INDEX

SYNCHRONOUS ALTERNATORS.

Fault Finding Guide Capacitor Excited Alternators

Alternators used on the majority of Briggs and Stratton Power Products generators are capacitor exited, self-regulating.
The alternator consists of a rotor and a stator. The rotor is connected to the engine crankshaft power take off and rotates within the stationary stator, which is bolted to the engine crankcase.

The stator generally has two windings; these are the excitation winding and the power winding. Some alternators have an additional battery charge winding.

Excitation (the function that turns the rotor into a magnet) is produced by the excitation winding. The outlet sockets are connected to the power winding. It is the action of the magnet (rotor) revolving within the stator power windings that produces the voltage output.

To create a magnetic field on the rotor, a direct current (DC) is produced in the rotor winding.
The output from the stator excitation winding is alternating current (AC) and it is the action of the diode(s) on the rotor that converts the alternating current (AC) to direct current (DC). When the alternator is at rest, the rotor retains a small amount of magnetism; this is termed as residual magnetism.
A capacitor is connected across the stator excitation winding. The current flowing through the capacitor induces a current in the rotor windings, and so regulates the strength of the rotor magnetic field.

Fault Finding

Follow these basic procedures to fault find:

Start engine and check engine speed, reset the governor if the engine is not running at the correct RPM

Check output voltage directly from the output sockets.
(*Use an accurate sensitive voltmeter because you are looking for zero or extremely low voltage)*

Note: Zero voltage indicates either an open circuit or total loss of residual magnetism on the rotor.

SYNCHRONOUS ALTERNATORS.

Voltage at Outlet Socket	Possible Fault	Test	Possible Cause and Action
0V	No Connection from Outlet to Main Winding.	Measure resistance at outlet socket.	Cable connection - Repair Faulty circuit breaker – Replace circuit Breaker Alternator to panel Connector. Repair/Replace
	Main Winding Fault	Measure resistance at connector.	Connector and/or cable – Repair connection/replace stator. Faulty main winding – Replace stator
	Rotor Not Rotating	Check rotation	Rotor bolt loose – Check crankshaft and refit/replace rotor bolt.
	Rotor Demagnetized (No Residual)	No Test	Alternator has been overloaded or shorted – Attempt to restore residual magnetism
Low Output 9 to 27V	Excitation circuit failure	Test Capacitor	Overload/ Short/RPM High –Check RPM and replace capacitor.
		Test Excitation Winding.	Overload/ Short/RPM High – Replace Stator
		Test Diode Set	As above – Replace Diode Set
		Test Rotor Winding	As Above – Replace Rotor
130 – 180V	Dual rotor winding – One Diode set failed	Test Diode Set	As above – Replace Diode Set
		Test Rotor Winding	As Above – Replace Rotor

SYNCHRONOUS ALTERNATORS.

Restoring Residual Magnetism:

Should only be carried out when test results show zero voltage and no open circuits are found on the alternator, panel and associated wiring.

To restore residual magnetism we pass 12V DC through the power windings by connecting a battery directly to the outlet sockets.

It is important to immobilize the engine by removing the spark plug lead from the spark plug.

1. Immobilize the engine.
2. Connect a 12 Volt battery directly to the outlet sockets (polarity is not important)
3. Turn the engine over. Note: 4 complete pulls of the recoil or approximately 3-4 seconds on the starter motor.
4. Remove the battery and connections.
5. Replace the spark plug lead.
6. Start the engine and measure output.
7. If the fault is loss of residual magnetism, output should be restored.

Restoring Residual Magnetism: Alternative Method

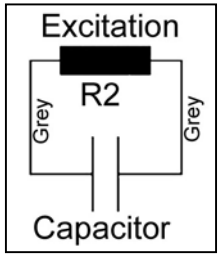
If a small amount of magnetism has been retained in the rotor it may be possible to restore out put by increasing the engine RPM slightly.
It is extremely important not to over rev the engine.

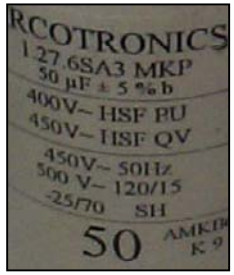
1. Start and run engine for a few minutes to warm.
2. Locate the throttle linkage at the carburetor and slowly increase RPM to a maximum of 3600RPM over a period of 5 seconds.
3. Allow engine to stabilize and recheck output at the outlet sockets.

CAPACITORS.

Capacitors are used in the excitation circuit of self-regulating alternators.

The capacitor is connected across the excitation winding (figure 1B). The current that flows through the capacitor produces a current in the rotor windings; this regulates the strength of the rotor magnetic field. It is the rotor magnetic field that generates the voltage in the power windings. The capacitor value is chosen to give the correct generator output voltage therefore it is important to always replace the capacitor with one of the same rating.





A: Capacitor *B: Circuit* *C: Capacitor Rating*

Figure 1

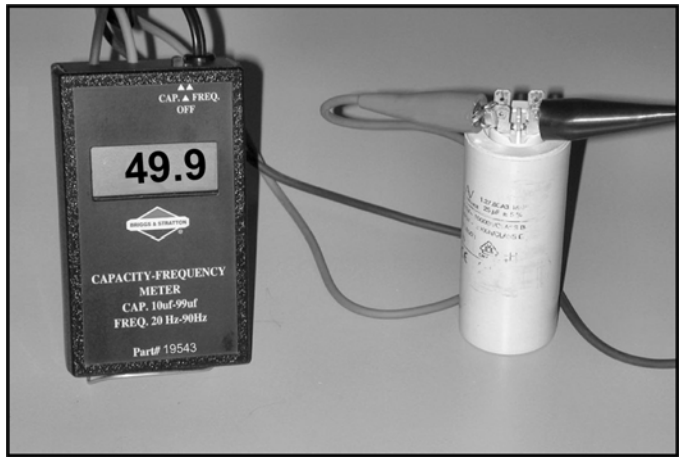
If the excitation capacitor fails, the alternator will loose it's regulating effect and the output voltage will drop. The output voltage will drop to between 9 and 27volts and will be due only to residual magnetism in the rotor.

If output tests indicate a failed capacitor, replace the capacitor with a known serviceable capacitor of the same voltage range. This "test" capacitor need not be of the same Farad rating. A significant change in output (160V – 250V) will confirm diagnosis.

CAPACITORS.

Testing Excitation Capacitors

Connect a suitable meter across the capacitor terminals. Meter may take up to 10 seconds to give a reading, which should be within the limits marked on the capacitor (figure 1C).



DIODES, VARISTORS, EMC CAPACITORS AND RECTIFIERS

Diodes

Diodes only allow current to flow in one direction. They are used to control the direction of current flow in the rotor windings. The current flow in the windings produces the magnetic field required to generate electricity.

Figure 1 shows a single diode. (Half Wave or Pulse Rectifier)

Figure 1

Symbol

Varistors

Diodes are protected by a varistor. The varistor diverts current from the diode when voltages are high enough to potentially cause damage to the diode.

Figure 2

Symbol

EMC Capacitors.

Some diode sets also include a small capacitor. This capacitor is fitted to suppress electronic noise (EMC) and cannot be tested without very

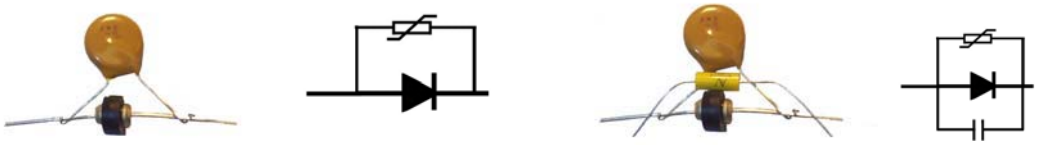
sensitive equipment.

