

Overview

The KEMET Tantalum Stack Polymer (TSP) Electrolytic is designed to provide the highest capacitance/voltage ratings in a surface mount configuration. KEMET's T540 COTS Polymer Electrolytic for High Reliability Applications 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 offers component level surge current testing options and standard and low ESR options. As with other KEMET KO-CAPs, this series may be operated at steady state voltages up to 90% of rated voltage for part types with rated voltages of greater or equal to 10 volts and up to 80% of rated voltage for part types greater than 10 volts. Stacking configurations allow for custom capacitance/voltage solutions and very low ESR options.

KOCAP Polymer Capacitors

The TSP series is the first polymer electrolytic capacitor available with failure rate options as defined by KEMET's Polymer Electrolytic Reliability Assessment method (PERA). The PERA method utilizes accelerated conditions (voltage and temperature) applied to board mounted samples to assess long term device reliability. The failure rates available are B (0.1%/Khrs.), C (0.01%/Khrs.) and D (0.001%/Khrs.). The PERA method was developed based on over ten (10) years of research and is described in numerous papers available on www.kemet.com.

Note: Custom stacking solutions are also available with other KEMET Polymer Electrolytic Surface Mount products. Please contact KEMET Sales for availability.

Benefits

- Polymer cathode technology
- High capacitance
- Surface mountable
- Capacitance values of 20 μ F to 6,000 μ F
- Capacitance can be custom specified
- Voltage ratings of 3 VDC to 63 VDC
- High volumetric efficiency
- Ultra low ESR
- Surge capability
- Operating temperature range of -55°C to $+125^{\circ}\text{C}$
- 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
- KEMET's PERA method testing



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.

K-SIM

For a detailed analysis of specific part numbers, please visit ksim.kemet.com to access KEMET's K-SIM software. KEMET K-SIM is designed to simulate behavior of components with respect to frequency, ambient temperature, and DC bias levels.

Ordering Information

T	SP	2D	207	M	010	A	H	65	20	D540
Capacitor Class	Series	Case Size	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Failure Rate/ Design	Termination Finish	Surge	ESR	C-Spec 2
T = Tantalum	Stacks Polymer Cathode	2B, 3B, 4B, 6B, 2D, 3D, 4D, 6D 2X, 3X 4X, 6X	First two digits represent significant figures. Third digit specifies number of zeros.	M = ±20%	003 = 3 004 = 4 006 = 6.3 010 = 10 016 = 16 025 = 25 035 = 35 050 = 50 063 = 63	A = N/A	H = Standard Solder Coated (SnPb 5% Pb minimum)	65 = No Surge 66 = 10 cycles at 25°C 67 = 10 cycles at -55°C and 85°C	10 = ESR - Standard 20 = ESR-Low	Designates discrete component series. D540 = T540 D541 = T541

Performance Characteristics

Item	Performance Characteristics
Operating Temperature	-55°C to 125°C
Rated Capacitance Range	20 µF – 6,000 µF at 120 Hz/25° C
Capacitance Tolerance	M Tolerance (20%)
Rated Voltage Range	3 V – 63 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

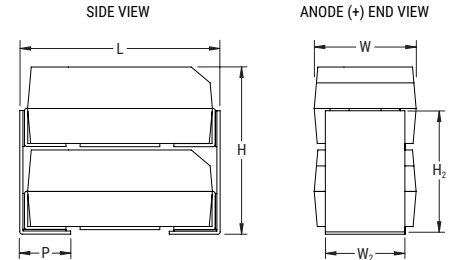
Qualification

Test	Condition	Characteristics	
Endurance	105°C at rated voltage, 2,000 hours 125°C at 2/3 rated voltage, 2,000 hours	Δ C/C	Within -20/+10% of initial value
		DF	≤ initial limit
		DCL	1.25 x IL at 125°C
		ESR	2 x initial limit
Thermal Shock	KEMET specified test, mounted, -55°C 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

