

Overview

The KEMET Organic Capacitor (KO-CAP) is a tantalum capacitor with a Ta anode and Ta₂O₅ dielectric. A conductive organic polymer replaces the more common MnO₂ as the cathode plate of the capacitor. This results in very low ESR and improved capacitance retention at high frequency. This advancement combined with the use of a multiple anode design delivers the lowest ESR values available in the industry. The KO-CAP may also be operated at steady state voltages at 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.

The T541 Series KO-CAP offers the same advantages as the T530 Series but is also designed for the Commercial Off-the-Shelf (COTS) requirements of military and aerospace applications. This surface mount product offers a tin lead (SnPb) leadframe finish, surge current testing options and standard or low ESR levels.

Benefits

- ESR: 10mΩ to 40mΩ
- 125°C maximum operating temperature
- Polymer cathode technology
- High frequency capacitance retention
- Benign failure mode
- Capacitance: 150μF to 1,000μF
- 100% accelerated steady state aging
- Surge current testing options
- Utilizes multiple tantalum anode technology
- Volumetric efficiency
- Use at up to 90% of rated voltage (10% derating) for part types ≤10V
- Use at up to 80% of rated voltage (20% derating) for part types >10V
- Very low ESR
- EIA standard case sizes

Applications

Typical applications include decoupling and filtering in military and aerospace applications that require low ESR or a benign failure mode.



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 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	541	D	157	M	010	A	H	65	10
Capacitor Class	Series	Case Size	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Failure Rate/Design	Lead Material	Surge Option	ESR
T = Tantalum	541 = Polymer COTS Multiple Anode	D = 7343-31 X = 7343-43 Y = 7343-40	First two digits represent significant figures. Third digit specifies number of zeros.	M = ±20%	2R5 = 2.5V 003 = 3V 004 = 4V 006 = 6.3V 010 = 10V 016 = 16V	A = N/A	H = Standard Solder Coated (SnPb 5% Pb minimum)	65 = No Surge 66 = 10 cycles @ 25°C 67 = 10 cycles -55°C and 85°C	10 = ESR-Standard 20 = ESR-Low

Performance Characteristics

Item	Performance Characteristics
Operating Temperature	-55°C to 125°C*
Rated Capacitance Range	150µF–1000µF @ 120 Hz/25°C
Capacitance Tolerance	M Tolerance (20%)
Rated Voltage Range	2.5V–16V
DF(120Hz)	8%
ESR (100kHz)	Refer to Part Number Electrical Specification Table
Leakage Current	≤ 0.1CV (µA) at Rated Voltage after 5 minutes

* KEMET's Polymer COTS (T540/T541 Series) capacitors are rated for operation between -55°C and +125°C. Parametric electrical performance remains within stated specification limits after 1,000 hours of continuous operation and/or storage at +125°C. Long-term duty cycles or storage at or above +125°C may result in an increase in ESR performance outside of the stated specification limits.

