Tantalum Stack Polymer (TSP) Series

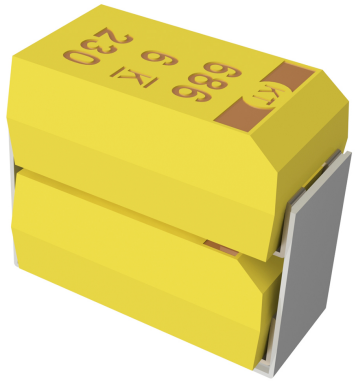
Overview

The KEMET Tantalum Stack Polymer (TSP) Series is designed to provide the highest capacitance/voltage ratings in surface mount configuration. KEMET's T540 Polymer COTS capacitors are utilized in stacks of 2,3,4 and 6 components to achieve a broad range of capacitance and voltage ratings. The T540 COTS series offers component level surge current testing options and standard and low ESR options. As with other KEMET Polymer product, this series may be operated at steady state voltages up to 90% of rated voltage for part types with rated voltages of ≤ 10 volts and up to 80% of rated voltage for part types > 10 volts. Stacking configurations offer this Polymer COTS product with custom capacitance/voltage solutions and very low ESR options.

Note: Custom stacking solutions are available with other KEMET Tantalum Surface Mount Series. Please contact KEMET Product Management for availability.

Benefits

- Polymer cathode technology
- High capacitance
- Surface mountable
- Capacitance values of 66 µF to 4080 µF
- Capacitance can be custom specified
- Voltage ratings of 3 VDC to 16 VDC
- High volumetric efficiency
- Ultra low ESR
- Surge capability
- Operating temperature range of -55˚C to +125˚C
- Laser-marked case
- Use up to 90% of rated voltage for part types ≤ 10 volts
- Use up to 80% of rated voltage for part types > 10 volts



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Applications

Typical applications include decoupling and filtering in a variety of market segments. The T540 Polymer COTS stack devices can be utilized in military and aerospace applications. Other KEMET series can be utilized in filtering and decoupling applications to service various market segments.

Environmental Compliance

RoHS Compliant (6/6) according to Directive 2002/95/EC when ordered with 100% Sn solder.

RoHS Compliant

SPICE

For a detailed analysis of specific part numbers, please visit www.kemet.com for a free download of KEMET's SPICE software. The KEMET SPICE program is freeware intended to aid design engineers in analyzing the performance of these capacitors over frequency, temperature, ripple, and DC bias conditions.

Ordering Information

T	SP	2D	207	M	010	A	H	65	20	D540
Capacitor Class	Series	Case Size	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Failure Rate/ Design	Lead Material	Surge	ESR	C-Spec 2
T = Tantalum	Stacks Polymer Cathode	2B, 3B, 4B, 6B, 2D, 3D, 4D, 6D	First two digits represent significant figures. Third digit specifies number of zeros.	M = ±20%	003 = 3 V 004 = 4 V 006 = 6.3 V 010 = 10 V 016 = 16 V	A = N/A	H = Standard Solder Coated (SnPb 5% Pb minimum)	65 = No Surge 66 = 10 cycles @ 25°C 67 = 10 cycles -55°C and 85°C	10 = ESR - Standard 20 = ESR-Low	Designates discrete component series. D540 = T540

Note: These TSP Stacks are specific to T540 COTS.

