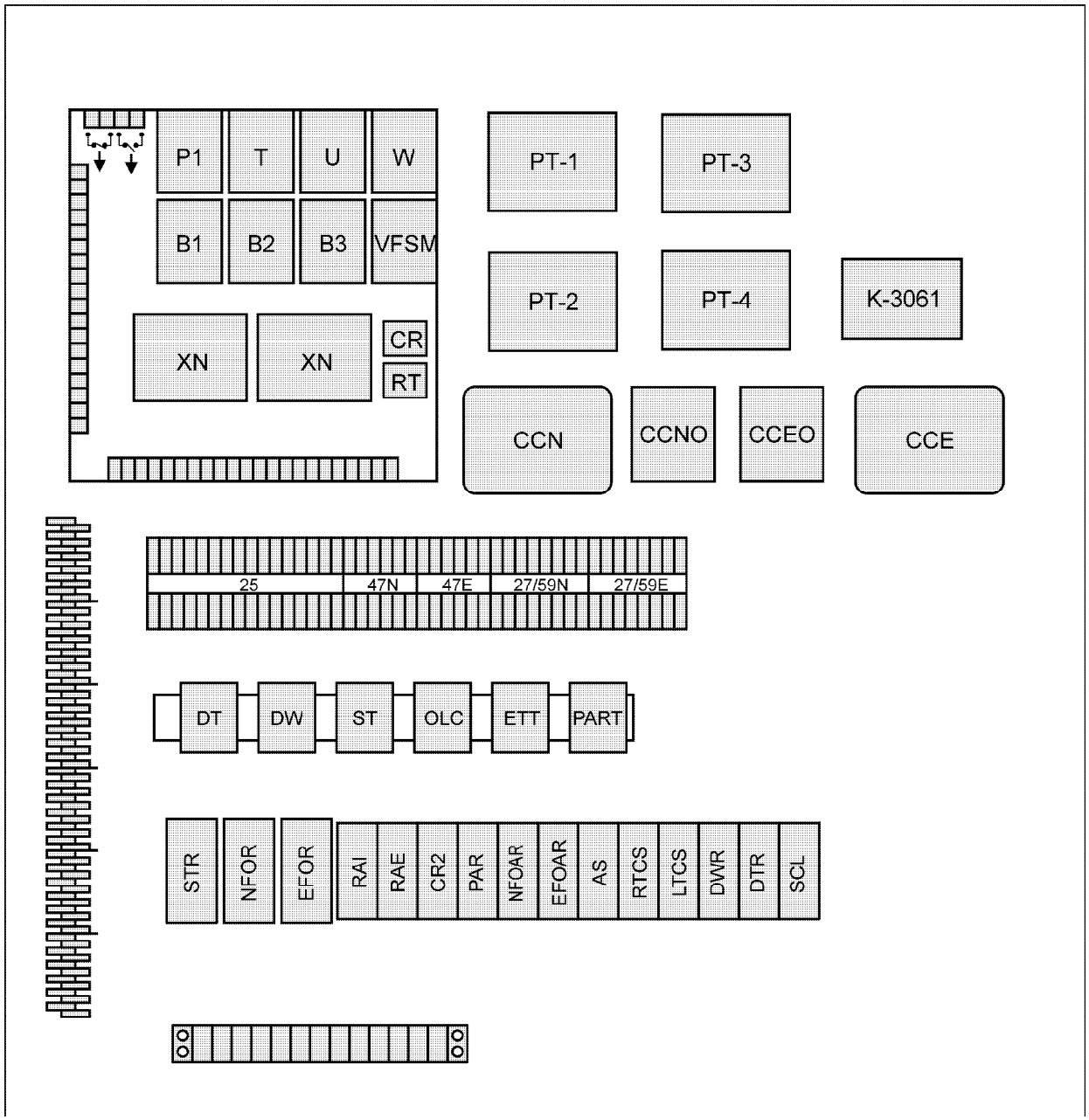
Main ATS Operating Coils								
	Voltage Systems							
	No.	Volts	Ph	Wire	Coil Volts	Poles	Part No.	
CN/CNO CE/CEO	-1	120	1	2	120	2	SPO	
	-2	120/240	1	3	240	2	SPO	
						3	K-2146	K-2147
	-3	240	3	3	240	3		
	-4	120/208	3	4	208	3, 4		
	-5	480	3	3	480	3	K-2158	K-2157
	-7	277/480	3	4	480	3, 4		
	-9	240/416	3	4	416	3, 4	SPO	

