Installation

Mobile Generator Sets

Model:

Paralleling Box GM88594-KP1-QS

Applicable Generator Set Models:

30–175 kW Mobile Generator Sets
equipped with the Decision-Maker® 3500 Controller

ISO 9001 KOHLER POWER SYSTEMS NATIONALLY REGISTERED

KOHLER® Power Systems

TT-1672 10/16a

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IMPORTANT SAFETY INSTRUCTIONS. Electromechanical equipment, including generator sets 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***.

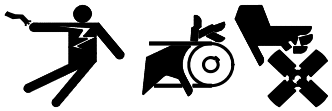
NOTICE

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.

This equipment must be installed and serviced by qualified electrical personnel.

DANGER

Hazard of electric shock, explosion, or arc flash.
Will cause severe injury or death.

The enclosure should be opened by trained and authorized personnel only. Any terminal may be energized when any cable is connected. Do not connect or disconnect cables under load. De-energize all cables at generator prior to opening the cover.

DANGER

Hazardous voltage.
Will cause severe injury or death.

Multiple power sources can automatically energize the distribution bus. Disconnect all power sources before connecting to the distribution bus.

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 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.

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

⚠ WARNING

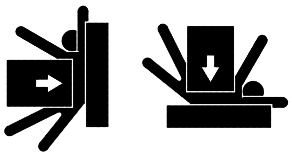
Hazardous voltage.
Backfeed to the utility system can cause property damage, severe injury, or death.

If the generator set is used for standby power, install an automatic transfer switch to prevent inadvertent interconnection of standby and normal sources of supply.

Electrical backfeed to the utility. Hazardous backfeed voltage can cause severe injury or death. Install a transfer switch in standby power installations to prevent the connection of standby and other sources of power. Electrical backfeed into a utility electrical system can cause severe injury or death to utility personnel working on power lines.

Heavy Equipment

⚠ WARNING



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

Always maintain a safe distance from the unit being lifted. Never stand under a unit. Use lifting bars inserted through the skid or the lifting eye to lift the paralleling box.

Hot Parts

⚠ CAUTION

Hot surfaces.

This manual contains installation, setup, and maintenance information for the Mobile Paralleling Box.

Use the paralleling box to connect two Kohler mobile generator sets equipped with the Decision-Maker® 3500 controller for parallel operation. The generator sets must have the same voltage and phase configuration, but can be different models and use different fuel types (for example, one diesel and one LPG unit can be used).

Up to four paralleling boxes and eight generator sets can be connected in one paralleling system.

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

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

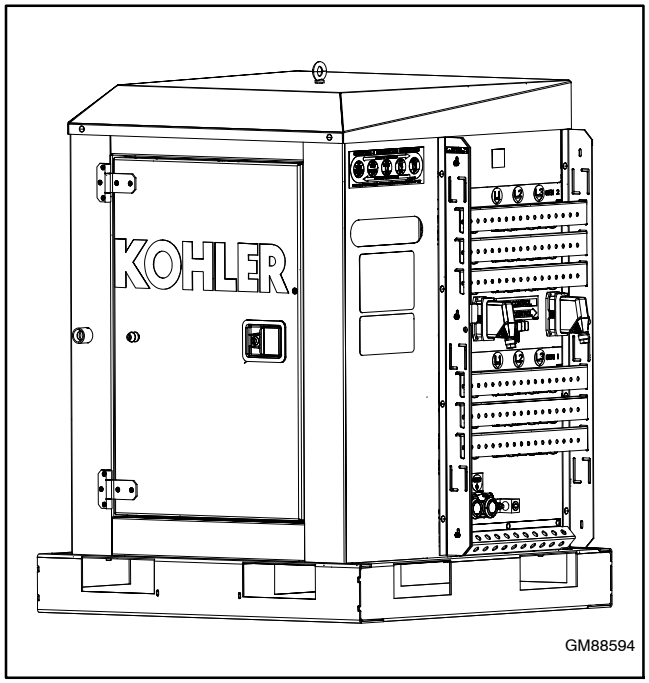


Figure 1 Paralleling Box GM88594-KP1-QS

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 for 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.

List of Related Materials

The paralleling box covered in this manual is one part of a paralleling system. Refer to the operation manual provided with the generator sets for detailed paralleling information and instructions. The following list shows additional literature relevant to the paralleling system.

Document	Part Number
Specification Sheet, Paralleling Box	G6-148
Generator Set Operation Manual, Model REOZT4	TP-6895
Generator Set Operation Manual, Model REZGT	TP-6935
SiteTech™ Software Operation Manual	TP-6701

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 decals 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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Japan, Korea
North Asia Regional Office
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1.1 Introduction

Different operation modes are possible with paralleled generator sets. Review the brief descriptions below and refer to the generator set Operation Manual for complete operation information. Determine which operation mode is needed for your application.

1.1.1 Generator Management Mode

In generator management mode, one generator set may shut down if the load is small and start again if the load increases. Generator management sequences the generator sets off in a predetermined order. Generator management must be enabled on all generator sets for this mode of operation.

If generator management is disabled, all the generator sets will run when a start signal is received.

Some sites may require generator management, and others may prohibit it. If generator management is not requested, it should be disabled.

Start the generator sets by holding AUTO and pressing RUN to start in generator management mode.

1.1.2 Redundant Mode

Press the RUN button on each generator set to run the generator sets without generator management. The generator sets run continuously, independent of the load. If one generator set shuts down, the others continue to run and supply the load.

1.1.3 Load Management

Most paralleling applications require some type of load management. Load management allows the removal of non-critical loads in order to prevent overload of a generator set if one or more generator sets are out of service or otherwise unavailable. Large loads that are not critical to human health and safety or the operation of the facility are good candidates for load management.

The Decision-Maker® 3500 controller supports 6 load priorities. Priority 1 adds first and sheds last. Priority 6 adds last and sheds first. The priorities are shared throughout the paralleling system, meaning that priority 1 will shed simultaneously on all controllers, regardless of the generator set state (running or stopped). See the generator set operation manual for additional information.

Connection of 1 – 3 priorities to each generator provides better redundancy than connecting all priorities to a single generator.

1.2 Paralleling Box Features

- Water-resistant enclosure designed and tested to NEMA type 3R enclosure specifications for outdoor installation
- Six inch high skid with forklift openings
- Single point lifting eye
- Indicator lights (ON when generator set is connected to the bus)
- Color-coded camlock power connectors
- Lockable security bars for unused input and output camlock connectors
- Cable strain-relief tie-down points
- Control harnesses, two provided with each paralleling box
- Cooling fans
- Storage locker with keyed latch and rack for control harnesses
- External ground lug
- Removable neutral/ground bonding bus for application flexibility
- Padlock hasp for electrical compartment security

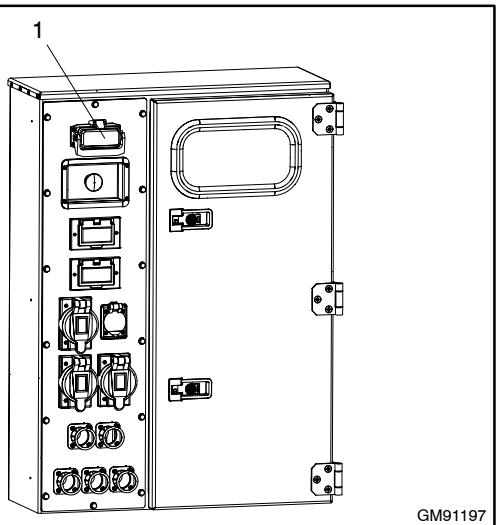
See ADV-8713 in Section 7 for paralleling box dimensions and features.

1.3 Requirements

Paralleled generator sets:

- Must be mobile models REOZT4 or REZGT equipped with the Decision-Maker® 3500 controller, voltage selector switch, and camlock connectors.
- Must have the same voltage configuration and number of phases (all single–phase or all three-phase).
- Must have the control harness connector shown in Figure 1-1. Install the retrofit kit, if necessary. See Figure 1-2 for kit numbers.
- Can be different kW models. For example, you can parallel one 35REOZT4 with one 175REOZT4.
- Can use different fuels (for example, one LPG generator set and one diesel unit).

The paralleling box is not intended for permanent stationary use.



1. Control harness connector

Figure 1-1 Control Harness Connector

Generator Set Model	Adapter Kit Number
30–125REZGT	GM98565–S
35/45REOZT4	GM98566–S

Figure 1-2 Generator Set Retrofit Kits

1.4 Specifications

Paralleling Box Specifications	
Source Input Voltage Range	120–600 VAC
Load Output voltage Range	120–600 VAC
Source Current Limit	1000 amps each (max.) *
	2000 amps total (max.) *
Output Bus Sensing	120–600 VAC (fused)
Contactor Coil	208–240 VAC 1200 W max.
Control Harness Length †	7.6 m (25 ft.)
* Derate 5% per 10°C (18°F) above 40°C (104°F). † Two (2) control harnesses are factory-supplied with each box.	

Figure 1-3 Electrical Specifications

Environmental Specifications	
Operating Temperature	–5 to 55°C (23 to 131°F)
Storage Temperature	–40 to 70°C (–40 to 158°F)
Humidity	5% to 95%

Figure 1-4 Environmental Specifications

Weight and Dimensions	
Weight, kg (lbs.) *	408 (900)
Dimensions, L x W x H mm (in.)	1067 x 1067 x 1431 (42.0 x 42.0 x 56.3)
* Approximate weight	

Figure 1-5 Weight and Dimensions

1.5 System Installation Overview and Interconnection Diagram

The figures in this section are intended to give an overview of the paralleling system installation and connections. They are not intended to replace the more detailed instructions given later in this manual. Be sure to read and follow all instructions and safety precautions in the next sections of this manual.

Figure 1-6 summarizes the installation procedure for the paralleling system. Each step refers to a section of this manual or the generator set documentation. Be sure to read and follow all instructions for each step.

Figure 1-7 shows an overall view of the paralleling system. Two to eight generator sets can be paralleled using one to four paralleling boxes. Be sure to follow the safety precautions and instructions in Section 4 for all electrical connections.

