Sun Fun Kits V3.5 Assembly Manual

Revision 1.3

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)

Video Manual (V3 Manual):
If you are more of a visual learner, you can view the build process on our official youtube channel: https://youtu.be/tWm65Pu0GuI

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 3.5 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 3.5 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 3 shims. For Sun Fun Kits certified cells (280K and LF304) you should be able to use 3 x 1.5mm shims to complete the install and have a nice tight fit.

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.

OPTION1: Basic Heating Element Setup:

Version 3.5'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.

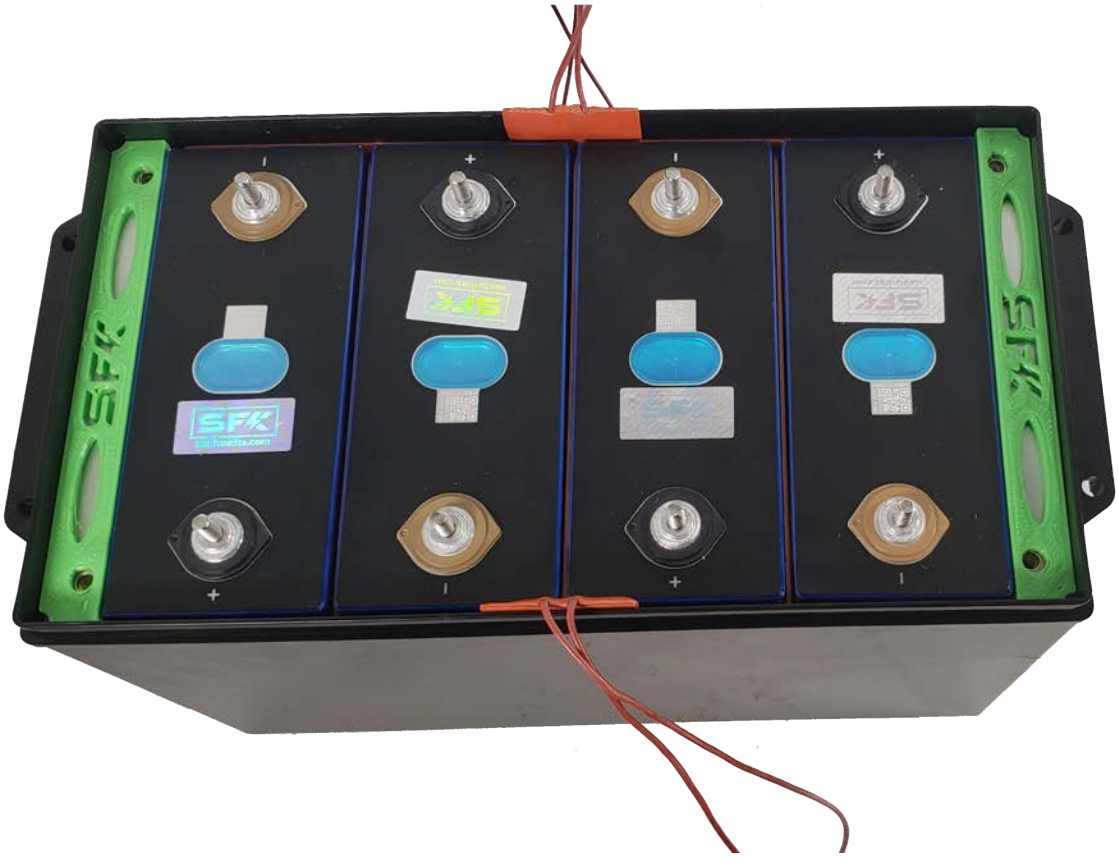
Note: You will want to have the textured side of the shim facing the cell you installed, with the smooth side facing the empty space. This will ensure the shim stays in place while you install cells.

For the last cell make sure the shim's smooth side is facing the opening, in this case we will be inserting cell no.2 and both sides of the shims will be smooth for an easy install.

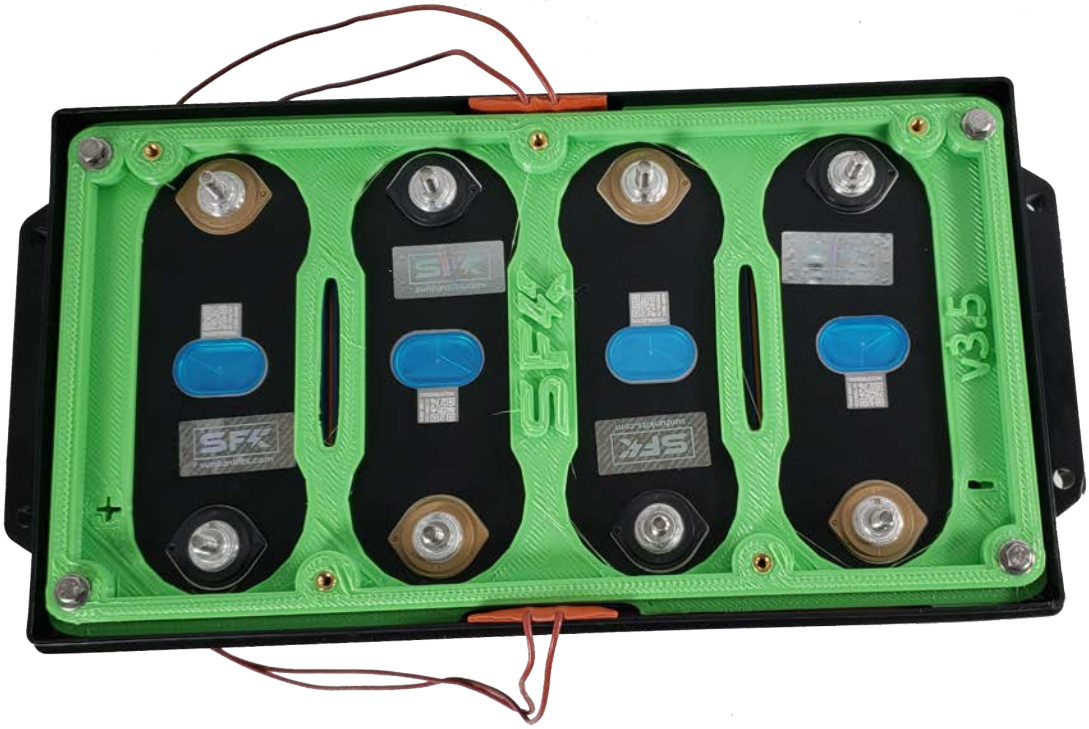
Note: you may find some resistance installing your cells, this is because the EPE foam exerts pressure on the cells to keep them in place; this is why we recommend adding the left most and right most cells first and then adding the remaining 2 inner cells in the end as shown in the illustrations above.

PLEASE MAKE SURE TO PLACE CELLS CORRECTLY IN THE ORDER ABOVE.

