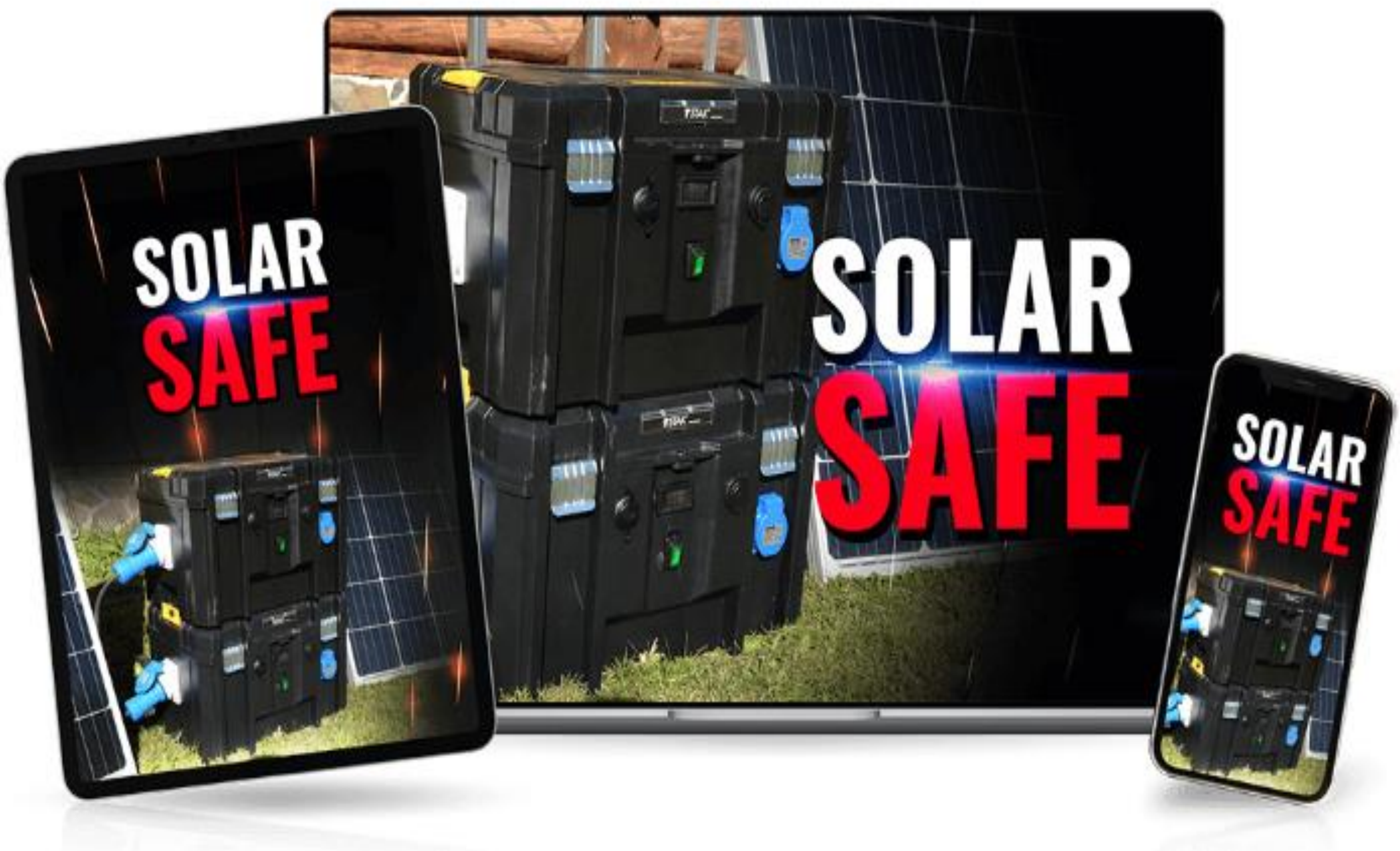
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* Please Remember *

<u>Safety First</u>! Everything you do that is related to your DIY project is at your own risk. Please use safety precautions at all times. If you do not understand something or do not feel comfortable doing something - consult a professional.

Thank you for trusting our product. Because you trust us, I'd like to return the favor by presenting you a fresh new project. I hope this project will mean a lot in terms of mobility, reliability and independence, regarding your energy independence.

James Hall

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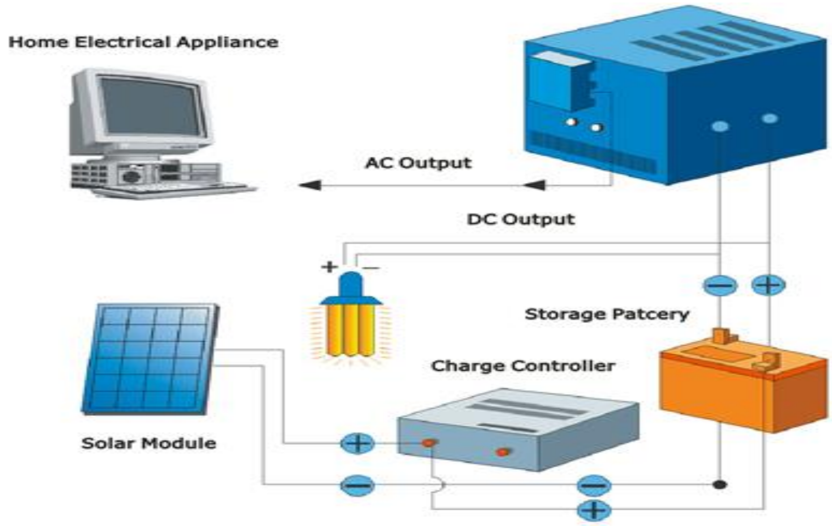
CHAPTER 1. Introduction

a. Basic principal regarding solar energy

There are three main types of solar electric systems: off-grid, grid-tied or grid-tied with battery back-up. Off grid systems typically use batteries as their form of energy storage and have been around for many decades. Grid-tied systems have only gained popularity in recent years, as utility, state and federal incentives have made the solar system much more cost competitive with its dirty rivals: the fossil fuels.

These grid-tied systems use the utility grid (the network of wires and cables that span every city and town in the US) to store their energy, sending excess energy into the grid during the day and pulling from it at night.

Every solar system, no matter which type, will always start at the solar panel. This is where the energy starts, and from there it must enter some conductor to reach its destination. This conductor is typically an insulated copper wire. The amount of energy and the distance of the wire will determine what size wire to use. In an off-grid application, the energy from the sun typically flows through these components:



(general scheme)

From the solar panel the current flows into a charge controller. This unit is in essence a regulator of energy. It is a customizable unit that regulates the flow of energy to the battery and determines how much energy is being pulled from the batteries at nighttime or in cloudy weather. Depending on the size of the solar array you may spend anywhere from under $100 to a couple hundred dollars for your charge controller(s).

Controllers are available in a variety of sizes and appearances.

The batteries are a crucial component of your off-grid system. This is what will be powering your appliances when the sun goes down or behind clouds. Most batteries now are lead-acid batteries, although as more funding is being put into the R &D of batteries the chemistry is constantly evolving and becoming more efficient.

Batteries are also available in unsealed and sealed types. The unsealed types are much more common due to their lower cost. However, they do require weekly maintenance to keep their electrolyte levels above the plates inside the battery. The sealed batteries come at a premium, but do not require the maintenance, since the electrolyte is usually in a gel substance.

For either battery you will want to keep them away from any potential heat or fire sources. A shed or a well vented room in your home will work best. Try to avoid temperature extremes for your battery bank, as this will affect the performance negatively.

The charge controller can be programmed to stop flow from the batteries when they reach a certain depth of discharge (DOD). The DOD is typically no less than 50% of the battery’s capacity. The further you discharge a battery on a regular basis the shorter the life span of a battery will be. For solar applications you will want to use deep cycle batteries. Wired together, they form a battery bank.

These may look very similar to car batteries but are only similar in appearance and greatly differ in their requirements. Car batteries are meant to be fully discharged and then rapidly recharged. Solar deep cycle batteries are slowly charged throughout the day and then discharged slowly at night. Their energy input will vary throughout the day and the discharge will be sporadic at night, too.

A car battery used for a solar application would not be expected to last even one year, while a well maintained deep-cycle battery can be expected to last 6 years or more, depending on the depth of discharge level you have set and how often you keep the electrolyte levels maintained.

If you are using just direct current (DC) loads you will not need an inverter and can just charge the loads from the battery, assuming the voltages match up. However, the cost and availability of DC appliances remains an impediment to the solely DC home.

