

# Company Overview

"KYOCERA AVX will foster an environment where our employees can reach their full potential. We will achieve superior customer satisfaction and expand our business by developing technologies and products that enhance society while delivering tomorrow's solutions."



*"Unifying 2 Great Brands to Provide Solutions for a Better Tomorrow"*

## Markets Served



## Product Offering:



CAPACITORS



ANTENNAS



RF / MICROWAVE



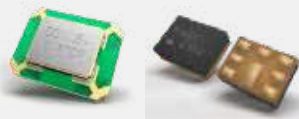
SENSORS / CONTROLS



CONNECTORS / MECHATRONICS



CIRCUIT PROTECTION



CRYSTALS / SAW DEVICES



**+\$3B**

Revenue

**20,000+**

Employees

**43**

Factories

**23**

Sales Offices



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# KYOCERA AVX | PRODUCT PORTFOLIO

## CAPACITORS

### Ta / NbO / Polymer Capacitors

- Automotive
- General
- High CV
- Radial Leaded
- High Reliability
- Low ESR
- Low Profile
- High Temp
- DLA / MIL SPEC
- SMD Ta MnO<sub>2</sub>
- Polymer Space (TCH series)
- Wet Ta & Wet Ta modules



### SuperCapacitors

- EDLC Capacitors
- Ultra Capacitors
- S-Capacitors
- Gold Capacitors



### Aluminum Capacitors (Commercial Grade)

- Conductive Polymer: Solid Electrolyte
- Hybrid: Solid/Liquid Electrolyte
- Electrolytic: Liquid Electrolyte



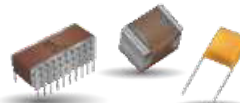
### Power / Chip Film Capacitors

- High Power Film
- Medium Power Film
- SMD Chip Film
- Energy Storage Discharge
- Automotive Film



### Ceramic Capacitors

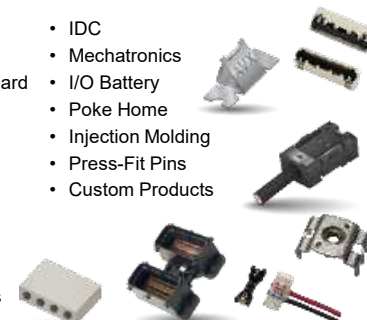
- Low Inductance
- Discoidal Ceramics
- High Voltage
- Surface Mount
- EMI Filtering
- Feedthru SMD
- Leaded
- Medical
- Stacked
- DLA / MIL SPEC
- Automotive



## CONNECTORS

### Automotive / Industrial

- Board to Board
- FPC/FFC
- Wire to Wire / Board
- Backplane
- Shunt
- Interface
- Card Edge
- Memory Card
- Shield Locks
- Power Terminals
- Application Tools
- IDC
- Mechatronics
- I/O Battery
- Poke Home
- Injection Molding
- Press-Fit Pins
- Custom Products



## SENSING and CONTROL

### Pedals / Controls / Sensors

- Active
- Passive
- Electronic Hand Throttle (EHT)
- Power
- Electric Motor
- Battery Management
- LED
- Temperature
- Position
- Proximity
- Quality
- Speed



## RF SOLUTIONS & SYSTEMS

### RF / Microwave

- Filters
- Diplexers
- Couplers
- Attenuators
- Capacitors
- Inductors
- Hi-Q Capacitors
- SLC Capacitors
- RF Varistors
- Resistors
- RC Networks
- Fuses
- Active Antennas
- Passive Antennas
- Test Measurement
- Test Services



## CIRCUIT PROTECTION / POWER SEMICONDUCTORS

### Devices

- MLV Transient Volt. Suppressors
- Fuses
- Thermistors
- Varistors
- Diodes
- Discretes Diodes
- Power Modules
- High-power Devices
- Stacks
- Units



## TIMING DEVICES

### Crystals / SAWs

- Crystal Units
- Clock Oscillators (SPXO)
- Volt. Controlled Crystal Oscillators (VCXO)
- Temp. Compensated Crystal Oscillators (TCXO)
- SAW Filters
- SAW Duplexers
- SAW Quadplexers



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# SUPERCAP MANUFACTURING



**Chengdu**  
**China**  
**80.5K sq.ft.**

The location is committed to the research, development, design and manufacturing of supercapacitor cells and modules. There are about 130 employees here.

It is located in the Qingbai Jiang Industrial Park in Chengdu.

Certifications:

IATF-16949

ISO 9001

ISO 14001



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# Advantages

- Design and Manufacturing Experience since 1997
- Focused on High Reliability / High Quality
- Lifetime up to 20 years
- High temperature performance and endurance capability
- 3 Manufacturing sites for Supercapacitors Worldwide - Greenville (SC), Juarez (Mexico), Chengdu (China).
- Qualification of the factory Chengdu (China) according to IATF-16949



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# SUPERCAPACITORS

**Oliver Zimmermann**  
Technical Support – DACH Region

ACCELERATING  
INNOVATION



# Supercapacitor Available Offerings

## SCC Series Cylindrical SuperCaps



- Acetonitrile (ACN) based electrolyte technology
- Provide extended back-up time, longer battery life, and provide instantaneous power pulses as needed
- **Capacitance Range: 1F to 3000F**
- **2.7V and 3.0V rated parts**
- **Operating Temp Range: -40°C to +85°C**
- **Automotive qualified range**
- Can offer bent leads on radial leaded offerings per customer request
- SCC LE Series that offer special low ESR products

## SCM Series Series-Connected Modules



- Feature very high capacitance, low ESR, and low leakage current
- **Capacitance Range: 0.33F to 15F**
- **Voltage Range: 5.0V to 9.0V**
- **Operating Temp Range: -40°C to +85°C**
- Offer High Reliability SCM Series parts featuring moisture ingress resistance for longer lifetime performance
- **Custom module design capability**

## PRIZMACAP™ SCP Series

**NEW!**



- Propylene carbonate (PC) based electrolyte technology
- Capacitance Range: 6F to 20F (and more to come)
- **Operating Temp Range: -55°C to +85°C (HT version up to +105°C)**
- **Rated Voltage: 2.5V** up to +65°C, derating to 2.0V for temp extension up to +85°C (HT version up to +105°C) operation
- Low ESR Design
- Leakage current ratings
- **Low profile starting from 0.8mm and ultra-lightweight from <2 grams**
- **Customizable form factor**
- Utilize KYOCERA AVX Interconnect Single 2 Piece Contacts: BTB, 70-9159 Series connectors instead of hand soldering

