

TROUBLESHOOTING LITHIUM

A guide to troubleshooting both prebuilt and DIY lithium batteries



Lithium batteries are made up of a set of cells, a BMS (battery management system), and a balancer. Lithium batteries always require protection circuitry (a BMS) to protect them. For prebuilt batteries, the BMS and balancer are built inside the battery. Lithium cells are sensitive to over-voltage, under-voltage, temperature, and high currents. It is the BMS' job to protect the cells from these damaging conditions.

What might cause lithium batteries to fail?

There are many reasons why a lithium battery may not be working as expected. Some of these common problems for lithium batteries are outlined in this guide.

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OGL BATTERY BOX

Universal Issues

Applies to most lithium batteries whether DIY or Prebuilt

It is important when charging lithium batteries to always use a lithium compatible charger with the correct charge profile selected. This will ensure that the battery charges to the correct voltages without tripping the BMS protection circuit.

Tripped BMS, battery too flat:

If your lithium battery has been discharged to fully flat, the BMS will switch the battery off to protect the battery. This protection is good because it saves your battery from damage.

Symptoms:

- Low battery voltage (often around or below 10V for a 12V battery)
- Battery not charging
- Battery not running any loads

Fix:

Switch off all battery loads. Connect a charger as soon as possible. You risk the battery never turning back on if you leave the battery fully flat for an extended period of time. If the charger does not charge the battery see the relevant section on resetting a tripped BMS.

Tripped BMS, battery too full:

Symptoms:

- Battery not accepting current when full
- Battery switching off when almost full while charging
- Chargers moving into absorption mode too early

Fix:

- Check your charger settings are correct. If you have selected the wrong charge profile, this is a likely cause of a BMS tripping while charging.
 - It is possible that if the battery cells are out of balance, that you will see the BMS tripping while charging. Please refer to the relevant section to troubleshoot unbalanced cells.
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Low capacity, battery not running for as long as it should:

Symptoms:

- Battery not running loads for as long as expected
- Battery capacity measuring significantly less than expected

Fix:

- Check that the cells are balanced, see the relevant section for balancing instructions
- Be sure that you are measuring capacity correctly. If you have a shunt, make sure its settings are correct. See the relevant section for instructions.
- If your battery is old or heavily used, it may be a sign that the cells are losing capacity.

Shunt settings incorrect:

Symptoms:

- Battery percentage shown on the shunt is inaccurate

Fix:

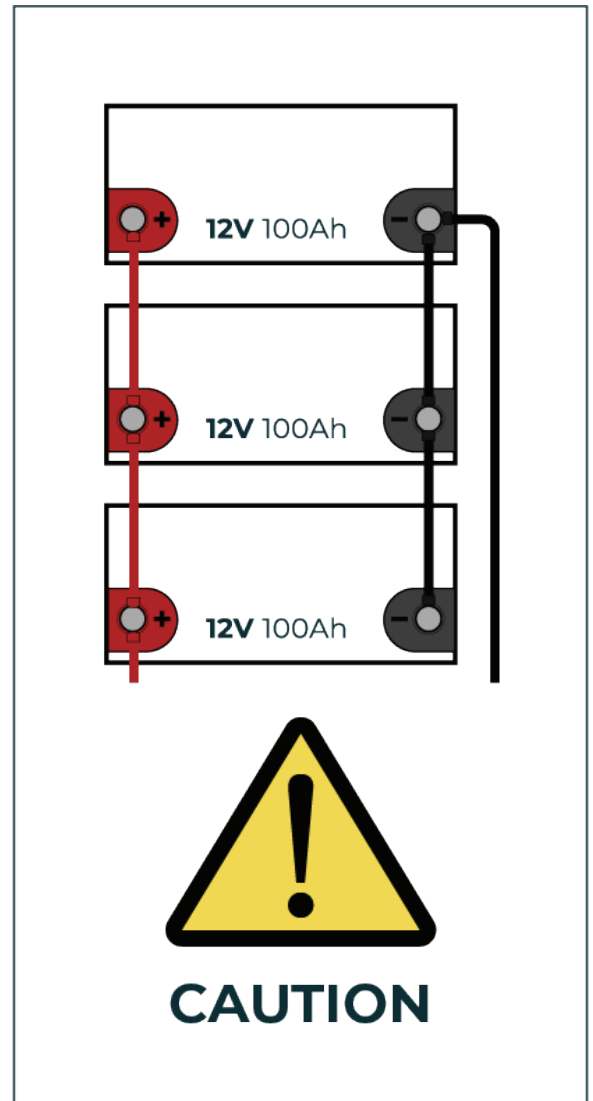
- Follow the instructions for your shunt to set the correct settings. If you have a Victron shunt purchased from Alt-Tech, please refer to the settings sheet you should have received.

Parallel batteries - damaged BMS:

Paralleling lithium batteries can be risky. Many prebuilt lithium batteries cannot be placed in parallel without risking damage and voiding their warranty. Be sure to check if your battery manufacturer will warranty parallel batteries, and what conditions they impose on their parallel use.

