

# Capacitor Array, X7R Dielectric, 10 – 200 VDC (Commercial & Automotive Grade)

## Overview

KEMET's Ceramic Chip Capacitor Array in X7R dielectric is an advanced passive technology where multiple capacitor elements are integrated into one common monolithic structure. Array technology promotes reduced placement costs and increased throughput. This is achieved by alternatively placing one device rather than two or four discrete devices. Use of capacitor arrays also saves board space which translates into increased board density and more functions per board. Arrays consume only a portion of the space required for standard chips resulting in savings in inventory and pick/place machine positions.

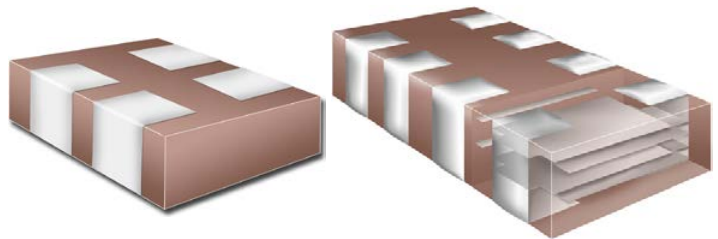
KEMET's X7R dielectric features a 125°C maximum operating temperature and is considered "temperature stable." The

Electronics Industries Alliance (EIA) characterizes X7R dielectric as a Class II material. Components of this classification are fixed, ceramic dielectric capacitors suited for bypass and decoupling applications or for frequency discriminating circuits where Q and stability of capacitance characteristics are not critical. X7R exhibits a predictable change in capacitance with respect to time and voltage and boasts a minimal change in capacitance with reference to ambient temperature. Capacitance change is limited to  $\pm 15\%$  from -55°C to +125°C.

KEMET automotive grade array capacitors meet the demanding Automotive Electronics Council's AEC-Q200 qualification requirements.

## Benefits

- -55°C to +125°C operating temperature range
- Saves both circuit board and inventory space
- Reduces placement costs and increases throughput
- RoHS Compliant
- EIA 0508 (2-element) and 0612 (4-element) case sizes
- DC voltage ratings of 10 V, 16 V, 25 V, 50 V, 100 V, and 200 V



## Ordering Information

| CA            | 06                               | 4                    | C  | 104                                    | K   | 4  | R          | A                    | C  | TU   |
|---------------|----------------------------------|----------------------|--|--|---|--|------------|----------------------|--|--|
| Ceramic Array | Case Size (L" x W") <sup>1</sup> | Number of Capacitors | Specification/ Series                    | Capacitance Code (pF)                  | Capacitance Tolerance                             | Voltage  | Dielectric | Failure Rate/ Design | Termination Finish <sup>2</sup>            | Packaging/Grade (C-Spec) <sup>3</sup>  |
|               | 05 = 0508<br>06 = 0612           | 2 = 2<br>4 = 4       | C = Standard<br>X = Flexible Termination | 2 Significant Digits + Number of Zeros | J = $\pm 5\%$<br>K = $\pm 10\%$<br>M = $\pm 20\%$ | 8 = 10 V<br>4 = 16 V<br>3 = 25 V<br>5 = 50 V<br>1 = 100 V<br>2 = 200 V | R = X7R    | A = N/A              | C = 100% Matte Sn<br>L = SnPb (5% minimum) | Blank = Bulk<br>TU = 7" Reel<br>Unmarked<br>TM = 7" Reel Marked<br>AUTO = Automotive Grade |

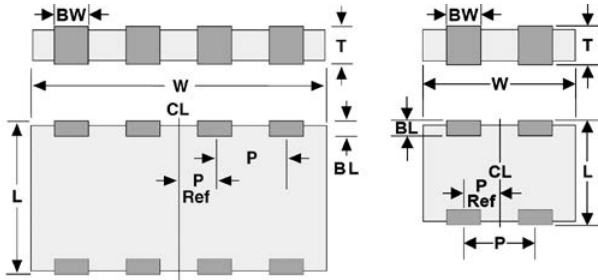
<sup>1</sup> All previous reference to metric case dimension "1632" has been replaced with an inch standard reference of "0612". Please reference all new designs using the "0612" nomenclature. "CA064" replaces "C1632" in the ordering code.

<sup>2</sup> Additional termination finish options may be available. Contact KEMET for details.

<sup>2,3</sup> SnPb termination finish option is not available on automotive grade product.

<sup>3</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                       | BW Bandwidth                  | BL Bandlength                 | T Thickness               | P Pitch                       | P Reference                   |
|---------------|------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|---------------------------|-------------------------------|-------------------------------|
| 0508          | 1220             | 1.30 (0.051)<br>±0.15 (0.006) | 2.10 (0.083)<br>±0.15 (0.006) | 0.53 (0.021)<br>±0.08 (0.003) | 0.30 (0.012)<br>±0.20 (0.008) | See Table 2 for Thickness | 1.00 (0.039)<br>±0.10 (0.004) | 0.50 (0.020)<br>±0.10 (0.004) |
| 0612          | 1632             | 1.60 (0.063)<br>±0.20 (0.008) | 3.20 (0.126)<br>±0.20 (0.008) | 0.40 (0.016)<br>±0.20 (0.008) | 0.30 (0.012)<br>±0.20 (0.008) |                           | 0.80 (0.031)<br>±0.10 (0.004) | 0.40 (0.016)<br>±0.05 (0.002) |

## Benefits cont'd

- Capacitance offerings ranging from 330 pF – 0.22 µF
- Available capacitance tolerances of ±5%, ±10%, and ±20%
- Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb termination finish option available upon request (5% minimum)
- Flexible termination option available upon request
- Commercial and Automotive (AEC-Q200) grades available

## Applications

Typical applications include those that can benefit from board area savings, cost savings and overall volumetric reduction such as telecommunications, computers, handheld devices and automotive.

