Service and Parts

DETROIT DIESEL®

mtu

Automatic Transfer Switches

Models:

ZCD, ZCI, ZCT
SBL, SCL

150–3000 Amperes

MP-5668 7/05e

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IMPORTANT SAFETY INSTRUCTIONS. Electromechanical equipment, including generator sets, transfer switches, switchgear, and accessories, can cause bodily harm and pose life-threatening danger when improperly installed, operated, or maintained. To prevent accidents be aware of potential dangers and act safely. Read and follow all safety precautions and instructions. SAVE THESE INSTRUCTIONS.

This manual has several types of safety precautions and instructions: Danger, Warning, Caution, and Notice.

DANGER

Danger indicates the presence of a hazard that ***will cause severe personal injury, death***, or ***substantial property damage***.

WARNING

Warning indicates the presence of a hazard that ***can cause severe personal injury, death,*** or ***substantial property damage***.

CAUTION

Caution indicates the presence of a hazard that ***will*** or ***can cause minor personal injury*** or ***property damage***.

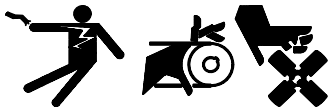
NOTICE

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

Safety decals affixed to the equipment in prominent places alert the operator or service technician to potential hazards and explain how to act safely. The decals are shown throughout this publication to improve operator recognition. Replace missing or damaged decals.

Accidental Starting

WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

Battery

WARNING

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

Wear protective goggles and clothing. Battery acid may cause blindness and burn skin.

WARNING

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

Locate the battery in a well-ventilated area. Isolate the battery charger from explosive fumes.

Battery electrolyte is a diluted sulfuric acid. Battery acid can cause severe injury or death. Battery acid can cause blindness and burn skin. Always wear splashproof safety goggles, rubber gloves, and boots when servicing the battery. Do not open a sealed battery or mutilate the battery case. If battery acid splashes in the eyes or on the skin, immediately flush the affected area for 15 minutes with large quantities of clean water. Seek immediate medical aid in the case of eye contact. Never add acid to a battery after placing the battery in service, as this may result in hazardous spattering of battery acid.

Battery acid cleanup. Battery acid can cause severe injury or death. Battery acid is electrically conductive and corrosive. Add 500 g (1 lb.) of bicarbonate of soda (baking soda) to a container with 4 L (1 gal.) of water and mix the neutralizing solution. Pour the neutralizing solution on the spilled battery acid and continue to add the neutralizing solution to the spilled battery acid until all evidence of a chemical reaction (foaming) has ceased. Flush the resulting liquid with water and dry the area.

Battery gases. Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flames or sparks to occur near a battery at any time, particularly when it is charging. Do not dispose of a battery in a fire. To prevent burns and sparks that could cause an explosion, avoid touching the battery terminals with tools or other metal objects. Remove all jewelry before servicing the equipment. Discharge static electricity from your body before touching batteries by first touching a grounded metal surface away from the battery. To avoid sparks, do not disturb the battery charger connections while the battery is charging. Always turn the battery charger off before disconnecting the battery connections. Ventilate the compartments containing batteries to prevent accumulation of explosive gases.

Battery short circuits. Explosion can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Disconnect the battery before generator set installation or maintenance. Remove all jewelry before servicing the equipment. Use tools with insulated handles. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery. Never connect the negative (-) battery cable to the positive (+) connection terminal of the starter solenoid. Do not test the battery condition by shorting the terminals together.

Hazardous Voltage/ Electrical Shock

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Grounding electrical equipment. Hazardous voltage can cause severe injury or death. Electrocution is possible whenever electricity is present. Open the main circuit breakers of all power sources before servicing the equipment. Configure the installation to electrically ground the generator set, transfer switch, and related equipment and electrical circuits to comply with applicable codes and standards. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

Short circuits. Hazardous voltage/current can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage**.** Do not contact electrical connections with tools or jewelry while making adjustments or repairs. Remove all jewelry before servicing the equipment.

Removing the transfer switch from bypass/isolation models. Hazardous voltage can cause severe injury or death. Bypass and isolate the transfer switch before removing it from the enclosure. The bypass/isolation switch is energized. Do not touch the isolation contact fingers or the control circuit terminals.

Installing the battery charger. Hazardous voltage can cause severe injury or death. An ungrounded battery charger may cause electrical shock. Connect the battery charger enclosure to the ground of a permanent wiring system. As an alternative, install an equipment grounding conductor with circuit conductors and connect it to the equipment grounding terminal or the lead on the battery charger. Install the battery charger as prescribed in the equipment manual. Install the battery charger in compliance with local codes and ordinances.

Connecting the battery and the battery charger. Hazardous voltage can cause severe injury or death. Reconnect the battery correctly, positive to positive and negative to negative, to avoid electrical shock and damage to the battery charger and battery(ies). Have a qualified electrician install the battery(ies).

Installing accessories to the transfer switch transformer assembly. Hazardous voltage can cause severe injury or death. To prevent electrical shock, deenergize all power sources and then disconnect the harness plug before installing accessories that will be connected to transformer assembly primary terminals 76, 77, 78, and 79. Terminals are at line voltage. *(Models with E33+, S340, S340+, 340, R340, and R33 controls only)*

Installing accessories to the transfer switch transformer assembly. Hazardous voltage can cause severe injury or death. To prevent electrical shock, deenergize all power sources and then disconnect the harness plug before installing accessories that will be connected to the transformer assembly primary terminals on microprocessor logic models. Terminals are at line voltage.

Making line or auxiliary connections. Hazardous voltage can cause severe injury or death. To prevent electrical shock deenergize the normal power source before making any line or auxiliary connections.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Open the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (-) leads first. Reconnect negative (-) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

Servicing the transfer switch controls and accessories within the enclosure. Hazardous voltage can cause severe injury or death. Disconnect the transfer switch controls at the inline connector to deenergize the circuit boards and logic circuitry but allow the transfer switch to continue to supply power to the load. Disconnect all power sources to accessories that are mounted within the enclosure but are not wired through the controls and deenergized by inline connector separation. Test circuits with a voltmeter to verify that they are deenergized before servicing.

Testing live electrical circuits. Hazardous voltage or current can cause severe injury or death. Have trained and qualified personnel take diagnostic measurements of live circuits. Use adequately rated test equipment with electrically insulated probes and follow the instructions of the test equipment manufacturer when performing voltage tests. Observe the following precautions when performing voltage tests: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Do not touch the enclosure or components inside the enclosure. (4) Be prepared for the system to operate automatically.
(600 volts and under)

Heavy Equipment

⚠ WARNING

Unbalanced weight.
Improper lifting can cause severe injury or death and equipment damage.

Use adequate lifting capacity.
Never leave the transfer switch standing upright unless it is securely bolted in place or stabilized.

Moving Parts

⚠ WARNING

Airborne particles.
Can cause severe injury or blindness.

Wear protective goggles and clothing when using power tools, hand tools, or compressed air.

⚠ WARNING

Spring-loaded parts.
Can cause severe personal injury or property damage.

Wear protective goggles when servicing spring-loaded parts. Hold parts securely during disassembly.

Disassembling the solenoid. Spring-loaded parts can cause severe personal injury or property damage. The spring in the solenoid assembly exerts substantial force on the coil. Hold the coil assembly securely when removing the screws.

Notice

NOTICE

Hardware damage. The transfer switch may use both American Standard and metric hardware. Use the correct size tools to prevent rounding of the bolt heads and nuts.

NOTICE

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

NOTICE

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

NOTICE

Electrostatic discharge damage. Electrostatic discharge (ESD) damages electronic circuit boards. Prevent electrostatic discharge damage by wearing an approved grounding wrist strap when handling electronic circuit boards or integrated circuits. An approved grounding wrist strap provides a high resistance (about 1 megohm), *not a direct short*, to ground.

NOTICE

Foreign material contamination. Cover the transfer switch during installation to keep dirt, grit, metal drill chips, and other debris out of the components. Cover the solenoid mechanism during installation. After installation, use the manual operating handle to cycle the contactor to verify that it operates freely. Do not use a screwdriver to force the contactor mechanism.

This manual provides service and parts information for DDC/MTU Power Generation ZCD, ZCI, ZCT, SBL, and SCL transfer switches. It includes operation, troubleshooting, repair, and maintenance procedures for the transfer switch.

The information included in this manual is intended solely for use by trained and qualified service personnel of authorized service distributors/dealers.

Information in this publication represents data available at the time of print. The manufacturer of DDC/MTU products reserves the right to change this literature and the products represented without notice and without any obligation or liability whatsoever.

Read this manual and carefully follow all procedures and safety precautions to ensure proper equipment operation and to avoid bodily injury. Read and follow the Safety Precautions and Instructions section at the beginning of this manual. Keep this manual with the equipment for future reference.

The equipment service requirements are very important to safe and efficient operation. Inspect parts often and perform required service at the prescribed intervals. Obtain service from an authorized service distributor/dealer to keep equipment in top condition.

Related Materials

Separate manuals cover service and parts information for transfer switch electrical controls. The following table lists the available manual part numbers.

Service/Parts Manuals	
Controller	**Service/ Parts Manual**
Controller BATS+ (ZCS only)	MP-5670
Controller SATS+	MP-5671
Controller MATS+	MP-5672

For operation and installation information, refer to the Operation and Installation Manual for your transfer switch. The following table lists the available manual part numbers.

Operation/Installation Manuals	
Transfer Switch Model	**Operation/ Installation Manual**
Model ZCD Transfer Switch	MP-5660
Model BATS+ Controls	MP-5662
Model SATS+ Controls	MP-5663
Model MATS+ Controls	MP-5664
Model ZCI, ZCT Bypass/Isolation Switch	MP-5665
Model SBL/SCL Closed-Transition Switch	MP-6228

Wiring diagrams for Model SBL and SCL closed-transition switches are shipped with the transfer switch. They are also available in Wiring Diagram Manual MP-6266.

Wiring Diagram Manual	
Transfer Switch Model	**Wiring Diagram Manual**
Model SBL/SCL Closed-Transition Switch	MP-6266

Service Assistance

For professional advice on generator power requirements and conscientious service, please contact your nearest DDC/MTU Power Generation distributor.

- Consult the Yellow Pages under the heading Generators—Electric
- Visit the DDC/MTU Power Generation website at ddcmtupowergeneration.com
- Look at the labels and stickers on your DDC/MTU Power Generation product or review the appropriate literature or documents included with the product

1.1 Automatic Transfer Switch Purpose

An Automatic Transfer Switch (ATS) is a device that transfers critical electrical loads from a normal (preferred) source of electrical 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 reaches an acceptable level and while testing and exercising.

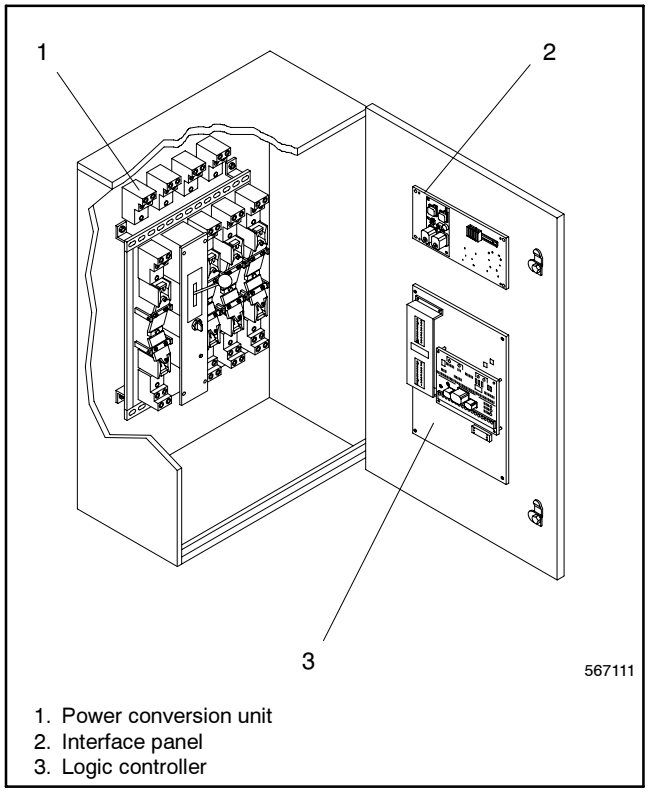
Upon normal source failure, the automatic transfer switch controller signals the generator set(s) to start and transfer to the emergency source. The automatic transfer switch controller continuously senses for an acceptable normal source and will retransfer the load to the normal source after it has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

1.2 Transfer Switch Components

A typical automatic transfer switch includes the actual power switching device and the logic controller to perform power monitoring and transfer sequencing tasks. See Figure 1-1. An ATS also includes an interface board to match the 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 a true power transfer switch. The switch is electrically actuated and then mechanically latched in the selected position. However, the switch also includes provisions for manual mechanical operation in emergency conditions. Within the switch, there are two sets of multipole contactors. One set selects power from the normal source while the other set selects power from the emergency source. The two sets of contacts are mechanically interlocked within the switch so that only one set of contactors can be closed at a given time. With this feature it is possible to select one power source to feed the load without cross coupling that power source to the other power source.

The three functional units that make up the automatic transfer switch mount in an enclosure with a hinged front door. The controller mounts on the back of the front door with controls and indicators available to the operator. A signal cable with inline connectors to facilitate component replacement and door removal connects the controller to the interface board and the switching devices.



1. Power conversion unit
2. Interface panel
3. Logic controller

Figure 1-1 Transfer Switch Components

1.3 Bypass/Isolation Switch Purpose

A bypass/isolation switch is a manually operated device. Use a bypass/isolation switch in conjunction with an ATS to directly connect load conductors to either a normal (preferred) power source or to an emergency (standby) power source. Use it also to disconnect the automatic transfer switch from the power sources and the load for inspection and maintenance.

The bypass switch also functions as a manual transfer switch, allowing transfer of the load from one source to the other, if required, with the automatic transfer switch removed from the system.

1.4 Bypass/Isolation Switch Components

A typical bypass/isolation transfer switch includes the actual power switching device, the bypass/isolation switching device, and the logic controller which performs power monitoring and transfer sequencing tasks. See Figure 1-2. A bypass/isolation transfer switch also includes an interface board to match the controller inputs/outputs to the levels required by a specific switching device.

The four functional units that make up the bypass/isolation automatic transfer switch mount in an enclosure with a hinged front door. The controller mounts on the back of the door so its controls and indicators are available to an operator. A signal cable with inline connectors to facilitate component replacement and door removal connects the controller to the interface board and the switching devices.

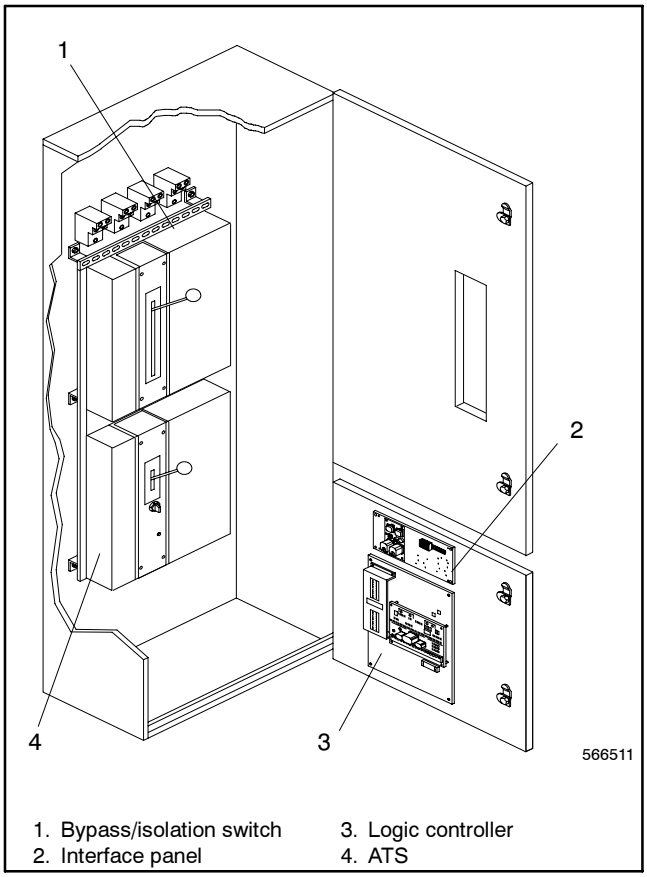


Figure 1-2 Transfer Switch Components

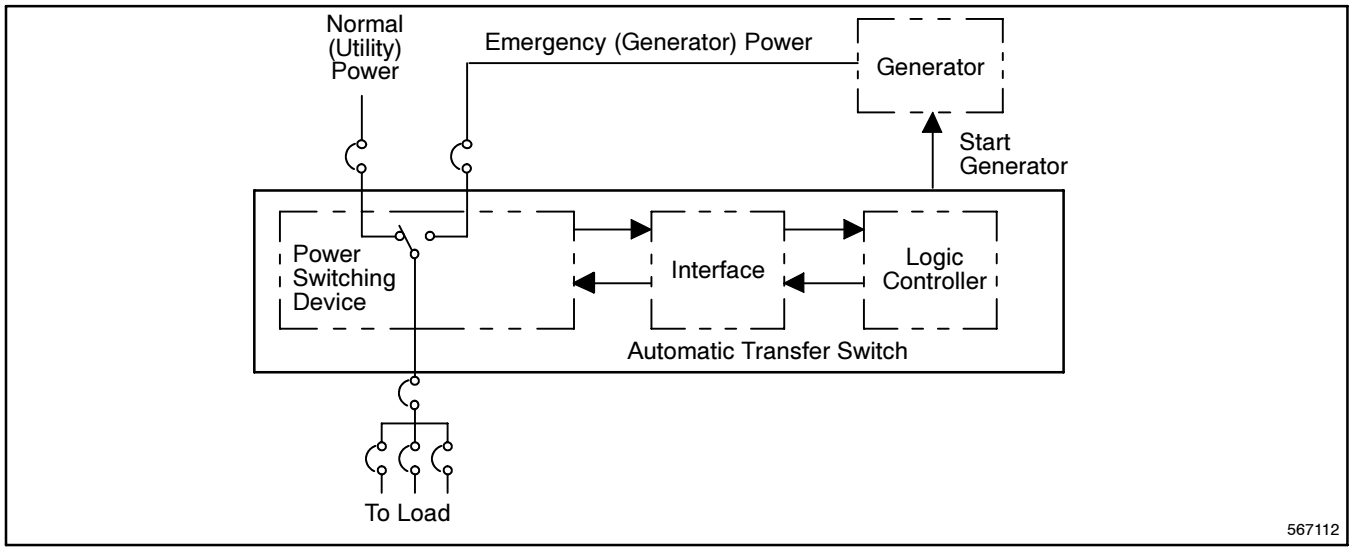


Figure 1-3 Basic Transfer Switch Block Diagram

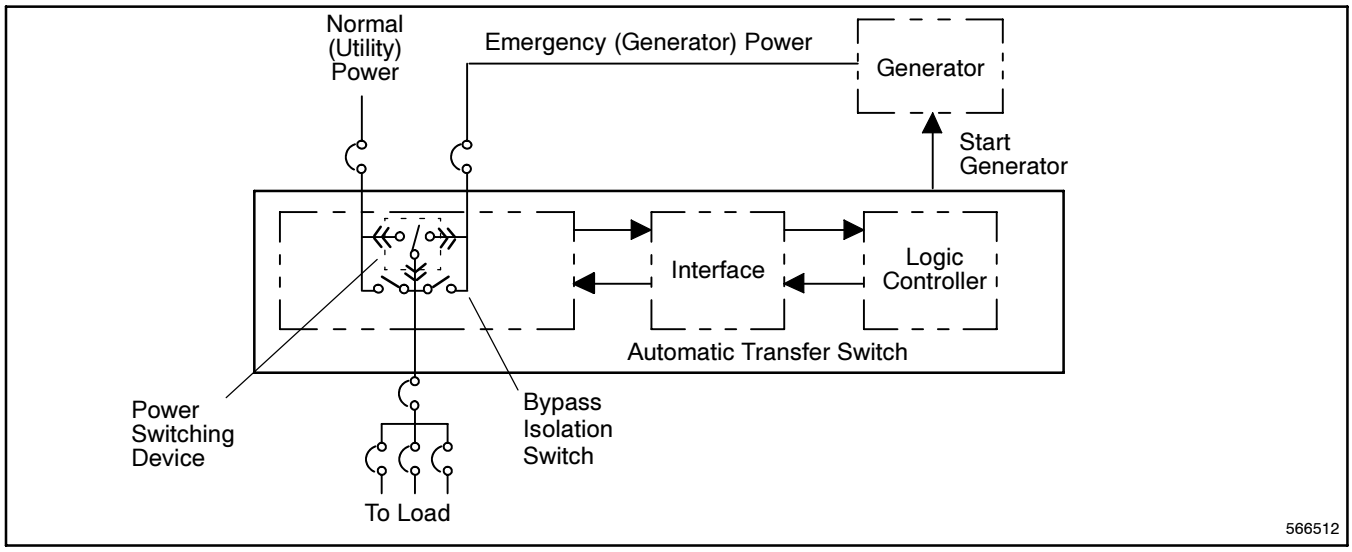


Figure 1-4 Basic Bypass/Isolation Transfer Switch Block Diagram

1.5 Ratings

A nameplate affixed to the ATS enclosure identifies the switch. Figure 1-5 shows the types of nameplates that have been used. The nameplate label includes a factory part number coded to provide characteristic and rating information that affects installation and operation. Copy the part number into the blank spaces provided in the chart in Figure 1-6 or Figure 1-7 and then use the information in the charts to interpret the part number.

Note: Also copy the part number and serial number from the nameplate into the spaces provided in the Service Assistance section of the Introduction for use when requesting service or parts.

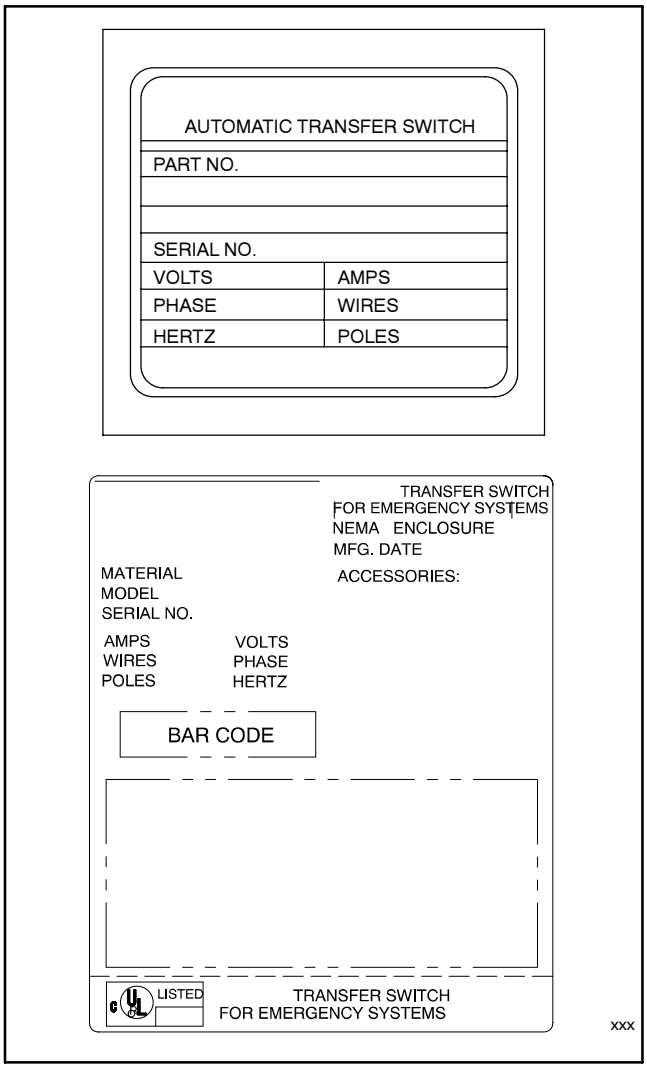
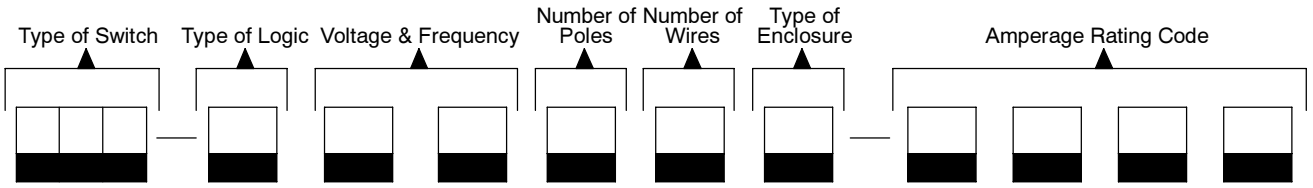


Figure 1-5 Transfer Switch Nameplates

1.6 Interpreting Transfer Switch Part Number

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



Spectrum Part Number Key

This chart explains the Spectrum transfer switch part numbering system. The sample part number shown is for a standard mechanical power conversion unit with MATS+ logic rated at 600 volts, 60 hertz, 3-phase, 3-pole, and 4 wires in a NEMA 1 enclosure with an amperage rating of 1000 amperes.

SAMPLE PART NUMBER

ZCD-560341-1000

Classification of Power Switch
Z: Power Switch

Type of Power Switch
C: Contactor

Type of Switch
D: Standard
I: Bypass/Isolation

Type of Logic
1: SATS+
2: BATS+
3: SATS+ with Programmed Transition
4: BATS+ with Programmed Transition
5: MATS+
6: MATS+ with Programmed Transition

Voltage Code

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

Number of Poles
2: 2 Pole, 1 Phase
3: 3 Pole, 3 Phase
6: 4 Pole, Fully Rated

Number of Wires
3: 3 wire
4: 4 wire

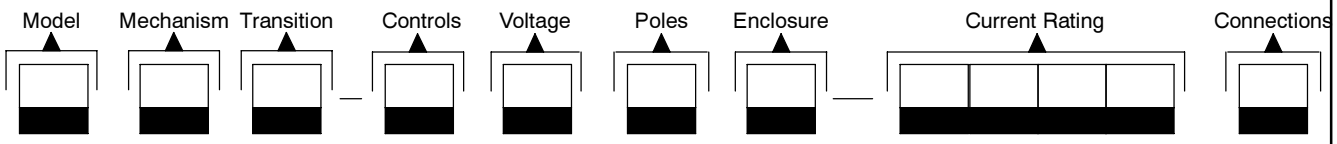
Enclosure
1: NEMA type 1

Amperes
Available sizes vary with the type of switch.

566513

Figure 1-6 Transfer Switch Model Description, Model Z

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



DDC/MTU Power Generation Model Designation Key

This chart explains the DDC/MTU Power Generation transfer switch model designation system. The sample model designation shown is for a Model S transfer switch that uses a closed-transition contactor with microprocessor controls rated at 480 volts/60 Hz, 3 poles, 4 wires, and solid neutral in a NEMA 1 enclosure with a current rating of 225 amperes. Not all possible combinations are available.

SAMPLE MODEL DESIGNATION

SCL-BMTA-0225S

Model
S: Model S Transfer Switch

Mechanism
C: Automatic
B: Bypass/Isolation

Transition
L: Closed-Transition

Electrical Controls
B: Microprocessor controller for closed-transition switches

Voltage/Frequency

C:	208 Volts/60 Hz	G:	380 Volts/50 Hz	N:	600 Volts/60 Hz
D:	220 Volts/50 Hz	J:	416 Volts/50 Hz	P:	380 Volts/60 Hz
F:	240 Volts/60 Hz	M:	480 Volts/60 Hz	S:	220 Volts/60 Hz

Number of Poles/Wires
N: 2-pole, 3-wire, solid neutral
T: 3-pole, 4-wire, solid neutral
V: 4-pole, 4-wire, switched neutral

Enclosure

A: NEMA 1 *	C: NEMA 3R †	F: NEMA 4X †
B: NEMA 12 †	D: NEMA 4 †	

* Standard
† Available; contact the factory

Current Rating: Numbers indicate the current rating of the switch in amperes:

0100	0400	1000	2000
0150	0600	1200	3000
0225	0800	1600	4000
0260			

Power Connections
S: Standard

Figure 1-7 Transfer Switch Model Description, Model S

1.7 ZCD Specifications

ZCD power switching device specifications follow:

- Transfer switch is provided as a complete automatic transfer switch with BATS+, SATS+ or MATS+ controller in a NEMA type 1 enclosure.
- Transfer switch meets UL and CSA standards.
- Transfer switch is rated up to 600VAC.
- Programmed transition switch is rated from 150–3000 amperes.
- Standard switch is rated from 800–3000 amperes.
- Transfer switch is electrically and mechanically interlocked.
- Transfer switch is available in two-, three-, and four-pole configurations.
- Four-pole switch is fully rated.
- Transfer switch can be operated manually.
- Transfer switch withstand and current closing ratings as shown in Figure 1-8.

	Standard and Programmed Transition Models Withstand and Closing Ratings When Coordinated With Any Current-Limiting Fuse		Standard Models Withstand and Closing Ratings With Coordinated Molded-Case Circuit Breakers		Standard Models Withstand and Closing Ratings For 3 Cycles per UL-1008 (any breaker)	Programmed Transition Models Withstand and Closing Ratings With Coordinated Molded-Case Circuit Breakers		Programmed Transition Models Withstand and Closing Ratings For 3 Cycles per UL-1008 (any breaker)
UL 1008 Switch Ratings	Max. Fuse Size, amps	Max. Circuit, amps	Max. Circuit Breaker Size, amps	Max. Circuit, amps	Max. Circuit, amps	Max. Circuit Breaker Size, amps	Max. Circuit, amps	Max. Circuit, amps
150	200	200000				350	50000	35000
225	300	200000				350	50000	35000
260	350	200000				350	50000	35000
400	600	200000				500	50000	35000
600	750	200000				800	65000	50000
800	1000	200000	1600	85000	50000	1600	85000	50000
1000	1250	200000	1600	85000	50000	1600	85000	50000
1200	1500	200000	1600	85000	50000	1600	85000	50000
1600	2000	200000	2000	100000	100000	2500	100000	100000
2000	2500	200000	2500	100000	100000	2500	100000	100000
2500	2500	200000	2500	100000	100000	2500	100000	100000
3000	4000	200000	4000	100000	100000	4000	100000	100000

Figure 1-8 Withstand and Current Closing Ratings at 480 VAC

1.8 ZCI Specifications

The specifications listed below are for the power conversion units. See the respective logic controller manual for its specifications.

1.9 Standard Features

- Transfer switch is rated identical to the ZCD.
- Transfer switch is provided as a complete automatic transfer switch with SATS+ or MATS+ controller in a NEMA type 1 enclosure.
- Transfer switch meets UL and CSA standards.
- Transfer switch is rated voltage up to 600 VAC.
- Transfer switch is rated from 150–3000 amps.
- Transfer switch is available with ZCD standard or programmed transition automatic transfer switches.
- Transfer switch is electrically and mechanically interlocked.
- Transfer switch is available in two pole, three pole, and four-pole configuration.
- Four-pole switch is fully rated.
- The load is not interrupted during bypass operation.

2.1 Operation Sequence

Automatic transfer switch operation typically consists of two separate sequences: (1) normal power failure and the resulting transfer to emergency power and (2) normal power restoration and the resulting transfer back to normal power. A brief description of both sequences follows below. Accessories described in the applicable controller operation and installation manual may affect these sequences. For more specific details on circuit operation including time delays, refer to the applicable Logic Controller Operation and Installation Manual. See List of Related Manuals in the Introduction.

2.1.1 Normal Source Failure

Source monitors within the controller detect normal source failure, either loss or deterioration of one or more phases (logic dependent). The monitor that detects the failure starts a time delay called Time Delay Engine Start (TDES). If power is restored before the time delay expires, the timer resets. 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 prevents generator set starting during short power interruptions.

A second set of source monitors within the controller checks the status of the emergency power. When the voltage and frequency of the emergency (generator) power are acceptable, these monitors start a Time Delay Normal to Emergency (TDNE) timing cycle which allows the generator outputs to stabilize. At the end of this timing cycle, the controller issues a signal to the transfer switch operators to remove normal power and then connect emergency power to the load.

The transfer switch mechanically latches in the emergency position once the emergency power connects to the load. The transfer switch supplies emergency source power to the load until normal power is restored.

2.1.2 Normal Source Restoration

Normal source restoration automatically begins a sequence that transfers the load back to the normal power source. The source monitors within the controller continue to check the status of the normal power, even when the load is operating on emergency power. When these monitors detect stable normal power, a Time Delay Emergency to Normal (TDEN) time delay starts. If the normal power fails again before the time delay expires, the time delay resets. This timing period ensures that the normal power stabilizes before it is reconnected to the load.

If the normal power remains acceptable and the time delay expires, the controller issues a signal to the transfer switch to remove emergency power and reconnect normal power to the load. After switching, the transfer switch mechanically latches in the normal position. Depending upon which logic is used, the controller starts a Time Delay Engine Cooldown (TDEC) timer simultaneously with the power transfer. After this time delay expires, the generator engine is stopped.

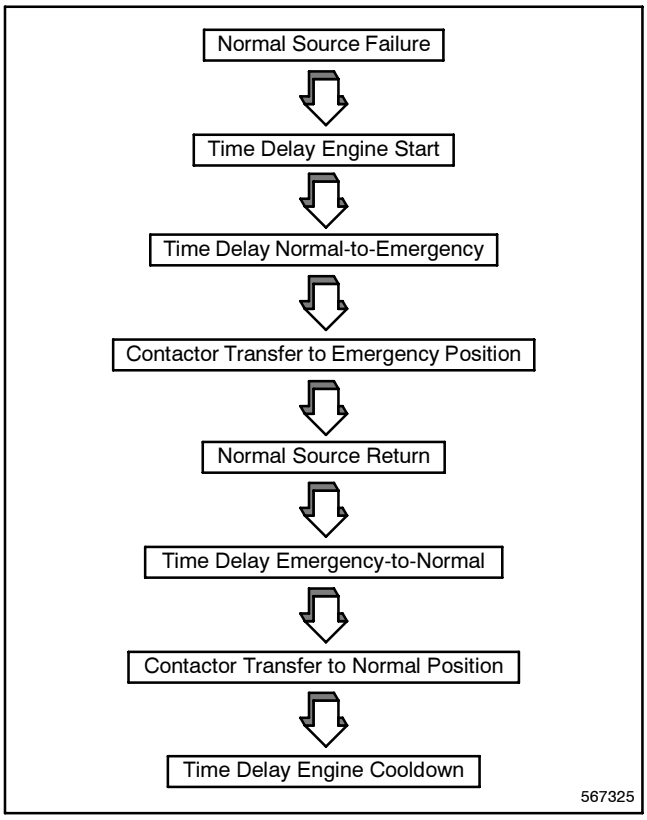


Figure 2-1 Logic Board Operation

2.2 Control Switches and Indicators

The controller choice determines the switches and indicators on the automatic transfer switch. For details on the control switches and indicators not covered in this manual, refer to the appropriate Operation and Installation Manual. See List of Related Manuals in the Introduction.

2.3 Manual Operation

Manually operate the automatic transfer switch when the controller fails or to test/troubleshoot the unit. An operator handle is provided for manual operation.

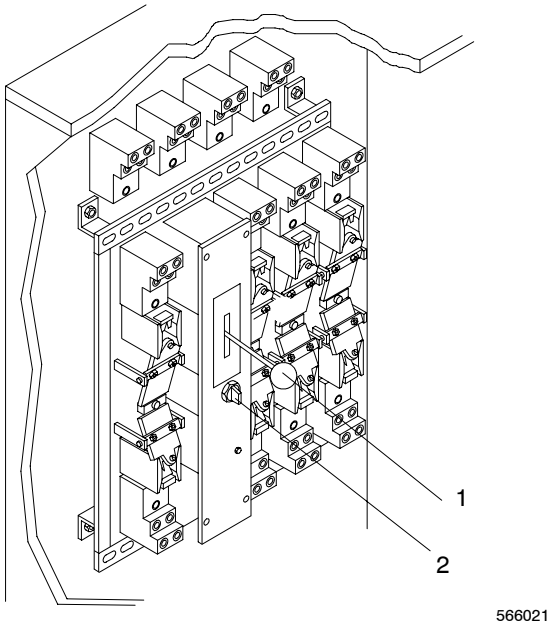
⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

To manually operate the automatic transfer switch, proceed as follows:

1. Disconnect or turn off both the normal and emergency power sources.
2. Open enclosure door of automatic transfer switch.
3. Set the disconnect switch (DS) to the DISCONNECT position to prevent the controller from energizing the solenoid(s). See Figure 2-2.



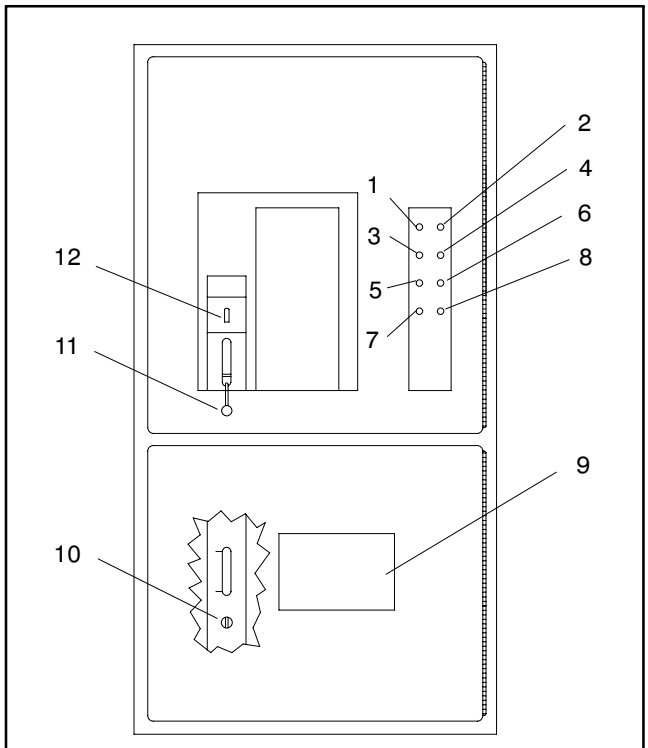
1. Manual handle
2. Disconnect switch

Figure 2-2 ATS Manual Operation

4. Insert the operator handle and set the transfer switch to the desired position.
5. Remove and stow the operator handle.
6. Return the disconnect (DS) switch to its normal position to reconnect the logic controller to the transfer switch solenoids.
7. Close the enclosure door.
8. Reconnect or turn on the applicable (normal or emergency) power source.

2.4 ZCI Operation, Switches and Indicators

Disconnect Switch. The disconnect switch controls the ATS coil operation. In the auto position the logic controls the ATS operation. In the inhibit position, the logic controller cannot energize the ATS coils.



1. LBE
2. LEA
3. LBN
4. LNA
5. LAI
6. LAI
7. LIT/LAH
8. LDS
9. Logic controls
10. Disconnect switch
11. Manual bypass handle
12. Bypass selector switch

Figure 2-3 Bypass/Isolation Switch

ATS Location Pointer. The ATS location pointer indicates the three positions of the ATS switch:

Auto: The ATS is connected to all of the buses.

Test: The ATS is disconnected from the load bus but connected to the normal and emergency buses.

Isolate: The ATS is disconnected from all buses.

2.4.1 Bypass/Isolation Cabinet Lights

Bottom Door

Choice of controller determines the switches and indicators for the automatic transfer switch. For details on switches and indicators, refer to the respective Logic Controller Operation and Installation Manual. See List of Related Manuals in the Introduction.

Top Door

LNA Lamp. Lamp illuminates when the normal power source is available.

LEA Lamp. Lamp illuminates when the emergency power source is available.

LBN Lamp.* Lamp illuminates when the normal bypass contacts are closed.

LBE Lamp.* Lamp illuminates when the emergency bypass contacts are closed.

LAT Lamp.* Lamp illuminates when the ATS is in the test location.

LAI Lamp.* Lamp illuminates when the ATS is isolated from the switch.

LAH Lamp.* Lamp illuminates when the ATS is not in the automatic mode (600-1200 amp switches only).

LIT Lamp.* Lamp illuminates when the ATS is not in the automatic mode (all except 600-1200 amp switches).

LDS Lamp.* Lamp flashes when the ATS coils are prevented from operating by the disconnect switch.

***These lamps will illuminate when any of the following are true:

1. The disconnect switch is in the inhibit position.
2. The bypass selector switch is in the normal or emergency position.
3. The ATS is not in the auto location.

2.4.2 Bypass/Isolation Switch Components

Bypass Normal Contacts. The bypass normal contact connects the load directly to the normal source, bypassing the ATS.

Bypass Emergency Contacts. The bypass emergency contacts connect the load directly to the emergency source, bypassing the ATS.

Bypass Operator. The bypass operator opens and closes the bypass normal or emergency contacts.

Manual Bypass Handle. The manual-bypass handle actuates the bypass operator. In the lower (open) position, the bypass normal and emergency contacts are open. In the upper (bypass) position, the bypass normal or emergency contacts are closed.

Bypass Selector Switch. The bypass selector switch determines which contacts the manual bypass handle actuates. Turn the bypass selector switch to the right to close the bypass normal contacts, center to open the bypass normal and emergency contacts, and left to close the bypass emergency contacts.

ATS Location Handle (150- to 400-amp switches only). The position of the ATS location handle determines the ATS mode of operation: auto, test or isolate. The ATS location handle can be moved only when the manual bypass handle is in the bypass position.

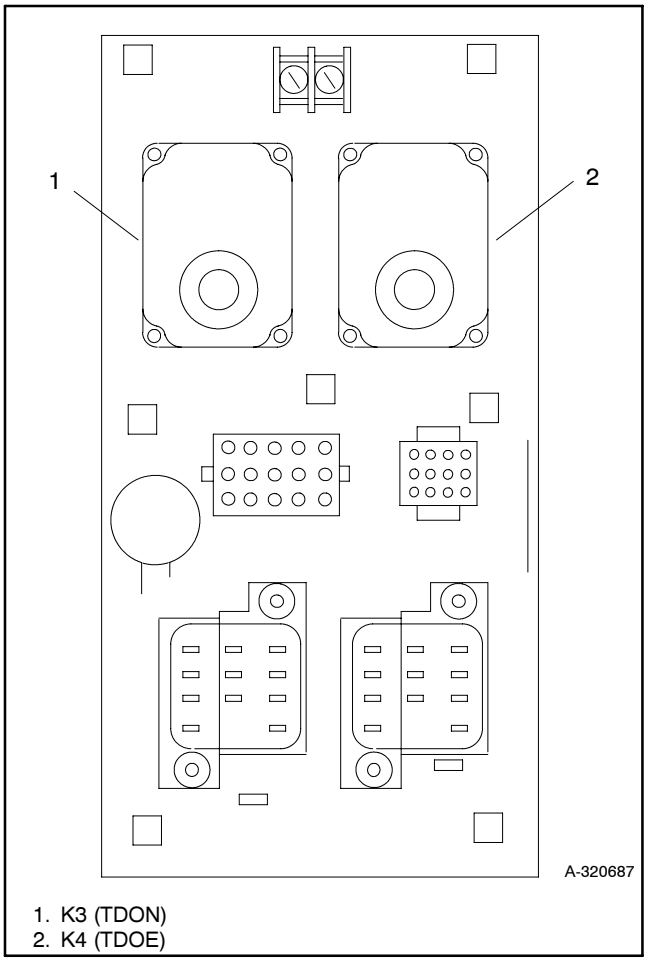
Crank Mechanism (600- to 3000-amp switches only). The crank mechanism determines the ATS mode of operation: auto, test or isolate. Turn the crank mechanism clockwise to raise the ATS and counterclockwise to lower the ATS through the three positions. The crank mechanism can be rotated only when the manual bypass handle is in the bypass position.

2.5 Time Delay Off

Note: This section does not apply to ATS utilizing microprocessor-based logic controls. On transfer switches equipped with microprocessor-based controls, the time delay is programmed into the controller.

The time-delay-off accessory for solid-state controls consists of two timing relays that plug into the interface board. See Figure 2-4. Power transfers from normal to emergency or emergency to normal power sources occur in three steps:

1. The switch 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.
3. The switch or circuit breaker for the new power source close.



1. K3 (TDON)
2. K4 (TDOE)

Figure 2-4 Interface Board with Time Delay Relays

2.6 Bypass/Isolation Switch Operation

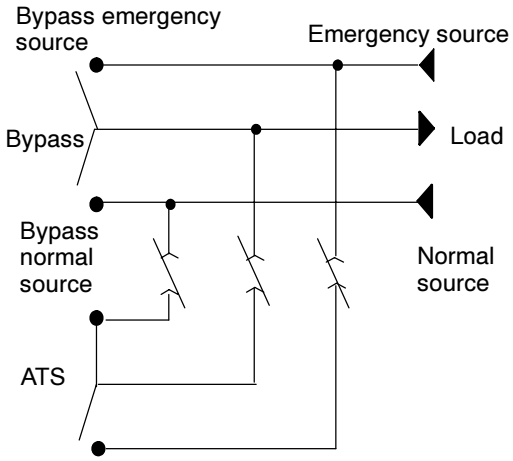
To place the ATS in the Automatic Mode

For 150- to 400-amp switches

1. Verify that the ATS contacts are in the same position as the bypass contacts.
2. Turn the disconnect switch to the INHIBIT position.
3. Move the ATS location handle to the AUTO position.
4. Move the manual bypass handle to the OPEN position.
5. Turn the disconnect switch to the AUTO position.

For 600- to 3000-amp switches

1. Verify that the ATS contacts are in the same position as the bypass contacts.
2. Turn the disconnect switch to the INHIBIT position.
3. Rotate the crank mechanism clockwise until the ATS is in the AUTO position.
4. Move the manual bypass handle to the OPEN position.
5. Turn the bypass selector switch to the OFF position.
6. Turn the disconnect switch to the AUTO position.



Bypass in the open position and ATS in the normal position

567326

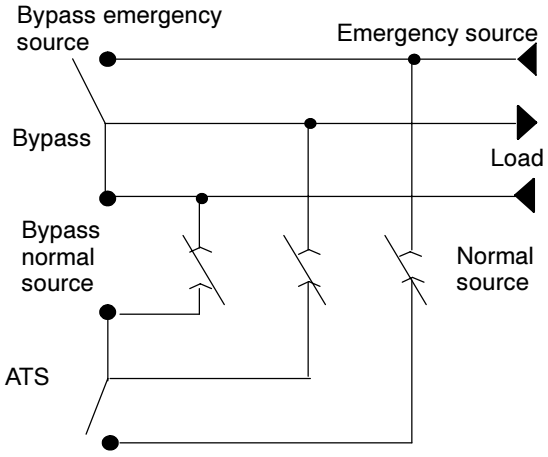
To Bypass the ATS

For 150- to 400-amp switches

1. Open the bottom cabinet door.
2. Turn the disconnect switch to the INHIBIT position.
3. Position the manual bypass handle to the same power source as the ATS. Note: The bypass switch uses safety interlocks to prevent cross phasing.

For 600- to 3000-amp switches

1. Open the bottom cabinet door.
2. Turn the disconnect switch to the INHIBIT position.
3. Position the bypass-selector switch to the same power source as the ATS. Note: The bypass switch uses safety interlocks to prevent cross phasing.
4. Move the manual-bypass handle to the BYPASS position.



Bypass in the normal position and ATS in the normal position

567327

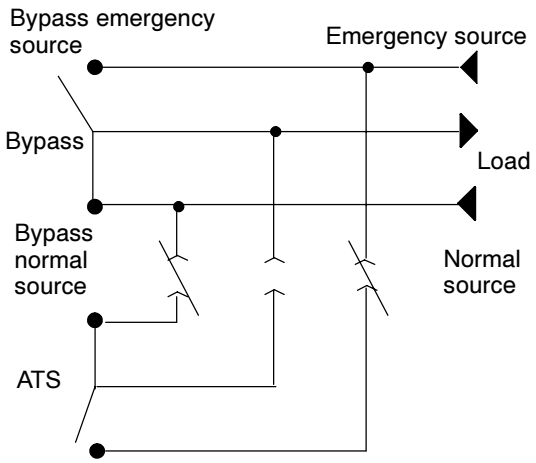
To Test the ATS

For 150- to 400-amp switches

1. Open the bottom cabinet door.
2. Turn the disconnect switch to the INHIBIT position.
3. Position the manual bypass handle to the ATS power source.
4. Move the ATS location handle to the TEST position.
5. Turn the disconnect switch to the AUTO position.
6. Move and hold the test switch on the logic controller to the TEST position.
7. Once the ATS transfers to the emergency position release the test switch.
8. The ATS will transfer back to the normal position.

For 600- to 3000-amp switches

1. Open the bottom cabinet door.
2. Turn the disconnect switch to the INHIBIT position.
3. Position the bypass-selector switch to the source that powers the ATS.
4. Move the manual bypass handle to the BYPASS position.
5. Rotate the crank mechanism counterclockwise until the ATS location pointer is aligned with isolate; the ATS isolate position lamp will illuminate.
6. Turn the disconnect switch to the AUTO position.
7. Move and hold the test switch on the logic controller to the TEST position.
8. Once the ATS transfers to the emergency position release the test switch.
9. The ATS will transfer back to the normal position.



Bypass in the normal position and ATS in the test position (ATS load connection is open)

567328

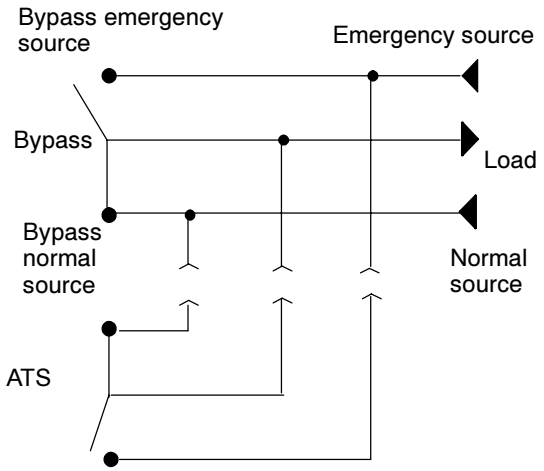
To Isolate the ATS

For 150- to 400-amp switches

1. Open the bottom cabinet door.
2. Turn the disconnect switch to the INHIBIT position.
3. Position the manual bypass handle to the power source that powers the ATS.
4. Move the ATS location handle to the ISOLATE position; the ATS isolate position lamp will illuminate.

For 600- to 3000-amp switches

1. Open the bottom cabinet door.
2. Turn the disconnect switch to the INHIBIT position.
3. Position the bypass-selector switch to the source that powers the ATS.
4. Move the manual bypass handle to the BYPASS position.
5. Rotate the crank mechanism counterclockwise until the ATS location pointer is aligned with isolate; the ATS isolate position lamp will illuminate.



Bypass in the normal position and ATS in the isolate position

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When the ATS is in the test or isolate position the bypass switch serves as a manual transfer switch. The transfer from the bypass emergency contacts to the bypass normal contacts results in a momentary loss of power to the load while the bypass switch is open.

The ATS will not operate if any of the following is true:

1. The harness plugs are not connected.
2. The disconnect switch is in the inhibit position.
3. The ATS is not in the auto or test positions.
4. The ATS is in the auto position and the bypass switch is not open.

The manual-bypass handle will not close in the bypass position if any of the following is true:

100- to 400-Amp Switches

1. The ATS location handle is not engaged in one of the following positions: auto, test, or isolate.
2. The selected source is opposite of the ATS position while in the auto position.
3. The ATS is in the test or isolate position and the selected source is not available.

600- to 3000-Amp Switches

1. The bypass selector switch is turned to the source opposite the ATS.
2. The bypass selector switch is turned to the source opposite the ATS.
3. The ATS location handle is not engaged in one of the following positions: auto, test, or isolate.
4. The source selected is opposite of the ATS position while in the auto position.
5. The ATS is in the test or isolate position and the source selected is not available.

The manual bypass handle will not open the bypass if any of the following is true:

600- to 3000-Amp Switches Only

1. The ATS is not in one of the following positions: auto, test, or isolate.
2. The ATS is in the test or isolate position and the opposite source is not available.

The ATS location handle will not operate if any of the following is true:

100- to 400-Amp Switches Only

1. The bypass switch and ATS are not positioned to the same source.
2. Power is not available.
3. The harness plugs are not connected.
4. The ATS has reached its limit of travel in the auto or isolate positions

The crank handle will not operate if any of the following is true:

600- to 3000-Amp Switches Only

1. The bypass switch and ATS are not positioned to the same source.
2. Power is not available.
3. The harness plugs are not connected.
4. The ATS has reached its limit of travel in the auto or isolate positions (clutch device on the crank mechanism slips).

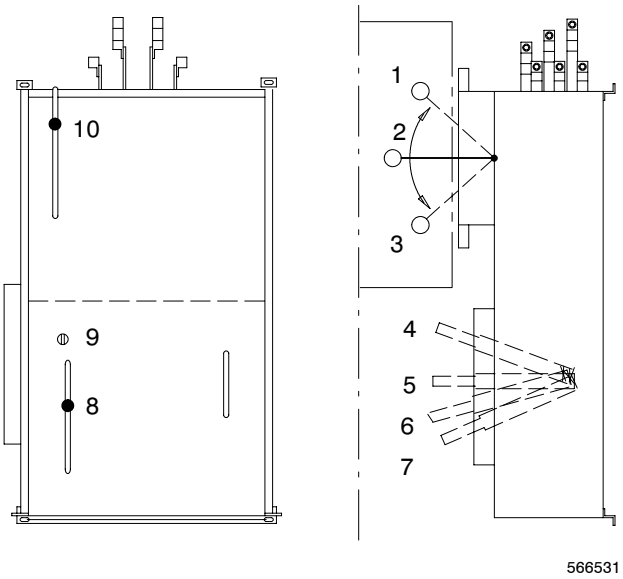
2.7 ATS Removal and Reconnection

2.7.1 Removing ATS in 150- to 400-Amp Switches

1. Open the cabinet door. See Figure 2-5.
2. Turn the disconnect switch to the inhibit position.
3. Position the manual bypass handle to the same power source as the ATS.
4. Move the ATS location handle to the RELEASE position.
5. Disconnect the multipin plugs and external connections from the ATS.
6. Lift the ATS out of its drawer.

2.7.2 Reconnecting ATS in 150- to 400-Amp Switches

1. Turn the disconnect switch to the INHIBIT position.
2. Place the ATS into its drawer slots (front rollers first).
3. Manually position the ATS to the same source as the bypass switch.
4. Reconnect the multipin plugs and external connections to the ATS.
5. Push the ATS inward to engage the carriage.
6. Move the ATS location handle to the test position.
7. Turn the disconnect switch to the AUTO position and use the test switch on the logic controller to electrically operate the ATS.
8. Move the ATS location handle to the AUTO position.
9. Turn the disconnect to AUTO position and move the manual bypass handle to the OPEN position.
10. To ensure correct ATS operation use the test steps in Section 2, Transfer Switch Operation.

