Operation Instructions

Standby Generator Sets

Manual Paralleling Controller

Kits Numbers: 326482-326576
328804-328888

For Models:
20-1600 kW

TT-1038 1/95

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Safety Precautions and Instructions

A generator set, like any other electromechanical device, can pose potential dangers to life and limb if improperly maintained or imprudently operated. The best way to prevent accidents is to be aware of the potential dangers and to always use good common sense. In the interest of safety, some general precautions relating to the operation of a generator set follow. Below are some general precautions relating to the operation of a generator set. SAVE THESE INSTRUCTIONS.

DANGER

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

WARNING

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

CAUTION

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

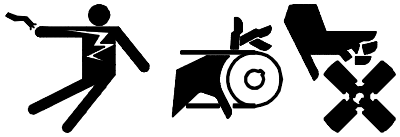
NOTE

Note communicates installation, operation, or maintenance information that is important but not hazard related.

Safety decals are affixed to the generator set in prominent places to advise the operator or service technician of potential hazards. The decals are reproduced here to improve operator recognition. For a further explanation of decal information, refer to the safety precautions throughout this manual. Before operating or servicing the generator set, be sure you understand the messages of these decals. Replace decals if missing or damaged.

Accidental Starting

⚠ WARNING



Accidental starting.
Can cause severe injury or death.

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

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 any equipment connected to generator set. The generator set can be started by automatic transfer switch or remote start/stop switch unless these precautions are followed.

Battery

⚠ WARNING

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

Use protective goggles and clothes. Battery acid can cause permanent damage to eyes, burn skin, and eat holes in clothing.

⚠ WARNING

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

Locate in a well-ventilated area. Keep explosive fumes away.

Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flame or spark to occur near a battery at any time, particularly when it is being charged. Avoid contacting terminals with tools, etc., to prevent burns and sparks that could cause an explosion. Remove wristwatch, rings, and any other jewelry before handling battery. Never connect negative (–) battery cable to positive (+) connection terminal of starter solenoid. Do not test battery condition by shorting terminals together. Sparks could ignite battery gases or fuel vapors. Ventilate any compartment containing batteries to prevent accumulation of explosive gases. To avoid sparks, do not disturb battery charger connections while battery is being changed. Always turn battery charger off before disconnecting battery connections. Remove negative lead first and reconnect it last when disconnecting battery.

Sulfuric acid in batteries can cause severe injury or death. Sulfuric acid in battery can cause permanent damage to eyes, burn skin, and eat holes in clothing. Always wear splash-proof safety goggles when working around the battery. If battery electrolyte is splashed in the eyes or on skin, immediately flush the affected area for 15 minutes with large quantities of clean water. Seek immediate medical aid in the case of eye contact. Never add acid to a battery once the battery has been placed in service. This may result in hazardous spattering of electrolyte.

Hazardous Voltage Electrical Shock

Hazardous voltage can cause severe injury or death. Electrically ground generator set before operating. The NEC (National Electrical Code) Article 250-6 addresses portable generator set electrical grounding. Due to variations in local codes, a grounding electrode is not provided. For electrical grounding in your particular application, consult your local codes or a qualified electrician.

⚠ WARNING

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

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

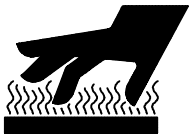
Hazardous voltage can cause severe injury or death. Whenever electricity is present, there is the hazard of electrocution. Open main circuit breaker on all power sources before servicing equipment. Electrically ground the generator set and electrical circuits when in use. Never come into contact with electrical leads or appliances when standing in water or on wet ground, as the chance of electrocution is increased under such conditions.

Hazardous voltage can cause severe injury or death. Disconnect generator set from load by opening line circuit breaker or by disconnecting generator set output leads from transfer switch and heavily taping ends of leads. If high voltage is transferred to load during test, personal injury and equipment damage may result. Do not use the safeguard circuit breaker in place of the line circuit breaker.

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 that can cause short circuits.

Hot Parts

⚠ WARNING



Hot engine and exhaust system.
Can cause severe injury or death.

