

New 6.0V SCM Series Supercapacitors Modules



Connected Supercapacitors



This new series of electrochemical, double-layer, series-connected supercapacitor modules offers excellent pulse power handling characteristics based on the combination of very high capacitance and very low ESR. Used by themselves or in conjunction with primary or secondary batteries, they provide extended back up time, longer battery life, and provide instantaneous power pulses as needed. Offers great solutions to Hold Up, Energy Harvesting, and Pulse Power Applications.

FEATURES

- High pulse power capability
- Low ESR
- Low Leakage Current

APPLICATIONS

- Camera Flash Systems
- Energy Harvesting
- GSM/GPRS Pulse Applications
- UPS/Industrial
- Wireless Alarms
- Remote Metering
- Scanners
- Toys and Games

HOW TO ORDER

SCM	R	14	H	474	M	R	B	B	-
Series SuperCap Module	Diameter Q = 6.3mm R = 8mm S = 10mm T = 12.5mm	Case Length Two digits Represent case Length in mm	Voltage Code F = 5.5V H = 6.0V	Capacitance Code 474 = 0.47F 105 = 1F 155 = 1.5F 255 = 2.5F 505 = 5F 755 = 7.5F	Tolerance M = $\pm 20\%$ S = $+30\%/-10\%$	Package/ Lead Format R = Shrink Wrap/ Radial	Package B = Bulk T = Tray*	Balancing A = Unbalanced B = Passive Balanced	Custom Code 0 = Straight Leads 1 = Bent Leads*

*Inquire about availability

QUALITY INSPECTION

Parts are tested for Life Cycle, high temperature load life, temperature characteristics, vibration resistance, and humidity characteristics. See page 2 for more information.

TERMINATION

These supercapacitors are compatible with hand soldering, as well as reflow and wave soldering processes, so long as appropriate precautions are followed. See page 4 for more information.

OPERATING TEMPERATURE

-40°C to +65°C @ 6.0V Balanced
-40°C to +85°C @ 5.1V Balanced

-40°C to +65°C @ 5.5V Unbalanced
-40°C to +85°C @ 4.6V Unbalanced



For RoHS compliant products,
please select correct termination style.

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RATINGS & PART NUMBER REFERENCE