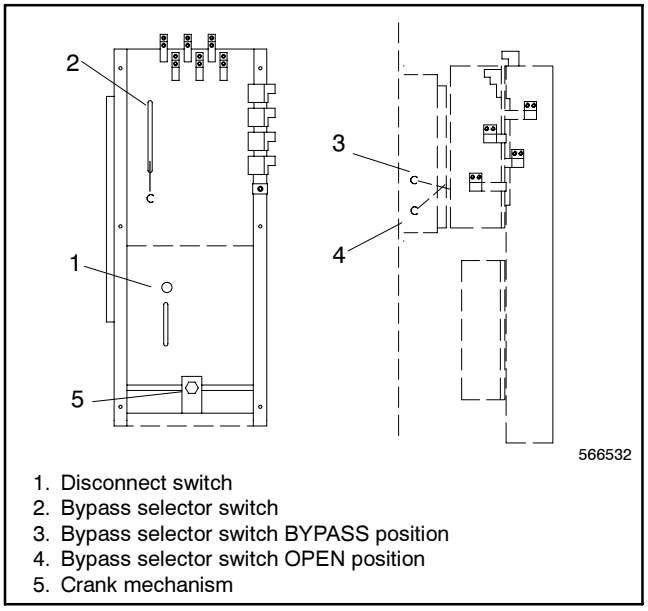


1. Manual bypass handle EMERGENCY position
2. Manual bypass handle OPEN position
3. Manual bypass handle NORMAL position
4. Release position
5. Isolate position
6. Test position
7. Auto position
8. ATS location handle
9. Disconnect switches
10. Manual bypass handle

Figure 2-5 Bypass Switch Handle Positions

2.7.3 Removing ATS in 600- to 1200-Amp Switches

1. Open the cabinet door. See Figure 2-6.



1. Disconnect switch
2. Bypass selector switch
3. Bypass selector switch BYPASS position
4. Bypass selector switch OPEN position
5. Crank mechanism

Figure 2-6 Bypass Switch Crank Mechanism Location

2. Turn the disconnect switch to the INHIBIT position.
3. Move the bypass selector switch to the source that powers the ATS.
4. Move the manual bypass handle to the BYPASS position.
5. Rotate the crank mechanism counterclockwise until the ATS location pointer is aligned with isolate.
6. Disconnect the multipin plugs and external connections from the ATS.
7. Rotate the four panel latches to the vertical position. See Figure 2-7.

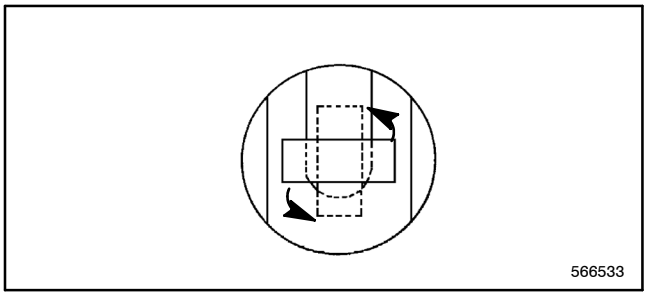


Figure 2-7 Panel Latch Rotation

8. Pull the ATS outward until the slide brackets are fully extended.
9. Engage the slide locks to prevent movement of the brackets.
10. Connect a lift bar to the ATS lifting brackets

2.7.4 Reconnecting ATS in 600- to 1200-Amp Switches

1. Turn the disconnect switch to the INHIBIT position.
2. Seat the ATS on the slide brackets.
3. Remove the lift bar assembly.
4. Release the slide locks (Note: Raise the slide locks approximately 60° to disengage.) See Figure 2-8.

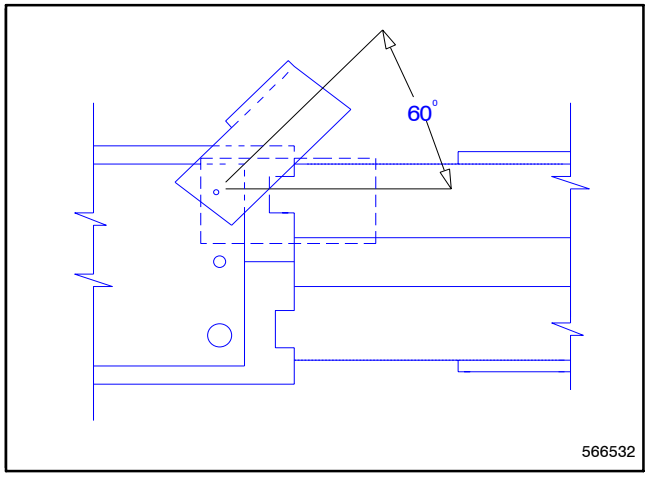


Figure 2-8 Panel Latch

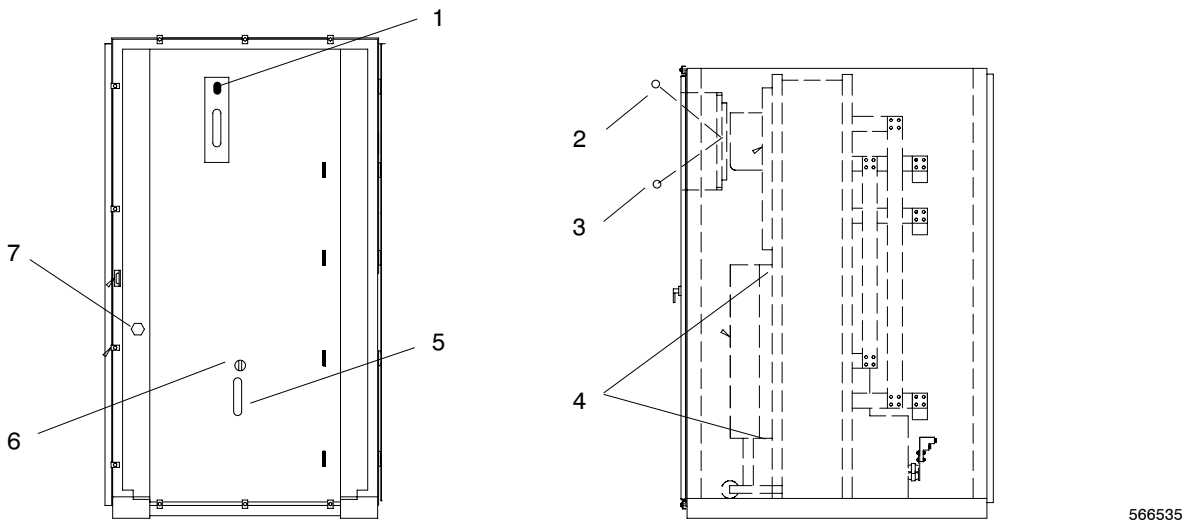
5. Push the ATS in until the power panel latches can be engaged and rotated to the horizontal position.
6. Confirm that the bypass switch is in the ISOLATE position.
7. Reconnect the multipin harness plugs.
8. Rotate the crank mechanism clockwise until the ATS is in the AUTO position.
9. Move manual-bypass handle to AUTO position.
10. Turn bypass-selector switch to the OFF position.
11. Turn the disconnect switch to the AUTO position.
12. To ensure correct ATS operation use the step in Section 2, Transfer Switch Operation.

2.7.5 Removing ATS in 1600- to 3000-Amp Switches

1. Open the cabinet door.
2. Turn the disconnect switch to the INHIBIT position.
3. Move the bypass-selector switch to the source that powers the ATS.
4. Move the manual-bypass handle to the BYPASS position.
5. Rotate the crank mechanism counterclockwise until the ATS location pointer aligns with isolate.
6. Disconnect the multipin plugs and external connections from the ATS.
7. Slide the four corner latches of the ATS to the innermost position.
8. The ATS can now be rolled out of the cabinet on the built-in cart.

2.7.6 Reconnecting ATS in 1600- to 3000-Amp Switches

1. Turn the disconnect switch to the INHIBIT position.
2. Roll cart back in the cabinet.
3. Slide the four corner latches of the ATS to the outermost position.
4. Turn the disconnect switch to the INHIBIT position.
5. Manually position the ATS to the same source as the bypass switch.
6. Reconnect the multipin harness plugs.
7. Rotate the crank mechanism clockwise until the ATS is in the AUTO location.
8. Move the manual bypass switch to the OPEN position.
9. Turn the disconnect switch to the AUTO position.
10. To ensure correct ATS operation use the step in Section 2, Transfer Switch Operation.



1. Bypass selector switch
2. Manual bypass handle BYPASS position
3. Manual bypass handle OPEN position
4. Corner latches
5. Manual ATS handle
6. Disconnect switch
7. Crank mechanism

Figure 2-9 1600-3000 Amp Bypass Handle Positions

Preventive maintenance will ensure high reliability and long life for the automatic transfer switch. Follow all applicable local codes and standards, and keep a log book for scheduled maintenance and repairs.

Operate the transfer switch at least once a month. Use the test switch to check the electrical operation of the transfer switch. The test switch simulates failure of the normal source. Service is interrupted only during the actual transfer of the load. The manufacturer recommends connecting an actual load during transfer.

Keep the automatic transfer switch clean. During installation, protect the switch from construction grit and metal chips. Once each year, with the control panel cover in place, brush and vacuum away any excessive dust accumulation.

Maintain transfer switch lubrication. The transfer switch is factory lubricated. The transfer switch requires no further lubrication.

Inspect the main current-carrying contacts. Once each year, de-energize all sources and remove barriers to check condition of contact material. Replace switch or circuit breaker contactor unit when contacts are pitted or excessively worn.

Torquing of contactor lug set screws. Torque set screws to spec when installing in the ATS. Check torque every six months. When using an aluminum conductor, apply joint compound to conductors. Check contactor lugs after tightening and wipe off excess joint compound.

Effect of ambient temperature and humidity conditions. Operate the contactor in an ambient temperature of 0°C–40°C (32°F–104°F). Contact the manufacturer if operating the contactor in a higher or lower ambient temperature. Humidity can vary from 5%–95% without affecting operation.

Notes

4.1 Power Switching Device Troubleshooting

This section provides troubleshooting procedures for mechanical failures of the power switching device. Refer to the applicable logic controller service and parts manual for troubleshooting the electrical functions of the switching device as well as the overall operation of the automatic transfer switch. See List of Related Manuals in the Introduction of this manual.

When troubleshooting the transfer switch mechanism, always check for simple causes first: broken or loose wires, corroded contacts, exposure to dirt or foreign material, etc.

Use the following chart as a reference to troubleshoot individual problems. The chart includes troubleshooting information for a specific automatic transfer switch problem. Included in this information is a list of possible causes of the problem, the recommended remedy for each possible cause, and a reference to detailed information or procedures for the remedy.

Have an authorized service dealer perform repairs. Improper repairs by unqualified personnel can lead to additional failures.

Problem	Possible Cause	Corrective Action	Reference
Contactor fails to move	Solenoid burned out	Replace solenoid	Section 6, Component Removal and Installation
	Contactor binding	Realign contactor	Section 6, Component Removal and Installation
	Logic not functioning correctly	Check logic controller	See applicable logic controller service and parts manual
Contactor transfers then hums or burns out solenoid	Auxiliary switches misaligned	Realign switches	Section 6, Component Removal and Installation
	Auxiliary switches failed	Replace switches	Section 6, Component Removal and Installation
Contactor hangs up	Contactor misaligned	Realign contactor	Section 6, Component Removal and Installation

Condition	Possible Cause	Check for
Failure to transfer	Mechanical binding	Loose hardware.
		Accumulation of dirt or other foreign material.
		Jammed main contacts. Check for foreign object.
		Jammed or damaged solenoid.
		Faulty or worn core spring.
		Bent main contact shaft.
	Electrical malfunction	Damaged or wrong coil. Check for signs of overheating.
		Damaged or wrong rectifier.
		Damaged or wrong resistor (not used on all models).
		Loose or broken wires.
		Corroded or fused contacts.
		SCE/SCN limit switch connections and operation.
		Improperly wired harness.
		Wrong voltage. Check system voltage, controller system voltage and over/undervoltage pickup and dropout settings, and controller meter calibration.
Chattering noise when attempting to transfer	Control contact operation	SCE/SCN limit switch connections and operation.
	Low voltage	Check source voltage and connections.
	Wrong coil	Check coil voltage rating.

Figure 4-1 Power Switching Device Troubleshooting Chart

4.2 Model SBL and SCL Controller and RT Box Troubleshooting

This section contains troubleshooting instructions for the controller and RT box on Model SBL and SCL closed-transition switches. See MP-6228, Operation/ Installation Manual, for more troubleshooting information for these models.

See Figure 4-2 for the RT box connectors.

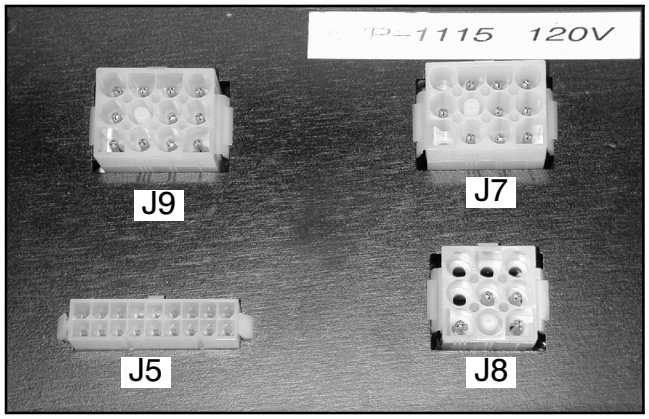


Figure 4-2 RT Box Connectors

If the controller does not light up/operate:

Check for the following voltages at the **J5** plug by removing it from the controller. Look at the pins in the plug to be sure that none of them have slipped out of their locked position in the plug. Check for the voltages in Figure 4-3.

Between Pins	Voltage, VAC
900-902	24
903-904	10
905-906	11
804-807	10

Figure 4-3 Connector J5 Voltage Checks

If any of the voltages listed in Figure 4-3 are *not* present then the RT box is not functioning correctly and should be replaced. If the voltages are present, replace the controller.

If these voltages are present and the controller still does not operate:

Remove the J7 plug from the RT box and check for the voltages in Figure 4-4 (note that the pin numbers in parenthesis are for three phase systems). Look at the pins in the plug to be sure that none of them have slipped out of their locked position in the plug.

If line voltage is not present at any of the pins listed in Figure 4-4 then the incoming line voltage (the voltage of your system) is suspect. Check the incoming line voltage to the system.

Between Pins	Voltage, VAC
20-21-(22)	Line voltage
30-31-(32)	Line voltage

Figure 4-4 Connector J7 voltage Checks

If the RT box and/or harness are burned:

Check rectifier and solenoid resistance before replacing any other components and reenergizing the system. See Sections 4.3 and 4.4.

4.3 Solenoid Tests

Disconnect the solenoid leads and use an ohmmeter to measure the coil resistance. Most damaged coils will result in an open circuit (very high resistance) or a shorted coil (near zero resistance). Generally, any burning of wiring or components indicates a shorted condition. Replace the coil if an open circuit or a short circuit is found.

4.4 Rectifier Test

Use an ohmmeter or a diode checker to test the rectifiers.

Disconnect all leads to the bridge rectifier and test each rectifier (diode) in the bridge individually using an ohmmeter (R x 1 scale) or diode checker. See Figure 4-5 and Figure 4-6. The diodes should exhibit a reverse resistance of at least 100 times the forward resistance. If the reverse resistance is low, replace the damaged rectifier assembly.

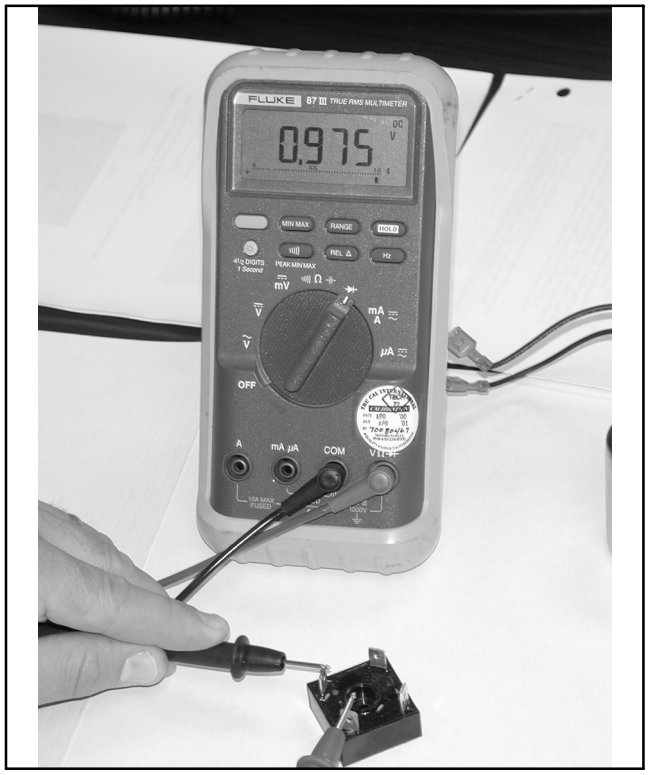
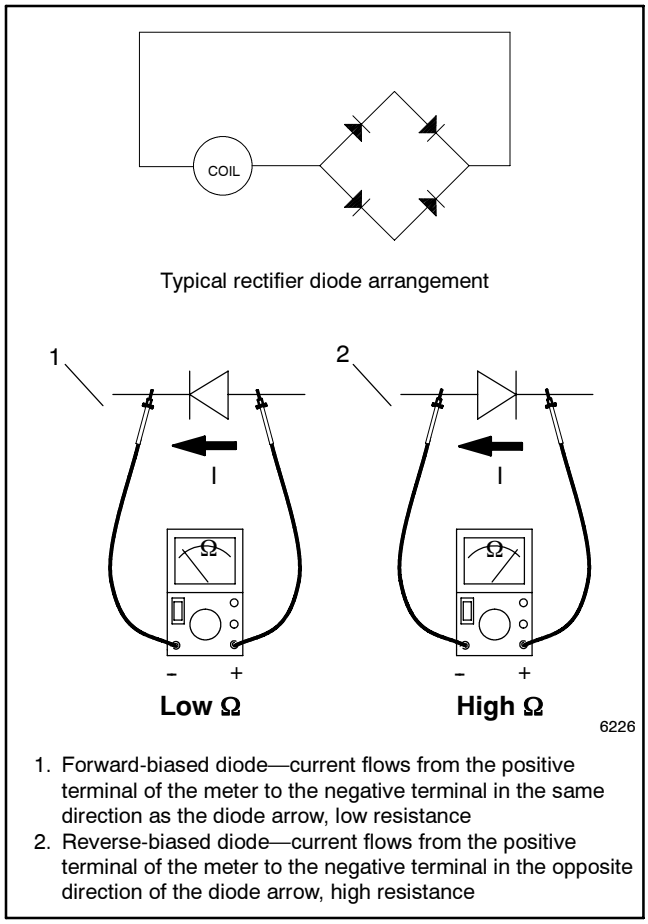


Figure 4-5 Checking Rectifier Diode Operation



1. Forward-biased diode—current flows from the positive terminal of the meter to the negative terminal in the same direction as the diode arrow, low resistance
2. Reverse-biased diode—current flows from the positive terminal of the meter to the negative terminal in the opposite direction of the diode arrow, high resistance

Figure 4-6 Testing Diodes (model SDT/SMT switches only)

Notes

5.1 Accessories

With the exception of the time-delay-off accessory, all other accessories are controller accessories. For controller accessory information and procedures, refer to the appropriate controller manual. See List of Related Manuals in the Introduction.

5.2 Programmed Transition

Note: This section does not apply to ATS utilizing the microprocessor logic control. The microprocessor controls the programmed transition function. Standard C-form relays replace the timing relays and therefore require no relay adjustment. See MP-5664 for operational details.

⚠ DANGER

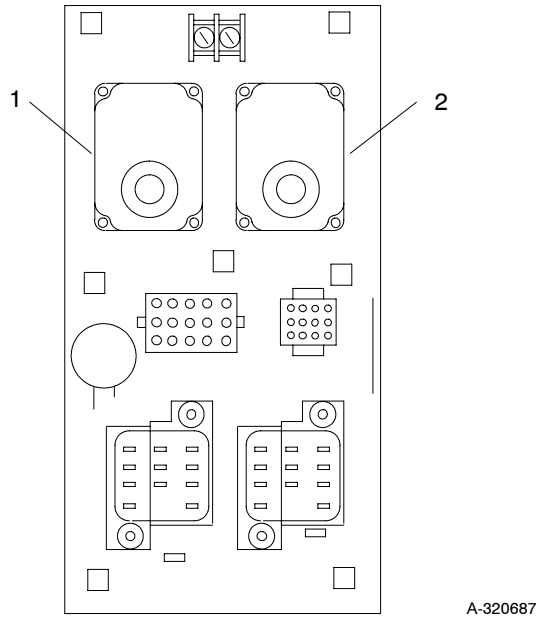
Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

Grounding electrical equipment. Hazardous voltage can cause severe injury or death. Electrocution is possible whenever electricity is present. Open the main circuit breakers of all power sources before servicing the equipment. Configure the installation to electrically ground the generator set, transfer switch, and related equipment and electrical circuits to comply with applicable codes and standards. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

There are two separate timing relays used: K4 (TDOE) and K3 (TDON). K4 produces the time delay for the normal to emergency power transfer; K3 produces the time delay for the emergency to normal power transfer. Each relay has a separate adjustment. To make an adjustment, proceed as follows:

1. Disconnect both the normal and emergency power sources.
2. Open the ATS door.
3. Locate the appropriate relay on the interface board. See Figure 5-1.



1. K3 (TDON)
2. K4 (TDOE)

Figure 5-1 Interface Board with Programmed Transition Relays

4. Insert a screwdriver into the adjustment slot of the adjustment screw. The adjustment slot is visible through the cover of the relay.
5. Turn the adjustment screw to the desired time delay period.
6. Close the enclosure door.
7. Reconnect the normal and emergency power source.
8. Operate the automatic transfer switch automatically and check the time-delay-off period to ensure that it is properly adjusted.

Notes

6.1 Introduction

This section covers the removal and replacement procedures for the transfer switch assembly. Although there are four separate amperage ranges, many of the procedures apply to more than one switch assembly. For servicing purposes, each transfer switch assembly is separated into the following components:

- Linear Actuator/Solenoids
- Contact Assemblies
- Auxiliary Switches

6.2 Linear Actuator/Solenoid Removal and Replacement

6.2.1 150-400 Amp Models

Disconnect both the normal and emergency power sources from the transfer switch before servicing. If a generator set provides standby emergency power, move the generator set master switch to OFF and disconnect the negative (–) battery cable from the generator set starting battery. The generator set master switch is located on the generator set control panel.

Removing Actuator Solenoid

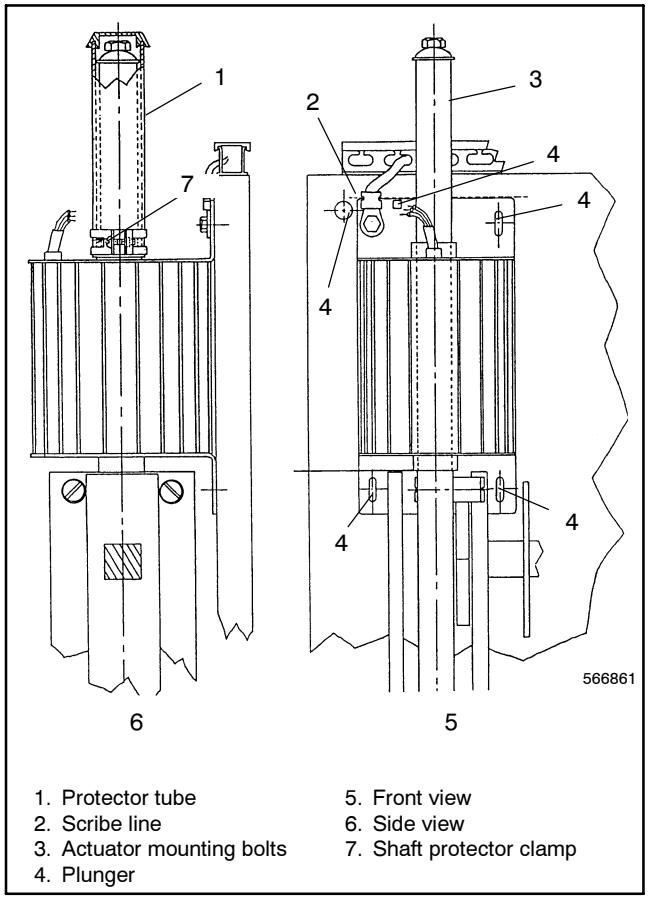
Refer to Figure 6-1 for the following procedure.

1. Loosen the screw from the shaft protector clamp.
2. Raise the protector tube and remove.
3. Scribe the position of the linear actuator on the panel.
4. Wrap the plunger with cloth and clamp a vise grip to hold the plunger. Be sure not to nick or distort the plunger.
5. Remove the bolt, belleville washer, and split lockwasher using an open end 12.7 mm (1/2 in.) wrench across the flats of the plunger.
6. Remove the actuator mounting bolts, lockwasher, and screw.
7. Use the manual handle to move the transfer switch to the emergency position.
8. Remove the leads at terminal board numbers 26, 28, and 36.
9. Pull out the leads and remove the actuator.

   Note: If the actuator is seized because the plunger in the linear actuator freezes to the internal components because of excessive heat buildup, making it impossible to remove. If this situation develops, perform the following steps:

   a. Tap the top of plunger downward with a hammer to loosen the plunger.

   b. Pull the entire assembly (actuator, plunger, and roller plate) out of the transfer switch and disassemble.



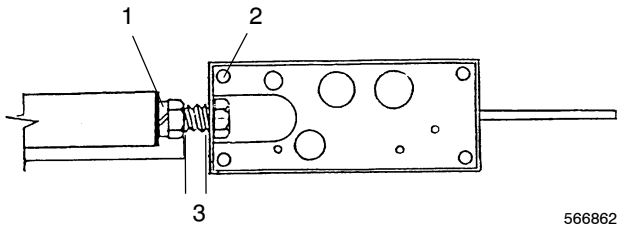
1. Protector tube
2. Scribe line
3. Actuator mounting bolts
4. Plunger
5. Front view
6. Side view
7. Shaft protector clamp

Figure 6-1 150-400 Amp Actuator/Solenoid

Replacing Actuator Solenoid, 150-400 Amps

Observe the following when reassembling the plunger and roller plate:

1. Insert the bolt through the hole in roller plate assembly. See Figure 6-2.



1. Lock washer and nut
2. Roller plate
3. 1-2 thread and gap

Figure 6-2 150-400 Amp Plunger Assembly

2. Maintain a 1-2 thread gap between the nut and frame of the assembly.

3. Tighten the lockwasher and nut to the plunger.

4. On 400 amp units, use a flatwasher between the plunger and lockwasher

Note: Do not tighten plunger to roller plate assembly; actuator binding occurs.

Refer to Figure 6-1 for the following procedure:

1. Match the new actuator to the scribed lines. Reinstall the actuator mounter bolts and lockwasher.

2. Connect the actuator wires to the 3 pt terminal block as follows:

   a. #26, black actuator lead.

   b. #28, white actuator lead. #28 is a double connection one lead going to the disconnect switch.

   c. #36, red actuator lead.

3. Replace and tighten nut, belleville washer, lockwasher, and actuator plunger. Do not burr plunger.

4. Manually rotate the plunger in the shaft to ensure binding does not occur. If binding occurs, loosen the actuator mounting bolts and adjust the actuator by tapping the left or right side while rotating the plunger until binding is eliminated. Retighten actuator mounting bolts and insert screw.

5. Replace plunger protector and tighten shaft protector clamp.

6. Check the upper and lower cams to ensure they are tight.

7. Test the switch operation with the manual handle. While manually operating the switch to normal, check the roller plate assembly to verify that nothing interferes with its operation.

During Manual Operation

1. Check contact force into the normal and emergency position.

2. Check that the distance between paddle and movable contact is 0.060 minimum to 0.094 maximum.

6.2.2 600-1200 Amp Models

Disconnect both the normal and emergency power sources from the transfer switch before servicing. If a generator set provides standby Emergency power, turn the generator set master switch to OFF/RESET and disconnect the negative (–) battery cable from the generator set starting battery. The generator set master switch is located on the generator set control panel.

Note: The disconnect switch contact block may also need replacement.

Removing the Actuator Solenoid

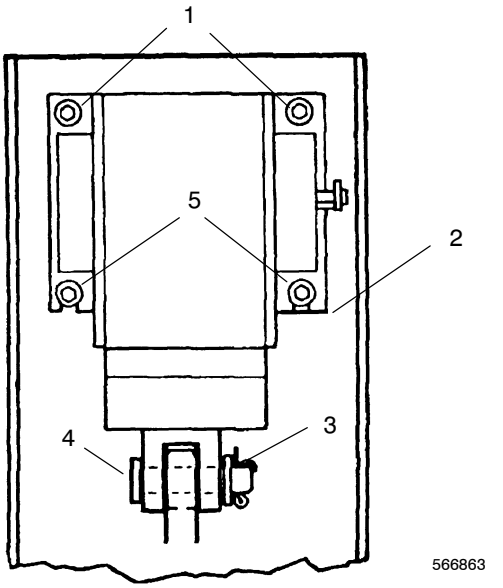
Refer to Figure 6-3 for the following procedure:

1. Remove the solenoid assembly cover.

2. Mark the solenoid location using a marker or scribe.

3. Disconnect the input voltage leads to the solenoid.

4. Remove the clevis pin holding the solenoid plunger to the actuator linkage.



1. Capscrews to remove
2. Scribe line
3. Cotter pin and washer
4. Clevis pin
5. Capscrew to loosen

Figure 6-3 600-1200 Amp Linear Actuator Solenoid

5. Manually position the transfer switch to the position of the solenoid being replaced.

6. Remove the two 6.35 mm (1/4 in.) socket head capscrews from the base of the solenoid.

7. Loosen the other two 6.35 mm (1/4 in.) socket head capscrews.

8. Remove the solenoid and plunger assembly.

Replacing the Actuator Solenoid

Refer to Figure 6-3 for the following procedure:

1. Align the actuator linkage with the solenoid plunger.

2. Align the solenoid assembly base with the mark scribed in step 2 of Removing the Actuator Solenoid.

3. Tighten the capscrews loosened in step 7 of Removing Actuator Solenoid to 34 Nm (25 ft. lb.).

4. Insert and tighten the capscrews removed in step 6 of Removing the Actuator Solenoid to 34 Nm (25 ft. lb.).

5. Install the clevis pin through the solenoid plunger and actuator linkage.

6. Reinstall the washer and cotter pin on the clevis pin.

7. Connect the coil leads.

8. Check the operation of the transfer switch by manually opening and closing the switch assemblies. Make sure there is no binding.

9. Check the auxiliary switches for proper tripping action. The auxiliary switch should close just as the mechanism reaches the over-center point during closure to normal or emergency.

10. Make certain that the plunger of the solenoid can touch the iron of the coil but is not bottomed out. The plunger must have play at all points of travel. If this is not true, readjust location of solenoid.

11. Reinstall the solenoid assembly cover.

12. Place the operator handle in its storage position.

13. Reconnect the normal power source and the emergency power source. If a generator set is the emergency power source, connect the negative (-) battery cable to the starting battery and place the generator set master switch to its original position.

14. Close the cabinet door.

15. Test the switch for proper operation.

6.2.3 1600-3000 Amp Models

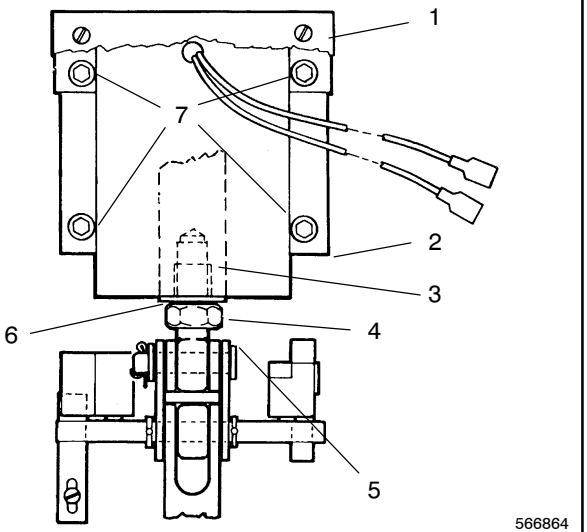
Disconnect both the normal and emergency power sources from the transfer switch before servicing. If a generator set provides standby emergency power, turn the generator set master switch to OFF/RESET and disconnect the negative (-) battery cable from the generator set starting battery. The generator set master switch is located on the generator set control panel.

This procedure applies to both upper and lower solenoids.

Note: Always replace the rectifier assembly when replacing the solenoid.

Removing Actuator Solenoid and Rectifier

Refer to Figure 6-4 for the following procedure.



1. Solenoid assembly
2. Scribe line
3. Plunger
4. Plunger jam nut
5. Swing bolt
6. 1/16 in. plunger protrude
7. Mounting bolts

Figure 6-4 1600-3000 Amp Linear Actuator Solenoid

1. Manually position the transfer switch to the position of the solenoid being replaced.
2. Loosen and remove the mounting screws and washers (4) that secure the solenoid cover to the transfer switch. Remove the cover.
3. Mark the solenoid location using a marker or scribe.
4. Cut the harness ties wraps to the associated rectifier.
5. Remove the 2 screws holding the rectifier and remove the rectifier.
6. Remove the four mounting bolts that secure the solenoid, solenoid cover plate, and ground wire.
7. Remove the cotter pin and washer from the solenoid plunger.
8. Remove the solenoid assembly from the plunger
9. Wipe the plunger with a clean cloth and inspect for damage, excessive wear, or any foreign matter. If the plunger is in good condition proceed to the solenoid replacement procedure. If the plunger is damaged or shows excessive wear, proceed to step 10.
10. Measure the total length of the old plunger, swing bolt to plunger bottom. Use a 22.225 mm (7/8 in.) opening wrench to hold the plunger jam nut and a 31.75 mm (1-1/4 in.) open-end wrench on the plunger flats. Turn the plunger counterclockwise to remove the plunger from the swing bolt.

Replacing Actuator Solenoid and Rectifier

1. Install the new rectifier.
2. Connect the rectifier AC connections to the wiring harness.
3. If replacing the plunger, install the new plunger on the swing bolt. Assemble plunger to the same length as the one removed in step 10 of 1600-3000 Amp, Removing Actuator Solenoid.
4. Align the solenoid plunger with the solenoid assembly and mount the solenoid assembly with the bolts removed in step 3 of 1600-3000, Removing Actuator Solenoid. Align the solenoid assembly with the scribed mark. The plunger should protrude approximately 1.59 mm (1/16 in.) from the plunger tube.
5. Tighten the solenoid mounting bolts to 34 Nm (25 ft. lb.).
6. If replacing the plunger, tighten the plunger to the nut by turning the plunger clockwise.
7. Connect the coil leads.
8. Check the operation of the transfer switch and the alignment of the plunger by manually opening and closing the switch.
9. Make sure that the plunger is not binding throughout its full range of travel.
10. Check that the auxiliary switches close just as the mechanism reaches the over-center point during closure to normal or emergency.
11. Reinstall the solenoid cover. Secure with the mounting screws and flatwashers (4).

12. Place the operator handle in its storage position.

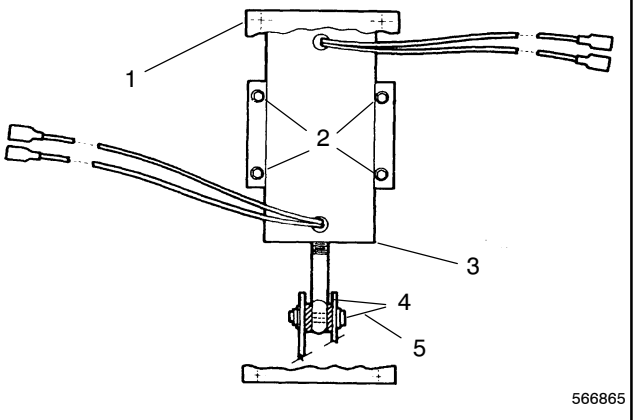
13. Reconnect the normal and emergency power source. If a generator set is the emergency power source, connect the negative (–) battery cable to the starting battery and place the generator set master switch in its original position.

14. Close the cabinet door.

15. Test the switch for proper operation.

6.2.4 1200-3000 Amp Programmed Transition Models

Refer to Figure 6-5 for the following procedure. This procedure applies to both upper and lower solenoids.



1. Solenoid assemble
2. Mounting bolts
3. Scribe line
4. Clevis pin
5. Cotter pin and washer

Figure 6-5 1200-3000 Amp Linear Actuator Solenoid

Disconnect both the normal and emergency power sources from the transfer switch before servicing. If a generator set provides standby emergency power, turn the generator set master switch to OFF/RESET and disconnect the negative (–) battery cable from the generator set starting battery. The generator set master switch is located on the generator set control panel.

Note: Always replace the rectifier assembly when replacing the solenoid.

Removing Actuator Solenoid and Rectifier

Refer to Figure 6-5 for the following procedure.

1. Loosen and remove the mounting screws and washers (4) that secure the solenoid cover to the transfer switch and remove the cover.

2. Mark the solenoid location using a marker or scribe line.

3. Cut the harness tie wraps to the associated rectifier.

4. Remove the cotter pin and washer from the solenoid plunger.

5. Remove the clevis pin from the two side links and sector yoke.

6. Disconnect the DC connections from the wiring harness.

7. Disconnect the AC connections to the rectifier from the wiring harness.

8. Remove the mounting bolts, lockwashers, and flatwashers that secure the solenoid assembly to the transfer switch.

9. Remove the solenoid assembly.

10. Remove 2 screws to remove the rectifier.

Replacing Actuator Solenoid and Rectifier

Refer to Figure 6-5 for the following procedure:

1. Install the new rectifier.

2. Connect the rectifier AC connections to the wiring harness.

3. Align the actuator linkage with the solenoid plunger and align the solenoid assembly base with the scribe line.

4. Secure the solenoid assembly with the mounting bolts, lockwashers, and flatwashers that were removed in step 8 of Removing Actuator Solenoid.

5. Tighten the solenoid mounting bolts to 34 Nm (25 ft. lb.).

6. Reinstall the clevis pin.

7. Reinstall the washer and cotter pin.
8. Connect the coil leads.
9. Check the operation of the transfer switch by manually opening and closing the switch.
10. Check that the auxiliary switches close just as the mechanism reaches the over-center point during closure to normal or emergency.
11. Reinstall the solenoid cover. Secure with the mounting screws and flatwashers (4).
12. Place the operator handle in its storage position.
13. Reconnect the normal and emergency power source. If a generator set is the emergency power source, connect the negative (-) battery cable to the starting battery and place the generator set master switch in its original position.
14. Close the cabinet door.
15. Test the switch for proper operation.

6.3 Contact Assembly Removal and Replacement

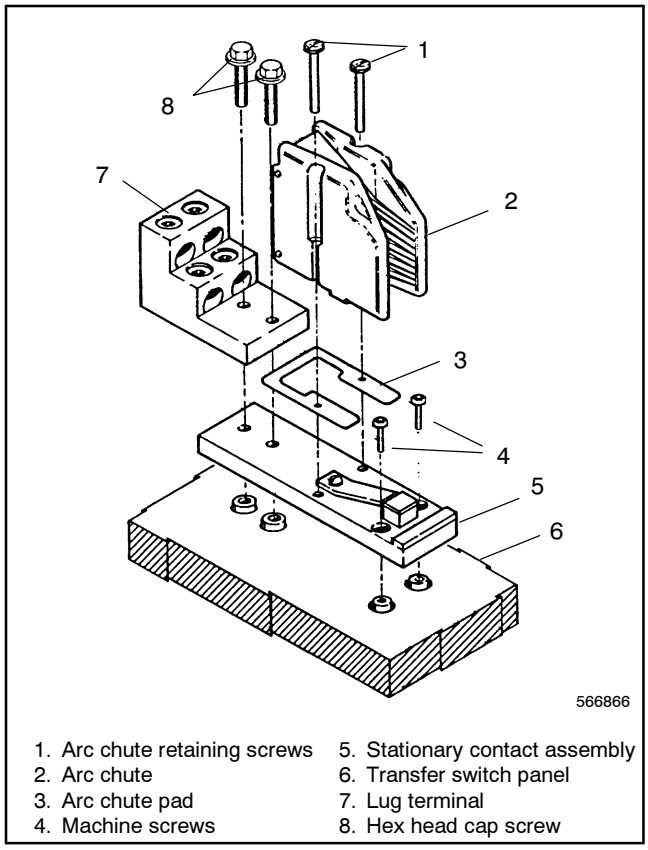
6.3.1 800-1200 Amp Models

Disconnect both the normal and emergency power sources from the transfer switch before servicing. If a generator set provides standby emergency power, turn the generator set master switch to STOP and disconnect the negative (-) battery cable from the generator set starting battery. Locate the generator set master switch on the generator set control panel.

Removing Contact Assemblies

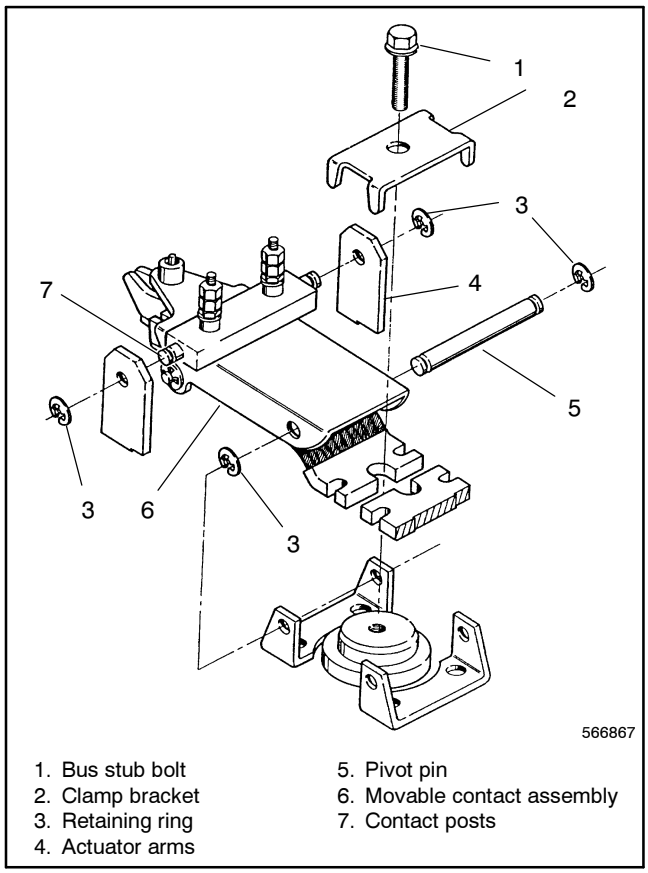
Refer to Figure 6-6 and Figure 6-7 for the following procedure:

1. Remove the machine screws and flatwashers that secure the blue plastic switch cover.
2. Remove the cover.
3. Manually place the movable contact assembly in the open position.
4. Remove the screws that secure the arc chute.
5. Remove the arc chute and arc chute pad.



1. Arc chute retaining screws
2. Arc chute
3. Arc chute pad
4. Machine screws
5. Stationary contact assembly
6. Transfer switch panel
7. Lug terminal
8. Hex head cap screw

Figure 6-6 800-1200 Amp Stationary Contact



1. Bus stub bolt
2. Clamp bracket
3. Retaining ring
4. Actuator arms
5. Pivot pin
6. Movable contact assembly
7. Contact posts

Figure 6-7 800-1200 Amp Movable Contact

6. Remove the two retaining rings and slide the actuator arms from the contact posts.

7. Remove one of the retaining rings from the pivot pin.

8. Slide out the pivot pin.

9. Remove the bus stud bolt, compression washer, and clamp bracket.

10. Remove the movable contact assembly.

11. If replacing the stationary contact, proceed to step 12. If not replacing the stationary contact, proceed to the replacement procedure.

12. Remove the hex head capscrews and the compression washers (2) that secure the lug terminal.

13. Remove the machine screws (2) that secure the other end of the stationary contact to the transfer switch panel.

14. Remove the stationary contact.

Replacing Contact Assemblies

Refer to Figure 6-6, Figure 6-7, Figure 6-8, Figure 6-9, and Figure 6-10 for the following procedure:

1. If replacing the stationary contact, position the new stationary contact on the transfer switch panel.

2. Secure the new stationary contact and the lug assembly using hex head capscrews, compression washers, and machine screws (2).

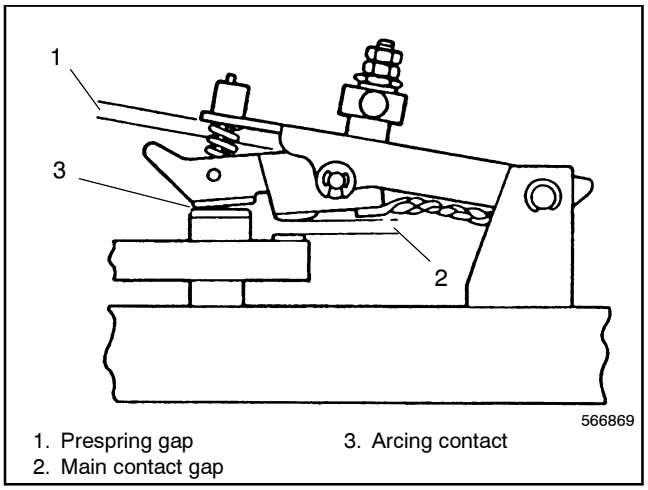


Figure 6-8 Contact Adjustment Part 1

3. Torque the capscrews to 31.2 Nm (23 ft. lb.) and the machine screws to 13.6 Nm (10 ft. lb.).

4. Using the new hardware supplied with the contact assemblies kit secure the new movable contact assembly with the bus stud bolt, compression washer, and clamp bracket.

5. Torque the bus stud bolt to 31.2 Nm (23 ft. lb.)

6. Install the pivot pin and secure with the retaining ring.

7. Connect the actuator arms to the contact posts and secure with the two retaining rings. See Figure 6-7.

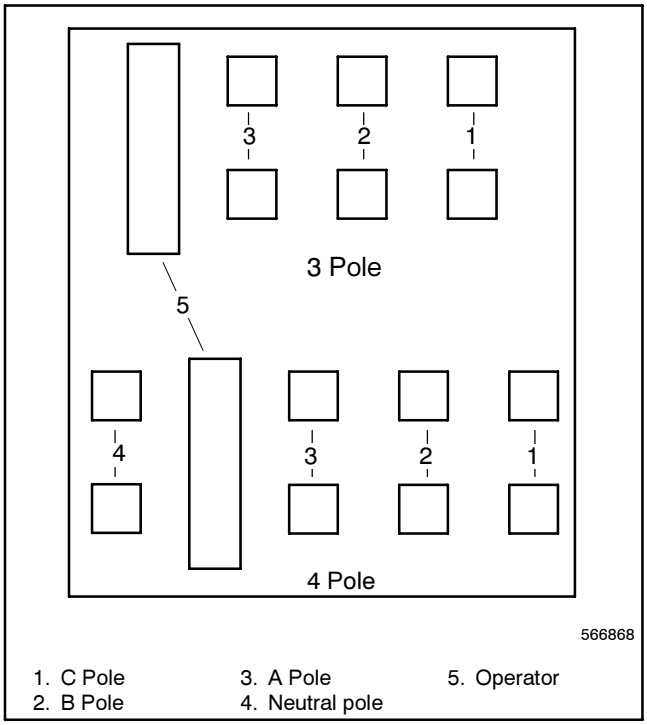


Figure 6-9 Contact Adjustment Order

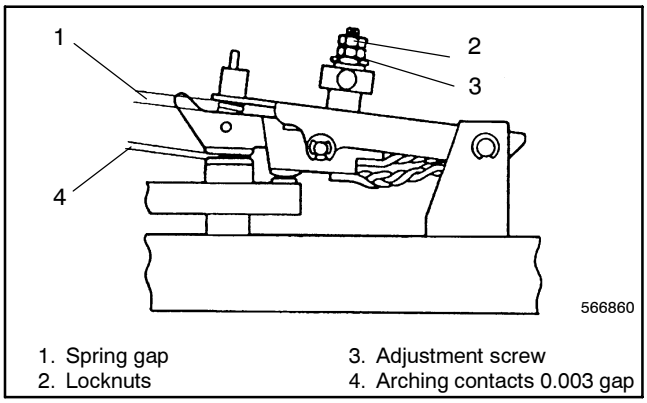


Figure 6-10 Contact Adjustment Part 2

8. Adjust the contacts (steps 9, 10, 12, and 13) in the sequence shown in Figure 6-9. For 3-pole switch all contacts should close at approximately the same time. For 4 pole switches poles A, B, and C should close at approximately at the same time. The neutral pole should close approximately 12.7 mm (1/2 in.) before the other three poles.

9. Manually close the contacts until the arcing contacts touch. See Figure 6-8. The main contacts should have a 1.59 mm (1/16 in.) minimum gap. If they do not, reject the contact assembly. Measure and record the prespring gap.

10. Close the contacts fully. See Figure 6-10.

11. Rock the arcing contact from toe to heel and verify that there is a 0.0762 mm (0.003 in.) minimum gap at the arching contacts. The feeler gauge must enter 1.59 mm (1/16 in.) past the edge of the silver.

12. Adjust the spring gap dimension to 3.175 mm (1/8 in.) maximum to 1.59 mm (1/16 in.) minimum deflection on the mains less than the prespring gap, measured in step 6, Bias to 1.59 mm (1/16 in.)

13. Turn the adjustment screw by hand to set the spring gap dimension.

14. Lock the setting by tightening the locknuts.

15. Check both sides of the main contacts to ensure they are level. Recheck the arch contact to make sure that it has not changed.

16. Secure the arc chute and arc chute pad with the two machine screws.

17. Check the operation of the transfer switch by manually opening and closing the switch assemblies.

18. Reinstall and secure the blue plastic cover.

19. Close cabinet door.

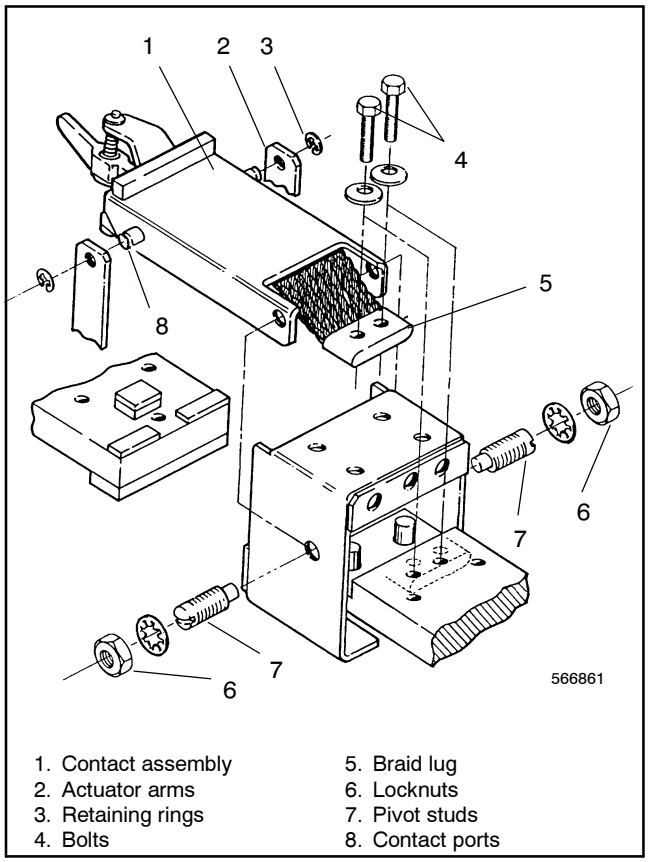
20. Reconnect the normal power source and the emergency power source. If a generator set is the emergency power source, connect the negative (-) battery cable to the starting battery and place the generator set master switch in its original position.

21. Test the switch for proper operation.

6.3.2 1600-2000 Amp Models

Removing the Contact Assembly

Refer to Figure 6-6 and 6-11 for the following procedure:



1. Contact assembly
2. Actuator arms
3. Retaining rings
4. Bolts
5. Braid lug
6. Locknuts
7. Pivot studs
8. Contact ports

Figure 6-11 1600-2000 Amp Movable Contact

1. Remove the machine screws and flatwashers that secure the blue plastic switch cover.

2. Remove the cover.

3. Remove the screws that secure the arc chute.

4. Remove the arc chute and arc chute pad.

5. Manually place the movable contact assembly that will be removed in the open position.

6. Remove the two retaining rings and slide the actuator arms from the contact posts. See Figure 6-11.

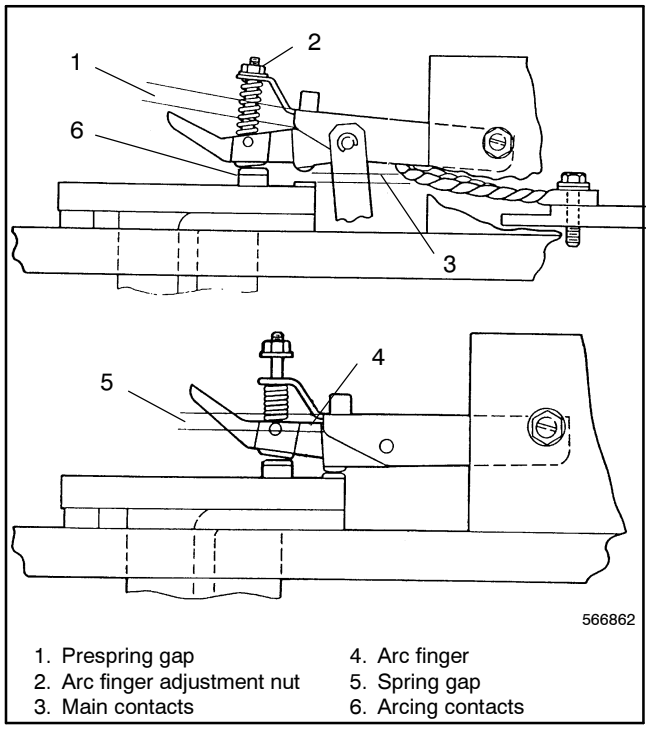
7. Remove the bolts and compression washers (2) from the braid lug.

8. Loosen the locknuts and remove the pivot studs.

9. Remove the contact assembly.

Replacing the Contact Assembly

Refer to Figure 6-11 and Figure 6-12 for the following procedure:



1. Prespring gap
2. Arc finger adjustment nut
3. Main contacts
4. Arc finger
5. Spring gap
6. Arcing contacts

Figure 6-12 Contact Adjustment

1. Secure the new movable contact assembly with the pivot studs, locknuts, and lockwashers.
2. Torque the locknuts to 13.6 Nm (10 ft. lb.).
3. Secure the braid lug with the braid lug bolts and compression washers.
4. Torque the bolts to 31.2 Nm (23 ft. lb.).
5. Connect the actuator arms to the contact posts and secure with the two retaining rings.
6. Manual close the contacts slowly until the arcing contacts touch. The main contacts should have 6.35 mm (1/4 in.) minimum gap. If not, adjust the arc finger adjustment nut as required. If the contacts cannot be brought within specifications, reject the contact assembly.
7. Measure and record the gap at the prespring gap.
8. Close the contacts fully.
9. Rock the arcing contact from toe to heel and verify that there is a 0.0762 mm (0.003 in.) minimum gap at the arcing contacts. The feeler gauge must enter 1.59 mm (1/16 in.) past the edge of the silver.
10. The spring gap dimension must be 1.59 mm (1/16 in.) less than prespring gap measured in step 4. If the contacts are not within specs, reject the contact assembly.
11. Check that the contact pressure of each of the three outside main contacts is between 1.7–2 kg (3.75–4.5 lb.).
12. Check that the contact pressure of the arc finger is between 4–6.4 kg (9–14 lb.).
13. Check that both main and arc contact fingers are not bottomed out when closed.
14. Secure the arc chute and arc chute pad with the two machine screws.
15. Check the operation of the transfer switch by manually opening and closing the switch assemblies.
16. Reinstall and secure the blue plastic cover.
17. Close cabinet door.
18. Reconnect the normal power source and the emergency power source. If a generator set is the emergency power source, connect the negative (–) battery cable to the starting battery and place the generator set master switch in its original position.
19. Test the switch for proper operation.

