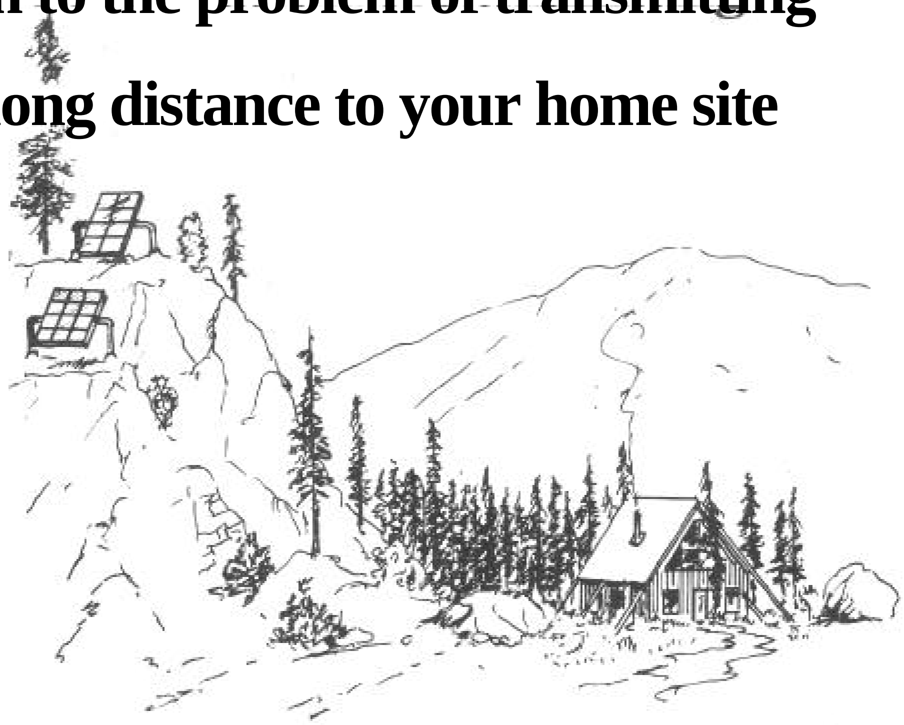
Here is a solution to the problem of transmitting solar electricity long distance to your home site



(This article addresses a new solutioxt to a technical problem In solar electric module siting. Only a qualified electrician with equipment for safe handling of 100 to 200 volt circuits, and several accurate digital meters, should construct this transmission line. —Editor)

By Steve Willey

Solar electric powered homes usually convert power to standard household 110 volt AC power to operate ordinary lights and appliances, but by the nature of solar modules and batteries, the power must start out as DC, usually low voltage DC.

Because of the low voltage batteries, (usually 12 or 24 volt) the solar electric modules need to be mounted pretty close to the batteries they are charging. An 8-module array requires heavy wiring and even so can only be routed about 75 feet (12 volt) to 300 feet (24 volt) before having excessive power losses in the wiring.

Usually this is sufficient to reach a clear spot in full sun all day either on the roof or in the yard. Still, I have seen several locations in tall forests, or on the north side of a mountain or the foot of a cliff, where clear sun access simply is not possible close to the house. But perhaps 600 feet away is a clear meadow with direct sunshine all day.

Wire modules in series

There is one way to set up such a site to locate solar modules many hundreds of feet away and still get the power to the home using small gauge wires. It does require that you have at least 9 or 10 solar modules, or multiples thereof. The trick is to wire the solar modules in series, which produces low current and high voltage, which can be transmitted greater distances on smaller wires. A device at the battery end of the long wize converts the power to charge a 12-volt battery set at higher current, about 90% as much as if the batteries were located close to the solar modules. (See Figure 1, the system diagram.)

"Switching" transformer

The device that makes this possible is a creative application of a new "switching!' type transformer-less battery charger made by Todd Engineermg. It is available under both Todd and Heliotrope names in most solar electric catalogs, from $84 to $250 for various models.

This charger was designed to plug into standard utility company or generator AC power to charge a 12-volt battery, automatically, to 14.0 or 14.8 or 16.5 volts, depending on the model selected. It automatically stops charging when the battery reaches the target voltage.

Joe Petrucelli, using solar and hydro power in Washington state, noticed that this type of charger will operate from DC as well as from AC power sources. Therefore it converts high voltage, low current DC into high current 12 volt battery charging power, and automatically regulates that charge as well. The result is a very reasonably priced solution to long distance solar charging, using small low current wiring to go the distance, with automatic charge control included in the package.

