

Overview

The low ESR, surge-robust T510 Series is designed for demanding applications that require high surge current and high ripple current capability. This series builds upon the proven capabilities of our industrial grade tantalum chip capacitors to offer several advantages such as low ESR, high ripple current capability, excellent capacitance stability, and improved resistance to high in-rush currents. These benefits are achieved through the utilization of multiple anodes as well as high-stress, low impedance electrical conditioning performed prior to screening.

Benefits

- Meets or exceeds EIA standard 535BAAC
- Taped and reeled per EIA 481-D
- High surge current capability
- Optional gold-plated terminations
- High ripple current capability
- 100% surge current test
- 100% steady-state accelerated aging
- Capacitance values of 10 μ F to 1000 μ F
- Tolerances of \pm 10% and \pm 20%
- Voltage rating of 4 to 50 VDC
- Case sizes E and X
- ESR as low as 18 m Ω
- RoHS compliance and lead-free terminations
- Operating temperature range of -55°C to +125°C

Applications

Typical applications include decoupling and filtering in industrial and automotive end applications, such as DC/DC converters, portable electronics, telecommunications, and control units requiring high ripple current capability.



Environmental Compliance

RoHS Compliant (6/6)* according to Directive 2002/95/EC

*When ordered with 100% Sn Solder

SPICE

For a detailed analysis of specific part numbers, please visit 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	510	X	477	M	006	A	T	E030	
Capacitor Class	Series	Case Size	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Failure Rate/Design	Lead Material	ESR Code	Packaging (C-Spec)
T = Tantalum	Multiple Anode Low ESR	E = 7260-38 X = 7343-43	First two digits represent significant figures. Third digit specifies number of zeros.	K = ±10% M = ±20%	004 = 4V 006 = 6.3V 010 = 10V 016 = 16V 020 = 20V 025 = 25V 035 = 35V 050 = 50V	A = N/A Z = N/A	T = 100% Matte Tin (Sn) Plated H = Standard Solder Coated (SnPb 5% Pb minimum) G = Gold Plated (A, B, C, D, X only)	E = ESR Last three digits specify ESR in mOhms. (030 = 30mOhms)	Blank = 7" Reel 7280 = 13" Reel

Performance Characteristics

Item	Performance Characteristics
Operating Temperature	-55°C to 125°C
Rated Capacitance Range	10µF–1,000µF @ 120 Hz/25°C
Capacitance Tolerance	K Tolerance (10%), M Tolerance (20%)
Rated Voltage Range	4V– 50V
DF(120Hz)	Refer to Part Number Electrical Specification Table
ESR (100kHz)	Refer to Part Number Electrical Specification Table
Leakage Current	≤ 0.01CV (µA) at Rated Voltage after 5 minutes

Qualification

Test	Condition	Characteristics					
Endurance	85°C @ Rated Voltage, 2000 Hours 125°C @ 2/3 Rated Voltage, 2000 Hours	ΔC/C	Within ± 10% of initial value				
		DF	Within initial limits				
		DCL	Within 1.25 x initial limit				
		ESR	Within initial limits				
Storage Life	125°C @ 0 Volts, 2000 Hours	ΔC/C	Within ± 10% of initial value				
		DF	Within initial limits				
		DCL	Within 1.25 x initial limit				
		ESR	Within initial limits				
Thermal Shock	MIL-STD-202, Method 107, Condition B, mounted, -55°C to 125° C, 1000 cycles	ΔC/C	Within ± 5% of initial value				
		DF	Within initial limits				
		DCL	Within 1.25 x initial limit				
		ESR	Within initial limits				
Temperature Stability	Extreme temperature exposure at a succession of continuous steps at +25°C, -55°C, +25°C, +85°C, +125°C, +25°C	+25°C	-55°C	+85°C	+125°C		
		ΔC/C	IL*	±10%	±10%	±20%	
		DF	IL	IL	1.5 x IL	1.5 x IL	
		DCL	IL	n/a	10 x IL	12 x IL	
		Surge Voltage	25°C and 85°C, 1.32 x Rated Voltage 1000 cycles (125°C, 1.2 x Rated Voltage)	ΔC/C	Within ± 5% of initial value		
				DF	Within initial limits		
DCL	Within initial limits						
ESR	Within initial limits						
Mechanical Shock/Vibration	MIL-STD-202, Meth. 213, Cond. I, 100G Peak. MIL-STD-202, Meth. 204, Cond. D, 10Hz to 2000Hz, 20G Peak	ΔC/C	Within ±10% of initial value				
		DF	Within initial limits				
		DCL	Within initial limits				