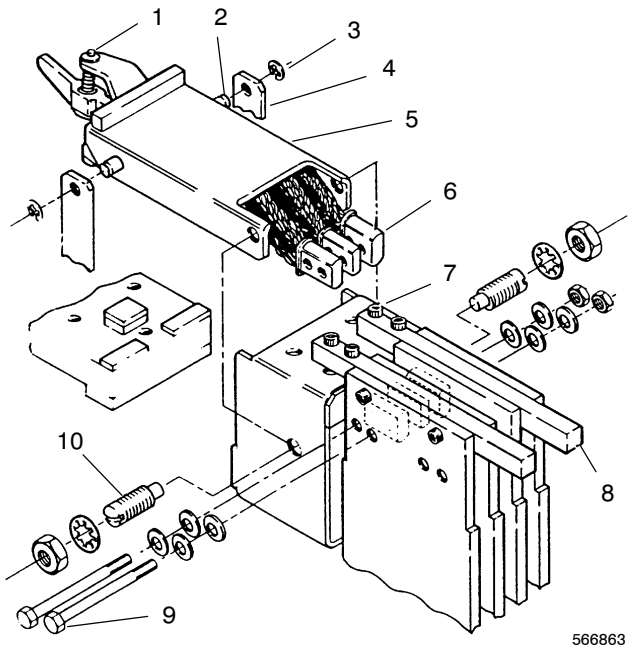
6.3.3 3000 Amp Models

Removing the Contact Assembly

Disconnect both the normal and emergency power sources from the transfer switch before servicing. If a generator set provides standby emergency power, turn the generator set master switch to OFF/RESET and disconnect the negative (–) battery cable from the generator set starting battery. Locate the generator set master switch on the generator set control panel.

Note: Replace the B-phase contact assembly only by first removing two bolts from the adjacent C-phase contact assembly. Refer to step 6b for this replacement procedure.

Refer to Figure 6-6 and Figure 6-13 for the following procedure:



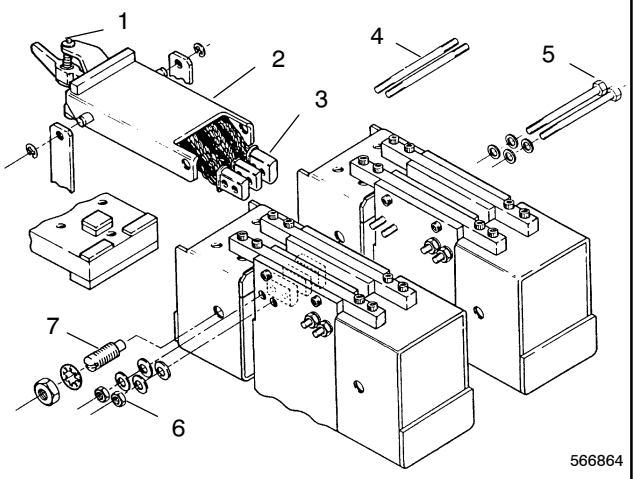
1. .Arc finger adjustment nuts
2. Contact post
3. Retaining rings
4. Actuator arms
5. Contact assembly
6. Braid lug
7. Socket head cap screws
8. Anchor bolts
9. Braid lug bolts
10. Pivot studs

Figure 6-13 3000 Amp Movable Contact A or C Phase

1. Remove the machine screws and flatwashers that secure the blue plastic switch cover.
2. Remove the cover.
3. Remove the screws that secure the arc chute.
4. Remove the arc chute and arc chute pad.
5. Manually place the movable contact assembly that will be removed in the open position.
6. Remove the two retaining rings and slide the actuator arms from the contact posts.
7. Remove the twelve 1/4-20 socket head capscrews from the load bus assembly and lift out the anchor bars. The longer capscrews are used on the sides.
   a. To remove an A-phase, C-phase, or neutral contact assembly: Remove the bolts, nuts, and compression washers that secure the braid lugs to the bus bars. To remove a B-phase contact assembly follow the procedure described in step 7b.
   b. To remove a B-phase contact assembly:
      i. Remove the nuts and compression washers from the ends of the braid lug studs.
      ii. Remove the nut and washers from the lower bolt on the C-phase braid lug.
      iii. Remove the bolt.
      iv. Slide the lower B-phase threaded stud into the hole where the C-phase bolt had been.
      v. Repeat this procedure with the upper C-phase bolt and corresponding upper B-phase stud. Keep the threaded studs in the C-phase assembly to hold the C-phase braid lugs in position.
8. Loosen the locknuts and remove the pivot studs.
9. Remove the contact assembly.

Replacing the Contact Assembly

Refer to Figure 6-12, Figure 6-13, and Figure 6-14 for the following procedure:



1. Arc finger, adjustment nut
2. Contact assembly
3. Braid lug
4. B-Phase brads lug studs
5. C-Phase braid lug bolts
6. Braid lug nuts and washers
7. Pivot stud

Figure 6-14 3000 Amp Movable Contact B Phase

1. Secure the new movable contact assembly with the pivot studs, locknuts, and lockwashers. Torque the locknuts to 13.6 Nm (10 ft. lb.).

2. To replace an A-phase, C-phase, or neutral contact assembly secure the braid lugs to the bus bars with the bolts, nuts and compression washers. Torque the nuts to 19 Nm (14 ft. lb.). To replace a B-phase contact assembly, follow the procedure described in step 2b.

   OR

3. To replace a B-phase contact assembly:

   a. Use a bent wire to align the bus bar holes with the braid lug holes.

   b. Use the braid lug bolts that were removed from the C-phase assembly to push the B-phase braid lug studs back into position in the B-phase assembly. Tap the bolts lightly with a hammer, if necessary.

   c. Secure the B-phase studs and C-phase bolts with compression washers and nuts. Torque the nuts to 19 Nm (14 ft. lb.).

4. Install the anchor bars on the load bus assembly with twelve 1/4-20 socket head capscrews. The longer capscrews are used on the sides. Torque the capscrews to 10.2 Nm (90 in. lb.).

5. Connect the actuator arms to the contact posts and secure with two retaining rings.

6. Close the contacts slowly until the arcing contacts touch. The main contacts should have a 6.35 mm (1/4 in.) minimum gap. If they do not, adjust the arc finger adjustment nut as required. If the contacts cannot be brought within specifications, reject the contact assembly.

7. Measure and record the prespring gap.

8. Close the contacts fully.

9. Rock the arcing contact from toe to heel and verify that there is an 0.0762 mm (0.003 in.) minimum gap at the arcing contact. A feeler gauge must enter 1.59 mm (1/16 in.) past the edge of the silver.

10. The spring gap dimension must be 1.59 mm (1/16 in.) less than the prespring gap dimension measured in step 5. If the contacts are not within specifications, reject the contact assembly.

11. Check that the contact pressure of each of the three outside main contacts is between 1.7–2 kg (3.75–4.5 lb.). Check that the contact pressure of the arc finger, is between 4–6.4 kg (9–14 lb.).

12. Check that both main and arc contact fingers are not bottomed out when closed.

13. Secure the arc chute and arc chute pad with two machine screws.

14. Check the operation of the transfer switch by manually opening and closing the switch assemblies.

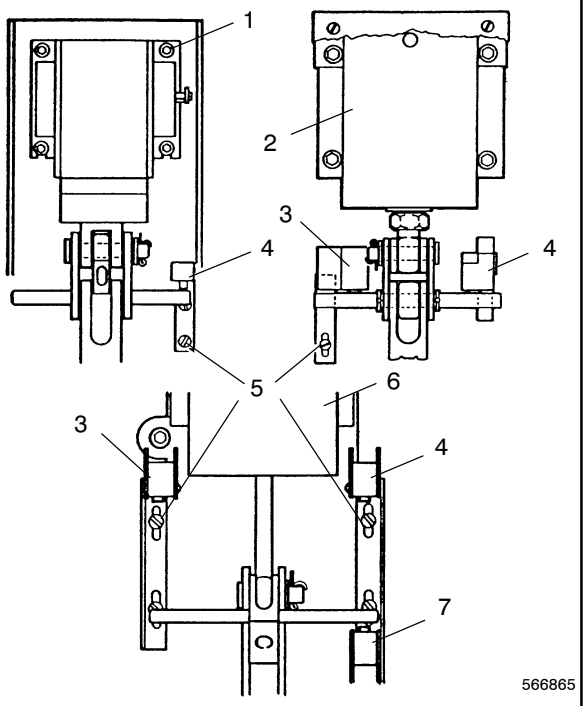
15. Reinstall and secure the blue plastic cover.

16. Close the cabinet door.

17. Reconnect the normal power source and the emergency power source. If a generator set is the emergency power source, connect the negative (-) battery cable to the starting battery and place the generator set master switch in the Auto (or Remote) position.

18. Test the switch for proper operation.

6.4 Auxiliary Switch Removal and Replacement



1. 1200 amp 2-position switches
2. 1600-3000 amp 2-position switches
3. SE switches
4. SN switches
5. Set screws
6. 1200-3000 amp 3-position switches
7. SNO switches

Figure 6-15 Auxiliary Switch

Disconnect both the normal and emergency power sources from the transfer switch before servicing. If a generator set provides standby emergency power, turn the generator set master switch to OFF/RESET and disconnect the negative (-) battery cable from the set starting battery.

Removing and Replacing the Auxiliary Switch Assembly

1. Remove the four machine screws, if applicable, and lift off the metal solenoid cover.

2. Remove the two mounting screws that secure the bracket-mounted switch assembly to the panel.

3. Before disconnecting the control wiring leads from the auxiliary switch, observe and note the switch terminal markings, NO, NC, and C, and which wire connects to each.

4. Disconnect the wires and connect them to the corresponding terminals of the replacement switch assembly.

5. Install the new auxiliary switch assembly with the two mounting screws.

6. Manually operate the transfer switch to make sure that the new auxiliary switch trips. Listen for an audible click when the switch trips.

7. Check the following on the new auxiliary switch:

   a. SN/SNO and SE/SEO pairs are adjusted to have the same over travel.

   b. The auxiliary switch trips 1.59 mm (1/16 in.) before it reaches its fully seated position.

   c. After the auxiliary switch trips, there must be over travel to ensure good switch operation.

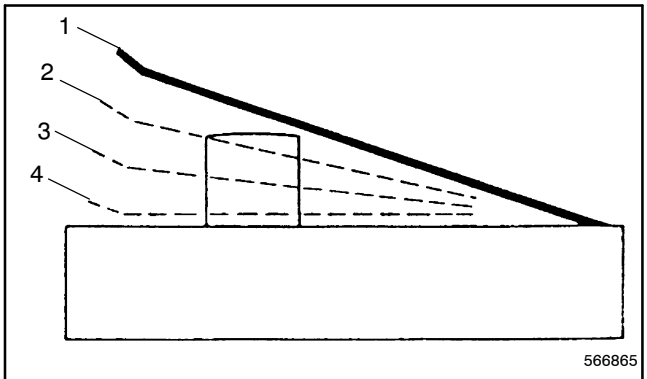
   d. Do not force the auxiliary switch into the fully operated position.

   e. The auxiliary switches that operate as the main contacts are closing should trip just as the contact mechanism reaches the overcenter point.

8. Close the cabinet door.

9. Reconnect the normal power source and emergency power source. If a generator set is the emergency power source, connect the negative (-) battery cable to the starting battery and place the generator set master switch in the Auto or Remote position.

10. Test the switch for proper operation.



1. Full release position
2. Trip position
3. Over travel position
4. Fully operated position

Figure 6-16 Auxiliary Adjustment

Section 7 Diagrams and Drawings

Note: This section contains wiring diagrams for the Model ZCD, ZCI, and ZCT transfer switches. For model SBL and SCL closed-transition switches, refer to the drawings shipped with the transfer switch or to Wiring Diagram Manual MP-6266.

Notes

BYPASS STANDARD SWITCH	NO. POLES	CABINET DIMENSIONS A	B	C	LUG RANGE	WIRE BENDING SPACE D (TOP)	E (BOTTOM)	WIRE GUTTERS F (LEFT)	G (RIGHT)
100–225 AMP	2,3	30.00 [762]	23.00 [584]	28.00 [711]	3/0–250 MCM	15.25 [387]	13.88 [353]	4.38 [111]	1.38 [35]
	4	36.00 [914]	29.00 [737]	34.00 [864]					5.00 [127]
260–400 AMP	2,3	30.00 [762]	23.00 [584]	28.00 [711]	3/0–250 MCM	15.25 [387]	13.88 [353]	4.38 [111]	1.38 [35]
	4	36.00 [914]	29.00 [737]	34.00 [864]					5.00 [127]
BYPASS PROGRAMMED TRANSITION SWITCH									
100–225 AMP	2,3	30.00 [762]	23.00 [584]	28.00 [711]	3/0–250 MCM	15.25 [387]	13.88 [353]	4.38 [111]	1.38 [35]
	4	36.00 [914]	29.00 [737]	34.00 [864]					5.00 [127]
260–400 AMP	2,3	30.00 [762]	23.00 [584]	28.00 [711]	3/0–250 MCM	15.25 [387]	13.88 [353]	4.38 [111]	1.38 [35]
	4	36.00 [914]	29.00 [737]	34.00 [864]					5.00 [127]

REV	DATE	REVISION	BY	MF
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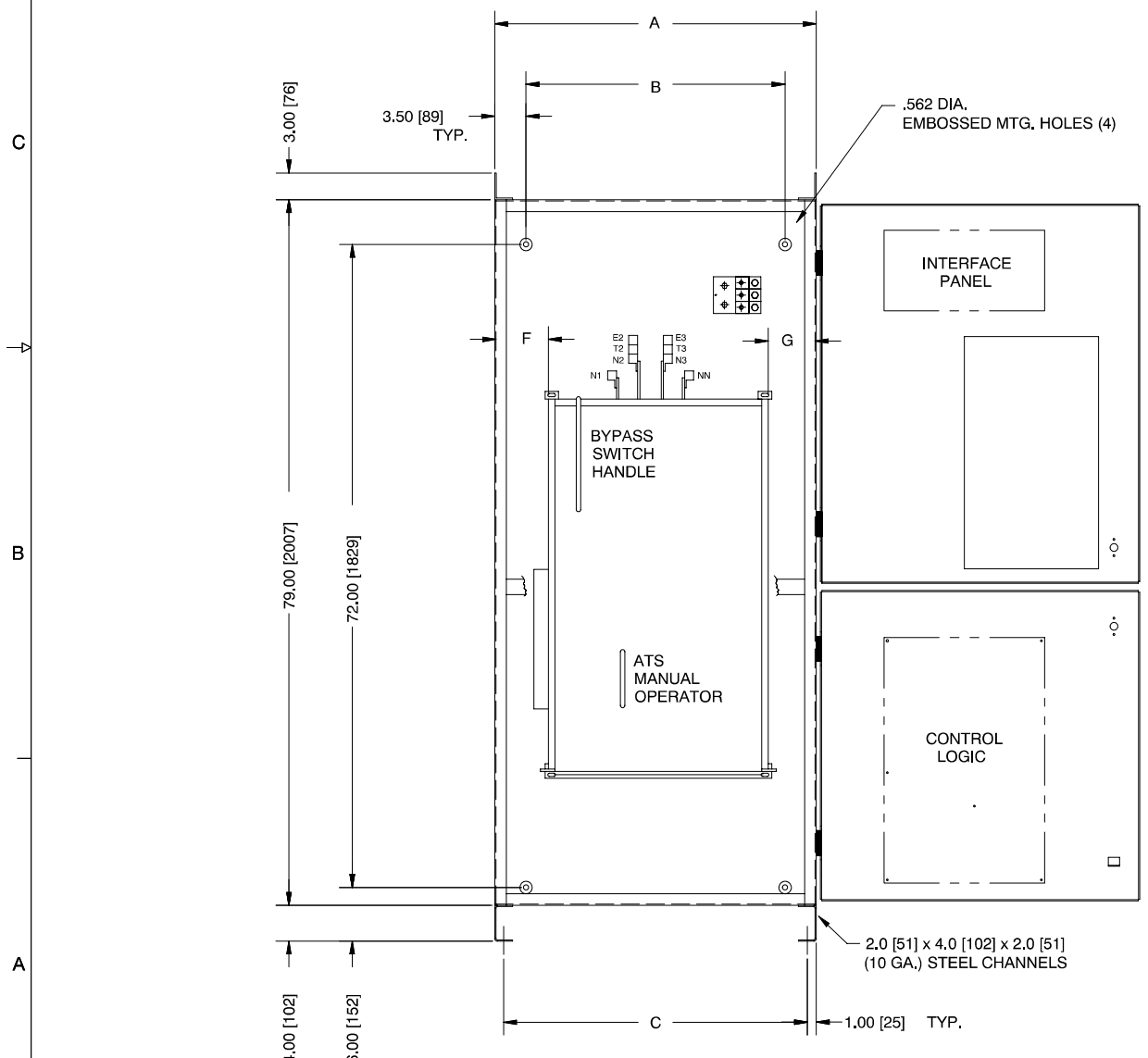
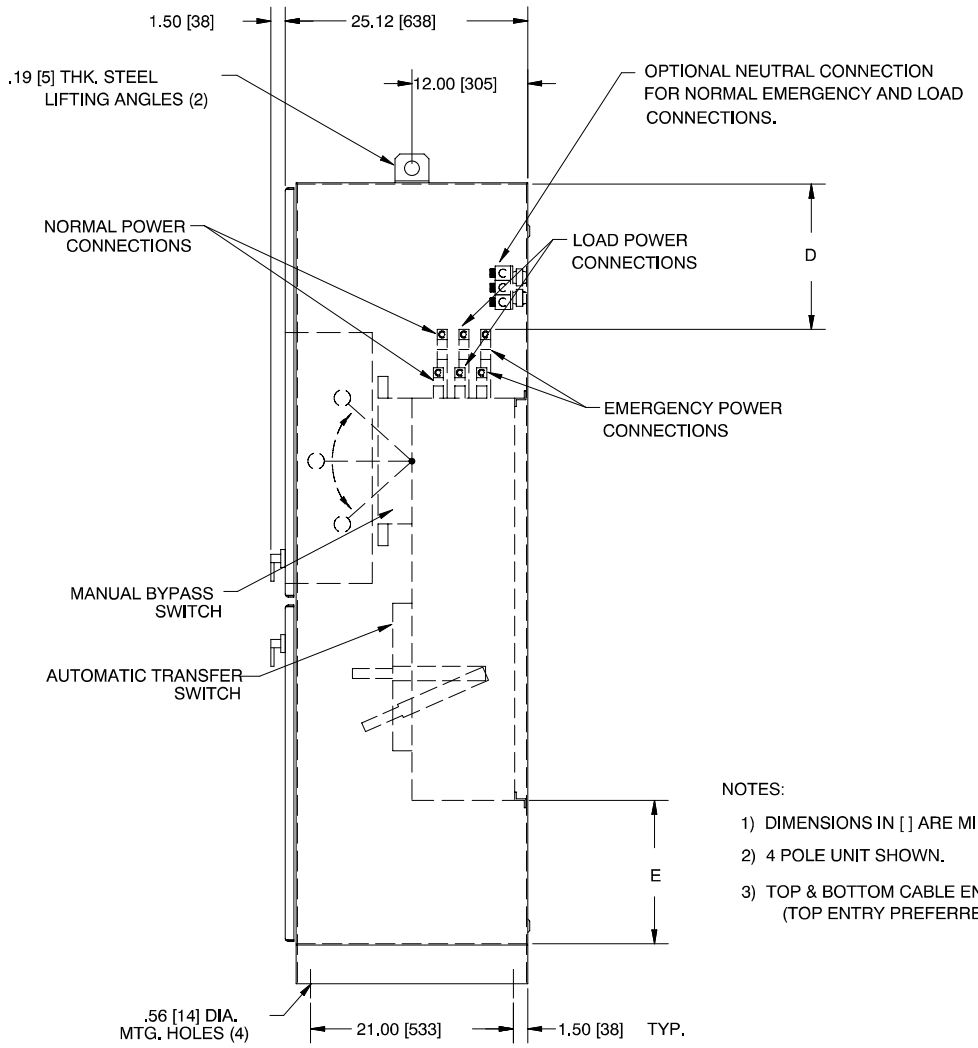


NEMA I ENCLOSURE



NOTES:

1) DIMENSIONS IN [ ] ARE MILLIMETER EQUIVALENTS.
2) 4 POLE UNIT SHOWN.
3) TOP & BOTTOM CABLE ENTRY ACCEPTABLE (TOP ENTRY PREFERRED)

BYPASS ISOLATION TRANSFER SWITCH
STANDARD & PROGRAMMED TRANSITION
100–400 AMP, 2,3 & 4 POLE

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 2°
.XX ± .030 SURFACE FINISH
.X ± .060 MAX
FRACTIONS

APPROVALS	DATE
DRAWN DFS	1–26–94
CHECKED AJH	2–22–94
APPROVED AJH	2–22–94

TITLE: DIMENSION PRINT

SCALE 1/8 | CAD NO. ADV5958A.dwg | SHEET 1–3
PLOTTED | DWG. NO. ADV–5958 | D

Enclosure Dimensions, NEMA Type 1, 100–400 Amps, ADV-5958A-S-A, Sheet 1

STANDARD BYPASS SWITCH	NO. POLES	CABINET DIMENSIONS A	CABINET DIMENSIONS B	LUG RANGE	WIRE BENDING SPACE C (TOP)	WIRE BENDING SPACE D (BOTTOM)	WIRE GUTTERS E (LEFT)	WIRE GUTTERS F (RIGHT)
100–225 AMP	2,3	30.00 [762]	28.00 [711]	3/0–250 MCM	15.25 [209]	13.88 [353]	4.38 [111]	1.38 [35]
	4	36.00 [914]	34.00 [867]					5.00 [127]
260–400 AMP	2,3	30.00 [762]	28.00 [711]	3/0–250 MCM	15.25 [387]	13.88 [353]	4.38 [111]	1.38 [35]
	4	36.00 [914]	34.00 [867]					5.00 [127]
PROGRAMMED TRANSITION BYPASS SWITCH								
100–225 AMP	2,3	30.00 [762]	23.00 [584]	3/0–250 MCM	15.25 [209]	13.88 [353]	4.38 [111]	1.38 [35]
	4	36.00 [914]	29.00 [737]					5.00 [127]
260–400 AMP	2,3	30.00 [762]	23.00 [584]	3/0–250 MCM	15.25 [387]	13.88 [353]	4.38 [111]	1.38 [35]
	4	36.00 [914]	29.00 [737]					5.00 [127]

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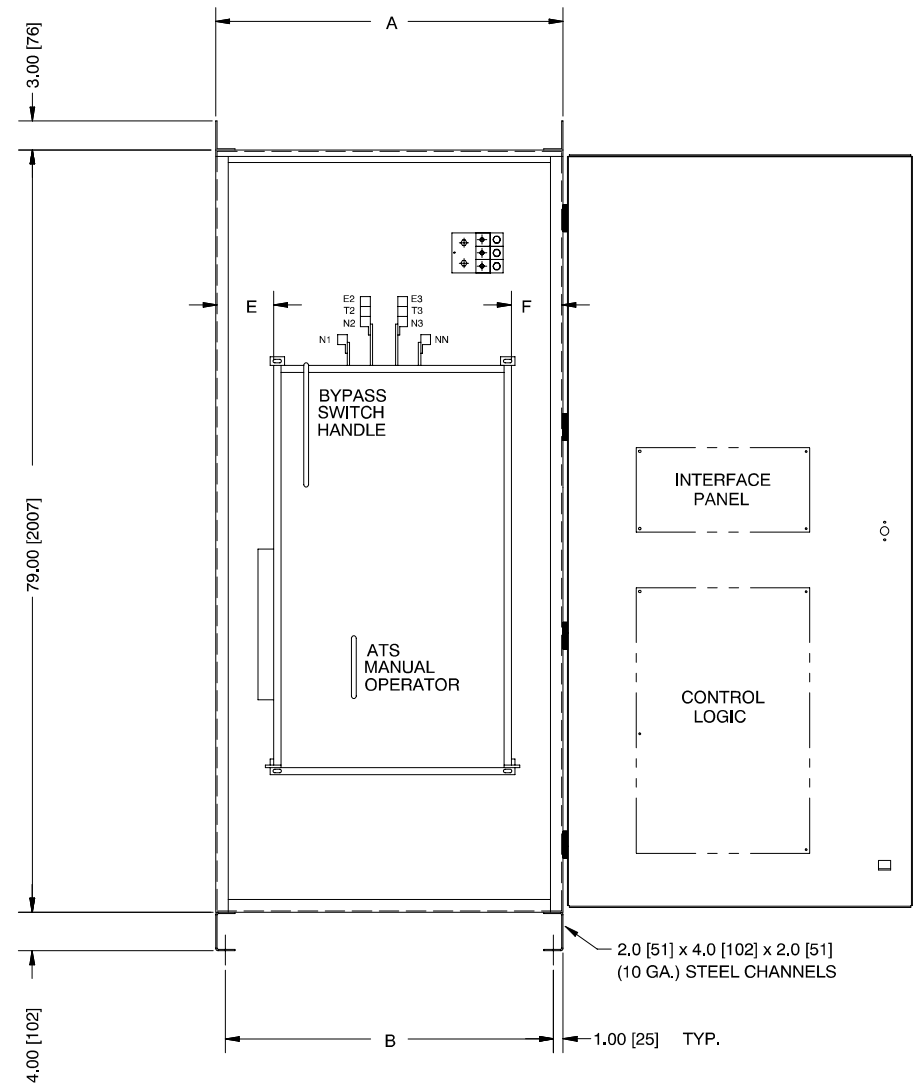

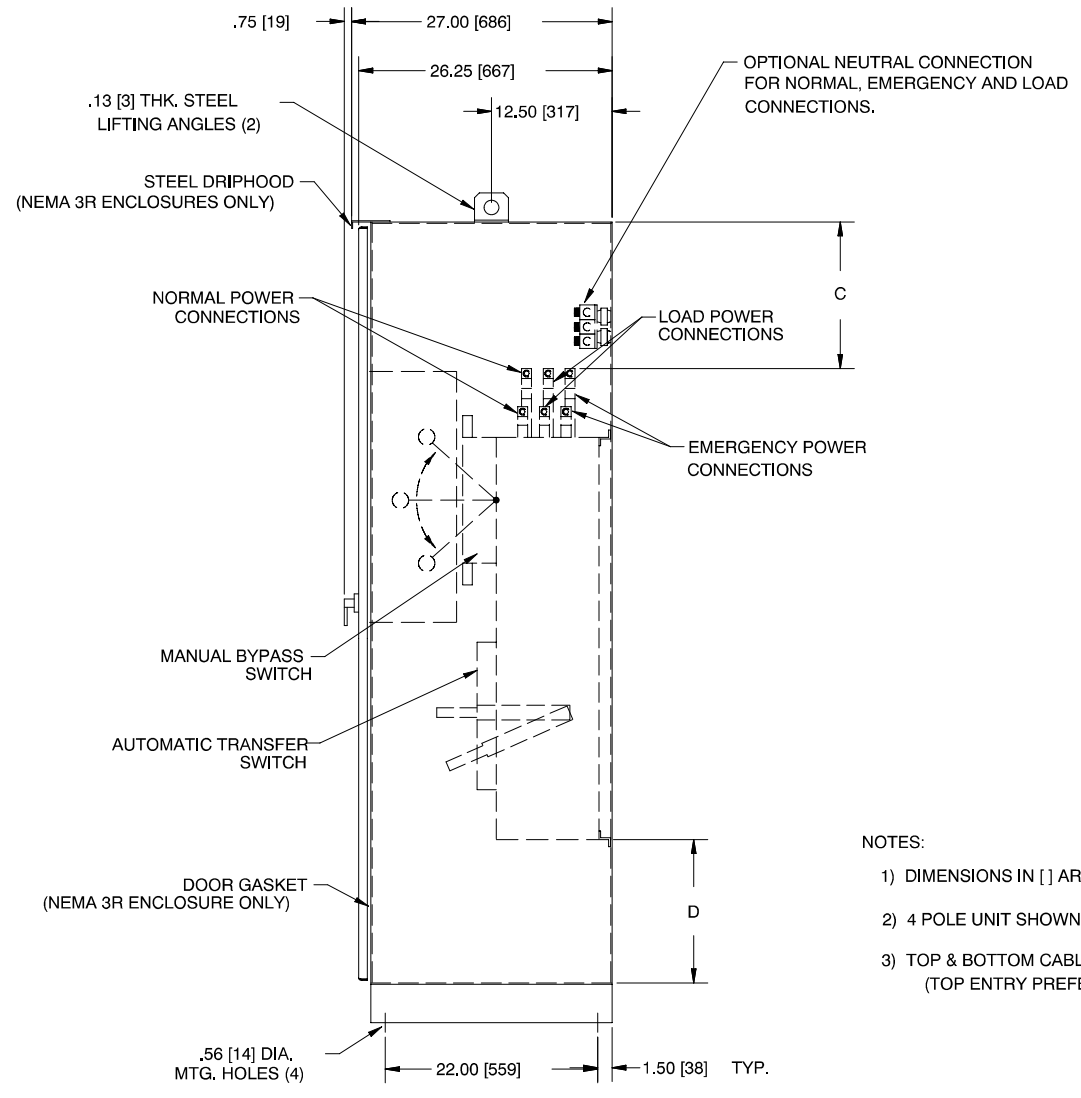

NOTES:

1) DIMENSIONS IN [ ] ARE MILLIMETER EQUIVALENTS.
2) 4 POLE UNIT SHOWN.
3) TOP & BOTTOM CABLE ENTRY ACCEPTABLE (TOP ENTRY PREFERRED).

NEMA 3R & 12 ENCLOSURES

BYPASS ISOLATION TRANSFER SWITCH
STANDARD & PROGRAMMED TRANSITION
100–400 AMP, 2,3 & 4 POLE

UNLESS OTHERWISE SPECIFIED
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XX± .010 ANGLES ± 1/2°
.XX± .030 SURFACE FINISH
.X ± .060 MAX
FRACTIONS

APPROVALS	DATE
DRAWN DFS	1–26–94
CHECKED AJH	2–22–94
APPROVED AJH	2–22–94

TITLE: DIMENSION PRINT

SCALE 1/8 | CAD NO. ADV5958B.dwg | SHEET 2–3
PLOTTED | DWG. NO. ADV–5958 | D

Enclosure Dimensions, NEMA Type 3R and 12, 100–400 Amps, ADV-5958B-S-A, Sheet 2

STANDARD BYPASS SWITCH	NO. POLES	CABINET DIMENSIONS A	CABINET DIMENSIONS B	LUG RANGE	WIRE BENDING SPACE C (TOP)	WIRE BENDING SPACE D (BOTTOM)	WIRE GUTTERS E (LEFT)	WIRE GUTTERS F (RIGHT)
100–225 AMP	2,3	30.00 [762]	28.00 [711]	3/0–250 MCM	15.25 [209]	13.88 [353]	4.38 [111]	1.38 [35]
	4	36.00 [914]	34.00 [867]					5.00 [127]
260–400 AMP	2,3	30.00 [762]	28.00 [711]	3/0–250 MCM	15.25 [387]	13.88 [353]	4.38 [111]	1.38 [35]
	4	36.00 [914]	34.00 [867]					5.00 [127]
PROGRAMMED TRANSITION BYPASS SWITCH								
100–225 AMP	2,3	30.00 [762]	23.00 [584]	3/0–250 MCM	15.25 [209]	13.88 [353]	4.38 [111]	1.38 [35]
	4	36.00 [914]	29.00 [737]					5.00 [127]
260–400 AMP	2,3	30.00 [762]	23.00 [584]	3/0–250 MCM	15.25 [387]	13.88 [353]	4.38 [111]	1.38 [35]
	4	36.00 [914]	29.00 [737]					5.00 [127]

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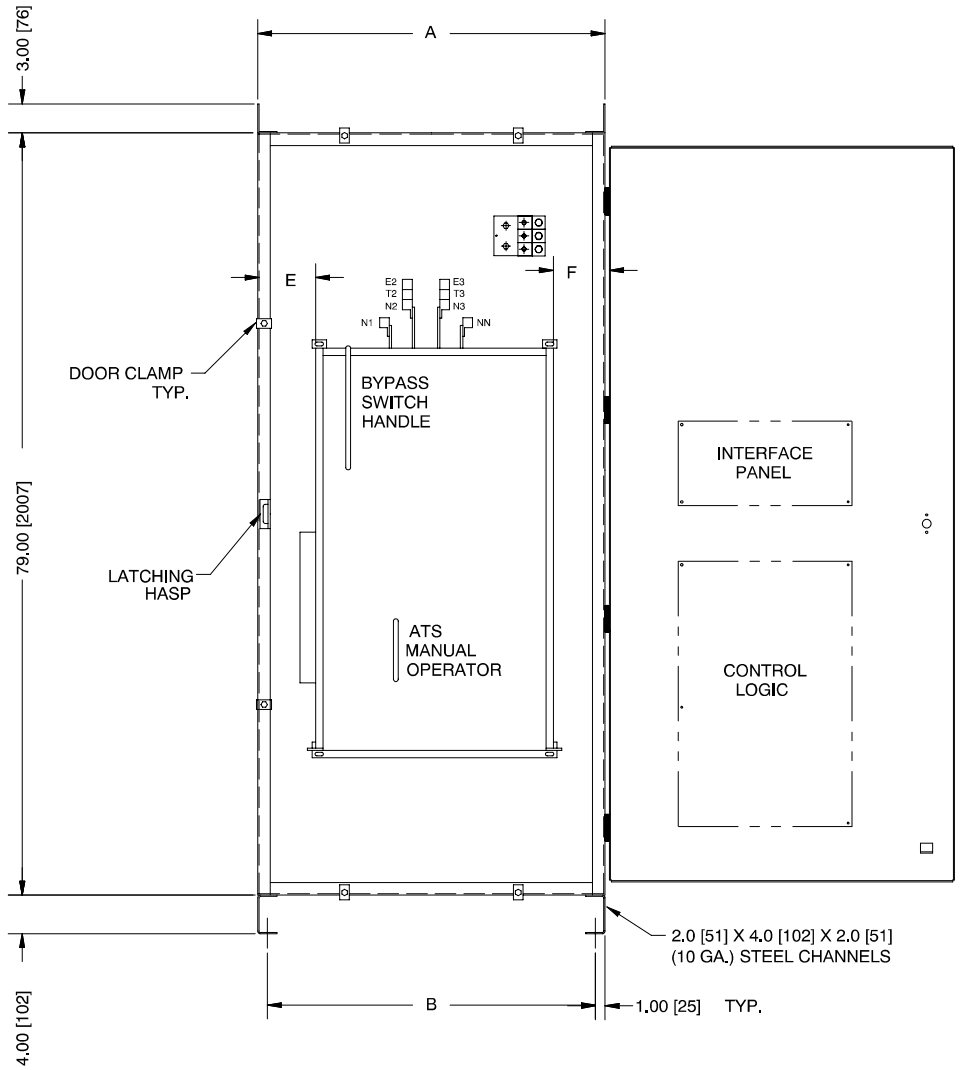
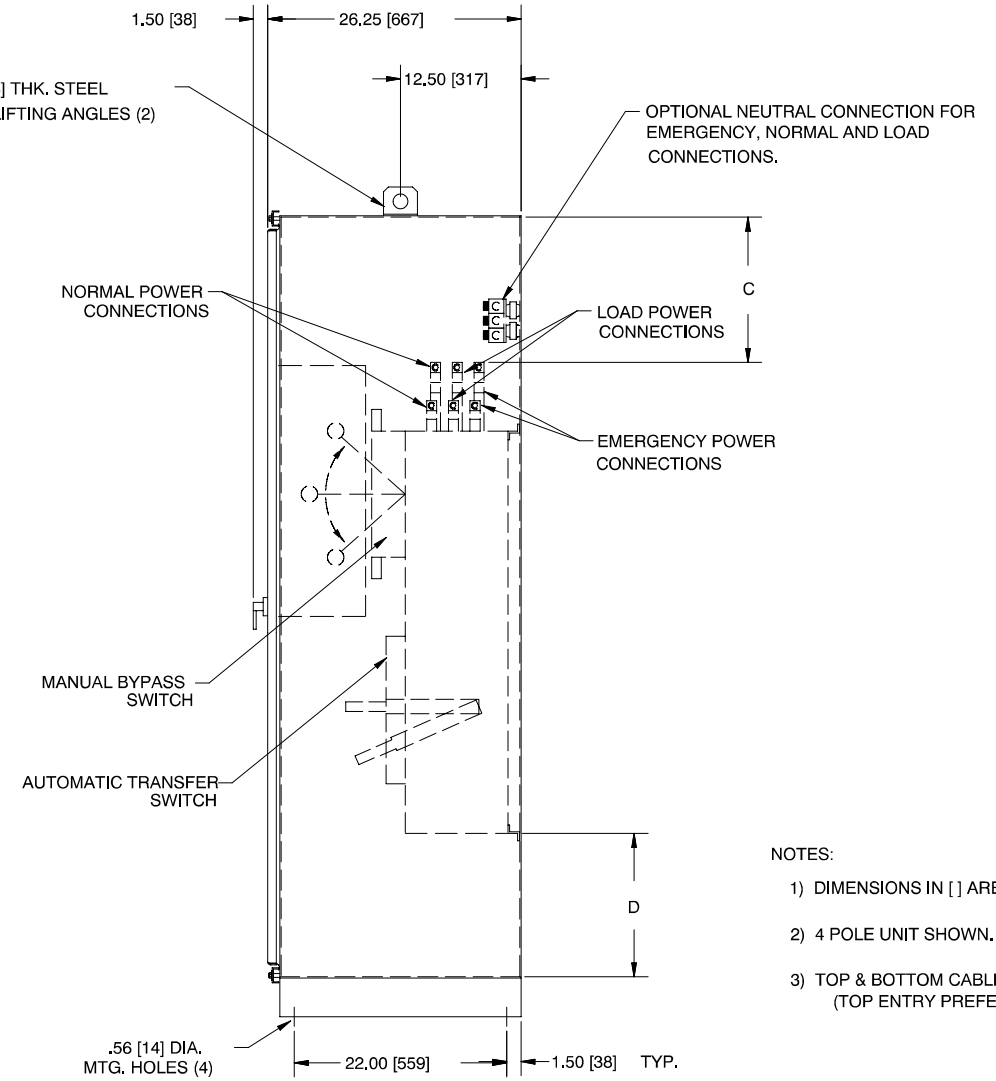


NEMA 4 ENCLOSURE



NOTES:

1) DIMENSIONS IN [ ] ARE MILLIMETER EQUIVALENTS.
2) 4 POLE UNIT SHOWN.
3) TOP & BOTTOM CABLE ENTRY ACCEPTABLE (TOP ENTRY PREFERRED).

BYPASS ISOLATION TRANSFER SWITCH
STANDARD & PROGRAMMED TRANSITION
100–400 AMP, 2,3 & 4 POLE

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES 1/2°
.XX ± .030 SURFACE FINISH
.X ± .060 MAX
FRACTIONS

APPROVALS	DATE
DRAWN DFS	1–26–94
CHECKED AJH	2–22–94
APPROVED AJH	2–22–94

TITLE: DIMENSION PRINT

SCALE 1/8 | CAD NO. ADV5958C.dwg | SHEET 3–3
PLOTTED | DWG. NO. ADV–5958 | D

-S-

Enclosure Dimensions, NEMA Type 4, 100–400 Amps, ADV-5958C-S-A, Sheet 3

STANDARD BYPASS SWITCH	NO. POLES	CABINET DIMENSIONS A	CABINET DIMENSIONS B	LUG RANGE	WIRE BENDING SPACE C (LOAD/EMERG.)	WIRE BENDING SPACE D (NORMAL)	ENTRY WIDTH E
600 AMP	2,3	36.00 [914]	29.00 [737]	#2–600 MCM (2)	18.25 [464]	31.38 [797]	35.00 [889]
	4	40.00 [1016]	33.00 [838]		18.25 [464]	27.12 [689]	39.00 [991]
800–1200 AMP	2,3	40.00 [1016]	33.00 [838]	#2–600 MCM (4)	18.25 [464]	29.62 [752]	39.00 [991]
	4	46.00 [1168]	39.00 [991]		18.25 [464]	25.12 [638]	45.00 [1143]
PROGRAMMED TRANSITION BYPASS SWITCH							
600 AMP	2,3	36.00 [914]	29.00 [737]	#2–600 MCM (2)	18.25 [464]	31.38 [797]	35.00 [889]
	4	40.00 [1016]	33.00 [838]		18.25 [464]	27.12 [689]	39.00 [991]
800–1200 AMP	2,3	40.00 [1016]	33.00 [838]	#2–600 MCM (4)	18.25 [464]	29.62 [752]	39.00 [991]
	4	46.00 [1168]	39.00 [991]		18.25 [464]	25.12 [638]	45.00 [1143]

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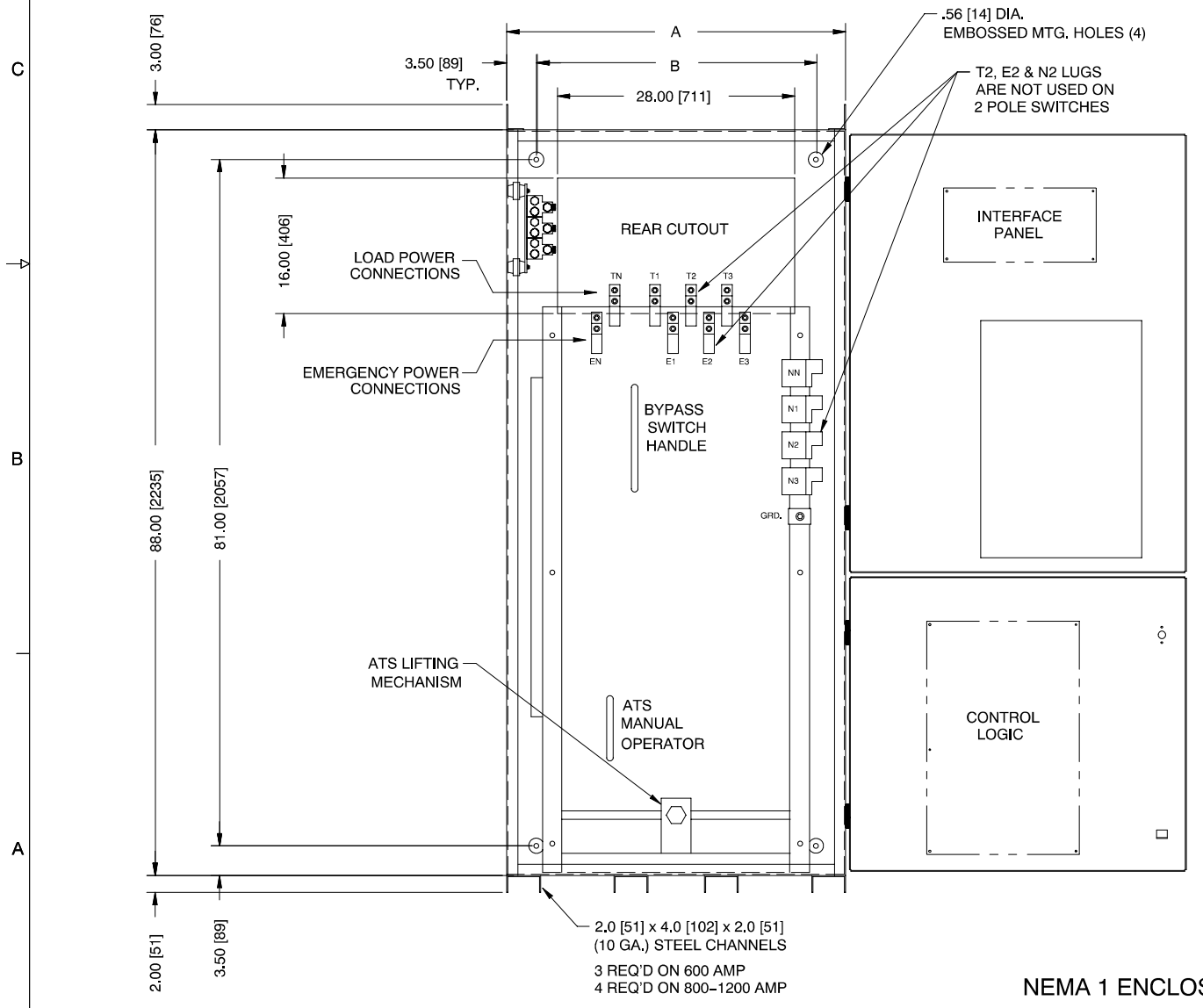
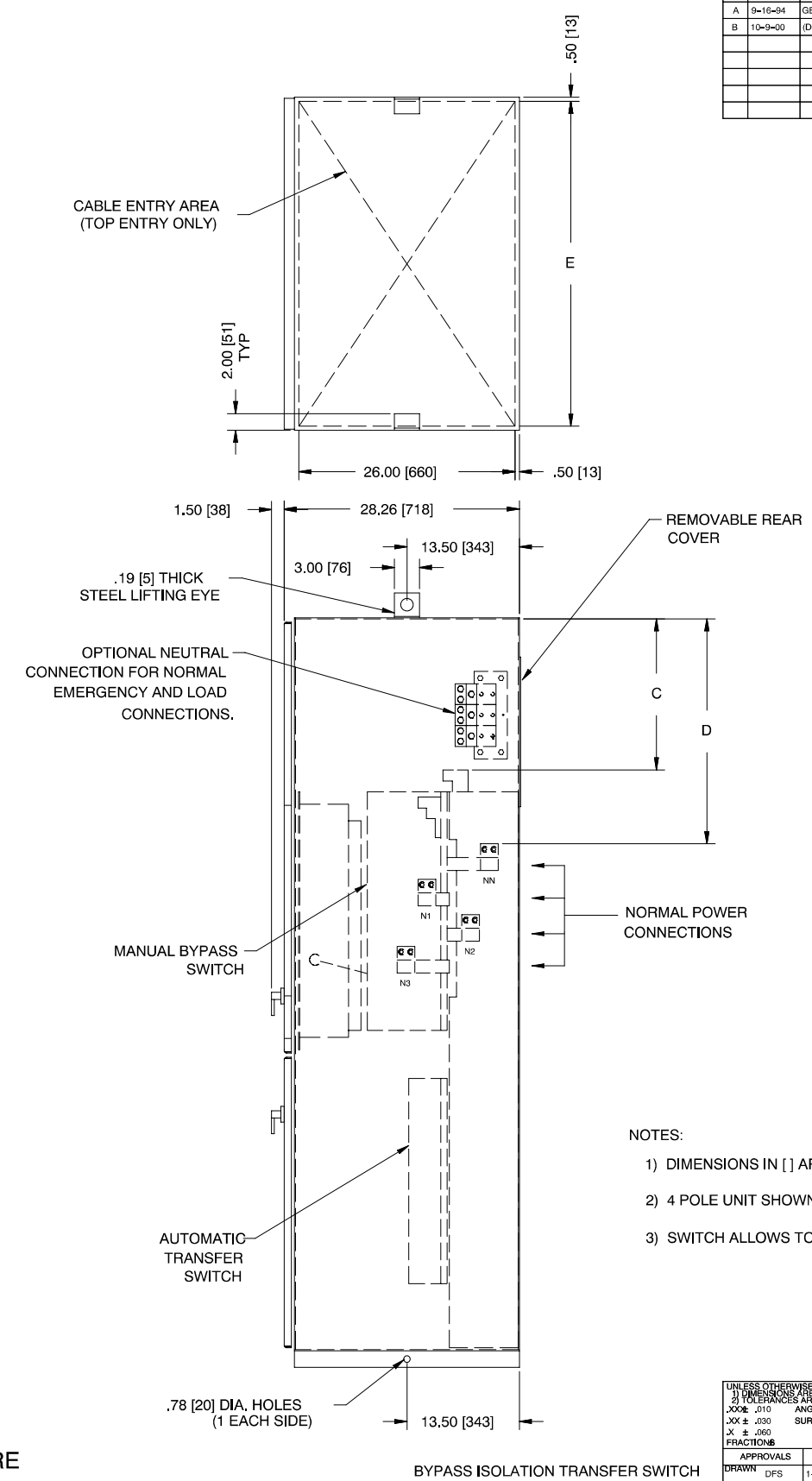


NEMA 1 ENCLOSURE



NOTES:

1) DIMENSIONS IN [ ] ARE MILLIMETER EQUIVALENTS.

2) 4 POLE UNIT SHOWN.

3) SWITCH ALLOWS TOP CABLE ENTRY ONLY.

BYPASS ISOLATION TRANSFER SWITCH
STANDARD & PROGRAMMED TRANSITION
600, 800–1200A/2, 3 & 4 POLE

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XX ± .010 ANGLES ± 1/2°
.XX ± .030 SURFACE FINISH
.X ± .060 √ MAX.
FRACTIONS

APPROVALS	DATE
DRAWN DFS	1–27–94
CHECKED AJH	2–2–94
APPROVED AJH	2–22–94

TITLE: DIMENSION PRINT

SCALE 1/8 | CAD NO. ADV5959A.DWG | SHEET 1–3
PLOTTED | DWG. NO. ADV–5959 | D G

ADV-5959A-B-S-

Enclosure Dimensions, NEMA Type 1, 600–1200 Amps, ADV-5959A-S-B, Page 1

STANDARD BYPASS SWITCH	NO. POLES	CABINET DIMENSIONS A	LUG RANGE	WIRE BENDING SPACE B (LOAD/EMERG.)	WIRE BENDING SPACE C (NORMAL)	ENTRY WIDTH E
600 AMP	2,3	36.00 [914]	#2–600 MCM (2)	17.88 [454]	31.00 [787]	35.00 [889]
	4	40.00 [1016]		17.88 [454]	26.75 [679]	39.00 [991]
800–1200 AMP	2,3	40.00 [1016]	#2–600 MCM (4)	17.88 [454]	29.25 [743]	39.00 [991]
	4	46.00 [1168]		17.88 [454]	24.75 [629]	45.00 [1143]
PROGRAMMED TRANSITION BYPASS SWITCH						
600 AMP	2,3	36.00 [914]	#2–600 MCM (2)	17.88 [454]	31.00 [787]	35.00 [889]
	4	40.00 [1016]		17.88 [454]	26.75 [679]	39.00 [991]
800–1200 AMP	2,3	40.00 [1016]	#2–600 MCM (4)	17.88 [454]	29.25 [743]	39.00 [991]
	4	46.00 [1168]		17.88 [454]	24.75 [629]	45.00 [1143]

REV	DATE	REVISION	BY	M E
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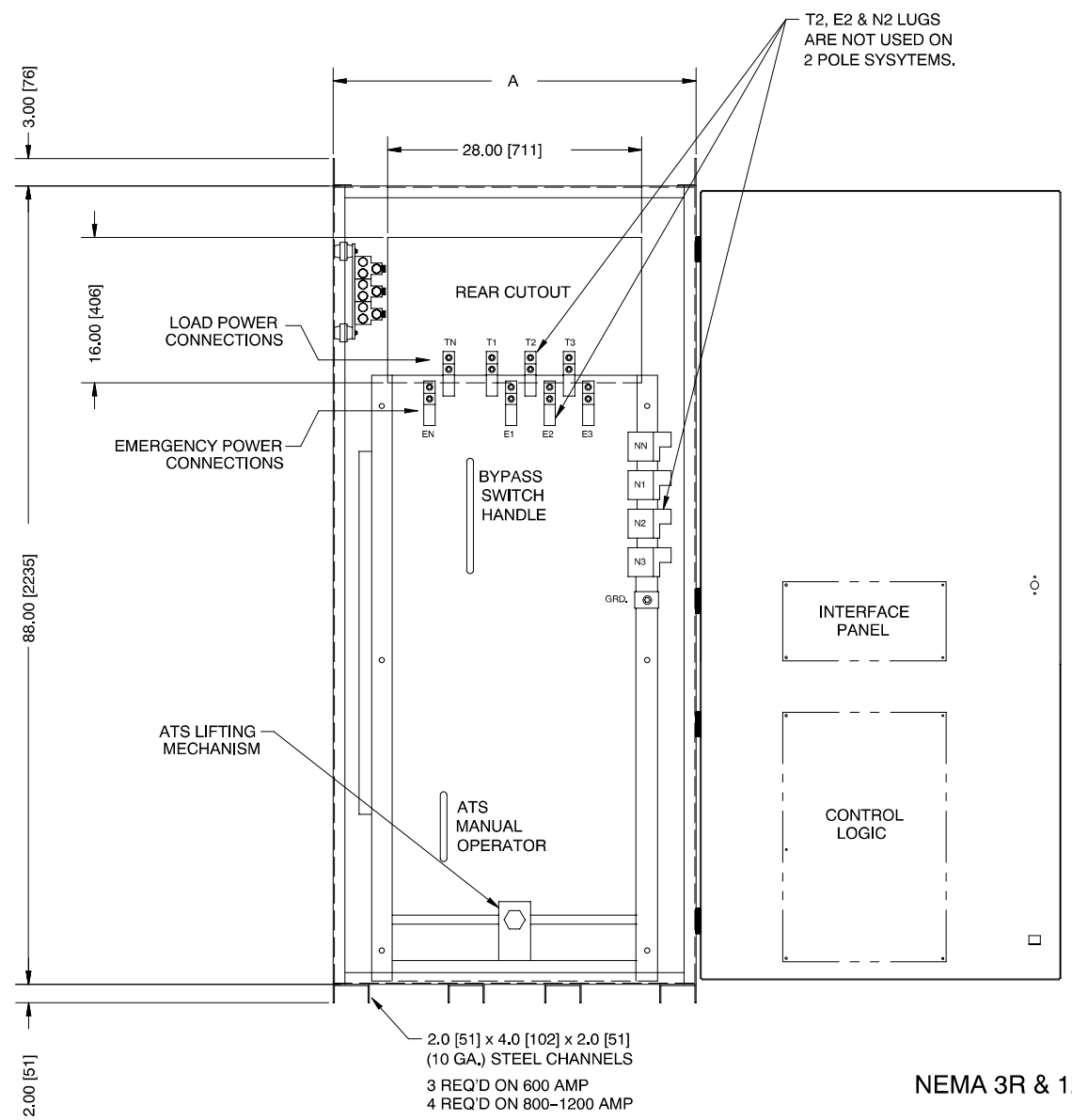
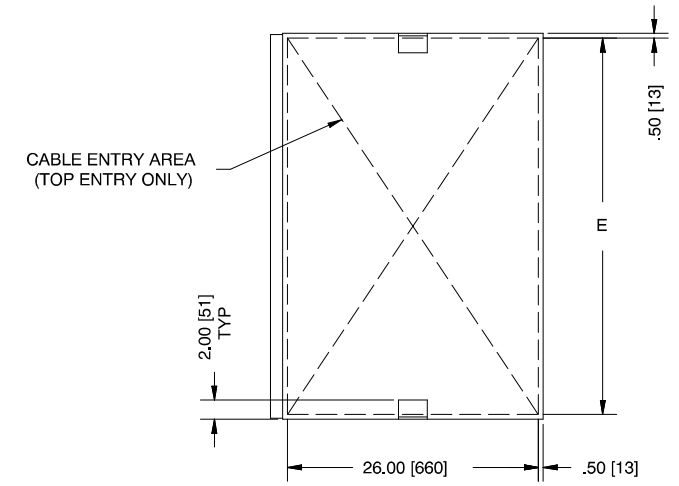
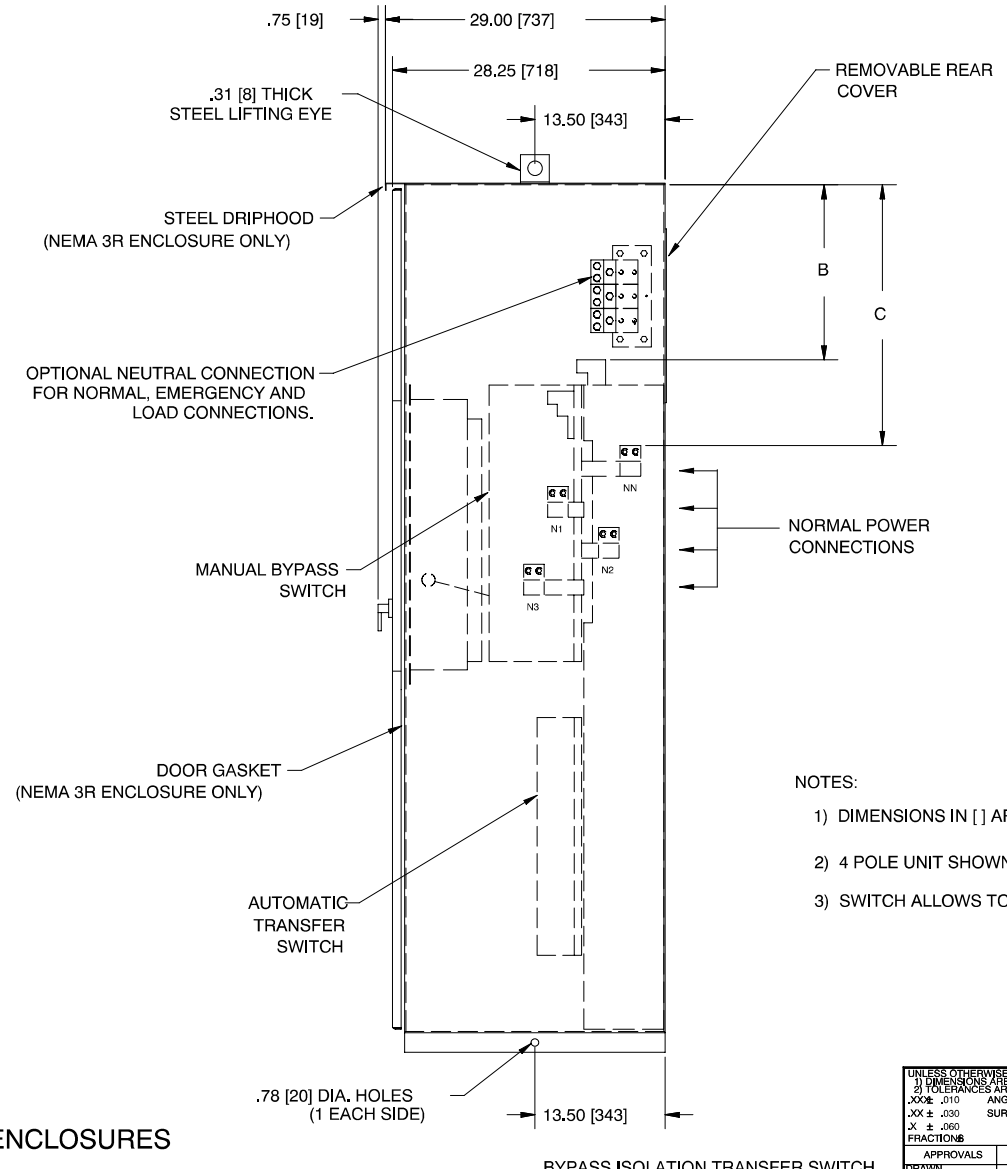


NEMA 3R & 12 ENCLOSURES





NOTES:

1) DIMENSIONS IN [ ] ARE MILLIMETER EQUIVALENTS.
2) 4 POLE UNIT SHOWN.
3) SWITCH ALLOWS TOP CABLE ENTRY ONLY.