## Standard & Custom Large Modules



### Std. Series 16V/500F, 48V/165F SCM Series

- Provides solutions to the power and performance limitations of batteries

### Example Applications:


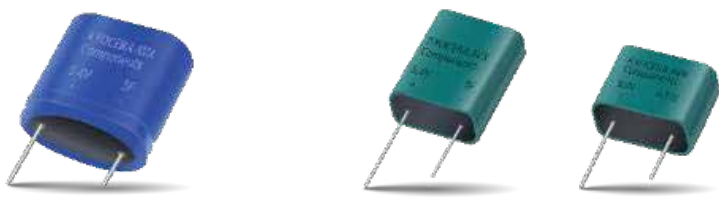

- HE/EV Vehicles, Rails, Heavy Industrial Equipment, Uninterruptable-Power-Supply (UPS) Systems, Medical and Renewable Energy
- **Large & custom module design capability** for markets such as large industrial, automotive, wind, grid, etc.



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# SuperCapacitor Portfolio

	Cylindrical			Modules				PrizmaCap™
	SCC	SCC LE	SCC 3 V	SCM		SCM Plastic Epoxy		SCP
				Balanced	Unbalanced	Balanced	Unbalanced	
								
Temperature	-40°C to +65°C -40°C to +85°C***	-40°C to +65°C -40°C to +85°C***	-40°C to +65°C -40°C to +85°C***	-40°C to +65°C -40°C to +85°C***	-40°C to +65°C -40°C to +85°C***	-40°C to +65°C -40°C to +85°C***	-40°C to +65°C -40°C to +85°C***	-40°C to +65°C -40°C to +90°C***
Rated Voltage	2.7 V : 2.3 V ***	2.7 V : 2.3 V ***	3 V : 2.5 V ***	5.4 - 9 V 4.6 - 7.6 V***	5 – 8.1 V 4.2 - 6.9 V***	5.4 V : 4.6 V ***	5 V : 4.2 V ***	2.1 V : 1.1 V ***
Max Energy [Wh]	0.001 - 3.0375	0.001 - 0.8606	0.0013 - 0.125	0.0016 - 0.063	0.0016 - 0.063	0.0016 - 0.0061	0.0016 - 0.0061	0.0021 - 0.0092
Energy Density [Wh/kg]	1.07 - 6.08	1.07 - 6.16	1.32 - 6.05	0.51 - 3.75	0.51 - 3.75	0.42 - 1.1	0.42 - 1.1	1.14 - 1.87
Power Density [W/kg]	1262 - 6033	2833 - 6943	1108 - 4645	498 - 4235	498 - 4235	447 - 1136	447 - 1136	1413 - 2582
Capacitance	1 - 3000 F	1 - 850 F	1 - 100 F	0.33 - 15 F	0.33 - 15 F	0.47 – 1.5 F	0.47 – 1.5 F	3.5 - 15 F
DCL <sub>Max</sub> @ 72Hrs	6 - 5200 µA	6 - 2200 µA	6 - 260 µA	6 - 90 µA	6 - 90 µA	2 - 15 µA	2 - 15 µA	50 - 110 µA
ESR <sub>Max</sub> @ DC	0.29 - 500 mΩ	1.16 - 325 mΩ	18 - 1500 mΩ	50 - 3000 mΩ	50 - 3000 mΩ	560 - 1720 mΩ	560 - 1720 mΩ	55 - 200 mΩ

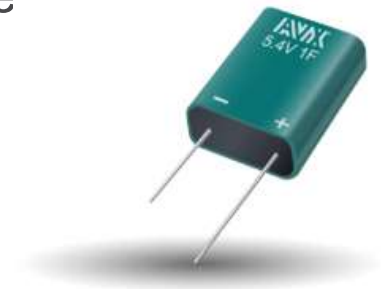


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# SCM SERIES

## SERIES-CONNECTED MODULES

- Series-connected (2 or 3 cells) standard SuperCapacitor modules
- Feature very high capacitance, low ESR, and low leakage current
- Capacitance range: 0.33F to 15F
- Voltage range: 5.0V to 9.0V
- Available in Balanced or Unbalanced versions
- Operating temperature range: -40°C to +85°C
- Available also with Epoxy filled plastic package (for high moisture environment & longer life time)



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# SuperCapacitor Modules

MAXWELL MODULE	EATON MODULE	KAVX SUPERCAP MODULE PN	UNIT RATING	DIMENSION (W x L) mm
BMO0165 P048 B03	XLR-48	SCMZ1EP1F6STAB2	165F/48V	194 x 418
BMOD0058 P016 B02	-	SCMA63K586SPPB2	58F/16V	48.6 x 226.2
BMOD0500 P016 B0X	XLR-16	SCMZ1EK507STAB2	500F/16V	68 x 418
BMDO0006 E160 B02	-	SCMA63S586SPPB2	5.8F/160V	234 x 364.50
BMOD0165 P048 B03	-	SCMZ85P836STAB2	83F/48V	194 x 418



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## 125°C High Temperature SuperCap (25F)

ACCELERATING  
INNOVATION



## SCC Series

### High Temperature Cylindrical SuperCapacitors



The new series of cylindrical electrochemical double-layer capacitors offers excellent pulse power handling characteristics based on the combination of very high capacitance and 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

- Temperature up to 125°C
- Cap Value of 25F
- High Pulse Power Capability
- Low Leakage Current

#### APPLICATIONS

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

#### HOW TO ORDER

SCC

Series  
SuperCap  
Cylindrical

U

Diameter  
U = 16mm

25

Case Length  
Two digits  
represent case  
length in mm

B

Voltage  
Code  
B = 2.7V

256

Capacitance Code  
256 = 25F

S

Tolerance  
S = +30%/-10%

R

Lead Format  
R = Radial Lead

B

Package  
B = Bulk

HT

Special Code  
HT = High  
Temperature

#### QUALITY INSPECTIONS

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 "Soldering Recommendations" on page 4 for more information.