Alternating current (AC) appliances dominate the home appliance landscape and require an inverter to change the DC current from the solar array to AC current for your refrigerator, TV, lights, etc. You should expect to spend around $0.50/watt or more depending on the size of the inverter needed.
Typically, all but the largest residential solar systems will work fine on one inverter.

Inverters, like the charge controllers, will vary in shape and size depending upon the inverter’s output rating and manufacturer.
You may be able to save some money on larger systems by purchasing an inverter that has a charge controller inside its circuitry.

Check the spec sheets to determine this. Many of the larger manufacturers of inverters have solar string sizing programs available for free on their website, so you may want to reference this to determine what size inverter to use. The inverter's input voltage window is the main determination to determine how many panels you can wire together in a series string, which is why they are often called string inverters.

You can get by with an inverter that is rated below the name plate rating of the array. For example, a solar array with a name plate rating of 3,300 watts (3.3 kilowatts) will work just fine with a 3,000 Watt inverter, since you will typically lose up to 20% of the output from the panels from many factors. Among them, voltage losses in the wires, panel mismatches, dirt or pollen on the panels and the DC to AC inversion.

Disconnect switches are often times built into the inverters, but many municipalities require a separate disconnect switch for either the DC side or the AC side, or both. If you are planning on getting your system inspected by a licensed inspector or are going to connect your system to the grid check with your local laws to determine which disconnects you will need to install. The National Electrical Code (NEC) book, too, has set laws on mounting the equipment, such as how high off the ground, distance from batteries and other components, etc.

Disconnect switches, depending on how many strings of panels you are creating may need to have an integrated fuse. These disconnects can be purchased at a local electrical supply or hardware store.

If you are constructing a small array, you may get away with just one battery, a small charge controller and a low wattage inverter, like the kind you can plug into your car adaptor. You can plug many AC electronics or even appliances directly into the inverter, so long as the inverter is rated to handle the load requirements.

For larger systems, you should opt to run the inverter AC wires directly into your homes breaker panel with breaker slots allotted for the inverter. A master electrician’s services should be sought for this step.

To make sure your breaker panel can handle the back fed current take the busbar rating found on the inside cover, multiply it by 1.2 and then subtract your main breaker size. The max continuous output current of the inverter multiplied by 1.25 (depending on which NEC Code year you reference) must be below this number.

For example, a 200 A breaker panel (standard in most new construction) with a 200 A main breaker will allow for 40 A to be backfed (200 x 1.2 – 200 = 40 A). You can typically fit up to about 7000 watts on a 200 A breaker panel since the max continuous output of a 7,000 Watt inverter is usually close to 32 A. The max continuous output of the inverter is found in the spec sheet or by contacting the manufacturer.

Grid-tied systems substitute the utility grid for the batteries. Most homes that are connected to the grid opt for this service. If going this route, you will want your utility provider to install a net meter for you.
This meter records the flow of electricity in both directions, essentially crediting your account for sending excess electricity into the grid.

When the sun is out and your panels are producing more electricity than your home needs, your meter will spin backwards. When the sun goes down and the lights come on you begin to pull electricity from the grid and your meter spins forwards again. Most states have now adopted net metering for renewable energy systems. If you don't get a net meter your old meter may actually charge you for energy consumed and energy produced!

It is important to note that when you lose power from the grid, you won't be able to use the power from your solar array. This is a safety feature built into the inverters so that if you have a utility lineman working on the power lines in your front yard they can be confident there is no current in the lines. If your array were in the backyard feeding the grid and he was working in the front he would run the chance of having a bad electric shock.

A small percentage of homeowners opt for a grid-tied solar system with battery backup. This is more common in places with an unreliable utility connection like very remote areas or places with inclement weather. Aside from the extra maintenance and introducing more toxic chemicals into your home and the environment, you could pay up to 50% more on the total cost of an installed system by adding battery backup. There are inverters out there that have grid-tied/battery backup capabilities, but you may need two inverters for this option.

Having a crucial load subpanel is a good option for when the power goes down and you are drawing from the batteries. This isolates some of your electric loads on a separate breaker panel so that you won't pull down the battery's storage too fast by running unnecessary loads.

b. General technical regards

The sun's rays are comprised of many tiny photons of light. These photons, while technically without matter, do possess energy. These little balls of energy multiplied many times over strike the surface of the solar panel and cause the necessary commotion to knock the electron free in the solar cell.

Solar cells are typically made up of high grade silicon as the semiconductor, but this alone is not sufficient to create an efficient enough solar cell. However, if a doping agent is introduced, commonly boron and phosphorus, it causes an unbalanced chemical structure, with a surplus of electrons in the silicon-phosphorus layer on the front surface of the cells.

This creates a negative charge and is referred to as the N-layer. Boron is often added to the back layer of the cells, creating a silicon-boron mixture that has a positive charge and can easily accept extra electrons, often referred to as the P-layer.

In between the two is a positive/negative junction, or P/N junction. This middle junction between the other two layers has a neutral charge and will only allow the flow of electrons in one direction; from the P-layer to the N-layer.

Inherently, electrons like to move from negative to positive charges, and the only pathway for the electrons to return to the P-layer from the

N-layer is through the conductor, which offers them very little resistance and allows them to flow out of the surface of the solar cell.

It then returns to the solar cell through the completed circuit into the Player.

By taking this flow of electrons, or electricity, and attaching a load to its circuit you make the electrons do work and have usable, renewable energy.

When each photon hits the cell it carries enough energy from the sun with it to excite one electron in the cell into the movement that creates the electricity. That is where the importance of the sun comes in.

Without an outside energy source, the circuit would not flow.

However, when there is enough sunlight, the electrons from the P-layer leave their unbalanced atom and leave holes behind, which are easily filled by new electrons returning from their work in the circuit. This process happens until the sun sets for the day and they lay in wait for a new day.

A blocking diode on the positive lead prevents any current from the cells at night and draining the batteries. You can wire the solar cells together to form a solar panel. When solar panels are wired together they form a solar array.

Of the three, monocrystalline cells are the most efficient, while polycrystalline cells are a close second.

Amorphous cells, while considerably less efficient tend to cost only a fraction of what the crystalline cells do. The crystalline cells comprise the panels that are typically used in residential installation. Because they are so much more efficient than the amorphous cells you do not need as much roof or ground space to provide enough energy to offset a typical home's usage.

However, due to amorphous panels' low costs they tend to be preferred for many commercial applications, since space is not an issue in many cases.

When you know both the voltage and amperage of a solar cell you can multiply them together to find its rating in watts. Completed solar panels are rated in watts, so it's important to understand this formula.

Knowing just two parts of the formula, you can also derive the third component. For example, understanding the basic formula V (volts) x A (amps) = W (watts) allows us to derive the amps from a 100 Watt 18 Volt panel.

V x A = W or W/V=A

100w / 18v = 5.55 amps that the panel will deliver

Once you know the voltage and amperage of your solar cells you can begin to wire them together to form the solar panel.

The solar cells are wired together with conductors, commonly tab ribbon. This allows us to take the single solar cell and pair it with similar cells to create a solar panel with customizable power outputs.

So, let's start to see how you can make this at home with a very decent budget and effort. This device is a solar charger but it can be also a small solar generator; in order to make it a power solar plant you can scale it up to your requirements

First, let's see what we need to complete this project.

CHAPTER 2. Tools and components

a. Tools

Pliers

Cable Cutter (Pliers);

Flat and Cross Screwdriver;

Cable Crimper Pliers;

Decorticator pliers;

Box Cutter Knife;

Sliding Measuring Calipers;

Fixed Wrenches;

Plastic Cable Ties;

Hand Drill

Drill Bits;

Multimeter (Amp\Voltage Measuring Device).

b. Components (electronic parts needed)

Solar Panel Cable Coupling – 4 pieces each;

Power Inverter 12V – 110V (220V) at 800W / 600W;

Solar charger controller – 2 pieces;

Electrical cables for wiring (red and black) ᶲ1.5-2mm– 3.5 ft (10 m);

Industrial socket for coupling the solar panels – 2 pieces

Screws, Washers and Nuts ᶲ6, 2.4 inches, 1.6 inches and 1 inch long;

Connectors;

On/Off Switch;

 or 

Socket for 110V or 220V;

Car Lighter Socket 12V;

USB Socket;

2 x Lamps 10W or 20W;

Aluminum Profile – 4 pieces;

4 x 100 / 110W Solar Panels;

2 AGM or car batteries from 60 A and above;

2 professional toolboxes with a clipping system for better maneuverability and ergonomics;

For testing the Device we'll use a cell phone and other household devices.