Performance Characteristics

Item	Performance Characteristics
Operating Temperature	-55°C to 125°C
Rated Capacitance Range	66 – 4080 µF @ 120 Hz/25° C
Capacitance Tolerance	M Tolerance (20%)
Rated Voltage Range	3 – 16 V
DF (120 Hz)	Refer to Part Number Electrical Specification Table
ESR (100 kHz)	Refer to Part Number Electrical Specification Table
Leakage Current	≤ 0.1 CV (µA) at rated voltage after 5 minutes

Qualification

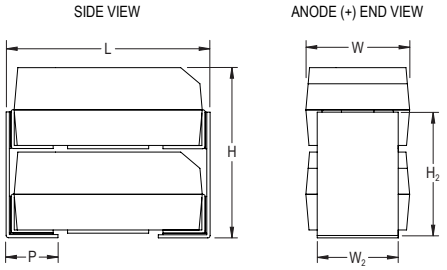
Test	Condition	Characteristics	
Endurance	105°C @ rated voltage, 2,000 hours 125°C @ 2/3 rated voltage, 2,000 hours	Δ C/C	Within -20/+10% of initial value
		DF	≤ initial limit
		DCL	1.25 x IL @125° C
		ESR	2 x initial limit
Thermal Shock	KEMET specified test, mounted, -55C° to 125° C, 5 cycles	Δ C/C	Within ±5% of initial value
		DF	Within initial limits
		DCL	Within 1.25 x initial limit
		ESR	Within initial limits
Surge Voltage	85° C, 1.15 x rated voltage 1,000 cycles	Δ C/C	Within ±5% of initial value
		DF	Within initial limits
		DCL	Within initial limits
		ESR	Within initial limits
Surge Voltage	125°C, 0.77 x rated voltage 1,000 cycles	Δ C/C	Within ±5% of initial value
		DF	Within initial limits
		DCL	Within initial limits
		ESR	Within initial limits
Mechanical Vibration	MIL–STD–202, Method 204, Condition D, 10 Hz to 2,000 Hz, 20 G peak	Δ C/C	Within ±10 of initial value
		DF	Within initial limits
		DCL	Within initial limits

Dimensions – Millimeters (Inches)

Metric will govern

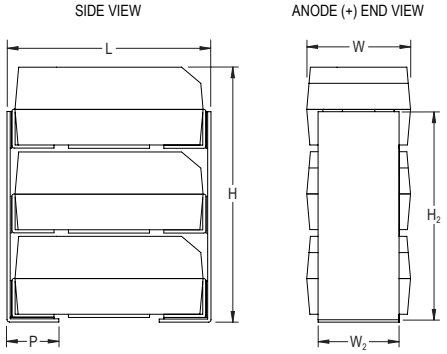
TSP2

KEMET 2 Component Stack Dimensions						
Case Code	L	W	H	W2	H2	P
2B	4.1 ± 0.38 (.162 ± .015)	3.1 ± 0.2 (.122 ± .008)	4.3 ± 0.38 (.170 ± .015)	2.3 ± 0.2 (.090 ± .008)	3.1 ± 0.38 (.124 ± .015)	0.76 ± 0.38 (.030 ± .015)
2D	8.0 ± 0.38 (.315 ± .015)	4.4 ± 0.2 (.174 ± .008)	6.2 ± 0.38 (.245 ± .015)	3.0 ± 0.2 (.120 ± .008)	4.8 ± 0.38 (.192 ± .015)	1.9 ± 0.38 (.075 ± .015)



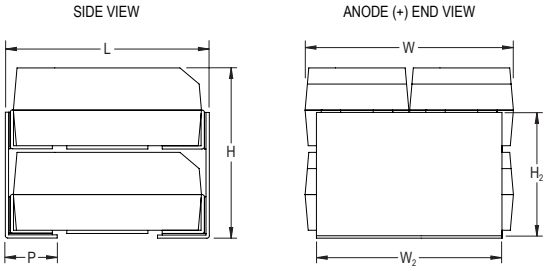
TSP3

KEMET 3 Component Stack Dimensions						
Case Code	L	W	H	W2	H2	P
3B	4.1 ± 0.38 (.162 ± .015)	3.1 ± 0.2 (.122 ± .008)	6.3 ± 0.38 (.248 ± .015)	2.3 ± 0.2 (.090 ± .008)	5.3 ± 0.38 (.210 ± .015)	0.76 ± 0.38 (.030 ± .015)
3D	8.0 ± 0.38 (.315 ± .015)	4.4 ± 0.2 (.174 ± .008)	9.2 ± 0.38 (365 ± .015)	3.0 ± 0.2 (.120 ± .008)	7.7 ± 0.38 (.304 ± .015)	1.9 ± 0.38 (.075 ± .015)



