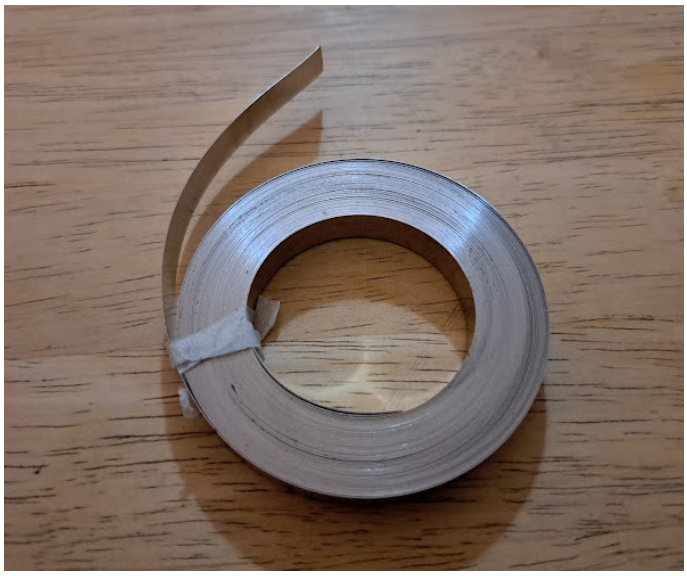
18650 battery pack. 3Cell

First thing you will need are jigs. Now… you can work without these but they just make life easier. I made jigs for 3Cell, 4Cell, and 6Cell, for this example we will be making the 3cell. I'm planning on making the 6Cell in the future and to have all robots running off those instead of the 3Cell. In the future I will leave the 3Cell only for stuff like remote controllers and other hand held stuff. Link for the jigs here: 18650-Battery-pack/Jigs at main · ap-tech/18650-Battery-pack

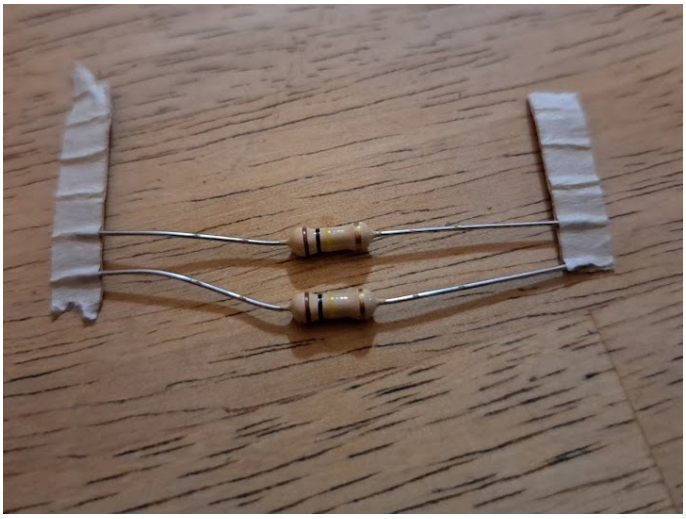
The 18650s. These are a bit hard to get depending on where you live because of regulations in transporting them. The ones you see here are used. given to me by a friend. They were pulled out of old Roomba vacuum robots. And indeed you can do the same. do it safely though since these things can explode if shorted. Now about getting them from AliExpress. I tried once and after ordering from someone who advertised them as having free shipping for where I live and waiting for 3 months with out the tracking updating I learned that the batteries were not coming. So my advice for if you are thinking of ordering from AliExpress is to talk to the seller first. Things to look for once you get the batteries. Check the voltage (especially if used) if the voltage is below 3v? throw it away. Also to look out for is the amp hour number on the side all the batteries in your pack must have the same number.



