KEMET Organic Capacitor (KO-CAP)

T521 High Voltage Polymer Tantalum

Overview

The KEMET Organic Capacitor (KO-CAP) 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 KO-CAP also exhibits a benign failure mode which eliminates the ignition failures that can occur in standard MnO_2 tantalum types. KO-CAPs may also 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 with equivalent or better reliability than traditional MnO_2 tantalum capacitors operated at 50% of rated voltage.

The T521 Series High Voltage Polymer Tantalum is designed for higher application voltages such as 12V, 24V and 28V input rails. This series demonstrates excellent high voltage handling capabilities and reliability and is commonly selected as a replacement for other high capacitance dielectrics such as MnO_2 tantalum and aluminum electrolytic capacitors. The T521 Series can be safely operated at 80% of the rated voltage and can withstand transient conditions up to the rated voltage of the component. This series offers higher capacitance for a given application voltage when compared to multilayer ceramic and tantalum MnO_2 devices. The T521 Series also offers superior ESR performance over tantalum MnO_2 and aluminum electrolytic capacitors and a much lower profile than aluminum polymer and aluminum electrolytic capacitors.

Benefits

- Voltage ratings to 35V
- Volumetric efficiency
- Stable temperature characteristics
- Up to 68µF capacitance value
- High ripple current capability
- Low ESR
- High reliability
- Low profile design
- Benign failure mode
- Pb Free when ordered with 100% Sn termination
- RoHS compliant and Halogen Free

Applications

Typical applications include DC/DC converters, power supply input and higher voltage applications such as 12V to 28V power input rails in the military/aerospace and industrial markets.

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	521	V	226	M	025	A	T	E060	
Capacitor Class	Series	Case Size	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Failure Rate/ Design	Lead Material	ESR Code	Packaging (C-Spec)
T = Tantalum	521 = High Voltage Polymer	D = 7343-31 V = 7343-19 W = 7343-15 X = 7343-43	First two digits represent significant figures. Third digit specifies number of zeros.	M = ±20%	016 = 16V 020 = 20V 025 = 25V 035 = 35V	A = N/A	T = 100% Matte Tin (Sn) Plated H = Tin/Lead (SnPb) Solder Coated (5% Pb minimum)	E = ESR Last three digits specify ESR in mOhms. (060 = 60mOhms)	Blank = 7" Reel 7280 = 13" Reel

Performance Characteristics

Item	Performance Characteristics
Operating Temperature	-55°C to 105°C/125°C - Refer to Part Number for Max Temp Rating
Rated Capacitance Range	15µF–68µF @ 120 Hz/25°C
Capacitance Tolerance	M Tolerance (20%)
Rated Voltage Range	16V–35V
DF(120Hz)	≤ 10%
ESR (100kHz)	Refer to Part Number Electrical Specification Table
Leakage Current	≤ 0.1CV (µA) at Rated Voltage after 5 minutes

Qualification

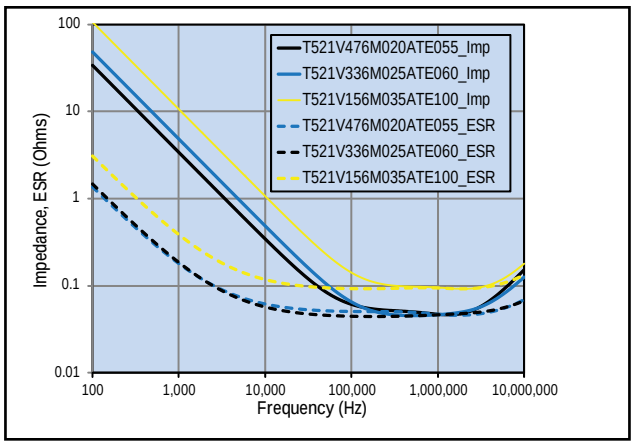
Test	Condition		Characteristics			
Endurance	105°C @ Rated Voltage, 2,000 Hours 125°C @ 2/3 Rated Voltage, 2,000 Hours**		ΔC/C	Within -20%/+10% of initial value		
			DF	Within initial limits		
			DCL	IL @ 105°C, 2 x IL @ 125°C		
			ESR	2 x Initial Limit		
Storage	105°C @ 0 Volts, 2,000 Hours 125°C @ 0 Voltage, 2,000 Hours**		ΔC/C	Within -20%/+10% of initial value		
			DF	Within initial limits		
			DCL	IL @ 105°C, 2 x IL @ 125°C		
			ESR	2 x Initial Limit		
Humidity	60° C, 90% RH, 500Hr, Rated Voltage 60° C, 90% RH, 500Hr, No Load		ΔC/C	Within -5%/+35% of initial value		
			DF	Within initial limits		
			DCL	Within 3.0 x initial limit		
Temperature Stability	Extreme temperature exposure at a succession of continuous steps at +25°C, -55°C, +25°C, +85°C, +105°/125°C, +25°C		+25°C	-55°C	+85°C	+105°/125°C
		ΔC/C	IL*	±20%	±20%	±30%
		DF	IL	IL	1.2 x IL	1.5 x IL
		DCL	IL	n/a	10 x IL	10 x IL
Surge Voltage	105°C, 1.32 x Rated Voltage, 33Ω Resistance, 1000 cycles		ΔC/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, 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*