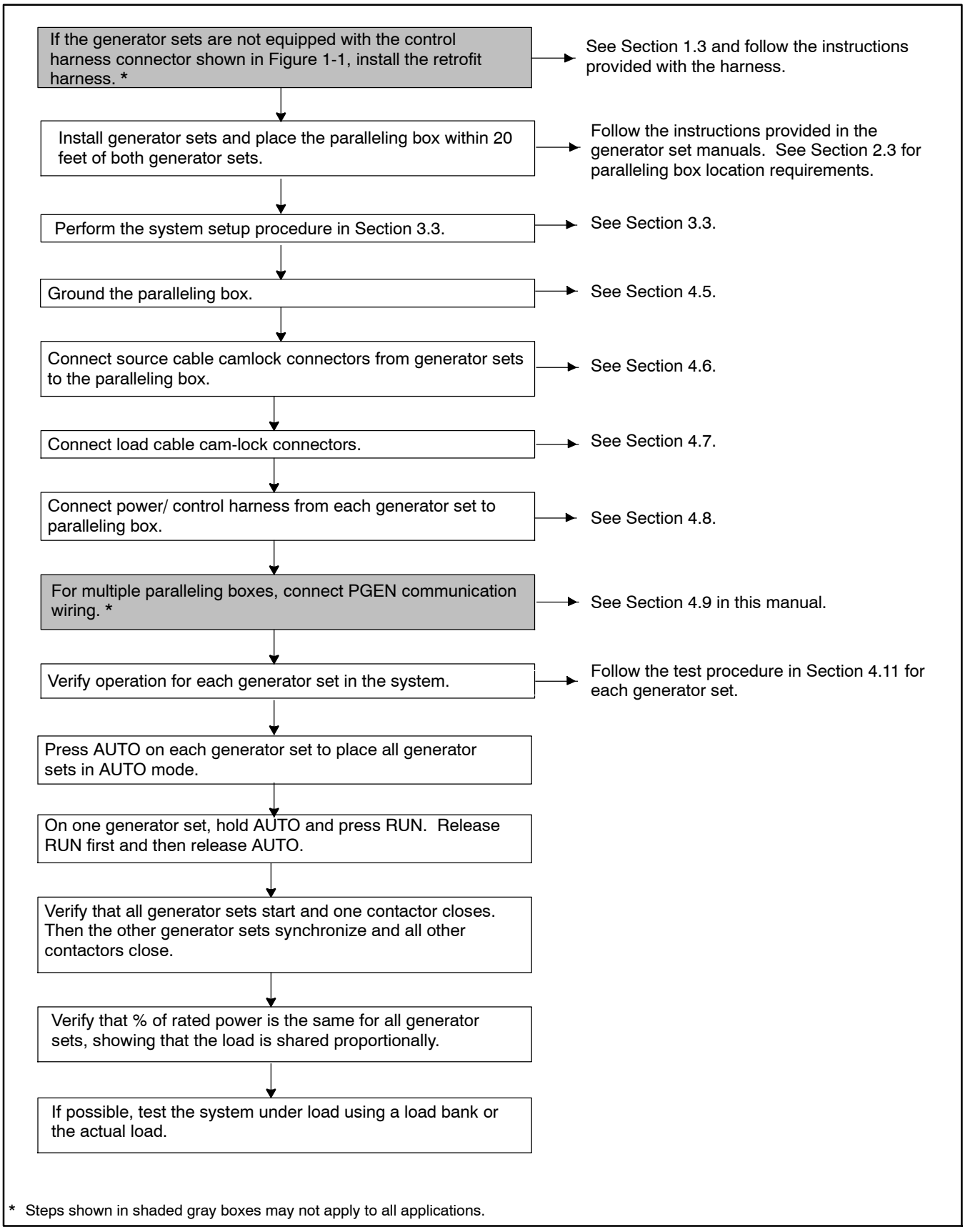


Figure 1-6 System Installation Overview

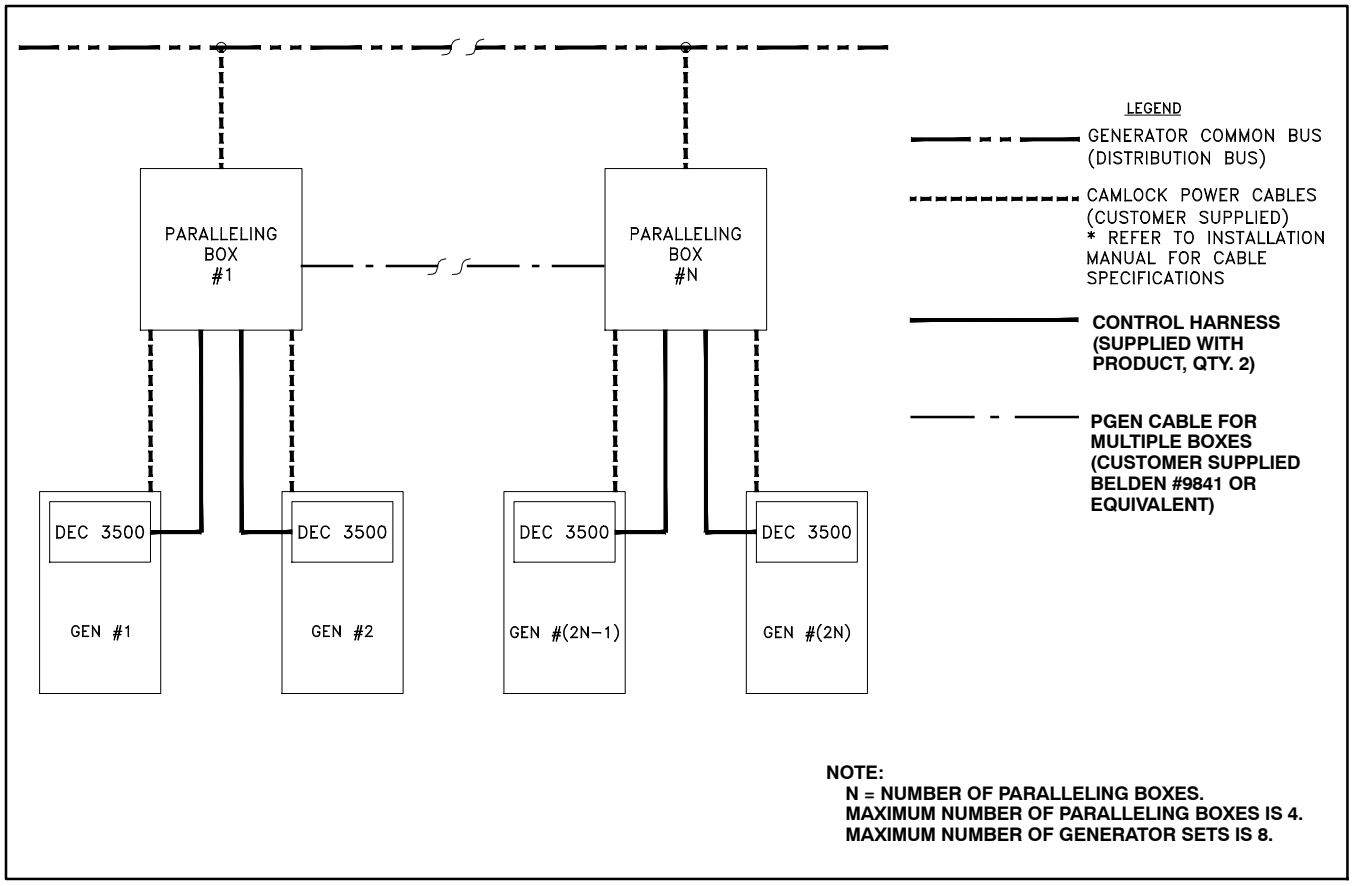


Figure 1-7 System Interconnection Diagram

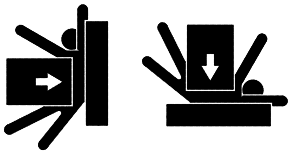
2.1 Introduction

Read and follow the safety precautions included in this manual. Pay attention to the decals on the equipment and follow the instructions in this manual.

All personnel involved in handling, site preparation, installation, testing, operation, and maintenance should be thoroughly familiar with the information in this manual and the customer drawings provided before working with this equipment.

2.2 Lifting and Transporting

⚠ WARNING



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

Always maintain a safe distance from the unit being lifted. Never stand under a unit. Use lifting bars inserted through the skid or the lifting eye to lift the paralleling box.

Use a truck or utility trailer of sufficient size to transport the unit. The box dimensions and weight are shown in Section 1.1.

The paralleling box can be lifted with a fork lift. Note the unit's weight shown in Section 1.1. Insert the forks through the openings in the skid.

The paralleling box is also equipped with a lifting eye for lifting and stabilizing the box. Use lifting equipment that is rated for the weight of the box.

2.3 Location

The paralleling box and connected generators make up the power system. Use the following information as a guideline when selecting a location for the paralleling box. Be aware of potential detrimental conditions and use common sense when determining a location. The contractor, property owner, and/or power system owner must address the issues of security and personnel safety in areas that are open to the public and occupied by children.

2.3.1 Generator Set Proximity

The paralleling box must be installed near the generator sets. Install the paralleling box within 6 m (20 ft) of the generator sets to allow connection of the 7.6-meter (25-foot) long control harness. A minimum clearance of 0.6 m (2 ft.) between the generator sets and the paralleling box is recommended for sufficient cooling air flow.

2.3.2 Surface Stability

Choose a location with a solid, level base and avoid loose gravel, soft dirt, mud, standing water, etc. Avoid steep dropoffs, rough terrain, etc. If the area is subject to heavy rain, evaluate the surrounding area to avoid flooding and/or mud damage.

2.3.3 Adequate Air Flow/Heat Dissipation

Select a location that provides adequate air flow. Avoid locations next to tall buildings that block normal air flow and cause air vacuum pockets. Avoid areas subject to high winds, excessive dust, or other airborne contaminants. Select a shaded area away from direct sunlight and/or other heat producing equipment when practical.

2.3.4 Combustible Materials

Avoid areas with combustible materials, including building materials as well as natural surroundings. Keep dry field grass, foliage, and combustible landscaping material a safe distance from the generator set exhaust systems. DO NOT locate the power system or operate the generator set in an environment with explosive fumes.

Notes

3.1 Prestart Checklist

Perform the prestart checks listed in the generator set operation manual. In addition to those generator set items, check the following on the paralleling box before startup and at regular intervals.

Air Inlets. Check for clean and unobstructed air inlets.

Enclosure Doors. Check that the service access doors are closed and secured.

Fire Extinguisher (user-supplied). Verify that a fully charged fire extinguisher that is rated for electrical fires is in place.

Operating Area. Check for obstructions that could block the flow of cooling air. Keep the area clean. Do not leave rags, tools, or debris on or near the equipment.

3.2 Weather and Climate Provisions and Operation Limitations

Operation and use of a generator set in the outdoors or in unsheltered areas require special attention to weather conditions and environmental surroundings. Weather conditions may limit the usability where rain or damp conditions increase the chance of electrocution.

A generator set, like any other electromechanical device, can pose potential dangers to life and limb if improperly maintained or operated. The best way to prevent accidents is to be aware of potential dangers and act safely. This manual and the generator set operation manual contain several types of safety precautions and instructions. Please read and follow the safety precautions and instructions to prevent harm to yourself and others.

Operate the generator set during rain or other inclement weather conditions only if the responsible electrician and/or contractor can secure and protect electrical connections from inclement weather exposure. Keep the trailer doors closed and all electrical boxes closed. Keep unauthorized personnel away from all electrical wiring and devices. The responsible electrician and/or contractor must maintain periodic inspection of the generator set and electrical devices during inclement weather conditions.

If at any time there is a question of generator set operation suitability during inclement weather, shut down the generator set immediately.

3.3 Paralleling System Setup

Use a personal computer with SiteTech™ software connected to the generator set controller to configure each generator in the paralleled system. Some settings can also be checked and adjusted using the Decision-Maker® 3500 controller menus. The controller settings are summarized in Figure 3-1 at the end of the procedure.

Refer to the operation manual provided with the generator set for Decision-Maker® 3500 controller instructions. The generator operation manual also contains detailed information about paralleling setup and operation, including synchronization, generator management, and load management (load control).

1. Check that the generator set voltage selector switch and/or alternator wiring matches the voltage configuration for the building (or loads being supplied). Repeat for all generator sets in the system.

2. Set the digital output to Contactor.
   In SiteTech go to Programmable Digital Output 116 and set the Digital Output Event to Contactor.
   This setting can be checked but not changed on the Decision-Maker® 3500 controller. Go to I/O > DIGITAL OUTPUT > DIGITAL OUTPUT 1:2
   Repeat for all generator sets in the system.

3. Set the reactive droop to 0.5 – 2%. The default setting of 1% works in nearly all applications. Use the same reactive droop setting on all generators in the paralleled system.
   In SiteTech go to Reactive Power Sharing and set the reactive droop slope.
   On the Decision-Maker® 3500 controller go to:
   GENERATOR INFO > VOLTAGE REGULATION (called VOLT DROOP AT 100% kVAR), or
   GENERATOR INFO > PARALLELING OPERATION > SHARING SETUP

4. Set the target voltage on all paralleled generators to the same value.
   In SiteTech go to Voltage Regulator and set Voltage Regulator Average Voltage Adjustment.
   On the Decision-Maker® 3500 controller go to:
   GENERATOR INFO > VOLTAGE REGULATION

5. Set the engine speed adjustment to 50 on all generators. The engine speed adjustment setting must be the same on all generators in the system.
   In SiteTech, go to Engine Speed Governor and set the Engine Speed Adjustment.

On the Decision-Maker® 3500 controller, go to GENERATOR INFO > CONFIGURATION > GENERATOR CONFIG.

Note: 50 is the default setting, which sets the engine speed to the nominal engine speed (for example, 1800 RPM). Settings between 40 and 60 are acceptable. A setting of 52 increases the engine speed by 2 RPM; 49 decreases the engine speed by 1 RPM; etc.

6. Verify metering. Check the voltage displayed on the generator set controller. If it is not correct, go to the calibration procedure in Section 3.4.
   Repeat for all generator sets in the system.

7. For all generators in the system, set the Sync Mode in AUTO setting to ACTIVE. Set the Sync Mode in Run setting to CHECK. Synch mode settings are summarized in Figure 3-2.
   In SiteTech, go to Synchronization Control and set the Sync Mode in AUTO and Sync Mode in Run settings.
   On the Decision-Maker® 3500 controller, go to GENERATOR INFO > PARALLELING OPERATION > SYNCHRONIZING SETUP.

   Note: When the generators are in AUTO mode, the ACTIVE setting will actively adjust the speed and voltage of the generator in order to synchronize with the paralleling bus and close the contactor in the paralleling box as soon as synchronization is maintained for a minimum length of time (which is set by the dwell timer). For other synchronization mode options, see Figure 3-2.

8. Set Generator Management Enabled to OFF at each generator set unless generator management is requested for the application. See the generator operation manual for detailed information about generator management.
   In SiteTech, go to Generator Management and set Gen Management Enabled ot OFF.
   On the Decision-Maker® 3500 controller, go to GENERATOR INFO > PARALLELING OPERATION > GENERATOR MANAGEMENT.

   Note: Generator management must be disabled manually at each generator set controller.

9. Set up load management for non-critical loads. Set the Load Shed Priority for each load. Priority 1 adds first and sheds last.
   In SiteTech, go to Programmable Digital Output 115 and set the Digital Output Event to Load Priority (1–6) Shed.
   On the Decision-Maker® 3500 controller, go to GENERATOR INFO > PARALLELING OPERATION > LOAD CONTROL

   Note: Load shed relays are required for load management. See the generator set documentation for relay connection information.

   Note: The generator sets must be in AUTO mode for load management operation.

10. Stop all generators by pressing the OFF button on each controller.

Parameter	Recommended Setting	DEC 3500 Menu	SiteTech Menu
Digital Output	Contactor	I/O > DIGITAL OUTPUT > DIGITAL OUTPUT 1:2 (verification only)	Programmable Digital Output 116 Menu Digital Output Event
Reactive Droop	Default setting = 1%. Range 0.5 – 2%.	GENERATOR INFO > VOLTAGE REGULATION (called VOLT DROOP AT 100% kVAR) or GENERATOR INFO > PARALLELING OPERATION > SHARING SETUP	Reactive Power Sharing Menu Reactive Droop Slope
Target Voltage	Rated voltage. Set the target voltage on each generator to the same value.	GENERATOR INFO > VOLTAGE REGULATION	Voltage Regulator Menu Voltage Regulator Average Voltage Adjustment
Engine Speed Adjustment	Default setting = 50 Range 40–60	GENERATOR INFO > CONFIGURATION > GENERATOR CONFIG.	Engine Speed Governor Menu Engine Speed Adjustment
Sync Mode in Auto *	Active	GENERATOR INFO > PARALLELING OPERATION > SYNCHRONIZING SETUP	Synchronization Control Menu Sync Mode in AUTO
Sync Mode in Run *	Check	GENERATOR INFO > PARALLELING OPERATION > SYNCHRONIZING SETUP	Synchronization Control Menu Sync Mode in Run
Generator Management	OFF	GENERATOR INFO > PARALLELING OPERATION > GENERATOR MANAGEMENT	Generator Management Menu Gen Management Enabled
Load Management	Load Priority 1 Shed Load Priority 2 Shed Load Priority 3 Shed Load Priority 4 Shed Load Priority 5 Shed Load Priority 6 Shed	GENERATOR INFO > PARALLELING OPERATION > LOAD CONTROL	Programmable Digital Output 115 Menu Digital Output Event
* See Figure 3-2 for other Sync Mode settings.			

