





Electronic Components
KEMET
CHARGED.®

Ta SMD capacitors with Polymer Counter Electrode for Space Applications

Ana Tomás¹, Cristina Mota-Caetano¹, Dr. Denis Lacombe², Leo Farhat²

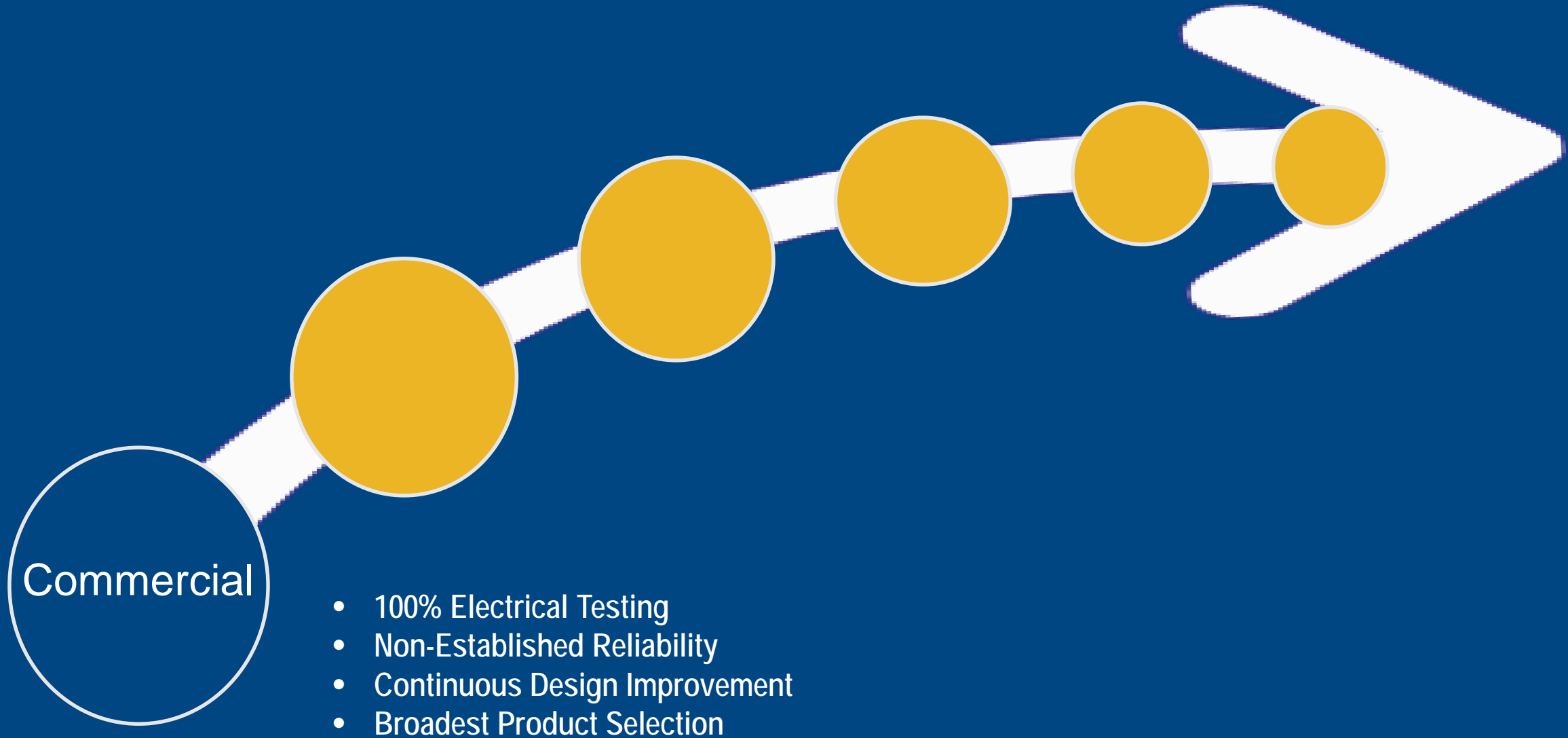
¹KEMET Electronics Portugal, S.A.; ²ESA/ ESTEC European Space Agency

-  Tantalum Polymer Technology
-  European Space Actual Offering
-  European Space Future Offering/ T584 Series – Multianode
-  Current Activities & Path Forward

