

# ST Style Generator

## Owners/Operators Manual

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# **ST Style of Single Phase AC Synchronous Generators**

## **Description**

The ST Style of generators are designed to operate as a primary AC power sources for standard electrical lighting, household electrical appliances and general small-scale residential use. The range of power ratings available in this series of generators make them suitable for households, farms and ranches, and even small towns, as well as supplying electricity for marine applications.

These units employ harmonic excitation to allow them to provide self-excitation and relatively constant voltage operation without a separate voltage regulator. This simple system minimizes complexity and has proven quite reliable in operation.

ST Style Generators are designed for continuous duty operations within their power ratings. When driven at constant rotational speed they generate single phase current at constant AC voltage and frequency. Internal connections may be changed to provide for 120 or 240 Volts at 60HZ. Conversion between voltages is a matter of changing contacts on a terminal strip inside the terminal box.

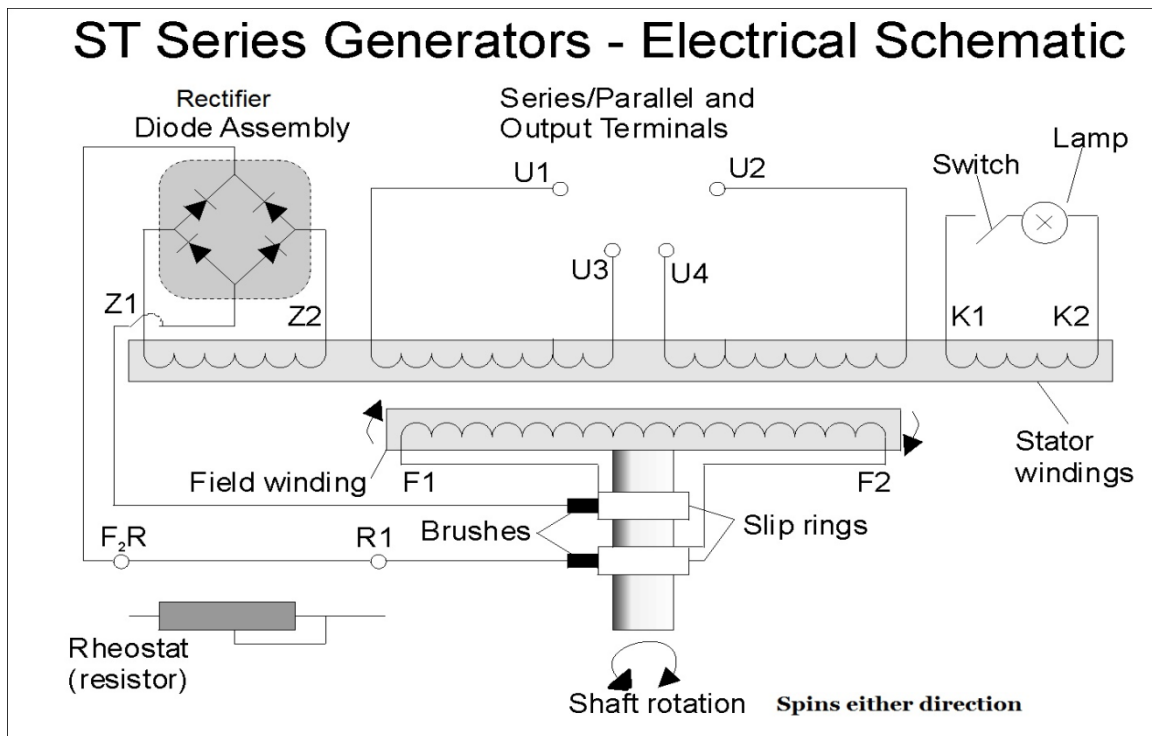
Generators may be coupled to the prime mover (driving engine) either by direct shaft-to-shaft coupling or by a flexible belt and sheaves or pulleys. The AC frequency of the output power is determined solely by the speed of rotation of the prime mover and the number of power in the generator. Four pole generators must spin at 1800 RPM to generate 60HZ power. Two pole generators must spin at 3600RPM for 60HZ output frequency. Generally, Central Georgia Generator only stocks 4 Pole Generators.