BYPASS ISOLATION TRANSFER SWITCH
STANDARD & PROGRAMMED TRANSITION
600, 800–1200 AMP, 2,3 & 4 POLE

UNLESS OTHERWISE SPECIFIED:
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES 1/2°
.XX ± .030 SURFACE FINISH
.X ± .060 √ MAX
FRACTIONS

APPROVALS	DATE
DRAWN DFS	1–27–94
CHECKED AJH	2–22–94
APPROVED AJH	2–22–94

TITLE: DIMENSION PRINT

SCALE 1/8 | CAD NO. ADV5959B.dwg | SHEET 2–3
PLOTTED | DWG. NO. ADV–5959 | D G

ADV5959B-B-S-

Enclosure Dimensions, NEMA Type 3R and 12, 600–1200 Amps, ADV-5959B-S-B, Page 2

STANDARD BYPASS SWITCH	NO. POLES	CABINET DIMENSIONS A	LUG RANGE	WIRE BENDING SPACE B (LOAD/EMERG.)	WIRE BENDING SPACE C (NORMAL)	ENTRY WIDTH E
600 AMP	2,3	36.00 [914]	#2–600 MCM (2)	17.88 [454]	31.00 [787]	35.00 [889]
	4	40.00 [1016]		17.88 [454]	26.75 [679]	39.00 [991]
800–1200 AMP	2,3	40.00 [1016]	#2–600 MCM (4)	17.88 [454]	29.25 [743]	39.00 [991]
	4	46.00 [1168]		17.88 [454]	24.75 [629]	45.00 [1143]
PROGRAMMED TRANSITION BYPASS SWITCH						
600 AMP	2,3	36.00 [914]	#2–600 MCM (2)	17.88 [454]	31.00 [787]	35.00 [889]
	4	40.00 [1016]		17.88 [454]	26.75 [679]	39.00 [991]
800–1200 AMP	2,3	40.00 [1016]	#2–600 MCM (4)	17.88 [454]	29.25 [743]	39.00 [991]
	4	46.00 [1168]		17.88 [454]	24.75 [629]	45.00 [1143]

REV	DATE	REVISION	BY	M F
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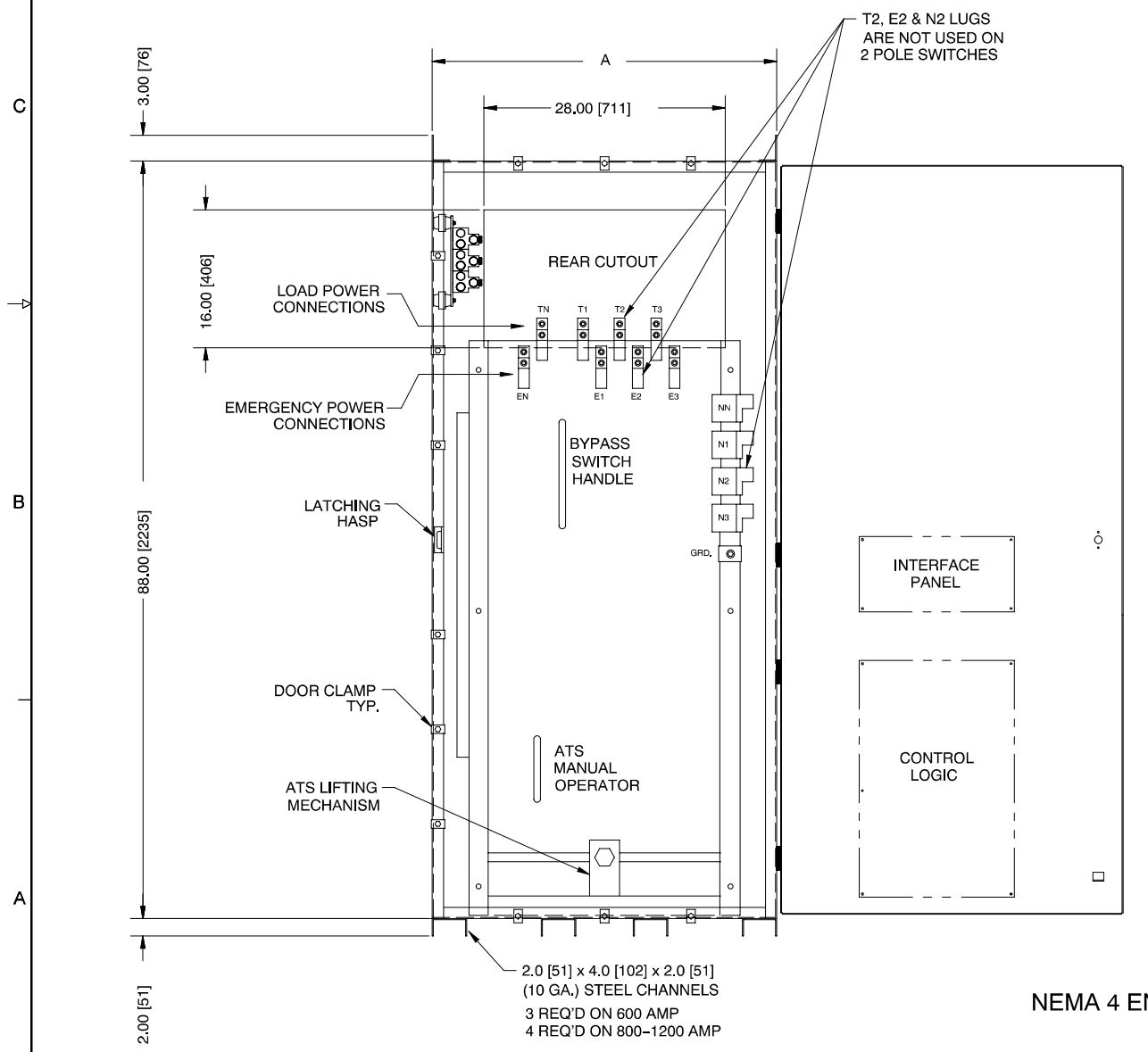
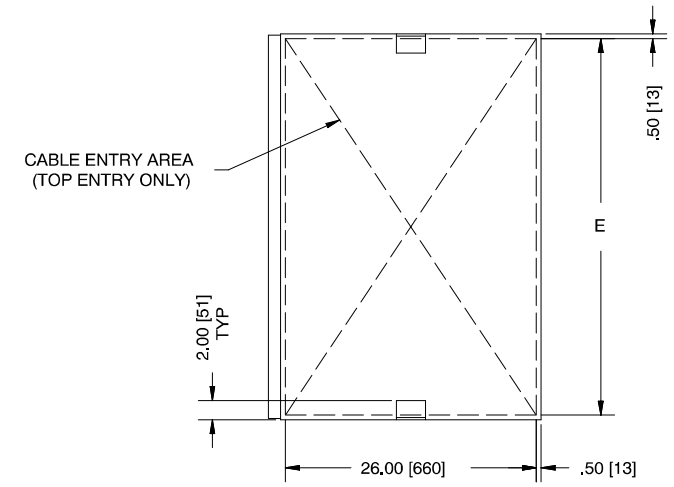
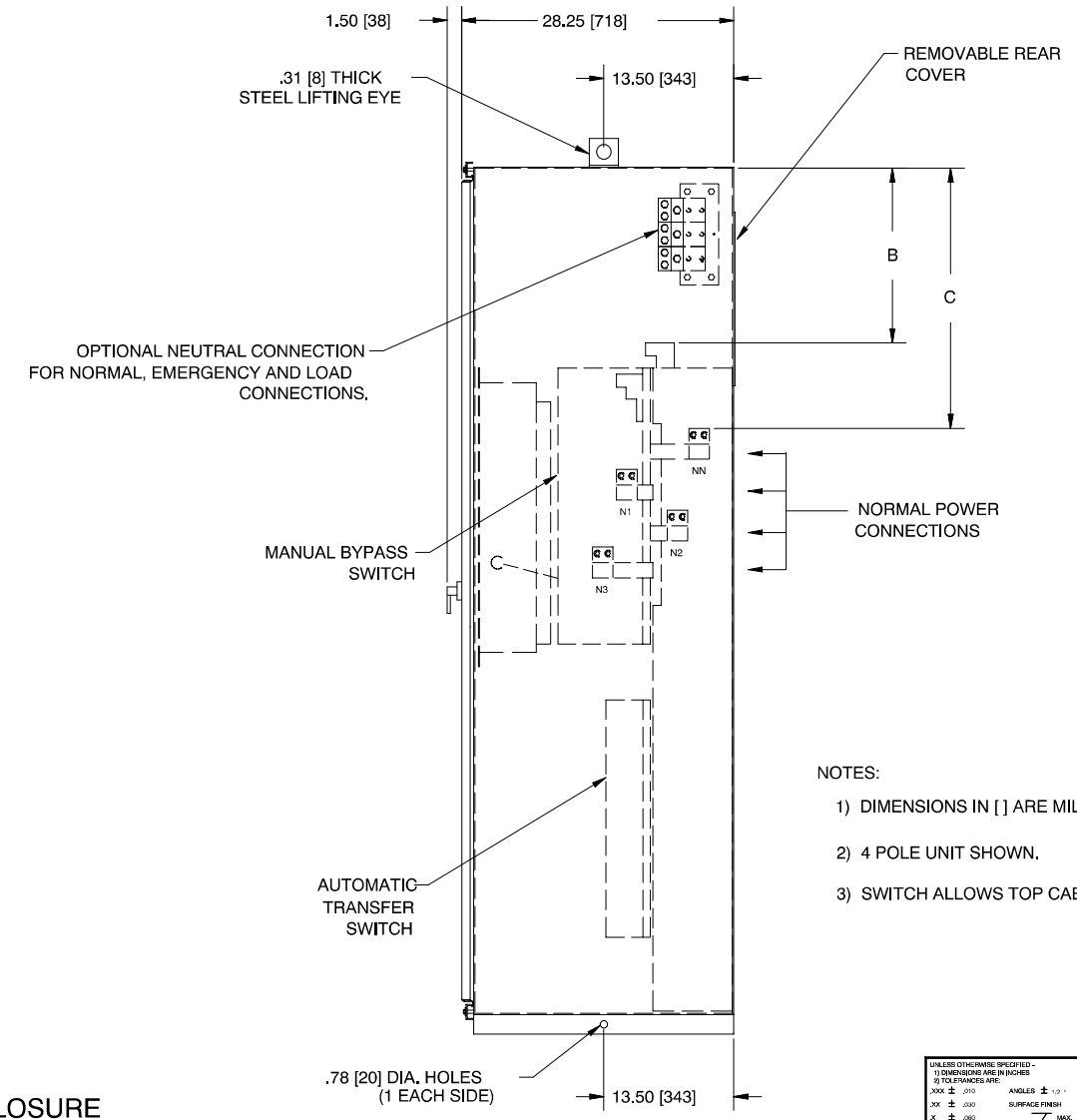
B	10–9–00	(D–3) TOP VIEW ADDED; (D–5) ENTRY WIDTH ADDED [63252]	WSD	



NEMA 4 ENCLOSURE





NOTES:

1) DIMENSIONS IN [ ] ARE MILLIMETER EQUIVALENTS.
2) 4 POLE UNIT SHOWN.
3) SWITCH ALLOWS TOP CABLE ENTRY ONLY.

BYPASS ISOLATION TRANSFER SWITCH
STANDARD & PROGRAMMED TRANSITION
600, 800–1200 AMP, 2,3 & 4 POLE

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1.0 °
.XX ± .030 SURFACE FINISH
.X ± .060 MAX.
FRACTIONS ±

APPROVALS	DATE
DRAWN DFS	1–27–94
CHECKED AJH	2–22–94
APPROVED AJH	2–22–94

TITLE: DIMENSION PRINT

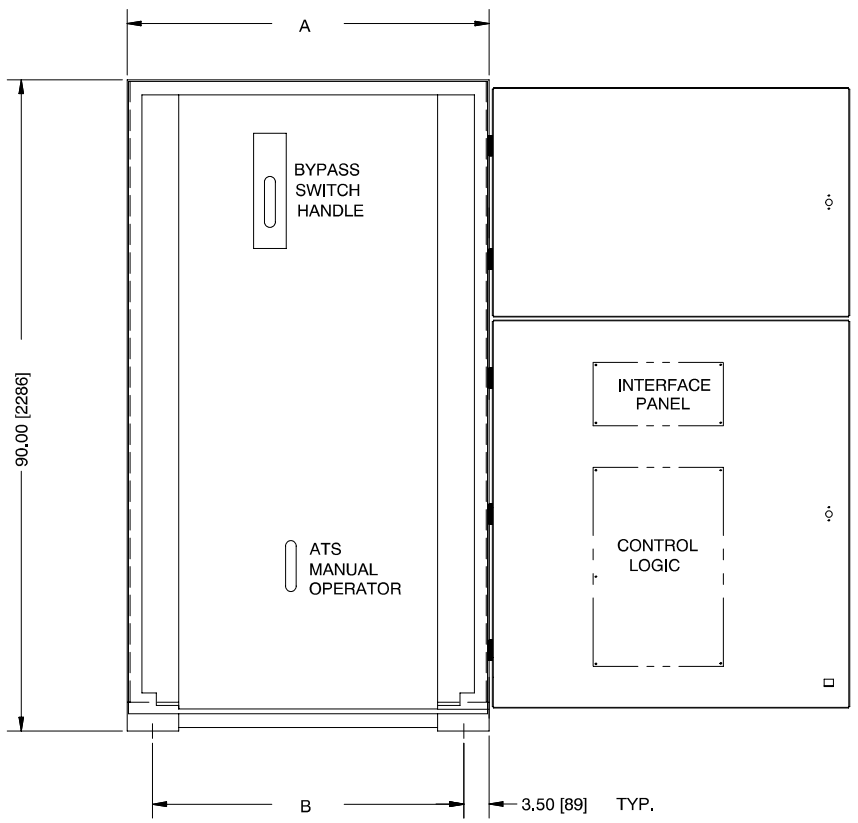
SCALE	1/8	CAD NO.	ADV5959C.dwg	SHEET	3–3
PLOTTED		DWG. NO.	ADV–5959		D

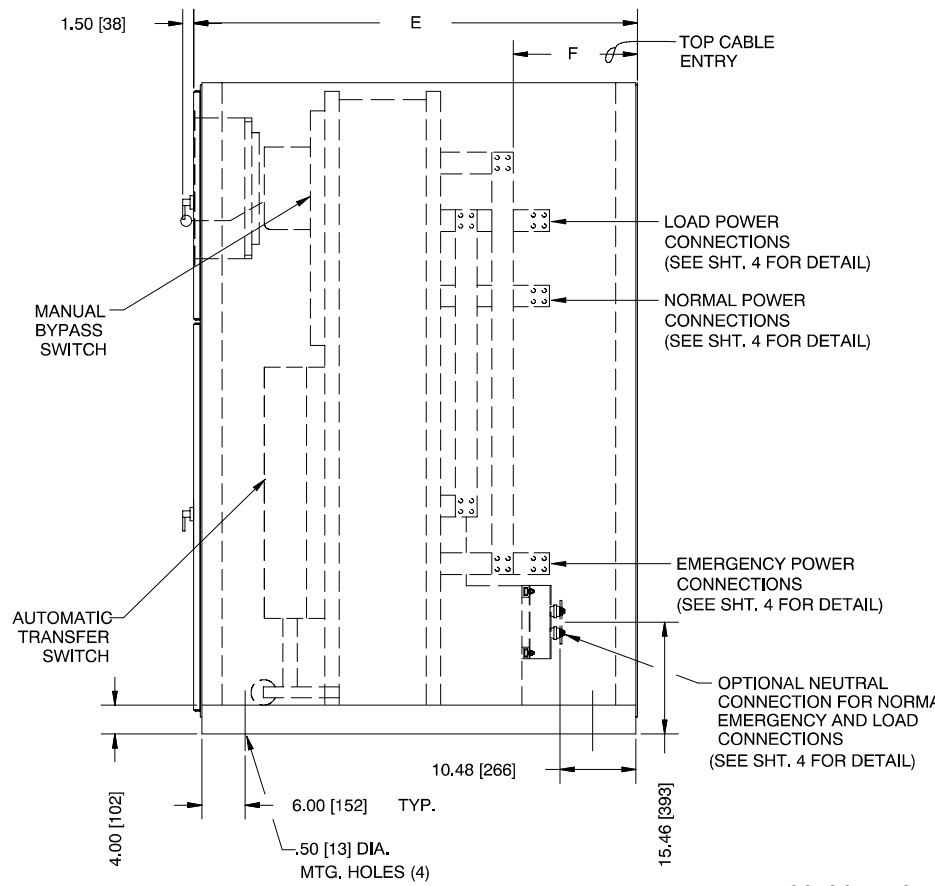
ADV5959C-B-S-

Enclosure Dimensions, NEMA Type 4, 600-1200 Amps, ADV-5959C-S-B, Page 3

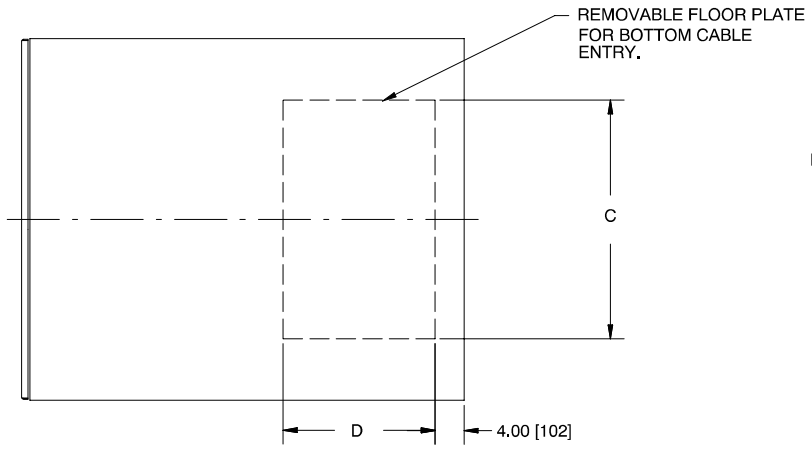
STANDARD BYPASS SWITCH	NO. POLES	CABINET DIMENSIONS						WIRE BENDING SPACE (TOP ENTRY)			WIRE BENDING SPACE (BOTTOM ENTRY)			WIRE GUTTERS		R
		A	B	C	D	E	F	G (LOAD)	H (NORMAL)	J (EMERG.)	K (LOAD)	L (NORMAL)	M (EMERG.)	N LEFT	P (RIGHT)	
1600–2000 AMP	2,3	40.00 [1016]	33.00 [838]	26.00 [660]	21.00 [533]	61.12 [1552]	14.00 [356]	18.76 [477]	29.16 [741]	66.16 [1680]	71.24 [1809]	60.84 [1545]	23.84 [606]	11.75 [298]	15.12 [384]	13.88 [353]
	4	50.00 [1270]	43.00 [1092]	36.00 [914]	21.00 [533]	61.12 [1552]	14.00 [356]								12.00 [305]	
3000 AMP	2,3	40.00 [1016]	33.00 [838]	26.00 [660]	33.00 [838]	73.12 [1857]	21.00 [533]	18.76 [477]	29.16 [741]	66.16 [1680]	71.24 [1809]	60.84 [1545]	23.84 [606]	11.75 [298]	15.12 [384]	11.75 [298]
	4	50.00 [1270]	43.00 [1092]	36.00 [914]	33.00 [838]	73.12 [1857]	21.00 [533]								12.00 [305]	
PROGRAMMED TRANSITION BYPASS SWITCH																
1600–2000 AMP	2,3	40.00 [1016]	33.00 [838]	26.00 [660]	21.00 [533]	61.12 [552]	61.12 [552]	18.76 [477]	29.16 [741]	66.16 [1680]	71.24 [1809]	60.84 [1545]	23.84 [606]	11.75 [298]	15.12 [384]	13.88 [353]
	4	50.00 [1270]	43.00 [1092]	36.00 [914]	21.00 [533]	61.12 [552]	61.12 [552]								12.00 [305]	
3000 AMP	2,3	40.00 [1016]	33.00 [838]	26.00 [660]	33.00 [838]	73.12 [1857]	73.12 [1857]	18.76 [477]	29.16 [741]	66.16 [1680]	71.24 [1809]	60.84 [1545]	23.84 [606]	11.75 [298]	15.12 [384]	11.75 [298]
	4	50.00 [1270]	43.00 [1092]	36.00 [914]	33.00 [838]	73.12 [1857]	73.12 [1857]								12.00 [305]	

REV	DATE	REVISION	BY	M F
B	9-6-95	(B-1,-4, A-1,-4) LUGS REMOVED FROM POWER & NEUTRAL		
		CONNECTIONS, NEUTRAL VIEW UPDATED, 10,48 [266], 15,46		
		[393] ADDED; (C-2) NOTE #3 ADDED; (D-3,-4,-5) DIM,S		
		G THRU M UPDATED PER LUG REMOVAL; (A-1) 1-4 WAS 1-3		
		[43377]	KDW	
C	6-2-97	(C-2) 5,5 & "R" DIM'S, ADDED; (D-2) "R" COLUMN ADDED;		
		(D-5) "LUG RANGE" COLUMN REMOVED [50729]	RSH	





NEMA I ENCLOSURE

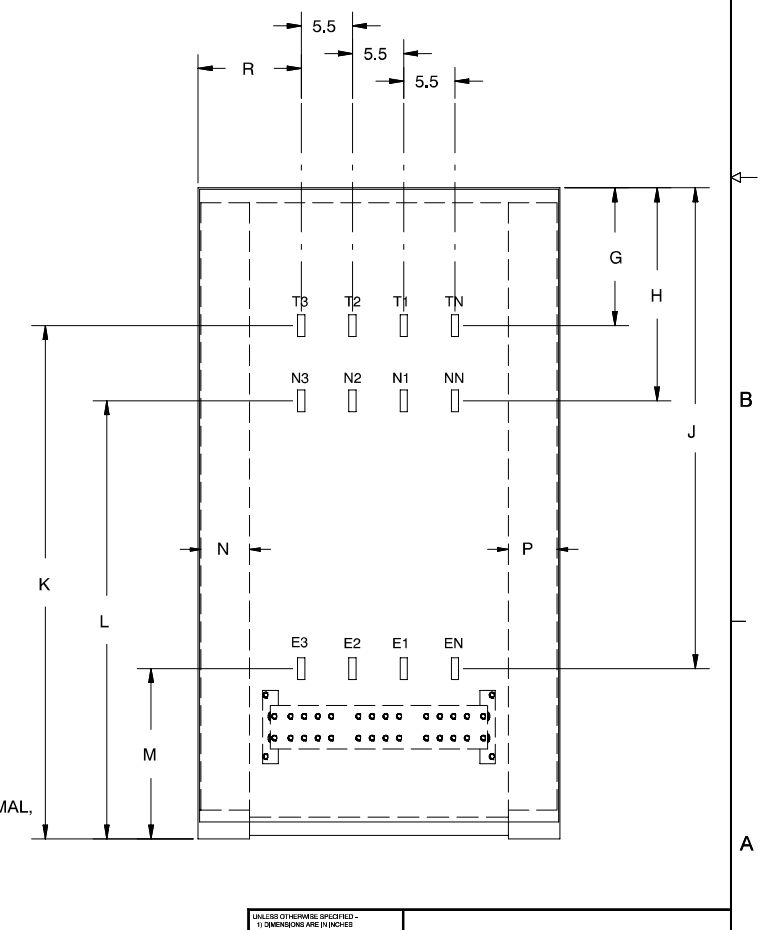


NOTES:

1) DIMENSIONS IN [ ] ARE MILLIMETER EQUIVALENTS.

2) 4 POLE UNIT SHOWN.

3) SEE SHEET 4 FOR POWER & NEUTRAL CONNECTION DETAILS.



UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1.0 °
.XX ± .030 SURFACE FINISH
.X ± .060 MAX.
FRACTIONS ±

APPROVALS	DATE
DRAWN DFS	1-31-94
CHECKED AJH	2-22-94
APPROVED AJH	2-22-94

TITLE: DIMENSION PRINT

SCALE 1/8 | CAD NO. ADV5960A.dwg | SHEET 1-4

PLOTTED | DWG. NO. ADV-5960 | D

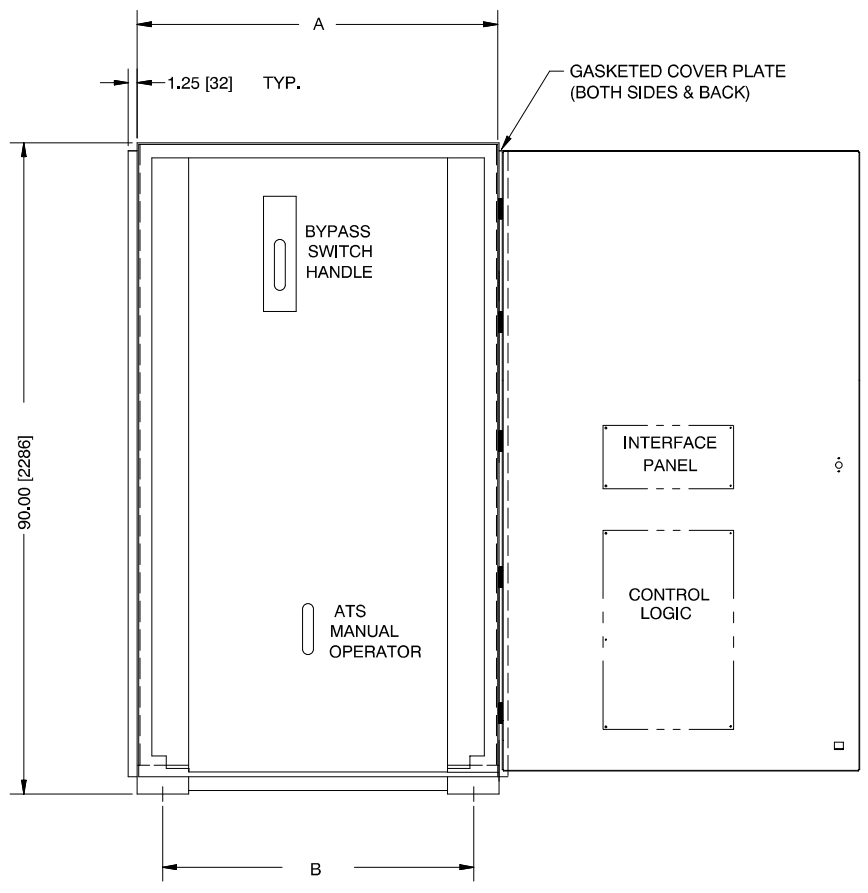
BYPASS ISOLATION TRANSFER SWITCH
STANDARD & PROGRAMMED TRANSITION
1600-2000, 3000 AMP 2, 3 & 4 POLE

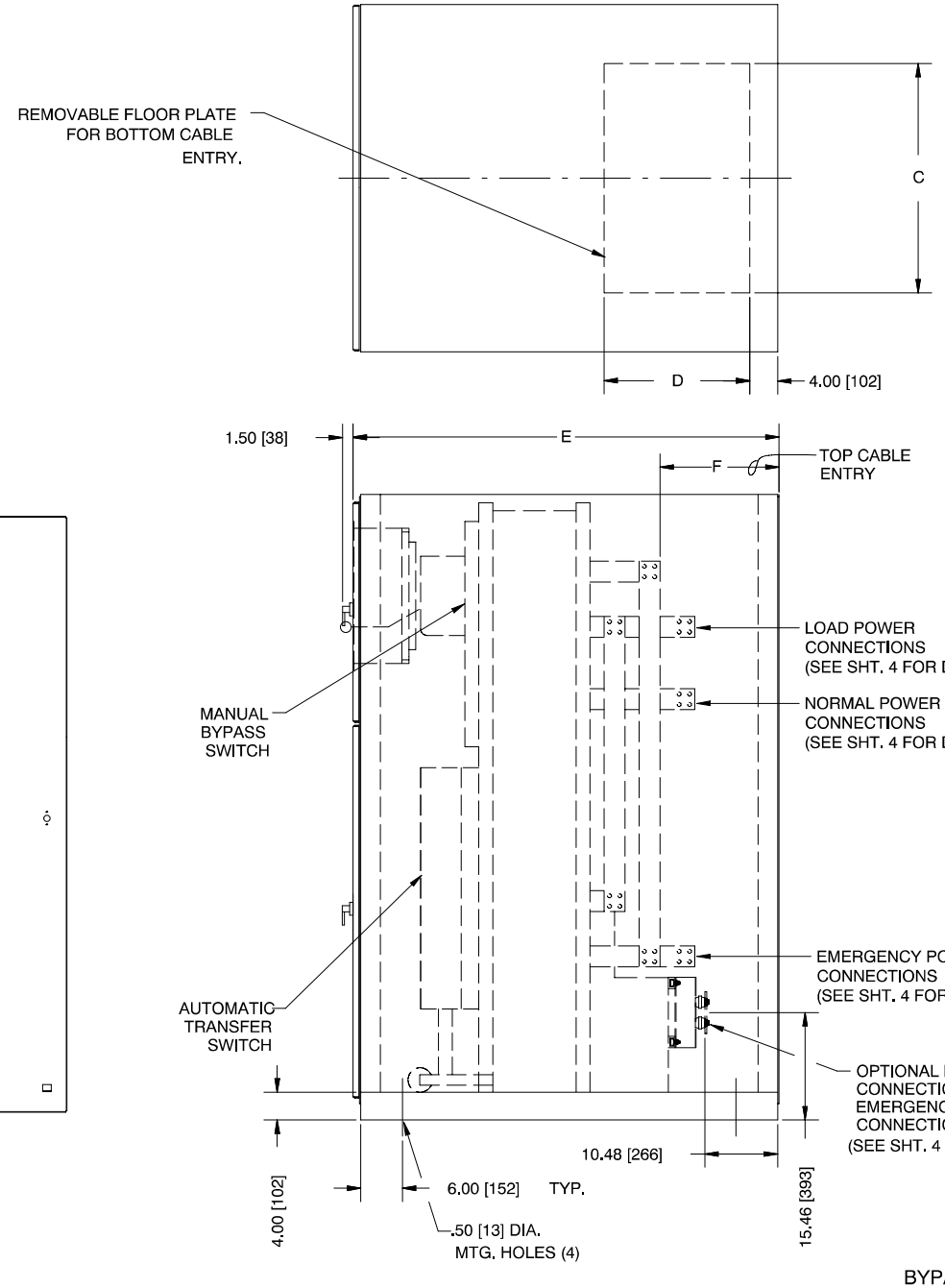
ADV5960A-C-S-

Enclosure Dimensions, NEMA Type 1, 1600-3000 Amps, ADV-5960A-S-C, Page 1

STANDARD BYPASS SWITCH	NO. POLES	CABINET DIMENSIONS						WIRE BENDING SPACE (TOP ENTRY)			WIRE BENDING SPACE (BOTTOM ENTRY)			WIRE GUTTERS		R
		A	B	C	D	E	F	G (LOAD)	H (NORMAL)	J (EMERG.)	K (LOAD)	L (NORM.)	M (EMERG.)	N (LEFT)	P (RIGHT)	
1600–2000 AMP	2,3	43.75 [1111]	34.25 [870]	26.00 [660]	21.00 [533]	62.62 [1591]	14.00 [356]	18.76 [477]	29.16 [741]	66.16 [1680]	71.24 [1809]	60.84 [1545]	23.84 [606]	11.75 [298]	15.12 [384]	13.88 [353]
	4	53.75 [1365]	44.25 [1124]	36.00 [914]	21.00 [533]	62.62 [1591]	14.00 [356]								12.00 [305]	
3000 AMP	2,3	43.75 [1111]	34.25 [870]	26.00 [660]	33.00 [838]	74.62 [1895]	21.00 [533]	18.76 [477]	29.16 [741]	66.16 [1680]	71.24 [1809]	60.84 [1545]	23.84 [606]	11.75 [298]	15.12 [384]	11.75 [298]
	4	53.75 [1365]	44.25 [1124]	36.00 [914]	33.00 [838]	74.62 [1895]	21.00 [533]								12.00 [305]	
PROGRAMMED TRANSITION BYPASS SWITCH																
1600–2000 AMP	2,3	43.75 [1111]	34.25 [870]	26.00 [660]	21.00 [533]	62.62 [1591]	14.00 [356]	18.76 [477]	29.16 [741]	66.16 [1680]	71.24 [1809]	60.84 [1545]	23.84 [606]	11.75 [298]	15.12 [384]	13.88 [353]
	4	53.75 [1365]	44.25 [1124]	36.00 [914]	21.00 [533]	62.62 [1591]	14.00 [356]								12.00 [305]	
3000 AMP	2,3	43.75 [1111]	34.25 [870]	26.00 [660]	33.00 [838]	74.62 [1895]	21.00 [533]	18.76 [477]	29.16 [741]	66.16 [1680]	71.24 [1809]	60.84 [1545]	23.84 [606]	11.75 [298]	15.12 [384]	11.75 [298]
	4	53.75 [1365]	44.25 [1124]	36.00 [914]	33.00 [838]	74.62 [1895]	21.00 [533]								12.00 [305]	

REV	DATE	REVISION	BY	M F
B	9-6-95	(B-1,-4, A-1,-4) LUGS REMOVED FROM POWER & NEUTRAL		
		CONNECTIONS, NEUTRAL VIEW UPDATED, 10,48 [266], 15,46		
		[393] ADDED; (C-2) NOTE #3 ADDED; (D-3,-4,-5) DIM,S		
		G THRU M UPDATED PER LUG REMOVAL; (A-1) 2-4 WAS 2-3		
		[43377]	KDW	
C	6-2-97	(C-2) 5,5 & "R" DIM'S, ADDED; (D-2) "R" COLUMN ADDED;		
		(D-5 "LUG RANGE" COLUMN REMOVED [50729]	RSH	



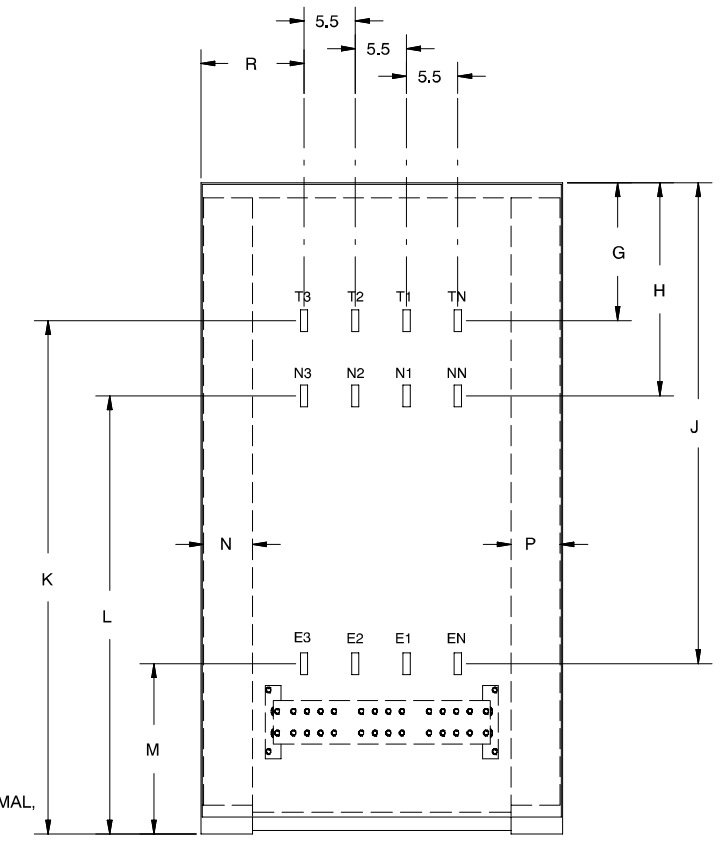


NOTES:

1) DIMENSIONS IN [ ] ARE MILLIMETER EQUIVALENTS.

2) 4 POLE UNIT SHOWN.

3) SEE SHEET 4 FOR POWER & NEUTRAL CONNECTION DETAILS.



NEMA 3R & 12 ENCLOSURES

BYPASS ISOLATION TRANSFER SWITCH
STANDARD & PROGRAMMED TRANSITION
1600–2000, 3000 AMP 2,3 & 4 POLE

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2 °
.XX ± .030 SURFACE FINISH
.X ± .060 MAX.
FRACTIONS ±

APPROVALS	DATE
DRAWN DFS	1-31-94
CHECKED AJH	2-22-94
APPROVED AJH	2-22-94

TITLE: DIMENSION PRINT

SCALE 1/8 | CAD I.D. ADV5960B.dwg | SHEET 2-4

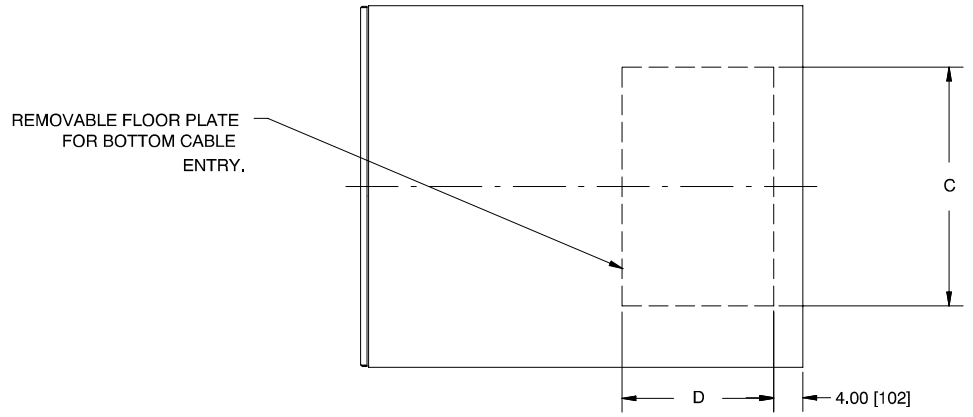
PLOTTED | DWG. NO. ADV-5960 | D

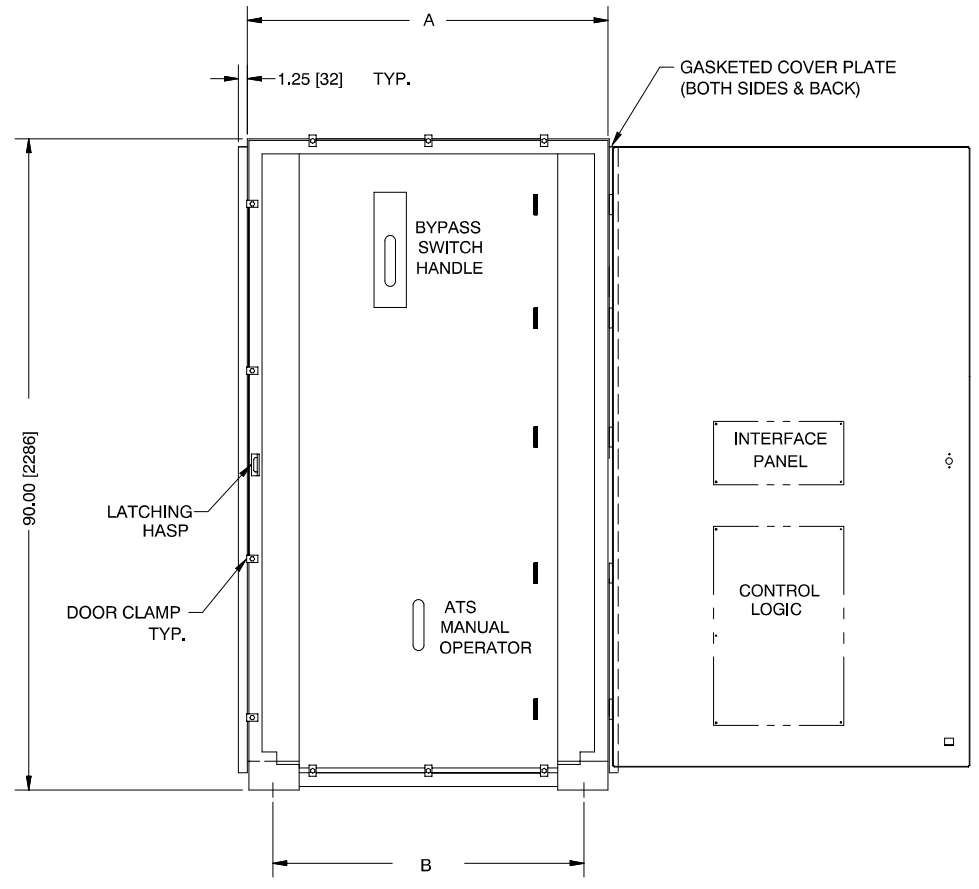
ADV5960B-C-S-

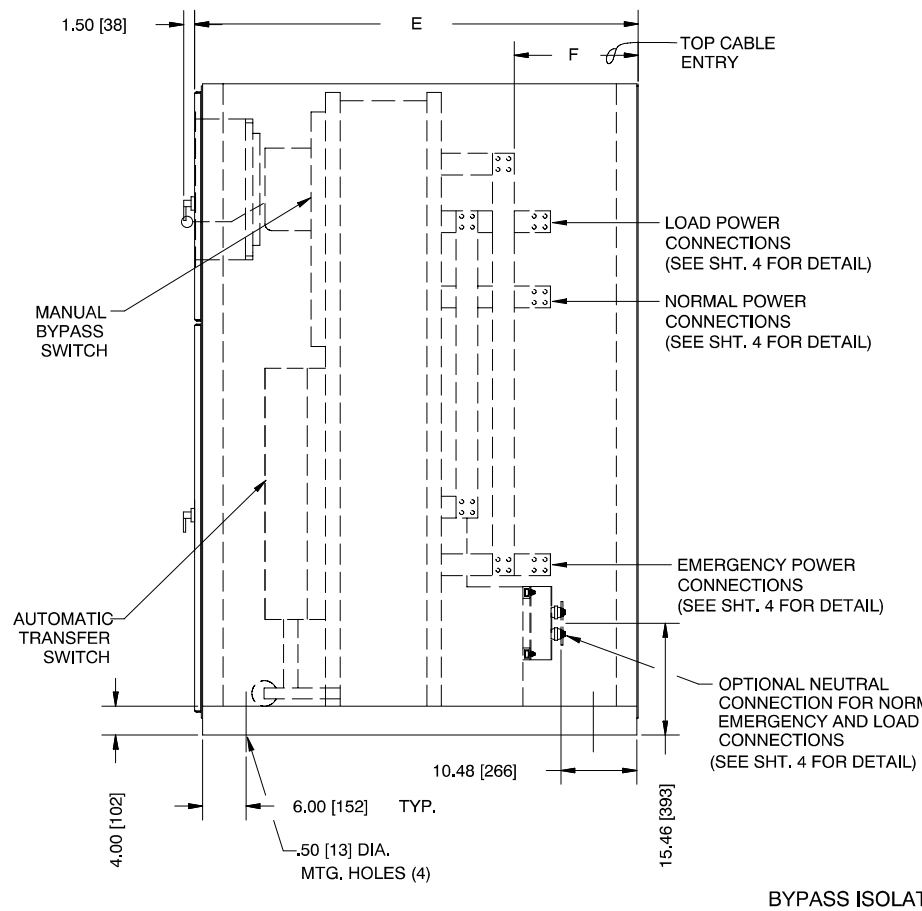
Enclosure Dimensions, NEMA Type 3R and 12, 1600-3000 Amps, ADV-5960B-S-C, Page 2

STANDARD BYPASS SWITCH	NO. POLES	CABINET DIMENSIONS						WIRE BENDING SPACE (TOP ENTRY)			WIRE BENDING SPACE (BOTTOM ENTRY)			WIRE GUTTERS		R
		A	B	C	D	E	F	G (LOAD)	H (NORMAL)	J (EMERG.)	K (LOAD)	L (NORM.)	M (EMERG.)	N (LEFT)	P (RIGHT)	
1600–2000 AMP	2,3	43.75 [1111]	34.25 [870]	26.00 [660]	21.00 [533]	61.12 [1552]	14.00 [356]	18.76 [477]	29.16 [741]	66.16 [1680]	71.24 [1809]	60.84 [1545]	23.84 [606]	11.75 [298]	15.12 [384]	13.88 [353]
	4	53.75 [1365]	44.25 [1124]	36.00 [914]	21.00 [533]	61.12 [1552]	14.00 [356]								12.00 [305]	
3000 AMP	2,3	43.75 [1111]	34.25 [870]	26.00 [660]	33.00 [838]	73.12 [1857]	21.00 [533]	18.76 [477]	29.16 [741]	66.16 [1680]	71.24 [1809]	60.84 [1545]	23.84 [606]	11.75 [298]	15.12 [384]	11.75 [298]
	4	53.75 [1365]	44.25 [1124]	36.00 [914]	33.00 [838]	73.12 [1857]	21.00 [533]								12.00 [305]	
PROGRAMMED TRANSITION BYPASS SWITCH																
1600–2000 AMP	2,3	43.75 [1111]	34.25 [870]	26.00 [660]	21.00 [533]	61.12 [1552]	14.00 [356]	18.76 [477]	29.16 [741]	66.16 [1680]	71.24 [1809]	60.84 [1545]	23.84 [606]	11.75 [298]	15.12 [384]	13.88 [353]
	4	53.75 [1365]	44.25 [1124]	36.00 [914]	21.00 [533]	61.12 [1552]	14.00 [356]								12.00 [305]	
3000 AMP	2,3	43.75 [1111]	34.25 [870]	26.00 [660]	33.00 [838]	73.12 [1857]	21.00 [533]	18.76 [477]	29.16 [741]	66.16 [1680]	71.24 [1809]	60.84 [1545]	23.84 [606]	11.75 [298]	15.12 [384]	11.75 [298]
	4	53.75 [1365]	44.25 [1124]	36.00 [914]	33.00 [838]	73.12 [1857]	21.00 [533]								12.00 [305]	

REV	DATE	REVISION	BY	M F
B	9-6-95	(B-1,-4, A-1,-4) LUGS REMOVED FROM POWER & NEUTRAL		
		CONNECTIONS, NEUTRAL VIEW UPDATED, 10.48 [266], 15.46		
		[393] ADDED; (C-2) NOTE #3 ADDED; (D-3,-4,-5) DIM.'S		
		G THRU M UPDATED PER LUG REMOVAL; (A-1) 3-4 WAS 3-3		
		[43377]	KDW	
C	6-2-97	(C-2) 5,5 & "R" DIM'S. ADDED; (D-2) "R" COLUMN ADDED;		
		(D-5) "LUG RANGE" COLUMN REMOVED [50729]	RSH	





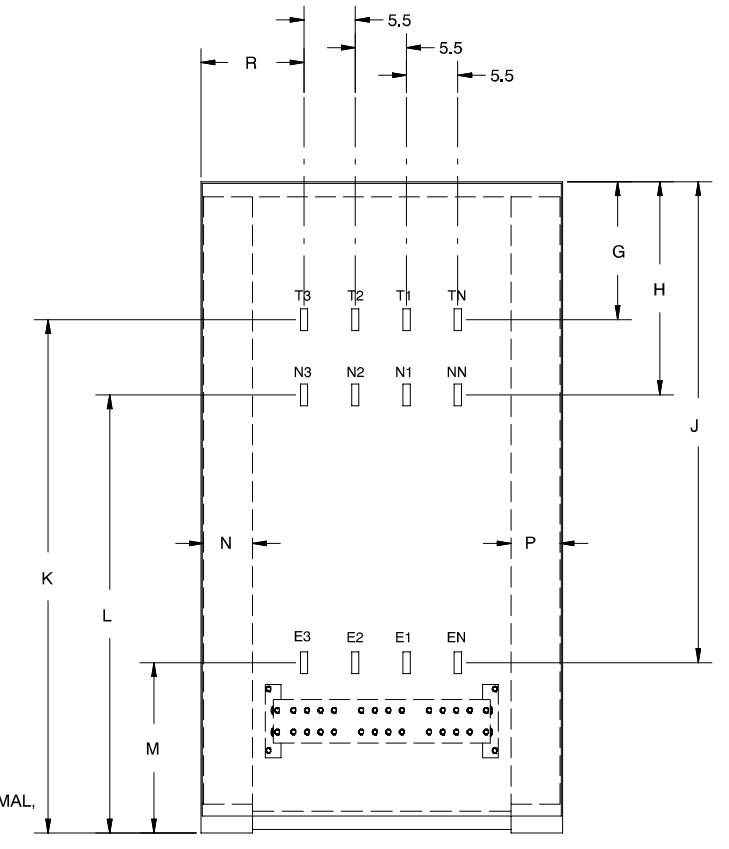


NOTES:

1) DIMENSIONS IN [ ] ARE MILLIMETER EQUIVALENTS.

2) 4 POLE UNIT SHOWN.

3) SEE SHEET 4 FOR POWER & NEUTRAL CONNECTION DETAILS.