Tantalum Polymer Technology

Product Hierarchy

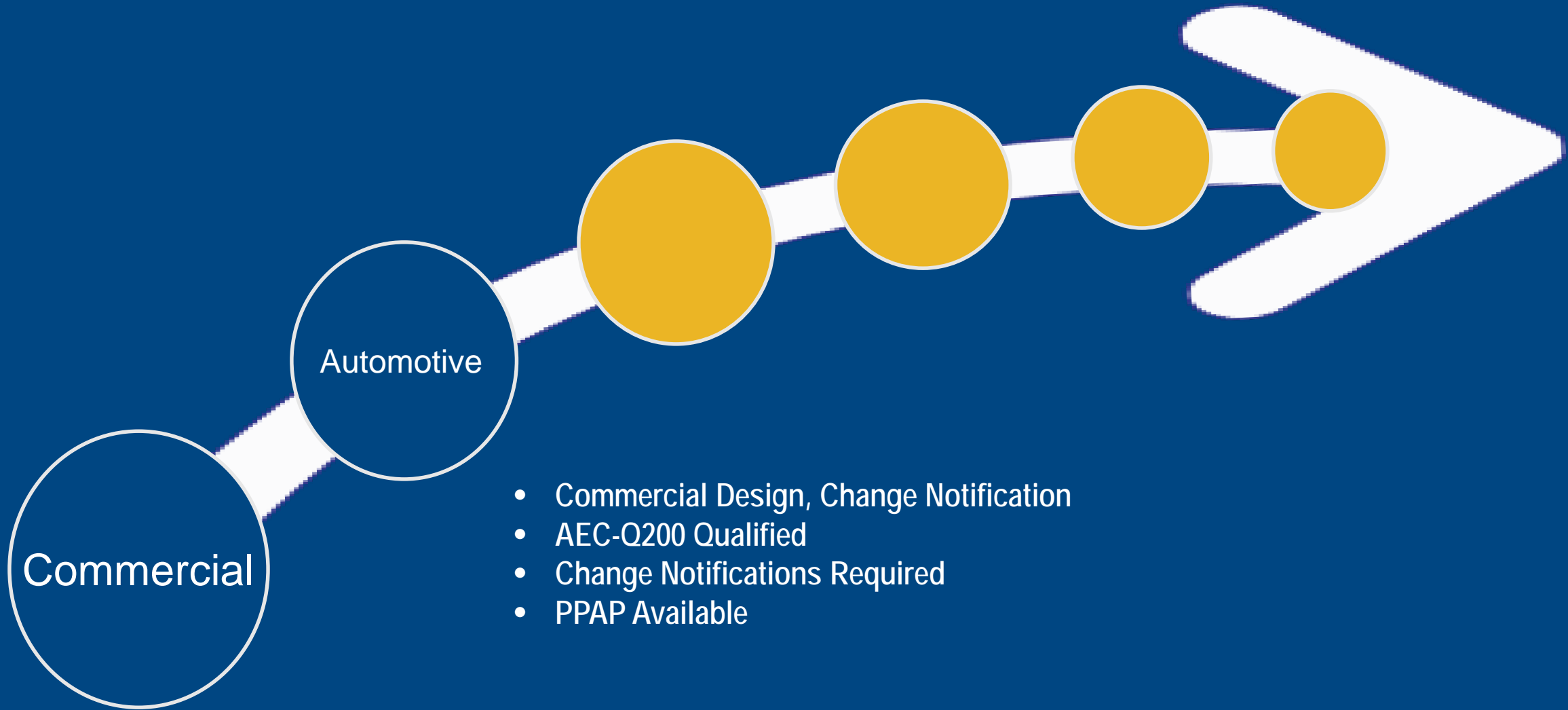
KEMET
CHARGED.®



Tantalum Polymer Technology

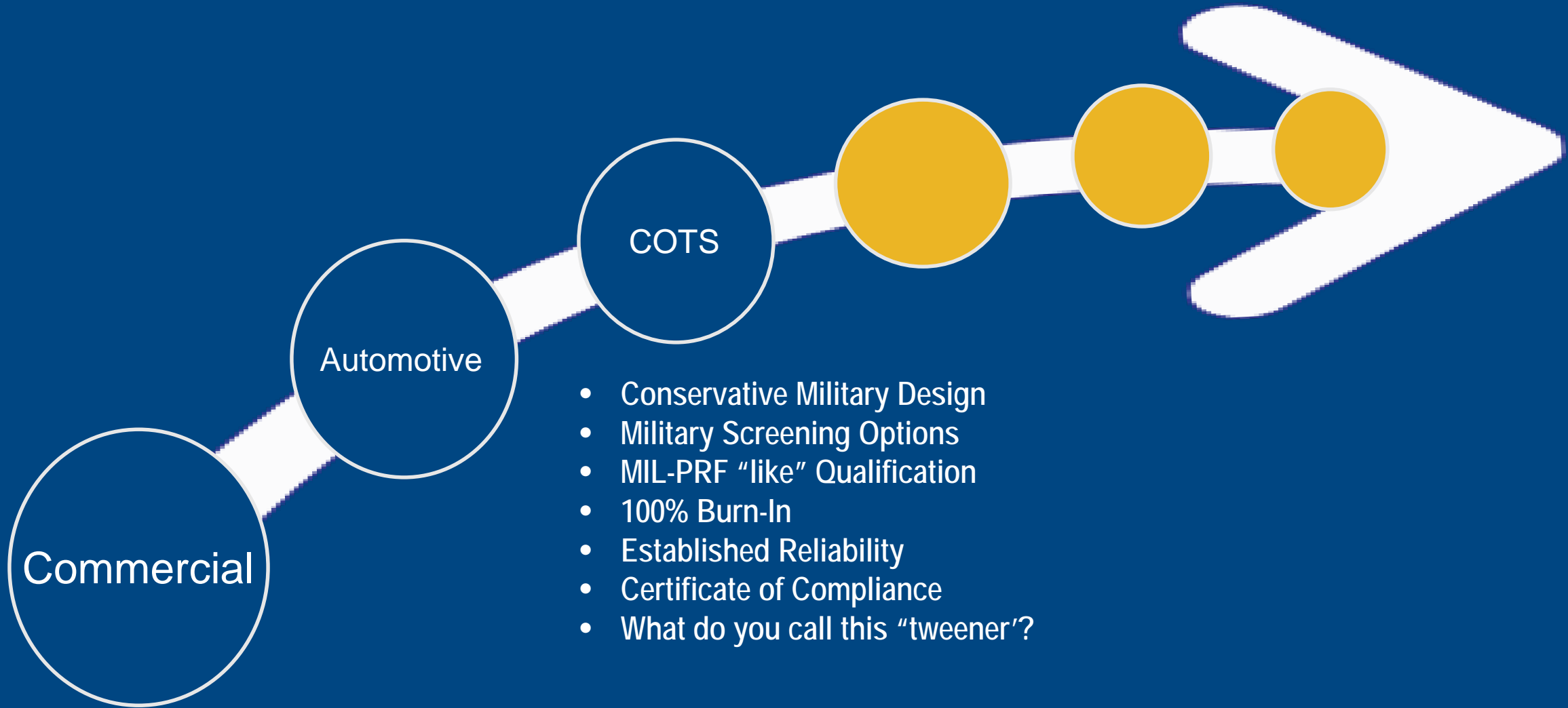
Product Hierarchy

KEMET
CHARGED.®



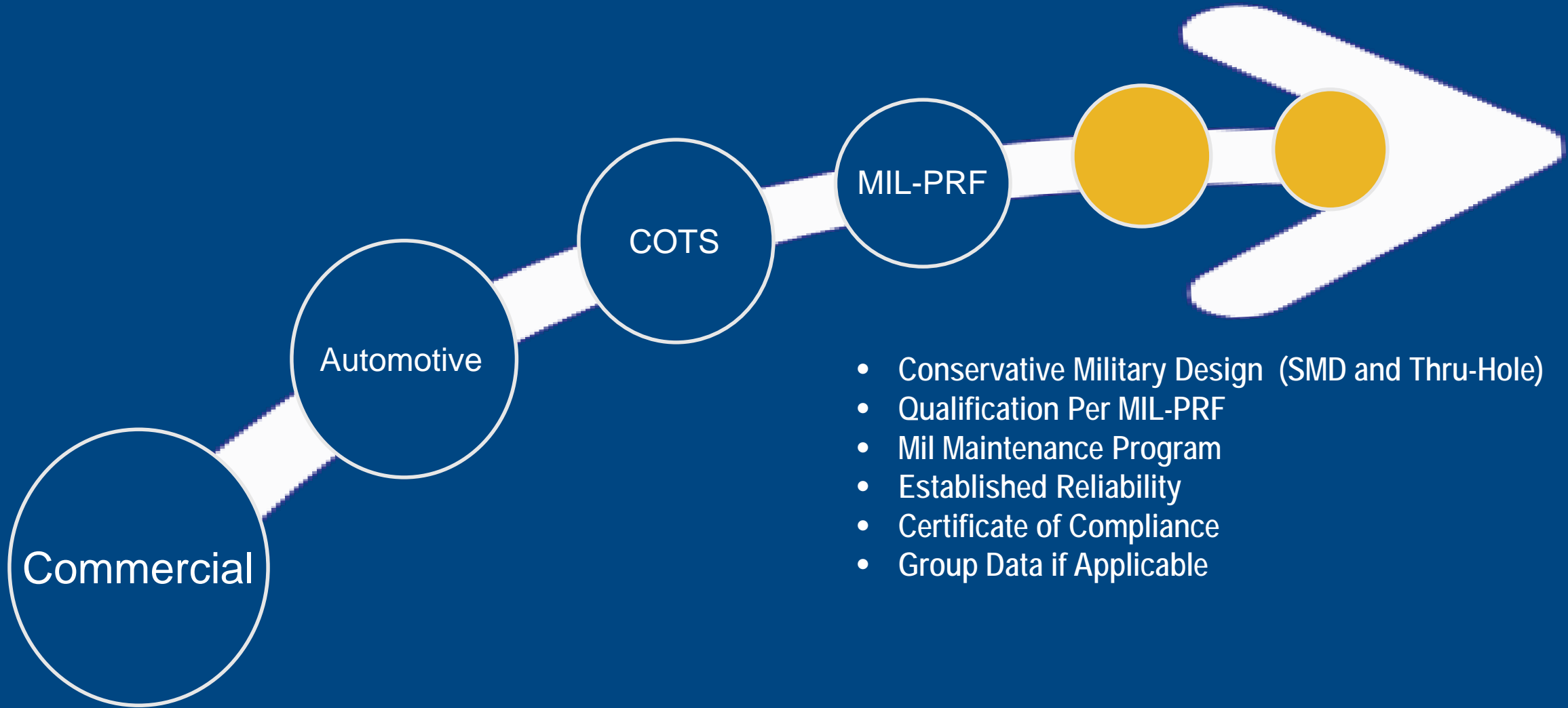
Tantalum Polymer Technology

Product Hierarchy



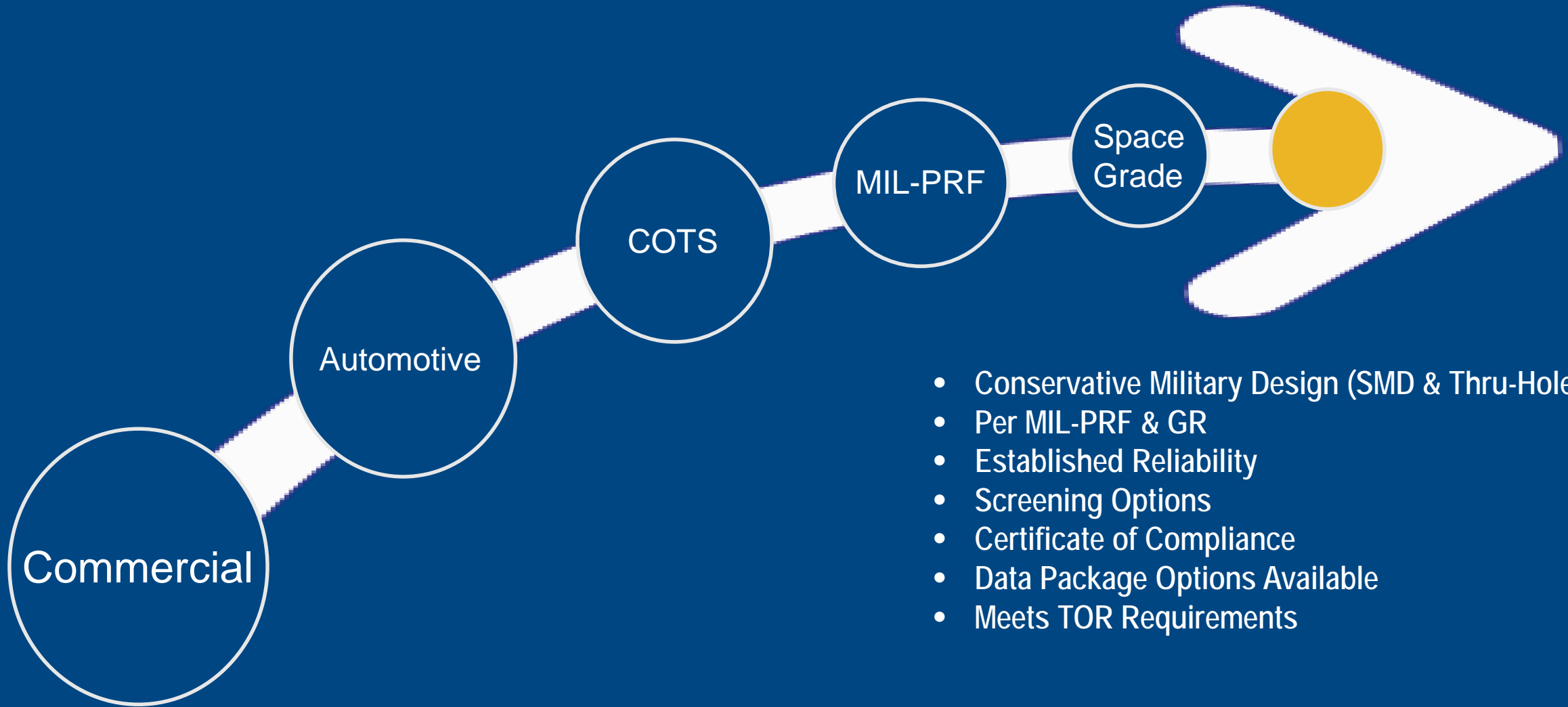
Tantalum Polymer Technology

Product Hierarchy



Tantalum Polymer Technology

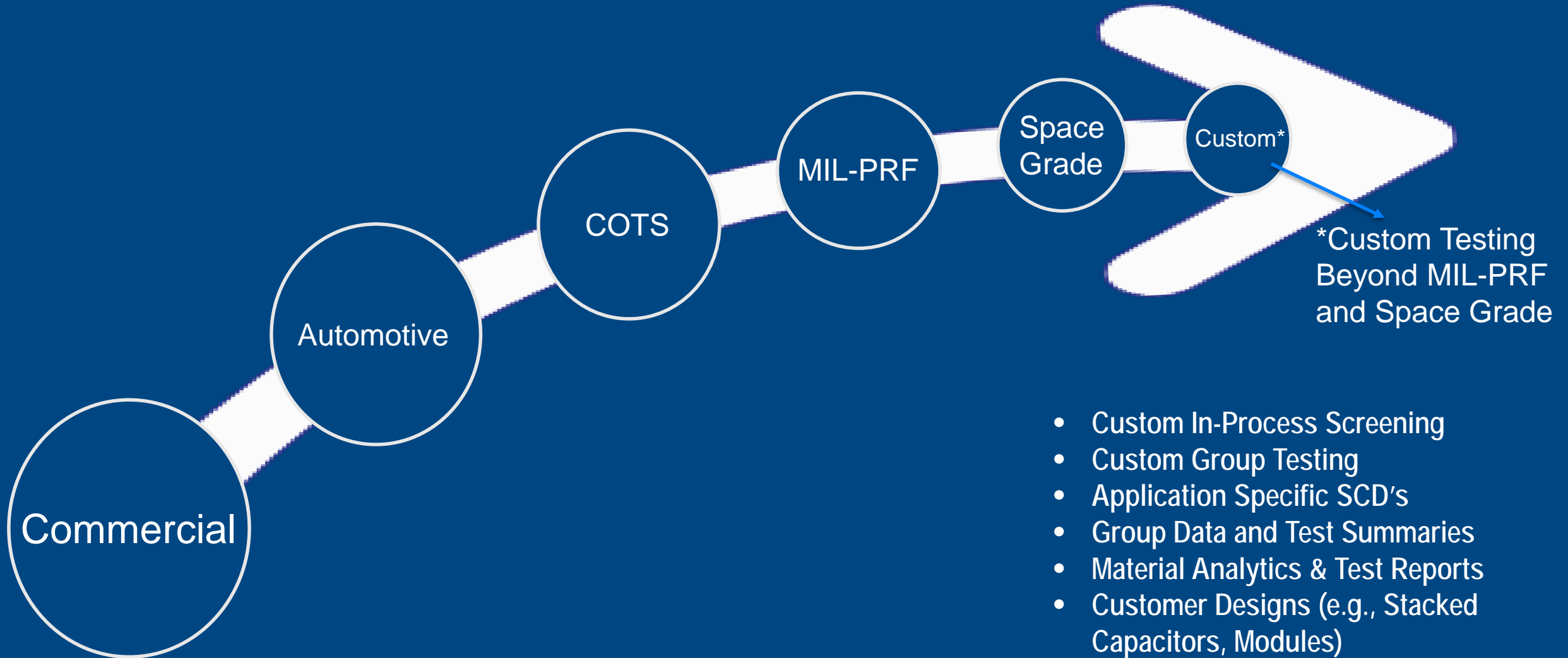
Product Hierarchy



- Conservative Military Design (SMD & Thru-Hole)
- Per MIL-PRF & GR
- Established Reliability
- Screening Options
- Certificate of Compliance
- Data Package Options Available
- Meets TOR Requirements

