

# Sun Fun Kits V4 Assembly Manual

Revision 1.1



## **Before you Begin:**

Thank you for purchasing your Sun Fun Kits V4 DIY heated battery kit, diy battery kits make assembling your battery quick and easy and only require basic tools and hardware to assemble. We recommend having a basic understanding of DC wiring in order to assemble your battery pack and you will also need the following tools:

- Hex driver set: 3mm, 4mm, 5mm, and 8mm
- Insulated drives for securing bolts
- Thread locking compound (such as blue Loctite)
- Kapton or PET tape 1" to 2" in width
- Double Sided Sticky tape
- Velcro style loop
- DC Voltmeter
- Standard scissors
- 90% isopropyl alcohol.
- Adjustable DC Power Supply that is able to charge up battery cells (3.65 volts, 20 Amps) if manually balancing or standard 13.6v to charge the battery.
- 300-400 grit sandpaper

## Optional:

- Electrical Safe Silicone sealant (for those looking to make a water resistant battery)
- Hot glue gun (if you wish to secure wires using this method)





### **Preparing your battery cells:**

Sun Fun Kits DIY battery kits support various prismatic cells, in this manual we will be using the EVE LF304 type, however the process is the same for other manufacturers such as CATL, REPT, Ganfeng and more, the V3 Kit includes spacers and other items to ensure maximum compatibility for cells in this class (270-320 AH)



Certified Automotive Grade Cells generally do not require balancing; however, you may choose to balance your cells, we have a video explaining this process.

This process is explained in this tutorial video:  
<https://www.youtube.com/watch?v=JGbZozzCYvM>

**NOTE:** if you are using an RTB (ready to build kit) the active balancer will assist in top balancing your cells, simply assemble your pack, charge the battery at 5-20 amps and within 1-2 hours your cells should be even balanced. Again, certified cells that are included with your RTB kit will balance very quickly and the active balancer is included simply to assist balancing during high amperage charging (over 80 amps).

### **Assembling your battery cells:**

Starting with version 4 we are now including different cell shims or spacers, this allows users to have a nice tight fit while also adding a third layer of insulation between cells. Version 4 includes 1 set of 1.5mm and 1.0mm shims (3 pieces each). The shims should be placed between the inner cells and most installs will use about 1-3 shims (depending on the install method). For Sun Fun Kits certified cells (LF280K, REPT 280, and LF304) you should be able to use 3 x 1.0 mm shims to complete the install and have a nice tight fit, however for maximum pack longevity and vibration isolating 3x 1.5mm shims will work the best.



If you find difficulty installing the 1.5mm shims you may go down to 1.0 MM shims, you can mix and match the 1.0 and 1.5mm shims as needed to suit your install preference.

**Note: Based on customer feedback, we are now recommending you use the 1.00 shims for the install, the 1.5mm shims should be used only by experienced installers.**

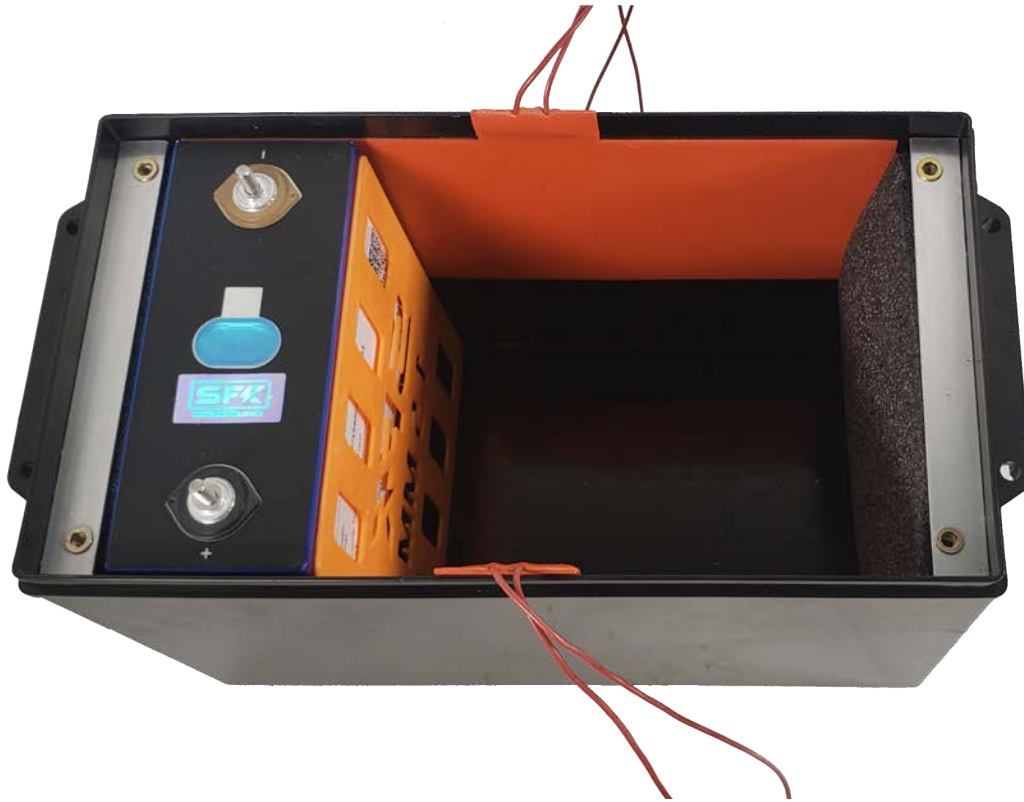
### **Sidewall Heating Setup (Basic setup):**

Version 4.0 includes 2 options for cell heating, a sidewall heating option as well as an in-between cell heating option. Both options will allow you to heat up your battery for low temperature charging (below freezing), however the sidewall heating method is generally an easier install method. **Note: both options will require the use of Kapton / PET high temperature tape.**

Version 4's basic heating element includes dual heating pads on the inside walls of your kit. This provides good heating and will raise the inside temperature of your case evenly. This method is quite easy to install and is the only method that should be used if you are using grade B cells or swollen cells as it provides the most amount of spacing for the cells.



