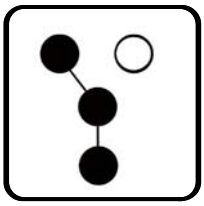
Service and Parts

Automatic Transfer Switches



Model:

RXT

100–400 Amp Automatic Transfer Switches

For use with Kohler® generator sets equipped with RDC2 or DC2 generator/transfer switch controllers

ISO 9001 KOHLER POWER SYSTEMS NATIONALLY REGISTERED

KOHLER® Power Systems

TP-6808 3/15b

Product Identification Information

Product identification numbers determine service parts. Record the product identification numbers in the spaces below immediately after unpacking the products so that the numbers are readily available for future reference. Record field-installed kit numbers after installing the kits.

Transfer Switch Identification Numbers

Record the product identification numbers from the transfer switch nameplate.

Model Designation _____

Serial Number _____

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Table of Contents, continued

Notes

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***.

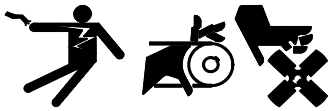
NOTICE

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 equipment connected to the set, disable the generator set as follows: (1) Press the generator set off/reset button to shut down the generator set. (2) Disconnect the power to the battery charger, if equipped. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent the starting of the generator set by the remote start/stop switch.

Hazardous Voltage/ Moving Parts

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.

Only authorized personnel should open the enclosure.

WARNING

Hazardous voltage. Moving parts.
Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

WARNING

Hazardous voltage.
Can cause severe injury or death.

Close and secure the enclosure door before energizing the transfer switch.

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

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.

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.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Turn off 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

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

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

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.

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.

This manual provides service and parts information for Kohler® Model RXT automatic transfer switches. See Figure 1 for typical Model RXT transfer switches.

Model RXT transfer switches operate only with Kohler® generator sets equipped with the RDC2 or DC2 generator/transfer switch controller. See Figure 2 for controller identification.

This manual covers troubleshooting, repair, maintenance, and service parts for the transfer switch including the power switching device and electrical controls. This manual is intended for use only by authorized personnel trained and qualified to work on electrical equipment.

Information in this publication represents data available at the time of print. Kohler Co. 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.

Figure 1 Typical Model RXT Transfer Switches (shown with optional status indicators)

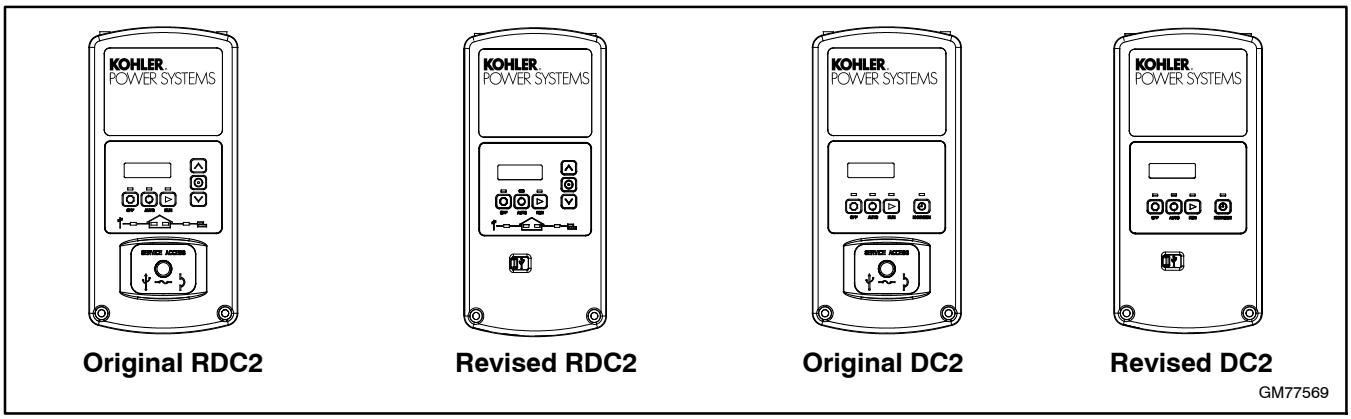


Figure 2 RDC2 and DC2 Generator/Transfer Switch Controllers (mounted on the generator set)

List of Related Materials

Refer to the transfer switch Operation and Installation Manual for information on installation, operation, and routine maintenance. The following table lists the available literature part numbers.

For RDC2 or DC2 controller operation, installation, and service information, refer to the documentation for the generator set.

Document	Part Number
Specification Sheet, Model RXT	G11-121
Specification Sheet, Model RXT (11/14 and later)	G11-140
Operation and Installation Manual, Model RXT Transfer Switch	TP-6807
Installation Instructions, ATS Status Indicator	TT-1585
Installation Instructions, Load Control Module (LCM)	TT-1574
Installation Instructions, Load Shed Kit	TT-1609
Operation Manual, SiteTech™ Software	TP-6701
Operation Manual, OnCue® Plus Software	TP-6928

Service Assistance

For professional advice on generator set power requirements and conscientious service, please contact your nearest Kohler distributor or dealer.

- Consult the Yellow Pages under the heading Generators—Electric.
- Visit the Kohler Power Systems website at KOHLERPower.com.
- Look at the labels and stickers on your Kohler product or review the appropriate literature or documents included with the product.
- Call toll free in the US and Canada 1-800-544-2444.
- Outside the US and Canada, call the nearest regional office.

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4761 ZC Zevenbergen
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China
North China Regional Office, Beijing
Phone: (86) 10 6518 7950
(86) 10 6518 7951
(86) 10 6518 7952
Fax: (86) 10 6518 7955

East China Regional Office, Shanghai
Phone: (86) 21 6288 0500
Fax: (86) 21 6288 0550

India, Bangladesh, Sri Lanka
India Regional Office
Bangalore, India
Phone: (91) 80 3366208
(91) 80 3366231
Fax: (91) 80 3315972

Japan, Korea
North Asia Regional Office
Tokyo, Japan
Phone: (813) 3440-4515
Fax: (813) 3440-2727

Latin America
Latin America Regional Office
Lakeland, Florida, USA
Phone: (863) 619-7568
Fax: (863) 701-7131

Notes

1.1 Specifications

Note: Transfer switch specifications are shown here for reference. Refer to the transfer switch dimension drawings for weights and dimensions. See the dimension drawings, wiring diagrams, and labels on the transfer switch for cable sizes and other wiring information.

Item	Specification
Operating Temperature	-20°C to 70°C (-4°F to 158°F)
Storage Temperature	-40°C to 85°C (-40°F to 185°F)
Humidity	5 to 95% noncondensing

Figure 1-1 Environmental Specifications

Amps	Description	Shipping Weight * kg	(lb.)
100	Single phase	7	(15)
	With 12- or 16-space load center (NEMA 1)	12	(26)
	With 16-space load center	9	(20)
	Three phase	15	(34)
	Service entrance (ASE)	12	(26)
	Service entrance (CSE)	14	(30)
150-200	Service entrance (ASE)	14	(30)
	Service entrance (CSE)	16	(34)
200	Single phase	8	(17)
	Three phase	16	(35)
300	Service entrance	59	(130)
400	Single phase	50	(110)
	3-Pole/208-240 volts	54	(120)
	3-Pole/480 volts	68	(150)
	4-Pole	73	(160)
	Service entrance	59	(130)

* Shipping weights are approximate and include packaging.

Note: Enclosures are type NEMA 3R except as noted.

Figure 1-2 Approximate Weights (see Note)

Cable Sizes						
AL/CU UL-Listed Solderless Screw-Type Terminals for External Power Connections						
Switch Size, Amps	Switch	Phases	Range of Wire Sizes, Cu/Al			
			Normal and Emergency	Load	Neutral	Ground
100	Standard	1	(1) #14 - 1/0 AWG	(1) #14 – 1/0 AWG	(3) #12 to 250 KCMIL (Cu) or (3) #10 to 250 KCMIL (Al)	(9) #4 – 14 AWG
	With load center	1	(1) #14 – 1/0 AWG	per customer-supplied circuit breaker	(1) #6 – 2/0 AWG	
	Service Entrance	1	Normal: (1) #12 – 2/0 AWG Emerg: (1) #6 – 250 MCM	(1) #6 – 250 MCM	(3) #12 to 250 KCMIL (Cu) or (3) #10 to 250 KCMIL (Al)	(3) #14 – 1/0 AWG
	3-Phase	3	(1) #8 – 3/0 AWG	(1) #8 – 3/0 AWG	(3) #6 AWG – 3/0 AWG	(3) #6 – 3/0 AWG
150 200	Service Entrance	1	Normal: (1) #4 – 300 MCM Emerg: (1) #6 - 250 MCM	(1) #6 AWG – 250 MCM	(3) #12 to 250 KCMIL (Cu) or (3) #10 to 250 KCMIL (Al)	(3) #14 – 1/0 AWG
200	Standard	1	(1) #6 AWG – 250 MCM	(1) #6 AWG – 250 MCM	(3) #12 to 250 KCMIL (Cu) or (3) #10 to 250 KCMIL (Al)	(9) #4 – 14 AWG
	3-Phase	3	(1) #6 AWG – 250 MCM	(1) #6 AWG – 250 MCM	(3) #4 AWG – 600 MCM (6) 1/0 – 250 MCM	(3) #6 – 3/0 AWG
300 400	Service Entrance	1	Normal: : (1) #1 - 600 MCM or (2) #1 – 250 MCM Emerg: (2) #6 - 250 MCM	(2) #6 – 250 MCM	(3) #4 – 600 MCM (6) 1/0 – 250 MCM	(3) #6 – 3/0 AWG
400	Standard	1	(2) #6 – 250 MCM	(2) #6 – 250 MCM	(3) #4 – 600 MCM (6) 1/0 – 250 MCM	(3) #6 – 3/0 AWG
	3-pole 208-240 V	3				
	3 or 4 pole 480 V	3	(1) #4 – 600 MCM (2) #6 – 250 MCM	(1) #4 – 600 MCM (2) #6 – 250 MCM		

Figure 1-3 Cable Sizes (see Note)

Terminal Block	Connection	Designation	Description	Wire Size
P10	P10-1	A	Communication Line	20 AWG shielded twisted-pair, Belden 9402 or equivalent
	P10-2	B	Communication Line	
	P10-3	PWR	12 VDC	20 AWG shielded twisted-pair Belden 9402 or 12–14 AWG wire
	P10-4	COM	12 VDC	
P11 †	P11–1 P11–2	LOAD	Load Control Contact rating: 10 A @ 250 VAC	Wire Size: #12–18 AWG
† Load control connection on standard interface board only				

Figure 1-4 Controller Interface Board Connections (also see Section 4.4.2 and the wiring diagrams in Section 6.)

Connection	Rating	Connection
Pilot Relays*	125VAC, 10 A total (general purpose) 120VAC, 125VA (pilot duty)	#12–20 AWG
HVAC Relays (qty. 2)	125VAC, 10 A (general purpose) 120VAC, 125VA (pilot duty)	#12–20 AWG
RBUS Communication and Power Connections to the RDC2/DC2 controller	0.5 A @ 12 VDC	Use Belden #9402 or equivalent 20 AWG shielded, twisted-pair communications cable †

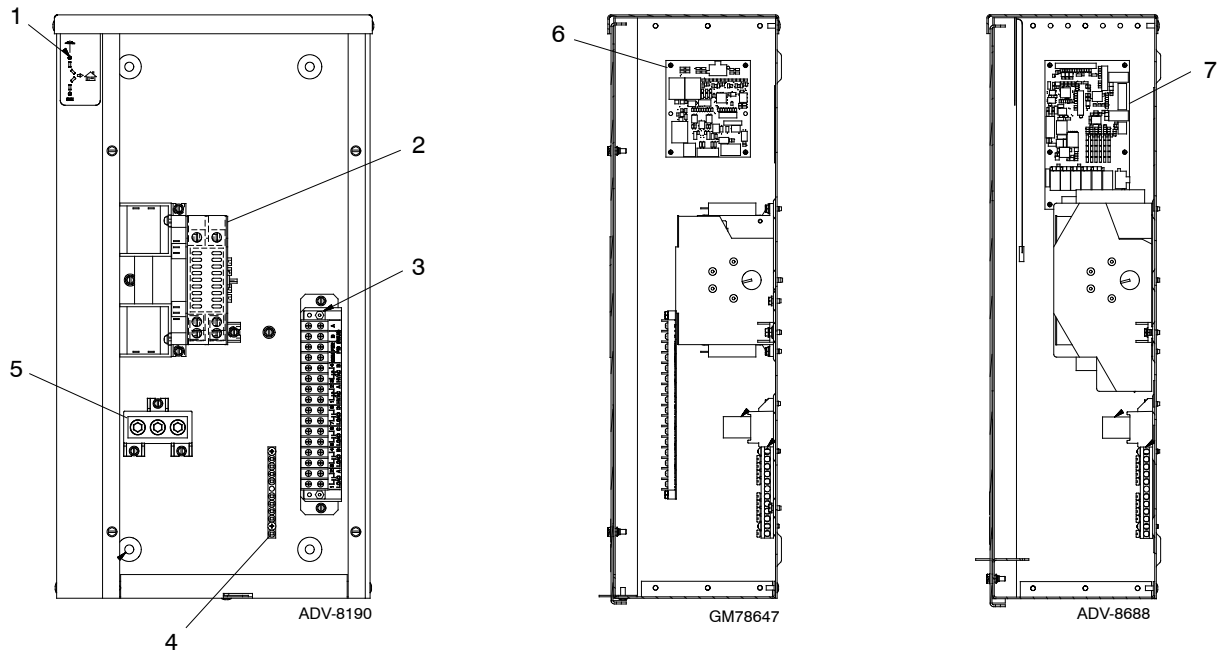
* Four (4) pilot relays are provided for customer-supplied load-switching contactors/relays. The combination of four load relay outputs cannot exceed 10 amps total current draw.

† For long distances, use an equivalent shielded, twisted–pair cable for RBUS connections and individual 12–20 AWG wires (qty. 2) for power connections.

Figure 1-5 Combined Interface/Load Management Board Load Control Specifications

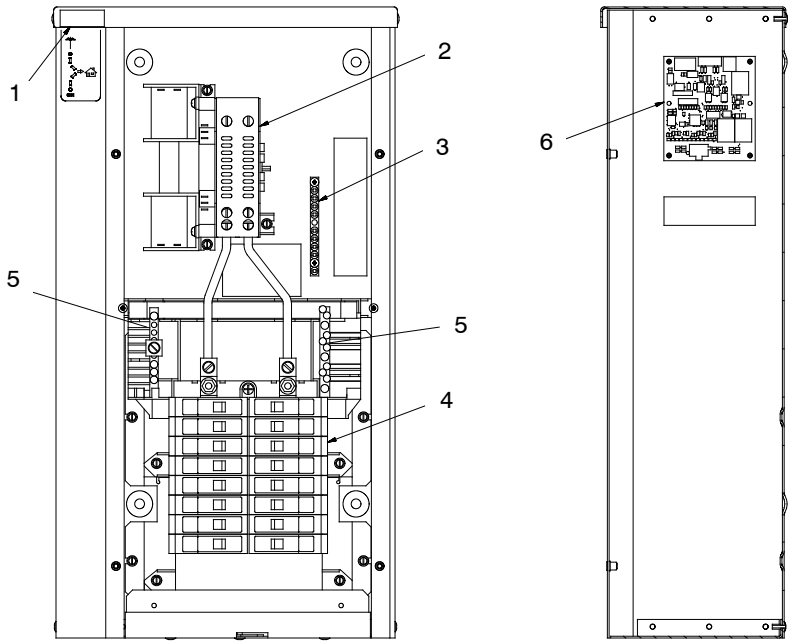
1.2 Transfer Switch Components

The illustrations in this section show the locations of major components of the transfer switch. Also refer to the dimension drawings included in the Operation and Installation Manual provided with the transfer switch.



1. LED status indicator panel (optional)
2. Contactor assembly
3. Load shed kit (optional)
4. Equipment ground
5. Neutral
6. Standard controller interface board
7. Optional combined interface/ load management board

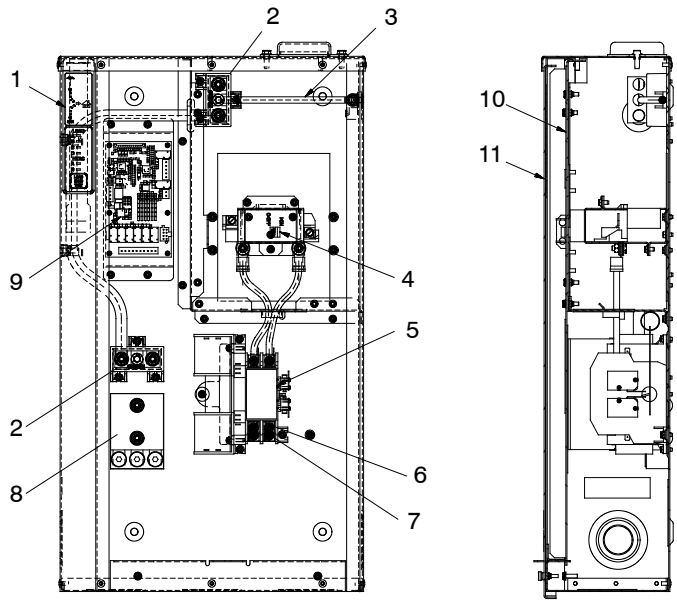
Figure 1-6 100/200 Amp Model without Load Center, Single-Phase Components



1. LED status indicator panel (optional)
2. Contactor assembly
3. Equipment ground
4. Load center (circuit breakers not supplied)
5. Neutral
6. Controller interface board

ADV-8197
GM79354

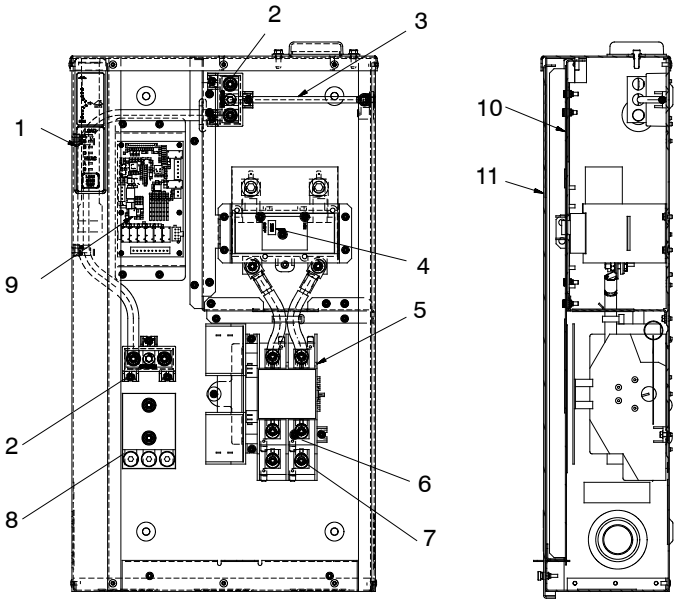
Figure 1-7 100 Amp Model with Load Center, Single-Phase Components



ADV-8665

1. LED status indicator panels (optional)
2. Neutral
3. Neutral bonding jumper
4. Utility disconnect
5. Transfer switch
6. Emergency source connection
7. Load connection
8. Ground
9. Controller interface board (optional combined interface/load management board shown)
10. Inner panel
11. Outer panel

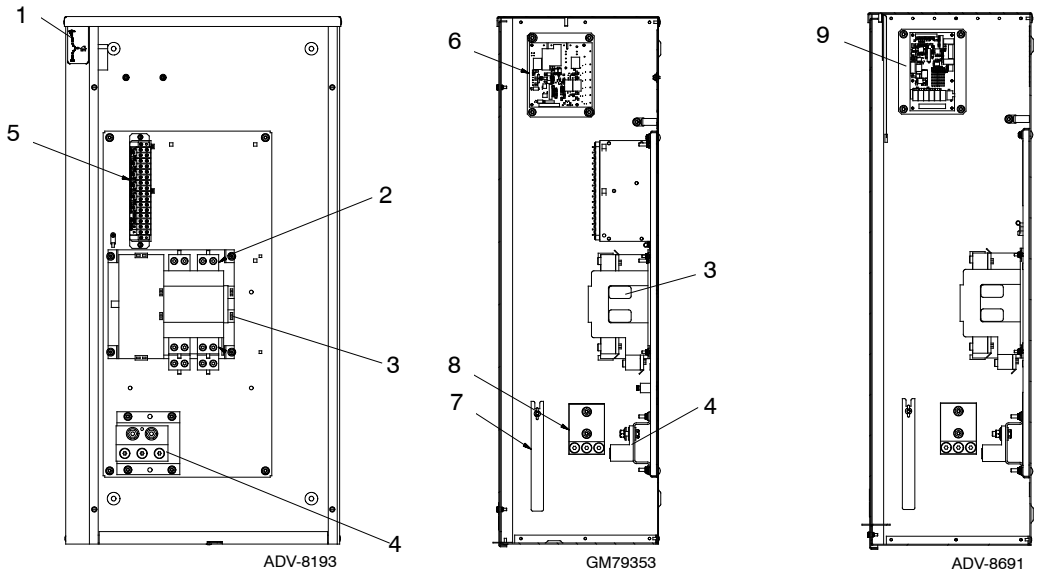
Figure 1-8 100 Amp, CSA Certified Service Entrance Model



ADV-8666

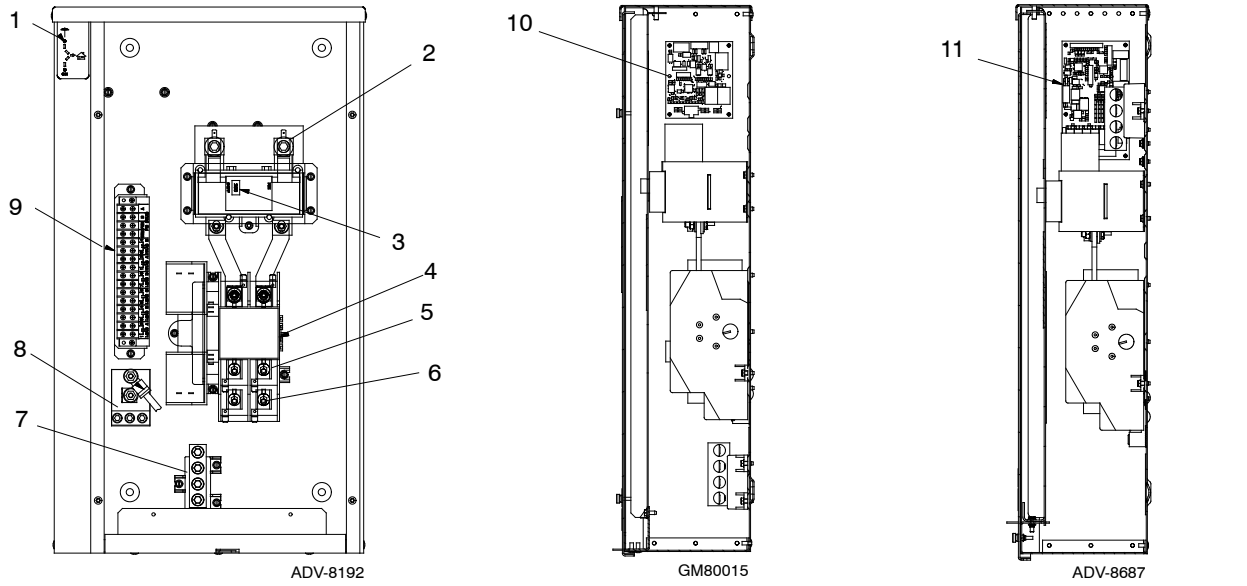
1. LED status indicator panels (optional)
2. Neutral
3. Neutral bonding jumper
4. Utility disconnect
5. Transfer switch
6. Emergency source connection
7. Load connection
8. Ground
9. Controller interface board (optional combined interface/load management board shown)
10. Inner panel
11. Outer panel

Figure 1-9 150–200 Amp, CSA Certified Service Entrance Model



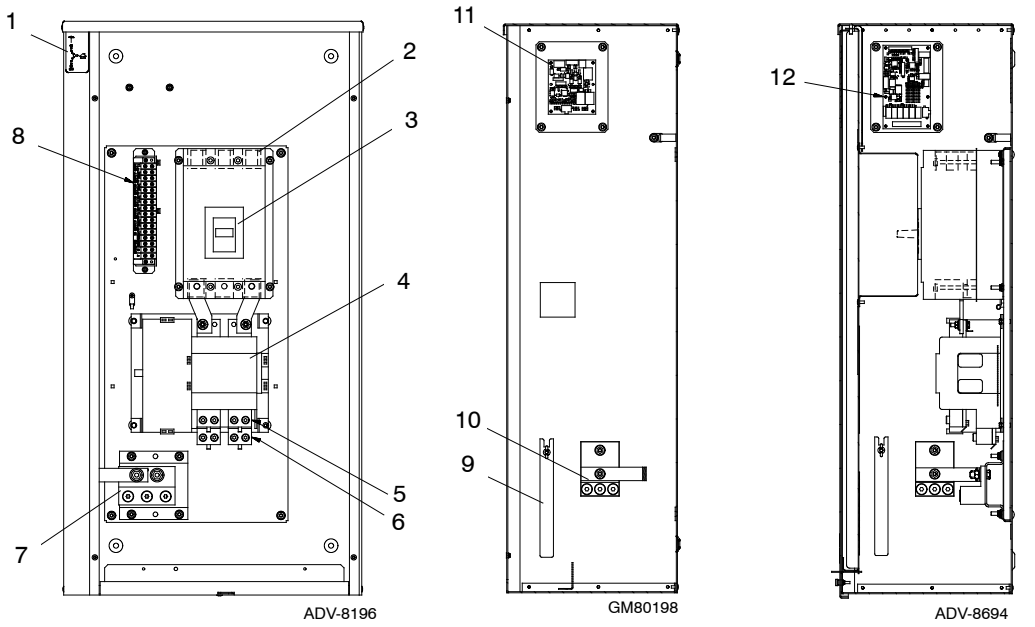
1. LED status indicator panel (optional)
2. Contactor assembly
3. Auxiliary and position-indicating contacts (optional)
4. Neutral
5. Load shed kit (optional)
6. Controller interface board
7. Manual operating handle (storage location)
8. Ground
9. Optional combined interface/load management board

Figure 1-10 400 Amp Model, Single-Phase Components



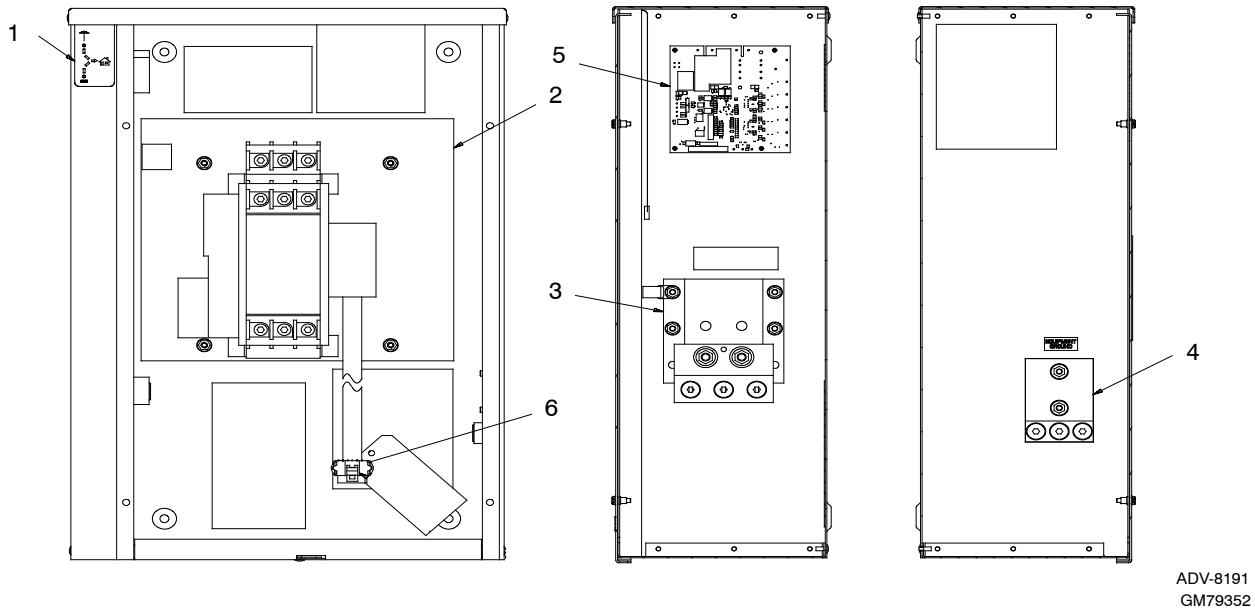
1. LED status indicator panel (optional)
2. Utility source connection
3. Utility service disconnect
4. Transfer switch
5. Emergency source connection
6. Load connection
7. Ground
8. Neutral with bonding strap (bonding strap required for service entrance applications)
9. Load shed kit (optional)
10. Controller interface board
11. Optional combined interface/load management board (single-phase only)

Figure 1-11 100–200 Amp Service Entrance Model, Components (200 A shown)



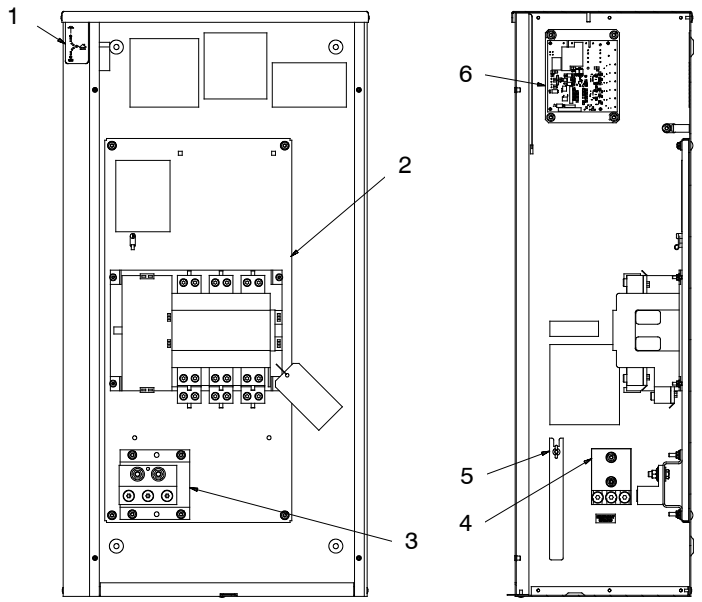
1. LED status indicator panel (optional)
2. Utility source connection
3. Utility service disconnect
4. Transfer switch
5. Emergency source connection
6. Load connection
7. Neutral with bonding strap
   (bonding strap required for service entrance applications)
8. Load shed kit (optional)
9. Manual operating handle (storage location)
10. Ground
11. Standard controller interface board
12. Optional combined interface/load management board

Figure 1-12 300/400 Amp Service Entrance Model, Components



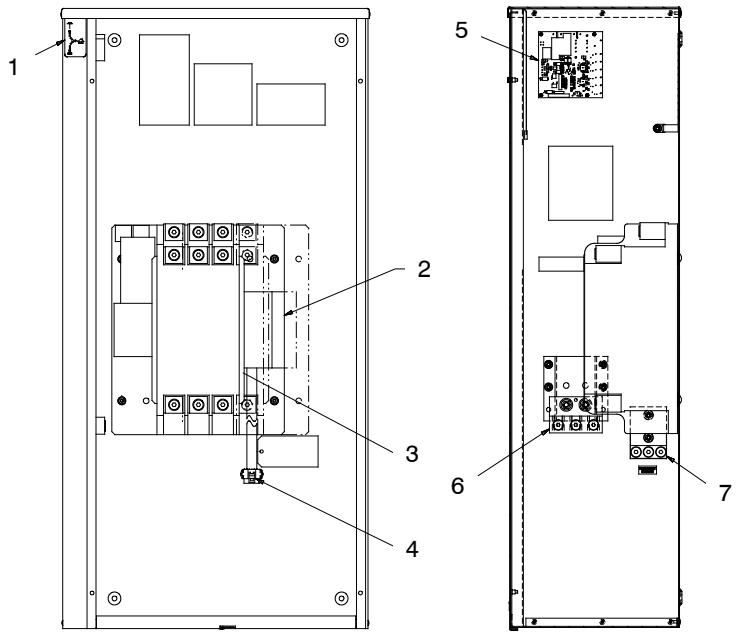
1. LED status indicator panel (optional)
2. Contactor assembly
3. Neutral
4. Equipment ground
5. Controller interface board (three-phase)
6. Inline connector (to interface board)

Figure 1-13 100/200 Amp Model, Three-Phase Components



1. LED status indicator panel (optional)
2. Contactor assembly
3. Neutral
4. Ground
5. Manual operating handle (storage location)
6. Controller interface board (three-phase)

Figure 1-14 400 Amp Model, 3 Pole/208–240V, Three-Phase Components



1. LED status indicator panel (optional)
2. Contactor assembly
3. Manual operating handle (storage location)
4. Inline connector (to interface board)
5. Controller interface board
6. Neutral
7. Ground

Figure 1-15 400 Amp Model, 3 Pole/480V & 4 Pole, Three-Phase Components

Notes

2.1 Model RXT Transfer Switch Operation

The Model RXT transfer switch must be connected to a generator set equipped with the RDC2 or DC2 controller. The RDC2/DC2 generator set/transfer switch controller manages automatic transfer switch (ATS) functions when connected to a Kohler® Model RXT transfer switch through the ATS interface board. The controller receives voltage sensing data from the Model RXT ATS and operates the generator set and transfer switch to provide standby power when utility power is lost. The RDC2/DC2 controller must be in AUTO for automatic transfer switch operation.

See the generator set operation manual for information about loaded exercise.

2.2 Sources

2.2.1 Terminology

The transfer switch labels and diagrams refer to the Normal source and the Emergency source. In this document, Normal refers to the source connected to the normal side of the ATS contactor, and is typically utility power. Emergency refers to the source connected to the emergency side of the contactor and is typically the standby generator set.

2.2.2 Source Availability

The Model RXT transfer switch supplies voltage sensing data to the RDC2 or DC2 controller through the ATS interface board. If the source voltage falls below the undervoltage dropout setting, the source is considered to have failed. See Figure 2-1.

After failure, the source voltage must rise to the pickup setting to be considered acceptable. See Sections 5.3 and 5.4 for more information on source sensing.

Voltage Sensing Parameter	Setting
Accuracy	±5%
Undervoltage Dropout	90% of Pickup
Undervoltage Pickup	90% of Nominal

Figure 2-1 Voltage Sensing Parameters

2.3 ATS Control Sequence of Operation

See Figure 2-2 for time delay settings.

Normal (Utility) Source Fails:

1. The load control contact opens.
2. The engine start time delay times out.
3. The generator set is signaled to start.
4. The generator starts and the emergency source becomes available.
5. The normal-to-emergency time delay times out.
6. The transfer switch transfers to the emergency source (generator set).
7. The load control contact time delay times out.
8. The load control contact closes.

Normal Source Returns:

1. The emergency-to-normal time delay times out.
2. The contactor transfers to the normal (utility) source.
3. The engine cooldown time delay times out.
4. The generator set is signaled to stop.

2.4 Time Delays

Time delays are factory-set to the values shown in Figure 2-2. An authorized distributor/dealer can adjust time delays using a personal computer and Kohler® SiteTech™ software.

Time delays described in this section operate only when the RDC2 or DC2 generator set controller is connected to a Kohler® Model RXT transfer switch.

The engine start and load transfer time delays prevent nuisance engine starts and load transfers caused by brief variations in the utility power source.

2.5 Load Control Time Delay

The load control output is included on the standard interface board. The combined interface/load management board is not equipped with this output.

Connector P11 on the standard interface module provides a connection point for optional load control circuits. See the transfer switch operation and installation manual for connection instructions.

The load control contact provides a delayed contact closure to allow startup of selected loads 5 minutes after transfer to the emergency power source (generator set). Use this contact to delay startup of equipment with large motor-starting loads such as air conditioners. The load control time delay is fixed at 5 minutes. It is not adjustable.

Note: For load add and load shed operation based on generator capacity, use the LCM, load shed kit, or the combined interface/load management board.

Time Delay	Setting	Description
Engine Start	3 seconds	Time delay after utility source is lost until the engine start cycle begins. Guards against starting the generator set because of a brief change in the utility source.
Transfer, Normal to Emergency	3 seconds	Time delay after emergency source becomes available until transfer to emergency source.
Transfer, Emergency to Normal	2 minutes	Time delay after the utility source returns until transfer back to normal. Ensures that the utility source is stable before transferring from the emergency source.
Load Control	5 minutes	Allows delayed connection of selected loads to the generator set. Prevents simultaneous starting of large motors after transfer to the emergency source. Recommended for delayed starting of air conditioners.
* Load control contact is included on the standard interface board only.		

Figure 2-2 Time Delays

2.6 Load Management Theory of Operation

The load shed kit or the combined interface/load management board adds and sheds loads as described in the following sections.

Note: Use the load shed kit OR the combined interface/load management board. Do not install the load shed kit on a transfer switch equipped with the combined interface/load management board.

2.6.1 Load Add

The load management board adds and sheds loads based on the available capacity of the generator set. When the generator has ample available capacity, loads are added quickly. When the available capacity is low, loads are added more slowly to give the generator time to recover and to allow ample time to ensure that any switching loads will come on before adding more load than the generator can handle.

The load add time ranges from 15 to 120 seconds depending on the loading of the generator set. Figure 2-3 shows an example of the load add timing for a 20 kW generator set with the maximum capacity set to the default setting of 70%. Figure 2-4 shows the HVAC load add timing for a 20 kW generator set.

Available Capacity (%)	Load (%)	Load (kW) for a 20 kW Generator	Time (Seconds)
70%	0%	0	15
50%	20%	4	23
37%	33%	6.6	34
30%	40%	8	40
20%	50%	10	48
5%	65%	13	60
<5%	>65%	>13 kW	Never Add

Figure 2-3 Example: Power Relay Load Add Timing for a 20 kW Generator

Available Capacity (%)	Load (%)	Load (kW) for a 20 kW Generator	Time * (Seconds)
70%	0%	0	30
50%	20%	4	66
37%	33%	6.6	91
30%	40%	8	102
20%	50%	10	120
<20%	>50%	>10 kW	Never Add
* After the 5-minute HVAC delay			

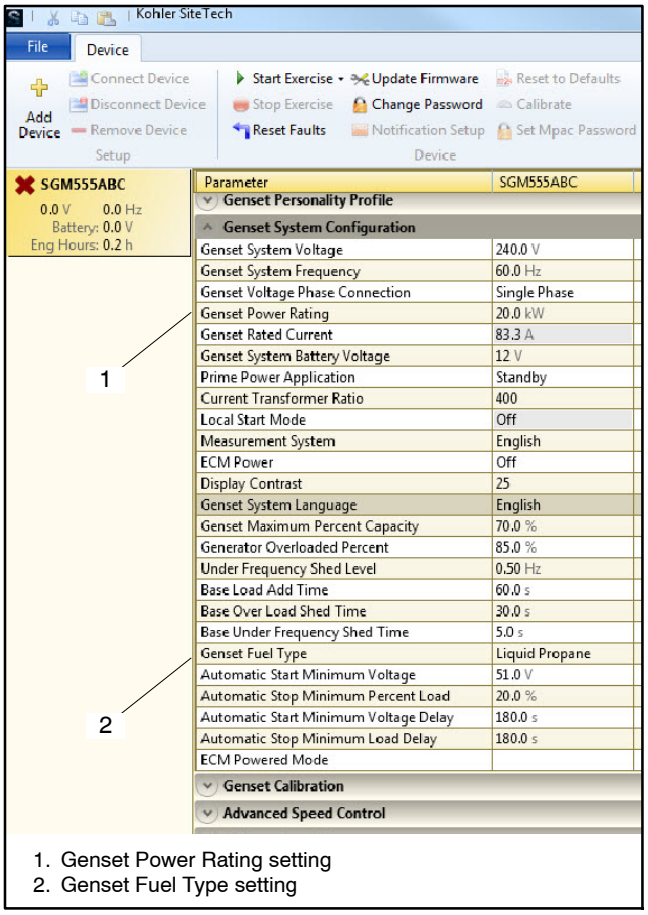
Figure 2-4 Example: HVAC Load Add Timing for a 20 kW Generator

Capacity

The Generator Maximum Percent Capacity setting dictates the maximum level that the load management board will automatically place on the generator. This setting is adjustable using a laptop computer connected to the RDC2 or DC2 controller and Kohler® SiteTech™ software. See Section 2.6.6.

The maximum load is calculated by multiplying the Generator Maximum Percent Capacity by the Genset Power Rating, which is a setting in the RDC2/DC2 controller. The Genset Power Rating, in kW, is factory-set to the natural gas rating. If the 14RESA or 20RESA has been converted to LP fuel, use SiteTech to verify that the fuel type has been changed on the controller and the Genset Power Rating is correct. Refer to the generator set specification sheet for the new rating, and change the fuel type under the Genset System Configuration in SiteTech™. See Figure 2-5 and TP-6701, SiteTech Software Operation Manual.

The load management function will operate if the rating setting is not changed, but loads will be shed at a kW level based on the factory default rating, rather than the rating of the reconfigured generator set.



1. Genset Power Rating setting
2. Genset Fuel Type setting

Figure 2-5 Genset Power Rating in SiteTech™

2.6.2 Load Shed

Less important (larger priority number) loads are shed when the generator is unable to support them. This permits more important loads to continue to receive power from the generator. The less important loads are re-added after the generator loading has gone down enough to support them again. The load management board sheds less important loads before the power quality of the generator suffers from the overload.

Loads are shed in two ways – Overload and Under Frequency.

2.6.3 Overload Shed

Loads are shed on a time scale which is based on the total generator overload. The loads will shed slowly when the generator is not heavily overloaded. Loads are shed much more quickly when the overload is higher. The timing variation allows consistent overloads to be removed, instantaneous excessive overloads to be very quickly removed and normal overloads (such as motor inrush) to remain online until the transient overload condition is removed.

Figure 2-6 shows the overload shed timing for a 20 kW generator set with the generator overloaded percent set to the default setting of 85%. If the overload condition persists, the load shed timing can be affected by load shed acceleration. See Section 2.6.5.

The Generator Overload Percent setting is the maximum load that the load management board will accept without shedding. The setting is adjustable using a laptop computer connected to the RDC2 or DC2 controller and Kohler® SiteTech™ software. See Section 2.6.6. Set the Generator Overload Percent at least 10% higher than the Generator Maximum Percent Capacity.

Generator Overload (%)	Load (%)	Load (kW) for a 20 kW Generator	Time (seconds)
0%	<85%	<17 kW	Never Shed
0%	85%	17	40
10%	95%	19	28
13%	98%	19.6	24
15%	100%	20	22
20%	105%	21	17
>35%	>120%	>24 kW	0.5

Figure 2-6 Overload Shed Timing for a 20 kW Generator

2.6.4 Under Frequency Shed

Loads are shed on a time scale which is based on the generator frequency droop. The loads will shed quickly when the frequency droop is high (output frequency is lower), and more slowly when the generator is running close to rated frequency. The timing variation allows large overloads to be shed very quickly, while allowing the generator to ride through normal transients (such as starting an AC compressor).

Figure 2-7 shows the under frequency shed timing for a 60 Hz generator set. If the underfrequency condition persists, the load shed timing can be affected by load shed acceleration. See Section 2.6.5.

Frequency (Hz)	Frequency Droop (Hz)	Time (seconds)
>59 Hz	<1 Hz	Never Shed
58.5	1.5	5.4
57	3	4.3
56	4	3.4
54	6	1.8
<52.5 Hz	>7.5 Hz	0.3

Figure 2-7 Under Frequency Shed Timing for a 60Hz Generator

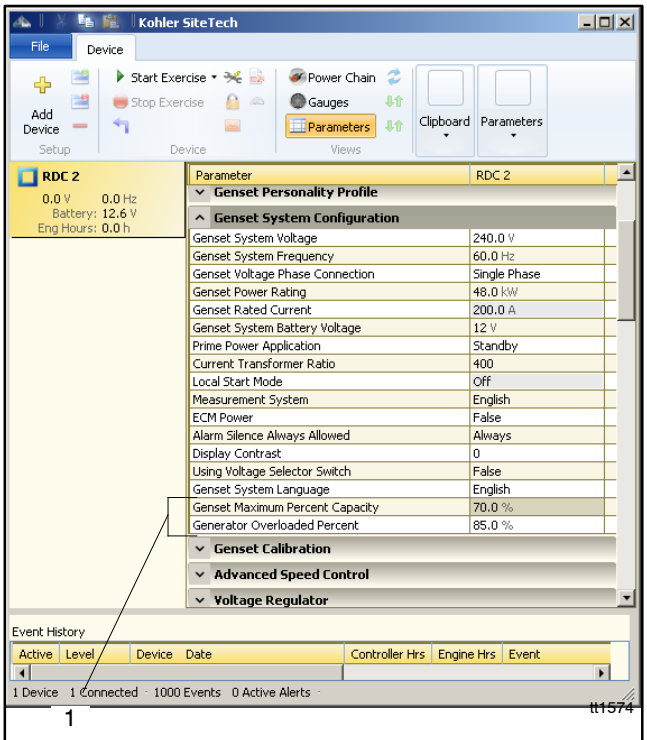
2.6.5 Load Shed Acceleration

Load shed acceleration is used to shed loads more quickly if an overload or underfrequency condition persists. If an overload condition is not cleared by shedding a load, each subsequent load will shed more quickly. The acceleration is more pronounced for an underfrequency shed.

2.6.6 Changing Settings

The Generator Maximum Percent Capacity and Generator Overloaded Percent settings can be changed using a laptop computer connected to the RDC2 or DC2 controller and Kohler® SiteTech™ software. The load control settings are found in the Genset System Configuration group. See Figure 2-8 and TP-6701, SiteTech Software Operation Manual.

Set the Generator Overload Percent at least 10% higher than the Generator Maximum Percent Capacity.



1. Load shed settings

Figure 2-8 SiteTech Screen

2.7 Manual Operation Check

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

Check the manual operation before energizing the transfer switch. Verify that the contactor operates smoothly without binding. Do not place the transfer switch into service if the contactor does not operate smoothly.

After checking the manual operation, place the contactor in the Normal (utility) position.

See Figure 2-9 to identify the manual operation procedure for your transfer switch.

ATS	Procedure	Figure
100–200 amps, 1-phase	2.7.1	Figure 2-10
100–200 amps, 3-phase	2.7.2	Figure 2-12
400 amps, 1-phase	2.7.1	Figure 2-11
400 amps, 3-phase, 3-pole, 208–240 Volts	2.7.1	Figure 2-11
400 amps, 3-phase, 3-pole/480 Volt and 4-pole	2.7.2	Figure 2-13

Figure 2-9 Manual Operation Procedure Guide

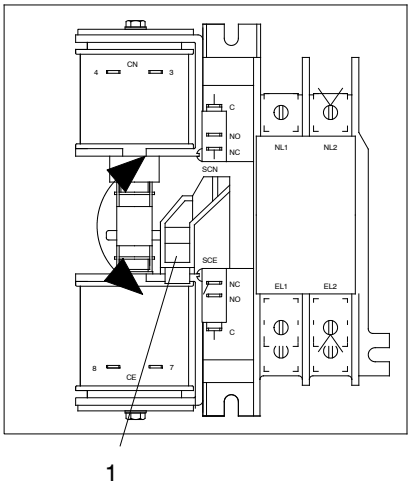
2.7.1 Manual Operation Procedure 1

Note: Never manually operate the transfer switch when the power is connected. Disconnect both power sources before manually operating the switch.

5. 100-200 amp switches: These switches have an attached handle as shown in Figure 2-10.
   400 amp switches: Slide the detachable handle or a wrench over the shaft. See Figure 2-11.

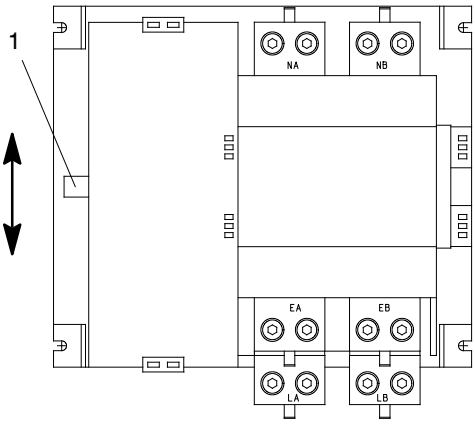
6. Move the handle up to place the transfer switch in the Normal Source position or down to place the contactor in the Emergency Source position. See Figure 2-10 or Figure 2-11.

7. 400 amp switches: Remove the detachable handle or wrench.



1. Handle (not detachable)

Figure 2-10 Manual Operation, 100 and 200 Amp Single-Phase Switches



1. Shaft (attach handle or wrench here)

Figure 2-11 Manual Operation, 300/400 Amp Single-Phase and 208–240 Volt Switches

2.7.2 Manual Operation Procedure 2

Note: Never use the maintenance handle to transfer the load with the power connected. Disconnect both power sources before manually operating the switch.

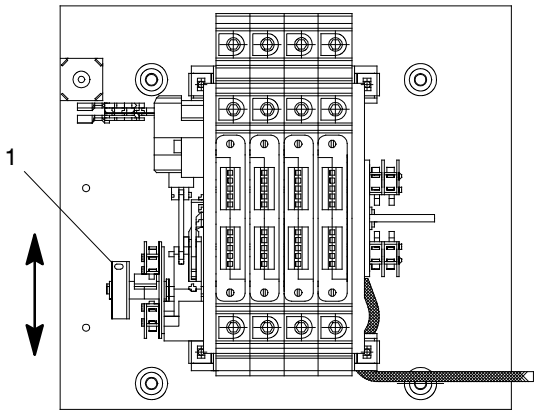
1. If the transfer switch is equipped with a maintenance handle, remove the handle from its storage location inside the enclosure. See Figure 2-13.

2. Insert the maintenance handle or a tool (such as a screwdriver) into the hole in the shaft on the left side of the operator as shown in Figure 2-12 or Figure 2-13.

3. Move the maintenance handle (or tool) up or down as shown to manually operate the transfer switch. It should operate smoothly without any binding. If it does not, check for shipping damage or construction debris.

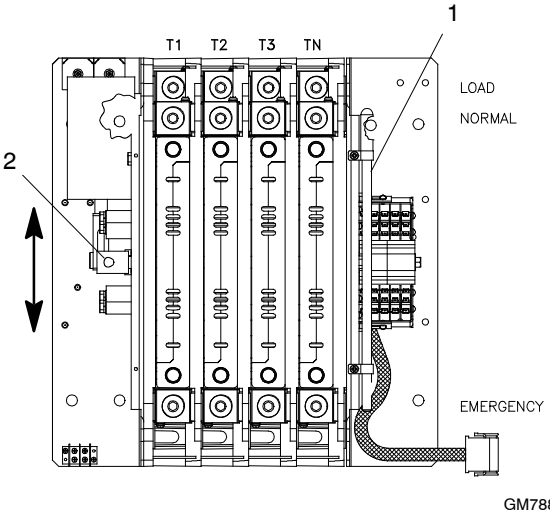
4. Return the transfer switch to the Normal position.

5. Remove the maintenance handle and return it to the storage location.



1. Insert handle or tool here for manual operation

Figure 2-12 Manual Operation, 100–200 Amp 3-Phase Switches



1. Handle storage location
2. Insert handle here for manual operation

Figure 2-13 Manual Operation, 400 Amp 3-Phase Switches

2.8 Automatic Operation Test

To test the automatic operation of the transfer switch, use the generator set controller to schedule a loaded exercise. Refer to the generator set operation manual for instructions to set the exerciser.

Set the exercise mode to Loaded Full Speed. Set the Exercise time to a few minutes after the current time, and set the date to today's date. Press AUTO on the generator set controller.

Verify that the generator set engine starts and the transfer switch transfers the load. After 20 minutes, verify that the load transfers back to utility power. The generator set engine may run for a few minutes to cool down before shutting down.

Kohler® SiteTech™ or OnCue® can be used to shorten the exercise duration to 10 minutes, if desired. See Section 4.3 for SiteTech information.

To end the exercise early, press the OFF button on the RDC2 or DC2 controller. If the utility source is available, the transfer switch will transfer the load back to the normal source. The engine may run for a few minutes to cool down before stopping.

After testing is complete, reprogram the exerciser to run for 20 minutes weekly or every two weeks on the desired date and time.

See Section 5.5 for a procedure to simulate the loss of the Normal source and test the system operation.

Notes

3.1 Introduction

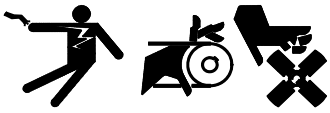
Regular preventive maintenance ensures safe and reliable operation and extends the life of the transfer switch. Preventive maintenance includes periodic testing, cleaning, inspecting, and replacing of worn or missing components. Section 3.4 contains a service schedule of recommended maintenance tasks.

A local authorized distributor/dealer can provide complete preventive maintenance and service to keep the transfer switch in top condition. Unless otherwise specified, have maintenance or service performed by an authorized distributor/dealer in accordance with all applicable codes and standards.

Keep records of all maintenance or service.

Replace all barriers and close and lock the enclosure door after maintenance or service and before reapplying power.

⚠ 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.

⚠ 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.

⚠ WARNING

Hazardous voltage. Moving parts.
Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

Grounding electrical equipment. Hazardous voltage can cause severe injury or death. Electrocution is possible whenever electricity is present. Ensure you comply with all applicable codes and standards. Electrically ground the generator set, transfer switch, and related equipment and electrical circuits. Turn off the main circuit breakers of all power sources before servicing the equipment. 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.

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)

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Turn off 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.

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

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.

3.2 Inspection and Service

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.

3.2.1 General Inspection

External Inspection. Inspect the transfer switch weekly.

- Look for signs of vibration, leakage, excessive noise, high temperature, contamination, or deterioration.
- Remove accumulations of dirt, dust, and other contaminants from the transfer switch's exterior with a vacuum cleaner or by wiping with a dry cloth or brush. *Do not use compressed air to clean the switch because it can cause debris to lodge in the components and damage the switch.*
- Replace any worn, missing, or broken external components with manufacturer-recommended replacement parts. Contact an authorized distributor/dealer for part information and ordering.
- Tighten loose external hardware.

Contact an authorized distributor/dealer to inspect and service the transfer switch when any wear, damage, deterioration, or malfunction of the transfer switch or its components is evident or suspected.

3.2.2 Internal Inspections and Maintenance

Internal Inspection. Have an authorized distributor/dealer perform an annual inspection of the transfer switch. Inspect the switch more frequently if it is located in a dusty or dirty area or when any condition noticed during an external inspection may have affected internal components. Disconnect all power sources, open the transfer switch enclosure, and inspect internal components. Look for:

- Accumulations of dirt, dust, moisture, or other contaminants
- Signs of corrosion
- Worn, missing, or broken components
- Loose hardware
- Wire or cable insulation deterioration, cuts, or abrasions
- Signs of overheating or loose connections: discoloration of metal, melted plastic, or a burning odor
- Other evidence of wear, damage, deterioration, or malfunction of the transfer switch or its components

Cleaning. Use a vacuum cleaner or a dry cloth or brush to remove contaminants from internal components. *Do not use compressed air to clean the switch because it can cause debris to lodge in the components and damage the switch.*

Periodically oil the enclosure door locks and screws.

Part Replacement and Tightening. Replace worn, missing, broken, deteriorated, or corroded internal components with manufacturer-recommended replacement parts. Contact an authorized distributor/dealer for part information and part ordering. Tighten loose internal hardware.

Terminal Tightening. Loose connections on the power circuits can lead to overheating or explosion. Tighten all lugs to the torque values shown on the label on the switch. Tighten engine start, input/output, and auxiliary connections to the torque indicated on the decals affixed to the unit. See Figure 3-1 and Figure 3-2 for general torque specifications for lugs and screw terminals.

Wire Size (AWG or MCM)	Torque		
	in. lb.	ft. lb.	Nm
8	75	6.2	8.5
6	110	9.2	12
4	110	9.2	12
2	150	13	17
1	150	13	17
1/0	180	15	20
2/0	180	15	20
3/0	250	21	28
4/0	250	21	28
250	325	27	37

Figure 3-1 Tightening Torque for Terminal Lugs

Wire Size (AWG or MCM)	Torque		
	in. lb.	ft. lb.	Nm
14	35	2.9	4.0
12	35	2.9	4.0
10	35	2.9	4.0
8	40	3.3	4.5
6	45	3.8	5.1
4	45	3.8	5.1

Figure 3-2 Tightening Torque for Screw Terminals

Signs of Overheating. Replace components damaged by overheating and locate the cause of the overheating. Overheating could be caused by loose power connections, overloading, or a short circuit in system. After tightening the power terminals, perform a millivolt drop test to locate areas with high contact resistance. See Section 3.3.3. Check the line circuit breakers in the system to be sure that they do not allow the load to exceed the switch rating. Use the controller troubleshooting and schematics to locate a control circuit short.

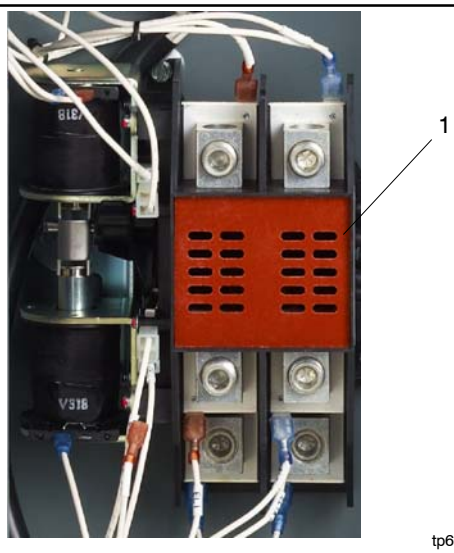
Wire Repair or Replacement. Replace wiring when there is any doubt about its condition or when there is extensive damage or deterioration. If the damaged or deteriorated wires are part of a wiring harness, replace the entire wiring harness.

Repair minor damage to leads in low power and control circuits operating up to 250 volts. Use UL-listed insulated (250 V minimum) connectors and follow the connector manufacturer's instructions. Fabricate new leads using the same type of wire and UL-listed insulated (250 V minimum) connectors and follow the connector manufacturer's instructions.

Power Circuit Wiring. Have damage to line voltage and power circuit wiring evaluated and repaired or replaced by a qualified electrician.

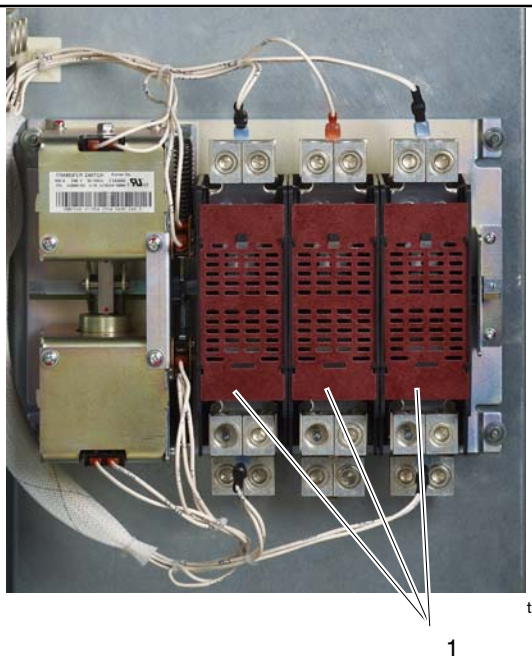
Transfer Switch Inspection. Remove the arc chute covers or assemblies at the front of the transfer switch and inspect the main contacts inside the transfer switch. See Figure 3-3 and Figure 3-5.

Remove surface deposits with a clean cloth. *Do not use an emery cloth or a file.* Discoloration of the contact surface does not affect performance. If the contacts are pitted, show signs of overheating, or are worn, replace the contacts. The contacts are worn if the contact surface material, a layer of silvery-colored metal, is worn through to the metal below. Check the condition of the arc chutes. If arc chutes show signs of disintegration, replace the arc chute assembly.



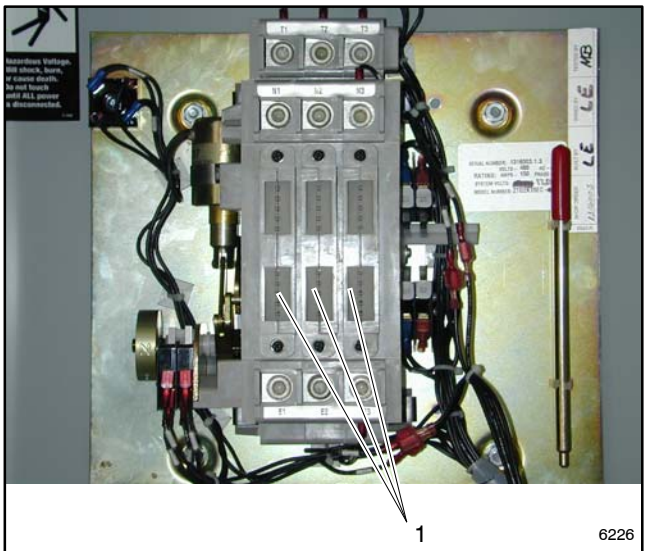
1. Arc chute cover

Figure 3-3 Typical Arc Chute Cover, 100–200 Amp Single-Phase Models



1. Arc chute covers

Figure 3-4 Typical Arc Chute Covers, 300/400-Amp Single-Phase Models



1. Arc chute assemblies

Figure 3-5 Typical Arc Chute Assemblies, 100–400 Amp 3 Phase Models (100/200 Amp Shown)

3.3 Testing

Periodic testing is important in any transfer switch application. It helps to ensure that the generator set will start and the transfer switch mechanisms and control circuits will operate when needed.

3.3.1 Weekly Generator Set Exercise

Use the exerciser to start and run the generator set once a week to maximize the reliability of the emergency power system. See the generator set operation and installation manual for additional information about the exerciser.

3.3.2 Monthly Automatic Operation Test

Test the transfer switch's automatic operation monthly. See Section 2.8 for the test procedure. Verify that the expected sequence of operations occurs as the switch transfers the load to the emergency source when a normal source failure occurs or is simulated. After the switch transfers the load to the emergency source, end the test and verify that the expected sequence of operations occurs as the transfer switch retransfers to the available normal source.

3.3.3 Other Tests

Every Year

Measure the voltage drop to help locate high-resistance contacts in the ATS. The test procedure measures the voltage drop across a contact and the current in the circuit, then uses those measured values to find the contact resistance.

The purpose of the test is to locate any contact that has significantly higher resistance than others. An unusually high voltage across one set of contacts may signal unacceptably high resistance in the contacts.

Run the test with the ATS under a moderate and balanced load. Use the following procedure to take voltage measurements and calculate resistances for both Source N and Source E.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

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)

Millivolt Drop Test Procedure

1. Apply a balanced load of at least 10% of the switch rating. (Currents of 10 amps or greater will give more accurate results than lower currents.)

2. Carefully measure the voltage on both sources from the source lug to the load lug. Take several readings to ensure accuracy. The readings may be erratic because of the small voltage measured, load fluctuations, and meter circuit contact resistances.

   Note: To obtain accurate readings, keep the meter as far as possible from current-carrying conductors and the meter leads as short, direct, and at right angles to current-carrying conductors as possible. This minimizes the effect of induced voltages (transformer effect) in the vicinity of the current-carrying conductors.

3. Use an ammeter to measure the current flow through the circuit.

4. Calculate the contact resistance using the following formula:

   R = V ÷ I

   Where:
   V = measured voltage in *millivolts*
   I = measured current in amps
   R = calculated resistance in milliohms

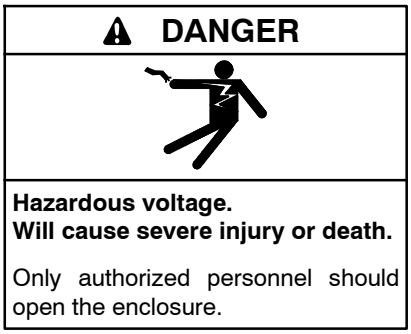
Compare the calculated values for resistance (R) to the values in the table in Figure 3-6. If the calculated resistance is significantly higher (2 times larger or more) than the value shown in the table, disconnect power, check the connections and lug torques, and repeat the test. If the second measurement also indicates that the resistance is too high, replace the contactor.

Transfer Switch Rating, Amps	Maximum Contact Resistance, Milliohms (mΩ)
100–200	0.250
300/400	0.200

Figure 3-6 Maximum Contact Resistance

Every Three Years

Test the wire insulation. Use the following procedure to check for insulation breakdown and replace any faulty components.



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)

Wire Insulation Breakdown Test Procedure

1. Disconnect all power sources by opening upstream circuit breakers or switches to the transfer switch. Disconnect the load from the transfer switch by opening circuit breakers or switches leading from the transfer switch. Disconnect the transfer switch wiring harness from the controller at connector P1.
2. Use a hi-pot tester or meggar to check the insulation resistance phase-to-phase and phase-to-neutral, and phase-to-ground if neutral and ground are isolated. For a hi-pot tester, the maximum potential is 500 VAC and the maximum test time is 1 second.
3. Verify that the measured insulation resistance exceeds 1.24 megohms (MΩ).
4. If the hi-pot tester indicates wire insulation breakdown or if the measured resistance is less than 1.24 MΩ, isolate the leakage current using an instrument designed for this purpose. Replace the faulty components.

   Note: You may need to disconnect power conductors from the lugs to isolate the problem. If you disconnect the power conductors, see transfer switch operation and installation manual for reconnection instructions.

3.4 Service Schedule

Follow the service schedule in Figure 3-7 for the recommended service intervals. The transfer switch operator can perform tasks marked by an X. Have an authorized distributor/dealer inspect the switch annually and perform all service marked by a D.

System Component or Procedure	See Section	Visually Inspect	Check	Adjust, Repair, or Replace	Clean	Test	Interval
Electrical System							
Check for signs of overheating or loose connections: discoloration of metal, melted plastic, or a burning odor.	3.2.2	X	X				Y
Check the transfer switch's external operating mechanism for cleanliness. Clean as needed.*	3.2.2	X			D		Y
Check wiring insulation for deterioration, cuts, or abrasion. Repair or replace wiring to regain the properties of the original wiring.	3.2.2	X					Y
		D	D	D			Y
Check the transfer switch's main power switching mechanisms' mechanical operation and integrity.	3.2.2	D	D			D	Y
Tighten control and power wiring connections to specifications.	3.2.2		D	D			Y
Check the transfer switch's main power switching contacts' condition. Clean or replace the main contacts or replace the transfer switch assembly as necessary.	3.2.2	D		D	D		Y
Perform a millivolt drop test to check for high contact resistances on power circuits. Tighten connections, clean main contacts, or adjust or replace main contacts or transfer switch assembly to eliminate high contact resistances.	3.3.3		D	D	D	D	Y
Test wire and cable insulation for electrical breakdown.	3.3.3					D	Every 3 Years
Control System							
Test the transfer switch's automatic control system.	2.8 5.5	X				X	M
Test all LED indicators, time delays, and remote control systems for operation.	5.5	D	D	D		D	Y
General Equipment Condition							
Inspect the outside of the transfer switch for any signs of excessive vibration, high temperature, contamination, or deterioration.*	3.2.1	X			X		M
Check that all external hardware is in place, tightened, and not badly worn.	3.2.1	X	X	X			M
Inspect the inside of the transfer switch for any signs of vibration, excessive noise, high temperature, contamination, or deterioration. Check for metal discoloration, melted plastic, or a burning odor.*	3.2.2	X					M
		D	D		D		Y
Check that all internal hardware is in place, tightened, and not badly worn.	3.2.2	X					M
		D	D	D			Y

***** Service more frequently if the ATS operates in extremely dusty or dirty areas.

See Section: Read these sections carefully for additional information before attempting maintenance or service.

Visually Inspect: Examine these items visually.

Check: Requires physical contact with or movement of system components, or the use of nonvisual indications.

Adjust, Repair, or Replace: Includes tightening hardware. May require replacement of components depending upon the severity of the problem.

Clean: Remove accumulations of dirt and contaminants from external transfer switch's components or enclosure with a vacuum cleaner or by wiping with a dry cloth or brush. *Do not use compressed air to clean the switch because it can cause debris to lodge in the components and cause damage.*

Test: May require tools, equipment, or training available only through an authorized distributor/dealer.

Symbols used in the chart:

O/I/M=See the transfer switch operation/installation manual.
X= The transfer switch operator can perform these tasks.
D=Authorized distributor/dealer must perform these tasks.
W=Weekly
M=Monthly
Q=Quarterly
S=Semiannually (every six months)
Y=Yearly (annually)

Figure 3-7 Service Schedule

Notes

This section contains transfer switch troubleshooting information. Refer to the generator set service manual for RDC2 or DC2 controller troubleshooting.