Tantalum Polymer Technology

Product Hierarchy



KO-CAP® Polymer Capacitors

History & NPD

KEMET
CHARGED®

Conductivity

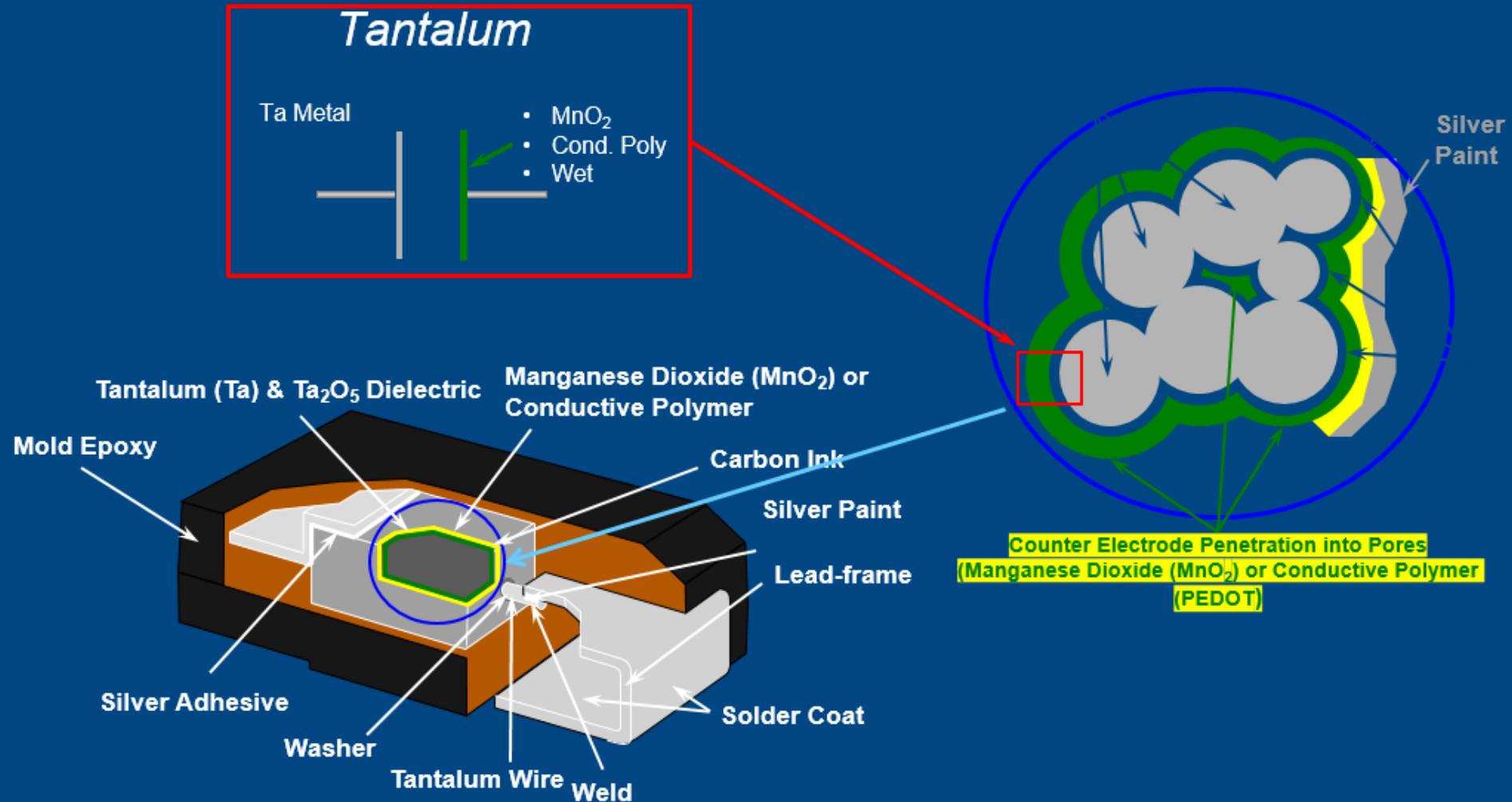


KOCAP Polymer Capacitors

- 2006: DLA Drawing Release 04051 and 04052
 - First Polymer for Mission Critical
- 2011: T540/541 – Hi-Rel Alternative
 - First-To-Market Series for MCA
 - 125°C
 - 100% Voltage Aging 24 Hours Minimum
 - 3 σ Screen (DCL & ESR)
 - 100% X-Ray
 - Temperature Stability & Solderability
- 2013: T543 COTS
 - Sn/Pb Termination Std.
 - Surge Current Options
 - 105°C/125°C
- 2013: T550/T551 PHS
 - Highest voltage & lowest DCL
- **2015: T583 ESCC (ESA) EPPL**
- 2016: Established Reliability Available
 - T540 & T541
- 2017: T540/T541 85/85 Capability (1,000 hrs.)
- 2019: MIL-PRF Including T Level
 - Group C Testing Available Today (SCD)
- 2018: AUTOMOTIVE Grade COTS (85/85)
 - T598 Series with Sn/Pb Termination
 - Surge Current Options.
- 2018: SMD PHS
 - Surge Current Options
 - Special Boardmounting
- 2019: 150°C T599 Series COTS
 - T598 Series with Sn/Pb Termination
 - Surge Current Options.
- **2019: T584 ESCC (ESA) EPPL**

Basic Construction

Tantalum SMD Capacitors (MnO₂ & Polymer)



European Space Actual Offering

T583 ESA Poly SMD Capacitors



Project Information

Project Objective Develop a very low ESR tantalum SMD chip capacitor manufactured in Europe for space applications using polymer technology as solid electrolyte cathode system.

Target Market: ESA OEM's and ODM's



Capacitance C_n (μ F)	Rated Voltage U_R		
	6.3V	10V	16V
33			60, 70
47			70
68		45, 60, 100	
100	45	55, 80	
150	45, 55		



Page 1 of 19

**CAPACITORS, LEADLESS SURFACE MOUNTED,
ORGANIC POLYMER TANTALUM, SOLID ELECTROLYTE,
ENCLOSED ANODE CONNECTION**

BASED ON TYPE T583

ESCC Detail Specification No. 3012/005



Download detail spec in
<https://escies.org/download/specdraftappub?id=3230>

© KEMET Electronics. All Rights Reserved.

European Space Future Offering

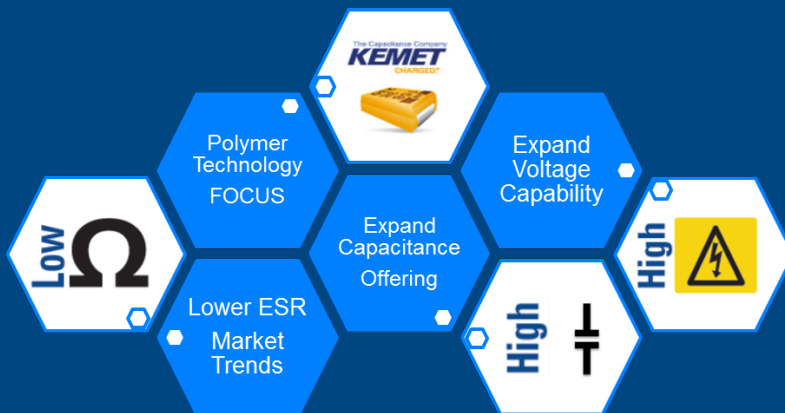
T584 ESA Poly Multianode SMD Capacitors

KEMET
CHARGED®

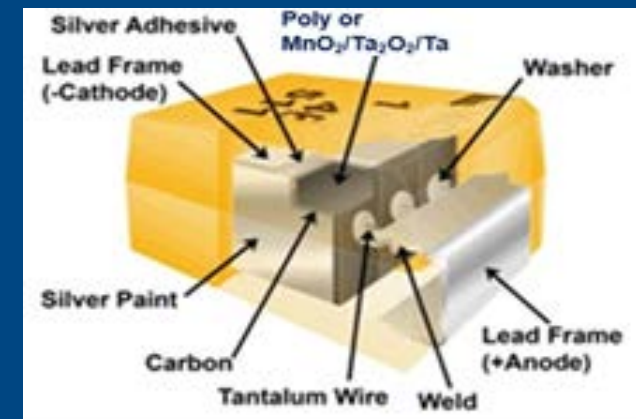
Project Information

Project Objective Develop an ultra-low ESR with maximum capacitance Polymer Multianode (MAT) SMD Capacitor for POL ('Point of load') solutions, $ESR \leq 15 \text{ m}\Omega\text{Ohms}$, manufactured in Europe, adequate for space applications.

Target Market: ESA OEM's and ODM's



**T583 Series
Single Anode
Knowledge &
Technology**

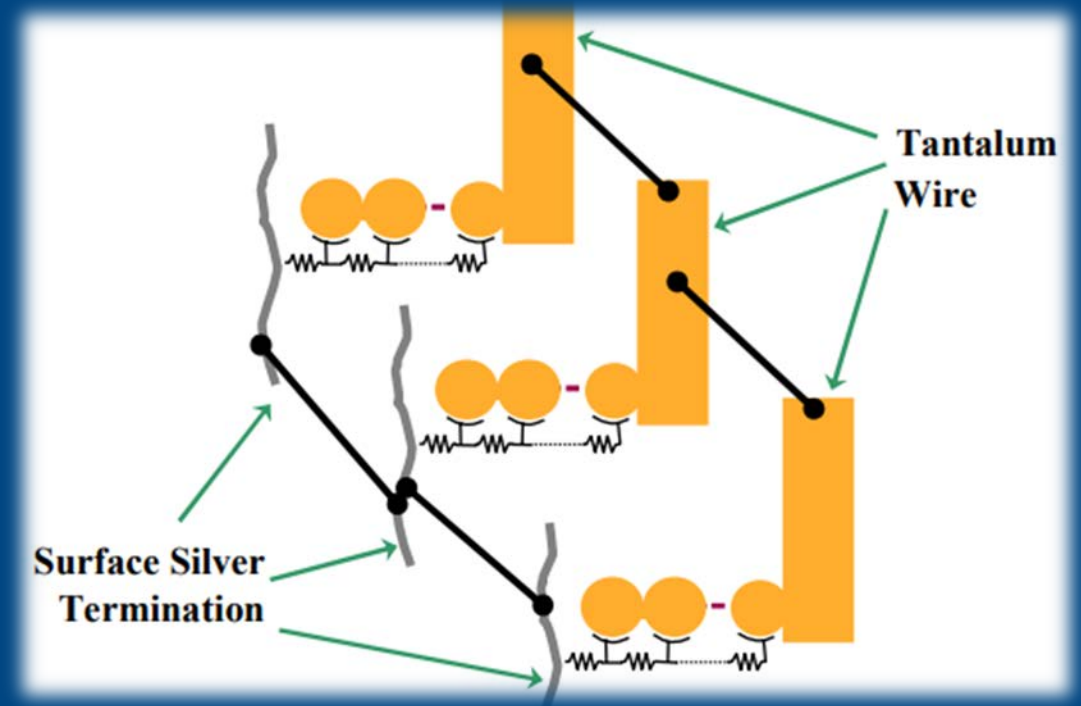
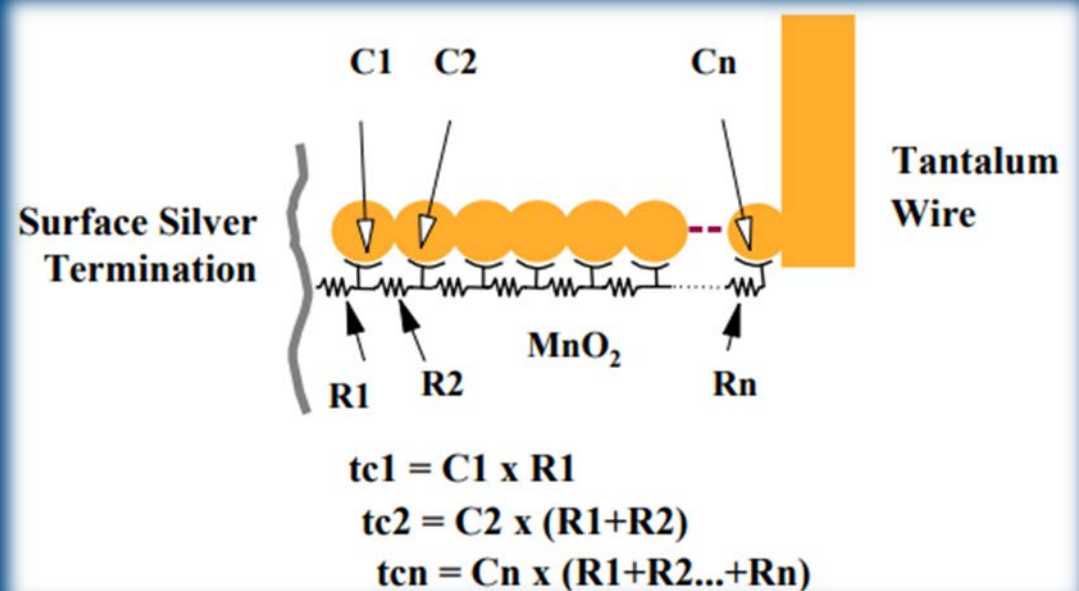


