INSTALLATION INSTRUCTIONS

Issue Date: **12/93**
Model: **Single-Phase Consumer Generator Sets**
Market: **Marine, RV, and Mobile**
Subject: **Line Circuit Breaker Kits**

The circuit breakers protect the generator set from short circuits. Mount the circuit breakers in the generator set controller or junction box. The generator set voltage/frequency configuration determines the correct circuit breaker amperage. If the circuit breaker was sized for one voltage configuration and at a later time the generator set is reconnected to a different voltage, the circuit breaker may require changing to provide optimum protection.

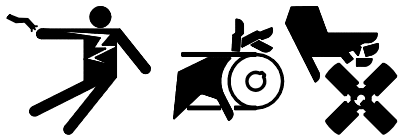
This instruction provides the circuit breaker kit installation numbers. For application and selection information contact an authorized distributor/dealer.

NOTE

Use only ignition-protected circuit breakers on marine gasoline generator sets. See C.F.R. 33, Part 183.410 for ignition-protection requirements. Do not use standard circuit breakers.

Have a qualified electrician or technician install circuit breakers and reconnect the generator set. Installation must comply with all governing standards and codes.

⚠ WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect battery cables before working on generator set (disconnect negative lead first and reconnect it last).

Disabling generator set. Accidental starting can cause severe injury or death. Turn generator set master switch to OFF position, disconnect power to battery charger, and remove battery cables (remove negative lead first and reconnect it last) to disable generator set before working on the generator set or connected equipment. The generator set can be started by an automatic transfer switch or remote start/stop switch unless these precautions are followed.

Disabling generator set. Accidental starting can cause severe injury or death. Disconnect battery cables (remove negative lead first and reconnect it last) to disable generator set before working on the generator set or connected equipment. The generator set can be started by the remote start/stop switch unless this precaution is followed.

⚠ WARNING

Hazardous voltage.

Moving rotor.

Can cause severe injury or death.

Operate generator set only with all guards and electrical enclosures in place.

Grounding generator set. Hazardous voltage can cause severe injury or death. Electrocution is possible whenever electricity is present. Open main circuit breakers of all power sources before servicing equipment. Configure the installation to electrically ground the generator set and electrical circuits when in use. Never contact electrical leads or appliances when standing in water or on wet ground, as the chance of electrocution is increased under such conditions.

Short circuits. Hazardous voltage 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 adjustments are made. Remove wristwatch, rings, and jewelry before servicing equipment.

Electrical backfeed to utility. Hazardous backfeed voltage can cause severe injury or death. Connect generator set to building/marina electrical system only through an approved device and after building/marina main switch is open. Backfeed connections can cause serious injury or death to utility personnel working on power lines and/or personnel in the vicinity of the work area. Unauthorized connection to utility electrical system may be unlawful in some states and/or localities. Install a ship-to-shore transfer switch to prevent interconnection of generator set power and shore power.

Circuit Breaker Kit Number	Circuit Breaker Number	Circuit Breaker Ampere Rating	Circuit Breaker Number of Poles	Max. Voltage
PA-225630	X-506-40 *	25	2	250
PA-225632	X-506-24	65	2	250
PA-225633	X-506-30	80	2	250
PA-225634	X-506-44 *	53	2	250
PA-225635	X-506-23	60	2	250
PA-225636	X-506-25	85	2	250
PA-225637	X-506-27	70	2	250
PA-225638 ★	225629	100	2	240
PA-225639	X-506-49 *	30	1	250
PA-225640	X-506-50 *	40	1	250
PA-225641	X-506-51 *	60	1	250
PA-225642	X-506-52	80	1	250
PA-228670	X-506-53	20	1	250
PA-229184	X-506-46 *	35	1	250
PA-229185	X-506-47 *	55	1	250
PA-229186	X-506-48 *	70	1	250
PA-229243 #	229205	60	2	240
PA-229244 #	229206	80	2	240
PA-229245	229207	90	2	240
PA-229391	X-506-41 *	18	2	250
PA-229392	X-506-42 *	35	2	250
PA-229393	X-506-43 *	42	2	250
PA-229394	X-506-36 *	30	2	250
PA-229400 #	249479	50	2	240
PA-229401 #	229397	70	2	240
PA-229542	X-506-38 *	50	2	250
PA-229543	X-506-39 *	33	2	250
PA-229914	229917	50	1	250
PA-229915	229918	70	1	250
PA-229916	229919	80	1	250
PA-344050	X-506-40 *	25	2	250
PA-344051	X-506-41 *	18	2	250
PA-344052	X-506-36 *	30	2	250
PA-344053	X-506-38 *	50	2	250
PA-344054	X-506-43 *	42	2	250
PA-344055	X-506-39 *	33	2	250
PA-344106	X-506-57 *	22	2	250
PA-344309	X-506-57 *	22	2	250

★ Locate this kit remotely. Junction box does not allow for mounting circuit breaker provided in kit PA-225638. See Figure 2 for mounting dimensions.

To install this kit on a 12-lead generator set, refer to TT-799 Instruction Sheet for 12-lead connections.

* Marine gasoline ignition-protected circuit breaker.

Figure 1. Circuit Breaker Selection/Ratings (Listed Numerically by Kit Number)

Installation

1. With generator set off, disconnect generator set engine starting battery, negative (–) lead first.
2. Remove the controller cover/junction box screws and remove access cover. (Mount kit PA-225638 remotely—the junction box does not allow for mounting the circuit breaker. See Figure 2.)
3. Remove screws and nuts to remove circuit breaker cover plate. Save mounting hardware. Discard original cover plate.

