

# T540 COTS Polymer Electrolytic for High Reliability Applications, 2.5 – 63 VDC

## Overview

## KOCAP Polymer Capacitors

The KEMET Organic Capacitor (KO-CAP) is a solid electrolytic capacitor with a conductive polymer cathode capable of delivering very low ESR and improved capacitance retention at high frequencies. KO-CAP combines the low ESR of multilayer ceramic, the high capacitance of aluminum electrolytic and the volumetric efficiency of tantalum into a single surface mount package. Unlike liquid electrolyte-based capacitors, KO-CAP has a very long operational life and high ripple current capabilities.

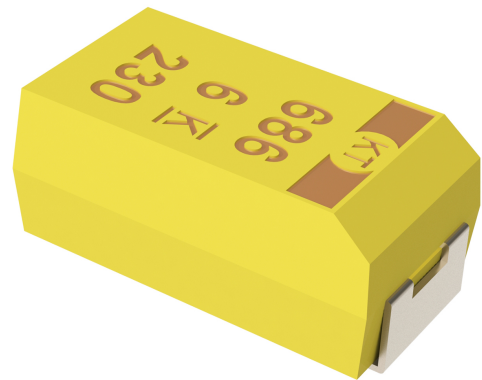
The T540 COTS Polymer Electrolytic offers the same performance advantages as other KO-CAP series with screening options associated with high reliability ("Hi-Rel") applications. These Commercial-Off-The-Shelf (COTS) grade components are built with a tin-lead (SnPb) termination finish and offer several

surge current screening options. The recommended application derating for these capacitors is 10 – 20%, rendering them suitable for application voltages from 2.25 to 50 VDC.

The T540 Series is the first polymer electrolytic capacitor available with failure rate options as defined by KEMET's KO-CAP Reliability Assessment method. This method utilizes accelerated conditions (voltage and temperature) applied to board-mounted samples to assess long term device reliability. The failure rates available are B (0.1% per 1,000 hours), C (0.01% per 1,000 hours) and D (0.001% per 1,000 hours). The KO-CAP Reliability Assessment method was developed as a result of over ten years of research and is described in numerous papers available on [www.kemet.com](http://www.kemet.com).

## Benefits

- Approved for DLA Drawing 04051
- B, C and D failure rates available
- High frequency capacitance retention
- Surge current testing options
- Volumetrically efficient
- Low ESR
- EIA standard case sizes
- 100% accelerated steady state aging
- KEMET's KO-CAP Reliability Assessment method



## Applications

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

When extreme temperatures and humidity are taken into account, polymer capacitors offer a number of advantages over other types of capacitors. KEMET continues to investigate the behavior of polymer capacitors in extreme conditions. If you have questions about using these capacitors in a specific environment or application, we suggest you contact your local KEMET representative or Field Application Engineer. You may also refer to "Considerations for Polymer Capacitors in Extreme Environments" located at [www.kemet.com/ExtremePolymerPaper](http://www.kemet.com/ExtremePolymerPaper).

## K-SIM

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

## Ordering Information

T	540	D	107	M	10	A	H	65	10	
Capacitor Class	Series	Case Size	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Failure Rate/Design	Termination Finish	Surge Option	ESR	Packaging (C-Spec)
T = Tantalum	540 = Polymer COTS	B, C, D	First two digits represent significant figures. Third digit specifies number of zeros.	M = ±20%	2R5 = 2.5 003 = 3 004 = 4 006 = 6.3 010 = 10 016 = 16 020 = 20 025 = 25 035 = 35 050 = 50 063 = 63	A = N/A B* = 0.1%/1,000 hours C* = 0.01%/1,000 hours D* = 0.001%/1,000 hours	H = Standard Solder Coated (SnPb 5% Pb minimum)	65 = 4 cycles at 25°C ±5°C** 66 = 10 cycles at 25°C ±5°C*** 67 = 10 cycles at -55°C +0°C/-5°C and +85°C ±5°C***	10 = ESR - Standard 20 = ESR - Low	Blank = 7" Reel 7280 = 13" Reel

\* Select part numbers,

\*\* Before voltage aging,

\*\*\* After voltage aging

## Ordering Information – DLA Drawing 04051

04051-	001	A
Drawing Number	Dash Number	Surge Current Option
04051	See Part Number List	Blank = 4 cycles +25°C ±5°C Before Voltage Aging A = 10 cycles +25°C ±5°C After Voltage Aging B = 10 cycles -55°C +0°C/-5°C and +85°C ±5°C After Voltage Aging

## Performance Characteristics

Item	Performance Characteristics
Operating Temperature	-55°C to 125°C *
Rated Capacitance Range	4.7 – 680 µF at 120 Hz/25°C
Capacitance Tolerance	M Tolerance (20%)
Rated Voltage Range	2.5 – 63 V
DF (120 Hz)	≤ 10%
ESR (100 kHz)	Refer to Part Number Electrical Specification Table
Leakage Current	≤ 0.1C V (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 at rated voltage, 2,000 hours 125°C at 2/3 rated voltage, 2,000 hours	Δ C/C	Within -20%/+10% of initial value			
		DF	≤ initial limit			
		DCL**	1.25 x initial limit at 125°C			
		ESR	2 x initial limit			
Storage Life	125°C at 0 volts, 2,000 hours	Δ C/C	Within -20%/+10% of initial value			
		DF	Within initial limits			
		DCL**	Within 2.0 x initial limit			
		ESR	Within 2.0 x initial limit			
Humidity	60°C, 90% RH, 500 hours, rated voltage 60°C, 90% RH, 500 hours, no load	Δ C/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	Δ C/C	+25°C	-55°C	+85°C (1)	+125°C (2)
		DF	±5%	±10%	±20%	±30%
		DCL	IL	IL	1.2 x IL	1.5 x IL
Surge Voltage	105°C, 1.32 x rated voltage, 33 Ω resistance, 1,000 cycles	Δ C/C	Within -20/+5% 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			
Additional Qualification Tests per MIL-PRF-55365/8	Please contact KEMET for more information.					

