APPLICATON BRIEF

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Automotive use of supercapacitors

In the highly competitive automotive market auto makers are in a technology arm race. Cutting-edge innovations are appearing in every aspect of a vehicle, providing the owner with features and convenience they didn't know they needed but cannot live without, as well as major improvements in safety. The move towards smaller and lighter components creates challenges to power this increase in capability. CAP-XX supercapacitors' small size, high burst power and unlimited cycle life can be the solution to bridge the gap in power delivery.

Supercapacitors in next gen car key fobs

Auto makers have been adding features to their smart car key fobs such as encryption for improved security, remote climate control and smart summon to name some examples. Having to transmit over longer distance these features require more power than the simple lock/unlock function of older car key fobs. The tiny coin cell used to power the car key will struggle with this increased demand. This either forces the car owner to change battery more frequently, which is inconvenient, or the key fob must be designed to house a larger battery. Neither is desirable. CAP-XX supercapacitors with their low ESR and ultra-thin prismatic design such as the DMF low ESR high power, DMT long life high temp or DMH ultra-thin is a simple inclusion to increase functionality and extend the battery life.

Fig 1 is an accelerated test two CR2032 batteries with and without a HA202 supercapacitor, 120mF, 120mΩ supercapacitor, running a short ranged BLE TX module. A single BLE TX draws ~15mA for around 50ms, similar to a smart key's RF TX power. The test in Fig1 transmits once per second until module brown-out.

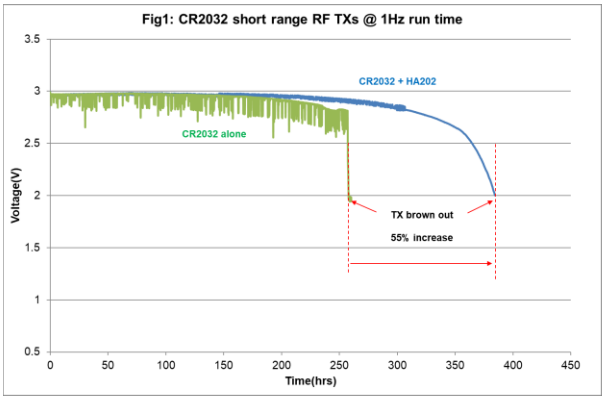

Fig1: CR2032 short range RF TXs @ 1Hz run time

A typical new CR2032 battery has an internal resistance ~10Ω. As the battery is discharged, the internal resistance will increase beyond 60Ω. Drawing 15mA will drop the battery voltage to ~2V, causing the electronics to brown out, while a CR2032 battery supported with an HA202 would still be ~2.8V. This reduced voltage drop allows the BLE TX to utilise much more of the energy in the battery before brown-out, hence the 55% increase in battery life observed in Fig 1.

Reduced cabling weight with support from a supercapacitor

A modern car contains no less than 1 mile of wiring. These copper cables deliver power, deliver control and collect information throughout the vehicle. With increasing emphasis on better fuel economy, auto makers are focusing on reducing weight without sacrificing features. A supercapacitor's low ESR and high C offsets the effect of cable impedance on supply voltage allowing thinner wire gauge to be used reducing electrical cable weight.

One system that can benefit greatly is the audio system. The high-end audio drivers responsible for the rich sound are often rated over 200W. To satisfy such a hungry load auto makers need to use much thicker power cables to eliminate harmonics from voltage variation in the supply rail due to cable impedance. CAP-XX supercapacitors' extremely low ESR and good frequency response holds the audio driver's supply rail steady, allowing thinner cable to be used saving significant weight while providing unparalleled audio quality.

Various electromechanical modules that provide door locking, window winding, power seat/steering wheel adjustment only require high power to overcome inertia and provide motor starting current then much lower power until the action is complete. These modules can take advantage of a built in supercapacitor to supply the high peak load and use thinner wiring only providing average power. Another example is a blinker with 50% duty cycle. A supercapacitor supplies peak blinker current while the wiring is sized for average current.

Supercapacitors Provide Voltage Stabilisation

The vehicle voltage rail can suffer sags, e.g. during engine cranking in stop-start operation. A supercapacitor can support the voltage and prevent interruptions to vehicle electronics such as the EMS, GPS, radio, etc.

Supercapacitors provide emergency power

Safety is paramount in today's cars. Modem vehicles are all designed to have multiple system to protect the occupants. All these safety systems rely on the electrical system. Any failure in the electrical system can spell disaster. Supercapacitors can help mitigate this risk.

As well being able to provide high pulse power a supercapacitor stores significant amount of energy which can be used to power some key vehicle systems for a short time, allowing a safe stop, in the event of a failure of the electrical system. With practically unlimited cycle life, a supercapacitor is a very reliable backup energy source.

Critical safety systems such as the airbag deployment and automatic emergency responder calling system with supercapacitor power backup can save lives if the vehicle suffers an early electrical failure in an accident.

Selecting your Supercapacitor

With a 3V battery you can use a single 3V cylindrical cell, GY13R0 series, or a 2.75V prismatic cell from our H series. The HA102 and HA130 fit over a CR2032 coin cell. If using a 2.75V cell, then a low power regulator is required between the battery and supercapacitor, see Coupling a Supercapacitor with a Battery. If you are using a higher voltage battery, then a dual cell supercapacitor is required with active balancing to minimise energy drain from the battery, see the DMF, DMT or DMH series and Cell Balancing. The supercapacitor needs to have low enough ESR and high enough C at end of life to support the peak pulse load, refer to Powering Pulsed Loads. The supercapacitor, with its very low ESR may draw a large inrush current when initially charging. The battery internal impedance may be enough to limit this current, or see Current Limiting for Supercapacitors.