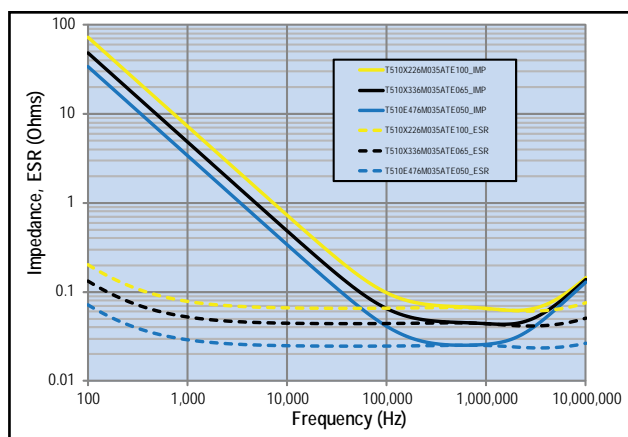
*IL = Initial limit

Certification

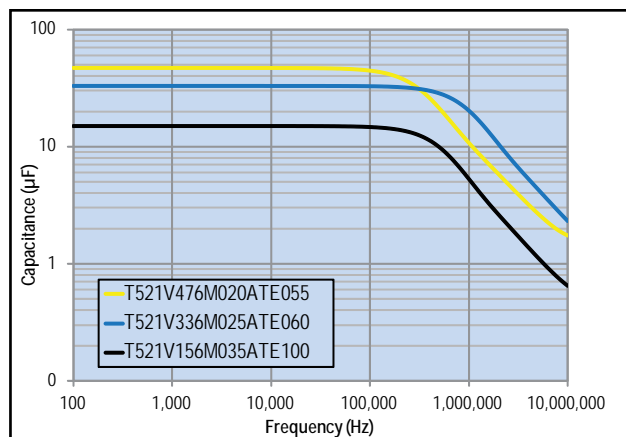
KEMET's Internal Qualification Plan for this Tantalum series of capacitors follows AEC-Q200 guidelines. Standard catalog part types ordered without a specific automotive designator, i.e., suffix AUTO or four digit customer specific designator (C SPEC), are not considered KEMET Automotive Grade Tantalum capacitors.

Electrical Characteristics

ESR vs. Frequency

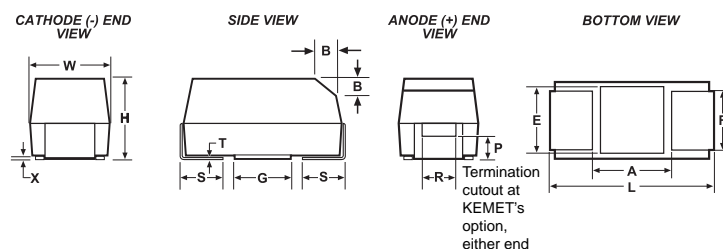


Capacitance vs. Frequency



Dimensions – Millimeters (Inches)

Metric will govern



Case Size		Component												
KEMET	EIA	L*	W*	H*	F* ±0.1 ±(.004)	S* ±0.3 ±(.012)	B* ±0.15 (Ref) ±.006	X (Ref)	P (Ref)	R (Ref)	T (Ref)	A (Min)	G (Ref)	E (Ref)
X	7343-43	7.3 ± 0.3 (.287 ± .012)	4.3 ± 0.3 (.169 ± .012)	4.0 ± 0.3 (.157 ± .012)	2.4 (.094)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	1.7 (.067)	1.0 (.039)	0.13 (.005)	3.8 (.150)	3.5 (.138)	3.5 (.138)
E	7260-38	7.3 ± 0.3 (.287 ± .012)	6.0 ± 0.3 (.236 ± .012)	3.6 ± 0.2 (.142 ± .008)	4.1 (.161)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	0.9 (.035)	1.0 (.039)	0.13 (.005)	0.13 (.005)	3.5 (.138)	3.5 (.138)

Notes: (Ref) – Dimensions provided for reference only. No dimensions are provided for B, P or R because low profile cases do not have a bevel or a notch.

