

# HV-HT Series, High Voltage, High Temperature 200°C, COG Dielectric, 500 – 2,000 VDC (Industrial Grade)

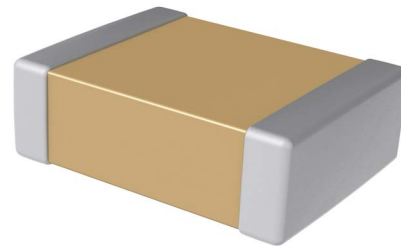
## Overview

KEMET's High Voltage-High Temperature (HV-HT) series surface mount COG Multilayer Ceramic Capacitors (MLCCs) are constructed of a robust and proprietary base metal electrode (BME) dielectric system that offers industry-leading performance at extreme temperatures. These surface mountable devices feature a 200°C maximum operating temperature and are specifically designed to withstand the demands of harsh industrial environments such as oil exploration and automotive/avionics engine compartment circuitry. They also offer higher and more uniform breakdown voltage performance than competitive products, resulting in increased yields in customer field applications. When dealing with expensive high temperature circuitry and systems, higher yields can quickly result in significant cost savings.

KEMET's HV-HT series MLCCs are temperature compensating and are suited for resonant circuit applications or those where Q and stability of capacitance characteristics are required. They exhibit no change in

capacitance with respect to time and voltage and boast a negligible change in capacitance with reference to ambient temperature. Capacitance change is limited to  $\pm 30$ ppm/°C from -55°C to +200°C. In addition, these capacitors exhibit high insulation resistance with low dissipation factor at elevated temperatures up to 200°C. They also exhibit low ESR at high frequencies and offer superior volumetric efficiency over competitive high temperature precious metal electrode (PME) and base metal electrode (BME) dielectric system devices.

These devices are Lead (Pb)-free, RoHS and REACH compliant without the need of any exemptions.



## Ordering Information

| C       | 2225   | H                            | 393   | J   | C   | G          | A                    | C   | TU  |
|---------|--|------------------------------|---|---|---|------------|----------------------|---|---|
| Ceramic | Case Size (L" x W")  | Specification/ Series        | Capacitance Code (pF)                       | Capacitance Tolerance <sup>1</sup>  | Rated Voltage (VDC)                                       | Dielectric | Failure Rate/ Design | Termination Finish <sup>2</sup>   | Packaging/ Grade (C-Spec)                     |
|         | 0805<br>1206<br>1210<br>1808<br>1812<br>1825<br>2220<br>2225<br>2824<br>3040<br>3640<br>4540 | H = High temperature (200°C) | Two significant digits and number of zeros. | B = $\pm 0.10$ pF<br>C = $\pm 0.25$ pF<br>D = $\pm 0.5$ pF<br>F = $\pm 1\%$<br>G = $\pm 2\%$<br>J = $\pm 5\%$<br>K = $\pm 10\%$<br>M = $\pm 20\%$ | C = 500<br>B = 630<br>D = 1,000<br>F = 1,500<br>G = 2,000 | G = COG    | A = N/A              | C = 100% Matte Sn<br>L = SnPb (5% Pb minimum)<br>E = Gold (Au) 1.97 – 11.8 $\mu$ in<br>F = Gold (Au) 30 – 70 $\mu$ in<br>G = Gold (Au) 100 $\mu$ in minimum | See "Packaging C-Spec Ordering Options Table" |

<sup>1</sup> Additional capacitance tolerance offerings may be available. Contact KEMET for details.

<sup>2</sup> Gold(Au) termination finish options are not available on 2824, 3040, 3640 and 4540 case sizes.

## Packaging C-Spec Ordering Options Table

| Termination Finish Options   | Packaging Type/Options                 | Packaging Ordering Code (C-Spec)  |
|--|--|---|
| <b>Standard Packaging – Unmarked<sup>3</sup></b>   |  |   |
| C = 100% Matte Sn<br>L = SnPb (5% Pb min.)<br>F = Gold (Au) 30 – 70 µin<br>G = Gold (Au) 100 µin minimum | Bulk Bag                               | Blank <sup>1</sup>  |
|  | Waffle Tray <sup>2</sup>               | 7292  |
|  | 7" Tape & Reel                         | TU  |
|  | 13" Reel                               | 7411 (EIA 0603 and smaller case sizes)<br>7210 (EIA 0805 and larger case sizes) |
|  | 7" Tape & Reel/2 mm pitch <sup>4</sup> | 7081  |
|  | 7" Tape & Reel – 50 pcs                | T050  |
|  | 7" Tape & Reel – 100 pcs               | T100  |
|  | 7" Tape & Reel – 250 pcs               | T250  |
|  | 7" Tape & Reel – 500 pcs               | T500  |
| 7" Tape & Reel – 1,000 pcs   | T1K0                                   |   |
| <b>Moisture Sensitive Packaging<sup>5</sup> – Unmarked<sup>3</sup></b>                                   |  |   |
| E = Gold (Au) 1.97 – 11.8 µin<br>F = Gold (Au) 30 – 70 µin<br>G = Gold (Au) 100 µin minimum              | Waffle Tray <sup>2</sup>               | 7282  |
|  | 7" Tape & Reel                         | 7130  |
|  | 7" Tape & Reel – 50 pcs                | Contact KEMET <sup>6</sup>  |
|  | 7" Tape & Reel – 100 pcs               |   |
|  | 7" Tape & Reel – 250 pcs               |   |
|  | 7" Tape & Reel – 500 pcs               |   |
|  | 7" Tape & Reel – 1,000 pcs             |   |

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

<sup>1</sup> "Bulk Bag" packaging option is not available for Gold (Au) termination finish options and case sizes larger than 2225 (5664 Metric).

<sup>2</sup> "Waffle Tray" packaging option is not available for case sizes larger than 2225 (5664 Metric).

<sup>3</sup> The terms "Marked" and "Unmarked" pertain to laser marking option of components. All packaging options labeled as "Unmarked" will contain capacitors that have not been laser marked. The option to laser mark is not available on these devices.

<sup>3</sup> Reeling quantities are dependent upon chip size and thickness dimension. When ordering using the "T1K0" packaging option, 1812 through 2225 case size devices with chip thickness of  $\geq 1.9\text{mm}$  (nominal) may be shipped on multiple 7" reels or a single 13" reel. Additional reeling or packaging options may be available. Contact KEMET for details.

<sup>4</sup> The 2 mm pitch option allows for double the packaging quantity of capacitors on a given reel size. This option is limited to EIA 0603 (1608 metric) case size devices. For more information regarding 2 mm pitch option see "Tape & Reel Packaging Information".

<sup>5</sup> Moisture sensitive packaging is required for Gold (Au) termination option "E" (1.97 µin min / 11.8 µin max.). Not available for case sizes larger than 2225 (5664 Metric).

<sup>6</sup> Additional reeling or packaging options may be available. Contact KEMET for details.

## Benefits

- Operating temperature range of  $-55^{\circ}\text{C}$  to  $+200^{\circ}\text{C}$
- Lead (Pb)-free, RoHS, and REACH compliant
- EIA 0805, 1206, 1210, 1808, 1812, 1825, 2220, 2225, 2824, 3040, 3640, and 4540 case sizes
- DC voltage ratings of 500 V, 630 V, 1 KV, 1.5 KV, and 2 KV
- Capacitance offerings ranging from 1 pF to 0.150  $\mu\text{F}$
- Available capacitance tolerances of  $\pm 0.10$  pF,  $\pm 0.25$  pF,  $\pm 0.5$  pF,  $\pm 1\%$ ,  $\pm 2\%$ ,  $\pm 5\%$ ,  $\pm 10\%$ , and  $\pm 20\%$
- No piezoelectric noise
- Extremely low ESR and ESL
- High thermal stability
- High ripple current capability
- No capacitance change with respect to applied rated DC voltage
- Negligible capacitance change with respect to temperature from  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
- No capacitance decay with time
- Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb plated termination finish option available upon request (5% Pb minimum)
- Gold (Au), Tin/Lead (Sn/Pb) and 100% pure matte Tin (Sn) termination finishes available

## Applications

Typical applications include critical timing, tuning, circuits requiring low loss, circuits with pulse, high current, switch mode power supplies (input filters, resonators, tank circuits, snubbed circuits, output filters), high voltage coupling, DC blocking and voltage multiplier circuits in extreme environments such as down-hole exploration, aerospace engine compartments and geophysical probes. Markets include power supply, HID lighting, industrial equipment/control, automotive, aerospace, and munitions.

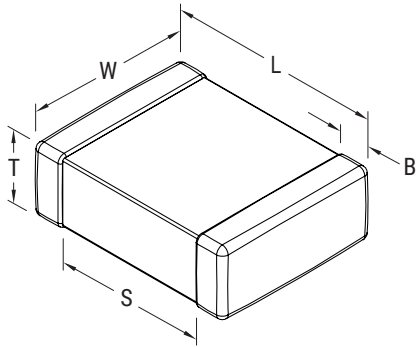
## Qualification/Certification

High temperature ( $200^{\circ}\text{C}$ ) Industrial grade products meet or exceed the requirements outlined in Table 4, Performance & Reliability. Qualification packages are available for review and download on our website at [www.kemet.com/hightemp](http://www.kemet.com/hightemp)

## Environmental Compliance

Lead (Pb)-free, RoHS, and REACH compliant without exemptions (excluding SnPb termination finish option).

## Dimensions – Millimeters (Inches)



| EIA Size Code | Metric Size Code | L Length                       | W Width                        | T Thickness               | B Bandwidth                   | S Separation Minimum | Mounting Technique           |
|---------------|------------------|--------------------------------|--------------------------------|---------------------------|-------------------------------|----------------------|------------------------------|
| 0805          | 2012             | 2.00 (0.079)<br>±0.20 (0.008)  | 1.25 (0.049)<br>±0.20 (0.008)  | See Table 2 for Thickness | 0.50 (0.02)<br>±0.25 (0.010)  | 0.75 (.030)          | Solder Wave or Solder Reflow |
| 1206          | 3216             | 3.20 (0.126)<br>±0.20 (0.008)  | 1.60 (0.063)<br>±0.20 (0.008)  |                           | 0.50 (0.02)<br>±0.25 (0.010)  | N/A                  |                              |
| 1210          | 3225             | 3.20 (0.126)<br>±0.20 (0.008)  | 2.50 (0.098)<br>±0.20 (0.008)  |                           | 0.50 (0.02)<br>±0.25 (0.010)  |                      |                              |
| 1808          | 4520             | 4.70 (0.185)<br>±0.50 (0.020)  | 2.00 (0.079)<br>±0.20 (0.008)  |                           | 0.60 (0.024)<br>±0.35 (0.014) |                      |                              |
| 1812          | 4532             | 4.50 (0.177)<br>±0.30 (0.012)  | 3.20 (0.126)<br>±0.30 (0.012)  |                           | 0.60 (0.024)<br>±0.35 (0.014) |                      |                              |
| 1825          | 4564             | 4.50 (0.177)<br>±0.30 (0.012)  | 6.40 (0.252)<br>±0.40 (0.016)  |                           | 0.60 (0.024)<br>±0.35 (0.014) |                      |                              |
| 2220          | 5650             | 5.70 (0.224)<br>±0.40 (0.016)  | 5.00 (0.197)<br>±0.40 (0.016)  |                           | 0.60 (0.024)<br>±0.35 (0.014) |                      |                              |
| 2225          | 5664             | 5.60 (0.220)<br>±0.40 (0.016)  | 6.40 (0.248)<br>±0.40 (0.016)  |                           | 0.60 (0.024)<br>±0.35 (0.014) |                      |                              |
| 2824          | 7260             | 7.10 (0.280)<br>±0.40 (0.016)  | 6.10 (0.240)<br>±0.40 (0.016)  |                           | 1.27 (0.050)<br>±0.40 (0.016) |                      |                              |
| 3040          | 7610             | 7.60 (0.300)<br>±0.40 (0.016)  | 10.20 (0.402)<br>±0.40 (0.016) |                           | 1.27 (0.050)<br>±0.40 (0.016) |                      |                              |
| 3640          | 9210             | 9.10 (0.358)<br>±0.40 (0.016)  | 10.20 (0.402)<br>±0.40 (0.016) |                           | 1.27 (0.050)<br>±0.40 (0.016) |                      |                              |
| 4540          | -                | 11.40 (0.449)<br>±0.40 (0.016) | 10.20 (0.402)<br>±0.40 (0.016) |                           | 1.27 (0.050)<br>±0.40 (0.016) | Solder Reflow Only   |                              |