Figure 3-1 Decision-Maker® 3500 Settings for Paralleling

Sync Mode Setting	Description
Sync Mode in Auto	Sync Mode in Auto is the synchronization mode that the controller uses when the engine control switch is in AUTO, as indicated by the blue indicator over the AUTO button. This Sync Mode defaults to Active, which will work for almost all applications.
Sync Mode in Run	Sync Mode in Run is the synchronization mode that the controller uses when the engine control switch is in RUN, as indicated by the blue indicator over the RUN button. If the generators will be primarily operated by pressing the RUN button on each generator, this sync mode should be set to Active.
Off	The controller does not attempt to synchronize in any way.
Check	The controller actively controls the speed and voltage of the generator in an effort to synchronize with the paralleling bus, but doesn't close the contactor in the paralleling box unless no other generators are powering the bus.
Passive	The controller does not attempt to synchronize in any way, but if it remains in phase with the paralleling bus for the duration of the dwell timer, it will close the paralleling contactor. This mode is used when the controller is unable to adjust engine speed or can only adjust engine speed to a higher speed.
Active	The controller actively controls the speed and voltage of the generator in order to synchronize with the paralleling bus, closing the contactor in the paralleling box as soon as it is synchronized for the duration of the dwell timer.

Figure 3-2 Synchronization Mode Settings

3.4 Calibration

Note: Copying personality profiles from one controller to another can overwrite the calibration coefficients. This requires re-calibrating the controller, which is often easier than attempting to change all the settings twice.

Line-to-line voltage calibration is important for good system performance. Paralleling compares line-to-line voltages (generator and paralleling bus), and the voltage regulator also regulates to line-to-line voltage. For wye-connected systems, line-to- neutral voltage should also be calibrated for correct power metering.

Generator Voltage: The generator set controllers must be calibrated to ensure that they are measuring voltage correctly in order to produce the correct output voltage. The controller uses the measured voltage to match the three-phase average voltage to the target. If the measured voltage is incorrect, the generator will not produce the correct target voltage.

Bus Voltage. During synchronization, the controller matches the generator voltage to the measured bus voltage to ensure that the reactive power exchange is a minimum when the breaker closes. If the bus metering is not calibrated correctly, the Decision-Maker® 3500 controller will match the generator voltage to the incorrect bus voltage. If the measured bus voltage is either higher or lower than the actual bus voltage, it will result in reactive power transfer when the breaker closes, potentially causing a generator to disconnect from the paralleling bus to protect itself.

A multimeter with a recent calibration verification is necessary to calibrate the generator controller. The controller should be within 2% accuracy without calibration. Using an uncalibrated meter could make the controller less accurate than it was before calibration.

1. Calibrate the Generator Voltage

   Generator voltage is calibrated most easily from the front panel of the controller. Use a calibrated multimeter to measure the generator voltage and enter the correct value in the CONTROLLER CONFIG -> CALIBRATION screen on the controller.

2. Calibrate the Bus Voltage

   Bus voltage is calibrated most easily from the front panel of the controller. Use a calibrated multimeter to measure the bus voltage and enter the correct value in the CONTROLLER CONFIG -> CALIBRATION screen on the controller.

Notes

4.1 Introduction

Read and follow the safety precautions included in this manual. Pay attention to the decals on the equipment and follow the instructions below.

- All personnel involved in handling, site preparation, installation, testing, operation, and maintenance should be thoroughly familiar with the information in this manual and the customer drawings provided before working with this equipment.
- Never make interlocks inoperative or operate the equipment with any safety barriers removed.
- Always assume that all high-voltage parts are energized until it is certain that they are de-energized.
- Use only test equipment rated for the service intended.
- Check interconnection diagrams and make sure there are no potential backfeed sources.
- Use out-of-service tags and padlocks when working on equipment. Leave tags in place until the work is completed and the equipment is ready to be put back into service.

The Decision-Maker® 3500 generator set controller provides advanced generator set control, system monitoring, and system diagnostics for paralleling multiple generator sets.

The Decision-Maker® 3500 interfaces the generator set to other power system equipment and other network management systems using standard industry network communications.

The controller uses unique software logic to manage sophisticated functions, such as voltage regulation, synchronizing and load-sharing controls, and protective relays for paralleling up to eight generator sets.

4.2 Electrical Panel Cover

⚠ DANGER

Hazard of electric shock, explosion, or arc flash.
Will cause severe injury or death.

The enclosure should be opened by trained and authorized personnel only. Any terminal may be energized when any cable is connected. Do not connect or disconnect cables under load. De-energize all cables at generator prior to opening the cover.

Do not remove the electrical panel cover during installation, connection, or operation of the paralleling box. Secure the cover with a padlock to prevent unauthorized access.

The cover should be removed only by trained service personnel during maintenance or service.

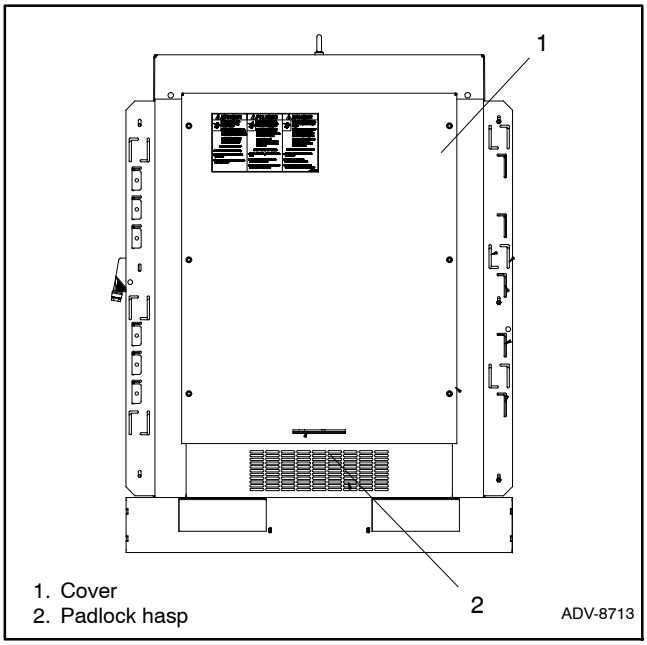


Figure 4-1 Electrical Panel Cover – DO NOT REMOVE

4.3 Cable Specifications

Two 7.6-meter (25-foot) long control harnesses are provided with each paralleling box. Grounding and power cables are customer-provided. If multiple paralleling boxes are used, the PGEN cable connecting the boxes is customer-provided. See Figure 4-2 through Figure 4-5 for customer-provided cable and camlock connector specifications.

To determine the size and number of source cables required for each generator set, refer to Figure 4-4.

To determine the size and number of output cables required, refer to the generator set nameplate or specification sheet for the maximum current rating for each generator set. Add the two current ratings to determine the maximum output current and see Figure 4-5.

Attach camlock connectors to the generator source cables and the output load cables. See Figure 4-3 for the connector specifications. Label the cables to match the connector labels on the paralleling box.

Note: Label both ends of each source and load camlock cable to prevent connection errors. Color-coded labels matching the colors shown in Figure 4-3 are strongly recommended.

Cable	Cable Size Range
Ground lug	(1) #4-600 or (2) 1/0-250
PGEN cable (for multiple paralleling boxes)	Belden #9841 (or equivalent)

Figure 4-2 Cable Specifications

Description	Source Cables (Generator Input)	Load Cables (Output)
Plug Rating	400 A, 600 VAC	400 A, 600 VAC
Cable Size *	2/0 - 4/0, Type W *	2/0 - 4/0, Type W *
Black	HBL400FBK	HBL400MBK
White	HBL400FW	HBL400MW
Red	HBL400FR	HBL400MR
Blue	HBL400FBL	HBL400ML
Green	HBL400FGN	HBL400MGN
* See Figure 4-4 for cable size		

Figure 4-3 Camlock Plug specifications

Model Number	Output Voltage	Wire Gauge, Min.	Number of Cables per Phase
30REZGT	120/208 wye	2/0	1
	277/480 wye	2/0	1
	120/240 dog-leg	2/0	1
35REOZT4	120/208 wye	2/0	1
	277/480 wye	2/0	1
	120/240 dog-leg	2/0	1
45REOZT4	120/208 wye	2/0	1
	277/480 wye	2/0	1
	120/240 dog-leg	2/0	1
50REZGT	120/208 wye	2/0	1
	277/480 wye	2/0	1
	120/240 dog-leg	2/0	1
55REOZT4	120/208 wye	2/0	1
	277/480 wye	2/0	1
	120/240 dog-leg	2/0	1
70REZGT	120/208 wye	2/0	1
	277/480 wye	2/0	1
	120/240 dog-leg	2/0	1
125REZGT	120/208 wye	4/0	1
	277/480 wye	2/0	1
	120/240 dog-leg	4/0	1
145REOZT4	120/208 wye	2/0	2
	277/480 wye	2/0	1
	120/240 dog-leg	2/0	2
175REOZT4	120/208 wye	2/0	2
	277/480 wye	2/0	1
	120/240 dog-leg	2/0	2

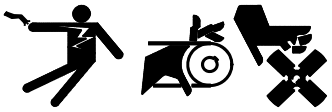
Figure 4-4 Cable Sizes for Camlock Source Connections

Maximum Output Current, Amps †	Number of Cables Required per Phase	
	2/0 Cables (300 A max. each)	4/0 Cables (405 A max. each) ‡
up to 300	1	1
301-400	2	1
401-600	2	2
601-800	3	2
801-900	3	3
901-1200	4	3
1201-1500	5	4
1501-1600	—	4
1601-2000	—	5
† Add the current ratings of the two paralleled generator sets. See the generator set nameplate or specification sheet.		
‡ Camlock connector rating is 400 amps.		

Figure 4-5 Output Cable Sizing

4.4 Disable the Generator Sets

⚠ 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.

1. Press the generator set master control OFF/RESET button.
2. Disconnect the power to the battery charger, if equipped.
3. Disconnect the generator set engine starting battery(ies), negative (-) lead first.

4.5 Grounding

⚠ DANGER

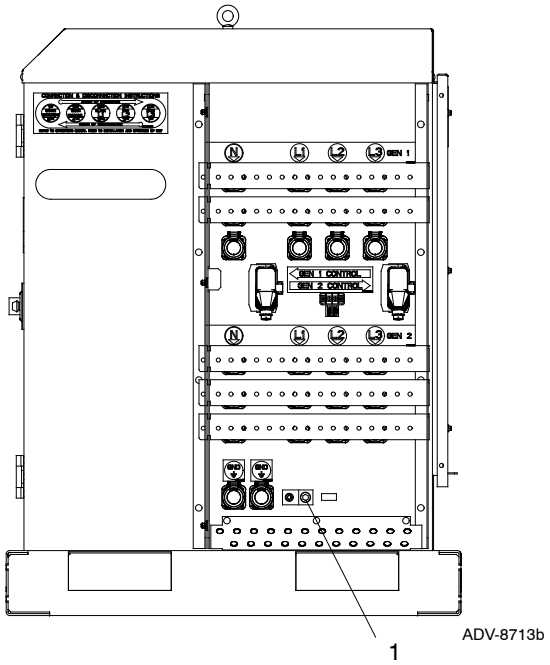
Hazard of electric shock, explosion, or arc flash.
Will cause severe injury or death.

The enclosure should be opened by trained and authorized personnel only. Any terminal may be energized when any cable is connected. Do not connect or disconnect cables under load. De-energize all cables at generator prior to opening the cover.

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 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.

Connect the ground lug on the paralleling box to earth ground according to applicable state and local codes. See Figure 4-6 for the ground lug location. Follow the NEC guidelines for grounding electrical equipment.

The neutral is bonded to ground inside the paralleling box enclosure. If required for compliance to applicable codes, disconnect the neutral from the ground by removing the bonding bus.



1. Ground lug

Figure 4-6 Ground Lug Location

4.6 Source Connections

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

This equipment must be installed and serviced by qualified electrical personnel.

Note: The maximum current allowed for each camlock cable is 400 amps. Use a sufficient number of cables for the maximum current rating of the generator. See Figure 4-4.

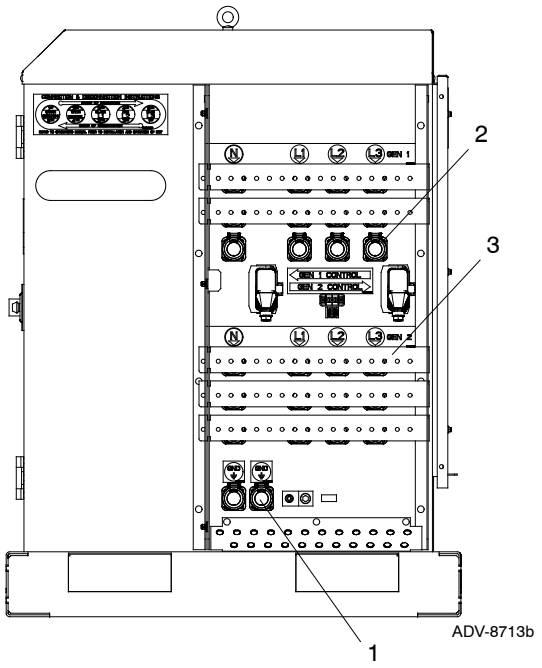
Remove the camlock security guard from one row of connectors for each generator. Store the security guard in one of the storage locations shown in Figure 7-2. Note that generator 2 connects to the upper set of camlocks, and generator 1 connects to the lower set.

See Section 4.3 for cable size specifications. Connect the camlock cables one at a time, matching colors and connecting in the order shown in the labels on the paralleling box. See Figure 4-7 and Figure 4-8.

