



Upgrading Your Vehicle Systems for Lithium Batteries

Lithium batteries are becoming ever more popular, owing to their greater efficiency, reduced weight and lower power-to-space ratio. But not every habitation system is able to cope with the change in battery type. Below are a list of actions and requirements for upgrading your vehicle with lithium batteries, as well as how we can help you achieve a safe and energy efficient switch-over.

How Does A Lithium Battery Differ To A Traditional Lead Acid Battery?

This is a question of chemistry, with a little bit of physics thrown in for good measure! In essence, a lead acid battery, when fully charged, is almost completely filled with an acidic compound which has the potential to release energy under the right circumstances. It achieves this by slowly converting the acid to water. When connected to a battery charger, the input of energy from the charger converts the water back to acid recharging the battery.

The principal is very much the same with a lithium battery, however the lithium iron phosphate compounds which are present in a lithium battery are chemically very different to those found in a lead acid battery. This is why lithium batteries behave differently to lead acid, allowing for more and deeper cycling of the battery before the material contained inside begins to degrade. However it is also why traditional lead acid battery chargers are not the best option for maintaining a lithium battery.

Terminal voltage refers to the voltage at which a battery can no longer accept current and can be considered fully charged. With a traditional lead acid battery, this will be 14.4V (+/-0.2V depending on battery manufacturer specifics).

How Is My Battery Recharged?

A battery charger will produce a terminal voltage and, when connected to a battery with a lower voltage potential than the charger's terminal voltage, a voltage gradient is created and current will flow from the higher voltage source to the lower.

For example, a lead acid battery which has not been charged in some weeks sits at 12.4V. The connected battery charger is switched on, producing a terminal voltage of 14.4V – a 2V difference or voltage potential gradient. The gradient is what allows current to flow from the battery charger to the battery. See Figure 1:

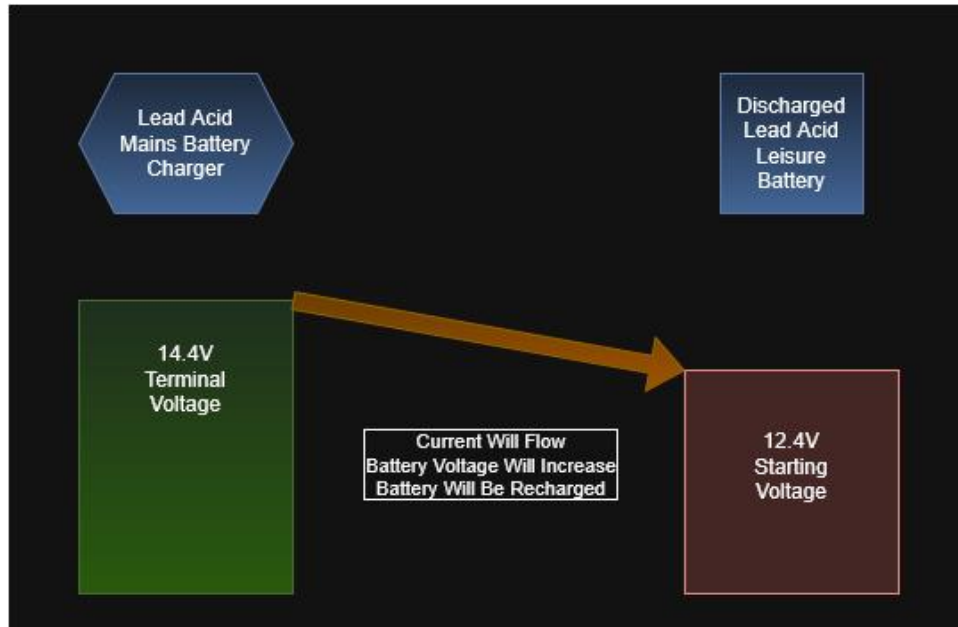


Figure 1: A traditional lead acid charger connected to a lead acid battery

Often people mistakenly believe that the battery charger “pushes” current into their battery, but it is actually the battery that “pulls” the current. A full charged battery connected to a charger will be drawing practically no current at all. See Figure 2:

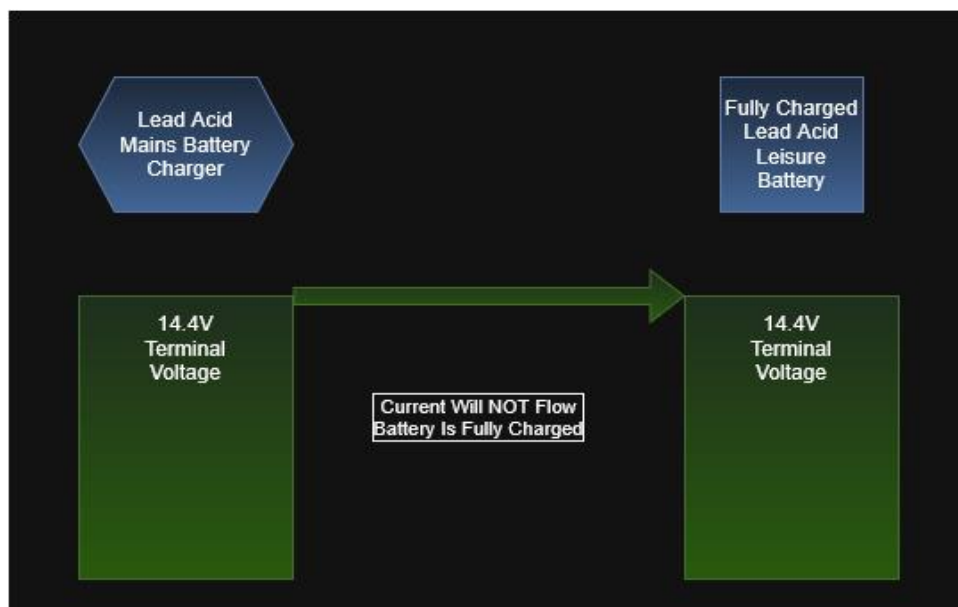


Figure 2: The traditional charger fully charges the lead acid battery

If the lead acid battery in the example was replaced with a lithium battery, then once the terminal voltage of the lithium battery had reached 14.4V (the terminal voltage of the charger) then no more current would flow, despite the lithium battery being quite able to accept more current as it has not

yet reached its fully charged voltage of 14.6V. It is this issue that necessitates upgrading the charger and other systems in your vehicle when fitting lithium batteries.

With a lithium battery, the terminal voltage is 14.6V as determined by the internal chemical make-up of the battery. 0.2V difference may not seem like a lot, but not reaching the battery's terminal voltage can mean as much as 25-30% of the battery capacity is not recharged! Given the higher cost of lithium batteries over lead acid, if you are purchasing one it would make sense to use all of it!

As you can see in Figures 3 and 4, the traditional charger will still charge a lithium battery, however as Figure 5 shows to fully charge a lithium battery it needs to be connected to a lithium charger with a higher terminal voltage.