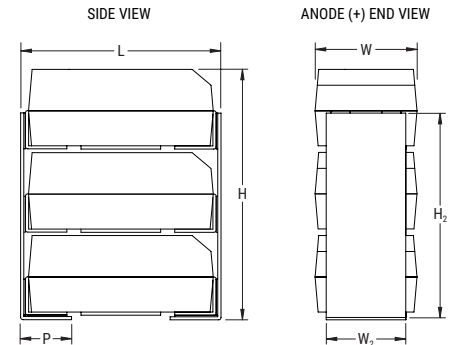
TSP2

KEMET 2 Component Stack Dimensions						
Case Code	L	W	H	W ₂	H ₂	P
2B	4.1±0.38 (0.162±0.015)	3.1±0.2 (0.122±0.008)	4.3±0.38 (0.170±0.015)	2.3±0.2 (0.090±0.008)	3.1±0.38 (0.124±0.015)	0.76±0.38 (0.030±0.015)
2D	8.0±0.38 (0.315±0.015)	4.4±0.2 (0.174±0.008)	6.2±0.38 (0.245±0.015)	3.0±0.2 (0.120±0.008)	4.8±0.38 (0.192±0.015)	1.9±0.38 (0.075±0.015)
2X	8.0±0.38 (0.315±0.015)	4.4±0.2 (0.174±0.008)	8.9±0.38 (0.352±0.015)	3.0±0.2 (0.120±0.008)	6.9±0.38 (0.272±0.015)	1.9±0.38 (0.075±0.015)



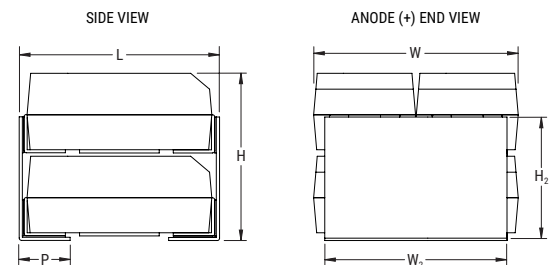
TSP3

KEMET 3 Component Stack Dimensions						
Case Code	L	W	H	W ₂	H ₂	P
3B	4.1±0.38 (0.162±0.015)	3.1±0.2 (0.122±0.008)	6.3±0.38 (0.248±0.015)	2.3±0.2 (0.090±0.008)	5.3±0.38 (0.210±0.015)	0.76±0.38 (0.030±0.015)
3D	8.0±0.38 (0.315±0.015)	4.4±0.2 (0.174±0.008)	9.2±0.38 (0.365±0.015)	3.0±0.2 (0.120±0.008)	7.7±0.38 (0.304±0.015)	1.9±0.38 (0.075±0.015)
3X	8.0±0.38 (0.315±0.015)	4.4±0.2 (0.174±0.008)	13.3±0.38 (0.525±0.015)	3.0±0.2 (0.120±0.008)	11.0±0.38 (0.436±0.015)	1.9±0.38 (0.075±0.015)



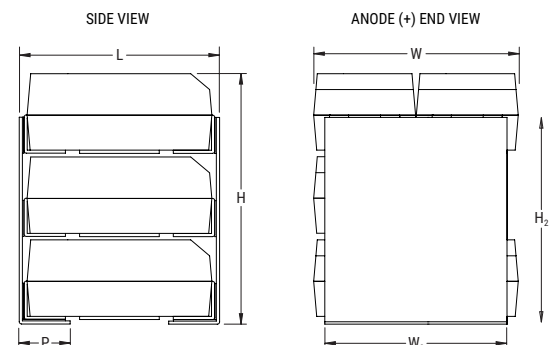
TSP4

KEMET 4 Component Stack Dimensions						
Case Code	L	W	H	W ₂	H ₂	P
4B	4.1±0.38 (0.162±0.015)	6.1±0.2 (0.242±0.008)	4.3±0.38 (0.170±0.015)	5.3±0.2 (0.210±0.008)	3.1±0.38 (0.124±0.015)	0.76±0.38 (0.030±0.015)
4D	8.0±0.38 (0.315±0.015)	8.9±0.2 (0.350±0.008)	6.2±0.38 (0.245±0.015)	7.4±0.2 (0.292±0.008)	4.8±0.38 (0.192±0.015)	1.9±0.38 (0.075±0.015)
4X	8.0±0.38 (0.315±0.015)	8.9±0.2 (0.350±0.008)	8.9±0.38 (0.352±0.015)	7.4±0.2 (0.292±0.008)	6.9±0.38 (0.272±0.015)	1.9±0.38 (0.075±0.015)