\*IL = Initial limit

\*\* The test voltage shall be maintained during the cool down from elevated test temperature to +25°C. After cool down, the capacitors shall be discharged for a minimum of 5 minutes. DC leakage measurements are allowed at this time.

(1) ≥16V - D C/C = ±30%

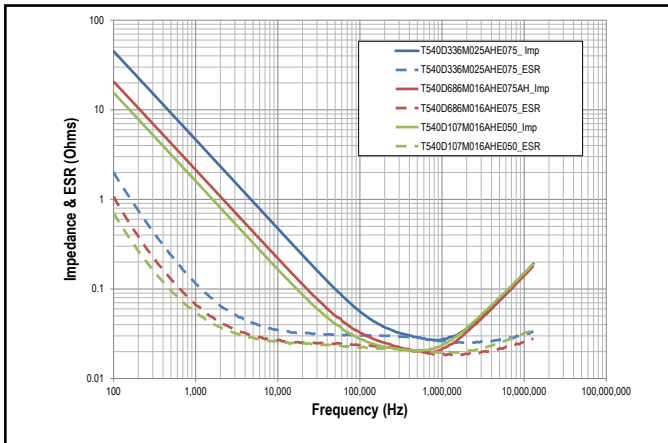
(2) ≥16V - D C/C = ±40%

## Certification

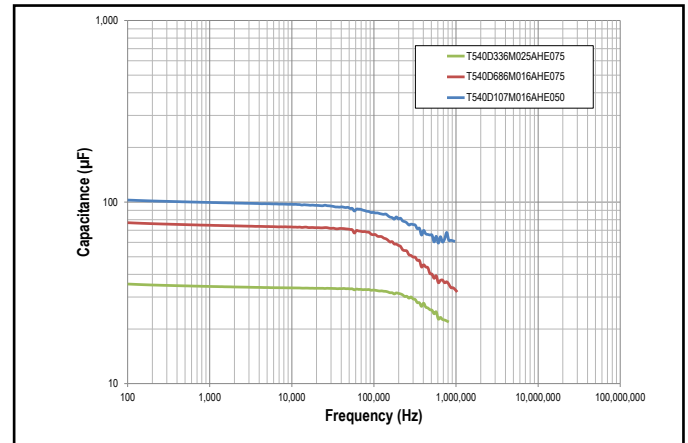
DLA Drawing 04051

## Electrical Characteristics

ESR vs. Frequency



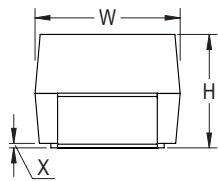
Capacitance vs. Frequency



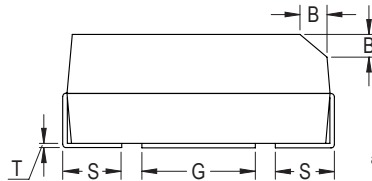
## Dimensions – Millimeters (Inches)

Metric will govern

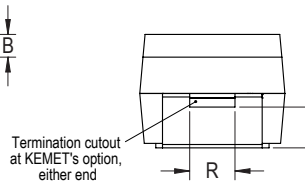
CATHODE (-) END VIEW



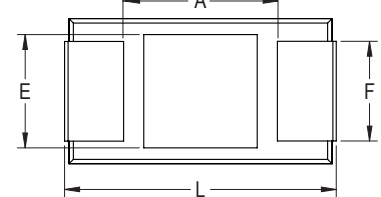
SIDE VIEW



ANODE (+) END VIEW



BOTTOM VIEW



Case Size		Component Dimensions													Total Weight
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)	(mg)
B	3528-21	3.5 ±0.2 (0.138 ±0.008)	2.8 ±0.2 (0.110 ±0.008)	1.9 ±0.1 (0.075 ±0.004)	2.2 (0.087)	0.8 (0.031)	0.4 (0.016)	0.10 ±0.10 (0.004 ±0.004)	0.5 (0.020)	1.0 (0.039)	0.13 (0.005)	1.9 (0.075)	1.8 (0.071)	2.2 (0.087)	98.30
C	6032-28	6.0 ±0.3 (0.236 ±0.012)	3.2 ±0.3 (0.126 ±0.012)	2.5 ±0.3 (0.098 ±0.012)	2.2 (0.087)	1.3 (0.051)	0.5 (0.020)	0.10 ±0.10 (0.004 ±0.004)	0.9 (0.035)	1.0 (0.039)	0.13 (0.005)	3.1 (0.122)	2.8 (0.110)	2.4 (0.095)	193.46
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 (0.095)	1.3 (0.051)	0.5 (0.020)	0.10 ±0.10 (0.004 ±0.004)	0.9 (0.035)	1.0 (0.039)	0.13 (0.005)	3.8 (0.150)	3.5 (0.138)	3.5 (0.138)	352.36

Notes: (Ref) – Dimensions provided for reference only.

