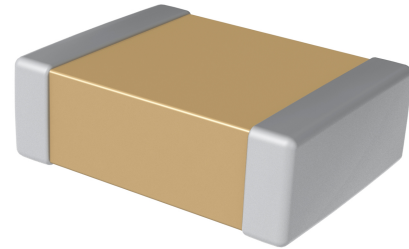


# High Temperature 175°C, X7R Dielectric, 16 – 200 VDC (Industrial Grade)

## Overview

KEMET's High Temperature X7R Dielectric capacitors are formulated and designed for extreme temperature applications. Constructed of a robust and proprietary base metal electrode (BME) dielectric system, these devices are capable of reliable operation in temperatures up to 175°C. Providing an attractive combination of performance and robustness in general high temperature applications, High Temperature X7R dielectric capacitors are well suited for high temperature bypass and decoupling applications or frequency discriminating circuits where Q and stability of capacitance characteristics are not critical. They exhibit a predictable change in capacitance with respect to time, voltage and temperature up to 175°C.



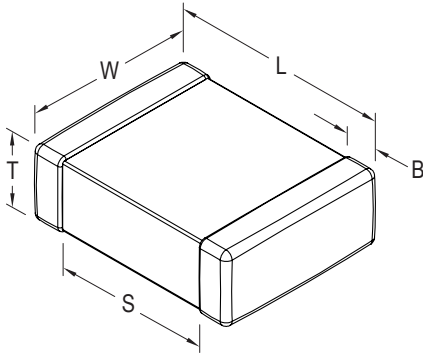
## Ordering Information

| C       | 1210   | R  | 225  | K                               | 3                                     | R          | A                       | C                     | T050  |
|---------|--|--|--|---------------------------------|---------------------------------------|------------|-------------------------|-----------------------|---|
| Ceramic | Case Size <sup>1</sup><br>(L" x W")          | Specification/<br>Series <sup>1</sup>  | Capacitance<br>Code (pF)   | Capacitance<br>Tolerance        | Rated Voltage<br>(VDC)                | Dielectric | Failure Rate/<br>Design | Termination<br>Finish | Packaging/Grade (C-Spec) <sup>2</sup>   |
|         | 0402<br>0603<br>0805<br>1206<br>1210<br>1812 | G = 175°C<br>with standard<br>termination<br>R = 175°C<br>w/ Flexible<br>Termination | First two digits<br>represent<br>significant<br>figures. Third<br>digit specifies<br>number of<br>zeros. | J = ±5%<br>K = ±10%<br>M = ±20% | 4 = 16<br>3 = 25<br>5 = 50<br>2 = 200 | R = X7R    | A = N/A                 | C = 100%<br>Matte Sn  | Blank = Bulk<br>7292 = Waffle Pack/Tray<br>TU = 7" Reel - Unmarked<br>(full reel quantity)<br>T050 = 50 pieces/7" Reel -<br>Unmarked<br>T100 = 100 pieces/7" Reel -<br>Unmarked<br>T250 = 250 pieces/7" Reel -<br>Unmarked<br>T500 = 500 pieces/7" Reel -<br>Unmarked<br>T1K0 = 1,000 pieces/Reel -<br>Unmarked |

<sup>1</sup> Flexible termination option is only available in 0603 (1608 metric) and larger case sizes.

<sup>2</sup> Reeling quantities are dependent upon chip size and thickness dimension. When ordering using the "T1K0" packaging option, 1812 case size devices with chip thickness of  $\geq 1.9$  mm (nominal) may be shipped on multiple 7" reels or a single 13" reel. The term "Unmarked" pertains to laser marking of components. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. Additional reeling or packaging options may be available. Contact KEMET for details.

## Dimensions – Millimeters (Inches) – Standard Termination



| EIA Size Code | Metric Size Code | L Length                   | W Width                    | T Thickness               | B Bandwidth                 | S Separation Minimum | Mounting Technique           |
|---------------|------------------|----------------------------|----------------------------|---------------------------|-----------------------------|----------------------|------------------------------|
| 0402          | 1005             | 1.00 (0.040) ±0.05 (0.002) | 0.50 (0.020) ±0.05 (0.002) | See Table 2 for Thickness | 0.30 (0.012) ± 0.10 (0.004) | 0.30 (0.012)         | Solder Reflow Only           |
| 0603          | 1608             | 1.60 (0.063) ±0.15 (0.006) | 0.80 (0.032) ±0.15 (0.006) |                           | 0.35 (0.014) ± 0.15 (0.006) | 0.70 (0.028)         | Solder Wave or Solder Reflow |
| 0805          | 2012             | 2.00 (0.079) ±0.20 (0.008) | 1.25 (0.049) ±0.20 (0.008) |                           | 0.50 (0.02) ± 0.25 (0.010)  | 0.75 (0.030)         |                              |
| 1206          | 3216             | 3.20 (0.126) ±0.20 (0.008) | 1.60 (0.063) ±0.20 (0.008) |                           | 0.50 (0.02) ± 0.25 (0.010)  | N/A                  | Solder Reflow Only           |
| 1210          | 3225             | 3.20 (0.126) ±0.20 (0.008) | 2.50 (0.098) ±0.20 (0.008) |                           | 0.50 (0.02) ± 0.25 (0.010)  |                      |                              |
| 1812          | 4532             | 4.50 (0.177) ±0.30 (0.012) | 3.20 (0.126) ±0.30 (0.012) |                           | 0.60 (0.024) ± 0.35 (0.014) |                      | Solder Reflow Only           |

## Dimensions – Millimeters (Inches) – Flexible Termination

| EIA Size Code | Metric Size Code | L Length                   | W Width                    | T Thickness               | B Bandwidth                | S Separation Minimum | Mounting Technique           |
|---------------|------------------|----------------------------|----------------------------|---------------------------|----------------------------|----------------------|------------------------------|
| 0603          | 1608             | 1.60 (0.064) ±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) ±0.20 (0.008) | 1.25 (0.049) ±0.20 (0.008) |                           | 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) ±0.20 (0.008) |                           | 0.60 (0.024) ±0.25 (0.010) | N/A                  | Solder Reflow Only           |
| 1210          | 3225             | 3.30 (0.130) ±0.40 (0.016) | 2.50 (0.098) ±0.20 (0.008) |                           | 0.60 (0.024) ±0.25 (0.010) |                      |                              |
| 1812          | 4532             | 4.50 (0.178) ±0.40 (0.016) | 3.20 (0.126) ±0.30 (0.012) |                           | 0.70 (0.028) ±0.35 (0.014) |                      | Solder Reflow Only           |

## Overview cont'd

Concerned with flex cracks resulting from excessive stresses produced during board flexure and thermal cycling? These devices are available with KEMET's Flexible termination technology which 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 flexible termination 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.

KEMET's High Temperature X7R surface mount MLCCs are manufactured in state of the art ISO/TS 16949:2009 certified facilities and are proven to function reliably in harsh, high temperature and high humidity, down-hole environments.

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## Benefits

- Operating temperature range of -55°C to +175°C
- Voltage derating not required
- Lead (Pb)-Free, RoHS and REACH compliant
- Base metal electrode (BME) dielectric system
- EIA 0402, 0603, 0805, 1206, 1210 and 1812 case sizes
- DC voltage ratings of 16 V, 25 V, 50 V & 200 V
- Capacitance offerings ranging from 2.7 nF to 3.3 µF
- Available capacitance tolerances of ±5%, ±10% & ±20%
- Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- Flexible termination option available upon request

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## Applications

Typical applications include decoupling, bypass, filtering and transient voltage suppression in extreme environments such as down-hole exploration, aerospace engine compartments and geophysical probes.

