KEMET Organic Capacitor (KO-CAP)

T545 Series High Energy Polymer Tantalum

Overview

The KEMET Organic Capacitor is a tantalum capacitor with a Ta anode and Ta_2O_5 dielectric. A conductive organic polymer replaces the traditionally used MnO_2 as the cathode plate of the capacitor. This results in very low ESR and improved capacitance retention at high frequency. The polymer technology also exhibits a benign failure mode which eliminates the ignition failures that can occur in standard MnO_2 tantalum types. Ta polymers may be operated at 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 with equivalent or better reliability than traditional MnO_2 tantalum capacitors operated at 50% of rated voltage.

The T545 Series was developed to deliver the highest energy per CC of any tantalum surface mount device (SMD). This capability makes this capacitor an excellent solution for designs requiring high energy at relatively low voltages, such as data hardening or data vaulting for solid state drives (SSD's). The T545 Series High Energy Polymer Tantalum Surface Mount Capacitor captures the best features of multilayer ceramic capacitors (low ESR and high frequency capacitance retention), aluminum electrolytic capacitors (higher capacitance and benign failure mode) and proven solid tantalum technology (volumetric efficiency, surface mount capability and extremely long life). In addition, this series is subjected to 100% thermal shock and voltage aging to insure long term reliability.

Benefits

- Extremely low ESR
- High energy delivery capability
- -55°C to 125°C operating temperature range
- Polymer cathode technology
- High frequency capacitance retention
- Non-ignition failure mode
- Capacitance up to 1,500 µF
- Voltage: 6.3 – 63 V
- 100% accelerated steady state aging
- 100% surge current tested
- 100% thermal shock
- Volumetric efficiency, very high capacitance
- Self-healing mechanism
- Taped and reeled per EIA 481–1, EIA standard case sizes

Applications

Typical applications include hold-up, data hardening or vaulting for enterprise and military SSDs, and high end desktop modems.

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	545	H	108	M	006	A	T	E055	
Capacitor Class	Series	Case Size	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Failure Rate/ Design	Lead Material	ESR	Packaging (C-Spec)
T = Tantalum	High Energy Polymer Tantalum	B, D, H, M, T, V, W, X, Y	First two digits represent significant figures. Third digit specifies number of zeros.	M = ±20% K = ±10 %	006 = 6.3 V 008 = 8 V 010 = 10 V 016 = 16 V 020 = 20 V 025 = 25 V 035 = 35 V 050 = 50 V 063 = 63 V	A = N/A	T = 100% Tin (Sn)	ESR in mΩ	Blank = 7" Reel 7280 = 13" Reel

Performance Characteristics

Item	Performance Characteristics
Operating Temperature	-55°C to 125°C
Rated Capacitance Range	47 µF – 1,500 µF @ 120 Hz/25°C
Capacitance Tolerance	K Tolerance (10%), M Tolerance (20%)
Rated Voltage Range	6.3 – 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

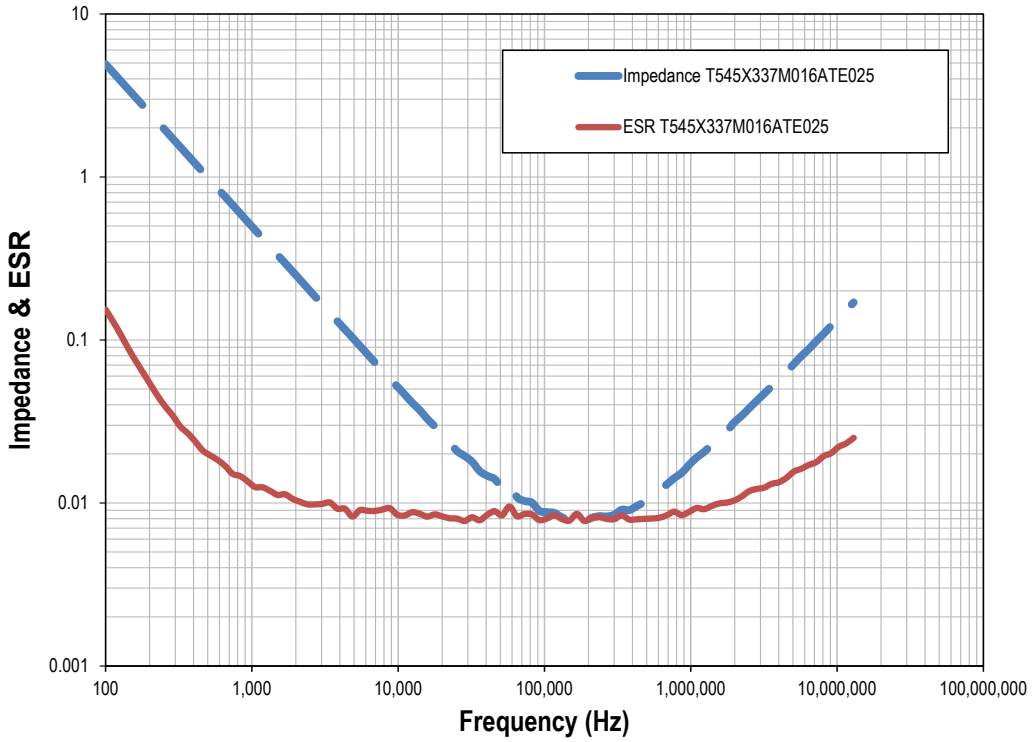
Test	Condition		Characteristics		
Endurance	85°C @ rated voltage, 2,000 hours**		Δ C/C	Within -20/+10 of initial value	
			DF	Within initial limits	
			DCL	Within 1.25 x initial limit	
			ESR	Within 2.0 x initial limit	
Storage Life	85°C @ 0 volts, 2,000 hours**		Δ C/C	Within -20/+10 of initial value	
			DF	Within initial limits	
			DCL	Within 1.25 x initial limit	
			ESR	Within 2.0 x initial limit	
Humidity	60°C, 90% RH, 1,000 hours		Δ C/C	Within -5%/+35% of initial value	
			DF	Within initial limits	
			DCL	Within 5.0 x initial limit	
			ESR	Within 2.0 x initial limit	
Temperature Stability	Extreme temperature exposure at a succession of continuous steps at +25ºC, -55ºC, +25ºC, +85ºC, +25º C		+25°C	-55°C	+85°C
		Δ C/C	IL*	+/-20%	+/-20%
		DF	IL	IL	1.2 x IL
		DCL	IL	n/a	10 x IL
Surge Voltage	85°C, 1.32 x rated voltage, 1,000 cycles		Δ C/C	Within -20/+10 of initial value	
			DF	Within initial limits	
			DCL	Within initial limits	
			ESR	Within initial limits	
Mechanical Shock/Vibration	MIL–STD–202, Method 213, Condition I, 100 G peak 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	

