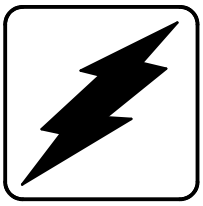
Service

Automatic Transfer Switches



Models:

S340 Logic Board

ISO 9001
KOHLER GENERATORS
INTERNATIONALLY REGISTERED
U.S.A. Plant ISO Registered

KOHLER®
POWER SYSTEMS

TP-5612 4/94c

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Safety Precautions and Instructions

A transfer switch, like any other electromechanical device, can pose potential dangers to life and limb if improperly maintained or imprudently operated. The best way to prevent accidents is to be aware of the potential dangers and to always use good common sense. In the interest of safety, some general precautions relating to operating of a transfer switch follow. Keep these in mind. This manual contains several types of safety precautions which are explained below.

DANGER

Danger is used to indicate the presence of a hazard that *will* cause *severe* personal injury, death, or substantial property damage if the warning is ignored.

WARNING

Warning is used to indicate the presence of a hazard that *can* cause *severe* personal injury, death, or substantial property damage if the warning is ignored.

CAUTION

Caution is used to indicate the presence of a hazard that *will* or *can* cause *minor* personal injury or property damage if the warning is ignored.

NOTE

Note is used to notify people of installation, operation, or maintenance information that is important but not hazard-related.

HAZARDOUS VOLTAGE/ ELECTRIC SHOCK

WARNING

Hazardous voltage.
Can cause severe injury or death.

Disconnect power sources before servicing. Barrier must be installed after adjustments, maintenance, or servicing.

(under 600 Volt)

DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect power sources before servicing. Barrier must be installed after adjustments, maintenance, or servicing.

WARNING

Hazardous voltage.
Can cause severe injury or death.

Do not open enclosure until all power sources are disconnected.

(under 600 Volt)

Hazardous voltage can cause severe injury or death. Disconnect inner panel harness at in-line connector. This will de-energize circuit board and logic circuitry, but allow transfer switch to continue to supply utility power to necessary lighting and equipment. Hazardous voltage will exist if any accessories mounted to inner panel are NOT wired through and de-energized by harness separation. Such accessories may be at line voltage.

Hazardous voltage can cause severe injury or death. Keep everyone away from the set and take precautions to prevent unqualified personnel from tampering. Have the set and electrical circuits serviced only by qualified technicians. Wiring should be inspected at the recommended interval shown in the service schedule– replace leads that are frayed or in poor condition. Do not operate electrical equipment when standing in water, on wet ground, or when hands are wet.

Hazardous voltage can cause severe injury or death. Disconnect harness plug before installing any accessories involving connection to transformer assembly primary terminals 76, 77, 78, and 79. Terminals are at line voltage!

600 VOLTS AND ABOVE ONLY

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Do not open enclosure until all power sources are disconnected.

(600 Volt and above)

NOTE

When replacing hardware, do not substitute with inferior grade hardware. Screws and nuts are available in different hardness ratings. American Standard hardware uses a series of markings and metric hardware uses a numeric system to indicate hardness. Check markings on bolt head and nuts for proper identification.

NOTE

HARDWARE DAMAGE! Transfer switch may make use of both American standard and metric hardware. Be sure to use the correct size tools to prevent rounding of bolt heads and nuts.

NOTE

A manual operator handle is provided on the transfer switch for maintenance purposes only. Return the transfer switch to the normal position. Remove manual operator handle (if used) and store it on the transfer switch in the place provided when service is completed.

Introduction

This manual covers the operation, troubleshooting and repair of automatic transfer switches.

Read through this manual and carefully follow all procedures and safety precautions to ensure proper generator operation and to avoid serious bodily injury. Keep this manual with the generator set for future reference.

Service requirements are minimal but are very important to the safe and reliable operation of the generator set; therefore, inspect associated parts often. It is recommended that an authorized service distributor perform required servicing to keep the set in top condition.

All information found in this publication is based on data available at time of printing. Kohler reserves the right to make changes to this literature and the products represented at any time without notice and without incurring obligation.

Service Assistance

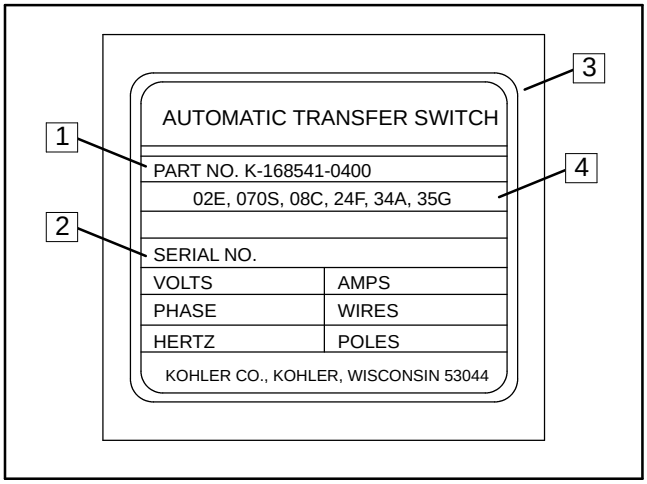
See the Yellow Pages under "Generators-Electric" for the closest Kohler Generator Dealer. Give switch part number and serial numbers from the transfer switch nameplate for complete parts list and information.

KOHLER CO., Kohler, Wisconsin 53044
Phone 920-565-3381
Fax 920-459-1646 (North American Sales)
920-459-1614 (International)
For sales and service in U.S.A. and Canada
Phone 1-800-544-2444

Whenever information is needed, include the voltage used as this may affect the switch number. The switch number reflects what was sent from the factory and may not be correct if a field-installed coil change for contactor voltage conversion was made or a field-installed kit was added.

Nameplate

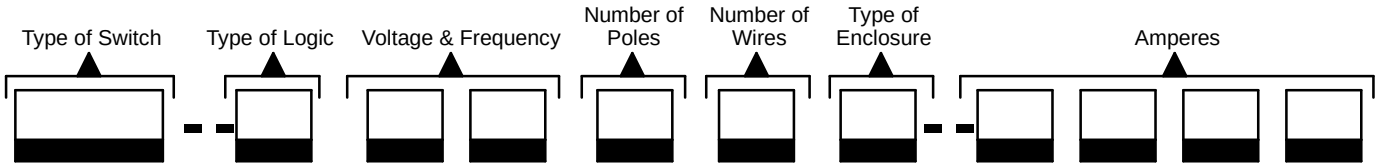
The transfer switch nameplate, located on the door's inside panel, includes important service information such as the product model number, serial number and any factory-installed accessories on the unit. The factory 1-800 service number is also provided near the nameplate.



1. Kohler number used to identify type of TS (refer to iv).
2. Used for ATS serial number.
3. Nameplate
4. Option numbers, indicate Kohler installed options that are included when operating or troubleshooting.

Figure 1. Transfer Switch Nameplate

Use the Model Number Key below to construct a model number specifying the type of transfer switch desired. Fill in the following boxes as a guide to constructing the model number:



Model Number Key

This diagram explains the Kohler Transfer Switch model numbering system. The sample number shown is for a microprocessor-logic automatic transfer switch, 480-Volt, 60-Hertz, 3-phase, 3-pole, 4-wire, 150-ampere model in a NEMA Type 1 enclosure.

SAMPLE MODEL NUMBER

K-166341-0150

Type Of Transfer Switch

K: Automatic Transfer Switch
KB: Automatic Transfer and Bypass Isolation Switch
KN: Nonautomatic Transfer Switch**

Includes domestic packing. Add prefix PE for above- or below-deck export packing.

Type Of Logic

1: Solid State
2: Relay
3: Manual Relay
4: Elevator Control Switch
5: Microprocessor

Voltage & Frequency Phase-to-Phase

Available in 30-100 ampere sizes only.

240V AC Max.	600V AC Max.	600V AC Max.
21: 110 Volt, 50 Hz	60: 600 Volt, 60 Hz	67: 190 Volt, 50 Hz
22: 120 Volt, 60 Hz	61: 110 Volt, 50 Hz	68: 208 Volt, 60 Hz
23: 220 Volt, 50 Hz	62: 120 Volt, 60 Hz	69: 440 Volt, 60 Hz
24: 240 Volt, 60 Hz	63: 220 Volt, 50 Hz	70: 400 Volt, 50 Hz
27: 190 Volt, 50 Hz	64: 240 Volt, 60 Hz	71: 380 Volt, 50 Hz
28: 208 Volt, 60 Hz	65: 550 Volt, 60 Hz	72: 380 Volt, 60 Hz
	66: 480 Volt, 60 Hz	73: 416 Volt, 50 Hz

Number of Poles

2: 2 pole, 1 phase
3: 3 pole, 3 phase
4: 3 pole, 1 phase
5: 3 pole, 3 phase with overlapping neutral contacts

Number of Wires

2: 2 wire
3: 3 wire
4: 4 wire

Type of Enclosure

0: Open	3: NEMA Type 3R
1: NEMA Type 1	4: NEMA Type 1 CSA*
2: NEMA Type 12	7: Open CSA*

Amperes

0030: 30 amperes	0800: 800 amperes
0070: 70 amperes	1000: 1000 amperes
0100: 100 amperes	1200: 1200 amperes
0104: 104 amperes	1600: 1600 amperes
0150: 150 amperes	2000: 2000 amperes
0225: 225 amperes	2500: 2500 amperes
0260: 260 amperes	3000: 3000 amperes
0400: 400 amperes	4000: 4000 amperes
0600: 600 amperes	

* CSA versions available up to 2000 amperes
** Must be selected when accessory KA-29-B-J is used with any Type R ATS or KB, A1 & BIS. Refer to accessory KA-50 (Accessory Catalog).

Glossary of Abbreviations

Abbreviations are used throughout this manual. Normally in the text they will appear in complete form with the abbreviation following in parentheses the first time they are used. After that they will appear in the abbreviated form. The commonly used abbreviations are shown below.

Abbreviation	Description
ABDC	after bottom dead center
AC	alternating current
AISI	American Iron and Steel Institute
AHWT	anticipatory high water temp.
ALOP	anticipatory low oil pressure
AM	amplitude modulation
amp.	ampere
amps.	amperes
ANSI	American National Standard Institute
API	American Petroleum Institute
approx.	approximate, approximately
A/R	as required, as requested
A/S	as supplied, as stated, as suggested
ASA	American Standards Association (former name of ANSI)
ASME	American Society of Mechanical Engineers
assy.	assembly
ASTM	American Society for Testing Materials
ATDC	after top dead center
aux.	auxiliary
A/V	audio-visual
AWG	American Wire Gauge
AWM	appliance wiring material
BBDC	before bottom dead center
BDC	before dead center
bhp	brake horsepower
bmep	brake mean effective power
B.&S.	Brown & Sharpe Wire Gauge
BTDC	before top dead center
Btu	British thermal unit
℃	Celsius degree
cc	cubic centimeter
CCA	cold cranking Amps.
CEC	Canadian Electrical Code
cfh	cubic feet per hour
cfm	cubic feet per minute
CID	cubic inch displacement
cm	centimeter, centimeters
cmm	cubic meters per minute
co.	company
cont'd.	continued
CPVC	chloropoly vinyl chloride
CRT	cathode ray tube
C.S.A.	Canadian Standards Association
CT	current transformer
cu. in.	cubic inch, cubic inches

Abbreviation	Description
cyl.	cylinder
dBA	decibels
DC	direct current
DCR	direct current resistance
deg.	degree
dept.	department
dia.	diameter
DIN	Deutsches Institut fur Normung e. V. (also Deutsche Industrie Normenausschuss)
e.g.	example given
EIA	Electronic Industries Association
EMI	electromagnetic interference
EPA	Environmental Protection Agency
etc.	etcetera, (and so forth)
ext.	external
℉	Fahrenheit degree
fl. oz.	fluid ounce, fluid ounces
FM	frequency modulation
ft.	foot, feet
ft. lbs.	foot pound, foot pounds
fs	full scale
ga.	gauge (meters, wire size)
gal., gals.	gallon, gallons
gal./hr.	gallons per hour
gph	gallons per hour
gpm	gallons per minute
gr.	grade
grd.	ground
HCHT	high cylinder head temperature
HET	high exhaust temperature
Hg	mercury (element)
H_2O	water
hp	horsepower
hr, hrs	hour
HWT	high water temperature
Hz	hertz (cycles per second)
ID	inside diameter
IEEE	Institute of Electrical and Electronics Engineers
in.	inch(es)
inc.	incorporated
in. lbs.	inch pounds
int.	internal
int.-ext.	internal-external
ISO	International Standards Organization
J	joule, joules
JIS	Japanese Industry Standard

Abbreviation	Description
kg	kilogram, kilograms
kg/cm^2	kilograms per square centimeter
kgm	kilogram meter(s)
km	kilometer, kilometers
kPa	kiloPascal, kiloPascals
kph	kilometers per hour
kV	kilovolt
kVA	kilovolt amperes
kW	kilowatt, kilowatts
kWH	kilowatt hour
L	liter, liters
L x W x H	length x width x height
LED, LEDs	light emitting diode
lb., lbs.	pound, pounds
L/hr.	liter per hour, liters per hour
L/min.	liter(s) per minutes,
LOP	low oil pressure
LP	liquefied petroleum
LWT	low water temperature
m	meter, meters
m^3	cubic meter, cubic meters
max.	maximum
MCM	one thousand circular mils.
MHz	megahertz
mi.	mile, miles
mil	one one-thousandth of an inch
min.	minimum
mJ	milli joule, milli joules
MJ	mega joule, mega joules
mm	millimeter, millimeters
m^3/min	cubic meters per minute
MPa	megaPascal
MPG	miles per gallon
mph	miles per hour
MS	military standard
mW	milliwatt, milliwatts
MW	megawatt, megawatts
N/A	not available
NBS	National Bureau of Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
meggar	megohmmeter
misc.	miscellaneous
NFPA	National Fire Protection Association
Nm	Newton meter, Newton meters
no., nos.	number, numbers

Abbreviation	Description
NPT	National Standard taper pipe thread per general use
N/R	not required
OC	overcrank
OD	outside diameter
OEM	original equipment manufacturer
OS	overspeed, oversize
OSHA	Occupational Safety and Health Act
OV	overvoltage
oz.	ounce, ounces
PF	power factor
PMG	permanent magnet generator
pot.	potentiometer
ppm	parts per million
psi	pounds per square inch
pt., pts.	pint, pints
PVC	polyvinyl chloride
qt., qts.	quart, quarts
qty.	quantity
ref.	reference
RFI	radio frequency interference
r.h.m.	round head machine (screw)
rms	root mean square
rpm	revolutions per minute
RV	recreational vehicle
SAE	Society of Automotive Engineers
SCR	silicon controlled rectifier
sec.	second, seconds
spec, specs	specification
sq.	square
sq. cm	square centimeters
sq. in.	square inch, square inches
tach	tachometer
TDC	top dead center
tech. pub.	technical publications
temp.	temperature
TIF	telephone influence factor
TP, TPs	technical publications
turbo	turbocharger
UHF	ultra high frequency
UNC	Unified coarse thread (was NC)
UNF	Unified fine thread (was NF)
UL	Underwriter ʼs Laboratories, Inc.
US	undersize
VAC	volts alternating current
VDC	volts direct current
VHF	very high frequency
W	watt, watts

Section 1. Specifications

Standard Features

- Normal source voltage sensing adjustable from 72% to 100% of normal for pickup and 70% to 98% for dropout; monitored line-to-line for all phases of 3-phase switches
- TDNE (Time Delay Normal to Emergency) adjustable from 0.6 to 60.0 seconds or 0–30 minutes
- TDES (Time Delay on Engine Starting) fixed at 3.0 seconds
- TDEN (Time Delay Emergency to Normal) adjustable from 1 to 30 minutes
- Frequency/voltage relay for emergency source, nonadjustable, monitors 1 phase only
- Test switch maintained simulates a normal source power failure.

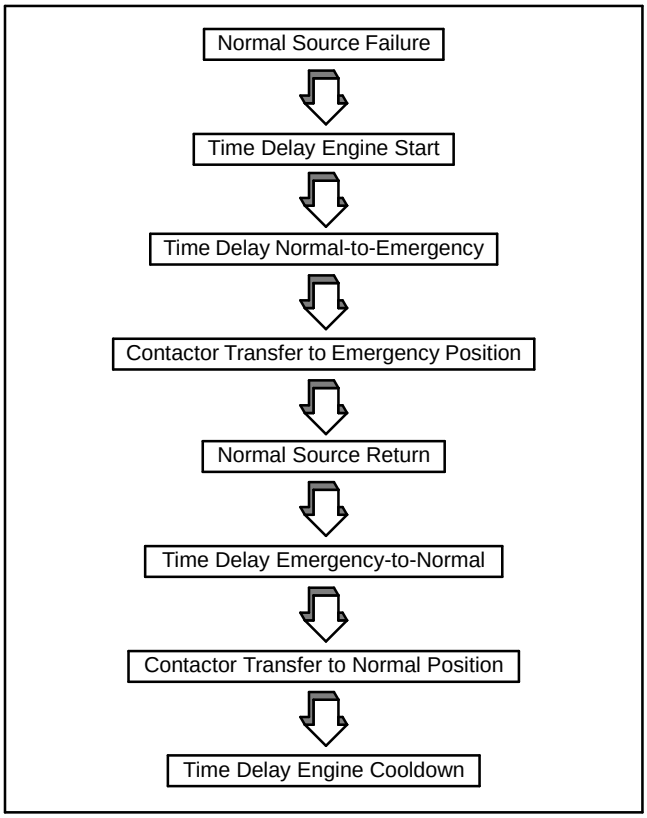


Figure 1-1. Logic Board Operation

0-60 Sec. Time Delay: Normal to Emergency
X-297372– Main Solid State Logic Board Assembly– 1 Phase, 50 Hertz
X-297373– Main Solid State Logic Board Assembly– 1 Phase, 60 Hertz
X-297374– Main Solid State Logic Board Assembly– 3 Phase, 50 Hertz
X-297375– Main Solid State Logic Board Assembly– 3 Phase, 60 Hertz
1-30 Min. Time Delay: Normal to Emergency
X-297380– Main Solid State Logic Board Assembly– 1 Phase, 50 Hertz
X-297381– Main Solid State Logic Board Assembly– 1 Phase, 60 Hertz
X-297382– Main Solid State Logic Board Assembly– 3 Phase, 50 Hertz
X-297383– Main Solid State Logic Board Assembly– 3 Phase, 60 Hertz

Figure 1-2. Transfer Switch Logic Board Part Numbers

NOTE

X represents the revision level of control boards.

General Maintenance

Reasonable care in preventive maintenance will insure high reliability and long life for the automatic transfer switch. Follow all applicable local codes and standards that apply, and keep a log book for scheduled maintenance and repairs.

Operate Transfer Switch at Least Once a Month. Use the test switch to check the electrical operation of the transfer switch. Because the test switch only simulates failure of the normal source, service is interrupted only during the actual transfer of the load. It is recommended that an actual load be connected while transfer takes place.

Keep Automatic Transfer Switch Clean. During installation, protect the switch from construction grit and metal chips. Once each year, brush and vacuum away any excessive dust accumulation. Leave the cover on the control panel.

Maintain Transfer Switch Lubrication. The transfer switch has been properly lubricated, and under normal operating conditions no further lubrication is required. Renew factory lubrication if the switch is subjected to severe dust or abnormal operating conditions. Relubricate the contactor core and spring if the transfer switch coil is replaced.

Inspect Main Current Carrying Contacts. Once each year, de-energize all sources, and remove barriers to check condition of contact material. Replace contacts when pitted or worn excessively on contactors rated 225 amperes and larger. Replace the entire contactor for ratings of 30 to 150 amperes.

Torquing of Contactor Lug Set Screws. Set screws must be properly torqued to specs when installed and should be checked every six months. When aluminum conductor is used, apply joint compound to conductor. Check contactor lugs after tightening and wipe off excess joint compound.

Effect of Ambient Temperature and Humidity Conditions. The contactor should be operated in an ambient temperature of 32° to 104° F (0° to 40° C). Contact the manufacturer if the contactor will be operated in a higher or lower ambient temperature. Humidity can vary from 0 to 100% without affecting operation.

Section 2. Adjustment

Disconnecting the Inner Control Panel Assembly

⚠ WARNING

Hazardous voltage.
Can cause severe injury or death.

Do not open enclosure until all power sources are disconnected.

(under 600 Volt)

Hazardous voltage can cause severe injury or death. Disconnect inner panel harness at in-line connector. This will de-energize circuit board and logic circuitry, but allow transfer switch to continue to supply utility power to necessary lighting and equipment. Hazardous voltage will exist if any accessories mounted to inner panel are NOT wired through and de-energized by harness separation. Such accessories may be at line voltage.

To Disconnect the Control Panel

1. **If the transfer switch is in the normal position**, place the generator set starting switch in the OFF position. Then open the emergency source circuit breaker.

2. **If the transfer switch is in the emergency position**, open the normal source circuit breaker. Place the generator set starting switch in the TEST or RUN position.

3. Separate the in-line disconnect plug by grasping and squeezing the plug. Do not pull on the wires.

4. Remove and tape the signal wires connected to the engine start terminals on the contactor (Terminals 3 and 4).

To Reconnect the Plug

1. If the transfer switch is in the normal position, place the generator set starting switch in the OFF position. Then open the emergency source circuit breaker.
2. If the transfer switch is in the emergency position, open the normal source circuit breaker.
3. Engage the in-line disconnect plug by grasping and pressing together.
4. If the transfer switch is in the normal position, place the generator set starting switch in the AUTOMATIC position. Then close the emergency source circuit breaker.
5. If the transfer switch is in the emergency position, close the normal source circuit breaker. The load will automatically retransfer to the normal source after a time delay. For immediate load retransfer, open and then reclose the emergency source circuit breaker. Place the generator set starting switch in the AUTOMATIC position.

Main Circuit Board Voltage and Time Delay Adjustments

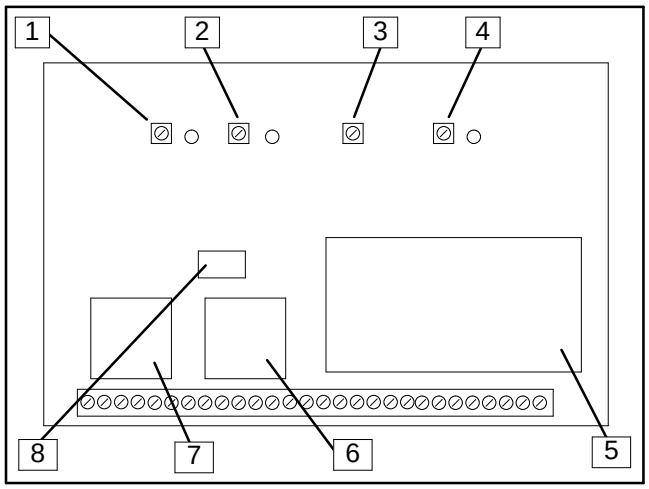
The main circuit board contains a normal source undervoltage circuit. To adjust, proceed as follows. The adjustments are the same for single- and three-phase systems. See Figure 2-1.

NOTE

Normal source must be disconnected. Use variable AC power supply to establish voltage levels.

1. Set dropout pot to maximum counterclockwise.
2. Set pull-in pot to maximum counterclockwise.
3. Set line volts to desired dropout value (normally 70%). LED should be ON.
4. Rotate dropout clockwise until LED goes OFF.
5. Rotate pull-in pot to maximum clockwise. LED is OFF.
6. Increase line volts to desired pickup value (normally 90%) LED is OFF.
7. Rotate pull-in pot counterclockwise until LED comes ON.
8. Recheck pull-in and dropout values by running voltage up and down. Watch for proper LED illumination.

The main circuit board also contains normal-to-emergency and emergency-to-normal time delay circuits. Each time delay is adjusted by turning the potentiometer clockwise to increase and counterclockwise to decrease (TDNE 0−60 sec.; TDEN 0−30 min.). When the time delay is complete, the corresponding LED will turn on.



1. Time Delay Normal-to-Emergency
2. Time Delay Emergency-to-Normal
3. Voltage Dropout
4. Voltage Pull-In
5. Daughter Board
6. TDES Relay
7. EFR Relay
8. NRI Relay

Figure 2-1. Main Circuit Board Adjustments

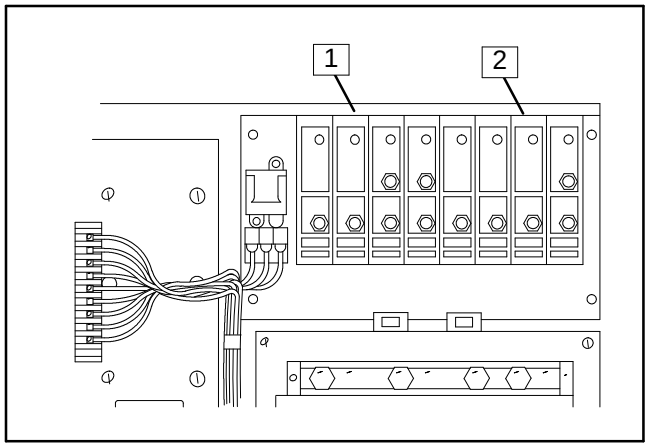
Accessory Card Adjustments

Voltage-sensing relays, timers, etc., are similar to the following types of devices. Adjustments should be made as shown for each type of device.

All accessory cards have LED indicators that will illuminate when conditions are acceptable. If the LED on a particular option card is not illuminated, then that condition is unacceptable.

NOTE

To make variable-voltage adjustments to the accessory cards, a variable-frequency AC supply is required. The AC supply must be connected to the transformer primaries of the source being simulated. The regular source (normal or emergency) must be disconnected during this simulation or adjustment procedure. The switch should be manually set to the other source.



1. Emergency-Source Cards
2. Normal-Source Cards

Figure 2-2. Accessory Card Adjustments

Place accessory cards in their proper location as indicated by the nameplate on top of the card cage. See Figure 2-2.

Undervoltage Card

1. Set dropout to maximum counterclockwise.
2. Set pickup to maximum counterclockwise.
3. Increase line volts to desired dropout value (normally 70%). LED should be ON.
4. Rotate dropout pot clockwise until LED goes OFF.
5. Rotate pickup pot to maximum clockwise. LED is OFF.
6. Increase line volts to desired pickup value (normally 90%). LED is OFF.
7. Rotate pickup pot counterclockwise until LED turns ON.
8. Recheck pickup and dropout by running voltage up and down. Check by LED illumination.

Overvoltage Card

1. Set dropout pot to maximum counterclockwise.
2. Set pickup pot to maximum counterclockwise.
3. Set line voltage to pull-in value desired (normally 105%) LED is OFF.
4. Rotate pickup pot clockwise until LED turns ON.
5. Rotate dropout pot maximum clockwise.
6. Set line voltage to desired dropout value (normally 115%).
7. Rotate dropout pot counterclockwise until LED is OFF.
8. Drop line voltage to desired pull-in value. LED should turn ON.
9. Increase line voltage to desired dropout value. LED should go OFF.