**Table 1A – Capacitance Range/Selection Waterfall (0805 – 1808 Case Sizes)**

| Capacitance   | Cap Code   | Case Size/Series      |   |   |   |   | C0805H   |     |      | C1206H |     |      |      |      | C1210H |     |      |      |      | C1808H |     |      |      |      |    |    |    |
|---------------|------------|-----------------------|---|---|---|---|--|-----|------|--------|-----|------|------|------|--------|-----|------|------|------|--------|-----|------|------|------|----|----|----|
|               |            | Voltage Code          |   |   |   |   | C  | B   | D    | C      | B   | D    | F    | G    | C      | B   | D    | F    | G    | C      | B   | D    | F    | G    |    |    |    |
|               |            | Rated Voltage (VDC)   |   |   |   |   | 500  | 630 | 1000 | 500    | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 |    |    |    |
|               |            | Capacitance Tolerance |   |   |   |   | Product Availability and Chip Thickness Codes<br>See Table 2 for Chip Thickness Dimensions |     |      |        |     |      |      |      |        |     |      |      |      |        |     |      |      |      |    |    |    |
| 1.0 - 9.1 pF* | 109 - 919* | B                     | C | D | F | G | J  | K   | M    | DG     | DG  | DG   | ED   | ED   | ED     | ED  | ED   | FM   | FM   | FM     | FM  | FM   | LB   | LB   | LB | LB | LB |
| 10 pF - 47pF* | 100 - 470* |                       |   |   | F | G | J  | K   | M    | DG     | DG  | DG   | ED   | ED   | ED     | ED  | ED   | FM   | FM   | FM     | FM  | FM   | LB   | LB   | LB | LB | LB |
| 51 pF         | 510        |                       |   |   | F | G | J  | K   | M    | DG     | DG  | DG   | ED   | ED   | ED     | ED  | ED   | FM   | FM   | FM     | FM  | FM   | LB   | LB   | LB | LB | LB |
| 56 pF         | 560        |                       |   |   | F | G | J  | K   | M    | DG     | DG  | DG   | ED   | ED   | ED     | ED  | ED   | FM   | FM   | FM     | FM  | FM   | LB   | LB   | LB | LB | LB |
| 62 pF         | 620        |                       |   |   | F | G | J  | K   | M    | DG     | DG  | DG   | ED   | ED   | ED     | ED  | ED   | FM   | FM   | FM     | FM  | FM   | LB   | LB   | LB | LB | LB |
| 68 pF         | 680        |                       |   |   | F | G | J  | K   | M    | DG     | DG  | DG   | ED   | ED   | ED     | ED  | ED   | FM   | FM   | FM     | FM  | FM   | LB   | LB   | LB | LB | LB |
| 75 pF         | 750        |                       |   |   | F | G | J  | K   | M    | DG     | DG  | DG   | ED   | ED   | ED     | ED  | EF   | FM   | FM   | FM     | FM  | FM   | LB   | LB   | LB | LB | LB |
| 82 pF         | 820        |                       |   |   | F | G | J  | K   | M    | DG     | DG  | DG   | ED   | ED   | ED     | ED  | EF   | FM   | FM   | FM     | FM  | FM   | LB   | LB   | LB | LB | LB |
| 91 pF         | 910        |                       |   |   | F | G | J  | K   | M    | DG     | DG  | DG   | ED   | ED   | ED     | ED  | EF   | FM   | FM   | FM     | FM  | FM   | LB   | LB   | LB | LB | LB |
| 100 pF        | 101        |                       |   |   | F | G | J  | K   | M    | DG     | DG  | DG   | ED   | ED   | ED     | ED  | EF   | FM   | FM   | FM     | FM  | FM   | LB   | LB   | LB | LB | LB |
| 110 pF        | 111        |                       |   |   | F | G | J  | K   | M    | DG     | DG  | DG   | ED   | ED   | ED     | ED  | EG   | FM   | FM   | FM     | FM  | FM   | LB   | LB   | LB | LB | LB |
| 120 pF        | 121        |                       |   |   | F | G | J  | K   | M    | DG     | DG  | DG   | ED   | ED   | ED     | ED  | EG   | FG   | FG   | FG     | FM  | FM   | LA   | LA   | LA | LA | LB |
| 130 pF        | 131        |                       |   |   | F | G | J  | K   | M    | DG     | DG  | DG   | ED   | ED   | ED     | ED  | EG   | FG   | FG   | FG     | FM  | FM   | LA   | LA   | LA | LA | LB |
| 150 pF        | 151        |                       |   |   | F | G | J  | K   | M    | DG     | DG  | DG   | ED   | ED   | ED     | ED  | EG   | FG   | FG   | FG     | FM  | FM   | LA   | LA   | LA | LA | LB |
| 160 pF        | 161        |                       |   |   | F | G | J  | K   | M    | DG     | DG  | DG   | ED   | ED   | ED     | ED  | EG   | FG   | FG   | FG     | FM  | FM   | LA   | LA   | LA | LA | LC |
| 180 pF        | 181        |                       |   |   | F | G | J  | K   | M    | DG     | DG  | DG   | ED   | ED   | ED     | ED  | EG   | FG   | FG   | FG     | FM  | FM   | LA   | LA   | LA | LA | LC |
| 200 pF        | 201        |                       |   |   | F | G | J  | K   | M    | DG     | DG  | DG   | ED   | ED   | ED     | ED  | EG   | FG   | FG   | FG     | FM  | FM   | LA   | LA   | LA | LA | LC |
| 220 pF        | 221        |                       |   |   | F | G | J  | K   | M    | DG     | DG  | DG   | ED   | ED   | ED     | ED  | EG   | FG   | FG   | FG     | FM  | FM   | LA   | LA   | LA | LA | LC |
| 240 pF        | 241        |                       |   |   | F | G | J  | K   | M    | DG     | DG  | DG   | ED   | ED   | ED     | ED  | EG   | FG   | FG   | FG     | FM  | FM   | LA   | LA   | LA | LB | LC |
| 270 pF        | 271        |                       |   |   | F | G | J  | K   | M    | DG     | DG  | DG   | ED   | ED   | ED     | ED  | EG   | FG   | FG   | FG     | FK  | FK   | LA   | LA   | LA | LB | LC |
| 300 pF        | 301        |                       |   |   | F | G | J  | K   | M    | DG     | DG  |      | ED   | ED   | ED     | ED  | EG   | FG   | FG   | FG     | FK  | FK   | LA   | LA   | LA | LB | LC |
| 330 pF        | 331        |                       |   |   | F | G | J  | K   | M    | DG     | DG  |      | ED   | ED   | ED     | ED  | EG   | FG   | FG   | FG     | FK  | FK   | LA   | LA   | LA | LB | LC |
| 360 pF        | 361        |                       |   |   | F | G | J  | K   | M    | DG     | DG  |      | ED   | ED   | ED     | ED  | EG   | FG   | FG   | FG     | FK  | FS   | LA   | LA   | LA | LB | LA |
| 390 pF        | 391        |                       |   |   | F | G | J  | K   | M    | DG     | DG  |      | ED   | ED   | ED     | ED  | EG   | FG   | FG   | FG     | FK  | FS   | LA   | LA   | LA | LB | LA |
| 430 pF        | 431        |                       |   |   | F | G | J  | K   | M    | DG     | DG  |      | ED   | ED   | ED     | ED  | EG   | FG   | FM   | FM     | FS  | FS   | LA   | LB   | LB | LC | LA |
| 470 pF        | 471        |                       |   |   | F | G | J  | K   | M    | DG     | DG  |      | ED   | ED   | ED     | ED  | EG   | FG   | FM   | FM     | FS  | FS   | LA   | LB   | LB | LC | LA |
| 510 pF        | 511        |                       |   |   | F | G | J  | K   | M    | DG     | DG  |      | ED   | ED   | ED     | ED  | EG   | FG   | FM   | FM     | FS  | FS   | LA   | LB   | LB | LC | LB |
| 560 pF        | 561        |                       |   |   | F | G | J  | K   | M    | DG     | DG  |      | ED   | ED   | ED     | ED  | EG   | FG   | FM   | FM     | FS  | FS   | LA   | LB   | LB | LC | LB |
| 620 pF        | 621        |                       |   |   | F | G | J  | K   | M    | DG     |     |      | ED   | ED   | ED     | ED  | EG   | FG   | FM   | FM     | FS  | FS   | LA   | LB   | LB | LA | LC |
| 680 pF        | 681        |                       |   |   | F | G | J  | K   | M    | DG     |     |      | ED   | ED   | ED     | ED  | EG   | FG   | FM   | FM     | FS  | FS   | LB   | LB   | LB | LA | LC |
| 750 pF        | 751        |                       |   |   | F | G | J  | K   | M    | DG     |     |      | ED   | ED   | ED     | ED  | EG   | FG   | FM   | FM     | FM  |      | LB   | LB   | LB | LA |    |
| 820 pF        | 821        |                       |   |   | F | G | J  | K   | M    | DG     |     |      | ED   | ED   | ED     | ED  | EG   | FG   | FM   | FM     | FM  |      | LB   | LB   | LB | LA |    |
| 910 pF        | 911        |                       |   |   | F | G | J  | K   | M    |        |     |      | ED   | ED   | ED     | ED  | EG   | FM   | FM   | FM     | FY  |      | LB   | LB   | LB | LA |    |
| 1,000 pF      | 102        |                       |   |   | F | G | J  | K   | M    |        |     |      | ED   | ED   | ED     | ED  | EG   | FM   | FM   | FM     | FY  |      | LB   | LB   | LB | LB |    |
| 1,100 pF      | 112        |                       |   |   | F | G | J  | K   | M    |        |     |      | EF   | EG   |        |     |      | FM   | FK   | FK     | FS  |      | LC   | LC   | LC | LB |    |
| 1,200 pF      | 122        |                       |   |   | F | G | J  | K   | M    |        |     |      | EF   | EG   |        |     |      | FM   | FK   | FK     | FS  |      | LC   | LC   | LC | LC |    |
| 1,300 pF      | 132        |                       |   |   | F | G | J  | K   | M    |        |     |      | EF   | EG   |        |     |      | FM   | FS   | FS     |     |      | LC   | LC   | LC | LC |    |
| 1,500 pF      | 152        |                       |   |   | F | G | J  | K   | M    |        |     |      | EF   | EG   |        |     |      | FK   | FS   | FS     |     |      | LC   | LC   | LC | LC |    |
| 1,600 pF      | 162        |                       |   |   | F | G | J  | K   | M    |        |     |      | EF   | EG   |        |     |      | FK   | FS   | FS     |     |      | LC   | LC   | LC |    |    |
| 1,800 pF      | 182        |                       |   |   | F | G | J  | K   | M    |        |     |      | EF   | EG   |        |     |      | FK   | FS   | FS     |     |      | LC   | LC   | LC |    |    |
| 2,000 pF      | 202        |                       |   |   | F | G | J  | K   | M    |        |     |      | EG   |      |        |     |      | FK   | FL   | FS     |     |      | LC   | LA   | LB |    |    |
| 2,200 pF      | 222        |                       |   |   | F | G | J  | K   | M    |        |     |      | EG   |      |        |     |      | FK   | FL   | FS     |     |      | LC   | LA   | LB |    |    |
| 2,400 pF      | 242        |                       |   |   | F | G | J  | K   | M    |        |     |      | EG   |      |        |     |      | FS   | FL   | FS     |     |      | LC   | LA   | LB |    |    |
| 2,700 pF      | 272        |                       |   |   | F | G | J  | K   | M    |        |     |      | EG   |      |        |     |      | FS   | FL   | FS     |     |      | LC   | LA   | LC |    |    |
| 3,000 pF      | 302        |                       |   |   | F | G | J  | K   | M    |        |     |      |      |      |        |     |      | FS   | FL   |        |     |      | LA   | LA   |    |    |    |
| 3,300 pF      | 332        |                       |   |   | F | G | J  | K   | M    |        |     |      |      |      |        |     |      | FS   | FM   |        |     |      | LA   | LA   |    |    |    |
| 3,600 pF      | 362        |                       |   |   | F | G | J  | K   | M    |        |     |      |      |      |        |     |      | FL   | FM   |        |     |      | LA   | LB   |    |    |    |
| 3,900 pF      | 392        |                       |   |   | F | G | J  | K   | M    |        |     |      |      |      |        |     |      | FL   | FY   |        |     |      | LA   | LB   |    |    |    |
| 4,300 pF      | 432        |                       |   |   | F | G | J  | K   | M    |        |     |      |      |      |        |     |      | FM   | FY   |        |     |      | LA   | LC   |    |    |    |
| 4,700 pF      | 472        |                       |   |   | F | G | J  | K   | M    |        |     |      |      |      |        |     |      | FM   | FY   |        |     |      | LA   | LC   |    |    |    |
| Capacitance   | Cap Code   | Rated Voltage (VDC)   |   |   |   |   | 500  | 630 | 1000 | 500    | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 |    |    |    |
|               |            | Voltage Code          |   |   |   |   | C  | B   | D    | C      | B   | D    | F    | G    | C      | B   | D    | F    | G    | C      | B   | D    | F    | G    |    |    |    |
|               |            | Case Size/Series      |   |   |   |   | C0805H   |     |      | C1206H |     |      |      |      | C1210H |     |      |      |      | C1808H |     |      |      |      |    |    |    |

\*Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, and 91)  
 KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).  
 These products are protected under US Patents 7,172,985 and 7,670,981, other patents pending, and any foreign counterparts.

