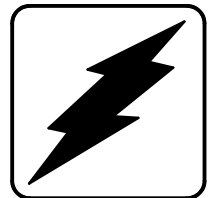


# Operation and Installation

## Automatic Transfer Switches



Models:

**MMS**

**MNS**

Contactors:

Molded-Case Circuit Breakers

Molded-Case Switches

40-3000 Amperes

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

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

TP-5658 11/93b

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# Safety Precautions and Instructions

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

This manual contains several types of safety precautions which are explained below.

## DANGER

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

## WARNING

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

## CAUTION

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

### NOTE

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

## HAZARDOUS VOLTAGE/ ELECTRICAL SHOCK

### DANGER



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

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

### NOTE

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

### NOTE

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

## HEAVY EQUIPMENT

### WARNING



**Unbalanced weight.  
Improper lift can cause severe injury, death, or  
equipment damage.**

Do not use lifting eyes.  
Use lifting bars thru holes in skid to lift set.

# Introduction

This manual provides operation and initial installation instructions for Kohler automatic transfer switches that use 25-400 ampere contactors as the power switching device.

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

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

## List of Related Manuals

The group of power switching devices covered by this manual is part of a family of related units. Separate operation and installation manuals are available for each group within the overall family. Be sure this manual is the correct manual for this automatic transfer switch.

Each automatic transfer switch includes a controller. There are three types of controllers and each type of controller is covered in a separate operation and installation manual. To be complete, this power switching device manual must be accompanied by a copy of the operation and installation manual for the controller used in the automatic transfer switch. Available controllers and the related manual numbers are as follows:

<b>Controllers</b>	<b>Operation/ Installation Manual</b>
Controller E33+	TP-5662
Controller, S340+, (Solid State)	TP-5663
Controller, M340+ (Microprocessor)	TP-5664

**Figure 1: Controller Manuals**

## Service Assistance

For sales and service in the U.S.A. and Canada, check the yellow pages of the telephone directory under the heading GENERATORS– ELECTRIC for an authorized service distributor/dealer or call 1-800-544-2444.

KOHLER CO., Kohler, Wisconsin 53044 U.S.A.  
Phone: 920-565-3381  
Fax: 920-459-1646 (U.S.A. Sales)  
920-459-1614 (International)

To ensure supply of correct parts or information, make note of the following identification numbers in the spaces provided:

### PART NUMBER AND SERIAL NUMBER

Part and serial numbers are provided on the nameplate attached to the transfer switch.

Part No. \_\_\_\_\_

Serial No. \_\_\_\_\_

# Notes

# Section 1. Specifications

## Purpose of Switch

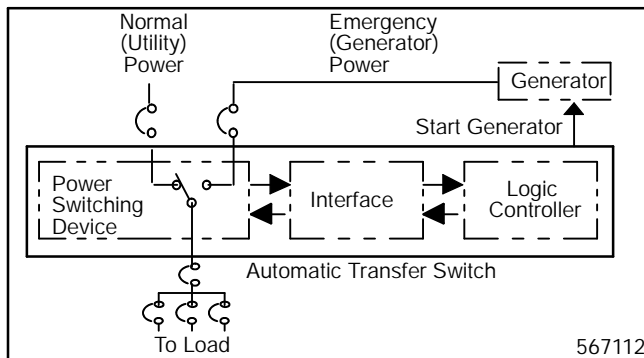
An automatic transfer switch is a switching device that automatically transfers critical electrical loads from a normal (preferred) power source to an emergency (standby) power source. The automatic transfer occurs when normal power fails or is substantially reduced. An automatic transfer switch also transfers the load back from emergency power to the normal power source when normal power is restored.

## Components of Switch

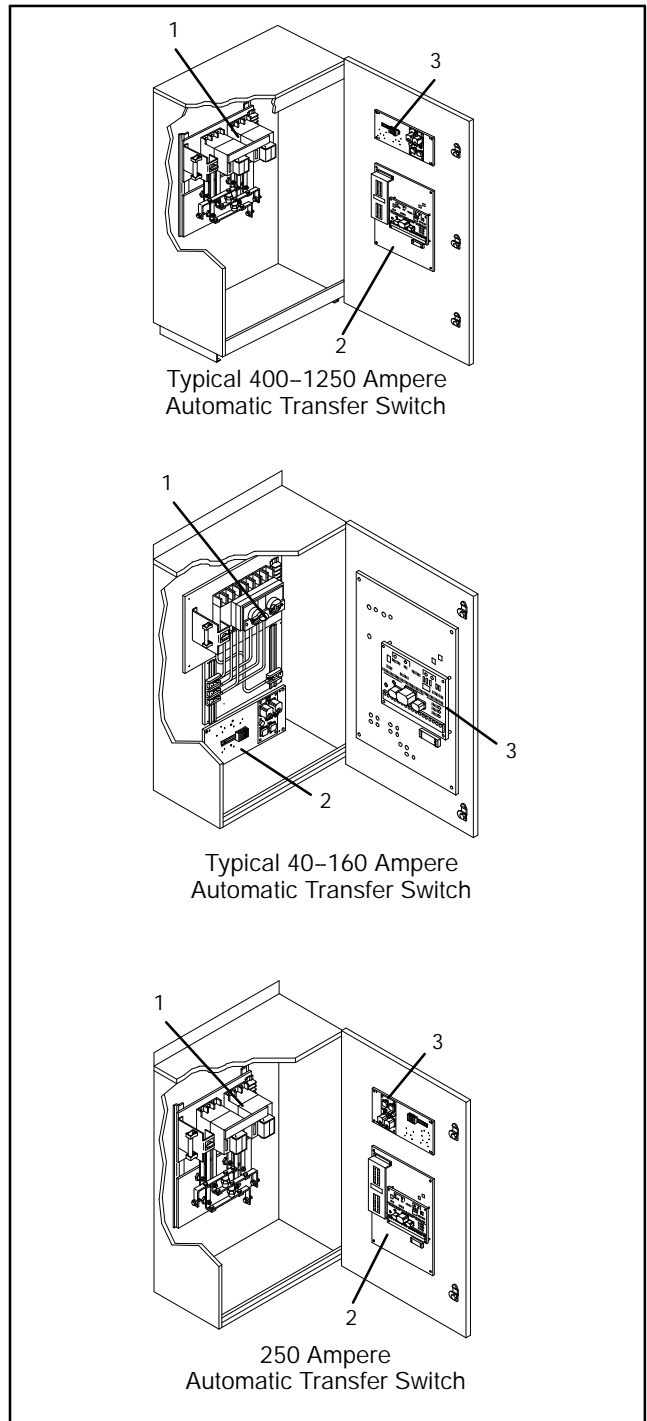
A typical automatic transfer switch (Figure 1-1) includes the actual power switching device and the logic controller to perform power monitoring and transfer sequencing tasks. An interface board is also included to match the standard controller inputs/outputs to the levels required by a specific switching device.

The power switching device used in the models covered by this manual is made of two multi-pole, molded-case, toggle-operated switches or circuit breakers. Each switch or circuit breaker is equipped with a motor operator to allow automatic operation. The two switches or circuit breakers are mechanically and electrically interlocked together to avoid conditions where both switches or circuit breakers are closed at the same time. With this feature it is possible to select one power source to feed the load without crosscoupling that power source to the other power source.

The three functional units that make up the automatic transfer switch are mounted in an enclosure with a hinged front door. See Figure 1-2. The controller mounts on the back of the front door so its controls and indicators are available to an operator. A signal cable, with in-line connectors to facilitate component replacement and door removal, connects the controller to the interface board and the switching devices.



**Figure 1-1. Basic Transfer Switch Block Diagram**



- 1 Switching Device
- 2 Interface Panel
- 3 Logic Controller

**Figure 1-2. Transfer Switch Components**

## Ratings

A nameplate (Figure 1-3) is attached to the automatic transfer switch enclosure. The nameplate label includes a Kohler part number coded to provide characteristic and rating information that affects installation and operation. Copy the part number into the blank spaces provided in Figure 4 and then use the tables in Figure 4 to interpret the correct part number.

### NOTE

Also copy the part number and serial number from the nameplate into the spaces provided on the inside front cover of this manual for use when requesting service or parts.