Next you'll see the step-by-step assembly process, and we'll do a final recap at the end of the video.

CHAPTER 3. Assembling and Wiring the Box

3.1 Preparing the boxes

Remove labels and any other fastening elements. While we exclusively used new products, it is not mandatory for you to do the same. However, it is essential to choose safe, high-quality products.

We will start by marking out the external elements of the box. We will label each component on the box (hence, it's important to have a light-colored marker to mark on black boxes). Measure the size of the reflector and trace its dimensions on the box. If you have irregular shapes, try to trace as close to the inner contour as possible.

On the opposite side of the box, we will attach a power coupling, which will ensure connection with the panels. In this regard, we will measure the diameter of the coupling using a caliper.

On the front side, we will mount a standard consumer socket, a USB socket, and a 12V car socket, a battery charge indicator, and a switch to disconnect the sockets. Another switch that will control the turning on/off of the spotlight will be fixed on the side with the spotlight. The sockets will be measured at their inner diameter, and their position will be determined while considering the box's opening system.

For a cleaner appearance of the box, we will aim to symmetrically align each socket vertically and horizontally. We will account for the inner diameter and ensure that we always have a margin that, even if it needs slight filing, will not be too wide. The positions of each element are indicative and can be chosen based on your convenience and preferences.

First, we measure each component, then we mark it on the box. Verify to see if it’s well placed, and only after that, make the cut. This is the golden rule to measure right and ensure that all the components will fix just in place. Measure twice, cut once.

The last to be marked will be the socket switch. The cutting path will be made inside the marking. We will also mark the spotlight switch. We will repeat all markings on the second box in the same order. For the spotlight part, we will explain another marking method using its frame, with the marking to be cut on the inside.

The coupling, sockets, and switches will sequentially receive their respective markings on the box. Both boxes have the positions of the external elements marked; next is the cutting of each position individually.

Straight cuts will be made using an oscillating saw in our case, and the round ones with the help of routers. After cutting, burrs are removed using a cutter, with the necessary caution to avoid injury. If you don't have a sufficiently large step router, you can use an electric router or any other manual device (saw).

Once the cuts are completed, we will fix the spotlights, noting that the chosen model has fixing screws on the corners. We will mark the screw locations and use a drill for drilling. After drilling, we will fix the screws using the drill. We will then drill the box for the fixing locations of the consumer socket and fix it with casing screws, and on the reverse, we will fix the nuts for the socket frame.

The other sockets, USB and 12V, will be pushed into their places. If certain burrs prevent entry into the socket, they will be slightly widened using the router.

IMPORTANT: Do not force to avoid cracking the box.

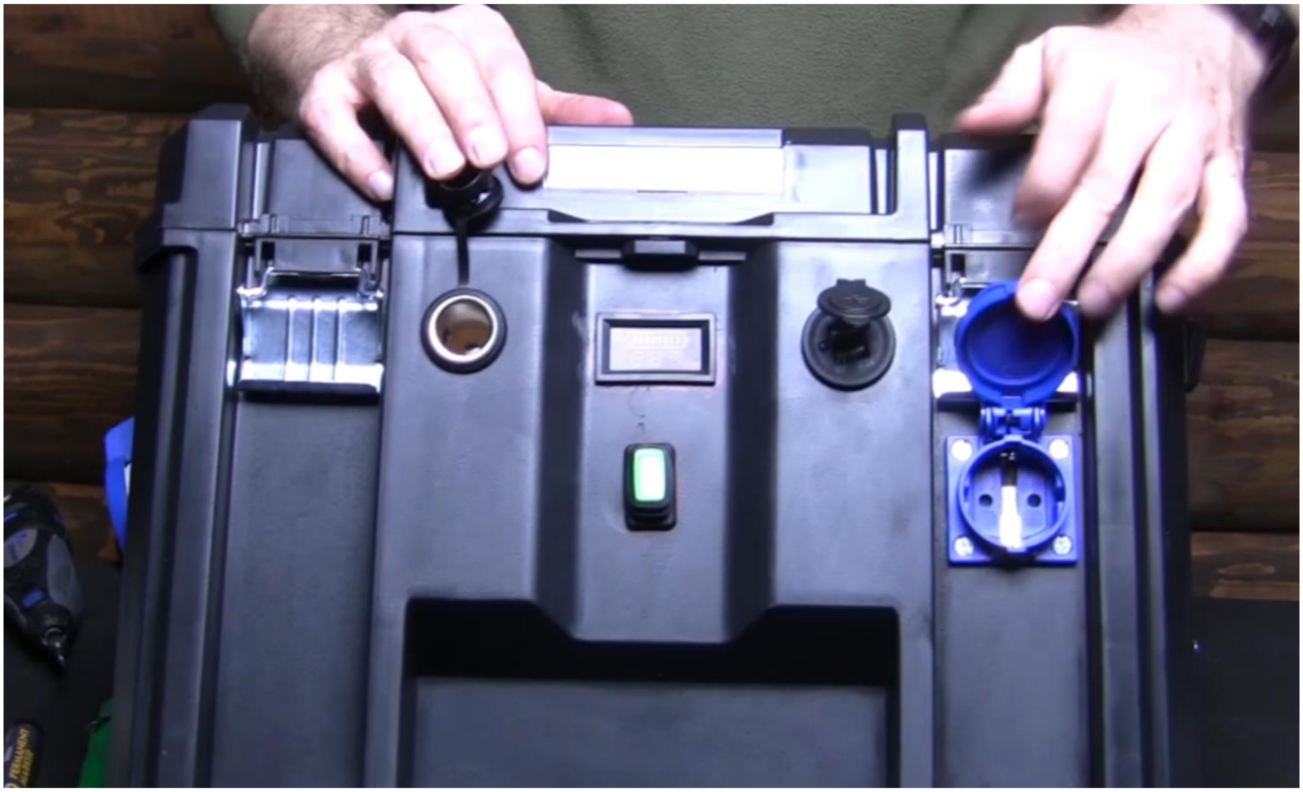
If any adjustment is needed in order not to force the attachment of any of the components into the box, a small drilling / or burrs removal will be performed.

Also, make sure that when you press the socket into the box, you have a counter part from the other side, so it won’t crack.

We will also fix the power coupling. If the chosen sockets have a gasket, then just pressing is sufficient. If not, use sanitary silicone for sealing.

In our case, will perform some drills to fix it with screws. Because it’s the power socket, we need to fix it tight to the box, in order to have all the safety measures when handling / transporting the box.

This is how the completed box looks, with the elements attached to the casing.



We perform the same operations for the second box.

This time, we will also show you how to apply silicone if needed. Wipe off the excess with a damp cloth.

Once the attachment of the sockets and spotlights is completed, the next step is the wiring of the boxes.

3.2. Wiring the boxes

The first step is to wire the plug that will connect the 220V / 110V output of the inverter to the consumer socket. For this, after connecting the plug to the inverter, we will measure the required wire length to reach the socket, ensuring it is neither excessive nor too tight.

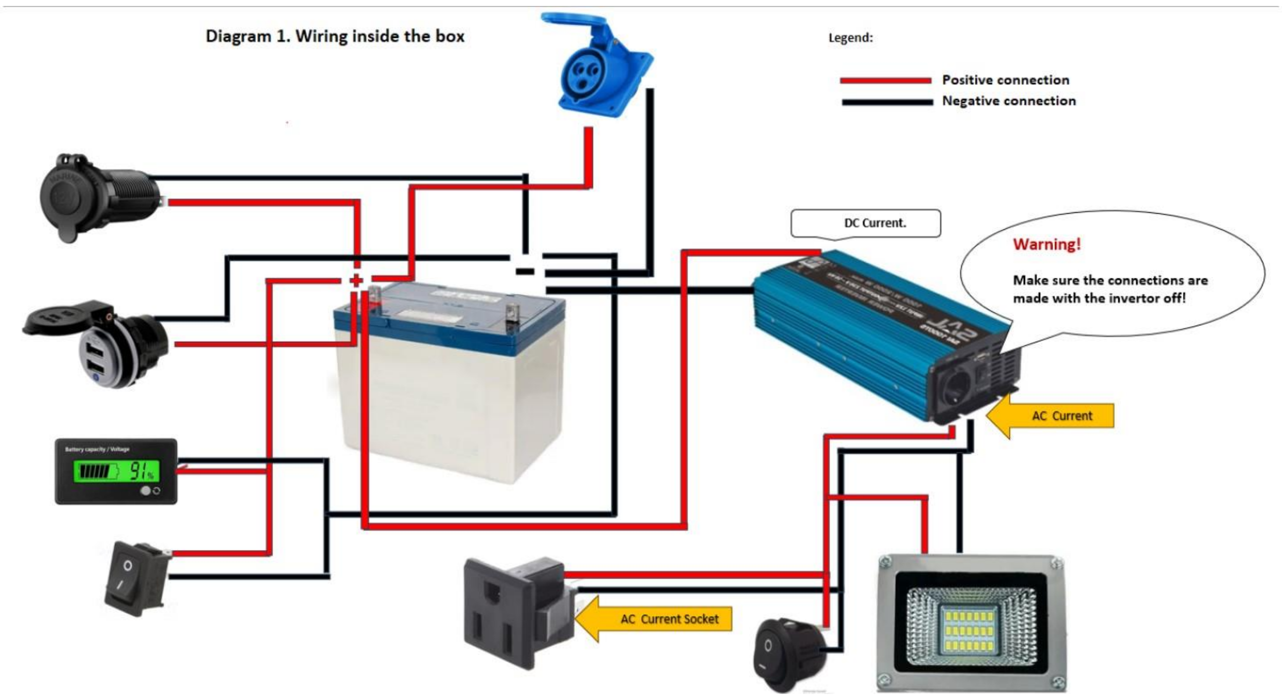
First, we strip the ends of the wires to connect them into the plug.

