

How to wire your home for solar electricity

By Steve Willey

To wire your own home, you should be familiar with the basic circuits for outlets, switched light fixtures, etc. that are used in any home. Library books and local electricians will be of help here. This article explains the added special features and considerations of solar electric house wiring. Several solar electric home books are available for more detail.

Choices

By the time you are ready to wire the house, you should have already decided about the use of low voltage DC and 110 volt AC power types in your home. Previous articles in *Backwoods Home Magazine* have explained the cost and benefits of each.

You might have selected ONLY low voltage DC for the smallest power system. Or, you could have decided on AC for all the appliance outlets, plus DC for all lighting fixtures, plus and few DC outlets for lowest cost in a larger system. Or maybe you selected ALL 110 volt AC power throughout for simplest wiring and fixtures at slightly higher cost (with 1 or 2 DC circuits as needed).

Wiring for the 110 volt AC part of the power (from an inverter or generator) will be completely standard. Wiring for the low voltage DC will have a few extra considerations but still will be more standard than you might expect.

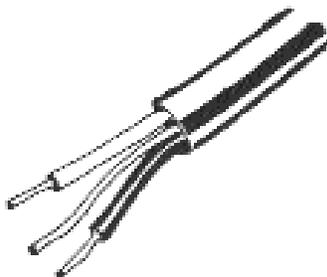
Do a good job with the right materials and try to meet local codes. Quick temporary jobs have a way of staying around for at least a decade, and with wiring, that can be dangerous.

All the wiring originates from some type of fuse or circuit breaker box. Don't even THINK of going without fuses on every wire, not even tem-

porarily. If a wire crosses or a defective appliance is used without a fuse in the circuit, your battery can quickly make the wiring get red hot, smoke, and flame. Value your home more than the cost of a fuse.

Wiring center

An area must be selected as your wiring center or utility area. This



space will be used for all the inside equipment concerned with your solar power system: charge controls, batteries, inverter, a power outlet for battery chargers connected directly to your generator, meters, and your fuse and breaker boxes. Every wire in the house originates here.

If low voltage DC is to be used extensively, the length of the wires from the fuse box to the point of use should be kept to the minimum practical distance. A centrally situated battery area allows all points in the home to be reached with shorter wires. If your house is primarily wired for 110 volt only, the location is not so critical. In any case, a warm dry clean location will help avoid equipment problems. The area should also be child-proof.

AC wiring will use standard fuses or breaker boxes to connect each circuit in the house to the AC power source. The source, in this case, is your own power inverter or engine generator rather than a power company. The

generator and inverter must never be both connected to your home wiring at the same time. The power source can be selected by a manual switch, by the standby feature of the inverter, or by an automatic relay box. You will not likely need any 220 volt wiring inside the house, so connect your fuse or breaker box all 110. Just wire both sides of the breaker box to the same 110 volt source.

The DC wiring also must have fuses or breakers for each circuit. There are a few DC rated house circuit breakers (try Square D brand "QO" model from local suppliers). There are also fuse box products available from the solar electric catalogs which feature an ampere meter to show power being used. Most DC circuits will be low amperage, requiring 10 or 15 ampere fuses or breakers for each.

Don't underwire

Remember that it is easier NOW to insert a few extra wires in the wall, than it will be after the wall is closed. Install light fixture wiring, switches, and power outlets in abundance! I assure you that after the walls are finished you will still find a few places that you can't believe you missed. This includes telephone outlets, stereo speakers, intercom wires, and a generator start-stop switch. TV and FM stereo need antenna wires to their locations. Did you remember the possible future need for a doorbell, alarms, water pump switch, ceiling fans, outdoor lights, or second refrigerator? Providing for your future needs now costs little even if you may never use some of the wires.

AC wiring

Follow all the electrical codes and use standard wiring equipment all the way to outlets and switches. The safety as well as resale value of your home will be enhanced. Consistently

keep black wires hot and white wires neutral. The white wire always connects to the wider slot in the 110 volt AC outlet. Connect all bare (ground) wires together and to the green screw on the outlets. bet advice and help from the library or a local electrician if in doubt.