## Qualification/Certification

Commercial Grade products are subject to internal qualification. Details regarding test methods and conditions are referenced in Table 4, Performance & Reliability.

Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC-Q200, Stress Test Qualification for Passive Components. 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

Pb-Free and RoHS Compliant (excluding SnPb termination finish option).



RoHS Compliant

## 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%  |
| Aging Rate (Maximum % Capacitance Loss/Decade Hour)                | 3.0%  |
| Dielectric Withstanding Voltage (DWV)                              | 250% of rated voltage<br>(5 ±1 seconds and charge/discharge not exceeding 50 mA)        |
| Dissipation Factor (DF) Maximum Limit @ 25°C                       | 5%(10 V), 3.5%(16 V and 25 V) and 2.5%(50 V to 200 V)                                   |
| Insulation Resistance (IR) Limit @ 25°C                            | 1,000 megohm microfarads or 100 GΩ<br>(Rated voltage applied for 120 ±5 seconds @ 25°C) |

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.

To obtain IR limit, divide MΩ-μF value by the capacitance and compare to GΩ limit. Select the lower of the two limits.

Capacitance and dissipation factor (DF) measured under the following conditions:

1 kHz ±50 Hz and 1.0 ±0.2 Vrms if capacitance ≤ 10 μF

120 Hz ±10 Hz and 0.5 ±0.1 Vrms if capacitance > 10 μF

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 |                  |                   |                                |                   |                       |
|---|------------------|-------------------|--------------------------------|-------------------|-----------------------|
| Dielectric  | Rated DC Voltage | Capacitance Value | Dissipation Factor (Maximum %) | Capacitance Shift | Insulation Resistance |
| X7R   | > 25             | All               | 3.0                            | ±20%              | 10% of Initial Limit  |
|   | 16/25            |                   | 5.0                            |                   |                       |
|   | < 16             |                   | 7.5                            |                   |                       |

**Table 1 – Capacitance Range/Selection Waterfall (0508 – 0612 Case Sizes)**

| Capacitance | Capacitance Code | Series                |   |   | C0508 (CA052C 2-Cap Case Size)   |    |    |    |     | C0612 (CA064C 4-Cap Case Size) |    |    |    |     |     |
|-------------|------------------|-----------------------|---|---|--|----|----|----|-----|--------------------------------|----|----|----|-----|-----|
|             |                  | Voltage Code          |   |   | 8  | 4  | 3  | 5  | 1   | 8                              | 4  | 3  | 5  | 1   | 2   |
|             |                  | Voltage DC            |   |   | 10   | 16 | 25 | 50 | 100 | 10                             | 16 | 25 | 50 | 100 | 200 |
|             |                  | Capacitance Tolerance |   |   | Product Availability and Chip Thickness Codes<br>See Table 2 for Chip Thickness Dimensions |    |    |    |     |                                |    |    |    |     |     |
| 330 pF      | 331              | J                     | K | M | PA   | PA | PA | PA | PA  | MA                             | MA | MA | MA | MA  | MA  |
| 390 pF      | 391              | J                     | K | M | PA   | PA | PA | PA | PA  | MA                             | MA | MA | MA | MA  | MA  |
| 470 pF      | 471              | J                     | K | M | PA   | PA | PA | PA | PA  | MA                             | MA | MA | MA | MA  | MA  |
| 560 pF      | 561              | J                     | K | M | PA   | PA | PA | PA | PA  | MA                             | MA | MA | MA | MA  | MA  |
| 680 pF      | 681              | J                     | K | M | PA   | PA | PA | PA | PA  | MA                             | MA | MA | MA | MA  | MA  |
| 820 pF      | 821              | J                     | K | M | PA   | PA | PA | PA | PA  | MA                             | MA | MA | MA | MA  |     |
| 1,000 pF    | 102              | J                     | K | M | PA   | PA | PA | PA | PA  | MA                             | MA | MA | MA | MA  |     |
| 1,200 pF    | 122              | J                     | K | M | PA   | PA | PA | PA | PA  | MA                             | MA | MA | MA | MA  |     |
| 1,500 pF    | 152              | J                     | K | M | PA   | PA | PA | PA | PA  | MA                             | MA | MA | MA | MA  |     |
| 1,800 pF    | 182              | J                     | K | M | PA   | PA | PA | PA | PA  | MA                             | MA | MA | MA | MA  |     |
| 2,200 pF    | 222              | J                     | K | M | PA   | PA | PA | PA | PA  | MA                             | MA | MA | MA | MA  |     |
| 2,700 pF    | 272              | J                     | K | M | PA   | PA | PA | PA | PA  | MA                             | MA | MA | MA | MA  |     |
| 3,300 pF    | 332              | J                     | K | M | PA   | PA | PA | PA | PA  | MA                             | MA | MA | MA | MA  |     |
| 3,900 pF    | 392              | J                     | K | M | PA   | PA | PA | PA | PA  | MA                             | MA | MA | MA | MA  |     |
| 4,700 pF    | 472              | J                     | K | M | PA   | PA | PA | PA | PA  | MA                             | MA | MA | MA | MA  |     |
| 5,600 pF    | 562              | J                     | K | M | PA   | PA | PA | PA |     | MA                             | MA | MA | MA |     |     |
| 6,800 pF    | 682              | J                     | K | M | PA   | PA | PA | PA |     | MA                             | MA | MA | MA |     |     |
| 8,200 pF    | 822              | J                     | K | M | PA   | PA | PA | PA |     | MA                             | MA | MA | MA |     |     |
| 10,000 pF   | 103              | J                     | K | M | PA   | PA | PA | PA |     | MA                             | MA | MA | MA |     |     |
| 12,000 pF   | 123              | J                     | K | M | PA   | PA | PA | PA |     | MA                             | MA | MA | MA |     |     |
| 15,000 pF   | 153              | J                     | K | M | PA   | PA | PA | PA |     | MA                             | MA | MA | MA |     |     |
| 18,000 pF   | 183              | J                     | K | M | PA   | PA | PA | PA |     | MA                             | MA | MA | MA |     |     |
| 22,000 pF   | 223              | J                     | K | M | PA   | PA | PA | PA |     | MA                             | MA | MA | MA |     |     |
| 27,000 pF   | 273              | J                     | K | M | PA   | PA | PA | PA |     | MA                             | MA | MA |    |     |     |
| 33,000 pF   | 333              | J                     | K | M | PA   | PA | PA | PA |     | MA                             | MA | MA |    |     |     |
| 39,000 pF   | 393              | J                     | K | M | PA   | PA | PA | PA |     | MA                             | MA | MA |    |     |     |
| 47,000 pF   | 473              | J                     | K | M | PA   | PA | PA | PA |     | MA                             | MA | MA |    |     |     |
| 56,000 pF   | 563              | J                     | K | M | PA   | PA | PA | PA |     | MA                             | MA | MA |    |     |     |
| 68,000 pF   | 683              | J                     | K | M | PA   | PA | PA | PA |     | MA                             | MA |    |    |     |     |
| 82,000 pF   | 823              | J                     | K | M | PA   | PA | PA | PA |     | MA                             | MA |    |    |     |     |
| 0.10 uF     | 104              | J                     | K | M | PA   | PA | PA | PA |     | MA                             | MA |    |    |     |     |
| 0.15 uF     | 154              | J                     | K | M | PA   |    |    |    |     |                                |    |    |    |     |     |
| 0.22 uF     | 224              | J                     | K | M | PA   |    |    |    |     |                                |    |    |    |     |     |
| Capacitance | Capacitance Code | Voltage DC            |   |   | 10   | 16 | 25 | 50 | 100 | 10                             | 16 | 25 | 50 | 100 | 200 |
|             |                  | Voltage Code          |   |   | 8  | 4  | 3  | 5  | 1   | 8                              | 4  | 3  | 5  | 1   | 2   |
|             |                  | Series                |   |   | C0508  |    |    |    |     | C0612                          |    |    |    |     |     |