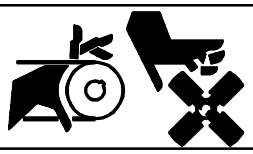
Do not work on generator set until it is allowed to cool.

Hot parts can cause severe injury or death. Avoid touching generator set field or exciter armature. Generator set field and exciter armature will become hot if shorted.

Hot parts can cause severe injury or death. Do not touch hot engine parts. An engine gets hot while running and exhaust system components get extremely hot.

Moving Parts

⚠ WARNING



Rotating parts.
Can cause severe injury or death.

Do not operate generator set without all guards, screens, and covers in place.

Exposed moving parts can cause severe injury or death. Keep hands, feet, hair, clothing, and test leads away from belts and pulleys when generator set is running. Replace guards, screens, and covers before operating generator set.

NOTE

Hardware Damage! Engine and generator set may use both American Standard and metric hardware. Use the correct size tools to prevent rounding of bolt heads and nuts.

Introduction

These instructions cover the general operation of the manual paralleling controller.

Read through these instructions and carefully follow all procedures and safety precautions to ensure safe and efficient generator operation. Keep these instructions with the generator set for future reference.

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

Service Assistance

For service or information, check the yellow pages of the telephone directory under the heading GENERATORS—ELECTRIC for an authorized service distributor/dealer.

KOHLER CO., Kohler, Wisconsin 53044 U.S.A.
Phone: 414-565-3381
Fax: 414-459-1646 (North American Sales)
414-459-1614 (International)
For Sales and Service in U.S.A. and Canada
Phone: 1-800-544-2444

In any communications regarding your generator set, please include the MODEL, SPEC, and SERIAL numbers found on the nameplate attached to the generator set and the ENGINE number found on the engine nameplate. In addition, add part nos. of ACCESSORIES when available. A nameplate located inside the junction box identifies factory-installed accessories. Enter numbers in spaces provided. This information will enable your authorized service distributor/dealer to supply the correct part or data for your generator set. Part numbers do not appear in this manual due to variations in this series of generator set models.

Model No. _____

Specification No. _____

Serial No. _____

Engine No. _____

Accessory Nos. _____

_____

_____

_____

_____

_____

_____

_____

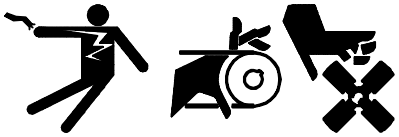
Specifications

The manual paralleling controller meets the need for an economical method of manually paralleling two generator sets. It also provides the reliability of the proven Kohler Decision Maker™ microprocessor controller. Large switchgear-style cubicles are unnecessary. An oversized controller box mounted on the generator set encloses the syncronizer controls. When two generator sets are parallel, the manual paralleling controller allocates the load between the generator sets based on their power ratings.

Kohler designed the manual paralleling controller to parallel similar generator set families (20-300 kW or 350-1600 kW). The manual paralleling controller cannot parallel two generator sets from different manufacturers. The manual paralleling controller can parallel only generator sets with the same rotor pitch, electronic governor, and voltage regulator. If the need to parallel two dissimilar generator sets arises, ask your local distributor for information on the complete line of Kohler paralleling switchgear.

Initial Setup

⚠ WARNING



Accidental starting.
Can cause severe injury or death.

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

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 any equipment connected to generator set. 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.

Do not operate generator set without all guards and electrical enclosures in place.

Hazardous voltage can cause severe injury or death. Whenever electricity is present, there is the hazard of electrocution. Open main circuit breaker on all power sources before servicing equipment. Electrically ground the generator set and electrical circuits when in use. Never come into contact with electrical leads or appliances when standing in water or on wet ground, as the chance of electrocution is increased under such conditions.

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 that can cause short circuits.

Reactive Droop Compensation Setup

For reactive droop compensation adjustment of 350-1600 kW generator sets refer to TP-5579 .

To test and adjust the reactive droop compensator for 20-300 kW generator sets proceed as follows. Read entire procedure before beginning.