TSP6

KEMET 6 Component Stack Dimensions						
Case Code	L	W	H	W ₂	H ₂	P
6B	4.1±0.38 (0.162±0.015)	6.1±0.2 (0.242±0.008)	6.3±0.38 (0.248±0.015)	5.3±0.2 (0.210±0.008)	5.3±0.38 (0.210±0.015)	0.76±0.38 (0.030±0.015)
6D	8.0±0.38 (0.315±0.015)	8.9±0.2 (0.350±0.008)	9.2±0.38 (0.365±0.015)	7.4±0.2 (0.292±0.008)	7.7±0.38 (0.304±0.015)	1.9±0.38 (0.075±0.015)
6X	8.0±0.38 (0.315±0.015)	8.9±0.2 (0.350±0.008)	13.3±0.38 (0.525±0.015)	7.4±0.2 (0.292±0.008)	11.0±0.38 (0.436±0.015)	1.9±0.38 (0.075±0.015)



Capacitance and Rated Voltage Chart

Capacitance		Rated Voltage								
µf	Code	3V	4V	6.3V	10	16	25	35	50	63
20	206									2X
30	306									2X, 3X
40	406									4X
44	446								2X	
45	456									3X
60	606									4X, 6X
66	666				2B			2X	2X, 3X	
88	886								4X	
90	906									6X
94	946					2D		2X		
99	996				3B					
100	107							3X	3X	
130	137			2B	4B		2X	4X	4X, 6X	
140	147					3D		3X		
190	197					4D		4X		
198	207				6B					
200	207		2B	3B	2D		3X	6X	6X	
260	267						4X			
272	277			4B						
280	287					6D		6X		
300	307		3B		2D	2X				
400	407		4B	6B	4D		6X			
440	447		2D		2D	2X				
450	457	3B				3X				
600	607	4B	6B			4X				
660	667	2D		2D	3D, 2X	2X, 3X				
880	887		4D		4D	4X				
900	907	6B			6D	6X				
940	947		2D	2X						
990	997			3D	3X	3X				
1300	138		2X	4D	6D, 4X	4X, 6X				
1360	148	2D								
1400	148		3D	3X						
1900	198		4D	4X						
1980	208			6D						
2000	208	3D	2X, 3X		6X	6X				
2700	278	4D	4X							
2800	288		6D	6X						
3000	308		3X							
4000	408	6D	4X, 6X							
6000	608		6X							

