Capacitors Session #1

Date: March 2026

VISHAY

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Vishay's New Capacitor Business Segment

Capacitor Solutions for Every Application

Aluminum

Tantalum

Single Layer Ceramic

Film

Polymer

Multilayer Ceramic

ESTA Power Capacitors

Proven Tough

Industrial ➔ Automotive ➔ Military/Avionics ➔ Medical ➔ Space

BUILT TO WIN
VISHAY EVERYDAY

AMERICAS SALES CONFERENCE

Capacitor Session #1: Presenters

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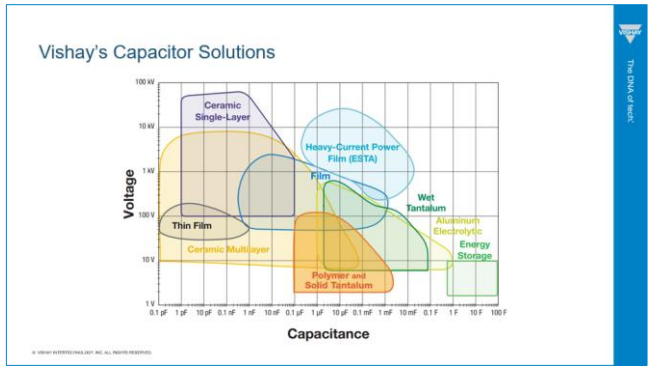
Capacitor Session #1: Agenda



Polymer

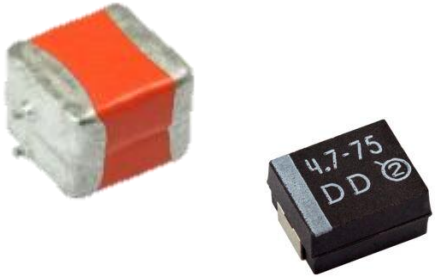
Low ESR
Low Voltage Derating
Benign Failure Mode

Voltage Range:
2.5V to 75V
Capacitance Range:
1µF to 2,800µF

Wet Tantalum

Highest Energy Density
Shock and Vibration
No wear out

Voltage Range:
10V to 125V
Capacitance Range:
1µF to 72,000µF



Solid Tantalum

Proven reliability
Low DCL
Small footprint

Voltage Range:
2V to 125V
Capacitance Range:
0.027µF to 2,200µF

Aluminum

High Performance
SMD
AEC-Q200

Voltage Range:
2.5V to 600V
Capacitance Range:
1µF to 60,000,000µF

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Tantalum Portfolio Overview, Focus Products

Broadest line of tantalum capacitors available in polymer, MnO_2 and wet ***tantalum technology with over 100 series***.

Molded Polymer

Molded MnO_2

Radial Dipped MnO_2

High Energy Wet

High Energy Wet

Microtan Polymer

Microtan MnO_2

Axial Molded MnO_2

Surface Mount Wet

Axial Wet

Hermetic Polymer

Conformal MnO_2

Hermetic MnO_2

Radial Molded MnO_2

SMD Axial Wet

Tantalum Focus Products

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Polymer

T51
Automotive Grade

T55
Industrial Grade

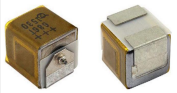
T52
High Energy & Low Profile

T54/DLA/MIL PRF
High-Rel COTS

Wet

HE5 & EP2
High Energy

T16, T18, STH & T34
Surface Mount



T22 & T24 DLA 20012
Supertan

MnO_2

597D, T97 & 13008
Conformal Multi-anode

TX3
E-Detonators

Polymer

Enabling next-generation of applications!

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Polymer Focus Products

Automotive Grade

- Development focus
- Automotive, Robotics and AMS
- Applications
  - ADAS & Infotainment
  - Humanoids
  - DC/DC converter

Industrial Grade

- Applications
  - AI Server
  - Computer
  - Data Center

High Energy & Low Profile

- Development focus
- Applications
  - Server/Storage
  - Data Center
  - SSD Memory

High-Rel COTS

- Applications
  - Aerospace & Defense
  - Computing

Automotive Grade

AEC-Q200 Qualified

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AUTOMOTIVE GRADE

Automotive Grade Polymer Capacitors

T51 Series

1

Ultra-Low ESR

Lowest ESR in the market, achieving down as 5mOhm

2

AEC-Q200 Qualified

Extended tests beyond AEC-Q200

Bias Humidity, Storage Test and Long Endurance Test

3

Benign Failure Mode

Low derating with non-combustion or ignition failure mode

Polymer is a different technology than Standard Tantalum capacitor

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AUTOMOTIVE GRADE

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Automotive Grade

Development Focus

	2.5V		4V		6.3V		10V		16V		20V		25V		35V		50V		63V		75V	
uF	V	K	V	K	V	K	V	K	V	K	V	K	V	K	V	K	V	K	V	K	V	K
1.5																		B				
2.2															B	B		B				
3.3															B	B		B				
4.7													B		B	B				D		D
6.8															D			D				
10											B	B	D		D	DV		DD		X		X
15											B	B	D			D				X		X
22					B	B	B	B			BD	B	D	D		D						X
33			B	B	B	BB	B	BB	D		D	D	D	D		DXX						
47			B	B	B	BB	B	B	D	D	VD	D	D	D		X						
68			B	B	B	B		V	D			D		X								
100	B	BBB	B	B B	B	B	D	DV	D	D		X		X								
150	B		BD	BD	D	BVD D	D	DV	D	D												
220	BVD	BV BVD	D	V	D	B BVD	D	D														
330	VD	VD	D	V	D	D		X														
470	D	DD	D	DD		X		X														
680	D	D	D			X																

105°C 125°C 150°C

Portfolio Targets

- X case:
  - Larger capacitance level on same voltage range
  - Automotive, AMS and Robotics
- >35V:
  - 48V systems for eV platforms
- 150°C
  - OBC, DC/DC and others where it is closer to power module

AUTOMOTIVE GRADE

Automotive Grade Polymer Capacitors

T51 Series

Where to hunt?

- Segments
  - Automotive
  - Robotics
  - AMS Markets
- Main Applications
  - ADAS & Infotainment
  - In-Car communication
  - Humanoids
  - Power Conversion
- Competitors
  - Kemet

How to engage customers?

- Do you require AEC-Q200 qualified part?
- Do you require multiple sources?

Vishay's Advantage

- Tested beyond AEC-Q200 requirements
- Lowest Single digit ESR available
- Production outside of China

