ANY BATTERY REPLACEMENT!

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VIEW IN BROWSER

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Summary

Replace batteries with any external power supply. Now available for AA, AAA, C, D, 18650, LR44 (A76) + some other later.

Hobby & Makers > Electronics

Tags: battery supply power charger adapter external rechargable dummy ac

Introduction.

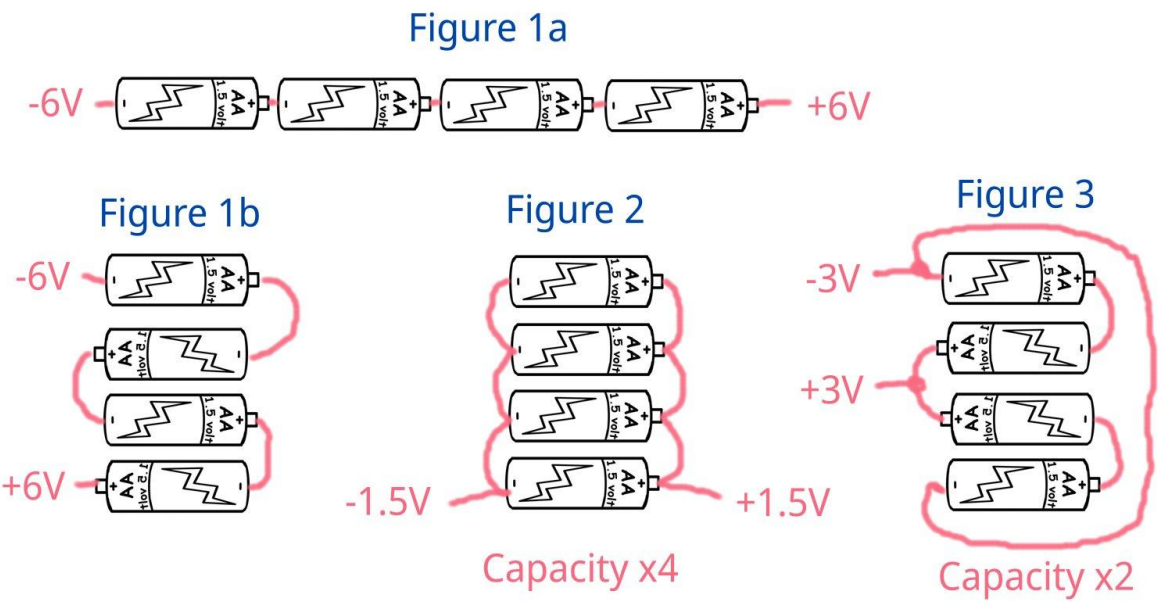
I expect that you have learned the basics of electronics in school so I only remind you the main stuff so that you won't kill your devices at once. Anyway, if you have no idea what the voltage is and what voltage is required by your devices, **DO NOT CONNECT ANY EXTERNAL POWER SUPPLY TO YOUR DEVICES!**

As you probably noticed, many modern devices are powered with batteries and have no socket for an external AC adapter. But batteries are known to die unexpectedly and you may need to continue using your device anyhow even if you are not able to buy new batteries immediately. Besides, some devices eat up the batteries too quickly and you may get tired of buying new ones every day or every week, and sometimes it gets too expensive. So the idea is to replace most commonly used standard batteries with any other power supply that you have in your household. It can be an AC

adapter or some other type of batteries or rechargeable elements that you have around. For example, expensive AAA batteries with little capacity can be replaced with cheaper AA batteries with larger capacity.