Begin by placing your cells in a series configuration with the left side of the battery having the **positive terminal on the lower left and the negative terminal on the lower right.**

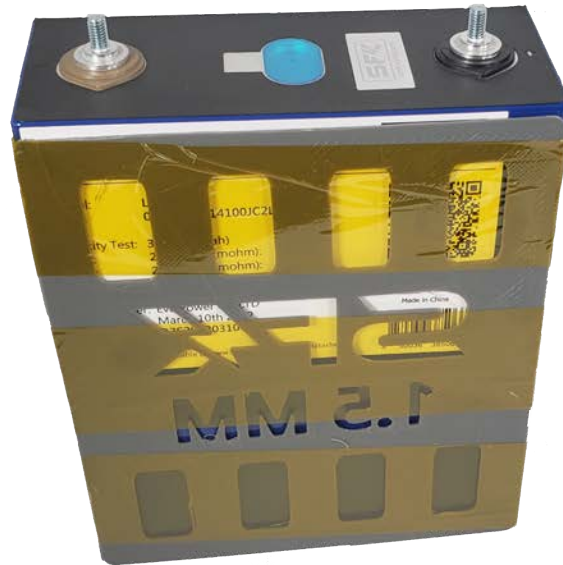


\*Image shown is from the V3.5 Kit, but the install process is the same on V4.

Test fit the cells to get an idea of the installation; you will now need to prepare the cells with shims. For this you have 2 options:

- 1) Place the cells and then insert the shims as you install the cells
- 2) **Recommended:** Tape the shims with Kapton tape to the cells and insert them together into the case.



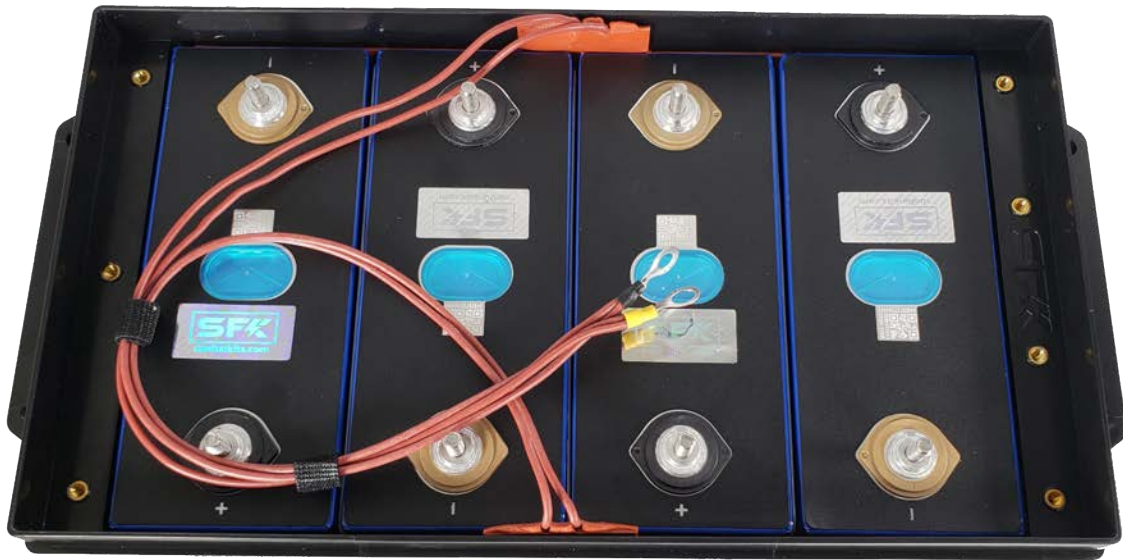


Note: You will want to have the textured side of the shim facing the cell you installed, with the smooth side facing outward. This will ensure the shim stays in place while you install cells.



\*Image shown is from the V3.5 Kit, but the install process is the same on V4.

**Note:** you may find some resistance installing your cells, this is because the EPE foam exerts pressure on the cells to keep them in place; this is why we recommend adding the left most and right most cells first and then adding the remaining 2 inner cells in the end as shown in the picture below:



**PLEASE MAKE SURE TO PLACE CELLS CORRECTLY IN THE ORIENTATION ABOVE.**

V4 kits support various cells and depending on your cell height you may or may not need cell spacers. For the LF280K, REPT 280 and LF304 cells sold by Sun Fun Kits, you will use the 1.5mm spacer on top of the case molded in ledges to raise the height of the support so that it matches the cell. If you are using EVE LF280N or other cells that are 200mm tall you will need the 2.5mm cell booster to raise the height of your cells.

**Note:** Starting with version 4, we are including a “Cell Puller” which will allow you to pull out your cell if you have oriented incorrectly. The V4 kit holds cells tightly in place and this can be challenging if you need to correct the orientation of a cell.





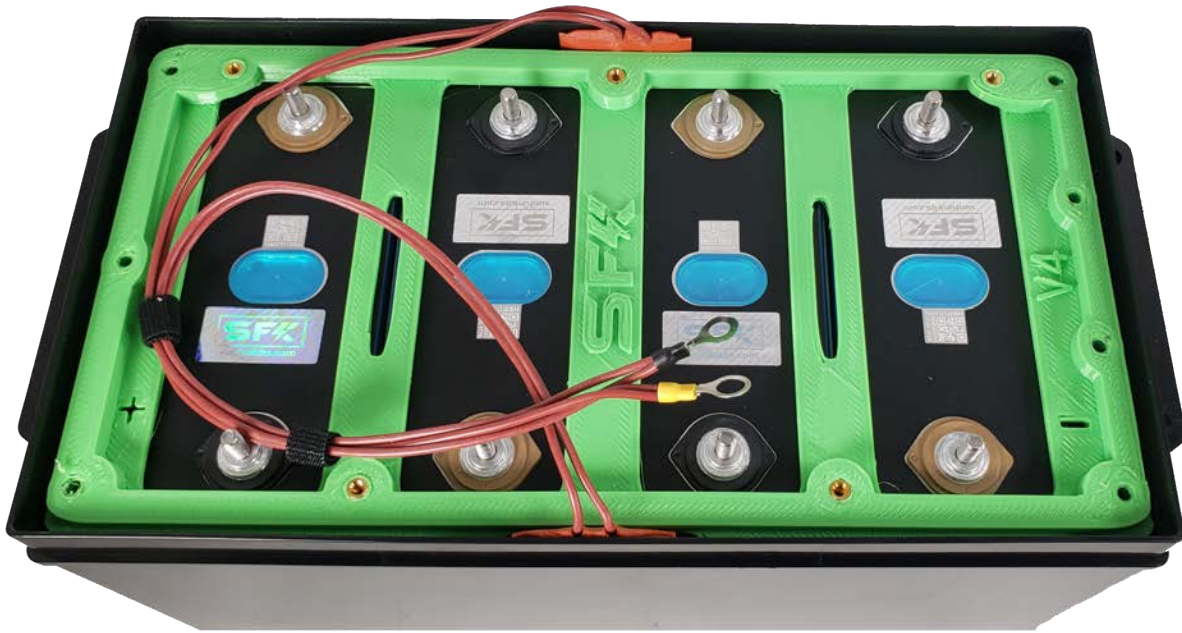
\*Take note of the 1.5mm Shims, these are needed to ensure a level surface for the main cell plate.

