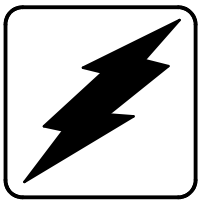
Operation, Installation and Service

Automatic Transfer Switches



Models:

HK and HKN with R33 Logic

Contactors:

30–320 Amperes

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

KOHLER®
POWER SYSTEMS

TP-5609 11/93b

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Safety Precautions and Instructions

A transfer switch, like any other electro-mechanical 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

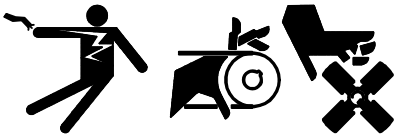
Caution is used to indicate the presence of a hazard that *will* or *can* cause *minor* personal injury or property damage if the warning is ignored.

NOTE

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

Safety decals are affixed to the transfer switch in prominent places to advise the operator or service technician of potentially hazardous situations. The decals are reproduced here to improve operator recognition and thereby increase decal effectiveness. For a further explanation of decal information, reference the accompanying safety precautions. Before operating or servicing the transfer switch, be sure you understand the message of these decals. Replace decals if missing or damaged.

ACCIDENTAL STARTING



⚠ WARNING

Accidental starting.
Can cause severe injury or death.
Disconnect battery cables before working on generator set (negative lead first and reconnect it last).

Accidental starting can cause severe injury or death. Turn generator master switch to OFF position, disconnect power to battery charger, and remove battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator. The generator set can be started by automatic transfer switch or remote start/stop switch unless these precautions are followed.

BATTERY

⚠ WARNING

Explosion.
Can cause severe injury or death. Relays in battery charger cause arcs or sparks.

Locate in a well ventilated area. Keep explosive fumes away.

Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flame or spark to occur near a battery at any time, particularly when it is being charged. Avoid contacting terminals with tools, etc. to prevent burns and to prevent sparks that could cause an explosion. Remove wristwatch, rings, and any other jewelry before handling battery. Never connect negative (–) battery cable to positive (+) connection terminal of starter solenoid. Do not test battery condition by shorting terminals together or sparks could ignite battery gases or fuel vapors. Any compartment containing batteries must be well ventilated to prevent accumulation of explosive gases. To avoid sparks, do not disturb battery charger connections while battery is being charged and always turn charger off before disconnecting battery connections. When disconnecting battery, remove negative lead first and reconnect it last.

⚠ WARNING

Sulfuric acid in batteries.
Can cause severe injury or death.

Use protective goggles and clothes. Can cause permanent damage to eyes, burn skin, and eat holes in clothing.

Sulfuric acid in batteries can cause severe injury or death. Sulfuric acid in battery can cause permanent damage to eyes, burn skin, and eat holes in clothing. Always wear splash-proof safety goggles when working around the battery. If battery electrolyte is splashed in the eyes or on skin, immediately flush the affected area for 15 minutes with large quantities of clean water. In the case of eye contact, seek immediate medical aid. Never add acid to a battery once the battery has been placed in service. Doing so may result in hazardous spattering of electrolyte.

HAZARDOUS VOLTAGE/ ELECTRICAL 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)

⚠ 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. Perform electrical service only as prescribed in equipment manual. Be sure that generator is properly grounded. Never touch electrical leads or appliances with wet hands, when standing in water, or on wet ground as the chance of electrocution is especially prevalent under such conditions. Wiring should be inspected at the interval recommended in the service schedule– replace leads that are frayed or in poor condition. The function of a generator set is to produce electricity and wherever electricity is present, there is the hazard of electrocution.

Hazardous voltage can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage**.** Do not contact electrical connections with tools or jewelry while adjustments are made. Remove wristwatch, rings, and jewelry that can cause short circuits.

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. To prevent the possibility of electrical shock, de-energize the normal power source to be connected to the transfer switch before making any line or auxiliary connections.

Hazardous voltage can cause severe injury or death. De-energize both normal and emergency power sources before proceeding. Move generator master switch on controller to OFF position and disconnect battery negative (–) before working on transfer switch! Turn the transfer switch selector switch to the OFF position.

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! (S, set models only)

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 your hands are wet.

Introduction

This manual covers the operation, maintenance, troubleshooting, and repair of a 30-320 amp transfer switch.

Service requirements are minimal but are very important to the safe and efficient operation of your transfer switch; therefore, inspect associated parts often.

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 transfer switch for future reference.

It is recommended that an authorized service dealer/distributor perform required servicing to keep your set in top condition.

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

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

Abbreviation	Description
JIS	Japanese Industry Standard
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
V	volt, volts
VAC	volts alternating current
VDC	volts direct current
TP, TPs	technical publications
turbo	turbocharger
UHF	ultra high frequency
UNC	Unified coarse thread (was NC)
UNF	Unified fine thread (was NF)
UL	Underwriter ъ Laboratories, Inc.
US	undersize
VHF	very high frequency
W	watt, watts

Service Assistance

For service or information, check the yellow pages of your telephone directory under the heading GENERATORS– ELECTRIC for the authorized Kohler service dealer/distributor in your area.

KOHLER CO., Kohler, Wisconsin 53044
Phone 414-565-3381
Fax 414-459-1646 (North American Sales)
414-459-1614 (International)
For Sales and Service in U.S.A. and Canada
Phone 1-800-544-2444

In any communications regarding your transfer switch, please include the MODEL, SERIAL, and accessory numbers as found on the nameplate attached to the transfer switch. Enter numbers in spaces provided below. This information will enable your authorized service dealer/distributor to supply the correct part or data for your particular version. Part numbers do not appear in this manual due to variations in this series of transfer switch models.

Model No. _____

Serial No. _____

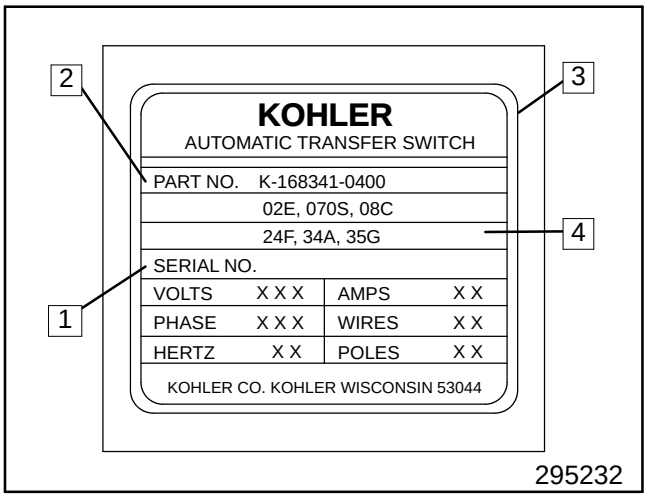
Accessory No. _____

_____

Nameplate

When using this manual, it is important to know which circuit board is used. Adjustments will vary with each circuit board design. See Figure 1.

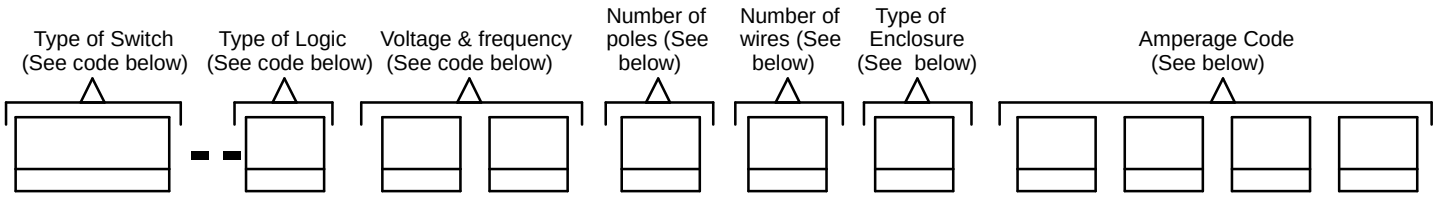
The transfer switch nameplate, located on the door's inside panel, includes important service information such as the product model number, serial number, and any factory-installed accessories on the unit.



1. Used for Kohler Warranty and Service.
2. Kohler number–used to identify type of transfer switch.
3. Nameplate
4. Option numbers–tell operator and Kohler what factory installed options are included when troubleshooting.

Figure 1. Transfer Switch Nameplate

Transfer Switch Model Number Identification



Kohler Model Number Key

This diagram explains the Kohler Transfer Switch model numbering code system. The sample number shown is for a relay logic Home Standby Automatic Transfer Switch, 120 Volt, 60 hertz, single phase, 2 pole, 3 wire, 30 ampere model in a NEMA 1 enclosure.

SAMPLE MODEL NUMBER

HK-222231-0030

TYPE OF TRANSFER SWITCH

HK–Home Standby Automatic Transfer Switch
HKN–Home Standby Nonautomatic Transfer Switch

TYPE OF LOGIC

2–Relay

VOLTAGE & FREQUENCY PHASE TO PHASE 240V AC MAX

21–110V 50/60 Hz
22–120V 50/60 Hz
23–220V 50/60 Hz
24–240V 50/60 Hz
27–190V 50/60 Hz
28–208V 50/60 Hz

NUMBER OF POLES

2–2 Pole, single-phase

NUMBER OF WIRES

2–2 Wire
3–3 Wire

TYPE OF ENCLOSURE

1–NEMA 1

AMPERES

0030–30 amperes
0080–80 amperes
0100–100 amperes
0160–160 amperes
0200–200 amperes
0225–225 amperes
0260–260 amperes
0320–320 amperes

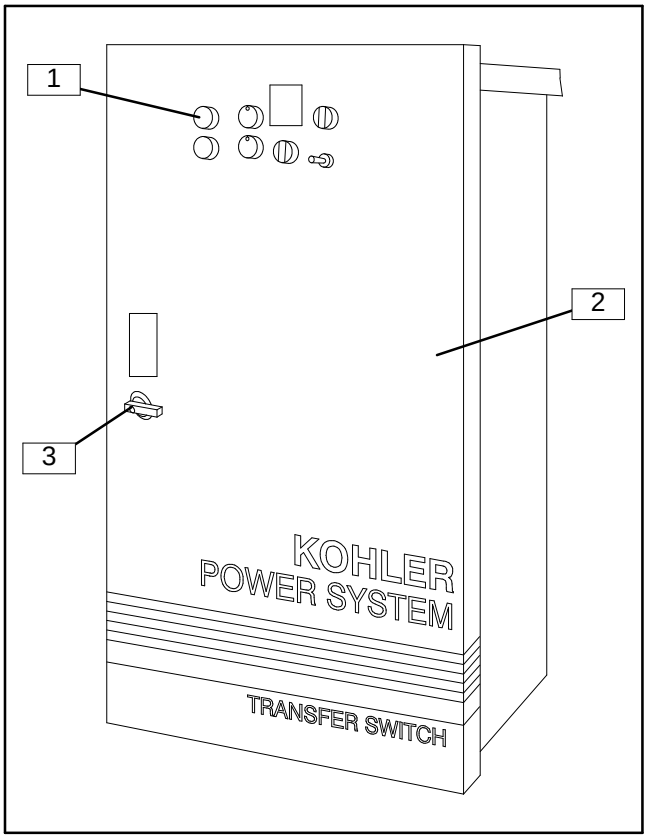
Section 1. Specifications

Automatic Transfer Switch Function

An automatic transfer switch is an electrical device used to transfer critical loads from a normal (commercial utility) source to an emergency (standby) source of power. This transfer automatically occurs when the normal source voltage fails or is substantially reduced (or the test switch is activated), *and* the emergency source voltage has reached an acceptable level.

Upon normal source failure, the automatic transfer switch signals the start of the generator set. When the emergency source is within the acceptable voltage limits, transfer of the electrical load to the emergency source will occur. The engine start signal is disabled in the manual (nonautomatic) mode. The engine must then be started manually. For more information on manual operation, see Manual Transfer Switch Function.

The automatic transfer switch continuously senses the presence of an acceptable normal source, and will retransfer the load to the normal source after it has been restored to an acceptable level. After retransfer of the load, the start signal from the automatic transfer switch is cancelled and the generator set is allowed to shut down. See Figure 1-5.



1. Operating Controls (optional)
2. Transfer Switch Enclosure
3. Locking Door Handle

Figure 1-5. Transfer Switch (typical)

Manual (Nonautomatic) Transfer Switch Function

An automatic/manual transfer switch has two functional modes– automatic or manual (nonautomatic). When the keyed selector switch is placed in the AUTO position, it is identical to the Automatic Transfer Switch Function.

When the keyed selector switch is placed in the MANUAL mode, automatic function is prevented. A toggle switch initiates transfer in either direction (*normal to emergency* or *emergency to normal*).

If the normal source fails or the test switch is activated, power is disrupted. The manual mode requires that the generator set be started by the operator. See generator set operation manual for proper starting procedure.

When proper voltage/frequency parameters are met, the *normal-to-emergency* toggle switch can be actuated to transfer to generator set power. The emergency source is available when the *white emergency* source lamp is on.

When the normal source is available or test switch is deactivated, the transfer switch will NOT automatically switch to normal (commercial utility) power. The normal source is available when the *white normal* source lamp is on. To switch to the normal source, move the *emergency-to-normal* switch to the normal position. The generator set must be manually stopped.

Should the normal source fail again, the process would need to be repeated.

NOTE

The AUTO/MANUAL switch may be positioned to the AUTO position at any time during manual operation. The transfer time delays will be reestablished when in the AUTO mode. If this is done, the generator set controller must be placed in the AUTO position for full automatic operation.

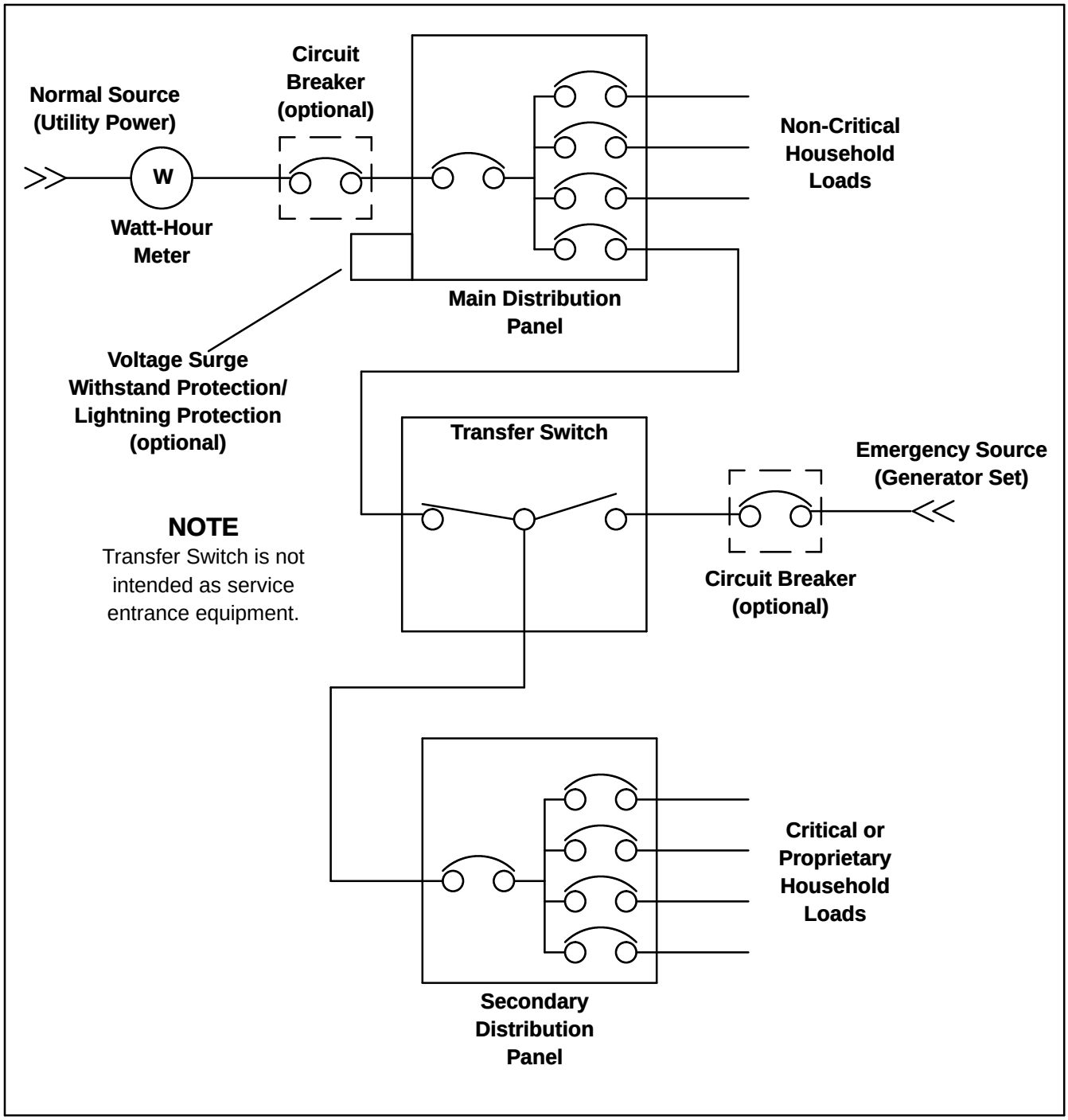


Figure 1-6. Transfer Switch Connection (typical)

Specifications

Switch Rating (Amperes)	Frequency (Hz)	Maximum Voltage	Number of Poles
30	50/60	250	2
80	50/60	250	2
100	50/60	250	2
160	50/60	250	2
200	50/60	250	2
225	50/60	250	2
260	50/60	250	2
320	50/60	250	2

Figure 1-7. Transfer Switch Rating, Frequency, Maximum Voltage and Number of Poles

Switch Rating (Amperes)	When Used with Current-Limiting Fuses (Type J and K1)		Long Time Withstand/Closing Ratings For Use with Any Overcurrent Protective Device	
	WCR *	Max. Fuse Size (Amps)	WCR *	Time (Cycles)
30	100,000	60	10,000	1.5
80	200,000	200	10,000	1.5
100	200,000	200	10,000	1.5
160	200,000	200	10,000	1.5
200	200,000	200	10,000	1.5
225	200,000	600	35,000	3.0
260	200,000	600	35,000	3.0
320	200,000	600	35,000	3.0
* Withstand Current Ratings are RMS symmetrical amperes at 240 vac.				

Figure 1-8. Withstand Current Ratings

Switch Rating (Amperes)	Enclosure Dimensions (approx.) (H x W x D)	Weight lbs. (kg)
30-100	31 x 18 x $11\frac{5}{8}$ in. (787 x 457 x 295 mm)	68 (31)
160, 200	31 x 18 x $11\frac{5}{8}$ in. (787 x 457 x 295 mm)	70 (32)
225-320	48 x 18 x $13\frac{1}{8}$ in. (1219 x 457 x 333 mm)	104 (47)

Figure 1-9. Transfer Switch Dimensions and Weights

Switch Rating (Amperes)	Range of Wire Sizes (Copper Wire only)
30	One #14 to #6
80	One #14 to 1/0
100	One #14 to 2/0
160, 200	One #8 to 3/0
225-320	Two #1/0 to 250 MCM or One #4 to 600 MCM

Figure 1-10. Range of Wire Sizes

Standard Accessories

AUTOMATIC AND MANUAL (NONAUTOMATIC)

- Normal source undervoltage protection (70% dropout, 90% pickup).
- Time delay emergency to normal (TDEN), adjustable from 0 to 30 minutes.
- Time delay engine start (TDES), fixed at 3 seconds.
- Frequency/voltage relay for emergency source, fixed (voltage: 85% ±5% pickup; frequency: 95% pickup).

MANUAL (NONAUTOMATIC) ONLY

- Green pilot light indicates transfer switch is in the normal source position.
- Red pilot light indicates transfer switch is in the emergency source position.
- White pilot light indicates normal source is available.
- White pilot light indicates emergency source is available.
- Key-operated Auto/Manual selector switch plus a NE (normal-to-emergency) and EN (emergency-to-normal) pushbutton.
- In the manual position, the engine start circuit is open. This will stop the generator set if it is running with the generator set controller switch in the AUTO position. The generator set must then be started locally (at the generator set).
- No override to normal in manual position (in other words, should the emergency source fail, the transfer switch will not automatically transfer to normal when it becomes available).

Optional Accessories

AUTOMATIC AND MANUAL (NONAUTOMATIC)

For a description of each option, refer to Section 3– Operation and Installation of Optional Accessories.

