

Surface Mount Multilayer Ceramic Chip Capacitors (SMD MLCCs)  
**250 VAC AC Rated Capacitors, CAN series**  
**(Industrial Grade)**

## Overview

KEMET's CAN series are AC rated ceramic capacitors designed for 250 VAC applications where higher CV values are required but not available in safety certified MLCCs. These capacitors are qualified for continuous use under AC line conditions of 250 VAC 50/60 Hz. Available in a variety of case sizes and industry leading CV values (capacitance/voltage), these devices exhibit low leakage current and low ESR at high frequencies.

For added reliability, KEMET's flexible termination technology is an available option that provides superior flex performance over standard termination systems. This series is available in X7R and C0G dielectrics. 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. C0G exhibits no change in capacitance with respect to time and voltage and boasts a negligible change in capacitance with reference to ambient temperature. CAN series is specifically designed and tested for 50/60 Hz line frequencies and other non-safety critical applications.

## Benefits

- Continuous AC voltage rating 250 VAC, 50/60 Hz
- Offers more than 50x capacitance versus Safety Rated MLCCs
- Base metal electrode (BME) dielectric system
- -55°C to +125°C operating temperature range
- Low ESR and ESL
- Lead (Pb)-free, RoHS, and REACH Compliant
- Temperature stable dielectric
- Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- Flexible termination option available upon request



## Applications

- AC-DC converters
- AC filtering
- Power factor correction
- Power supply

## Ordering Information

| CAN                          | 08  | C                        | 103                                    | K   | A                       | R                  | A                    | C                  | TU  |
|------------------------------|---|--------------------------|--|---|-------------------------|--------------------|----------------------|--------------------|---|
| Series                       | Case Size (L"x W")  | Specification/ Series    | Capacitance Code (pF)                  | Capacitance Tolerance   | Rated Voltage (V)       | Dielectric         | Subclass Designation | Termination Finish | Packaging (Suffix/C-Spec)                     |
| CAN = Ceramic AC Rated MLCCs | 06 = 0603<br>08 = 0805<br>12 = 1206<br>13 = 1210<br>17 = 1808<br>18 = 1812<br>19 = 1825<br>21 = 2220<br>22 = 2225 | C = Standard<br>X = Flex | Two single digits and number of zeros. | F = $\pm 1\%$<br>G = $\pm 2\%$<br>J = $\pm 5\%$<br>K = $\pm 10\%$<br>M = $\pm 20\%$ | A = 250 VAC<br>50/60 Hz | R = X7R<br>G = COG | A = N/A              | C = 100% matte Sn  | See "Packaging C-Spec Ordering Options Table" |

See Table 1 for available capacitance and voltage ratings.

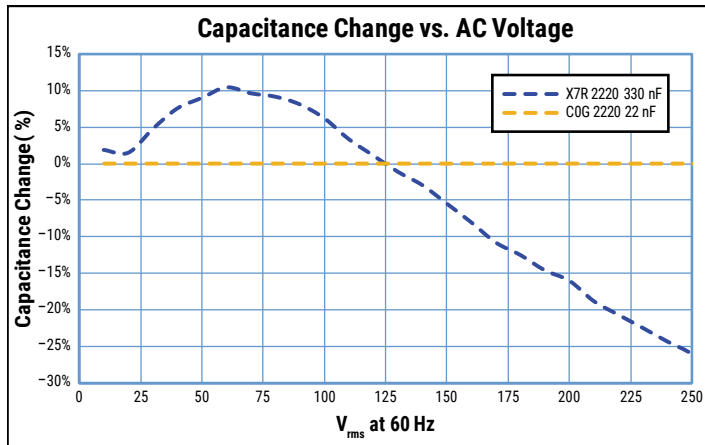
## Packaging C-Spec Ordering Options Table

| Packaging Type                | Packaging/Grade Ordering Code (C-Spec)                             |
|-------------------------------|--|
| Bulk Bag <sup>1</sup>         | Not Required (Blank)   |
| 7" Reel/Unmarked <sup>2</sup> | TU   |
| 13" Reel/Unmarked             | 7411 (EIA 0603 case size)<br>7210 (EIA 0805 and larger case sizes) |
| 7" Reel/Marked <sup>2</sup>   | TM   |
| 13" Reel/Marked               | 7215   |

<sup>1</sup> Default packaging is "Bulk Bag." An ordering code C-Spec is not required for "Bulk Bag" packaging.

<sup>2</sup> The terms "Marked" and "Unmarked" pertain to laser marking option of capacitors. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked.

## Typical Performance



## Electrical Parameters/Performance Characteristics

| Item  | Dielectric | Parameters/Characteristics |
|---|------------|----------------------------|
| Operating temperature range   | X7R        | -55°C to +125°C            |
|   | C0G        | -55°C to +125°C            |
| Capacitance change with reference to +25°C and 0 VDC applied (TCC)  | X7R        | ±15%                       |
|   | C0G        | ±30 ppm/°C                 |
| <sup>1</sup> Aging rate (maximum % capacitance loss/decade hour)  | X7R        | 3.0%                       |
|   | C0G        | 0%                         |
| <sup>2</sup> Dielectric withstanding voltage (DWV)<br>5 ±1 seconds and charge/discharge not exceeding 50 mA | X7R        | 945 VDC                    |
|   | C0G        | 819 VDC                    |
| <sup>3</sup> Dissipation factor (DF) maximum limit at 25°C  | X7R        | 2.5%                       |
|   | C0G        | 0.1%                       |
| <sup>4</sup> Insulation resistance (IR) minimum limit at 25°C<br>500 VDC applied for 120 ±5 seconds         | X7R        | 100 MΩ-μF or 10 GΩ         |
|   | C0G        | 1,000 MΩ-μF or 100 GΩ      |

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

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

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

1 kHz ±50 Hz and 1.0 ±0.2 V<sub>rms</sub> if capacitance ≤ 10 μF

120 Hz ±10 Hz and 0.5 ±0.1 V<sub>rms</sub> if capacitance > 10 μF

<sup>4</sup> To obtain IR limit, divide MΩ-μF value by the capacitance and compare to GΩ limit. Select the lower of the two limits.

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

## Dimensions – Millimeters (Inches)



### Standard Termination

| Case Size | EIA Size Code | Metric Size Code | L Length                      | W Width                       | T Thickness               | B Bandwidth                   | S Separation Minimum | Mounting Technique           |
|-----------|---------------|------------------|-------------------------------|-------------------------------|---------------------------|-------------------------------|----------------------|------------------------------|
| 06        | 0603          | 1608             | 1.60 (0.063)<br>±0.15 (0.006) | 0.80 (0.032)<br>±0.15 (0.006) | See Table 2 for Thickness | 0.35 (0.014)<br>±0.15 (0.006) | 0.70 (0.028)         | Solder Wave or Solder Reflow |
| 08        | 0805          | 2012             | 2.00 (0.079)<br>±0.20 (0.008) | 1.25 (0.049)<br>±0.20 (0.008) |                           | 0.50 (0.02)<br>±0.25 (0.010)  | 0.75 (0.030)         |                              |
| 12        | 1206          | 3216             | 3.20 (0.126)<br>±0.20 (0.008) | 1.60 (0.063)<br>±0.20 (0.008) |                           |                               | N/A                  |                              |
| 13        | 1210          | 3225             | 3.20 (0.126)<br>±0.20 (0.008) | 2.50 (0.098)<br>±0.20 (0.008) |                           |                               |                      |                              |
| 17        | 1808          | 4520             | 4.70 (0.185)<br>±0.50 (0.020) | 2.00 (0.079)<br>±0.20 (0.008) |                           |                               |                      |                              |
| 18        | 1812          | 4532             | 4.50 (0.177)<br>±0.30 (0.012) | 3.20 (0.126)<br>±0.30 (0.012) |                           |                               |                      |                              |
| 19        | 1825          | 4564             | 4.50 (0.177)<br>±0.30 (0.012) | 6.40 (0.252)<br>±0.40 (0.016) |                           |                               |                      |                              |
| 21        | 2220          | 5650             | 5.70 (0.224)<br>±0.40 (0.016) | 5.00 (0.197)<br>±0.40 (0.016) |                           |                               |                      |                              |
| 22        | 2225          | 5664             | 5.60 (0.220)<br>±0.40 (0.016) | 6.40 (0.252)<br>±0.40 (0.016) |                           |                               |                      |                              |