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## Application Notes

X7R dielectric is not recommended for AC line filtering or pulse applications.

Voltage derating of these capacitors is not required for application temperatures up to 175°C.

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## Qualification/Certification

High temperature Industrial grade products meet or exceed the requirements outlined Table 4, Performance & Reliability. Qualification packages are available upon request.

## Environmental Compliance

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

## Electrical Parameters/Characteristics

| Item   | Parameters/Characteristics  |
|--|---|
| Operating Temperature Range  | -55°C to +175°C   |
| Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC) | ±15% (-55°C to +125°C) beyond 125°C see "Capacitance vs. Temperature Performance" plot - Reference Only |
| 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 at 25°C                      | See Dissipation Factor Limit Table  |
| Insulation Resistance (IR) Limit at 25°C                           | 1,000 megohm microfarads or 100 GΩ<br>(Rated voltage applied for 120 ± 5 secs at 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

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."

## Dissipation Factor Limit Table

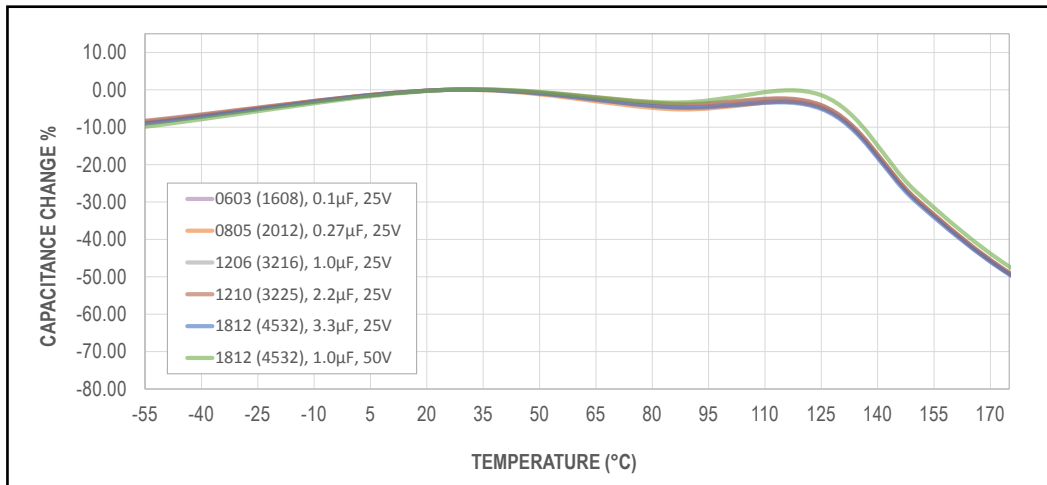
| Rated DC Voltage | Dissipation Factor |
|------------------|--------------------|
| 16/25            | 3.5%               |
| >25              | 2.5%               |

## Post Environmental Limits

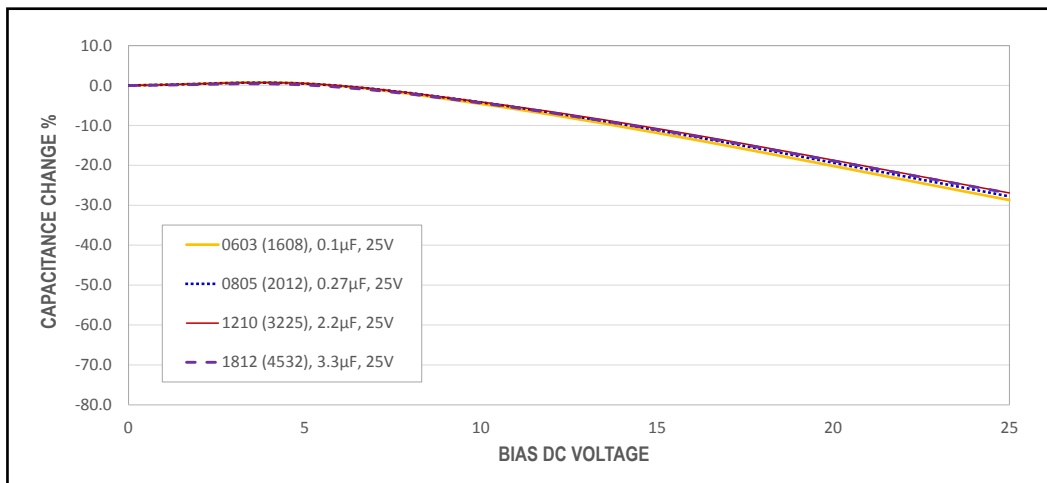
| High Temperature Life, Biased Humidity, Moisture Resistance |                  |                   |                                |                   |                       |
|---|------------------|-------------------|--------------------------------|-------------------|-----------------------|
| Dielectric  | Rated DC Voltage | Capacitance Value | Dissipation Factor (Maximum %) | Capacitance Shift | Insulation Resistance |
| X7R   | 16/25            | All               | 5.0                            | ± 20%             | 10% of Initial Limit  |
|   | >25              |                   | 3.0                            |                   |                       |

## Electrical Characteristics

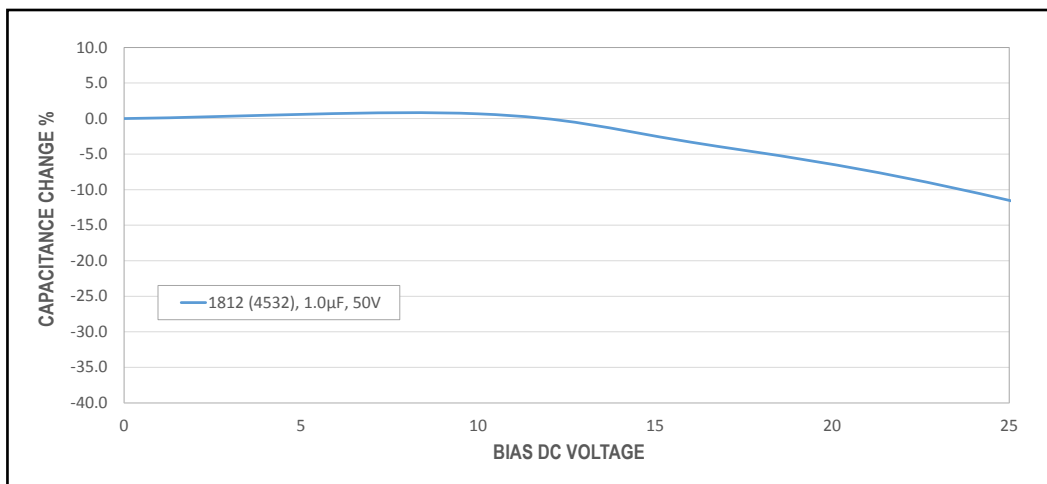
### Capacitance vs. Temperature Performance (-55°C to +175°C)



