



TTI – AVX

Tantalum Power Solutions



Power Conversion & Distribution

Power Supplies –

Providing smooth, filtered DC power

- Applications:
 - From Digital Consumer to Nuclear Power Plant Start-Up.
- Hand Held (DSC, IPOD, PDA, Notebook, etc)
 - High Volume, Low Cost.
 - Mainly Offshore Production
- ***High End: Industrial to MIL / AeroSpace***
 - Space, MIL QPL, COTS-plus Established Reliability
 - US Design / Mfg



“High End” Applications

MIL-PRF-55365

Qualification Standard for all tantalum capacitors

- “Traditional” – Satellite, MIL & Commercial Avionics
 - Space Level:
 - Power supply, 28v Bus
 - Avionics:
 - Power Conversion, Instrumentation, Engine control, Flight Systems, Flight Recorders
 - Portable / Comms
- Emerging – UAV, ElectroMechanical, Surveillance
 - High Speed Data Processing, DSP, CCD, GP
 - High Volumetric Efficiency, Micro Miniature



All About Reliability...

Space Level → MIL QPL → COTS-plus

All Based on Established Reliability Burn-In:

ALL BURN-IN IS NOT THE SAME!!

Since 1990, DSCC have recommended **Weibull Grading** for **ALL** Established Reliability Tantalum Chip:

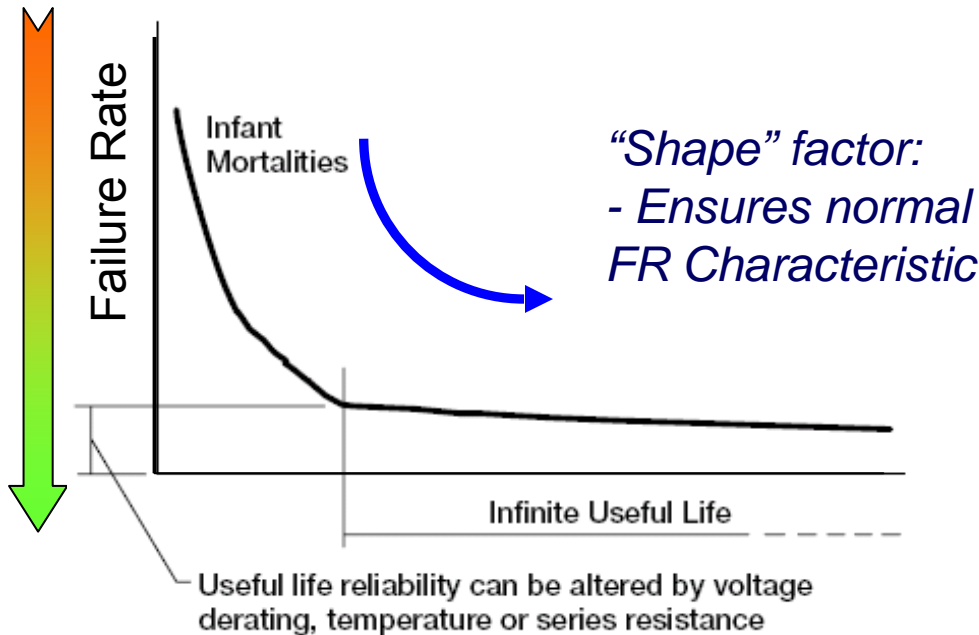
- 100% Test – All Parts in the Lot
- Apply Accelerated Voltage
- Apply Accelerated Temperature
- Minimum 42.5 hours in Burn In
- Statistically Monitored Throughout Test



Reliability Baseline

Weibull Grading and Reliability

- This Results in:
 - Lot Acceptance Test – Lots Discarded if FR “shape” is incorrect.
 - Documented Reliability for every lot – Measured as:
 - % / 1000 Hrs
 - **@ 90% Confidence**
 - (commercial & “exponential” based on 60% confidence only).