The side-mounted silicon heating pads will provide additional resistance to cells when they are being installed, however, there is still sufficient space to insert the cells. It is recommended that you do not install fully charged cells as they will make the process more challenging.

Once your cells are in the correct position; it is now time to install your cell plate. With our v4 kits we have made our cell bracket universal and it should fit virtually all cells in the 270-320 AH class.

Version 4 changes the 4x m5 screws mounting method in favor of 7x m4. This method provides us with superior holding power and also ensures that the plate can not be mounted incorrectly as 1 side has 4 mounting points while the other has 3. **NOTE: Ensure the negative and positive signs on the plate match your cells.**

The side notches on the plate provide the opening channel to route your heating pad wires.



### **Setting up heating using heated cell-separators (advanced):**

The cell separator option is the more advanced heating option available in version 4 kits, this allows 2 cells to be heated by a single silicon rubber heating element; 2 elements in total are able to heat all 4 cells. The direct contact nature of this option means that the cells will heat up faster so there is a potential of having a bigger delta in temperature between the cells and the rest of the case. However, this method will provide for superior cell heating.



Locate the 2 silicone rubber heating elements and attach them to your cells using KAPTON TAPE or PET/Polyester high temp Tape. **DO NOT USE SCOTCH™** or other forms of plastic tape, KAPTON (PET or Polyester BASED) is required to handle the heat being generated by the silicone pads.



Once attached you will be able to place this into your battery case (note in this case there are no heating elements on the sides of the case walls).

As with the non-heated kits, place the leftmost and rightmost cell first, ensuring they have the correct polarity before installing.



For the inner 2 cells you will use a shim for one of the cells to provide the final cell separator for the kit, you can select from either the 1.0mm or the 1.5mm shim depending on how tight you want your install to be (the tighter the better for most installations, however, we recommend going with the 1.0mm shim if this is your first kit).

**Note: for the in-between cell heating install you will only need a single cell shim as the heating pads act as shims as well and being made out of silicone rubber are excellent electrical insulators.**

The textured side of the shim should be facing the cell while the smooth side should be exposed.



Some resistance is normal as this will ensure a tight fit and make sure your cells do not move around, installing the last cell can be a bit challenging, take your time and press into the side foam if you need to to increase the area for the last cell to be inserted in.



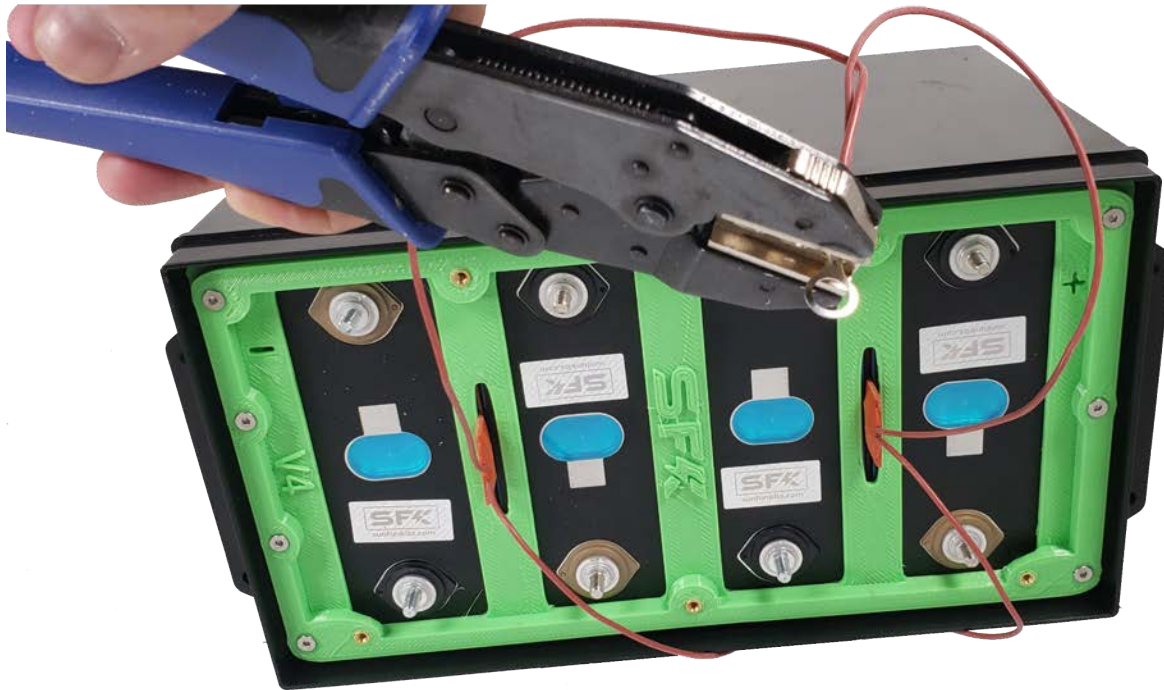
**\*Once you have the base of the cell in, you will need to rock it from side to side to fully insert it into the case.**



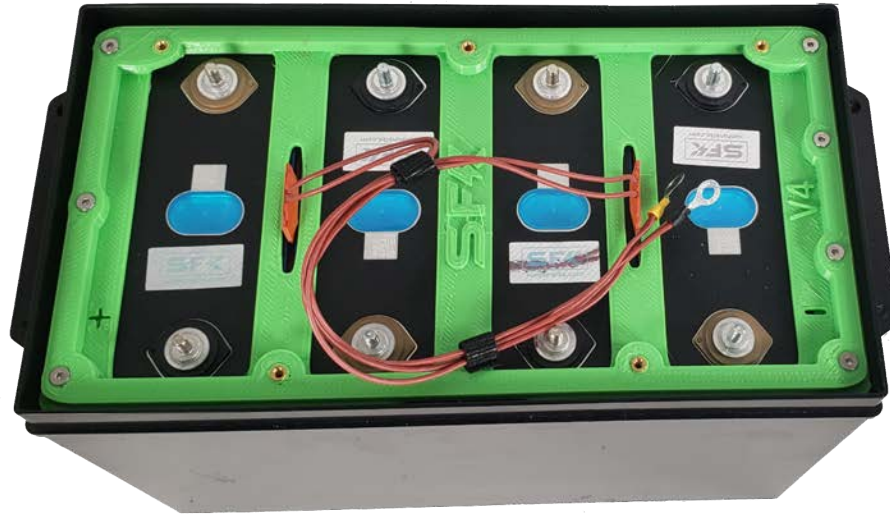
After inserting the cells you will have 2 heating pads and 1 shim, now you can place the cells spacers (shown above as the green pieces that sit on top of the molded ledges) and proceed with mounting the v4 main plate (note the cell spacers are needed for cells that are 204mm or



taller, if you have 200mm tall cells you will not use them install you will place the 2.5mm cell booster beneath your cells to raise the height of your cell to match the molded ledge).