* MIL-C-55365/8 specified dimensions

Table 1 – Ratings & Part Number Reference

Rated Voltage	Rated Cap	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	ESR	Maximum Allowable Ripple Current			Moisture Sensitivity
							+25°C 100kHz	+85°C 100kHz	+125°C 100kHz	
VDC	120Hz	KEMET/EIA	(See below for part options)	μAmps +20°C	+20°C 120Hz	+20°C 100kHz	+25°C 100kHz	+85°C 100kHz	+125°C 100kHz	Temp≤260°C
	μF			max/5min	% Max	mOhms	mAmps	mAmps	mAmps	J-STD-020D
4	680	X/7343-43	T510X687(1)004A(2)E030	27.2	6.0	30	3000	2700	1200	1
4	1000	X/7343-43	T510X108(1)004A(2)E018	40.0	6.0	18	3873	3486	1549	1
4	1000	X/7343-43	T510X108(1)004A(2)E023	40.0	6.0	23	3426	3083	1370	1
4	1000	E/7260-38	T510E108(1)004A(2)E018	40.0	6.0	18	3979	3581	1592	1
4	1000	E/7260-38	T510E108(1)004A(2)E010	40.0	6.0	10	5339	4805	2136	1
6.3	470	X/7343-43	T510X477(1)006A(2)E030	29.6	6.0	30	3000	2700	1200	1
6.3	680	X/7343-43	T510X687(1)006A(2)E023	42.8	6.0	23	3426	3083	1370	1
6.3	680	X/7343-43	T510X687(1)006A(2)E045	42.8	12.0	45	2449	2204	980	1
6.3	680	E/7260-38	T510E687(1)006A(2)E023	42.8	6.0	23	3520	3168	1408	1
6.3	680	E/7260-38	T510E687(1)006A(2)E012	42.8	6.0	12	4873	4386	1949	1
10	330	X/7343-43	T510X337(1)010A(2)E035	33.0	6.0	35	2777	2499	1111	1
16	150	X/7343-43	T510X157(1)016A(2)E030	24.0	6.0	30	3000	2700	1200	1
16	150	X/7343-43	T510X157(1)016A(2)E040	24.0	6.0	40	2598	2338	1039	1
16	220	X/7343-43	T510X227(1)016A(2)E040	35.2	10.0	40	2598	2338	1039	1
16	220	X/7343-43	T510X227(1)016A(2)E025	35.2	10.0	25	3286	2957	1314	1
20	100	X/7343-43	T510X107(1)020A(2)E035	20.0	8.0	35	2777	2499	1111	1
20	100	X/7343-43	T510X107(1)020A(2)E040	20.0	6.0	40	2598	2338	1039	1
20	100	X/7343-43	T510X107(1)020A(2)E045	20.0	6.0	45	2449	2204	980	1
25	68	X/7343-43	T510X686(1)025A(2)E045	17.0	8.0	45	2449	2204	980	1
25	100	E/7260-38	T510E107(1)025A(2)E050	25.0	8.0	50	2387	2148	955	1
35	22	X/7343-43	T510X226(1)035A(2)E100	7.7	6.0	100	1643	1479	657	1
35	22	X/7343-43	T510X226(1)035A(2)E080	7.7	6.0	80	1837	1653	735	1
35	22	X/7343-43	T510X226(1)035A(2)E060	7.7	6.0	60	2121	1909	848	1
35	33	X/7343-43	T510X336(1)035A(2)E065	11.6	6.0	65	2038	1834	815	1
35	33	X/7343-43	T510X336(1)035A(2)E050	11.6	6.0	50	2324	2092	930	1
35	47	X/7343-43	T510X476(1)035A(2)E055	16.5	8.0	55	2216	1994	886	1
35	47	X/7343-43	T510X476(1)035A(2)E065	16.5	8.0	65	2038	1834	815	1
35	47	E/7260-38	T510E476(1)035A(2)E050	16.5	8.0	50	2387	2148	955	1
50	10	X/7343-43	T510X106(1)050A(2)E120	5.0	8.0	120	1500	1350	600	1
50	10	X/7343-43	T510X106(1)050A(2)E090	5.0	8.0	90	1732	1559	693	1
VDC	μF	KEMET/EIA	(See below for part options)	max/5min	% Max	mOhms	mAmps	mAmps	mAmps	J-STD-020D
	120Hz			μAmps +20°C	+20°C 120Hz	+20°C 100kHz	+25°C 100kHz	+85°C 100kHz	+125°C 100kHz	Temp≤260°C
Rated Voltage	Rated Cap	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	ESR	Maximum Allowable Ripple Current			Moisture Sensitivity

(1) To complete KEMET part number, insert M for ± 20% or K for ± 10%. Designates Capacitance tolerance.

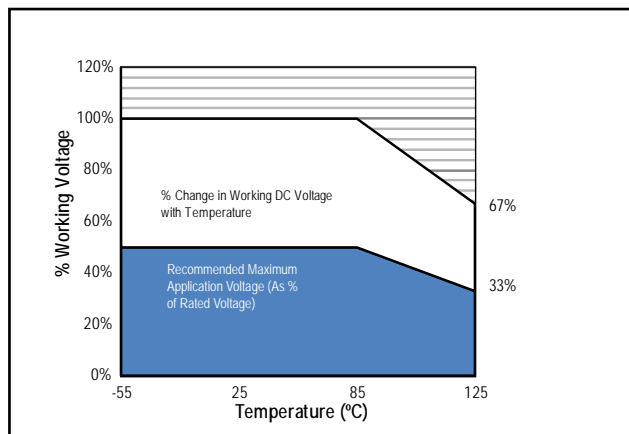
(2) To complete KEMET part number, insert T = 100% Matte Tin (Sn) Plated, G = Gold Plated, H = Standard Solder coated (SnPb 5% Pb minimum).

Designates Termination Finish.

Refer to Ordering Information for additional detail.

Higher voltage ratings and tighter tolerance product including ESR may be substituted within the same size at KEMET's option. Voltage substitution will be marked with the higher voltage rating. Substitutions can include better than series.