Figure 3

Symbol

DIODES, VARISTORS, EMC CAPACITORS AND RECTIFIERS

Figure 5 shows two typical diode sets that you will find on synchronous alternator rotors, note that one set includes the small capacitor. Rotors may have one or two diode sets.



Symbol

Symbol

Diode set without Capacitor

Diode set with EMC Capacitor

Figure 5

Testing Diodes

To test the rotor diodes, remove one end of the electrical connection to the rotor winding. Using a high power, fine point soldering gun heat the solder until the wires from the diode set can be unwrapped from the rotor main winding. Isolate the diode from the varistor and capacitor (if fitted) and connect your resistance meter across the diode (figure 6). Follow the instructions for the meter you are using.

Figure 6 (Meter and diode)

Alternatively make up a small test lamp using a 12V bulb. Using a 12V supply, place the bulb in series with the diode, first in one direction, then reverse the test leads and repeat the test. The bulb should light in only one direction.

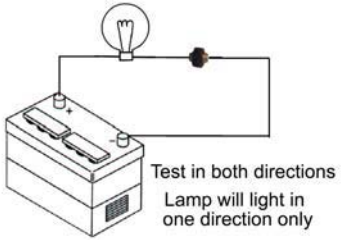


Figure 7 (Battery, test lamp and diode)

IMPORTANT! If the diode test fails replace the complete diode set (diode, varistor and capacitor). The new diode must be connected in the same direction as the one being replaced. All diodes used are marked with either a silver or red band indicating direction. Remember to test the rotor winding for continuity before replacing the diode set.

Diode failure where only one set is fitted will generally result in a voltage of between 4 and 18V (residual magnetism). Where two sets are fitted, failure of one diode will result in voltages of approximately 170V.

Testing Varistors

It is not practical to test the varistor therefore; it is recommended that whenever a diode set is removed for test, the varistor should be replaced.

Testing EMC Capacitors

It is not practical to test the EMC capacitor

DIODES, VARISTORS, EMC CAPACITORS AND RECTIFIERS

Bridge Rectifiers

Bridge rectifiers are used to convert AC current to DC current. They are used in battery charge circuits and in the excitation circuit of DC welders and 3 phase direct excited alternators. Often termed as full wave rectifiers the bridge rectifier is generally made up of 4 diodes and a varistor as shown in figures 8 and 9.

Figure 8 Bridge Rectifier

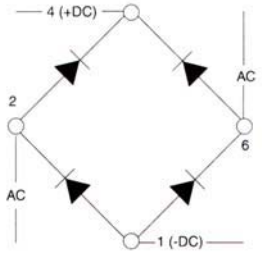


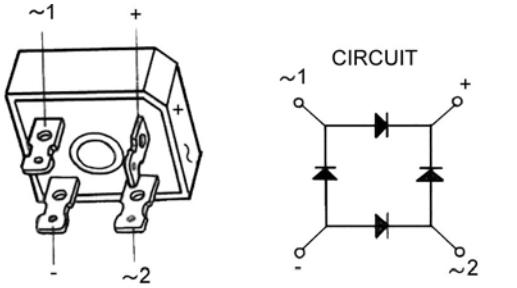
Figure 9 Bridge Rectifier Schematic

The bridge rectifier is often protected across the output positive and negative terminals by a varistor.

Testing Bridge Rectifiers

Each of the 4 diodes are tested individually using a resistance meter or a test lamp.
Refer to figure 9

Yes = Circuit Exists
No = No Circuit Exists
Replace bridge rectifier if any of the diodes fail test.



Positive Test Lead (+) \ Negative Test lead (-)	(+)	~1	~2	(-)
(+)		YES	YES	YES
~1	NO		NO	YES
~2	NO	NO		YES
(-)	NO	NO	NO	

Figure 9

ROTORS

Testing Rotor Windings

To test the rotor winding one end of the connection to the diode set must be electrically isolated. To do this use a high power fine point soldering iron and a pair of pliers. The electrical connections for the diode set and the terminating wires of the rotor are wound together at manufacture and soldered in place. Extreme care should be taken when removing the connection in order to avoid damage to the rotor winding and the plastic supports for the diode sets.

Refer to figures 1 through 3, heat the solder around either of the diode set connections until the terminating ends of the diode set and rotor winding can be untwisted. Carefully separate the rotor winding termination wire from the diode set and position so that it is electrically disconnected from the diode, varistor and the EMC capacitor.

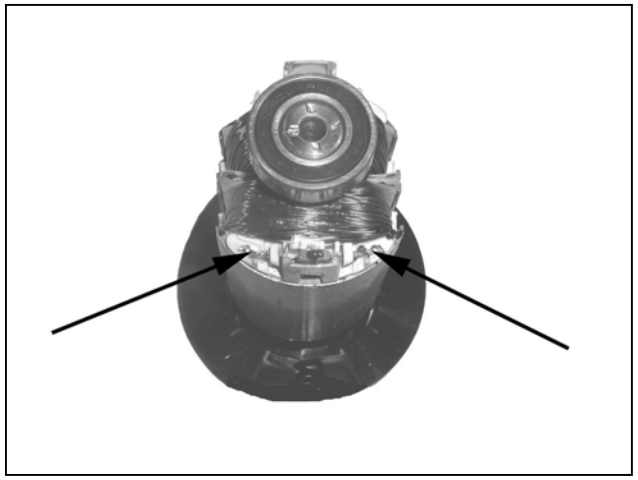


Figure 1: Rotor Test Point

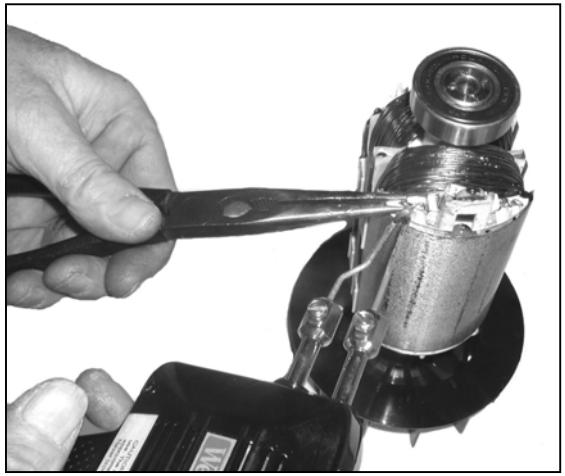


Figure 2 Isolating Diode Set

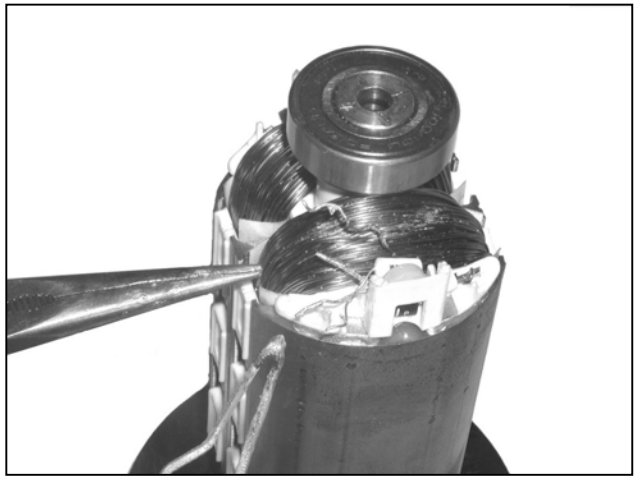


Figure 3. Rotor Winding Connection Isolated

ROTORS

Refer to figure 4; connect the test probes across the rotor winding previously disconnected from the rotor diode, varistor and EMC capacitor. Measure the resistance of winding and check for short to the body of the rotor.
Replace rotor if tests are not to specification.