**IL = Initial limit*

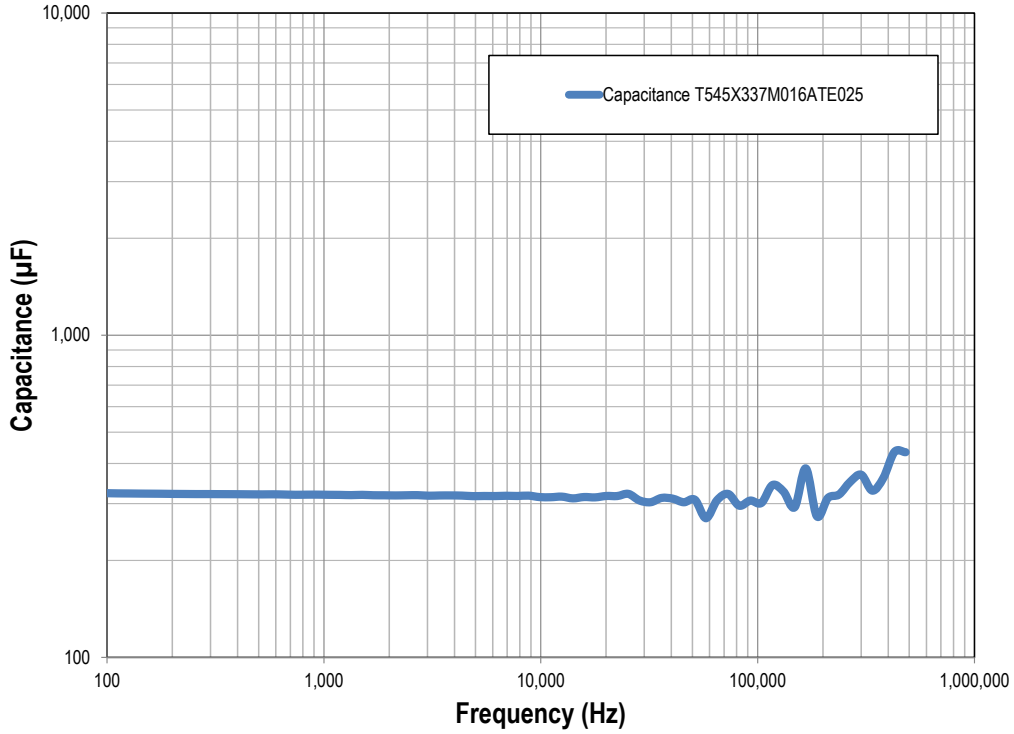
***Minimum temperature test condition 85ºC*