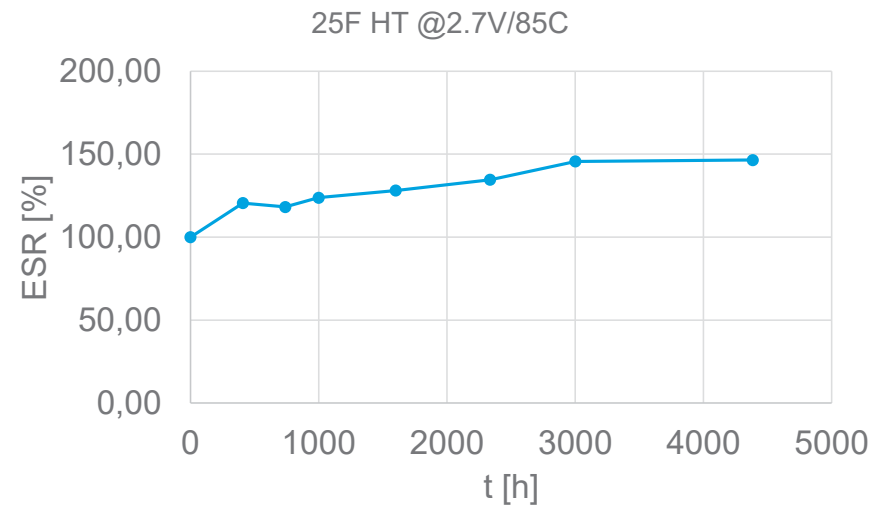
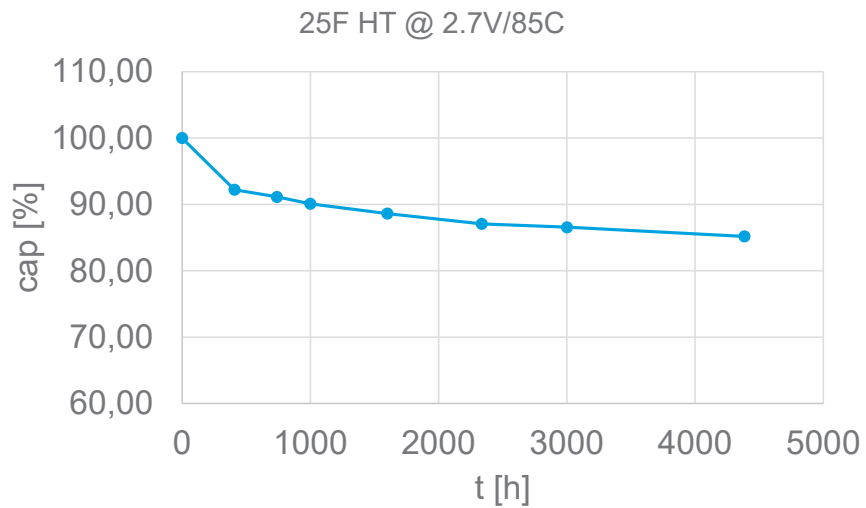
#### OPERATING TEMPERATURE

-25°C to +85°C @ 2.7V  
+125°C @ 1.5V



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## 25F HT performance at 85C/2.7V



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# IDC 9176 Connector Solutions for Supercaps

Bring **AVX Supercaps** on PCB with **AVX IDC** connection termination

## BENEFITS OF USING IDC CONNECTOR

### Good shock / vibration performance

- Referring to test report 202-01-073

### Better quality control comparing with hand soldering

- Not controlled by operator soldering skill

### A reliable connection lasting for 20+ years

- Proven [technology](#) by automotive customers

### Stable gas tight connection which makes potting possible

- Referring to test report 202-01-078

### Cost effective

- \*Soldering and inspection take more time.
- \*Soldering may cause potential rework cost

### SMD pick and place component

### Good match with capacitor

- Referring to test report 202-01-079



Application Example



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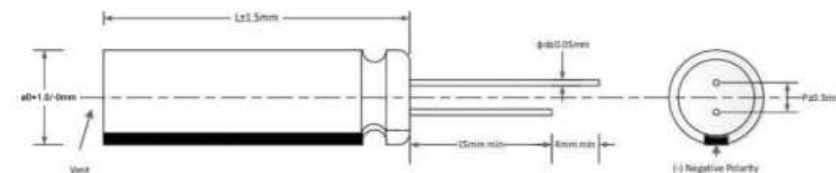
d (mm)	Recommended IDC connector / contact
0.8	00-9176-00x-011-x06
	70-9176-001-511-006

d (mm)	Recommended IDC connector / contact
0.6	00-9176-00x-022-x06
	00-9176-00x-853-x06
	70-9176-001-522-006
	70-9176-001-422-006

## SCC Series

### MECHANICAL SPECIFICATIONS

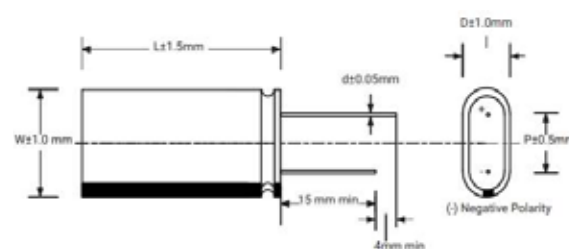
#### RADIAL LEAD TYPE 1F - 100F



D (mm)	P (mm)	d (mm)
6.3	2.3	0.6
8	3.5	0.6
10	5.0	0.6
12.5	5.5	0.6
16	7.5	0.8
18	8	0.8

## SCM Series

### MECHANICAL SPECIFICATIONS

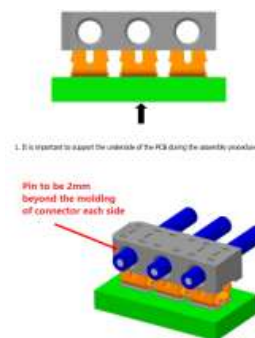
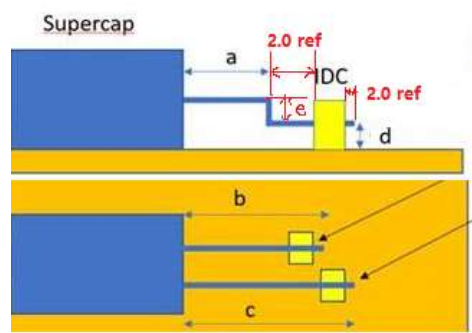
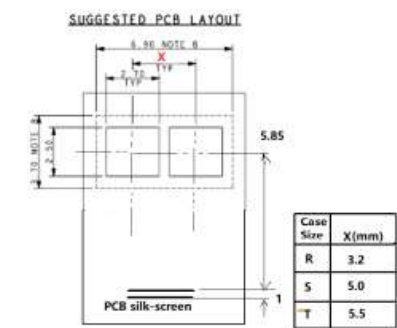