- Taking Advantage of:
- Cumulative Charge Storage Characteristics
- Cathode Material Low Resistivity
- Geometry of the paths within its elements.
- Better Frequency Performance
- “No ignition” Benefit

T584 Series – Multinode

Capacitive Structure Model for Single and Multinode

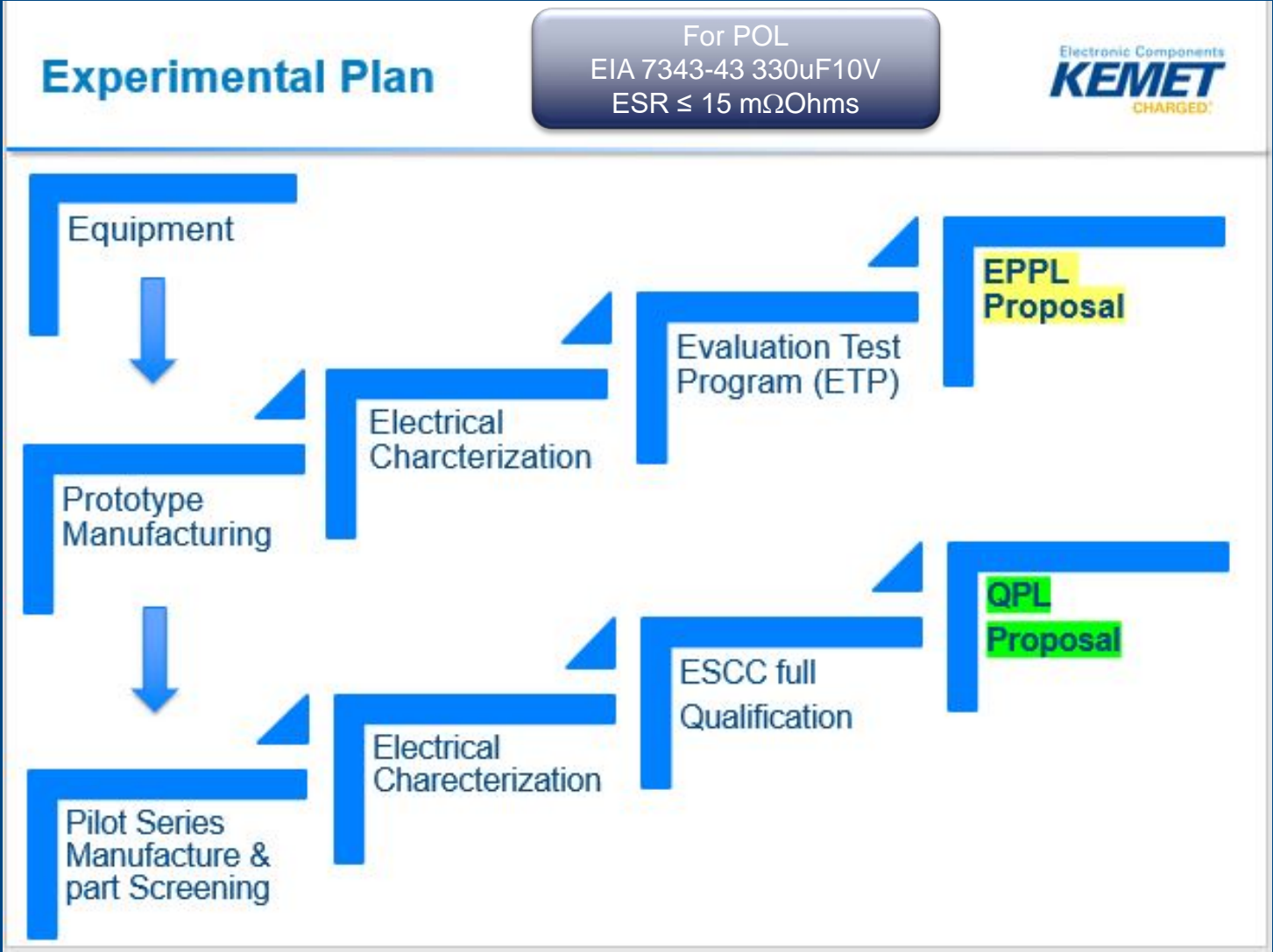
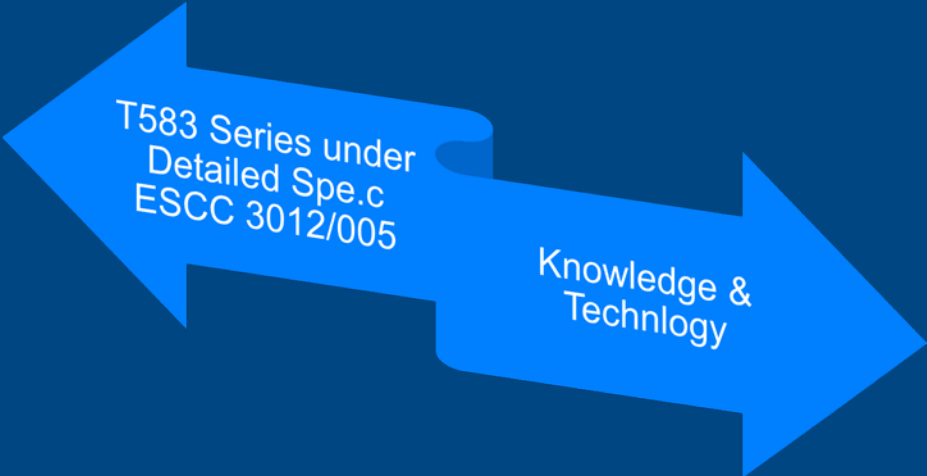
- The deepest capacitive element is the one that defines the worst or highest resistive connection to these elements and is the first element to stop responding at increasing frequencies, continuing to the outermost capacitive elements.



- Reduce Resistance
- Reduce the penetration depth by one third

T584 Series – Multianode

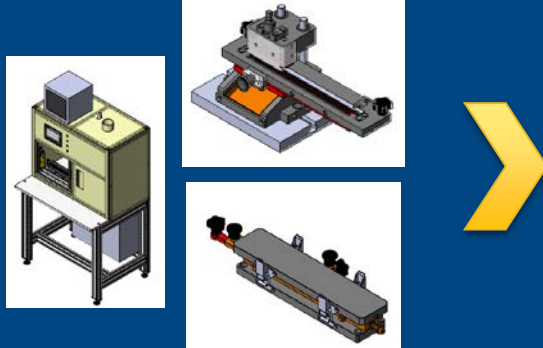
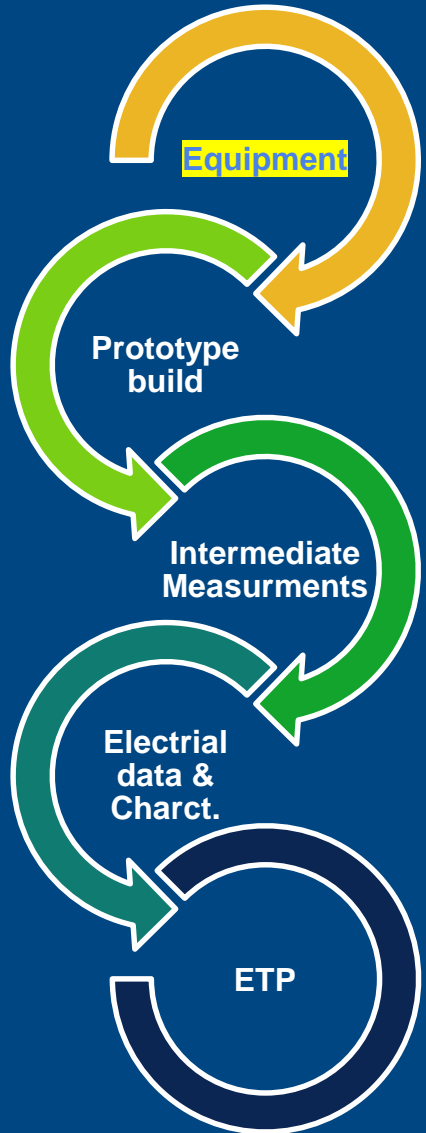
Experimental Plan Outline



T584 Series – Multianode

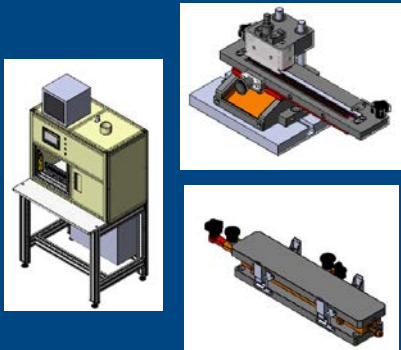
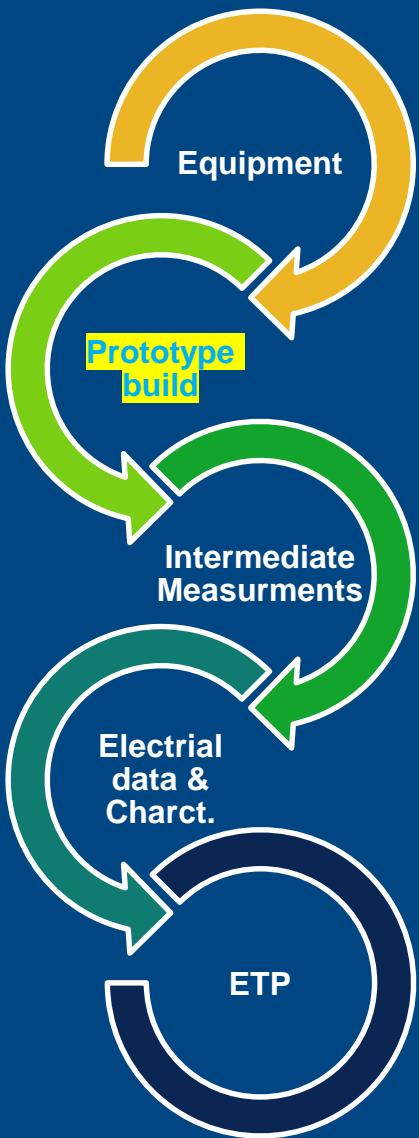
Prototype Build

