

Are The Days of The Starter Motor Over?

By: Robert Gell, GELCOservices Pty. Ltd.

As the motor vehicle industry changes to adopt new drive systems technology it appears – *at least for Hybrid drive systems* – that the days of a Starter motor and flywheel ring gear may be numbered!

Ultracapacitors are now beginning to be applied in low-end hybrid electric vehicles for support for primarily the Idle Stop Start (ISS) feature. In reality, an ISS system is not a true hybrid electric vehicle, rather a micro-hybrid, since it applies no electric torque to the vehicle drive wheels.

The micro-hybrid features can be summed up as:

- Engine shuts off while the vehicle is in motion and below approximately 8 kph.
- In emergency braking, the engine remains running to provide vacuum / hydraulic assist to the brakes.
- If the battery State of Charge (SOC) is low, the engine remains on to charge the battery via the alternator.
- If the temperature is above 30⁰C, the engine remains on to sustain cabin air conditioning.
- When the temperature is below -5⁰C, the engine stays on for cabin heating.
- A possible two cell Ultracapacitor module is designed to aid the battery by boosting voltage during engine cranking so the vehicle electrical distribution system voltage is stabilised.

Micro-hybrid implementations come in two basic design varieties;

1. Belt integrated starter generator (B-ISG) or belt alternator starter (BAS) system.
2. Crankshaft mounted integrated starter generator (ISG).

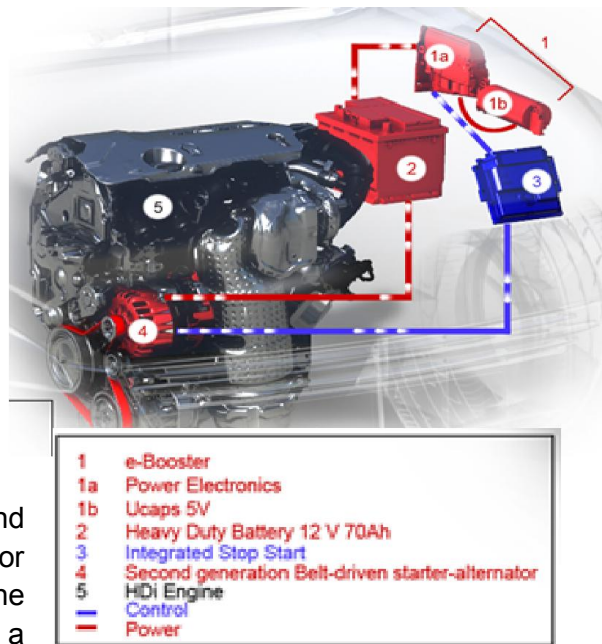
Internationally the most recognised mild hybrid early design (2006) is the BAS that GM put into production in the Saturn Vue Greenline hybrid as a 42 volt system (36 volt battery) and more recently in the Malibu Hybrid and the 2014 Buick LaCrosse Hybrid. In this system, the alternator is an especially designed reversible unit by Hitachi that is rated at 5.0kW electrical power and >4kW mechanical power, 60Nm into the drive belt torque during warm ICE restart.



The second most recognised type of micro-hybrid is the Honda IMA (Integrated Motor Assist) comprising a crankshaft mounted starter generator, separate power electronics unit, and a 144 volt NiMH battery pack. The Honda Civic 4th generation IMA is sandwiched between the 1.3L iVTEC engine and the continuously variable transmission.

The PSA Peugeot Citroen system consists of a Valeo iStARS (integrated Starter-Alternator Reversible System) that provides engine stop-start function by way of the alternator belt. The iStARS delivers, on its own, a 15% fuel consumption reduction on the urban driving cycle when integrated into the 1.4 and 1.6L diesels.

The iStARS system is designed for 600,000 warm restarts of the engine in <400ms. The alternator is rated at 2.2kW and can assist in engine cranking when the temperature is below -25°C by being operated as a motor and provided a special belt tensioner is used for reverse flow of torque to the engine. The Ultracapacitor used in this iStARS system is a two cell single pack rated at 600F at 5.0 volts.



This PSA ISS system technology will also be made available to Ford, Mazda, and Volvo

This revolutionary iStARS system represents two industry firsts:

1. A belt driven system for a diesel
2. An Ultracapacitor for energy storage.

Ultracapacitor electric storage can help because the nature of energy exchanges in the vehicle environment is dynamic with constant cycling of energy, including in some vehicles regenerative braking. Idle Stop Start systems also place additional energy storage demands on a battery and that energy available from all sources can be stored in an Ultracapacitor and delivered in fast time to the ICE start system.

Industry numbers in sales of hybrid vehicles are consistently growing so it may be in the not too distant future that the age of the “old” starter motor design and use may diminish.

Bob Gell – GELCOservices - operates a Technical Laboratory service and Consultancy in Adelaide which focusses on battery testing and Validation to manufacturer’s specifications and relevant Standards.

GELCOservices Pty. Ltd.
www.gelcoservices.com.au

References: Dr. John Miller – Ultracapacitor Applications, W. Diem - “PSA Peugeot Citroens’ stop start future” J. Gonder – SAE2010 “Hybrid Vehicle Technologies Symposium”, Author research.