# Construction

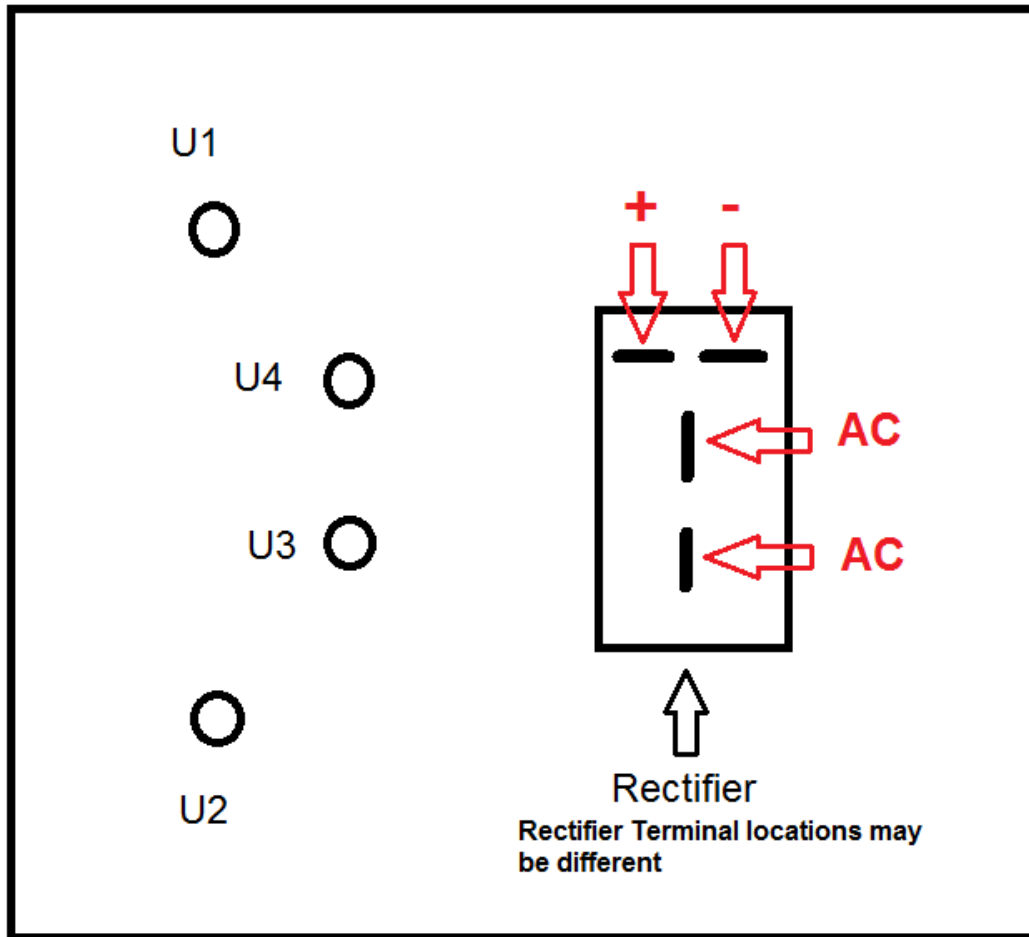
ST Style Generators are “Rotating field” types. In this type of generator, the output power comes from windings that are held fixed in position on the motor frame (the Stator) while an electrically-generated magnetic field is rotated past the stator windings by turning the rotating assembly (the Rotor). The Rotor windings carry DC current obtained by rectifying a portion of the generator’s AC output. This “exciting current” is self-generated, and is used in a manner which causes the output voltage to be self-regulating.

