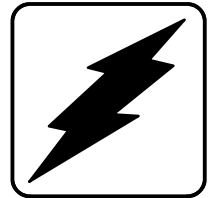


# Operation and Installation

## Automatic Transfer Switches



Models:

**S340**

Logic:

Solid-State

(Automatic and Nonautomatic)

**KOHLER**<sup>®</sup>  
POWER SYSTEMS

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

TP-5087 8/93c

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# Safety Precautions and Instructions

A transfer switch, like any other electromechanical device, can pose potential dangers to life and limb if improperly maintained or operated. The best way to prevent accidents is to be aware of potential dangers and act safely. Please read and follow the safety precautions and instructions below to prevent harm to yourself and others. This manual contains several types of safety precautions and instructions which are explained below. **SAVE THESE INSTRUCTIONS.**

## **DANGER**

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



## **NOTICE**

Notice communicates installation, operation, or maintenance information that is important but not hazard related.



## **Hazardous Voltage/ Electrical Shock**

 <b>WARNING</b>

<b>Hazardous voltage. Can cause severe injury or death. Disconnect power sources before servicing. Barrier must be installed after adjustments, maintenance, or servicing.</b>



*(under 600 Volt)*

 <b>DANGER</b>

<b>Hazardous voltage. Will cause severe injury or death. Disconnect power sources before servicing. Barrier must be installed after adjustments, maintenance, or servicing.</b>

*(600 Volt and above)*

 <b>WARNING</b>

<p><b>Hazardous voltage.</b>  <b>Can cause severe injury or death.</b>  <b>Do not open enclosure until all power sources are disconnected.</b></p>

*(under 600 Volt)*

 <b>DANGER</b>

<p><b>Hazardous voltage.</b>  <b>Will cause severe injury or death.</b>  <b>Do not open enclosure until all power sources are disconnected.</b></p>

*(600 Volt and above)*

**Hazardous voltage can cause severe injury or death.**

Disconnect set from load by opening line circuit breaker or by disconnecting generator output leads from transfer switch and heavily taping ends of leads. If high voltage is transferred to load during test, personal injury and equipment damage may result. The GENERATOR SAFEGUARD BREAKER MUST NOT BE USED IN PLACE OF LINE CIRCUIT BREAKER!

**Hazardous voltage can cause severe injury or death.**

The transfer switch is energized; proceed with care! High voltage can cause personal injury, damage equipment, or lead to future failures. Remove watch, rings, and jewelry that can cause short circuits.

**Hazardous voltage can cause severe injury or death.**

The transfer switch is energized; proceed with care! High Voltage can cause personal injury, damage equipment, or lead to future failures. Remove rings, watches, and jewelry that can cause short circuits. This test should be done only by a qualified electrician. Follow manufacturer's instructions when operating tester.

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

**Hazardous voltage can cause severe injury or death.**

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

**Hazardous voltage can cause severe injury or death.**

Disconnect harness plug before installing any accessories involving connection to transformer assembly primary terminals. Terminals are at line voltage!

**NOTICE**

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

**NOTICE**

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

# Introduction

An **Automatic Transfer Switch** is an emergency device used for transferring critical electrical loads from a normal (preferred) source of electric power to an emergency (standby) source. This transfer occurs automatically when the normal source voltage fails, or is substantially reduced, and the emergency source's voltage has reached an acceptable level.

Upon normal source failure, the automatic transfer switch signals the generator set(s) to start. The automatic transfer switch continuously senses for an acceptable normal source and will retransfer load to the normal source after it has been restored to an acceptable level. After retransfer of the load, the generator set start signal is cleared and the generator set(s) are allowed to shut down.

A S340 ATS can function as a **Nonautomatic Transfer Switch** when equipped with accessory KA-29. Depending upon the version of accessory 29 that is used, power transfers are initiated manually using door-mounted switches. Some versions of accessory 29 allow for automatic retransfer (override) of the connected power source fails and the alternate power source is acceptable. See the "Accessories" section for descriptions of individual accessories.

## Ratings

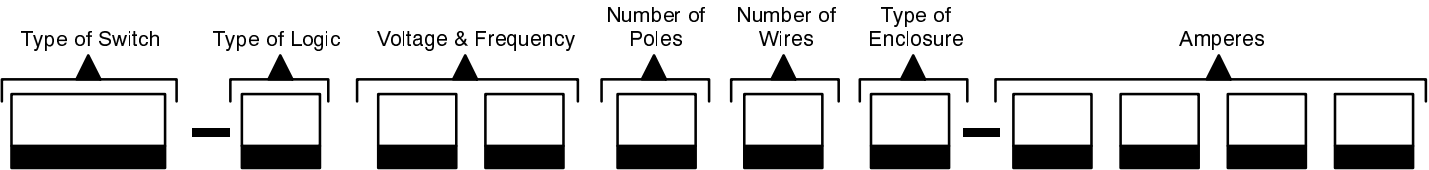
The rating label is attached to the transfer switch. Data relating to each specific switch is included on the nameplate. Unit installation must not exceed the rated capacity of the switch as shown on the nameplate. A sample nameplate is shown in Figure 1.

AUTOMATIC TRANSFER SWITCH	
PART NO.	
2AS 4CS 23GD	
1	
SERIAL NO.	
VOLTS	AMPS
PHASE	WIRES
HERTZ	POLES
KOHLER, SHEBOYGAN FALLS, WI.	

1. Accessories list

**Figure 1. Typical Nameplate**

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



## Kohler Model Number Key

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

## SAMPLE MODEL NUMBER

**K-166341-0150**

### Type Of Transfer Switch

- K Automatic Transfer Switch
- KB Automatic Transfer and Bypass Isolation Switch
- KN Nonautomatic Transfer Switch

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

### Type Of Logic

- 1: Solid State
- 4: Elevator Control Switch
- 5: Microprocessor

### Voltage & Frequency Phase-to-Phase

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

### Number of Poles

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

### Number of Wires

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

### Type of Enclosure

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

### Amperes


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

\* Available in 30-100 ampere sizes only.

\*\* CSA versions available up to 2000 amperes.


# Section 1. Installation

Kohler transfer switches are factory wired and tested. Installation requires mounting and control initialization plus connection of utility, load, emergency cables and any auxiliary contact/control circuits. Do not remove protective packing until ready for complete installation. Protect switch at all times from excessive moisture, construction grit, and metal chips.

<b>⚠ WARNING</b>

<b>Hazardous voltage. Can cause severe injury or death. Disconnect power sources before servicing. Barrier must be installed after adjustments, maintenance, or servicing.</b>

*(under 600 Volt)*

**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.

<b>⚠ DANGER</b>

<b>Hazardous voltage. Will cause severe injury or death. Disconnect power sources before servicing. Barrier must be installed after adjustments, maintenance, or servicing.</b>

*(600 Volt and above)*

**Hazardous voltage will 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.

## Unpacking

Carefully unpack or uncrate switch and check for damage. Report any damage immediately to the Kohler Distributor/Dealer.

## Lifting

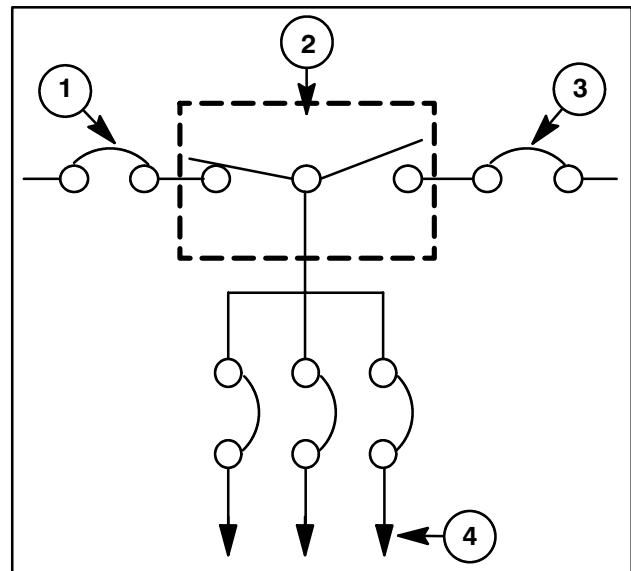
Any lifting devices must be attached to the switch's mounting holes or lifting eyes only. Do not lift the switch at any other points. Protect arc barriers from impact at all times.

## Mounting

All enclosed switches have the control panel mounted on the cabinet door. For open-type switches, mount the control panel to the right of the transfer switch. See installation drawings for open switch mounting dimensions and spacing requirements.

## Line Connections

For location of the transfer switch in the system see Figure 1-1. The switch should be as close as possible to the critical electrical loads connected to it.



1. Normal Source
2. Transfer Switch
3. Emergency Source
4. Loads

**Figure 1-1. Transfer Switch Location**

Wiring diagrams are furnished at the back of this manual. Interconnection diagrams (3-pole and 2-pole) are furnished to show actual lead wiring.

All conductors should enter enclosure adjacent to the transfer switch terminals. 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 dimension drawings.

Do not run cables behind the transfer switch. Cables can be bundled to the side of the switch. Maintain proper electrical clearance between the live metal parts and grounded metal. Use cable spacers provided on 70, 104 and 150-Amp, 600-Volt class switches. Spacers are not required on 240-Volt class switches.

On 225–400-Amp switches, remove the cover shields from the switch to connect power cables to the emergency lugs and switched neutral lugs (Accessory 36).



Connect source and load conductors to clearly marked contactor terminal lugs. Remove surface oxides from conductors by cleaning with a wire brush. When aluminum conductors are used, apply oxidation inhibitor to conductors. Tighten lugs and carefully wipe away excess oxidation inhibitor. Tighten cable lugs to the torque specified in table A.

#### NOTE

Application of oxidation inhibitor is required for all aluminum terminations.

<b>Contactor Rated Amps</b>	<b>Tightening Torque inch pounds (Nm)</b>
<b>30-104</b>	<b>50 (5.6)</b>
<b>150</b>	<b>200 (22.6)</b>
<b>225-400</b>	<b>600 (67.8)</b>
<b>600-1200</b>	<b>500 (56.5)</b>
<b>1600-4000</b>	<b>Suitable for Bus Bar Lugs</b>

**Figure 1-2. Table A. Tightening Torque Values  
for Lug Connectors**


 <b>WARNING</b>

<p><b>Hazardous voltage. Can cause severe injury or death. Do not open enclosure until all power sources are disconnected.</b></p>

*(under 600 Volt)*

#### **Hazardous voltage can cause death or severe injury!**

On 225–400-Amp switches, reinstall the cover shields over the emergency lugs and overlapping neutral (accessory 36) lugs. If these shields are not in place when the switch is energized, the lugs will be exposed. Touching these energized lugs can result in shock, burns, or death.