When making DIY kits, paralleling BMSs is not advised. If parallel BMSs are required the system design should be approached with caution.

When two lithium batteries are paralleled you have two BMSs working together. This can be ok until one of them trips (switches off). When one BMS switches off it leaves the other BMS to do all the work. If you are drawing 150A and one of your 100A rated BMSs switches off because the battery is flat, you will almost certainly damage the remaining BMS. You CAN NOT rely on BMSs switching off at the same time. Some batteries have communications built in, this is an elegant solution for paralleling lithium batteries correctly.



Over temperature:

Over temperature (or under temperature although less common in Australia) damages lithium batteries. Over 60C is an absolute NO for lithium. This means no under bonnet use. Lithium batteries should be kept within their rated temperature limits.

Over Current:

If too much current is drawn from your lithium battery, exceeding the manufacturer specifications, you have likely permanently damaged your battery. Drawing too much current will damage the BMS. If the BMS happens to have over-current protection, removing the load may reset the BMS to allow it to continue working.

Prebuilt Issues

When talking about prebuilt lithium batteries, we are referring to batteries that are premade by a manufacturer. They are commonly fully sealed with a BMS built in.



Resetting a BMS

If your BMS has tripped it will need to be reset:

1. Remove the load or charger. The BMS may self reset after a few seconds
2. Put a charger on the battery. It should reset the BMS and the battery should begin charging.

If these two methods don't reset your BMS you can try the following options. These options can help reset even more troublesome BMSs:

1. Charge the battery with a Victron MPPT charger. Victron MPPT chargers begin to charge regardless of tripped BMSs. This can sometimes restart a stubborn tripped battery
2. You can momentarily connect the battery to a power supply of appropriate voltage (not recommended).

Balancing Cells:

If you suspect the cells within your battery are unbalanced, often evident through poor battery capacity, it is possible to help them balance. What you need to do is discharge the battery slowly using a fridge or small load (around 1-5A). Once the battery is discharged almost fully, slowly charge the battery (2-6A charge current). Repeating this process a few times can allow the battery balancer to work and bring the cells back into balance:

DIY Issues

Common fixes for batteries built from lithium cells

Incorrect cell wiring:

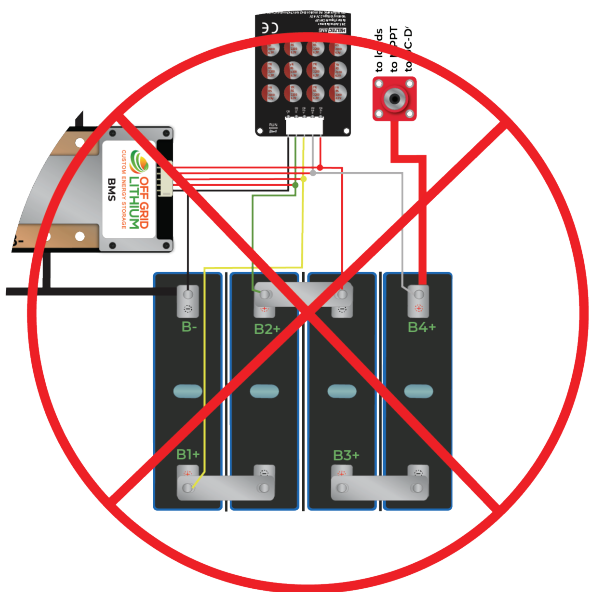
(Very common)

Symptoms:

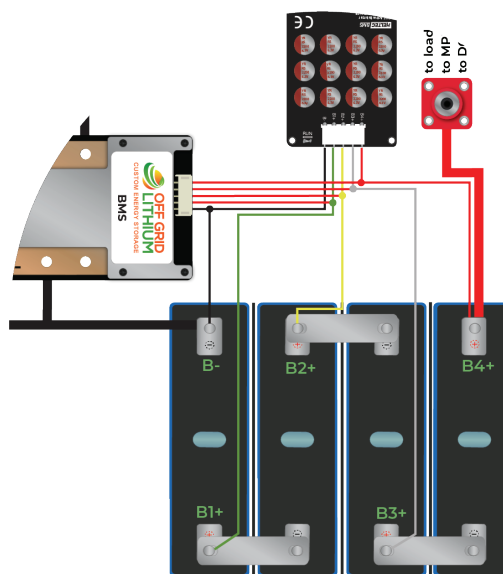
- Balancer damage
- BMS damage
- Cell bulging/damage

Fix:

- Ensure there are no loose connections
- Make sure the sense wires are connected in the correct order and to the correct cell
- Check that the sense wires are protected from strain and physical damage



HERE YOU CAN SEE THE SENSE WIRES ARE IN THE **WRONG** ORDER



HERE YOU CAN SEE THE SENSE WIRES ARE IN THE **CORRECT** ORDER

Incorrect cell wiring is a critical error. You must ensure that when building a DIY lithium battery you wire every sense wire to the BMS and balancer in the correct order and tighten them very securely. Sense wires need to be protected from strain and damage.