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AUTOMOTIVE GRADE

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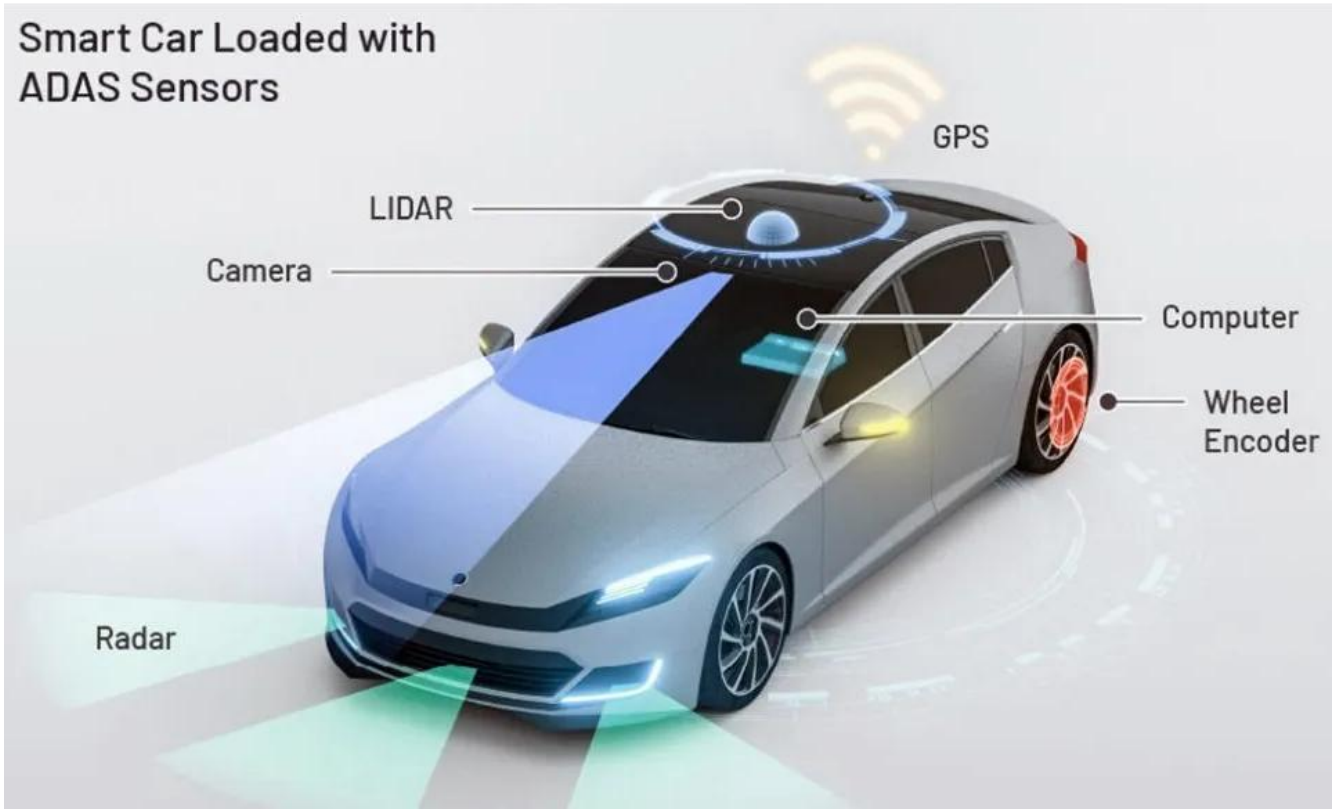
Automotive Typical Applications

ADAS & Infotainment



Content

- SoC:
  - Nvidia, Horizon Robotic, Qualcomm, Mobileye
- Platforms
  - Orin X or Y
  - Thor
- Polymer
  - Min 38 per board ($17 total)
  - Multiple boards per car

NVIDIA · Ford · gm · TESLA · Aurora · eyeris · RIVIAN · GENTEX CORPORATION · Qualcomm · Ambarella · Applied Intuition

AUTOMOTIVE GRADE

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Robotic New and Hot Application

Humanoids

Design in!!

- Requirements: AEC-Q200 parts
- PNs:
  - T51D337M6R3C0040
  - T51B686M6R3C0070
  - T51B107M6R3C0070
  - T51D476M016C0070
- Content
  - 24 parts per bot
  - >$5/bot
  - Forecasted >100Mbots in 2030

Industrial Grade

High Performance

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Industrial Grade Polymer Capacitors

T55 Series

1

Extended Portfolio

Capacitance values up to 1500µF, voltage from 2.5 to 63V and ESR as low as 5mOhm.

2

Stable Electrical Characteristics

Long lifetime, over temperature and voltage compared to other capacitors technology

3

High Performance

Ultra-low ESR

High ripple current capability

100% surge current tested

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Industrial Grade Polymer Capacitors

T55 Series

Where to hunt?

- Segment
  - Computing
  - Telecom
  - Industrial
- Main Applications
  - AI Servers
  - PC/Laptop/Tablets
  - PD3.1 chargers
  - Storage
  - 5G Network
  - Equipment test
- Competitors
  - Kemet, AVX, Panasonic

How to engage customers?

- Do you require board size or component profile reduction?
- Do you require high performance associated with long life?

Vishay's Advantage

- Single digit ESR (mOhm)
- Low derating
- No DC-Bias
- Stable electrical features & Long mission profile
- Production outside of China

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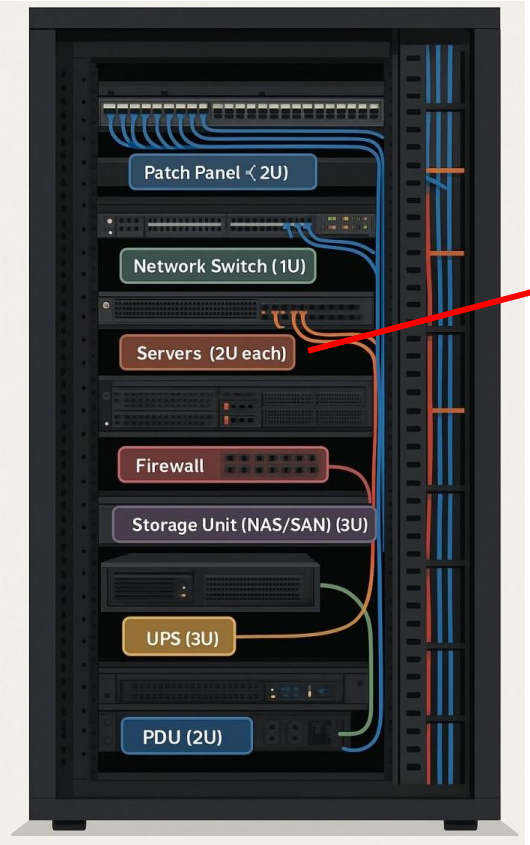
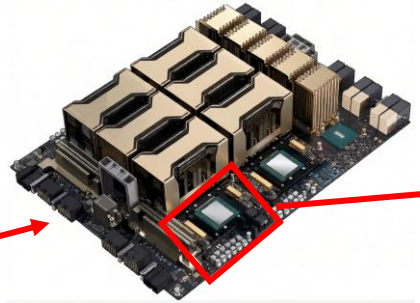
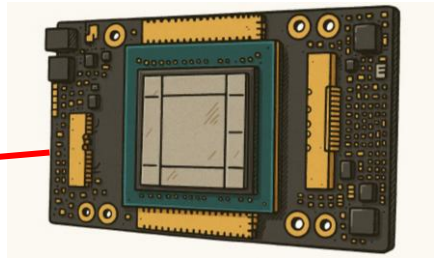
Industrial Grade Typical Applications

AI Server & Data Center







Base Board

T55D107M025C0040
(100uF 25V D Case)
T55V107M020C0055
T55D157M025C0040
T55X337M016C0025
T59EL337M016C0025

Acceleration Card / GPU

Low voltage ultra-low ESR options
T55D477M2R5C0006
T55D687M2R5C0006
T55D108M2R5C0006
T55X158M2R5C0005

Low profile options
T52B2156M025C0200
T52B2226M025C0200

NVIDIA
DELL
AMD
Google
intel
Meta
aws
IBM

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High Energy & Low Profile

Energy Efficiency!