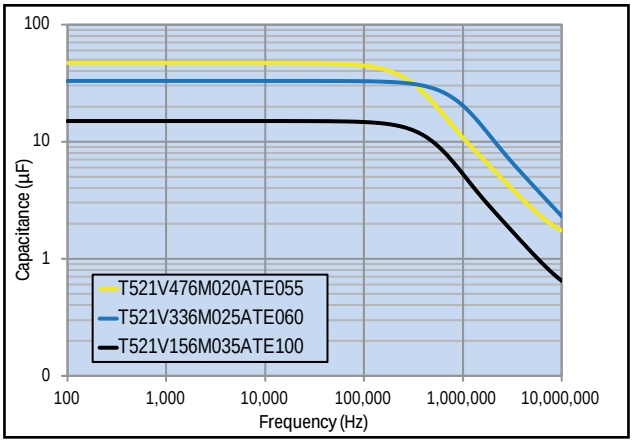
***Refer to part number specifications for individual temperature classification.*

Electrical Characteristics

ESR vs. Frequency

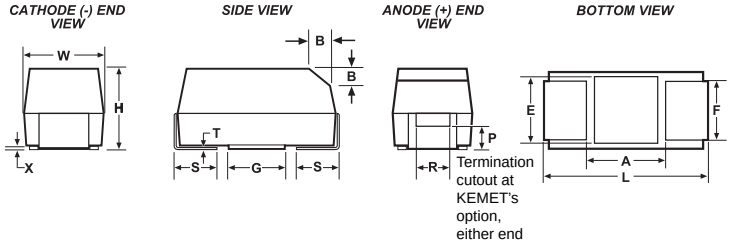


Capacitance vs. Frequency



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)
D	7343-31	7.3 ± 0.3 (287 ± .012)	4.3 ± 0.3 (.169 ± .012)	2.8 ± 0.3 (.110 ± .012)	2.4 (.094)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	0.9 (.035)	1.0 (.039)	0.13 (.005)	3.8 (.150)	3.5 (.138)	3.5 (.138)
V	7343-19	7.3 ± 0.3 (287 ± .012)	4.3 ± 0.3 (.169 ± .012)	1.9 max	2.4 (.094)	1.3 (.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 (287 ± .012)	4.3 ± 0.3 (.169 ± .012)	1.5 (.059)	2.4 (.094)	1.3 (.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 (.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)