KEMET
CHARGED.®



T584 Series – Multianode

Prototype Build

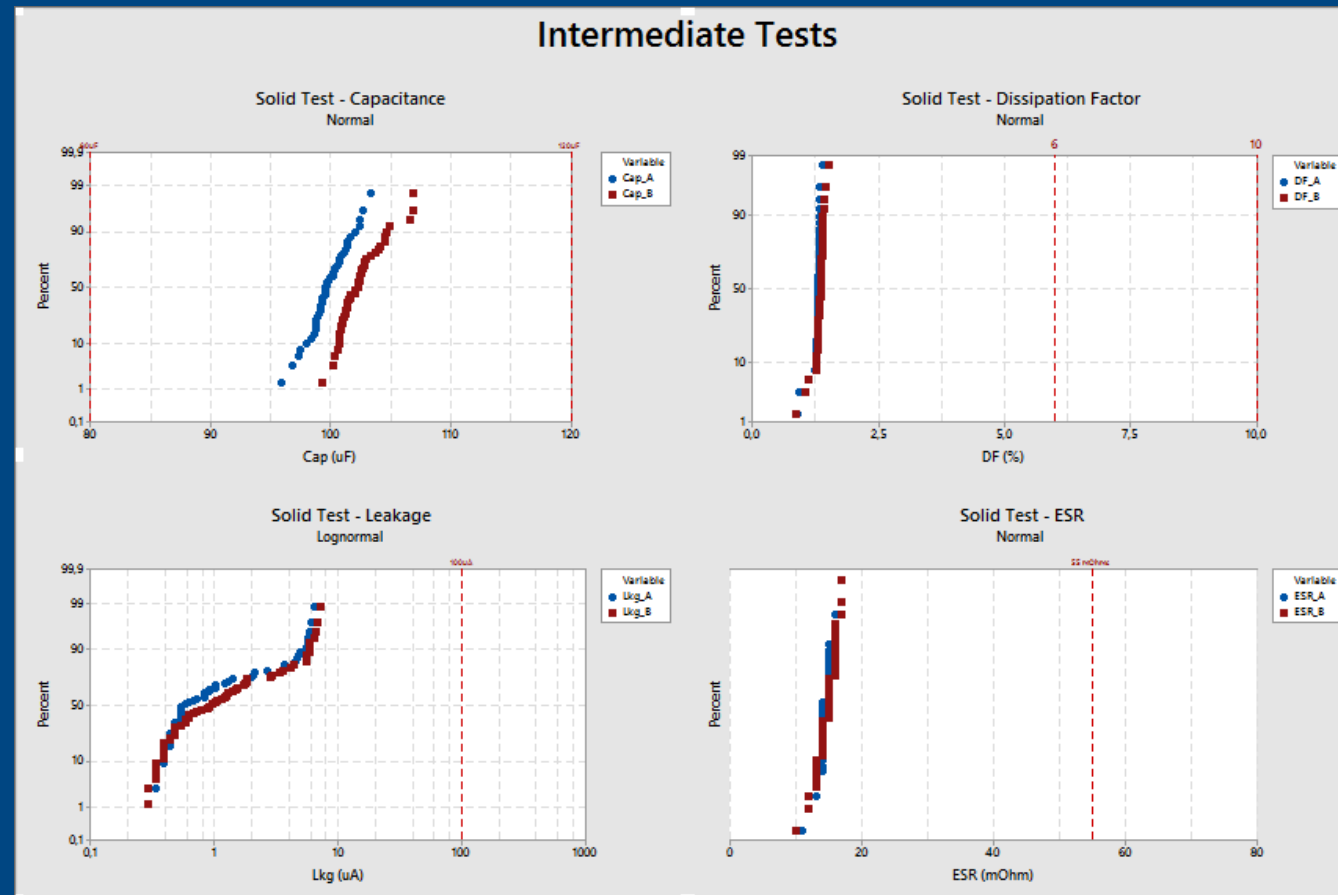
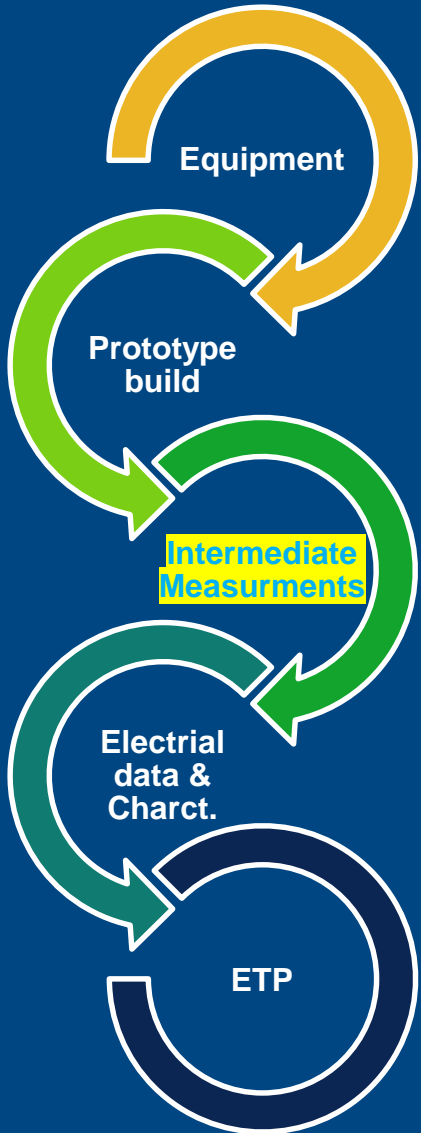


T584 Series – Multianode

Prototype Build

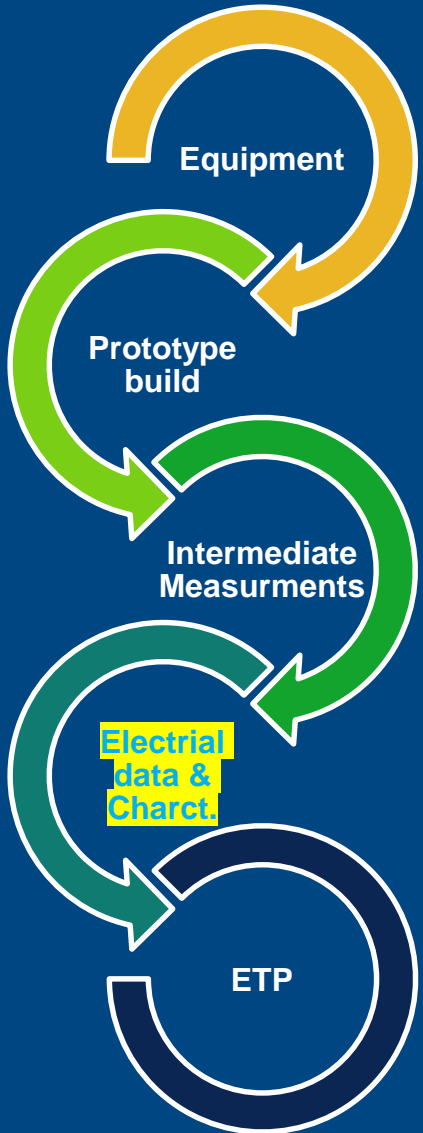
KEMET
CHARGED.®

- Indicator & first control of the parts electrical quality before Assembly:



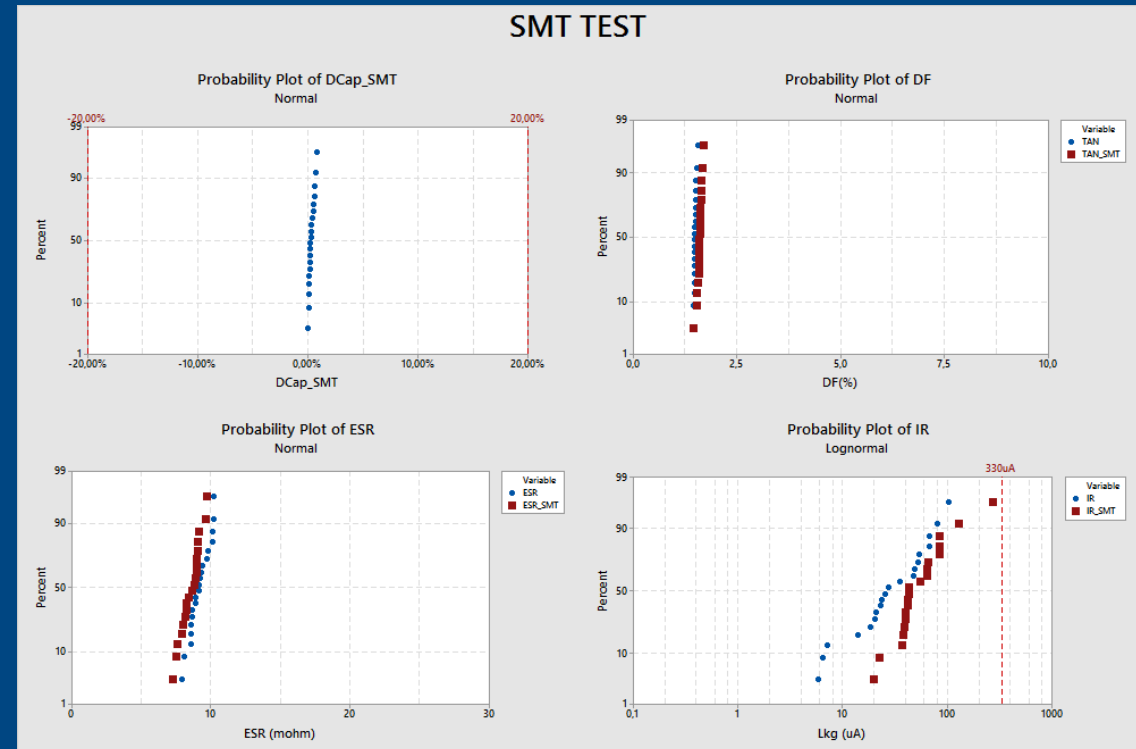
T584 Series – Multianode

Prototype Build



- 100% Electrical Screening:
- SMT –Surface Mount Test:
 - LCDR before and after assembled components on PCB.