Electrical Characteristics

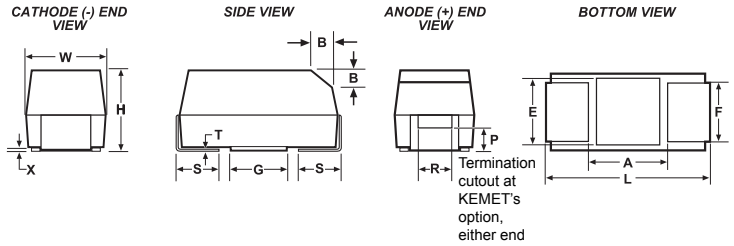
ESR vs. Frequency



Capacitance vs. Frequency



Dimensions – Millimeters



Case Size		Component												
KEMET	EIA	L*	W*	H*	F* ±0.1 ±(0.004)	S* ±0.3 ±(0.012)	B* ±0.15 (Ref) ±0.006	X (Ref)	P (Ref)	R (Ref)	T (Ref)	A (Min)	G (Ref)	E (Ref)
B	3528-21	3.5 ± 02 (0.138 ± 0.008)	2.8 ±0.2 (0.110 ±0.008)	1.9 ± 0.2 (0.075 ± 0.008)	2.2 (0.087)	0.8 (0.031)	0.4 (0.016)	0.10 ± 0.10 (0.004 ±0.004)	0.5 (.020)	1.0 (.039)	0.13 (.005)	1.1 (0.043)	1.8 (.071)	2.2 (.087)
D	7343-31	7.3 ±0.3 (0.287 ±0.012)	4.3 ±0.3 (0.169 ±0.012)	2.8 ±0.3 (0.110 ±0.012)	2.4 (0.094)	1.3 (0.051)	0.5 (0.020)	0.10 ± 0.10 (0.004 ± .004)	0.9 (.035)	1.0 (.039)	0.13 (.005)	3.8 (.150)	3.5 (.138)	3.5 (.138)
H	7360-20	7.3 ±0.3 (0.287 ±0.012)	6.0±0.3 (0.236 ±0.012)	2.0 (0.078) Maximum	4.1 (0.161)	1.3 (0.051)	n/a	0.10 ± 0.10 (.004 ± .004)	n/a	n/a	0.13 (.005)	3.3 (.130)	3.5 (.138)	3.5 (.138)
M	3528-15	3.5 ± 0.2 (0.138 ± 0.008)	2.8 ±0.2 (0.110 ±0.008)	1.5 (0.059)	2.2 (0.087)	0.8 (0.031)	n/a	0.05 (0.002)	n/a	n/a	0.13 (0.005)	1.1 (.043)	1.8 (0.071)	2.2 (0.087)
T	3528-12	3.5 ± 0.2 (0.138 ± 0.008)	2.8 ±0.2 (0.110 ±0.008)	1.2 (0.047)	2.2 (0.087)	0.8 (0.031)	n/a	0.05 (0.002)	n/a	n/a	0.13 (0.005)	1.1 (.043)	1.8 (0.071)	2.2 (0.087)
V	7343-20	7.3 ±0.3 (0.287 ±0.012)	4.3 ±0.3 (0.169 ±0.012)	2.0 (0.079)	2.4 (0.094)	1.3 (0.051)	n/a	0.05 (.002)	n/a	n/a	0.13 (.005)	3.8 (.150)	3.5 (.138)	3.5 (.138)
W	7343-15	7.3 ±0.3 (0.287 ±0.012)	4.3 ±0.3 (0.169 ±0.012)	1.5 (0.059)	2.4 (0.094)	1.3 (0.051)	n/a	0.05 (.002)	n/a	n/a	0.13 (.005)	3.8 (.150)	3.5 (.138)	3.5 (.138)
X	7343-43	7.3 ±0.3 (0.287 ±0.012)	4.3 ±0.3 (0.169 ±0.012)	4.0 ±0.3 (0.157 ±0.012)	2.4 (0.094)	1.3 (0.051)	0.5 (0.020)	0.10 ± 0.10 (.004 ± .004)	1.7 (.067)	1.0 (.039)	0.13 (.005)	3.8 (.150)	3.5 (.138)	3.5 (.138)
Y	7343-40	7.3 ±0.3 (0.287 ±0.012)	4.3 ±0.3 (0.169 ±0.012)	4.0 (0.157)	2.4 (0.094)	1.3 (0.051)	0.5 (0.020)	0.10 ± 0.10 (.004 ± .004)	1.7 (.067)	1.0 (.039)	0.13 (.005)	3.8 (.150)	3.5 (.138)	3.5 (.138)

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–PRF–55365/8 specified dimensions*