For this purpose, we will position the inverter demonstratively, without fixing it, just to gauge the necessary cable length. We cut the cable and strip its ends, after which we connect it to the 220V / 110V socket. You can use terminals for a better connection.

Currently, we also measure the wires for the socket switch. For those who are very meticulous, the joints with the switch cable can be soldered using a soldering gun. We opted for the simplest version, using insulating tape.

The spotlight is connected as follows: the yellow wire (ground) is nullified (cut off/isolated). One of the wires goes to the switch, and the other goes directly to the 220V/110V socket in the switch.

Attached you have the electrical diagram for the connections:



For the inverter, we will adhere to the color code, considering we are working with direct current: red for positive, black for negative. Once the ends are fixed in the inverter, we will determine the cable length needed to connect to the battery, keeping in mind the same observation: cables should neither be left too long nor too tight, risking disconnection. With the battery already positioned, we will also connect the 12V sockets, and fix the necessary terminals on the ends of the USB/12V sockets for direct connection to the terminals.

For an easy connection, we'll use **cable connectors** at one end of the cable (the one that will be connected to the battery. The other end of the cable will be either soldered or simply connected to the cable of the 12 V sockets, and then taped.

All positive (red) wires will be connected to the battery's positive terminal using a screw directly into the battery, and the negative (black) ones to the negative terminal.

After wiring the 12V and USB sockets, we will also wire the battery charge indicator. For those who did not understand just from the video, please also consult the diagram in the documentation.

The last to be connected is the coupling that will link the panels and the box (battery). Here too, we use the color code, but we will mark on the terminals which is the positive (red) terminal. Ensure the terminals are correctly mounted and the connections in the coupling are tightly secured.

Once the wiring is completed, we remove the battery, clean the inside of the box from burrs, wire remnants, etc., and proceed to mount the inverter and battery inside the box. You will now more easily observe how the connections are made.

The inverter has red and black wires at one end for connection to the battery, and a consumer socket for 220V/110V at the other end. The connection between the box socket and the inverter socket is made through wires with a plug at the end, as you saw above.

Press gently to secure.

For fixing the battery, we will use the foam part that came with the box, cutting off the excess while leaving some space around for wires. First, fix the foam support and then the battery. Ensure all cables are pulled to the side and do not obstruct when placing the battery inside. With the remaining pieces, stabilize the positioning, especially around the main switch. Ensure everything is okay and there are no loose parts. If needed, and if you find it useful, you can use double-sided tape on the back of the battery for additional fixation.

After positioning, all negative (black) terminals are connected to the battery. Similarly, the positive (red) ones. Tightening will be done using screws and a wrench. Before connecting to the positive terminal, ensure the main switch is in the off position.

After tightening the terminals (solid but not overly tight, with slightly flared connectors), we will secure all the wiring with cable ties. Also, all contacts inside the box will be insulated with insulating tape or shrink tape. Proper insulation and proper cable arrangement will significantly reduce any risk regarding the use of the boxes.

We have now reached the end. Turn on the inverter (the battery has some charge in it), close the box, and press the button. For disconnection, remember to also turn off the inverter!

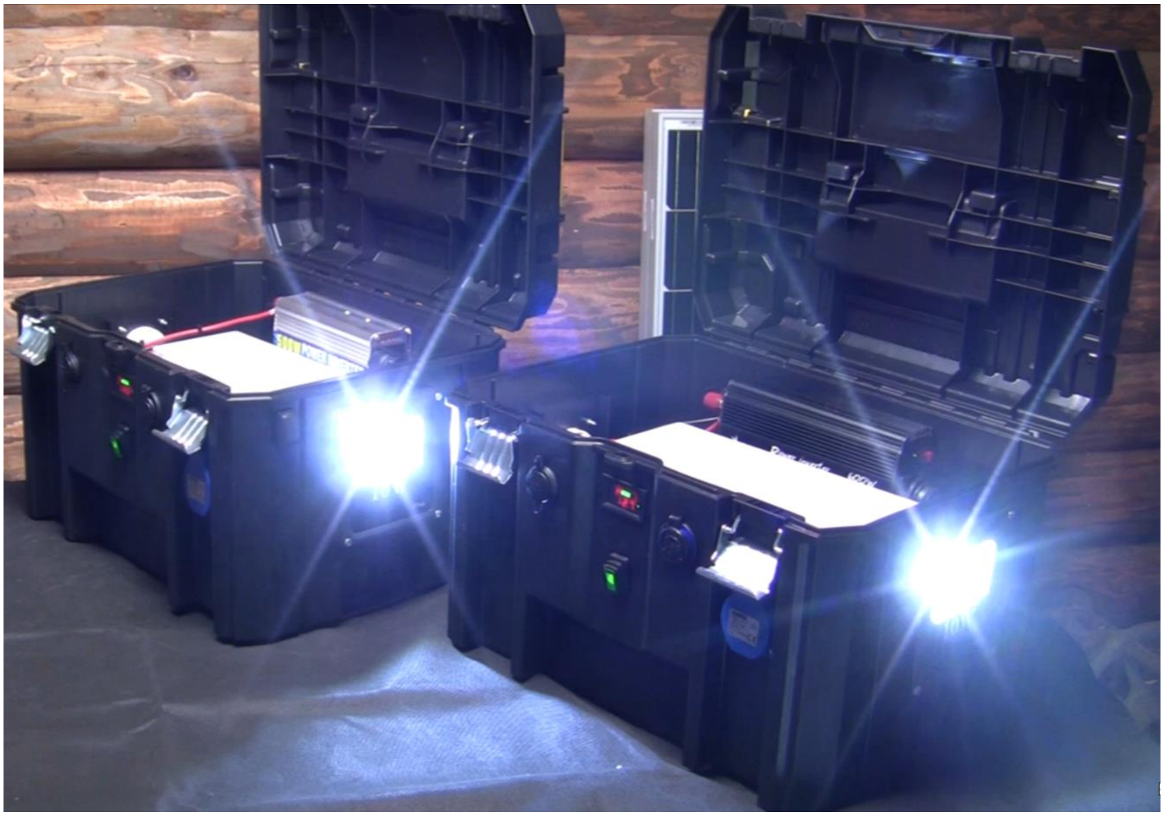
As you notice, you can leave the light on but have the rest of the consumers turned off for better battery power management.

Similarly, we will prepare the second box, with the wiring being perfectly identical.

For an extended period of non-use, we recommend completely disconnecting the battery (both terminals down) and bundling the cables corresponding to each terminal in an insulated bunch.

The only difference is given by the size of the inverter and the positioning of the 220/110V output socket.

Here is the final version, with both boxes built from scratch.



CHAPTER 4. Assembly and Wiring of the Panels

4.1 Tools and Components Required for Solar Panel Production

Before we begin, it's important to note that the tools utilized here surpass the minimum requirements. They are included in this presentation because they can save time during project assembly. Lack of a particular tool does not preclude you from completing this project.