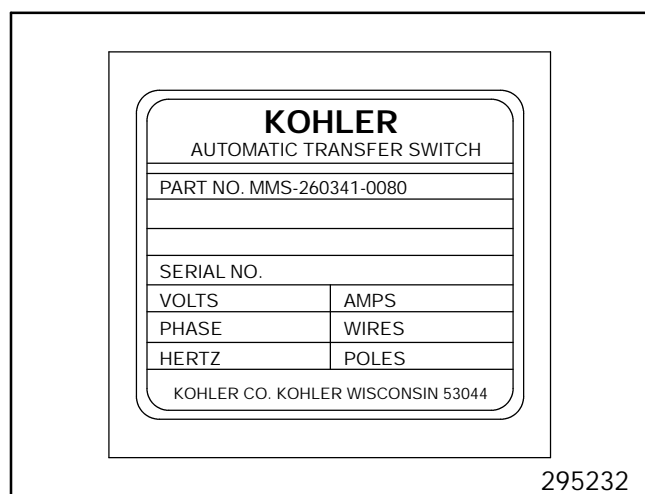


Figure 1-3. Transfer Switch Nameplate

## Specifications

Specifications for automatic transfer switches covered by this manual are listed below:

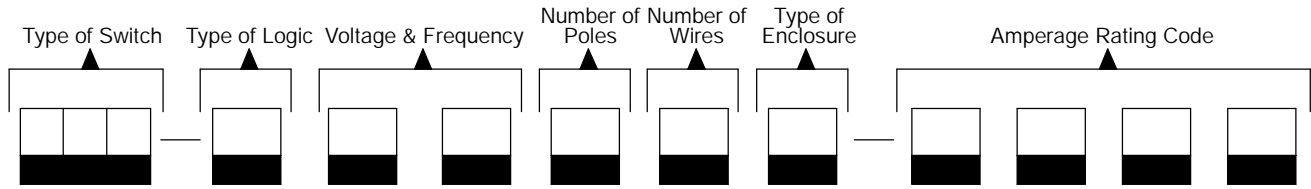
- D Provided as a complete automatic transfer switch with E33+, S340+ (solid state logic) or M340+ (microprocessor logic) controller in a NEMA Type 1 enclosure
- D Meets IEC standards
- D Rated voltage up to 690 vac
- D Amperage ratings from 40 to 1250 amperes
- D Breaking capacity of 85 kVA at 220/240 volts
- D Available as a circuit breaker automatic transfer switch with short circuit and overload protection
- D Available as a molded-case switch with no overload protection
- D Switching device electrically and mechanically interlocked
- D Three-pole and four-pole
- D Four-pole fully rated (no overlapping neutral)
- D Can be operated manually
- D Ambient temperature range  $-5^{\circ}\text{C}$  to  $+60^{\circ}\text{C}$
- D Time delay neutral function available
- D Circuit breaker characteristics summarized in Figure 1-4

Transfer Switch Rating (Amperes)	Rated Operational Voltage	Rated Ultimate Breaking Capacity AC (kA rms)* according to IEC 947.2 (P1 according to IEC 157-1)					Rated Admissible Short Time Current	
		220/240V	380/415V	440V	500V	660/690V	kA (rms)	t (s)
40	690	85	25	20	14	8		
80	690	85	25	20	14	8		
100	690	85	25	20	14	8		
160	690	85	25	22	14	8		
250	690	85	35	30	15	8		
400	690	85	35	30	15	10	6	0.1
630	690	85	35	30	15	10	9	0.1
800	690	85	50	42	40	25	12	1
1000	690	85	50	42	40	25	12	1
1250	690	85	50	42	40	25	12	1

\*Defined for a power factor of:  
 0.5 if  $8 < \text{kA rms} < 10$       0.3 if  $10 < \text{kA rms} < 20$   
 0.25 if  $20 < \text{kA rms} < 50$       0.2 if  $\text{kA rms} < 50$

Figure 1-4. Summary of Circuit Breaker Characteristics

Record the transfer switch part number in the boxes below. The transfer switch part number defines characteristics and ratings as explained in the accompanying chart.



**Kohler Part Number Key**

This chart explains the Kohler Transfer Switch part numbering code system. The sample part number shown is for a standard molded-case switch with E33+ Logic rated at 480 Volts, 60 Hertz, 3-phase, 3-pole, and 4 wires in a NEMA 1 enclosure with an amperage rating of 80 amperes.

**SAMPLE PART NUMBER**

**MNS-266341-0080**

**Classification of Power Switch**

M: Switch or Circuit Breaker

**Type of Power Switch**

M: Molded-Case Circuit Breaker  
N: Molded-Case Switch (No Protection)

**Type of Switch**

S: Standard

**Type of Logic**

- 1: S340+
- 2: E33+
- 3: S340+ with Program Transition
- 4: E33+ with Program Transition
- 5: M340+
- 6: M340+ with Program Transition

**Voltage Code**

- 60: 600 Volt, 60 Hz
- 62: 120 Volt, 60 Hz
- 63: 220 Volt, 50 Hz
- 64: 240 Volt, 60 Hz
- 66: 480 Volt, 60 Hz
- 68: 208 Volt, 60 Hz
- 71: 380 Volt, 50/60 Hz

**Number of Poles**

- 3: 3 Pole, 3 Phase
- 6: 4 Pole-Fully Rated Poles (No Overlapping Neutral)

**Number of Wires**

- 3: 3 Wire
- 4: 4 Wire

**Enclosure**

NEMA Type 1

**Amperes**

Numbers Indicate Ampere Rating of Switch

Figure 1-5. Transfer Model Designations

# Notes

# Section 2. Installation

## Upon Receipt of Unit

Kohler automatic transfer switches are shipped factory wired and tested, ready for installation. The actual installation process consists of mechanically mounting and electrically wiring the unit to the normal and emergency power sources, to the load, and to the generator.

### Inspection

Carefully unpack or uncrate the automatic transfer switch and check for shipping damage. If damage is discovered, file damage claims with the shipping company immediately and also notify the distributor/dealer.

### Storage

Do not remove the protective packing until ready for final installation. Protect the automatic transfer switch at all times from excessive moisture, construction grit, and metal chips. Avoid storage in low-temperature, high-humidity areas where moisture could condense on the unit.

## Mechanical Installation

To plan the installation, use the dimensions given on the enclosure dimension drawings in Section 6. Select the mounting site to match local electrical code restrictions for the enclosure type. Mount the automatic transfer switch as near the load and power sources as possible. Also be sure to allow adequate space for switch servicing and full opening of the enclosure door.

### Lifting

The approximate weight of each automatic transfer switch covered by this manual is given in Figure 2-1. For lifting, use a spreader bar. Attach the bar only to the enclosure's mounting holes or lifting eyes; do not lift the unit at any other points. Ensure the front door is in place and latched closed when moving or mounting the unit.

## Mounting

The 40-250 ampere automatic transfer switches covered by this manual must be mounted vertically to a rigid supporting structure such as a wall. Key hole slots for mounting purposes are provided in the mounting brackets on the top and bottom of each unit. When mounting one of these units, plumb the enclosure to ensure that the door hinges are vertical to avoid any distortion of the enclosure or door. Place washers behind the mounting bracket key holes to shim the enclosure to a plumb condition.



The 400-1250 ampere automatic transfer switches covered by this manual are equipped with mounting feet for floor mounting and key hole slots for hanging on a rigid supporting structure such as a wall. When floor mounting one of these units, shim the mounting feet as needed to plumb the enclosure so that the door hinges are vertical to avoid any distortion of the enclosure or door. When wall mounting one of these units, plumb the enclosure to ensure that the door hinges are vertical to avoid any distortion of the enclosure or door. Place washers behind the key holes to shim the enclosure to a plumb condition.

Automatic Transfer Switch Rating (Amps)	Approximate Weight lb (kg)
40	226 (103)
80	226 (103)
100	226 (103)
160	226 (103)
250	336 (153)
400	614 (279)
630	629 (286)
800	685 (311)
1000	714 (324)
1250	714 (324)

Figure 2-1. Automatic Transfer Switch Weight

# Electrical Wiring

All internal electrical connections are prewired. The only wiring necessary when installing the automatic transfer switch is the connections from the automatic transfer switch to the external devices.

 <b>DANGER</b>

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

## NOTE

For easy access during installation wiring, the front door of the enclosure can be removed. Simply disconnect the cable plug that connects the front door components to the internal components and then lift the door off its hinge pins.

## Power Connections

All conductors should enter the enclosure at recommended locations as noted on the enclosure dimension drawings in Section 6. When drilling entry holes for any conductors, cover the transfer switch components for protection from metal chips and construction grit. Remove any debris from the enclosure with a vacuum cleaner (*using compressed air for this purpose can lodge contaminants in components and cause damage*).

Connection points for the normal power, emergency power, and load are clearly marked on the switch or

circuit breaker assembly and also shown and marked on the enclosure dimension drawings in Section 6. Be sure to heed the phase markings (A, B, C, and N).

## NOTE

Connect source and load phases as indicated by the markings and drawings. Improper connections may cause short circuits and can cause phase-sensitive load devices to run in reverse or prevent load devices from functioning.

Complete individual cable connections as follows:

1. Strip insulation to bare end of cable for length indicated in Figure 2-2.
2. Remove surface oxides from conductors by cleaning with a wire brush. When aluminum conductors are used, apply oxidation inhibitor to the conductors.
3. Insert bare end of conductor into circuit breaker terminal.
4. Tighten terminal screw to torque listed in Figure 2-2.
5. Carefully wipe away excess oxidation inhibitor.

## Start Generator Connection

The generator start signal connections are located on a terminal block on the transfer switch contactor. The location of terminal block is marked by a red decal within the enclosure. Connect the generator conductors for the start signal to terminals 3 and 4 as shown in the interconnection diagrams provided in Section 6 of this manual.

## Other Accessory Connections

Any external connections necessary for accessories are described in the applicable controller manual. (See **List of Related Manuals** in Section 1 of this manual.)

