## Series-Connected SuperCapacitor Modules





This new series of plastic, epoxy-filled SuperCapacitor modules feature high reliability when used in elevated temperatures and/or high humidity conditions. In addition to moisture resistance features, these SuperCapacitor modules offer excellent pulse power handling characteristics based on the combination of very high capacitance and very low ESR. Degradation of electrical characteristics under normal conditions are lengthened in large part to the special plastic, epoxy-filled packaging technology of these SuperCapacitor modules. 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. These modules offer great solutions to hold up, energy harvesting, pulse power applications, and battery replacement.

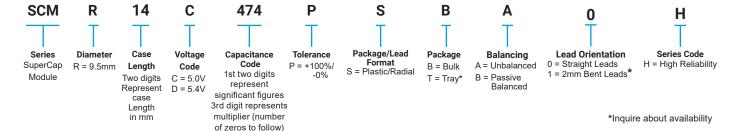
#### **FEATURES**

- · High Pulse Power Capability
- · Low ESR
- · Low Leakage Current
- · Plastic, Moisture Resistant
- · High Reliability

#### **APPLICATIONS**

- · Smart/Remote Metering
- Telemetry
- Hybrid Battery Packs
- · Scanners
- · Environmental Controls
- · Network Power Hold-Up
- · Pulse Power Handling
- · Solid State Drives
- UPS/Industrial
- Energy Harvesting

#### **HOW TO ORDER**



#### **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 and wave soldering processes, so long as appropriate precautions are followed. See page 4 for more information.





For RoHS compliant products, please select correct termination style.





#### **RATINGS & PART NUMBER REFERENCE**

AVX Part Number	Diameter (mm)	Length (mm)	Rated Capacitance (F)	Capacitance Tolerance	Rated Voltage (V)	Rated Temperature (°C)	DCL Max @ 72 Hrs (μΑ)	ESR Max @ 1000 Hz (mΩ)	ESR Max @ DC (mΩ)	Peak Current (A)	Power Density (W/kg)	Max Energy (Wh)	Energy Density (Wh/kg)
Plastic / Radial Lead													
SCMR14C474PSBA0H	9.5	16	0.47	+100%/-0%	5.0/4.2*	65/85*	2	300	1720	0.65	447	0.0016	0.42
SCMR14D474PSBB0H	9.5	16	0.47	+100%/-0%	5.4/4.6*	65/85*	6	300	1720	0.70	522	0.0019	0.49
SCMR18C105PSBA0H	9.5	20	1	+100%/-0%	5.0/4.2*	65/85*	6	250	720	1.45	906	0.0035	0.75
SCMR18D105PSBB0H	9.5	20	1	+100%/-0%	5.4/4.6*	65/85*	10	250	720	1.57	1057	0.0041	0.88
SCMR22C155PSBA0H	9.5	24	1.5	+100%/-0%	5.0/4.2*	65/85*	10	200	560	2.04	974	0.0052	0.95
SCMR22D155PSBB0H	9.5	24	1.5	+100%/-0%	5.4/4.6*	65/85*	15	200	560	2.20	1136	0.0061	1.10

<sup>\*</sup>with appropriate voltage derating operating temperature can be extended to 85°C

#### **OPERATING TEMPERATURE**

-40°C to +65°C @ 5.4V Balanced, 5.0V Unbalanced

#### **QUALIFICATION TEST SUMMARY**

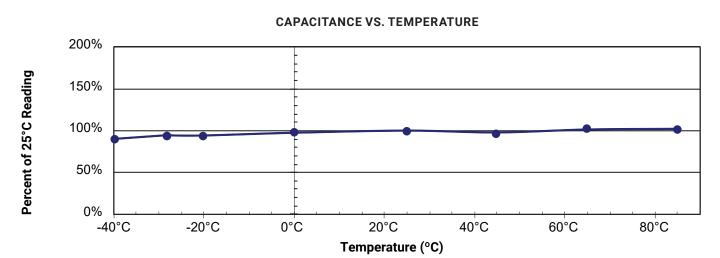
Test	Test Method		Limits		
Life Cycle	Capacitors are cycled between rated voltage and half-rated voltage under constant current at +25°C for 500,000 cycles	Capacitance Change ESR Appearance	≤30% of initial spec value ≤2 times initial spec value No remarkable defects		
High Temperature Load Life	Temperature: 70°C Voltage: Rated Voltage Test Duration: 2,000 hours	Capacitance Change ESR Appearance	≤30% of initial spec value ≤2 times initial spec value No remarkable defects		
Storage Temperature Characteristics	No Load		≤30% of initial spec value ≤2 times initial spec value No remarkable defects		
- 10.100			≤30% of initial spec value ≤2 times initial spec value No remarkable defects		
Humidity	Voltage: Rated Voltage RH: 90~95% Temperature: 60°C Test Duration: 3,000 hours	Capacitance Change ESR Appearance	≤30% of initial spec value ≤2 times initial spec value No remarkable defects		