Cap (F)	D (mm)	W (mm)	L (mm)	P (mm)	d (mm)
0.47	6.3	13.6	14.0	9.0	0.6
0.47	8.0	16.0	14.0	11.5	0.6
1	8.0	16.0	18.0	11.5	0.6
1.5	8.0	16.0	22.0	11.5	0.6
2.5	10.0	20.0	22.0	15.5	0.6
5	10.0	20.0	32.0	15.5	0.6
5	12.5	25.0	22.0	18.0	0.6
7.5	12.5	25.0	32.0	18.0	0.6
15	16.0	32.0	33.0	23.7	0.8

# Connector Solutions for Supercap

## Suggested PCB Layout

Cap Specs		Lead Specs (mm)		Lead Form Dimensions (mm)					Proposed Connectors Options			
Case Size	Can Dia	Pitch	Lead Dia	a $\pm 0.5$ ( $\geq 2$ )	b $\pm 0.5$	c $\pm 0.5$ (b+Y)	d $\pm 0.2$	e $\pm 0.2$ ( $\geq 2$ )	Capped IDC	Pad Design( Center Offline, X, Y )	Naked IDC	Pad Design(Center Offline, X, Y
R	8	3.2	0.6	2	9.7	9.7	1.25	2.75	00917600 2853906	X 3.2; Y 0	NA	NA
S	10	5	0.6	2	9.7	9.7	1.25	3.75	00917600 1853906	X 5.0; Y 0	NA	NA
T	12.5	5.5	0.6	2	9.7	9.7	1.25	5	00917600 1853906	X 5.5; Y 0	NA	NA



**Low Profile IDC 22-26 AWG 9176-800**

Application	Discrete Wire
# of Positions	1, 2, 3, 4
Current Rating	Up to 6A/Contact
Voltage Rating	1p: 600VAC 2p-4p: 100VAC
Operating Temp	-40°C to +125°C
Certifications	UL 1977

009176001853906; 009176002853906 for R, S, T Size



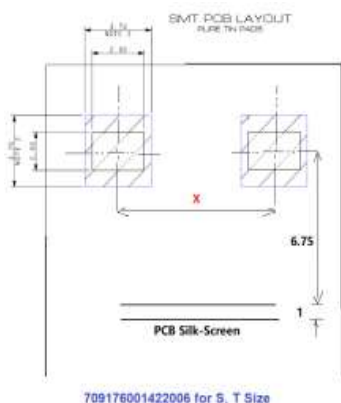
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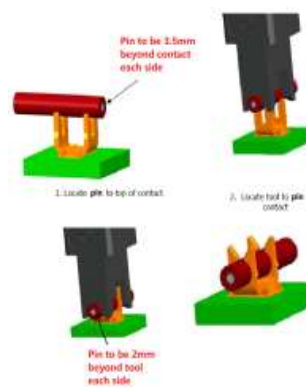
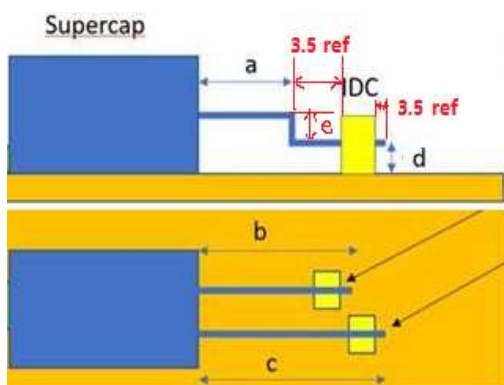
# Connector Solutions for Supercap

## Suggested PCB Layout

Cap Specs		Lead Specs (mm)		Lead Form Dimensions (mm)					Proposed Connectors Options			
Case Size	Can Dia	Pitch	Lead Dia	a $\pm 0.5$ ( $\geq 2$ )	b $\pm 0.5$	c $\pm 0.5$ (b+Y)	d $\pm 0.2$	e $\pm 0.2$ ( $\geq 2$ )	Capped IDC	Pad Design( Center Offline, X, Y )	Naked IDC	Pad Design( Center Offline, X, Y )
S	10	5	0.6	2	11.5	11.5	1.4	3.6	NA	NA	709176 001422 006	X 5.0; Y 0
T	12.5	5.5	0.6	2	11.5	11.5	1.4	4.85	NA	NA	709176 001422 006	X 5.5; Y 0



Case Size	V(mm)
S	5.0
T	5.5



Single IDC Contact 22-28 AWG 9176-400	
Application	Discrete Wire
# of Positions	1
Current Rating	6A/Contact
Voltage Rating	300 VAC
Operating Temp	-40°C to +125°C
Certifications	UL 1977