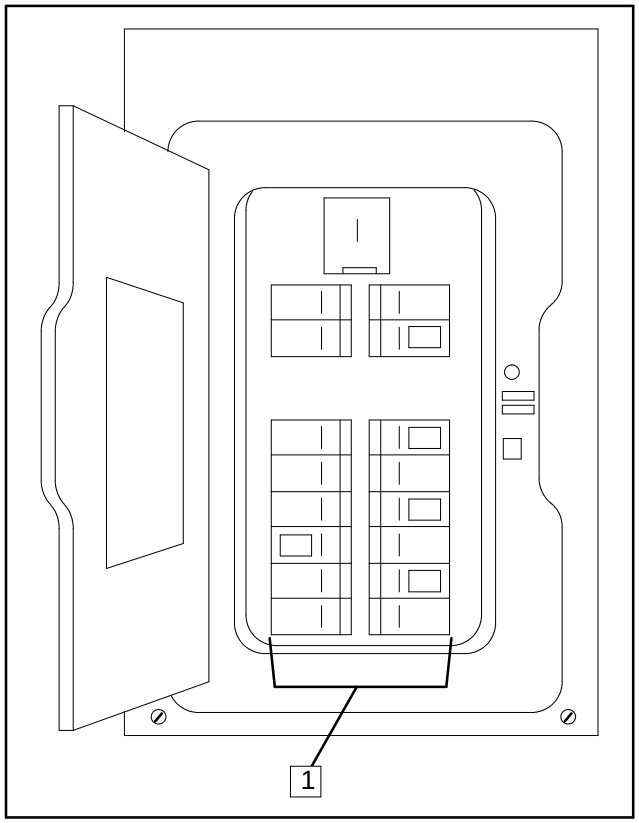
- Key-operated test switch, momentary contact in test position, key removable in auto position only (HKA-06-F).
- Plant exerciser, seven-day clock with day and hour of exercise selectable, adjustable at 1-minute increments. One exercise period per week with non-load application only (HKA-23-C).
- Solid-state, automatic, adjustable, 2-amp float battery charger, 240-volt AC input (HKA-24-D).
- Solid-state, automatic, adjustable, 2-amp float battery charger, 220-volt AC input (HKA-24-G).
- Voltage surge withstand protection, externally mounted (loose accessory only) (HKA-38-A).

Using Standby Power

Managing Power Demands

When using electricity generated by the standby generator set, remember that the power is limited in comparison to the commercial-utility power normally available. Consider operating only those lights and appliances that are most needed in order to keep power or wattage demands within the generator set's capabilities. Limit the wattage demands by one or a combination of the following three methods:

4. Trip circuit breakers at the main circuit breaker panel or any subpanels, to shut off areas in the house where need for electricity is not critical (have the electrician tag each circuit breaker to describe the household circuit area protected). See Figure 1-11. It will still be necessary to calculate the wattage demand created by the lights and appliances which may be operating simultaneously. See Wattage Requirements.
5. Have the electrician install a selected-circuit breaker box to supply standby power only to critical areas. Wattage demands of lights and appliances used simultaneously must be calculated. See Wattage Requirements.



1. Tag Breakers

Figure 1-11. Main Circuit Breaker Panel

6. Use lights and appliances only when necessary. Calculate load to keep demand within the generator set's capabilities. See Wattage Requirements.

NOTE

Discuss the use of standby power with an electrician so the proper wattage limitation method will be used.

Wattage Requirements

The wattage demand that is placed on the generator set will be a total of the wattage ratings for the lights and appliances used at one time. Determine the lighting load by adding the watt ratings of the lights and lamps being used. Check the nameplate rating on appliances and motors for wattages. Figure 1-12 lists some common appliances and the typical wattage required. Always check the appliance's nameplate to be sure its wattage requirements are within the generator's rating (see generator set operation manual for specifications). If the appliance wattage is not shown, use the following formula:

Volts x Amps = Watts

(Example: 120 Volts x 3 Amps = 360 Watts)

NOTE

The preceding formula assumes a power factor of 1.0. Where power factor is not 1.0, the formula will only estimate wattage.

Use Figure 1-13 for future reference in figuring wattage demands when using emergency power. Record the lighting loads for various rooms and appliance loads. Calculate the total load demand as lights and appliances are turned on to avoid overloading the generator set.

NOTE

The appliances indicated by an asterisk (*) in Figure 1-13 will turn on automatically. Operate only as needed (unplug if necessary to ensure nonoperation), or turn off enough other lights and appliances to allow those indicated to turn on automatically. Remember that electric motors require several times more wattage at startup than during normal running. Central air conditioning should normally be turned OFF unless generator was sized to accommodate this load.

Appliance	Motor Starting Watts	Running Watts
Entertainment		
Phonograph	–	30-50
Radio	–	50-100
Tape Deck	–	150
Television	–	300-750
VCR	–	50
Garden/Yard Tools		
Edger	1500	1100
Hedge Trimmer	600	330
Power Snow Shovel 12 in.	1500	800
Pruning Saw	900	480
Saw, Chain 14 in.	3000	1200
Weed Trimmer	600-900	300-450
Construction Tools		
Air Compressor (Small)	1500	725
Air Compressor (3/4 hp)	4000 +	2000
Drill, 1/4 in.	500	250
Drill, 3/8 in.	600	350
Drill, 1/2 in.	800	600
Grinder 1/2 hp	1500	1200
Hammer, Demolition	2000	1800
Hammer, HD Rotary	1500	1200
Paint Sprayer (Airless)	400	240
Polisher, Orbit	500	360
Power Paint Roller	120	90
Power Plane	600	450
Router	900	700
Saw, Circular, 6 1/2 in.	2200	1000
Saw, Circular, 7 1/4 in.	2500	1200
Saw, Table 10 in.	4000	1500
Saw, Sabre (Worm Drive)	2500	1200
Sander, Belt	1500	600
Sander, Finishing	900	360
Screwdriver, Power	1000	530
Shear, 12 Gauge	1800	720
Soldering Gun	–	250
Vacuum Cleaner, Wet/Dry	1500	1260
Wrench, Impact 1/2 in.	2000	840

Appliance	Motor Starting Watts	Running Watts
Kitchen Appliances		
Blender	800	600
Broiler	–	1350
Electric Range (per element)	–	1000-1500
Freezer, Food	600-1500	300-600
Microwave Oven (Small)	–	750
Mixer	400	235
Pan, Frying	–	1200
Popcorn Maker	–	1500
Percolator, Coffee	–	650
Refrigerator/Freezer (typical)	1200	600
Slow Cooker	–	300
Toaster	–	750-1200
Household Appliances/ Equipment		
Air Conditioner (7000 Btu)	2000	1200
Curling Iron	–	40
Dishwasher	2000	1200
Electric Blanket	–	50-250
Fan, Air Circulating	50-200	25-100
Fan, Furnace 1/4 hp	1000	400
Fan, Window	400	200
Hair Dryer	–	850-1200
Hair Setter	–	400
Heater, Space	–	750-1500
Heater, Water	–	1500
Light Bulb	–	(as indicated)
Sump Pump 1/3 hp (loaded)	4000 +	2000-3000
Washing Machine	950	375
Water Pump (small)	875-1500	350-500
Well Pump (loaded)	4000 +	2000-3000
Motor Requirements hp		
1/8	600	300
1/4	750	350
1/3	1000	400
1/2	1500	600
3/4	2000	750
1	3300	1100
2	4000	2000
3	5000	3000

NOTE

Motor-driven equipment generally takes 2 to 3 times the listed running amperage or wattage to start the motor. Always check the appliance or motor nameplate to be sure.

Figure 1-12. Appliance Average Wattage Ratings

ROOM/APPLIANCE				
Kitchen	**Living Room**	**Family Room**	**Bathrooms**	**Bedroom 1**
Stove/Oven	Television			
Frying Pan	Radio/Stereo			
Coffee Maker	VCR			
Toaster				
Dishwasher				
*Refrigerator				
Starting				
Running				
Microwave				

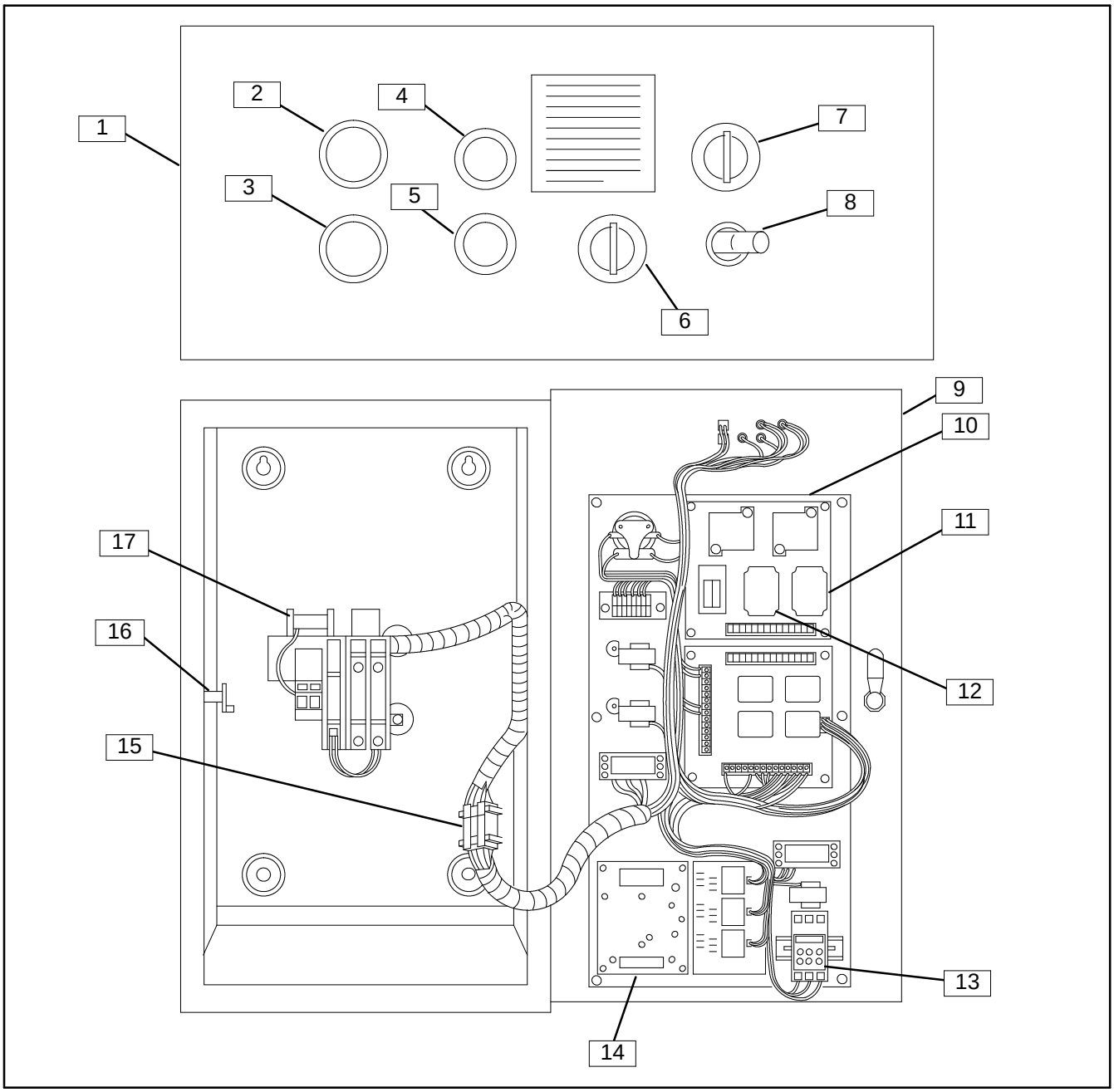
Bedroom 2	**Bedroom 3**	**Garage**	**Basement**	**Other**
			*Furnace	
			*Furnace Fan	
			Starting	
			Running	
			*Water Heater	
			*Well Pump	
			Starting	
			Running	
			*Sump Pump	
			Starting	
			Running	
			Washer	
			Starting	
			Running	
			Dryer	
			Starting	
			Running	

* Items will turn on automatically. Operate as needed.

Figure 1-13. Appliance Wattage Requirement Worksheet

Section 2. Operation

User operation of the transfer switch is not required when in the AUTO position. When in the MANUAL (nonautomatic) position, all activities require user manual operation. The following will describe operating features of the transfer switch. Accessories that do not require user operation are covered within the subject matter of other accessories where applicable. Please note that these features include *optional* accessories which may not necessarily apply to the installed transfer switch. See Figure 2-1.



1. Transfer Switch Control Panel
2. White Pilot Light
3. White Pilot Light
4. Green Pilot Light
5. Red Pilot Light
6. Momentary Test Switch (HKA-06-F)
7. Auto/Manual Switch
8. Manual NE and EN Switch
9. Enclosure With Open Door
10. Inner Control Panel
11. Time Delay Engine Start (TDES)
12. Time Delay Emergency to Normal (TDEN)
13. Plant Exerciser (HKA-23-C)
14. Battery Charger (HKA-24)
15. In-Line Disconnect Plug
16. Neutral Lug Assembly
17. Transfer Switch Contactor

Figure 2-1. Transfer Switch Features

Automatic Transfer Switch

The automatic transfer switch, as the name implies, is automatic. No normal user operation is required.

The available optional accessories do require manual operation. A description of these can be found in the Optional Accessories section.

This switch, when in the AUTO position, will monitor both sources. The normal (commercial utility) will be the primary choice. Should the normal source fail, the transfer switch will signal the generator set to start. After the time delay engine start (TDES) relay times out (3 seconds), the engine/generator will start its cranking cycle. After the generator starts and voltage/frequency requirements are met, the transfer to the emergency (generator set) source will take place.

When the normal source is restored and is within 90% of its rated voltage and frequency limits, the switch will transfer back to the normal source after the time delay emergency-to-normal (TDEN) relay times out. This time delay is adjustable from 0 to 30 minutes.

The engine/generator will continue to run until the time delay engine cooldown (part of generator set controller function) times out (two minutes), if so equipped. The engine/generator will then shut down.

The transfer switch will then return to its normal mode and monitor the normal source for the next failure or undervoltage condition.

Nonautomatic Transfer Switch

This transfer switch has two functional modes– automatic and manual. When in the automatic mode, no user operation is required. When the Auto/Manual switch is placed in the MANUAL position, user operation *is* required.

Auto/Manual Switch And Manual NE And EN Switch

AUTOMATIC POSITION (MANUAL NE AND EN SWITCH IS NOT USED)

When the Auto/Manual switch is in the AUTO position, the transfer switch will monitor both sources. The normal (commercial utility) source will be the primary choice. Should the normal source fail, the transfer switch will signal the generator set to start. After time delay engine start (TDES) relay times out (3 seconds), the engine/generator will start the cranking cycle. After the generator set starts and its voltage/frequency requirements are met, the transfer to the emergency (generator set) source will take place.

When the normal source is restored and is within acceptable voltage limits, the transfer switch will transfer back to the normal source after the time delay emergency-to-normal (TDEN) relay times out. This time delay is adjustable from 0 to 30 minutes.

The engine/generator will continue to run until the time delay engine cooldown (part of generator set controller function) times out (two minutes), if so equipped. The engine/generator will then shut down.

The transfer switch will then return to its normal mode and monitor the normal source for the next normal source failure or undervoltage condition.

MANUAL (NONAUTOMATIC) POSITION (REQUIRES MANUAL NE AND EN SWITCH)

This switch, in the MANUAL position, bypasses the automatic function. A toggle switch (normal to emergency [NE] or emergency to normal [EN]) initiates transfer in either direction. This switch has a center OFF position. The transfer switch has no primary choice in the manual mode. Should the normal source fail, the emergency source (generator set) must be started manually at the generator set. See the generator set operation manual for starting procedure.

In the manual position, the engine start circuit is open. This stops the generator set from running if the generator set controller switch is in the AUTO position. The generator set *must* be started manually.

When the voltage/frequency requirements are met, transfer to emergency can be initiated by actuating the manual (NE) toggle switch. The power source will continue to be the emergency source until the manual (EN) toggle switch is actuated. The normal source must be available for transfer to take place.

NOTE

There is no override to normal in the manual mode. In other words, should the emergency source fail while the transfer switch is in the emergency position, the transfer switch will NOT transfer back to the normal source when it becomes available.

After transfer to the normal source is made using the manual (EN) toggle switch, the generator set must be manually shut down at the generator set. Should the normal source fail again, the entire manual transfer procedure would need to be repeated.

Pilot Lights

GREEN PILOT LIGHT

This light indicates that the transfer switch contactor mechanism is in the normal (commercial utility) power source position. This light is especially useful to operators when transfer switch is in the MANUAL position. It is also useful in readily determining transfer switch position.

RED PILOT LIGHT

This light indicates that the transfer switch contactor mechanism is in the emergency (generator set) power source position. This light is especially useful to operators when transfer switch is in the MANUAL position.

WHITE PILOT LIGHTS

One white light indicates that the normal (commercial utility) power source is available. This light is especially useful to operators when transfer switch is in the MANUAL position. It is also useful in readily determining normal source availability.

NOTE

If the optional test switch is activated, normal source failure is simulated. The white normal source light will turn *off*, although the normal source is *actually* available.

The other white light indicates that the emergency (generator set) power source is available. This light is especially useful to operators when transfer switch is in the MANUAL position.

Optional Accessories

Momentary Test Switch (HKA-06-F)

The test switch (spring loaded to auto) will interrupt the normal source as long as the switch is in the TEST position. The normal source failure sequence will take place when the transfer switch is in the AUTO mode. If the transfer switch is in the MANUAL position, generator set starting and transfer must be done manually. This switch is used to test the transfer switch for proper operation.

By placing and holding the keyed switch in the TEST position, normal source failure is simulated. The white normal source light (if installed) will turn *off*, although the normal source is *actually* available. See Pilot Lights for more information regarding lights.

The transfer switch will react as if the normal source has failed with the transfer switch in the AUTO position during this test. After time delay engine start (TDES) relay times out (3 seconds), the engine/generator will start the cranking cycle. After the generator set starts and voltage/frequency parameters are met, the transfer to the emergency (generator set) source will take place. The emergency source will remain in use as long as the test switch is held in the TEST position.

Releasing the test switch will reestablish normal source availability.

When the normal source is restored and is within acceptable voltage parameters, the transfer switch will transfer back to the normal source after the time delay emergency-to-normal (TDEN) relay times out. This time delay is adjustable from 0 to 30 minutes.

The engine/generator will continue to run until the time delay engine cooldown (part of generator set controller function) times out (two minutes), if so equipped. The engine/generator will then shut down.

The transfer switch will then return to its AUTO mode and monitor the normal source for the next normal source failure or undervoltage condition.

Plant Exerciser (HKA-23-C)

The plant exerciser is used for the automatic, periodic, unloaded exercising of the generator set. During the exercise period, the engine will start and run. The generator set should be exercised under load once a week for a minimum of 30 minutes. At the end of this period, the engine will shut down after the time delay engine cooldown (part of generator set controller function) has timed out, if equipped. The contactor will NOT transfer during the exercise period unless the normal source fails.

NOTE

The starting circuit is disabled whenever the Auto/Manual switch is in the MANUAL position.

See Section 4– Optional Accessories for information regarding the cycle adjustment of plant exerciser.

Battery Charger (HKA-24)

The battery charger is a solid-state, float type designed to keep lead-acid batteries fully charged. The output is switchable 12/24 volts. The switch is factory-set at 12 volts. The battery charger is located on the inner control panel inside the enclosure.

Recently, this switchable 12/24-volts unit has been replaced by a 12- OR 24-volt battery charger. This charger was factory installed on R33 transfer switch models starting in 1993. These chargers may be ordered either from the factory or the nearest sales dealer/distributor. Refer to the battery charger portion of Section 3– Operation and Installation of Optional Accessories for part numbers when ordering.

Voltage Surge Withstand Protection (HKA-38-A)

This accessory is usually installed at the service entrance or a location near the utility power entrance in the building. No user operation is required, but inspect annually and after a lightning storm. If the electrical circuit was subject to a voltage surge, failure will be indicated by darkening and/or distortion of the case end. Replace this device if any evidence of damage is noted.

Section 3. Operation and Installation of Optional Accessories

Optional accessories are either factory installed or field installed. Most factory-installed accessories are also offered as field-installed kits. Optional accessories ordered with the switch from the factory are normally installed and wired at the factory. The electrician needs only to verify that the optional accessory was installed. Optional accessories can be installed at the time of transfer switch installation or at a later date. Where applicable, adjustment procedures are included.