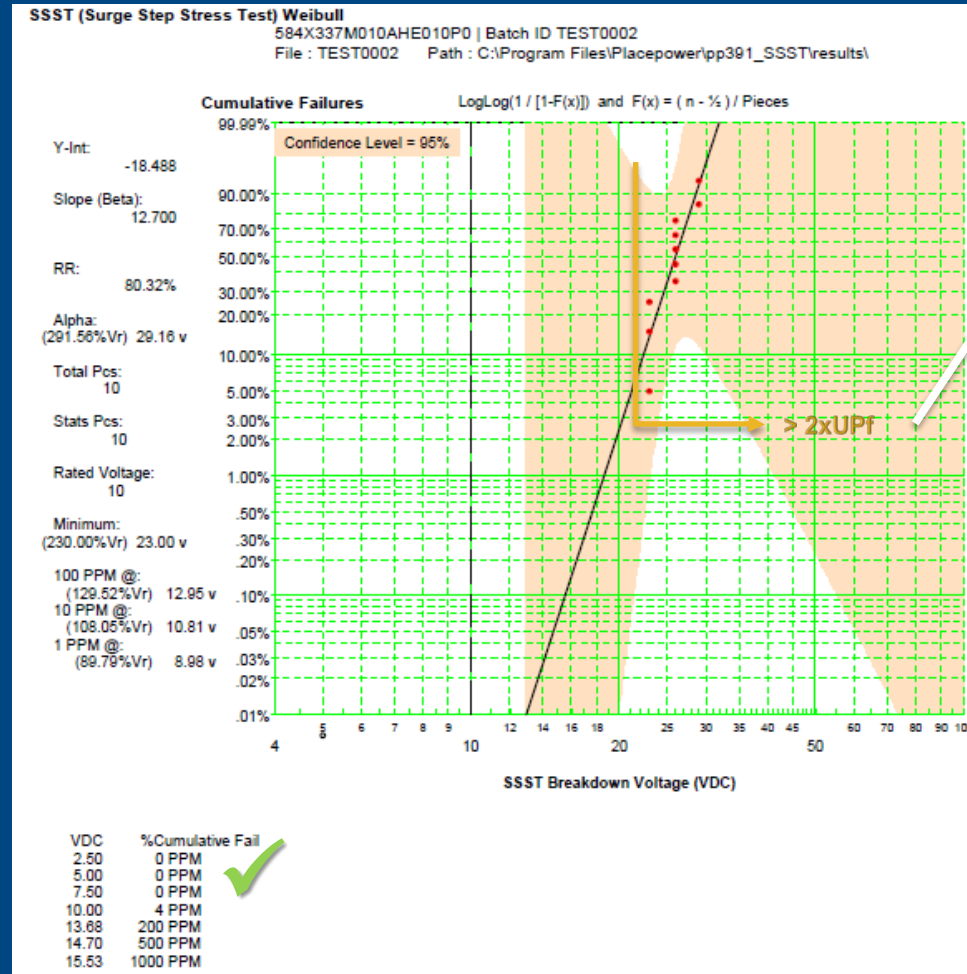
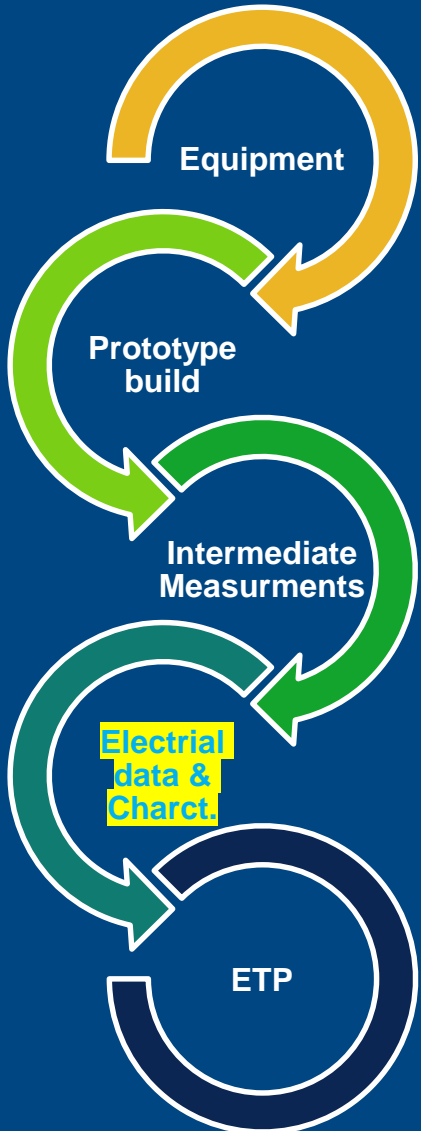
Electrical Performance	
Parameters	T584X337M010AHE010P000
KO Batch #	TEST0002
Lkg mean (μA)	45,25
Cap mean (μF)	300,36
DF mean (%)	1,54
ESR mean (Ω)	0,0079



T584 Series – Multianode

Prototype Build

- **SSST (Surge Step Stress Test):**



Consistent with
technology

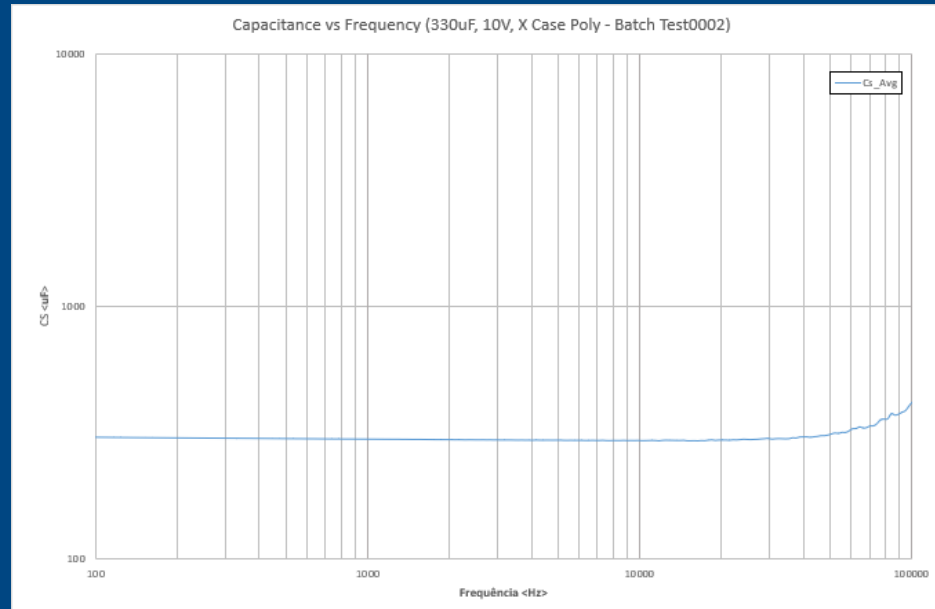
Low resistance, high current test that subjects the components to increasing voltages until failure. This is a destructive supplementary test that is a good indicator of dielectric stability.

T584 Series – Multianode

Prototype Build

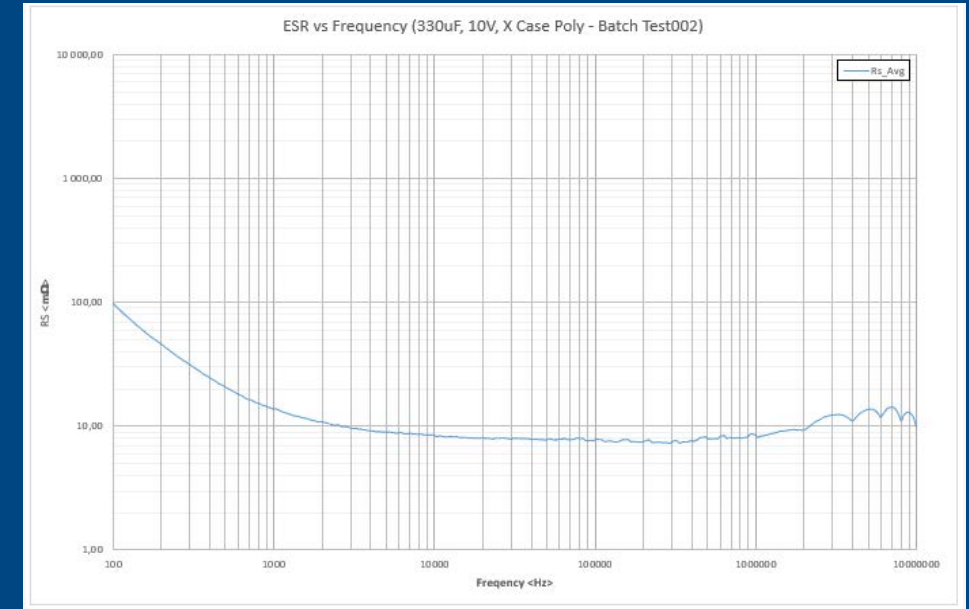
KEMET
CHARGED®

- Frequency Characterization:



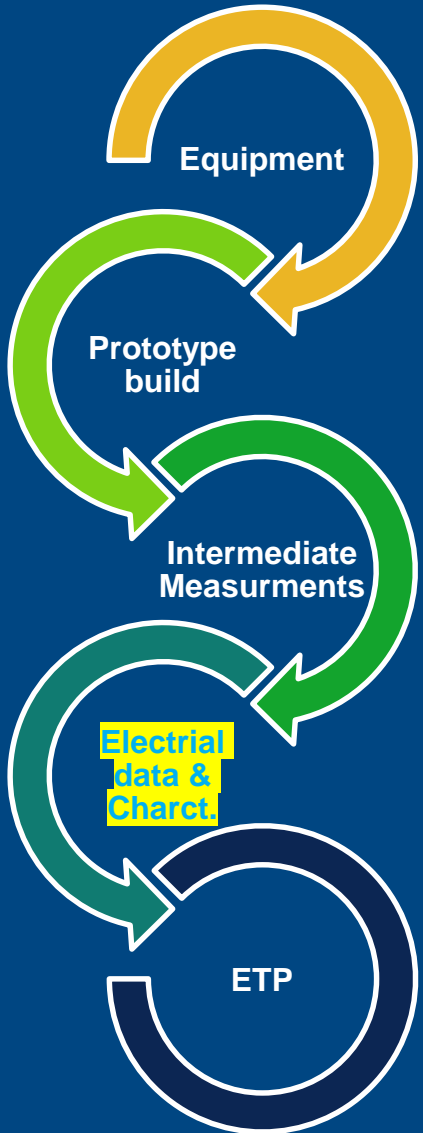
⇒ Typical polymer Ta Cap behavior of Capacitance in frequency

Result of the high conductivity of the organic polymer conductive coating, combined with the previously described advantages of a multianode construction