### Flexible Termination

| Case Size | EIA Size Code | Metric Size Code | L Length                      | W Width                       | T Thickness               | B Bandwidth                   | S Separation Minimum | Mounting Technique           |
|-----------|---------------|------------------|-------------------------------|-------------------------------|---------------------------|-------------------------------|----------------------|------------------------------|
| 06        | 0603          | 1608             | 1.60 (0.063)<br>±0.15 (0.006) | 0.80 (0.032)<br>±0.15 (0.006) | See Table 2 for Thickness | 0.35 (0.014)<br>±0.15 (0.006) | 0.70 (0.028)         | Solder Wave or Solder Reflow |
| 08        | 0805          | 2012             | 2.00 (0.079)<br>±0.30 (0.012) | 1.25 (0.049)<br>±0.30 (0.012) |                           | 0.50 (0.02)<br>±0.25 (0.010)  | 0.75 (0.030)         |                              |
| 12        | 1206          | 3216             | 3.30 (0.130)<br>±0.40 (0.016) | 1.60 (0.063)<br>±0.35 (0.013) |                           |                               | N/A                  |                              |
| 13        | 1210          | 3225             | 3.30 (0.130)<br>±0.40 (0.016) | 2.60 (0.102)<br>±0.30 (0.012) |                           |                               |                      |                              |
| 17        | 1808          | 4520             | 4.70 (0.185)<br>±0.50 (0.020) | 2.00 (0.079)<br>±0.20 (0.008) |                           |                               |                      |                              |
| 18        | 1812          | 4532             | 4.50 (0.178)<br>±0.40 (0.016) | 3.20 (0.126)<br>±0.30 (0.012) |                           |                               |                      |                              |
| 19        | 1825          | 4564             | 4.60 (0.181)<br>±0.40 (0.016) | 6.40 (0.252)<br>±0.40 (0.016) |                           |                               |                      |                              |
| 21        | 2220          | 5650             | 5.90 (0.232)<br>±0.75 (0.030) | 5.00 (0.197)<br>±0.40 (0.016) |                           |                               |                      |                              |
| 22        | 2225          | 5664             | 5.90 (0.232)<br>±0.75 (0.030) | 6.40 (0.252)<br>±0.40 (0.016) |                           |                               |                      |                              |

**Table 1A – X7R Dielectric Capacitance Range/Selection Waterfall  
Standard and Flexible Terminations**

| Cap       | Cap Code | Case Size/Series      |   |   |   |   | CAN06<br>0603                              | CAN08<br>0805 | CAN12<br>1206 | CAN13<br>1210 | CAN17<br>1808 | CAN18<br>1812 | CAN19<br>1825 | CAN21<br>2220 | CAN22<br>2225 |  |
|-----------|----------|-----------------------|---|---|---|---|--|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|--|
|           |          | Voltage Code          |   |   |   |   | A  |               |               |               |               |               |               |               |               |  |
|           |          | Rated Voltage (VAC)   |   |   |   |   | 250  |               |               |               |               |               |               |               |               |  |
|           |          | Capacitance Tolerance |   |   |   |   | See Table 2 for chip thickness dimensions. |               |               |               |               |               |               |               |               |  |
| 1,000 pF  | 102      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 1,200 pF  | 122      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 1,500 pF  | 152      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 2,200 pF  | 222      | F                     | G | J | K | M |  | DG            |               |               |               |               |               |               |               |  |
| 2,700 pF  | 272      | F                     | G | J | K | M |  | DG            |               |               |               |               |               |               |               |  |
| 3,300 pF  | 332      | F                     | G | J | K | M |  | DG            |               |               |               |               |               |               |               |  |
| 3,900 pF  | 392      | F                     | G | J | K | M |  | DG            |               |               |               |               |               |               |               |  |
| 4,700 pF  | 472      | F                     | G | J | K | M |  | DG            |               |               |               |               |               |               |               |  |
| 5,600 pF  | 562      | F                     | G | J | K | M |  | DG            |               |               |               |               |               |               |               |  |
| 6,800 pF  | 682      | F                     | G | J | K | M |  | DG            |               |               |               |               |               |               |               |  |
| 8,200 pF  | 822      | F                     | G | J | K | M |  | DG            |               |               |               |               |               |               |               |  |
| 10,000 pF | 103      | F                     | G | J | K | M |  | DG            |               |               |               |               |               |               |               |  |
| 12,000 pF | 123      | F                     | G | J | K | M |  | DG            | EJ            |               |               |               |               |               |               |  |
| 15,000 pF | 153      | F                     | G | J | K | M |  |               | EJ            |               |               |               |               |               |               |  |
| 18,000 pF | 183      | F                     | G | J | K | M |  |               | EJ            | LE            |               |               |               |               |               |  |
| 22,000 pF | 223      | F                     | G | J | K | M |  |               | EJ            | FZ            | LE            |               |               |               |               |  |
| 27,000 pF | 273      | F                     | G | J | K | M |  |               | EJ            | FZ            | LA            | GB            |               |               |               |  |
| 33,000 pF | 333      | F                     | G | J | K | M |  |               | EJ            | FZ            | LA            | GB            |               |               |               |  |
| 39,000 pF | 393      | F                     | G | J | K | M |  |               |               | FZ            | LA            | GB            |               |               |               |  |
| 47,000 pF | 473      | F                     | G | J | K | M |  |               |               | FU            | LB            | GC            |               |               |               |  |
| 56,000 pF | 563      | F                     | G | J | K | M |  |               |               | FU            | LB            | GE            |               |               |               |  |
| 62,000 pF | 623      | F                     | G | J | K | M |  |               |               | FK            | LC            | GE            |               |               |               |  |
| 68,000 pF | 683      | F                     | G | J | K | M |  |               |               | FK            | LC            | GE            |               |               |               |  |
| 82,000 pF | 823      | F                     | G | J | K | M |  |               |               | FK            | LC            | GE            |               |               |               |  |
| 0.10 µF   | 104      | F                     | G | J | K | M |  |               |               | FS            | LC            | GH            |               |               |               |  |
| 0.12 µF   | 124      | F                     | G | J | K | M |  |               |               |               |               | GK            | HE            |               |               |  |
| 0.15 µF   | 154      | F                     | G | J | K | M |  |               |               |               |               | GN            | HE            |               |               |  |
| 0.18 µF   | 184      | F                     | G | J | K | M |  |               |               |               |               |               | HG            | JE            | KE            |  |
| 0.22 µF   | 224      | F                     | G | J | K | M |  |               |               |               |               |               | HJ            | JK            | KF            |  |
| 0.27 µF   | 274      | F                     | G | J | K | M |  |               |               |               |               |               | HJ            | JL            | KH            |  |
| 0.33 µF   | 334      | F                     | G | J | K | M |  |               |               |               |               |               |               | JN            | KH            |  |
| Cap       | Cap Code | Rated Voltage (VAC)   |   |   |   |   | 250  |               |               |               |               |               |               |               |               |  |
|           |          | Voltage Code          |   |   |   |   | A  |               |               |               |               |               |               |               |               |  |
|           |          | Case Size/Series      |   |   |   |   | CAN06<br>0603                              | CAN08<br>0805 | CAN12<br>1206 | CAN13<br>1210 | CAN17<br>1808 | CAN18<br>1812 | CAN19<br>1825 | CAN21<br>2220 | CAN22<br>2225 |  |

