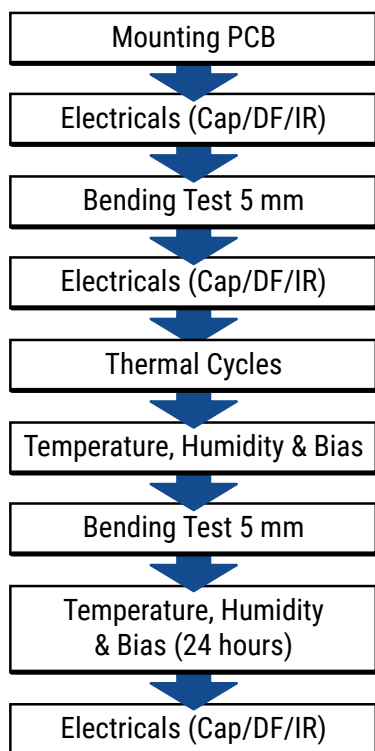


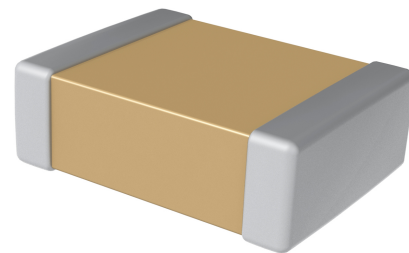
# Flexible Termination System (FT-CAP), X7R Dielectric, 6.3 – 250 VDC, VW 80808 Specification

## Overview

The KEMET VW80808 Automotive Grade Flexible Termination (FT-CAP) multilayer ceramic capacitors in X7R dielectric are suited for a variety of applications requiring proven, reliable performance in harsh-environment conditions. Whether automotive under hood or in-cabin, these devices emphasize the vital and robust nature of capacitors required for mission and safety of critical automotive subsystems and are compliant with AEC-Q200 and VW80808 specifications.



These devices use flexible termination technology that inhibits the transfer of board stress to the rigid ceramic body, therefore mitigating flex cracks, which can result in low IR or short circuit failures. Although this technology does not eliminate the potential for mechanical damage that may propagate during extreme environmental and handling conditions, it does provide superior flex performance over standard termination systems. Combined with the stability of an X7R dielectric and designed to accommodate all capacitance requirements, these flex-robust devices are RoHS-compliant, offer up to 5 mm of flex-bend capability and exhibit a predictable change in capacitance with respect to time and voltage.



## Benefits

- VW 80808 Specification Compliant
- AEC-Q200 automotive qualified.
- Superior flex performance (5 mm)
- DC voltage ratings up to 250 V
- Capacitance offerings ranging from 180 pF – 4.7  $\mu$ F
- Non-polar device, minimizing installation concerns
- Lead (Pb)-Free, RoHS and REACH compliant

## Applications

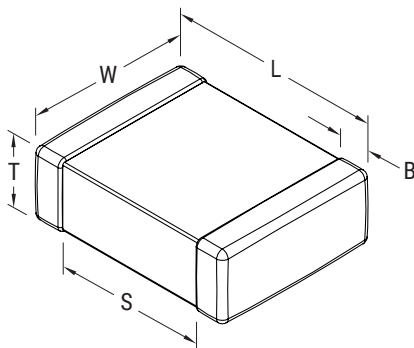
- High current applications (automobile battery line)
- Circuits (direct battery/power connection)
- Control units, sensors, and actuators in motor vehicles
- Filtering (power plane/bus)
- Electronic and Electrical subsystems

## Ordering Information

C	1206	X	106	K	4	R	A	C	3316
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish <sup>1</sup>	Packaging/Grade (C-Spec)
	0603 0805 1206 1210	X = Flexible Termination	Two significant digits and number of zeros	J = ±5% K = ±10% M = ±20%	9 = 6.3 8 = 10 4 = 16 3 = 25 5 = 50 1 = 100 2 = 200 A = 250	R = X7R	A = N/A	C = 100% Matte Sn	3316 = 7" Reel Unmarked (VW80808 & AEC-Q200) 3317 = 13" Reel Unmarked (VW80808 & AEC-Q200)

<sup>1</sup> Additional reeling or packaging options may be available. Contact KEMET for details.

## Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Minimum	Mounting Technique
0603	1608	1.60 (0.063) ±0.17 (0.007)	0.80 (0.032) ±0.15 (0.006)	See Table 2 for Thickness	0.45 (0.018) ±0.15 (0.006)	0.58 (0.023)	Solder wave or solder reflow
0805	2012	2.00 (0.079) ±0.30 (0.012)	1.25 (0.049) ±0.30 (0.012)		0.50 (0.02) ±0.25 (0.010)	0.75 (0.030)	
1206	3216	3.30 (0.130) ±0.40 (0.016)	1.60 (0.063) ±0.35 (0.013)		0.60 (0.024) ±0.25 (0.010)	N/A	Solder reflow only
1210	3225	3.30 (0.130) ±0.40 (0.016)	2.60 (0.102) ±0.30 (0.012)		0.60 (0.024) ±0.25 (0.010)		

<sup>1</sup> For capacitance values  $\geq 0.56 \mu\text{F}$  add 0.03 (0.001) to length tolerance dimension.

<sup>2</sup> For capacitance values  $\geq 2.7 \mu\text{F}$  add 0.05 (0.002) to length tolerance dimension.

## Qualification/Certification

This product is VW 80808 Specification Compliant and AEC-Q200 automotive qualified. For additional information regarding the Automotive Electronics Council and AEC-Q200, please visit their website at [www.aecouncil.com](http://www.aecouncil.com).

## Environmental Compliance

Lead (Pb)-free, RoHS, and REACH compliant without exemptions.

## Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC)	±15%
<sup>1</sup> Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
<sup>2</sup> Dielectric Withstanding Voltage (DWV)	250% of rated voltage (5 ±1 seconds and charge/discharge not exceeding 50 mA)
<sup>3</sup> Dissipation Factor (DF) Maximum Limit at 25°C	5% (6.3 V and 10 V), 3.5% (16 V and 25 V) and 2.5% (50 V to 250 V)
<sup>4</sup> Insulation Resistance (IR) Minimum Limit at 25°C	See Insulation Resistance Limit table (Rated voltage applied for 120 ±5 seconds at 25°C)

<sup>1</sup> Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

<sup>2</sup> DWV is the voltage a capacitor can withstand (survive) for a short period of time. It exceeds the nominal and continuous working voltage of the capacitor.

