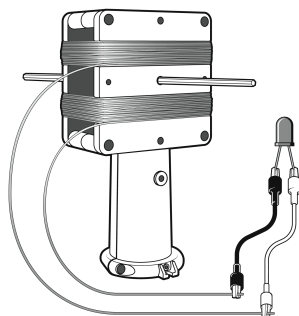


# simpleGEN

(Order Code KW-SGEN)

All wind turbines contain generators that transform the energy of the wind into electrical energy. Engineers are constantly trying to improve the performance of these generators, allowing the turbines to transform a greater percentage of wind energy into electricity and thus increasing the turbine efficiency. This kit will allow you to explore how a simple generator works.



With the simpleGEN, students can:

- Explore the main parts of an electrical generator
- Identify the relationships between the main parts of an electrical generator
- Construct a simple generator
- Investigate how electricity is generated
- Use a digital multimeter to measure AC voltage

## What's Included

### simpleGEN

- Wind Turbine Hub (1)
- Alligator clip cord pair (1)
- Digital multimeter (1)
- Sandpaper 1/8 sheet (1)
- Magnet holder (1)
- Ceramic magnet (4)
- 8" hex shaft with hub quick connect (1)
- 4" hex shaft (1)
- SimpleGEN housing half (2)
- Dowels\* (25)
- Red superbright LED\* (1)
- Bi-polar LED bulb\* (1)
- 28 gauge magnet wire on spool\* (1)
- Hex locks (2)

### Classroom Pack

- Wind Turbine Hub (10)
- Alligator clip cord pair (10)
- Digital multimeter (3)
- Sandpaper 1/8 sheet (10)
- Magnet holder (10)
- Ceramic magnet (40)
- 8" hex shaft with hub quick connect (10)
- 4" hex shaft (10)
- SimpleGEN housing half (20)
- Dowels\* (150)
- Red superbright LED\* (10)
- Bi-polar LED bulb\* (10)
- 28 gauge magnet wire on spool\* (10)
- Hex locks (20)

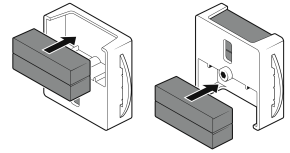
**NOTE:** Vernier products are designed for educational use. Our products are not designed nor recommended for any industrial, medical, or commercial process such as life support, patient diagnosis, control of a manufacturing process, or industrial testing of any kind.

\*This part is a consumable and is excluded from the warranty.

## Step 1: Assemble the Magnet Holder

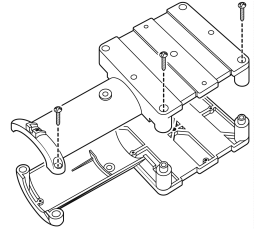
Connect two ceramic magnets together and insert them into the top of the magnet holder. Take the other two and insert them into the bottom of the holder.

In order for the generator to work properly, opposite fields need to be facing outwards: north on one side, south on the other. As you assemble them, you will feel the fields of the magnets pulling them into proper alignment.



## Step 2: Assemble the simpleGEN Housing

Fit the posts of one half of the simpleGEN housing into the holes on the other half. Secure the halves together with screws.

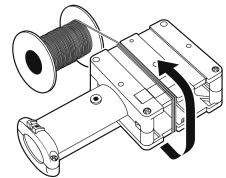


## Step 3: Wrap the simpleGEN Housing with Wire

Determine how many turns of wire you will wrap around the box. Each turn will use approximately 25 cm of wire. The spool of wire included in the simpleGEN kit has about 130 meters of wire, which is enough for at least 500 turns around the housing.

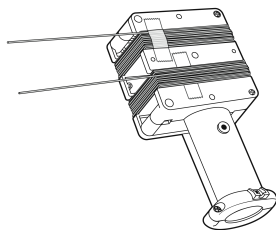
As you begin, keep in mind that all the wire must be wrapped in the same direction around the housing. Also keep in mind that you will need to leave at least 15 cm of wire free when you start and finish wrapping the wire around the housing, for connecting to the LED or multimeter. Sticky tape such as electrical tape, “duct” tape, or painter’s tape can be used to secure the wire while you get started.

Wrap the wire neatly around the simpleGEN housing, evenly distributing it in the two grooves. For example, if you plan to wrap 300 turns of wire, make 150 loops in one groove and 150 loops in the other. Always wrap the wire in the same direction.



Be sure that you have wound your coils neatly. The wires should be straight, fit entirely within the grooves on the housing, and fit the housing snugly. Do not cut the wire connecting the top and bottom coils!

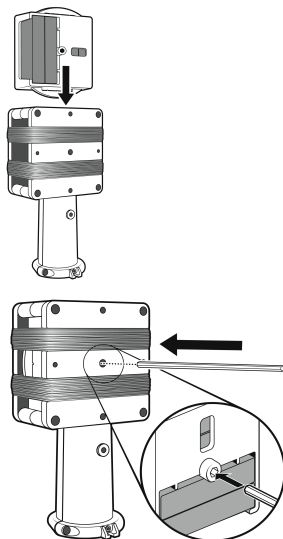
When you have finished wrapping the wire, use another piece of tape to ensure that the last loops of wire remain securely in place.