SN/SNO-1,2	ATS Normal Position Coil	23P-1533
SN/SNO-3,4	Cutout Switch DPDT	23P-1535
SE/SEO-1,2	ATS Emergency Position Coil	23P-1534
SE/SEO-3,4	Cutout Switch DPDT	23P-1536
A3	ATS Emergency Position Switch	L-5021
A4	ATS Normal Position Switch	
	Limit Switch, DPDT Roller Actuator	
AA	ATS Auto Location Switch	L-3052
AT	ATS Test Location Switch	L-3054, L-3052
ACU/ACD	Crank Limit Switches	L-3054
AI	ATS Isolate Location	L-3052
AE	Engine Start Transfer	L-3052
	Limit Switch, DPDT Lever Actuator	
AB3	Bypass Emergency Position Switch	L-5021
AB4	Bypass Normal Position Switch	
ASE	BSS Emergency Position Switch	
ASN	BSS Normal Position Switch	
DS	**ATS Solenoid Disconnect Switch**	
	Operator 2-Position Maintain	L-4009
	Contact Block N.C. (3)	L-1020
	Contact Block N.O. (2)	L-1024
CBE	Emergency Interlock Solenoid	K-2192
CBN	Normal Interlock Solenoid	
CBC	Crank Mechanism Solenoid	K-2159
RN/RNO RE/REO	Coil Rectifiers	23P-1473

APPENDIX B - REPLACEMENT PARTS (Continued)

Power Panel Replacement Parts List 1600-4000 Amps									
Tag	Description						1600/2000A	3000A	4000A
NL1,2,3 EL1,2,3	Cable Connection at Rear						S-1302F(2) Optional T1,2,3 (8) 600MCM-2		
	Stationary Contact Assembly Bypass and ATS						S-2308	S-2343	23P-1655
	Arc Grid Assembly Kit						23P-1171		
	Movable Contact Assembly						23P-1400	23P-1344	23P-1640
	Movable Contact						23P-1399	23P-1338	SPO
XBN, XBE	Bypass Step-Down Transformer 25VA, Secondary 24V						**Voltage**	**Part No.**	
							120/240	K-3061	
							208/416	K-3063	
							220/440	K-3064	
							240/480	K-3062	
							380	K-3067	
							575	K-3065	
							600	K-3066	
Main ATS Operating Coils									
CN/O & CE/O	Voltage Systems								
	No.	Volts	Ph	Wire	Coil Volts	Poles	Part No.		
	-1	120	1	2	120	2	SPO		
	-2	120/240	1	3	240	2, 3	K-2151		K-2219
	-3	240	3	3	240	3			
	-4	120/208	3	4	208	3, 4			
	-5	480	3	3	480	3	K-2160		K-2218
	-6	575	3	3	600	3	SPO		
	-7	277/480	3	4	480	3, 4	K-2160		K-2218
	-8	120/240	2	4	240	4	K-2151		K-2219
	-9	240/416	3	4	416	3, 4	Consult Zenith Factory		K-2220
SN/SNO	Limit Switch						23P-1540		
SE/SEO	Limit Switch						23P-1541		
A3	ATS Emergency Position Switch						23P-1543		
A4	ATS Normal Position Switch						23P-1542		
AA AT AI	ATS Auto Location Switch ATS Test Location Switch ATS Isolate Location Switch						L-3071		
	Limit Switch DPDT, Roller Actuator								
AE	Engine Start Transfer						L-3052		
	Limit Switch DPDT, Lever Actuator								
AB3 AB4	Bypass Emergency Position Switch Bypass Normal Position Switch						L-5021		
DS	ATS Solenoid Disconnect Switch: Operator 2-Position Maintain						L-4018		
	Contact Block N.C. (1) Contact Block N.O. (2)						L-1020 L-1024		
CBE CBN	Emergency Interlock Solenoid Normal Interlock Solenoid						K-2192		
CBC	Crank Enable Solenoid						K-2159R		
CH	Crank Handle Limit Switch						L-3052		
RN/RNO RE/REO	Coil Rectifiers						23P-1473 23P-1582 (480VAC)		