Frequency Cards

Test underfrequency and overfrequency cards on a generator set. Underfrequency and overfrequency cards for both normal and emergency are factory set for 60 Hz voltage. Pickup and dropout values should be as follows:

System Hz	Overfrequency	Underfrequency
60	Dropout @ 65 Hz Pickup @ 63 Hz	Dropout @ 55 Hz Pickup @ 57 Hz
50	Dropout @ 55 Hz Pickup @ 53 Hz	Dropout @ 45 Hz Pickup @ 47 Hz

Use the following procedures when altering frequency card settings. See Figure 2-3.

CAUTION

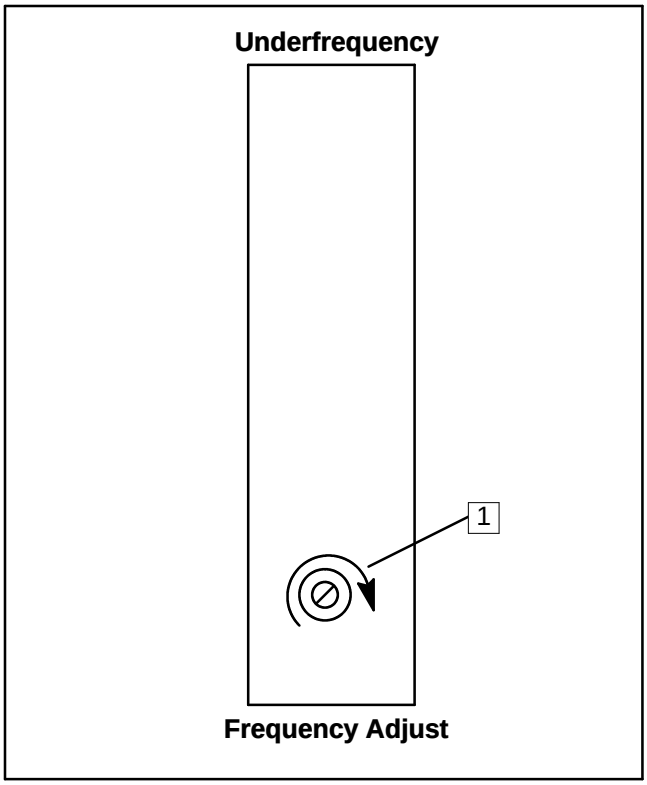
Do not adjust R23 and R24 on circuit cards.

60 Hz Underfrequency Card Adjustment

1. Move card to emergency slot in accessory card box.
2. Rotate pot to fully counterclockwise.
3. Decrease generator frequency to 55 Hz.
4. Turn pot clockwise until LED turns OFF.
5. Adjust generator frequency to 57 Hz.
6. LED should turn ON.

60 Hz Overfrequency Card Adjustment

1. Move card to emergency slot in accessory card box.
2. Rotate pot to fully clockwise.
3. Decrease generator frequency to 65 Hz.
4. Turn pot counterclockwise until LED turns OFF.
5. Adjust generator frequency to 63 Hz.
6. LED should turn ON.



1. Potentiometer

Figure 2-3. Frequency Card Adjustment

50 Hz Underfrequency Card Adjustment

1. Move card to emergency slot in accessory card box.
2. Rotate pot to fully counterclockwise.
3. Decrease generator frequency to 45 Hz.
4. Turn pot clockwise until LED turns OFF.
5. Adjust generator frequency to 47 Hz.
6. LED should turn ON.

50 Hz Overfrequency Card Adjustment

1. Move card to emergency slot in accessory card box.
2. Rotate pot to fully clockwise.
3. Decrease generator frequency to 55 Hz.
4. Turn pot counterclockwise until LED turns OFF.
5. Adjust generator frequency to 53 Hz.
6. LED should turn ON.

Time Delay Engine Cooldown Card

This card is adjustable from 1 to 30 minutes. To increase time, turn pot clockwise. To decrease time, turn pot counterclockwise. The LED will turn ON after the timing cycle is complete.

Section 3. ATS Troubleshooting

Sequence of Operation

Note any optional accessories that may have been furnished on this switch and review their operation. See "Standard and Operational Accessories."

Normal Source Failure

Load transfer to the emergency source automatically begins when the voltage-sensing circuit detects reduced voltage or total loss of the normal source. Relay NR1 will de-energize whenever the voltage level falls below the preset dropout point of the voltage sensing circuit.

NR1 relay de-energizes, signalling a failure while the TDES starts its timing cycle. At the same time, the NR relay de-energizes. TDES is a dropout time delay relay designed to override momentary outages. This delay prevents nuisance starting of the generator set. If the normal source voltage returns above the voltage pickup setting before the time delay expires, the NR1 and NR relays wil re-energize causing the timing cycle to reset.

TDES relay de-energizes after the time delay and signals the generator set to start. The emergency voltage/frequency relay (EFR) monitors the emergency source. The EFR will energize when the emergency source voltage and frequency reach the proper pickup points.

When the emergency source is acceptable, the emergency relay (ER) is energized after a timing cycle (TDNE). The ER relay is controlled by a time delay to prevent immediate load transfer to the emergency source.

When the ER relay energizes, the transfer switch solenoid coil is energized and the switch transfers load to the emergency source. The transfer switch is now supplying the load from the emergency source and will remain in this position until the normal source is restored.

Normal Source Restoration

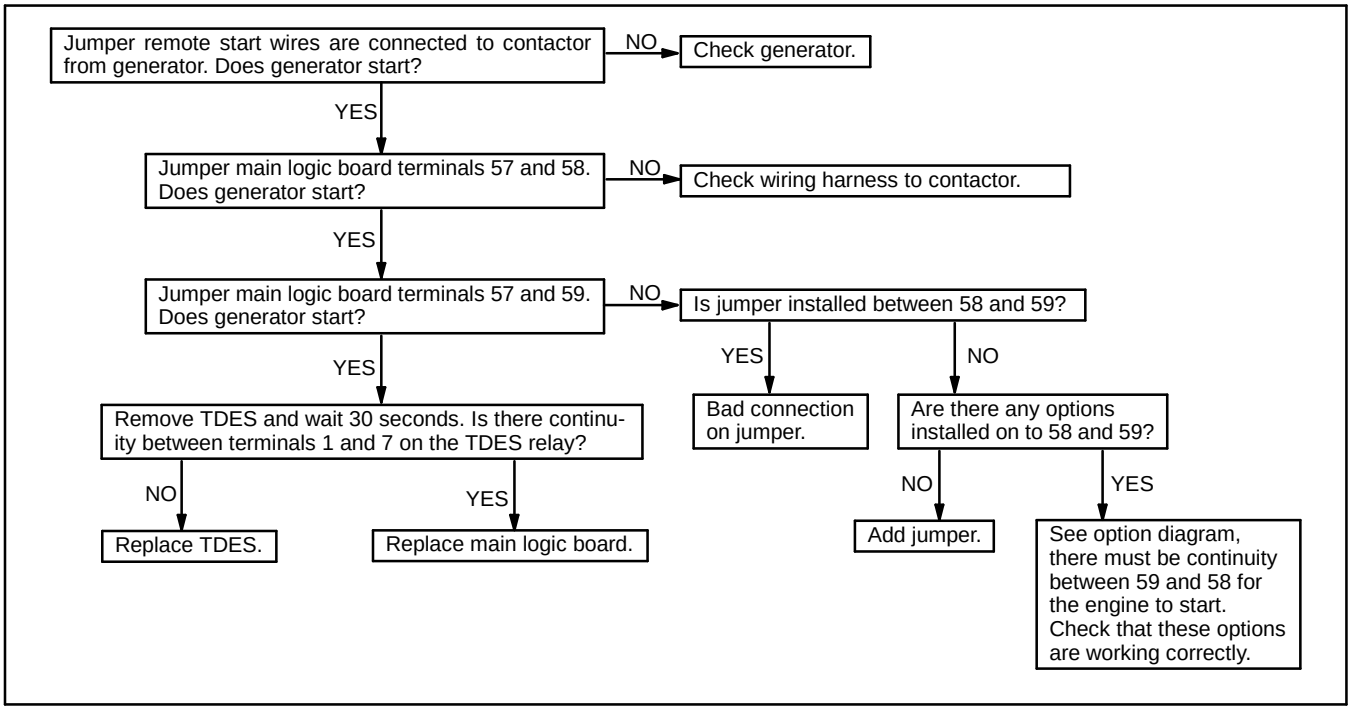
Load transfer to the normal source automatically begins when the voltage-sensing circuit detects restoration of the normal source. The voltage level must rise above the preset pickup point on all phases before the circuit will accept the normal source again.

When the normal source is accepted by the voltage-sensing circuit the NR1 relay is energized after a TDEN. This time delay insures that the normal source has stabilized before vital loads are reconnected. If the emergency source fails during this timing cycle, the EFR relay drops out and the load is immediately transferred to the normal source, if acceptable.

The NR1 relay energizes, which in turn activates the NR relay and the ER relay is dropped out. The transfer switch coil is energized and the switch transfers load back to the normal source. The transfer switch is in the normal position.

The NR1 relay energizes the TDES relay, which signals the generator set to shut down. All circuits are reset for any future normal source failure.

Generator will not Start when Power Fails or with Test Switch Depressed.



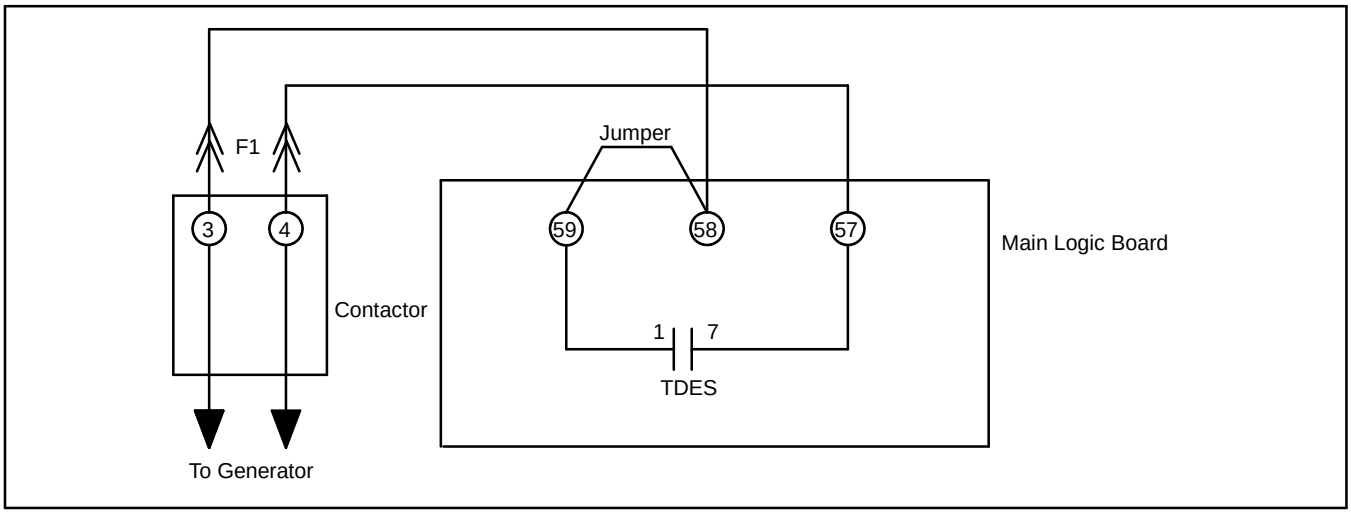
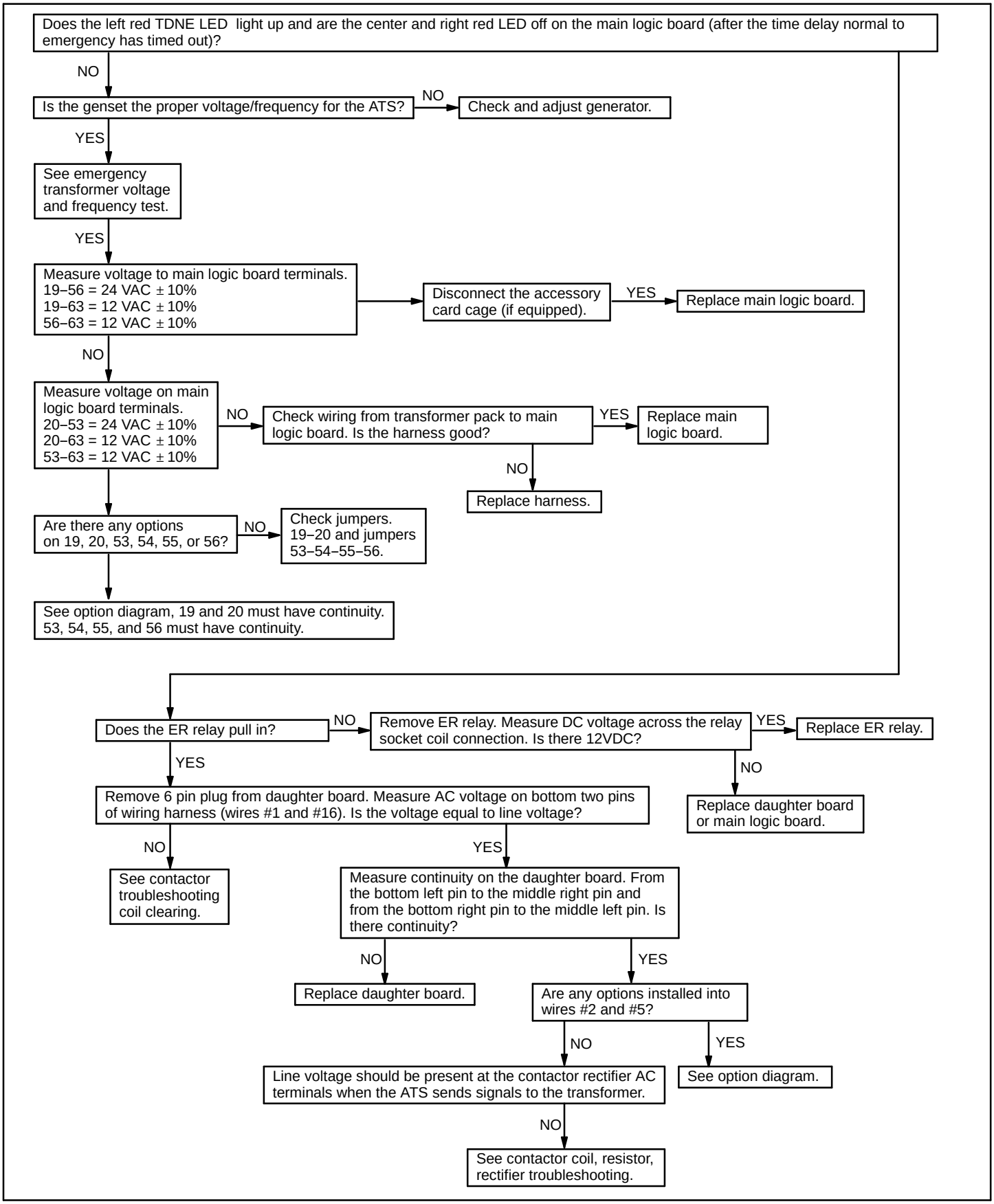
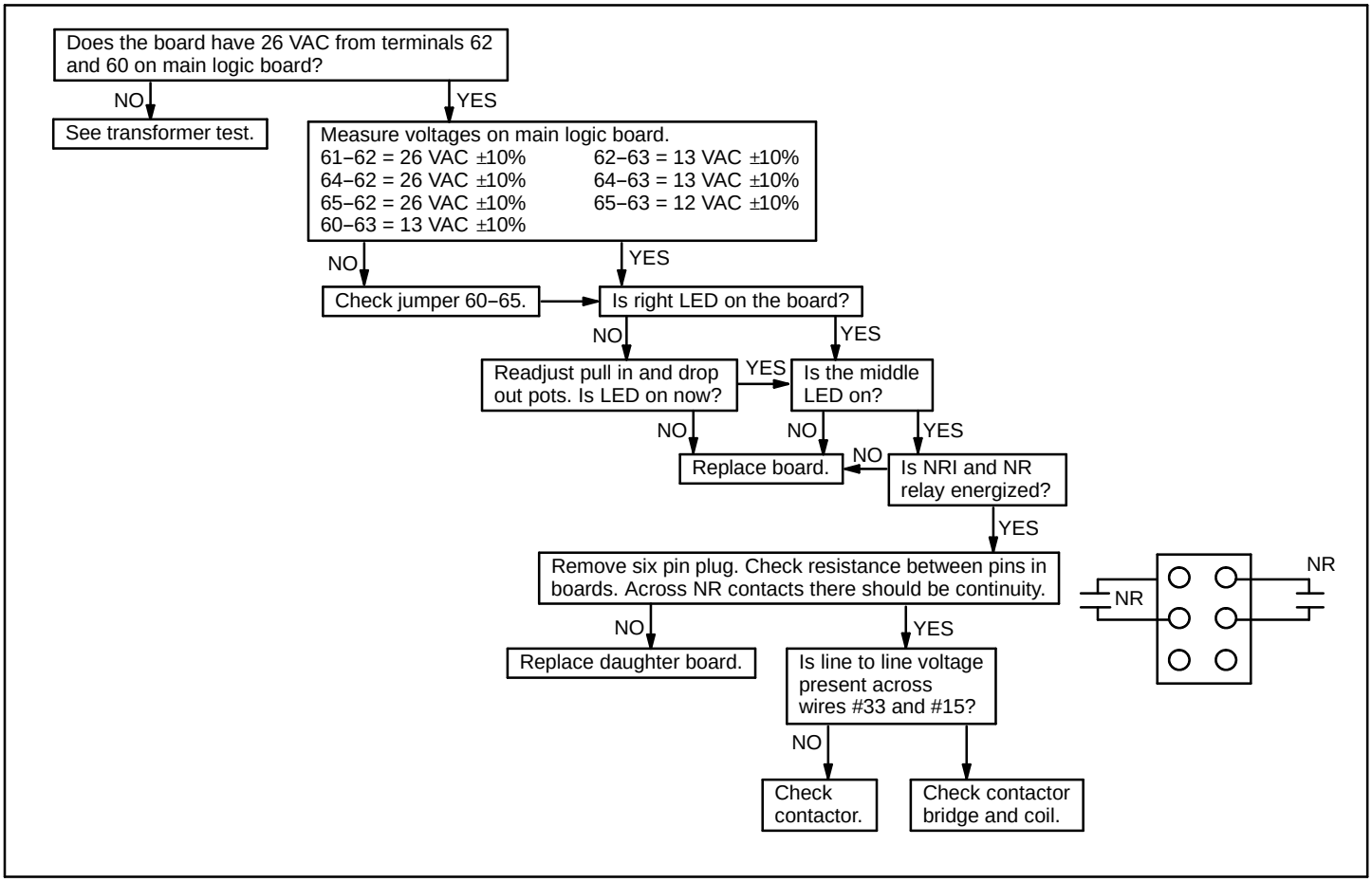


Figure 3-1. Basic Engine Start Circuit

Generator runs, but transfer switch does not transfer load to emergency during a power failure or with test switch depressed.



Transfer switch will not transfer back to normal.



With Normal Power Energized:

NA–NB = Line to line voltage
NB–NC = Line to line voltage
NC–NA = Line to line voltage
T2–T3 = 25.75 VAC–26.25 VAC NA–NC
T1–T2 = 12.75 VAC–13.25 VAC NA–NC
T1–T3 = 12.75 VAC–13.25 VAC NA–NC
T1–T4** = 12.75 VAC–13.25 VAC NB–NC
T1–T5** = 12.75 VAC–13.25 VAC NA–NB

T1
T2
T3
T4
T5
T6
T7
T8
T9

With Emergency Power Energized:

EA–EC = Line to line voltage
EA–EB* = Line to line voltage
EB–EC* = Line to line voltage
T6–T7 = 25.48 VAC–26.52 VAC EA–EC
T1–T6 = 12.74 VAC–13.26 VAC EA–EC
T1–T7 = 12.74 VAC–13.26 VAC EA–EC
T1–T8* = 12.74 VAC–13.26 VAC EB–EC
T1–T9* = 12.74 VAC–13.26 VAC EB–EA

NA
NB
NC
EA
EB
EC

*Only on units with three phase emergency sensing option.
**Only on units with three phase sensing.

Figure 3-2. ATS Transformer Tests

Standard Features

- Provision for installing accessories that are not mounted on enclosure doors.
- Easily accessible terminal blocks.
- Panel cover protects against tampering and foreign material.
- NR and ER relays are of the plug-in type with spring retaining clips.
- Hot-ink-stamped numbers on the entire length of each wire match connection diagram to facilitate identification.
- All printed circuit boards are conformal coated for environmental protection.
- The normal source voltage is monitored across live lines of 1-phase switches, and all phases of normal power are monitored line-to-line in 3-phase switches. The emergency source is monitored across 1 phase.
- Status panel front accessible on NEMA type 1 enclosures.

Standard Accessories

- KA-01-A	(TDNE) Time Delay on Transfer from Normal to Emergency (adjustable 0.6 to 60 seconds). TDNE delays transfer of the switch from the normal source to the emergency source. This overrides momentary power outages or fluctuations that may occur on the system if the emergency source is utility, or allows the emergency source to stabilize before accepting the load if the emergency source is a generator set. The timer begins timing when the emergency source appears, but will not transfer to it until the time delay setting has elapsed.	STD
- KA-02-E	(TDES) Time Delay on Engine Starting (fixed at 3 seconds). TDES delays initiation of the engine-start circuit in order to ignore momentary power outages or fluctuations. This timer begins timing when the normal source fails. It is intended for use when the emergency source is an engine generator and does not affect the transfer switch's ability to transfer from normal to emergency.	STD
- KA-03-C	(TDEN) Time Delay on Transfer from Emergency to Normal (adjustable 1 to 30 minutes) TDEN delays retransfer from emergency to normal in order to permit stabilization of the normal power source before retransfer or to allow a minimum generator run time. This timer begins timing when the normal source appears. If the standby source fails while this timer is timing and the normal source is available, the switch will immediately transfer to normal, overriding this time delay.	STD
- KA-15-A	Main shaft auxiliary contact, one closed on normal, one closed on emergency. (For 600-volt maximum switches only; not available for 240-Volt switches.)	STD
- KA-05-B	Frequency voltage relay for emergency source, nonadjustable. Monitors 1 phase only.	STD
- KA-06-B	Test switch for mounting on the enclosure door. The momentary test switch will interrupt power to the normal source relay and simulate a power failure on normal as long as the switch is held in the test position. (Omitted if accessory KA-07 is selected.)	STD

Optional Accessories

Time Delays		**K-1**
- KA-01-B	(TDNE) Time Delay on Transfer from Normal to Emergency (adjustable 1 to 30 minutes) TDNE delays transfer of the switch from the normal source to the emergency source. This overrides momentary power outages or fluctuations that may occur on the system if the emergency source is utility, or allows the emergency source to stabilize before accepting the load if the emergency source is a generator set. The timer begins timing when the emergency source appears, but will not transfer to it until the time delay setting has elapsed.	X
- KA-02-A	(TDES) Time Delay on Engine Starting (adjustable 3 to 20 seconds). TDES delays initiation of the engine-start circuit in order to ignore momentary power outages or fluctuations. This timer begins timing when the normal source fails. It is intended for use when the emergency source is an engine generator and does not affect the transfer switch's ability to transfer from normal to emergency.	X
- KA-02-F	(TDES) Time Delay on Engine Starting (adjustable 20 to 240 seconds). TDES delays initiation on the engine-start circuit in order to ignore momentary power outages or fluctuations. This timer begins timing when the normal source fails. It is intended for use when the emergency source is an engine generator and does not affect the transfer switch's ability to transfer from normal to emergency.	X
- KA-02-G	(TDES) Time Delay on Engine Starting (adjustable 0.5 to 6 seconds). TDES delays initiation of the engine-start circuit in order to ignore momentary power outages or fluctuations. This timer begins timing when the normal source fails. It is intended for use when the emergency source is an engine generator and does not affect the transfer switch's ability to transfer from normal to emergency.	X
- KA-02-H	(TDES) Time Delay on Engine Starting (adjustable 3 to 30 minutes). TDES delays initiation of the engine-start circuit in order to ignore momentary power outages or fluctuations. This timer begins timing when the normal source fails. It is intended for use when the emergency source is an engine generator and does not affect the transfer switch's ability to transfer from normal to emergency. It is a separate relay and not part of the main logic board. Not necessary if they are UL listed.	X
- KA-04-C	(TDEC) Time Delay for Engine Cool-Off (adjustable 1 to 30 minutes). TDEC permits the generator to run under a no-load condition after transfer from emergency to normal. This timer begins when the switch transfers to normal.	X

Optional Accessories (continued)

Time Delays (continued)		K-1
- KA-04-D	(TDEC) Time Delay for Engine Cool-Off (set at 5 minutes). TDEC permits the generator to run under a no-load condition after transfer from emergency to normal. This timer begins when the switch transfers to normal. It does not require a logic cage. This is a separate relay.	X
Plant Exercisers		
- KA-23-C	Plant exerciser for periodic no load exercising of the emergency generator set. Timer is adjustable over a 336-hour (14-day) period in increments of 30 minutes. Timer does not simulate a normal source failure.	X
- KA-23-D	Plant exerciser for periodic exercising under load. Timer is adjustable over a 336-hour (14-day) period in increments of 30 minutes. The timer simulates a normal power failure. Includes override circuit to provide immediate retransfer to normal if emergency fails.	X
- KA-23-G	Plant exerciser with a two-position selector switch marked (Load/No Load) that permits either operation. Timer is adjustable over a 336-hour (14-day) period in increments of 30 minutes. When switched to No Load, the timer does not simulate a normal source failure. The automatic transfer switch is not affected. The generator set is signaled to run unloaded for the set time period. When switched to Load, the timer simulates a normal power failure. Includes override circuit to provide immediate retransfer to normal if emergency fails.	X
- KA-23-P	Solid-state plant exerciser for periodic no load exercising of the emergency generator set. Timer is adjustable over 7-day period in any time increment desired.	X
- KA-23-R	Solid-state plant exerciser for periodic exercising under load. Timer is adjustable over 7-day period in any time increment desired. Includes override circuit to provide immediate retransfer to normal if emergency fails.	X
- KA-23-S	Solid-State plant exerciser with a two-position selector switch marked that permits either operation. Timer is adjustable over 7-day period in any time increment desired. Includes override circuit to provide immediate retransfer to normal if emergency fails.	X
Pilot Lights		
- KA-12-A	Pilot light to normal supply for separate mounting. Green lamp indicates transfer switch in normal position and normal power is supplying load. Up to four pilot lights can be paralleled. Does not require accessory KA-15.	X
- KA-12-B	Pilot light emergency supply for separate mounting. Red lamp indicates transfer switch in emergency position and emergency power is supplying load. Up to four pilot lights can be paralleled. Does not require accessory KA-15.	X