These weights are provided as reference. If exact weights are needed, please contact your KEMET Sales Representative

**Table 1 – Ratings & Part Number Reference**

Rated Voltage	Rated Capacitance	Case Code/ Case Size	KEMET Part Number	DSCC Drawing Number 04051	DC Leakage	DF	ESR	Maximum Allowable Ripple Current	Maximum Operating Temp
VDC at 105°C	µF	KEMET/EIA	(See below for part options)	Part Number	µA at 25°C Maximum	% at 25°C 120 Hz Maximum	mΩ at 25°C 100 kHz Maximum	mA at 45°C 100 kHz	°C
2.5	330	D/7343-31	T540D337M2R5AH(1)10	04051-002(2)	83	10	25	3000	125
2.5	330	D/7343-31	T540D337M2R5(3)H(1)10	N/A	83	10	25	3000	125
2.5	470	D/7343-31	T540D477M2R5AH(1)10	04051-003(2)	118	10	25	3000	125
2.5	470	D/7343-31	T540D477M2R5(3)H(1)10	N/A	118	10	25	3000	125
2.5	680	D/7343-31	T540D687M2R5AH(1)10	04051-004(2)	170	10	25	3000	125
2.5	680	D/7343-31	T540D687M2R5(3)H(1)10	N/A	170	10	25	3000	125
3	100	B/3528-21	T540B107M003AH(1)10	04051-005(2)	30	8	80	1260	125
3	100	B/3528-21	T540B107M003(3)H(1)10	N/A	30	8	80	1260	125
3	150	B/3528-21	T540B157M003AH(1)10	04051-006(2)	45	8	80	1260	125
3	150	B/3528-21	T540B157M003(3)H(1)10	N/A	45	8	80	1260	125
3	330	D/7343-31	T540D337M003AH(1)10	04051-007(2)	99	10	25	3000	125
3	330	D/7343-31	T540D337M003(3)H(1)10	N/A	99	10	25	3000	125
3	470	D/7343-31	T540D477M003AH(1)10	04051-008(2)	141	10	25	3000	125
3	470	D/7343-31	T540D477M003(3)H(1)10	N/A	141	10	25	3000	125
3	680	D/7343-31	T540D687M003AH(1)10	04051-009(2)	204	10	25	3000	125
3	680	D/7343-31	T540D687M003(3)H(1)10	N/A	204	10	25	3000	125
4	68	B/3528-21	T540B686M004AH(1)10	04051-011(2)	28	8	80	1260	125
4	68	B/3528-21	T540B686M004(3)H(1)10	N/A	28	8	80	1260	125
4	100	B/3528-21	T540B107M004AH(1)10	04051-012(2)	40	8	80	1260	125
4	100	B/3528-21	T540B107M004(3)H(1)10	N/A	40	8	80	1260	125
4	220	D/7343-31	T540D227M004AH(1)10	04051-013(2)	88	10	25	3000	125
4	220	D/7343-31	T540D227M004(3)H(1)10	N/A	88	10	25	3000	125
4	330	D/7343-31	T540D337M004AH(1)10	04051-014(2)	132	10	25	3000	125
4	330	D/7343-31	T540D337M004(3)H(1)10	N/A	132	10	25	3000	125
4	470	D/7343-31	T540D477M004AH(1)20	04051-015(2)	188	10	25	3000	125
4	470	D/7343-31	T540D477M004(3)H(1)20	N/A	188	10	25	3000	125
4	470	D/7343-31	T540D477M004AH(1)10	04051-016(2)	188	10	40	2372	125
4	470	D/7343-31	T540D477M004(3)H(1)10	N/A	188	10	40	2372	125
6.3	33	B/3528-21	T540B336M006AH(1)10	04051-017(2)	21	8	80	1260	125
6.3	33	B/3528-21	T540B336M006(3)H(1)10	N/A	21	8	80	1260	125
6.3	47	B/3528-21	T540B476M006AH(1)10	04051-019(2)	30	8	80	1260	125
6.3	47	B/3528-21	T540B476M006(3)H(1)10	N/A	30	8	80	1260	125
6.3	68	B/3528-21	T540B686M006AH(1)10	04051-020(2)	43	8	80	1260	125
6.3	68	B/3528-21	T540B686M006(3)H(1)10	N/A	43	8	80	1260	125
6.3	150	D/7343-31	T540D157M006AH(1)10	04051-021(2)	95	10	25	3000	125
6.3	150	D/7343-31	T540D157M006(3)H(1)10	N/A	95	10	25	3000	125
6.3	220	D/7343-31	T540D227M006AH(1)10	04051-022(2)	139	10	25	3000	125
6.3	220	D/7343-31	T540D227M006(3)H(1)10	N/A	139	10	25	3000	125
6.3	330	D/7343-31	T540D337M006AH(1)20	04051-023(2)	208	10	25	3000	125
6.3	330	D/7343-31	T540D337M006(3)H(1)20	N/A	208	10	25	3000	125
6.3	330	D/7343-31	T540D337M006AH(1)10	04051-024(2)	208	10	40	2372	125
6.3	330	D/7343-31	T540D337M006(3)H(1)10	N/A	208	10	40	2372	125
10	22	B/3528-21	T540B226M010AH(1)10	04051-025(2)	22	8	80	1260	125
10	22	B/3528-21	T540B226M010(3)H(1)10	N/A	22	8	80	1260	125
10	33	B/3528-21	T540B336M010AH(1)10	04051-027(2)	33	8	80	1260	125
10	33	B/3528-21	T540B336M010(3)H(1)10	N/A	33	8	80	1260	125
10	100	D/7343-31	T540D107M010AH(1)20	04051-028(2)	100	10	25	3000	125
10	100	D/7343-31	T540D107M010(3)H(1)20	N/A	100	10	25	3000	125
10	100	D/7343-31	T540D107M010AH(1)10	04051-029(2)	100	10	55	2023	125
VDC at 105°C	µF	KEMET/EIA	(See below for part options)	Part Number	µA at 25°C Maximum	% at 25°C 120 Hz Maximum	mΩ at 25°C 100 kHz Maximum	w/ΔT = 20°C at -55°C to 105°C	°C
Rated Voltage	Rated Capacitance	Case Code/ Case Size	KEMET Part Number	DSCC Drawing Number 04051	DC Leakage	DF	ESR	Maximum Allowable Ripple Current (A) 100 kHz	Maximum Operating Temp