Check the items listed in Section 4.1, Initial Troubleshooting first.

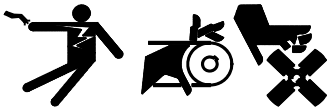
Note: Only trained qualified personnel following all applicable codes and standards should attempt to service the transfer switch.

See schematic and interconnection diagrams in Section 6, the parts drawings in Section 8, and the labeling on system components to identify and troubleshoot system components.

A personal computer with Kohler SiteTech software can be used for ATS metering and setup. See Section 4.3.

Observe all safety precautions while troubleshooting and servicing the transfer switch.

⚠ 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 equipment connected to the set, disable the generator set as follows: (1) Press the generator set off/reset button to shut down the generator set. (2) Disconnect the power to the battery charger, if equipped. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent the starting of the generator set by the remote start/stop switch.

⚠ WARNING

Hazardous voltage. Moving parts.
Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

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

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Turn off 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.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

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.

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)

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.

4.1 Initial Troubleshooting

Many service problems are caused by faulty connections due to corrosion, loose terminals, and damaged wiring or connectors. With all power supplies disconnected, perform the following general checks while troubleshooting.

- Unplug connectors and check terminals and leads for corrosion. Remove corrosion from terminals and leads.
- Tighten loose terminals.
- Check wiring harnesses for continuity or short circuits.
- Recrimp or replace loosely connected lead terminals.

Also check the following:

- Verify that the source circuit breakers/switches to the transfer switch are closed and at least one power source is available.
- Check that the RDC2 or DC2 controller on the generator set is in AUTO mode and that the engine starting battery is connected and charged.
- Check the connections from the RXT interface board to the generator set for loose or open connections or short circuits.
- Disconnect optional equipment such as the Load Control Module (LCM) and test the ATS operation to isolate problems to the transfer switch or connected accessories.
- Check the ATS status and settings. Use the RDC2 controller menus and/or connect a personal computer (PC) to the RDC2 or DC2 controller on the generator set and use the Kohler® SiteTech™ program on your PC. See Sections 4.2 and 4.3.
- Check the application code version number on the RDC2/DC2 controller. Check TechTools for the latest information about application code updates, and obtain the latest version if necessary. See the generator set documentation and the SiteTech™ or OnCue® operation manuals for information on identifying the code version and loading new code.

4.2 Controller Settings

The Model RXT transfer switch is controlled by the RDC2 or DC2 controller that is mounted on the generator set. There are a number of settings on the RDC2/DC2 controller that affect the transfer switch operation.

Some ATS settings can be viewed and adjusted using the RDC2 controller menus. Those settings plus additional parameters are available using a personal computer and Kohler® SiteTech™ software. See Section 4.3.

The Normal source (typically utility power) is called Source 1 in SiteTech. The Emergency source (typically the standby generator set) is called Source 2 in SiteTech.

4.2.1 DC2 Controller

On systems equipped with the DC2 controller, a personal computer and Kohler® SiteTech™ software must be used to adjust the ATS settings. See Section 4.3.

4.2.2 RDC2 Controller Menus

The RDC2 controller menus include ATS status displays and an ATS configuration menu that allows checking and adjustment of transfer switch settings.

If the ATS Status and Configuration menus are not displayed on the RDC2 controller, check the RBUS connections from the RDC2 controller on the generator to the interface board on the RXT transfer switch.

ATS Status Menu

ATS menus appear on the RDC2 controller if a Model RXT transfer switch is connected to the generator set. If no transfer switch is connected, or another model ATS is connected to the engine start connections, Remote ATS is displayed on the ATS Status screen.

The ATS Status menu displays Model RXT transfer switch and source information.

The Normal (Source 1) system voltage and frequency should match the system voltage and frequency in the genset system configuration. Note that changing the genset system voltage and frequency also changes the Source 1 system voltage and frequency. However, changing the Source 1 system voltage does not affect the generator set system voltage.

The voltage shown in these menus can be calibrated. See Section 5.2.2 for instructions.

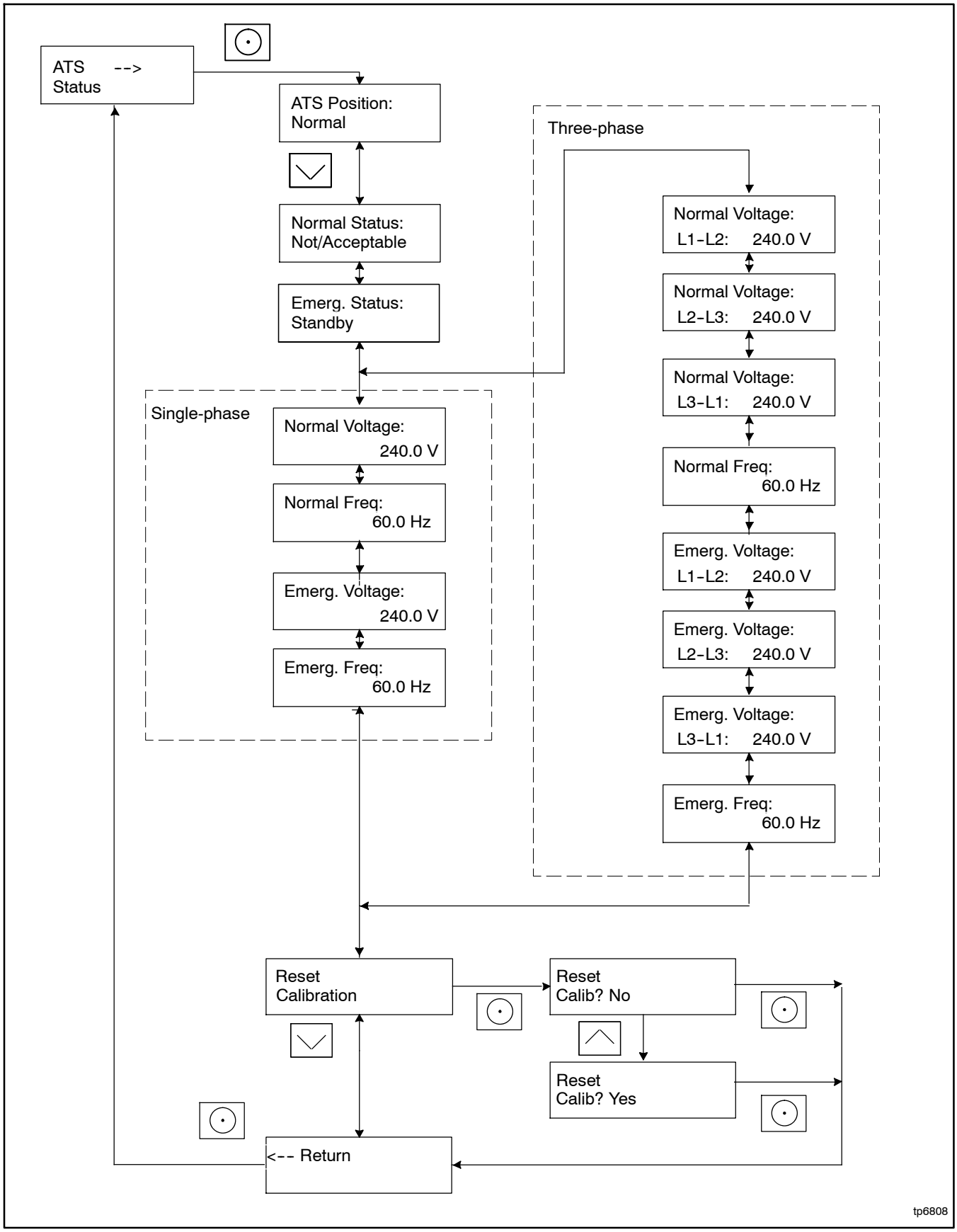


Figure 4-1 ATS Status Menu

ATS Configuration Menu

Note: The ATS Configuration menu appears on the RDC2 controller only if a Model RXT transfer switch is connected.

Use the ATS Configuration submenu to check the Model RXT transfer switch system settings and time delays, and change the settings, if necessary.

To enable editing, press the select button. The value flashes to indicate that it can be changed. Press the up and down arrow buttons to change the value. Press the Select button to save the value shown.

Use the up and down arrow buttons to move to the next value to be changed. Repeat the adjustment process until all values are correct.

Press the down arrow until Return is displayed. Press the select button to return to the main menu.

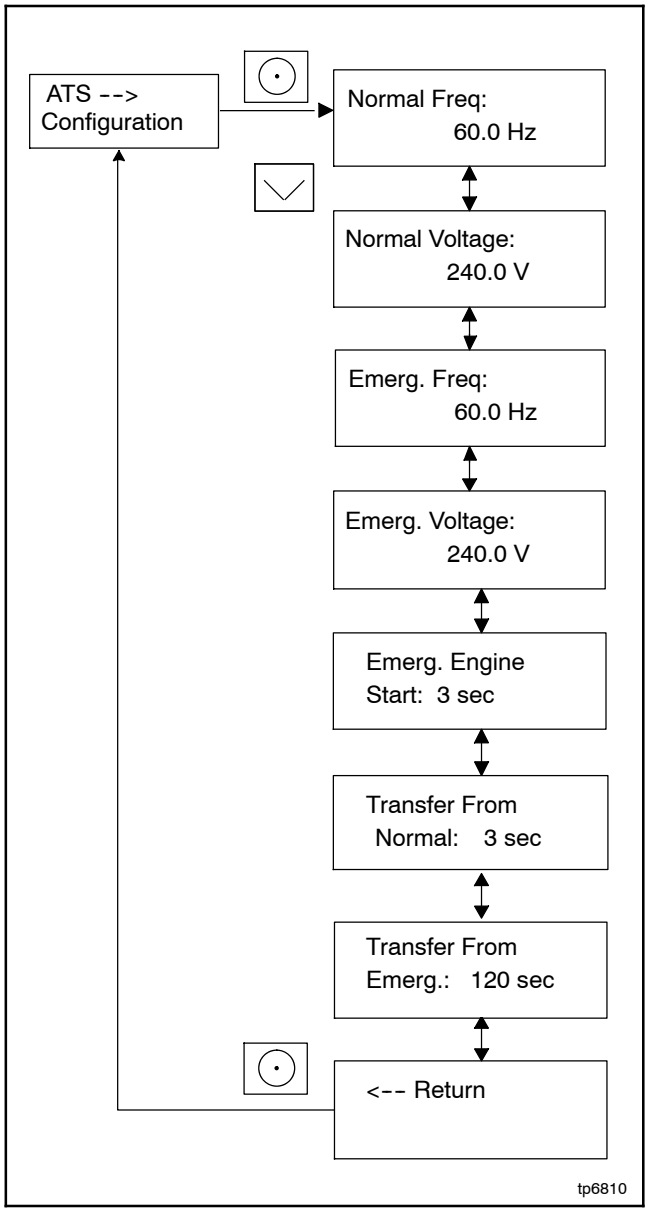


Figure 4-2 ATS Configuration Menu

4.3 SiteTech Software

A personal computer (or laptop) and Kohler® SiteTech™ software can be used to view and adjust transfer switch settings. Connect the computer to the RDC2 or DC2 controller *on the generator set* as shown in Figure 4-3.

See TP-6701, SiteTech Software Operation Manual, for instructions to use the software.

The Normal source (typically utility power) is called Source 1 in SiteTech. The Emergency source (typically the standby generator set) is called Source 2 in SiteTech.

ATS screens available in SiteTech are shown in Figure 4-4 through Figure 4-6.

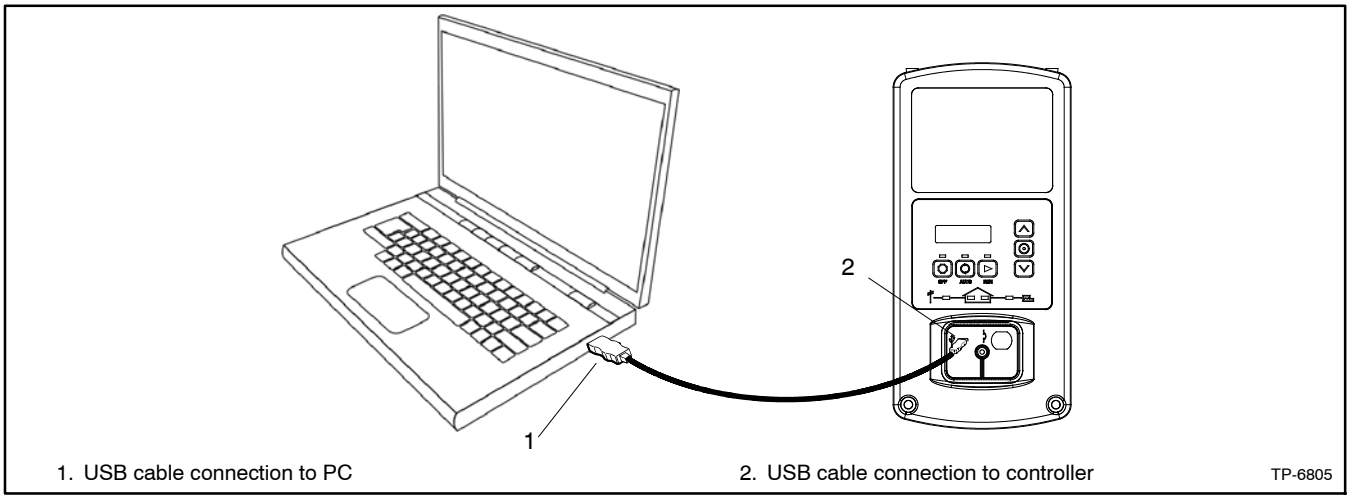


Figure 4-3 RDC2 Controller Connection to a Personal Computer through the USB Port

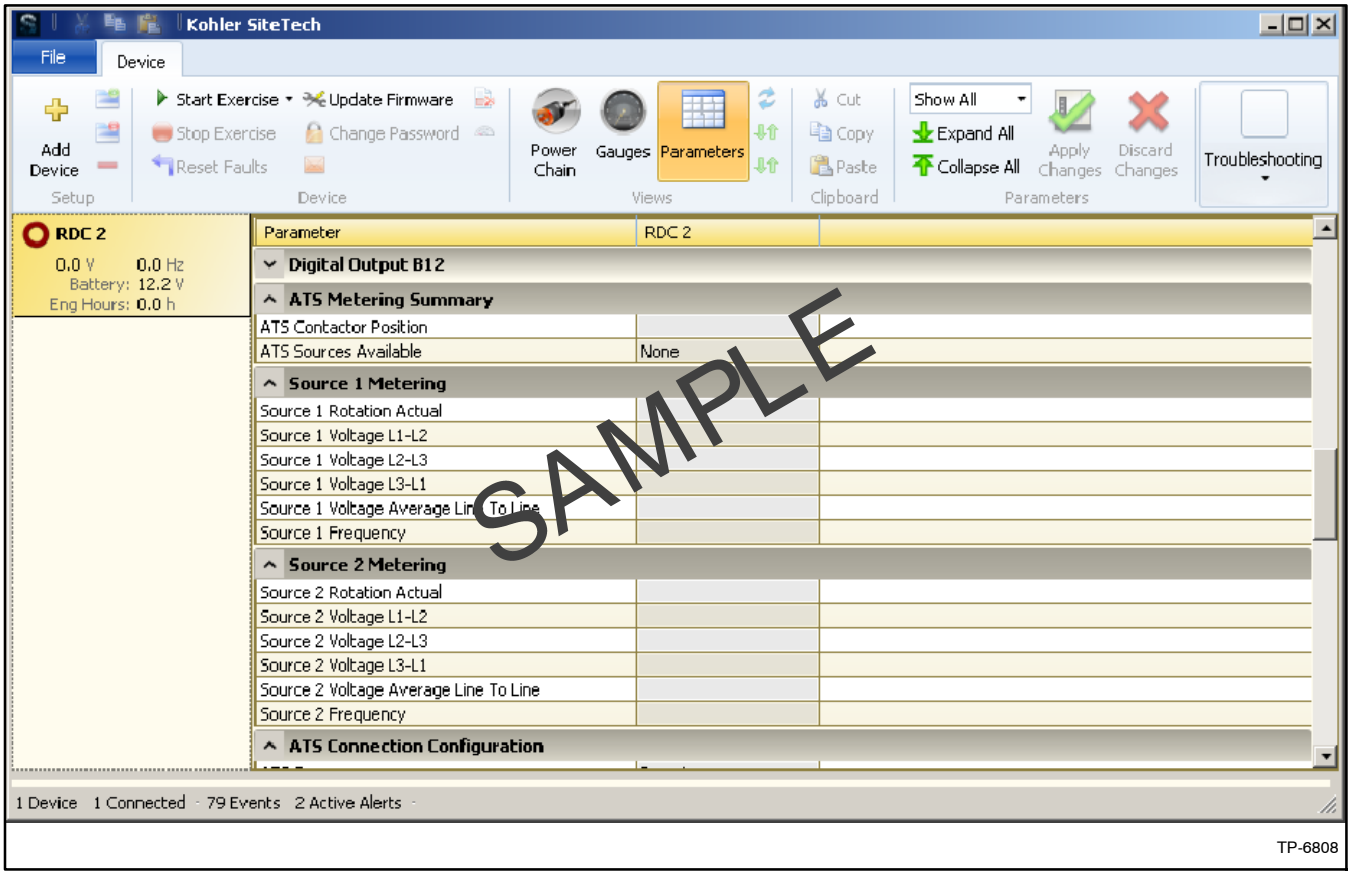


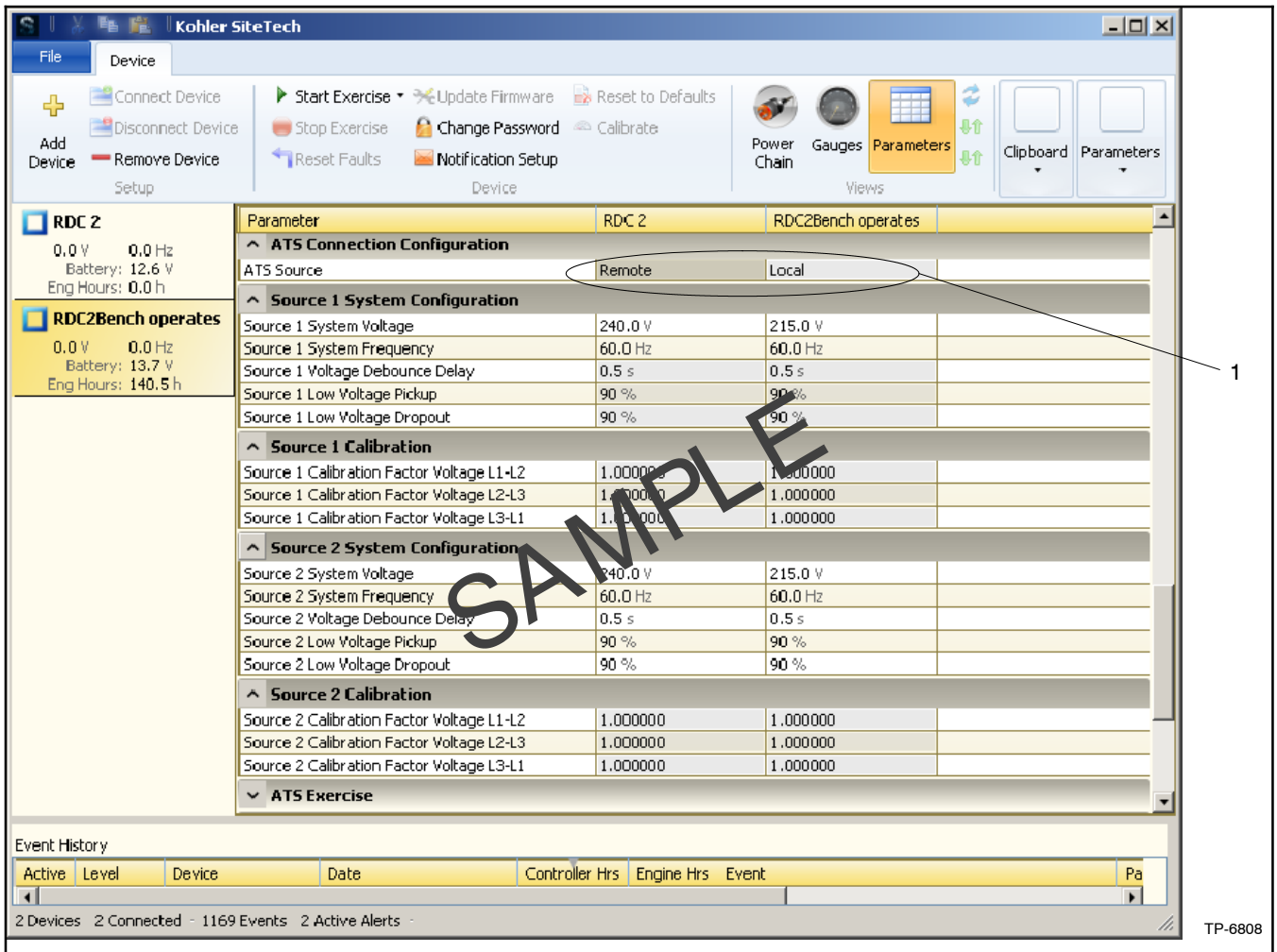
Figure 4-4 ATS Source Metering Screens in SiteTech

ATS Source

Check the ATS Source under ATS Connection Configuration shown in Figure 4-5. ATS Source indicates whether a Model RXT transfer switch is communicating with the generator set controller.

- Local = Model RXT ATS is communicating.
- Remote = No RXT is detected. Remote will be displayed if a different model ATS or no ATS is connected to the RDC2 or DC2 controller.

If ATS source shows remote, indicating no RXT is detected, check the RBUS connections from the generator controller to the RXT interface board.



1. ATS Source indicates whether a Model RXT transfer switch is communicating with the generator set controller.
   Local = Model RXT ATS is communicating. Remote = No RXT is detected.
   Remote will be displayed if a different model ATS or no ATS is connected to the RDC2 or DC2 controller.

Figure 4-5 ATS System Configuration and Calibration Screens in SiteTech

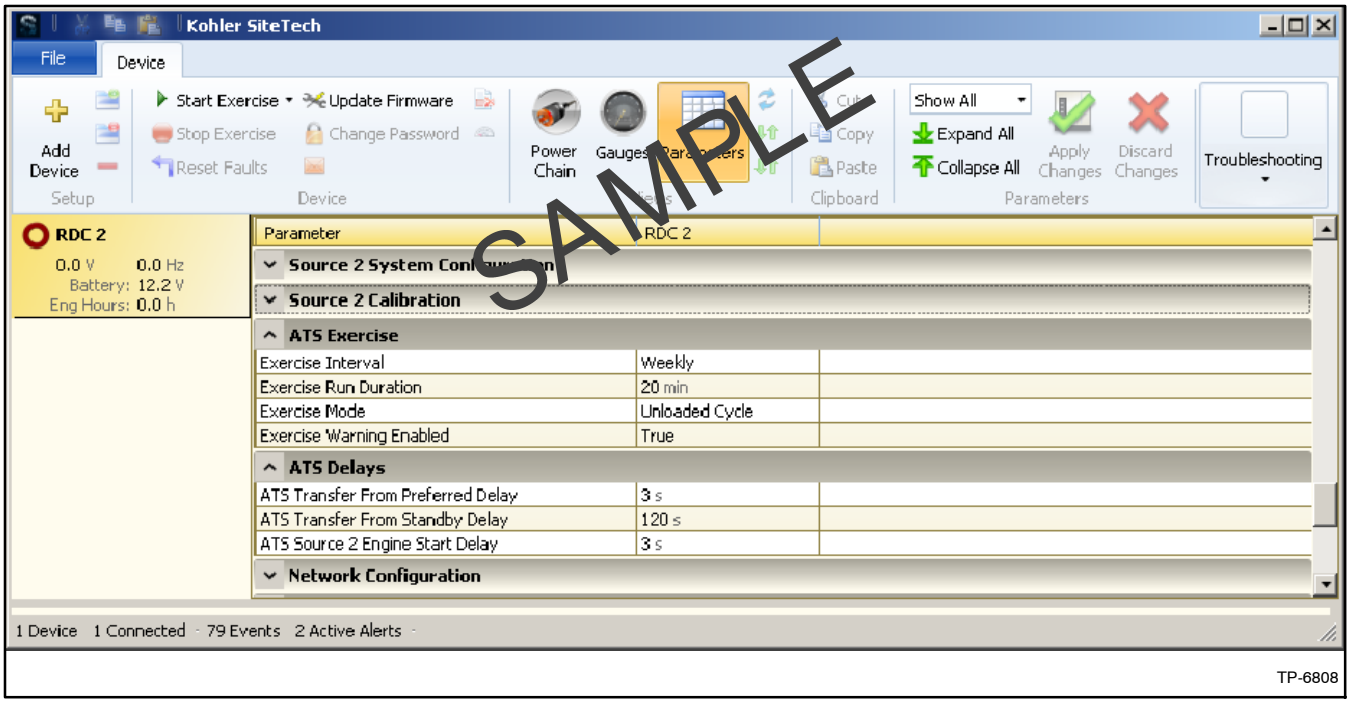


Figure 4-6 ATS Exercise and Time Delay Settings in SiteTech

SiteTech Group	Parameter	Units	Adjustment Range *	Default Setting
ATS Metering Summary	ATS Contactor Position		Read Only	N/A
	ATS Sources Available		Read Only	N/A
Source 1 Metering	Source 1 Rotation Actual		Read Only	N/A
	Source 1 Voltage L1-L2	V	Read Only	N/A
	Source 1 Voltage L2-L3	V	Read Only	N/A
	Source 1 Voltage L3-L1	V	Read Only	N/A
	Source 1 Voltage Average Line To Line	V	Read Only	N/A
	Source 1 Frequency	Hz	Read Only	N/A
Source 2 Metering	Source 2 Rotation Actual		Read Only	N/A
	Source 2 Voltage L1-L2	V	Read Only	N/A
	Source 2 Voltage L2-L3	V	Read Only	N/A
	Source 2 Voltage L3-L1	V	Read Only	N/A
	Source 2 Voltage Average Line To Line	V	Read Only	N/A
	Source 2 Frequency	Hz	Read Only	N/A
ATS Connection Configuration	ATS Source		Read Only Local (RXT) or Remote (no ATS or other model ATS connected to engine start circuit)	N/A
Source 1 System Configuration	Source 1 System Voltage	V	110.0 – 600.0	Genset System Voltage
	Source 1 System Frequency	Hz	48.0 – 62.0	Genset System Frequency
	Source 1 Voltage Debounce Delay	s	Not adjustable	0.5
	Source 1 Low Voltage Pickup	%	Not adjustable	90
	Source 1 Low Voltage Dropout	%	Not adjustable	90
Source 1 Calibration	Source 1 Calibration Factor Voltage L1-L2		Read Only	1
	Source 1 Calibration Factor Voltage L2-L3		Read Only	1
	Source 1 Calibration Factor Voltage L3-L1		Read Only	1
Source 2 System Configuration	Source 2 System Voltage	V	110.0 – 600.0	240.0
	Source 2 System Frequency	Hz	48.0 – 62.0	60.0
	Source 2 Voltage Debounce Delay	s	0.1 – 9.9	0.5
	Source 2 Low Voltage Pickup	%	85 – 100	90
	Source 2 Low Voltage Dropout	%	75 – 98	90
Source 2 Calibration	Source 2 Calibration Factor Voltage L1-L2		Read Only	1
	Source 2 Calibration Factor Voltage L2-L3		Read Only	1
	Source 2 Calibration Factor Voltage L3-L1		Read Only	1
ATS Exercise	Exercise Interval		Weekly or Every Other Week	Weekly
	Exercise Run Duration	min	10 – 30	20
	Exercise Mode		Pulldown See List	Unloaded Cycle (2)
	Exercise Warning Enabled		True or False	True
ATS Delays	ATS Transfer From Preferred Delay	s	1 – 10	3
	ATS Transfer From Standby Delay	s	1 – 600	120
	ATS Source 2 Engine Start Delay	s	1 – 10	3
* Read Only = Not adjustable				

Figure 4-7 ATS Parameters in SiteTech (through the RDC2 or DC2 generator set controller)

4.4 RBUS Communication Troubleshooting

The Model RXT transfer switch uses Kohler-proprietary RBUS communication to communicate with an RDC2 or DC2 controller, which is mounted on the generator set. The interface board on the Model RXT must be connected to the RBUS communication terminals (A, B, PWR, and COM) on the generator set.

4.4.1 RBUS Connection Labels

On RXT transfer switches shipped from January 2012 to March 2012, the labels on the T-shaped green terminal block (GM84150) for RBUS connections were reversed. The manuals and interface board labels were correct. Reversing the connections will not damage the equipment, but the transfer switch and other accessories will not operate. Connect the wiring according to the labels on the interface board for correct operation.

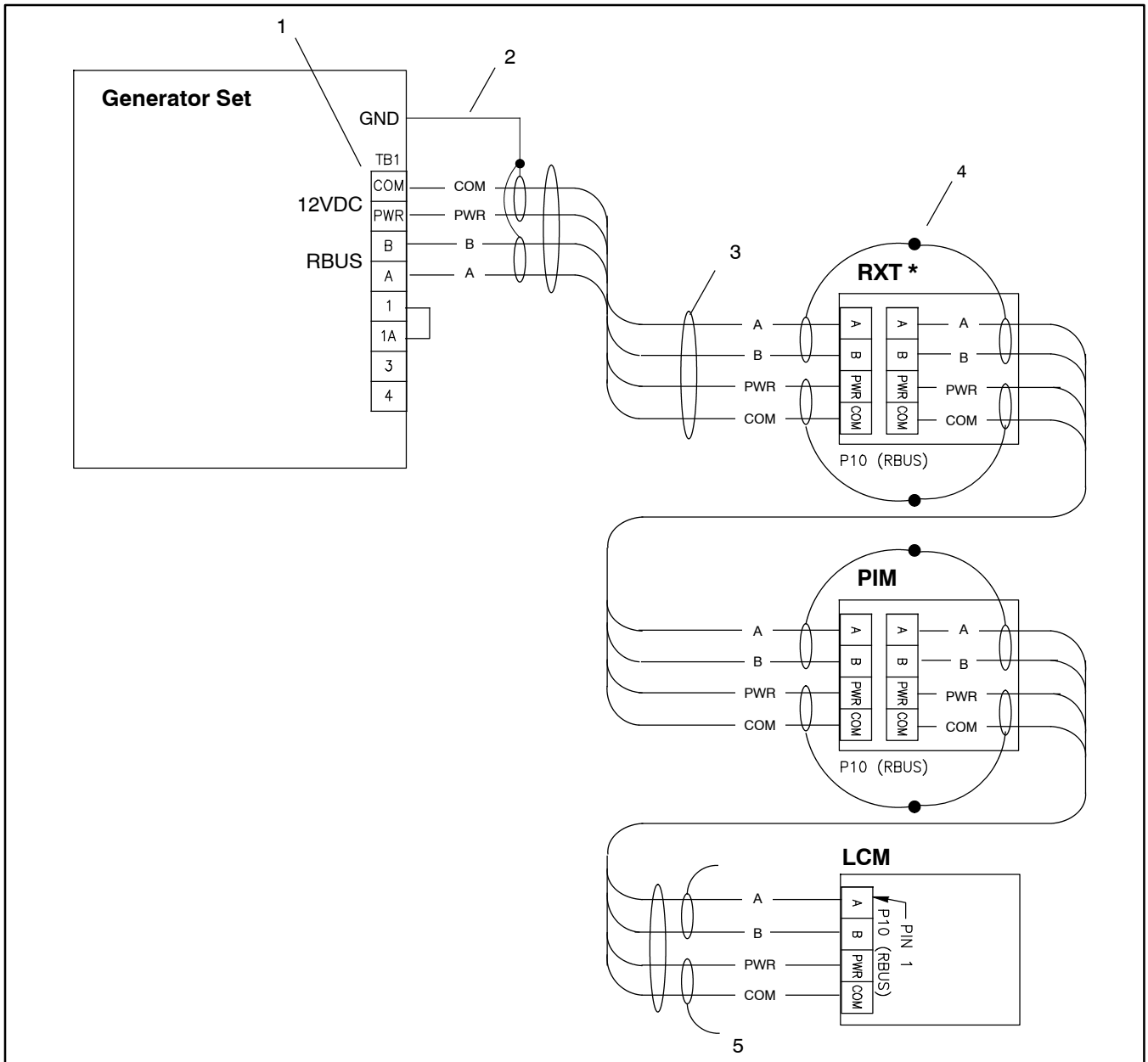
4.4.2 Communication Cables

Verify that the communication cable used to connect the RXT interface board to the RDC2/DC2 controller complies with the cable specifications and maximum cable lengths shown in Figure 4-8. Note that the maximum cable lengths are shorter if additional RBUS modules are connected or if the APM is used to parallel two generators.

- The maximum cable length depends on the number of optional modules connected. A module can be a model RXT transfer switch, a load control module (LCM), or a programmable interface module (PIM). See Figure 4-8 for the maximum total cable length with 1, 2, or 3 modules per cable run. Note the shield connections shown in Figure 4-9.
- For indoor installations with the shorter cable runs and/or few RBUS modules shown in Figure 4-8, use Belden #9402 or equivalent shielded, twisted-pair communication cable with four conductors (2 pairs).
- For outdoor installations, including those with buried cables and/or conduit, use outdoor-rated Belden #1075A or equivalent 20 AWG shielded, twisted-pair communication cable.
- For the longer cable runs shown in Figure 4-8, use 12–14 AWG wire for the COM and PWR connections. See Figure 4-8. Belden #8762 or equivalent 20 AWG shielded, twisted-pair cable with two conductors (1 pair) can be used for the A and B connections.
- When the Automatic Paralleling Module (APM) is used, the allowable communication cable lengths are reduced as shown in Figure 4-8.

Cable	Maximum length per run, meters (ft.)			
	Number of Modules per Run			
	1	2	3	4
20AWG Belden #9402, #1075A or equivalent (4 conductors) with RXT, PIM, and/or LCM or other load management device	61 (200)	31 (100)	21 (67)	—
20AWG Belden #9402, #1075A or equivalent (4 conductors) when the APM is used	46 (150)	15 (50)	5 (17)	Do not use 20AWG cable for PWR and COM
14 AWG †	152 (500)	152 (500)	122 (400)	122 (400)
12 AWG †	152 (500)	152 (500)	152 (500)	152 (500)
† For longer cable runs, use Belden 20 AWG cable for A and B, and 12 or 14 AWG wire for PWR and COM.				

Figure 4-8 Total Cable Lengths with Accessory Modules



1. Generator Set Terminal Block TB1. Check the decal on the generator set for terminal block connections.
2. Connect one end of each cable shield to GROUND at the generator set.
3. See Figure 4-8 for cable specifications, including maximum total cable length per run (1 run shown).
4. Connect shields together as shown.
5. Leave the end of each cable shield disconnected at the last device.

* RXT standard interface board OR combined interface/load management board

Figure 4-9 RXT and Other RBUS Module Connections to Generator Set

4.4.3 ATS Source Parameter in SiteTech

Use Kohler® SiteTech™ to check for ATS communication with the RDC2 or DC2 controller. Connect a personal computer to the generator set controller as shown in Section 4.3. Check the ATS Source parameter shown in Figure 4-5.

- **Local:** Indicates that a Model RXT transfer switch is connected and communicating with the RDC2 or DC2 controller.
- **Remote:** Indicates that no Model RXT transfer switch is detected. “Remote” will be displayed if a different model of transfer switch is connected (through engine start leads 3 and 4 to the generator set) or if no transfer switch is connected to the generator set.

4.4.4 Number of RBUS Modules

One Model RXT transfer switch can be connected to a generator set with an RDC2 or DC2 controller.

An RXT transfer switch with the combined interface/load management board acts as two RBUS devices: one RXT transfer switch and one load management device.

One of each of the following RBUS devices can be connected to the generator’s RDC2 or DC2 controller:

- One RXT transfer switch
- One Programmable Interface Module (PIM)
- One of the following load management devices:
  - Load Control Module (LCM) OR
  - Load shed kit OR
  - Combined interface/load management board on the RXT transfer switch
- One PowerSync Automatic Paralleling Module (APM)
- The second generator set in a paralleled system that uses the APM

A paralleled system using the PowerSync Automatic Paralleling Module (APM) uses one RXT transfer switch and two model 14RESA or two model 20RESA generator sets.

4.4.5 Communication Troubleshooting Flowcharts

See the flowcharts in Figure 4-10 through Figure 4-12 to troubleshoot communication problems between the RXT and the RDC2 or DC2 controller.

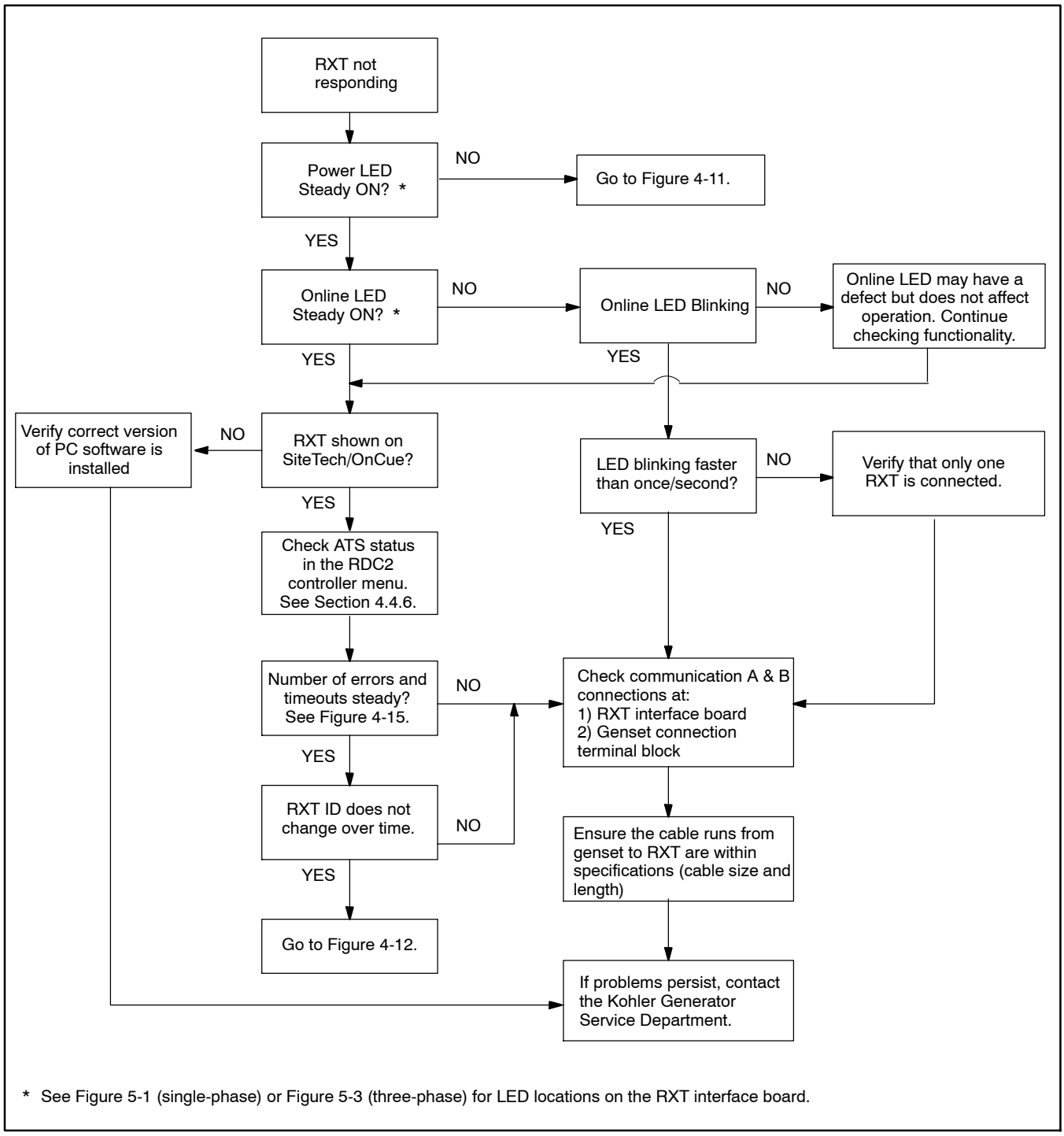


Figure 4-10 Communication Troubleshooting Chart, Part 1 of 3

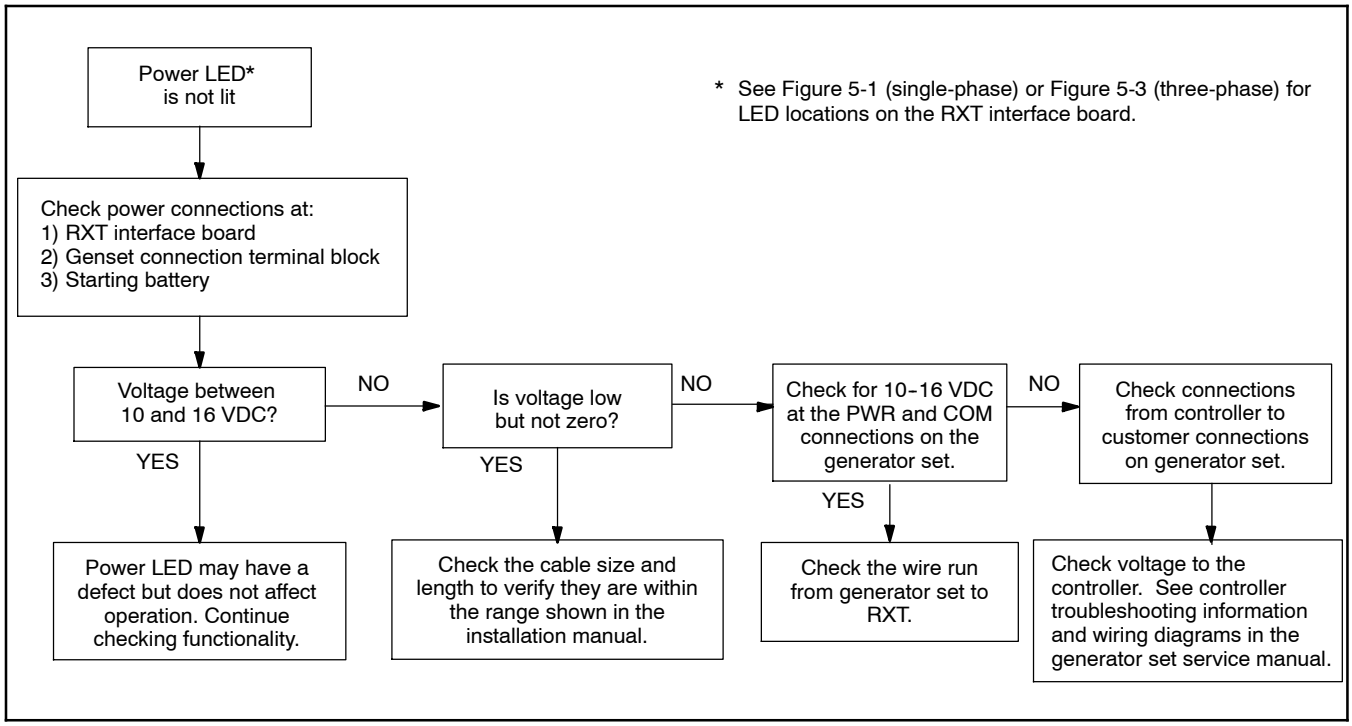


Figure 4-11 RXT Troubleshooting, Part 2 of 3, Troubleshooting Power to the RXT Interface Board

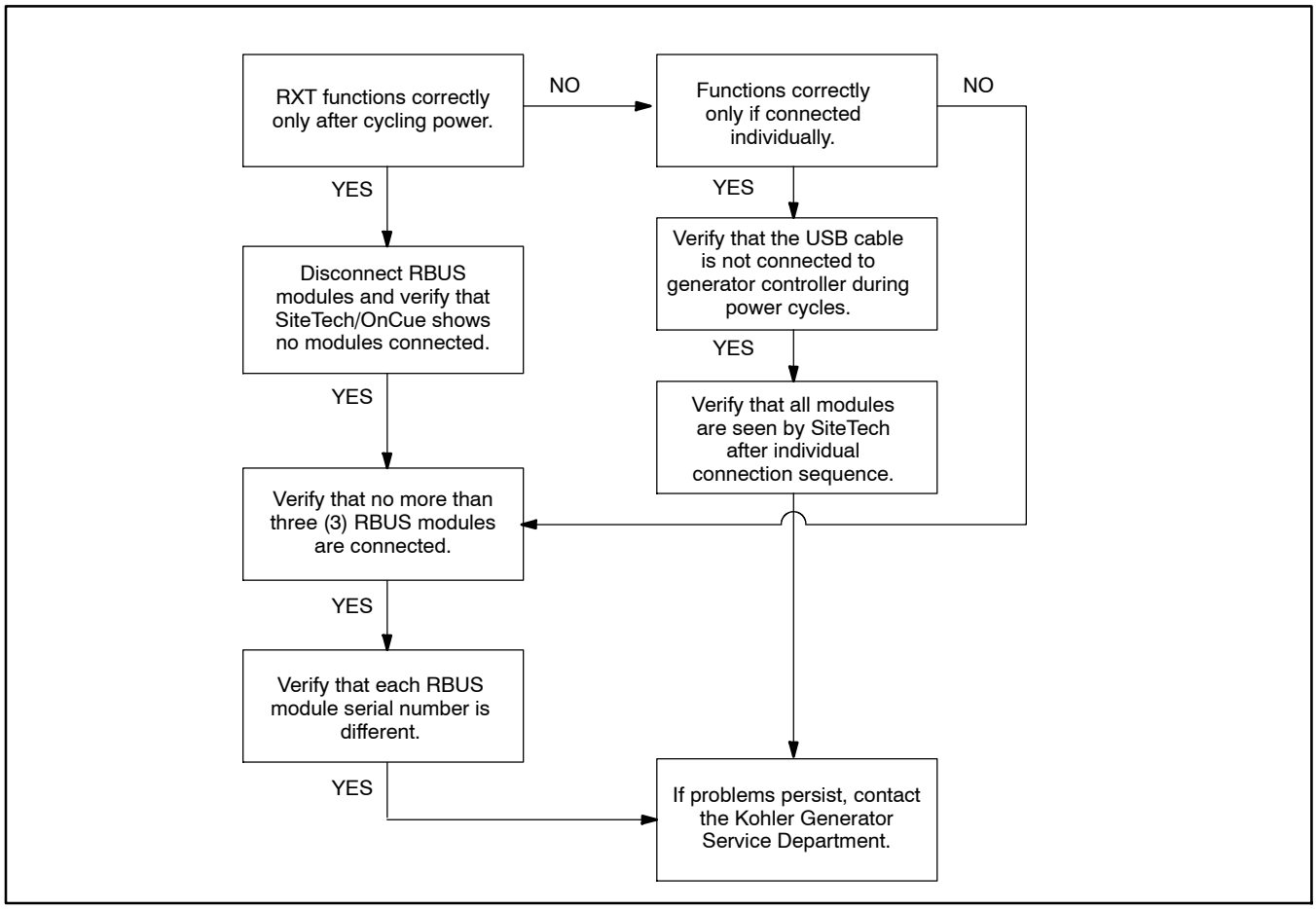


Figure 4-12 RXT Troubleshooting Chart, Part 3 of 3

4.4.6 Verify that the Controller Recognizes the RXT

There are three ways to verify that the RDC2 controller recognizes the RXT transfer switch and load shed kit or combined interface/load management board.

Note: The combined interface/load management board acts as two RBUS devices: one RXT interface board and one load management device.

1. On the RDC2 controller, navigate to the Networking Menu and check the number of modules connected and the information for remote devices. See Figure 4-13 and Figure 4-14. The number should equal the number of RBUS devices connected, including the load shed kit or combined interface/load management board, RXT transfer switch (if used) and the PIM (if used). A Model RDT transfer switch is not an RBUS device.

2. For the RDC2 or DC2 controller, use a laptop computer connected to the controller's USB port and Kohler® SiteTech™ software. In the Parameters view of SiteTech, check that the RBUS network screen shows the correct number of RBUS devices connected (one Load Shed Kit or combined interface/load management board, RXT transfer switch, and PIM, if used). See SiteTech Operation Manual TP-6701 for instructions.

3. For the RDC2 or DC2 controller, use OnCue Plus. Go to the Controls screen and check that a Load Shed tab is visible below the exercise information. See the OnCue Plus Operation Manual, TP-6928 for instructions.

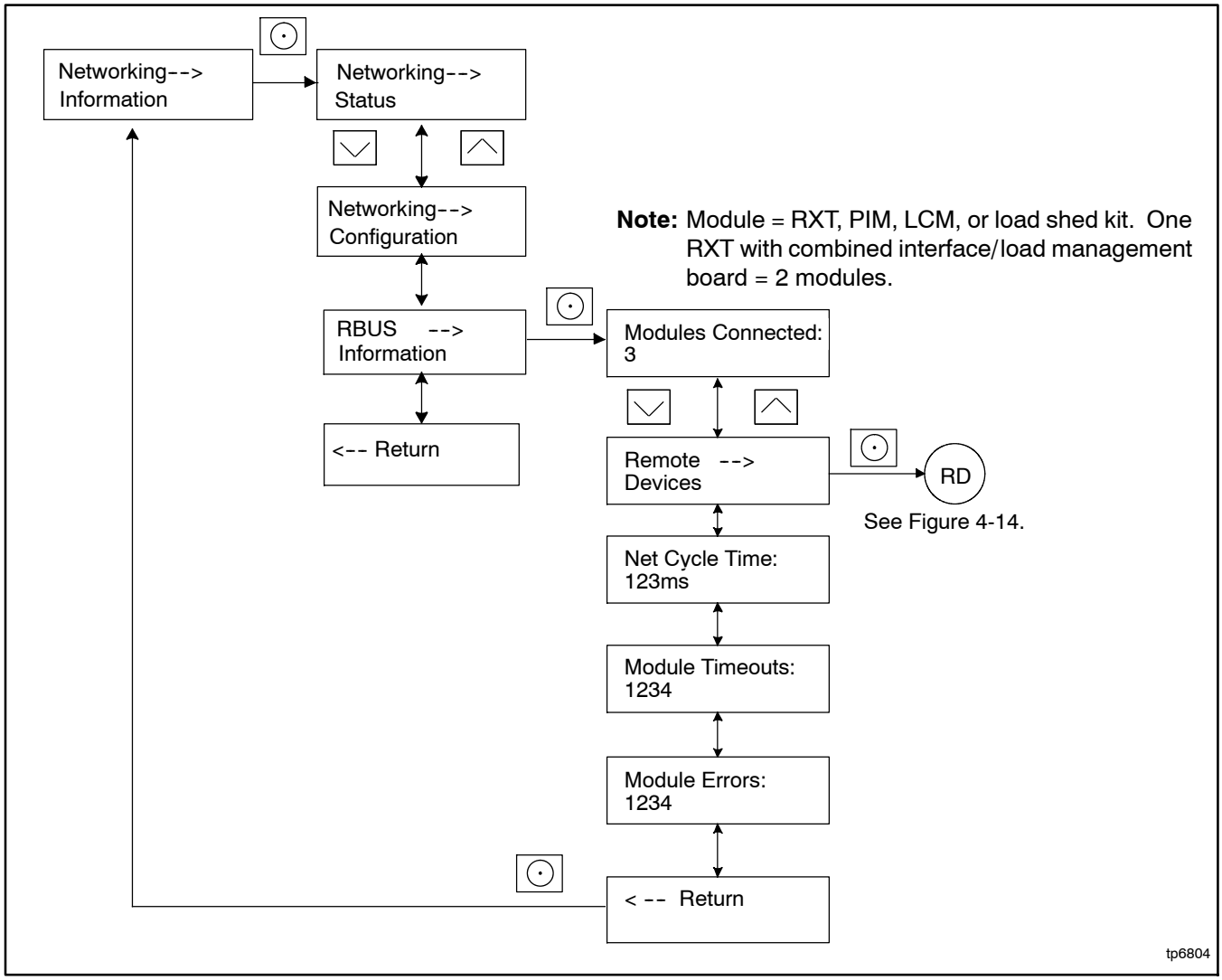


Figure 4-13 RDC2 Controller Menu, Networking Information

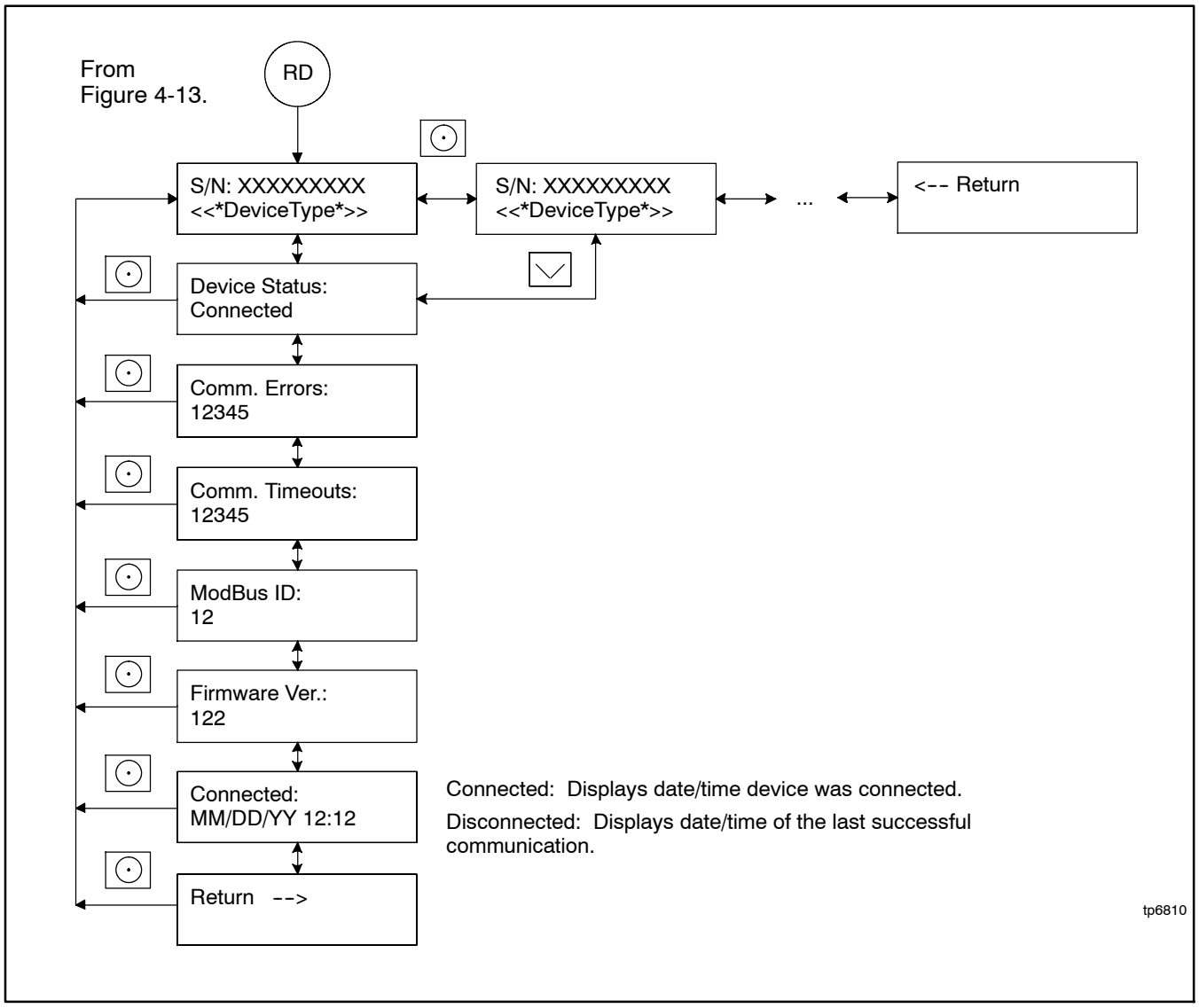


Figure 4-14 RDC2 Remote Devices Submenu

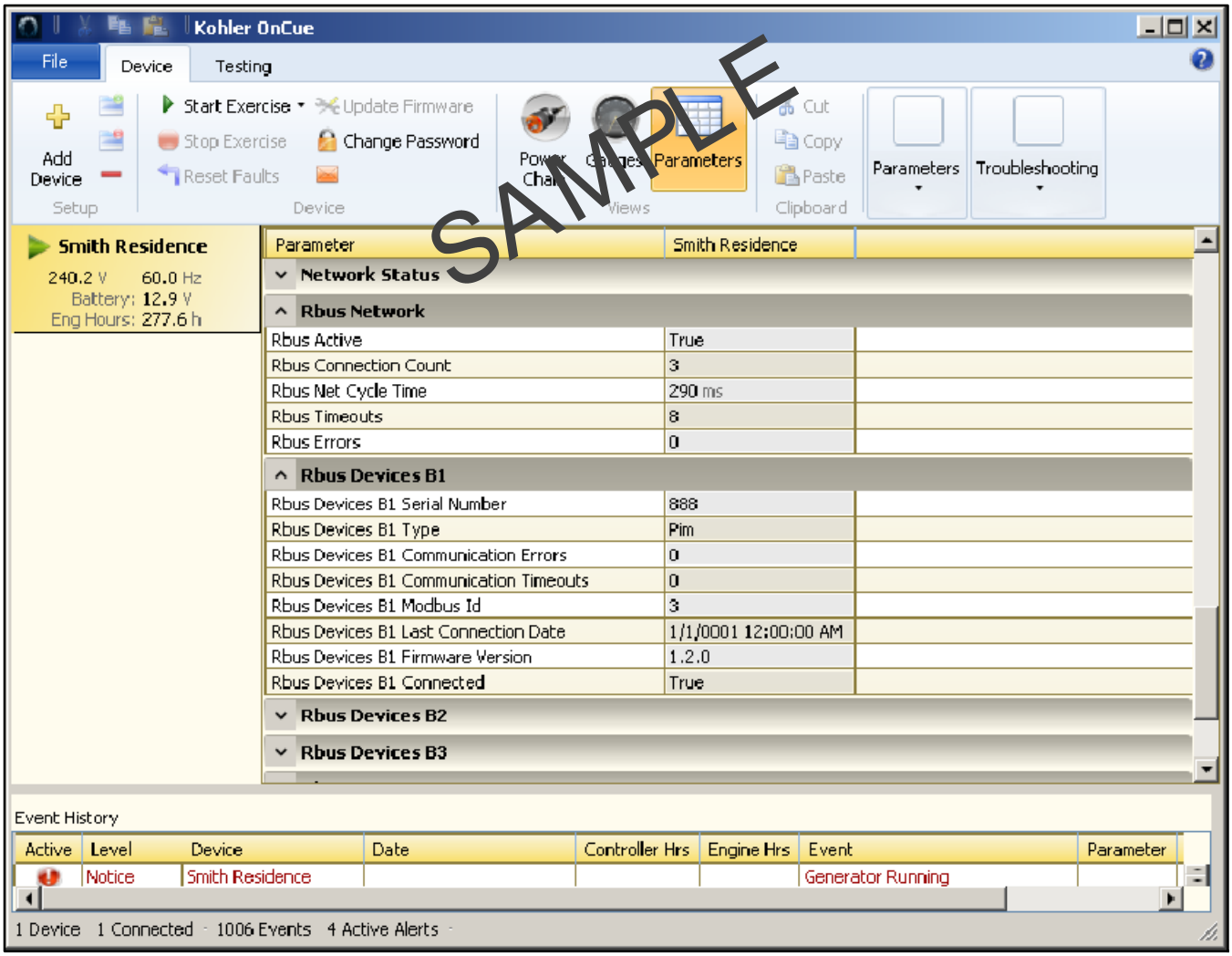


Figure 4-15 RBUS Device Parameters in OnCue® or SiteTech™

4.5 Faults and Notices

The OFF LED on the generator set's RDC2 or DC2 controller flashes quickly and a fault message is displayed to indicate various fault conditions. Figure 4-16 lists ATS-related faults and notices. A notices communicates system status; it is not a fault.

Refer to the generator set Service Manual for a complete list of fault and status messages.

Fault Message	Action	Description/ Comments	Check
ATS ComError Warning (ATS communication error)	Warning	The controller has lost communications with the RXT ATS that had previously been communicating properly.	Check connections from ATS interface module to generator set. Check the power LED on the interface board. See Section 5.1.
ATS Fail Xfr Warning (ATS fail to transfer)	Warning	The RXT ATS has reported a fail to transfer, the digital output for ATS Fail To Transfer (PIM) is active (contacts closed).	See the troubleshooting charts in Section 4.6. Also see Section 4.7.
Emerg Pwr On (Emergency Power System Supplying Load)	Notice	The digital output for EPS Supplying Load (PIM) is active (contacts closed), indicating there is current output (>5%) from the alternator, only if CTs are installed.	—
NormSrcUnavl (RXT required)	Notice	The normal power source (source1) is disconnected, unavailable or unacceptable.	Check for utility source power outage. Check wiring and connections to the ATS.
Rmt StartCmd (Remote Start Command Issued)	Notice	The controller has received a remote start signal while the master switch is in AUTO, and will go to normal running.	Verify remote start signal.

Figure 4-16 ATS-Related Faults Indicated on the Generator Set's RDC2 or DC2 Controller

4.6 Troubleshooting Charts

Use the following troubleshooting charts to diagnose transfer switch problems. Possible causes of problems are generally listed in the order of likelihood.

Check the items listed in Section 4.1, Initial Troubleshooting, before proceeding.

Problem	Possible Cause	Corrective Action
ATS fails to operate and no LEDs are lit	No power to the transfer switch/controller.	Close circuit breakers leading from power sources to the transfer switch. Troubleshoot power to the system. See Section 4.2.
Generator set does not start when the normal source fails	Generator set is OFF or the batteries are not charged or connected.	Press the AUTO button on the generator set controller. Check that the generator set batteries are charged and connected.
	Generator set is malfunctioning.	See the generator set operation or service manual.
Generator set does not start with the exerciser (Also see Figure 4-18)	Exercise settings incorrect.	Check the exerciser settings. See generator set Installation Manual.
	Generator set is OFF or the batteries are not charged or connected.	Press the AUTO button on the generator set controller. Check that the generator set batteries are charged and connected.
	Generator set is malfunctioning.	See the generator set operation or service manual.
Generator set does not shut down (Also see Figure 4-20)	Generator set is in the RUN mode.	Press the AUTO button on the generator set controller.
	The exerciser is operating.	Wait for the exercise period to end.
	Engine cooldown is operating. (after retransferring the load to the normal source)	Wait for the generator set to stop after the engine cooldown time delay expires or the engine cools down.
	Generator set is malfunctioning.	See the generator set operation or service manual.
ATS fails to transfer the load to the emergency source after the generator set starts (Also see Figure 4-19)	Generator set circuit breaker is open.	Close circuit breakers leading from the generator set to the ATS.
	The normal-to-emergency transfer time delay is operating.	Check operation. Enough time must pass for the normal-to-emergency time delay to expire.
	Generator voltage is out of range or emergency source sensing circuits are malfunctioning.	Check the emergency source voltage. Repair or adjust generator set if the output voltage is it is out of range, otherwise see Section 5.4. Check the voltage calibration on the RDC2 controller. See Section 5.2.2. Check voltage pickup and dropout settings.
	Transfer switch operation problems.	See Section 4.7, Transfer Switch Troubleshooting.
ATS fails to retransfer the load to the normal source after the normal source returns (Also see Figure 4-19)	Normal source circuit breaker is open.	Close circuit breakers leading from the normal source to the transfer switch.
	Emergency-to-normal retransfer time delay has not timed out.	Check time delay settings. See Section 5.5.
	Normal source voltage levels are out of range.	Check the normal source voltage. See Section 4.2. Check the voltage calibration on the RDC2 controller. See Section 5.2.2. Check voltage pickup and dropout settings.
	Normal source sensing circuits are malfunctioning.	See Section 5.3, Normal Source Sensing.
	Transfer switch operation problems.	See Section 4.7, Transfer Switch Troubleshooting.
Transfer switch mechanism is binding	Debris is in the transfer switch mechanism.	Clean the transfer switch assembly. See Section 3.2.2.
	Transfer switch mechanism is damaged.	Replace the transfer switch assembly. See Section 7.4.
ATS operates erratically or operates out of specifications	Power supply problems/loose connection.	Check wiring for loose connections especially those that supply power to the controller or in the affected circuit. Check the power supply. See Section 4.2.
	Incorrect transfer switch controller operation/calibration.	See Section 5.5 for problems related to time delays in the operating sequence. Check the voltage calibration on the RDC2 controller. See Section 5.2.2. For problems related to dropout and pickup specifications see Section 5.3 for the normal source or Section 5.4 for the emergency source.
Source available LED off when Source is available	Controller does not recognize an available source.	Check switches, circuit breakers for open circuit. Check source connections to the ATS. Check connections from interface board to generator set controller. Check source voltage and compare to source pickup and dropout levels. See Sections 5.3 and 5.4. Check source sensing. See Sections 5.3 and 5.4. Check the voltage calibration on the RDC2 controller. See Section 5.2.2.
	Malfunctioning LED.	If no LEDs light, troubleshoot power and connections to the controller.

Problem	Possible Cause	Corrective Action
Position LED not lit	Position microswitch malfunction. (3-phase only)	Check the operation of the position microswitches. See Section 5.7.
	Transfer switch in intermediate position.	Manually operate the transfer switch and check the position LED operation. See Section 2.7. Check for evidence of solenoid coil damage. Replace the solenoid assembly if necessary. See the Table of Contents to locate solenoid assembly replacement procedures for your model transfer switch. Check the connections from the ATS interface board to the generator set controller.
	LEDs not functioning.	If no LEDs light, troubleshoot power and connections to the controller.
Exerciser does not operate when expected (Also see Figure 4-18)	The exercise setting on the RDC2/DC2 controller has been cleared.	Set the exerciser for the desired time and day. See the generator set operation manual for instructions.
	Generator set malfunction.	Troubleshoot the generator set. See the generator set service manuals.

