

# Goldmax, 300 Series, Radial, Conformally Coated, COG Dielectric, 25 – 250 VDC (Automotive Grade)

## Overview

KEMET's Goldmax conformally coated radial leaded ceramic capacitors in COG dielectric feature a 125°C maximum operating temperature. The Electronics Industries Alliance (EIA) characterizes COG dielectric as a Class I "stable" material. Components of this classification are temperature compensating and are suited for resonant circuit applications or those where Q and stability of capacitance characteristics are required. COG exhibits no change in capacitance with respect to time and voltage and boasts a negligible change in capacitance with reference to ambient temperature. Capacitance change is limited to  $\pm 30\text{ppm}/^\circ\text{C}$  from  $-55^\circ\text{C}$  to  $+125^\circ\text{C}$ .

These devices meet the flame test requirements outlined in UL Standard 94V-0 and the demanding Automotive Electronics Council's AEC-Q200 qualification requirements.

## Benefits

- Radial leaded form factor
- Conformally coated
- Encapsulation meets flammability standard UL 94V-0
- 0.100", 0.200" and 0.250" lead spacing
- Operating temperature range of  $-55^\circ\text{C}$  to  $+125^\circ\text{C}$
- Lead (Pb)-free, RoHS and REACH compliant
- DC voltage ratings of 25 V, 50 V, 100 V, 200 V and 250 V
- Capacitance offerings ranging from 1.0 pF up to 0.22  $\mu\text{F}$



## Ordering Information

| C       | 320        |     |     | C                        | 153  | J   | 5   | G          | 5                 | T                           | A               | 9170  |
|---------|------------|-----|-----|--------------------------|--|---|---|------------|-------------------|-----------------------------|-----------------|---|
| Ceramic | Style/Size |     |     | Specification/<br>Series | Capacitance<br>Code (pF)   | Capacitance<br>Tolerance <sup>1</sup>   | Voltage   | Dielectric | Design            | Lead<br>Finish <sup>2</sup> | Failure<br>Rate | Packaging/Grade<br>(C-Spec)   |
|         | 315        | 322 | 328 | C =<br>Standard          | First two digits<br>represent<br>significant<br>figures. Third<br>digit specifies<br>number of<br>zeros. | D = $\pm 0.5$ pF<br>F = $\pm 1\%$<br>G = $\pm 2\%$<br>J = $\pm 5\%$<br>K = $\pm 10\%$ | 3 = 25<br>5 = 50<br>1 = 100<br>2 = 200<br>A = 250 | G =<br>COG | 5 =<br>Multilayer | T =<br>100%<br>Matte Sn     | A =<br>N/A      | Automotive Grade<br>See<br>"Packaging<br>C-Spec<br>Ordering<br>Options Table" |
|         | 316        | 323 | 330 |                          |  |   |   |            |                   |                             |                 |   |
|         | 317        | 324 | 331 |                          |  |   |   |            |                   |                             |                 |   |
|         | 318        | 325 | 333 |                          |  |   |   |            |                   |                             |                 |   |
|         | 320        | 326 | 335 |                          |  |   |   |            |                   |                             |                 |   |
|         | 321        | 327 | 336 |                          |  |   |   |            |                   |                             |                 |   |

<sup>1</sup> Additional capacitance Tolerance offerings may be available. Contact KEMET for details.  
For Overmolding applications please contact your KEMET representative.

## Benefits cont.

- Available capacitance Tolerances of  $\pm 0.5$  pF,  $\pm 1\%$ ,  $\pm 2\%$ ,  $\pm 5\%$ , and  $\pm 10\%$
- 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 lead finish allowing for excellent solderability
- Automotive (AEC-Q200) grade

## Applications

Typical applications include critical timing, tuning, circuits requiring low loss, circuits with pulse, high current, decoupling, bypass, filtering, transient voltage suppression, blocking and energy storage.

## Application Notes

These devices are not recommended for use in overmold applications and/or processes.

## Packaging C-Spec Ordering Options Table

| Packaging Type <sup>1</sup>                     | Packaging/Grade Ordering Code (C-Spec) |
|---|--|
| Bulk Bag Automotive Grade                       | 9170                                   |
| 12" Tape & Reel (16.0 $\pm$ 0.5 mm lead length) | 9170 (7301)                            |
| 12" Tape & Reel (18.0 mm minimum lead length)   | 9170 (7303) and 9170 TR                |
| Ammo Pack (16.0 $\pm$ 0.5 mm lead length)       | 9170 (7305)                            |
| Ammo Pack (18.0 mm minimum lead length)         | 9170 (7317)                            |