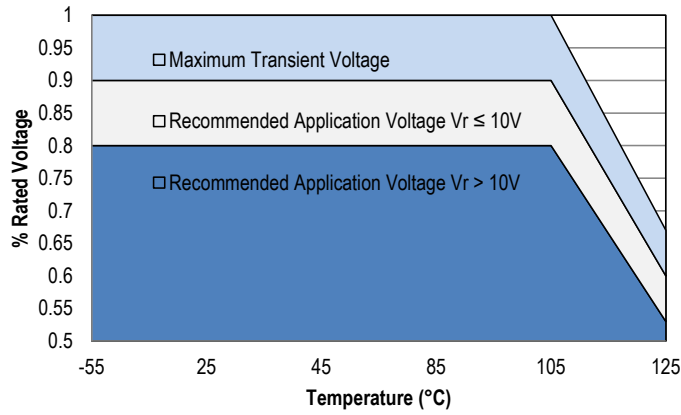
(1) To complete KEMET part number, insert 65 = None, 66 = 10 cycles +25°C, 67 = 10 cycles -55°C and +85°C. Designates surge current option.  
 (2) To complete DLA part number, insert Blank = 4 cycles 25°C, A = 10 cycles 25°C, B = 10 cycles -55°C and 85°C. Designates surge current option.  
 (3) To complete KEMET part number for non-DLA, insert B=0.1%/1,000 hours, C=0.01%/1,000 hours, D=0.001%/1,000 hours. Designates Reliability Level.  
 (4) To complete KEMET part number for non-DLA, insert B = 0.1%/1,000 hours or C = 0.01%/1,000 hours. Designates Reliability Level.  
 Please refer to Ordering Information for additional details.

**Table 1 – Ratings & Part Number Reference cont'd**

Rated Voltage	Rated Capacitance	Case Code/ Case Size	KEMET Part Number	DSCC Drawing Number 04051	DC Leakage	DF	ESR	Maximum Allowable Ripple Current	Maximum Operating Temp
VDC at 105°C	µF	KEMET/EIA	(See below for part options)	Part Number	µA at 25°C Maximum	% at 25°C 120 Hz Maximum	mΩ at 25°C 100 kHz Maximum	mA at 45°C 100 kHz	°C
10	100	D/7343-31	T540D107M010(3)H(1)10	N/A	100	10	55	2023	125
10	150	D/7343-31	T540D157M010AH(1)20	04051-030(2)	150	10	25	3000	125
10	150	D/7343-31	T540D157M010(3)H(1)20	N/A	150	10	25	3000	125
10	150	D/7343-31	T540D157M010AH(1)10	04051-031(2)	150	10	55	2023	125
10	150	D/7343-31	T540D157M010(3)H(1)10	N/A	150	10	55	2023	125
10	220	D/7343-31	T540D227M010AH(1)10	04051-032(2)	220	10	25	3000	125
10	220	D/7343-31	T540D227M010(3)H(1)10	N/A	220	10	25	3000	125
16	47	D/7343-31	T540D476M016AH(1)20	04051-033(2)	76	10	35	2535	125
16	47	D/7343-31	T540D476M016(3)H(1)20	N/A	76	10	35	2535	125
16	47	D/7343-31	T540D476M016AH(1)10	04051-034(2)	76	10	65	1861	125
16	47	D/7343-31	T540D476M016(3)H(1)10	N/A	76	10	65	1861	125
16	68	D/7343-31	T540D686M016AH(1)10	04051-035(2)	109	10	75	1732	125
16	68	D/7343-31	T540D686M016(3)H(1)10	N/A	109	10	75	1732	125
16	100	D/7343-31	T540D107M016AH(1)10	04051-036(2)	160	10	50	2121	125
16	100	D/7343-31	T540D107M016(3)H(1)10	N/A	160	10	50	2121	125
20	22	D/7343-31	T540D226M020AH(1)10	04051-037(2)	44	10	75	1732	125
20	22	D/7343-31	T540D226M020(3)H(1)10	N/A	44	10	75	1732	125
20	33	D/7343-31	T540D336M020AH(1)10	04051-038(2)	66	10	75	1732	125
20	33	D/7343-31	T540D336M020(3)H(1)10	N/A	66	10	75	1732	125
20	47	D/7343-31	T540D476M020AH(1)10	04051-039(2)	94	10	75	1732	125
20	47	D/7343-31	T540D476M020(3)H(1)10	N/A	94	10	75	1732	125
25	6.8	C/6032-28	T540C685M025(3)H(1)10	NA	17	10	150	1049	125
25	10	C/6032-28	T540C106M025(3)H(1)10	NA	25	10	150	1049	125
25	15	D/7343-31	T540D156M025AH(1)20	04051-040(2)	38	10	75	1732	125
25	15	D/7343-31	T540D156M025(3)H(1)20	N/A	38	10	75	1732	125
25	15	D/7343-31	T540D156M025AH(1)10	04051-041(2)	38	10	100	1500	125
25	15	D/7343-31	T540D156M025(3)H(1)10	N/A	38	10	100	1500	125
25	22	D/7343-31	T540D226M025AH(1)10	04051-042(2)	55	10	75	1732	125
25	22	D/7343-31	T540D226M025(3)H(1)10	N/A	55	10	75	1732	125
25	33	D/7343-31	T540D336M025AH(1)10	04051-043(2)	83	10	75	1732	125
25	33	D/7343-31	T540D336M025(3)H(1)10	N/A	83	10	75	1732	125
30	22	D/7343-31	T540D226M030(3)H(1)10	N/A	66	10	75	1732	125
35	15	D/7343-31	T540D156M035AH(1)20	04051-044(2)	53	10	75	1732	125
35	15	D/7343-31	T540D156M035(4)H(1)20	N/A	53	10	75	1732	125
35	15	D/7343-31	T540D156M035AH(1)10	04051-045(2)	53	10	100	1500	125
35	15	D/7343-31	T540D156M035(4)H(1)10	N/A	53	10	100	1500	125
50	10	D/7343-31	T540D106M050AH(1)20	04051-046(2)	50	10	100	1500	125
50	10	D/7343-31	T540D106M050(4)H(1)20	N/A	50	10	100	1500	125
50	10	D/7343-31	T540D106M050AH(1)10	04051-047(2)	50	10	125	1342	125
50	10	D/7343-31	T540D106M050(4)H(1)10	N/A	50	10	125	1342	125
63	4.7	D/7343-31	T540D475M063AH(1)20	04051-048(2)	30	10	100	1500	125
63	4.7	D/7343-31	T540D475M063(4)H(1)20	N/A	30	10	100	1500	125
63	4.7	D/7343-31	T540D475M063AH(1)10	04051-049(2)	30	10	120	1369	125
63	4.7	D/7343-31	T540D475M063(4)H(1)10	N/A	30	10	120	1369	125
VDC at 105°C	µF	KEMET/EIA	(See below for part options)	Part Number	µA at 25°C Maximum	% at 25°C 120 Hz Maximum	mΩ at 25°C 100 kHz Maximum	w/ΔT = 20°C at -55°C to 105°C	°C
Rated Voltage	Rated Capacitance	Case Code/ Case Size	KEMET Part Number	DSCC Drawing Number 04051	DC Leakage	DF	ESR	Maximum Allowable Ripple Current (A) 100 kHz	Maximum Operating Temp