The Construction of the ST Style generator is intended to be drip-proof. This means that a few drops of liquid onto the generator should not cause damage immediately. However, like any electrical equipment, the generator should be protected from damp conditions, immersion in water or water dripping on the generator.

The Frame and End Covers are cast iron. The stator is built from high quality 0.5MM thick silicon steel lamination, wound with Class B temperature rated insulated wire. Overall, the generator carries a protective class rating of IP21. Schematic and details of wiring are shown below.



## Terminal Location Layout



The output frequency of the generator is completely dependent on the rotational speed of the generator shaft. If accurate output frequency is needed, then some means must be provided to accurately govern the speed of the prime mover which drives the generator.

However, the output voltage is also dependent on the rotational speed of the prime mover (as well as the amount of current in the field windings). If very accurate frequency of the output power is not necessary, as might be the case for incandescent lighting applications, it is possible to use the output voltage as an indicator of the proper rotational speed.

All that is necessary is to regulate the speed of the prime mover so that the voltmeter indicates the rated voltage. Since the output voltage depends partially on the prime mover's rotational speed, if the AVR is not installed, the output voltage provides a fairly accurate estimate of the rotational speed. The resulting frequency may not match commercial power line standards exactly, but the voltage will be correct and for applications such as incandescent lighting, correct voltage and close frequency is sufficient for use.

If an exact adjustment of voltage is needed, you must set both the rotational speed and the current through the field windings. Remove the short connection strip between terminals F2R and R1 in the terminal box and connect a rheostat (Variable power resistor) between these two points. Set the prime mover or a frequency meter on the output power. (Either method works equally well as the output frequency is controlled only by the prime mover rotational speed.) Set for 62 Hertz or 1860 RPM, No Load.

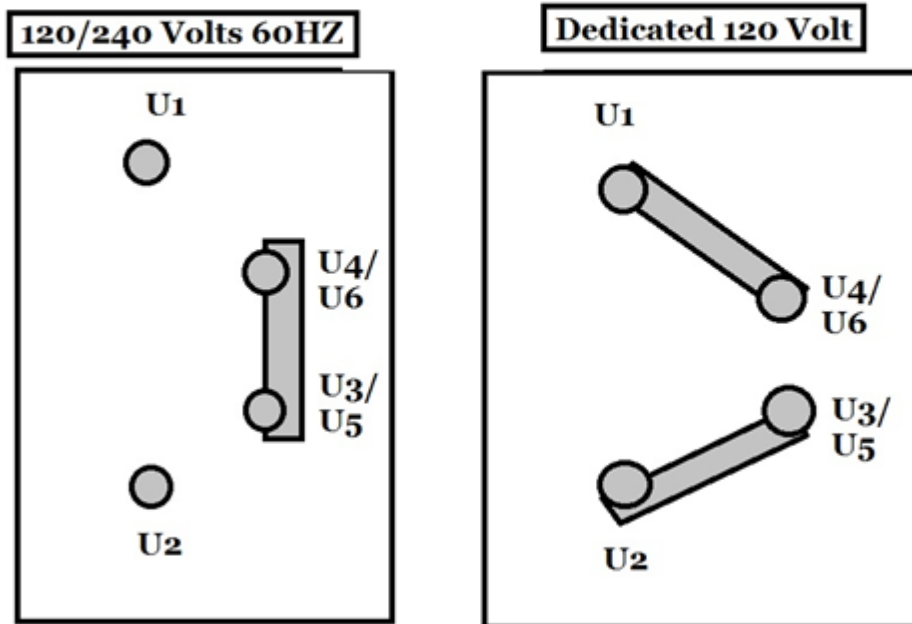
The Output frequency will now be exactly 62 Hertz, no load. Adjust the rheostat resistance to set the desired output voltage. Once the rheostat is adjusted in this manner with no load, it is generally unnecessary to readjust it for correct voltage under load. Rheostats should be rated for 10 ohms.