NOTE

Use instructions supplied with field-installed kit(s) for the most *current* information on installation and operation.

⚠ DANGER

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.

Momentary Test Switch (HKA-06-F)

Test switch will interrupt the normal source to the NR and NR1 relays as long as the switch is in the TEST position. The normal source failure sequence will then take place. See Figure 3-1.

The test switch is key operated and uses a momentary contact to interrupt the normal sensing voltage. This interruption simulates a normal power failure and causes the engine/generator to start after the time delay engine start (TDES) relay times out. See Section 1– Specifications for time delay period.

The contactor will transfer to the emergency source and remain there until the switch is released and moved to the AUTO position.

The contactor will transfer back to normal after the TDEN (time delay emergency to normal) relay times out. See Section 1– Specifications for time delay period.

The generator/engine will stop after the time delay engine cooldown (part of generator set controller function) has elapsed (two minutes), if equipped.

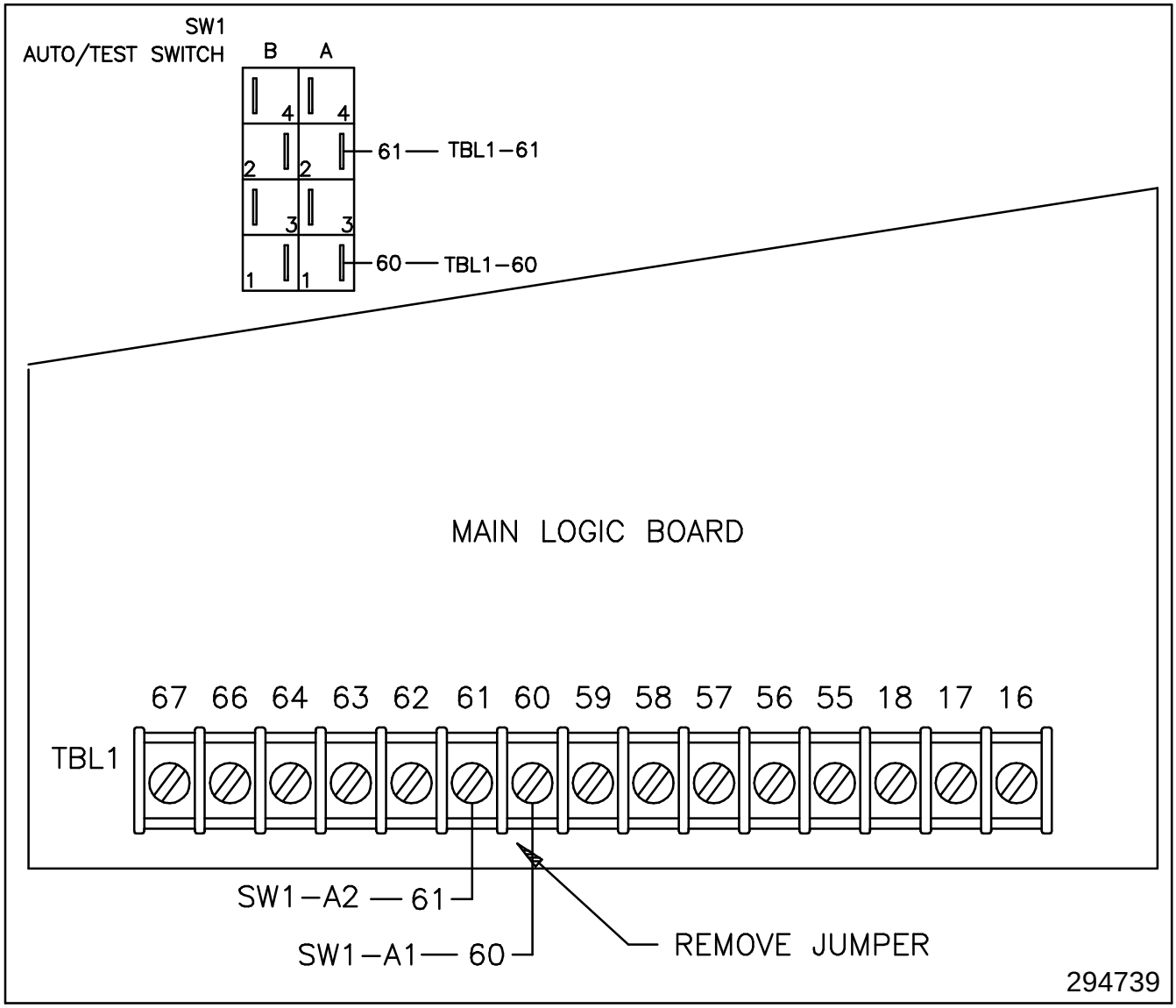
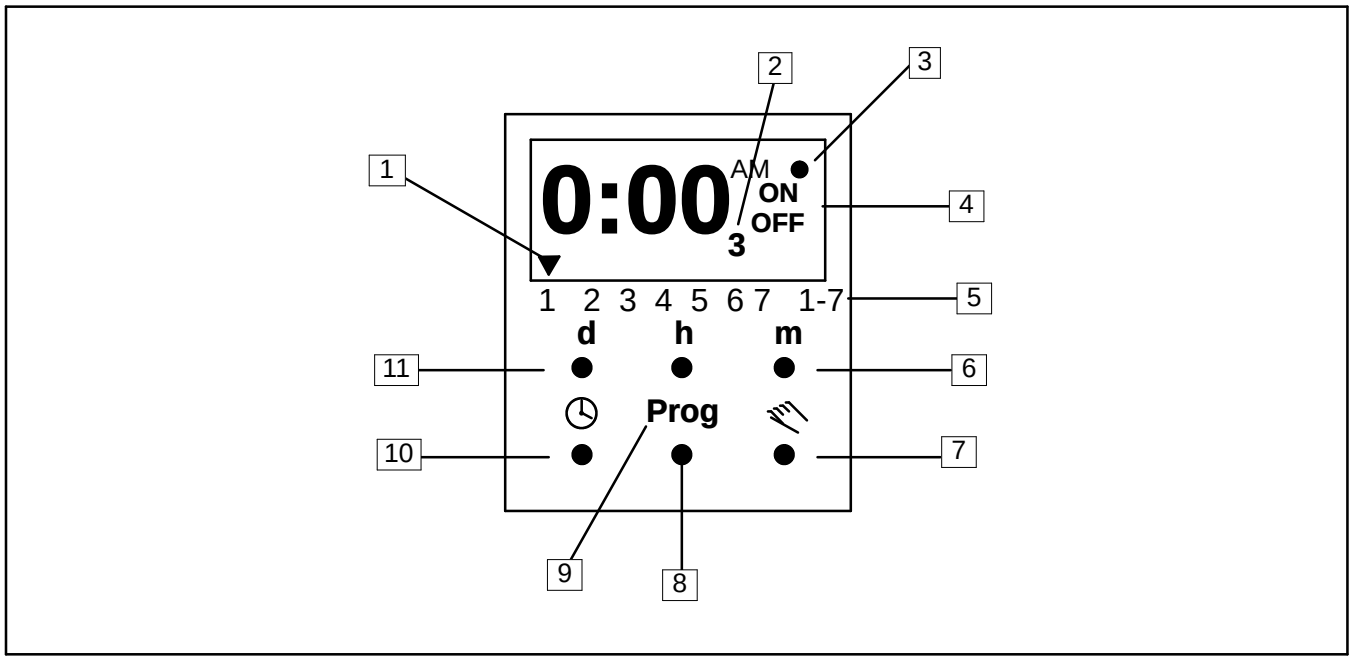


Figure 3-1. Momentary Test Switch Connections

24-Hour, 7-DAY Plant Exerciser (HKA-23-C)



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 3-2. Plant Exerciser Features

Adjustment

See Figure 3-2 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 **d**, , **m** and buttons.

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, refer to Entering Daily Time Periods, following.

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 faster time change. When nearing the desired time, release the button to use the slow sequence so the desired time is not passed.

NOTE

Some earlier models may use a 24-hour clock. Use military time when setting.

4. After the time and day setting procedure is complete, release the button.

Daylight Savings Time Adjustment

If this semi-annual time change applies in the 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) is 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 exercising be done when observation by a responsible person is possible.

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. 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. Up to six time periods (6 start and 6 stop times) can be set in this mode.

To use the daily-program mode, do not set a current day of the week. Rather, 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, preceding.

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 a.m. 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/ generator power source when voltage/frequency conditions are met. When utility/normal power is restored, the transfer switch will return to the utility/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.

The plant exerciser incorporates a *non-serviceable*, nickel-cadmium battery, which is automatically recharged when connected to a power supply.

12- or 24-Volt Battery Charger (HKA-24-64A) (HKA-24-64B) (HKA-24-63A) (HKA-24-63B)

The battery chargers are designed for various AC voltage, 50- or 60-Hz input, and capable of charging as follows:

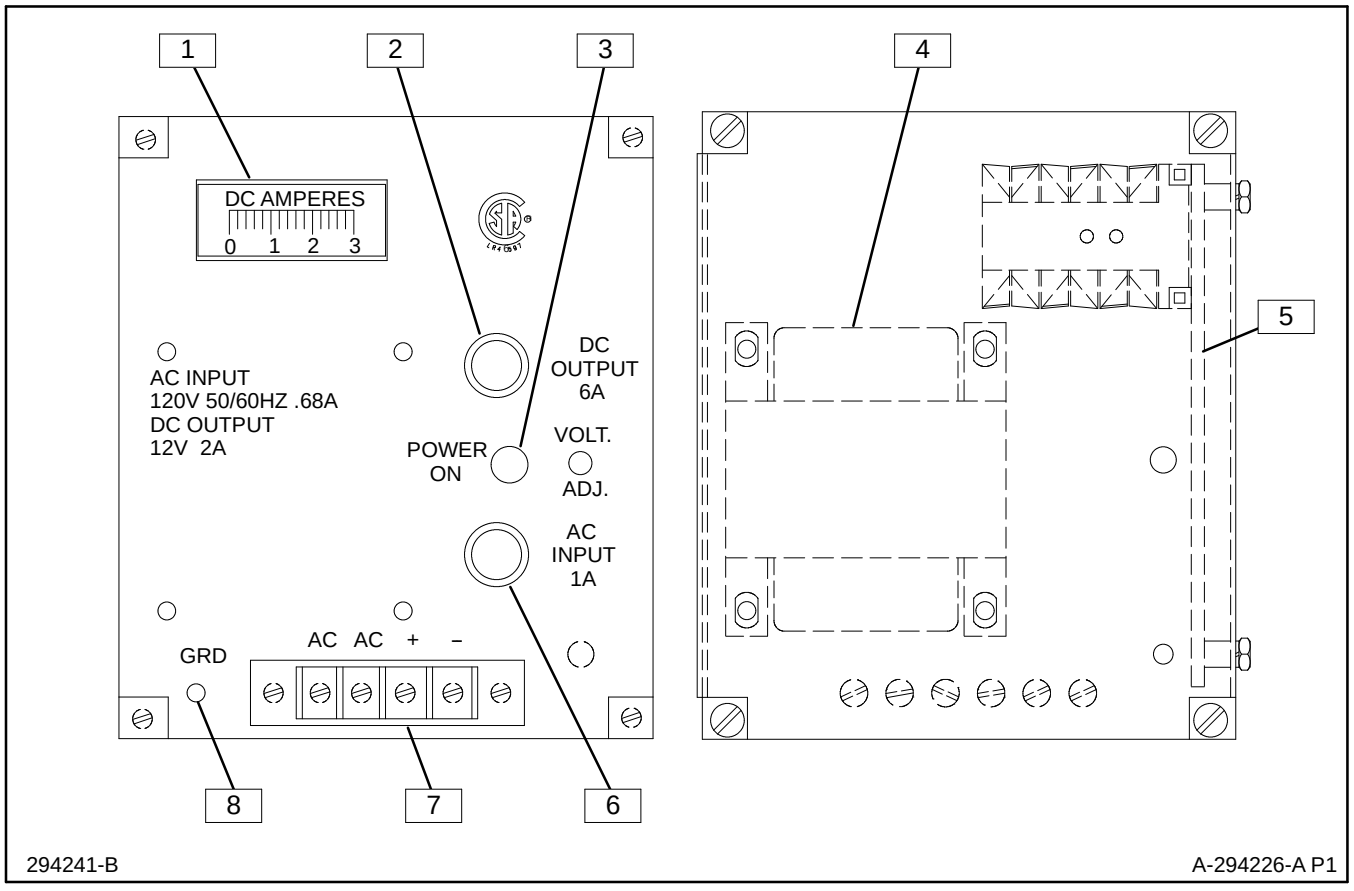
12-Volt Charger Lead-Acid Battery (6-cell)

24-Volt Charger Lead-Acid Battery (12-cell)

Determine input voltage and type of battery(ies) to be charged. Make any necessary modifications before using charger.

Specifications

The automatic battery charger is designed to charge and maintain lead-acid automotive-type batteries in a fully charged state without any manual intervention. The charger output provided by the power transformer is controlled by the circuit board. The control board provides the charger with current-limiting, AC line compensation, reverse-polarity protection, ambient-temperature compensation, and constant voltage charging mode. The control circuit board continuously monitors the battery and load conditions to maintain the battery's proper state of charge. Refer to Figure 3-3 for component identification. The chargers are factory adjusted to maintain the battery at the proper float voltages. The 12-volt charger will maintain a lead-acid (6-cell) battery with no adjustment required. The 24-volt charger will maintain a lead-acid (12-cell) battery with no adjustment required.



1. DC Ammeter
2. DC Output Fuse
3. "Power On" Lamp
4. Transformer
5. Main Circuit Board Assembly
6. AC Input Fuse
7. Terminal Block
8. Ground Terminal

Figure 3-3. Battery Charger Components

Accessory Descriptions	Input Voltage	
	240 Volt 50/60 Hz	220 Volt 50/60 Hz
12 Volt Transfer Switch Accessory No. (Factory Installed)	HKA-24-64A	HKA-24-63A
12 Volt Battery Charger Kit No. (Loose Accessory)	PA-320767	PA-320765
24 Volt Transfer Switch Accessory No. (Factory Installed)	HKA-24-64B	HKA-24-63B
24 Volt Battery Charger Kit No. (Loose Accessory)	PA-320768	PA-320766

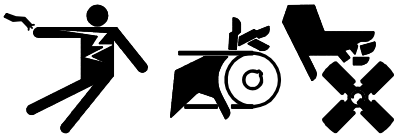
Figure 3-4. Automatic Transfer Switch Battery Charger Kit Selection Table

Descriptions	Input Voltage	
	240 Volt 50/60 Hz	220 Volt 50/60 Hz
Primary Circuit Protection	0.5 Amp 12 Volt/1 Amp 24 Volt	0.5 Amp 12 Volt/1 Amp 24 Volt
Secondary Circuit Protection	6 Amp Slo-Blo	
Output Level Preset at Factory	12 Volt Charger– 13.2 Volt, 2 Amp Current Limiting 24 Volt Charger– 26.4 Volt, 2 Amp Current Limiting	

Figure 3-5. Automatic Transfer Switch Battery Charger Specification Table

⚠ CAUTION

Hazardous voltage can cause severe injury or death. De-energize both normal and emergency power sources before proceeding. Move generator master switch on controller to OFF position and disconnect battery negative (–) before working on transfer switch! Turn the transfer switch selector switch to the OFF position.



⚠ WARNING

Accidental starting.
Can cause severe injury or death.
Disconnect battery cables before working on generator set (negative lead first and reconnect it last).

Accidental starting can cause severe injury or death. Turn generator master switch to OFF position, disconnect power to battery charger, and remove battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator. The generator set can be started by automatic transfer switch or remote start/stop switch unless these precautions are followed.

⚠ WARNING

Explosion.
Can cause severe injury or death. Relays in battery charger cause arcs or sparks.

Locate in a well ventilated area. Keep explosive fumes away.

Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flame or spark to occur near a battery at any time, particularly when it is being charged. Avoid contacting terminals with tools, etc. to prevent burns and to prevent sparks that could cause an explosion. Remove wristwatch, rings, and any other jewelry before handling battery. Never connect negative (–) battery cable to positive (+) connection terminal of starter solenoid. Do not test battery condition by shorting terminals together or sparks could ignite battery gases or fuel vapors. Any compartment containing batteries must be well ventilated to prevent accumulation of explosive gases. To avoid sparks, do not disturb battery charger connections while battery is being charged and always turn charger off before disconnecting battery connections. When disconnecting battery, remove negative lead first and reconnect it last.

⚠ WARNING

Sulfuric acid in batteries.
Can cause severe injury or death.

Use protective goggles and clothes. Can cause permanent damage to eyes, burn skin, and eat holes in clothing.

Sulfuric acid in batteries can cause severe injury or death. Sulfuric acid in battery can cause permanent damage to eyes, burn skin, and eat holes in clothing. Always wear splash-proof safety goggles when working around the battery. If battery electrolyte is splashed in the eyes or on skin, immediately flush the affected area for 15 minutes with large quantities of clean water. In the case of eye contact, seek immediate medical aid. Never add acid to a battery once the battery has been placed in service. Doing so may result in hazardous spattering of electrolyte.

NOTE

These chargers are designed strictly for use in Kohler transfer switches and conform with UL and CSA listing requirements where specified. Do not attempt to use battery charger before reading instructions.

Mount Charger

1. Move generator master switch to OFF position. Disconnect battery cables, negative lead first. Open circuit breaker of AC power source to be applied.
2. Turn automatic transfer switch selector to OFF position.
3. Open automatic transfer switch enclosure.
4. Install four captive nuts (298811) in the transfer switch inner panel and install battery charger (see Figure 3-6).
5. The battery charger rating is factory set to maintain the proper output for the battery, for which it is rated. No customer adjustments are required.

Output Connections

NOTE

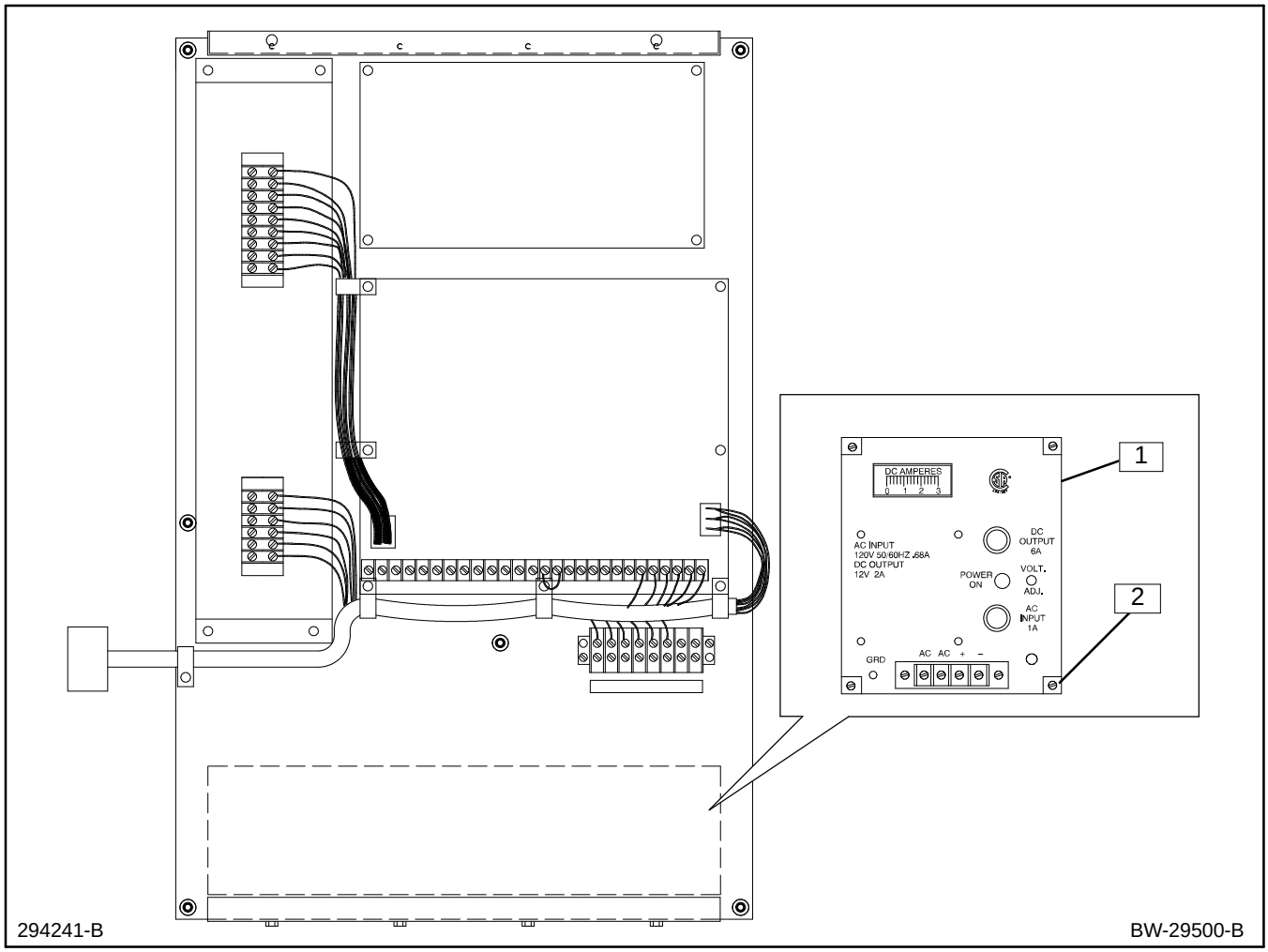
For DC connections use stranded copper wire, 600 V, 105 _C vinyl plastic insulation UL style 1015, CSA type TEW.

