# Battery backup alternative

Supercapacitors voltage characteristics are of primary concern in this application. Supercapacitors have a capacitive and resistive component that directly affect the voltage charge/discharge rate of the capacitors. The resistive components determined by the ESR (DC) characteristics of the capacitor governed by:

$$V=i*R$$

The capacitive component is governed by

$$i=C*dv/dt$$

Solving for voltage

$$dv=i*dt/C$$

Combining the resistive and capacitive components get

$$dv= i*dt/C + i*R$$

Where

dv= the change in voltage that the system can tolerate to operate correctly. Vm-Vn
Vm is normally the operating voltage of the system prior to the system discharging.
Vn is the minimum voltage the system needs to operate.
dt is the amount of time the discharge pulse.
C is the capacitance of the system needed. This value will be based on the combination of capacitors in series and parallel.

$$C= Cc*\#P/\#S$$

Cc is the capacitance of individual cell.
#P is the number of capacitors in parallel.
#S is the number of capacitors in series. Number of capacitors needed to be in series is determined by taking the operating voltage of the system divided by the capacitors rated voltage.

R is the total resistance of the capacitor bank. R is calculated by

$$R=ESR*\#S/\#P$$

Where ESR is the ESR value of the capacitor selected and #S is the number of capacitors in series while #P is the number of capacitors in parallel.

i is the average amount of current required during the discharge cycle. I is calculated from determining the maximum and minimum system currents

$$i=(im+in)/2$$

Maximum current (im) =system power/ Vn
Minimum current (in) = system power/Vm