

Defense and Aerospace

When reliability is a must, rely on KEMET.



One world. One KEMET.

KEMET
CHARGED.®

Tantalum Defense and Aerospace Parts

QPL (Qualified Product Listing)	Style	MIL-PRF/DLA/ KEMET Specification	KEMET Series	Space Qualified	Thermal Shock	Surge Current	Capacitance/Dissipation Factor	DC Leakage	ESR	3 Sigma Screening	Seal Test	Voltage Aging	Weibull Grading	X-Ray	Reflow Conditioning	DPA	Lead Pull Strength	Visual/Mechanical	Surge Voltage	PDA	Temperature Stability	Solderability	F1 Anode	Stimulated Breakdown Screening (SBDS)	Step Stress Surge Test (SSST)	Polymer Reliability Assessment Test	Group C	Group B	
N/A	N/A	GR500	T210/T220/T240	★	●	●	●	●	●		●		●	2															
QPL 39003	CSS13/33	MIL-PRF-39003/10	T216/T256	★	●	●	●	●	●		●		●	2															
QPL 39003	CSR13	MIL-PRF-39003/01	T212		●	○	●	●			●		●	1															
QPL 39003	CSR09	MIL-PRF-39003/02	T222		●	○	●	●			●		●	1															
QPL 39003	CSR23	MIL-PRF-39003/03	T242		●	○	●	●			●		●	1															
QPL 39003	CSR91	MIL-PRF-39003/04	T213		●	○	●	●			●		●	1															
QPL 39003	CSR33	MIL-PRF-39003/06	T252		●	●	●	●	●		●		●	1															
QPL 39003	CSR21	MIL-PRF-39003/09	T262		●	●	●	●	●		●		●	1					●		●	●							
QPL 49137	CX01, CX05	MIL-PRF-49137/1/5	T323		●														●		●	●							
QPL 49137	CX02, CX12	MIL-PRF-49137/2	T363, T369		●														●		●	●							
QPL 49137	CX06	MIL-PRF-49137/6	T378		●																								
N/A	N/A	Polymer Herm Seal	T550			○	●	●	●		●	●		1				●					●	●		○			
Through-Hole SCD			All Through-Hole Series		○	●	○	○	○	○	○	○	○	○		○	○	○	○	○	○	○	○	○			○	○	
QPL 55365	CWR11	MIL-PRF-55365/8	T492		●	○	●	●	●				●	1	●		○	●			●	●							
QPL 55365	CWR09/19/29	MIL-PRF-55365/4/11	T409/T419/T429		●	○	●	●	●				●		●			●			●	●							
QPL 55365 ^T	CWR09/11/19/29	MIL-PRF-55365/4/8/11	T492/T409/T419/T429	★	●	●	●	●	●	●			●	1	●	●		●		●	●	●					●		
N/A	N/A	DLA 04051	T540		○	○	●	●	●	●		●		1	●			●		●	●	●	○	○		○	○		
N/A	N/A	DLA 04052	T541		○	○	●	●	●	●		●		2	●			●		●	●	●	○	○		○	○		
N/A	N/A		T543			○	●	●	●						●			●											
N/A	N/A	DLA 04053	T496		○	○	●	●	●	○		●			●			●		●	○	○	○	○			○		
N/A	N/A	DLA 95158	T495		○	○	●	●	●	○		●			●			●		●	○	○	○	○			○		
N/A	N/A	DLA 07016	T493		○	○	●	●	●	○			●		●			●		●	○	○	○	○			○		
N/A	N/A	KEMET COTS	T493/T497/T513/T496		●	○	●	●	●	○			●		●			●		●	○	○	○	○	○		○		
N/A	N/A	Ta MnO ₂ Stacks	TSM			◆	◇	◇	◇			◆					●												
N/A	N/A	KO (Polymer) Stacks	TSP			◆	◇	◇	◇			◆																	
N/A	N/A	KEMET Space Grade	T493/T496/T497/T510	★	●	○	●	●	●	○		●	●	○	●	●		●		●	●	●	○	○			●	●	
N/A	N/A	HVE	T428		●	○	●	●	●			●			●			●											
Surface Mount SCD			T495		○	○	○	○	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○	○		○	○

Key: ● Standard
○ Optional

1 1 Plane
2 2 Plane

◆ Indicated per PIN
◇ Sample on PIN,
100% on Stacks

^T Weibull Failure Rate Level “T”
★ Space Qualified

Optional tests performed on military specification parts will affect JAN branding.

