Solar Power for Wildlife Telemetry Transmitters

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Radio tracking or radio telemetry is often used in studies of the orientation or behavior of birds. Although larger animals can tolerate heavy radio transmitter packages, the weight of batteries needed to power a telemetry system is often a major problem in avian studies. It is usually desirable to provide maximum power and life for the transmitter. Both of these require added battery power and the experimenter often ends up with the heaviest package he thinks the bird can carry (see Cochran, 1963, for further discussion). Solar cells (or technically, photovoltaic cells), which convert the energy of the sun to electrical energy, offer the potential solution to this problem. Until recently, solar cells were either too large or too expensive for wildlife telemetry work. Recent advances in the production of these cells have brought small cells within the grasp of the ornithologist.

We have successfully tested solar cells with a 30 gm, 400 MHz transmitter we use for studies of Herring Gull orientation. This transmitter, described in Williams and Lawson (in prep.), draws about 10 ma at 2.8 v and has a tested range of over 80 km. The power source should work equally well for a number of other wildlife transmitters now available.

MATERIALS AND METHODS

We investigated a number of photovoltaic cells obtained from the International Rectifier Corp., El Segundo, California, and used two types for testing. The first is a ready made, inexpensive but relatively large unit; catalog #SP5G26C. The solar cells are enclosed in a plastic case which measures 7.8 × 4.9 × 0.9 cm (about 3″ × 2″ × ¼″). The entire unit with leads weighs 21 gm and costs about $8.00. This unit would be suitable for larger birds such as geese, large herons, the largest gulls, or game birds. For our tests of the power output of the solar cells, we measured the current through a 500 ohm resistor (an approximate value for many telemetry transmitters). The tests were made at Buffalo, N. Y , with the sun about 40° above the horizon. Under these conditions, the unit delivered 16 ma at 8 v in full sun, and 6.5 ma at 3.2 v in full shade

We constructed a second more compact solar cell unit from component parts. Twelve International Rectifier photovoltaic cells, catalog #S1010GE10, were cemented inside the clear polystyrene case which we use for our transmitters (see figure 1). The photocells were very brittle and had to be handled with care. For use in wildlife telemetry, they must be cemented to a rugged base. Each cell has a metal grid network on the light sensitive side while the back is completely metallized. The cells were connected in series by adding a small amount of solder to the end connecting strip of the grid network of one cell and a small amount to the back of the second cell. With the cells placed with the edges of contact together, we ran a soldering iron along the joint on the back of the second cell. No more than a 30 watt soldering iron with a small tip should be used, and care must be taken not to overheat the cells. The assembled solar cell unit weighed about 3 gm and measured 4.3 × 2 8 × 0.2 cm. With the case shown in figure 1, the total weight was under 6 gm. The total cost was $23.00.

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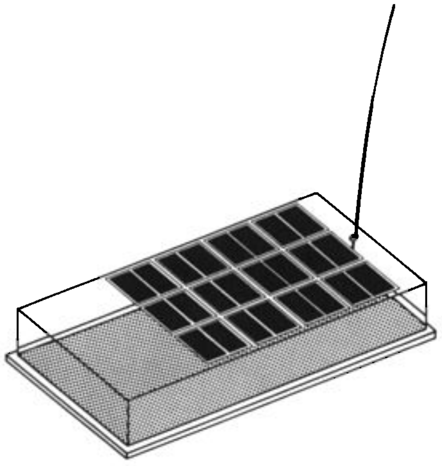

Figure 1. Clear polystyrene case of the transmitter showing photocells comented to the inner surface. The case measures 3.2 cm × 7.5 cm × 1.5 cm. The electronic components of the transmitter have been eliminated from the drawing for clarity.

Under the conditions of the power output tests described above, the smaller unit gave 7 ma at 3.5 volts with a 500 ohm load. In shade the values dropped sharply to about 2 ma at 1 v.

In using solar power sources with the transmitters we have developed, we found it desirable to wire the cell in parallel with either an alkaline or nickel-cadmium battery, as shown in figure 2. The battery stabilizes the output of the transmitter by providing power whenever the output of the solar cell falls below the battery voltage. In such a case, the photocells act as reverse biassed diodes and do not drain battery current. When the photocell output rises above the battery voltage, the battery is recharged.

DISCUSSION

Although the solar powered transmitter has not yet been used on a bird, we tested it for three months under a variety of weather conditions including snow. The size N alkaline cells we use with the transmitter normally provide power for only four days. With the addition of the larger solar cells, the transmitter was fully operative after two weeks under skies which were overcast about half of the time.

The solar cells stand up well to a variety of environmental conditions such as heat, cold and even condensation inside their plastic cases. If care is taken to construct transmitters which are resistant to environmental effects, it would be possible to perform telemetric studies of game birds extending over a number of years, or perhaps to trace the movements of the Laysan Albatross.

Advances in the electronics industry take place so rapidly that there may already be photovoltaic cells superior to the ones we have described and tested. Even a small reduction in the size of the cells would make possible the first telemetric studies of the full migratory routes of some of the larger songbirds.

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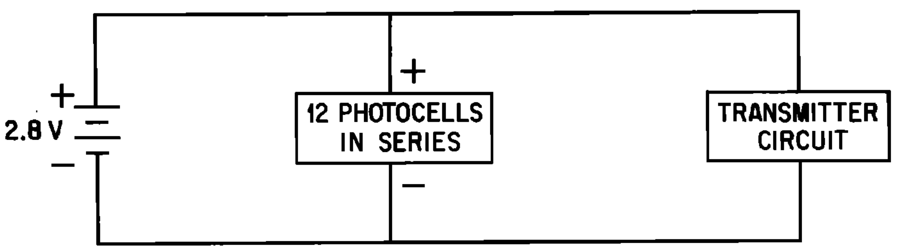

Figure 2. Simplified circuit diagram of power source for transmitter.