SOLAR PANEL INSTALLATION REQUIREMENTS AND INSTALLATION PROCESS

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Abstract: The article first discusses the various requirements for installing solar panels, including local building codes, permits, site assessment, and equipment selection. It also highlights the importance of evaluating the structural integrity of the roof or ground where the solar panels will be installed. Furthermore, the article delves into the installation process itself, covering key steps such as mounting the panels, connecting them to an inverter, and integrating them with the electrical grid. It also explores safety considerations and best practices for ensuring a successful installation. Overall, this article serves as a valuable resource for individuals and professionals interested in understanding the essential requirements and process involved in installing solar panels. By providing insights into these critical aspects, it aims to facilitate informed decision-making and promote the adoption of solar energy technology.

Key words: Solar panel, installation slope, electricity Production capacity, network connection, solar panel size

As you can see, in the example we have two 12V solar panels. They are wired in parallel, so that makes the plusses together and the minuses together. And that keeps it at 12V. Let’s go to the combiner box: a Midnite PV3 combiner box.The plus and minus from solar panel 1 come in to, the plus goes into its own breaker. And the minus goes into the negative bus bar. Then the plus and minus from solar panel 2, the plus goes into a separate breaker, and the negative goes to the negative bus bar. The output of the breakers is combined with this included positive finger bus bar. So, it slides into the top of the breakers and that combines the positives. The negative bus bar combines the negatives. And that gives you your parallel wiring. There is also a lightning arrestor that will protect us from any lightning strikes. And notice the ground going to the grounding bus bar, the positive going to the positive bus bar, and the negative going to the negative bus bar [1-4].

The ground comes from the racking going into the grounding bus bar. So, the rails are grounded through this, and then the grounded mid-clamp from IronRidge takes that ground, across the rail, up to the edges, the frame of the solar panels.

This setup gives a nice bonded connection through all of it. I would then go off to a grounding rod, and that would give me my nice earth ground connection. Because this example is a portable system, I've transitioned to "invisible conduit". But know that this is going to be conduit all the way into the house [5-9].

Let's transition into the house to our DC Load Center.

The DC Load Center is really just a fancy way of saying breaker box. The combined negative, positive, and ground, all come into our DC Load Center. We have it going into a breaker. It's coming out of the breaker, into the PV In to the charge controller. My negative is also coming in, and it's actually just transitioning right on out. It's just going in there as a nice place to land the negative. But it's going in and then it's coming right back out and it's going to the negative PV In of my charge controller. Then the battery is out from the charge controller. I've got the plus and minus going into the DC Load Center. The plus is going to a breaker, and it's going to be coming out, and going to my positive bus bar. The positive bus bar is going to be going to my battery. So, I've got the negative coming out of the charge controller, going to the negative bus bar. And that negative is also going to be going to my battery. So, that's going from the charge controller, to the battery [11-16].

Basically, what the busbars do, is give a nice easy way to connect everything to the battery. So, you only have one connection to the battery, because it's just connecting into the busbars. So, anything you need to connect to the battery, you can just connect to the busbar, through a breaker. So I have going from the positive and the negative, I'm actually going to a cigarette outlet.

Now you have the DC load. From the positive bus bar, to another breaker, and out to the DC input of my inverter. And here comes the 12V inverter. The negative is coming from the negative bus bar, which is just acting like the battery, going to the negative of the inverter. The inverter turns that into 120V 60Hz pure sinewave, because I'm in North America. If I was someplace that used 230V 50Hz, I would just use a different inverter for that [17-18].

The inverter creates the AC power for me and goes to an AC breaker box. For the example I imagined a Midnite Baby Box, but if you've got a lot of AC loads, you would have a bigger AC breaker box.