Terminology Guide

- **C-SAM:** C-Mode Scanning Acoustic Microscopy (ceramics only)
 - **DPA:** Destructive Physical Analysis
 - **DWV:** Dielectric Withstanding Voltage (ceramics only)
 - **ESR:** Equivalent Series Resistance (ESR) is the preferred high-frequency statement of the resistance unavoidably appearing in these capacitors. ESR is not a pure resistance, and it decreases with increasing frequency.
- **F1:** KEMET’s F1 Technology package incorporates three process methodologies for improved tantalum anode quality resulting increased reliability, stable and low DC leakage.
 - **HVE:** High Volumetric Efficiency
- **PDA:** Percent Defective Allowed
 - **Polymer Reliability Assessment Test:** Sample test under accelerated conditions to demonstrate long-term device reliability. Please contact KEMET for details (polymer only).
 - **SBDS:** KEMET has developed a special patented screening technique which allows the identification of tantalum capacitors with hidden defects in the dielectric, without any damage to the general population of the capacitors.
- **Thermal Shock:** Parts are temperature cycled.
 - **Voltage Conditioning:** Parts receive a voltage conditioning at X rated voltage and X°C for a minimum and maximum amount of hours (ceramics only).

Ceramic Defense and Aerospace Parts

QPL (Qualified Product Listing)	Style	MIL-PRF/DLA/ KEMET Specification	KEMET Series	Space Qualified	CSAM	In-Process - 100% Visual Inspection	In-Process DPA	In-Process Lead Pull Strength	Thermal Shock	Voltage Conditioning	Capacitance/Dissipation Factor	Room IR (+25°C)	HOT IR (+125°C)	DWV	PDA	Visual/Mechanical	X-Ray	Solderability (each lot)	Group B (each lot)	Periodic Group B	Group C Lot Test per MIL-PRF-55681	Periodic Group C	Data Pack (standard w/ order)	Pb (lead) Content C of C	Humidity Steady State Low Voltage (LV/H)	Final DPA	X-Ray Fluorescence (XRF) Analysis	Additional Thermal Shock Cycles (applies to Group A only)	100% Final Visual Inspection	Hot IR @+125°C (X7R, C0G), @+85°C (X5R)	
N/A	N/A	GR900	"B" Spec Through-Hole	★	○	●	●	●	●	●	●	●	●	●	●	●	●		○				●	○	○	●				○	
N/A	N/A	GR900	"A" Spec SMD	★	○	●	●	●	●	●	●	●	●	●	●	●	●		○				●	○	○	●	○			○	
N/A	N/A	MIL-PRF-123 In-Process, Group A Tested	"Q" Spec Through-Hole	★	●	●	●	●	●	●	●	●	●	●	●	●	●		○				●	○	○	●				○	
N/A	N/A	MIL-PRF-123 In-Process, Group A Tested	"Q" Spec SMD	★	●	●	●	●	●	●	●	●	●	●	●	●	●		○				●	○	○	●	○			○	
QPL M123/1	CKS05	MIL-PRF-123/1 *	C052Z	★	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●	●	○	○	○	●			○	
QPL M123/2	CKS06	MIL-PRF-123/2 *	C062Z	★	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●	●	○	○	○	●			○	
QPL M123/3	CKS07	MIL-PRF-123/3 *	C512Z	★	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●	●	○	○	○	●			○	
QPL M123/10	CKS51	MIL-PRF-123/10 *	C0805Z	★	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●	●	○	○	○	●	○		○	
QPL M123/11	CKS52	MIL-PRF-123/11 *	C1210Z	★	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●	●	○	○	○	●	○		○	
QPL M123/12	CKS53	MIL-PRF-123/12 *	C1808Z	★	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●	●	○	○	○	●	○		○	
QPL M123/13	CKS54	MIL-PRF-123/13 *	C2225Z	★	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●	●	○	○	○	●	○		○	