Make sure to leave the two ends of the wire (about 15 cm each) free and extended from the box.

#### Step 4: Assemble the Generator

Insert the magnet holder with magnets into the simpleGEN housing.

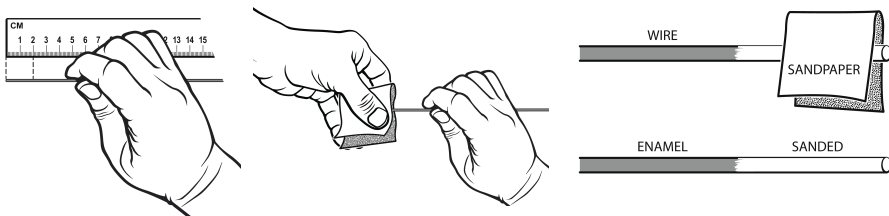


Align the hex driveshaft with the magnet holder's center hole and insert.

Make sure that the magnet holder is centered in the housing so it can spin freely.

#### Step 5: Prepare the Wire Ends

Magnet wire is covered with a thin coat of enamel. To reach the conductive wire beneath, you will need to scrape off the enamel coating. Fold the sandpaper around the wire and pull it gently along the wire toward the ends, starting from about 2 cm from the ends of the leads.



Now you are ready to perform experiments with your simpleGEN!

## Testing Your simpleGEN

### Qualitative testing with LEDs

Depending on how many turns of wire or the size of the wire used, you may be able to light up an LED as you spin the generator. You can get a rough idea of how much power you are generating by seeing if the LED lights up and how brightly it glows.

### Testing with a KidWind Power Output Board (KW-POBD)

For a visual representation of the voltage produced by your generator, clip the generator wires to the AC terminals of the bridge rectifier on the KidWind Power Output Board. Then connect the DC terminals of the bridge rectifier to the appropriate terminals on the visual voltmeter. The more voltage you generate, the more LEDs will light.

### Quantitative testing with a multimeter

Using a simple multimeter set to measure AC voltage, you can collect data on the output of your generator as you conduct comparative experiments. Use the lowest AC voltage setting on the multimeter.

### How to spin the Generator

You can use your hands or a drill to spin your generator, or you can connect a Wind Turbine Hub with blades and use wind from a fan or wind tunnel.

## Troubleshooting

### If the generator does not spin

Make sure there is nothing catching on the magnet holder and it is centered in the box.

If you are using a wind turbine to turn the generator, try increasing the wind speed or moving the turbine closer to the fan or source of wind.

### If the LED does not light

The red LED requires a minimum of 1.6 volts, and the bi-polar LED requires 1.6 volts to start glowing red and 1.8 volts in the opposite direction to start glowing green. If the LED does not glow, either you do not have a connection or you do not have enough voltage.

- Make sure that you have wound enough coils around the box. Fewer than 100 turns, in total, will not light an LED bulb.
- You might need to make the generator spin faster. The voltage you generate is related to how fast the magnetic field changes.
- Make sure you have removed the enamel from the ends of the wires or you will not conduct any electricity.
- Be sure that you have wound your coils neatly around the simpleGEN housing. They should be straight, not crooked, and fit tightly around the housing.

### If the multimeter does not show a reading

Make sure the meter is set on AC Voltage. Use the lowest setting for measuring AC voltage.

- Make sure you have removed the enamel from the ends of the wires or you will not conduct any electricity.

- If the multimeter does not display any digits at all, it may need a new battery.

## **Sample Experiments**

You can access several different experiments on our website.

[www.vernier.com/kw-sgen](http://www.vernier.com/kw-sgen)

### **Coils**

How you wind your coils can affect how well a generator works. Try testing generators with different numbers of turns of wire, different orientations of coils, or different numbers of coils.

### **Number of Magnets**

On one generator, use only one magnet on each side of the magnet holder. You can do this by making a cardboard shim and substituting it for one of the magnets on each side. How does this affect your voltage output?

### **Strength of Magnets (SAFETY!)**

You can buy larger neodymium magnets from a number of online companies. Look for sizes that will fit into the magnet holder. Use caution as large neodymium magnets are very strong and can cause injury if they snap together with your fingers in between them!

### **Speed of Spinning**

How fast you spin your magnets can affect your voltage output. Try spinning your generator at different speeds and see what happens.

### **Diameter of Wire**

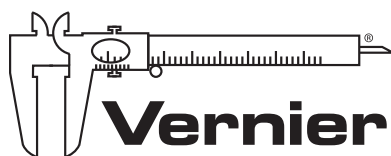
Try wrapping the same number of turns of wire, but using different wire gauges. You can get different sizes of wire at a local electronics store or online. What happens to your voltage output?

### **Distance from Magnets to Coils**

We have provided a simple housing that you can wind your coils around. If you want to get creative, you could build your own housing so that the coils are closer to the magnets. This can greatly improve the performance of your generator

## **Warranty**

Vernier warrants this product, excluding consumables, to be free from defects in materials and workmanship for a period of five years from the date of shipment to the customer. Consumables are clearly marked on Page 1 of the user manual.



**MEASURE. ANALYZE. LEARN.™**

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