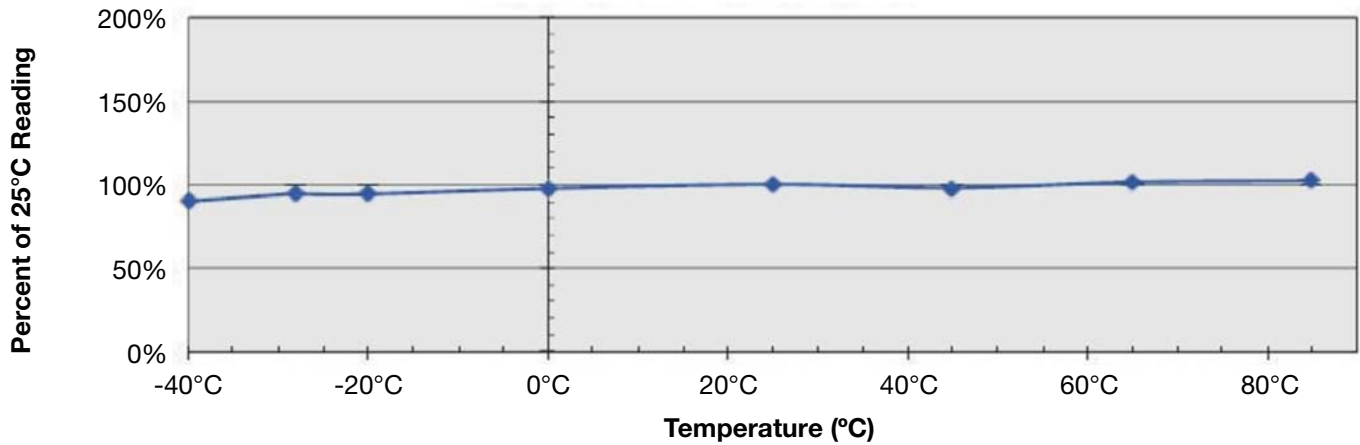
AVX Part Number	Diameter (mm)	Length (mm)	Capacitance (F)	Capacitance Tolerance	Rated Voltage (V)	Rated Temperature (°C)	DCL Max @ 72 Hrs (µA)	ESR Max @ 1000 Hz (mΩ)	ESR Max @ DC (mΩ)	Peak Current (A)	Power Density (W/kg)	Max Energy (Wh)	Energy Density (Wh/kg)
SCMQ14F474MRBA0	6.3	14	0.47	±20%	5.5	65	6	500	3000	0.6213	952.7298	0.0028	1.5278
SCMQ14H474SRBB0	6.3	14	0.47	+30%/-10%	6.0	65	7	500	3000	0.6778	1133.8272	0.0030	1.6667
SCMR14F474MRBA0	8	14	0.47	±20%	5.5	65	6	380	1720	0.8759	1940.9379	0.0019	1.0185
SCMR14H474MRBB0	8	14	0.47	±20%	6.0	65	7	380	1720	0.9556	2309.8765	0.0021	1.1111
SCMR18F105MRBA0	8	18	1	±20%	5.5	65	6	250	720	1.5991	2173.3110	0.0041	1.7315
SCMR18H105MRBB0	8	18	1	±20%	6.0	65	12	250	720	1.7444	2586.4198	0.0044	1.8889
SCMR22F155MRBA0	8	22	1.5	±20%	5.5	65	12	200	560	2.1694	2240.7407	0.0061	2.3426
SCMR22H155MRBB0	8	22	1.5	±20%	6.0	65	18	200	560	2.3667	2666.6667	0.0067	2.5556
SCMS22F255MRBA0	10	22	2.5	±20%	5.5	65	24	180	340	3.1269	1791.5552	0.0103	2.4444
SCMS22H255MRBB0	10	22	2.5	±20%	6.0	65	30	180	340	3.4111	2132.0988	0.0112	2.6667
SCMS32F505MRBA0	10	32	5	±20%	5.5	65	30	120	150	6.8750	2592.4126	0.0206	2.9537
SCMS32H505MRBB0	10	32	5	±20%	6.0	65	36	120	150	7.5000	3085.1852	0.0224	3.2222
SCMT22F505MRBA0	12.5	22	5	±20%	5.5	65	30	120	150	6.8750	2592.4126	0.0206	2.9537
SCMT32F755MRBA0	12.5	32	7.5	±20%	5.5	65	78	90	120	9.3704	2426.4318	0.0207	3.2593