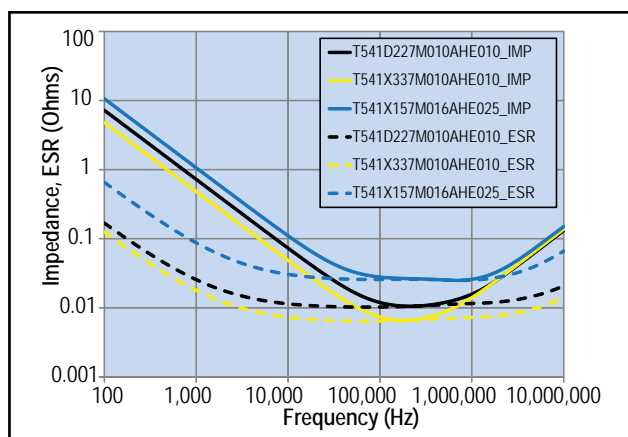
Qualification

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	≤ initial limit			
		DCL	1.25 x initial limit @ 125°C			
		ESR	2 x IL @ 105°C, 5 x IL @ 125°C			
Storage Life	125°C @ 0 Volts, 2,000 Hours	ΔC/C	Within -20%/+10% of initial value			
		DF	Within initial limits			
		DCL	Within 2.0 x initial limit			
		ESR	Within 5.0 x initial limit			
Humidity	60°C, 90% RH, 500 Hours, Rated Voltage 60°C, 90% RH, 500 Hours, no load	ΔC/C	Within -5%/+35% of initial value			
		DF	≤ initial limit			
		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, +125°C, +25°C		+25°C	-55°C	+85°C	+125°C
		ΔC/C	IL*	±20%	±20%	±30%
		DF	IL	IL	1.2 x IL	1.5 x IL
Surge Voltage	105°C, 1.32 x Rated Voltage, 33Ω Resistance, 1,000 cycles	ΔC/C	Within -20%/+10% of initial value			
		DF	Within initial limits			
		DCL	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			
Additional Qualification Testing per MIL-PRF-55365/8						

