

TECHNICAL NOTE: CHARGING LITHIUM BATTERIES USING A POWER SUPPLY

During the development and testing phase of the battery pack, users may not have the proper charger available for testing. Here is a straightforward way of charging lithium batteries during the development using a lab quality power supply.

Proper charging of lithium cells (Li-Ion) is an extremely important function and cannot be taken lightly, most lithium cells require a precisely controlled process that must follow the cell manufacturer recommendations closely.

The most important items are the charge voltage and current.

Li-Ion cells require a constant current, constant voltage (CC/CV) type of charger. Charge current flows into the cell at a constant rate of 0.5C to 1C rate until the cell voltage reaches 4.20 volts. At this point, the charger switches to constant voltage mode, sometimes referred to as CC to CV point.

At this point, the charger must hold the voltage extremely accurately while the charge current drops to C/10 or C/20. Once the current drops to that level the charger should disconnect and prevent any further current flow into the cell.

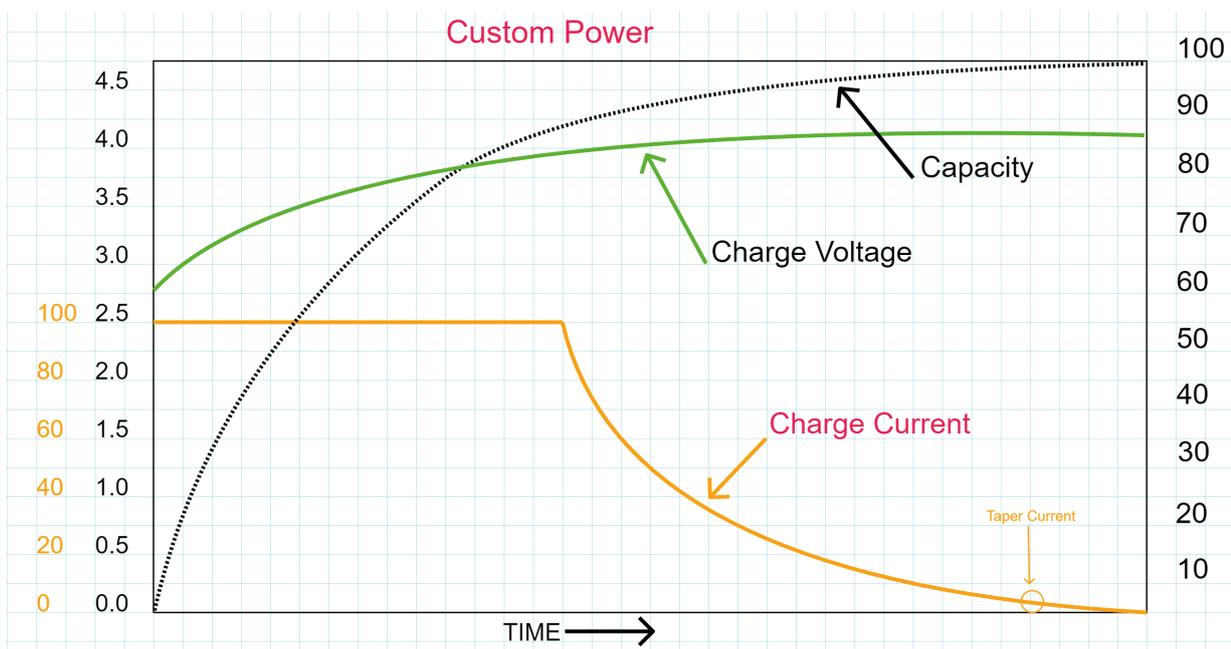


Figure 1: Lithium Ion charging profile



Figure 1 shows the typical charge profile of a lithium cell. If the cell voltage is below a certain threshold, it should be charged at a low charge rate ($\sim 0.1C$) until the cell voltage reaches approximately 3 volts.

Once the cell voltage is above 3 volts the charge rate can be increased to $0.5C$ to $1C$. As the cell voltage approaches 4.2 volts, charge transitions to constant voltage mode and the charge current starts to drop (Taper Current) until it reaches $0.1C$. This is referred to as taper current set point, at this point the charger should turn off and no more current should be allowed to flow into the battery pack.

Over voltage charging can lead to lithium plating, even a slight increase (above 4.20 volts) in CC/CV point can cause lithium plating to occur which can cause internal cell short.

Once the charger is shut off, it is important to observe that no current flows into the battery pack, even a small leakage current over a few hours can create an unsafe condition.



Charging 2S lithium pack using a power supply

We will show you two examples of charging two different packs.