(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 DLA part number, insert Blank = 4 cycles 25°C, A = 10 cycles 25°C, B = 10 cycles -55°C and 85°C. Designates surge current option.  
(3) To complete KEMET part number for non-DLA, insert B=0.1%/1,000 hours, C=0.01%/1,000 hours, D=0.001%/1,000 hours. Designates Reliability Level.  
(4) To complete KEMET part number for non-DLA, insert B = 0.1%/1,000 hours or C = 0.01%/1,000 hours. Designates Reliability Level.  
Please refer to Ordering Information for additional details.

## 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	
$2\text{ V} \leq V_R \leq 10\text{ V}$	90% of $V_R$	$V_R$	See Chart	67% of $V_R$
$12.5\text{ V} \leq V_R \leq 63\text{ V}$	80% of $V_R$	$V_R$	See Chart	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 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.

Case Code	EIA Case Code	Maximum Power Dissipation (P max) mWatts at 45°C with +30°C Rise
B	3528-21	127
C	6032-28	165
D	7343-31	225

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

Temperature Compensation Multipliers for Maximum Ripple Current		
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)*

## Reverse Voltage

Polymer electrolytic 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	W	L	S	V1	V2	W	L	S	V1	V2	W	L	S
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

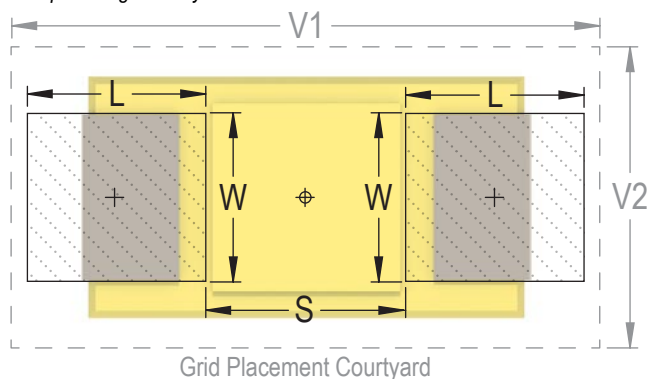
**Density Level A:** For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes.

**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).

<sup>1</sup> Height of these chips may create problems in wave soldering.

<sup>2</sup> 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.

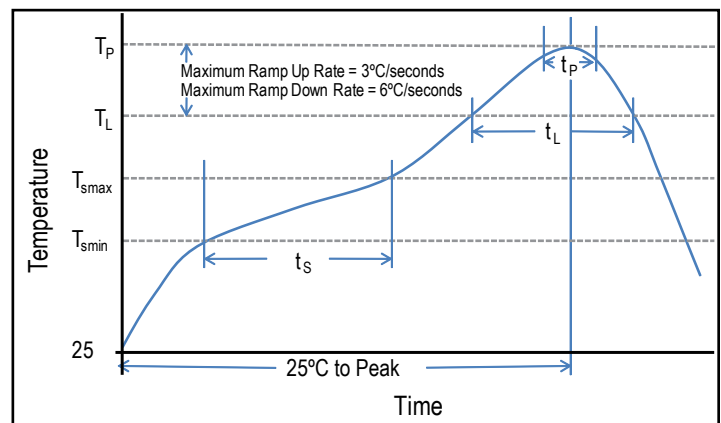
During typical reflow operations, a slight darkening of the gold-colored epoxy may be observed. This slight darkening is normal and not harmful to the product. Marking permanency is not affected by this change.