Table 1 – Ratings & Part Number Reference

Rated Voltage	Rated Capacitance	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	ESR	Maximum Allowable Ripple Current	MSL	Rated Temperature	Energy (mJ)
V	µF	KEMET/EIA	(See below for part options)	(µA) @ V_R, 20°C Maximum/ 5 Minutes	% @ 20°C 120 Hz Maximum	(mΩ) @ 20°C 100 kHz Maximum	(mA) 45°C 100 kHz	Reflow Temperature ≤ 260°C	(°C)	(½CVa²) - (½CVd²) Va = Voltage Applied Vd = Voltage Drop
6.3	1000	H/7360-20	T545H108M006ATE055	630.0	20	55	1850.0	3	85	11.57
6.3	1500	H/7360-20	T545H158M006ATE035	945.0	20	35	2300.0	3	85	17.36
6.3	1500	H/7360-20	T545H158M006ATE055	945.0	20	55	1850.0	3	85	17.36
6.3	**100**	**T/3528-12**	**T545T107M006ATE070**	**63.0**	**8**	**70**	**1200.0**	**3**	**105**	**1.16**
6.3	**100**	**W/7343-16**	**T545W107M006ATE040**	**63.0**	**10**	**40**	**2100.0**	**3**	**105**	**1.16**
6.3	**150**	**M/3528-15**	**T545M157M006ATE200**	**94.5**	**8**	**200**	**800.0**	**3**	**105**	**1.74**
6.3	**150**	**W/7343-16**	**T545W157M006ATE040**	**94.5**	**10**	**40**	**2100.0**	**3**	**105**	**1.74**
6.3	**220**	**V/7343-20**	**T545V227M006ATE040**	**138.6**	**10**	**40**	**2200.0**	**3**	**105**	**2.55**
6.3	**330**	**V/7343-20**	**T545V337M006ATE045**	**207.9**	**10**	**45**	**2000.0**	**3**	**105**	**3.82**
6.3	470	W/7343-16	T545W477M006ATE045	296.0	10	45	2300.0	3	105	5.44
6.3	470	W/7343-15	T545W477M006ATE055	296.0	10	55	1800.0	3	105	5.44
6.3	470	Y/7343-40	T545Y477M006ATE025	296.0	10	25	3100.0	3	105	5.44
6.3	470	X/7343-43	T545X477M006ATE006	296.0	10	6	6700.0	3	125	5.44
8	**47**	**B/3528-21**	**T545B476M008ATE070**	**37.6**	**8**	**70**	**1300.0**	**3**	**105**	**1.01**
8	**150**	**V/7343-20**	**T545V157M008ATE040**	**120.0**	**10**	**40**	**2200.0**	**3**	**105**	**3.21**
10	**33**	**T/3528-12**	**T545T336M010ATE080**	**33.0**	**8**	**80**	**1100.0**	**3**	**105**	**1.19**
10	**68**	**W/7343-15**	**T545W686M010ATE040**	**68.0**	**10**	**40**	**2100.0**	**3**	**105**	**2.45**
10	100	W/7343-15	T545W107M010ATE040	100.0	10	40	2100.0	3	105	3.60
10	**150**	**V/7343-20**	**T545V157M010ATE040**	**150.0**	**10**	**40**	**2200.0**	**3**	**105**	**5.40**
10	**220**	**D/7343-31**	**T545D227M010ATE040**	**220.0**	**10**	**40**	**2400.0**	**3**	**105**	**7.92**
10	**220**	**V/7343-20**	**T545V227M010ATE045**	**220.0**	**10**	**45**	**2000.0**	**3**	**105**	**7.92**
10	330	Y/7343-40	T545Y337M010ATE035	330.0	10	35	2600.0	3	105	11.88
10	330	X/7343-43	T545X337M010ATE006	330.0	10	6	6700.0	3	125	11.88
16	**33**	**W/7343-15**	**T545W336M016ATE045**	**52.8**	**10**	**45**	**2000.0**	**3**	**105**	**2.55**
16	47	W/7343-15	T545W476M016ATE045	75.0	10	45	2000.0	3	105	3.64
16	**68**	**D/7343-31**	**T545D686M016ATE050**	**108.8**	**10**	**50**	**1900.0**	**3**	**105**	**5.26**
16	**150**	**X/7343-43**	**T545X157M016ATE040**	**240.0**	**10**	**40**	**2500.0**	**3**	**105**	**11.61**
16	180	H/7360-20	T545H187M016ATE055	288.0	20	55	1843.0	3	85	13.94
16	220	X/7343-43	T545X227M016ATE035	352.0	10	35	2700.0	3	125	17.03
16	330	X/7343-43	T545X337(1)016ATE025	528.0	10	25	3300.0	3	125	25.55
16	100	V/7343-20	T545V107M016ATE055	160.0	10	55	1850.0	3	105	7.74
16	100	D/7343-31	T545D107M016ATE055	160.0	10	55	2050.0	3	105	7.74
20	**22**	**V/7343-20**	**T545V226M020ATE090**	**44.0**	**10**	**90**	**1400.0**	**3**	**125**	**2.72**
20	**47**	**V/7343-21**	**T545V476M020ATE090**	**94.0**	**10**	**90**	**1400.0**	**3**	**125**	**5.80**
25	**15**	**V/7343-22**	**T545V156M025ATE090**	**37.5**	**10**	**90**	**1400.0**	**3**	**105**	**2.93**
25	**22**	**V/7343-23**	**T545V226M025ATE090**	**55.0**	**10**	**90**	**1400.0**	**3**	**105**	**4.30**
25	**33**	**V/7343-24**	**T545V336M025ATE060**	**82.5**	**10**	**60**	**1800.0**	**3**	**105**	**6.45**
25	**100**	**X/7343-43**	**T545X107M025ATE060**	**250.0**	**10**	**60**	**2000.0**	**3**	**105**	**19.55**
35	**15**	**V/7343-24**	**T545V156M035ATE125**	**52.5**	**10**	**125**	**1200.0**	**3**	**125**	**5.81**
35	**33**	**D/7343-31**	**T545D336M035ATE065**	**115.5**	**10**	**65**	**1900.0**	**3**	**125**	**12.79**
35	**47**	**X/7343-43**	**T545X476M035ATE070**	**164.5**	**10**	**70**	**1900.0**	**3**	**125**	**18.21**
50	**6.8**	**D/7343-31**	**T545D685M050ATE090**	**34.0**	**10**	**90**	**1600.0**	**3**	**125**	**5.41**
50	**10**	**D/7343-31**	**T545D106M050ATE120**	**50.0**	**10**	**120**	**1369.0**	**3**	**125**	**7.96**
50	**18**	**X/7343-44**	**T545X186M050ATE070**	**90.0**	**10**	**70**	**1900.0**	**3**	**125**	**14.32**
63	**4.7**	**D/7343-31**	**T545D475M063ATE300**	**29.6**	**10**	**300**	**900.0**	**3**	**125**	**5.95**
63	**10**	**X/7343-44**	**T545X106M063ATE050**	**63.0**	**10**	**50**	**2200.0**	**3**	**125**	**12.66**
63	**15**	**X/7343-45**	**T545X156M063ATE150**	**94.5**	**10**	**150**	**1300.0**	**3**	**125**	**18.98**
V	µF	KEMET/EIA	(See below for part options)	(µA) @ V_R, 20°C Maximum/ 5 Minutes	% @ 20°C 120 Hz Maximum	(mΩ) @ 20°C 100 kHz Maximum	(mA) 45°C 100 kHz	Reflow Temperature ≤ 260°C	(°C)	(½CVa²) - (½CVd²) Va = Voltage Applied Vd = Voltage Drop
Rated Voltage	Rated Capacitance	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	ESR	Maximum Allowable Ripple Current	MSL	Rated Temperature	Energy (mJ)

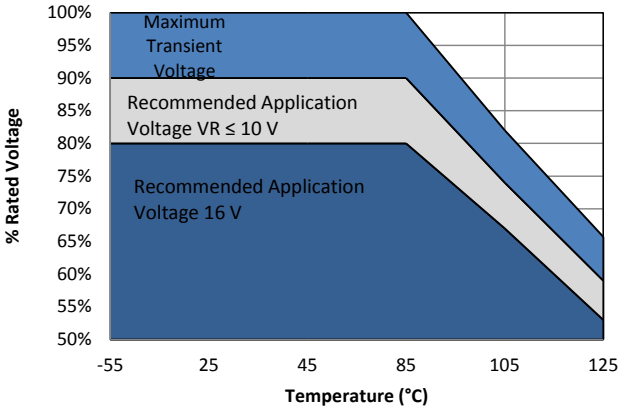
***Bold** black text denotes black epoxy product*

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

The T545 is an 85ºC rated temperature series. For higher temperature requests, please contact KEMET.

Roll Over for Order Info.

Derating Guidelines



Voltage Rating	Maximum Recommended Steady State Voltage	Maximum Recommended Transient Voltage (1 ms – 1 µs)	Maximum Recommended Steady State Voltage	Maximum Recommended Transient Voltage (1 ms – 1 µs)
	-55°C to 105°C		105°C to 125°C	
6.3 V ≤ V_R ≤ 10 V	90% of V_R	V_R	60% of V_R	V_R
V_R = 16 V	80% of V_R	V_R	54% of V_R	V_R

V_R= Rated Voltage

Ripple Current/Ripple Voltage

Permissible AC ripple voltage and current are related to equivalent series resistance (ESR) and the power dissipation capabilities of the device. Permissible AC ripple voltage which may be applied is limited by two criteria:

1. The positive peak AC voltage plus the DC bias voltage, if any, must not exceed the DC voltage rating of the capacitor.
2. The negative peak AC voltage in combination with bias voltage, if any, must not exceed the allowable limits specified for reverse voltage. See the Reverse Voltage section for allowable limits.