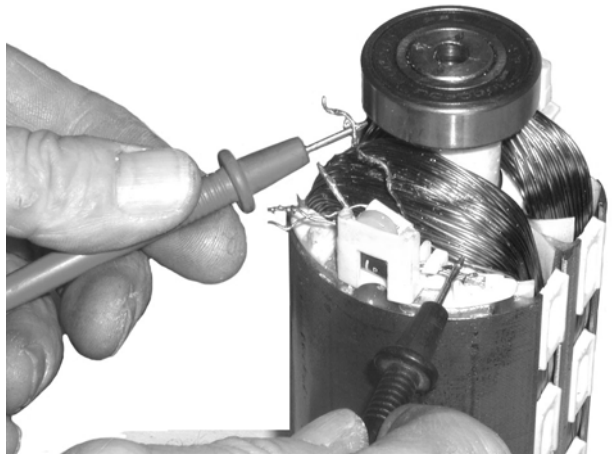
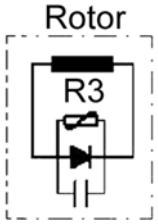


Figure 4 Testing Rotor Winding



Resistance Table

Ref	Winding	Ω @ 20° C
R1	Stator Power	2.1 Ω
R2	Stator Excitation	4.0 Ω
R3	Rotor	1.8 Ω

Wiring Diagram Data

STATORS

Testing Stator Windings

Testing the stator windings is relatively straightforward providing an accurate resistance meter is used. Figure 4 shows the wiring diagram for the continental EP3.0 alternator. Wiring diagrams include stator resistance values. Note that resistance values stated are at 20 degrees Celsius and depending on temperature and type of meter, readings could be up to 20% variance from those stated on the resistance table.

Main (Power) Winding

Refer to figure 1; set the meter to the Ohms scale, insert test probes directly to one of the outlet sockets and check for continuity. Trace the wiring through the back of the outlet sockets to the circuit breaker and to the panel connector. Locate the connection block from the stator and take readings between the black and the white wires (figure 2) and repeat the tests from the brown and blue wires.
From the wiring diagram it can be seen that we are in fact measuring both halves of the stator main (power) winding. A reading of infinity or high resistance indicates an open circuit in the stator winding. A low reading indicated a shorted stator winding.

Figure 1

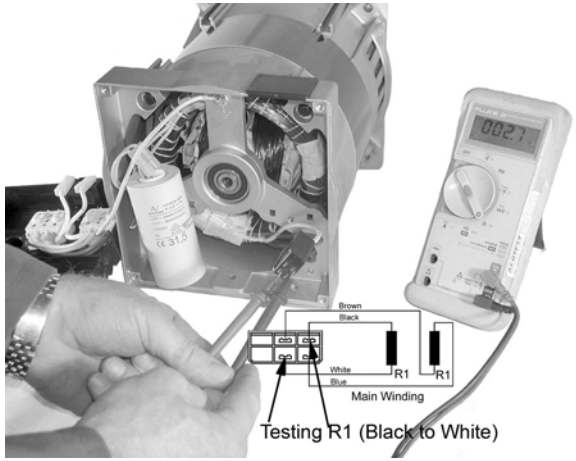


Figure 2

Check each half of the winding for a short to ground. A reading of infinity should be measured. A reading other than infinity indicates a stator winding shorted to ground - replace stator.

STATORS

Battery Charge Windings

Some alternators include a battery charge winding. The procedure for testing battery charge windings is the same as stator and excitation windings.

Testing Excitation Winding

Disconnect the two grey wires to the capacitor and measure the resistance of the excitation winding at the connectors (Figure 3). Connect one test lead to a good ground and connect the other to the stator excitation winding. A reading other than infinity indicates a stator excitation winding shorted to ground – replace stator.

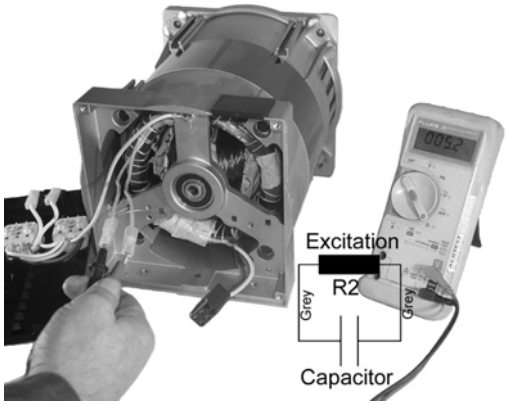
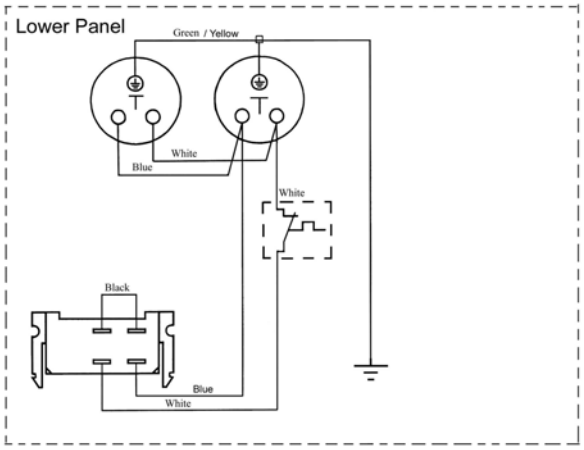


Figure 3

EP 3.0 Continental



Resistance Table

Ref	Winding	Ω @ 20° C
R1	Stator Power	2.1 Ω
R2	Stator Excitation	4.0 Ω
R3	Rotor	1.8 Ω

Figure4

DC WELDERS

The Sincro DC Welder Generator range of alternators used on Briggs and Stratton Power Products generators are direct exited with a transformer and selector switch regulating the welding current. The alternator consists of a rotor and a stator. The rotor is connected to the engine crankshaft power take off and rotates within the stationary stator, which is bolted to the engine crankcase. The stator has three windings; these are the excitation winding, the power winding and the welding winding. Excitation (the function that turns the rotor into a magnet) is produced by the excitation winding and boosted by current through the welding impedance transformer. The outlet sockets are connected to the power winding. It is the action of the magnet (rotor) revolving within the stator power windings that produces the voltage output.

To create a magnetic field on the rotor, a direct current (DC) is produced in the rotor winding. The output from the stator excitation winding is alternating current (AC). The alternating current produced by the excitation winding is connected to the rotor windings via a bridge rectifier, brush assembly and slip rings. The welding circuit consists of three welder windings connected in series to the welding impedance and a heavy-duty diode pack. The center coil of the weld impedance has an additional winding (secondary winding), which is connected to a second bridge rectifier; this winding boosts the current to the rotor during welding and is protected by a thermal circuit breaker. The bridge rectifiers convert the alternating current (AC) to direct current (DC). When the alternator is at rest, the rotor retains a small amount of magnetism; this is termed as residual magnetism.

Fault Finding - Generator output

Follow these basic procedures to fault find:

- Start engine and check engine speed, reset the governor if the engine is not running at the correct RPM
- Check output voltage directly from the output sockets.

(*Use an accurate sensitive voltmeter because you are looking for zero or extremely low voltage)*
Note: Zero voltage indicates either an open circuit or total loss of residual magnetism on the rotor.

- Compare output voltage with the table below.

DC WELDERS

Voltage at Outlet Socket	Possible Fault	Test	Possible Cause and or Action/ Remarks
0V	No Connection from Outlet to Main Winding.	Measure resistance at outlet socket.	Cable connection - Repair Faulty circuit breaker – Replace circuit Breaker Alternator to panel Connector. Repair/Replace
	Main Winding Fault	Measure resistance at connector block.	Connector and/or cable – Repair connection/replace stator. Faulty main winding – Replace stator
	Rotor Not Rotating	Check rotation	Rotor bolt loose – Check crankshaft and refit/replace rotor bolt.
	Rotor Demagnetized (No Residual)	No Test	Alternator has been overloaded or shorted – Attempt to restore residual magnetism
Low Output 4 to 15V	Excitation Circuit Failure Faulty Bridge Rectifier	Carry Out Rectifier Test	Replace if necessary.
	Faulty Excitation Winding	Measure excitation-winding resistance.	Alternator has been overloaded or shorted. Replace stator.
Low Output 4 to 15V	Faulty Rotor	Measure Rotor resistance	Measure directly on to slip rings. Check Condition of slip rings and brushes
Unstable Output Voltage drops off under load.	Fault in Bridge Rectifier High resistance on brushes to slip rings.	Test Bridge Rectifier Check resistance and condition of brushes	Replace if necessary. Clean or replace brush assembly.
	Excitation winding fault.	Carry our resistance checks.	Replace if fails.