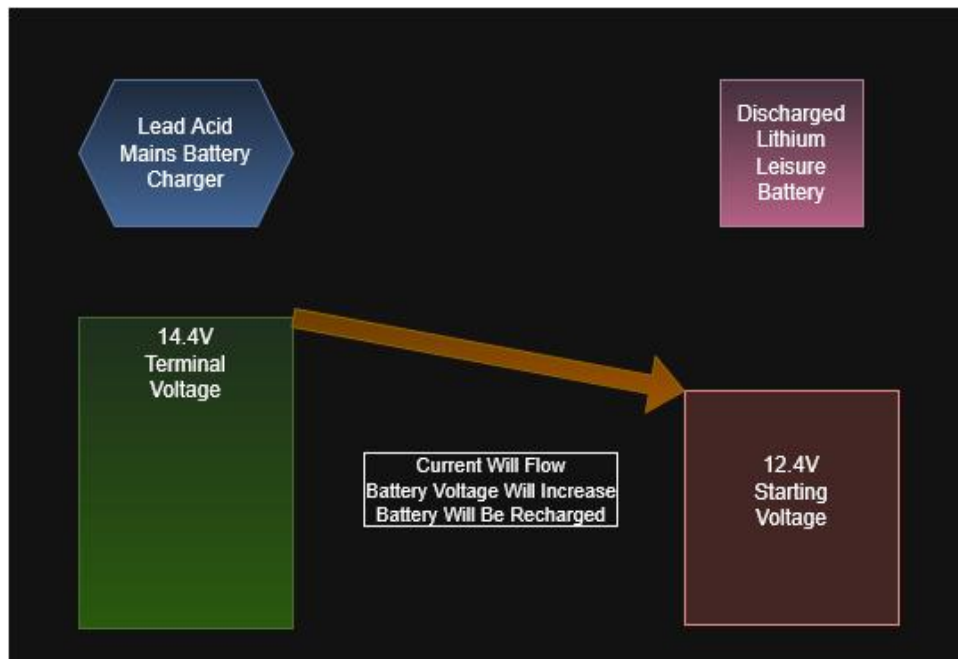


Figure 3: A traditional lead acid charger connected to a lithium battery

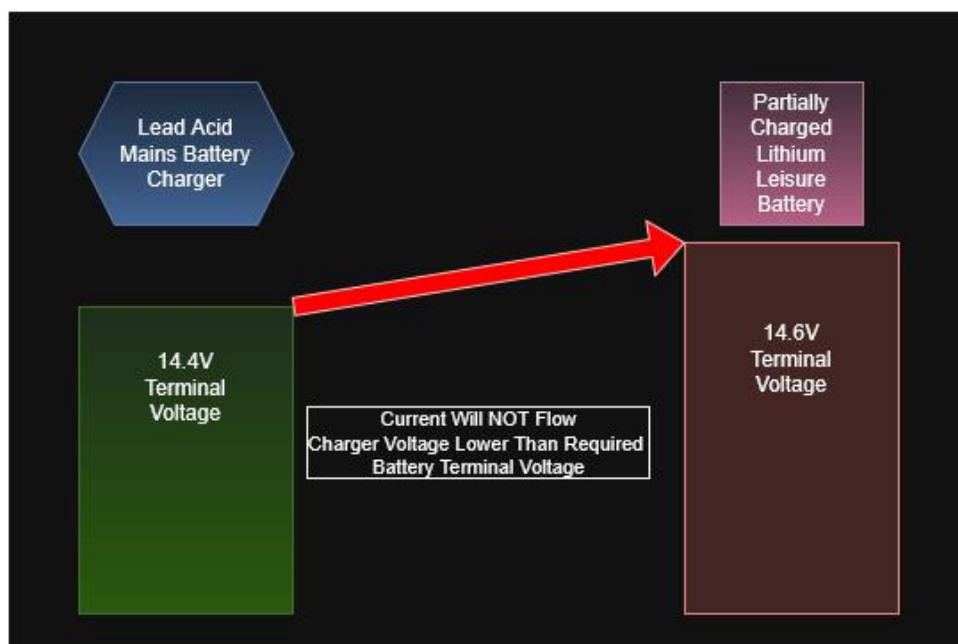


Figure 4: A traditional lead acid charger is unable to fully charge the lithium battery

