

Windmill Powered LEDs

General

In this exercise you will build a not very pretty version of a moving part to use in your city model. This is called a Proof of Concept or POC. It gives you experience in working with the materials and connecting the electrical circuits. The version you build for your city model will look much better, but work basically the same.

All of the parts and supplies you need are in your team's brown bag or on the table. **Leave scissors, needle nose pliers, tape and other supplies on the table when you leave the room.** You may want to partially disassemble your moving part so it fits in your pack, or you can just carry it around. A few supplies like duct tape and masking tape may be at the front table.

The wiring harness was assembled so that the POC could be built in the time available. Additional LEDs and connectors can be purchased and added to the assembly. The harness can also be built using soldered joints instead of the connectors.

IMPORTANT

LEDs are diodes and only work in one direction with a current flow in one direction. The wire connected to the positive side of an LED is slightly longer than the wire on the other side. In these kits, wire extensions were added for clarity.

Red is the positive wire.

Black is the negative wire.

The positive wire must be attached to the positive side of the LED.

Test each LED just before you assemble it by using the battery pack. Touch the red wire from the battery pack to the positive side and black wire to the negative side. The LED should light. If it does not, you have it reversed. Switch it and test again. If it still does not light up make sure the batteries are set correctly in the battery holder and the build in switch is in the on position.

The polarity of the generator depends upon which way the shaft is rotating. The air is blown towards the propellers from the front, the generator will rotate in a direction that makes the red wire negative and the black wire positive.

***Review the Parts List and Receipt before starting the exercise. ***

***Take the parts out of the bag and arrange them neatly on the table. ***

1. Assemble and test the LED array

- 1.1. The LEDs only work when the polarity is correct.
- 1.2. Insert the batteries in the battery pack.
- 1.3. Layout the electrical harness on the base cardboard. Do not tape anything down yet.
- 1.4. For each LED –
 - 1.4.1. Test the polarity with the battery pack by touch the leads from the battery pack to the connectors on the LED. Connect the positive (red) side first, then black.
 - 1.4.2. If the LED lights it can be disconnected from the battery and added to a spot along the electrical harness. You do not need to fully insert the clips into the harness at this time, as they can be difficult to disconnect later.
- 1.5. Test the harness by touching the wires from the batter pack to the corresponding wires on the electrical harness. All of the LEDs should light. Do not hold the connection on any longer than necessary.

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2. Build the generator and tower assembly

- 2.1. Attach the propeller to the generator
- 2.2. Attach the generator to the tower (plastic cup), bringing the wires down the outside or inside of the tower.
- 2.3. Attach the tower-generator assembly at an end of the base piece so that the propeller is facing away from the length of the base piece.
- 2.4. Use duct tape to fasten the tower assembly in the upright position to the large cardboard base. DUCT TAPE SHOULD NOT BE ATTACHED TO THE TABLES.

3. Assembly

- 3.1. Layout the wires in an orderly manner on the remainder of the cardboard base. Evenly space LEDs/harness connections.
- 3.2. Important – the generator is really a generator/motor. When used as a motor the red wire is positive and black negative. When used as a generator you can think of it as running backwards and the red wire is **negative** and the black is **positive**.
- 3.3. Connect the wires from the generator to the electrical harness using grey wire nuts. Black from generator to red from harness and vice versa.
 - 3.3.1. Twist the two wires together
 - 3.3.2. Insert into wire nut
 - 3.3.3. Screw (turn clockwise) the wire nut onto the wires.

4. Test the assembly

- 4.1. Use the can of air on the table to create wind aimed that the propeller. The end of the nozzle will have to be within a few inches of the propeller and aimed directly out it so generate enough energy to light up the lights.
- 4.2. If you get the LEDs to light up continue, otherwise ask one of the volunteer engineers for assistance.

5. Make light poles

- 5.1. In your model city the LEDs can be used to light up a building or as street lights. For this exercise, we will make some street lights.
- 5.2. Disconnect LEDs from the harness.
- 5.3. Carefully slide the LED (wires first) into straws until just its small dome is just sticking out of the end. Straws may be cut shorter as needed.
- 5.4. Insert LED connections back into harness. The strength on the harness should be enough to hold poles vertical, however tape and additional straws may be used for bracing.

6. Make some wind and turn on the lights!

7. Things to know plus some things you can do with your city.

- 7.1. LED ballast – If you are asked about that the answer is that the generator powered by the can of air, barely makes enough voltage to light up the LEDs, which have a forward voltage of 2 volts so ballast is not needed.
- 7.2. You have extra wire nuts so you can use additional wire to locate the lights anywhere in your city and not necessarily very close to the windmill. Just be sure to tell the judges where the lights are when you demonstrate the windmill.
- 7.3. In your city hide the wiring
- 7.4. Paint and make the windmill tower pretty.
- 7.5. If you are also interested in using some battery powered LEDs to light up your city, contact Mr. Ken Golkin at kgolkin@futurecityphilly.org We have a bunch of LEDs left over and can find volunteer to help you configure them and calculate what batteries and ballast you will need.

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Parts List and Receipt for Parts

(The parts free, but you do have to claim them as an expense on your submission)

	Unit Cost	Qty	Cost
Motor Generator	\$2.00	1	\$2.00
Electrical harness with connectors and insulating sleeves	\$0.55	1	\$0.55
Propeller	\$0.70	1	\$0.70
Grey Wire Nuts	\$0.04	6	\$0.24
AAA Batteries	\$0.40	2	\$0.80
Battery Holders	\$0.54	1	\$0.54
LEDs	\$0.03	3	\$0.09
Can of Wind	NA	1	
Straws	\$0.00	3	
Cardboard base	\$0.00	1	
Tower material (Plastic Cup)	\$0.00	1	
Total			\$4.92