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High Energy & Low-Profile Polymer Capacitors

T52 Series

1

Compact Volumetric Efficiency

Latest Polymer technology in the market achieving the highest energy density

2

Miniaturization

Z axis as low as 1.2mm, perfect for low profile applications and bottom boards assembly

3

High Reliability

Lower derating with non-combustion or ignition failure mode

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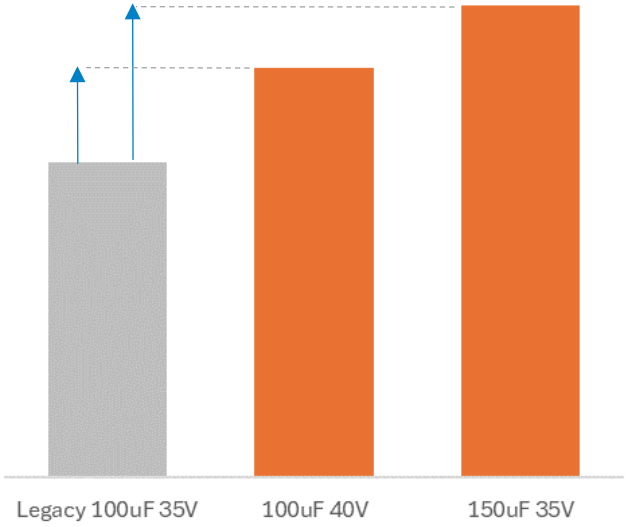
High Energy & Low-Profile

Development Focus

+30% and +50% vs Legacy ratings



M1 Case

Same package, More energy!!

$$E = \frac{CV^2}{2}$$

- **New Gen/Ratings**
- T52M1107M040C0100
- T52M1157M035C0100
- T52E5686M035C0100

- **Legacy Gen/Ratings**
- T52M1107M035C0070
- T52E5478M035C0070
- T52M1227M025C0055

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High Energy & Low-Profile Polymer Capacitors

T52 Series

Where to hunt?

- Segment
  - Computing
  - Telecom
  - Consumer
- Main Applications
  - Data Storage
  - Bulk energy HHD&SSD
  - AI Servers
  - Chargers
- Competitors
  - Kemet, AVX

How to engage customers?

- Does your application require low profile component?
- Do you require high energy & performance associated with long life?

Vishay's Advantage

- High Energy density/Low Profile
- Low & Stable DC Leakage through time
- Stable Capacitance & ESR from -55 to 105°C
- Production outside of China

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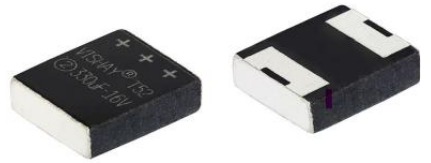
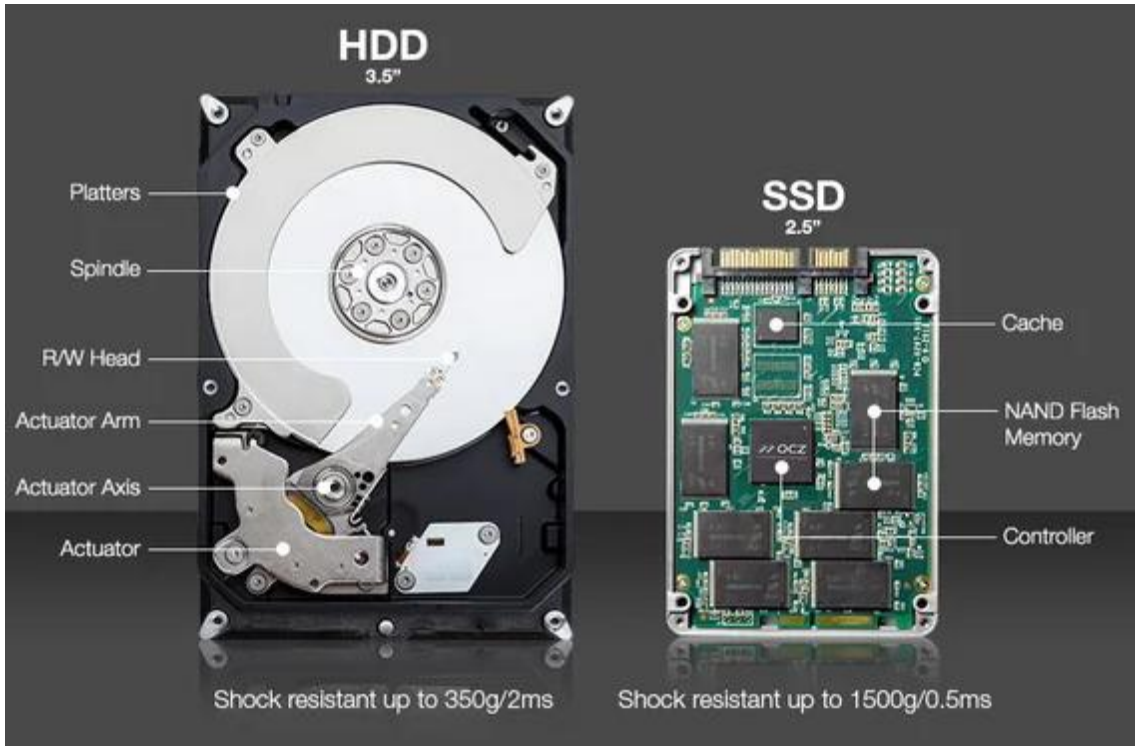


High Energy & Low-Profile Typical Applications

SSD Memory



SSD

New Gen/Ratings
T52M1107M040C0100
T52M1157M035C0100
T52E5686M035C0100

Legacy Gen/Ratings
T52M1107M035C0070
T52E5478M035C0070
T52M1227M025C0055

SanDisk
msi
Kingston TECHNOLOGY
SEAGATE
WD Western Digital
Micron
IBM

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High-Rel COTS Polymer Capacitors

Avionics & Defense

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High-Rel COTS Polymer Capacitors

T54

DLA04051

MIL PRF 32700

1

High Energy Density

Capacitance values up to 2800µF, voltage from 16 to 75V on multiple sizes and stack combinations

2

High Level Qualification

Under strict control of MIL-PRF-32700 and Defense Logistics Agency (DLA) approval

3

Robust Design

High Shock & Vibration Performance

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High-Rel COTS Capacitors

T54, DLA04051, MIL PRF 32700 series

T54

- High Vibration & Shock performance
- High reliability level and Screening available
- Multiple options from single to 2x6 pieces in stacks.

DLA 04051

- High Vibration & Shock performance
- 100% surge current tested (3 options)
- Volumetric efficiency

MIL-PRF-32700

- High Vibration & Shock performance
- Bias Humidity 85°C/85%RH 500h
- **Under DLA approval**

High-Rel COTS Capacitors

T54, DLA04051, MIL PRF 32700 series

Where to hunt?

- Segment
  - Aerospace
  - Defense
  - Computing
- Main Applications
  - Radar
  - Missile systems
  - Satellites
  - Cabin Equipment & Systems
- Competitors
  - Kemet, AVX

How to engage customers?

- Does your application require high voltage and capacitance on single piece capacitor?
- Do you require special screening?

Vishay's Advantage

- Statistical DC Leakage screening at elevated temperature and voltage available
- High energy density and volumetric efficiency
- Production in Israel – Out of China

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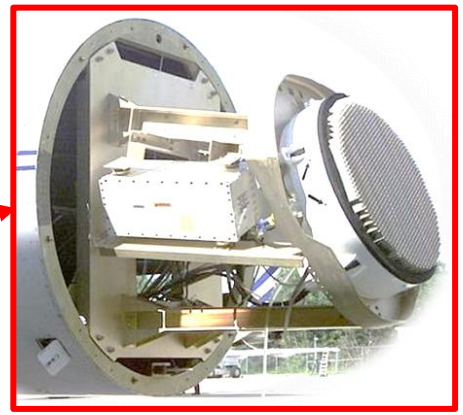
High-Rel COTS Typical Applications

Radar



Antenna

T54 Stacks (space saving):

EE/EL
E2/2E
E3/3E
E4/4E
E6/6E

BOEING
NORTHROP GRUMMAN
Relativity
MDA SPACE
qorvo
L3HARRIS™
Raytheon Technologies
Honeywell
LOCKHEED MARTIN

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Wet tantalum

Best in class volumetric efficiency!

