DIRECT CURRENT POWER DISTRIBUTION

We often receive questions concerning power distribution for our Solar Ammo Can Project, specifically "what will the ammo can power" or "how would you go about charging a cell phone". Realistically, the Solar Ammo Can Project was designed as an introduction to Solar Power; by understanding how the components work together it can be scaled for smaller or larger solar power applications. So remove the ammo can from the project, replace with larger batteries, higher wattage solar panels, a beefier charge controller, mount everything on your garage wall, and now you have a larger, more capable, solar power solution.

With that said, the ammo can is capable of charging portable devices (cell phones, GPS, etc.) and providing power for Alternating Current devices and appliances if used with an inverter. What we did not cover in the initial projects, and why we are creating this guide, is that most of your small devices (TVs, monitors, laptops, tablets, cell phones, phone systems, etc.) can be powered directly from you alternative energy system using Direct Current; without the need to use a power hungry inverter. That is as long as you understand your devices and the voltage they require to operate.

Recommended Products

- 12 Volt DC to 5 Volt DC USB converter
- 12V/5V Power Supply Module
- 2.1mm x 5.5mm outlets
- Adjustable Step Down Power Supply Module

Required Tools

- Rotary Tool (or equivalent)
- Soldering Iron

AC vs. DC

If you live in the United States, 240 volts of Alternating Current (AC) is sent from the power line to your main control panel/breaker in your home. This is then stepped down to 110-120 volts for primary wall outlets, and between 220-240 volts for specialty outlets (stove/range, water heater, dryer, HVAC).

In contrast, batteries provide Direct Current (DC) and voltage is determined by the type of batteries and how they are wired. For instance, most car batteries are 12 volts, golf cart batteries are usually 6 volts, and AA/AAA/C/D batteries range between 1.2-1.65 volts (depending on the type). Of course you have a 9 volt battery that provides 9 volts, and other specialty batteries that provide their required voltages. Also, when dealing with batteries you need to consider capacity. AA, AAA, C, and D batteries generally provide the same voltage, however their reserve capacity is different; the larger the battery the more reserve capacity.

On the other side of the equation, you have the thing that you are trying to power; whether it be a laptop, TV, or radio. These too operate on a specific voltage or voltage range. So now that we have a basic understanding between AC and DC, and their voltages, let's jump forward a bit.

Without getting into the Alternating Current vs. Direct Current debate (read War of Currents), most small devices are actually powered by Direct Current even if you plug them into a wall outlet which supplies Alternating Current. What, I thought you stated wall outlets are Alternating Current, so shouldn't my device be powered by Alternating Current? Well, most small electronics have a visible transformer, usually located along the power supply (cord), or this transformer may be integrated inside of your device (such as a computer power supply). The responsibility of the transformer is to step-down the 120-240 volts of Alternating Current to the Direct Current voltage the device requires. Confused? Ok a little on the War of Currents and why we actually use a combination of AC and DC power for our everyday electronics.

Alternating Current distribution can be transmitted more efficiently over long distances at high voltages using transformers. In typical USA, transmission lines from power plants carry 345,000 volts of electricity, which is feed to sub-transmission lines at 69,000 volts, to local transmission lines at 13,800 volts, until it reaches your home at 240 volts. Your control panel/breaker, then steps this down again to 110-120 volts at the wall outlets.

In contrast, Direct Current is more energy-efficient at shorter distances (your wall outlet to your device), and does not require as many components as AC power. Additionally, DC power is more stable and cleaner than AC power. Most of our devices, especially computers and medical equipment, rely on clean power at a consistent voltage. Therefore, for transmission over long distances we use AC power, and once we get to the endpoint, the device, it is transformed again to DC power for stability.

So how do you know if your devices are AC or DC?

For most small electronics, determining if it is AC or DC is easy to figure out. The first obvious check is to look at your power cord. For laptop/tablet computers, monitors, and small TVs, somewhere along the power cord you will usually see what is called a "brick"; a rectangular shaped transformer. The responsibility of the transformer is to step down the 120-240 volt AC to the voltage your device requires. However, this transformer may also be located on the part of the cord you plug into an outlet.