Consequently, the tools used in this tutorial include:

- Wire stripping pliers

- Various types of screwdrivers

- Marker for markings

- Adjustable wrench
- Cutter
- Insulating tape
- Screwdriver bit set
- Cordless drill
- Measuring tape
- Wood/metal drill bit set
- A measuring device

In terms of materials, the list of items you'll need for connecting the panels is as follows:

- 6 mm cables for connections - 10 meters
- Double cables for internal connections (power cable) - 4 pieces of identical sizes
- Power connectors - 2 pieces
- Y-type solar panel connectors (for parallel connection) - 4 pieces
- Charge controller (specific characteristics such as voltage, amperage, etc., may need to be checked) - 1 piece
- Separate connectors - 4 pieces
- Locks - 2 pieces
- Hinges - 6 pieces
- Carrying handles - 2 pieces
- Corresponding screws and nuts

- Aluminum brackets - 4 pieces
- 4 photovoltaic panels 100/110 W

4.2 Preparing the Panels for Use and Panel Wiring

We will position two panels back-to-back, aiming to create a single "suitcase" type panel.

Initially, the attachment of the hinges is paramount. Utilizing three for each set of panels, we mark the location of the holes on the solar panels' frames. Selecting a drill bit that corresponds with the size of the chosen screws, we carefully drill into the panels' aluminum frame. Post-drilling, the hinges are attached. First, the screws are inserted into the designated holes, with their final tightening adjusted at the hinge end. For the bottom panels, it's recommended to insert the screw first, followed by securing it with a nut.

Aluminum corner brackets will be utilized as lifting supports to establish an optimal angle for the panels, thereby maximizing the efficiency of solar energy capture. These brackets will be attached to the inside of the frame and anchored using wooden reinforcements, enhancing the attachment and ensuring safer and more effective use of the arm. The wooden plates are attached as depicted in the image, using wood screws, after which the aluminum corner bracket is secured to the wooden plate. This solution was chosen to provide sufficient sliding distance from the panel's surface. The same operation is repeated for the arm of the second panel.

Once the “arm” is installed, we do the same operation to the other solar panel.

IMPORTANT: Ensure correct sizing by measuring the same attachment distance from the panel frame's corner for the wooden plates, so that the support arms are assembled equidistant from the edge.

Subsequently, we will affix the handles, measuring according to their size and identifying the panel's center. Drilling into the panel frame, the handle is secured by tightening. To amalgamate the two panels into a single entity, a lock will be employed for each set individually, ensuring they remain closed and immobile during handling/transportation.

Securing the lock proceeds similarly to the hinges, with initial marking of the holes. Careful drilling at the markings is followed by affixing the lock (both upper and lower parts using screws).

HINT: The marking for the upper part of the lock should be made in the "closed" position.

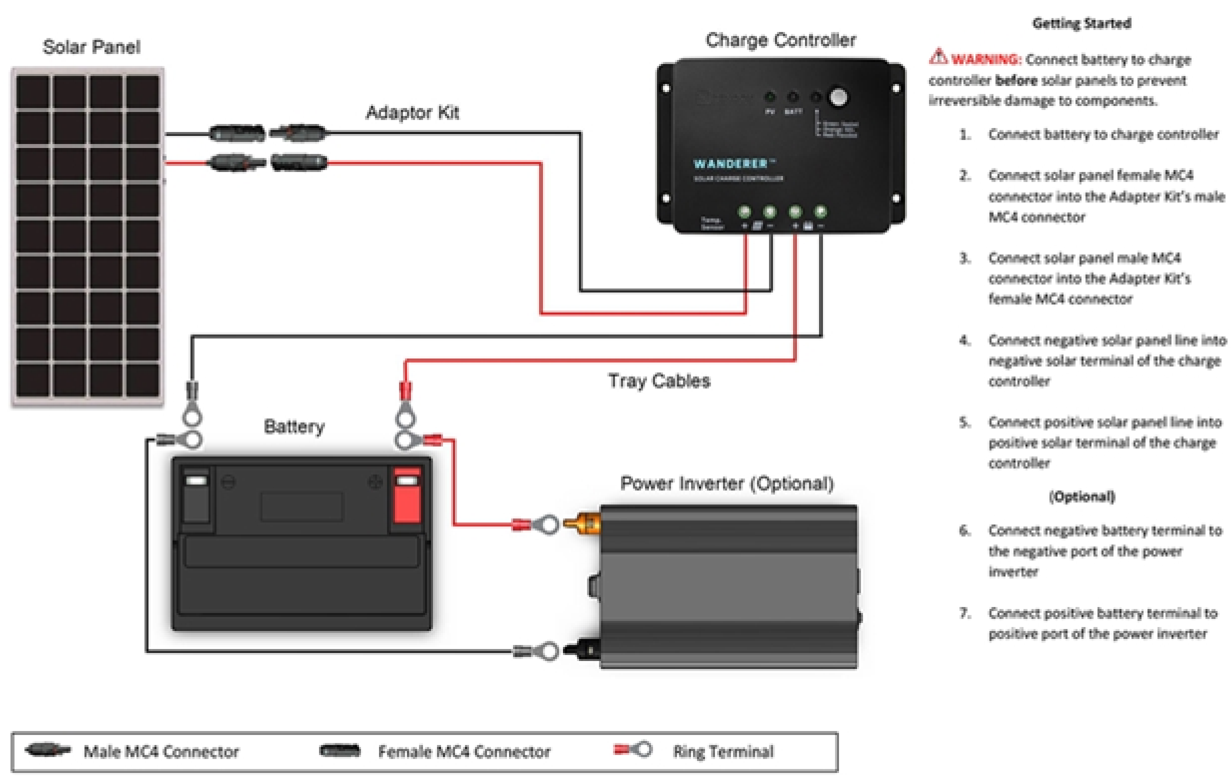
Once secured, they will provide optimal fastening of the panels for transportation to any desired location. We opted for this variant as it offers maximum mobility and flexibility, eliminating issues caused by affixing the panels in a stationary location (such as a roof).

4.3 Cable Preparation and Panel Connection

We will utilize the double cable (power cable), stripping it at both ends. One end is inserted into the power plug, with wires introduced into the corresponding slots of the coupling plugs, ensuring consistency with the respective colors. The coupling on the plug is tightened, followed by securing the screw at the back for stabilization. The same procedure is applied to the other power cable.

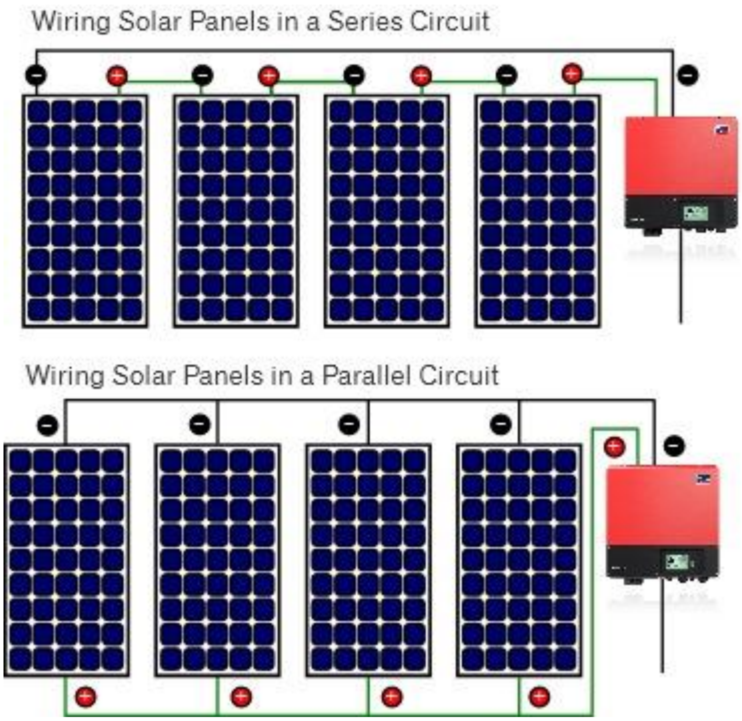
IMPORTANT: Remember the color code for + and -. You can mark on the industrial socket the + sign.

The subsequent step involves preparing the cables for connecting the panels. Utilizing the individual connectors, we strip the wire ends and affix the connector to the wire as depicted in the image, proceeding in this manner with both ends. Male connectors will be used for +, and female connectors for -.



