

OPERATING 60 CYCLE INDUCTION MOTORS AS GENERATORS

any motor can be used as a generator and any generator will motor under the proper Circumstances. The purpose of this paper is to describe the connections required to convert the two most common types of induction motors into AC generators.

The two types of *motors* most readily Converted are three phase Squirrel cage Induction motors and capacitor start single-phase induction motors.

Although the connections are different, both types of machines exhibit similar operating characteristics. Below is an outline form applying to either type of generator? The instruction, for connecting the machines and small parts that you will need are discussed later.

STEP 1- Electrically connect the unit as outlined under the connection section.

STEP 2- Connect the machine by belt or other suitable means to a Source of mechanical power such as a gasoline engine. Turn the machine at about its nameplate speed. Most machines will be either about 1800 RPM or about 3600 RPM.

STEP 3- With no loads of any kind connected to the generator, its voltage should build-up (usually a faint generator hum is audible). If you are using a Single-phase machine, be sure it is turning the same direction that it turned as a motor. Build up can be checked by momentarily connecting a light bulb across the output terminals to check for power.

STEP 4- Reduce generator Speed until the machine will just keep the light bulb lit. You will find below this Speed, the generator will simply stop generating.

STEP 5- with the generator Operating at minimum speed where it continued to generate, connect a light *bulb* load to the average load for the generator. If you have been using a smaller load to test for generator build-up, it may be necessary to increase the Speed a bit to maintain generating mode.

STEP 6- set the generator speed by checking the generators output voltage. The faster you turn the generator the higher its voltage will become, etc. If a voltmeter is not available, a simple method is to compare the brightness of two bulbs of the same type, one plugged into the generator and the other plugged into the wall. The speed is about right when the bulbs are equally bright.

RATING- your generator can be rated at 500 watts per motor horse- power, This is a comfortable rating and allows for some short time Overload capacity. When selecting the loads for the generator remember that most electric motors require six to ten times their rated power when starting. As an example, a 1/3HP-freezer motor may require up to 3 HP worth of generating capacity to start it. High Speed portable tool motors are the main exception. These Series wound motors usually start quite successfully at 2 or 3 times their rated power current at rated voltage) level, Motor loads are best estimated by multiplying their nameplate volts times nameplate amps. This product is really $V \times I$ but can be used safely as watts for the purpose of generator rating.

Your generator will produce sine wave power generally at a frequency slightly below 60 HZ. An electric clock with a second hand will read the exact frequency in seconds in one minute.

CAUTIONS-

1- You are generating lethal voltages- use appropriate care.

2- The generator will not build-up its voltage when loaded.
It must always be started with no load connected.

3- Running the generator at speeds higher than the nameplate rating may generate very high voltages and cause the capacitors to explode or the machine to flash over inside and catch fire. Speeds in excess of 4000 RPM may even cause the rotor to fly apart inside the machine.

4- Don't leave the generator unattended until it has run about 2 hours without overheating. A safe motor temperature is when you can barely hold your hand on the generator for 5- 10 seconds and no hot or oily smell is coming from the machine.

Faults or dead shorts may be placed on the generator without harm since it will simply stop generating.