V3.5 kits support various cells and depending on your cell height you may or may not need cell spacers. For LF280K and LF304 cells sold by Sun Fun Kits, you will use the 4mm spacer on top of the aluminum braces 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 can skip this step as the aluminum bracket matches the height of your cells.



The heated kits 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 challenging.



Once your cells are in the correct position; it is now time to install your bottom bracket. With our v3 kits we have made our cell bracket universal and it should fit virtually all cells in the 270-320 AH class.

Install the bottom bracket with the M5 bolts and washers, you can use power tools to assist in this step. **NOTE:** Ensure the negative and positive signs on the plate match your cells.

Version 3.5 has a notch cut on the upper and lower middle to allow the wires from the rubber heating elements which provide a channel for the wires into the main battery assembly.

OPTION2: Setting up heating using heated cell-separators (advanced):

The cell separator option is the more advanced heating option available in version 3.5 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 1.0m or the 1.5mm shim depending on how tight you want your install to be (the tighter the better for most installations).

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

You will use the same method to install the final cell as in the non-heated kits and work the cell in. Some resistance is normal as this will ensure a tight fit and make sure your cells do not move around.

After completing you will 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 aluminum brackets) and proceed with mounting the V3.5 main plate (note the cell spacers are needed for cells that are 204mm or taller, if you have 200mm tall cells you do no need to add the cell spacers on

Route the heated cell-separators through the dedicated slots on the v3.5 kit.

You will now need to crimp connectors to the wires of your heating pads, to do this you will need to crimp 1 wire from each pad together for the yellow terminal (this will go to the positive lug on the case) and 1 wire from each pad to the black terminal (this will go to the heater port on the BMS). **DO NOT CRIMP BOTH wires of the same pad together it will not complete the circuit.** Which wires you chose does not matter as long as the wires being crimped are not from the same pad.

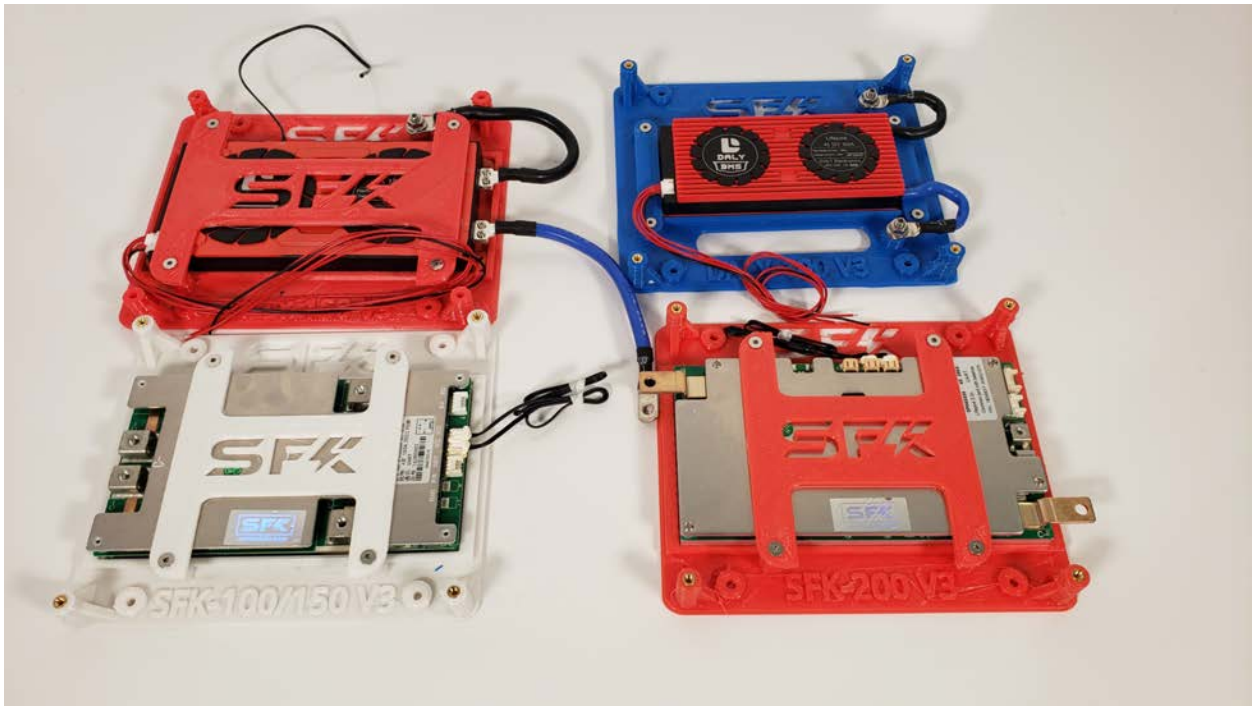
Setting Up Electronics & Cell wiring:

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.

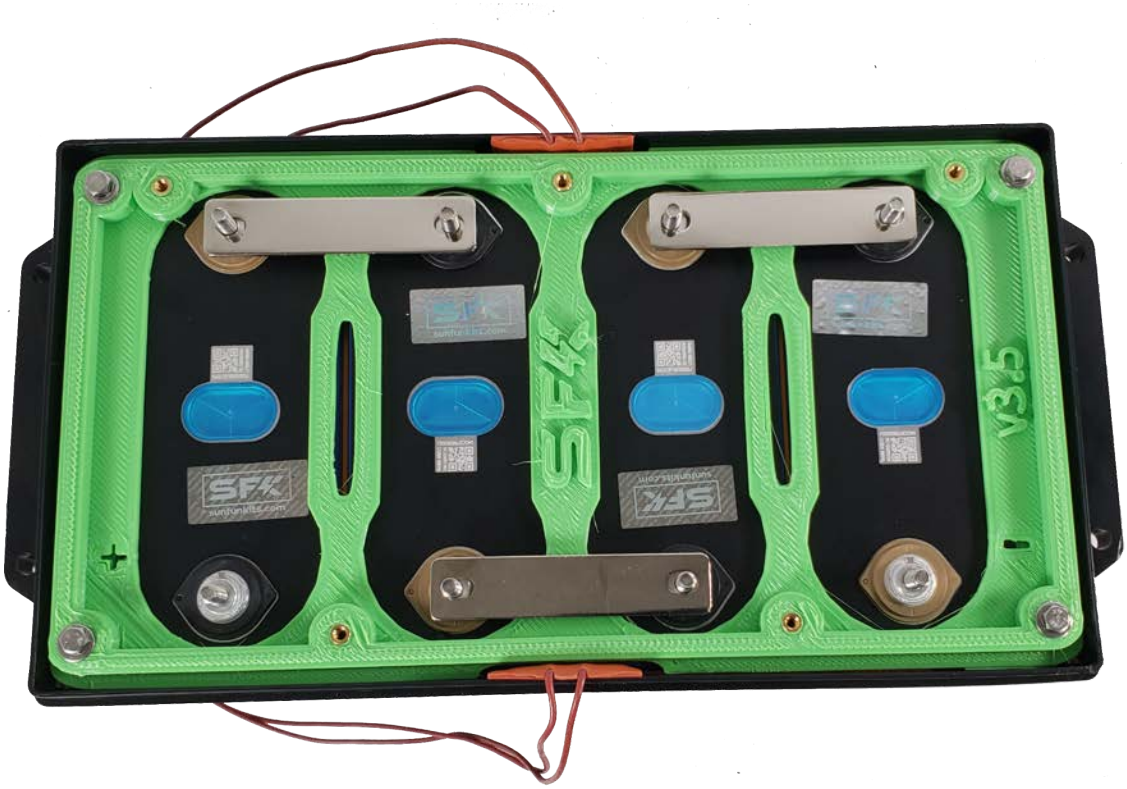
Begin by placing your bus bars in the orientation shown below and then place a m6 washer on top of the bus bars, this is needed to provide an even and stable base for your BMS terminals.