Pilot Lights (continued)		K-1
- KA-12-C	Pilot light to normal supply enclosure door mounted. Green lamp indicates transfer switch in normal position and normal power is supplying load. Up to four pilot lights can be paralleled. Does not require accessory KA-15.	X
- KA-12-D	Pilot light emergency supply enclosure door mounted. Red lamp indicates transfer switch in emergency position and emergency power is supplying load. Up to four pilot lights can be paralleled. Does not require accessory KA-15.	X
- KA-12-E	Pilot light to normal supply for separate mounting. White lamp indicates normal power is present. Up to four pilot lights can be paralleled.	X
- KA-12-F	Pilot light emergency supply for separate mounting. White lamp indicates emergency power is present. Up to four pilot lights can be paralleled.	X
- KA-12-G	Pilot light to normal supply enclosure door mounted. White lamp indicates normal power is present. Up to four pilot lights can be paralleled.	X
- KA-12-H	Pilot light emergency supply enclosure door mounted. White lamp indicates emergency power is present. Up to four pilot lights can be paralleled.	X
- KA-12-T	Push-to-test lamp switch, enclosure-mounted. Tests position-indicating lights.	X
- KA-12-U	Push-to-test lamp switch for separate mounting. Tests position-indicating lights. Not UL listed.	X
Battery Chargers		
- KA-24	Solid-state battery charger. Two-ampere maximum charge rate with automatic adjustable float. For 12 or 24 VDC.	X
Auxiliary Contacts		
- KA-14-C	Relay auxiliary contacts (normal source 2 NO and 2 NC). Relay coil is energized when normal power is available.	X
- KA-14-D	Relay auxiliary contact (emergency source 2 NO and 2 NC). Relay coil is energized when emergency power is available. Suitable for use in operating louvers.	X
- KA-15-E	One additional closed on normal, for switches 30–150 and 600–800 amperes.	X
- KA-15-F	One additional closed on emergency, for switches 30–150 and 600–800 amperes.	X
- KA-15-G	Two additional closed on normal, for switches 30–150 and 600–800 amperes.	X
- KA-15-H	Two additional closed on emergency, for switches 30–150 and 600–800 amperes.	X
- KA-15-J	Three additional closed on normal, for switches 30–150 and 600–800 amperes.	X
- KA-15-K	Three additional closed on emergency, for switches 30–150 and 600–800 amperes.	X

Optional Accessories (continued)

Auxiliary Contacts (continued)		K-1
- KA-15-L	Two additional closed on normal, two additional closed on emergency, for switches 225–400 and 1000–4000 amperes.	X
- KA-15-M	Three additional closed on normal, three additional closed on emergency, for switches 225–400 amps.	X
Source Monitors		
- KA-34-A	Inphase monitor. Monitors single phase of the normal and emergency sources and permits transfer in either direction only when the phase angles of both sources are within ±15 degrees and have a frequency difference within ±2 cycles. If the source from which the switch is transferring fails or voltage drops below 70%, the monitor limitations will be overriden and it will permit immediate transfer. For use with utility generator or two generator set sources. Accessory operates in either direction.	X
- KA-34-E	Inphase monitor. Monitors the normal and emergency sources and permits transfer in either direction only when the phase angles of both sources are within ±15 degrees and have a frequency difference within ±2 cycles. If the source from which the switch is transferring fails or voltage drops below 70%, the monitor limitations will be overriden and it will permit immediate transfer. For use with two utility sources. Not UL listed. Accessory operates in either direction.	X
- KA-34-B	Sync-check relay. Monitors single-phase normal and emergency sources. Will not permit transfer until phase voltages have been within ±10 degrees for approximately 60 milliseconds. If the source from which the switch is transferring fails or voltage drops below 70% the sync-check relay permits immediate transfer. Accessory operates in either direction.	X
- KA-34-C	Sync-check relay. Monitors single-phase normal and emergency sources. Will not permit transfer until phase voltages have been within ±10 degrees for approximately 60 milliseconds. If the source from which the switch is transferring fails or voltage drops below 70% the sync-check relay permits immediate transfer. Operates in emergency to normal direction. Uses closed on normal accessory KA-15-A.	X
- KA-34-D	Sync-check relay. Monitors normal and emergency sources. Will not permit transfer until phase voltages have been within ±10 degrees for approximately 60 milliseconds. If the source from which the switch is transferring fails or voltage drops below 70% the sync-check relay permits immediate transfer. Operates in normal to emergency direction. Uses closed on emergency accessory KA-15-A.	X
- KA-26-C	Overvoltage protection for the normal source. Plug-in printed circuit card. Adjustable from 100 to 115%, nominally set at 115% unless otherwise specified. Monitors one phase only.	X

Source Monitors (continued)		K-1
- KA-26-C	Overvoltage protection for the normal source. Plug-in printed circuit card. Adjustable from 100 to 115%, nominally set at 115% unless otherwise specified. Monitors ALL phases.	X
- KA-26-D	Area protection with override circuit. For use with an external area protection panel. Starts engine and transfers the load to emergency upon receiving an open contact signal from the area protection panel. In the event the emergency source fails and the normal source is present, the override circuit will bypass the area protection panel signal and retransfer the switch to the normal source.	X
- KA-26-G	Overfrequency protection for the normal source. Adjustable from 50 to 65 Hz. Monitors one phase only. Plug-in printed circuit card.	X
- KA-26-H	Underfrequency protection for the normal source. Adjustable from 45 to 60 Hz. Monitors one phase only. Plug-in printed circuit card.	X
- KA-05-A	Underfrequency card for emergency source (adjustable 45 to 60 Hz). Monitors generator frequency (monitors one phase only). If the emergency source fails or is outside of the card setting and normal is available, the switch will immediately transfer to normal.	X
- KA-05-C	Overfrequency card for emergency source (adjustable 55 to 65 Hz). Monitors one phase only. Plug-in printed circuit card.	X
- KA-05-D	Undervoltage card for emergency source. Monitors emergency source voltage (monitors one phase only). The switch will immediately transfer to normal if the emergency source fails or is outside of the card setting and normal is available. Adjustable voltage sensing from 72 to 100% of nominal for pickup and 70 to 98% for dropout.	X
- KA-05-E	Overvoltage card for emergency source (adjustable from 100 to 115%, nominally set at 115% drop to out unless otherwise specified). Monitors emergency source voltage (monitors one phase only). The switch will immediately transfer to normal if the emergency source fails or is outside of the card setting and normal is available.	X
- KA-05-F	Undervoltage card for emergency source. Monitors three phases. The switch will immediately transfer to normal If the emergency source fails or is outside of the card setting and normal is available. Adjustable voltage sensing from 72 to 100% of nominal for pickup and 70 to 98% for dropout.	X
- KA-05-G	Overvoltage card for emergency source (adjustable from 100 to 115%, nominally set at 115% dropout unless otherwise specified). Monitors three phases. If the emergency source fails or is outside of the card setting and normal is available, the switch will immediately transfer to normal.	X

Optional Accessories (continued)

Source Monitors (continued)		K-1
- KA-05-H	Phase sequence relay permits transfer in either direction only when both sources have same phase rotation.	X
Test Switches		
- KA-06-A	Test switch for separate mounting. The momentary test switch will interrupt power to the normal source relay and simulate a power failure on normal as long as the switch is held in the test position. (Omitted if accessory KA-07 is selected.)	X
- KA-06-C	Maintained contact test switch for separate mounting.	X
- KA-06-D	Maintained contact test switch for mounting on enclosure door.	X
- KA-06-E	Test switch for separate mounting. The key-operated test switch will interrupt power to the normal source relay and simulate a power failure on normal as long as the switch is held in the test position. (Omitted if accessory KA-07 is selected).	X
- KA-06-F	Test switch mounted on the enclosure door. The key-operated test switch will interrupt power to the normal source relay and simulate a power failure on normal as long as the switch is held in the test position. (Omitted if accessory KA-07 is selected).	X
- KA-06-G	Maintained contact key-operated test switch for separate mounting.	X
- KA-06-H	Maintained contact key-operated test switch mounted on the enclosure door.	X
- KA-06-L	Three-position test switch. Permits three modes of operation: test with Load (momentary contact), Auto, Test without Load (maintained contact). For separate mounting.	X
- KA-06-M	Three-position test switch. Permits three modes of operation: test with Load (momentary contact), Auto, Test without Load (maintained contact). Mounted on the enclosure door.	X
- KA-07-C	Four-position selector switch (selector switch with white light, for separate mounting). Permits four modes of switch operation: Test, Auto, Off and Engine Start. The Off position de-energizes the control circuitry and opens the engine-start circuit. The transfer switch will not operate nor will the engine start on power failure. The Test position simulates a normal power failure. The Auto position returns the transfer switch to automatic operation. The Engine Start position closes the engine-start circuit. The switch will transfer only if the normal source fails. A white lamp will light in all positions except the Auto position (accessory KA-06 is omitted if accessory KA-07 is selected). NEMA Type 1 only.	X

Test Switches (continued)		K-1
- KA-07-D	Four-position selector switch (selector switch with white light, installed on enclosure door). Permits four modes of switch operation: Test, Auto, Off and Engine Start. The Off position de-energizes the control circuitry and opens the engine-start circuit. The transfer switch will not operate nor will the engine start on power failure. The Test position simulates a normal power failure. The Auto position returns the transfer switch to automatic operation. The Engine Start position closes the engine-start circuit. The switch will transfer only if the normal source fails. A white lamp will light in all positions except the Auto position (accessory KA-06 is omitted if accessory KA-07 is selected). NEMA Type 1 only.	X
- KA-07-E	Four-position key-operated selector switch (selector switch with white light, installed on enclosure door). Permits four modes of switch operation: Test, Auto, Off and Engine Start. The Off position de-energizes the control circuitry and opens the engine start circuit. The transfer switch will not operate nor will the engine start on power failure. The Test position simulates a normal power failure. The Auto position returns the transfer switch to automatic operation. The Engine Start position closes the engine start circuit. The switch will transfer only if the normal source fails. A white lamp will light in all positions except the Auto position (accessory KA-06 is omitted if accessory KA-07 is selected). NEMA Type 1 only.	X
- KA-07-F	Four-position key-operated selector switch (selector switch with white light, for separate mounting). Permits four modes of switch operation: Test, Auto, Off and Engine Start. The Off position de-energizes the control circuitry and opens the engine start circuit. The transfer switch will not operate nor will the engine start on power failure. The Test position simulates a normal power failure. The Auto position returns the transfer switch to automatic operation. The Engine Start position closes the engine start circuit. The switch will not transfer unless the normal source fails. A white lamp will light in all positions except the Auto position (accessory KA-06 is omitted if accessory KA-07 is selected. NEMA Type 1 only.	X

Optional Accessories (continued)

Test Switches (continued)		K-1
- KA-07-H	Four-position key-operated selector switch (selector switch with white light, mounted on NEMA Type 3R or 12 enclosure door). Permits four modes of switch operation: Test, Auto, Off and Engine Start. The Off position de-energizes the control circuitry and opens the engine start circuit. The transfer switch will not operate nor will the engine start on power failure. The Test position simulates a normal power failure. The Auto position returns the transfer switch to automatic operation. The Engine Start position closes the engine start circuit. The switch will transfer only if the normal source fails. A white lamp will light in all positions except the Auto position (accessory KA-06 is omitted if accessory KA-07 is selected). Not UL listed.	X
Time Delay Override Switches		
- KA-08-A	Override-to-normal pushbutton. Bypasses accessory KA-03-C and allows manual transfer at any time after normal power is restored. For separate mounting.	X
- KA-08-C	Override-to-normal pushbutton. Bypasses accessory KA-03-C and allows manual transfer at any time after normal power is restored. Enclosure-door mounted.	X
Transfer-Inhibit Switches		
- KA-09-F	Inhibitor switch to prevent transfer in either direction for separate mounting. Also opens engine-start circuit. Not UL listed.	X
- KA-09-G	Inhibitor switch to prevent transfer in either direction for enclosure mounting. Also opens engine-start circuit. Not UL listed.	X
- KA-09-H	Inhibitor key-operated switch to prevent transfer in either direction for separate mounting. Also opens engine-start circuit. Not UL listed.	X
- KA-09-J	Inhibitor key-operated switch to prevent transfer in either direction for enclosure mounting. Also opens engine-start circuit. Not UL listed.	X
Meters		
- KA-18-G	Frequency meter mounted in enclosure door (not available with NEMA Type 3R and 12 enclosure).	X
- KA-18-H	Running-time meter mounted in enclosure door (not available with NEMA Type 3R and 12 enclosure).	X
- KA-18-J	Voltmeter, ammeter and selector switch mounted in enclosure door (not available with NEMA Type 3R and 12 enclosure).	X
Load-Shedding Contacts		
- KA-35-G	Load-shedding contacts (2 NO and 2 NC) that operate from an adjustable 0.6 to 60 seconds prior to transfer in either direction and reset immediately after transfer.	X

Load-Shedding Contacts (continued)		K-1
- KA-35-H	Load-shedding contacts (2 NO and 2 NC) that operate from an adjustable 0.6 to 60 seconds prior to transfer in either direction and reset 3 seconds after transfer.	X
- KA-35-J	Load-shedding contacts (2 NO and 2 NC) that operate immediately at time of transfer in either direction (contact reset is adjustable 0.6 to 60 seconds after transfer).	X
- KA-35-K	Load-shedding contacts (2 NO and 2 NC) that operate 0.3 seconds before transfer, and 3 to 300 seconds (adjustable) after transfer in both directions.	X
- KA-35-L	Load-shedding contacts (2 NC) that operate 3 to 300 seconds (adjustable) before and after transfer in both directions.	X
- KA-35-M	Load-shedding contacts (2 NC) that operate 0.3 to 30 seconds (adjustable) before and after transfer.	X
Overlapping Neutral Contacts		
- KA-36-A	Overlapping neutral contacts. Provides switched neutral contacts for applications requiring a four-pole switch. Normal and emergency source neutrals are both connected to load during transfer for 100 milliseconds or less.	X
Preferred-Source Switches		
- KA-10-A	Two-position selector switch. This switch permits selection of either the normal or emergency source as the preferred power source. The preferred source is the one the switch will always transfer to if that source is available. For use with either two commercial power sources or one commercial power source and one engine-generator. For separate mounting.	X
- KA-10-B	Two-position selector switch. This switch permits selection of either the normal or emergency source as the preferred power source. The preferred source is the one the switch will always transfer to if that source is available. For use with either two commercial power sources or one commercial power source and one engine-generator. Mounted on the enclosure door.	X
- KA-10-C	Two-position selector switch for separate mounting. This switch permits selection of either the normal or emergency source as the preferred power source. The preferred source is the one the switch will always transfer to if that source is available. For use when both sources are engine-generators.	X
- KA-10-D	Two-position selector switch. This switch permits selection of either the normal or emergency source as the preferred power source. The preferred source is the one the switch will always transfer to if that source is available. For use when both sources are engine-generators. Mounted on the enclosure door.	X

Optional Accessories (continued)

Preferred-Source Switches (continued)		K-1
- KA-10-E	Two-position selector switch with electric automatic operation (50 Hz). This switch permits selection of either the normal or emergency source as the preferred power source. The preferred source is the one the switch will always transfer to if that source is available. For use when both sources are engine-generators. Uses accessory KA-23 Plant Exerciser Timer. For separate mounting. Not UL listed.	X
- KA-10-F	Two-position selector switch with electric automatic operation (60 Hz). This switch permits selection of either the normal or emergency source as the preferred power source. The preferred source is the one the switch will always transfer to if that source is available. For use when both sources are engine-generators. Uses accessory KA-23 Plant Exerciser Timer. Mounted on the enclosure door.	X
Non-Standard Terminals		
- KA-21-C	CU/AL terminal lugs, for 2000-ampere, 3-pole, not UL listed.	X
- KA-21-D	CU/AL terminal lugs, for 2000-ampere, 3-pole, with overlapping neutral, not UL listed.	X
- KA-21-E	CU/AL terminal lugs, for 2500/3000-ampere, 3-pole, not UL listed.	X
- KA-21-F	CU/AL terminal lugs, for 2500/3000-ampere, 3-pole, with overlapping neutral, not UL listed.	X
- KA-21-E	CU/AL terminal lugs, for 4000 amp, 3 pole, not UL listed.	X
- KA-21-F	CU/AL terminal lugs, for 4000 amp, 3 pole, with overlapping neutral, not UL listed.	X
Logic Protection Fuse		
- KA-28-A	Intelligence circuit fuses. Provides fuses for all non-essential circuitry. Used with accessories KA-12, KA-14 and KA-31. One KA-28-A used per accessory.	X
Manual Switch Operation		
- KA-29-O	Manual Switch operation from emergency to normal with override circuit permitting transfer if connected source fails and other source is available. Plus a two-position selector switch providing automatic or manual operation. For separate mounting. Key switch available.	X
- KA-29-P	Manual Switch operation from emergency to normal, with override circuit permitting transfer if connected source fails and other source is available. Plus a two-position selector switch providing automatic or manual operation. Mounted on the enclosure door. Key switch available.	X
- KA-29-Q	Manual Switch operation from emergency to normal and normal to emergency with override circuit permitting transfer if connected source fails and other source is available. For separate mounting. Key switch available.	X

Manual Switch Operation (continued)		K-1
- KA-29-R	Manual Switch operation from emergency to normal and normal to emergency with override circuit permitting transfer if connected source fails and other source is available. Mounted on the enclosure door.	X
- KA-29-S	Manual Switch operation from emergency to normal and normal to emergency with override circuit permitting transfer if connected source fails and other source is available. Plus a two-position selector switch providing automatic or manual operation. For separate mounting.	X
- KA-29-T	Manual Switch operation from emergency to normal and normal to emergency with override circuit permitting transfer if connected source fails and other source is available. Plus a two-position selector switch providing automatic or manual operation. Mounted on the enclosure door. Key switch available.	X
- KA-29-U	Manual Switch operation from emergency to normal with override circuit permitting transfer if connected source fails and other source is available. For separate mounting. Key switch available.	X
- KA-29-V	Manual Switch operation from emergency to normal, with override circuit permitting transfer if connected source fails and other source is available. Mounted on the enclosure door. Key switch available.	X
Cranking Limiters		
- KA-30-A	Cranking limiter. Opens the 2-wire engine start circuit after its time delay is completed. It is initiated by an engine-start contact closure. Adjustable from 30 to 200 seconds.	X
- KA-30-B	Cranking limiter. Opens the 3-wire engine start circuits after its time delay is completed It is initiated by and engine-start contact closure. Adjustable from 30 to 200 seconds. No cranking disconnect.	X
- KA-30-C	Cranking limiter. Opens the 3-wire engine start circuits after its time delay is completed It is initiated by and engine-start contact closure. Adjustable from 30 to 200 seconds with cranking disconnect.	X
Audible Alarms		
- KA-31-A	Audible alarm. Sounds alarm when the automatic transfer switch is in the emergency position. A silencing switch is included. For separate mounting.	X
- KA-31-B	Audible alarm. Sounds alarm when the automatic transfer switch is in the emergency position. A silencing switch is included. Mounted in the enclosure.	X
Enclosure Heaters		
- KA-39-A	Space heaters for enclosed switches for use in ambient temperatures that do not exceed 80 _F (_C). Not thermostatically controlled. Wattages are 50W (30-150A), 100W (225-400A) and 200W (600-800A).	X

Optional Accessories (continued)

Enclosure Heaters (continued)		K-1
- KA-39-B	Space heaters for enclosed switches for use in ambient temperatures that do not exceed 80 _F (_C). Thermostatically controlled. Wattages are 50W (30-150A), 100W (225-400A) and 200W (600-800A).	X
External Manual Operating Handles		
- KA-40-A-C	External "quick-make, quick-break" manual operating handle with logic circuit disconnect switch. Mounts through side of enclosure. Available on open and NEMA Type 1 enclosures only. Not available on NEMA Type 3R and 12 enclosures.	X
- KA-40-D-H	External "quick-make, quick-break" manual operating handle with logic circuit disconnect switch. Mounts through front of enclosure. Handle accessible through door cutout that closes flush to handle. Available on open and NEMA Type 1 enclosures only. Not available on NEMA Type 3R and 12 enclosures.	X
Dead Bus Relay		
- KA-54-A	Provides Automatic operation when external contact (not furnished with switch) is open. Closing contact causes transfer to normal, whether normal is energized or not (dead bus), using emergency power. Can be used to shed generator set load. Not UL listed.	X
CSA Certification		
	Bilingual nameplate and CSA certification is provided as an enclosure option, for 30–2000 ampere switches only. KN-1 type must have override circuitry in Accessory 29. This makes them K-1 type.	X

Loose Accessories

Logic Panel Wire Harness Extension	
- PA-295771	5-foot extension KA-37-A
- PA-295772	10-foot extension KA-37-B
- PA-295773	20-foot extension KA-37-C
Elevator Control Switch	
- PA-297872	Six-position selector to control up to six elevator circuits. For surface mounting, NEMA Type 1 enclosure. **Note:** this accessory is available only as a part of a factory quotation for an entire elevator control system. Not UL listed.
- PA-297873	Six-position selector to control up to six elevator circuits. For flush mounting. **Note:** this accessory is available only as a part of a factory quotation for an entire elevator control system. Not UL listed.
Pedestal Mounting Feet	
- PA-297265	For 30–150 ampere NEMA Type 1 or 3R enclosures
- PA-297267	For 225–400 ampere NEMA Type 1 or 3R enclosures
- PA-297269	For 600–800 ampere NEMA Type 1 or 3R enclosures
Neutral Lug Assembly	
- PA-295070	30–150 ampere
- PA-295071	225–260 ampere
- PA-295072	400 ampere
- PA-295073	600–800 ampere
- PA-297583	1000–1200 ampere
- PA-294151	1600 ampere
- PA-297607	2000 ampere
- PA-297606	2500–3000 ampere

KA Option	Option Description	Affects Transfer Normal to Emergency	Transfer Emergency to Normal	Engine Starts	Engine Shutdown
01-A	TDNE (0.6–60 SEC)	X			
01-B	TDNE (1–30 MIN)	X			
02-A	TDES (3–20 SEC)			X	X
02-E	TDES (FIXED 3 SEC)			X	X
02-F	TDES (20–240 SEC)			X	X
02-G	TDES (0.5–6 SEC)			X	X
03-C	TDEN (1–30 MIN)		X		
04-C	TDEC (1–30 MIN)				X
04-D	TDEC (FIXED 5 MIN)				X
05-A	UNDERFREQ (CARD) EMERGENCY	X			
05-C	OVERFREQ (CARD) EMERGENCY	X			
05-D	UNDERVOLT (CARD 1PH) EMERGENCY	X			
05-E	OVERVOLT (CARD 1PH) EMERGENCY	X			
05-F	UNDERVOLT (CARD 3PH) EMERGENCY	X			
05-G	OVERVOLT (CARD 3PH) EMERGENCY	X			
06-D	TEST SWITCH MAINTAINED	X	X		
06-L	THREE POSITION TEST SWITCH	X	X	X	X
06-M	MOMENTARY TEST SWITCH	X	X	X	X
07-C	4 POS SELECTOR SWITCH W/LAMP	X	X	X	X
07-D	4 POS SELECTOR SWITCH W/LAMP	X	X	X	X
07-E	4 POS SELECTOR SWITCH W/LAMP	X	X	X	X
07-H	4 POS SELECTOR SWITCH W/LAMP	X	X	X	X
08-C	BY-PASS SWITCH PBEN		X		
09-G	INHIBITOR SWITCH	X	X		
23-C	PLANT EXERCISER			X	X
23-D	PLANT EXERCISER	X	X		
23-G	PLANT EXERCISER	X	X	X	X
26-C2	OVERVOLT (CARD 3PH) NORMAL		X		
26-C1	OVERVOLT (CARD 1PH) NORMAL		X		
26-D	AREA PROTECTION	X	X	X	X
26-G	OVERFREQUENCY (CARD) NORMAL		X		
26-H	UNDERFREQUENCY (CARD) NORMAL		X		
28-A	INTELLIGENT CIRCUIT FUSES	X	X	X	X
29-P	AUTO/MANUAL OPERATION	X	X	X	X
29-T	MANUAL SWITCH OPERATION	X	X		
34-A	INPHASE MONITOR	X	X		
34-B	SYNCH CHECK RELAY	X	X		
35-G	LOAD-SHEDDING CONTACTS	X	X		
35-J	LOAD-SHEDDING CONTACT	X	X		
35-L	LOAD-SHEDDING CONTACTS	X	X		
35-M	LOAD-SHEDDING CONTACT	X	X		
40-A	EXTERNAL MANUAL OPERATOR	X	X		

NOTE: Use grid when troubleshooting to reference accessories that may cause transfer switch failure.

Figure 3-3. Accessory Troubleshooting Grid

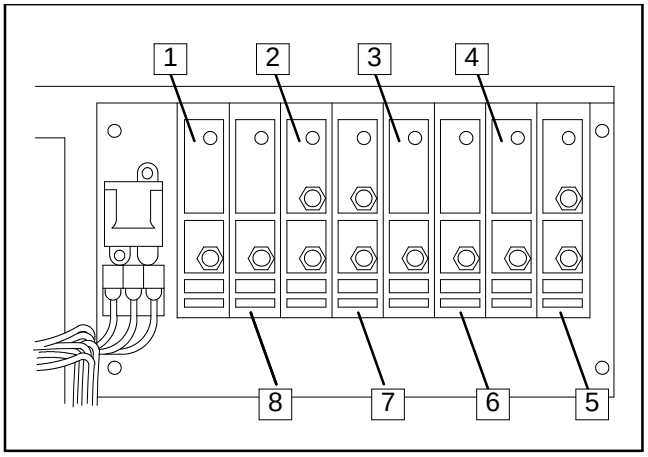
Accessory Card Troubleshooting

1. Check connection ribbon to be sure the plugs are firmly attached and the pins are not bent.

2. Move the card to an emergency slot in the card cage. Use a generator set to be sure the LED is operating properly.

3. Be sure card is firmly in slot.

Some solid-state accessories listed from 4-C to 26-C (refer to spec. sheet earlier in book) utilize additional circuit boards in a mother board card cage and/or front panel controls or indicators. The card cage is bolted to the inner panel and uses its own ribbon interconnection cord for attachment to the main circuit board. See Figure 3-4.