The next step is to decipher the text on the transformer, specifically the output voltage. The output voltage is the voltage the device requires. This voltage may also be printed next to where you plug in the cord to the device. Additionally you need to understand the amperage the device requires.

Alternatively, if your device is battery powered, it requires DC power. Each AA, AAA, C, and D battery is on average 1.5 volts when fully charged. Like I stated earlier, the size difference between the batteries indicates reserve power capacity, not the voltage. Now what gets tricky is knowing how your batteries are wired. For instance you can have two AA batteries, and the device voltage could be between 1.5-3 volts (depends if wired in series or parallel). So to be safe, for devices that are battery powered and also have a power input socket, locate the sticker that indicates the correct input voltage, or refer to the device's manual.

Lastly, if your device is powered or charged by an USB port on your computer, then it requires 5 volts DC. The universal standard for USB is 5 volts, and any device that plugs into a USB port thus is powered by 5 volts DC.

So Why am I Reading This?

Okay, so now that we understand that most of our small electronics require DC power, we can take the leap by incorporating this knowledge into our alternative energy systems and grid-down power plan. Most of us understand that we can use inverters, connected to a car battery or battery bank, to power devices that are designed to be plugged into our wall. But, most of us do not consider the amount of energy that is lost during this conversion process. You see, any time you step power up or down, there is efficiency loss. Some inverters actually require more power to run in standby, than the actual device you are trying to power consumes. The larger the inverter, theoretically the more power it will waste during the process.

Our goal should be to minimize the loss of efficiency wherever possible, and luckily our small devices allow us to do that.

Examples, Products, and Methods

I think the best way to move forward is by providing a few examples of devices which require DC power, additional components that you will need, and how to put everything together. For these examples to work, and so that you do not cause any damage to your device, we will use a 12 volt battery as base voltage.

Prepper Link is not responsible if you damage your device or are injured. Please conduct additional research before conducting any modifications. Lastly, the product links provided are ones we have tested, and/or the best price when the article was created. Please check recent prices, as they fluctuate.

Example 1 – 12 Volt Devices

There are many devices which are 12 volt. A dead giveaway is a product that includes a cigarette lighter adapter so that it can be used in a vehicle. Even if the device does not come with a cigarette lighter adapter, the input voltage may still be 12 volts. Some of the products which we have successfully powered directly from a battery include: **Uniden 500 Channel Clock/Radio Scanner with Weather Alert**, **O2 Cool Portable Tent Fan**, **O2 Cool Battery Operated Indoor/Outdoor Fan**, **Axess LED AC/DC TV with DVD Player**, and many of the **12 volt appliances** intended for the camping and trucking industries. Some of the smaller laptops/netbooks are powered by 12 volt DC.

To wire the device for 12 volt directly to your battery bank, you can cut the existing power cord, leaving plenty of room to splice it back together, and/or install male/female terminal connectors so that you can quickly connect/disconnect the cord for use with the AC cord or a DC battery bank. Or you can use the male cigarette lighter adapter, with a **cigarette lighter socket** (as used in the Ammo Can Project).

If you cutting a cord that has a transformer, whether it is integrated in the plug or a brick, you will not need the transformer when connecting directly to a 12 volt power supply. Remember the transformer is used to step the voltage down for the device. Just leave room so you can splice the cord back together if you want to use AC to power your device later down the road.

Example 2 – USB/5 Volt Devices

There are many devices which require 5 volt DC, and are usually charged by a USB cord. These include most cell phones, rechargeable-portable/vehicle GPS devices, small computer devices, external hard drives, and tablets. If it is charged by USB, or powered by USB (computer devices), then it requires 5 volt DC. I have successfully charged/powered my smartphones, **Amazon Kindle**, and **Raspberry Pi** using my 12 volt battery bank. So, how do you go from 12 volt to 5 volt? Easy, use a DC to DC converter.

There are several types of DC to DC converters, each has a specific application, and each can be connected directly to a 12 volt battery (or 12 volt battery bank).

