Use Case
Transportation

Supercapacitor modules accelerate the future of electric vehicles

More commercial vehicle OEMs have been designing and launching multiple vehicle platforms that feature electrified drivetrains with the reasons for doing so well documented: increased energy efficiency, lower emissions, environmental sustainability, but also potentially improved performance and lower total cost of ownership.

One of the most heavily investigated components of electrified drivetrains are the batteries that store the electrical energy in HEV, PHEV and BEV systems. In this investigation, determining the lifetime of the battery over the estimated drive cycles is quite often the one the top priorities. Even with the dynamic advances in technology for automotive batteries, primarily Lithium Ion technologies, there still will be maximum lifetimes and drive ranges that can be achieved. The lifetime of batteries, and all energy storage devices, is impacted by the number of charge/discharge cycles, duty cycle and ambient temperature to name a few. The more cycles, the higher the duty cycle and higher temperatures all result in abbreviated lifetimes.

In just about all electrified drivetrains, regenerative braking is a feature that is implemented to improve the energy efficiency of the vehicle. This results in higher duty cycles and an increase in charge/discharge cycles, thus limiting the lifetime of the battery. For vehicles designed for frequent start/stop drive cycles, such as public transportation or delivery vehicles, this increases drastically. Supercapacitor modules have been increasingly integrated in the ESS (Energy Storage System) drivetrains due to the high power density and long lifetime. Supercapacitor modules are much more resilient compared to battery technologies to the number high power charge/discharge demonstrated in these heavier systems.

Large bus OEMs have long selected higher voltage supercapacitor modules to integrate into their hybrid drivetrains due to these features, including Eaton's ruggedized XLR modules. By doing so, the supercapacitor modules provide higher peak power during acceleration which could result in reducing the overall size of the onboard internal combustion engine (ICE) required to power the vehicle. Depending on the configuration, this can demonstrate up to a 30% improvement in fuel economy. Also, given the longer lifetime compared to batteries, the overall life cycle costs can be reduced through fewer ESS replacements.

Similarly, a hybrid energy storage systems (HESS) in battery electric vehicles have been deployed that feature a tandem of batteries and supercapacitors in full BEV (Battery Electric Vehicles). Because supercapacitors offer lower ESR than batteries, it is possible to wire the two energy storage solutions directly in parallel and still provide advantages. This topology can offer battery lifetime improvements and some extension of drive range between charges. However, the greatest improvement with HESS is to have integrated power electronics to control which storage technology provides the necessary energy to the drivetrain. Supercapacitors, due to their higher power density would provide more power during acceleration and capture more energy during regenerative braking. This can help stabilize the use of the battery for longer range. By doing this, Eaton has simulated lifetime benefits of up to 3x given this topology[1]. Supercapacitor modules can demonstrate dramatic improvements in the lifetime costs of BEVs.

1 Battery life estimation model and analysis for electronic buses with auxiliary energy storage systems

Results may vary by energy source specifications, drive cycles and environmental conditions.

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