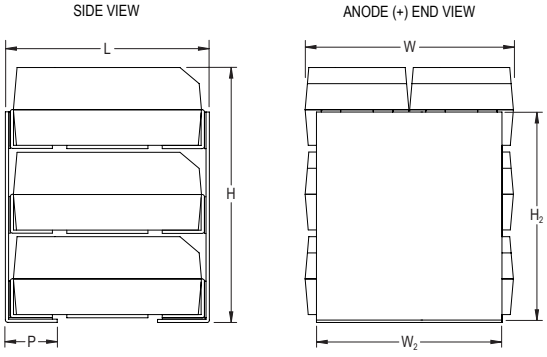
TSP4

KEMET 4 Component Stack Dimensions						
Case Code	L	W	H	W2	H2	P
4B	4.1 ± 0.38 (.162 ± .015)	6.1 ± 0.2 (.242 ± .008)	4.3 ± 0.38 (.170 ± .015)	5.3 ± 0.2 (.210 ± .008)	3.1 ± 0.38 (.124 ± .015)	0.76 ± 0.38 (.030 ± .015)
4D	8.0 ± 0.38 (.315 ± .015)	8.9 ± 0.2 (.350 ± .008)	6.2 ± 0.38 (245 ± .015)	7.4 ± 0.2 (.292 ± .008)	4.8 ± 0.38 (.192 ± .015)	1.9 ± 0.38 (.075 ± .015)



TSP6

KEMET 6 Component Stack Dimensions						
Case Code	L	W	H	W2	H2	P
6B	4.1 ± 0.38 (.162 ± .015)	6.1 ± 0.2 (.242 ± .008)	6.3 ± 0.38 (.248 ± .015)	5.3 ± 0.2 (.210 ± .008)	5.3 ± 0.38 (.210 ± .015)	0.76 ± 0.38 (.030 ± .015)
6D	8.0 ± 0.38 (.315 ± .015)	8.9 ± 0.2 (.350 ± .008)	9.2 ± 0.38 (365 ± .015)	7.4 ± 0.2 (.292 ± .008)	7.7 ± 0.38 (.304 ± .015)	1.9 ± 0.38 (.075 ± .015)



Capacitance and Rated Voltage Chart

Capacitance		Rated Voltage				
µF	Code	3	4	6.3	10	16
66	666				2B	
94	946					2D
99	996				3B	
132	137				4B	
136	137			2B		
141	147					3D
188	197					4D
198	207				6B	
200	207		2B		2D	
204	207			3B		
272	277			4B		
282	287					6D
300	307		3B		2D	
400	407		4B		4D	
408	407			6B		
440	447		2D		2D	
450	457	3B				
600	607	4B	6B			
660	667	2D		2D	3D	
880	887		4D		4D	
900	907	6B			6D	
940	947		2D			
990	997			3D		
1320	138			4D	6D	
1360	148	2D				
1410	148		3D			
1880	198		4D			
1980	208			6D		
2040	208	3D				
2720	278	4D				
2820	288		6D			
4080	418	6D				