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	Maximum Operating Temp
VDC @ 105°C	µF	KEMET/EIA	(See below for part options)	µA @ +25°C Max/5 Min	% @ +25°C 120 Hz Max	mΩ @ +25°C 100 kHz Max	mΩ @ +25°C 100 kHz Max	°C
4	200	2B	TSP2B207M004AH(1)(2)D540	80	8	40	N/A	125
6.3	130	2B	TSP2B137M006AH(1)(2)D540	86	8	40	N/A	125
10	66	2B	TSP2B666M010AH(1)(2)D540	66	8	40	N/A	125
3	660	2D	TSP2D667M003AH(1)(2)D540	198	10	13	N/A	125
3	1400	2D	TSP2D148M003AH(1)(2)D540	408	10	13	N/A	125
4	440	2D	TSP2D447M004AH(1)(2)D540	176	10	13	N/A	125
4	940	2D	TSP2D947M004AH(1)(2)D540	376	10	20	13	125
6.3	660	2D	TSP2D667M006AH(1)(2)D540	416	10	20	13	125
10	200	2D	TSP2D207M010AH(1)(2)D540	200	10	28	13	125
10	300	2D	TSP2D307M010AH(1)(2)D540	300	10	28	13	125
10	440	2D	TSP2D447M010AH(1)(2)D540	440	10	13	N/A	125
16	94	2D	TSP2D946M016AH(1)(2)D540	152	10	33	18	125
4	1300	2X	TSP2X138M004AH(1)(2)D541	520	10	5	3	125
4	2000	2X	TSP2X208M004AH(1)(2)D541	800	10	5	3	125
6.3	940	2X	TSP2X947M006AH(1)(2)D541	564	10	5	3	125
10	660	2X	TSP2X667M010AH(1)(2)D541	660	10	5	3	125
16	300	2X	TSP2X307M016AH(1)(2)D541	480	10	20	12	125
16	440	2X	TSP2X447M016AH(1)(2)D541	704	10	20	12	125
16	660	2X	TSP2X667M016AH(1)(2)D541	1056	10	25	12	125
25	130	2X	TSP2X137M025AH(1)(2)D541	325	10	25	N/A	125
35	66	2X	TSP2X666M035AH(1)(2)D541	231	10	30	N/A	125
35	94	2X	TSP2X946M035AH(1)(2)D541	329	10	30	N/A	125
50	44	2X	TSP2X446M050AH(1)(2)D541	220	10	40	N/A	125
50	66	2X	TSP2X666M050AH(1)(2)D541	330	10	40	N/A	125
63	20	2X	TSP2X206M063AH(1)(2)D541	126	10	75	50	125
63	30	2X	TSP2X306M063AH(1)(2)D541	189	10	25	N/A	125

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	Maximum Operating Temp
VDC @ 105°C	µF	KEMET/EIA	(See below for part options)	µA @ +25°C Max/5 Min	% @ +25°C 120 Hz Max	mΩ @ +25°C 100 kHz Max	mΩ @ +25°C 100 kHz Max	°C
3	450	3B	TSP3B457M003AH(1)(2)D540	135	8	27	N/A	125
4	300	3B	TSP3B307M004AH(1)(2)D540	120	8	27	N/A	125
6.3	200	3B	TSP3B207M006AH(1)(2)D540	129	8	27	N/A	125
10	99	3B	TSP3B996M010AH(1)(2)D540	99	8	27	N/A	125
3	2000	3D	TSP3D208M003AH(1)(2)D540	612	10	9	N/A	125
4	1400	3D	TSP3D148M004AH(1)(2)D540	564	10	14	9	125
6.3	990	3D	TSP3D997M006AH(1)(2)D540	624	10	14	9	125
10	660	3D	TSP3D667M010AH(1)(2)D540	660	10	9	N/A	125
16	140	3D	TSP3D147M016AH(1)(2)D540	226	10	22	12	125
4	2000	3X	TSP3X208M004AH(1)(2)D541	800	10	3	2	125
4	3000	3X	TSP3X308M004AH(1)(2)D541	1200	10	3	2	125
6.3	1400	3X	TSP3X148M006AH(1)(2)D541	840	10	3	2	125
10	990	3X	TSP3X997M010AH(1)(2)D541	990	10	3	2	125
16	450	3X	TSP3X457M016AH(1)(2)D541	720	10	15	9	125
16	660	3X	TSP3X667M016AH(1)(2)D541	1056	10	15	9	125
16	990	3X	TSP3X997M016AH(1)(2)D541	1584	10	18	9	125
25	200	3X	TSP3X207M025AH(1)(2)D541	500	10	18	N/A	125
35	100	3X	TSP3X107M035AH(1)(2)D541	350	10	20	N/A	125
35	140	3X	TSP3X147M035AH(1)(2)D541	490	10	20	N/A	125
50	66	3X	TSP3X666M050AH(1)(2)D541	330	10	25	N/A	125
50	100	3X	TSP3X107M050AH(1)(2)D541	500	10	25	N/A	125
63	30	3X	TSP3X306M063AH(1)(2)D541	189	10	50	35	125
63	45	3X	TSP3X456M063AH(1)(2)D541	283.5	10	18	N/A	125