### Capacitance vs. Bias Voltage Performance (25 VDC Rated)



### Capacitance vs. Bias Voltage Performance (1812 Case Size, 1.0 µF, 50 VDC Rated)



**Table 1 – Capacitance Range/Selection Waterfall (0402 – 1812 Case Sizes)**

| Capacitance | Cap Code | Case Size/<br>Series  |   |   | C0402G   |    |    |     | C0603G/R |    |     | C0805G/R |    |     | C1206G/R |    |     | C1210G/R |    |     | C1812G/R |    |     |     |
|-------------|----------|-----------------------|---|---|--|----|----|-----|----------|----|-----|----------|----|-----|----------|----|-----|----------|----|-----|----------|----|-----|-----|
|             |          | Voltage Code          |   |   | 4  | 3  | 5  | 1   | 3        | 5  | 1   | 3        | 5  | 1   | 3        | 5  | 1   | 3        | 5  | 1   | 3        | 5  | 1   | 2   |
|             |          | Rated Voltage (VDC)   |   |   | 16   | 25 | 50 | 100 | 25       | 50 | 100 | 25       | 50 | 100 | 25       | 50 | 100 | 25       | 50 | 100 | 25       | 50 | 100 | 200 |
|             |          | Capacitance Tolerance |   |   | Product Availability and Chip Thickness Codes<br>See Table 2 for Chip Thickness Dimensions |    |    |     |          |    |     |          |    |     |          |    |     |          |    |     |          |    |     |     |
| 2700 pF     | 272      | J                     | K | M | BB   | BB | BB |     |          |    |     |          |    |     |          |    |     |          |    |     |          |    |     |     |
| 3300 pF     | 332      | J                     | K | M | BB   | BB | BB |     |          |    |     |          |    |     |          |    |     |          |    |     |          |    |     |     |
| 3900 pF     | 392      | J                     | K | M | BB   | BB | BB |     |          |    |     |          |    |     |          |    |     |          |    |     |          |    |     |     |
| 4700 pF     | 472      | J                     | K | M | BB   | BB | BB |     |          |    |     |          |    |     |          |    |     |          |    |     |          |    |     |     |
| 5600 pF     | 562      | J                     | K | M | BB   | BB | BB |     |          |    |     |          |    |     |          |    |     |          |    |     |          |    |     |     |
| 6800 pF     | 682      | J                     | K | M | BB   | BB | BB |     |          |    |     |          |    |     |          |    |     |          |    |     |          |    |     |     |
| 8200 pF     | 822      | J                     | K | M | BB   | BB | BB |     |          |    |     |          |    |     |          |    |     |          |    |     |          |    |     |     |
| 10000 pF    | 103      | J                     | K | M | BB   | BB | BB |     |          |    |     |          |    |     |          |    |     |          |    |     |          |    |     |     |
| 12000 pF    | 123      | J                     | K | M | BB   | BB |    |     |          |    |     |          |    |     |          |    |     |          |    |     |          |    |     |     |
| 15000 pF    | 153      | J                     | K | M | BB   | BB |    |     |          |    |     |          |    |     |          |    |     |          |    |     |          |    |     |     |
| 18000 pF    | 183      | J                     | K | M | BB   | BB |    | CF  | CF       |    |     |          |    |     |          |    |     |          |    |     |          |    |     |     |
| 22000 pF    | 223      | J                     | K | M | BB   | BB |    | CF  | CF       |    |     |          |    |     |          |    |     |          |    |     |          |    |     |     |
| 27000 pF    | 273      | J                     | K | M |  |    |    | CF  | CF       |    |     |          |    |     |          |    |     |          |    |     |          |    |     |     |
| 33000 pF    | 333      | J                     | K | M |  |    |    | CF  | CF       |    |     |          |    |     |          |    |     |          |    |     |          |    |     |     |
| 39000 pF    | 393      | J                     | K | M |  |    |    | CF  | CF       |    |     |          |    |     |          |    |     |          |    |     |          |    |     |     |
| 47000 pF    | 473      | J                     | K | M | BB   |    |    | CF  | CF       | DN | DN  |          |    |     |          |    |     |          |    | GN  | GN       | GN | GN  |     |
| 56000 pF    | 563      | J                     | K | M |  |    |    | CF  | CF       | DN | DN  |          |    |     |          |    |     |          |    |     |          |    |     |     |
| 68000 pF    | 683      | J                     | K | M |  |    |    | CF  | CF       | DN | DN  |          |    |     |          |    |     |          |    |     |          |    |     |     |
| 82000 pF    | 823      | J                     | K | M |  |    |    | CF  | CF       | DN | DN  |          |    |     |          |    |     |          |    |     |          |    |     |     |
| 0.1 µF      | 104      | J                     | K | M |  |    |    | CF  | CF       | DN | DN  | ED       | ED |     |          |    |     |          |    | GM  | GM       | GM | GM  |     |
| 0.12 µF     | 124      | J                     | K | M |  |    |    | CF  |          | DP | DP  | ED       | ED |     |          |    |     |          |    |     |          |    |     |     |
| 0.15 µF     | 154      | J                     | K | M |  |    |    | CF  |          | DP | DP  | ED       | ED |     |          |    |     |          |    |     |          |    |     |     |
| 0.18 µF     | 184      | J                     | K | M |  |    |    |     |          | DF | DF  | ED       | ED | FE  | FE       |    |     |          |    | GB  | GB       |    |     |     |
| 0.22 µF     | 224      | J                     | K | M |  |    |    |     |          | DG | DG  | EP       | EP | FE  | FE       |    |     |          |    | GB  | GB       |    |     |     |
| 0.27 µF     | 274      | J                     | K | M |  |    |    |     |          | DG | DG  | EP       | EP | FF  | FF       |    |     |          |    | GB  | GB       |    |     |     |
| 0.33 µF     | 334      | J                     | K | M |  |    |    |     |          | DP |     | EJ       | EJ | FF  | FF       |    |     |          |    | GB  | GB       |    |     |     |
| 0.39 µF     | 394      | J                     | K | M |  |    |    |     |          | DP |     | EJ       | EJ | FG  | FG       |    |     |          |    | GB  | GB       |    |     |     |
| 0.47 µF     | 474      | J                     | K | M |  |    |    |     |          | DG |     | EJ       | EJ | FG  | FG       |    |     |          |    | GB  | GB       |    |     |     |
| 0.56 µF     | 564      | J                     | K | M |  |    |    |     |          | DG |     | EP       |    | FH  | FH       |    |     |          |    | GB  | GB       |    |     |     |
| 0.68 µF     | 684      | J                     | K | M |  |    |    |     |          | DG |     | EJ       |    | FM  | FM       |    |     |          |    | GC  | GC       |    |     |     |
| 0.82 µF     | 824      | J                     | K | M |  |    |    |     |          |    |     | EJ       |    | FK  | FK       |    |     |          |    | GE  | GE       |    |     |     |
| 1 µF        | 105      | J                     | K | M |  |    |    |     |          |    |     | EJ       |    | FK  | FK       |    |     |          |    | GG  | GG       |    |     |     |
| 1.2 µF      | 125      | J                     | K | M |  |    |    |     |          |    |     |          |    | FH  |          |    |     |          |    | GJ  | GJ       |    |     |     |
| 1.5 µF      | 155      | J                     | K | M |  |    |    |     |          |    |     |          |    | FM  |          |    |     |          |    | GL  | GL       |    |     |     |
| 1.8 µF      | 185      | J                     | K | M |  |    |    |     |          |    |     |          |    | FK  |          |    |     |          |    | GE  |          |    |     |     |
| 2.2 µF      | 225      | J                     | K | M |  |    |    |     |          |    |     |          |    |     |          |    |     |          |    | GG  |          |    |     |     |
| 2.7 µF      | 275      | J                     | K | M |  |    |    |     |          |    |     |          |    |     |          |    |     |          |    | GJ  |          |    |     |     |
| 3.3 µF      | 335      | J                     | K | M |  |    |    |     |          |    |     |          |    |     |          |    |     |          |    | GL  |          |    |     |     |
| Capacitance | Cap Code | Rated Voltage (VDC)   |   |   | 16   | 25 | 50 | 100 | 25       | 50 | 100 | 25       | 50 | 100 | 25       | 50 | 100 | 25       | 50 | 100 | 25       | 50 | 100 | 200 |
|             |          | Voltage Code          |   |   | 4  | 3  | 5  | 1   | 3        | 5  | 1   | 3        | 5  | 1   | 3        | 5  | 1   | 3        | 5  | 1   | 3        | 5  | 1   | 2   |
|             |          | Case Size/<br>Series  |   |   | C0402G   |    |    |     | C0603G/R |    |     | C0805G/R |    |     | C1206G/R |    |     | C1210G/R |    |     | C1812G/R |    |     |     |