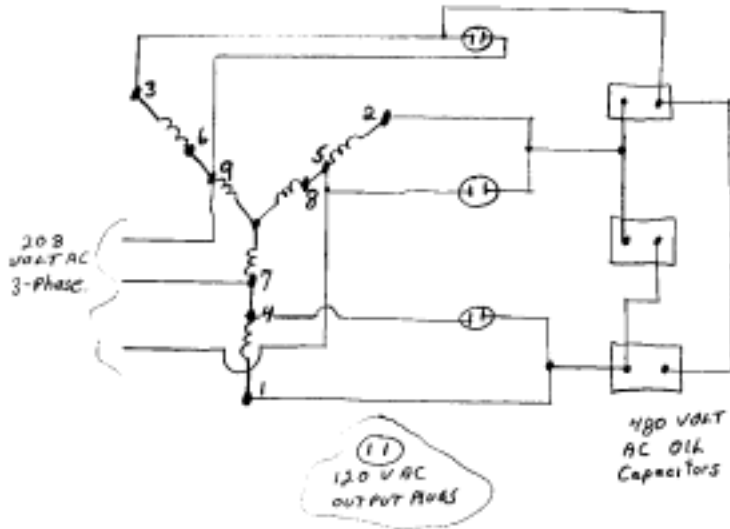
TROUBLE SHOOTING- If the generator will not build-up voltage when initially operated at or near nameplate speed, the capacitors may be too small, If single phase it may be turning backwards, the connections may be incorrect, the machine may be faulty or the iron in the machine may have lost its residual magnetism and need to be flashed. All the fixes are evident except flashing. To flash it momentarily, connect a car battery across the generator output terminals while it is running full speed 'with no load'. ONE second is more than enough time to flash the machine.

MACHINE SELECTION- Either a three-phase squirrel cage induction motor or a capacitor type motor may be used. Of the two choices, the old three-phase motor makes a better selection. These usually can be located in motor shops, junkyards, etc, for very little investment. The size machine to use depends on the rating you need from the generator but generally should not exceed about 10 HP for a three-phase machine or 3 HP for a single-phase machine. *Poor* results can be expected below about 1/2HP for three phase or 1/6 HP for single phase. The best generators are machines rated at 1700 RPM or higher. Lower speed machines can be used, but will require larger capacitors.

THEORY OF OPERATION- For either type of machine, capacitors will be used to provide excitation to the machine. The excitation magnetizes the machine's rotor. The magnetized rotor moving past the windings generates voltage in the windings. The machine voltage and frequency are determined by how many turns are in the windings, how fast the rotor turns and how much load is applied to the generator.

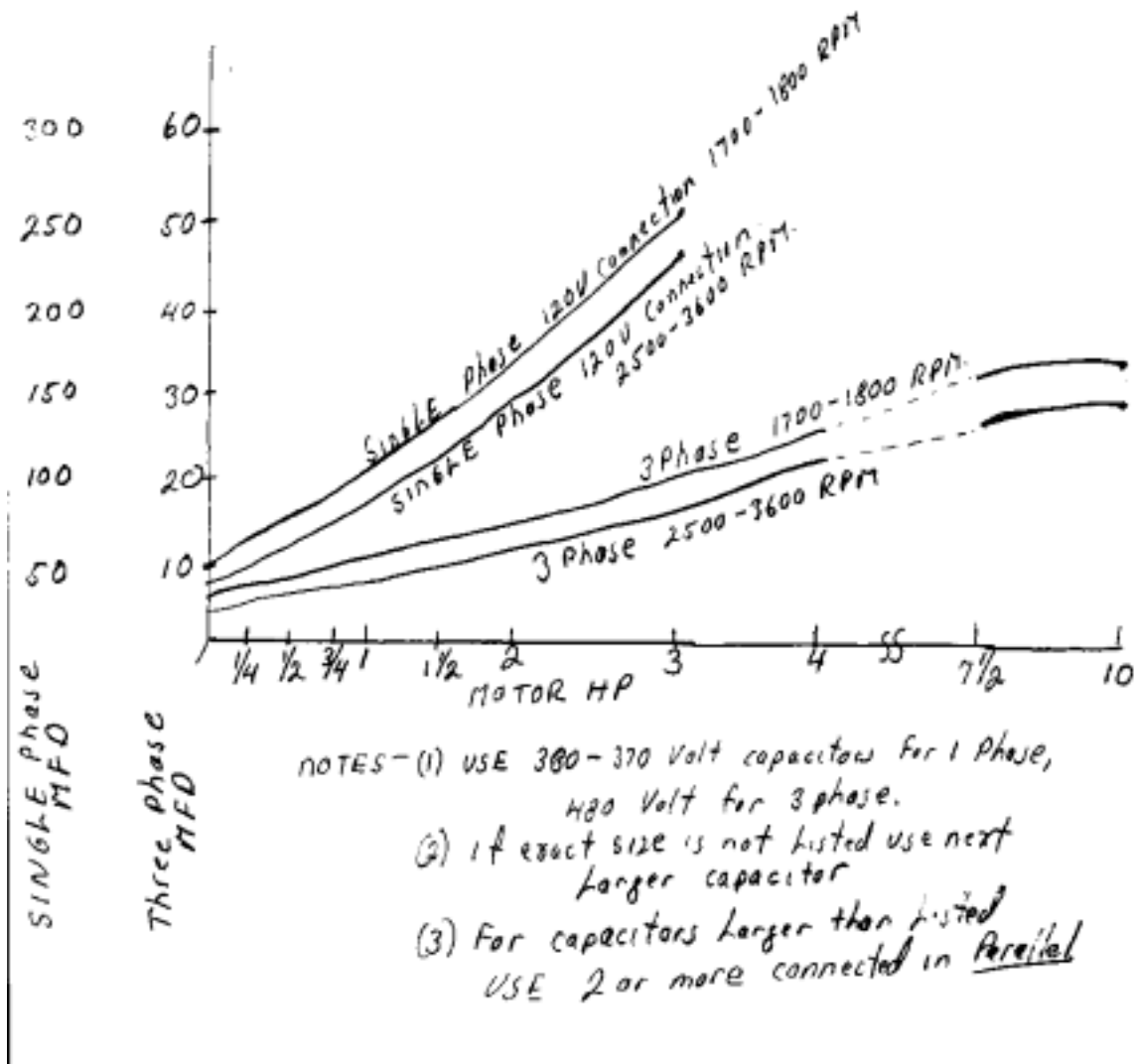
REGULATION- At constant speed, capacitor excited Induction generators have rather poor regulation curves often running from 140 volts no load to 100 volts full load.

