Connecting Solar Panels Together

How to Connect Solar Panels Together

Connecting solar panels together is a simple and effective way of increasing your solar power capabilities. Going green is a great idea, and as the sun is our ultimate power source, it makes sense to utilize this energy to power our homes. As solar power becomes more accessible, more and more homeowners are buying photovoltaic solar panels.

However, these photovoltaic solar panels can be very costly so buying them over time helps to spread the cost. But the problem then becomes how do we connect these extra solar panels together to increase the voltage and power output of what's already there.

The trick here when connecting solar panels together is to choose a connection method that is going to give you the most energy efficient configuration for your particular requirements. Connecting solar panels together can seem like a daunting task when you first start to look at how it should be done, but connecting multiple solar panels together is not that hard with a little thought. Wiring solar panels together in either parallel or series combinations to make larger arrays is an often overlooked, yet completely essential part of any well designed solar power system.

There are three basic but very different ways of connecting solar panels together and each connection method is designed for a specific purpose. For example, to produce more output voltage or to produce more current. Solar panels can be wired in a series or parallel combination to increase the voltage or amperage respectively, or they can be wired together in both series and parallel to increase both the voltage and current output producing a higher wattage array.

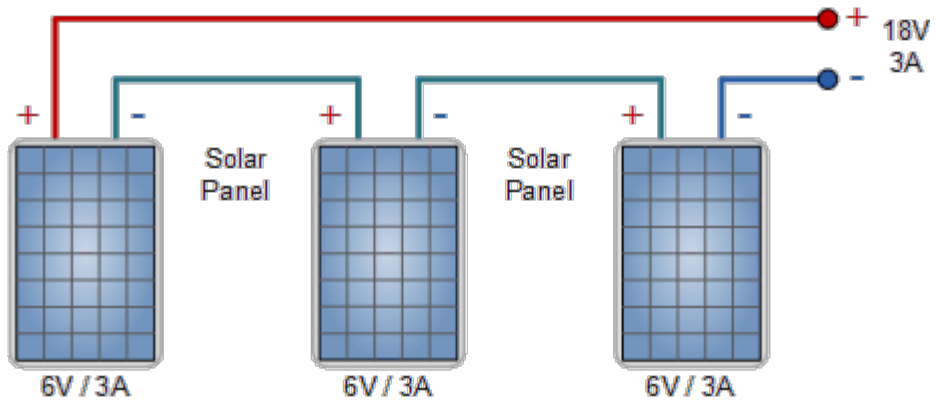
Whether you are connecting two solar panels more more, as long as you understand the basic principles of how connecting multiple solar panels together increases power and how each of these wiring methods works, you can easily decide on how to wire your own panels together. After all connecting solar panels together correctly can greatly improve the efficiency of your solar system.

Connecting Solar Panels in Series

The first method we will look at for connecting solar panels together is what's known as "**Series Wiring**". Connecting solar panels together in series is used to increase the total system voltage. Solar panels in series are generally used when you have a grid connected inverter or charge controller that requires 24 volts or more. To series wire the panels together you connect the positive terminal to the negative terminal of each panel until you are left with a single positive and negative connection.

Solar panels in series add up or sum the voltages produced by each individual panel, giving the total output voltage of the array as shown.