Figure 4-17 Troubleshooting Chart

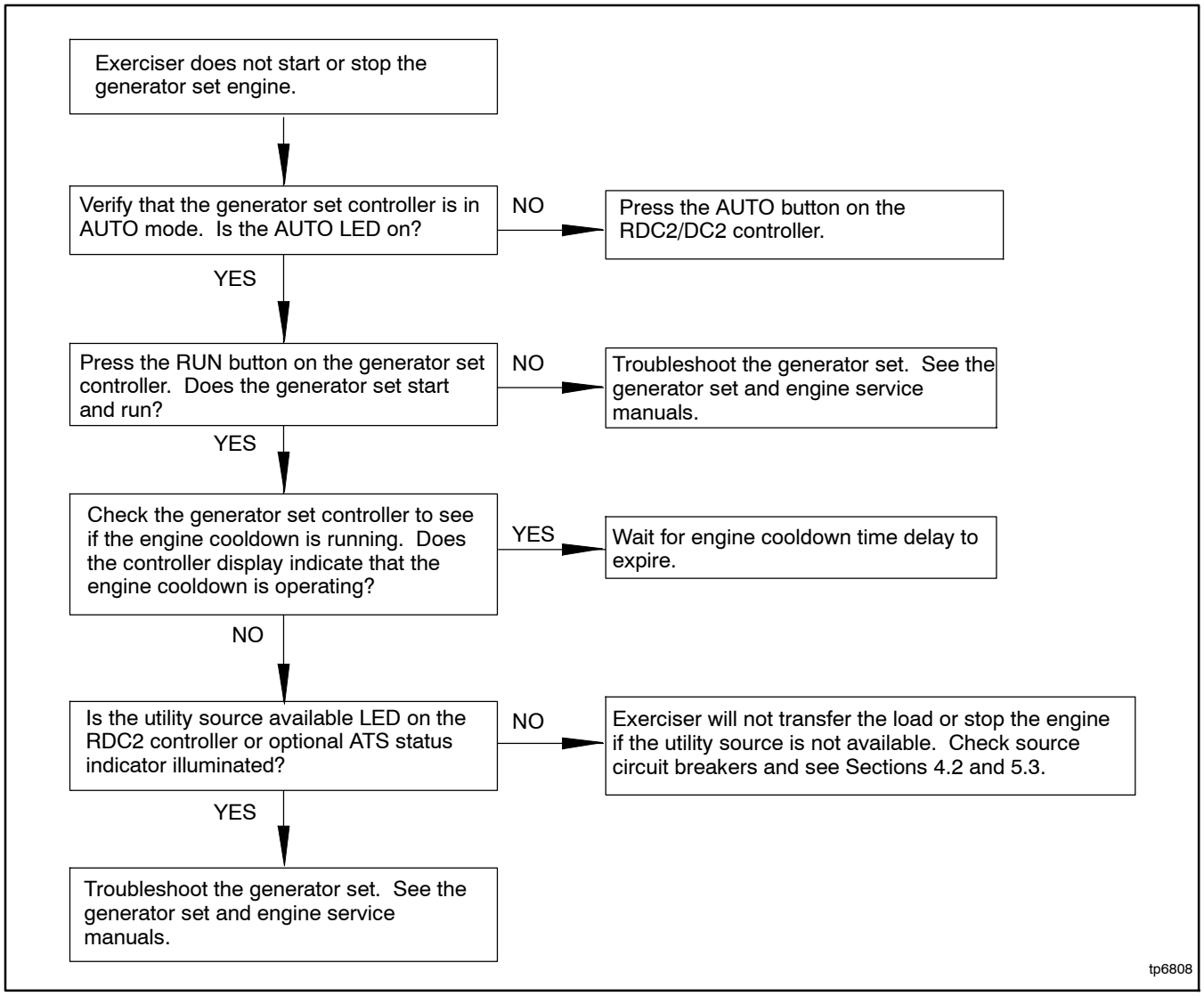


Figure 4-18 Exerciser Troubleshooting

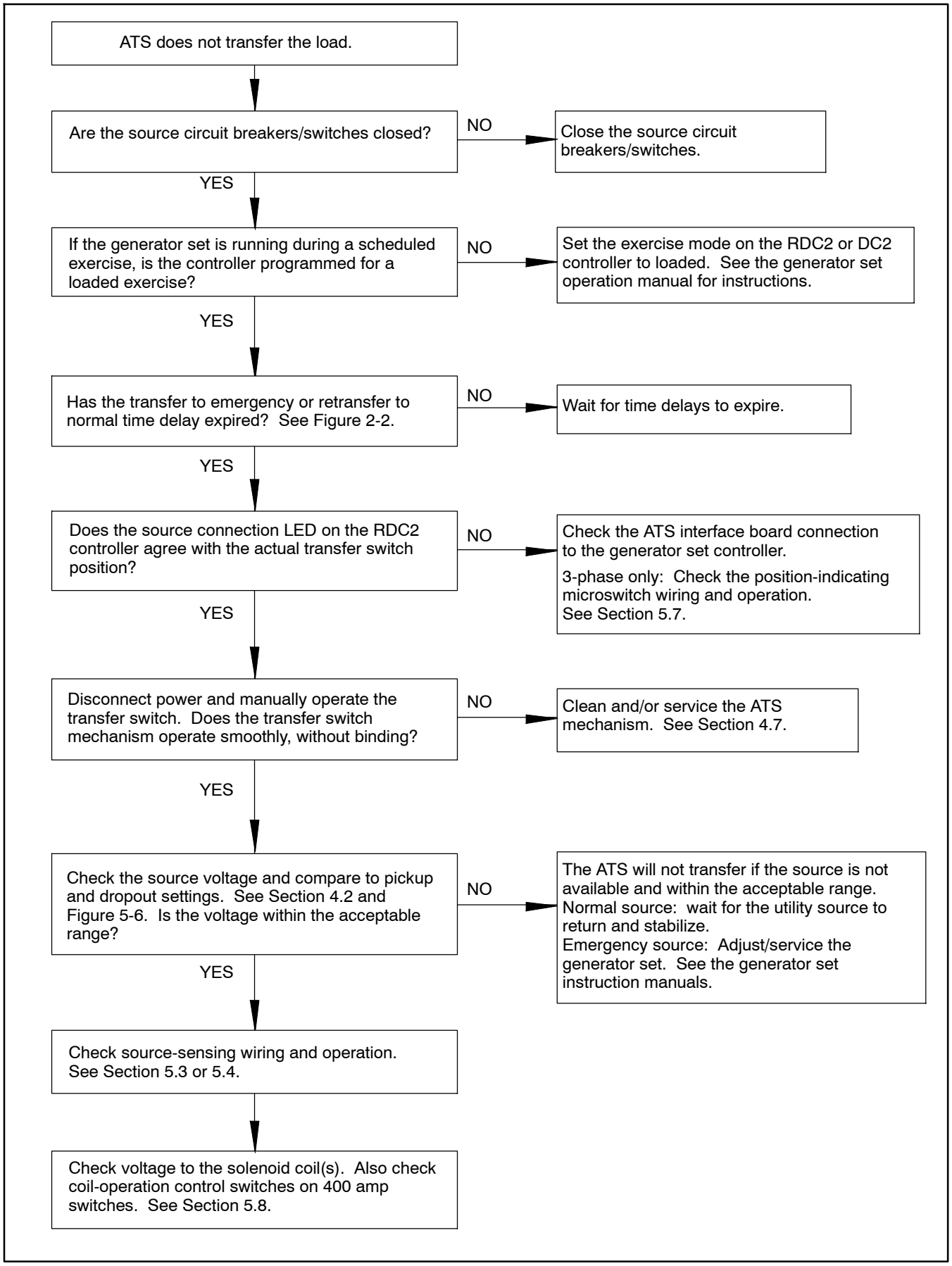


Figure 4-19 Failure to transfer

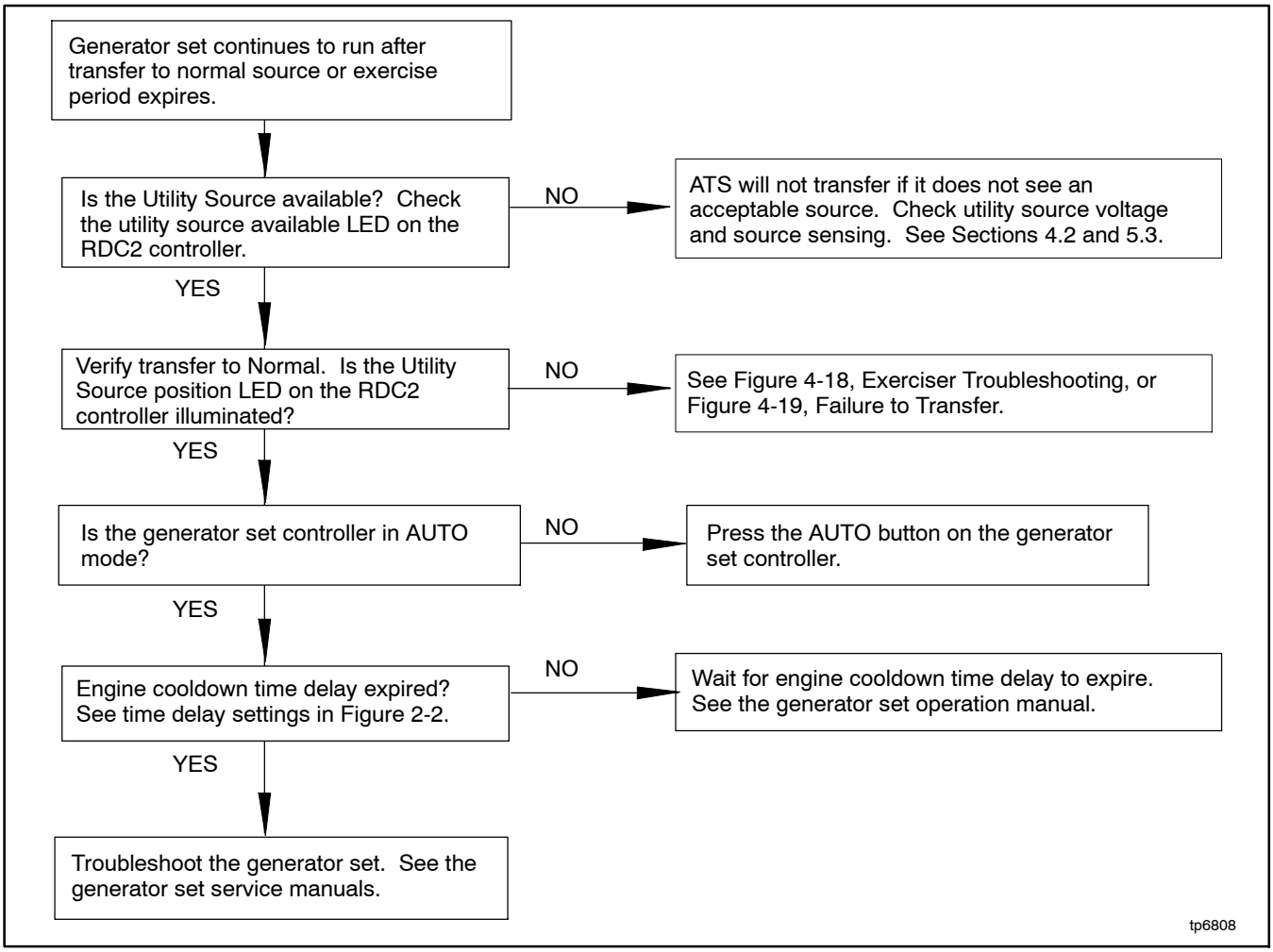


Figure 4-20 Generator Set Continues to Run

4.7 Transfer Switch Troubleshooting

Check the items in this section when the switch fails to transfer or transfers improperly when one source fails and the other source is available and is indicated by the corresponding source-available LED.

There may be both mechanical and electrical causes of transfer switch operation problems. If the transfer switch is binding, the transfer switch solenoid coil and other components could be damaged.

4.7.1 Neutral Connection

Check the neutral connection and verify that the transfer switch is properly grounded in accordance with the NEC and local codes.

4.7.2 Mechanical Check

Manually operate the transfer switch to check that it operates smoothly without binding.

If the transfer switch assembly is replaced, check the solenoid on the damaged transfer switch assembly before reapplying power. If the solenoid is damaged, visually check the wiring, interface board assembly, and other components for evidence of overheating (discolored metal, burning odor or melted plastic). Replace damaged components.

4.7.3 Solenoid Troubleshooting

The solenoid coils require rated voltage for operation. The rectifier is sealed inside the coil assembly and is not accessible for testing. During normal operation, the coils are energized for approximately 0.5 second to initiate transfer.

Visually inspect the coils for signs of overheating. A transfer switch solenoid is not designed to operate continuously. When operated continuously the solenoid coil windings first tend to short circuit, then eventually burn, and the solenoid becomes an open circuit. Therefore, a damaged solenoid most likely indicates that the transfer switch was mechanically binding or that something in the control circuit failed and allowed the solenoid to operate over a longer period than it should.

See Section 5.8 to test the voltage to the solenoid coils and the coil operation control switches (400 amp models).

Note: Checking the voltage to the coil requires a fast (250 microseconds) digital multimeter with a maximum recording feature.

After solenoid replacement and before applying power:

- Check that the transfer switch operates freely without binding.
- Visually check the wiring, controller assembly, and other components for evidence of overheating (discolored metal, burning odor or melted plastic). Replace damaged components.

4.8 Load Control Module (LCM)

Note: Only one load management option can be used with the generator. If the LCM is connected to an RXT equipped with the combined interface/load management board, disable the load management function on the combined board as described in Section 4.8.2.

See TT-1574, installation instruction sheet for the load control module, for troubleshooting instructions for the load control module. The instruction sheet is shipped with the LCM.

4.8.1 LCM and RXT with Standard Interface Board

If the Load Control Module (LCM) is used with an RXT transfer switch equipped with the standard interface board, follow the instructions in TT-1574, provided with the LCM, to connect the load control module and the current transformer and troubleshoot the LCM.

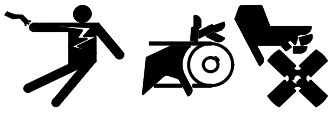
4.8.2 LCM and RXT with Combined Interface/Load Management Board

If the LCM is used with an RXT that is equipped with the combined interface/load management board, load management must be disabled on the combined interface board. Check the following:

- Verify that the P11 jumper on the combined interface board is connected across terminals 1 and 2, which disables the load management function on the interface board. See Figure 4-21.
- Make sure that the RBUS communication cable is connected to the RXT combined interface board AND the LCM, as well as the generator controller and any other RBUS accessories.
- Verify that the current transformer on the generator is connected to the LCM (not to the combined interface/load management board on the RXT).
- DO NOT connect power relays, HVAC relays, or current transformer to the combined board. Connect to the LCM as described in the LCM instruction sheet.

Note: The load status LEDs on the status indicator for the combined interface/load management board will not show the load control status of the LCM.

⚠ 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 equipment connected to the set, disable the generator set as follows: (1) Press the generator set off/reset button to shut down the generator set. (2) Disconnect the power to the battery charger, if equipped. (3) Remove the battery cables, negative (–) lead first. Reconnect the negative (–) lead last when reconnecting the battery. Follow these precautions to prevent the starting of the generator set by the remote start/stop switch.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

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.

Procedure to connect an LCM if the combined board is used on the RXT

1. Press the OFF button on the generator set controller.
2. Disconnect the utility power to the generator set.
3. Disconnect the generator set engine starting battery(ies), negative (–) lead first.
4. Disconnect power to the transfer switch.

5. Remove the ATS enclosure cover.

6. Find the combined interface/load management board, which is typically mounted on the upper left side of the enclosure. See Section 1.2, if necessary.

7. See Figure 4-21. Move the P11 jumper from terminals 2 and 3 to terminals 1 and 2 to disable the load management function on the combined board.

8. Connect RBUS communication cable to the combined interface board: Connect the generator controller's interface connection to A, B, PWR, and COM on terminal block P10 on the interface/load management board. See Figure 4-21. See Section 4.4 for detailed RBUS connection instructions.

9. Follow the instructions in TT-1574, provided with the LCM, to connect the load control module.

   a. Connect the LCM RBUS connections to either the combined interface board or to the generator's RDC2 or DC2 controller.

   b. Connect the current transformer (CT) to the LCM. Do not connect the CT to the combined interface board in the RXT enclosure.

   c. Connect power relays, HVAC connections, and 120 VAC power to the LCM as described in TT-1574.

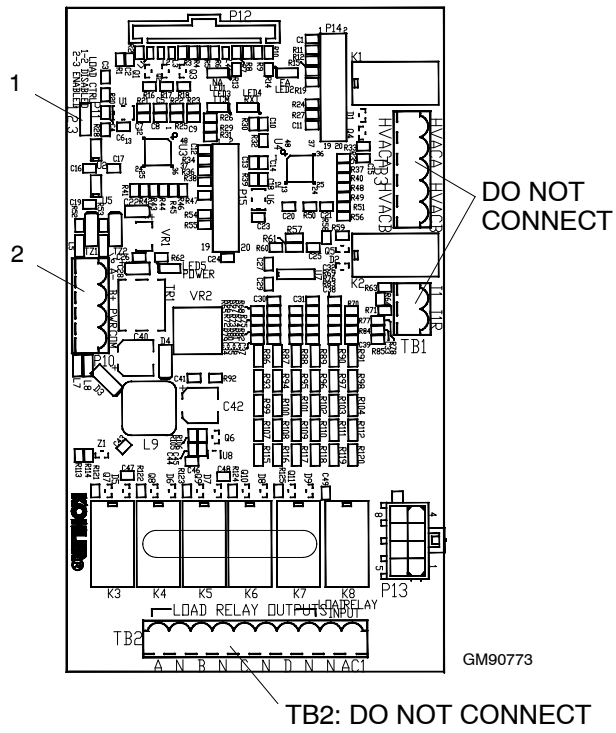
10. Install the ATS enclosure cover.

11. Check that the generator set is OFF.

12. Reconnect the utility power to the transfer switch.

13. Reconnect the generator set engine starting battery, negative (–) lead last.

14. Reconnect utility power to the generator set.



1. P11: Install jumper across pins 1 and 2 to disable load management
2. Connect RBUS communication cable to P10 on the combined board.

Note: DO NOT connect power relays, HVAC relays, or current transformer to the combined board. Connect to the LCM as described in the LCM instruction sheet.

Figure 4-21 Combined Interface/ Load Management Board Connections with LCM

4.9 Load Management Troubleshooting

The load shed kit and the combined interface/load management board perform load management as described in Section 2.6.

Note: Only one load management option can be used with the generator. If the load control module (LCM) is connected to an RXT equipped with the combined interface/load management board, disable the load management function on the combined board as described in Section 4.8.2.

Note: Use the load shed kit OR the combined interface/load management board. Do not install the load shed kit on a transfer switch equipped with the combined interface/load management board.

If the load management does not operate as expected, follow the procedures in this section to troubleshoot the equipment. First check that the controller is communicating with the load shed kit or the combined interface/load management board as shown in Section 4.4.6. Then check the troubleshooting tables for potential problems and recommendations.

4.9.1 Verify that Controller Recognizes Load Management Device

See Section 4.4.6 for instructions to verify that the controller recognizes the load shed kit or the combined interface/load management board.

4.9.2 Load Management Troubleshooting Table

The table in Figure 4-24 lists potential load shed kit or combined interface/load management board operation problems and recommendations for troubleshooting.

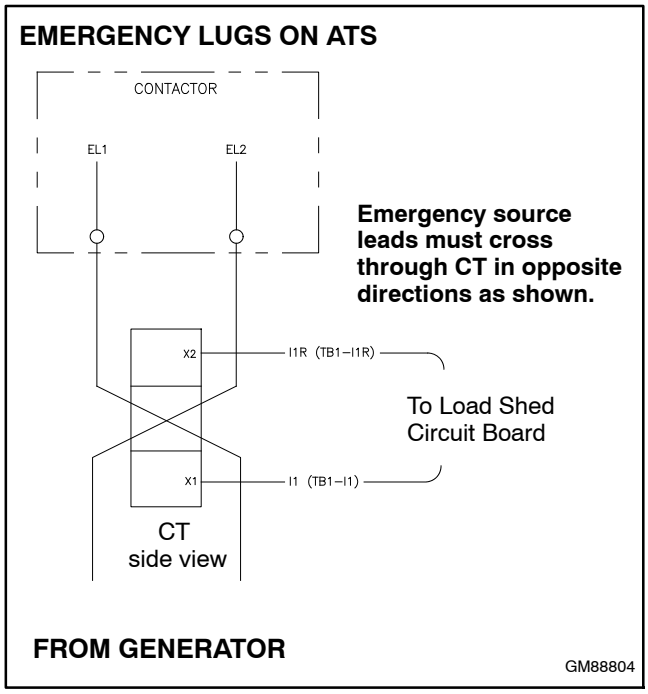
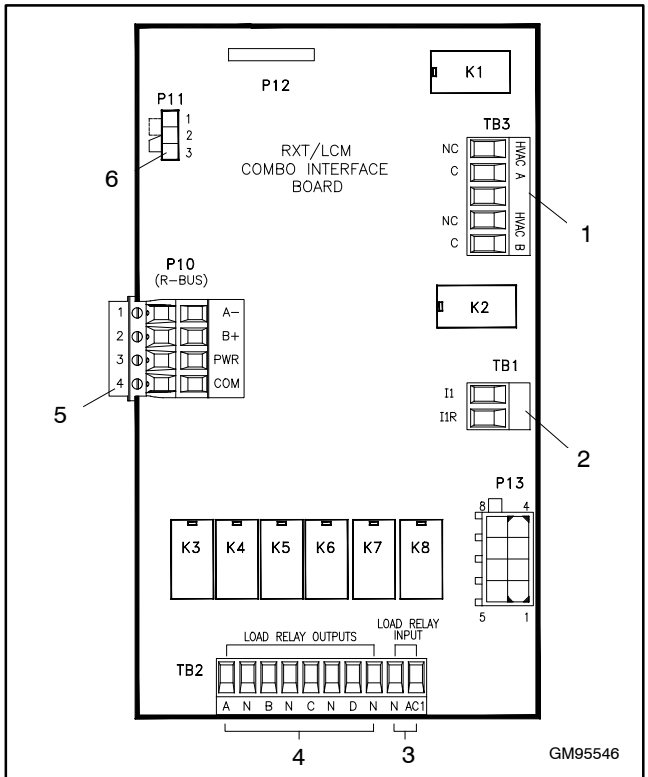


Figure 4-22 CT Wiring



1. TB3 HVAC relay connections
2. TB1 connection for current transformer (CT)
3. TB2 120 VAC input connection
4. TB2 connections to customer-supplied power relays (max 4 relays)
5. P10 RDC2/DC2 controller interface RBUS connections
6. P11 jumper (factory-installed across 2 and 3 for load management)

Figure 4-23 Combined Interface/Load Management Board Customer Connections

Load shed kit or combined interface/load management board functional issues.	
Problem	**Check**
Load shed AC relays do not activate.	Verify 120 VAC supply voltage to relays. Verify correct wiring to the load shed kit or combined interface/load management board and AC relays.
Metering always reads 0% under load.	Verify that the Emergency feed to the ATS goes through the CT correctly. See Figure 4-22. Verify the the CT leads are connected to the load shed kit or combined interface/load management board input correctly. See Figure 4-23 or the wiring diagrams in Section 6. Verify that the correct CT is used. (400 A to 3V)
Metering never reads 0%.	Verify that the CT is wired correctly. Verify that twisted-pair cable was used. Verify that CT wiring is in separate conduit from AC leads.
Load shed kit or combined interface/load management board does not shed enough load for the generator to recover.	
Problem	**Check**
HVAC units do not shed.	Verify normally closed (NC) output is used to control AC relays.
Does not shed when load is between 85% and 90%.	Verify that the load is not intermittently dropping below 85%. Verify that the load remains above 90% for at least 40 seconds. Verify that the % load is metering correctly. Verify that the overload percent is set at 10% or more below indicated level. Verify that the load shed kit or combined interface/load management board is communicating with the generator set controller.
Does not shed when load is at 100%.	Verify that the % load is steady at 100% for approximately 25 seconds. Verify that the % load is metering correctly. Verify that the overload percent is set at 10% or more below indicated level. Verify that the load shed kit or combined interface/load management board is communicating with the generator set controller.
Does not shed when load is greater than 110%.	Wait at least 15 seconds. Verify that frequency is greater than 59 Hz. Verify that the load shed kit or combined interface/load management board is communicating with the generator set controller.
Generator still overloaded when all loads are shed.	Verify that only non-essential load are connected through the load shed kit or combined interface/load management board. Correctly set up unused relays for the run length. Verify that all load shed kit or combined interface/load management board AC relays are properly supplied. Verify that the wire size is correct for the run length.
Loads do not add when they should.	
Problem	**Check**
Loads do not add when load is below 56%.	Verify that the generator set maximum load capacity is adequately sized for the application. Verify that the load is not jumping above the maximum capacity.
Loads never add.	Verify that % load is below 50%. Verify that the wiring between the load shed kit or combined interface/load management board and the generator set controller is correct. Verify that the generator set maximum load capacity is adequately sized for the application. Verify that the load is not jumping above the maximum capacity.

Sporadic load adds and sheds.	
Problem	**Check**
Load adds and then sheds after about 6 seconds.	Verify that the fuel pressure to the generator set is within specification. Verify that the % load is correctly measured. Verify that the wiring between the load shed kit or combined interface/load management board and the CT meets specifications. Verify that the Generator Set maximum Load Capacity is not set too high. One AC relay may have too much load. Even out the loads on the AC relays. Verify that generator frequency is within specification.
Loads continually add and shed.	One AC relay may have too much load. Even out the loads on the AC relays. Verify that generator frequency is within specification.
Some loads add but then all loads shed suddenly.	Verify stable communication between the load shed kit or combined interface/load management board and the ATS with the generator controller. One AC relay may have too much load. Even out the loads on the AC relays. Verify that generator frequency is within specification.
Load does not shed after transfer to Emergency.	
Problem	**Check**
Load does not shed after transfer to Emergency.	Verify that frequency is greater than 59 Hz. Verify that the transfer switch is a model RXT. Verify that the remote start signal is true. Verify that generator set controller is configured as a single-phase unit. Verify that the load shed kit or combined interface/load management board sensed load is less than 7%.
Load sheds when Normal is available.	Verify that the ATS is connected correctly. Verify that the system indicates that the Normal source is available. If an RDT transfer switch is used, verify that the remote start signal is off (false). Verify that the load shed kit or combined interface/load management board sensed load is less than 7%.

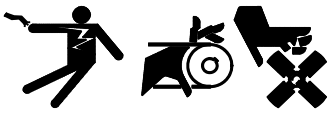
Figure 4-24 Troubleshooting Load Shed Kit or Combined Interface/Load Management Board Functional Issues

This section contains component testing information.

Note: Only trained qualified personnel following all applicable codes and standards should attempt to service the transfer switch.

Observe all safety precautions while servicing the transfer switch.

⚠ 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 equipment connected to the set, disable the generator set as follows: (1) Press the generator set off/reset button to shut down the generator set. (2) Disconnect the power to the battery charger, if equipped. (3) Remove the battery cables, negative (–) lead first. Reconnect the negative (–) lead last when reconnecting the battery. Follow these precautions to prevent the starting of the generator set by the remote start/stop switch.

⚠ WARNING

Hazardous voltage. Moving parts.
Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

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

⚠ 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.

Only authorized personnel should open the enclosure.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Turn off 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.

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.

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)

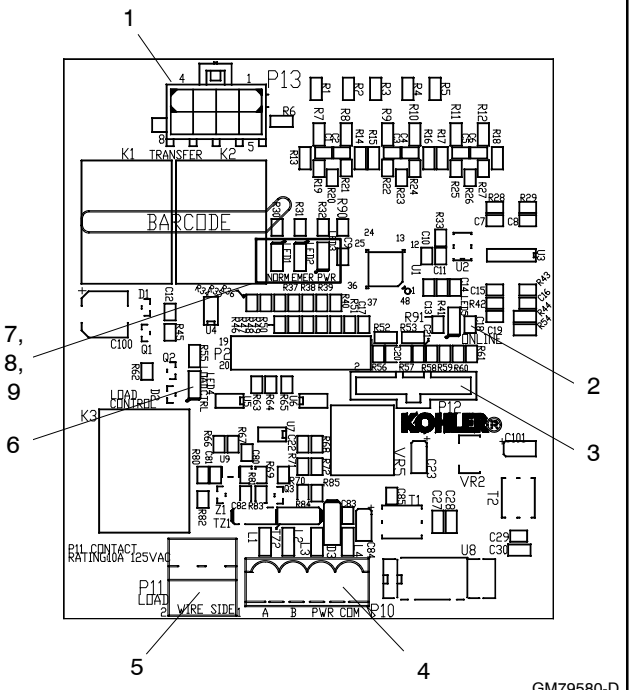
NOTICE

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.

5.1 Interface Boards

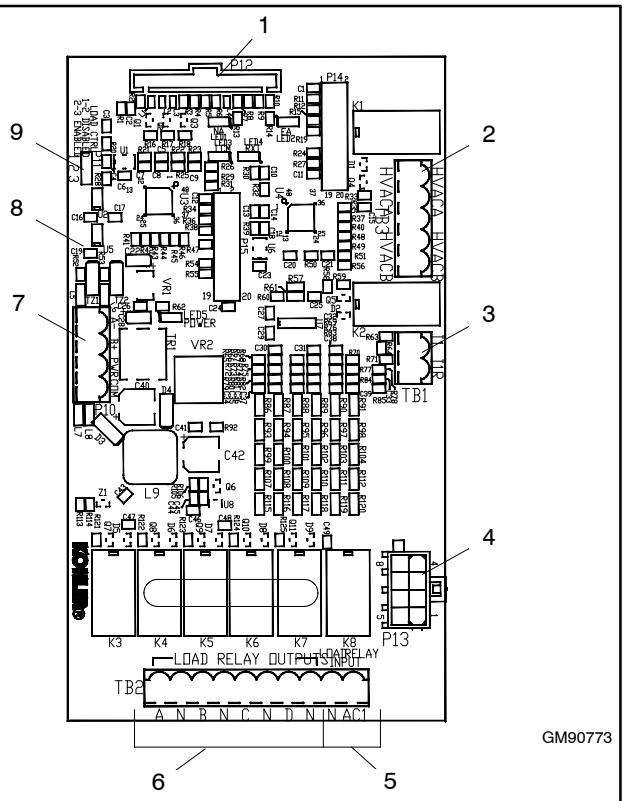
The interface board on the Model RXT transfer switch communicates with the RDC2 or DC2 controller mounted on the generator set. The interface board is equipped with LEDs that indicate power, source availability, load control relay operation, and communication with the RDC2 or DC2 controller. See the views in Section 1.2 for the interface board location.

Refer to these views of the single-phase and three-phase interface boards as needed during the test procedures in this section.



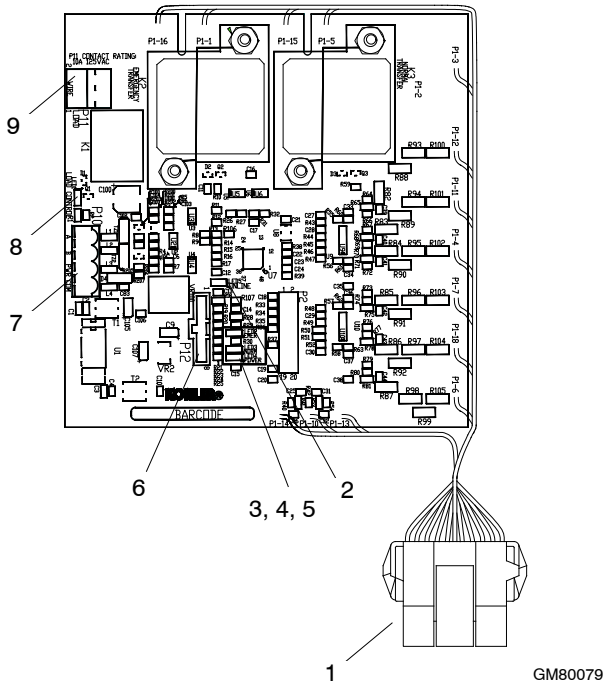
1. P13, Transfer switch harness connection
2. LED5, RBUS communication to RDC2/DC2 controller
3. P12, Optional status indicator connection
4. P10, Communication (RBUS) connection to RDC2/DC2 controller on generator set
5. P11, Load control connection
6. LED4, Load control relay
7. LED1, Normal source available
8. LED2, Emergency source available
9. LED3, Power to the interface board

Figure 5-1 Interface Board (1 Phase)



1. P12, optional status indicator connection
2. TB3, HVAC relay connections (load management)
3. TB1, current transformer (CT) connection
4. P13, transfer switch harness connection
5. TB2, 120 VAC input connection (load management)
6. TB2, power relay connections (load management)
7. P10, RBUS communication connection
8. LED 5, power
9. P11: Install jumper across pins 2 and 3 to enable load management or pins 1 and 2 to disable load management

Figure 5-2 Combined Interface/Load Management Board (1 Phase)



1. P1, Transfer switch harness connection
2. LED5, RBUS communication to RDC2/DC2 controller
3. LED2, Emergency source available
4. LED3, Normal source available
5. LED4, Power to the interface board
6. P12, Optional status indicator connection
7. P10, Communication (RBUS) connection to RDC2/DC2 controller on generator set
8. LED1, Load control relay
9. P11, Load control connection

Figure 5-3 Interface Board (3 Phase)

5.2 System Voltage and Frequency

The voltage and frequency of the transfer switch and the power sources must be the same to avoid damage to loads and the transfer switch. Compare the voltage and frequency ratings of the utility source, transfer switch, and generator set, and verify that the ratings are all the same. Check the settings on the RDC2 or DC2 controller for Normal and Emergency Source voltage and frequency. See Section 4.2.

Use the procedure in Section 5.2.1 to measure the normal and emergency source voltage to the transfer switch. See Sections 5.2.2 and 5.2.3 for instructions to calibrate the voltage on the RDC2 or DC2 controller.

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

Refer to the wiring diagrams in Section 6, as required.

5.2.1 Source Voltage and Frequency Check Procedure

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

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)

Voltage check procedures require a digital voltmeter (DVM) with electrically insulated probes capable of measuring the rated voltage and frequency.

1. Press the OFF button on the generator set controller. Check the OFF LED on the controller to verify that the generator set is off.
2. Disconnect both power sources from the transfer switch.
3. Disconnect the transfer switch contactor wiring harness from P13 on the single-phase interface board or P1 on the 3-phase interface board. See Figure 5-1 or Figure 5-3.

   Note: Do not connect or disconnect the controller wiring harness when the power is connected.
4. Manually operate the transfer switch to position E. See the transfer switch operation and installation manual for manual operation instructions.
5. Close the utility source circuit breaker or switch.
6. Use a voltmeter to check the utility source voltage to the transfer switch.
   a. Check for nominal voltage across lugs NL1 and NL2.
   b. Check for nominal voltage from NL1 to neutral.
   c. Check for nominal voltage from NL2 to neutral.
7. For three-phase systems, repeat the voltage checks across NL1–NL3 and NL3–NL1.
8. Disconnect Source N by opening upstream circuit breakers or switches.
9. Manually operate the transfer switch to position N.
10. Press the RUN button on the RDC2 or DC2 controller to start the generator set.
11. Use a voltmeter to check the generator source voltage and frequency at lugs EL1 and EL2.
    a. Check the voltage across lugs EL1 and EL2.
    b. Check the source frequency at EL1 and EL2.
    c. Check the voltage from EL1 to neutral.
    d. Check the voltage from EL2 to neutral.
12. For three-phase systems, repeat the voltage checks across EL2–EL3 and EL3–EL1.
13. If the generator set output voltage and frequency do not match the nominal system voltage and frequency shown on the transfer switch nameplate, follow the manufacturer's instructions to adjust the generator set. The automatic transfer switch will only function with the rated system voltage and frequency specified on the nameplate.
14. Stop the generator set by pressing the OFF button on the generator set controller.
15. Disconnect both sources to the transfer switch by opening the circuit breakers or switches.

16. Connect the transfer switch wiring harness to the interface board at connector P13 or P1.

    Note: Do not connect or disconnect the wiring harness when the power is connected.

17. Close and lock the transfer switch enclosure door.
18. Reconnect both power sources by closing the circuit breakers or switches.
19. Press the AUTO button on the generator set master controller.

5.2.2 Voltage Calibration using RDC2 Menus

Accurate voltage calibration on the RDC2 controller is required for correct transfer switch operation. The RDC2 controller user interface can be used to calibrate the normal and emergency source voltage.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

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)

Voltage check procedures require a digital voltmeter (DVM) with electrically insulated probes capable of measuring the rated voltage and frequency.

Measure the voltage at the transfer switch lugs as described in Section 5.2.1.

1. On the RDC2 controller, navigate to the ATS Status menu. See Figure 5-4. Press the Select button and then use the down arrow button to navigate to the Normal Voltage display in the ATS Status menu. Refer to the generator set Operation Manual, if necessary.
2. Use a digital voltmeter to measure the voltage across lugs NL1 and NL2. If the voltage displayed on the controller does not match the voltmeter reading, calibrate the voltage:
   a. Press the Select button. The voltage flashes.
   b. Press the Up or Down arrow button to change the display to match the voltmeter reading.
   c. Press the Select button to save the setting.
3. For 3-phase models, repeat step 2 for NL2–NL3 and NL3–NL1.
4. Start the generator set.
5. On the RDC2 controller, press the down arrow button to navigate to the Emergency Voltage display in the ATS Status menu.
6. Measure the voltage across lugs EL1 and EL2 on the ATS. If the voltage displayed on the controller does not match the voltmeter reading, calibrate the voltage as described in step 2.
7. For 3-phase models, repeat step 6 for EL2–EL3 and EL3–EL1.
8. Press the down arrow button to move to the next menu.
9. Stop the generator set.

Reset Calibration

The Reset Calibration menu allows you to set the voltage readings back to the original values, if necessary. See Figure 5-4.

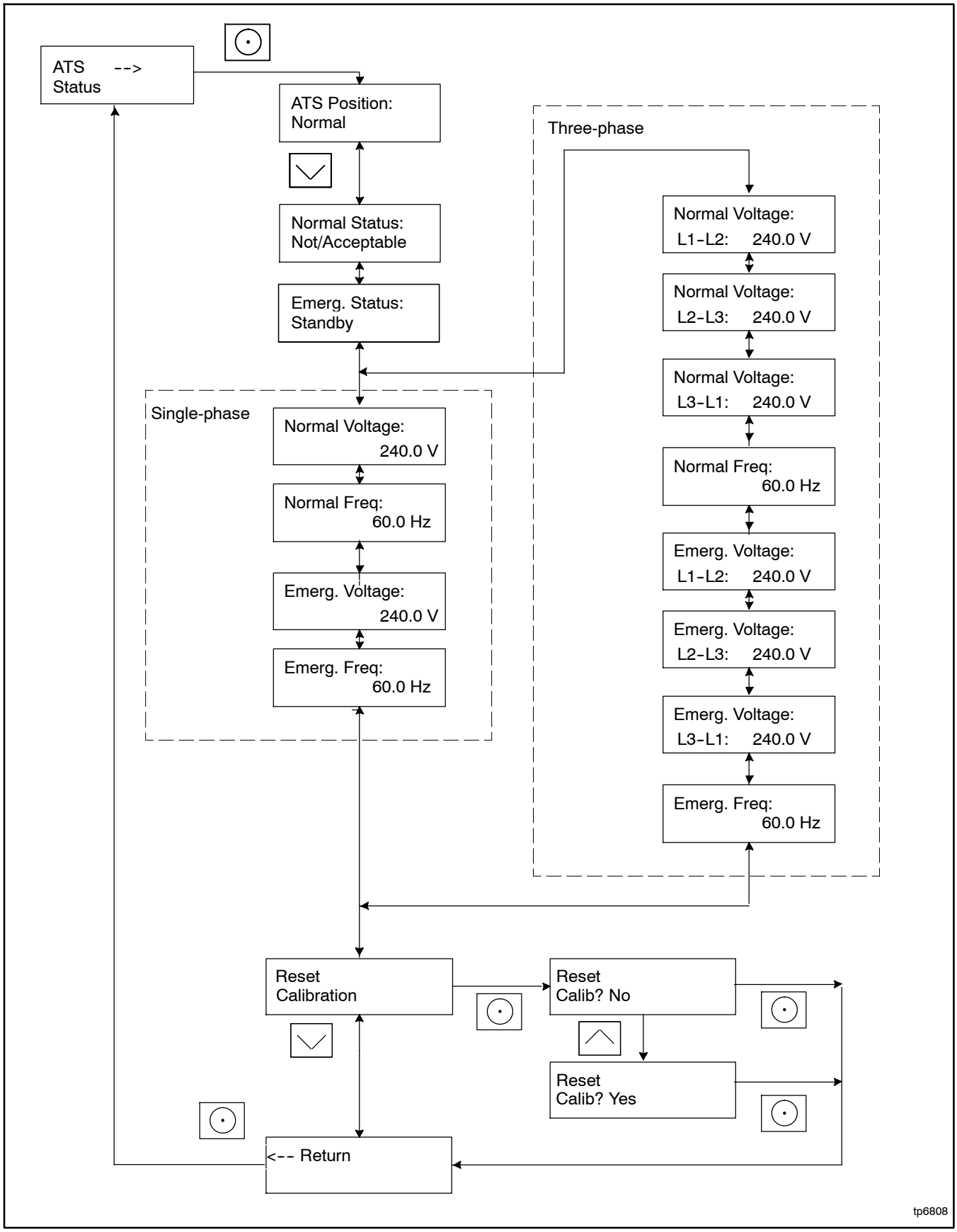


Figure 5-4 ATS Status Menu (for voltage calibration)

5.2.3 Voltage Calibration Using SiteTech

Use the Source 1 and Source 2 Calibration factors in SiteTech™ to calibrate the voltage with the RDC2 or DC2 controller. See Section 4.3 for instructions to connect a PC to the generator set controller. Refer to the SiteTech screens shown in Figure 4-4 and Figure 4-5 during the calibration procedure. See TP-6701, SiteTech Software Operation manual, for additional instructions, if necessary.

1. Measure the voltage across transfer switch lugs NL1 and NL2 as described in Section 5.2.1.
2. Check the voltage displayed for Source 1 Voltage L1–L2 in the Source 1 Metering group in SiteTech. Compare to the voltmeter reading.
3. If the voltage displayed in SiteTech does not match the voltmeter reading, use the formula in Figure 5-5 to calculate the new calibration factor.
4. In the Source 1 Calibration group in SiteTech, type the new value for Source 1 Calibration Factor Voltage, L1–L2 into SiteTech and click on Apply Changes. See Figure 4-5.
5. Allow a few seconds for the controller to adjust to the new factor and then compare the voltmeter reading with the voltage displayed on the controller.
6. For three-phase models, repeat the calibration procedure for voltage across L2–L3 and L3–L1.
7. Start the generator set and repeat the calibration procedure for Source 2. Use the Source 2 Metering and Source 2 Calibration groups in SiteTech.

$$(V_{meter} \div V_{control}) \times F_{old} = F_{new}$$

V_{meter} = Voltmeter reading

$V_{control}$ = Voltage displayed in SiteTech

F_{old} = Source Calibration Factor, Voltage L–L, from SiteTech before calibration

F_{new} = New value to enter for Source Calibration Factor, Voltage L–L, in SiteTech

Example:

Voltmeter reading: 241.2

Controller display: 240

Old calibration factor (from SiteTech): 1.00

New calibration factor:

(241.2 ÷ 240) x 1.00 = **1.005**

Figure 5-5 Voltage Calibration Factor

5.3 Normal Source Sensing

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

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(600 volts and under)

Follow this section when the system does not recognize the normal power source as available, or when it fails to recognize normal power source failure. See Figure 5-6 for pickup and dropout settings.

This section requires a voltmeter with a minimum accuracy of ±1% on the scale being measured.

Source available LEDs referred to in the following procedures are located on the interface board in the transfer switch enclosure, the RDC2 controller (mounted on the generator set), and the optional status indicator on the transfer switch. See Section 5.1, Interface Boards, and Section 5.6, Status Indicator.

Initial Normal Source Sensing Test

Use this section to initially check normal source sensing. This procedure requires normal source availability.

1. Connect the normal source and verify that the Normal Source Available LED lights. If the LED does not light, or the RDC2/DC2 controller does not recognize that the Normal Source is available, proceed to the next step.

2. Check for nominal voltage on at the lugs on the ATS contactor.

   a. Single-phase: measure across NL1 and NL2

   b. Three-phase: measure across NL1–NL2, NL2–NL3, and NL3– NL1.

   c. If voltage is not present on the lugs, check the normal source, normal source wiring, and circuit breaker.

3. If voltage is present on the lugs, check the LEDs on the interface board. If the Normal Available LED is not lit, check for voltage at the interface board connector.

   a. Single-Phase: Check for nominal voltage across P13-1 and P13-5 at the interface board connector. Check that LED1 on the interface board is on.

   b. Three-phase: Check for nominal voltage across the following connectors to the interface board:

      - P1–12 to P1–11
      - P1–11 to P1–4
      - P1–4 to P1–12

4. If voltage is not present at the interface board connectors, check the wiring from the contactor to the interface board. Repair or replace wiring as needed.

5. If the voltage at the interface board connectors exceeds the pickup voltage (see Figure 5-6) then the Utility Available LED on the RDC2 controller assembly should light. If the Utility Available LED on the RDC2 controller is not lit, check the communications wiring from the interface board to the RDC2 controller.

6. Optional ATS status indicator (see Section 5.6): If the voltage at the interface board connectors exceeds the pickup voltage (see Figure 5-6) then the Utility Available LED on the status indicator should light. If the Utility Available LED is not lit, check the status indicator connection to P12 on the interface board.

7. Disconnect the normal source. If the Utility Available LED does not turn off within a few seconds, proceed to the next section, normal Source Sensing Accuracy Test.

Normal Source Sensing Accuracy Test

After performing the source sensing test above, use the following procedure to check the accuracy of normal-source voltage sensing. This procedure requires a variable voltage source that ranges from about 5% below the dropout setpoint to about 5% above the pickup setpoint.

1. Disconnect the normal and emergency power sources and the load from the transfer switch.
2. Connect a variable voltage source to lugs NL1 and NL2 on the transfer switch assembly. Increase the voltage until the Utility Available LED lights or the voltage is 5% above the pickup voltage setpoint in Figure 5-6.
3. If the Utility Available LED on the RDC2 controller does not light, replace the controller.
4. If the Utility Available LED lights, reduce the voltage until the Utility Available LED turns off or is 5% below the dropout voltage setpoint If the Utility Available LED remains lit, replace the controller. If the LED turns off, check the voltage. If the voltage is not within ±5% of the dropout voltage setpoint , replace the controller.
5. Increase the voltage until the Utility Available LED lights. If the voltage is not within ±5% of the pickup setpoint , replace the controller.

Setpoint		240 V	220 V
Undervoltage pickup	90% of nominal	216 VAC	198 VAC
Undervoltage dropout	90% of pickup	194 VAC	178 VAC

Figure 5-6 Undervoltage Setpoints, Normal Source

5.4 Emergency Source Sensing

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

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)

Follow this section when the transfer switch starts the generator set but does not recognize the emergency source as available by lighting the Generator Power Available LED, or it fails to recognize emergency power source failure.

This section requires a voltmeter with a minimum accuracy of ±1% on the scale being measured.

Initial Emergency Source Sensing Test

Use this section to initially check emergency source sensing. This procedure requires emergency source availability.

1. Use SiteTech to check the Source 2 pickup and dropout settings. The default settings are shown in Figure 5-7.
2. Move the generator set master switch to the RUN position to start the emergency source generator set.
3. Disconnect the emergency source. If the Generator Power Available LED remains lit more than a few seconds, proceed with the following steps.

4. Reconnect the emergency source and check for nominal voltage between pins 1 and 2 at connector P1 to the interface board.

   a. Check for AC voltage at the interface connector P13 (single-phase) or P1 (3-phase):

      - Single-phase: Check for nominal voltage across P13-3 and P13-7.

      - Three-phase: Check for nominal voltage across P1–7 and P1–18, P1-6 and P1-7, and P1-6 and P1-18 at connector P1.

   b. If voltage is not present at the controller, check for voltage on lugs EL1 and EL2 on the transfer switch assembly. If voltage is not present at the lugs, check the emergency source and the emergency source wiring and circuit breaker. If voltage is present at the lugs, check the transfer switch wiring harness connections from the lugs to the interface board.

   c. If the voltage at pins 1 and 2 on P1 on the controller exceeds the pickup voltage setpoint in Figure 5-7, the Generator Power Available LED on the controller assembly should light; replace the controller assembly if the Generator Power Available LED does not light.

Setpoints		240 Volt 60 Hz	220 Volt 50 Hz
Undervoltage pickup	90% of nominal	216	198
Undervoltage dropout	90% of pickup	194	178
Note: The emergency source pickup and dropout settings can be adjusted using SiteTech.			

Figure 5-7 Undervoltage Setpoints, Emergency Source

Emergency Source Voltage Sensing Accuracy Test

After performing the Emergency Source Sensing test above, follow the next steps to check the accuracy of emergency source voltage sensing. This procedure requires a variable voltage source that ranges from about 5% below the dropout specification to about 5% above the pickup specification. See Figure 5-7.

1. Disconnect the normal and emergency power sources and the load from the transfer switch.

2. Connect a variable voltage source that ranges from about 5% below the dropout setpoint to about 5% above the pickup setpoint to lugs EL1 and EL2 on the transfer switch assembly.

3. Increase the voltage until the Generator Power Available LED lights or the voltage is 5% above the pickup voltage setpoint. If the Generator Power Available LED does not light, replace the controller assembly. Otherwise, reduce the voltage until the Generator Power Available LED turns off or the voltage is 5% below the dropout voltage setpoint.

4. If the Generator Power Available LED remains lit, replace the controller assembly. If the LED turns off, check the voltage. If the voltage is not within ±5% of the dropout voltage setpoint, replace the controller assembly.

5. Increase the voltage until the Generator Power Available LED lights. If the voltage is not within ±5% of the pickup voltage setpoint, replace the controller assembly.

Emergency Source Frequency Sensing Test

If the generator set frequency is adjustable, follow the instructions in the generator set manual to adjust the frequency above and below the pickup and dropout settings. Use a digital multimeter to measure to source frequency.

Note: Carefully follow the instructions and safety precautions in the generator set manual.

Check the operation of the Generator Power Available LED as the frequency is increased and decreased. The ATS frequency sensing should be accurate to ±2%.

5.5 Operation Sequence Test

Follow this section to check the automatic operation sequence including LED functions, engine starting, time delays, and transfer switch operation. Use SiteTech to check the time delay settings. See Figure 5-8 for time delays.

Check the LEDs on the interface board as well as LEDs on the RDC2 controller and the optional ATS status indicator. If the LEDs on the interface board operate correctly, but the LEDs on the RDC2 controller or the optional status indicator do not, check the connections before replacing the controller or the status indicator. See Section 5.1, Interface Boards.

Time Delay	Factory Setting	Adjustment	
		Range	Increment
Engine Start	3 sec.	1–10 sec.	1 sec.
Transfer from Normal to Emergency	3 sec.	1–10 sec.	1 sec.
Retransfer from Emergency to Normal	2 min.	1 sec. – 10 min.	1 sec.
Exercise Time Duration	20 min.	10–30 min.	1 min.
Undervoltage Dropout Time	0.5 sec.	NA	

Figure 5-8 Time Delays

This sequence simulates the loss of normal power by disconnecting the source and executes all applicable time delays.

Operation Test

1. Press the OFF button on the generator set controller.
2. Disconnect ALL power sources to the transfer switch.
3. Manually operate the transfer switch to the normal position.

   Note: Do not manually operate the transfer switch with the power connected.
4. Close and secure the enclosure door.
5. Apply the normal power source. If the Utility Available LED does not light, see Section 5.3.
6. Press the AUTO button on the generator set controller.
7. Disconnect the normal power source and wait for the engine start time delay. If the engine-is not signalled to start within ±10% of the engine start time delay setting, replace the controller assembly.
8. Reconnect the emergency source and check the Generator Power Available LED. If the Generator Power Available LED does not light, see Section 5.4. Wait for the Normal-to-Emergency transfer time delay to expire and the switch to transfer to the emergency source. If the switch fails to transfer, see Section 4.2. If the switch transfers but not within ±10% of the Normal-to-Emergency transfer time delay setting, replace the controller assembly.
9. Reconnect the normal power source. Wait for the Emergency-to-Normal retransfer time delay and for the switch to transfer back to the normal source. If the switch fails to transfer, see Section 4.2. If the switch transfers but not within ±10% of the Emergency-to-Normal retransfer time delay setting, replace the controller assembly.
10. Wait for the engine cooldown time delay. If the engine is not signalled to stop within ±10% of the engine cooldown time delay setting (after transfer to normal or after the engine cools down), replace the controller assembly.

5.6 Status Indicator (Optional)

Two status indicator panels are available:

- GM84662-KP1-QS is designed for use only with a standard RXT interface board.
- GM84662-KP2-QS is designed for use only with a combined interface/load management board.

The status indicator's ribbon cable connects to the interface circuit board at connector P12. See Figure 5-10. The ribbon cable connectors for the two status indicator kits are not the same. GM84662-KP2-QS must be used with the combined board even if the load management function on the board is disabled.

5.6.1 Operation

The LEDs on the status indicator operate as shown in Figure 5-9. To check the operation, see Sections 5.3 and 5.4.

Note: Utility LEDs indicate the source connected to the Normal side of the transfer switch. Generator LEDs indicate the source connected to the Emergency side.

LED	State/ Color	Indicates
Utility Available	On	Utility power is available
	Off	Utility power is not available
Utility Connected	On	Utility power is connected (ATS in normal position)
	Off	Utility power is not connected
Generator Available	On	Generator set is running and producing power
	Off	Generator set power is not available
Generator Connected	On	Generator is connected to the load (ATS in Emergency position)
	Off	Generator not connected
Load LEDs, **GM84662-KP2-QS only:**		
Loads A through D	Red	Load disconnected (shed)
	Green	Load connected (added)
	Flashing red	Disconnected (test)
HVAC Loads A, B	Red	Load disconnected (shed)
	Green	Load connected (added)
	Flashing red	Disconnected (test)

Figure 5-9 Status Indicator LEDs

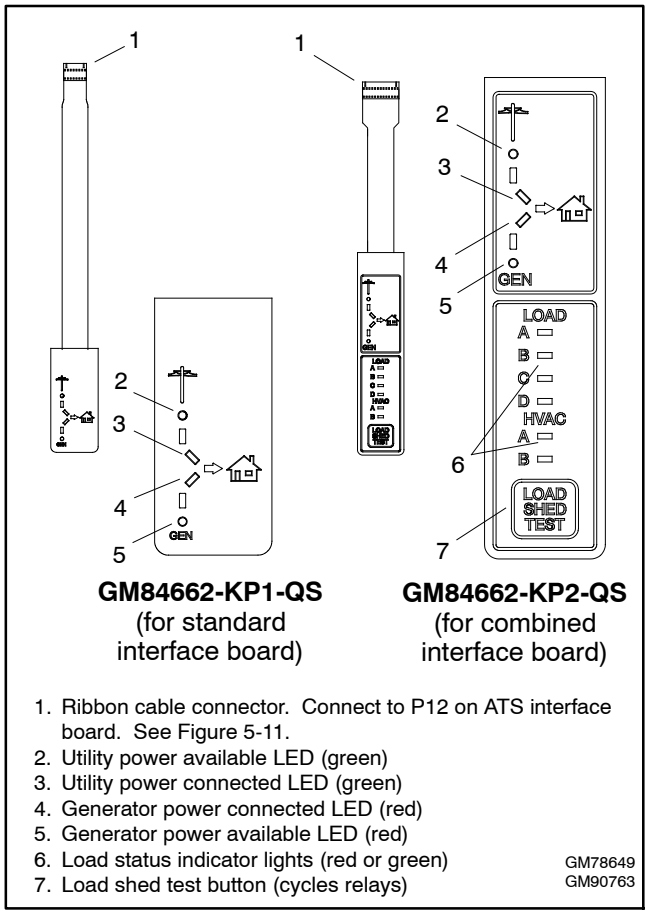
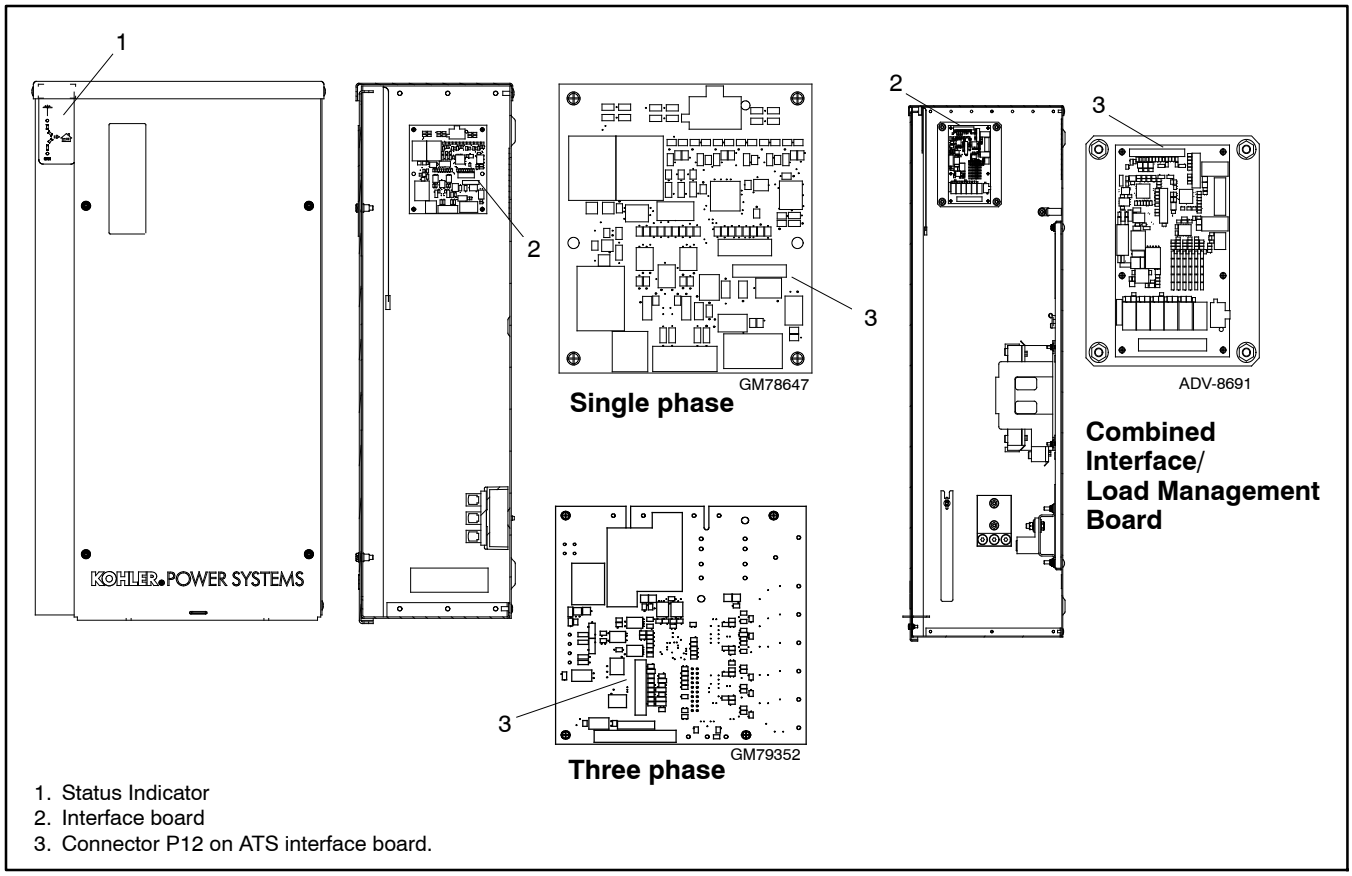


Figure 5-10 Optional Status Indicators



1. Status Indicator
2. Interface board
3. Connector P12 on ATS interface board.

Figure 5-11 Status Indicator Connection P12 on the RXT Interface Boards

5.6.2 Test (GM84662-KP2-QS)

On **GM84662-KP2-QS,** use the TEST button to exercise the load shed relays in sequence according to the assigned priorities. Operate the generator set in RUN mode, not AUTO, during this test. The generator set must be running, but the automatic transfer switch must NOT transfer to the generator set for this test.

Note: The load shed must be active to exercise the load shed relays with the TEST button. Load shed will be disabled when the transfer switch is set to RXT only mode. See the RXT operation and installation manual.

Test Procedure

1. Press RUN on the RDC2 or DC2 generator set controller to start the generator set.

2. Press the TEST button on the indicator panel to exercise the first relay.

3. Press TEST again for the next relay, and repeat to cycle through all of the relays in order.

The test mode ends automatically after 15 minutes. To end the test manually, hold the TEST button for 5 seconds or press OFF or AUTO on the RDC2 or DC2 generator set controller.

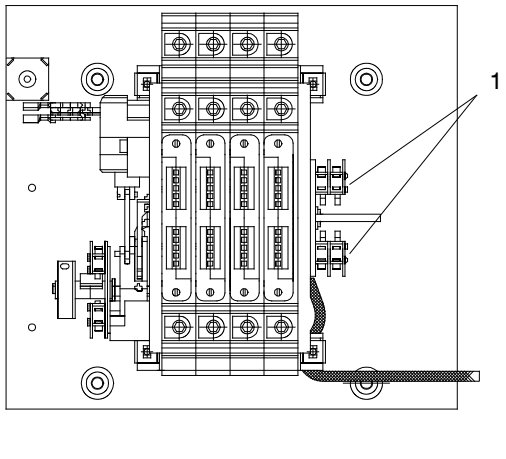
Note: When **GM84662-KP2-QS** is used with a load control module (LCM), the load portion of the status indicator is disconnected and does not work. Instead, the load is displayed by the LCM status indicator.

5.7 Position-Indicating Microswitches (3-phase only)

Three-phase models include position-indicating microswitches on the contactor assembly. Check the position-indicating microswitch operation in the case of faulty position indication, failure to transfer fault, or auxiliary switch fault. Disconnect power to the ATS before checking the switches.

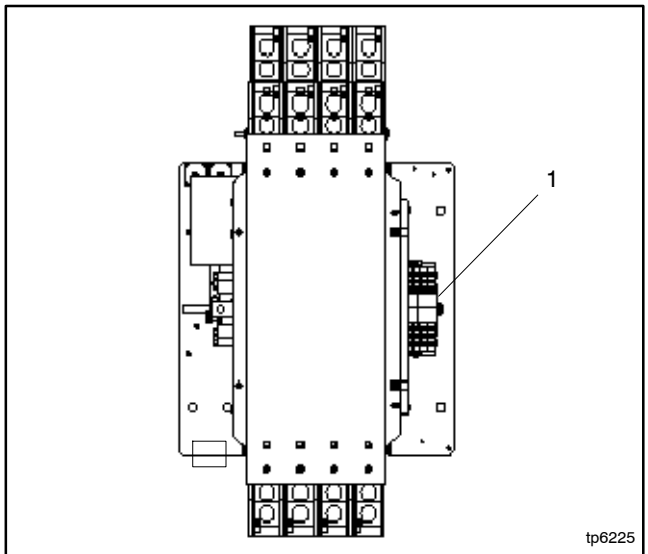
Position-Indicating Microswitch Test Procedure

1. Press the OFF button on the generator set controller.
2. Disconnect the engine starting battery, negative (–) lead first.
3. Disconnect the utility power to the generator set.
4. Disconnect power to the ATS by opening the source circuit breakers or switches.
5. See Figure 5-12 or Figure 5-13 for the position-indicating microswitch locations.



1. Contactor position microswitches

Figure 5-12 Position-Indicating Microswitches, 100/200-Amp 3-Phase Models



1. Contactor position microswitches

Figure 5-13 Position-Indicating Microswitches, 400-Amp 3-Phase Models

6. Connect an ohmmeter or a test lamp across terminals NO (normally open) and C of switch LSN or SN.
7. Manually operate the transfer switch. Check that the transfer switch lever operates the position-indicating switch and verify that the contact opens and closes. The NO contact should close when the switch is pressed and open when the switch is released.
8. Repeat steps 6 and 7 for the NC (normally closed) contact. The NC contact should open when the switch is pressed and close when the switch is released.
9. Verify that there is no continuity between the NO and NC terminals.
10. Repeat steps 6 through 9 for switch LSE or SE.

5.8 Solenoid Coil Testing

DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

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(600 volts and under)

Use a digital voltmeter or multimeter to check the voltage to the solenoid coil if there are signs of coil overheating or binding of the mechanism. See Figure 5-14 to determine whether to use test procedure A or B for your unit.

5.8.1 Voltage to the Coil Test Procedure A

See Figure 5-14 to determine whether to use procedure A or B for your unit. Refer to the operation diagrams in Section 5.9 or the wiring diagrams in Section 6 while performing this procedure.

1. Disconnect the leads to the Emergency source (lower) coil.
2. Connect the voltmeter across the disconnected leads to test the voltage to the Emergency (lower) coil. Verify that there is no voltage across the leads at this time.
3. With the transfer switch in the normal position, disconnect the Normal source. The generator set will start.
4. Use the voltmeter to verify that rated voltage is applied to the leads as the controller attempts to transfer to the Emergency source.
5. The unit should attempt to transfer 3 times before indicating a failure to transfer fault.
6. Press the OFF button to stop the generator set and reset the fault condition.
7. Reconnect the leads to the Emergency source coil rectifier. Manually transfer the mechanism to the Emergency source.
8. Check that the Normal source is still disconnected.
9. Disconnect the leads to the Normal source (upper) solenoid coil.
10. Connect the voltmeter across the disconnected leads to test the voltage to the Normal (upper) coil.
11. Reconnect the Normal source.
12. Use the voltmeter to verify that rated voltage is applied to the leads as the controller attempts to transfer back to the Normal source.
13. After testing, disconnect both sources and manually operate the switch to the Normal position. Reconnect the coil leads. Secure the ATS enclosure door before reconnecting power.

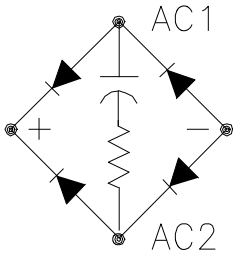
	Single Phase	3-Phase, 3-Pole			3-Phase, 4-Pole		
Amps	240 V	208 V	240 V	480 V	208 V	240 V	480 V
100	A	B	B	B	B	B	B
200	A	B	B	B	B	B	B
400	A	A	A	B	B	B	B

Figure 5-14 Test Procedures

5.8.2 Voltage to the Coil Test Procedure B

See Figure 5-14 to determine whether to use procedure A or B for your unit. Refer to the operation diagrams in Section 5.9 or the wiring diagrams in Section 6 while performing this procedure.

1. Disconnect the leads from AC1 and AC2 of the rectifier for the emergency source (lower) coil. See Figure 5-15 and the wiring diagram in Section 6.



GM80672

Disconnect leads from AC1 and AC2.

Figure 5-15 Rectifier Connections, Typical

2. Connect the voltmeter across the disconnected leads to test the voltage to the Emergency (lower) coil. Verify that there is no voltage across the leads at this time.

3. With the transfer switch in the Normal position, disconnect the Normal power. The generator set will start.

4. Use the voltmeter to verify that rated voltage is applied to the leads as the controller attempts to transfer to the Emergency source.

5. The unit should attempt to transfer 3 times before indicating a failure to transfer fault.

6. Press the OFF button to stop the generator set and reset the fault condition.

7. Reconnect the leads to the Emergency source coil rectifier. Manually transfer the mechanism to the Emergency source.

8. Check that the Normal source is still disconnected.

9. Disconnect the leads from AC1 and AC2 of the rectifier for the Normal source (upper) solenoid coil.

10. Connect the voltmeter across the disconnected leads to test the voltage to the Normal (upper) coil.

11. Reconnect the Normal source.

12. Use the voltmeter to verify that rated voltage is applied to the leads as the controller attempts to transfer back to the Normal source.

13. After testing, disconnect both sources and manually operate the switch to the Normal position. Reconnect the coil leads. Secure the ATS enclosure door before reconnecting power.

5.8.3 Solenoid Coil Resistance, Three-Phase Models

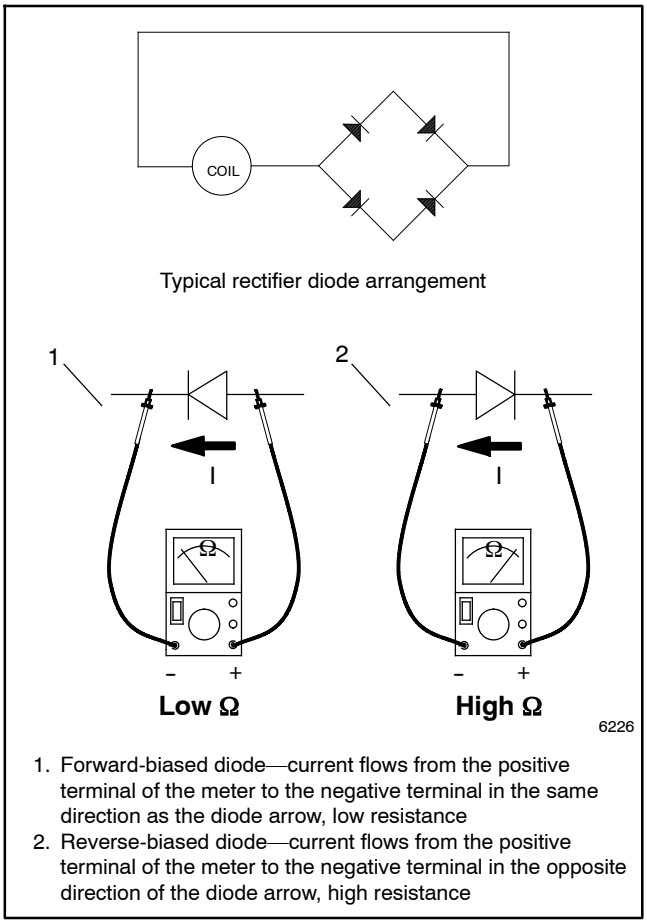
See Section 7.8.4 for solenoid and rectifier test procedures for 100–200 amp three-phase models. See Section 7.8.7 for solenoid and rectifier test procedures for 400 amp three-phase models.

5.8.4 Rectifier Test, Three-Phase Models

Use an ohmmeter or a diode checker to test the rectifiers when instructed in Sections 7.8.4 and 7.8.7.

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 5-16 and Figure 5-17. 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 5-16 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 5-17 Testing Diodes

5.9 Operating Sequence Diagrams

In the following figures, the current path is highlighted.
Also note the open and closed contacts in each case.