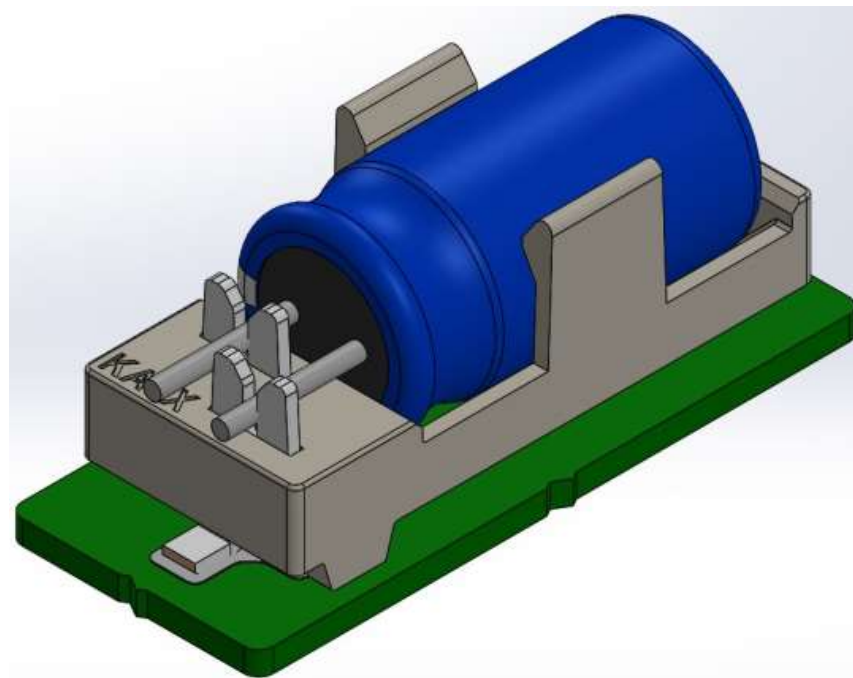
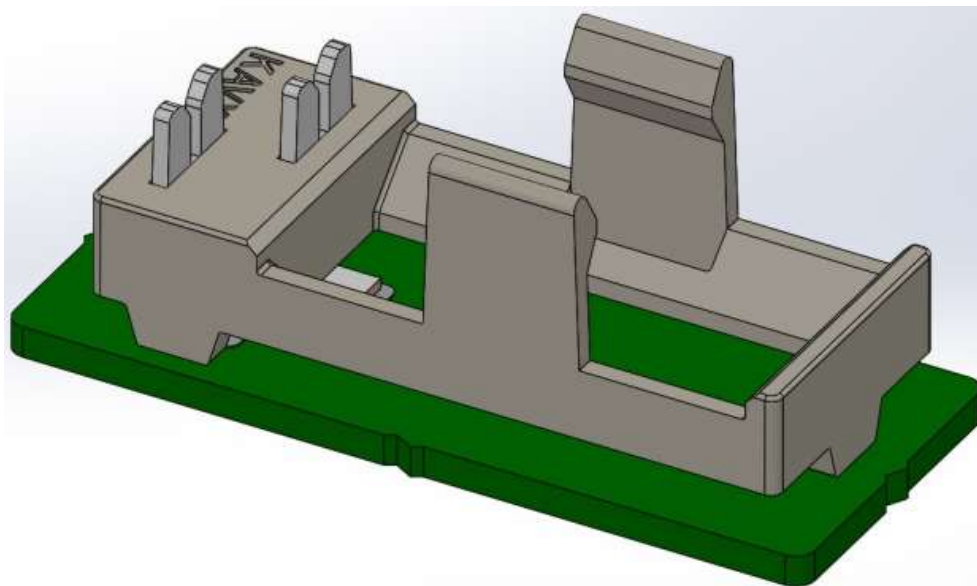


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# Connector Solutions for Supercaps

## SMT version for SuperCap Holder

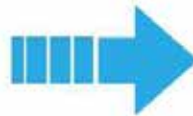
For the SMT version, cap needs to be installed after reflow soldering of the holder,



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# Connector Solutions for Supercaps

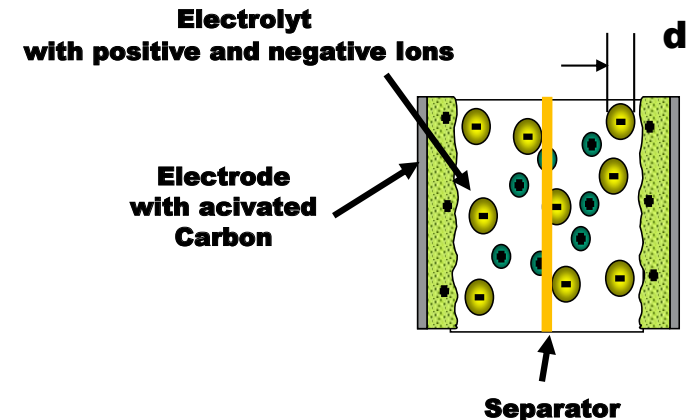
**Press Fit for SuperCap Holder – 18mm Diameter Capacitor**  
pressfit it should be installed in the holder before press in to the PCB.,



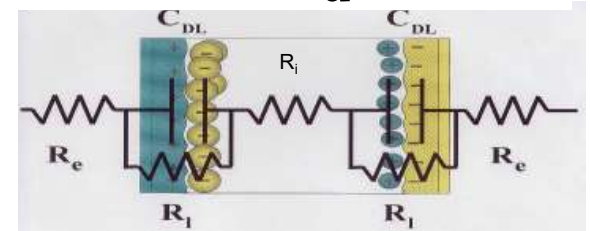
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# SuperCap - Properties

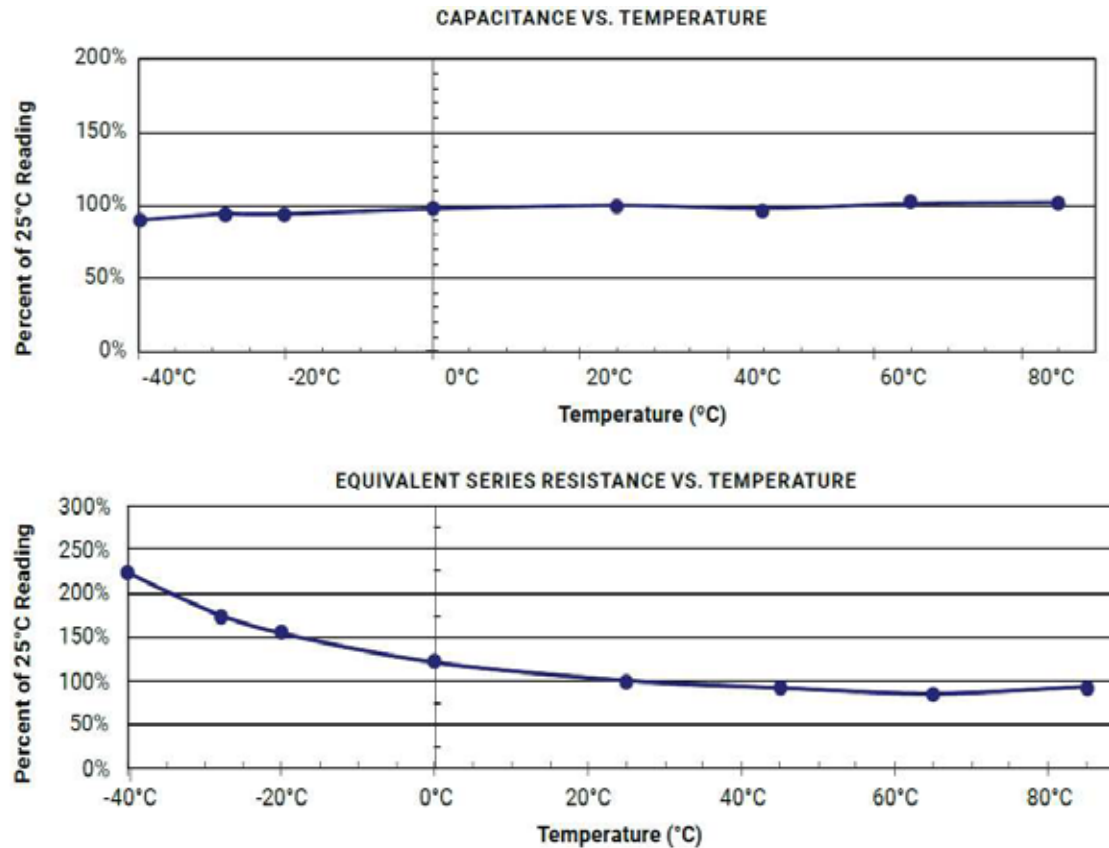
- **Cap values** ranging from several mF to 1000s of Farads due to Activated carbon which amplifies the surface area of the electrode and the very small dielectric thickness  $d$  which is defined by the diameter of the Salt Ion in the Electrolyte
- **Cell Voltage** however is a function of Ionic Breakdown of the Salt ion, and is a function of Temperature and voltage!
- **ESR** ranging 1mOhm to 620mOhm
- **Temperature Range** Operating Temp Range:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  / Wave Soldering Temperature max.  $100^{\circ}\text{C}$
- **Leakage Current**  $1\mu\text{A}$  up to 1mA



