Central Georgia Generator, Brushless Generator Diagnostic and Repair Manual

Go to cgg1.com and watch the videos on how alternators/generators work

Most everyone calls the alternator a generator, but actually it is an alternator because it produces alternating voltage and current, that is, the voltage changes direction at the rate of 120 times a second for 60 hertz.
This was previously called cycles per second before about 1960. You will still hear cycles per second sometimes.

The generator is actually a DC device that produces direct voltage and current just as a battery.

We will be referring to the brushless AC generator as it is most commonly known as a generator.

First, we need a rotating magnetic field to produce AC voltage. In order to produce a magnetic field, we need a DC voltage or permanent magnets to produce this rotating field.

1) You will need a Volt-Ohm meter.
Make sure the voltmeter reads correctly by checking in a known good AC outlet.
Reason: I worked with a customer for almost an hour before suggesting he check his meter with known good AC source. We found he had a bad meter.

2) With the volt meter, check the output across the main terminals after STARTING THE GENERATOR!

3) For single phase, the terminals will be U1 and U2.

4) For 3 phase, it will be terminals U, V, and W marked on the white terminal block.

5) For single phase, it should read between 15 and 26 volts, sometimes a little more.

6) For 3 phase, output voltage should read between 18 and 30 volts, or a little more.

We use this voltage to feed back into the AVR to produce a DC output on the F+ and F- into the exciter stator that we will be discussing later.

With the above voltages correct, then everything on ther rotor including the rotating diodes should be ok. There is a permanent magnet in the exciter stator that produces this voltage and automatically flashes the rotor and this produces a rotating magnetic field.
The magnet may not be in the exciter stator on all brushless generators, but this manual can be used to check most any brushless generator.

Generator must be running at or close to 1800 RPM. The AVR will shut the generator off at or close to 1650 RPM the red light will light up on the AVR; over this RPM the red light will go out.
If the light is red on the AVR and the RPM is correct, then there is a problem with the rotor or

the AVR itself is possibly bad.

If 15 to 30 volts or more is present, skip down to STEP 13

7) If this reading is zero or pretty close, STOP THE GENERATOR!
Disconnect the output leads from the generator going to the load or breaker box.

This also applies if the voltages are not normal at the load you have connected. There may be a problem between the generator and the load.

*I have found a poor neutral connection on several between the load and the breaker panel. This causes all types of weird voltage readings.

*Also, I have found shorted hot wires from the generator to the breaker panel and between the breaker panel and the load.
This will cause almost no voltage at the output terminals of the generator, but usually does not damage the generator unless it happens with the generator running.

BE SURE AND TIGHTEN ALL THE NUTS BACK DOWN WHEN REMOVING ALL OUTPUT WIRES FROM THE GENERATOR.
DO NOT REMOVE THE WIRES INTERNALLY FROM THE GENERATOR TO THE TERMINAL BLOCK.

Start the generator, if all voltages at the output terminal of the generator return to normal with all OUTPUT wires disconnected from the output terminals, then the problem is not in the generator.

8) If it still does not have the required minimum output voltage, **STOP THE GENERATOR!**

9) Using the ohm meter on the highest scale of the resistance scale or if it is autoranging, check all the output terminals to the frame of the generator. There should not be any resistance at all or should be wide open. Be sure and not touch the probes with your fingers, it will measure your body resistance.
There should not be any resistance at all between any terminal and frame of generator.
If there is a low resistance, then the stator wires are possibly shorted to the frame.

10) If you discovered there is **any** resistance from the output terminals, U1 and U2 or neutral, (U3 & U4 tied together), to the frame, then remove all wires that come from the generator to the terminal block of the generator. Take pictures so you can tell how to wire it back properly, You may want to write the wiring numbers down on a piece of paper also.
This is for single phase

For 3 phase, remove all the wires from terminal block making sure to write the numbers

* Also, may want to take pictures of the terminal block or have the main terminal connections diagram handy so you can rewire the generator properly.

Measure the resistance from the end of each wire to the frame, if no resistance or wide open,

then check for a fine wire shorting from the terminal or terminal block itself to frame

11) While the wires are disconnected, measure the resistance of each one of the wires.
Two ends of each winding should show a low resistance of 1 ohm or less.

BE SURE AND FIND THE CORRECT END FOR EACH WINDING, MEASURE THE ENDS OF THE WIRES.
There are 4 wires or two windings on a single phase.

There are 12 wires or 6 windings on a 3 phase.