Recommended Voltage Derating Guidelines



Ripple Current/Ripple Voltage

Case Code		Maximum Power Dissipation (Pmax) mWatts @ 25°C w/+20°C Rise
KEMET	EIA	
A	3216-18	75
B	3528-21	85
C	6032-28	110
D	7343-31	150
X	7343-43	165
E	7260-38	200
R	2012-12	25
S	3216-12	60
T	3528-12	70
U	6032-15	90
V	7343-20	125
T510X	7343-43	270
T510E	7260-38	285

Temperature Compensation Multipliers for Maximum Power Dissipation		
≤25°C	85°C	125°C
1.00	0.90	0.40

T = Environmental Temperature

Using the P max of the device, the maximum allowable rms ripple current or voltage may be determined.

$$I(max) = \sqrt{P_{max}/R}$$

$$E(max) = \sqrt{P_{max} \cdot R}$$

I = rms ripple current (amperes)

E = rms ripple voltage (volts)

*P*_{max} = maximum power dissipation (watts)

R = ESR at specified frequency (ohms)

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	Metric Size Code	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	EIA	X	Y	C	V1	V2	X	Y	C	V1	V2	X	Y	C	V1	V2
		E ¹	7260-38	4.25	2.65	3.20	10.10	7.20	4.15	2.25	3.30	9.40	6.70	4.05	1.85	3.00	8.10	6.40
		X ¹	7343-43	2.55	3.75	2.70	10.20	5.50	2.45	3.35	2.60	9.10	5.00	2.35	2.95	2.50	8.20	4.70

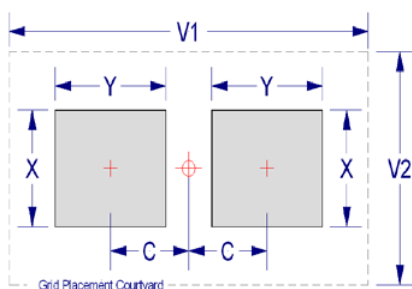
Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes.

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.

² Land pattern geometry is too small for silkscreen outline.



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.

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.

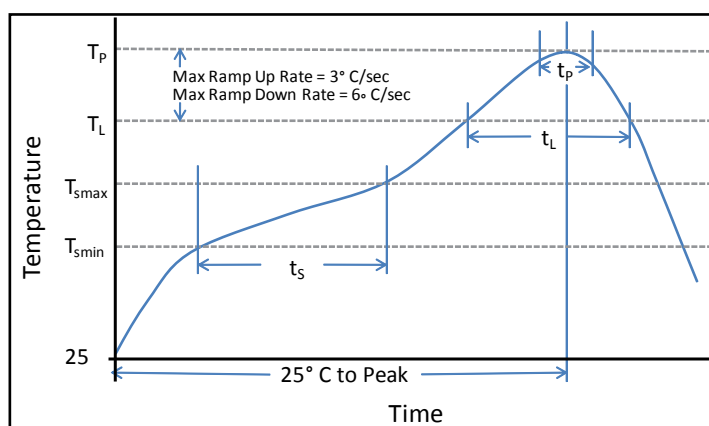
During typical reflow operations, a slight darkening of the gold-colored epoxy may be observed. This slight darkening is normal and is not harmful to the product. Marking permanency is not affected by this change.

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

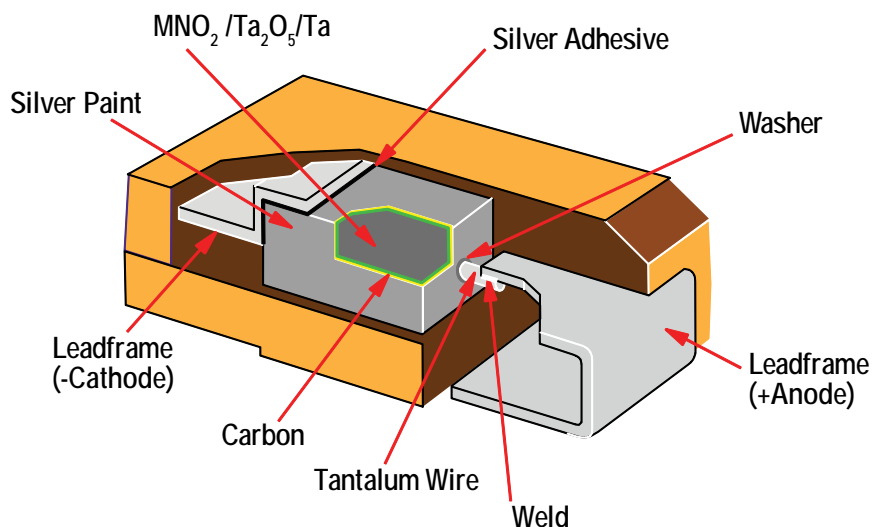
Note: All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow.