**Table 1A – Capacitance Range/Selection Waterfall (0805 – 1808 Case Sizes) cont.**

| Capacitance | Cap Code | Case Size/Series   | C0805H |     |      | C1206H |     |      |      |      | C1210H |     |      |      |      | C1808H |     |      |      |      |  |  |
|-------------|----------|--|--------|-----|------|--------|-----|------|------|------|--------|-----|------|------|------|--------|-----|------|------|------|--|--|
|             |          | Voltage Code   | C      | B   | D    | C      | B   | D    | F    | G    | C      | B   | D    | F    | G    | C      | B   | D    | F    | G    |  |  |
|             |          | Rated Voltage (VDC)  | 500    | 630 | 1000 | 500    | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 |  |  |
| 5,100 pF    | 512      |  |        |     |      |        |     |      |      |      |        |     |      |      |      |        |     |      |      |      |  |  |
| 5,600 pF    | 562      |  | F      | G   | J    | K      | M   |      |      |      |        |     |      |      | FY   | FS     |     |      |      |      |  |  |
| 6,200 pF    | 622      |  | F      | G   | J    | K      | M   |      |      |      |        |     |      |      | FY   | FS     |     |      |      |      |  |  |
| 6,800 pF    | 682      |  | F      | G   | J    | K      | M   |      |      |      |        |     |      |      | FY   | FS     |     |      |      |      |  |  |
| 7,500 pF    | 752      |  | F      | G   | J    | K      | M   |      |      |      |        |     |      |      | FY   | FS     |     |      |      |      |  |  |
| 8,200 pF    | 822      |  | F      | G   | J    | K      | M   |      |      |      |        |     |      |      | FY   | FS     |     |      |      |      |  |  |
|             |          | Product Availability and Chip Thickness Codes<br>See Table 2 for Chip Thickness Dimensions |        |     |      |        |     |      |      |      |        |     |      |      |      |        |     |      |      |      |  |  |
| Capacitance | Cap Code | Case Size/Series   | C0805H |     |      | C1206H |     |      |      |      | C1210H |     |      |      |      | C1808H |     |      |      |      |  |  |
|             |          | Rated Voltage (VDC)  | 500    | 630 | 1000 | 500    | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 |  |  |
|             |          | Voltage Code   | C      | B   | D    | C      | B   | D    | F    | G    | C      | B   | D    | F    | G    | C      | B   | D    | F    | G    |  |  |

\*Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).

These products are protected under US Patents 7,172,985 and 7,670,981, other patents pending, and any foreign counterparts.

**Table 1B – Capacitance Range/Selection Waterfall (1812 – 2225 Case Sizes)**

| Capacitance   | Cap Code   | Case Size/Series      | C1812H   |     |      |      |      | C1825H |     |      |      |      | C2220H |     |      |      |      | C2225H |     |      |      |      |
|---------------|------------|-----------------------|--|-----|------|------|------|--------|-----|------|------|------|--------|-----|------|------|------|--------|-----|------|------|------|
|               |            | Voltage Code          | C  | B   | D    | F    | G    | C      | B   | D    | F    | G    | C      | B   | D    | F    | G    | C      | B   | D    | F    | G    |
|               |            | Rated Voltage (VDC)   | 500  | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 |
|               |            | Capacitance Tolerance | Product Availability and Chip Thickness Codes<br>See Table 2 for Chip Thickness Dimensions |     |      |      |      |        |     |      |      |      |        |     |      |      |      |        |     |      |      |      |
| 10 pF - 47pF* | 100 - 470* | F G J K M             | GK   | GK  | GK   | GK   | GK   | HG     | HG  | HG   | HG   | HG   | JK     | JK  | JK   | JK   | JK   | KF     | KF  | KF   | KF   | KF   |
| 51 pF         | 510        | F G J K M             | GK   | GK  | GK   | GK   | GK   | HG     | HG  | HG   | HG   | HG   | JK     | JK  | JK   | JK   | JK   | KF     | KF  | KF   | KF   | KF   |
| 56 pF         | 560        | F G J K M             | GK   | GK  | GK   | GK   | GK   | HG     | HG  | HG   | HG   | HG   | JK     | JK  | JK   | JK   | JK   | KF     | KF  | KF   | KF   | KF   |
| 62 pF         | 620        | F G J K M             | GK   | GK  | GK   | GK   | GK   | HG     | HG  | HG   | HG   | HG   | JK     | JK  | JK   | JK   | JK   | KF     | KF  | KF   | KF   | KF   |
| 68 pF         | 680        | F G J K M             | GK   | GK  | GK   | GK   | GK   | HG     | HG  | HG   | HG   | HG   | JK     | JK  | JK   | JK   | JK   | KF     | KF  | KF   | KF   | KF   |
| 75 pF         | 750        | F G J K M             | GK   | GK  | GK   | GK   | GK   | HG     | HG  | HG   | HG   | HG   | JK     | JK  | JK   | JK   | JK   | KF     | KF  | KF   | KF   | KF   |
| 82 pF         | 820        | F G J K M             | GK   | GK  | GK   | GK   | GK   | HG     | HG  | HG   | HG   | HG   | JK     | JK  | JK   | JK   | JK   | KF     | KF  | KF   | KF   | KF   |
| 91 pF         | 910        | F G J K M             | GK   | GK  | GK   | GK   | GK   | HG     | HG  | HG   | HG   | HG   | JK     | JK  | JK   | JK   | JK   | KF     | KF  | KF   | KF   | KF   |
| 100 pF        | 101        | F G J K M             | GK   | GK  | GK   | GK   | GK   | HG     | HG  | HG   | HG   | HG   | JK     | JK  | JK   | JK   | JK   | KF     | KF  | KF   | KF   | KF   |
| 110 pF        | 111        | F G J K M             | GK   | GK  | GK   | GK   | GK   | HG     | HG  | HG   | HG   | HG   | JK     | JK  | JK   | JK   | JK   | KF     | KF  | KF   | KF   | KF   |
| 120 pF        | 121        | F G J K M             | GK   | GK  | GK   | GK   | GK   | HG     | HG  | HG   | HG   | HG   | JK     | JK  | JK   | JK   | JK   | KF     | KF  | KF   | KF   | KF   |
| 130 pF        | 131        | F G J K M             | GK   | GK  | GK   | GK   | GK   | HG     | HG  | HG   | HG   | HG   | JK     | JK  | JK   | JK   | JK   | KF     | KF  | KF   | KF   | KF   |
| 150 pF        | 151        | F G J K M             | GK   | GK  | GK   | GK   | GK   | HG     | HG  | HG   | HG   | HG   | JK     | JK  | JK   | JK   | JK   | KF     | KF  | KF   | KF   | KF   |
| 160 pF        | 161        | F G J K M             | GK   | GK  | GK   | GK   | GK   | HG     | HG  | HG   | HG   | HG   | JK     | JK  | JK   | JK   | JK   | KF     | KF  | KF   | KF   | KF   |
| 180 pF        | 181        | F G J K M             | GK   | GK  | GK   | GK   | GK   | HG     | HG  | HG   | HG   | HG   | JK     | JK  | JK   | JK   | JK   | KF     | KF  | KF   | KF   | KF   |
| 200 pF        | 201        | F G J K M             | GH   | GH  | GH   | GH   | GH   | HE     | HE  | HE   | HE   | HE   | JK     | JK  | JK   | JK   | JK   | KF     | KF  | KF   | KF   | KF   |
| 220 pF        | 221        | F G J K M             | GH   | GH  | GH   | GH   | GH   | HE     | HE  | HE   | HE   | HE   | JK     | JK  | JK   | JK   | JK   | KF     | KF  | KF   | KF   | KF   |
| 240 pF        | 241        | F G J K M             | GH   | GH  | GH   | GH   | GH   | HE     | HE  | HE   | HE   | HE   | JK     | JK  | JK   | JK   | JK   | KE     | KE  | KE   | KE   | KE   |
| 270 pF        | 271        | F G J K M             | GH   | GH  | GH   | GH   | GH   | HE     | HE  | HE   | HE   | HE   | JK     | JK  | JK   | JK   | JK   | KE     | KE  | KE   | KE   | KE   |
| 300 pF        | 301        | F G J K M             | GH   | GH  | GH   | GH   | GH   | HE     | HE  | HE   | HE   | HE   | JK     | JK  | JK   | JK   | JK   | KE     | KE  | KE   | KE   | KE   |
| 330 pF        | 331        | F G J K M             | GH   | GH  | GH   | GH   | GH   | HE     | HE  | HE   | HE   | HE   | JE     | JE  | JE   | JE   | JE   | KE     | KE  | KE   | KE   | KE   |
| 360 pF        | 361        | F G J K M             | GK   | GK  | GK   | GK   | GK   | HE     | HE  | HE   | HE   | HE   | JE     | JE  | JE   | JE   | JE   | KE     | KE  | KE   | KE   | KE   |
| 390 pF        | 391        | F G J K M             | GK   | GK  | GK   | GK   | GK   | HE     | HE  | HE   | HE   | HE   | JE     | JE  | JE   | JE   | JE   | KE     | KE  | KE   | KE   | KE   |
| 430 pF        | 431        | F G J K M             | GK   | GK  | GK   | GK   | GK   | HE     | HE  | HE   | HE   | HE   | JE     | JE  | JE   | JE   | JE   | KE     | KE  | KE   | KE   | KE   |
| 470 pF        | 471        | F G J K M             | GK   | GK  | GK   | GK   | GK   | HE     | HE  | HE   | HE   | HE   | JE     | JE  | JE   | JE   | JE   | KF     | KF  | KF   | KF   | KF   |
| 510 pF        | 511        | F G J K M             | GH   | GH  | GH   | GH   | GH   | HE     | HE  | HE   | HE   | HE   | JK     | JK  | JK   | JK   | JK   | KF     | KF  | KF   | KF   | KE   |
| 560 pF        | 561        | F G J K M             | GH   | GH  | GH   | GK   | GH   | HE     | HE  | HE   | HE   | HG   | JK     | JK  | JK   | JK   | JK   | KF     | KF  | KF   | KF   | KE   |
| 620 pF        | 621        | F G J K M             | GH   | GH  | GH   | GK   | GH   | HE     | HE  | HE   | HE   | HG   | JK     | JK  | JK   | JK   | JK   | KF     | KF  | KF   | KF   | KE   |
| 680 pF        | 681        | F G J K M             | GH   | GH  | GH   | GK   | GH   | HE     | HE  | HE   | HE   | HG   | JE     | JE  | JE   | JK   | JK   | KF     | KF  | KF   | KF   | KE   |
| 750 pF        | 751        | F G J K M             | GH   | GH  | GH   | GK   | GK   | HE     | HE  | HE   | HG   | HG   | JE     | JE  | JE   | JK   | JK   | KE     | KE  | KE   | KE   | KE   |
| 820 pF        | 821        | F G J K M             | GH   | GH  | GH   | GK   | GK   | HE     | HE  | HE   | HG   | HG   | JE     | JE  | JE   | JK   | JK   | KE     | KE  | KE   | KF   | KE   |
| 910 pF        | 911        | F G J K M             | GH   | GH  | GH   | GH   | GM   | HE     | HE  | HE   | HG   | HG   | JE     | JK  | JK   | JK   | JK   | KE     | KE  | KE   | KF   | KE   |
| 1,000 pF      | 102        | F G J K M             | GH   | GH  | GH   | GH   | GM   | HE     | HE  | HE   | HG   | HG   | JE     | JK  | JK   | JK   | JK   | KE     | KE  | KE   | KF   | KE   |
| 1,100 pF      | 112        | F G J K M             | GH   | GK  | GH   | GH   | GO   | HE     | HE  | HE   | HG   | HG   | JE     | JK  | JK   | JK   | JK   | KE     | KE  | KE   | KF   | KF   |
| 1,200 pF      | 122        | F G J K M             | GH   | GK  | GK   | GH   | GO   | HE     | HE  | HE   | HG   | HG   | JE     | JK  | JK   | JK   | JK   | KE     | KE  | KE   | KF   | KF   |
| 1,300 pF      | 132        | F G J K M             | GH   | GK  | GK   | GH   | GO   | HE     | HE  | HE   | HG   | HE   | JE     | JK  | JK   | JK   | JE   | KE     | KE  | KE   | KF   | KF   |
| 1,500 pF      | 152        | F G J K M             | GK   | GK  | GK   | GK   | GO   | HE     | HE  | HE   | HG   | HE   | JE     | JK  | JK   | JK   | JE   | KE     | KE  | KE   | KF   | KF   |
| 1,600 pF      | 162        | F G J K M             | GK   | GK  | GK   | GK   |      | HE     | HG  | HG   | HG   | HG   | JE     | JK  | JK   | JK   | JE   | KE     | KE  | KE   | KF   | KE   |
| 1,800 pF      | 182        | F G J K M             | GK   | GK  | GK   | GM   |      | HE     | HG  | HG   | HG   | HG   | JE     | JK  | JK   | JK   | JE   | KE     | KE  | KE   | KF   | KE   |
| 2,000 pF      | 202        | F G J K M             | GK   | GK  | GK   | GM   |      | HE     | HG  | HG   | HE   | HJ   | JE     | JK  | JK   | JE   | JK   | KE     | KE  | KE   | KF   | KE   |
| 2,200 pF      | 222        | F G J K M             | GK   | GK  | GK   | GO   |      | HE     | HG  | HG   | HE   | HJ   | JE     | JK  | JK   | JE   | JK   | KE     | KE  | KE   | KF   | KF   |
| 2,400 pF      | 242        | F G J K M             | GK   | GH  | GK   | GO   |      | HE     | HG  | HG   | HE   | HJ   | JK     | JK  | JK   | JE   | JL   | KE     | KE  | KE   | KE   | KH   |
| 2,700 pF      | 272        | F G J K M             | GK   | GH  | GK   | GO   |      | HE     | HG  | HG   | HE   | HK   | JK     | JK  | JK   | JE   | JL   | KE     | KE  | KE   | KE   | KH   |
| 3,000 pF      | 302        | F G J K M             | GK   | GH  | GK   |      |      | HG     | HG  | HG   | HE   | HK   | JK     | JK  | JK   | JE   | JL   | KE     | KE  | KE   | KE   | KH   |
| 3,300 pF      | 332        | F G J K M             | GK   | GH  | GK   |      |      | HG     | HG  | HG   | HG   |      | JK     | JK  | JK   | JN   | KE   | KE     | KE  | KE   | KJ   |      |
| 3,600 pF      | 362        | F G J K M             | GK   | GH  | GM   |      |      | HG     | HG  | HG   | HG   |      | JK     | JK  | JK   | JN   | KE   | KF     | KF  | KF   | KJ   |      |
| 3,900 pF      | 392        | F G J K M             | GK   | GH  | GM   |      |      | HG     | HG  | HG   | HJ   |      | JK     | JK  | JK   | JN   | KE   | KF     | KF  | KF   | KJ   |      |
| 4,300 pF      | 432        | F G J K M             | GH   | GH  | GO   |      |      | HG     | HG  | HG   | HJ   |      | JK     | JK  | JK   |      | KE   | KF     | KF  | KF   |      |      |
| 4,700 pF      | 472        | F G J K M             | GH   | GH  | GO   |      |      | HG     | HG  | HG   | HJ   |      | JK     | JK  | JK   | JL   | KE   | KF     | KF  | KH   |      |      |

\*Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, and 91)

KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).