1. Emergency Underfrequency
2. Emergency Overfrequency
3. Emergency Overvoltage
4. Emergency Undervoltage
5. Normal Overvoltage
6. Normal Overfrequency
7. Normal Underfrequency
8. Time Delay Engine Cooldown

Figure 3-4. Accessory Cards

Each plug-in card has a locknut that can be adjusted using a screwdriver. The locknut prevents the preset setting from accidentally changing. Accessory cards are held in place by two captive screws. All empty card slots are covered with blank plastic strips. On each sensing or time-delay card an LED is supplied that illuminates when the monitored voltage or frequency is within its preset limits. The LED on the time-delay cards also lights after the preset time has elapsed.

Accessory 4: Time Delay Engine Cooldown

Accessory 4-C-S (Time Delay Engine Cooldown) allows the engine to run at no load for an adjustable time (1–30 min.) after transferring back to normal. Upon normal source restoration the TDEC timing circuit keeps the engine running for a cooldown period. After a time delay, the board will signal the EC Relay to pickup and shut the generator off. See Figure 3-5 for connections.

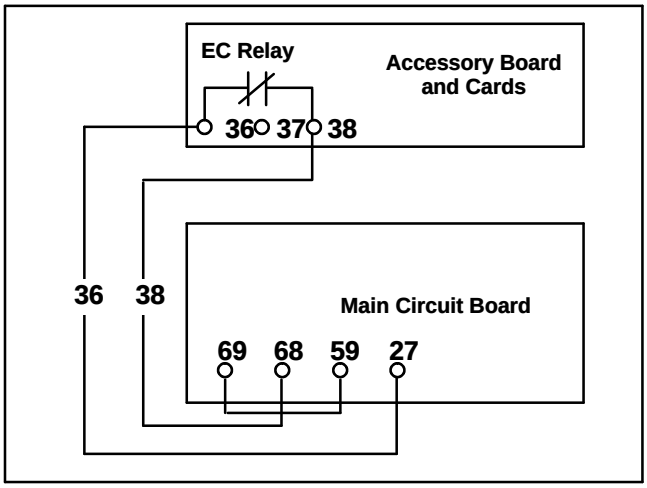


Figure 3-5. TDEC Connections

Accessory 4-D-S (Delay for Engine Cooldown) is fixed at 5 minutes. It is designed to start the engine cooldown after transfer is made to normal.

Accessory 5: Frequency, Volts, Phase Sequence

Accessory 5-A is an under-frequency card for emergency source (adjustable 45–60 Hz). It monitors generator frequency (one phase only) and will initiate transfer to the normal source if available.

Accessory 5-C is an over-frequency card for emergency source (adjustable 50–65 Hz). It monitors generator frequency (one phase only) and will initiate transfer to the normal source if available.

Accessory 5-D (one-phase) is an undervoltage card for emergency source (adjustable– factory set to drop out at 70% voltage and to pick up again at 90% voltage, unless otherwise specified). It monitors generator voltage and will initiate transfer to normal source if available.

Accessory 5-F (three-phase) is an undervoltage card for emergency source (adjustable– factory set to drop out at 70% voltage and to pick up again at 90% voltage, unless otherwise specified). It monitors generator voltage and will initiate transfer to normal source if available.

Accessory 5-E is an overvoltage card for emergency source (adjustable– factory set to drop out at 115% voltage and to pick up again at 105% voltage, unless otherwise specified). It monitors generator voltage (one phase only) and will initiate transfer to normal source if available.

Accessory 5-H is a Phase Sequence Relay. It will not permit transfer in either direction unless both sources have same phase rotation.

Accessory 6: Test Selector Switch

Accessories 6-A, C-H have a two-position switch, either momentary or maintained contact; toggle or key operated. This switch selects one of two modes of operation:

Automatic mode enables automatic transfer switch operation depending upon the source available.

Test mode simulates a normal source failure for as long as the switch is held or remains in the TEST position. See Figure 3-6 for connections.

NOTE

If selector switch is in the TEST position, no transfer to the normal source will occur even if emergency source fails or is unacceptable.

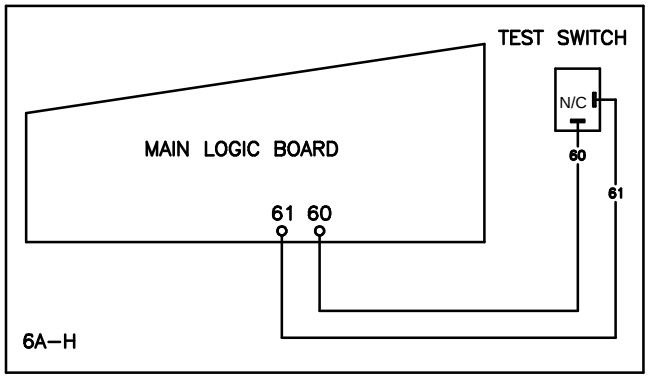


Figure 3-6. Maintained Test Switch Connection

Accessories 6-L, 6-M use a three-position switch that selects one of three modes of operation:

Automatic mode enables automatic transfer switch operation depending upon source available.

Test with load mode initiates transfer of load to the generator set.

Test without load mode signals generator set to start and run unloaded. See Figure 3-7 for connections.

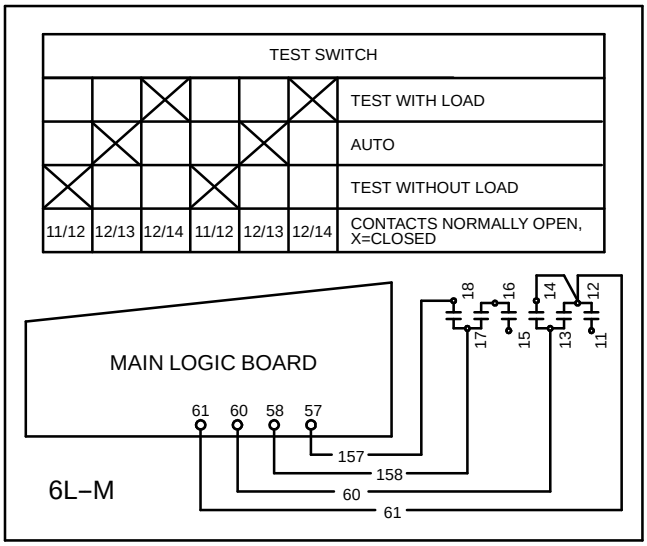


Figure 3-7. Three-Position Switch Connection

Accessory 7: Operation Mode Selector Switch with Lamp

Accessories 7-C, 7-D, 7-E, and 7-F use a four-position switch with lamp to select one of four operation modes. The lamp lights to show that the switch is not in the AUTO position.

Engine start closes the engine-start circuit to test run generator set. The transfer switch will not transfer unless the normal source fails.

Off mode de-energizes control circuits and opens the engine-start circuit. The transfer switch will not operate.

Automatic mode enables automatic transfer switch operation.

Test mode simulates normal source failure. See Figure 3-8 for connections.

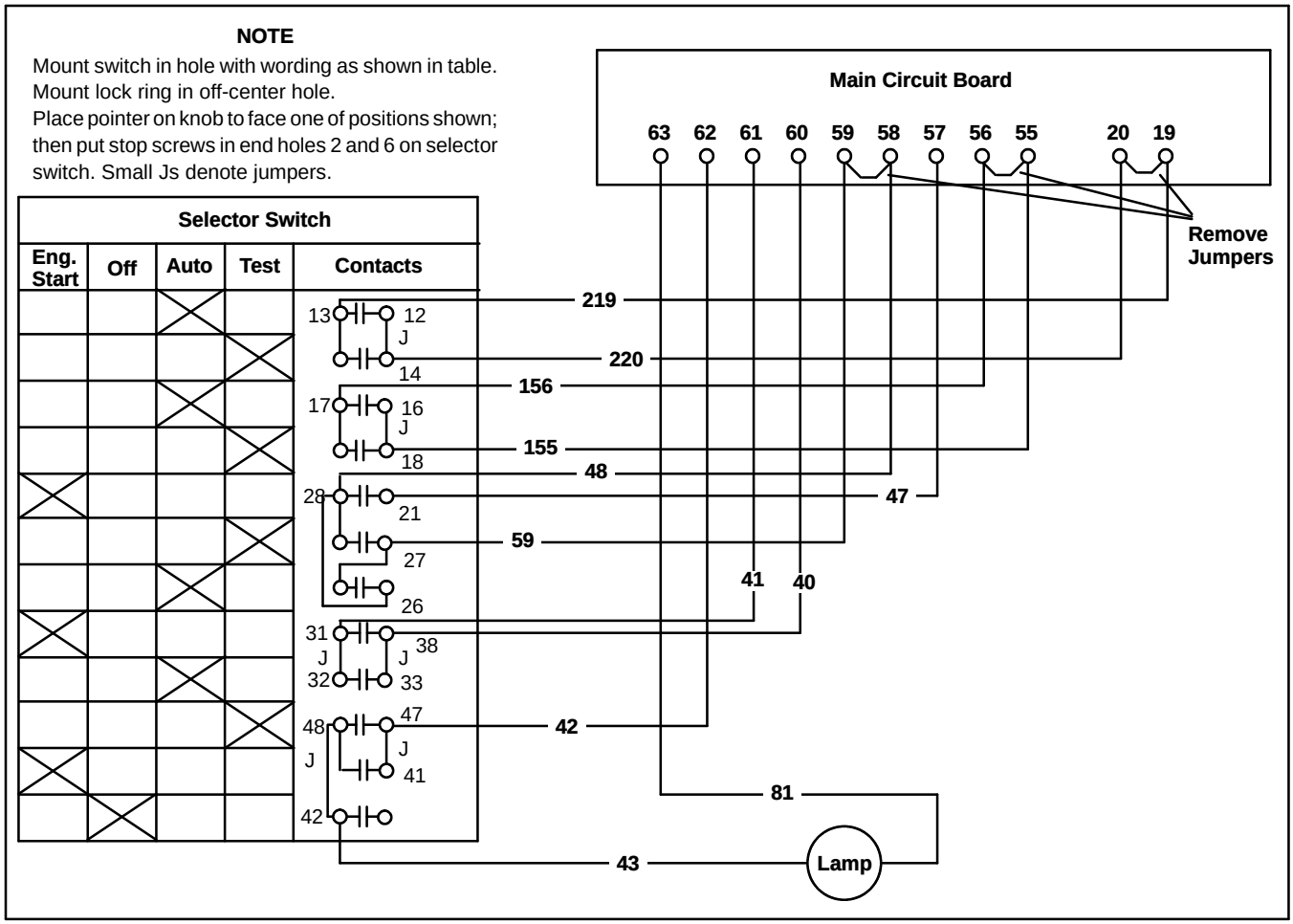


Figure 3-8. Four-Position Switch Connection

NOTE

Be sure to connect all eight switch contact jumpers.
Remove standard auto-test switch.

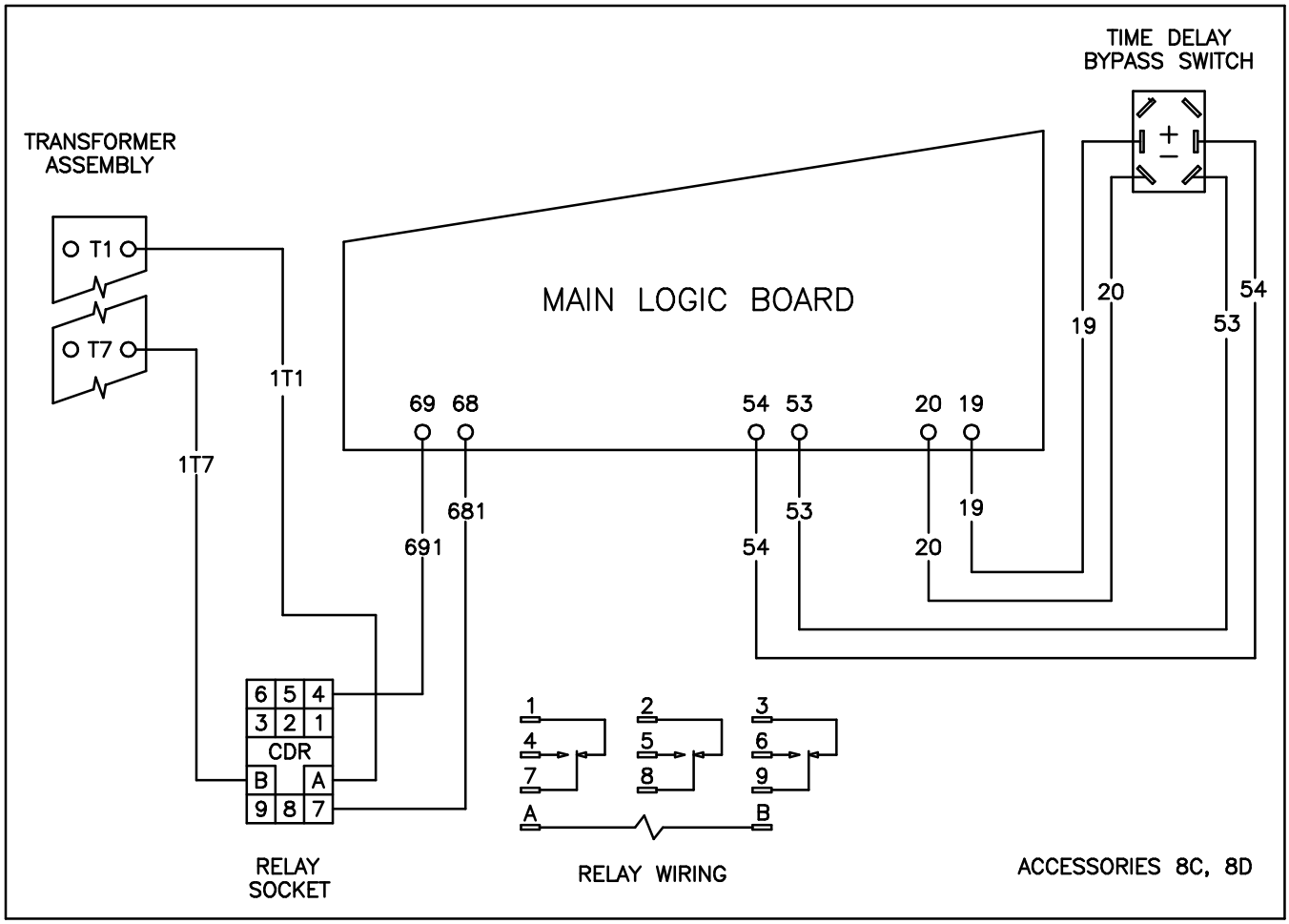


Figure 3-9. Bypass Switch Connection

Accessory 8: Bypass Time Delay Override Switch

Accessories 8-C, 8-D are a bypass time delay, emergency to normal that may be used to override the standard time delay emergency to normal when transferring to the normal source. See Figure 3-9 for connections.

Accessory 12: Panel Lamps

All panel lamps, if furnished, are mounted on the transfer switch enclosure door or shipped loose as specified. See Figure 3-9 for connections.

Accessories 12-A, 12-C have a normal position lamp that lights when the transfer switch is connected to the normal source. See Figure 3-10 for connections.

Accessories 12-B, 12-D have an emergency position lamp that lights when the transfer switch is connected to the emergency source. See Figure 3-11 for connections.

Accessories 12-E, 12-G have a normal source light when the normal source is available. See Figure 3-12 for connections.

Accessories 12-F, 12-H have an emergency source lamp that lights when the emergency source is available. See Figure 3-13 for connections.

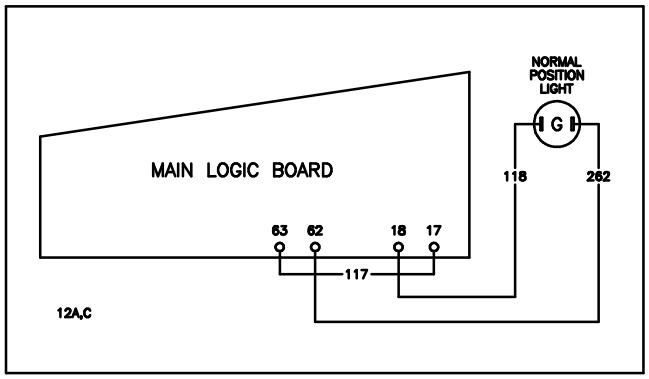


Figure 3-10. Accessories 12-A, C Connections

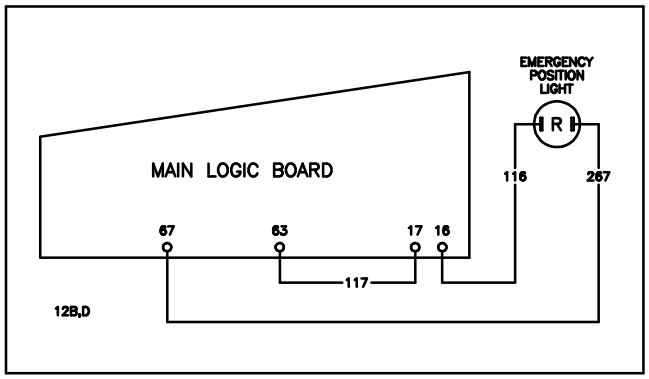


Figure 3-11. Accessories 12-B, D Connections

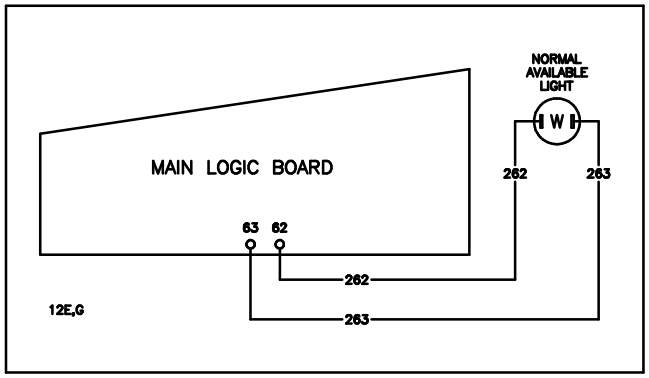


Figure 3-12. Accessories 12-E, G Connections

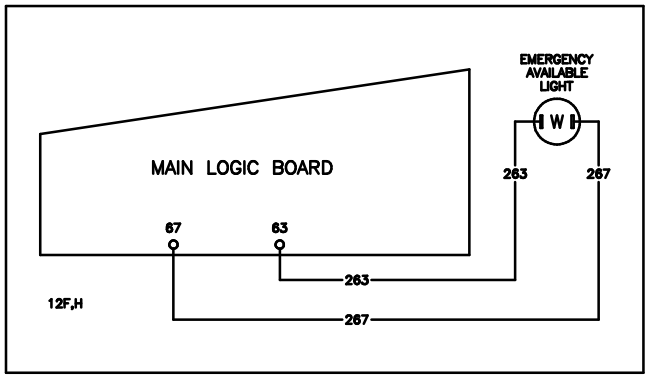


Figure 3-13. Accessories 12-F, H Connections

⚠ WARNING

Hazardous voltage.
Can cause severe injury or death.

Do not open enclosure until all power sources are disconnected.

(under 600 Volt)

Hazardous voltage can cause severe injury or death. Disconnect harness plug before installing any accessories involving connection to transformer assembly primary terminals 76, 77, 78, and 79. Terminals are at line voltage!

Accessory 14: Auxiliary Relay Contacts

These relay contacts operate from the voltage source and are energized as soon as normal or emergency power is available. They are located on the left-hand side of the inner panel mounted on the door. Contacts are rated for 10 Amperes, 1/3 HP at 120 Vac.

Accessory 14-C has three sets of contacts on the normal side. See Figure 3-14 for connections.

Accessory 14-D has three sets of contacts on emergency side. See Figure 3-15.

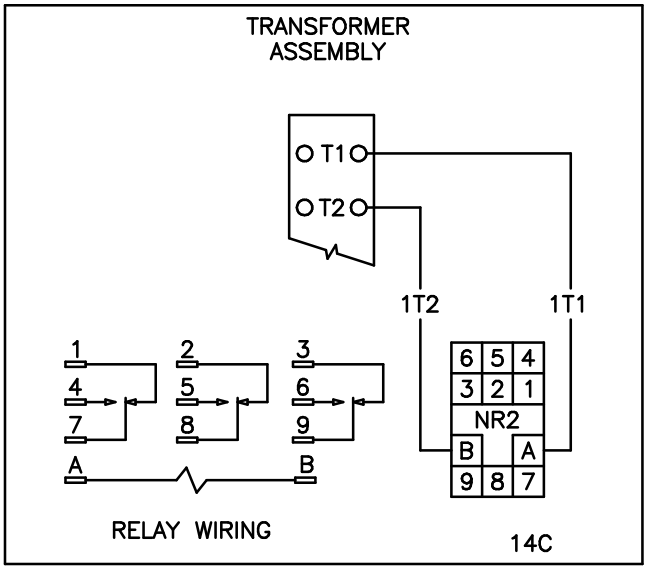


Figure 3-14. Accessory 14-C Connections

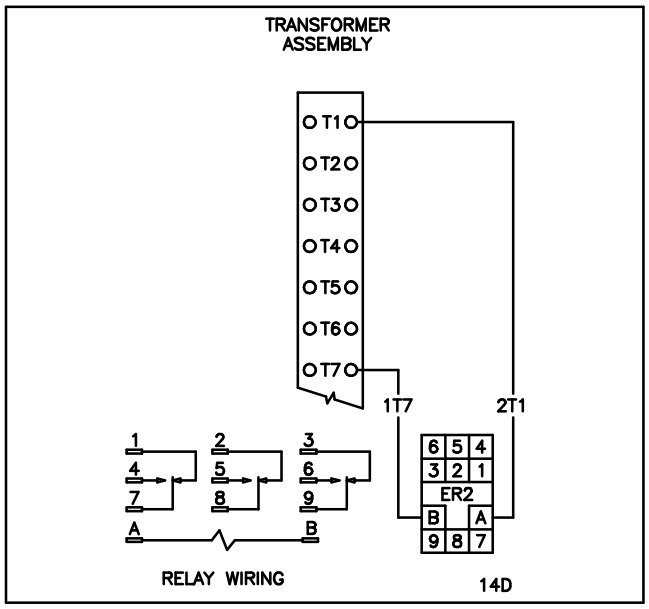


Figure 3-15. Accessory 14-D Connections

Accessory 23: Generator Set Exercisers

This timer, if furnished, is used for periodic exercising of the emergency generator set. The generator set should be exercised under load once each week for a minimum of 30 minutes. Optional accessory 23 can be added later in kit form. Include the transfer switch serial number and switch number when ordering.

Accessories 23-C, D & G: 14-Day Generator Set Exercising Timer

Accessory 23 signals the generator set to run unloaded for the set time period. Timer does not simulate a normal source failure. The transfer switch is not affected.

Accessory 23-C has an override circuit designed to return the switch to normal if the emergency source fails during an exercise run. Normal LEDs on logic cards will stay off until the exerciser completes timing.

Accessory 23-D timer simulates a normal source failure. The transfer switch transfers load to the emergency generator during the exercise period.

Accessory 23-G includes a two-position switch to simulate a normal-source failure or to test the generator set only.

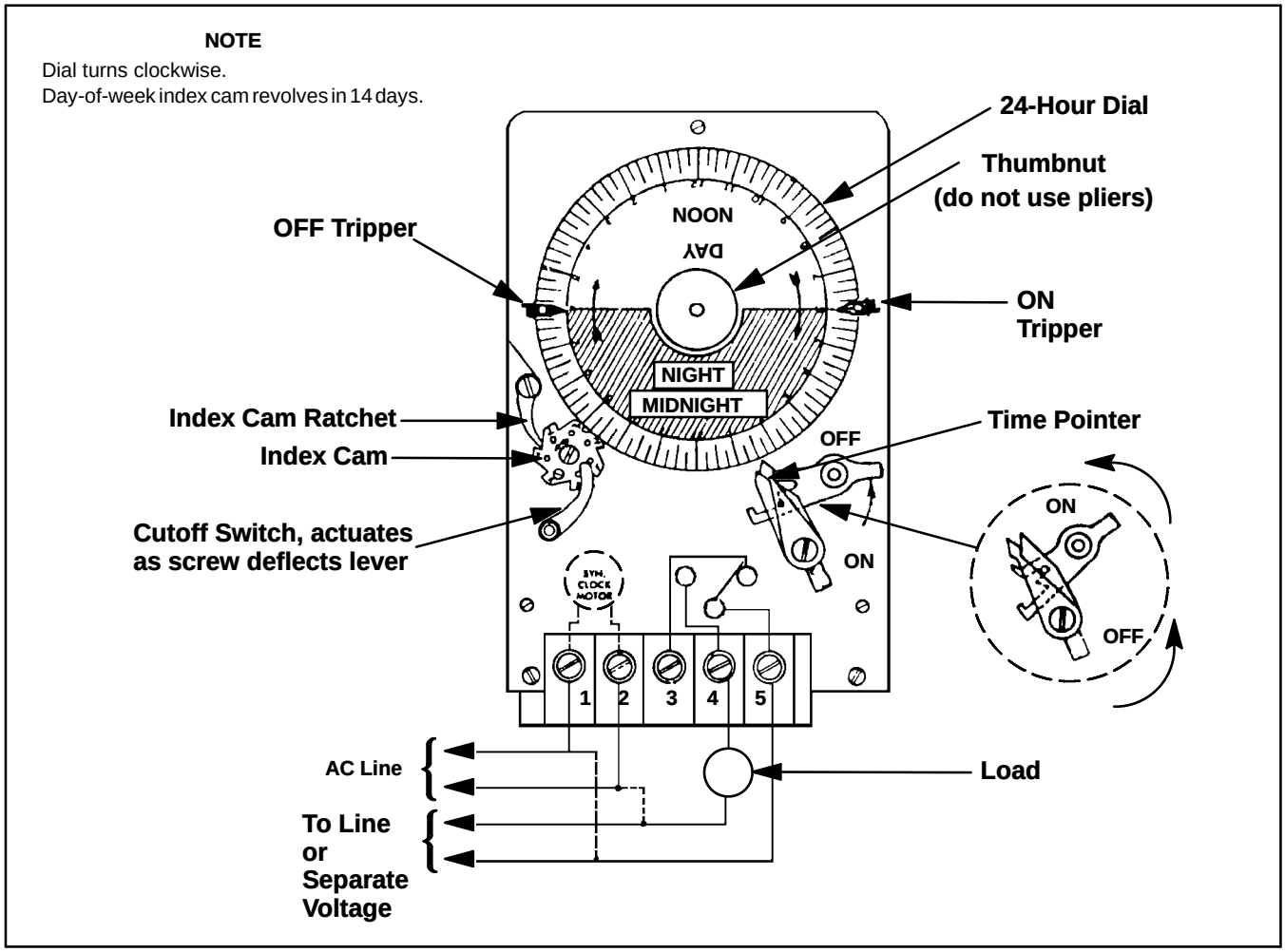


Figure 3-16. Exercise Timer (Accessory 23) Connections & Setting

Exercise Day and Period Adjustment Procedure

1. Decide what day (or days) of the week to exercise the generator set.
2. Remove the screw from the index cam lobe marked with the decided day(s).
3. Hold the 24-hour dial to prevent it from turning, then unscrew the thumbnut by turning it clockwise.
4. Set the black ON tripper to the time of day when the exercise period should start. Set the copper OFF tripper to the time of day when the exercise period should stop.
5. The index cam has 14 day positions. Turn the index cam counterclockwise until the desired exercise day is under the tip of the cutoff switch lever. Thread a supplied screw into each position hole except the position(s) for the desired exercise day(s).
6. Turn the dial clockwise until the actual time of day aligns with the time pointer. Hand tighten the thumbnut (turn it counterclockwise) while holding the dial to prevent it from turning. Do not use excessive force to turn thumbnut.