5. CONTROL PANEL LAYOUT AND PARTS LIST



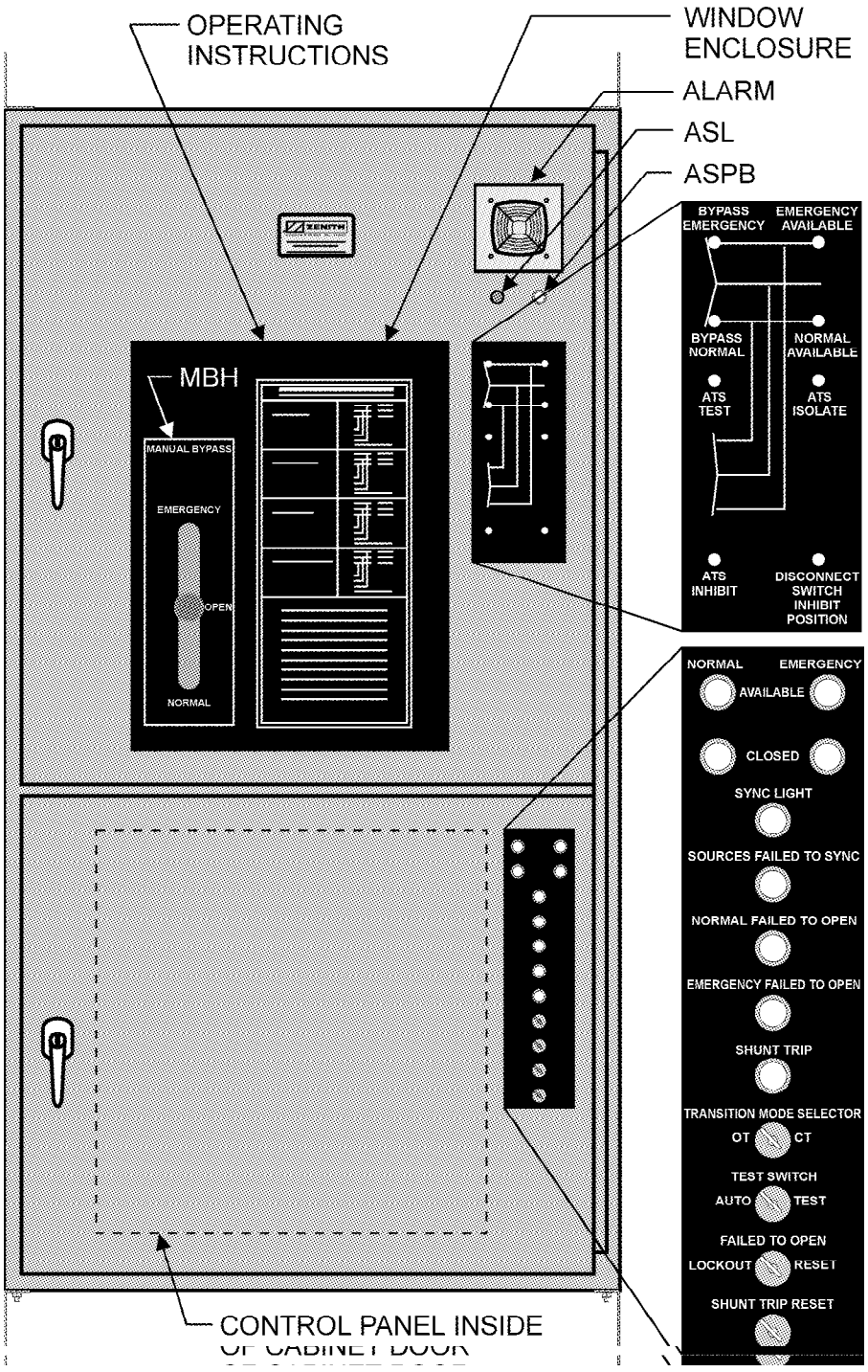
Closed Transition Transfer Switch Control Panel Parts List			
Tag	Description	Voltage	Part No.
CR2	Normal Control Relay	120 VAC	K-1204
DT	Transfer Delay Timer Neutral to Normal	120 VAC	K-1230
DTR	Normal Transfer Latch Relay	120 VAC	K-1204
DW	Transfer Delay Timer Neutral to Emergency	120 VAC	K-1230
DWR	Emergency Transfer Latch Relay	120 VAC	K-1204
EFOAR	Relay, Emergency Fail to Open Alarm	24 VDC	K-1242
EFOR	Emergency Fail to Open Latching Relay	120 VDC	K-1240
ETT	Emergency Trip Timer	120 VAC	K-1230
LTCS	Latch Test Cycle Start	120 VAC	K-1204
NFOAR	Relay, Normal Fail to Open Alarm	24 VDC	K-1242
NFOR	Normal Fail to Open Latching Relay	120 VDC	K-1240
OLC	Open Last Close	120 VAC	K-1230
PAR	Power Available Relay	120 VAC	K-1204
PART	Power Available Timer	120 VAC	K-1249
PT1,2,3,4	Potential Transformers	120 /480 VAC	K-3094
		120/240 VAC	K-3095
		120/208 VAC	K-3096
RAI	Normal Available Relay	120 VAC	K-1204
RAE	Emergency Available Relay	120 VAC	K-1204
RTCS	Relay Test Cycle Start	240 VAC	K-1256
SCL	Sync Check Latch Relay	120 VAC	K-1204
ST	Sync Timer	120 VAC	K-1230
STR	Shunt Trip Relay	120 VDC	K-1240
XNE	Normal/Emergency Control Transformers	24/120 VAC	K-3061