QPL M123/21	CKS55	MIL-PRF-123/21 *	C1206Z	★	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●	●	○	○	○	●	○		○	
QPL M123/22	CKS56	MIL-PRF-123/22 *	C1812Z	★	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●	●	○	○	○	●	○		○	
QPL M123/23	CKS57	MIL-PRF-123/23 *	C1825Z	★	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●	●	○	○	○	●	○		○	
QPL 49470/1	PS01	MIL-PRF-49470/1 "T" LEVEL	L1XN, L1RN, L1QN	★	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	○	○	○	○	○		○	
	PS02	MIL-PRF-49470/1 "B" LEVEL	L1XN, L1RN, L1QN			●			●	●	●	●	●	●	●	●	●	●	●	●	●		●	○	○	○	○	○		○	
QPL 49470/2	PS02	MIL-PRF-49470/2 "B" LEVEL	L1XN, L1RN, L1QN			●			●	●	●	●	●	●	●	●	●	●	●	●	●		●	○	○	○	○	○		○	
QPL 55681/1	CDR01,02,03,04	MIL-PRF-55681/1	C0805P, C1805P, C1808P, C1812P				○			●	●	●	●	●	●	●	●	●	●	●	●	●	○	○	○	○	○	○	○	○	
QPL 55681/2	CDR05	MIL-PRF-55681/2	C1825P				○			●	●	●	●	●	●	●	●	●	●	●	●	●	○	○	○	○	○	○	○	○	
QPL 55681/3	CDR06	MIL-PRF-55681/3	C2225P				○			●	●	●	●	●	●	●	●	●	●	●	●	●	○	○	○	○	○	○	○	○	
QPL 55681/7,8,9,10,11	CDR31,32,33,34,35	MIL-PRF-55681/7,8,9,10,11	C0805N, C1206N, C1210N, C1812N, C1825N				○			●	●	●	●	●	●	●	●	●	●	●	●	●	○	○	○	○	○	○	○	○	
QPL 20/27,28,29,30,31	CCR/75,76,77,78,79	MIL-PRF-20/27,28,29,30,31	C114G, C124G, C192G, C202G, C222G					○	●	●	●	●	●	●	●	●	■	●	●	●	●			○	○	○	○	○	○	○	
QPL 20/27,28,29,30,32	CC/75,76,77,78,80	MIL-PRF-20/27,28,29,30,32	C114G, C124G, C192G, C202G, C222G (no FR)					○	●	●	●	●	●	●	●	●	■	●	●	●	●				○	○	○	○	○	○	
QPL 20/35	CCR05	MIL-PRF-20/35	C052G, C056G					○	●	●	●	●	●	●	●	●	■	●	●	●	●				○	○	○		○	○	
QPL 20/36	CC05	MIL-PRF-20/36	C052G, C056G (no FR)					○	●	●	●	●	●	●	●	●	■	●	●	●	●										
QPL 20/36	CCR06	MIL-PRF-20/36	C062G, C065G, C066G					○	●	●	●	●	●	●	●	●	■	●	●	●	●				○	○	○		○	○	
QPL 20/36	CC06	MIL-PRF-20/36	C062G, C065G, C066G (no FR)					○	●	●	●	●	●	●	●	●	■	●	●	●	●										
QPL 20/37,38	CCR/07,08	MIL-PRF-20/37,38	C512G, C522G					○	●	●	●	●	●	●	●	●	■	●	●	●	●				○	○	○		○	○	
QPL 20/37,38	CC/07,08	MIL-PRF-20/37,38	C512G, C522G (no FR)					○	●	●	●	●	●	●	●	●	■	●	●	●	●										
QPL 39014/1	CKR05	MIL-PRF-39014/1	C052T, C056T					○	●	●	●	●	●	●	●	●	■	●	●	●	●				○	○	○		○	○	
QPL 39014/2	CKR06	MIL-PRF-39014/2	C062T, C066T					○	●	●	●	●	●	●	●	●	■	●	●	●	●				○	○	○		○	○	
QPL 39014/5	CKR11,12,14,15,16	MIL-PRF-39014/5	C114T, C124T, C192T, C202T, C222T					○	●	●	●	●	●	●	●	●	■	●	●	●	●				○	○	○		○	○	
N/A	N/A	DLA 03028	"D" Spec 0603			●	○			●	●	●	●	●	●	●		●			○	○									
N/A	N/A	DLA 03029	"D" Spec 0402			●	○			●	●	●	●	●	●	●		●			○	○									
N/A	N/A	DLA 05006	"D" Spec 0805			●	○			●	●	●	●	●	●	●		●			○	○									
N/A	N/A	DLA 05007	"D" Spec 1206			●	○			●	●	●	●	●	●	●		●			○	○									
N/A	N/A	DLA 91019	"E" Spec 2220			●	○			●	●	●	●	●	●	●		●			○	○									
N/A	N/A	N/A	"T" Spec 0603***							●	●	●	●	●	●	●		○							○	○	○		○	○	
N/A	N/A	N/A	"T" Spec 0402***							●	●	●	●	●	●	●		○							○	○	○		○	○	
N/A	N/A	N/A	"T" Spec 0805***							●	●	●	●	●	●	●		○							○	○	○		○	○	
N/A	N/A	N/A	"T" Spec 1206***							●	●	●	●	●	●	●		○							○	○	○		○	○	
N/A	N/A	N/A	"T" Spec 1210***							●	●	●	●	●	●	●		○							○	○	○		○	○	
N/A	N/A	N/A	"T" Spec 1812***							●	●	●	●	●	●	●		○							○	○	○		○	○	
N/A	N/A	N/A	"T" Spec 1825***							●	●	●	●	●	●	●		○							○	○	○		○	○	
N/A	N/A	N/A	"T" Spec 2220***							●	●	●	●	●	●	●		○													