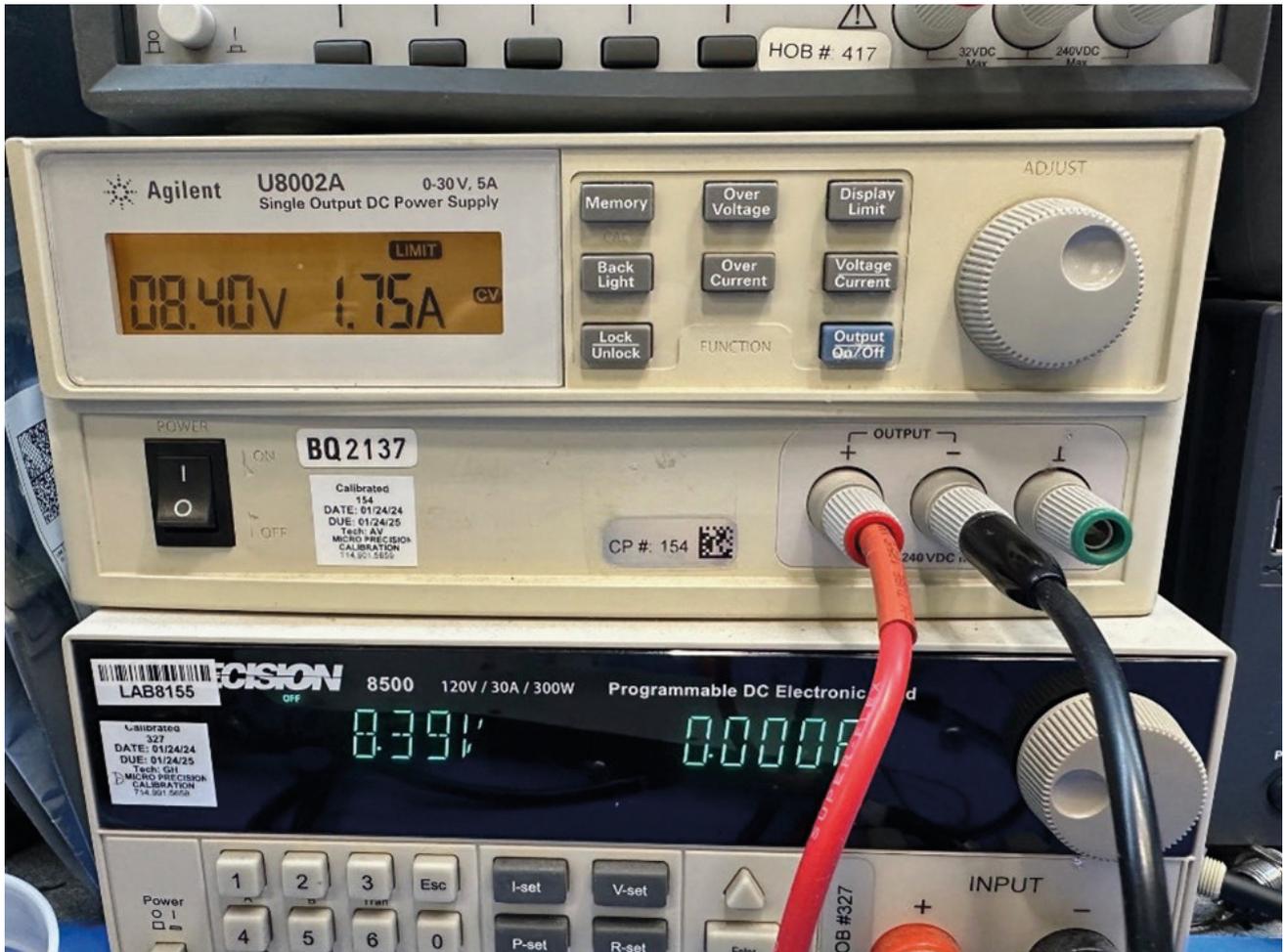
Two cell lithium pack

Charge voltage 8.40 volts.

In this example we will use an Agilent U8002A (Keysight) power supply with analogue controls.

Set the power supply voltage to 8.40 volts.

Press limit and set the maximum current to 1.75 amps.



The power supply is set to 8.40 volts and maximum current 1.75 amps. Power supply functions as a constant current source up to 8.4 volts and then as constant voltage 8.40 volt supply.

You can use this to charge a two cell lithium battery for evaluation and testing. Be sure to disconnect the pack from the power supply when the current goes below ~50mA.