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Wet Tantalum Focus Products

High Energy

- Development focus
- Industrial and automotive
- Applications

Surface Mount

- Applications
  - Power conversion
  - Space Grade

Supertan

- Robust Shock & Vibration
- High Temperature Series for Oil & Gas
- Applications
  - Power suppliers
  - Air purification
  - DC/DC converter

High Energy

Highest energy in smallest package!

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High Energy tantalum capacitors

HE5 & EP2 Series

1

Highest Energy Density

Highest capacitance in the smallest volume! up to 2 Joules per cc.

2

Largest Capacitance

Capacitance values up to 96,000µF.

3

Robust Design

Vibration up to 50G Shock,20G sine, 19.4G Random.

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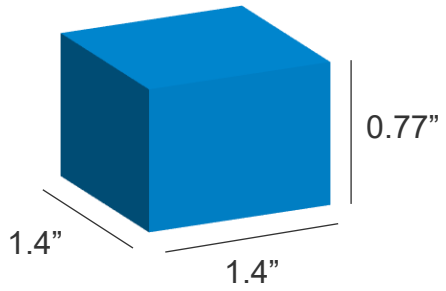
Energy Dense & High Capacitance

Comparison to aluminum competitor, 25V

96mF

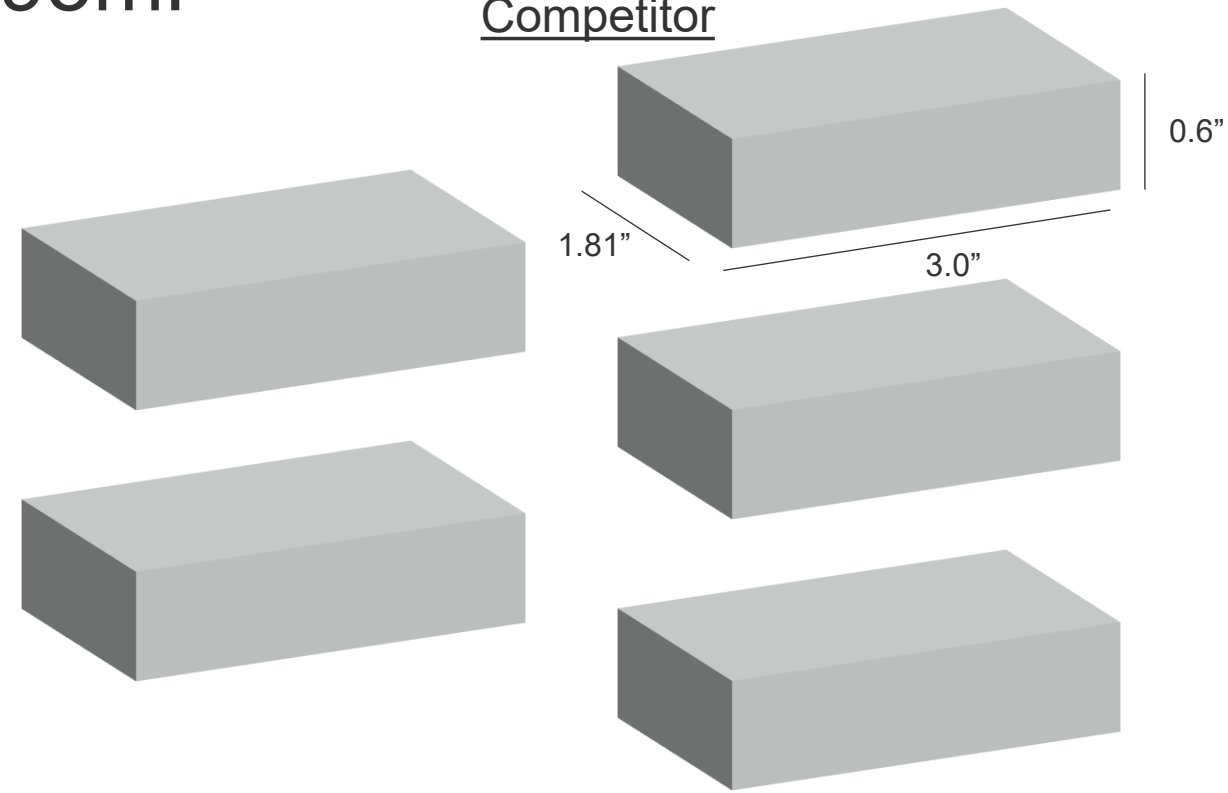
EP2 Series
Vishay



1.5 in^3

95mF

Aluminum
Competitor



16.3 in^3

High Energy Capacitors

HE5 & EP2 Series

Where to hunt?

- Industrial, Aerospace, Defense & Space Markets
- Radar, Missile Systems, Power Conversion, Pulsed Power (Laser)
- Competitors
  - Evans

How to engage customers?

- Do you need higher capacitance in a smaller volume?

Vishay's Advantage

The highest energy density available!

Application: Defense Systems

EP2

HE5

Customers

Ducommun

Sure Power

Raytheon

Kimball

DRS

CAES

Lockheed Martin

L3

Collins

Missile Systems

Radar Systems

Supertan

Ruggedized for harsh applications.

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Rugged Supertan capacitors

T16, T18, STH & T34[2] Series

1

Ruggedized Design

500G shock / 80G Vibration – Sine
50G Vibration - Random

2

Reverse Bias Voltage[1]

Up to 3.0V reverse bias capable.

3

High Temperature[2]

Up to **200°C** maximum temperature.

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SuperTan® Series

Wet tantalum capacitors – highest capacitance

T16 / T18

- Reverse Bias Voltage
- Random Vibration
- Vibration (sinusoidal)
- Shock (impact)

STH

- Random Vibration
- Vibration (sinusoidal)
- Shock (impact)

T34

- Max Temperature +200°C
- Random Vibration
- Vibration (sinusoidal)
- Shock (impact)