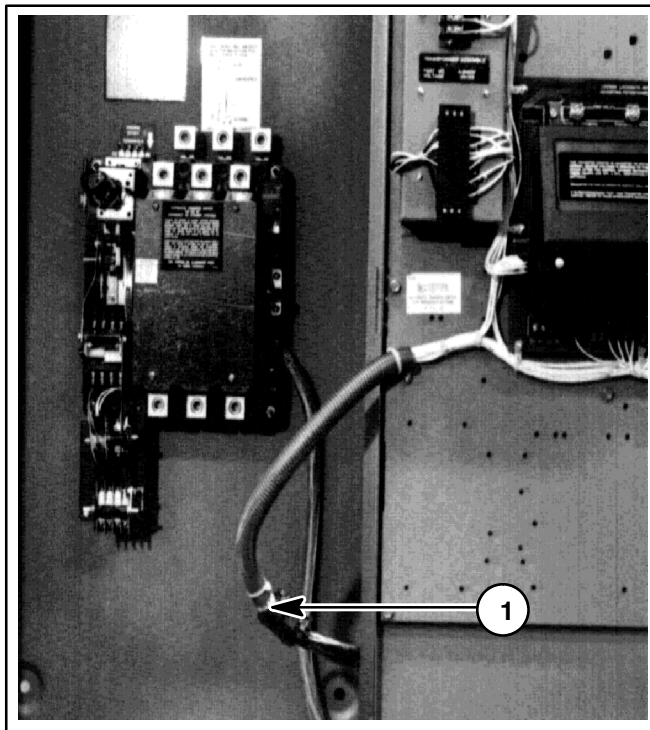


<b>⚠ DANGER</b>

<p><b>Hazardous voltage.</b>  <b>Will cause severe injury or death.</b>  <b>Do not open enclosure until all power sources</b>  <b>are disconnected.</b></p>

*(600 Volt and above)*

### **Hazardous voltage will cause death or severe injury!**

On 225-400-Amp switches, reinstall the cover shields over the emergency lugs and overlapping neutral (accessory 36) lugs. If these shields are not in place when the switch is energized, the lugs will be exposed. Touching these energized lugs can result in shock, burns, or death.



1. In-Line Disconnect Plug

**Figure 1-3. In-Line Disconnect Plug**

All internal connections are made at the factory. The transfer switch and the control panel each have their own wire harness. The two harnesses are joined together by the in-line disconnect plug. For all switches, the plug must be connected after installation is completed. See Figure 1-3 .

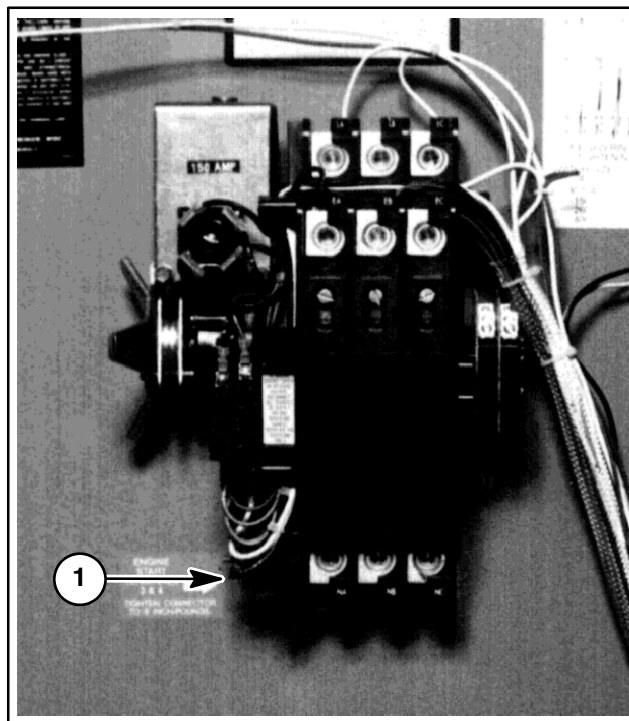
## **Auxiliary Connections**

Connect auxiliary circuit wires to appropriate control panel terminals as shown on the appropriate diagram (see contactor wiring diagrams in the "Wiring Diagrams & Drawings" section). Any auxiliary contact connections are customer specified and should be shown on the installation's plans. Standard auxiliary contacts include one set closed in the normal position and one set closed in the emergency position. Additional contacts of both types are optional.

Note any optional accessories that may have been furnished on this switch and make auxiliary connections if necessary.

## **Engine-Starting Connections**

The engine-starting connections are located on the transfer switch contactor. A red decal near the contactor points to engine-start terminals. Engine-start terminal locations are also described on interconnection diagrams in this book. Connect engine-start signal wires to terminals 3 and 4 on the contactor. See Figure 1-4.



1. Engine-Starting Connections

**Figure 1-4. Typical Engine-Starting Connections  
 30-150-Amp Contactor Shown**

# Notes

# Section 2. Functional Tests

Functional Testing consists of three parts: *manual operation, voltage checks and electrical operation.*

## CAUTION

Perform these checks in the order given to avoid damaging the switch.

Read and understand all instructions on installation drawings and labels affixed to the switch. Note any optional accessories furnished with the switch and review their operation.

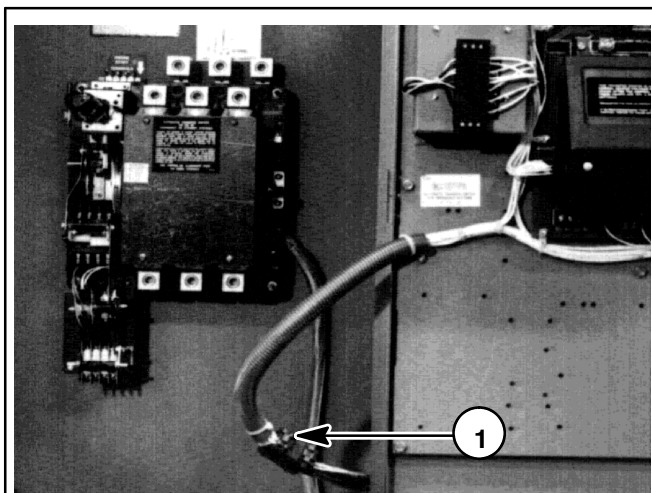
Check the transfer switch nameplate for rated voltage. It should be the same as normal line voltage and emergency line voltage as indicated on the generator set nameplate.

## Manual Operation Check

Perform the manual operation test **before** attempting to electrically test the automatic transfer switch. The intent is to verify that the contactor and all auxiliary switches operate smoothly and that there is no damage from shipping or installation.

This procedure will check manual operation of the Transfer Switch.

1. Open the normal, emergency and load circuit breakers.
2. Separate the contactor control in-line disconnect plugs if you have not already done so. See Figure 2-1.



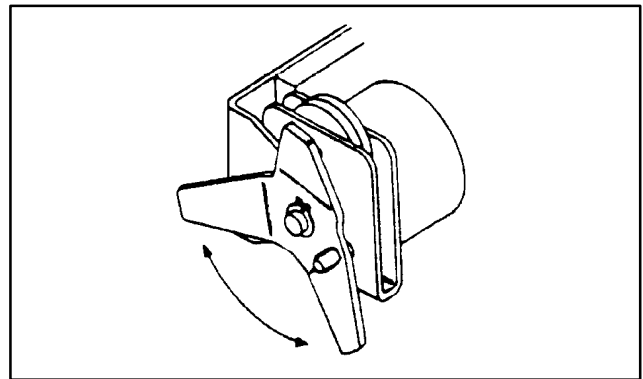
1. In-Line Disconnect Plug

**Figure 2-1. In-Line Disconnect Plug**

3. A permanently-mounted handle is provided on 30-150-Amp switches. A detachable manual operator handle is provided on 225-4000-Amp switches. Manual operator handles are to be used for maintenance and inspection purposes only. Select the appropriate switch amperage size below and follow directions for installing the handle. See Figure 2-2 through Figure 2-5.

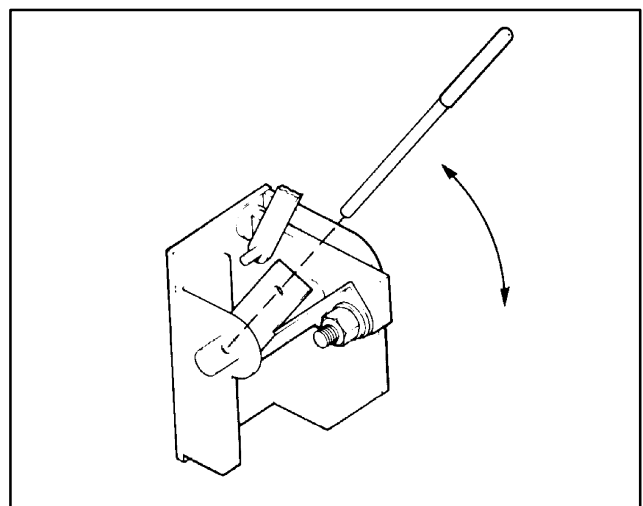
## NOTICE

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



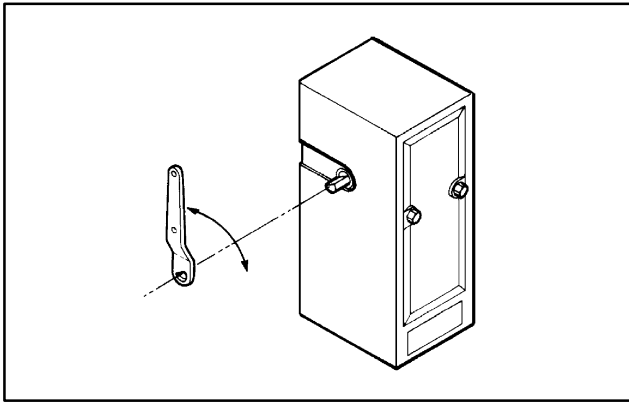
**Figure 2-2. Operating Handle, 30-150-Amp.**

*For 30-150-Amp Switches, operate 3-point handle as shown in Figure 2-2.*



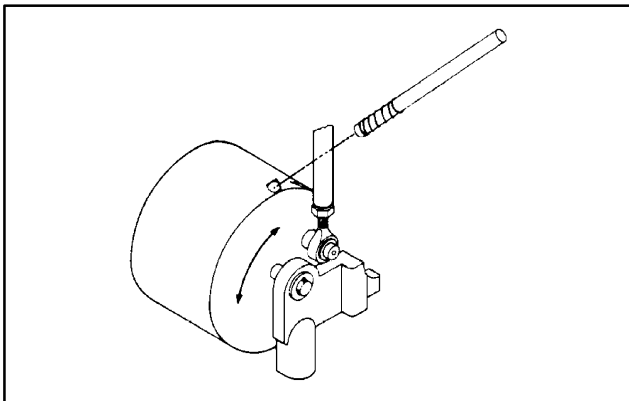
**Figure 2-3. Operating Handle, 225-400-Amp.**

*For 225-400-Amp Switches, insert manual handle as shown in Figure 2-3.*



**Figure 2-4. Operating Lever,  
600-800-Amp.**



*For 600-800-Amp Switches, place the operating handle onto the pivot shaft extension as shown in Figure 2-4.*



**Figure 2-5. Operating Lever,  
1000-4000-Amp.**



*For 1000-4000-Amp Switches, insert manual handle into hole provided in rotating weight. See Figure 2-5.*

Move the installed handle in the direction shown to manually operate the transfer switch. The switch should operate smoothly and without binding. Return the transfer switch to the normal position. Remove manual operator handle and store it on the transfer switch in the place provided.