*Case Size D, E, P, Y and X

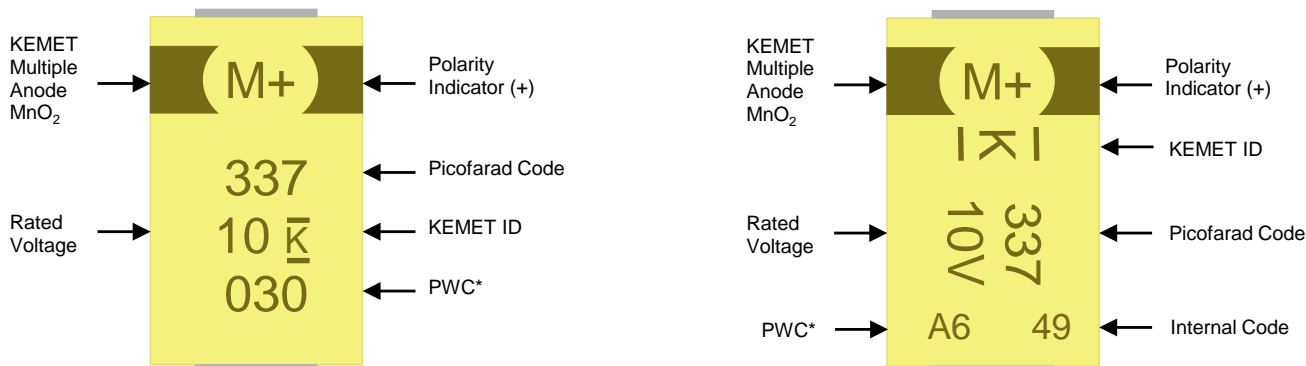
**Case Size A, B, C, H, I, K, M, R, S, T, U, V, W and Z



Construction



Capacitor Marking



* 030 = 30th week of 2010

PWC*		
Year	Month	
V = 2008	1 = Jan	7 = Jul
W = 2008	2 = Feb	8 = Aug
X = 2009	3 = Mar	9 = Spt
A = 2010	4 = Apr	O = Oct
B = 2011	5 = May	N = Nov
C = 2012	6 = Jun	D = Dec

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 40°C, and maximum storage humidity not exceed 60% relative humidity. In addition, 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.

Tape & Reel Packaging Information

KEMET's Molded Tantalum and Aluminum Chip Capacitor families are packaged in 8 mm and 12 mm plastic tape on 7" and 13" reels, in accordance with EIA Standard 481-D: Taping of Surface Mount Components for Automatic Handling. This packaging system is compatible with all tape fed automatic pick and place systems.