**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 |
| BB             | 0402      | 0.50 ± 0.05            | 10,000         | 50,000   | 0                | 0        |
| CF             | 0603      | 0.80 ± 0.07            | 4,000          | 15,000   | 0                | 0        |
| DN             | 0805      | 0.78 ± 0.10            | 4,000          | 15,000   | 0                | 0        |
| DP             | 0805      | 0.90 ± 0.10            | 4,000          | 15,000   | 0                | 0        |
| DF             | 0805      | 1.10 ± 0.10            | 0              | 0        | 2,500            | 10,000   |
| DG             | 0805      | 1.25 ± 0.15            | 0              | 0        | 2,500            | 10,000   |
| ED             | 1206      | 1.00 ± 0.10            | 0              | 0        | 2,500            | 10,000   |
| EP             | 1206      | 1.20 ± 0.20            | 0              | 0        | 2,500            | 10,000   |
| EJ             | 1206      | 1.70 ± 0.20            | 0              | 0        | 2,000            | 8,000    |
| FE             | 1210      | 1.00 ± 0.10            | 0              | 0        | 2,500            | 10,000   |
| FF             | 1210      | 1.10 ± 0.10            | 0              | 0        | 2,500            | 10,000   |
| FG             | 1210      | 1.25 ± 0.15            | 0              | 0        | 2,500            | 10,000   |
| FH             | 1210      | 1.55 ± 0.15            | 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    |
| GB             | 1812      | 1.00 ± 0.10            | 0              | 0        | 1,000            | 4,000    |
| GC             | 1812      | 1.10 ± 0.10            | 0              | 0        | 1,000            | 4,000    |
| GE             | 1812      | 1.30 ± 0.10            | 0              | 0        | 1,000            | 4,000    |
| GG             | 1812      | 1.55 ± 0.10            | 0              | 0        | 1,000            | 4,000    |
| GJ             | 1812      | 1.70 ± 0.15            | 0              | 0        | 1,000            | 4,000    |
| GN             | 1812      | 1.70 ± 0.20            | 0              | 0        | 1,000            | 4,000    |
| GL             | 1812      | 1.90 ± 0.20            | 0              | 0        | 500              | 2,000    |
| GM             | 1812      | 2.00 ± 0.20            | 0              | 0        | 500              | 2,000    |
| Thickness Code | Case Size | Thickness ± Range (mm) | 7" Reel        | 13" Reel | 7" Reel          | 13" Reel |
|                |           |                        | Paper Quantity |          | Plastic Quantity |          |

Package quantity based on finished chip thickness specifications.

**Table 3A – Land Pattern Design Recommendations per IPC–7351 – Standard Termination**

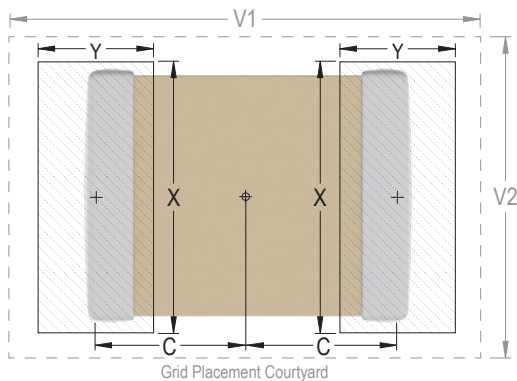
| EIA Size Code | Metric Size Code | Density Level A: Maximum (Most) Land Protrusion (mm) |      |      |      |      | Density Level B: Median (Nominal) Land Protrusion (mm) |      |      |      |      | Density Level C: Minimum (Least) Land Protrusion (mm) |      |      |      |      |
|---------------|------------------|--|------|------|------|------|--|------|------|------|------|---|------|------|------|------|
|               |                  | C  | Y    | X    | V1   | V2   | C  | Y    | X    | V1   | V2   | C   | Y    | X    | V1   | V2   |
| 0402          | 1005             | 0.50   | 0.72 | 0.72 | 2.20 | 1.20 | 0.45   | 0.62 | 0.62 | 1.90 | 1.00 | 0.40  | 0.52 | 0.52 | 1.60 | 0.80 |
| 0603          | 1608             | 0.90   | 1.15 | 1.10 | 4.00 | 2.10 | 0.80   | 0.95 | 1.00 | 3.10 | 1.50 | 0.60  | 0.75 | 0.90 | 2.40 | 1.20 |
| 0805          | 2012             | 1.00   | 1.35 | 1.55 | 4.40 | 2.60 | 0.90   | 1.15 | 1.45 | 3.50 | 2.00 | 0.75  | 0.95 | 1.35 | 2.80 | 1.70 |
| 1206          | 3216             | 1.60   | 1.35 | 1.90 | 5.60 | 2.90 | 1.50   | 1.15 | 1.80 | 4.70 | 2.30 | 1.40  | 0.95 | 1.70 | 4.00 | 2.00 |
| 1210          | 3225             | 1.60   | 1.35 | 2.80 | 5.65 | 3.80 | 1.50   | 1.15 | 2.70 | 4.70 | 3.20 | 1.40  | 0.95 | 2.60 | 4.00 | 2.90 |
| 1812          | 4532             | 2.15   | 1.60 | 3.60 | 6.90 | 4.60 | 2.05   | 1.40 | 3.50 | 6.00 | 4.00 | 1.95  | 1.20 | 3.40 | 5.30 | 3.70 |