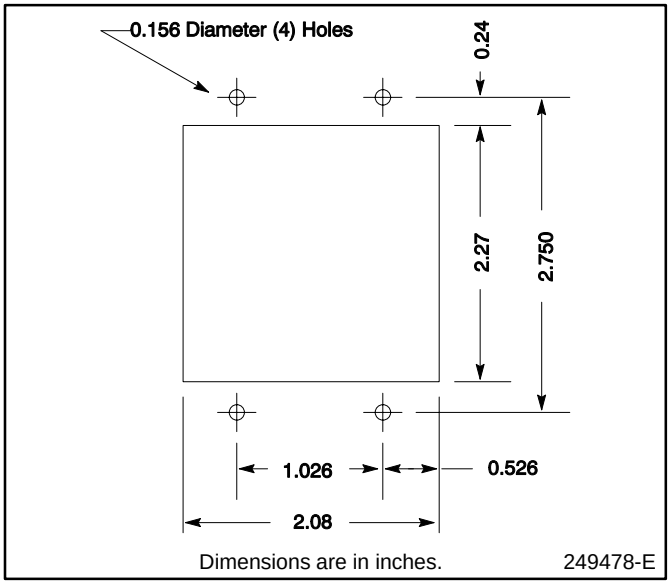


Figure 2. Suggested Mounting Detail for Circuit Breaker Provided in Kit PA-225638

4. Install circuit breaker from the inside of the cutout panel and mount using existing screws. Position circuit breaker with ON in the normal upright position or to the left side. Use the circuit breaker cover plate to fill the unused cutout hole (if applicable) using existing screws and nuts.
5. If voltage reconnection is required, see Four-Lead Reconnection of (Single-Phase) Generator Sets in this instruction sheet or refer to the appropriate Operation and Installation Manual or Service Manual.

NOTE

Some four-lead generator sets are not intended for voltage reconnection. To determine reconnection possibilities, check the model Specification Sheet, Operation and Installation Manual, or Service Manual. Refer to Figure 3 for models affected and identification of broadrange generator sets.

Model	Single-Voltage Reconnection	Dual-Voltage Reconnection	Voltage Adjustment	Frequency Adjustment
Marine—Gasoline				
4CZ/3.5CFZ 4ESZ/3.5EFZ	Yes	Yes	No	No
6.5CZ/5CFZ 6.5ESZ/5EFZ	Yes	Yes	No	No
8/10/12.5C 8/10/12.5E	Yes	Yes	No	No
Marine—Diesel				
5CCOZ/4CCFOZ 5EOZ/4EFOZ	Yes	Yes	Yes	Yes
9CCOZ/8CCFOZ 9EOZ/8EFOZ	Yes	Yes	Yes	Yes
13.5CCOZ/11CCFOZ	Yes *	Yes	Yes	Yes
18.5CCOZ/15CCFOZ	Yes *	Yes	Yes	Yes
21CCOZ/16.5CCFOZ	Yes *	Yes	Yes	Yes
RV/Mobile—Diesel				
7/10/15/20CCO	Yes	Yes	Yes	Yes

* Not available on specs: PA-126113, PA-126114, PA-126115 using A-258296 (PowerBoost™ V) voltage regulator.
NOTE: Broadrange generator sets have voltage and frequency adjustment capabilities.

Figure 3. Generator Set Voltage/Frequency Reconnection Capabilities

6. Install insulation boots over stator lead terminals (if included in kit).

   Four reconnection systems using circuit breakers follow:

   Two-pole circuit breaker with a single-voltage system (example: 120 volt, 3 wire).

   Attach stator leads marked 2 and 4 to side of circuit breaker marked LINE. Install jumper lead across LINE side of circuit breaker terminals (see Figure 4). Attach stator leads 1 and 3 to L0.

   Single-pole circuit breaker with a single-voltage system (example: 120 volt, 2 wire).

   Attach stator leads marked 2 and 4 to side of circuit breaker marked LINE (see Figure 5). Attach stator leads 1 and 3 to L0.

   Two-pole circuit breaker with a dual-voltage system (example: 120/240 volt, 3 wire).

   Attach stator leads marked 1 and 4 to side of circuit breaker marked LINE. Do not use jumper lead (see Figure 6). Attach stator leads 2 and 3 to L0.

   Single-pole circuit breaker with a single-voltage system (example: 240 volt, 2 wire).

   Attach stator lead marked 2 to side of circuit breaker marked LINE (see Figure 7). Bolt together leads 1 and 4, and tape to insulate from ground. Attach stator lead marked 3 to L0.

   Connect stator lead(s) used for neutral connection to L0 stud. Positions of terminals and leads must allow access to LOAD connection studs. See illustration in Figures 4, 5, 6, or 7.

7. Connect side of circuit breaker marked LOAD to ship-to-shore switch or craft wiring (marine) or transfer switch or vehicle (RV/mobile). Attach insulation boots to black leads if included in kit. With a single-pole circuit breaker use one black lead L1. With a two-pole circuit breaker use two black leads L1 and L2. Connect neutral white lead to L0 stud. Connect equipment ground green lead to GRD. stud.

