

**IMPORTANT!**

**FRAGILE**

**Do not squeeze cells**

**DO NOT PICK UP ENTIRE STACK**

**Handle Individually**

**By “EDGES”**

# Instructions to build a DIY solar panel

DO NOT ATTEMPT TO MEASURE THE VOLTAGE AND CURRENT OF YOUR CELLS INDIVIDUALLY WITH A METER. IT CANNOT BE ACCOMPLISHED WITHOUT HAVING ALL BUSS WIRES CONNECTED AND POSITIONED EXACTLY TO THE SUN. THE COLLECTOR GRID ABSORBS ENERGY FROM THE ENTIRE CELL AND WHEN YOU EXPERIMENT WITH A METER YOU ARE ONLY MEASURING TWO POINTS ON THE CELL. IT DOES NOT FUNCTION LIKE A SOLID PIECE OF WIRE. ALSO, YOUR VOLT OHM METER HAS INTERNAL RESISTANCE THAT WILL NOT ALLOW THE CURRENT (AMPS) OF INDIVIDUAL OR SMALL STRINGS OF CELLS TO BE MEASURED. ALL OF OUR CELLS HAVE BEEN PRETESTED AT THE FACTORY AND ALL CELLS MEET 100% SPECIFICATIONS.

## More Important Stuff

I recommend using two 120 Watt panels instead of a single 250 Watt panel. The 120 Watt panels are easier to maneuver and are built stronger. It only costs a couple of dollars more and is well worth it.

I STRONGLY recommend .250 thick tempered glass if you are in an area with hail and snow loads. My second choice is .250 Polycarbonate. Third choice is .125 tempered glass. Fourth choice is standard window pane glass sandwiched behind a thin polycarbonate glass.

IF YOU USE FLIMSY GLASS OR PLEXIGLASS YOUR PROJECT IS DOOMED TO FAILURE!

Tools and materials you will need.

100W kit: 36"x36" glass or Plexiglas (frame if not included) 55 3"x6" cells in 5 rows of 11 cells

120W kit 36"x36" glass or Plexiglas (frame if not included) 25 6"x6" cells in 5 rows of 5 cells

250W kit 36"x72" glass or Plexiglas (frame if not included) 55 6"x6" cells in 5 rows of 11 cells

A ruler, 60 Watt soldering pencil, double tipped cotton swabs, razor knife, bowl with sponge and water to clean solder tip, wire cutter, paper towels, hot air gun, ink marker, caulk dispenser, duct tape.

Lay Plexiglas over the EVA encapsulant and trim EVA to exact size of the Plexiglas then set EVA aside.



Cut with razor and remove protective coating from the perimeter of one side of Plexiglas using the frame as a guide and dispose of thin strip of coating. DO NOT REMOVE ANY OF THE OTHER PROTECTIVE COATING AT THIS TIME. WE WILL LATER USE IT TO DRAW A GUIDE FOR JUNCTION BLOCK AND SOLAR CELL PLACEMENT.



Using silicone caulk place a bead of the silicone on the inside edge of the ANGLE CUT side of each frame piece and adhere to the Plexiglas perimeter where you previously removed the protective coating. Push Plexiglas into silicone on frame embedding it. Clean off excess caulk to make it easier for EVA placement later in the build. **DO NOT RECAULK PERIMETER AT THIS TIME. THAT WILL COME LATER.**



Use duct tape to keep frame firmly in position against Plexiglas until it has dried sufficiently (allow 24 hours to set)



In the meantime, while frame is setting up please move on to soldering the small jumper leads to the solar cells with the provided flat tab wire.

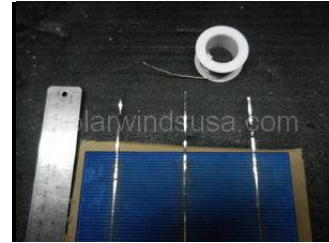
Cut 2-1/2" strips of tab wire and set aside. 250W kit qty. 175 strips, 100W kit qty. 175 strips, 120W kit qty. 90 strips.

Locate flat silver tab wire and your first solar cell positioned on the cardboard carrier. Remove the cap from the solder flux bottle and apply a minute amount of the flux liquid to a cotton swab. Brush cotton swab containing flux onto the edge (1/2") of the collector busses located on the shiny blue side of the solar cells.