Route the heated cell-separator wires through the dedicated slots on the v4 kit. You will then need to crimp the heating pad wires together. The V4 kit with in-between-cell heating option includes 2 terminal lugs for this: an 8mm diameter yellow lug and a 6mm diameter black lug. Take 1 wire from each pad and crimp it together with the yellow lug, and the other 2 wires and crimp to the black lug. **Note: you must make sure each lug has a wire coming from a different heating pad, do not crimp the wires from the same pad together as 1 lug or it will not complete the heating circuit.**



### **Setting Up Electronics & Cell wiring:**

This step involves wiring up your cells, you will need a BMS system and optionally a supplementary balancing device to complete this step. You will also need to have the appropriate wiring done to complete the electrical setup. If you are using our SFK-200V2 4s Bms, all wiring and prep has been done for you; simply bolt onto your components; no crimping or cutting is necessary.

The V4 kit system will be focusing exclusively with the SFK-200V2 BMS initially, with support for the SFK-150V2 and other BMS units being added in the future.

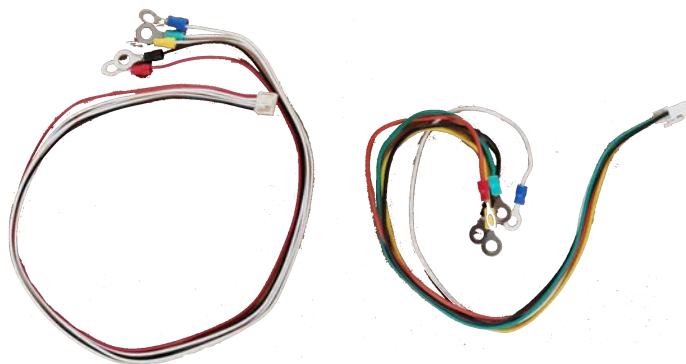


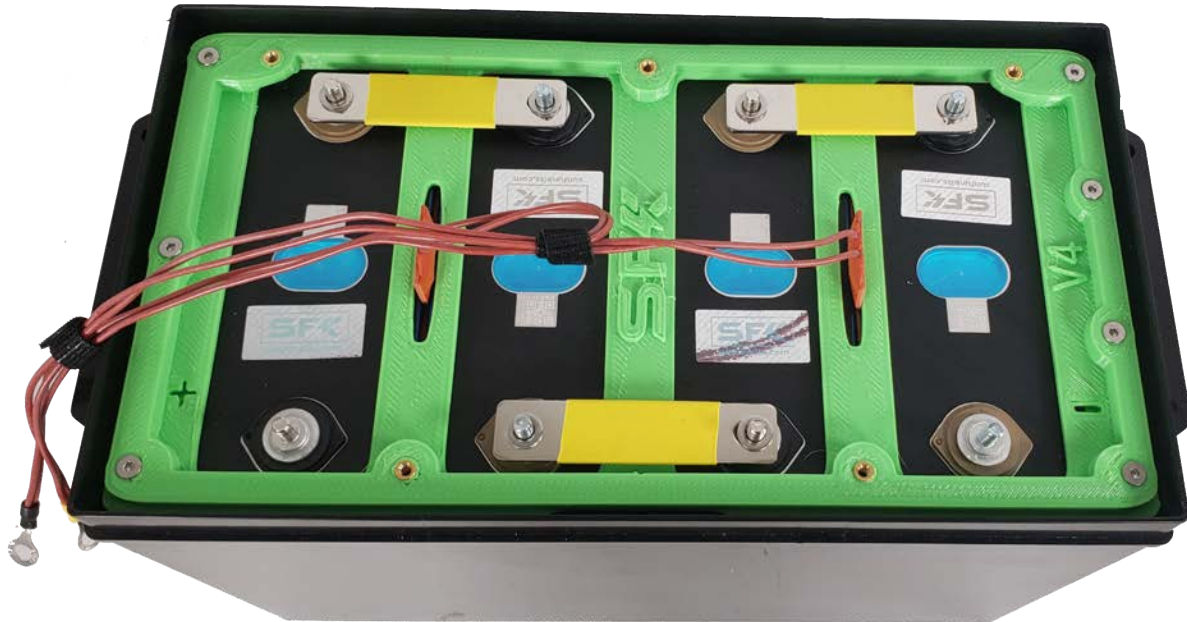
With version 4, we are now using a 3mm / 1/8" thick Garolite FR4 / fiberglass main plate along with aluminum standoffs with custom 3d printed holders to secure the BMS in place. This provides us with superior heat resistance, increased strength, and greater dimensional accuracy for our kits. Many of these changes are in response to queries and suggestions form our customers, we would like to thank you for your input 😊 .

**Note: Before beginning this step it is EXTREMELY IMPORTANT that you clean and wipe down all of your bus bars, washers, terminals and battery post with 90% isopropyl alcohol. Dirty terminals and connections will result in improper readings and poor results.**



Begin by placing your bus bars in the orientation shown below and then place a m6 washer on top of the bus bars, this is needed to provide an even and stable base for your BMS terminals.





Now you will add your series terminals and BMS balancing/monitoring wires as well as the active balancer wires (NOTE the initial negative post; and the final positive post are shared between both the active balancer & BMS, all other posts may be separate for each cell). Place the BMS ring terminal directly over the main lug and then the active balancer ring on top of it.

NOTE: be sure to use the included washers for the BMS and Active balancer terminals. A washer should be placed above each bus bar, for version 4 we are now including M8 nylon lock nuts as they provide excellent anti-vibration capabilities without needing thread locking compound.

Please note your BMS wires should be routed to the positive terminal and the active balancer wires should be routed to the negative terminal.