Transfer Switch Rating (Amperes)	Strip Length in. (mm)	Material	Cable Size (AWG)	Size (mm <sup>2</sup> )	No. of Cables	Torque in-lb (Nm)
40	0.75 (19)	Copper	14-10	2.5-4	1	35 (4)
			8	8.4	1	40 (4.5)
			6-4	10-16	1	45 (5)
			3-1	25-40	1	50 (5.5)
		Aluminum	3-1/0	25-50	1	50 (5.5)
80	0.75 (19)	Copper	14-10	2.5-4	1	35 (4)
			8	8.4	1	40 (4.5)
			6-4	10-16	1	45 (5)
			3-1	25-40	1	50 (5.5)
		Aluminum	3-1/0	25-50	1	50 (5.5)
100	0.75 (19)	Copper	14-10	2.5-4	1	35 (4)
			8	8.4	1	40 (4.5)
			6-4	10-16	1	45 (5)
			3-1	25-40	1	50 (5.5)
		Aluminum	3-1/0	25-50	1	50 (5.5)
160	1.0 (25)	Copper	4-250 MCM	16-126.7	1	375 (42)
		Aluminum	4-350 MCM	16-185	1	375 (42)
250	1.0 (25)	Copper	4-250 MCM	16-126.7	1	375 (42)
		Aluminum	4-350 MCM	16-185	1	375 (42)
400	1.375 (35)	Copper	2/0-600 MCM	70-304	1	375 (42)
		Aluminum	4/0-500 MCM	110-300	1	375 (42)
630	1.375 (35)	Copper	2/0-600 MCM	70-304	1	375 (42)
		Copper	2/0-350 MCM	70-185	2	375 (42)
		Aluminum	4/0-500 MCM	110-300	1 or 2	375 (42)
800	1.25 (32)*	Copper-Aluminum	2/0-400 MCM	70-240	1 or	375 (42)
		Copper	2/0-300 MCM	70-150	1, 2, or 3	375 (42)
		Aluminum	2/0-400 MCM	70-240	1, 2, or 3	375 (42)
1000	1.25 (32)*	Copper-Aluminum	2/0-400 MCM	70-240	1, 2, 3, or 4	375 (42)
1250	1.25 (32)*	Copper-Aluminum	3/0-500 MCM	95-300	1, 2, 3, or 4	375 (42)

\* Front holes only. For rear holes, 2.25 (57)

**Figure 2-2. Lug Sizes and Tightening Torque Values**

# Notes

# Section 3. Operation

## Switches and Indicators

The switches and indicators on an automatic transfer switch are determined by the logic controller. For details on this subject, refer to the appropriate controller operation and installation manual. (See **List of Related Manuals** in Section 1.)

## Manual Operation

Manual operation of the automatic transfer switch may be of use when the controller fails or when testing/troubleshooting the unit. Because the switches differ slightly, two separate procedures are provided for: (1) units with 40-160 ampere ratings and (2) units with 250-1250 ampere ratings.

### NOTE

Circuit breaker switching devices will trip open automatically in the event of a short circuit. When this occurs, clear the short circuit. Then manually operate the switch to select the desired power source as described in the appropriate procedure.

### NOTE

Due to mechanical interlocking, both switches or circuit breakers cannot be on at the same time. To set one switch or circuit breaker to ON, the other switch or circuit breaker must first be set to OFF.

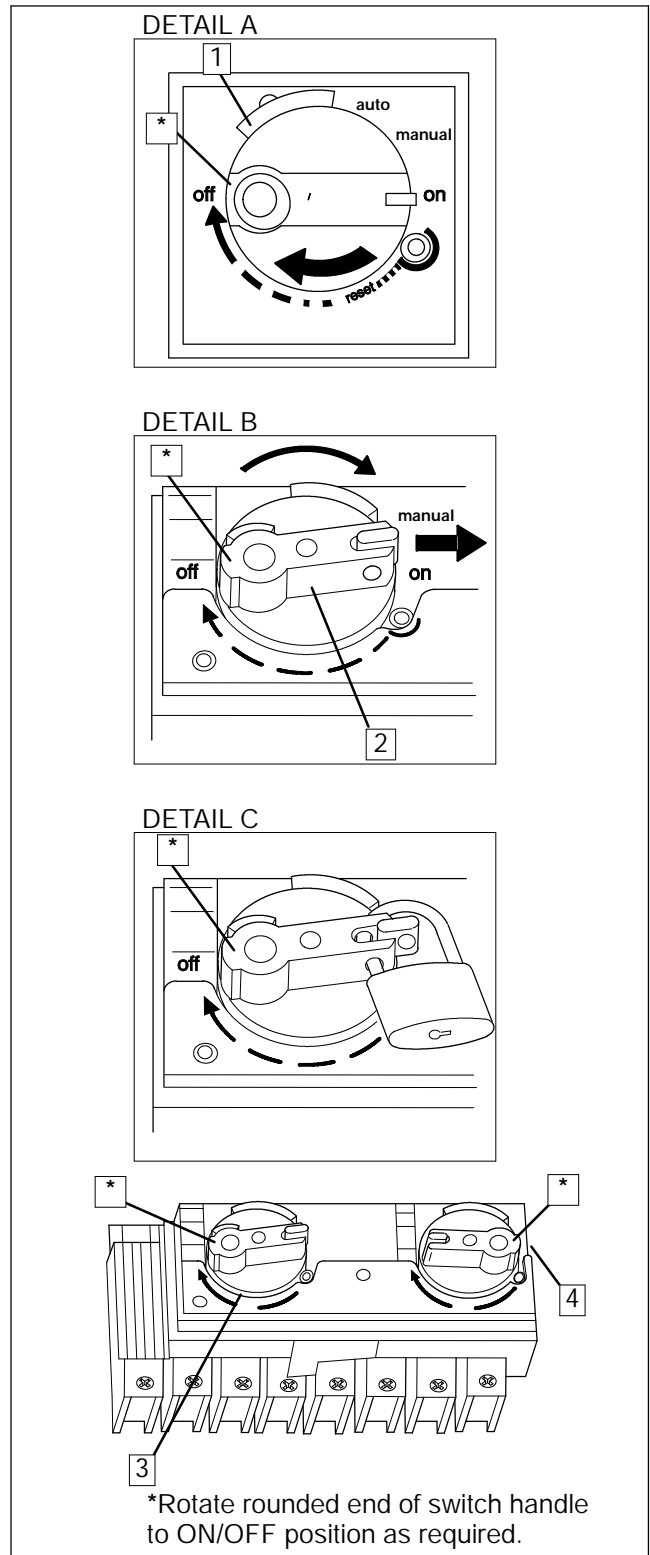
## Units with 40-160 Ampere Ratings

Manual operation of these units (Figure 3-1) is as follows:

1. Set control switch in upper left corner of the switch-mounting plate to off (0) to disconnect motor operators from controller.
2. To operate a switch or circuit breaker, first set its slide switch to manual. Then rotate the switch handle clockwise to the desired position (on or off).

### NOTE

Switches/circuit breakers can be locked in the OFF position as shown in Detail C of Figure 3-1.




1. Slide Switch
2. Switch Handle
3. Normal Switch/Circuit Breaker
4. Standby Switch/Circuit Breaker

**Figure 3-1. Automatic Transfer Switch (40-160 Ampere) Operation**

## Units with 250-1250 Ampere Ratings

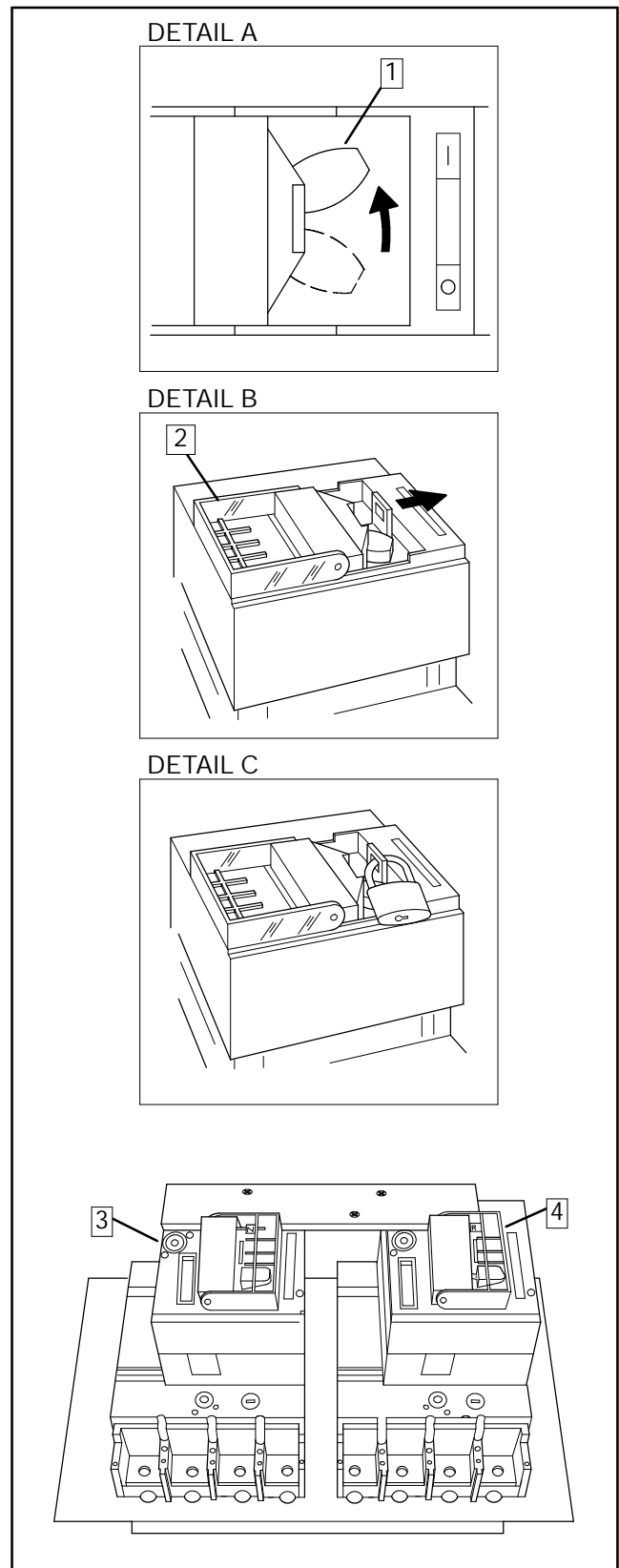
Manual operation of these units (Figure 3-2) is as follows:


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

1. Set control switch in upper left corner of switch mounting plate to off (0).
2. Open plastic door over front of switch or circuit breaker. Opening the door disconnects the motor operator from the controller.
3. Slide the switch lever to the desired position (1 for ON or 0 for OFF) as shown in detail A of Figure 3-2.