DC WELDERS

Fault Finding - Welding Output

Whilst static and running tests will indicate the majority of faults some may not be detected until the welder is put under load by carrying out welding tests. The main welding winding and the welding impedance winding resistances are measured in mili-Ohms. Test equipment available at service level would not be able to measure to this accuracy. If a welding or impedance winding has failed this should show up as open circuit with evidence of overheating and damaged insulation.

Note: before carrying out tests on the welder circuit ensure that the engine is running at the correct RPM.

Problem	**Possible Fault**	**Test**	**Action/ Remarks**
Low Welding Current	Faulty Bridge Rectifier	Carry out Rectifier Test.	Replace if Necessary
	Faulty Welder Winding	Test For Continuity	Replace Stator if Open Circuit or High Resistance
Faulty Weld	Faulty Welding Impedance	Test For Continuity	Replace if Open Circuit or High Resistance
No Weld Output	Fault In Welder Diode Pack	Check for damaged or failed Diodes	Replace Diode pack if any diodes have failed
	Thermal Circuit Breaker Tripped	Test Impedance Secondary Winding for Open Circuit	Allow Alternator to Cool down.. Replace Stator if Breaker does not reset

DC WELDERS

Restoring Residual Magnetism

1. Remove alternator lower outlet panel.
2. Locate the positive (red) and negative leads (black) from the left bridge rectifier to the brush assembly (figure 1)
3. Locate the positive and negative link wires on the right hand bridge rectifier and isolate from the rectifier.
4. Connect a 12 Volt battery directly to the positive and negative leads to the brush assembly.
5. Run engine and measure voltage from the 230V outlet socket (Approximately 120-150V).
6. If the fault is loss of residual magnetism, output should be restored.
7. Remove the battery and connections.
8. Run engine and measure output.

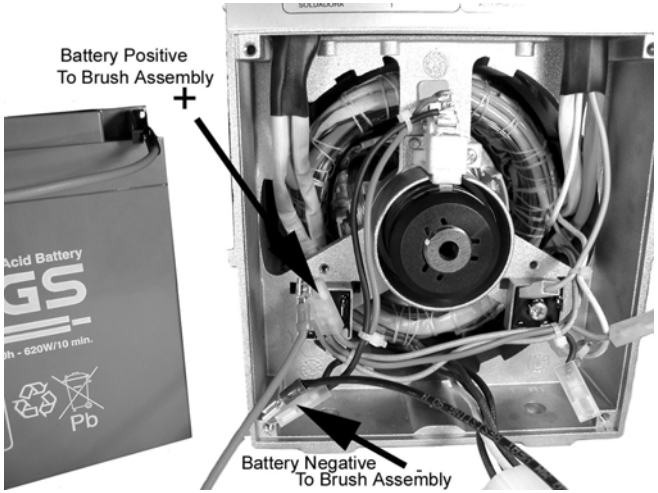


Figure 1

Restoring Residual Magnetism: Alternative Method.

If a small amount of magnetism has been retained in the rotor it may be possible to restore output by increasing the engine RPM slightly.
It is extremely important not to over rev the engine.

1. Start and run engine for a few minutes to warm.
2. Locate the throttle linkage at the carburetor and slowly increase RPM to a maximum of 3600RPM over a period of 5 seconds.
3. Allow engine to stabilize and recheck output at the outlet sockets.

DC WELDERS

Rotor

To test the rotor, measure resistance from the slip rings. Inspect slip rings for scoring.

Welder Main Winding

The welder main winding is measured in fractions of an Ohm (0.02Ohms), test equipment that can record to this level will probably not be available at service level. A faulty main welder winding will either be open circuit with evidence of winding damage in the form of burnt insulation or short circuit again with physical signs of damage.
To test for resistance, measure between the welding bridge rectifier and the welding impedance (Figure 2).

Impedance Winding

To test the impedance winding for resistance measure between two impedance terminals (Figure 3). As with the welder main winding the resistance of the impedance winding is in fractions of an Ohm therefore test for continuity. Any faults with the impedance should be seen with the naked eye.

Testing Welder Impedance Secondary Winding

The impedance secondary winding is connected to the 7-position main current selector switch and the 2-position range selector switch.
To test the winding disconnect the white and orange wires on the bridge rectifiers and connect a resistance meter across them (Figure 4).
Measure resistances as per the table below.

Low (50-110 Amps)	50A	60A	70A	80A	90A	100A	110A
Resistance (Ohms)	1.0 (Ohms)	1.07 (Ohms)	1.1 (Ohms)	1.3 (Ohms)	1.4 (Ohms)	1.5 (Ohms)	1.6 (Ohms)
High (120-200Amps)	120A	130A	140A	150A	165A	180A	200A
Resistance (Ohms)	0.3 (Ohms)	0.5 (Ohms)	0.57 (Ohms)	0.6 (Ohms)	0.8 (Ohms)	0.87 (Ohms)	1.0 (Ohms)

Note: Readings will vary depending on ambient temperature and type of meter used. A breakdown on any part of the winding should show up clearly on tests.