The maximum power dissipation by case size can be determined using the table at right. The maximum power dissipation rating stated in the table must be reduced with increasing environmental operating temperatures. Refer to the table below for temperature compensation requirements.

Temperature Compensation Multipliers for Maximum Power Dissipation		
T ≤ 45°C	45° C < T ≤ 85°C	85°C < T ≤ 125°C
1.00	0.70	0.25

T= Environmental Temperature

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

$I(max) = \sqrt{P\ max/R}$
$E(max) = Z\sqrt{P\ max/R}$

I = rms ripple current (amperes)
E = rms ripple voltage (volts)
P max = maximum power dissipation (watts)
R = ESR at specified frequency (ohms)
Z = Impedance at specified frequency (ohms)

Case Code	EIA Case Code	Maximum Power Dissipation (P max) mWatts @ 45°C with +30°C Rise
T	3528-12	105
M	3528-15	120
A	3216-18	112
B	3528-21	127
U	6032-15	135
L	6032-19	150
C	6032-28	165
W	7343-15	180
V	7343-20	187
D	7343-31	225
Y	7343-40	241
X	7343-43	247
H	7360-20	187
I	3216-10	95

The maximum power dissipation rating must be reduced with increasing environmental operating temperatures. Refer to the Temperature Compensation Multiplier table for details.

Reverse Voltage

Polymer tantalum capacitors are polar devices and may be permanently damaged or destroyed if connected in the wrong polarity. These devices will withstand a small degree of transient voltage reversal for short periods as shown in the below table.

Temperature	Permissible Transient Reverse Voltage
25°C	15% of Rated Voltage
55°C	10% of Rated Voltage
85°C	5% 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	W	L	S	V1	V2	W	L	S	V1	V2	W	L	S	V1	V2
A	3216–18	1.35	2.20	0.62	6.02	2.80	1.23	1.80	0.82	4.92	2.30	1.13	1.42	0.98	4.06	2.04
B	3528–21	2.35	2.21	0.92	6.32	4.00	2.23	1.80	1.12	5.22	3.50	2.13	1.42	1.28	4.36	3.24
C	6032–25	2.35	2.77	2.37	8.92	4.50	2.23	2.37	2.57	7.82	4.00	2.13	1.99	2.73	6.96	3.74
D	7343–31	2.55	2.77	3.67	10.22	5.60	2.43	2.37	3.87	9.12	5.10	2.33	1.99	4.03	8.26	4.84
L	6032-19	2.35	2.77	2.37	8.92	4.50	2.23	2.37	2.57	7.82	4.00	2.13	1.99	2.73	6.96	3.74
M	3528-15	2.35	2.20	0.92	6.32	4.00	2.23	1.80	1.12	5.22	3.50	2.13	1.42	1.28	4.36	3.24
H	7360-20	4.25	2.77	3.67	10.22	7.30	4.13	2.37	3.87	9.12	6.80	4.03	1.99	4.03	8.26	6.54
E[1]	7360–38	4.25	2.77	3.67	10.22	7.30	4.13	2.37	3.87	9.12	6.80	4.03	1.99	4.03	8.26	6.54
Q	7343-12	2.55	2.77	3.67	10.22	5.60	2.43	2.37	3.87	9.12	5.10	2.33	1.99	4.03	8.26	4.84
R[2]	2012-12	1.05	1.83	0.15	4.82	2.50	0.93	1.50	0.22	3.72	2.00	0.83	1.12	0.38	2.86	1.74
S[2]	3216–12	1.35	2.20	0.62	6.02	2.80	1.23	1.80	0.82	4.92	2.30	1.13	1.42	0.98	4.06	2.04
T	3528–12	2.35	2.20	0.92	6.32	4.00	2.23	1.80	1.12	5.22	3.50	2.13	1.42	1.28	4.36	3.24
U	6032–15	2.35	2.77	2.37	8.92	4.50	2.23	2.37	2.57	7.82	4.00	2.13	1.99	2.73	6.96	3.74
V	7343–20	2.55	2.77	3.67	10.22	5.60	2.43	2.37	3.87	9.12	5.10	2.33	1.99	4.03	8.26	4.84
W	7343–15	2.55	2.77	3.67	10.22	5.60	2.43	2.37	3.87	9.12	5.10	2.33	1.99	4.03	8.26	4.84
X[1]	7343–43	2.55	2.77	3.67	10.22	5.60	2.43	2.37	3.87	9.12	5.10	2.33	1.99	4.03	8.26	4.84
Y[1]	7343–40	2.55	2.77	3.67	10.22	5.60	2.43	2.37	3.87	9.12	5.10	2.33	1.99	4.03	8.26	4.84

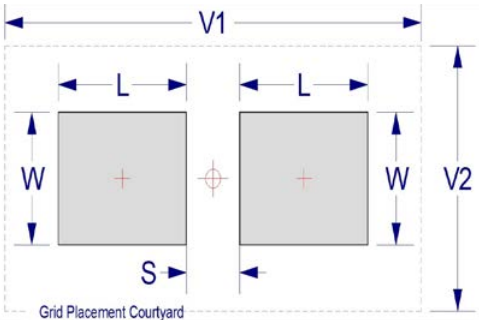
Density Level A: *For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes.*

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 desity 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.

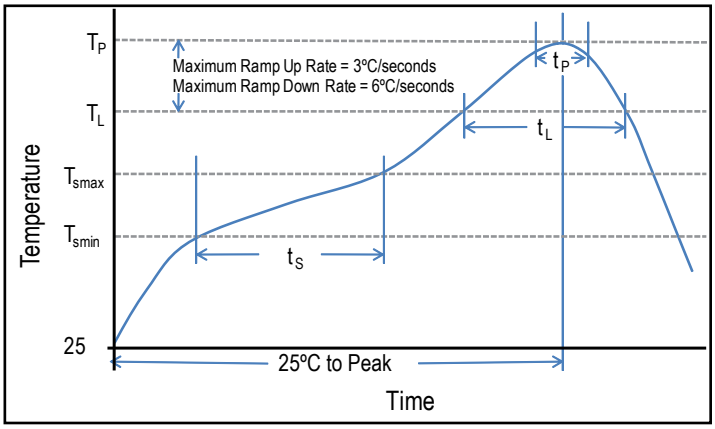
Please note that although the X/7343–43 case size can withstand wave soldering, the tall profile (4.3 mm maximum) dictates care in wave process development.