**Table 1B – COG Dielectric Capacitance Range/Selection Waterfall  
 Standard Termination**

| Cap      | Cap Code | Case Size/Series      |   |   |   |   | CAN06<br>0603                              | CAN08<br>0805 | CAN12<br>1206 | CAN13<br>1210 | CAN17<br>1808 | CAN18<br>1812 | CAN19<br>1825 | CAN21<br>2220 | CAN22<br>2225 |  |
|----------|----------|-----------------------|---|---|---|---|--|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|--|
|          |          | Voltage Code          |   |   |   |   | A  |               |               |               |               |               |               |               |               |  |
|          |          | Rated Voltage (VAC)   |   |   |   |   | 250  |               |               |               |               |               |               |               |               |  |
|          |          | Capacitance Tolerance |   |   |   |   | See Table 2 for chip thickness dimensions. |               |               |               |               |               |               |               |               |  |
| 100 pF   | 101      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 110 pF   | 111      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 120 pF   | 121      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 130 pF   | 131      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 150 pF   | 151      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 160 pF   | 161      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 180 pF   | 181      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 200 pF   | 201      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 220 pF   | 221      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 240 pF   | 241      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 270 pF   | 271      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 300 pF   | 301      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 330 pF   | 331      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 360 pF   | 361      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 390 pF   | 391      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 430 pF   | 431      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 470 pF   | 471      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 510 pF   | 511      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 560 pF   | 561      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 620 pF   | 621      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 680 pF   | 681      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 1,000 pF | 102      | F                     | G | J | K | M |  | DN            | EF            | FM            | LB            | GB            | HE            | JK            | KE            |  |
| 1,100 pF | 112      | F                     | G | J | K | M |  | DN            | EG            | FK            | LC            | GB            | HE            | JK            | KE            |  |
| 1,200 pF | 122      | F                     | G | J | K | M |  | DN            | EG            | FK            | LC            | GB            | HE            | JK            | KE            |  |
| 1,300 pF | 132      | F                     | G | J | K | M |  | DN            | EG            | FS            | LC            | GB            | HE            | JK            | KE            |  |
| 1,500 pF | 152      | F                     | G | J | K | M |  | DP            | EG            | FS            | LC            | GB            | HE            | JK            | KE            |  |
| 1,600 pF | 162      | F                     | G | J | K | M |  | DP            | EG            | FS            | LC            | GD            | HG            | JK            | KE            |  |
| 1,800 pF | 182      | F                     | G | J | K | M |  | DG            | EG            | FS            | LC            | GD            | HG            | JK            | KE            |  |
| 2,000 pF | 202      | F                     | G | J | K | M |  | DG            | EB            | FL            | LA            | GH            | HG            | JK            | KE            |  |
| 2,200 pF | 222      | F                     | G | J | K | M |  | DG            | EB            | FL            | LA            | GH            | HG            | JK            | KE            |  |
| Cap      | Cap Code | Rated Voltage (VAC)   |   |   |   |   | 250  |               |               |               |               |               |               |               |               |  |
|          |          | Voltage Code          |   |   |   |   | A  |               |               |               |               |               |               |               |               |  |
|          |          | Case Size/Series      |   |   |   |   | CAN06<br>0603                              | CAN08<br>0805 | CAN12<br>1206 | CAN13<br>1210 | CAN17<br>1808 | CAN18<br>1812 | CAN19<br>1825 | CAN21<br>2220 | CAN22<br>2225 |  |

<sup>1</sup> Not available in Flex termination.

<sup>2</sup> Different thickness codes between standard and flex termination options. Example: HE/HJ - Standard Termination = HE, Flexible Termination = HJ

**Table 1B – COG Dielectric Capacitance Range/Selection Waterfall  
Standard Termination cont.**

| Cap       | Cap Code | Case Size/Series      |   |   |   |   | CAN06<br>0603                              | CAN08<br>0805 | CAN12<br>1206 | CAN13<br>1210 | CAN17<br>1808 | CAN18<br>1812 | CAN19<br>1825 | CAN21<br>2220 | CAN22<br>2225 |  |
|-----------|----------|-----------------------|---|---|---|---|--|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|--|
|           |          | Voltage Code          |   |   |   |   | A  |               |               |               |               |               |               |               |               |  |
|           |          | Rated Voltage (VAC)   |   |   |   |   | 250  |               |               |               |               |               |               |               |               |  |
|           |          | Capacitance Tolerance |   |   |   |   | See Table 2 for chip thickness dimensions. |               |               |               |               |               |               |               |               |  |
| 2,400 pF  | 242      | F                     | G | J | K | M |  | DG            | EB            | FL            | LA            | GH            | HG            | JK            | KE            |  |
| 2,700 pF  | 272      | F                     | G | J | K | M |  | DG            | EB            | FL            | LA            | GH            | HG            | JK            | KE            |  |
| 3,000 pF  | 302      | F                     | G | J | K | M |  |               | EB            | FL            | LA            | GH            | HG            | JK            | KE            |  |
| 3,300 pF  | 332      | F                     | G | J | K | M |  |               | EB            | FM            | LA            | GH            | HG            | JK            | KE            |  |
| 3,600 pF  | 362      | F                     | G | J | K | M |  |               | EC            | FM            | LB            | GH            | HG            | JK            | KF            |  |
| 3,900 pF  | 392      | F                     | G | J | K | M |  |               | EC            | FY            | LB            | GH            | HG            | JK            | KF            |  |
| 4,300 pF  | 432      | F                     | G | J | K | M |  |               | ED            | FY            | LC            | GH            | HG            | JK            | KF            |  |
| 4,700 pF  | 472      | F                     | G | J | K | M |  |               | ED            | FY            | LC            | GH            | HG            | JK            | KF            |  |
| 5,100 pF  | 512      | F                     | G | J | K | M |  |               | EE            | FS            | LB            | GK            | HE            | JK            | KF            |  |
| 5,600 pF  | 562      | F                     | G | J | K | M |  |               | EF            | FS            | LC            | GK            | HE            | JK            | KF            |  |
| 6,200 pF  | 622      | F                     | G | J | K | M |  |               | EF            | FE            | LC            | GK            | HE            | JE            | KF            |  |
| 6,800 pF  | 682      | F                     | G | J | K | M |  |               | EG            | FE            | LC            | GM            | HE            | JE            | KF            |  |
| 7,500 pF  | 752      | F                     | G | J | K | M |  |               | EG            | FF            | LA            | GM            | HE            | JE            | KE            |  |
| 8,200 pF  | 822      | F                     | G | J | K | M |  |               | EG            | FF            | LA            | GO            | HE            | JE            | KE            |  |
| 9,100 pF  | 912      | F                     | G | J | K | M |  |               | EG            | FF            | LA            | GO            | HG            | JE            | KE            |  |
| 10,000 pF | 103      | F                     | G | J | K | M |  |               | EH            | FG            | LA            | GO            | HG            | JE            | KE            |  |
| 12,000 pF | 123      | F                     | G | J | K | M |  |               |               | FG            | LA            | GH            | HG            | JK            | KE            |  |
| 15,000 pF | 153      | F                     | G | J | K | M |  |               |               | FM            | LB            | GH            | HJ            | JL            | KF            |  |
| 18,000 pF | 183      | F                     | G | J | K | M |  |               |               | FM            | LC            | GH            | HK            | JL            | KH            |  |
| 22,000 pF | 223      | F                     | G | J | K | M |  |               |               | FY            |               | GH            | HE            | JN            | KJ            |  |
| 27,000 pF | 273      | F                     | G | J | K | M |  |               |               | FS            |               | GK            | HE            | JN            | KJ            |  |
| 33,000 pF | 333      | F                     | G | J | K | M |  |               |               | FS            |               | GM            | HK            | JN            | KH            |  |
| 39,000 pF | 393      | F                     | G | J | K | M |  |               |               |               |               | GO            | HE            | JE            | KJ            |  |
| 47,000 pF | 473      | F                     | G | J | K | M |  |               |               |               |               | GO            | HE            | JE            | KE            |  |
| 56,000 pF | 563      | F                     | G | J | K | M |  |               |               |               |               |               | HG            | JK            | KE            |  |
| 68,000 pF | 683      | F                     | G | J | K | M |  |               |               |               |               |               | HJ            | JL            | KF            |  |
| 82,000 pF | 823      | F                     | G | J | K | M |  |               |               |               |               |               | HK            | JL            | KH            |  |
| 0.1 µF    | 104      | F                     | G | J | K | M |  |               |               |               |               |               | HK            | JN            | KH            |  |
| Cap       | Cap Code | Rated Voltage (VAC)   |   |   |   |   | 250  |               |               |               |               |               |               |               |               |  |
|           |          | Voltage Code          |   |   |   |   | A  |               |               |               |               |               |               |               |               |  |
|           |          | Case Size/Series      |   |   |   |   | CAN06<br>0603                              | CAN08<br>0805 | CAN12<br>1206 | CAN13<br>1210 | CAN17<br>1808 | CAN18<br>1812 | CAN19<br>1825 | CAN21<br>2220 | CAN22<br>2225 |  |

<sup>1</sup> Not available in Flex termination.

