

FAQ: Charging Batteries

When batteries are made at the factory the cells are spot welded into parallel groups and series. A battery management System is then soldered to each parallel group.

For example a 52 volt 11.5ah or 13.5ah Shark pack will have 56 cells and the packs is called a 14s 4p.

When charging the Battery Management System (BMS) monitors the pack so individual cells do not go over 4.2 volt. (High voltage charger cutoff is 4.25)

A fully charged 52 volt pack is 58.8 Volts.

A fully charged 48 volt pack is 54.6 Volts

A fully charged 36 volt pack is 42.0 volts

A fully charged 60 volt pack is 67.2 volts

A fully charged 72 volt pack is 84.0 volts

VERY IMPORTANT: The battery needs to be charged prior to the first ride. The packs are shipped with 30-50% state of charge only!

CRITICALLY IMPORTANT: Never ever attempt to charge a frozen Li-Ion battery that is under 32 deg F (or 0 deg Celcius) Below freezing permanent damage will occur if you try to charge your battery pack. If your pack is frozen bring it inside your house and let it sit for a few hours till the battery is over 50F (10C) [READ MORE HERE.](#)

VERY VERY IMPORTANT ALSO: Never charge your battery from the discharge port (or more than a few seconds if it's just to jumstart it), charging like this will bypass the BMS protections and can be dangerous if you have an issue in the battery.

JUST IMPORTANT BUT NOT CRITICALLY ;) : please fully charge the battery to 100% for the first few cycles(3-5), leave it on till the charger stops...can take up quite a few hours (anywhere from 2 hours to10



hours, depending on the capacity and charger rate). Remember to charge the battery when it's at room temp (not hot or freezing).

You get the picture.. all important stuff to get the most life out of your battery and avoid certain issues.

Simple charging FAQ's (if you don't want to read all the rest)

-After a bike ride do not charge the battery yet, let it rest for an hour or more.

-After a charge, let the battery rest for an hour or two to cool down but also to let the BMS balance the cells.

-Charging 80% and discharging to 20% are best for a long live!

-It's OK to charge it to 100% to get more range, just don't let the battery sit at 100% for more than 2hours.

-Standard BMS only balances to 100% (top balance), only really expensive BMS can balance at any voltage so far only the Luna APEX has one.

-Balancing is slow so that's the reason to let the battery sit after a charge

-Balancing can take a couple 100% charge cycles to complete.

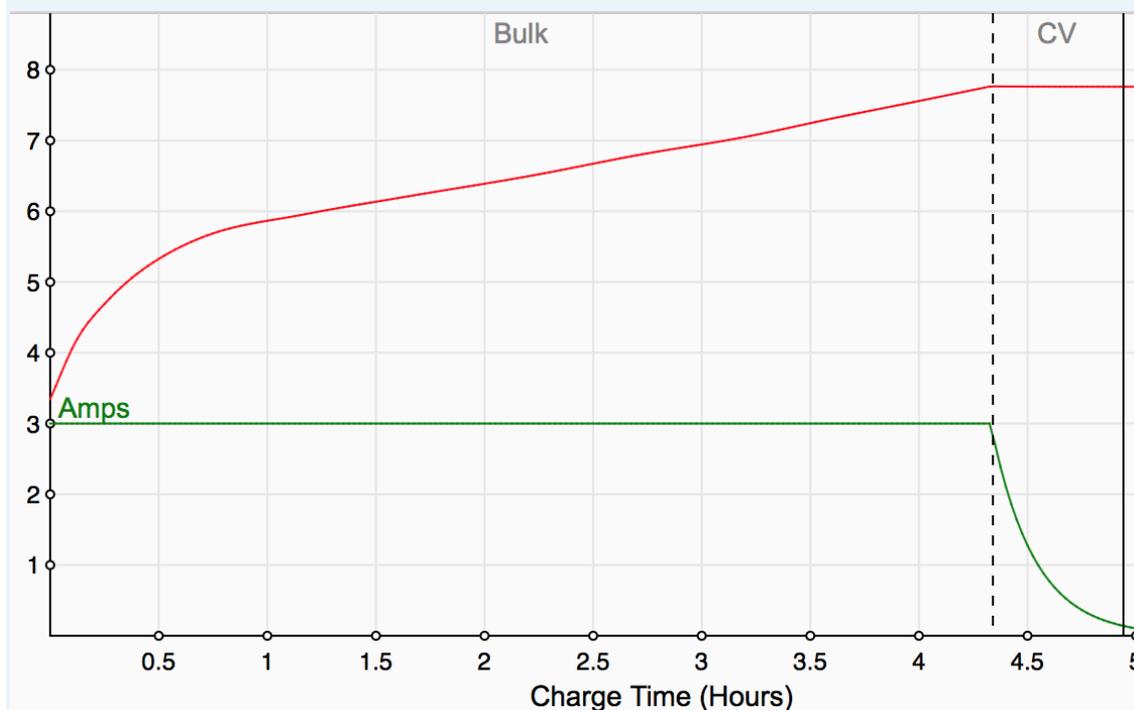
-Don't leave the charger unattended, charge in a same place and unplug the charger when done to avoid a drain on the battery.