 <b>WARNING</b>

<p><b>Hazardous voltage.</b> <b>Can cause severe injury or death.</b></p> <p><b>Disconnect power sources before servicing.</b> <b>Barrier must be installed after adjustments, maintenance, or servicing.</b></p>

*(under 600 Volt)*

**Hazardous voltage can cause severe injury or death.**  
The Transfer Switch is energized; proceed with care! High voltage can cause personal injury, damage equipment, or lead to future failures. Remove watch, rings, and jewelry that can cause short circuits.

 <b>DANGER</b>

<p><b>Hazardous voltage.</b> <b>Will cause severe injury or death.</b></p> <p><b>Disconnect power sources before servicing.</b> <b>Barrier must be installed after adjustments, maintenance, or servicing.</b></p>

*(600 Volt and above)*

**Hazardous voltage will cause severe injury or death.**  
The Transfer Switch is energized; proceed with care! High voltage will cause personal injury, damage equipment, or lead to future failures. Remove watch, rings, and jewelry that can cause short circuits.

## Voltage Checks

Perform the following steps to check voltage.

1. Close the normal source circuit breaker.
2. Use an accurate voltmeter to check for proper voltage (phase-to-phase and phase-to-neutral voltages) and phase rotation at the contactor's normal-source terminals.
3. Close the emergency-source circuit breaker.
4. Manually start the generator set using the engine control switch on the generator set controller.
5. Use an accurate voltmeter to check for proper voltage (phase-to-phase and phase-to-neutral voltages) and phase rotation at the contactor's emergency-source terminals.
6. If necessary, adjust the generator voltage regulator following the generator set manufacturer's instructions. The automatic transfer switch will respond only to rated voltage and frequency specified on the nameplate. Check phase rotation; it should be the same as that of the normal source.
7. Shut down the generator set using the engine control switch on the generator set controller. Reconnect the contactor control in-line disconnect plugs. See Figure 2-1. Wait until the time delay engine cooldown (TDEC, if equipped) has completed timing per the factory setting (see the factory test sheet for settings). After the TDEC has completed timing, the generator set controller's engine control switch can be placed in the AUTO position.

## Electrical Operation Test

The transfer switch should be in the Normal position. The following procedure will check the electrical operation of the automatic transfer switch.

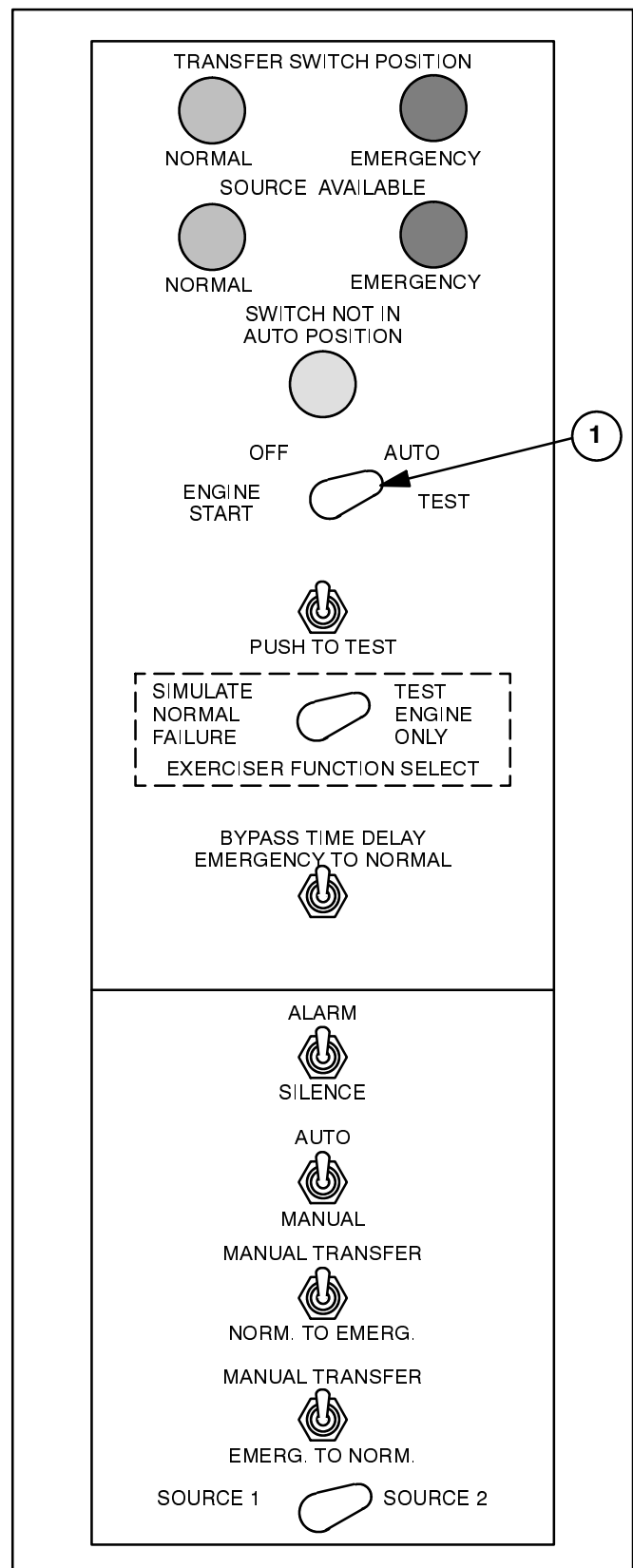
8. Place the test selector switch in the TEST position (if so equipped). See Figure 2-6.
9. Move the door-mounted test switch to TEST and hold it for generator set start. The generator set should start and run. This should happen after the Time Delay Engine Start (TDES) has completed timing.
10. The transfer switch will transfer to the emergency position. The transfer will occur after the Normal-to-Emergency Time Delay (TDNE) has completed timing.
11. Release the door-mounted test switch. The transfer switch will retransfer to normal after the emergency-to-normal time delay has completed timing.
12. Time Delay Engine Cooldown (TDEC, if equipped) allows the engine to continue running for an additional unloaded running time. The transfer switch TDEC will complete timing before any TDEC function in the generator set controller begins timing.

### NOTICE

During the generator set controller's cooldown period, connecting the transfer switch in-line disconnect plugs together with the generator controller's master switch in the AUTO position, immediately causes the generator set to start and run. Position the generator controller's master switch to OFF or allow the cooldown period to elapse.

13. Close load circuit breaker(s) when loads may be safely energized.

This completes functional tests of the transfer switch. The generator set starting control should be left in the "automatic" position.

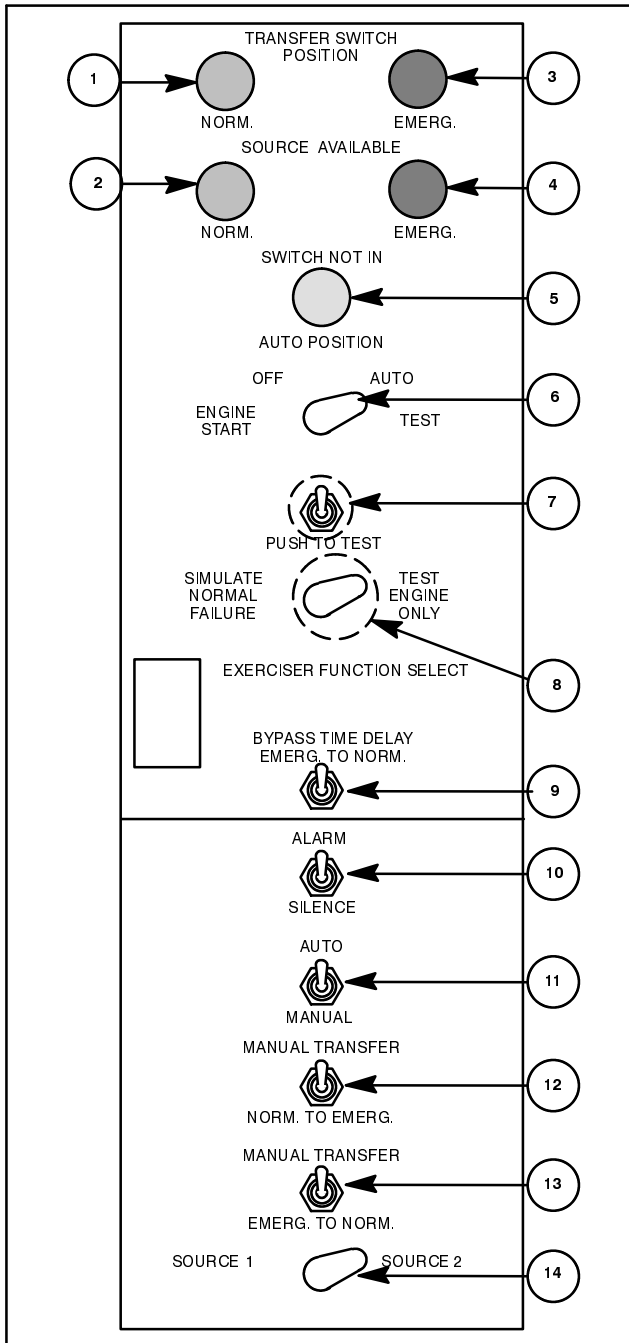


1. Test Selector Switch

**Figure 2-6. Transfer Switch Control Switches & Indicators**

# Notes

# Section 3. Operation



**Figure 3-1. Transfer Switch Control Switches & Indicators**

## Control Switches and Indicators

Various optional control switches and indicator lamps may be present on the transfer switch door. See Figure 3-1.

1. **Normal Transfer Switch Position Lamp (green):** lights to indicate that load is connected to the normal source (accessory 12-A, C).

2. **Normal Source Available Lamp (white):** lights to indicate presence of normal source voltage (accessory 12-E, G).
3. **Emergency Transfer Switch Position Lamp (red):** lights to indicate that load is connected to the emergency source (accessory 12-B, D).
4. **Emergency Source Available Lamp (white):** lights to indicate presence of emergency source voltage (accessory 12-F, H).
5. **Switch-Not-in-Auto Lamp (white):** lights to indicate that the four-position selector switch (6) is not in the automatic position, preventing automatic transfer switch operation (accessory 7-D, E, F).
6. **Four-Position Selector Switch:** selects transfer switch mode of operation. *Engine-Start* position signals the generator set to start. *Off* position prevents automatic transfer switch operation by de-energizing control circuits and opening the engine-start circuit. If the generator set is started locally (at the generator set controller) and the generator line circuit breaker is closed, the switch will transfer to emergency. *Auto* position enables automatic transfer switch operation. *Test* position simulates a normal-source failure (accessory 7-D, E, F).
7. **Test Switch:** *Auto* position allows automatic transfer switch operation. *Test* position signals generator set to start.
8. **Plant Exerciser Selector Switch:** *Simulate-Normal-Failure* position will exercise the generator set under load. *Test-Engine-Only* position will exercise the generator set unloaded (accessory 23-G).
9. **Bypass Time Delay Emerg. to Normal:** Operating the switch will cause the emergency-to-normal time delay to be overridden. It will cause the transfer switch to transfer to normal immediately, if the normal source is available (accessory 8-A, C).
10. **Alarm Silence Switch:** Operating the switch will silence the audible alarm that sounds when the transfer switch is in the emergency position (accessory 31-B).
11. **Auto-Manual Selector Switch:** *Auto* position selects automatic transfer switch operation. *Manual* position allows operation of transfer switch using the manual transfer toggle switches below (accessory 29-F, G, H, J).
12. **Manual Transfer, Normal-to-Emergency Switch:** Operating the switch will cause normal-to-emergency transfer if the normal source is available after any time delay (accessory 29-F, B, G, D).