   Use stranded copper for all wiring. Wire gauges and insulation, conductor temperature ratings, sheath stripping, conductor support and protection, conductor terminals and splices, and overcurrent protection (circuit breakers, fuses) must conform to standards and codes.

   Marine applications must conform to USCG Regulations #33 (Pleasurecraft) and #46 (Commercial Craft).

   Use rubber grommets and cable ties as necessary to protect and secure wiring from sharp objects, exhaust system, and any moving parts.

8. Replace controller cover or circuit breaker box access panel.
9. Reconnect the generator set engine starting battery, negative (–) lead last.
10. If voltage or frequency adjustments are required, see Voltage Regulator Adjustment later in this instruction.

NOTE

Some four-lead generator sets are not intended for voltage/frequency adjustment. To determine adjustment possibilities, check the model specification sheet, operation and installation manual, or service manual. If reconnecting the generator set from a single voltage to a dual voltage configuration (example: from 120 volt to 120/240 volt) or a dual voltage to a single voltage (example: from 120/240 volt to 120 volt) with the same primary voltage, no voltage/frequency adjustment is required. Adjust voltage/frequency if changing frequency or changing setting of primary voltage (example: from 120 volt to 100 volt). Refer to Figure 3 for models affected.

Four-Lead Reconnection of (Single-Phase) Generator Sets 100-120 Volt or 100-120/200-240 Volt, 50 or 60 Hz; or 200-240 Volt, 50 Hz

NOTE

Not all models offer straight 100-120 volt or 200-240 volt (50 or 60 Hz) configurations.

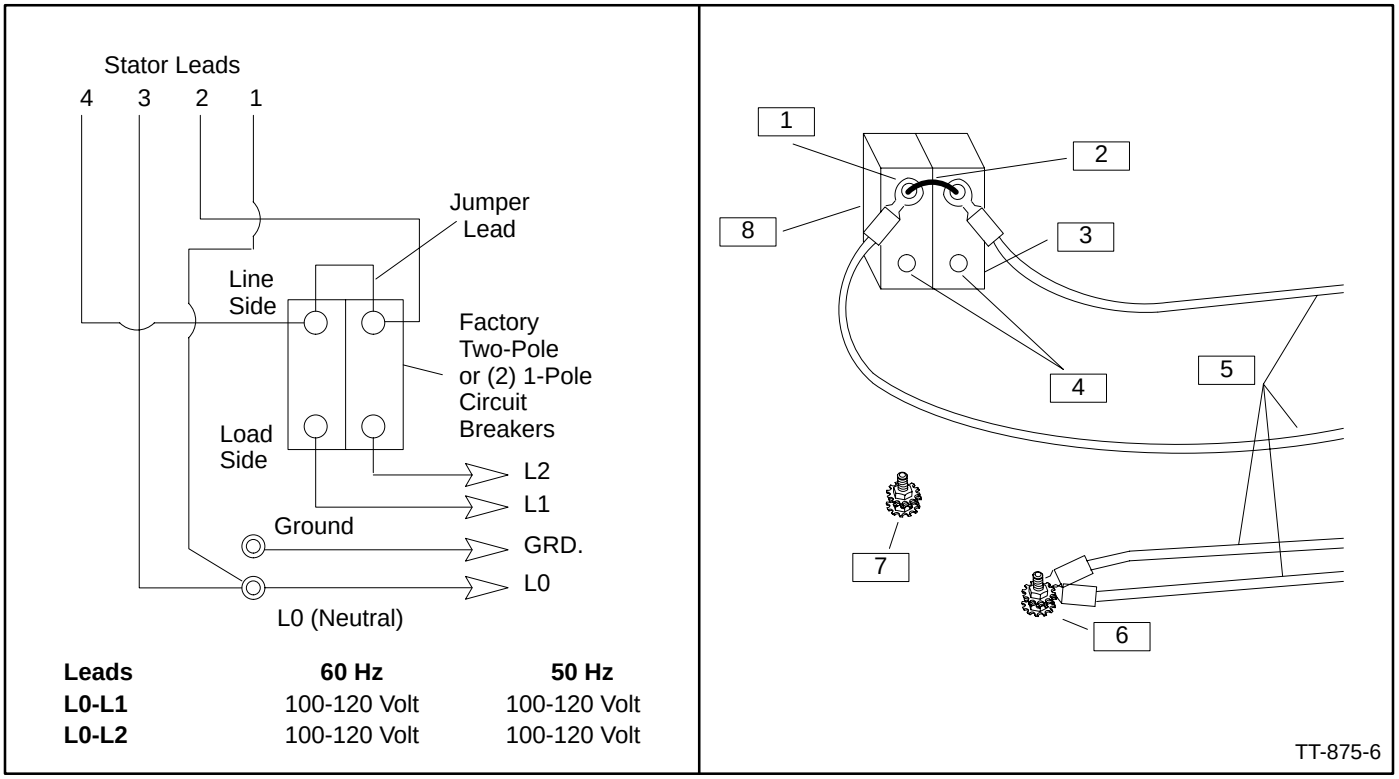
Use the following information to illustrate the reconnection of 4-lead generator sets. In all cases, follow the National Electrical Code (NEC).

NOTE

When reconnecting a generator set to a voltage different from nameplate voltage, place a notice on the unit indicating this change. Authorized service distributors/dealers supply a decal (part no. 246242) for this purpose.