<sup>2</sup> Different thickness codes between standard and flex termination options. Example: HE/HJ - Standard Termination = HE, Flexible Termination = HJ

**Table 1C – COG Dielectric Capacitance Range/Selection Waterfall  
Flexible Termination**

| Cap      | Cap Code | Case Size/Series      |   |   |   |   | CAN06<br>0603                              | CAN08<br>0805 | CAN12<br>1206 | CAN13<br>1210 | CAN17<br>1808 | CAN18<br>1812 | CAN19<br>1825 | CAN21<br>2220 | CAN22<br>2225 |  |
|----------|----------|-----------------------|---|---|---|---|--|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|--|
|          |          | Voltage Code          |   |   |   |   | A  |               |               |               |               |               |               |               |               |  |
|          |          | Rated Voltage (VAC)   |   |   |   |   | 250  |               |               |               |               |               |               |               |               |  |
|          |          | Capacitance Tolerance |   |   |   |   | See Table 2 for chip thickness dimensions. |               |               |               |               |               |               |               |               |  |
| 100 pF   | 101      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 110 pF   | 111      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 120 pF   | 121      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 130 pF   | 131      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 150 pF   | 151      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 160 pF   | 161      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 180 pF   | 181      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 200 pF   | 201      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 220 pF   | 221      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 240 pF   | 241      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 270 pF   | 271      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 300 pF   | 301      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 330 pF   | 331      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 360 pF   | 361      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 390 pF   | 391      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 430 pF   | 431      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 470 pF   | 471      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 510 pF   | 511      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 560 pF   | 561      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 620 pF   | 621      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 680 pF   | 681      | F                     | G | J | K | M | CG   |               |               |               |               |               |               |               |               |  |
| 1,000 pF | 102      | F                     | G | J | K | M |  | DN            | EF            | FM            | LB            | GB            | JK            | KE            |               |  |
| 1,100 pF | 112      | F                     | G | J | K | M |  | DN            | EG            | FK            | LC            | GB            | JK            | KE            |               |  |
| 1,200 pF | 122      | F                     | G | J | K | M |  | DN            | EG            | FK            | LC            | GB            | HJ            | JK            | KE            |  |
| 1,300 pF | 132      | F                     | G | J | K | M |  | DN            | EG            | FS            | LC            | GB            | HE            | JK            | KE            |  |
| 1,500 pF | 152      | F                     | G | J | K | M |  | DP            | EG            | FS            | LC            | GB            | HE            | JK            | KE            |  |
| 1,600 pF | 162      | F                     | G | J | K | M |  | DP            | EG            | FS            | LC            | GD            | HG            | JK            | KE            |  |
| 1,800 pF | 182      | F                     | G | J | K | M |  | DG            | EG            | FS            | LC            | GD            | HG            | JK            | KE            |  |
| 2,000 pF | 202      | F                     | G | J | K | M |  | DG            | EB            | FL            | LA            | GH            | HE            | JK            | KE            |  |
| 2,200 pF | 222      | F                     | G | J | K | M |  | DG            | EB            | FL            | LA            | GH            | HE            | JK            | KE            |  |
| Cap      | Cap Code | Rated Voltage (VAC)   |   |   |   |   | 250  |               |               |               |               |               |               |               |               |  |
|          |          | Voltage Code          |   |   |   |   | A  |               |               |               |               |               |               |               |               |  |
|          |          | Case Size/Series      |   |   |   |   | CAN06<br>0603                              | CAN08<br>0805 | CAN12<br>1206 | CAN13<br>1210 | CAN17<br>1808 | CAN18<br>1812 | CAN19<br>1825 | CAN21<br>2220 | CAN22<br>2225 |  |

<sup>1</sup> Not available in Flex termination.

<sup>2</sup> Different thickness codes between standard and flex termination options. Example: HE/HJ - Standard Termination = HE, Flexible Termination = HJ



**Table 1C – COG Dielectric Capacitance Range/Selection Waterfall  
Flexible Termination cont.**

| Cap       | Cap Code | Case Size/Series      |   |   |   |   | CAN06<br>0603                              | CAN08<br>0805 | CAN12<br>1206 | CAN13<br>1210 | CAN17<br>1808 | CAN18<br>1812 | CAN19<br>1825 | CAN21<br>2220 | CAN22<br>2225 |  |
|-----------|----------|-----------------------|---|---|---|---|--|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|--|
|           |          | Voltage Code          |   |   |   |   | A  |               |               |               |               |               |               |               |               |  |
|           |          | Rated Voltage (VAC)   |   |   |   |   | 250  |               |               |               |               |               |               |               |               |  |
|           |          | Capacitance Tolerance |   |   |   |   | See Table 2 for chip thickness dimensions. |               |               |               |               |               |               |               |               |  |
| 2,400 pF  | 242      | F                     | G | J | K | M |  | DG            | EB            | FL            | LA            | GH            | HE            | JK            | KE            |  |
| 2,700 pF  | 272      | F                     | G | J | K | M |  | DG            | EB            | FL            | LA            | GH            | HE            | JK            | KE            |  |
| 3,000 pF  | 302      | F                     | G | J | K | M |  |               | EB            | FL            | LA            | GH            | HE            | JK            | KE            |  |
| 3,300 pF  | 332      | F                     | G | J | K | M |  |               | EB            | FM            | LA            | GH            | HG            | JK            | KE            |  |
| 3,600 pF  | 362      | F                     | G | J | K | M |  |               | EC            | FM            | LB            | GH            | HG            | JK            | KF            |  |
| 3,900 pF  | 392      | F                     | G | J | K | M |  |               | EC            | FY            | LB            | GH            | HJ            | JK            | KF            |  |
| 4,300 pF  | 432      | F                     | G | J | K | M |  |               | ED            | FY            | LC            | GH            | HJ            | JK            | KF            |  |
| 4,700 pF  | 472      | F                     | G | J | K | M |  |               | ED            | FY            | LC            | GH            | HJ            | JK            | KF            |  |
| 5,100 pF  | 512      | F                     | G | J | K | M |  |               | EE            | FS            | LB            | GK            | HE            | JK            | KF            |  |
| 5,600 pF  | 562      | F                     | G | J | K | M |  |               | EF            | FS            | LC            | GK            | HE            | JK            | KF            |  |
| 6,200 pF  | 622      | F                     | G | J | K | M |  |               | EF            | FE            | LC            | GK            | HE            | JE            | KF            |  |
| 6,800 pF  | 682      | F                     | G | J | K | M |  |               | EG            | FE            | LC            | GM            | HE            | JE            | KF            |  |
| 7,500 pF  | 752      | F                     | G | J | K | M |  |               | EG            | FF            | LA            | GM            | HE            | JE            | KE            |  |
| 8,200 pF  | 822      | F                     | G | J | K | M |  |               | EG            | FF            | LA            | GO            | HE            | JE            | KE            |  |
| 9,100 pF  | 912      | F                     | G | J | K | M |  |               | EG            | FF            | LA            | GO            | HG            | JE            | KE            |  |
| 10,000 pF | 103      | F                     | G | J | K | M |  |               | EH            | FG            | LA            | GO            | HG            | JE            | KE            |  |
| 12,000 pF | 123      | F                     | G | J | K | M |  |               |               | FG            | LA            | GH            | HG            | JK            | KE            |  |
| 15,000 pF | 153      | F                     | G | J | K | M |  |               |               | FM            | LB            | GH            | HJ            | JL            | KF            |  |
| 18,000 pF | 183      | F                     | G | J | K | M |  |               |               | FM            | LC            | GH            | HK            | JL            | KH            |  |
| 22,000 pF | 223      | F                     | G | J | K | M |  |               |               | FY            |               | GH            | HE            | JN            | KJ            |  |
| 27,000 pF | 273      | F                     | G | J | K | M |  |               |               | FS            |               | GK            | HE            | JN            | KJ            |  |
| 33,000 pF | 333      | F                     | G | J | K | M |  |               |               | FS            |               | GM            | HK            | JN            | KH            |  |
| 39,000 pF | 393      | F                     | G | J | K | M |  |               |               |               |               | GO            | HE            | JE            | KJ            |  |
| 47,000 pF | 473      | F                     | G | J | K | M |  |               |               |               |               | GO            | HE            | JE            | KE            |  |
| 56,000 pF | 563      | F                     | G | J | K | M |  |               |               |               |               |               | HG            | JK            | KE            |  |
| 68,000 pF | 683      | F                     | G | J | K | M |  |               |               |               |               |               | HJ            | JL            | KF            |  |
| 82,000 pF | 823      | F                     | G | J | K | M |  |               |               |               |               |               | HK            | JL            | KH            |  |
| 0.1 µF    | 104      | F                     | G | J | K | M |  |               |               |               |               |               | HK            | JN            | KH            |  |
| Cap       | Cap Code | Rated Voltage (VAC)   |   |   |   |   | 250  |               |               |               |               |               |               |               |               |  |
|           |          | Voltage Code          |   |   |   |   | A  |               |               |               |               |               |               |               |               |  |
|           |          | Case Size/Series      |   |   |   |   | CAN06<br>0603                              | CAN08<br>0805 | CAN12<br>1206 | CAN13<br>1210 | CAN17<br>1808 | CAN18<br>1812 | CAN19<br>1825 | CAN21<br>2220 | CAN22<br>2225 |  |

