How to Improve Battery Life in Low Power Electronics

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Portable electronics are evolving so quickly that one can barely keep up with the new devices available to end-users. These devices range from more powerful cell phones that feature cameras, MP3 audio and Internet access, to portable medical instrumentation such as wearable patient monitors. Regardless of the system, consumers expect more functionality in a smaller device that operates for a longer period of time between charges.

Significant progress has been made to increase the efficiency of a portable devices power operation, specifically the optimization of RF circuit and digital ASIC / support logic power consumption. Designers are currently concentrating on power losses due to passive components that can negatively impact the systems overall power consumption.

Passive component manufacturers, such as AVX, have developed several products that are optimized to reduce power consumption as well as improve battery life and reliability in low and ultra low power electronic applications. Most recently, much research and development efforts have been focused on providing low leakage transient suppression and low leakage capacitors for DC conversion and burst power applications. Below are two examples of products that can improve battery life and reliability.

Transient Voltage Suppressors

Multilayer varistors (MLVs) are essentially miniature bi-directional transient voltage suppressors (TVSs) that act as EMI filters in their 'off' state. In the 'off' state, MLVs also exhibit a leakage current. A typical system might have a large number of these devices typically protecting any connection to the outside world – battery terminals, charge ports, Vcc lines to critical and susceptible ICs such as charge controllers and Asics are some of the most common applications. Since MLVs are used between signal and ground or power and ground – in shunt configuration, the leakage currents of the MLV add to the loading on the battery and can represent a significant drain on battery life.

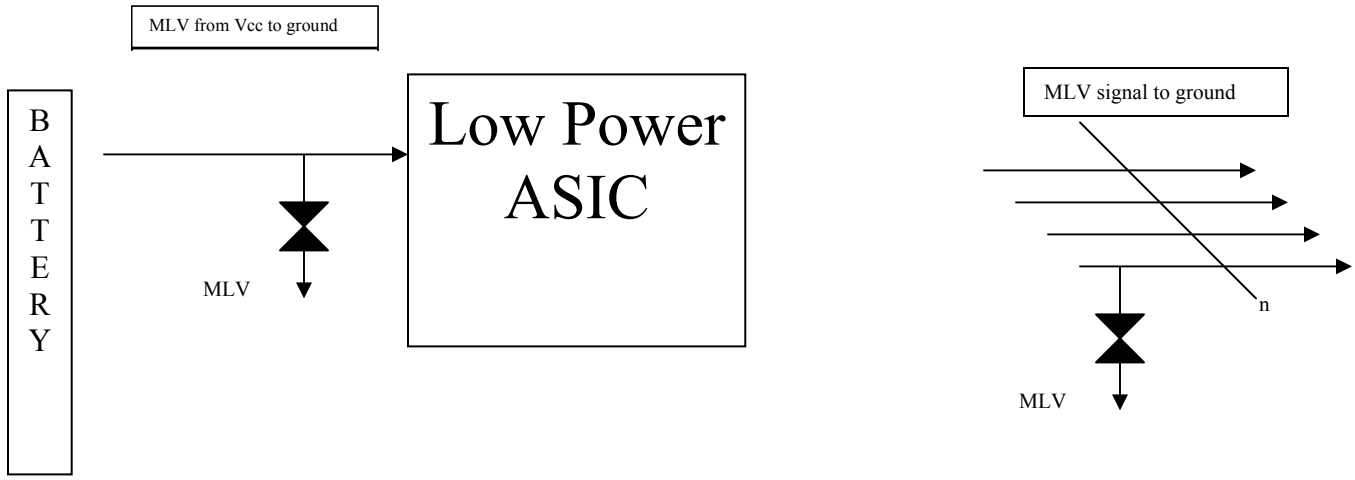
Recognizing this, AVX has developed an ultra low leakage MLV with an 'off' state leakage of 1ua. This represents an improvement of approximately 50x over standard MLVs and positively impacts battery life, signal to noise ratio and even light intensity from LED light engines needing TVS protection.

These devices are readily available in case sizes as small as 0402 with AVX developing an 0201 version of the device. Due to their ultra miniature package, this single component can take the place of a back-to-back zener diode and an EMC capacitor, providing up to 97% PCB area reduction.

Additionally, these low leakage MLVs offer a sub 1 FIT failure rate and a higher 'in rush' current capability than diodes, as well as a higher peak power capability with virtually no wear out phenomena.