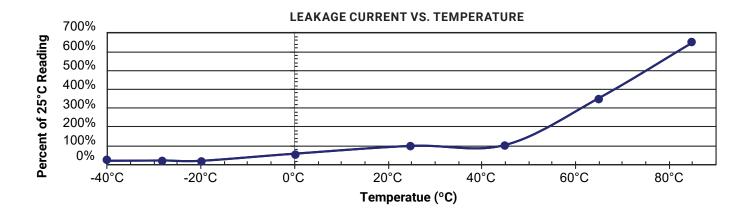
<sup>-40°</sup>C to +85°C @ 4.6V Balanced, 4.2V Unbalanced

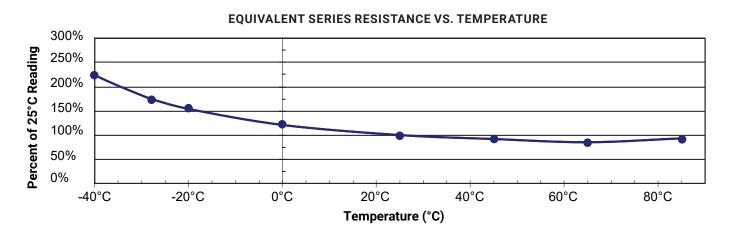
## **Series-Connected SuperCapacitor Modules**



**QUALITY AND RELIABILITY** 







## **Series-Connected SuperCapacitor Modules**

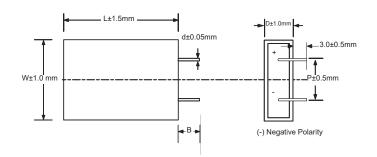


#### **MECHANICAL SPECIFICATIONS**

#### **PLASTIC TYPE - STRAIGHT LEADS**

# W±1.0 mm d±0.05mm d±0.05mm (-) Negative Polarity

#### **PLASTIC TYPE - BENT LEADS**



Cap (F)	D (mm)	W (mm)	L (mm)	P (mm)	d (mm)	B (mm)*
0.47	9.5	18.5	16.0	11.5	0.6	2.0
1	9.5	18.5	20.0	11.5	0.6	2.0
1.5	9.5	18.5	24.0	11.5	0.6	2.0

<sup>\*</sup>for version with bent leads

#### **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 not in contact with the PCB or other components during soldering. Temperature cycling during soldering may cause the case to shrink or crack, potentially damaging the PCB or other components.

#### **HAND SOLDERING**

Keep some distance between the SuperCapacitor body and the tip of the soldering iron; contact between SuperCapacitor body and soldering iron will cause extensive damage to the SuperCapacitor. It is recommended that the soldering iron temperature should be less than 350°C, and contact time should be limited to no more 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 SuperCapacitor.

#### **WAVE SOLDERING**

Only use wave soldering on Radial type SuperCapacitors. The PCB should be preheated for no longer than 60 seconds, with temperature at, or below, 100°C. Soldering tin should be 0.8mm or thicker.