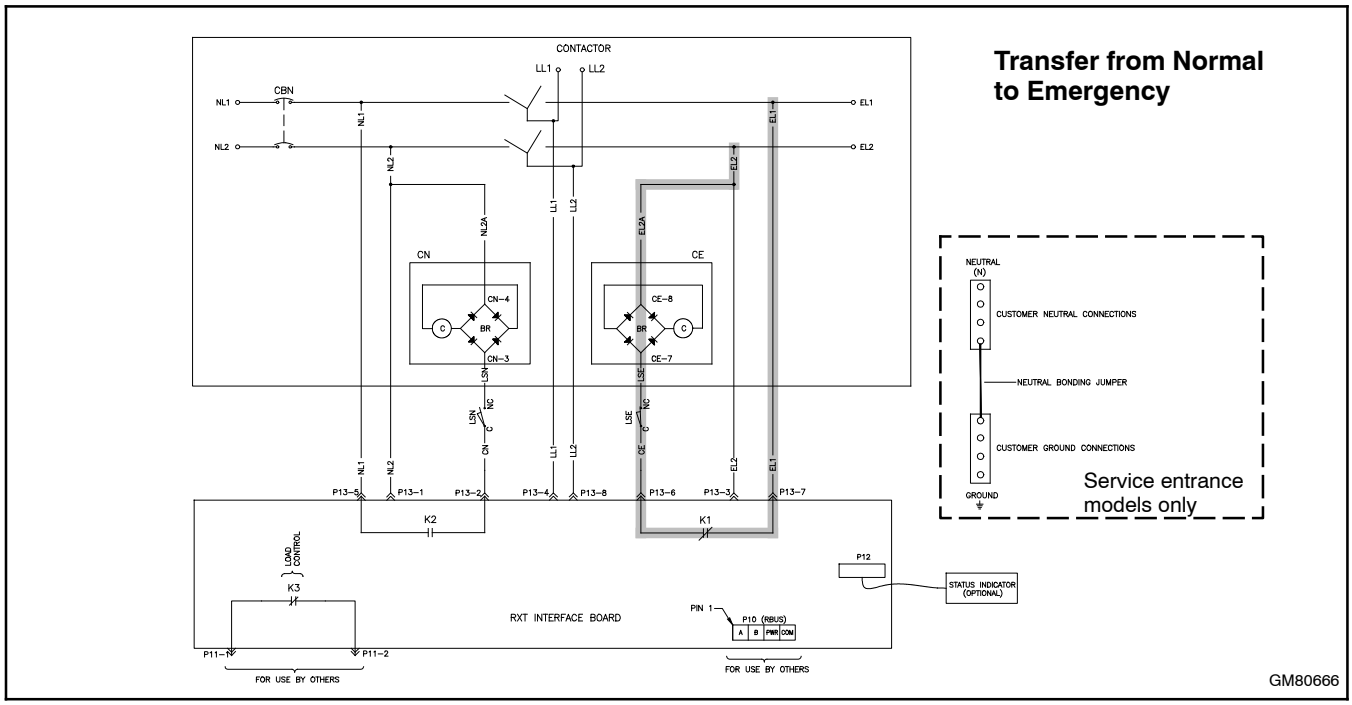


Figure 5-18 100–400 Amp, Single-Phase Models (service entrance model shown)

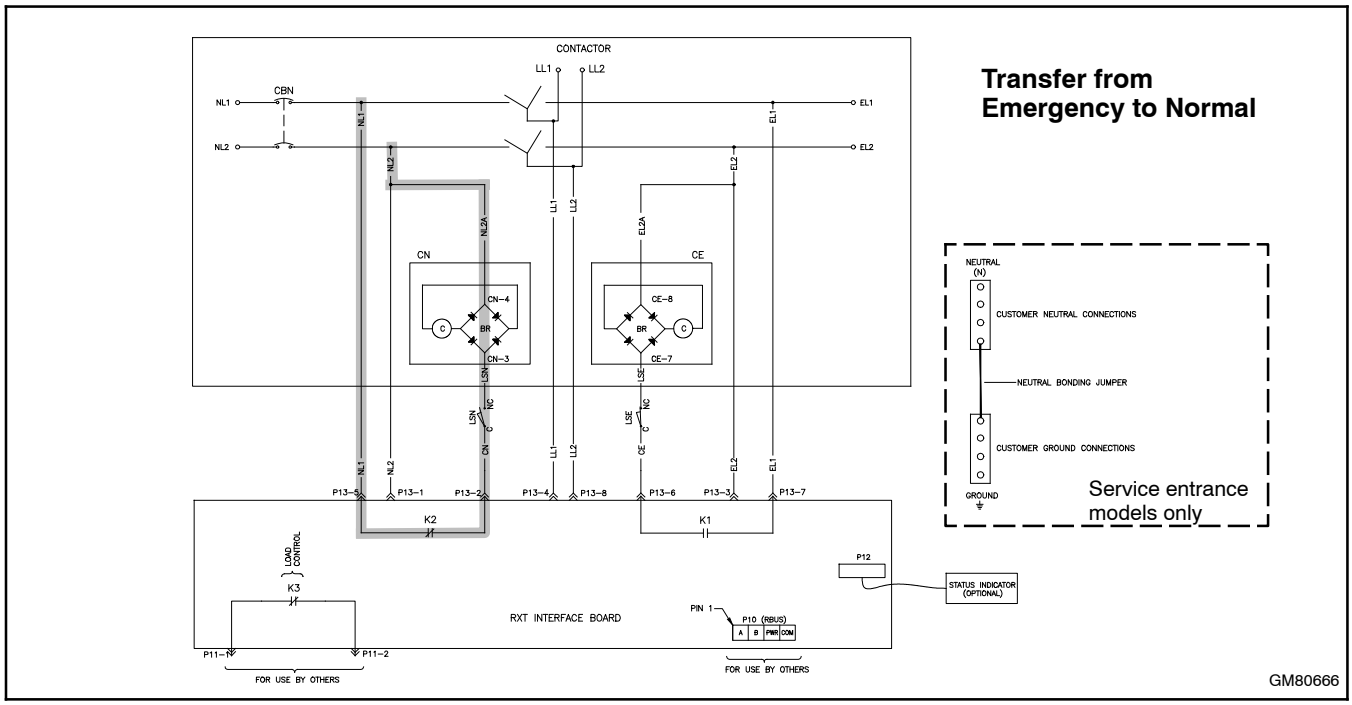


Figure 5-19 100–400 Amp, Single-Phase Models (service entrance model shown)

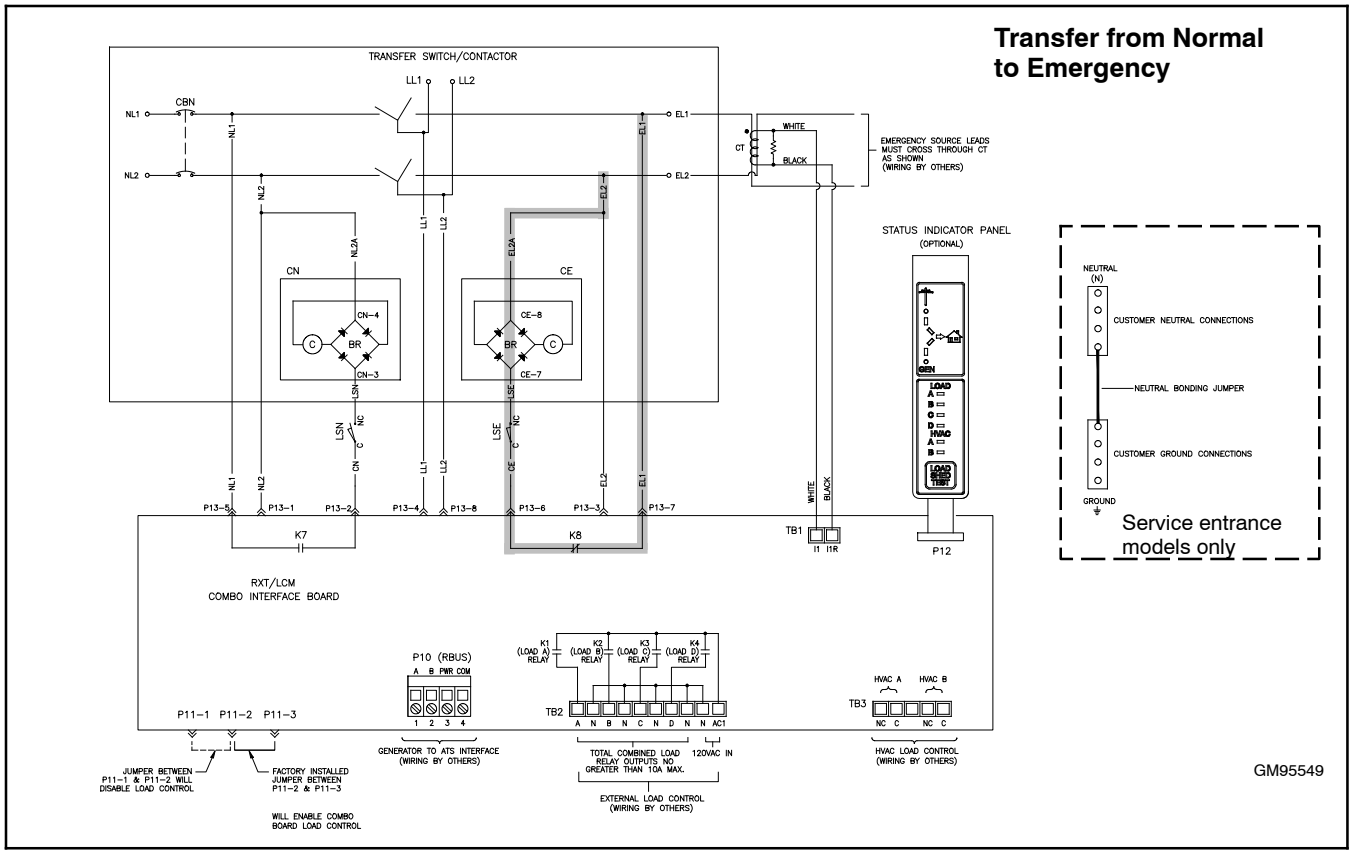


Figure 5-20 100–400 Amp Single-Phase with Combined Interface/Load Management Board

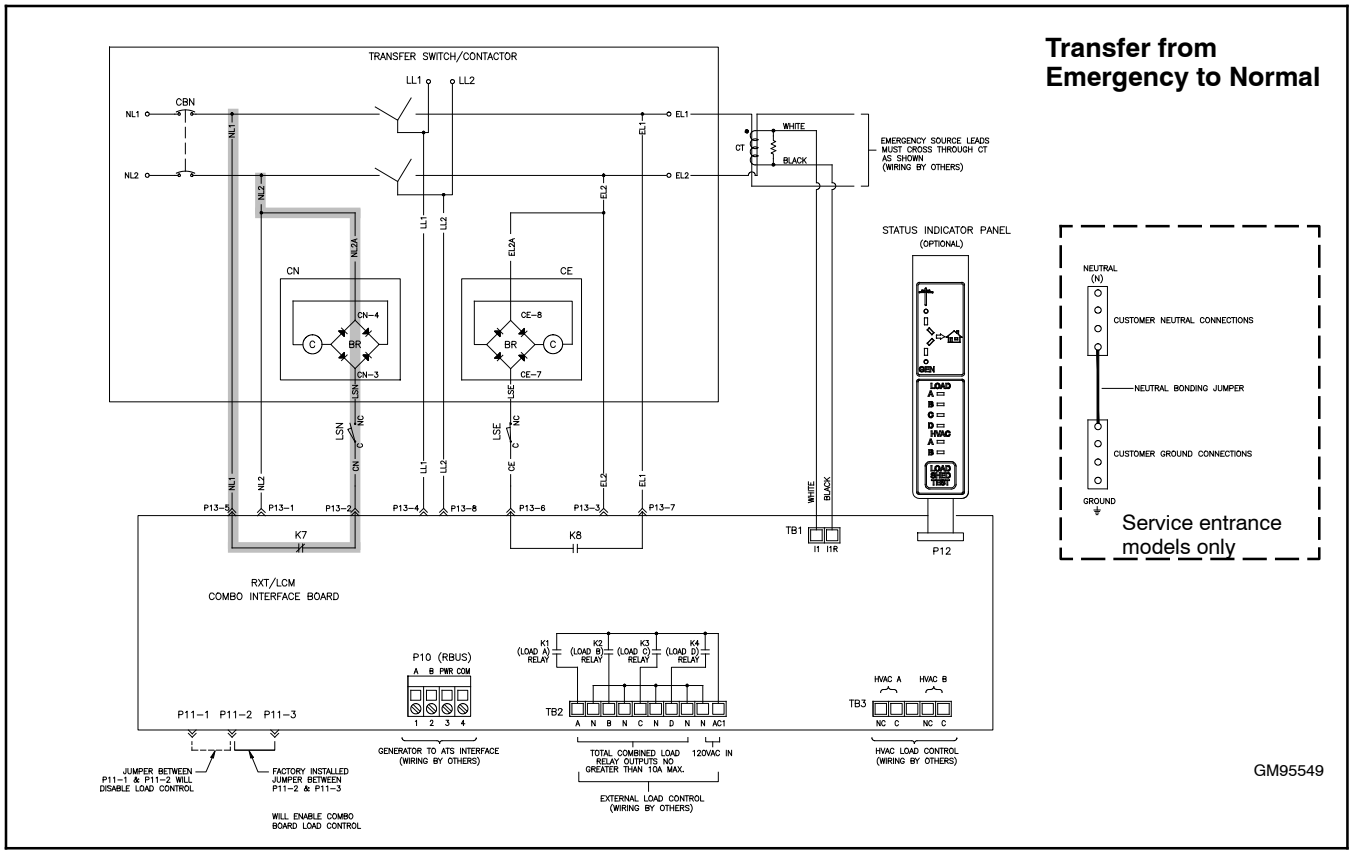


Figure 5-21 100–400 Amp Single-Phase with Combined Interface/Load Management Board

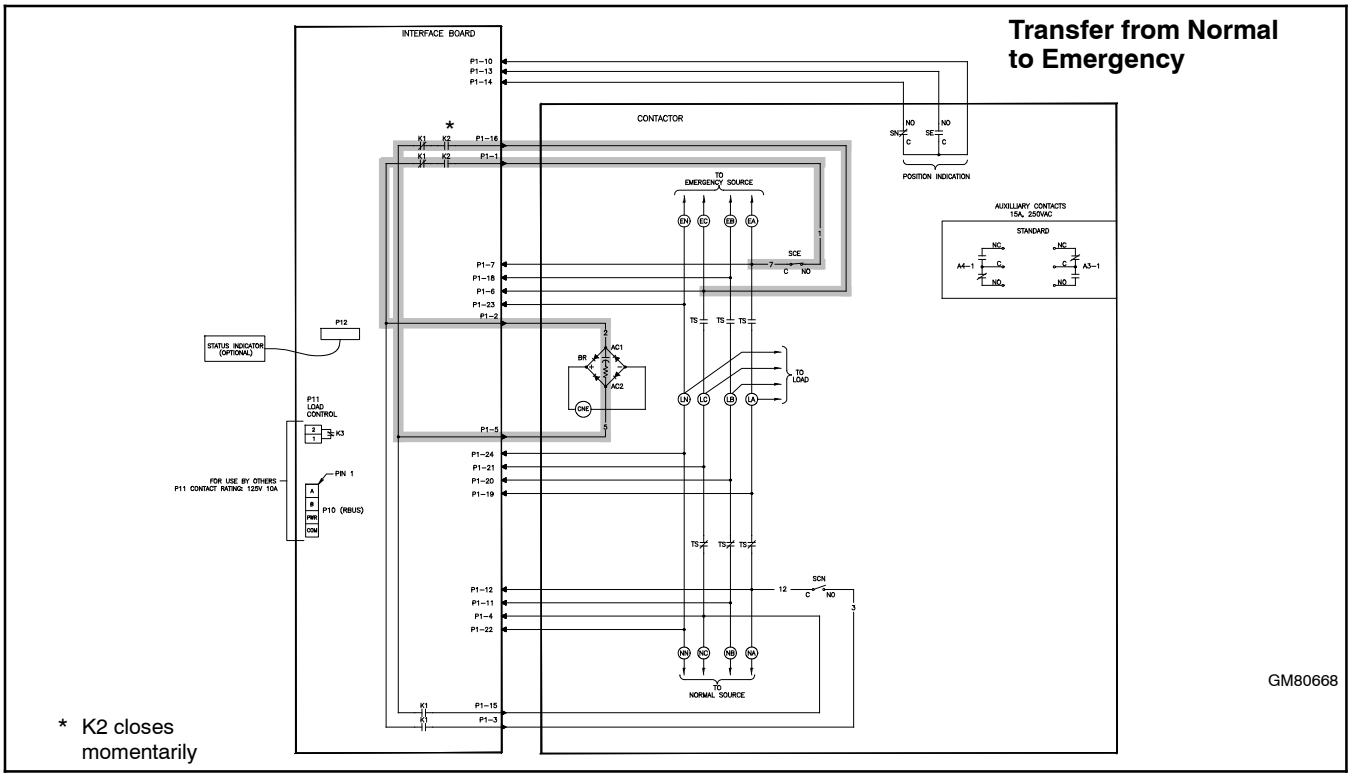


Figure 5-22 100–200 Amp, 3-Phase Models

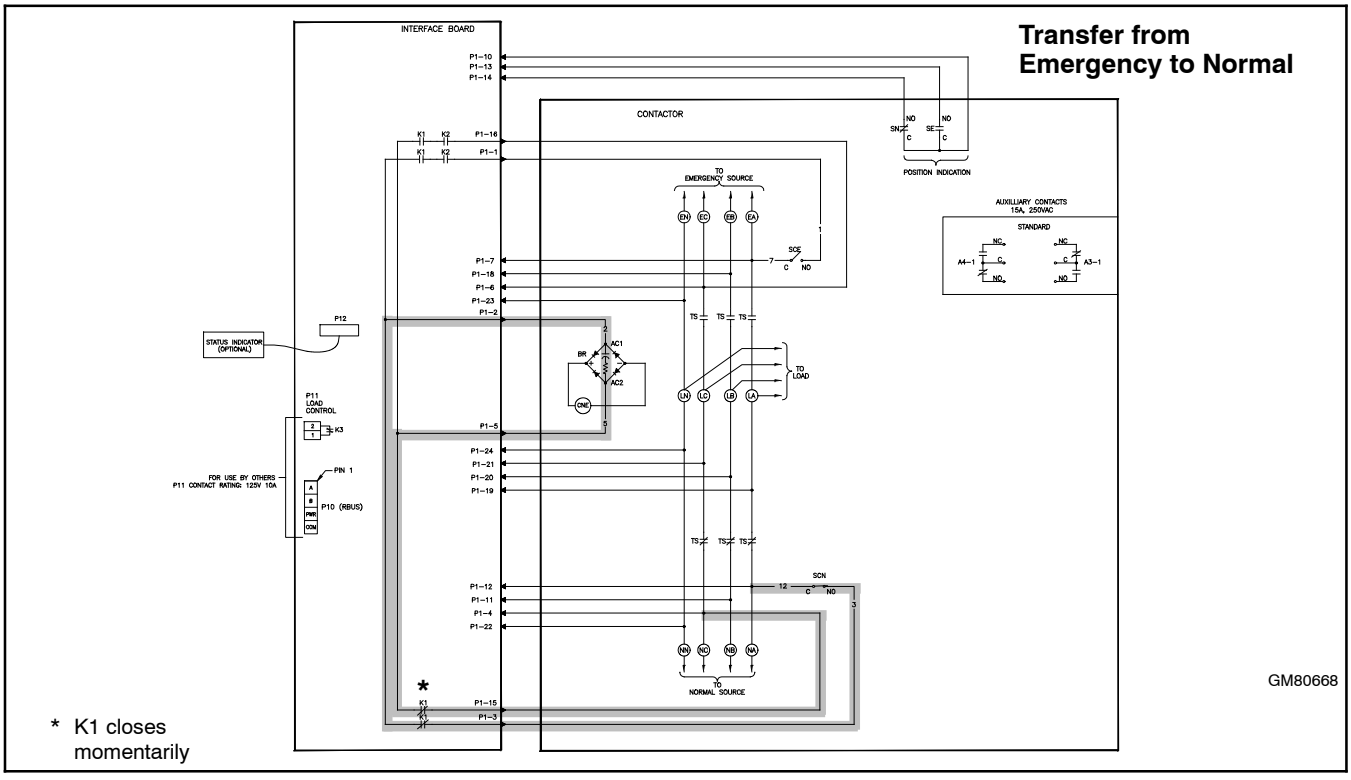


Figure 5-23 100–200 Amp, 3-Phase Models

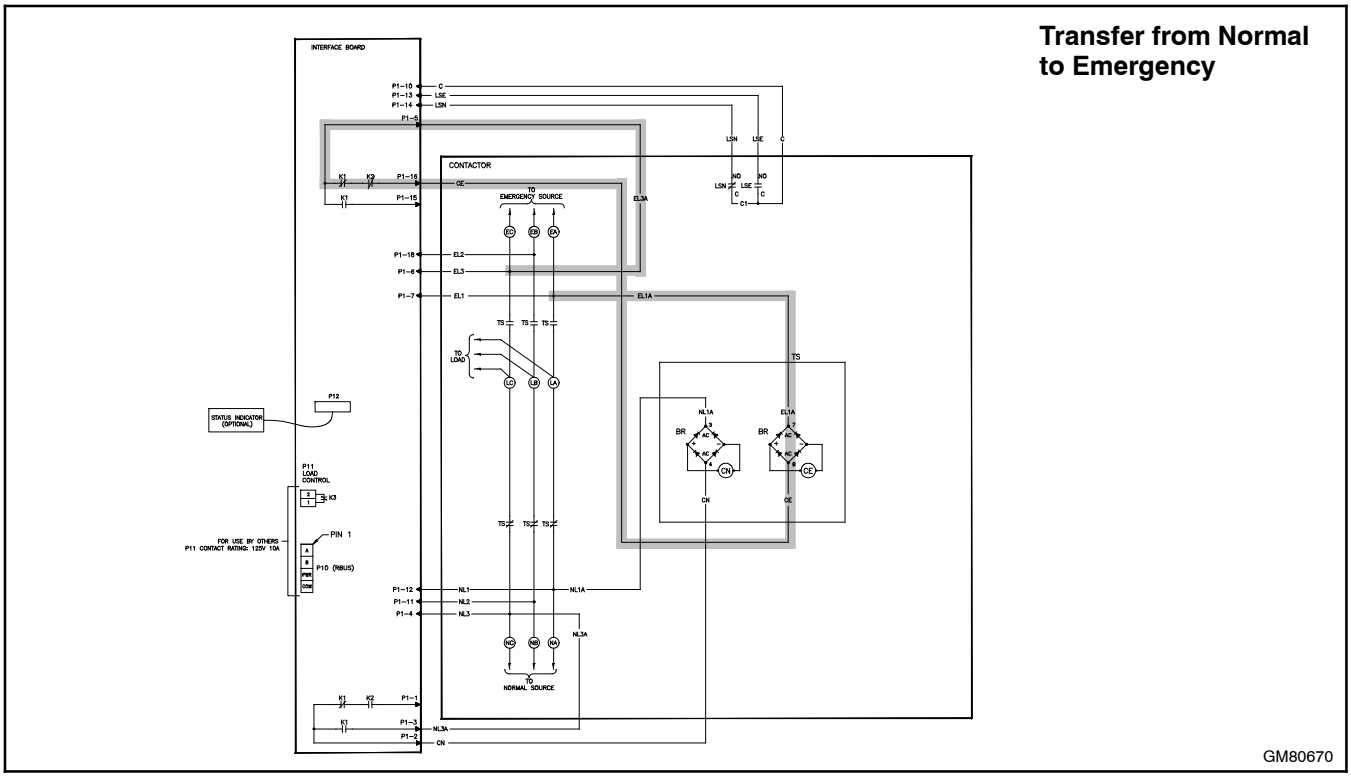


Figure 5-24 400 Amp, 3 Phase, 3-Pole 208/240 Volt Models

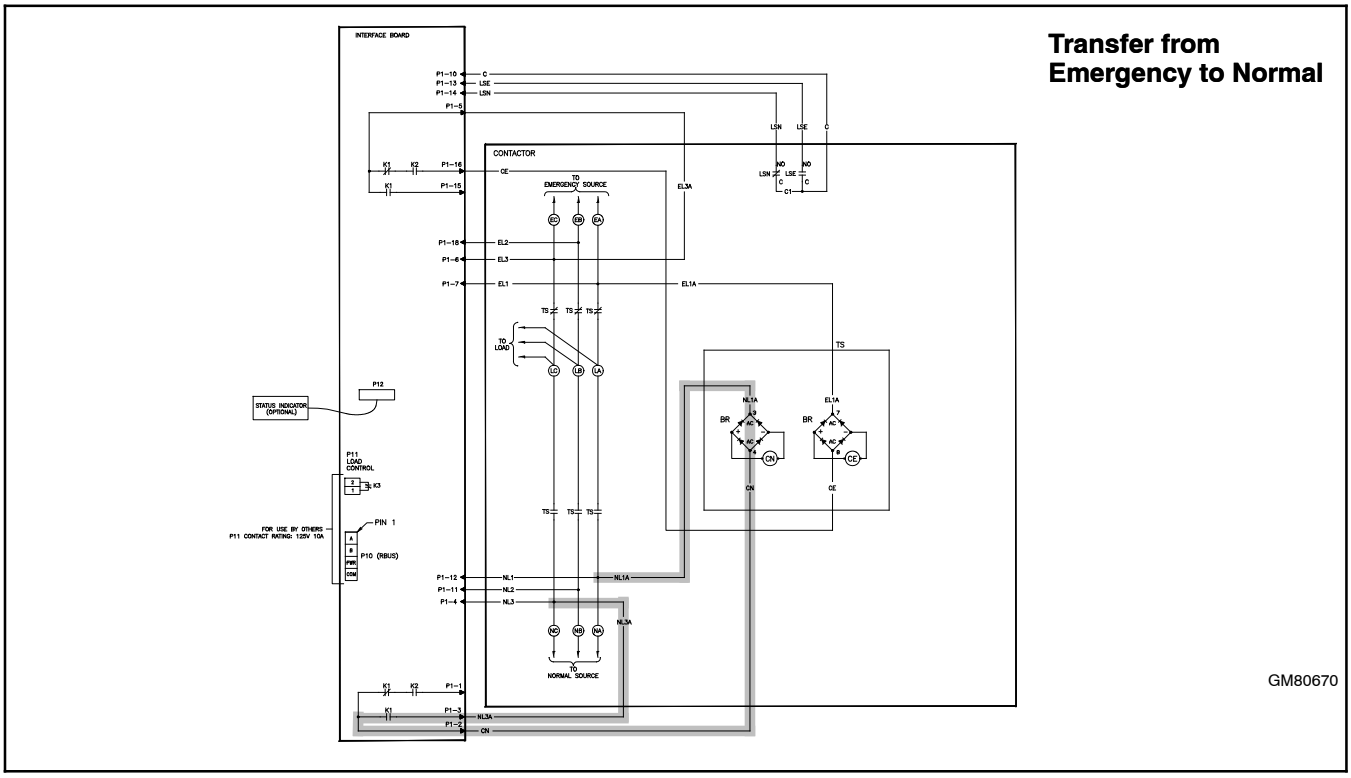


Figure 5-25 400 Amp, 3 Phase, 3-Pole 208/240 Volt Models

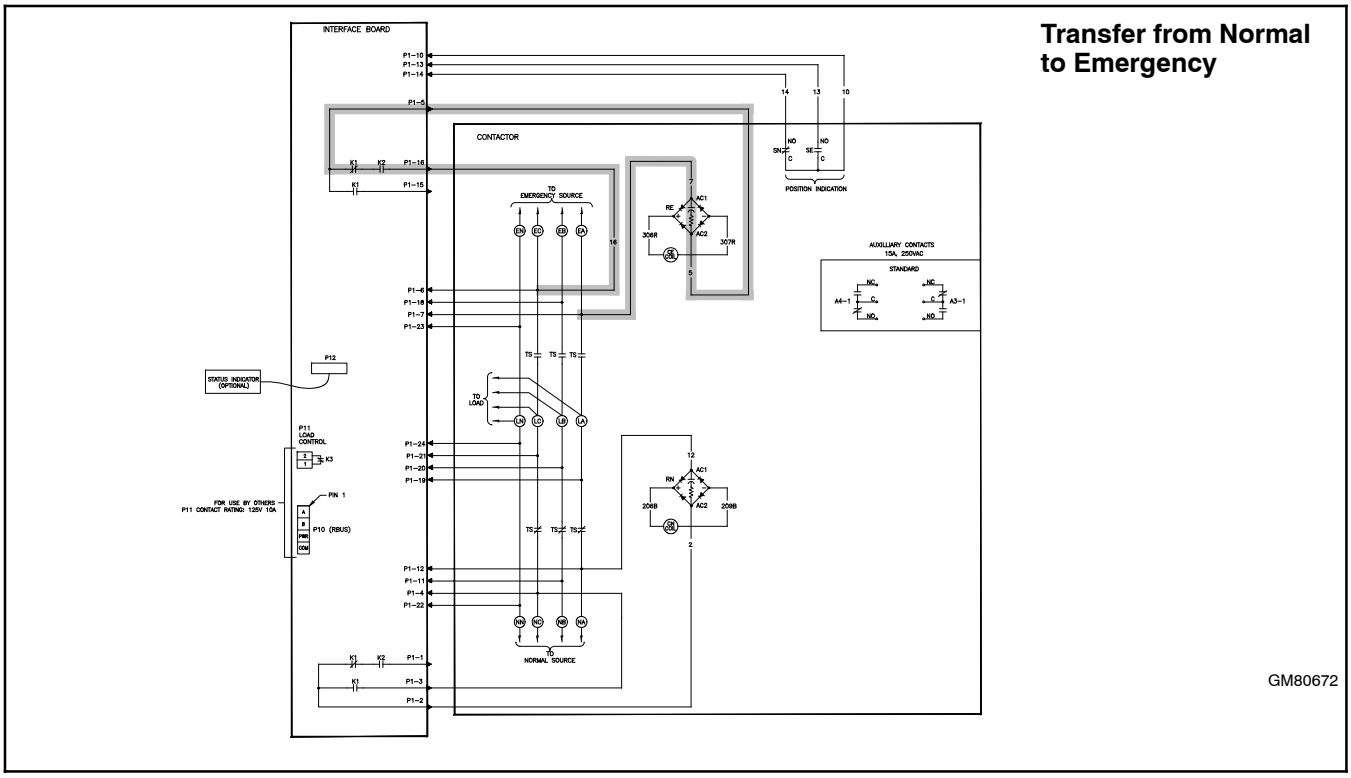


Figure 5-26 400 Amp, 3 Phase, 3-Pole/480V and 4-Pole Models

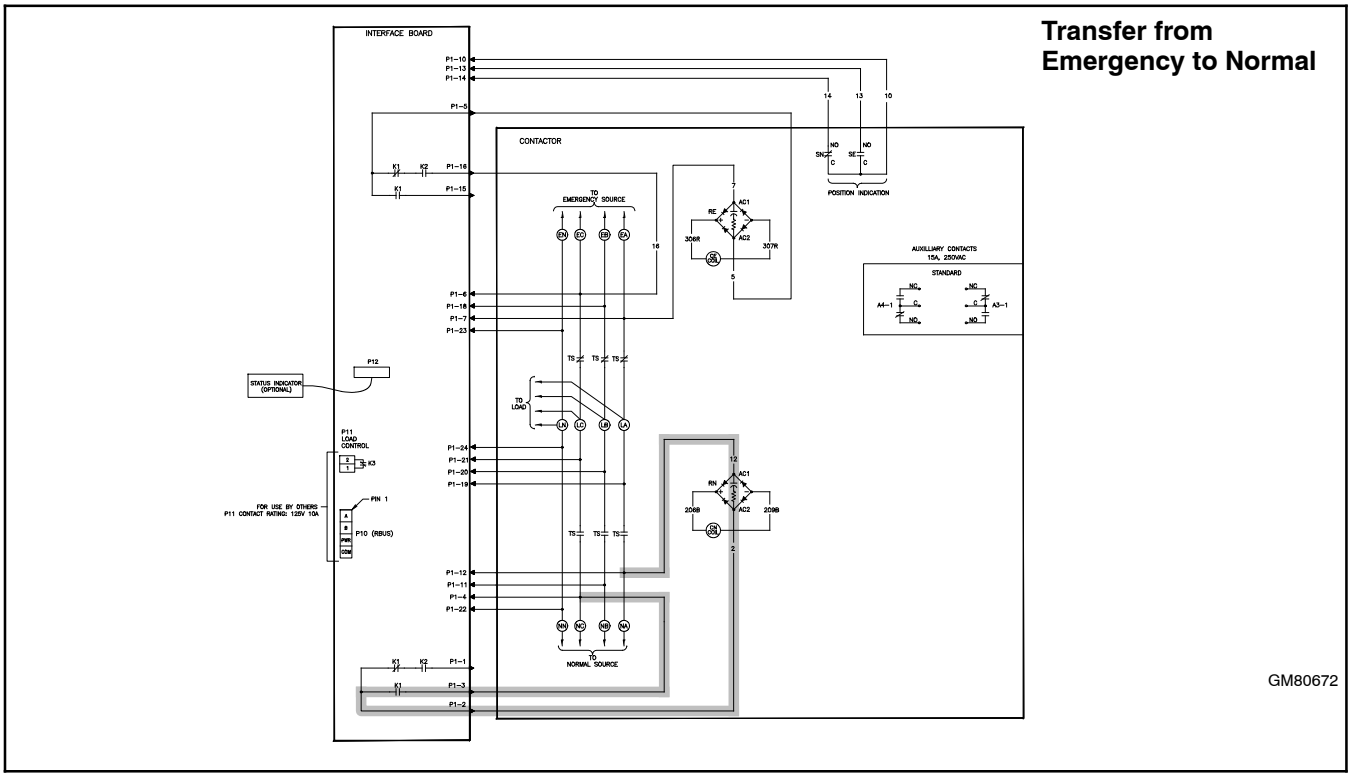


Figure 5-27 400 Amp, 3 Phase, 3-Pole/480V and 4-Pole Models

Section 6 Diagrams and Drawings

Note: The drawings are arranged in alphanumeric order on the following pages.

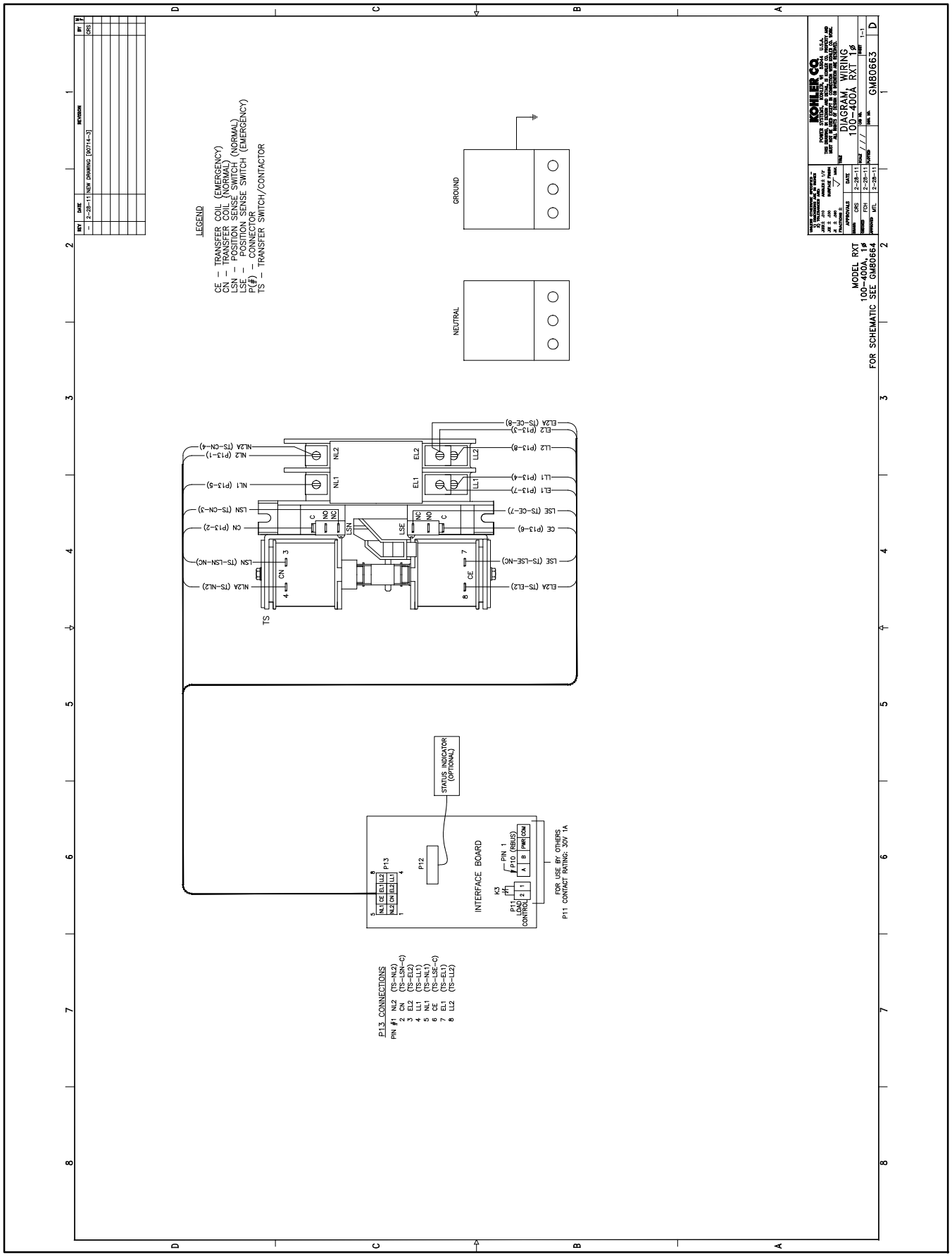


Figure 6-1 Wiring Diagram, 100–400 Amp Single-Phase, GM80663

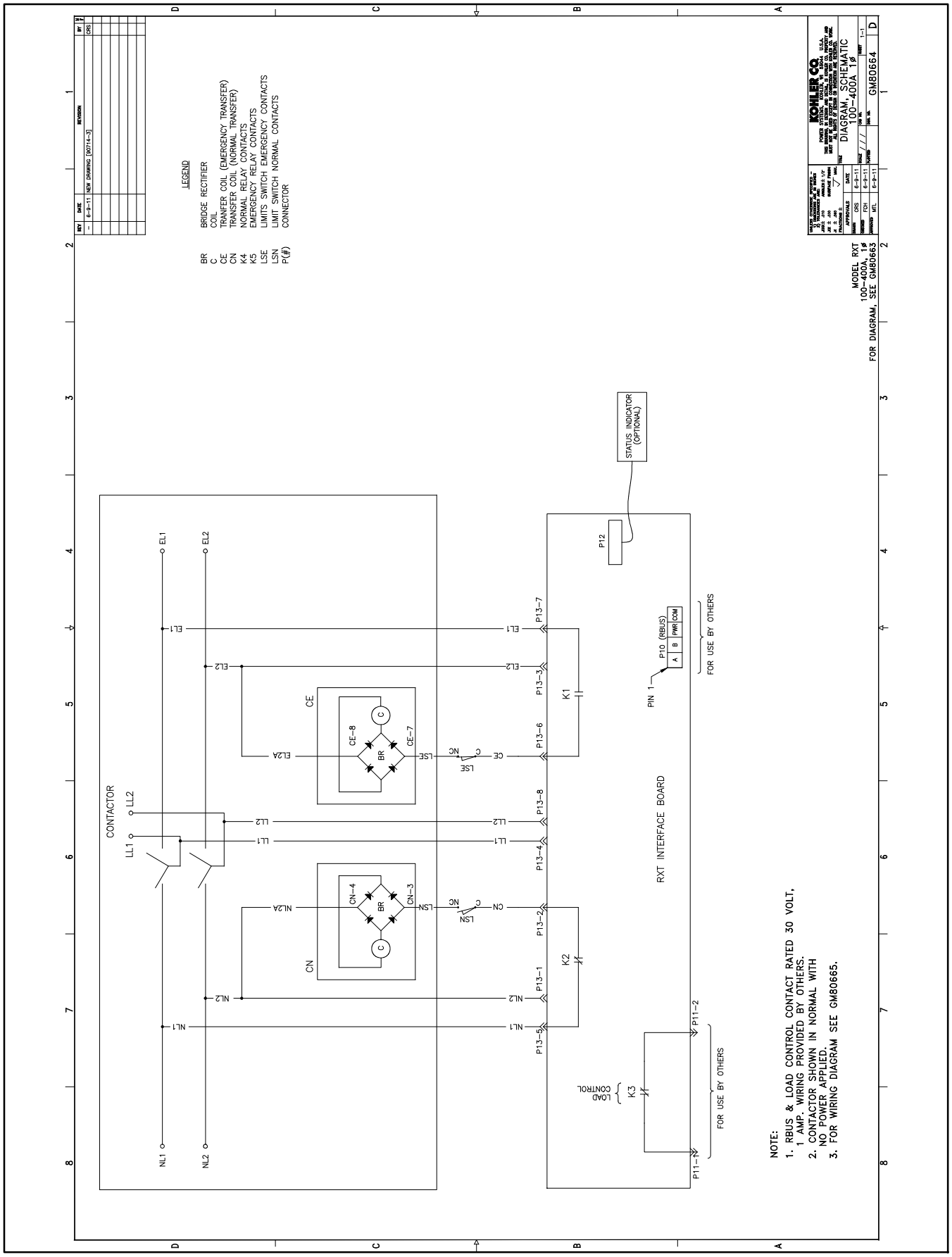


Figure 6-2 Schematic Diagram, 100–400 Amp Single-Phase, GM80664

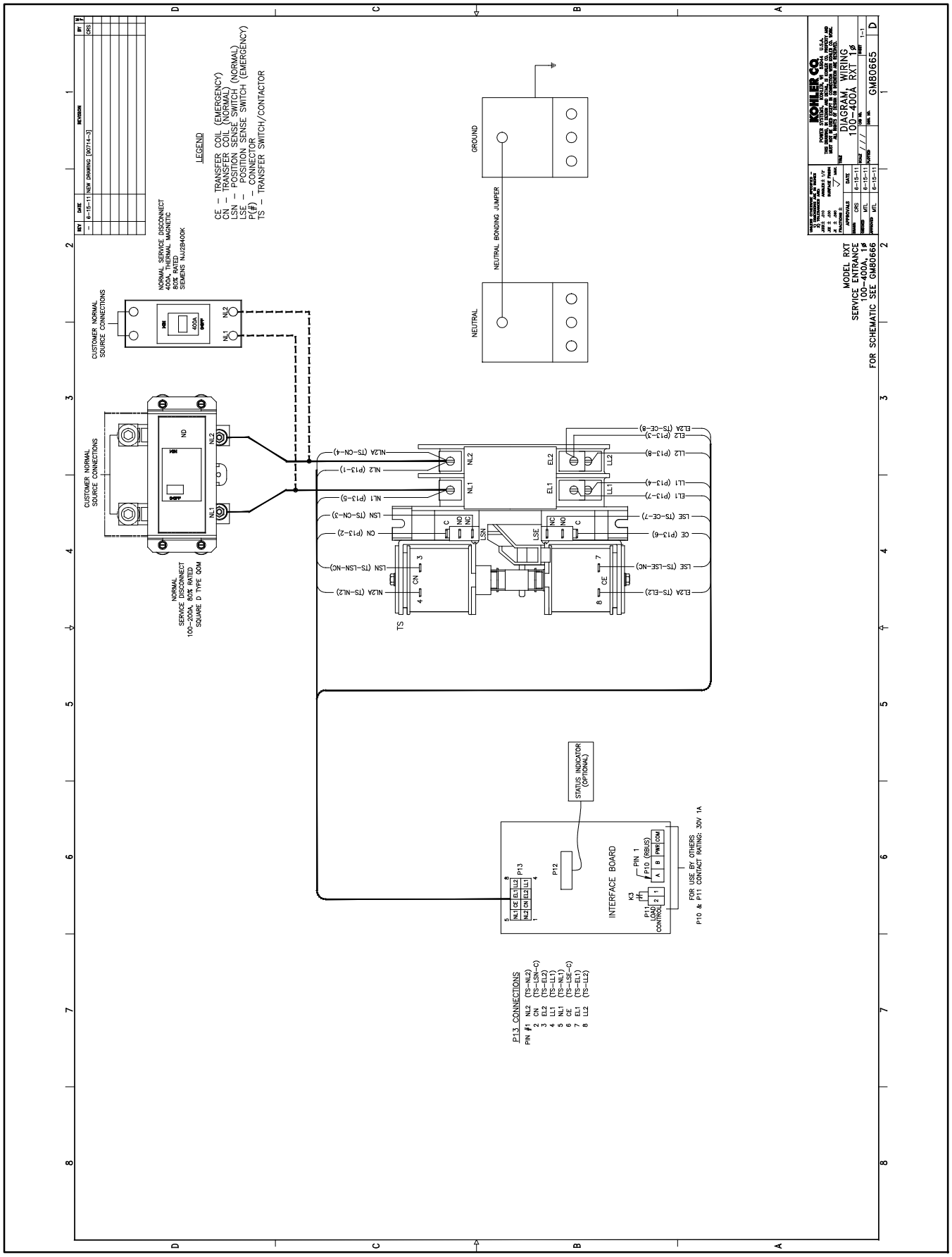


Figure 6-3 Wiring Diagram, 100–400 Amp Service Entrance, GM80665

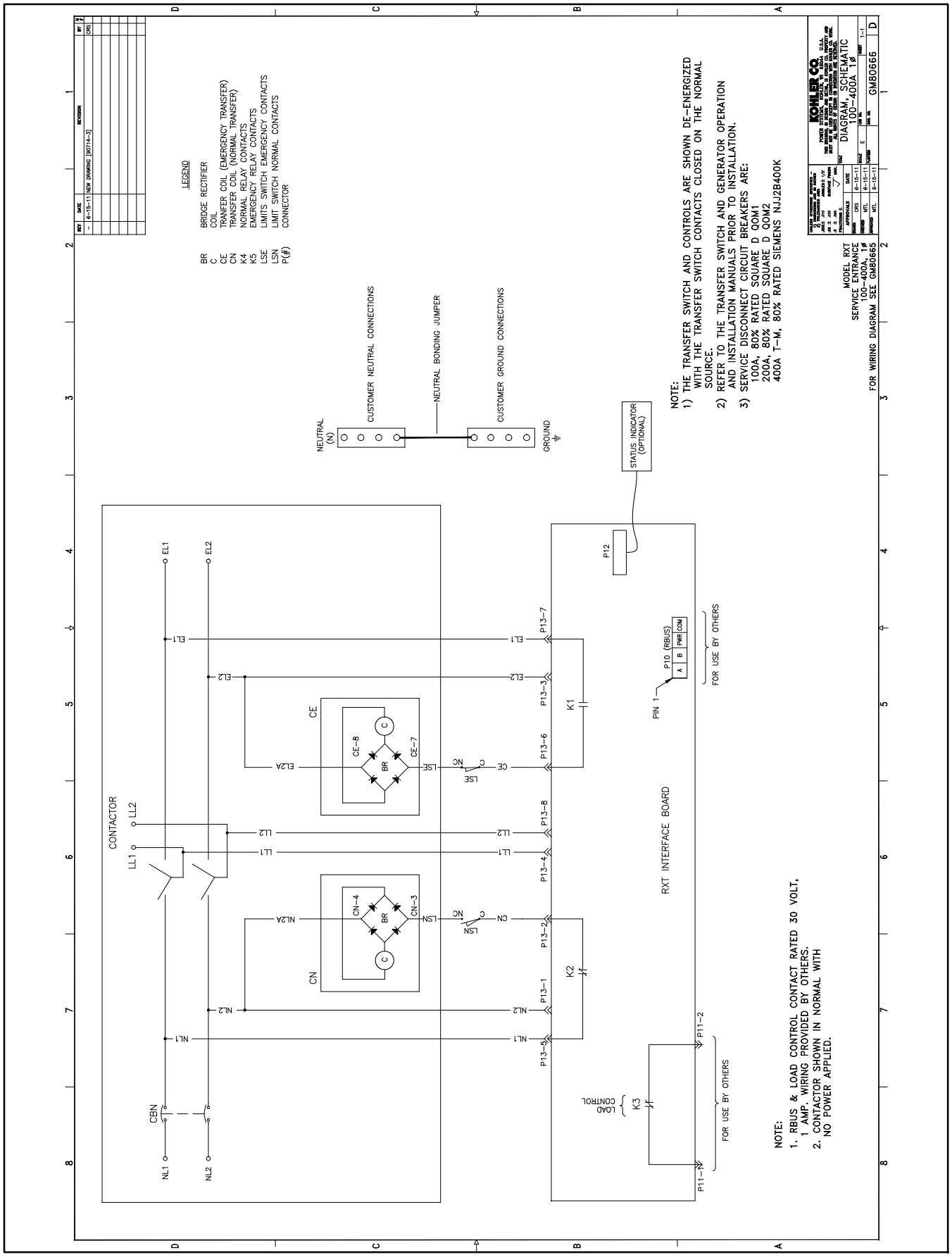


Figure 6-4 Schematic Diagram, 100–400 Amp Service Entrance, GM80666

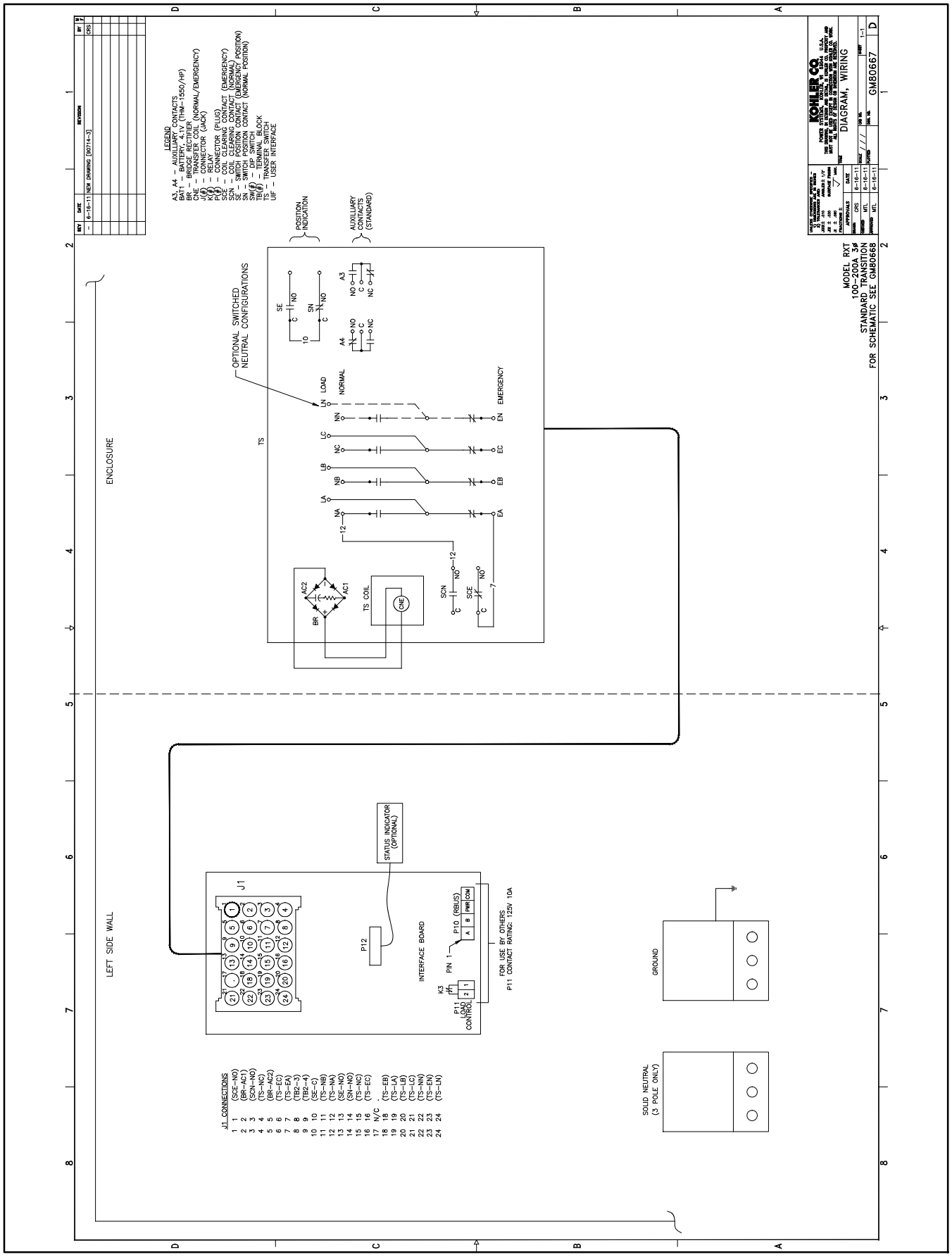


Figure 6-5 Wiring Diagram, 100–200 Amp Three-Phase, 3- and 4-Pole, GM80667

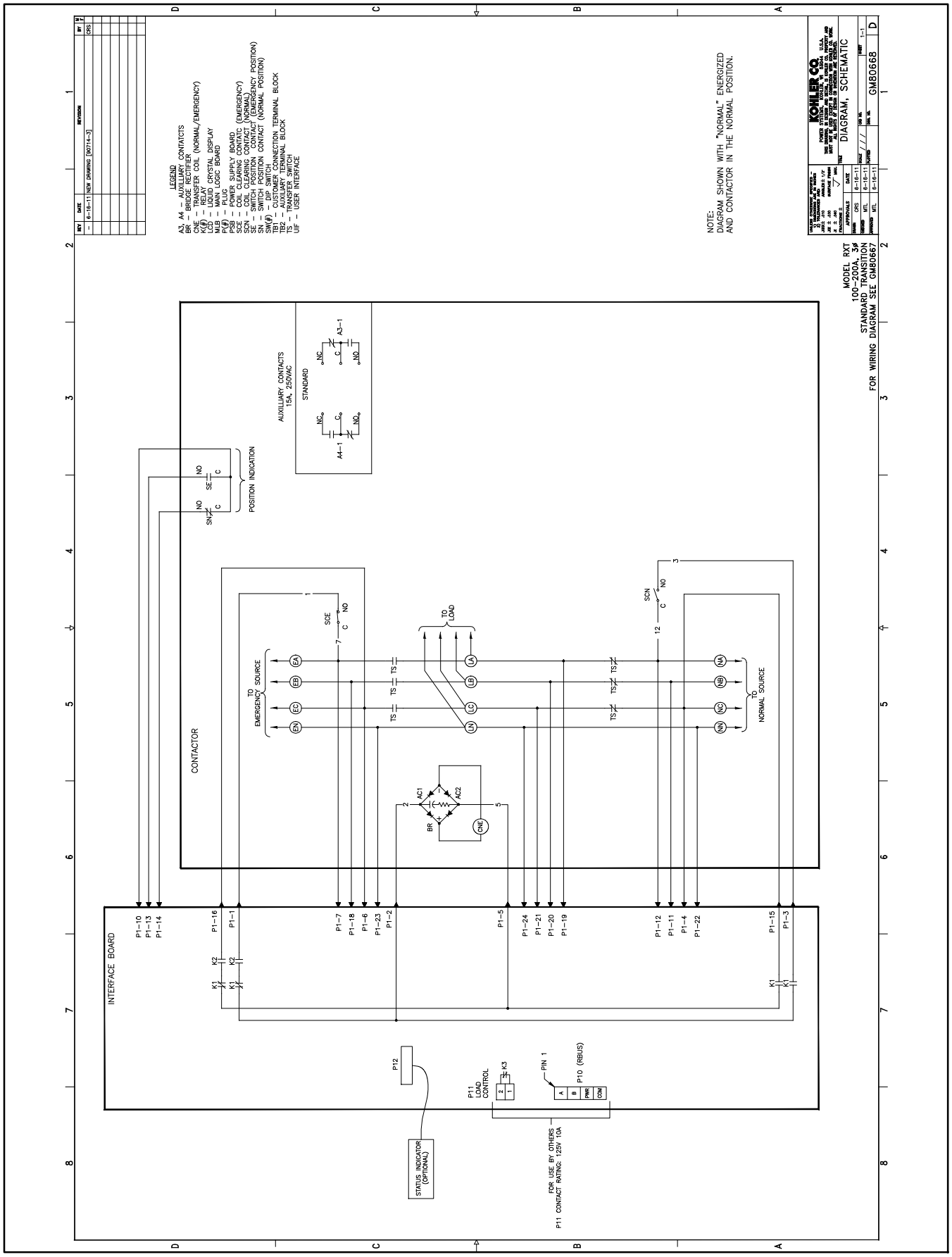


Figure 6-6 Schematic Diagram, 100–200 Amp Three-Phase, 3- and 4-Pole, GM80668

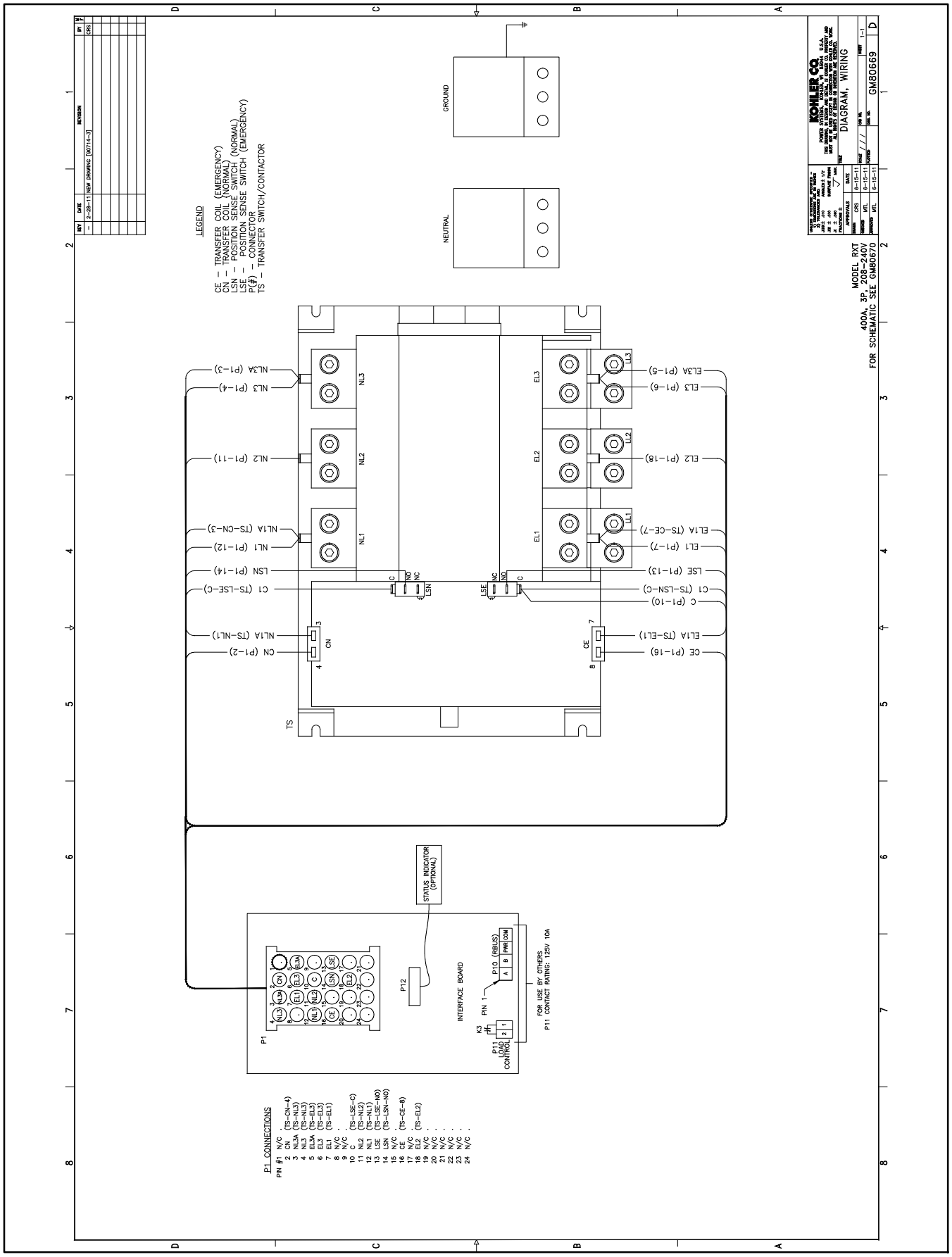


Figure 6-7 Wiring Diagram, 400 Amp Three-Phase, 3-Pole/208–240 Volts, GM80669

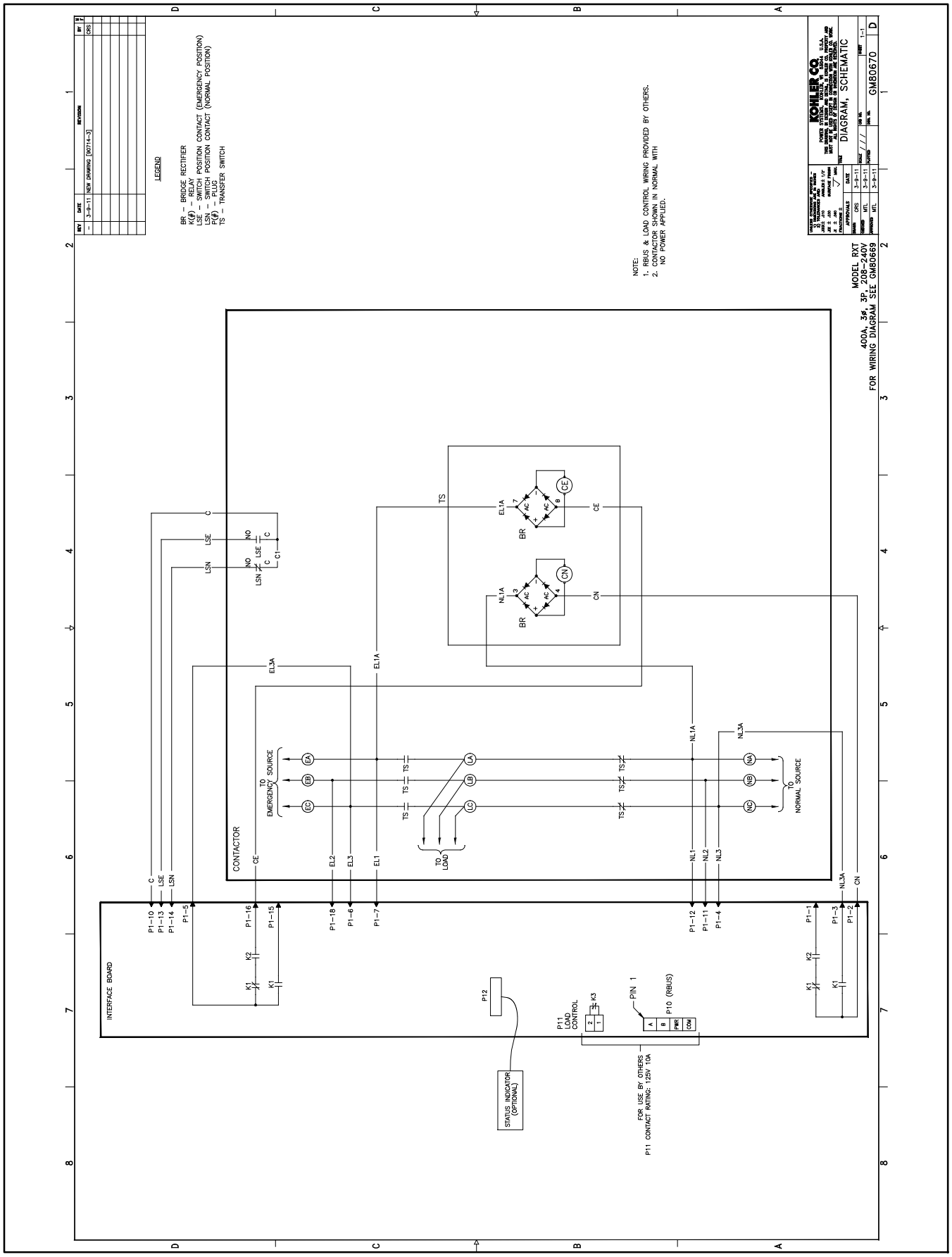


Figure 6-8 Schematic Diagram, 400 Amp Three-Phase, 3-Pole/208–240 Volts, GM80670

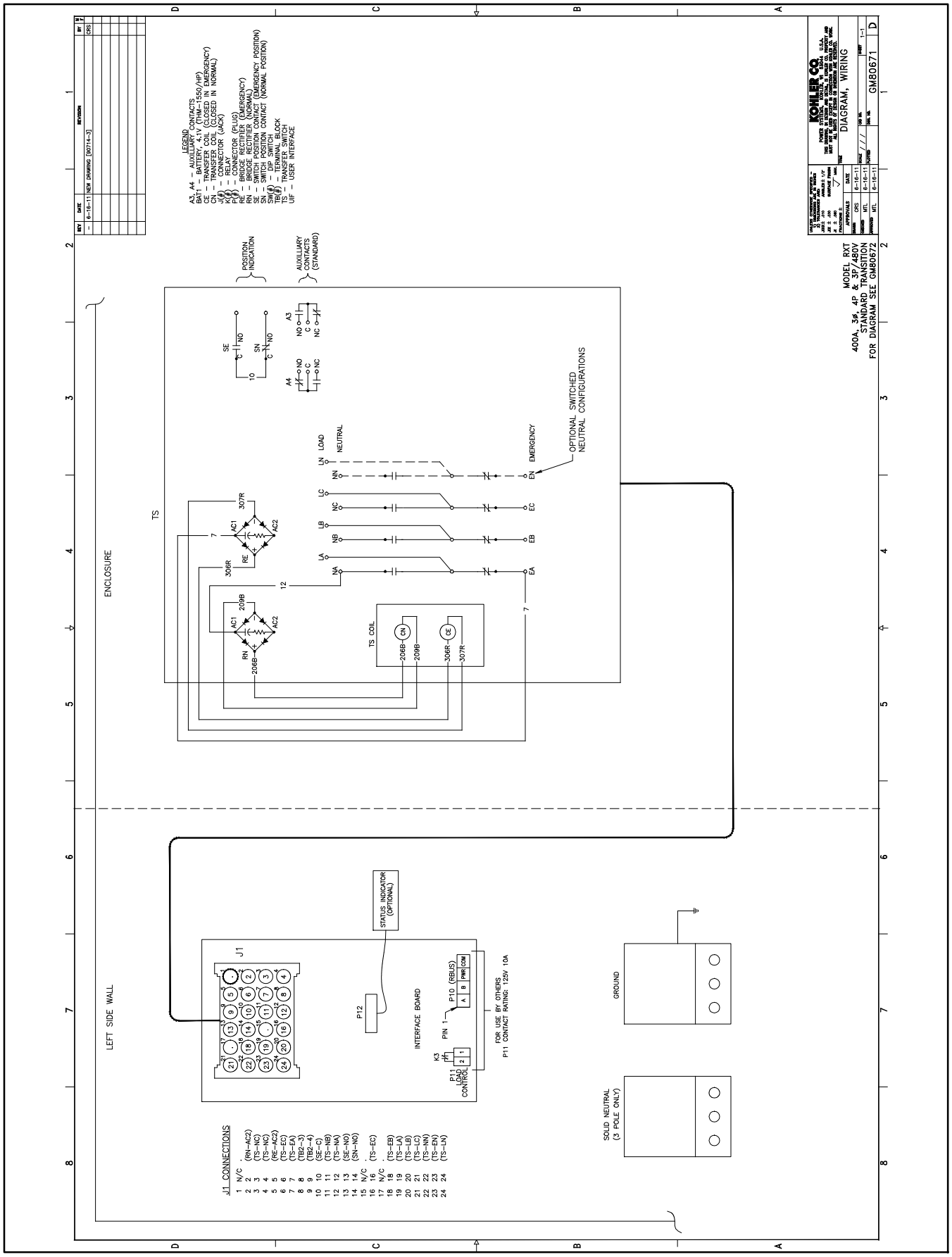


Figure 6-9 Wiring Diagram, 400 Amp Three-Phase, 3-Pole/480 Volts and 4-Pole, GM80671

