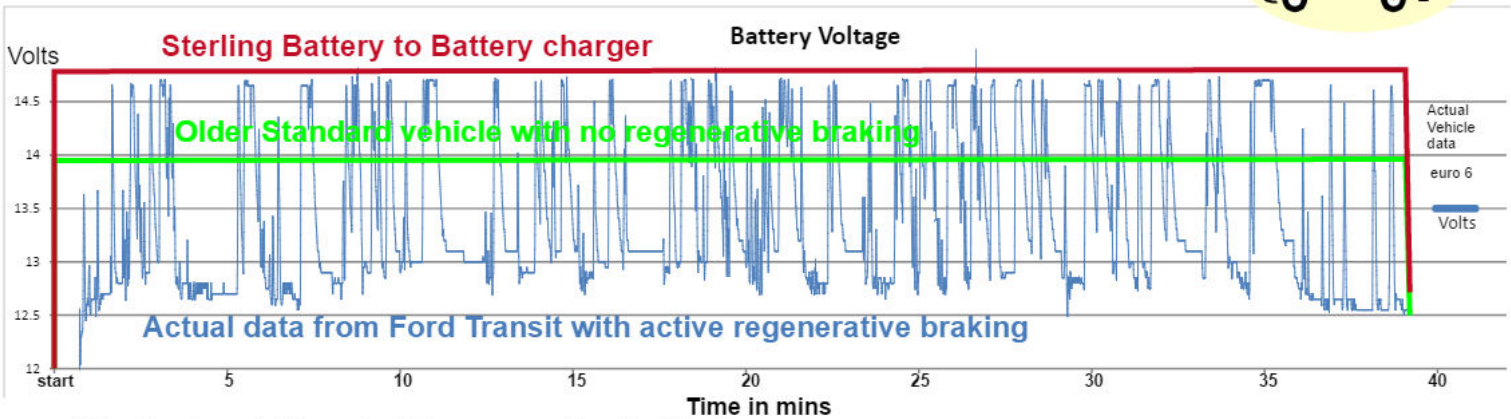
Regenerative Braking - Introduction to the problem and the solution.

Voltage variations associated with vehicle regenerative braking / smart alternator Systems (Energy Recovery System) and what a Sterling Battery to Battery Charge does to rectify this problem.



What is Smart Alternator/ Regenenerative Braking?

The initiative behind the introduction of smart alternators / regenerative braking is to lower CO_2 emissions and to improve miles per gallon / KM per litre for EU regulations. These smart alternators are installed on modern European Vehicles (Euro 5, Euro 6 + and newer engine models).
The object of this new system is to utilise a vehicles wasted kinetic energy during braking / deceleration cycles experienced in every day motoring and rapidly convert as much of that energy (which is usually wasted as braking heat) into useful electricity and store this energy in the starter battery. Then, during acceleration and cruising release this energy back into the vehicles running system as "free electrical energy " thus reducing the time where a alternator loads the main engine. This increases MPG/KPH and lowers CO_2 emissions.

However, in order for this system to be affective the starter battery must have 'free space' to boost the energy into the battery, this requires the battery to be about 20% depleted (low enough to allow more power to be boosted into it but not too low as to prevent the engine from restarting when switched off). To replenish this 'free space', during deceleration or braking events, the voltage on the alternator shoots up to approximately 15V+. This higher voltage fast charges the stater battery to replenish its capacity. As you are using the inertia of the vehicle to charge the battery, rather than fuel, it is seen as 'free energy'. Then the voltage drops to about 12.4V to allow the free energy to be consumed by the vehicle allowing the battery to deplete itself by about 20% ready for the next speed reduction and so on and so forth. Albeit an improvement in terms of emissions, there are knock on affects regarding the auxiliary charging systems on board commercial vehicles, read on:

Problems w/ Smart Alternator/ Regenenerative Braking

The system requires a 20% empty starter battery for the system to work. It needs the space to "dump" the fast energy build up during braking. This is in conflict with the auxiliary charging system, why?:
1) No charge going into the batteries during the 12.2-12.4V phase (which is totally by design). Therefore, an auxiliary system would not be charged during this time frame. This shall certainly be a problem if you require a charged auxiliary battery during travel or at location to location.
2) High alternator charge rate during vehicle deceleration / braking. This is relatively problem free for the starter battery as its relatively full . However, a large flat auxiliary bank could experience high currents at high voltages which could be detrimental to the battery (especially sealed, AGM and Gel) leading to premature destruction.

Problem with using voltage sensitive/controlled relays?

1) Most VSR/VCRs have 2-3 minute time delays before activating.
2) Even if the relay engages the massive voltage swings would prevent the second battery from getting any serious charge when on low voltage and would certainly damage many batteries when at high voltage due to the voltage and massive current in rushes.

The Solution Sterling Bat to Bat chargers 20-180A

Sterling's Battery to Battery Charger: The battery to battery charger range is designed to be connected between the starter battery and the auxiliary system. This unit will increase the vehicles voltage to the auxiliary battery when its low and reduce the vehicles voltage to the auxiliary battery when its high. It will also NOT permit high current inrush beyond the rating of the product and so delivers the auxiliary battery system the correct voltage for different battery types (programmable) regardless off the main system voltage swings, thus, protecting the auxiliary batteries from unnecessary damage. It ensures a constant, safer and much faster charge from the system.

It should also be noted that even on older vehicles or vehicles without smart alternators / Regen. Braking system the Battery to Battery charger will charge auxiliary batteries much faster than conventional non active products such as relays. This product, also, has the ability to compensate for cable voltage drops over distance which will still result in up to a 10 times faster charge rate.

The Test

Vehicle used in test (use graph for illustration)

Vehicle tested was a new (2013) Ford Transit van. Most, if not all vans and cars are now operating on this principle (no inditement to the Transit).

Route chosen:

The route involved some urban, then town, then motorway driving over about 40 minutes.

Graph / Voltage measured.

Blue line: Is the voltage measured at the battery from the Ford Transit using the regenerative system over the journey (acquired on actual journey).
Green line: Is the typical voltage one would see from a standard older vehicle not operation under regenerative braking control.
Red line: This is the voltage on the auxiliary battery sustained by the Sterling Battery to Battery charger regardless of the voltage on the input to the unit (or what ever voltage the unit is set for depending on the aux battery chemistry). The important thing to glean from this is that the Sterling unit is still boosting to 14.8V even when the input voltage drops to 12.6V. It also reduces the high 15V+ (not on the Ford sample) down to the correct 14.4 or 14.8V.
Conclusion: One can clearly see the voltage swing associated with the regenerative braking. Swing from 12.6V - 15.0V. this presents 2 major problems: When at 12.6V the auxiliary charging would simply be useless and at 15.0V it would destroy Gel / AGM batteries. Voltage swings with other manufactures have been in the order of 12.2V - 15.4V. There are also massive current fluctuations which adversely effects fuse and cable sizes.

The Vehicles Route