Note: Be sure to check the camlock connections at the generator and connect the cables correctly in the order shown below:

- Ground to Ground (Connect the ground first)
- Neutral to Neutral
- L1 to L1
- L2 to L2
- L3 to L3

1. Connect the source side ground (green) camlock cables to the paralleling box first and then to each generator.
2. Connect the source side neutral (white) camlock cables to the paralleling box first and then to each generator.
3. Connect the source side L1 (black), L2 (red) and L3 (blue) camlock cables to the paralleling box first and then to each generator.



Note: Security guards are shown over some of the camlocks .

1. Camlock ground connections. CONNECT FIRST
2. Camlock source connections, generator 2
3. Camlock source connections, generator 1

Figure 4-7 Source Connections

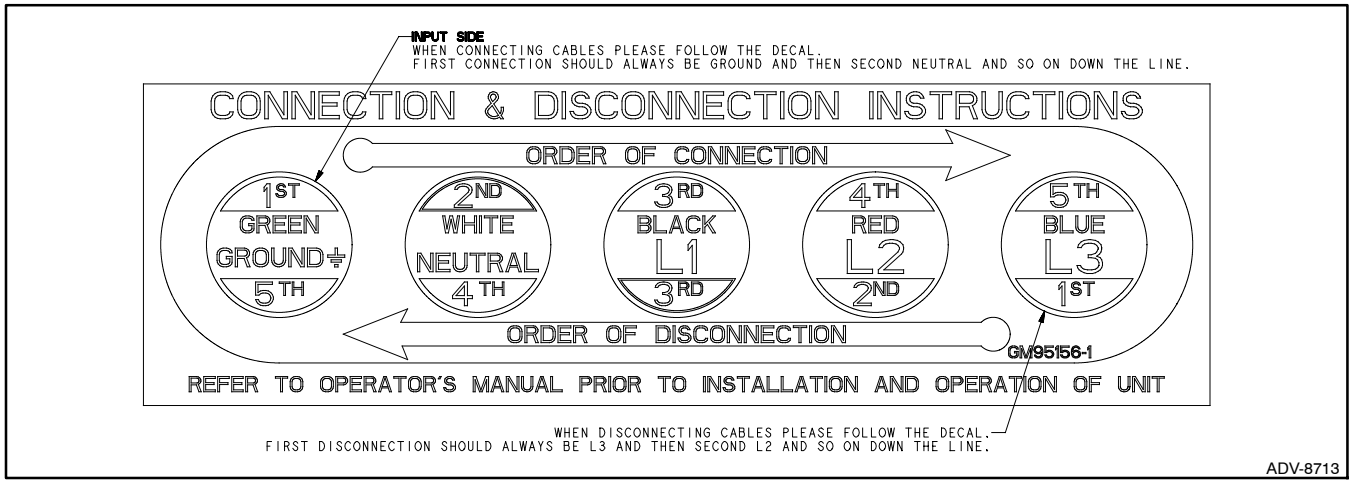


Figure 4-8 Source Side Camlocks, Order of Connection and Disconnection

4.7 Load Connections

DANGER

Hazardous voltage.
Will cause severe injury or death.

Multiple power sources can automatically energize the distribution bus. Disconnect all power sources before connecting to the distribution bus.

Multiple power sources can energize the distribution bus. Disconnect all power sources to the distribution bus, including all generators and utility power.

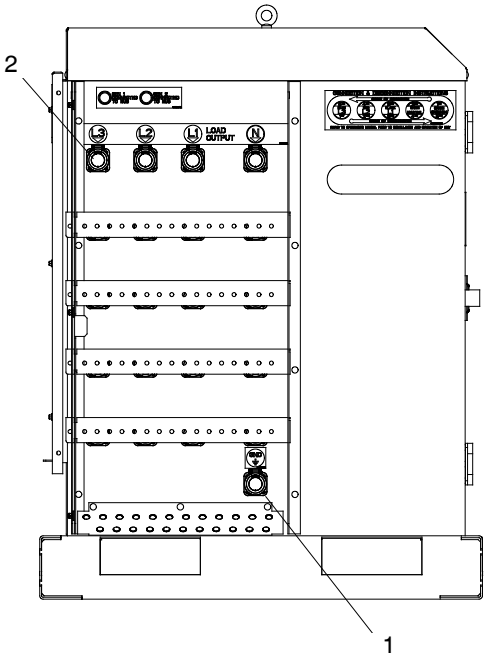
Remove the camlock security guard from one row of connectors for each generator. Store the security guard in one of the storage locations shown in Figure 7-2.

See Section 4.3 for cable size specifications. Connect the camlock cables one at a time, matching colors and connecting in the order shown in the labels on the paralleling box. See Figure 4-9 and Figure 4-10. Connect the ground cable first.

Note: Be sure to check the camlock connections at the generator and connect the cables correctly in the order shown below:

- Ground to Ground
- Neutral to Neutral
- L1 to L1
- L2 to L2
- L3 to L3

1. Connect the load side ground (green) camlock cables to the distribution bus and then to the paralleling box.
2. Connect the load side neutral (white) camlock cables to the distribution bus and then to the paralleling box.
3. Connect the load side L1 (black), L2 (red) and L3 (blue) camlock cables to the distribution bus and then to the paralleling box.



Note: Security guards are shown over some of the camlocks .

1. Ground camlock connection. CONNECT FIRST
2. Load camlock connections

Figure 4-9 Load Side Connections

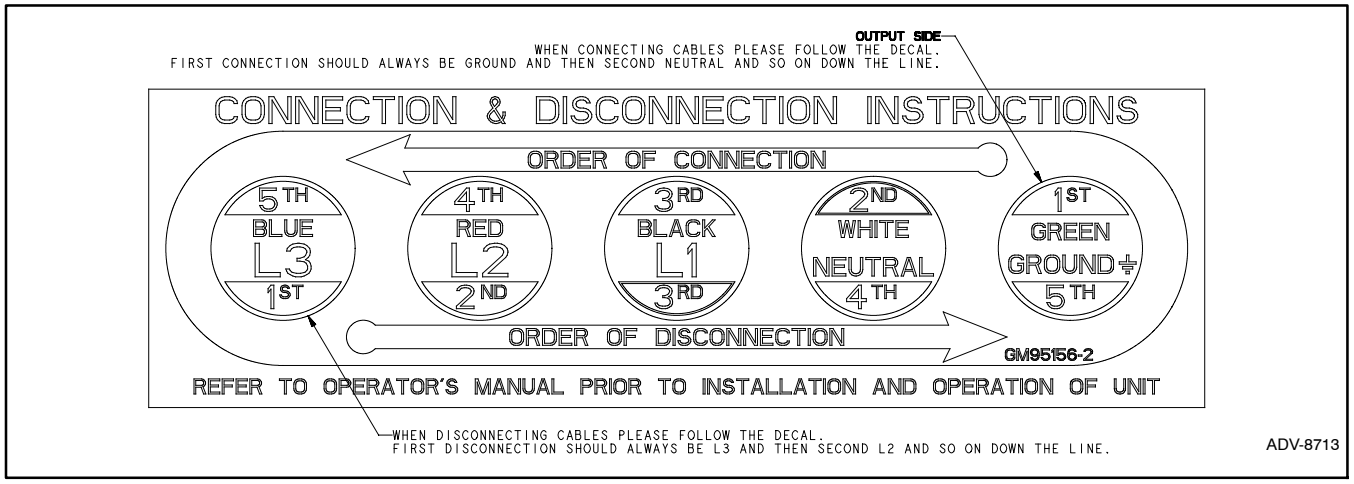


Figure 4-10 Load Side Camlocks, Order of Connection and Disconnection

4.8 Control Harness Connections

Two control harnesses (GM97197) are included with the paralleling box. Each harness includes:

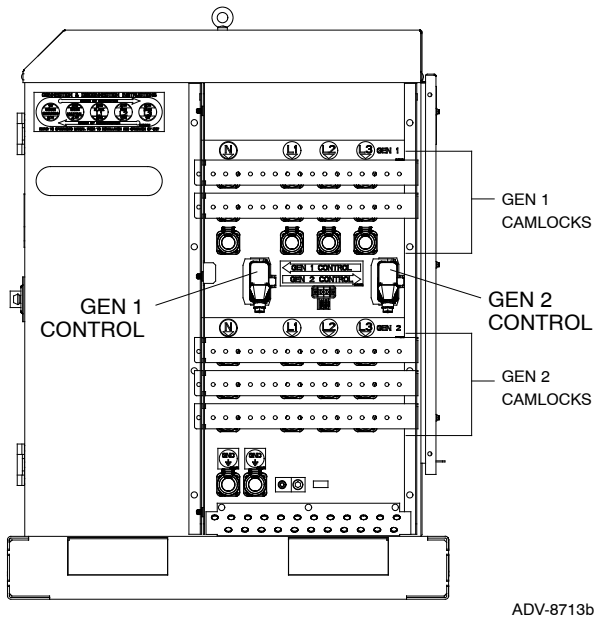
- Power leads to supply power for the contactors, lights, and fans in the relay box.
- Communication leads from the generator controller to the paralleling box.

The camlock connections and the control harness connections are labeled GEN 1 and GEN 2. Identify which generator set is GEN 1 and which unit is GEN 2 according to the source camlock cable connections to the paralleling box. See Figure 4-11.

Note: It is essential that the control harness connections for GEN 1 and GEN 2 correspond to the source camlock cable connections.

- Connect the control harness from the generator set that is connected to the GEN 1 camlock connectors to GEN 1 CONTROL.
- Connect the control harness from the generator set that is connected to the GEN 2 camlock connectors to GEN 2 CONTROL.

When not used, store the control harnesses on the storage rack inside the enclosure. See Section 5.2.



Note: Check the labels on the paralleling box to verify GEN 1 and GEN 2 connections.

Figure 4-11 Control Harness Connections

4.9 Multiple Paralleling Boxes (PGEN Connections)

Up to four paralleling boxes with eight generator sets can be connected together. Connect one or two generators to each paralleling box as described in the previous sections. Connect the paralleling boxes together using the PGEN terminal blocks as described below. The PGEN terminal box is identified by the decal shown in Figure 4-12.

Use Belden cable #9841 (or equivalent) shielded twisted-pair communication cable to connect the PGEN terminal blocks on the paralleling boxes. See Figure 4-13 for the location of the terminal block and Figure 4-14 for the connections.. Tighten the connections to 0.5 Nm (4.4 in. lbs.).

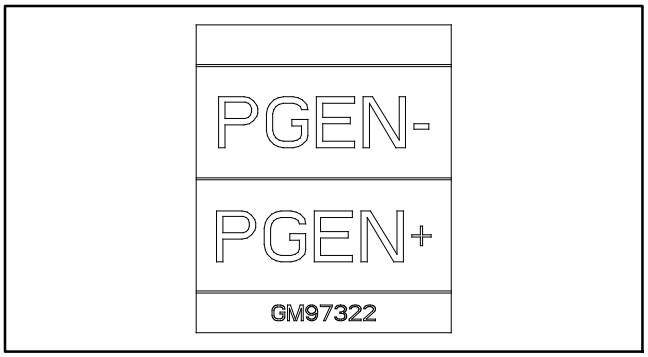
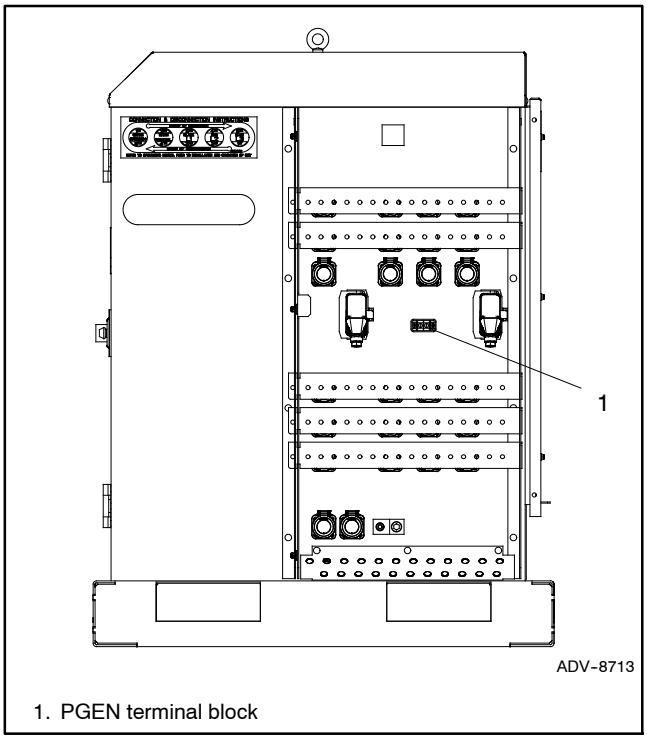


Figure 4-12 PGEN Terminal Block Decal



1. PGEN terminal block

Figure 4-13 PGEN Terminal Block for Connecting Multiple Paralleling Boxes

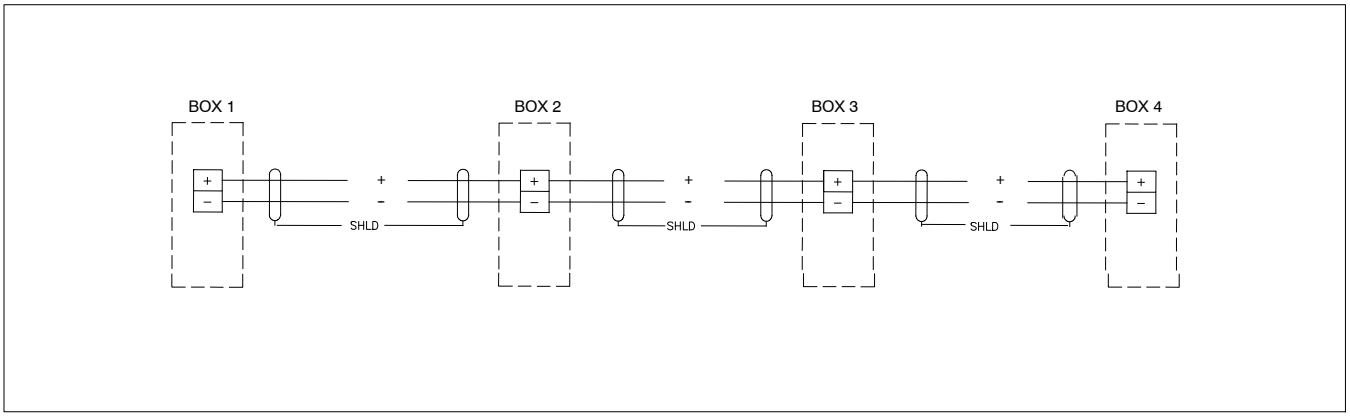


Figure 4-14 PGEN Connections, Multiple Paralleling Boxes

4.10 Re-enable the Generator Sets

DANGER

Hazardous voltage.
Will cause severe injury or death.