SSRCP Control Panel Standard Items Parts List			
Tag	Description	Voltage	Part No.
XN, XE	Control Transformer	208 VAC	K-3070
		240/480 VAC	K-3071
B1,2,3	Solid State Phase Relay	208/240 VAC	K-1186
		480 VAC	K-1188
VFSM	Voltage Frequency Sensor	120 VAC	K-1192
CR	Control Relay	120 VAC	K-1204
RT	Bypass T Relay	120 VAC	K-1204
J1-J11	Jumpers	-	PS-5067
T	Time Delay to Normal, Timer Solid State	120 VAC (Adjustable .1 second to 9990 hours)	K-1230
U	Engine Cool Down, Timer Solid State	120 VAC (Adjustable .1 second to 9990 hours)	K-1230
W	Time Delay to Emergency, Timer Solid State	120 VAC (Adjustable .1 second to 9990 hours)	K-1230
P1	Time Delay Engine Start, Timer	120 VAC (Adjustable .5 to 6 seconds)	K-1201

Closed Transition Transfer Switch Control Panel (Standard Items)				
Tag	Description	Voltage	Part No.	
25	Sync Check Relay	120 VAC	K-1234	
47N	Phase Sequencing, Normal	120 VAC	K-1246	
47E	Phase Sequencing, Emergency	120 VAC	K-1246	
27/59E	Over/Undervoltage, Emergency	120 VAC	K-1269	
27/59N	Over/Undervoltage, Normal	120 VAC	K-1269	
AS	Alarm Silence Relays	24 VDC	K-1242	
CCN	Power Relay for CN Solenoid	120 VAC	K-1120	400-1200A
			K-1257	1600-3000A
CCNO	Power Relay for CNO Solenoid	120 VAC	K-1120	
CCE	Power Relay for CE Solenoid	120 VAC	K-1120	400-1200A
			K-1257	1600-3000A
CCEO	Power Relay for CEO Solenoid	120 VAC	K-1120	

Bypass Control Panel Parts List		
Tag	Description	Part No.
BR-1,2,3	Bridge Rectifier	PS-5076
RNH	Normal Voltage Relay	K-1218
R1	Resistor, RNH, 30 ohm	PS-4056
R2	Resistor, LDS, 120 ohm	PS-4057
D1	Diode	PS-4812
C	Capacitor RNH	PS-4058
ATR	Auxiliary Test Relay	K-1218

6. CABINET DOOR PILOT DEVICES



BYPASS-ISOLATION CLOSED TRANSITION TRANSFER SWITCH CONTROLS

APPENDIX B - REPLACEMENT PARTS (Continued)

Controls and Indicating Lights Parts List				
Controls		**Part No.**		
Description		**Operator**	**Switch**	**Mounting Base**
Transition Mode Selector		L-3081	L-1028 (4) L-1029 (2)	PS-3473
Test Switch		L-3081	L-1029	
Failed to Open Lock Out Reset		L-4020	L-1028	
Shunt Trip Reset		L-4020	L-1028	
Alarm Silence Push Button (ASPB)		L-1025	L-1028 L-1029	
Alarm		Y780001		
Indicating Lights (Upper Door)		**Part No.**		
Description	**Color**	**Socket**	**Bulb**	**Lens**
Normal Available	Green	PS-5046	Y500005	PS-5048
Emergency Available	Red			PS-5047
Bypass Normal Location	Green			PS-5048
Bypass Emergency Location	Red			PS-5047
ATS Test Position	Amber			PS-5049
ATS Isolate Position	Amber			PS-5049
ATS Inhibit	Red			PS-5047
ATS Disconnect Switch “Off”	Red			PS-5047
Indicating Lights (Lower Door)		**Part Numbers**		
Description	**Color**	**Socket**	**Bulb**	**Lens**
Normal Available	Green	PS-5046	PS-5105	PS-5048
Emergency Available	Red			PS-5047
Normal Closed	Green			PS-5048
Emergency Closed	Red	PS-5054		PS-5047
Sync Light	White	PS-5046	Y500005	PS-5051
Fail To Sync Light	Red		PS-5105	PS-5047
Normal Failed To Open	Red		Y500005	
Emergency Failed To Open	Red		Y500005	
Shunt Trip Light	Red		PS-1272	
Alarm Silence (ASL)	Red		Y500005	

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