Failure Rates @ 90% Conf:
B = 0.1% / 1000 Hrs
C = 0.01% / 1000 hrs
D = 0.001% / 1000 Hrs
Commercial product = 1%

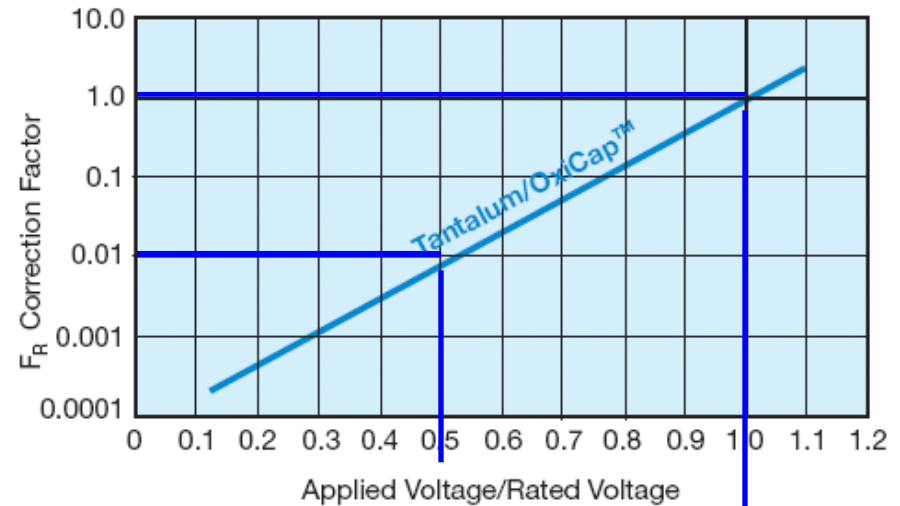
Failure Rate:
“Open Bathtub” Model
- Failures tend to “Early Life”



Application Considerations

Voltage Derating

- **Steady State Reliability**
- **Voltage Dependence**
 - The most important variable – Logarithmic effect on Failure Rate.
- **Temperature dependence**
 - Secondary effect on Failure Rate – but power supplies cook, so - *offset with voltage derating!*
- **Series Resistance**
 - Target 0.1 Ohms / Volt – if less than this - *offset with voltage derating!!*



