QUESTIONAIRE

Design-In of Supercapacitors in 4 Steps

Supercapacitors (SC) are often used as energy storage devices. In those cases, the early conceptual phase of the design-in process can be subdivided 4 steps.

1. Determine the number of serial connected supercapacitors. Some applications require higher voltage than the rated voltage of an individual SC.
2. Determine the capacitance of the stack, based on the required power.
3. Determine the requirements of the charging unit. Determine the charging time.
4. Determine the lifetime, based on the operational conditions.

Once the concept is developed, the electrical engineer can make qualified decision about the circuit design and choose the appropriate electronic components.

Please, answer the following questions. With the given information we are able to provide the parameters of the SC application.

TO CALCULATE THE SIZE OF THE STACK

Larger operating voltages require the serial connection (cascades) of supercapacitors.

Please, specify the required charging voltage V_c of the supercapacitor unit and its cut off voltage V_{cut} an.

V_c = [_ _ _ _]

V_{cut} = [_ _ _ _]

Please fill in the relevant magnitude and corresponding unit.

TO CALCULATE THE REQUIRED CAPACITANCE

Identify the mode of operation for the discharge process. Please mark the appropriate box with an “x”.

Constant Current ☐

Please, specify the required current I.

I = [_ _ _ _]

Constant Power ☐

Please, specify the required power P.

P = [_ _ _ _]

Constant Resistance ☐

Please, specify the resistance R of the load.

R = [_ _ _ _]

How long is the discharge time ***t*** for the above chosen process?

t = [_ _ _ _]

TO CALCULATE THE CHARGING TIME OR CHARGING CURRENT OR PROTECTIVE RESISTOR

What type of power source is used to charge the capacitor unit?

Please, identify the relevant charging process. Please, mark the appropriate box with an "X".

Constant Current ☐

To calculate the charging time t_c please state current output I_c of the constant current source, used for charging the SC unit.

I_c = [_ _ _ _]

OR

To calculate the required charging current please, state the desired charging time t_c

t_c = [_ _ _ _]

Constant Voltage ☐

To calculate the protective resistor for your charging voltage source, please, state the maximum allowable current I_{cm} of your source. Please fill in the relevant magnitude and corresponding unit.

I_{cm} = [_ _ _ _]

TO ESTIMATE THE LIFETIME

We may also estimate the degradation of capacitance for user defined operational profiles. The user may define a "typical working day" (24 h), such as given in Table 1. Based on this operational profile the remaining relative capacitance vs. time can be calculated, as given in Figure A1.

You may choose between two load schemes:

1. DC-voltage load and
2. Low current load (i.e. cycle life test conditions).

Load Scheme	Low current load	Low current load	Low current load	Low current load
Op. Time [h]	_____	_____	_____	_____
Op. Temp. [°C]	_____	_____	_____	_____
Applied Voltage [V]	_____	_____	_____	_____

Load Scheme	DC-voltage load	Low current load	Low current load	Low current load
Op. Time [h]	3	4	12	5
Op. Temp. [°C]	65	50	40	22
Applied Voltage [V]	/	2.0	2.7	0

Table 1: Example of high temperature operational profile for 24 h.

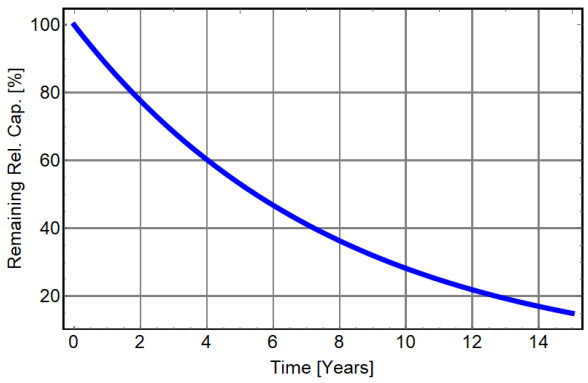

Figure A1: Example. Relative capacitance vs. time for operational profile, given in Table 1