This equipment must be installed and serviced by qualified electrical personnel.

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

1. Check that the generator set is OFF.
2. Reconnect the generator set engine starting battery, negative (–) lead last.
3. Reconnect power to the battery charger, if equipped.

4.11 Test the System

Perform the test procedures in this section to verify that the system is set up properly and operating correctly.

4.11.1 Verify Generator Operation

1. Ensure that the load is not connected to the load bus or that it is drawing less power than a single generator can provide.
2. With the cables connected to the paralleling box, navigate to the CONTROLLER CONFIG -> COMMUNICATION SETUP menu and verify that the PGEN Nodes Online parameter indicates that the appropriate number of nodes (generators) is online. This parameter is also viewable in SiteTech under Synchronization Control. See Figure 4-15.

Synchronization Control	
Voltage Match Window	1.0 %
Sync Frequency Window	2.0 Hz
Phase Match Window	5.0 °
Dwell Time	0.3 s
Fail To Sync Delay	300 s
Breaker Reclose Time	2.0 s
Breaker Close Attempts	3
First On Close Delay	0.5 s
Circuit Breaker Current Fault Limit	5.0 %
Circuit Breaker Current Fault Delay	1.0 s
Volts Hertz Okay Time Delay	0.5 s
Sync Mode In Auto	Active
Sync Mode In Run	Check
Synchronization Disabled	False
Circuit Breaker Phase Angle Fault Limit	30.0 °
Circuit Breaker Phase Angle Fault Delay	1.00 s
Dead Bus Level	10.00 %
Pickup Acceptable Voltage Window	10.00 %
Dropout Acceptable Voltage Window	30.00 %
Pickup Acceptable Frequency Window	2.50 Hz
Dropout Acceptable Frequency Window	30.00 Hz
Stand Alone Operation	Off
P Gen Baud Rate	57600 b/s
P Gen Node Id	1
P Gen Nodes Connected	1

Figure 4-15 Synchronization Control Menu in SiteTech

3. Verify alternator connection (voltage selector switch position), system voltage, and voltage regulator target on each generator. The generators must all operate at the same frequency, voltage, and phase connection in order to parallel.

Note: The controllers will alert if the system frequency, voltage, and phase connection in the system differ between generators that are communicating over PGEN. They will not close the contactors in the paralleling box while there is a difference in one of those three parameters in any generator in the system.

4. Start a single generator by pressing the Run button. The contactor in the paralleling box should close (the closing of the contactor is audible when near the paralleling box, barring excessive background noise). The Generator Connected to Bus indicator should light when the contactor closes.

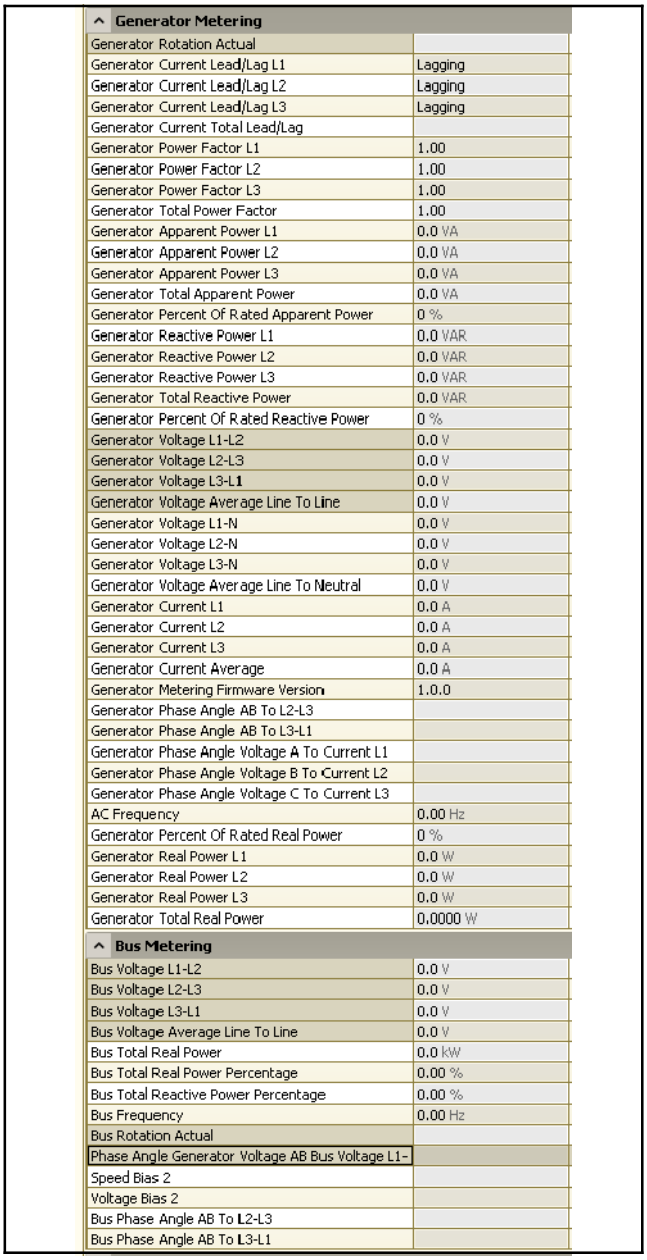
5. With the contactor in the paralleling box closed, verify the following metered values in SiteTech under Generator Metering and Bus Metering, or under GENERATOR INFO -> PARALLELING OPERATION -> SYNCHRONIZING SETUP on the DEC3500 controller. See Figure 4-16.

- Bus Voltage L1-L2 should match Generator Voltage L1-L2 (not necessary to check if not using SiteTech™)
- Bus Voltage L2-L3 should match Generator Voltage L2-L3 (not necessary to check if not using SiteTech™)
- Bus Voltage L3-L1 should match Generator Voltage L3-L1 (not necessary to check if not using SiteTech™)
- Bus Average Voltage L-L should match Generator Average Voltage L-L. If the bus voltage reads 0V, it is very likely that the control harnesses are not connected correctly (the generator 1 control harness must go to the same generator as the generator 1 load leads) or that the output breaker on the generator is open.
- Generator to Bus Phase Angle (phase difference) should be between -10° and 10°.
- Bus Phase Rotation should match Generator Phase Rotation

6. Verify that the load bus is energized and available at the load. If the contactor closed and the load is not receiving voltage, ensure that the control harnesses are connected correctly (the generator 1 control harness must go to the same generator as the generator 1 load leads) and that the output breaker on the generator is closed.

7. Stop the generator by pressing the OFF button. The contactor should open.

8. Repeat steps 1 through 7 for each generator in the paralleling system.



Generator Metering	
Generator Rotation Actual	
Generator Current Lead/Lag L1	Lagging
Generator Current Lead/Lag L2	Lagging
Generator Current Lead/Lag L3	Lagging
Generator Current Total Lead/Lag	
Generator Power Factor L1	1.00
Generator Power Factor L2	1.00
Generator Power Factor L3	1.00
Generator Total Power Factor	1.00
Generator Apparent Power L1	0.0 VA
Generator Apparent Power L2	0.0 VA
Generator Apparent Power L3	0.0 VA
Generator Total Apparent Power	0.0 VA
Generator Percent Of Rated Apparent Power	0 %
Generator Reactive Power L1	0.0 VAR
Generator Reactive Power L2	0.0 VAR
Generator Reactive Power L3	0.0 VAR
Generator Total Reactive Power	0.0 VAR
Generator Percent Of Rated Reactive Power	0 %
Generator Voltage L1-L2	0.0 V
Generator Voltage L2-L3	0.0 V
Generator Voltage L3-L1	0.0 V
Generator Voltage Average Line To Line	0.0 V
Generator Voltage L1-N	0.0 V
Generator Voltage L2-N	0.0 V
Generator Voltage L3-N	0.0 V
Generator Voltage Average Line To Neutral	0.0 V
Generator Current L1	0.0 A
Generator Current L2	0.0 A
Generator Current L3	0.0 A
Generator Current Average	0.0 A
Generator Metering Firmware Version	1.0.0
Generator Phase Angle AB To L2-L3	
Generator Phase Angle AB To L3-L1	
Generator Phase Angle Voltage A To Current L1	
Generator Phase Angle Voltage B To Current L2	
Generator Phase Angle Voltage C To Current L3	
AC Frequency	0.00 Hz
Generator Percent Of Rated Real Power	0 %
Generator Real Power L1	0.0 W
Generator Real Power L2	0.0 W
Generator Real Power L3	0.0 W
Generator Total Real Power	0.0000 W
Bus Metering	
Bus Voltage L1-L2	0.0 V
Bus Voltage L2-L3	0.0 V
Bus Voltage L3-L1	0.0 V
Bus Voltage Average Line To Line	0.0 V
Bus Total Real Power	0.0 kW
Bus Total Real Power Percentage	0.00 %
Bus Total Reactive Power Percentage	0.00 %
Bus Frequency	0.00 Hz
Bus Rotation Actual	
Phase Angle Generator Voltage AB Bus Voltage L1-	
Speed Bias 2	
Voltage Bias 2	
Bus Phase Angle AB To L2-L3	
Bus Phase Angle AB To L3-L1	

Figure 4-16 Metering Menus in SiteTech

4.11.2 Verify Paralleling and Load Sharing

When all generators in the paralleling system have been verified, perform the following tests.

9. Place all generators in automatic mode by pressing the Auto button and verify that the shutdown indicator (RED) is not illuminated on any of the generators.

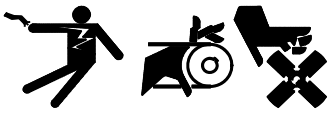
10. Provide the system with a local start request by holding down the AUTO button, pressing the RUN button, releasing the RUN button and then releasing the AUTO button on any of the generators in the system. If the system is connected and functioning correctly, all the generators should start, one generator should close the contactor that it controls in the appropriate paralleling box, and the other generators should synchronize to it (often undergoing audible changes in speed) and close their contactors in the appropriate paralleling boxes.

11. After all generators are online, verify that the % of rated power of the generators matches. This shows that the generators are sharing load equally. The reactive power should also be shared between the generators, relative to their capacity.

12. If a load bank is available, test the system under load. This step is recommended if full site load is not available at the time of generator installation.

5.1 Turn OFF all Power Sources

⚠ 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.

This equipment must be installed and serviced by qualified electrical personnel.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Multiple power sources can automatically energize the distribution bus. Disconnect all power sources before connecting to the distribution bus.

Multiple power sources can energize the distribution bus. Disconnect all power sources to the distribution bus, including all generators and utility power.

Turn off and disable all generators to prevent accidental starting:

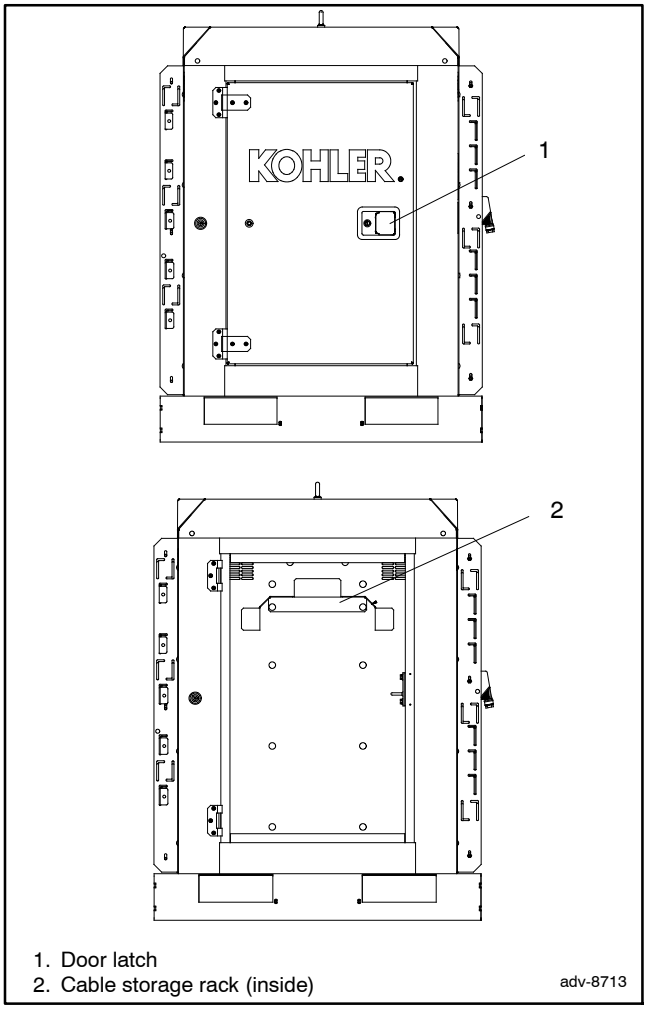
1. Press the OFF button on the generator set controller.
2. Disconnect power to the battery charger, if equipped.
3. Disconnect the generator set engine starting battery(ies), negative (-) lead first.
4. Repeat steps 1 through 3 for the second generator set.

5.2 Control Harnesses

Disconnect the control harnesses from both generators and the paralleling box.