Solar Panels in Series of Same Characteristics

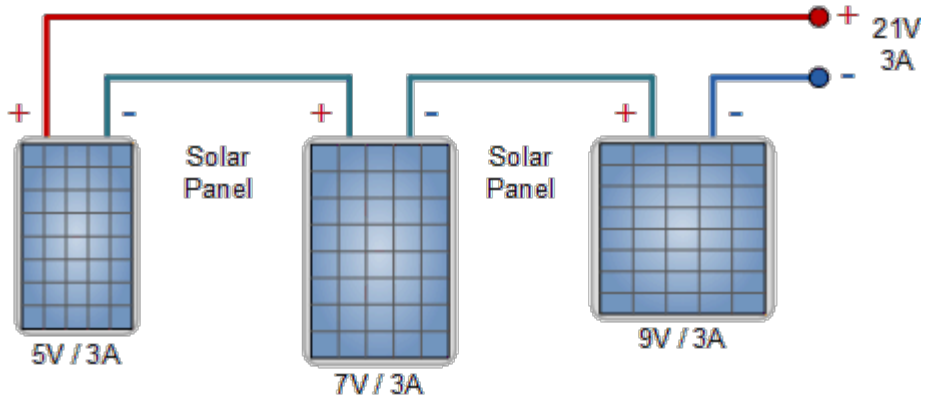


In this method ALL the solar panels are of the same type and power rating. The total voltage output becomes the

sum of the voltage output of each panel. Using the same three 6 volt, 3.0 amp panels as above, we can see that when they are connected together in series, the array produces 18 volts (6 + 6 + 6) at 3.0 amps, or 54 watts (volts x amps).

Now lets look at connecting solar panels in series with different nominal voltages but with identical current ratings.

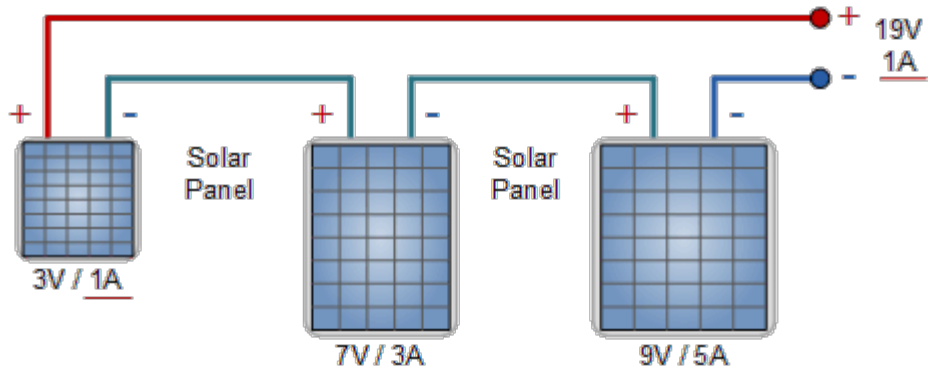
Solar Panels in Series of Different Voltages



In this method all the solar panels are of different types and power rating but have a common current rating. When they are connected together in series, the array produces 21 volts at 3.0 amps, or 63 watts. Again the amperage remains the same at 3.0 amps but the voltage output jumps to 21 volts (5 + 7 + 9) .

Finally, lets look at connecting solar panels in series with completely different nominal voltages and different current ratings.

Solar Panels in Series of Different Currents



In this method all the solar panels are of different types and power rating. The individual panel voltages will add together as before, but this time the amperage will be limited to the value of the lowest panel in the series string, in this case 1 amp. Then the array will produce 19 volts (3 + 7 + 9) at 1.0 amp only, or only 19 watts out of a possible 69 watts available reducing the arrays efficiency.

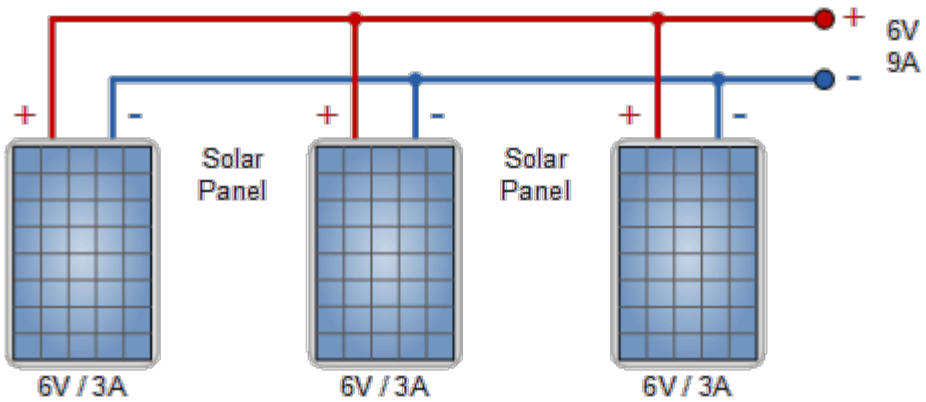
We can see that the solar panel rated at 9 volts, 5 amps, will only use one fifth or 20% of its maximum current potential reducing its efficiency and wasting money on the purchase of this solar panel. Connecting solar panels in series with different current ratings should only be used provisionally, as the solar panel with the lowest rated current determines the current output of the whole array.