CONNECTIONS FOR THREE MACHINES Three-phase machines will say 3 phase on the nameplate along with the voltage rating and speed. For a 120 volt 60hz output, the nameplate should say 208 or 230/460 volts and the motor should have nine leads as shown below. CHART #1



The correct size capacitor can be selected from the following graph. Each plug will be capable of about 1/3 of the generators rating. There will be approximately 480 volts ac at the capacitors, so use care not to touch them when the generator is operating CHART #2

CAPACITOR Selection - GRAPH.



CONNECTIONS FOR SINGLE PHASE CAPACITOR TYPE AC MOTORS- these motors are the type with the little can on the outside of the motor. Generally, they are found on older refrigerators and freezers, air compressors, pumps, washing machines, etc. The outline below applies to these single-phase motors only.

STEP 1- Run the machine as a motor to verify that it operates and note the direction or rotation. You should turn the machine this direction when operating it as a generator. If the motor is dual, voltage use the 120-volt connection.

STEP 2- Carefully disassemble the motor. Inside, attached to one end bell of the machine, will be a

centrifugal switch mechanism. This starting switch will have contacts such that the circuit it controls opens when the machine speeds up. Solder a short section of insulated wire around this switch so that the circuit the switch controls is permanently engaged.

STEP 3- Carefully reassemble the motor watching that no wires are where they will be hit by moving machine parts or cut by the end bells as you assemble the motor.

STEP 4- Locate the capacitor and cut the two wires leading to the capacitor. Large motors may have two capacitors hooked together. A few motors have the capacitors located inside an end bell or in the base of the machine. In any case, the capacitor(s) will be a cylinder shaped object with 2 wires.

STEP 5- Connect an ac oil capacitor to the wires that went to the original capacitor. The oil capacitor may be selected from the capacitor selection graph or use a capacitor of about _ the value shown on the capacitor you removed. This step completes the conversion for single (1) phase motors.