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# Vishay Solutions For Avionic, Military and Space Market (AMS)

Components for Military & Space  
Electronics Conference & Exhibition

April 2021



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# Space-Grade IHLP® Power Inductors - SGIHLP®



- For avionics, military and space applications
- Offers all the advantages of IHLP
  - Stable inductance over temperature and current
  - Low core loss up to 1 MHz
  - Proven robust design
  - 5 A – 100 A current range
- Overmolded with LCP to provide space-required isolation voltage
- Slightly larger than standard IHLP with Sn / Pb terminations
- 180°C continuous operation
- Widely used for satellite power applications



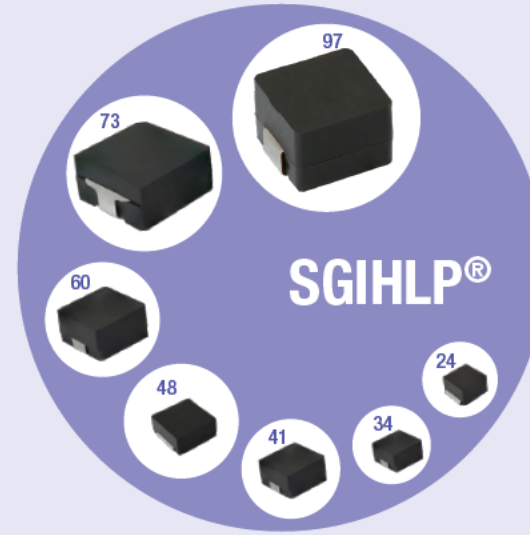
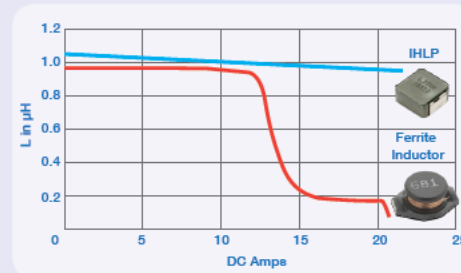
## SPACE GRADE SGIHLP® POWER INDUCTORS | IN A NUTSHELL

MIL-STD-981 CLASS S COMPLIANT

### APPLICATIONS

- Low profile, high current power supplies
- High current POL converters
- DC/DC converters in distributed power systems
- “Flight-ready” solar inverters
- Noise suppression

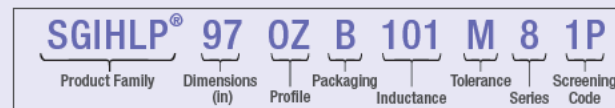
### SATURATION – IHLP® VS. FERRITE INDUCTOR



### SEVEN FOOTPRINTS AVAILABLE

Size	Current Rating for 1 µH (A)	Footprint (mm)	Profile	Profile Height (mm)
24	10.8	6.2 x 6.2	DC	DC = 4.3
34	12	9 x 9	EB	EB = 5.2
41	19	10.5 x 10.5	FA	FA = 6.1
48	23.5	12.2 x 12.2	FA	FA = 6.1
60	40.0	15.2 x 15.2	HE	HE = 8.5
73	53.0	18.8 x 18.8	HF	HF = 8.6
97	69.0	24.5 x 24.5	OZ	OZ = 15

SGIHLP® Screening Code	Two Different Levels of Screening
1P	Basic Production Screen
1S	MIL-STD-981 Group A / B Full Screen



Product and testing can be customized based on your requirements. Contact us!