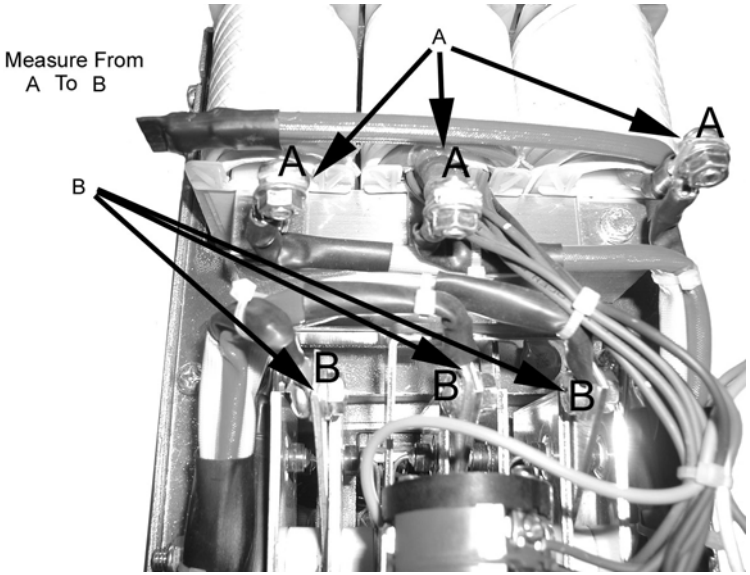


Figure 2 Main Winding Test Points

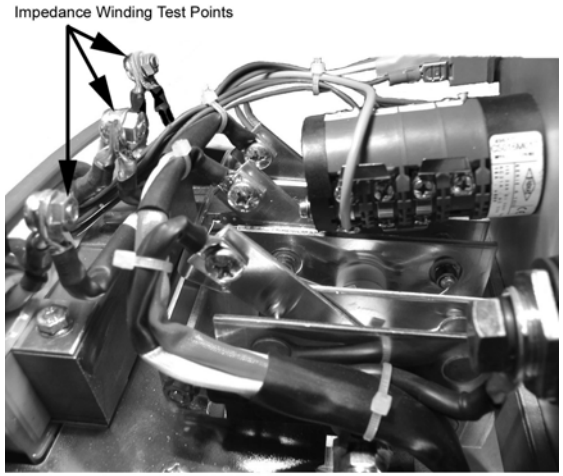


Figure 3 Impedance Winding Test Points

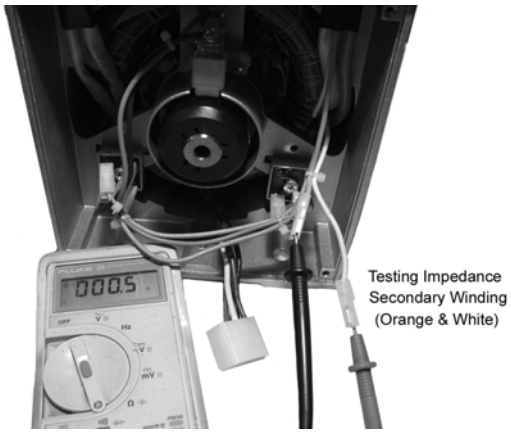


Figure 4 Impedance Secondary Winding Test

3-PHASE ALTERNATORS

3 Phase alternators used on Briggs and Stratton Power Products generators are direct excited, with automatic (mechanical) voltage regulation.
The alternator consists of a rotor and a stator. The rotor is connected to the engine crankshaft power take off and rotates within the stationary stator, which is bolted to the engine crankcase. The stator has two windings; these are the excitation winding and the power winding. Unlike the single phase alternators the stator main and excitation winding consists of 3 windings, one for each of the 3 phases (figure 1).
Excitation (the function that turns the rotor into a magnet) is produced by the excitation winding. The outlet sockets are connected to the power winding. It is the action of the magnet (rotor) revolving within the stator power windings that produces the voltage output.

To create a magnetic field on the rotor, a direct current (DC) is produced in the rotor winding. The output from the stator excitation winding is alternating current (AC); the alternating current produced by the excitation winding is connected to the rotor windings via slip rings. Bridge rectifiers in the circuit from the excitation winding to the rotor convert the alternating current (AC) to direct current (DC). When the alternator is at rest, the rotor retains a small amount of magnetism; this is termed as residual magnetism.
A compound transformer voltage regulator controls the amount of current in the rotor windings, and so regulates the strength of the rotor magnetic field.
Voltage Regulation

The voltage regulator fitted to the 3-phase alternator consists of 3 transformers (compound transformer) figure 2. The excitation winding is connected to the secondary windings of the compound transformer, bridge rectifiers and to the slip rings. The main windings of the alternator are connected to the primary winding of the compound transformer and to the outlet sockets. As load is applied to the generator the compound transformer (transformer effect) increases the amount of excitation current to the rotor windings and this regulates the voltage output.

Voltage Regulator Adjustment
Increasing or decreasing the air gap of the compound transformer will alter voltage output. Adjust the air gap by adding or removing insulator spacers as shown in figure 3. Note the compound transformer is set at manufacture and should not normally require adjustment. Increasing the air gap will increase the voltage. For safety reasons, adjustments must always be carried out when the generator is shut down.

3-PHASE ALTERNATORS

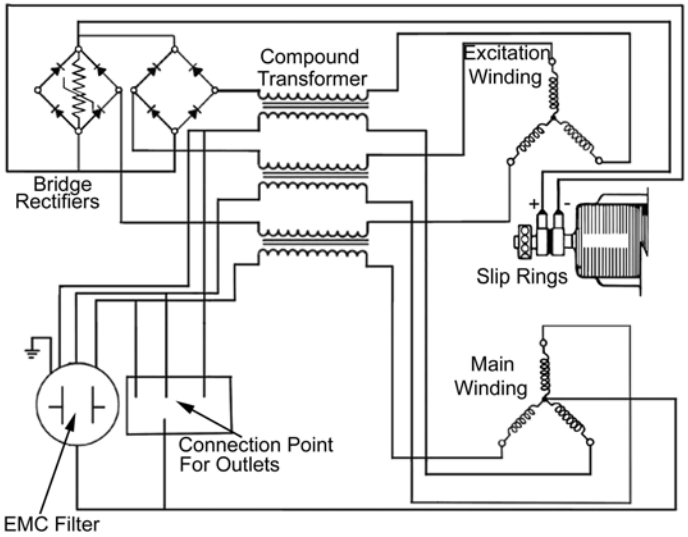


Figure 1

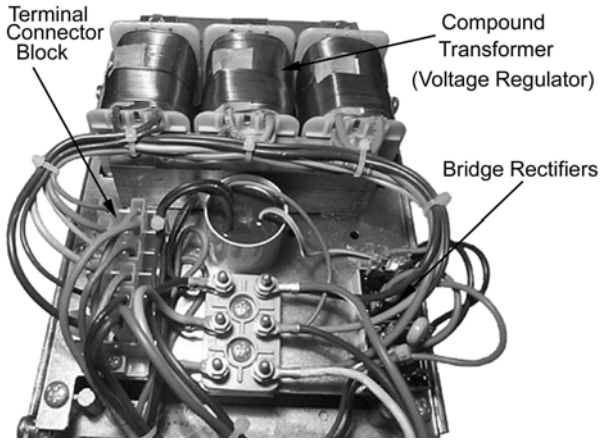


Figure 2

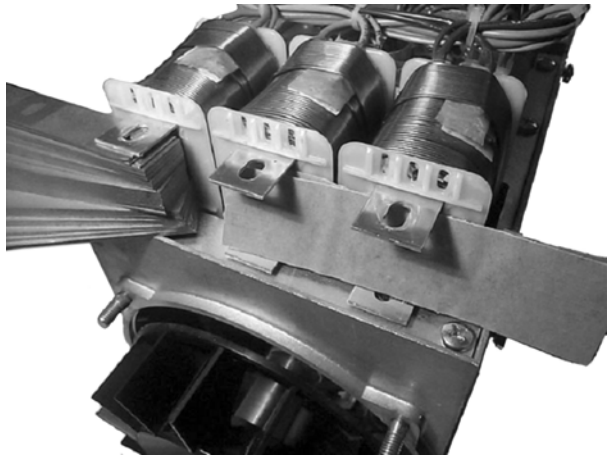


Figure 3

3-PHASE ALTERNATORS

Fault Finding

Follow these basic procedures to fault find:

- Start engine and check engine speed, reset the governor if the engine is not running at the correct RPM
- Check output voltage directly from the output sockets.

(*Use an accurate sensitive voltmeter because you are looking for zero or extremely low voltage)*

Set voltage selector switch to 230V single phase, start engine and measure voltage at socket.

Set selector switch to the 380V 3-phase position measure from the neutral line to each one of the three phases. Voltage readings should be the same on all phases.

Note: Zero voltage indicates either an open circuit or total loss of residual magnetism on the rotor.

- Compare output voltage with the table below

Voltage at Outlet Socket	**Possible Fault**	**Test**	**Possible Cause and or Action/ Remarks**
0V	No Connection from Outlet to Main Winding.	Measure resistance at outlet socket.	Cable connection - Repair Faulty circuit breaker – Replace circuit Breaker Alternator to panel Connector. Repair/Replace
	Main Winding Fault	Measure resistance at connector block. (Figure 2)	Connector and/or cable – Repair connection/replace stator. Faulty main winding – Replace stator
	Rotor Not Rotating	Check rotation	Rotor bolt loose – Check crankshaft and refit/replace rotor bolt.
	Rotor Demagnetized (No Residual)	No Test	Alternator has been overloaded or shorted – Attempt to restore residual magnetism
Low Output 9 to 27V	Excitation Circuit Failure Faulty bridge rectifiers.	Test Bridge Rectifiers.	Alternator has been overloaded continuously or shorted, replace rectifiers.
	Faulty Excitation winding.	Measure excitation-winding resistance.	Alternator has been overloaded or shorted. Replace stator.
	Faulty Rotor	Measure Rotor resistance	Measure directly on to slip rings. Check Condition of slip rings and brushes
	Faulty Compound Transformer.	Measure compound resistance.	Alternator has been overloaded or shorted. Replace compound.