Table 1A – TSP2 Ratings & Part Number Reference

Rated Voltage	Rated Capacitance	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	Standard ESR	Low ESR
V	µF	KEMET/EIA	(See below for part options)	µA @ +20°C Max/5 Min	% @ +20°C 120 Hz Max	mΩ +25°C 100 kHz Max	mΩ +25°C 100 kHz Max
4	200	2B	TSP2B207M004AH(1)(2)D540	80	8	40	N/A
6.3	130	2B	TSP2B137M006AH(1)(2)D540	86	8	40	N/A
10	66	2B	TSP2B666M010AH(1)(2)D540	66	8	40	N/A
3	660	2D	TSP2D667M003AH(1)(2)D540	198	10	13	N/A
3	1400	2D	TSP2D148M003AH(1)(2)D540	408	10	13	N/A
4	440	2D	TSP2D447M004AH(1)(2)D540	176	10	13	N/A
4	940	2D	TSP2D947M004AH(1)(2)D540	376	10	20	13
6.3	660	2D	TSP2D667M006AH(1)(2)D540	416	10	20	13
10	200	2D	TSP2D207M010AH(1)(2)D540	200	10	28	13
10	300	2D	TSP2D307M010AH(1)(2)D540	300	10	28	13
10	440	2D	TSP2D447M010AH(1)(2)D540	440	10	13	N/A
16	94	2D	TSP2D946M016AH(1)(2)D540	152	10	33	18
V	µF	KEMET/EIA	(See below for part options)	µA @ +20°C Max/5 Min	% @ +20°C 120 Hz Max	mΩ +25°C 100 kHz Max	mΩ +25°C 100 kHz Max
Rated Voltage	Rated Capacitance	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	Standard ESR	Low ESR

Table 1B – TSP3 Ratings & Part Number Reference

Rated Voltage	Rated Capacitance	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	Standard ESR	Low ESR
V	µF	KEMET/EIA	(See below for part options)	µA @ +20°C Max/5 Min	% @ +20°C 120 Hz Max	mΩ +25°C 100 kHz Max	mΩ +25°C 100 kHz Max
3	450	3B	TSP3B457M003AH(1)(2)D540	135	8	27	N/A
4	300	3B	TSP3B307M004AH(1)(2)D540	120	8	27	N/A
6.3	200	3B	TSP3B207M006AH(1)(2)D540	129	8	27	N/A
10	99	3B	TSP3B996M010AH(1)(2)D540	99	8	27	N/A
3	2000	3D	TSP3D208M003AH(1)(2)D540	612	10	9	N/A
4	1400	3D	TSP3D148M004AH(1)(2)D540	564	10	14	9
6.3	990	3D	TSP3D997M006AH(1)(2)D540	624	10	14	9
10	660	3D	TSP3D667M010AH(1)(2)D540	660	10	9	N/A
16	140	3D	TSP3D147M016AH(1)(2)D540	226	10	22	12
V	µF	KEMET/EIA	(See below for part options)	µA @ +20°C Max/5 Min	% @ +20°C 120 Hz Max	mΩ +25°C 100 kHz Max	mΩ +25°C 100 kHz Max
Rated Voltage	Rated Capacitance	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	Standard ESR	Low ESR

(1) To complete KEMET part number, insert 65 = None, 66 = 10 cycles +25°C, 67 = 10 cycles -55°C +85°C. Designates surge current option.
(2) To complete KEMET part number, insert 10 = Standard ESR, 20 = Low ESR. Designates ESR option.
Refer to Ordering Information for additional detail.