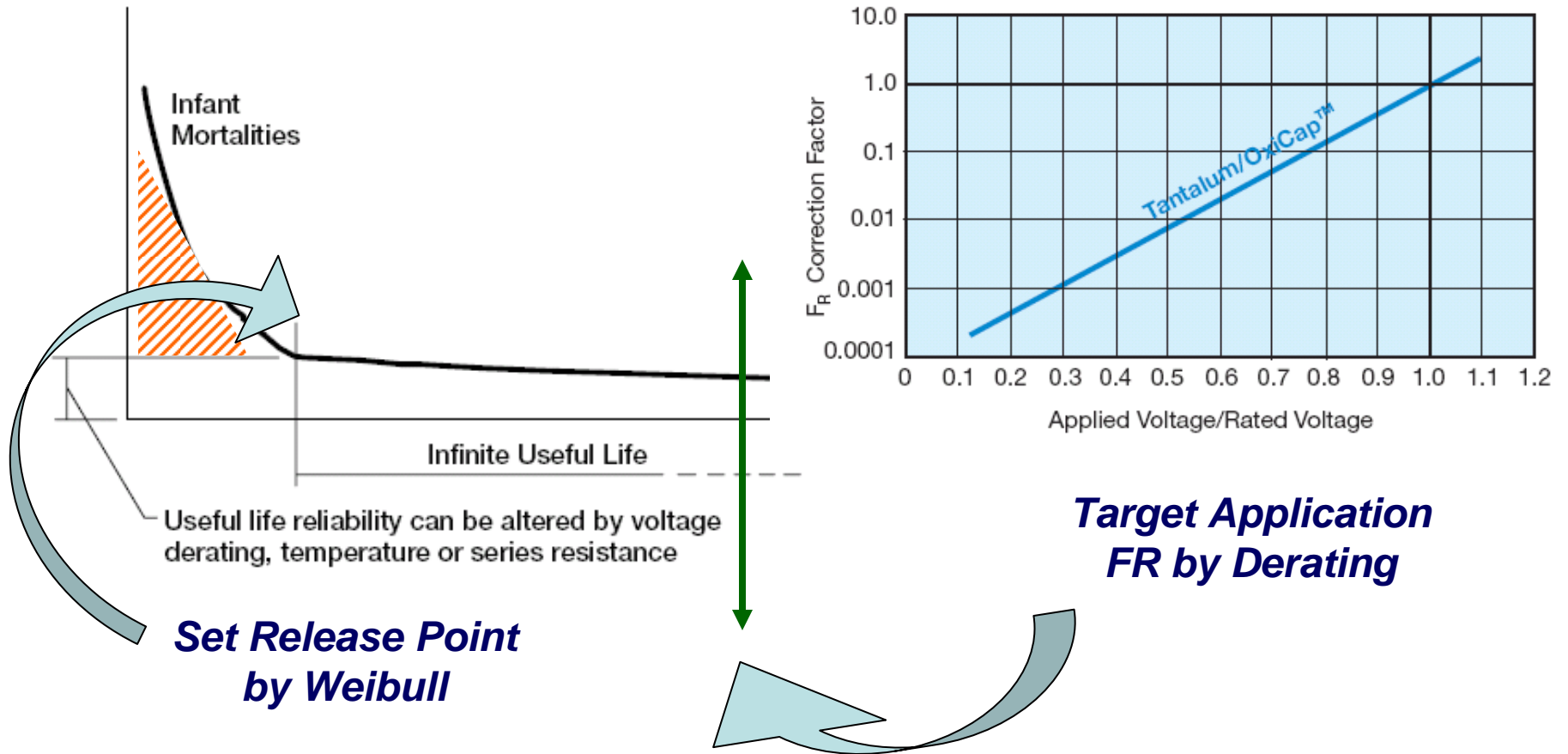
50% Derating is equivalent to 2 Decades improved failure rate.



Reliability Management

Reliability Management:

Weibull Grading & Voltage Derating:





Application Preconditioning

Dynamic Reliability

- Thermo-Mechanical Preconditioning
 - Thermal Cycling
 - Reflow Preconditioning
- Surge Preconditioning
 - MIL-PRF-55365 Surge options:
 - A – 10 cycles at 25°C
 - B – 10 cycles at -55°C, 10 cycles at +85°C
 - C – 10 cycles at -55°C, 10 cycles at +85°C

Conformance Test

- Space, MIL-QPL, COTSplus
 - Group A, Group C options



Tantalum Solutions

Re-introducing: TAZ Series

9 Case sizes / Individual Footprints

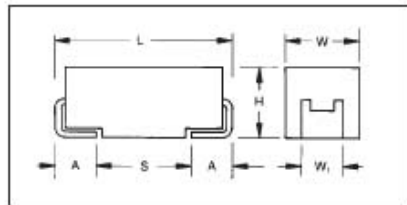
Full Range Qualification

- 4v – 50v
- 0.1uF / 330uF
- Weibull B, C, D
- Surge A, B, C

Widest range of QPL Approvals:

- CWR09
- CWR19
- CWR29

Case Code	Length (L) ±0.38 (0.015)	Width (W) ±0.38 (0.015)	Height (H) ±0.38 (0.015)
A	2.54 (0.100)	1.27 (0.050)	1.27 (0.050)
B	3.81 (0.150)	1.27 (0.050)	1.27 (0.050)
C	5.08 (0.200)	1.27 (0.050)	1.27 (0.050)
D	3.81 (0.150)	2.54 (0.100)	1.27 (0.050)
E	5.08 (0.200)	2.54 (0.100)	1.27 (0.050)
F	5.59 (0.220)	3.43 (0.135)	1.78 (0.070)
G	6.73 (0.265)	2.79 (0.110)	2.79 (0.110)
H	7.24 (0.285)	3.81 (0.150)	2.79 (0.110)
X	6.93 Max (0.273)	5.41 Max (0.213)	2.74 Max (0.108)