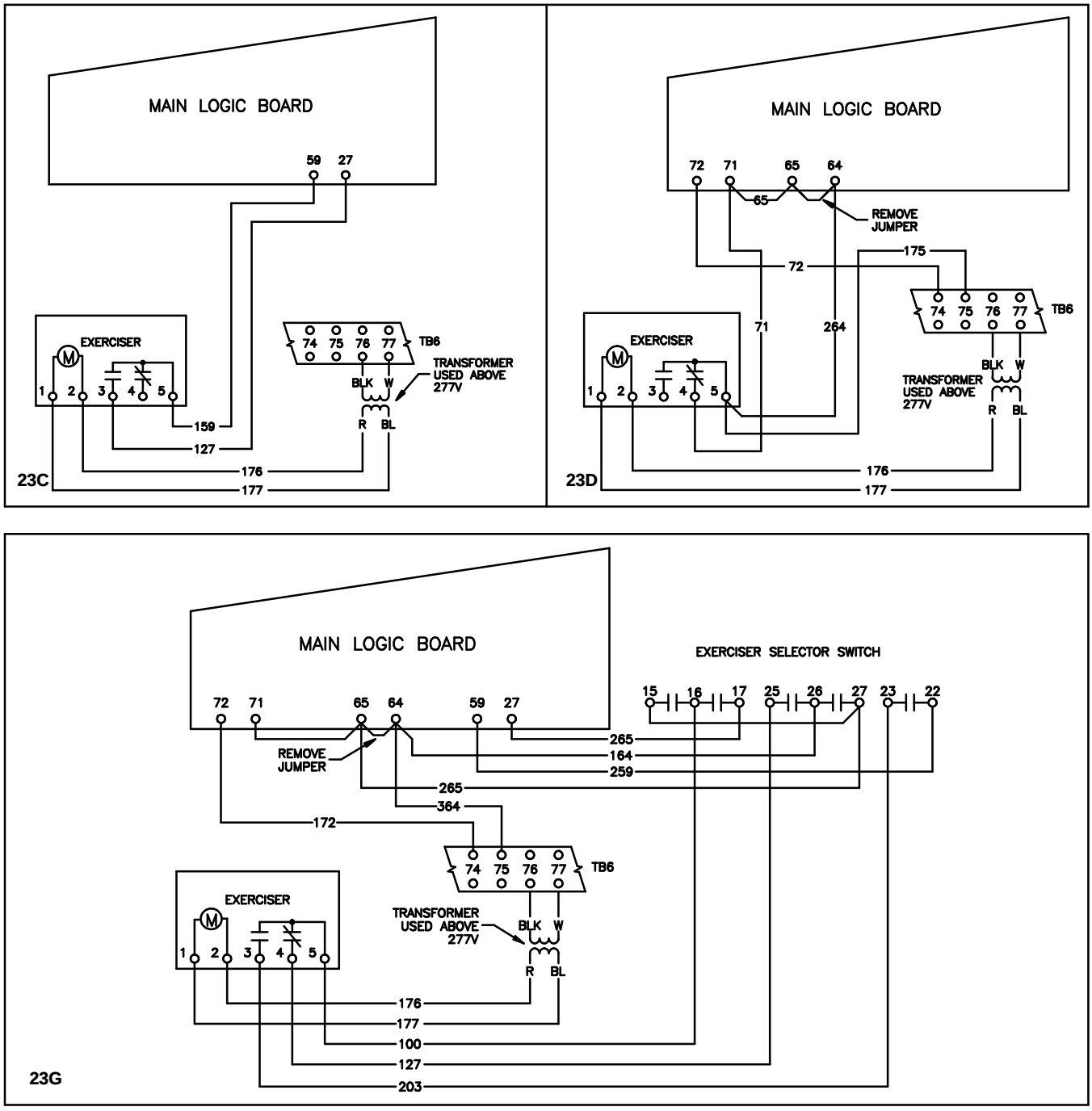


Figure 3-17. Exercise Timer Connections

Troubleshooting Accessory 23

If Accessory 23-C timer contact 3-5 does not close during the set exercise period, the engine-generator set will not be signaled to run. If the contact remains closed beyond the set exercise period, the generator set will continue running. In either case, Accessory 23-C timer is malfunctioning.

If Accessory 23-D timer contact does not open during the set exercise period, the engine-generator plant will not be signalled to run and the load will not be transferred to the emergency source. If the contact remains open beyond the set exercise period, the plant will continue running and the load will remain connected to the emergency source. Immediate retransfer may be accomplished by manually opening the emergency source circuit breaker. Make sure that full rated normal voltage is available before doing this. In either case, Accessory 23-D timer is malfunctioning.

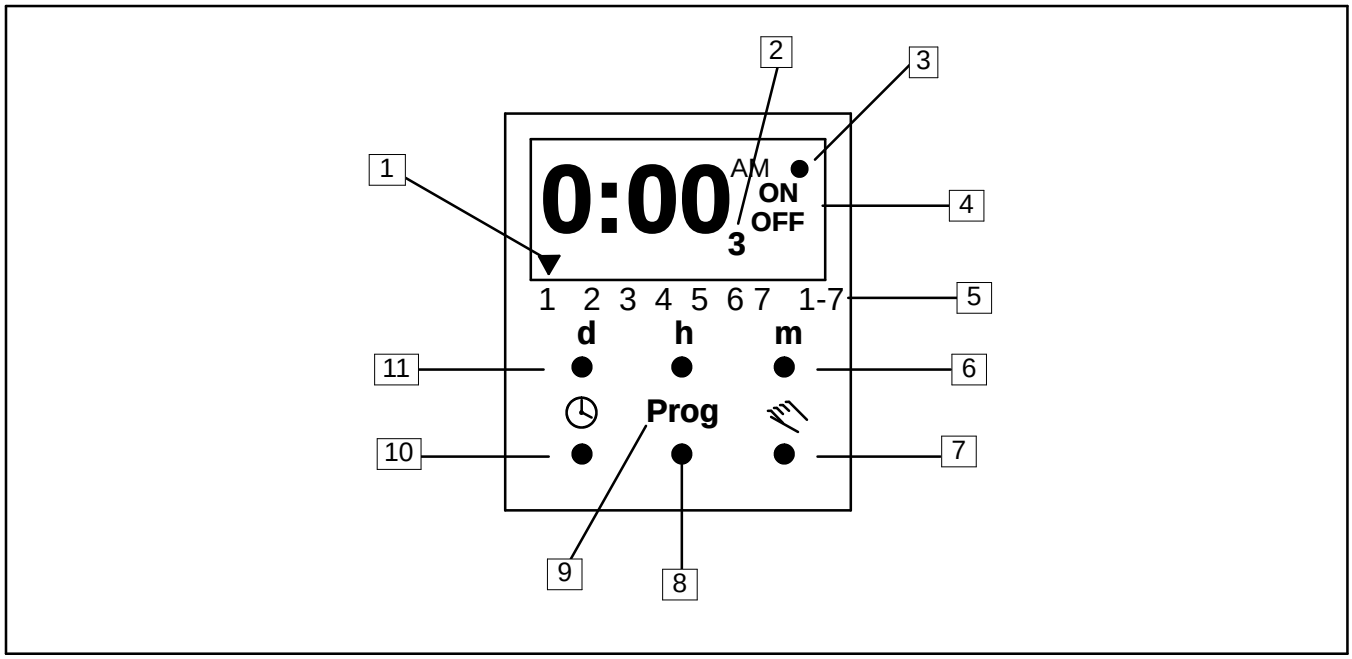
Accessory 23-G is a plant exerciser with selector switch to select a simulation of power failure or engine test mode. The selector switch selects a 23-C or 23-D type of operation. See Figure 3-17.

Accessories 23-P, R, S: 7-Day, Solid-State Generator Set Exercise Timer

Accessory 23-P signals the generator set to run unloaded for the set time period. Timer does not simulate a normal source failure. The transfer switch is not affected.

Accessory 23-R simulates a normal source failure. The transfer switch transfers load to the emergency generator during the exercise period.

Accessory 23-S includes a switch to select between Simulate Normal Failure (exercise generator under load) and Test Engine Only (exercise generator set without load).



1. Day of Week
   1 = Monday
   2 = Tuesday
   3 = Wednesday
   4 = Thursday
   5 = Friday
   6 = Saturday
   7 = Sunday
2. Response Time Number for the weekday indicated (1 ON, 1 OFF, 2 ON, 2 OFF, etc.) ☰ OFF Holiday program.
3. Dot indicates permanent override control ON or OFF.
4. Switch Position ON or OFF.
5. Programmed Daily display, 1-7.
6. Minute Setting.
7. Override and Permanent Control.
8. Program Entry/Recall.
9. Hours/Holiday Setting.
10. Time Setting.
11. Weekday Setting.

Figure 3-18. Plant Exerciser Features

Adjustment

See Figure 3-18 for operational information. Remove the transparent timer cover when making adjustments. Replace the cover when adjustment is complete.

NOTE

If an entry is interrupted (postponed) or finished, the display will remain for about 40 seconds and will switch to normal automatic operation.

To Reset & Clear Memory:

1. The power supply must be connected to the plant exerciser before setting the clock timer. Check to see that the in-line disconnect plug attaching the contactor to the logic panel is connected.
2. The following four keys must be pressed simultaneously to reset the timer's programming. This will clear the memory and permit new programming. Press the weekday setting button, time setting button, minute setting button and override and permanent control button.

Setting Day of Week and Time

1. During the day and time setting procedure, hold down the ⏲ button.

   NOTE

   This timer may be set as either a seven-day or a one-day timer. To set the generator set to run during certain hours of every day, go to Entering Daily Response Times.

2. Press the **d** button to select the weekday. The arrow on the display will move to indicate the day of the week selected (1–7).
3. Set the time by pressing the **h** button or the **m** button, for hours or minutes. If the button is depressed for more than one second, the quick sequence will start allowing a faster time change. When nearing the desired time, release the button and use the slow sequence so the desired time is not passed.
4. After the time and day setting procedure is complete, release the ⏲ button.

Daylight Savings Time Adjustment

If this semi-annual change takes place in your area, use the following procedure to conveniently set the hour without having to completely reset the timer.

1. To add 1 hour, press the **d** and the **h** buttons simultaneously.
2. To subtract 1 hour, press the **d** and the **m** buttons simultaneously.

Setting Exercise Start and Stop Times

A maximum of four time periods (four start and four stop times) are programmable for each day of the week. A maximum of 28 time periods (28 start and 28 stop times) are possible. For exercising the generator set, only one start and stop period per week is usually necessary.

1. Decide upon a convenient day and time to test run the generator set that will not disturb usual work or living routines. It is recommended that transfer switch exercising be done when a responsible person can observe the unit.

   NOTE

   If the setting procedure is interrupted, postponed, or finished, the display will show the actual time after approximately 40 seconds. The system will then switch to normal automatic operation.

2. Press the **Prog** button once. Now press the **d** button. The display will show an arrow above 1 which indicates Monday (2 = Tuesday, 3 = Wednesday, etc.). Press the **d** button until the arrow is above the decided weekday. Press the ☜ button to store the selected day. Start/stop commands can now be entered for the selected day.
3. When ON is indicated on the right-hand side of the display, set the START time by pressing the **h** button and/or the **m** button.
4. Store the START time command by pressing the **Prog** button. This command places the program in the OFF mode.
5. When OFF is indicated on the right side of the display, press the **d** button until the arrow is above the decided weekday. Press the ☜ button to store the selected day. Set the STOP time by pressing the **h** button and/or the **m** button.
6. Store the STOP time command by pressing the **Prog** button. This command places the program in the ON mode for the next set of response times.
7. Periods 2, 3 and 4 of the same weekday can be set at this time using the same procedure, if required. To override/cancel this function and go to another weekday, press the **d** button until the required weekday is shown.
8. If programming is complete, press the ⏲ button. The timer is now set to function as programmed.

Entering Daily Time Periods

The timer may be set to run the generator set during certain hours of every day.

After the timer's memory has been reset and cleared, the timer can be set as a one-day timer. Six time periods (6 start and 6 stop times) can be set in this mode.

To use the daily-program mode, leave the day pointer above the **1-7**. Set the ON/OFF times following steps 3–8 in section Setting Exercise Start and Stop Times.

Program Recall/Check

1. To check or verify the programmed START/ON and STOP/OFF times, simultaneously press the **Prog** button and **d** button for each respective day. Press the **Prog** button to display START/ON and STOP/OFF response times. Daily response times are displayed for each day following the normal program locations (1 ON, 1 OFF, 2 ON, 2 OFF, 3 ON, 3 OFF).
2. On days where a daily response time has been entered and a normal display occurs such as 3 ON with an arrow appearing above **1-7**, press the ⏲ button to finish the recall procedure.

Program Change

1. To change one or more previously programmed START or STOP times without clearing the entire memory press the **Prog** button and **d** button until the required weekday is shown. Press ☜ to store the selected day.
2. Change the 1 ON time by pressing the **h** button or the **m** button. Press the **Prog** button to advance to the next time setting. Clear the program by pressing **h** and **m** buttons simultaneously.
3. Press the **Prog** and **d** buttons to advance to the next program requiring a change.
4. When all changes are complete, press ⏲ . The timer is now set to function as programmed.

Vacation/Holiday Setting

The Vacation/Holiday Setting suspends the automatic program sequence for 1 to 45 days.

1. During the vacation/holiday setting procedure, press and hold the **h** button.
2. Press ☜ for the number of nonexercising days desired. After 45 days the display returns to zero. The vacation/holiday program starts at 12:00 AM the next day and is indicated on the display by ≡ OFF.

NOTE

The vacation/holiday setting places the exercise cycle (plant exerciser) on hold only. Should failure of the utility/normal power source occur, the transfer switch will start the generator set and transfer to the emergency power source when voltage/frequency conditions are met. When normal power is restored, the transfer switch will return to the normal power position.

3. To recall/check the remaining vacation/holidays, press **h**. The display will momentarily show the number of days.
4. To change the number of vacation/holidays, press and hold **h** while pressing ☜ each time until the desired number of vacation/holidays is displayed.

Temporary Program Override

1. Press ☜ to alternate between the ON and OFF modes. This bypasses the present programmed mode and places the plant exerciser in the ON or OFF mode (as displayed on the readout). **A change to the OFF mode will signal the generator set to start.** The plant exerciser will remain in this position until the next programmed mode changes it.
2. If override is no longer required, press ☜ to place plant exerciser in normal automatic mode.

If the normal functioning mode is not known, use the following procedure to put the timer in the normal automatic mode.

Permanent Program Override

Press ☜ and **m** simultaneously to switch between modes ON D, OFF D. The automatic normal programmed mode bypasses the present programmed mode and places the plant exerciser in one of the other two modes. The plant exerciser will remain in the ON D or OFF D position until the permanent override is manually changed.

Troubleshooting

If plant exerciser signal circuit (terminals 1–2) does not close during the set exercise period, the generator set will not be signalled to run. If the contact remains closed beyond the set exercise period, the generator set will continue running. In either case, the plant exercise timer is malfunctioning and should be replaced.