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[www.vishay.com](http://www.vishay.com)

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# Hi-Reliability MLCCs / Lead (Pb)-Bearing AEC-Q200 Qualified MLCCs



# Hi-Reliability MLCCs: *Performance is Paramount*

## CKS Type - MIL-PRF-123

- Highest quality level
  - Qualification requires 4000 hr life testing
  - Every shipment requires 1000 hr life test
  - Every piece gets an acoustic scan

## CDR Type - (MIL-PRF-55681)

- Established reliability

## DLA Drawings

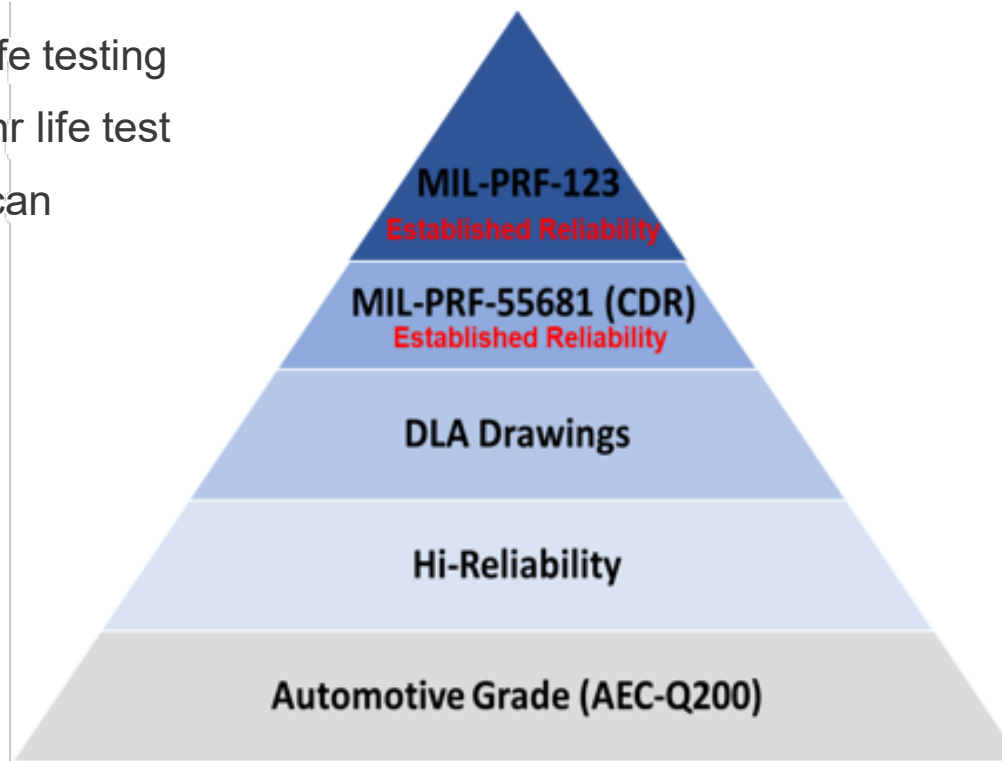
- Broader product offering

## Hi-Reliability Series

- Robust designs / high reliability
- Widest product offering
- Customer-specific products

## New: VJ...32 Series

- *AEC-Q200* certification + *SnPb* termination finish



# Lead (Pb)-Bearing AEC-Q200 Qualified MLCCs

## VJ....32 Lead-Bearing Finish MLCCs

### FEATURES

- Tin / lead termination finish ( $\geq 4\%$  Pb)
- AEC-Q200 qualified with PPAP available
- Available in 0402 to 1210 body sizes
- Wet build process
- Noble Metal Electrode (NME) system

### APPLICATIONS

- Low earth orbit satellites (LEO)
- Space
- Aerospace
- Avionics
- Military
- Tin whisker mitigation

### WHITE PAPER SUPPORT

- Applications
- Reliability



**VJ....32 Lead-Bearing Finish MLCCs**  
Vishay Vitramon

Surface Mount Multilayer Ceramic Chip Capacitors  
With Lead-Bearing Finish Termination

**FEATURES**

- Lead termination finish
- Minimum 4% lead
- Available in 0402 to 1210 body size
- Three electrode materials
- High operating temperature
- Wet build process
- Durable Noble Metal Electrode (NME) system
- AEC-Q200 qualified with PPAP available
- Custom configurations to meet specific need
- Material submittals for definition of compliance please see [www.vishay.com/vishaydocs/200202](http://www.vishay.com/vishaydocs/200202)