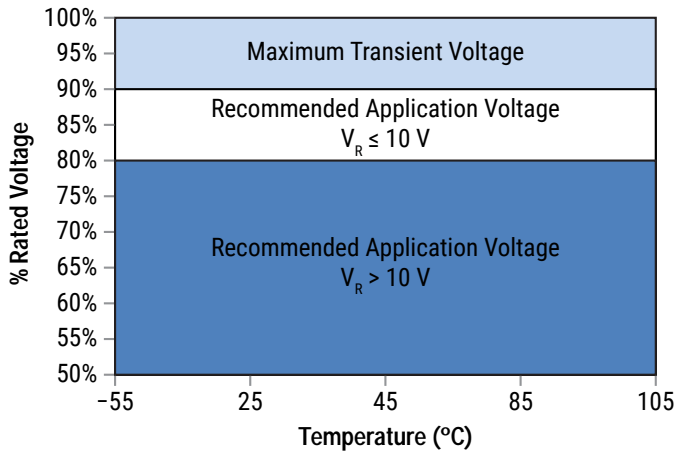
Table 1C – TSP4 Ratings & Part Number Reference



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	Maximum Operating Temp
VDC @ 105°C	µF	KEMET/EIA	(See below for part options)	µA @ +25°C Max/5 Min	% @ +25°C 120 Hz Max	mΩ @ +25°C 100 kHz Max	mΩ @ +25°C 100 kHz Max	°C
3	900	6B	TSP6B907M003AH(1)(2)D540	270	8	14	N/A	125
4	600	6B	TSP6B607M004AH(1)(2)D540	240	8	14	N/A	125
6.3	400	6B	TSP6B407M006AH(1)(2)D540	258	8	14	N/A	125
10	200	6B	TSP6B207M010AH(1)(2)D540	198	8	14	N/A	125
3	4100	6D	TSP6D418M003AH(1)(2)D540	1224	10	5	N/A	125
4	2800	6D	TSP6D288M004AH(1)(2)D540	1128	10	7	5	125
6.3	2000	6D	TSP6D208M006AH(1)(2)D540	1248	10	7	5	125
10	900	6D	TSP6D907M010AH(1)(2)D540	900	10	10	5	125
10	1300	6D	TSP6D138M010AH(1)(2)D540	1320	10	5	N/A	125
16	280	6D						

Derating Guidelines



Recommended Application Voltage

KOCAP's are solid state capacitors that demonstrate no wearout mechanism when operated within their recommended guidelines. While the KOCAP can be operated at full rated voltage, most circuit designers seek a minimum level of assurance in long term reliability which should be demonstrated with data.

A voltage derating can provide the desired level of demonstrated reliability based on industry accepted acceleration models. Since most applications do require long term reliability, KEMET recommends that designers consider a voltage derating, according the graphic above, for the maximum steady state voltage.

Voltage Rating	Maximum Recommended Steady State Voltage
-55°C to 105°C	

Table 2 – Land Dimensions/Courtyard

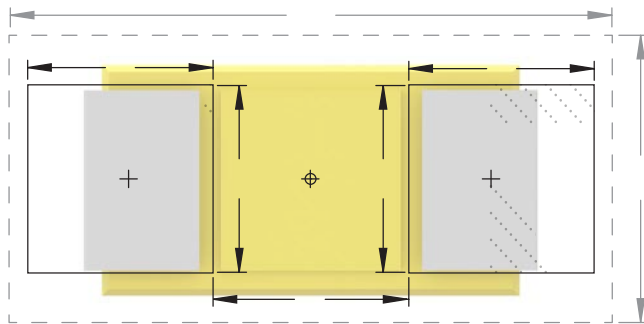
KEMET Case	Density Level A: Maximum (Most) Land Protrusion (mm)					Density Level B: Median (Nominal) Land Protrusion (mm)					Density Level C: Minimum (Least) Land Protrusion (mm)				
	L	W	S	V1	V2	L	W	S	V1	V2	L	W	S	V1	V2
TSP2B	2.34	2.54	1.41	7.10	4.30	1.94	2.42	1.61	6.00	3.80	1.56	2.32	1.77	5.14	3.54
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
TSP2X	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
TSP3X	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
TSP4X	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
TSP6X	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:
 solder processes.