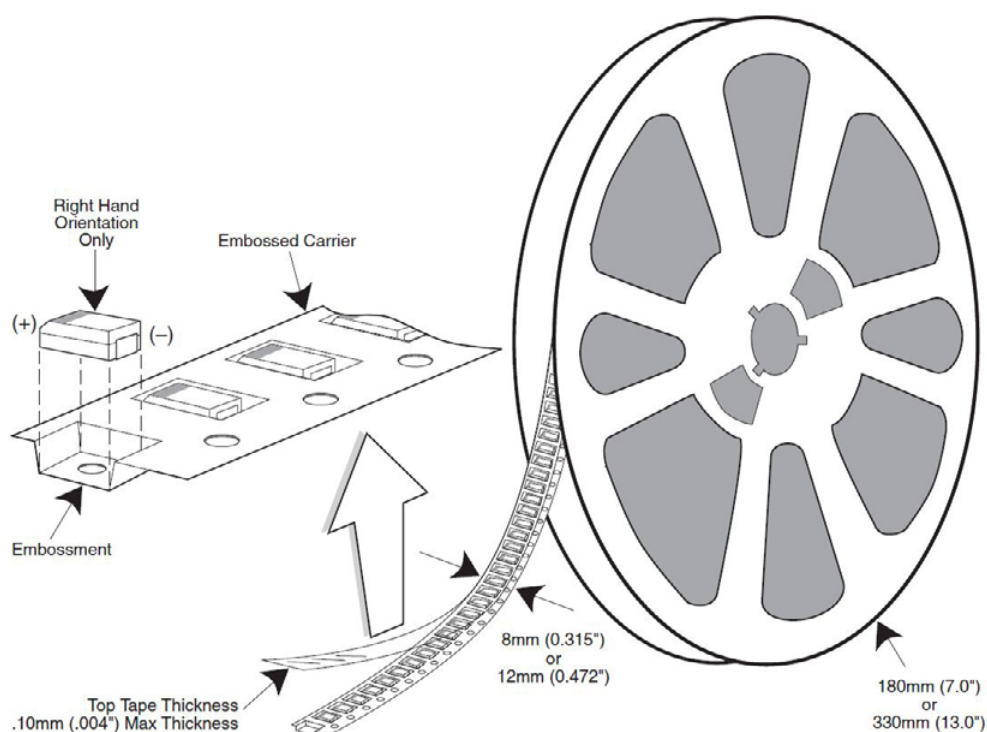


Table 3 – Packaging Quantity

Case Code		Tape Width-mm	7" Reel*	13" Reel*
KEMET	EIA			
R	2012-12	8	2,500	10,000
I	3216-10	8	3,000	12,000
S	3216-12	8	2,500	10,000
T	3528-12	8	2,500	10,000
M	3528-15	8	2,000	8,000
U	6032-15	12	1,000	5,000
L	6032-19	12	1,000	5,000
W	7343-15	12	1,000	3,000
Z	7343-17	12	1,000	3,000
V	7343-20	12	1,000	3,000
A	3216-18	8	2,000	9,000
B	3528-21	8	2,000	8,000
C	6032-28	12	500	3,000
D	7343-31	12	500	2,500
Y	7343-40	12	500	2,000
X	7343-43	12	500	2,000
E	7260-38	12	500	2,000

* No c-spec required for 7" reel packaging. C-7280 required for 13" reel packaging.

Figure 1 – Embossed (Plastic) Carrier Tape Dimensions

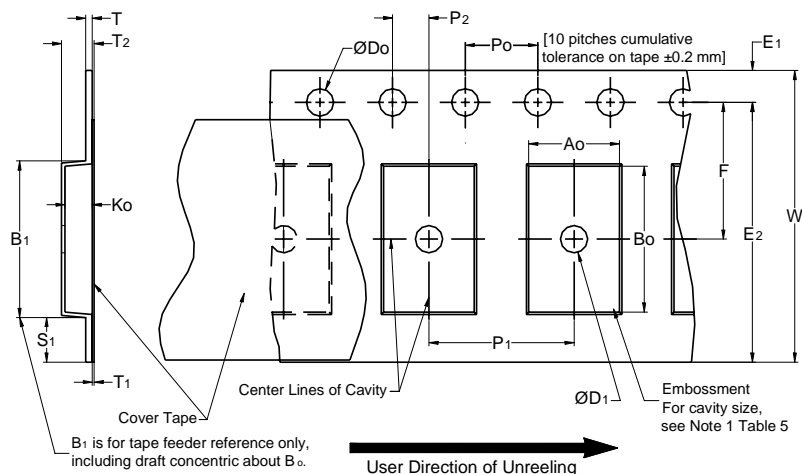


Table 4 – Embossed (Plastic) Carrier Tape Dimensions

Metric will govern

Constant Dimensions — Millimeters (Inches)									
Tape Size	D ₀	D ₁ Min. Note 1	E ₁	P ₀	P ₂	R Ref. Note 2	S ₁ Min. Note 3	T Max.	T ₁ Max.
8mm	1.5 +0.10/-0.0 (0.059 +0.004/-0.0)	1.0 (0.039)	1.75 ± 0.10 (0.069 ± 0.004)	4.0 ± 0.10 (0.157 ± 0.004)	2.0 ± 0.05 (0.079 ± 0.002)	25.0 (0.984)	0.600 (0.024)	0.600 (0.024)	0.100 (0.004)
12mm		1.5 (0.059)				30 (1.181)			
16mm									
Variable Dimensions — Millimeters (Inches)									
Tape Size	Pitch	B ₁ Max. Note 4	E ₂ Min.	F	P ₁	T ₂ Max	W Max	A ₀ , B ₀ & K ₀	
8mm	Single (4mm)	4.35 (0.171)	6.25 (0.246)	3.5 ± 0.05 (0.138 ± 0.002)	4.0 ± 0.10 (0.157 ± 0.004)	2.5 (0.098)	8.3 (0.327)	Note 5	
12mm	Single (4mm) & Double (8mm)	8.2 (0.323)	10.25 (0.404)	5.5 ± 0.05 (0.217 ± 0.002)	8.0 ± 0.10 (0.315 ± 0.004)	4.6 (0.181)	12.3 (0.484)		
16mm	Triple (12mm)	12.1 (0.476)	14.25 (0.561)	5.5 ± 0.05 (0.217 ± 0.002)	8.0 ± 0.10 (0.315 ± 0.004)	4.6 (0.181)	16.3 (0.642)		

1. The embossment hole location shall be measured from the sprocket hole controlling the location of the embossment. Dimensions of embossment location and hole location shall be applied independent of each other.
2. The tape with or without components shall pass around R without damage (see Figure 5).
3. If S₁ < 1.0 mm, there may not be enough area for cover tape to be properly applied (see EIA Document 481 paragraph 4.3 (b)).
4. B₁ dimension is a reference dimension for tape feeder clearance only.
5. The cavity defined by A₀, B₀ and K₀ shall surround the component with sufficient clearance that:
 - (a) the component does not protrude above the top surface of the carrier tape.
 - (b) the component can be removed from the cavity in a vertical direction without mechanical restriction, after the top cover tape has been removed.
 - (c) rotation of the component is limited to 20° maximum for 8 and 12mm tapes and 10° maximum for 16mm tapes (see Figure 3).
 - (d) lateral movement of the component is restricted to 0.5 mm maximum for 8mm and 12mm wide tape and to 1.0mm maximum for 16mm tape (see Figure 4).
 - (e) see Addendum in EIA Document 481 for standards relating to more precise taping requirements.