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**Table 1B – Capacitance Range/Selection Waterfall (1812 – 2225 Case Sizes) cont.**

| Capacitance           | Cap Code | Case Size/Series   | C1812H |     |      |      |      | C1825H |     |      |      |      | C2220H |     |      |      |      | C2225H |     |      |      |      |     |     |      |      |      |    |    |  |  |
|-----------------------|----------|--|--------|-----|------|------|------|--------|-----|------|------|------|--------|-----|------|------|------|--------|-----|------|------|------|-----|-----|------|------|------|----|----|--|--|
|                       |          | Voltage Code   | C      | B   | D    | F    | G    | C      | B   | D    | F    | G    | C      | B   | D    | F    | G    | C      | B   | D    | F    | G    |     |     |      |      |      |    |    |  |  |
|                       |          | Rated Voltage (VDC)  | 500    | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 |     |     |      |      |      |    |    |  |  |
| Capacitance Tolerance |          | Product Availability and Chip Thickness Codes<br>See Table 2 for Chip Thickness Dimensions |        |     |      |      |      |        |     |      |      |      |        |     |      |      |      |        |     |      |      |      |     |     |      |      |      |    |    |  |  |
| 5,100 pF              | 512      | F  | G      | J   | K    | M    | GH   | GK     | GO  |      |      |      | HG     | HE  | HG   | HK   |      |        |     | JK   | JK   | JK   | JL  |     |      | KE   | KF   | KF | KH |  |  |
| 5,600 pF              | 562      | F  | G      | J   | K    | M    | GH   | GK     | GO  |      |      |      | HG     | HE  | HG   | HK   |      |        |     | JK   | JK   | JK   | JN  |     |      | KE   | KF   | KF | KH |  |  |
| 6,200pF               | 622      | F  | G      | J   | K    | M    | GH   | GK     |     |      |      |      | HG     | HE  | HG   |      |      |        | JK  | JE   | JE   | JN   |     |     | KE   | KF   | KF   | KJ |    |  |  |
| 6,800pF               | 682      | F  | G      | J   | K    | M    | GH   | GM     |     |      |      |      | HG     | HE  | HJ   |      |      |        | JK  | JE   | JK   | JN   |     |     | KE   | KF   | KF   | KJ |    |  |  |
| 7,500pF               | 752      | F  | G      | J   | K    | M    | GH   | GM     |     |      |      |      | HG     | HE  | HJ   |      |      |        | JK  | JE   | JK   |      |     |     | KF   | KE   | KF   |    |    |  |  |
| 8,200 pF              | 822      | F  | G      | J   | K    | M    | GK   | GO     |     |      |      |      | HG     | HE  | HJ   |      |      |        | JK  | JE   | JL   |      |     |     | KF   | KE   | KF   |    |    |  |  |
| 9,100 pF              | 912      |  |        |     |      |      | GM   | GO     |     |      |      |      | HE     | HG  | HK   |      |      |        | JE  | JE   | JL   |      |     |     | KF   | KE   | KH   |    |    |  |  |
| 10,000 pF             | 103      |  |        |     |      |      | GM   | GO     |     |      |      |      | HE     | HG  | HK   |      |      |        | JE  | JE   | JL   |      |     |     | KF   | KE   | KH   |    |    |  |  |
| 12,000 pF             | 123      |  |        |     |      |      | GO   |        |     |      |      |      | HE     | HG  |      |      |      |        | JE  | JK   | JN   |      |     |     | KE   | KE   | KH   |    |    |  |  |
| 15,000 pF             | 153      |  |        |     |      |      | GO   |        |     |      |      |      | HE     | HJ  |      |      |      |        | JE  | JL   |      |      |     |     | KE   | KF   | KJ   |    |    |  |  |
| 18,000 pF             | 183      |  |        |     |      |      |      |        |     |      |      |      | HG     | HK  |      |      |      |        | JE  | JL   |      |      |     |     | KE   | KH   |      |    |    |  |  |
| 22,000 pF             | 223      |  |        |     |      |      |      |        |     |      |      |      | HJ     |     |      |      |      |        | JK  | JN   |      |      |     |     | KF   | KJ   |      |    |    |  |  |
| 27,000 pF             | 273      |  |        |     |      |      |      |        |     |      |      |      | HJ     |     |      |      |      |        | JL  | JN   |      |      |     |     | KF   | KJ   |      |    |    |  |  |
| 33,000 pF             | 333      |  |        |     |      |      |      |        |     |      |      |      | HK     |     |      |      |      |        | JN  |      |      |      |     |     | KH   | KJ   |      |    |    |  |  |
| 39,000 pF             | 393      |  |        |     |      |      |      |        |     |      |      |      |        |     |      |      |      |        |     |      |      |      |     |     | KJ   |      |      |    |    |  |  |
| Capacitance           | Cap Code | Rated Voltage (VDC)  | 500    | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 | 500 | 630 | 1000 | 1500 | 2000 |    |    |  |  |
|                       |          | Voltage Code   | C      | B   | D    | F    | G    | C      | B   | D    | F    | G    | C      | B   | D    | F    | G    | C      | B   | D    | F    | G    | C   | B   | D    | F    | G    |    |    |  |  |
|                       |          | Case Size/Series   | C1812H |     |      |      |      | C1825H |     |      |      |      | C2220H |     |      |      |      | C2225H |     |      |      |      |     |     |      |      |      |    |    |  |  |

\*Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, and 91)  
 KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).  
 These products are protected under US Patents 7,172,985 and 7,670,981, other patents pending, and any foreign counterparts.



**Table 1C – Capacitance Range/Selection Waterfall (2824 – 4540 Case Sizes)**

| Capacitance   | Cap Code  | Case Size/<br>Series  |   |   | C2824H   |     |      |      |      | C3040H |     |      |      |      | C3640H |     |      |      |      | C4540H |     |      |      |      |
|---------------|-----------|-----------------------|---|---|--|-----|------|------|------|--------|-----|------|------|------|--------|-----|------|------|------|--------|-----|------|------|------|
|               |           | Voltage Code          |   |   | C  | B   | D    | F    | G    | C      | B   | D    | F    | G    | C      | B   | D    | F    | G    | C      | B   | D    | F    | G    |
|               |           | Rated Voltage (VDC)   |   |   | 500  | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 |
|               |           | Capacitance Tolerance |   |   | Product Availability and Chip Thickness Codes<br>See Table 2 for Chip Thickness Dimensions |     |      |      |      |        |     |      |      |      |        |     |      |      |      |        |     |      |      |      |
| 10 - 2,000 pF | 100 - 202 | J                     | K | M |  |     |      |      |      |        |     |      |      |      |        |     |      |      |      |        |     |      |      |      |
| 2,200 pF      | 222       | J                     | K | M | TA   | TA  | TA   | TA   | TA   |        |     |      |      |      |        |     |      |      |      |        |     |      |      |      |
| 2,400 pF      | 242       | J                     | K | M |  |     |      |      |      |        |     |      |      |      |        |     |      |      |      |        |     |      |      |      |
| 2,700 pF      | 272       | J                     | K | M | TA   | TA  | TA   | TA   | TA   |        |     |      |      |      |        |     |      |      |      |        |     |      |      |      |
| 3,000 pF      | 302       | J                     | K | M |  |     |      |      |      |        |     |      |      |      |        |     |      |      |      |        |     |      |      |      |
| 3,300 pF      | 332       | J                     | K | M | TA   | TA  | TA   | TA   | TA   | QB     | QB  | QB   | QB   | QB   |        |     |      |      |      |        |     |      |      |      |
| 3,600 pF      | 362       | J                     | K | M |  |     |      |      |      |        |     |      |      |      |        |     |      |      |      |        |     |      |      |      |
| 3,900 pF      | 392       | J                     | K | M | TA   | TA  | TA   | TA   | TB   | QB     | QB  | QB   | QB   | QB   | MA     | MA  | MA   | MA   | MA   |        |     |      |      |      |
| 4,300 pF      | 432       | J                     | K | M |  |     |      |      |      |        |     |      |      |      |        |     |      |      |      |        |     |      |      |      |
| 4,700 pF      | 472       | J                     | K | M | TA   | TA  | TA   | TB   | TB   | QB     | QB  | QB   | QB   | QB   | MA     | MA  | MA   | MA   | MA   | SA     | SA  | SA   | SA   | SA   |
| 5,100 pF      | 512       | J                     | K | M |  |     |      |      |      |        |     |      |      |      |        |     |      |      |      |        |     |      |      |      |
| 5,600 pF      | 562       | J                     | K | M | TA   | TA  | TA   | TB   | TC   | QB     | QB  | QB   | QB   | QB   | MA     | MA  | MA   | MA   | MA   | SA     | SA  | SA   | SA   | SA   |
| 6,200 pF      | 622       | J                     | K | M |  |     |      |      |      |        |     |      |      |      |        |     |      |      |      |        |     |      |      |      |
| 6,800 pF      | 682       | J                     | K | M | TA   | TA  | TA   | TB   |      | QB     | QB  | QB   | QB   | QC   | MA     | MA  | MA   | MA   | MA   | SA     | SA  | SA   | SA   | SA   |
| 7,500 pF      | 752       | J                     | K | M |  |     |      |      |      |        |     |      |      |      |        |     |      |      |      |        |     |      |      |      |
| 8,200 pF      | 822       | J                     | K | M | TA   | TA  | TA   | TC   |      | QB     | QB  | QB   | QC   | QC   | MA     | MA  | MA   | MA   | MB   | SA     | SA  | SA   | SA   | SA   |
| 9,100 pF      | 912       | J                     | K | M |  |     |      |      |      |        |     |      |      |      |        |     |      |      |      |        |     |      |      |      |
| 10,000 pF     | 103       | J                     | K | M | TA   | TA  | TA   |      |      | QB     | QB  | QB   | QC   | QD   | MA     | MA  | MA   | MA   | MB   | SA     | SA  | SA   | SA   | SB   |
| 12,000 pF     | 123       | J                     | K | M | TA   | TA  | TA   |      |      | QB     | QB  | QB   | QD   |      | MA     | MA  | MA   | MB   | MB   | SA     | SA  | SA   | SA   | SB   |
| 15,000 pF     | 153       | J                     | K | M | TA   | TA  | TB   |      |      | QB     | QB  | QB   | QD   |      | MA     | MA  | MA   | MB   | MC   | SA     | SA  | SA   | SB   | SB   |
| 18,000 pF     | 183       | J                     | K | M | TA   | TA  | TB   |      |      | QB     | QB  | QB   |      |      | MA     | MA  | MA   | MC   |      | SA     | SA  | SA   | SB   | SC   |
| 22,000 pF     | 223       | J                     | K | M | TA   | TB  | TC   |      |      | QB     | QB  | QC   |      |      | MA     | MA  | MA   |      |      | SA     | SA  | SA   | SB   | SB   |
| 27,000 pF     | 273       | J                     | K | M | TA   | TB  |      |      |      | QB     | QB  | QC   |      |      | MA     | MA  | MA   |      |      | SA     | SA  | SA   | SC   |      |
| 33,000 pF     | 333       | J                     | K | M | TB   | TB  |      |      |      | QB     | QC  | QC   |      |      | MA     | MA  | MB   |      |      | SA     | SA  | SA   |      |      |
| 39,000 pF     | 393       | J                     | K | M | TB   | TC  |      |      |      | QB     | QC  | QD   |      |      | MA     | MA  | MB   |      |      | SA     | SA  | SB   |      |      |
| 47,000 pF     | 473       | J                     | K | M | TB   |     |      |      |      | QB     | QC  |      |      |      | MA     | MB  | MC   |      |      | SA     | SA  | SB   |      |      |
| 56,000 pF     | 563       | J                     | K | M | TC   |     |      |      |      | QC     | QD  |      |      |      | MA     | MB  |      |      |      | SA     | SA  | SB   |      |      |
| 68,000 pF     | 683       | J                     | K | M |  |     |      |      |      | QC     | QD  |      |      |      | MB     | MC  |      |      |      | SA     | SB  | SC   |      |      |
| 82,000 pF     | 823       | J                     | K | M |  |     |      |      |      | QC     |     |      |      |      | MB     |     |      |      |      | SA     | SB  |      |      |      |
| 0.1 µF        | 104       | J                     | K | M |  |     |      |      |      | QD     |     |      |      |      | MC     |     |      |      |      | SB     | SC  |      |      |      |
| 0.12 µF       | 124       | J                     | K | M |  |     |      |      |      |        |     |      |      |      | MC     |     |      |      |      | SB     |     |      |      |      |
| 0.15 µF       | 154       | J                     | K | M |  |     |      |      |      |        |     |      |      |      | MC     |     |      |      |      | SC     |     |      |      |      |
| Capacitance   | Cap Code  | Rated Voltage (VDC)   |   |   | 500  | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 | 500    | 630 | 1000 | 1500 | 2000 |
|               |           | Voltage Code          |   |   | C  | B   | D    | F    | G    | C      | B   | D    | F    | G    | C      | B   | D    | F    | G    | C      | B   | D    | F    | G    |
|               |           | Case Size/Series      |   |   | C2824H   |     |      |      |      | C3040H |     |      |      |      | C3640H |     |      |      |      | C4540H |     |      |      |      |

\*Capacitance range Includes E24 decade values only. (i.e., 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, and 91)  
 KEMET reserves the right to substitute product with an improved temperature characteristic, tighter capacitance tolerance and/or higher voltage capability within the same form factor (configuration and dimensions).  
 These products are protected under US Patents 7,172,985 and 7,670,981, other patents pending, and any foreign counterparts.