1. Set the reactive droop rheostat at minimum (full counterclockwise position [ccw]).
2. Move the voltage sense lead inside the controller from terminal V7 to terminal V9.
3. Start the generator set and adjust the voltage using the voltage-adjusting potentiometer to rated system voltage.
4. Check droop compensation on each generator set as follows:
   a. With the first generator set operating at rated speed and voltage, apply a resistive load (1.0 pf) until rated current is obtained.
   b. Adjust the reactive droop rheostat to obtain 6-8% droop in voltage.
5. Remove the load from the generator set.
6. Shut the generator set down by placing the RUN/OFF-RESET/AUTO switch in the OFF-RESET position.
7. Move the voltage sense lead inside the controller from terminal V9 to terminal V7.

Repeat steps 1-7 for any additional generator sets.

After adjusting all generator sets, parallel the generator sets. See procedure for paralleling generator sets.

In addition to steps 1-7, use the following procedure to ensure the units are sharing the reactive load correctly:

1. Parallel the units at one-half to full load. Check the wattmeters to determine that each generator set is carrying equal kW load or a load proportional to its capacity. If the loads are incorrect, adjust and recheck the governor throttle control to balance loading. Engine speed will determine load-sharing ability.
2. With the load balanced, check the ammeters to verify equal current and that the current is proportional according to capacity. If the currents are incorrect, adjust the reactive droop rheostat to reduce the highest reading.

Load-Sharing Module Setup

Use the following procedure to calibrate the load-sharing module for a 3% droop.

1. With the droop adjustment pot in the fully counterclockwise position, calibrate the 8000 governor as described in the DYNA 8000 technical manual (F-23721).
2. Set no-load speed to rated frequency.
3. Adjust the AC line voltage for rated value.
4. Start the first generator set and apply 100% load.
5. While monitoring the frequency adjust the droop set potentiometer clockwise to achieve 3% droop.
6. Unload the generator and repeat steps 1 through 4 on the remaining generator sets.
7. After adjusting all the generators for equal droop, parallel the generator sets. See procedure for parallel generator sets.
8. If the governors are unstable when the generator sets are paralleled, repeat steps 4-7 and gradually increase the percentage of droop until stable.

NOTE

If there is unequal loading of the phases, the droop will not be linear but the units will share load proportionally.