### NOTE

Switches/circuit breakers can be padlocked in the OFF position as shown in details B and C of Figure 3-2.



1. Lever
2. Door
3. Normal Switch/Circuit Breaker
4. Standby Switch/Circuit Breaker

**Figure 3-2. Automatic Transfer Switch (250-1250 Ampere) Operation**

# Automatic Operation

## Initial Settings

Before turning on the power for the first time or when returning from manual operation to automatic operation, manually operate the automatic transfer switch to select the normal power source. (See **Manual Operation** above.) Then continue as follows:

- D Units with Ratings of 40-160 Amperes.** (See Figure 3-1.) First set the slide switch on each switch or circuit breaker to its auto position. Then set the control switch in the upper left corner of the switch mounting plate to its on (1) position to connect the controller to the motor operators.
- D Units with Ratings of 250-1250 Amperes.** (See Figure 3-2). First close the plastic door on the front of each switch. Then set the control switch in the upper left corner of the switch mounting plate to its on (1) position to connect the controller to the motor operators.

### NOTE

A short circuit will automatically trip open circuit breaker switching devices. Clear the short circuit and manually operate the switch to select the desired power source as described in Manual Operation. To return to automatic operation after resetting a tripped circuit breaker, complete the Initial Settings described above.

Automatic operation is a function of the controller installed in the unit. For automatic operation details and procedures, refer to the appropriate controller operation and installation manual. (See **List of Related Manuals** in Section 1.)

## Sequence of Operation

Operation of the typical automatic transfer switch (Figure 1-1) is divided into two separate sequences: (1) failure of normal power and the resulting transfer to emergency power and (2) restoration of normal power and the resulting transfer back to normal power. A brief description of both sequences is provided below. Note that these sequences may be affected by accessories described in Section 5 of this manual or in the applicable logic controller operation and installation manual. In addition, for more specific details on circuit operation including time delays, refer to the applicable controller operation and installation manual. (See **List of Related Manuals** earlier in this Section.)

# Failure of Normal Power

Loss or deterioration of one or more phases is detected by monitors within the controller, and is interpreted as failure of the normal power supply. The monitor that detects the failure starts a time delay, typically called Time Delay Engine Start. If power is restored before the time delay expires, the timer is reset. But, if the failure persists and the time delay expires, the controller issues a signal to start the standby (emergency) power generator. This time delay scheme is used to prevent unnecessary starting of the generator during short power interruptions.

A second set of monitors within the controller check the status of the emergency power. When the voltage and frequency of the emergency (generator) power is good, these monitors start a timing cycle, typically called Time Delay Normal to Emergency. At the end of the timing cycle, which is provided to allow the generator outputs to stabilize, the controller issues a signal to the transfer switch motor operators to remove normal power and then connect emergency power to the load.

Once it is switched, the transfer switch remains in the emergency position, supplying power to the load from the emergency source until normal power is restored.

## Restoration of Normal Power

Restoration of Normal Power automatically begins a sequence that transfers the load back to the normal power source. The monitors within the controller continue to check the status of the normal power, even when the load is operating from emergency power. When these monitors detect a stable condition of the normal power, a time delay, typically called Time Delay Emergency to Normal, is started. If the normal power fails again before the time delay expires, the time delay is reset. This timing period is included to ensure that the normal power is stabilized before it is reconnected to the load.

If the normal power remains acceptable and the time delay expires, the controller issues signals to the transfer switch motor operators to remove emergency power and reconnect normal power to the load. Normally, at the same time as the power transfer, the controller starts a timer, typically called Time Delay Engine Cooldown. After this time delay expires, the generator engine is stopped.

# Notes

# Section 4. Accessories

## Program Transition

### NOTE

For ATS utilizing the M340+ logic control, the program transition function is accomplished within the microprocessor and therefore no timing relays are required. See TP-5664 for operational details. DO NOT use this section.

### Description

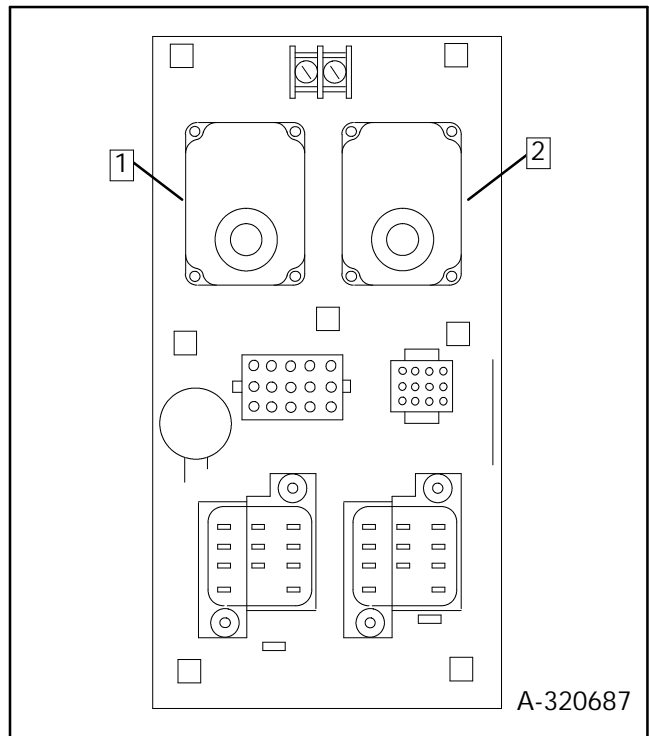
The program transition accessory consists of two timing relays that plug into the interface board. (See Figure 4-1.) If these relays are present, power will transfer from normal to emergency power source or emergency to normal power source in the following sequence: (1) the switch or circuit breaker for the previously connected power source opens, (2) there is a delay period, adjustable from 2 to 40 seconds, to allow residual voltage in the load circuit to decay, and (3) the switch or circuit breaker for the new power source is closed.

### Adjustment

Two separate timing relays are used. One relay produces the time delay for the normal to emergency power transfer Time Delay OFF to Emergency (TDOE) and the other relay produces the time delay for the emergency to normal power transfer Time Delay OFF to Normal (TDON). Each relay has a separate adjustment. To make the adjustment, proceed as follows:

1. Disconnect or turn off both the normal and emergency power sources.



2. Open enclosure door of automatic transfer switch.
3. Locate the appropriate relay on the interface board. (See Figure 4-1.)
4. Insert a screwdriver into the slot of the adjustment screw visible through the cover of the relay and turn the adjustment screw until the slot points to the desired time delay period.
5. Close the enclosure door.
6. Reconnect or turn on the applicable (normal or emergency) power source.
7. Operate the automatic transfer switch automatically and check the time delay off period to ensure that it is properly adjusted.