If you have incorrect cell wiring there is a good chance you have damaged your BMS and balancer. You may need to purchase replacements to get your battery working again.

Unbalanced cells:

Fix:

- Attempt to encourage the cells to balance by discharging the pack using a light load and slowly charging the pack. This can help the balancer do its job more effectively.
 - Check your balancer is working correctly. Ensure that it does not appear damaged and that all the appropriate indicator lights come on. If you have a clamp meter, check to see if current is flowing while the battery is charging and almost full.
 - If the balancer is working and the cells are still going out of balance, it is possible that you have a weak cell. This cell needs to be identified and replaced. To test a cell you can perform a full rundown test (recommended) or monitor the cells and see which cell is causing the BMS to trip on both high and low voltages. The normal range for a cell voltage is between 2.5 to 3.65V. Cell voltages around or outside these values will cause a BMS to trip.
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Tripped BMS:

If you have a tripped BMS on your DIY lithium kit you should first attempt to reset it in the same way as a prebuilt battery.

If you still cannot get the BMS to turn back on you may attempt to manually reset the BMS. With our range of OGL BMSs you can very briefly place a piece of wire between the B- and P- terminals of the BMS to manually reset it. NEVER leave this wire connected for longer periods of time. Ensure that there are no heavy loads running or big chargers charging while you do this.

Damaged BMS:

Symptoms:

- BMS not turning on despite all the cells being within the correct voltage range and attempts have been made to reset the BMS.
- BMS getting extremely hot despite current draw being within its rated limits

Fix

- It is unlikely that a BMS has failed for no reason. First find the cause of the failure whether that be incorrect installation, overheating, over-current, etc. Then replace the BMS.



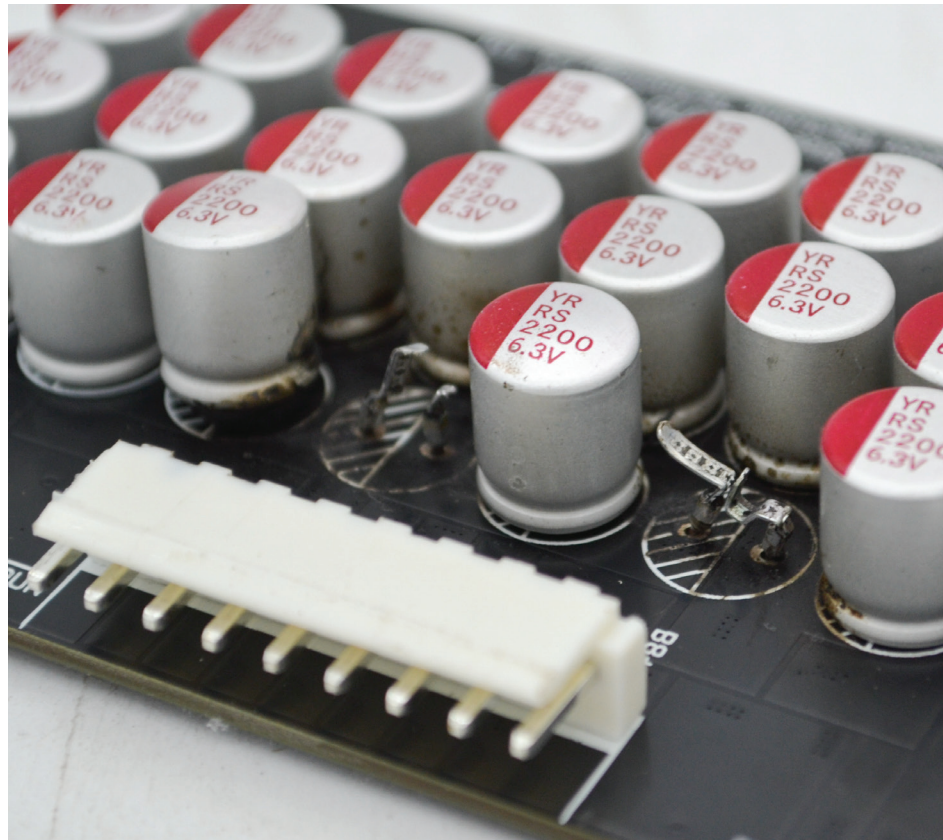
Damaged Balancer

Symptoms:

- Cells going out of balance
- Balancer looks burnt or capacitors have come off

Fix:

- Commonly the balancer fails because it was connected while the sense wires were installed on the cells. Having sense wires partially connected to the balancer, either while installing or due to loose connections, WILL damage the balancer. Once the cause of the balancer failure has been determined, replace the balancer.



Moisture

- Water and electronics do NOT mix. Water or humidity can easily damage the BMS or balancer.
- Water and Lithium ABSOLUTELY do not mix. Lithium batteries should never get wet and should be placed in a dry, cool environment.