13. **Manual Transfer, Emergency-to-Normal Switch:** Operating the switch will cause an emergency-to-normal transfer if the normal source is available after any time delay (accessory 29-B, D, H, J, C, E).
14. **Preferred-Source Selector Switch:** Selects either the normal or emergency source as the source that the transfer switch will transfer to if the selected source is available. Sources may be two utilities or two generator sets. Most installations will have a utility for one source and a generator set for the other source (accessory 10-A, B, C, D).

## Sequence of Operation

Note any Optional Accessories that may have been furnished on this switch and review their operation. See "Accessories."

### Normal Source Failure

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

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

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

points. If the emergency source is available immediately, the sensor may accept as soon as TDES relay drops out.

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

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

### Normal Source Restoration

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

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

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

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



## Section 4. Accessories

### 14-Day Generator Set Exercising Timer-Accessories 23-C, D and G

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



#### WARNING



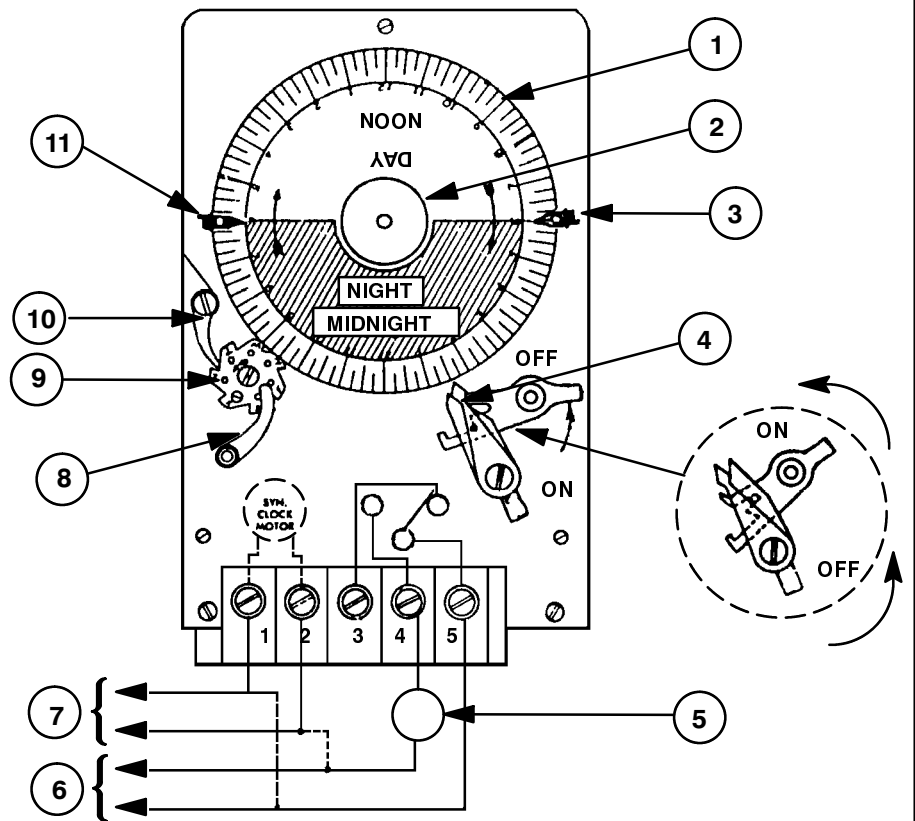
**SHOCK HAZARD!** Disconnect harness plug before installing any accessories involving connection to transformer assembly primary terminals 76, 77, 78 and 79. Terminals are at line voltage!

Acc. 23-C- The generator set is signaled to run unloaded for the set time period. Timer does not simulate a normal source failure. The transfer switch is not affected. Accessory 23-C has an override circuit to return the switch to normal should emergency source fail during an exercise run. Normal LEDs on logic cards will stay off until the exerciser completes timing.

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

Acc. 23-G- Includes a two-position switch to select to simulate a normal-source failure or to test the engine (generator set) only.

**Note: Dial turns clockwise.  
Day-of-week index cam  
revolves in 14 days.**



1. 24-Hour Dial
2. Thumbnut (do not use pliers)
3. "On" Tripper
4. Time Pointer
5. Load
6. To Line or Separate Voltage

7. AC Line
8. Cutoff Switch, actuates as screw deflects lever
9. Index Cam
10. Index Cam Ratchet
11. "Off" Tripper

**Figure 4-1. 14-Day Exercise Timer (Acc. 23) Connections & Setting**

## To Adjust/Set Exercise Day and Period (see Figure 4-1)

1. Decide what day (or days) of the week to exercise the generator set.
2. Remove the screw from the index cam lobe marked with the decided day(s).
3. Hold the 24-hour dial to prevent it from turning and, with the other hand, unscrew the thumbnut by turning it clockwise.
4. Set the black ON tripper to the time of day when the exercise period should start. Set the copper OFF tripper to the time of day when the exercise period should stop.
5. The index cam has 14 day positions. Turn the index cam counterclockwise until the desired exercise day is under the tip of the cutoff switch lever. Thread a supplied screw into each position hole except the position(s) for the desired exercise day(s).

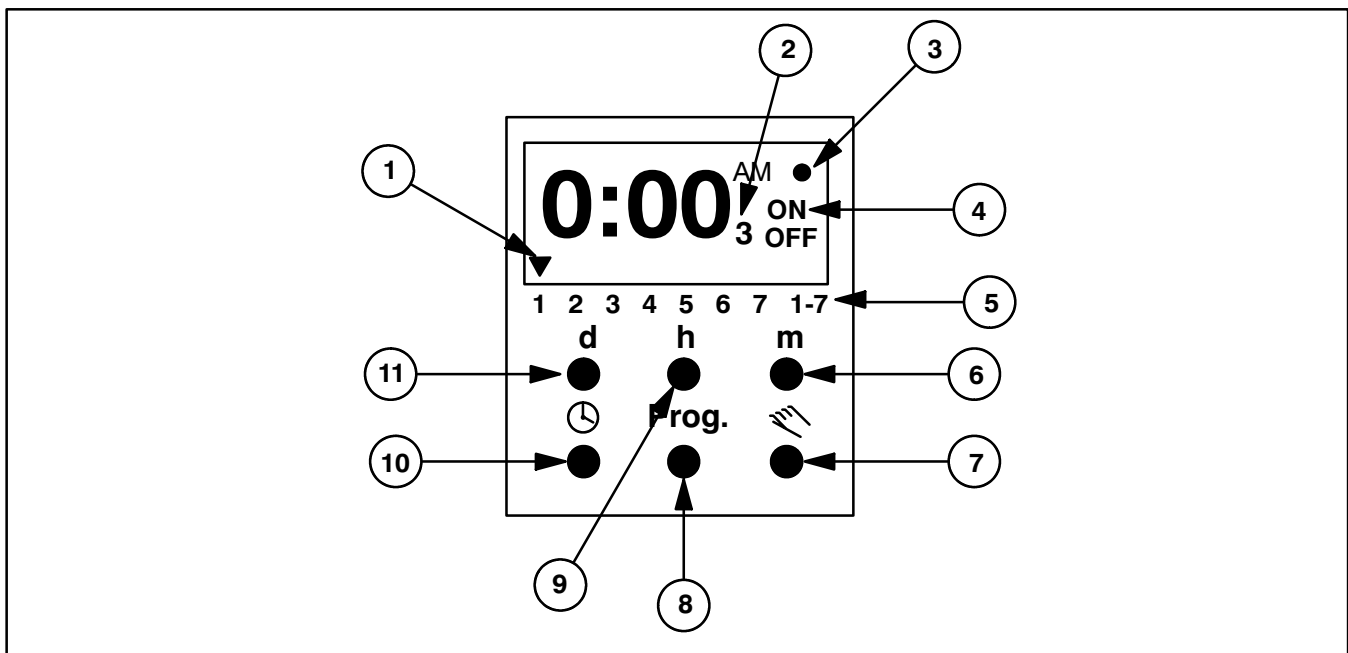
6. Turn the dial clockwise until the actual time of day aligns with the time pointer. Hand tighten the thumbnut (turn it counterclockwise) while holding the dial to prevent it from turning. Do not use excessive force to turn thumbnut.

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

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

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

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



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

Figure 4-2. Plant Exerciser Features

## Adjustment

See Figure 4-2 for operational information. Remove the transparent timer cover when making adjustments. Replace the cover when adjustment is complete.


### NOTICE

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 connecting 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 all previous memory and permit new programming. Press the weekday setting button, time setting button, minute setting button and override and permanent control button.

### Setting Day of Week and Time

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

### NOTICE

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

2. Press the **d** button to select the actual weekday. The arrow on the display will move to indicate the day of the week selected (1 through 7).
3. Set the actual 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 and go to the slow sequence so you do not pass the desired time.
4. After the time and day setting procedure is complete, release the  button.

### Daylight Savings Time Adjustment

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

1. To add 1 hour, press the **d** button and the **h** button *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) is programmable for each day of the week. A total (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.

### NOTICE

If the setting procedure is interrupted (postponed) or finished, the display will show the actual time after about 40 seconds and will 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 then 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 through 8 under "**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 one after the other. 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 go to the next time setting. Clear the program by pressing **h** and **m** buttons *simultaneously*.
3. Press **Prog.** and **d** buttons to go 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


This 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 the display returns to 0. The



vacation/holiday program starts at 12:00 AM the next day and is indicated on the display by OFF.

### NOTICE

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 alternately switch among the following modes: ON ●, OFF ●, and the automatic normal programmed mode. This bypasses the present programmed mode and places the plant exerciser in one of the other two modes. The plant exerciser remains in ON ● or OFF ● 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.

# Accessories

## Time Delays

KA-01-A: (TDNE) Time Delay on transfer from Normal to Emergency (adjustable 0.6 to 60 seconds).

KA-01-B: (TDNE) Time Delay on transfer from Normal to Emergency (adjustable from 1 to 30 minutes).

KA-02-A: (TDES) Time Delay on Engine Starting (adjustable from 3 to 20 seconds).

