Polymer Tantalum Capacitors for Advanced High Reliability Applications

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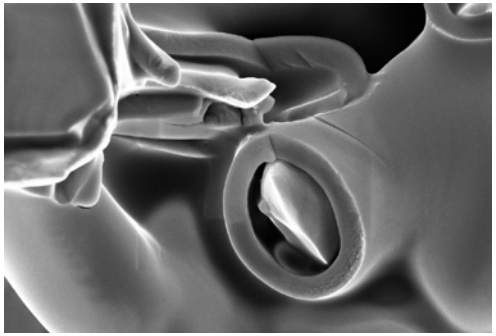
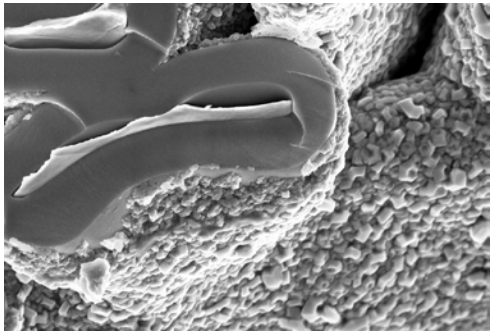
Tantalum Capacitors – Dielectric Contacting

Liquid electrolyte



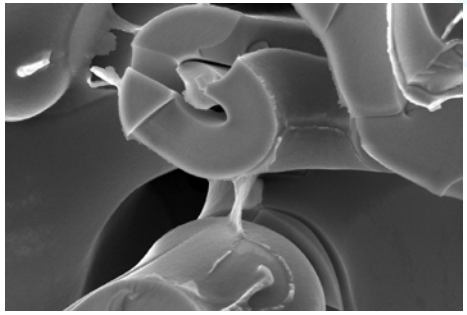
WET Tantalums
ionic conduction
hermetically sealed
+ surge robust
+ high voltage
+ high temperature
- temperature dependent
- frequency dependent
- electrolyte leak possible

MnO_2



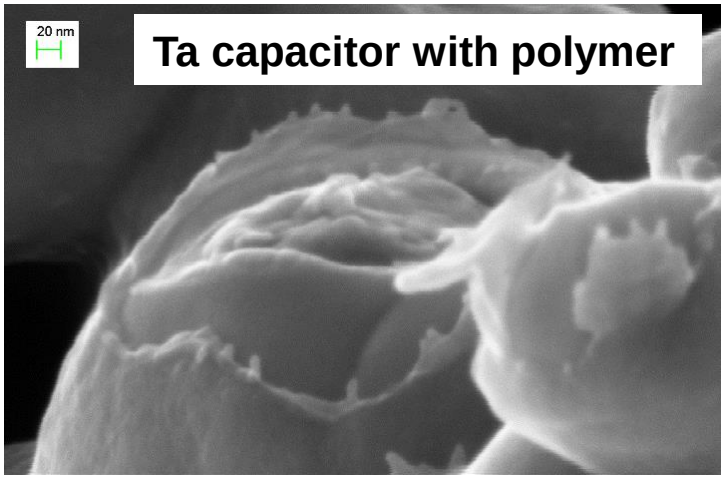
Solid - MnO2
electronic conduction
+ high temperature
+ well established reliability
- failure mode
- voltage limited
- ESR higher

Polymer



Solid - Polymer
electronic conduction
+ low ESR
+ safe failure mode
+ high voltage
- temperature limited
- humidity & oxygen sensitive

Hermetically Sealed Polymer Capacitor



Why Hermetical Packaging

Thin cathode layers under extreme condition are subject of potential degradation

Stable low ESR

Stable parts under extreme conditions

Solution developed with ESA partnership

TCH Series Hermetic seal:

Protects from degradation by humidity

Protects from degradation by oxidation

High Voltage Low ESR Polymer Capacitor

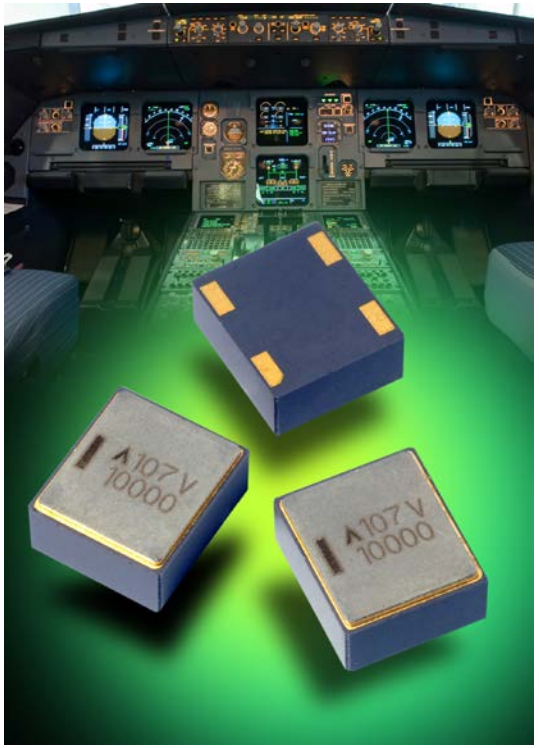
Basic concept

- optimized anode with robust dielectric
- pre-polymerized PEDT based cathode material