<sup>3</sup> Capacitance and dissipation factor (DF) measured under the following conditions:

1 kHz ±50 Hz and  $1.0 \pm 0.2 V_{rms}$  if capacitance  $\leq 10 \mu F$

120 Hz ±10 Hz and  $0.5 \pm 0.1 V_{rms}$  if capacitance  $> 10 \mu F$

<sup>4</sup> To obtain IR limit, divide  $M\Omega - \mu F$  value by the capacitance and compare to  $G\Omega$  limit. Select the lower of the two limits.

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 and Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON."

## Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance					
EIA Case Size	Rated DC Voltage	Capacitance	Dissipation Factor (Maximum %)	Capacitance Shift	Insulation Resistance
X7R	> 25	All	3.0	±20%	10% of Initial Limit
	16/25		5.0		
	< 16		7.5		

## Insulation Resistance Limit Table

EIA Case Size	1,000 megohm microfarads or 100 GΩ	500 megohm microfarads or 10 GΩ
0603	< 0.047 μF	≥ 0.047 μF
0805	< 0.15 μF	≥ 0.15 μF
1206	< 0.47 μF	≥ 0.47 μF
1210	< 0.39 μF	≥ 0.39 μF

**Table 1 – Capacitance Range/Selection Waterfall (0603 – 1210 Case Sizes)**

Capacitance (pF)	Cap Code	Case Size/ Series	0603						0805						1206						1210							
			Rated Voltage (VDC)						Rated Voltage (VDC)						Rated Voltage (VDC)						Rated Voltage (VDC)							
			6.3V	10V	16V	25V	50V	100V	6.3V	10V	16V	25V	50V	100V	200V	250V	6.3V	10V	16V	25V	50V	100V	6.3V	10V	16V	25V	50V	100V
Voltage Code						Voltage Code						Voltage Code						Voltage Code										
Voltage Code						Voltage Code						Voltage Code						Voltage Code										
180pF	181	Capacitance Tolerances: J = ±5% K = ±10% M = ±20%	CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR												
220pF	221		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR												
270pF	271		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR												
330pF	331		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR												
390pF	391		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR												
470pF	471		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR												
560pF	561		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR												
680pF	681		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR												
820pF	821		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DR												
1.0 nF	102		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DG	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ			
1.2 nF	122		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DG	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ				
1.5 nF	152		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DG	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ				
1.8 nF	182		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DG	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ				
2.2 nF	222		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DG	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN
2.7 nF	272		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DG	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN
3.3 nF	332		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DG	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN
3.9 nF	392		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DG	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN
4.7 nF	472		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DG	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN
5.6 nF	562		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DG	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN
6.8 nF	682		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR	DG	EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN
8.2 nF	822		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR		EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN
10 nF	103		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR		EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN
12 nF	123		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR		EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN
15 nF	153		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR		EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN
18 nF	183		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR		EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN
22 nF	223		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR		EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN
27 nF	273		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR		EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN
33 nF	333		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR		EQ	EQ	EQ	EQ	EQ	EQ	EQ	EQ	FN	FN	FN	FN
39 nF	393		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR		EQ	EQ	EQ	EQ	ER	EQ	EQ	EQ	FN	FN	FN	FN
47 nF	473		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DG		EQ	EQ	EQ	EQ	ER	ES	EQ	EQ	FN	FN	FN	FQ
56 nF	563		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR		EQ	EQ	EQ	EQ	ER	ES	EQ	EQ	FN	FN	FN	FQ
68 nF	683		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR		EQ	EQ	EQ	EQ	ER	ES	EQ	EQ	FN	FN	FN	FQ
82 nF	823		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR		EQ	EQ	EQ	EQ	ER	ES	EQ	EQ	FN	FN	FN	FQ
100 nF	104		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR		EQ	EQ	EQ	EQ	ER	EM	EQ	EQ	FN	FN	FN	FX
120 nF	124		CJ	CJ	CJ	CJ	CJ	CJ	DR	DR	DR	DR	DR	DR	DR		ER	ER	ER	ER	ER	EU	ER	ER	FN	FN	FN	FX
150 nF	154								DR	DR	DR	DR	DR	DR	DR		ER	ER	ER	ER	ER	EU	ER	ER	FQ	FQ	FQ	FQ
180 nF	184								DR	DR	DR	DR	DR	DR	DR		ER	ER	ER	ER	ER	ER	ER	ER	FQ	FQ	FQ	FQ
220 nF	224								DR	DR	DR	DR	DR	DR	DR		ER	ER	ER	ER	ER	ER	ER	ER	FQ	FQ	FQ	FQ
270 nF	274								DR	DR	DR	DR	DR	DR	DR		ER	ER	ER	ER	ER	ER	EM	ER	FQ	FQ	FQ	FQ
330 nF	334								DR	DR	DR	DR	DR	DR	DR		ER	ER	ER	ER	ER	EU	ER	ER	FX	FX	FX	FX
390 nF	394								DS	DS	DS	DS	DS	DS	DS		ER	ER	ER	ER	ER	ER	ER	ER	FX	FX	FX	FX
470 nF	474								DS	DS	DS	DS	DS	DS	DS		ER	ER	ER	ER	ER	ER	ER	ER	FX	FX	FX	FX
560 nF	564								DG	DG	DG	DG	DG	DG	DG		ER	ER	ER	ER	ER	ER	ER	ER	FX	FX	FX	FX
680 nF	684								DG	DG	DG	DG	DG	DG	DG		ES	ES	ES	ES	ES	ES	ES	ES	FX	FX	FX	FZ
820 nF	824								DG	DG	DG	DG	DG	DG	DG		ES	ES	ES	ES	ES	ES	ES	ES	FA	FA	FA	FA
1.0 μF	105								DG	DG	DG	DG	DG	DG	DG		ES	ES	ES	ES	ES	ES	ES	ES	FU	FU	FU	FU
1.2 μF	125															EH	EH	EH	EH	EH	EH	EH	EH	FZ	FZ	FZ	FZ	
1.5 μF	155															EH	EH	EH	EH	EH	EH	EH	EH	FZ	FZ	FZ	FZ	
1.8 μF	185															EH	EH	EH	EH	EH	EH	EH	EH	FZ	FZ	FZ	FZ	
2.2 μF	225															EH	EH	EH	EH	EH	EH	EH	EH	FZ	FZ	FZ	FZ	
2.7 μF	275																							FZ	FZ	FZ	FZ	
3.3 μF	335																							FZ	FZ	FU	FU	
3.9 μF	395																							FM	FM	FM	FM	
4.7 μF	475																							FK	FK	FK	FK	
																								FS	FS	FS	FS	

