

## 652-1025 (05-025) Wind Electronic Generator

**Introduction:** Wind power is very old. It has been used on sailing ships and grain mills for millennia, but in modern times has been used principally to generate electricity. Although it accounts for less than 1% of global electrical supplies, it is the fastest growing type of power source. Some countries have a high use of wind power, such as Denmark, which generates almost a fifth of its electricity through wind turbines.

Advantages of wind power include its localized design, making it practical for remote areas, ease of use, the fact that it causes no pollution, and that it is almost maintenance free. Disadvantages are high cost, unreliable sources of wind, and low power density. It takes thousands of windmills to equal an average size coal power plant.

### **Description:**

Wind turbines are relatively simple machines similar to the original windmills created thousands of years ago. They rely on a rotor of some type, with angled blades connected to a shaft. When wind strikes the rotor, it pushes the angled blades, causing the rotor to spin. This drives the shaft, which is connected to a dynamo. This in turn generates electricity.

Most commercial windmills use the three bladed 'Danish' design. This is cheaper than other designs and is less prone to stress damage. Our design uses twelve blades. This allows it to extract more energy from the wind. If this were done on a commercial scale, the generator would be subject to enormous stresses, but for our purposes it is sufficient.

Rotor size has a great deal to do with the longevity of the system. A low diameter rotor can work in almost any wind speed. As rotors increase in size, the tips of the blades move faster and faster because they are farther from the shaft. If a rotor were too large or turned too fast, the tips of the blades could well reach supersonic speeds. This would cause damage to the system. Our generator is too small for this to occur.

### **Operation:**

Begin by clamping the windmill firmly to a tabletop or other surface, using the included clamp. You will notice that the angle of the blades is fully adjustable. You can use this to have your students determine the best arrangement for the blades. The generator has a tail and can swivel on its base, allowing it to face directly into the wind independently. It is geared to produce as much electricity as possible

You will need a high-powered fan to operate this set. After setting up the generator you will need to attach a set of banana plugs, not included allowing them to be attached to a voltmeter, small lamp, and other instruments. This is useful because it allows your students to measure the relationship between wind speed and current. An anemometer is helpful for this.

### **Discussion:**

Using a stroboscope or anemometer, determine the speed of the wind affecting the generator. You can use this data to determine the efficiency of the turbine. In addition, by turning blades so that they face into the wind edgewise, you can effectively remove them. This will in turn affect the amount of current generated. You will need a multimeter to measure this difference.



Wind speed, m/s	Number of blades	Voltage generated

At what wind speed does the generator operate most effectively?

What is the minimum wind speed required to generate current?

What is the maximum capacity of the generator?

To determine the speed of the wind, you will need an anemometer or stroboscope. An anemometer will measure the speed of the wind directly, while a stroboscope will enable you to count the revolutions of a fan, and determine the speed of the wind through calculation.

For the anemometer method, determine the radius of the rotor. Next, count the number of revolutions the anemometer undergoes in one minute. Since you know the radius, you can determine the circumference of the rotor. Thus, since you know the circumference of the rotor and the number of revolutions per minute, you can determine how far the unit “traveled” in one minute. From this data you can compute the wind speed.

The stroboscope method is similar to the anemometer way. Use the stroboscope to count the number of revolutions the fan and determine the speed at which the fan is rotating. Of course, the actual wind speed will not be the same as this result. It will be a percentage of the fan speed. This is due to the design of the fan blades, among other factors. However, the drop will be the same regardless of the speed of the fan. For this reason, treat the fan speed as being the same as the wind speed when determining the capacity of the turbine.

#### **Warranty and Parts:**

We replace all defective or missing parts free of charge. Additional replacement parts may be ordered toll-free. We accept MasterCard, Visa, checks and School P.O.s. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse or normal wear and tear. Intended for children 13 years of age and up. This item is not a toy. It may contain small parts that can be choking hazards. Adult supervision is required.

#### **May we suggest:**

**652-1010 Anemometer:** This colorful working model is sensitive to breezes as slight as 2 mph. Since it rotates at speeds 1/6 that of the wind velocity, wind speeds can be determined quantitatively by counting the rotations. Includes four plastic molded cups, 3 black, 1 red for contrast; low friction axle; sturdy plastic base; instructions with sample problem and wind speed chart.

**611-1610 High Precision Digital Stroboscope: 12-15,000 flashes/ minute** The 5-digit LED digital readout on this economical stroboscope gives the exact number of flashes per second. Features include: xenon flashlamp, solid-state design, 3 modes (RPM, Hz and mSec). Can use internal or external signal source. Can be fine-tuned. Uses 120V AC, 60/50 Hz operations.

**615-4735 Digital Multimeter:** This is a great new multimeter with a 1" high contrast LCD that can tilt up and down for ease of use. It includes a single 32-position easy-to-use rotary switch for function and range. The device features auto power off and overload protection. The multimeter is CE approved. A protective holster, fold-out stand and full instructions are provided