Connecting Solar Panels in Parallel

The next method we will look at of connecting solar panels together is what's known as "**Parallel Wiring**". Connecting solar panels together in parallel is used to boost the total system current and is the reverse of the series connection. By parallel wiring panels you connect all the positive terminals together (positive to positive) and all of the negative terminals together (negative to negative) until you are left with a single positive and negative connection to attach to your regulator and batteries.

When you connect solar panels together in parallel, the total voltage output remains the same as it would for a single panel, but the output current becomes the sum of the output of each panel as shown.

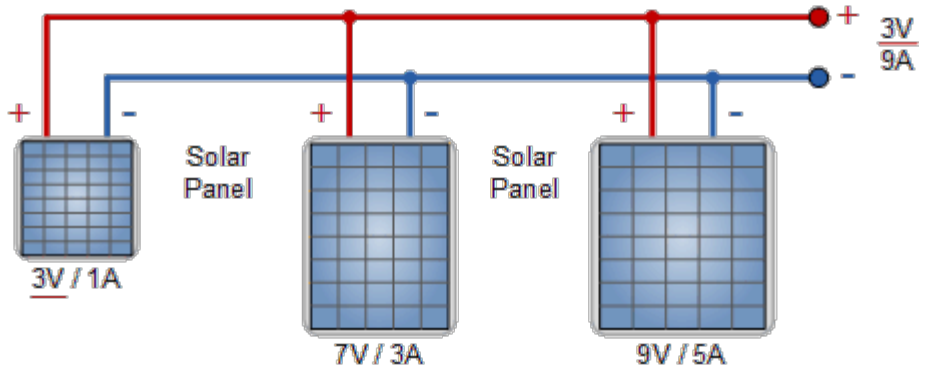
Solar Panels in Parallel of Same Characteristics



In this method ALL the solar panels are of the same type and power rating. Using the same three 6 volt, 3.0 amp panels as above, the total output of the panels, when connected together in parallel, the voltage output would remain the same at 6 volts, but the amperage would increase to 9.0 amps (3 + 3 + 3), or 54 watts.

But what if our newly acquired solar panels are non-identical, how will this affect the other panels. We have seen that the currents add together, so no real problem there, just as long as the panel voltages are the same and the output voltage remains constant. Lets look at connecting solar panels in parallel with different nominal voltages and different current ratings.

Solar Panels in Parallel with Different Voltages and Currents



Here the parallel currents add up as before but the voltage adjusts to the lowest value, in this case 3 volts. Solar panels must have the same output voltage to be useful in parallel. If one panel has a higher voltage it will supply the load current to the degree that its output voltage drops to that of the lower voltage panel.

We can see that the solar panel rated at 9 volts, 5 amps, will only operate at a maximum voltage of 3 volts as its operation is being influenced by the smaller panel, reducing its efficiency and wasting money on the purchase of this higher power solar panel. Connecting solar panels in parallel with different voltage ratings is not recommended

as the solar panel with the lowest rated voltage determines the voltage output of the whole array.

Then when connecting solar panels together in parallel it is important that they ALL have the same nominal voltage value, but it is not necessary that they have the same ampere value.