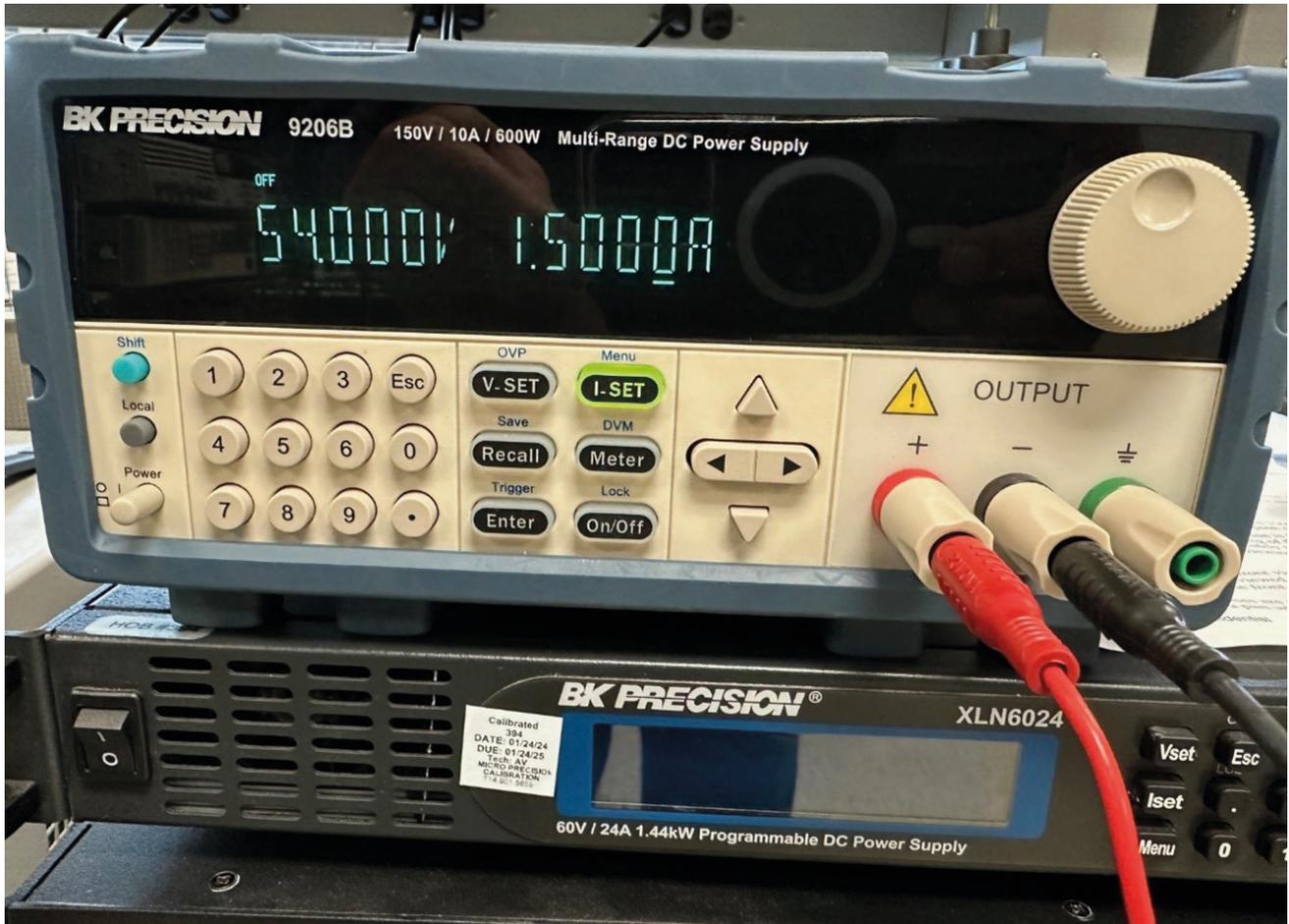


Thirteen cell lithium pack

Pack charge voltage $13 * 4.2 = 54.6$ volts, to be safe we will charge 54 volts only.

Charge current 1.5 amps.

In this example we will use a BK Precision 9206B power supply with digital controls.



Press V-Set and enter 54.0 (Voltage setting).

Press I-Set and enter 1.50 (Current setting).

The power supply is set to 54.0 volts and maximum current 1.50 amps. Power supply functions as a constant current source up to 54.0 volts and then as constant voltage 54.0 volt supply.

You can use this setup to charge thirteen cell lithium battery packs for evaluation and testing. Be sure to disconnect the pack from the power supply when the current goes below ~100mA. Always avoid float charging lithium battery packs as Lithium plating may occur.





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