QUALIFICATION TEST SUMMARY

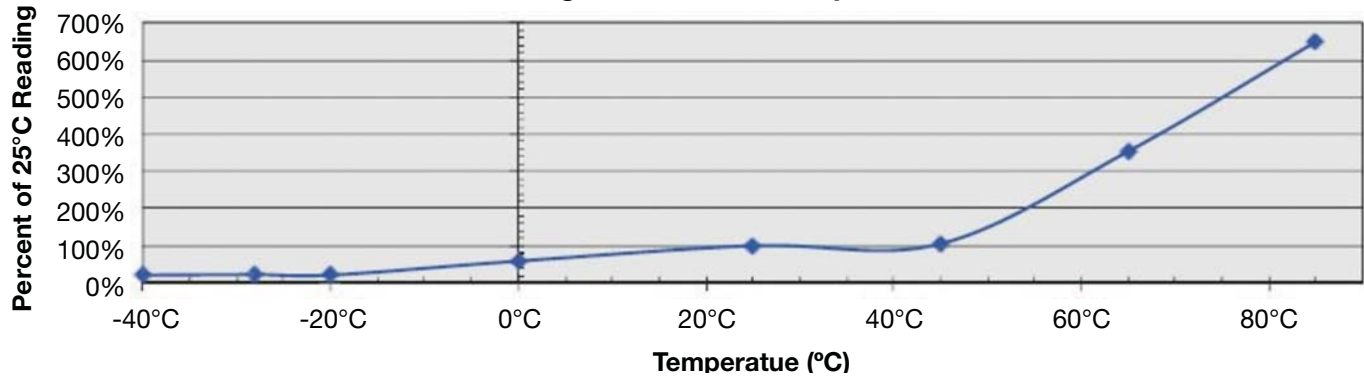
Test	Test Method	Parameter	Limits
Life Cycle	Capacitors are cycled between specified voltage and half-rated voltage under constant current at +25°C for 500,000 cycles	Capacitance Change ESR Appearance	≤30% of initial value ≤200% initial value No remarkable defects
High Temperature Load Life	Temperature: 60 ± 2°C Voltage: V _R Test Duration: 1,000 +48/-0 hours	Capacitance Change ESR Appearance	≤30% of initial value ≤200% initial value No remarkable defects
Shelf Life	Storage Duration: 12 hours No Load Temperature: Maintain at 25°C	Capacitance Change ESR Appearance	≤30% of initial value ≤200% initial value No remarkable defects
Vibration Resistance	Amplitude: 1.5mm Frequency: 10 ~ 55Hz Direction: X, Y, Z (Each for 2 hours)	Capacitance Change ESR Appearance	≤30% of initial value ≤200% initial value No remarkable defects
Humidity	Voltage: V _R RH: 90~95% Temperature: 40 ± 2°C Test Duration: 240 hours	Capacitance Change ESR Appearance	≤30% of initial value ≤200% initial value No remarkable defects