**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.





**Table 3B – Land Pattern Design Recommendations per IPC–7351 – Flexible Termination**

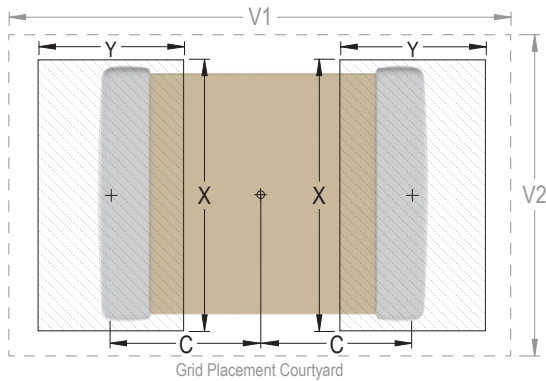
| EIA Size Code | Metric Size Code | Density Level A: Maximum (Most) Land Protrusion (mm) |      |      |      |      | Density Level B: Median (Nominal) Land Protrusion (mm) |      |      |      |      | Density Level C: Minimum (Least) Land Protrusion (mm) |      |      |      |      |
|---------------|------------------|--|------|------|------|------|--|------|------|------|------|---|------|------|------|------|
|               |                  | 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             | 1.00   | 1.35 | 1.55 | 4.40 | 2.60 | 0.90   | 1.15 | 1.45 | 3.50 | 2.00 | 0.75  | 0.95 | 1.35 | 2.80 | 1.70 |
| 1206          | 3216             | 1.60   | 1.65 | 1.90 | 5.90 | 2.90 | 1.50   | 1.45 | 1.80 | 5.00 | 2.30 | 1.40  | 1.25 | 1.70 | 4.30 | 2.00 |
| 1210          | 3225             | 1.60   | 1.65 | 2.80 | 5.90 | 3.80 | 1.50   | 1.45 | 2.70 | 5.00 | 3.20 | 1.40  | 1.25 | 2.60 | 4.30 | 2.90 |
| 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 |

**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

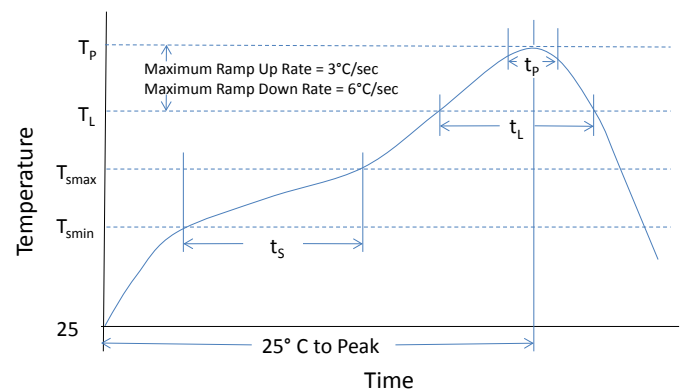
### Recommended Soldering Technique:

- 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 |
|---|--------------------|
|   | 100% Matte Sn      |
| <b>Preheat/Soak</b>                                   |                    |
| Temperature Minimum ( $T_{Smin}$ )                    | 150°C              |
| Temperature Maximum ( $T_{Smax}$ )                    | 200°C              |
| Time ( $t_s$ ) from $T_{Smin}$ to $T_{Smax}$          | 60 – 120 seconds   |
| Ramp-Up Rate ( $T_L$ to $T_p$ )                       | 3°C/second maximum |
| Liquidous Temperature ( $T_L$ )                       | 217°C              |
| Time Above Liquidous ( $t_L$ )                        | 60 – 150 seconds   |
| Peak Temperature ( $T_p$ )                            | 260°C              |
| Time Within 5°C of Maximum Peak Temperature ( $t_p$ ) | 30 seconds maximum |
| Ramp-Down Rate ( $T_p$ to $T_L$ )                     | 6°C/second maximum |
| Time 25°C to Peak Temperature                         | 8 minutes maximum  |



Note 1: All temperatures refer to the center of the package, measured on the capacitor body surface that is facing up during assembly reflow.

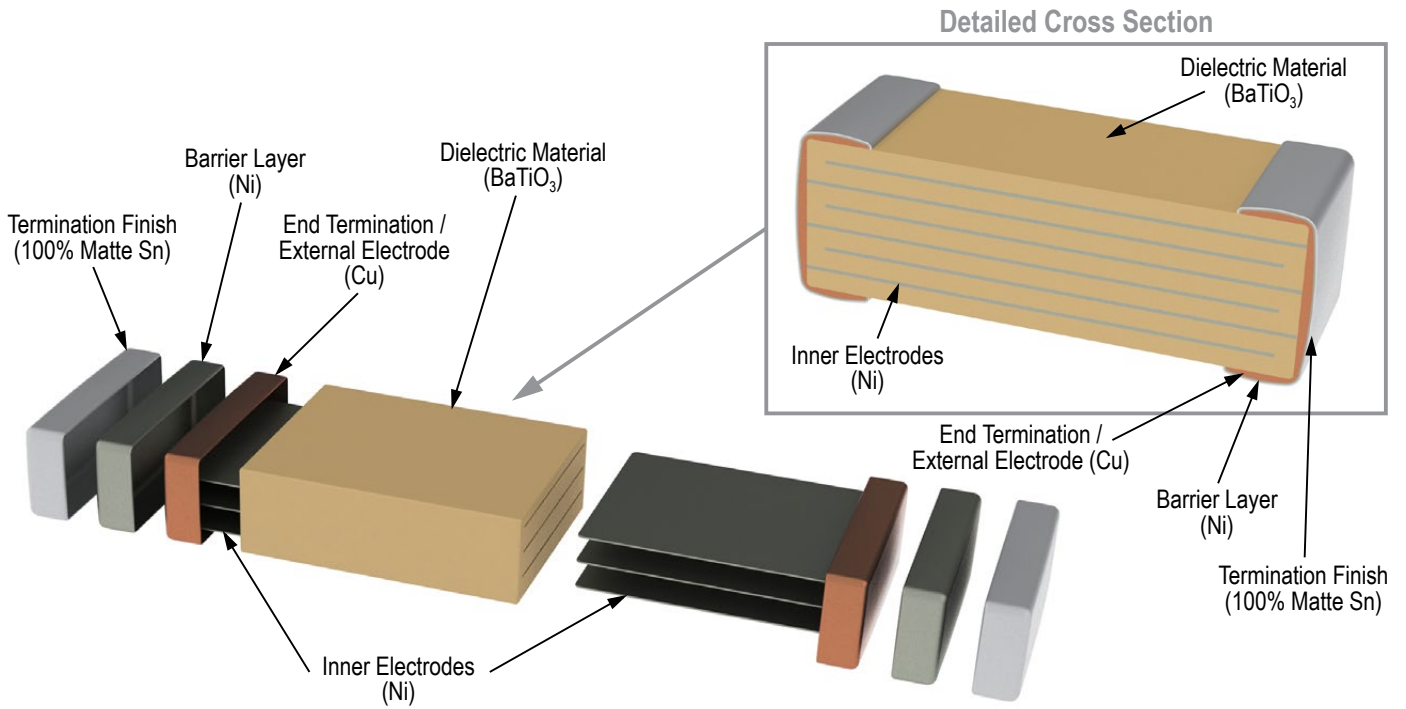
**Table 4 – Performance & Reliability: Test Methods and Conditions**