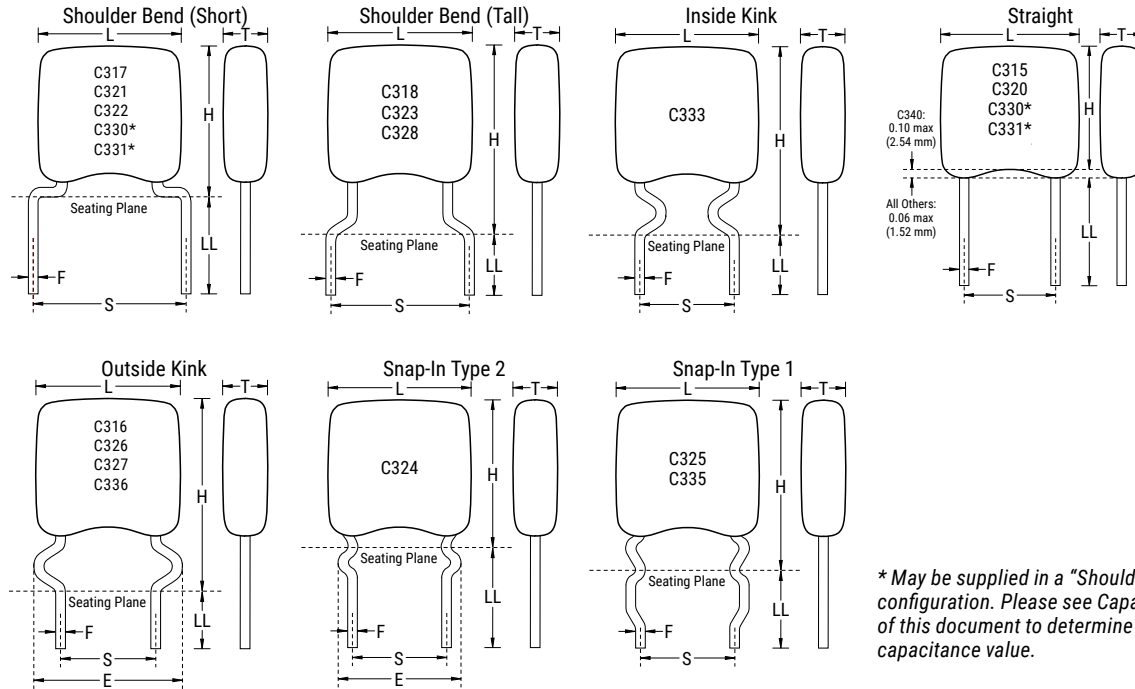
<sup>1</sup> Default packaging is "Bulk Bag" with ordering code 9170 for Automotive Grade. Bulk bag option is required for Size/Style C321 & C331.

<sup>1</sup> "Tape and Reel" packaging option is not available for Size/Style C321 and C331. For more information see "Packaging Quantities".

<sup>1</sup> "Ammo Pack" packaging option is not available for Size/Style C321 and C331. For more information see "Packaging Quantities".

<sup>1</sup> "Ammo Pack" and "Tape and Reel" packaging options have the same lead tape configuration. For more information see "Tape & Reel Packaging Information".

## Dimensions – Inches (Millimeters)



\* May be supplied in a "Shoulder Bend" or "Straight" Lead configuration. Please see Capacitance Range Waterfall section of this document to determine lead configuration availability by capacitance value.

| Series | Style / Size | S Lead Spacing<br>±0.030 (0.78) | L Length Maximum | H Height Maximum          | T Thickness Maximum       | F Lead Diameter<br>+0.004 (0.10),<br>-0.001 (0.025) | LL Lead Length Minimum |
|--------|--------------|---------------------------------|------------------|---------------------------|---------------------------|---|------------------------|
| C31X   | 315          | 0.100 (2.54)                    | 0.150 (3.81)     | 0.120 (3.14)              | 0.100 (2.54)              | 0.020 (0.51)  | 0.276 (7.00)           |
|        | 316          |                                 | 0.150 (3.81)     | 0.230 (5.08)              | 0.100 (2.54)              |   | 0.200 (5.08)           |
| C32X   | 324          | 0.100 (2.54)                    | 0.200 (5.08)     | 0.230 (5.84)              | 0.125 (3.18) <sup>1</sup> |   | 0.276 (7.00)           |
|        | 320          |                                 | 0.200 (5.08)     | 0.230 (5.84)              | 0.125 (3.18) <sup>1</sup> |   | 0.276 (7.00)           |
| C32X   | 326          | 0.100 (2.54)                    | 0.200 (5.08)     | 0.300 (7.62)              | 0.125 (3.18) <sup>1</sup> |   | 0.200 (5.08)           |
|        | 327          |                                 | 0.200 (5.08)     | 0.320 (8.13)              | 0.125 (3.18) <sup>1</sup> |   | 0.200 (5.08)           |
| C31X   | 317          | 0.200 (5.08)                    | 0.150 (3.81)     | 0.200 (5.08)              | 0.100 (2.54)              |   | 0.276 (7.00)           |
|        | 318          |                                 | 0.150 (3.81)     | 0.235 (5.97)              | 0.100 (2.54)              |   | 0.276 (7.00)           |
| C32X   | 321          | 0.250 (6.35)                    | 0.200 (5.08)     | 0.260 (6.60)              | 0.125 (3.18) <sup>1</sup> |   | 0.276 (7.00)           |
|        | 322          | 0.200 (5.08)                    | 0.200 (5.08)     | 0.260 (6.60)              | 0.125 (3.18) <sup>1</sup> |   | 0.276 (7.00)           |
|        | 323          |                                 | 0.200 (5.08)     | 0.300 (7.62)              | 0.125 (3.18) <sup>1</sup> |   | 0.276 (7.00)           |
|        | 325          |                                 | 0.200 (5.08)     | 0.300 (7.62)              | 0.125 (3.18) <sup>1</sup> |   | 0.276 (7.00)           |
|        | 328          |                                 | 0.200 (5.08)     | 0.300 (7.62)              | 0.125 (3.18) <sup>1</sup> |   | 0.276 (7.00)           |
|        | 327          |                                 | 0.200 (5.08)     | 0.320 (8.13)              | 0.125 (3.18) <sup>1</sup> |   | 0.200 (5.08)           |
| 329    | 0.200 (5.08) |                                 | 0.320 (8.13)     | 0.125 (3.18) <sup>1</sup> | 0.200 (5.08)              |   |                        |
| C33X   | 330          | 0.250 (6.35)                    | 0.280 (7.11)     | 0.360 (9.14)              | 0.160 (4.07)              | 0.276 (7.00)  |                        |
|        | 331          | 0.250 (6.35)                    | 0.300 (7.62)     | 0.360 (9.14)              | 0.160 (4.07)              | 0.276 (7.00)  |                        |
|        | 333          |                                 | 0.280 (7.11)     | 0.400 (10.16)             | 0.160 (4.07)              | 0.276 (7.00)  |                        |
|        | 335          | 0.200 (5.08)                    | 0.280 (7.11)     | 0.400 (10.16)             | 0.160 (4.07)              | 0.276 (7.00)  |                        |
|        | 336          |                                 | 0.280 (7.11)     | 0.400 (10.16)             | 0.160 (4.07)              | 0.200 (5.08)  |                        |