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

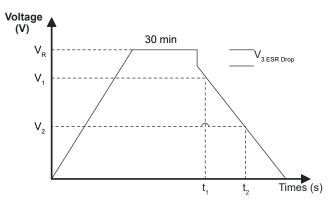
## **Series-Connected SuperCapacitor Modules**



#### **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 \* VR
  - Noting V1, t1, V2, t2 and performing the calculation for C



I - Discharge Current [mA], 4 \* C \* VR VR - Rated Voltage

V1 - Initial Test Voltage, 80% of VR

V2 - Final Test Voltage, 40% of VR

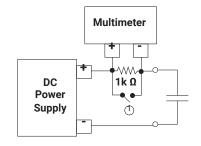
t1 - Initial Test time

t2 - Final Test time

C = I \* (t2 - t1) / (V1 - V2)

#### **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

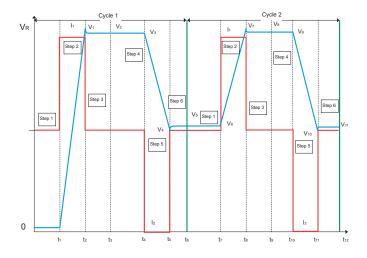


#### **INITIAL ESR MEASUREMENT @ 25°C**

- · 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 = (CDC1+CDC2) / 2



#### **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\*V2 / RDC) / mass

#### **ENERGY DENSITY**

Energy density = (½ CV²) / (3600\*mass)

## **Series-Connected SuperCapacitor Modules**



#### **POLARITY / REVERSE VOLTAGE**

For product consistency and optimum performance, it is recommended that the capacitor be connected with polarity indicated. Reversing polarity could result in permanent damage to the circuit including much higher leakage current for a short duration of time and the life time of the supercapacitors will be reduced.

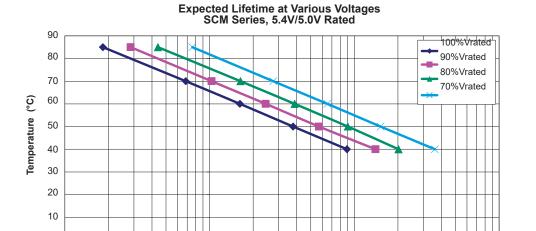
#### LIFE TIME AND TEMPERATURE PERFORMANCE

0.1

The life of a SuperCapacitor is impacted by a combination of operating voltage and the operating temperature according to the following equation: time to failure, t  $\infty$  Vn \* exp (-Q / k\*T)......(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 SuperCapacitor end of life is when the equivalent series resistance, ESR, increases to

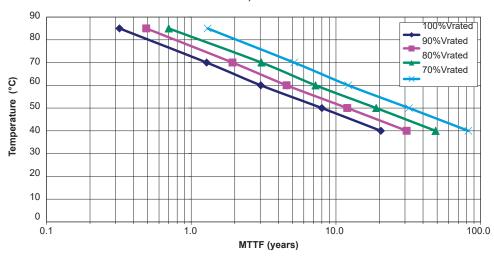
200% of the original value and the capacitance drops by 30%. Typically a SuperCapacitor shows an initial change in the ESR value and then levels off. If the capacitors are exposed to excessive temperatures the ESR will show a continuous degradation. In the extreme case, if the temperatures or voltages 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.

100.0



Expected Lifetime at Various Voltages SCM Series, 4.6V/4.2V Rated

MTTF (years)



### **Series-Connected SuperCapacitor Modules**



#### SAFETY RECOMMENDATIONS

#### **WARNINGS**

- To avoid short circuit, after usage or test, SuperCapacitor voltage needs to discharge to ≤ 0.1V
- Do not apply over-voltage, reverse charge, burn or heat higher than 150°C, explosion-proof valve may break open
- Do not press, damage or disassemble the SuperCapacitor, 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"

Licensed by CAP-XX

#### **REGULATORY**

- UL 810A
- · 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 SuperCapacitors in the following environments
- High temperature / high humidity environments >40°C / 70% 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



OOO «ЛайфЭлектроникс" "LifeElectronics" LLC

ИНН 7805602321 КПП 780501001 P/C 40702810122510004610 ФАКБ "АБСОЛЮТ БАНК" (ЗАО) в г.Санкт-Петербурге К/С 3010181090000000703 БИК 044030703

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С конца 2013 года компания активно расширяет линейку поставок компонентов по направлению коаксиальный кабель, кварцевые генераторы и конденсаторы (керамические, пленочные, электролитические), за счёт заключения дистрибьюторских договоров

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- Подбор аналогов.
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- Техническую поддержку проекта.
- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.



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