Hybrid Power Management (HPM) Program Resulted in Several New Applications

Hybrid Power Management (HPM) is the innovative integration of diverse, state-of-the-art power devices in an optimal configuration for space and terrestrial applications. The appropriate application and control of the various power devices significantly improves overall system performance and efficiency. The advanced power devices include ultracapacitors, fuel cells, and photovoltaics. HPM has extremely wide potential with applications from nanowatts to megawatts. Applications include power generation, transportation systems, biotechnology systems, and space power systems. HPM has the potential to significantly alleviate global energy concerns, improve the environment, and stimulate the economy.

Hybrid Power Management Program-Power for a Brighter Tomorrow. Left: Electric toothbrushes powered by ultracapacitors. Center: Utility vehicle powered by ultracapacitors. Right: Smoke detectors with ultracapacitor backup power.

The continuation of HPM through NASA Glenn Research Center's Commercial Technology Office resulted in several new successful applications of this pioneering technology for fiscal year 2002. A typical commercial alternating-current- (ac-) powered smoke detector is powered by an ac power system and has a battery for backup power in the event of a power outage. The battery must be replaced at least once a year. In contrast, the HPM smoke detector, which also is powered from an ac power system, has ultracapacitors for backup power in the event of a power outage. The ultracapacitors can provide 7 days of backup power, and they never need to be replaced; thus, they provide a safer, environmentally friendly, longer life solution.

A typical electric toothbrush is powered by batteries. The batteries provide reduced performance over time, and eventually need to be replaced and disposed of. The HPM toothbrush can be charged in 10 seconds and provides 2 minutes of operation, as typically required for tooth brushing. The ultracapacitors can be charged quickly, and never need replacement.

An electric bicycle also was tested. It has lead acid batteries that provide a range up to 20 miles, but the batteries require 4 hours to recharge. The range degrades over time, and the batteries must be replaced after about 300 charging cycles. The low-temperature performance of the batteries is greatly reduced. This year, the bicycle was tested with ultracapacitors. It charged in 5 minutes and provided 1 hour of operation at 10 mph for a 10-mi range. The ultracapacitors have unlimited life and can be charged quickly. The low-temperature performance of the ultracapacitors is excellent.

An electric utility vehicle also is being tested. It is equipped with lead acid batteries that must be watered weekly and replaced annually under normal use. The recharge time is 8 hours. The vehicle is being equipped with ultracapacitors that require no maintenance, have unlimited life, and can be charged in minutes rather than hours.

In addition, HPM is being considered for providing reliable, long-life energy storage systems, essential for space missions, such as the exploration of Mars, and deep space missions, such as the exploration of Europa. The technology is also being considered for various aeronautical electrical system applications.

Bibliography

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