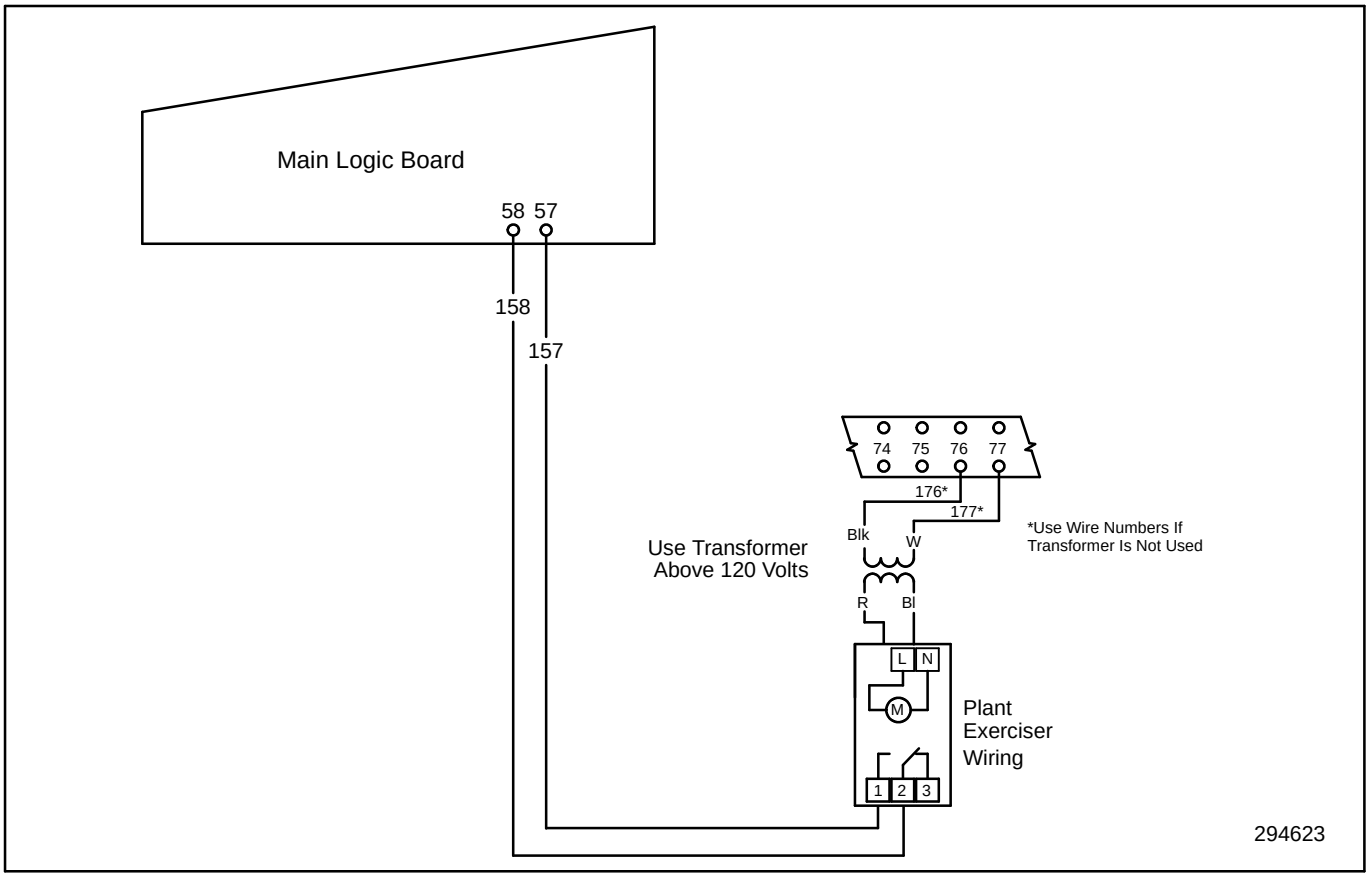


Figure 3-19. Generator Set Exercise Without Load, Accessory 23-P

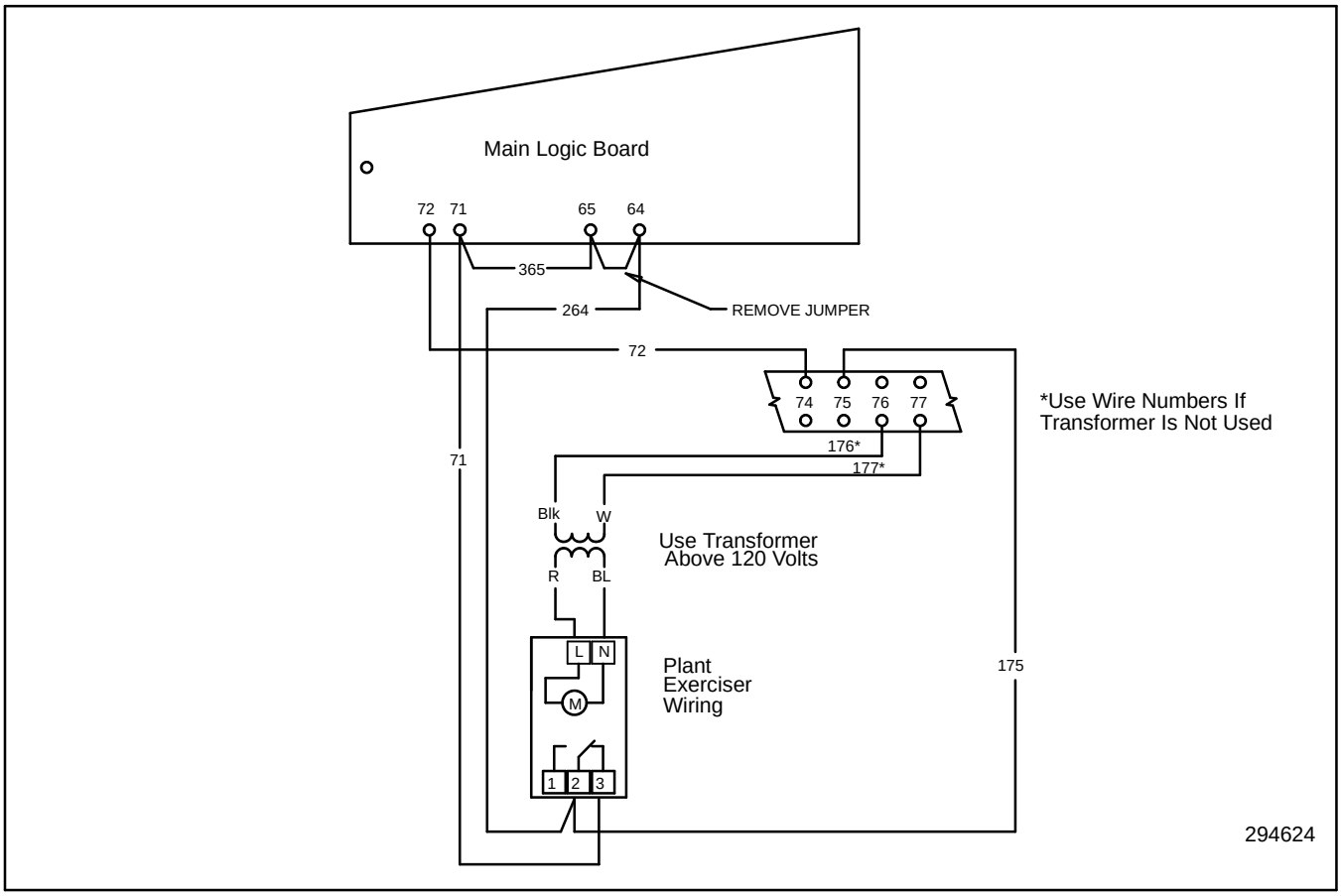


Figure 3-20. Generator Set Exercise With Load, Accessory 23-R

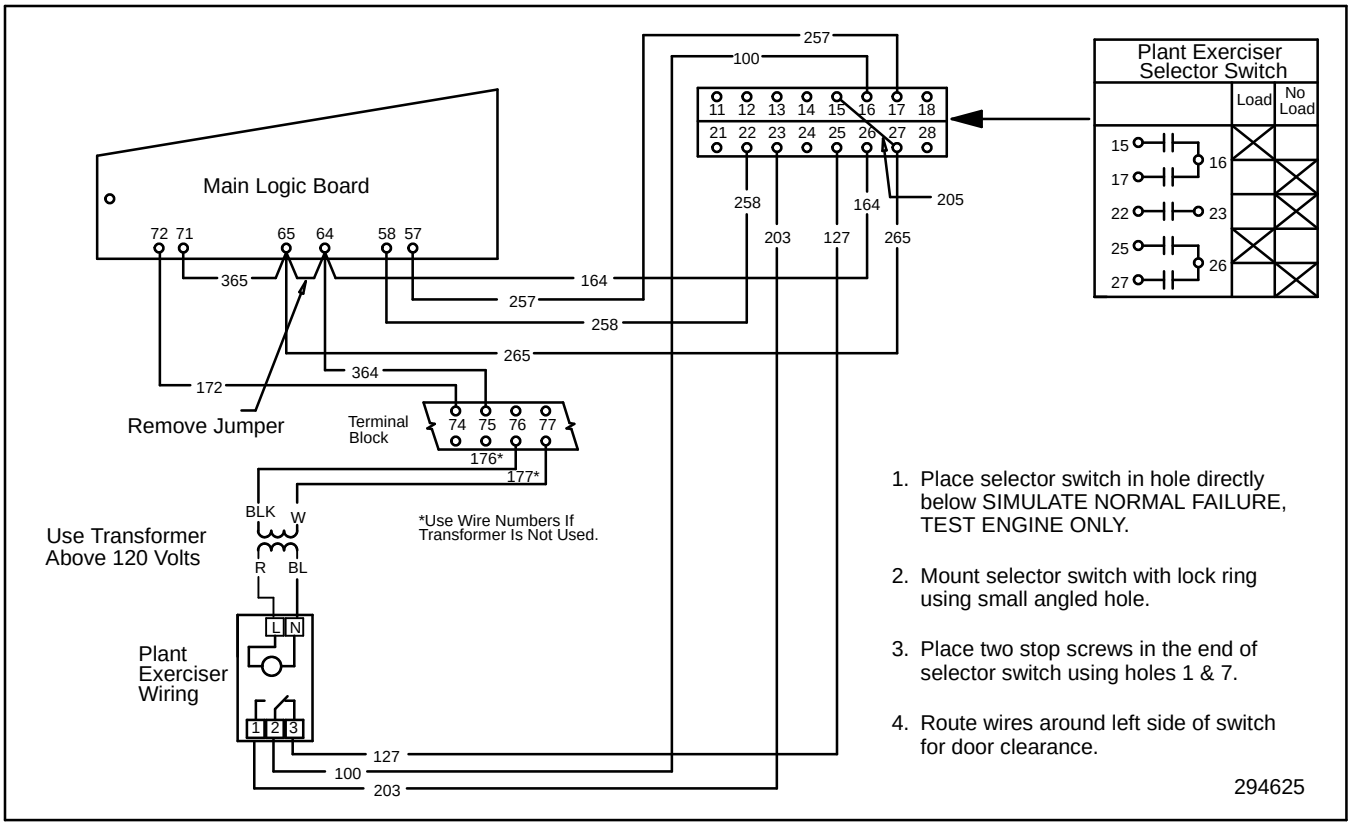


Figure 3-21. Simulate Normal Failure or Test Engine Only, Accessory 23-S

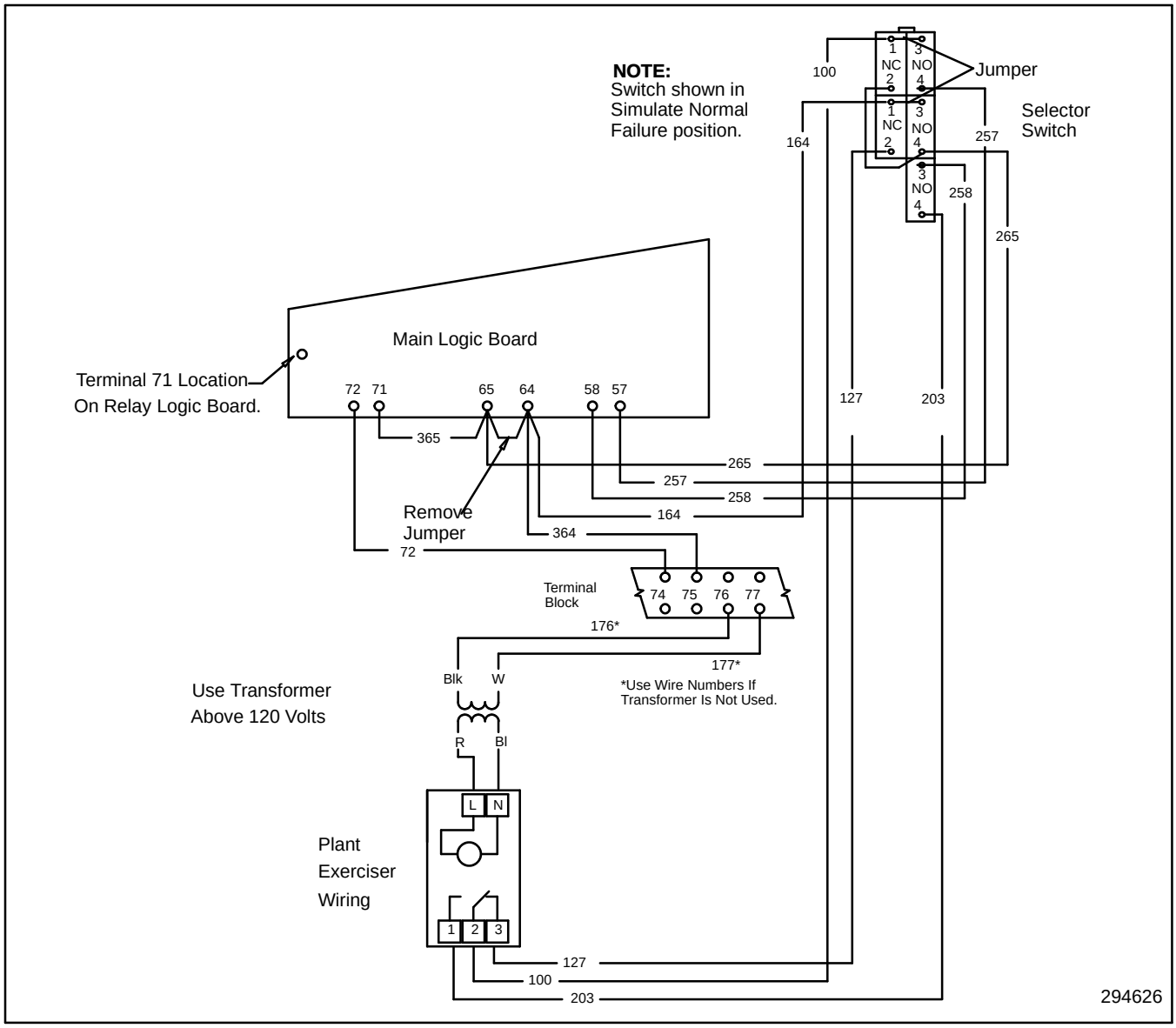


Figure 3-22. Simulate Normal Failure or Test Engine Only, Accessory 23-S3

Accessory 24: Battery Charger

Automatic, adjustable-float battery chargers are mounted below the main circuit board on the enclosure door. Select charger by normal line-to-line voltage. See Figure 3-23 and Figure 3-24 for connections.

⚠ WARNING

Hazardous voltage.
Can cause severe injury or death.

Do not open enclosure until all power sources are disconnected.

(under 600 Volt)

Shock Hazard! Terminals 78 and 79 are at line voltage. Disconnect harness plug before installing charger.

Accessory 24-A 12-Volt output

Accessory 24-B 24-Volt output

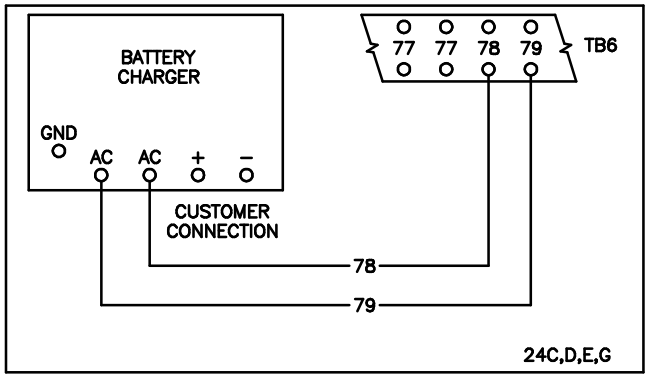


Figure 3-23. Accessories 24-C,D,E Connections

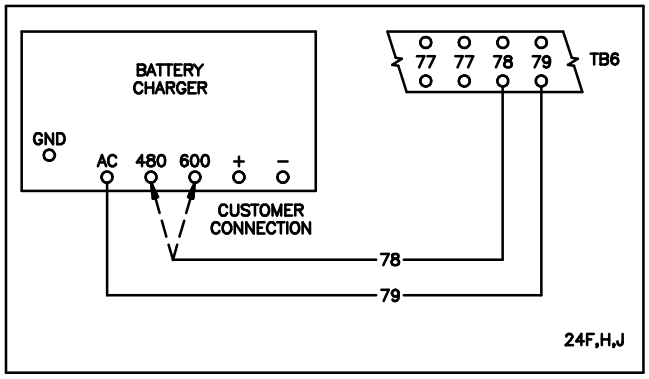


Figure 3-24. Accessories 24-F,H,J Connections

Accessory 34: Motor Load Transfer, Inphase Monitor or Sync-Check Relay

Accessory 34 is a control for transfer and retransfer of motor loads, so that inrush currents do not exceed normal starting currents. This avoids tripping circuit breakers and causing possible mechanical damage to motor couplings.

Accessory 34-A, E: Is an inphase monitor that samples the relative phase angle between the source supplying a motor load and the alternate source its being transferred to. Once the two voltages are within a predetermined phase angle and approaching zero phase angle difference, the monitor signals the transfer switch to operate allowing reconnection to close inphase.

An inhibit circuit prevents transfer when both sources are going away from synchronism. An inhibit circuit is designed to prevent actuation of the output relay in case the monitor is energized while both sources are within the allowed acceptance window.

When power is applied to the inphase monitor, the built-in enabling circuit activates a two-second delay before the monitor goes into its sampling mode. Disconnection of the enabling input automatically resets the monitor.

Voltage bypass is included in the monitor so that if the source supplying the load drops below 70% of system voltage during retransfer, the output relay of the inphase monitor will energize immediately, causing a random transfer to the alternate source. If both sources are below 70% of system voltage, the output relay is prevented from operating.

Accessory 34-A is intended for use when utility-to-generator or generator-to-generator sources are involved. See Figure 3-25 for connections.

Accessory 34-E is used when both sources are directly inphase (utility-to-utility). In this situation, the inphase inhibit option is cancelled, allowing load transfer between synchronized sources.

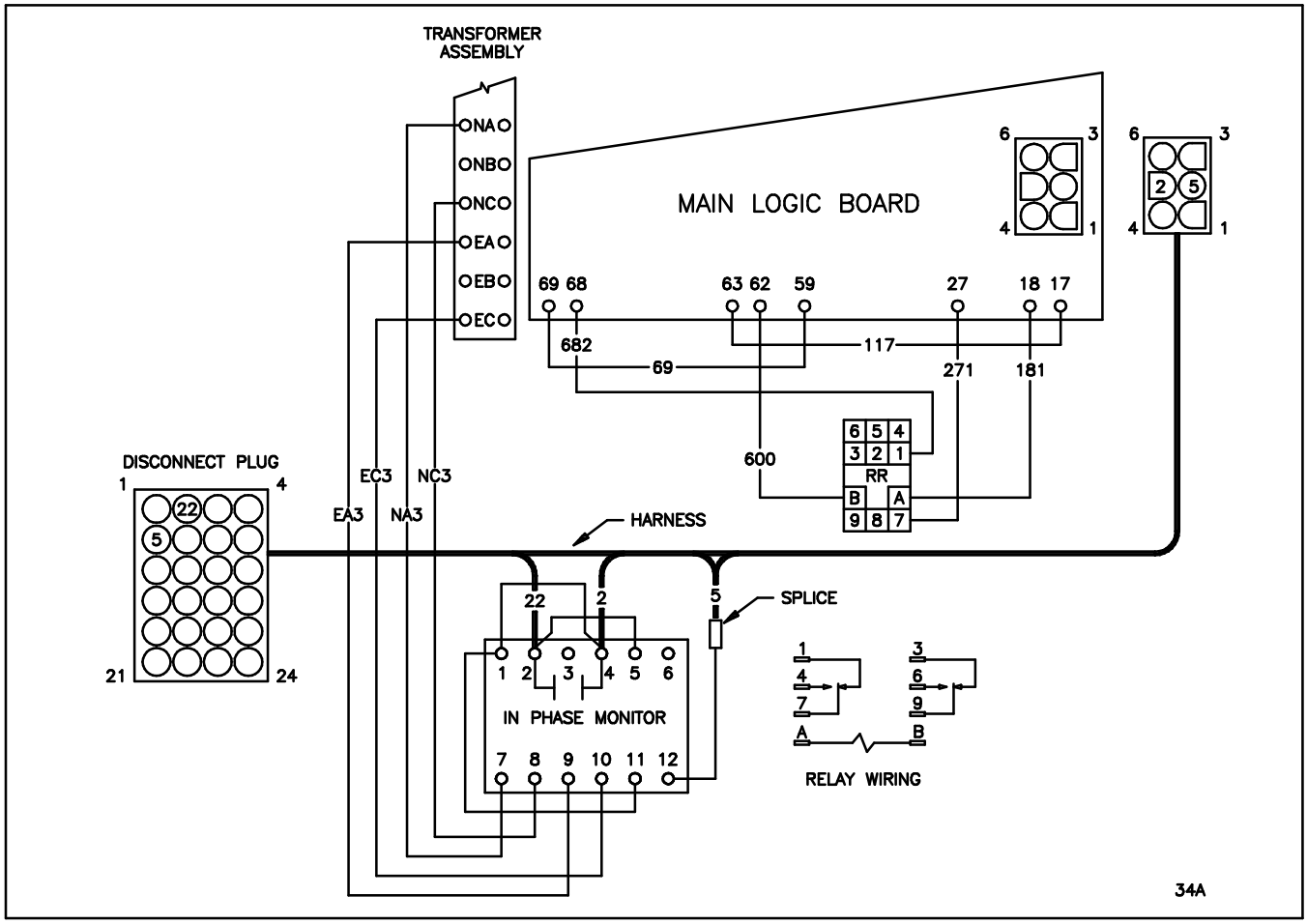


Figure 3-25. Inphase Monitor Connections

Accessory 34-B, C, D is a sync-check relay that monitors normal and emergency sources. It will not transfer load until phase voltages are above pickup voltage and the phase angle difference is below the pickup setting. The phase angle window is adjustable from ±5 to ±30°. Pickup time delay is approximately 50 milliseconds.

A voltage bypass is included in the sync-check relay in case the source supplying the load drops below 70% of system voltage during retransfer. The sync-check relay will energize immediately causing a random transfer to the alternate source. If both sources are below 70% of system voltage, the relay is prevented from operating.

Accessory 34-B operates for emergency-to-normal and normal-to-emergency transfer. Accessory 34-C operates only in the emergency-to-normal direction.

Accessory 34-D operates only in the normal-to-emergency direction. See Figure 3-26 for connections. Accessories 34-C and 34-D require option 15-A.

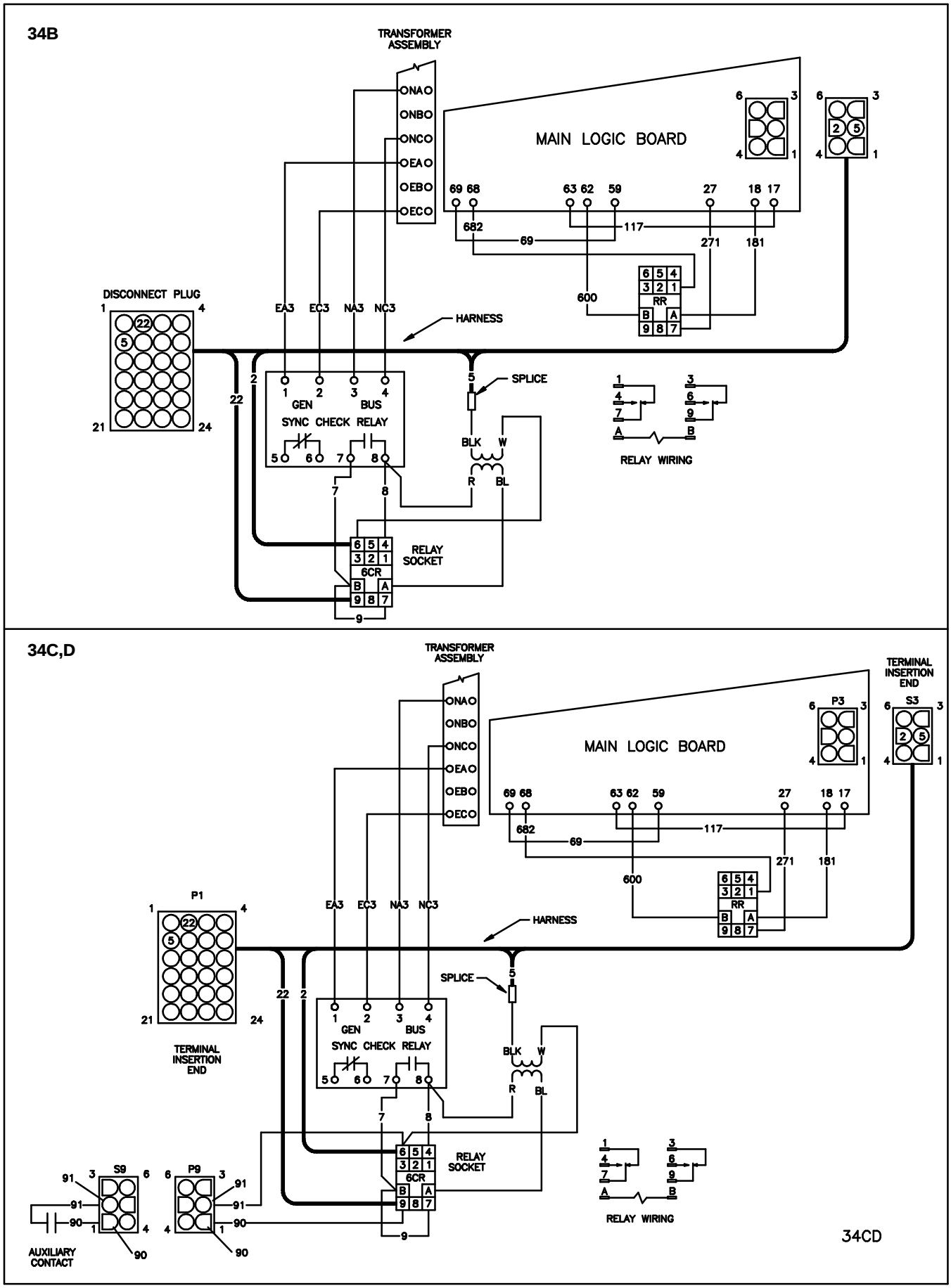


Figure 3-26. Sync-Check Relay Connections

Troubleshooting Accessory 34

1. Connect a voltmeter between terminals NA and EA on the transfer switch. Set the meter scale to at least twice the system phase-to-phase voltage.

2. Manually start the generator set. After it has reached maximum output voltage, the meter needle should sweep back and forth at a regular rate between zero volts and about twice the system voltage.

3. Place the test switch in TEST position. The load should transfer to the emergency source when the meter indicates approximately zero volts. If transfer does not occur, Accessory 34 is malfunctioning.

4. Place test switch in AUTOMATIC position. The load should retransfer back to the normal source after a time delay. The retransfer should occur when the meter reads approximately zero volts. If retransfer does not occur after the time delay, Accessory 34 is malfunctioning.

5. Immediate retransfer may be accomplished by manually opening the generator set emergency source circuit breaker. Make sure that fully rated normal voltage is available before doing this.

6. Disconnect and remove the voltmeter.

Accessory 35: Load-Shedding Contacts

Load-shed contacts (2NO, 2NC) are controlled by an adjustable time delay to operate before and/or after transfer. The contacts are provided for use in disconnecting and adding a load. See Figure 3-27 and Figure 3-28.

⚠ WARNING

Hazardous voltage.
Can cause severe injury or death.

Do not open enclosure until all power sources are disconnected.

(under 600 Volt)

Shock Hazard! Disconnect harness plug before installing any accessories involving connection to transformer assembly primary terminals 76, 77, 78, and 79. Terminals are at line voltage!

Accessory 35-G operates from 0.6 to 60 seconds prior to transfer and resets immediately after transfer.

Accessory 35-H operates from 0.6 to 60 seconds prior to transfer and resets 3 seconds after transfer.

Accessory 35-J operates immediately at time of transfer, and from 0.6 to 60 seconds after transfer.

Accessory 35-K operates 0.3 seconds before transfer and from 3 to 300 seconds after transfer.

Accessory 35-L operates from 3 to 300 seconds before and after transfer.

Relay Contact Ratings

Service Voltage	Amps, 2 Poles
120 AC	10.0
240 AC	10.0
480 AC	10.0
600 AC	7.5
12 DC	10.0
24 DC	10.0
32 DC	10.0
125 DC	0.4