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.

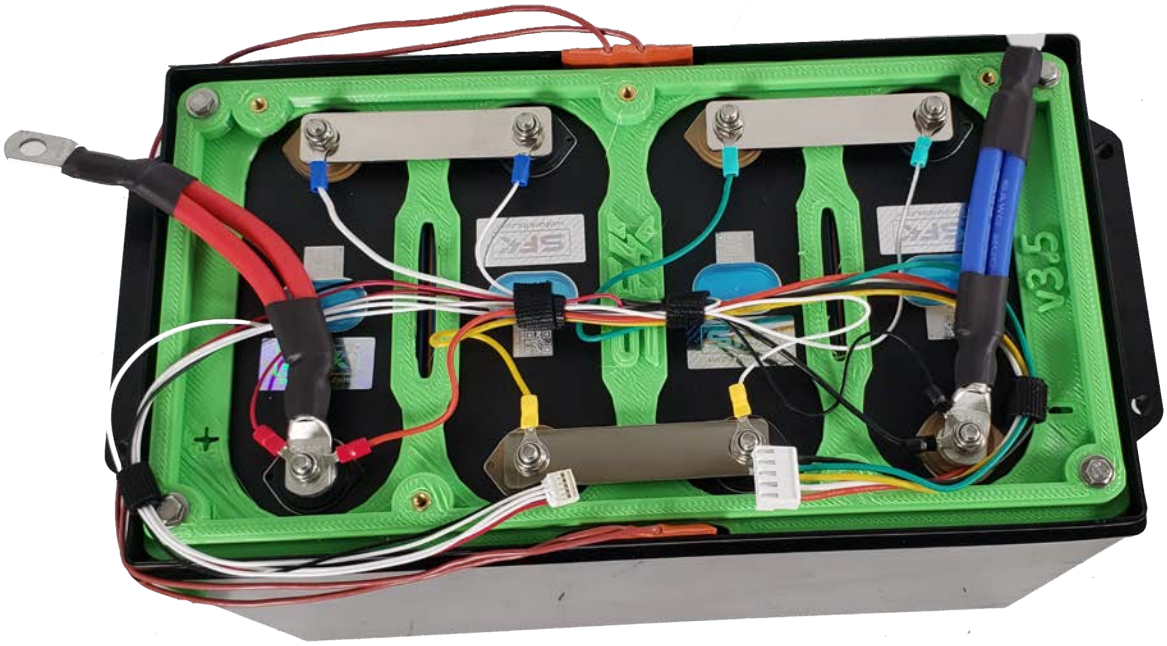
The V3.5 kit system supports various BMS devices from manufacturers such as JBD (SFK Series), Daly, Ant, QUCC, and more. New device support is being added constantly; if you need a specific mounting plate made, simply contact Sun Fun Kits support at cs@sunfunkits.com



Begin by aligning your buss bars as follows:



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)



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: be sure to use the included washers for the BMS and Active balancer terminals. A washer should be placed above each bus bar, and optionally above it. For version 3.5 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.

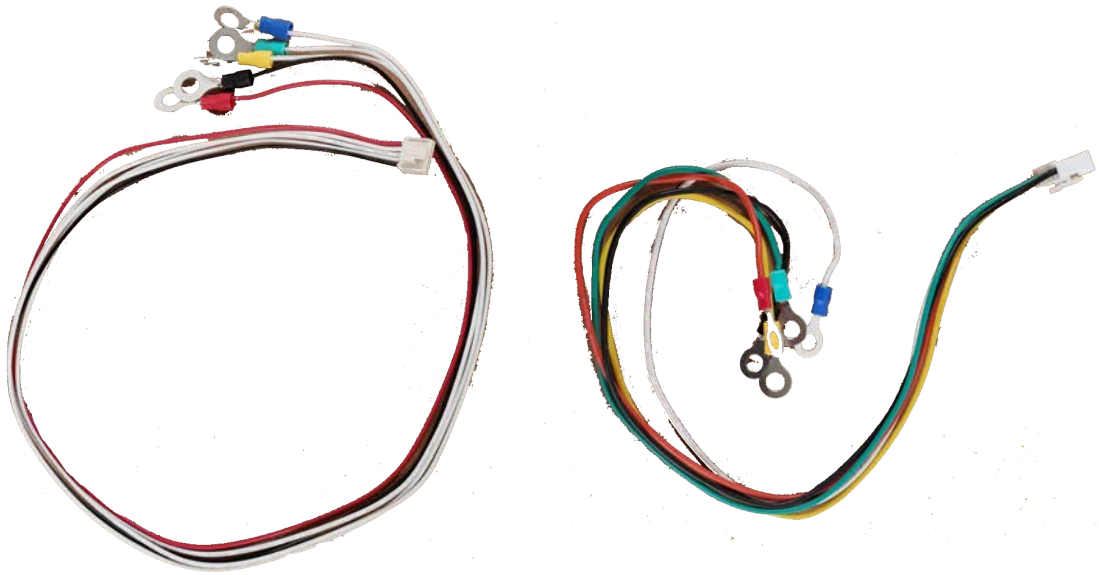
black wire = cell 1**(black lug)** negative **(0.00 Volts)**
1st white wire **(green lug)** = cell 1 positive / **(3.3 Volts)**
2nd white wire **(yellow lug)**= cell 2 positive / **(6.6 Volts)**
3rd white wire **(blue lug)** = cell 3 positive /**(9.9 Volts)**
red wire = cell 4 **(red lug)** positive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