| Stress                 | Reference                       | Test or Inspection Method   |                        |            |          |      |               |            |      |                |        |                |
|------------------------|---------------------------------|---|------------------------|------------|----------|------|---------------|------------|------|----------------|--------|----------------|
| Terminal Strength      | JIS-C-6429                      | Appendix 1, Note:   |                        |            |          |      |               |            |      |                |        |                |
|                        |                                 | <table border="1"> <thead> <tr> <th>Package Size (L" x W")</th> <th>Force</th> <th>Duration</th> </tr> </thead> <tbody> <tr> <td>0402</td> <td>5 N (0.51 kg)</td> <td rowspan="3">60 seconds</td> </tr> <tr> <td>0603</td> <td>10 N (1.02 kg)</td> </tr> <tr> <td>≥ 0805</td> <td>18 N (1.83 kg)</td> </tr> </tbody> </table> | Package Size (L" x W") | Force      | Duration | 0402 | 5 N (0.51 kg) | 60 seconds | 0603 | 10 N (1.02 kg) | ≥ 0805 | 18 N (1.83 kg) |
|                        |                                 | Package Size (L" x W")  | Force                  | Duration   |          |      |               |            |      |                |        |                |
|                        |                                 | 0402  | 5 N (0.51 kg)          | 60 seconds |          |      |               |            |      |                |        |                |
| 0603                   | 10 N (1.02 kg)                  |   |                        |            |          |      |               |            |      |                |        |                |
| ≥ 0805                 | 18 N (1.83 kg)                  |   |                        |            |          |      |               |            |      |                |        |                |
|                        |                                 |   |                        |            |          |      |               |            |      |                |        |                |
|                        |                                 |   |                        |            |          |      |               |            |      |                |        |                |
| 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 at 155°C, dry heat at 235°C  |                        |            |          |      |               |            |      |                |        |                |
|                        |                                 | b) Method B at 215°C category 3   |                        |            |          |      |               |            |      |                |        |                |
|                        |                                 | c) Method D, category 3 at 260°C  |                        |            |          |      |               |            |      |                |        |                |
| Temperature Cycling    | KEMET defined                   | 50 cycles (-55°C to +220°C). Measurement at 24 hours +/- 4 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.   |                        |            |          |      |               |            |      |                |        |                |
| High Temperature Life  | MIL-STD-202 Method 108 /EIA-198 | 1,000 hours at 175°C with 2 X rated voltage applied.  |                        |            |          |      |               |            |      |                |        |                |
| Storage Life           | KEMET defined                   | 200°C, 0 VDC for 1,000 hours.   |                        |            |          |      |               |            |      |                |        |                |
| Vibration              | MIL-STD-202 Method 204          | 5 g's for 20 minutes, 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.  |                        |            |          |      |               |            |      |                |        |                |

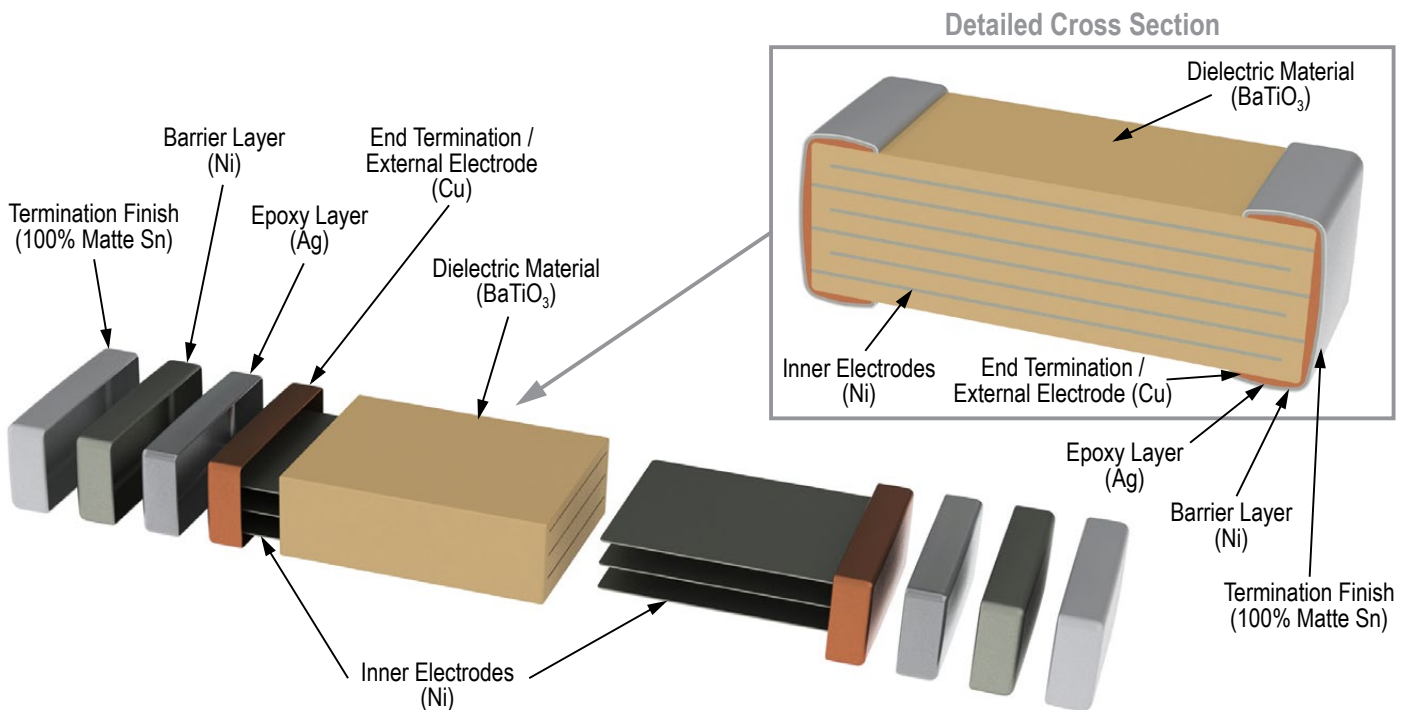
## Storage and Handling

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 – Standard Termination



## Construction – Flexible Termination



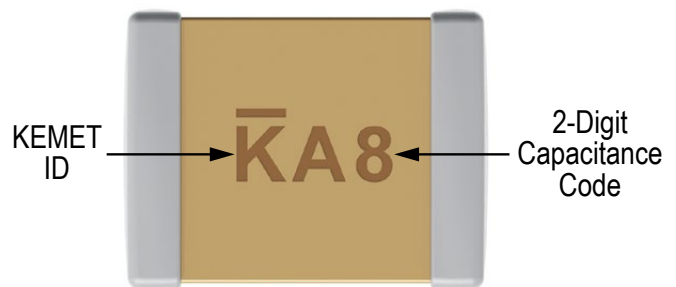
## Capacitor Marking (Optional):

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:

- COG, 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  $\mu\text{F}$ . Orientation of marking is vendor optional.