Reverse Power Relay Test

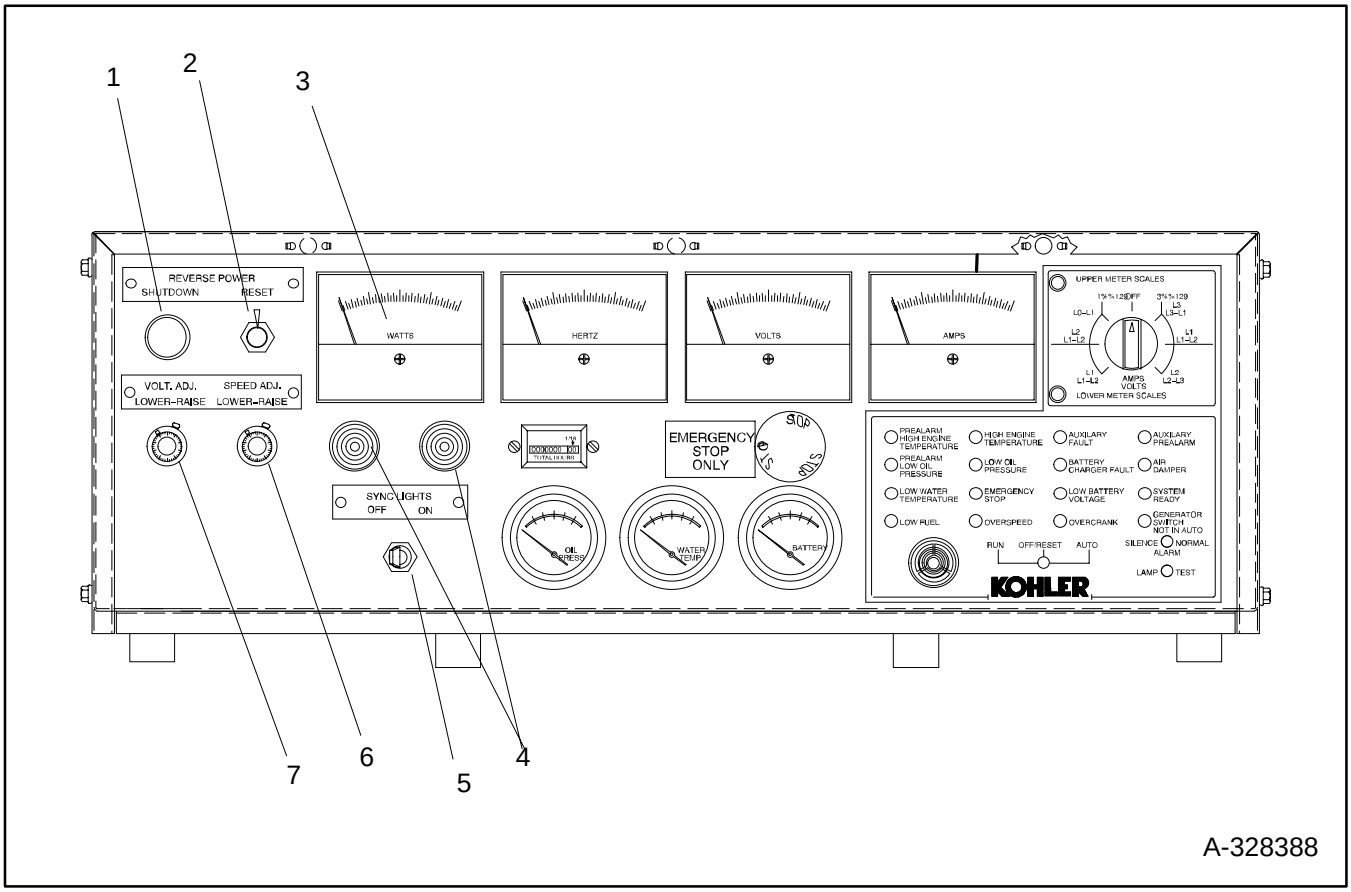
To test the reverse power relay, proceed as follows. Read the entire procedure before beginning:

1. Start the generator set and adjust the voltage using the voltage-adjusting potentiometer to rated system voltage.
2. Close the generator set's circuit breaker.
3. Press the PUSH TO TEST switch on the reverse power relay module.
4. The generator set's circuit breaker will open and the reverse-power relay shutdown lamp will illuminate.
5. Press the reverse-power reset button to reset the relay.

Repeat steps 1-5 for any additional generator sets.

Operation

For identification of manual paralleling controller components and an explanation of their function, refer to Figure 1 and the following descriptions.



1. Reverse Power Shutdown Lamp
2. Reverse Power Reset Pushbutton
3. Wattmeter
4. Sync Lights
5. Syncroscope Switch OFF/ON
6. Speed Adjustment Potentiometer
7. Voltage Adjustment Potentiometer

Figure 1. Manual Paralleling Component

Features

NOTE

For an explanation of the functions of all controller components not identified, refer to the generator set operation manual.

Sync Lights. Lights used for manual paralleling operation.

Syncroscope Switch OFF/ON. Switch controls the operation of the synchroscope lights.

Reverse Power Reset Pushbutton. Pushbutton resets reverse power shutdown circuit.

Reverse Power Shutdown Lamp. Lamp illuminates when reverse power shutdown occurs.

Speed Adjustment Potentiometer. Potentiometer adjusts frequency of generator set.

Voltage Adjustment Potentiometer. Potentiometer adjusts output voltage of generator set.

Single Generator Set Operation

Start the first generator set as described in the generator set operation manual. When the generator set is at rated voltage and frequency close the circuit breaker to the load. The first generator can operate from no load to full load as described in the generator set operation manual.

Procedure for Paralleling Multiple Generator Sets

Parallel two or more generator sets if the load is expected to be greater than the full-load rating of the first generator set. Perform the following steps to parallel additional generator sets:

NOTE

Do not parallel two or more generator sets without load. A reverse power condition can shut down one of the generator sets. If the load is less than 10% of the full-load rating of the first generator set, shut down all additional generator sets.