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	Rated Temp
VDC	120Hz	KEMET/EIA	(See below for part options)	+20°C	+20°C 120Hz	+20°C 100kHz	+45°C 100kHz	Temp≤260°C	(°C)
	µF			µAmps	% Max	mOhms	mAmps	J-STD-020D	
16	47	V/7343-19	T521V476M016A(1)E080	75.2	10	80	1500.0	3	105
16	68	V/7343-19	T521V686M016A(1)E050	108.8	10	50	1900.0	3	105
16	68	V/7343-19	T521V686M016A(1)E090	108.8	10	90	1400.0	3	105
16	100	V/7343-19	T521V107M016A(1)E050	160.0	10	50	1900.0	3	125
16	100	D/7343-31	T521D107M016A(1)E050	160.0	10	50	2100.0	3	105
16	150	X/7343-43	T521X157M016A(1)E080	240.0	10	80	1800.0	3	105
16	220	X/7343-43	T521X227M016A(1)E035	352.0	10	35	2700.0	3	125
16	220	X/7343-43	T521X227M016A(1)E050	352.0	10	50	2200.0	3	125
16	330	X/7343-43	T521X337M016A(1)E025	528.0	10	25	3100.0	3	125
16	330	X/7343-43	T521X337M016A(1)E050	528.0	10	50	2200.0	3	125
20	47	V/7343-19	T521V476M020A(1)E090	94.0	10	90	1400.0	3	125
20	47	V/7343-19	T521V476M020A(1)E055	94.0	10	55	1800.0	3	125
20	47	D/7343-31	T521D476M020A(1)E055	94.0	10	55	2000.0	3	125
25	22	V/7343-19	T521V226M025A(1)E060	55.0	10	60	1800.0	3	105
25	33	V/7343-19	T521V336M025A(1)E060	82.5	10	60	1800.0	3	105
25	33	D/7343-31	T521D336M025A(1)E060	82.5	10	60	1900.0	3	105
25	100	X/7343-43	T521X107M025A(1)E060	250.0	10	60	2000.0	3	105
35	15	V/7343-19	T521V156M035A(1)E100	52.5	10	100	1400.0	3	125
35	15	V/7343-19	T521V156M035A(1)E125	52.5	10	125	1200.0	3	125
35	33	D/7343-31	T521D336M035A(1)E065	115.5	10	65	1900.0	3	125
35	47	X/7343-43	T521X476M035A(1)E030	164.5	10	30	2900.0	3	125
35	47	X/7343-43	T521X476M035A(1)E070	164.5	10	70	1900.0	3	125
VDC	µF	KEMET/EIA	(see below for part options)	µAmps	% Max	mOhms	mAmps	J-STD-020d	(°C)
	120Hz			+20°C	+20°C 120Hz	+20°C 100kHz	+45°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	Rated Temp

Other part number options:

1- Standard with tin terminations (14th character = T). Tin/lead terminations is also available (14th character = H).

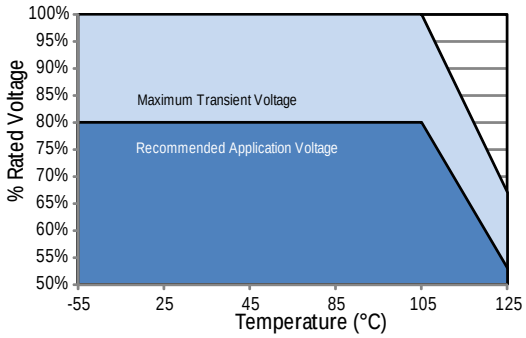
Also available on large (13 inch) reels. Add 7280 to the end of the part number.

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

Derating Guidelines

Voltage Rating	Max Recommended Steady State Voltage	Max Recommended Transient Voltage (1ms - 1µs)
-55°C to 105°C		
16V ≤ V_r ≤ 35V	80% of V_r	V_r
105°C to 125°C		
16V ≤ V_r ≤ 35V	54% of V_r	67% of 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 below left table. The maximum power dissipation rating stated in the table must be reduced with increasing environmental operating temperatures. Please refer to the below right table for temperature compensation requirements.

Case Code		Maximum Power Dissipation (Pmax) mWatts @ 45°C w/ +30°C Rise
KEMET	EIA	
T520/525/T540T	3528-12	105
T520M	3528-15	120
T520A	3216-18	112
T520/525/T540B	3538-21	127
T520U	6032-15	135
T520L	3528-19	150
T520C	6032-28	165
T520W	7343-15	180
T520V	7343-20	187
T520/525/T540D	7343-31	225
T520Y/525Y	7343-40	241
T520X	7343-43	247
T528K	3528-10	150
T528W	7343-15	325
T528Z	7343-17	325
T530/T541D	7343-31	255
T530/T541Y	7343-40	263
T530/T541X	7443-43	270

Temperature Compensation Multipliers for Maximum Power Dissipation (Pmax)		
≤45°C	45°C < T ≤ 85°C	85°C < T ≤ 105°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.