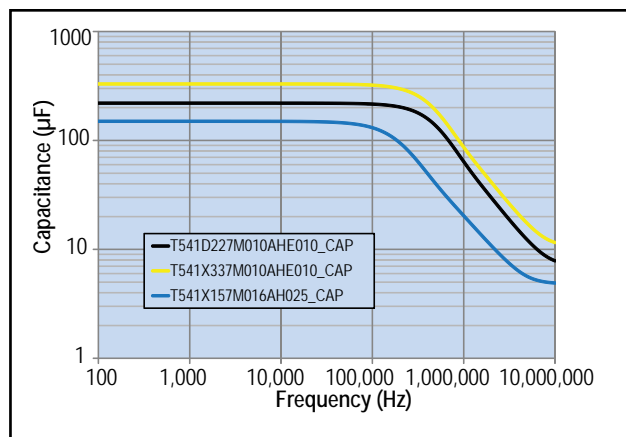
*IL = Initial limit

Electrical Characteristics

ESR vs. Frequency

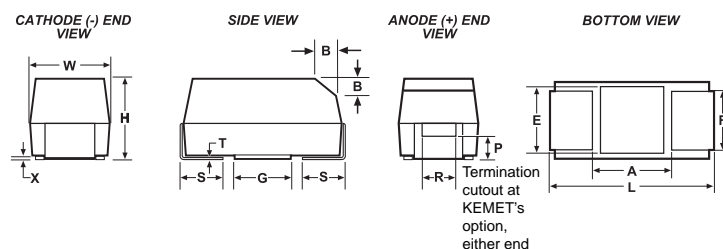


Capacitance vs. Frequency



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)
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)
Y	7343-40	7.3 ± 0.3 (.287 ± .012)	4.3 ± 0.3 (.169 ± .012)	4.0 (.157)	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	Standard ESR	Low ESR
				+25°C	+25°C	+25°C 120Hz	+25°C 100kHz	+25°C 100kHz
VDC	120Hz µF	KEMET/EIA	(See below for part options)	µAmps	% Max	mOhms	mOhms	
2.5	470	D/7343-31	T541D477M2R5AH(1)(2)	118	8.0	10.0	N/A	
2.5	680	D/7343-31	T541D687M2R5AH(1)(2)	170	8.0	10.0	N/A	
2.5	680	Y/7343-40	T541Y687M2R5AH(1)(2)	170	8.0	10.0	N/A	
2.5	1000	X/7343-43	T541X108M2R5AH(1)(2)	250	8.0	10.0	N/A	
3	470	D/7343-31	T541D477M003AH(1)(2)	141	8.0	10.0	N/A	
3	680	D/7343-31	T541D687M003AH(1)(2)	204	8.0	10.0	N/A	
3	1000	X/7343-43	T541X108M003AH(1)(2)	300	8.0	10.0	N/A	
4	330	D/7343-31	T541D337M004AH(1)(2)	132	8.0	10.0	N/A	
4	470	D/7343-31	T541D477M004AH(1)(2)	188	8.0	10.0	N/A	
4	470	Y/7343-40	T541Y477M004AH(1)(2)	188	8.0	10.0	N/A	
4	680	X/7343-43	T541X687M004AH(1)(2)	272	8.0	10.0	N/A	
4	1000	X/7343-43	T541X108M004AH(1)(2)	400	8.0	10.0	N/A	
6	220	D/7343-31	T541D227M006AH(1)(2)	139	8.0	10.0	N/A	
6	330	D/7343-31	T541D337M006AH(1)(2)	208	8.0	10.0	N/A	
6	330	Y/7343-40	T541Y337M006AH(1)(2)	208	8.0	10.0	N/A	
6	470	X/7343-43	T541X477M006AH(1)(2)	296	8.0	10.0	N/A	
10	150	D/7343-31	T541D157M010AH(1)(2)	150	8.0	10.0	N/A	
10	220	D/7343-31	T541D227M010AH(1)(2)	220	8.0	10.0	N/A	
10	220	Y/7343-40	T541Y227M010AH(1)(2)	220	8.0	10.0	N/A	
10	330	X/7343-43	T541X337M010AH(1)(2)	330	8.0	10.0	N/A	
16	150	X/7343-43	T541X157M016AH(1)(2)	240	8.0	40.0	25.0	
VDC	µF	KEMET/EIA	(see below for part options)	µAmps	% Max	mOhms	mOhms	
	120Hz			+25°C	+25°C 120Hz	+25°C 100kHz	+25°C 100kHz	
Rated Voltage	Rated Cap	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	Standard ESR	Low ESR	

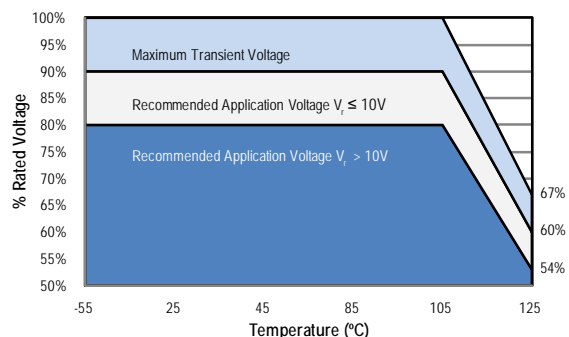
Notes:

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

Please refer to Ordering Information for additional details.

Derating Guidelines

Voltage Rating	Max Recommended Steady State Voltage	Max Recommended Transient Voltage (1ms–1μs)
-55°C to 105°C		
$2.5V \leq V_r \leq 10V$	90% of V_r	V_r
$V_r = 16V$	80% of V_r	V_r
105°C to 125°C		
$2.5V \leq V_r \leq 10V$	60% of V_r	67% of V_r
$V_r = 16V$	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.

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

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

I = rms ripple current (amperes)

E = rms ripple voltage (volts)

Pmax = maximum power dissipation (watts)

R = ESR at specified frequency (ohms)

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

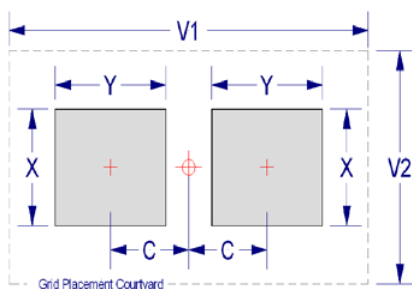
KEMET	Metric Size Code	Density Level A: Maximum (Most) Land Protrusion (mm)					Density Level B: Median (Nominal) Land Protrusion (mm)					Density Level C: Minimum (Least) Land Protrusion (mm)						
		Case	EIA	X	Y	C	V1	V2	X	Y	C	V1	V2	X	Y	C	V1	V2
		D	7343-31	2.55	3.75	2.70	10.20	5.50	2.45	3.35	2.60	9.10	5.00	2.35	2.95	2.50	8.20	4.70
		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
		Y ¹	7343-35	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.