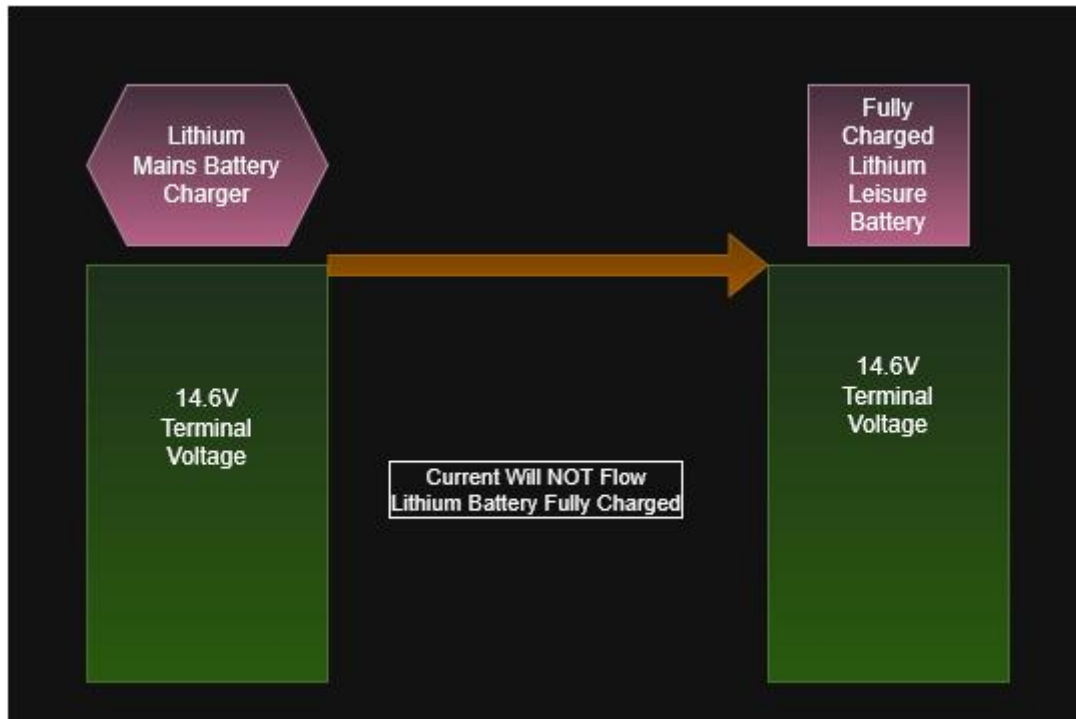


Figure 5: A lithium charger is required to reach the higher terminal voltage and recharge the lithium battery

Upgrading your mains battery charger should be your 1st step in converting your system to lithium. Please get in touch with us for more information on this service via info@apuljackelectronics.co.uk or 01278 588 922.

What Happens When I Drive My Vehicle?

Split charge, or engine charging, refers to the action of charging your leisure battery from the alternator of your motorhome or towing vehicle whilst the engine is running/the vehicle is travelling.

In older systems, this is achieved through a series of signals and switching circuits to effectively join the leisure battery and the starter battery together, allowing the alternator to recharge both as you are travelling. In newer systems, specific modules in your vehicle habitation system are designed to allow this to happen in a more efficient and secure way. They are often referred to as Battery-To-Battery chargers, DC-to-DC chargers or simply Boosters.

If your vehicle already has a booster module fitted, then changing your leisure battery to lithium shouldn't be a problem. The starter and leisure batteries are isolated from each other by the booster. You often find boosters fitted in vehicles with smart alternators (which switch themselves on and off during a journey), and many already have a lithium mode as standard. If so, you should switch over to the lithium mode once your lithium battery has been fitted.

Boosters take the variable voltage provided by the smart alternator and produce a constant output voltage, to ensure your leisure battery is charged correctly when driving. Those boosters with a lithium mode will accept a variable input voltage and provide a lithium-suitable 14.6V output.

However, in older systems it is not always so simple. Split charge works well, assuming both batteries are of the same terminal voltage. Once you fit a lithium battery however, you can create a voltage gradient between the lithium leisure battery (14.6V) and the lead acid starter battery (14.4V) and

actually end up depleting your leisure battery as you drive! The best way to over-come this is to fit a lithium-compatible booster as described above.

But this in turn causes another problem – the original split charge system is still in place. This will create a loop of sorts. See below:

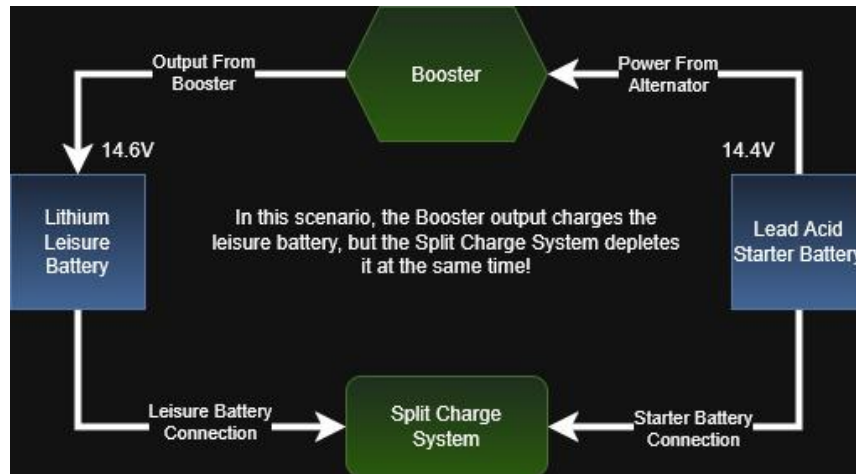


Figure 5: A split charge system and booster working against each other

We offer a service for many different systems which allows the split charge to be disabled. This will nearly always require you to send a unit to us, as it requires a reconfiguration of the split charge system to disable it. This process should be considered semi-permanent; as the only way to reverse it would be to return the unit to us for further work.