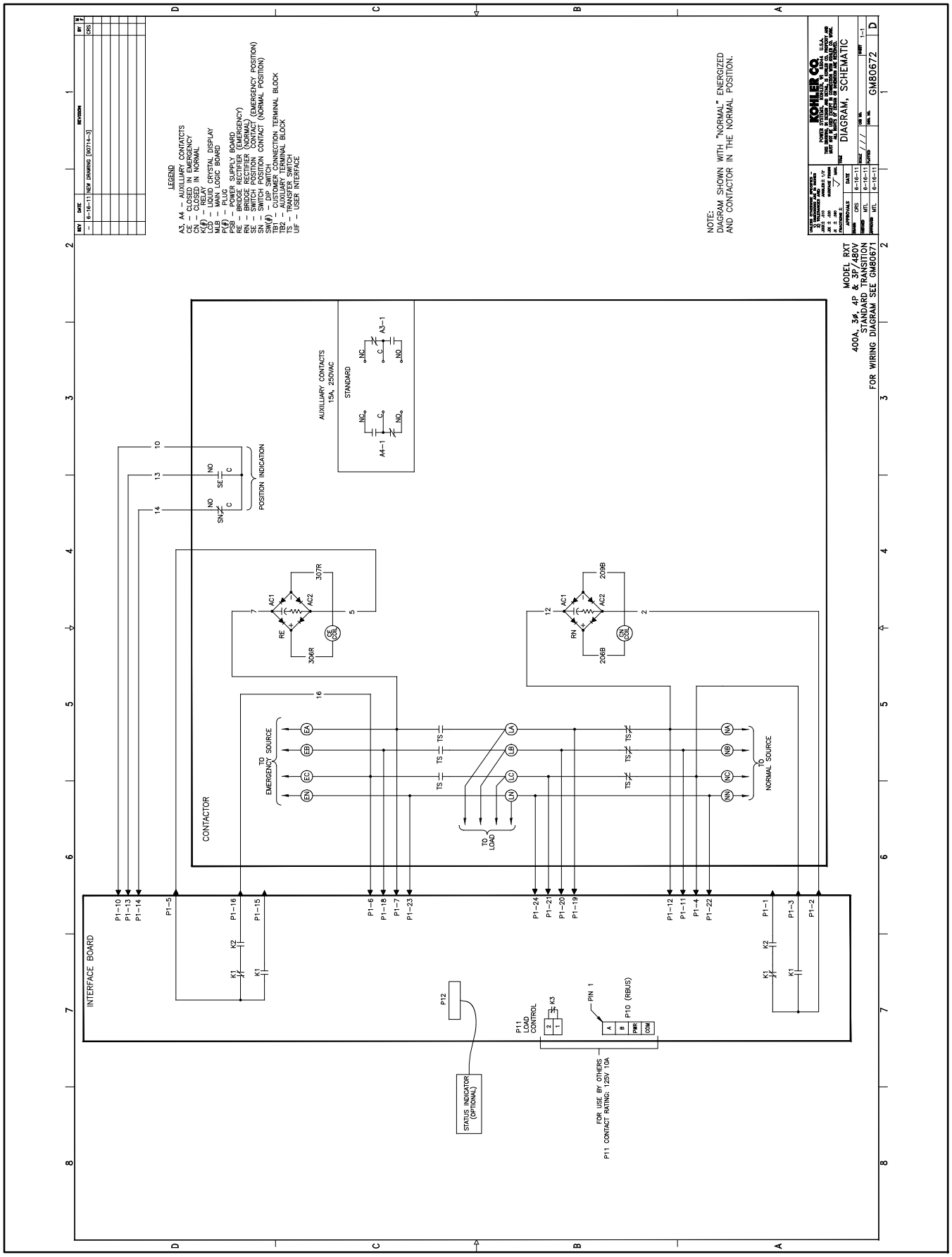


Figure 6-10 Schematic Diagram, 400 Amp Three-Phase, 3-Pole/480 Volts and 4-Pole, GM80672

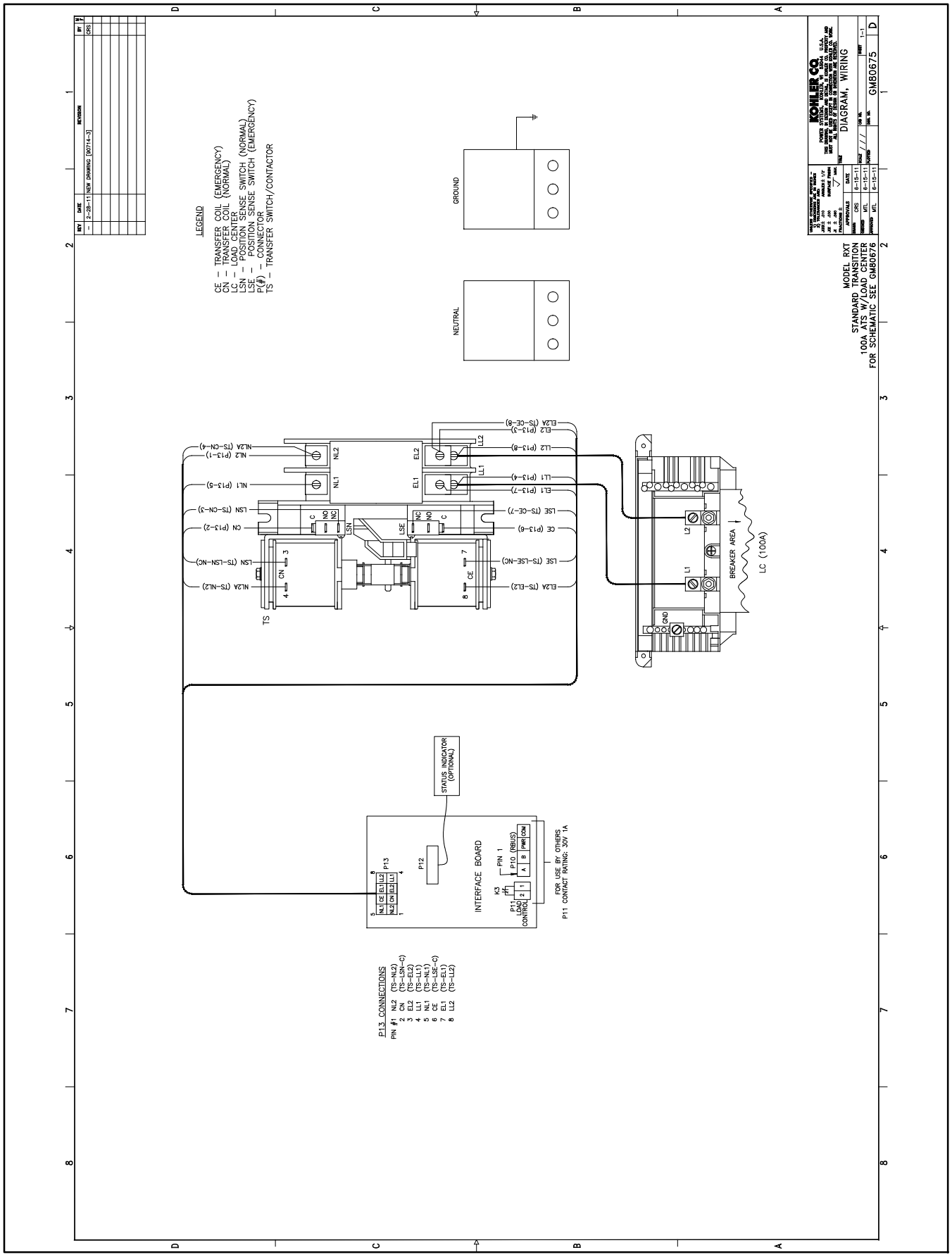


Figure 6-11 Wiring Diagram, 100 Amp Single-Phase with Load Center, GM80675

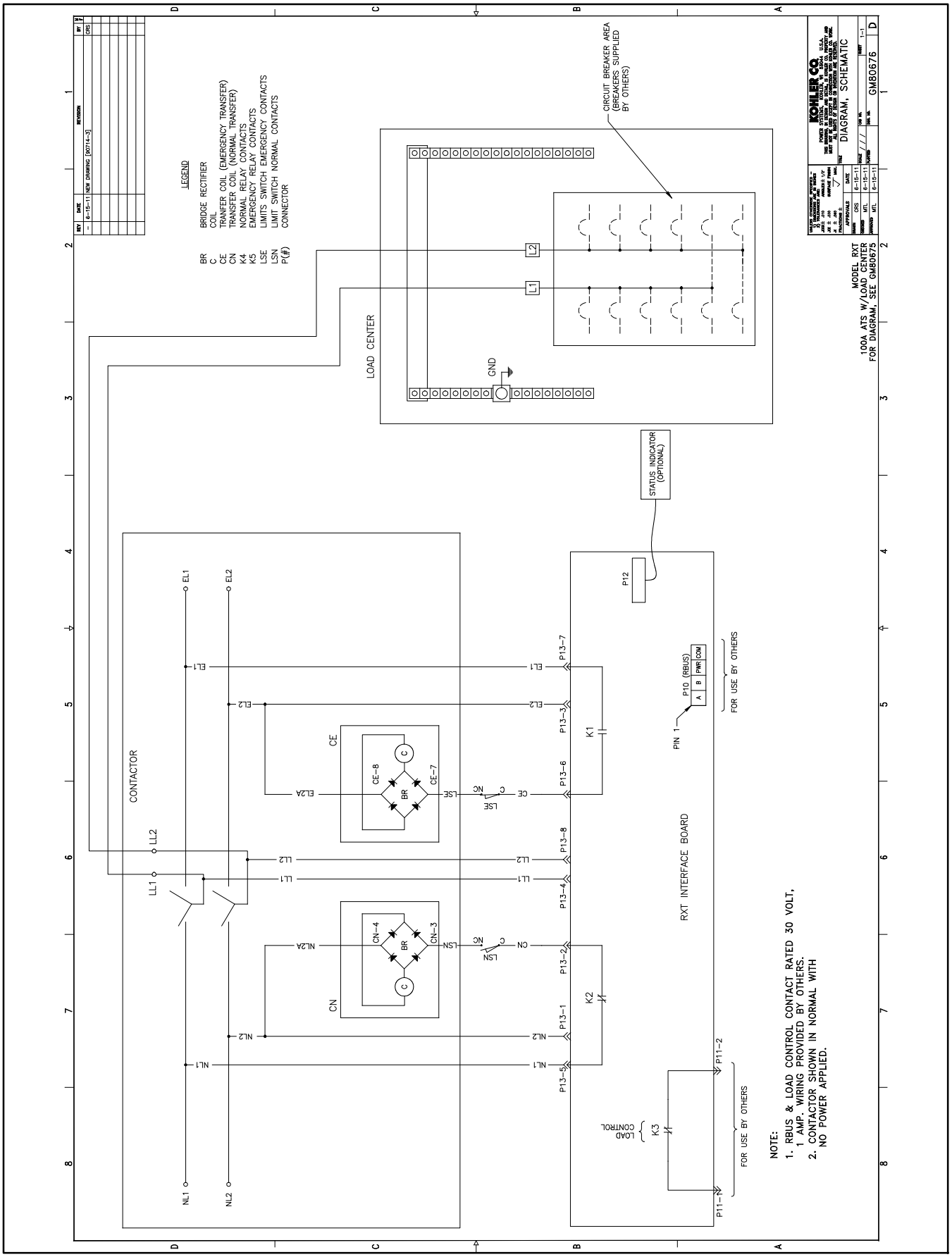


Figure 6-12 Schematic Diagram, 100 Amp Single-Phase with Load Center, GM80676

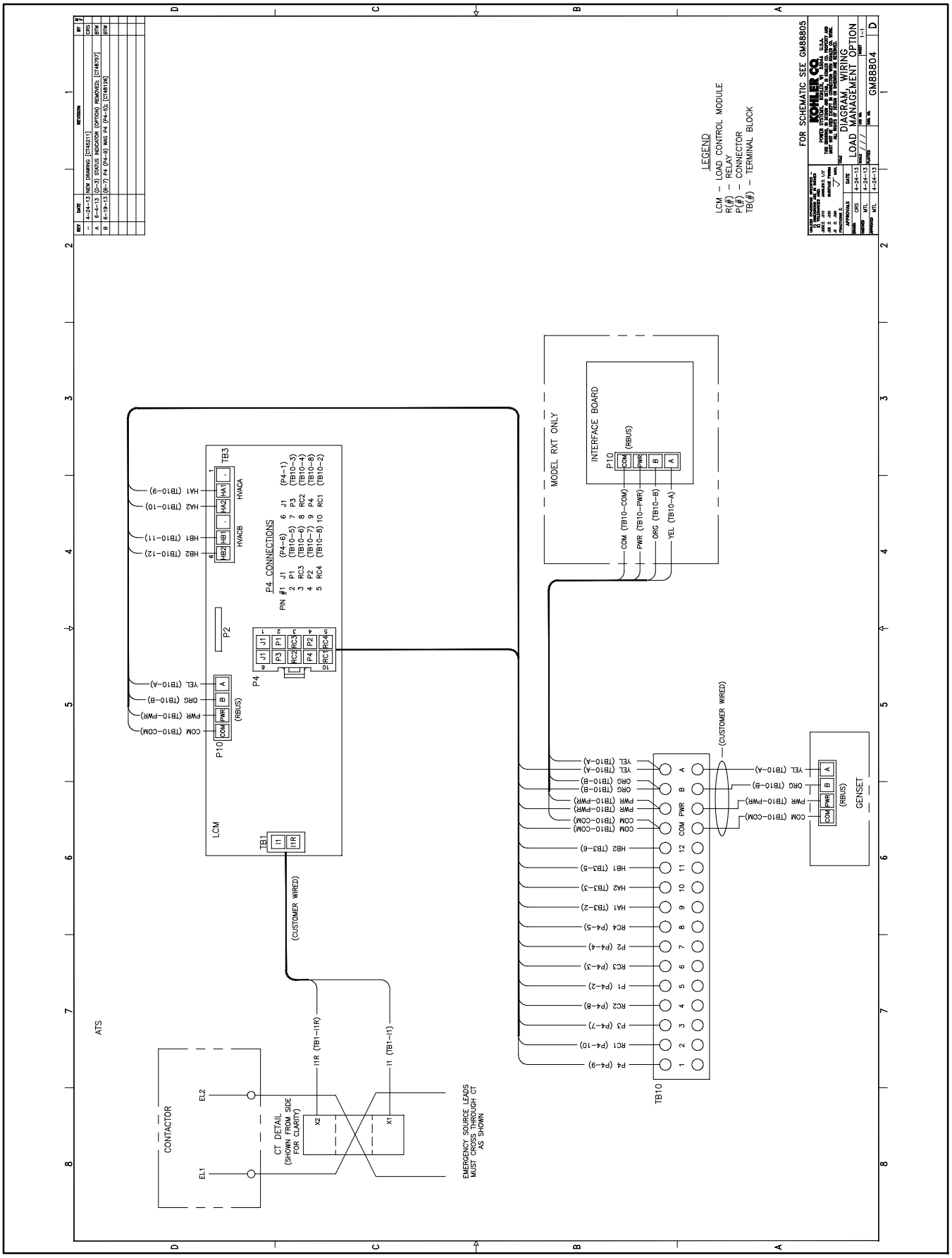


Figure 6-13 Load Shed Kit Wiring Diagram GM88804

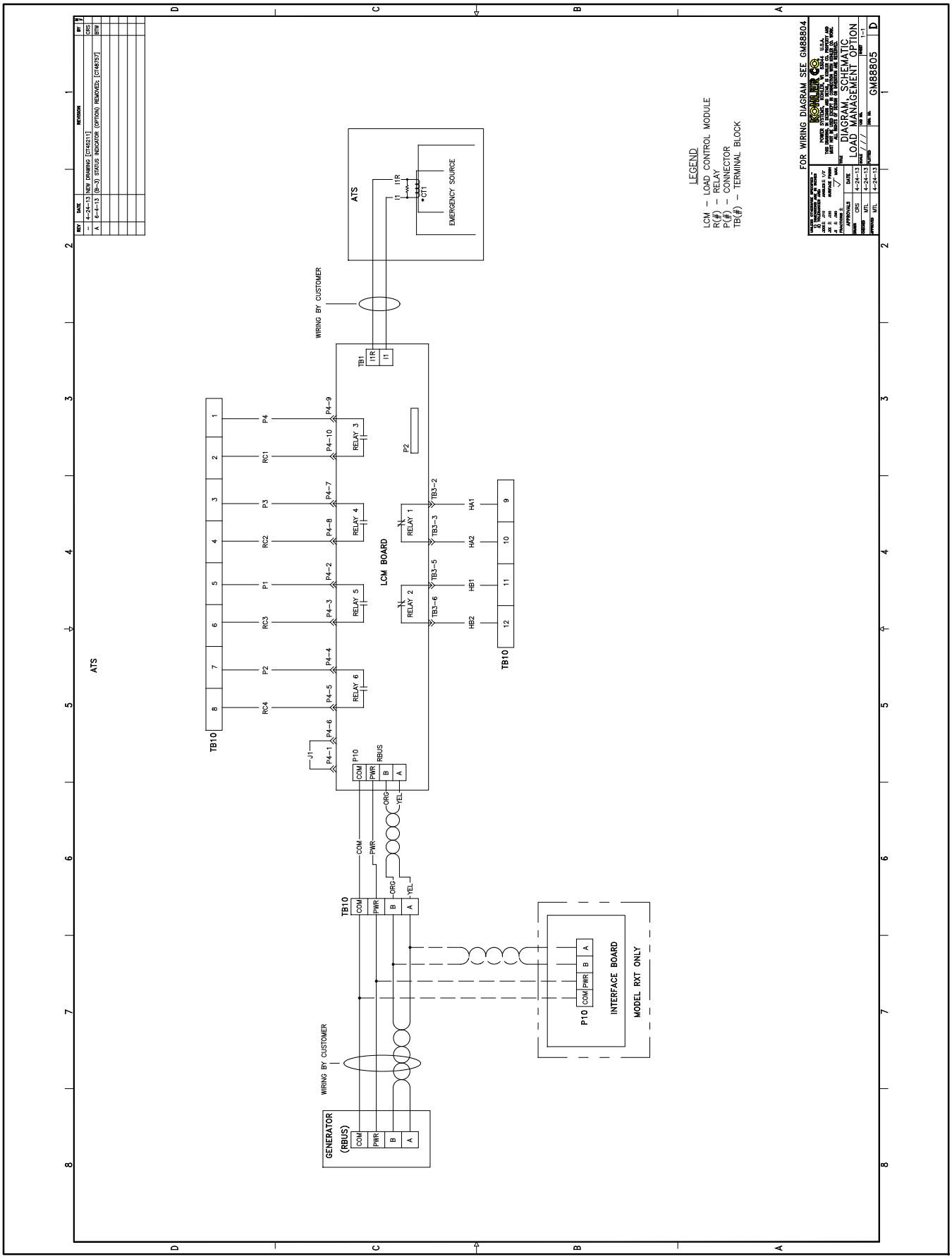


Figure 6-14 Load Shed Kit Schematic Diagram GM88805

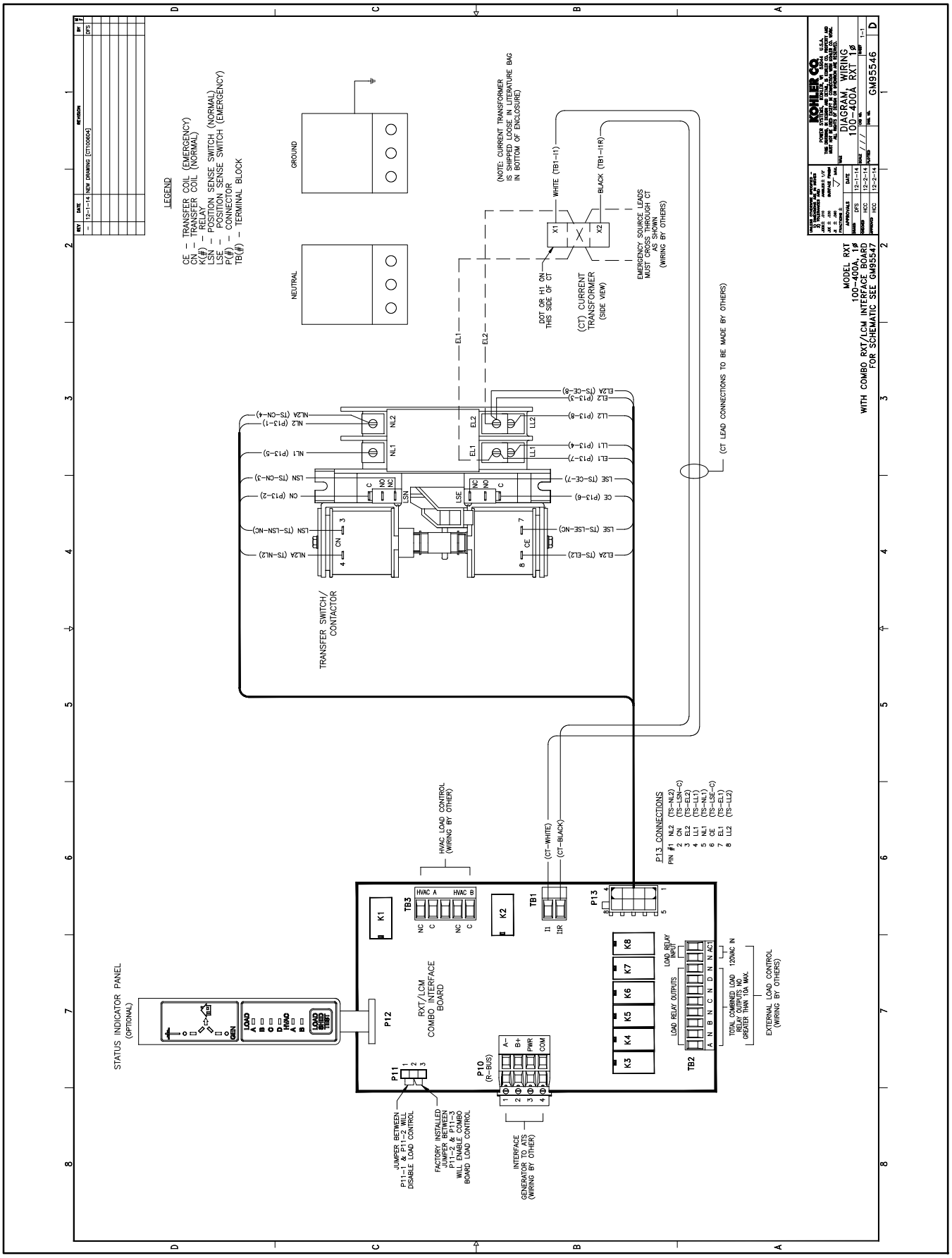


Figure 6-15 Wiring Diagram, 100–400 Amp Single-Phase with Combined Interface Board, GM95546

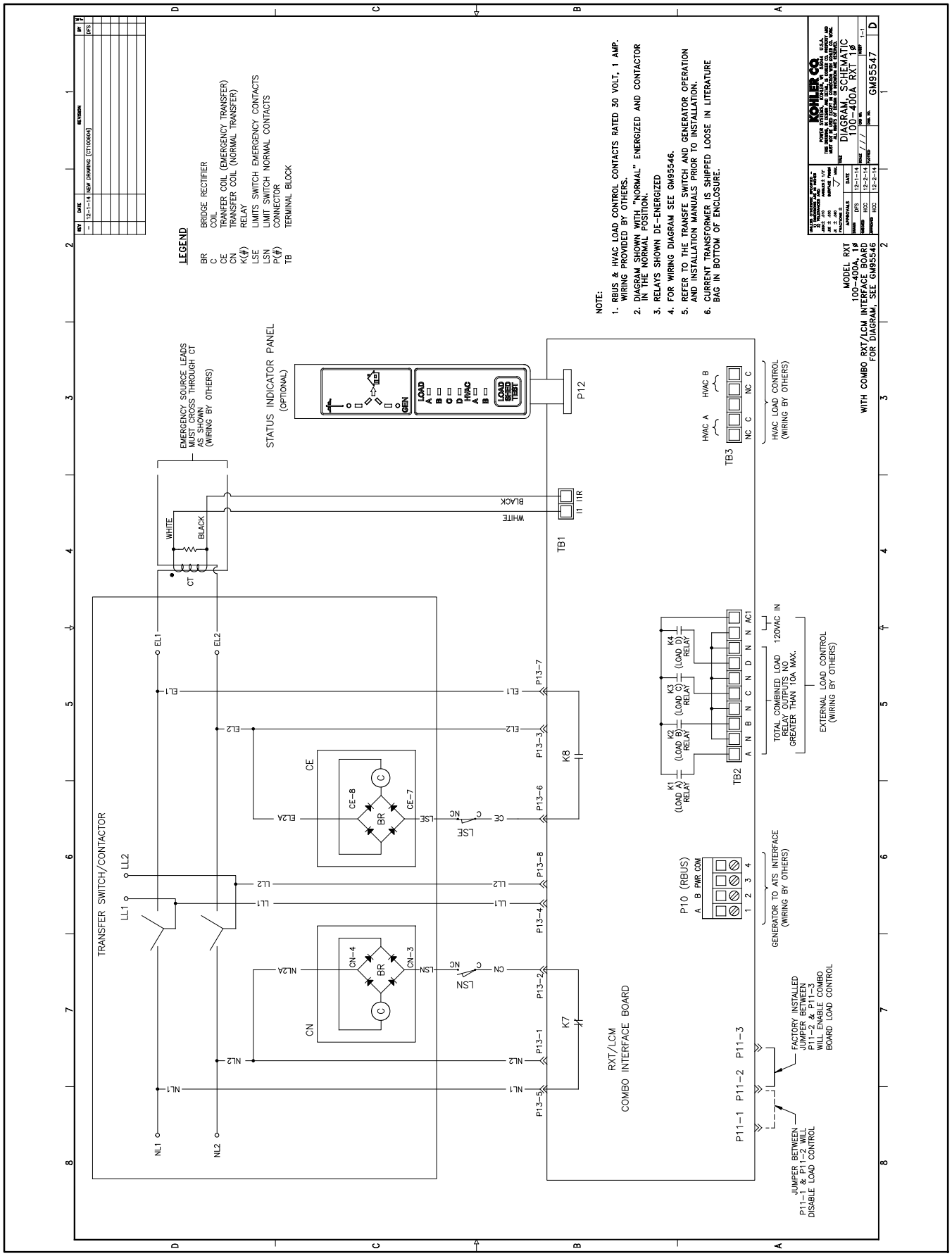


Figure 6-16 Schematic Diagram, 100–400 Amp Single-Phase with Combined Interface Board, GM95547

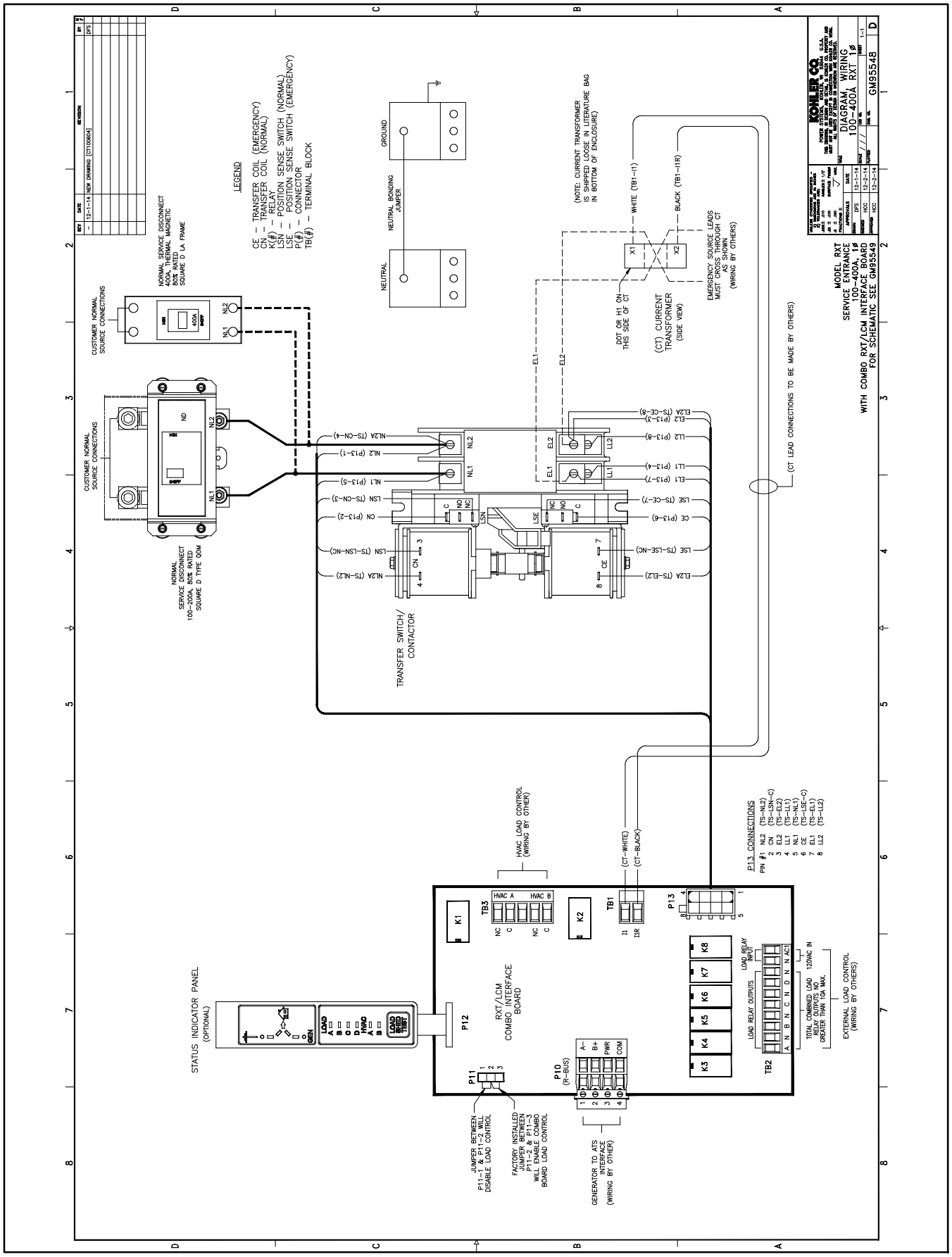


Figure 6-17 Wiring Diagram, 100–400 Amp Service Entrance with Combined Interface Board, GM95548

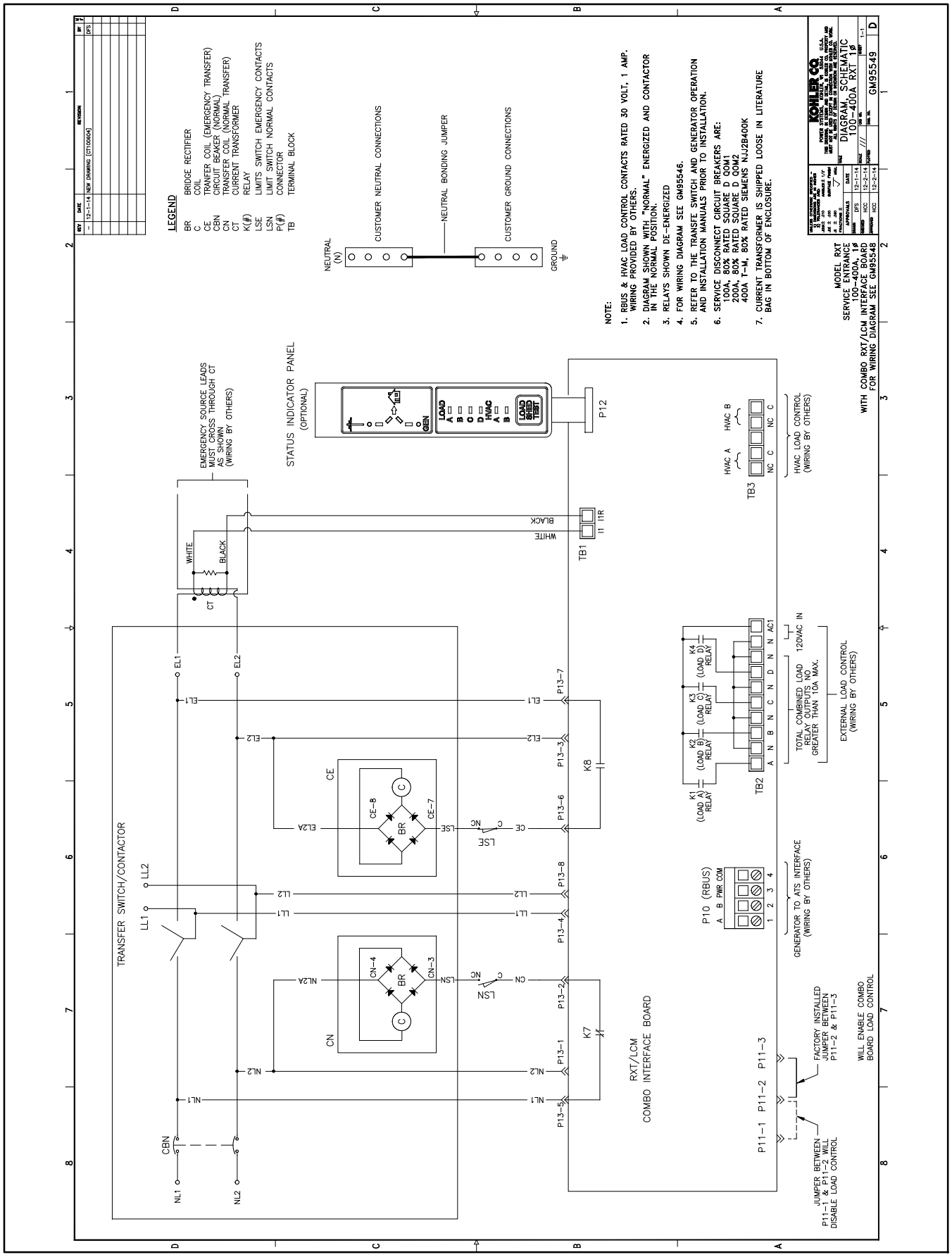
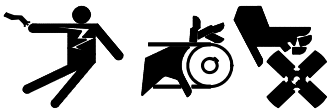


Figure 6-18 Schematic Diagram, 100–400 Amp Service Entrance with Combined Interface Board, GM95549

Notes

Use the instructions in this section for transfer switch service part replacement. See Section 8 for service parts.

⚠ 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 equipment connected to the set, disable the generator set as follows: (1) Press the generator set off/reset button to shut down the generator set. (2) Disconnect the power to the battery charger, if equipped. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent the starting of the generator set by the remote start/stop switch.

⚠ 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.

Only authorized personnel should open the enclosure.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Turn off 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.

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)

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.

⚠ 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.

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

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.

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.

7.1 Before and After Servicing Components

Before Service. Follow these instructions before opening the enclosure and servicing the transfer switch.

1. Prevent the emergency power source generator set from starting:

   a. Press the OFF button on the generator set controller.

   b. Disconnect utility power to the generator set.

   Note: Utility power is connected to the generator set for the RDC2/DC2 controller's integral battery charger. Be sure to disconnect the power before disconnecting the battery.

   c. Disconnect the generator set engine start battery cables, negative (–) lead first.

2. Disconnect or turn off *both* the normal and emergency power sources before opening the transfer switch enclosure door. Check circuits with a voltmeter to verify that the power is off before servicing components inside the enclosure.

After Service. After servicing the transfer switch, remove debris from the enclosure and reinstall barriers. Do not use compressed air to remove debris from the enclosure.

7.2 Circuit Board Handling

Electronic printed circuit boards (PCBs) are sensitive to a variety of elements and can be damaged during removal, installation, transportation, or storage. Observe the following when working with circuit boards.

- Store circuit boards in the anti-static, cushioned packaging provided by the factory in a clean environment away from moisture, vibration, static electricity, corrosive chemicals, solvents, or fumes until installation.
- Wear an approved grounding, anti-static wrist strap when handling circuit boards or components.
- Carefully hold the circuit board only by its edges, not by any of its components.
- Don't bend or drop the circuit board or any of its components.
- Don't strike the circuit board or any of its components with a hard object.
- Clean dusty or dirty circuit boards only with a vacuum cleaner or dry brush.
- Never attempt component-level circuit repairs.
- Never remove or install a circuit board with power connected.
- Label wiring when disconnecting it for reconnection later.

7.3 Controller Interface Board Replacement

The ATS includes a controller interface board mounted inside the ATS enclosure.

Replace the interface board only if the troubleshooting and test procedures in this manual indicate conclusively that the interface board is damaged or inoperative. Check the following items before replacing the circuit board:

- Check for open source circuit breakers or switches.
- Check for loose connections and faulty wiring.
- Check the neutral connection.
- Check the RBUS communication wiring from the ATS interface board to the generator set controller. Verify that the wiring used is the size and type specified in the installation manuals and does not exceed the maximum length listed for the RBUS communication and power connections.
- Reset the controller and retest the operation.

Disconnect power to the transfer switch before starting to disconnect the controller. Observe the following safety precautions to avoid injury or equipment damage.

⚠ 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.

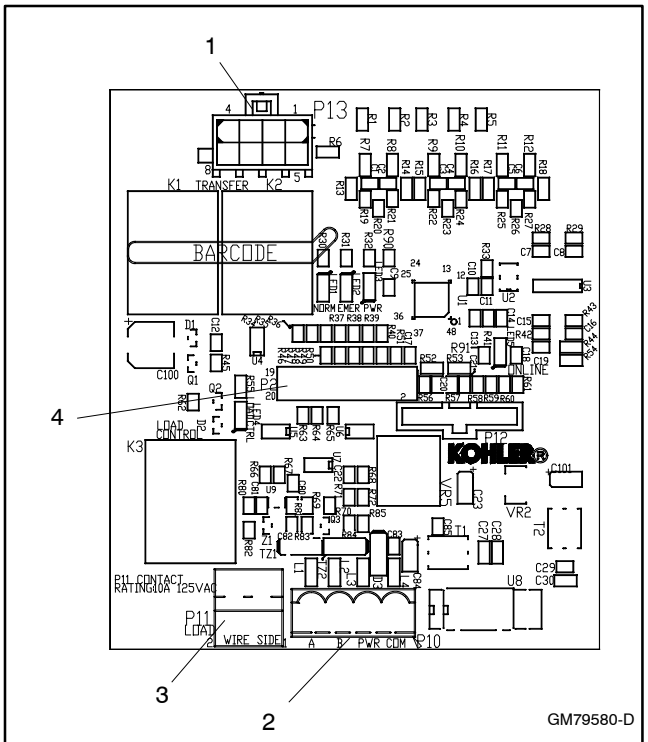
Only authorized personnel should open the enclosure.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Turn off 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.

Circuit Board Replacement Procedure

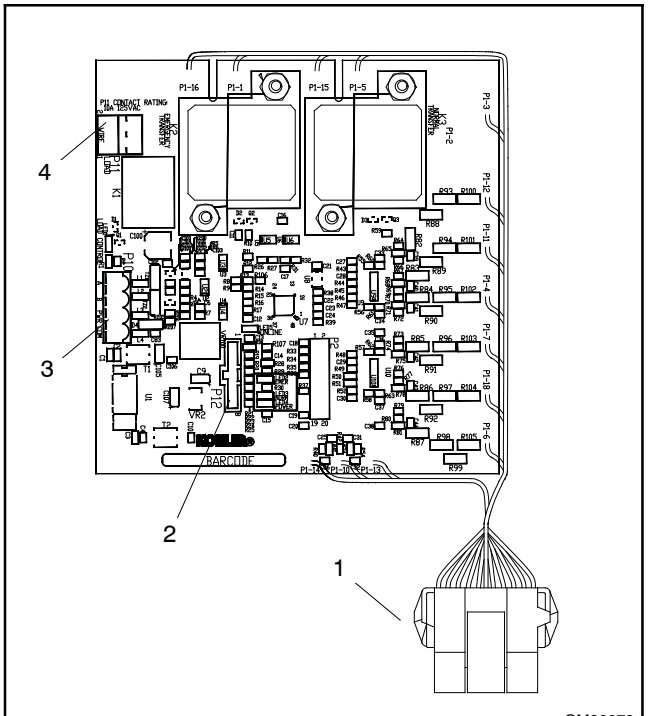
1. Press the OFF button on the generator set controller.
2. Disconnect utility power to the generator set.

   Note: Utility power is connected to the generator set for the RDC2/DC2 controller's integral battery charger. Be sure to disconnect the power before disconnecting the battery.
3. Disconnect the generator set engine starting battery, negative (-) lead first.
4. Disconnect power to the transfer switch by opening switches or circuit breakers to the switch.
5. Open the transfer switch enclosure.
6. Check the voltage at the source connections to verify that the power is off.
7. Disconnect all connections to the circuit board. See Figure 7-1 for the standard single-phase board, Figure 7-2 for the three-phase board, or Figure 7-3 for the combined single-phase interface/load management board.
8. The circuit board is mounted with four standoffs. Note the orientation of the circuit board and then carefully pull the board off the standoffs.
9. Place the new circuit board on the standoffs in the same orientation as the original board. Push firmly until all four corners snap into place.
10. Reconnect all connectors removed in step 7.
11. Replace the ATS enclosure door.
12. Reconnect power to the ATS.
13. Reconnect the generator set engine starting battery, negative (-) lead last.
14. Reconnect utility power to the generator set.
15. Press the AUTO button on the generator set controller.
16. Check the transfer switch operation.
17. Set the exerciser. See the generator set operation manual.



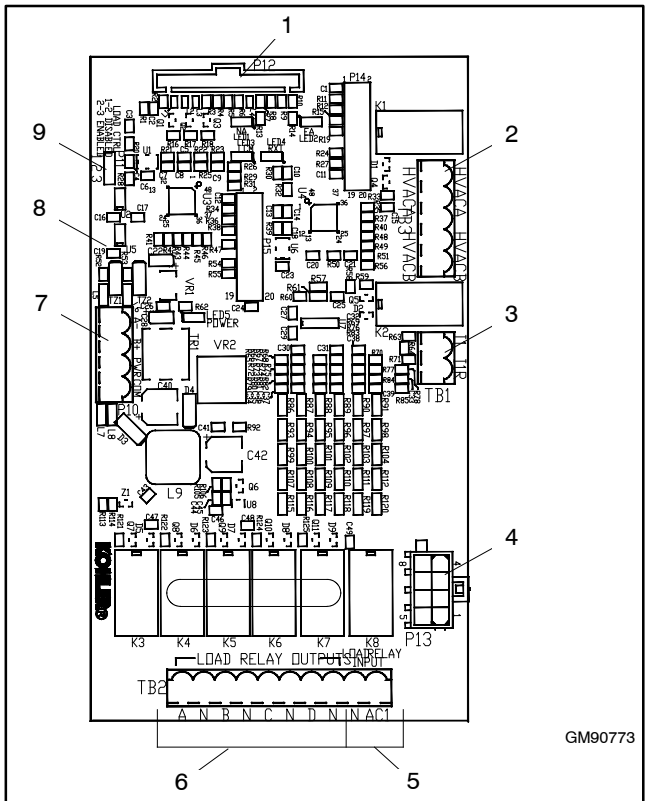
1. Transfer switch harness connection P13
2. Controller interface connection P10
3. Load control connection P11
4. Status indicator connection P12

Figure 7-1 Single-Phase Interface Board



1. Transfer switch harness connection P1
2. Optional status indicator connection P12
3. Communication (RBUS) connection to RDC2/DC2 controller on generator set P10
4. Load control connection P11

Figure 7-2 Three-Phase Interface Board



1. P12, optional status indicator connection
2. TB3, HVAC relay connections (load management)
3. TB1, current transformer (CT) connection
4. P13, transfer switch harness connection
5. TB2, 120 VAC input connection (load management)
6. TB2, power relay connections (load management)
7. P10, RBUS communication connection
8. LED 5, power
9. P11: Install jumper across pins 2 and 3 to enable load management or pins 1 and 2 to disable load management

Figure 7-3 Combined Interface/Load Management Board (1 Phase)

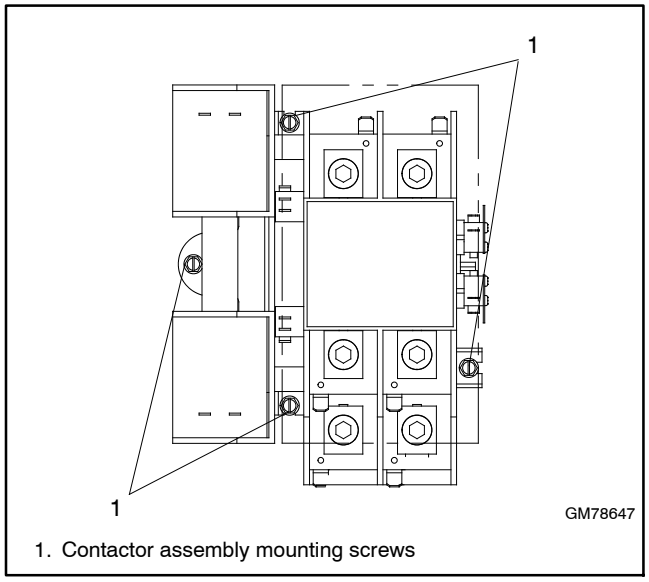
7.4 Contactor Assembly Removal and Installation (Single-Phase Models)

Use the instructions in this section if it is necessary to remove the entire contactor assembly from the enclosure.

Note: Serviceable contactor assembly parts can be replaced without removing the contactor assembly from the enclosure.

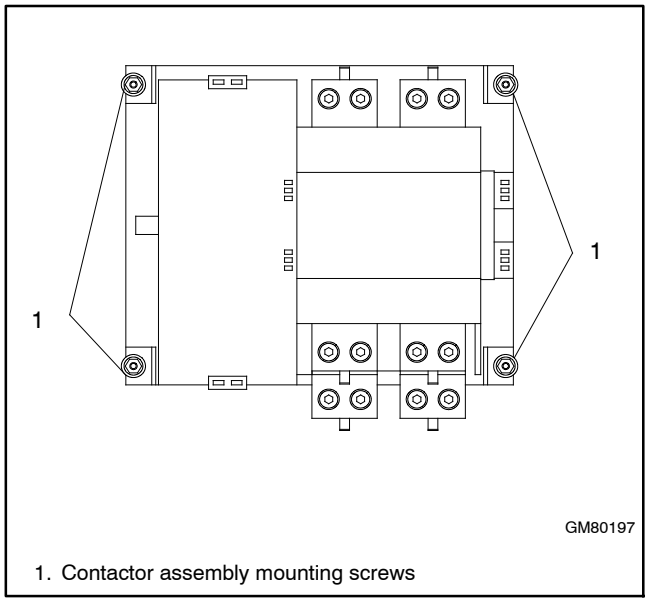
7.4.1 Contactor Assembly Removal

1. Disable the generator set and disconnect all power sources as described in Section 7.1 before opening the transfer switch enclosure.
2. Loosen the power terminal lugs and disconnect the normal, emergency, and load power conductors, and label and tape the ends of the conductors.
3. Disconnect the contactor wiring harness from the controller at connector P13.
4. Support the contactor and remove the screws located at the corners of the contactor's base that secure the contactor assembly to the back wall of the enclosure. See Figure 7-4 or Figure 7-5.
5. Lift and pull the contactor assembly from the enclosure.



1. Contactor assembly mounting screws

Figure 7-4 Contactor Mounting Screws, 100–200 Amp Models, Typical



1. Contactor assembly mounting screws

Figure 7-5 Contactor Mounting Screws, 300/400 Amp Models

7.4.2 Contactor Assembly Installation

1. Align the contactor assembly mounting holes with the mounting holes in the transfer switch enclosure.
2. Reinstall the screws that secure the contactor assembly. Tighten the screws to the torques shown in Figure 7-6.
3. Reconnect the power source and load conductors to the lugs. Tighten the connections to the torques shown in Section 3.2.2 of this manual.
4. Reconnect the contactor wiring harness to the controller at connector P1.

Model	Torque, Nm (in. lb.)
100 Amp	2.4 (21)
150/200 Amp	2.4 (21)
300/400 Amp	6.8 (60)

Figure 7-6 Tightening Torques, Contactor Mounting Screws

7.5 Contactor Assembly Removal and Installation (Three-Phase Models)

Required tools and equipment:
Basic electrician's hand tools
Multimeter digital or analog
Wiring harness
Tie wraps
Required protective equipment:
Rubber insulating gloves class 0
Safety glasses
Electrical hazard safety shoes

Contactor Replacement Procedure

1. Disable all connected generator sets.
2. Disconnect normal and emergency power to the transfer switch.
3. Open the enclosure.
4. Check for zero volts on the normal and emergency power lugs.
5. Remove the tie wraps securing the harness.
6. Disconnect the contactor harness from the interface board harness.

   Note: The replacement contactor is shipped with a factory-wired contactor harness.

7. Disconnect the engine start leads from the ATS engine start terminals.
8. Disconnect the emergency power supply cables from the switch.

   Note: Mark each cable as to its position as it is removed from the switch. Example: E1, E2 and E3 for the emergency side of the switch.

9. Disconnect the normal power supply cables from the switch, marking the cables as they are removed.
10. Disconnect the load cables from the switch, marking the cables as they are removed.
11. Remove the four nuts securing the power panel.
12. Remove the contactor.
13. Install the new contactor onto the studs in the back of the enclosure. See Figure 7-7.
14. Fasten the contactor with flat washers, lock washers and nuts.
15. Torque the nuts to 7.3 Nm (65 in. lb.).
16. Connect the contactor harness to the controller harness at the inline connector.
17. Connect the load cables to the T terminals.
18. Tighten the connecting bolts to 16.3 Nm (12 ft. lb.).
19. Connect the normal cables to the N terminals.

Figure 7-7 Installing the Contactor

20. Tighten the connecting bolts to 16.3 Nm (12 ft. lb.).
21. Connect the emergency supply cables to the E terminals.
22. Tighten the connecting bolts to 16.3 Nm (12 ft. lb.).
23. Install tie wraps as needed to secure the harness.
24. Connect the generator set engine start leads.
25. Close the transfer switch enclosure.
26. Connect power to the ATS.
27. Enable the generator set.
    a. Reconnect the generator set engine starting battery, negative (–) lead last.
    b. Reconnect utility power to the generator set.
28. Press the AUTO button on the generator set controller.
29. Test the transfer switch operation.

7.6 100–200 Amp Single-Phase Model Service

7.6.1 Solenoid Assembly

Disable the generator set and disconnect all power sources as described in Section 7.1 before opening the transfer switch enclosure.

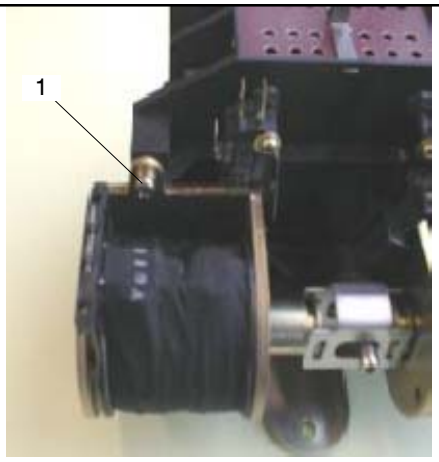
Procedures shown are for the Normal source coil. Use the same procedures for the Emergency source coil. Perform the coil replacement procedures on one source side at a time.

- To replace the Normal source coil, first move the contactor to the Emergency source position.
- To replace the Emergency source coil, first move the contactor to the Normal source position.

Solenoid Assembly Removal

Remove the solenoid assembly from the current-carrying unit by removing two mounting screws from the assembly. See Figure 7-8.

Note: Two square nuts will be released when the mounting screws are removed. Save the screws and nuts for reinstallation later.



1. Remove screws, 2 locations

Figure 7-8 Solenoid Assembly

Solenoid Disassembly

1. Remove two screws from the core plate. See Figure 7-9.

1. Remove 2 screws

Figure 7-9 Disassembling the Coil Assembly

2. Remove the core plate and the steel core with washer. See Figure 7-10.

3. Remove the coil from the coil bracket. See Figure 7-10.

1. Coil
2. Coil bracket
3. Assembly mounting screws and nuts
4. Core plate screws
5. Core plate
6. Steel core
7. Washer

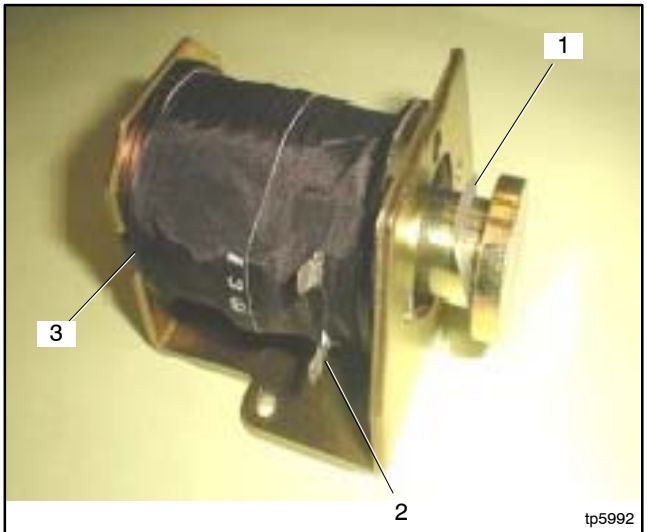
Figure 7-10 Coil Assembly Parts

Solenoid Reassembly

1. Position the coil in the bracket with the tab on the top of the coil and operating circuit terminal oriented as shown in Figure 7-11 for the Normal source coil or in Figure 7-12 for the Emergency source coil.

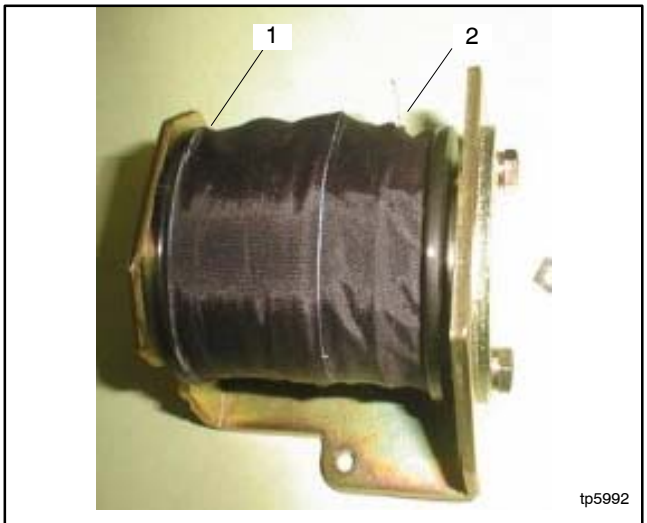
2. Insert the steel core with washer into the coil. See Figure 7-11.

3. Install the core plate and tighten the two core plate screws. See Figure 7-9.



1. Core and washer
2. Operating circuit terminal
3. Coil orientation tab, Normal source coil

Figure 7-11 Coil Assembly, Normal Source Coil Shown (note the coil orientation)

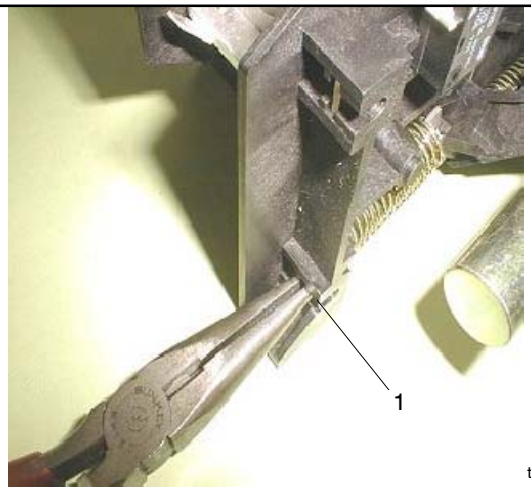


1. Coil orientation tab, Emergency source coil
2. Operating circuit terminal

Figure 7-12 Emergency Source Coil Assembly (note the coil orientation)

7.6.2 Solenoid Assembly Installation

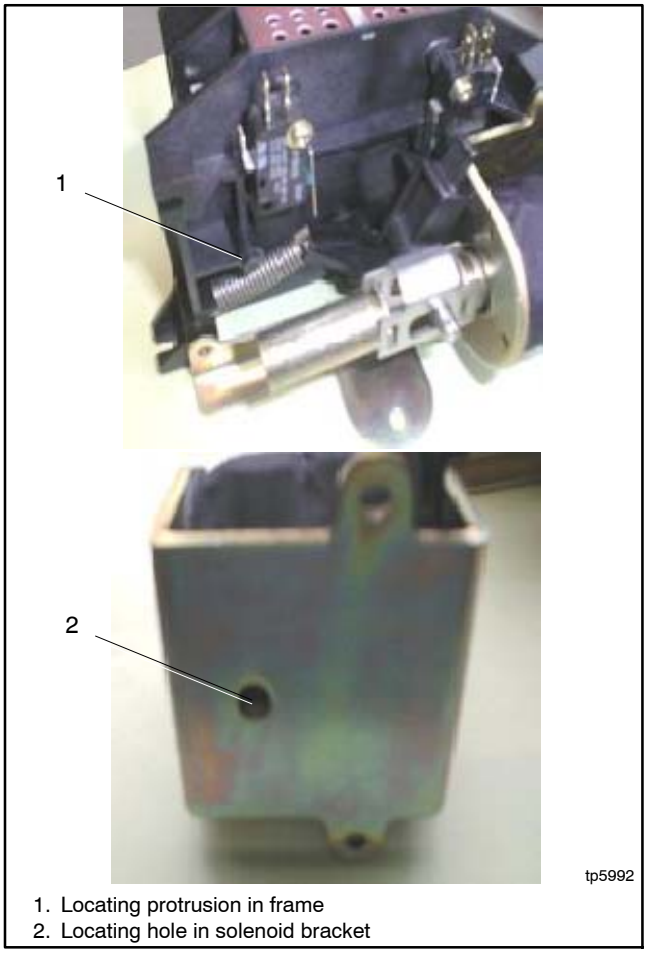
1. Insert the two square nuts into the grooves on the frame. See Figure 7-13.



1. Insert square nuts into the grooves in the frame (two locations)

Figure 7-13 Reinstalling the Coil Assembly Nuts

2. Align locating hole in the solenoid bracket with the locating protrusion in the frame. See Figure 7-14.



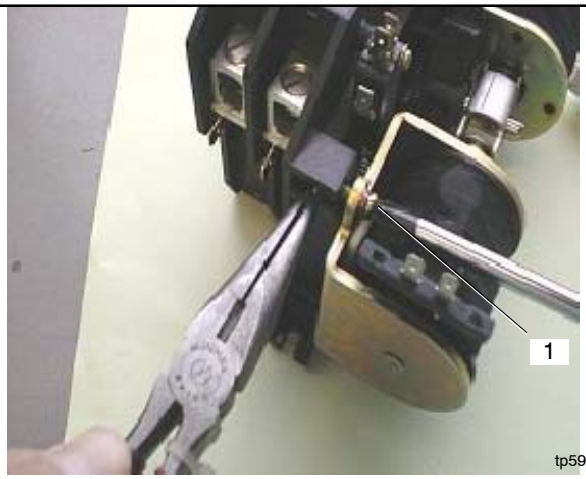
1. Locating protrusion in frame
2. Locating hole in solenoid bracket

Figure 7-14 Locating the Solenoid Assembly, Typical

3. Install and tighten the two mounting screws. Use pliers to hold the nuts while inserting and tightening the screws. See Figure 7-15.

4. Operate the contactor using the manual operating handle to verify that the mechanism operates smoothly without binding.

5. Follow the instructions under **After Service** in Section 7.1.



1. Install and tighten 2 mounting screws

Figure 7-15 Installing the Coil Assembly,Typical

7.6.3 Microswitch Replacement

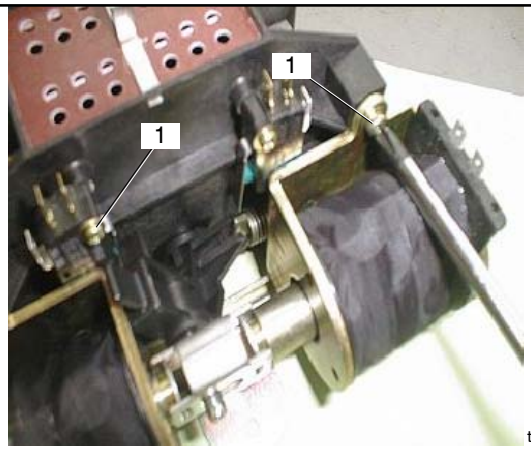
Procedures shown are for the microswitch at the Emergency source coil. Use the same procedures for the microswitch at the Normal source coil.

Perform the switch replacement procedures on one source side at a time.

- To replace the microswitch at the Normal source coil, first move the contactor to the Emergency source position.
- To replace the microswitch at the Emergency source coil, first move the contactor to the Normal source position.

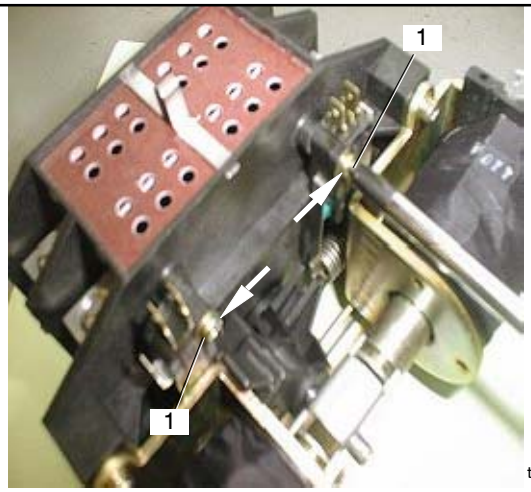
100 Amp Models

1. Loosen the four coil mounting screws (two for each coil) by two full rotations. Do not remove the coils. See Figure 7-16.
2. Remove the microswitch mounting screw and microswitch. See Figure 7-17 and Figure 7-18.
3. Install the new microswitch. Push the microswitch mounting screw in the direction of the arrow shown in Figure 7-17 and tighten it to 0.44 Nm (4 in. lb.).
4. Tighten the four coil mounting screws.



1. Coil mounting screws

Figure 7-16 Loosen Coil Mounting Screws



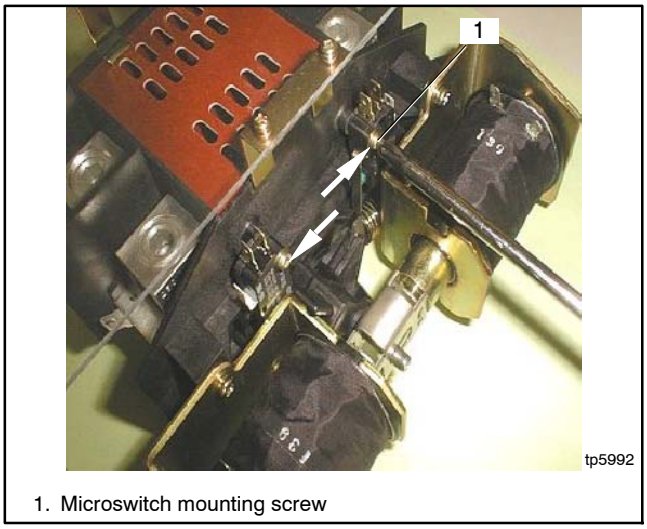
1. Microswitch mounting screw

Figure 7-17 Microswitch Mounting Screw

Figure 7-18 Microswitch and Mounting Screw

150/200 Amp Models

1. Remove the microswitch mounting screw and microswitch. See Figure 7-19.
2. Install the new microswitch. Push the microswitch mounting screw in the direction of the arrow shown in Figure 7-19 and tighten it to 0.44 Nm (4 in. lb.).



1. Microswitch mounting screw

Figure 7-19 Install new Microswitch, 200 A Models

7.7 300/400 Amp Single-Phase Model Service

Disable the generator set and disconnect all power sources as described in Section 7.1 before opening the transfer switch enclosure.

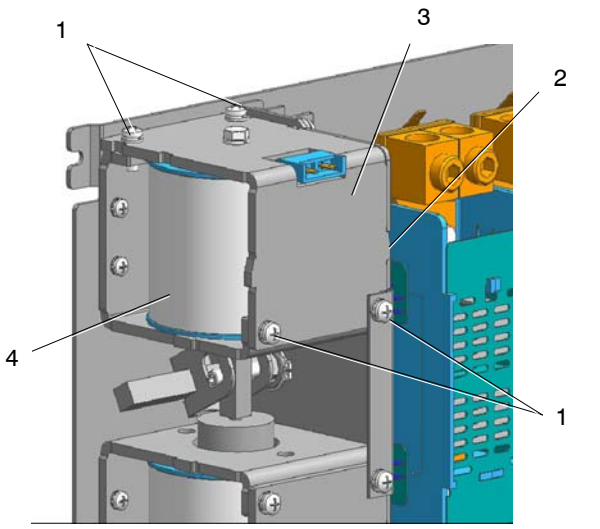
Procedures shown are for the Normal source coil. Use the same procedures for the Emergency source coil. Perform the coil replacement procedures on one source side at a time.

7.7.1 Coil Removal

Note: Be careful handling the coil. When the M5 screws are removed, the coil and the steel frame may drop, resulting in damage.

1. Remove four M5 screws. See Figure 7-20.

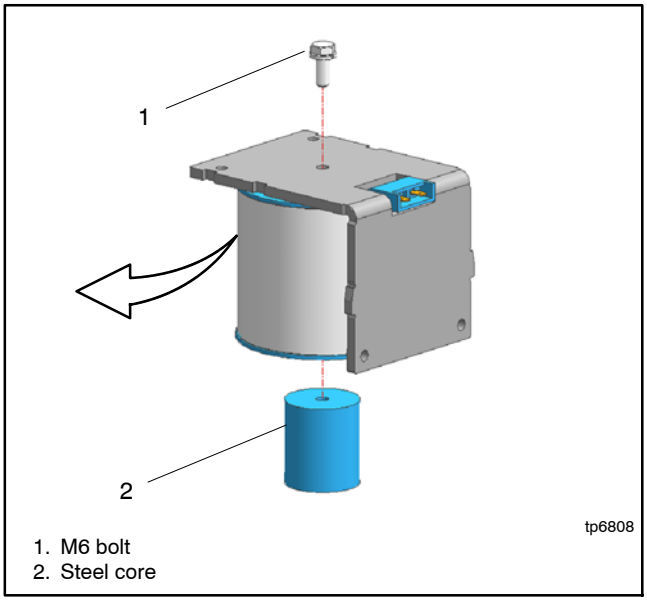
2. Remove the steel frame by sliding toward the left. The frame is fit to the body at the mating section. See Figure 7-20.



1. M5 Screw
2. Mating section
3. Steel frame
4. Coil

Figure 7-20 Coil and Frame

3. Remove the M6 bolt holding the steel frame and the steel core. Remove the coil from the steel frame. See Figure 7-21.



1. M6 bolt
2. Steel core

Figure 7-21 Coil Removal

7.7.2 Coil Installation

1. Insert the terminal block section of the coil into the opening in the steel frame. See Figure 7-22.

   Note: The coil is fragile. Handle it carefully.

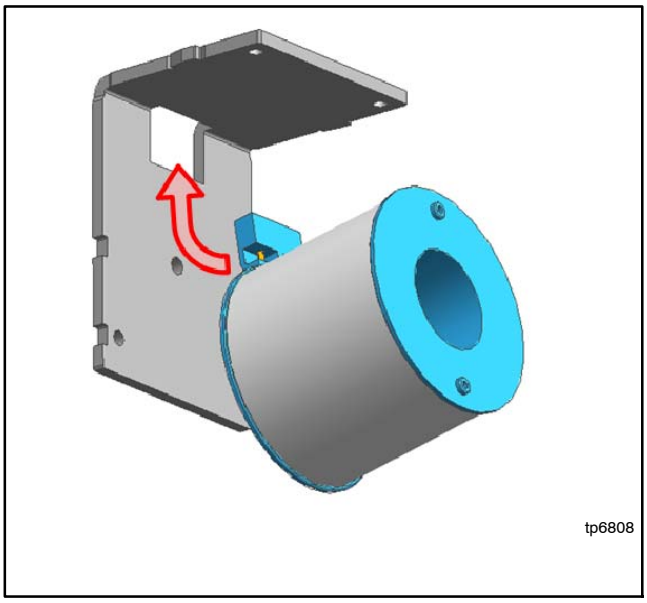
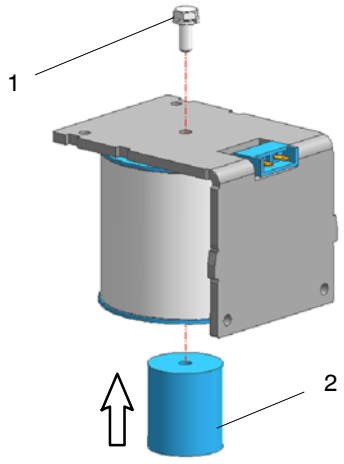


Figure 7-22 Coil Terminal In Steel Frame

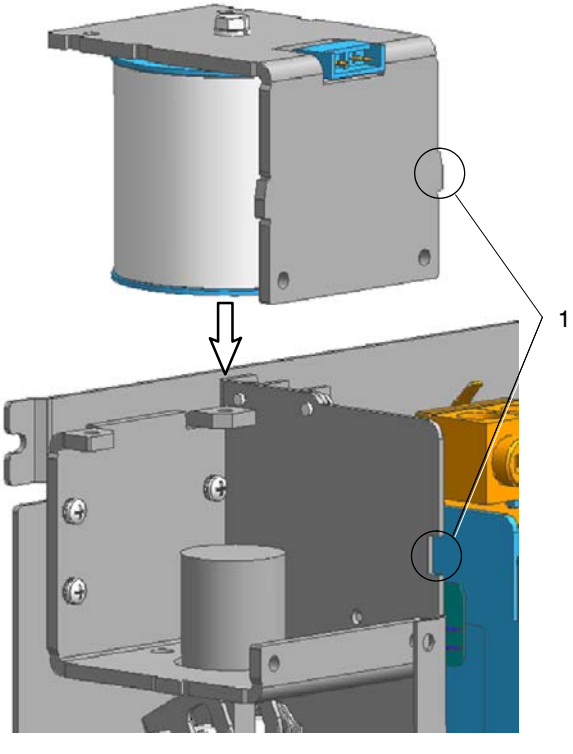
2. Insert the steel core into the coil and tighten the M6 bolt to create the coil assembly. Tightening torque for the M6 bolt: 6 Nm. See Figure 7-23.



