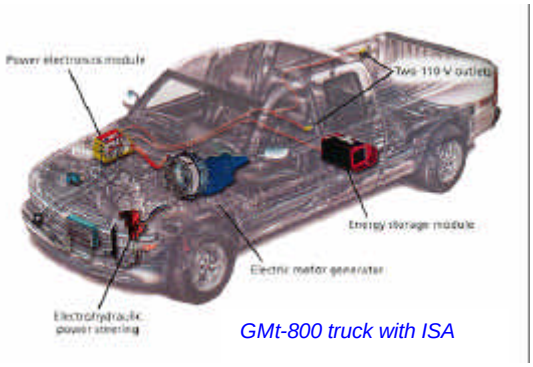
# 42 Volt Super-Capacitor Provides Cranking Amps to Integrated Starter Alternator

Success of Honda Prius leaves little doubt in the future propagation of the Integrated Starter Alternator (ISA) technology as the means of providing significant fuel economy gains in future vehicles, which has been convincingly demonstrated by other developers of ISA as well. For example, General Motors is developing a full-size truck with 5.3-L V8 rated at 213 kW equipped with the ISA system. In this vehicle the ISA is not used as an assist motor, as in Honda Prius, but rather to provide stop-and-go capability, which allows this "monster truck" to boost fuel economy up to 14% without compromising its towing/hauling capacity. As an alternator the ISA system provides power to a 42-V pack of lead-acid batteries supporting the electrically driven onboard systems including the coolant-circulating pump providing heat when the engine is stopped. GM's approach to the hybrid design is in contrast to DC's Durango SUV, which uses a V6 engine assisted by an electric motor providing V8 like level of acceleration at the cost of somewhat reduced towing power. Auto manufacturers including Siemens Automotive, ISAD Continental AG, Valeo and many others are developing similar 42-V ISA technologies to provide vehicles with the fuel saving stop-and-go and regenerative braking capabilities.



*GMt-800 truck with ISA*


*Valeo 42-V ISA system*


*Siemens 42-V ISA*

The stop-and-go and regenerative braking capabilities are very hard on the batteries of the ISA system and require special measures to prolong their useful life. These measures may involve expensive electronic devices limiting the batteries' state of charge, which in turn reduces their efficiency and adds to the cost of the system. On the contrary, super-capacitors are ideal for starting engines either alone or combined with suitable batteries. A battery/super-capacitor system substantially prolongs the battery service life due to the super-capacitor's unique ability of handling high power cycles without damage. Field testing of numerous prototypes has confirmed that the battery/super-capacitor system is the most economical and reliable way of providing repetitive cranking power to the starter and accumulating the energy of regenerative braking. Since, the ISA is connected directly to the crankshaft it requires a much stronger electric current than the conventional starter. For instance, the aforementioned GM truck's motor rates at 4.8 kW running in the alternator mode. The same motor draws almost 286 A as a starter, thus requiring a powerful source of stored energy. The ultimate power and high efficiency of super-capacitors has finally started to receive the deserved recognition from automotive engineers. In this regard, Japan is a proven world leader. Recently introduced in Frankfurt, Toyota's ES$^3$ prototype gets 25% of additional fuel savings due to its powertrain efficiency and reuse of energy. The regenerated energy of deceleration is stored in a 42-V super-capacitor, connected through a DC/DC converter to a 12-V lead-acid battery. In this vehicle Toyota confirms the fact that the lead-acid battery and super-capacitor system is more efficient and less expensive than the nickel/metal-hydride batteries used in the production Toyota Prius hybrid vehicle. Not to be outdone, Honda uses a super-capacitor in its Dualnote conceptual hybrid electric sports car, as well. The super-capacitor, according to a Honda engineer, "…delivers an instantaneous electric "wallop" to the motor, which is its strength. Unproven in the real world at this time is its reliability and durability, which will be solved with time as with other innovations…" We cannot agree more, knowing all to well the


*Toyota ES$^3$ diesel electric with super-capacitor attains 2.7 L/100 km*

considerable amount of time and resources, which were invested in our super-capacitor to make it reliable and durable.

*Honda Dualnote 298-kW HEV with super-capacitor*

Our existing technology allows us to produce super-capacitors with voltages from 6-V to 300-V capable of discharging high power pulses of energy whilst reliably withstanding hundreds of thousands of cycles. European and American engineers, just like their Japanese counterparts, are interested in exploiting the advantages presented by the super-capacitors, especially the ones operating at 42-V, because this is the prevalent voltage of most ISA systems. The energy rating of such super-capacitor does not have to be high since it can be quickly recharged from its fellow battery. For instance, to meet peak power requirements of the starting system of the previously mentioned GM truck the capacitor must be rated at 10-kJ, 42-V. Energy stored in such super-capacitor is sufficient for two consecutive engine starts. Due to the high velocity of cranking the engine would start in 0.3 to 0.5 sec.

We are developing a relatively inexpensive 42-V automotive super-capacitor feasible due to limited use of special materials and an efficient manufacturing. Our basic technology is proven to be one of the most cost-efficient and reliable high voltage super-capacitor technologies on the market today. Considering rapid development of the ISA automotive systems we look forward to meet anticipated demand with our 42-V super-capacitors.

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