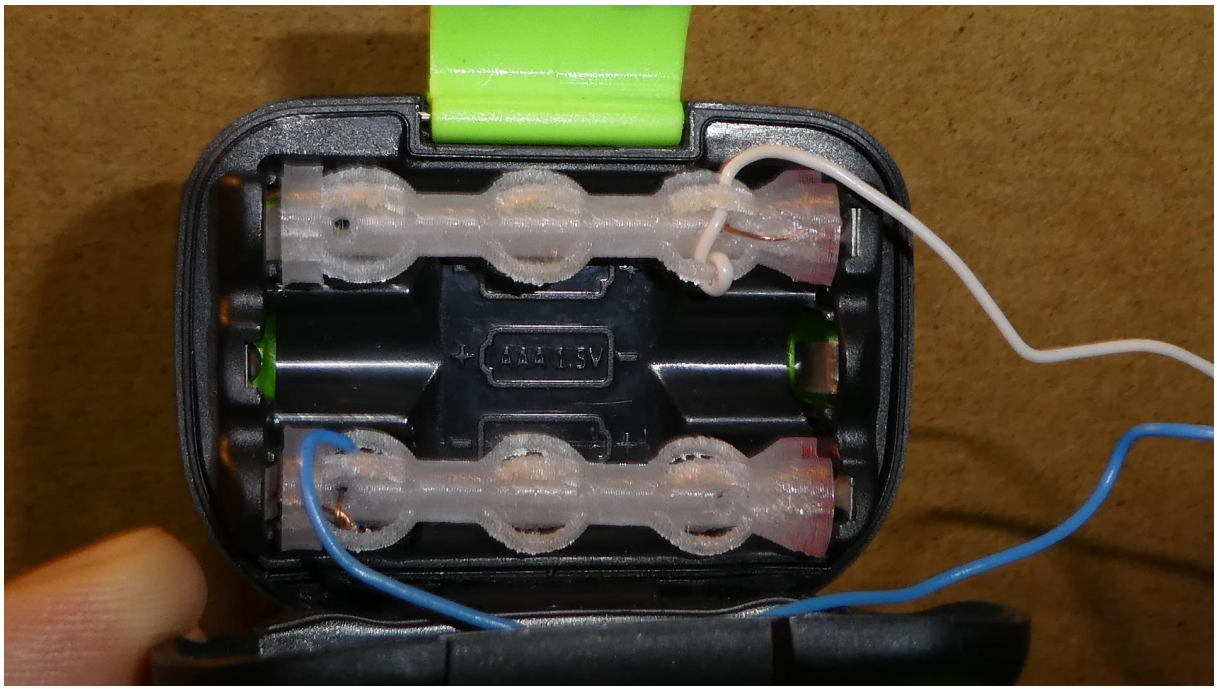
I made a video demo to show how it works, and there I used a pretty much old but still working 12V Ni-MH battery from some ancient video camera with a LM2596S step-down converter to reduce 12V voltage to the voltage required by the devices that I used for this demo (9V, 4.5V, 4.1V, 3V). This step-down converter can be purchased for $1.50 in Aliexpress/Ebay/Amazon and many local electronics shops and I also designed a free enclosure for it. A step-up converter can be used to increase voltage, for example, if you want to get 12 or 9V output from 5V usb power bank. It is not shown in the demo video, but it's also cheap and sold everywhere. If you happen to buy XL6009E1, feel free to use my free enclosure for it. You don't need any voltage converter if the output voltage of your external power supply is exactly the same as required by your device. For example, if some device uses 3 AA batteries and you have a 4.5V AC adapter, you can use it without any voltage converters.

So, here is the thing. Most devices use serial connection of batteries. It means that their voltage is summed up. They can be placed one after another or side by side - their position in the battery compartment doesn't matter, only the type of connection matters. The battery compartment may look like in the figures 1a and 1b.



In this example, we see a serial connection of 4 AA batteries. Each battery gives out 1.5V, but together they give out 1.5*4 = 6V. Once we found the voltage used by the device, we don't need 4 batteries anymore, we only need to connect 2 wires with 6V to the electrical contacts that go inside the device (note that most contacts do not go inside the device but only connect batteries with one another, and only 2 wires go inside the device). This is quite easy with the negative contact that looks like a spring, we can just bind a wire around it. But the positive contact is flat and we cannot make a reliable connection there without some adapter. And this is why I made a few models that have the sizes of the most commonly used batteries. I called them "dummies". First we connect wires to the dummies and then just insert the dummies into the device as ordinary batteries when we need to use it, and remove them easily when we don't need to power the device anymore. These dummies kind of replace a socket for an external AC adapter for the devices that don't have it by design.

It's important to understand that if a device uses 4 batteries, it doesn't mean that you should print 4 dummies. You should only have one dummy with a positive wire and one dummy with a negative wire, and these two dummies will replace ANY number of the batteries with serial connection.



You should know, however, that some rare devices may have intricate connections of the batteries, for example, parallel connection. Figure 2 shows a parallel connection of 4 batteries. Their total voltage remains 1.5V, but the capacity increases 4 times compared to the capacity of one battery. And figure 3 shows a more intricate case - combined serial and parallel connection. Here we have a parallel connection of 2 pairs of batteries that were connected with a serial connection. They give us only 3V, but their capacity doubles. All these connections are rather rare in modern devices, but you should know that they exist anyway.

If you determine the type of the connection incorrectly, you will most likely burn down your device by applying wrong voltage. So, before connecting any dummies to your device, you should find the exact contacts that go inside the device and understand what real voltage should be applied to these contacts. If you have difficulties in understanding it, you can insert real batteries, find the wires that go inside the device and measure the total output voltage on these 2 wires with a voltmeter.