3-PHASE ALTERNATORS

Unstable Output Voltage drops off under load.	Failed single diode or diodes in bridge rectifier.	Test Bridge Rectifiers.	Replace Rectifiers.
	High resistance on brushes to slip rings.	Check resistance and condition of brushes	Clean or replace brush assembly.
	Compound Transformer Faulty	Carry our resistance checks.	Replace if test fails.
Low no load voltage	Excitation winding fault.	Carry our resistance checks.	Replace if test fails.
	Low compound air gap	No Test	Increase air gap.

3-PHASE ALTERNATORS

Restoring Residual Magnetism:

Should only be carried out when test results show zero voltage and no open circuits are found on the alternator, panel and associated wiring.
To restore residual magnetism we connect a 12V battery to the cables from the bridge rectifiers to the brush assembly and run the engine.
Important safety note: The following procedure is carried out with covers removed and requires the engine to be started. Ensure that test cables are connected securely and do not attempt to remove or replace the battery to bridge rectifier leads whilst the engine is running.

1. Remove the 4 screws securing the alternator outlet panel to gain access to the brush assembly.
2. Remove alternator top cover.
3. Locate the positive and negative leads from the bridge rectifier to the brush assembly (1 & 2 Figure 4)
4. Remove the connecting link wires from the bridge rectifiers as shown at 3 & 4 in figure 4 and isolate.
5. Connect a 12 Volt battery directly to the positive and negative leads to the brush assembly (figure 5).
6. Refit outlet panel to allow voltage output tests at the outlet sockets.
7. Run engine and measure voltage from the 230V outlet socket.
8. If the fault is loss of residual magnetism, output should be restored.
9. Remove the battery and connections.
10. Replace bridge rectifier cables.
11. Run engine and measure output.

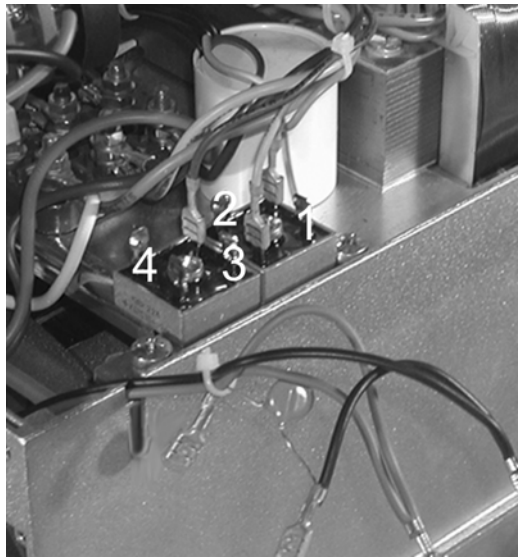


Figure 4

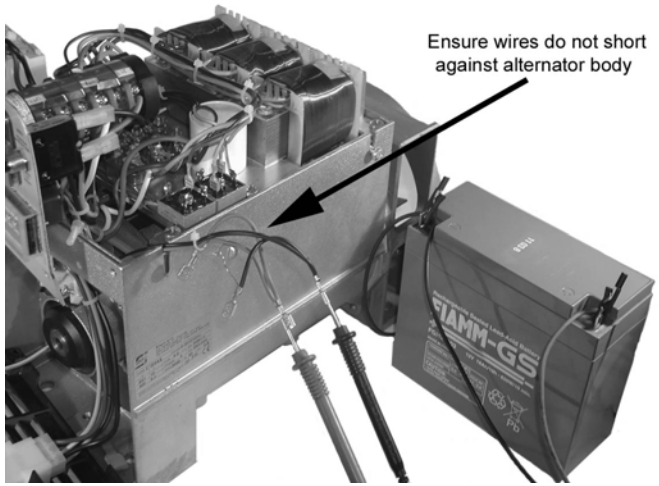


Figure 5

3-PHASE ALTERNATORS

Restoring Residual Magnetism: Alternative Method

If a small amount of magnetism has been retained in the rotor it may be possible to restore output by increasing the engine RPM slightly.
It is extremely important not to over rev the engine.

1. Start and run engine for a few minutes to warm.
2. Locate the throttle linkage at the carburetor and slowly increase RPM to a maximum of 3600RPM over a period of 5 seconds.
3. Allow engine to stabilize and recheck output at the outlet sockets.

EMC Filter

Testing of the EMC filter is not possible without specialist equipment.

Compound Transformer

The compound assembly is made up of 3 simple transformers connected to the main and the excitation winding.
To test the transformers, locate the appropriate wires on the terminal connector block and measure the resistance of each primary (from main winding) and secondary (excitation winding) winding. Refer to the wiring diagram for resistances remembering that temperature will affect readings significantly and readings taken could be up to 20% variance from those stated. Replace the compound as an assembly if any of the windings fail test.

Rotor

To test the rotor, measure resistance from the slip rings. Inspect slip rings for scoring.

AVR ALTERNATORS

The Sincro ER-R range of alternators used on Briggs and Stratton Power Products generators are direct exited, with Automatic Voltage Regulation (AVR)
The alternator consists of a rotor and a stator. The rotor is connected to the engine crankshaft power take off and rotates within the stationary stator, which is bolted to the engine crankcase. The stator has two windings; these are the excitation winding and the power winding.
Excitation (the function that turns the rotor into a magnet) is produced by the excitation winding. The outlet sockets are connected to the power winding. It is the action of the magnet (rotor) revolving within the stator power windings that produces the voltage output.

To create a magnetic field on the rotor, a direct current (DC) is produced in the rotor winding. The output from the stator excitation winding is alternating current (AC). The alternating current produced by the excitation winding is connected to the rotor windings via a voltage regulator and slip rings. The voltage regulator in the circuit from the excitation winding to the rotor converts the alternating current (AC) to direct current (DC). When the alternator is at rest, the rotor retains a small amount of magnetism; this is termed as residual magnetism.
The solid-state automatic (AVR) voltage regulator controls the amount of current in the rotor windings, and so regulates the strength of the rotor magnetic field.

Voltage Regulation

The voltage regulator (figure 1) is connected to the main winding, excitation winding and to the rotor winding via slip rings and brush assembly. Input (sensing) voltage from one half of the main winding is compared to a reference voltage, which can be adjusted by a voltage adjustment pot. If the sensing voltage is lower than the reference voltage (low outlet socket voltage), the regulator electronically switches more current to the rotor. If the sensing voltage is higher than the reference voltage (high outlet socket voltage), the regulator will reduce the amount of current to the rotor and the voltage output will decrease. This constant electronic adjustment of the current to the rotor maintains a steady output voltage.

Voltage Regulator Adjustment

Important safety note: Adjustment of the voltage regulator is carried out with the engine running and alternator cover removed. Avoid contact with the hot exhaust and electrical wires
Before carrying out any adjustments to the voltage regulator it is important to ensure that engine RPM is correct.

1. Start engine and run for a few minutes to warm.
2. Using an accurate voltmeter measure the output at the outlet socket.
3. Adjust voltage as indicated at figure 1 using a fine point screwdriver.