Connecting solar panels together to form bigger arrays is not all that complicated. How many series or parallel strings of panels you make up per array depends on what amount of voltage and current you are aiming for. If you are designing a 12 volt battery charging system than parallel wiring is perfect. If you are looking at a higher voltage grid connected system, than you're probably going to want to go with a series or series-parallel combination depending on the number of solar panels you have.

But for a simple reference in regards to how to connect solar panels together in either parallel or series wiring configurations, just remember that parallel wiring = more amperes, and series wiring = more voltage, and with the right type and combination of solar panels you can power just about any electrical device you may have in your home.

For more information about **Connecting Solar Panels Together** in either series or parallel combinations, or to obtain more information about the different types of solar panels available, or to explore the advantages and disadvantages of using solar power in your home, then Click Here to order your copy from Amazon today and learn more about designing, wiring and installing photovoltaic solar electric systems in your home.

Some high quality solar panels you may be interested in which can be connected together and used in solar arrays.

Tagged with: akt solar | solar panel | solar power

<< Previous Energy Article

Next Energy Article >>

Related Energy Articles

Akt Solar – 180W Mono Panel

Akt Solar – 140W AKT Solar Panel

Akt Solar – 100W AKT Solar Panel

221 Comments » for Connecting Solar Panels Together

‹ Older comments

krishna says:
15/12/2018 at 5:09 pm

i have a 100w 18voltage solar panal and 50w 12voltage panal how to connect maximum solar power reciving system i need to help me

Reply

Rob C says:
25/11/2018 at 4:39 pm

So I'm new to solar power however I'm very interested in getting my home and 2 garages off the grid this would include ALL of my appliances and per tools etc … I'm not even sure where to start most of my power tools are 220 stove is 240 dryer is 230 and then the started 110 for lights appliances etc … what would I need to do to run solar into my breaker boxes? Do I need different solar arrays for 110, 220, 230 & 240 ?

Reply

Administrator says:
26/11/2018 at 6:58 pm

This is a very open-ended question as the size of your solar array, storage batteries and/or inverters depends greatly on your homes energy consumption. Living off-grid will only work if you drastically reduce your consumption and change to low voltage appliancies that can be powered from a battery bank during night time use.

You can leaarn more from this tutorial DIY Solar Syatem

Reply

John Mburu says:
11/10/2018 at 8:46 pm

Hello Admin,
I have a 12V 200W Solar panel and a 12V 200Ah Battery. The system seem faulty as the battery is not going above 12.9Volts. Nevertheless it functioned only one day and went 12V off. What should I change or add ?.
Thanks.
John (Kenya)

Reply

Administrator says:
13/10/2018 at 7:01 am

Perhaps your solar panel is underrated as a 12 volt 200Ah battery would give fully charged 2400Whr (12*200). If you drain the battery to 50% charge (it could be more), then the amount of solar energy needed to fully recharge the battery back to 100% is 2400Whr*50% = 1200Whr. Assume 6 hours of full sun during the day, thus you would need a 1200Whr/6Hr = 200W Solar Panel which is what you have.

But here it is assumed you only discharge the battery to 50%, you have 6 hours per day of full sun, no

system losses (which could be upto 30-40%) and no charge controller. Worst case with 10% charge and only 3 hours per day of full sun, would require a 720 watt panel minimum.

Reply

mario fonseca says:
26/10/2018 at 9:13 pm

i have a system composed of 950w solar painel and a 900ah battery bank.how long can the system last? and how do i connect the panels 150w +8(100w)panel and a pwm 60amps solar controller?
Can you Help?

Reply

Administrator says:
27/10/2018 at 7:12 am

a) “how long can the system last?” – It depends on the load consumption and depth of discharge
b) “how do i connect the panels” – It depends on the input characteristics of the controller
c) “Can you Help?” – No.