For an extended AEC-Q200 flexible termination offering please visit: [https://content.kemet.com/datasheets/KEM\\_C1078\\_X7R\\_FT-CAP\\_AUTO\\_SMD.pdf](https://content.kemet.com/datasheets/KEM_C1078_X7R_FT-CAP_AUTO_SMD.pdf)

**Table 2 – Chip Thickness/Tape & Reel Packaging Quantities**

Thickness Code	Case Size	Thickness ± Range (mm)	Paper Quantity <sup>1</sup>		Plastic Quantity	
			7" Reel	13" Reel	7" Reel	13" Reel
CJ	0603	0.80 ± 0.15*	4,000	15,000	0	0
DR	0805	0.78 ± 0.20	0	0	4,000	10,000
DD	0805	0.90 ± 0.10	0	0	4,000	10,000
DS	0805	1.00 ± 0.20	0	0	2,500	10,000
DG	0805	1.25 ± 0.15	0	0	2,500	10,000
EQ	1206	0.78 ± 0.20	0	0	4,000	10,000
ER	1206	0.90 ± 0.20	0	0	4,000	10,000
ES	1206	1.00 ± 0.20	0	0	2,500	10,000
EM	1206	1.25 ± 0.15	0	0	2,500	10,000
EH	1206	1.60 ± 0.20	0	0	2,000	8,000
EU	1206	1.60 ± 0.25	0	0	2,000	8,000
FN	1210	0.78 ± 0.20	0	0	4,000	10,000
FQ	1210	0.90 ± 0.20	0	0	4,000	10,000
FX	1210	0.95 ± 0.20	0	0	4,000	10,000
FA	1210	1.10 ± 0.15	0	0	2,500	10,000
FZ	1210	1.25 ± 0.20	0	0	2,500	10,000
FL	1210	1.40 ± 0.15	0	0	2,000	8,000
FU	1210	1.55 ± 0.20	0	0	2,000	8,000
FM	1210	1.70 ± 0.20	0	0	2,000	8,000
FK	1210	2.10 ± 0.20	0	0	2,000	8,000
FS	1210	2.50 ± 0.30	0	0	1,000	4,000
Thickness Code	Case Size	Thickness ± Range (mm)	7" Reel	13" Reel	7" Reel	13" Reel
			Paper Quantity <sup>1</sup>		Plastic Quantity	

**Table 3 – Chip Capacitor Land Pattern Design Recommendations per IPC–7351**

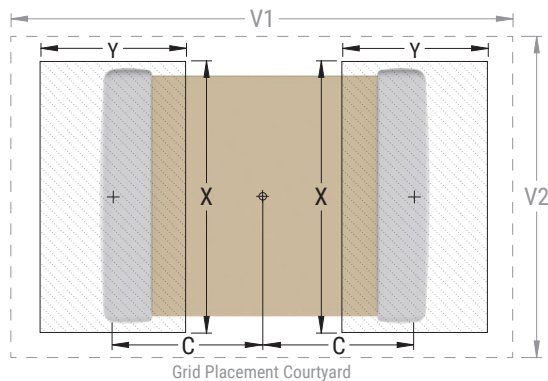
EIA Size Code	Metric Size Code	Density Level A: Maximum (Most) Land Protrusion (mm)					Density Level B: Median (Nominal) Land Protrusion (mm)					Density Level C: Minimum (Least) Land Protrusion (mm)				
		C	Y	X	V1	V2	C	Y	X	V1	V2	C	Y	X	V1	V2
0603	1608	0.85	1.25	1.10	4.00	2.10	0.75	1.05	1.00	3.10	1.50	0.65	0.85	0.90	2.40	1.20
0805	2012	0.99	1.44	1.66	4.47	2.71	0.89	1.24	1.56	3.57	2.11	0.79	1.04	1.46	2.42	1.81
1206	3216	1.59	1.62	2.06	5.85	3.06	1.49	1.42	1.96	4.95	2.46	1.39	1.22	1.86	4.25	2.16
1210	3225	1.59	1.62	3.01	5.90	4.01	1.49	1.42	2.91	4.95	3.41	1.39	1.22	2.81	4.25	3.11
1808	4520	2.30	1.75	2.30	7.40	3.30	2.20	1.55	2.20	6.50	2.70	2.10	1.35	2.10	5.80	2.40
1812	4532	2.10	1.80	3.60	7.00	4.60	2.00	1.60	3.50	6.10	4.00	1.90	1.40	3.40	5.40	3.70
1825	4564	2.15	1.80	6.90	7.10	7.90	2.05	1.60	6.80	6.20	7.30	1.95	1.40	6.70	5.50	7.00
2220	5650	2.85	2.10	5.50	8.80	6.50	2.75	1.90	5.40	7.90	5.90	2.65	1.70	5.30	7.20	5.60
2225	5664	2.85	2.10	6.90	8.80	7.90	2.75	1.90	6.80	7.90	7.30	2.65	1.70	6.70	7.20	7.00

**Density Level A:** For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805 and 1206 case sizes.

**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).

Image below based on Density Level B for an EIA 1210 case size.



## Soldering Process

### Recommended Soldering Technique:

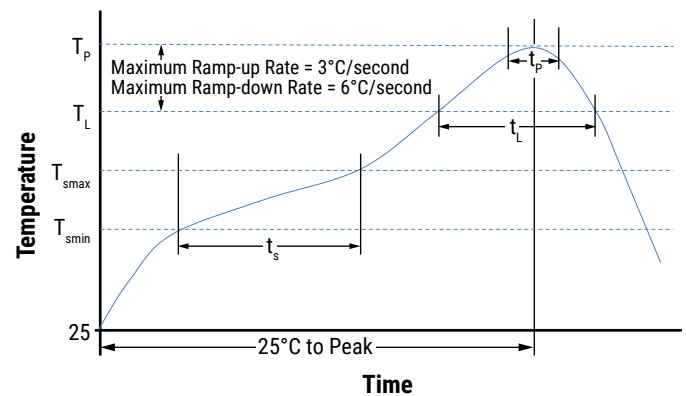
- Solder wave or solder reflow for EIA case sizes 0603, 0805 and 1206
- All other EIA case sizes are limited to solder reflow only

### Recommended Reflow Soldering Profile:

KEMET's families of surface mount multilayer ceramic capacitors (SMD MLCCs) 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-020 standard for moisture sensitivity testing. These devices can safely withstand a maximum of three reflow passes at these conditions.