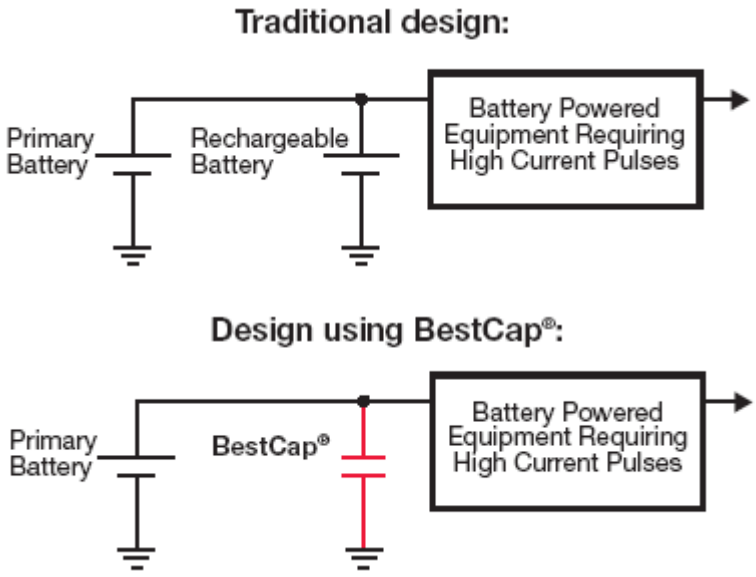
Generally speaking, MLVs are available in case sizes range from single element discrete devices in case sizes from 0402 to 1206. Dual element devices are available in 0405 and 0508 case size and four element arrays are available in 0612 case size. These array devices are ideal for multiplexed bus protection and sensor protection.

General example of Low leakage 19x series MLV implementation is below:

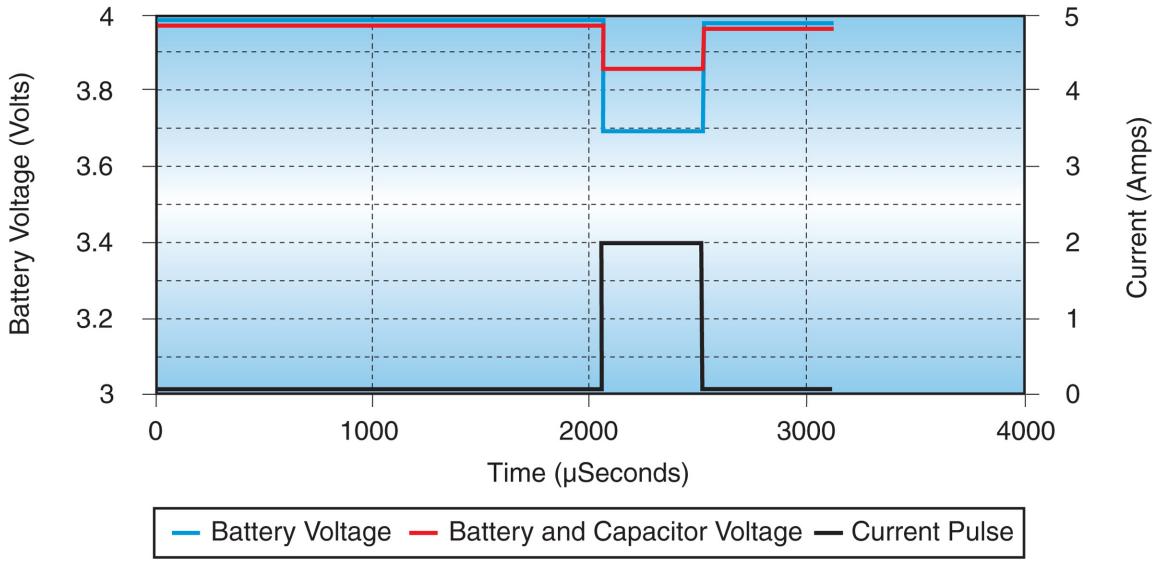


Double Barrier Layer Capacitors

A typical supercapacitor is available in values from 10mf to 1f at voltages up to 15vdc. These devices exhibit low leakage characteristics from 5ua to 40ua depending on the case size and value of the capacitor. This low level of leakage allows them to be used in parallel with the portable systems battery to create a hybrid battery capable of powering pulsed power end systems efficiently. Their low leakage prevents them from drawing significant power during powered down states of the system. AVX's BestCap® devices, for example, offer significantly low voltage drop for pulse power applications of durations of up to ~ 100msec. Typical configuration is shown below.



Because BestCap, when used in parallel with a battery, provides a current pulse with a substantially higher voltage than that available just from a battery (shown below), the efficiency of the system is improved.



Additionally, the higher battery voltage supplied by the supercapcitor keeps the voltage pulse above the “cut off voltage” limit for a significantly longer time.

Summary:

Due to the significant increase in the use of battery powered equipment, there is a growing demand for low leakage components that are used across the battery line to maximize battery life and reliability. Transient suppression of MLVs offer a lower current draw in the ‘off’ state than with diode TVS’s, thus maximizing a systems battery life. A MLV’s current draw is so minimal that it can be placed on sensors with virtually no loss in sensor accuracy.

A low ESR supercapacitor can be placed in parallel to the battery and supply peak power draw for pulsed load application. This configuration maximizes battery life by offering a unique combination of high pulse power and high-energy characteristics with low leakage and low voltage drop.

These solutions can also reduce PCB board space in a design, as they can replace multiple components within a design.