100-120 Volt Configurations— Figure 4 (Two Pole) and Figure 5 (Single Pole)

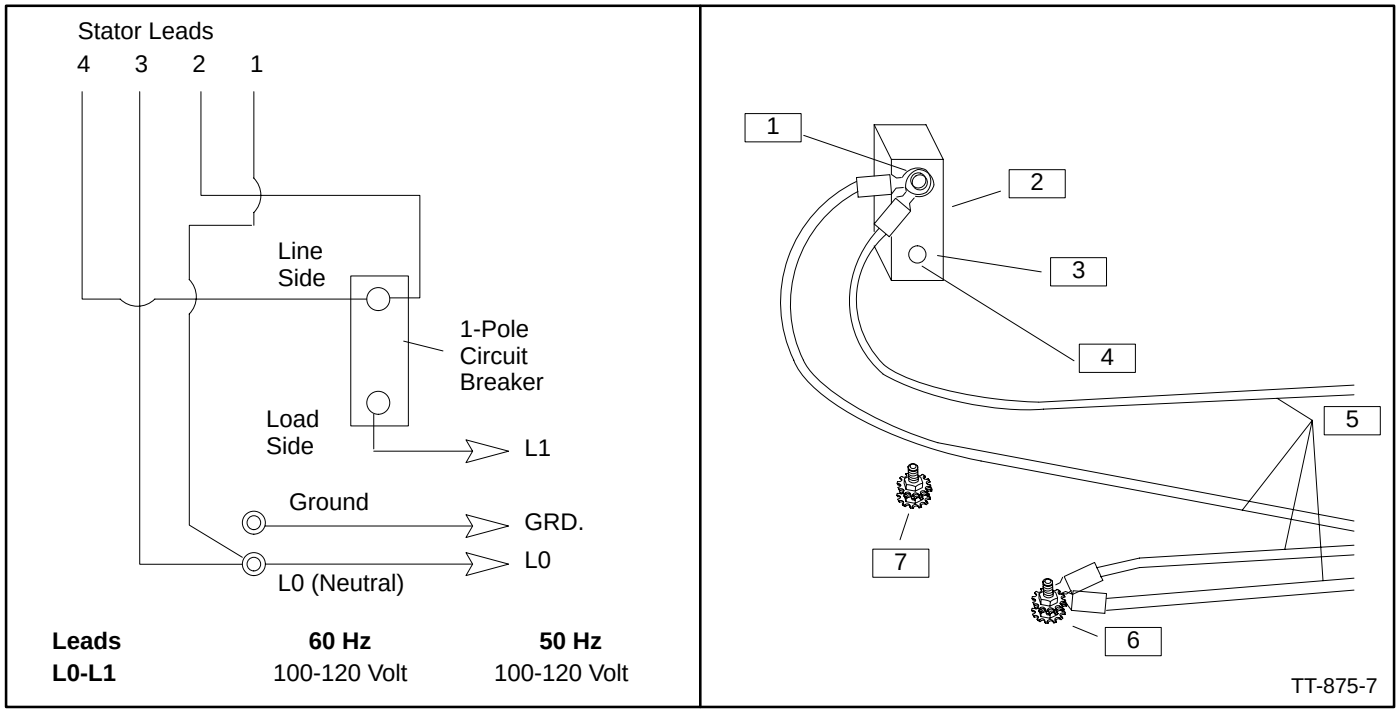
Do not connect the load side terminals of the circuit breaker together when using a factory-supplied two-pole circuit breaker (see Figure 4). If the installation requires a 100-120 volt, 2-wire system, use a single-pole circuit breaker (see Figure 5). When connecting stator phase leads together, size the output lead (L1) accordingly to handle the amperage. Connect a jumper lead on the *line* side of the circuit breaker when using a single voltage, 3-wire system to balance the load of the generator set.



Leads	60 Hz	50 Hz
L0-L1	100-120 Volt	100-120 Volt
L0-L2	100-120 Volt	100-120 Volt

1. Line side
2. Jumper leads
3. Load side
4. L1/L2 phase (black) leads
5. Stator leads
6. L0 neutral (white) leads
7. GRD. ground (green) leads
8. AC circuit breaker

Figure 4. Two-Pole Circuit Breaker (with Single-Voltage System) Mounting (100-120 Volt, 3 Wire)