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.

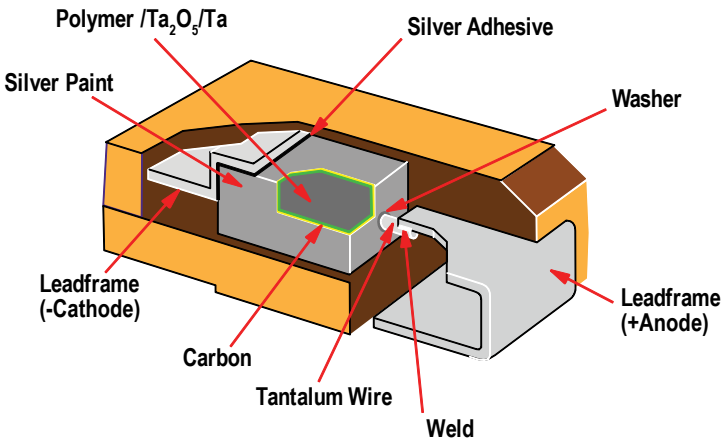
During typical reflow operations, a slight darkening of the gold-colored epoxy may be observed. This slight darkening is normal and not harmful to the product. Marking permanency is not affected by this change.

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

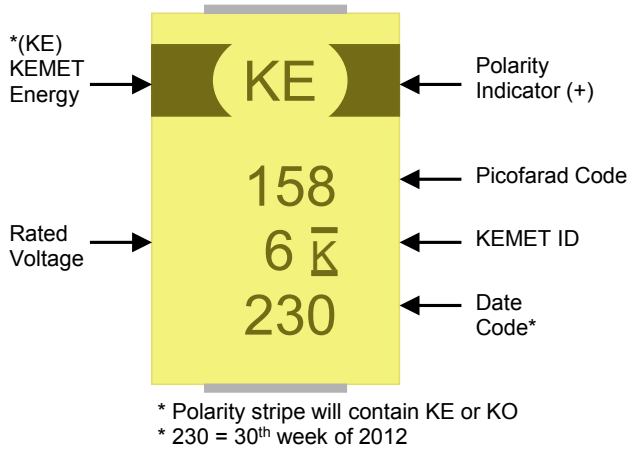
Note: All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow.
**Case Size D, E, P, Y, and X*
***Case Size A, B, C, H, I, K, M, R, S, T, U, V, W, and Z*



Construction



Capacitor Marking



* Polarity stripe will contain KE or KO
* 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

Storage

All KO-CAP Series are shipped in moisture barrier bags with a desiccant and moisture indicator card. These series are classified as MSL3 (Moisture Sensitivity Level 3). Product contained within the moisture barrier bags should be stored in normal working environments with temperatures not to exceed 40°C and humidity not in excess of 60% RH.

Tape & Reel Packaging Information

KEMET's molded tantalum and aluminum chip capacitor families are packaged in 8 and 12 mm plastic tape on 7" and 13" reels in accordance with *EIA Standard 481–1*: Embossed Carrier Taping of Surface Mount Components for Automatic Handling. This packaging system is compatible with all tape-fed automatic pick-and-place systems.

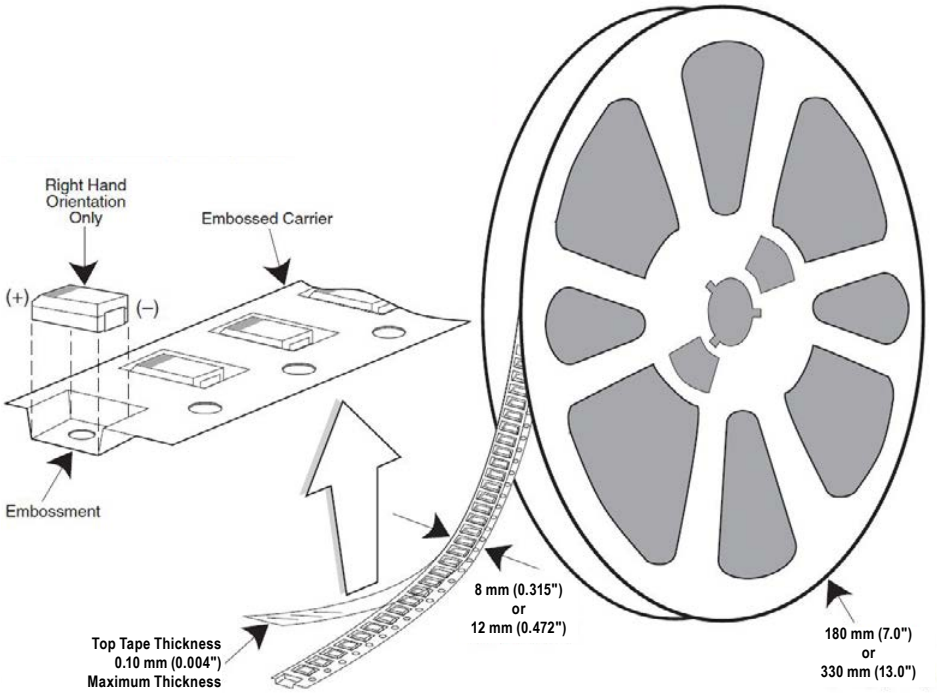


Table 3 – Packaging Quantity

Case Code		Tape Width (mm)	7" Reel*	13" Reel*
KEMET	EIA			
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/T428P	7360-38	12	500	2,000
H	7360-20	12	1,000	2,500