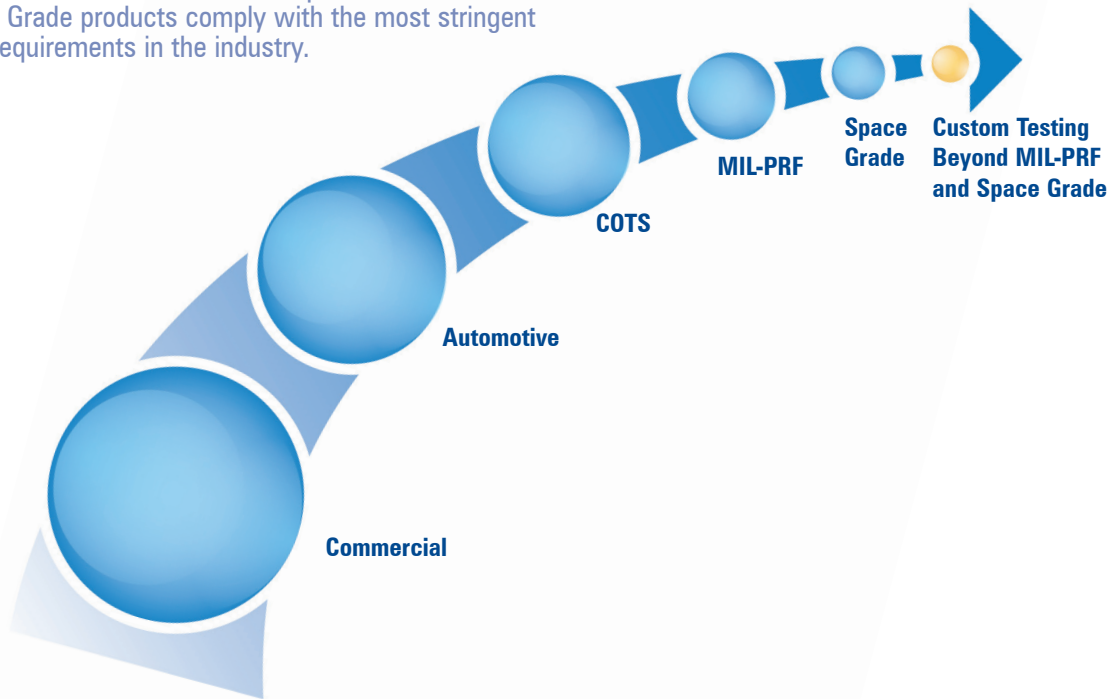
Key: ● Standard
○ Optional - with fee
○ JAN Branding will be affected

■ S Failure Rate
★ Space Qualified

Optional tests performed on military specification parts will affect JAN branding.
* Non-stocking Item
*** MIL-PRF-55681 Group A Tested.
BME Dielectric, PME also available
on select part numbers.

Quality Hierarchy

KEMET is the undisputed global leader in delivering high performance ceramic and tantalum capacitors. Our Defense and Space Grade products comply with the most stringent reliability requirements in the industry.



Formula 1 (F1) Technology and Simulated Breakdown Screening (SBDS)

Advancing Tantalum Technology to the Pinnacle Level of Reliability

Formula 1 (F1) Technology

KEMET’s Formula 1 (F1) Technology eliminates hidden defects in the dielectric which continue to grow in the field, causing capacitor failures. Based on the fundamental understanding of degradation mechanisms in tantalum and niobium capacitors, F1 Technology incorporates multiple process methodologies. Some minimize the oxygen and carbon content in the anodes which become contaminants and can lead to the crystallization of the anodic oxide dielectric. This process methodology reduces the contaminants, improving quality of the dielectric. An additional technology provides a

stronger mechanical connection point between the tantalum lead wire and tantalum anode, enhancing robustness and product reliability. The benefit of this F1 Technology is illustrated by a 2000 hour, 85°C, 1.32 X rated voltage accelerated life test. The F1 Technology parts see no degradation while standard tantalums have 1.5 orders of magnitude degradation in leakage current. F1 Technology is currently available for T493 Series (select D and X case capacitance values in 20 V and higher rated voltage) and T497 Series (select H case capacitance values in 20 V and higher rated voltage).