-100% is about 58.8V on a 52V...if yours charger charges to 58.6 or 58.9V it's fines no worries.

How long does it take to charge?

Charging time is quite simple to estimate:

A 13.5 ah GA shark pack will require about 5 hours total at 3amps (standard basic 3a charger) about 4.5h to put pack most of the juice back ($13.5\text{ah} / 3\text{amps} = 4.5\text{h}$) and about 30min or more to saturate (constant voltage mode)



Break-in period

The battery when new can take a few cycles to balance and settle. This is called the break in period. Typically we recommend charging to 100% for 4 to 6 charges. It does not have to be full discharges or full



cycles, it can be shallow discharges, Just discharge gently (can be as little as 1V discharge) and then let it cool down and charge again till you see a green light and repeat a few times!

Its also important during the break in period not to run the pack to Low Voltage Cut Off. Also take it easy on the pack by not drawing maximum amps otherwise the pack will not balance and this can lead to the pack shutting down prematurely. If the pack does charge to 58.8 volts (52 volt battery. 54.6 for a 48 volt, 42V for a 36V or 84V for a 72V batt) then the packs well balanced. Lower voltage may mean the pack maybe out of balance or the charger is not fully charging to 58.8 volt. Normally after the battery has been disconnected the pack can drop a little, this can be up to 1 volt. This is not uncommon. **But don't be too pointy about it... 58.7V is fine too (0.1V shy of 58.8V)!**

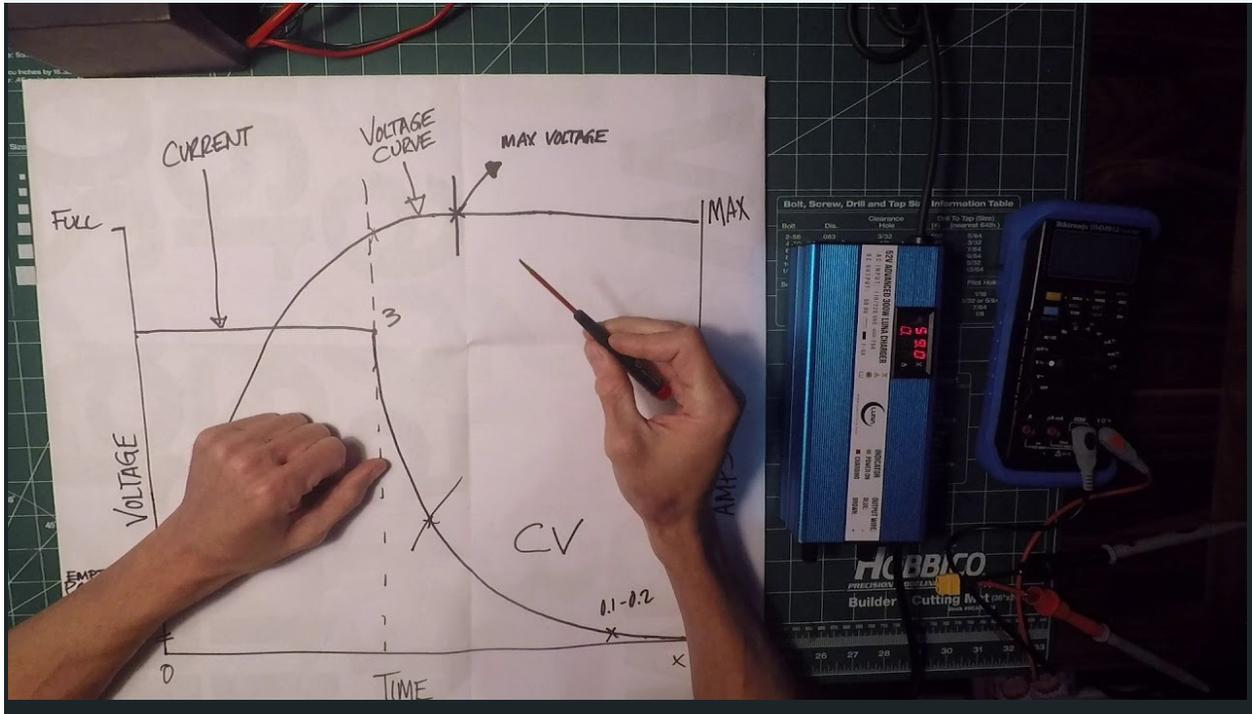
Link [HERE](#) to checking the charger voltage, Post 1