Through my breaker, out to an AC outlet, let there be lights! You are totally

wired! Then we just write those down in a triangle with V at the top and we draw a line to separate the letters. Now, all we do when we need to use a formula is cover up the letter we need. So, if we want to find the voltage, then we write V = and then we cover up the V in the triangle. That leaves us with I and R, so we write I multiplied by R, which means voltage equals current multiplied by resistance. You can write a little multiplication symbol in the triangle between the two letters if it helps you. Now, I know what you're thinking. Why is current represented with a letter I and not a C for current? Or even a letter A for the unit of Ampere. Well the unit of current is the Ampere or the Amp and this is named after Andre Ampere, a French physicist. A couple of hundred years ago, he undertook lots of experiments, many involved varying the amount of electrical current. So, he called this intensité du courant or the intensity of current. So, when he published his work, they took the letter I and it became standard until this day. Now, you might also come across formulas where the letter E is used instead of V. The letter E stands for EMF, or Electromotive Force, but don't worry about that, just stick to using V and substitute V for E if you see it used in Ohm's Law's questions. Anyway, so by covering V, we get voltage equals current multiplied by resistance. If we want to find current then we write down I = and then we cover up the letter I in the triangle. That gives us V and R, so as V is above the R like a fraction we can write V divided by R. Therefore, current is equal to voltage divided by resistance. If we want to find resistance, then we write down R = and then we cover up R in the triangle. That leaves us with V and I. So, we write V divided by I, which gives us resistance equals the voltage divided by current. Let's say we have a simple electrical circuit with a battery and a resistor. We don't know what the voltage of the battery is though. The resistor is 3 Ohms and when we connect a multi meter into the circuit, we see that we get a reading of two Amps of current [19]. We want to find the voltage. So, using Ohm's triangle, we can cover up the V and that gives us V equals I multiplied by R. We know the current is two Amps so we can write that in and we know the resistance is three Ohms, so we can write that in also. Therefore, two Amps multiplied by three Ohms, gives us six volts. The battery is therefore six volts [20]. If we now double the voltage by connecting two six volt batteries in a series, we get 12 volts. If we now connect this to the same circuit, the current also doubles from two Amps to four Amps. If we double the voltage again to 24 volts, the current will also double to eight Amps. So, what's the relationship here? We can see that current is therefore directly proportional to voltage. If we double the voltage, we double the current. Remember, voltage is like pressure, it's the pushing force in the circuit. It pushes the electrons around the wires and we place things like lamps in the way of these electrons so that they have to flow through these and that causes the lamp to light up. By doubling the voltage, we see that the current also doubles, meaning that more electrons are flowing and this occurs as we apply more pressure or more voltage [21-23]. This is just like if we were to use a bigger water pump then more water will flow. What about finding current? Let's say we now have a three Amp lamp connected to a six volt power supply. To find the current, we cover up I in the triangle. That gives us V divided by R, so current equals voltage divided by resistance. We know the voltage is six volts and the resistance is at three Ohms, so the current is therefore two Amps and that's what we see on the multi-meter. If we double the resistance to six Ohms, by placing another three Ohm lamp into the circuit, the current halves are just one Amp. If we double the resistance again to 12 Ohms, the current will half again to .05 Amps. We can visually see this because the lamps will become less bright as the current reduces from the increase in resistance. So, what's the relationship here? We can see that the current is inversely proportional to the resistance. When we double the resistance, the current will decrease by half. If we half the resistance the current will double. Current is the flow of electrons or the flow of free electrons. For us to make this lamp shine, we need to push electrons through it. How do we do that? We apply a voltage across the two ends [24-25]. The voltage will push the electrons. The atoms inside the copper wire have free electrons in their valance shell, which means they can very easily move to other copper atoms. They will naturally move to other atoms by themselves, but this will be in random directions, which is of no use to us. For the lamp to turn on, we need lots of electrons to flow in the same direction. When we connect a voltage source, we use the pressure of a battery to push the electrons through the circuit all in the same direction. For example, to power a 1.5 Ohm resistive lamp, with a 1.5-volt battery, requires one Amp of current. This is equal to six quintillion, two hundred and forty-two quadrillion electrons passing from the battery and through the lamp every second. And if you can achieve this, then the lamp will stay at full brightness. If the voltage or current reduces or the resistance of the circuit increases, then the lamp will become dimmer. Finally, let's tackle the resistance. Let's imagine a resistive lamp connected to a 12-volt power supply, we don't know how much resistance is adding to the circuit, but we measure the current at 0.5 Amps. To find the resistance, we write down R = and then we cover up the R in the triangle. We're left with V and I, so resistance equals voltage divided by current. We know the voltage is 12 volts and the current is 0.5 Amps, so 12 divided by 0.5 gives us 24 Ohms of resistance. Resistance is the opposition to the flow of electrons. It tries to prevent electrons from flowing. That's why we use resistance in circuits to reduce the current and protect components such as an LED. If we tried to connect an LED directly to a nine-volt battery, it would blow out because the voltage and the current are too high. But, when we add a resistor into the circuit, then these are reduced, so the LED is protected and will shine brightly. So, given the circuit, we can increase the current by increasing the voltage [26-28]. Or we can also increase the current by reducing the resistance. We can also reduce the current by increasing the resistance. It's time for you to test your skills. Can you solve these problems? Problem one : Let's say we have this lamp which has a resistance of 240 Ohms. If we plug this into an outlet in the US, which uses 120 volts, what will the current be? Problem two : If I plug the same 240 Ohm resistive lamp into an outlet in the UK, we get a current of 0.958 Amps. So, what is the voltage being applied here? Solution one: $I = V \div R$ $I = 120V \div 240\ \Omega$ $I = 0.5A$ Solution two: $V = I \times R$ $V = 0.958A \times 240\Omega$ $V = 229.9V$ (~230V)

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