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

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

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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
105°C	3% of Rated Voltage
125°C*	1% of Rated Voltage

**For series rated to 125°C*

Table 2 – Land Dimensions/Courtyard

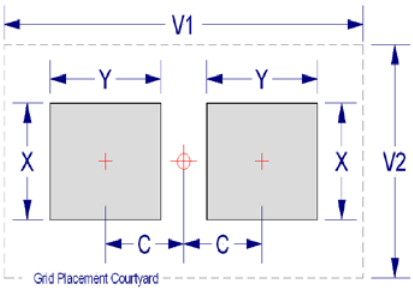
KEMET	Metric Size Code	Density Level A: Maximum (Most) Land Protrusion (mm)					Density Level B: Median (Nominal) Land Protrusion (mm)					Density Level C: Minimum (Least) Land Protrusion (mm)				
Case	**EIA**	X	Y	**C**	V1	V2	X	Y	**C**	V1	V2	X	Y	**C**	V1	V2
D	7343-31	2.55	3.75	2.70	10.20	5.50	2.45	3.35	2.60	9.10	5.00	2.35	2.95	2.50	8.20	4.70
V	7343-20	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
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
W	7343-15	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.



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.

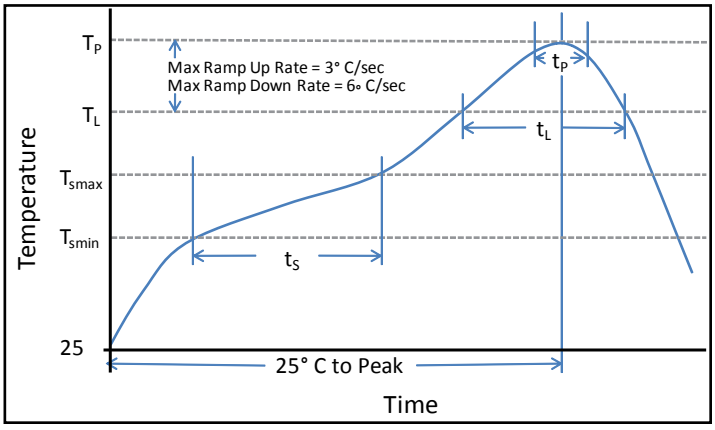
Note that although the X/7343-43 case size can withstand wave soldering, the tall profile (4.3 mm maximum) dictates care in wave process development.

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.

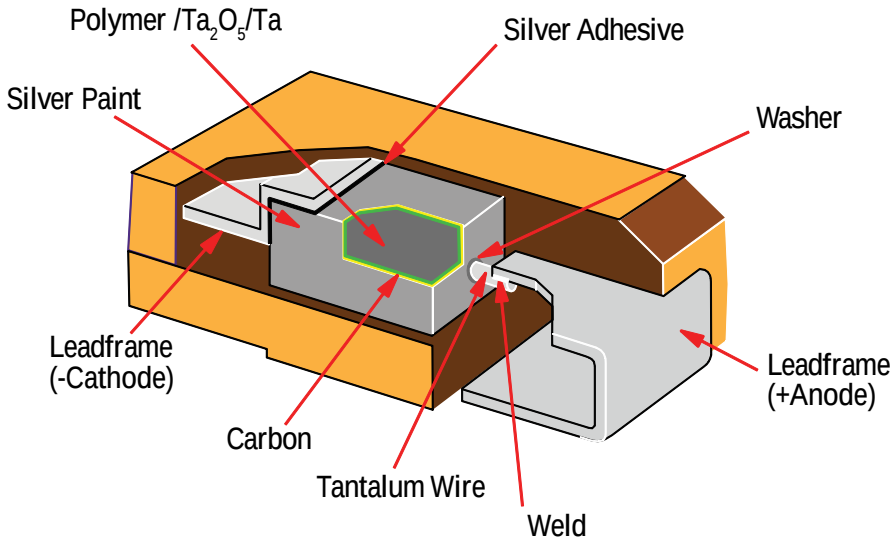
During typical reflow operations, a slight darkening of the gold-colored epoxy may be observed. This slight darkening is normal and is not harmful to the product. Marking permanency is not affected by this change.