Your cells should come with the bus bar, terminal studs or welded terminals. Tidy up your install using electrical tape, zip ties, or velcro strips. Setup the wiring schematic as follows:

**Note: CAUTION!!! In many prismatic cells the positive terminal is colored black and the negative terminal is colored brown! Please double check your cells with a volt/multimeter before continuing.**

black wire = cell 1(**black lug**) negative (0.00 Volts)  
1st white wire (**green lug**) = cell 1 positive / (3.3 Volts)  
2nd white wire (**yellow lug**) = cell 2 positive / (6.6 Volts)  
3rd white wire (**blue lug**) = cell 3 positive //(9.9 Volts)  
red wire = cell 4 (**red lug**) positive (13.2 Volts)



\*The 1st white wire is the wire that is right next to the black wire, the subsequent wires will be white wire 2, and white wire 3.

The active balancer should be wired as follows we will be using the negative terminal post for most of the cells for this harness:

**black wire** = cell 1 negative (**0.00 Volts**)

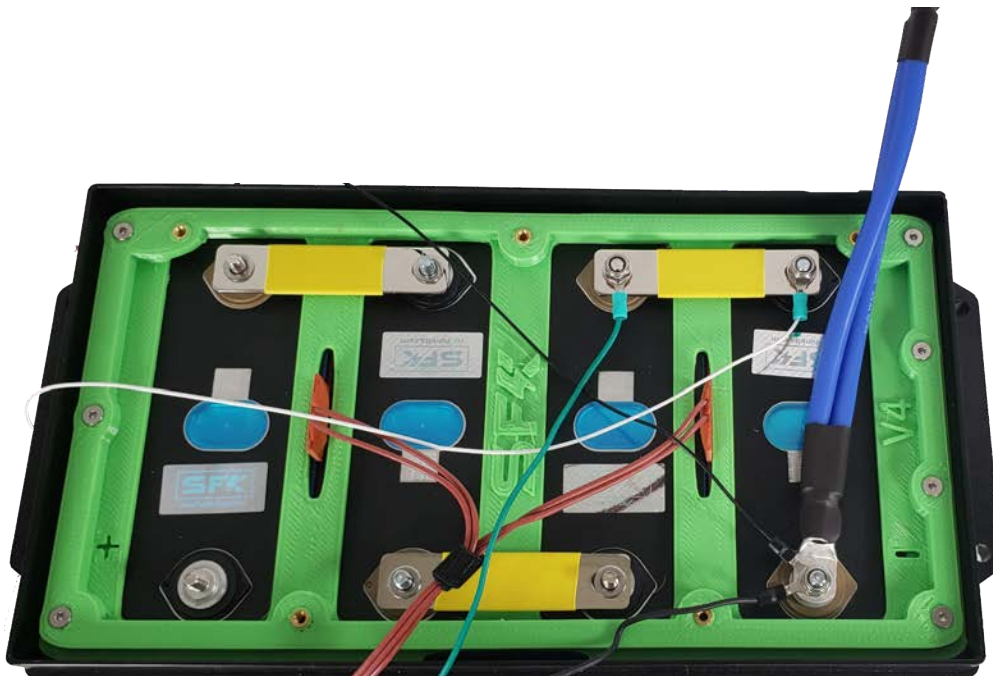
**green wire** = cell 2 negative (**3.3 Volts**)

**yellow wire** = cell 3 negative bus bar (**6.6 Volts**)

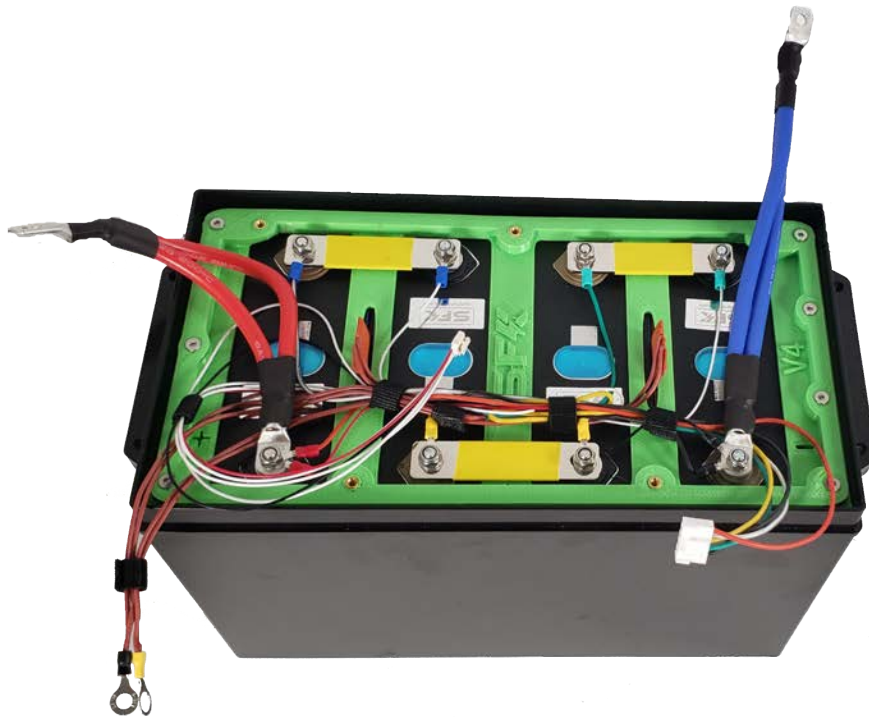
**white wire (with blue lug)** = cell 4 negative bus bar (**9.9 Volts**)

**red wire** = cell 4 **positive** (**13.2 Volts**)

You will need to ensure a tight fit, take care not to strip your battery terminals, if you are using a torque wrench you will want to tighten down to 4-6 NM. **WARNING! Loose terminals will cause the cells & batteries to fail.**



You will align the balancing wires towards the main lugs leaving the center area clear for the active balancer.