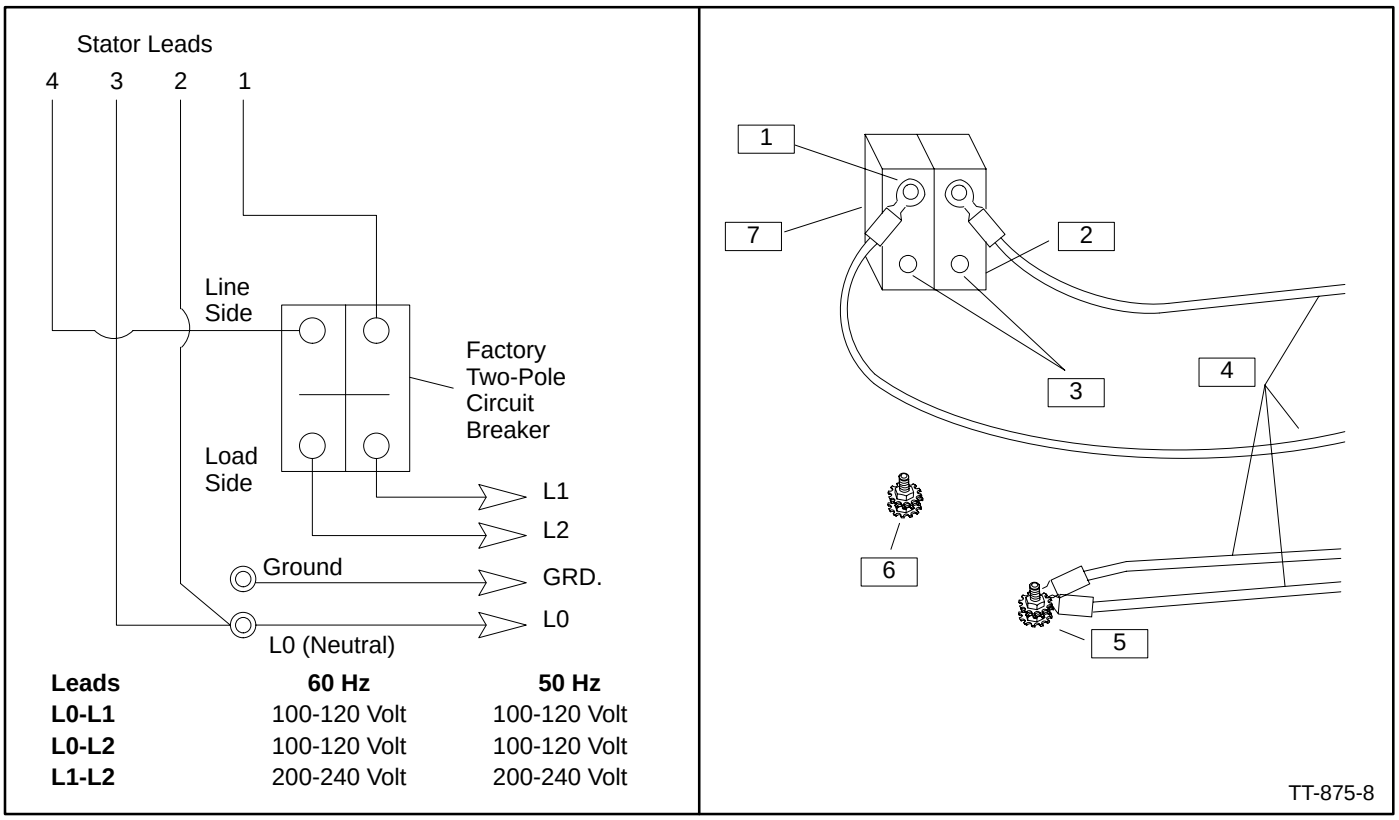


1. Line side
2. AC circuit breaker
3. Load side
4. L1 phase (black) lead
5. Stator leads
6. L0 neutral (white) lead
7. GRD. ground (green) lead

Figure 5. Single-Pole Circuit Breaker Mounting (100-120 Volt, 2 Wire)

100-120/200-240 Volt Configurations—Figure 6

Dual-voltage systems (example 120/240 volt) do not use a jumper lead. If unit was originally wired for straight 100-120 volt, 3-wire, remove jumper lead (see Figure 4 for location and usage of jumper lead). Select a circuit breaker manufacturer supplying a two-pole circuit breaker. Application of two single-pole circuit breakers does not conform to NEC requirements for supplying a 200-240 volt load—even if the breakers are mechanically attached together. Leads L1 and L2 are for different phase legs—**never** connect them together.