KA-02-E: (TDES) Time Delay on Engine Starting (fixed at 3 seconds).

KA-02-F: (TDES) Time Delay on Engine Starting (adjustable from 20 to 240 seconds).

KA-02-G: (TDES) Time Delay on Engine Starting (adjustable from 0.5 to 5 seconds).

KA-02-H: (TDES) Time Delay on Engine Starting (adjustable from 3 to 30 minutes).

KA-03-C: (TDEN) Time Delay of transfer from Emergency to Normal (adjustable from 1 to 30 minutes).

KA-04-C: (TDEC) Time Delay card for Engine Cooldown (adjustable from 1 to 30 minutes).

KA-04-D: (TDEC) Time Delay relay for Engine Cooldown (adjustable from 1 to 30 minutes).

## Pilot Lights

KA-12-A and C: Green pilot light indicates normal position.

KA-12-B and D: Red pilot light indicates emergency position.

KA-12-E and G: White pilot light indicates normal supply is present.

KA-12-F and H: White pilot light indicates emergency supply is present.

KA-12-T and U: Push-to-test lamp switch.

## Battery Charger

KA-24: Solid-state automatic adjustable float battery charger. For 12 or 24 VDC.

## Auxiliary Contacts—Relay

KA-14-C: Relay auxiliary contact (DPDT) is energized when normal power is available.

KA-14-D: Relay auxiliary contact (DPDT) is energized when emergency power is available.

## Auxiliary Contacts—Main Shaft

KA-15-A: Main shaft auxiliary contacts—one closed on normal, one closed on emergency (not available for 250-Volt-class switches).

KA-15-E: One additional contact closed on normal, for switches 30-150 and 600-800 Amps.

KA-15-F: One additional contact closed on emergency, for switches 30-150 and 600-800 Amps.

KA-15-G: Two additional contacts closed on normal, for switches 30-150 and 600-800 Amps.

KA-15-H: Two additional contacts closed on emergency, for switches 30-150 and 600-800 Amps.

KA-15-J: Three additional contacts closed on normal, for switches 30-150 and 600-800 Amps.

KA-15-K: Three additional contacts closed on emergency, for switches 30-150 and 600-800 Amps.

KA-15-L: Two additional contacts closed on normal, two additional contacts closed on emergency, for switches 225-400 Amp and 1000-4000 Amps.

KA-15-M: Three additional contacts closed on normal, three additional contacts closed on emergency, for switches 225-400 Amps.

## Source Monitors—Inphase

KA-34-A: Inphase monitor. For use with utility and generator or two generator sources.

KA-34-E: Inphase monitor. For use with two utility sources.

## Source Monitors—Sync Check Relay

KA-34-B: Sync-check relay operates in either direction.

KA-34-C: Sync-check relay operates only in emergency-to-normal direction.

KA-34-D: Sync-check relay operates only in normal-to-emergency direction.

## Source Monitors—Voltage, Frequency, Phase Sequence

KA-26C1: Overvoltage protection for the normal source. Adjustable from 100 to 115%, nominally set at 115%. Monitors one phase only.

KA-26C2: Overvoltage protection for the normal source. Adjustable from 100 to 115%, nominally set at 115%. Monitors three phases.

KA-26-D: Area protection with override circuit.

KA-26-G: Overfrequency protection for the normal source. Adjustable from 50 to 65 Hz. monitors one phase only.

KA-26-H: Underfrequency protection for the normal source. Adjustable from 45 to 60 Hz. monitors one phase only.

KA-05-A: Underfrequency card for emergency source (adjustable from 45 to 60 Hz).

KA-05-C: Overfrequency card for emergency source (adjustable from 55 to 65 Hz.).

KA-05-D: Undervoltage card for one phase of emergency source. Adjustable voltage sensing from 72 to 100% of nominal for pickup and 70 to 98% for dropout.

KA-05-E: Overvoltage card for one phase of emergency source. Adjustable from 100 to 115%, nominally set at 115% dropout unless otherwise specified.

KA-05-F: Undervoltage card for three phases of emergency source. Adjustable voltage sensing from 72 to 100% of nominal for pickup and 70 to 98% for dropout.

KA-05-G: Overvoltage card for emergency three phases of source. Adjustable from 100 to 115%, nominally set at 115% dropout unless otherwise specified.

KA-05-H: Phase sequence relay permits transfer in either direction when both sources have same phase rotation.

## Test Switches

KA-06-A and B: Momentary test switch.

KA-06-C and D: Maintained contact test switch. Nonautomatic switches.

KA-06-E and F: Key operated test switch.

KA-06-G and H: Maintained contact key operated test switch. Nonautomatic switches.

KA-06-L and M: Three-position test switch.

KA-07-C and D: Four-position selector switch with white light, for (accessory KA-06 is omitted if accessory KA-07 is selected).

KA-07-E, F and H: Four-position key operated selector switch with white light (accessory KA-06 is omitted if accessory KA-07 is selected).

## Time Delay Override Switches

KA-08-A and C: Override time delay from emergency to normal.

## Transfer Inhibit Switches

KA-09-C: Disconnect plug for intelligence circuit wire harness.

KA-09-F and G: Inhibitor switch. Nonautomatic switches.

KA-09-H and J: Key-operated inhibitor switch. Nonautomatic switches.

## Meters

KA-18-G: Frequency meter (not available with NEMA 3R & 12 enclosure).

KA-18-H: Running time meter (not available on NEMA 3R & 12 enclosure).

KA-18-J: Voltmeter, ammeter and selector switch (not available with NEMA 3R & 12 enclosure).

## Load Shedding Contacts

KA-35-G: Operates prior to transfer and resets immediately after transfer. Adjustable from 0.6 to 60 seconds.

KA-35-H: Operates prior to transfer and resets 0.3 seconds after transfer. Adjustable from 0.6 to 60 seconds.

KA-35-J: Operates immediately at time of transfer and 0.6-60 seconds (adjustable) after transfer.

KA-35-K: Operates 30 seconds before transfer and 3-300 seconds (adjustable) after transfer.

KA-35-L: Operates 3-300 seconds (adjustable) before and after transfer.

KA-35-M: Operates 0.3-30 seconds (adjustable) before and after transfer.

## Overlapping Neutral

KA-36-A: Overlapping neutral.

## Preferred Source Switches

KA-10-A and B: Two-position selector switch to select the preferred power source.

KA-10-C and D: Two-position selector switch to select the preferred power source. For use when both sources are engine-generators.

KA-10-F: Two-position selector switch with electric automatic operation to select the preferred power source. For use when both sources are engine-generators. Uses accessory KA-23 Plant Exerciser Timer.

## Terminal Lugs

KA-21: CU/AL terminal lugs for 1600-4000 Amp, 3-pole with/without overlapping neutral.

## Logic Protection Fuses

KA-28-A: Intelligence circuit fuses.

## Nonautomatic Switch Operation

KA-29-B and D: Switch operation from emergency to normal and normal to emergency, without override circuit to retransfer to an available source if the connected source fails. Nonautomatic switches.

KA-29-C and E: Switch operation from emergency to normal, without override circuit to retransfer to an available source if the connected source fails. Nonautomatic switches.

KA-29-F and G: Switch operation from emergency to normal and normal to emergency. Plus a two-position selector switch providing automatic/manual operation, without override circuit to retransfer to an available source if the connected source fails. Nonautomatic switches.

KA-29-H and J: Switch operation from emergency to normal. Plus a two-position switch providing automatic/manual operation, without override circuit to retransfer to an available source if the connected source fails. Nonautomatic switches.

Accessories KA-29-O through KA-29-V also include a selector switch override circuit, allowing automatic transfer if the connected source fails and the other source is available.

KA-29-O and P: Switch operation from emergency to normal, with override circuit to retransfer to an available source if the connected source fails. Plus a two-position selector switch providing automatic or manual operation.

KA-29-Q and R: Switch operation from emergency to normal and normal to emergency, with override circuit to retransfer to an available source if the connected source fails.

KA-29-S and T: Switch operation from emergency to normal and normal to emergency, with override circuit to retransfer to an available source if the connected source fails. Plus a two-position selector switch providing automatic or manual operation.

KA-29-U and V: Switch operation from emergency to normal, with override circuit to retransfer to an available source if the connected source fails.

## **Engine Cranking Limiter**

KA-30-A: Cranking limiter with 2-wire engine start circuits. Adjustable from 30 to 200 seconds.

KA-30-B: Cranking limiter for use on 3-wire engine start circuits. No cranking disconnect. Adjustable from 30 to 200 seconds.

KA-30-C: Cranking limiter for use on 3-wire engine start circuits. With cranking disconnect. Adjustable from 30 to 200 seconds.

## **Audible Alarm**

KA-31-B: Audible alarm with silencing switch. Alarm sounds to indicate emergency position.

## **Enclosure Heaters**

KA-39-A: Space heater for enclosed switches with ambient temperature not exceeding 80°F. Not thermostatically controlled.

KA-39-B: Space heater for enclosed switches with ambient temperatures exceeding 80°F. Thermostatically controlled.

## **Voltage Surge Withstand Protection**

KA-38-A: Voltage surge withstand protection, using MOV design.