**Table 2 – Chip Thickness / Packaging Quantities**

| Thickness Code | Case Size | Thickness ± Range (mm) | Paper Quantity |          | Plastic Quantity |          |
|----------------|-----------|------------------------|----------------|----------|------------------|----------|
|                |           |                        | 7" Reel        | 13" Reel | 7" Reel          | 13" Reel |
| PA             | 0508      | 0.80 ± 0.10            | 0              | 0        | 4,000            | 10,000   |
| MA             | 0612      | 0.80 ± 0.10            | 0              | 0        | 4,000            | 10,000   |

Package quantity based on finished chip thickness specifications.

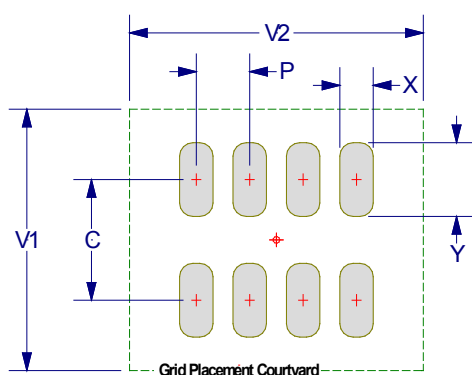
**Table 3 – Chip Capacitor Array Land Pattern Design Recommendations per IPC–7351**

| EIA SIZE CODE | METRIC SIZE CODE | Density Level A:<br>Maximum (Most) Land Protrusion (mm) |      |      |      |      |      | Density Level B:<br>Median (Nominal) Land Protrusion (mm) |      |      |      |      |      | Density Level C:<br>Minimum (Least) Land Protrusion (mm) |      |      |      |      |      |
|---------------|------------------|---|------|------|------|------|------|---|------|------|------|------|------|--|------|------|------|------|------|
|               |                  | C   | Y    | X    | P    | V1   | V2   | C   | Y    | X    | P    | V1   | V2   | C  | Y    | X    | P    | V1   | V2   |
| 0508/CA052    | 1220             | 1.60  | 1.00 | 0.55 | 1.00 | 3.50 | 3.30 | 1.50  | 0.90 | 0.50 | 1.00 | 2.90 | 2.80 | 1.40   | 0.75 | 0.45 | 1.00 | 2.40 | 2.50 |
| 0612/CA064    | 1632             | 1.80  | 1.10 | 0.50 | 0.80 | 3.90 | 4.40 | 1.80  | 0.95 | 0.50 | 0.80 | 3.30 | 3.90 | 1.70   | 0.85 | 0.40 | 0.80 | 2.80 | 3.60 |

**Density Level A:** For low-density product applications. 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).



## Soldering Process

Recommended Soldering Technique:

- Solder reflow only

Recommended Soldering Profile:

- KEMET recommends following the guidelines outlined in IPC/JEDEC J–STD–020

**Table 4 – Performance & Reliability: Test Methods and Conditions**

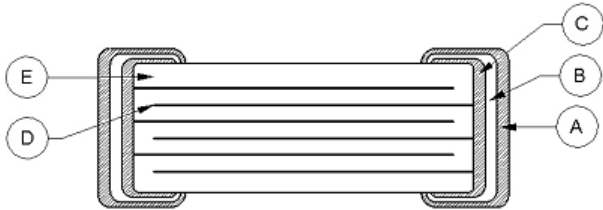
| Stress                 | Reference                       | Test or Inspection Method   |
|------------------------|---------------------------------|---|
| Terminal Strength      | JIS-C-6429                      | Appendix 1, Note: Force of 1.8 kg for 60 seconds.   |
| Board Flex             | JIS-C-6429                      | Appendix 2, Note: Standard termination system – 2.0 mm (minimum) for all except 3 mm for COG. Flexible termination system – 3.0 mm (minimum).   |
| Solderability          | J-STD-002                       | Magnification 50 X. Conditions:   |
|                        |                                 | a) Method B, 4 hours @ 155°C, dry heat @ 235°C  |
|                        |                                 | b) Method B @ 215°C category 3  |
|                        |                                 | c) Method D, category 3 @ 260°C   |
| Temperature Cycling    | JESD22 Method JA-104            | 1,000 Cycles (-55°C to +125°C). Measurement at 24 hours +/- 2 hours after test conclusion.  |
| Biased Humidity        | MIL-STD-202 Method 103          | Load Humidity: 1,000 hours 85°C/85% RH and rated voltage. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.  |
|                        |                                 | Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/- 2 hours after test conclusion.  |
| Moisture Resistance    | MIL-STD-202 Method 106          | t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours +/- 2 hours after test conclusion.   |
| Thermal Shock          | MIL-STD-202 Method 107          | -55°C/+125°C. Note: Number of cycles required – 300, maximum transfer time – 20 seconds, dwell time – 15 minutes. Air – Air.  |
| High Temperature Life  | MIL-STD-202 Method 108 /EIA-198 | 1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.  |
| Storage Life           | MIL-STD-202 Method 108          | 150°C, 0 VDC for 1,000 hours.   |
| Vibration              | MIL-STD-202 Method 204          | 5 g's for 20 min., 12 cycles each of 3 orientations. Note: Use 8" X 5" PCB 0.031" thick 7 secure points on one long side and 2 secure points at corners of opposite sides. Parts mounted within 2" from any secure point. Test from 10 – 2,000 Hz |
| Mechanical Shock       | MIL-STD-202 Method 213          | Figure 1 of Method 213, Condition F.  |
| Resistance to Solvents | MIL-STD-202 Method 215          | Add aqueous wash chemical, OKEM Clean or equivalent.  |

## Storage & 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 – Standard Termination

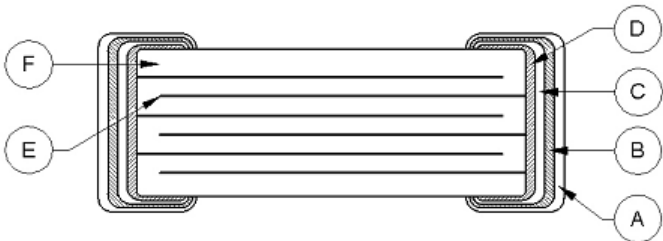
| Reference | Item                |               | Material           |
|-----------|---------------------|---------------|--------------------|
| A         | Termination System  | Finish        | 100% Matte Sn      |
| B         |                     | Barrier Layer | Ni                 |
| C         |                     | Base Metal    | Cu                 |
| D         | Inner Electrode     |               | Ni                 |
| E         | Dielectric Material |               | BaTiO <sub>3</sub> |



Note: Image is exaggerated in order to clearly identify all components of construction.

Construction – Flexible Termination

| Reference | Item                |               | Material           |
|-----------|---------------------|---------------|--------------------|
| A         | Termination System  | Finish        | 100% Matte Sn      |
| B         |                     | Barrier Layer | Ni                 |
| C         |                     | Epoxy Layer   | Ag                 |
| D         |                     | Base Metal    | Cu                 |
| E         | Inner Electrode     |               | Ni                 |
| F         | Dielectric Material |               | BaTiO <sub>3</sub> |



Note: Image is exaggerated in order to clearly identify all components of 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.

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.



Laser marking option is not available on:

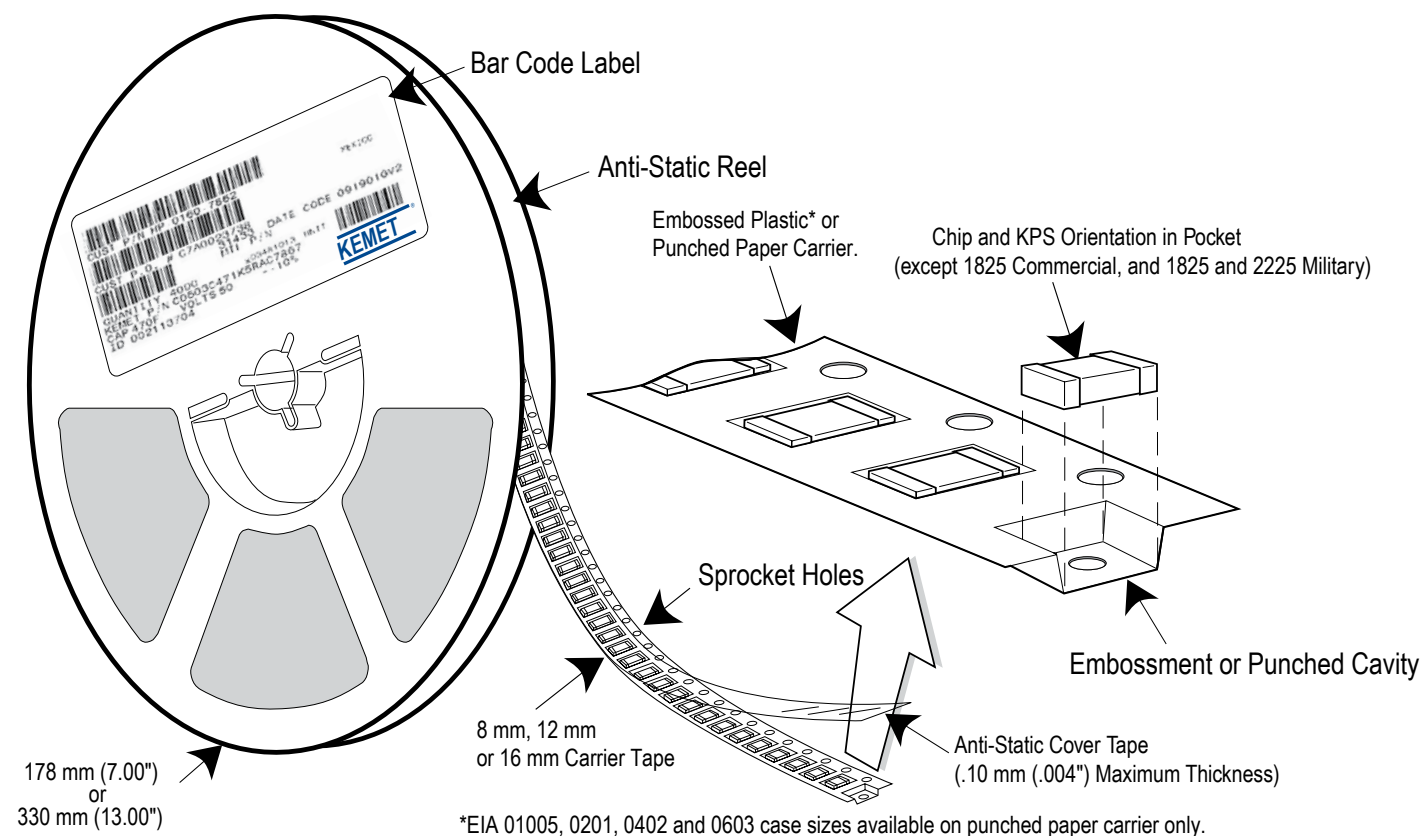
- C0G, Ultra Stable X8R and Y5V dielectric devices
- EIA 0402 case size devices
- EIA 0603 case size devices with Flexible Termination option.
- KPS Commercial and Automotive Grade stacked devices.

| Capacitance (pF) For Various Alpha/Numeral Identifiers |         |     |    |     |       |        |         |           |            |             |
|--|---------|-----|----|-----|-------|--------|---------|-----------|------------|-------------|
| Alpha Character  | Numeral |     |    |     |       |        |         |           |            |             |
|  | 9       | 0   | 1  | 2   | 3     | 4      | 5       | 6         | 7          | 8           |
| Capacitance (pF)                                       |         |     |    |     |       |        |         |           |            |             |
| A  | 0.1     | 10  | 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  | 0.2     | 20  | 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  | 0.3     | 30  | 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  | 0.4     | 40  | 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  | 0.5     | 50  | 50 | 500 | 5,000 | 50,000 | 500,000 | 5,000,000 | 50,000,000 | 500,000,000 |
| m  | 0.6     | 60  | 60 | 600 | 6,000 | 60,000 | 600,000 | 6,000,000 | 60,000,000 | 600,000,000 |
| n  | 0.7     | 70  | 70 | 700 | 7,000 | 70,000 | 700,000 | 7,000,000 | 70,000,000 | 700,000,000 |
| t  | 0.8     | 80  | 80 | 800 | 8,000 | 80,000 | 800,000 | 8,000,000 | 80,000,000 | 800,000,000 |
| y  | 0.9     | 90  | 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.



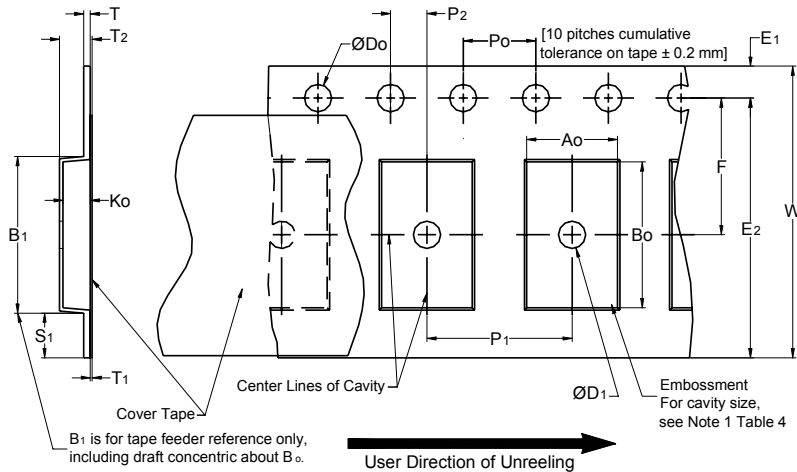
**Table 5 – Carrier Tape Configuration – Embossed Plastic & Punched Paper (mm)**

| EIA Case Size     | Tape Size (W)* | Pitch (P <sub>1</sub> )* |
|-------------------|----------------|--------------------------|
| 01005 – 0402      | 8              | 2                        |
| 0603 – 1210       | 8              | 4                        |
| 1805 – 1808       | 12             | 4                        |
| ≥ 1812            | 12             | 8                        |
| KPS 1210          | 12             | 8                        |
| KPS 1812 & 2220   | 16             | 12                       |
| Array 0508 & 0612 | 8              | 4                        |

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

\*Refer to Tables 6 & 7 for tolerance specifications.