Reply

gothusang ntsorogwane says:
17/09/2018 at 2:46 pm

i want know when u are using solar panel to run compressor with centrifigucal pump in well.how many needed

Reply

Dirt says:
05/09/2018 at 3:08 am

Hi,
thanks for this informative page.
I have 6 200w 12v panels; wanting to know the best way to hook them up to an Outback Flexmax 80 controller rated to 1000w 12v max, 2000w 24v max or 4000w 48v max. Do I just do 5 panels in parallel = 1000w 12v, or 2 pairs of 3 12v in series then hooked together in parallel, or 4 panels hooked in series with the 2 additional panels in parallel?
This will all be hooked up to 8 x 6v 520ah agm’s in a 12v configuration. Thanks for your help; any advice or

suggestions welcome.

Keep up the good work

Reply

Rusha says:

23/08/2018 at 6:27 am

Hey, I want my solar panel to deliver 5kW if I use it for suppose 6 hours. So basically, I want my solar panel to give 1kW or 1.5kW in one hour and I want my voltage delivery to be around 200. But I am not able to do so.If I increase the series strings to get more voltage, then power increases which I dont want and if I keep the combination of series low then I dont get the required voltage.

Reply

George Abraham says:

07/08/2018 at 2:26 pm

We have two 5 KW systems (Off Grid, 5 years old) in separate locations. We plan to move them to a single location and convert them in to a single 10 KW On Grid system. One thought is to go for a 20 KW Inverter so that any future upgrades only requires addition of solar panels. What are the risks involved in the upgrade to 20KW?

Reply

Administrator says:

07/08/2018 at 7:33 pm

You work it out, location not suitable, not enough solar irradience, cabling too small, equipment under rated, investment cost high, etc, etc.

Reply

William Solomon says:

04/08/2018 at 8:43 pm

Hi I have 4 300 watt solar panels what size charge controller will I need

Reply

Administrator says:
05/08/2018 at 1:17 pm

4 panels of 300W each would give a maximum output of 1.2kW at full sun and 100% efficiency.

Reply

Shawn says:
31/07/2018 at 8:54 pm

Great explanation!

I recently installed 1x100wx12vx5a + 2x235Wx12v8a and a 40amp MPPT EPEVER tracker. I thought I had wired them in parallel (+ to + and – to -) but my charge controller monitor is showing 34.1v and 10.8amp. My battery bank is 3 24 series 79ahp hour AGM deep cycles connected (+ to + and – to -). Because now I think the panels are in series should my battery bank also be connected + to -??

Reply

Steve says:
27/07/2018 at 10:28 am

Hi .I presently have a system with 3 – 180w 12/24v (5.05amp@ 12v) solar panels going to a 45 amp Tracer regulator .I think it is in series because it shows 42 volts on the tracer monitor . With 3M of AWG 6 gauge cable , (56 amp) . I ‘m looking at extending 3M and install a 200w 12/24 (5.35amp@ 12v) panel and keep it in series. Would that be the thing to do or is there a reason to change the system to parallel ? I believe I am at the limit with the length of wiring (WH 3062) @50 amps and the 45 Amp Tracer about 43 amps ? Hope you can help me.

Reply

Administrator says:
30/07/2018 at 4:43 am

Connecting panels in series will increase the voltage and not the current, although there may be a small adjustment in the current value if your panels are mismatched. As solar panels are a DC system, cabling is important as it has a resistive value and therefore as current passes through it creates an I^2*R voltage drop across its length. The result is for long cable runs the voltage at the load could be a lot lower than the voltage generated at the source. However in your case of 3 metres, the voltage drop would be minimal, and the cable would be more than capable of carrying the amperage at the increased series voltage.

Reply

Zaigham says:
21/07/2018 at 12:41 am

If we have Voc=500 volts, I=13 amp. What would me maximum wattage that could be connected with solar panel if: 100 watt, Impp=5.7 amp Vmpp=18volts 36 cells

Reply

Kofi says:
20/07/2018 at 8:42 am

i have 155w panel with 4.48a 35v i want to add 70w 4.0a 17v together, please should i do it in series or parallel connection

Reply

Administrator says:
21/07/2018 at 6:10 am

series

Reply

kofi says:
21/07/2018 at 10:51 am

i connected in series the Voltaga increases and the amp reduced, while i connected in parallel the voltage reduced and the amp increases, which one should i choose.