0.2x8x nickel sheet roll. 10 metres of it from AliExpress. Now I will not be linking any particular AliExpress links for these products since these stores just disappear almost over night so I'll be giving search terms like "nickel sheets 18650" for this product in the pic on the left.

solder preferably lead since these batteries can't tolerate heat (I believe the silver stuff melts at higher temperatures) this is to solder the nickel strips to the battery terminals. I get this stuff from a supplier here in my country. but if you can't find it? you can probably get it from AliExpress. Now this isn't the best way to attach these nickel strips to these batteries because of the high prolonged heat from the soldering iron. but when I get to making the 6 cell ones? I will experiment with spot welding. This I hear is the best way.

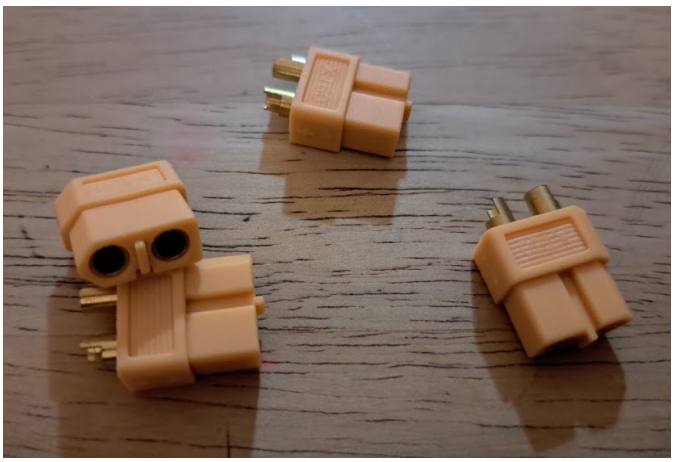
Silicone flexible cable. It is important when working with these batteries that you are using wire with a silicone insulator. These wires are more moisture, heat, and chemical resistant. Colours, Red, Black. 12AWG. (these are the thick wire) And Black, Yellow, Rad. 22AWG. (these are the thin wire) Weird right? But that is how the numbering system on these wires works. the thicker the smaller the number. the thiner the greater the number. I get my supply from AliExpress since I can't find this kind of wire anywhere in my country. Its more expensive than normal wire but well worth it for safety.



100k resistors 1 watt type I get these from a supplier here where I live. But you can also get them from AliExpress too.

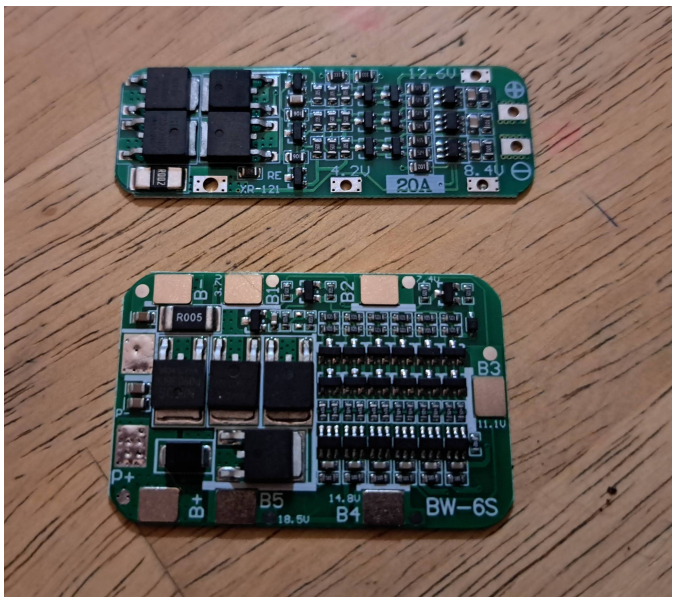
Kapton Tape. I got the 15mm, 20mm, and 30mm width tape. I use this stuff for insulating certain parts and for tying the cells together. For this project I mostly used the 20mm and the 30mm.

18650 Lipo Battery PVC Heat Shrink Tube. 110mm width. From AliExpress.



XT60 Female connectors. I bought a bag of these both male and female from AliExpress. But for making the battery packs we will be using the female ones.