MARKING

(White marking on black body)



Polarity Stripe (+)
Capacitance Code
Rated Voltage



High End Applications

CWR09 - Original MIL SMD Series

- Most flexible design Range available
- Smaller size options than original EIA range
 - Sub 3216 (1206) size
- Original Low Profile Series (0.050")

CWR19 - Updated Range

- New part numbering system – ***includes case size!!***
- All currently available Capacitance / Voltage Options included.
- “Living” specification – can accommodate additional ratings when available

CWR29 – Low ESR Versions

- ALL:
- SnPb Term is Standard
 - Fused Solder or Hot Solder Dip (HSD)
 - Au Term (Epoxy / Wire Bond)
 - ***Au Term for RoHS Compliance***





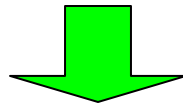
High End Applications

TAZ CWR QPL Extension Example

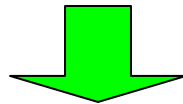
Original QPL Listing:

H case 47uF / **10v** / 900mOhms

Upgrade from CWR06 to CWR09 Molded / Compliant Lead

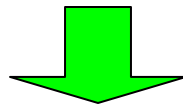


Upgrade Voltage rating to **15v** (CWR19)



Upgrade to **15v** Low ESR Version (CWR29)

H case 47uF / 15v / 180 mOhms



Downsize to G case **15v** Low ESR (CWR29)

G case 47uF / 15v / 275 mOhms

Same
Case
Size

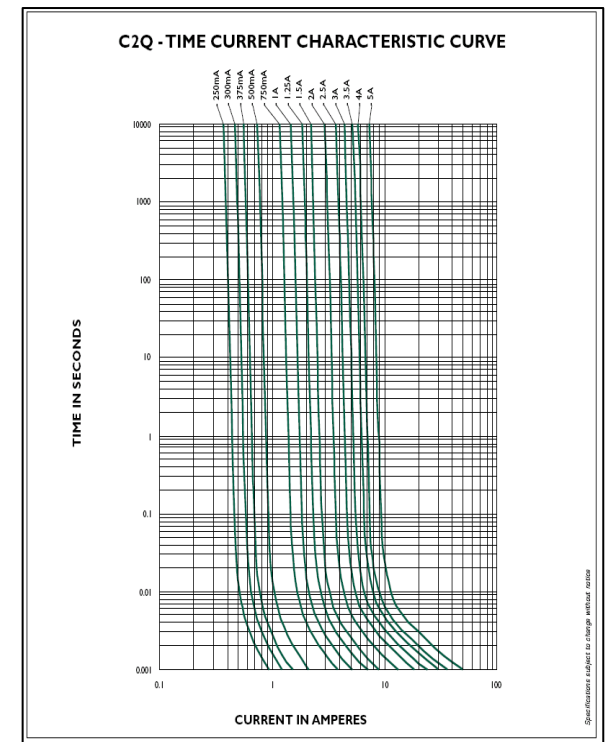
Smaller
Case Size



Reliability & Failsafe

Failsafe Option – Internal Fusing

- TBW Series – Internally Fused Low ESR
 - Failsafe with Full Weibull capability
 - B, C, D case, 10v – 50v ratings
 - Fastest activation Thin-Film fuse
 - Range of Fuse Characteristic options