<sup>1</sup> Thickness maximum (T) = 0.160" (4.07 mm) for capacitance values greater than or equal to 4.7 μF

## Automotive C-Spec Information

KEMET Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. The details regarding test methods and conditions are referenced in the document AEC-Q200, Stress Test Qualification for Passive Components. These products are supported by a Product Change Notification (PCN) and Production Part Approval Process warrant (PPAP).

Automotive products offered through our distribution channel have been assigned an inclusive ordering code C-Spec, “9170.” This C-Spec was developed in order to better serve small and medium-sized companies that prefer an automotive grade component, without the requirement to submit a customer Source Controlled Drawing (SCD) or specification for review by a KEMET engineering specialist. This C-Spec is therefore not intended for use by KEMET’s OEM Automotive customers and are not granted the same “privileges” as other automotive C-Specs. Customer PCN approval and PPAP request levels are limited (see details below).

### Product Change Notification (PCN)

The KEMET Product Change Notification system is used to communicate primarily the following types of changes:

- Product/process changes that affect product form, fit, function, and/or reliability
- Changes in manufacturing site
- Product obsolescence

| KEMET Automotive C-Spec     | Customer Notification due to:    |               | Days prior to implementation |
|-----------------------------|----------------------------------|---------------|------------------------------|
|                             | Process/Product change           | Obsolescence* |                              |
| KEMET assigned <sup>1</sup> | Yes (with approval and sign off) | Yes           | 180 days Minimum             |
| 9170                        | Yes (without approval)           | Yes           | 90 days Minimum              |

<sup>1</sup> KEMET assigned C-Specs require the submittal of a customer SCD or customer specification for review. For additional information contact KEMET.

### Production Part Approval Process (PPAP)

The purpose of the Production Part Approval Process is:

- To ensure that supplier can meet the manufacturability and quality requirements for the purchased parts.
- To provide the evidence that all customer engineering design record and specification requirements are properly understood and fulfilled by the manufacturing organization.
- To demonstrate that the established manufacturing process has the potential to produce the part

| KEMET Automotive C-Spec     | PPAP Level |   |   |   |   |
|-----------------------------|------------|---|---|---|---|
|                             | 1          | 2 | 3 | 4 | 5 |
| KEMET assigned <sup>1</sup> | ●          | ● | ● | ● | ● |
| 9170                        |            |   | ○ |   |   |

<sup>1</sup> KEMET assigned C-Specs require the submittal of a customer SCD or customer specification for review. For additional information contact KEMET.

- Part number specific PPAP available with customer information included.
- Product family PPAP only

## Qualification/Certification

Automotive Grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC-Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC-Q200, please visit their website at [www.aecouncil.com](http://www.aecouncil.com).

## Environmental Compliance

Lead (Pb)-free, REACH and RoHS compliant without exemptions when ordered with a 100% tin (Sn) wire lead finish.

| Series     | Termination Finish (Wire Lead) | RoHS Compliant | RoHS Exemption Code | REACH Compliant <sup>1</sup> | Halogen Free |
|------------|--------------------------------|----------------|---------------------|------------------------------|--------------|
| 300 (C3XX) | 100% Matte Sn                  | Yes            | n/a                 | Yes                          | Yes          |

<sup>1</sup> REACH compliance indicates product does not contain Substance/s of Very High Concern (SVHC)

## Electrical Parameters/Characteristics

| Item   | Parameters/Characteristics  |
|--|---|
| Operating Temperature Range  | -55°C to +125°C   |
| Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC) | ±30 ppm/°C  |
| Aging Rate (Maximum % Cap Loss/Decade Hour)                        | 0%  |
| Dielectric Withstanding Voltage                                    | 250% of rated voltage<br>(5±1 second and charge/discharge not exceeding 50 mA)          |
| Dissipation Factor (DF) Maximum Limit at 25°C                      | 0.1%  |
| Insulation Resistance (IR) Limit at 25°C                           | 1,000 megohm microfarads or 100 GΩ<br>(Rated voltage applied for 120±5 seconds at 25°C) |