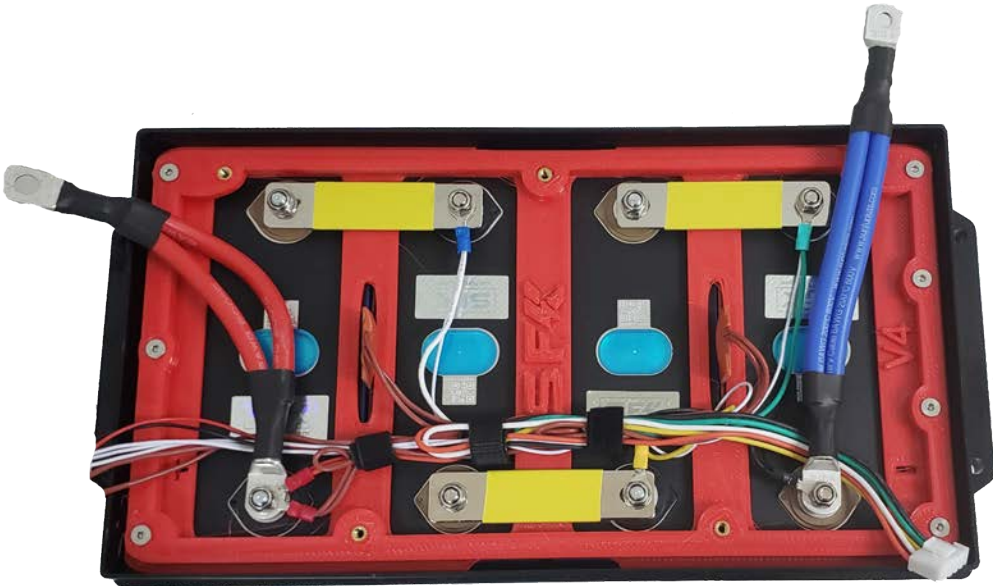


**USE EXTREME CAUTION! THE BLUE WIRE SHOULD NOT TOUCH THE POSITIVE TERMINAL OF THE FIRST CELL OR IT WILL ARC AND DESTROY THE CELL. You should consider covering this terminal with kapton tape or other insulating material to ensure that it can not short circuit the first cell.**

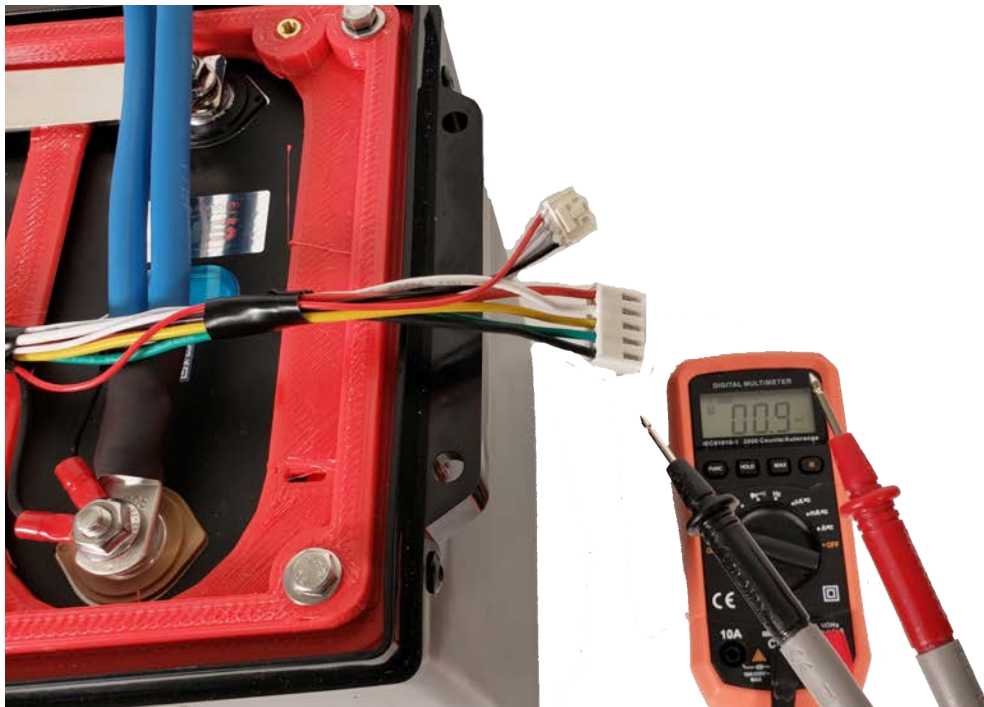
NOTE: Beginning May 20, 2023 all V4 Premium kits now come with a combined AB/Balancer harness:



The combo harness installs just as the regular harness except now the terminals are installed on the main negative of cell 1, cell1 positive, cell 2 positive, cell 3 positive and main positive of cell 4.



NOTE: The heating pad now shares the main positive of cell 4 and no longer requires a connection to the LID.

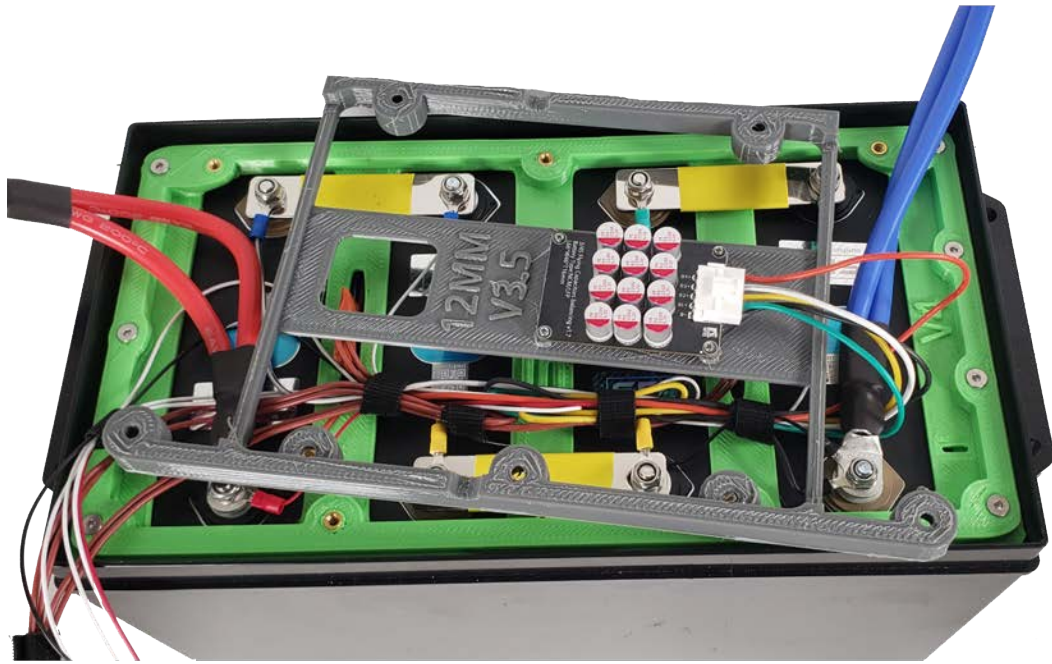


### **Verify your voltages using a volt/multi-meter**

Once you have verified the wiring has been installed correctly, you can now begin by attaching the top plate & your BMS.