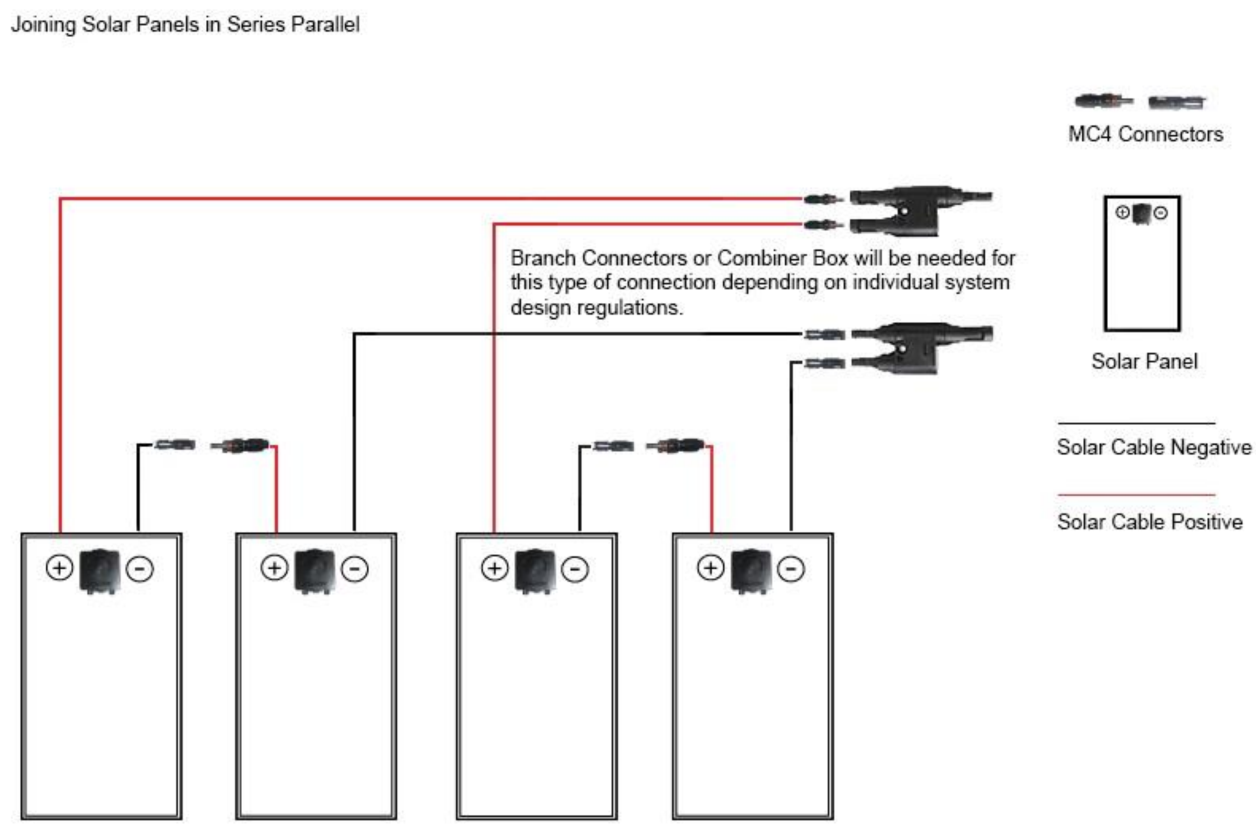
A set of shorter cables (red and black) - approximately 50 cm, will also be prepared to provide the "exit" from the charge controller. They are connected to the charge controller.

Power cables are connected in parallel (plus to plus, minus to minus). In the image, brown denotes +, while blue represents -. These will be connected to the charge controller and will proceed to the boxes for battery charging.

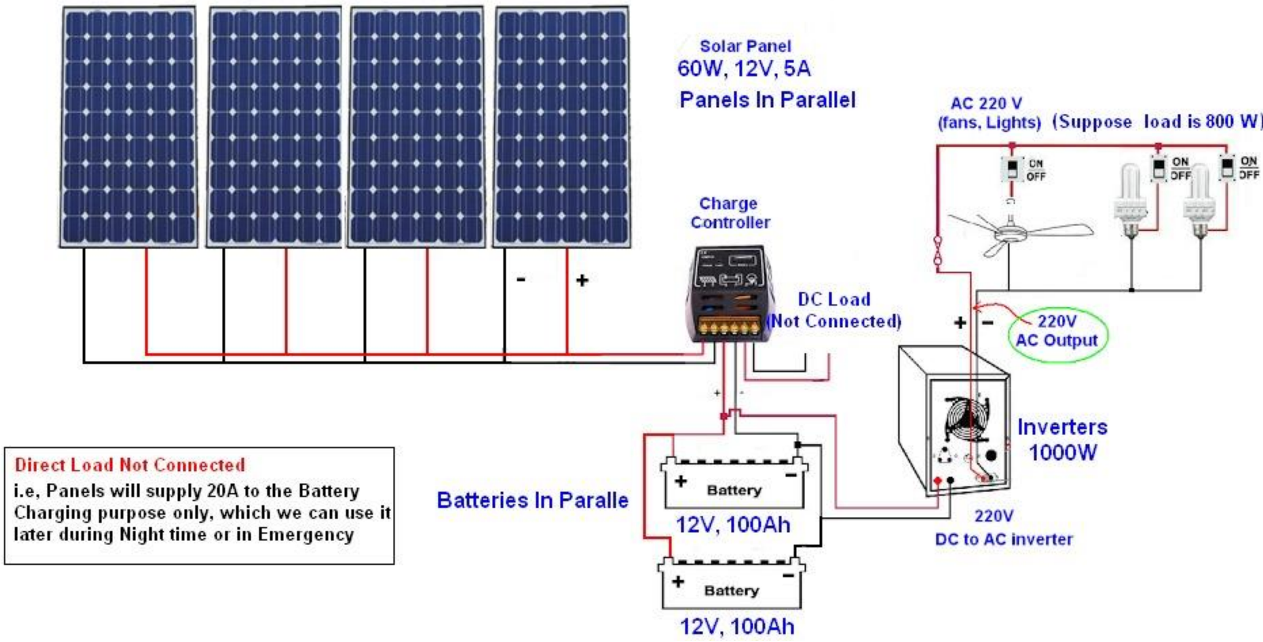


OBSERVATION: Consistently, the plus from the battery must correspond with the plus on the charge controller. Thus, it is vital to remember both the color used for the plus terminal and the connection in the power plug. For convenience, you may mark the plus terminal, analogous to how the phase is marked on a plug.

Subsequently, the panels are connected in series: one of the plus terminals from the first panel to the minus on the second. The plus terminal from the second panel is connected to the Y connector, into which the plus from the entrance to the controller is introduced. The minus from the controller is connected to a new Y connector and to the minus of the first panel. In the plugs remaining free in the Y connectors, the second set of panels will be connected, plus to plus and minus to minus, adhering to the same principle as stated above.



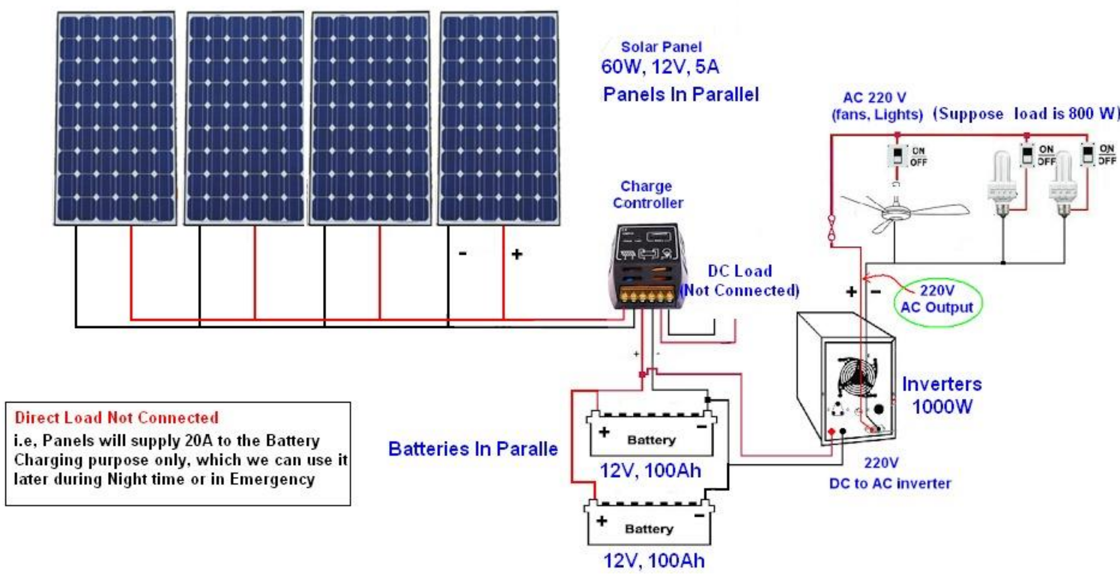
The final operation, post-connection completion, is to affix the charge controller to one of the panels, on the interior side, ensuring they are independent of the boxes. This step also maximizes mobility and flexibility in the panels' movement and use. Gently press after applying the double-sided adhesive tape. Ultimately, the basic set of panels used for this project appears as follows. While the other set is optional, this set (where we affix the charge controller) is mandatory to utilize the boxes.