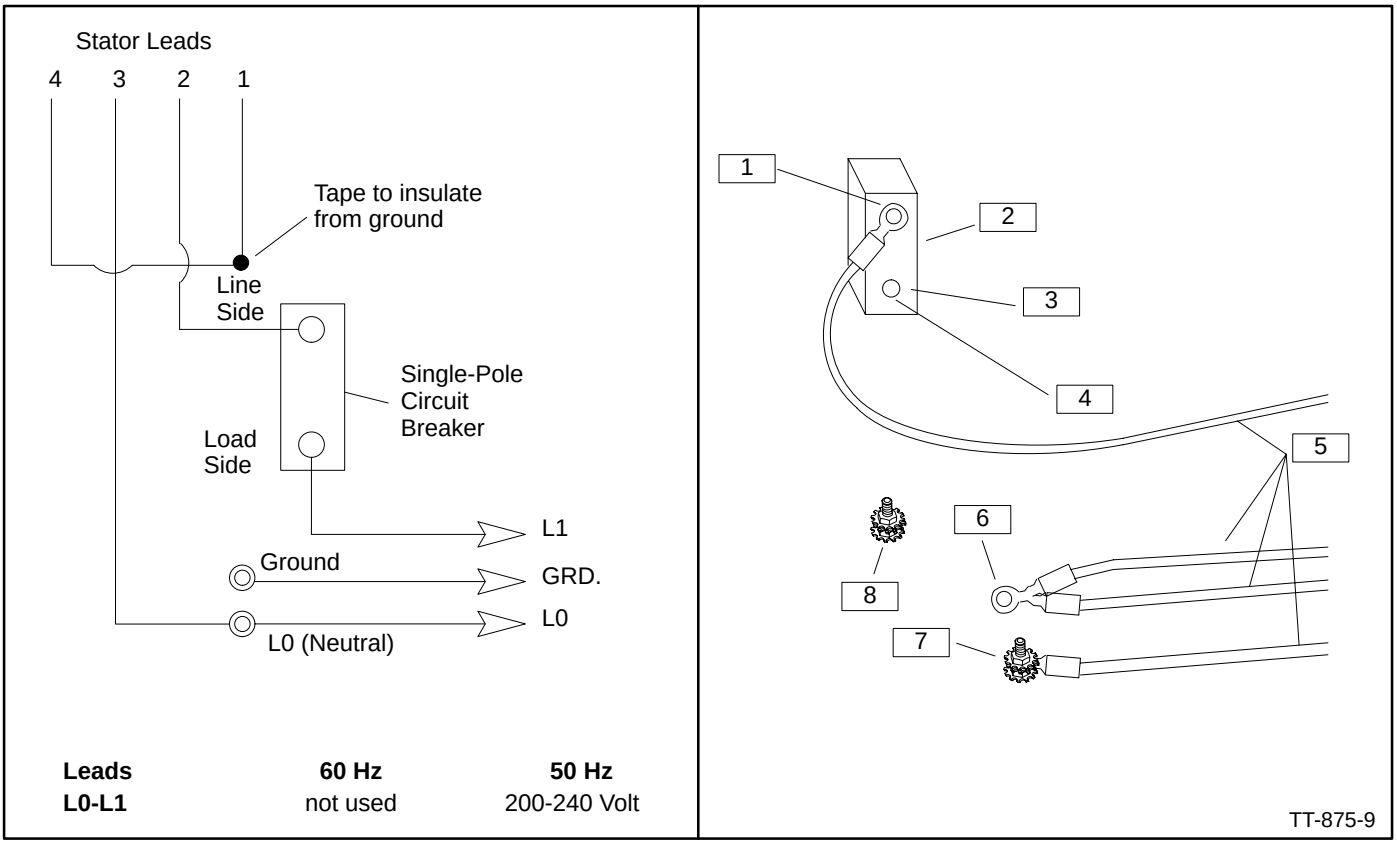
Leads	60 Hz	50 Hz
L0-L1	100-120 Volt	100-120 Volt
L0-L2	100-120 Volt	100-120 Volt
L1-L2	200-240 Volt	200-240 Volt

1. Line side
2. Load side
3. L1/L2 phase (black) leads
4. Stator leads
5. L0 neutral (white) lead
6. GRD. ground (green) leads
7. AC circuit breaker

Figure 6. Two-Pole Circuit Breaker (with Dual-Voltage System) Mounting (100-120/200-240 Volt, 3 Wire)

200-240 Volt Configurations—Figure 7

This system uses a single-pole circuit breaker with 200-240 volt, 2-wire.



1. Line side
2. AC circuit breaker
3. Load side
4. L1 phase (black) lead
5. Stator leads
6. Tape to insulate from ground
7. L0 neutral (white) lead
8. GRD. ground (green) lead

Figure 7. Single-Pole Circuit Breaker Mounting (200-240 Volt, 2 Wire)

Circuit Breaker Kits

Parts List		
	Kits: PA-225630, PA-229391, PA-229393, PA-229394, PA-229542, PA-229543, and PA-344106	
Qty.	**Description**	**Part Numbers**
1	Circuit breaker	See Figure 1
1	Terminal, jumper	249956
1	Decal, notice	246242
	Kits: PA-225632, PA-225633, and PA-225636	
Qty.	**Description**	**Part Numbers**
1	Circuit breaker	See Figure 1
1	Lead	LN-1003-1515
1	Decal, notice	246242
	Kits: PA-225639, PA-225640, PA-225641, PA-225642, PA-228670, PA-229184, PA-229185, and PA-229186	
Qty.	**Description**	**Part Numbers**
1	Circuit breaker	See Figure 1
1	Plate, cover	229183
1	Decal, notice	246242
	Kits: PA-225634, PA-225635, PA-225637, PA-225638, PA-229392, PA-344050, PA-344051, PA-344052, PA-344053, PA-344054, PA-344055, and PA-344309	
Qty.	**Description**	**Part Numbers**
1	Circuit breaker	See Figure 1
1	Decal, notice	246242
	Kits: PA-229243, PA-229244, PA-229245, PA-229400, and PA-229401	
Qty.	**Description**	**Part Numbers**
1	Circuit breaker	See Figure 1
1	Plate, cover	229208
4	Boot, insulation (kits PA-229244, PA-229245, PA-229400, and PA-229401)	238915
4	Boot, insulation (kit PA-229243)	290262
1	Decal, notice	246242
	Kits: PA-229914, PA-229915, and PA-229916	
Qty.	**Description**	**Part Numbers**
1	Circuit breaker	See Figure 1
2	Plate, cover	229208
4	Boot, insulation	238915
1	Decal, notice	246242

Voltage Regulator Adjustment

⚠ WARNING

Hazardous voltage.

Moving rotor.

Can cause severe injury or death.

Operate generator set only with all guards and electrical enclosures in place.

Testing voltage regulator. Hazardous voltage can cause severe injury or death. High voltage is present at the voltage regulator heat sink. Do not touch voltage regulator heat sink when testing or electrical shock will occur.
(PowerBoost™, PowerBoost™ III, and PowerBoost™ V voltage regulator models only.)