### **Installing riser and BMS mounting plates:**

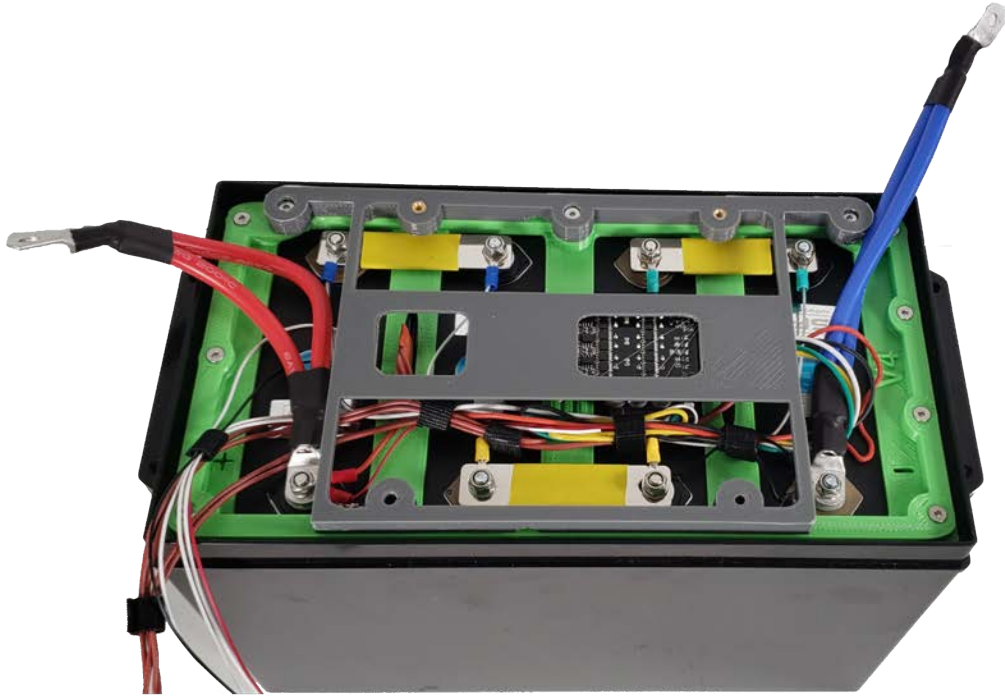
After you have verified that your cells are mounted correctly **AND VERIFIED** they have correct voltage readings, you can now begin mounting the BMS and other related electronics. Begin by mounting the riser plate by first inserting the active balancer connector into the balancing unit and then rotate it so that it matches the mounting holes on the main kit plate:



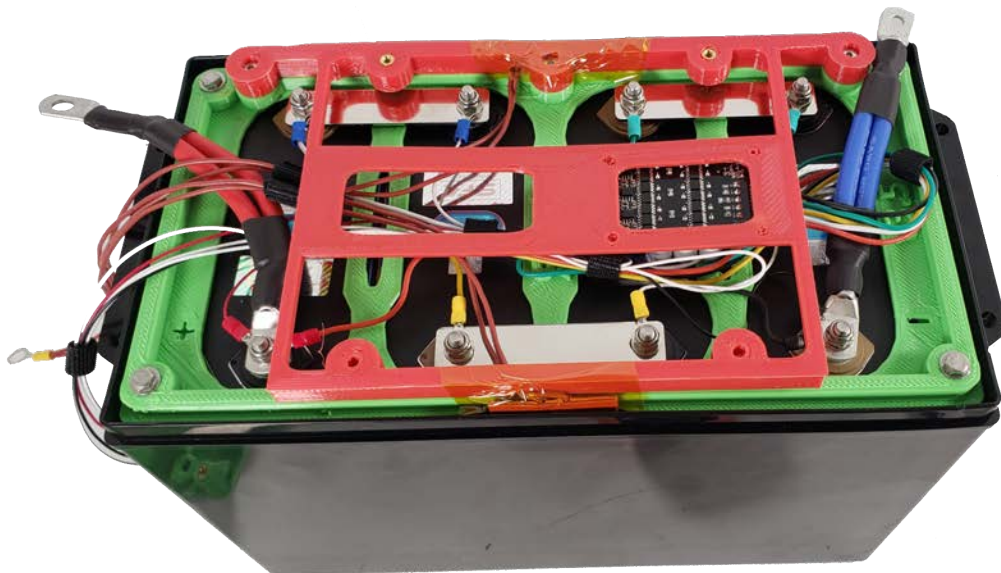
Secure the riser plate using the 3 countersunk M4 screws. We recommend only using hand tools for this process (despite the youtube videos where the installer and author of this manual uses an impact hammer... 🙄).

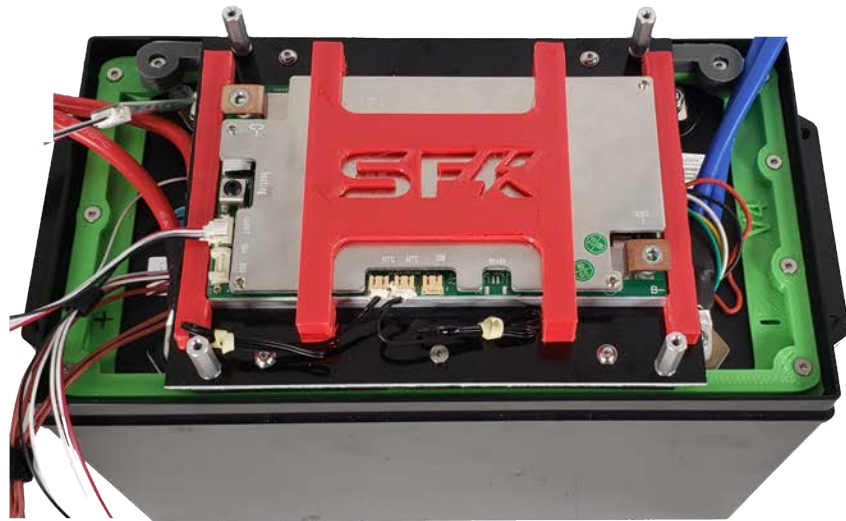
The heated kits will power the silicon rubber heating elements either form dedicated ports on the BMS. With Version 4 we will be exclusively using BMS based heating as based on your user feedback this is the preferred method most users want. The SFK-200 V2 BMS is an excellent choice for this as it has a dedicated heating port that is activated during low temperature charging.





For sidewall heating installs, you will need to secure the heating pad flap to the riser using kapton tape. This is required to ensure that the heating pads do not interfere with the tongue and groove construction of the case and lid.