1. Because of the variety of generator installations, battery cables are not provided. To make battery connections, cut red (+) 10-gauge stranded wire to proper length and strip insulation from both ends. To one end of wire attach a post-type connector. Route other end of battery cable and connect to output positive (+) terminal on charger DC terminal block. See Figure 3-6. Tighten terminal block lock screw to secure battery cable. Repeat procedure with black (−) 10-gauge stranded wire; connect black wire to output negative (−) terminal on DC terminal block and secure with lock screw.
2. Connect red charger lead(s) to battery positive (+) terminal and black charger lead(s) to battery negative (−) terminal.

Grounding Instructions– Connect the battery charger to a grounded, metal, permanent wiring system or an equipment-grounding conductor with circuit conductors and connect it to an equipment-grounding terminal or lead on battery charger. Connections to battery charger should comply with all local codes and ordinances.

Input Connections

1. Connect the correct voltage, 50/60 Hz, AC power source as indicated by nameplate or transfer switch wiring diagram.
2. Turn AC power on. Power ON lamp will light and ammeter will show charging current.



1. Battery Charger Assembly (see parts lists)
2. Captive Nuts (298811) (Qty. 4)

Figure 3-6. Battery Charger Installation–Solid-State Transfer Switch

To Disconnect Charger (When Replacing or Servicing Battery)

1. Move generator master switch to OFF position.
2. Remove AC power supply from battery charger.
3. Remove charger connectors from battery, negative lead first.

Battery Charger Operation

Charging Lead-Acid Batteries

Charge 6- or 12-cell lead-acid batteries according to the following procedure.

1. Inspect battery for defective cables, loose posts, and loose terminals. Battery terminals and battery charger clips must be tight and cleaned of all corrosion for efficient charging.

2. Check the fluid level in each cell. If fluid level is low, add distilled water until fluid is at proper level. (No maintenance is required for sealed batteries.) When using a dry-charge battery, the battery must be given a conditioning charge immediately after the electrolyte fluid has been added. An automatic charger will not operate properly on this type of battery unless it has been given a conditioning charge. Follow the battery manufacturer's recommendations for length of charge.

3. The charge rate the charger is delivering to the battery is indicated on the ammeter. The charger control circuit limits the maximum charging current to 2 amps. No cranking disconnect is required due to the current-limit protection feature. A battery is almost fully charged when one of the following occurs:

   - **Charging rate will taper to zero.** This occurs as a battery becomes charged and the battery voltage approaches the control voltage setting. The ammeter needle may fluctuate, indicating a continuous supply of pulsating current that automatically keeps the battery in a charged condition.
   - **Specific gravity reading (using a hydrometer) should be between 1.250 and 1.285 at an electrolyte temperature of 80 _F (26.7 _C).** This hydrometer reading indicates a battery that is in good condition.
   - **Bubbles appear at the surface of the battery fluid.** This indicates a battery that is 80 to 85% charged. Vigorous bubbling occurs when the battery is near full charge.

Checking Specific Gravity (Lead-Acid Batteries)

Use a battery hydrometer to check the specific gravity of the electrolyte in each battery cell. While holding the hydrometer vertically, read the number on the glass bulb at the top of the electrolyte level. The battery is fully charged if the specific gravity is 1.260 at an electrolyte temperature of 80 _F (26.7 _C). The difference between specific gravities of each cell should not exceed 0.01. The battery should be charged if the specific gravity is below 1.215 at an electrolyte temperature of 80 _F (26.7 _C). **The temperature of the battery electrolyte will affect the specific gravity reading and must be taken into consideration when checking battery specific gravity. If the hydrometer used does not have a temperature correction table, use the one shown in Figure 3-7.**

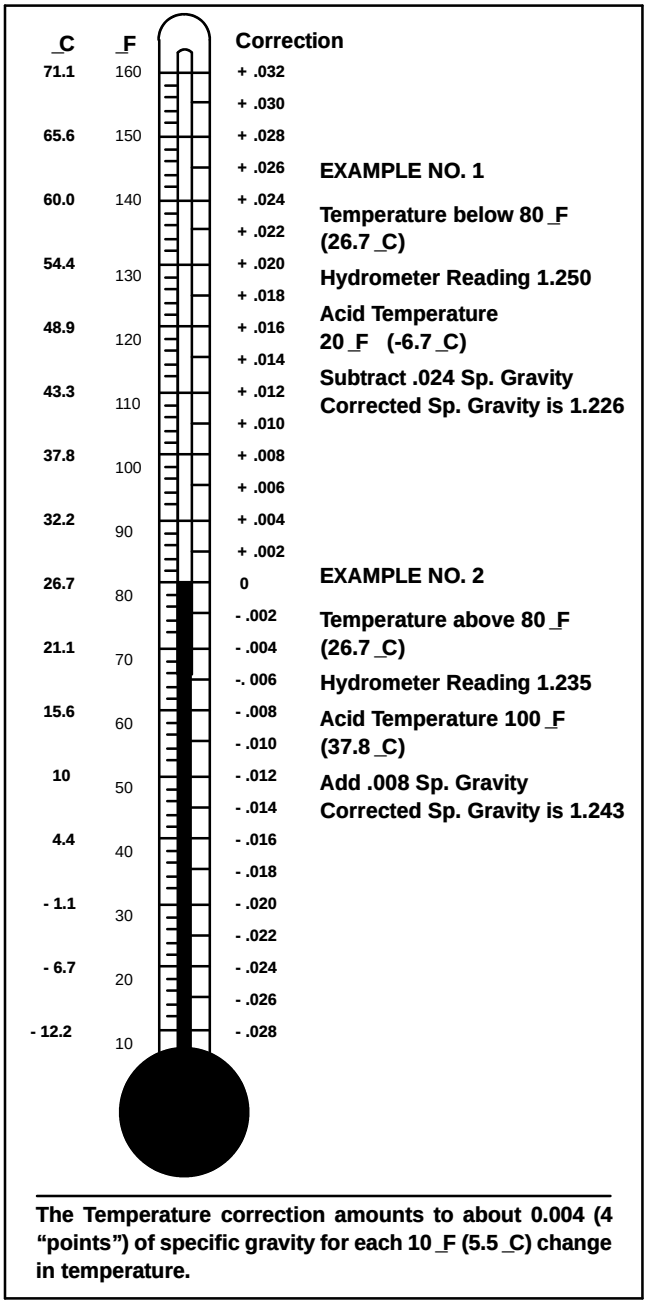


Figure 3-7. Specific Gravity Temperature Correction

Charging Nickel-Cadmium Batteries

Since charging recommendations vary between manufacturers of nickel-cadmium batteries, specific nickel-cadmium battery charging instructions are not provided in this manual. Contact the manufacturer of the nickel-cadmium battery for specific charging and maintenance instructions. If the voltage setting recommended by the battery manufacturer is different from the battery charger's factory setting, call Kohler for the procedure for properly adjusting the battery charger.

Charger Voltage Adjustment

The battery charger's output settings are factory set and normally require no customer adjustment. If adjustment is required, contact an authorized dealer/distributor for service or service literature. The factory settings are listed below.

Charger Voltage	Float Voltage	Current Limit (Amps)
12	13.2	2
24	26.4	2

Figure 3-8. Factory Output Settings

Charger and Battery Maintenance

NOTE

Warranty repairs must be made through an authorized dealer/distributor.

1. Check battery terminals and charger connectors for clean contact surfaces. Clean battery terminals and charger connectors as necessary with a mild baking soda/water solution. If battery charger does not work, see Troubleshooting section below.

2. Check battery fluid level regularly; maintain battery fluid at proper level.

Troubleshooting

Problem	Remedy
No Ammeter Reading	1. Check charger connections to battery for correct polarity. 2. Turn off AC supply prior to rechecking the battery charger for clean, tight connections. 3. Check for AC at the charger terminal strip. 4. Check AC input and DC output fuses. 5. Check secondary voltage at transformer: 24 volts across secondary with 12 volts to center tap. 6. With AC supply disconnected, check DC output lead connections from circuit board to DC output terminal block.
Needle Remains at 2 Amps Indefinitely	1. Battery charger not matched to battery voltage. 2. Battery may be severely discharged or have shorted cells.

Figure 3-9. Battery Charger Troubleshooting

Standard Accessories

Current Limiting

The charger is protected from overload by its current-limiting circuitry. This circuitry continuously monitors the charger output current and is set to limit the current to 2 amps from full load to short circuit. Therefore, no crank disconnect is required when the plant is exercised.

Reverse Polarity Protection

When the charger is connected to the battery, the reverse polarity protection circuit determines if the connection is of the proper polarity. If the polarity is incorrect, the charger will not turn on when AC input is connected.

Automatic Float Operation

When the charger is properly connected to the battery and AC power is applied to the charger, the charger operates in the constant-current mode until the battery voltage rises to the preset float level. At the preset float level, the charger will switch to the constant-voltage float mode. The charger will operate in constant-voltage float mode until AC input power is lost or the current required to maintain the battery at the float voltage setting exceeds 2 amps.

Temperature Compensation

The charger will provide temperature compensation of −2 mV/ _C per cell over the ambient temperature range of −40 _C (−40 _F) to +60 _C (+140 _F). This feature will automatically adjust the float voltage setting to prevent the battery from being overcharged at high ambient temperatures and undercharged at low ambient temperatures.

AC Input Fuse

When AC input is applied, the AC input fuse will open to protect the power transformer from damage due to a short circuit condition. The fuse may also open if subjected to vibration for an extended period of time. Replace the fuse to return the charger to operation. See Figure 3-4 and Figure 3-5 for fuse value.

DC Output Fuse

The DC output fuse will open and protect the power transformer from damage if the current limit setting has been disabled or set to its maximum. It will also open if the charger output leads are shorted together for an extended period of time.

Power On Lamp

The Power On lamp is connected across the power transformer's primary winding and indicates when AC power is present.

Wiring Diagrams

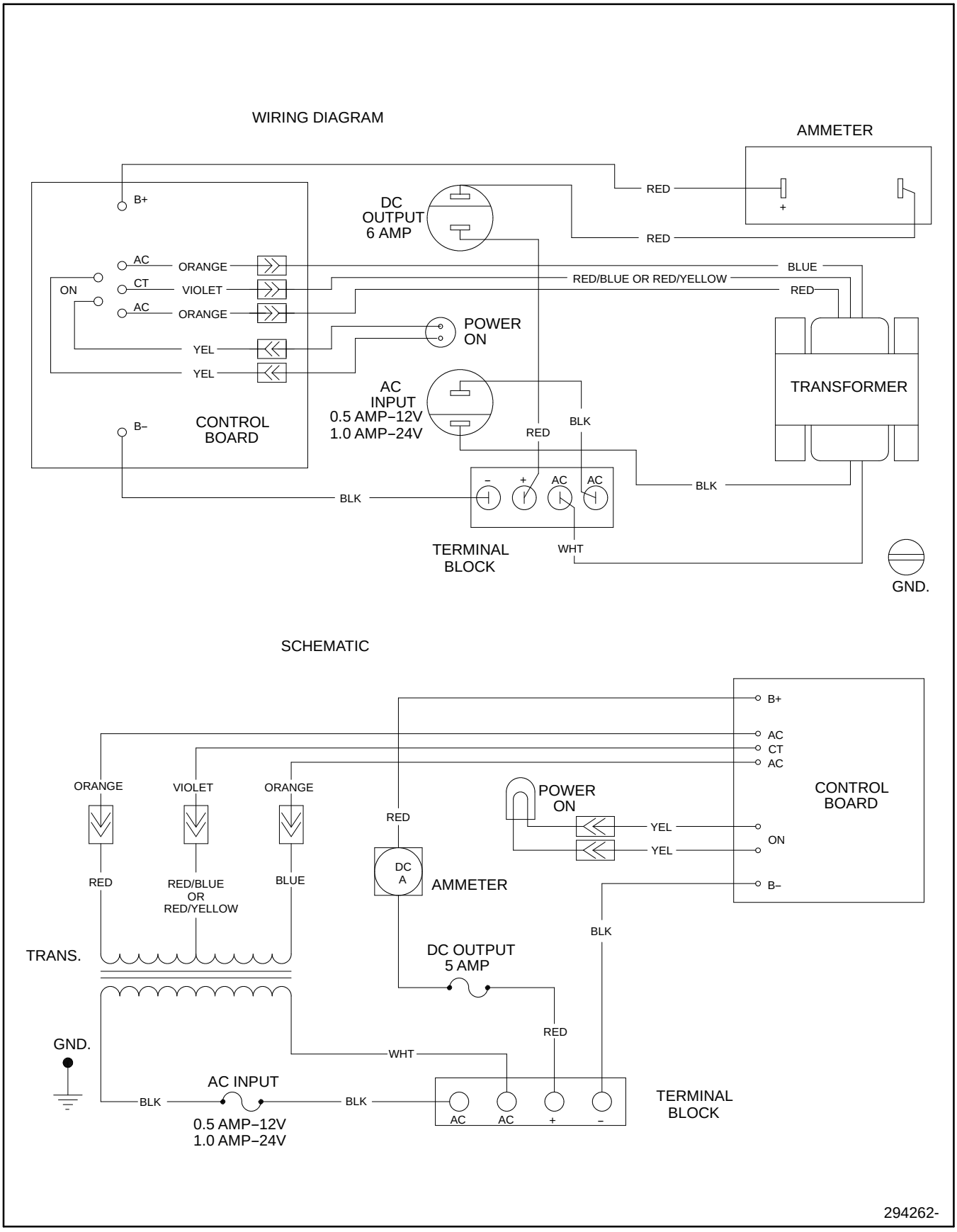


Figure 3-10. Wiring Diagram, Schematic– 220-Volt Battery Charger

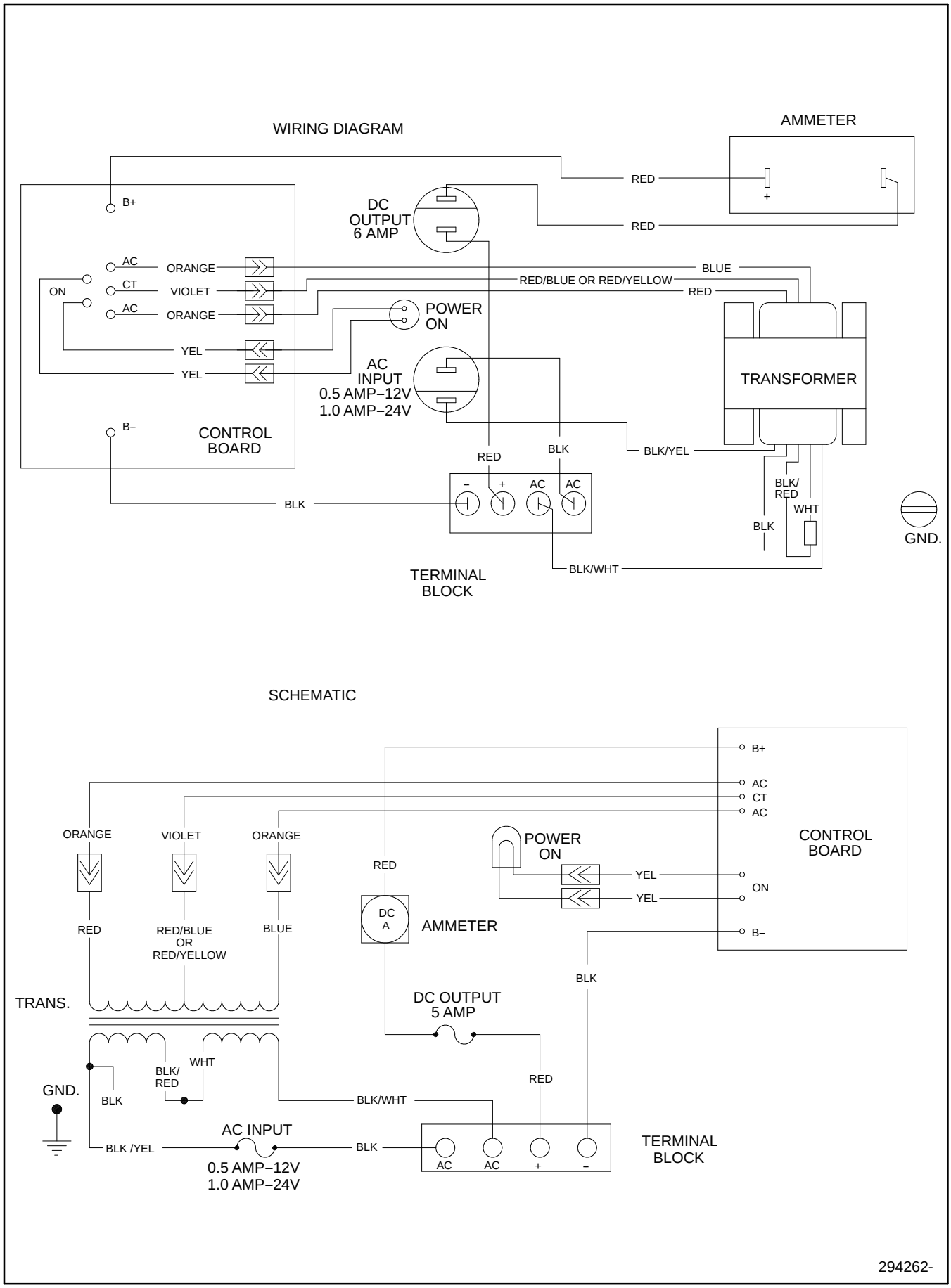


Figure 3-11. Wiring Diagram, Schematic– 240-Volt Battery Charger

Battery Charger
240 Volt AC (HKA-24-D)
220 Volt AC (HKA-24-G)

The battery charger is a solid-state, float type designed to keep lead-acid starting batteries fully charged. The power input for the charger is connected to terminals 78 and 79 through the disconnect plug and to the load terminals L1 and L2. The output is switchable 12/24 volts. The switch is factory-set for 12 volts. See Figure 3-13.