Packaging Information Performance Notes

1. **Cover Tape Break Force:** 1.0 Kg minimum.
2. **Cover Tape Peel Strength:** The total peel strength of the cover tape from the carrier tape shall be:

Tape Width	Peel Strength
8mm	0.1 Newton to 1.0 Newton (10gf to 100gf)
12mm & 16mm	0.1 Newton to 1.3 Newton (10gf to 130gf)

The direction of the pull shall be opposite the direction of the carrier tape travel. The pull angle of the carrier tape shall be 165° to 180° from the plane of the carrier tape. During peeling, the carrier and/or cover tape shall be pulled at a velocity of 300±10 mm/minute.

3. **Labeling:** Bar code labeling (standard or custom) shall be on the side of the reel opposite the sprocket holes. Refer to EIA-556 and EIA-624.

Figure 2 – Maximum Component Rotation

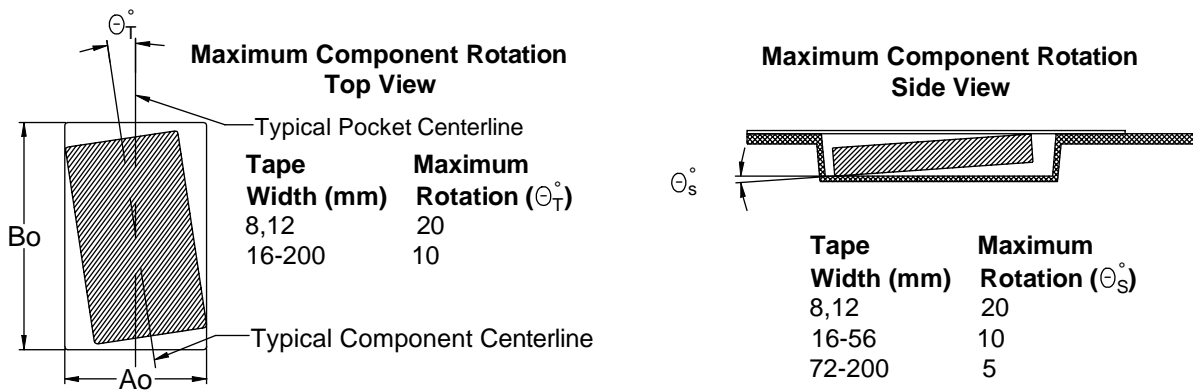


Figure 3 – Maximum Lateral Movement

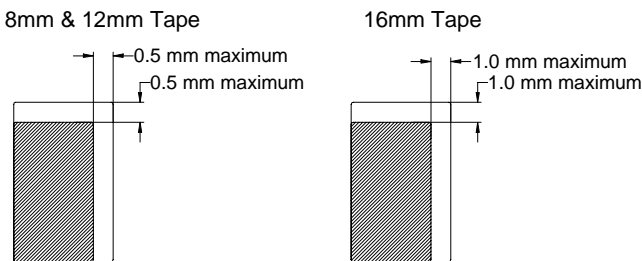


Figure 4 – Bending Radius

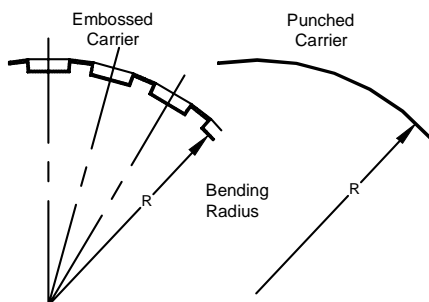
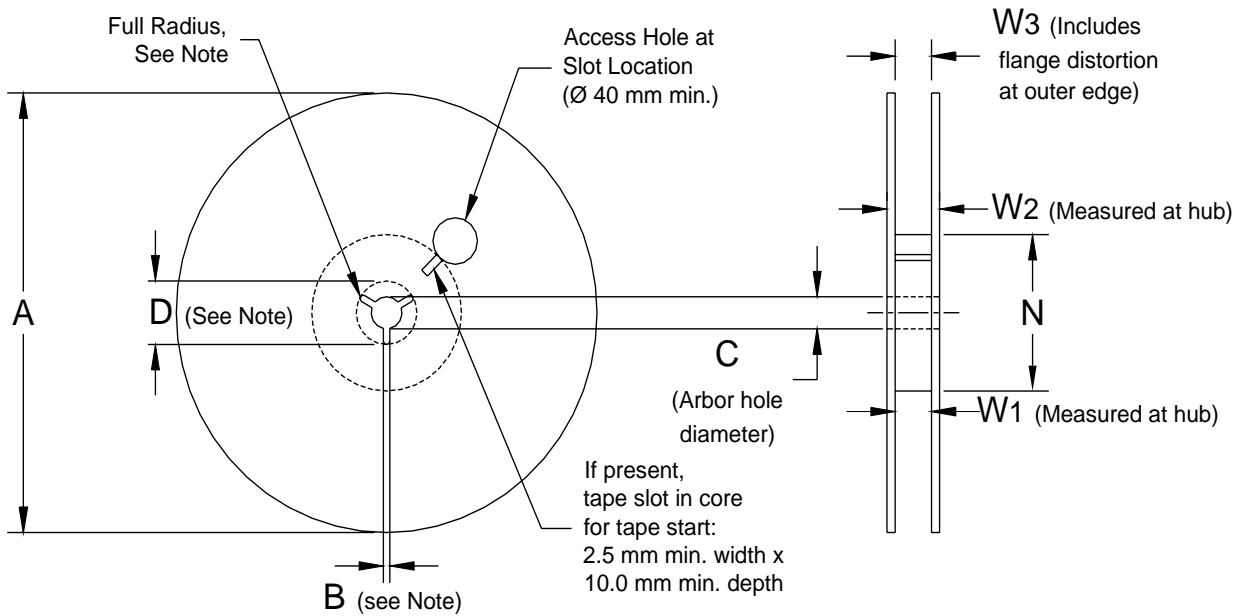