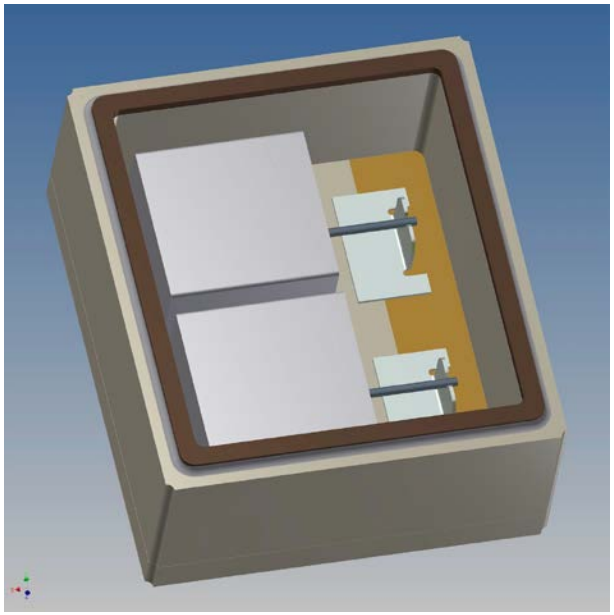
high voltage potential
up to 100 – 125V

low ESR potential

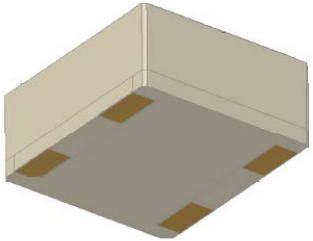
- use of special ageing and screening processes
- hermetic seal, inert atmosphere
- parallel connection of multiple capacitors

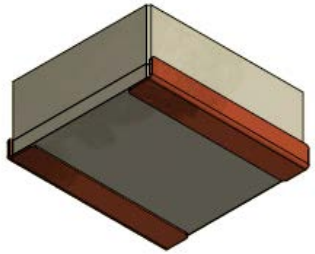


Robust Mechanical Design



- ceramic case
- anode wire **welded** to leadframe
- leadframe **welded** to internal contacts
- internal filler applied
- inert dry atmosphere
- metal lid welded
- undertab or L-shape J lead

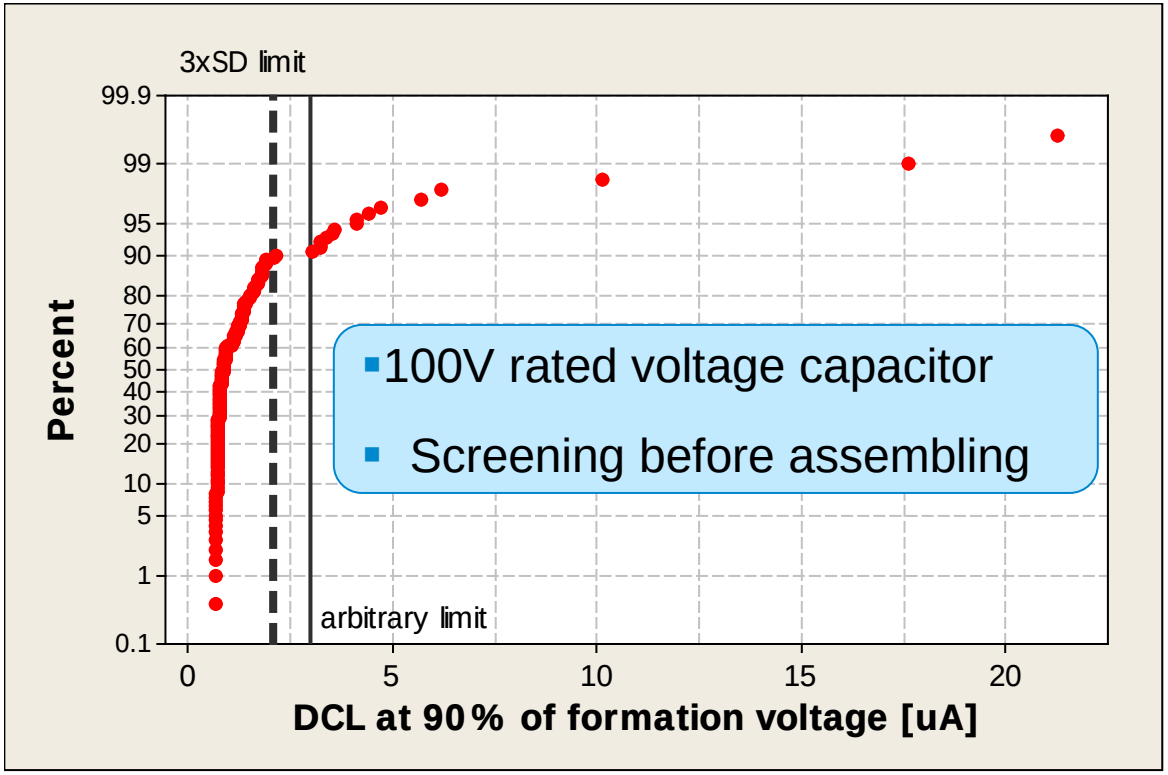




Mechanical Test	Method Reference	Result
Shock	**100g** (MIL-STD-202, Method 213, Condition C)	PASS
Vibration	**20g** (MIL-STD-202, Method 204, Condition D)	PASS
PIND	**20g** (MIL-STD-883, Method 2020, Condition A)	PASS

Ageing and Screening Procedures

- Every capacitor is stressed by voltage
- Statistical approach applied to removal of weaker parts
- Final capacitors are aged 168h



Internal Filler Influence on Highly Accelerated Ripple Current Life

Measurement conditions:

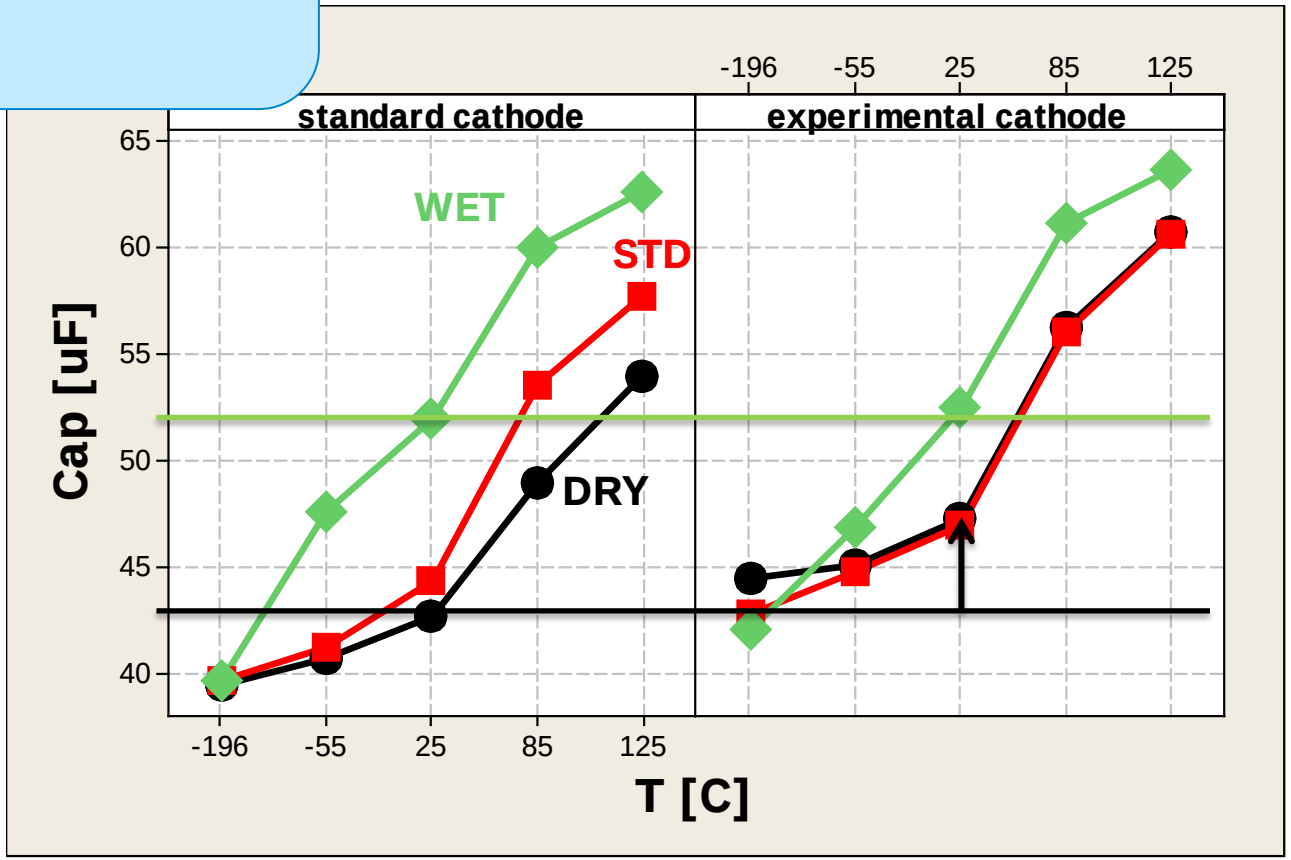
- TCH 9 22µF 100V
- external ambient temperature
- 10V DC bias
- 20 kHz, 8A AC
- case filled by gas or solid material

heat conductive and inert material increases life under high power conditions

Moisture Influence on Capacitance

- capacitance retained up to -196 ºC
- humidity increases cap
- cathode modification can increase dry capacitance

nominal capacitance 47uF



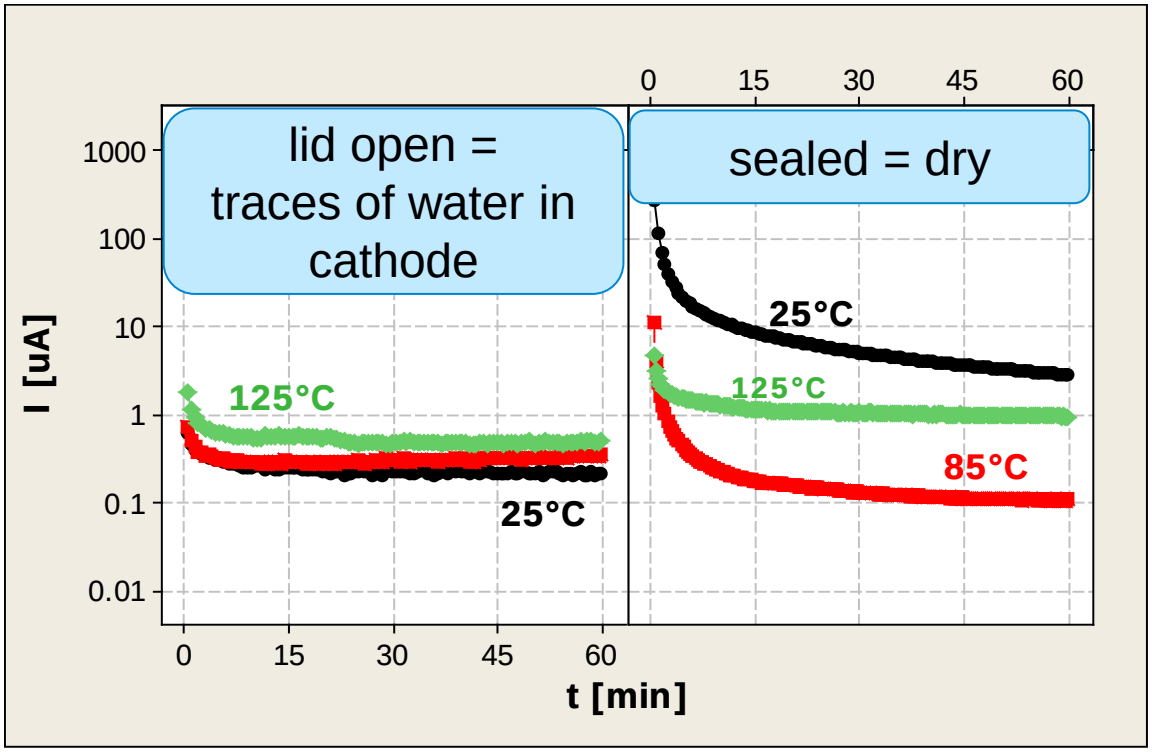
parts before final sealing:

