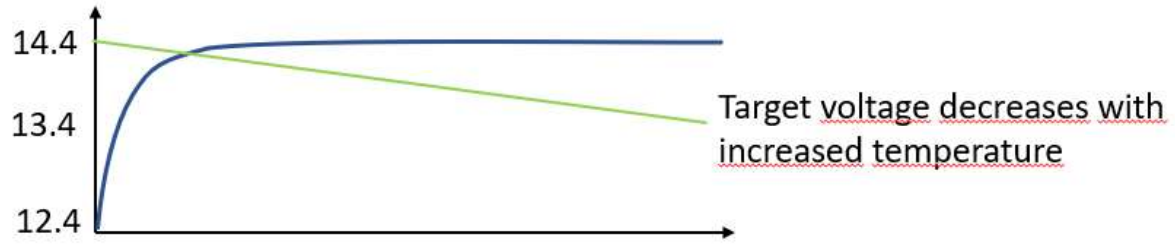
# How does an alternator with a built-in regulator work, and can I charge LiFePO4 with it without modifications?

Regulators on older alternators has a simple transistor logic. When the outgoing voltage is a bit away from the target 14.4V (can differ between models, but here we use 14.4) it always creates max current. Then when the voltage closes up to 14.4, it starts limiting the power, and when 14.4 is reached, it only produces enough current to maintain that voltage.

More modern alternators often have a digital circuit controlling it, and this circuit has then also often a temp-sensor used to decrease the target voltage with around 10 mV per degree above 25.

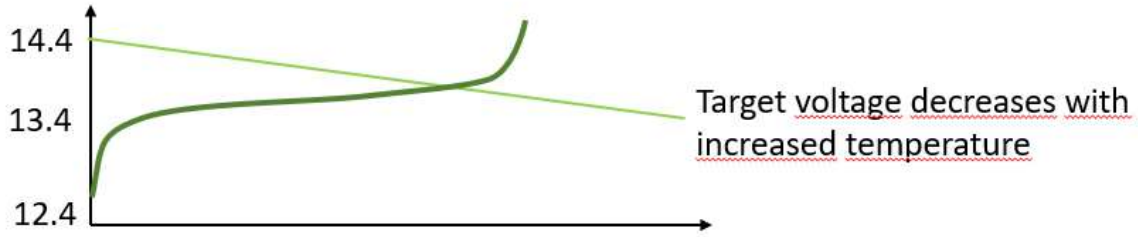
Both of these can have a voltage-sense-cable making it possible to move the place to measure the voltage closer to the battery.

In a perfect installation there is no voltage drop between the alternator and the lead-battery, then the charging curve will look like this:



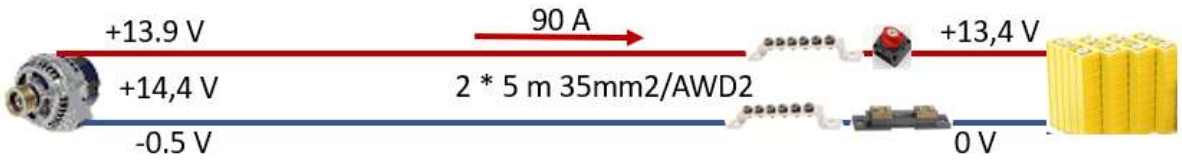

As you can see the target voltage is reached very soon, and if the regulator decreases the target voltage with increased temperature, the target will be reached even earlier (where the lines crosses)

If we then insert the charging curve of LiFePO4, the graph will look like this:




As you can see the alternator will get a lot hotter before it reaches the target 14.4, even if the target is decreased due to increased temperature (where the lines are crossed). It shall also be noted that it is the temperature of the regulator that is measured, and not of the alternator. The alternators internal will be a lot hotter.

Based on this a lot more alternators should burn when change over to LiFePO4, but many survives, why? The answer is bad (non optimal) installations. There are often not very thick cables between the alternator and the battery, and there are breakers, busbars, shunts etc on the path, and this gives loss of voltage. It can look like this:




When charging with 90 A there can easily be 0.5 V loss on each cable, which means that the alternators voltage reading is 14.4 V when the voltage at the battery is 13.4 V. This means that the alternator will start decreasing its output almost immediately. For a lead battery this is not so important since it will anyway decrease its hunger for amps very soon as the voltage increases.

But for a LiFePO4 battery that will take all amps it can get, this is will almost eliminate the advantage LiFePO4 has over lead to charge fast. But it is often also the reason that alternators survive the switch over to LiFePO4.

If the alternator has a voltage-sense-cable, placing it at the battery will “remove” the voltage drop in the plus-cable and significantly increase the charging current (and also the risk of burning the alternator).

So how can I then optimize charging without risking the alternator? Install some equipment that measures the voltage at the battery, the alternator temperature, and then controls the alternator based on this. Wakespeed has an external regulator that does this, Balmar has several, Mastervolt as well, and HLPdatas BMS4S does it.

So, the answer of the headline-question is: yes, if you have a non-optimal installation it can work, but if you want to take advantage of the possibility to charge LiFePO4 fast you must do some modifications.