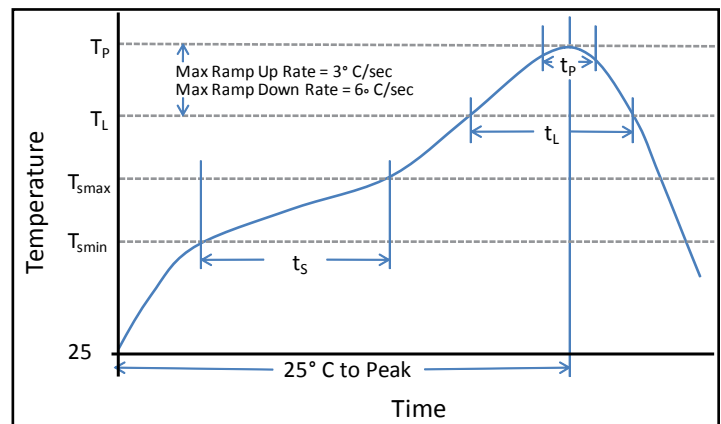
During typical reflow operations, a slight darkening of the gold-colored epoxy may be observed. This slight darkening is normal and is not harmful to the product. Marking permanency is not affected by this change.

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

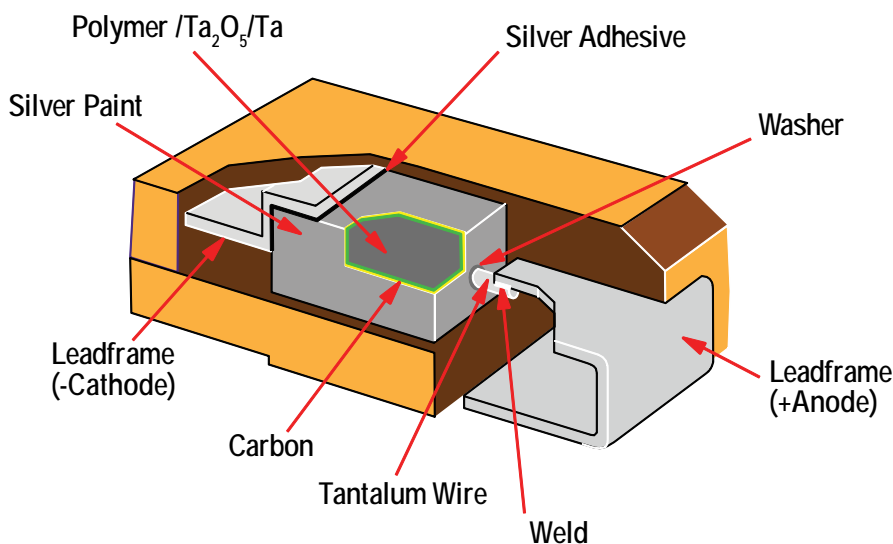
Note: All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow.

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

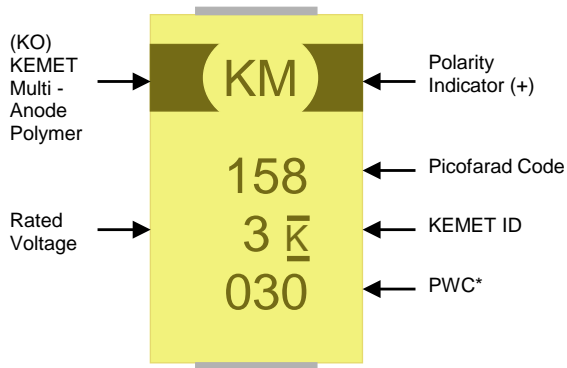
**Case Size A, B, C, H, I, K, M, R, S, T, U, V, W and Z



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.