**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 |
| DG             | 0805      | 1.25±0.15              | 0              | 0        | 2,500            | 10,000   |
| ED             | 1206      | 1.00±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    |
| 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    |
| 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    |
| 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              | 2,500    |
| TB             | 2824      | 2.00±0.20              | 0              | 0        | 300              | 2,000    |
| TC             | 2824      | 2.50±0.20              | 0              | 0        | 300              | 2,000    |
| QB             | 3040      | 1.40±0.15              | 0              | 0        | 500              | 1,650    |
| QC             | 3040      | 2.00±0.20              | 0              | 0        | 500              | 1,650    |
| QD             | 3040      | 2.50±0.20              | 0              | 0        | 350              | 1,400    |
| MA             | 3640      | 1.40±0.15              | 0              | 0        | 250              | 1,550    |
| MB             | 3640      | 2.00±0.20              | 0              | 0        | 250              | 1,550    |
| MC             | 3640      | 2.50±0.20              | 0              | 0        | 250              | 1,000    |
| SA             | 4540      | 1.40±0.15              | 0              | 0        | 200              | 1,500    |
| SB             | 4540      | 2.00±0.20              | 0              | 0        | 200              | 1,500    |
| SC             | 4540      | 2.50±0.20              | 0              | 0        | 200              | 1,500    |
| 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 2B – Bulk Packaging Quantities**

| Packaging Type                |             | Loose Packaging        |  | Secure Packaging                      |         |         |
|-------------------------------|-------------|------------------------|--|---------------------------------------|---------|---------|
|                               |             | Bulk Bag (default)     |  | 2" x 2" Waffle Pack/Tray <sup>3</sup> |         |         |
| Packaging C-Spec <sup>1</sup> |             | N/A <sup>2</sup>       |  | 7282/7292                             |         |         |
| Case Size                     |             | Chip Thickness<br>(mm) | Packaging Quantities (pieces/unit packaging) |                                       |         |         |
| EIA (in)                      | Metric (mm) |                        | Minimum                                      | Maximum                               | Minimum | Maximum |
| 0402                          | 1005        | All                    | 1  | 50,000                                | 1       | 368     |
| 0603                          | 1608        |                        |  |                                       |         | 368     |
| 0805                          | 2012        |                        |  |                                       |         | 100     |
| 1206                          | 3216        | ≤ 1.25 (nominal)       |  | 126                                   |         |         |
| 1206                          | 3216        | > 1.25 (nominal)       |  | 50                                    |         |         |
| 1210                          | 3225        | All                    |  | 20,000                                |         | 1       |
| 1808                          | 4520        |                        | 50   |                                       |         |         |
| 1812                          | 4532        |                        | 42   |                                       |         |         |
| 1825                          | 4564        |                        | 20   |                                       |         |         |
| 2220                          | 5650        |                        | 20   |                                       |         |         |
| 2225                          | 5664        |                        | 20   |                                       |         |         |

<sup>1</sup> The "Packaging C-Spec" is a 4-digit code which identifies the packaging type. When ordering, the proper code must be included in the 15th through 18th character positions of the ordering code. See "Ordering Information" section of this document for further details. Product ordered without a packaging C-Spec will default to our standard "Bulk Bag" packaging.

<sup>2</sup> A packaging C-Spec (see note 1 above) is not required for "Bulk Bag" packaging (excluding Anti-Static Bulk Bag). The 15th through 18th character positions of the ordering code should be left blank. All product ordered without a packaging C-Spec will default to our standard "Bulk Bag" packaging.

<sup>3</sup> Also commonly referred to as "Chip Carrier" or "Molded Tray". All tray packaging options offer static protection.

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

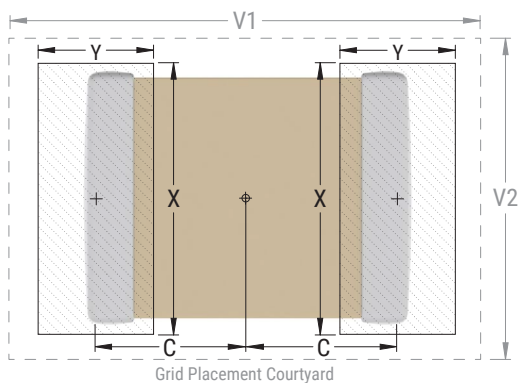
| EIA Size Code | Metric Size Code | Density Level A:<br>Maximum (Most)<br>Land Protrusion (mm) |      |       |       |       | Density Level B:<br>Median (Nominal)<br>Land Protrusion (mm) |      |       |       |       | Density Level C:<br>Minimum (Least)<br>Land Protrusion (mm) |      |       |       |       |
|---------------|------------------|--|------|-------|-------|-------|--|------|-------|-------|-------|---|------|-------|-------|-------|
|               |                  | C  | Y    | X     | V1    | V2    | C  | Y    | X     | V1    | V2    | C   | Y    | X     | V1    | V2    |
| 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  |
| 2824          | 7260             | 3.45   | 1.70 | 6.60  | 9.60  | 7.60  | 3.35   | 1.50 | 6.50  | 8.70  | 7.00  | 3.25  | 1.30 | 6.40  | 8.00  | 6.70  |
| 3040          | 7610             | 3.70   | 1.70 | 10.70 | 10.10 | 11.70 | 3.60   | 1.50 | 10.60 | 9.20  | 11.10 | 3.50  | 1.30 | 10.50 | 8.50  | 10.80 |
| 3640          | 9210             | 4.45   | 1.70 | 10.70 | 11.60 | 11.70 | 4.35   | 1.50 | 10.60 | 10.70 | 11.10 | 4.25  | 1.30 | 10.50 | 10.00 | 10.80 |
| 4540          | -                | 5.60   | 1.70 | 10.70 | 13.90 | 11.70 | 5.50   | 1.50 | 10.60 | 13.00 | 11.10 | 5.40  | 1.30 | 10.50 | 12.30 | 10.80 |

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

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

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

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



## Soldering Process

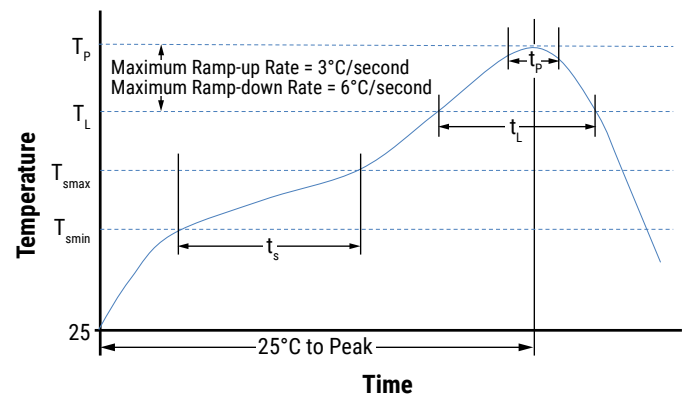
### Recommended Soldering Technique:

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

### Recommended Reflow Soldering Profile:

KEMET’s families of surface mount multilayer ceramic capacitors (SMD MLCCs) are compatible with wave (single or dual), convection, IR or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET’s recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J-STD-020 standard for moisture sensitivity testing. These devices can safely withstand a maximum of three reflow passes at these conditions.

| Profile Feature                                       | Termination Finish |                    |
|---|--------------------|--------------------|
|   | SnPb               | 100% Matte Sn      |
| <b>Preheat/Soak</b>                                   |                    |                    |
| Temperature Minimum ( $T_{Smin}$ )                    | 100°C              | 150°C              |
| Temperature Maximum ( $T_{Smax}$ )                    | 150°C              | 200°C              |
| Time ( $t_s$ ) from $T_{Smin}$ to $T_{Smax}$          | 60 – 120 seconds   | 60 – 120 seconds   |
| Ramp-Up Rate ( $T_L$ to $T_p$ )                       | 3°C/second maximum | 3°C/second maximum |
| Liquidous Temperature ( $T_L$ )                       | 183°C              | 217°C              |
| Time Above Liquidous ( $t_L$ )                        | 60 – 150 seconds   | 60 – 150 seconds   |
| Peak Temperature ( $T_p$ )                            | 235°C              | 260°C              |
| Time Within 5°C of Maximum Peak Temperature ( $t_p$ ) | 20 seconds maximum | 30 seconds maximum |
| Ramp-Down Rate ( $T_p$ to $T_L$ )                     | 6°C/second maximum | 6°C/second maximum |
| Time 25°C to Peak Temperature                         | 6 minutes maximum  | 8 minutes maximum  |

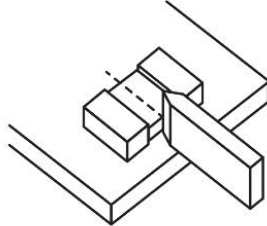
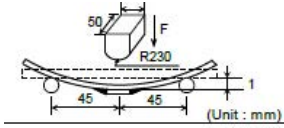


Note 1: All temperatures refer to the center of the package, measured on the capacitor body surface that is facing up during assembly reflow.

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

| Stress                                       | Reference                     | Test Condition   | Limits   |                  |   |       |   |       |   |                               |   |        |   |
|--|-------------------------------|--|--|------------------|---|-------|---|-------|---|-------------------------------|---|--------|---|
| Visual and Mechanical                        | KEMET Internal                | No defects that may affect performance (10X)   | Dimensions according KEMET Spec Sheet  |                  |   |       |   |       |   |                               |   |        |   |
| Capacitance (Cap)                            | KEMET Internal                | $C \leq 1,000 \text{ pF}$<br>Frequency: 1 MHz $\pm 100 \text{ kHz}$<br>Voltage*: 1.0 V <sub>rms</sub> $\pm 0.2 \text{ V}$<br>$C > 1,000 \text{ pF}$<br>Frequency: 1 kHz $\pm 50 \text{ Hz}$<br>Voltage: 1.0 V <sub>rms</sub> $\pm 0.2 \text{ V}$<br>* See part number specification sheet for voltage  | Within Tolerance   |                  |   |       |   |       |   |                               |   |        |   |
| Dissipation Factor (DF)                      | KEMET Internal                | $C \leq 1,000 \text{ pF}$<br>Frequency: 1 MHz $\pm 100 \text{ kHz}$<br>Voltage*: 1.0 V <sub>rms</sub> $\pm 0.2 \text{ V}$<br>$C > 1,000 \text{ pF}$<br>Frequency: 1 kHz $\pm 50 \text{ Hz}$<br>Voltage: 1.0 V <sub>rms</sub> $\pm 0.2 \text{ V}$<br>* See part number specification sheet for voltage  | Within Specification<br>Dissipation factor (DF) maximum limit at 25°C = 0.1%   |                  |   |       |   |       |   |                               |   |        |   |
| Insulation Resistance (IR)                   | KEMET Internal                | 500 VDC applied for 120 $\pm 5$ seconds at 25°C  | Within Specification<br>To obtain IR limit, divide M $\Omega$ - $\mu\text{F}$ value by the capacitance and compare to G $\Omega$ limit. Select the lower of the two limits: 1,000 megohm microfarads or 100 G $\Omega$ . |                  |   |       |   |       |   |                               |   |        |   |
| Temperature Coefficient of Capacitance (TCC) | KEMET Internal                | Capacitance change with reference to +25°C and 0 VDC applied.<br>* See part number specification sheet for voltage<br><table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Step</th> <th>Temperature (°C)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>+25°C</td> </tr> <tr> <td>2</td> <td>-55°C</td> </tr> <tr> <td>3</td> <td>+25°C (Reference Temperature)</td> </tr> <tr> <td>4</td> <td>+125°C</td> </tr> </tbody> </table> | Step   | Temperature (°C) | 1 | +25°C | 2 | -55°C | 3 | +25°C (Reference Temperature) | 4 | +125°C | Within Specification: $\pm 30 \text{ ppm} / ^\circ\text{C}$ |
| Step   | Temperature (°C)              |  |  |                  |   |       |   |       |   |                               |   |        |   |
| 1  | +25°C                         |  |  |                  |   |       |   |       |   |                               |   |        |   |
| 2  | -55°C                         |  |  |                  |   |       |   |       |   |                               |   |        |   |
| 3  | +25°C (Reference Temperature) |  |  |                  |   |       |   |       |   |                               |   |        |   |
| 4  | +125°C                        |  |  |                  |   |       |   |       |   |                               |   |        |   |