Description	Specification
Input Voltage	240 volt AC, 50/60 Hz (HKA-24-D) 220 volt AC, 50/60 hz (HKA-24-G)
Primary Circuit Protection	0.75 amp (HKA-24-D) 1.5 amp (HKA-24-G)
Output Voltage	12 or 24 volt, 2 amp rated
Secondary Circuit Protection	4 amp automatic rest circuit breaker
Maintains Voltage Level (preset at factory)	12-volt charger–13.7 volts 24-volt charger–27.4 volts
Voltage-Adjusting Rheostat	5 volt adjustment from factory preset value
Power On Lamp	Indicates primary circuit is energized

Figure 3-12. Battery Charger Specifications

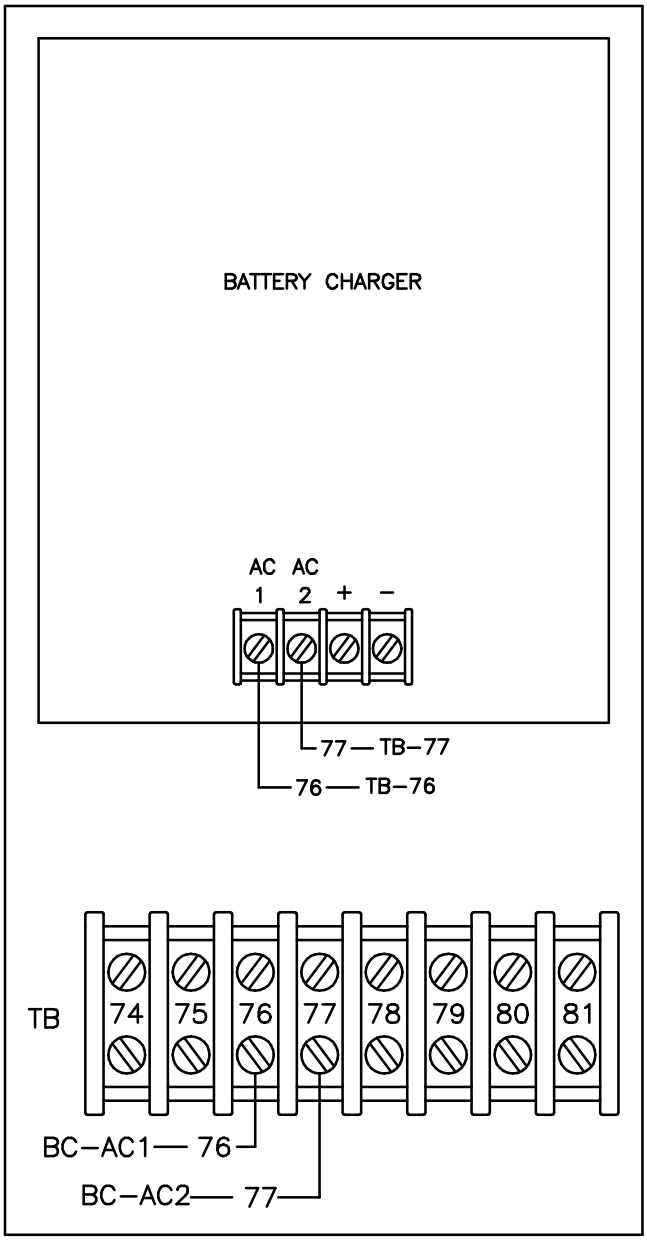
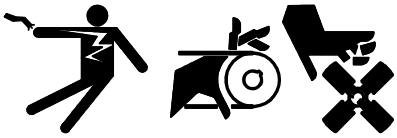


Figure 3-13. Battery Charger Connections

⚠ CAUTION

Hazardous voltage can cause severe injury or death. De-energize both normal and emergency power sources before proceeding. Move generator master switch on controller to OFF position and disconnect battery negative (–) before working on transfer switch! Turn the transfer switch selector switch to the OFF position.



⚠ WARNING

Accidental starting.
Can cause severe injury or death.
Disconnect battery cables before working on generator set (negative lead first and reconnect it last).

Accidental starting can cause severe injury or death. Turn generator master switch to OFF position, disconnect power to battery charger, and remove battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator. The generator set can be started by automatic transfer switch or remote start/stop switch unless these precautions are followed.

⚠ WARNING

Explosion.
Can cause severe injury or death. Relays in battery charger cause arcs or sparks.

Locate in a well ventilated area. Keep explosive fumes away.

Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flame or spark to occur near a battery at any time, particularly when it is being charged. Avoid contacting terminals with tools, etc. to prevent burns and to prevent sparks that could cause an explosion. Remove wristwatch, rings, and any other jewelry before handling battery. Never connect negative (–) battery cable to positive (+) connection terminal of starter solenoid. Do not test battery condition by shorting terminals together or sparks could ignite battery gases or fuel vapors. Any compartment containing batteries must be well ventilated to prevent accumulation of explosive gases. To avoid sparks, do not disturb battery charger connections while battery is being charged and always turn charger off before disconnecting battery connections. When disconnecting battery, remove negative lead first and reconnect it last.

⚠ WARNING

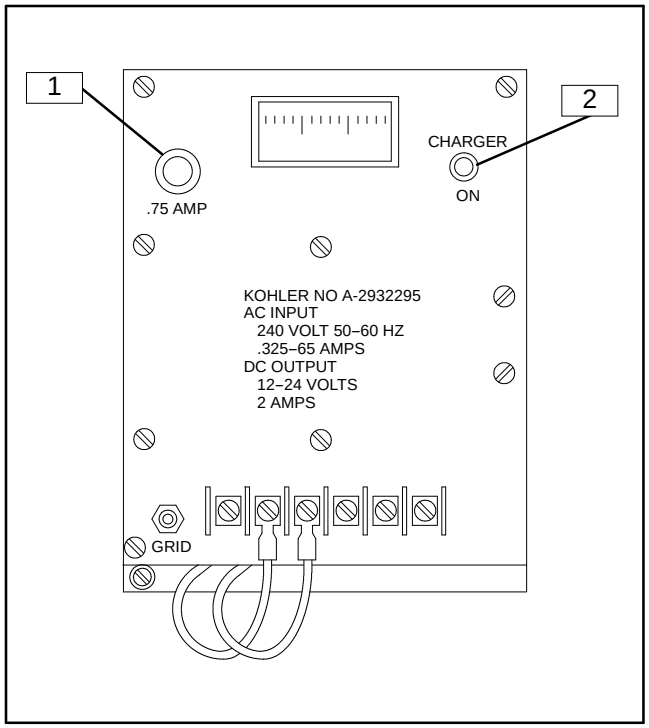
Sulfuric acid in batteries.
Can cause severe injury or death.

Use protective goggles and clothes. Can cause permanent damage to eyes, burn skin, and eat holes in clothing.

Sulfuric acid in batteries can cause severe injury or death. Sulfuric acid in battery can cause permanent damage to eyes, burn skin, and eat holes in clothing. Always wear splash-proof safety goggles when working around the battery. If battery electrolyte is splashed in the eyes or on skin, immediately flush the affected area for 15 minutes with large quantities of clean water. In the case of eye contact, seek immediate medical aid. Never add acid to a battery once the battery has been placed in service. Doing so may result in hazardous spattering of electrolyte.

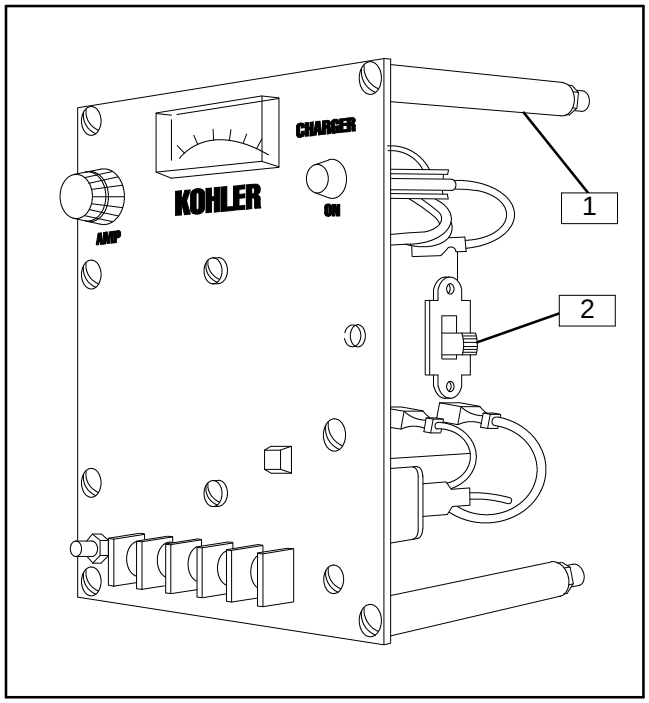
NOTE

These chargers are designed strictly for use in Kohler transfer switches and conform with UL and CSA listing requirements where specified. Do not attempt to use battery charger before reading instructions.



1. Fuse 2. Line Voltage 'ON' Light

Figure 3-14. Battery Charger



1. Fiber Spacers 2. Slide Switch

Figure 3-15. Battery Charger 12/24-Volt Switch

Information Prior To Charging Battery

BATTERY

This charger is specifically designed for charging wet cell (lead-acid) batteries. Do not use on any other batteries.

Dry-charge batteries must be given a conditioning charge right after the electrolyte fluid has been added. An automatic charger will not operate properly on this type of battery unless it has been given a conditioning charge. Follow the battery manufacturer's recommendations for length of charge.

CYCLING

The charger is equipped with an automatic-reset thermal circuit breaker to protect from overloads. In the event of an overload, the circuit breaker will automatically reset (this process is referred to as cycling and can be recognized by an audible clicking sound). During the generator cranking cycle this circuit breaker may operate.

A severely discharged battery can cause the circuit breaker to cycle repeatedly. If the battery is otherwise in good condition, the cycling can continue until the battery has recovered sufficiently to allow a normal charging rate.

NOTE

A battery with a shorted cell(s) can cause the circuit breaker to cycle indefinitely. The battery will have to be replaced. Regardless of cause, the circuit breaker must not cycle indefinitely. Battery charger should not be left unattended under these conditions.

To Connect/Disconnect Charger

NOTE

Charging unsuitable batteries can damage charger. Connect battery charger only to battery with the same DC voltage to prevent damage to charger circuitry.

1. Inspect battery for defective cables, loose posts or terminals. Battery terminals and battery charger clips must be tight and cleaned of all corrosion for efficient battery charging.
2. Check fluid level in each cell; if low, add distilled water until fluid is at proper level. If using a sealed battery, no maintenance is required.
3. A battery may be charged without disconnecting it from the generator set or disturbing the cable

connectors at the battery posts by making the connections as listed.

a. Connect positive (+) charger terminals to battery positive (+) post and negative (–) charger terminals to battery negative (–).

b. Connect to correct voltage, 50/60 Hz, AC power source as indicated by nameplate or transfer switch wiring diagram.

4. The charge rate the charger is delivering to the battery is indicated on the ammeter. The initial charging rate may be higher or lower than the charger capacity, depending on the internal condition of the battery; a supply higher or lower than 240 volt AC (HKA-24-D) or 220 volt AC (HKA-24-G) will cause a corresponding higher or lower charging rate. The two-amp, charge maximum may be exceeded because of battery condition or during cranking period.

   A battery is almost fully charged when one of the following occurs:

   a. **Charging rate will taper to zero.** This occurs as a battery becomes charged and the battery voltage approaches the control voltage setting. The ammeter needle may fluctuate, indicating a continuous supply of pulsating current that automatically keeps the battery in a charged condition.

   b. **Specific gravity reading (using a hydrometer) should be between 1.250 and 1.285 at an electrolyte temperature of 80 _F (26.7 _C).** This hydrometer reading indicates a battery that is in good condition.

   c. **Bubbles appear at the surface of the battery fluid.** This indicates a battery that is 80 to 85% charged. Vigorous bubbling occurs when the battery is near full charge.

5. To disconnect charger: first disconnect charger from AC power; then disconnect charger from the battery posts, negative (–) lead first.

Voltage Control

Unlike new batteries, older batteries can and usually do exhibit various degrees of sulphation. The degree of sulphation increases with the age of the battery. The effect of this sulphation is to cause a decrease in the battery voltage.

For this reason it is necessary to check the voltage of the battery and, if necessary, adjust the charger to meet the requirements of the battery at least once every six months or whenever the battery is replaced.

The voltage control of the charger was set at the factory to properly maintain a voltage of 13.7 volts for 12-volt batteries and 27.4 volts for 24-volt batteries.

When the battery reaches the cutoff voltage, the ammeter will oscillate. The amount of oscillation will vary on the condition of the battery. Oscillation is normal and should not be misunderstood as a problem. The best way to check the battery is to take a hydrometer reading, if possible, and a voltage reading. A good quality voltmeter should be used, preferably with a least 20,000 ohms per volt sensitivity. The charger is equipped with a voltage control that will allow a slight voltage variation from the preset reading. If adjustment are necessary, disconnect the AC power and adjust voltage control slightly (clockwise to increase and counterclockwise to decrease).

Service

1. Check and maintain battery fluid at proper level.

2. Check battery terminals and cable connectors for clean contact surfaces.

Troubleshooting

Problem	Remedy
No Meter reading	D Open AC power circuit and recheck the battery charger clips for clean, tight connections. D Check charger connections to battery for correct polarity. D Check for voltage at AC outlet (terminal strip). D Check fuse.
Ammeter pointer moves to extreme right, remains for a short time, returns to zero with a clicking sound.	D 12- or 24-volt slide switch is not on proper setting to match battery voltage. D A severely discharged battery may go into cycling process (see Cycling).

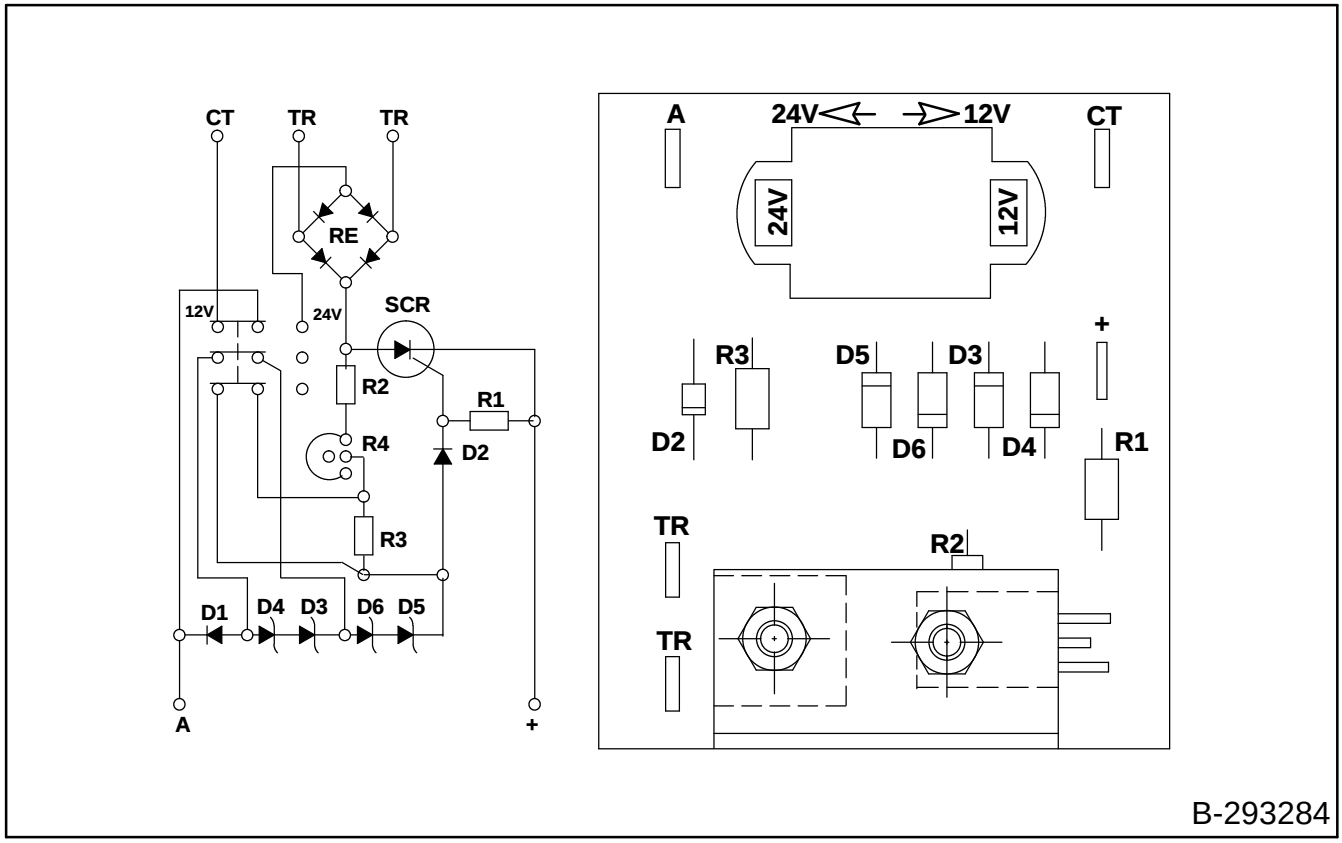


Figure 3-16. Battery Charger Board Wiring Diagram

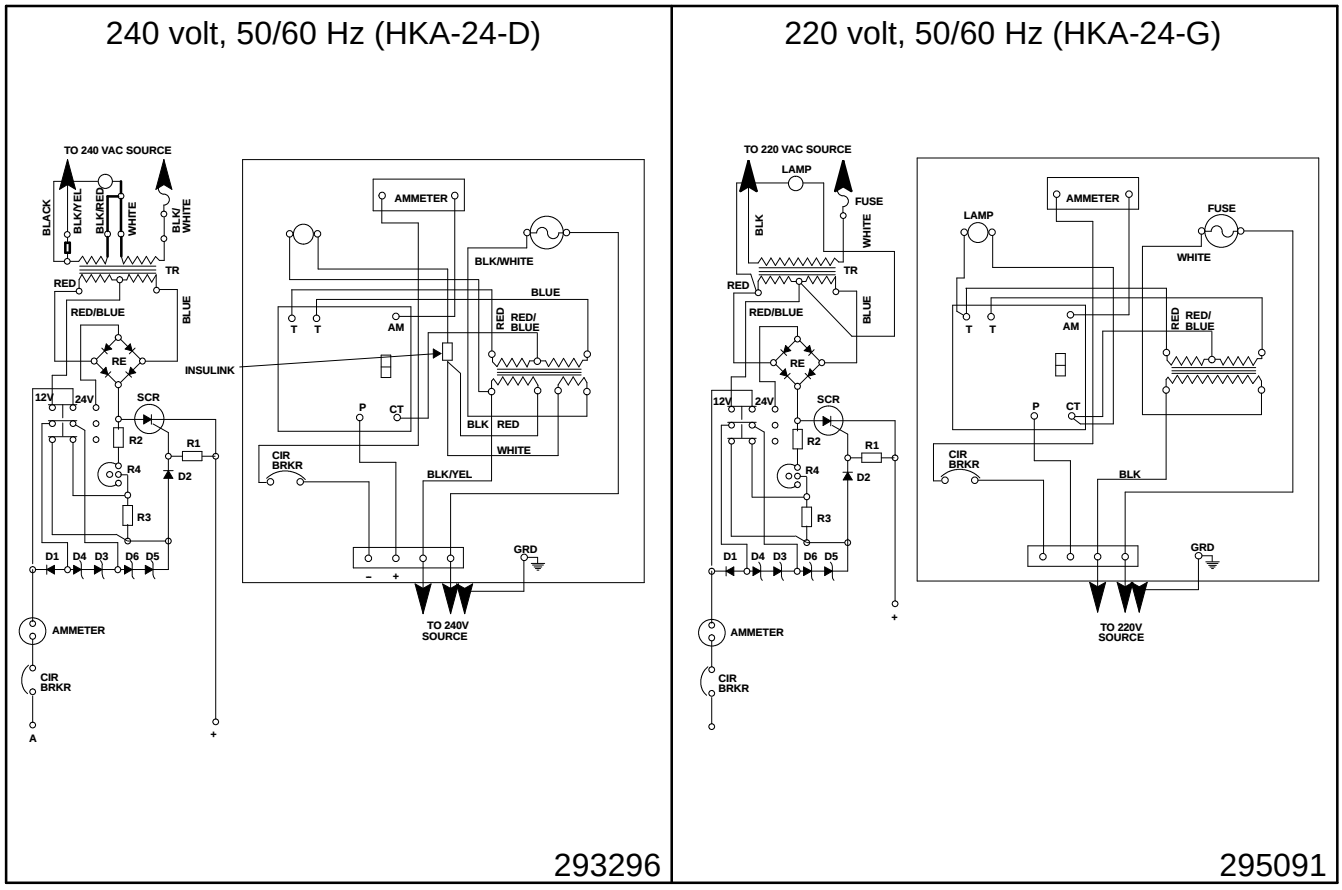


Figure 3-17. Battery Charger Wiring Digrams

Voltage Surge Withstand Protection/ (HKA-38-A)

⚠ DANGER

Hazardous voltage can cause severe injury or death. De-energize both normal and emergency power sources before proceeding. Move generator master switch on controller to OFF position and disconnect battery negative (–) before working on transfer switch! Turn the transfer switch selector switch to the OFF position.

The following is general information about the voltage surge withstand protection/lightning protection kit. Use the instructions with the kit for *current and complete* installation instructions.

Standards

- ANSI C62.2: Guide for Application of Valve-Type Lightning Arrestors for Alternating Current Systems.
- ANSI C37.90A: Guide for Surge Withstand Capability Tests.
- ANSI/IEEE Standard 28-1974: Standard for Surge Arrestors for AC Power Circuits.
- UL 1449: Standard for Transient Voltage Surge Suppressors, in repeated limiting of transient voltage surges on 50 and 60 Hz power circuits, indoor use, on load side of service disconnect, not exceeding 600 volts RMS.