Experienced help necessary

This has been tried in only a few instances that I know of, so performance and reliability is a bit of a gamble. If you are familiar enough with electrical principals and have several accurate test meters, you can test and fine tune your own transmission system. But if you are not familiar with the concepts of amperes, voltage, efficiency measurements, and safe handling of high voltage DC, you should get experienced help to set up this system.

High voltage hazard

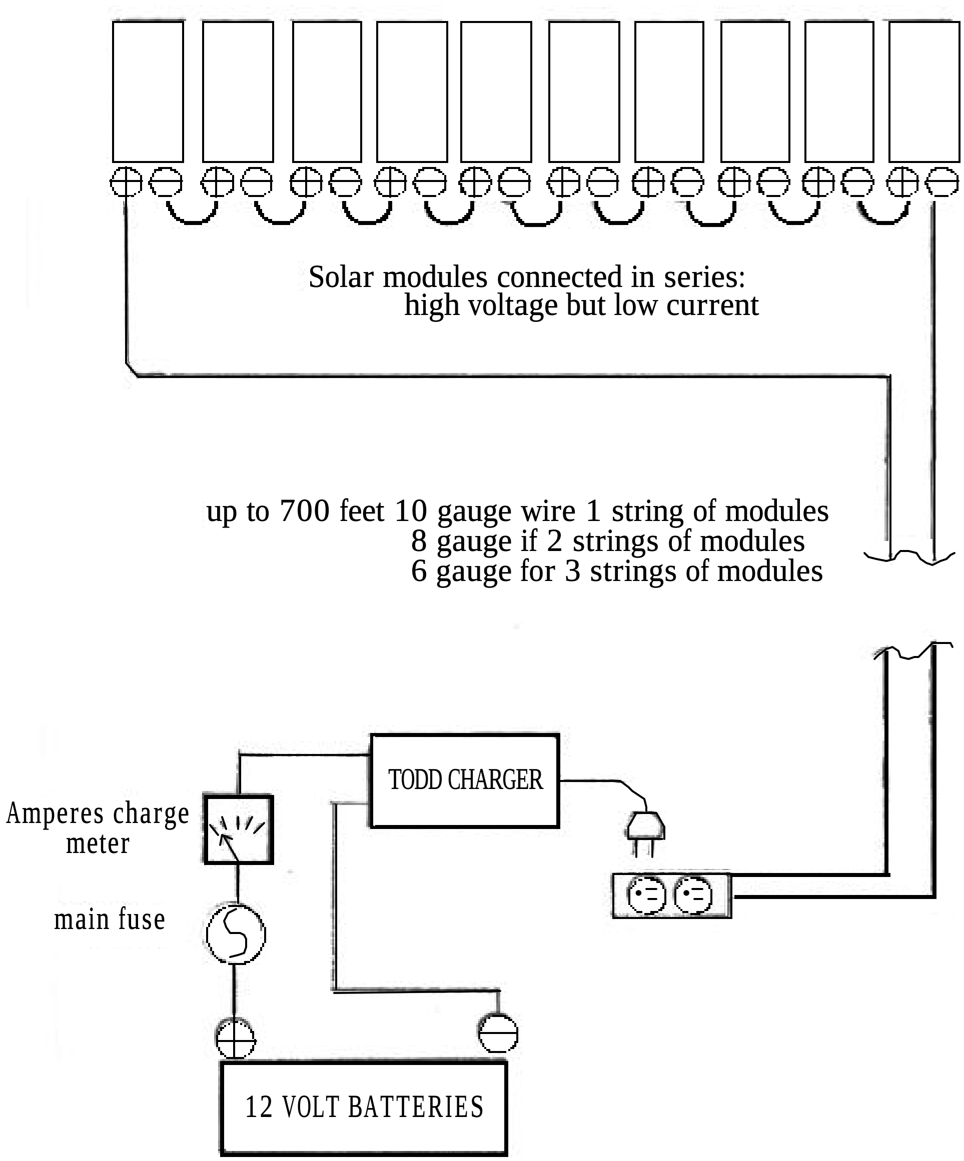
The high voltage DC makes the transmission line a hazard that should be buried in plastic conduit, and routed to appropriate 120/240 volt wiring hardware at both ends. Modules connected in series produce high voltage all day, so should be the last thing connected after the wiring is completed. Also "bypass" diodes (different from a night blocking diode) -are used on each module when connected for high voltage. Hoxan brand modules provide this diode with each solar module.