Displayed here is the final assembly, featuring two sets of "suitcase" type panels and the two boxes.

4.4 Recap – short review of the process

Let's recap. From the solar panels we have to outputs (negative to negative and positive to positive). These will connect to the controller, which will be connected to the battery bases.



The green LEDs show that the panels are already charging. The inverter is also connected to the battery through an on/off switch on the positive side, and the negative coupling is connected directly to the battery. The 110V (220V) socket is connected through a plug to the inverter and also connected with the 10W lamp to a switch. The 12V sockets go directly to the battery, following the polarities (red to red and black to black). We also have a switch connected to the battery and also to a switch. This will show you how much battery you have at your disposal. All the appliances will be connected to the 110V / 220V. If you have more than one, you can add an extension cord socket. The maximum amount of appliances that can be connected to the box is given by the maximum output of the inverter. For example, if you have a 800 W inverter, you can connect a number of appliances of which amount of power needed is 800 W. We also recommend to use though no more than 700 Watts.

NOTE: on the back of every appliance is written the power absorbed. For example, a new model of TV is about 70 to 90 Watts (top), a new fridge is about 130 to 150 Watts, a microwave is about 1500 Watts, a LED light bulb power absorbed is between 5 and 15 Watts, a vacuum cleaner can need up to 350 Watts and so on.

Below you can find in full size the three diagrams for wiring: the one for the boxes (inside connections) and the one for the connections of the solar panels to the boxes:

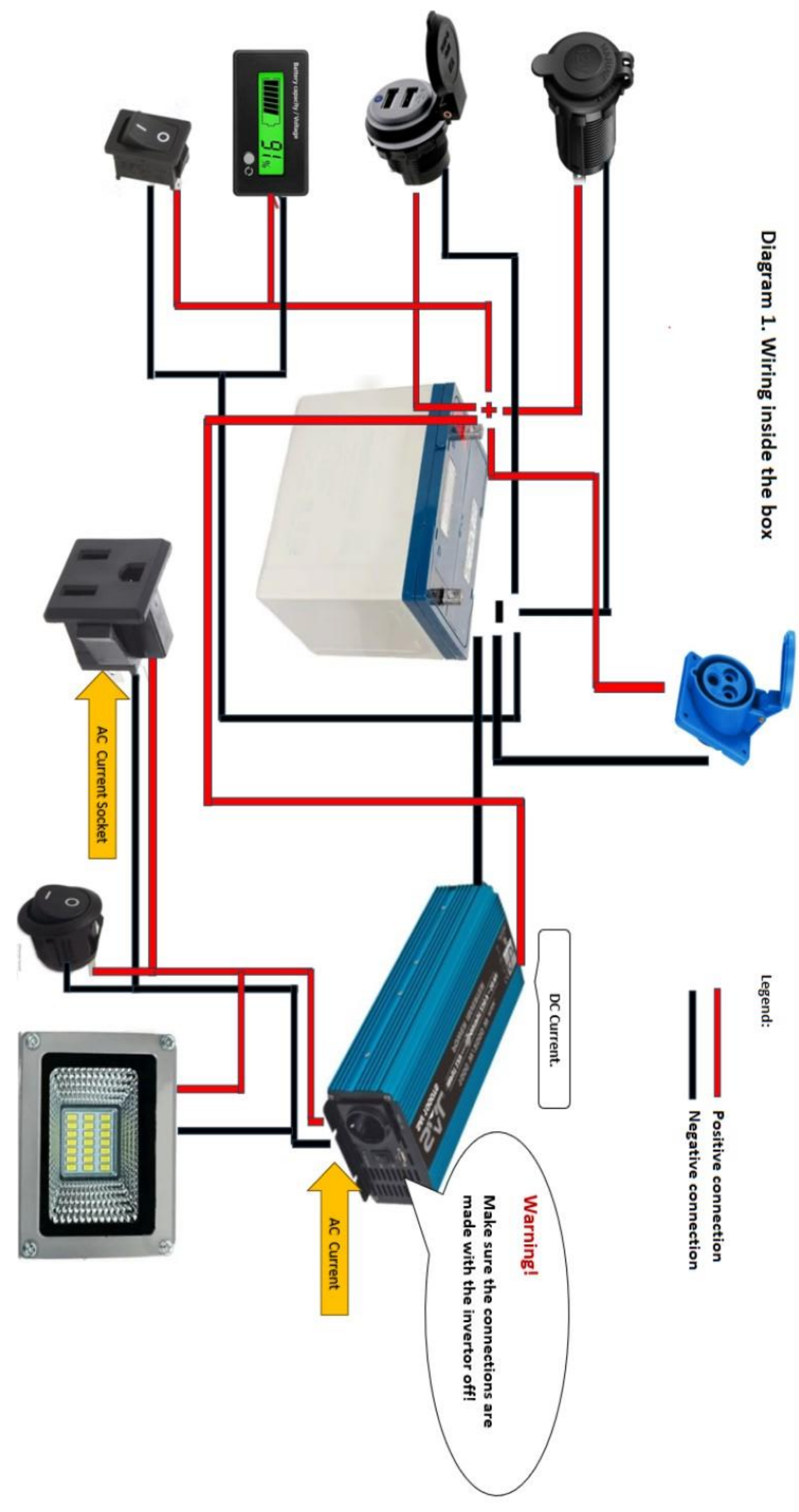
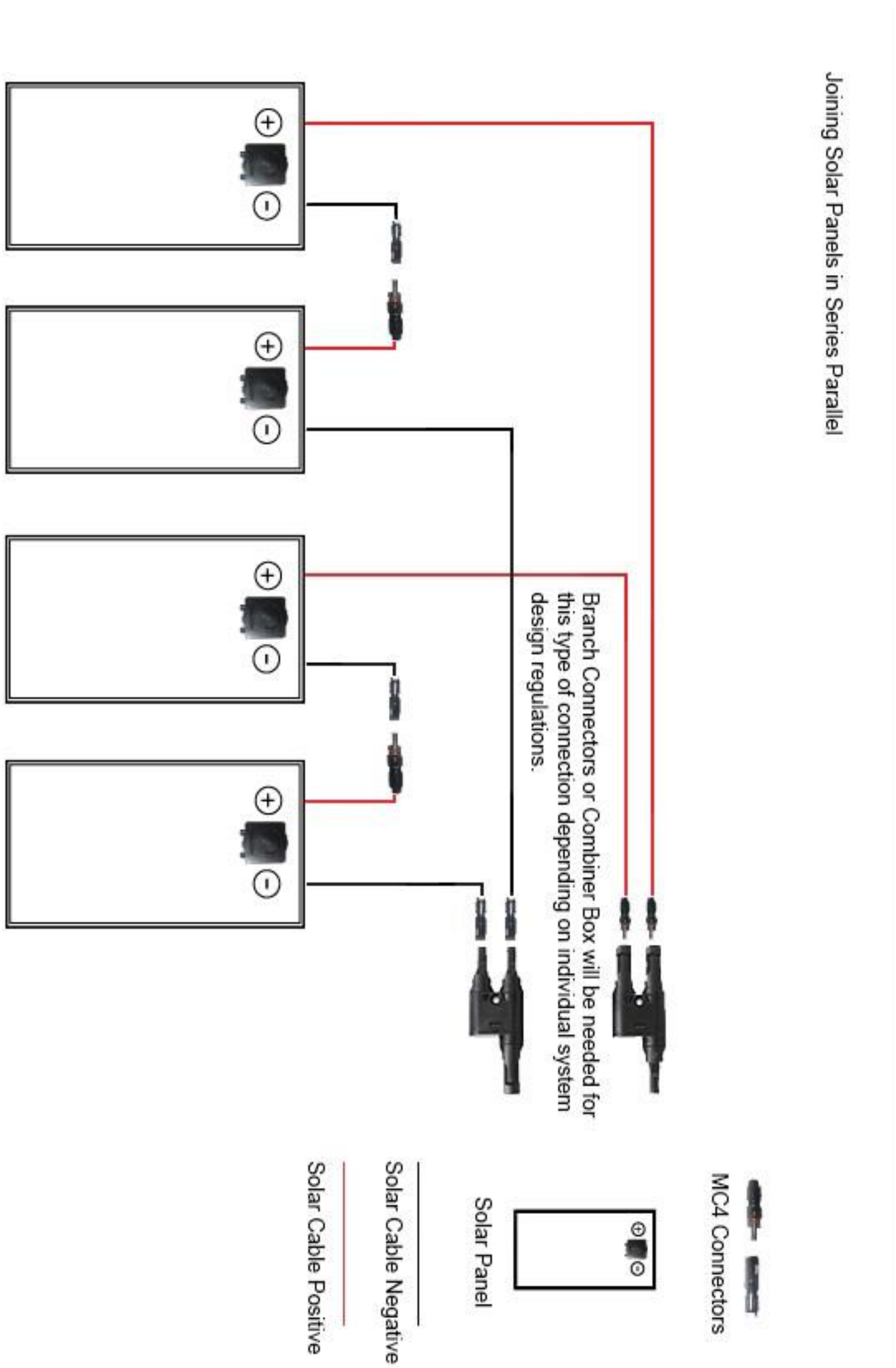
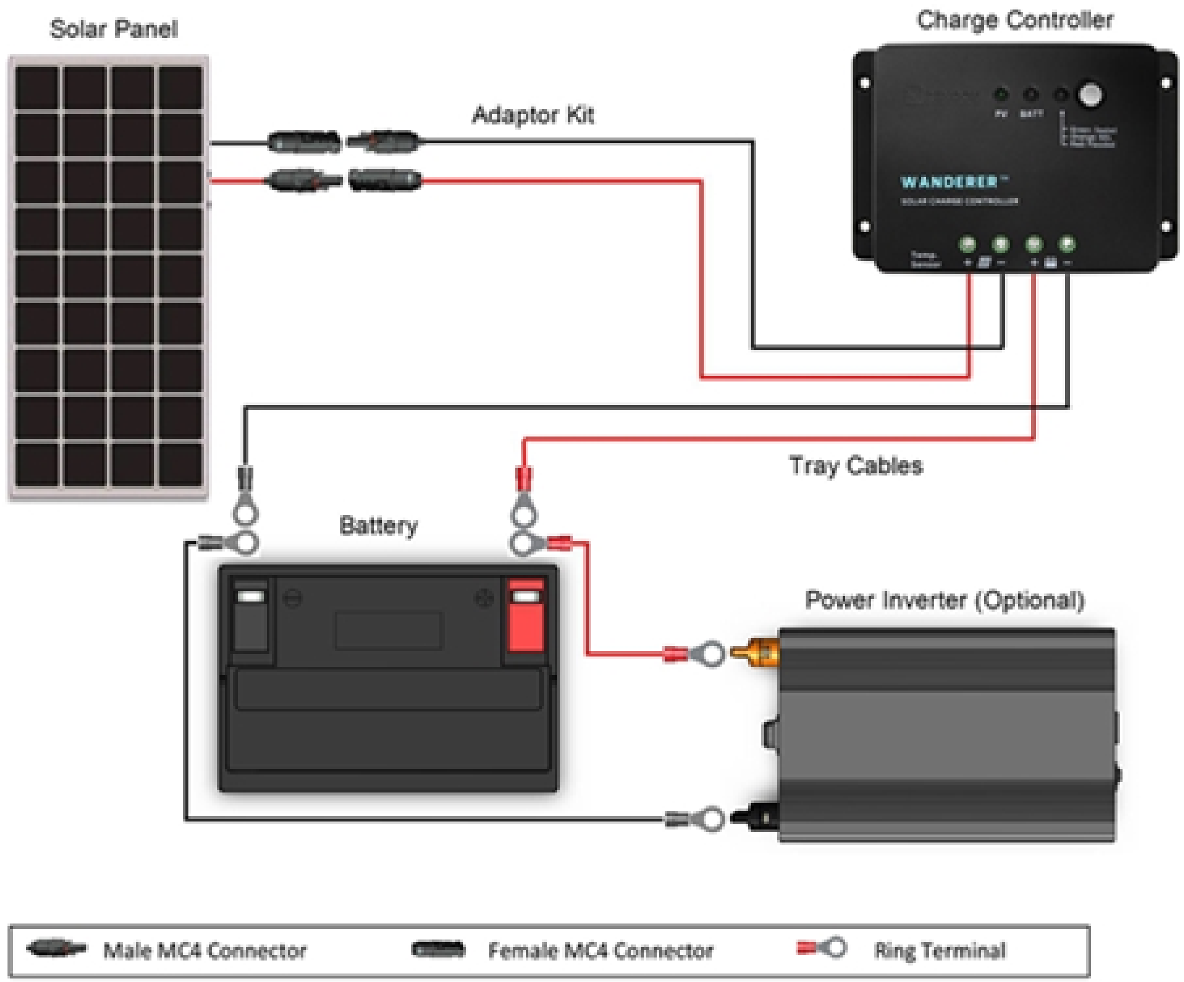