1. M6 bolt
2. Steel core

Figure 7-23 Create Coil Assembly

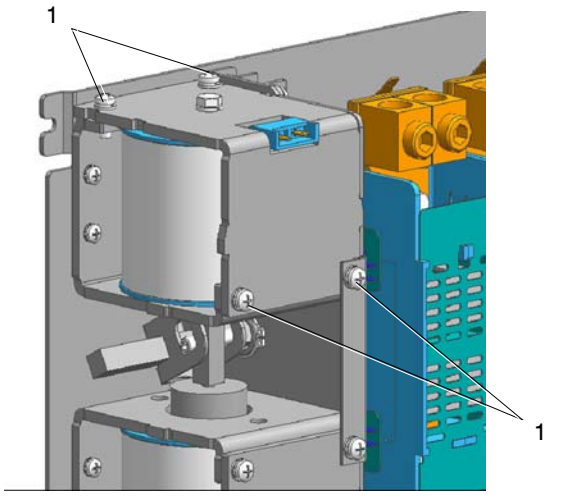
3. Place the coil assembly made in step 2 into the body. Be sure that the coil assembly fits perfectly into the body at the mating section. See Figure 7-24.



1. Mating section

Figure 7-24 Install Coil Assembly

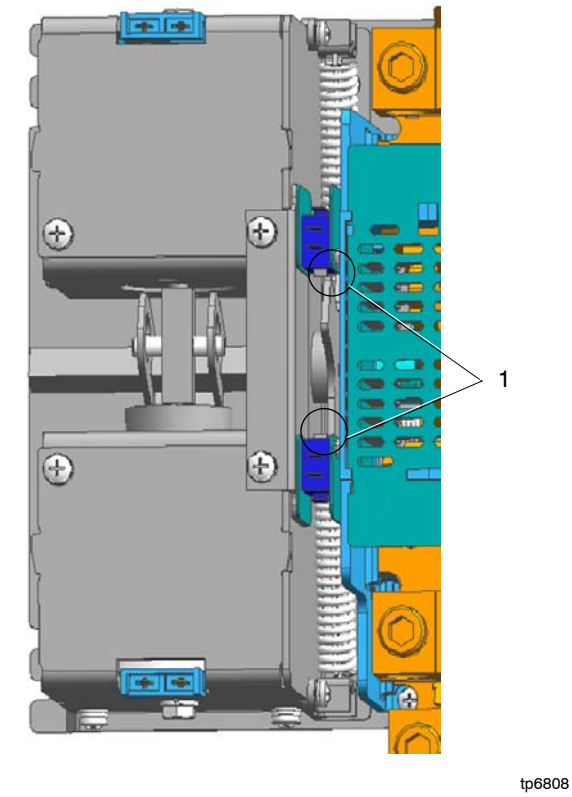
4. Tighten the M5 screws at four locations. Tightening torque for the M5 screws: 3 Nm. See Figure 7-25.



1. M5 screws

Figure 7-25 Install Coil Assembly

5. Make sure the degree of the clearance for both microswitches is the same. See Figure 7-26. For details, refer to step 3 in **Microswitch Assembly**.



1. Clearance for microswitch

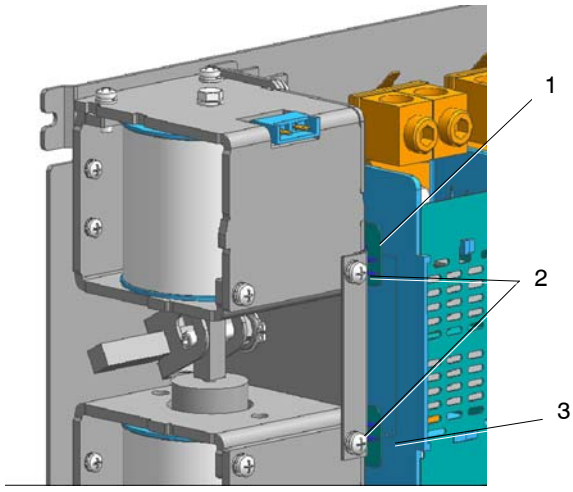
Figure 7-26 Microswitch Clearance

7.7.3 Microswitch Replacement

The following procedures are explained for the A-side microswitch. The procedures for replacing the B-side microswitch are the same as those for the A-side microswitch.

Microswitch Disassembly

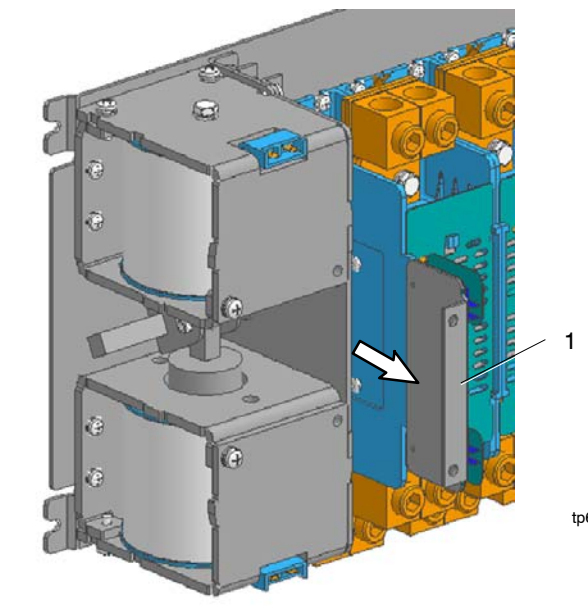
1. Remove the two M5 screws. See Figure 7-27.



1. A Side microswitch
2. M5 screws
3. B Side microswitch

Figure 7-27 Microswitch Disassembly

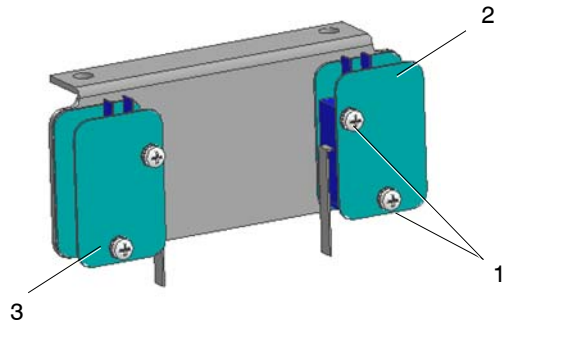
2. Move the microswitch mounting plate toward the direction of arrow for removal. See Figure 7-28.



1. Microswitch mounting plate

Figure 7-28 Microswitch Mounting Plate

3. Remove two M3 screws to remove the microswitch and separators. See Figure 7-29 and Figure 7-30.



1. M3 screws
2. A Side
3. B Side

Figure 7-29 Microswitch Screws

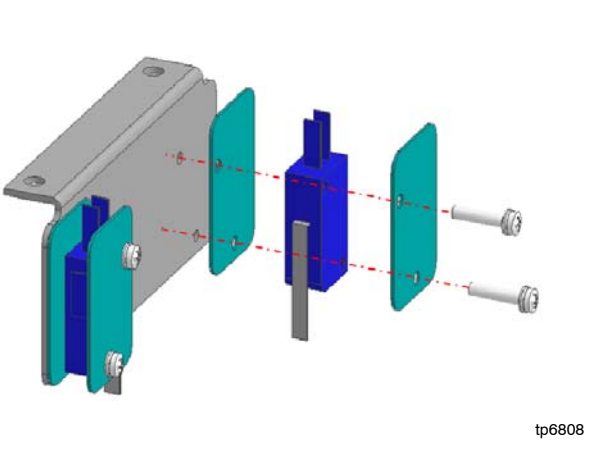


Figure 7-30 Microswitch and Separators

Microswitch Assembly

Assemble the microswitches in reverse order of the disassembly procedures above. Pay special attention to the tightening torque values and the movable range of the microswitches after being assembled.

1. Install the two M3 screws after placing a separator, a microswitch, and the second separator in this order. See Figure 7-31. See Figure 7-32 for the correct orientation of the separators.

   Tightening torque for the M3 screw: 0.7 Nm (0.5 ft. lbs.) .

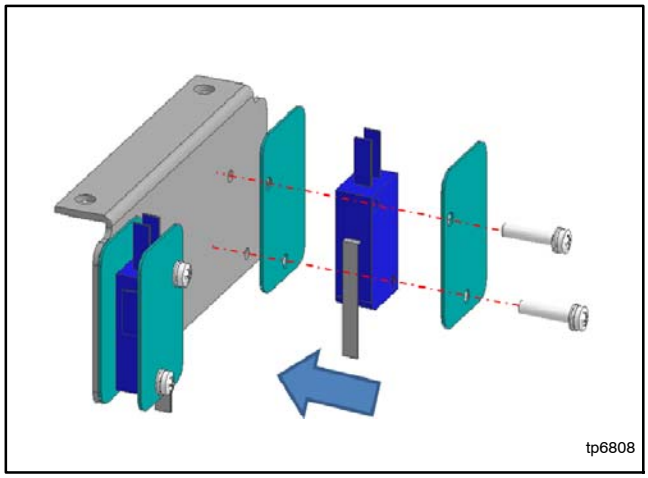


Figure 7-31 Microswitch Assembly

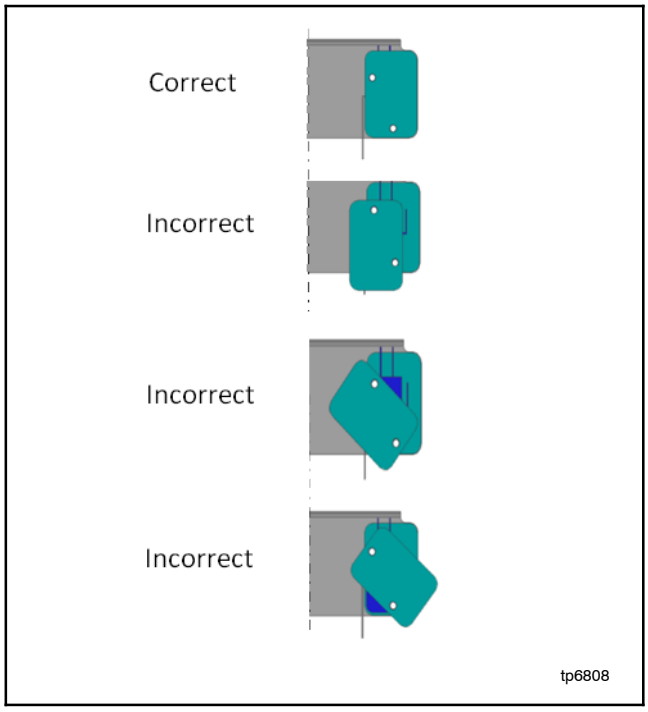
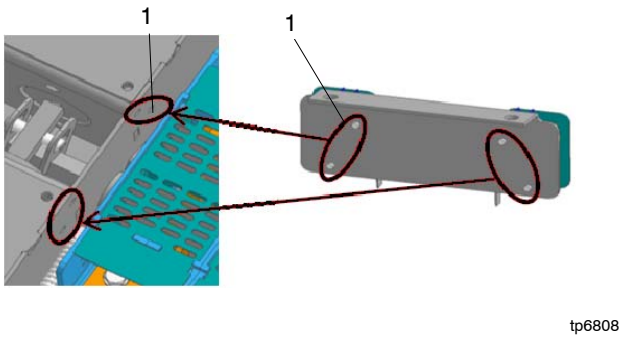


Figure 7-32 Microswitch Separator Orientation

2. Replace the microswitch mounting plate and reinstall the two M5 screws. See Figure 7-33. Tightening torque for the M5 screw: 3 Nm.

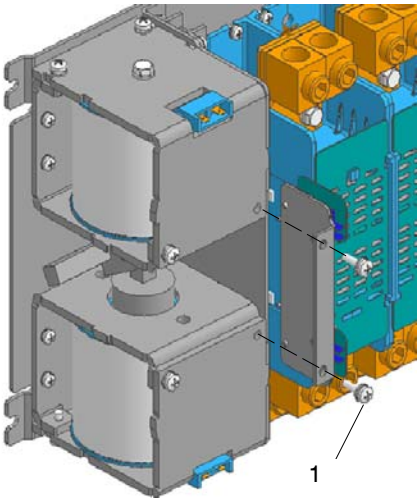
   Note: The holes of the microswitch mounting plate must be aligned to the holes on the steel frames. See Figure 7-34.

   Note: Make sure that the microswitch lever and the T-shaped lever are aligned. In addition, make sure that the T-shaped lever is correctly touching the microswitch lever. See Figure 7-35.



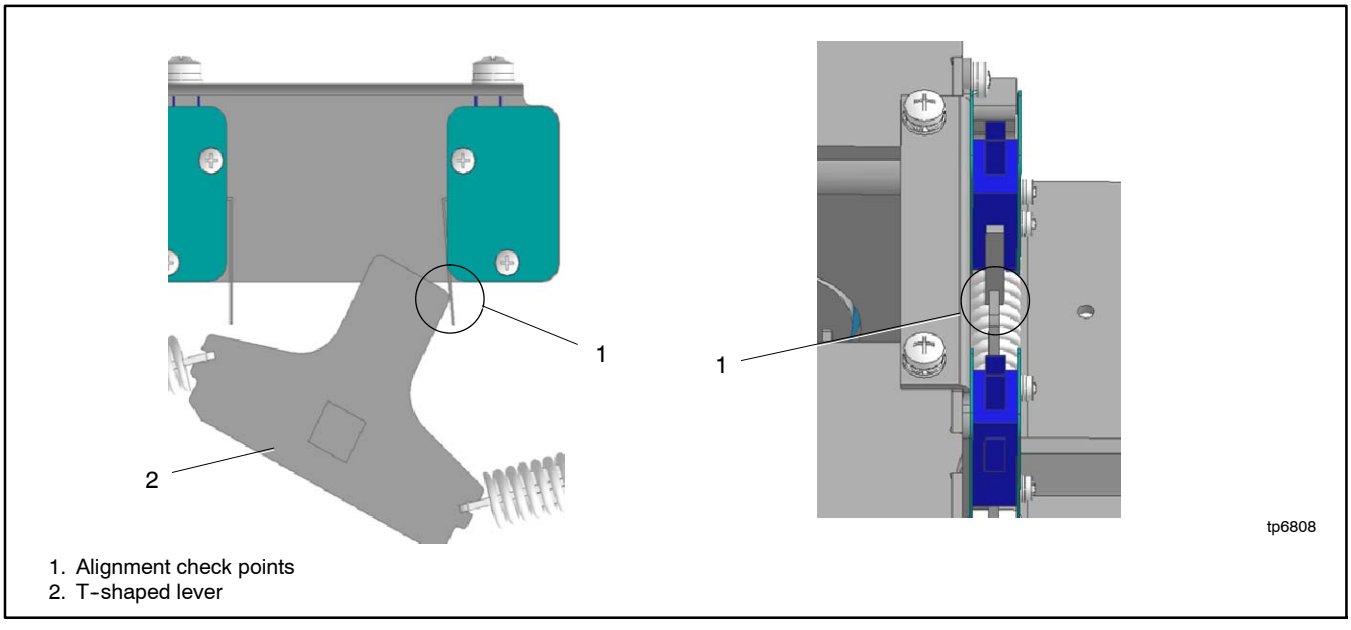
1. Alignment holes

Figure 7-34 Microswitch Mounting Plate Alignment



1. M5 screws

Figure 7-33 Microswitch Mounting Plate

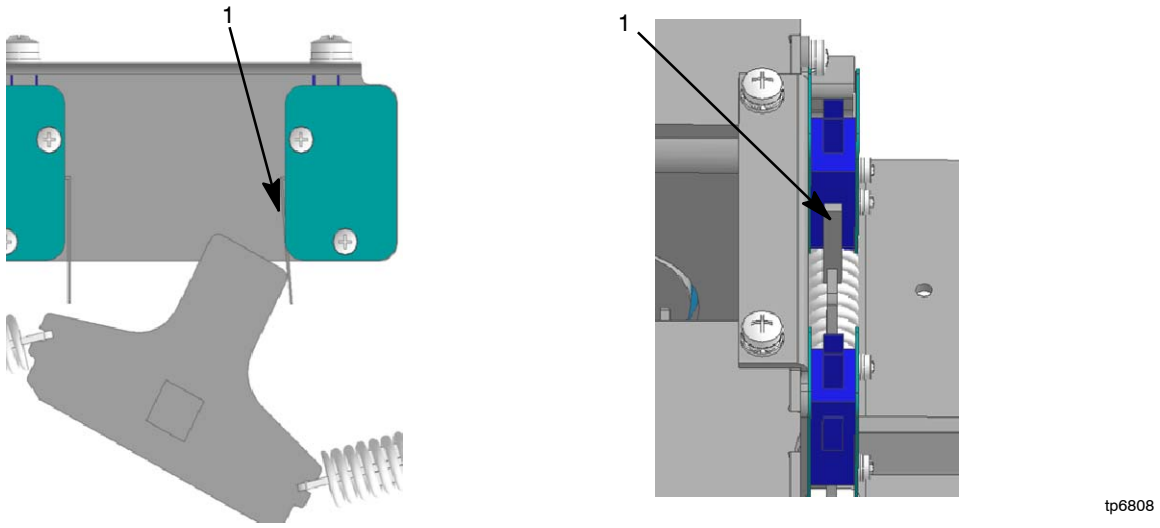


1. Alignment check points
2. T-shaped lever

Figure 7-35 Microswitch Lever Alignment

3. Check to see if there is a clearance with the microswitch lever by pressing the movement verification point indicated in Figure 7-36. Check the other side also by switching the T-shaped lever to the other side. Even if you replaced only one of the microswitches, it is necessary to check the clearance on both sides.

Note: If there is no clearance with either microswitch lever, loosen the M5 screws tightened in step 2 and adjust the mounted position of the microswitch before repeating steps 2 and 3.



1. Movement verification points

Figure 7-36 Microswitch Movement

7.8 100–400 Amp 3 Phase Model Service

7.8.1 Arc Chute Replacement

Required tools and equipment:
Basic electrician's hand tools
Arc chute
Required protective equipment:
Rubber insulating gloves class 0
Safety glasses
Electrical hazard safety shoes

Arc Chute Replacement Procedure

1. Prevent all connected generator sets from starting.
   a. Place the generator set master switch in the OFF position.
   b. Disconnect the battery charger, if equipped.
   c. Disconnect the generator set engine starting batter(ies), negative (–) lead first.
2. Disconnect power to the transfer switch.
3. Open the transfer switch enclosure.
4. Verify zero volts across each phase.
5. Remove the arc chute hold down screws. See Figure 7-37.
6. Remove the arc chute.
7. Inspect the movable contact for damage. See Figure 7-38. If damage is found, order a replacement contactor and continue to Step 8.

1. Arc chute hold down screws

Figure 7-37 Arc Chute Screws

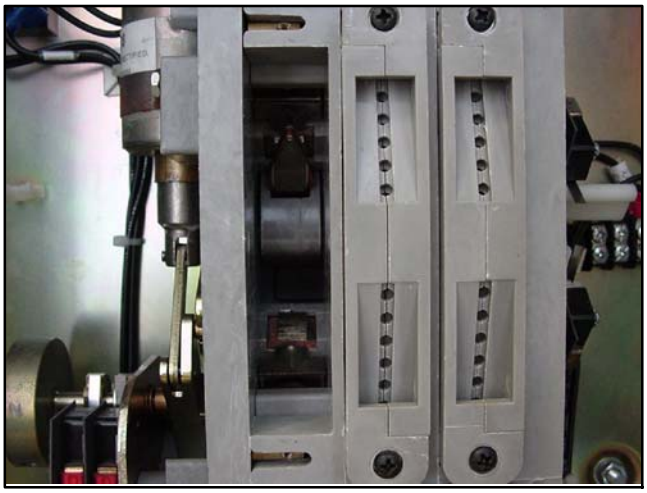


Figure 7-38 Movable Contacts (arc chute removed)

8. Install the new arc chute.
9. Install the holding screws and washers.
10. Torque screws to 2.8 Nm (25 in. lb.).
11. Manually operate the switch several times to ensure that it does not stick. See Figure 7-39.
12. Close the enclosure.
13. Reconnect power to the ATS.
14. Enable the generator set.
    a. Check that the generator set master switch is in the OFF position.
    b. Reconnect the generator set engine starting batter(ies), negative (–) lead last.
    c. Reconnect the battery charger, if equipped.
15. Move the generator set master switch to the AUTO position.
16. Test the transfer switch operation.

Figure 7-39 Manual Operation Handle Inserted

7.8.2 Microswitch Replacement

Required tools and equipment:
Basic electrician's hand tools
Microswitch
Required protective equipment:
Rubber insulating gloves class 0
Safety glasses
Electrical hazard safety shoes

100/200 Amp Microswitch Replacement Procedure

1. Prevent all connected generator sets from starting.
    a. Place the generator set master switch in the OFF position.
    b. Disconnect the power to the battery charger, if equipped.
    c. Disconnect the generator set engine starting battery(ies), negative (–) lead first.

    Note: On systems with multiple transfer switches connected to a single generator set, disconnect all power sources to the generator set before proceeding.
2. Disconnect power to the transfer switch.
3. Open the transfer switch enclosure.
4. Verify zero volts across each phase.
5. Note the location of the fast-on connectors to the microswitch terminals. See Figure 7-40.

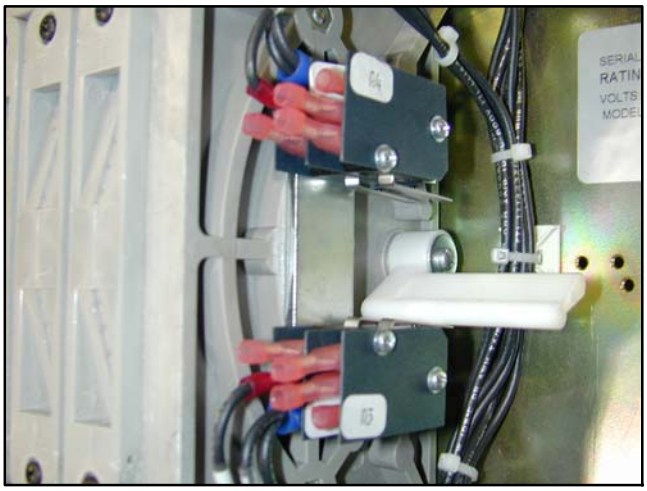


Figure 7-40 Microswitches

6. Disconnect the fast-on connectors.
7. Remove the holding screws.

8. Remove the suspect microswitch.

   Note: For SN/SE assemblies that have four microswitches, you must remove the end plate to access the microswitches. See Figure 7-41.

9. Install the new microswitch.

   Note: For SN/SE assemblies that have four microswitches, you must install an end plate for stability. See Figure 7-41.

10. Install the holding screws.

11. Tighten the holding screws to 0.3 Nm (3 in. lb.).

12. Connect the fast-on connections to the microswitch terminals. See Figure 7-40.

    Note: The terminals used were noted in step 5.

13. Close the ATS enclosure.

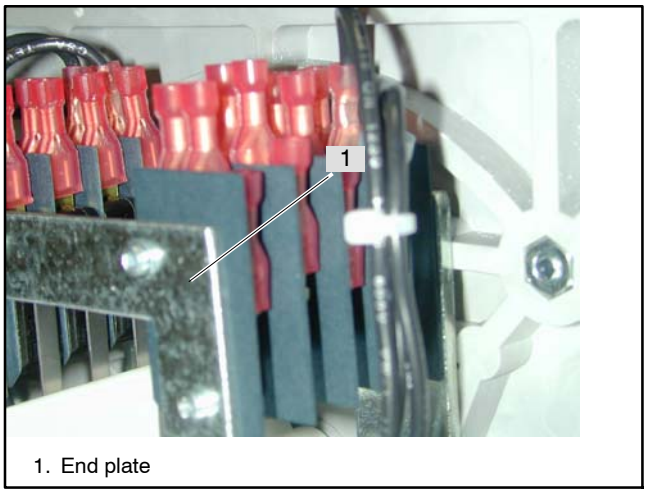
14. Connect power to the ATS.

15. Enable the generator set.

    a. Check that the generator set master switch is in the OFF position.

    b. Reconnect the generator set engine starting battery, negative (–) lead last.

    c. Reconnect power to the battery charger, if equipped.



1. End plate

Figure 7-41 End Plate (required for assemblies with four microswitches)

16. Move the generator set master switch to the AUTO position.

17. Test the transfer switch operation.

400 Amp Microswitch Replacement Procedure

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

1. Prevent all connected generator sets from starting.

   a. Place the generator set master switch in the OFF position.

   b. Disconnect the power to the battery charger, if equipped.

   c. Disconnect the generator set engine starting battery(ies), negative (–) lead first.

      Note: On systems with multiple transfer switches connected to a single generator set, disconnect all power sources to the generator set before proceeding.

2. Disconnect power to the transfer switch.

3. Open the transfer switch enclosure.

4. Verify zero volts across each phase.

   Note: A3/A4 microswitches can still be energized with customer power. The microswitches may be used for primary alarm circuits or primary controlling devices. Verify that all power is disconnected before proceeding.

5. Note the location of the fast-on connectors to the microswitch terminals. See Figure 7-42.

6. Disconnect the fast-on connectors. See Figure 7-43.

7. Remove the microswitch holding screws. See Figure 7-44.

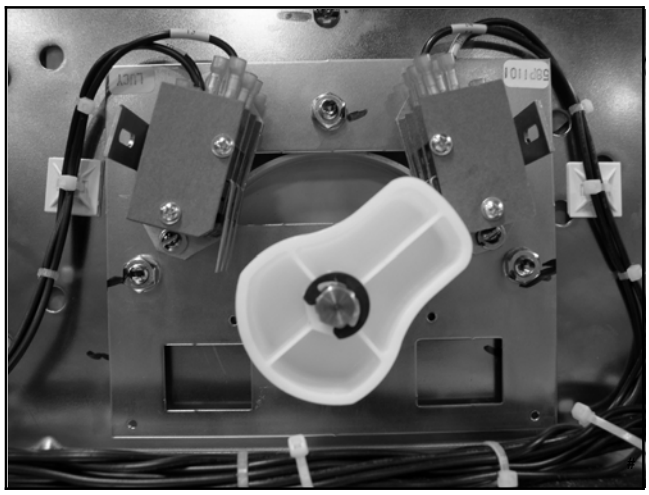


Figure 7-42 Microswitches

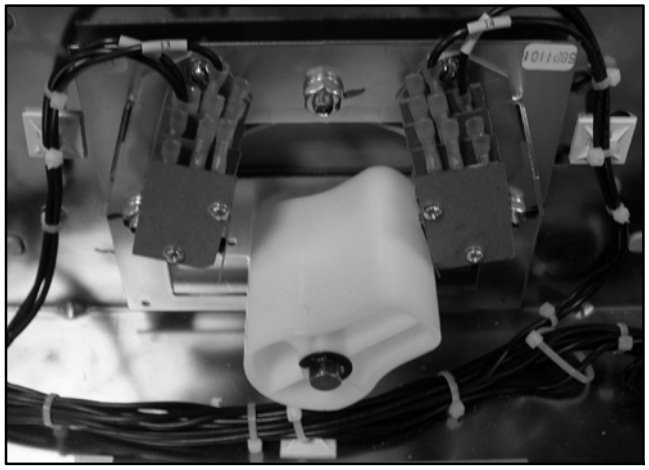


Figure 7-43 Microswitch Fast-On Connectors

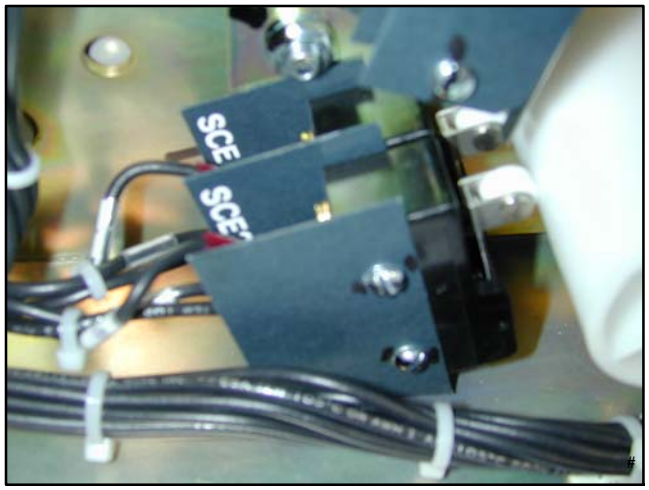


Figure 7-44 Microswitch Holding Screws

8. Remove the suspect microswitch.
9. Install the new microswitch.
10. Install the holding screws.
11. Tighten the holding screws to 0.3 Nm (3 in. lb.).
12. Connect the fast-on connections to the microswitch terminals as noted in step 5.
13. Close the transfer switch enclosure.
14. Connect power to the ATS.
15. Enable the generator set startup.
    a. Check that the generator set master switch is in the OFF position.
    b. Reconnect the generator set engine starting battery, negative (–) lead last.
    c. Reconnect power to the battery charger, if equipped.
16. Test the transfer switch operation.

7.8.3 Limit Switch Assembly Replacement

Required tools and equipment:
Basic electrician's hand tools
Multimeter digital or analog
Limit switch
Required protective equipment:
Rubber insulating gloves class 0
Safety glasses
Electrical hazard safety shoes

Procedure

1. Prevent all connected generator sets from starting.
   a. Place the generator set master switch in the OFF position.
   b. Disconnect the battery charger, if equipped.
   c. Disconnect the generator set engine starting batter(ies), negative (–) lead first.
2. Disconnect power to the transfer switch.
3. Open the transfer switch enclosure.
4. Verify zero volts across each phase.
5. Note the location of the fast-on connections to the SCN/SCE microswitch terminals.
6. Disconnect the fast-on connectors. See Figure 7-45.

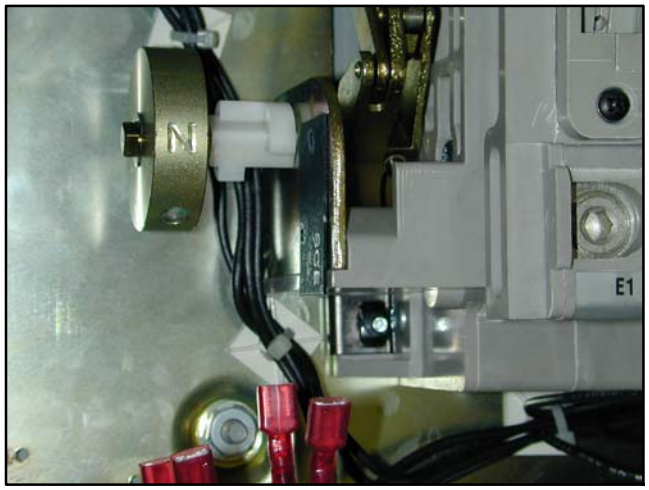


Figure 7-45 Microswitch Fast-On Connectors

7. Remove the holding screws. Note the microswitch labels on the insulators. See Figure 7-46.
8. Remove the microswitch assembly.
9. Remove the suspect microswitch. See Figure 7-47.
10. Install the new microswitch into the assembly.

    Note: Replace SCN/SCE insulators in the correct order. Normally, the SCE is closest to the base.

11. Reinstall the microswitch assembly. See Figure 7-48.
    a. Install the holding screws.
    b. Tighten the holding screws.
    c. Connect the fast-on connections to the microswitch terminals as noted in step 5.

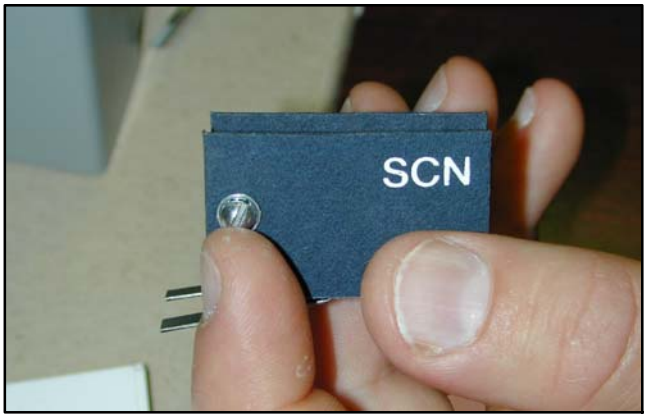


Figure 7-46 Microswitch Insulator with Label

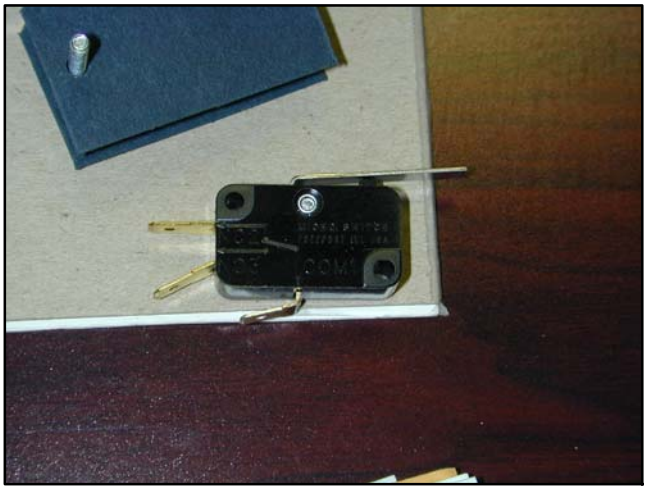


Figure 7-47 Microswitch

12. Clean the inside of the ATS.
13. Close and lock the enclosure.
14. Connect power to the ATS.
15. Enable the generator set startup.
    a. Check that the generator set master switch is in the OFF position.
    b. Reconnect the generator set engine starting batter(ies), negative (–) lead last.
    c. Reconnect the battery charger, if equipped.
16. Move the generator set master switch to the AUTO position.
17. Test the transfer switch operation.

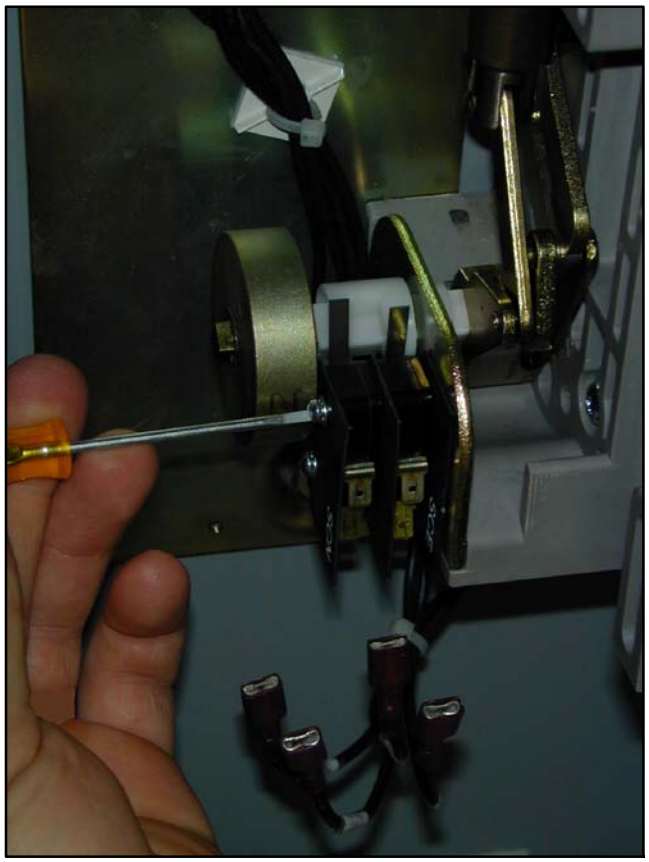


Figure 7-48 Microswitch Installation

7.8.4 Solenoid and Rectifier Test and Replacement, 100–200 Amp Models

Required tools and equipment:
Basic electrician's hand tools
Multimeter digital or analog
Solenoid
Tie wraps
Required protective equipment:
Rubber insulating gloves class 0
Safety glasses
Electrical hazard safety shoes

Procedure

1. Open the ATS enclosure.
2. Prevent all connected generator sets from starting.
    a. Place the generator set master switch in the OFF position.
    b. Disconnect the battery charger, if equipped.
    c. Disconnect the generator set engine starting batter(ies), negative (–) lead first.
3. Disconnect main power.
4. Verify zero volts across each phase.
5. Remove DC fast-on connections from the rectifier terminals. See Figure 7-49.
6. Check the coil resistance. See Figure 7-50.

    Note: If the resistance reading is infinite or shorted, replace the coil.

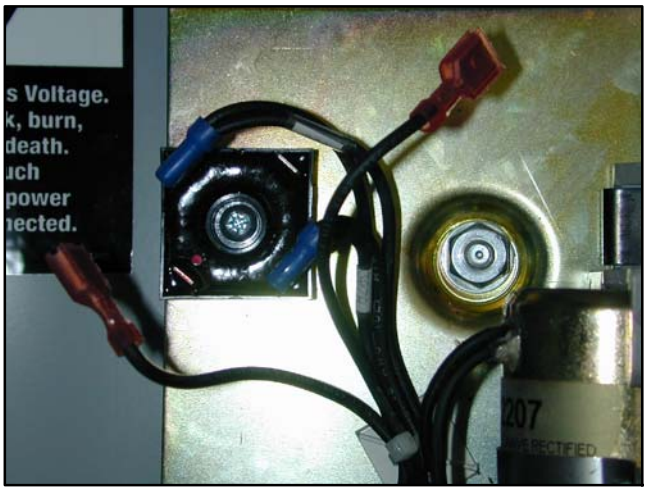


Figure 7-49 Rectifier Connections (DC solenoid leads shown disconnected)

Figure 7-50 Checking Coil Resistance

Rectifier Check and Replacement

7. Remove the AC fast-on connections from the AC terminals of the rectifier.

8. Check the diode operation of the rectifier. See Figure 7-51 and Section 5.8.4 for rectifier test instructions. If the rectifier is good, go to step 11. If the rectifier is bad, continue on.

9. Remove the faulty rectifier.

10. Install the new rectifier so that the red dot is in the upper right corner.

11. Connect the AC fast-on connections to the AC terminals.

    Note: The AC terminals are in the upper left and lower right hand corners.

Figure 7-51 Checking Diode Operation of Rectifier

Solenoid Replacement

⚠ 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.

12. Remove tie wraps, as necessary.

    Note: Do not cut the insulation on the wiring.

13. Remove the front bolt of the coil securing the strap. See Figure 7-52.

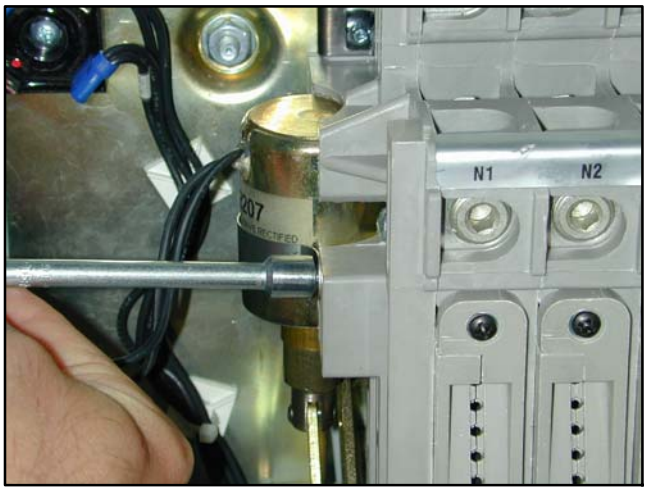


Figure 7-52 Coil Securing Strap

14. Loosen the rear bolt of the coil securing the strap.

15. Remove the coil.

    Note: The plunger assembly is spring-loaded. See Figure 7-53.

16. Lubricate the spring and plunger assembly.

17. Insert the spring into the new coil.

    Note: Insert and seat the spring into the spring holder of the coil. The spring should be centered in the hole. See Figure 7-54.

18. Install the plunger into the new coil.

    Note: The spring will slide into the plunger. See Figure 7-53.

Figure 7-53 Spring and Plunger Assembly

Figure 7-54 Spring Holder in Coil

19. Install the new coil into the coil slot.

20. Install the coil holding strap.

21. Tighten the bolts for the coil holding strap. See Figure 7-52.

22. Connect the DC fast-on connections to the DC terminals of the rectifier.

    Note: The DC terminals are in the lower left and upper right hand corners.

23. Install any required tie wraps.

24. Close the enclosure.

25. Reconnect power to the ATS.

26. Enable the generator set startup.

    a. Check that the generator set master switch is in the OFF position.

    b. Reconnect the generator set engine starting batter(ies), negative (–) lead last.

    c. Reconnect the battery charger, if equipped.

27. Move the generator set master switch to the AUTO position.

28. Test the transfer switch operation.

7.8.5 Solenoid Coil Replacement, 400 Amp 3-Phase Models

For 400 amp, 3-phase models, see the chart in Figure 7-55 to identify service procedures.

400 Amp 3-Phase, 3-Pole			400 Amp 3-Phase, 4-Pole		
208 V	**240 V**	**480 V**	**208 V**	**240 V**	**480 V**
Section 7.8.6		Section 7.8.7			

Figure 7-55 Service Procedures for 400 Amp 3-Phase Models

7.8.6 400 Amp 208-240 Volt Three-Phase 3-Pole Models

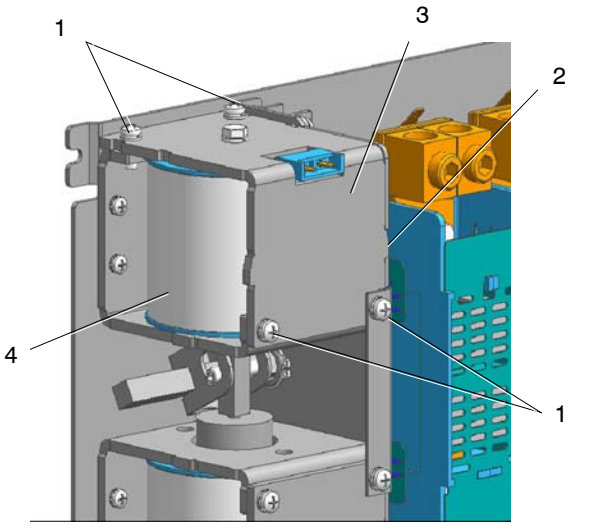
Disable the generator set and disconnect all power sources as described in Section 7.1 before opening the transfer switch enclosure.

Procedures shown are for the Normal source coil. Use the same procedures for the Emergency source coil. Perform the coil replacement procedures on one source side at a time.

Coil Removal

Note: Be careful handling the coil. When the M5 screws are removed, the coil and the steel frame may drop, resulting in damage.

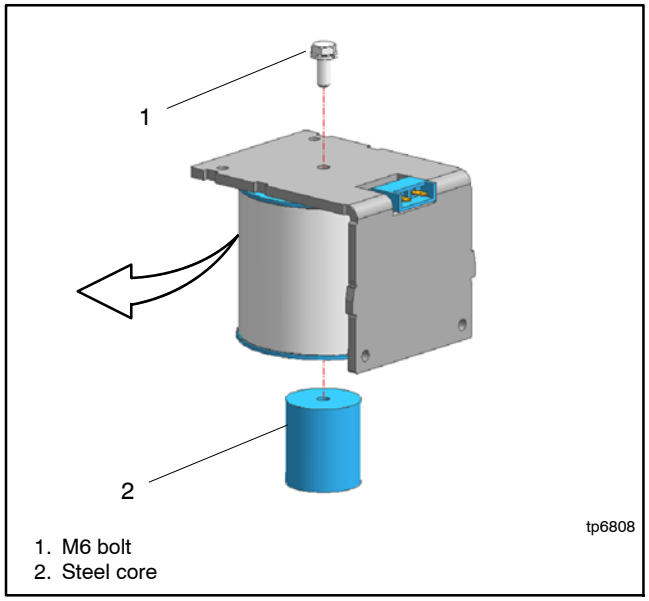
1. Remove four M5 screws. See Figure 7-56.
2. Remove the steel frame by sliding toward the left. The frame is fit to the body at the mating section. See Figure 7-56.



1. M5 Screw
2. Mating section
3. Steel frame
4. Coil

Figure 7-56 Coil and Frame

3. Remove the M6 bolt holding the steel frame and the steel core. Remove the coil from the steel frame. See Figure 7-57.



1. M6 bolt
2. Steel core

Figure 7-57 Coil Removal

Coil Installation

1. Insert the terminal block section of the coil into the opening in the steel frame. See Figure 7-58.

   Note: The coil is fragile. Handle it carefully.

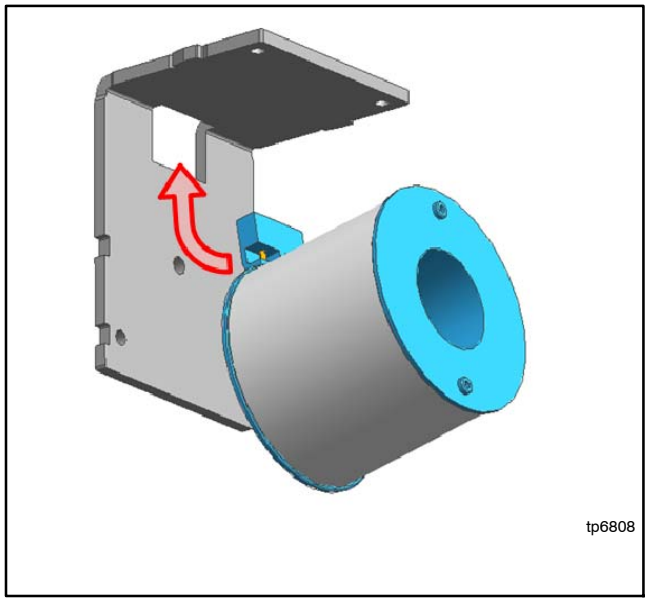
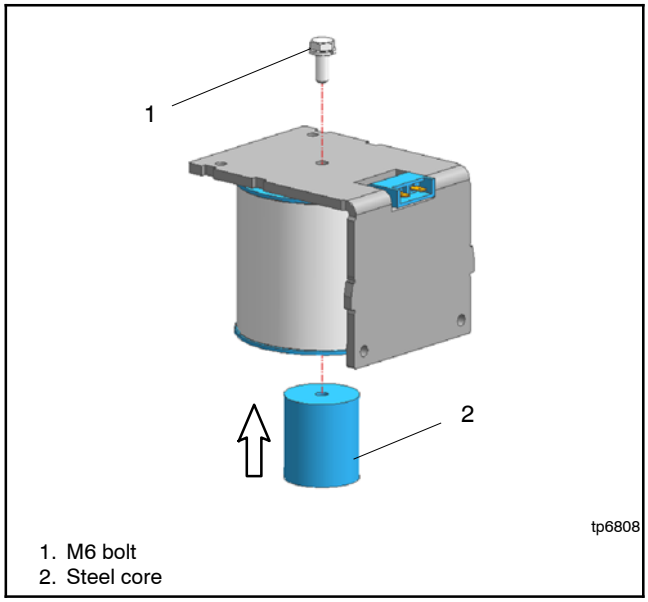


Figure 7-58 Coil Terminal In Steel Frame

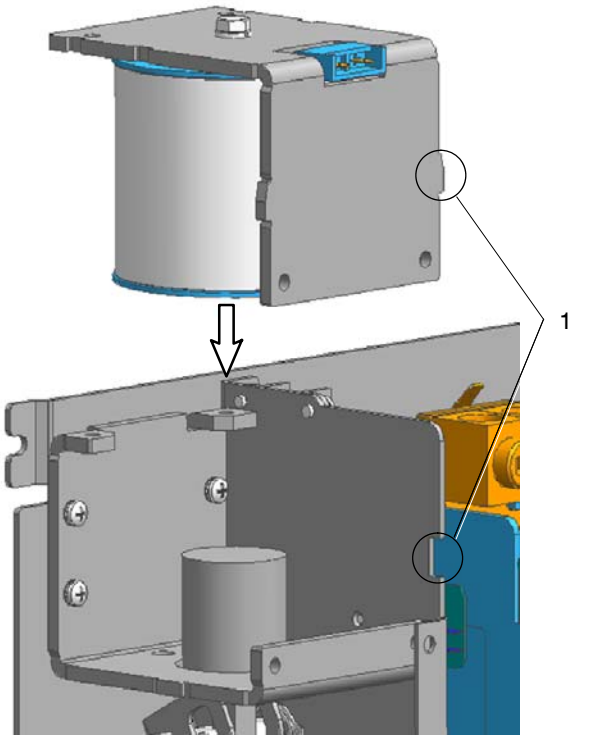
2. Insert the steel core into the coil and tighten the M6 bolt to create the coil assembly. Tightening torque for the M6 bolt: 6 Nm. See Figure 7-59.



1. M6 bolt
2. Steel core

Figure 7-59 Create Coil Assembly

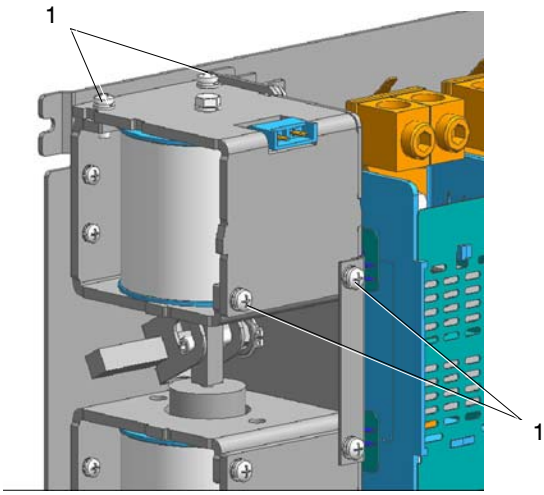
3. Place the coil assembly made in step 2 into the body. Be sure that the coil assembly fits perfectly into the body at the mating section. See Figure 7-60.



1. Mating section

Figure 7-60 Install Coil Assembly

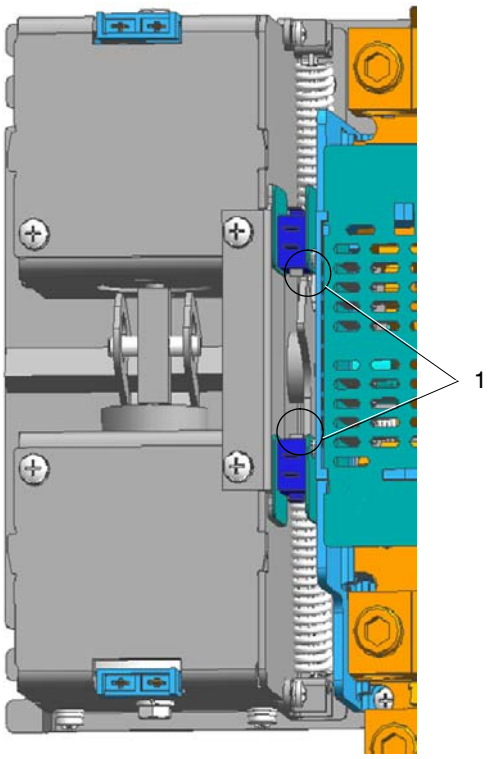
4. Tighten the M5 screws at four locations. Tightening torque for the M5 screws: 3 Nm. See Figure 7-61.



1. M5 screws

Figure 7-61 Install Coil Assembly

5. Make sure the degree of the clearance for both microswitches is the same. See Figure 7-62. For details, refer to step 3 in **Microswitch Assembly**.



1. Clearance for microswitch

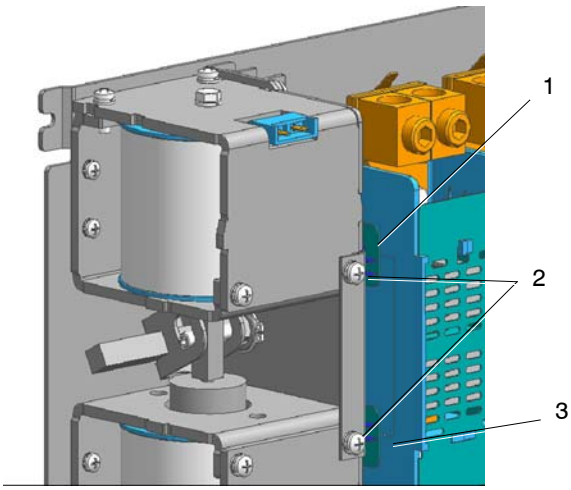
Figure 7-62 Microswitch Clearance

Microswitch Replacement

The following procedures are explained for the A-side microswitch. The procedures for replacing the B-side microswitch are the same as those for the A-side microswitch.

Microswitch Disassembly

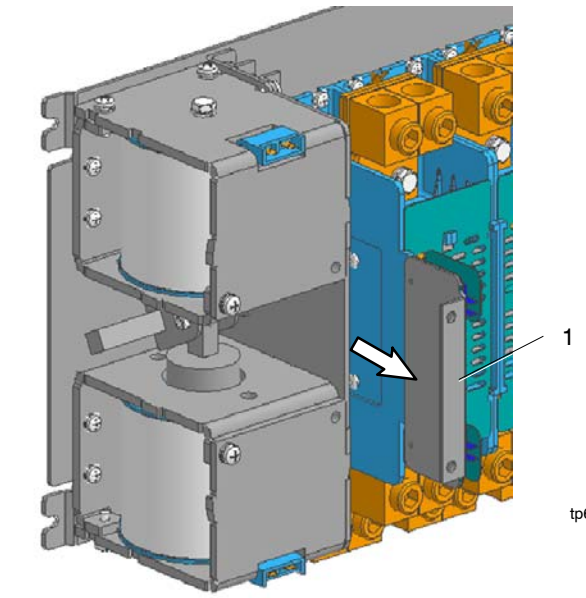
1. Remove the two M5 screws. See Figure 7-63.



1. A Side microswitch
2. M5 screws
3. B Side microswitch

Figure 7-63 Microswitch Disassembly

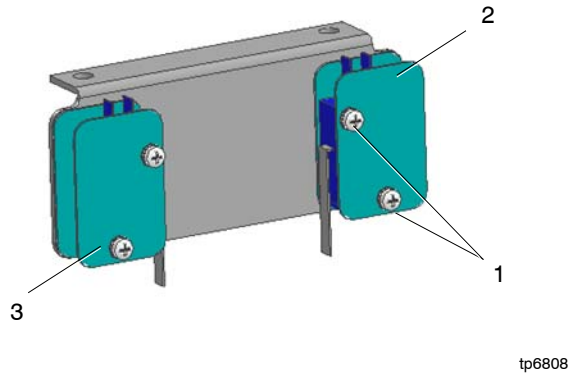
2. Move the microswitch mounting plate toward the direction of arrow for removal. See Figure 7-64.



1. Microswitch mounting plate

Figure 7-64 Microswitch Mounting Plate

3. Remove two M3 screws to remove the microswitch and separators. See Figure 7-65 and Figure 7-66.



1. M3 screws
2. A Side
3. B Side

Figure 7-65 Microswitch Screws

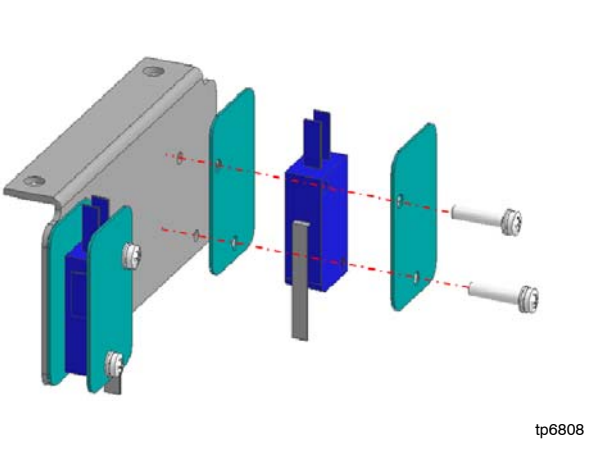


Figure 7-66 Microswitch and Separators

Microswitch Assembly

Assemble the microswitches in reverse order of the disassembly procedures above. Pay special attention to the tightening torque values and the movable range of the microswitches after being assembled.

1. Install the two M3 screws after placing a separator, a microswitch, and the second separator in this order. See Figure 7-67. See Figure 7-68 for the correct orientation of the separators.

   Tightening torque for the M3 screw: 0.7 Nm (0.5 ft. lbs.) .

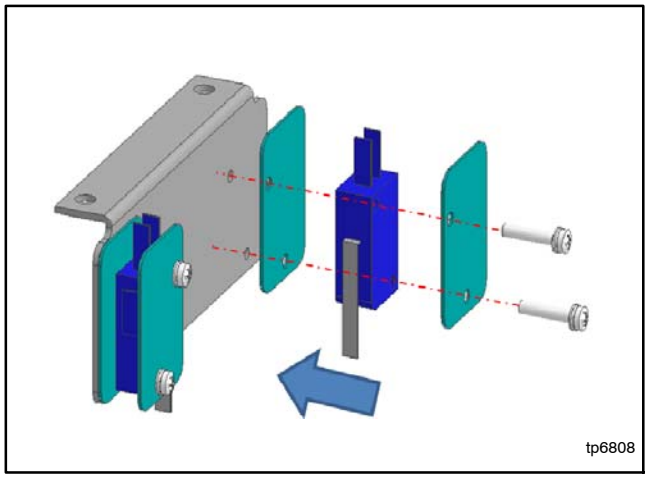


Figure 7-67 Microswitch Assembly

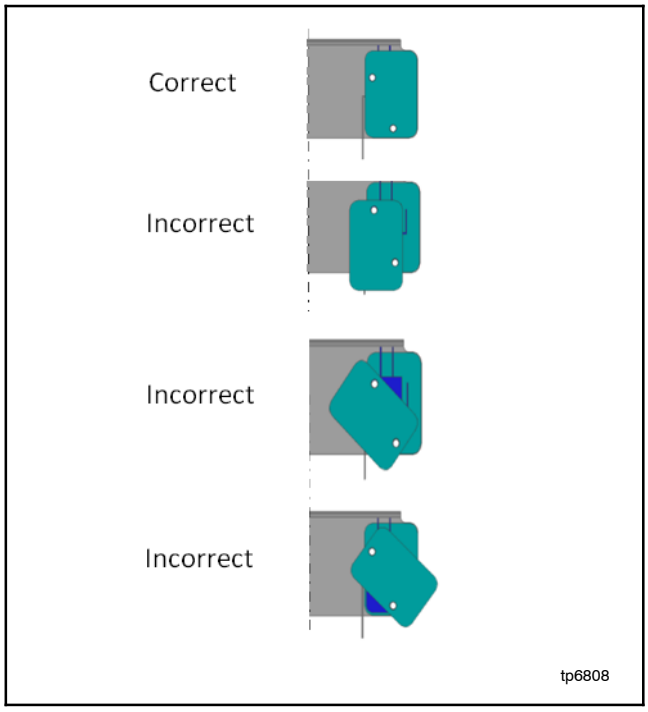
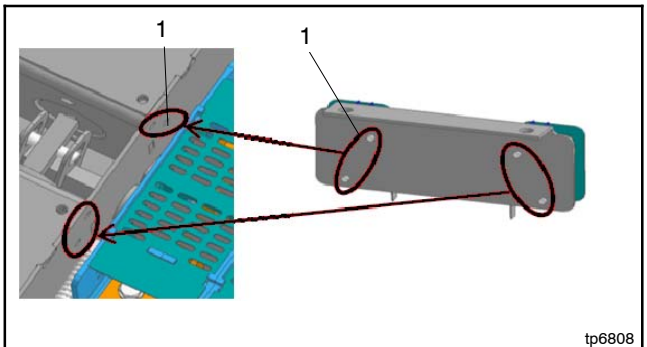


Figure 7-68 Microswitch Separator Orientation

2. Replace the microswitch mounting plate and reinstall the two M5 screws. See Figure 7-69. Tightening torque for the M5 screw: 3 Nm.

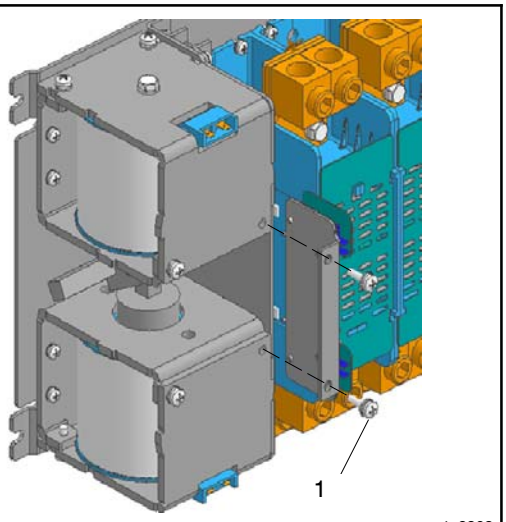
Note: The holes of the microswitch mounting plate must be aligned to the holes on the steel frames. See Figure 7-70.

Note: Make sure that the microswitch lever and the T-shaped lever are aligned. In addition, make sure that the T-shaped lever is correctly touching the microswitch lever. See Figure 7-71.



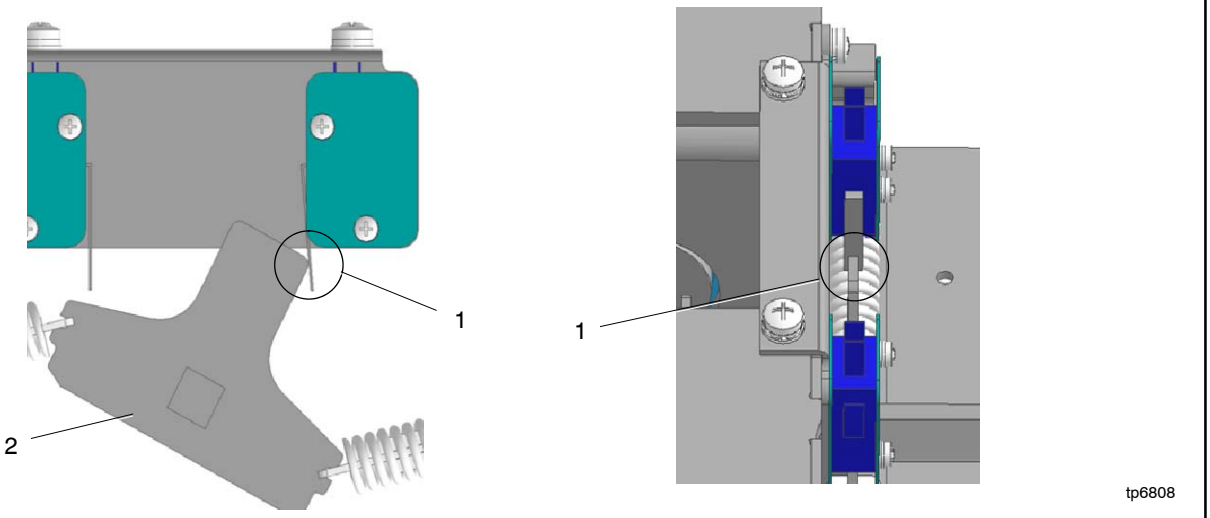
1. Alignment holes

Figure 7-70 Microswitch Mounting Plate Alignment



1. M5 screws

Figure 7-69 Microswitch Mounting Plate

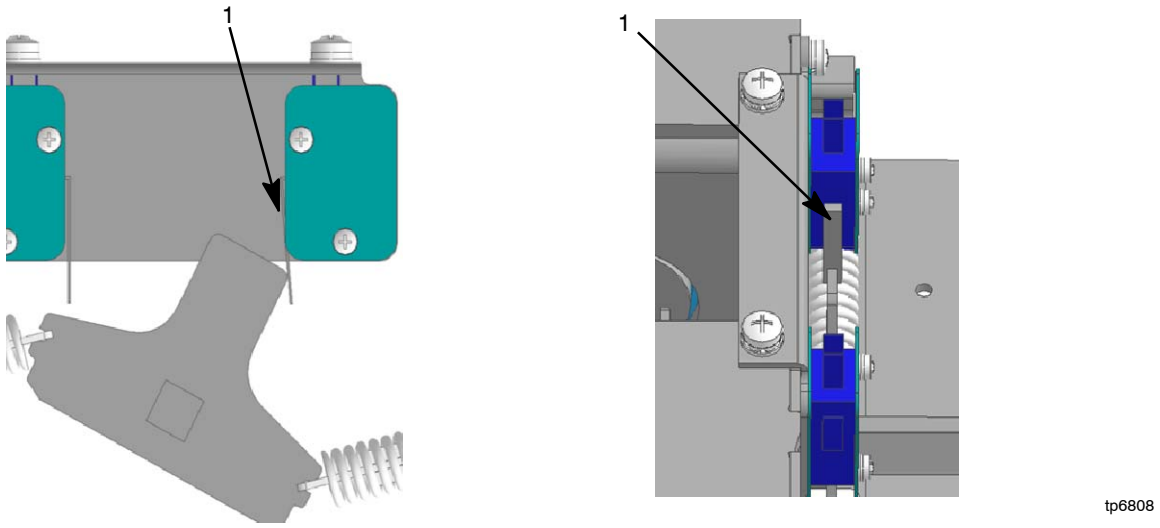


1. Alignment check points
2. T-shaped lever

Figure 7-71 Microswitch Lever Alignment

3. Check to see if there is a clearance with the microswitch lever by pressing the movement verification point indicated in Figure 7-72. Check the other side also by switching the T-shaped lever to the other side. Even if you replaced only one of the microswitches, it is necessary to check the clearance on both sides.

Note: If there is no clearance with either microswitch lever, loosen the M5 screws tightened in step 2 and adjust the mounted position of the microswitch before repeating steps 2 and 3.



1. Movement verification points

Figure 7-72 Microswitch Movement

7.8.7 Solenoid and Rectifier Test and Replacement, 400 Amp Models

See Figure 7-73 to identify the 400 Amp 3-Phase models covered in this section.

400 Amp 3-Phase, 3-Pole			400 Amp 3-Phase, 4-Pole		
208 V	**240 V**	**480 V**	**208 V**	**240 V**	**480 V**
Section 7.8.6		Section 7.8.7			

Figure 7-73 Service Procedures for 400 Amp, 3-Phase Models

Required tools and equipment:
Basic electrician's hand tools
Multimeter digital or analog
Solenoid
Tie wraps
Required protective equipment:
Rubber insulating gloves class 0
Safety glasses
Electrical hazard safety shoes

Procedure

1. Prevent all connected generator sets from starting.
   a. Place the generator set master switch in the OFF position.
   b. Disconnect the battery charger, if equipped.
   c. Disconnect the generator set engine starting batter(ies), negative (–) lead first.
2. Disconnect main power and open the ATS enclosure.
3. Verify zero volts across each phase.

Rectifier Check and Replacement

4. Remove the DC fast-on connections from the rectifier terminals. See Figure 7-74.

   Note: A red dot identifies one DC terminal. The other DC terminal is at the opposite corner of the rectifier.

5. Check the coil resistance.

   Note: If reading is infinite or shorted, replace coil.

6. Remove the AC fast-on connections from the AC terminals of the rectifier.
7. Check the diode operation of the rectifier. See Figure 7-75 and Section 5.8.4 for rectifier test instructions. If the rectifier is bad, replace it. If the rectifier is good, proceed to step 9.
8. Replace the rectifier. Orient the new rectifier so that the red dot is in the upper right corner when the contactor is mounted in the enclosure.
9. Connect AC fast-on connections to AC terminals.