NOTE

No protective devices will withstand a direct lightning strike. Each of these accessories are intended to provide protection within designed limits.

Specifications

Voltage surge withstand protection incorporating metal oxide varistor (MOV) design to provide class C protection as defined in ANSI C62.41-1980 for voltage surges produced by lightning and other induced causes.

Maximum RMS Voltage: 650 volts.

Initial Clamp Voltage: 1100 volts.

Suppression Power: 2.6 kiloJoules.

Response Time: less than 50 nanoseconds.

Failure Indication: darkening and/or distortion of case end, pressure plug.

Standard 3/4-inch conduit nipple for mounting.

Water-tight housing.

Solid-state, bipolar nonlinear voltage-dependent resistors.

Waveshape: 8 kA (magnitude) x 20 microsecond (duration)

Response Time: 1,000 times faster than fastest lightning surges.

Surge Current (Amps)	Crest kVA
1500	2.2
5000	2.6
10,000	2.9
20,000	3.5

Figure 3-18. Voltage Surge Protection

Section 4. General Maintenance

Reasonable care in preventive maintenance will insure high reliability and long life for the transfer switch.

⚠ DANGER

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 your hands are wet.

OPERATE TRANSFER SWITCH AT LEAST ONCE A MONTH. Use the test switch to check the electrical operation of the transfer switch. Since the test switch only simulates failure of the normal source, actual service interruption will occur at the time of actual transfer of the load. Prior to transfer the normal source will remain, causing a very brief (tenths-of-a-second) interruption. An actual normal source failure will cause interruption to last at least several seconds.

NOTE

The generator set can be manually started prior to initiating a momentary test, minimizing the time without power to the load.

KEEP AUTOMATIC TRANSFER SWITCH CLEAN. Once a year brush and vacuum away any excessive dust accumulation on the enclosure. Do not open enclosure!

INSPECT VOLTAGE SURGE WITHSTAND PROTECTION. This optional accessory is usually installed at the service entrance. Inspection is recommended annually and following a lightning storm. If the electrical circuit was subject to a voltage surge, failure will be indicated by darkening and/or distortion of the case end. Contact an authorized distributor/dealer for replacement parts and service.

NOTE

The following maintenance items are to be done only by qualified service technicians.

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 subject to abnormal operating conditions. Relubricate the solenoid core if the transfer switch coil is replaced. Order lubrication kit 296233. Contact an authorized distributor/dealer for service parts.

INSPECT MAIN CURRENT-CARRYING CONTACTS. Once a year de-energize all sources; then remove barriers to check conditions of contact material. Replace contacts when pitted or excessively worn.

NOTE

The remainder of this manual is provided SPECIFICALLY and SOLELY as a guide for certified electricians and electrical contractors in installing the connection, wiring, and transfer switch for home standby systems in conformance with NEC (National Electrical Code) and local regulations.

INSTALLATION AND TROUBLESHOOTING OF THE TRANSFER SWITCH IS NOT TO BE DONE BY THE HOME OWNER!

The following procedure may vary from some local codes and regulations. Consult appropriate codes and regulations regarding installation of EMERGENCY SYSTEMS and generator set before proceeding with installation.

Notify local electrical utility of intent to install EMERGENCY SYSTEM and generator set, as the utility's **"prior written consent may be necessary"** to perform installation.

Section 5. Testing and Troubleshooting

Sequence Of Operation

Automatic Transfer Switch

EMERGENCY SOURCE PICKUP

Load transfer to the emergency source automatically begins when the voltage sensing relay (VSR) detects reduced voltage or total loss of the normal source. The VSR will de-energize whenever the voltage level falls below the preset dropout point. See Figure 5-1.

Voltage/Frequency	Pickup/Dropout Points
Normal Voltage	(Pickup) 85% 5 volts (Dropout) 70% 0, -5 volts
Emergency Voltage	(Pickup) 85% 5 volts
Emergency Frequency	(Pickup) 95%

Figure 5-1. Voltage/Frequency Pickup/Dropout Points

When the VSR de-energizes, signaling the loss of normal voltage, relay NR and NR1 are de-energized. In addition, TDES de-energizes after a fixed time delay of three seconds. The contact from TDES, in series with the NR1 contact, forms a path for the engine start signal between terminals 3 and 4 located on the contactor.

The engine starts and attains proper voltage and frequency. When the emergency source is within the correct parameters, the emergency relay EFR becomes energized and closes the circuit to the ER relay.

ER relay energizes and the transfer switch (TS) coil is energized, the transfer switch operates and all switch contacts (main, controls, auxiliaries) reverse position. The transfer switch is now supplying power to the load from the emergency source.

The switch will remain in this position until the normal source is restored.

EMERGENCY SOURCE DISCONNECTION

Load retransfer to the normal source occurs automatically when the VSR relay detects restoration of the normal source. The voltage level must rise above the preset pickup point before the VSR relay will accept the normal source.

When the normal source is within the correct limits, the VSR relay and the TDEN relay are energized through the CR contact. The timed TDEN contact closes after a period of time (time delay transfer emergency to normal, adjustable 0–30 minutes) and energizes CR, NR and NR1 relays. The NR1 contact locks-in NR and NR1. The CR contact de-energizes. TDEN and CR de-energizes. When NR contacts close the transfer coil is energized, the transfer switch operates, and all switch contacts (main, controls, auxiliaries) reverse position. The transfer switch is now supplying the load from the normal source.

If the generator fails during the time delay transfer emergency to normal, the ER contact in series with NR1 closes and energizes NR and NR1. The switch will transfer to the normal source without a time delay.

Energizing the NR1 relay signals the engine-driven generator to shut down. All circuits are reset for the next normal source failure.

Manual (Nonautomatic) Transfer Switch

A key-operated selector switch selects automatic or manual (nonautomatic) operation. The manual operation is identical to that of the previous Automatic Transfer Switch. The MANUAL position inhibits the automatic starting of the engine-generator. It also requires the use of the transfer to emergency/transfer to normal toggle switch to make the contactor switch from normal to emergency. The emergency source must meet proper voltage and frequency requirements before the logic will allow the operation to function.

NOTE

In the manual position, the engine start circuit is open. This will stop the generator set if it was running with the generator set controller switch in the AUTO position. Generator set *must* then be started manually at the unit.

When the normal source fails or the test switch is actuated, the manual operation requires the operator to start the engine. Refer to the generator set operation manual for further information. When the engine has reached the proper voltage and frequency, the emergency source available lamp will light.

Positioning the transfer to emergency/transfer to normal toggle switch to the TRANSFER TO EMERGENCY position will cause the contactor to switch the load to the

emergency source. The transfer switch position lamp will indicate when the contactor has transferred to the emergency source.

When the normal source returns the normal source indicating lamp will light (indicating the normal source has the proper voltage). Positioning the transfer to emergency/transfer to normal toggle switch to the TRANSFER TO NORMAL position, will cause the contactor to switch the load to the normal source immediately. The transfer switch position lamp will indicate when the contactor has transferred to the normal source.

The engine must be shut down manually after it has had time to run without load for the proper cooldown period.

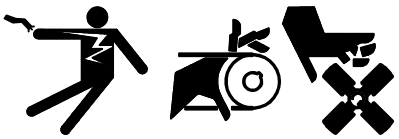
The engine/generator master switch may be placed in the AUTO start mode or in the OFF position depending on the choice of the operator.

Functional Test

Read and understand all instructions and labels attached to the transfer switch. Note any optional accessories that may have been furnished on this switch, and review their operation. See Section 3– Operation and Installation of Optional Accessories. The following Manual Operation must be checked before proceeding to Electrical Operation.

⚠ DANGER

Hazardous voltage can cause severe injury or death. De-energize both normal and emergency power sources before proceeding. Move generator master switch on controller to OFF position and disconnect battery negative (–) before working on transfer switch! Turn the transfer switch selector switch to the OFF position.



⚠ WARNING

Accidental starting.
Can cause severe injury or death.
Disconnect battery cables before working on generator set (negative lead first and reconnect it last).

Manual Operation

A manual operator handle is provided on the transfer switch for maintenance purposes only. Select the appropriate switch amperage size and follow directions for installing the handle. The 30-200-amp models use a 3-point 'star' manual operator handle, which is permanently attached, see Figure 5-2. The 225-320-amp models use a detachable manual operator handle, see Figure 5-3.

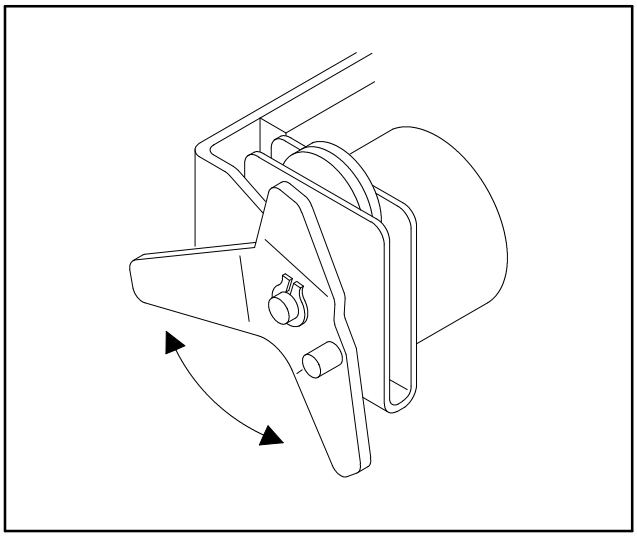


Figure 5-2. 30-200-amp Manual Handle

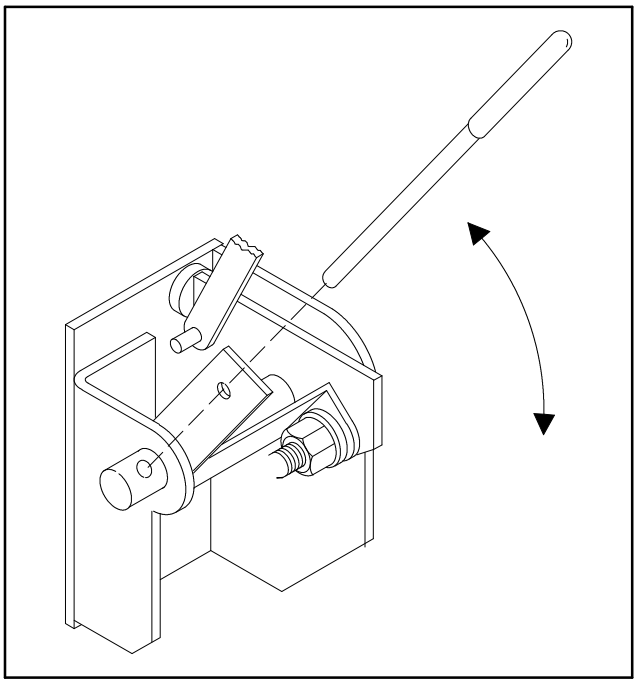


Figure 5-3. 225-320-amp Manual Handle

Move the installed handle up and down to manually operate the transfer switch. The switch should operate smoothly without binding. Return the transfer switch to the normal position. Remove manual operator handle (225-320 amp models only) and store it on the transfer switch in the place provided.

Electrical Operation

First check transfer switch nameplate for rated voltage and frequency. It should be the same as the normal and emergency line voltages and frequency. The transfer switch should be in the normal position. Follow procedure below to check the electrical operation of the automatic transfer switch.

For manual operation transfer switches, first test with transfer switch in AUTO position, then test using procedure in Section 2 for Manual (Nonautomatic) Operation.

⚠ DANGER

Hazardous voltage can cause severe injury or death. To prevent the possibility of electrical shock, de-energize the normal power source to be connected to the transfer switch before making any line or auxiliary connections.

1. Close normal source circuit breaker.
2. Use an accurate voltmeter to check phase-to-phase and phase-to-neutral voltages present at the transfer switch normal source terminals.
3. Close emergency source circuit breaker.
4. Manually start the generator set. Place the generator master switch in the TEST or RUN position.
5. Use an accurate voltmeter to check phase-to-phase and phase-to-neutral voltages present at the transfer switch emergency source terminals.
6. If necessary, adjust the voltage regulator on the generator set according to the manufacturer's recommendations. See generator set operation manual for procedure. The transfer switch will respond only to rated voltage and frequency specified on the nameplate.
7. Shut down the generator set by placing the generator set master switch in the OFF position. Wait until the generator set comes to a complete stop. Then place the generator master switch in the AUTO position.
8. Place the transfer switch auto-test switch (if equipped) in the TEST position, the generator set should crank and start within 15 seconds.
9. The transfer switch will transfer to the emergency position.
10. Place the transfer switch selector switch in the AUTO position. The transfer switch will transfer back to normal after the time delay emergency to normal (TDEN) times out (up to 30 minutes).
11. The time delay engine cooldown (part of generator set controller function) allows the engine to continue to run for an additional unloaded running time of two minutes.

This completes the functional test of the automatic transfer switch. The generator set master switch should be left in the AUTO position.

Disconnecting/Reconnecting The Inner Control Panel Assembly

The in-line disconnect plug is furnished for service purposes only and should not have to be separated. If it must be separated, carefully follow these steps. See Figure 5-4.

⚠ DANGER

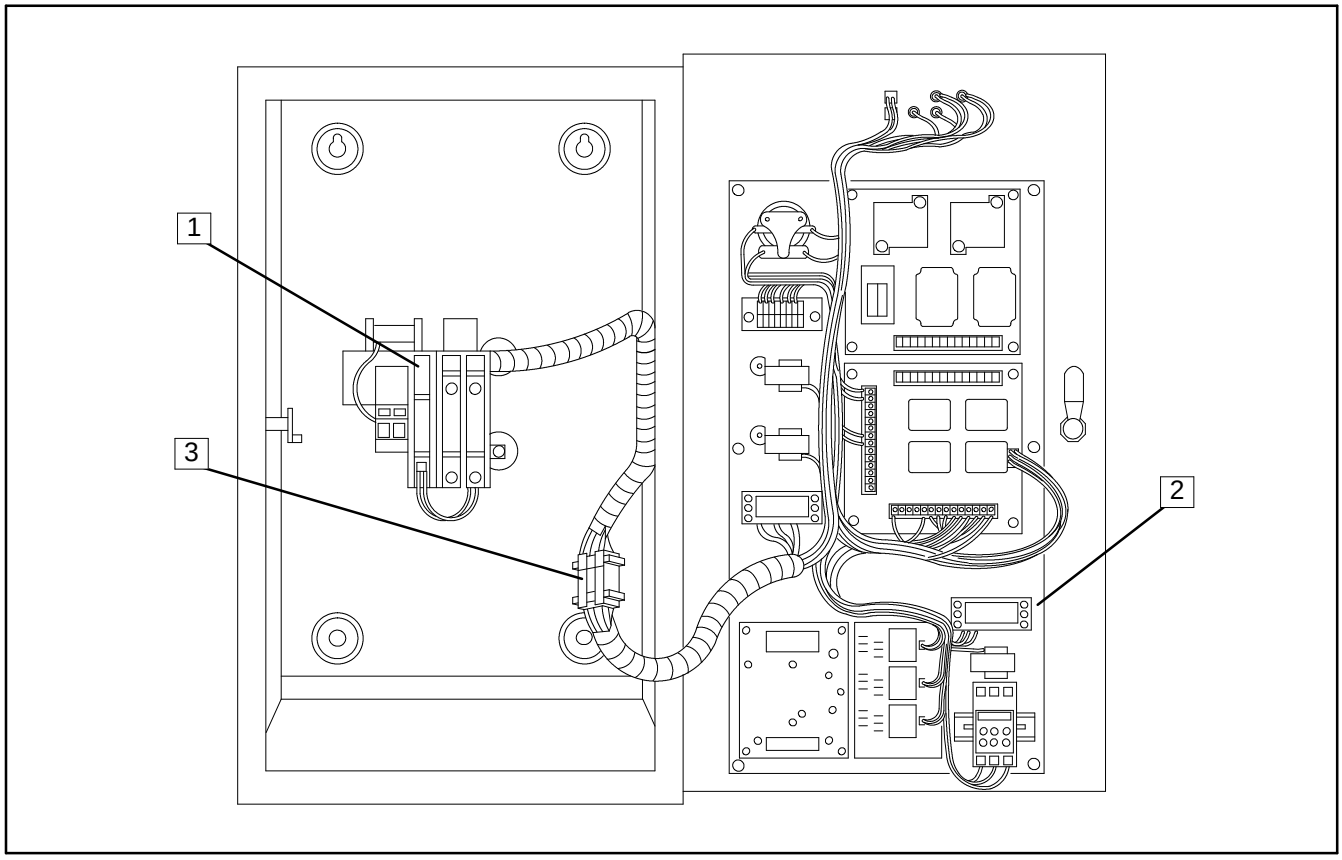
Hazardous voltage can cause severe injury or death. To prevent the possibility of electrical shock, de-energize the normal power source to be connected to the transfer switch before making any line or auxiliary connections.

To Disconnect The P1 Plug

1. If the transfer switch is in the normal position, place the generator set start 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 start 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.



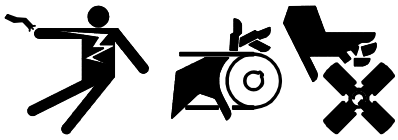
1. Transfer Switch Contactor
2. Inner Control Panel
3. In-Line Disconnect Plug

Figure 5-4. Typical Automatic Transfer Switch

To Reconnect The P1 Plug

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

Manual Load Transfer



⚠ WARNING

Accidental starting.
Can cause severe injury or death.
Disconnect battery cables before working on generator set (negative lead first and reconnect it last).

1. Open the normal and emergency-source circuit breakers.
2. Install the manual operator handle (refer to Functional Test, Manual Operation) and manually operate the transfer switch to the emergency position. Remove handle.
3. Manually start the generator set by placing the generator set master switch in the TEST or RUN position. Close the emergency-source circuit breaker.

Troubleshooting

⚠ DANGER

Hazardous voltage can cause severe injury or death. To prevent the possibility of electrical shock, de-energize the normal power source to be connected to the transfer switch before making any line or auxiliary connections.

Note any optional accessories that may have been furnished on this switch and review their operation. See Section 3– Operation and Installation of Optional Accessories.

Basic Troubleshooting Grid

Problem	Possible Cause	Corrective Action
Generator Does Not Start When Test Switch Is Operated	The test switch is not in the TEST position.	Check operation. Move test switch to the TEST position.
	Generator master switch is not in the AUTO position.	Check generator set master switch. Move switch to the AUTO position. Batteries must be charged and connected.
	Generator start signal wiring leads are loose or disconnected at the transfer switch contactor or generator controller.	Check wiring. Connect start signal wires from the generator set controller to terminals 3 and 4 on the contactor.
	Engine start circuit is malfunctioning.	Check signal circuit. Disconnect and tape engine start wires. NOTE: Engine start contacts and circuit may be disabled by removing wires from terminals 57 and 58 at main logic circuit board. Connect ohmmeter between terminals 57 and 58 on main logic board. Reading should indicate an open circuit. Place the test switch in the TEST position. After time delay engine start (TDES) relay times out, ohmmeter should indicate a closed circuit.
Transfer Switch Does Not Retransfer to Normal After The Normal Source Returns When Switch Is In The AUTO Position.	Time Delay Emergency to Normal (TDEN) has not timed out.	Check operation. Enough time must pass for the time delay emergency to normal (TDEN) to operate. Depending upon the setting, this requires at least 30 minutes.
	Normal source voltage levels are not allowing the voltage pickup and dropout points to operate properly.	Check normal source voltage levels. Take this reading on the transformer assembly terminals. On a single-phase system, voltmeter should read system voltage between terminals NL1 and NL2.
	The AC circuit voltage is not proper.	Check low AC voltage circuits. Check voltage on transformer secondaries. On single-phase systems, voltage at T2-T3 should be 24 volts AC. Between T1-T3 and T1-T2, voltage should be 12 volts AC. If these voltages are correct, check the circuit board voltages at terminals 62-S3 (12 volts AC) and 62-63 (24 volts AC). No voltage at these points indicates interconnection harness problems.

Figure 5-5. Transfer Switch Basic Troubleshooting Chart (Sheet 1 of 2)

Basic Troubleshooting Grid (Cont.)