<sup>1</sup> Not available in Flex termination.

<sup>2</sup> Different thickness codes between standard and flex termination options. Example: HE/HJ - Standard Termination = HE, Flexible Termination = HJ

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

| Thickness Code | Case Size | Thickness ± Range (mm) | Paper Quantity |          | Plastic Quantity |          |
|----------------|-----------|------------------------|----------------|----------|------------------|----------|
|                |           |                        | 7" Reel        | 13" Reel | 7" Reel          | 13" Reel |
| CG             | 0603      | 0.80 ± 0.10*           | 4,000          | 15,000   | 0                | 0        |
| DN             | 0805      | 0.78 ± 0.10*           | 4000           | 15000    | 0                | 0        |
| DP             | 0805      | 0.90 ± 0.10*           | 4000           | 15000    | 0                | 0        |
| DG             | 0805      | 1.25 ± 0.15            | 0              | 0        | 2,500            | 10,000   |
| EB             | 1206      | 0.78 ± 0.10            | 0              | 0        | 4,000            | 10,000   |
| EC             | 1206      | 0.90 ± 0.10            | 0              | 0        | 4,000            | 10,000   |
| ED             | 1206      | 1.00 ± 0.10            | 0              | 0        | 2,500            | 10,000   |
| EE             | 1206      | 1.10 ± 0.10            | 0              | 0        | 2,500            | 10,000   |
| EF             | 1206      | 1.20 ± 0.15            | 0              | 0        | 2,500            | 10,000   |
| EG             | 1206      | 1.60 ± 0.15            | 0              | 0        | 2,000            | 8,000    |
| EH             | 1206      | 1.60 ± 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   |
| FL             | 1210      | 1.40 ± 0.15            | 0              | 0        | 2,000            | 8,000    |
| FM             | 1210      | 1.70 ± 0.20            | 0              | 0        | 2,000            | 8,000    |
| FY             | 1210      | 2.00 ± 0.20            | 0              | 0        | 2,000            | 8,000    |
| FK             | 1210      | 2.10 ± 0.20            | 0              | 0        | 2,000            | 8,000    |
| FS             | 1210      | 2.50 ± 0.30            | 0              | 0        | 1,000            | 4,000    |
| LA             | 1808      | 1.40 ± 0.15            | 0              | 0        | 1,000            | 4,000    |
| LB             | 1808      | 1.60 ± 0.15            | 0              | 0        | 1,000            | 4,000    |
| LC             | 1808      | 2.00 ± 0.15            | 0              | 0        | 1,000            | 4,000    |
| GB             | 1812      | 1.00 ± 0.10            | 0              | 0        | 1,000            | 4,000    |
| GD             | 1812      | 1.25 ± 0.15            | 0              | 0        | 1,000            | 4,000    |
| GH             | 1812      | 1.40 ± 0.15            | 0              | 0        | 1,000            | 4,000    |
| GK             | 1812      | 1.60 ± 0.20            | 0              | 0        | 1,000            | 4,000    |
| GM             | 1812      | 2.00 ± 0.20            | 0              | 0        | 500              | 2,000    |
| GO             | 1812      | 2.50 ± 0.20            | 0              | 0        | 500              | 2,000    |
| HE             | 1825      | 1.40 ± 0.15            | 0              | 0        | 1,000            | 4,000    |
| HG             | 1825      | 1.60 ± 0.20            | 0              | 0        | 1,000            | 4,000    |
| HJ             | 1825      | 2.00 ± 0.20            | 0              | 0        | 500              | 2,000    |
| HK             | 1825      | 2.50 ± 0.20            | 0              | 0        | 500              | 2,000    |

*Package quantity based on finished chip thickness specifications.*

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

| Thickness Code | Case Size | Thickness ± Range (mm) | Paper Quantity |          | Plastic Quantity |          |
|----------------|-----------|------------------------|----------------|----------|------------------|----------|
|                |           |                        | 7" Reel        | 13" Reel | 7" Reel          | 13" Reel |
| JE             | 2220      | 1.40 ± 0.15            | 0              | 0        | 1,000            | 4,000    |
| JK             | 2220      | 1.60 ± 0.20            | 0              | 0        | 1,000            | 4,000    |
| JL             | 2220      | 2.00 ± 0.20            | 0              | 0        | 500              | 2,000    |
| JN             | 2220      | 2.50 ± 0.20            | 0              | 0        | 500              | 2,000    |
| KE             | 2225      | 1.40 ± 0.15            | 0              | 0        | 1,000            | 4,000    |
| KF             | 2225      | 1.60 ± 0.20            | 0              | 0        | 1,000            | 4,000    |
| KH             | 2225      | 2.00 ± 0.20            | 0              | 0        | 500              | 2,000    |
| KJ             | 2225      | 2.50 ± 0.20            | 0              | 0        | 500              | 2,000    |
| TA             | 2824      | 1.40 ± 0.15            | 0              | 0        | 750              |          |
| TB             | 2824      | 2.00 ± 0.20            | 0              | 0        | 300              |          |
| TC             | 2824      | 2.50 ± 0.20            | 0              | 0        | 300              |          |
| QB             | 3040      | 1.40 ± 0.15            | 0              | 0        | 500              |          |
| QC             | 3040      | 2.00 ± 0.20            | 0              | 0        | 500              |          |
| QD             | 3040      | 2.50 ± 0.20            | 0              | 0        | 350              |          |
| MA             | 3640      | 1.40 ± 0.15            | 0              | 0        | 250              |          |
| MB             | 3640      | 2.00 ± 0.20            | 0              | 0        | 250              |          |
| MC             | 3640      | 2.50 ± 0.20            | 0              | 0        | 250              |          |
| SA             | 4540      | 1.40 ± 0.15            | 0              | 0        | 200              |          |
| SB             | 4540      | 2.00 ± 0.20            | 0              | 0        | 200              |          |
| SC             | 4540      | 2.50 ± 0.20            | 0              | 0        | 200              |          |

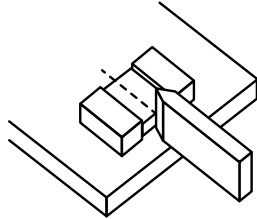
Package quantity based on finished chip thickness specifications.

**Table 2B – Bulk Packaging Quantities**

| Packaging Type   |          | Loose Packaging                              |         |
|------------------|----------|--|---------|
|                  |          | Bulk Bag (default)                           |         |
| Packaging C-Spec |          | N/A  |         |
| Case Size        |          | Packaging Quantities (pieces/unit packaging) |         |
| CAN              | EIA (in) | Minimum                                      | Maximum |
| 06               | 0603     | 1  | 50,000  |
| 08               | 0805     |  |         |
| 12               | 1206     |  |         |
| 13               | 1210     |  |         |
| 17               | 1808     |  | 20,000  |
| 18               | 1812     |  |         |
| 19               | 1825     |  |         |
| 21               | 2220     |  |         |
| 22               | 2225     |  |         |

For Industrial grade products ordered without a packaging, C-Spec will default to our standard "Bulk Bag" packaging.