⇒ ESR decreasing up to 100KHz and remaining low and stable at higher frequencies

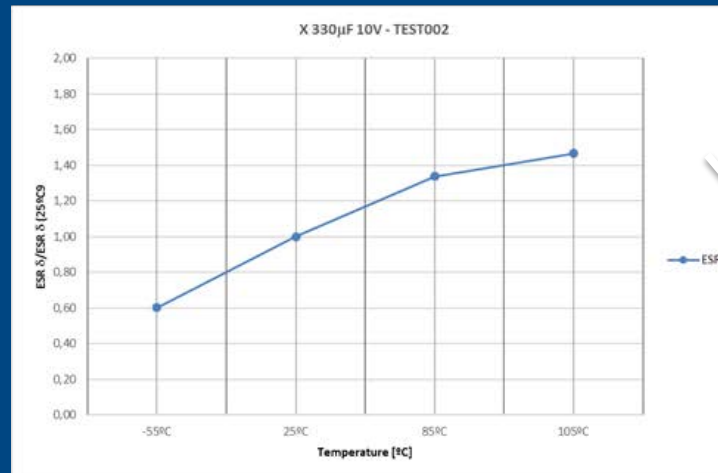
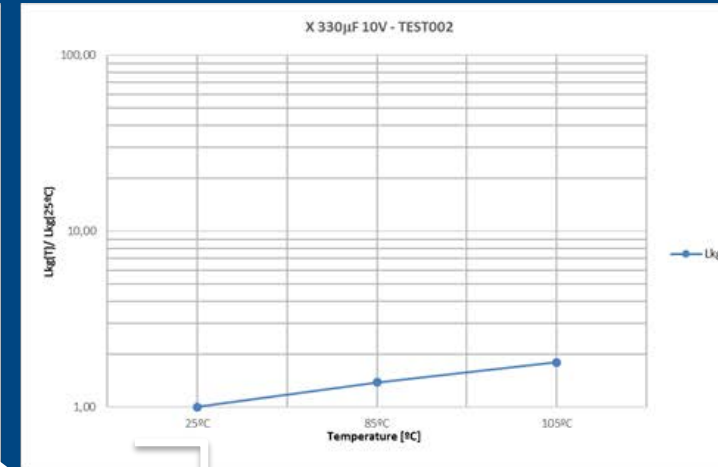
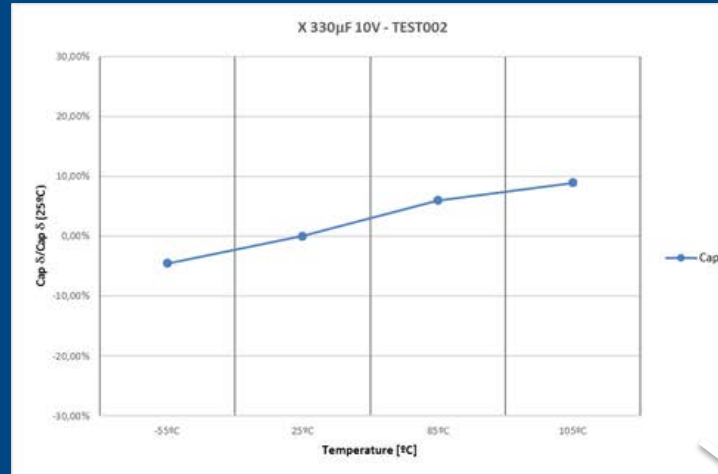
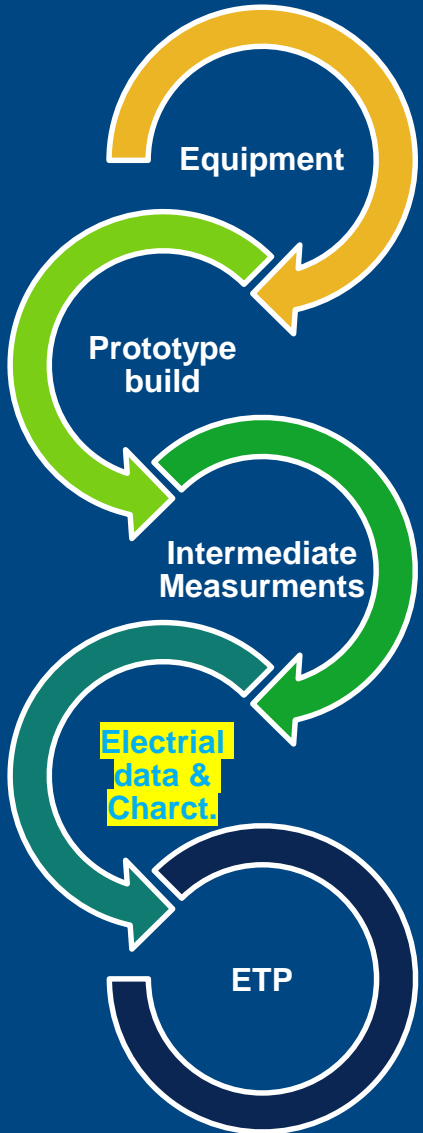
Results from the higher contribution of oxide losses to ESR at lower frequencies, which become smaller with increasing frequency.



T584 Series – Multianode

Prototype Build

- Temperature Characterization (-55°C to 105°C):



Consistent with
technology

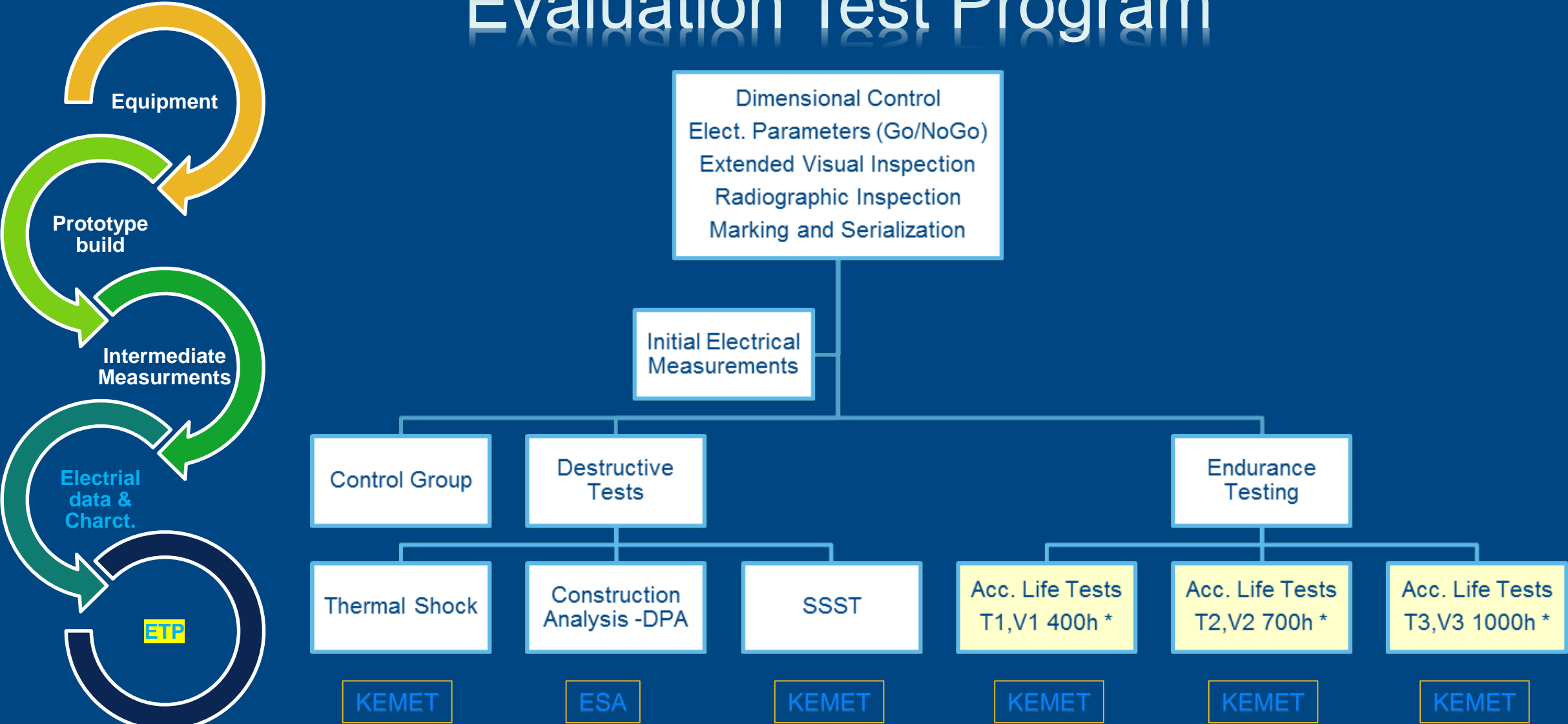
Slight ESR increase
⇒ Metal resistance
contributions

T584 Series – Multianode

Prototype Build - ETP



Evaluation Test Program

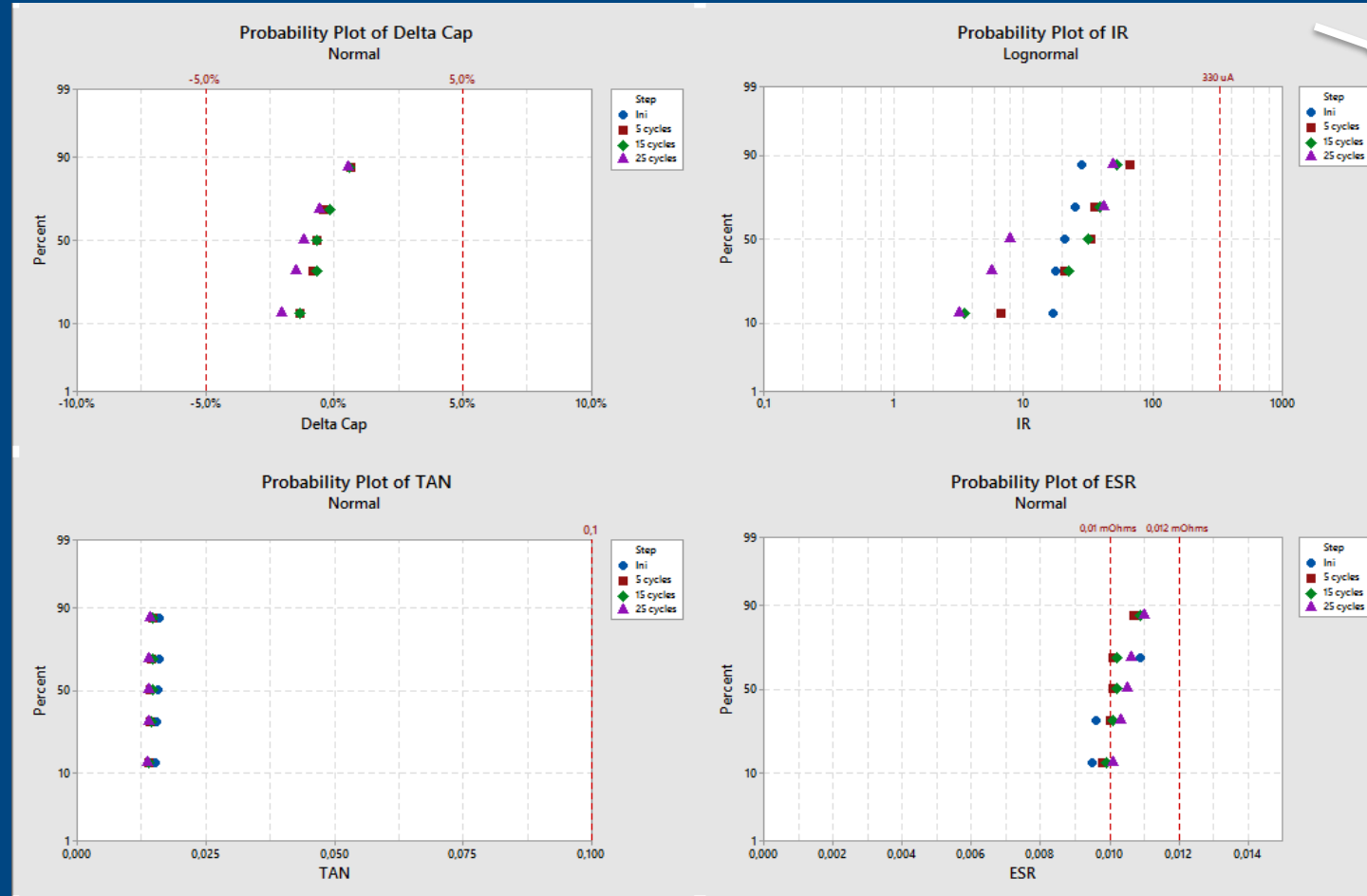
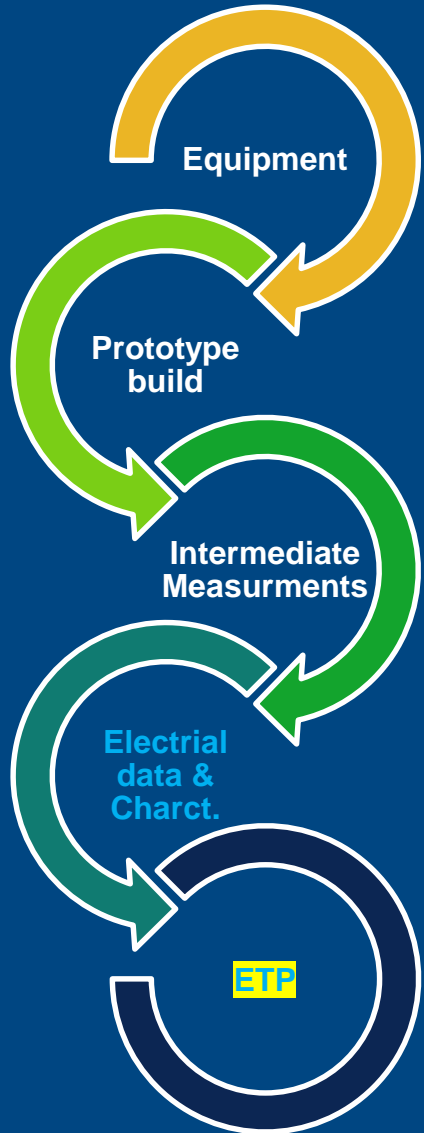


T584 Series – Multianode

Prototype Build - ETP



• Thermal Shock



No indication of issues in the device construction or materials.