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



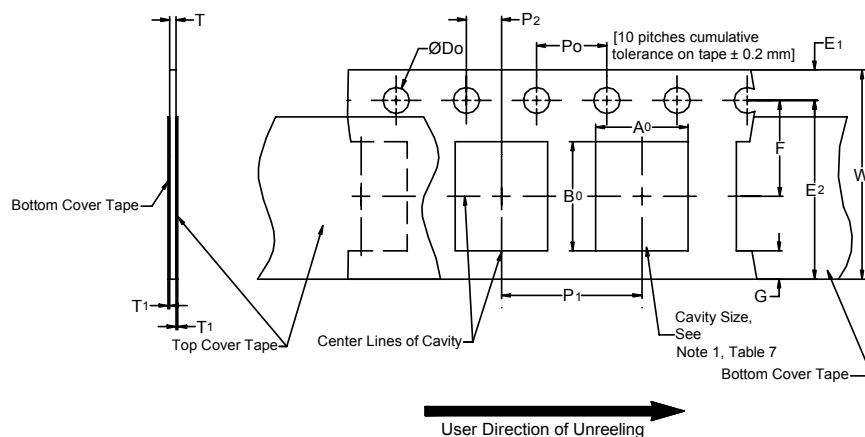
**Table 6 – Embossed (Plastic) Carrier Tape Dimensions**

Metric will govern

| Constant Dimensions — Millimeters (Inches) |                                       |                                  |                              |                             |                              |                           |                                  |  |                           |
|--|---------------------------------------|----------------------------------|------------------------------|-----------------------------|------------------------------|---------------------------|----------------------------------|--|---------------------------|
| Tape Size                                  | D <sub>0</sub>                        | D <sub>1</sub> Minimum<br>Note 1 | E <sub>1</sub>               | P <sub>0</sub>              | P <sub>2</sub>               | R Reference<br>Note 2     | S <sub>1</sub> Minimum<br>Note 3 | T<br>Maximum                                     | T <sub>1</sub><br>Maximum |
| 8 mm                                       | 1.5 +0.10/-0.0<br>(0.059 +0.004/-0.0) | 1.0<br>(0.039)                   | 1.75 ±0.10<br>(0.069 ±0.004) | 4.0 ±0.10<br>(0.157 ±0.004) | 2.0 ±0.05<br>(0.079 ±0.002)  | 25.0<br>(0.984)           | 0.600<br>(0.024)                 | 0.600<br>(0.024)                                 | 0.100<br>(0.004)          |
| 12 mm                                      |                                       | 1.5<br>(0.059)                   |                              |                             |                              | 30<br>(1.181)             |                                  |  |                           |
| 16 mm                                      |                                       |                                  |                              |                             |                              |                           |                                  |  |                           |
| Variable Dimensions — Millimeters (Inches) |                                       |                                  |                              |                             |                              |                           |                                  |  |                           |
| Tape Size                                  | Pitch                                 | B <sub>1</sub> Maximum<br>Note 4 | E <sub>2</sub><br>Minimum    | F                           | P <sub>1</sub>               | T <sub>2</sub><br>Maximum | W<br>Maximum                     | A <sub>0</sub> , B <sub>0</sub> & K <sub>0</sub> |                           |
| 8 mm                                       | Single (4 mm)                         | 4.35<br>(0.171)                  | 6.25<br>(0.246)              | 3.5 ±0.05<br>(0.138 ±0.002) | 4.0 ±0.10<br>(0.157 ±0.004)  | 2.5<br>(0.098)            | 8.3<br>(0.327)                   | Note 5   |                           |
| 12 mm                                      | Single (4 mm) &<br>Double (8 mm)      | 8.2<br>(0.323)                   | 10.25<br>(0.404)             | 5.5 ±0.05<br>(0.217 ±0.002) | 8.0 ±0.10<br>(0.315 ±0.004)  | 4.6<br>(0.181)            | 12.3<br>(0.484)                  |  |                           |
| 16 mm                                      | Triple (12 mm)                        | 12.1<br>(0.476)                  | 14.25<br>(0.561)             | 7.5 ±0.05<br>(0.138 ±0.002) | 12.0 ±0.10<br>(0.157 ±0.004) | 4.6<br>(0.181)            | 16.3<br>(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 6).
3. If  $S_1 < 1.0$  mm, there may not be enough area for cover tape to be properly applied (see EIA Standard 481 paragraph 4.3 section b).
4.  $B_1$  dimension is a reference dimension for tape feeder clearance only.
5. The cavity defined by  $A_0$ ,  $B_0$  and  $K_0$  shall surround the component with sufficient clearance that:
  - (a) the component does not protrude above the top surface of the carrier tape.
  - (b) the component can be removed from the cavity in a vertical direction without mechanical restriction, after the top cover tape has been removed.
  - (c) rotation of the component is limited to 20° maximum for 8 and 12 mm tapes and 10° maximum for 16 mm tapes (see Figure 3).
  - (d) 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).
  - (e) for KPS Series product,  $A_0$  and  $B_0$  are measured on a plane 0.3 mm above the bottom of the pocket.
  - (f) see Addendum in EIA Standard 481 for standards relating to more precise taping requirements.

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



**Table 7 – 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                                       | $1.5 +0.10 -0.0$<br>(0.059 +0.004 -0.0) | $1.75 \pm 0.10$<br>(0.069 $\pm$ 0.004) | $4.0 \pm 0.10$<br>(0.157 $\pm$ 0.004) | $2.0 \pm 0.05$<br>(0.079 $\pm$ 0.002) | 0.10<br>(0.004) Maximum | 0.75<br>(0.030) | 25<br>(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<br>(0.246)                        | $3.5 \pm 0.05$<br>(0.138 $\pm$ 0.002) | $2.0 \pm 0.05$<br>(0.079 $\pm$ 0.002) | 1.1<br>(0.098)          | 8.3<br>(0.327)  | Note 1             |
| 8 mm                                       | Single (4 mm)                           |  |                                       | $4.0 \pm 0.10$<br>(0.157 $\pm$ 0.004) |                         | 8.3<br>(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