Simulated Breakdown Screening (SBDS)

KEMET’s patented SBDS is a nondestructive testing technique that simulates the breakdown voltage (BDV) of a capacitor without damage to its dielectric or the general population of capacitors. This screening identifies hidden defects in the dielectric, providing the highest level of dielectric testing. SBDS is based on the simulation of breakdown voltage (BDV), the ultimate test of the dielectric in a capacitor. Low BDV indicates defects in the dielectric, and therefore a higher probability of failure in the field. High BDV indicates a stronger dielectric and high-reliability performance in the field. This new screening method allows KEMET to identify the breakdown voltage of each individual capacitor and provide only the strongest capacitors from each lot. The benefit of SBDS is illustrated by a

minimum breakdown voltage greater than 2 X rated voltage as compared to Weibull Graded parts with breakdown voltages as low as 1.25 X rated voltage. Also, this is done without inducing wear out sometime associated with Weibull Grading. SBDS is currently available on part types in the T493 and T497 Series.

KEMET offers these technologies in the following arrangements:

- F1 Technology only
- SBDS only
- Combination of both F1 Technology and SBDS for the ultimate protection



Defense and Aerospace Product Spotlights

DLA (Formerly DSCC) High Reliability MLCCs

DLA 05006/7, 03028/9 and 91019

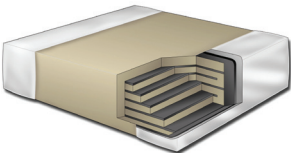
- Meets U.S. Department of Defense specifications per MIL-PRF-55681, MIL-STD-202 and MIL-STD-1285
- 05006/7 available in BP, BR and BX dielectrics
- 03028/9 available in BR and BX dielectrics
- 9109 available in BR dielectric
- High capacitance
- Voltage range of 6.3 – 200 VDC
- Non-polar device, minimizing installation concerns
- EIA case sizes 0402, 0603, 0805, 1206 and 2220



Space Grade MLCCs

GR900, MIL-PRF-123

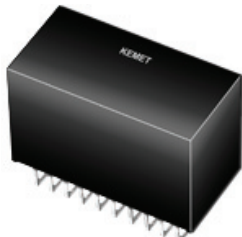
- For use in applications where the chance of failure must be reduced to the lowest possible level
- Meets U.S. Department of Defense specifications per MIL-PRF-123
- BP, BR and BX dielectrics
- Voltage range of 16 – 200 VDC
- Numerous end metallization options available including 100% pure matte tin, SnPb plated (70/30), SnPb coated (60/40) and gold plated
- Receive special attention in all phases of manufacture including raw materials selection, clean room production, individual batch testing, C-SAM (when applicable), maintenance of singular batch identity and destructive physical analysis



Multilayer Ceramic Stacked Capacitors

KPS MIL

- Meets U.S. Department of Defense specifications per MIL-PRF-49470
- Reliable and robust termination system
- Higher capacitance in the same footprint
- Advanced protection against thermal and mechanical stress
- Reduces audible microphonic noise
- Extremely low ESR and ESL
- T-Level reliability available (Space Grade)



Polymer COTS

T540/541 and T543 Series

- Polymer cathode technology
- High frequency capacitance retention
- Benign failure mode
- Low ESR
- Surge current testing options
- High ripple current
- 10% derating for part types ≤ 10 V
- 20% derating for part types > 10 V



Polymer Herm Seal

T550 Series

- Low and stable ESR across temperature range and frequency
- Stable capacitance across temperature range and frequency
- Non-catastrophic failure mode
- Mechanical robustness (shock and vibration)
- Lighter weight (~25%) and same case sizes as wet tantalum
- Patented polymer slurry technology
- 20% derating



Space Grade MnO₂ Tantalum

T493 COTS, T496 Fused, T497 High Grade COTS & T510 Multiple Anode Low ESR Series

- MIL-PRF-55365 and MIL-STD-1580
- Incorporates customizable intensive testing and screening protocol such as Weibull grading level (C = 0.01%/k hours), surge current level (10 cycles -55°C and +85°C before and/or after Weibull grading) and variety of additional performance testing level options
- Low and standard ESR options
- Variety of termination finishes
- Fused versions available for built-in circuit protection
- Multi-anode designs for very low ESR values



We're everywhere you need us to be.

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