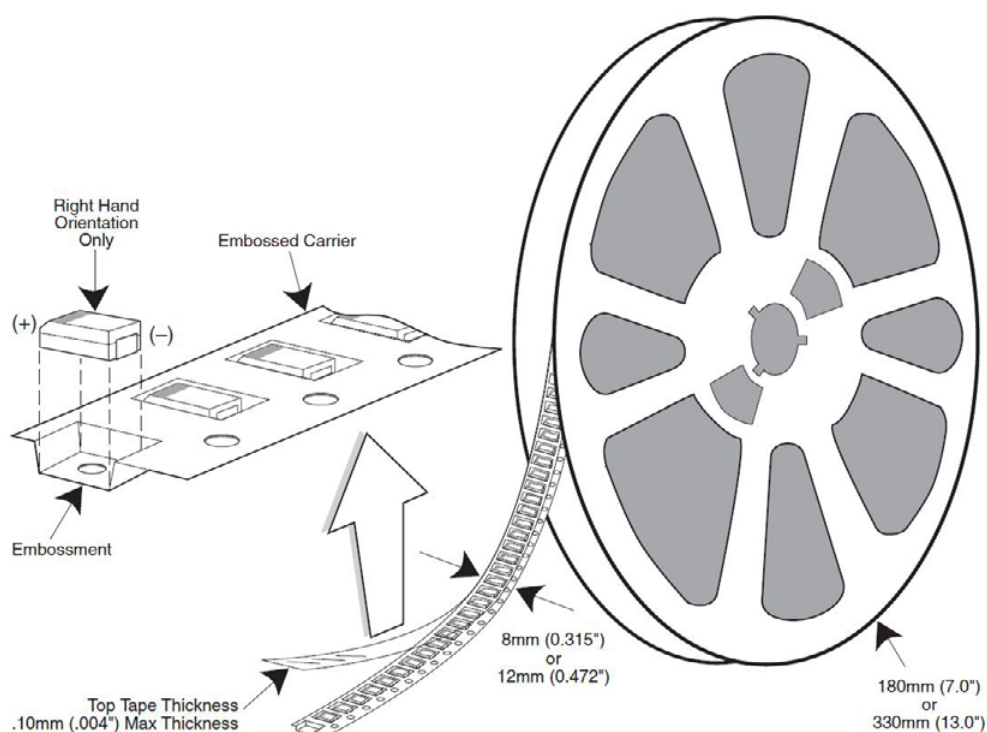


Table 3 – Packaging Quantity

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

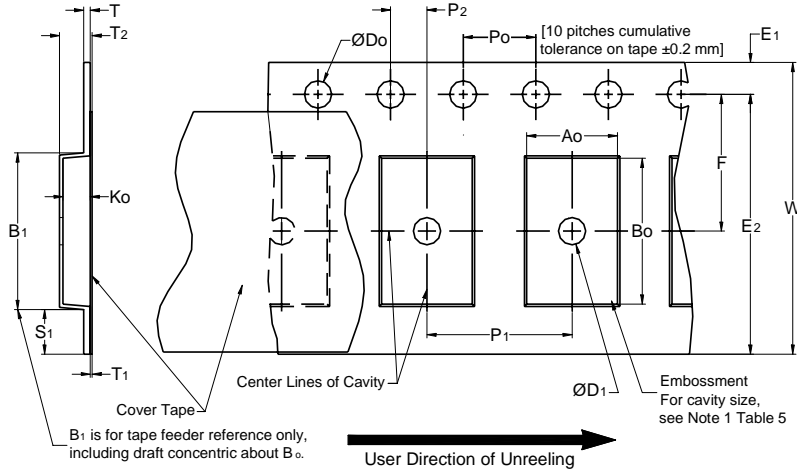


Table 4 – Embossed (Plastic) Carrier Tape Dimensions

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