Heat Shrink Tube With Glue. It is important that they are the glue type. These things need to stay on for good, for safety. The sizes 5mm and 3mm for the project in this PDF. something else about the sizing standard for heat shrink from what I gathered it seems that the size is taken from the inside of the tube which makes sense since this stuff has to ‘go around something’ the ones I have from my assortment have nothing written on them and I just measured the inside with a calliper. I get them locally but you can also get them from AliExpress.



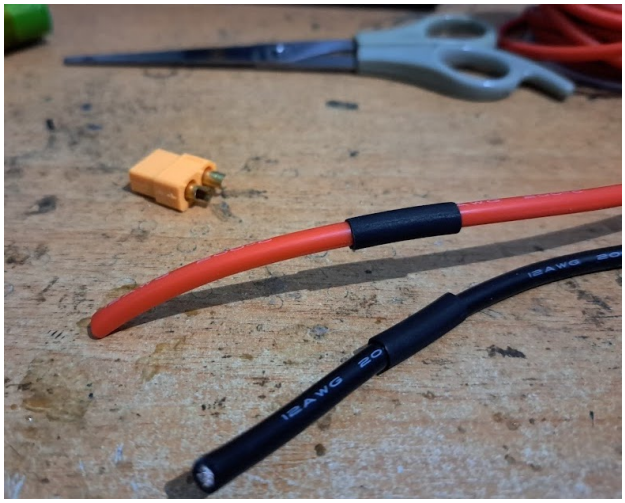
Charge Protection Board. Or “PCB BMS” The one at the top in this pic is the 3cell one. The one we are going to use. The bottom one is a 6cell one for when I make a 6cell battery pack in the future. These I get from AliExpress.

List of the tools you will need starting from top left all the way to top right. And then bottom left all the way to bottom right. Hot Glue Gun, Soldering Iron, Heat Gun, Multimeter, Wire Stripper. Flash Cutter (Or you can just use a Side Cutter), Scissors, And Tin Snips. you may need more tools but I think this is all the tools I used.

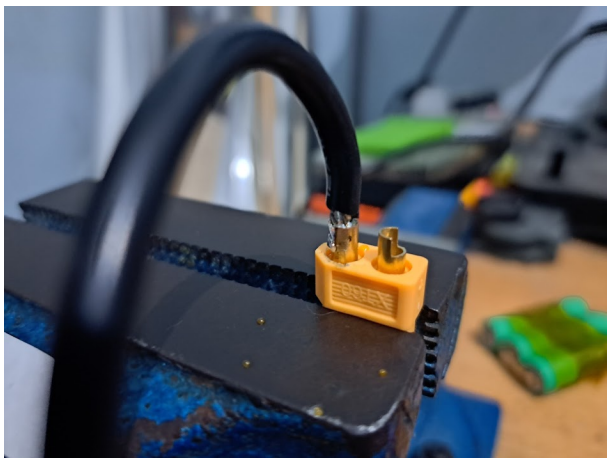
First after having checked the voltage and inspected the batteries for damage. give the anodes of the batteries a good rub with an emory cloth or a mild sand paper this will make solder stick faster to the anodes. Remember. You are trying the minimise the time spent heating them. If you find any scratches on the outer plastic layer just cover it with the Kapton Tape. The body of the battery is the negative so you have to be careful even when levering the old nickel strips from the plus of a used battery not to pinch the plastic that covers the body. Then in an alternating pattern (+-+) or (-+-) you are going to put the cells in your jig. then you are going to solder a dab of lead on all the anodes. Then using the tin snips you are going to cut two pieces of the nickel sheets. the length must be enough to bridge the anodes of two cells in my case it was 25mm. round off the edges by cutting the corners also drilling holes at the ends of the two strips will help the solder heat up faster since the solder is in direct contact with the soldering iron via the hole. So the next step is to apply solder to both ends of the strips then (Like in the right pic) you are gonna bridge from left to the centre cell. Then you are going the turn the assembly over and this time from the opposite or right to the centre cell you are going the do the same. it is important you get this right or you will have a short.