Printing dummies.

I printed with 0.4 nozzle, 0.2 layer height, without supports. Slower speed may improve the quality for the dummies with small layer area, especially for the AAA type. Use brim if the adhesion to the bed is poor and your dummy falls off during the printing process (it was fine for me without brims but with 3D-glue-spray).

Assembling.

The models are universal and designed for any wires that are less than 1 mm in diameter (1.2 mm for 18650 due to possibly high current), however, the holes are designed with 1.8 mm diameter as 3D printers are known to shrink them. If your wires are too thick, you may need some extra work to enlarge the holes with a drill bit or a hot needle. The assembling process is hard to explain, so I made a demo video. As I already mentioned, you will only need one dummy with a positive wire and one dummy with a negative wire in most cases if you deal with 2+ batteries compartments. A dummy with the wires at both sides may be needed for the devices where a single battery is used. It is possible to direct the wires either to the sides of the dummies or to the middle, depending on where exactly the wires should go out of the device. Some compartment lids will not close with the wires going out. The solutions are obvious: either do not close the compartment lid at all or drill a little hole in it and pass the wires through it (if it's a long-term installation but not a single time usage).

Usage.

1) Set the correct voltage in your power supply (or use appropriate source batteries of any type that give out required voltage).
2) Connect the positive wire of one dummy to the positive output of the external power supply.
3) Connect the negative wire of the other dummy to the negative output of the external power supply.
4) Insert the positive dummy to the positive contact of your device.
5) Insert the negative dummy to the negative contact of your device.
6) Enjoy!

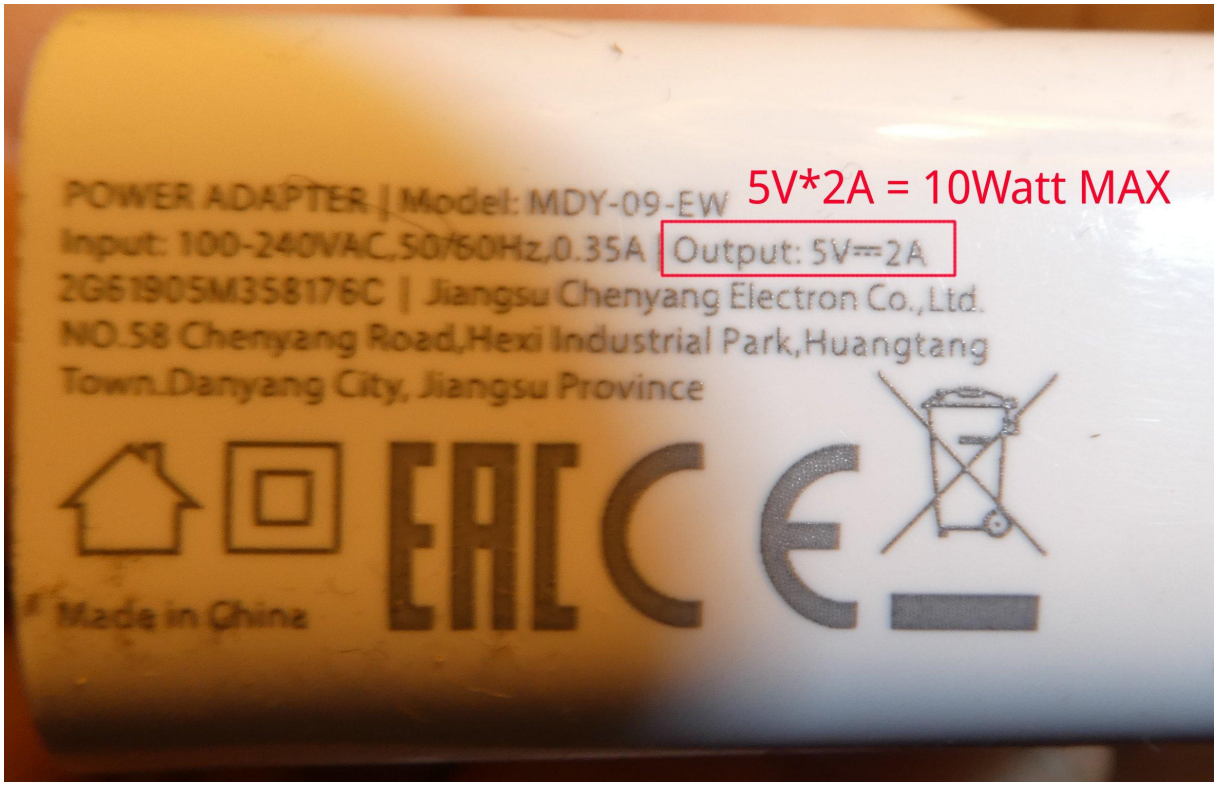
External power supplies to consider.