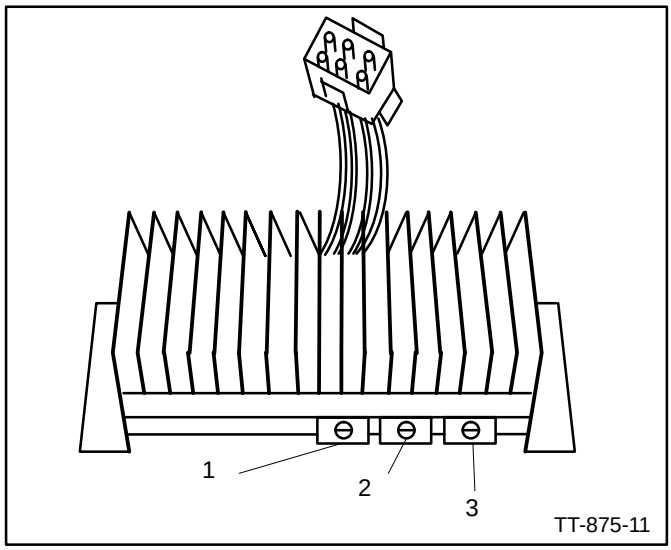
The voltage regulator is typically located in the controller or circuit breaker junction box. Adjustments are possible without removing the voltage regulator. This procedure applies to both the PowerBoost™ IIIE (Figure 8) and PowerBoost™ V (Figure 9) voltage regulators.

NOTE

This adjustment procedure is for readjustment of the voltage regulator and governor for broadrange generator sets with mechanical governors. Figure 3 identifies broadrange generator sets.

NOTE

Special Tools: Frequency meter 50/60 Hz.

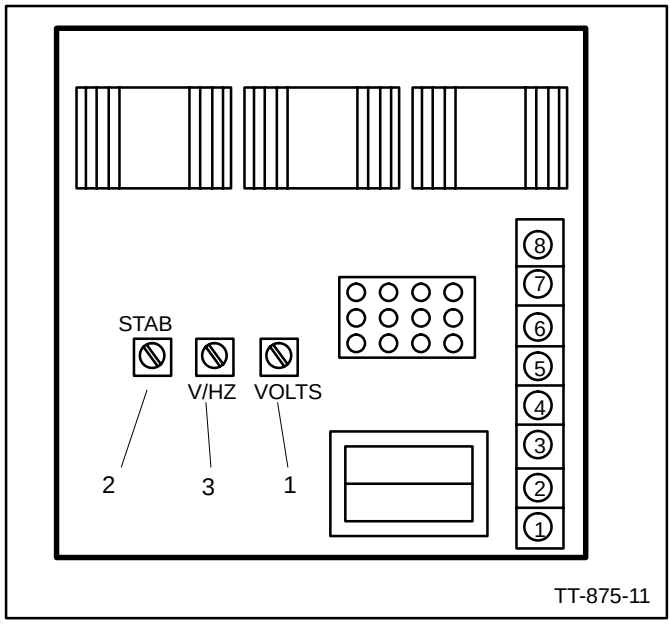


1. Voltage adjustment potentiometer
2. Stability adjustment potentiometer
3. Volts/Hz adjustment potentiometer

Figure 8. PowerBoost™ IIIE Voltage Regulator

NOTE

A customer-provided rheostat may be connected across regulator leads/terminals 33 and 66 to adjust generator output voltage from a location remote from the set. The rheostat (10K ohms, 1/2 watt minimum) will provide a 5-volt adjustment range.



1. Voltage adjustment potentiometer
2. Stability adjustment potentiometer
3. Volts/Hz adjustment potentiometer

Figure 9. PowerBoost™ V Voltage Regulator

Stabilizer Potentiometer (Pot)—Fine-tunes regulator circuitry to reduce light flicker.

Voltage Adjustment Potentiometer (Pot)—Adjusts generator voltage output within a range of approximately 100-130 volts.

Volts/Hz Potentiometer (Pot)—Determines engine speed (Hz) at which generator output voltage will begin to drop.

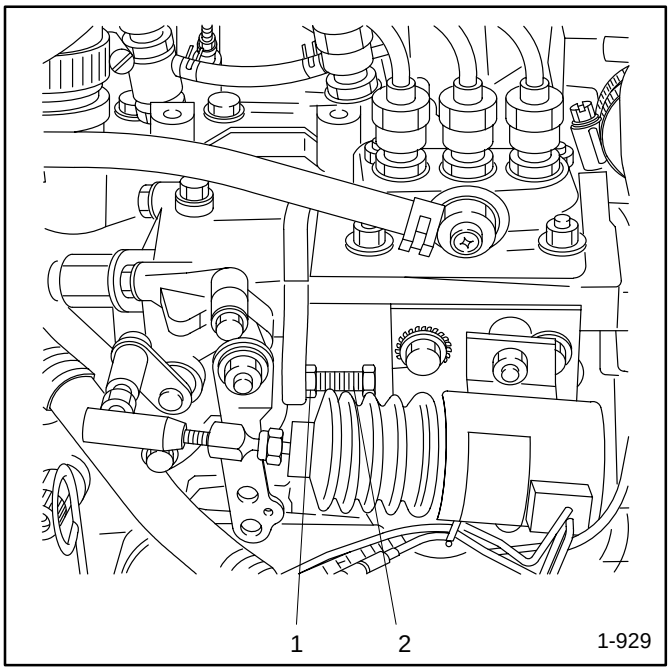
NOTE

Volt/Hz adjustment does not apply to 7/10CCO—RV and 5/9CCOZ—Marine units.