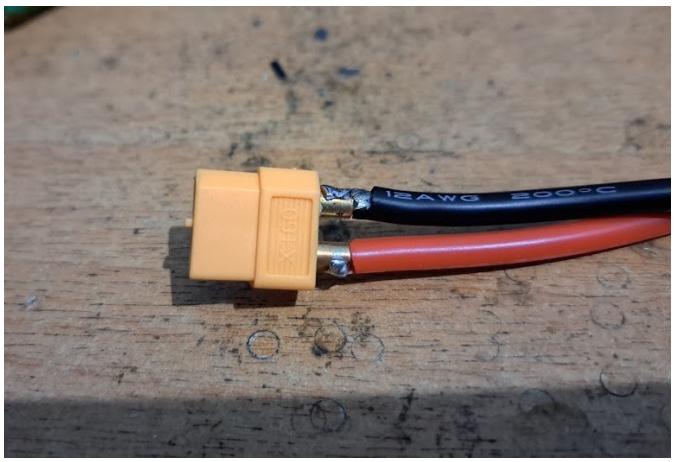
So the batteries here are from a different build that's why the different colour but this is what you are supposed to end up with when you finish the steps from the previous page. Also notice how the nickel strips don't have rounded corners like I mention that you should do in the previous page. Again. this is an older build. So in the first pic the positive output is unoccupied and in the second pic the 0v or negative is unoccupied. These are where the power outputs will be connected. Also I gave the assembly two turns of 30mm Kapton tape to keep everything together.

Now… The first thing you will notice in this pic is the war crime of me holding these cells with a metal jaw vice. Now. I was very careful but don't do this yourselves. Do as I say and not as I do. Here you can see the output nickel strip with the rounded corners this time, Put one on the positive and one the negative. This is what the power output cables are going to be attached too. The length of these nickel strips should be 12mm give or take.

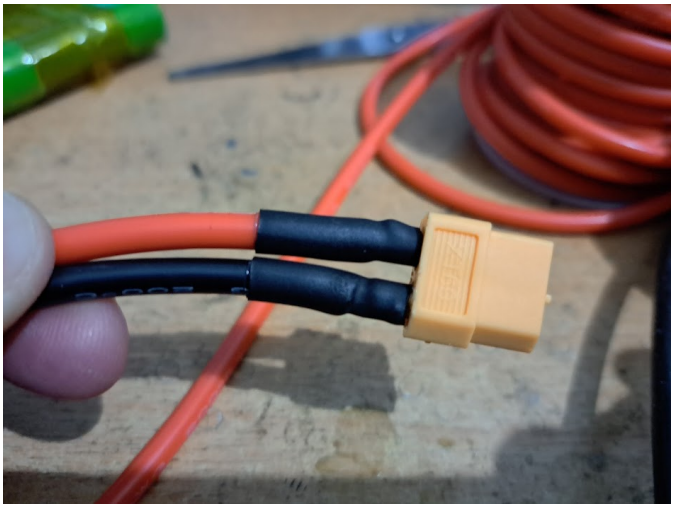


Cut two 20mm lengths of the 5mm Heat Shrink Tube and slide them down the 16WG Red and Black wire. strip the ends of the wire. twist them and soak them in solder.