Profile Feature	Termination Finish	
	SnPb	100% Matte Sn
<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/second maximum	3°C/second maximum
Liquidous Temperature ( $T_L$ )	183°C	217°C
Time Above Liquidous ( $t_L$ )	60 – 150 seconds	60 – 150 seconds
Peak Temperature ( $T_p$ )	235°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/second maximum	6°C/second 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 capacitor body surface that is facing up during assembly reflow.

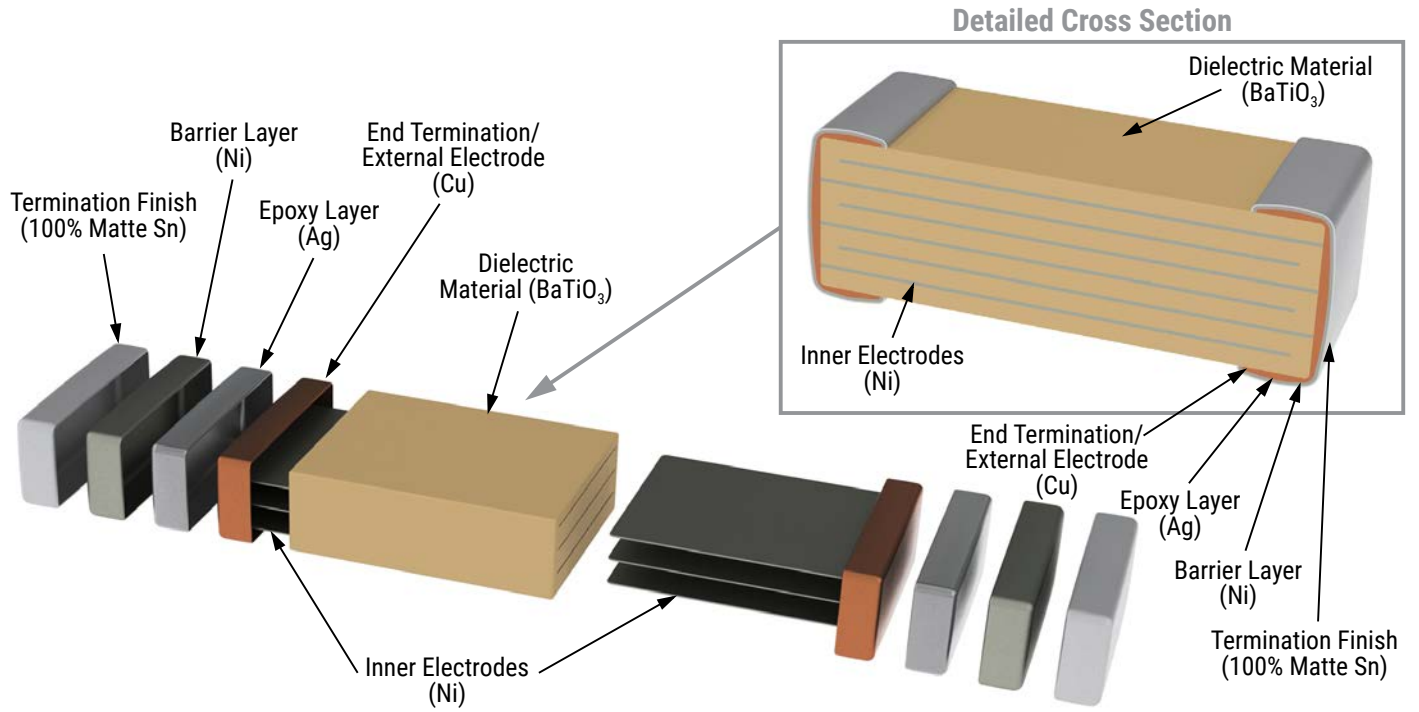


## Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature – reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 40°C and maximum storage humidity not exceed 70% relative humidity. Temperature fluctuations should be minimized to avoid condensation on the parts and atmospheres should be free of chlorine and sulfur bearing compounds. For optimized solderability chip stock should be used promptly, preferably within 1.5 years of receipt.



## Construction



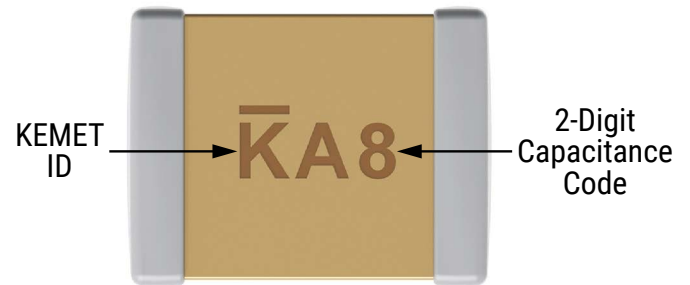
## Capacitor Marking (Optional)

These surface mount multilayer ceramic capacitors are normally supplied unmarked. If required, they can be marked as an extra cost option. Marking is available on most KEMET devices, but must be requested using the correct ordering code identifier(s). If this option is requested, two sides of the ceramic body will be laser marked with a “K” to identify KEMET, followed by two characters (per EIA-198 - see table below) to identify the capacitance value. EIA 0603 case size devices are limited to the “K” character only.

Laser marking option is not available on:

- C0G, ultra stable X8R and Y5V dielectric devices.
- EIA 0402 case size devices.
- EIA 0603 case size devices with flexible termination option.
- KPS commercial and automotive grade stacked devices.
- X7R dielectric products in capacitance values outlined below.

Marking appears in legible contrast. Illustrated below is an example of an MLCC with laser marking of “KA8”, which designates a KEMET device with rated capacitance of 100  $\mu$ F. Orientation of marking is vendor optional.