T584 Series – Multianode

Prototype Build - ETP

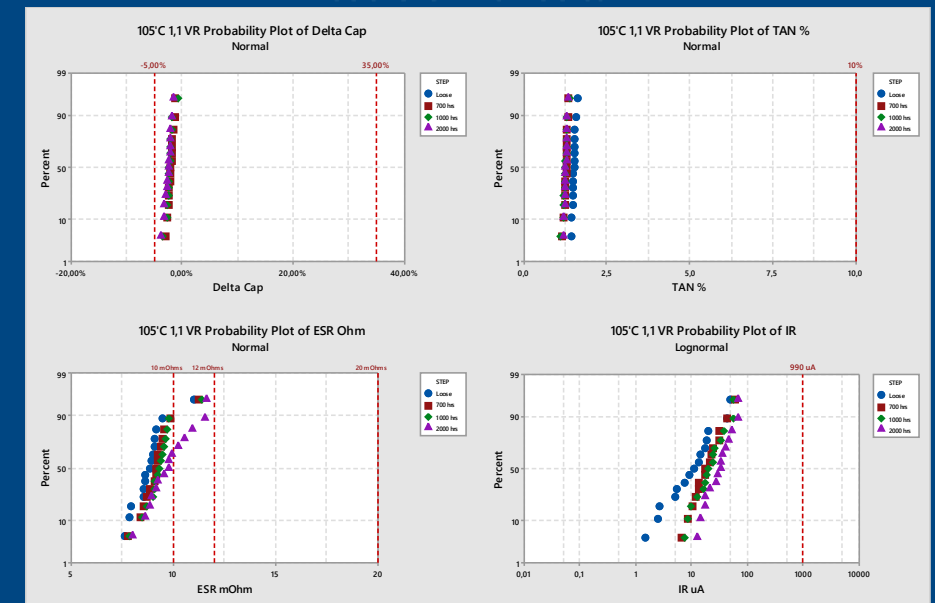
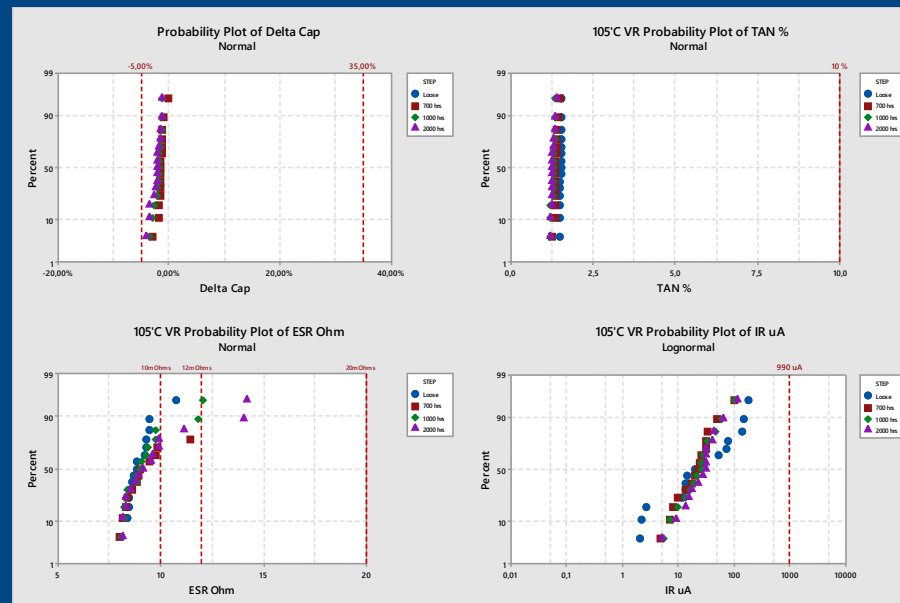
KEMET
CHARGED®

- **SSALT (Steady Steate Accelerated Life Tests):**
 - Same conditions as evaluated T583 single Anode

SSALT presented a good behaviour up to the estimated failure time.
Extended to 1000 & 2000 hrs.

105°C Ur

105°C 1.1Ur



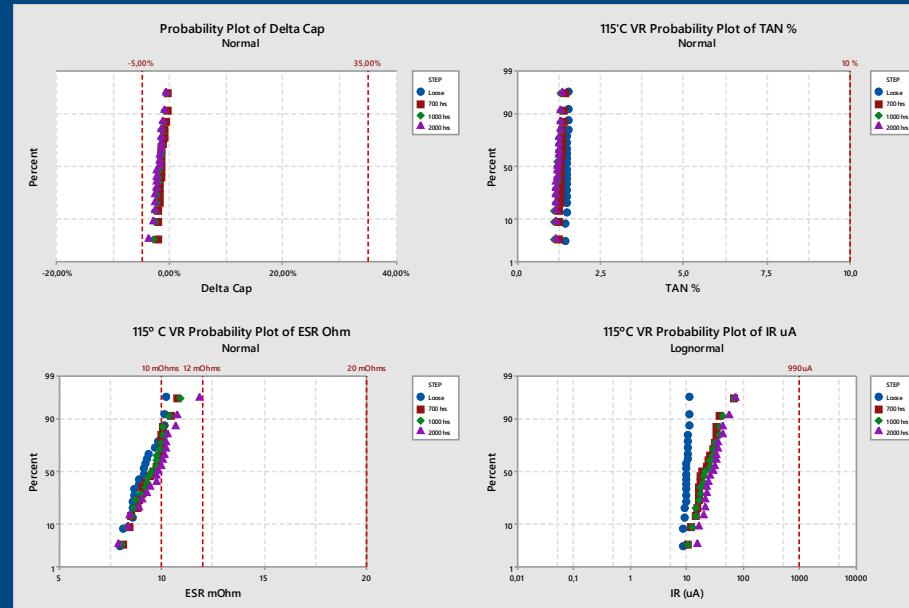
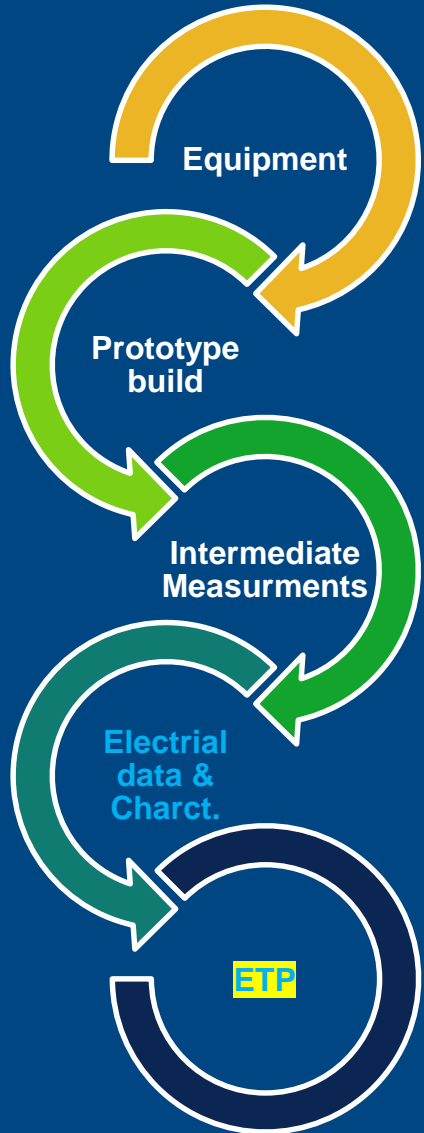
T584 Series – Multianode

Prototype Build - ETP

KEMET
CHARGED.®

- SSALT (cont.)

115°C Ur



T584 Series – Multianode

EPPL – PART 2 Application



- ESCC 3012/007 under approval/ T584 Series – product portfolio:

TABLE 1(a) – COMPONENT TYPE VARIANTS AND RANGE OF COMPONENTS

Variant Number	Case Code (Style) (Note 1)	Capacitance Values C_n (μF) (Note 2)	Rated Voltage U_R (V)	Maximum Equivalent Series Resistance ESR (mΩ)	Weight Max (g)
01	X (7343-43)	220	10	10, 12, 15	0.46
		330	6.3	10, 12	
			10	10, 12, 15	
		470	6.3	10, 12	

Space Series /ESCC Activities

Current Activities & Path Forward



KEMET
CHARGED®



T583 Series

- ESCC Detail Specification **3012/005** up to 16V
- Low voltage QPL Testing/ Submission for Q1'19
- Higher than 20V Voltage Portfolio extension / EPPL Submission Q2'19



T584 MAT Series

- ESCC Detail Specification for T584 series (**3012/007**) submitted – Sep.'18
- EPPL –part 2 application submitted - Sep.'18
- QPL Testing/ Submission – Q2'19



Future

- T583/T584 Product Portfolio extension acc. Customer needs.

Actual Offering

In Progress

Future



Mission critical electronics



High-performance
power management



Where failure is
not an option

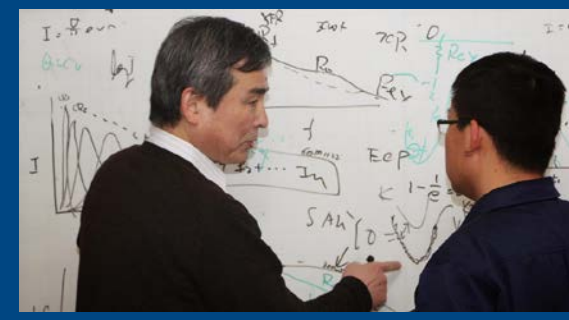
KEMET
CHARGED.®



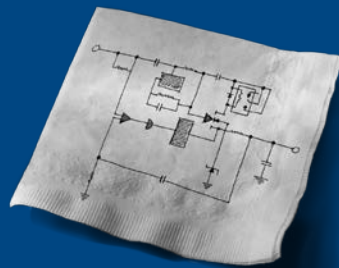
Breakthrough technology



Unparalleled borderless service



Smart people



Thank You!

Innovative products that solve customer
challenges