NEMA 4 ENCLOSURE

BYPASS ISOLATION TRANSFER SWITCH
STANDARD & PROGRAMMED TRANSITION
1600–2000, 3000 AMP 2,3 & 4 POLE

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2 °
.XX ± .020 SURFACE FINISH
.X ± .060 MAX.
FRACTIONS ±

APPROVALS	DATE
DRAWN DFS	1-31-94
CHECKED AJH	2-22-94
APPROVED AJH	2-22-94

TITLE: DIMENSION PRINT

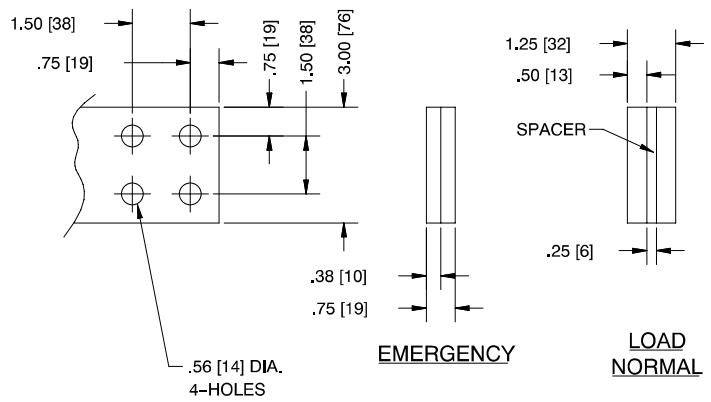
SCALE 1/8 | CAD NO. ADV5960C.dwg | SHEET 3-4

PLOTTED | DWG. NO. ADV-5960 | D G

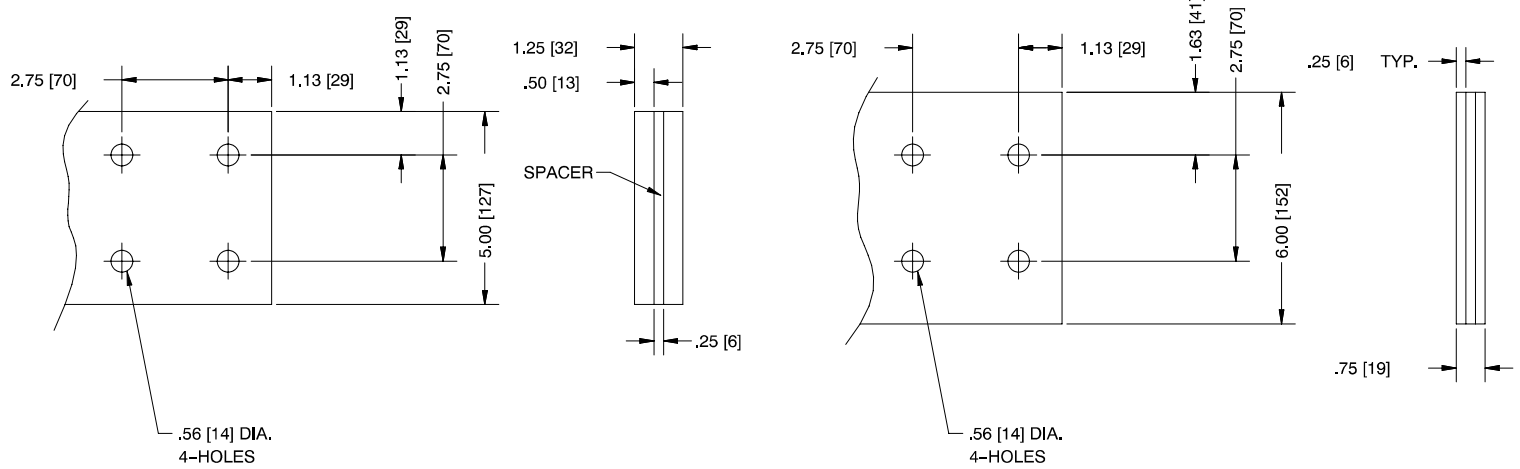
ADV5960C-C-S-

Enclosure Dimensions, NEMA Type 4, 1600-3000 Amps, ADV-5960C-S-C, Page 3

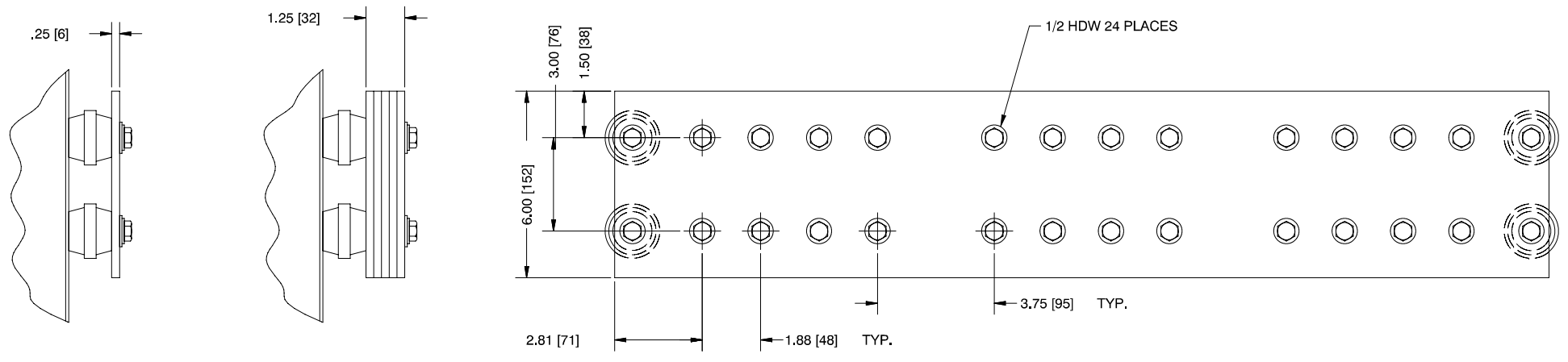
REV	DATE	REVISION	BY	M F
A	6-3-97	(D-4, D-7) SPACER WAS SPACE [50729]	RSH	



1600-2000 AMP BUS DETAIL



3000 AMP BUS DETAIL



1600 AMP

2000-3000 AMP

1600-3000 AMP NEUTRAL DETAIL

NOTE:
DIMENSIONS IN [ ] ARE
MILLIMETER EQUIVALENTS.

BYPASS ISOLATION TRANSFER SWITCH
STANDARD & PROGRAMMED TRANSITION
1600-2000, 3000 AMP 2, 3 & 4 POLE

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2 °
.XX ± .030 SURFACE FINISH
X ± .060 MAX.
FRACTIONS ±

APPROVALS	DATE
DRAWN KDW	9-5-95
CHECKED JJC	9-25-95
APPROVED AJH	9-25-95

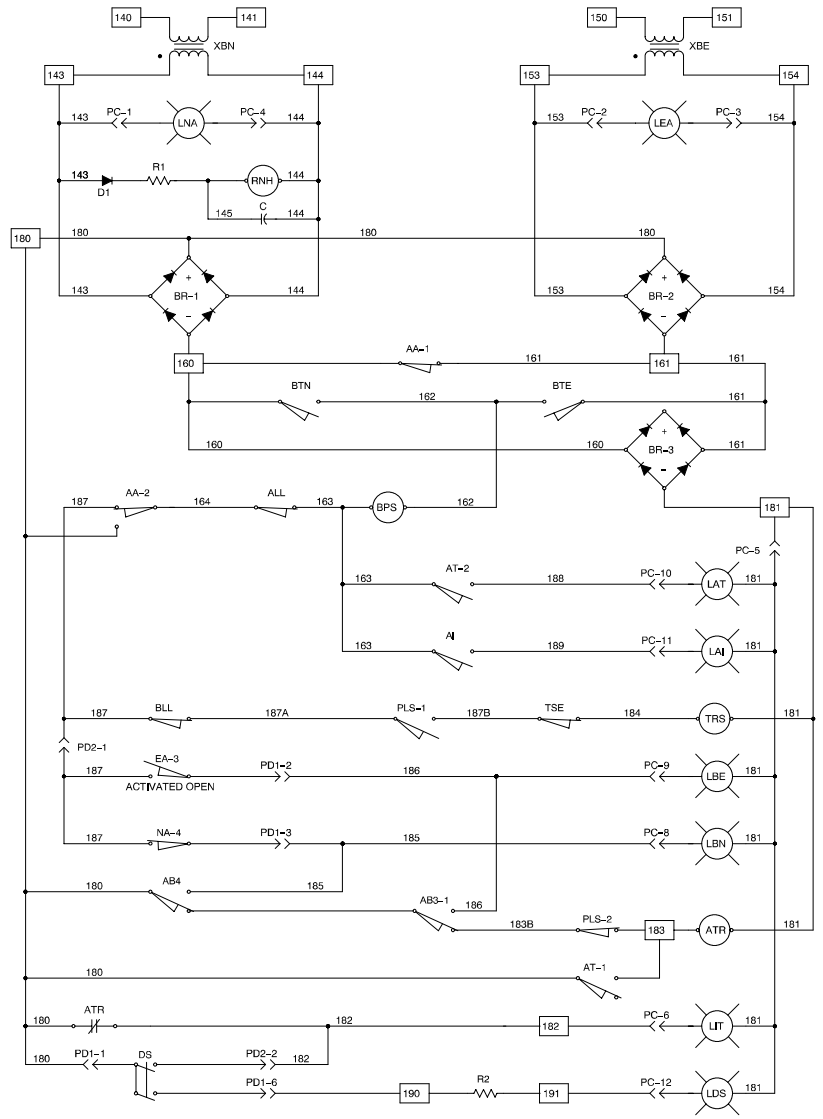
TITLE: DIMENSION PRINT

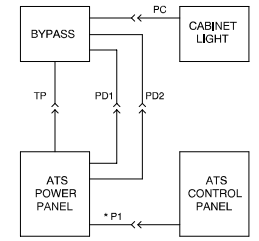
SCALE 3/8 | CAD NO. ADV5960D.DWG | SHEET 4-4
PLOTTED | DWG. NO. ADV-5960 | D

ADV5960D-A-S-

Dimensions, Neutral and Bus Details, 1600-3000 Amps, ADV-5960D-S-A, Page 4

REV	DATE	REVISION	BY	M F
A	3-24-94	WIRE NUMBERS REVISED	AH	





* SEE ATS POWER CIRCUIT SCHEMATIC, LIGHTS & PLUGS

LIMIT SWITCH CHART

X = ACTUATED	ATS LOCATION			ATS MODE		BYPASS MODE		
	AUTO	TEST	ISO	REMOVE	NORM	EMERG.	NORM	EMERG.	OPEN
AA	X								
AT		X							
AI			X	X					
ALL	X	X	X	X					
TSE	X	X	X						
AE			X	X					
NA					X				
EA						X			
AB4							X		
AB3								X	
BLL							X	X	X
PLS	ACTIVATED WHEN ALH IS OPERATED								

LEGEND

AA-1,2	LIMIT SWITCH, ATS AUTO LOCATION
AB3-1	LIMIT SWITCH, BYPASS EMERGENCY
AB4	LIMIT SWITCH, BYPASS NORMAL
AI	LIMIT SWITCH, ATS IN ISOLATE
ALH	ATS LOCATION HANDLE
ALL	LIMIT SWITCH, ATS LOCK LOCATION
AT-1,2	LIMIT SWITCH, ATS TEST LOCATION
ATR	AUTO/TEST RELAY
BLL	LIMIT SWITCH, BYPASS LOCK LOCATION
BPS	BYPASS SOLENOID
BTE	LIMIT SWITCH, BYPASS TRANSFER EMERGENCY (MBH MOVEMENT TO NORMAL)
BTN	LIMIT SWITCH, BYPASS TRANSFER NORMAL (MBH MOVEMENT TO EMERGENCY)
BR	BRIDGE RECTIFIER
DS	ATS DISCONNECT SWITCH
EA-3	LIMIT SWITCH, ATS IN EMERGENCY
LBE	BYPASS EMERGENCY LIGHT
LBN	BYPASS NORMAL LIGHT
LAI	ATS ISOLATE LIGHT
LAT	ATS TEST LOCATION
LDS	DISCONNECT SWITCH INHIBIT POSITION
LEA	EMERGENCY AVAILABLE LIGHT
LIT	ATS INHIBIT LIGHT
LNA	NORMAL AVAILABLE LIGHT
NA-4	LIMIT SWITCH, ATS IN NORMAL
PLS-1,2	PERMISSIVE LIMIT SWITCH
RNH	NORMAL VOLTAGE RELAY
TRS	SOLENOID, TRANSFER RELEASE
TSE	LIMIT SWITCH, TRANSFER SWITCH ENGAGED
81	TERMINAL ON BYPASS SUBPANEL

100-400 AMP
3 & 4 POLE

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE
.XXX ± .010 ANGLES ± 1/2 °
.XX ± .030 SURFACE FINISH
.X ± .060 MAX.
FRACTIONS ±

APPROVALS		DATE
DRAWN	WJB	1-11-94
CHECKED	AH	2-14-94
APPROVED	AH	2-14-94

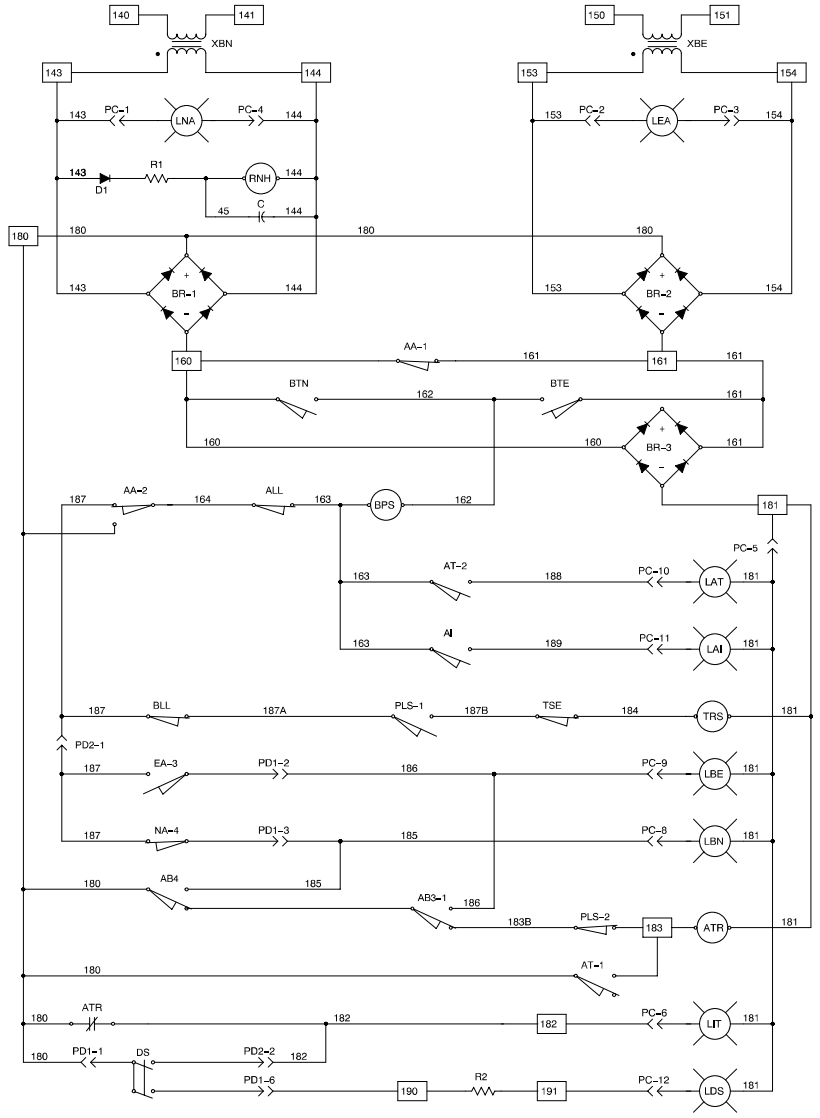
TITLE: SCHEMATIC DIAGRAM

SCALE	CAD NO.	SHEET
NONE	321443.DWG	1-1
PLOTTED	DWG. NO.	
	321443	E

321443-A-S-

Transfer Switch Lamps, 100-400 Amps, Programmed-Transition, 321443-S-A

REV	DATE	REVISION	BY	M F
A	3-28-94	WIRE NUMBERS REVISED	AH	

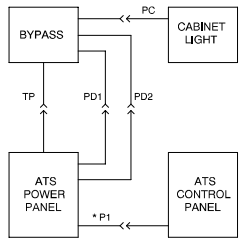


LIMIT SWITCH CHART

X = ACTUATED	ATS LOCATION				ATS MODE		BYPASS MODE		
	AUTO	TEST	ISO	REMOVE	NORM	EMERG.	NORM.	EMERG.	OPEN
AA	X								
AT		X							
AI			X	X					
ALL	X	X	X	X					
TSE	X	X	X						
AE			X	X					
NA					X				
EA						X			
AB4							X		
AB3								X	
BLL							X	X	X
PLS	ACTIVATED WHEN ALH IS OPERATED								

LEGEND

AA-1,2	LIMIT SWITCH, ATS AUTO LOCATION
AB3-1	LIMIT SWITCH, BYPASS EMERGENCY
AB4	LIMIT SWITCH, BYPASS NORMAL
AI	LIMIT SWITCH, ATS IN ISOLATE
ALH	ATS LOCATION HANDLE
ALL	LIMIT SWITCH, ATS LOCK LOCATION
AT-1,2	LIMIT SWITCH, ATS TEST LOCATION
ATR	AUTO/TEST RELAY
BLL	LIMIT SWITCH, BYPASS LOCK LOCATION
BPS	BYPASS SOLENOID
BTE	LIMIT SWITCH, BYPASS TRANSFER EMERGENCY (MBH MOVEMENT TO NORMAL)
BTN	LIMIT SWITCH, BYPASS TRANSFER NORMAL (MBH MOVEMENT TO EMERGENCY)
BR	BRIDGE RECTIFIER
DS	ATS DISCONNECT SWITCH
EA-3	LIMIT SWITCH, ATS IN EMERGENCY
LBE	BYPASS EMERGENCY LIGHT
LBN	BYPASS NORMAL LIGHT
LAI	ATS ISOLATE LIGHT
LAT	ATS TEST LOCATION
LDS	DISCONNECT SWITCH INHIBIT POSITION
LEA	EMERGENCY AVAILABLE LIGHT
LIT	ATS INHIBIT LIGHT
LNA	NORMAL AVAILABLE LIGHT
NA-4	LIMIT SWITCH, ATS IN NORMAL
PLS-1,2	PERMISSIVE LIMIT SWITCH
RNH	NORMAL VOLTAGE RELAY
TRS	SOLENOID, TRANSFER RELEASE
TSE	LIMIT SWITCH, TRANSFER SWITCH ENGAGED
81	TERMINAL ON BYPASS SUBPANEL



* SEE ATS POWER CIRCUIT SCHEMATIC, LIGHTS & PLUGS

100-400 AMP
3 & 4 POLE

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2 °
.XX ± .030 SURFACE FINISH
.X ± .060 MAX.
FRACTIONS ±

APPROVALS	DATE
DRAWN WJB	1-11-94
CHECKED AH	2-14-94
APPROVED AH	2-14-94

TITLE: SCHEMATIC DIAGRAM

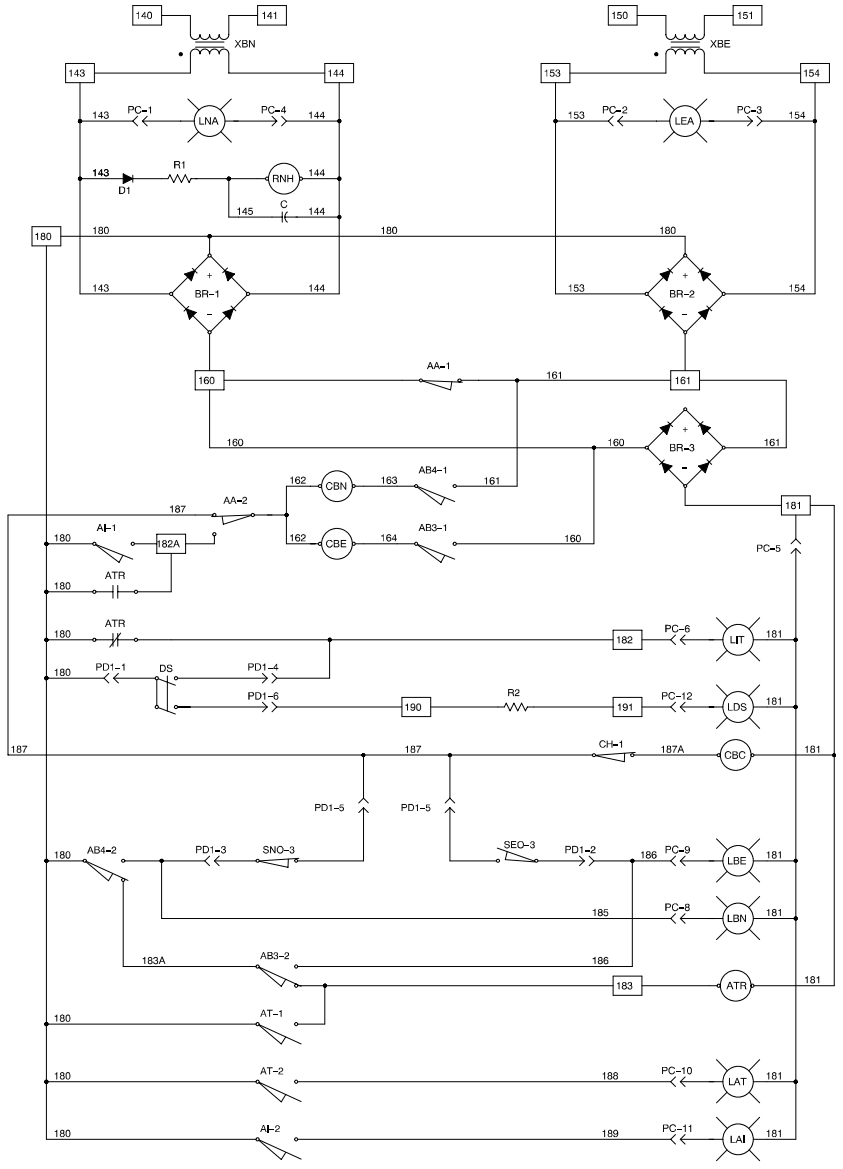
SCALE: NONE | CAD NO.: 321444.DWG | SHEET: 1-1

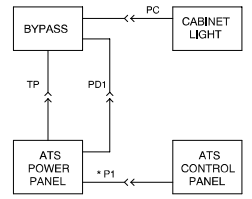
PLOTTED | DWG. NO.: 321444 | E

321444-A-S-

Transfer Switch Lamps, 100-400 Amps, 321444-S-A

REV	DATE	REVISION	BY	M F
A	3-28-94	WIRE NUMBERS REVISED	AH	





* SEE ATS POWER CIRCUIT SCHEMATIC, LIGHTS & PLUGS

LIMIT SWITCH CHART

X = ACTUATED	ATS LOCATION				ATS MODE		BYPASS MODE	
	AUTO	TEST	ISO	REMOVE	NORM	EMERG.	NORM	EMERG.
AA	X							
AT		X						
AI			X	X				
AE			X	X				
SN					X			
SE						X		
AB4							X	
AB3								X

LEGEND

AA-1,2,3	LIMIT SWITCH, ATS AUTO LOCATION
AB3-1,2	LIMIT SWITCH, BYPASS EMERGENCY
AB4-1,2	LIMIT SWITCH, BYPASS NORMAL
AI-1,2,3	LIMIT SWITCH, ATS IN ISOLATE
AT-1,2	LIMIT SWITCH, ATS TEST LOCATION
ACD	LIMIT SWITCH, CRANK HANDLE ENGAGED
ACU	LIMIT SWITCH, CRANK HANDLE ENGAGED
ATR	AUTO/TEST RELAY
BR	BRIDGE RECTIFIER
CBC	CRANK SOLENOID
CBE	EMERGENCY TRANSFER OPERATOR
CBN	NORMAL TRANSFER OPERATOR
DS	ATS DISCONNECT SWITCH
LBE	BYPASS EMERGENCY
LBN	BYPASS NORMAL LIGHT
LAI	ATS ISOLATE LIGHT
LAT	ATS TEST LOCATION
LDS	DISCONNECT SWITCH
LEA	EMERGENCY AVAILABLE LIGHT
LIT	ATS INHIBIT LIGHT
LNA	NORMAL AVAILABLE LIGHT
RNH	NORMAL VOLTAGE RELAY
[81]	TERMINAL ON BYPASS SUBPANEL

1600-3000 AMP
3 & 4 POLE

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2 °
.XX ± .030 SURFACE FINISH
.X ± .060 MAX.
FRACTIONS ±

APPROVALS	DATE
DRAWN WJB	1-11-94
CHECKED AH	2-14-94
APPROVED AH	2-14-94

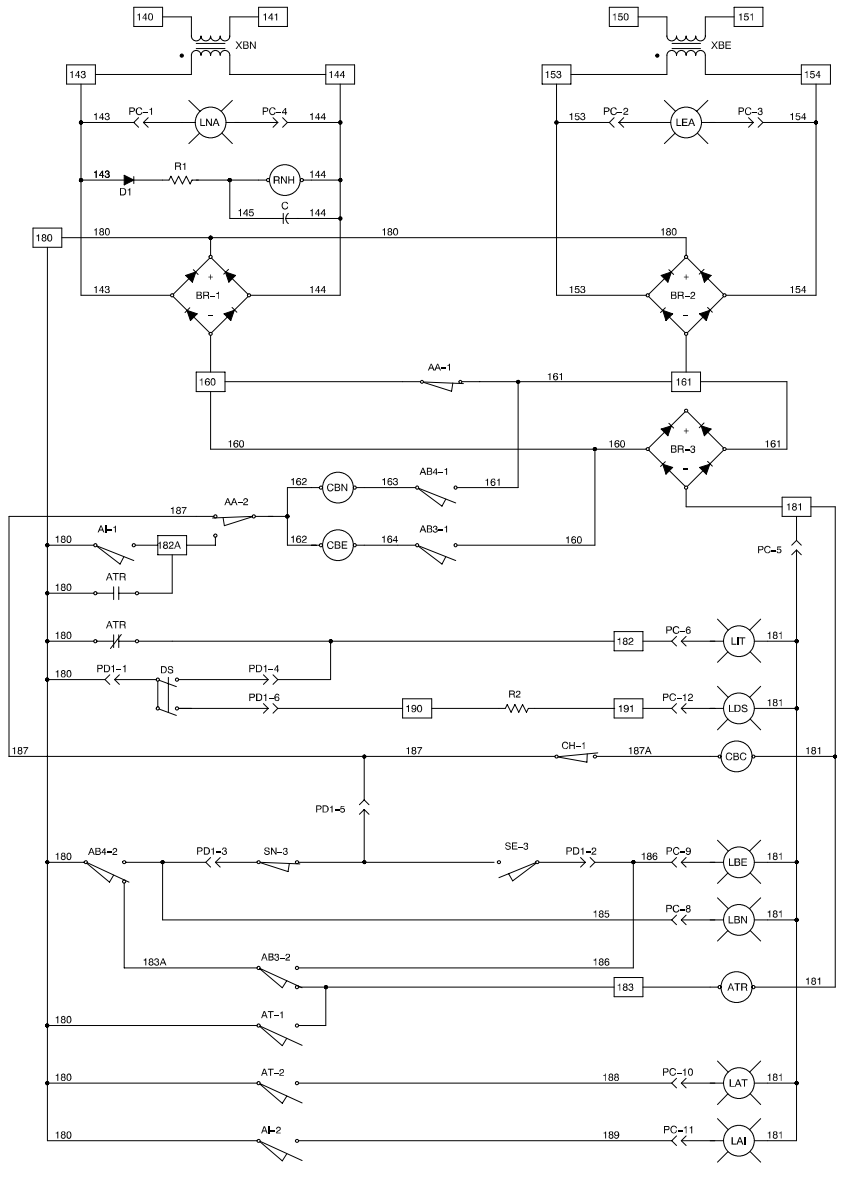
TITLE: SCHEMATIC DIAGRAM

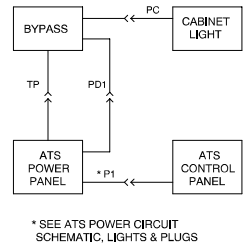
SCALE	CAD NO.	SHEET
NONE	321445.DWG	1-1
PLOTTED	DWG. NO.	
	321445	E

321445-A-S-

Transfer Switch Lamps, 1600-3000 Amps, Programmed-Transition, 321445-S-A

REV	DATE	REVISION	BY	M F
A	3-25-94	WIRE NUMBERS REVISED	AH	





* SEE ATS POWER CIRCUIT SCHEMATIC, LIGHTS & PLUGS

LIMIT SWITCH CHART

X = ACTUATED	ATS LOCATION				ATS MODE		BYPASS MODE	
	AUTO	TEST	ISO	REMOVE	NORM	EMERG.	NORM	EMERG. OPEN
AA	X							
AT		X						
AI			X	X				
AE			X	X				
SN					X			
SE						X		
AB4							X	
AB3								X

LEGEND

AA–1,2,3	LIMIT SWITCH, ATS AUTO LOCATION
AB3–1,2	LIMIT SWITCH, BYPASS EMERGENCY
AB4–1,2	LIMIT SWITCH, BYPASS NORMAL
AI–1,2,3	LIMIT SWITCH, ATS IN ISOLATE
AT–1,2	LIMIT SWITCH, ATS TEST LOCATION
ACD	LIMIT SWITCH, CRANK HANDLE ENGAGED
ACU	LIMIT SWITCH, CRANK HANDLE ENGAGED
ATR	AUTO/TEST RELAY
BR	BRIDGE RECTIFIER
CBC	CRANK SOLENOID
CBE	EMERGENCY TRANSFER OPERATOR
CBN	NORMAL TRANSFER OPERATOR
DS	ATS DISCONNECT SWITCH
LBE	BYPASS EMERGENCY
LBN	BYPASS NORMAL LIGHT
LAI	ATS ISOLATE LIGHT
LAT	ATS TEST LOCATION
LDS	DISCONNECT SWITCH
LEA	EMERGENCY AVAILABLE LIGHT
LIT	ATS INHIBIT LIGHT
LNA	NORMAL AVAILABLE LIGHT
RNH	NORMAL VOLTAGE RELAY
61	TERMINAL ON BYPASS SUBPANEL

1600–3000 AMP
3 & 4 POLE

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2 °
.XX ± .030 SURFACE FINISH
.X ± .060 MAX.
FRACTIONS ±

APPROVALS	DATE
DRAWN WJB	1-11-94
CHECKED AH	2-14-94
APPROVED AH	2-14-94

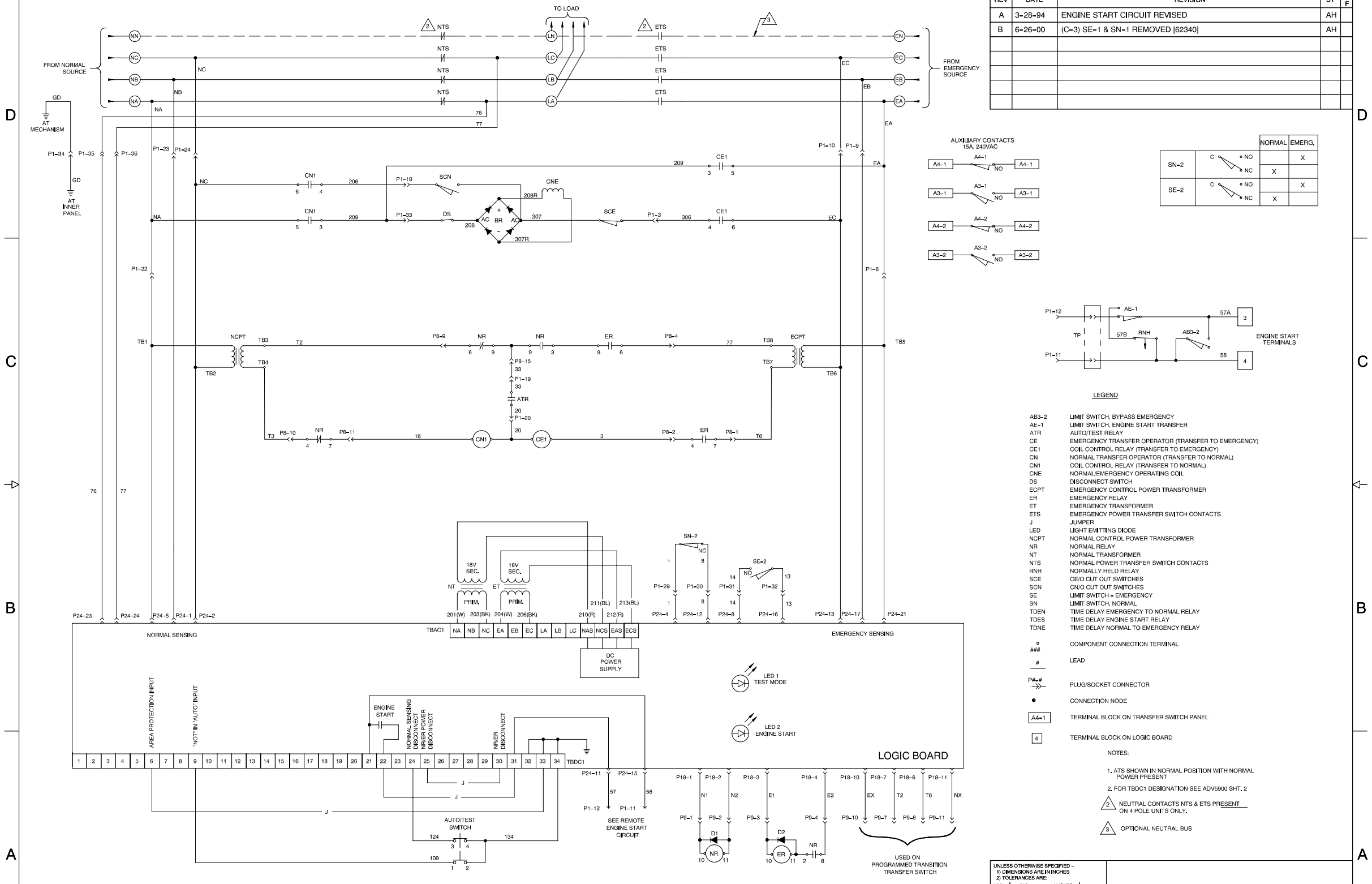
TITLE: SCHEMATIC DIAGRAM

SCALE	CAD NO.	SHEET
NONE	321454.DWG	1-1
PLOTTED	DWG. NO. 321454	E G

321454-A-S-

Transfer Switch Lamps, 1600–3000 Amps, 321454-S-A

REV	DATE	REVISION	BY	M F
A	3-28-94	ENGINE START CIRCUIT REVISED	AH	
B	6-26-00	(C-3) SE-1 & SN-1 REMOVED [62340]	AH	



LEGEND

AB3-2	LIMIT SWITCH, BYPASS EMERGENCY
AE-1	LIMIT SWITCH, ENGINE START TRANSFER
ATR	AUTO/TEST RELAY
CE	EMERGENCY TRANSFER OPERATOR (TRANSFER TO EMERGENCY)
CE1	COIL CONTROL RELAY (TRANSFER TO EMERGENCY)
CN	NORMAL TRANSFER OPERATOR (TRANSFER TO NORMAL)
CN1	COIL CONTROL RELAY (TRANSFER TO NORMAL)
CNE	NORMAL/EMERGENCY OPERATING COIL
DS	DISCONNECT SWITCH
ECPT	EMERGENCY CONTROL POWER TRANSFORMER
ER	EMERGENCY RELAY
ET	EMERGENCY TRANSFORMER
ETS	EMERGENCY POWER TRANSFER SWITCH CONTACTS
J	JUMPER
LED	LIGHT EMITTING DIODE
NCPT	NORMAL CONTROL POWER TRANSFORMER
NR	NORMAL RELAY
NT	NORMAL TRANSFORMER
NTS	NORMAL POWER TRANSFER SWITCH CONTACTS
RNH	NORMALLY HELD RELAY
SCE	CE/O CUT OUT SWITCHES
SCN	CN/O CUT OUT SWITCHES
SE	LIMIT SWITCH – EMERGENCY
SN	LIMIT SWITCH, NORMAL
TDEN	TIME DELAY EMERGENCY TO NORMAL RELAY
TDES	TIME DELAY ENGINE START RELAY
TDNE	TIME DELAY NORMAL TO EMERGENCY RELAY
° ###	COMPONENT CONNECTION TERMINAL
#	LEAD
P#-#	PLUG/SOCKET CONNECTOR
•	CONNECTION NODE
A4-1	TERMINAL BLOCK ON TRANSFER SWITCH PANEL
4	TERMINAL BLOCK ON LOGIC BOARD

NOTES:

1. ATS SHOWN IN NORMAL POSITION WITH NORMAL POWER PRESENT
2. FOR TBDC1 DESIGNATION SEE ADV5900 SHT. 2
2. NEUTRAL CONTACTS NTS & ETS PRESENT ON 4 POLE UNITS ONLY.
3. OPTIONAL NEUTRAL BUS

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2 °
.XX ± .030 SURFACE FINISH
.X ± .060 MAX.
FRACTIONS ±

APPROVALS	DATE
DRAWN AJH	2-10-94
CHECKED AH	2-14-94
APPROVED AH	2-14-94

TITLE: SCHEMATIC DIAGRAM

SCALE /// | CAD NO. 321469.DWG | SHEET 1-1

PLOTTED | DWG. NO. 321469 | E G

321469-B-S-

Schematic Diagram, M340+ Logic, 100-400 Amps, 321469-S-B

REV	DATE	REVISION	BY	MF
A	3-28-94	ENGINE START CIRCUIT REVISED	AH	
B	6-26-00	(C-3) SE-1 & SN-1 REMOVED [62340]	JS	
C	1-22-03	(B-3) LIMIT SWITCHES SEO-1 & SNO-1 REMOVED FROM		
		COIL CONTROL CIRCUIT [68908]	DFS	

		NORMAL	OFF	EMERG.
SE-2	C NO	X		
	NC		X	X
SN-2	C NO			X
	NC	X	X	

		NORMAL	OFF	EMERG.
SEO-1	C NO	X		
	NC		X	X
SEO-2	C NO	X		
	NC		X	X
SNO-1	C NO			X
	NC	X	X	
SNO-2	C NO			X
	NC	X	X	

AUXILIARY CONTACTS
15A, 240VAC

ENGINE START TERMINALS

LEGEND

AB3-2	LIMIT SWITCH, BYPASS EMERGENCY
AE-1	LIMIT SWITCH, ENGINE START TRANSFER
ATR	AUTO/TEST RELAY
CC1	COIL CONTROL RELAY - NORMAL
CE1	TRANSFER OPERATOR - CLOSE TO EMERGENCY
CEO	COIL CONTROL RELAY - EMERGENCY OPEN TRANSFER OPERATOR
CE/O	EMERGENCY TRANSFER OPERATOR
CN1	TRANFER OPERATOR - CLOSE TO NORMAL
CNO	COIL CONTROL RELAY - NORMAL OPEN TRANSFER OPERATOR
CN/O	NORMAL TRANSFER OPERATOR
DS	DISCONNECT SWITCH
ECPT	EMERGENCY CONTROL POWER TRANSFORMER
ER	EMERGENCY RELAY
ET	EMERGENCY TRANSFORMER
ETS	EMERGENCY POWER TRANSFER SWITCH CONTACTS
J	JUMPER
K3	TIME DELAY TO NORMAL RELAY
K4	TIME DELAY TO EMERGENCY RELAY
LED	LIGHT EMITTING DIODE
NCPT	NORMAL CONTROL POWER TRANSFORMER
NR	NORMAL RELAY
NT	NORMAL TRANSFORMER
RE	BRIDGE RECTIFIER - EMERGENCY TRANSFER OPERATOR
RN	BRIDGE RECTIFIER - NORMAL TRANSFER OPERATOR
RNH	NORMALLY HELD RELAY
SCE	CE/O CONTACT SWITCH
SCN	CN/O CONTACT SWITCH
SCEO	CE/O CONTACT SWITCH
SCNO	CN/O CONTACT SWITCH
SE,SEO	LIMIT SWITCH - EMERGENCY
SN,SNO	LIMIT SWITCH, NORMAL
TDEN	TIME DELAY EMERGENCY TO NORMAL RELAY
TDES	TIME DELAY ENGINE START RELAY
TDNE	TIME DELAY NORMAL TO EMERGENCY RELAY
TP	TEST PLUG
###	COMPONENT CONNECTION TERMINAL
#	LEAD
P#-#	PLUG/SOCKET CONNECTOR
	CONNECTION NODE
A4-1	TERMINAL BLOCK ON TRANSFER SWITCH PANEL
4	TERMINAL BLOCK ON LOGIC BOARD

NOTES:
1. ATS SHOWN IN NORMAL POSITION WITH NORMAL POWER PRESENT
2. FOR TBDC1 DESIGNATION SEE ADV5900 SHT. 2

2 NEUTRAL CONTACTS NTS & ETS PRESENT ON 4 POLE UNITS ONLY.

3 OPTIONAL NEUTRAL BUS

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2 °
.XX ± .030 SURFACE FINISH
.X ± .060 MAX.
FRACTIONS ±

APPROVALS	DATE
DRAWN WJB	1-27-94
CHECKED AH	2-14-94
APPROVED AH	2-14-94

TITLE: SCHEMATIC DIAGRAM

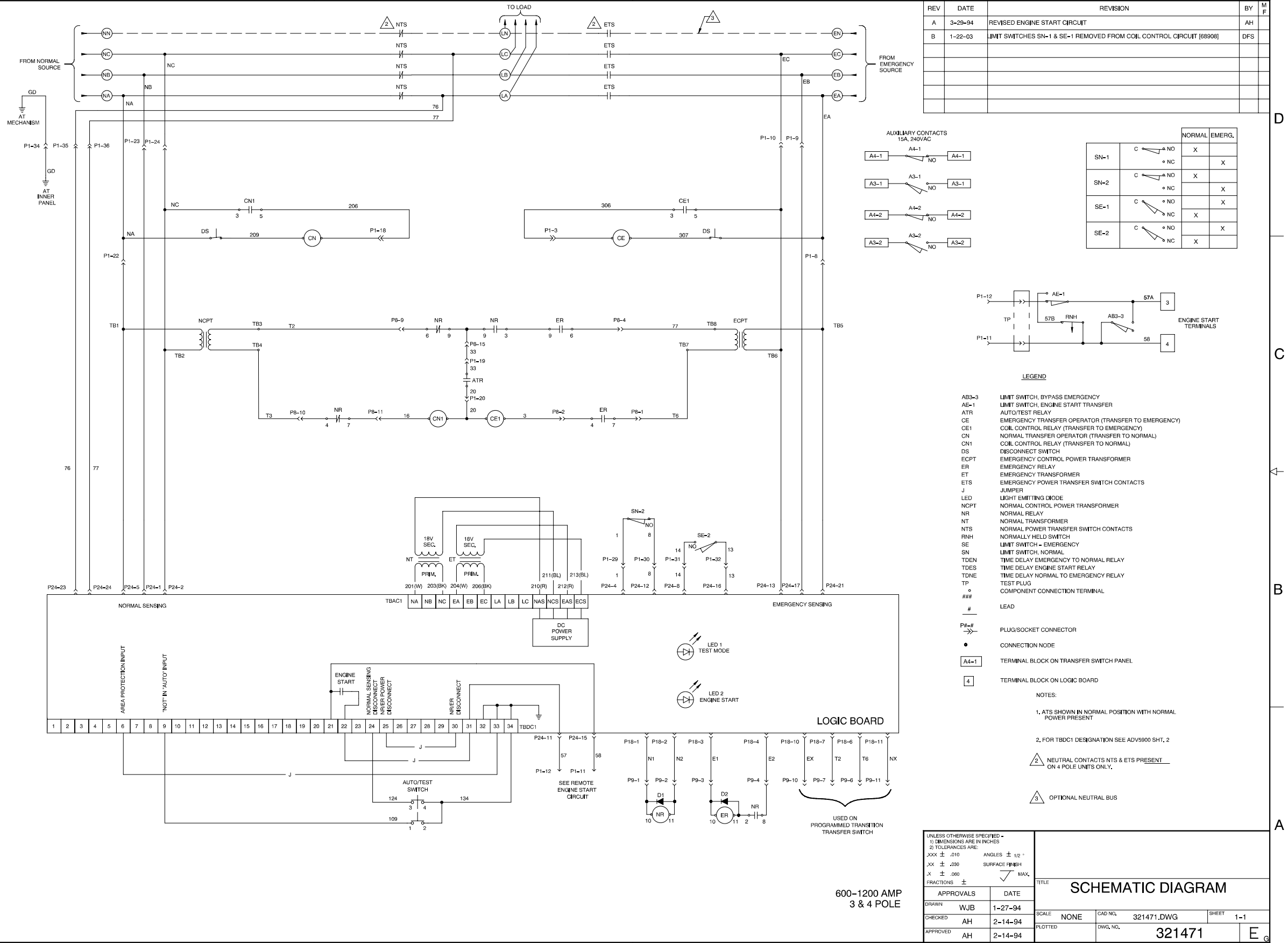
SCALE /// | CAD NO. 321470.DWG | SHEET 1-1

PLOTTED | DWG. NO. 321470 | E G

321470-C-S-

Schematic Diagram, MATS+ Logic, 150-400 Amps, Programmed-Transition, 321470-S-C

REV	DATE	REVISION	BY	M E
A	3-29-94	REVISED ENGINE START CIRCUIT	AH	
B	1-22-03	LIMIT SWITCHES SN-1 & SE-1 REMOVED FROM COIL CONTROL CIRCUIT [68908]	DFS	



LEGEND

AB3-3	LIMIT SWITCH, BYPASS EMERGENCY
AE-1	LIMIT SWITCH, ENGINE START TRANSFER
ATR	AUTO/TEST RELAY
CE	EMERGENCY TRANSFER OPERATOR (TRANSFER TO EMERGENCY)
CE1	COIL CONTROL RELAY (TRANSFER TO EMERGENCY)
CN	NORMAL TRANSFER OPERATOR (TRANSFER TO NORMAL)
CN1	COIL CONTROL RELAY (TRANSFER TO NORMAL)
DS	DISCONNECT SWITCH
ECPT	EMERGENCY CONTROL POWER TRANSFORMER
ER	EMERGENCY RELAY
ET	EMERGENCY TRANSFORMER
ETS	EMERGENCY POWER TRANSFER SWITCH CONTACTS
J	JUMPER
LED	LIGHT EMITTING DIODE
NCPT	NORMAL CONTROL POWER TRANSFORMER
NR	NORMAL RELAY
NT	NORMAL TRANSFORMER
NTS	NORMAL POWER TRANSFER SWITCH CONTACTS
RNH	NORMALLY HELD SWITCH
SE	LIMIT SWITCH - EMERGENCY
SN	LIMIT SWITCH, NORMAL
TDEN	TIME DELAY EMERGENCY TO NORMAL RELAY
TDES	TIME DELAY ENGINE START RELAY
TDNE	TIME DELAY NORMAL TO EMERGENCY RELAY
TP	TEST PLUG
° ###	COMPONENT CONNECTION TERMINAL
#	LEAD
P#-#	PLUG/SOCKET CONNECTOR
•	CONNECTION NODE
A4-1	TERMINAL BLOCK ON TRANSFER SWITCH PANEL
4	TERMINAL BLOCK ON LOGIC BOARD

NOTES:

1. ATS SHOWN IN NORMAL POSITION WITH NORMAL POWER PRESENT

2. FOR TBDC1 DESIGNATION SEE ADV5900 SHT. 2

2 NEUTRAL CONTACTS NTS & ETS PRESENT ON 4 POLE UNITS ONLY.

3 OPTIONAL NEUTRAL BUS

600-1200 AMP
3 & 4 POLE

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2 °
.XX ± .030 SURFACE FINISH
.X ± .060 MAX.
FRACTIONS ±

APPROVALS	DATE
DRAWN WJB	1-27-94
CHECKED AH	2-14-94
APPROVED AH	2-14-94

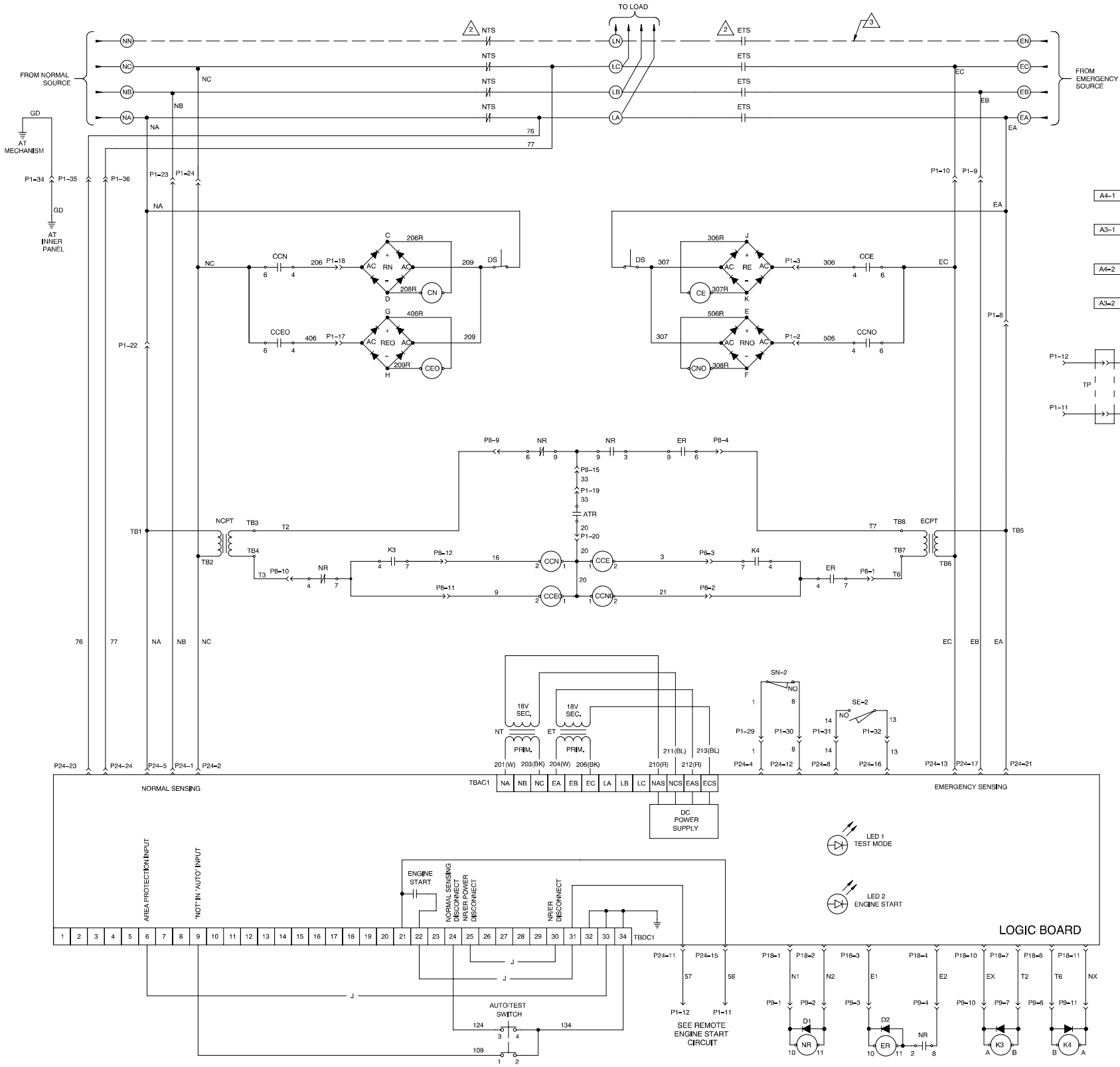
TITLE: SCHEMATIC DIAGRAM

SCALE	CAD NO.	SHEET
NONE	321471.DWG	1-1
PLOTTED	DWG. NO. 321471	E

321471-B-S-

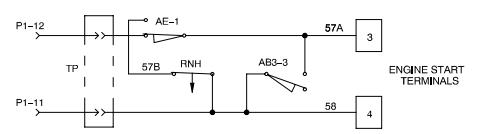
Schematic, MATS+ Logic, 600-1200 Amps, 321471-S-B

REV	DATE	REVISION	BY	M F
A	3-25-94	ENGINE START CIRCUIT REVISED	AH	
B	6-23-00	(D-3) SE-1 & SN-1 REMOVED [62340]	JS	
C	1-22-03	(B-3) LIMIT SWITCHES SEO-1 & SNO-1 REMOVED FROM		
		COIL CONTROL CIRCUIT [68908]	DFS	



AUXILIARY CONTACTS
15A, 240VAC

	NORMAL	OFF	EMERG.
SN-2 C NO	X		
SN-2 NC		X	X
SE-2 NO			X
SE-2 NC	X	X	
SEO-1 NO	X	X	
SEO-1 NC			X
SNO-1 NO		X	X
SNO-1 NC	X		



LEGEND

AB3-3	LIMIT SWITCH, BYPASS EMERGENCY
AE-1	LIMIT SWITCH, ENGINE START TRANSFER
ATR	AUTO/TEST RELAY
CCE	CLOSE EMERGENCY RELAY
CCEO	CEO COIL CONTROL RELAY
CCN	CLOSE NORMAL RELAY
CCNO	CNO COIL CONTROL RELAY
CE	EMERGENCY TRANSFER OPERATOR (TRANSFER TO EMERGENCY)
CEO	OPEN EMERGENCY RELAY
CN	NORMAL TRANSFER OPERATOR (TRANSFER TO NORMAL)
CNO	OPEN NORMAL RELAY
DS	DISCONNECT SWITCH
ECPT	EMERGENCY CONTROL POWER TRANSFORMER
ER	EMERGENCY RELAY
ET	EMERGENCY TRANSFORMER
ETS	EMERGENCY POWER TRANSFER SWITCH CONTACTS
J	JUMPER
K3	TIME DELAY TO NORMAL RELAY
K4	TIME DELAY TO EMERGENCY RELAY
LED	LIGHT EMITTING DIODE
NCPT	NORMAL CONTROL POWER TRANSFORMER
NR	NORMAL RELAY
NT	NORMAL TRANSFORMER
NTS	NORMAL POWER TRANSFER SWITCH CONTACTS
SE	LIMIT SWITCH – EMERGENCY
SN	LIMIT SWITCH, NORMAL
TDEN	TIME DELAY EMERGENCY TO NORMAL RELAY
TDES	TIME DELAY ENGINE START RELAY
TDNE	TIME DELAY NORMAL TO EMERGENCY RELAY
TP	TEST PLUG
RE	CE BRIDGE RECTIFIER
REO	CEO BRIDGE RECTIFIER
RN	CN BRIDGE RECTIFIER
RNO	CNO BRIDGE RECTIFIER
○ ###	COMPONENT CONNECTION TERMINAL
#	LEAD
P#–#	PLUG/SOCKET CONNECTOR
•	CONNECTION NODE
A4-1	TERMINAL BLOCK ON TRANSFER SWITCH PANEL
4	TERMINAL BLOCK ON LOGIC BOARD

NOTES:
1. ATS SHOWN IN NORMAL POSITION WITH NORMAL POWER PRESENT
2. FOR TBDC1 DESIGNATION SEE ADV5900 SHT. 2
2 NEUTRAL CONTACTS NTS & ETS PRESENT ON 4 POLE UNITS ONLY.
3 OPTIONAL NEUTRAL BUS

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2 °
.XX ± .030 SURFACE FINISH
.X ± .060 MAX.
FRACTIONS ±