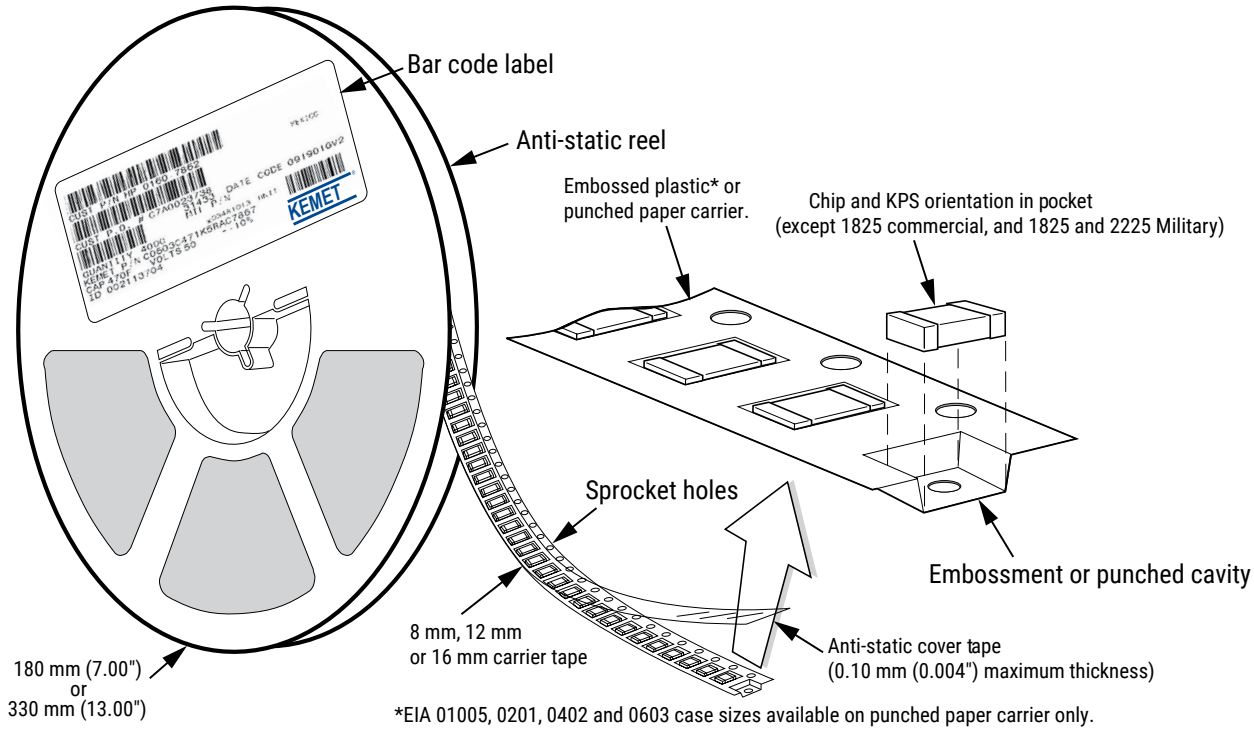
EIA Case Size	Metric Size Code	Capacitance
0603	1608	$\leq 170$ pF
0805	2012	$\leq 150$ pF
1206	3216	$\leq 910$ pF
1210	3225	$\leq 2,000$ pF
1808	4520	$\leq 3,900$ pF
1812	4532	$\leq 6,700$ pF
1825	4564	$\leq 0.018$ $\mu$ F
2220	5650	$\leq 0.027$ $\mu$ F
2225	5664	$\leq 0.033$ $\mu$ F

## Capacitor Marking (Optional) cont.

Capacitance (pF) For Various Alpha/Numeral Identifiers										
Alpha Character	Numeral									
	9	0	1	2	3	4	5	6	7	8
Capacitance (pF)										
A	0.10	1.0	10	100	1,000	10,000	100,000	1,000,000	10,000,000	100,000,000
B	0.11	1.1	11	110	1,100	11,000	110,000	1,100,000	11,000,000	110,000,000
C	0.12	1.2	12	120	1,200	12,000	120,000	1,200,000	12,000,000	120,000,000
D	0.13	1.3	13	130	1,300	13,000	130,000	1,300,000	13,000,000	130,000,000
E	0.15	1.5	15	150	1,500	15,000	150,000	1,500,000	15,000,000	150,000,000
F	0.16	1.6	16	160	1,600	16,000	160,000	1,600,000	16,000,000	160,000,000
G	0.18	1.8	18	180	1,800	18,000	180,000	1,800,000	18,000,000	180,000,000
H	0.20	2.0	20	200	2,000	20,000	200,000	2,000,000	20,000,000	200,000,000
J	0.22	2.2	22	220	2,200	22,000	220,000	2,200,000	22,000,000	220,000,000
K	0.24	2.4	24	240	2,400	24,000	240,000	2,400,000	24,000,000	240,000,000
L	0.27	2.7	27	270	2,700	27,000	270,000	2,700,000	27,000,000	270,000,000
M	0.30	3.0	30	300	3,000	30,000	300,000	3,000,000	30,000,000	300,000,000
N	0.33	3.3	33	330	3,300	33,000	330,000	3,300,000	33,000,000	330,000,000
P	0.36	3.6	36	360	3,600	36,000	360,000	3,600,000	36,000,000	360,000,000
Q	0.39	3.9	39	390	3,900	39,000	390,000	3,900,000	39,000,000	390,000,000
R	0.43	4.3	43	430	4,300	43,000	430,000	4,300,000	43,000,000	430,000,000
S	0.47	4.7	47	470	4,700	47,000	470,000	4,700,000	47,000,000	470,000,000
T	0.51	5.1	51	510	5,100	51,000	510,000	5,100,000	51,000,000	510,000,000
U	0.56	5.6	56	560	5,600	56,000	560,000	5,600,000	56,000,000	560,000,000
V	0.62	6.2	62	620	6,200	62,000	620,000	6,200,000	62,000,000	620,000,000
W	0.68	6.8	68	680	6,800	68,000	680,000	6,800,000	68,000,000	680,000,000
X	0.75	7.5	75	750	7,500	75,000	750,000	7,500,000	75,000,000	750,000,000
Y	0.82	8.2	82	820	8,200	82,000	820,000	8,200,000	82,000,000	820,000,000
Z	0.91	9.1	91	910	9,100	91,000	910,000	9,100,000	91,000,000	910,000,000
a	0.25	2.5	25	250	2,500	25,000	250,000	2,500,000	25,000,000	250,000,000
b	0.35	3.5	35	350	3,500	35,000	350,000	3,500,000	35,000,000	350,000,000
d	0.40	4.0	40	400	4,000	40,000	400,000	4,000,000	40,000,000	400,000,000
e	0.45	4.5	45	450	4,500	45,000	450,000	4,500,000	45,000,000	450,000,000
f	0.50	5.0	50	500	5,000	50,000	500,000	5,000,000	50,000,000	500,000,000
m	0.60	6.0	60	600	6,000	60,000	600,000	6,000,000	60,000,000	600,000,000
n	0.70	7.0	70	700	7,000	70,000	700,000	7,000,000	70,000,000	700,000,000
t	0.80	8.0	80	800	8,000	80,000	800,000	8,000,000	80,000,000	800,000,000
y	0.90	9.0	90	900	9,000	90,000	900,000	9,000,000	90,000,000	900,000,000