**Table 3 – Performance & Reliability: Test Methods & Conditions**

| Stress                 | Reference                 | Test or Inspection Method   |           |               |       |    |      |     |    |      |      |    |      |      |    |      |      |      |
|------------------------|---------------------------|---|-----------|---------------|-------|----|------|-----|----|------|------|----|------|------|----|------|------|------|
| Terminal Strength      | AEC-Q200-006              | Shear force per specific case size; Time: 60 ±1 second  |           |               |       |    |      |     |    |      |      |    |      |      |    |      |      |      |
|                        |                           | <table border="1"> <thead> <tr> <th>Case Size</th> <th>EIA Size Code</th> <th>Force</th> </tr> </thead> <tbody> <tr> <td>06</td> <td>0603</td> <td>5 N</td> </tr> <tr> <td>08</td> <td>0805</td> <td>10 N</td> </tr> <tr> <td>12</td> <td>1206</td> <td>10 N</td> </tr> <tr> <td>13</td> <td>1210</td> <td>10 N</td> </tr> <tr> <td>≥ 17</td> <td>≥ 1808</td> <td>18 N</td> </tr> </tbody> </table>  | Case Size | EIA Size Code | Force | 06 | 0603 | 5 N | 08 | 0805 | 10 N | 12 | 1206 | 10 N | 13 | 1210 | 10 N | ≥ 17 |
| Case Size              | EIA Size Code             | Force   |           |               |       |    |      |     |    |      |      |    |      |      |    |      |      |      |
| 06                     | 0603                      | 5 N   |           |               |       |    |      |     |    |      |      |    |      |      |    |      |      |      |
| 08                     | 0805                      | 10 N  |           |               |       |    |      |     |    |      |      |    |      |      |    |      |      |      |
| 12                     | 1206                      | 10 N  |           |               |       |    |      |     |    |      |      |    |      |      |    |      |      |      |
| 13                     | 1210                      | 10 N  |           |               |       |    |      |     |    |      |      |    |      |      |    |      |      |      |
| ≥ 17                   | ≥ 1808                    | 18 N  |           |               |       |    |      |     |    |      |      |    |      |      |    |      |      |      |
| Board Flex             | AEC-Q200-005              | Standard termination system - 2.0 mm (minimum)<br>Flexible termination system and COG Dielectric - 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, category 3, at 215°C   |           |               |       |    |      |     |    |      |      |    |      |      |    |      |      |      |
|                        |                           | c) Method D, category 3, at 260°C   |           |               |       |    |      |     |    |      |      |    |      |      |    |      |      |      |
| Temperature Cycling    | JESD22<br>Method JA-104   | 1,000 cycles (-55°C to +125°C). Measurement at 24 hours ±4 hours after test conclusion.   |           |               |       |    |      |     |    |      |      |    |      |      |    |      |      |      |
| Biased Humidity        | MIL-STD-202<br>Method 103 | Load humidity: 1,000 hours 85°C/85% RH and 200 VDC maximum. Add 100 KΩ resistor. Measurement at 24 hours ±4 hours after test conclusion.  |           |               |       |    |      |     |    |      |      |    |      |      |    |      |      |      |
|                        |                           | Low volt humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 KΩ resistor. Measurement at 24 hours ±4 hours after test conclusion.  |           |               |       |    |      |     |    |      |      |    |      |      |    |      |      |      |
| Moisture Resistance    | MIL-STD-202<br>Method 106 | t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours ±4 hours after test conclusion.  |           |               |       |    |      |     |    |      |      |    |      |      |    |      |      |      |
| AC Rated Life Test     | KEMET Custom Test         | 1,000 hours at 125°C 250 V <sub>rms</sub> 50/60 Hz<br>Measurement at 24 hours ±2 hours after test conclusion.   |           |               |       |    |      |     |    |      |      |    |      |      |    |      |      |      |
| Storage Life           | MIL-STD-202<br>Method 108 | 125°C, 0 VDC, for 1,000 hours   |           |               |       |    |      |     |    |      |      |    |      |      |    |      |      |      |
| Vibration              | MIL-STD-202<br>Method 204 | 5 G 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<br>Method 213 | Figure 1 of Method 213, Condition F   |           |               |       |    |      |     |    |      |      |    |      |      |    |      |      |      |
| Resistance to Solvents | MIL-STD-202<br>Method 215 | Add aqueous wash chemical, OKEM Clean or equivalent   |           |               |       |    |      |     |    |      |      |    |      |      |    |      |      |      |

## Environmental Compliance



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

**Table 4 – Land Pattern Design Recommendations per IPC-7351**

Standard Termination

| EIA Size Code | Metric Size Code | Density Level A:<br>Maximum (Most)<br>Land Protrusion (mm) |      |      |      |      | Density Level B:<br>Median (Nominal)<br>Land Protrusion (mm) |      |      |      |      | Density Level C:<br>Minimum (Least)<br>Land Protrusion (mm) |      |      |      |      |
|---------------|------------------|--|------|------|------|------|--|------|------|------|------|---|------|------|------|------|
|               |                  | C  | Y    | X    | V1   | V2   | C  | Y    | X    | V1   | V2   | C   | Y    | X    | V1   | V2   |
| 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 |
| 1808          | 4520             | 2.30   | 1.75 | 2.30 | 7.40 | 3.30 | 2.20   | 1.55 | 2.20 | 6.50 | 2.70 | 2.10  | 1.35 | 2.10 | 5.80 | 2.40 |
| 1812          | 4532             | 2.15   | 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 |
| 1825          | 4564             | 2.15   | 1.60 | 6.90 | 6.90 | 7.90 | 2.05   | 1.40 | 6.80 | 6.00 | 7.30 | 1.95  | 1.20 | 6.70 | 5.30 | 7.00 |
| 2220          | 5650             | 2.75   | 1.70 | 5.50 | 8.20 | 6.50 | 2.65   | 1.50 | 5.40 | 7.30 | 5.90 | 2.55  | 1.30 | 5.30 | 6.60 | 5.60 |
| 2225          | 5664             | 2.70   | 1.70 | 6.90 | 8.10 | 7.90 | 2.60   | 1.50 | 6.80 | 7.20 | 7.30 | 2.50  | 1.30 | 6.70 | 6.50 | 7.00 |

Flexible Termination

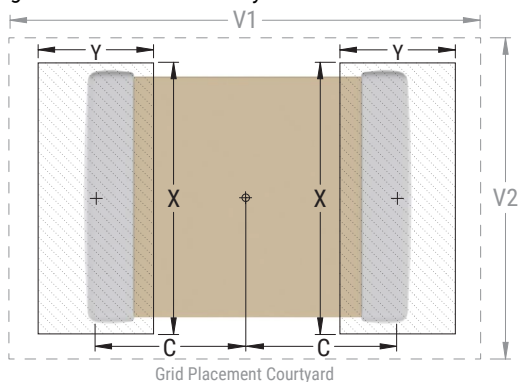
| EIA Size Code | Metric Size Code | Density Level A:<br>Maximum (Most)<br>Land Protrusion (mm) |      |      |      |      | Density Level B:<br>Median (Nominal)<br>Land Protrusion (mm) |      |      |      |      | Density Level C:<br>Minimum (Least)<br>Land Protrusion (mm) |      |      |      | 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

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

**Density Level B:** For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes.

**Density Level C:** For high component density product applications. Before adapting the minimum land pattern variations, the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC-7351).