Install the 3x m4-25 mm bolts on the bottom, and the 2x m4-16mm bolts on top of the bms plate. The next step is to prepare the case lid. **NOTE: Make sure the balancing lead is NOT connected to the BMS! This will be inserted in a later step.**

With the plate secured, it is now time to start attaching the terminal cables to the BMS, this will vary depending on which BMS you are using, for all Sun Fun Kits BMS units, we provide the BMS to you with appropriately sized crimped and ready-to-install wires that you easily attach to your kit.

Please take note of the lug mounting orientation for the blue cell to BMS wire and the black BMS to case lid wire:



**\*The blue wire end with its wires crimped vertically is attached in this inverted lug manor. Secure the wire to the BMS terminal with the included m6 hex bolt.**



**\*Similar to the blue wire, the black bms to case wire is also installed inverted, this allows for greater flexibility in wire routing. Secure with the included M6 hex bolt.**

During the injection molding process some residual abs material may have gotten deposited onto the main brass conductor rings, these need to be cleaned. Using 300-400 grit sandpaper, gently scrub the conductor ring until all traces of residual abs plastic are removed.



Once cleaned, use isopropyl alcohol to wipe clean and then begin to attach the main BMS and cell wires.



Heated kits shall attach the positive terminal of the thermal switch/silicone heater terminal to the final post on the lid (except if you have a new combination harness see page 21). **NOTE: be**



sure that the heater terminal sits **ABOVE THE MAIN LUG**, it should never be below it as this will result in a poor connection resulting in a high resistance connection and will cause damage to your battery.

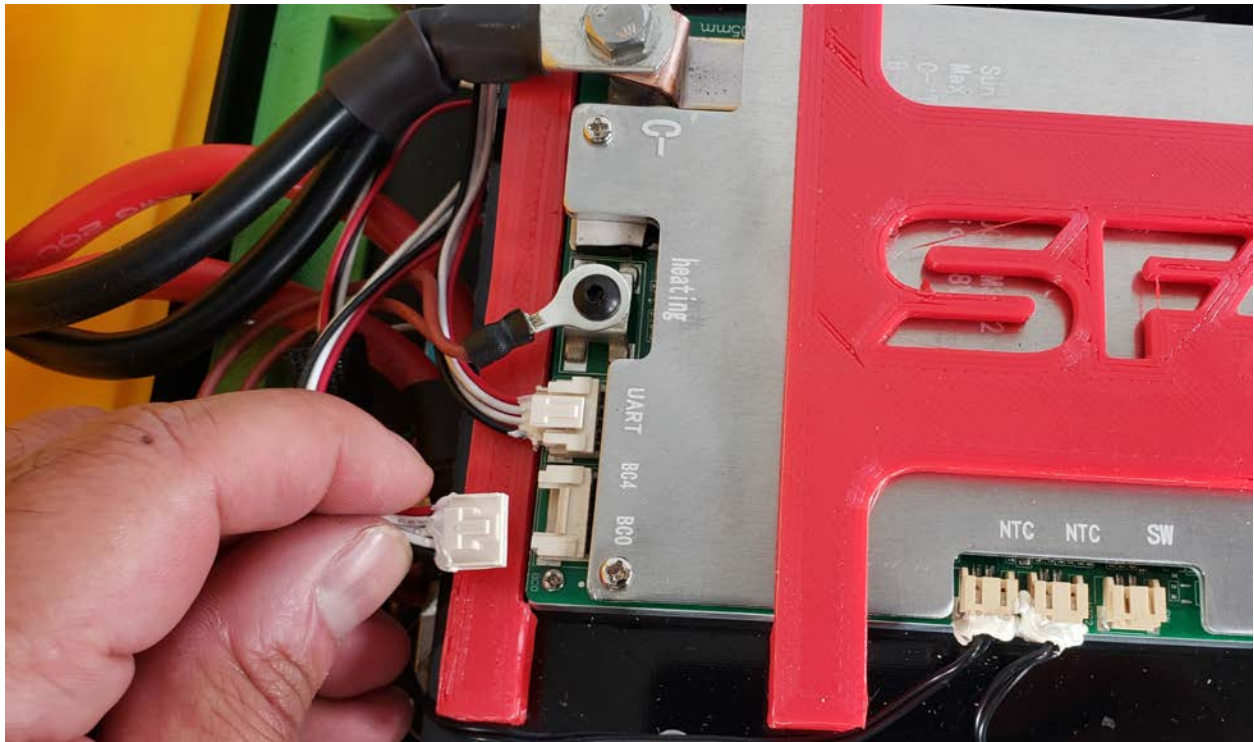
**Brass Conductor Ring -> Main Red Cable Lug -> Yellow Heating ring.**

Secure the battery lid using the included m8x10mm screws, take note that the negative terminal wire sits on top of the red wire for the final install. The space is limited but does fit, however, if you do not have the orientation set correctly, you will find the final step difficult as the case lid will not close properly.

Most BMS units will include one or more NTP probes, these can be mounted at the position of your choice. For The SFK-200V2 BMS unit, you may place these on one of the cells or on the mounting plate (to get internal case temperature).

**ENSURE A TIGHT FIT!** You must make sure the bolt is making proper and solid contact to the brass insert, a loose contact will generate heat and can lead to battery failure. Ensure at least 8-12 NM torque setting (appx 110 inch/lbs).

Once the lid wires are secured, you can now insert the balancing wires into your BMS.



Finish off by bolting down the top lid using the 4x16mm countersunk screws. **USE HAND TOOLS! No Impact Drivers for this step!**





Optionally, if you would like to have a moisture/water resistant seal, you can use electrical safe silicone (low order) sealant between the lid and the lip of the battery. A good example is this brand:



Simply apply a bead of it before closing the lid, we have a video of this process (shown on a v1 kit):

<https://www.youtube.com/watch?v=g7AIX0kE1Lw>

The last step in your kit assembly is to attach the handles & grips. This process is very simple: thread the nylon rope through the plastic barrel and through the hole on the kit handles.



Once through simply insert the nylon barrel into the built in latch using a flat head screwdriver:



Once done your kit is now complete and ready for testing.

**Monitoring Apps & Tests:**

You can now connect to your battery and perform tests; visit Google Play Store or Apple IOS App store and search for: Sun Fun Kits BMS

<https://play.google.com/store/apps/details?id=com.companyname.sfkble&hl=en&gl=US>

<https://apps.apple.com/tt/app/sun-fun-kits-bms/id1600445506>