## Tape & Reel Packaging Information

KEMET offers multilayer ceramic chip capacitors packaged in 8, 12 and 16 mm tape on 7" and 13" reels in accordance with EIA Standard 481. This packaging system is compatible with all tape-fed automatic pick and place systems. See Table 2 for details on reeling quantities for commercial chips.



**Table 4 – Carrier Tape Configuration, Embossed Plastic & Punched Paper (mm)**

EIA Case Size	Tape Size (W)*	Embossed Plastic		Punched Paper	
		7" Reel	13" Reel	7" Reel	13" Reel
		Pitch (P <sub>1</sub> )*		Pitch (P <sub>1</sub> )*	
01005 – 0402	8			2	2
0603	8			2/4	2/4
0805	8	4	4	4	4
1206 – 1210	8	4	4	4	4
1805 – 1808	12	4	4		
≥ 1812	12	8	8		
KPS 1210	12	8	8		
KPS 1812 and 2220	16	12	12		
Array 0612	8	4	4		

### New 2 mm Pitch Reel Options\*

Packaging Ordering Code (C-Spec)	Packaging Type/Options
C-3190	Automotive grade 7" reel unmarked
C-3191	Automotive grade 13" reel unmarked
C-7081	Commercial grade 7" reel unmarked
C-7082	Commercial grade 13" reel unmarked

\* 2 mm pitch reel only available for 0603 EIA case size.  
2 mm pitch reel for 0805 EIA case size under development.

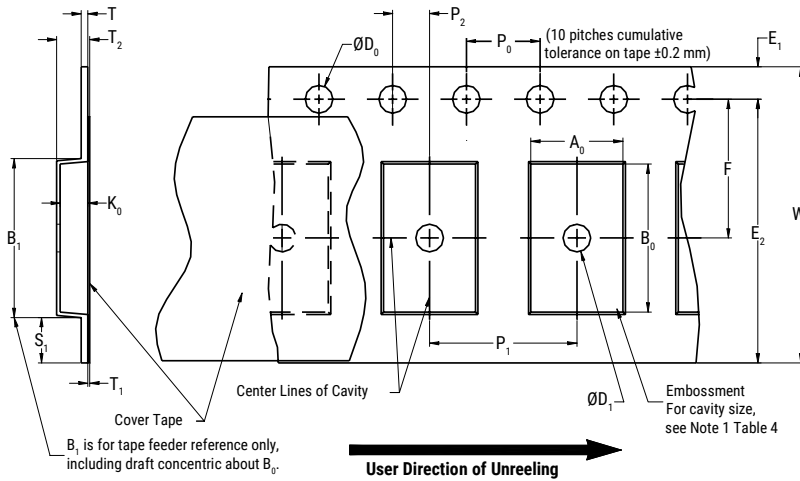
### Benefits of Changing from 4 mm to 2 mm Pitching Spacing

- Lower placement costs.
- Double the parts on each reel results in fewer reel changes and increased efficiency.
- Fewer reels result in lower packaging, shipping and storage costs, reducing waste.

\*Refer to Figures 1 and 2 for W and P<sub>1</sub> carrier tape reference locations.

\*Refer to Tables 5 and 6 for tolerance specifications.

**Figure 1 – Embossed (Plastic) Carrier Tape Dimensions**

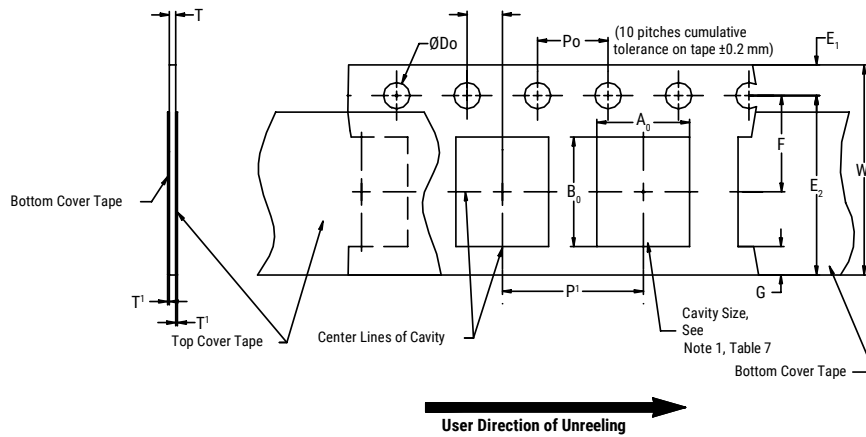


**Table 5 – Embossed (Plastic) Carrier Tape Dimensions**  
Metric will govern

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)							
16 mm		1.5 (0.059)							
24 mm	1.5 +0.10/-0.0 (0.059 +0.004/-0.0)	1.5 (0.059)	1.75 ±0.10 (0.069 ±0.004)	4.0 ±0.10 (0.157 ±0.004)	2.0 ±0.10 (0.078 ±0.003)	30 (1.181)	5 (0.196)	0.250 (0.009)	0.350 (0.013)
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)	4.0 ±0.10 (0.157 ±0.004)	2.5 (0.098)	8.3 (0.327)	Note 5	
12 mm	Single (4 mm) and 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)	7.5 ±0.05 (0.138 ±0.002)	12.0 ±0.10 (0.157 ±0.004)	4.6 (0.181)	16.3 (0.642)		
24 mm	16 mm	11.5 (0.452)	22.25 (0.875)	11.5 ±0.10 (0.452 ±0.003)	16.0 ±0.10 (0.629 ±0.004)	3 (0.118)	24.3 (0.956)		