1. K3 (TDON)

2. K4 (TDOE)

**Figure 4-1. Interface Board with Timing Relays**

 <b>DANGER</b>

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

## Other Accessories

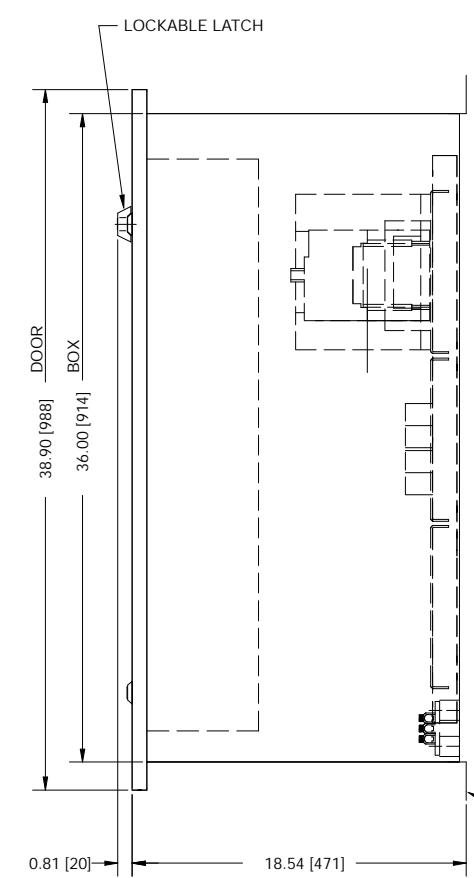
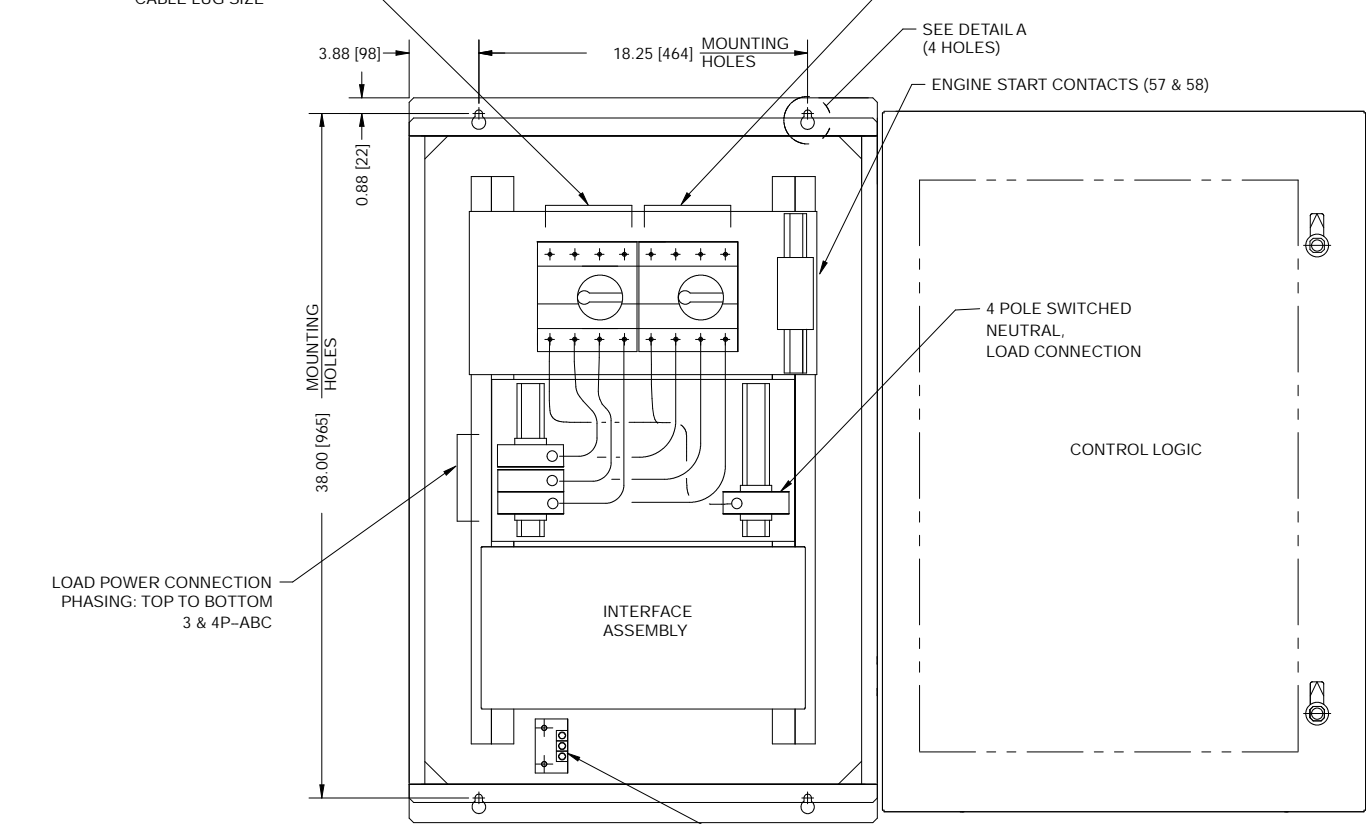
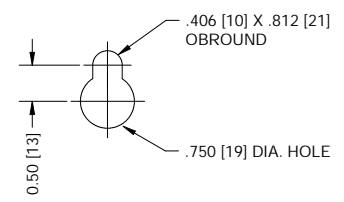
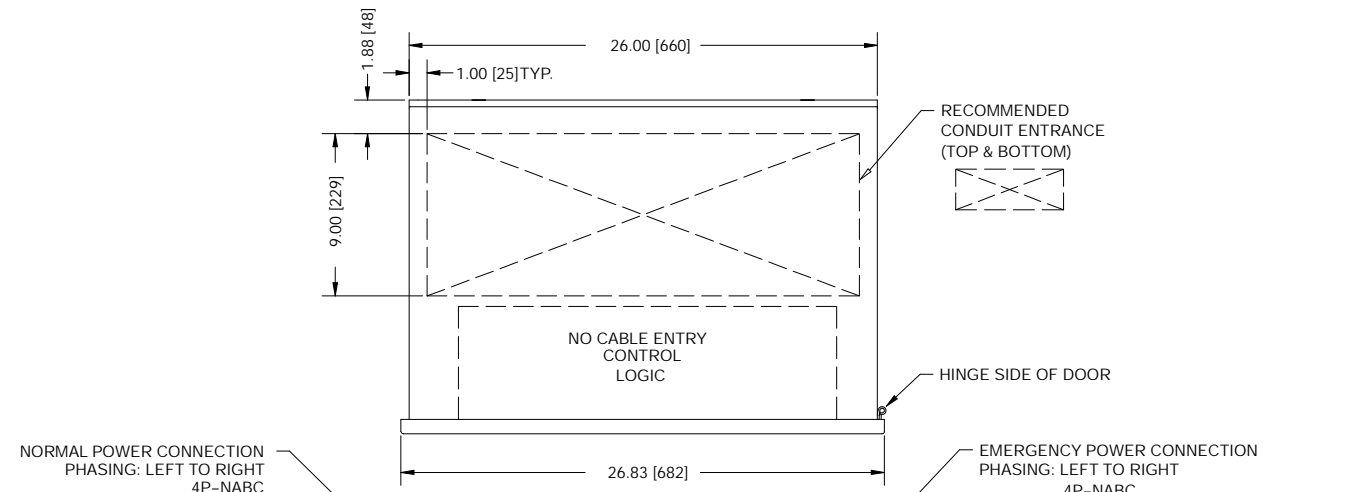
All other accessories are controller accessories. For controller accessory information and procedures, refer to the appropriate controller operation and installation manual. (See **List of Related Manuals** in Section 1.)

# Notes

# Section 5. Diagrams and Drawings

Diagram or Drawing	Drawing Number	Page
<b>Enclosure Dimensions</b>		
Enclosure Dimensions, 40-160-Amp.	ADV-5910	5-3
Enclosure Dimensions, 250 Amp.	ADV-5922	5-4
Enclosure Dimensions, 400-1250 Amp.	ADV-5923	5-5
<b>Schematic Diagrams</b>		
S340+ Logic		
40-160 Amp., 110, 120, 220, 240 Volts	321106	5-6
40-160 Amp., 208, 408, 600 Volts	321107	5-7
250-1250 Amp., 110, 120, 220, 380, 416, 480 Volts	321106	5-6
250-1250 Amp., 600 Volt	321107	5-7
E33+ Logic		
40-160 Amp., 110, 120, 220, 240 Volts	321161	5-8
40-160 Amp., 208, 408, 600 Volts	321160	5-9
250-1250 Amp., 110, 120, 220, 380, 416, 480 Volts	321161	5-8
250-1250 Amp., 600 Volt	321160	5-9