humidified	**WET**
not conditioned	**STD**
dried	**DRY**

Moisture Influence on DCL

fast DCL stabilization for open case or closed case and elevated temperatures

DCL measurement at temperatures (22uF/ 100V)



Moisture Influence on DCL

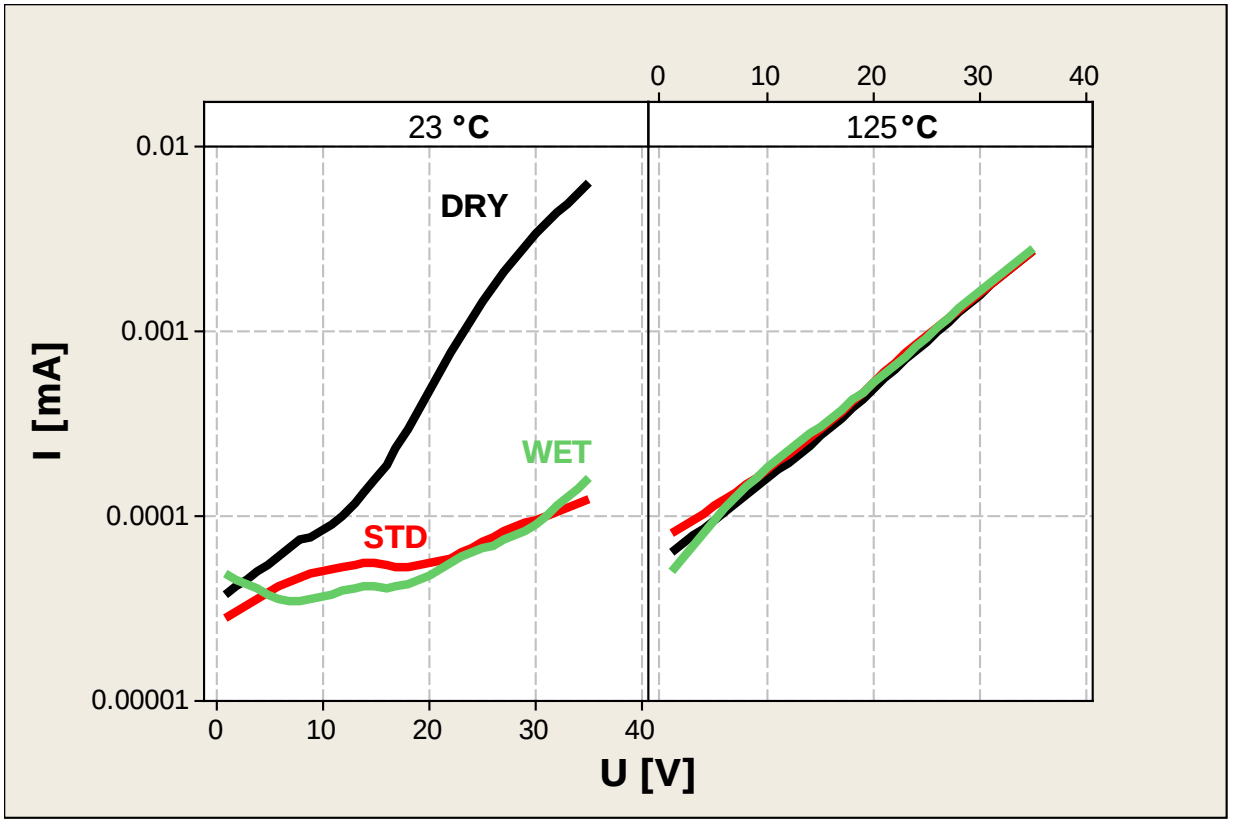
dry unit at low temperature has steeper characteristics

how is this DCL related to its stability under accelerated conditions?