If the charger is already charging to 58.8 volts you still need to do a break-in and do a couple charges to 100%, charging to 58.8V does not mean the cells are balanced, some cell can be at 4.24V and csome to 4.16V. So what you can do is to discharge the pack a few volts and then you charge it again to 100% and let it sit unplugged for a few hours. Balancing only occurs when one or more cell group reaches the 4.2V per cell mark.

If you need to adjust the charger follow this [link](#).

Let me explain quickly how a charger and BMS works when it gets close to 100%

You can watch this video or read below.



When charging as all the parallel cell groups starts to hit 4.2 volts, the charger will change setting to what is called the CV (constant voltage) then the current drop gradually down to 3-5% of the rated amperage of the charger (see graph up, CC and CV phases)

Once at this 5-3% amp level the charger will shut down (If not do not worry the BMS as an internal protection for over charging and will cut the charge if necessary.) ONCE the first cells hit the 4.2V mark, the BMS will let the high cells bleed off to the lowest cell. Balancing can happen while charging but normally the imbalance is pretty slim and the BMS won't have the time to balance fully it before the charge done (can take a few hours to balance, it's better to let the pack unplugged in a safe place over night.)

If you leave the charger plugged in after the charge is complete and you have a little unbalance some charger models can restart once the BMS as bleed off a little... This can cause the charger to cycle on and



off depending on which model. But our recommendation is to unplug the charger once you see the green light. Leaving the charge plugged in can actually draw a little current back in the charger to power the LCD and some components.

In the end of the break in period, you will have a balanced pack with all groups close to 4.2 volts.

After the break in period the battery can now be charged to 80 or 90%.

Periodically charging to 100% is required to keep the pack balanced. Charging the pack to 90% does not do this. So over time the pack can become unbalanced. So now you need to get the pack back in balance so it needs to be charged to 100% for 2 to 3 cycles in a row. The balancing process is long so when you are doing the balancing, leave the pack alone for a few hours to let the BMS do his job, you can then ride your bike and charge to 100% again...till you complete 2-3 100% charges.

This will need to be done over a period of time. can be every 30 cycles, after a 3-6 months period and specially after a storing the battery for a few weeks ([tip on storing the battery click here](#))

Charging to 80-90% does increase battery life by double some say but that's only provided the packs also treated correctly.

Other things that decrease pack life can include, running the pack under 10% of capacity. Sometimes this is unavoidable. Using a packs to the max discharge rate of the cells for long periods of time will result in poor range and permanent capacity loss over time (meaning you won't get the 400+ cycle life). The pack does shut down as it has a temperature sensor to prevent damage. These are just some examples.

Additional Links

[Beginners guide on how to use a charger](#)