The paralleling box has a lockable compartment for cable storage. Open the hinged door and store the control harnesses on the storage rack inside the compartment. See Figure 5-1.

Note: Do not open the electrical compartment on the opposite side of the enclosure. That compartment should be opened only by Kohler authorized distributors or dealers for maintenance and service purposes.

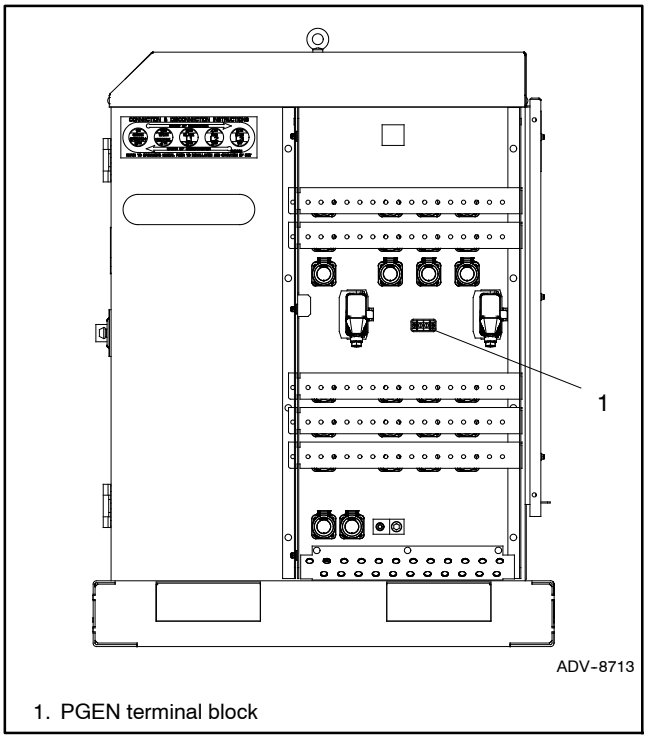


1. Door latch
2. Cable storage rack (inside)

Figure 5-1 Cable Storage

5.3 PGEN Connections

If multiple paralleling boxes are used, disconnect the PGEN cables between the boxes. See Figure 5-2 for the location of the PGEN cable connection.



1. PGEN terminal block

Figure 5-2 PGEN Cable Connection

5.4 Disconnect Load Cables

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

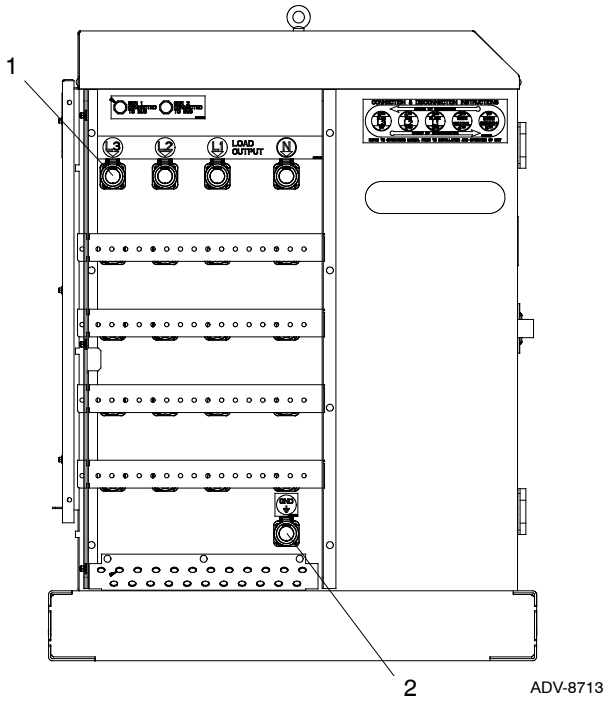
Multiple power sources can automatically energize the distribution bus. Disconnect all power sources before connecting to the distribution bus.

Multiple power sources can energize the distribution bus. Disconnect all power sources to the distribution bus, including all generators and utility power.

Disconnect the load camlock cables on the output side of the paralleling box. Disconnect each cable from the distribution bus first, following the disconnection order shown in Figure 5-4. Remove the ground connection last. See Figure 5-3 for connector locations.

1. Disconnect the load side L3 (blue) camlock cables from the distribution bus. Then disconnect the L3 (blue) cable from the paralleling box.
2. Disconnect the load side L2 (red) camlock cables from the distribution bus. Then disconnect the L2 (red) cable from the paralleling box.
3. Disconnect the load side L1 (black) camlock cables from the distribution bus. Then disconnect the L1 (black) cable from the paralleling box.
4. Connect the load side neutral L0 (white) camlock cables from the distribution bus. Then disconnect the neutral L0 cable from the paralleling box.
5. Connect the load side ground GND (green) camlock cable from the distribution bus. Then disconnect the GND cable from the paralleling box.

Remove the camlock security guards from their storage locations and install over the camlock connectors on the box. Insert padlocks to prevent unauthorized access to the connectors.



1. Load camlock connections
2. Ground camlock connection. DISCONNECT LAST

Figure 5-3 Load Side Connections

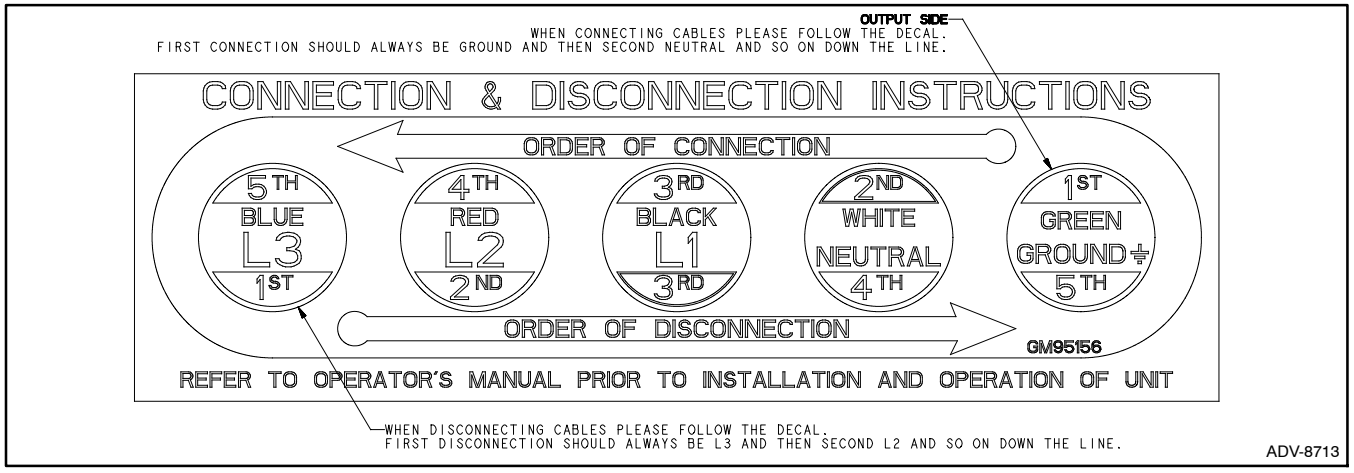
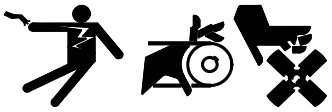


Figure 5-4 Load Side Camlocks, Order of Connections and Disconnection

5.5 Disconnect Source Cables

⚠ 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.

Disconnect the camlock connectors from the generator set, disconnecting in the order shown in the labels on the paralleling box. See Figure 5-6. Disconnect the ground cable last. See Figure 5-5 for connector locations.

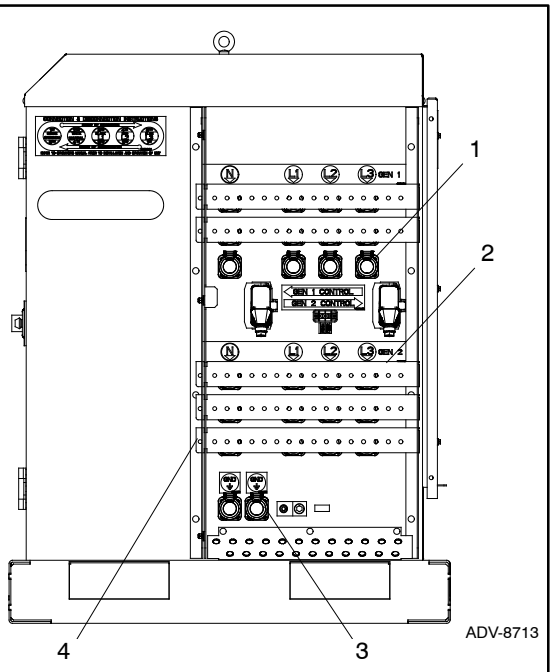
1. Verify that all generator sets have been shut down as described in Section 5.1.

2. Disconnect the source side L1 (black), L2 (red) and L3 (blue) camlock cables at the generator set first and then at the paralleling box.

3. Disconnect the source side neutral (white) camlock cables at the generator set first and then at the paralleling box.

4. Disconnect the source side ground (green) camlock cables at the generator set first and then at the paralleling box.

Remove the camlock security guards from their storage locations and install over the camlock connectors on the box. Insert padlocks to prevent unauthorized access to the connectors.



1. Camlock source connections, generator 1
2. Camlock source connections, generator 2 (security guards shown in place)
3. Camlock ground connections. DISCONNECT LAST
4. Insert padlocks through security guards

Figure 5-5 Source Connections

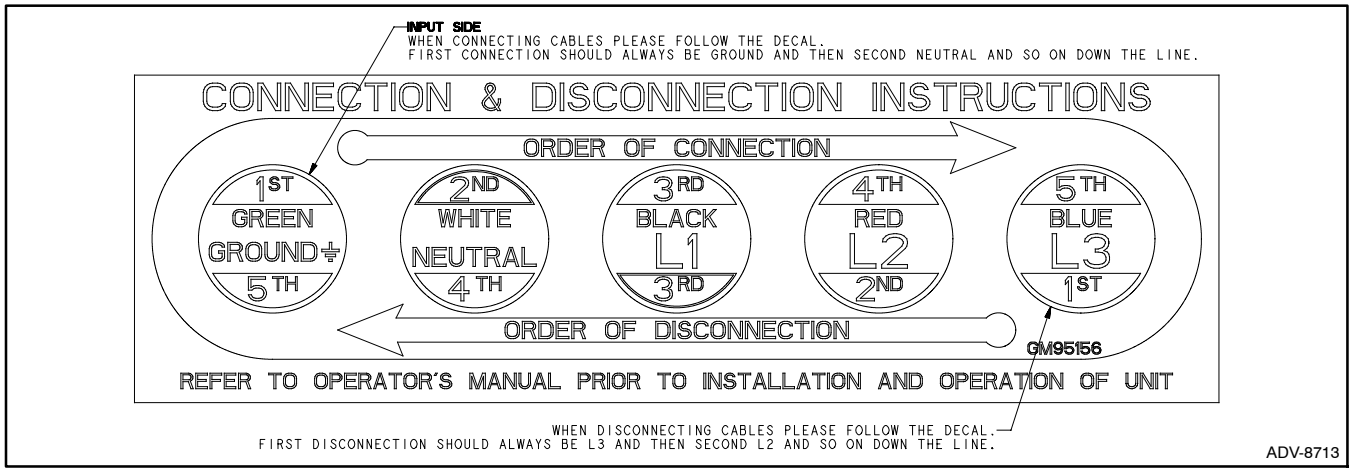
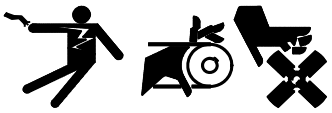


Figure 5-6 Source Side Camlocks, Order of Connection and Disconnection

6.1 Scheduled Maintenance

⚠ 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.

⚠ DANGER

Hazard of electric shock, explosion, or arc flash.
Will cause severe injury or death.

The enclosure should be opened by trained and authorized personnel only. Any terminal may be energized when any cable is connected. Do not connect or disconnect cables under load. De-energize all cables at generator prior to opening the cover.

⚠ CAUTION

Hot surfaces.

Regular preventive maintenance ensures safe and reliable operation and extends the life of the paralleling box. Preventive maintenance includes periodic testing, cleaning, inspection, and replacement of worn or missing components.

A Kohler authorized distributor/dealer can provide complete preventive maintenance and service to keep the equipment in top condition. Unless otherwise specified, have maintenance or service performed by a Kohler authorized distributor/dealer in accordance with all applicable codes and standards. See the Service Assistance section in this manual for how to locate a local distributor/dealer.

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.

6.2 Inspection

Contact a Kohler authorized distributor/dealer to inspect and service the paralleling box annually and also when any wear, damage, deterioration, or malfunction of the paralleling box or its components is evident or suspected.

6.2.1 External Inspection

Keep the paralleling box clean and in good condition by performing a weekly general external inspection of the unit for any condition of vibration, leakage, excessive temperature, contamination, or deterioration. Remove accumulations of dirt, dust, and other contaminants from the paralleling box's external components or enclosure with a vacuum cleaner or by wiping with a dry cloth or brush.

Note: Do not use compressed air to clean the paralleling box because it can cause debris to lodge in the components and damage the equipment.

Tighten loose external hardware. Replace any worn, missing, or broken external components with Kohler-recommended replacement parts. Contact a local Kohler authorized distributor/dealer for specific part information and ordering.

Inspect all harnesses and cables for wire or cable insulation deterioration, cuts, or abrasion. Check that all camlock connectors are securely attached to the cables. Check that the camlock cables are clearly labeled.

6.2.2 Internal Inspection

⚠ DANGER

Hazard of electric shock, explosion, or arc flash.
Will cause severe injury or death.

The enclosure should be opened by trained and authorized personnel only. Any terminal may be energized when any cable is connected. Do not connect or disconnect cables under load. De-energize all cables at generator prior to opening the cover.