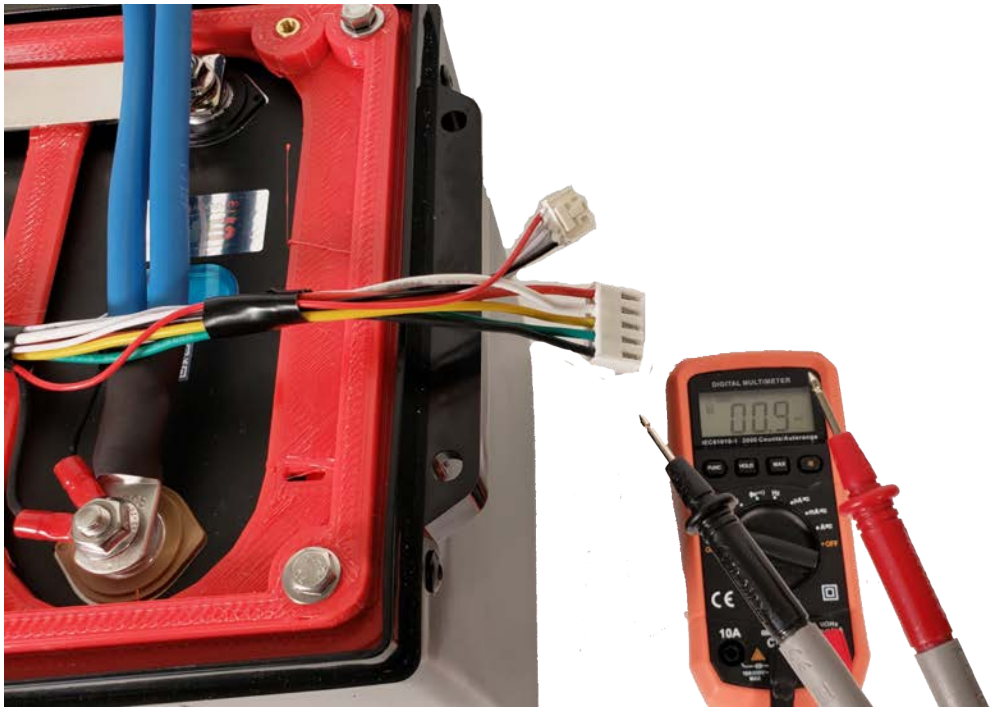
You will need to ensure a tight fit, take care not to strip your battery terminals, if you are using a torque wrench you will want to tighten down to 4-6 NM. **WARNING!** Loose terminals will cause the cells & batteries to fail.



With version 3.5 we have color coded the BMS wires to match the active balancer to assist in installs, you can use this combination to ensure you have matching connections.

If you are using a supplementary balance, you should install this as well, you will need to share the final negative and positive terminals of the battery for the bms and the supplementary

balancer.. **Make sure the wired main lugs are the ones that touch the cell terminal** and only stack the other bms and active balancer rings on top.



Your voltages should read:

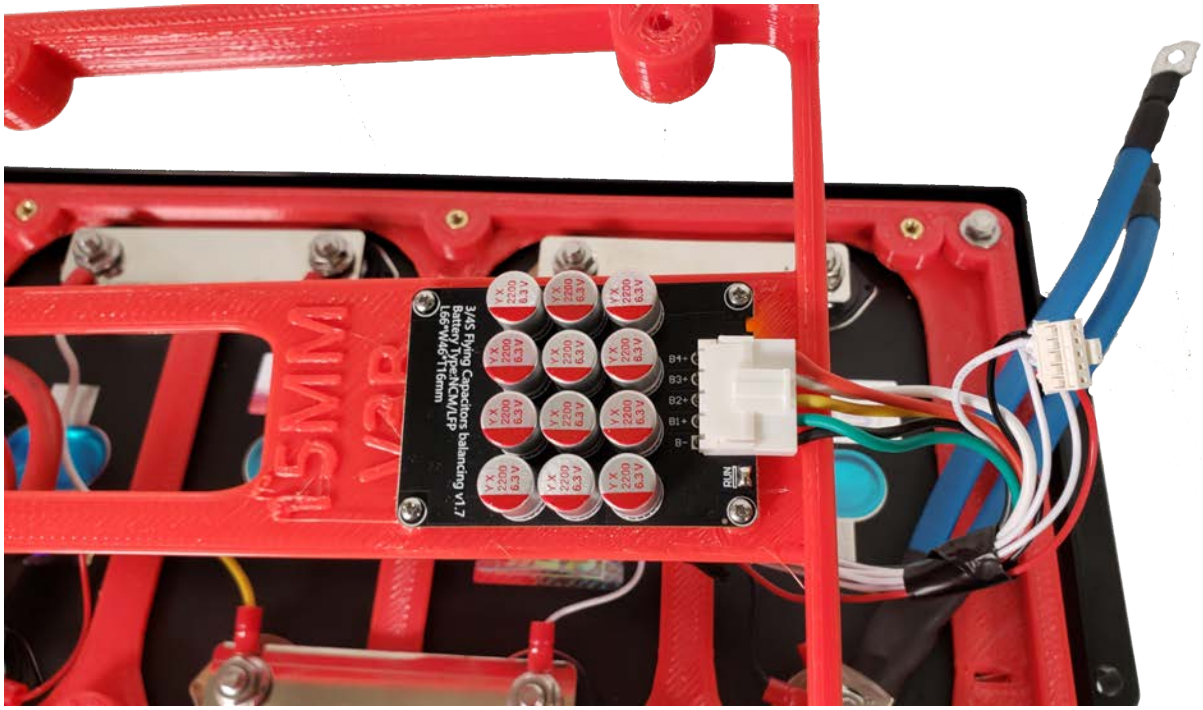
3.3, 6.6, 9.9,13.2 (Nominal Voltage).

All V3.5 RTB kits include the active balancer, and we highly recommend using it as it reduces the balancing stress on your BMS and is able to balance out cells significantly faster during charging.