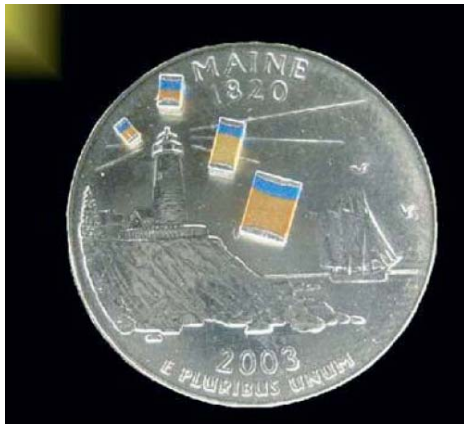
Micro-Miniature Applications

Digital / RF / Analog / Cpu Power Distribution

- Satellite / Micro Sat
- Avionic Instrumentation & Comms
- UAV Sensors & Comms
- Common Requirements:
 - Mission Critical Reliability
 - Smallest Size
 - Lightest Payload
 - Hybrid & PCB Compatibility



Micro-Miniature Applications



Micro Miniature Solution:

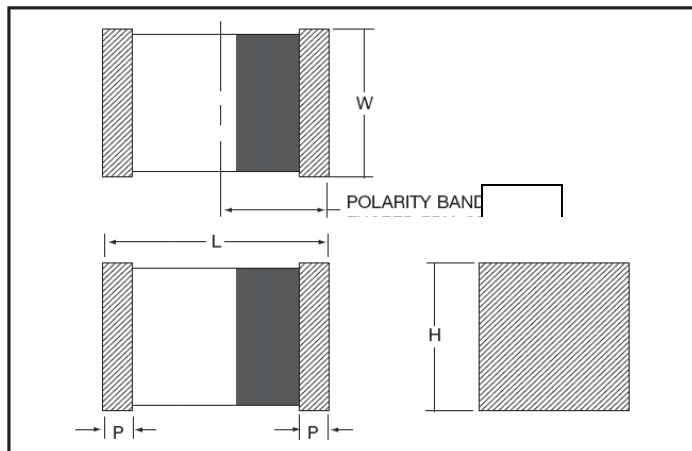
TBC Series Tantalum Microchip™

3 QPL Case sizes – 0603, 0805, 1206

COTS-Plus 0402!!!

Latest QPL Approval:

CWR15 - Current Status: 4v – 20v approval



CASE DIMENSIONS: millimeters (inches)

Case Code	Length (L)	Width (W)	Height (H)
L	1.60+0.25/-0.15 (0.063+0.010/-0.006)	0.85+0.20/-0.10 (0.033+0.008/-0.004)	0.85+0.20/-0.10 (0.033+0.008/-0.004)
R	2.00+0.25/-0.15 (0.079+0.010/-0.006)	1.35+0.20/-0.10 (0.053+0.008/-0.004)	2.00+0.25/-0.15 (0.079+0.001/-0.006)
A	3.20±0.20 (0.126±0.008)	1.60±0.20 (0.063±0.008)	1.60±0.20 (0.063±0.008)



Pulse Power

Heavy Duty - Pulse Power Applications

Providing high energy / fast repetition on demand

Application defined by:

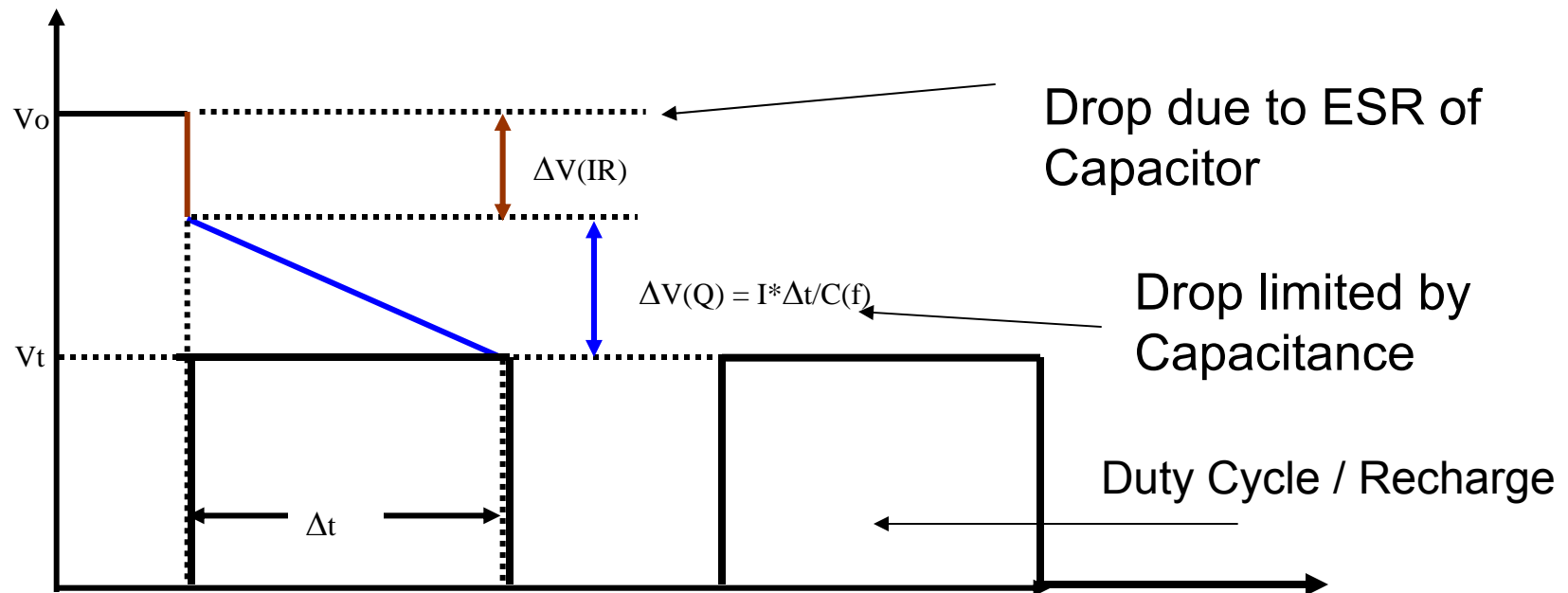
- Pulse Width
- Pulse Current
- Hold Up Voltage / Allowable Voltage Droop
- Capacitor Solution Defined By:
 - High Capacitance...
 - Low ESR...