⚠ CAUTION

Hot surfaces.

Disconnect all power sources, remove the enclosure cover, and inspect internal components monthly or when any condition noticed during an external inspection may have affected internal components.

Contact a Kohler authorized distributor/dealer to inspect and service the paralleling box if any of the following conditions are found inside the paralleling box enclosure.

- Accumulations of dirt, dust, moisture, or other contaminants

  Note: Do not use compressed air to clean the paralleling box because it can cause debris to lodge in the components and damage the equipment.

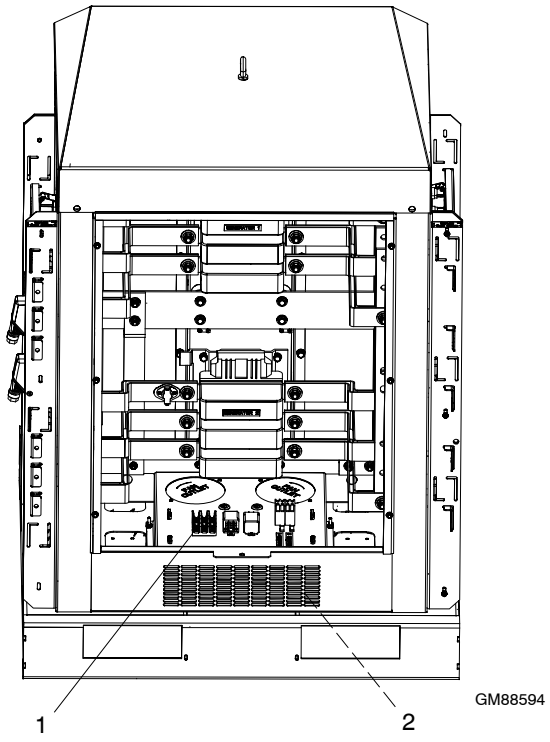
- Signs of corrosion
- Worn, missing, or broken components
- Loose hardware
- Wire or cable insulation deterioration, cuts, or abrasion
- Signs of overheating or loose connections: discoloration of metal, melted plastic, or a burning odor
- Other evidence of wear, damage, deterioration, or malfunction of the equipment.

Filter

A filter is located in the air duct at the bottom of the enclosure. See Figure 6-1. Check the condition of the filter before operation. Clean or replace the filter as needed.

Fuses

Fuses are located inside the enclosure. See Figure 6-1. Check fuses and replace when necessary.



1. Fuses
2. Filter location (behind louvers)

Figure 6-1 Maintenance Item Locations

6.3 Storage Procedure

Store control harnesses on the storage rack inside the box when not in use. Lock the cabinet door with the key provided and store the key in a secure location.

Use the guards to cover the camlock connectors.

Attach padlocks to the electrical panel cover and the camlock guards to prevent unauthorized access.

Notes

Section 7 Drawings and Diagrams

Refer to the drawings as needed during installation.

Drawing Description	Drawing Number	Page
Dimension Drawing	ADV-8713	
	Sheet 1	40
	Sheet 2	41
	Sheet 3	42
	Sheet 4	43
Schematic Diagram	ADV-8769	44
Wiring Diagram	GM95768	45