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



## Soldering Process

### Recommended Soldering Technique:

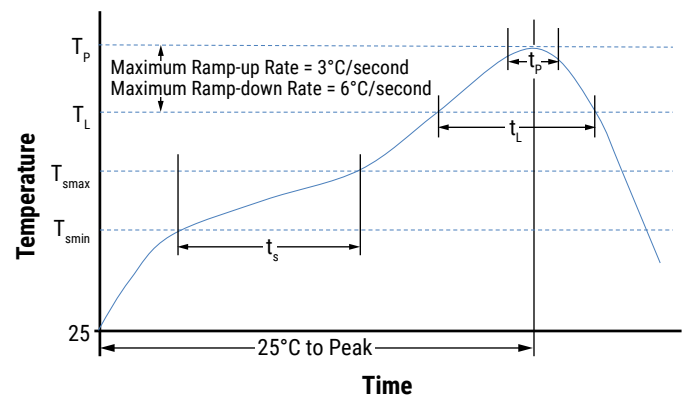
- Solder wave or solder reflow for EIA case sizes 0805 and 1206
- All other EIA case sizes are limited to solder reflow only

### Recommended Reflow Soldering:

KEMET's family of surface mount multilayer ceramic capacitors (SMD MLCCs) are compatible with wave (single or dual), convection, IR, or vapor phase reflow techniques. Preheating 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: All temperatures refer to the center of the package, measured on the capacitor body surface that is facing up during assembly reflow.

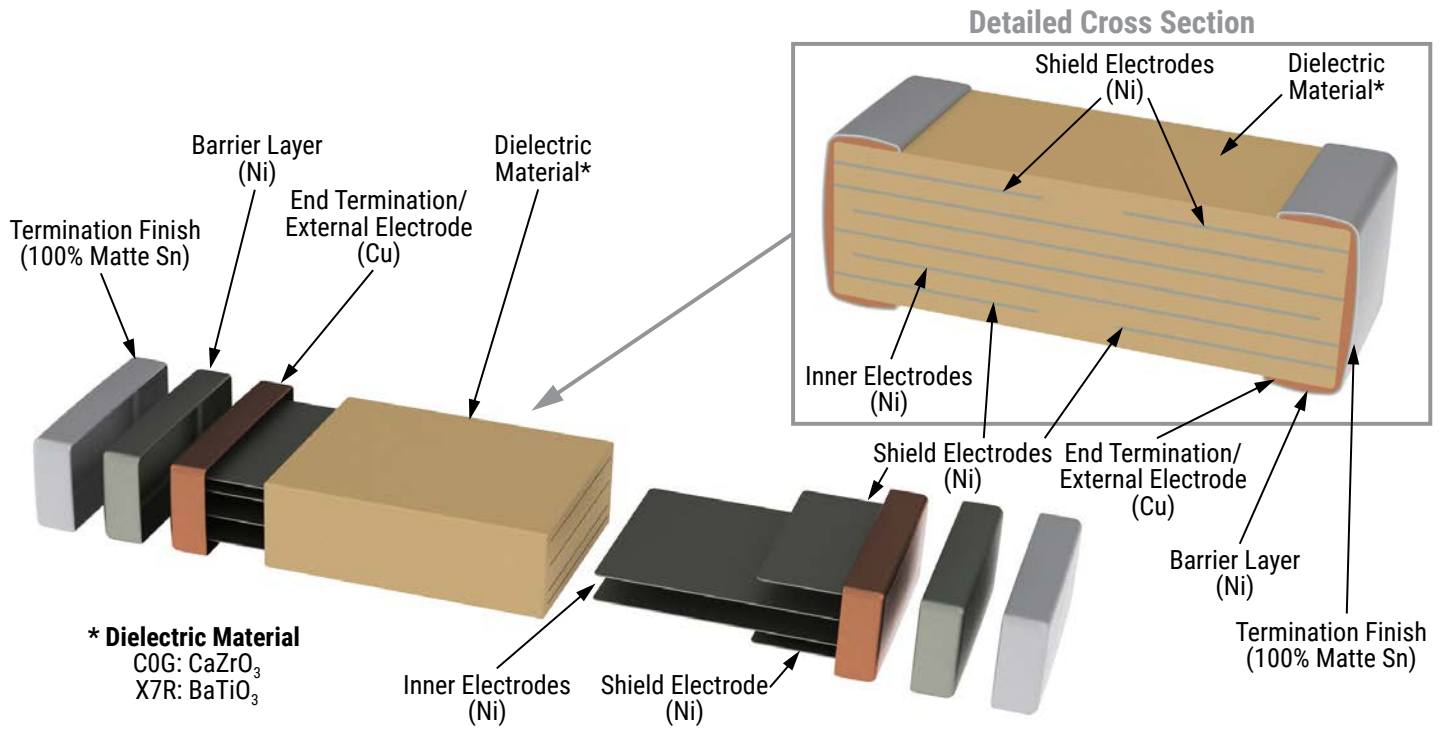


## Storage & Handling

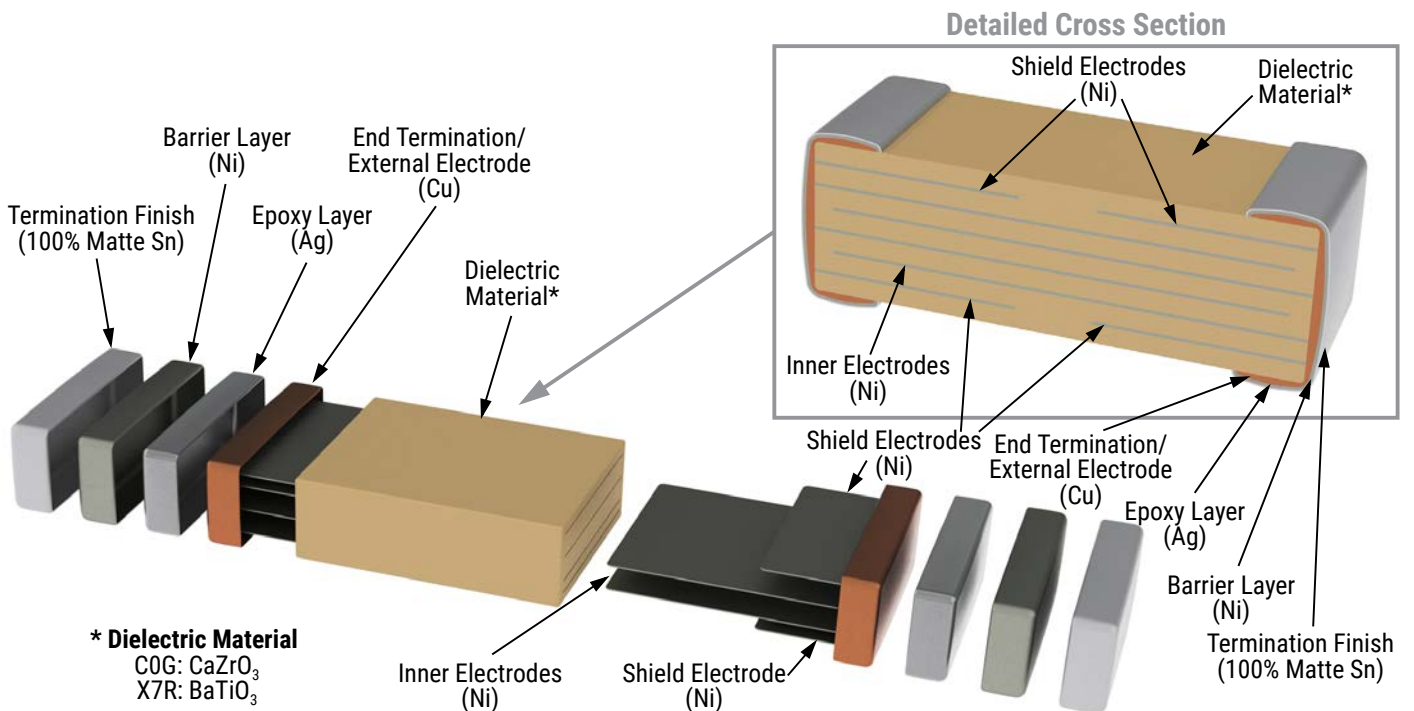
Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. Packaging materials will be degraded 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 upon receipt.