...AT THE APPLICATION FREQUENCY & DUTY CYCLE



Pulse Power

Pulse Hold-Up: Voltage-time relation: Current Draw & Voltage Drop



$$\Delta V \text{ total} = I \cdot R(f) + I \cdot \Delta t / C(f)$$

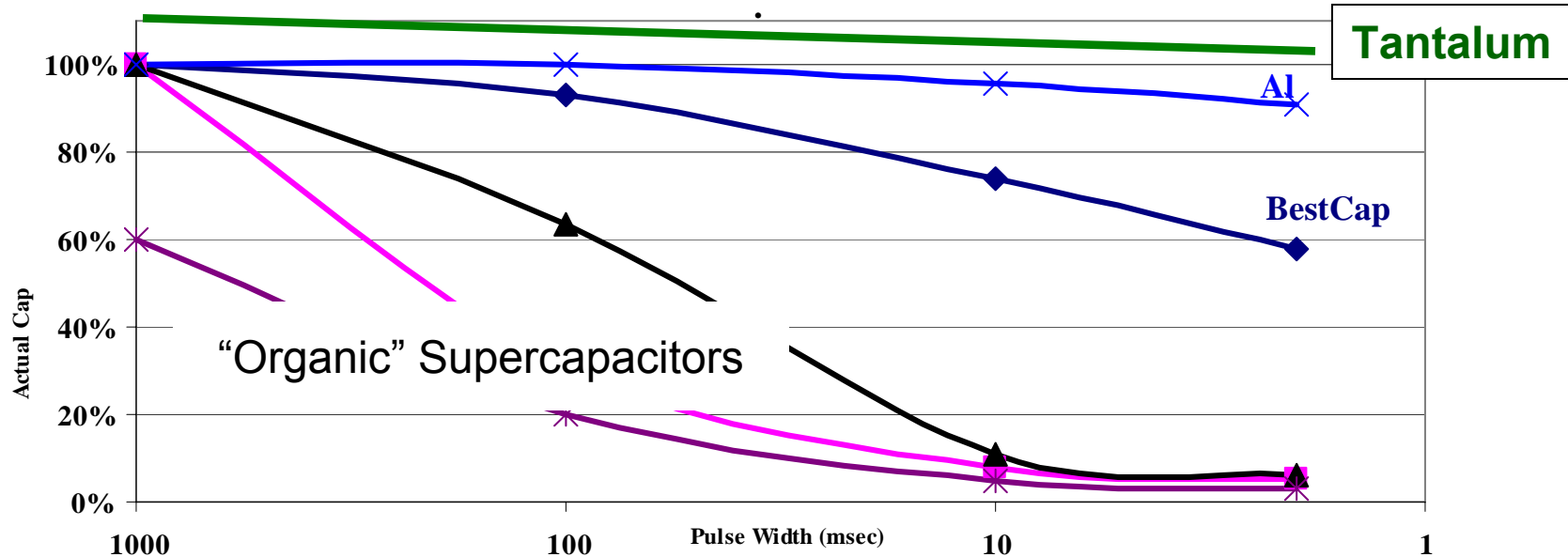
R(f) = ESR AT APPLICATION FREQUENCY

C(f) = Cap AT APPLICATION FREQUENCY



Pulse Power

Competing Technologies – Capacitance vs Frequency



ESR Characteristics:

- TamOhm @ 100kHz
- Pulse Supercaps mOhms @ 1kHz
- Wet TaOhms @ 10kHz
- SupercapsOhms @ 1 kHz

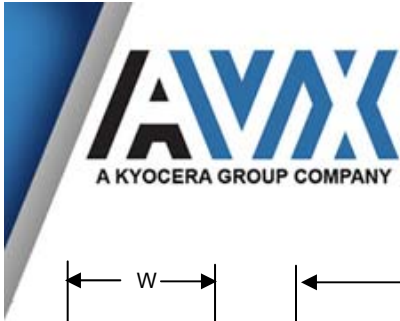


Pulse Power

Pulse Power Application Examples

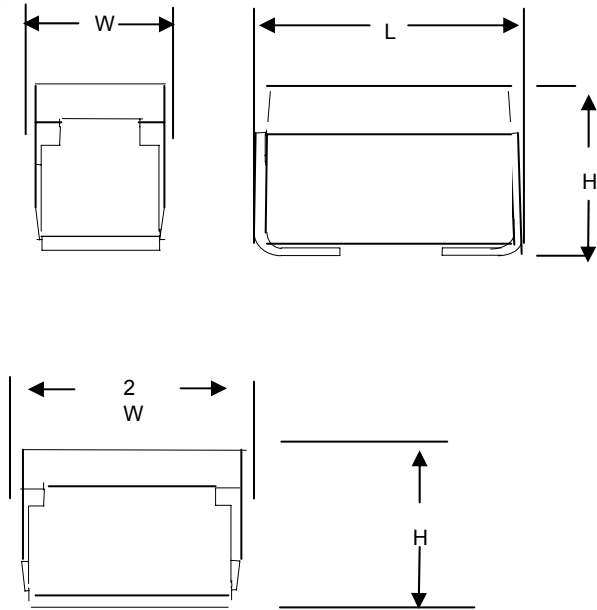
Cpu: High Current, Low Voltage, High Frequency

- **NEEDS: Low ESR – Low ESL (pH) solutions**
 - IDC, LGA, LICA... (that's another presentation...)
- **PCMCIA: 3G - GPRS / EDGE / 3G**
 - **NEEDS: High Cap (mF), Low ESR, Low Voltage**
 - BestCap, Tantalum Polymer, Oxicap... (more later...)
- ***Radar, Laser, Avionic Fly By Wire***
 - **NEEDS: Low ESR Banks, Max volumetric Efficiency**
 - **Medium Voltage, MIL Temp Range / Reliability**