Table 1C – TSP4 Ratings & Part Number Reference

Rated Voltage	Rated Capacitance	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	Standard ESR	Low ESR
V	µF	KEMET/EIA	(See below for part options)	µA @ +20°C Max/5 Min	% @ +20°C 120 Hz Max	mΩ +25°C 100 kHz Max	mΩ +25°C 100 kHz Max
3	600	4B	TSP4B607M003AH(1)(2)D540	180	8	20	N/A
4	400	4B	TSP4B407M004AH(1)(2)D540	160	8	20	N/A
6.3	270	4B	TSP4B277M006AH(1)(2)D540	172	8	20	N/A
10	130	4B	TSP4B137M010AH(1)(2)D540	132	8	20	N/A
3	2700	4D	TSP4D278M003AH(1)(2)D540	816	10	7	N/A
4	880	4D	TSP4D887M004AH(1)(2)D540	352	10	7	N/A
4	1900	4D	TSP4D198M004AH(1)(2)D540	752	10	10	7
6.3	1300	4D	TSP4D138M006AH(1)(2)D540	832	10	10	7
10	400	4D	TSP4D407M010AH(1)(2)D540	400	10	14	7
10	880	4D	TSP4D887M010AH(1)(2)D540	880	10	7	N/A
16	190	4D	TSP4D197M016AH(1)(2)D540	301	10	17	9
V	µF	KEMET/EIA	(See below for part options)	µA @ +20°C Max/5 Min	% @ +20°C 120 Hz Max	mΩ +25°C 100 kHz Max	mΩ +25°C 100 kHz Max
Rated Voltage	Rated Capacitance	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	Standard ESR	Low ESR

Table 1D – TSP6 Ratings & Part Number Reference

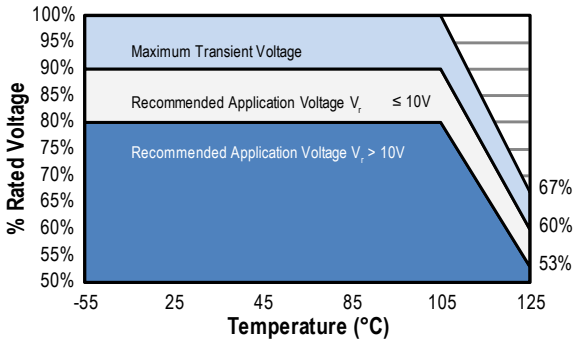
Rated Voltage	Rated Capacitance	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	Standard ESR	Low ESR
V	µF	KEMET/EIA	(See below for part options)	µA @ +20°C Max/5 Min	% @ +20°C 120 Hz Max	mΩ +25°C 100 kHz Max	mΩ +25°C 100 kHz Max
3	900	6B	TSP6B907M003AH(1)(2)D540	270	8	14	N/A
4	600	6B	TSP6B607M004AH(1)(2)D540	240	8	14	N/A
6.3	400	6B	TSP6B407M006AH(1)(2)D540	258	8	14	N/A
10	200	6B	TSP6B207M010AH(1)(2)D540	198	8	14	N/A
3	4100	6D	TSP6D418M003AH(1)(2)D540	1224	10	5	N/A
4	2800	6D	TSP6D288M004AH(1)(2)D540	1128	10	7	5
6.3	2000	6D	TSP6D208M006AH(1)(2)D540	1248	10	7	5
10	900	6D	TSP6D907M010AH(1)(2)D540	900	10	10	5
10	1300	6D	TSP6D138M010AH(1)(2)D540	1320	10	5	N/A
16	280	6D	TSP6D287M016AH(1)(2)D540	452	10	11	6
V	µF	KEMET/EIA	(See below for part options)	µA @ +20°C Max/5 Min	% @ +20°C 120 Hz Max	mΩ +25°C 100 kHz Max	mΩ +25°C 100 kHz Max
Rated Voltage	Rated Capacitance	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	Standard ESR	Low ESR

(1) To complete KEMET part number, insert 65 = None, 66 = 10 cycles +25°C, 67 = 10 cycles -55°C +85°C. Designates surge current option.
(2) To complete KEMET part number, insert 10 = Standard ESR, 20 = Low ESR. Designates ESR option.
Refer to Ordering Information for additional detail.