APPROVALS		DATE
DRAWN	WJB	1-27-94
CHECKED	AH	2-14-94
APPROVED	AH	2-14-94

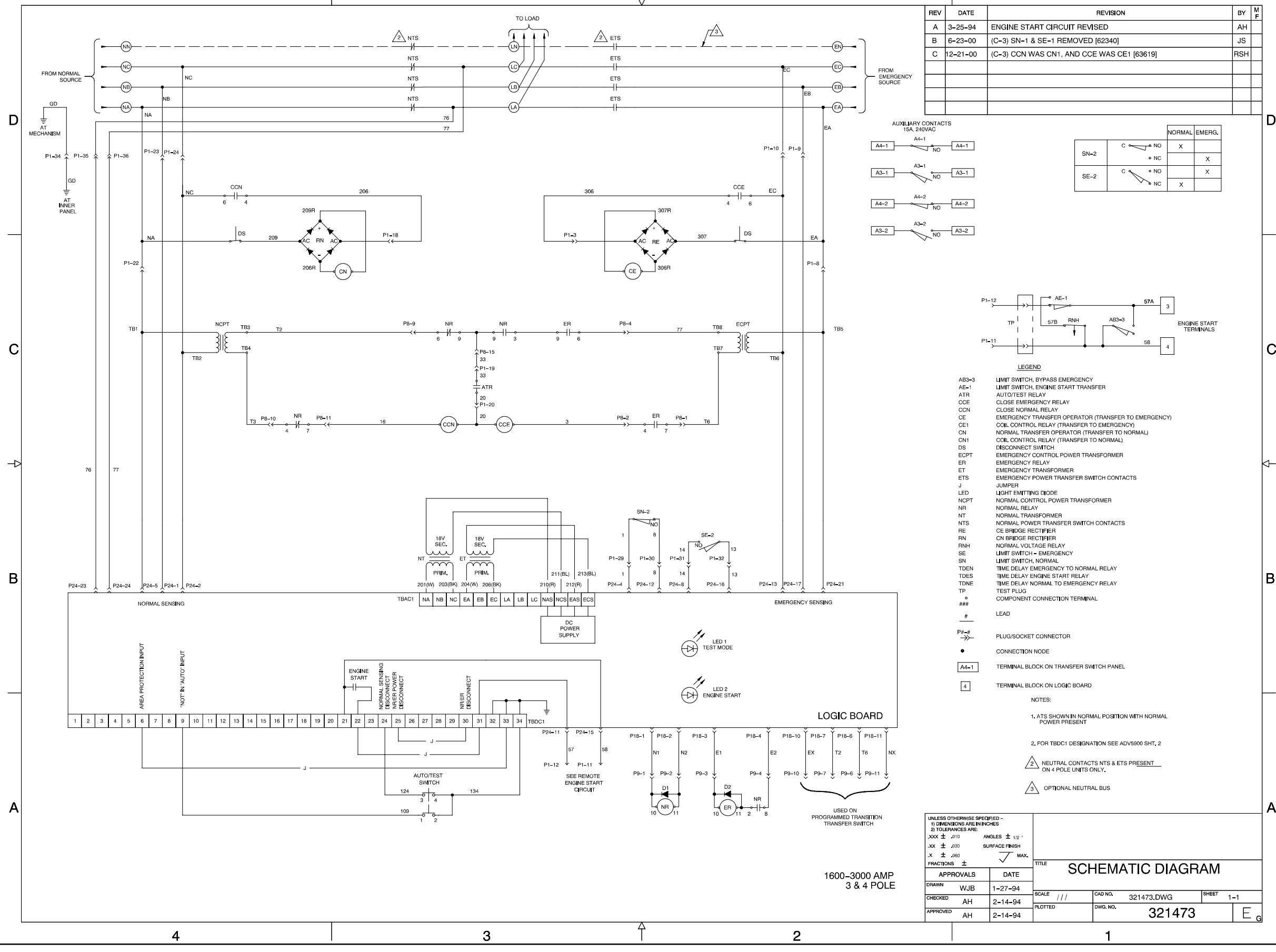
TITLE: SCHEMATIC DIAGRAM

SCALE ///	CAD NO. 321472.DWG	SHEET 1-1
PLOTTED	DWG. NO. 321472	E G

321472-C-S-

Schematic, MATS+ Logic, 600-3000 Amps, Programmed-Transition, 321472-S-C

REV	DATE	REVISION	BY	M F
A	3-25-94	ENGINE START CIRCUIT REVISED	AH	
B	6-23-00	(C-3) SN-1 & SE-1 REMOVED [62340]	JS	
C	12-21-00	(C-3) CCN WAS CN1, AND CCE WAS CE1 [63619]	RSH	



LEGEND

AB3-3	LIMIT SWITCH, BYPASS EMERGENCY
AE-1	LIMIT SWITCH, ENGINE START TRANSFER
ATR	AUTO/TEST RELAY
CCE	CLOSE EMERGENCY RELAY
CCN	CLOSE NORMAL RELAY
CE	EMERGENCY TRANSFER OPERATOR (TRANSFER TO EMERGENCY)
CE1	COIL CONTROL RELAY (TRANSFER TO EMERGENCY)
CN	NORMAL TRANSFER OPERATOR (TRANSFER TO NORMAL)
CN1	COIL CONTROL RELAY (TRANSFER TO NORMAL)
DS	DISCONNECT SWITCH
ECPT	EMERGENCY CONTROL POWER TRANSFORMER
ER	EMERGENCY RELAY
ET	EMERGENCY TRANSFORMER
ETS	EMERGENCY POWER TRANSFER SWITCH CONTACTS
J	JUMPER
LED	LIGHT EMITTING DIODE
NCPT	NORMAL CONTROL POWER TRANSFORMER
NR	NORMAL RELAY
NT	NORMAL TRANSFORMER
NTS	NORMAL POWER TRANSFER SWITCH CONTACTS
RE	CE BRIDGE RECTIFIER
RN	CN BRIDGE RECTIFIER
RNH	NORMAL VOLTAGE RELAY
SE	LIMIT SWITCH – EMERGENCY
SN	LIMIT SWITCH, NORMAL
TDEN	TIME DELAY EMERGENCY TO NORMAL RELAY
TDES	TIME DELAY ENGINE START RELAY
TDNE	TIME DELAY NORMAL TO EMERGENCY RELAY
TP	TEST PLUG
○ ###	COMPONENT CONNECTION TERMINAL
#	LEAD
P#-#	PLUG/SOCKET CONNECTOR
●	CONNECTION NODE
A4-1	TERMINAL BLOCK ON TRANSFER SWITCH PANEL
4	TERMINAL BLOCK ON LOGIC BOARD

NOTES:

1. ATS SHOWN IN NORMAL POSITION WITH NORMAL POWER PRESENT
2. FOR TBDC1 DESIGNATION SEE ADV5900 SHT. 2
2. NEUTRAL CONTACTS NTS & ETS PRESENT ON 4 POLE UNITS ONLY.
3. OPTIONAL NEUTRAL BUS

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2 °
.XX ± .030 SURFACE FINISH
.X ± .060 MAX.
FRACTIONS ±

APPROVALS	DATE
DRAWN WJB	1-27-94
CHECKED AH	2-14-94
APPROVED AH	2-14-94

TITLE: SCHEMATIC DIAGRAM

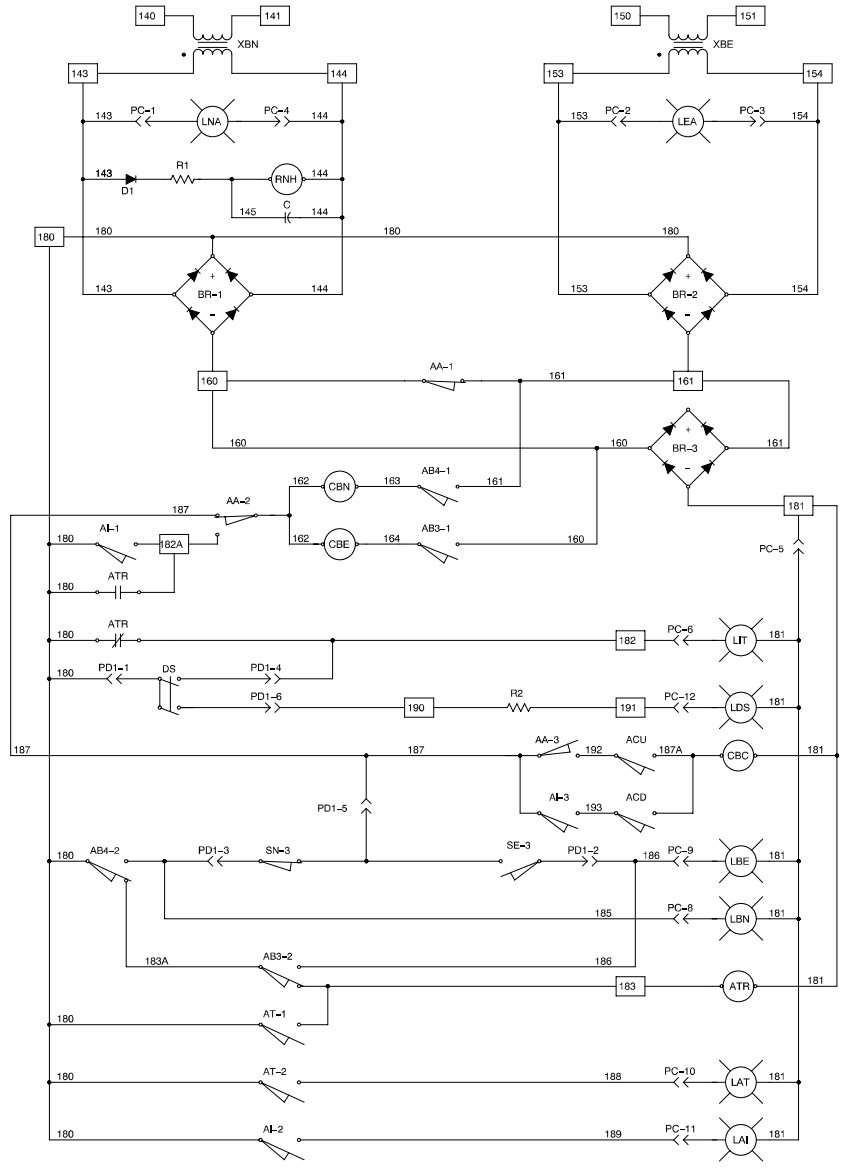
SCALE /// | CAD NO. 321473.DWG | SHEET 1-1

PLOTTED | DWG. NO. 321473 | E G

321473-C-S-

Schematic, MATS+ Logic, 1600-3000 Amps, 321473-S-C

REV	DATE	REVISION	BY	M F
A	3-25-94	WIRE NUMBERS REVISED	AH	

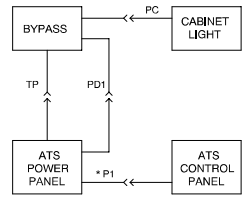


LIMIT SWITCH CHART

X = ACTUATED	ATS LOCATION				ATS MODE		BYPASS MODE		
	AUTO	TEST	ISO	REMOVE	NORM.	EMERG.	NORM.	EMERG.	OPEN
AA	X								
AT		X							
AI			X	X					
AE			X	X					
SN					X				
SE						X			
AB4							X		
AB3								X	

LEGEND

AA-1,2,3	LIMIT SWITCH, ATS AUTO LOCATION
AB3-1,2	LIMIT SWITCH, BYPASS EMERGENCY
AB4-1,2	LIMIT SWITCH, BYPASS NORMAL
AI-1,2,3	LIMIT SWITCH, ATS IN ISOLATE
AT-1,2	LIMIT SWITCH, ATS TEST LOCATION
ACD	LIMIT SWITCH, CRANK HANDLE ENGAGED
ACU	LIMIT SWITCH, CRANK HANDLE ENGAGED
ATR	AUTO/TEST RELAY
BR	BRIDGE RECTIFIER
CBC	CRANK SOLENOID
CBE	EMERGENCY TRANSFER OPERATOR
CBN	NORMAL TRANSFER OPERATOR
DS	ATS DISCONNECT SWITCH
LBE	BYPASS EMERGENCY
LBN	BYPASS NORMAL LIGHT
LAI	ATS ISOLATE LIGHT
LAT	ATS TEST LOCATION
LDS	DISCONNECT SWITCH
LEA	EMERGENCY AVAILABLE LIGHT
LIT	ATS INHIBIT LIGHT
LNA	NORMAL AVAILABLE LIGHT
RNH	NORMAL VOLTAGE RELAY
81	TERMINAL ON BYPASS SUBPANEL



* SEE ATS POWER CIRCUIT SCHEMATIC, LIGHTS & PLUGS

600-1200 AMP
3 & 4 POLE

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2 °
.XX ± .030 SURFACE FINISH
.X ± .060 MAX.
FRACTIONS ±

APPROVALS	DATE
DRAWN WJB	1-11-94
CHECKED AH	2-14-94
APPROVED AH	2-14-94

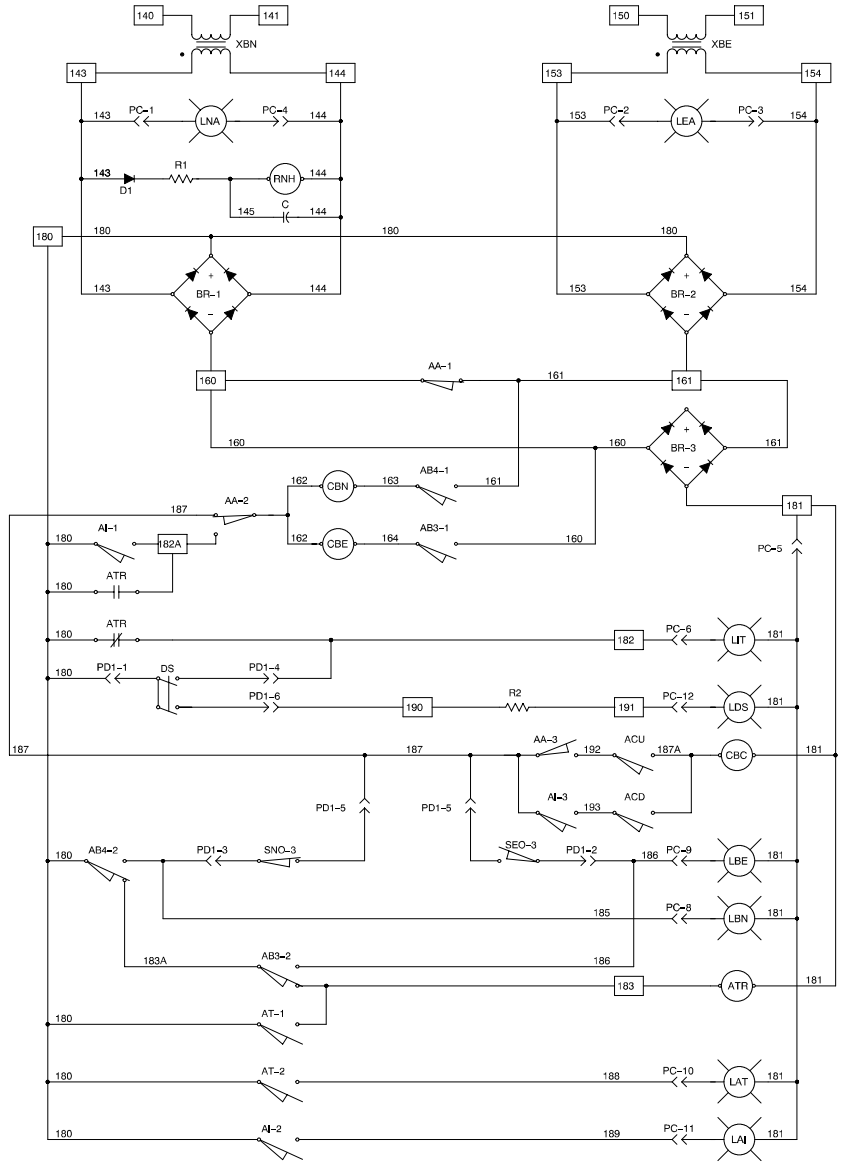
TITLE: SCHEMATIC DIAGRAM

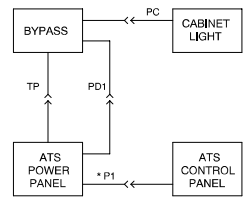
SCALE	CAD NO.	SHEET
NONE	321484.DWG	1-1
PLOTTED	DWG. NO. 321484	E

321484-A-S-

Transfer Switch Lamps, 600-1200 Amps, 321484-S-A

REV	DATE	REVISION	BY	M F
A	3-25-94	WIRE NUMBERS REVISED	AH	





* SEE ATS POWER CIRCUIT SCHEMATIC, LIGHTS & PLUGS

LIMIT SWITCH CHART

X = ACTUATED	ATS LOCATION			ATS MODE		BYPASS MODE	
	AUTO	TEST	ISO	REMOVE	NORM	EMERG.	NORM	EMERG.	OPEN
AA	X								
AT		X							
AI			X	X					
AE			X	X					
SN					X				
SE						X			
AB4							X		
AB3								X	

LEGEND

AA-1,2,3	LIMIT SWITCH, ATS AUTO LOCATION
AB3-1,2	LIMIT SWITCH, BYPASS EMERGENCY
AB4-1,2	LIMIT SWITCH, BYPASS NORMAL
AI-1,2,3	LIMIT SWITCH, ATS IN ISOLATE
AT-1,2	LIMIT SWITCH, ATS TEST LOCATION
ACD	LIMIT SWITCH, CRANK HANDLE ENGAGED
ACU	LIMIT SWITCH, CRANK HANDLE ENGAGED
ATR	AUTO/TEST RELAY
BR	BRIDGE RECTIFIER
CBC	CRANK SOLENOID
CBE	EMERGENCY TRANSFER OPERATOR
CBN	NORMAL TRANSFER OPERATOR
DS	ATS DISCONNECT SWITCH
LBE	BYPASS EMERGENCY
LBN	BYPASS NORMAL LIGHT
LAI	ATS ISOLATE LIGHT
LAT	ATS TEST LOCATION
LDS	DISCONNECT SWITCH
LEA	EMERGENCY AVAILABLE LIGHT
LIT	ATS INHIBIT LIGHT
LNA	NORMAL AVAILABLE LIGHT
RNH	NORMAL VOLTAGE RELAY
81	TERMINAL ON BYPASS SUBPANEL

600-1200 AMP
3 & 4 POLE

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2 °
.XX ± .030 SURFACE FINISH
.X ± .060 MAX.
FRACTIONS ±

APPROVALS	DATE
DRAWN WJB	1-11-94
CHECKED AH	2-14-94
APPROVED AH	2-14-94

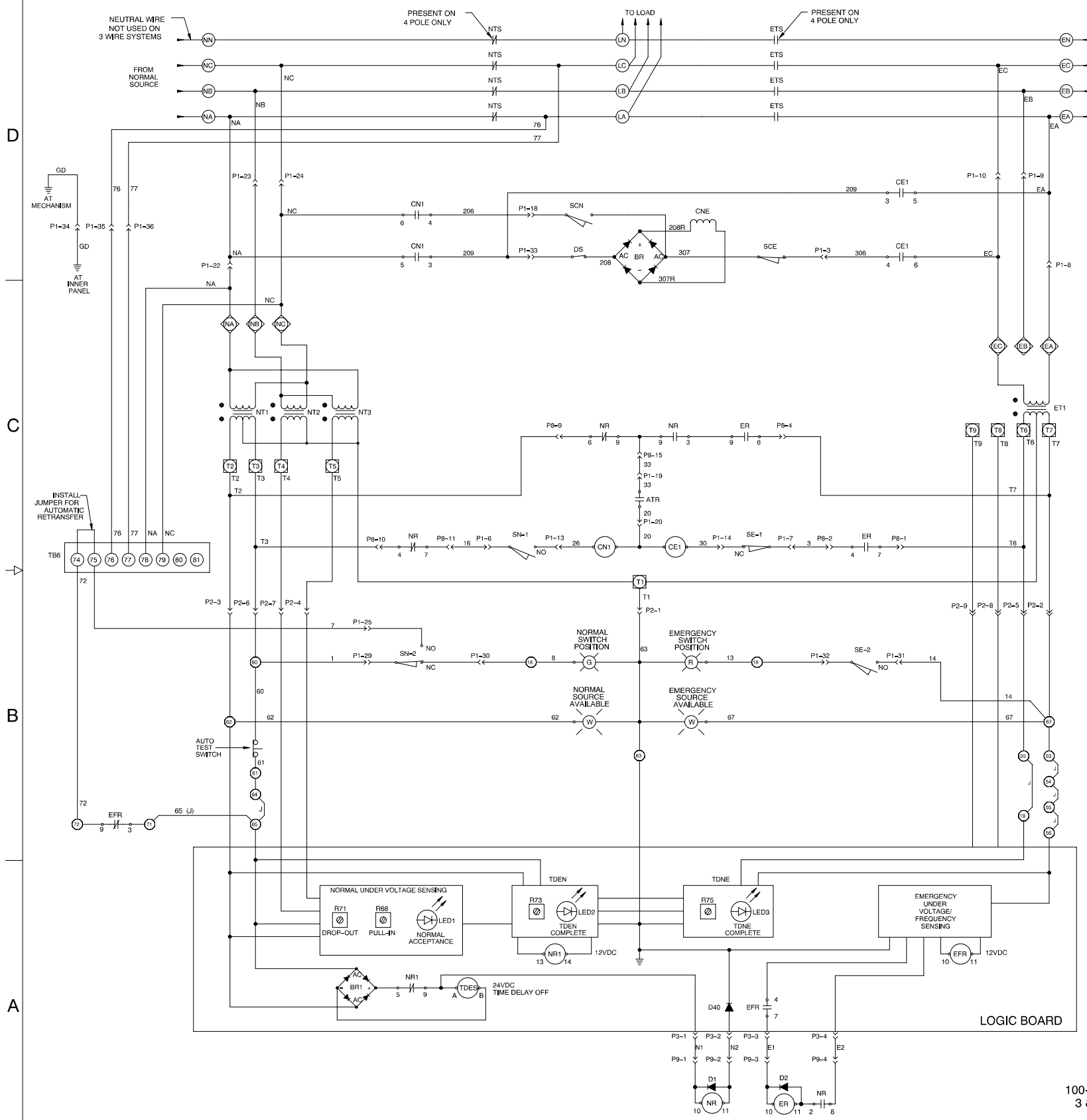
TITLE: SCHEMATIC DIAGRAM

SCALE NONE | CAD NO. 321490.DWG | SHEET 1-1
PLOTTED | DWG. NO. 321490 | E

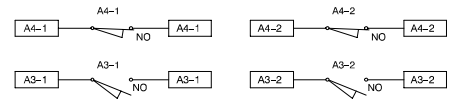
321490-A-S-

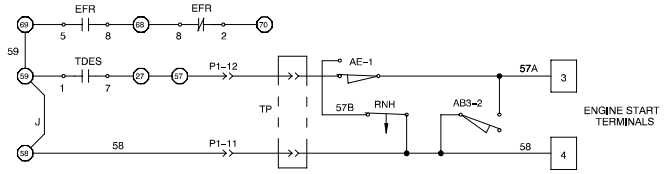
Transfer Switch Lamps, 600-1200 Amps, Programmed-Transition, 321490-S-A

REV	DATE	REVISION	BY	M E
A	3-25-94	ENGINE START CIRCUIT REVISED	AJH	



AUXILIARY CONTACTS
15A, 240VAC





LEGEND

AB3-2	LIMIT SWITCH, BYPASS EMERGENCY
AE-1	LIMIT SWITCH, ENGINE START TRANSFER
ATR	AUTO/TEST RELAY
BR	BRIDGE RECTIFIER
CE1	COIL CONTROL RELAY (TRANSFER TO EMERGENCY)
CN	NORMAL TRANSFER OPERATOR (TRANSFER TO NORMAL)
CNE	NORMAL/EMERGENCY OPERATING COIL
CN1	COIL CONTROL RELAY (TRANSFER TO NORMAL)
DS	DISCONNECT SWITCH
ECPT	EMERGENCY CONTROL POWER TRANSFORMER
ER	EMERGENCY RELAY
ET	EMERGENCY TRANSFORMER
ETS	EMERGENCY POWER TRANSFER SWITCH CONTACTS
J	JUMPER
LED	LIGHT EMITTING DIODE
NCPT	NORMAL CONTROL POWER TRANSFORMER
NR	NORMAL RELAY
NT	NORMAL TRANSFORMER
NTS	NORMAL POWER TRANSFER SWITCH CONTACTS
RNH	NORMAL VOLTAGE RELAY
SCE	CNE CUTOUT SWITCH
SCN	CNE CUTOUT SWITCH
SE	LIMIT SWITCH – EMERGENCY
SN	LIMIT SWITCH, NORMAL
TDEN	TIME DELAY EMERGENCY TO NORMAL RELAY
TDES	TIME DELAY ENGINE START RELAY
TDNE	TIME DELAY NORMAL TO EMERGENCY RELAY
TP	TEST PLUG
###	COMPONENT CONNECTION TERMINAL
#	LEAD
P#-#	PLUG/SOCKET CONNECTOR
	CONNECTION NODE
4	TERMINAL BLOCK ON TRANSFER SW. PANEL
EA	TERMINAL BLOCK PRIMARY OF TRANSFORMER
T7	TERMINAL BLOCK SECONDARY OF TRANSFORMER
58	TERMINAL BLOCK ON LOGIC BOARD
R	INDICATOR LAMP
	G — GREEN
	R — RED
	W — WHITE

		NORMAL	EMERG.
SN-1	C, NO		X
	C, NC	X	
SN-2	C, NO		X
	C, NC	X	
SE-1	C, NO		X
	C, NC	X	
SE-2	C, NO		X
	C, NC	X	

NOTES:

ATS SHOWN IN NORMAL POSITION WITH NORMAL POWER PRESENT.

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2 °
.XX ± .030 SURFACE FINISH
.X ± .060 MAX.
FRACTIONS ±

APPROVALS	DATE
DRAWN AJH	2-10-94
CHECKED AH	2-14-94
APPROVED AH	2-14-94

TITLE: SCHEMATIC DIAGRAM

SCALE	CAD NO.	SHEET
NONE	321491.DWG	1-1
PLOTTED	DWG. NO. 321491	E G

321491-A-S

Schematic Diagram, SATS+ Logic, 150-400 Amps, 321491-S-A

REV	DATE	REVISION	BY	M F
A	3-25-94	ENGINE START CIRCUIT REVISED	AH	

AUXILIARY CONTACTS
15A, 240VAC

ENGINE START TERMINALS

	NORMAL	OFF	EMERG.
SE-1		X	X
SE-2		X	X
SN-1	X		
SN-2		X	X

	NORMAL	OFF	EMERG.
SEO-1		X	X
SEO-2		X	X
SNO-1	X	X	
SNO-2	X	X	

LEGEND

AB3-2	LIMIT SWITCH, BYPASS EMERGENCY
AE-1	LIMIT SWITCH, ENGINE START TRANSFER
ATR	AUTO/TEST RELAY
BR1	BRIDGE RECTIFIER
CE1	COIL CONTROL RELAY (TRANSFER TO EMERGENCY)
CEO	CONTROL RELAY OPENING EMERGENCY
CE/O	EMERGENCY TRANSFER OPERATOR
CN1	COIL CONTROL RELAY (TRANSFER TO NORMAL)
CNO	CONTROL RELAY OPENING NORMAL
CN/O	COIL CONTROL RELAY (TRANSFER TO NORMAL)
DS	DISCONNECT SWITCH
ECPT	EMERGENCY CONTROL POWER TRANSFORMER
ER	EMERGENCY RELAY
ET	EMERGENCY TRANSFORMER
ETS	EMERGENCY POWER TRANSFER SWITCH CONTACTS
J	JUMPER
LED	LIGHT EMITTING DIODE
NCPT	NORMAL CONTROL POWER TRANSFORMER
NR	NORMAL RELAY
NT	NORMAL TRANSFORMER
NTS	NORMAL POWER TRANSFER SWITCH CONTACTS
RNH	NORMAL VOLTAGE RELAY
RTE	BRIDGE RECTIFIER
RTN	BRIDGE RECTIFIER
SCE	CE/O CUTOUT SWITCH
SCEO	CE/O CUTOUT SWITCH
SCN	CN/O CUTOUT SWITCH
SCNO	CN/O CUTOUT SWITCH
SE	LIMIT SWITCH – EMERGENCY
SEO	LIMIT SWITCH EMERGENCY OPEN
SN	LIMIT SWITCH, NORMAL
SNO	LIMIT SWITCH NORMAL OPEN
TDEN	TIME DELAY EMERGENCY TO NORMAL RELAY
TDES	TIME DELAY ENGINE START RELAY
TDNE	TIME DELAY NORMAL TO EMERGENCY RELAY
TDOE	TIME DELAY ON EMERGENCY RELAY
TDON	TIME DELAY ON NORMAL RELAY
TP	TEST PLUG

- ### — COMPONENT CONNECTION TERMINAL
- # — LEAD
- P#-# — PLUG/SOCKET CONNECTOR
- • — CONNECTION NODE
- [4] — TERMINAL BLOCK ON TRANSFER SW. PANEL
- (A1) — TERMINAL BLOCK PRIMARY OF TRANSFORMER
- (T7) — TERMINAL BLOCK SECONDARY OF TRANSFORMER
- (58) — TERMINAL BLOCK ON LOGIC BOARD
- (R) — INDICATOR LAMP
  - G — GREEN
  - R — RED
  - W — WHITE

NOTES:

ATS SHOWN IN NORMAL POSITION WITH NORMAL POWER PRESENT.

150-400 AMP
3 & 4 POLE

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2 °
.XX ± .030 SURFACE FINISH
.X ± .060 MAX.
FRACTIONS ±

APPROVALS	DATE
DRAWN WJB	1-27-94
CHECKED AH	2-14-94
APPROVED AH	2-14-94

TITLE: SCHEMATIC DIAGRAM

SCALE NONE | CAD NO. 321492.DWG | SHEET 1-1

PLOTTED | DWG. NO. 321492 | E

321492-A-S-

Schematic Diagram, SATS+ Logic, 150-400 Amps with Programmed Transition, 321492-S-A

REV	DATE	REVISION	BY	M F
A	3-25-94	ENGINE START CIRCUIT REVISED.	AH	X
B	4-12-95	(D-4) CN1 CONTACT: TERMINAL 6 WAS 3 & 4 WAS 5 [41626]	DFS	

NOTES:

ATS SHOWN IN NORMAL POSITION WITH NORMAL POWER PRESENT.

600-1200 AMP
3 & 4 POLE

LEGEND

AB3-3	LIMIT SWITCH, BYPASS EMERGENCY
AE-1	LIMIT SWITCH, ENGINE START TRANSFER
ATR	AUTO/TEST RELAY
CE	EMERGENCY TRANSFER OPERATOR (TRANSFER TO EMERGENCY)
CE1	COIL CONTROL RELAY (TRANSFER TO EMERGENCY)
CN	NORMAL TRANSFER OPERATOR (TRANSFER TO NORMAL)
CN1	COIL CONTROL RELAY (TRANSFER TO NORMAL)
DS	DISCONNECT SWITCH
ECPT	EMERGENCY CONTROL POWER TRANSFORMER
ER	EMERGENCY RELAY
ET	EMERGENCY TRANSFORMER
ETS	EMERGENCY POWER TRANSFER SWITCH CONTACTS
J	JUMPER
LED	LIGHT EMITTING DIODE
NCPT	NORMAL CONTROL POWER TRANSFORMER
NR	NORMAL RELAY
NT	NORMAL TRANSFORMER
NTS	NORMAL POWER TRANSFER SWITCH CONTACTS
RNH	NORMAL VOLTAGE RELAY
SE	LIMIT SWITCH - EMERGENCY
SN	LIMIT SWITCH, NORMAL
TDEN	TIME DELAY EMERGENCY TO NORMAL RELAY
TDES	TIME DELAY ENGINE START RELAY
TDNE	TIME DELAY NORMAL TO EMERGENCY RELAY
TP	TEST PLUG
° ###	COMPONENT CONNECTION TERMINAL
#	LEAD
P#-#	PLUG/SOCKET CONNECTOR
•	CONNECTION NODE
4	TERMINAL BLOCK ON TRANSFER SW. PANEL
T2	TERMINAL BLOCK PRIMARY OF TRANSFORMER
T7	TERMINAL BLOCK SECONDARY OF TRANSFORMER
58	TERMINAL BLOCK ON LOGIC BOARD
R	INDICATOR LAMP
	G — GREEN
	R — RED
	W — WHITE

		NORMAL	EMERG.
SN-1	C NO	X	
	C NC		X
SN-2	C NO	X	
	C NC		X
SE-1	C NO		X
	C NC	X	
SE-2	C NO		X
	C NC	X	

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
XXX ± .010 ANGLES ± 1/2 °
XX ± .030 SURFACE FINISH
X ± .060 √ MAX.
FRACTIONS ±

APPROVALS	DATE
DRAWN WJB	1-27-94
CHECKED AH	2-14-94
APPROVED AH	2-14-94

TITLE: SCHEMATIC DIAGRAM

SCALE: NONE | CAD NO. 321493.DWG | SHEET 1-1
PLOTTED | DWG. NO. 321493 | E

321493-B-S-

Schematic Diagram, SATS+ Logic, 600-1200 Amps, 321493-S-B

REV	DATE	REVISION	BY	M F
A	3-24-94	ENGINE START CIRCUIT REVISED	AH	

		NORMAL	OFF	EMERG.
SN-1	C NO	X		
	NC		X	X
SN-2	C NO	X		
	NC		X	X
SE-1	C NO			X
	NC	X	X	
SE-2	C NO			X
	NC	X	X	

		NORMAL	OFF	EMERG.
SEO-1	C NO	X	X	
	NC			X
SEO-2	C NO	X	X	
	NC			X
SNO-1	C NO		X	X
	NC	X		
SNO-2	C NO		X	X
	NC	X		

LEGEND

ATR — AUTO/TEST RELAY
CE — CLOSE TO EMERGENCY COIL
CNO — TRANSFER OPERATOR, OPEN FROM NORMAL
CN — CLOSE TO NORMAL COIL
CEO — TRANSFER OPERATOR, OPEN FROM EMERGENCY
CCN — CLOSE NORMAL RELAY
CCE — CLOSE EMERGENCY RELAY
CCEO — CLOSE TO EMERGENCY COIL
CCNO — CLOSE TO NORMAL COIL
DS — DISCONNECT SWITCH
EFR — EMERGENCY FREQUENCY RELAY
ER — EMERGENCY RELAY
ET# — EMERGENCY TRANSFORMER
ETS — EMERGENCY POWER TRANSFER SWITCH CONTACTS
D# — DIODE
J — JUMPER
LED — LIGHT EMITTING DIODE
NR — NORMAL RELAY
NR1 — NORMAL RELAY #1
NT# — NORMAL TRANSFORMER
NTS — NORMAL POWER TRANSFER SWITCH CONTACTS
RE — CE BRIDGE RECTIFIER
REO — CEO BRIDGE RECTIFIER
RN — CN BRIDGE RECTIFIER
RNH — NORMAL VOLTAGE RELAY
RNO — CNO BRIDGE RECTIFIER
SE — EMERGENCY LIMIT SWITCH
SEO — EMERGENCY OPEN LIMIT SWITCH
SN — NORMAL LIMIT SWITCH
SNO — NORMAL OPEN LIMIT SWITCH
TDEN — TIME DELAY EMERGENCY TO NORMAL RELAY
TDES — TIME DELAY ENGINE START RELAY
TDNE — TIME DELAY NORMAL TO EMERGENCY RELAY
TDON — TIME DELAY ON NORMAL RELAY
TDOE — TIME DELAY ON EMERGENCY RELAY

* — COMPONENT CONNECTION TERMINAL
— LEAD
P#-# — PLUG/SOCKET CONNECTOR
● — CONNECTION NODE
4 — TERMINAL BLOCK ON TRANSFER SW. PANEL
5A — TERMINAL BLOCK PRIMARY OF TRANSFORMER
T7 — TERMINAL BLOCK SECONDARY OF TRANSFORMER
58 — TERMINAL BLOCK ON LOGIC BOARD
R — INDICATOR LAMP
R — RED
W — WHITE
G — GREEN

NOTE:
ATS SHOWN IN NORMAL POSITION WITH NORMAL POWER PRESENT

600-3000 AMP
3 & 4 POLE

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2 °
.XX ± .030 SURFACE FINISH √ MAX.
.X ± .060
FRACTIONS ±

APPROVALS	DATE
DRAWN WJB	1-27-94
CHECKED AH	2-14-94
APPROVED AH	2-14-94

TITLE: SCHEMATIC DIAGRAM

SCALE NONE | CAD NO. 321494.DWG | SHEET 1-1
PLOTTED | DWG. NO. 321494 | E

321494-A-S-

Schematic Diagram, SATS+ Logic, 600-3000 Amp Programmed-Transition, 321494-S-A

REV	DATE	REVISION	BY	M F
A	3-24-94	ENGINE START CIRCUIT REVISED	AH	

AUXILIARY CONTACTS
15A, 240VAC

	NORMAL	EMERG.
SN-1 C NO	X	
SN-1 C NC		X
SN-2 C NO	X	
SN-2 C NC		X
SE-1 C NO		X
SE-1 C NC	X	
SE-2 C NO		X
SE-2 C NC	X	

LEGEND

AB3-3	LIMIT SWITCH, BYPASS EMERGENCY
AE-1	LIMIT SWITCH, ENGINE START TRANSFER
ATR	AUTO/TEST RELAY
CE	EMERGENCY TRANSFER OPERATOR (TRANSFER TO EMERGENCY)
CCE	COIL CONTROL RELAY (TRANSFER TO EMERGENCY)
CN	NORMAL TRANSFER OPERATOR (TRANSFER TO NORMAL)
CCN	COIL CONTROL RELAY (TRANSFER TO NORMAL)
DS	DISCONNECT SWITCH
ECPT	EMERGENCY CONTROL POWER TRANSFORMER
ER	EMERGENCY RELAY
ET	EMERGENCY TRANSFORMER
ETS	EMERGENCY POWER TRANSFER SWITCH CONTACTS
J	JUMPER
LED	LIGHT EMITTING DIODE
NCPT	NORMAL CONTROL POWER TRANSFORMER
NR	NORMAL RELAY
NT	NORMAL TRANSFORMER
NTS	NORMAL POWER TRANSFER SWITCH CONTACTS
RE	CE BRIDGE RECTIFIER
RN	CN BRIDGE RECTIFIER
RNH	NORMAL VOLTAGE RELAY
SE	LIMIT SWITCH – EMERGENCY
SN	LIMIT SWITCH, NORMAL
TDEN	TIME DELAY EMERGENCY TO NORMAL RELAY
TDES	TIME DELAY ENGINE START RELAY
TDNE	TIME DELAY NORMAL TO EMERGENCY RELAY
TP	TEST PLUG
◇ ###	COMPONENT CONNECTION TERMINAL
#	LEAD
P#-#	PLUG/SOCKET CONNECTOR
●	CONNECTION NODE
4	TERMINAL BLOCK ON TRANSFER SW. PANEL
EA	TERMINAL BLOCK PRIMARY OF TRANSFORMER
T2	TERMINAL BLOCK SECONDARY OF TRANSFORMER
58	TERMINAL BLOCK ON LOGIC BOARD
R	INDICATOR LAMPS
	G — GREEN
	R — RED
	W — WHITE

NOTES:

ATS SHOWN IN NORMAL POSITION WITH NORMAL POWER PRESENT.

1600-3000 AMP
3 & 4 POLE

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2 °
.XX ± .030 SURFACE FINISH √ MAX.
.X ± .060
FRACTIONS ±

APPROVALS	DATE
DRAWN WJB	1-27-94
CHECKED AH	2-14-94
APPROVED AH	2-14-94

TITLE: SCHEMATIC DIAGRAM

SCALE NONE | CAD NO. 321495.DWG | SHEET 1-1
PLOTTED | DWG. NO. 321495 | E

321495-A-S-

Schematic Diagram, SATS+ Logic, 1600-3000 Amps, 321495-S-A

8.1 Introduction

Use this section to locate and identify service parts for the 150–3000 ampere models of the automatic transfer switches that use a contactor as the power conversion unit. The part numbers of the automatic transfer switches covered by the parts lists in this section begin with SBL-, SCL-, ZCD-, ZCI-, or ZCT-.

This section does not include nonserviceable parts of the automatic transfer switch or any parts of the model ZCD, ZCI, or ZCT logic controller within the automatic transfer switch. A separate service and parts manual covers each ZCD, ZCI, or ZCT logic controller model. Refer to the List of Related Manuals in the Introduction for the name and number of the service and parts manual for the applicable logic controller.

8.2 Using Parts Lists

8.2.1 Finding Parts Information

1. Use the illustration on the next page to determine the group that lists the needed part.

   Example: The needed part is an enclosed door hinge. It is part of the enclosure.

2. Use the list on the next page to locate the illustration identified in step 1.

   Example: Turn to the Enclosures illustration.

   Note: Some items have more than one illustration. In this case, be sure to pick the illustration that corresponds to the ATS rating.

3. Locate the part needed in the illustration.

   Example: The door hinge is item 4.

4. Find the item number in the associated parts list on the same or facing page.

   Example: Find number 4 in the item column.

5. Use the remaining columns of the parts list to find the factory part name and number.

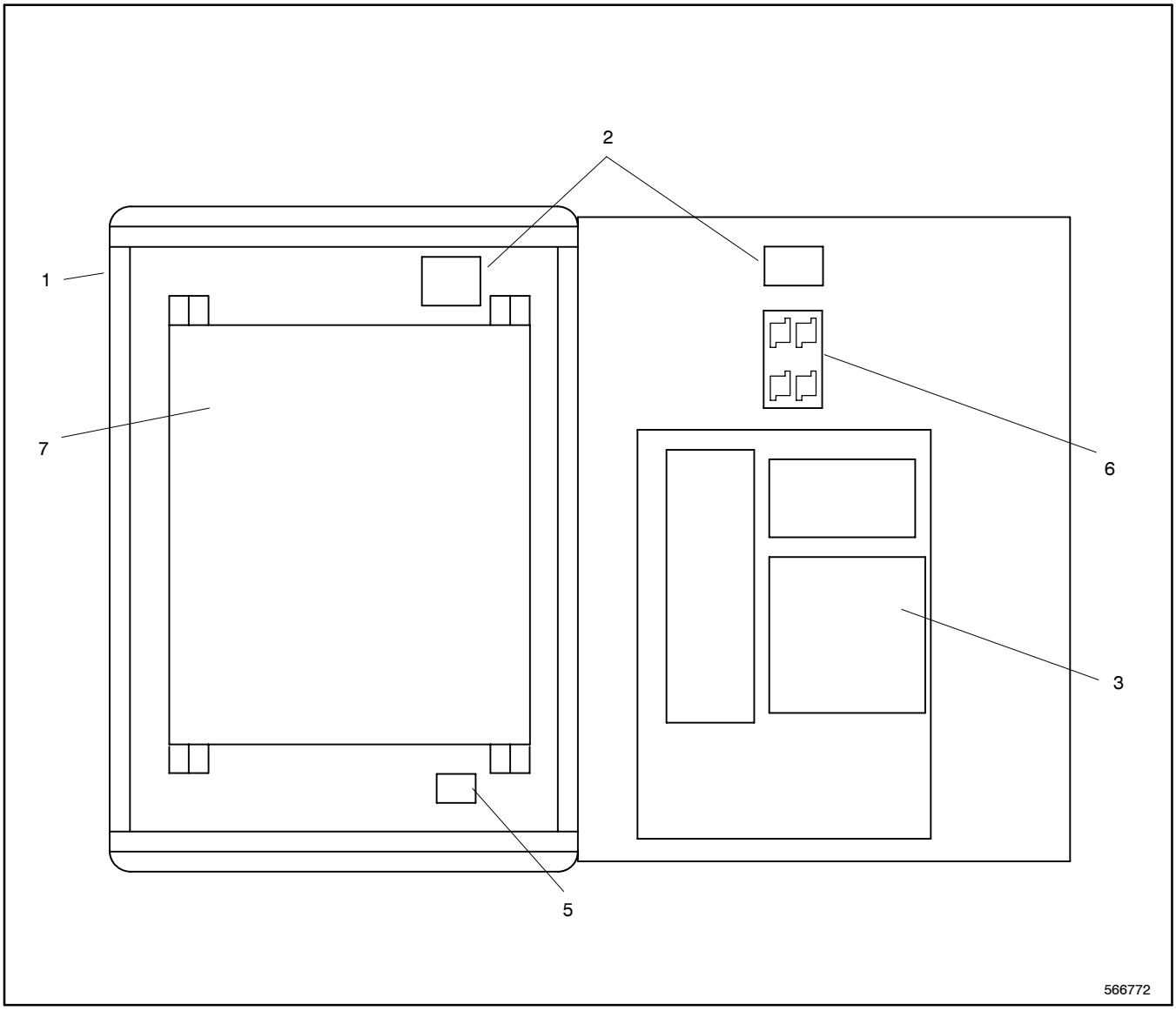
   Example: The name in the description column for item 4 is Hinge. The number listed in the part number columns for both sets of ratings given for item 4 is 294749-BLK. The number 2 or 3 in parentheses ( ) at the end of the entry in the part number columns indicates the quantity of the item used.

   Note: If there is no number in parentheses at the end of the listing in the part number column, the quantity of that item is one (1). All contact assembly kits and arc chute kits include the parts for one contact, therefore, each pole requires two kits.

8.2.2 Leads

Most leads are included with the wiring harness. For lead replacement, fabricate a lead using the same type of standard copper wire (gauge, color, length). Add terminals and lead designations at each end of the new lead.

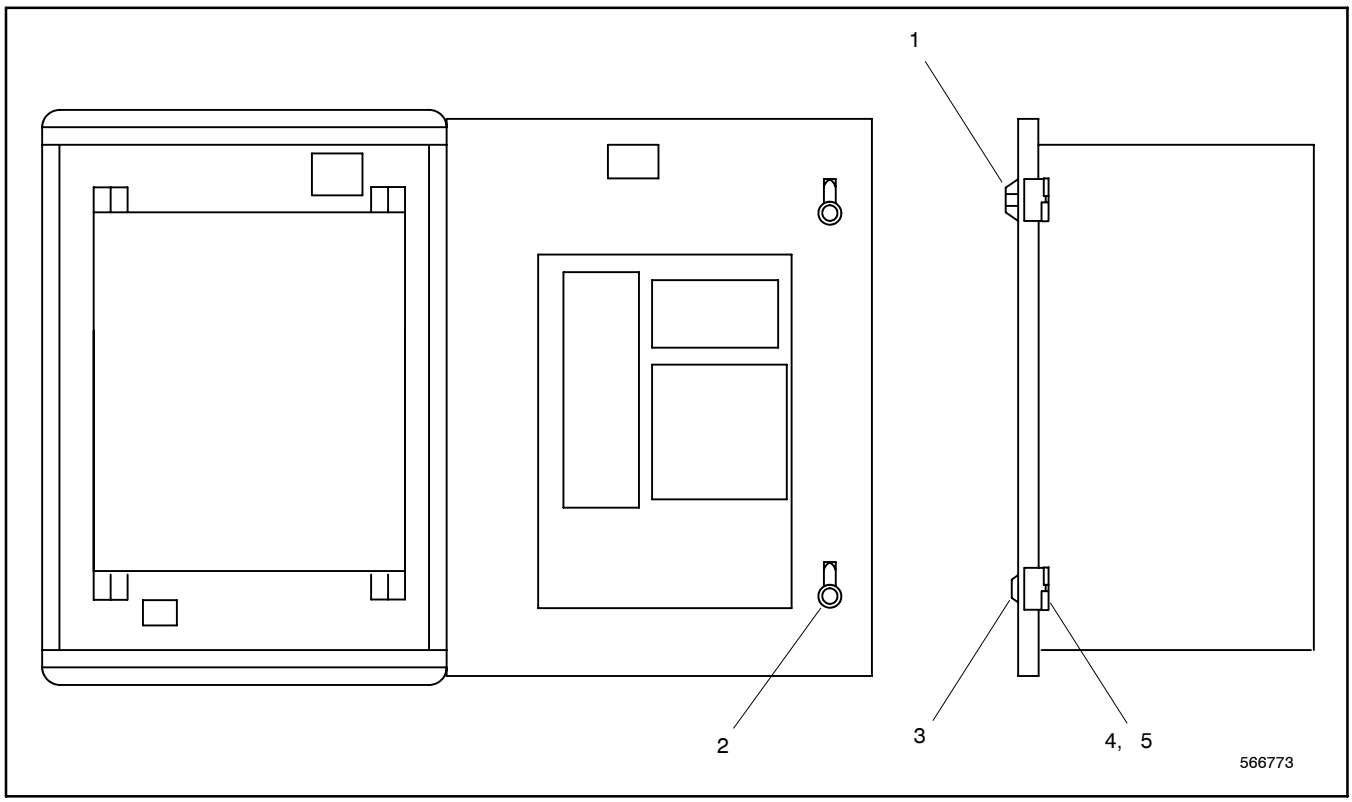
8.3 Automatic Transfer Switch



Item	Description	For further breakdown, see:
1	Enclosures and adapter bays	**Enclosures**, Section 8.4
2	Decals	**Decals**, Section 8.5
3	Logic controller (Models ZCD, ZCI, and ZCT)	Appropriate logic controller manual
4	Logic controller and R/T box (Models SBL and SCL closed-transition switches)	**KBL and KCL Logic Controller**, Section 8.6
5	Neutral lug (optional)	**Neutral Lugs**, Section 8.7
6	Interface panel assembly	**Interface Panel Assemblies**, Section 8.8
7	Contractor assembly	**Contactor Assemblies**, Sections 8.9 through 8.22

8.4 Enclosures, ZCD Only

Note: Contact factory for Model SBL, SCL, ZCI, or ZCT enclosure parts.