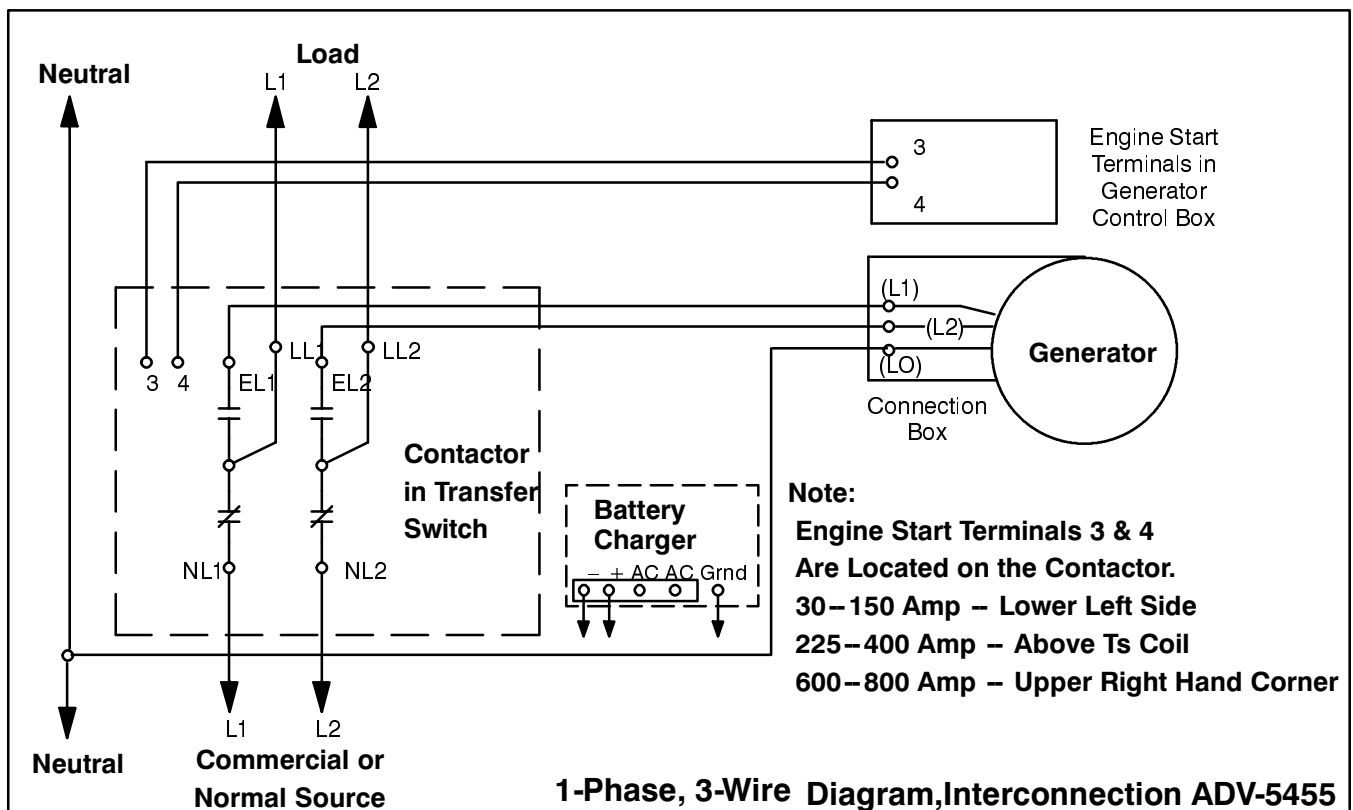
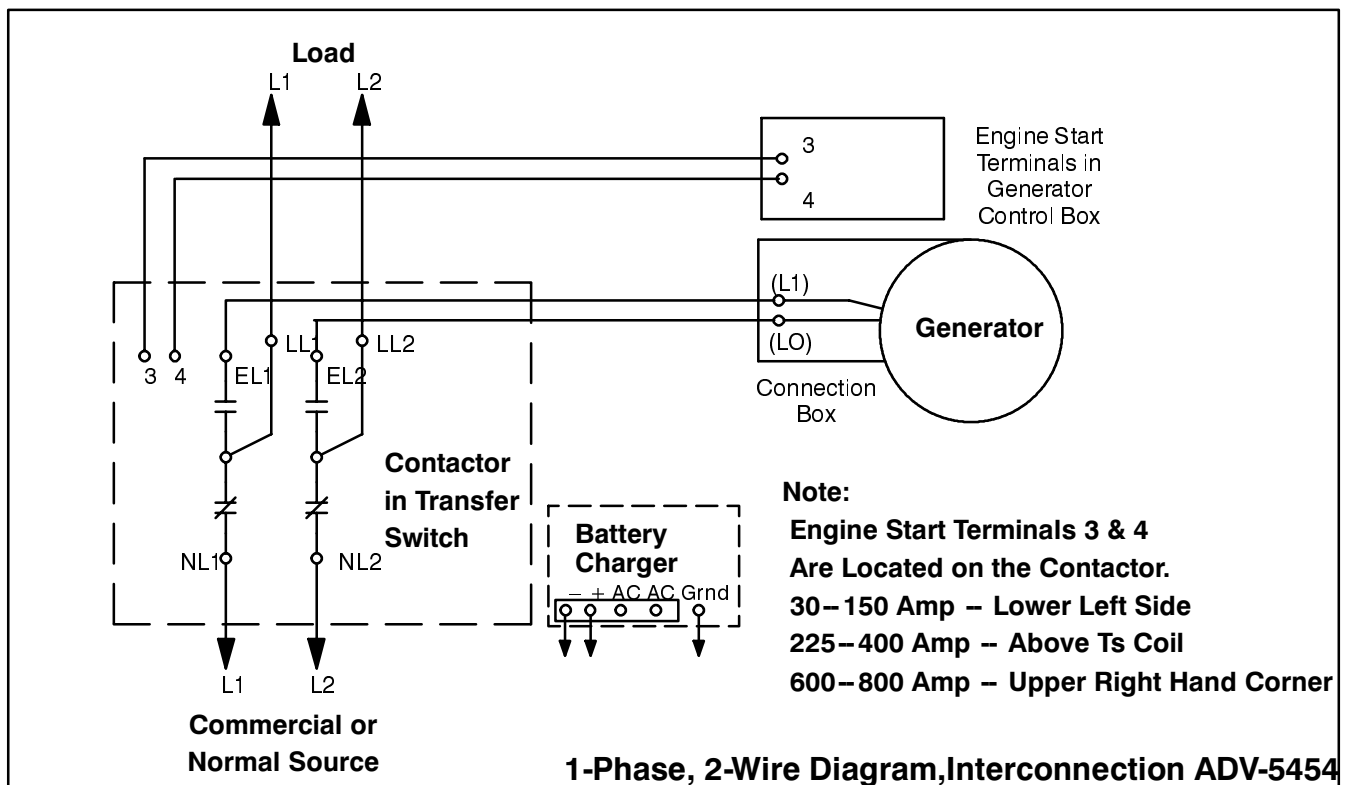
KA-38-B: Voltage surge withstand protection, using MOV design, plus solid-state silicon junction design (silicon avalanche).

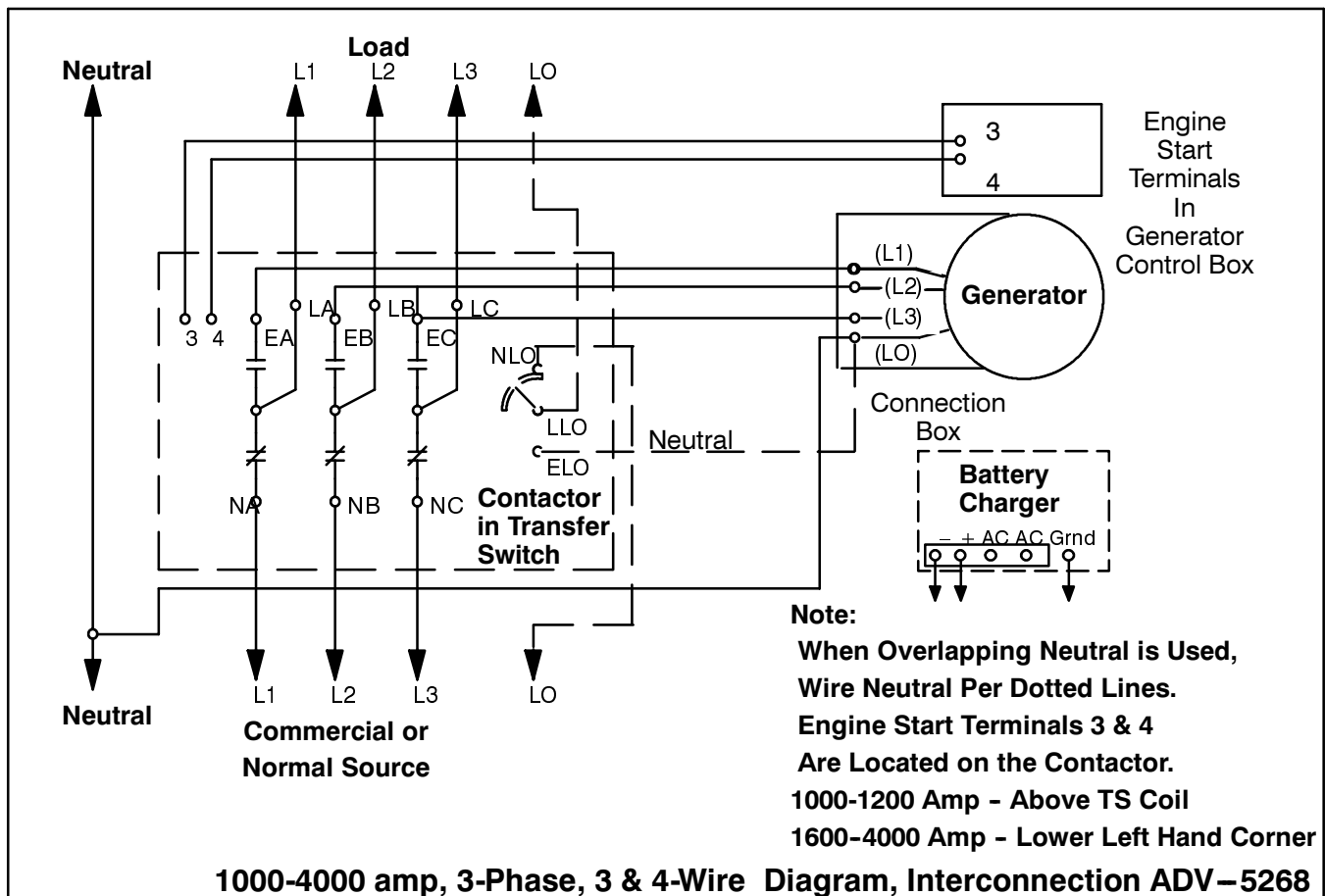
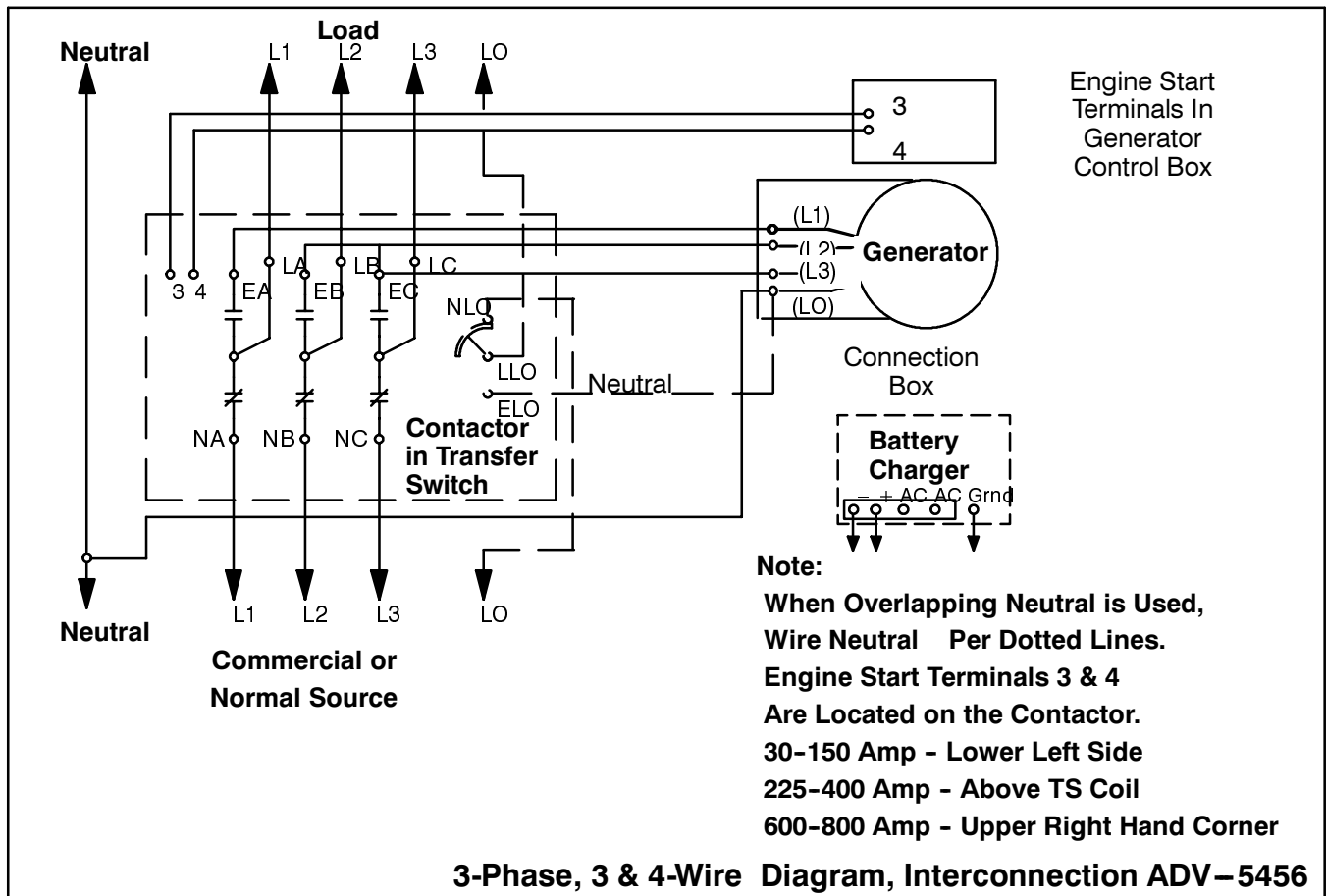
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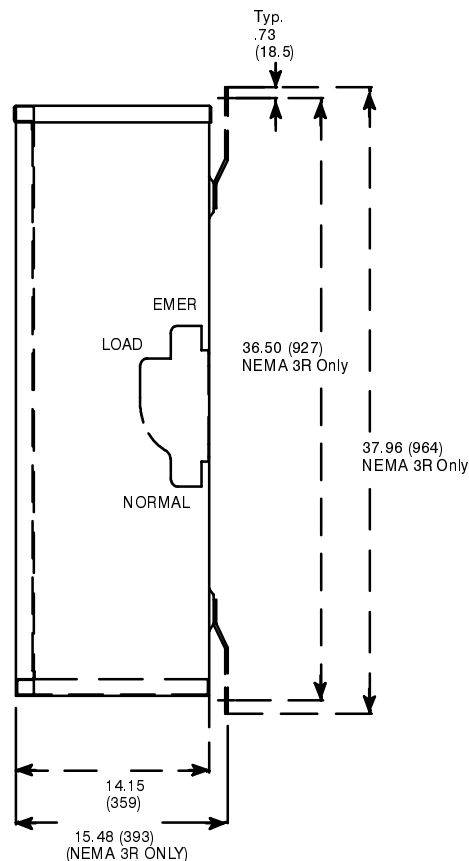
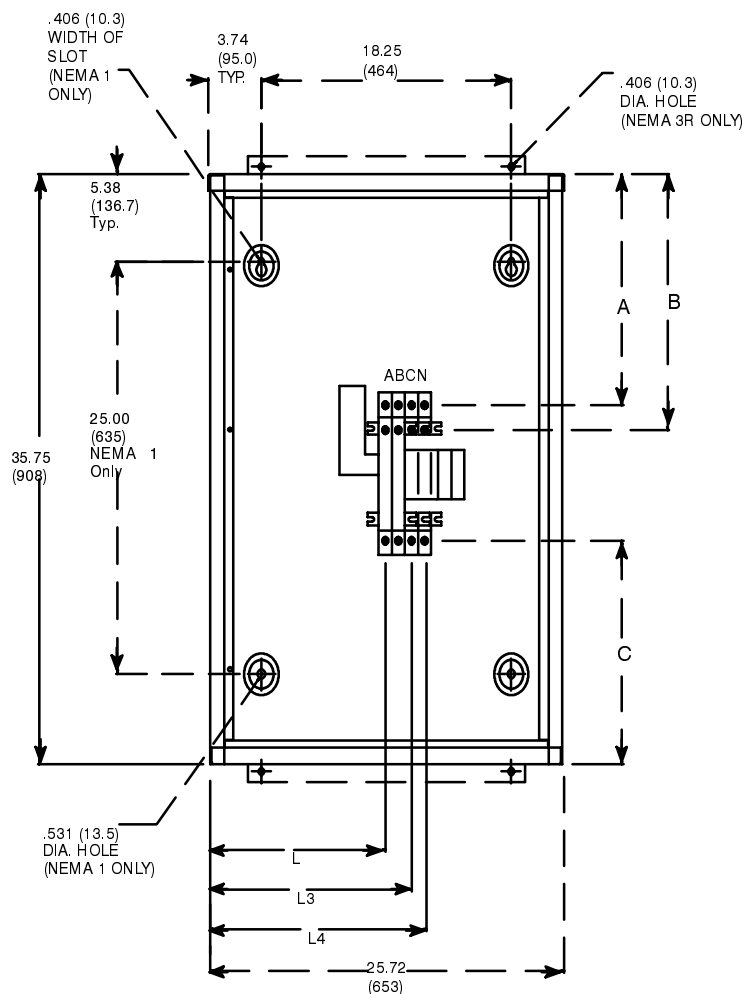