$$C = \frac{\epsilon_r \epsilon_0 A}{d}$$

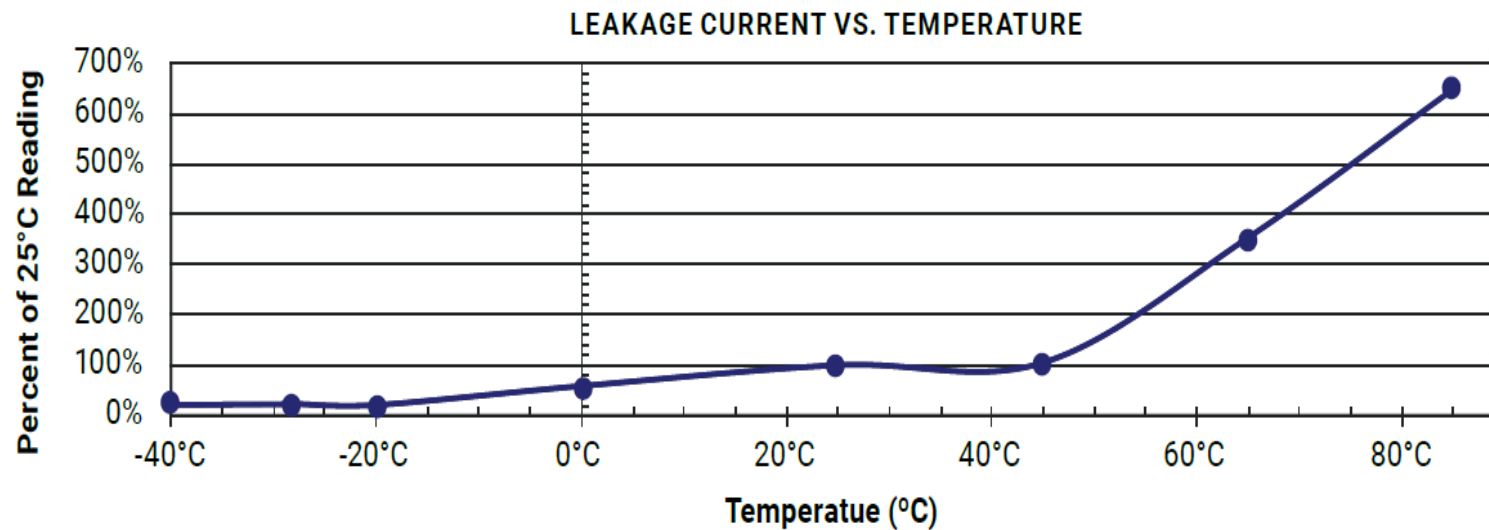


# Temperature Characteristic



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# Temperature Characteristic