NEMA 1

Item	Description	Part Number		
		40-260 Amp	**400-1200 Amp**	**1600-3000 Amp**
1	Latch, lockable	320822	320822	320821
1	Key, latch (not shown)	362361	362361	N/A
2	Cam	320824 (2)	320824 (3)	X-6172-1
3	Latch, slotted	320823	320823 (2)	320823 (2)
4	Hinge	294749 (3)	294749 (3)	297600 (4)
5	Screw	295098 (6)	295098 (6)	295098 (16)

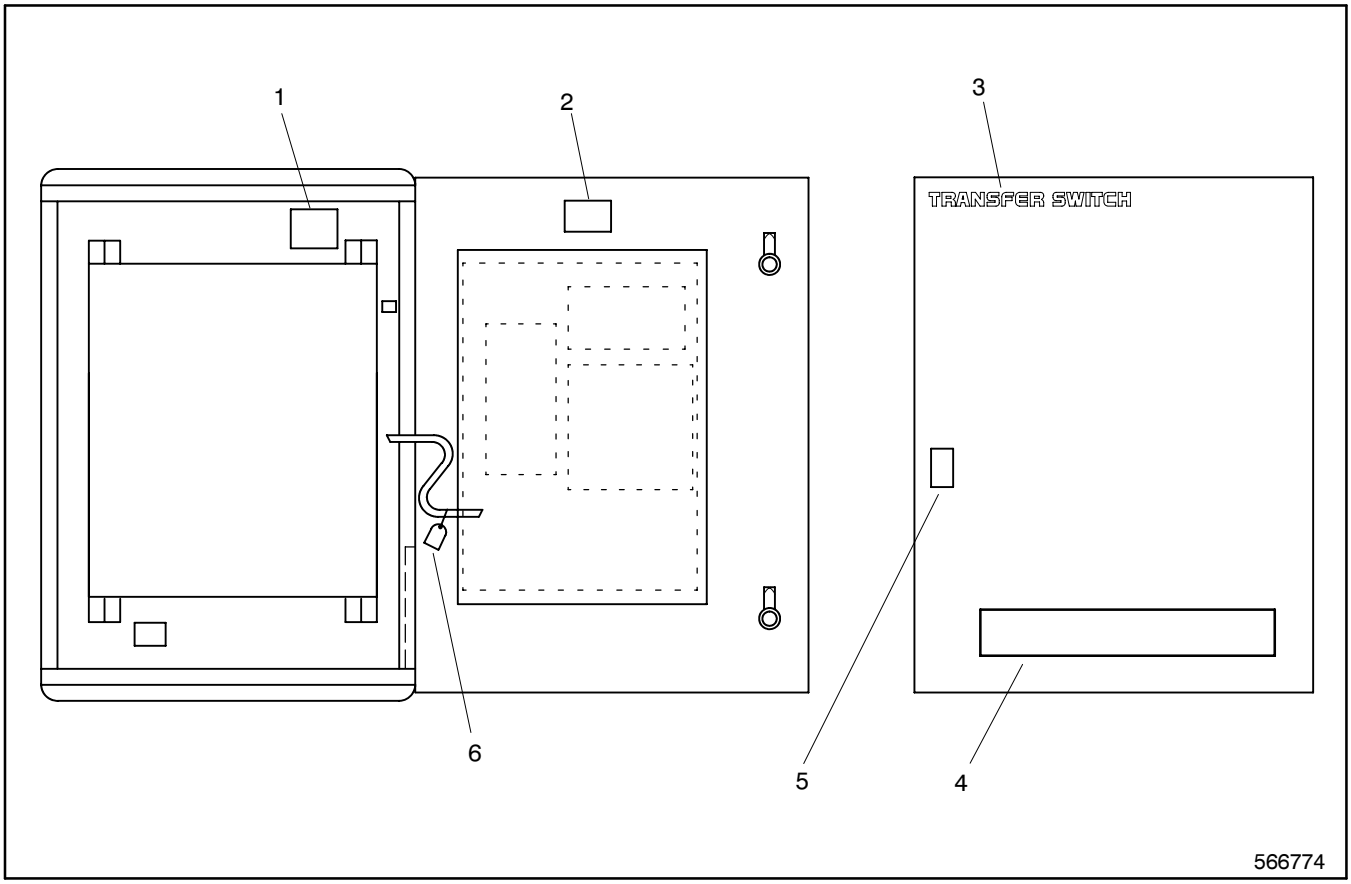
NEMA 3R

Item	Description	Part Number		
		40-260 Amp	**400-1200 Amp**	**1600-3000 Amp**
1	Latch, lockable	346053	346053	N/A
1	Gasket	346382	346382	N/A
2	—	N/A	N/A	N/A
3	Latch	346155	346155 (2)	N/A
3	Gasket	346382	346382 (2)	N/A
4	Hinge	294749 (3)	294749 (3)	N/A
5	Screw	346058 (6)	346058 (6)	N/A
6	Latch, slotted (microprocessor logic door)	320823	320823	N/A
7	Cam	320824	320824	N/A
8	Handle, internal thread	N/A	N/A	GM14177

SBL/ZCI Adapter Bays

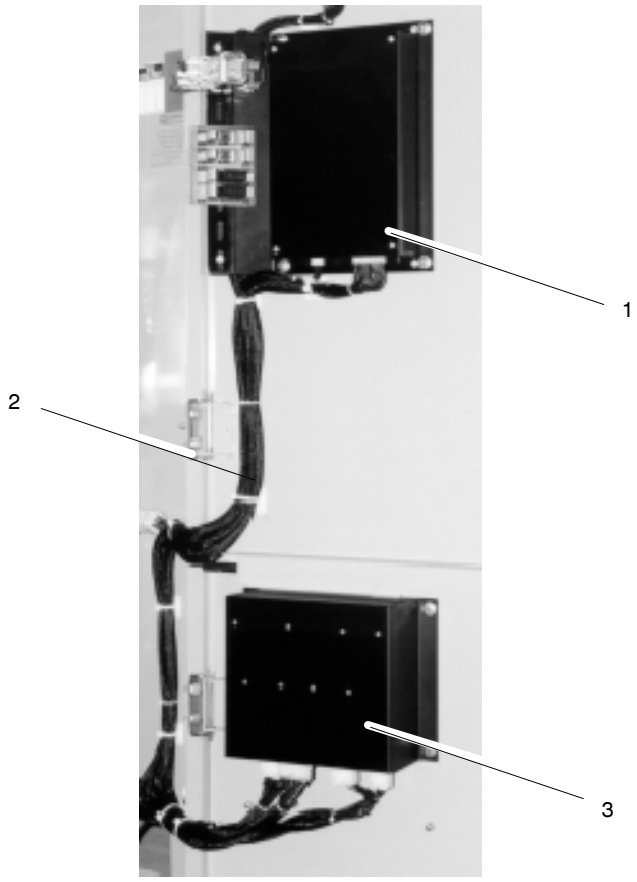
Item	Description	Part Number		
		GM38492-KP1	**GM38492-KP2**	**GM38492-KP3**
1	Adapter, bay	GM38493	GM38494	GM38495

8.5 Decals



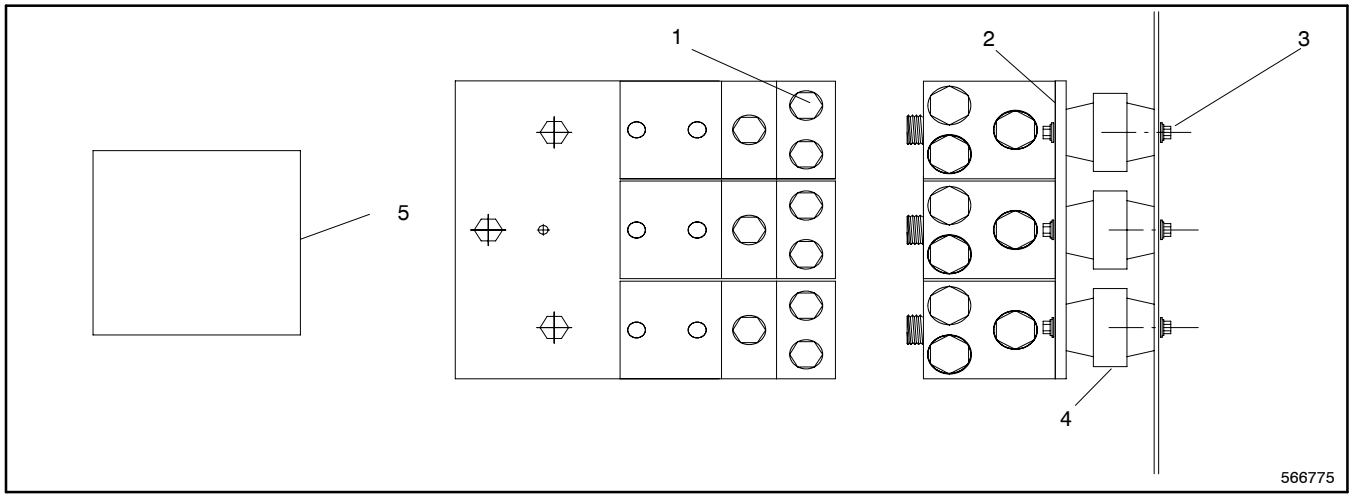
Item	Description	Part Number BATS+/SATS+/MATS+ Logic
1	Decal, notice	294414
2	Decal, nameplate	320657
3	Decal, “Transfer Switch”	X-6303-1
4	Decal, “DDC/MTU”	GM23477-3
5	Decal, danger	294520
6	Tag, hang	297949

8.6 SCL Logic Controller

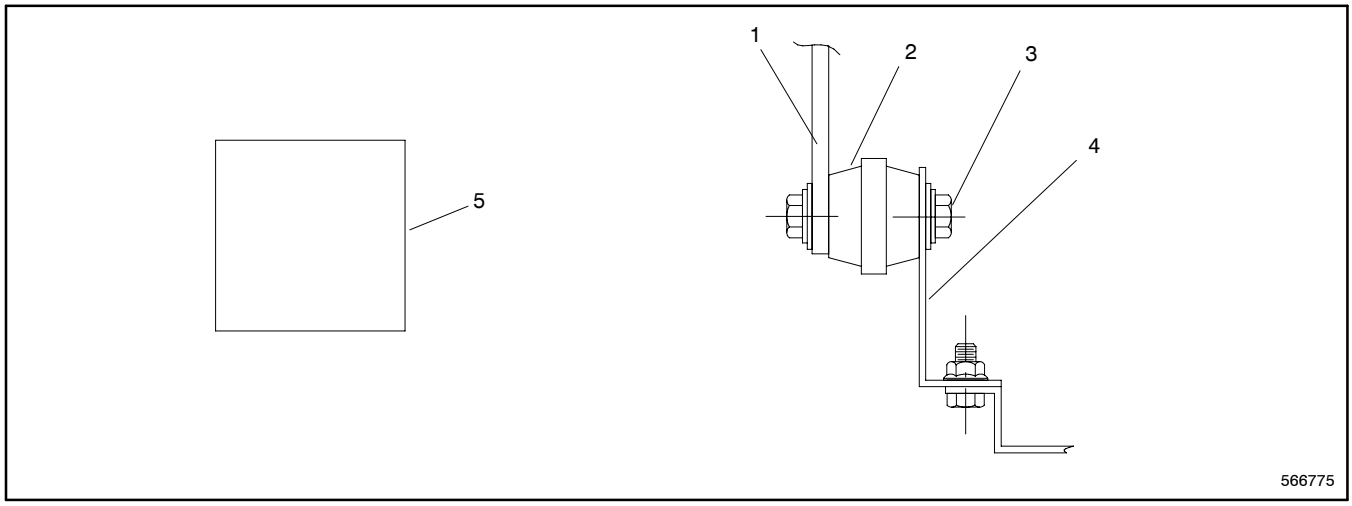


Item	Description	Part Number
1	Logic Controller	GM39168
2	Wiring Harness	Contact factory
3	Relay/Transformer (R/T Box)	
	Primary Voltage	
	208-220	GM39170
	240	GM39171
	277	GM39172
	380-400	GM39173
	416-440	GM39174
	480	GM39175
	575-600	GM39176

8.7 Neutral Lugs

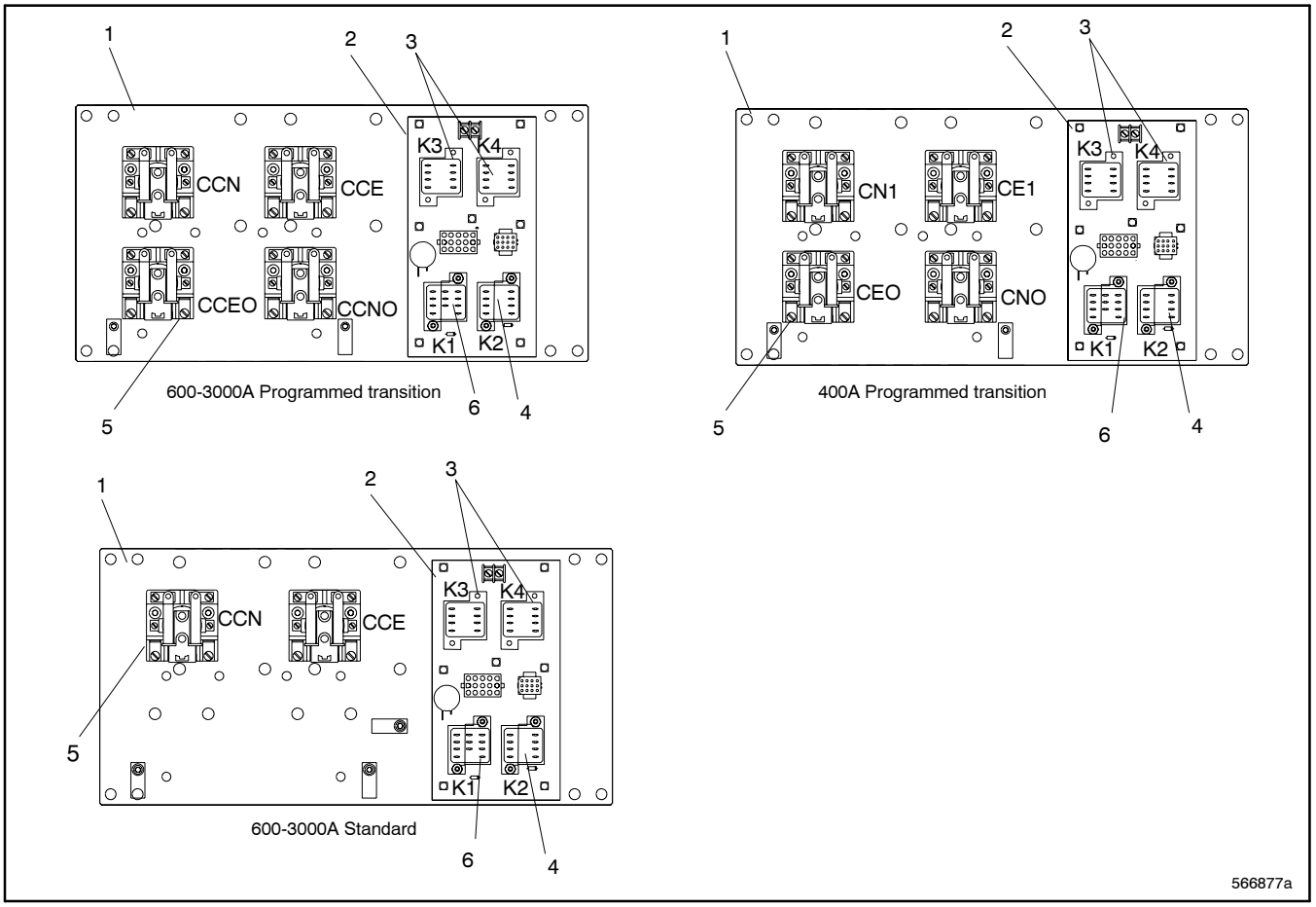


Item	Description	Part Number				
		150 Amp	225-260 Amp	400 Amp	600-800 Amp	1000-1200 Amp
1	Lug terminal	(3) 297712	(3) X-6207-5	(3) X-6207-9	(3) 295296	(3) 297582
2	Bracket, mounting	297713	294362	294359	295298	295298
3	Screw	(2) X-465-17	(2) X-6238-17	(2) X-6238-37	(3) X-6238-10	(3) X-6238-10
4	Insulator, standoff	(2) 233568	(2) 233568	(2) 233568	(3) X-6128-29	(3) X-6128-29
5	Decal, torque	297556	297556	297556	297556	297556

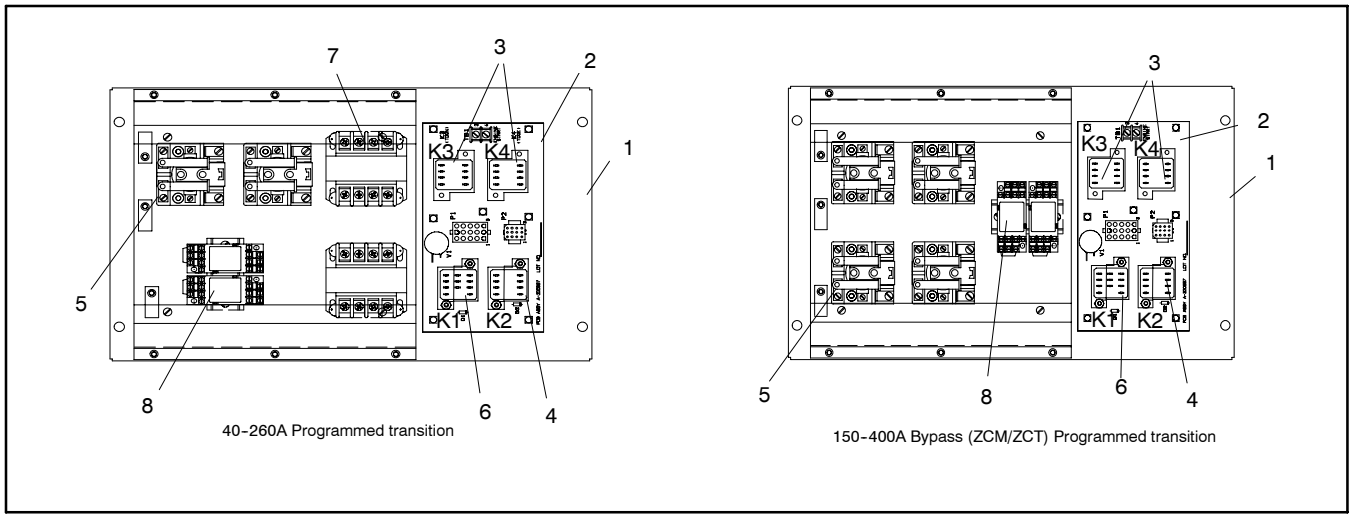


Item	Description	Part Number	
		1600 Amp Standard	2000-3000 Amp Standard
1	Bus, neutral (7.44 x 6)	—	(6) 346206
1	Bus, neutral (1.5 x 6)	—	(4) 346207
1	Bus, neutral (30 x 6)	346208	(3) 346208
2	Insulator, standoff	(4) 233568	(4) 233568
3	Screw, H.C.	(4) X-6238-2	(4) X-6238-2
4	Bracket, neutral connector	(2) 346210	(2) 346209
5	Decal, torque	297556	297556

8.8 Interface Panel Assemblies

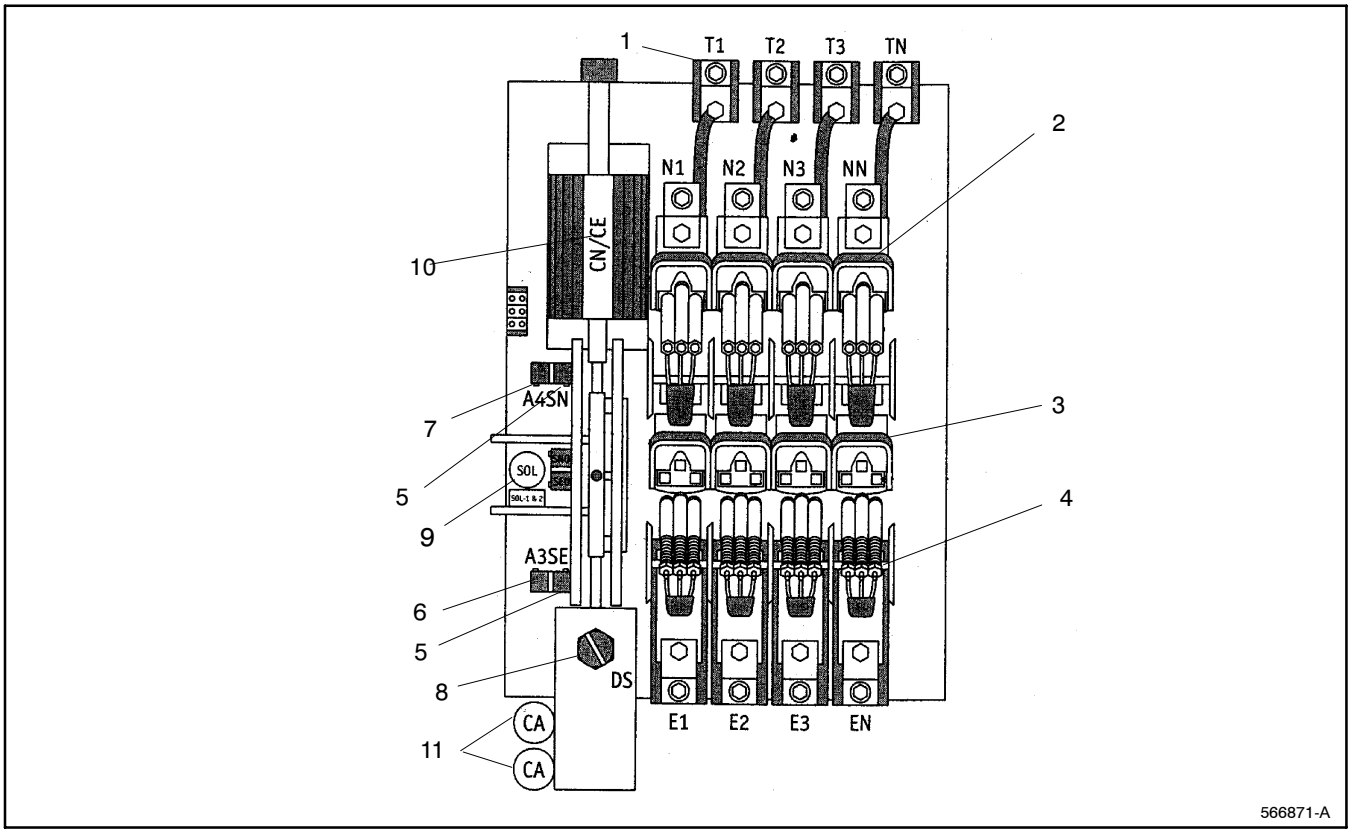


Item	Description	Part Number		
		600-3000 Amp Standard	150-400 Amp Programmed Transition	600-3000 Amp Programmed Transition
1	Panel, interface	320737	320737	320737
2	Interface board assembly	A-320687	A-320687	A-320687
3	Relay, time delay	—	(2) 320695	(2) 320695
4	Relay	294571	294571	294571
5	Relay, control	(2) 320725	(4) 320725	(4) 320725
6	Relay	320889	320889	320889



Item	Description	Part Number	
		40-260 Amp Programmed Transition	**150-400 Amp Bypass (ZCM/ZCT) Programmed Transition**
1	Panel, interface	353164	353164
2	Interface board assembly	A-320687	A-320687
3	Relay, time delay	(2) 320695	(2) 320695
4	Relay	294571	294571
5	Relay control	(2) 320725	(4) 320725
6	Relay	320889	320889
7	Transformer (208 V) Transformer (240/480 V) Transformer (550/600 V) Transformer (380/400/416 V)	353125 353126 353127 353128	— — — —
8	Relay	(2) 353131	(2) 353131

8.9 Contactor Assemblies, 40–260 Amp Programmed-Transition Models

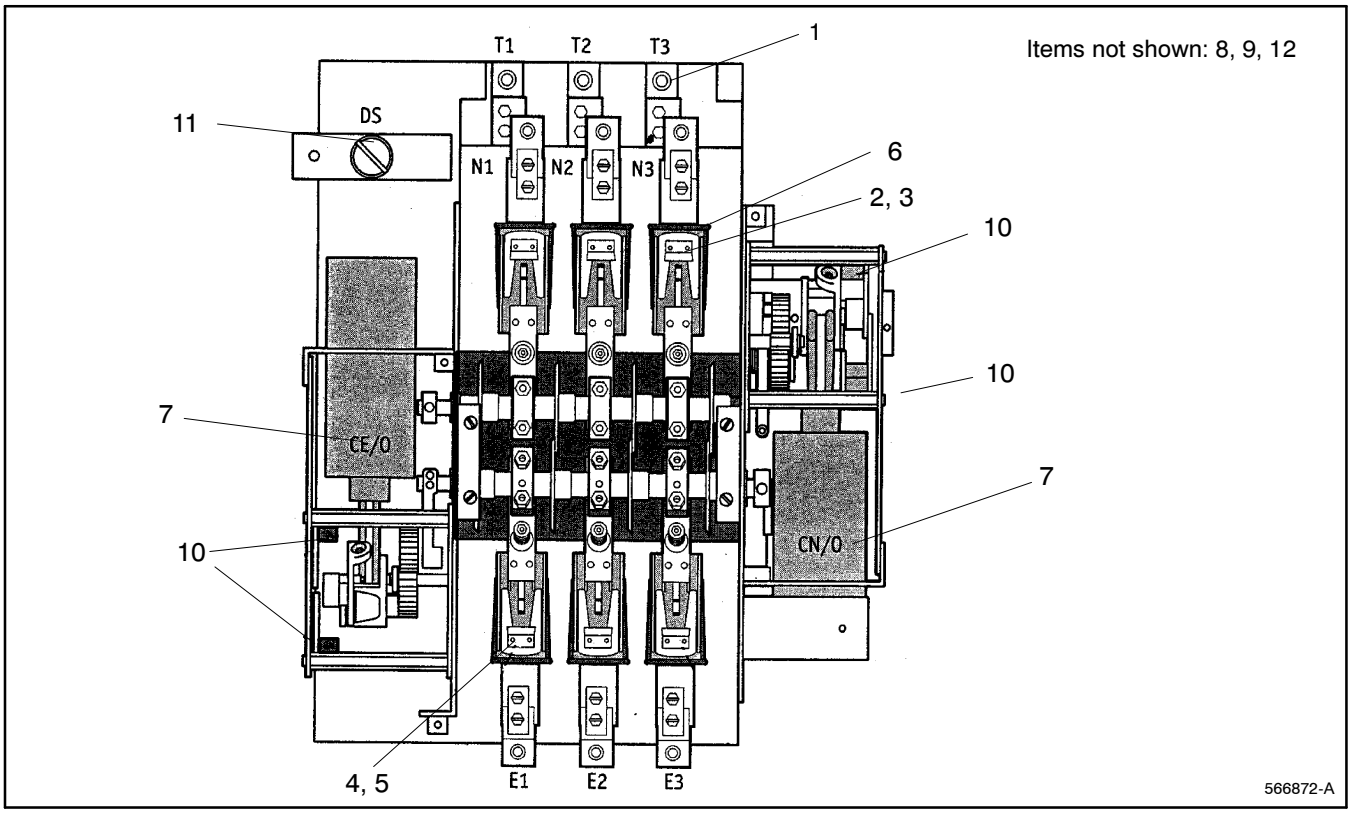


Item	Description	Part Numbers by Amperage					
		40	80	100	150	225	260
1	Cable connection lug	GM14353	346584	346584	346543	346544	346545
2	Stationary contact assembly kit	346546	346546	346546	346547	346547	346547
3	Arc chute assembly kit*	346549	346549	346549	346549	346549	346549
4	Moveable contact assembly*	346550	346550	346550	346551	346551	346551
5	CN1/CE1 cutout switch	346564					
6	Emergency position aux. contact DPDT	321819					
7	Normal position aux. contact DPDT	321819					
8	Disconnect switch	Operator 321772; contact block GM14352					
9	Solenoid	GM45897					

* All kits include the parts for only one contact. Order two kits for each pole.

Volts	Poles	Part Numbers	
		Item 10 Linear Actuator	**Item 11** Capacitor(s) (Qty.)
120	2	346552	346559 (1)
240	2	346553	346561 (1)
	3	346553	346561 (1)
208	3	346554	GM14354 (1)
	4	346555	GM14354 (1)
575/600	3	346556	GM14355 (2)
480	3	346557	346560 (2)
	4	346558	346560 (2)
416	3	GM14356	346560 (2)

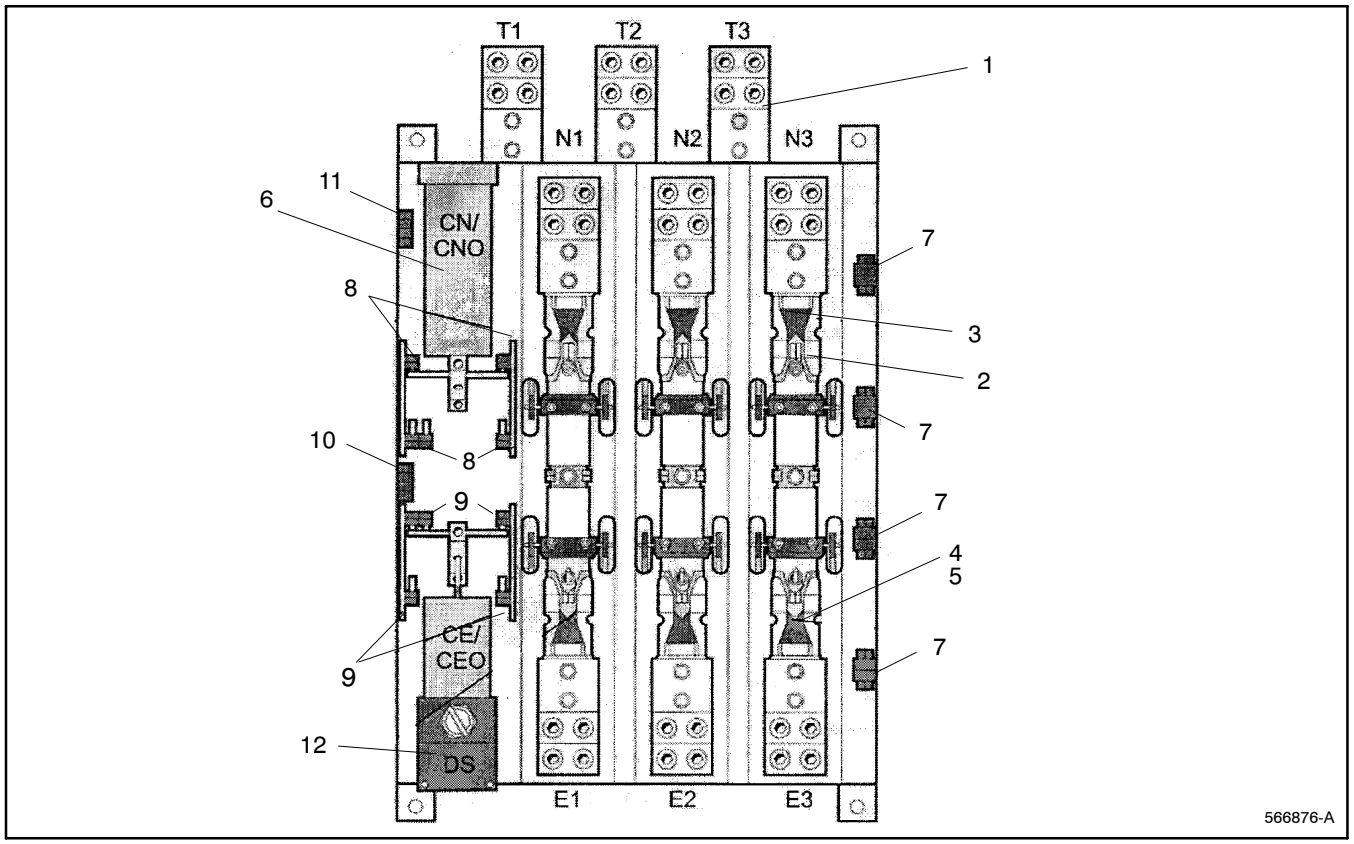
8.10 Contactor Assemblies, 400 Amp Programmed-Transition and 100–400 Amp Closed-Transition Models



Item	Description					Part Number by Amperage 400
1	Cable connection lugs					321743
2	Normal contact assembly (NL)*					321787
3	Switched neutral normal (NLN)*					321792
4	Emergency contact assembly (EL)*					321797
5	Switched neutral emergency (ELN)*					321802
6	Arc chute assembly*					321752
7	Main ATS operating coils					
	Volts	**Phase**	**Wire**	**Coil Volts**	**Poles**	
	120	1	2	120	2	Consult factory
	120/240	1	3	240	2,3	321808
	240	3	3	240	3	321808
	120/240	3	4	240	3,4	321808
	120/208	3	4	208	3,4	321805
	480	3	3	480	3	321804
	575/600	3	3	575/600	3	Consult factory
	277/480	3	4	480	3,4	321804
	240/416	3	4	416	3,4	Consult factory
	220/380	3	4	380	3,4	Consult factory
8	ATS emergency position switch (not shown)					GM14357
9	ATS normal position switch (not shown)					GM14357
10	Solenoid limit switch, SCN/SCNO, SCE/SCEO					321782
11	ATS solenoid disconnect switch					
	Operator 2-position maintain					321772
	Contact block N.C. (1)					321774
12	Rectifier (not shown)					321781

* All kits include the parts for one contact; therefore, each pole requires two kits.

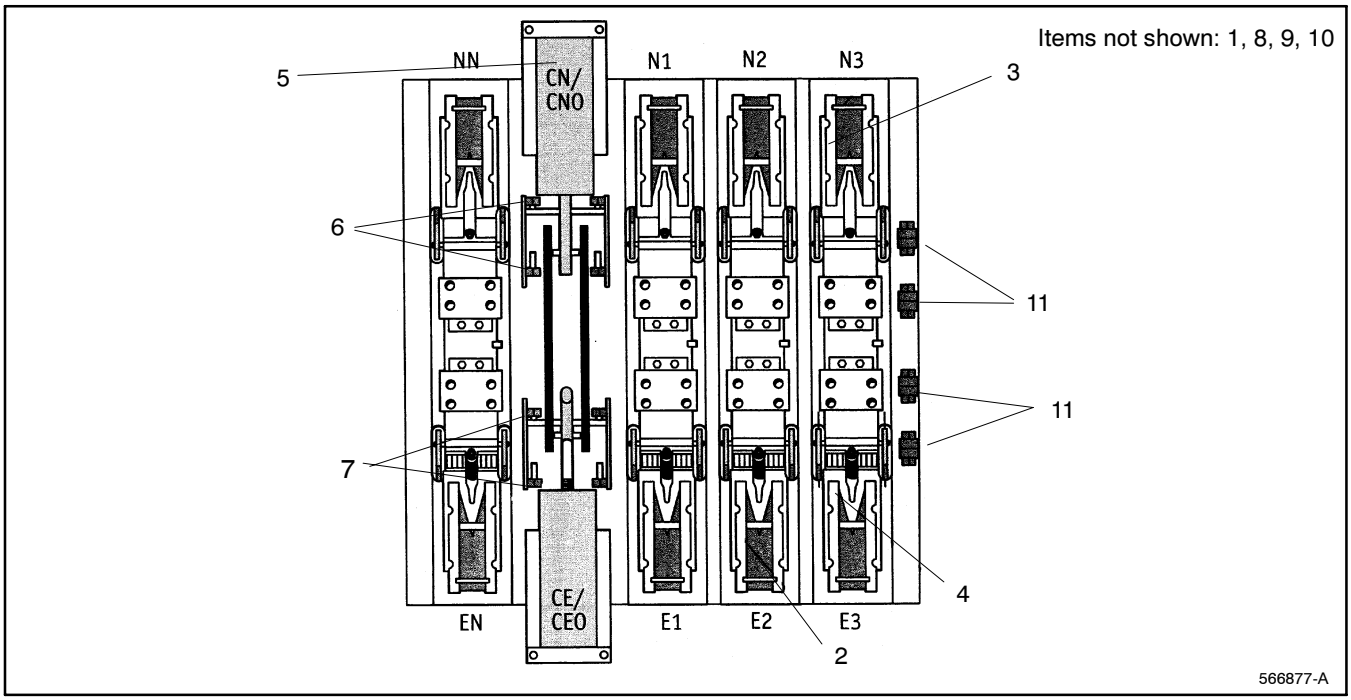
8.11 Contactor Assemblies, 600–1200 Amp Programmed-Transition and Closed-Transition Models



Item	Description					Part Number by Amperage	
						600	800–1200
1	Cable connection lugs					321744	321746
2	Stationary contact assembly kit*					321748	GM14358
3	Arc chute assembly kit*					321753	321753
4	Movable contact assembly kit*					321755	321756
5	Movable contact switched neutral*					321759	321760
6	Main operating coils DC						
	Volts	**Phase**	**Wire**	**Coil Volts**	**Pole**	**Part Number**	
	120 —	1 —	2 —	120 —	2 2	Consult factory	
	120/240	1	3	240	3	321811	321813
	240	3	3	240	3	321811	321813
	120/208	3	4	208	3,4	321811	321813
	480	3	3	480	3	321812	321814
	575/600	3	3	575/600	3	Consult factory	
	277/480	3	4	480	3,4	321812	321814
	120/240	2	4	240	4	321811	321813
	240/416	3	4	416	3	Consult factory	
7	Coil rectifier					321761 (up to 240 VAC); GM14351 (up to 600 VAC)	
8	Cutout switch, SN/SNO					GM14359 (L); GM14360 (R)	
9	Cutout switch, SE/SEO					GM14361 (L); GM14362 (R)	
10	Emergency position auxiliary contact					GM14361	
11	Normal position auxiliary contact					GM14359	
12	Disconnect switch					Operator 321773; contact block 296300	

* All kits include the parts for one contact, therefore, each pole requires two kits.

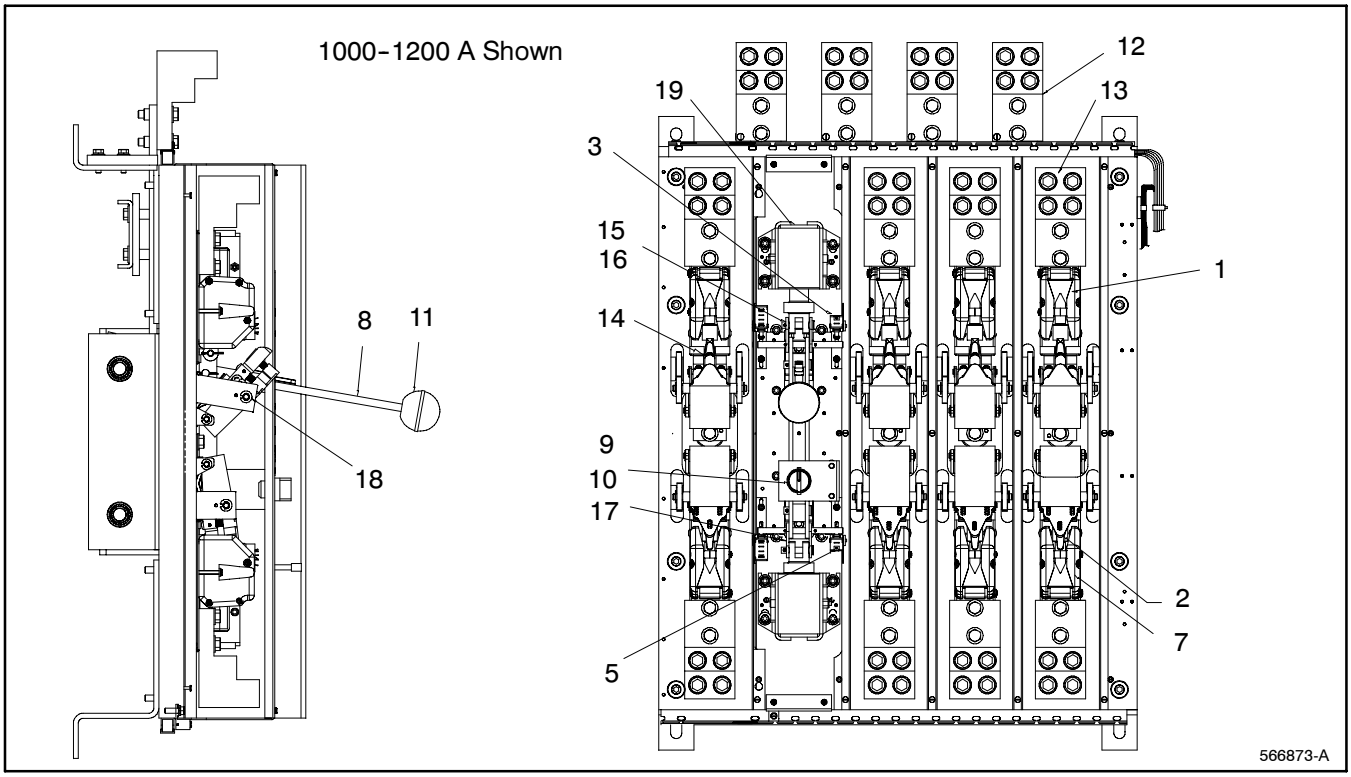
8.12 Contactor Assemblies, 1600–3000 Amp Programmed-Transition and Closed-Transition Models



Item	Description					Part Number by Amperage			
						1600	2000	2500	3000
1	Cable connection at rear (not shown)					321747	321747	321747	321747
2	Stationary contact assembly kit*					321749	321750	321751	321751
3	Arc chute assembly kit*					321872	321872	321872	321872
4	Movable contact assembly kit*					321757	321757	321873	321873
5	Main operating coils DC								
	Volts	**Phase**	**Wire**	**Coil Volts**	**Pole**	**Part Number**			
	120	1	2	120	2	Consult factory			
	120/240	1	3	240	2	321809	321809	321809	321809
					3	321809	321809	321809	321809
	240	3	3	240	3	321809	321809	321809	321809
	120/208	3	4	208	3,4	321809	321809	321809	321809
	480	3	3	480	3	321810	321810	321810	321810
	575	3	3	575/600	3	Consult factory			
	277/480	3	4	480	3	321810	321810	321810	321810
	277/480	3	4	480	4	321810	321810	321810	321810
	120/240	2	4	240	4	321809	321809	321809	321809
	240/416	3	4	416	3	Consult factory			
6	Cutout switch, SN/SNO					GM14364 (1, 2); GM14366 (3, 4)			
7	Cutout switch, SE/SEO					GM14365 (1, 2); GM14367 (3, 4)			
8	Emergency position aux. contact					GM14367			
9	Normal position aux. contact					GM14366			
10	Disconnect switch					Operator 321773; contact block 296300			
11	Rectifier					321761 (up to 240 VAC); GM14351 (up to 600 VAC)			

* All kits include the parts for one contact, therefore, each pole requires two kits.

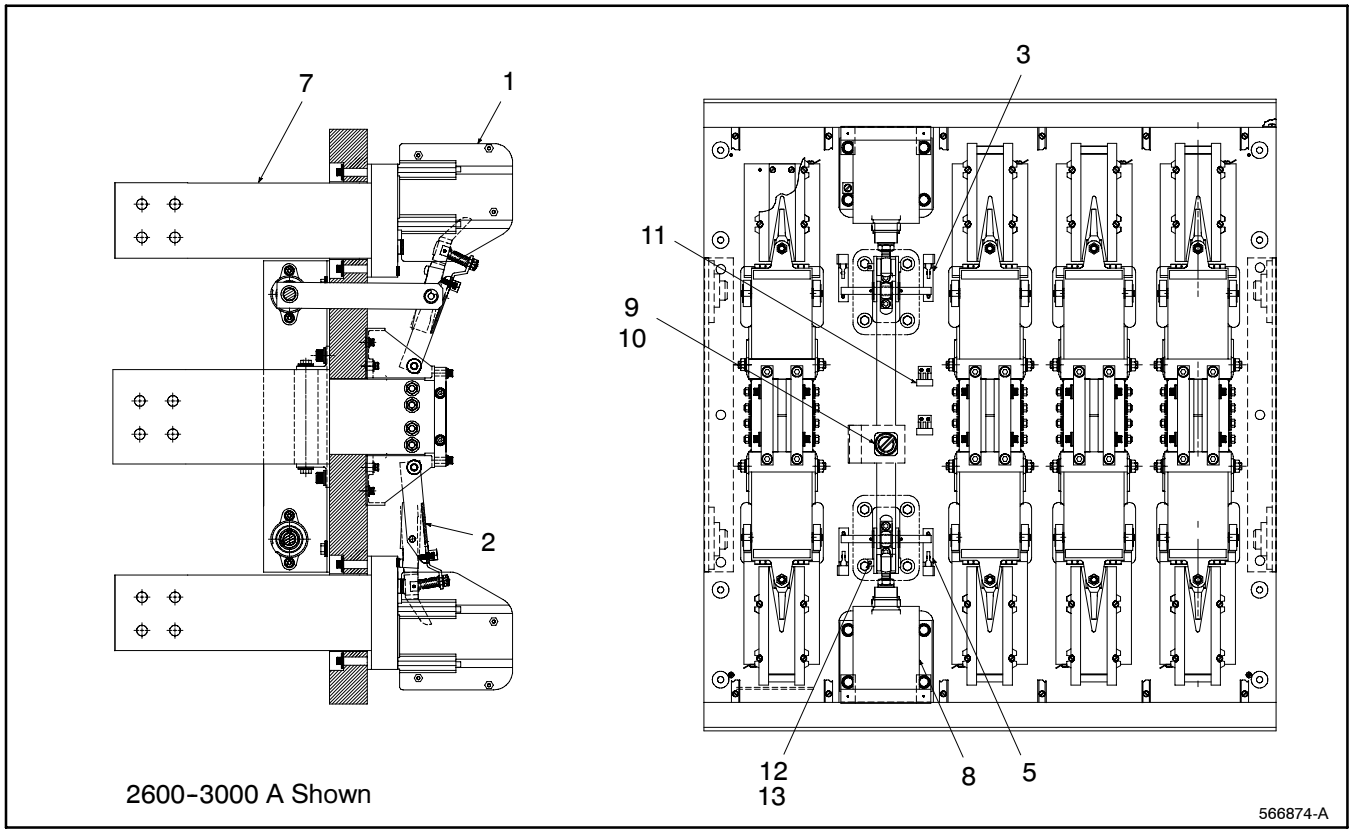
8.13 Contactor Assemblies, 600–1200 Amp ATS



Item	Description			Part Number by Amperage			
				600	800	1000	1200
1	Arc chute			GM39177	GM39177	GM39177	GM39177
2	Movable contact assy., neutral*			321876	321876	GM39178	GM39178
3	Limit switch						
	0 A3 + SE			296299	346572	346572	346572
	1 A3 + SE			321855	321856	321856	321856
5	Limit switch						
	0 A4 + SN			296298	296298	296298	296298
	1 A4 + SN			321758	321758	321758	321758
7	Stationary contact assembly*			321847	321847	321895	321895
8	Handle stud			GM39179	GM39179	GM39179	GM39179
9	Selector switch			321773	321773	321773	321773
10	Contact block			296300	296300	296300	296300
11	Control knob			GM39182	GM39182	GM39182	GM39182
12	Lug			321744	321746	321746	321746
13	Lug			GM39183	GM39184	GM39184	GM39184
14	Movable assembly, neutral (4 P)*			GM39185	GM39185	GM39186	GM39186
15	Pin, cotter					GM39187	GM39187
16	Pin, clevis					GM39188	GM39188
17	Connecting link					GM39189	GM39189
18	E-ring					GM39190	GM39190
19	Main operating solenoid	**Volts**	**Poles**	**Part Number**			
		208	2, 3, 4	321866	321866	296296	296296
		220	2, 3, 4	321866	321866	321862	321862
		240	2	321861	321861	321862	321862
			3, 4	321865	321865	321862	321862
		380/400/416	2	321869	321896	296297	296297
		380/400	3, 4	GM39180	GM39180	296297	296297
		416	3	321867	321867	296297	296297
			4	GM39180	GM39180	296297	296297
		440/480	2, 3	321867	321867	296297	296297
			4	321869	321869	296297	296297
		575/600	2, 3	321868	321868	346571	346571
			4	GM39181	GM39181	346571	346571

* All kits include the parts for one contact, therefore, each pole requires two kits.

8.14 Contactor Assemblies, 1600–4000 Amp ATS



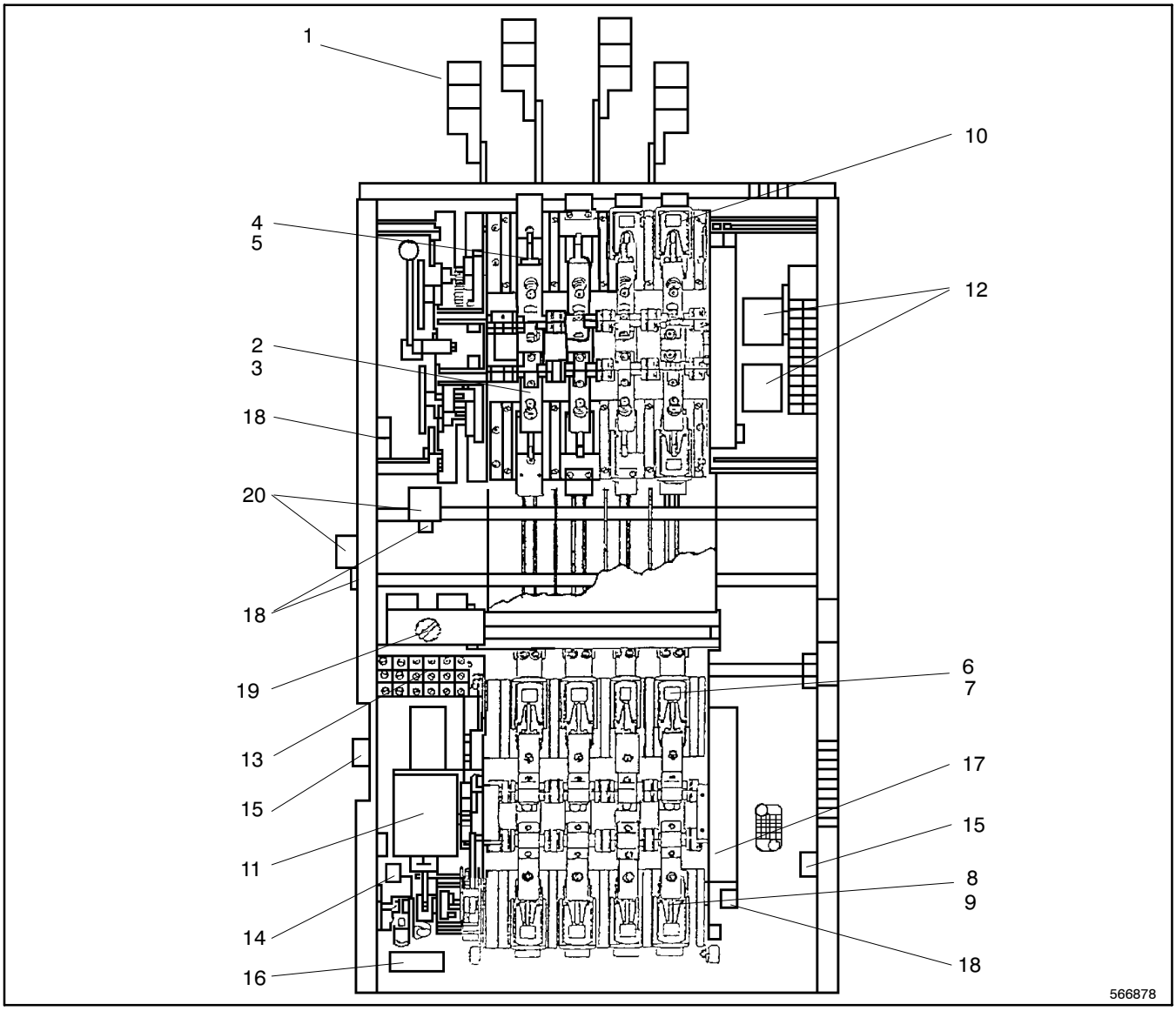
2600–3000 A Shown

Contactor Assemblies, 1600–4000 Amp ATS

Item	Description			Part Number by Amperage		
				1600–2000	2600–3000	4000
1	Arc chute assembly kit*			321872	321872	321872
2	Moveable contact assembly kit*			321757	321873	GM39191
3	Limit switch					
	0 A4 + SN			296303	296303	296303
	1 A4 + SN			321877	321877	321877
5	Limit switch					
	0 A3 + SE			296304	296304	296304
	1 A3 + SE			321881	321881	321881
7	Stationary contact, mechanical lug			GM39192		
7	Stationary contact, compression lug			GM39193	GM39194	GM39195
8	Main operating solenoid	**Coil Volts**	**Poles**	**Part Number**		
		208	2, 3, 4	321754	321754	GM39198
		220	2,3	321893	321754	GM39197
			4	321754	321754	GM39197
		240	2, 3, 4	321893	321893	GM39197
		380/400/416	2, 3, 4	GM39201	GM39201	GM39200
		440/480	2	296302		
			3, 4	296302	296302	GM39196
		575/600	2, 3, 4	346578	346578	GM39199
9	Selector switch			321773	321773	321773
10	Contact block			296300	296300	296300
11	Quad pack rectifier			321761	321761	321761
12	Pin, clevis			GM39202	GM39202	GM39202
13	Pin, cotter			GM39187	GM39187	GM39187

* All kits include the parts for one contact, therefore, each pole requires two kits.

8.15 Contactor Assemblies, 100-400 Amp ATS/BIS (ZCI)



Contactor Assemblies, 100–400 Amp ATS/BIS (ZCI)

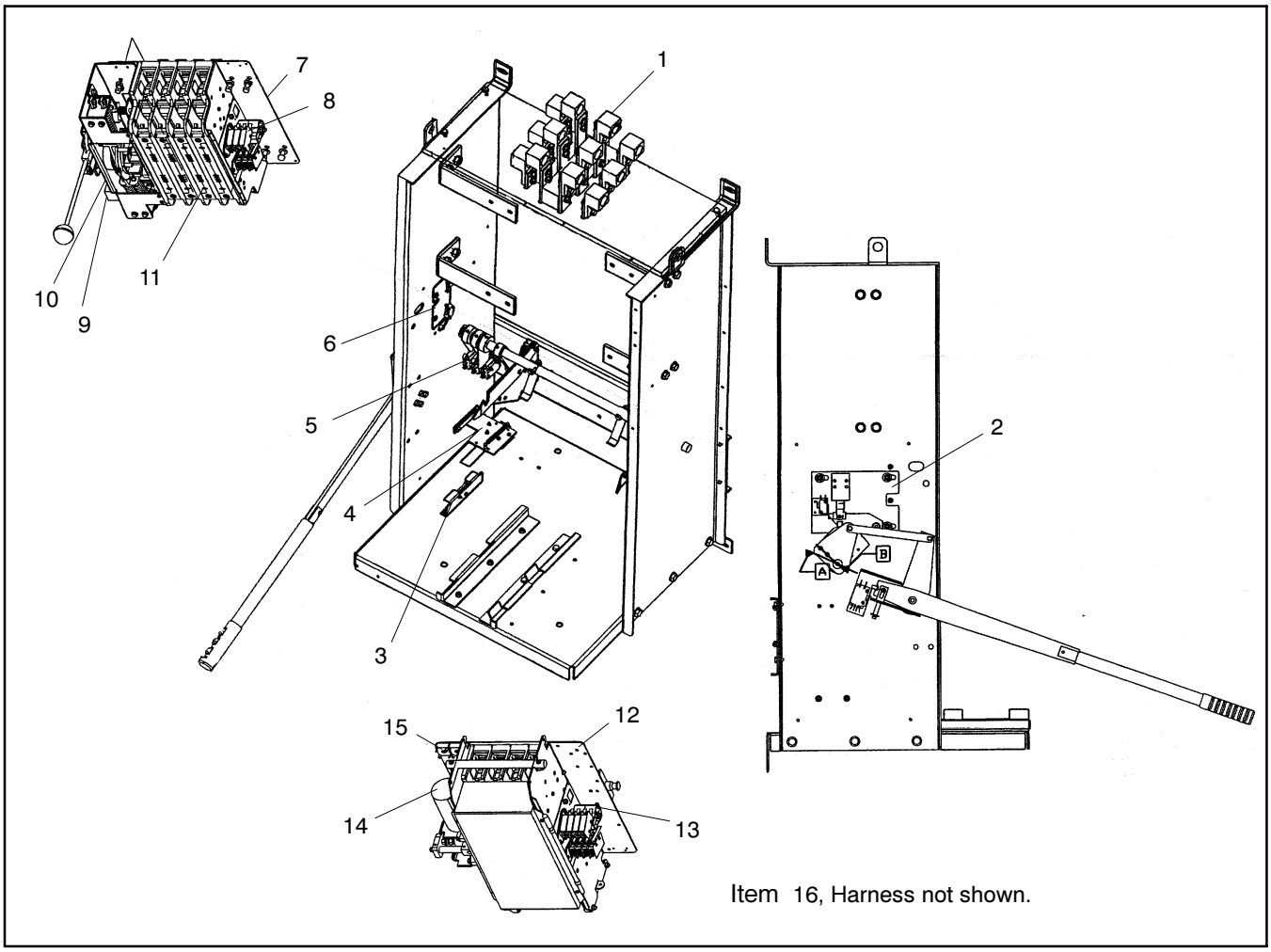
Item	Description	Part Number by Amperage				
		100	150	225	260	400
1	Cable connection lugs	321742	321742	321742	321743	321743
2	Bypass normal contact assembly*	321823	321824	321825	321826	321827
3	Bypass switched neutral normal contact assembly*	321828	321829	321830	321831	321832
4	Bypass emergency contact assembly*	321833	321834	321835	321836	321837
5	Bypass switched neutral emergency contact assembly*	321838	321839	321840	321841	321842
6	ATS normal contact assembly*	321783	321784	321785	321786	321787
7	ATS switched neutral normal contact assembly*	321788	321789	321790	321791	321792
8	ATS emergency contact assembly*	321793	321794	321795	321796	321797
9	ATS switched neutral emergency contact assembly*	321798	321799	321800	3217801	3217802
10	Arc chute assembly*	321752				

* All kits include the parts for one contact, therefore, each pole requires two kits.

Item	Description					Part Number by Amperage				
						100	150	225	260	400
11	Main ATS operating coils									
	Volts	Ph	Wire	Coil Volts	Poles					
	120	1	2	120	2	321806				
	120/240	1	3	240	2,3	321808				
	240	3	3	240	3	321808				
	120/240	3	4	240	3,4	321808				
	120/208	3	4	208	3,4	321805				
	480	3	3	480	3	321804				
	575/600	3	3	575/600	3	Consult factory				
	277/480	3	4	480	3,4	321804				
	240/416	3	4	416	3,4	Consult factory				
	220/380	3	4	380	3,4	321807				
				Voltage						
12	Bypass stepdown Transformer 25VA Secondary 24V			120/240		321864				
				208/416		321844				
				220/440		321845				
				240/480		321846				
				380		321894				
				575		321848				
				600		321849				
13	Switch CN 1 CE 1 ATS emergency ATS normal					321822				
14	CNE limit switches					321782				
15	Switch ATS auto location ATS isolate/remove location Position lever					321821				
16	Location switch ATS isolate ATS test					321820				
17	Switch Bypass emergency position Bypass normal position Normal TRS limit switch Emergency TRS limit switch					321819				
18	Switch Bypass emergency position Bypass normal position ATS engaged Bypass lock location ATS lock location					321818				
19	ATS solenoid disconnect switch Operator 2-position maintain Contact block N.O. (1) Contact block N.O. (2)					321772 321774 321888 321817				
20	Interlock solenoid Bypass interlock Transfer release					321815				

8.16 Contactor Assemblies, 150-400 Amp ATS/BIS (ZCT)

Note: SBL, SCL, ZCI, or ZCTSee pages 94 and 95 for detailed view of the contactors.