# Notes

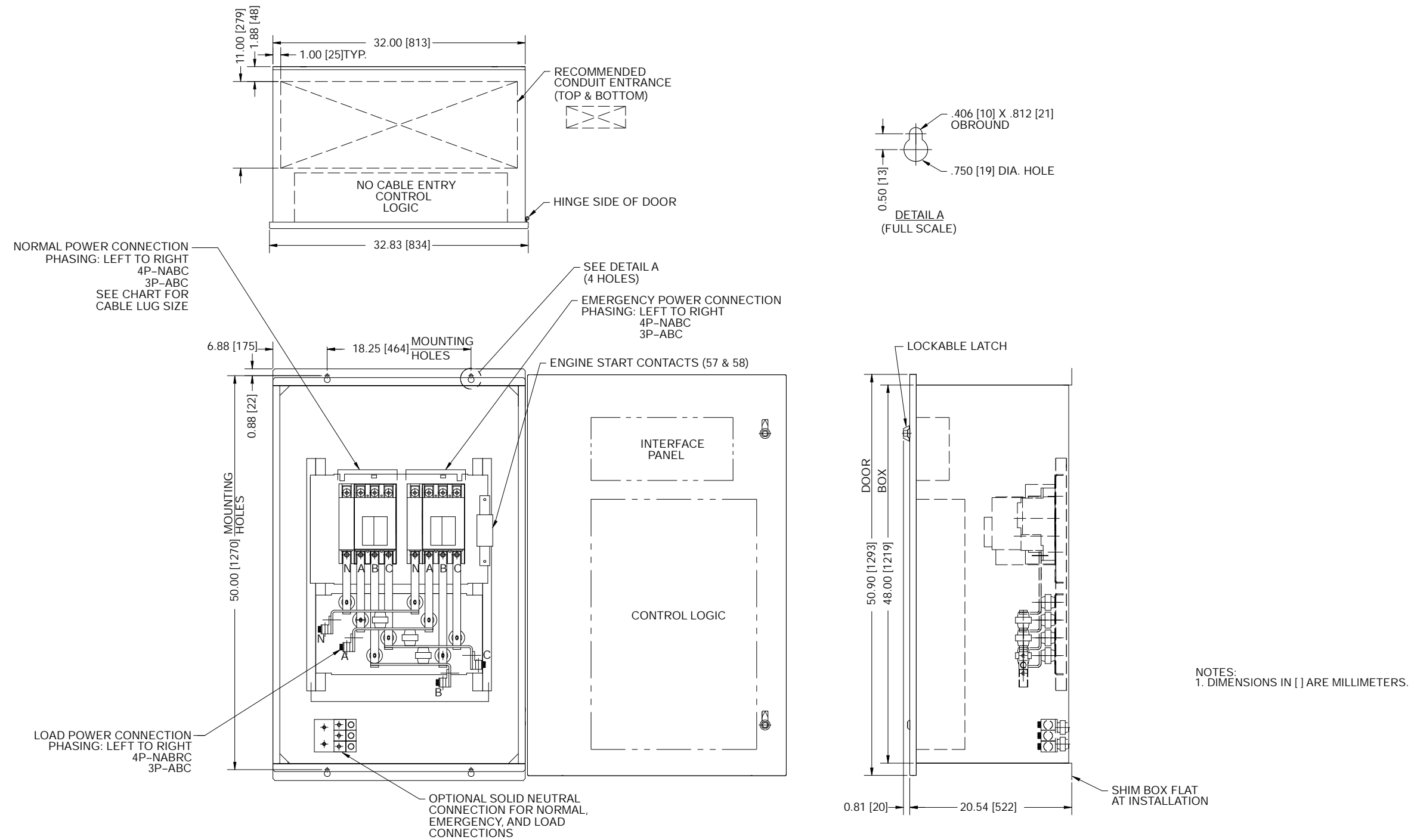


NOTES:  
1. DIMENSIONS IN [ ] ARE MILLIMETERS.

AMPERE	CABLE LUG SIZE PER PHASE A,B,C,N WHEN PRESENT	
	SIZE (USA)	SIZE (METRIC)
40	1 CABLE 14 AWG to 2/0 AWG	1 CABLE 1.5 to 70 MM <sup>2</sup>
80	1 CABLE 14 AWG to 2/0 AWG	1 CABLE 1.5 to 70 MM <sup>2</sup>
100	1 CABLE 14 AWG to 2/0 AWG	1 CABLE 1.5 to 70 MM <sup>2</sup>
160	1 CABLE 6 AWG to 3/0	1 CABLE 16 to 95 MM <sup>2</sup>

OPTIONAL SOLID NEUTRAL CONNECTION FOR NORMAL, EMERGENCY, AND LOAD CONNECTIONS

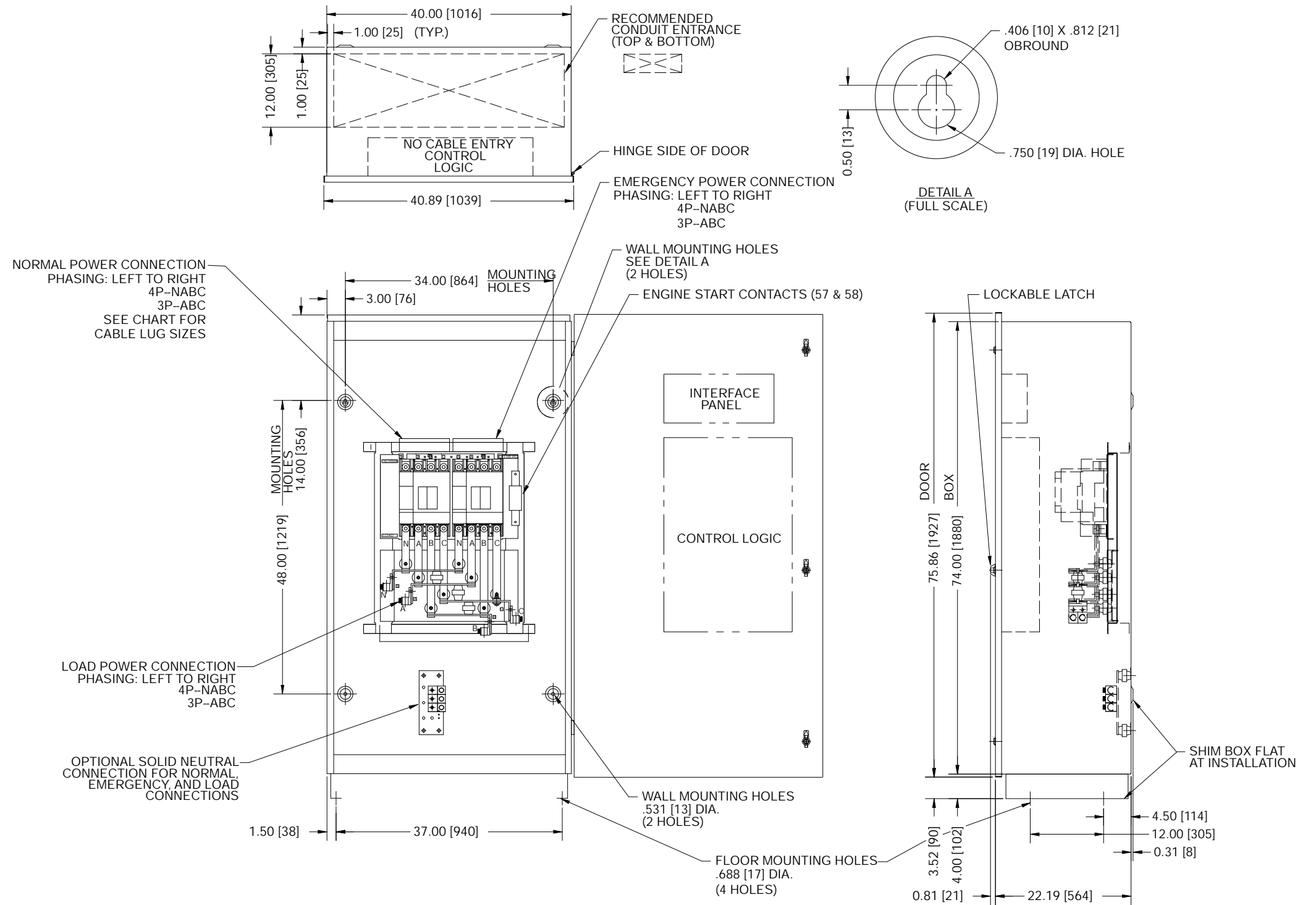
Figure 1. NEMA Type 1 Enclosure, 40-160 Ampere Rating



AMPERE	CABLE LUG SIZES PER PHASE A,B,C,N WHEN PRESENT	
	SIZE (USA)	SIZE (METRIC)
250	1 CABLE 4 AWG TO 350 MCM	1 CABLE 16 to 185 MM <sup>2</sup>