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

| Stress  | Reference              | Test Condition   | Limits   |       |      |    |        |     |                                  |
|---|------------------------|--|--|-------|------|----|--------|-----|----------------------------------|
| Dielectric Withstanding Voltage (DWV)               | KEMET Internal         | 150% of rated voltage for voltage rating of < 1,000 V<br>120% of rated voltage for voltage rating of ≥ 1,000 V<br>(5 ±1 seconds and charge/discharge not exceeding 50 mA)  | Cap: Initial Limit<br>DF: Initial Limit<br>IR: Initial Limit<br><br>Withstand test voltage without insulation breakdown or damage. |       |      |    |        |     |                                  |
| Aging Rate (Maximum % Capacitance Loss/Decade Hour) | KEMET Internal         | Maximum % capacitance loss/decade hour   | 0% Loss/Decade Hour  |       |      |    |        |     |                                  |
| Terminal Strength                                   | KEMET Internal         | Shear stress test per specific case size,<br>Time: 60 ±1 second.<br><br><table border="1" style="display: inline-table; margin-right: 20px;"> <thead> <tr> <th>Case Size</th> <th>Force</th> </tr> </thead> <tbody> <tr> <td>0805</td> <td>9N</td> </tr> <tr> <td>≥ 1206</td> <td>18N</td> </tr> </tbody> </table>  | Case Size  | Force | 0805 | 9N | ≥ 1206 | 18N | No evidence of mechanical damage |
| Case Size   | Force                  |  |  |       |      |    |        |     |                                  |
| 0805  | 9N                     |  |  |       |      |    |        |     |                                  |
| ≥ 1206  | 18N                    |  |  |       |      |    |        |     |                                  |
| Board Flex  | AEC-Q200-005           | Standard Termination System 2.0 mm<br>Flexible Termination System 3.0 mm<br>Test Time: 60± 5 seconds<br>Ramp Time: 1 mm/second<br><br>   | No evidence of mechanical damage   |       |      |    |        |     |                                  |
| Resistance to Soldering Heat                        | MIL-STD-202 Method 210 | Condition B, no per-heat of samples, Single Wave Solder  | No evidence of mechanical damage   |       |      |    |        |     |                                  |
| Thermal Shock                                       | MIL-STD-202 Method 107 | 300 cycles (-55°C to +150°C),<br>20 seconds transfer, 15 minute dwell  | Measurement at 24 hours ±4 hours after test conclusion.<br>Cap: Initial Limit<br>DF: Initial Limit<br>IR: Initial Limit            |       |      |    |        |     |                                  |
| Temperature Cycling                                 | JESD22 Method JA-104   | 50 cycles (-55°C to +200°C)  | Measurement at 24 hours ±4 hours after test conclusion.<br>Cap: Initial Limit<br>DF: Initial Limit<br>IR: Initial Limit            |       |      |    |        |     |                                  |

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

| Stress                 | Reference              | Test Condition  | Limits   |
|------------------------|------------------------|---|--|
| Biased Humidity        | MIL-STD-202 Method 103 | Load Humidity: 1,000 hours 85°C/85% RH and 200 VDC maximum<br><br>Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. | Measurement at 24 hours ±4 hours after test conclusion.<br>Within Post Environmental Limits<br>Cap: ±0.3% or ±0.25 pF shift<br>IR: 10% of Initial Limit<br>DF Limits Maximum: 0.5% |
| Moisture Resistance    | MIL-STD-202 Method 106 | Number of Cycles Required: 10, 24 hours per cycle.<br>Steps 7a and 7b not required                                      | Cap: Initial Limit<br>DF: Initial Limit<br>IR: Initial Limit   |
| Thermal Shock          | MIL-STD-202 Method 107 | Number of Cycles Required: 5, (-55°C to 125°C)<br>Dwell time 15 minutes.  | Cap: Initial Limit<br>DF: Initial Limit<br>IR: Initial Limit   |
| Vibration              | MIL-STD-202 Method 204 | 5 g's for 20 minutes, 12 cycles each of 3 orientations.<br>Test from 10 – 2,000 Hz                                      | Cap: Initial Limit<br>DF: Initial Limit<br>IR: Initial Limit   |
| Mechanical Shock       | MIL-STD-202 Method 213 | 1,500 g's 0.5 millisecond Half-sine,<br>Velocity Change: 15.4 feet/second<br>(Condition F)                              | Cap: Initial Limit<br>DF: Initial Limit<br>IR: Initial Limit   |
| Resistance to Solvents | MIL-STD-202 Method 215 | Add Aqueous wash chemical OKEMCLEAN<br>(A 6% concentrated Oakite cleaner) or equivalent.<br>Do not use banned solvents. | Visual Inspection 10X<br>Readable marking, no decoloration or stains.<br>No physical damage.   |

## 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. In addition, 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 the time frame outlined in the table below:

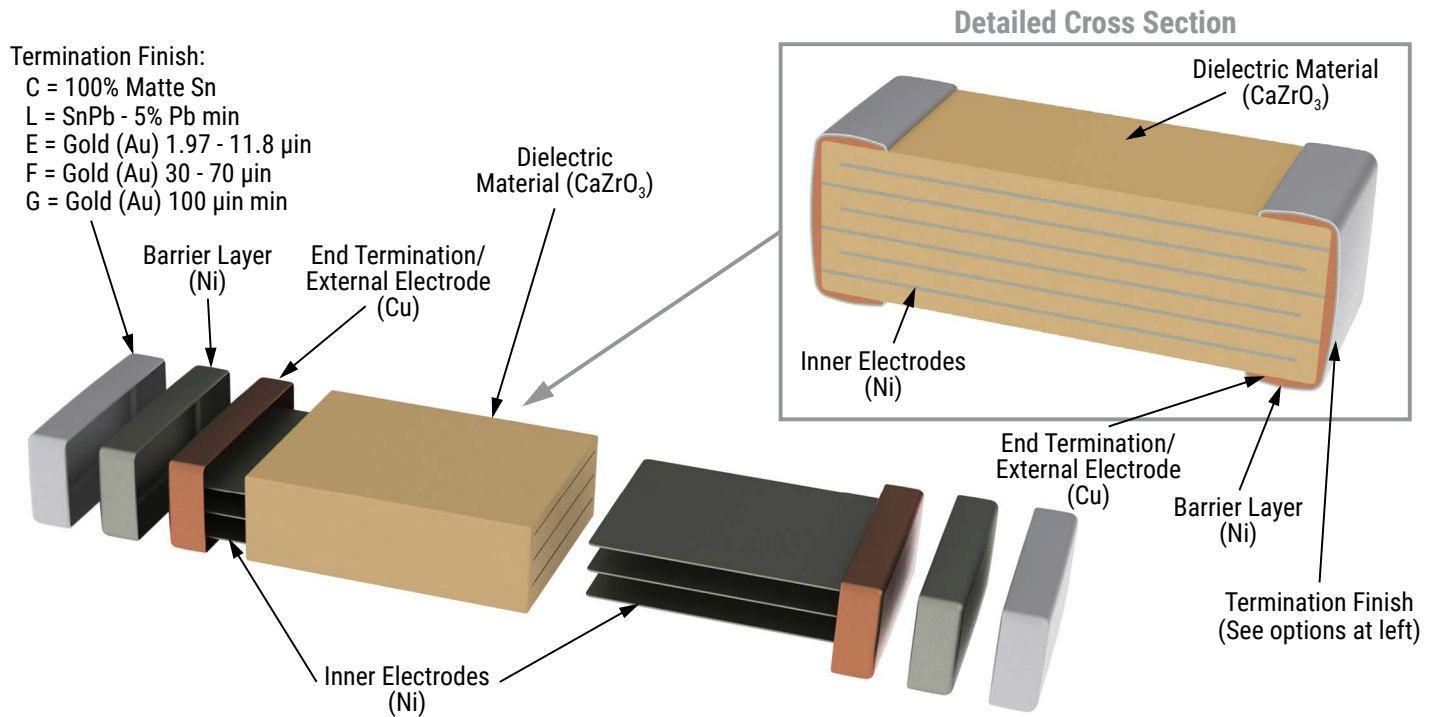
| Termination Finish                     | Termination Finish Ordering Code <sup>1</sup> | Storage Life                       |
|--|---|------------------------------------|
| 100% Matte Tin (Sn)                    | C   | 1.5 years upon receipt             |
| SnPb (5% Pb min.)                      | L   | 1.5 years upon receipt             |
| Gold (Au) 1.97 – 11.8 µin <sup>2</sup> | E   | 6 months upon receipt <sup>2</sup> |
| Gold (Au) 30 – 70 µin                  | F   | 1.5 years upon receipt             |
| Gold (Au) 100 µin min.                 | G   | 1.5 years upon receipt             |

<sup>1</sup> The fourteenth (14th) character position of the KEMET part number is assigned to identify and/or define the termination finish. For more information, see "Ordering Information" section of this document.

<sup>2</sup> Gold plating option "E" devices should remain in its factory sealed moisture sensitive packaging during storage. If the factory sealed packaging is disturbed please store any remaining packaged components in a dry box container to prevent oxidation of the termination finish.



## Construction (Typical)



## Capacitor Marking (Optional):

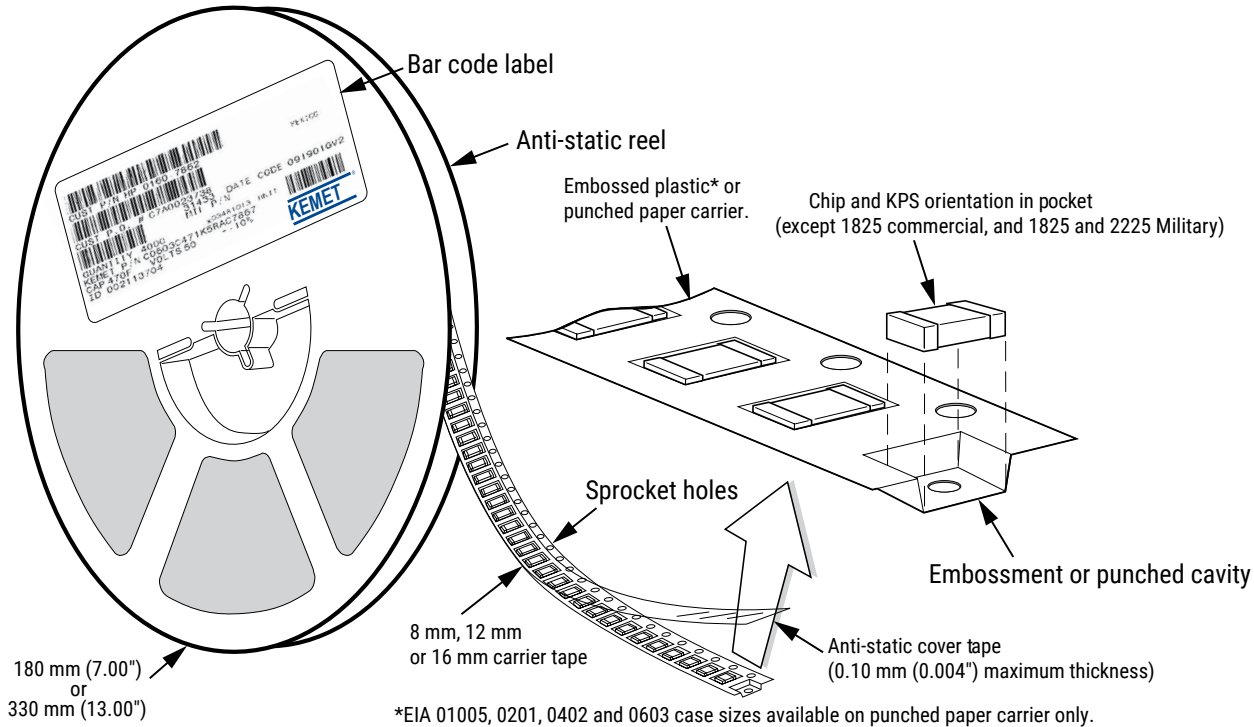
Laser marking option is not available on:

- 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.

These capacitors are supplied unmarked only.