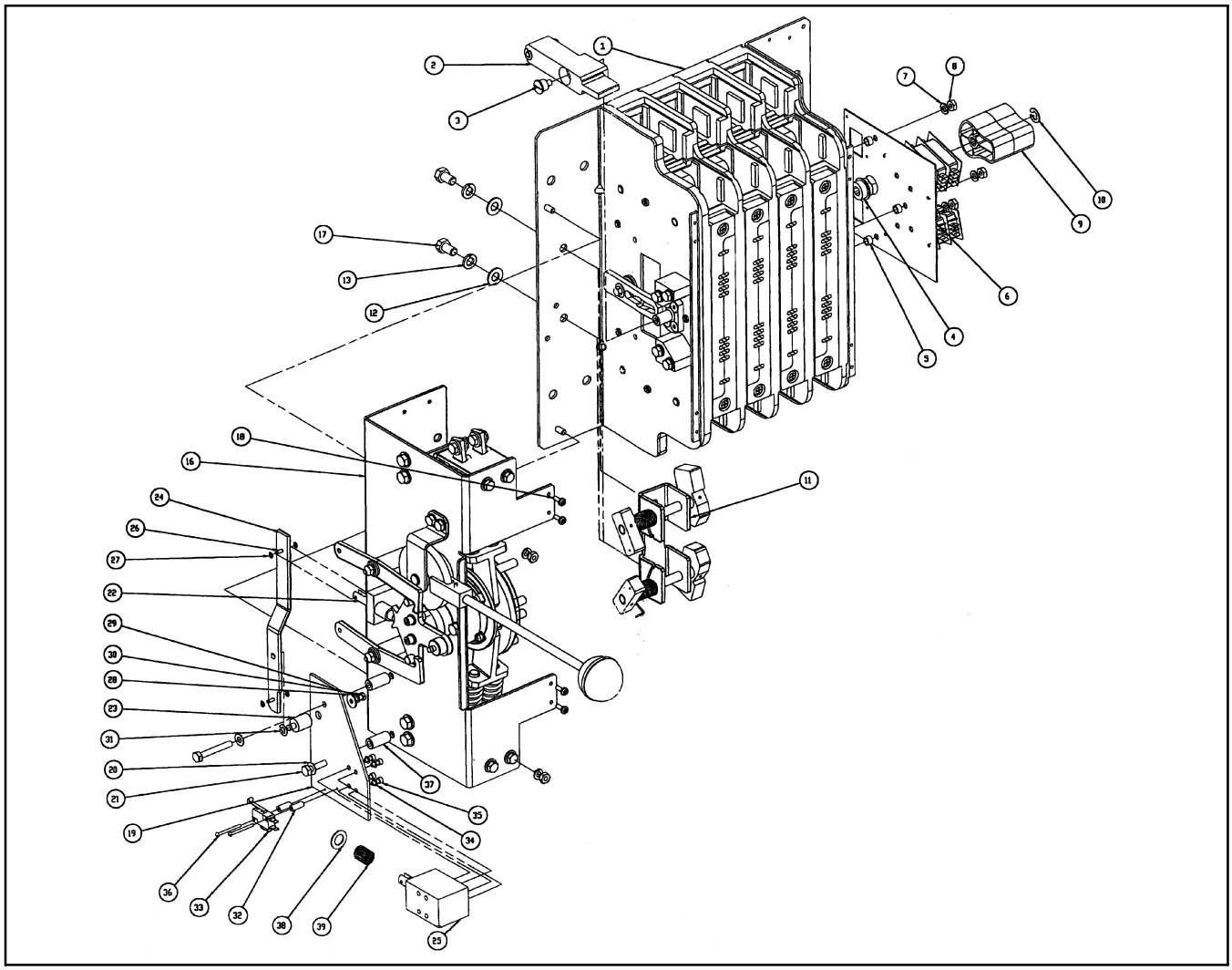
Item 16, Harness not shown.

Contactor Assemblies, 150–400 Amp ATS/BIS (ZCT)

Item	Description		Part Number
1	Cable connection lugs		321743
2	Interlock assembly		GM39154
3	Roller arm limit switch		321818
4	Position indicator switch assy.		GM39135
5	Limit switch		321821
6	Switch assembly		GM39153
7	Top power panel (4 pole)		GM39138
7	Top power panel (3 pole)		GM39137
7	Top power panel (2 pole)		GM39136
8	Limit switch assembly		GM39156
9	Solenoid, ATS release		321815
10	Roller arm limit switch		321818
11	Arc chute assembly		GM39145
12	Bottom power panel (4 pole)		GM39141
12	Bottom power panel (3 pole)		GM39140
12	Bottom power panel (2 pole)		GM39139
13	Limit switch assembly		GM39155
14	Solenoid assembly	**Volts**	
		120	GM39159
		208/240	GM39160
		380/415	GM39161
		480	GM39162
		575/600	GM39163
15	Rectifier		GM39166
16	Harness, contactor		GM39157

Contactor Assemblies, 150-400 Amp ATS/BIS (ZCT)

Top Power Panel Details



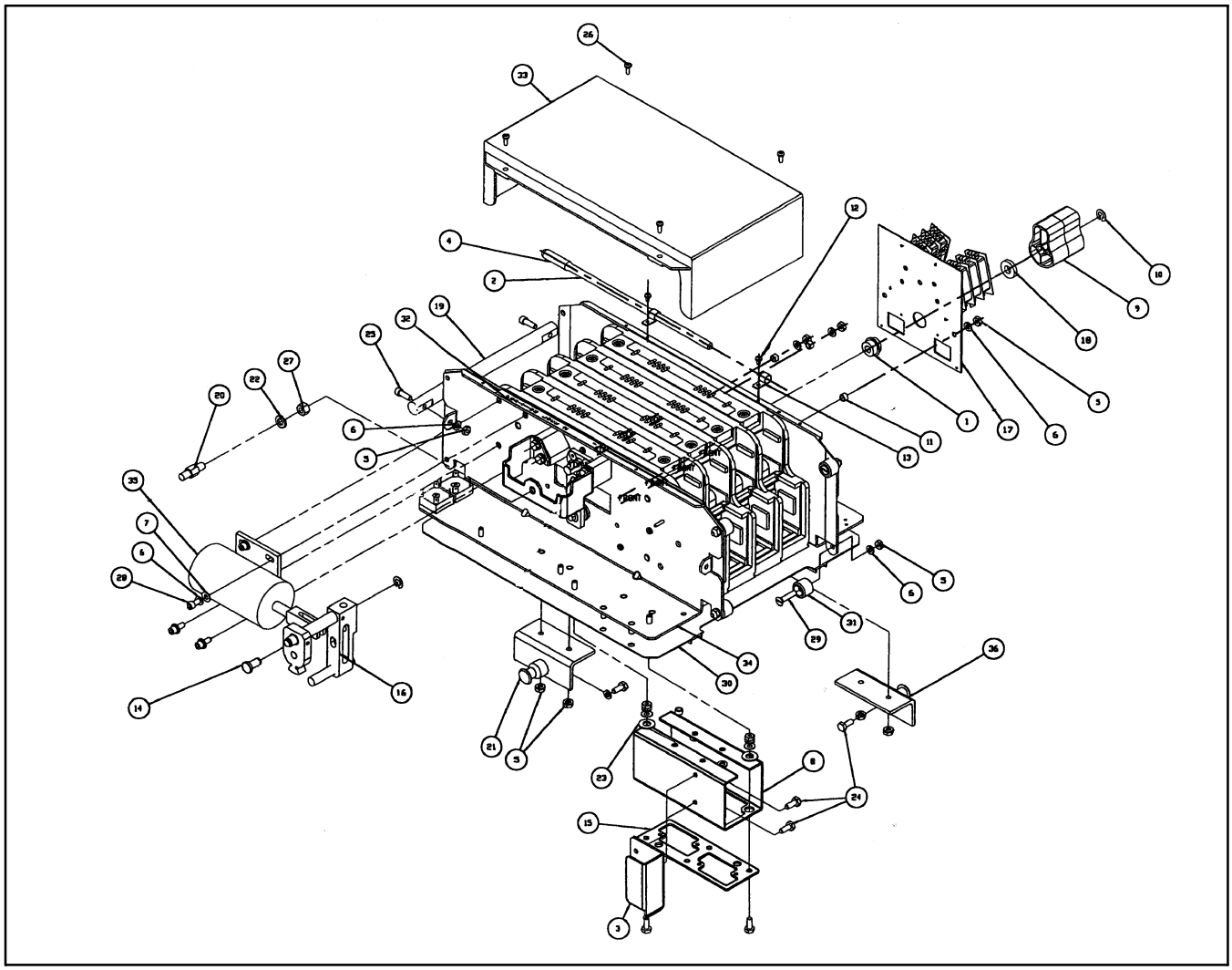
Item	Description	Part Number
1	Power panel assembly	*
2	Drive linkage assembly	*
3	Shoulder pin (lock)	*
4	Bushing, fork	*
5	Limit switch spacer	*
6	Limit switch assembly	See page 93
7	1/4 split lock washer	*
8	1/4-20 hex jam nut	*
9	Cam	*
10	E-Ring	*
11	Mid stop assembly	*
12	3/8 flat washer	*
13	3/8 split lock washer	*
16	QMQB assembly	*
17	3/8-16 x .63 hex hd c/s	*
18	8-32 x .50 bind hd ext sems screw	*
19	Bracket, solenoid	*
20	1/4 flat washer	*
21	1/4-20 x 1.75 hex hd c/s	*

Item	Description	Part Number
22	Pin lock	*
23	Stud, solenoid	*
24	Lever, solenoid	*
25	Solenoid, ATS release	See page 93
26	Shaft, solenoid	*
27	E-ring	*
28	#10 flat washer	*
29	#10 split lock washer	*
30	10-32 x .50 hex hd mach. screw	*
31	E-ring	*
32	-	*
33	Roller arm limit switch	See page 93
34	#8 int. tooth l/w	*
35	8-32 x .38 soc hd c/s	*
36	4-40 x 1.25 round hd m/s	*
37	Spacer	*
38	Washer	*
39	Spring, sol. plunger	*
40	QMBQ kit (includes items 3, 11, 16, and 24)	*

* Serviceable items without part numbers are available by recording the serial numbers and model designation and contacting your supplier of DDC/MTU Power Generation parts.

Contactor Assemblies, 150–400 Amp ATS/BIS (ZCT)

Bottom Power Panel Details

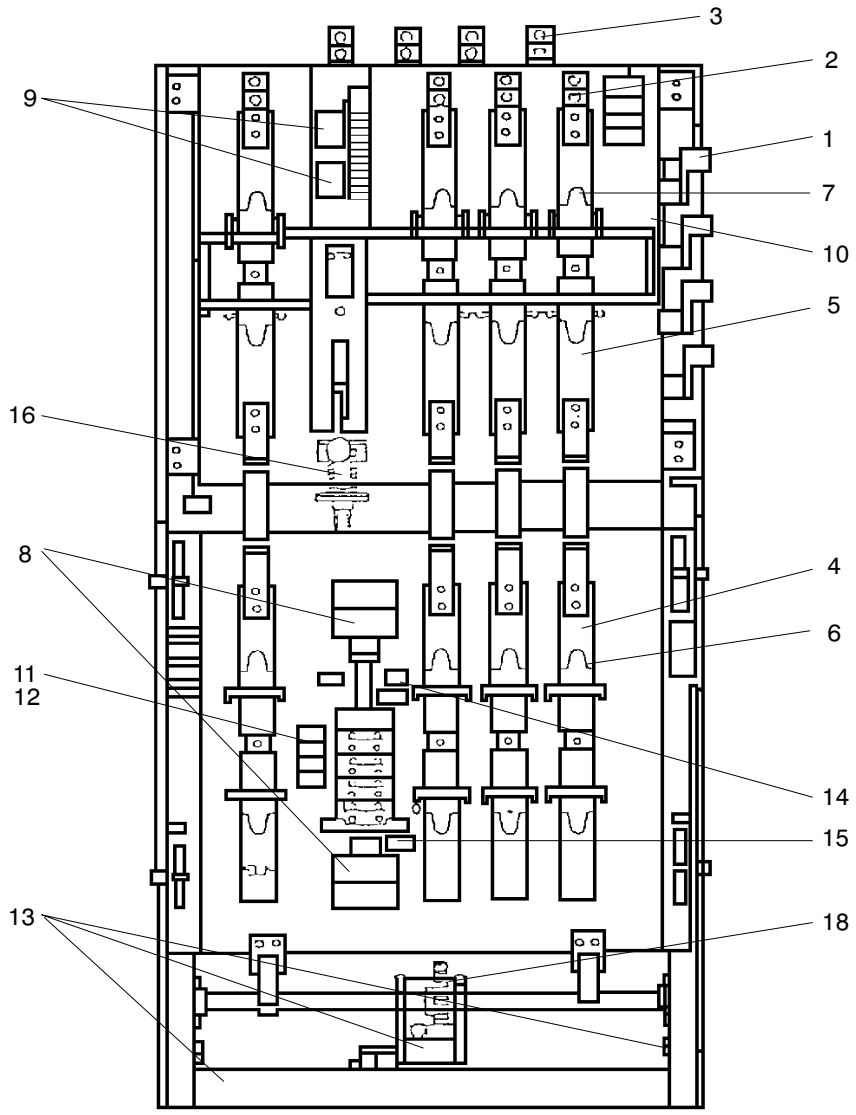


Item	Description	Part Number
1	Bushing, fork	*
2	Handle, manual	*
3	Limit switch actuator	*
4	Handle grip	*
5	1/4-20 hex jam nut	*
6	1/4 split lock washer	*
7	1/4 flat washer	*
8	Bracket, lug	*
9	Cam	*
10	E-ring	*
11	Limit switch spacer	*
12	8–32 x .31 rwd hd ext sems screw	*
13	Clamp	*
14	Solenoid pin	*
15	Bracket, plug (25 pin)	*
16	Drive linkage	*
17	Limit switch assembly	See page 93
18	Spacer	*

Item	Description	Part Number
19	Handle	*
20	Connecting stud	*
21	Stud	*
22	3/8 split lock washer	*
23	3/8 flat washer	*
24	1/4-20 x .63 hex hd c/s	*
25	1/4-20 x .75 soc hd c/s	*
26	8-32 x .50 bind hd ext sems screw	*
27	3/8-16 grade 8 hex nut	*
28	1/4-20 x .63 soc hd c/s	*
29	1/4-20 x 1.13 flt c'sunk hd m/s	*
30	Barrier	*
31	Skid	*
32	Position lock label	*
33	Cover	*
34	Power panel assembly	*
35	Solenoid assembly	See page 93
36	Stud bracket	*
37	Harness (not shown)	*

* Serviceable items without part numbers are available by recording the serial numbers and model designation below and contacting your supplier of DDC/MTU Power Generation parts.

8.17 Contactor Assemblies, 600–1200 Amp ATS/BIS (ZCI)



Item 17 not shown

566879

Contactor Assemblies, 600–1200 Amp ATS/BIS (ZCI)

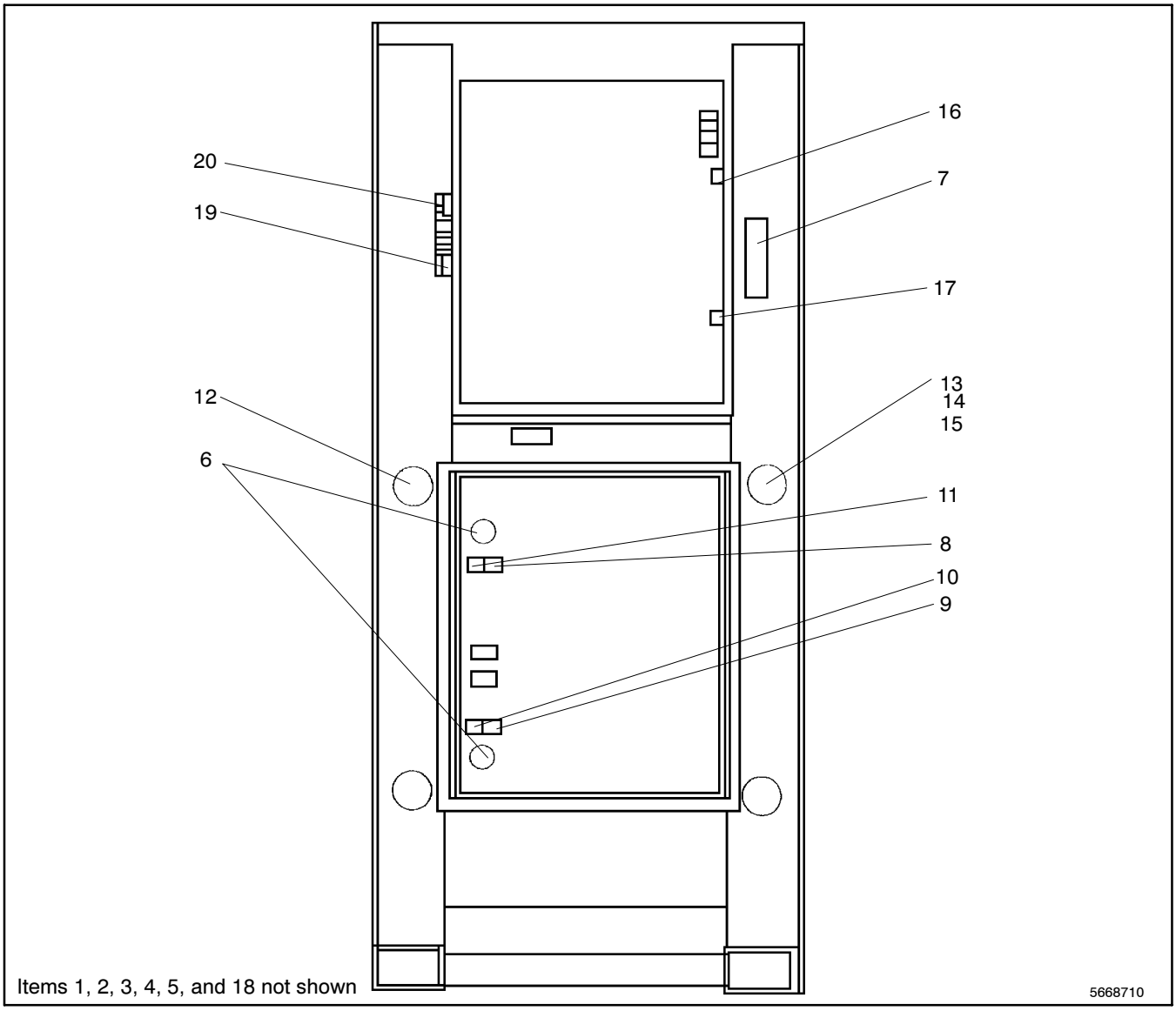
Item	Description	Part Number by Amperage			
		600	800	1000	1200
1	Normal lugs	321843	321853	321854	321854
2	Emergency lugs	321744	321745	321746	321746
3	Load lugs	321744	321745	321746	321746
4	Stationary contact assembly bypass*	321847	346583	346583	346583
5	Stationary contact assembly ATS*	321847	346583	346583	346583
6	Arc chute assembly kit*	321753	321753	321753	321753
7	Moveable contact assembly*	321876	321880	321880	321880
	Moveable contact (switched neutral)*	321876	321816	321816	321816

* All kits include the parts for one contact, therefore, each pole requires two kits.

Item	Description	Voltage System				Part Number by Amperage			
						600	800	1000	1200
8	ATS Main operating coils					Part Numbers By Amperage			
		Volts	Ph	Wire	Coil Volts / Pole				
		120	1	2	120 / 2	321859	321860	321860	321860
		120/240	1	2	240 / 2	321861	321862	321862	321862
			1	2	240 / 3	321865	321862	321862	321862
		120/240	3	4	240 / 3	321865	321862	321862	321862
		120/208	3	4	208 / 3,4	321866	296296	296296	296296
		480	3	3	480 / 3	321867	296297	296297	296297
		575	3	3	575/600 / 3	321868	Consult factory	Consult factory	Consult factory
		277/480	3	4	480 / 3	321867	296297	296297	296297
			3	4	480 / 4	321869	296297	296297	296297
		240/416	3	4	416 / 3	321867	296297	296297	296297

		Voltage	Part Number
9	Bypass stepdown transformer 25VA, 24 volt secondary	120/240	321864
		208/416	321844
		220/440	321845
		240/480	321846
		380	321894
		575	321848
		600	321849
10	Switch Bypass emergency position Bypass normal position BSS emergency position BSS normal position Limit switch DPDT, lever actuator	321819	
11	ATS auto location switch	321851	
	ATS test Location switch	321852	
	Crank limit switches	321818	
	ATS isolate location switch	321851	
	Limit switch DPDT, roller actuator	321852	
12	ATS emergency position switch	(SPDT) 296298	(DPDT) 321758
13	ATS normal position switch (aux. contact)	296299	321855
14	ATS normal position coil cutout switch DPDT	321758	
15	ATS emergency position coil cutout switch DPDT	321856	
16	ATS solenoid disconnect switch		
	Operator 2-position maintain	321773	
	Contact block N.O.	296300	
	Contact block N.O.	321857	
17	Solenoid Emergency interlock Normal interlock	321858	
18	Crank mechanism solenoid	321858	

8.18 Contactor Assemblies, 1600–3000 Amp ATS/BIS (ZCI)



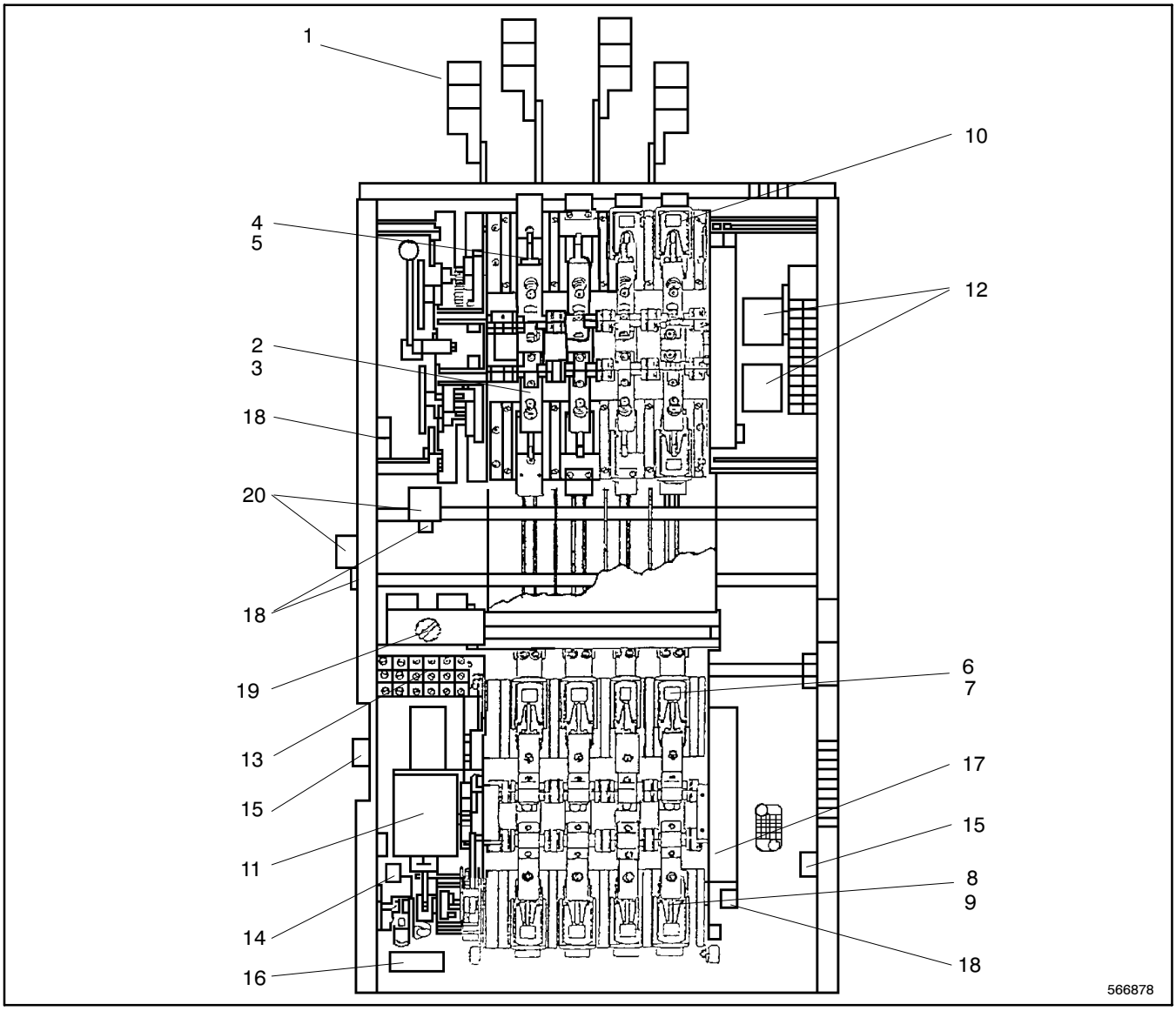
Contactor Assemblies, 1600–3000 Amp ATS/BIS (ZCI)

Item	Description	Part Number by Amperage		
		1600	2000	3000
1	Cable connection at rear	321746 (2)	321746	321746
2	Stationary contact assembly (bypass)*	321870	321870	321871
3	Stationary contact assembly (ATS)*	321870	321870	321871
4	Arc chute assembly*	321872	321872	321872
5	Movable contact assembly*	321757	321757	321873

* All kits include the parts for one contact, therefore, each pole requires two kits.

6	ATS Main operating coils							
	Volts	**Phase**	**Wire**	**Coil Volts**	**Pole**	**1600**	**2000**	**3000**
	120/240	1	3	240	3	321891	321891	321891
	240	3	3	240	3	321891	321891	321891
	240	3	4	240	4	321893	321893	321893
	120/280	3	4	208	3	321892	321892	321892
	120/208	3	4	208	4	321895	321895	321895
	480	3	3	480	3	296301	296301	296301
	277/480	3	4	480	3	296301	296301	296301
	277/480	3	4	480	4	296302	296302	296302
	240/416	3	4	416	3	321896	321896	321896
						Voltage	**Part Number**	
7	Bypass stepdown transformer 24 volt secondary					120/240	321864	
						208/416	321844	
						220/440	321845	
						240/480	321846	
						380	321894	
						575	321848	
						600	321849	
8	ATS normal position coil cutout switch					321874		
9	ATS emerg. position coil cutout switch					321875		
10	ATS emergency position switch					296303, 321877, 321878, 321879		
11	ATS normal position switch					296304, 321881, 321882, 321883		
12	Crank handle limit switch					321851		
13	ATS auto location switch					321821		
14	ATS isolate/remove location switch					321851		
15	Location switch ATS isolate ATS test					321821		
16	Position switch Bypass emergency Bypass normal					321819		
17	ATS latched limit switch					321818		
18	ATS solenoid disconnect switch							
	Operator 2-position maintain					321772		
	Contact block N.O. (1)					321774		
	Contact block N.O. (2)					321888		
	Contact block mounting plate					321817		
19	Bypass interlock solenoid					321884		
20	Crank enable solenoid					321885		

8.19 Contactor Assemblies, 100–400 Amp ATS/BIS Delay (ZCI)



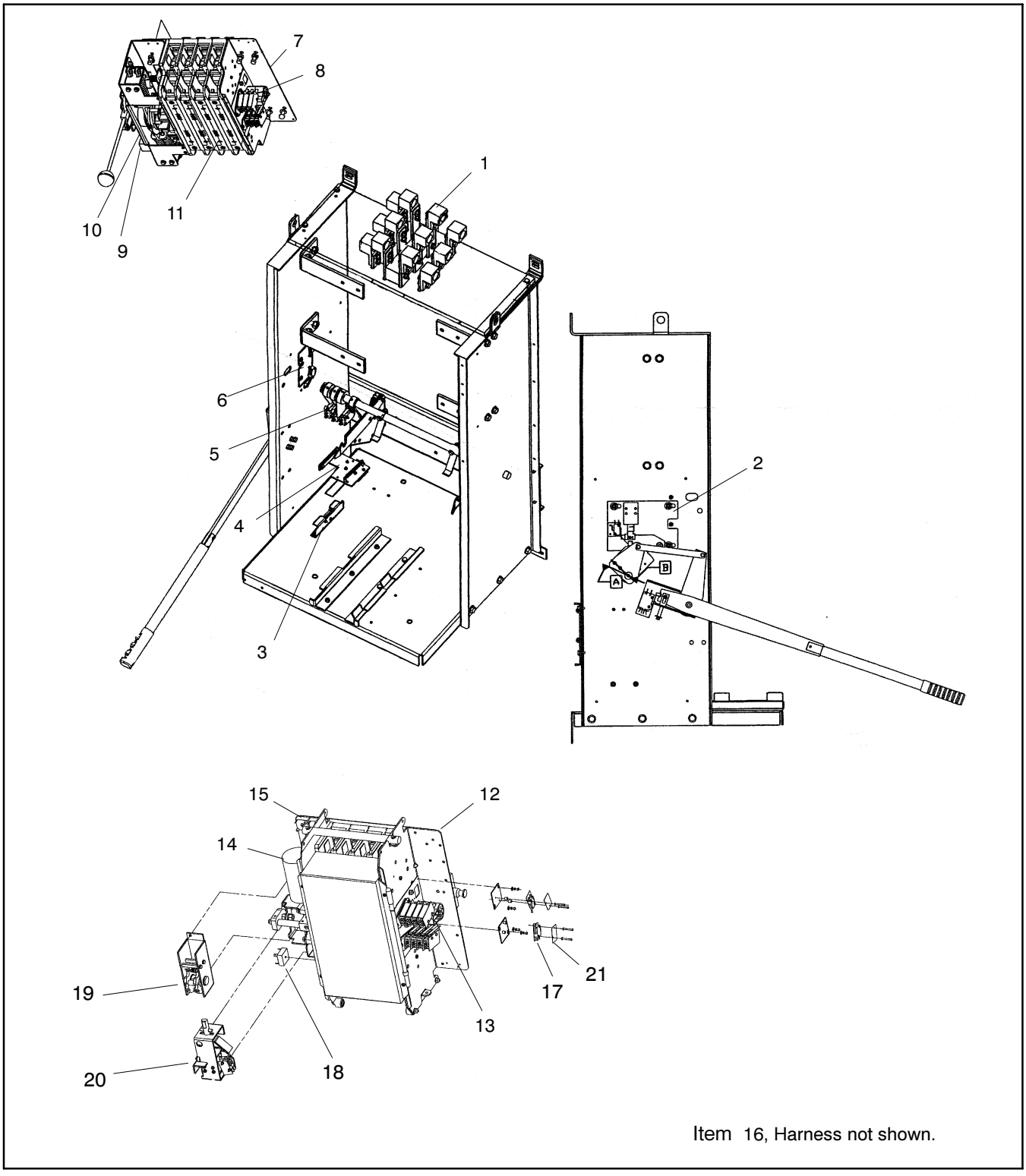
Contactor Assemblies, 100–400 Amp ATS/BIS Delay (ZCI)

Item	Description	Part Number by Amperage				
		100	150	225	260	400
1	Cable connection lugs	321742	321742	321742	321743	321743
2	Bypass normal contact assembly*	321823	321824	321825	321826	321827
3	Bypass switched neutral normal contact assembly*	321828	321829	321830	321831	321832
4	Bypass emergency contact assembly*	321833	321834	321835	321836	321837
5	Bypass switched neutral emergency contact assembly*	321838	321839	321840	321841	321842
6	ATS normal contact assembly*	321783	321784	321785	321786	321787
7	ATS switched neutral normal contact assembly*	321788	321789	321790	321791	321792
8	ATS emergency contact assembly*	321793	321794	321795	321796	321797
9	ATS switched neutral emergency contact assembly*	321798	321799	321800	3217801	3217802
10	Arc chute assembly*	321752				

* All kits include the parts for one contact, therefore, each pole requires two kits.

Item	Description					Part Number
11	Main ATS operating coils					
	Volts	**Ph**	**Wire**	**Coil Volts**	**Poles**	
	120	1	2	120	2	321806
	120/240	1	3	240	2,3	321808
	240	3	3	240	3	321808
	120/240	3	4	240	3,4	321808
	120/208	3	4	208	3,4	321805
	480	3	3	480	3	321804
	575/600	3	3	575/600	3	Consult factory
	277/480	3	4	480	3,4	321804
	240/416	3	4	416	3,4	Consult factory
	220/380	3	4	380	3,4	321807
				Voltage		
12	Bypass stepdown Transformer 25VA Secondary 24V			120/240		321864
				208/416		321844
				220/440		321845
				240/480		321846
				380		321894
				575		321848
				600		321849
13	Switch CN 1 limit switch CE 1 limit switch ATS emergency position ATS normal position					321803
14	CNE limit switches					321782
15	Switch ATS auto location ATS isolate/remove location Position lever					321821
16	Location switch ATS isolate ATS test					321820
17	Switch Bypass emergency position Bypass normal position Normal TRS limit switch Emergency TRS limit switch					321819
18	Switch Bypass emergency position Bypass normal position ATS engaged Bypass lock location ATS lock location					321818
19	ATS solenoid disconnect switch Operator 2-position maintain Contact block N.O. (1) Contact block N.O. (2)					321772 321774 321888 321817
20	Solenoid Bypass interlock Transfer release					321815

8.20 Contactor Assemblies, 100-400 Amp ATS/BIS Delay (ZCT)

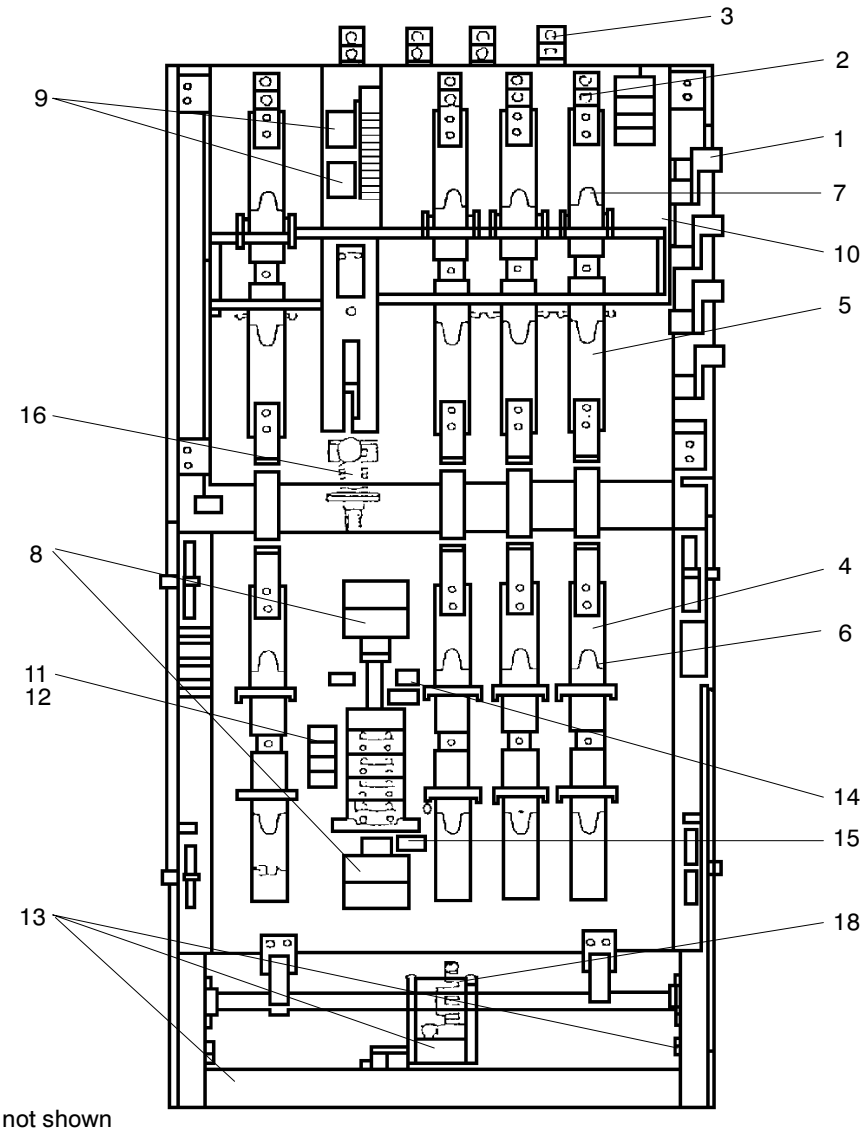


Item 16, Harness not shown.

Contactor Assemblies, 100–400 Amp ATS/BIS Delay (ZCT)

Item	Description		Part Number
1	Cable connection lugs		321743
2	Interlock assembly		GM39154
3	Roller arm limit switch		321818
4	Position indicator switch assy.		GM39135
5	Limit switch		321821
6	Switch assembly		GM39153
7	Top power panel (2 pole)		GM39136
7	Top power panel (3 pole)		GM39137
7	Top power panel (4 pole)		GM39138
8	Limit switch assembly		GM39156
9	Solenoid, ATS release		321815
10	Roller arm limit switch		321818
11	Arc chute assembly		GM39145
12	Bottom power panel (2 pole)		GM39142
12	Bottom power panel (3 pole)		GM39143
12	Bottom power panel (4 pole)		GM39144
13	Limit switch assembly		GM39155
14	Solenoid assembly	**Volts**	
		120	GM39159
		208/240	GM39160
		380/415	GM39161
		480	GM39162
		575/600	GM39163
15	Rectifier		GM39166
16	Harness, contactor		GM39158
17	Simulated roller limit switch		GM39164
18	Rectifier		GM39166
18	Rectifier (above 380 V)		GM39165
19	Cam module		GM39146
20	Solenoid assembly	**Volts**	
		120	GM39147
		208	GM39148
		240	GM39149
		380/415	GM39150
		480	GM39151
		575/600	GM39152
21	Switch insulator		362203

8.21 Contactor Assemblies, 600–1200 Amp ATS/BIS Delay (ZCI)



Items 17, 19, and 20 not shown

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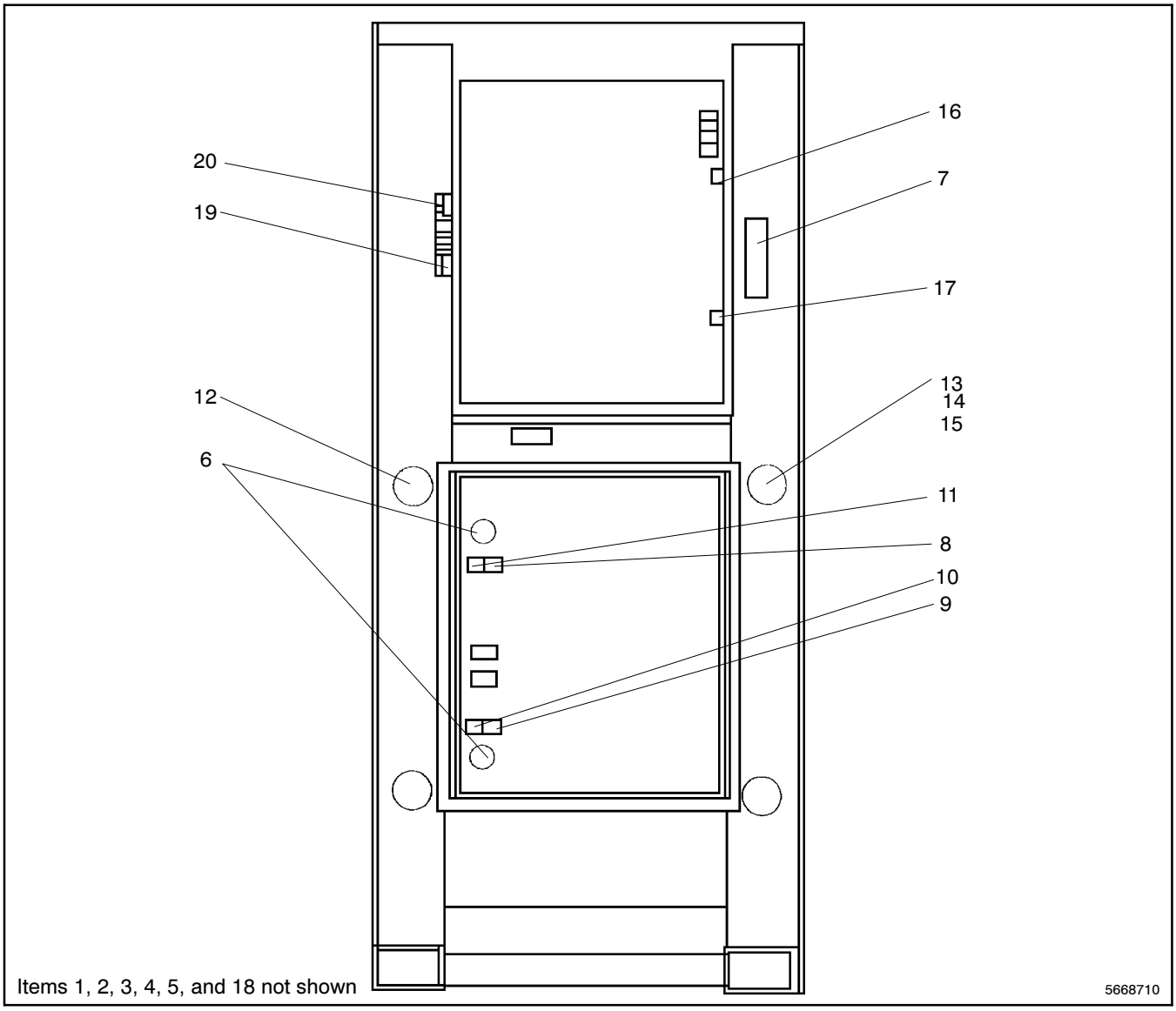
Contactor Assemblies, 600–1200 Amp ATS/BIS Delay (ZCI)

Item	Description	Part Number by Amperage			
		600	800	1000	1200
1	Normal lugs	321843	321853	321854	321854
2	Emergency lugs	321744	321745	321746	321746
3	Load lugs	321744	321745	321746	321746
4	Stationary contact assembly bypass*	321847	346583	346583	346583
5	Stationary contact assembly ATS*	321847	346583	346583	346583
6	Arc chute assembly kit*	321753	321753	321753	321753
7	Moveable contact assembly*	321876	321880	321880	321880
	Moveable contact (switched neutral)*	321876	321816	321816	321816

* All kits include the parts for one contact, therefore, each pole requires two kits.

Item	Description					Part Number by Amperage			
						600	800	1000	1200
8	ATS Main operating coils					Part Numbers By Amperage			
	Voltage System								
	Volts	Ph	Wire	Coil Volts	Pole	600	800	1000	1200
	120	1	2	120	2	Consult factory	Consult factory	Consult factory	Consult factory
	120/240	1	2	240	2	Consult factory	Consult factory	Consult factory	Consult factory
		1	2	240	3	321811	321813	321813	321813
	120/240	3	4	240	3	321811	321813	321813	321813
	120/208	3	4	208	3,4	321811	321813	321813	321813
	480	3	3	480	3	321812	321814	321814	321814
	277/480	3	4	480	3	321812	321814	321814	321814
		3	4	480	4	321812	321814	321814	321814
	240/416	3	4	416	3	Consult factory	Consult factory	Consult factory	Consult factory
						Voltage		Part Number	
9	Bypass stepdown transformer 25VA, 24 volt secondary					120/240 208/416 220/440 240/480 380 575 600		321864 321844 321845 321846 321894 321848 321849	
10	Switch Bypass normal position BSS emergency position BSS normal position Limit switch DPOT, lever actuator					321819			
11	ATS auto location switch ATS test Location switch Crank limit switches ATS isolate Location switch Limit switch DPOT, roller actuator					321851 321852 321818 321851 321852			
12	ATS emergency position switch					(SPDT) 296298		(DPDT) 321758	
13	ATS normal position switch (aux. contact)					296299		321855	
14	ATS normal position coil cutout switch DPDT					321758			
15	ATS emergency position coil cutout switch DPDT					321856			
16	ATS solenoid disconnect switch Operator 2-position maintain Contact block N.O. Contact block N.O.					321773 296300 321857			
17	Solenoid Emergency interlock Normal interlock					321858			
18	Crank mechanism solenoid					321858			
19	Bypass permissive pushbutton Operator pushbutton Contact block N.O.					321887 321888			
20	Coil rectifiers					321761			

8.22 Contactor Assemblies, 1600–3000 Amp ATS/BIS Delay (ZCI)



Contactor Assemblies, 1600–3000 Amp ATS/BIS Delay (ZCI)

Item	Description	Part Number by Amperage		
		1600	2000	3000
1	Cable connection at rear	321746 (2)	321746	321746
2	Stationary contact assembly (bypass)*	321870	321870	321871
3	Stationary contact assembly (ATS)*	321870	321870	321871
4	Arc chute assembly*	321872	321872	321872
5	Movable contact assembly*	321757	321757	321873

* All kits include the parts for one contact, therefore, each pole requires two kits.

Item	Description					Part Number by Amperage		
6	ATS Main operating coils							
	Volts	Phase	Wire	Coil Volts	Pole	1600	2000	3000
7	120	1	2	120	2	Consult factory	Consult factory	Consult factory
	120/240	1	3	240	3	321809	321809	321809
	240	3	3	240	4	321809	321809	321809
	120/208	3	4	208	3,4	321809	321809	321809
	480	3	3	480	3	321810	321810	321820
	575	3	3	575/600	3	Consult factory	Consult factory	Consult factory
	277/480	3	4	480	3,4	321810	321810	321810
	240/416	3	4	416	3	Consult factory	Consult factory	Consult factory
						Voltage	Part Number	
8	Bypass stepdown transformer 24 volt secondary					120/240	321864	
						208/416	321844	
						220/440	321845	
						240/480	321846	
						380	321894	
						575	321848	
						600	321849	
9	ATS normal position coil cutout switch					321889		
10	ATS emerg. position coil cutout switch					321890		
11	ATS emergency position switch					296303, 321877, 321878, 321879		
12	ATS normal position switch					296304, 321881, 321882, 321883		
13	Crank handle limit switch					321851		
14	ATS auto location switch					321821		
15	ATS isolate/remove location switch					321851		
16	Location switch ATS isolate ATS test					321821		
17	Position switch Bypass emergency Bypass normal					321819		
18	ATS latched limit switch					321818		
19	ATS solenoid disconnect switch							
	Operator 2-position maintain					321772		
	Contact block N.O. (1)					321774		
	Contact block N.O. (2)					321888		
	Contact block mounting plate					321817		
20	Bypass interlock solenoid					321884		
21	Crank enable solenoid					321885		

Notes

Appendix A Abbreviations

The following list contains abbreviations that may appear in this publication.

A, amp	ampere
ABDC	after bottom dead center
AC	alternating current
A/D	analog to digital
ADC	analog to digital converter
adj.	adjust, adjustment
ADV	advertising dimensional drawing
AHWT	anticipatory high water temperature
AISI	American Iron and Steel Institute
ALOP	anticipatory low oil pressure
alt.	alternator
Al	aluminum
ANSI	American National Standards Institute (formerly American Standards Association, ASA)
AO	anticipatory only
API	American Petroleum Institute
approx.	approximate, approximately
AR	as required, as requested
AS	as supplied, as stated, as suggested
ASE	American Society of Engineers
ASME	American Society of Mechanical Engineers
assy.	assembly
ASTM	American Society for Testing Materials
ATDC	after top dead center
ATS	automatic transfer switch
auto.	automatic
aux.	auxiliary
A/V	audiovisual
avg.	average
AVR	automatic voltage regulator
AWG	American Wire Gauge
AWM	appliance wiring material
bat.	battery
BBDC	before bottom dead center
BC	battery charger, battery charging
BCA	battery charging alternator
BCI	Battery Council International
BDC	before dead center
BHP	brake horsepower
blk.	black (paint color), block (engine)
blk. htr.	block heater
BMEP	brake mean effective pressure
bps	bits per second
br.	brass
BTDC	before top dead center
Btu	British thermal unit
Btu/min.	British thermal units per minute
C	Celsius, centigrade
cal.	calorie
CARB	California Air Resources Board
CB	circuit breaker
cc	cubic centimeter
CCA	cold cranking amps
ccw.	counterclockwise
CEC	Canadian Electrical Code
cert.	certificate, certification, certified
cfh	cubic feet per hour
cfm	cubic feet per minute
CG	center of gravity
CID	cubic inch displacement
CL	centerline
cm	centimeter
CMOS	complementary metal oxide substrate (semiconductor)
cogen.	cogeneration
com	communications (port)
coml	commercial
Coml/Rec	Commercial/Recreational
conn.	connection
cont.	continued
CPVC	chlorinated polyvinyl chloride
crit.	critical
CRT	cathode ray tube
CSA	Canadian Standards Association
CT	current transformer
Cu	copper
cu. in.	cubic inch
cw.	clockwise
CWC	city water-cooled
cyl.	cylinder
D/A	digital to analog
DAC	digital to analog converter
dB	decibel
dBA	decibel (A weighted)
DC	direct current
DCR	direct current resistance
deg., °	degree
dept.	department
dia.	diameter
DI/EO	dual inlet/end outlet
DIN	Deutsches Institut fur Normung e. V. (also Deutsche Industrie Normenausschuss)
DIP	dual inline package
DPDT	double-pole, double-throw
DPST	double-pole, single-throw
DS	disconnect switch
DVR	digital voltage regulator
E, emer.	emergency (power source)
EDI	electronic data interchange
EFR	emergency frequency relay
e.g.	for example (*exempli gratia)*
EG	electronic governor
EGSA	Electrical Generating Systems Association
EIA	Electronic Industries Association
EI/EO	end inlet/end outlet
EMI	electromagnetic interference
emiss.	emission
eng.	engine
EPA	Environmental Protection Agency
EPS	emergency power system
ER	emergency relay
ES	engineering special, engineered special
ESD	electrostatic discharge
est.	estimated
E-Stop	emergency stop
etc.	et cetera (and so forth)
exh.	exhaust
ext.	external
F	Fahrenheit, female
fglass.	fiberglass
FHM	flat head machine (screw)
fl. oz.	fluid ounce
flex.	flexible
freq.	frequency
FS	full scale
ft.	foot, feet
ft. lb.	foot pounds (torque)
ft./min.	feet per minute
g	gram
ga.	gauge (meters, wire size)
gal.	gallon
gen.	generator
genset	generator set
GFI	ground fault interrupter
GND, ⏚	ground
gov.	governor
gph	gallons per hour
gpm	gallons per minute
gr.	grade, gross
GRD	equipment ground
gr. wt.	gross weight
H x W x D	height by width by depth
HC	hex cap
HCHT	high cylinder head temperature
HD	heavy duty
HET	high exhaust temperature, high engine temperature
hex	hexagon
Hg	mercury (element)
HH	hex head
HHC	hex head cap
HP	horsepower
hr.	hour
HS	heat shrink
hsg.	housing
HVAC	heating, ventilation, and air conditioning
HWT	high water temperature
Hz	hertz (cycles per second)
IC	integrated circuit
ID	inside diameter, identification
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IMS	improved motor starting
in.	inch
in. H_2O	inches of water
in. Hg	inches of mercury
in. lb.	inch pounds
Inc.	incorporated
ind.	industrial
int.	internal
int./ext.	internal/external
I/O	input/output
IP	iron pipe
ISO	International Organization for Standardization
J	joule
JIS	Japanese Industry Standard

k	kilo (1000)
K	kelvin
kA	kiloampere
KB	kilobyte (2^{10} bytes)
kg	kilogram
kg/cm^2	kilograms per square centimeter
kgm	kilogram-meter
kg/m^3	kilograms per cubic meter
kHz	kilohertz
kJ	kilojoule
km	kilometer
kOhm, kΩ	kilo-ohm
kPa	kilopascal
kph	kilometers per hour
kV	kilovolt
kVA	kilovolt ampere
kVAR	kilovolt ampere reactive
kW	kilowatt
kWh	kilowatt-hour
kWm	kilowatt mechanical
L	liter
LAN	local area network
L x W x H	length by width by height
lb.	pound, pounds
lbm/ft^3	pounds mass per cubic feet
LCB	line circuit breaker
LCD	liquid crystal display
ld. shd.	load shed
LED	light emitting diode
Lph	liters per hour
Lpm	liters per minute
LOP	low oil pressure
LP	liquefied petroleum
LPG	liquefied petroleum gas
LS	left side
L_{wa}	sound power level, A weighted
LWL	low water level
LWT	low water temperature
m	meter, milli (1/1000)
M	mega (10^6 when used with SI units), male
m^3	cubic meter
m^3/min.	cubic meters per minute
mA	milliampere
man.	manual
max.	maximum
MB	megabyte (2^{20} bytes)
MCM	one thousand circular mils
MCCB	molded-case circuit breaker
meggar	megohmmeter
MHz	megahertz
mi.	mile
mil	one one-thousandth of an inch
min.	minimum, minute
misc.	miscellaneous
MJ	megajoule
mJ	millijoule
mm	millimeter
mOhm, mΩ	milliohm
MOhm, MΩ	megohm
MOV	metal oxide varistor
MPa	megapascal
mpg	miles per gallon
mph	miles per hour
MS	military standard
m/sec.	meters per second
MTBF	mean time between failure
MTBO	mean time between overhauls
mtg.	mounting
MW	megawatt
mW	milliwatt
μF	microfarad
N, norm.	normal (power source)
NA	not available, not applicable
nat. gas	natural gas
NBS	National Bureau of Standards
NC	normally closed
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
Nm	newton meter
NO	normally open
no., nos.	number, numbers
NPS	National Pipe, Straight
NPSC	National Pipe, Straight-coupling
NPT	National Standard taper pipe thread per general use
NPTF	National Pipe, Taper-Fine
NR	not required, normal relay
ns	nanosecond
OC	overcrank
OD	outside diameter
OEM	original equipment manufacturer
OF	overfrequency
opt.	option, optional
OS	oversize, overspeed
OSHA	Occupational Safety and Health Administration
OV	overvoltage
oz.	ounce
p., pp.	page, pages
PC	personal computer
PCB	printed circuit board
pF	picofarad
PF	power factor
ph., ∅	phase
PHC	Phillips head crimptite (screw)
PHH	Phillips hex head (screw)
PHM	pan head machine (screw)
PLC	programmable logic control
PMG	permanent-magnet generator
pot	potentiometer, potential
ppm	parts per million
PROM	programmable read-only memory
psi	pounds per square inch
pt.	pint
PTC	positive temperature coefficient
PTO	power takeoff
PVC	polyvinyl chloride
qt.	quart, quarts
qty.	quantity
R	replacement (emergency) power source
rad.	radiator, radius
RAM	random access memory
RDO	relay driver output
ref.	reference
rem.	remote
Res/Coml	Residential/Commercial
RFI	radio frequency interference
RH	round head
RHM	round head machine (screw)
rly.	relay
rms	root mean square
rnd.	round
ROM	read only memory
rot.	rotate, rotating
rpm	revolutions per minute
RS	right side
RTV	room temperature vulcanization
SAE	Society of Automotive Engineers
scfm	standard cubic feet per minute
SCR	silicon controlled rectifier
s, sec.	second
SI	*Systeme international d'unites,* International System of Units
SI/EO	side in/end out
sil.	silencer
SN	serial number
SPDT	single-pole, double-throw
SPST	single-pole, single-throw
spec, specs	specification(s)
sq.	square
sq. cm	square centimeter
sq. in.	square inch
SS	stainless steel
std.	standard
stl.	steel
tach.	tachometer
TD	time delay
TDC	top dead center
TDEC	time delay engine cooldown
TDEN	time delay emergency to normal
TDES	time delay engine start
TDNE	time delay normal to emergency
TDOE	time delay off to emergency
TDON	time delay off to normal
temp.	temperature
term.	terminal
TIF	telephone influence factor
TIR	total indicator reading
tol.	tolerance
turbo.	turbocharger
typ.	typical (same in multiple locations)
UF	underfrequency
UHF	ultrahigh frequency
UL	Underwriter's Laboratories, Inc.
UNC	unified coarse thread (was NC)
UNF	unified fine thread (was NF)
univ.	universal
US	undersize, underspeed
UV	ultraviolet, undervoltage
V	volt
VAC	volts alternating current
VAR	voltampere reactive
VDC	volts direct current
VFD	vacuum fluorescent display
VGA	video graphics adapter
VHF	very high frequency
W	watt
WCR	withstand and closing rating
w/	with
w/o	without
wt.	weight
xfmr	transformer

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