NOTE

For optimum results, apply full load when adjusting voltage regulator.

1. With generator set off, turn remote rheostat (if equipped) to midpoint. Turn **Voltage, Volts/Hz, and Stability pots** fully counterclockwise. Connect voltmeter and frequency meter to AC circuit or an electrical outlet.
2. Start generator set. Rotate **Voltage Adjustment pot** clockwise to increase voltage (counterclockwise to decrease voltage) until desired output voltage is achieved.
3. Rotate **Stability pot** clockwise to obtain minimum light flicker.
4. Readjust **Voltage Adjustment pot** (if necessary).
5. Adjust engine speed to desired cut-in frequency (factory setting 57.5-58 Hz for 60 Hz models or 47.5-48 Hz for 50 Hz models) as measured on frequency meter. Typically, to change engine speed adjust the governor arm. Loosen the locknut and turn either clockwise or counterclockwise to achieve the correct frequency. See Figure 10, 11, or 12. If using a second screw to hold the governor arm, loosen locknut and back out screw.



1. Locknut
2. Speed adjusting screw

Figure 10. Governor Adjustment (Yanmar-Powered, 5CCOZ/4CCFOZ, 5EOZ/4EFOZ Shown)

NOTE

Volt/Hz adjustment does not apply to 7/10CCO—RV and 5/9CCOZ—Marine units.

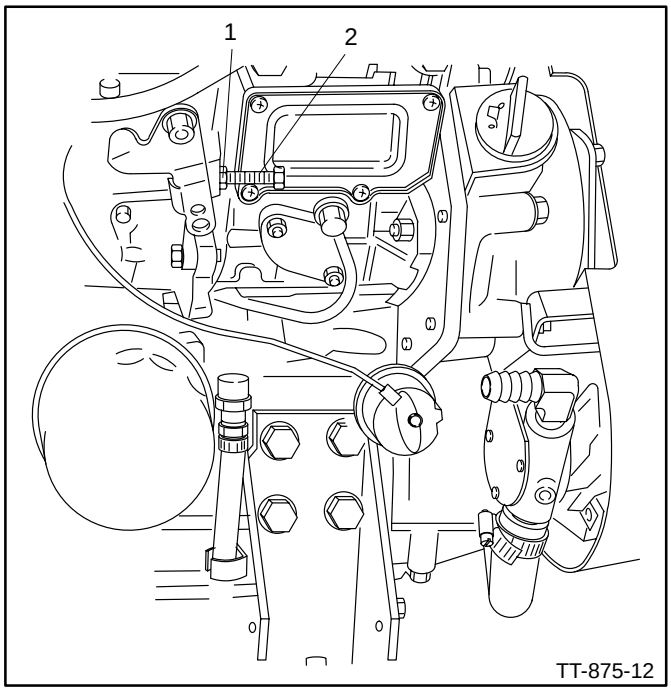
6. Rotate **Volts/Hz Adjustment pot** clockwise until voltage level (as measured on voltmeter) begins to drop. When set to these specifications, the generator will attempt to maintain normal output until engine speed drops below the frequency set in Step 5 (as load is applied).

7. Readjust engine speed to normal (63 Hz/1890 rpm for 60 Hz or 52.5 Hz/1575 rpm for 50 Hz). Tighten locknut when adjustments are complete. Turn the second screw (if used) to lock governor arm in place and tighten the locknut.

8. Readjust **Voltage Adjustment pot** (if necessary).

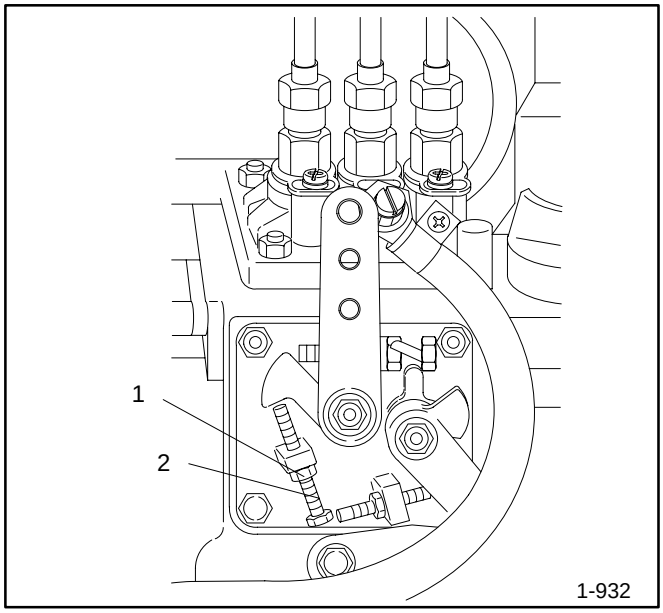
9. Readjust **Stability pot** (if necessary).

10. Use remote rheostat (if equipped) to make final voltage adjustments. Stop the generator set.



1. Locknut
2. Speed adjusting screw

Figure 11. Governor Adjustment (Yanmar-Powered, 9CCOZ/8CCFOZ, 9EOZ/8EFOZ Shown) (13.5-21CCOZ/11-16.5CCFOZ Models Similar)



1. Locknut
2. Speed adjusting screw

Figure 12. Governor Adjustment (Kubota-Powered, Typical)