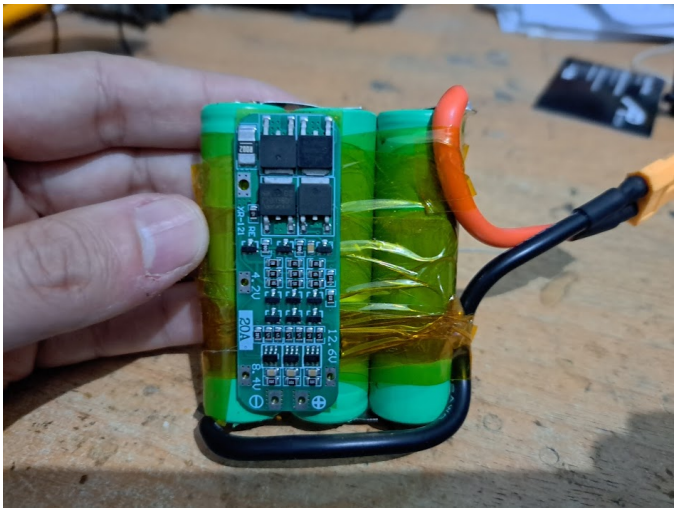
Solder the wires to the XT60 connector. The black (or negative) wire will be connected to the triangular side of the connector. The red wire (or positive) will be connected to the flat side of the connector.



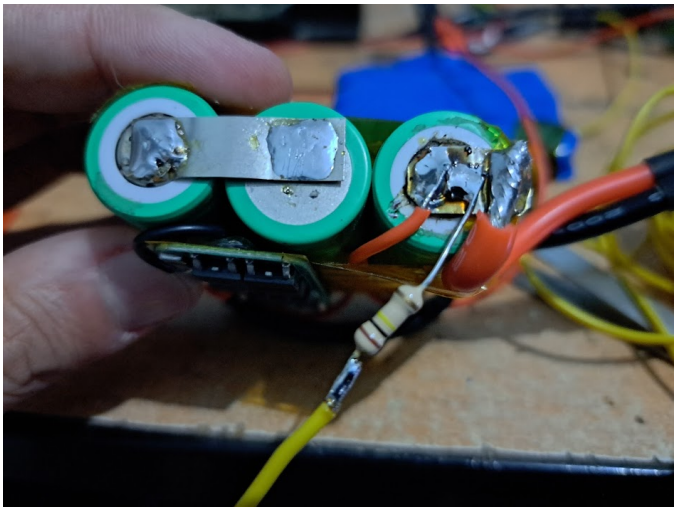
Then you are going to slide the heat shrink tubes down to cover the metal XT60 connectors and using a lighter (A tool that I did not include in the tools list) you are going to shrink the heat shrinks around that those parts.

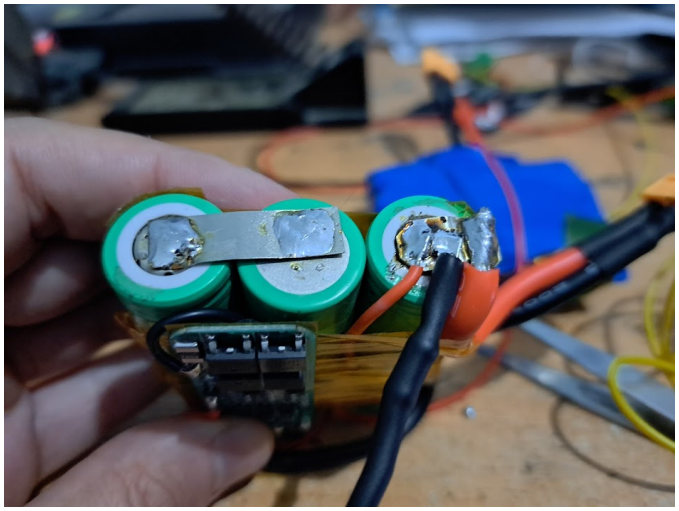
Cut the red wire 12cm. Strip the end, soak it in solder, And attach it to the positive short nickel strip. Then using the 15mm Kapton tape rap the red wire to the assembly in a way where the wire ends up on the centre of the cell. Do the same to the black wire. rap the 15mm Kapton tape in a way where the black wire is coming out of the centre of the cell. Then you are gone measure the rest of the black wire all the way to the bottom negative terminal and you are going to cut it, strip it, soak it in solder, and attach it to the negative short nickel strip. End you should and end up with what looks like the pic on the left. make sure when attaching the wires that the soldered tip are all pointed away from you. This is so that the back insulated bits that are going to create a bump in the heat shrink (when you finally wrap this thing) will all be on one side. This will also be the side you put the BMS on.