Don't mix DC and AC

Never interconnect any part of AC wiring to DC wiring, or even run it through the same boxes. You cannot use the same wiring for AC and DC. Alternating your wiring from one to the other type of power as needed will cause more trouble and accidents than it can possibly save in extra wire.

“Double” wiring, once for AC and once for DC, is not really doubling the cost or effort. It's more “split” wiring, since you don't need both kinds of voltage everywhere, just one here and the other there. Generally, you will need extensive wiring in just one voltage, and to that you add a few circuits of the other voltage as needed for your lifestyle and power system.

Stranded vs solid wire

There is a FALSE belief that stranded wire is better than solid wire for DC. A 10 gauge stranded wire seems bigger because of the air spaces in the strands, but there is the same amount of metal and electrical conductivity in either one.

Stranded is most often used in sizes larger than 10 gauge because it is more flexible. In most house wiring, 10 gauge and smaller (12 gauge) solid ROMEX wire is a lot easier to work with and costs a lot less. It wraps neatly around the screw connections on switches and outlets without loose strands or fitting problems of the larger stranded wire. (14 gauge Romex is a bit too small for low voltage house wiring.)

Romex

Romex has three solid wires in it one black, one white, and one bare. Traditionally in AC house wiring, white has been the “neutral” (grounded) wire, and black has been the one with “hot” AC power. (Bare wire is the safety ground for the third prong of the outlet).

However, in automotive, radio, and most other DC electronic industries, black is always ground or negative. This leaves a conflict for DC usage in house wiring. The convention seems to be toward the house wiring industry, where white becomes negative and black positive in DC housewiring. Ideally, red positive and grey negative would be understood by all, but ROMEX only comes in black and white.

DC wiring length

I mentioned some restrictions on low voltage wiring length and wire size.

This is caused by the low voltage, not because the power is DC.

Loss of 3 volts from under sized wiring when you only have 12 volts to start with (only 9 left) is a greater harm than a similar loss of 3 volts would be in 110 volt wiring. Fortunately, if you are following the power conservation ideas outlined in previous articles, you will be using a lot less power to light your home than a power line connected home. Because of this, the wire size standard in a typical home will still be adequate for your 12 volt power saving lamps and appliances.

Rules of thumb for 12 volt DC wiring

Each circuit handles only 3 or 4 items of 1/2 to 2 amperes each: it can be any combination of lights, DC TV, radio or car stereo.

#12 GAUGE ROMEX wire is good for 40 feet in the above applications, #10 GAUGE ROMEX is good for 80 feet maximum distance from the battery to the end use point.

Use many short and direct wire runs from a centrally located battery room, like spokes of a wheel, rather than one long rambling loop throughout the house.

For greater distances or the higher current of a DC refrigerator, DC pump or motor, pick the right wire size from the 12 volt chart (below) for 5% maximum loss.

Find the maximum amperes to be used at one time on the wire by adding the ratings of each appliance and light.

Amps in Wire	Wattage at 12 volts	Wire Size									
		#14	#12	#10	#8	#6	#4	#2	1/0	2/0	3/0
1	12	113	175	275	450	710	—	—	—	—	—
2	24	56.3	87.5	138	225	355	576	900	—	—	—
4	48	25.0	43.8	68.8	113	178	288	450	725	900	—
6	72	18.8	30.0	43.8	75.0	119	188	300	481	600	760
8	96	13.8	21.3	36.3	56.3	88.8	144	225	363	450	570
10	120	11.3	17.5	28.8	45.0	71.3	113	180	290	360	457
15	180	7.7	11.3	17.5	30.0	47.5	75.0	120	193	240	304
20	240	05.0	08.8	13.8	22.5	36.3	56.3	90.0	145	180	229
25	300	04.5	07.0	11.3	17.5	28.8	45.0	72.5	115	145	183
30	360	03.8	06.0	08.8	15.0	23.8	37.5	60.0	96.3	120	152
40	480	—	—	07.0	11.3	17.5	28.8	45.0	72.5	90.0	114
50	600	—	—	05.8	09.0	13.8	22.8	36.3	57.5	72.5	91.3

Locate this ampere number in the left column. Read across that row to find the distance the wire will run from the battery. Read the required wire size from the top of the column found.