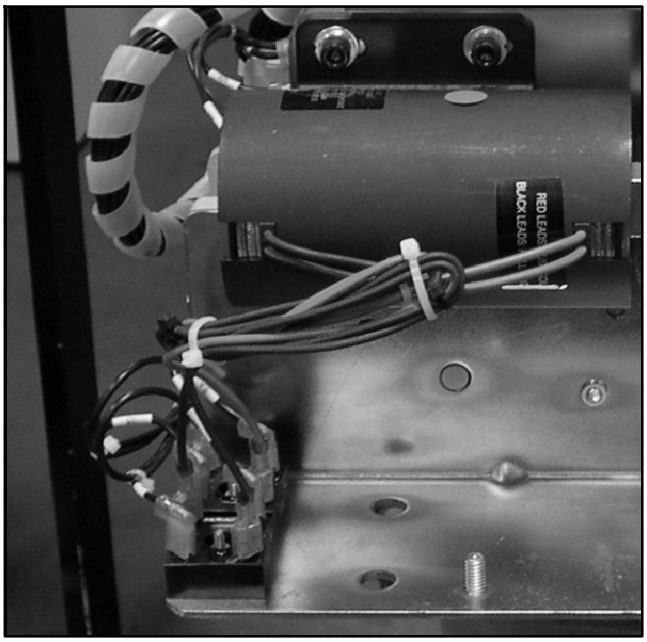


Figure 7-74 Rectifier Fast-On Connectors (contactor shown on the bench)

Figure 7-75 Checking Rectifier Diode Operation

Solenoid Replacement

⚠ WARNING

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

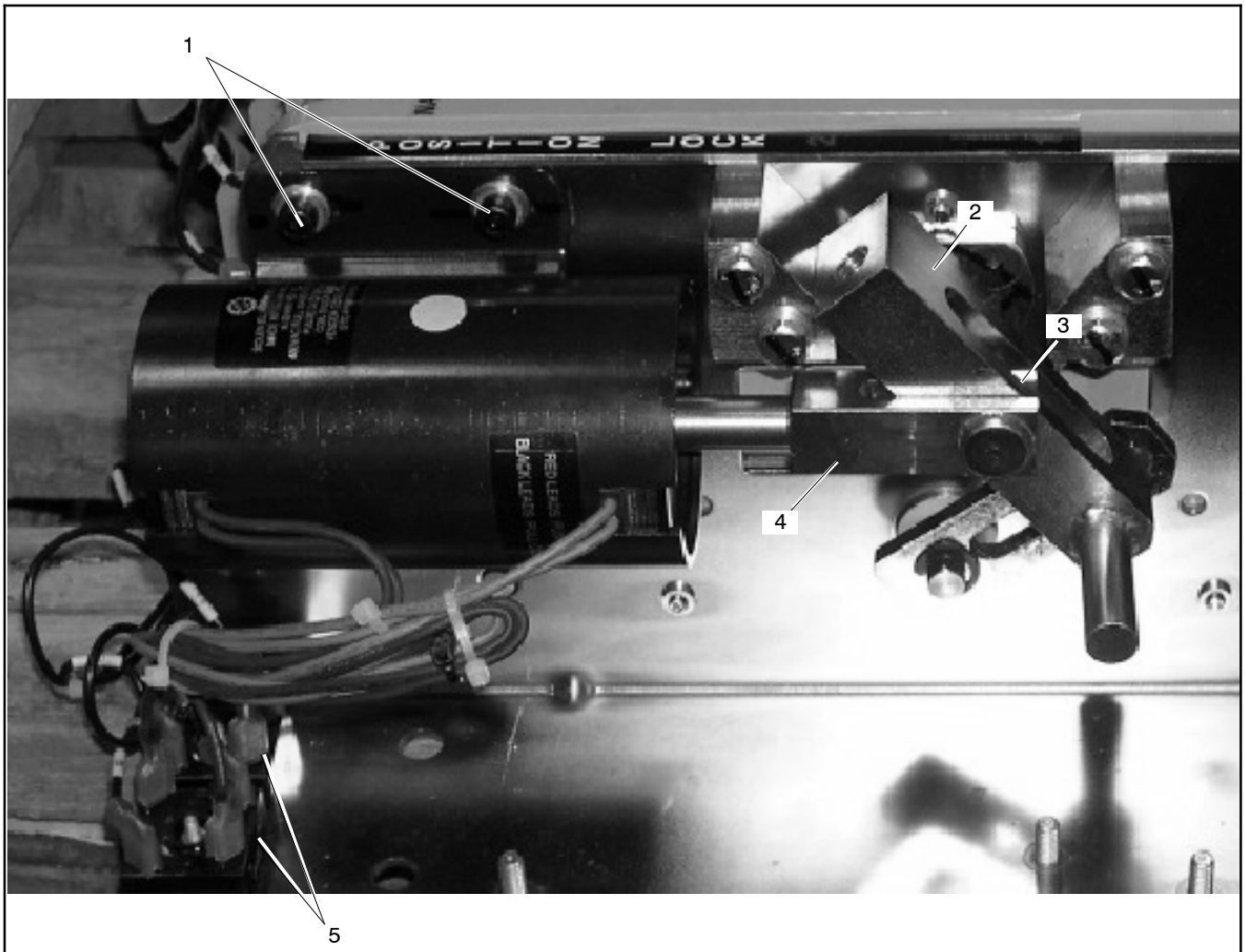
Wear protective goggles when servicing spring-loaded parts. Hold parts securely during disassembly.

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.

10. Note the rectifier connections and disconnect the AC leads. See Figure 7-76.
11. Remove tie wraps as necessary.

    Note: Be careful to avoid cutting the insulation on the leads.

12. Place the switch in the Normal position.
13. Mark the location of the solenoid assembly mounting bracket.
14. Hold the solenoid coil firmly and remove the four screws and washers. See Figure 7-76.



1. Mounting screws with washers (4 ea.)
2. Linkage
3. Clip location (not visible this view)
4. Plunger
5. Rectifier connections

Figure 7-76 Solenoid Assembly (shown on the bench)

15. Pull the solenoid assembly with the attached linkage away from the contactor.

    Note: The sealed solenoid coil assembly contains the coil and the plunger. Do not attempt to remove the plunger from the coil assembly.

16. Remove the clip that secures the plunger to the linkage and remove the linkage from the coil assembly.

17. Use the clip to attach the linkage to the new coil assembly.

18. Place the new solenoid assembly into position, aligning the linkage pins with the mechanism slots. See Figure 7-76.

19. Insert four mounting screws with washers and align the mounting bracket with marks made in step 13.

20. Tighten all four bolts to 10.8 Nm (96 in. lb).

21. Connect the DC fast-on connections to the DC terminals of the rectifier. See Figure 7-77.

    Note: A red dot identifies one DC terminal. The other DC terminal is at the opposite corner.

22. Install any required tie wraps. See Figure 7-77.

23. Close the ATS enclosure.

24. Reconnect power to the ATS.

25. Enable the generator set startup.

    a. Check that the generator set master switch is in the OFF position.

    b. Reconnect the generator set engine starting batter(ies), negative (–) lead last.

    c. Reconnect the battery charger, if equipped.

26. Move the generator set master switch to the AUTO position.

27. Test the transfer switch operation.

Figure 7-77 Rectifier Connections and Tie Wraps

8.1 Introduction

Use this manual to locate and identify serviceable parts for the transfer switch model covered by this manual.

8.2 Finding Parts Information

Some part numbers vary according to transfer switch characteristics or ratings. When there are multiple possibilities for parts, use the following steps to determine the module number.

1. **Locate the transfer switch model designation** on the nameplate and record the characters.
2. **Look for the Module Number Key.** The first columns list the designations. The last column lists the module number.
3. Match the characters from the model designation to the line with the matching elements and read across to the last column **to find the module number**.
4. Locate the parts list table and select **the part number that corresponds to your module number**.

8.3 Leads

Fabricate replacement leads using the same type of wire as the old leads. Add terminals and lead markers at each end of the new lead.

8.4 Common Hardware

Common hardware such as nuts, bolts, screws, and washers are Grade 2 unless otherwise noted and can be obtained locally if the same type and grade is available. Refer to Appendices for general torque specifications and to help to identify parts that may not be shown in the parts lists.

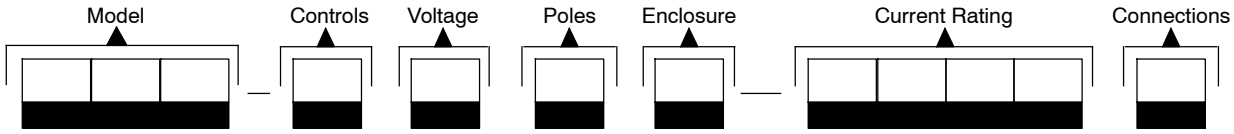
8.5 Transfer Switch Model Designation

The transfer switch model designation defines characteristics and ratings as explained in Figure 8-1.

8.6 Parts Lists

Parts lists appear on the following pages.

Model Designation



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

Sample Model Designation: RXT-JFNC-0200A

Model
RXT: Kohler Automatic Transfer Switch

Controls
J: Interface for RDC2/DC2 Controller

Voltage/Frequency
C: 208 Volts/60 Hz (3-phase only)
F: 240 Volts/60 Hz
M: 480 Volts/60 Hz (3-phase only)

Number of Poles/Wires
N: 2-pole, 3-wire, solid neutral (120/240 V only)
T: 3-pole, 4-wire, solid neutral
V: 4-pole, 4-wire, switched neutral

Enclosure
A: NEMA 1
C: NEMA 3R

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

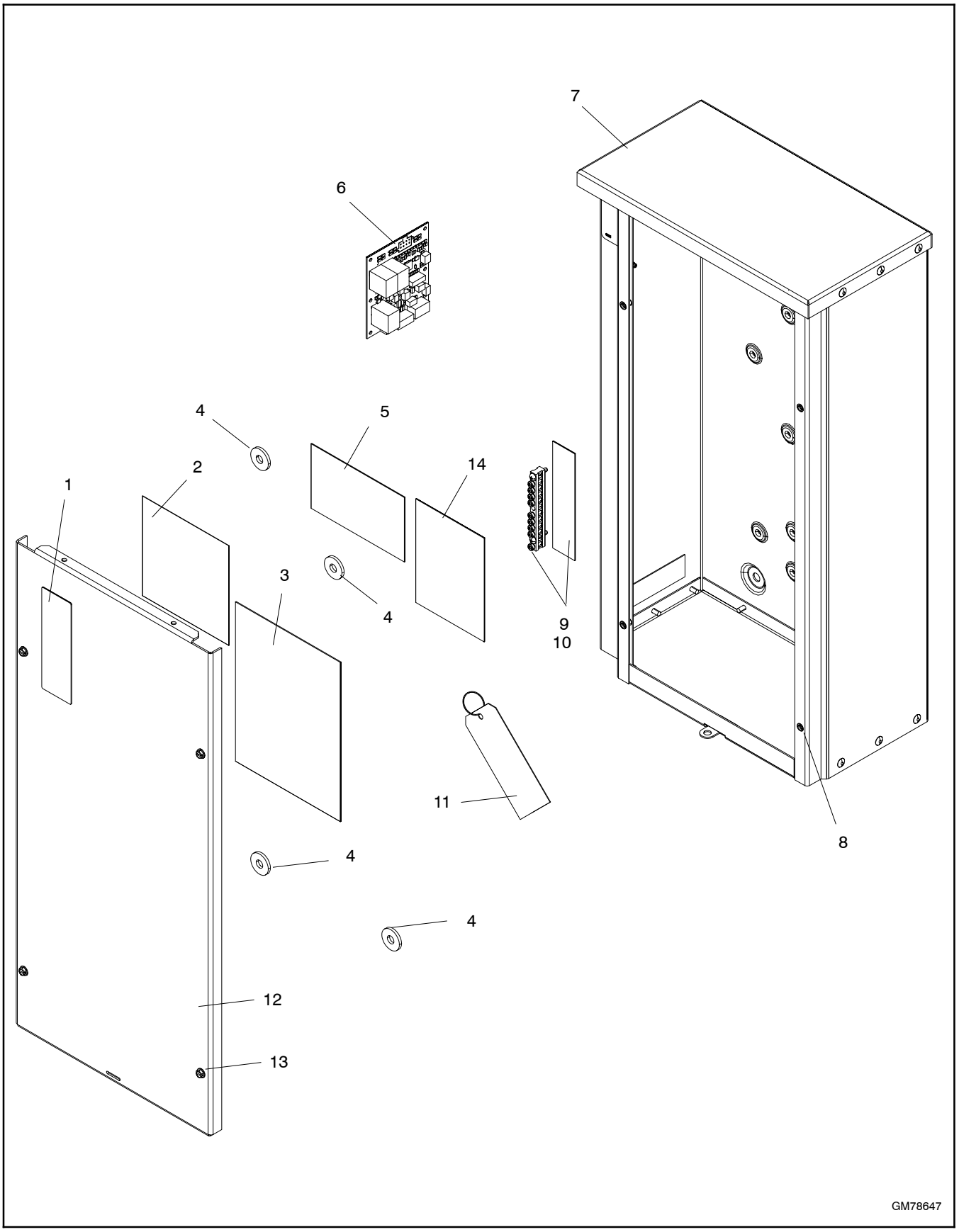
0100	0300
0150	0400
0200	

Connections
A: No load center
B: With load center (100 amp single-phase only)
ASE: Service entrance rated
CSE: Service entrance rated with CSA certification

Figure 8-1 Model Designation

Enclosure and Door, 100–200 Amp

1 Phase



Enclosure and Door, 100–200 Amp

Item	Part No.	Description	Qty. Module GM78647-KA1	GM78647-KA2	GM89397-KA1	GM89397-KA2
1	GM81264	Decal, Warning	1	1	1	1
2	GM82733	Decal, Wiring	1	1	1	1
3	GM64476	Insulation, Inner Panel	1	1	1	1
4	GM20990	Gasket	4	4	4	4
5	297721	Decal, CSA	1	1	1	1
6	–	PCB Assy., ATS Interface (See ATS Interface page 163)	1	1	1	1
7	GM78582	Enclosure, ATS*	1	1		
7	GM89394	Enclosure, ATS**			1	1
8	346258	Insert, Threaded, #10-24 Round	4	4		
8	GM88058	Insert, Threaded, #10-24 Hex (as of approx. 5/24/2013)	4	4	2	2
9	GM55452	Bar, Grounding 9 Position (includes decal)	1	1	1	1
10	X-67-132	Screw, Tapping	2	2	2	2
11	297949	Tag, Hang	1	1	1	1
12	GM80083	Silkscreen, Cover*	1	1		
12	GM89396	Silkscreen, Cover**			1	1
13	X-97-23	Screw, Hex Head Machine	4	4	2	2
14	GM64157	Decal, ATS Ratings	1	1	1	1
15	X-301-43	Plug, Button, 1.37 (Hole Dia. 1.01) (drainage holes, not shown)			2	2

Enclosure and Door

Module Number Key

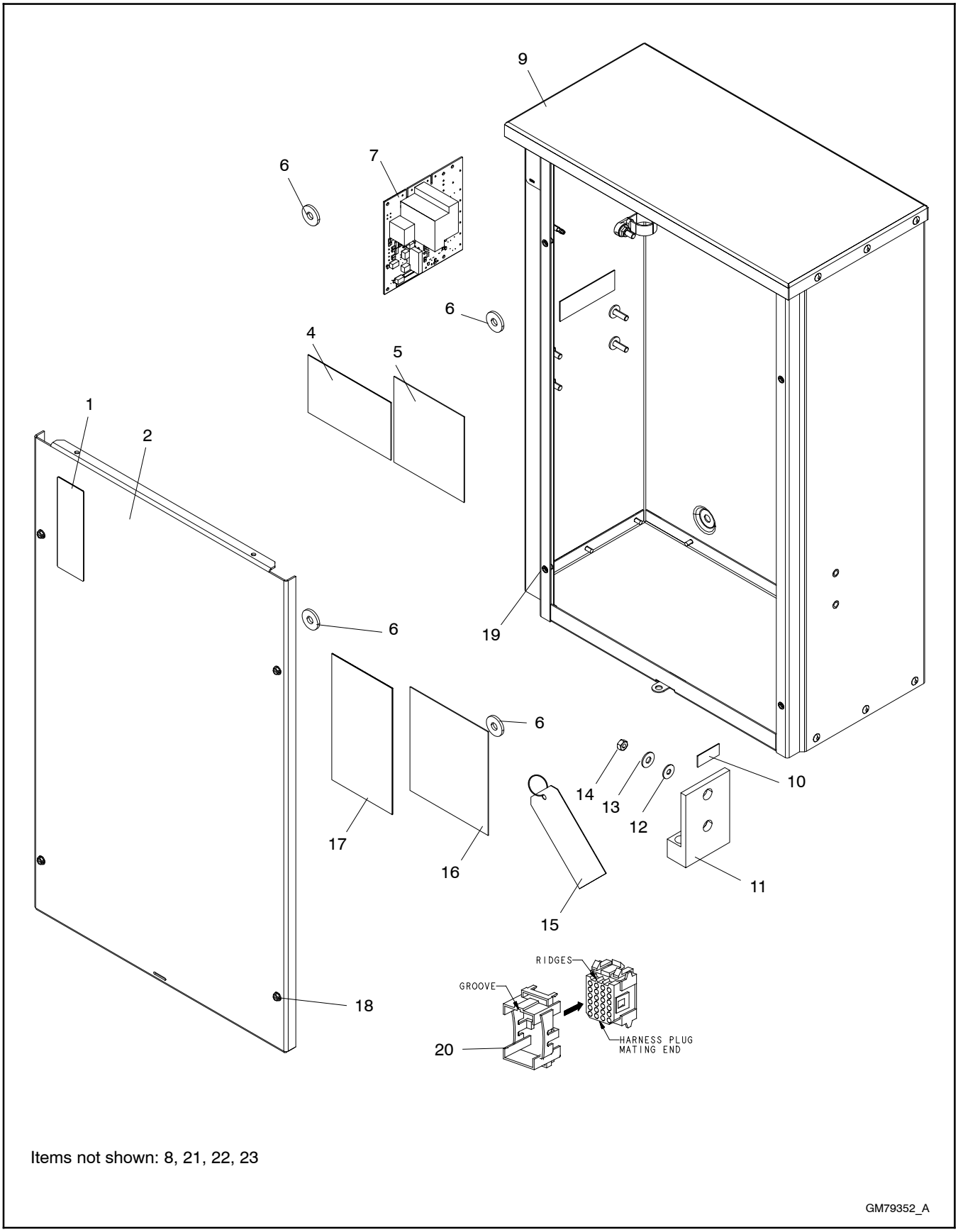
Model Designation Code							Module Number
Model	Controls	Voltage	Poles	Enclosure	Current Rating	Connection	
RXT	J	F	N	C	0100	A	GM78647-KA1*
RXT	J	F	N	C	0100	A	GM89397-KA1**
RXT	J	F	N	C	0200	A	GM78647-KA2*
RXT	J	F	N	C	0200	A	GM89397-KA2**

Please refer to Section 8.2 for an explanation of how to use this table.

* Enclosure with 4 cover screws. **Enclosure with 2 cover screws. See page 162 for indentification.

Enclosure and Door, 100–200 Amp

3 Phase



Items not shown: 8, 21, 22, 23

GM79352_A

Enclosure and Door, 100–200 Amp

Item	Part No.	Description	Qty. Module GM79352-KA1	Qty. Module GM92524-KA1
1	GM81264	Decal, Warning	1	1
2	GM80084	Silkscreen, Cover*	1	
2	GM92527	Silkscreen, Cover**		1
4	297721	Decal, CSA	1	1
5	294414	Decal, Notice	1	1
6	GM20990	Gasket	4	4
7	-	PCB Assy., ATS Interface (See ATS Interface page 163)	1	1
8	GM82734	Decal, Wiring (not shown)	1	1
9	GM79158	Enclosure, ATS*	1	
9	GM92525	Enclosure, ATS**		1
10	344295	Decal, Equipment Grd	1	1
11	X-6207-12	Lug, Terminal	1	1
12	X-25-40	Washer, Plain, .281 ID X .625 In. OD	6	6
13	X-6086-24	Washer, Spring	2	2
14	X-81-10	Nut, Hex, 1/4-20	2	2
15	297949	Tag, Hang	1	1
16	297556	Decal, Torque	1	1
17	362230	Decal, ATS Rating	1	1
18	X-97-23	Screw, Hex Head Machine	4	2
19	346258	Insert, Threaded, #10-24 Round	4	
19	GM88058	Insert, Threaded, #10-24 Hex (as of approx. 5/24/2013)	4	2
20	321330	Boot, Connector	1	1
21	295008	Bolt, Carriage (not shown)	4	4
22	295009	Retainer (not shown)	4	4
23	X-6210-2	Nut, flange spiralock, 1/4–20 (not shown)	5	5
24	X–301–43	Plug, Button, 1.37 (Hole Dia. 1.01) (drainage holes, not shown)		2

Enclosure and Door

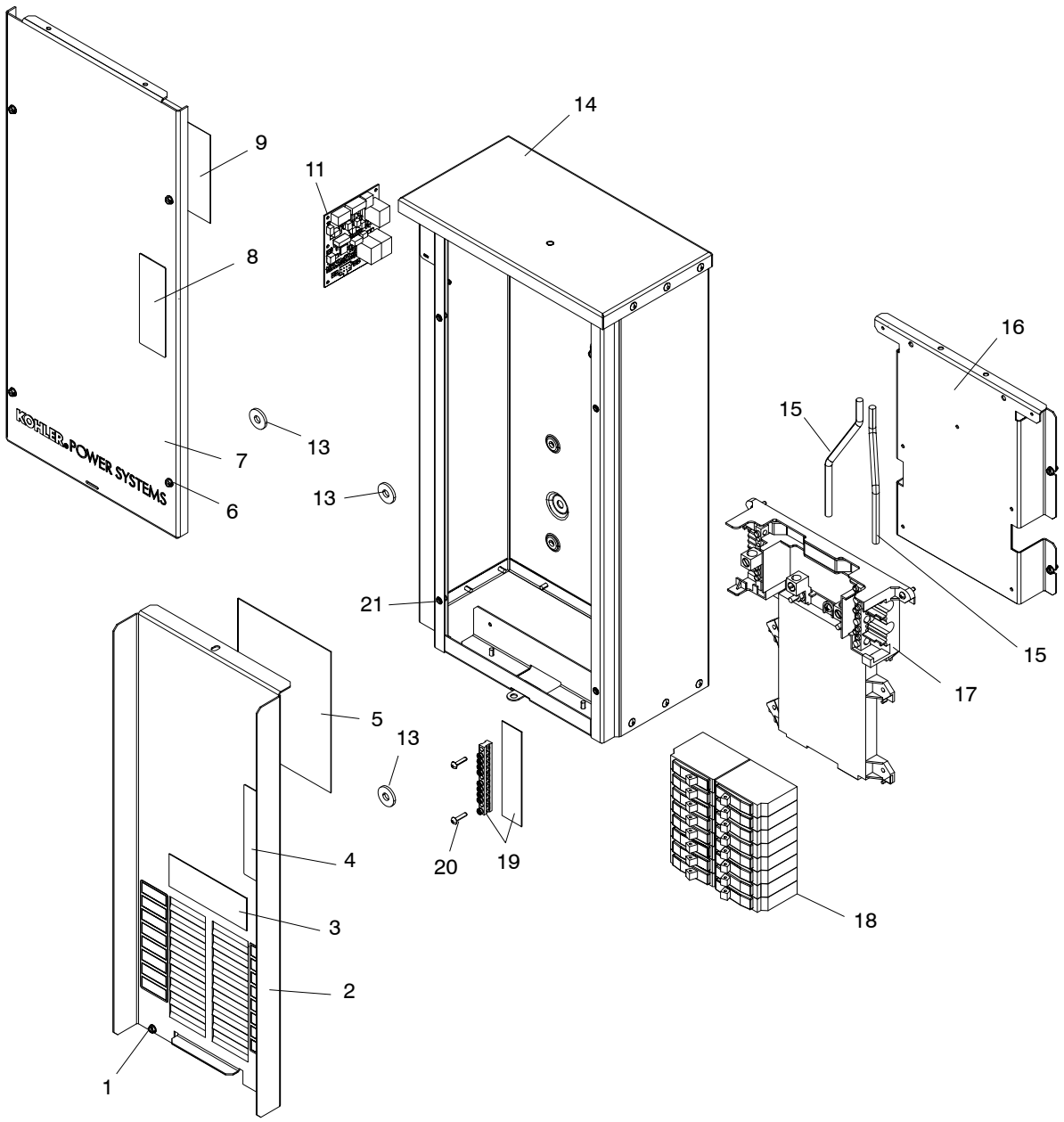
Module Number Key

Model Designation Code							Module Number
Model	Controls	Voltage	Poles	Enclosure	Current Rating	Connection	
RXT	J	C, F, M	T, V	C	0100	A	GM79352-KA1*
RXT	J	C, F, M	T, V	C	0100	A	GM92524-KA1**

Please refer to Section 8.2 for an explanation of how to use this table.

* Enclosure with 4 cover screws. **Enclosure with 2 cover screws. See page 162 for indentification.

Enclosure and Door, 100 Amp w/Load Center



Items not shown: 22, 24, 25

GM79354_C

Enclosure and Door, 100 Amp w/Load Center

Item	Part No.	Description	Qty. Module GM79354-KA1	GM89408-KA1	GM85273-KA1	GM85273-KA2	GM85276-SA1	GM85276-SA2
1	X-67-133	Screw, Hex Washer, Thread-Forming	6					
1	X-97-23	Screw, Hex Head Machine		1				
1	X-67-52	Screw, hex washer, thread-forming			4	4	4	4
2	GM80907	Silkscreen, Inner Cover*	1					
2	GM89409	Silkscreen, Inner Cover**		1				
2	GM85275	Silkscreen, Cover (cover with opening for status indicator & with 16 circuit LC)			1			
2	GM85283	Silkscreen, Cover (with 16 circuit load center)				1		
2	GM85278	Silkscreen, Cover (with 12 circuit load center)					1	
2	GM85281	Silkscreen, Cover (cover with opening for status indicator and 12 circuit LC)						1
3	GM39383	Decal, CB	1	1	1	1	1	1
4	GM81264	Decal, Warning	1	1	1	1	1	1
5	GM64476	Insulation, Inner Panel	1	1	1	1	1	1
6	GM84586	Screw, Thumb	4	2				
7	GM80083	Silkscreen, Cover*	1					
7	GM89396	Silkscreen, Cover**		1				
8	GM81264	Decal, Warning	1	1				
9	GM82733	Decal, Wiring	1	1	1	1	1	1
11	-	PCB Assy., ATS Interface (See ATS Interface page 163)	1	1	1	1	1	1
13	GM20990	Gasket	4	4				
14	GM79160	Enclosure, ATS*	1					
14	GM89407	Enclosure, ATS**		1				
14	GM85272	Enclosure, ATS			1	1	1	1
15	GM80911	Cable, Lead	2	2				
15	GM39361	Cable, Lead			2	2	2	2
16	GM80908	Bracket, LC Mounting*	1					
16	GM89410	Bracket, LC Mounting**		1				
16	GM63987	Bracket, LC Mounting			1	1	1	1
17	GM63986	Base, Load Center (16 circuit load center)	1	1	1	1		
17	GM55429	Base, Load Center (12 circuit load center)					1	1
18	-	Circuit Breaker, Square D type QO (See note below)	1	1	1	1		
18	-	Circuit Breaker, Homeline (See note below)					1	1
19	GM55452	Bar, Grounding 9 Position	1	1	1	1	1	1
20	X-67-132	Screw, Tapping	4	4	2	2	2	2
21	346258	Insert, Threaded, #10-24 Round	4					
21	GM88058	Insert, Threaded, #10-24 Hex (as of approx. 6/17/2013)	4	2				
22	GM64156	Decal, 100A ATS Rating (not shown)	1	1				
24	GM85279	Decal, Cover (cover without status indicator, not shown)			1			1
25	X-301-43	Plug, Button, 1.37 (Hole Dia. 1.01) (drainage holes, not shown)		2				

Note: Because the size and number of circuit breakers required will vary with each application, load center circuit breakers are not provided with the transfer switch. Obtain Square D type QO or Homeline circuit breakers locally as required. Please verify load center for appropriate breaker style for your ATS.

Enclosure and Door

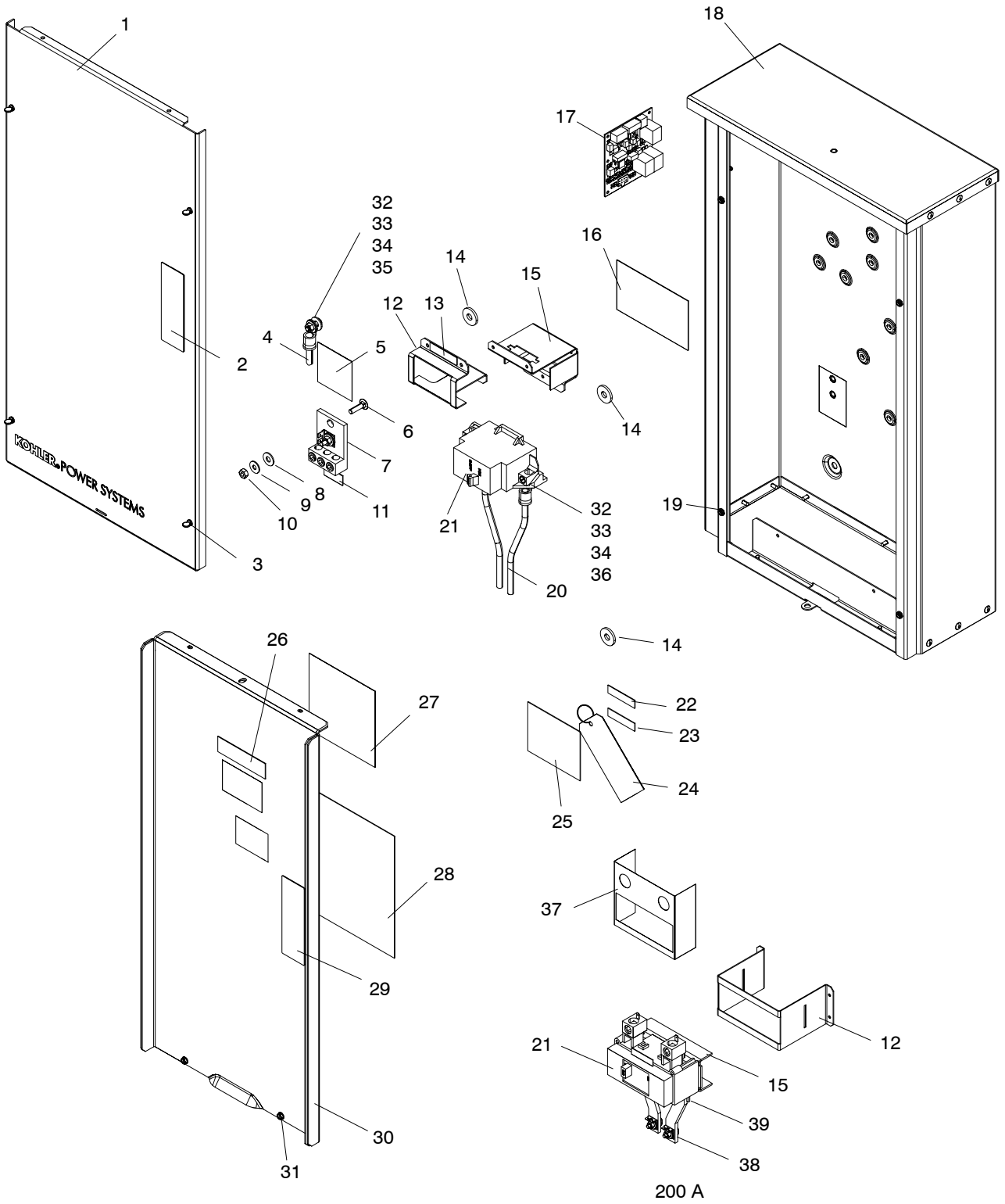
Module Number Key

Model Designation Code							Module Number
Model	Controls	Voltage	Poles	Enclosure	Current Rating	Connection	
RXT	J	F	N	C	0100	B	GM79354-KA1*
RXT	J	F	N	C	0100	B	GM89408-KA1**
RXT	J	F	N	A	0100	B	GM85273-KA1
RXT	J	F	N	A	0100	B	GM85273-KA2
RXT	J	F	N	A	0100	B	GM85276-SA1
RXT	J	F	N	A	0100	B	GM85276-SA2

Please refer to Section 8.2 for an explanation of how to use this table.

* Enclosure with 4 cover screws. **Enclosure with 2 cover screws. See page 162 for indentification.

Enclosure and Door, 100–200 Amp Service Entrance



Items not shown: 42

GM79351_B,
GM80015_B

Enclosure and Door, 100–200 Amp Service Entrance

Item	Part No.	Description	Qty. Module GM79351-KA1	GM92538-KA1	GM80015-KA1	GM80015-KA2	GM92537-KA1	GM92537-KA2
1	GM80016	Silkscreen, Cover*	1		1	1		
1	GM89390	Silkscreen, Cover**		1			1	1
2	GM81264	Decal, Warning	1	1	1	1	1	1
3	GM84586	Screw, Thumb	4	2	4	4	2	2
4	LK-0409-1508	Lead	1	1	1	1	1	1
5	GM74922	Decal, Service Equipment	1	1	1	1	1	1
6	295008	Bolt, Carriage	2	2	2	2	2	2
7	X-6207-17	Lug, Terminal	1	1	1	1	1	1
8	X-25-20	Washer, Flat .312 ID X.75 OD	2	2	2	2	2	2
9	X-6086-24	Washer, Spring	2	2	2	2	2	2
10	X-81-10	Nut, Hex, 1/4-20	2	2	2	2	2	2
11	344295	Decal, Equipment Grd	1	1	1	1	1	1
12	GM47588	Bracket, Circuit Breaker			1	1	1	1
12	GM79955	Bracket, Circuit Breaker	1	1				
13	X-6333-5	Decal, Marker	1	1	1	1	1	1
14	GM20990	Gasket	4	4	4	4	4	4
15	GM47589	Support, Circuit Breaker			1	1	1	1
15	GM79956	Bracket, Circuit Breaker	1	1				
15	X-67-133	Screw, Hex Washer, Thread-Forming	12	12	9	9	9	9
16	297721	Decal, CSA	1	1	1	1	1	1
17	–	PCB Assy., ATS Interface (See ATS Interface page 163)	1	1	1	1	1	1
18	GM79157	Enclosure, ATS	1		1	1		
18	GM92534	Enclosure, ATS		1			1	1
19	346258	Insert, Threaded, #10-24 Round	4	4	4	4	4	4
19	GM88058	Insert, Threaded, #10-24 Hex (as of approx. 5/24/2013)	4	3	4	4	3	3
20	GM82003	Cable, Lead	2	2				
21	GM46847	Circuit Breaker, Main W/Tabs			1		1	
21	GM48762	Circuit Breaker, Main W/Tabs				1		1
21	GM79954	Breaker, Circuit Main 100a	1	1				
22	X-6333-6	Decal, Marker	1	1	1	1	1	1
23	X-6333-7	Decal, Marker	1	1	1	1	1	1
24	297949	Tag, Hang	1	1	1	1	1	1
25	GM55084	Decal, ATS Ratings	1	1	1	1	1	1
26	GM52664	Decal, Service Disconnect Normal/Utility	1	1	1	1	1	1
27	GM82733	Decal, Wiring	1	1	1	1	1	1
28	GM64476	Insulation, Inner Panel	2	2	1	1	1	1
29	GM81264	Decal, Warning	1	1	1	1	1	1
30	GM80013	Panel, Inner*			1	1		
30	GM80014	Panel, Inner*	1					
30	GM92536	Panel, Inner**		1				
30	GM89384	Panel, Inner**					1	1
31	X-67-52	Screw, Hex Washer, Thread-Forming	8	8	8	8	6	6
32	X-25-20	Washer, Flat .312 ID X.75 OD	8	8	10	10	10	10
33	X-6086-24	Washer, Spring	3	3	5	5	5	5
34	X-465-16	Bolt, Hex Cap	1	1	1	1	1	1
35	X-81-10	Nut, Hex, 1/4-20	3	3	5	5	5	5
36	X-465-7	Bolt, Hex Cap	4	4	4	4	4	4
37	GM47372	Insulation, Circuit Breaker			1	1	1	1
38	GM31854	Terminal, ATS Lug Sensing			2	2	2	2
39	GM47371	Bus, Line CB To Contactor			2	2	2	2
42	X–301–43	Plug, Button, 1.37 (Hole Dia. 1.01) (drainage holes, not shown)		2			2	2

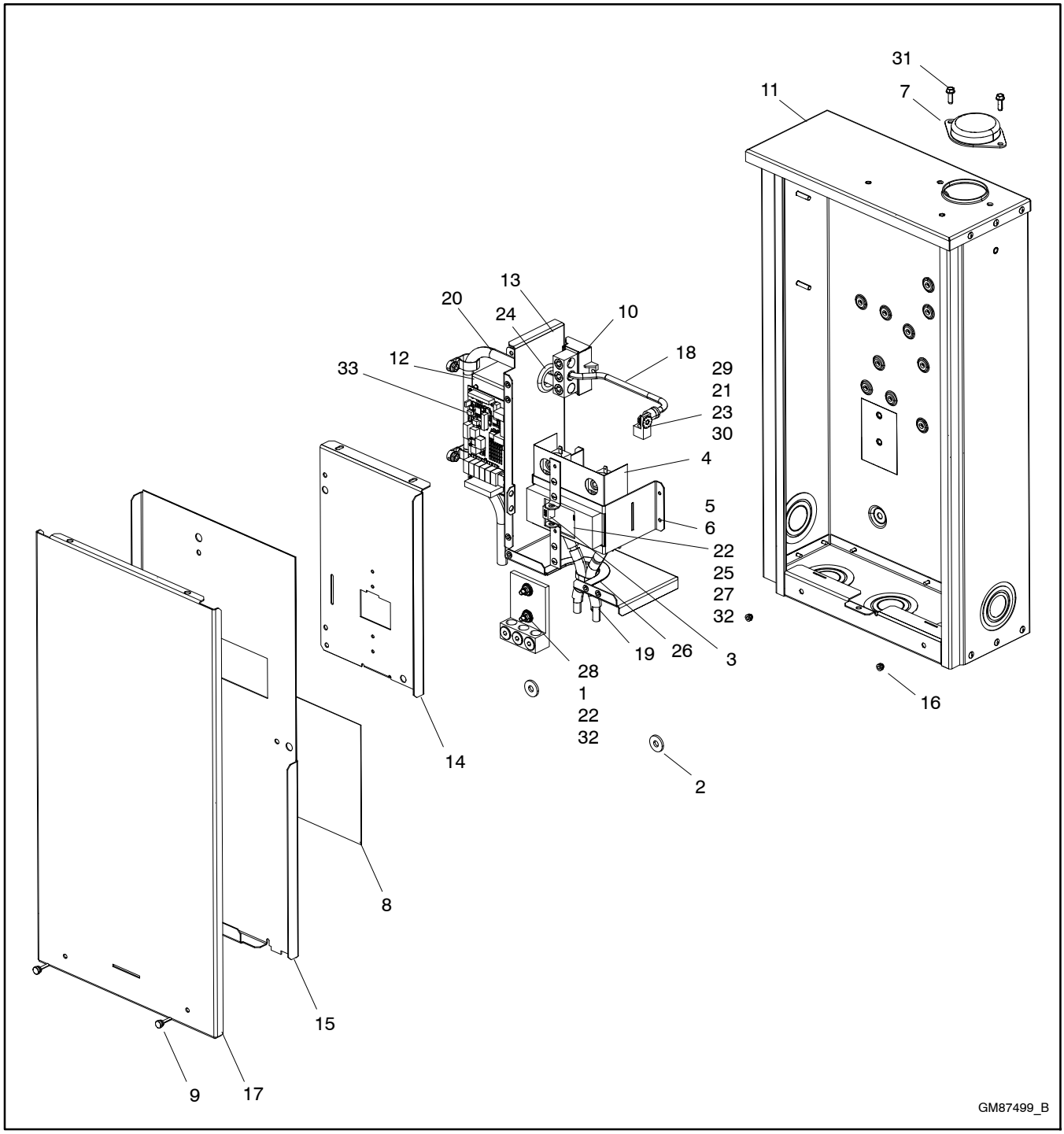
Enclosure and Door

Module Number Key

Model Designation Code							Module Number
Model	Controls	Voltage	Poles	Enclosure	Current Rating	Connection	
RXT	J	F	N	C	0100	ASE	GM79351-KA1*
RXT	J	F	N	C	0100	ASE	GM92538-KA1**
RXT	J	F	N	C	0150	ASE	GM80015-KA2*
RXT	J	F	N	C	0150	ASE	GM92537-KA1**
RXT	J	F	N	C	0200	ASE	GM80015-KA1*
RXT	J	F	N	C	0200	ASE	GM92537-KA2**

* Enclosure with 4 cover screws. **Enclosure with 2 cover screws. See page 162 for indentification.

Enclosure and Door, 150–200 Amp Service Entrance CSA



Enclosure and Door

Module Number Key

Model Designation Code							Module Number
Model	Controls	Voltage	Poles	Enclosure	Current Rating	Connection	
RXT	J	F	N	C	0100	CSE	GM87507-KA1
RXT	J	F	N	C	0150	CSE	GM87499-KA2
RXT	J	F	N	C	0200	CSE	GM87499-KA1

Please refer to Section 8.2 for an explanation of how to use this table.

Enclosure and Door, 150–200 Amp Service Entrance CSA

Item	Part No.	Description	Qty. Module GM87507-KA1	Qty. Module GM87499-KA1	Qty. Module GM87499-KA2
1	295008	Bolt, Carriage	2	2	2
2	GM20990	Gasket	4	4	4
3	GM79954	Circuit Breaker, Main 100A	1		
3	GM46847	Circuit Breaker, Main w/Tabs 200A		1	
3	GM48762	Circuit Breaker, Main w/Tabs			1
4	GM47372	Insulation, Circuit Breaker		1	1
5	GM47588	Bracket, Circuit Breaker		1	1
5	GM79955	Bracket, Circuit Breaker	1		
6	GM79956	Support, Circuit Breaker	1		
6	GM47589	Support, Circuit Breaker		1	1
7	GM47594	Cap, Hub	1	1	1
8	GM64476	Insulation, Inner Panel	2	1	1
9	GM84586	Screw, Thumb	2	2	2
10	GM85087-2	Neutral, 100-200A RXT (Sub-Assembled)	1	1	1
11	GM87498	Enclosure ATS	1	1	1
12	GM87500	Plate, Interface Mtg.	1	1	1
13	GM87501	Guard, Cabling	1	1	1
14	GM87508	Cover, Breaker 100A	1		
14	GM87502	Cover, Breaker 200A		1	1
15	GM87503	Panel, Inner	1	1	1
16	GM88058	Insert, Threaded, #10-24, Hex	8	8	8
17	GM89390	Silkscreen, Cover	1	1	1
18	LK-0409-1509	Lead, cable	1	1	1
19	LK-0406-1508	Lead, Cable	2		
19	LN-9005-3501	Lead, Cable		2	2
20	LN-9022-0101	Lead	1	1	1
21	X-22-12	Washer, lock.262 IDx.743 in. OD	2	2	2
22	X-25-20	Washer, Flat .312 ID x.75 OD	6	6	6
23	X-25-40	Washer, plain, .281 ID x .625 in. OD	1	1	1
24	X-284-3	Grommet, round	1	1	1
25	X-465-2	Bolt, Hex Cap	2		
25	X-465-7	Bolt, Hex Cap		2	2
26	X-6047-37	Channel, U	1	1	1
27	X-6086-24	Washer, Spring	4	4	4
28	X-6207-12	Lug, Terminal	1	1	1
29	X-6207-3	Lug, terminal, aluminum	1	1	1
30	X-6210-2	Nut, flange spiralock, 1/4-20	3	3	3
31	X-67-114	Screw, hex washer, thread-forming	2	2	2
32	X-81-10	Nut, hex, 1/4-20	4	4	4
33	-	PCB Assy, ATS Interface (See ATS Interface page 163)	1	1	1
		Items not shown:	1	1	1
	297721	Decal, CSA	1	1	1
	297949	Tag, hang	1	1	1
	344295	Decal, equipment grd	2	2	2
	GM21291	Decal, Nameplate	1	1	1
	GM24703	Label, Blank	2	2	2
	GM52664	Decal, Service Disconnect Normal/Utility	1	1	1
	GM55084	Decal, ATS Ratings	1	1	1
	GM74922	Decal, Service Equipment	1	1	1
	GM81264	Decal, Warning	1	1	1
	GM82733	Decal, Wiring	1	1	1
	X-6333-5	Decal, Marker	1	1	1
	X-6333-6	Decal, Marker	1	1	1
	X-6333-7	Decal, Marker	1	1	1

Enclosure and Door

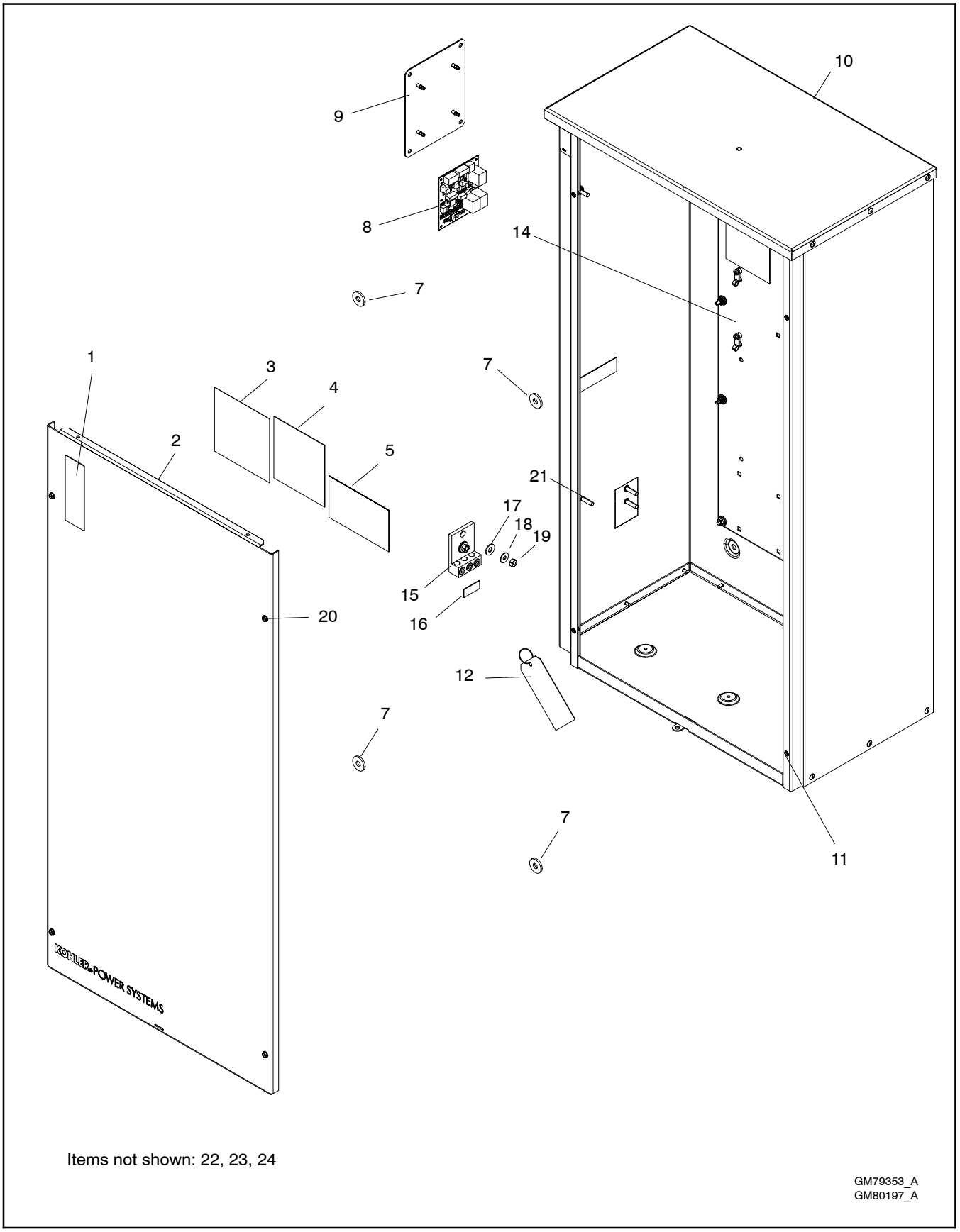
Module Number Key

Model Designation Code							Module Number
Model	Controls	Voltage	Poles	Enclosure	Current Rating	Connection	
RXT	J	F	N	C	0100	CSE	GM87507-KA1
RXT	J	F	N	C	0150	CSE	GM87499-KA1
RXT	J	F	N	C	0200	CSE	GM87499-KA2

Please refer to Section 8.2 for an explanation of how to use this table.

Enclosure and Door, 400 Amp

1 Phase and 208/240V 3 Phase



Items not shown: 22, 23, 24

GM79353_A
GM80197_A

Enclosure and Door, 400 Amp

Item	Part No.	Description	Qty. Module GM79353-KA1	GM89401-KA1	GM80197-KA1	GM92528-KA1
1	GM81264	Decal, Warning	1	1	1	1
2	GM80085	Silkscreen, Cover*	1		1	
2	GM89400	Silkscreen, Cover**		1		1
3	GM82733	Decal, Wiring	1	1	1	1
4	294414	Decal, Notice	1	1	1	1
5	297721	Decal, CSA	1	1	1	1
7	GM20990	Gasket	4	4	4	4
8	–	PCB Assy., ATS Interface (See ATS Interface page 163)	1	1		
9	GM80200	Plate, Mtg. PCB*	1			
9	GM89402	Plate, Mtg. PCB**		1		
10	GM79159	Enclosure, ATS*	1		1	
10	GM89398	Enclosure, ATS**		1		1
11	346258	Insert, Threaded, #10-24 Round	4		4	
11	GM88058	Insert, Threaded, #10-24 Hex (as of approx. 6/17/2013)	4	2	4	2
12	297949	Tag, Hang	1	1	1	1
14	295008	Bolt, Carriage	8	8	8	8
14	295009	Retainer	8	8	8	8
14	GM80193	Plate, Contactor Mtg.	1	1	1	1
14	X-25-40	Washer, Plain, .281 ID X .625 In. OD	8	8	8	8
14	X-6210-2	Nut, flange spiralock, 1/4–20	13	13	13	13
15	X-6207-17	Lug, Terminal	1	1	1	1
16	344295	Decal, Equipment Grd	1	1	1	1
17	X-25-20	Washer, Flat .312 ID X.75 OD	2	2	2	2
18	X-6086-24	Washer, Spring	2	2	2	2
19	X-81-10	Nut, Hex, 1/4-20	2	2	2	2
20	X-97-23	Screw, Hex Head Machine	4	2	4	2
21	X-276-9	Nut, Wing, 1/4-20	1	1	1	1
22	295010	Retainer (not shown)	4	4	4	4
23	X-6224-17	Bolt, Carriage (not shown)	4	4	4	4
24	X-6210-5	Nut, flange whiz, 10–24 (not shown)	4	4	4	4
25	X-301-43	Plug, Button, 1.37 (Hole Dia. 1.01) (drainage holes, not shown)		2		2

* Enclosure with 4 cover screws. **Enclosure with 2 cover screws. See page 162 for indentification.

Enclosure and Door

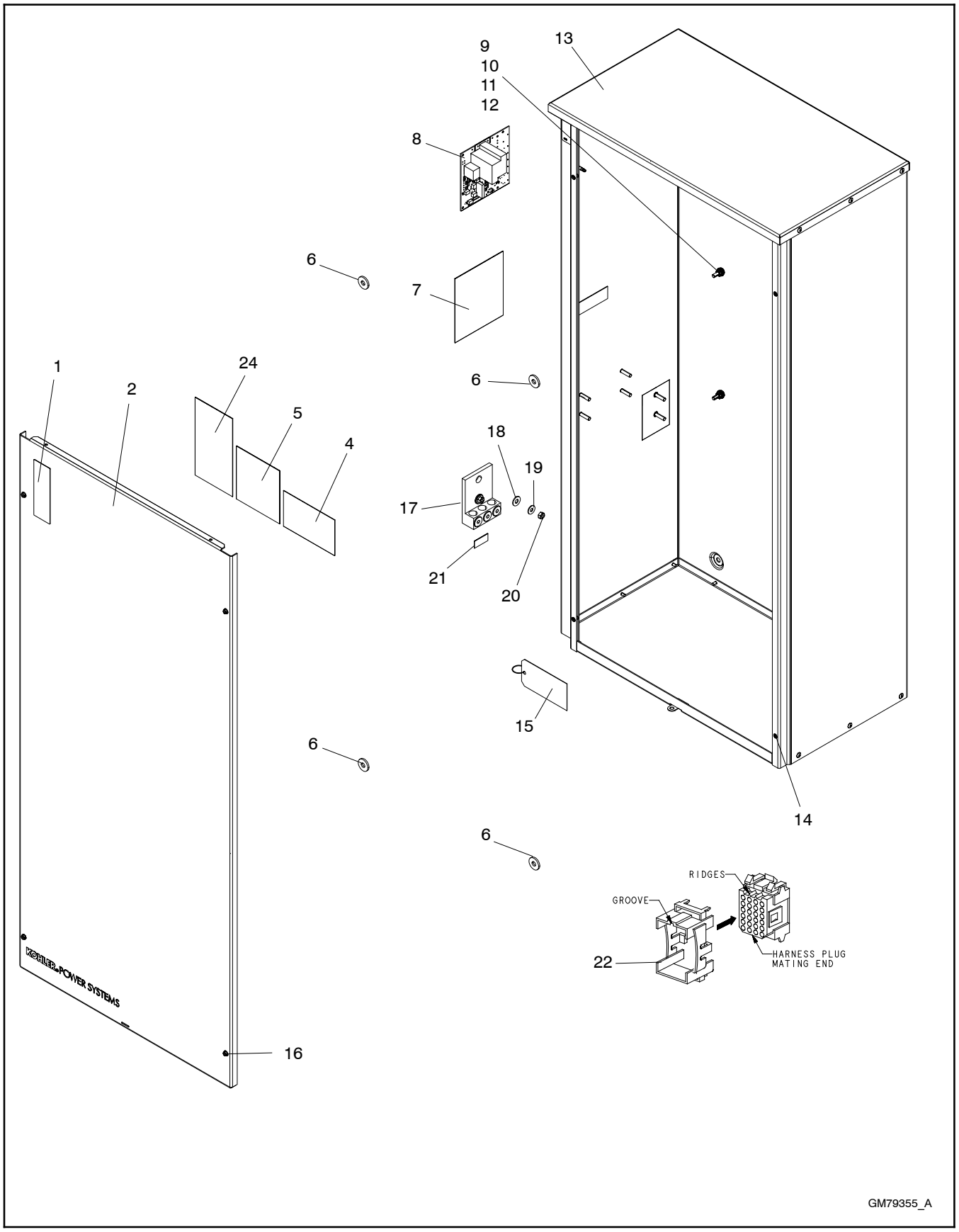
Module Number Key

Model Designation Code: Model	Controls	Voltage	Poles	Enclosure	Current Rating	Connection	Module Number
RXT	J	F	N	C	0400	A	GM79353-KA1*
RXT	J	F	N	C	0400	A	GM89401-KA1**
RXT	J	C, F	T	C	0400	A	GM80197-KA1*
RXT	J	C, F	T	C	0400	A	GM92528-KA1**

Please refer to Section 8.2 for an explanation of how to use this table.

Enclosure and Door, 400 Amp

3 Phase 3P/480V and 4P



Enclosure and Door, 400 Amp

Item	Part No.	Description	Qty. Module GM79355-KA1	Qty. Module GM92532-KA1
1	GM81264	Decal, Warning	1	1
2	GM80086	Silkscreen, Cover*	1	
2	GM92531	Silkscreen, Cover**		1
4	297721	Decal, CSA	1	1
5	294414	Decal, Notice	1	1
6	GM20990	Gasket	4	4
7	297556	Decal, Torque	1	1
8	-	PCB Assy., ATS Interface (See ATS Interface page 163)	1	1
9	295008	Bolt, Carriage	4	4
10	295009	Retainer	4	4
11	X-25-40	Washer, Plain, .281 ID X .625 In. OD	4	4
12	X-6210-2	Nut, Flange Spiralock, 1/4-20	5	5
13	GM79161	Enclosure, ATS*	1	
13	GM92529	Enclosure, ATS**		1
14	346258	Insert, Threaded, #10-24 Round	4	4
14	GM88058	Insert, Threaded, #10-24 Hex (as of approx. 6/17/2013)	4	2
15	297949	Tag, Hang	1	1
16	X-97-23	Screw, Hex Head Machine	4	2
17	X-6207-12	Lug, Terminal	1	1
18	X-25-20	Washer, Flat .312 ID X.75 OD	2	2
19	X-6086-24	Washer, Spring	2	2
20	X-81-10	Nut, Hex, 1/4-20	2	2
21	344295	Decal, Equipment Grd	1	1
22	321330	Boot, Connector	1	1
24	362274	Decal, ATS rating	1	
25	X-301-43	Plug, Button, 1.37 (Hole Dia. 1.01) (drainage holes, not shown)		2

* Enclosure with 4 cover screws. **Enclosure with 2 cover screws. See page 162 for indentification.

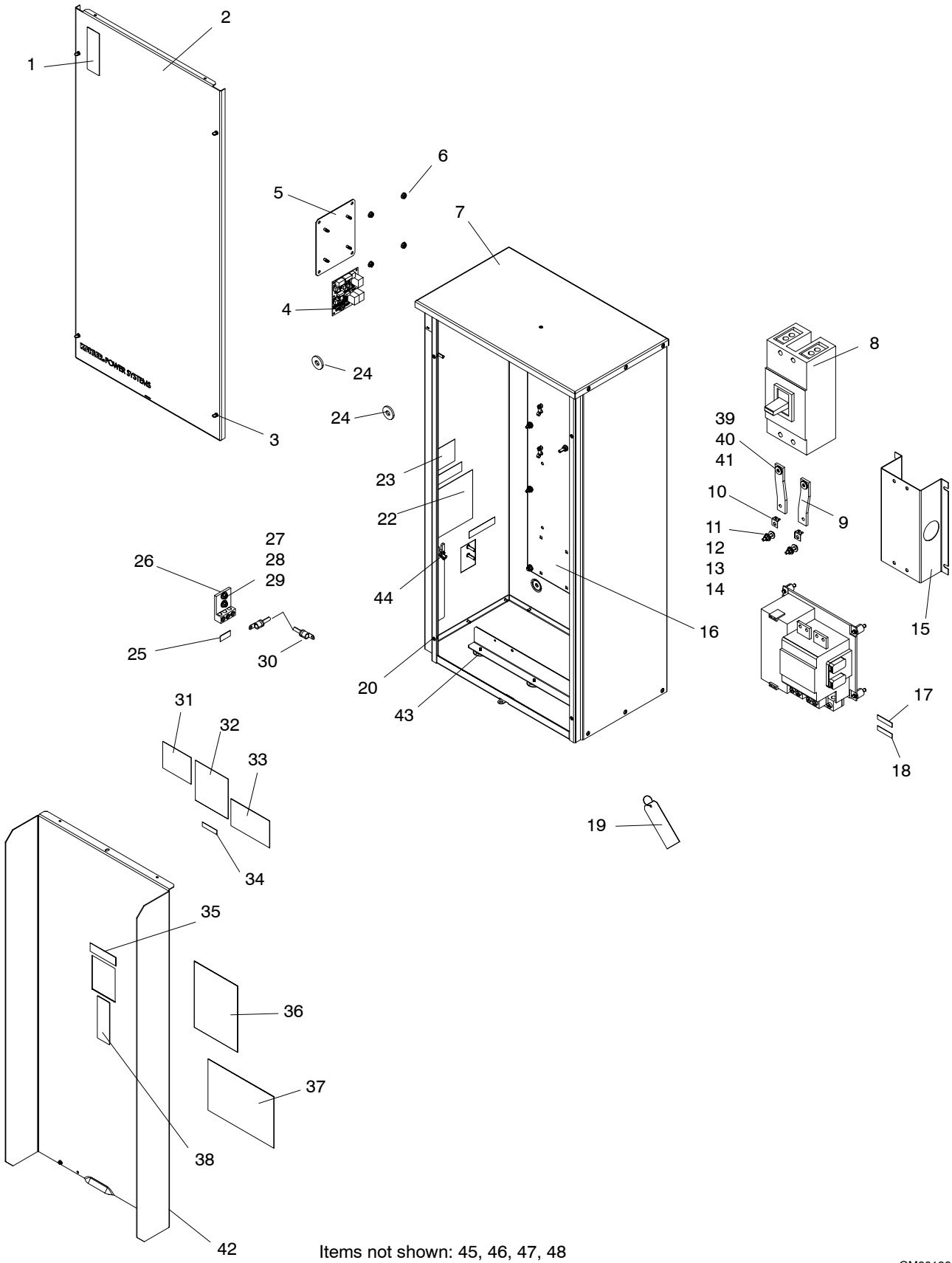
Enclosure and Door

Module Number Key

Model Designation Code							Module Number
Model	Controls	Voltage	Poles	Enclosure	Current Rating	Connection	
RXT	J	C, F, M	V	C	0400	A	GM79355-KA1*
RXT	J	C, F, M	V	C	0400	A	GM92532-KA1**
RXT	J	M	T	C	0400	A	GM79355-KA1*
RXT	J	M	T	C	0400	A	GM92532-KA1**

Please refer to Section 8.2 for an explanation of how to use this table.

Enclosure and Door, 300–400 Amp Service Entrance



Enclosure and Door, 300–400 Amp Service Entrance

It.	Part No.	Description	Qty. Mod. GM80198-KA1	GM80198-KA2	GM89403-KA1	GM89403-KA2
1	GM81264	Decal, Warning	1	1	1	1
2	GM80085	Silkscreen, Cover*	1	1		
2	GM89400	Silkscreen, Cover**			1	1
3	GM84586	Screw, Thumb	4	4	2	2
4	–	PCB Assy., ATS Interface (See ATS Interface page 163)	1	1	1	1
5	GM80200	Plate, Mtg. PCB*	1	1		
5	GM89402	Plate, Mtg. PCB**			1	1
6	X-6210-2	Nut, Flange Spiralock, 1/4-20	16	16	16	16
7	GM79159	Enclosure, ATS*	1	1		
7	GM89398	Enclosure, ATS**			1	1
8	X-6304-201	Breaker, Circuit	1		1	
8	X-6304-210	Breaker, Circuit		1		1
8	GM78518	Insulation, CB L–Frame	1	1	1	1
9	GM88368	Bus, Line CB To Contactor	2	2	2	2
10	GM31854	Terminal, ATS Lug Sensing	2	2	2	2
11	X-25-20	Washer, Flat .312 ID X.75	4	4	4	4
12	X-465-8	Bolt, Hex Cap	2	2	2	2
13	X-6086-24	Washer, Spring	4	4	4	4
14	X-81-10	Nut, Hex, 1/4-20	2	2	2	2
15	GM88367	Support, LCB*	1	1		
15	GM89405	Support, LCB**			1	1
16	GM80193	Plate, Contactor Mtg.	1	1	1	1
16	295008	Bolt, Carriage	12	12	12	12
16	295009	Retainer	12	12	12	12
16	X-25-40	Washer, plain, .281 ID x .625 in.OD	8	8	8	8
17	X-6333-6	Decal, Marker	1	1	1	1
18	X-6333-7	Decal, Marker	1	1	1	1
19	297949	Tag, Hang	1	1	1	1
20	346258	Insert, Threaded, #10-24 Round	4	4	4	4
20	GM88058	Insert, Threaded, #10-24 Hex (as of approx. 6/17/2013)	4	4	2	2
22	297556	Decal, Torque	1	1	1	1
23	GM74922	Decal, Service Equipment	1	1	1	1

* Enclosure with 4 cover screws. **Enclosure with 2 cover screws. See page 162 for indentification.

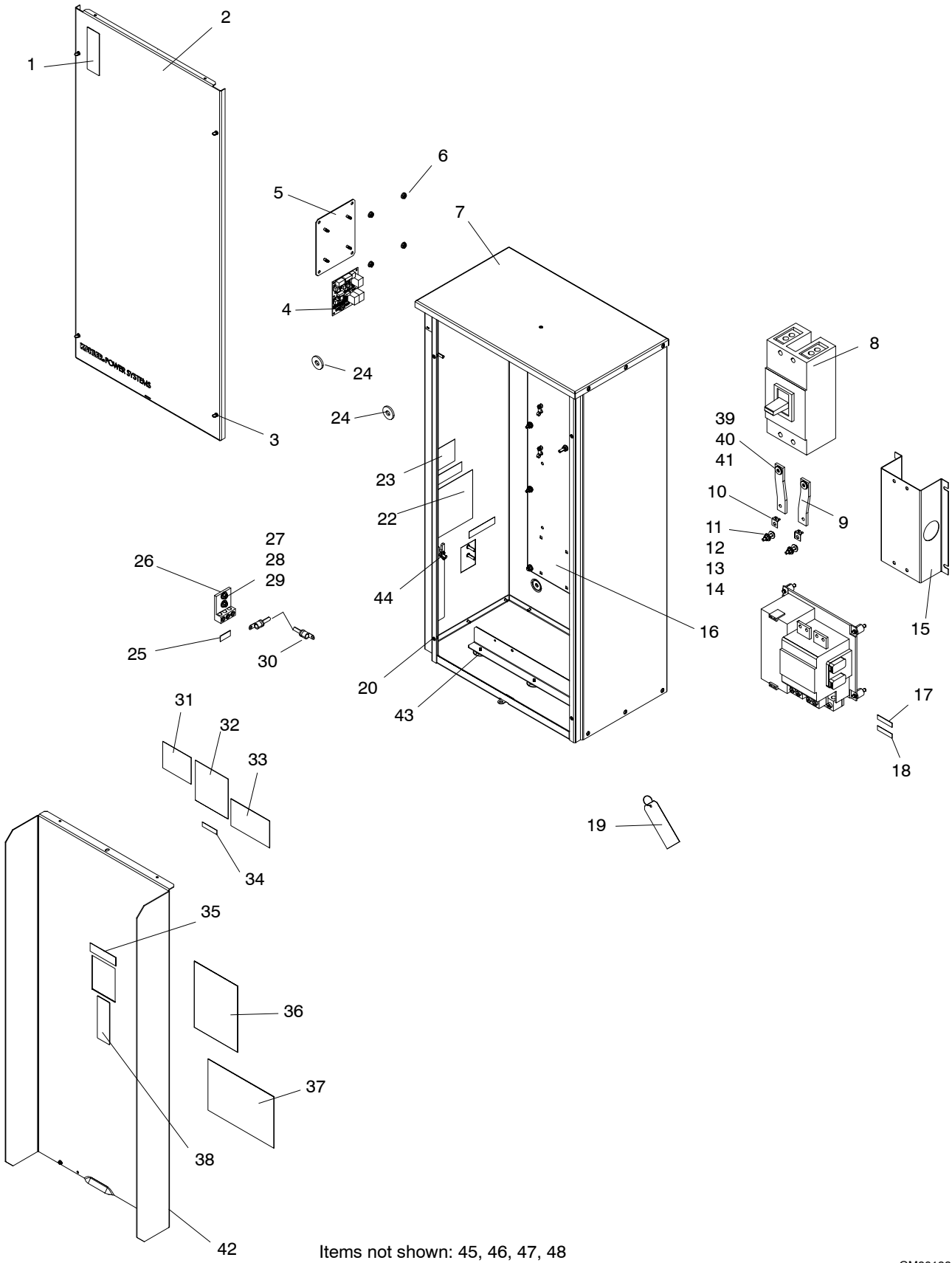
Enclosure and Door

Module Number Key

Model Designation Code							Module Number
Model	Controls	Voltage	Poles	Enclosure	Current Rating	Connection	
RXT	J	F	N	C	0300	ASE	GM80198-KA2*
RXT	J	F	N	C	0300	ASE	GM98403-KA1**
RXT	J	F	N	C	0400	ASE	GM80198-KA1*
RXT	J	F	N	C	0400	ASE	GM89403-KA2**

Please refer to Section 8.2 for an explanation of how to use this table.