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

Figure 1 – Embossed (Plastic) Carrier Tape Dimensions

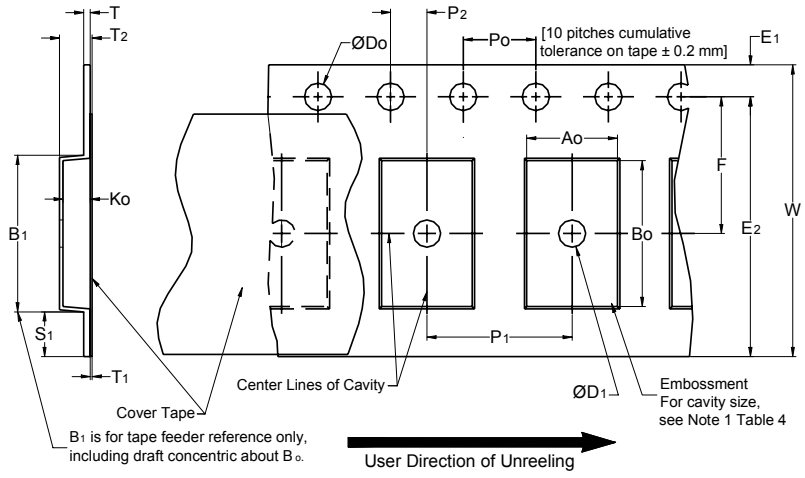


Table 4 – Embossed (Plastic) Carrier Tape Dimensions

Metric will govern

Constant Dimensions — Millimeters (Inches)									
Tape Size	D_0	D_1 Minimum Note 1	E_1	P_0	P_2	R Reference Note 2	S_1 Minimum Note 3	T Maximum	T_1 Maximum
8 mm	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)
12 mm		1.5 (0.059)				30 (1.181)			
16 mm									

Variable Dimensions — Millimeters (Inches)								
Tape Size	Pitch	B_1 Maximum Note 4	E_2 Minimum	F	P_1	T_2 Maximum	W Maximum	A_0, B_0 & K_0
8 mm	Single (4 mm)	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
12 mm	Single (4 mm) & Double (8 mm)	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)	
16 mm	Triple (12 mm)	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 S_1 < 1.0 mm, there may not be enough area for cover tape to be properly applied (see EIA Standard 481–D, paragraph 4.3, section b).

4. B_1 dimension is a reference dimension for tape feeder clearance only.

5. The cavity defined by A_0, B_0 and K_0 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 12 mm tapes and 10° maximum for 16 mm tapes (see Figure 2).

(d) lateral movement of the component is restricted to 0.5 mm maximum for 8 mm and 12 mm wide tape and to 1.0 mm maximum for 16 mm tape (see Figure 3).

(e) see Addendum in EIA Standard 481–D for standards relating to more precise taping requirements.

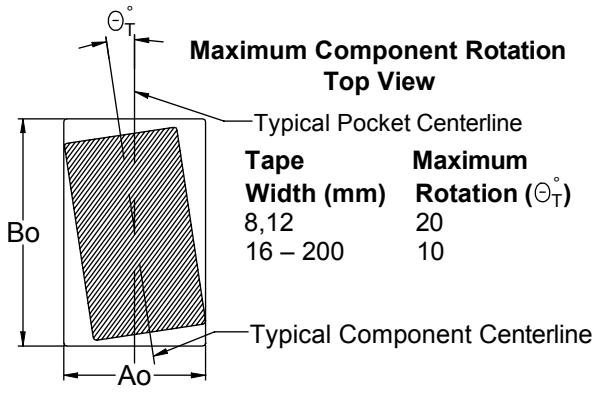
Packaging Information Performance Notes

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
8 mm	0.1 to 1.0 Newton (10 to 100 gf)
12 and 16 mm	0.1 to 1.3 Newton (10 to 130 gf)