Must have correct number of modules

Since the charger is not actually designed for this purpose, it is not adjustable for the number of solar electric modules you have. You must have the right number of modules to give the charger approximately the input voltage it was designed for. Regular AC power has a voltage that constantly changes from + to -, but is equivalent to about 110 or 115 volts.

However the highest peaks it reaches are around 160 volts. Therefore the Todd chargers work fine with a DC input of 160 volts, and perform poorly at 110 volts or less. That means you will need at least 9 solar modules, perhaps 10, connected in series to produce the voltage needed. The exact number that works best depends on the type of module used and depends somewhat on the length and size of the wire.

The trick is not to exceed the safe limit of 200 volts, even when the charger cuts its power consumption when your battery becomes full. Todd makes three sizes of charger, each available in the voltage control selection mentioned above. The smallest is a 30-ampere maximum charger, the next is 45 amperes, and the largest is 75 amperes maximum. Unless the battery is very low, each of these normally operates at about 2/3 its rated maximum.



Some tests

Joe Petrucelli used 10 Kyocera modules and a 150 volts DC from a hydropower generator at the same time. Power from both was fed into the 75 ampere (PC-75) Todd charger. The solar modules alone produced 30 amps 12 volt battery charge. When the hydro was started his total charge rose to 65 amperes. Input voltage to the charger measured 154 volts DC. Eventually there was a failure in the Todd charger, which was replaced on warranty, but the new unit was not quite as efficient as the original.

I set up a test with 7, 8, and 9 Hoxan solar modules in one series string, and several hundred feet of 10 gauge romex wire from there back to the house. I tried all three chargers, 30, 45, and 60 ampere models all with 14.8 volt charge regulation. This test clearly showed the necessity to maintain 150 volts or more input to the charger.

Input to output efficiency through the charger was as high as 91% with 9 modules, 150 volts, and 86% with 8 modules, 142 volts at the input. Charge to the battery was 22 amperes and 15 amperes respectively. Changing to the 45 and,75 ampere charger model created a heavier load on the solar array, and input voltage dropped to 110 volts and. 106 volts respectively, with only 1Z to 15 amperes charge to the battery no matter whether 7, 8, or 9 modules were used. The higher current chargers would have worked more efficiently with 10 modules, or with several groups of 9 or 10 modules together to raise the operating power closer to what the 75-amp model charger was designed for.

Note that there is always a loss going through the charger of 10 to 20% of the power that would be produced were the modules able to be located close to the batteries and directly connected with ample wire size. You can measure the DC volts

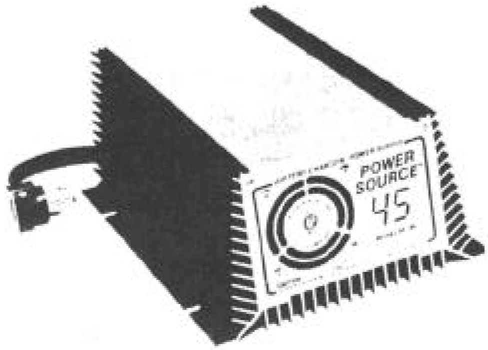


Figure 2. Todd charger.

and amps 901119 into the charger, multiply together to get input watts. Then measure the DC amps and volts going from charger to the battery and multiply those together to get watts output. Comparing these two watt figures gives efficiency of operation of the charger, which we would like to be near 90%.

There is also 5% or so loss in the wire, depending on the size and length. You can also calculate how much current your modules should deliver to the batteries in a direct close connection, and compare that to what you are actually getting to judge oveiall efficiency. This transmission method should only be used where the distance is clearly too long for direct wiring with less than 20% loss.

I talked with Bed Todd, degigner of the charger. He was willing to say that the charger could very well be used in this manner without harm, and recommended the input voltage could be as high as 170 to 190 volts for best performance. However it should never go above 200 volts! Watch the voltage as the charger begins to taper off when batteries become full, to prevent the possibility of unloaded solar module array rising over 200 volts.

I can’t provide tried and proven answers for all the possible variations and combinations of charger model and numbers and brand of solar modules, over all the possible distances and wire sizes. I would like to hear of problems or successes you encounter if you find this a solution to solar access problems.

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