## Tape & Reel Packaging Information

KEMET offers multilayer ceramic chip capacitors packaged in 8, 12, 16 and 24 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              |                          |          | 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        |                          |          |
| 2824              | 16             | 12                       | 12       |                          |          |
| 3040 – 4540       | 24             | 16                       | 16       |                          |          |
| KPS 1210          | 12             | 8                        | 8        |                          |          |
| KPS 1812 & 2220   | 16             | 12                       | 12       |                          |          |
| Array 0508 & 0612 | 8              | 4                        | 4        |                          |          |

### New 2 mm Pitch Reel Options\*

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

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

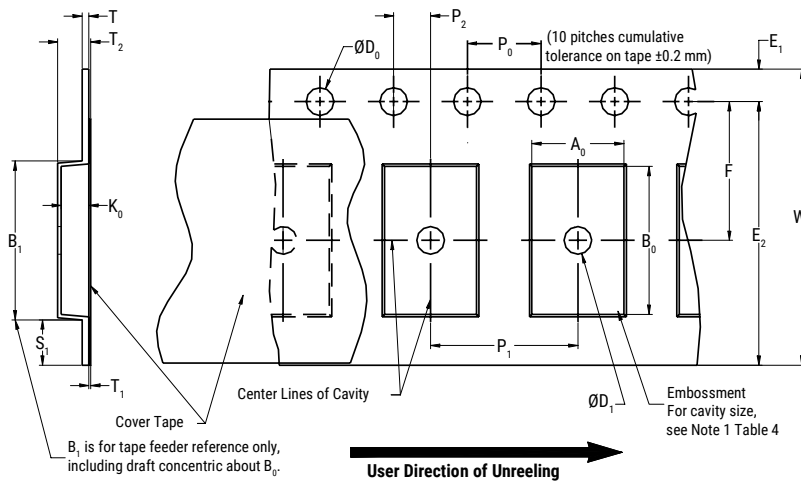
### Benefits of Changing from 4 mm to 2 mm Pitching Spacing

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

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

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

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



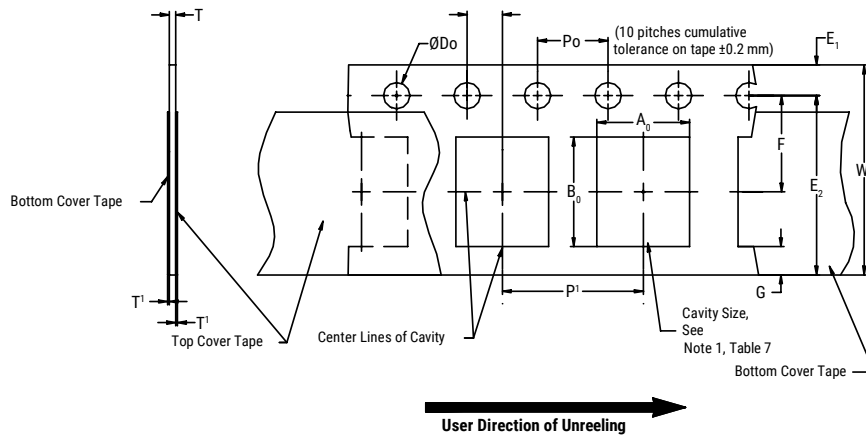
**Table 6 – Embossed (Plastic) Carrier Tape Dimensions**

Metric will govern

| Constant Dimensions – Millimeters (Inches) |                                     |                            |                            |                            |                           |                                  |  |                  |
|--|-------------------------------------|----------------------------|----------------------------|----------------------------|---------------------------|----------------------------------|--|------------------|
| Tape Size                                  | D <sub>0</sub>                      | 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                                     | T1<br>Maximum    |
| 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)  | 25.0<br>(0.984)           | 0.600<br>(0.024)                 | 0.600<br>(0.024)                                 | 0.100<br>(0.004) |
| 12 mm                                      |                                     |                            |                            |                            | 30<br>(1.181)             |                                  |  |                  |
| 16 mm                                      |                                     |                            |                            |                            |                           |                                  |  |                  |
| 24 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±0.10<br>(0.078±0.003)  | 30<br>(1.181)             | 5<br>(0.196)                     | 0.250<br>(0.009)                                 | 0.350<br>(0.013) |
| Variable Dimensions – Millimeters (Inches) |                                     |                            |                            |                            |                           |                                  |  |                  |
| Tape Size                                  | Pitch                               | 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)                       | 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)    | 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)                      | 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                               | 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 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                                  | $D_0$   | $E_1$                                    | $P_0$                                   | $P_2$                                   | $T_1$ Maximum                    | G Minimum       | R Reference Note 2 |
| 8 mm                                       | $1.5 \pm 0.10 / -0.0$<br>( $0.059 \pm 0.004 / -0.0$ ) | $1.75 \pm 0.10$<br>( $0.069 \pm 0.004$ ) | $4.0 \pm 0.10$<br>( $0.157 \pm 0.004$ ) | $2.0 \pm 0.05$<br>( $0.079 \pm 0.002$ ) | $0.10$<br>( $0.004$ )<br>Maximum | 0.75<br>(0.030) | 2<br>(0.984)       |
| Variable Dimensions – Millimeters (Inches) |   |  |   |   |                                  |                 |                    |
| Tape Size                                  | Pitch   | E2 Minimum                               | F                                       | $P_1$                                   | T Maximum                        | W Maximum       | $A_0 B_0$          |
| 8 mm                                       | Half (2 mm)   | 6.25<br>(0.246)                          | $3.5 \pm 0.05$<br>( $0.138 \pm 0.002$ ) | $2.0 \pm 0.05$<br>( $0.079 \pm 0.002$ ) | 1.1<br>(0.098)                   | 8.3<br>(0.327)  | Note 1             |
| 8 mm                                       | Single (4 mm)   |  |   | $4.0 \pm 0.10$<br>( $0.157 \pm 0.004$ ) |                                  |                 |                    |

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

## Packaging Information Performance Notes

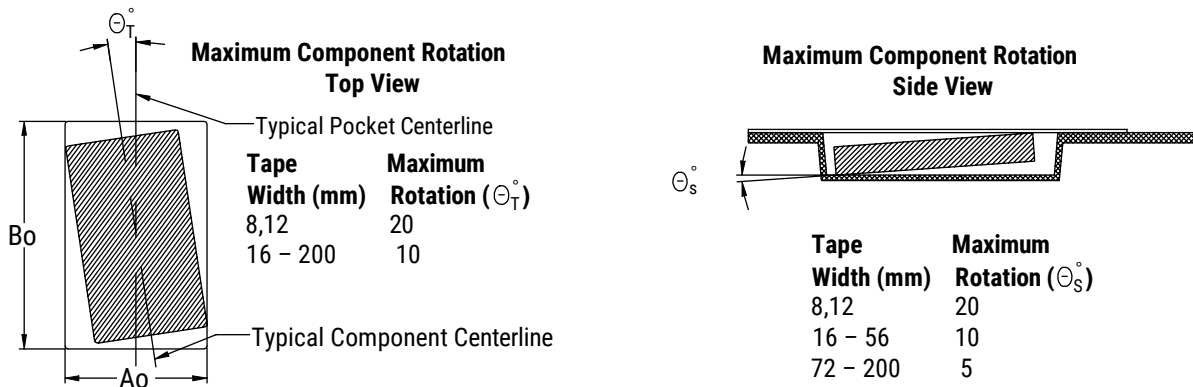
- Cover Tape Break Force:** 1.0 Kg minimum.
- Cover Tape Peel Strength:** The total peel strength of the cover tape from the carrier tape shall be:

| Tape Width   | Peel Strength                    |
|--------------|----------------------------------|
| 8 mm         | 0.1 to 1.0 newton (10 to 100 gf) |
| 12 and 16 mm | 0.1 to 1.3 newton (10 to 130 gf) |
| 24 mm        | 0.1 to 1.6 newton (10 to 160 gf) |

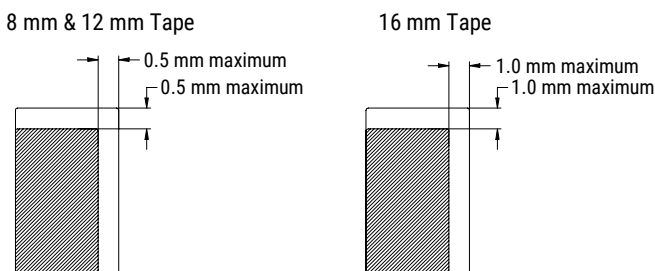
The direction of the pull shall be opposite the direction of the carrier tape travel. The pull angle of the carrier tape shall be 165° to 180° from the plane of the carrier tape. During peeling, the carrier and/or cover tape shall be pulled at a velocity of 300 ±10 mm/minute.

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

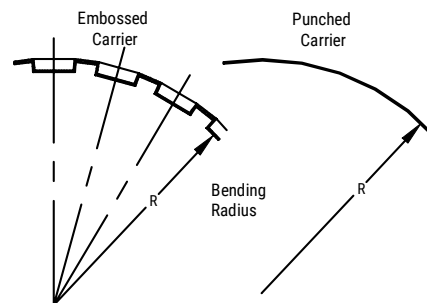
### Figure 3 – Maximum Component Rotation