Some Generators do not have the F2R and R1, in this case, Remove the negative lead of rectifier and install the rheostat between the rectifier and brush as shown on the electrical schematic above.

A good alternative to the rheostat would be an Automatic Voltage Regulator (AVR). It would be installed in a similar fashion to the rheostat but it is recommended to use the wiring diagram that comes with the AVR. Central Georgia Generator does carry AVR's.

## Before Operating the Generator

Check to ensure that all the internal terminals are correctly connected for the desired output voltage, as seen in the wiring diagram below.



Connect the output wiring to the output terminals U1 and U2 inside the terminal box of the generator. U4/U6 and U3/U5 is the neutral. Pay particular attention to making sure that the wires connected to the generator output are of a heavy enough wire gauge to carry the output current rated output current.

Open the outer covering plate of the rear cover and inspect the brushes to ensure that the brushes are making good contact with the slip rings. If this is the first operation of the generator, the slip rings should be cleaned with a fine emery cloth abrasive sheet. Ensure that the wiring to the load is correctly installed, secure, and that switches and fuses or circuit breakers rated for carrying and interrupting the rated power output are in place. Switches and/or circuit breakers capable of isolating all electrical loads should be correctly installed, and should be opened before starting the generator. Once the generator is up to speed and indicating the correct output voltage, the switches may be closed.

# Starting and Stopping

## Starting

1. Start the prime mover and bring it up to the rated speed. When the rotational speed of the prime mover and generator near the rated speed, the generator will start generating voltage by the self-excitation circuit.
2. Adjust the speed of the prime mover exactly if needed. Read the voltmeter on the unit. This should be at or near the rated value.
3. After a short warm up time under no load, the generator voltage will drop slightly. This is a consequence of the changes that increased temperature cause in the self-excitation circuit. If needed, the voltage rheostat or AVR may be adjusted for a more precise output voltage after this initial warm up.
4. Once the frequency and voltage are acceptably adjusted, turn on the output switch to the load.

## Stopping

1. Remove the load from the output by opening the output switch.
2. Stop the prime mover

## Caution!

1. Read the attached sheet called “Setting up your Generator”
2. Be very careful not to allow short circuits at the output of the generator. This can damage the rectifier diodes in the voltage regulating circuit.
3. Before stopping the generator, remove all output electrical loading first before turning off the prime mover. If the prime mover is turned off while the generator is under load, the resulting spin-down and gradually reducing electric fields will erase the residual magnetism in the rotor that allows the generator to start self-excitation.
4. If the residual magnetism in the rotor is too weak to start self-excitation, the rotor will need to be re-magnetized.



# Maintenance and Repair

## General Maintenance

- a) If the generator is to be stored, ensure that the storage place is dry and clean. If the generator is to be stored on earth or concrete floors, place a wooden base under it to prevent contact between the generator and floor. Cover the generator with a water repellent tarpaulin or other water resistant covering to prevent water and dust from entering the generator.
- b) Take steps to prevent water, dust, metal chips, and shavings, and other foreign material from entering the generator.
- c) Do not cover the generator with cloth, wood, paper, etc. While operating. The generator should have free, unimpeded air circulation to allow it to dissipate normal internal heat buildup. The generator may be damaged by heat buildup if it is covered during operation.
- d) Do not overload the generator. Provide circuit breakers or other means to prevent this.
- e) During operation, check the generator periodically for unusual sounds and/or sparks from the brushes and slip rings. Stop the generator immediately if such sounds or sparks are noticed, and then inspect and repair the generator.
- f) Do not operate the generator in atmospheres that are very humid or dusty, or when there are combustible gases in the area of the generator.

## Inspecting and Overhauling

The Generator should be inspected at intervals of no more than six months. Be sure to inspect more regularly if using for continuous use.