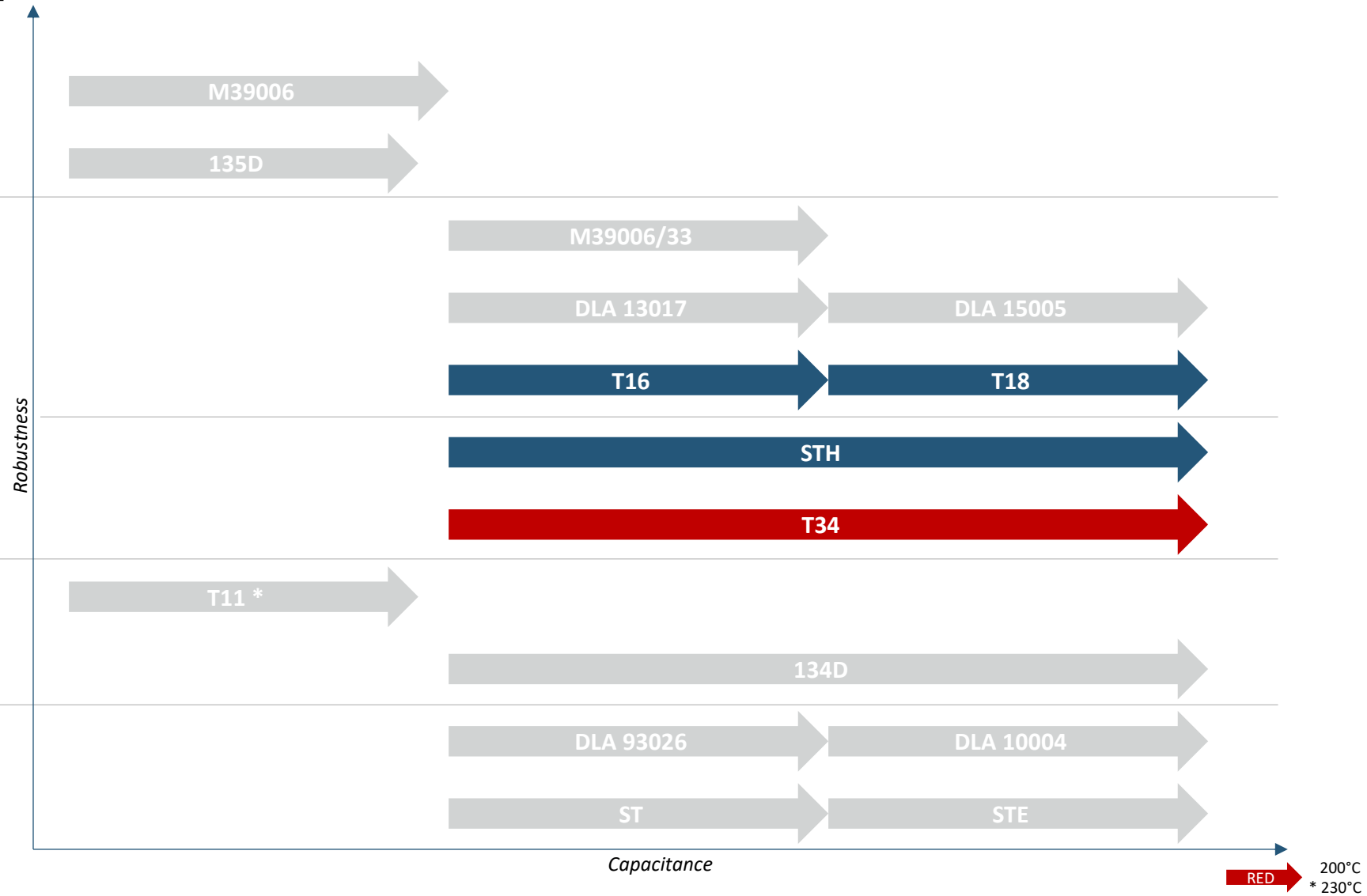
Through hole to Surface mount option

Inward
L-leads

Outward
L-leads

Wet tantalum axial products same shape but vary in robustness and design.

Shock	Vibration	Random	Reverse Bias Voltage
500g	80g	54g	3V
500g	80g	54g	1.5V - 3V
500g	80g	54g	-
100g	20g	-	-
100g	20g	-	-



SuperTan Capacitors

T16, T18 & STH Series

T34 High Temperature

Where to hunt?

- Aerospace, Defense & Space Markets
- High Temperature – Oil & Gas Markets
- Radar, Missile Systems, Power Conversion
- Competitors
  - AVX & Evans

How to engage customers?

- Do you need higher capacitance values?
- Do you have challenging shock and vibration requirements?
- Application above 125°C?

Vishay's Advantage

Best shock and vibration performance!

Longest history of high temperature products!

Applications for Supertan

T16 / T18 / STH / T34

Customers

Space

Ball Aerospace

Lockheed Martin

BAE

Raytheon

MDA

Boeing

Oil Drilling

Halliburton

Schlumberger

Baker Hughes

Satellite Systems

Oil Drilling Systems

Surface Mount Wet Tantalum

Optimized design

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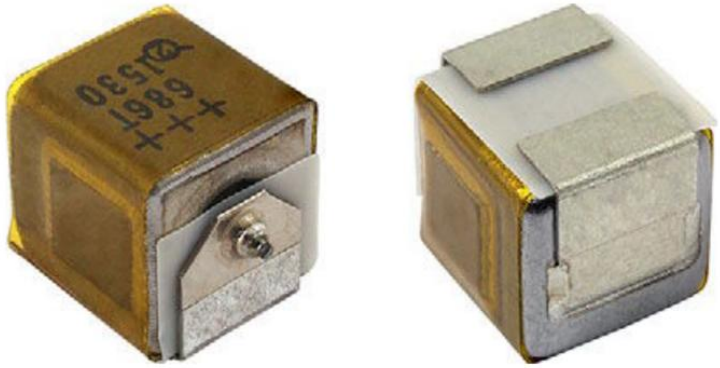

SMD Designed wet tantalum capacitors

T22 & T24 Series

20012 Space Grade

1

Ruggedized Design

500G shock / 80G Vibration – Sine
27.8G Vibration - Random

2

Space Grade

NASA recommended DLA 20012

3

High Temperature(1)

Up to **200°C** maximum temperature.

(1) T24 series only

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SMD designed wet tantalum capacitors

T22 & T24 Series

Where to hunt?

- Aerospace, Defense, Space & Oil and Gas Markets
- Radar, Missile Systems, Power Conversion
- Competitors
  - Exxelia (tabs)

How to engage customers?

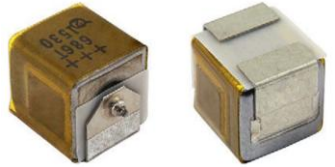
- Are you trying to eliminate through hole components?

Vishay's Advantage

Volumetric efficiency better than competitors!

Voltage ratings up to 125V!

Applications for SMD wet tantalum



T22 / T24

Customers

Satellite

Ball Aerospace

Lockheed Martin

BAE

Raytheon

MDA

Boeing

Train Signaling

Schneider Electric

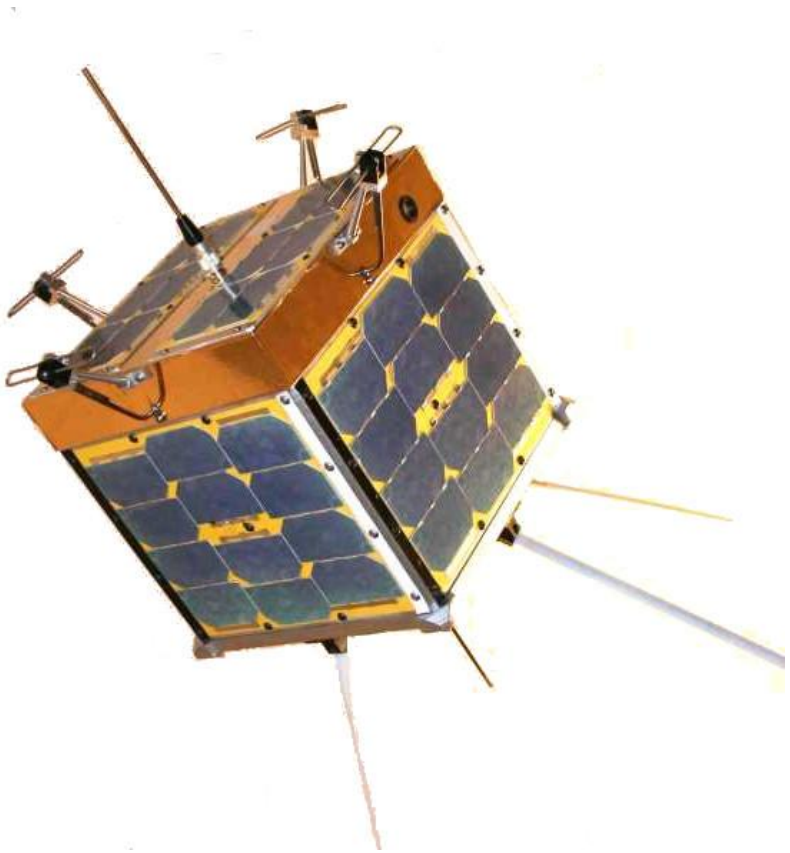
GE Transportation

ABB

Siemens Mobility

Train Signaling

Satellite Systems



MnO_2 Solid Tantalum

Stable, Reliable, long lifetime capacitors!

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MnO_2 Solid Tantalum Focus Products

Conformal Multi-anode

- Highest Energy
- Lower ESR
- High Reliability

TX3 Series

- Designed for Electronic Detonation Systems

Multi-anode conformal coated tantalum capacitors

Highest capacitance & voltage ratings!