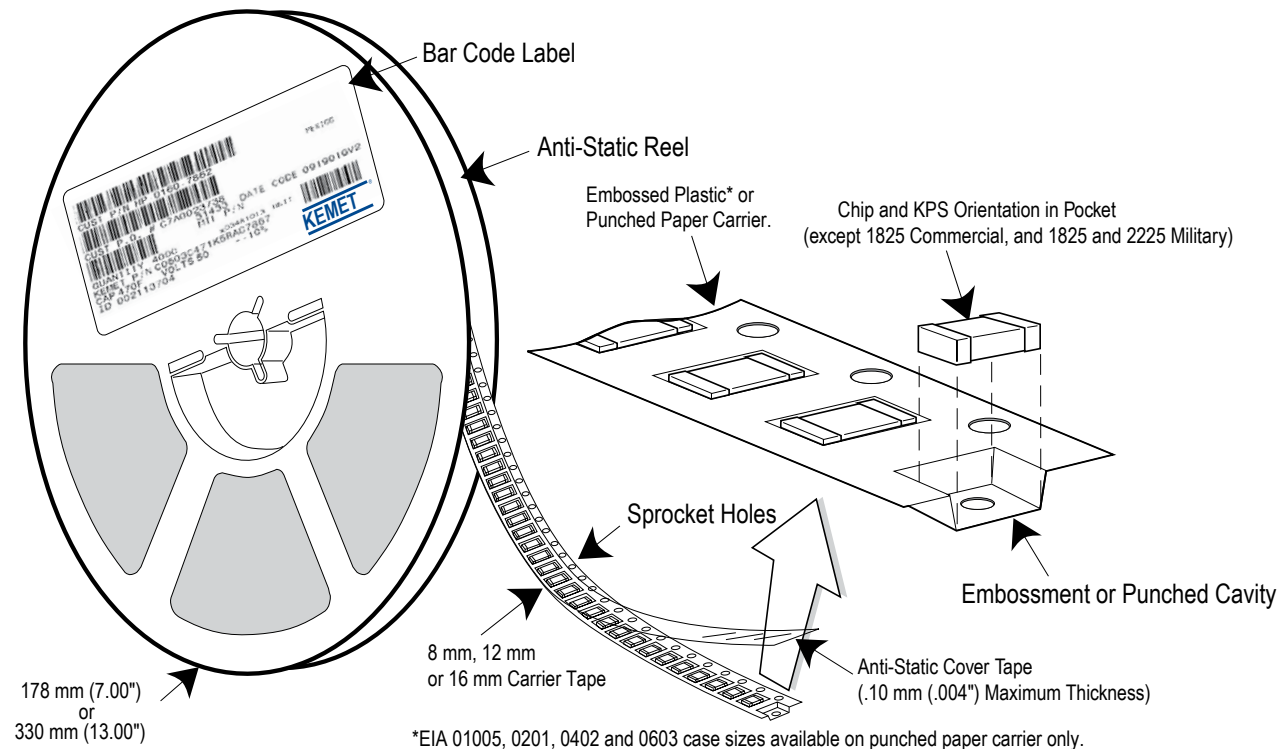
| EIA Case Size | Metric Size Code | Capacitance                      |
|---------------|------------------|----------------------------------|
| 0603          | 1608             | $\leq 170 \text{ pF}$            |
| 0805          | 2012             | $\leq 150 \text{ pF}$            |
| 1206      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

## Capacitor Marking (Optional) cont'd

| 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.



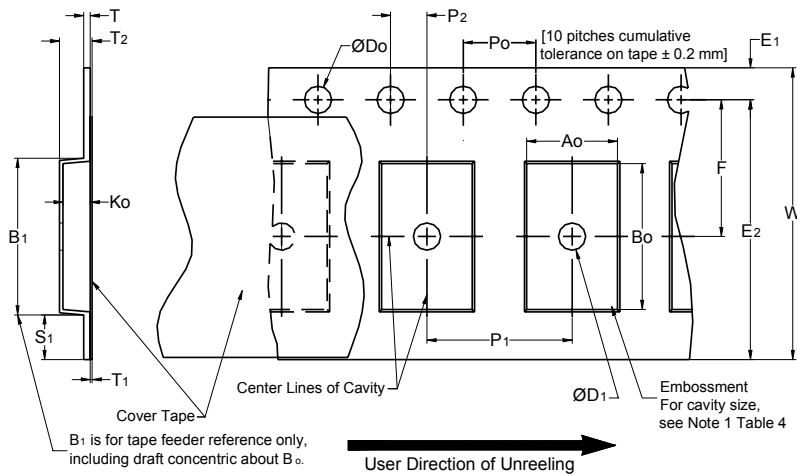
**Table 5 – Carrier Tape Configuration, Embossed Plastic & Punched Paper (mm)**

| EIA Case Size     | Tape size (W)* | 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              |                          |          | 4                        | 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 & 2220   | 16             | 12                       | 12       |                          |          |
| Array 0508 & 0612 | 8              | 4                        | 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**

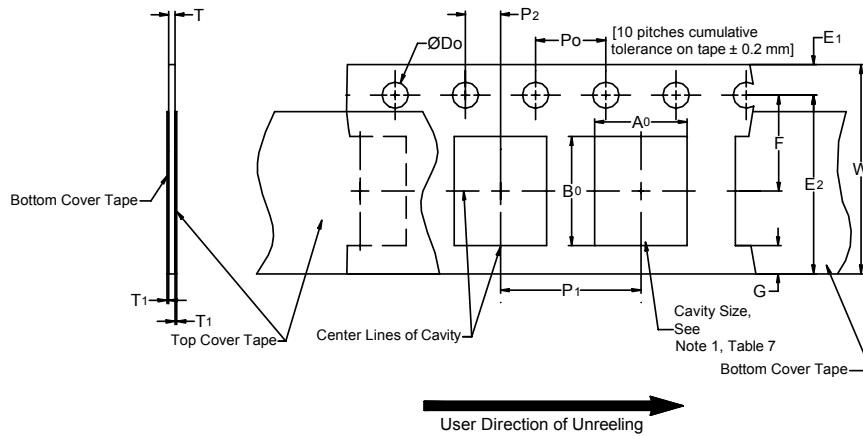
Metric will govern

| 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)                  |  |                           |

- 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 Series 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 7 – Punched (Paper) Carrier Tape Dimensions**

Metric will govern

| Constant Dimensions — Millimeters (Inches) |                                       |                              |                             |                             |                         |                 |                               |
|--|---------------------------------------|------------------------------|-----------------------------|-----------------------------|-------------------------|-----------------|-------------------------------|
| Tape Size                                  | D <sub>0</sub>                        | E <sub>1</sub>               | P <sub>0</sub>              | P <sub>2</sub>              | T <sub>1</sub> Maximum  | G Minimum       | R Reference Note 2            |
| 8 mm                                       | 1.5 +0.10 -0.0<br>(0.059 +0.004 -0.0) | 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) | 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 <sub>1</sub>              | T Maximum               | W Maximum       | A <sub>0</sub> B <sub>0</sub> |
| 8 mm                                       | Half (2 mm)                           | 6.25<br>(0.246)              | 3.5 ±0.05<br>(0.138 ±0.002) | 2.0 ±0.05<br>(0.079 ±0.002) | 1.1<br>(0.098)          | 8.3<br>(0.327)  | Note 1                        |
| 8 mm                                       | Single (4 mm)                         |                              |                             | 4.0 ±0.10<br>(0.157 ±0.004) |                         | 8.3<br>(0.327)  |                               |

- The cavity defined by A<sub>0</sub>, B<sub>0</sub> 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