Cover the back of the BMS with Kapton tape. It is probably unnecessary but do it just to be safe.

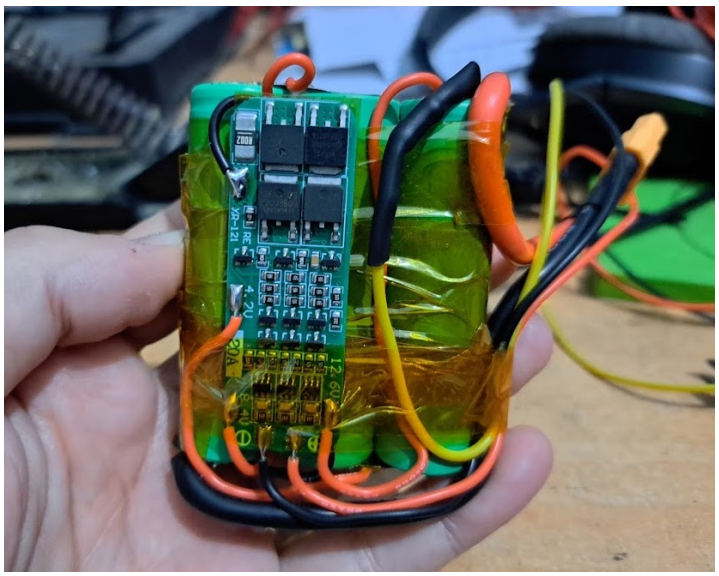


Stick the BMS to the pack between two cells and on the same side where the wires are bulging out from by using the hot glue gun.