Enclosure & Door, 300–400 A Service Entrance, continued



Enclosure & Door, 300–400 A Service Entrance, continued

It.	Part No.	Description	Qty. Mod. GM80198-KA1	GM80198-KA2	GM89403-KA1	GM89403-KA2
24	GM20990	Gasket	4	4	4	4
25	344295	Decal, Equipment Grd	1	1	1	1
26	X-6207-12	Lug, Terminal	1	1	1	1
27	X-25-20	Washer, Flat .312 ID X.75	2	2	2	2
28	X-6086-24	Washer, Spring	2	2	2	2
29	X-81-10	Nut, Hex, 1/4-20	2	2	2	2
30	GM88370	Bonding jumper	1	1	1	1
31	GM55084	Decal, ATS Ratings	1	1	1	1
32	294414	Decal, Notice	1	1	1	1
33	297721	Decal, CSA	1	1	1	1
34	X-6333-5	Decal, Marker	1	1	1	1
35	GM52664	Decal, Service Disconnect Normal/Utility	1	1	1	1
36	GM64476	Insulation, Inner Panel	1	1	1	1
37	GM82714	Decal, ATS Wiring	1	1	1	1
38	GM81264	Decal, Warning	1	1	1	1
39	X-25-118	Washer, Flat	2	2	2	2
40	X-6086-6	Washer, Spring	2	2	2	2
41	X-6238-11	Screw, Hex Cap	2	2	2	2
42	GM88377	Panel, Inner*	1	1		
42	GM89404	Panel, Inner**			1	1
42	GM89406	Guard, Breaker (not shown)			1	1
43	GM80196	Support, Inner Panel	1	1	1	1
43	X-67-133	Screw, hex washer, thread-forming (not shown)	5	5	5	5
44	X-276-9	Nut, Wing, 1/4-20	1	1	1	1
45	GM11040-6	Insert, Threaded, M5-0.8 (not shown)	4	4	4	4
46	M125A-05-80	Washer, Plain (not shown)	4	4	4	4
47	X-400-37	Spacer,.437 ID x .75 OD x .812 in. (not shown)	4	4		
48	X-25-118	Washer, plain, .406 ID x 1 in. OD (not shown)	4	4	4	4
49	X-301-43	Plug, Button, 1.37 (Hole Dia. 1.01) (drainage holes, not shown)	4	4	2	2

* Enclosure with 4 cover screws. **Enclosure with 2 cover screws. See page 162 for indentification.

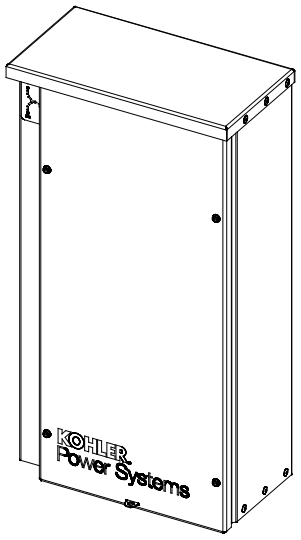
Enclosure and Door

Module Number Key

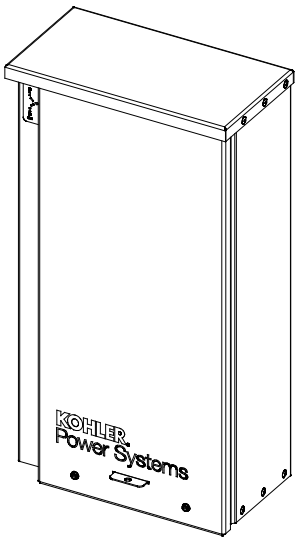
Model Designation Code							Module Number
Model	Controls	Voltage	Poles	Enclosure	Current Rating	Connection	
RXT	J	F	N	C	0300	ASE	GM80198-KA2*
RXT	J	F	N	C	0300	ASE	GM98403-KA1**
RXT	J	F	N	C	0400	ASE	GM80198-KA1*
RXT	J	F	N	C	0400	ASE	GM89403-KA2**

Please refer to Section 8.2 for an explanation of how to use this table.

Enclosure and Door Identification



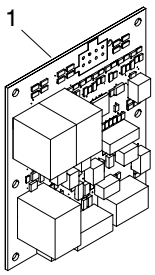
Enclosure with 4 Cover Screws



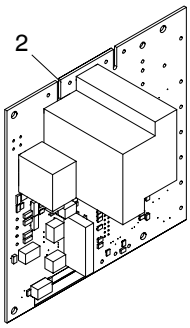
Enclosure with 2 Cover Screws

100–200 Amp Single-Phase Shown

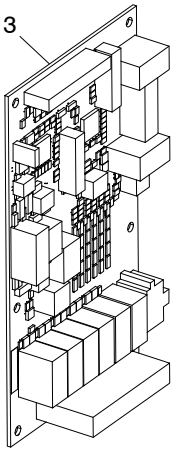
ATS Interface



Single Phase



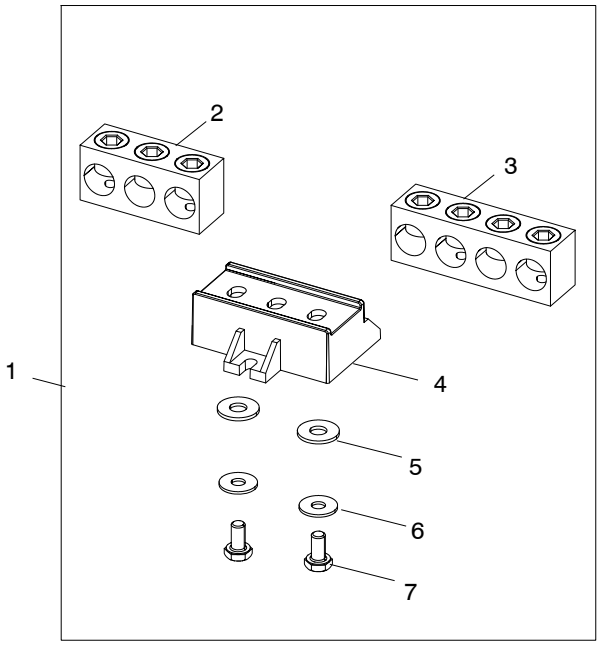
Three Phase



Single Phase with Load Control

Item	Part Number	Description	Part Number Module GM95061-KA1	Part Number Module GM95062-KA2	Part Number Module GM93969-KA1
1	GM79580	PCB Assy, RXT 1-Phase ATS Interface	1		
2	GM80079	PCB Assy, RXT 3-Phase ATS Interface		1	
3	GM90773	PCB Assy, RXT/LCM Combo			1
4	GM83929	Transformer, Current (not shown)			1

Neutral Assembly



GM85087

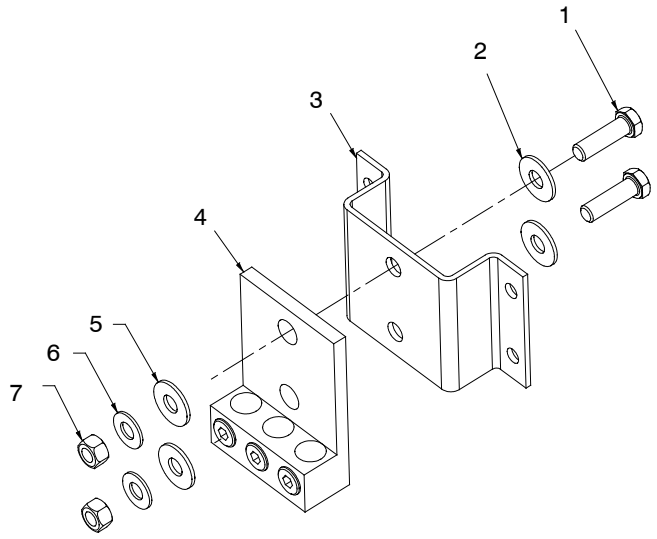
Item	Part Number	Description	Part Number Module GM85087-KA2	Part Number Module GM85087-KA3
1	GM85087-2	Neutral, 100-200A (Sub-Assembled)	1	
1	GM85087-3	Neutral, 100-200A SE (Sub-Assembled)		1
2	X-6207-22	Lug, Terminal	1	
3	X-6207-23	Lug, Terminal		1
4	GM36201	Base, Neutral	1	1
5	X-25-20	Washer, Flat .312 ID x.75 OD	2	2
6	X-6086-24	Washer, Spring	2	2
7	X-465-6	Bolt, Hex Cap (1/4-20 x 1/2") Gr5	2	2

Neutral Assembly

Module Number Key

Model Designation Code							Module Number
Model	Controls	Voltage	Poles	Enclosure	Current Rating	Connection	
RXT	J	F	N	C	100-200	A	GM85087-KA2
RXT	J	F	N	C	0400	A	GM21071-KA2
RXT	J	F	N	C	100-200	ASE	GM85087-KA3
RXT	J	F	N	C	300-400	ASE	GM21071-KA2
RXT	J	C, F, M	T, V	C	0100	A	GM21070-KA1/KA3
RXT	J	C, F, M	T, V	C	0200	A	GM21071-KA1/KA3
RXT	J	C, F, M	T, V	C	0400	A	GM21071-KA2

Please refer to Section 8.2 for an explanation of how to use this table.



GM21070_B

Item	Part Number	Description	Part Number Module GM21070-KA1	Part Number Module GM21070-KA3
1	X-6238-4	Bolt, Hex Cap	2	2
2	X-25-118	Washer, Plain, .406 ID X 1 In. OD	2	2
3	GM20991	Bracket, Neutral Mtg. (30-400A.)	1	1
4	X-6207-12	Lug, Terminal	1	1
5	X-25-118	Washer, Plain, .406 ID X 1 In. OD	2	2
6	X-6086-6	Washer, Spring, .39 ID X .81 In. OD	2	2
7	X-83-7	Nut, Hex, 3/8-16, Zinc	2	2

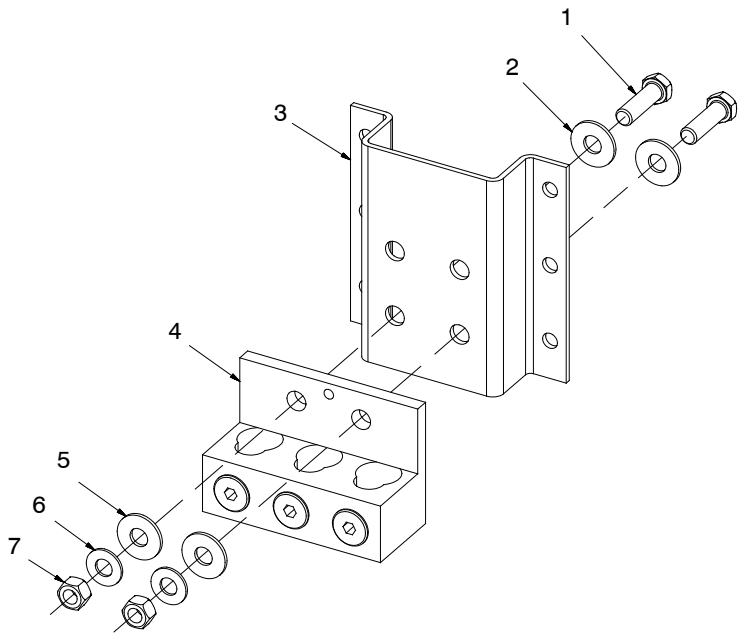
Neutral Assembly

Module Number Key

Model Designation Code							Module Number
Model	Controls	Voltage	Poles	Enclosure	Current Rating	Connection	
RXT	J	F	N	C	100–200	A	GM85087-KA2
RXT	J	F	N	C	0400	A	GM21071-KA2
RXT	J	F	N	C	100–200	ASE	GM85087-KA3
RXT	J	F	N	C	300–400	ASE	GM21071-KA2
RXT	J	C, F, M	T, V	C	0100	A	GM21070-KA1/KA3
RXT	J	C, F, M	T, V	C	0200	A	GM21071-KA1/KA3
RXT	J	C, F, M	T, V	C	0400	A	GM21071-KA2

Please refer to Section 8.2 for an explanation of how to use this table.

Neutral Assembly, continued



GM21071_C

Item	Part Number	Description	Part Number Module GM21071-KA1	GM21071-KA2	GM21071-KA3
1	X-6238-4	Bolt, Hex Cap	2	2	2
2	X-25-118	Washer, Plain, .406 ID X 1 In. OD	2	2	2
3	GM25826	Bracket, Neutral Mtg. ATS 225-400A	1	1	1
4	X-6207-14	Lug, Terminal	1	1	1
5	X-25-118	Washer, Plain, .406 ID X 1 In. OD	2	2	2
6	X-6086-6	Washer, Spring, .39 ID X .81 In. OD	2	2	2
7	X-83-7	Nut, Hex, 3/8-16, Zinc	2	2	2

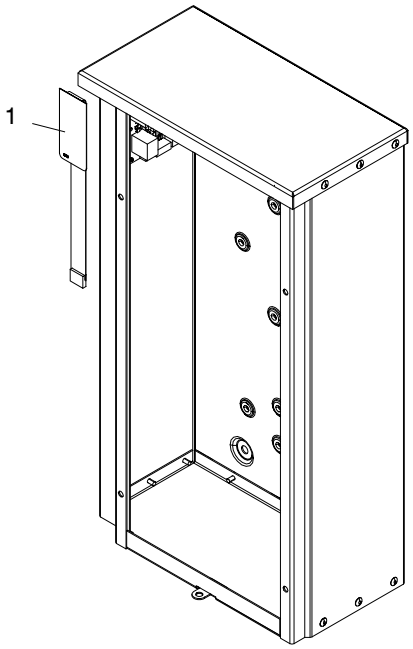
Neutral Assembly

Module Number Key

Model Designation Code							Module Number
Model	Controls	Voltage	Poles	Enclosure	Current Rating	Connection	
RXT	J	F	N	C	100–200	A	GM85087-KA2
RXT	J	F	N	C	0400	A	GM21071-KA2
RXT	J	F	N	C	100–200	ASE	GM85087-KA3
RXT	J	F	N	C	300–400	ASE	GM21071-KA2
RXT	J	C, F, M	T, V	C	0100	A	GM21070-KA1/KA3
RXT	J	C, F, M	T, V	C	0200	A	GM21071-KA1/KA3
RXT	J	C, F, M	T, V	C	0400	A	GM21071-KA2

Please refer to Section 8.2 for an explanation of how to use this table.

Status Indicator

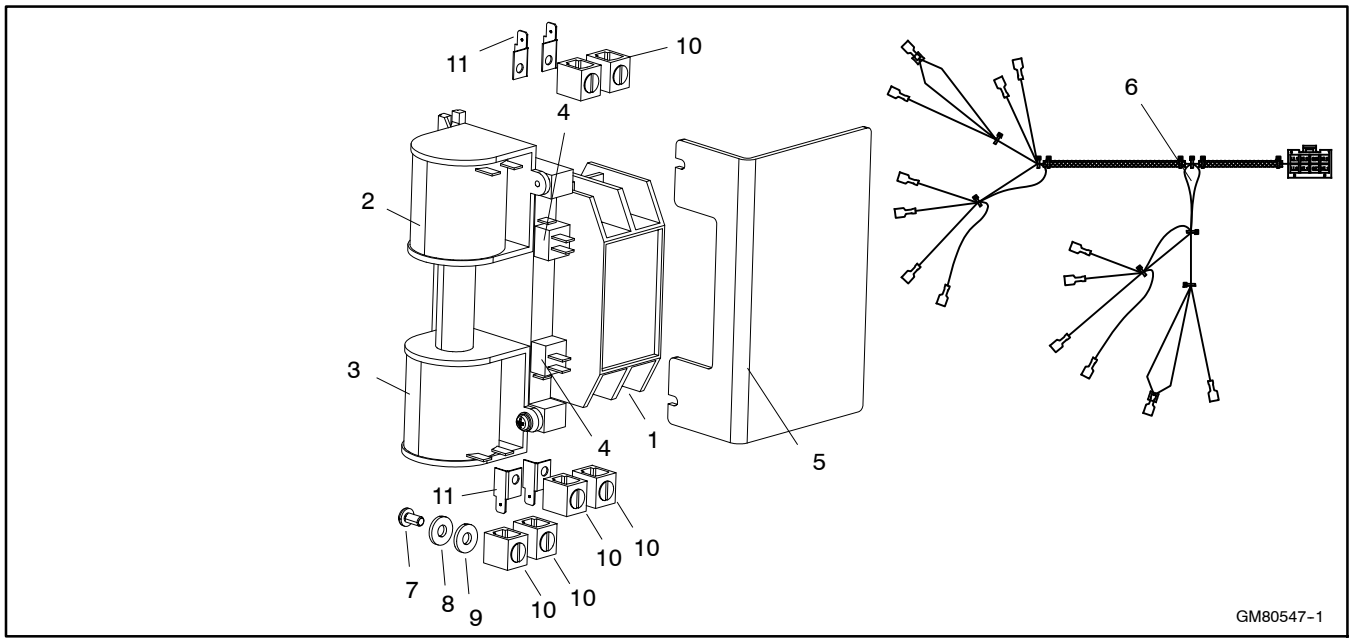


GM84662

Item	Part Number	Description	Part Number Module GM84662-KA1	Part Number Module GM84662-KA2
1	GM78649	Membrane Status Indicator	1	
1	GM90763	Membrane, Switch/LED, RXT/LCM Combo		1

Contactor, 100 Amp

2 Pole



Item	Part Number	Description	Qty.
1	See chart	Cotactor Assembly	1
2	See chart	Solenoid Coil (240V)	1
3	See chart	Solenoid Coil (240V)	1
4	GM29867	Limit Switch	2
5	See chart	Power Terminal Cover	1
6	GM80778-S	Contactor Harness	1
7	X-50-2	Screw, Machine	6
8	X-6086-23	Washer	6
9	X-25-36	Washer,plain,.219 ID x .5 in. OD	6
10	GM28412	Lug, Terminal	6
11	GM31593	Terminal, ATS Lug Sensing	4

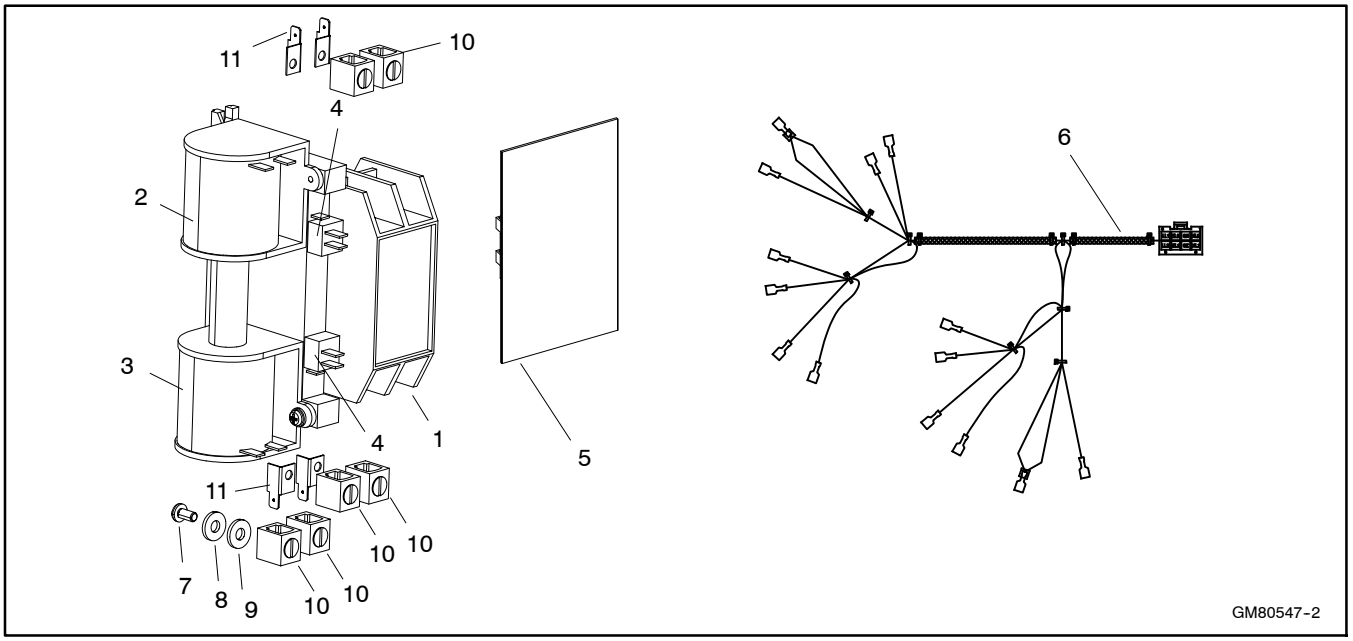
Items 1, 2, 3, 5

Amps	Poles Code	Poles	Voltage Code(s)	Voltage	Conn.	Part Number			
						Item 1, Contactor Assembly	Item 2, Solenoid Coil (upper)	Item 3, Solenoid Coil (lower)	Item 5, Terminal Cover
100	2	N	F	240	A, B	GM80547	GM84872	GM84873	Not Used
100	2	N	F	240	ASE	GM80547*	GM84872	GM84873	Not Used
100	2	N	F	240	ASE	GM80548*	GM84874	GM84875	GM84879

***** Contactor part number GM80547 used on ASE models effective approximately August 30, 2012.

Contactor, 150/200 Amp

2 Pole



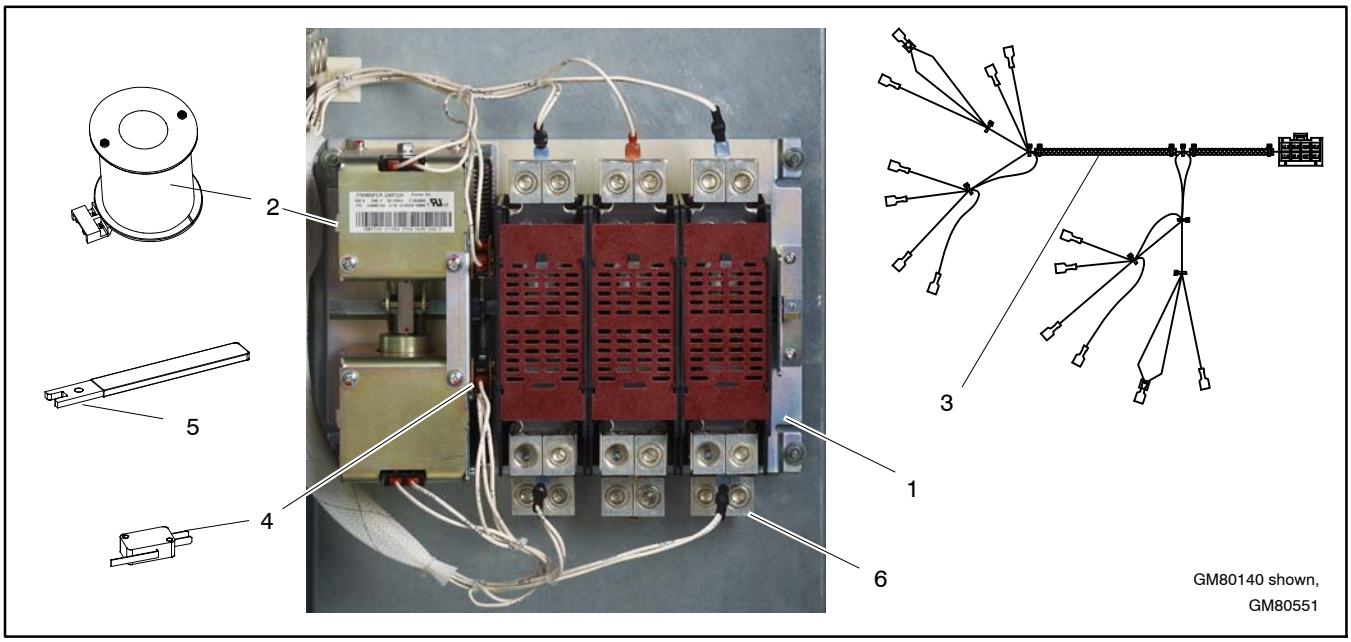
Item	Part Number	Description	Qty. Connection A	Qty. Connection ASE
1	See chart	Cotactor Assembly	1	1
2	See chart	Solenoid Coil (240V)	1	1
3	See chart	Solenoid Coil (240V)	1	1
4	GM29867	Limit Switch	2	2
5	GM77077	Power Terminal Cover	1	1
6	GM80778-S	Contactor Harness	1	1
7	X-465-6	Bolt, Hex Cap (1/4-20 x 1/2") Gr5	6	4
8	X-6086-24	Washer, Spring	6	4
9	X-25-20	Washer, Flat .312 ID x.75 OD	6	4
10	297712	Lug, Terminal	6	4
11	GM31593	Terminal, ATS Lug Sensing	6	4

Items 1-3								
						Part Number		
Amps	Poles Code	Poles	Voltage Code(s)	Voltage	Connection	Item 1, Contactor Assembly	Item 2, Solenoid Coil (upper)	Item 3, Solenoid Coil (lower)
200	2	N	F	240	A	GM80549	GM84876	GM84877
150/200	2	N	F	240	ASE	GM80549*	GM84876	GM84877
200	2	N	F	240	ASE	GM80550*	GM84878	GM84878

* Contactor part number GM80549 used on ASE models effective approximately August 30, 2012.

Contactor, 300/400 Amp, 2/3 Pole

3 Pole Shown



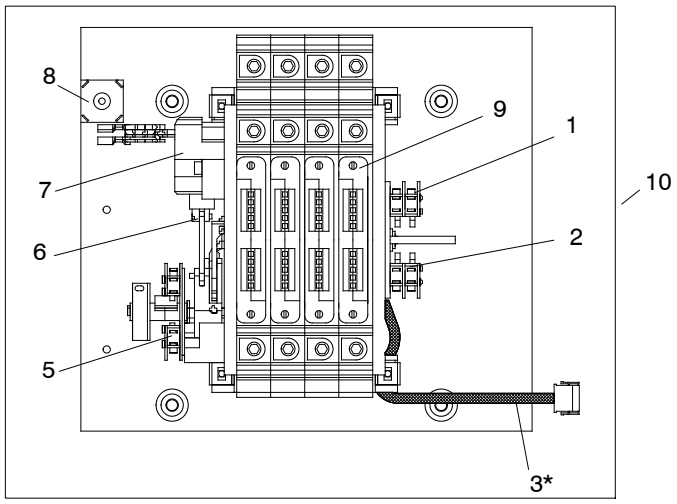
Item	Part Number	Description	Quantity Connection		
			A	ASE	3-pole
1	See chart	Contactor Assembly	1	1	1
2	See chart	Solenoid Coil	2	2	2
3	See chart	Contactor Harness	1	1	1
4	GM29867	Limit Switch	2	2	2
5	GM84883	Handle, Manual	1	1	1
6	297712	Lug, Terminal	12	8	18

Items 1-3

Amps	Poles Code	Poles	Voltage Code(s)	Voltage	Connection	Part Number		
						Item 1, Contactor Assembly	Item 2, Solenoid	Item 3, Harness, Contactor
400	N	2	F	240	A	GM80139	GM84880	GM80779
300/400	N	2	F	240	ASE	GM80551	GM84880	GM80779
400	T	3	C	208	A	GM81111	GM84882	GM80780
400	T	3	F	240	A	GM80140	GM84881	GM80780

Contactor, 100–200 Amp

3 Phase



GM78867

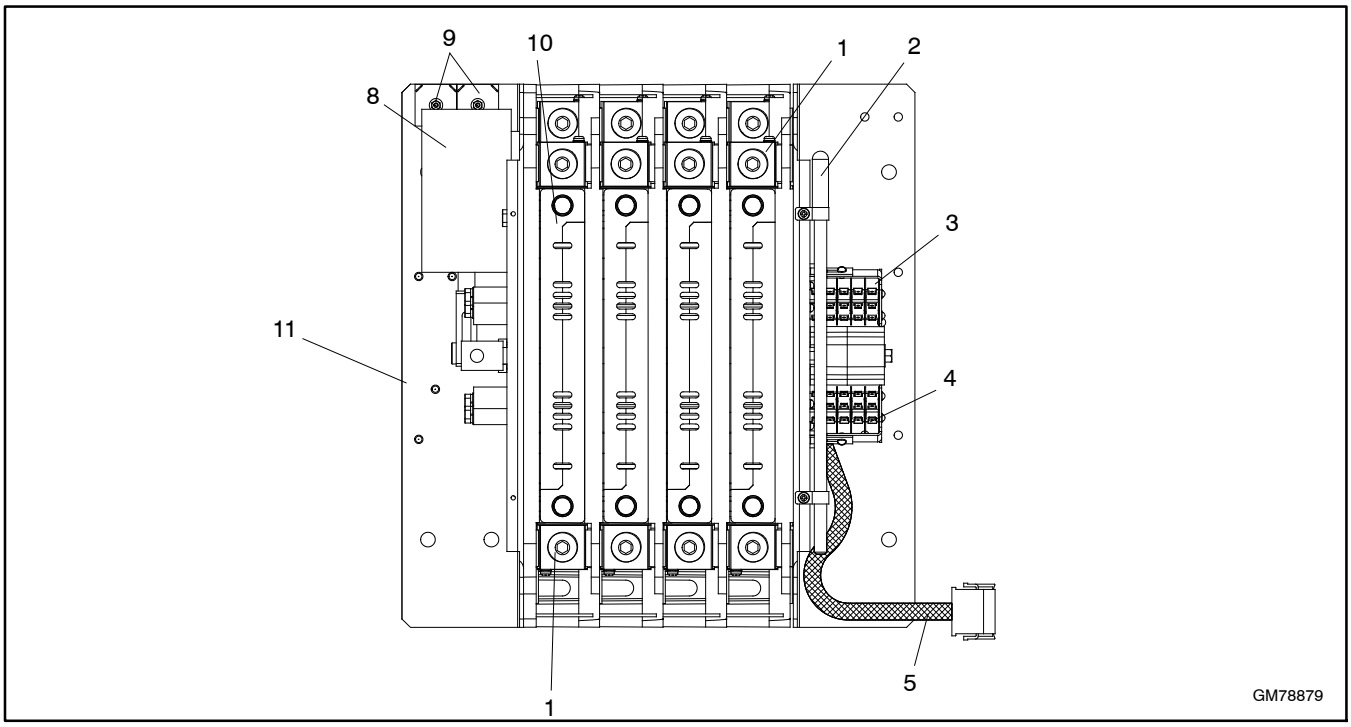
Item	Part Number	Description	Qty.
1	362081	Contacts, auxiliary	1
2	362081	Contacts, auxiliary	1
3	GM41995	Contactor harness	1
5	362081	Switch, coil cutout	2
6	GM32387	Plunger and link, solenoid	1
7	See chart	Solenoid	1
8	See chart	Rectifier	1
9	See chart	Arc chutes	–
10	See chart	Contactor assembly	1

Items 7–10

Amps	Poles Code	Poles	Voltage Code(s)	Voltage	Part Number			
					Item 7, Solenoid	Item 8, Rectifier	Item 9, Arc Chutes	Item 10, Contactor Assembly
100	T	3	C	208	362087	GM32388	GM84884 (1)	GM78867
100	T	3	F	240	362135	GM32388	GM84884 (1)	GM78868
100	T	3	M	480	362090	GM83720	362084 (3)	GM78869
100	V	4	C	208	362087	GM32388	GM84884 (1)	GM78870
100	V	4	F	240	362135	GM32388	GM84884 (1)	GM78871
100	V	4	M	480	362090	GM83720	362084 (4)	GM78872
200	T	3	C	208	362087	GM32388	GM84884 (1)	GM78873
200	T	3	F	240	362135	GM32388	GM84884 (1)	GM78874
200	T	3	M	480	362090	GM83720	362084 (3)	GM78875
200	V	4	C	208	362087	GM32388	GM84884 (1)	GM78876
200	V	4	F	240	362135	GM32388	GM84884 (1)	GM78877
200	V	4	M	480	362090	GM83720	362084 (4)	GM78878

Contactor, 400 Amp

3 Phase



Item	Part Number	Description
1	GM51138	Lugs, cable connection
2	GM84885	Handle
3	GM25434	Switch, coil cutout
4	GM25434	Contacts, auxiliary
5	GM84886	Harness, wiring
8	See chart	Solenoid
9	See chart	Rectifier
10	See chart	Arc chute assembly
11	See chart	Contactor assembly

Items 8–11								
					Part Number			
Amps	Poles Code	Poles	Voltage Code(s)	Voltage	Item 8, Solenoid	Item 9, Rectifier	Item 10, Arc Chute Assy.	Item 11, Contactor Assembly
400	T	3	M	480	GM32392	GM83720	GM39145 (3)	GM78881
400	V	4	C	208	GM32390	GM32388	GM39145 (4)	GM78882
400	V	4	F	240	GM32390	GM32388	GM39145 (4)	GM78883
400	V	4	M	480	GM32392	GM83720	GM39145 (4)	GM78884

Literature

Item	Part Number	Description	Qty. Model RXT
1	TP-6753	Warranty, 5-yr. Limited	1
2	TP-6807	O/I/M RXT ATS	1
3	TP-6808	S/P/M RXT ATS	1

Accessories

Qty.	Description	Part No.

Load Control Module, w/ Harness **GM77177-KP1-QS**

1	Load Control Module Assy, w/ Harness	GM77177-1
1	Decal, equipment grd	344295
2	Insert, threaded, #10-24	346258
1	Dimension Print, Load Control Module	ADV-8198
4	Gasket	GM20990
1	Decal, Nameplate	GM84656-1
2	Label, Blank	GM24703
1	Decal, 120VAC Only	GM75393
1	Plate, Mounting	GM77176
4	Relay, 50A	GM77178
1	Cover w/ Decals, Load Shed	GM77191
1	Enclosure, Load Shed	GM79445
1	Harness, Load Control	GM80092
1	Harness, Relay Control	GM80673
1	Indicator, Load Status	GM80879
1	Decal, Wiring Diagram	GM80950
1	Decal, Warning	GM81264
1	PCB Assy, RDC2 Load Control	GM81372-1
1	Diagram, Wiring Load Control	GM81374
1	Diagram, Schematic Load Control	GM81638
1	Transformer, Current	GM83929
1	TT Load Control Module, Res/Comm	TT-1574
1	Terminal block	X-405-2
3	Washer	X-6086-23
3	Lug, terminal, aluminum	X-6207-3
2	Insulink	X-367-1

Load Control Module, w/ Terminal Blocks **GM77177-KP2-QS**

1	Load Control Module Assy, w/ Term.	GM77177-2
1	Decal, equipment grd	344295
2	Insert, threaded, #10-24	346258
1	Dimension Print, Load Control Module	ADV-8198
4	Gasket	GM20990
1	Decal, Nameplate	GM84656-2
2	Label, Blank	GM24703
1	Decal, 120VAC Only	GM75393
1	Plate, Mounting	GM77176
4	Relay, 50A	GM77178
1	Cover w/ Decals, Load Shed	GM77191
1	Enclosure, Load Shed	GM79445
1	Harness, Relay Control	GM80673
8	Harness, Terminal Block	GM80674
4	Block, Terminal	GM80862
1	Indicator, Load Status	GM80879
1	Marker, Strip	GM80949
1	Decal, Wiring Diagram	GM80950
1	Decal, Warning	GM81264
1	PCB Assy, RDC2 Load Control	GM81372-1
1	Diagram, Wiring Load Control	GM81374
1	Diagram, Schematic Load Control	GM81638
1	Transformer, Current	GM83929
1	TT Load Control Module, Res/Comm	TT-1574
1	Terminal block	X-405-2
3	Washer	X-6086-23
3	Lug, terminal, aluminum	X-6207-3
2	Insulink	X-367-1

Qty.	Description	Part No.

Load Control Module, w/ Harness, CSA **GM77177-KP3-QS**

1	Load Control Module Assy, w/ Harness	GM77177-1
1	Decal, CSA	297721
1	Decal, equipment grd (NRP)	344295
2	Insert, threaded, #10-24	346258
1	Dimension Print, Load Control Module	ADV-8198
4	Gasket	GM20990
2	Label, Blank	GM24703
1	Decal, 120VAC Only	GM75393
1	Plate, Mounting	GM77176
4	Relay	GM77178
1	Cover w/ Decals, Load Shed	GM77191
1	Enclosure, Load Shed	GM79445
1	Harness, Load Control	GM80092
1	Harness, Relay Control	GM80673
1	Indicator, Load Status	GM80879
1	Decal, Wiring Diagram	GM80950
2	Decal, Warning	GM81264
1	PCB Assy, RDC2 Load Control	GM81372-1
1	Transformer, Current	GM83929
1	Decal, LCM - w/ whip	GM84656-1
1	TT Load Control Module, Res/Comm	TT-1574
1	Terminal block	X-405-2
3	Washer	X-6086-23
3	Lug, terminal, aluminum	X-6207-3

Load Control Module, w/ Terminal Blocks, CSA **GM77177-KP4-QS**

1	Load Control Module Assy, w/ Term.	GM77177-2
1	Decal, CSA	297721
1	Decal, equipment grd (NRP)	344295
2	Insert, threaded, #10-24	346258
1	Dimension Print, Load Control Module	ADV-8198
4	Gasket	GM20990
1	Decal, Nameplate	GM21291
2	Label, Blank	GM24703
1	Decal, 120VAC Only	GM75393
1	Plate, Mounting	GM77176
4	Relay,	GM77178
1	Cover w/ Decals, Load Shed	GM77191
1	Enclosure, Load Shed	GM79445
1	Harness, Relay Control	GM80673
8	Harness, Terminal Block	GM80674
4	Block, Terminal	GM80862
1	Indicator, Load Status	GM80879
1	Marker, Strip	GM80949
1	Decal, Wiring Diagram	GM80950
2	Decal, Warning	GM81264
1	PCB Assy, RDC2 Load Control	GM81372-1
1	Diagram, Wiring Load Control	GM81374
1	Diagram, Schematic Load Control	GM81638
1	Transformer, Current	GM83929
1	TT Load Control Module, Res/Comm	TT-1574
1	Terminal block	X-405-2
3	Washer	X-6086-23
3	Lug, terminal, aluminum	X-6207-3

Accessories

Qty.	Description	Part No.
Indicator, Status - RXT		**GM84662-KP1-QS**
1	Decal, Membrane Status Indicator	GM78649
1	TT Status Indicator, Model RXT ATS	TT-1585
Indicator, Status - RXT		**GM84662-KP2-QS**
1	Membrane, Switch/LED, RXT/LCM Combo	GM90763
1	TT Status Indicator, Model RXT ATS	TT-1585

Qty.	Description	Part No.
Load Shed, ATS		**GM88281-KP1-QS**
1	Transformer, Current	GM83929
1	Harness, Communications	GM88557
1	Load Management Kit for Residential ATS	TT-1609
1	Load Control, ATS	GM88281-1
1	Strip, terminal	241621
2	Base, tie wrap snapin	361567
1	PCB Assy, RDC2 Load Control	GM81372-1
1	Bracket, Load Control	GM88391
1	Marker, Strip Load Control	GM88392
1	Harness, Wiring	GM88483
2	Screw, Tapping	X-67-152
RXT Interface/Load Shed PCBA		**GM93969-KP1-QS**
1	PCB Assy, RXT/LCM Combo	GM90773

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	advanced digital control; analog to digital converter
adj.	adjust, adjustment
ADV	advertising dimensional drawing
Ah	amp-hour
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
APDC	Air Pollution Control District
API	American Petroleum Institute
approx.	approximate, approximately
AQMD	Air Quality Management District
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
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
CAN	controller area network
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
cUL	Canadian Underwriter's Laboratories
CUL	Canadian Underwriter's Laboratories
cu. in.	cubic inch
cw.	clockwise
CWC	city water-cooled
cyl.	cylinder
D/A	digital to analog
DAC	digital to analog converter
dB	decibel
dB(A)	decibel (A weighted)
DC	direct current
DCR	direct current resistance
deg., °	degree
dept.	department
DFMEA	Design Failure Mode and Effects Analysis
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)
ECM	electronic control module, engine control module
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
ftp	file transfer protocol
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 temp., high engine temp.
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)
KBus	Kohler communication protocol
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
kWth	kilowatt-thermal
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/hr.	cubic meters per hour
m^3/min.	cubic meters per minute
mA	milliampere
man.	manual
max.	maximum
MB	megabyte (2^{20} bytes)
MCCB	molded-case circuit breaker
MCM	one thousand circular mils
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
ms	millisecond
m/sec.	meters per second
MTBF	mean time between failure
MTBO	mean time between overhauls
mtg.	mounting
MTU	Motoren-und Turbinen-Union
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
psig	pounds per square inch gauge
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
RTU	remote terminal unit
RTV	room temperature vulcanization
RW	read/write
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
SNMP	simple network management protocol
SPDT	single-pole, double-throw
SPST	single-pole, single-throw
spec	specification
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
THD	total harmonic distortion
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

Appendix B Common Hardware Application Guidelines

Use the information below and on the following pages to identify proper fastening techniques when no specific reference for reassembly is made.

Bolt/Screw Length: When bolt/screw length is not given, use Figure 1 as a guide. As a general rule, a minimum length of one thread beyond the nut and a maximum length of 1/2 the bolt/screw diameter beyond the nut is the preferred method.

Washers and Nuts: Use split lock washers as a bolt locking device where specified. Use SAE flat washers with whiz nuts, spiralock nuts, or standard nuts and preloading (torque) of the bolt in all other applications.

See Appendix C, General Torque Specifications, and other torque specifications in the service literature.

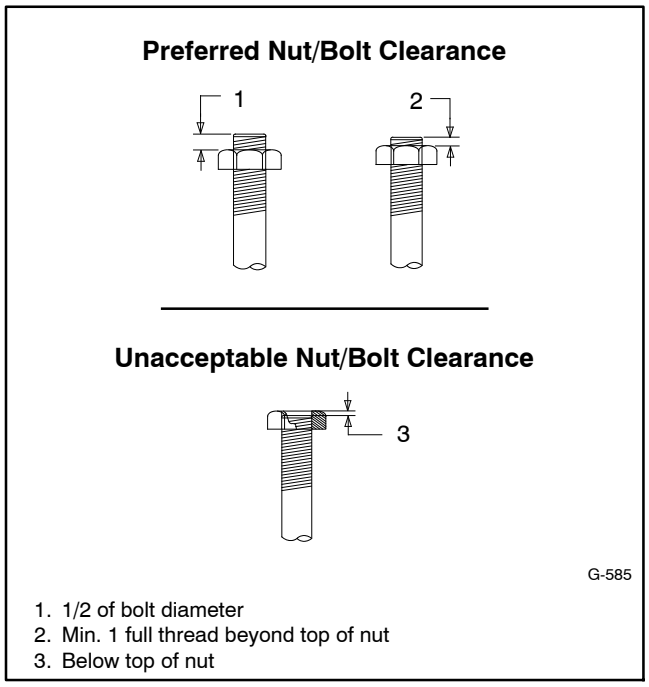


Figure 1 Acceptable Bolt Lengths

Steps for common hardware application:

1. Determine entry hole type: round or slotted.
2. Determine exit hole type: fixed female thread (weld nut), round, or slotted.

   For round and slotted exit holes, determine if hardware is greater than 1/2 inch in diameter, or 1/2 inch in diameter or less. Hardware that is *greater than 1/2 inch* in diameter takes a standard nut and SAE washer. Hardware *1/2 inch or less* in diameter can take a properly torqued whiz nut or spiralock nut. See Figure 2.
3. Follow these SAE washer rules after determining exit hole type:
   a. Always use a washer between hardware and a slot.
   b. Always use a washer under a nut (see 2 above for exception).
   c. Use a washer under a bolt when the female thread is fixed (weld nut).
4. Refer to Figure 2, which depicts the preceding hardware configuration possibilities.

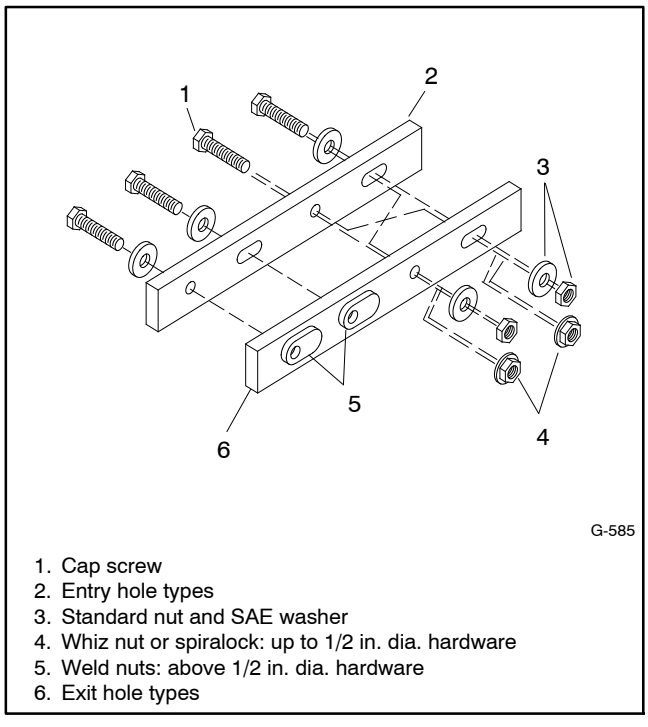


Figure 2 Acceptable Hardware Combinations

Appendix C General Torque Specifications

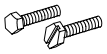
American Standard Fasteners Torque Specifications									
Size	Torque Measurement	Assembled into Cast Iron or Steel						Assembled into Aluminum Grade 2 or 5
		Grade 2		Grade 5		Grade 8		
8-32	Nm (in. lb.)	1.8	(16)	2.3	(20)	—		See Note 3
10-24	Nm (in. lb.)	2.9	(26)	3.6	(32)	—		
10-32	Nm (in. lb.)	2.9	(26)	3.6	(32)	—		
1/4-20	Nm (in. lb.)	6.8	(60)	10.8	(96)	14.9	(132)	
1/4-28	Nm (in. lb.)	8.1	(72)	12.2	(108)	16.3	(144)	
5/16-18	Nm (in. lb.)	13.6	(120)	21.7	(192)	29.8	(264)	
5/16-24	Nm (in. lb.)	14.9	(132)	23.1	(204)	32.5	(288)	
3/8-16	Nm (ft. lb.)	24.0	(18)	38.0	(28)	53.0	(39)	
3/8-24	Nm (ft. lb.)	27.0	(20)	42.0	(31)	60.0	(44)	
7/16-14	Nm (ft. lb.)	39.0	(29)	60.0	(44)	85.0	(63)	
7/16-20	Nm (ft. lb.)	43.0	(32)	68.0	(50)	95.0	(70)	
1/2-13	Nm (ft. lb.)	60.0	(44)	92.0	(68)	130.0	(96)	
1/2-20	Nm (ft. lb.)	66.0	(49)	103.0	(76)	146.0	(108)	
9/16-12	Nm (ft. lb.)	81.0	(60)	133.0	(98)	187.0	(138)	
9/16-18	Nm (ft. lb.)	91.0	(67)	148.0	(109)	209.0	(154)	
5/8-11	Nm (ft. lb.)	113.0	(83)	183.0	(135)	259.0	(191)	
5/8-18	Nm (ft. lb.)	128.0	(94)	208.0	(153)	293.0	(216)	
3/4-10	Nm (ft. lb.)	199.0	(147)	325.0	(240)	458.0	(338)	
3/4-16	Nm (ft. lb.)	222.0	(164)	363.0	(268)	513.0	(378)	
1-8	Nm (ft. lb.)	259.0	(191)	721.0	(532)	1109.0	(818)	
1-12	Nm (ft. lb.)	283.0	(209)	789.0	(582)	1214.0	(895)	

Metric Fasteners Torque Specifications, Measured in Nm (ft. lb.)								
Size (mm)	Assembled into Cast Iron or Steel						Assembled into Aluminum Grade 5.8 or 8.8
	Grade 5.8		Grade 8.8		Grade 10.9		
M6 x 1.00	6.2	(4.6)	9.5	(7)	13.6	(10)	See Note 3
M8 x 1.25	15.0	(11)	23.0	(17)	33.0	(24)	
M8 x 1.00	16.0	(11)	24.0	(18)	34.0	(25)	
M10 x 1.50	30.0	(22)	45.0	(34)	65.0	(48)	
M10 x 1.25	31.0	(23)	47.0	(35)	68.0	(50)	
M12 x 1.75	53.0	(39)	80.0	(59)	115.0	(85)	
M12 x 1.50	56.0	(41)	85.0	(63)	122.0	(90)	
M14 x 2.00	83.0	(61)	126.0	(93)	180.0	(133)	
M14 x 1.50	87.0	(64)	133.0	(98)	190.0	(140)	
M16 x 2.00	127.0	(94)	194.0	(143)	278.0	(205)	
M16 x 1.50	132.0	(97)	201.0	(148)	287.0	(212)	
M18 x 2.50	179.0	(132)	273.0	(201)	390.0	(288)	
M18 x 1.50	189.0	(140)	289.0	(213)	413.0	(305)	

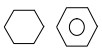
Notes:

1. The torque values above are general guidelines. Always use the torque values specified in the service manuals and/or assembly drawings when they differ from the above torque values.
2. The torque values above are based on new plated threads. Increase torque values by 15% if non-plated threads are used.
3. Hardware threaded into aluminum must have either two diameters of thread engagement or a 30% or more reduction in the torque to prevent stripped threads.
4. Torque values are calculated as equivalent stress loading on American hardware with an approximate preload of 90% of the yield strength and a friction coefficient of 0.125.

Appendix D Common Hardware Identification

Screw/Bolts/Studs	
Head Styles	
Hex Head or Machine Head	
Hex Head or Machine Head with Washer	
Flat Head (FHM)	
Round Head (RHM)	
Pan Head	
Hex Socket Head Cap or Allen™ Head Cap	
Hex Socket Head or Allen™ Head Shoulder Bolt	
Sheet Metal Screw	
Stud	
Drive Styles	
Hex	
Hex and Slotted	
Phillips®	
Slotted	
Hex Socket	

Nuts	
Nut Styles	
Hex Head	
Lock or Elastic	
Square	
Cap or Acorn	
Wing	
Washers	
Washer Styles	
Plain	
Split Lock or Spring	
Spring or Wave	
External Tooth Lock	
Internal Tooth Lock	
Internal-External Tooth Lock	

Hardness Grades	
American Standard	
Grade 2	
Grade 5	
Grade 8	
Grade 8/9 (Hex Socket Head)	
Metric	
Number stamped on hardware; 5.8 shown	

Allen™ head screw is a trademark of Holo-Krome Co.

Phillips® screw is a registered trademark of Phillips Screw Company.

Sample Dimensions

American Standard (Screws, Bolts, Studs, and Nuts)

1/4-20 x 1

- Length In Inches (Screws and Bolts)
- Threads Per Inch
- Major Thread Diameter In Fractional Inches Or Screw Number Size

Metric (Screws, Bolts, Studs, and Nuts)

M8-1.25 x 20

- Length In Millimeters (Screws and Bolts)
- Distance Between Threads In Millimeters
- Major Thread Diameter In Millimeters

Plain Washers

9/32 x 5/8 x 1/16

- Thickness
- External Dimension
- Internal Dimension

Lock Washers

5/8

- Internal Dimension

Appendix E Common Hardware List

The Common Hardware List lists part numbers and dimensions for common hardware items.

American Standard

Part No.	Dimensions
Hex Head Bolts (Grade 5)	
X-465-17	1/4-20 x .38
X-465-6	1/4-20 x .50
X-465-2	1/4-20 x .62
X-465-16	1/4-20 x .75
X-465-18	1/4-20 x .88
X-465-7	1/4-20 x 1.00
X-465-8	1/4-20 x 1.25
X-465-9	1/4-20 x 1.50
X-465-10	1/4-20 x 1.75
X-465-11	1/4-20 x 2.00
X-465-12	1/4-20 x 2.25
X-465-14	1/4-20 x 2.75
X-465-21	1/4-20 x 5.00
X-465-25	1/4-28 x .38
X-465-20	1/4-28 x 1.00
X-125-33	5/16-18 x .50
X-125-23	5/16-18 x .62
X-125-3	5/16-18 x .75
X-125-31	5/16-18 x .88
X-125-5	5/16-18 x 1.00
X-125-24	5/16-18 x 1.25
X-125-34	5/16-18 x 1.50
X-125-25	5/16-18 x 1.75
X-125-26	5/16-18 x 2.00
230578	5/16-18 x 2.25
X-125-29	5/16-18 x 2.50
X-125-27	5/16-18 x 2.75
X-125-28	5/16-18 x 3.00
X-125-22	5/16-18 x 4.50
X-125-32	5/16-18 x 5.00
X-125-35	5/16-18 x 5.50
X-125-36	5/16-18 x 6.00
X-125-40	5/16-18 x 6.50
X-125-43	5/16-24 x 1.75
X-125-44	5/16-24 x 2.50
X-125-30	5/16-24 x .75
X-125-39	5/16-24 x 2.00
X-125-38	5/16-24 x 2.75
X-6238-2	3/8-16 x .62
X-6238-10	3/8-16 x .75
X-6238-3	3/8-16 x .88
X-6238-11	3/8-16 x 1.00
X-6238-4	3/8-16 x 1.25
X-6238-5	3/8-16 x 1.50
X-6238-1	3/8-16 x 1.75
X-6238-6	3/8-16 x 2.00
X-6238-17	3/8-16 x 2.25
X-6238-7	3/8-16 x 2.50
X-6238-8	3/8-16 x 2.75
X-6238-9	3/8-16 x 3.00
X-6238-19	3/8-16 x 3.25
X-6238-12	3/8-16 x 3.50
X-6238-20	3/8-16 x 3.75
X-6238-13	3/8-16 x 4.50
X-6238-18	3/8-16 x 5.50
X-6238-25	3/8-16 x 6.50

Part No.	Dimensions
Hex Head Bolts, cont.	
X-6238-14	3/8-24 x .75
X-6238-16	3/8-24 x 1.25
X-6238-21	3/8-24 x 4.00
X-6238-22	3/8-24 x 4.50
X-6024-5	7/16-14 x .75
X-6024-2	7/16-14 x 1.00
X-6024-8	7/16-14 x 1.25
X-6024-3	7/16-14 x 1.50
X-6024-4	7/16-14 x 2.00
X-6024-11	7/16-14 x 2.75
X-6024-12	7/16-14 x 6.50
X-129-15	1/2-13 x .75
X-129-17	1/2-13 x 1.00
X-129-18	1/2-13 x 1.25
X-129-19	1/2-13 x 1.50
X-129-20	1/2-13 x 1.75
X-129-21	1/2-13 x 2.00
X-129-22	1/2-13 x 2.25
X-129-23	1/2-13 x 2.50
X-129-24	1/2-13 x 2.75
X-129-25	1/2-13 x 3.00
X-129-27	1/2-13 x 3.50
X-129-29	1/2-13 x 4.00
X-129-30	1/2-13 x 4.50
X-463-9	1/2-13 x 5.50
X-129-44	1/2-13 x 6.00
X-129-51	1/2-20 x .75
X-129-45	1/2-20 x 1.25
X-129-52	1/2-20 x 1.50
X-6021-3	5/8-11 x 1.00
X-6021-4	5/8-11 x 1.25
X-6021-2	5/8-11 x 1.50
X-6021-1	5/8-11 x 1.75
273049	5/8-11 x 2.00
X-6021-5	5/8-11 x 2.25
X-6021-6	5/8-11 x 2.50
X-6021-7	5/8-11 x 2.75
X-6021-12	5/8-11 x 3.75
X-6021-11	5/8-11 x 4.50
X-6021-10	5/8-11 x 6.00
X-6021-9	5/8-18 x 2.50
X-6239-1	3/4-10 x 1.00
X-6239-8	3/4-10 x 1.25
X-6239-2	3/4-10 x 1.50
X-6239-3	3/4-10 x 2.00
X-6239-4	3/4-10 x 2.50
X-6239-5	3/4-10 x 3.00
X-6239-6	3/4-10 x 3.50
X-792-1	1-8 x 2.25
X-792-5	1-8 x 3.00
X-792-8	1-8 x 5.00

Part No.	Dimensions	Type
Hex Nuts		
X-6009-1	1-8	Standard
X-6210-3	6-32	Whiz
X-6210-4	8-32	Whiz
X-6210-5	10-24	Whiz
X-6210-1	10-32	Whiz
X-6210-2	1/4-20	Spiralock
X-6210-6	1/4-28	Spiralock
X-6210-7	5/16-18	Spiralock
X-6210-8	5/16-24	Spiralock
X-6210-9	3/8-16	Spiralock
X-6210-10	3/8-24	Spiralock
X-6210-11	7/16-14	Spiralock
X-6210-12	1/2-13	Spiralock
X-6210-15	7/16-20	Spiralock
X-6210-14	1/2-20	Spiralock
X-85-3	5/8-11	Standard
X-88-12	3/4-10	Standard
X-89-2	1/2-20	Standard

Washers

Part No.	ID	OD	Thick.	Bolt/ Screw
X-25-46	.125	.250	.022	#4
X-25-9	.156	.375	.049	#6
X-25-48	.188	.438	.049	#8
X-25-36	.219	.500	.049	#10
X-25-40	.281	.625	.065	1/4
X-25-85	.344	.687	.065	5/16
X-25-37	.406	.812	.065	3/8
X-25-34	.469	.922	.065	7/16
X-25-26	.531	1.062	.095	1/2
X-25-15	.656	1.312	.095	5/8
X-25-29	.812	1.469	.134	3/4
X-25-127	1.062	2.000	.134	1

Metric

Hex head bolts are hardness grade 8.8 unless noted.

Part No.	Dimensions
Hex Head Bolts (Partial Thread)	
M931-05055-60	M5-0.80 x 55
M931-06040-60	M6-1.00 x 40
M931-06055-60	M6-1.00 x 55
M931-06060-60	M6-1.00 x 60
M931-06060-SS	M6-1.00 x 60
M931-06070-60	M6-1.00 x 70
M931-06070-SS	M6-1.00 x 70
M931-06075-60	M6-1.00 x 75
M931-06090-60	M6-1.00 x 90
M931-06145-60	M6-1.00 x 145
M931-06150-60	M6-1.00 x 150
M931-08035-60	M8-1.25 x 35
M931-08040-60	M8-1.25 x 40
M931-08045-60	M8-1.25 x 45
M931-08050-60	M8-1.25 x 50
M931-08055-60	M8-1.25 x 55
M931-08055-82	M8-1.25 x 55*
M931-08060-60	M8-1.25 x 60
M931-08070-60	M8-1.25 x 70
M931-08070-82	M8-1.25 x 70*
M931-08075-60	M8-1.25 x 75
M931-08080-60	M8-1.25 x 80
M931-08090-60	M8-1.25 x 90
M931-08095-60	M8-1.25 x 95
M931-08100-60	M8-1.25 x 100
M931-08110-60	M8-1.25 x 110
M931-08120-60	M8-1.25 x 120
M931-08130-60	M8-1.25 x 130
M931-08140-60	M8-1.25 x 140
M931-08150-60	M8-1.25 x 150
M931-08200-60	M8-1.25 x 200
M931-10040-82	M10-1.25 x 40*
M931-10040-60	M10-1.50 x 40
M931-10045-60	M10-1.50 x 45
M931-10050-60	M10-1.50 x 50
M931-10050-82	M10-1.25 x 50*
M931-10055-60	M10-1.50 x 55
M931-10060-60	M10-1.50 x 60
M931-10065-60	M10-1.50 x 65
M931-10070-60	M10-1.50 x 70
M931-10080-60	M10-1.50 x 80
M931-10080-82	M10-1.25 x 80*
M931-10090-60	M10-1.50 x 90
M931-10090-82	M10-1.50 x 90*
M931-10100-60	M10-1.50 x 100
M931-10110-60	M10-1.50 x 110
M931-10120-60	M10-1.50 x 120
M931-10130-60	M10-1.50 x 130
M931-10140-60	M10-1.50 x 140
M931-10180-60	M10-1.50 x 180
M931-10235-60	M10-1.50 x 235
M931-10260-60	M10-1.50 x 260
M960-10330-60	M10-1.25 x 330
M931-12045-60	M12-1.75 x 45
M960-12050-60	M12-1.25 x 50
M960-12050-82	M12-1.25 x 50*
M931-12050-60	M12-1.75 x 50
M931-12050-82	M12-1.75 x 50*
M931-12055-60	M12-1.75 x 55
M931-12060-60	M12-1.75 x 60
M931-12060-82	M12-1.75 x 60*
M931-12065-60	M12-1.75 x 65
M931-12075-60	M12-1.75 x 75
M931-12080-60	M12-1.75 x 80
M931-12090-60	M12-1.75 x 90
M931-12100-60	M12-1.75 x 100
M931-12110-60	M12-1.75 x 110

Part No.	Dimensions
Hex Head Bolts (Partial Thread), continued	
M960-16090-60	M16-1.50 x 90
M931-16090-60	M16-2.00 x 90
M931-16100-60	M16-2.00 x 100
M931-16100-82	M16-2.00 x 100*
M931-16120-60	M16-2.00 x 120
M931-16150-60	M16-2.00 x 150
M931-20065-60	M20-2.50 x 65
M931-20090-60	M20-2.50 x 90
M931-20100-60	M20-2.50 x 100
M931-20120-60	M20-2.50 x 120
M931-20140-60	M20-2.50 x 140
M931-20160-60	M20-2.50 x 160
M931-22090-60	M22-2.50 x 90
M931-22120-60	M22-2.50 x 120
M931-22160-60	M22-2.50 x 160
M931-24090-60	M24-3.00 x 90
M931-24120-60	M24-3.00 x 120
M931-24160-60	M24-3.00 x 160
M931-24200-60	M24-3.00 x 200
Hex Head Bolts (Full Thread)	
M933-04006-60	M4-0.70 x 6
M933-05030-60	M5-0.80 x 30
M933-05035-60	M5-0.80 x 35
M933-05050-60	M5-0.80 x 50
M933-06010-60	M6-1.00 x 10
M933-06012-60	M6-1.00 x 12
M933-06014-60	M6-1.00 x 14
M933-06016-60	M6-1.00 x 16
M933-06020-60	M6-1.00 x 20
M933-06025-60	M6-1.00 x 25
M933-06030-60	M6-1.00 x 30
M933-06040-60	M6-1.00 x 40
M933-06050-60	M6-1.00 x 50
M933-07025-60	M7-1.00 x 25
M933-08010-60	M8-1.25 x 10
M933-08012-60	M8-1.25 x 12
M933-08016-60	M8-1.25 x 16
M933-08020-60	M8-1.25 x 20
M933-08025-60	M8-1.25 x 25
M933-08030-60	M8-1.25 x 30
M933-08030-82	M8-1.25 x 30*
M933-10012-60	M10-1.50 x 12
M961-10020-60	M10-1.25 x 20
M933-10020-60	M10-1.50 x 20
M933-10025-60	M10-1.50 x 25
M961-10025-60	M10-1.25 x 25
M933-10025-82	M10-1.50 x 25*
M961-10030-60	M10-1.25 x 30
M933-10030-60	M10-1.50 x 30
M933-10030-82	M10-1.50 x 30*
M961-10035-60	M10-1.25 x 35
M933-10035-60	M10-1.50 x 35
M933-10035-82	M10-1.50 x 35*
M961-10040-60	M10-1.25 x 40

Part No.	Dimensions
Hex Head Bolts (Full Thread), continued	
M933-12016-60	M12-1.75 x 16
M933-12020-60	M12-1.75 x 20
M961-12020-60F	M12-1.50 x 20
M933-12025-60	M12-1.75 x 25
M933-12025-82	M12-1.75 x 25*
M961-12030-60	M12-1.25 x 30
M933-12030-82	M12-1.75 x 30*
M961-12030-82F	M12-1.50 x 30*
M933-12030-60	M12-1.75 x 30
M933-12035-60	M12-1.75 x 35
M961-12040-82	M12-1.25 x 40*
M933-12040-60	M12-1.75 x 40
M933-12040-82	M12-1.75 x 40*
M961-14025-60	M14-1.50 x 25
M933-14025-60	M14-2.00 x 25
M961-14050-82	M14-1.50 x 50*
M961-16025-60	M16-1.50 x 25
M933-16025-60	M16-2.00 x 25
M961-16030-82	M16-1.50 x 30*
M933-16030-82	M16-2.00 x 30*
M933-16035-60	M16-2.00 x 35
M961-16040-60	M16-1.50 x 40
M933-16040-60	M16-2.00 x 40
M961-16045-82	M16-1.50 x 45*
M933-16045-82	M16-2.00 x 45*
M933-16050-60	M16-2.00 x 50
M933-16050-82	M16-2.00 x 50*
M933-16060-60	M16-2.00 x 60
M933-16070-60	M16-2.00 x 70
M933-18035-60	M18-2.50 x 35
M933-18050-60	M18-2.50 x 50
M933-18060-60	M18-2.50 x 60
M933-20050-60	M20-2.50 x 50
M933-20055-60	M20-2.50 x 55
M933-24060-60	M24-3.00 x 60
M933-24065-60	M24-3.00 x 65
M933-24070-60	M24-3.00 x 70
Pan Head Machine Screws	
M7985A-03010-20	M3-0.50 x 10
M7985A-03012-20	M3-0.50 x 12
M7985A-04010-20	M4-0.70 x 10
M7985A-04016-20	M4-0.70 x 16
M7985A-04020-20	M4-0.70 x 20
M7985A-04050-20	M4-0.70 x 50
M7985A-04100-20	M4-0.70 x 100
M7985A-05010-20	M5-0.80 x 10
M7985A-05012-20	M5-0.80 x 12
M7985A-05016-20	M5-0.80 x 16
M7985A-05020-20	M5-0.80 x 20
M7985A-05025-20	M5-0.80 x 25
M7985A-05030-20	M5-0.80 x 30
M7985A-05080-20	M5-0.80 x 80
M7985A-05100-20	M5-0.80 x 100
M7985A-06100-20	M6-1.00 x 100
Flat Head Machine Screws	
M965A-04012-SS	M4-0.70 x 12
M965A-05012-SS	M5-0.80 x 12
M965A-05016-20	M5-0.80 x 16
M965A-06012-20	M6-1.00 x 12

* This metric hex bolt's hardness is grade 10.9.

Metric, continued

Hex Nuts

Part No.	Dimensions	Type
M934-03-50	M3-0.50	Standard
M934-04-50	M4-0.70	Standard
M934-04-B	M4-0.70	Brass
M934-05-50	M5-0.80	Standard
M934-06-60	M6-1.00	Standard
M934-06-64	M6-1.00	Std. (green)
M6923-06-80	M6-1.00	Spiralock
M982-06-80	M6-1.00	Elastic Stop
M934-08-60	M8-1.25	Standard
M6923-08-80	M8-1.25	Spiralock
M982-08-80	M8-1.25	Elastic Stop
M934-10-60	M10-1.50	Standard
M934-10-60F	M10-1.25	Standard
M6923-10-80	M10-1.50	Spiralock
M6923-10-62	M10-1.50	Spiralock†
M982-10-80	M10-1.50	Elastic Stop
M934-12-60	M12-1.75	Standard
M934-12-60F	M12-1.25	Standard
M6923-12-80	M12-1.75	Spiralock
M982-12-80	M12-1.75	Elastic Stop
M982-14-60	M14-2.00	Elastic Stop
M6923-16-80	M16-2.00	Spiralock
M982-16-80	M16-2.00	Elastic Stop
M934-18-80	M18-2.5	Standard
M982-18-60	M18-2.50	Elastic Stop
M934-20-80	M20-2.50	Standard
M982-20-80	M20-2.50	Elastic Stop
M934-22-60	M22-2.50	Standard
M934-24-80	M24-3.00	Standard
M982-24-60	M24-3.00	Elastic Stop
M934-30-80	M30-3.50	Standard

Washers

Part No.	ID	OD	Thick.	Bolt/ Screw
M125A-03-80	3.2	7.0	0.5	M3
M125A-04-80	4.3	9.0	0.8	M4
M125A-05-80	5.3	10.0	1.0	M5
M125A-06-80	6.4	12.0	1.6	M6
M125A-08-80	8.4	16.0	1.6	M8
M125A-10-80	10.5	20.0	2.0	M10
M125A-12-80	13.0	24.0	2.5	M12
M125A-14-80	15.0	28.0	2.5	M14
M125A-16-80	17.0	30.0	3.0	M16
M125A-18-80	19.0	34.0	3.0	M18
M125A-20-80	21.0	37.0	3.0	M20
M125A-24-80	25.0	44.0	4.0	M24

† This metric hex nut's hardness is grade 8.

Notes

Notes

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Phone 920-457-4441, Fax 920-459-1646

Kohler Power Systems
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For the nearest KOHLER authorized installation, service, and sales dealer in the US and Canada:
Call 1-800-544-2444 or visit KOHLERPower.com

TP-6808 3/15b