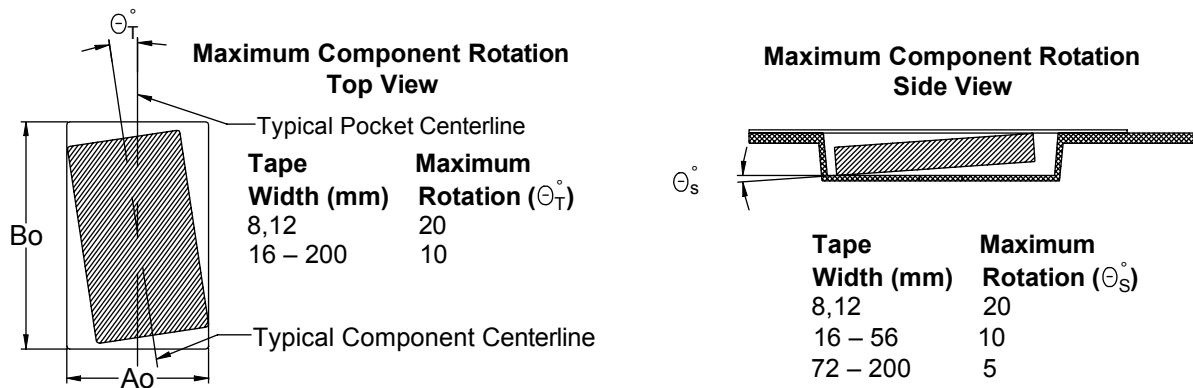
- 1. Cover Tape Break Force:** 1.0 Kg minimum.
- 2. Cover Tape Peel Strength:** The total peel strength of the cover tape from the carrier tape shall be:

| 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) |

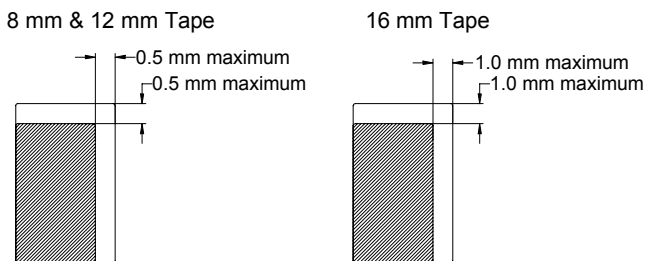
The direction of the pull shall be opposite the direction of the carrier tape travel. The pull angle of the carrier tape shall be 165° to 180° from the plane of the carrier tape. During peeling, the carrier and/or cover tape shall be pulled at a velocity of 300 ±10 mm/minute.

- 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.

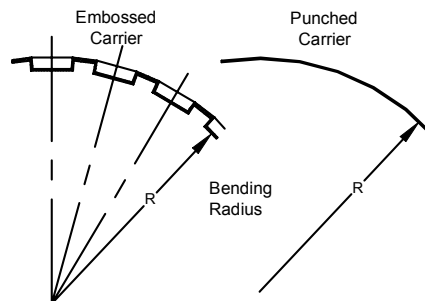
### Figure 3 – Maximum Component Rotation



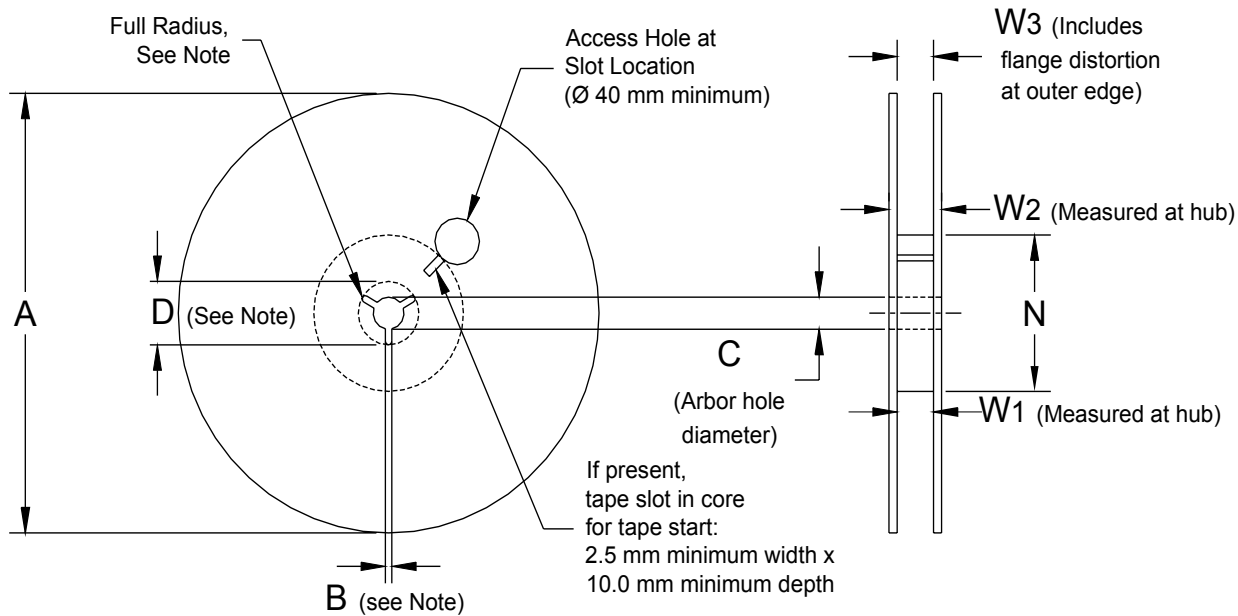
### Figure 4 – Maximum Lateral Movement



### Figure 5 – Bending Radius



## Figure 6 – Reel Dimensions



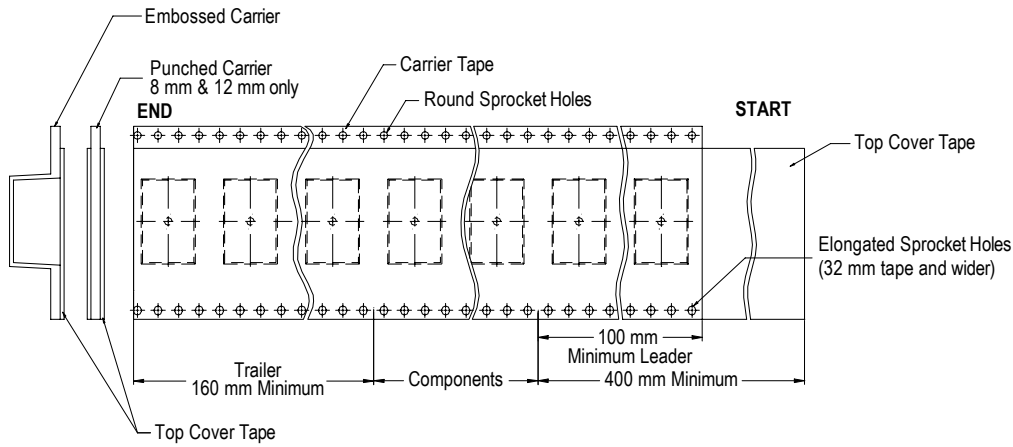
Note: Drive spokes optional; if used, dimensions B and D shall apply.

### Table 8 – Reel Dimensions

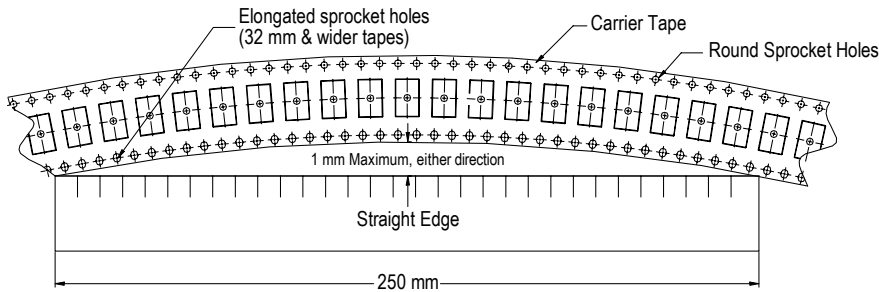
Metric will govern

| 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 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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