Problem	Possible Cause	Corrective Action
Generator Set Is On, But It Does Not Transfer Load To Emergency Source	Time Delay Emergency to Normal (TDEN) has not timed out.	Check operation. Enough time must pass for the time delay emergency to normal (TDEN) relay to operate. Depending upon setting, this requires at least 30 minutes.
	Generator master switch frequency and voltage is out of range.	Check generator master switch. Check generator output frequency and voltage. Output should be at least 90% of rated voltage and 95% to rated frequency. Make sure the generator output circuit breaker is closed.
	System is not reading phase-to-phase voltage.	Check wiring. Voltmeter should read phase-to-phase voltage between transfer switch terminals EL1 and EL2.
	Low voltage circuit is not picking up or dropping out properly.	Check low voltage circuit. With the proper voltage on the transformer primaries, check the secondary voltage at ES1 and ES2 (24 volts AC). If this voltage is correct at terminals ES1 and TBL3-26 (12 volts AC) and terminals TBI1-55 and TBL3-26 (12 volts DC). No voltage at these points indicates interconnection harness problems.
Transfer Switch Retransfers To The Normal Source, But Generator Continues To Run	Time Delay Emergency to Normal (TDEN) has not timed out.	Check operation. Make sure enough time has passed for the time delay emergency-to-normal (TDEN) relay to operate. Depending upon setting, this may require at least 30 minutes.
	Generator master switch is not in the AUTO position.	Check generator master switch. Make sure generator set master switch is in the AUTO position.
	Engine start circuit is malfunctioning.	Check signal circuit. Disconnect and tape wires from terminals 57 and 58 on the main logic board. Connect ohmmeter between these terminals. Ohmmeter reading should indicate an open circuit.

Figure 5-5. Transfer Switch Basic Troubleshooting Chart (Sheet 2 of 2)

Troubleshooting Flowchart

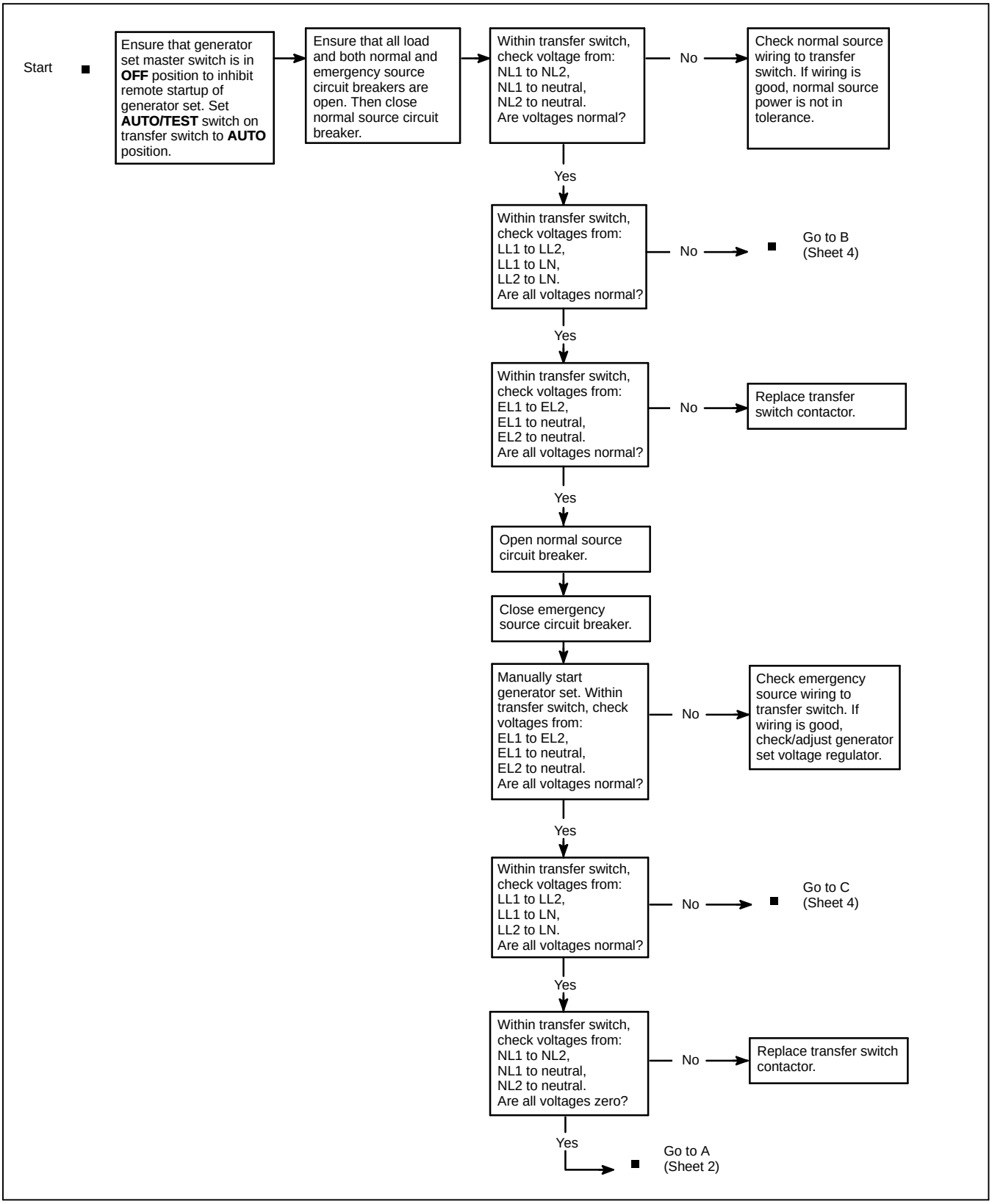


Figure 5-6. Troubleshooting Flowchart (Sheet 1 of 4)

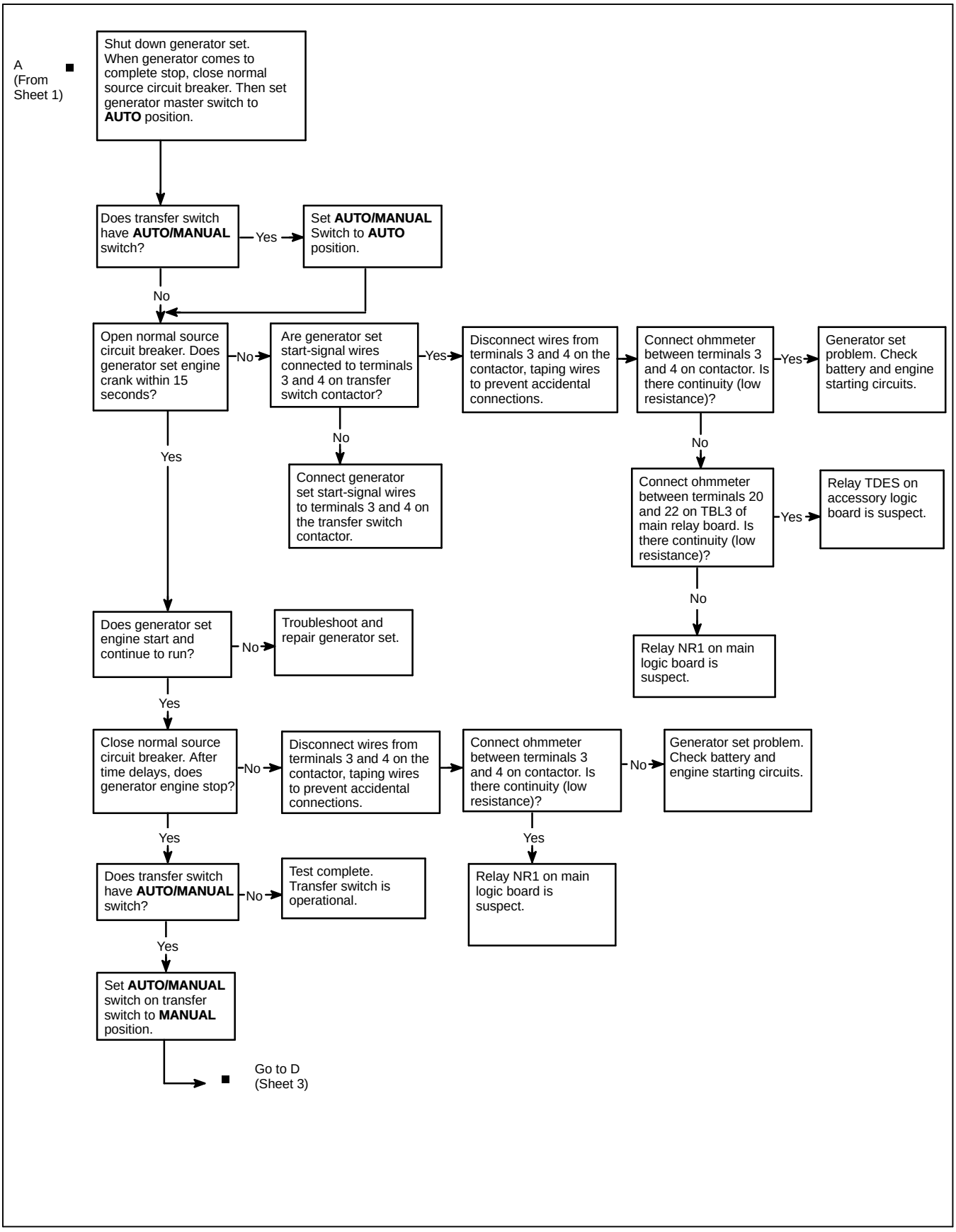


Figure 5-6. Troubleshooting Flowchart (Sheet 2 of 4)

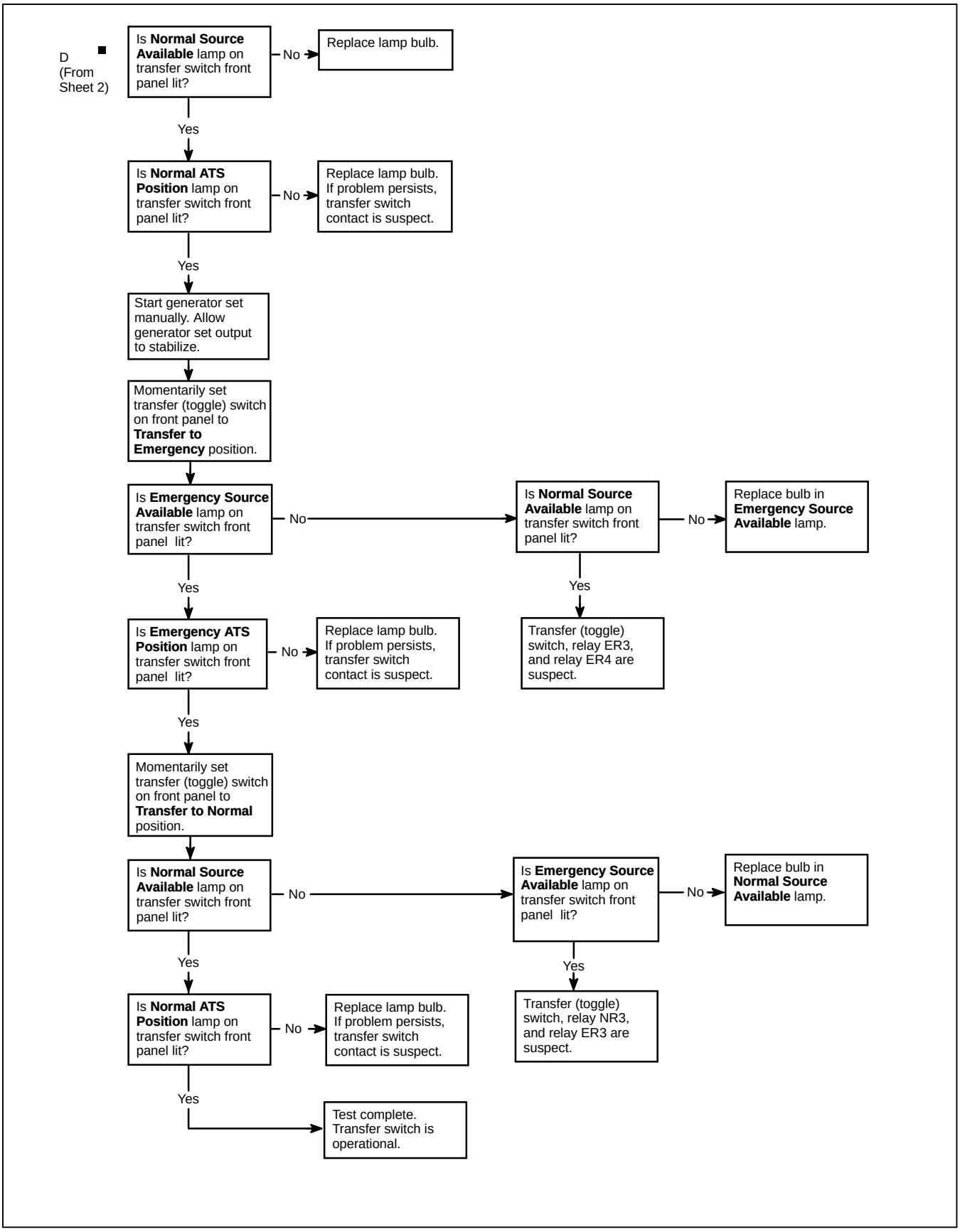


Figure 5-6. Troubleshooting Flowchart (Sheet 3 of 4)

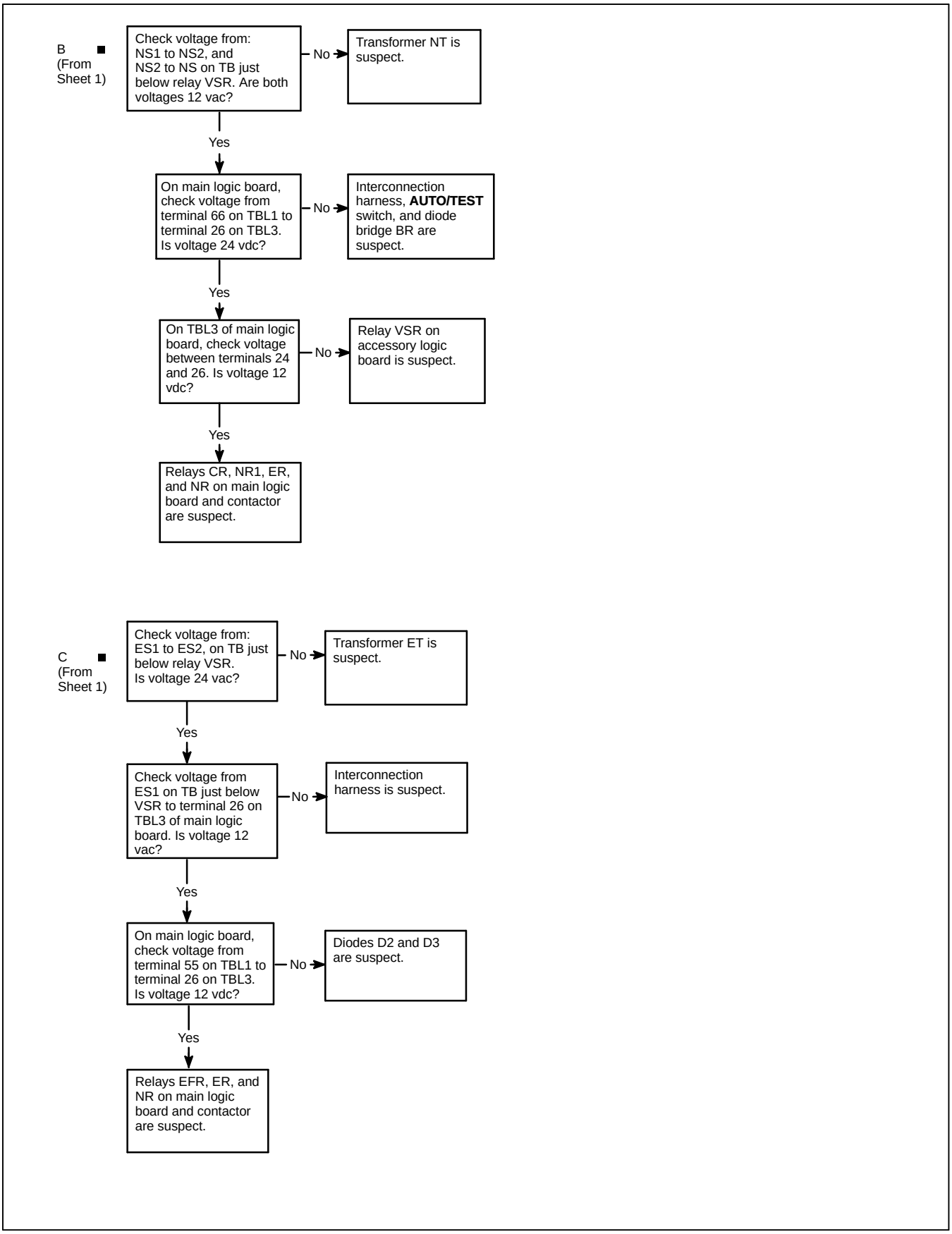


Figure 5-6. Troubleshooting Flowchart (Sheet 4 of 4)