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

<u>Installing riser and BMS mounting plates:</u>

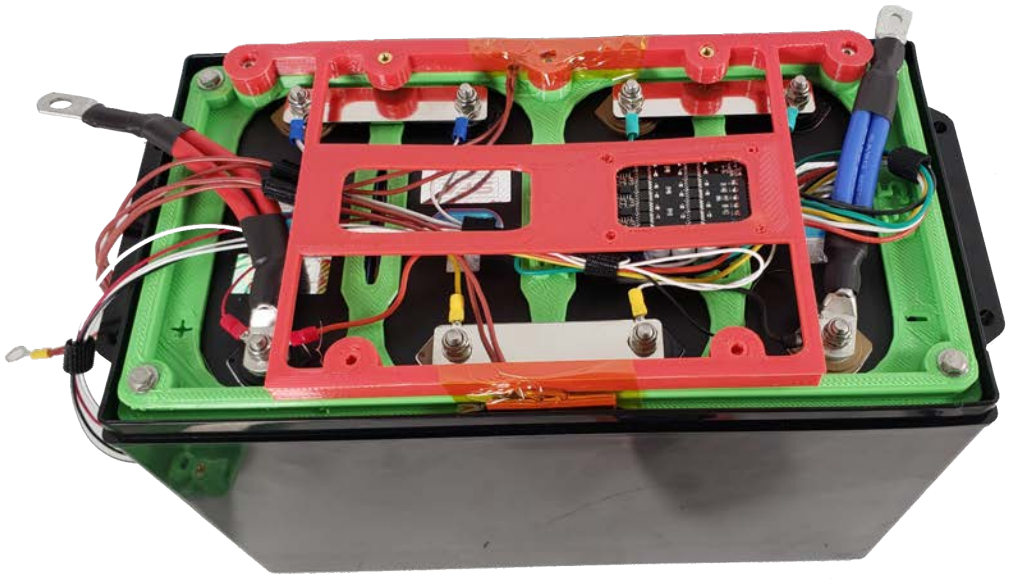
After you have verified that your cells are mounted correctly **AND VERIFIED** they have correct voltage readings, you can now begin mounting the BMS and other related electronics. Being by mounting the riser plate by first inserting the active balancer connector into the balancing unit and then rotate 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. Starting with Version 3.5 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.

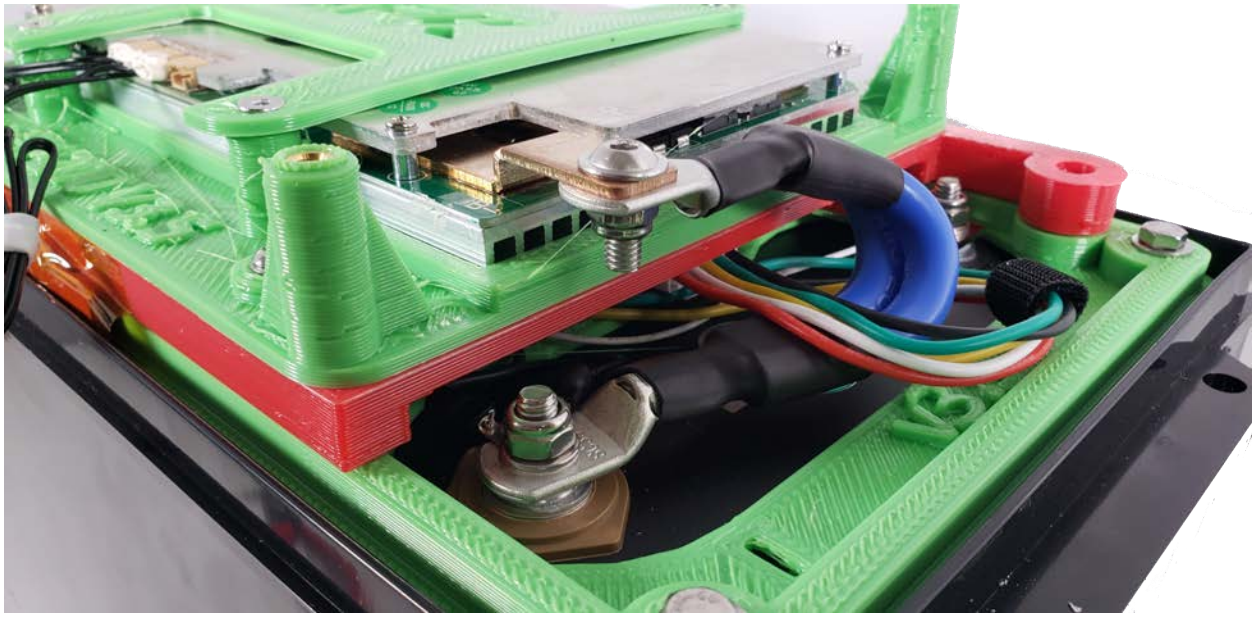
For heated kits it is recommended to use kapton tape to secure the wires and flap of the silicon rubber heating elements to the sides of the riser plate.



Install the m4x15-25 mm bolts on the bottom, and the m4x15mm bolts on the top.

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, we provide the BMS to you with appropriately sized crimped and ready-to-install wires that you easily attach to your kit.



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 and on a mounting plate (to get internal case temperature).

NOTE: With hardware revisions, you may receive slightly different BMS mounting terminals, if this is the case use the images below as a reference for your install:

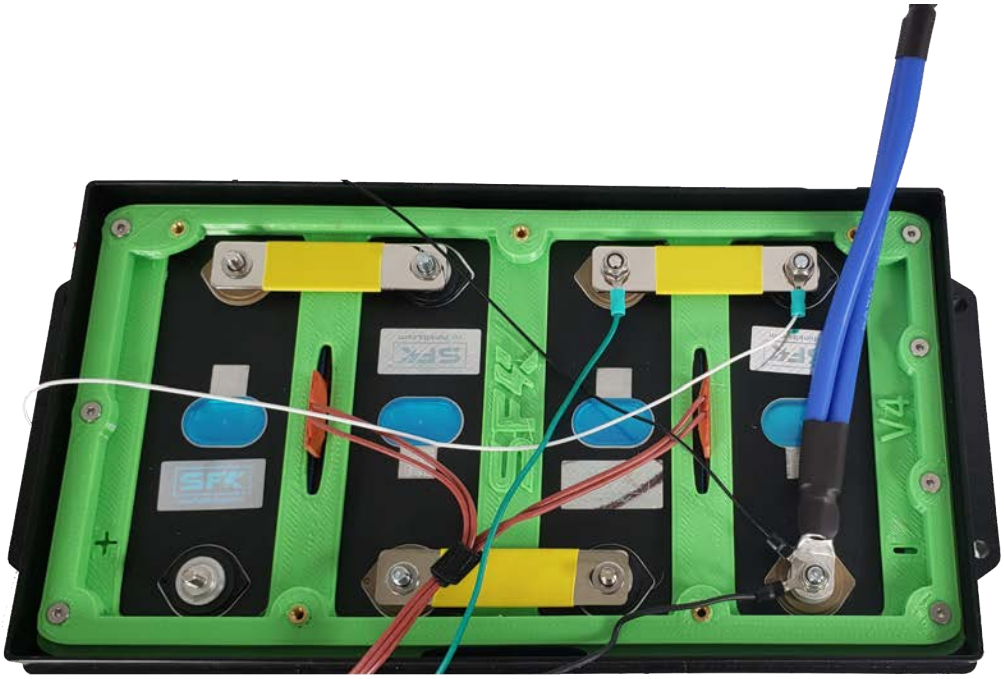


Image shown is from the v4 kit.