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

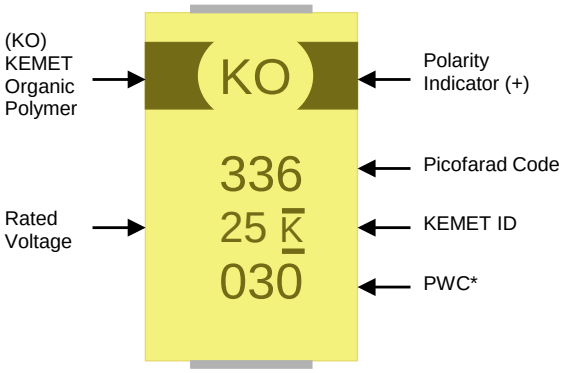
Note: All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow.
**Case Size D, E, P, Y and X*
***Case Size A, B, C, H, I, K, M, R, S, T, U, V, W and Z*



Construction



Capacitor Marking



* 030 = 30th week of 2010

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 mm and 12 mm plastic tape on 7" and 13" reels, in accordance with EIA Standard 481-1: Taping of Surface Mount Components for Automatic Handling. This packaging system is compatible with all tape fed automatic pick and place systems.

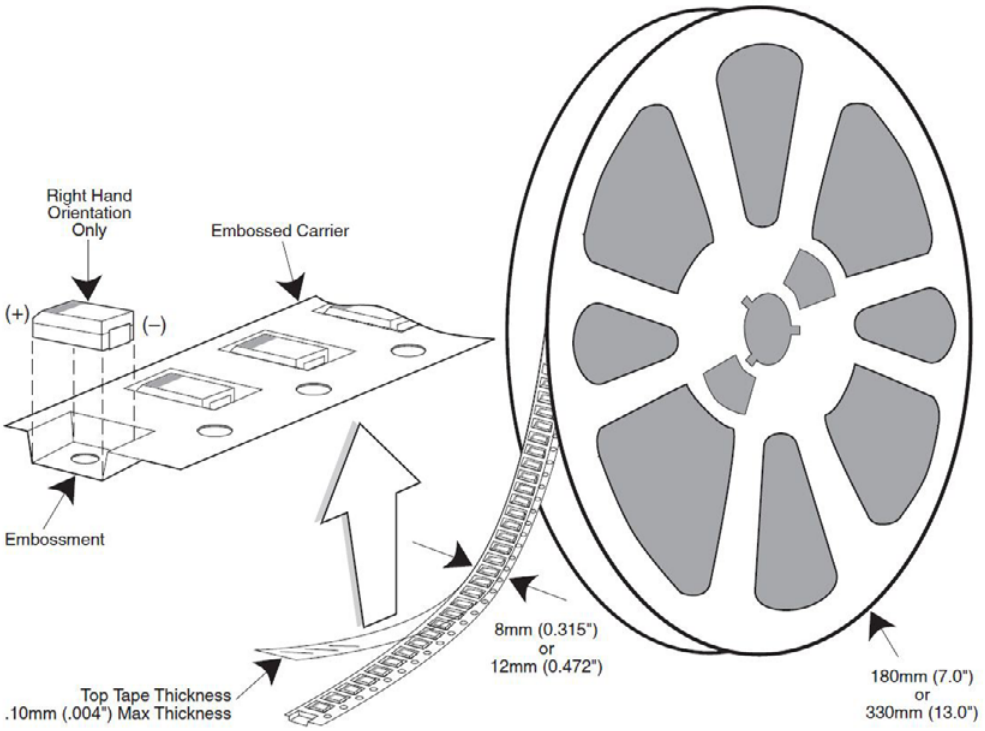


Table 3 – Packaging Quantity

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

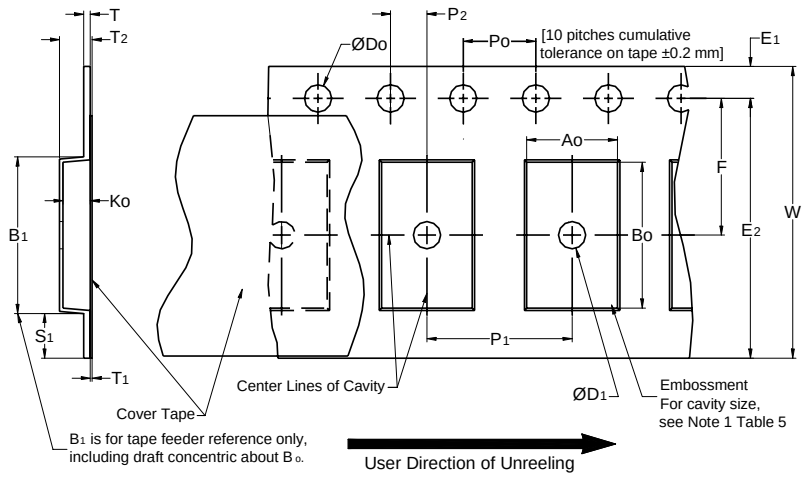


Table 4 – Embossed (Plastic) Carrier Tape Dimensions

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 S_1<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. 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 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

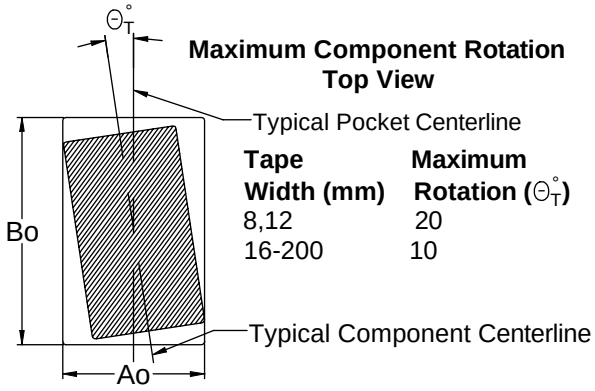
1. **Cover Tape Break Force:** *1.0 Kg minimum.*
2. **Cover Tape Peel Strength:** *The total peel strength of the cover tape from the carrier tape shall be:*