Reply

Administrator says:
21/07/2018 at 11:29 am

series

Reply

heinz says:
25/07/2018 at 4:16 am

Neither way is good. Either replace one panel or run each panel to a separate controller.

Reply

Administrator says:
30/07/2018 at 4:48 am

That was not his question, perhaps he has no funds to replace panels or buy additional equipment. The voltage mismatch is too great for a parallel connection but in series with an increased voltage (35v + 17v) the current is less mismatched, 4.48A to 4.0A. Hence a series connection would make more sense for his existing panels.

Rotimi says:
18/07/2018 at 12:35 pm

Good day,please help me,I have a 1.5kv inverter with a 40 amp charge controller and four 250 Watt solar panels ,am I to connect the panels in parallel or series the inverter is 24v.thank you.

Reply

Administrator says:
19/07/2018 at 6:56 am

It depends on the rating of your panels

Reply

eric says:
18/07/2018 at 1:29 am

can i use 155w panel (4.4a, 35v) for 10amp charger controller

Reply

Nancy says:

11/07/2018 at 9:15 pm

I would like to know how it is best to hook up batteries for solar panels for maximum output. I can run 3 fans all night at our cottage, but if I do I can't use the coffee maker in the morning. I have 3 solar panels, inverter and 2 deep cell batteries in parallel. Solar panels are also in parallel. And it is a 3000 watt inverter. Do I need more batteries, hooked in series???

Reply

Administrator says:
12/07/2018 at 3:07 pm

If your existing configuration is not capable of powering the load you require, then yes you may need more battery capacity.

Reply

Yariv Edery says:
06/07/2018 at 3:42 am

Thank you for an interesting conversation. My question:
I have a 15kW rated grid-tied 3 phase inverter and can connect 3 strings of 290W PV modules limited to 750Vdc per string.
Connecting my PV strings in series will provide Isc =9.8A (module datasheet) per string.
The inverter AC output is balanced 23A per phase.
I have a 20A EV charger and want to make sure that the actual inverter AC output current will be sufficient for charging using the PV system.
Does this mean that I better arranging my solar arrays in 2 parallel strings in order to achieve 19.6A current input on the DC side?
Does higher current on the DC side equal higher current on the AC output?
Thanks in advance.

Reply

Administrator says:
07/07/2018 at 7:46 am

Power is voltage times amperes (V*I) so higher current on the DC side will result in a proportionally equal change on the AC output up to the max rating of the inverter, both DC and AC sides. Your electric vehicle charger will draw the required current from the inverter at an amount determined by the charge condition of the batteries. If your vehicle requires more charge, then you could try reconfiguring your connections.

Your vehicle manufacturer and solar seller can advise better on this.

Reply

Yariv Edery says:
07/07/2018 at 11:24 pm

Great reply, Thanks!
The solar seller is intending to make the connection I describe here.
3 solar arrays (Sth= 10 panels, East = 12 panels and West = 20 panels)
The inverter has 3 string solar inputs.
Sting 1 = 10x290W modules in series (2.9kW array, Voc=393V, Isc =9.8A)
String 2 = 12x290W modules in series (3.48kW array, Voc=471.6V, Isc= 9.8A)
String 3+4 = each string 10x290W in series, connected in parallel (5.8kW, Voc=471.6V, Isc=19.6A)
I wonder what will be the3 phase inverter's AC current output (after losses). I know that it will have an equal output for each phase but not sure if it will be an average of the input currents or the lower of the lot…

Reply

‹ Older comments

Leave a Reply

Your email address will not be published. Required fields are marked *

Comment

Name *

E-mail *

Website

What's the Answer *

+ four = nine

Post Comment