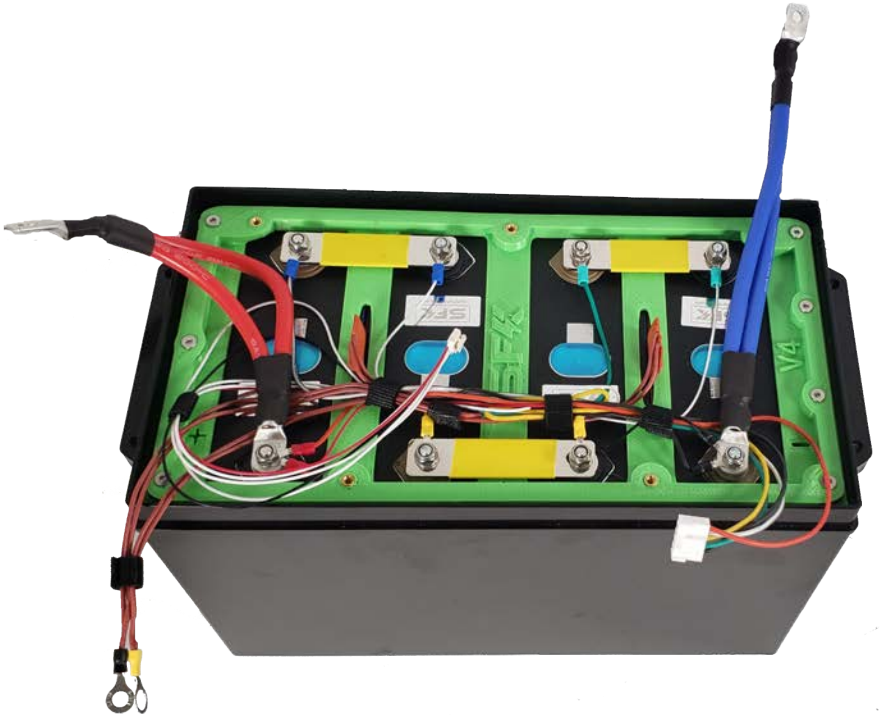


Image shown is from the v4 kit.

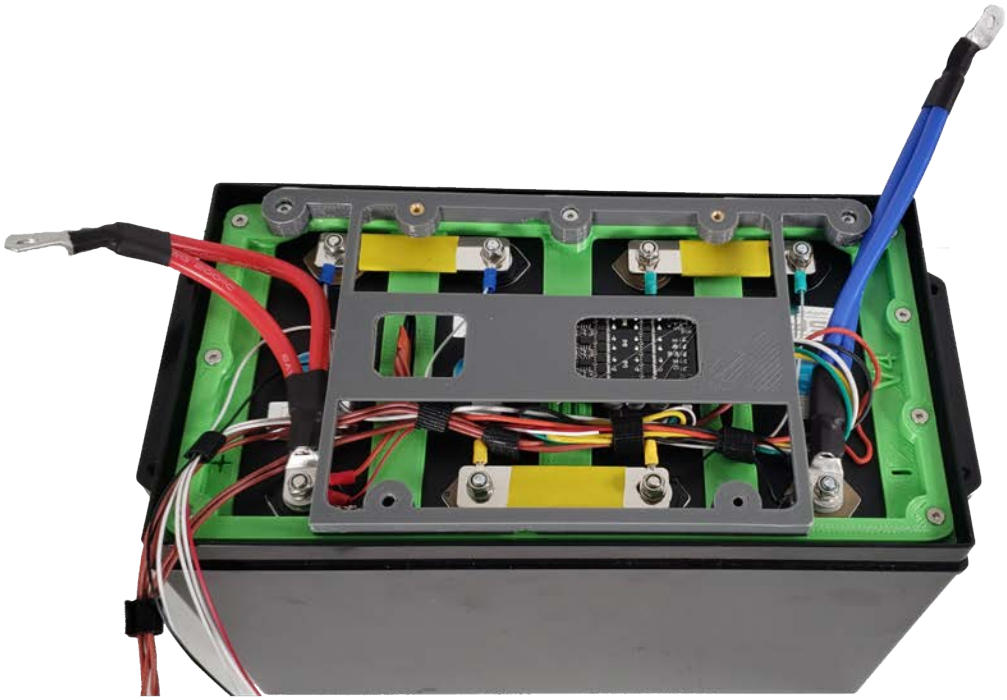
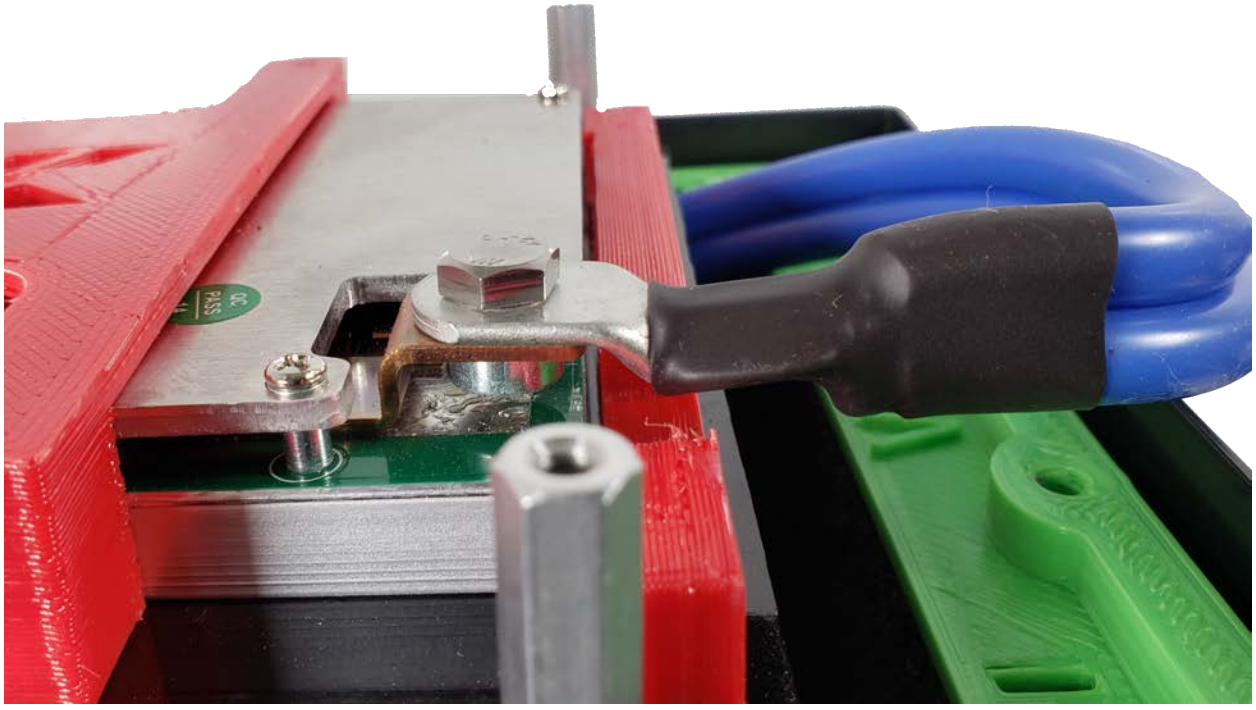
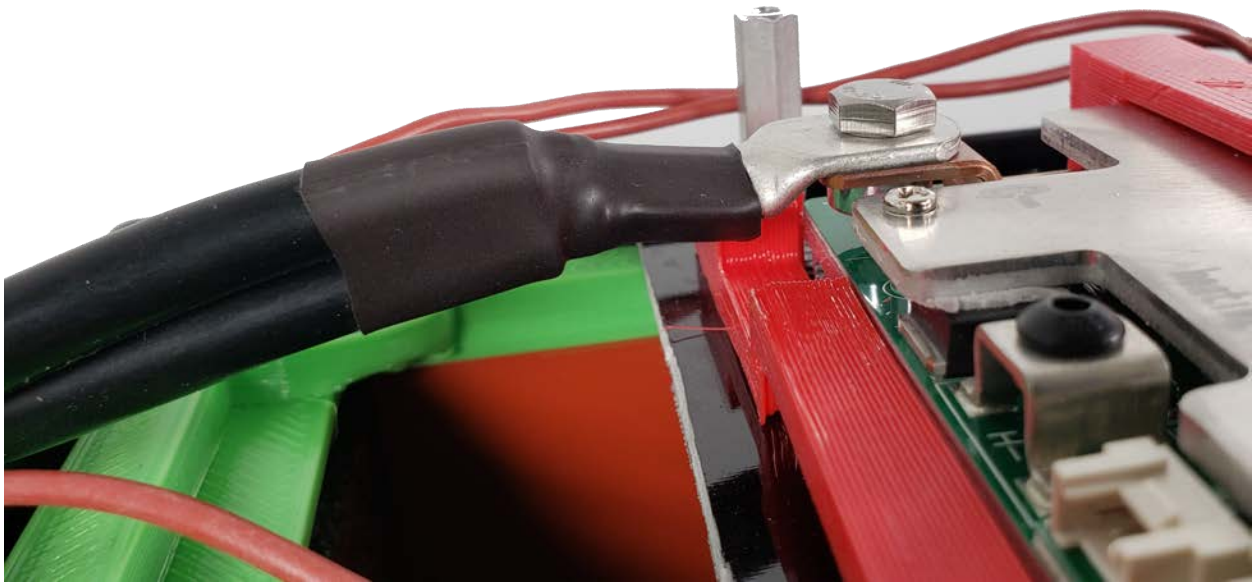