QUALITY AND RELIABILITY

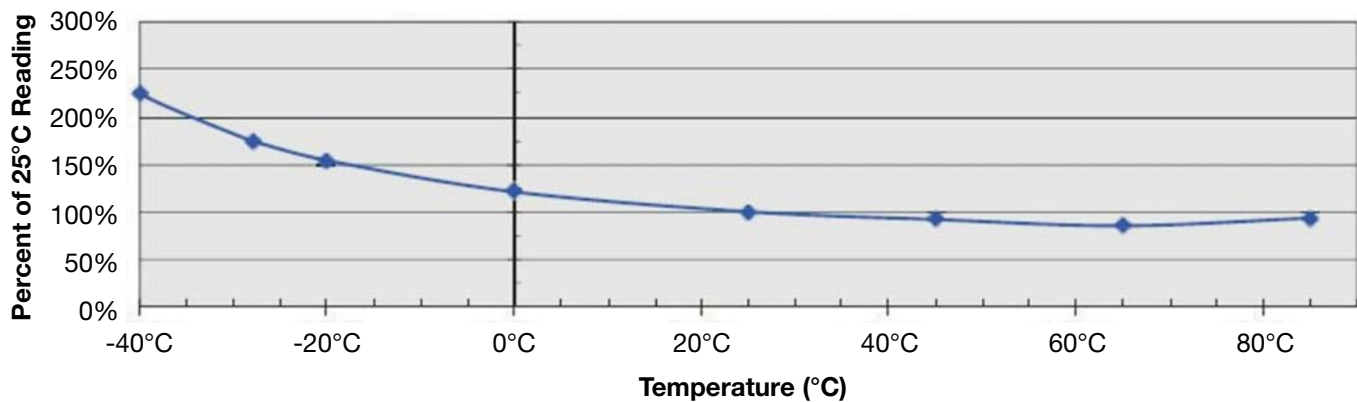
Capacitance vs. Temperature



Leakage Current vs. Temperature



Equivalent Series Resistance vs. Temperature



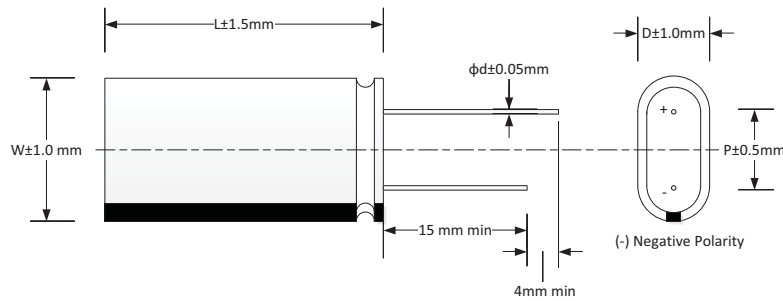
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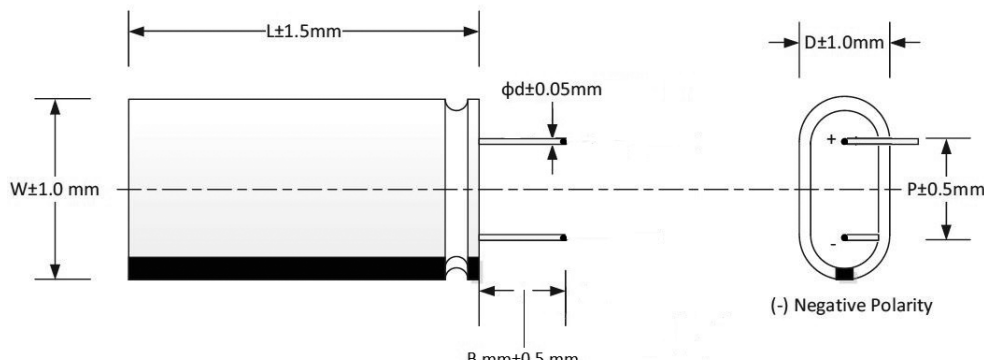
MECHANICAL SPECIFICATIONS

Shrink Wrap Type



AVX PN	D (mm)	W (mm)	L (mm)	P (mm)	d (mm)
SCMQ14F474MRBA0	6.3	13.6	14	9	0.6
SCMQ14H474SRBBO	6.3	13.6	12	9	0.6
SCMR14F474MRBA0	8	16	14	11.5	0.6
SCMR14H474MRBBO	8	16	14	11.5	0.6
SCMR18F105MRBA0	8	16	18	11.5	0.6
SCMR18H105MRBBO	8	16	18	11.5	0.6
SCMR22F155MRBA0	8	16	22	11.5	0.6
SCMR22H155MRBBO	8	16	22	11.5	0.6
SCMS22F255MRBA0	10	20	22	15.5	0.6
SCMS22H255MRBBO	10	20	22	15.5	0.6
SCMS32F505MRBA0	10	20	32	15.5	0.6
SCMS32H505MRBBO	10	20	32	15.5	0.6
SCMT22F505MRBA0	12.5	25	22	18	0.6
SCMT32F755MRBA0	12.5	25	32	18	0.6

Radial Bent Lead Type (Both Shrink Wrap & Plastic)



SOLDERING RECOMMENDATIONS

When soldering supercapacitors to a PCB, the temperature & time that the body of the supercapacitor sees during soldering can have a negative effect on performance. We advise following these guidelines:

- Do not immerse the supercapacitors in solder. Only the leads should come in contact with the solder.
- Ensure that the body of the supercapacitor is never in contact with the molten solder, the PCB or other components during soldering.
- Excessive temperatures or excessive temperature cycling during soldering may cause the safety vent to burst or the case to shrink or crack, potentially damaging the PCB or other components, and significantly reduce the life of the capacitor.

HAND SOLDERING

Keep distance between the supercapacitor body and the tip of the soldering iron and the tip should never touch the body of the capacitor. Contact between supercapacitor body and soldering iron will cause extensive damage to the supercapacitor, and change its electrical properties. It is recommended that the soldering iron temperature should be less than 350°C, and contact time should be limited to less than 4 seconds. Too much exposure to terminal heat during soldering

can cause heat to transfer to the body of the supercapacitor, potentially damaging the electrical properties of the supercapacitor.