Derating Guidelines

Voltage Rating	Maximum Recommended Steady State Voltage	Maximum Recommended Transient Voltage (1 ms – 1 µs)
-55°C to 105°C		
10 V ≤ V_R	90% of V_R	V_R
V_R > 10	80% of V_R	V_R

V_R = Rated Voltage



Reverse Voltage

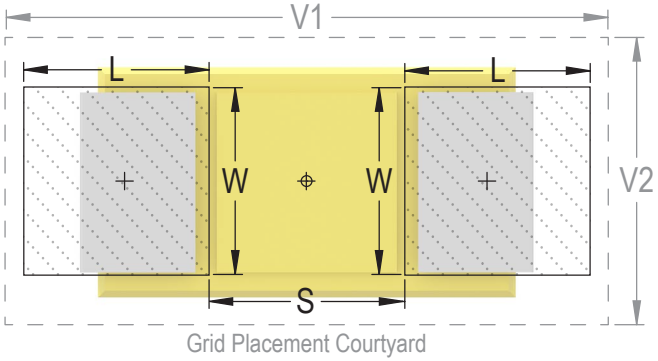
Solid tantalum capacitors are polar devices and may be permanently damaged or destroyed if connected with the wrong polarity. The positive terminal is identified on the capacitor body by a stripe plus in some cases a beveled edge. A small degree of transient reverse voltage is permissible for short periods per the table. The capacitors should not be operated continuously in reverse mode, even within these limits.

Temperature	Permissible Transient Reverse Voltage
25°C	15% of Rated Voltage
85°C	5% of Rated Voltage
125°C	1% of Rated Voltage

Table 2 – Land Dimensions/Courtyard

KEMET	Density Level A: Maximum (Most) Land Protrusion (mm)					Density Level B: Median (Nominal) Land Protrusion (mm)					Density Level C: Minimum (Least) Land Protrusion (mm)				
Case	L	W	S	V1	V2	L	W	S	V1	V2	L	W	S	V1	V2
TSP2B	2.34	2.54	1.41	7.10	4.30	1.94	2.42	1.61	6.00	3.80	1.56	2.32	1.77	5.14	3.54
TSP2D	3.48	3.24	3.03	11.00	5.60	3.08	3.12	3.23	9.90	5.10	2.70	3.02	3.39	9.04	4.84
TSP3B	2.34	2.54	1.41	7.10	4.30	1.94	2.42	1.61	6.00	3.80	1.56	2.32	1.77	5.14	3.54
TSP3D	3.48	3.24	3.03	11.00	5.60	3.08	3.12	3.23	9.90	5.10	2.70	3.02	3.39	9.04	4.84
TSP4B	2.34	5.54	1.41	7.10	7.30	1.94	5.42	1.61	6.00	6.80	1.56	5.32	1.77	5.14	6.54
TSP4D	3.48	7.64	3.03	11.00	10.10	3.08	7.52	3.23	9.90	9.60	2.70	7.42	3.39	9.04	9.34
TSP6B	2.34	5.54	1.41	7.10	7.30	1.94	5.42	1.61	6.00	6.80	1.56	5.32	1.77	5.14	6.54
TSP6D	3.48	7.64	3.03	11.00	10.10	3.08	7.52	3.23	9.90	9.60	2.70	7.42	3.39	9.04	9.34

Density Level A: *For low-density Product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes.*
Density Level B: *For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes.*
Density Level C: *For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC standard 7351 (IPC-7351).*
[1] Height of these chips may create problems in wave soldering.



Soldering Process

KEMET's families of surface mount capacitors are compatible with wave (single or dual), convection, IR, or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J–STD–020D standard for moisture sensitivity testing. The devices can safely withstand a maximum of three reflow passes at these conditions.

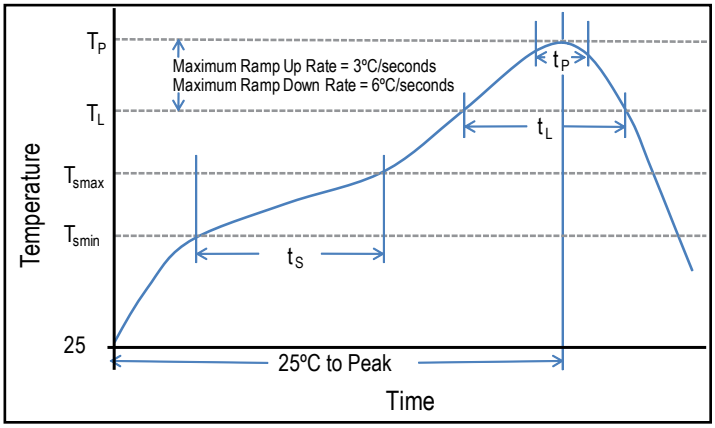
Please note that although the X/7343–43 case size can withstand wave soldering, the tall profile (4.3 mm maximum) dictates care in wave process development.