Density Level B:

Density Level C: For high component density product applications. Before adapting the minimum land pattern variations the user should perform

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.

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

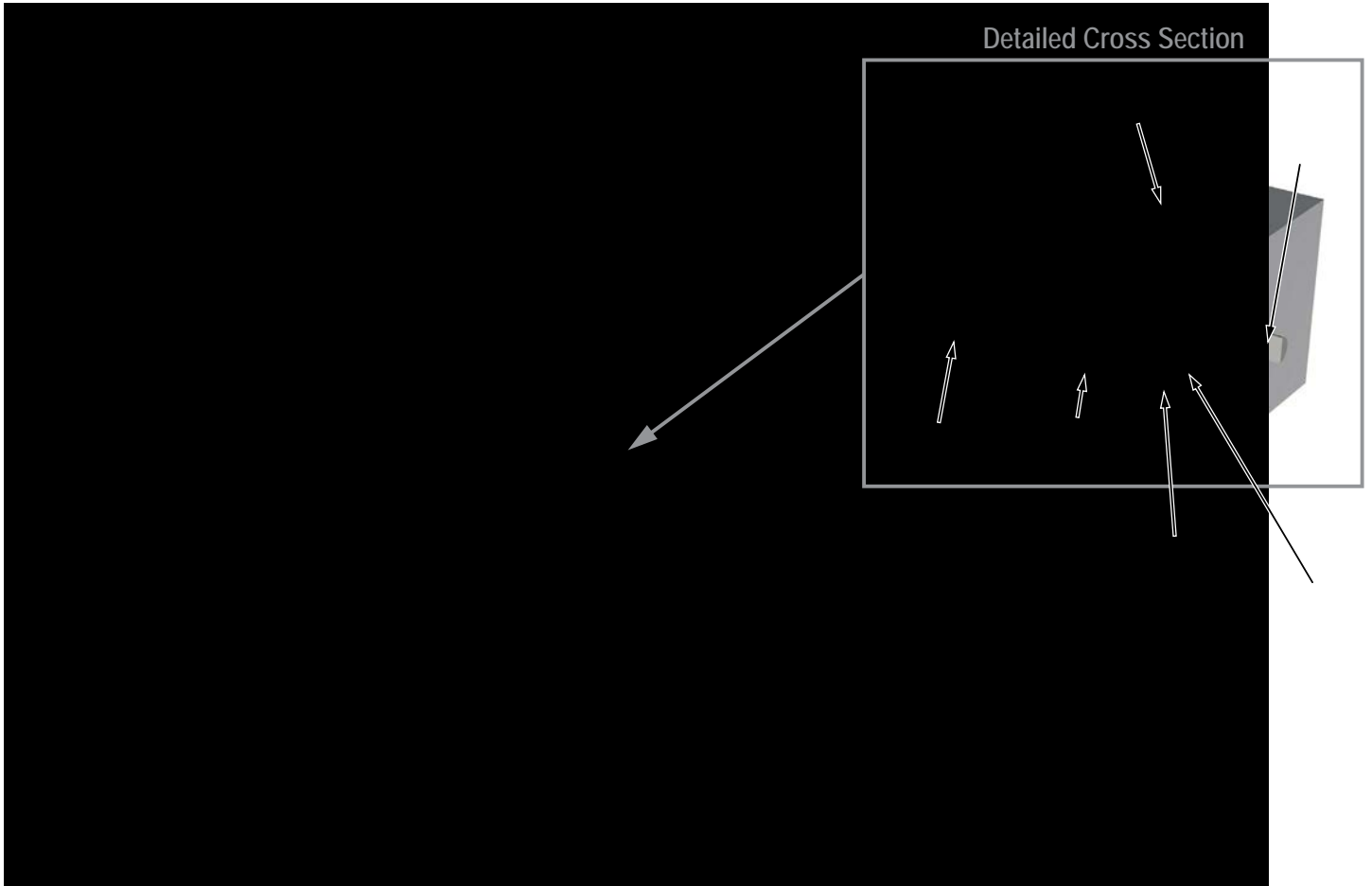
Note: All temperatures refer to the center of the package, measured on the