**APPLICATIONS**

- Low earth orbit satellites (LEO)
- Space
- Aerospace
- Avionics
- Military
- Tin whisker mitigation

**ELECTRICAL SPECIFICATIONS**

**ESD (NPO) DIELECTRIC (1)**

**GENERAL SPECIFICATION**

Note: Electrical characteristics at +25 °C unless otherwise specified

Operating Temperature: -55 °C to +150 °C  
Below +75 °C changed characteristics

Capacitance Range: 1 pF to 15 µF  
Voltage Range: 25 Vdc to 630 Vdc

Temperature Coefficient of Capacitance (TC):  
±1 ppm/°C ± 30 ppm/°C from -55 °C to +125 °C

Dielectric Factor (DF):  
≤ 1.16 maximum at 1.0 Vdc and 1 kHz for values > 1000 pF  
≤ 1.16 maximum at 1.0 Vdc and 1 kHz for values > 1000 pF

Insulating Resistance:  
at +25 °C: 10 000 MΩ min. or 1000 GΩ whichever is less  
at +125 °C: 10 000 MΩ min. or 1000 GΩ whichever is less

Ageing: 0% maximum per decade

Dielectric Strength Test:  
performed per method 103 of EIA 198-2-E.  
Applied test voltages:  
1 200 Vdc-rated: 200 % of rated voltage  
200 Vdc-rated: 150 % of rated voltage

**X7R DIELECTRIC**

**GENERAL SPECIFICATION**

Note: Electrical characteristics at +25 °C unless otherwise specified

Operating Temperature: -55 °C to +150 °C  
Below +75 °C changed characteristics

Capacitance Range: 10 pF to 1 µF  
Voltage Range: 10 Vdc to 630 Vdc

Temperature Coefficient of Capacitance (TC):  
±1.0 % from -55 °C to +125 °C, with 0 Vdc applied  
±1.0 % to 25 Vdc, ±0.5 % maximum at 1.0 Vdc and 1 kHz  
±2.5 Vdc, ±0.5 % maximum at 1.0 Vdc and 1 kHz

Insulating Resistance:  
at +25 °C: 10 000 MΩ min. or 1000 GΩ whichever is less  
at +125 °C: 10 000 MΩ min. or 1000 GΩ whichever is less

Ageing Rate: 1% maximum per decade

Dielectric Strength Test:  
performed per method 103 of EIA 198-2-E.  
Applied test voltages:  
1 200 Vdc-rated: 200 % of rated voltage  
200 Vdc-rated: 150 % of rated voltage  
630 Vdc-rated: min. 120 % of rated voltage

Note:  
1) Under qualification, contact factory for availability

Revision: 10 Aug 2020 Document Number: 4222

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...ing Finish MLCCs  
Vishay Vitramon

CAPACITANCE	MINIMUM		MAXIMUM	
	ESD (NPO)	X7R	ESD (NPO)	X7R
10 pF	1.0	1.0	1.0	1.0
15 pF	1.0	1.0	1.0	1.0
22 pF	1.0	1.0	1.0	1.0
33 pF	1.0	1.0	1.0	1.0
47 pF	1.0	1.0	1.0	1.0
68 pF	1.0	1.0	1.0	1.0
100 pF	1.0	1.0	1.0	1.0
150 pF	1.0	1.0	1.0	1.0
220 pF	1.0	1.0	1.0	1.0
330 pF	1.0	1.0	1.0	1.0
470 pF	1.0	1.0	1.0	1.0
680 pF	1.0	1.0	1.0	1.0
1 nF	1.0	1.0	1.0	1.0
1.5 nF	1.0	1.0	1.0	1.0
2.2 nF	1.0	1.0	1.0	1.0
3.3 nF	1.0	1.0	1.0	1.0
4.7 nF	1.0	1.0	1.0	1.0
6.8 nF	1.0	1.0	1.0	1.0
10 nF	1.0	1.0	1.0	1.0
15 nF	1.0	1.0	1.0	1.0
22 nF	1.0	1.0	1.0	1.0
33 nF	1.0	1.0	1.0	1.0
47 nF	1.0	1.0	1.0	1.0
68 nF	1.0	1.0	1.0	1.0
100 nF	1.0	1.0	1.0	1.0
150 nF	1.0	1.0	1.0	1.0
220 nF	1.0	1.0	1.0	1.0
330 nF	1.0	1.0	1.0	1.0
470 nF	1.0	1.0	1.0	1.0
680 nF	1.0	1.0	1.0	1.0
1 µF	1.0	1.0	1.0	1.0