WAVE SOLDERING

Only use wave soldering on Radial type supercapacitors. The PCB should be preheated only from the bottom and for less than 60 seconds, with temperature at, or below, 100°C on the top side of the board for PCBs equal to or greater than 0.8 mm thick.

Solder Temperature (°C)	Suggested Solder Time (s)	Maximum Solder Time (s)
220	7	9
240	7	9
250	5	7
260	3	5

REFLOW SOLDERING

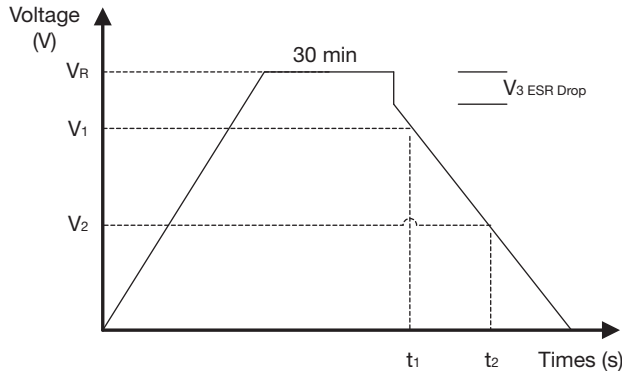
Infrared or conveyor over reflow techniques can be used on these supercapacitors. Do not use a traditional reflow oven without clear rated reflow temperature for supercapacitors.

Connected Supercapacitors

TEST METHODS

IEC Capacitance Test Method

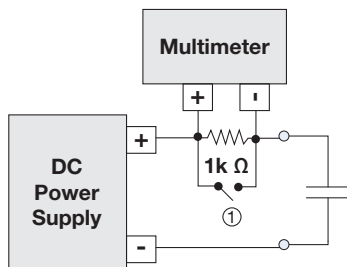
- Capacitance is measured using a Keithley 2400 or 2602 Meter
- Procedure
 - Charge Capacitor to Rated Voltage at room temperature
 - Disconnect parts from voltage to remove charging effects
 - Discharge cells with a constant current I determined by $4 * C * V_R$
 - Noting V_1 , t_1 , V_2 , t_2 and performing the calculation for C



- I – Discharge Current [mA], $4 * C * V_R$
- V_R – Rated Voltage
- V_1 – Initial Test Voltage, 80% of V_R
- V_2 – Final Test Voltage, 40% of V_R
- t_1 – Initial Test time
- t_2 – Final Test time
- $C = I * (t_2 - t_1) / (V_1 - V_2)$

DCL Measurement @ 25°C

- DCL is measured using a Multimeter with high internal impedance across a resistor
 - Charge Capacitor to Rated Voltage at room temperature for 72 Hours
 - Disconnect parts from Voltage by opening switch 1 (Stabilize for 10 Min)
 - Measure Voltage across a known Valued Resistor (1K Ohm)
 - Calculate $DCL = V/R$



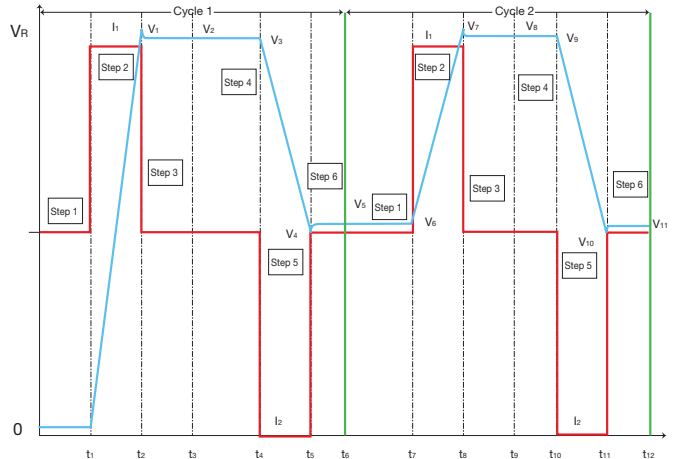
Initial ESR Measurement @ 25°C

- Using an Agilent 4263B LCR Meter and a Kelvin connection
 - Measure at frequency of 1000 Hz
 - Measurement Voltage of 10mV