## Construction

### Standard Termination



### Flexible Termination



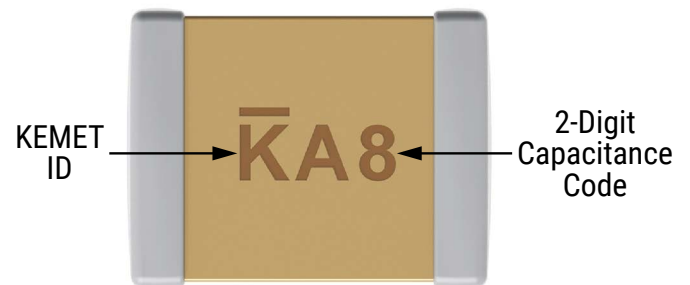
## Capacitor Marking (Optional)

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  $\mu$ F. Orientation of marking is vendor optional.



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

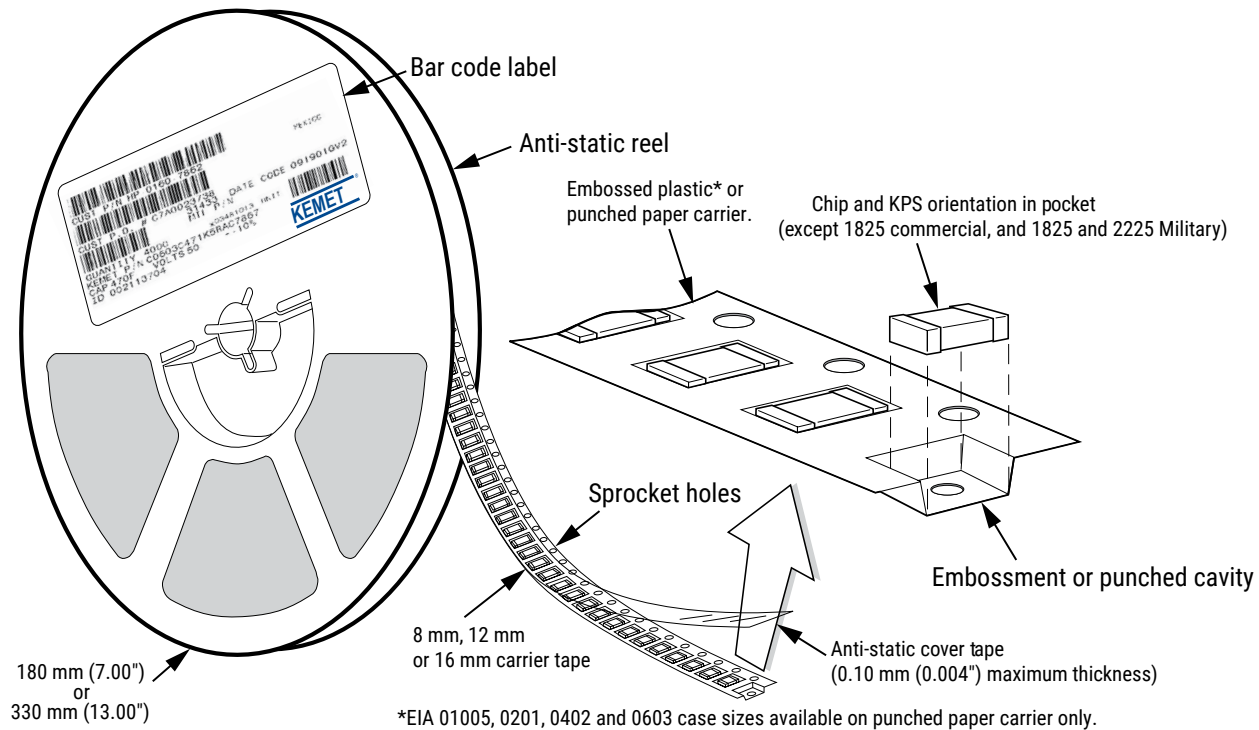


## Capacitor Marking (Optional) cont.

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

## Tape & Reel Packaging Information

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



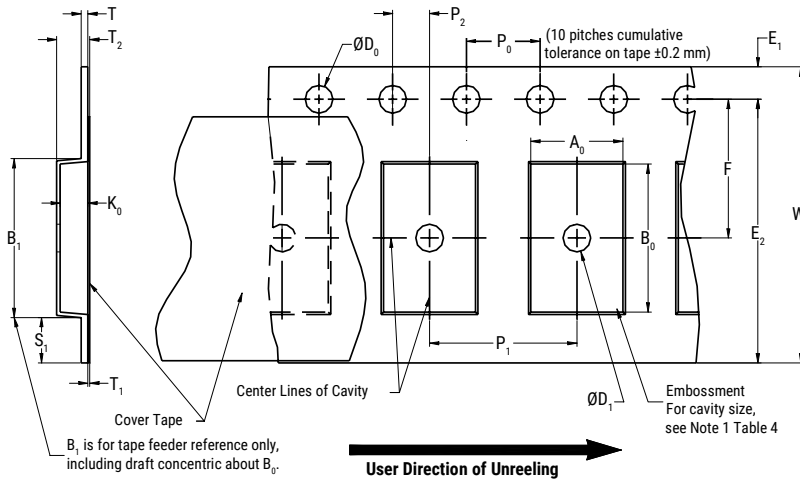
**Table 5 – Carrier Tape Configuration, Embossed Plastic & Punched Paper (mm)**

| 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> )* |          |
| 0603          | 8              | –                        | –        | 2/4                      | 2/4      |
| 0805          | 8              | 4                        | 4        | 4                        | 4        |
| 1206 – 1210   | 8              | 4                        | 4        | 4                        | 4        |
| 1805 – 1808   | 12             | 4                        | 4        | –                        | –        |
| ≥ 1812        | 12             | 8                        | 8        | –                        | –        |

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

\*Refer to Tables 7 and 8 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                                      |                                       |                                  |                              |                              |                              | 30.0<br>(1.181)           | 5.0<br>(0.196)                   | 0.250<br>(0.009)                                 | 0.350<br>(0.013)          |
| 24 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>and 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)                  |  |                           |
| 24 mm                                      | 16 mm                                 | 11.5<br>(0.452)                  | 22.25<br>(0.875)             | 11.5 ±0.10<br>(0.452 ±0.003) | 16.0 ±0.10<br>(0.629 ±0.004) | 3<br>(0.118)              | 24.3<br>(0.956)                  |  |                           |

- The embossment hole location shall be measured from the sprocket hole controlling the location of the embossment. Dimensions of the embossment location and the hole location shall be applied independently of each other.
- The tape with or without components shall pass around R without damage (see Figure 6).
- If  $S_1 < 1.0$  mm, there may not be enough area for a cover tape to be properly applied (see EIA Standard 481, paragraph 4.3, section b.)
- $B_1$  dimension is a reference dimension for tape feeder clearance only.
- The cavity defined by  $A_0$ ,  $B_0$  and  $K_0$  shall surround the component with sufficient clearance that:
  - the component does not protrude above the top surface of the carrier tape.
  - the component can be removed from the cavity in a vertical direction without mechanical restriction, after the top cover tape has been removed.
  - rotation of the component is limited to 20° maximum for 8 and 12 mm tapes and 10° maximum for 16 mm tapes (see Figure 3).
  - lateral movement of the component is restricted to 0.5 mm maximum for 8 and 12 mm wide tape and to 1.0 mm maximum for 16 mm tape (see Figure 4).
  - for KPS product,  $A_0$  and  $B_0$  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.

## Packaging Information Performance Notes

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

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

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

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

## Figure 2 – Maximum Component Rotation



## Figure 3 – Maximum Lateral Movement



## Figure 4 – Bending Radius



**Figure 5 – Reel Dimensions**



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

**Table 7 – Reel Dimensions**

Metric will govern

| Constant Dimensions – Millimeters (Inches) |   |                                       |   |   |
|--|---|---------------------------------------|---|---|
| Tape Size                                  | A   | B Minimum                             | C                                       | D Minimum   |
| 8 mm                                       | 178 ±0.20<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                                      |   |                                       |   |   |
| 24 mm                                      |   | 1.2<br>(0.047)                        | 13.0 ±0.2<br>(0.521 ±0.008)             | 21<br>(0.826)                                     |
| 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)                         |   |
| 24 mm                                      |   | 25 +1.0/-0.0<br>(0.984 +0.039/-0.0)   | 27.4 +1.0/-1.0<br>(1.078 +0.039/-0.039) |   |

**Figure 6 – Tape Leader & Trailer Dimensions**



**Figure 7 – Maximum Camber**



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