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

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

1 MHz ±100 kHz and 1.0 V<sub>rms</sub> ±0.2 V if capacitance ≤ 1,000 pF

1 kHz ±50 Hz and 1.0 V<sub>rms</sub> ±0.2 V if capacitance > 1,000 pF

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

**Table 1A – C31X Style/Size (0.100" & 0.200" Lead Spacing), Capacitance Range Waterfall**

| C315, C316, C317, C318 Style/Size (0.100" & 0.200" Lead Spacing) |   |  |     |     |     |     |
|--|---|--|-----|-----|-----|-----|
| Rated Voltage (VDC)  |   | 25                                       | 50  | 100 | 200 | 250 |
| Voltage Code   |   | 3  | 5   | 1   | 2   | A   |
| Capacitance  | Capacitance Tolerance                     | Capacitance Code (Available Capacitance) |     |     |     |     |
| 1pF  | D = ±0.5pF                                | 109                                      | 109 | 109 | 109 | 109 |
| 1.1pF  |   | 119                                      | 119 | 119 | 119 | 119 |
| 1.2pF  |   | 129                                      | 129 | 129 | 129 | 129 |
| 1.3pF  |   | 139                                      | 139 | 139 | 139 | 139 |
| 1.5pF  |   | 159                                      | 159 | 159 | 159 | 159 |
| 1.6pF  |   | 169                                      | 169 | 169 | 169 | 169 |
| 1.8pF  |   | 189                                      | 189 | 189 | 189 | 189 |
| 2.0pF  |   | 209                                      | 209 | 209 | 209 | 209 |
| 2.2pF  |   | 229                                      | 229 | 229 | 229 | 229 |
| 2.4pF  |   | 249                                      | 249 | 249 | 249 | 249 |
| 2.7pF  |   | 279                                      | 279 | 279 | 279 | 279 |
| 3.0pF  |   | 309                                      | 309 | 309 | 309 | 309 |
| 3.3pF  |   | 339                                      | 339 | 339 | 339 | 339 |
| 3.6pF  |   | 369                                      | 369 | 369 | 369 | 369 |
| 3.9pF  |   | 399                                      | 399 | 399 | 399 | 399 |
| 4.3pF  |   | 439                                      | 439 | 439 | 439 | 439 |
| 4.7pF  |   | 479                                      | 479 | 479 | 479 | 479 |
| 5.1pF  |   | 519                                      | 519 | 519 | 519 | 519 |
| 5.6pF  |   | 569                                      | 569 | 569 | 569 | 569 |
| 6.2pF  |   | 629                                      | 629 | 629 | 629 | 629 |
| 6.8pF  | 689                                       | 689                                      | 689 | 689 | 689 |     |
| 7.5pF  | 759                                       | 759                                      | 759 | 759 | 759 |     |
| 8.2pF  | 829                                       | 829                                      | 829 | 829 | 829 |     |
| 9.1pF  | 919                                       | 919                                      | 919 | 919 | 919 |     |
| 10pF   | F = ±1%<br>G = ±2%<br>J = ±5%<br>K = ±10% | 100                                      | 100 | 100 | 100 | 100 |
| 11pF   |   | 110                                      | 110 | 110 | 110 | 110 |
| 12pF   |   | 120                                      | 120 | 120 | 120 | 120 |
| 13pF   |   | 130                                      | 130 | 130 | 130 | 130 |
| 15pF   |   | 150                                      | 150 | 150 | 150 | 150 |
| 16pF   |   | 160                                      | 160 | 160 | 160 | 160 |
| 18pF   |   | 180                                      | 180 | 180 | 180 | 180 |
| 20pF   |   | 200                                      | 200 | 200 | 200 | 200 |
| 22pF   |   | 220                                      | 220 | 220 | 220 | 220 |
| 24pF   |   | 240                                      | 240 | 240 | 240 | 240 |
| 27pF   |   | 270                                      | 270 | 270 | 270 | 270 |
| 30pF   |   | 300                                      | 300 | 300 | 300 | 300 |
| 33pF   |   | 330                                      | 330 | 330 | 330 | 330 |
| 36pF   |   | 360                                      | 360 | 360 | 360 | 360 |
| 39pF   |   | 390                                      | 390 | 390 | 390 | 390 |
| 43pF   |   | 430                                      | 430 | 430 | 430 | 430 |
| 47pF   |   | 470                                      | 470 | 470 | 470 | 470 |
| 51pF   |   | 510                                      | 510 | 510 | 510 | 510 |
| 56pF   |   | 560                                      | 560 | 560 | 560 | 560 |
| 62pF   |   | 620                                      | 620 | 620 | 620 | 620 |
| 68pF   | 680                                       | 680                                      | 680 | 680 | 680 |     |
| 75pF   | 750                                       | 750                                      | 750 | 750 | 750 |     |
| 82pF   | 820                                       | 820                                      | 820 | 820 | 820 |     |
| 91pF   | 910                                       | 910                                      | 910 | 910 | 910 |     |
| 100pF  | 101                                       | 101                                      | 101 | 101 | 101 |     |
| 110pF  | 111                                       | 111                                      | 111 | 111 | 111 |     |
| 120pF  | 121                                       | 121                                      | 121 | 121 | 121 |     |
| 130pF  | 131                                       | 131                                      | 131 | 131 | 131 |     |
| 150pF  | 151                                       | 151                                      | 151 | 151 | 151 |     |
| 160pF  | 161                                       | 161                                      | 161 | 161 | 161 |     |
| Rated Voltage (VDC)  |   | 25                                       | 50  | 100 | 200 | 250 |
| Voltage Code   |   | 3  | 5   | 1   | 2   | A   |

These products are protected under one or more of the following United States Patents and their non-US counterparts: US Pat. No. 7172985; U.S. Pat. No. 7670981.