Section 6. Wiring Diagrams

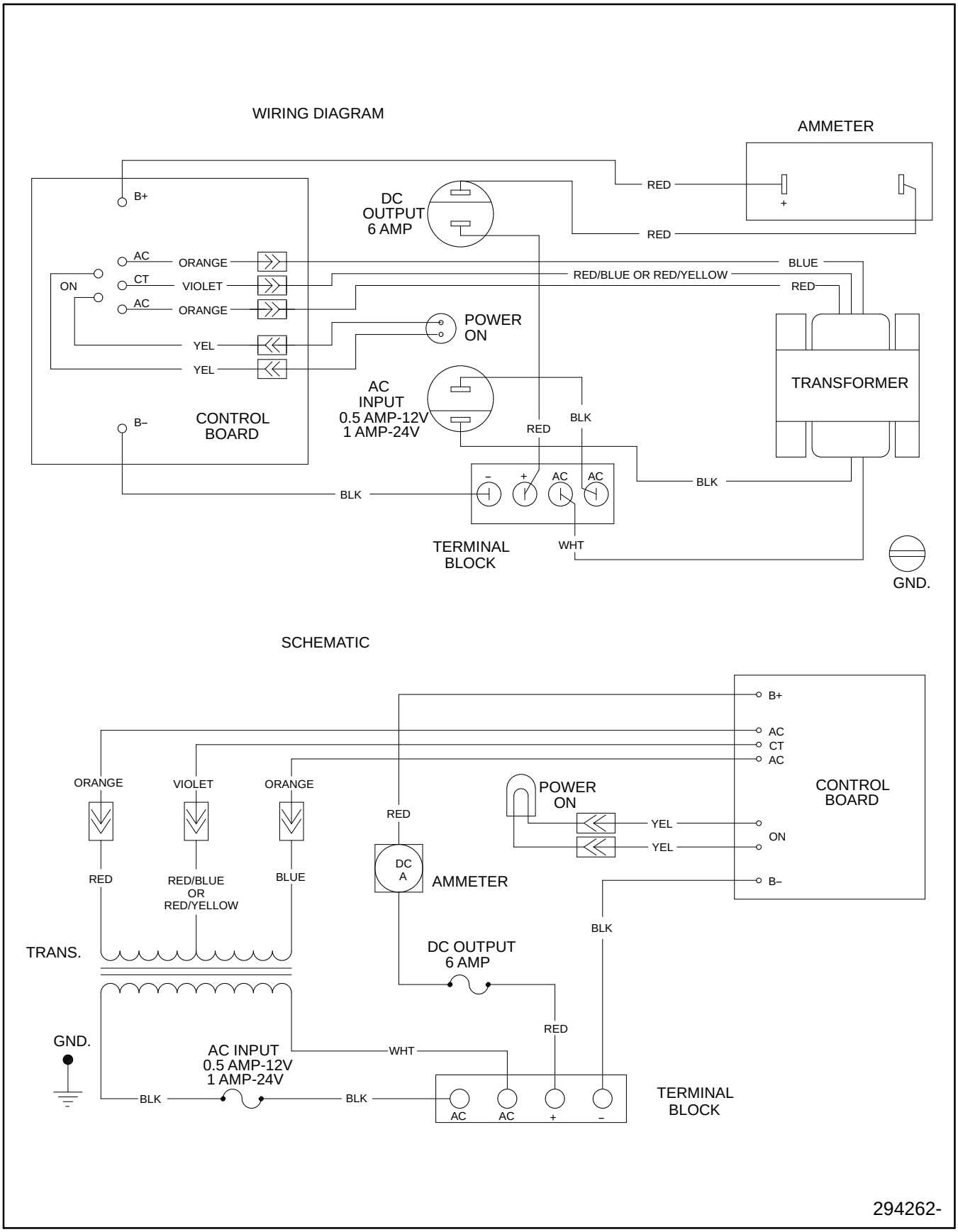


Figure 6-1. Wiring Diagram, Schematic– 220-Volt Battery Charger

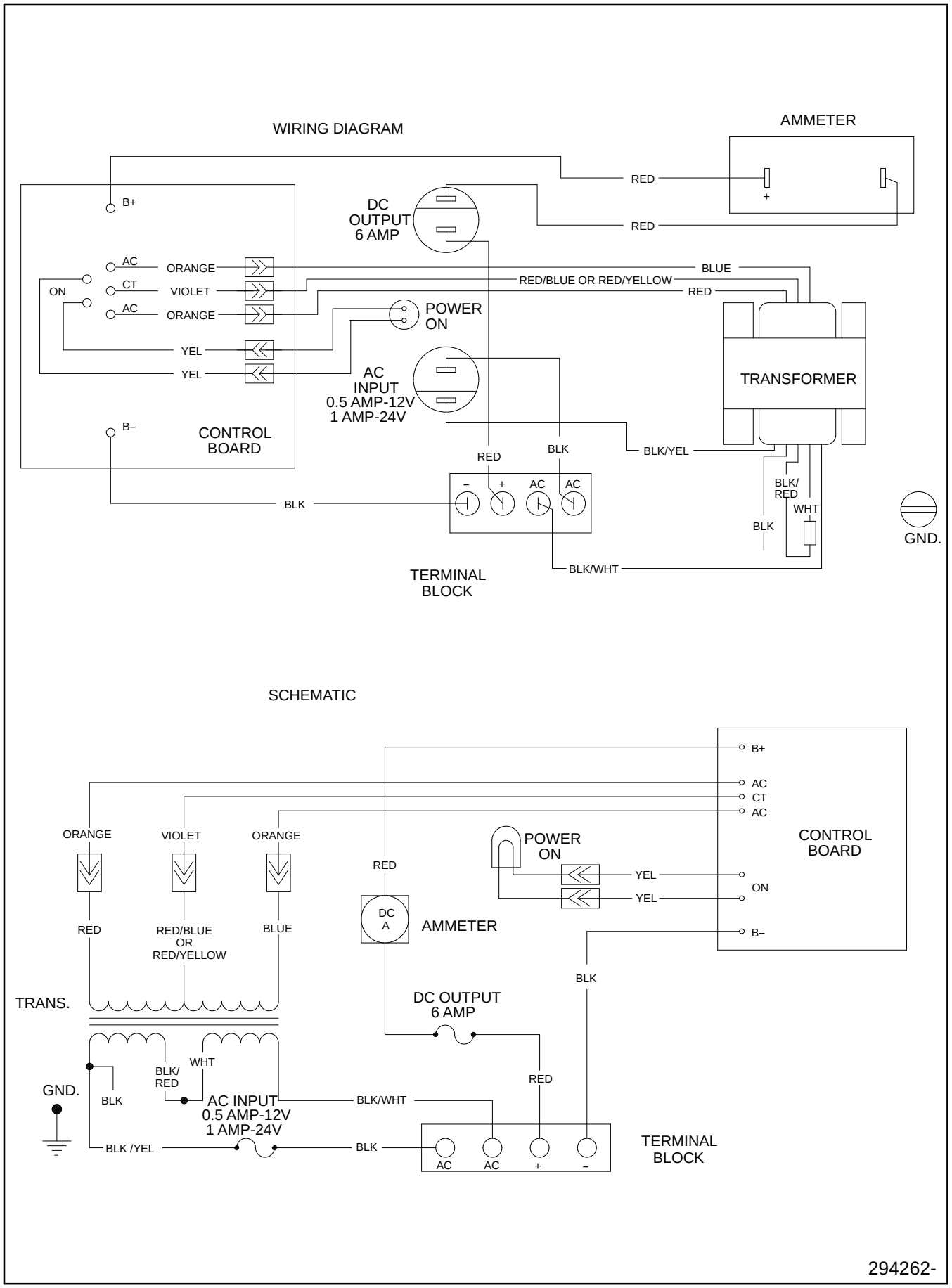


Figure 6-2. Wiring Diagram, Schematic– 240-Volt Battery Charger

Section 7. Installation of Transfer Switch

Transfer switches are factory wired and tested. Installation requires mounting and connection of supply cables. Do not remove protective packing until ready for complete installation. Protect switch at all times from excessive moisture, construction grit, and metal chips.

NOTE

Transfer switch is NOT intended as service entrance equipment.

Unpacking

Carefully unpack or uncrate transfer switch and check for damage. Report any damage immediately to the respective sales dealer/distributor.

Attach lifting devices to the transfer switch mounting holes only. Do not lift transfer switch at any other points. Protect arc barriers at all times from impact.

Mounting

The transfer switch must be mounted vertically to a rigid supporting structure. Level all mounting points by using flat washers behind holes to avoid forced distortion of transfer switch. The control panel is mounted on the inside of the door.

⚠ DANGER

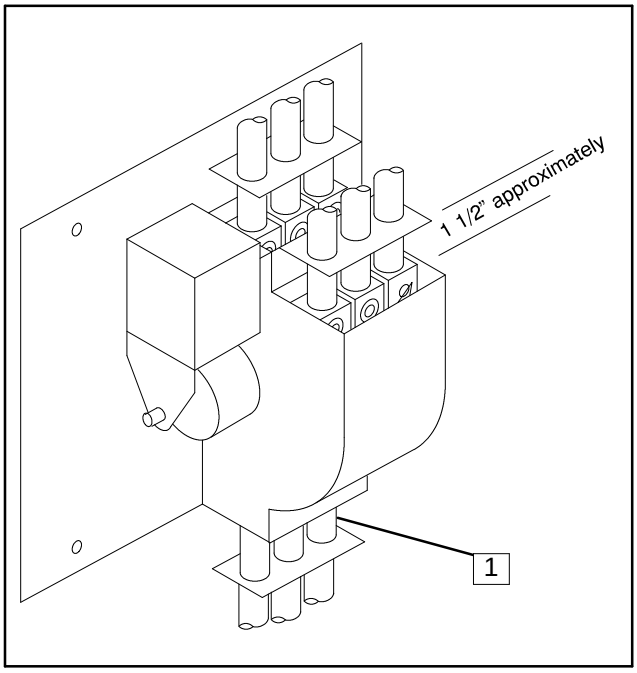
Hazardous voltage can cause severe injury or death. De-energize both normal and emergency power sources before proceeding. Move generator master switch on controller to OFF position and disconnect battery negative (–) before working on transfer switch! Turn the transfer switch selector switch to the OFF position.

Line Connections

Reference Section 6– Wiring Diagrams when making electrical connections.

All conductors should enter enclosure adjacent to the transfer switch terminals in order to eliminate excessive lead lengths in the enclosure. Protect the transfer switch from metal chips and construction grit at all times. Standard terminal lugs are solderless, screw type and will accept the conductor sizes listed on the installation drawing (see Section 8– Installation Drawings).

Cables should be bundled to the side of the switch. Maintain proper electrical clearance between the live metal parts and grounded metal. Use the three cable spacers provided on 160-amp transfer switches. Position the cable spacer within 1 1/2 in. (38 mm) of the terminal lugs. See Figure 7-1.



1. Cable Spacer

Figure 7-1. Cable Spacers

Connect source and load conductors to transfer switch terminal lugs. Each terminal lug has markings for identification purposes.

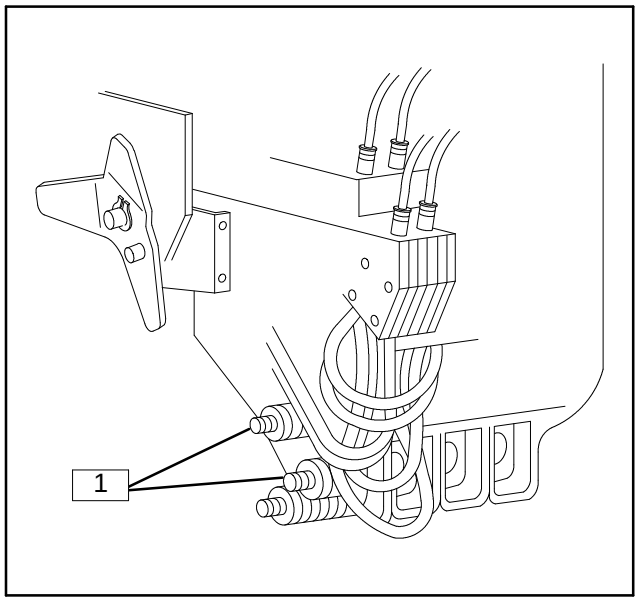
NOTE

All connections made to transfer switch must be made with **copper** wire.

Tighten conductor to proper torque spec., refer to torque decal.

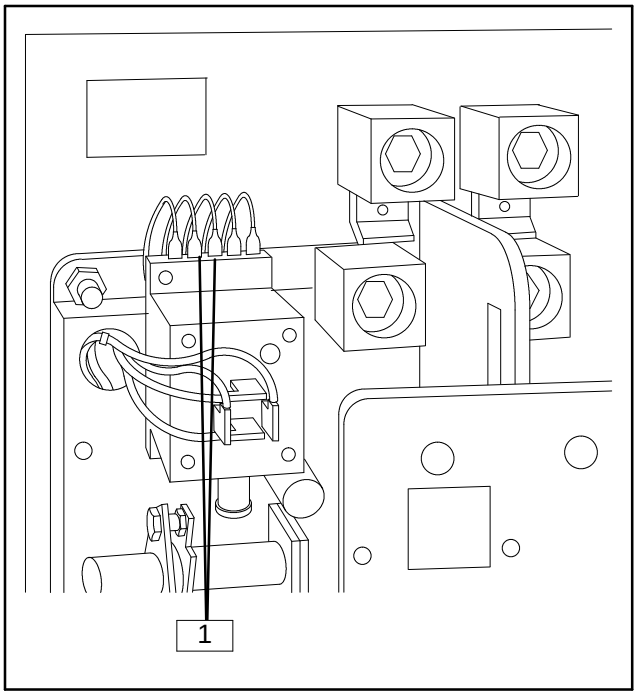
All internal connections are made at the factory. Both the transfer switch and the inner control panel have their own wire harness. The two harnesses are joined together by an in-line disconnect plug. The plug should be connected at this time if not already done.

Auxiliary Connections



1. Engine Start Terminals 3 and 4

Figure 7-2. Engine Start Terminals (30-200 Amperes)

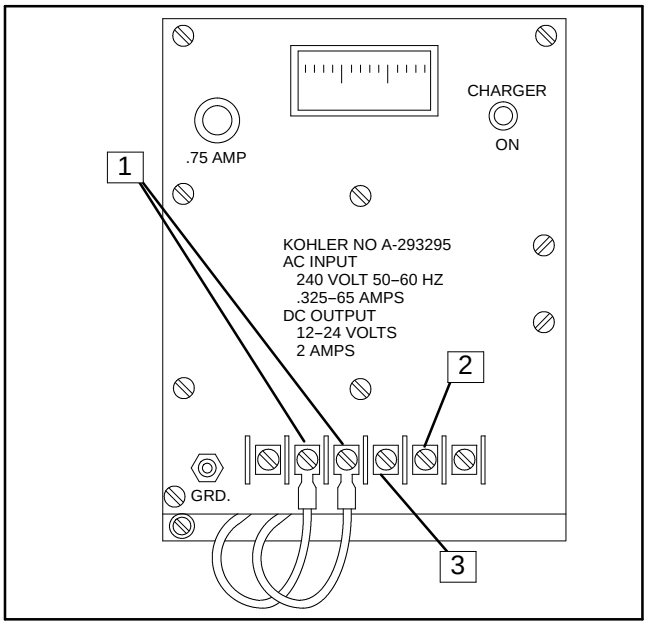


1. Engine Start Terminals 3 and 4

Figure 7-3. Engine Start Terminals (225-320 Amperes)

Connect auxiliary circuit wires to appropriate inner control panel terminals as shown on the appropriate wiring diagram, see Section 6– Wiring Diagrams. External connections include generator set start signal and battery charging cables. The engine start connections are located on the transfer switch and are identified by a decal as terminals 3 and 4, see Figure 7-2 or 7-3. Battery charging connections are located on lower part of the inner control panel, see Figure 7-4.

Note any optional accessories that may have been furnished on this transfer switch and make auxiliary connections, if necessary. See Section 3– Operation and Installation of Optional Accessories for more information.



1. AC Line Connection
2. Battery Negative (–) Connection
3. Battery Positive (+) Connection

Figure 7-4. Battery Charging Terminals

Section 8. Installation Drawings

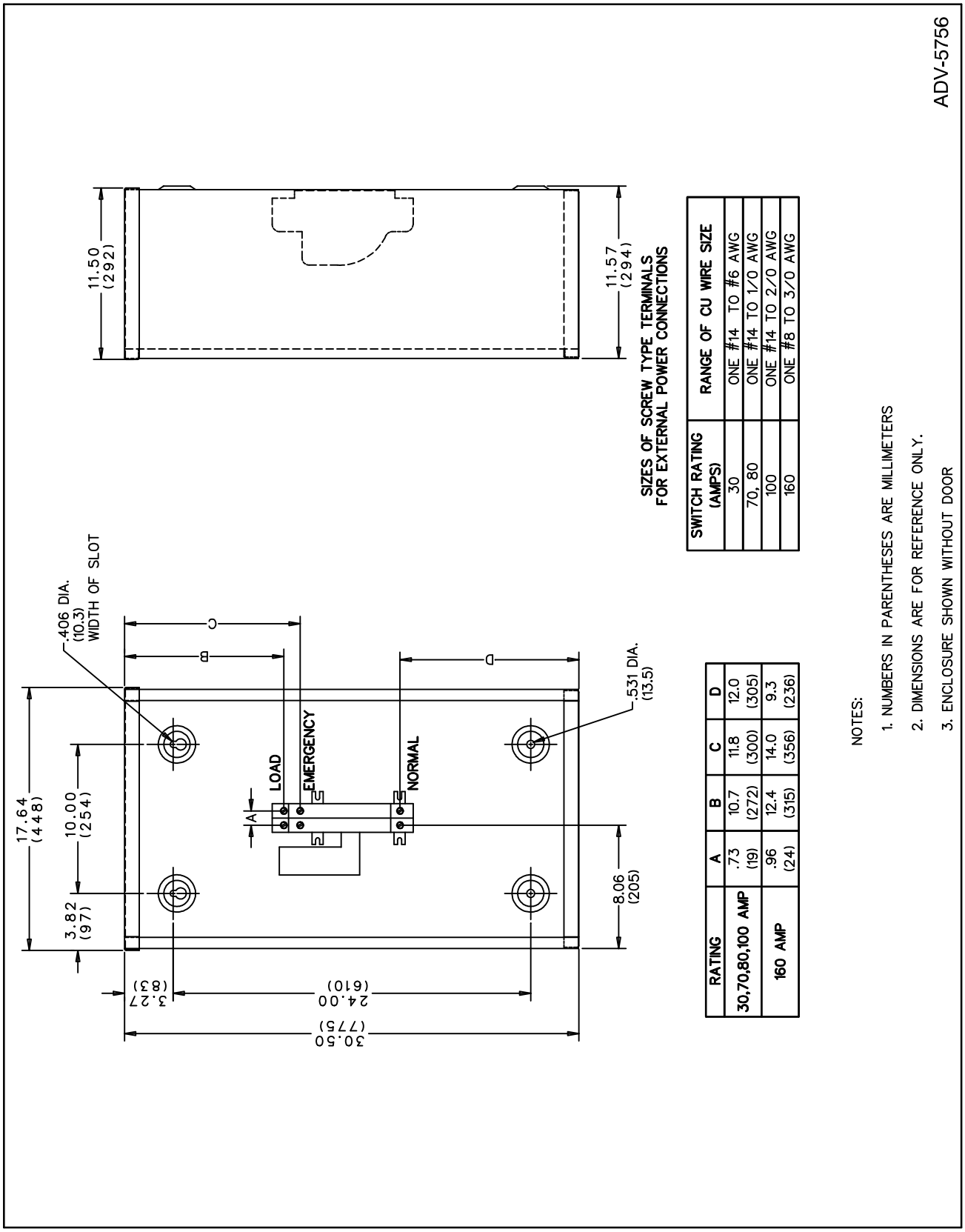


Figure 8-1. Installation Drawing– 30-160 Amperes, Enclosure Mounting

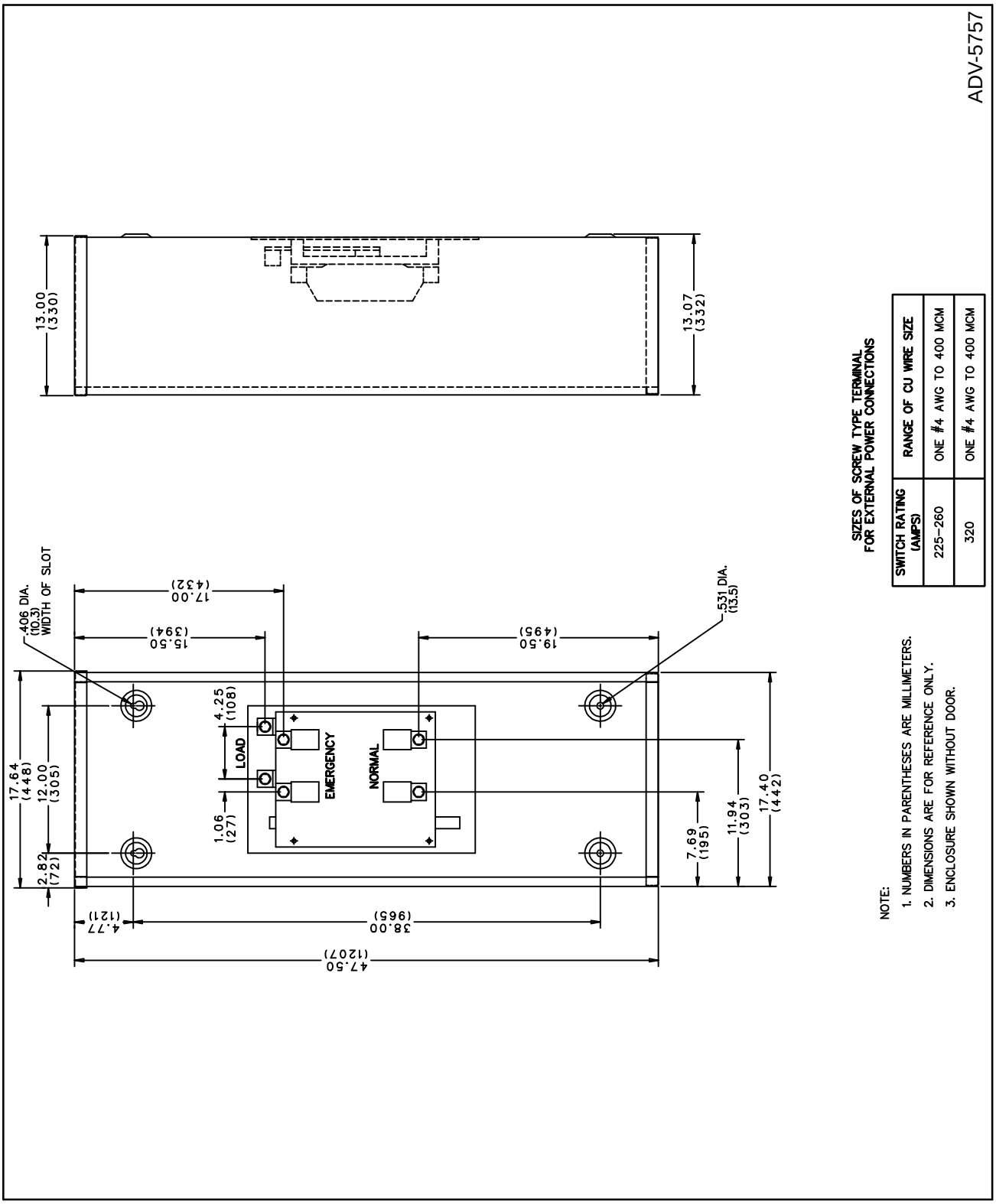


Figure 8-2. Installation Drawing– 225-320 Amperes, Enclosure Mounting

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