1. Start the first generator set according to the procedure in the generator set operation manual.
2. After the generator set is at rated voltage and frequency, close the first generator set's circuit breaker.
3. When the load is at approximately 80% of maximum rated load for the first generator set start an additional generator set.
4. After the incoming generator set is at rated voltage and frequency, place the sync light switch in the ON position.
5. Use the speed pot to adjust the frequency of the incoming generator set until the sync lights darken from full illumination to being dark in a minimum of 20 seconds.
6. After the sync lights are dark for a minimum of 2 seconds close the incoming generator set circuit breaker.
7. Observe the kilowatt meters of the paralleled generator sets. Adjust the speed pot of the second generator to share the load proportionally with the first generator set.

Follow the above procedure for paralleling any additional generator sets.

Procedure for Disconnecting Load from Paralleled Generator Sets

Disconnect a generator set when the total system load drops to less then 50% of the lowest single generator set rating. Open the circuit breaker of the desired generator set to remove it from the load. Allow the generator set to run for an additional five minutes unloaded for a cooldown period, then place the engine control switch in the OFF/RESET position to shut down the generator set.

Troubleshooting

When troubles occur, do not overlook simple causes which might seem too obvious to be considered. A starting problem, for example, could be attributed to an empty fuel tank. As a general aid to diagnosing common problems, refer to the troubleshooting table below. If the trouble cannot be corrected through routine servicing, contact an authorized service distributor for assistance.

Problem	Possible Cause	Corrective Action
Unit will not crank	Weak or dead battery	Recharge or replace; check charger operation
	Reversed or poor battery connections	Check connections
	Fuse blown in controller	Replace fuse
	Emergency stop switch activated (local or remote)	Reset controller and emergency stop switch (remote) and air damper (Detroit Diesel Powered)
	Fault shutdown	Correct fault and reset controller
Unit cranks but will not start	Improper fuel	Replace fuel
	No fuel	Add fuel; check fuel control circuit
	Air in fuel system	Bleed air from system
	Air cleaner clogged	Clean or replace filter element
No AC output	Line circuit breaker in the OFF position	Return to the ON position
	Generator problem such as defective voltage regulator or other internal fault	Contact authorized service distributor
Low output or excessive drop in voltage	Unit overloaded	Reduce load
	Engine speed too low	Contact authorized service distributor
	Faulty voltage rheostat or voltage regulator	Contact authorized service distributor
Unit stops suddenly	Low oil pressure shutdown	Check oil level. If low, check for leaks
	High temperature shutdown	Check for cooling air restrictions or poor belt tension
	Low coolant level shutdown (if equipped)	Check coolant level. If low, check for leaks
	Out of fuel	Add fuel
	Overcrank shutdown	Reset—if overcrank fault reoccurs, contact authorized service distributor
	Fuse blown in controller	Replace fuse—if fuse blows again, contact authorized service distributor
	Engine malfunction	Contact authorized service distributor
	Overspeed shutdown	Reset—if unit overspeeds again, contact authorized service distributor
	High oil temperature shutdown	Check oil level and type. If shutdown reoccurs, contact authorized service distributor
	Overvoltage shutdown (if equipped)	Contact authorized service distributor
Unit stops suddenly	Generator master switch in OFF/RESET position	Move switch to RUN or AUTO position
	Emergency stop switch activated (local or remote)	Check reason for emergency shutdown; Reset switch

Problem	Possible Cause	Corrective Action
Sync Lights do not illuminate	Syncronizer not turned on	Turn syncronize switch to the ON position
	Burned-out sync lights	Replace sync light bulbs
Reverse power shutdown lamp illuminates when the circuit breaker is closed	Generator sets not adjusted for paralleling	Verify operating voltage of both generator sets is the same
		Verify that the frequencies of both generators are within .5 Hz of each other
	Load is below the recommended kW	Shut down one of the paralleled generator sets
Circuit Breaker trips when it is moved to the closed position	Generator sets not syncronized	Syncronize generator sets. See procedure for paralleling generator sets
	Generator set overloaded	Reduce load on generator set before closing circuit breaker

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