# Section 5. Wiring Diagrams and Drawings

Diagram or Drawing	Drawing Number	Page
<b>Interconnection Diagrams</b>		
Interconnection Diagram 30-800-Amp, 1-phase, 2-wire	ADV-5454	5-2
Interconnection Diagram 30-800-Amp, 1-phase, 3-wire	ADV-5455	5-2
Interconnection Diagram 30-800-Amp, 3-phase, 3- & 4-wire	ADV-5456	5-3
Interconnection Diagram 1000-4000-Amp, 3-phase, 3- & 4-wire	ADV-5268	5-3
<b>Enclosure Dimensions</b>		
Enclosure Dimensions, 30-150-Amp	ADV-5238, sheet 1 of 3	5-4
Enclosure Dimensions, 225-400-Amp	ADV-5238, sheet 2 of 3	5-5
Enclosure Dimensions, 600-800-Amp	ADV-5238, sheet 3 of 3	5-6
Enclosure Dimensions, 1000-1200-Amp	ADV-5448, sheet 1 of 2	5-7
Enclosure Dimensions, 1600-4000-Amp	ADV-5448, sheet 2 of 2	5-8
<b>Contactor Wiring</b>		
2-Pole Contactor Wiring	294859, sheet 1 of 2	5-9
3-Pole Contactor Wiring	294859, sheet 2 of 2	5-10







Sizes Of Screw Type Terminals  
For External Power Connections

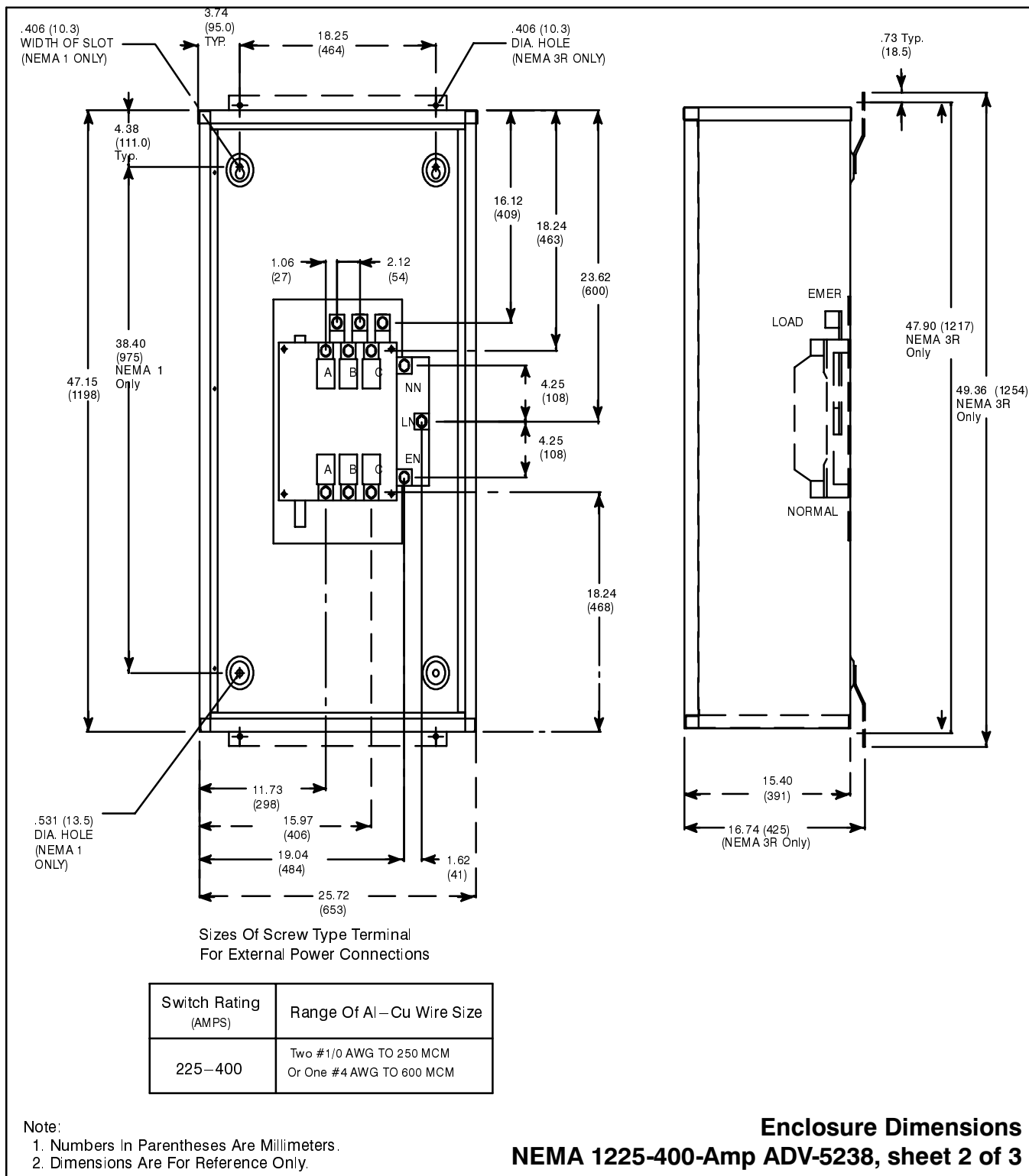
RATING	A	B	C	L	L3	L4
30,70,104 AMP	14.38 (365)	15.50 (394)	14.50 (368)	11.00 (279)	12.46 (316)	13.19 (335)
150 AMP	14.25 (362)	15.88 (403)	13.38 (340)	12.30 (312)	14.22 (361)	15.18 (386)