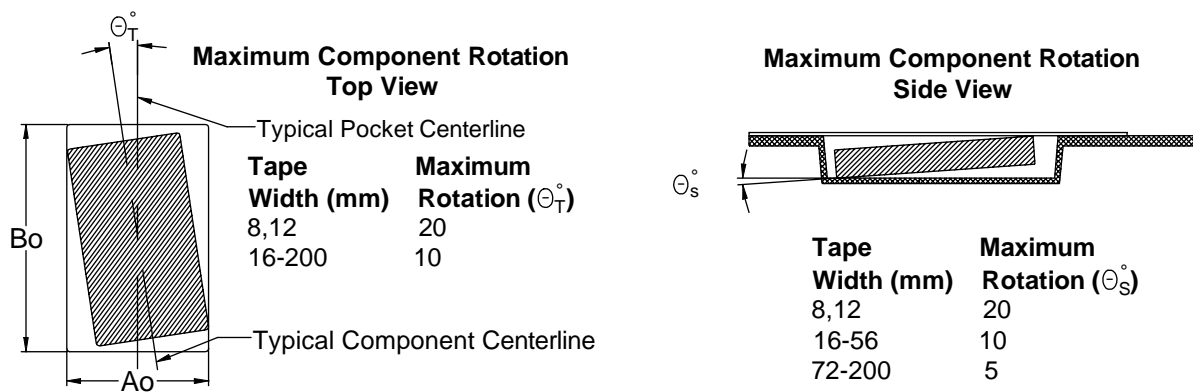


Figure 3 – Maximum Lateral Movement

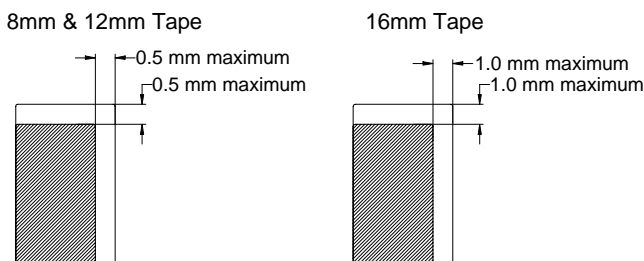


Figure 4 – Bending Radius

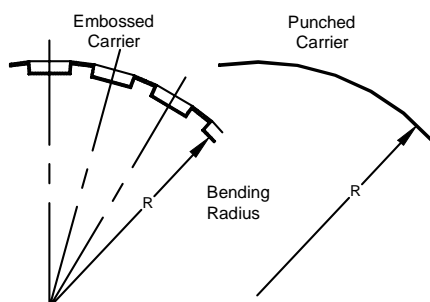


Figure 5 – Reel Dimensions

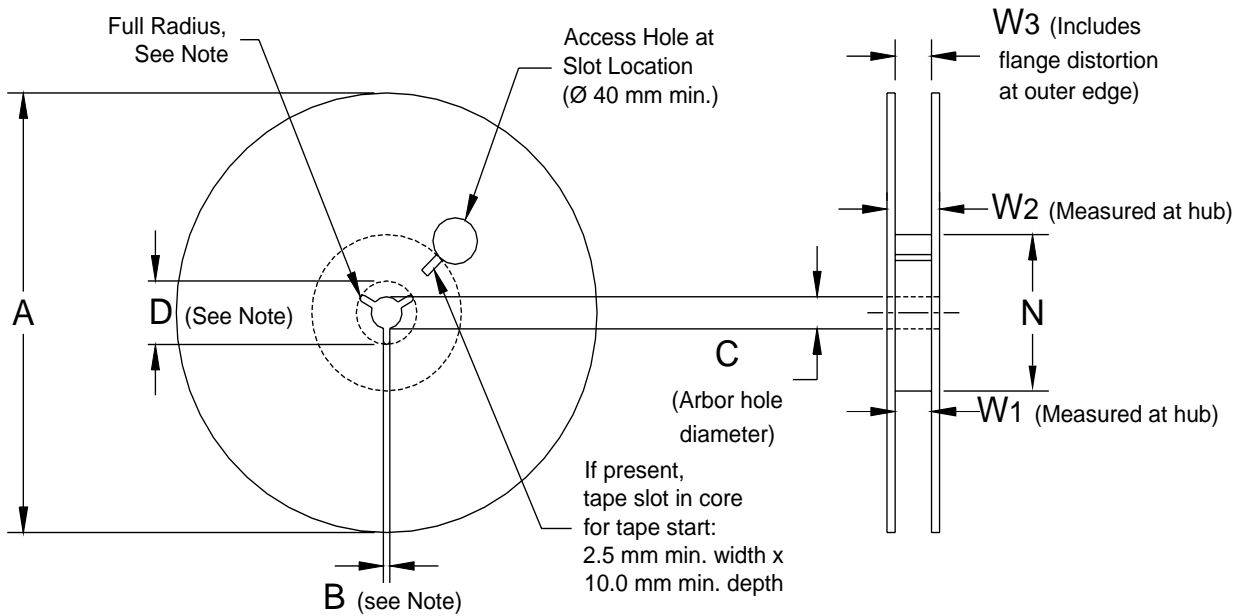