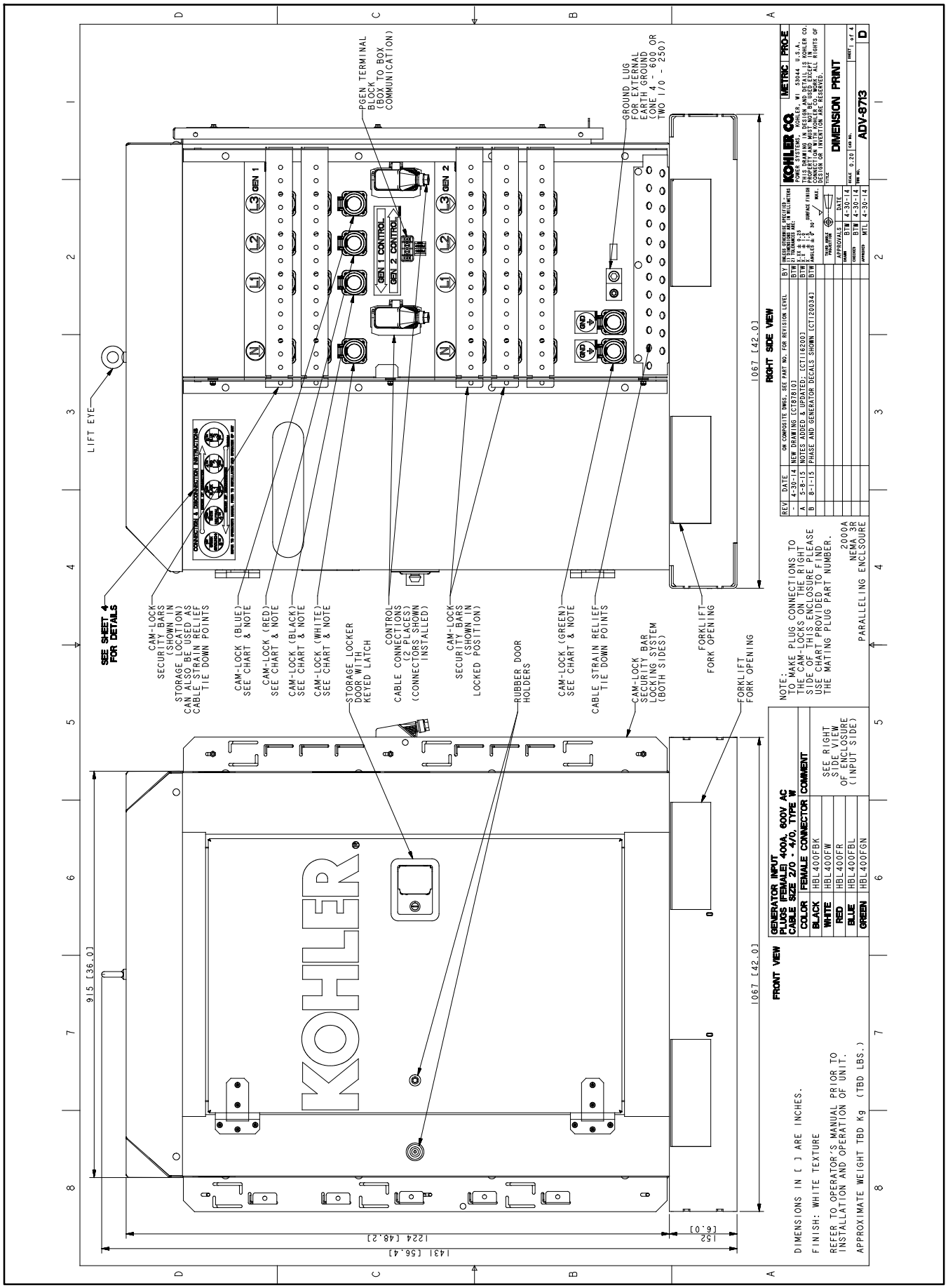


Figure 7-1 Dimension Drawing ADV-8713, Sheet 1 of 4

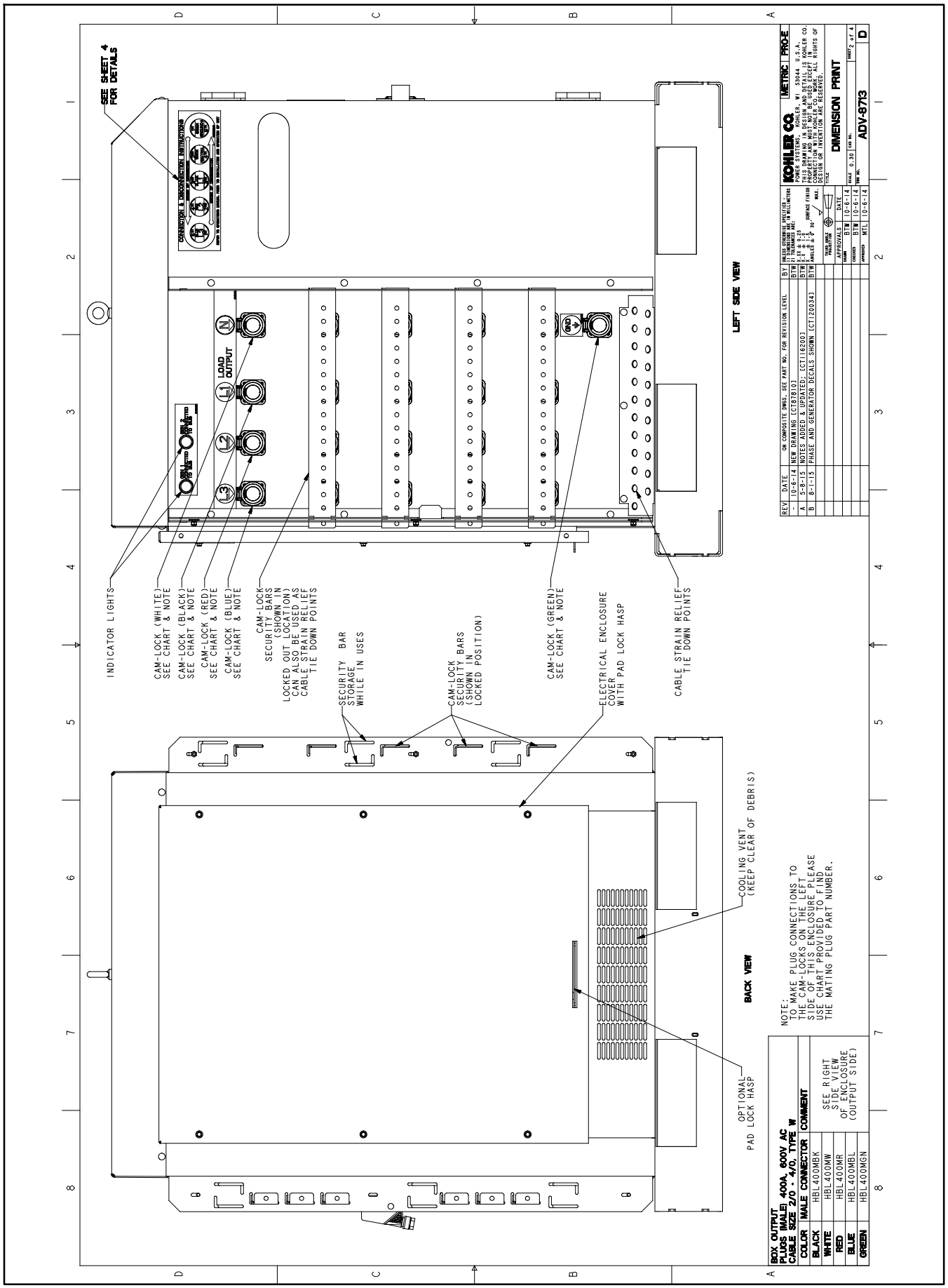


Figure 7-2 Dimension Drawing ADV-8713, Sheet 2 of 4

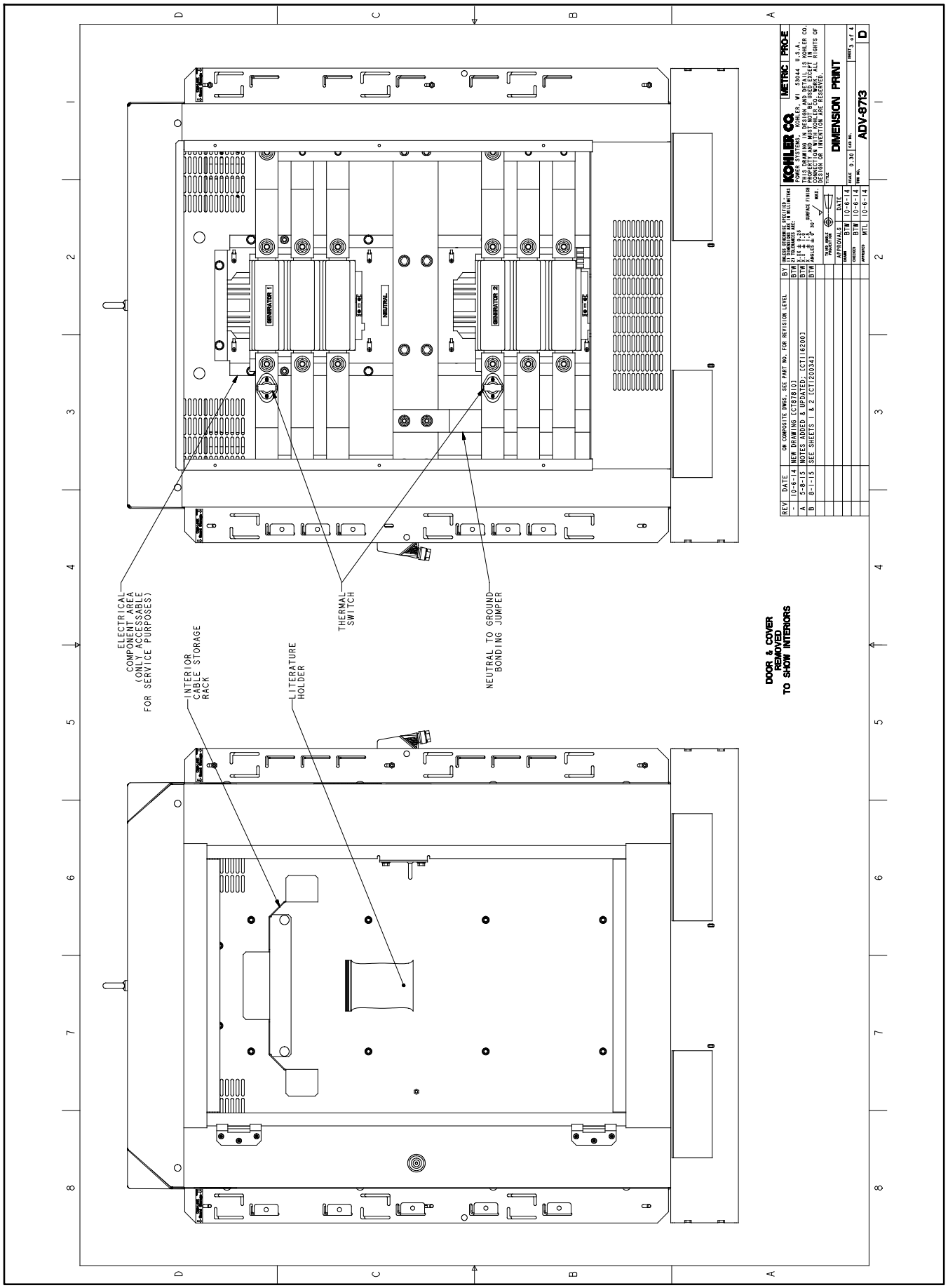


Figure 7-3 Dimension Drawing ADV-8713, Sheet 3 of 4

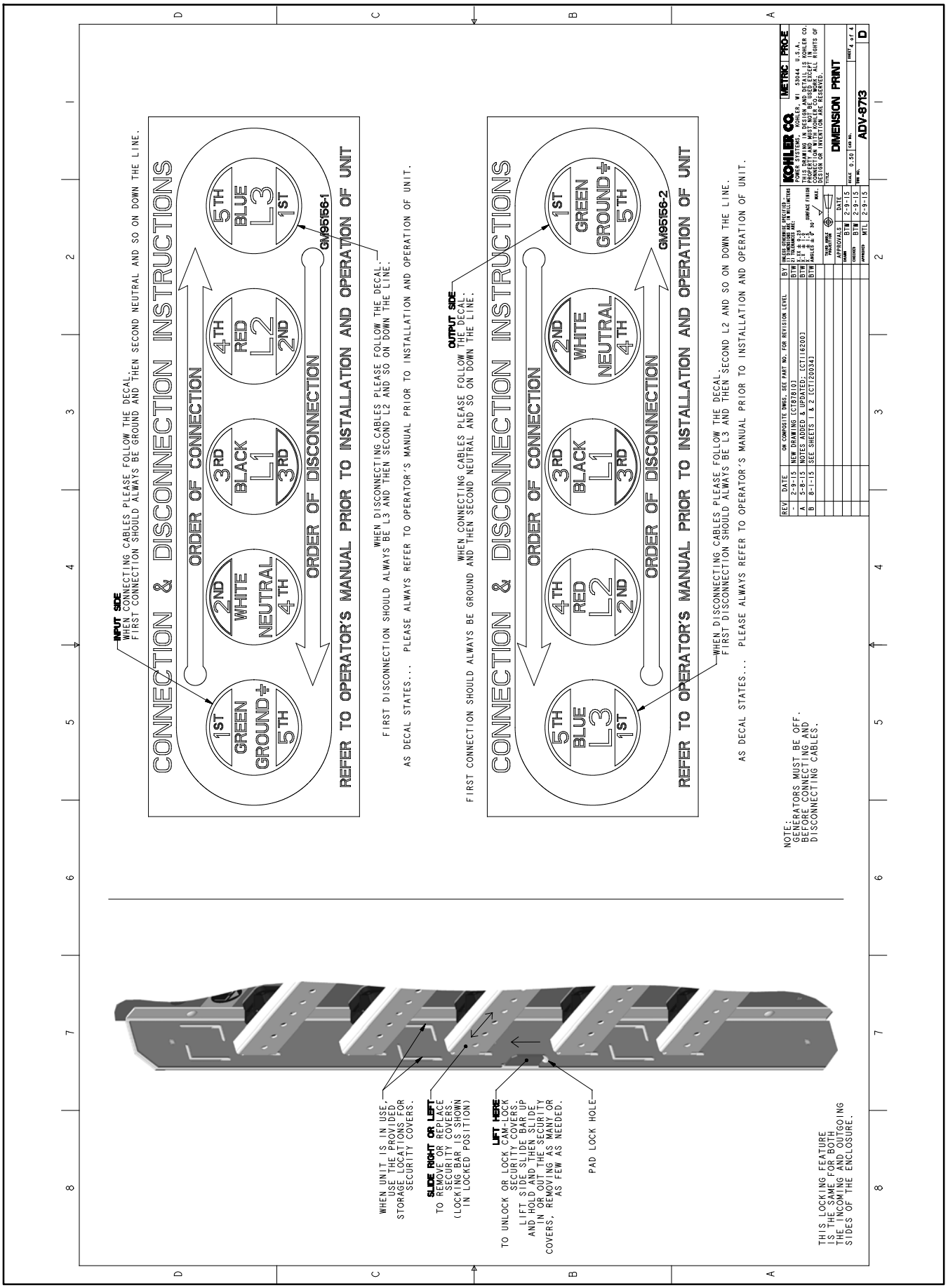


Figure 7-4 Dimension Drawing ADV-8713, Sheet 4 of 4

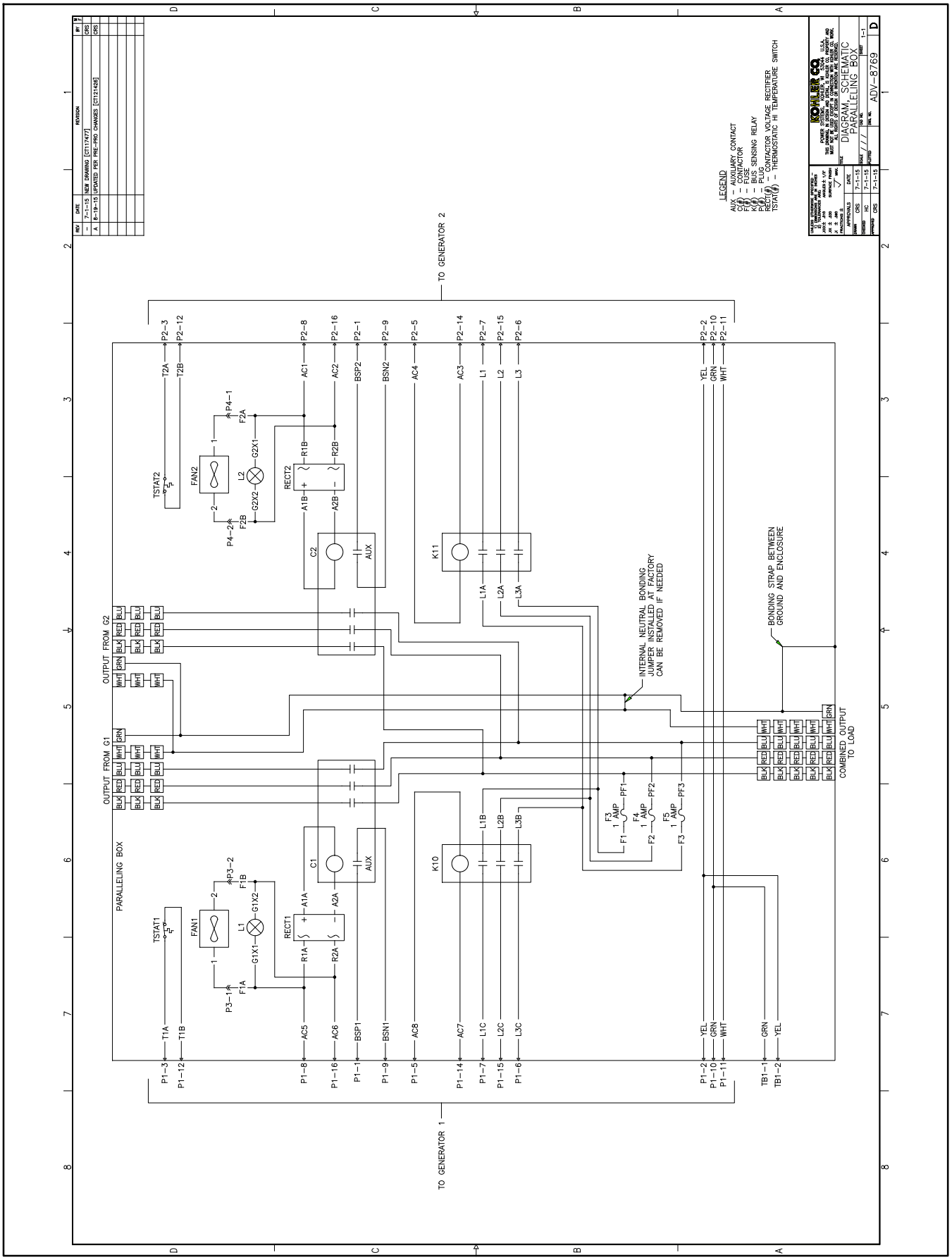


Figure 7-5 Schematic Diagram ADV-8769

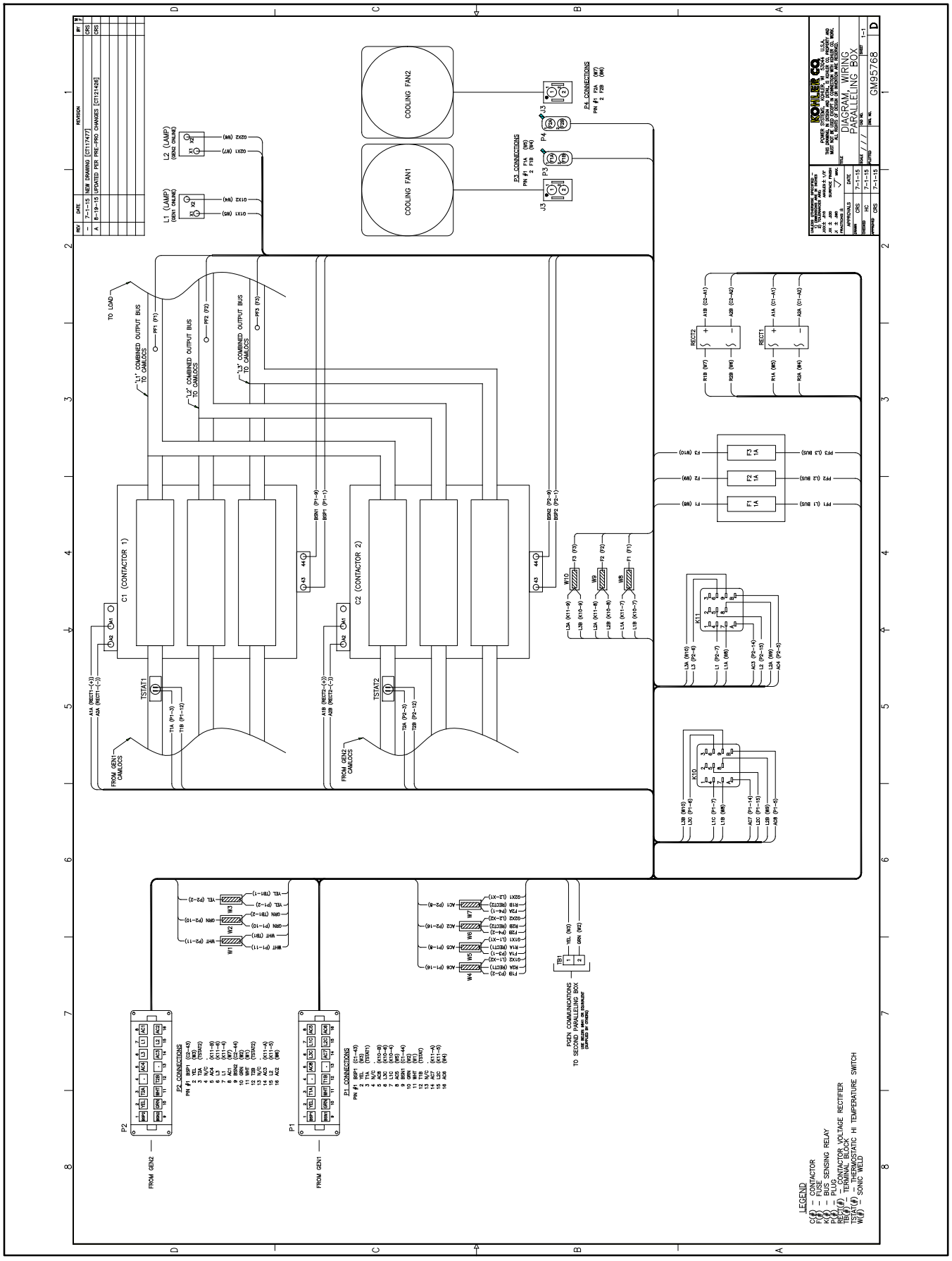


Figure 7-6 Wiring Diagram GM95768

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
APU	Auxiliary Power Unit
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
CAT5	Category 5 (network cable)
CB	circuit breaker
CC	crank cycle
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)
com	communications (port)
coml	commercial
Coml/Rec	Commercial/Recreational
conn.	connection
cont.	continued
CPVC	chlorinated polyvinyl chloride
crit.	critical
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
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^2PROM, EEPROM	electrically-erasable programmable read-only memory
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
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)
IBC	International Building Code
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	internet protocol
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
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
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
RO	read only
ROM	read only memory
rot.	rotate, rotating
rpm	revolutions per minute
RS	right side
RTDs	Resistance Temperature Detectors
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
SMTP	simple mail transfer protocol
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
SMS	short message service
SS	stainless steel
std.	standard
stl.	steel
tach.	tachometer
TB	terminal block
TCP	transmission control protocol
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
tol.	tolerance
turbo.	turbocharger
typ.	typical (same in multiple locations)
UF	underfrequency
UHF	ultrahigh frequency
UIF	user interface
UL	Underwriter's Laboratories, Inc.
UNC	unified coarse thread (was NC)
UNF	unified fine thread (was NF)
univ.	universal
URL	uniform resource locator (web address)
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
WO	write only
w/o	without
wt.	weight
xfmr	transformer

Notes

Notes

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Power Systems

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