...2 Lead-Bearing Finish MLCCs  
Vishay Vitramon

CAPACITANCE	MINIMUM		MAXIMUM	
	ESD (NPO)	X7R	ESD (NPO)	X7R
10 pF	1.0	1.0	1.0	1.0
15 pF	1.0	1.0	1.0	1.0
22 pF	1.0	1.0	1.0	1.0
33 pF	1.0	1.0	1.0	1.0
47 pF	1.0	1.0	1.0	1.0
68 pF	1.0	1.0	1.0	1.0
100 pF	1.0	1.0	1.0	1.0
150 pF	1.0	1.0	1.0	1.0
220 pF	1.0	1.0	1.0	1.0
330 pF	1.0	1.0	1.0	1.0
470 pF	1.0	1.0	1.0	1.0
680 pF	1.0	1.0	1.0	1.0
1 nF	1.0	1.0	1.0	1.0
1.5 nF	1.0	1.0	1.0	1.0
2.2 nF	1.0	1.0	1.0	1.0
3.3 nF	1.0	1.0	1.0	1.0
4.7 nF	1.0	1.0	1.0	1.0
6.8 nF	1.0	1.0	1.0	1.0
10 nF	1.0	1.0	1.0	1.0
15 nF	1.0	1.0	1.0	1.0
22 nF	1.0	1.0	1.0	1.0
33 nF	1.0	1.0	1.0	1.0
47 nF	1.0	1.0	1.0	1.0
68 nF	1.0	1.0	1.0	1.0
100 nF	1.0	1.0	1.0	1.0
150 nF	1.0	1.0	1.0	1.0
220 nF	1.0	1.0	1.0	1.0
330 nF	1.0	1.0	1.0	1.0
470 nF	1.0	1.0	1.0	1.0
680 nF	1.0	1.0	1.0	1.0
1 µF	1.0	1.0	1.0	1.0

### Ceramic Capacitors

### White Paper

## Lead (Pb)-Bearing, Vishay Automotive Grade MLCCs for Tin Whisker Mitigation in Low Earth Orbit Satellites

By Brian Ward

### Executive Summary

- Vishay's VJ....32 Lead-Bearing Finish Series of MLCCs is the industry's first to combine a lead (Pb)-bearing termination finish with Vishay Automotive Grade reliability
- Termination finish with a minimum lead (Pb) content of 4 %
- Qualified to AEC-Q200
- Provides designers with a cost-effective alternative to more expensive MIL-qualified and hi-rel products in low earth orbit (LEO) satellites in which tin whiskers must be avoided but space-level reliability is not required



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### Ceramic Capacitors

### White Paper

## Reliability of Lead (Pb)-Bearing Vishay Automotive Grade MLCCs

By Brian Ward

Building products with Automotive Grade quality begins with the manufacturing facility. The manufacturing process is one that's driven by a quality system that promotes defect prevention, reduction of variation, and continuous improvement. Processes are statistically monitored with all key variables controlled by the quality management system. The requirements such a system are established by the International Automotive Task Force (IATF) and maintained in the specification IATF 16949. The production facility must be recertified every three years. The location where Vishay's Lead (Pb)-Bearing Finish MLCCs are manufactured holds this certification.