Image shown is from the v4 kit.



***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. Image shown is from the v4 kit.**



***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. Image shown is from the v4 kit.**

Heated kits will include 2 additional terminals that will need to be installed, these will vary based on the BMS and or thermal switch you are using. For most BMS units, you will attach the positive to the main battery terminal post on the lid, followed by the negative terminal which is connected to the output port of the BMS **NOTE: it is extremely important that you do not hook up the thermal switch or silicone heater pads directly to the posts on your cells, this will by pass your BMS which may cause your cells to drain below the critical 2.5 volts level.**

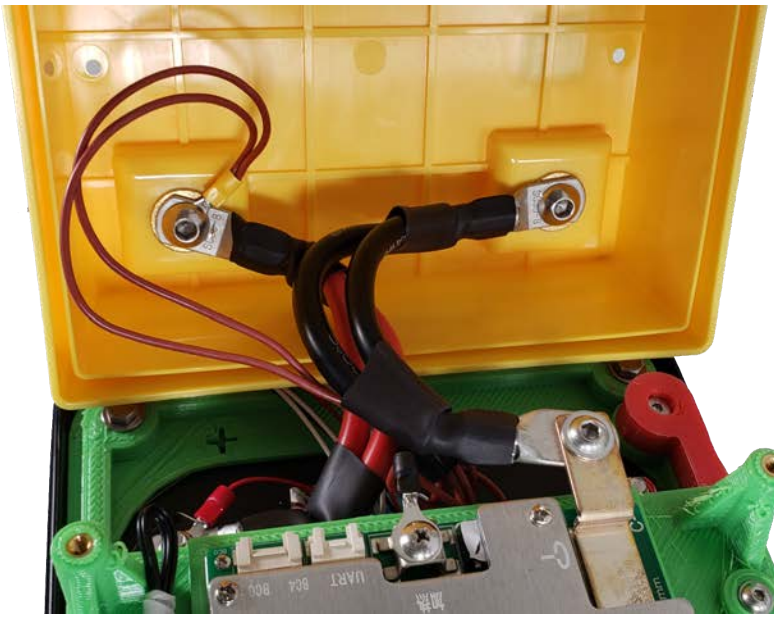
Installing the kit lid and selecting lug mounting options:

With your cables prepped and mounted, it's now time to determine how you will want to mount your cable lugs to your battery kit. The V3.5 kits include 2 options: Terminal Studs as well as flanged top bolts. The terminal stud option provides flexibility in terms of parallel and series connections, however, care must be taken that you do not loosen the connection when installing lugs above. The default / safer option are the flanged top bolts as they make loose terminal bolts impossible while also providing a height benefit as they are about one inch shorter.

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.

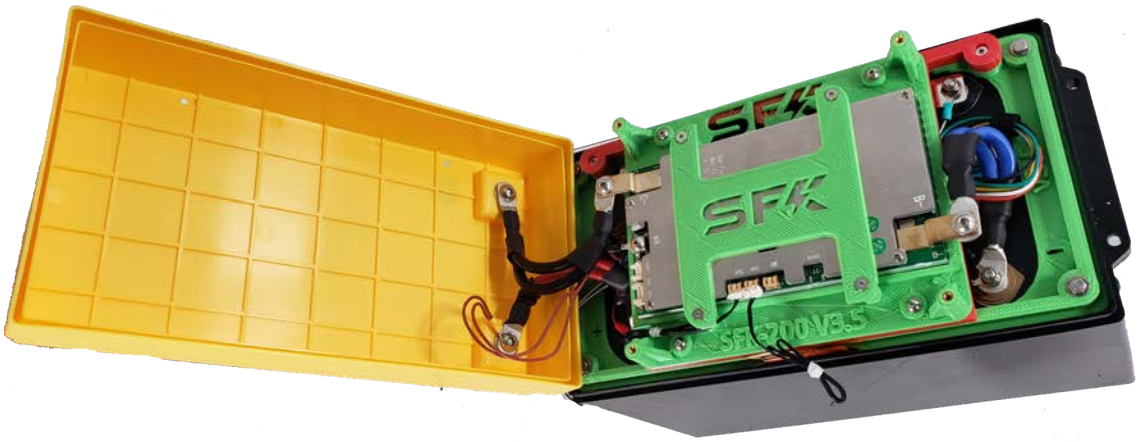
Once cleaned, use isopropyl alcohol to wipe clean and then begin to attach the main BMS and cell wires.