- 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.
- The tape with or without components shall pass around R without damage (see Figure 6).
- 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 paragraph 4.3 section b).
- B<sub>1</sub> dimension is a reference dimension for tape feeder clearance only.
- 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:
  - the component does not protrude above the top surface of the carrier tape.
  - the component can be removed from the cavity in a vertical direction without mechanical restriction, after the top cover tape has been removed.
  - rotation of the component is limited to 20° maximum for 8 and 12 mm tapes and 10° maximum for 16 mm tapes (see Figure 3).
  - lateral movement of the component is restricted to 0.5 mm maximum for 8 and 12 mm wide tape and to 1.0 mm maximum for 16 mm tape (see Figure 4).
  - for KPS product, A<sub>0</sub> and B<sub>0</sub> are measured on a plane 0.3 mm above the bottom of the pocket.
  - see addendum in EIA Standard 481 for standards relating to more precise taping requirements.

**Figure 2 – Punched (Paper) Carrier Tape Dimensions**



**Table 6 – Punched (Paper) Carrier Tape Dimensions**  
 Metric will govern

Constant Dimensions – Millimeters (Inches)							
Tape Size	$D_0$	$E_1$	$P_0$	$P_2$	$T_1$ Maximum	G Minimum	R Reference Note 2
8 mm	1.5 +0.10 -0.0 (0.059 +0.004 -0.0)	1.75 ±0.10 (0.069 ±0.004)	4.0 ±0.10 (0.157 ±0.004)	2.0 ±0.05 (0.079 ±0.002)	0.10 (0.004) Maximum	0.75 (0.030)	25 (0.984)
Variable Dimensions – Millimeters (Inches)							
Tape Size	Pitch	E2 Minimum	F	$P_1$	T Maximum	W Maximum	$A_0 B_0$
8 mm	Half (2 mm)	6.25 (0.246)	3.5 ±0.05 (0.138 ±0.002)	2.0 ±0.05 (0.079 ±0.002)	1.1 (0.098)	8.3 (0.327)	Note 1
8 mm	Single (4 mm)			4.0 ±0.10 (0.157 ±0.004)		8.3 (0.327)	

- The cavity defined by  $A_0$ ,  $B_0$  and  $T$  shall surround the component with sufficient clearance that:
  - the component does not protrude beyond either surface of the carrier tape.
  - the component can be removed from the cavity in a vertical direction without mechanical restriction, after the top cover tape has been removed.
  - rotation of the component is limited to 20° maximum (see Figure 3).
  - lateral movement of the component is restricted to 0.5 mm maximum (see Figure 4).
  - see addendum in EIA Standard 481 for standards relating to more precise taping requirements.
- The tape with or without components shall pass around R without damage (see Figure 6).

## Packaging Information Performance Notes

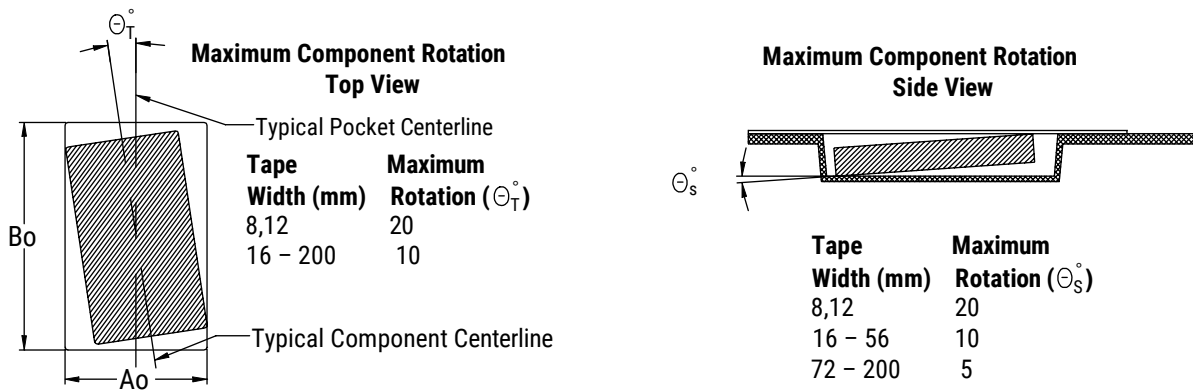
- Cover Tape Break Force:** 1.0 kg minimum.
- Cover Tape Peel Strength:** The total peel strength of the cover tape from the carrier tape shall be:

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)

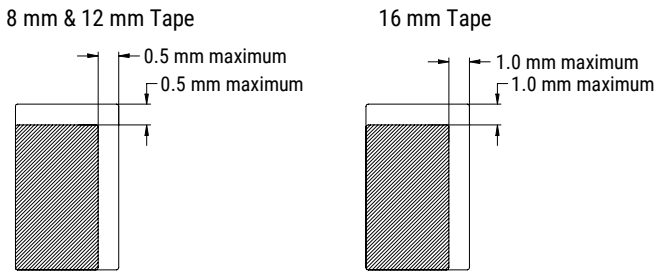
The direction of the pull shall be opposite the direction of the carrier tape travel. The pull angle of the carrier tape shall be 165° to 180° from the plane of the carrier tape. During peeling, the carrier and/or cover tape shall be pulled at a velocity of 300 ±10 mm/minute.

- 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.