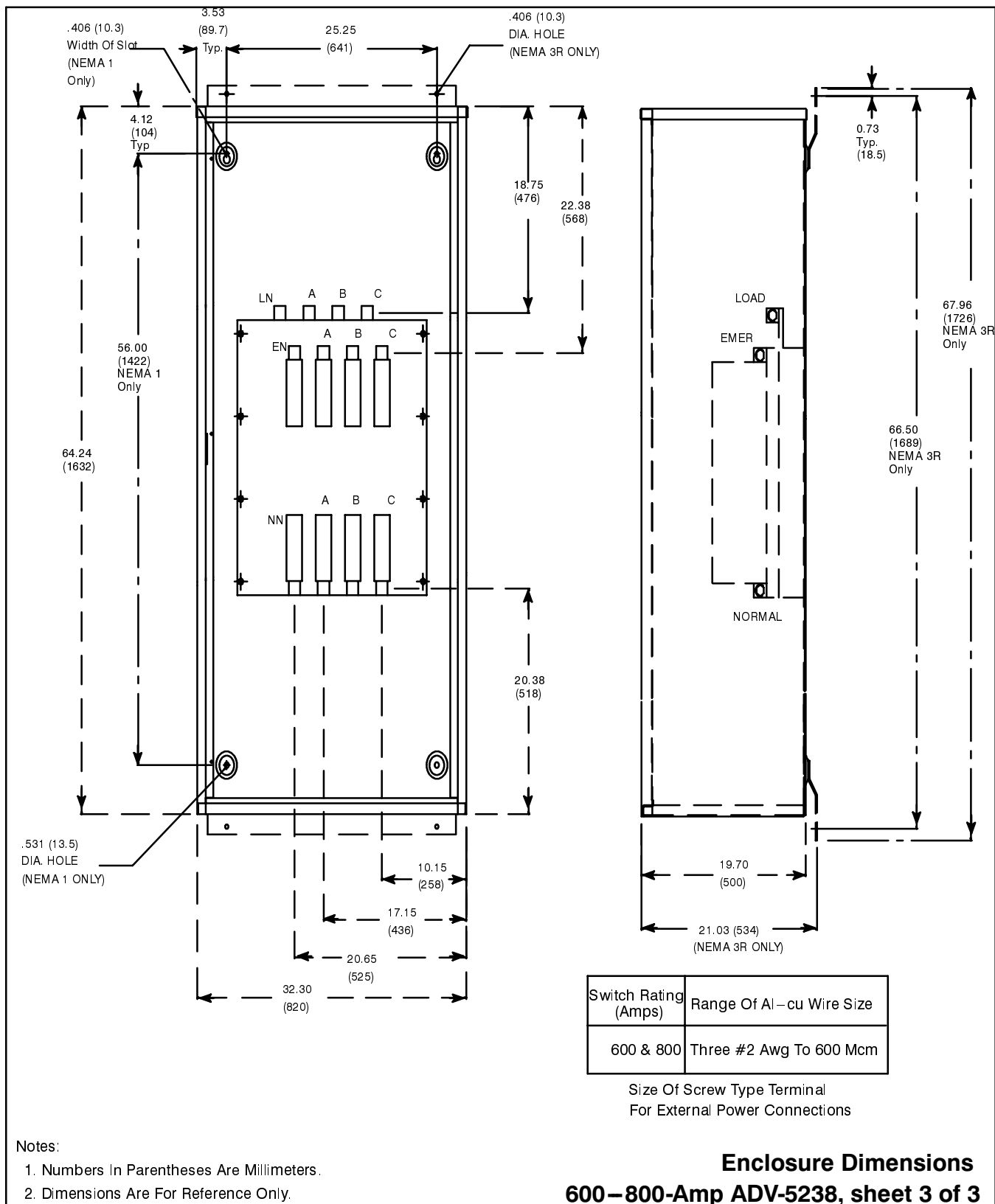
Switch Rating (AMPS)	Range Of AL-CU Wire Size
30	One #14 To #6 AWG
70	One #14 To 1/0 AWG
104	One #14 To 2/0 AWG
150	One #8 To 3/0 AWG

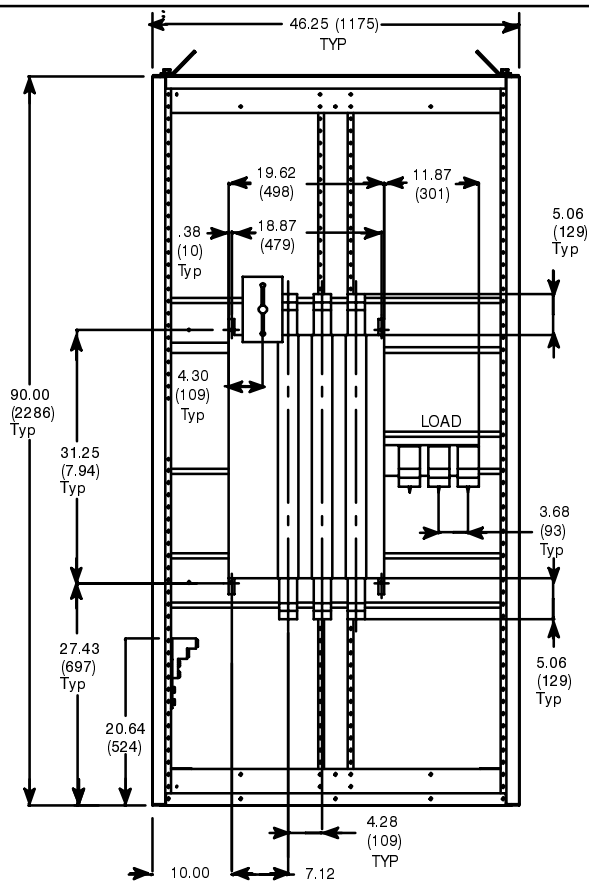
Notes:

1. Numbers In Parentheses Are Millimeters
2. Dimensions Are For Reference Only.

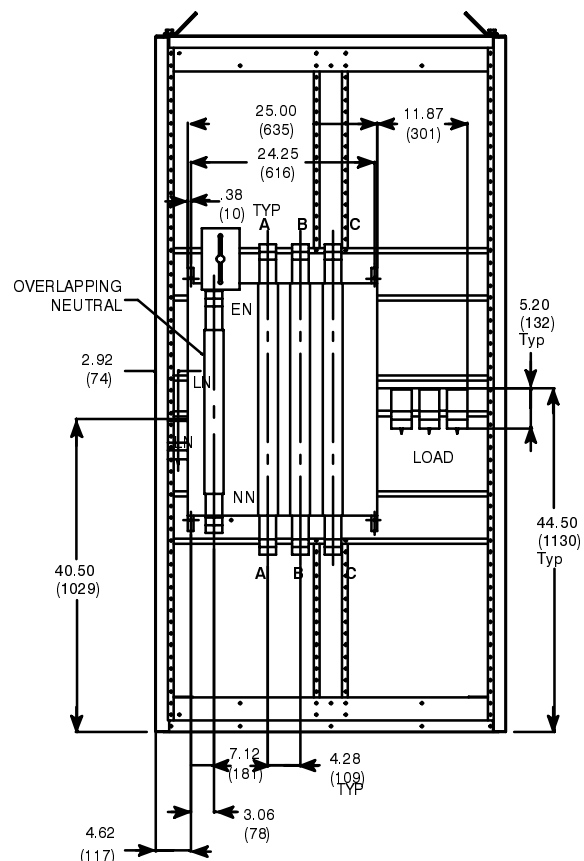
**Enclosure Dimensions**  
**30-150-Amp ADV-5238, sheet 1 of 3**



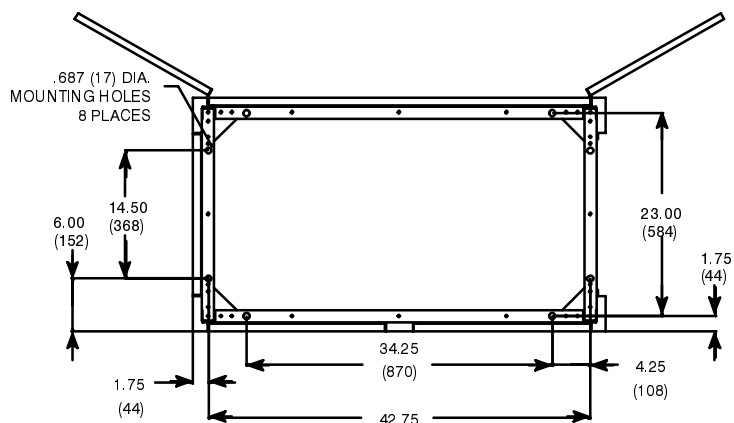
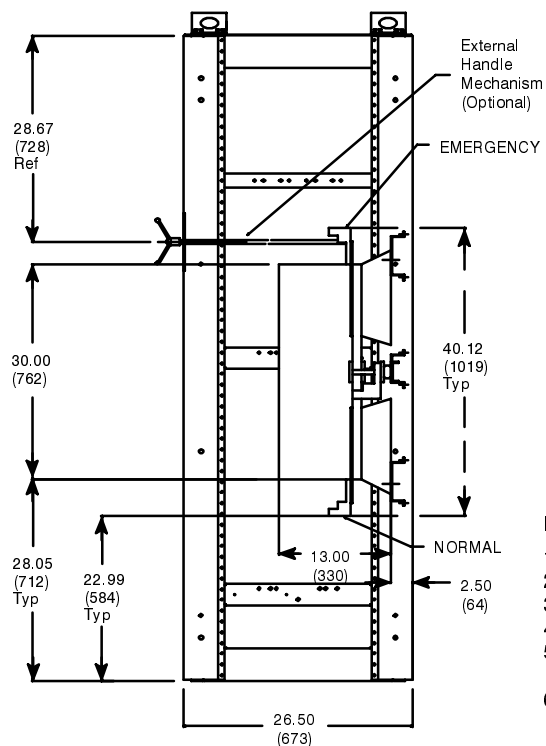




**2 & 3 Pole Without Overlapping Neutral**



**2 & 3 Pole With Overlapping Neutral**



**Bottom View**

NEMA Type 1 - General Purpose, Indoor, Floor Supported.

1. Free Standing, Frame Construction.
2. Removable Doors, Key Locking Handle. Two Doors With Single, Center Latch.
3. Sides, Top, And Back Removable. Open Bottom.
4. Provisions For Lifting.
5. Enclosures Constructed In Accordance With UL Standard 508 (Ansi C33.76-1971) As Referenced In UL Standard 1008.
6. Use Operator's Manual. Refer To This Publication Prior To Installation And Operation Of The Switch. Dimensions In ( ) Are Millimeter Equivalents. Size Of UL Listed Solderless Screw Type Terminals For External Power Connections. Four # 2 AWG To 600 MCM AL-CU Wire.

**1000-1200-Amp, 2 & 3 Pole With Overlapping Neutral ADV-5448**









**TP-5087 8/93c**

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