If any of the windings do not show continuity, then the stator is open.

12) If all above checks out, then we will go to the exciter stator and AVR
(automatic voltage regulator).

13) Remove the F- , black wire from the AVR and F+, the red wire from the AVR.
Measure the resistance of the ends of the two wires, these two wires go to the exciter stator.

The resistance beween F- and F+ wire ends should be between 17 and 30 ohms.
If open, then the exciter stator is bad, if the resistance is correct, then move on to next step.
Check the F - and F+ wires, with the wires removed from the AVR, to the frame of the generator,
this should be open or OL or some volt-ohm meters set to the highest scale or if autoranging.
If there is any resistance at all, then there is a short between the frame and the windings,
which indicates that the stater must be replaced.
If resistance seems correct, plug the wires back into the correct terminal on the AVR.
An open exciter stater must be replaced.

14) Remove the next two wires, they should be yellow or red and go back to two of the
main output terminals.
These are the sense wires from the output to the AVR.
Measure the resistance from the end of the wires to the terminals that they connect to on
the generator. *(I Have found several bad connections at this point where they plug into the AVR).

15) If the above shows to have a good low resistance, less than one OHM. Then
remove the last two black or a red and black wire from the AVR, this is terminal 8 and Z2,
this is the auxiliary winding wires. They can be black or red and black.
Measure the resistance at the end of these two wires, it should be very low, around 1 ohm or less.
This is the auxillary winding and or the boost winding.
Next measure the auxiliary winding wires to the frame of the generator, it should show OL
If any resistance at all, the winding is shorted to the frame, then go to the next step.

If the auxiliary winding are open or shorted to the frame, then jump the 8 and Z2 terminals on the
AVR where the two wires were removed, this will allow the generator to be put back in service if
the AVR is good.
BE SURE AND TAPE OFF THE AUXILIARY WINDINGS SO THEY WILL NOT TOUCH ANYTHING!

With 15-30 volts or more, on the main output terminals, and resistance measurements

Start generator, measure the ouput with a known good meter. If still no voltage output on the main terminals, STOP THE GENERATOR! RUN CHECKS BELOW.

16) If all of the resistance measures good but still very low voltage or none at all, then you need to check the rotating diodes at the rear of the rotor and the rotor winding itself.

17) The rear plastic cover (on 164 and 184 series) can be easily removed so you can see the diodes. There are two halves of the rotating diodes, one is the positive half and the other is the negative. Remove the wire from the largest screw on each of the rotating diodes. These are the two wires that go to the rotor.

Check the resistance of each of these wires to the rotor shaft. It should be wide open or have no resistance at all. Just like the meter reads when you are holding the leads out in the air.

Check the resistance of the ends of each of the wires (main rotor winding) you removed from the large screw on the rotaing diodes. This resistance should be less than 1 ohm.

If the windings are shorted to the rotor (Very rare for this) then the rotor or generator must be replaced. Same applies if the rotor winding is open.

18) If all checks out good on the rotor winding, then we will need to check the rotating diodes for shorted or open diodes.

All readings below were taken with a Fluke 77 volt-ohm meter.
Other meters may not show the dot when and only show 450 or something similar.
Become familiar with your meter!

If you do not have a volt-ohm meter, I would suggest purchasing a Fluke 107 or a good meter with a diode check scale on it, look at the Fluke 77 below and notice the diode symbol, which is an arrow pointing to a bar.
Become familiar with your meter. There are a lot of videos online showing how to operate a volt -ohm meter.


.400


.400

Put one of the leads of the ohm meter, with the meter set for the diode check scale, on the large screw on the diode pack. Then place the other lead on each one of the 3 smaller screws.
Make sure the wire from the large screw to the rotor is removed and not touching the screw.

Check each one at a time while keeping the lead in place on the large screw.

They should measure .400 to .510 ohms That is .400 to .510 **with the Fluke** 77.
Other meters may not have the point but measurements should be about the same.
This is with the diode check scale only.
If you do not have a diode check scale, use the highest ohm scale you have.
The reading will be higher, but each reading should be fairly close to each other.

Think of the diodes as a one way valve. When reading from the large screw to any of the others on the same block, one direction is open and the other has a low reading.

If the above reading is good, then reverse the leads, that is use the lead you were checking the 3 small screws with. Now put it on the large screw.
The reading should be open or no resistance.

Check the other half of the rotating diodes same as you did for the one above.

Give me a call and we will go over the trouble shooting chart together.
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