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



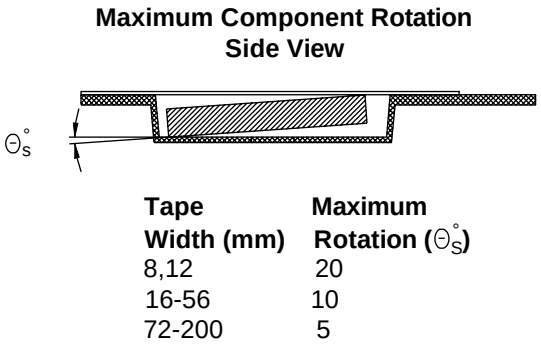


Figure 3 – Maximum Lateral Movement

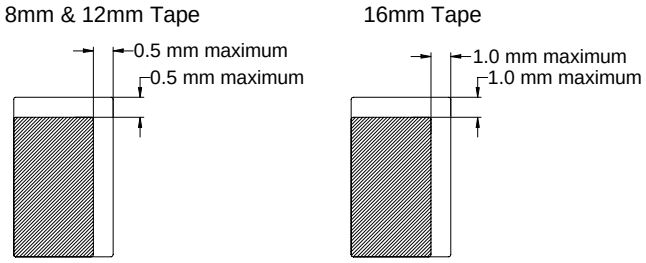


Figure 4 – Bending Radius

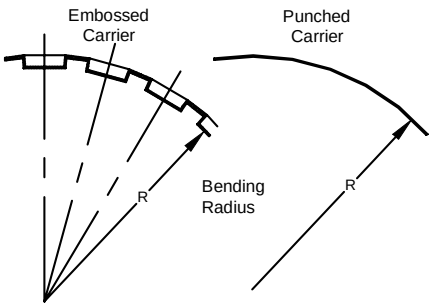
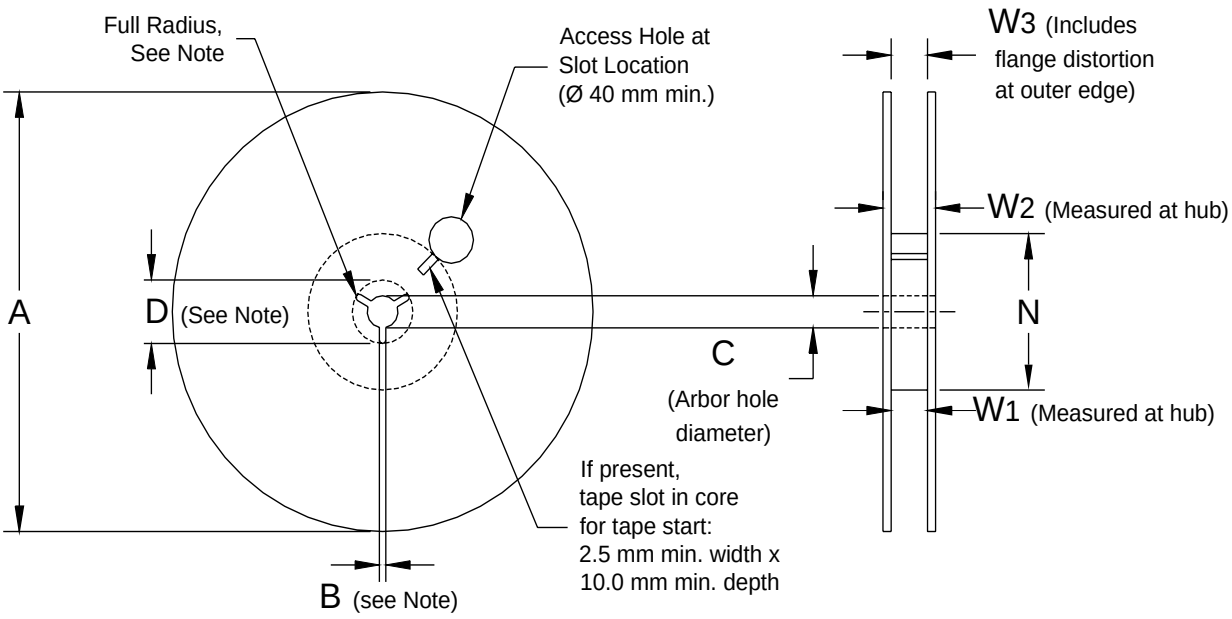


Figure 5 – Reel Dimensions