DC ESR Measurement

- Six steps capacity and ESRDC Test Method is used as illustrated in the figure right.
- Tests are carried out by charging and discharging the capacitor for two cycles at rated voltage and half rated voltage

- $C = (C_{DC1} + C_{DC2}) / 2$
- $ESR_{DC} = (ESR_{DC1} + ESR_{DC2}) / 2$
- Where: $C_{DC1} = I_2 * (t_5 - t_4) / (V_3 - V_4)$
- $C_{DC2} = I_2 * (t_{11} - t_{10}) / (V_9 - V_{10})$
- $ESR_{DC1} = (V_5 - V_4) / I_2$
- $ESR_{DC2} = (V_{11} - V_{10}) / I_2$
- $I_1 = I_2 = 75mA/F$



Maximum Operating Current

- This is the maximum current when capacitor temperature rise of the capacitor during its operation is less than 15°C

Maximum Peak Current

- This is the maximum current in less than 1 sec

Watt Density

- $Watt\ Density = (0.12 * V^2 / R_{DC}) / mass$

Energy Density

- $Energy\ density = (1/2 * CV^2) / (3600 * mass)$

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POLARITY / REVERSE VOLTAGE

In principal the positive and negative electrodes of the super-capacitors are symmetrical and in theory they should not have a polarity but for product consistency and for optimum performance the negative polarity is marked because the capacitors do not discharge completely when in use. It is recommended that the

polarity should be used as marked. If the polarity is reversed the circuit will not have a catastrophic failure but the circuit will see a much higher leakage current for a short duration of time and the life time of the super-capacitors will be reduced.

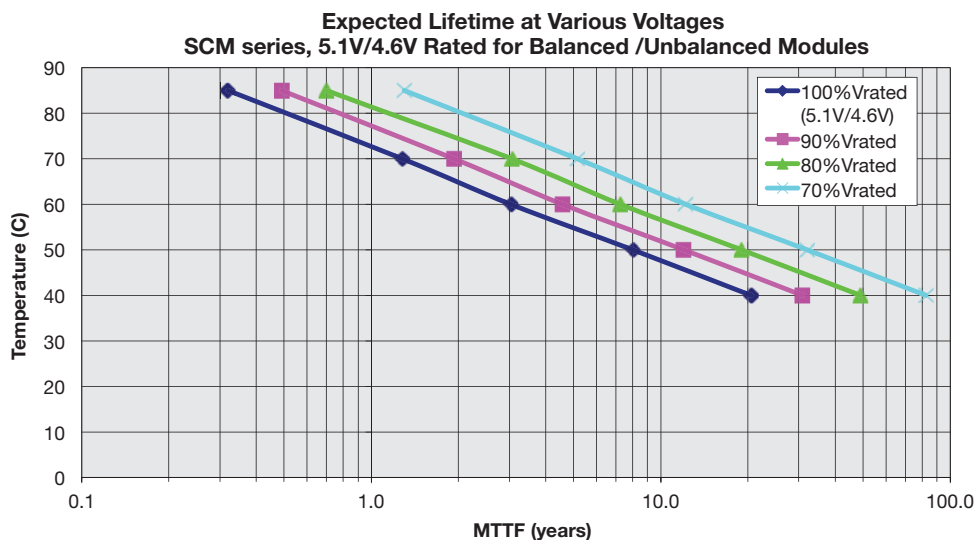
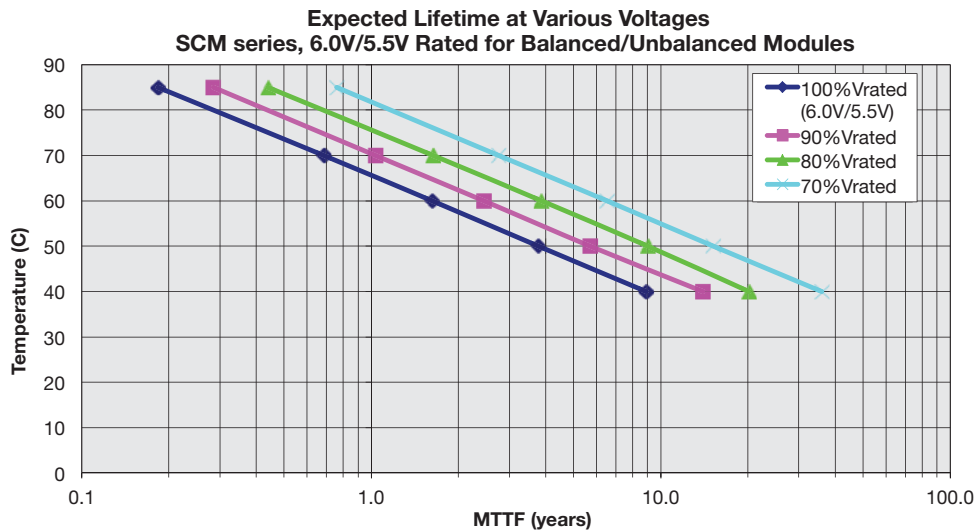
LIFE TIME AND TEMPERATURE PERFORMANCE