**TABLE 2 - SUMMARIZED FIT / MTTF VALUES FOR VISHAY'S LEAD (Pb)-BEARING FINISH SERIES OF MLCCs**

BODY SIZE	NPO		X7R	
	FIT (1)	MTTF (1) (YEARS)	FIT (1)	MTTF (1) (YEARS)
0402	0.0122	9 360 731	0.013	8 618 721
0603	0.0308	3 710 046	0.101	1 130 137
0805			0.072	1 575 342
1206			0.130	877 854
1210			0.092	1 244 292

Note  
(1) 25 °C and 50 % rated voltage



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# VISHAY TANTALUM CAPACITORS



# Space Grade Tantalum Capacitors

**Vishay: Proven Success from HiRel COTS to QPL T-Level!**

MIL-PRF-55365 T-Level:

(Meets NASA/TP-2003-212242,  
Level 1 requirements)

CWR06 – Standard Ratings

CWR16 – Extended Range Ratings

CWR26 – Low ESR

CWR11 – Molded Case

HiRel COTS Series:

Screening IAW MIL-PRF-55365

TM8 (DLA 11020) – MicroTan®; High Density Cap in Small Sizes

T83 – Molded; Extended Range Ratings

T95 (DLA 14002)/T97 (DLA 13008) – Conformal; Max Cap & Voltage



# Space Grade Tantalum Capacitors

## Vishay: Proven Success from HiRel COTS to Space Grade

MIL-PRF-39006:  
EPPL Listed

CLR79 (M39006/22) – Standard Ratings  
CLR81 (M39006/25) – Extended Range Ratings  
CLR90 (M39006/30) – Low ESR, Standard Ratings  
CLR91 (M39006/31) – Low ESR, Extended Range Ratings



DLA Approved for Space\*:

\*DLA 06013-06016 specifications

meet or exceed NASA / TP-2003-212242,

Level 1 requirements

06013 [CLR79 (M39006/22) Ratings]  
06014 [CLR81 (M39006/25) Ratings]  
06015 [CLR90 (M39006/30) Ratings]  
06016 [CLR91 (M39006/31) Ratings]

# High Performance Wet Tantalum Capacitors

## Axial Leaded – T16 / T18 Series

- MIL-PRF-39006/33
- DLA 13017 / 20001 (space) / 15005
- Case Sizes: T1, T2, T3, T4
- Voltage Range: 25 V<sub>DC</sub> to 125 V<sub>DC</sub>
- Capacitance Range: 10µF to 1,800µF
- Operating Temperature: -55°C to +125°C
- Key Ratings: 1,200µF/75V, 470µF/100V

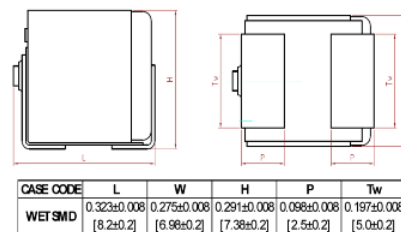
### Enhanced performance for Avionics and Space

- 300 thermal shocks
- 500 g mechanical shock
- 80 g sine vibration
- 54 g random vibration
- 1.5 V to 3.0 V reverse voltage



## SMD – T22 Series

- DLA 19001
- Case Sizes: C
- Voltage Range: 50 V<sub>DC</sub> to 125 V<sub>DC</sub>
- Capacitance Range: 10µF to 110µF
- Operating Temperature: -55°C to +125°C
- NASA paper: <https://nepp.nasa.gov/files/29192/NEPP-TR-2018-Teverovsky-T22-Capacitors-TN52048.pdf>



