

Photovoltaics (Solar Panel) Investigation

The solar panel is the power source for that car. Sunlight strikes the solar cells and the light is converted to electricity on an atomic level. How much electricity is produced is related to the amount of light that the panel collects and how efficiently it can convert the light into electricity.

Your car will have a solar panel mounted somewhere on it. You want the panel to collect as much light as possible, and to convert it as efficiently as possible. The first task is to figure out where to position the panel on the car. The top side is probably best, and nothing should cast a shadow across it.

Trade-off: Tilting panel vs. Fixed panel

The angle of the panel to the sun also makes a difference. Look at the shadow cast by the panel when it is rotated to different angles. The larger the shadow the more light it is catching. However, you may not be able to aim the solar panel directly at the sun with your car design. The position of the sun during the race is unknown (time of day, time of year and racetrack orientation play a role in the sun's position compared to your car). A tiltable solar panel is harder to build than a fixed panel, it may weigh more and cause more aerodynamic drag. These last two will slow your car down. Is a tiltable panel worth all the drawbacks? To answer that question you need to know how much difference the angle of the panel to the sun make. If you get a lot more power, maybe it is worth the extra effort. If it doesn't seem to make a big difference, spend your time making the car better and faster in other ways.

Panel efficiency

Once the sunlight has hit the panel, the panel converts the energy of the sun to electricity. Does all of the solar energy get converted or does some get reflected and some get turned into heat and lost? A lot of the efficiency of the solar cells has to do with how well they were designed and built. Unfortunately good solar cells are expensive. The solar racing car built by Honda that won the 1993 race across Australia had some of the best cells ever made. A five inch by 12 inch panel (like the one in the kit) made of these cells would cost about \$9,000! Over 200 panels that size allowed the car to average over 50 mph across the entire continent on solar power alone! These cells were almost 25% efficient. That means that solar panel is not as good, probably around 10% efficient. However, there are some ways to make your panel as efficient as possible. Keep it clean (dirt and dust will block sunlight like a dirty window). Keep it cool. Solar cells work better when they are not hot. Teams racing full size solar cars will often spray water on the race car's solar panels to keep them cool and running more efficiently when the car is parked and charging its batteries from the sun.

Solar Panel Investigation #1: Power generation

Materials

Solar panel
Motor
Voltage and/or current meter
Sunlight
Lamps

Hook up the leads of the solar panel to a voltmeter (or a motor). Try the following tests to get a feel for how sensitive the solar panel is to different conditions.

- Vary light level on solar panel (indoor light, incandescent light bulbs, fluorescent lights, direct sunlight, open shade)
- Vary angle of panel to sun (watch the size of the panel's shadow change and see how the volt meter changes)
- Investigate effects of shadows on part or all of panel. What happens if you cover only 1 cell?
- Investigate how much difference temperature makes. Take a cool panel and quickly place it in the sun. Let the panel warm up in the sun and see if you can detect the difference on the voltmeter.
- Does it matter which way the motor (or voltmeter) is hooked up to the solar panel?

Put a current meter (ammeter) in series with the motor and solar panel. How does the light level affect the current?