NEMA 1 ENCLOSURE  
MN ( ) & MM ( ) 250A (IEC RATING) ADV-5922

Figure 2. NEMA Type 1 Enclosure, 250 Ampere Rating

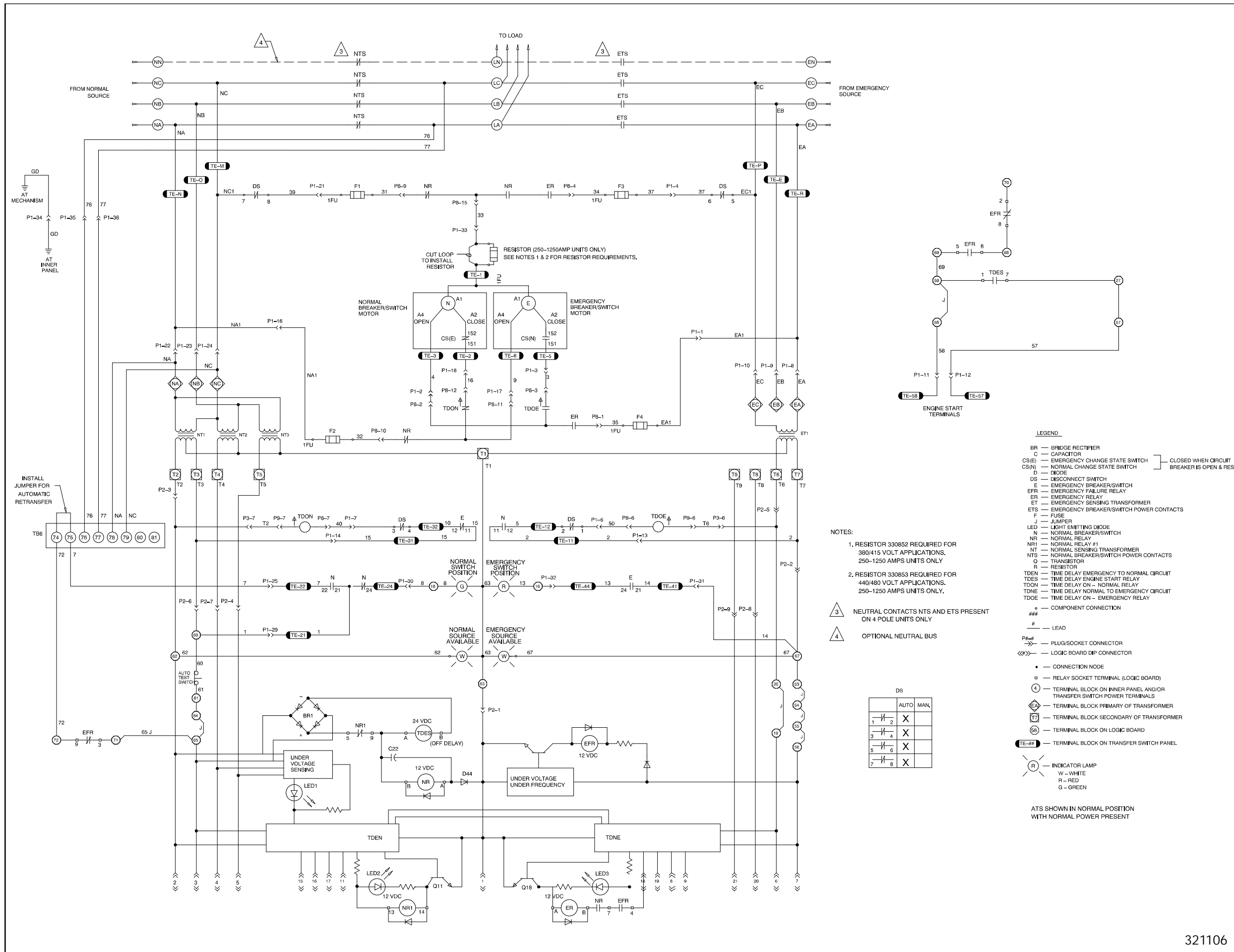


AMPERE	CABLE LUG SIZE PER PHASE A,B,C,N WHEN PRESENT	
	SIZE (USA)	SIZE (METRIC)
400	1 CABLE 2/0 TO 500 MCM	1 CABLE 70 to 300 MM <sup>2</sup>
600	1 CABLE 2/0 TO 500 MCM	1 CABLE 70 to 300 MM <sup>2</sup>
800	4 CABLES 2/0 TO 400 MCM	4 CABLES 70 to 240 MM <sup>2</sup>
1000	4 CABLES 2/0 TO 400 MCM	4 CABLES 70 to 240 MM <sup>2</sup>
1200	4 CABLES 2/0 TO 400 MCM	4 CABLES 70 to 240 MM <sup>2</sup>

NOTES:  
1. DIMENSIONS IN [ ] ARE MILLIMETERS.

NEMA 1 ENCLOSURE  
MN( ) & MM( ) 400A-1250A (IEC RATING)

Figure 3. NEMA Type 1 Enclosure, 400-1250 Ampere Rating



321106

Figure 4. S340+ Logic, 110, 120, 220, 240 Volts (40-160 Amp.) and 110, 120, 208, 220, 380, 416, 480 Volts (250-1250 Amp.)

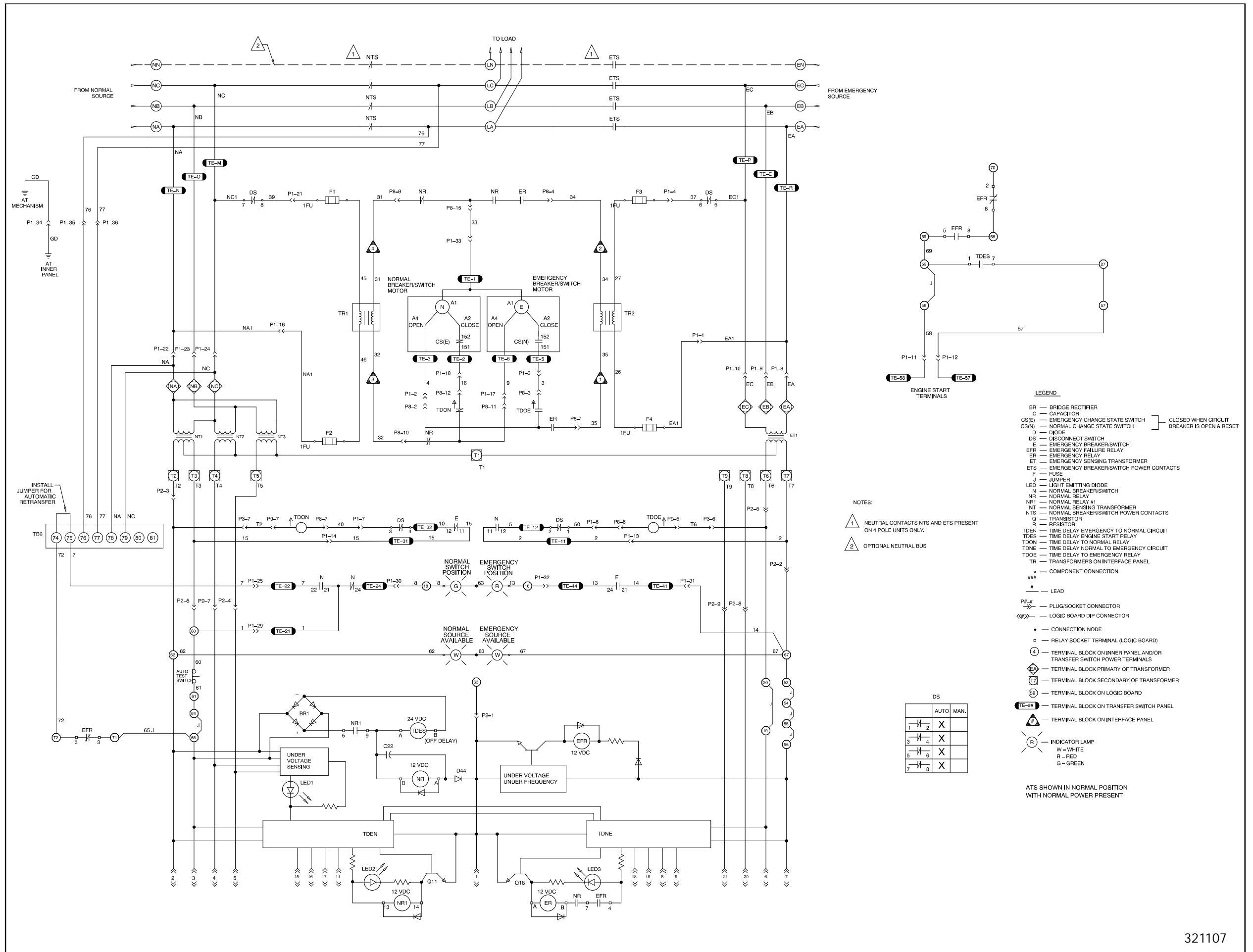


Figure 5. S340+ Logic, 208, 480, 600 Volts (40-160 Amp.) and 600 Volts (250-1250 Amp.)