**Table 1A – C31X Style/Size (0.100" & 0.200" Lead Spacing), Capacitance Range Waterfall cont.**

| C315, C316, C317, C318 Style/Size (0.100" & 0.200" Lead Spacing) |   |  |     |     |     |     |
|--|---|--|-----|-----|-----|-----|
| Rated Voltage (VDC)  |   | 25                                       | 50  | 100 | 200 | 250 |
| Voltage Code   |   | 3  | 5   | 1   | 2   | A   |
| Capacitance  | Capacitance Tolerance                     | Capacitance Code (Available Capacitance) |     |     |     |     |
| 180pF  | F = ±1%<br>G = ±2%<br>J = ±5%<br>K = ±10% | 181                                      | 181 | 181 | 181 | 181 |
| 200pF  |   | 201                                      | 201 | 201 | 201 | 201 |
| 220pF  |   | 221                                      | 221 | 221 | 221 | 221 |
| 240pF  |   | 241                                      | 241 | 241 | 241 | 241 |
| 270pF  |   | 271                                      | 271 | 271 | 271 | 271 |
| 300pF  |   | 301                                      | 301 | 301 | 301 | 301 |
| 330pF  |   | 331                                      | 331 | 331 | 331 | 331 |
| 360pF  |   | 361                                      | 361 | 361 | 361 | 361 |
| 390pF  |   | 391                                      | 391 | 391 | 391 | 391 |
| 430pF  |   | 431                                      | 431 | 431 | 431 | 431 |
| 470pF  |   | 471                                      | 471 | 471 | 471 | 471 |
| 510pF  |   | 511                                      | 511 | 511 | 511 | 511 |
| 560pF  |   | 561                                      | 561 | 561 | 561 | 561 |
| 620pF  |   | 621                                      | 621 | 621 | 621 | 621 |
| 680pF  |   | 681                                      | 681 | 681 | 681 | 681 |
| 750pF  |   | 751                                      | 751 | 751 | 751 | 751 |
| 820pF  |   | 821                                      | 821 | 821 | 821 | 821 |
| 910pF  |   | 911                                      | 911 | 911 | 911 | 911 |
| 1000pF   |   | 102                                      | 102 | 102 | 102 | 102 |
| 1100pF   |   | 112                                      | 112 | 112 | 112 | 112 |
| 1200pF   |   | 122                                      | 122 | 122 | 122 | 122 |
| 1300pF   |   | 132                                      | 132 | 132 | 132 | 132 |
| 1500pF   |   | 152                                      | 152 | 152 | 152 | 152 |
| 1600pF   |   | 162                                      | 162 | 162 | 162 | 162 |
| 1800pF   |   | 182                                      | 182 | 182 | 182 | 182 |
| 2000pF   |   | 202                                      | 202 | 202 | 202 | 202 |
| 2200pF   |   | 222                                      | 222 | 222 | 222 | 222 |
| 2400pF   |   | 242                                      | 242 | 242 | 242 | 242 |
| 2700pF   |   | 272                                      | 272 | 272 | 272 | 272 |
| 3000pF   |   | 302                                      | 302 | 302 | 302 | 302 |
| 3300pF   |   | 332                                      | 332 | 332 | 332 | 332 |
| 3600pF   |   | 362                                      | 362 | 362 | 362 | 362 |
| 3900pF   |   | 392                                      | 392 | 392 | 392 | 392 |
| 4300pF   |   | 432                                      | 432 | 432 | 432 | 432 |
| 4700pF   |   | 472                                      | 472 | 472 | 472 | 472 |
| 5100pF   |   | 512                                      | 512 | 512 | 512 | 512 |
| 5600pF   |   | 562                                      | 562 | 562 | 562 | 562 |
| 6200pF   |   | 622                                      | 622 | 622 | 622 | 622 |
| 6800pF   |   | 682                                      | 682 | 682 | 682 | 682 |
| 7500pF   |   | 752                                      | 752 | 752 | 752 | 752 |
| 8200pF   | 822                                       | 822                                      | 822 | 822 | 822 |     |
| 9100pF   | 912                                       | 912                                      | 912 |     |     |     |
| 0.01μF   | 103                                       | 103                                      | 103 |     |     |     |
| 0.012μF  | 123                                       | 123                                      | 123 |     |     |     |
| 0.015μF  | 153                                       | 153                                      | 153 |     |     |     |
| 0.018μF  | 183                                       | 183                                      |     |     |     |     |
| 0.022μF  | 223                                       | 223                                      |     |     |     |     |
| 0.027μF  | 273                                       |  |     |     |     |     |
| 0.033μF  | 333                                       |  |     |     |     |     |
| 0.039μF  | 393                                       |  |     |     |     |     |
| 0.047μF  | 473                                       |  |     |     |     |     |
| Rated Voltage (VDC)  |   | 25                                       | 50  | 100 | 200 | 250 |
| Voltage Code   |   | 3  | 5   | 1   | 2   | A   |

These products are protected under one or more of the following United States Patents and their non-US counterparts: US Pat. No. 7172985; U.S. Pat. No. 7670981.