For very long buildings, some people try a long run, of heavy gauge wires down the entire length, then small romex branches off of it here and there. This is not recommended because you must have appropriately smaller fuses located at each point where the smaller wires branch off the larger one. A better method is to select only 2 or 3 points along the heavy wire and locate a small secondary fuse box at each. Then fan out several lines for each area from those fuse boxes.

Generally, a home will have just one or two DC power uses that require extra large wire sizes: a pump, a DC refrigerator, or special DC motor used on an appliance or power tool. In our home business we use two half size refrigerators built into the wall, one in the kitchen, and one in the office directly above the kitchen. Since these need a 10 amp surge momentarily to start, we ran a special 4 gauge copper wire pair 35 feet to the kitchen refrigerator and then directly on up to the office refrigerator.

Outlets

Again, with AC power from an inverter or generator, there is nothing different from ordinary household outlets and switches.

DC outlets must be of a different style so that AC appliance cords cannot be plugged in to DC power, nor DC appliances to AC power. This prevents accidental damage to your equipment and meets code requirements.

DC outlets also must be polarized, that is, they must not be able to reverse + and - wires by turning the plug over and plugging it in other side up. Plugs must only go in one way, as does a 3 prong plug.

DC wire standards?

There are really no universal standards for low voltage DC wiring in a home yet, except perhaps for automobile cigarette lighter sockets as used in

trailers and campers. I refuse to use such poor quality sockets as these. Many people have selected 15 amp 220 volt outlets, available from electrical stores. These are the same size and construction as regular 110 wall outlets, fit the same wall boxes and cover plates, but the prongs are turned to a different angle.

Don't use AC outlets for DC

Don't be tempted to use regular AC outlets for DC, even if you have no AC. You would be surprised how many people have told me they are the only ones using the house and they can handle it. Later they come back with something expensive that has been ruined by plugging into the wrong type of power.

When you put your own type of plug on an appliance for DC, be careful to get the + and - polarity right. If there was a cigarette lighter plug on originally, the tip of the plug is +. If there is a red wire, that is +. If the wires are other colors, try to find printed instructions to be sure of the right connection.

Switches

Regular wall light switches are rated AC only-usually 15 amperes. The tiny arc when the switch is turned off is harder on the contacts with DC than AC. The truth is that these standard wall switches can handle DC but only 2 or 3 amperes. That is just about right for each of your lights, or even pairs of lights, since you are using such power saving lights!

If they are installed in standard wall switch boxes, and one should fail, they are easy to change and cost little. Use the same 3-way light switches as for AC to turn lights on at top of stairs and off when you reach the bottom.

Conservation tips

There are a few things you can do to promote conservation and at the same time improve the elegance of your electrical system. I like to use motion sensors to turn on lights when I come up the front steps, and timers to light

the stairs and hallways and outside walks. Hit the button once and the path is lit for three minutes. There is no chance of losing power because of forgetting to turn it off and we come and go with the lights on. Another timer turns any DC auto stereo into a quality clock radio.

Provide a wall switch to control any outlet that may be used with AC-powered color TV or VCR. This prevents them from drawing power when turned off, as most models otherwise will do. A little learning and some custom improvising will make your solar electric home more conveniently appointed than the typical city home.

You're the pioneer

Please, don't skip the fuses or do any wiring hastily or temporarily. "Temporary" work has a way of staying around long enough to cause trouble. Get advice or help if needed to do a safe, neat job. You are a showplace pioneer of safe, natural, clean energy!

(Steve Willey owns and operates Backwoods Solar Electric Systems, 8530 Rapid Lightning Creek Road, Sandpoint, Idaho, 83864.) Δ

The Color Silver

*In a manner of speaking
my hair is silver.
My granddaughter told me so.*

*Grammy, she said,
your hair is silver.
I would have said gray.*

*Salt and pepper would do.
But, of course, she should
know:
she is five.*

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