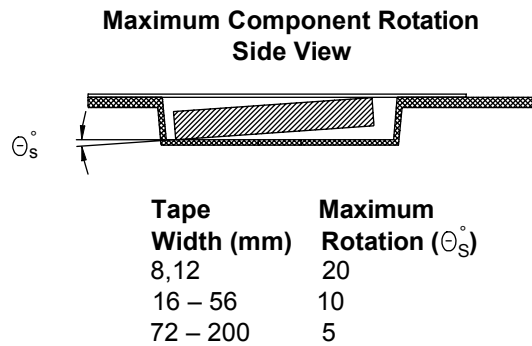
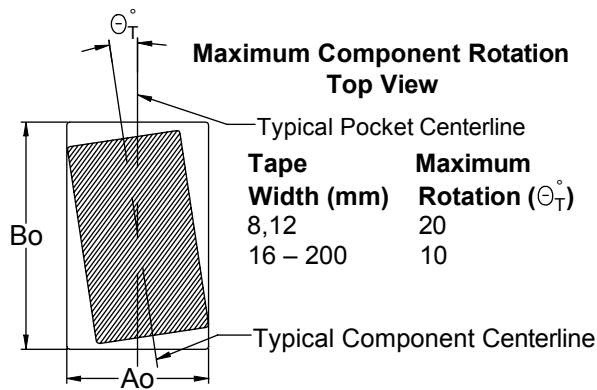
- 1. Cover Tape Break Force:** 1.0 Kg minimum.
- 2. Cover Tape Peel Strength:** The total peel strength of the cover tape from the carrier tape shall be:

| Tape Width   | Peel Strength                    |
|--------------|----------------------------------|
| 8 mm         | 0.1 to 1.0 Newton (10 to 100 gf) |
| 12 and 16 mm | 0.1 to 1.3 Newton (10 to 130 gf) |

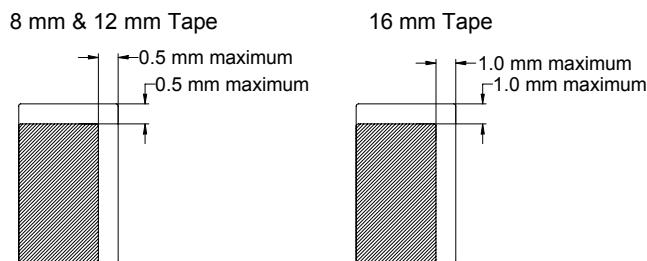
The direction of the pull shall be opposite the direction of the carrier tape travel. The pull angle of the carrier tape shall be 165° to 180° from the plane of the carrier tape. During peeling, the carrier and/or cover tape shall be pulled at a velocity of 300 ±10 mm/minute.

- 3. Labeling:** Bar code labeling (standard or custom) shall be on the side of the reel opposite the sprocket holes. *Refer to EIA Standards 556 and 624.*

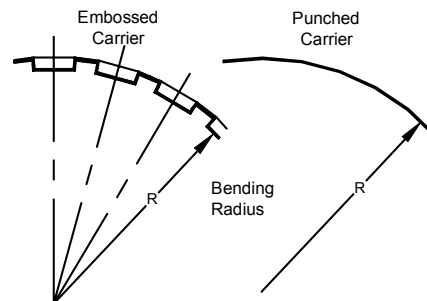
## Figure 3 – Maximum Component Rotation