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Multi-anode conformal coated tantalum capacitors

597D, T97 & 13008 Series

1

Highest Capacitance

Leading the industry with the highest capacitance in a rated voltage for SMD solid tantalum capacitors.

2

Lower ESR

Approximately 1/3 the ESR of standard molded tantalum capacitors.

3

High reliability

Reliability and testing available including failure rate levels, surge current testing, 3-sigma DCL, 100% reflow options and others.

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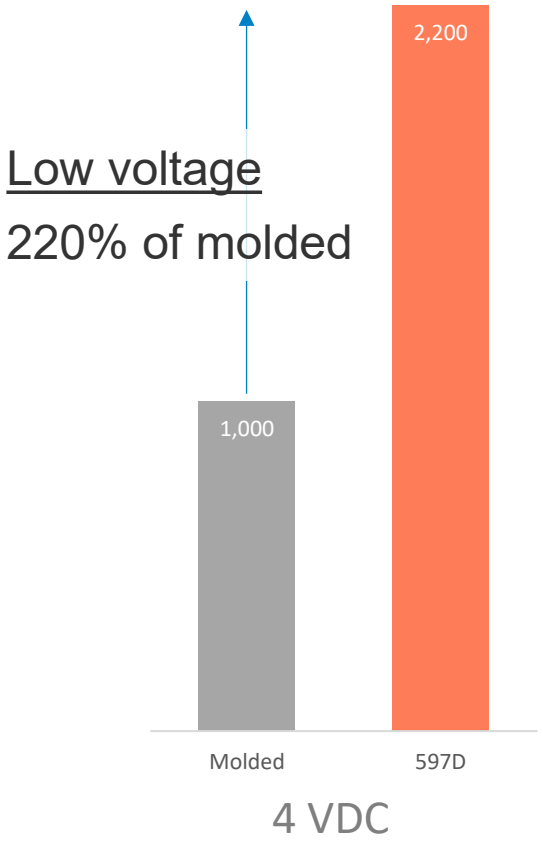
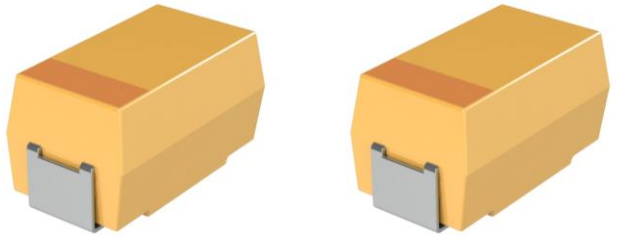
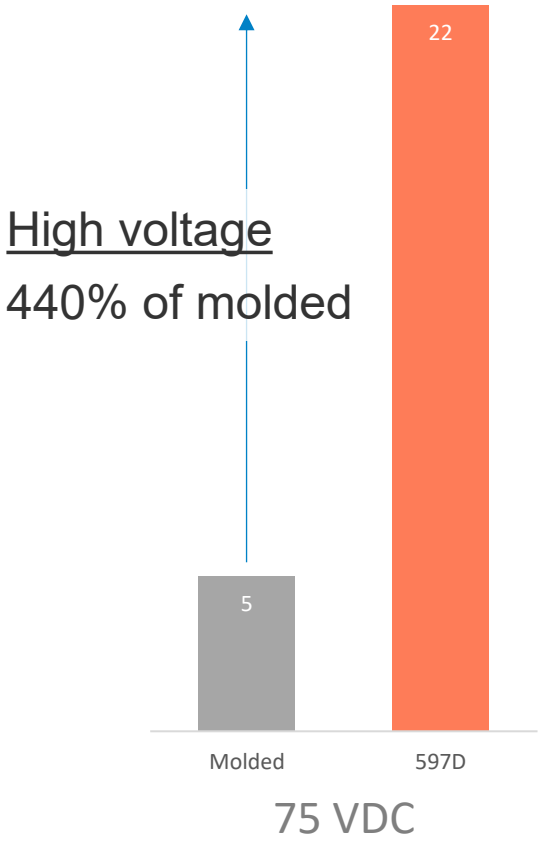
Highest capacitance for MnO_2 SMD tantalum capacitors!

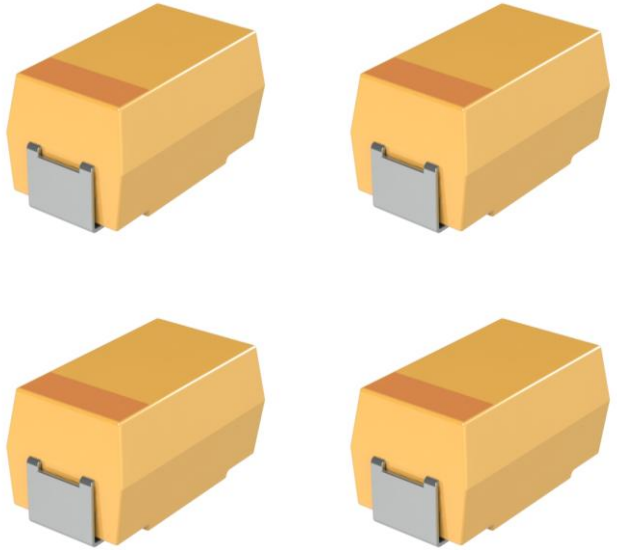




Higher capacitance in a single capacitor reduces the number of components on the board, decreases overall PCB footprint and lowers weight.

Highest capacitance for MnO_2 SMD tantalum capacitors!

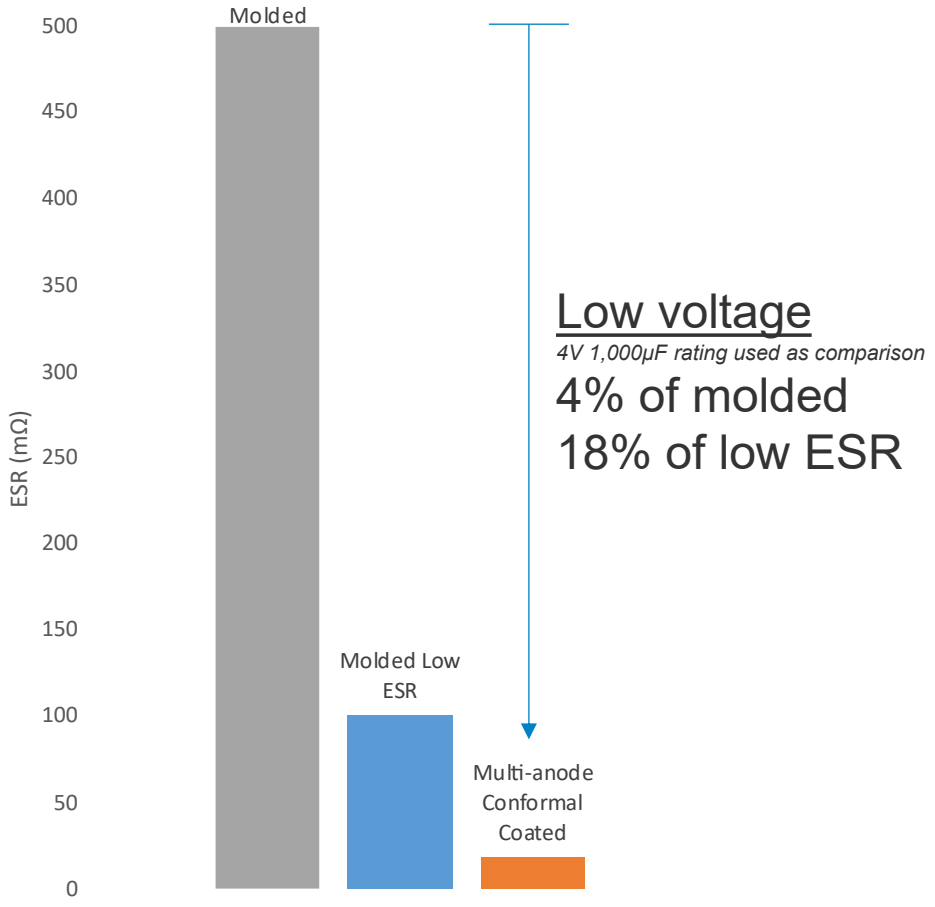




Higher capacitance in a single capacitor reduces the number of components on the board, decreases overall PCB footprint and lowers weight.