- a) Remove the window cover and clean out any dust that may have accumulated in the generator. The preferred method for this is to use compressed air at no more than 5.7 psi.
- b) Clean the slip rings. Wipe the rings clean with a piece of coarse cloth lightly moistened with kerosene. Do not use waste yarn or other fibrous material. Once the slip ring surfaces are clean, wipe them dry with a dry cloth.
- c) Inspect the brushes and spring assemblies for wear and tear. Replace worn out brushes and springs with new ones.

## **Necessary Precautions**

When inspecting and working on the generator, follow these precautions:

- a) If you have any questions, or are unsure of anything, please contact Central Georgia Generator or a local electrician before doing anything!
- b) Keep the disassembled parts in a suitable container to prevent loss or contamination.
- c) Mark terminal leads before disconnecting them so they can be easily identified and replaced in the correct position upon reassembly. Central Georgia Generator cannot help reattaching wires unless they are marked!
- d) When mounting a brush, make certain that its position is correct and that it makes good contact with the slip rings. The generator will not operate correctly without the brushes making good contact.
- e) After the generator is properly installed, turn the rotor by hand to make sure that it moves freely.

## **Instructions on how to flash the field:**

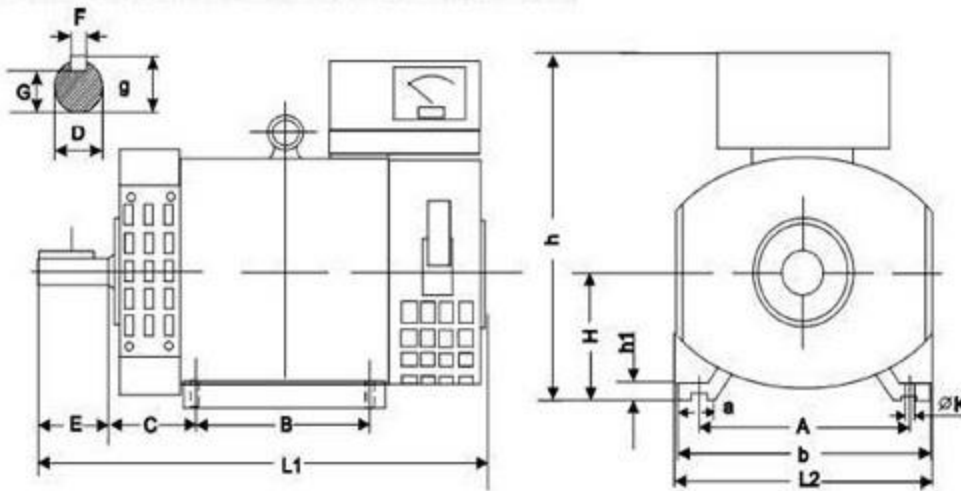
**\*\*\*\*\*If you are unsure or uncomfortable doing this procedure, get a certified electrician! \*\*\*\*\***

To Flash the Field (rotor winding): Find the two wires that go from the brushes to the rectifier. Check the resistance from the slip ring of the inside brushes (closest to the rotor winding). This should go to the positive terminal on the rectifier. The resistance should be 1 ohm or less. The outside brush (Brush next to back bearing) should go to the negative terminal on the rectifier. This should be 1 ohm or less also. Now we can flash it!

1. Remove the wire from the positive terminal on the rectifier.
2. Connect a jumper wire from the negative terminal on a 12 volt battery to the negative terminal on the rectifier.
3. Connect a jumper wire to the positive terminal on the battery but do not connect the other end to the positive wire that was removed.
4. Start the generator; then while watching the voltmeter, connect the positive terminal of the batter to the wire that you removed from the positive terminal or rectifier, this must NOT be connected to the rectifier when you do this!!!!
5. When the voltage reaches max, usually around 70-90 Volts, remove the positive lead. Make sure there was a small spark when you touched the positive battery terminal wire to the wire you removed from the rectifier.
6. Stop the generator and reconnect the wire from the inside brush back to the positive terminal of the rectifier. You can then start the generator and it should work!