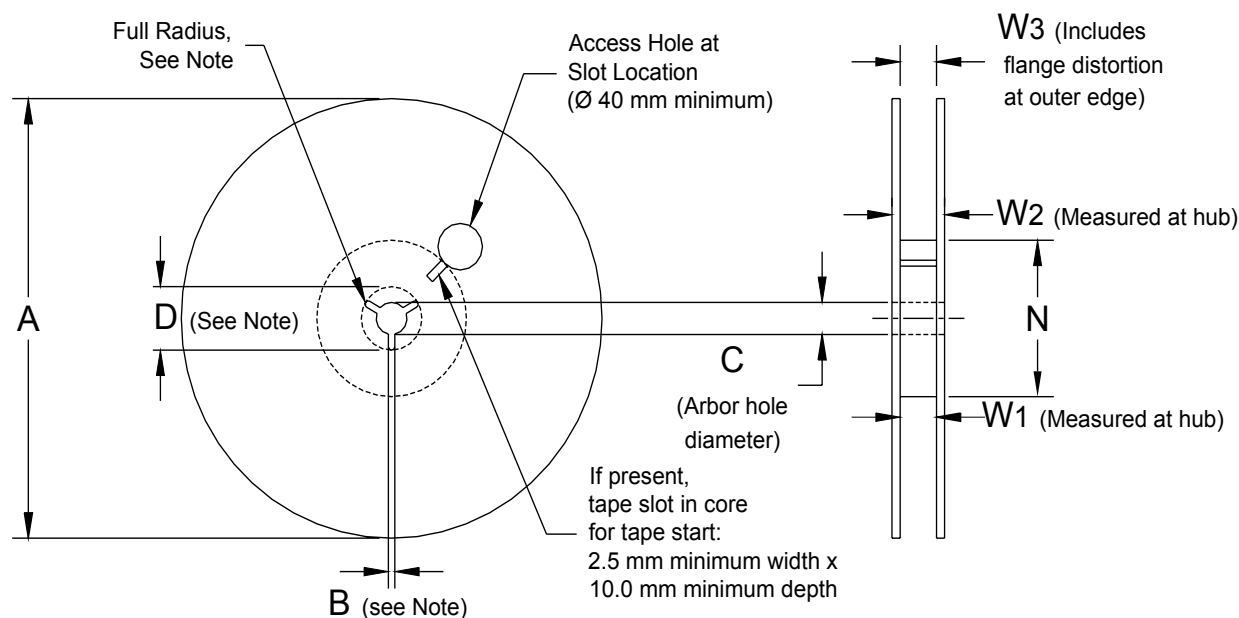
## Figure 4 – Maximum Lateral Movement



## Figure 5 – Bending Radius



**Figure 6 – Reel Dimensions**



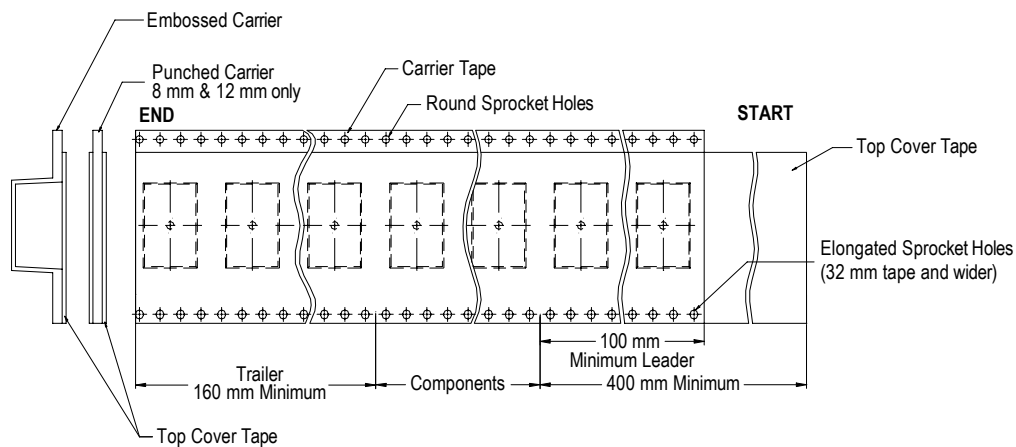
Note: Drive spokes optional; if used, dimensions B and D shall apply.

**Table 8 – Reel Dimensions**

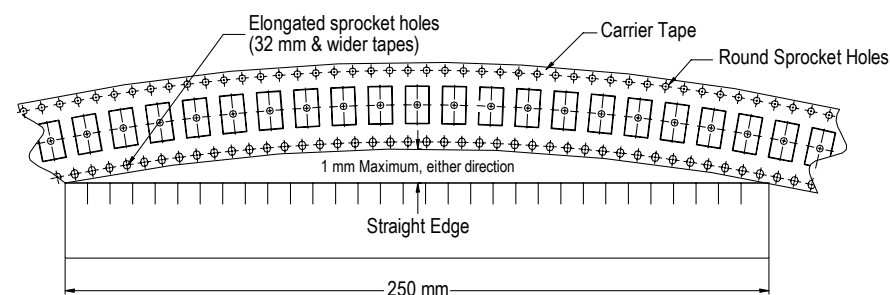
Metric will govern

| Constant Dimensions — Millimeters (Inches) |   |                                       |  |  |
|--|---|---------------------------------------|--|--|
| Tape Size                                  | A   | B Minimum                             | C                                      | D Minimum  |
| 8 mm                                       | 178 ±0.20<br>(7.008 ±0.008)<br>or<br>330 ±0.20<br>(13.000 ±0.008) | 1.5<br>(0.059)                        | 13.0 +0.5/-0.2<br>(0.521 +0.02/-0.008) | 20.2<br>(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<br>(1.969)   | 8.4 +1.5/-0.0<br>(0.331 +0.059/-0.0)  | 14.4<br>(0.567)                        | Shall accommodate tape width<br>without interference |
| 12 mm                                      |   | 12.4 +2.0/-0.0<br>(0.488 +0.078/-0.0) | 18.4<br>(0.724)                        |  |
| 16 mm                                      |   | 16.4 +2.0/-0.0<br>(0.646 +0.078/-0.0) | 22.4<br>(0.882)                        |  |

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



**Figure 8 – Maximum Camber**



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## Other KEMET Resources

| Tools                          |   |
|--------------------------------|---|
| Resource                       | Location  |
| Configure A Part: CapEdge      | <a href="http://capacitoredge.kemet.com">http://capacitoredge.kemet.com</a> |
| SPICE & FIT Software           | <a href="http://www.kemet.com/spice">http://www.kemet.com/spice</a>         |
| Search Our FAQs: KnowledgeEdge | <a href="http://www.kemet.com/keask">http://www.kemet.com/keask</a>         |
| Electrolytic LifeCalculator    | <a href="http://www.kemet.com:8080/elc">http://www.kemet.com:8080/elc</a>   |

| Product Information                                  |   |
|--|---|
| Resource   | Location  |
| Products   | <a href="http://www.kemet.com/products">http://www.kemet.com/products</a>                 |
| Technical Resources (Including Soldering Techniques) | <a href="http://www.kemet.com/technicalpapers">http://www.kemet.com/technicalpapers</a>   |
| RoHS Statement                                       | <a href="http://www.kemet.com/rohs">http://www.kemet.com/rohs</a>                         |
| Quality Documents                                    | <a href="http://www.kemet.com/qualitydocuments">http://www.kemet.com/qualitydocuments</a> |

| Product Request         |   |
|-------------------------|---|
| Resource                | Location  |
| Sample Request          | <a href="http://www.kemet.com/sample">http://www.kemet.com/sample</a> |
| Engineering Kit Request | <a href="http://www.kemet.com/kits">http://www.kemet.com/kits</a>     |

| Contact            |   |
|--------------------|---|
| Resource           | Location  |
| Website            | <a href="http://www.kemet.com">www.kemet.com</a>                                    |
| Contact Us         | <a href="http://www.kemet.com/contact">http://www.kemet.com/contact</a>             |
| Investor Relations | <a href="http://www.kemet.com/ir">http://www.kemet.com/ir</a>                       |
| Call Us            | 1-877-MyKEMET   |
| Twitter            | <a href="http://twitter.com/kemetcapacitors">http://twitter.com/kemetcapacitors</a> |

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