The life of a supercapacitor is impacted by a combination of operating voltage and the operating temperature according to the following equation:

$$\text{time to failure, } t \propto V^n \cdot \exp(-Q / k \cdot T) \dots\dots\dots(1)$$

where V is the voltage of operation, Q is the activation energy in electron volts (eV), k is the Boltzmann's constant in eV and T is the operating temperature in °K (where K is in degrees Kelvin). Typical values for the voltage exponent, n, is between 2.5 - 3.5, and Q is between 1.0 - 1.2 eV in the normal operating temperature range of 40° to 65°C.

The industry standard for super-capacitor end of life is when the equivalent series resistance, ESR, increases to 200% of the original value and the capacitance drops by 30%. Typically a super-capacitance shows an initial change in the ESR value and then levels off. If the capacitors are exposed to excessive temperatures the ESR will show a continuous degradation. In the extreme case, if the temperatures or voltages are substantially higher, than the rated voltage, this will lead to cell leakage or gas leakage and the product will show a faster change in the ESR which may increase to many times the original value.



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SAFETY RECOMMENDATIONS

Warnings

- To Avoid Short Circuit, after usage or test, Super Capacitor voltage needs to discharge to $\leq 0.1V$
- Do not Apply Overvoltage, Reverse Charge, Burn or Heat Higher than $150^{\circ}C$, explosion-proof valve may break open
- Do not Press, Damage or disassemble the Super Capacitor, housing could heat to high temperature causing Burns
- If you observe Overheating or Burning Smell from the capacitor disconnect Power immediately, and do not touch

Emergency Applications

- If Housing is Leaking:
 - Skin Contact: Use soap and water thoroughly to wash the area of the skin
 - Eye Contact: Flush with flowing water or saline, and immediately seek medical treatment
 - Ingestion: Immediately wash with water and seek medical treatment

Transportation

Not subjected to US DOT or IATA regulations
UN3499, <10Wh, Non-Hazardous Goods
International shipping description –
“Electronic Products – Capacitor”

Regulatory

- UL810a
- RoHS Compliant
- Reach Compliant / Halogen Free

Storage

- Capacitors may be stored within the operating temperature range of the capacitor
- Lower storage temperature is preferred as it extends the shelf life of the capacitor
- Do Not Store the Super Capacitors in the following Environments
 - High Temperature / High Humidity environments
> $70^{\circ}C$ / 40% RH
 - Direct Sunlight
 - In direct contact with water, salt oil or other chemicals
 - In direct contact with corrosive materials, acids, alkalis, or toxic gases
 - Dusty environment
 - In environment with shock and vibration conditions

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