# Ultra High Capacitance Hermetically Sealed Wet Tantalum

**Commercial Series: HE3 / HE5 w/mounting Studs**

**Military: DLA 10011 (HE3)**

**Case Sizes: A, B, C**

**Voltage Range: 25 V<sub>DC</sub> to 125 V<sub>DC</sub>**

**Capacitance Range: 1,100μF to 72,000μF**

**Operating Temperature: -55°C to +125°C**



**Commercial Series: EP1 Energy-Pack**

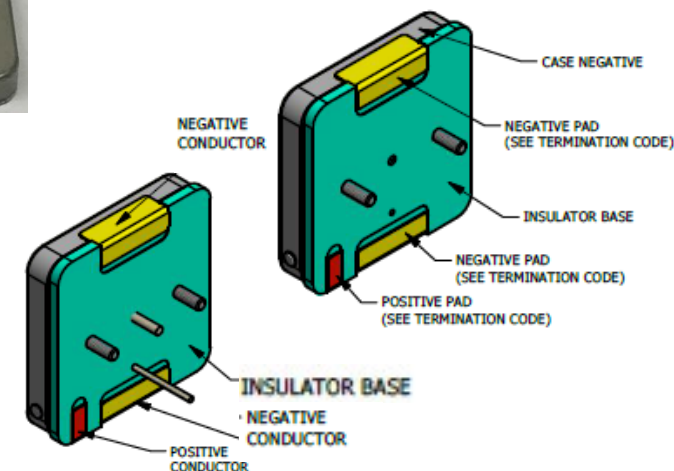
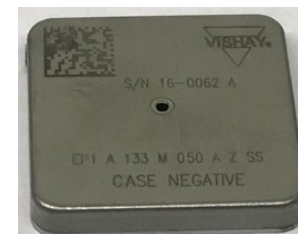
**Military: DLA 20002**

**Case Sizes: A, B, C**

**Voltage Range: 25 V<sub>DC</sub> to 125 V<sub>DC</sub>**

**Capacitance Range: 2,000μF to 58,000μF**

**Operating Temperature: -55°C to +125°C**



# Vishay Polymer Tantalum – Hi-Rel COTS vPOLY TAN™

## T56 Series – High Reliability Molded Case

- Low ESR
- B, V, D Case Sizes
- High Reliability Processing included:
  - MIL-PRF-55365 reliability screening
  - 100% Surge Current Tested
  - Accelerated Voltage Conditioning
  - Thermal Shock
  - Offered with Vishay's Patented DC Leakage Screening Methodology at elevated temperature and voltage for maximum reliability

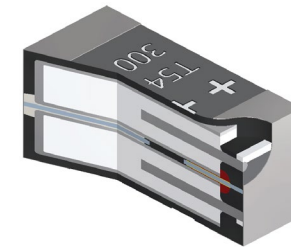


Working as part of the SAE CE-11 committee and in collaboration with the DLA, OEMs, and other suppliers, Vishay is helping to define the MIL-PRF-POLY specification. The T56 series will be qualified to the first MIL-PRF slash sheet.

# Vishay Polymer Tantalum – Hi-Rel COTS vPOLYNTAN™

## T54 Series – High Reliability Leadframeless Molded Capacitor

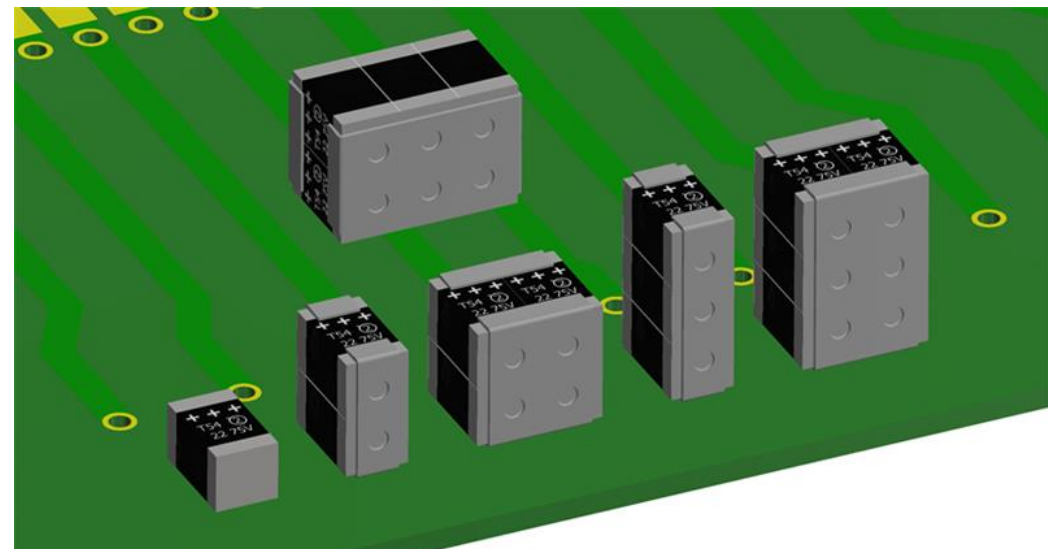
- Ultra Low ESR
- EE Case Sizes (7343-43)
- High Reliability Processing included:
  - MIL-PRF-55365 reliability screening
  - 100% Surge Current Tested
  - Accelerated Voltage Conditioning
  - Thermal Shock
  - Offered with Vishay's Patented DC Leakage Screening Methodology at elevated temperature and voltage for maximum reliability
  - Leading edge capacitor / voltage offering
    - EE – 150 $\mu$ F/35V, 47 $\mu$ F/50V, 22 $\mu$ F/75V
- **DLA-20021 (T54 Series)**