Hand soldering should be performed with care due to the difficulty in process control. If performed, care should be taken to avoid contact of the soldering iron to the molded case. The iron should be used to heat the solder pad, applying solder between the pad and the termination, until reflow occurs. Once reflow occurs, the iron should be removed immediately. "Wiping" the edges of a chip and heating the top surface is not recommended.

During typical reflow operations, a slight darkening of the gold-colored epoxy may be observed. This slight darkening is normal and not harmful to the product. Marking permanency is not affected by this change.

Profile Feature	SnPb Assembly	Pb-Free Assembly
Preheat/Soak		
Temperature Minimum (T_{Smin})	100°C	150°C
Temperature Maximum (T_{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax})	60 – 120 seconds	60 – 120 seconds
Ramp-up Rate (T_L to T_P)	3°C/seconds maximum	3°C/seconds maximum
Liquidous Temperature (T_L)	183°C	217°C
Time Above Liquidous (t_L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T_P)	220°C* 235°C**	250°C* 260°C**
Time within 5°C of Maximum Peak Temperature (t_P)	20 seconds maximum	30 seconds maximum
Ramp-down Rate (T_P to T_L)	6°C/seconds maximum	6°C/seconds maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum

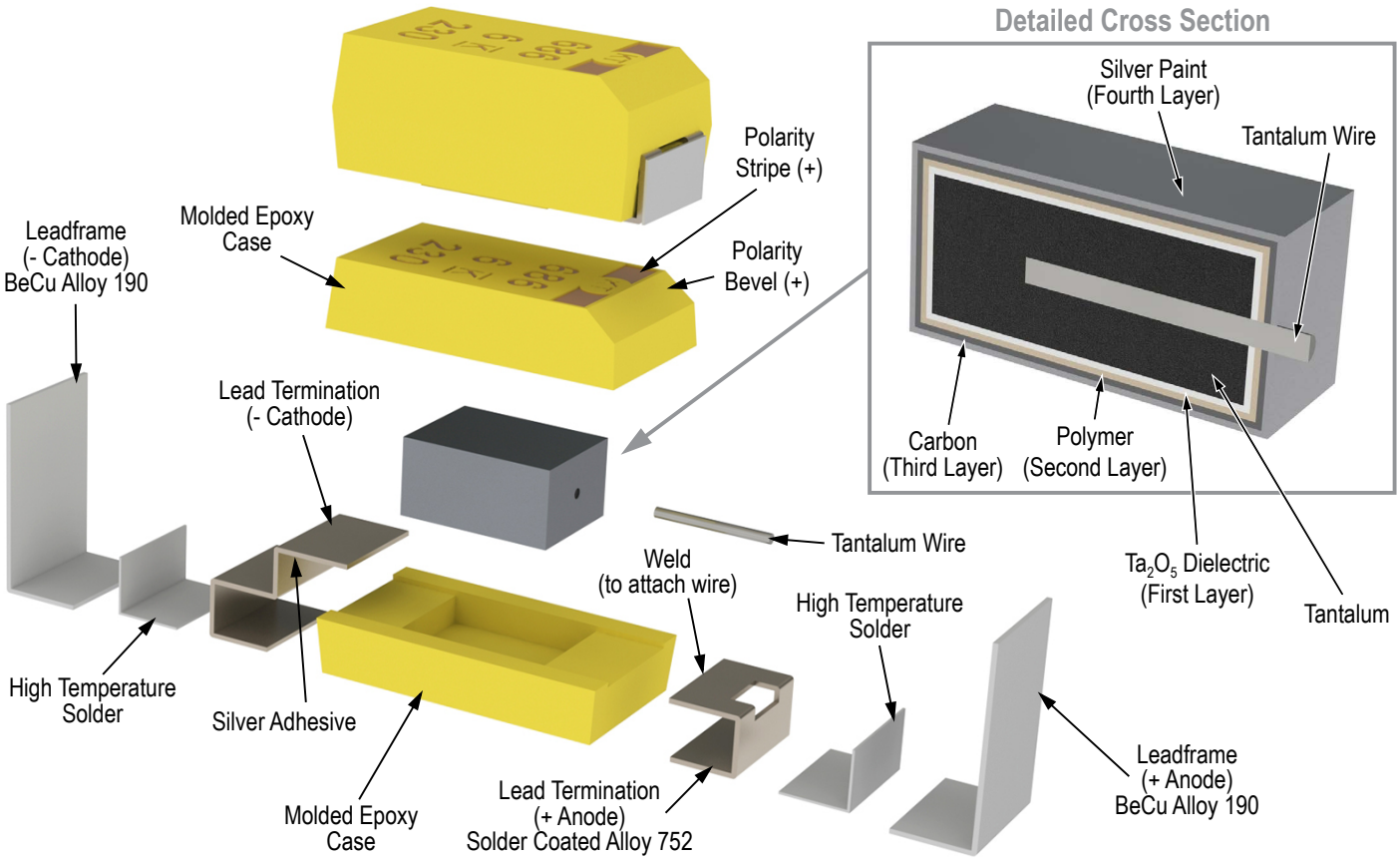
Note: All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow.
**Case Size D, E, P, Y, and X*
***Case Size A, B, C, H, I, K, M, R, S, T, U, V, W, and Z*



