

Auxiliary Battery Charging In Vehicles With 'Smart' Alternators



Vehicle manufacturers are having to comply with increasingly stringent environmental regulations so are continually researching and employing clever technologies to lower fuel consumption and reduce emissions. One of the technologies that has been around for several years, but which is now becoming standard on new vehicles, is the 'smart' or 'intelligent' ECU-controlled alternator.

For those of us wanting to charge a second (auxiliary or leisure) battery whilst driving this presents a problem because traditional split charge systems cannot be used. This article explains why and looks at how [Battery-To-Battery chargers](#) overcome these issues and the other benefits they have when compared with split charging.

Note: this issue is not generally applicable to boats as the emissions regulations that apply to vehicles don't apply to leisure craft and so 'smart' alternators on boats are relatively rare.

For an introduction to battery-battery chargers and VSRs check out our YouTube Video 

What are 'smart' alternators and how do they help with emissions?

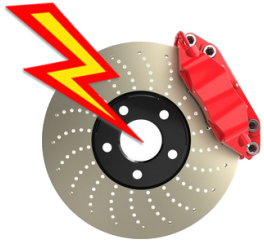
Smart alternators are essentially those that have their output voltage controlled externally via the Engine Control Unit (ECU) rather than by an internal voltage regulator as found on traditional alternators.

When an alternator is running and producing a charging voltage the electromagnetic field generated inside it produces a mechanical load on the engine via the alternator drive belt. This load increases as the output voltage rises, meaning that the engine has to work harder to turn the alternator which consumes more fuel in the process. Traditional alternators maintain their voltage between 13.8-14.4V depending on the state of charge of the battery and various other factors. This means that there is always a significant load on the engine from the alternator which requires fuel to be consumed.



As smart alternators are ECU-controlled it enables manufacturers to vary the voltage output more than can be achieved with an internal regulator. This provides the opportunity to bring the voltage below 13.8V during periods when no further charging is required (e.g. when the battery is nearly full) meaning that engine loads are reduced, fuel consumption is reduced and emissions are lowered, all helping manufacturers to comply with industry environmental regulations.

What is regenerative braking?



Regenerative braking is an energy recovery technology that takes the kinetic energy of the vehicle that is normally converted into wasted heat in the brake pads and discs during braking and instead converts it into electrical energy to re-charge the starter battery. This is made possible because of the use of smart alternators that can be controlled by the ECU when deceleration is detected. During deceleration (for example when taking your foot off the accelerator) the ECU boosts the alternator voltage output as high as 15V+ to create a burst of charge into the battery. This high voltage puts an increased mechanical load on the engine, resulting in increased engine braking, meaning less of the kinetic energy is converted to wasted heat in the pads and discs. So the deceleration of the vehicle is putting charge back into the battery, saving fuel that would otherwise be required to re-charge it.

This charge is then used to power the vehicle's electrical systems when the vehicle is accelerating or travelling at constant speed. During this time the alternator output voltage is reduced (to as low as around 12.5V), which reduces the load on the engine with a consequent reduction in emissions.

Regenerative braking is only effective if the starter battery has some spare storage capacity to absorb the charge created by the alternator during deceleration. If the starter battery was fully charged the electrical energy created would be wasted and so the ECU aims to maintain the battery at around 80% state of charge (low enough to have spare storage capacity but high enough to guarantee engine starting if required).