Storage

All KO-Cap Series are shipped in moisture barrier bags (MBBs) with desiccant and humidity indicator card (HIC). These parts are classified as MSL3 (Moisture Sensitivity Level 3) per IPC/JEDEC J–STD–020 and packaged per IPC/JEDEC J–STD–033

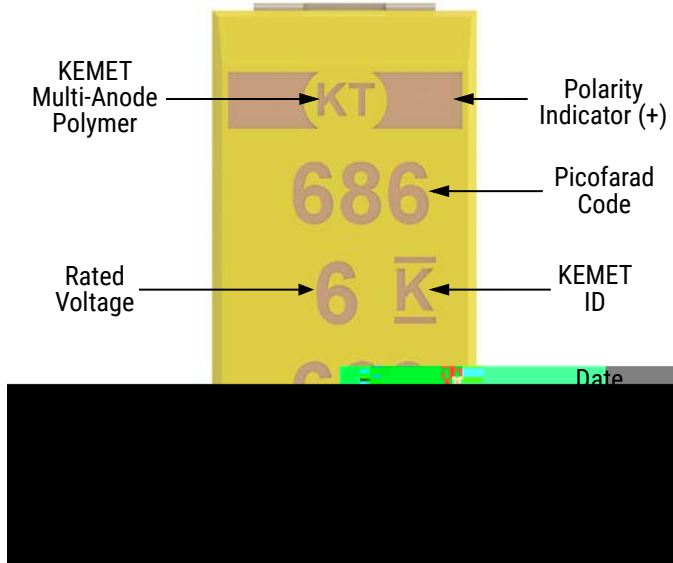
MSL3 specifies a floor time of 168H at 30°C maximum temperature and 60% relative humidity

Construction



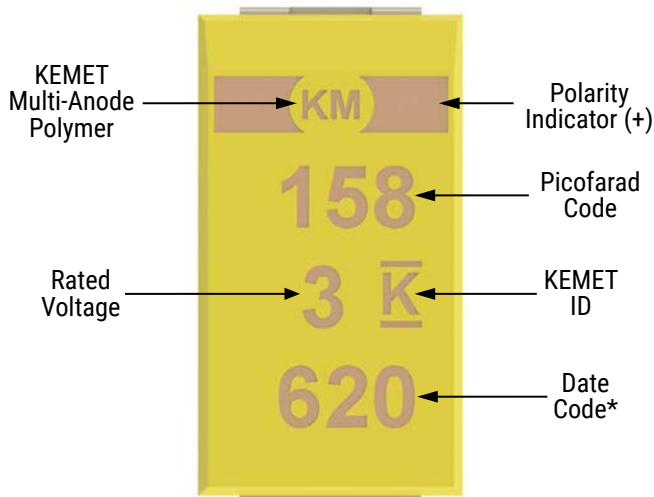
Capacitor Marking

T540



Date Code *	
1 st digit = Last number of Year	2 = 2012 3 = 2013 4 = 2014 5 = 2015 6 = 2016 7 = 2017
2 nd and 3 rd digit = Week of the Year	01 = 1 st week of the Year to 52 = 52 nd week of the Year

T541



* 620 = 20th week of 2016

Date Code *	
1 st digit = Last number of Year	2 = 2012 3 = 2013 4 = 2014 5 = 2015 6 = 2016 7 = 2017
2 nd and 3 rd digit = Week of the Year	01 = 1 st week of the Year to 52 = 52 nd week of the Year

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