1) AC adapter - extremely cheap and long-lasting energy for your devices. Use step-up or step-down converters to adjust voltage if needed.
2) Other types of batteries. For example, you can replace AAA batteries with long-lasting D batteries. Converters are not required in this case as the voltage is the same.
3) Li-pol power banks with a USB out - cheap and long lasting energy, fast to charge. May need a step-up or step-down converter to adjust output voltage.
4) Solar panels with power banks (can be used for unattended charging of camera traps in the forest, for example).
5) You name it...

Max current and power.

Your AC adapter or other power supply should be able to provide the max current required by your device. It is written somewhere on the AC

adapter, for example, the following adapter can provide 5V*2A (10 Watt max):



It can be used with the devices that require less than 2A, but it cannot be used with the devices that require more than 2A. In the best case, the motors inside the device will not start and the device will not work properly; in the worst case your AC adapter will burn down (sometimes with the device connected to it!).

The voltage, max current (A) or power (W) should be stated in the datasheet for your device. A=W/V. If you don't have a datasheet for your device, you can measure the voltage and current with a multimeter while the device is used with batteries (I hope you know how to do it correctly, if not, you should learn it somewhere else). Note that the max current can be much higher than typical, for example at the moment when a DC motor starts, so make sure that you use an AC adapter that has the max specified current 2-3 times higher than the typical device current. Just for reference, here is the max tested current for duracell batteries according to their datasheet: AA,AAA=1A; C, D=2A. Your devices shouldn't take more than that if they use these batteries. Although I have an inflatable mattress with a built-in pump that discharges C batteries at 4A and surely they die very quickly!

Rechargeable batteries is another case. 18650 can be discharged at 5-20A depending on the battery producer. Ni-Cd and Ni-MH batteries can also be discharged at more than 10A current. I've got a screwdriver powered with NiCd batteries with a motor that uses 3A at normal speed and 18A at stall!

Of course, you will not be able to use a 2A USB adapter to power such a device! But, for example, the typical current in cheap headlights is usually within the range of 0.5-2A and it can be powered with a classic USB AC adapter.

Max current for LM2596S step-down converter is 2A (some people say it can handle 3A with a heatsink). Keep in mind that max output voltage for LM2596S is 1.2V lower than the input voltage, so if you use a 5V USB adapter as input, you will get from 1.2V to approximately 3.8V output voltage. And XL6009E1 step-up converter also gives out the minimum voltage 1.2V higher than the input voltage, so it will be 6.2V if you use a 5V USB adapter as a power supply.

To cut a long story short, a 2A adapter + a step-up/down converter should be enough to be used with most devices that are powered with AA,AAA,C and D batteries, but some devices with powerful motors may require a more powerful power supply. The devices that use rechargeable batteries by design should be treated with more caution when selecting a proper power supply for them.

Further development.

I only tested AA, AAA and 18650 because this is what I use in real life. They work fine for me, but as different people have different printers and different applications of the dummies, somebody may find that something is not very well designed in my models. In this case contact me and describe the situation, suggest how to improve the model, and if I find your suggestion useful, I will try to improve the models.

There are many types of batteries, I made only those that I have in my household because I needed to measure them before modelling and also check how the printed dummies work in real devices. If you use other types of batteries and want to have a dummy for it, you may suggest it in the comments section, and maybe me or somebody else will make it. You can also make your own remixes for the existing or new types of batteries and add them to the remix section so that other people could easily find them.

If you want to replace a 1604 (9V) battery, there is no need to make a dummy for it, because their connectors are dirty cheap, something like $0.5 for 10 pieces.

But if you are too lazy to buy them, you can disassemble a dead battery and get the top part out of it. You will only need to solder 2 wires to the pins to get your own “eternal 9V battery” :)

LR44 (A76) can be printed fine but be sure to make good insulation between + and -, which is a tricky task due to the tiny battery size. For the same reason I didn't even try to make CR2016 and CR2032 dummies yet, although maybe I'll try later if I have free time to play with it...

Feedback.

If you like my models and find them useful, it would be nice if you could post photos of your dummies and a short description what you use them for. This will let me know that I wasn't uselessly wasting my time when I was wrining this long text :)

Model files

aa_v1.stl

aaa_v1.stl

18650_v1.stl

18650_nopin_v1.stl

c_v1.stl

d_v1.stl

lr44_a76_v1.stl

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