Profile Feature	SnPb Assembly	Pb-Free Assembly
<b>Preheat/Soak</b>		
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

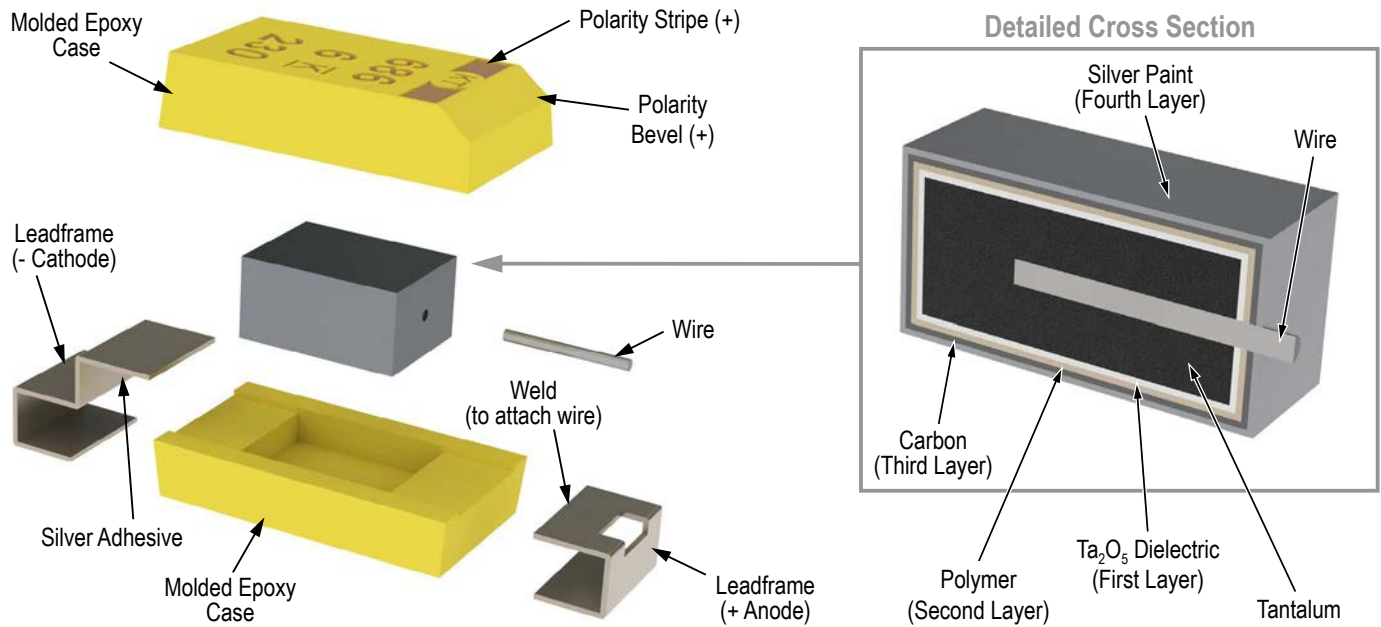
\*\*Case Size A, B, C, H, I, K, M, R, S, T, U, V, W, and Z



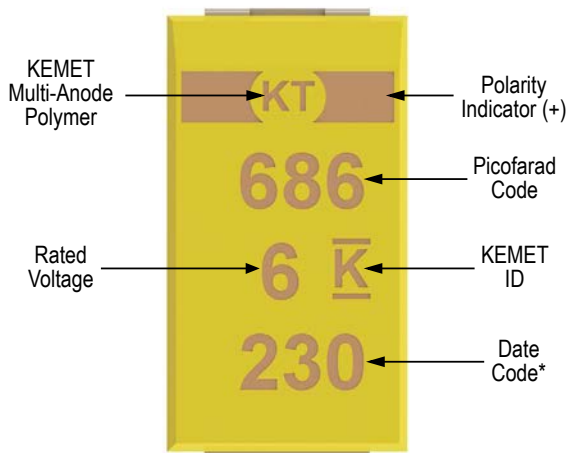
## Storage

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 90% RH.