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) 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)
12mm				
16mm				

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

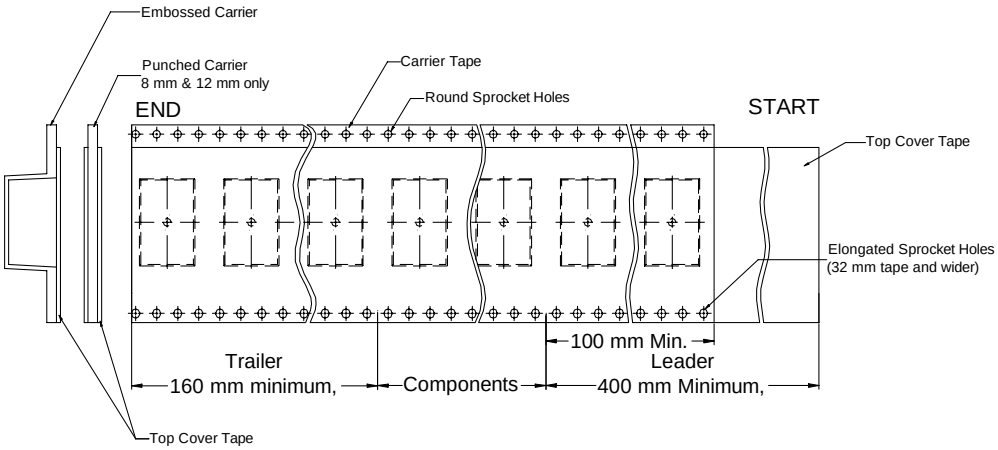
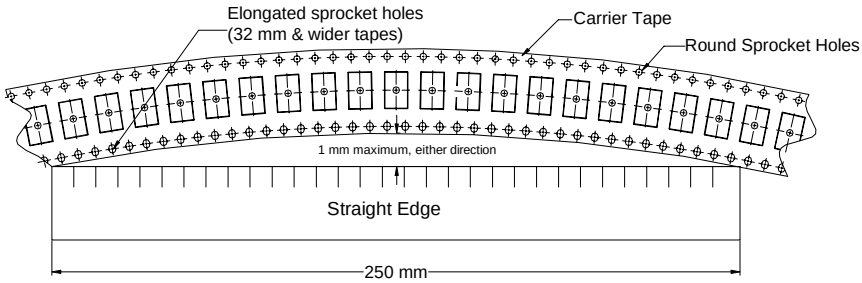


Figure 7 – Maximum Camber



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