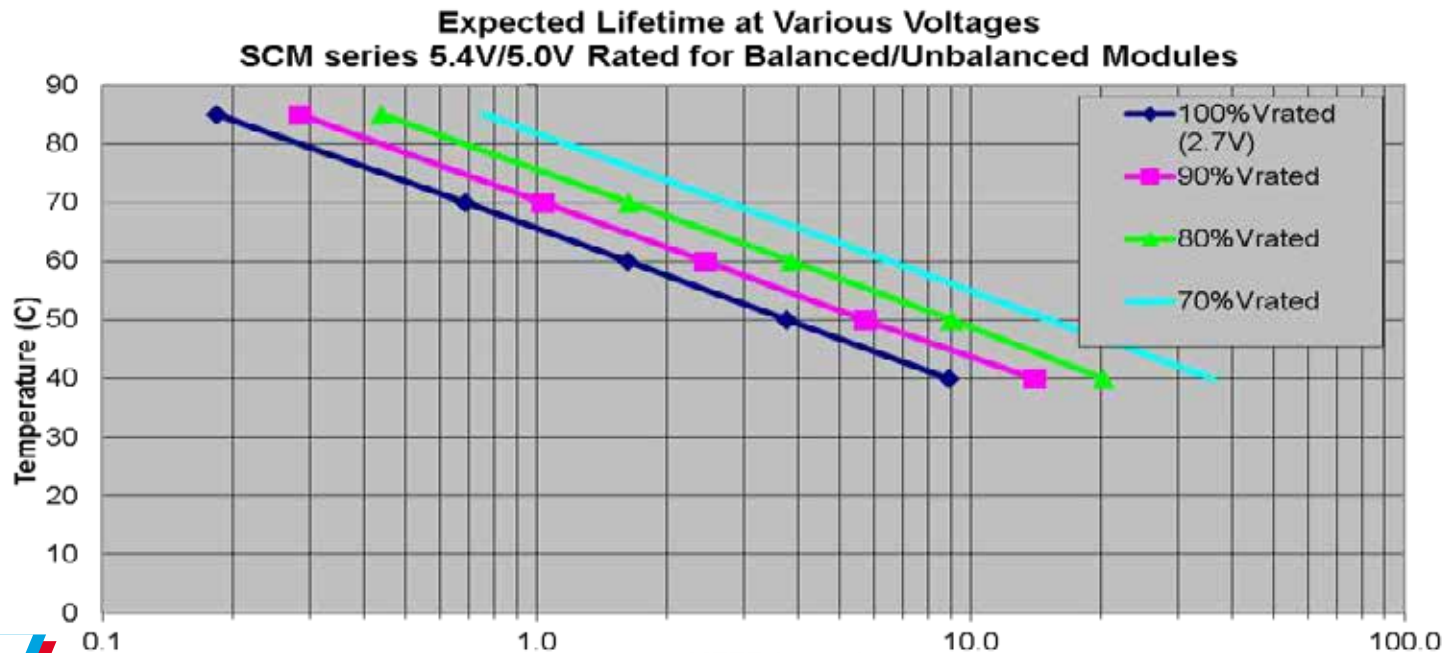


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# Understanding Life Time

- Life time is a function of voltage and temperature
- From internal testing and “rule of thumb,” we know that life time doubles for every 10°C lower operating temperature, and again doubles for every 0.1-0.2V lower operating voltage



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# KAVX Reliability Test Data

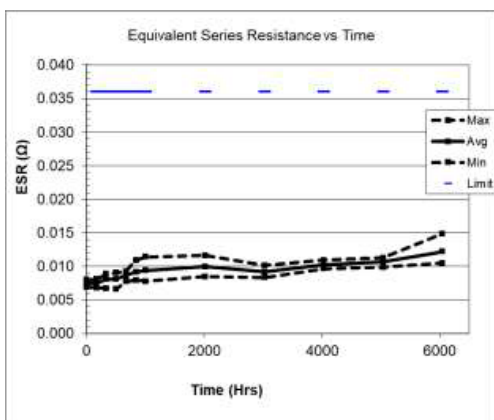
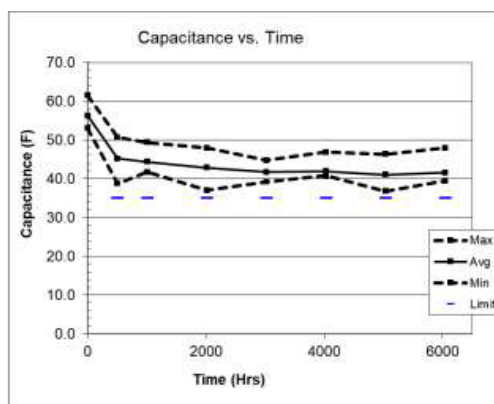
- Reliability tests were performed for 3V SuperCap with 25F and 50F
- The supercap behavior is similar for the range 1F to 100F and uses the same electrolyte and electrode.
- We present two behaviors at 70 and 85 deg C
- We also look at the higher range of the voltage 2.3 V and 2.7V which is a stress case for the caps
- Typically when the temperature is high, we use less voltage to have a longer life and validate the model



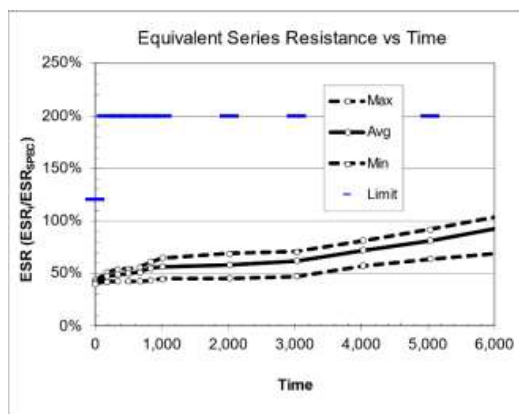
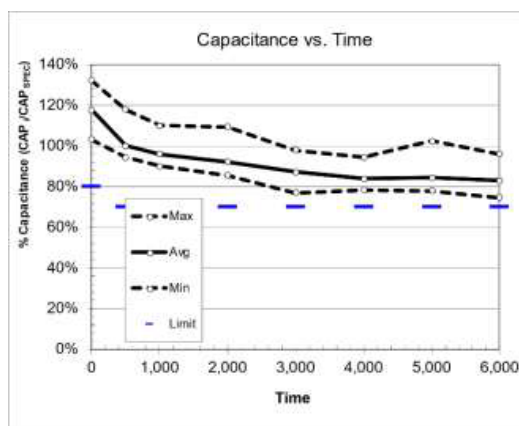
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# KAVX Reliability Test Data (50F)

## 50F at 85°C, 2.3V



## 50F at 70°C, 2.7V



The test were done on a sample of 20 caps.

Isolating the min, the max and the average, this characterizing the quality of the spread and outliers.

The supercap, as expected, tends to Change its cap value fairly fast in the first 1000 hours and stabilizes afterward still having a slower degradation.

It is more obvious at 85deg C and 70 Deg C shows a better behavior for life.

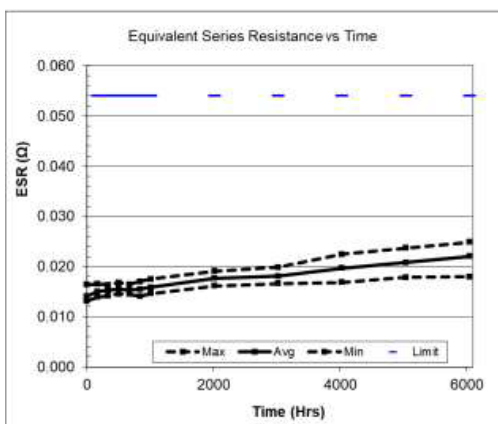
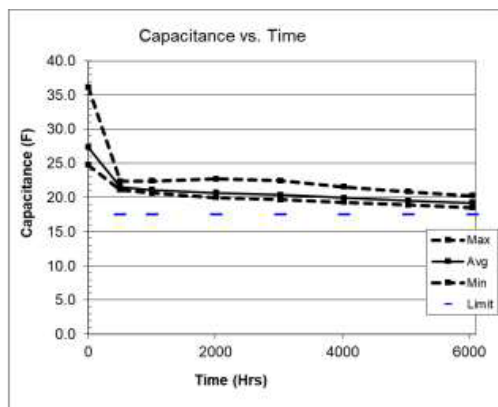
In this test only 6000 Hours were required (test stopped at 6000 Hours)  
The ESR is less of a problem