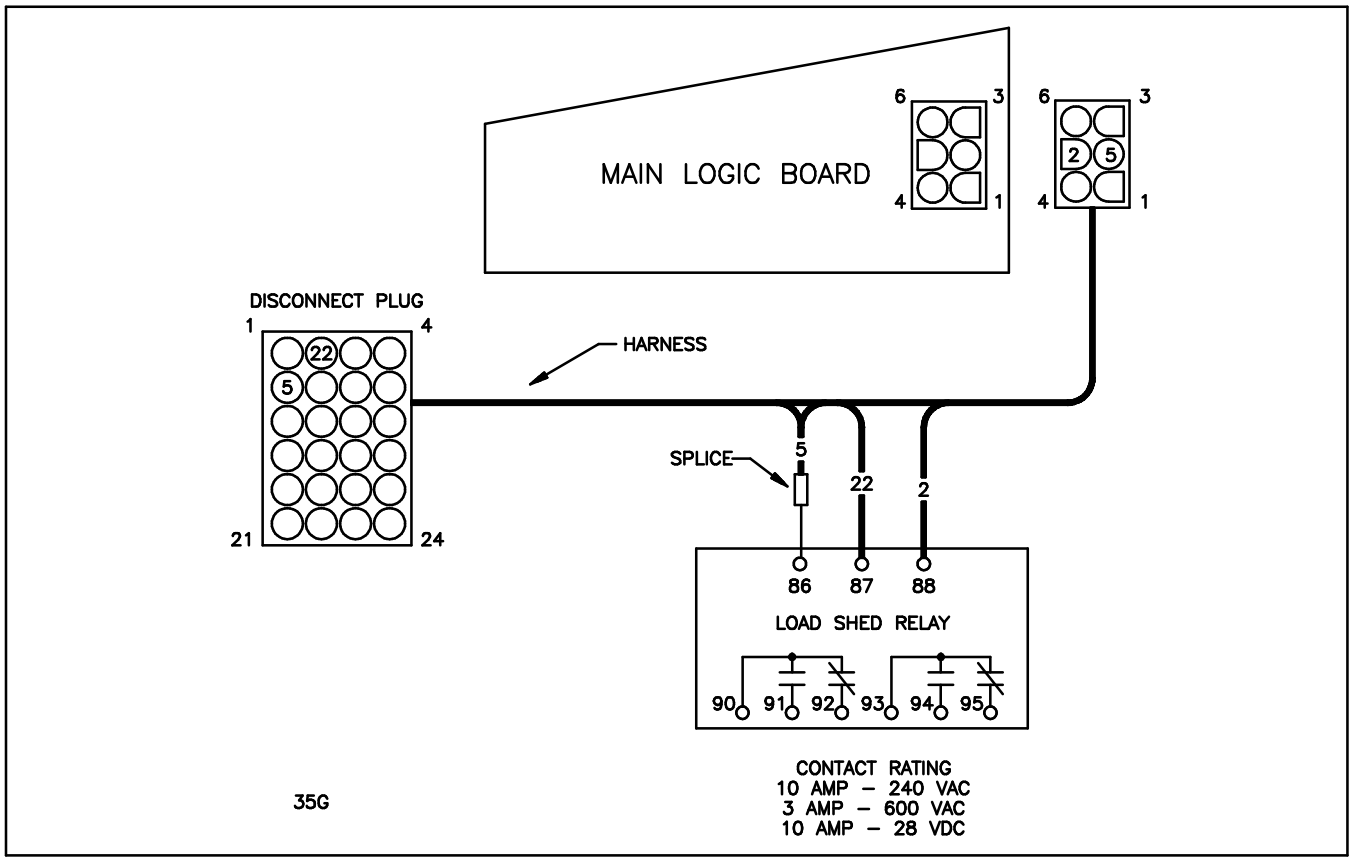


Figure 3-27. Accessories 35-G, H Connections

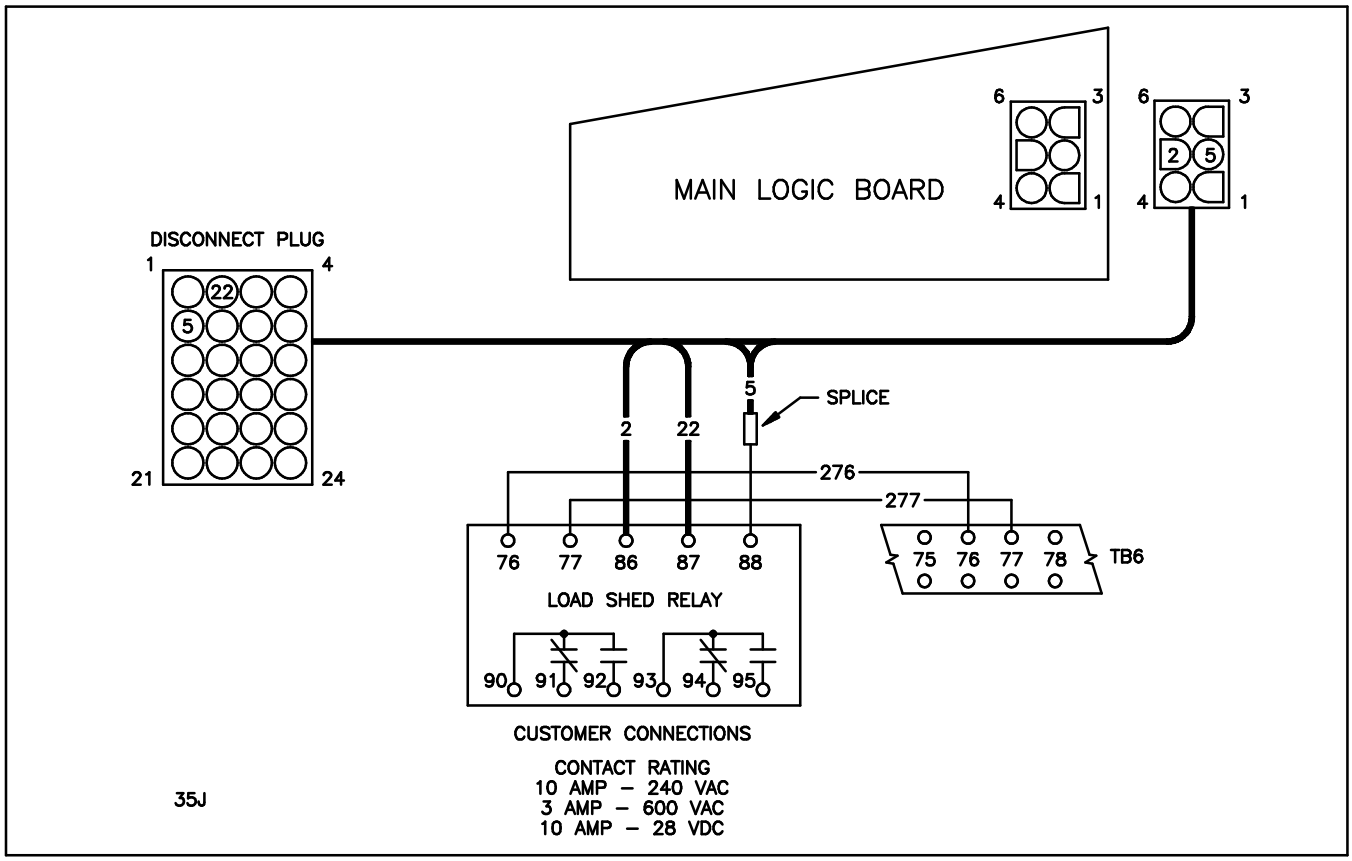


Figure 3-28. Accessories 35-J, K Connections

Section 4. Wiring Diagrams

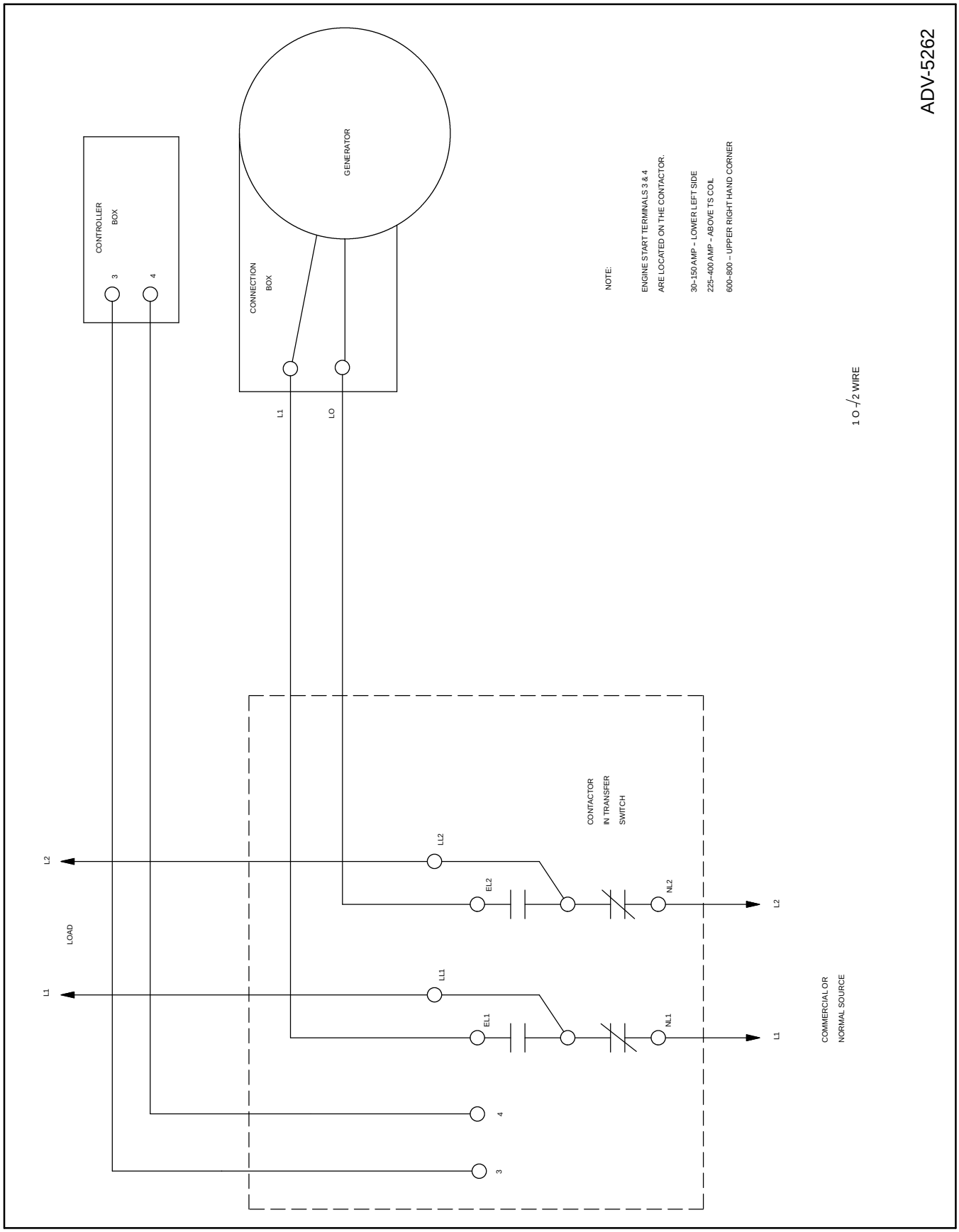


Figure 4-1. Generator/ATS Interconnect

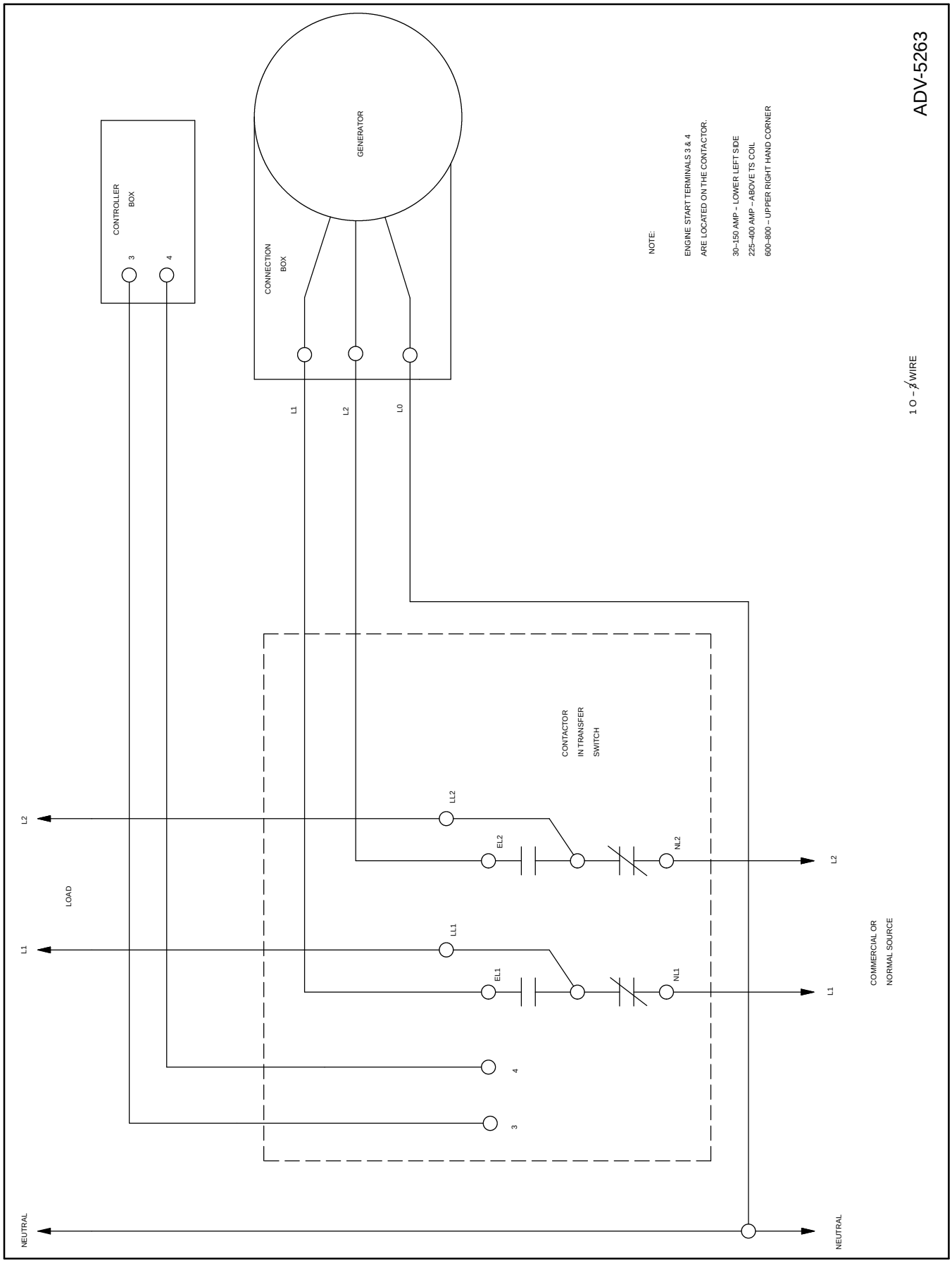


Figure 4-2. Generator/ATS Interconnect

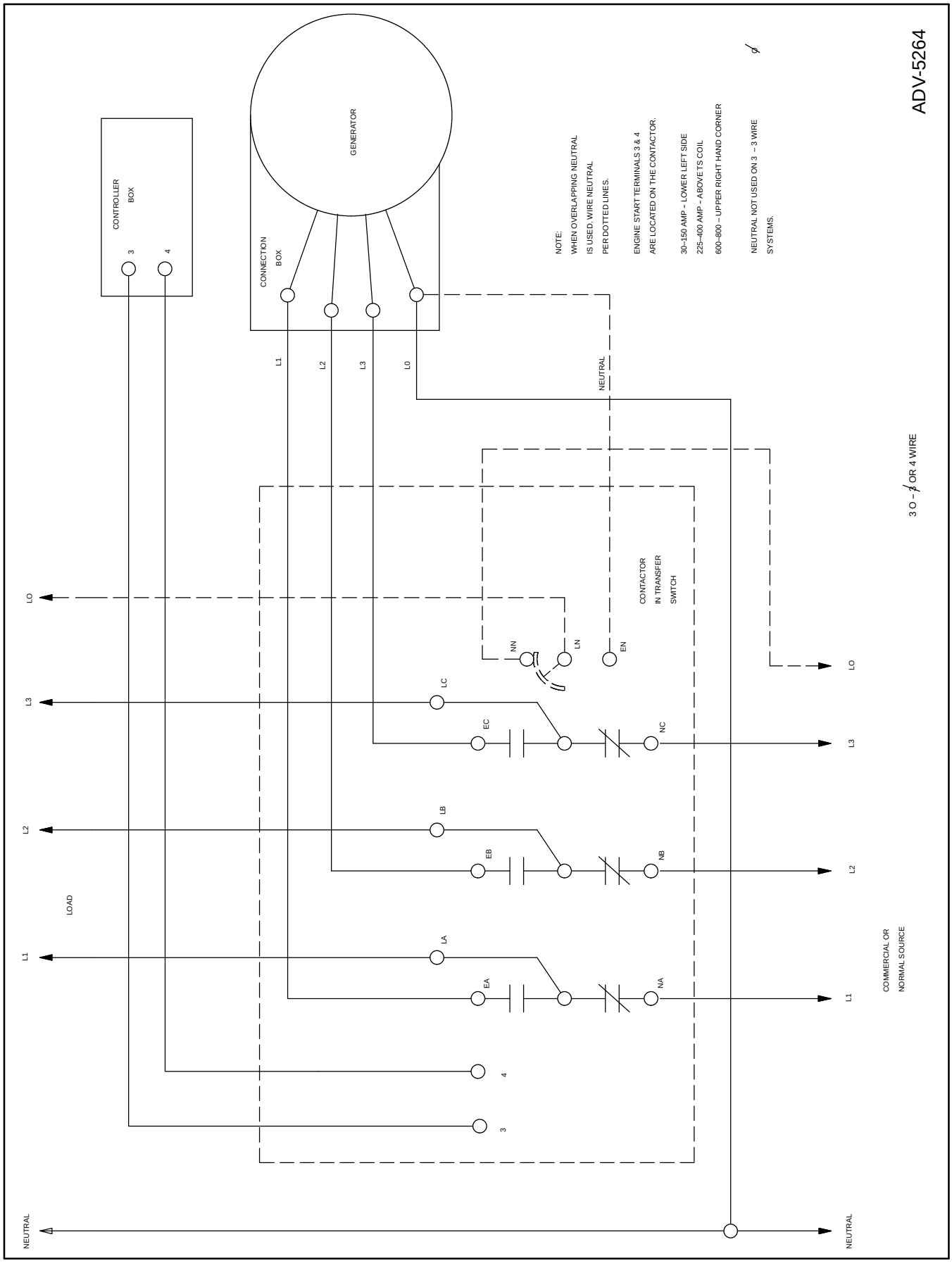


Figure 4-3. Generator/ATS Interconnect

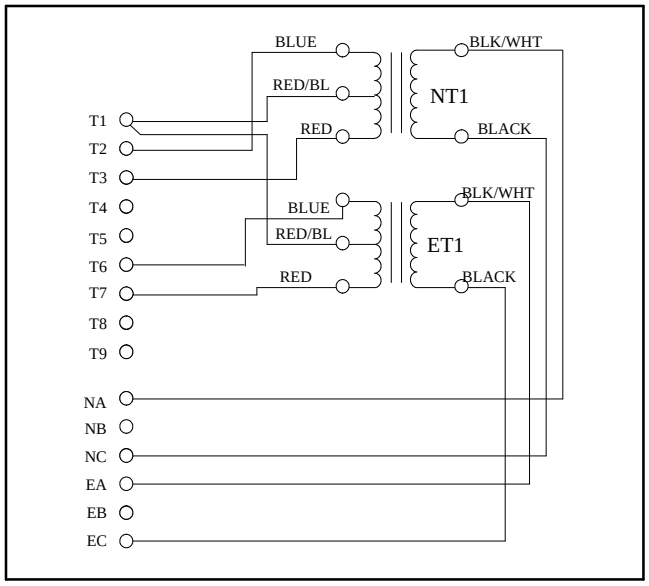


Figure 4-4. 1-Phase ATS

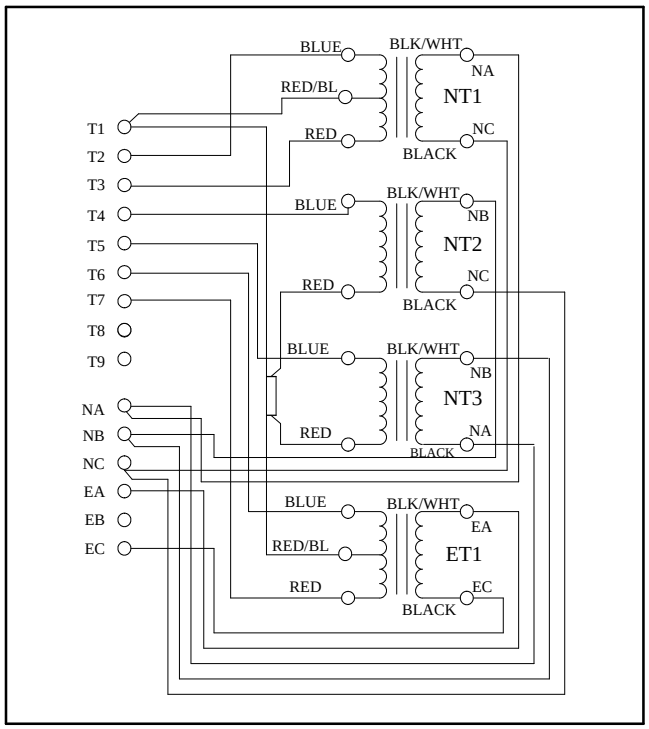


Figure 4-5. 3-Phase ATS (Standard)

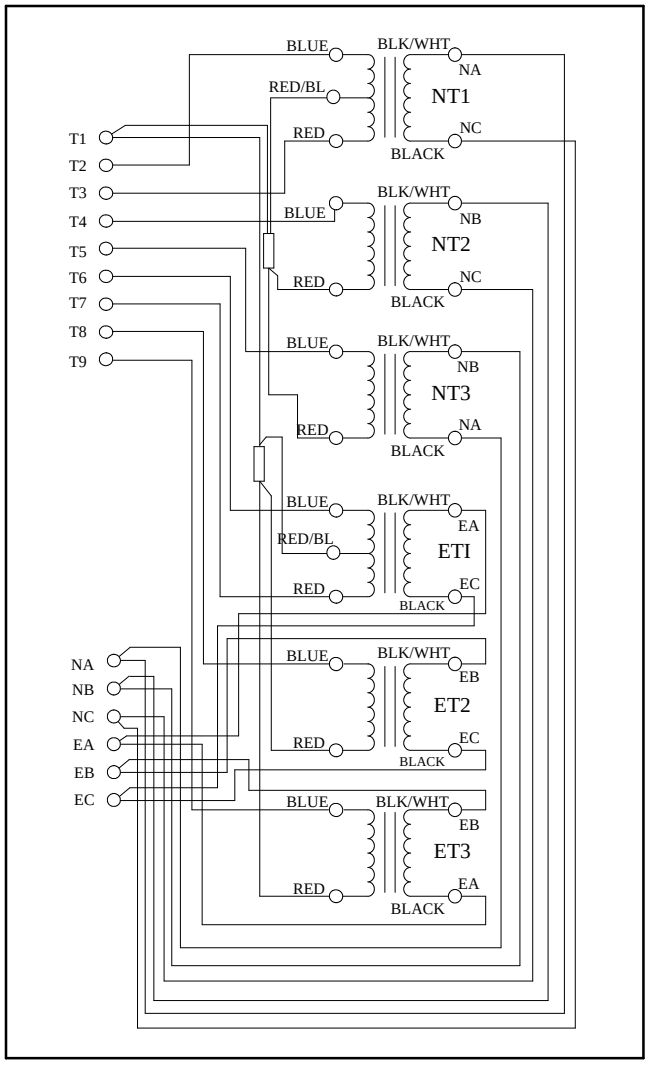
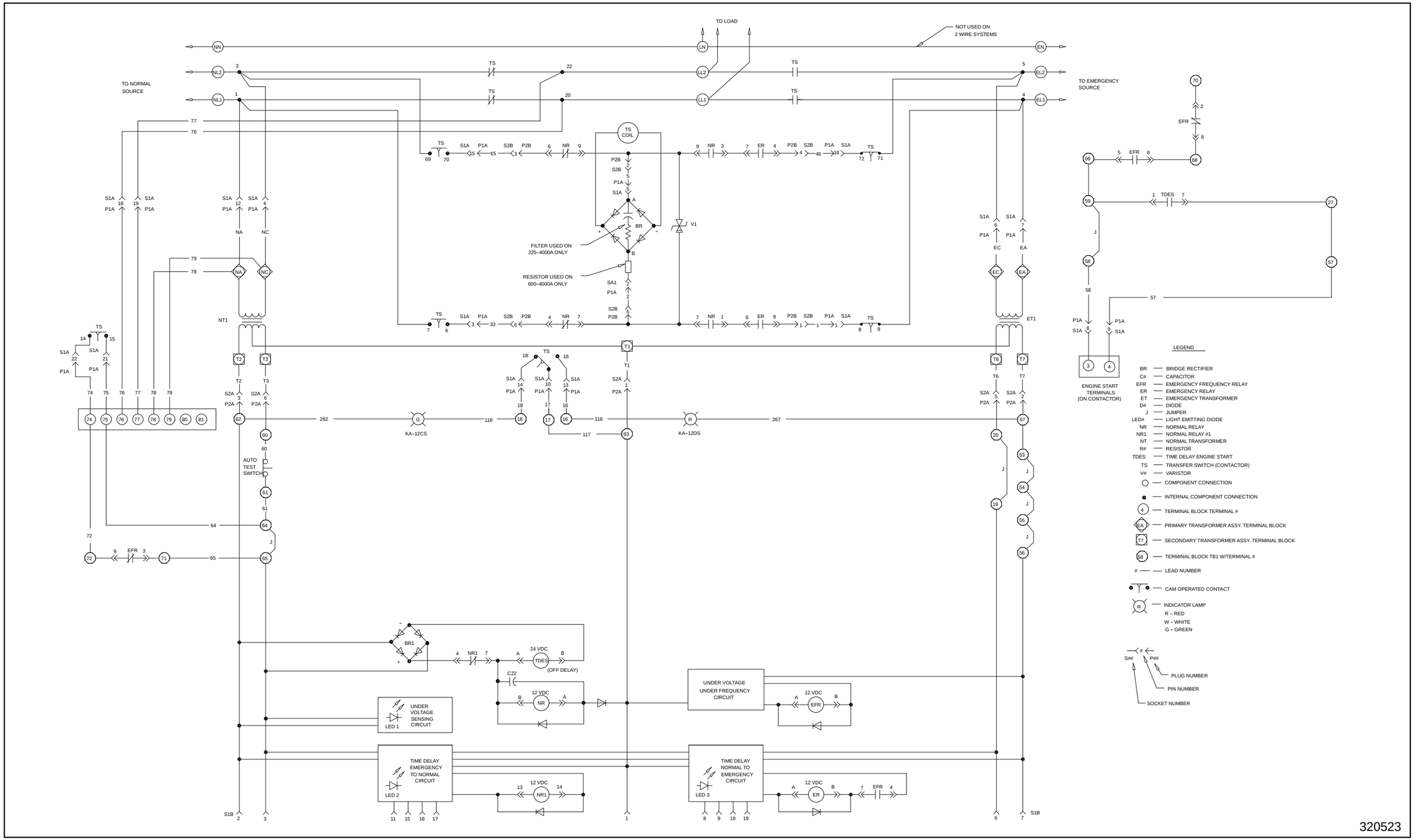


Figure 4-6. 3-Phase ATS with Option KA-05



LEGEND

BR	BRIDGE RECTIFIER
C#	CAPACITOR
EFR	EMERGENCY FREQUENCY RELAY
ER	EMERGENCY RELAY
ET	EMERGENCY TRANSFORMER
D#	DIODE
J	JUMPER
LED#	LIGHT EMITTING DIODE
NR	NORMAL RELAY
NR1	NORMAL RELAY #1
NT	NORMAL TRANSFORMER
R#	RESISTOR
TDES	TIME DELAY ENGINE START
TS	TRANSFER SWITCH (CONTACTOR)
V#	VARISTOR
○	COMPONENT CONNECTION
●	INTERNAL COMPONENT CONNECTION
4	TERMINAL BLOCK TERMINAL #
EA	PRIMARY TRANSFORMER ASSY. TERMINAL BLOCK
T7	SECONDARY TRANSFORMER ASSY. TERMINAL BLOCK
68	TERMINAL BLOCK TB1 W/TERMINAL #
#	LEAD NUMBER
	CAM OPERATED CONTACT
R	INDICATOR LAMP R – RED W – WHITE G – GREEN