AVR ALTERNATORS

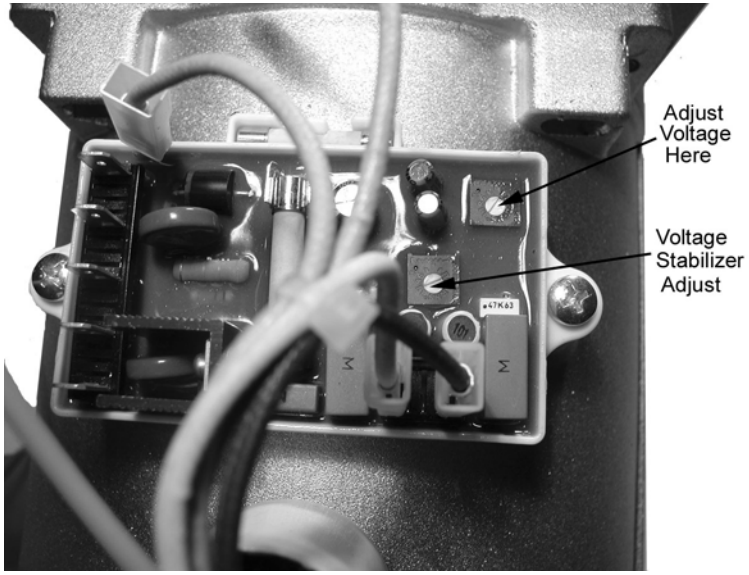


Figure 1

Note: The secondary pot (stabilizing) at figure 1 should not normally require adjustment. This adjustment is generally set at production. When fitting a new voltage regulator set this to the mid position and adjust voltage as described above.

Fault Finding

Follow these basic procedures to fault find:

- Start engine and check engine speed, reset the governor if the engine is not running at the correct RPM
- Check output voltage directly from the output sockets.

(*Use an accurate sensitive voltmeter because you are looking for zero or extremely low voltage)*

Note: Zero voltage indicates either an open circuit or total loss of residual magnetism on the rotor.

- Compare output voltage with the table below

AVR ALTERNATORS

Voltage at Outlet Socket	Possible Fault	Test	Possible Cause and or Action/ Remarks
0V	No Connection from Outlet to Main Winding.	Measure resistance at outlet socket.	Cable connection - Repair Faulty circuit breaker – Replace circuit Breaker Alternator to panel Connector. Repair/Replace
	Main Winding Fault	Measure resistance at connector block.	Connector and/or cable – Repair connection/replace stator. Faulty main winding – Replace stator
	Rotor Not Rotating	Check rotation	Rotor bolt loose – Check crankshaft and refit/replace rotor bolt.
	Rotor Demagnetized (No Residual)	No Test	Alternator has been overloaded or shorted – Attempt to restore residual magnetism
Low Output 9 to 27V	Excitation Circuit Failure Faulty AVR.	Carry Out AVR Test	*See Section on AVR Test Below* Replace if necessary. See below
	Blown AVR 3A Fuse	Test Fuse	Replace if Blown
	Faulty Excitation winding.	Measure excitation-winding resistance.	Alternator has been overloaded or shorted. Replace stator.
	Faulty Rotor	Measure Rotor resistance	Measure directly on to slip rings. Check Condition of slip rings and brushes
Unstable Output Voltage drops off under load.	AVR Faulty	Carry Out AVR Test	*See Section on AVR Test Below* Replace if necessary. See below.
	High resistance on brushes to slip rings.	Check resistance and condition of brushes	Clean or replace brush assembly.
	Excitation winding fault.	Carry our resistance checks.	Replace if test fails.

AVR ALTERNATORS

Fault Finding Automatic Voltage Regulator

It is not possible to test the voltage regulator as a component and apart from a 3A field fuse there are no service replacement parts. Faultfinding is by process of elimination:

1. Carry out restoring residual magnetism from 1 through 6
2. Measure voltage output from the excitation winding (readings should be 200-250V)
3. Measure the sensing voltage from the main winding (reading should be approximately 110-130V)

If tests above are satisfactory the voltage regulator should be replaced.
Explanation Note: The tests carried out have proved voltage in, from the excitation and power winding. The restoring residual steps 1 through 6 have proved the brushes, slip rings and rotor as well as output to the outlet sockets. At this stage we can only confirm a faulty voltage regulator by replacement.

Restoring Residual Magnetism:

Should only be carried out when test results show zero voltage and no open circuits are found on the alternator, panel and associated wiring.
To restore residual magnetism we connect a 12V battery to the cables from the Voltage Regulator to the brush assembly and run the engine.
Important safety note: The following procedure is carried out with covers removed and requires the engine to be started. Ensure that test cables are connected securely and do not attempt to remove or replace the battery to Voltage Rectifier leads whilst the engine is running.

1. Remove alternator top cover.
2. Locate the positive and negative leads on the voltage regulator.
3. Remove the excitation wires from the voltage regulator.
4. Connect a 12 Volt battery directly to the positive and negative leads to the brush assembly.
5. Refit outlet panel to allow voltage output tests at the outlet sockets.
6. Run engine and measure voltage from the 230V outlet socket.
7. If the fault is loss of residual magnetism, output should be restored.
8. Remove the battery and connections.
9. Replace excitation winding wires.
10. Run engine and measure output.

AVR ALTERNATORS

Restoring Residual Magnetism: Alternative Method

If a small amount of magnetism has been retained in the rotor it may be possible to restore out put by increasing the engine RPM slightly. It is extremely important not to over rev the engine.

1. Start and run engine for a few minutes to warm.
2. Locate the throttle linkage at the carburetor and slowly increase RPM to a maximum of 3600RPM over a period of 5 seconds.
3. Allow engine to stabilize and recheck output at the outlet sockets.

Rotor

To test the rotor, measure resistance from the slip rings. Inspect slip rings for scoring.

ASYNCHRONOUS ALTERNATORS

The capacitor excited self regulating asynchronous alternator is found on some of the vertical generators manufactured by Briggs and Stratton Power Products. For fault finding purposes the alternator is very similar to the synchronous capacitor excited alternator. The stator housing is generally finned for cooling purposes and the rotor is of solid construction with no windings or diodes.
The alternator consists of a rotor and a stator. The rotor is connected to the engine crankshaft power take off and rotates within the stationary stator, which is bolted to the engine crankcase.

The stator has two windings; these are the excitation winding and the power winding. Excitation (the function that turns the rotor into a magnet) is produced by the excitation winding. The outlet sockets are connected to the power winding. It is the action of the magnet (rotor) revolving within the stator power windings that produces the voltage output.

When the alternator is at rest, the rotor retains a small amount of magnetism; this is termed as residual magnetism.
A capacitor is connected across the stator excitation winding. The current flowing through the capacitor induces a current in the rotor windings, and so regulates the strength of the rotor magnetic field.

Fault Finding

To fault find the asynchronous alternator follow exactly the same procedures as for the synchronous alternator however there are no rotor windings or diodes to check. Damage to the rotor can only be mechanical (bearing failure) and apart from a physical check to ensure the rotor is attached to and rotating with the engine crankshaft there are no other checks to be made.
Follow these basic procedures to fault find:

- Start engine and check engine speed, reset the governor if the engine is not running at the correct RPM
- Check output voltage directly from the output sockets.

(*Use an accurate sensitive voltmeter because you are looking for zero or extremely low voltage)*

- Compare output voltage with the table below

Note: Zero voltage indicates either an open circuit or total loss of residual magnetism on the rotor.

ASYNCHRONOUS ALTERNATORS

Voltage at Outlet Socket	Possible Fault	Test	Possible Cause and Action
0 V	No Connection from Outlet to Main Winding.	Measure resistance at outlet socket.	Cable connection - Repair Alternator to panel Connector. Repair/Replace
	Main Winding Fault	Measure resistance at connector.	Connector and/or cable – Repair connection/replace stator. Faulty main winding – Replace stator
	Rotor Not Rotating	Check rotation	Rotor bolt loose – Check crankshaft and refit/replace rotor bolt.
	Rotor Demagnetized (No Residual)	No Test	Alternator has been overloaded or shorted – Attempt to restore residual magnetism
Low Output 9 to 27V	Excitation circuit failure	Test Capacitor	Overload/ Short/RPM High –Check RPM and replace capacitor.
		Test Excitation Winding.	Overload/ Short/RPM High – Replace Stator

ASYNCHRONOUS ALTERNATORS

Restoring Residual Magnetism:

Should only be carried out when test results show zero voltage and no open circuits are found on the alternator, panel and associated wiring.
To restore residual magnetism we pass 12V DC through the power windings by connecting a battery directly to the outlet sockets.
It is important to immobilize the engine by removing the spark plug lead from the spark plug.