Lower ESR than traditional molded designs

Low ESR can improve circuit power efficiency, reduce heat generation for the circuit, and increase long-term reliability



Comment: Comparison is based on Vishay Molded - 293D / Low ESR Molded – TR3 / multi-anode ccc - 597D series

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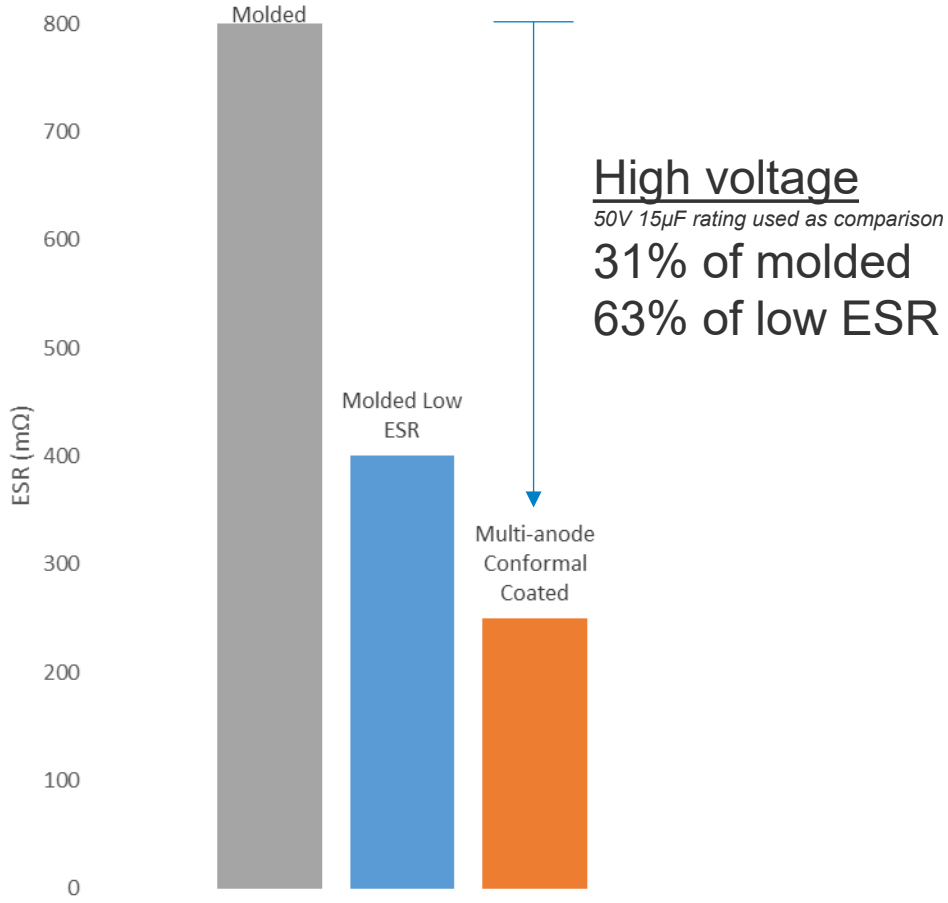


High voltage

50V 15µF rating used as comparison

31% of molded

63% of low ESR

Comment: Comparison is based on Vishay Molded - 293D / Low ESR Molded – TR3 / multi-anode ccc - 597D series

HI REL COTS are more robust capacitors due to additional tests and screening

597D Commercial	VS	**T97** HI REL COTS
-	**Reliability Levels** 100%	**Yes**
Limited	**Surge Current test** 100%	**Yes**
-	**Electrical test - 2** 100% (CAP,DF,DCL,ESR)	**Yes** **with 3sigma DCL limit**
Sample	**QC Final Inspection** (Reflow test)	**100%**

Multi-anode conformal coated tantalum capacitors

597D, T97 & 14002 Series

Where to hunt?

- Industrial
  - Semiconductor testing equipment
- Avionics, Military & Space
  - Power conversion
  - Radar Systems
- Competitors
  - AVX

How to engage customers?

- Do you need higher capacitance in a smaller footprint?
- Do you need high reliability testing or screening?

Vishay's Advantage

Vishay has leading edge SMD capacitance and voltage ratings!

Commercial or Military Aircraft

597D / T97

Customers

Ducommun

Sure Power

Plexus

Kimball

DRS

CAES

Lockheed Martin

L3

Collins

TX3 Series Solid Tantalum

SMD Capacitor for Electric Detonator Applications

VISHAY

The DNA of tech.®

TX3 X-Factor for e-Detonation

TANTAMOUNT, Molded Case
Low DCL min to 1.25µA
Enhanced performance for e-Detonator applications

1

Low DC Leakage

Half of standard tantalum capacitor series at 0.005 CV.

Tantalum's high energy density makes this the best choice for electronic detonation systems, providing more energy to ensure proper ignition.

2

100% Tested

Tested to more stringent requirements to ensure reliability.

Best in class screening technology substantially reduces eliminates lot-to-lot variation.

3

Mechanically Robust

Unlike other capacitor technologies, the TX3's low profile, metal lead-frame and molded composite construction offers a robust mechanical solution for high shock and vibration environments

VISHAY

The DNA of tech.®

TX Series comparison to standard commercial series

Characteristic / Process	TX3 E-Detonator Series	293D Commercial Series
Tantalum Powder	Highest-grade	Standard grade
Dielectric Formation Process	Shell formation whenever possible	Industry standard formation
Pyrolysis (MnO_2 solid electrolyte deposition)	Advanced proprietary process	Standard process
Silver Check	100% of lots are tested	Sampling approach (24 pcs/lot)
Assembly	Enhanced screening is used to ensure zero defects post final assembly	Standard assembly procedure
Surge Current Test	100% at 1.1 x V_R (minimum)	Surge testing is only done on certain case sizes
Final Test	Final test: Two screenings are conducted for all part numbers	Single screening
DCL Limit	Max 0.005*Cap*Voltage, 2nd test with 3 Sigma limit	Max 0.01*Cap*Voltage (fixed)

Tantalum Capacitor for Electric Detonator Applications

TX3 Series

Where to hunt?

- Detonation systems
  - Mining Equipment
  - Demolition equipment
  - Military Application
- Competitors
  - AVX & Kemet

How to engage customers?

- Does your application require low DCL to maximize battery power (remote / wireless)?