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 Standards 556 and 624.*

Figure 2 – Maximum Component Rotation



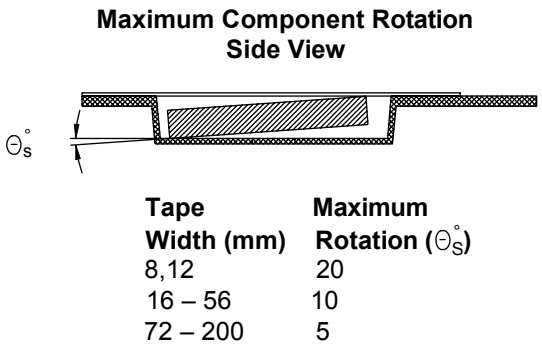


Figure 3 – Maximum Lateral Movement

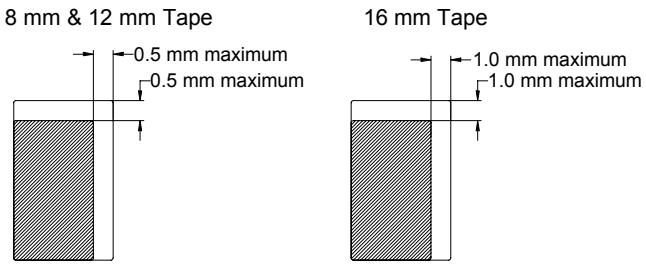


Figure 4 – Bending Radius

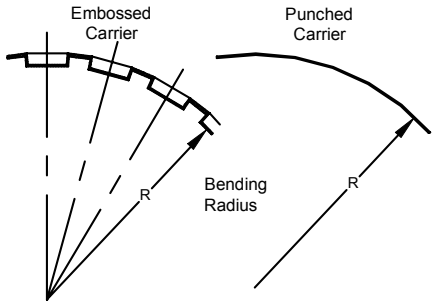
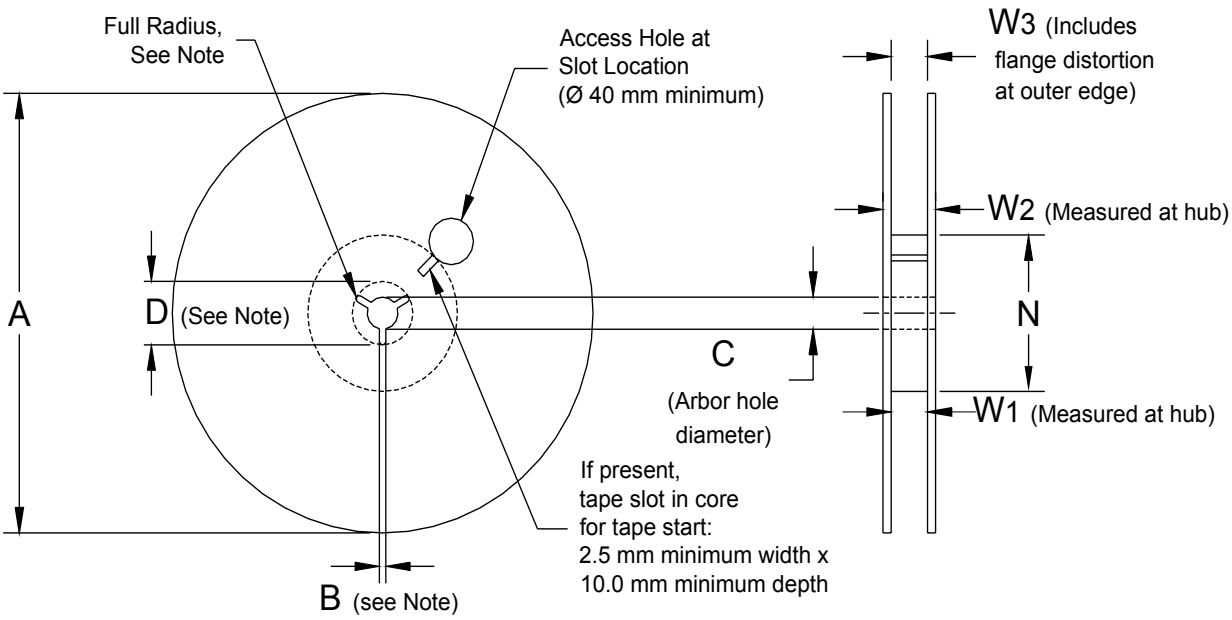


Figure 5 – Reel Dimensions



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 Minimum	C	D Minimum
8 mm	178 ±0.20 (7.008 ±0.008) or 330 ±0.20 (13.000 ±0.008)	1.5 (0.059)	13.0 +0.5/-0.2 (0.521 +0.02/-0.008)	20.2 (0.795)
12 mm				
16 mm				

Variable Dimensions — Millimeters (Inches)				
Tape Size	N Minimum	W_1	W_2 Maximum	W_3
8 mm	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
12 mm		12.4 +2.0/-0.0 (0.488 +0.078/-0.0)	18.4 (0.724)	
16 mm		16.4 +2.0/-0.0 (0.646 +0.078/-0.0)	22.4 (0.882)	

Figure 6 – Tape Leader & Trailer Dimensions

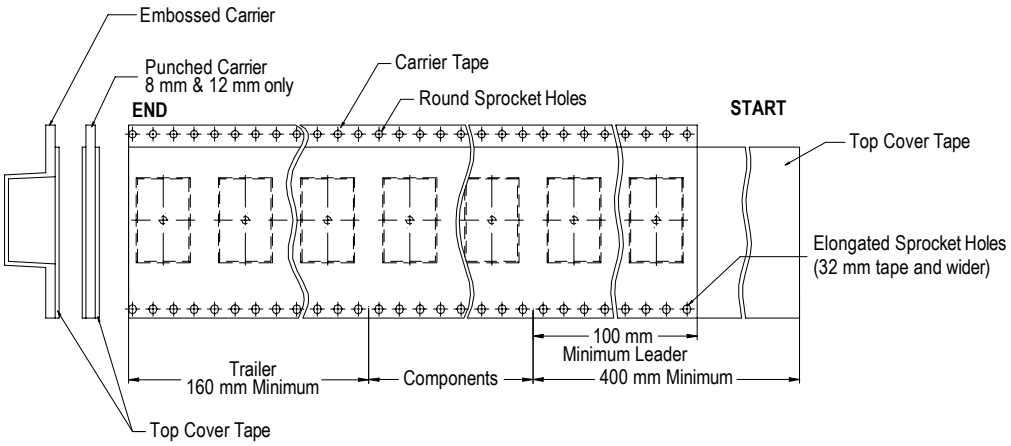
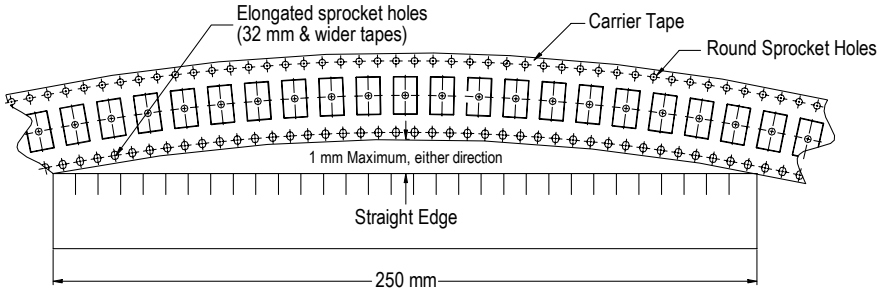


Figure 7 – Maximum Camber



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Resource	Location
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SPICE & FIT Software	http://www.kemet.com/spice
Search Our FAQs: KnowledgeEdge	http://www.kemet.com/keask
Electrolytic LifeCalculator	http://www.kemet.com:8080/elc

Product Information	
Resource	Location
Products	http://www.kemet.com/products
Technical Resources (Including Soldering Techniques)	http://www.kemet.com/technicalpapers
RoHS Statement	http://www.kemet.com/rohs
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