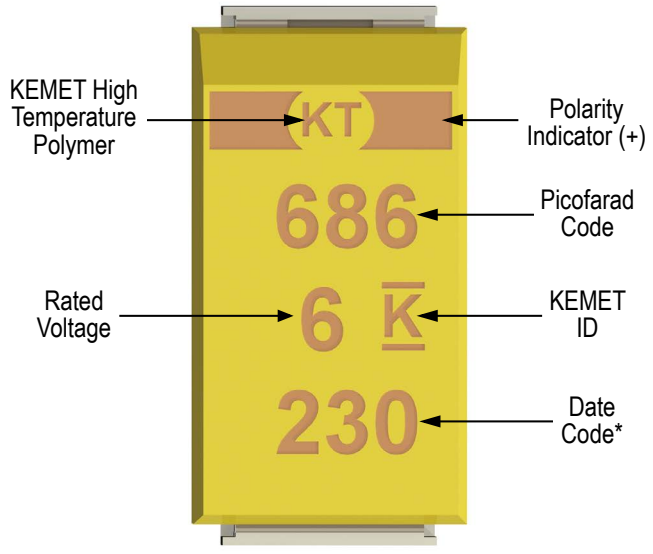
Storage

Tantalum chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature– reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 40ºC and maximum storage humidity not exceed 60% relative humidity. Temperature fluctuations should be minimized to avoid condensation on the parts and atmospheres should be free of chlorine and sulphur bearing compounds. For optimized solderability chip stock should be used promptly, preferably within three years of receipt.

Construction



Capacitor Marking



* 230 = 30th week of 2012

Date Code *	
1st digit = Last number of Year	9 = 2009 0 = 2010 1 = 2011 2 = 2012 3 = 2013 4 = 2014
2nd and 3rd digit = Week of the Year	01 = 1st week of the Year to 52 = 52nd week of the Year

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