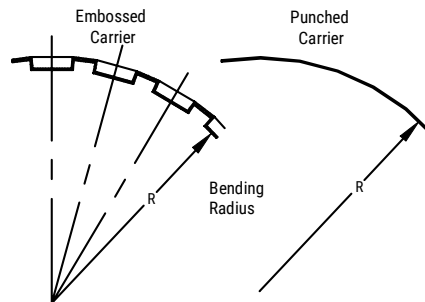
### Figure 3 – Maximum Component Rotation



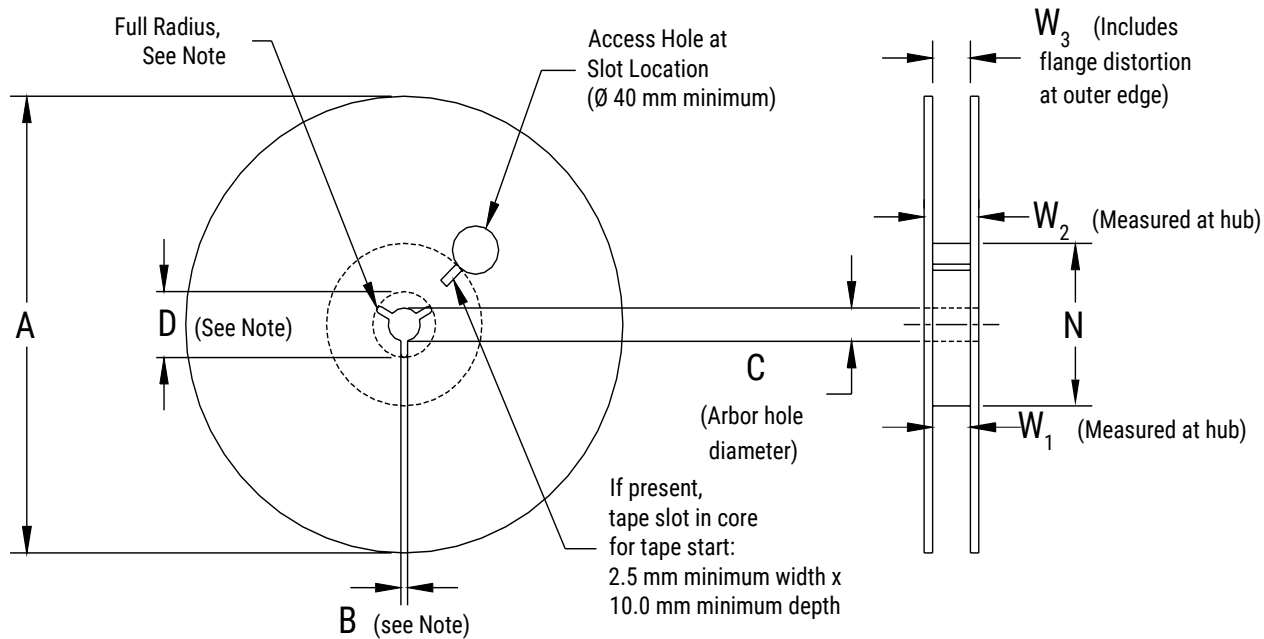
### Figure 4 – Maximum Lateral Movement



### Figure 5 – Bending Radius



**Figure 6 – Reel Dimensions**



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

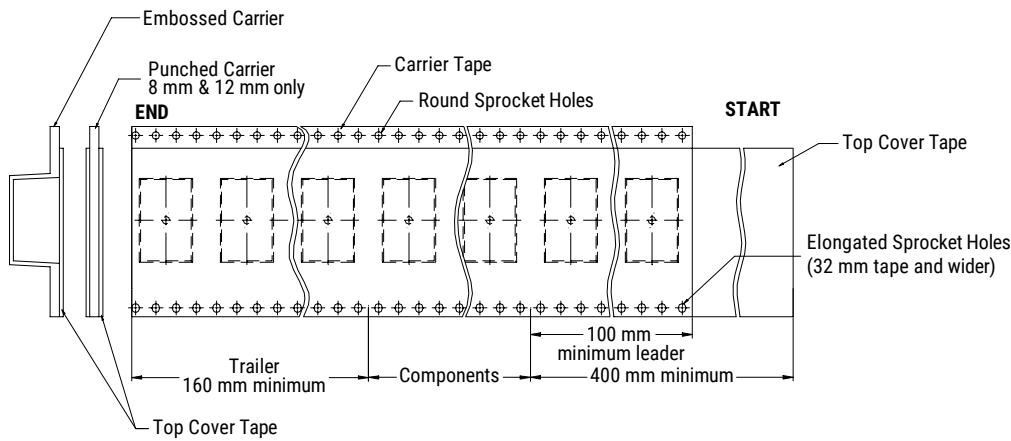
**Table 7 – Reel Dimensions**

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	1.5 (0.059)	13.0 +0.5/-0.2 (0.521 +0.02/-0.008)	20.2 (0.795)
12 mm				
16 mm	330 ±0.20 (13.000 ±0.008)	1.2 (0.047)	13.0 ±0.2 (0.521 ±0.008)	21 (0.826)
24 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)	
24 mm		25 +1.0/-0.0 (0.984 +0.039/-0.0)	27.4 ±1.0 (1.078 ±0.039)	



**Figure 7 – Tape Leader & Trailer Dimensions**



**Figure 8 – Maximum Camber**



## KEMET Electronics Corporation Sales Offices

For a complete list of our global sales offices, please visit [www.kemet.com/sales](http://www.kemet.com/sales).

---

### Disclaimer

All product specifications, statements, information and data (collectively, the "Information") in this datasheet are subject to change. The customer is responsible for checking and verifying the extent to which the Information contained in this publication is applicable to an order at the time the order is placed. All Information given herein is believed to be accurate and reliable, but it is presented without guarantee, warranty, or responsibility of any kind, expressed or implied.

Statements of suitability for certain applications are based on KEMET Electronics Corporation's ("KEMET") knowledge of typical operating conditions for such applications, but are not intended to constitute – and KEMET specifically disclaims – any warranty concerning suitability for a specific customer application or use. The Information is intended for use only by customers who have the requisite experience and capability to determine the correct products for their application. Any technical advice inferred from this Information or otherwise provided by KEMET with reference to the use of KEMET's products is given gratis, and KEMET assumes no obligation or liability for the advice given or results obtained.

Although KEMET designs and manufactures its products to the most stringent quality and safety standards, given the current state of the art, isolated component failures may still occur. Accordingly, customer applications which require a high degree of reliability or safety should employ suitable designs or other safeguards (such as installation of protective circuitry or redundancies) in order to ensure that the failure of an electrical component does not result in a risk of personal injury or property damage.

Although all product-related warnings, cautions and notes must be observed, the customer should not assume that all safety measures are indicated or that other measures may not be required.

*KEMET is a registered trademark of KEMET Electronics Corporation.*