1. Immobilize the engine.
2. Connect a 12 Volt battery directly to the outlet sockets (polarity is not important)
3. Turn the engine over. Note: 4 complete pulls of the recoil.
4. Remove the battery and connections.
5. Replace the spark plug lead.
6. Start the engine and measure output.
7. If the fault is loss of residual magnetism, output should be restored.

Restoring Residual Magnetism: Alternative Method

If a small amount of magnetism has been retained in the rotor it may be possible to restore out put by increasing the engine RPM slightly.
It is extremely important not to over rev the engine.

1. Start and run engine for a few minutes to warm.
2. Locate the throttle linkage at the carburetor and slowly increase RPM to a maximum of 3600RPM over a period of 5 seconds.
3. Allow engine to stabilize and recheck output at the outlet sockets.

AC WELDERS

The Sincro AC Welder Generator range of alternators used on Briggs and Stratton Power Products generators are capacitor excited self-regulating with a selector switch regulating the welding current. The alternator consists of a rotor and a stator. The rotor is connected to the engine crankshaft power take off and rotates within the stationary stator, which is bolted to the engine crankcase. The stator has two windings; these are the excitation winding and the main winding.

The excitation winding is a 7 stage thermal circuit breaker protected winding, controlled by the welding current selector switch (figure 1). Excitation (the function that turns the rotor into a magnet) is produced by the excitation winding. When switched to generator mode the outlet sockets are connected to the main winding. It is the action of the magnet (rotor) revolving within the stator power windings that produces the voltage output.

To create a magnetic field on the rotor, a direct current (DC) is produced in the rotor winding. The output from the stator excitation winding is alternating current (AC). The output from the stator excitation winding is alternating current (AC) and it is the action of the diode(s) on the rotor that converts the alternating current (AC) to direct current (DC). When the alternator is at rest, the rotor retains a small amount of magnetism; this is termed as residual magnetism.

A capacitor is connected across the stator excitation winding. The current flowing through the capacitor induces a current in the rotor windings, and so regulates the strength of the rotor magnetic field.

When switched to welding mode the main winding is connected in series with the welding impedance (Figure 2). When the alternator is at rest, the rotor retains a small amount of magnetism; this is termed as residual magnetism.

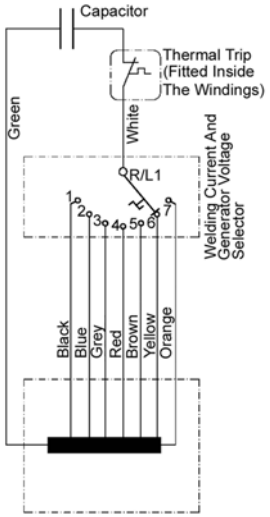


Figure 1

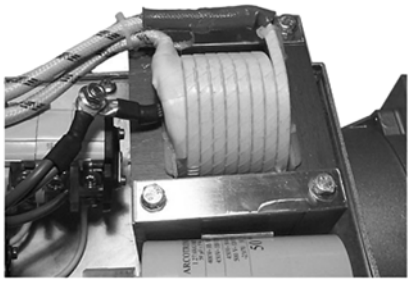


Figure 2

AC WELDERS

Fault Finding: Generator output

Fault finding on the AC welder generator in principle is the same as fault finding a standard capacitor excited self-regulating alternator. Users may report a fault when welding. Always start by fault finding in generator mode and then move on to the additional components.

Follow these basic procedures to fault find:

- Start engine and check engine speed, reset the governor if the engine is not running at the correct RPM
- Check output voltage directly from the output sockets.

(*Use an accurate sensitive voltmeter because you are looking for zero or extremely low voltage)*

- Compare output voltage with the table below

Note: Zero voltage indicates either an open circuit or total loss of residual magnetism on the rotor.

Voltage at Outlet Socket	**Possible Fault**	**Test**	**Possible Cause and or Action/ Remarks**
0V	No Connection from Outlet to Main Winding.	Measure resistance at outlet socket.	Cable connection - Repair Faulty circuit breaker – Replace circuit Breaker Alternator to panel Connector. Repair/Replace
	Main Winding Fault	Measure resistance at connector block.	Connector and/or cable – Repair connection/replace stator. Faulty main winding – Replace stator
	Rotor Not Rotating	Check rotation	Rotor bolt loose – Check crankshaft and refit/replace rotor bolt.
	Rotor Demagnetized (No Residual)	No Test	Alternator has been overloaded or shorted – Attempt to restore residual magnetism
Low Output 4 to 15V	Excitation Circuit Failure Faulty Capacitor	Test Capacitor	Replace if necessary.
	Faulty Excitation Winding	Measure excitation-winding resistance.	Alternator has been overloaded or shorted. Replace stator.
Low Output 4 to 15V	Faulty Rotor	Carry Out Rotor Tests	Repair/Replace if necessary. See documents 102964GS and 102965GS for test procedures
Voltage drops off under Load	Fault in Excitation Windings	Test Excitation Resistance	Check resistance in all current selector switch position. Replace if necessary.

AC WELDERS

Fault Finding: Welder output

Whilst static and running tests will indicate the majority of faults some may not be detected until the welder is put under load by carrying out welding tests. The welding impedance winding resistances are measured in mili-Ohms. Test equipment available at service level would not be able to measure to this accuracy. If the welding impedance has failed this should show up as open circuit with evidence of overheating and damaged insulation.

Note: before carrying out tests on the welder circuit ensure that the engine is running at the correct RPM.

Problem	Possible Fault	Test	Action/ Remarks
Low Welding Current	Faulty Diodes	Carry out Diode Test.	Replace if Necessary
	Faulty Main Winding	Test For Continuity	Replace Stator if Open Circuit or High Resistance
Faulty Weld	Faulty Welding Impedance	Test For Continuity	Replace if Open Circuit or High Resistance

Restoring Residual Magnetism

Should only be carried out when test results show zero voltage and no open circuits are found on the alternator, panel and associated wiring.
To restore residual magnetism we pass 12V DC through the power windings by connecting a battery directly to the outlet sockets.
It is important to immobilize the engine by removing the spark plug lead from the spark plug.

1. Immobilize the engine.
2. Connect a 12 Volt battery directly to the outlet sockets (polarity is not important)
3. Turn the engine over. Note: 4 complete pulls of the recoil or approximately 3-4 seconds on the starter motor.
4. Remove the battery and connections.
5. Replace the spark plug lead.
6. Start the engine and measure output.
7. If the fault is loss of residual magnetism, output should be restored.

Restoring Residual Magnetism: Alternative Method

If a small amount of magnetism has been retained in the rotor it may be possible to restore output by increasing the engine RPM slightly.
It is extremely important not to over rev the engine.

1. Start and run engine for a few minutes to warm.
2. Locate the throttle linkage at the carburetor and slowly increase RPM to a maximum of 3600RPM over a period of 5 seconds.
3. Allow engine to stabilize and recheck output at the outlet sockets.

AC WELDERS

Main Winding

Refer to STATOR section.

Impedance Winding

To test the impedance winding for resistance measure between two impedance terminals. Note that the resistance of the impedance winding is in fractions of an Ohm therefore test for continuity. Any faults with the impedance should be seen with the naked eye.

Testing Excitation Winding

The excitation winding is connected to the 7-position main current selector switch.

To test the winding measure output voltage in generator mode through all the ranges, voltage should change as each position is selected. Voltage should range from 190 to 240 approximately.

Test resistance by turning the selector switch to maximum and measure on the capacitor wires. Refer to the resistance table included with wiring diagrams for resistance value.

Note: Readings will vary depending on ambient temperature and type of meter used. A breakdown on any part of the winding should show up clearly on tests.