Once you have determined your mounting preference, take your preferred mounting option and attach your top lid.

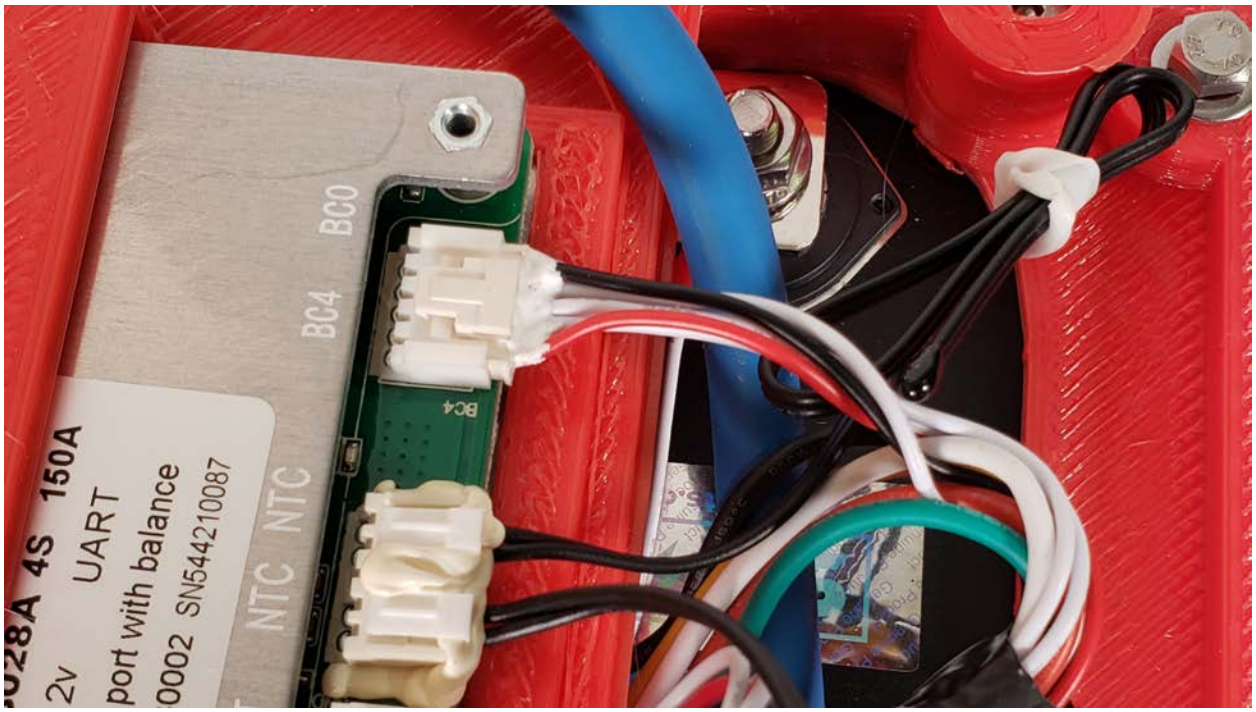


ENSURE A TIGHT FIT! You must make sure the bolt is making proper and solid contact to the brass insert, a loose contact will generate heat and can lead to battery failure. Ensure at least 8-12 NM torque setting (appx 110 inch/lbs).

Heated kits shall attach the positive terminal of the thermal switch/silicone heater terminal to the final post on the lid. **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.**



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 4x15mm countersunk screws. **USE HAND TOOLS! No Impact Drivers for this step!**

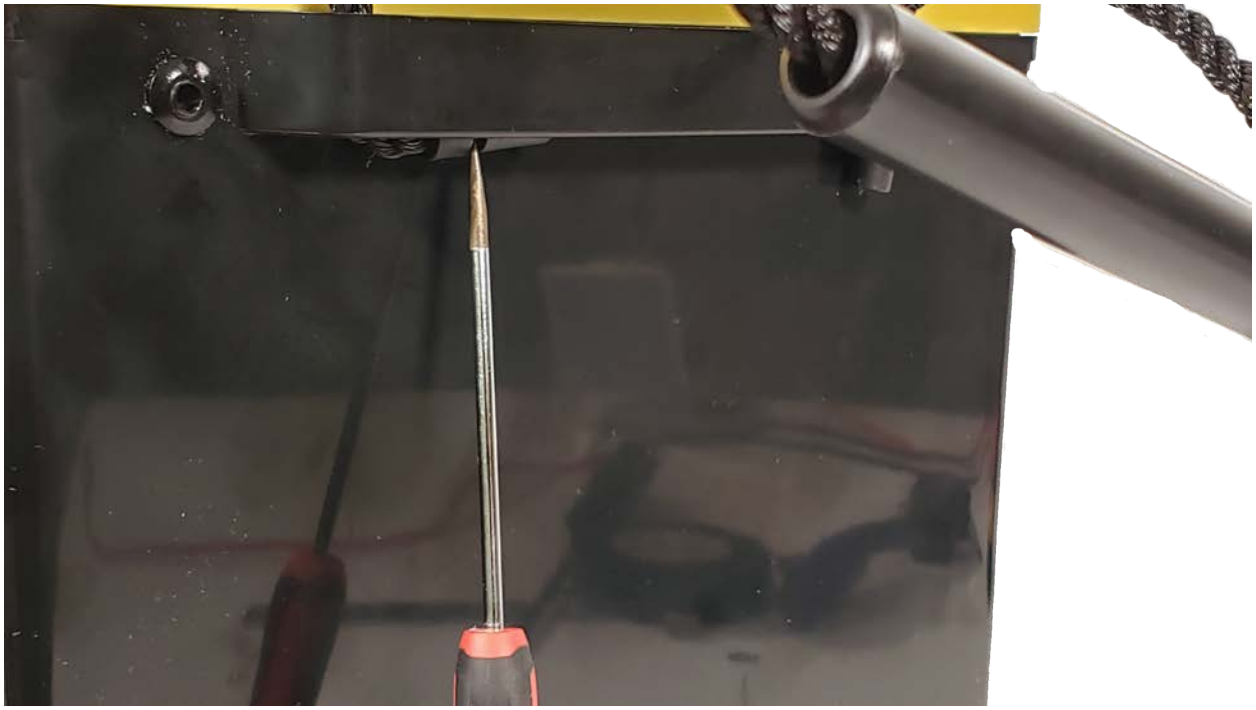
Optionally, if you would like to have a moisture/water resistant seal, you can use electrical safe silicone (low order) sealant between the lid and the lip of the battery. A good example is this brand:

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