## Construction



## Capacitor Marking

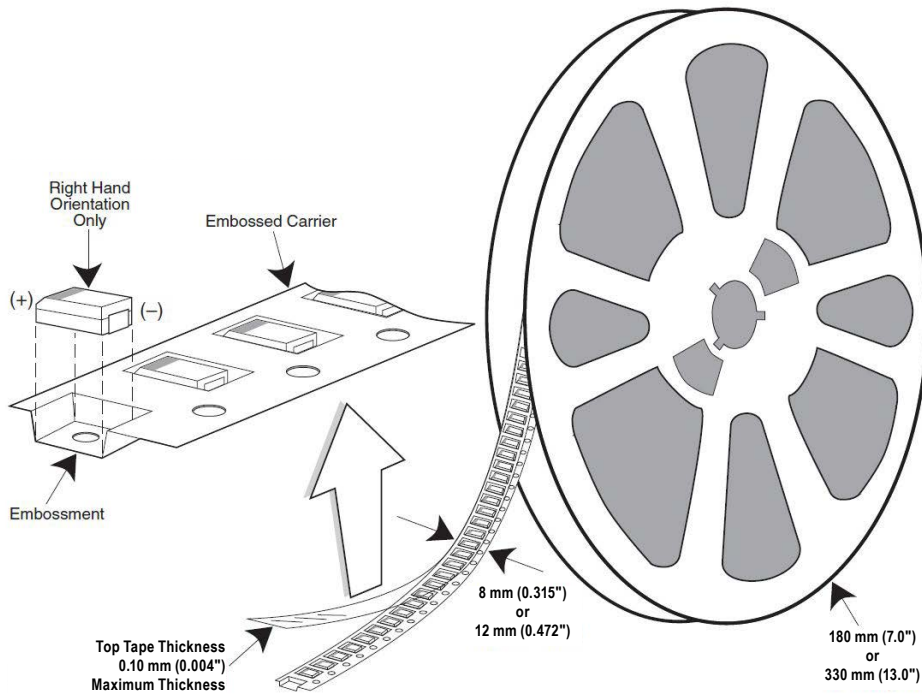


\* 230 = 30<sup>th</sup> week of 2012

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

## Tape & Reel Packaging Information

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

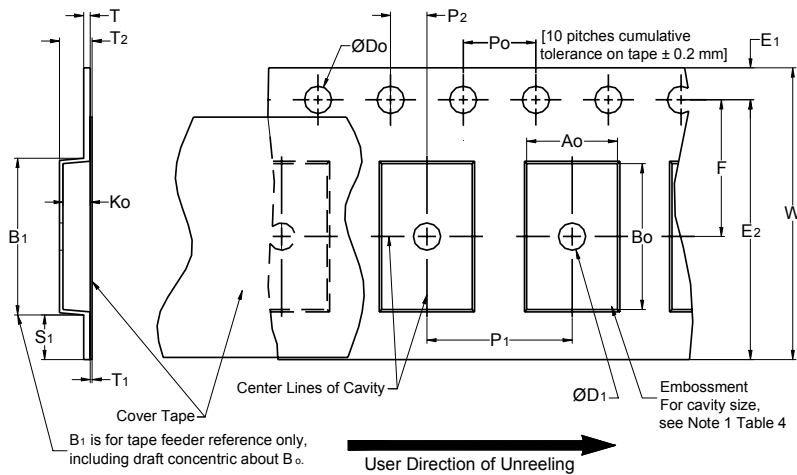


**Table 3 – Packaging Quantity**

Case Code		Tape Width (mm)	7" Reel*	13" Reel*
KEMET	EIA			
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	3,000
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
Q	7343-12	12	1,000	3,000
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 <sub>0</sub>	D <sub>1</sub> Minimum Note 1	E <sub>1</sub>	P <sub>0</sub>	P <sub>2</sub>	R Reference Note 2	S <sub>1</sub> Minimum Note 3	T Maximum	T <sub>1</sub> 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)								2.0 ±0.1 (0.079 ±0.059)	30 (1.181)
16 mm											
Variable Dimensions — Millimeters (Inches)											
Tape Size	Pitch	B <sub>1</sub> Maximum Note 4	E <sub>2</sub> Minimum	F	P <sub>1</sub>	T <sub>2</sub> Maximum	W Maximum	A <sub>0</sub> , B <sub>0</sub> & K <sub>0</sub>			
8 mm	Single (4 mm)	4.35 (0.171)	6.25 (0.246)	3.5 ±0.05 (0.138 ±0.002)	2.0 ±0.05 or 4.0 ±0.10 (0.079 ±0.002 or 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)	2.0 ±0.05 (0.079 ±0.002) or 4.0 ±0.10 (0.157 ±0.004) or 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)	7.5 ±0.10 (0.295 ±0.004)	4.0 ±0.10 (0.157 ±0.004) to 12.0 ±0.10 (0.472 ±0.004)	8.0 (0.315)	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 4).
3. If S<sub>1</sub> < 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<sub>1</sub> dimension is a reference dimension for tape feeder clearance only.
5. The cavity defined by A<sub>0</sub>, B<sub>0</sub> and K<sub>0</sub> 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

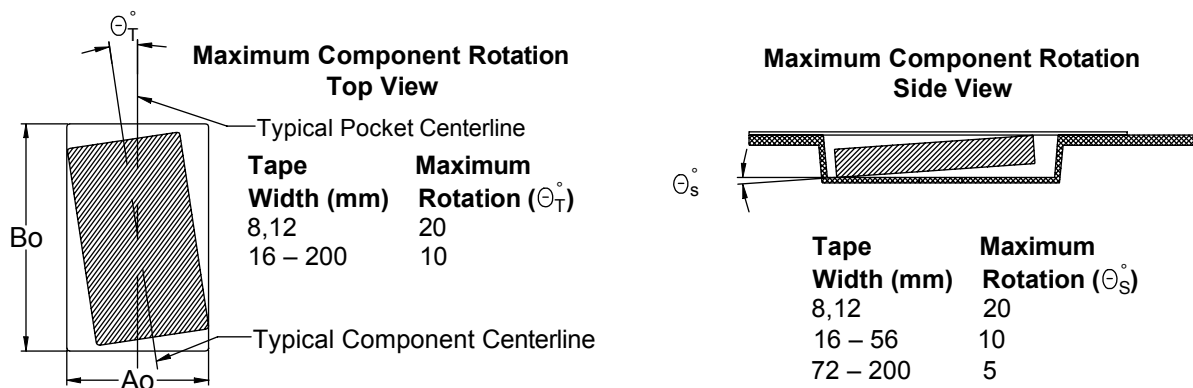
- Cover Tape Break Force:** 1.0 Kg minimum.
- Cover Tape Peel Strength:** The total peel strength of the cover tape from the carrier tape shall be:

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)

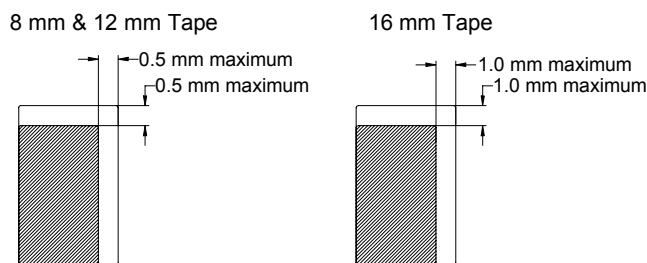
The direction of the pull shall be opposite the direction of the carrier tape travel. The pull angle of the carrier tape shall be 165° to 180° from the plane of the carrier tape. During peeling, the carrier and/or cover tape shall be pulled at a velocity of 300 ±10 mm/minute.

- 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.