(TIP) You must start with a CLEAN pre-conditioned solder tip. (To condition a new solder tip you must plug it in and allow it to reach full temperature and apply a small bit of solder to the tip. This small bit of solder allows heat transfer to the solar cell when you are soldering. If the tip becomes dirty with old solder or other substance clean it using a new sponge dampened with distilled water. This is an important aspect of building the solar panel.)

**SIDE NOTE:** The shiny blue side of the solar cell which faces towards the sun is actually the – Negative side. The dull grey side that faces away from the sun is the + Positive side

Leaving the solar cell on the cardboard carrier proceed to solder flat tab wire to the large collector busses located on the shiny blue side of the cell. Once soldered you should have approximately 2" overhang of wire. Do this on all of the two or three collector grid busses. Do this only on one end of the cell and working from the top is easier.



Continue this procedure all while stacking your cells along with original cardboard carriers until all cells have been completed.

After you have finished soldering the tab wire to the shiny blue side we now need to turn five of the cells over so the dull gray side is facing you and attach three more flat tab wires to the back of the cell facing opposite the original wires. These cells will be used as the last cell in each string of cells to jumper over from adjacent string of cells.



It is time to decide how to configure the layout of our solar cells and junction block in the panel. Place the plexiglass on a soft non-scratching surface face down. Place your junction block at the top  $\frac{3}{4}$ " away from the frame and equal distance from sides. Take a magic marker and draw around perimeter of junction block and then set block aside.



To get a feel for the layout we suggest you lay all of your cells out in a pattern in the panel face down. (We will be removing them-later this is just to determine layout in your mind) Start with the first cell in the top left corner shiny blue side down and wires facing upwards. Place this first cell 4-1/2" from the top and 13/16" from the left side of the panel.



Take your next cell and bend wires back to grey side just a little. Place this cell 1/16" below first cell keeping the row straight. Continue placing cells in this row until you reach the last space and then use one of the five cells that have wires on both ends and lay it in place (wires attached to the gray side face downwards).

Start a new row this time with the wires facing down right next to the last cell in the first string. Space this row 13/16" away from the first string. Continue to the top of the panel and when you reach the top last cell in this string use one of your five special cells. Begin row three just like row one. Row four is like row two. Row five is like row one.



Once you have all of your cells laid out use a felt marker and place a guide mark at the top and bottoms of the rows.



Remove all of the cells. Darken your marks so you can see them easily. Turn frame over to front side and with a straight edge draw a line from the marks you originally made. Trace around the marks you made for the junction block.



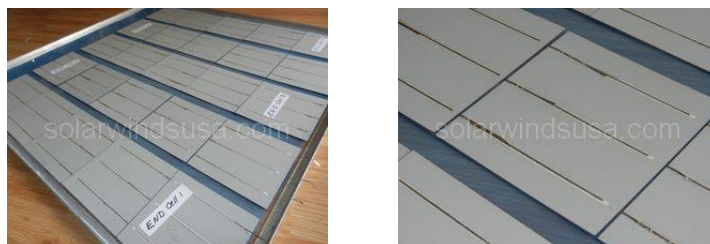
Turn frame back over and remove protective film from Plexiglas. Your grid lines and junction block pattern should be clearly visible from opposite side.



It is time to adhere the cells to the Plexiglas. You will be repeating the above process but this time you will be adding a very small amount of silicon to the center of the shiny blue side of the solar cells. NOT THE EDGES OR CORNERS-IF YOU DO IT THIS WAY IT WILL CAUSE BREAKAGE IN THE CELLS LATER IN THE BUILD.

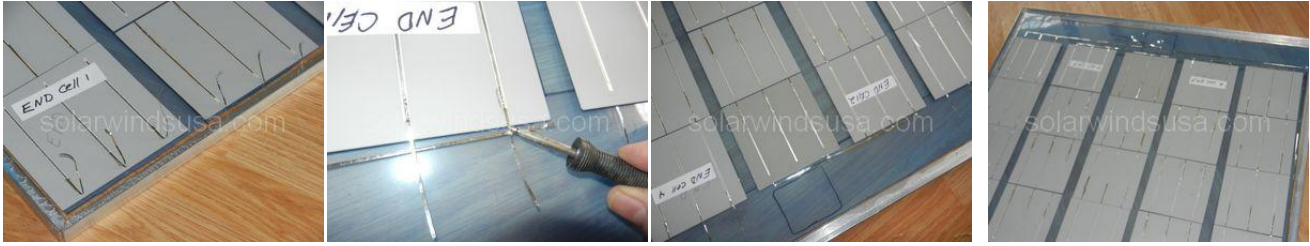


Bend the wires on the solar cells so they overlap the adjacent cell either directly above or below. Now solder those overhanging wires to the adjacent solar cell creating one continuous string of front to back wiring.