V/I measurement by 1V/80s

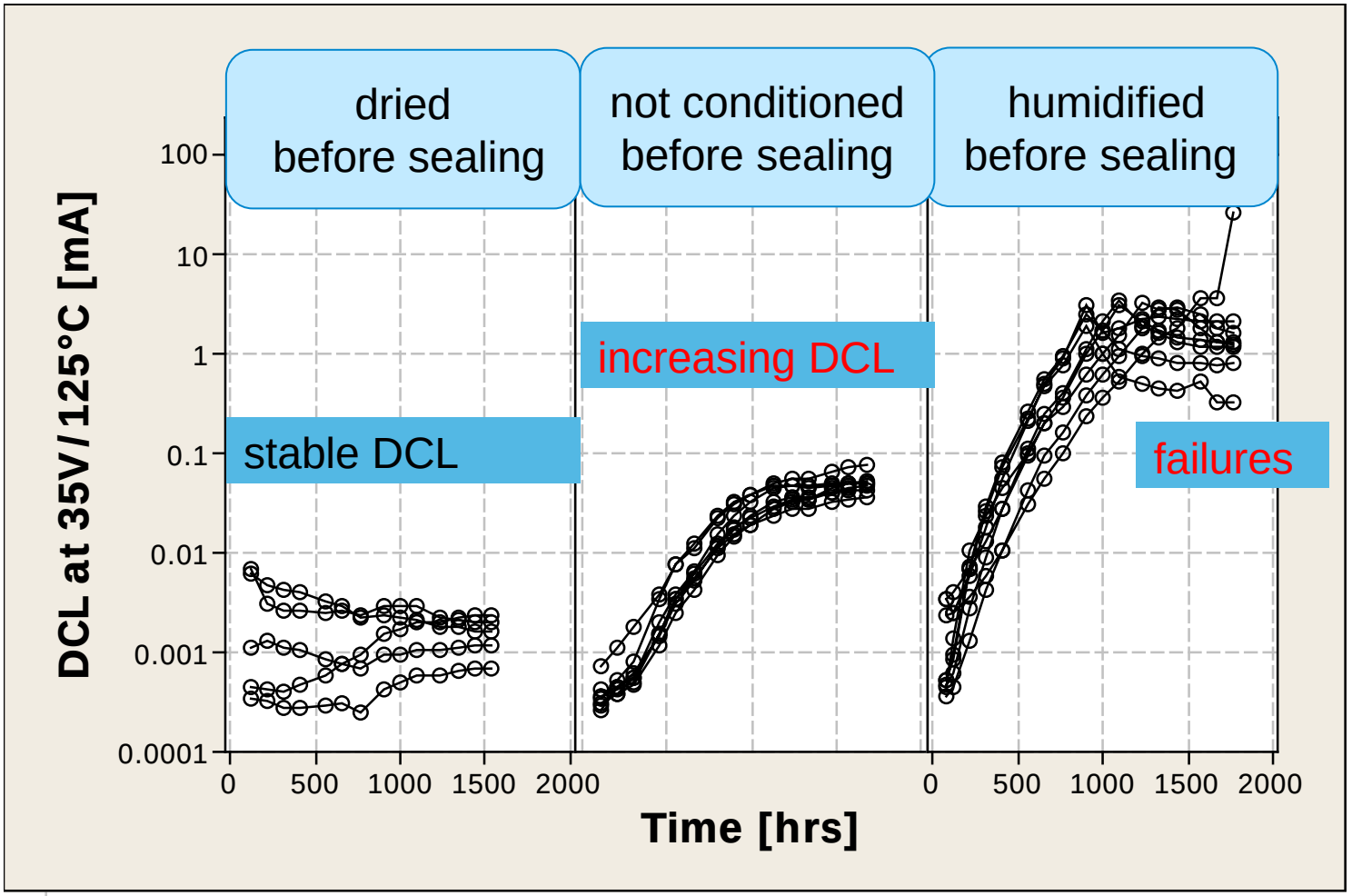
parts before final sealing:

humidified	**WET**
not conditioned	**STD**
dried	**DRY**

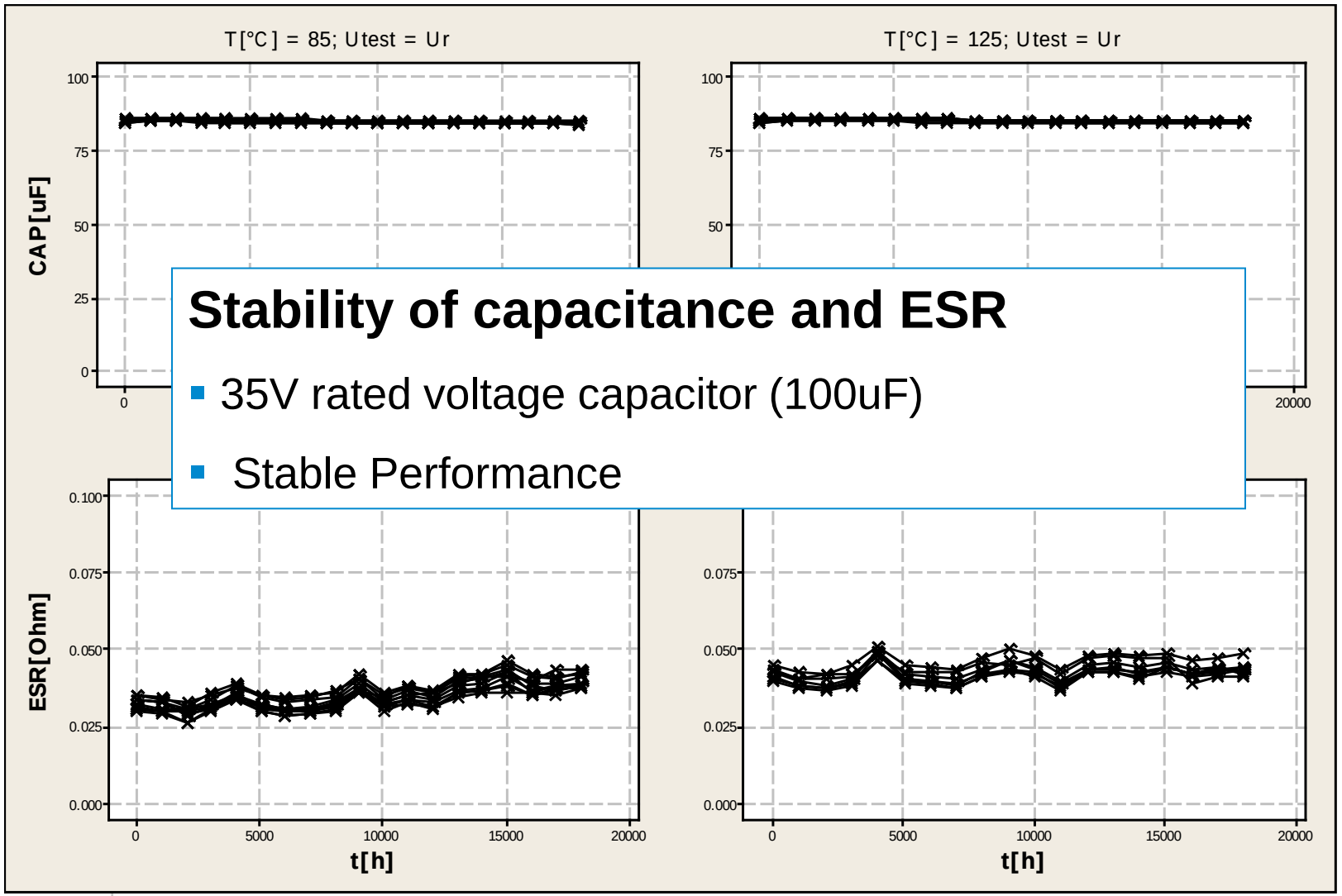


Moisture Influence on DCL Stability

Highly accelerated life test (2.1x recommended voltage/ 125ºC)



Stability of Hermetically Sealed Capacitors

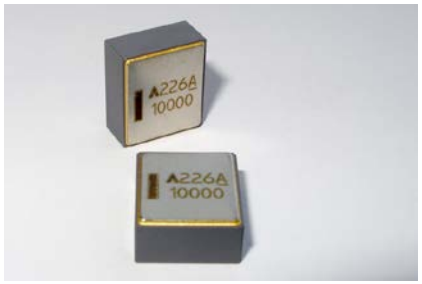


Stability of capacitance and ESR

- 35V rated voltage capacitor (100uF)
- Stable Performance

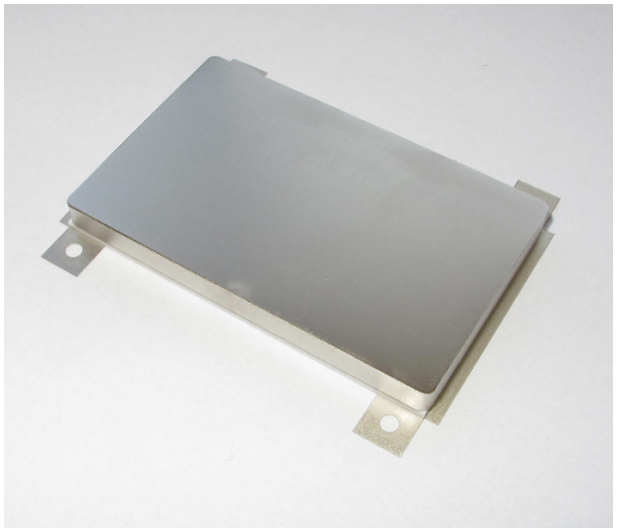
Challenges – super low ESR - Modular Solution

- **TCH 9 case**
- 22µF/ 100V
- ESR 60 mOhm



- **TO3 case**
- 100µF/ 100V
- ESR 9 mOhm

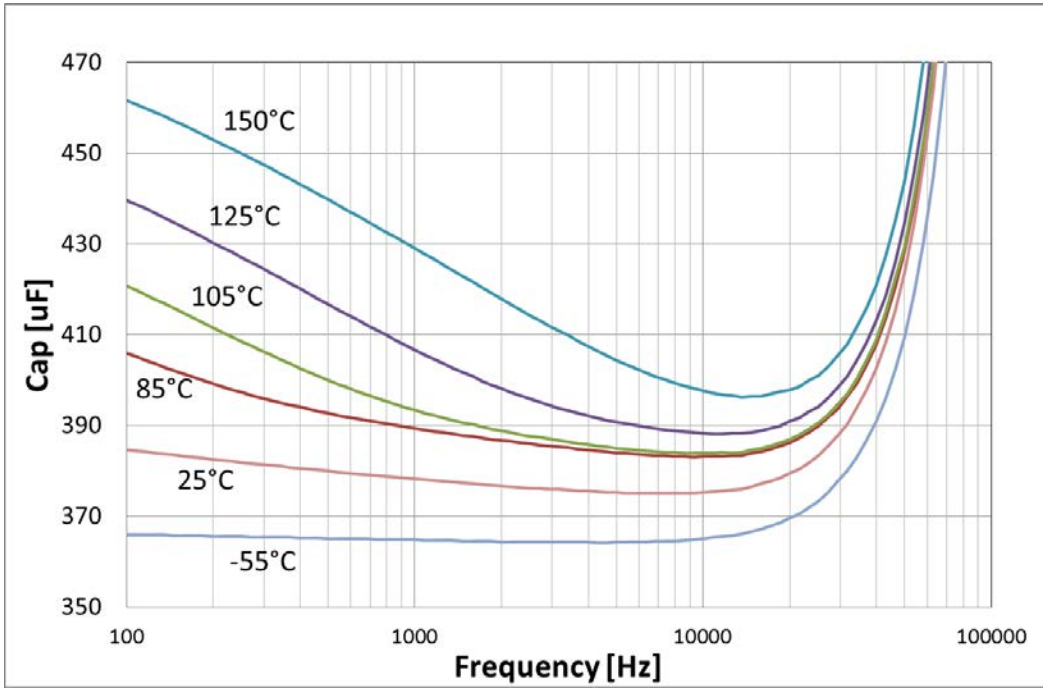
- **Customized case**
- 400µF/ 100V
- ESR 3 mOhm