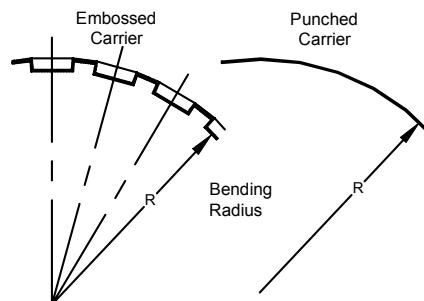
### Figure 2 – Maximum Component Rotation



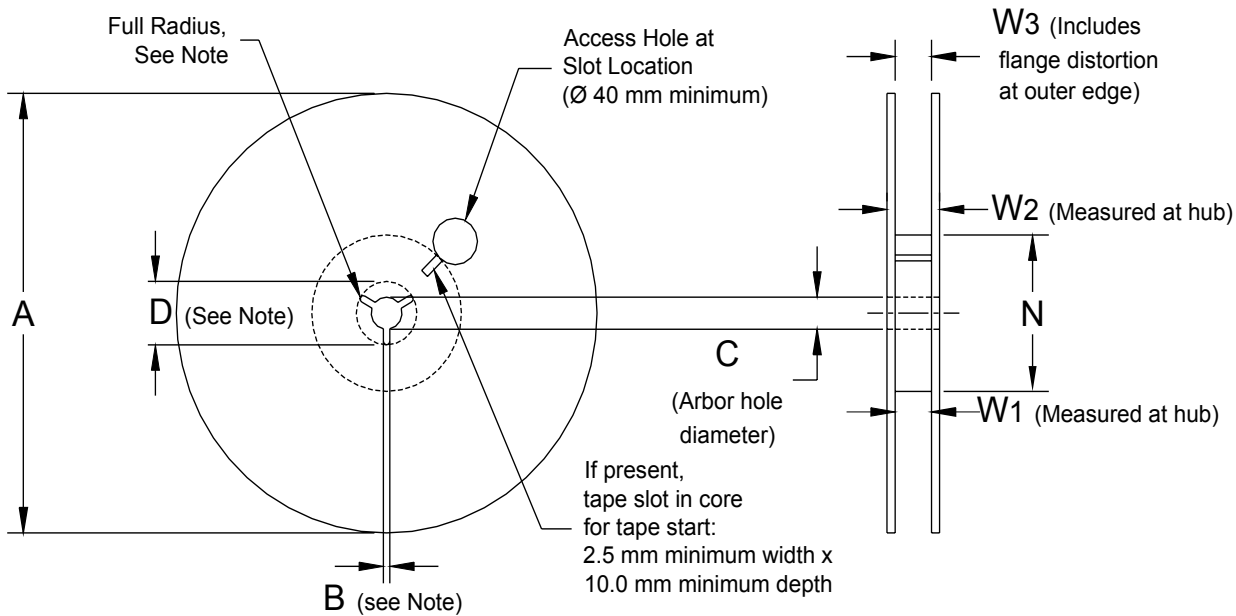
### Figure 3 – Maximum Lateral Movement



### Figure 4 – Bending Radius



**Figure 5 – Reel Dimensions**



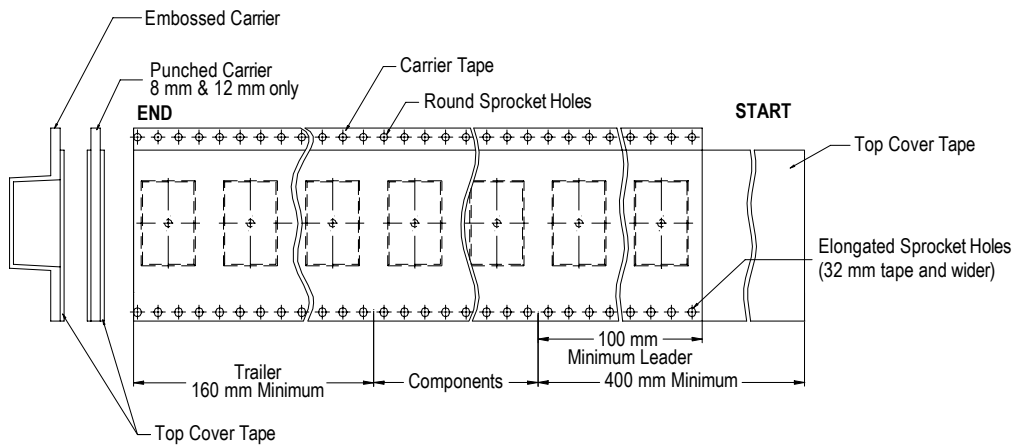
**Table 5 – Reel Dimensions**

Metric will govern

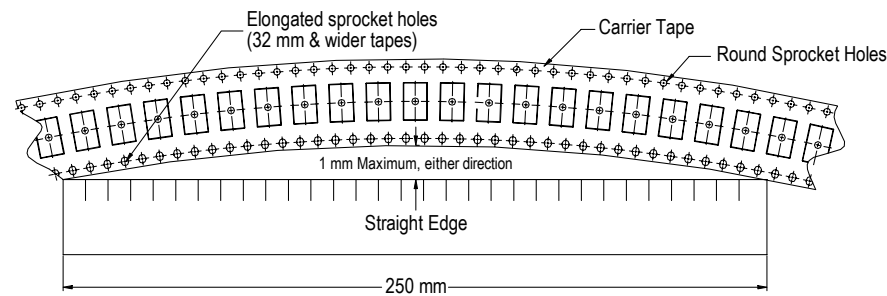
Constant Dimensions — Millimeters (Inches)				
Tape Size	A	B Minimum	C	D Minimum
8 mm	178 ±0.20 (7.008 ±0.008) or 330 ±0.20 (13.000 ±0.008)	1.5 (0.059)	13.0 +0.5/-0.2 (0.521 +0.02/-0.008)	20.2 (0.795)
12 mm				
16 mm				
Variable Dimensions — Millimeters (Inches)				
Tape Size	N Minimum	W <sub>1</sub>	W <sub>2</sub> Maximum	W <sub>3</sub>
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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