Vishay's Advantage

- Enhanced performance for electronic detonators
- More stringent testing specifications on key electrical characteristics
- High CV (Volumetric Efficiency) reduces number of capacitors required and decreases footprint on PCB

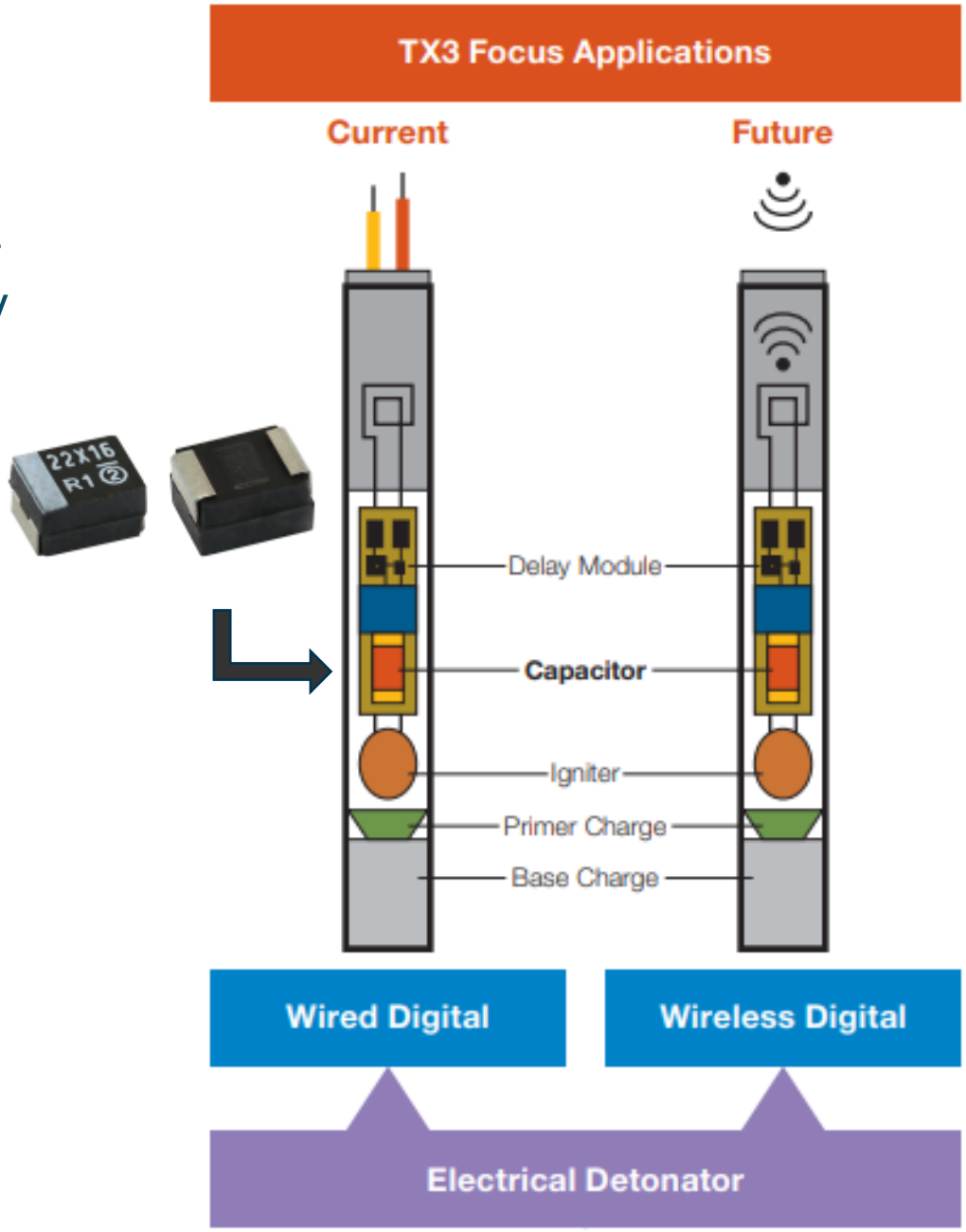
Primary Application

TX3's Advantage over other capacitive technologies:

Low DC Leakage and tantalum's high energy density makes it the best choice for electronic detonation systems, providing more energy to ensure proper ignition.

Capacitor functions as *energy storage / buffering* for detonation systems.

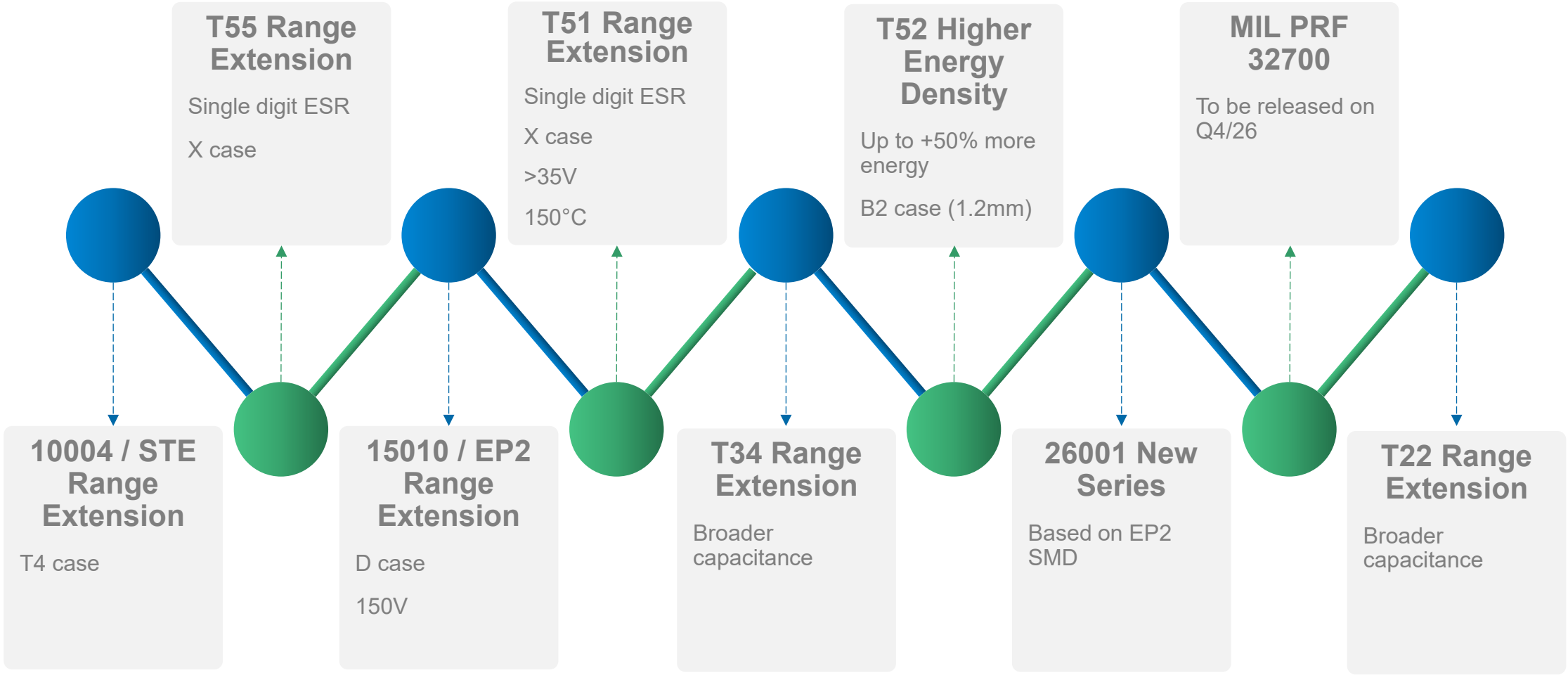
Example: Mining & demolition ignitors (wired and wireless)



Products Roadmap

Product Development Roadmap

The DNA of tech™.



Tantalum Capacitor Design Tools and Resources

Parametric Search

3D Models

SPICE Models

Related Documents

Order Samples

Technical Notes

Calculators

White Paper

Call to Action

How Will We Win Together?

- All shipments to North America are from locations other than China!
- Bring any identified T51-Automotive grade opportunity to Division. Strong growth focus.
- Attention to AI Server and Data Center applications, demanding large qty of T55&T52
- Aerospace & Defense focus customer engagement early and often!
- Tantalum portfolio can fulfill any Aerospace & Defense requirement among, Polymer, Wet and Solid on standard or custom design. Bring to us!

VISHAY

The DNA of tech.®

AMERICAS SALES CONFERENCE

Vishay's Capacitor Solutions