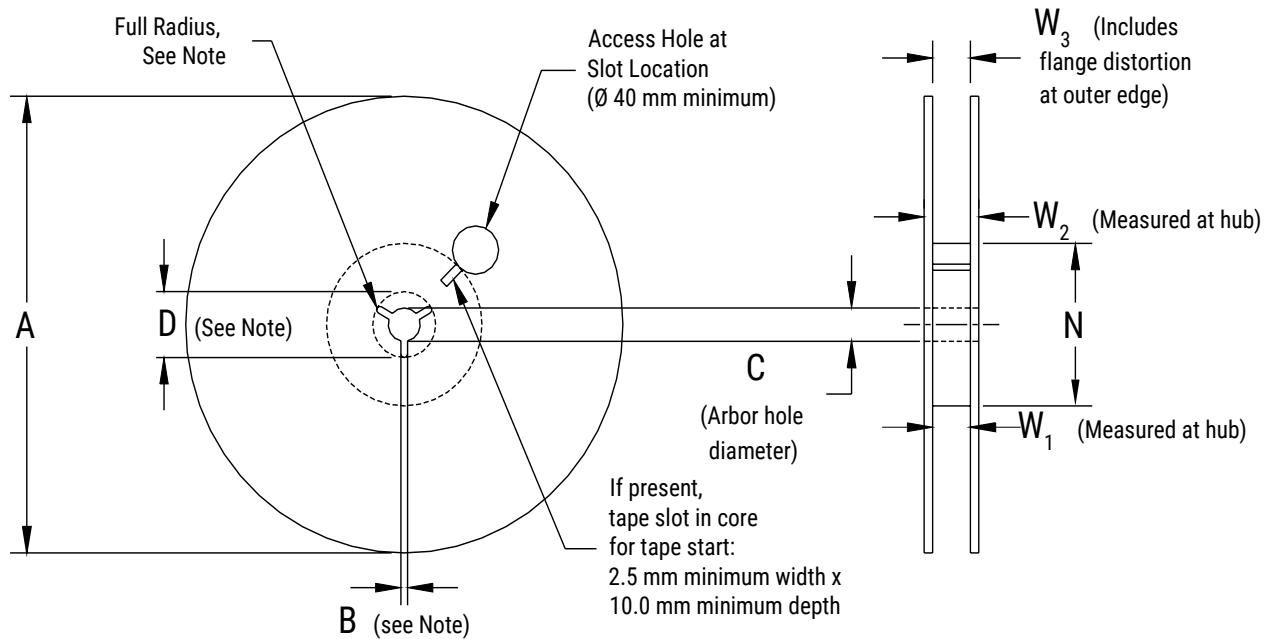
### Figure 4 – Maximum Lateral Movement



### Figure 5 – Bending Radius



**Figure 6 – Reel Dimensions**

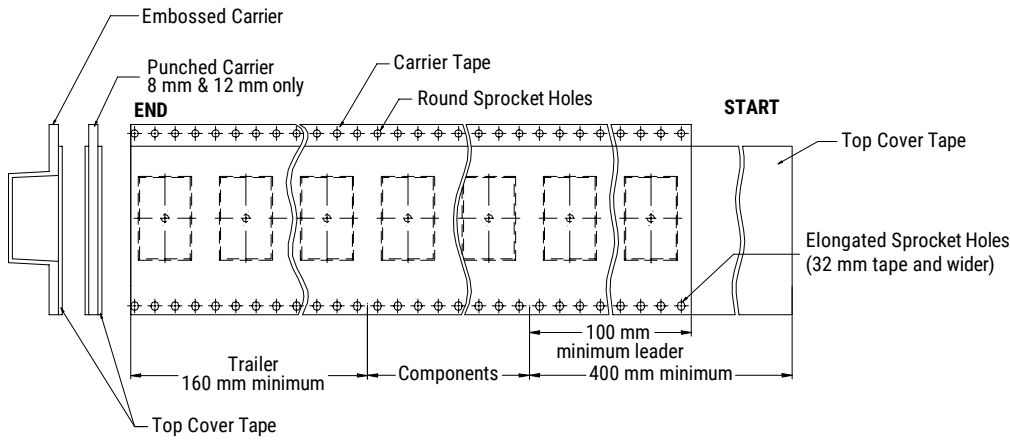


**Table 8 – Reel Dimensions**

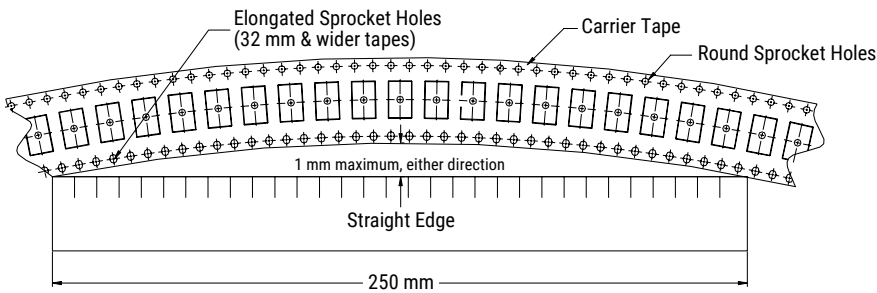
Metric will govern

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

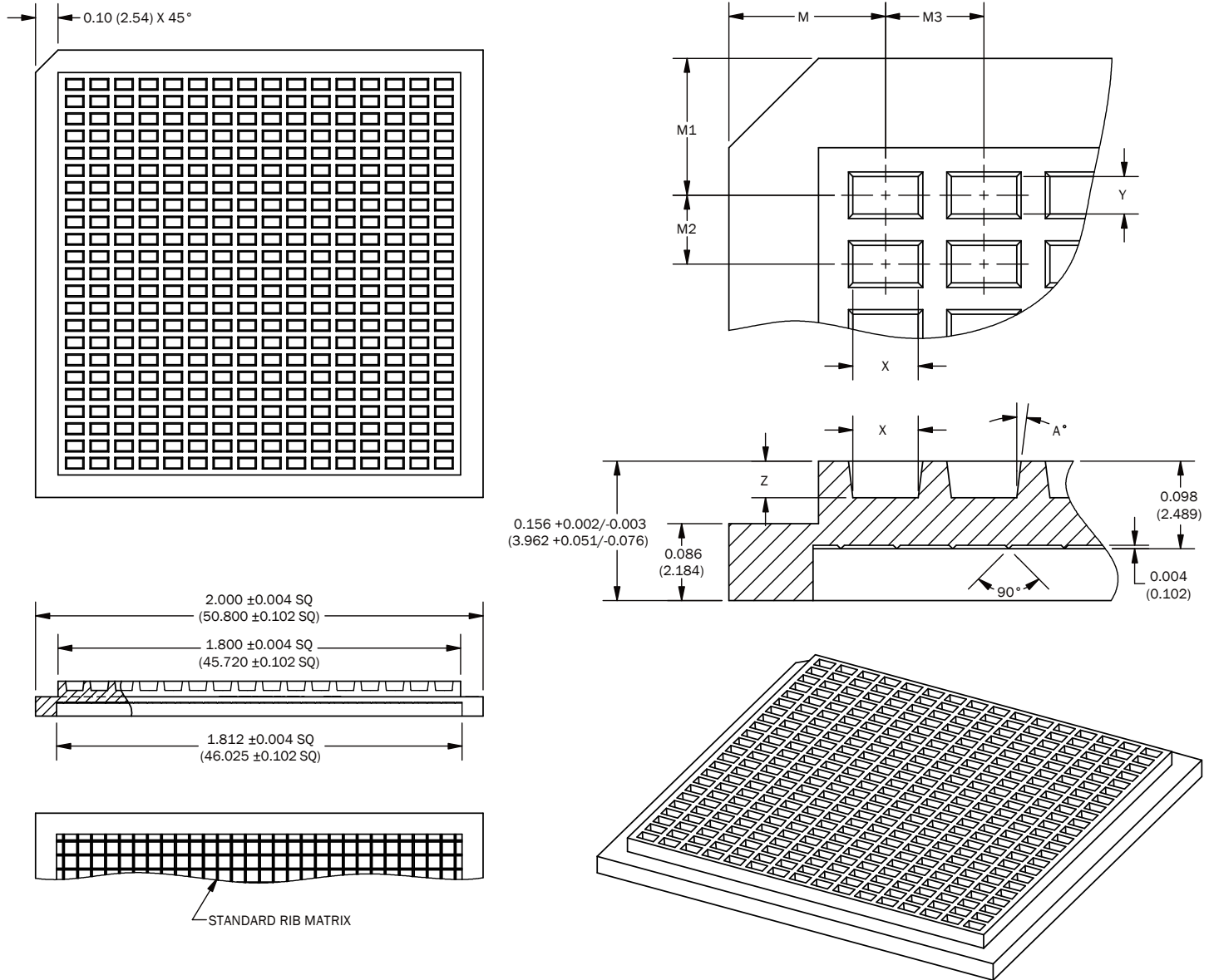


**Figure 8 – Maximum Camber**



## Waffle Tray Packaging Information – 2" x 2" w/ Static Protection

Figure 9 – Waffle Tray Dimensions – Inches (Millimeters)





**Table 9A – Waffle Tray Dimensions – Inches**

| Case Size           |             | 2" x 2" Waffle Tray Dimensions – Inches |        |        |        |        |        |        |        |         | Packaging Quantity<br>(pcs/unit<br>packaging) |
|---------------------|-------------|---|--------|--------|--------|--------|--------|--------|--------|---------|---|
|                     |             | M                                       | M1     | M2     | M3     | X      | Y      | Z      | A°     | MATRIX  |   |
| EIA (in)            | Metric (mm) | ±0.003                                  | ±0.003 | ±0.002 | ±0.002 | ±0.002 | ±0.002 | ±0.003 | ± 1/2° | (X x Y) |   |
| 0402                | 1005        | 0.175                                   | 0.153  | 0.077  | 0.110  | 0.073  | 0.042  | 0.041  | 7      | 16 X 23 | 368   |
| 0504                | 1210        | 0.235                                   | 0.226  | 0.172  | 0.170  | 0.080  | 0.090  | 0.055  | 5      | 10 X 10 | 100   |
| 0603                | 1608        | 0.175                                   | 0.153  | 0.077  | 0.110  | 0.073  | 0.042  | 0.041  | 7      | 16 X 23 | 368   |
| 0805                | 2012        | 0.232                                   | 0.186  | 0.181  | 0.171  | 0.062  | 0.092  | 0.036  | 10     | 10 X 10 | 100   |
| 1005                | 2512        | 0.230                                   | 0.240  | 0.190  | 0.140  | 0.060  | 0.110  | 0.075  | 5      | 12 X 9  | 108   |
| 1206 <sup>1,2</sup> | 3216        | 0.194                                   | 0.228  | 0.193  | 0.124  | 0.067  | 0.130  | 0.065  | 5      | 14 X 9  | 126   |
| 1206 <sup>1,3</sup> | 3216        | 0.250                                   | 0.250  | 0.375  | 0.167  | 0.100  | 0.200  | 0.070  | 5      | 10 X 5  | 50  |
| 1210                | 3225        | 0.217                                   | 0.244  | 0.215  | 0.174  | 0.110  | 0.145  | 0.080  | 5      | 10 X 8  | 80  |
| 1808                | 4520        | 0.271                                   | 0.285  | 0.286  | 0.243  | 0.150  | 0.200  | 0.075  | 5      | 7 X 6   | 42  |
| 1812                | 4532        | 0.271                                   | 0.285  | 0.286  | 0.243  | 0.150  | 0.200  | 0.075  | 5      | 7 X 6   | 42  |
| 1825                | 4564        | 0.318                                   | 0.362  | 0.424  | 0.34   | 0.24   | 0.32   | 0.032  | 5      | 5 X 4   | 20  |
| 2220                | 5650        | 0.318                                   | 0.362  | 0.424  | 0.34   | 0.24   | 0.32   | 0.032  | 5      | 5 X 4   | 20  |
| 2225                | 5664        | 0.318                                   | 0.362  | 0.424  | 0.34   | 0.24   | 0.32   | 0.032  | 5      | 5 X 4   | 20  |

<sup>1</sup> Packaging of 1206 (3216 metric) case size capacitors is dependent upon the nominal chip thickness of the device. See "Capacitance Range/Selection Waterfall" and "Chip Thickness/Tape & Reel Packaging Quantities" to identify the nominal chip thickness of the capacitor.

<sup>2</sup> Assigned to 1206 (3216 metric) case size capacitors with nominal thickness of ≤ 1.25mm (0.049 inches).

<sup>3</sup> Assigned to 1206 (3216 metric) case size capacitors with nominal thickness of > 1.25mm (0.049 inches).

**Table 9B – Waffle Tray Dimensions – Millimeters**

| Case Size           |             | 2" x 2" Waffle Tray Dimensions – Millimeters |       |       |       |       |       |       |        |         | Packaging Quantity<br>(pcs/unit<br>packaging) |
|---------------------|-------------|--|-------|-------|-------|-------|-------|-------|--------|---------|---|
|                     |             | M  | M1    | M2    | M3    | X     | Y     | Z     | A°     | MATRIX  |   |
| EIA (in)            | Metric (mm) | ±0.08  | ±0.08 | ±0.05 | ±0.05 | ±0.05 | ±0.05 | ±0.08 | ± 1/2° | (X x Y) |   |
| 0402                | 1005        | 4.45   | 3.89  | 1.96  | 2.79  | 1.85  | 1.07  | 1.04  | 7      | 16 X 23 | 368   |
| 0504                | 1210        | 5.97   | 5.74  | 4.37  | 4.32  | 2.03  | 2.29  | 1.40  | 5      | 10 X 10 | 100   |
| 0603                | 1608        | 4.45   | 3.89  | 1.96  | 2.79  | 1.85  | 1.07  | 1.04  | 7      | 16 X 23 | 368   |
| 0805                | 2012        | 5.89   | 4.72  | 4.60  | 4.34  | 1.57  | 2.34  | 0.91  | 10     | 10 X 10 | 100   |
| 1005                | 2512        | 5.84   | 6.10  | 4.83  | 3.56  | 1.52  | 2.79  | 1.91  | 5      | 12 X 9  | 108   |
| 1206 <sup>1,2</sup> | 3216        | 4.93   | 5.79  | 4.90  | 3.15  | 1.70  | 3.30  | 1.65  | 5      | 14 X 9  | 126   |
| 1206 <sup>1,3</sup> | 3216        | 6.35   | 6.35  | 9.53  | 4.24  | 2.54  | 5.08  | 1.78  | 5      | 10 X 5  | 50  |
| 1210                | 3225        | 5.51   | 6.20  | 5.46  | 4.42  | 2.79  | 3.68  | 2.03  | 5      | 10 X 8  | 80  |
| 1808                | 4520        | 6.88   | 7.24  | 7.26  | 6.17  | 3.81  | 5.08  | 1.91  | 5      | 7 X 6   | 42  |
| 1812                | 4532        | 6.88   | 7.24  | 7.26  | 6.17  | 3.81  | 5.08  | 1.91  | 5      | 7 X 6   | 42  |
| 1825                | 4564        | 8.08   | 9.19  | 10.77 | 8.64  | 6.10  | 8.13  | 0.81  | 5      | 5 X 4   | 20  |
| 2220                | 5650        | 8.08   | 9.19  | 10.77 | 8.64  | 6.10  | 8.13  | 0.81  | 5      | 5 X 4   | 20  |
| 2225                | 5664        | 8.08   | 9.19  | 10.77 | 8.64  | 6.10  | 8.13  | 0.81  | 5      | 5 X 4   | 20  |

<sup>1</sup> Packaging of 1206 (3216 metric) case size capacitors is dependent upon the nominal chip thickness of the device. See "Capacitance Range/Selection Waterfall" and "Chip Thickness/Tape & Reel Packaging Quantities" to identify the nominal chip thickness of the capacitor.

<sup>2</sup> Assigned to 1206 (3216 metric) case size capacitors with nominal thickness of ≤ 1.25mm (0.049 inches).

<sup>3</sup> Assigned to 1206 (3216 metric) case size capacitors with nominal thickness of > 1.25mm (0.049 inches).

## Application Guide

### Solder Fluxes and Cleaning

The use of water-soluble fluxes provides advantages of excellent solderability due to high activation. However, these fluxes contain organic acids that can induce arcing under high DC or AC voltages. Notable problem areas are underneath the MLCC where flux can be trapped between the ceramic material and PCB. It is therefore critical that PCBs are properly cleaned to remove all flux residue to maintain reliability.

### Coating for High Voltage MLCCs

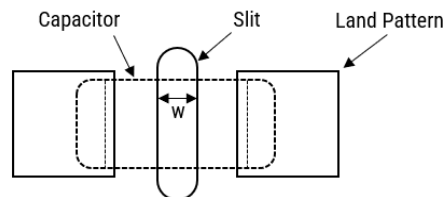
For MLCC ratings  $\geq 1500V$ , it is recommended to apply a conformal coating to MLCC to prevent surface arcing. To reduce possibility of inducing cracks in the MLCC, select a coating with thermal expansions close to that of the MLCC.

| Dielectric                  | CTE (ppm/°C) |
|-----------------------------|--------------|
| Class II BaTiO <sub>3</sub> | 10.7         |
| Class I CaZrO <sub>3</sub>  | 9.8          |

### Slits in PCB

It is recommended to apply a slit in the PCB under the MLCC to improve washing of flux residue that may get trapped underneath. In some cases, it is not possible to slit entirely through the PCB due to underlying metal planes. It is also acceptable to apply a recessed slit under the MLCC which will also promote cleaning.

- Recommended for case sizes  $\geq 1206$
- The width (w) of the slit should be 1mm
- Length of the slit should be as short as possible to prevent damaging the MLCC due to mechanical stress of the PCB.
- Slits also reduce the risk of solder balls under MLCC which decreased the creepage distance.



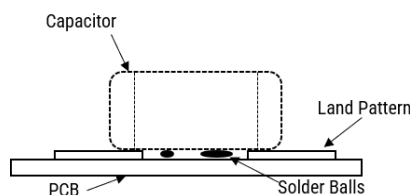
### Solder Resist

If a slit cannot be applied as above, it is recommended to not use solder resist directly under the MLCC. The use of solder resist material reduces the distance between MLCC ceramic material and PCB thus making it difficult to clean.

### Solder Balls

Improper reflow techniques and/or improper washing can induce solder balls under or adjacent to the MLCC. Solder balls reduce the creepage distance between the MLCC terminations and increase the risk of arcing or damage to the ceramic material. To reduce the risk of solder balls:

- Follow KEMET's solder recommendations as outlined in the datasheet.
- If performing a cleaning procedure, properly clean the PCB per KEMET's cleaning recommendations.
- Add slit to the PCB as shown above.



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