If you have a USB device, you can use a **12 Volt DC to 5 Volt DC USB converter** or a **12 Volt DC to 5 Volt DC USB converter (panel mount)**.

Some devices may require a **Mini USB** or Micro B plug. You have a couple options here, and can use the USB to adapter cord provided with the device, or purchase a separate converter for the adapter.

If your device does not have a USB cord, you can use a **12V/5V Power Supply Module** which can be connected to an outlet. The size of outlet depends on you device, but I have successfully used **2.1mm x 5.5mm outlets**. You may also require **male power plugs** for your outlets if your device does not come with one.

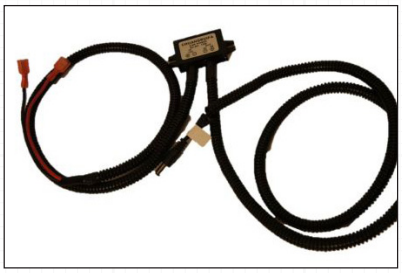
When using converters, you must also account for power consumed even if the device is not stepping down the DC to a different voltage; meaning it consumes power in standby. While power consumption while in standby is usually minimal, one way to bypass this power loss is to install a **switch** between the battery bank/fuse block and the converter.

Example 3 – 9 Volt and Others

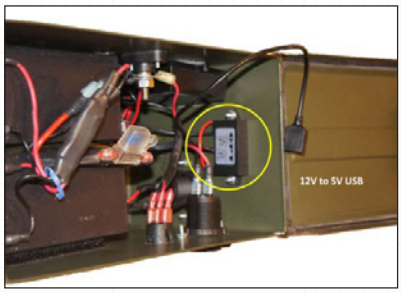
For 9 volt devices, you can use a **12V/9V Power Supply Module**. Alternatively, you can use an **Adjustable Step Down Power Supply Module** for any voltage; however I keep these around for the just-in-case applications.

Applications – Power Distribution Examples

Now that we have identified some of the products, and understand our device power requirements, let's focus on putting this all together. Before we start, let me first caveat this with the Prepper Link project theory. Our goal is to take off-the-shelf components, throw them together in the easiest way possible, to achieve a goal. If you have electronics knowledge, then you can probably come up with a better solution. However, if you are like me, easy is better (even if it costs a little more).

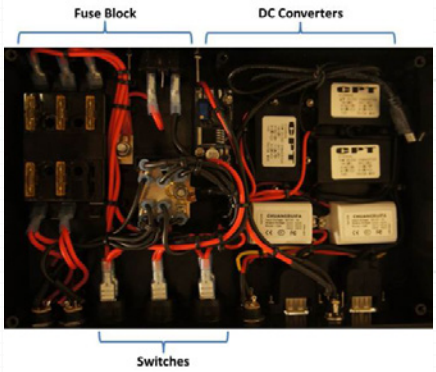


One extremely simple solution is using the converters somewhere along your power cord. The following example shows a 12V/5V Power Supply Module inserted along a power cord, which powers a VOIP phone (which will be covered in a future project).



The next example demonstrates a 12V/5V USB converter incorporated into the Solar Ammo Can project

For a more complex solution, what we call our DC Power Hub, we have several converters and a DC fuse block mounted inside of an ABS enclosure. This enclosure includes 4 x 12 volt outlets, 2 x 5 volt outlets, 1 x 9 volt outlet, and 2 x 5 volt USB ports. Additionally, it includes a 12/5V Micro B converter which powers a **Raspberry Pi**.



If you tackle the ABS enclosure option, a **Rotary tool** (or equivalent) and a soldering iron are necessary. The rotary tool will be used for square cuts for the USB ports. The **soldering iron** is used to connect the wire to the small sockets. Most small sockets require soldering.

Conclusion

I always like to say, "We only know, what we know." And, we use that mentality in each and every article we produce. Obviously, there is a market for all of the solutions we have provided. However, being able to associate what you need, with a product that achieves your task, is the hard part of preparedness. For our small electronics, you have many different options to maximize energy efficiency. Hopefully, this article shed some light on different wiring methods.