Designing and Installing a Large Solar Panel System

So you may have read my earlier article on sizing a solar panel system or you just want to put all of the panels you can on your boat. This article discusses how to design such a system, select a controller, install the panels and wire and hook them up to your boat's electrical system.

Fitting the Panels on Your Boat

Some boats like hard top cruisers have lots of unobstructed room on the hard top to install the panels. Others like sport fishermen have no room. Conventional fly bridge trawlers like the Grand Banks have room on the boat deck in back of the fly bridge but it is sometimes shaded by the fly bridge at certain anchorage angles to the sun.

So look at what space you have, and try to keep the panels at least 45 degrees from the edge of the bimini so you won't be shaded too much. I once put two 200 watt panels on the space in front of the fly bridge on my friend's CHB 45. It worked fine except for early morning or late afternoon when the boat was aligned east/west.

If you have limited room and you want the maximum wattage, go to one of the big solar panel websites, like wholesalesolar.com and play with panel sizes and dimensions to see what fits.

Using Flexible Panels on/over Your Bimini

As noted above, some boats just don't have room for fixed solar panels, particularly sailboats. During my cruising life I dealt with this in two ways: flexible panels sewed to the bimini top and fixed panels mounted on an external frame over the bimini.

Flexible panels are less efficient, more expensive and may not put out their rated output over time. But they do have some good uses since they are light and flexible. On a sailboat I took three of the really flexible panels, put them on the bimini crosswise and sewed through the corner grommets into the bimini fabric to hold them in place. This worked pretty good, but five years later their output had dropped in half.

The really flexible panels aren't made any more but the current ones are flexible enough to match your bimini contours and hopefully they have solved the longevity problem.

On another sailing catamaran the PO had an external frame made out of SS tubing that provided a base for the panels on top of the bimini. This takes more hardware and expense but lets you mount conventional rigid panels.

Selecting a Controller

Since we are talking about big panels, larger than 150 watts each, these are always 24v nominal or larger panels and require a MPPT controller to manage the voltage output. MPPT controllers are generally rated by their DC output in amps. Take the total wattage of your solar panels and divide by 12 to get the maximum output amps from the controller.

So if you have 400 watts of panels you need a 400/12= 33 amp controller. Go with at least a 40A controller to have a little leeway.

The other spec that is important is Voc, the maximum voltage that your panel can produce which varies from 40-45 V for most panels depending on the type and number of cells. Your controller should have a maximum input voltage of at least that much.

All of this assumes that you are wiring the panels in parallel. I don't recommend series wiring of these big panels for two reasons: Two panels in series can produce as much as 90 volts which is beyond simple low voltage wiring practices and is dangerous. Also series wiring will block the output if one panel is shaded. Parallel wiring at least gives you one panel working if the other is shaded.

Finally make sure that the controller is capable of 12V output to the battery and that it has a three or four step charging algorithm built in. Some home system controllers designed to be connected directly to the grid don't do this.

Mounting the Panels

You can buy mounting brackets online or you can make your own by cutting aluminum angle in short sections. Bolt the brackets to the panel. You need about an inch of clearance below for air circulation The simplest way to attach them to the roof is with 3M 5200 or thickened epoxy.

Wiring

Most panels have a junction box on the back with a couple of short MC4 cables coming out. Since this will probably be a semi-permanent installation I would just cut off the MC4 conector end and wire directly to it with crimp connectors. Make sure that you maintain proper polarity all the way to the controller.

You can either wire each panel separately to the controller or you can combine the panel wiring either outside or inside the boat before connecting to the controller. Use a cable gland at the hull/deck penetration point.

For my three flexible panel system described above I used a plastic junction box to

combine all individual panels outside so I could just run one bigger cable inside the boat. But you could also connect two 10 gauge wires to an 8 gauge wire with a crimp connector if you just had two panels.

Wire size is important. You need to keep the total voltage drop from the panel to the controller to a half volt or less. Ancor and others have on line calculators that let you size the wire appropriately. Use the panel's Imp current spec for this calculation and multiply it by the number of panels to size the wire from the junction point if you are wiring them this way.

Controller Location

There are two common places to mount your controller: Either in back of the main DC panel where you back feed the batteries from a spare breaker. This works for up to 300 watts of panels. Or install it near the batteries but preferably outside of the engine room.

If you wire to the DC panel use a spare breaker that will accommodate the total amperage from the controller, say a 30A breaker for a 300 watt panel. In fact in that example you could wire directly to the main DC breaker if it is 50A and use 8 gauge wire to make the final connection. A short length of 8 gauge will have minimal voltage drop and will be protected by the main breaker if it faults. DC panels usually have pretty big wire back to the battery, probably 6 gauge so the voltage drop will be low.

If you put your controller near the batteries then you also need to keep the voltage drop very low, say a few tenths of a volt. And you need a fuse within 6” of the battery to protect the wire, sized to be no more than the ampacity of the wire but more than the maximum controller output.

Cost of a Large System

So lets figure up the cost of a two panel, 400 watt system. These solar panels are about $275 each today plus maybe $100 in shipping (they have to be shipped motor freight) or $650 total. The controller will cost about as much. A 40A Morningstar MPPT controller is about $500.

I would stick with the name brand controllers: Morningstar, Outback, Blue Sky, Magnum, Midnight, Schneider and forget the cheap Chinese made ones.

Wiring will cost maybe $100. Genuinedealz.com is a good source of tinned boat wire. Their 8 gauge two conductor cable is $2.65 per foot. Add another $50 for brackets and adhesive and the whole system will cost about $1,300. Three dollars a watt is a good round number for planning.