# Vishay Polymer Tantalum – Hi-Rel COTS vPOLYNTAN™

## T54 Series – High Reliability Stack Capacitor Arrays

- Ultra Low ESR
- Stacked “EE” Case Sizes
- Available in Stacks of 2-, 3-, 4-, and 6- arrays for high density energy storage applications
- High Reliability Processing in accordance to MIL-PRF-55365
- Leading edge capacitor / voltage offering
  - Stacked – 2800 $\mu$ F/16V, 280 $\mu$ F/50V, 130 $\mu$ F/75V





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# VISHAY DALE RESISTORS



# Established Reliability Commitment

The Vishay Mil-790 test lab supports qualification maintenance

- Group C life testing alone loads over 90K+ resistors each year
- Over 125,000 resistors are on life test at any point in time
  - Life testing is generally 10,000 hours (~14 months)
- Accumulating over 1,000,000,000 test hours annually
- Since 2004, 1.7M pcs have accumulated 18.7B test hours

Qualified for 12 military resistor specifications and over 100 DLA Land and Maritime Drawings

Adding M55342/14 (0201 size) and lower ohmic values across all slash sheets

RER (Mil-PRF 39009) wirewound resistors, adding laser part marking

# Military Resistor Qualifications

## Film Technology

- MIL-R-10509: RN Precision / High Stability Leaded Resistor
- MIL-PRF-22684: RL Leaded Resistor
- MIL-PRF-32159: RCZ SMD Zero Ohm Jumper, Established Reliability
- MIL-PRF-39017: RLR Leaded Resistor, Established Reliability
- MIL-PRF-55182: RNC / RNR / RNN Precision Leaded Resistors, Established Reliability
- MIL-PRF-55342: RM Thick / Thin Film SMD Resistors, Established Reliability

## Wirewound Technology

- MIL-PRF-26: RW Precision Power Leaded Resistor
- MIL-PRF-18546: RE Chassis Mount Power Resistor
- MIL-PRF-39007: RWR Leaded Power Resistor, Established Reliability
- MIL-PRF-39009: RER Chassis Mount Power Resistor, Established Reliability
- MIL-PRF-49465: RLV Low Value Power Leaded Resistor

## Networks

- MIL-PRF-83401: RZ Thick / Thin Film Resistor Networks



# MIL-PRF vs. AEC-Q200? At Vishay We Have Both..

## Qualification Testing

- Military-established reliability load life testing up to 10,000 hours per part with cumulative test hours exceeding 110 Million hours in a 12-month period (S failure rate)
- AEC maintenance testing every two years with emphasis on process control vs. product control

## Other Factors

- Military is appropriate for high mix / low volumes; automotive is best for high volumes
- AEC is Lead-free Terminations and Military remains Lead-Bearing Terminations due to tin whisker
- AEC employs safe launch, control plans, and continuous improvement activity based on breadth of market and industry feedback
- Vishay offers the best of both worlds

Support of MIL-PRF and AEC-Q200 assures Vishay's ability to support customized requirement including special testing, Pb-bearing terminations, custom documentation for resistors, capacitors and power inductors.



Thank you