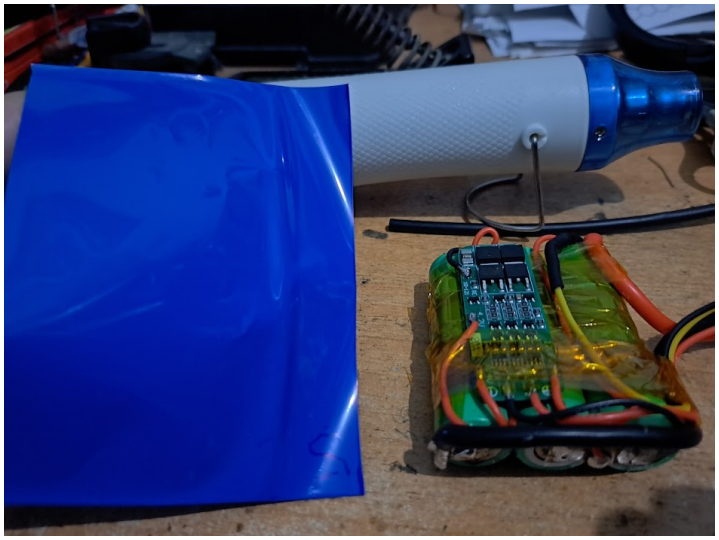


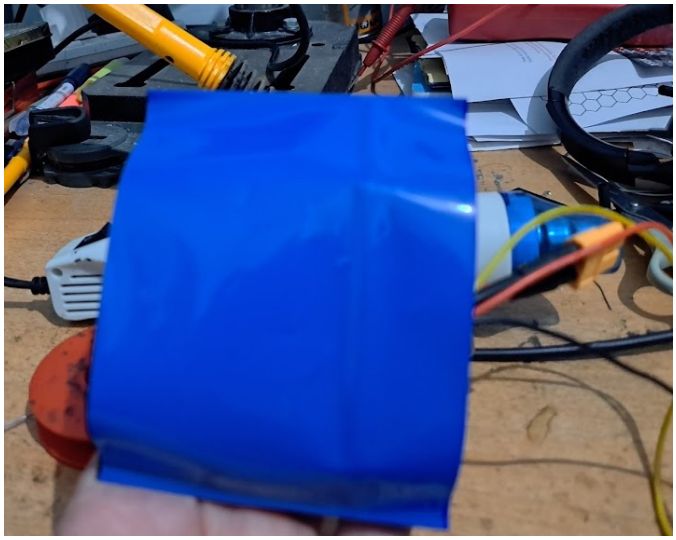


In the left pic I attach a 100K resistor to the positive terminal and on the other side of the resistor I attach the yellow 22AWG wire. This will be our sense wire. The resister is there so as to have one less dangerous wire. We only need to see the voltage while keeping the high current out. Then as can be seen in the left pic. we cover the resistor and the wire in heat shrink. to make everything more safe.

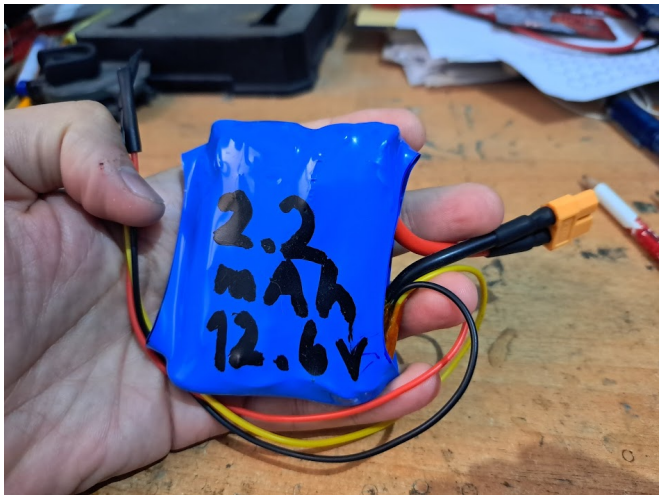


So this part is gonna be all done with the 22AWG wires. One black wire goes from the 0v of the BMS to the negative terminal of the pack (occupying the same space as the thick negative wire) notice how I pass the wires behind the BMS between the cells and under the tape to save space. Next is the BMS pin that says 4.2v connect this using the red wire to the nickel 2 cell connecting strip that is next to the positive output on the top of the pack. Next is the 8.4v (with a red wire again) will be connected to the bottom nickel 2 cell connecting strip the one next to the negative terminal. Next is the 12.6 output (with the red wire again) goes to the output positive terminal next to the big wire and the resistor. The only thing left now is to connect the charging wires to the charging tabs. these are marked with plus and minus. black wire on the minus and the red wire on the plus.





Tie the charge and sense wires with Kapton tape to the pack and cut them to 30cm. Remember these are not just charging wires but the battery can also discharge from them so cut them one by one not simultaneously or else you will create a short. After if you are storing the battery cover the ends of the charge wire and sense wire with shrink tubing. Then in the next pic on the left. You or going to cut 80mm off the 18650 Lipo Battery PVC Heat Shrink Tube. You are going to centre the battery pack inside. and using the heat gun you are going to shrink the tubing around the assembly.



The pic on the left is what you should end up with. I've also wrote down the milliampere-hour and the voltage on the pack. Next time though I will use a finer marker. A question the audience may have is "why don't you use the BMS wires as the voltage out and not just for charging" Well that is because if the BMS thinks you've had enough power for the batteries it will just cut off preventing you from getting more power. that is good in some cases since over discharging these batteries will destroy them. But. imagine if you had a Drone. and the BMS suddenly says "this guy has had enough juice for now" Well then your Drone would just fall out of the sky. Not good. It's better to just bring the Drone back and if needed change the battery.

Written By: Anthony Pirotta.
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Notes:
Disclaimer: AP tech and Anthony Pirotta are not responsible for any fires, explosions, damage or death occurring after someone uses these instructions. Making lithium batteries is a risky activity and one that you and only you are responsible for. Also before following these instructions it is best to have prior electrical, electronics, And soldering knowledge and experience.