After the split charge system has been disabled, the loop will be eliminated, allowing for correct and efficient charging to take place. See below:

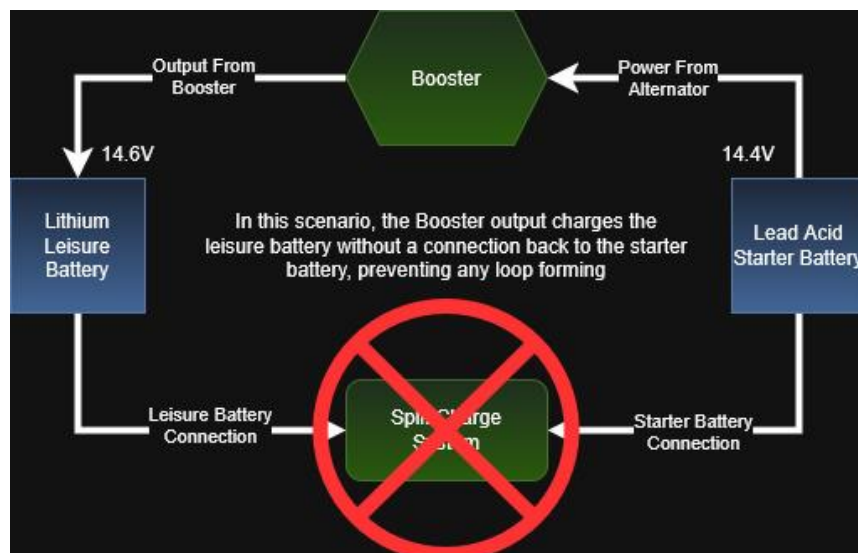


Figure 6: With the split charge system disabled, the booster can recharge the leisure battery

We rank this as the 2nd most important action to take when fitting lithium batteries, especially if you do not already have a booster module fitted. Please get in touch with us for more information on this service via info@apuljackelectronics.co.uk or 01278 588 922.

What about Solar Panels?

Solar panels, properly routed through a solar regulator, are a great way to top up your leisure battery to extend your time off-grid. This is true for traditional lead acid as much as it is for lithium batteries. However, solar regulators behave much the same as chargers, and therefore your solar regulator will need to either already have a lithium mode you can switch to, or be replaced with one that does. This is not as essential as having a lithium-compatible mains charger, as the total amount of power delivered to your battery from your solar panels is much, much less than from your mains charger, but it is advisable to implement eventually. We rank this as the 3rd step in a lithium upgrade.

What If I Don't Upgrade My Charger?

As previously mentioned, without upgrading your charger to one with a lithium mode, you will not be able to fully recharge your battery and will miss out on making full use of the enhanced capacity lithium batteries offer.

However, it is perfectly safe to use a non-lithium charger with a lithium battery, it's just not very efficient.

What Does My Battery Management System (BMS) Do?

Your BMS, which is fitted as part of nearly all lithium batteries, manages the incoming power from your system to your battery. It achieves this in several ways; by protecting the battery from over-voltage events such as spikes and surges, it evenly distributes power across the individual cells in your battery (referred to as battery balancing) and on some batteries it even communicates the battery status information to either your habitation display panel or mobile phone app.

Because the BMS is in place to monitor and distribute power as required, you do not need a multi-stage charger. With lead acid batteries, which do not have a BMS system, a multi-stage charger is a great way to ensure the battery is well maintained, through cycles of de-sulphation, cell balancing and alternating boost and float voltages. But with a lithium battery with a built-in BMS, a multi-stage charger is not needed – let the BMS handle the management, that's its job!

Is There A Problem Trickle Charging My Starter Battery With A Lithium Charger?

In short, no. Starter batteries are inherently different in their structure and design and as such are less prone to suffering damage if they are over-charged. When connecting your vehicle to mains hook-up, many systems allow a low-power (or "trickle") charge to reach the starter battery. This is usually limited to 2 or 5A. It is designed to maintain the starter battery to prevent the engine from failing to start after the vehicle has been left standing for some time. A higher terminal voltage from a lithium charger should not be considered an issue. If you are concerned about this, or if you have specific circumstances that would mean disabling this feature would be a benefit to you then please get in touch with us for more information via info@apuljackelectronics.co.uk or 01278 588 922.