Diagram 1. Wiring inside the box


Joining Solar Panels in Series Parallel
Branch Connectors or Combiner Box will be needed for this type of connection depending on individual system design regulations.
MC4 Connectors
Solar Panel
Solar Cable Negative
Solar Cable Positive



Getting Started

⚠ **WARNING:** Connect battery to charge controller **before** solar panels to prevent irreversible damage to components.

1. Connect battery to charge controller
2. Connect solar panel female MC4 connector into the Adapter Kit's male MC4 connector
3. Connect solar panel male MC4 connector into the Adapter Kit's female MC4 connector
4. Connect negative solar panel line into negative solar terminal of the charge controller
5. Connect positive solar panel line into positive solar terminal of the charge controller

(Optional)

6. Connect negative battery terminal to the negative port of the power inverter
7. Connect positive battery terminal to positive port of the power inverter

CHAPTER 5. List of places where you can by components

Here is the list where you can find the most important components for this project:

For **Solar Panel Battery Charging Controller** 60A 12/24v:
Amazon: - version one: >> Click Here <<

- Version two : >>> Click Here <<<
- Version Three : >> Click Here <<

Walmart: >> Click Here <<

eBay: >>> Click Here <<<

For **AGM battery 100A 12v**:

Walmart: >>> Click Here <<<

eBay: - version one : >>> Click Here <<<

- Version two: >>> Click Here <<<
- Version three : >>> Click Here <<<

For **Solar Panels**:

a. Amazon.com >> Click Here << or >>> Click Here <<<
b. Walmart.com >> Click Here <<
c. Enjoy-solar.de >> Click Here << (a good kit)

For Invertor 110/220-12v:

a. Walmart.com >> Click Here << or >>> Click Here <<<
b. Eco-worthy.com >> Click Here <<
c. Ebay.com >> Click Here << (for upgrades)

For 110/220v Panel Mounting Socket:

a. Alliedelec.com >> Click Here <<

For 12V Auto Socket

a. Amazon.com >> Click Here <<

For USB Socket:

a. Amazon.com >> Click Here <<

For ON/OFF switch:

a. Amazon.com >>Click Here <<

For Terminal Connectors (on the cables):

a. Eco-worthy.com >> Click Here <<

For Digital battery monitor:

a. Amazon.com >>> Click Here <<<
b. eBay : >>> Click Here <<<

For all the other components, we recommend you General / Local Shops.

In order to cut your acquisition bill, we recommend you follow these steps:

- Decide the scale of your system according to your needs.
- See if you can find items like batteries, inverters, cables on General Shops or even secondhand shops. If you buy anything from a secondhand shop, make sure that you receive what you asked for and also a test for the device would spare you for further problems.
- Follow our video guides as much as you need to complete your device.

Thank you for your time and trust. If you have questions, we'll be more than happy to answer them on the support address support@solarsafegrid.com and will reply as fast as possible.

James Hall

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Using and working with solar panels, alternative energy & related equipment/sources, and electricity are dangerous. You are working with many dangerous factors *(including but not limited to electricity, hot soldering equipment, power tools, the roof of your house if you decide to mount your solar panel, and many other unknown conditions that will arise during your project)* so seek expert opinions and help when necessary.

The authors and publishers assume that you are aware of all the risks and possible damage associated with a DIY project and while using electricity and renewable energy resources.

Check with your local officials, state, county, and country for applicable laws about home improvements, alterations, and using alternative energy (especially if connecting to the grid). It is often necessary to obtain local government permits and licenses to prevent legal implications.

We also highly recommend you consult with your local electrician, and other applicable home improvement professionals, to assist in your alternative energy project. Failure to do so could result in injury, loss/damage of property, or death - you are acting at your own risk.

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