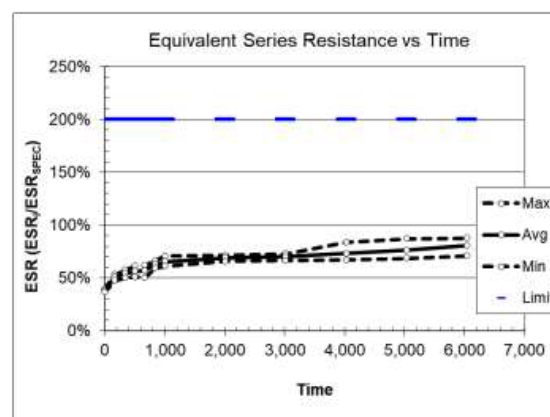
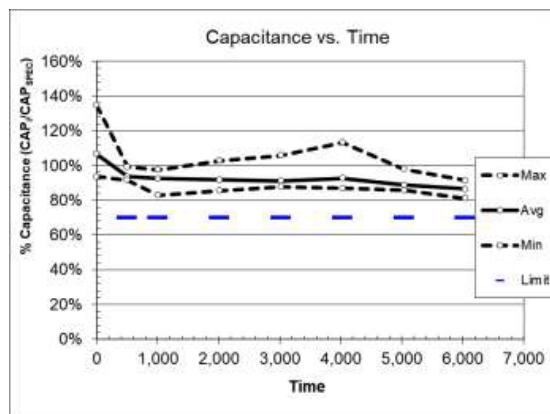
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# KAVX Reliability Test Data (25F)

## 25F at 85°C, 2.3V



## 25F at 70°C, 2.7V



Same as previously The test were done on a sample size of 20 caps. Isolating the min, the max and the average, this characterizing the quality of the spread and outliers.

We see the same trends, Showing that the critical behavior deteriorating the cap is the high temperature.



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# Actual KAVX Test results

KAVX test data		Results		
Voltage	T (°C)	Total Hours	F value	Final Cap %
2.3 V	85	6 000	25	72.1%
2.7 V	70	6 000	25	81.0%

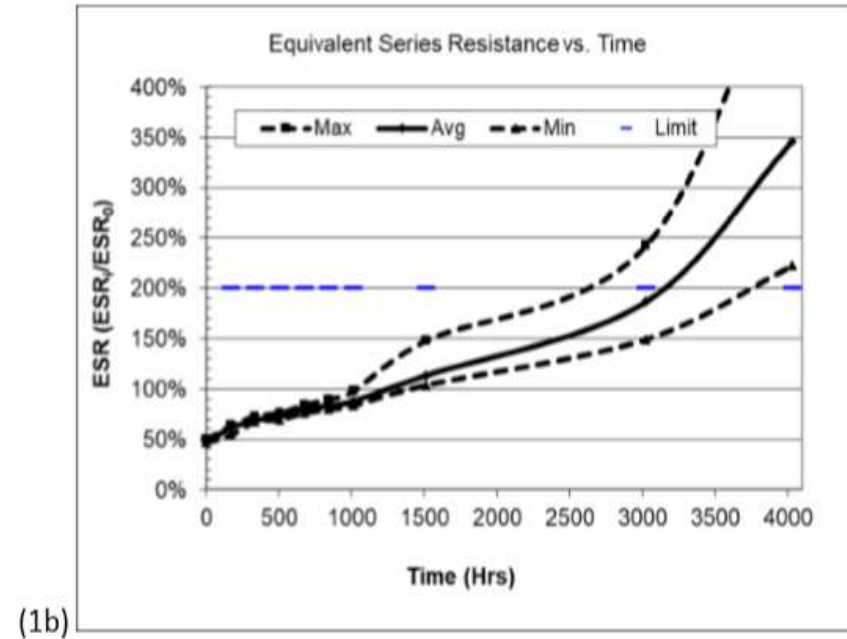
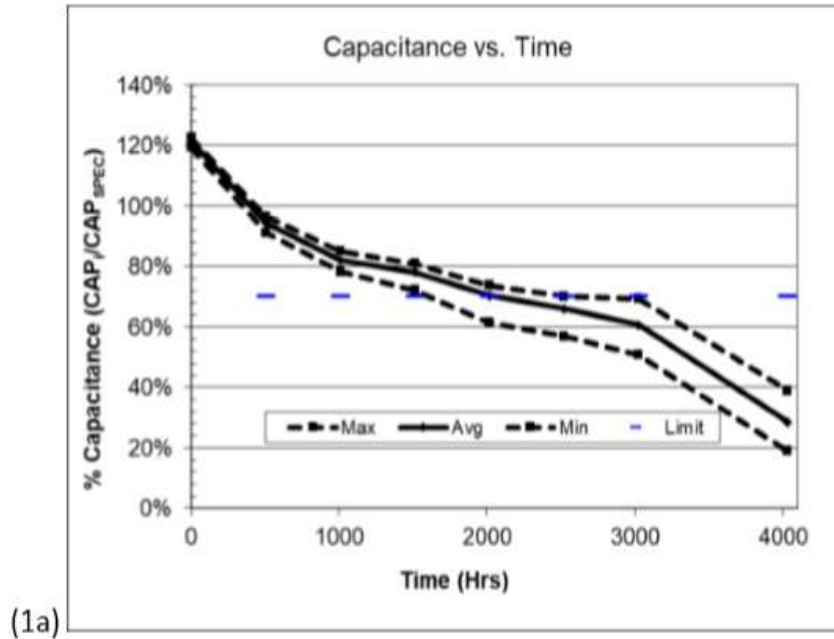
As an example we see that high temperature and high voltage need to be within a trade off as they will create a faster degradation and loss of life in the capacitor.

Reliability data at a typical 6,000 hours (tests stopped at 6 000 Hours)



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## Life Time Test Data @ 85°C & rated voltage



Figures 1a and 1b represent Capacitance vs. Time and Equivalent Series Resistance vs. Time, respectively, for SCMT22C505MRBA0 at rated voltage for 4,000 hours at 85°C.



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# THANK YOU.



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