Figure 5 – Reel Dimensions



Note: Drive spokes optional; if used, dimensions B and D shall apply.

Table 5 – Reel Dimensions

Metric will govern

Constant Dimensions — Millimeters (Inches)				
Tape Size	A	B Min	C	D Min
8mm	178 ± 0.20 (7.008 ± 0.008)	1.5 (0.059)	13.0 +0.5/-0.2 (0.521 +0.02/-0.008)	20.2 (0.795)
12mm	or			
16mm	330 ± 0.20 (13.000 ± 0.008)			
Variable Dimensions — Millimeters (Inches)				
Tape Size	N Min	W ₁	W ₂ Max	W ₃
8mm	50 (1.969)	8.4 +1.5/-0.0 (0.331 +0.059/-0.0)	14.4 (0.567)	Shall accommodate tape width without interference
12mm		12.4 +2.0/-0.0 (0.488 +0.078/-0.0)	18.4 (0.724)	
16mm		16.4 +2.0/-0.0 (0.646 +0.078/-0.0)	22.4 (0.882)	

Figure 6 – Tape Leader & Trailer Dimensions

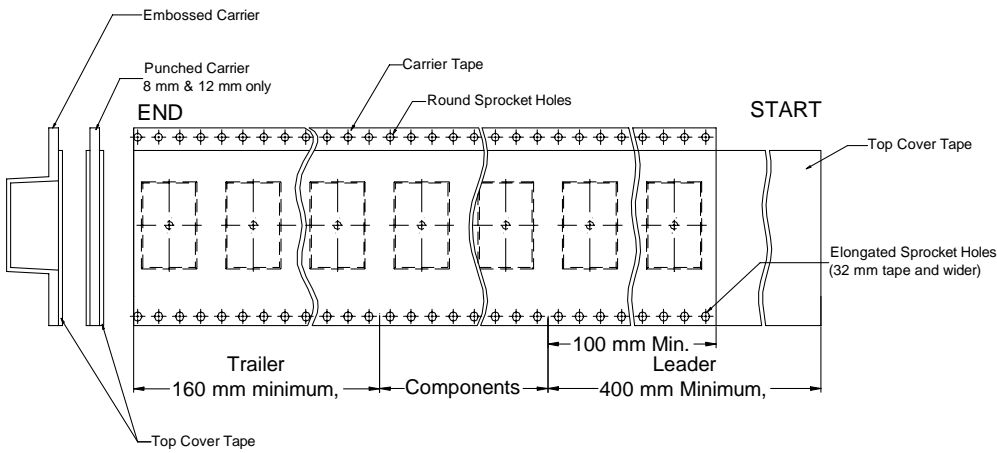
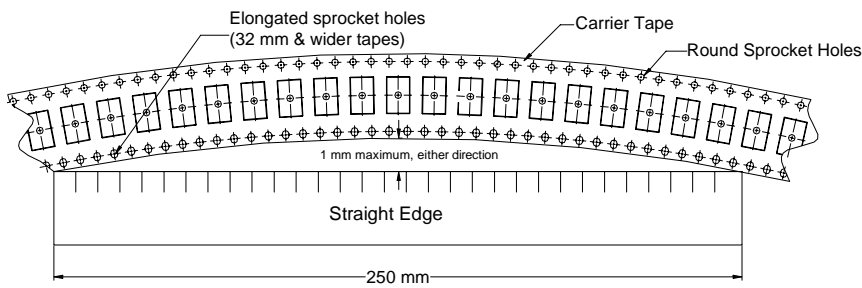


Figure 7 – Maximum Camber



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Southeast Asia

Singapore
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SPICE & FIT Software	http://www.kemet.com/spice
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