**Table 1B – C32X Style/Size (0.100" & 0.200" Lead Spacing), Capacitance Range Waterfall**

| C320, C322, C323, C326, C328 Style/Size (0.100" & 0.200" Lead Spacing) |   |  |     |     |     |     |
|--|---|--|-----|-----|-----|-----|
| Rated Voltage (VDC)  |   | 25                                       | 50  | 100 | 200 | 250 |
| Voltage Code   |   | 3  | 5   | 1   | 2   | A   |
| Capacitance  | Capacitance Tolerance                     | Capacitance Code (Available Capacitance) |     |     |     |     |
| 1pF  | D = ±0.5pF                                | 109                                      | 109 | 109 | 109 | 109 |
| 1.1pF  |   | 119                                      | 119 | 119 | 119 | 119 |
| 1.2pF  |   | 129                                      | 129 | 129 | 129 | 129 |
| 1.3pF  |   | 139                                      | 139 | 139 | 139 | 139 |
| 1.5pF  |   | 159                                      | 159 | 159 | 159 | 159 |
| 1.6pF  |   | 169                                      | 169 | 169 | 169 | 169 |
| 1.8pF  |   | 189                                      | 189 | 189 | 189 | 189 |
| 2.0pF  |   | 209                                      | 209 | 209 | 209 | 209 |
| 2.2pF  |   | 229                                      | 229 | 229 | 229 | 229 |
| 2.4pF  |   | 249                                      | 249 | 249 | 249 | 249 |
| 2.7pF  |   | 279                                      | 279 | 279 | 279 | 279 |
| 3.0pF  |   | 309                                      | 309 | 309 | 309 | 309 |
| 3.3pF  |   | 339                                      | 339 | 339 | 339 | 339 |
| 3.6pF  |   | 369                                      | 369 | 369 | 369 | 369 |
| 3.9pF  |   | 399                                      | 399 | 399 | 399 | 399 |
| 4.3pF  |   | 439                                      | 439 | 439 | 439 | 439 |
| 4.7pF  |   | 479                                      | 479 | 479 | 479 | 479 |
| 5.1pF  |   | 519                                      | 519 | 519 | 519 | 519 |
| 5.6pF  |   | 569                                      | 569 | 569 | 569 | 569 |
| 6.2pF  |   | 629                                      | 629 | 629 | 629 | 629 |
| 6.8pF  | 689                                       | 689                                      | 689 | 689 | 689 |     |
| 7.5pF  | 759                                       | 759                                      | 759 | 759 | 759 |     |
| 8.2pF  | 829                                       | 829                                      | 829 | 829 | 829 |     |
| 9.1pF  | 919                                       | 919                                      | 919 | 919 | 919 |     |
| 10pF   | F = ±1%<br>G = ±2%<br>J = ±5%<br>K = ±10% | 100                                      | 100 | 100 | 100 | 100 |
| 11pF   |   | 110                                      | 110 | 110 | 110 | 110 |
| 12pF   |   | 120                                      | 120 | 120 | 120 | 120 |
| 13pF   |   | 130                                      | 130 | 130 | 130 | 130 |
| 15pF   |   | 150                                      | 150 | 150 | 150 | 150 |
| 16pF   |   | 160                                      | 160 | 160 | 160 | 160 |
| 18pF   |   | 180                                      | 180 | 180 | 180 | 180 |
| 20pF   |   | 200                                      | 200 | 200 | 200 | 200 |
| 22pF   |   | 220                                      | 220 | 220 | 220 | 220 |
| 24pF   |   | 240                                      | 240 | 240 | 240 | 240 |
| 27pF   |   | 270                                      | 270 | 270 | 270 | 270 |
| 30pF   |   | 300                                      | 300 | 300 | 300 | 300 |
| 33pF   |   | 330                                      | 330 | 330 | 330 | 330 |
| 36pF   |   | 360                                      | 360 | 360 | 360 | 360 |
| 39pF   |   | 390                                      | 390 | 390 | 390 | 390 |
| 43pF   |   | 430                                      | 430 | 430 | 430 | 430 |
| 47pF   |   | 470                                      | 470 | 470 | 470 | 470 |
| 51pF   |   | 510                                      | 510 | 510 | 510 | 510 |
| 56pF   |   | 560                                      | 560 | 560 | 560 | 560 |
| 62pF   |   | 620                                      | 620 | 620 | 620 | 620 |
| 68pF   | 680                                       | 680                                      | 680 | 680 | 680 |     |
| 75pF   | 750                                       | 750                                      | 750 | 750 | 750 |     |
| 82pF   | 820                                       | 820                                      | 820 | 820 | 820 |     |
| 91pF   | 910                                       | 910                                      | 910 | 910 | 910 |     |
| 100pF  | 101                                       | 101                                      | 101 | 101 | 101 |     |
| 110pF  | 111                                       | 111                                      | 111 | 111 | 111 |     |
| 120pF  | 121                                       | 121                                      | 121 | 121 | 121 |     |
| 130pF  | 131                                       | 131                                      | 131 | 131 | 131 |     |
| 150pF  | 151                                       | 151                                      | 151 | 151 | 151 |     |
| 160pF  | 161                                       | 161                                      | 161 | 161 | 161 |     |
| 180pF  | 181                                       | 181                                      | 181 | 181 | 181 |     |
| 200pF  | 201                                       | 201                                      | 201 | 201 | 201 |     |
| Rated Voltage (VDC)  |   | 25                                       | 50  | 100 | 200 | 250 |
| Voltage Code   |   | 3  | 5   | 1   | 2   | A   |

These products are protected under one or more of the following United States Patents and their non-US counterparts: US Pat. No. 7172985; U.S. Pat. No. 7670981.