Table 5 – Reel Dimensions

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

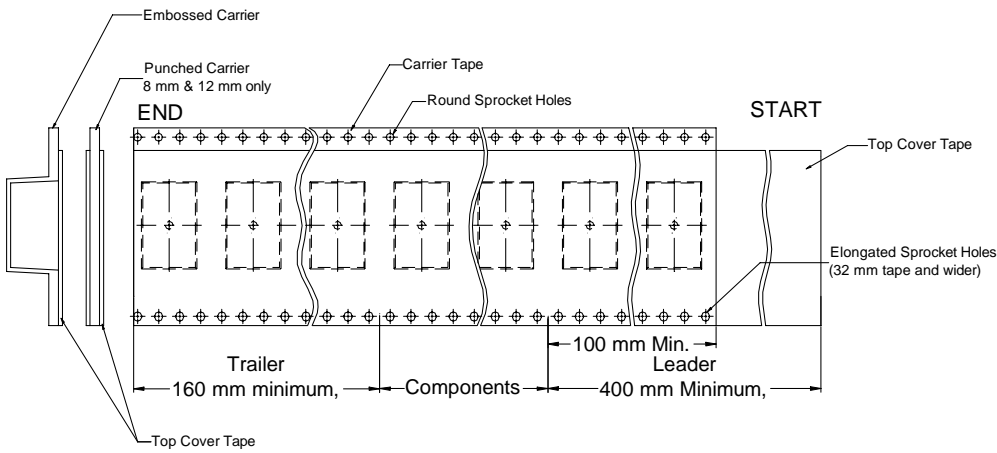
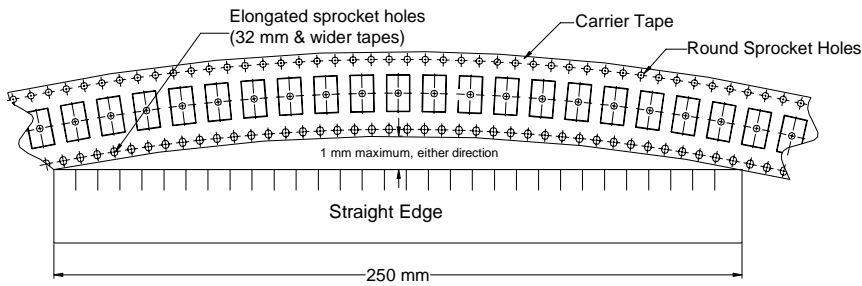


Figure 7 – Maximum Camber



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