Pulse Power

Introducing TCP Series



- Extended Capacitance / Low ESR
- Extended Height Package
- Based on Single & Dual Width CWRs
 - Maximizes volumetric efficiency.
 - Maximizes Brick-Wall / Banking capability.
 - Minimizes Real Estate.
- Full Weibull Capability
- Fused option available

Product Range:

- Max outline: 7.3mm x 7.8mm – custom configs available
- Max capacitance Available:
 - 2000uF / 6v / 30mOhms max
 - 28uF / 50v / 80mOhms max.
 - Can Serialize for > 50v Applications



Commercial Pulse Power

Low ESR Tantalum Chip

- **TPS Series -**
 - 1st Low ESR Tantalum Series (1989)
 - Established pedigree in demanding applications
- **TPS Series III**
 - Full Range – All Case Sizes / Voltages.
 - Lowest ESR / Highest Ripple Rating for 25v – 5v ratings.”
- **TBM Series.**
 - Ultra Low ESR, Full Voltage Range 4v – 50v.
 - Standard E Case package, Maximum CV
- **Surge Robustness**
 - All above series have multiple surge preconditioning at > rated voltage – toughest standard in the industry.
 - pSpice Library available on website.

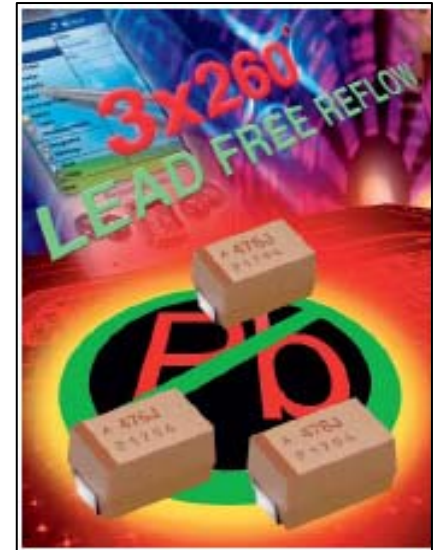




Commercial Pulse Power

TCJ Tantalum Polymer

- Mechanically Robust, High Thermal tolerance
 - 1st polymer rated for 3x 260°C reflow
 - Voltage Range 2.5v – 16v
- Low Profile / max Cap capability
 - H case = B case outline, 1.5mm height.
 - 150uF / 6v / 150mOhms
 - Replaces commercial “conformals”
- Ideal for standard reliability applications.
 - For Ultimate Low ESR (Low Voltage) requirements
 - Hand Held - Wireless GPS / GPRS / Edge
- Not a “Failsafe” Solution
 - Same failure mode as tantalum (hard short) with limited derating or serializing ability.....

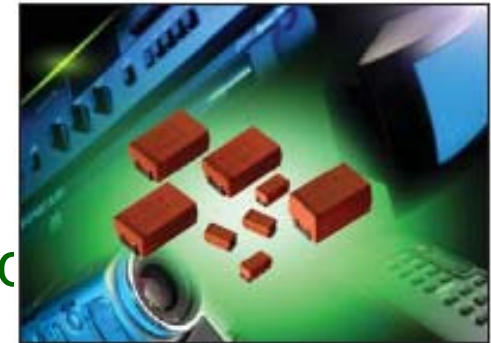




Commercial Safety

NOS Oxicap – Low ESR Niobium Oxide

- The first safe commercial electrolytic technology
- Safe Failure Mode - Does **NOT** fail as a hard short
 - High Resistance (~10 – 100)kOhms in forward bias
 - Part remains functional in the circuit!
 - “Failed” part can have better DCL than a “Good” polymer!!
- Non Burn – Non Smoke
 - No Metal content – lowest ignition potential.
 - Tantalum metal replaced with inert NbO
- 1.8v – 10v ratings, minimum derating required
 - Weibull Capable Technology



Ideal for Low voltage / Low ESR standard reliability applications in “Smoke Critical” environments – or just as a general Tantalum alternative.