**Table 1B – C32X Style/Size (0.100" & 0.200" Lead Spacing), Capacitance Range Waterfall cont.**

| C320, C322, C323, C326, C328 Style/Size (0.100" & 0.200" Lead Spacing) |                       |  |     |     |     |     |
|--|-----------------------|--|-----|-----|-----|-----|
| Rated Voltage (VDC)  |                       | 25                                       | 50  | 100 | 200 | 250 |
| Voltage Code   |                       | 3  | 5   | 1   | 2   | A   |
| Capacitance  | Capacitance Tolerance | Capacitance Code (Available Capacitance) |     |     |     |     |
| 220pF  |                       | 221                                      | 221 | 221 | 221 | 221 |
| 240pF  |                       | 241                                      | 241 | 241 | 241 | 241 |
| 270pF  |                       | 271                                      | 271 | 271 | 271 | 271 |
| 300pF  |                       | 301                                      | 301 | 301 | 301 | 301 |
| 330pF  |                       | 331                                      | 331 | 331 | 331 | 331 |
| 360pF  |                       | 361                                      | 361 | 361 | 361 | 361 |
| 390pF  |                       | 391                                      | 391 | 391 | 391 | 391 |
| 430pF  |                       | 431                                      | 431 | 431 | 431 | 431 |
| 470pF  |                       | 471                                      | 471 | 471 | 471 | 471 |
| 510pF  |                       | 511                                      | 511 | 511 | 511 | 511 |
| 560pF  |                       | 561                                      | 561 | 561 | 561 | 561 |
| 620pF  |                       | 621                                      | 621 | 621 | 621 | 621 |
| 680pF  |                       | 681                                      | 681 | 681 | 681 | 681 |
| 750pF  |                       | 751                                      | 751 | 751 | 751 | 751 |
| 820pF  |                       | 821                                      | 821 | 821 | 821 | 821 |
| 910pF  |                       | 911                                      | 911 | 911 | 911 | 911 |
| 1000pF   |                       | 102                                      | 102 | 102 | 102 | 102 |
| 1100pF   |                       | 112                                      | 112 | 112 | 112 | 112 |
| 1200pF   |                       | 122                                      | 122 | 122 | 122 | 122 |
| 1300pF   |                       | 132                                      | 132 | 132 | 132 | 132 |
| 1500pF   |                       | 152                                      | 152 | 152 | 152 | 152 |
| 1600pF   |                       | 162                                      | 162 | 162 | 162 | 162 |
| 1800pF   |                       | 182                                      | 182 | 182 | 182 | 182 |
| 2000pF   |                       | 202                                      | 202 | 202 | 202 | 202 |
| 2200pF   |                       | 222                                      | 222 | 222 | 222 | 222 |
| 2400pF   |                       | 242                                      | 242 | 242 | 242 | 242 |
| 2700pF   |                       | 272                                      | 272 | 272 | 272 | 272 |
| 3000pF   | F = ±1%               | 302                                      | 302 | 302 | 302 | 302 |
| 3300pF   | G = ±2%               | 332                                      | 332 | 332 | 332 | 332 |
| 3600pF   | J = ±5%               | 362                                      | 362 | 362 | 362 | 362 |
| 3900pF   | K = ±10%              | 392                                      | 392 | 392 | 392 | 392 |
| 4300pF   |                       | 432                                      | 432 | 432 | 432 | 432 |
| 4700pF   |                       | 472                                      | 472 | 472 | 472 | 472 |
| 5100pF   |                       | 512                                      | 512 | 512 | 512 | 512 |
| 5600pF   |                       | 562                                      | 562 | 562 | 562 | 562 |
| 6200pF   |                       | 622                                      | 622 | 622 | 622 | 622 |
| 6800pF   |                       | 682                                      | 682 | 682 | 682 | 682 |
| 7500pF   |                       | 752                                      | 752 | 752 | 752 | 752 |
| 8200pF   |                       | 822                                      | 822 | 822 | 822 | 822 |
| 9100pF   |                       | 912                                      | 912 | 912 | 912 | 912 |
| 0.01µF   |                       | 103                                      | 103 | 103 | 103 | 103 |
| 0.012µF  |                       | 123                                      | 123 | 123 | 123 | 123 |
| 0.015µF  |                       | 153                                      | 153 | 153 | 153 | 153 |
| 0.018µF  |                       | 183                                      | 183 | 183 | 183 | 183 |
| 0.022µF  |                       | 223                                      | 223 | 223 | 223 | 223 |
| 0.027µF  |                       | 273                                      | 273 | 273 | 273 | 273 |
| 0.033µF  |                       | 333                                      | 333 | 333 | 333 | 333 |
| 0.039µF  |                       | 393                                      | 393 | 393 | 393 | 393 |
| 0.047µF  |                       | 473                                      | 473 | 473 | 473 | 473 |
| 0.056µF  |                       | 563                                      | 563 | 563 |     |     |
| 0.068µF  |                       | 683                                      | 683 | 683 |     |     |
| 0.082µF  |                       | 823                                      | 823 | 823 |     |     |
| 0.100µF  |                       | 104                                      | 104 | 104 |     |     |
| 0.120µF  |                       | 124                                      | 124 |     |     |     |
| 0.150µF  |                       | 154                                      | 154 |     |     |     |
| 0.180µF  |                       | 184                                      |     |     |     |     |
| Rated Voltage (VDC)  |                       | 25                                       | 50  | 100 | 200 | 250 |
| Voltage Code   |                       | 3  | 5   | 1   | 2   | A   |

These products are protected under one or more of the following United States Patents and their non-US counterparts: US Pat. No. 7172985; U.S. Pat. No. 7670981.