Once you have completed soldering the cells into strings it is time to connect the strings together. First we will connect string one with string two. Then move on to string two to string three etc. By cutting two pieces of tab wire longer than the distance between all of the buss connections on the two cells. Start by soldering one wire one lead at a time until

you have soldered all six connections. Repeat process with second wire immediately adjacent to the first wire. Do this for strings 1-2, 2-3, 3-4, 4-5. Trim excess wire off being careful not to lift wire and break the solar cells.



We now need to connect our first cell in the upper left corner which is the negative -, and the last cell in the lower left corner which is positive + to the junction box. First, roll out a piece of tab wire from the first cell and extend it across all three solar cell connections and 6" beyond the junction box. Solder the wire to the leads and touch melt the wire adhering it to the Plexiglas just before the junction box. Repeat this with a second wire. Do not trim wires yet



Now we need to solder the last cell in our string which is in the lower right hand corner and is our positive cell to the junction block. Solder a piece of tab wire across all three leads extending to the right aluminum frame. Repeat this with a second wire next to the first. Tape wires just to hold them in place. This should be midway between the cell and the frame. Solder two additional wires to the previous wires going vertically up the side of the panel taping it every six inches or so to the Plexiglas. Cut wire at top of frame. Place a third set of wires over these vertical wires and extends 6" beyond the junction block and tape them just before the junction block template. Trim excess wires.



You will now need to consider the mounting position of the junction block. Without removing the protective paper position your EVA encapsulant over the solar cells and align. Roll back the EVA a few inches where your junction block will be mounted. IMPORTANT: Note that the wires are facing away from the solar cells. Pull your tab wire at an angle

and tape it to the Plexiglas in a fashion that matches the opening and leads on the junction box. Mark the EVA with a felt marker and cut two slits in the EVA corresponding to the tab wire and junction block placement.



You are almost ready to adhere the EVA but, first we need to place thin beads of silicon caulk on the glass, between the rows of cells running vertically. This should be a very small bead starting to the left of the first string and right of the last string and in between all of the strings. You will embed the EVA into it in a moment.

It is time to remove the protective paper from the EVA. Make sure you keep it free from dust and debris or it will crack your solar cells once in place. Lay the side of the EVA that had paper on it into the panel over the solar cells. Align all edges and slip tab wire through slits you made earlier.



Press the EVA into the beads of silicon caulk you previously applied. Smooth out wrinkles and avoid breaking cells. Allow silicon caulk and EVA to dry for 6 hours.

We need to heat affix the EVA to the solar cells and panel.

This is accomplished with a hot air gun. I would like to point out that infrared heat lamps like the ones used in bathrooms may have better results. Position these a few inches away from the EVA. Also, infrared convection heaters (ones without fans used in overhangs in garages and commercial entry ways) also seem to have an edge over the hot air guns. The hot air guns cause rippling and bubbles which are purely cosmetic however we all want solar panels to look great!

Heat the edges of the solar panel until the EVA becomes wet looking. CAUTION it heats very quickly and will melt through easily. DO NOT TOUCH OR ALLOW THE CORD FROM THE HEAT GUN TO TOUCH OR IT WILL RUIN YOUR PROJECT. EVA can always be patched later. Once the edges have been heated continue on heating from cell to cell paying particular attention to the area between the cells. EVA should now be clear looking. Allow a few minutes to cool.



Locate your junction block and remove the protective paper from the self adhesive backing. Orient the junction box so the large black wires feed away from the solar panel. Feed the tab wires into the junction box all while sliding junction box towards the solar panel and firmly mounting the self stick adhesive to the now cooled EVA. Wrap the tab wire around the outermost leads of the junction box and solder in place. Trim wires. Fill the junction box completely with silicone caulk and snap junction box cover in place.



Use silicone caulk around the entire perimeter of the inside of the frame. Wet your finger and press caulk into corners. Turn solar panel and repeat caulking at perimeter and corner miter gaps. Allow to cure for 24 hours. (Don't get impatient and screw it up now please let it set up)



Here is what your solar panel should look like. Those are reflections on the glass from my patio door.



I hope it was fun for you to build!

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