If you did not get any voltage when you flashed the rotor, make sure you got a spark. If you did get a spark, then there is a bad stator winding or it is open. Make sure the volt meter is good. We have seen some folks have bad lead wire connections and bad volt meters. This can cause huge heartaches!

## Dimensions and Mechanical Data



Model	Output	Mounting Dimension MM								Overall Dimensions MM						WGT
#	KW	A	B	C	D	E	F	G	H	a	b	h1	h	L1	L2	Lbs
ST-3	3	216	178	89	32	80	10	27	132	34	250	13	385	480	270	116
ST-5	5	254	254	108	38	80	10	33	160	50	310	13	440	580	325	200
ST-7.5	7.5	254	254	108	38	80	10	33	160	50	310	13	440	580	325	217
ST-10	10	279	203	121	42	110	12	37	180	60	339	13	480	610	365	234
ST-12	12	279	203	121	42	110	12	37	180	60	339	13	480	610	365	243
ST-15	15	318	228	133	48	110	14	43	200	60	378	13	540	660	400	327
ST-20	20	318	228	133	48	110	14	43	200	60	378	13	540	660	400	347
ST-24	24	318	228	133	48	110	14	43	200	60	378	13	540	660	400	352
ST-30	30	356	286	140	60	110	18	52	230	60	381	16	610	800	477	469
STG-3	3	216	178	89	32	80	10	27	132	34	250	13	385	480	270	130
STG-5	5	254	254	108	38	80	10	33	160	50	310	13	440	580	325	189
STG-7.5	7.5	254	254	108	38	80	10	33	160	50	310	13	440	580	325	207
STG-10	10	279	203	121	42	110	12	37	180	60	339	13	480	610	365	244
STG-12	12	279	203	121	42	110	12	37	180	60	339	13	480	610	365	289
STG-15	15	318	228	133	48	110	14	43	200	60	378	13	540	660	400	318
STG-20	20	318	228	133	48	110	14	43	200	60	378	13	540	660	400	349
STG-24	24	318	228	133	48	110	14	43	200	60	378	13	540	660	400	364
STG-30	30	318	228	140	60	110	18	52	230	60	381	16	610	800	477	469

### **Steps for setting up a Generator**

- 1) RPM of the generator must be set first. This is the most important step!!!!
- 2) Use a known accurate method of setting RPM to 1860 RPM no load (a digital laser tach available from us or a Kill-A-Watt Meter to check frequency).
- 3) If using a Kill-A-Watt Meter, (available at RadioShack or on EBay) set for 62 HZ no load.
- 4) If using a Kill-A-Watt Meter, wire a 120 volt AC outlet to the side of the generator so the frequency can be monitored as you adjust RPM of the engine. For 480 volt 3 Phase, connect the Kill A Watt meter across one winding (139 volts)
- 5) If the generator uses an AVR, set the voltage adjust pot for 240 volts (480 if 3 phase, 12 wire) while measuring the 240 (480 3phase) output only after setting RPM or frequency.
- 6) The engine must have a good governor to maintain the RPM between 1860 no load and 1740 RPM fully loaded. This is a function of the governor and engine power. IF the engine has enough power, it can maintain this RPM.
- 7) **WARNING!!! RED LINE ON THE 1800 RPM GENERATORS IS 2100 RPM. AT APPROXIMATELY 1950 RPM, THE AVR WILL EXPLODE!!!! AT 2100 RPM, THE ROTOR WIRE WILL START COMING APART. DO NOT LET THE ENGINE DRIVE THE GENERATOR ABOVE 1860 RPM.**
- 8) See the enclosed diagram, (picture) on the correct way to wire generator. The strap that connects the two windings together is the neutral. The ground connection on the side is for **SAFETY ONLY!!!!** CONNECT THE GROUND CONNECTION TO A GOOD EARTH GROUND