S## P## # PLUG NUMBER PIN NUMBER SOCKET NUMBER

Figure 4-7. Single Phase, 2 Wire Accessories KA-12-C & KA-12-D

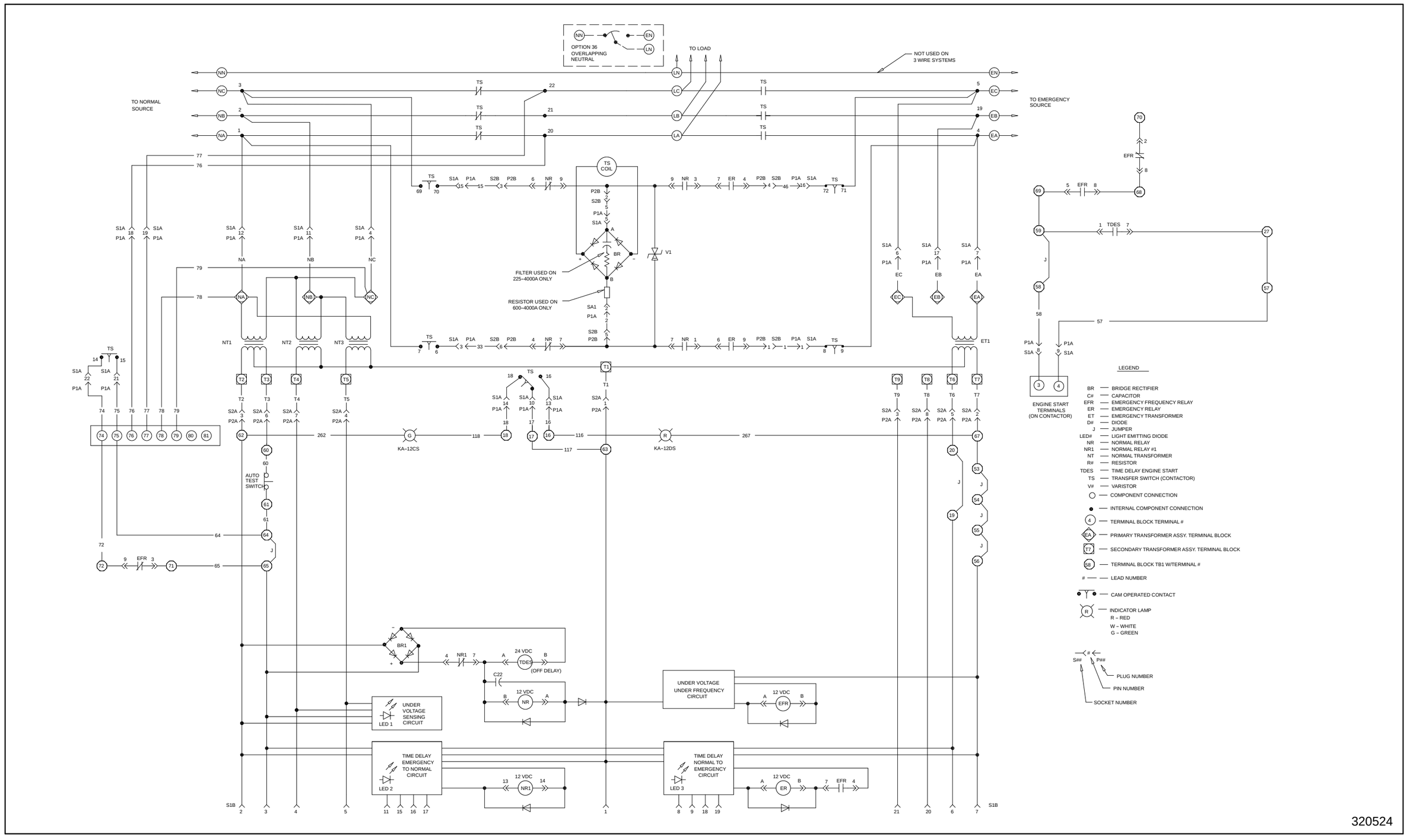


Figure 4-8. Accessories KA-12-C & KA-12-D

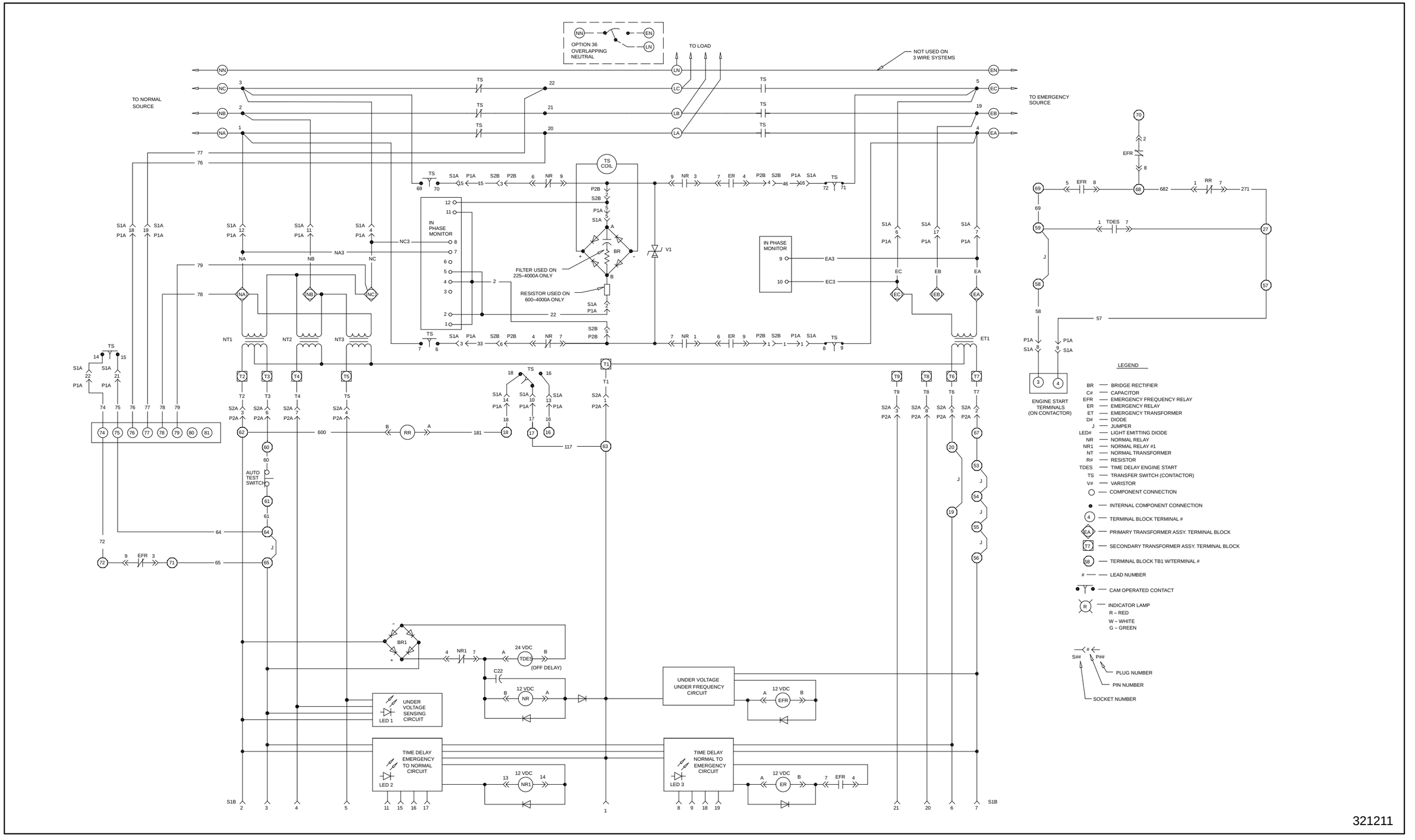


Figure 4-9. Accessory KA-34-A

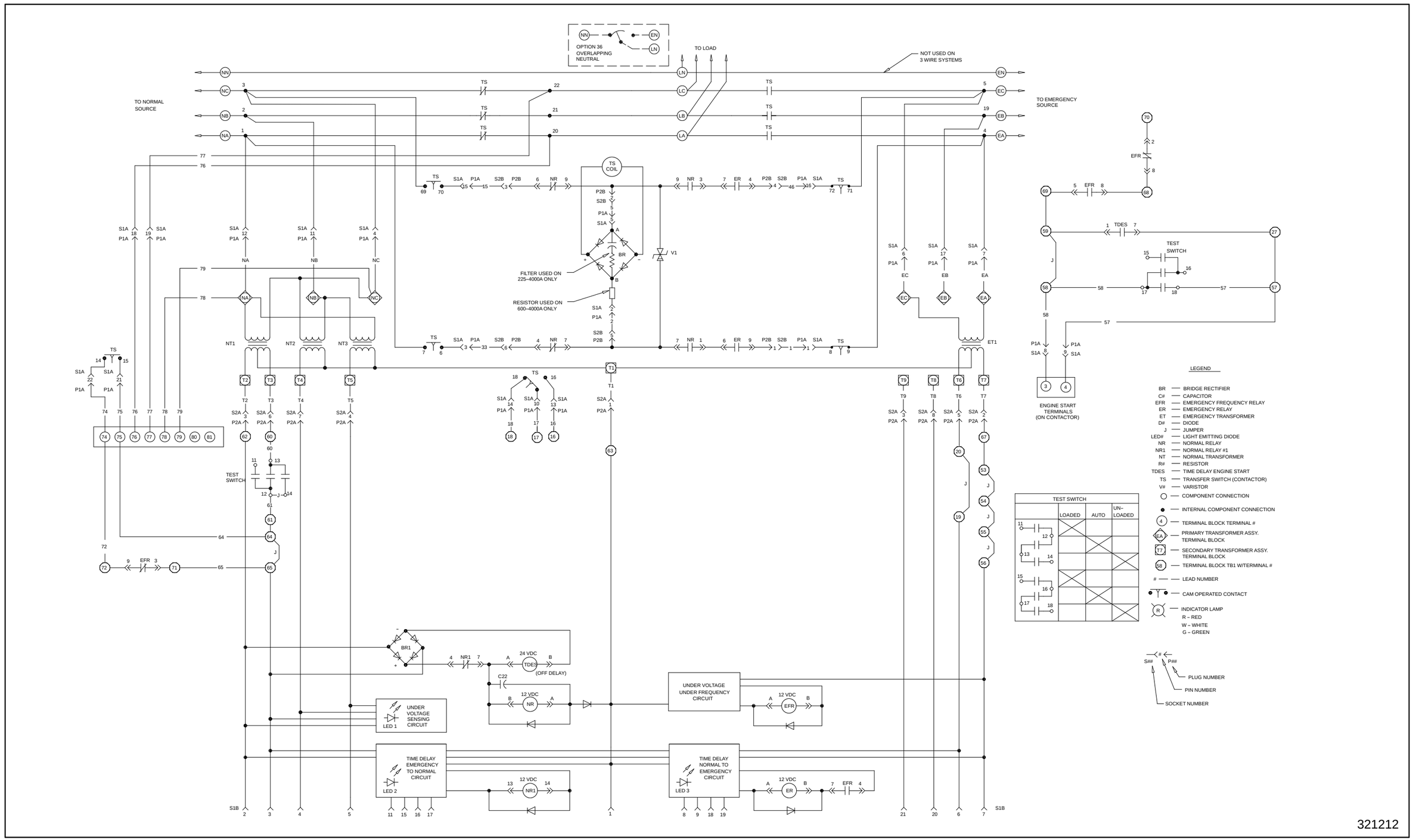
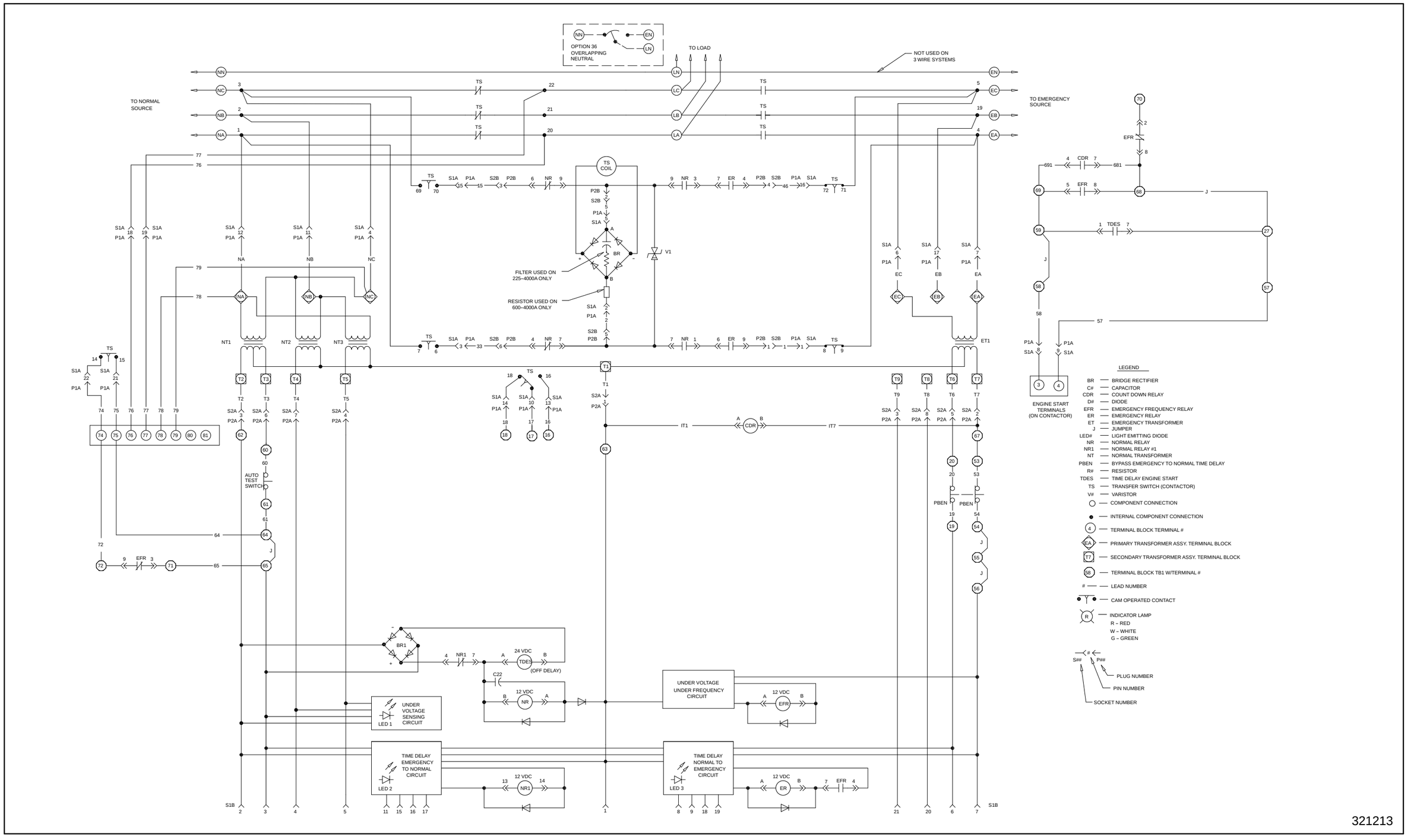


Figure 4-10. Accessory KA-6-C



LEGEND

BR	BRIDGE RECTIFIER
C#	CAPACITOR
CDR	COUNT DOWN RELAY
D#	DIODE
EFR	EMERGENCY FREQUENCY RELAY
ER	EMERGENCY RELAY
ET	EMERGENCY TRANSFORMER
J	JUMPER
LED#	LIGHT EMITTING DIODE
NR	NORMAL RELAY
NR1	NORMAL RELAY #1
NT	NORMAL TRANSFORMER
PBEN	BYPASS EMERGENCY TO NORMAL TIME DELAY
R#	RESISTOR
TDES	TIME DELAY ENGINE START
TS	TRANSFER SWITCH (CONTACTOR)
V#	VARISTOR
○	COMPONENT CONNECTION
●	INTERNAL COMPONENT CONNECTION
(4)	TERMINAL BLOCK TERMINAL #
EA	PRIMARY TRANSFORMER ASSY. TERMINAL BLOCK
T7	SECONDARY TRANSFORMER ASSY. TERMINAL BLOCK
58	TERMINAL BLOCK TB1 W/TERMINAL #
#	LEAD NUMBER
	CAM OPERATED CONTACT
R	INDICATOR LAMP R – RED W – WHITE G – GREEN

S## P## PLUG NUMBER, PIN NUMBER, SOCKET NUMBER

321213

Figure 4-11. Accessory KA-08

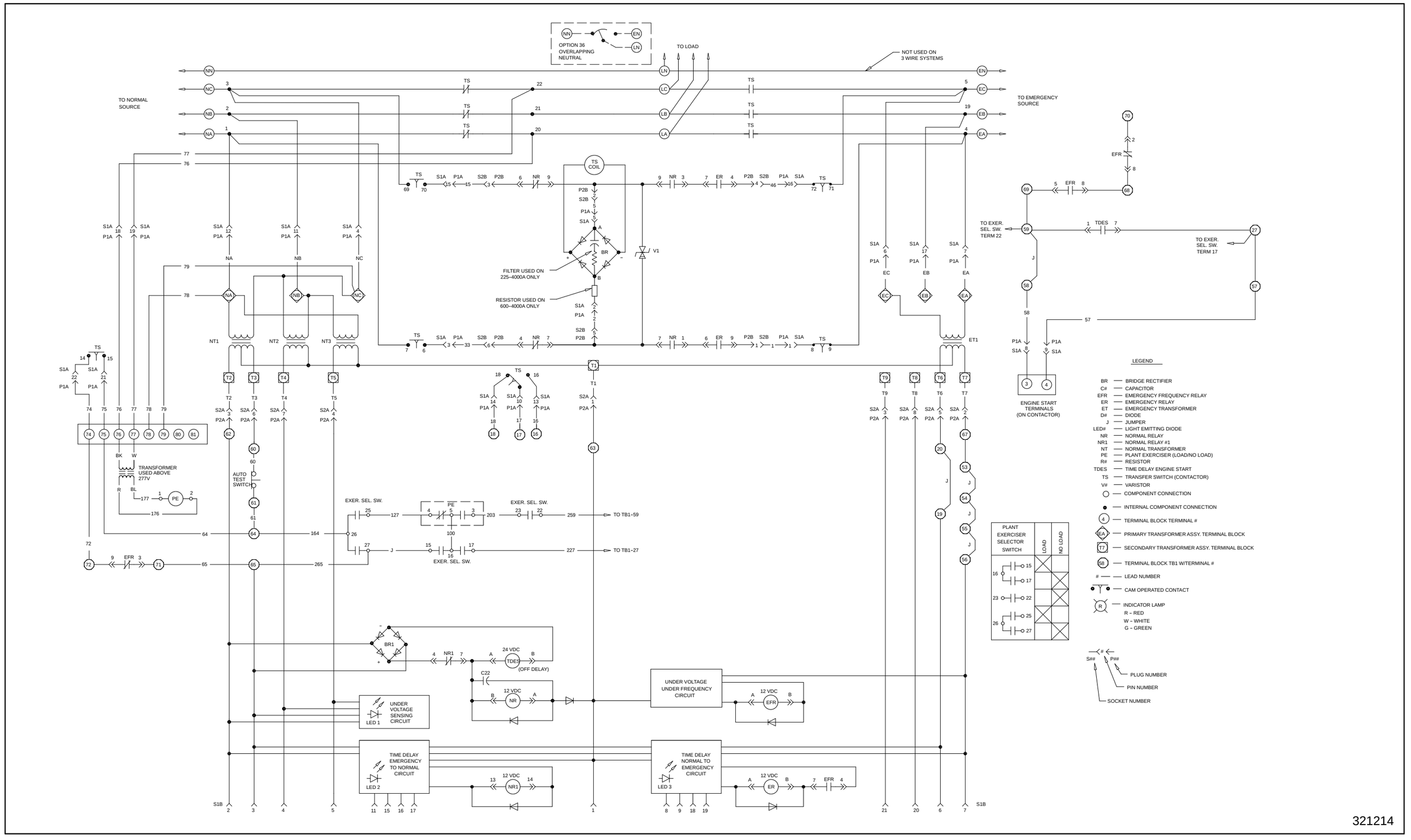
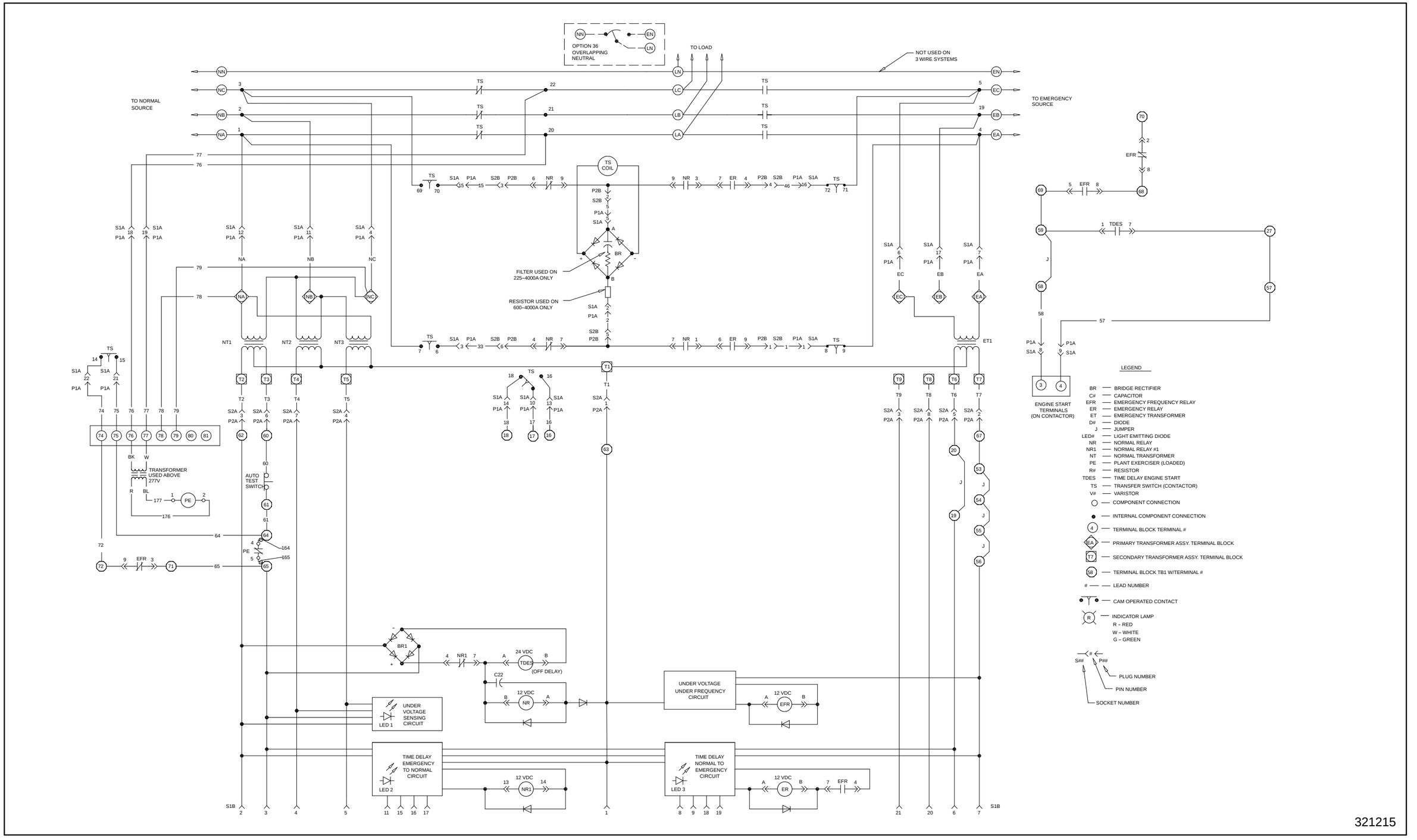


Figure 4-12. Accessory KA-23-G



LEGEND

BR	BRIDGE RECTIFIER
C#	CAPACITOR
EFR	EMERGENCY FREQUENCY RELAY
ER	EMERGENCY RELAY
ET	EMERGENCY TRANSFORMER
D#	DIODE
J	JUMPER
LED#	LIGHT EMITTING DIODE
NR	NORMAL RELAY
NR1	NORMAL RELAY #1
NT	NORMAL TRANSFORMER
PE	PLANT EXERCISER (LOADED)
R#	RESISTOR
TDES	TIME DELAY ENGINE START
TS	TRANSFER SWITCH (CONTACTOR)
V#	VARISTOR
○	COMPONENT CONNECTION
●	INTERNAL COMPONENT CONNECTION
4	TERMINAL BLOCK TERMINAL #
EA	PRIMARY TRANSFORMER ASSY. TERMINAL BLOCK
T7	SECONDARY TRANSFORMER ASSY. TERMINAL BLOCK
58	TERMINAL BLOCK TB1 W/TERMINAL #
#	LEAD NUMBER
	CAM OPERATED CONTACT
R	INDICATOR LAMP R – RED W – WHITE G – GREEN
S## P##	PLUG NUMBER PIN NUMBER SOCKET NUMBER

Figure 4-13. Accessory KA-23-D

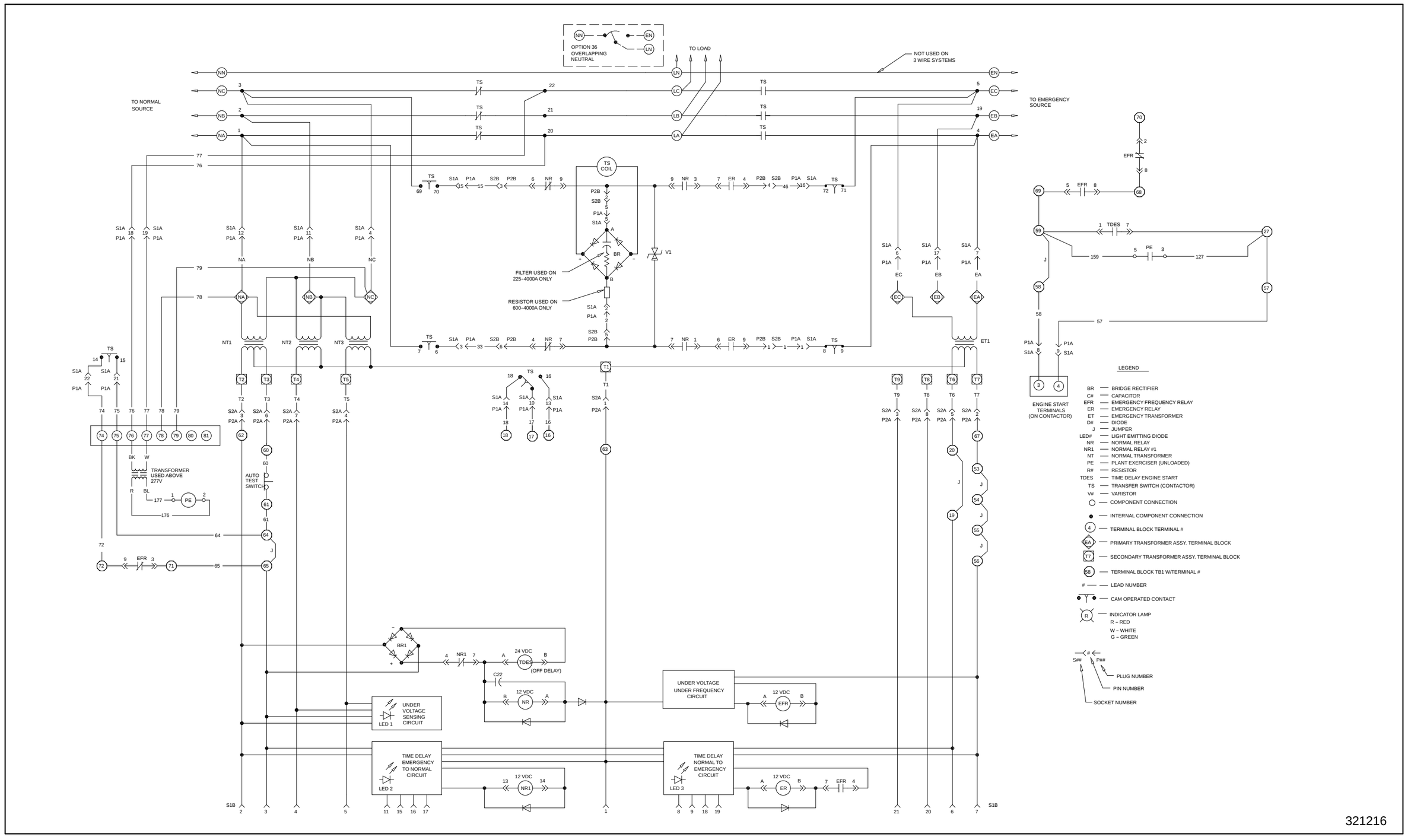


Figure 4-14. Accessory KA-23-C

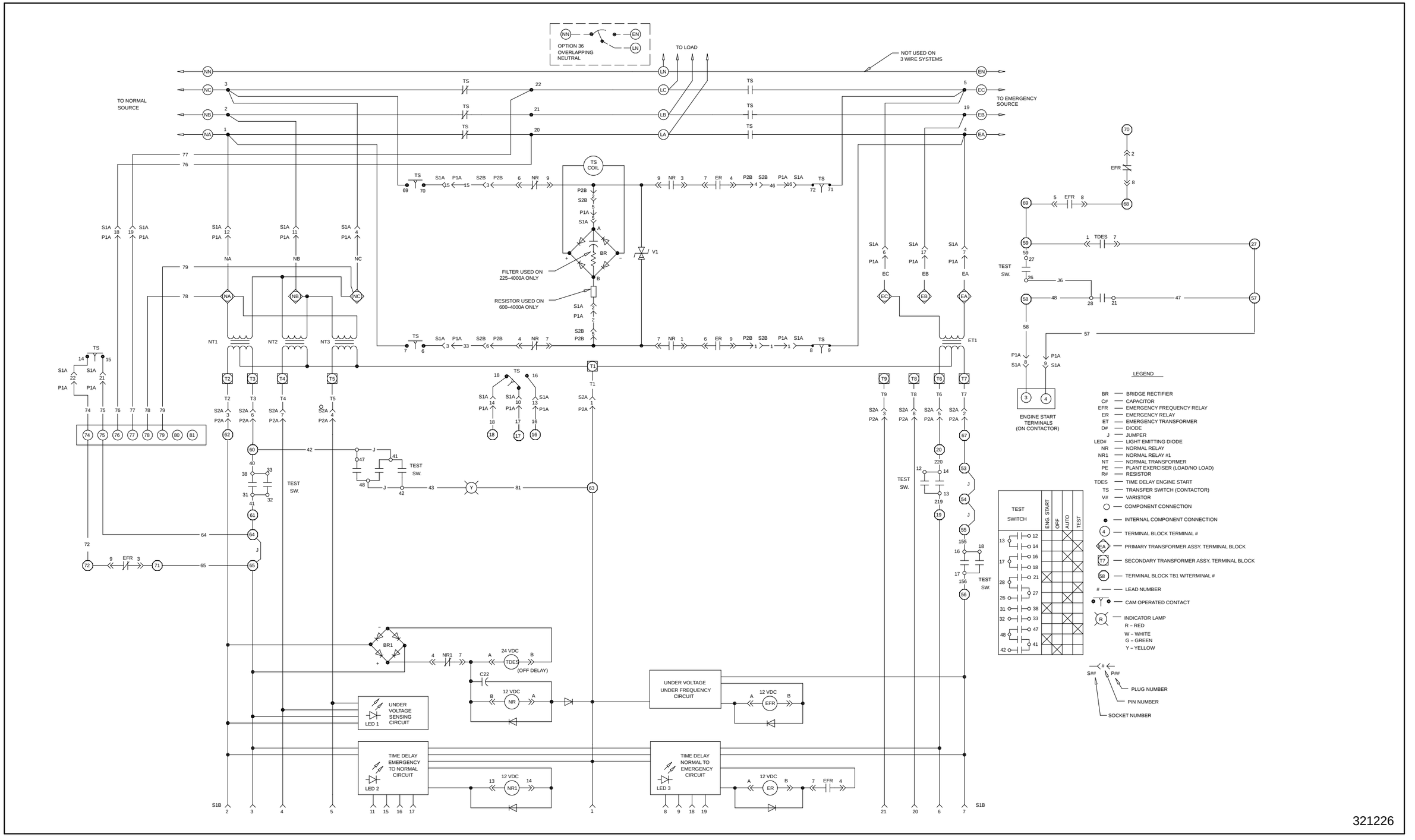


Figure 4-15. Accessory KA-07

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