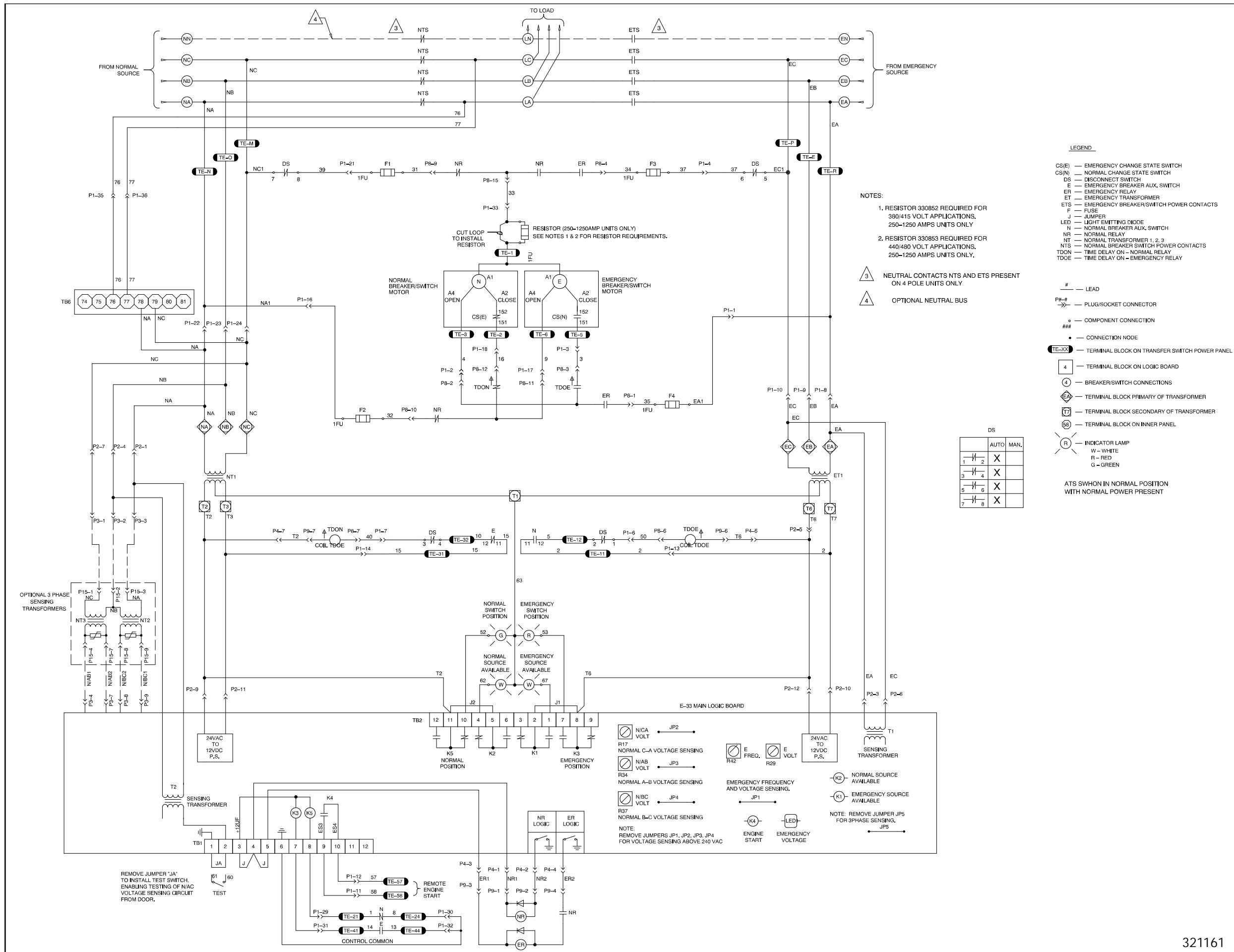
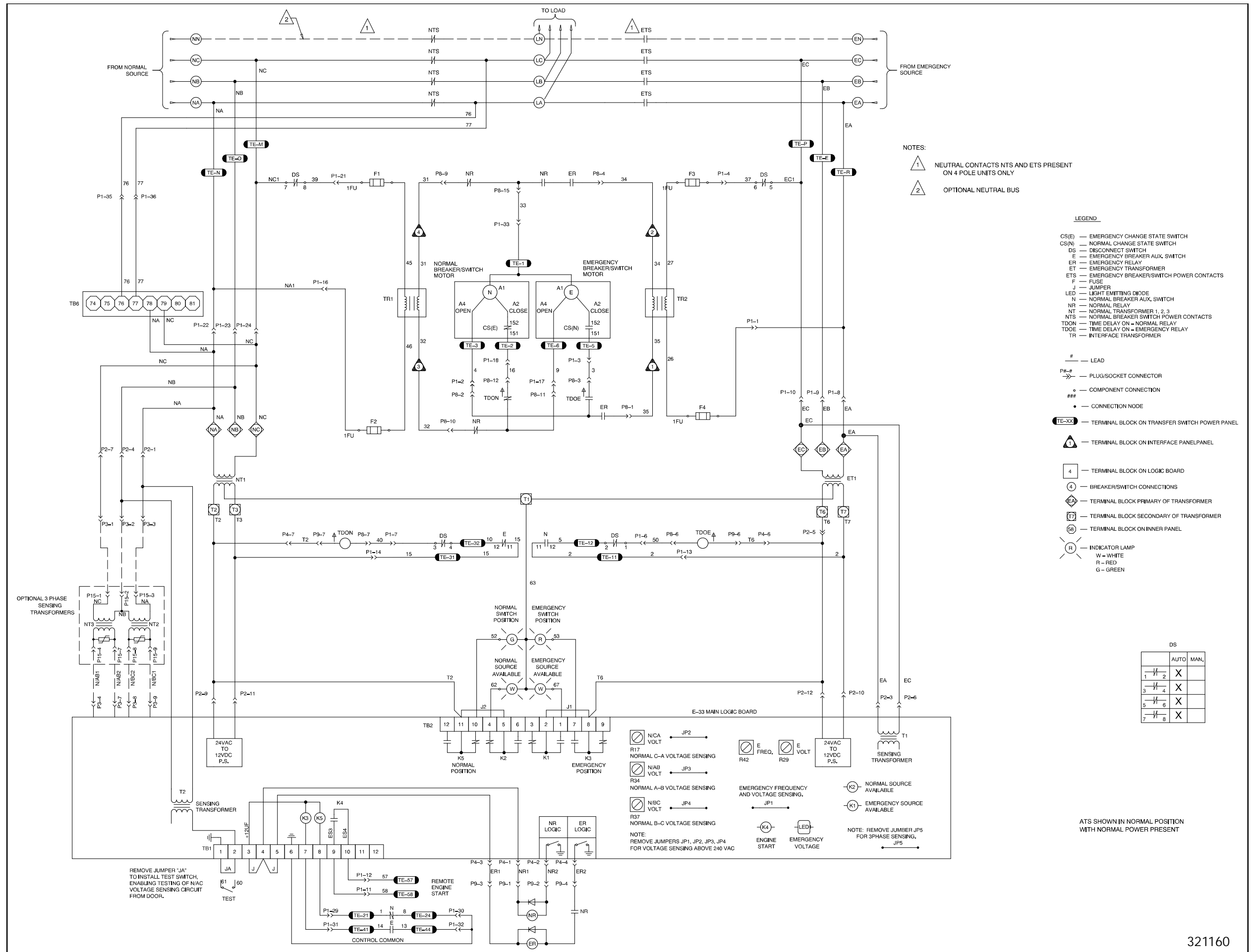


Figure 6. E33+ Logic, 110, 120, 220, 240 Volts (40-160 Amp.) and 110, 120, 208, 220, 380, 416, 480 Volts (250-1250 Amp.)



321160

Figure 7. E33+ Logic, 208, 480, 600 Volts (40-160 Amp.) and 600 Volts (250-1250 Amp.)

# Glossary of Abbreviations

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

<b>Abbreviation</b>	<b>Description</b>	<b>Abbreviation</b>	<b>Description</b>
AC	alternating current	dept.	department
AHWT	anticipatory high water temp.	dia.	diameter
ALOP	anticipatory low oil pressure	e.g.	example given
AM	amplitude modulation	EMI	electromagnetic interference
Amp.	ampere	etc.	et cetera, (and so forth)
Amps.	amperes	ext.	external
ANSI	American National Standard Institute	°F	Fahrenheit degree
API	American Petroleum Institute	fl. oz.	fluid ounce, fluid ounces
approx.	approximate, approximately	FM	frequency modulation
A/R	as required, as requested	fs	full scale
A/S	as supplied, as stated, as suggested	ft.	foot, feet
ASA	American Standards Association	ft. lbs.	foot pound, foot pounds
assy.	assembly	ga.	gauge
ASTM	American Society for Testing Materials	gal., gals.	gallon, gallons
ATDC	after top dead center	gal./hr.	gallons per hour
ATS	automatic transfer switch	gph	gallons per hour
aux.	auxiliary	gpm	gallons per minute
AWG	American Wire Gauge	gr.	grade
AWM	appliance wiring material	grd.	ground
bhp	brake horsepower	HCHT	high cylinder head temperature
bmep	brake mean effective power	HET	high exhaust temperature
Btu	British thermal unit	Hg	mercury (element)
°C	Celsius degree	H <sub>2</sub> O	water
cc	cubic centimeter	hp	horsepower
CCA	cold cranking Amps.	hr, hrs	hour
CEC	Canadian Electrical Code	HWT	high water temperature
cfh	cubic feet per hour	Hz	hertz (cycles per second)
cfm	cubic feet per minute	ID	inside diameter
CID	cubic inch displacement	in.	inch(es)
cm	centimeter, centimeters	inc.	incorporated
cmm	cubic meters per minute	in. lbs.	inch pounds
co.	company	int.	internal
cont'd.	continued	int.-ext.	internal-external
C.S.A.	Canadian Standards Association	ISO	International Standards Organization
cu. in.	cubic inch, cubic inches	J	joule, joules
cyl.	cylinder	JIS	Japanese Industry Standard
dBA	decibels	kg	kilogram, kilograms
DC	direct current	kg/cm <sup>2</sup>	kilograms per square centimeter
DCR	direct current resistance	kgm	kilogram meter(s)
deg.	degree	km	kilometer, kilometers
		kPa	kiloPascal, kiloPascals

<b>Abbreviation</b>	<b>Description</b>
kph	kilometers per hour
kV	kilovolt
kVA	kilovolt amperes
kW	kilowatt, kilowatts
kWH	kilowatt hour
L	liter, liters
LxWxH	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 <sup>3</sup>	cubic meter, cubic meters
max.	maximum
MCM	one thousand circular mils.
mi.	mile, miles
mil	one one-thousandth of an inch
min.	minimum
mJ	millijoule, millijoules
MJ	mega joule, mega joules
mm	millimeter, millimeters
m <sup>3</sup> /min	cubic meters per minute
MPa	megaPascal
mph	miles per hour
MS	military standard
mW	milliwatt, milliwatts
MW	megawatt, megawatts
N/A	not available
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
Nm	Newton meter, Newton meters
no., nos.	number, numbers
NPT	National Standard taper pipe thread per general use

<b>Abbreviation</b>	<b>Description</b>
N/R	not required
OC	overcrank
OD	outside diameter
OEM	original equipment manufacturer
OS	overspeed, oversize
OV	overvoltage
oz.	ounce, ounces
PF	power factor
pot.	potentiometer
ppm	parts per million
psi	pounds per square inch
pt., pts.	pint, pints
qt., qts.	quart, quarts
qty.	quantity
ref.	reference
RFI	radio frequency interference
rms	root mean square
rpm	revolutions per inch
SAE	Society of Automotive Engineers
sec.	second, seconds
SCR	silicon controlled rectifier
spec, specs	specification
sq.	square
sq. cm	square centimeters
sq. in.	square inch, square inches
tach	tachometer
TDC	top dead center
temp.	temperature
TIF	telephone influence factor
turbo	turbocharger
UNC	Unified coarse thread (was NC)
UNF	Unified fine thread (was NF)
UL	Underwriter's Laboratories, Inc.
US	undersize
V	volt, volts
VAC	Volts alternating current
VDC	volts direct current
W	watt, watts

# Notes

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