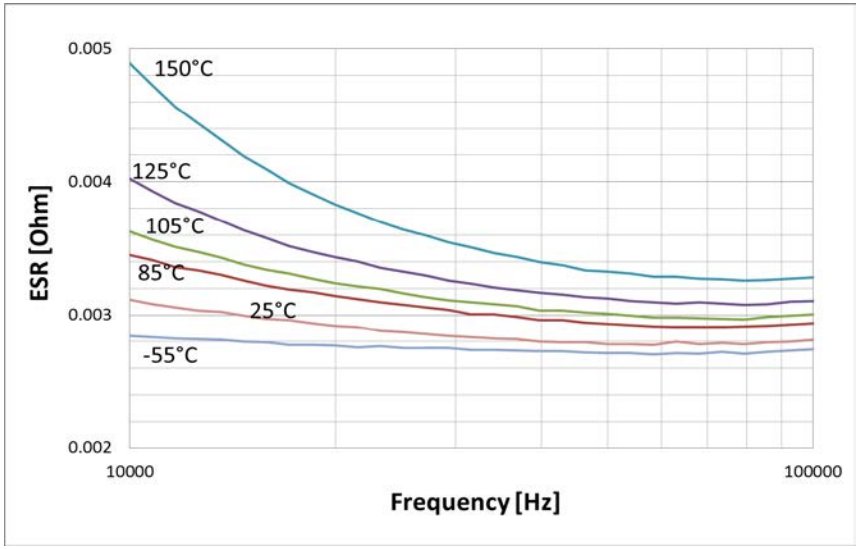


- Multiple capacitors connected in parallel
- Capacitace high
- ESR low

Challenges – super low ESR - Modular Solution

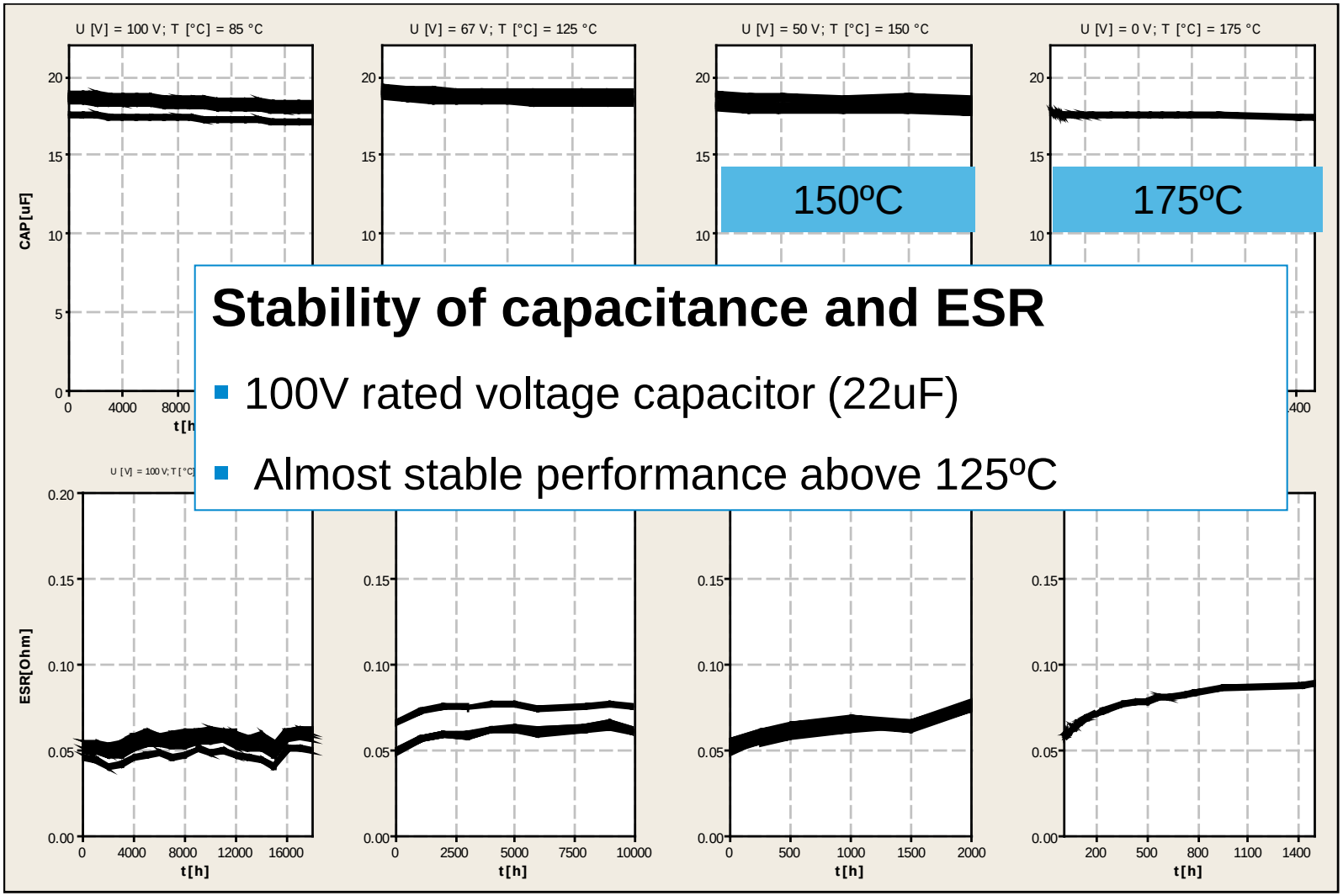
- **400µF/ 100V**





- Capacitace stable with temperature and frequency

Challenges – Higher Temperature

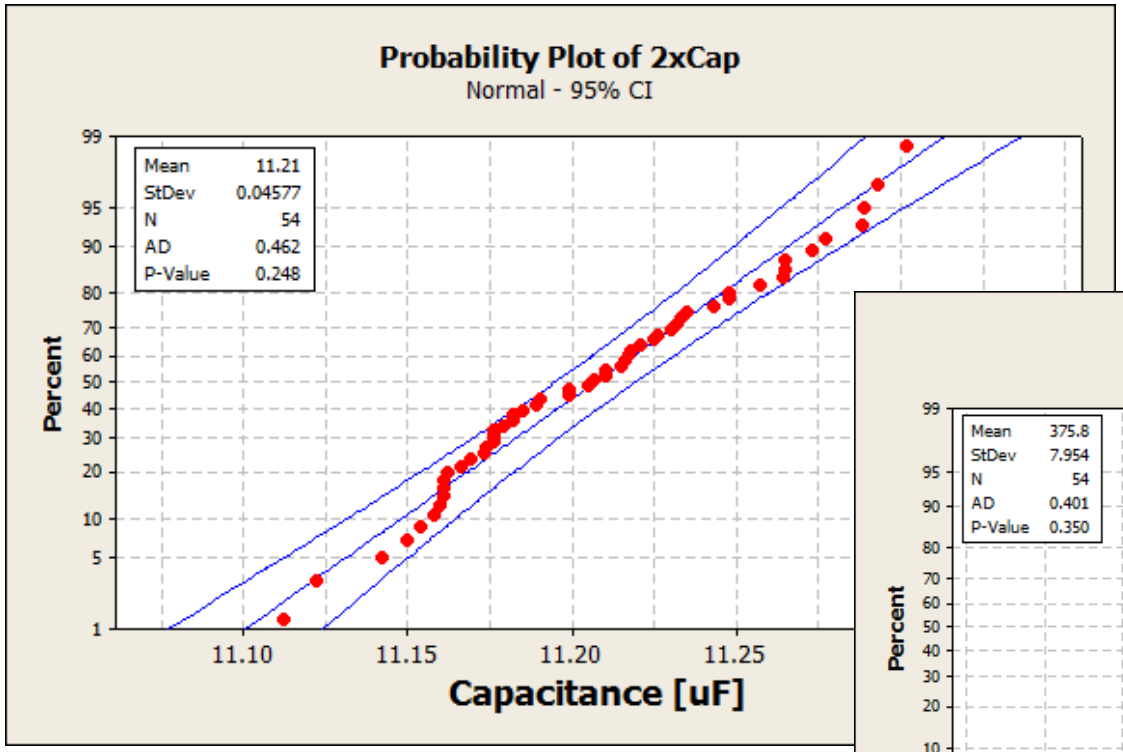


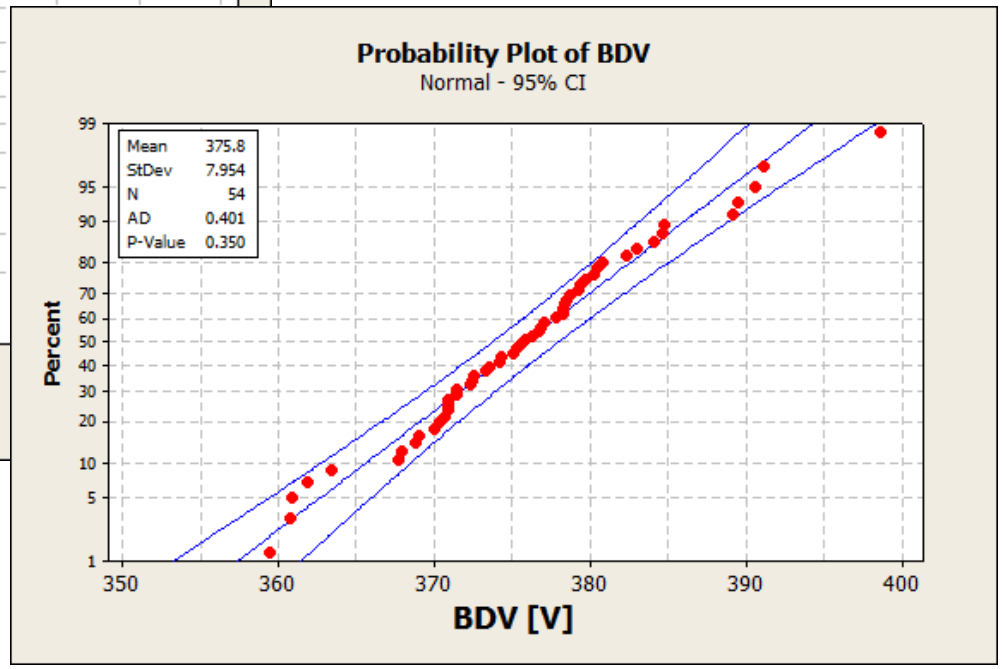
Stability of capacitance and ESR

- 100V rated voltage capacitor (22uF)
- Almost stable performance above 125ºC

Challenges – Higher Voltage

Extremely High Voltage Ta Polymer Capacitors **TCH 9 10uF/175V**





Summary & Conclusion

Hermetically Sealed Low ESR high voltage high Reliability Tantalum Capacitors

- stable performance and reliability exceeding 10,000 hours, 85°C at Vr, 125°C at 0.66xVr
- up to 100V rated voltages (22uF in CTC21D size)
- lightweight solution typically 2.2g per CTC21D size
- ESCC evaluation under progress

Potential for

- higher temperatures: 150°C at 0.5xVr released soon
- very low ESR, high voltage, high ripple current modular solution
- higher voltages up to 175V