**Table 1C – C32X Style/Size (0.100" & 0.250" Lead Spacing), Capacitance Range Waterfall**

| C321, C324, C325, C327 Style/Size (0.100" & 0.250" Lead Spacing) |   |  |     |     |     |     |
|--|---|--|-----|-----|-----|-----|
| Rated Voltage (VDC)  |   | 25                                       | 50  | 100 | 200 | 250 |
| Voltage Code   |   | 3  | 5   | 1   | 2   | A   |
| Capacitance  | Capacitance Tolerance                     | Capacitance Code (Available Capacitance) |     |     |     |     |
| 1pF  | D = ±0.5pF                                | 109                                      | 109 | 109 | 109 | 109 |
| 1.1pF  |   | 119                                      | 119 | 119 | 119 | 119 |
| 1.2pF  |   | 129                                      | 129 | 129 | 129 | 129 |
| 1.3pF  |   | 139                                      | 139 | 139 | 139 | 139 |
| 1.5pF  |   | 159                                      | 159 | 159 | 159 | 159 |
| 1.6pF  |   | 169                                      | 169 | 169 | 169 | 169 |
| 1.8pF  |   | 189                                      | 189 | 189 | 189 | 189 |
| 2.0pF  |   | 209                                      | 209 | 209 | 209 | 209 |
| 2.2pF  |   | 229                                      | 229 | 229 | 229 | 229 |
| 2.4pF  |   | 249                                      | 249 | 249 | 249 | 249 |
| 2.7pF  |   | 279                                      | 279 | 279 | 279 | 279 |
| 3.0pF  |   | 309                                      | 309 | 309 | 309 | 309 |
| 3.3pF  |   | 339                                      | 339 | 339 | 339 | 339 |
| 3.6pF  |   | 369                                      | 369 | 369 | 369 | 369 |
| 3.9pF  |   | 399                                      | 399 | 399 | 399 | 399 |
| 4.3pF  |   | 439                                      | 439 | 439 | 439 | 439 |
| 4.7pF  |   | 479                                      | 479 | 479 | 479 | 479 |
| 5.1pF  |   | 519                                      | 519 | 519 | 519 | 519 |
| 5.6pF  |   | 569                                      | 569 | 569 | 569 | 569 |
| 6.2pF  |   | 629                                      | 629 | 629 | 629 | 629 |
| 6.8pF  | 689                                       | 689                                      | 689 | 689 | 689 |     |
| 7.5pF  | 759                                       | 759                                      | 759 | 759 | 759 |     |
| 8.2pF  | 829                                       | 829                                      | 829 | 829 | 829 |     |
| 9.1pF  | 919                                       | 919                                      | 919 | 919 | 919 |     |
| 10pF   | F = ±1%<br>G = ±2%<br>J = ±5%<br>K = ±10% | 100                                      | 100 | 100 | 100 | 100 |
| 11pF   |   | 110                                      | 110 | 110 | 110 | 110 |
| 12pF   |   | 120                                      | 120 | 120 | 120 | 120 |
| 13pF   |   | 130                                      | 130 | 130 | 130 | 130 |
| 15pF   |   | 150                                      | 150 | 150 | 150 | 150 |
| 16pF   |   | 160                                      | 160 | 160 | 160 | 160 |
| 18pF   |   | 180                                      | 180 | 180 | 180 | 180 |
| 20pF   |   | 200                                      | 200 | 200 | 200 | 200 |
| 22pF   |   | 220                                      | 220 | 220 | 220 | 220 |
| 24pF   |   | 240                                      | 240 | 240 | 240 | 240 |
| 27pF   |   | 270                                      | 270 | 270 | 270 | 270 |
| 30pF   |   | 300                                      | 300 | 300 | 300 | 300 |
| 33pF   |   | 330                                      | 330 | 330 | 330 | 330 |
| 36pF   |   | 360                                      | 360 | 360 | 360 | 360 |
| 39pF   |   | 390                                      | 390 | 390 | 390 | 390 |
| 43pF   |   | 430                                      | 430 | 430 | 430 | 430 |
| 47pF   |   | 470                                      | 470 | 470 | 470 | 470 |
| 51pF   |   | 510                                      | 510 | 510 | 510 | 510 |
| 56pF   |   | 560                                      | 560 | 560 | 560 | 560 |
| 62pF   |   | 620                                      | 620 | 620 | 620 | 620 |
| 68pF   | 680                                       | 680                                      | 680 | 680 | 680 |     |
| 75pF   | 750                                       | 750                                      | 750 | 750 | 750 |     |
| 82pF   | 820                                       | 820                                      | 820 | 820 | 820 |     |
| 91pF   | 910                                       | 910                                      | 910 | 910 | 910 |     |
| 100pF  | 101                                       | 101                                      | 101 | 101 | 101 |     |
| 110pF  | 111                                       | 111                                      | 111 | 111 | 111 |     |
| 120pF  | 121                                       | 121                                      | 121 | 121 | 121 |     |
| 130pF  | 131                                       | 131                                      | 131 | 131 | 131 |     |
| 150pF  | 151                                       | 151                                      | 151 | 151 | 151 |     |
| 160pF  | 161                                       | 161                                      | 161 | 161 | 161 |     |
| 180pF  | 181                                       | 181                                      | 181 | 181 | 181 |     |
| 200pF  | 201                                       | 201                                      | 201 | 201 | 201 |     |
| 220pF  | 221                                       | 221                                      | 221 | 221 | 221 |     |
| Rated Voltage (VDC)  |   | 25                                       | 50  | 100 | 200 | 250 |
| Voltage Code   |   | 3  | 5   | 1   | 2   | A   |

These products are protected under one or more of the following United States Patents and their non-US counterparts: US Pat. No. 7172985; U.S. Pat. No. 7670981.

**Table 1C – C32X Style/Size (0.100" & 0.250" Lead Spacing), Capacitance Range Waterfall cont.**

| C321, C324, C325, C327 Style/Size (0.100" & 0.250" Lead Spacing) |                       |  |     |     |     |     |
|--|-----------------------|--|-----|-----|-----|-----|
| Rated Voltage (VDC)  |                       | 25                                       | 50  | 100 | 200 | 250 |
| Voltage Code   |                       | 3  | 5   | 1   | 2   | A   |
| Capacitance  | Capacitance Tolerance | Capacitance Code (Available Capacitance) |     |     |     |     |
| 240pF  |                       | 241                                      | 241 | 241 | 241 | 241 |
| 270pF  |                       | 271                                      | 271 | 271 | 271 | 271 |
| 300pF  |                       | 301                                      | 301 | 301 | 301 | 301 |
| 330pF  |                       | 331                                      | 331 | 331 | 331 | 331 |
| 360pF  |                       | 361                                      | 361 | 361 | 361 | 361 |
| 390pF  |                       | 391                                      | 391 | 391 | 391 | 391 |
| 430pF  |                       | 431                                      | 431 | 431 | 431 | 431 |
| 470pF  |                       | 471                                      | 471 | 471 | 471 | 471 |
| 510pF  |                       | 511                                      | 511 | 511 | 511 | 511 |
| 560pF  |                       | 561                                      | 561 | 561 | 561 | 561 |
| 620pF  |                       | 621                                      | 621 | 621 | 621 | 621 |
| 680pF  |                       | 681                                      | 681 | 681 | 681 | 681 |
| 750pF  |                       | 751                                      | 751 | 751 | 751 | 751 |
| 820pF  |                       | 821                                      | 821 | 821 | 821 | 821 |
| 910pF  |                       | 911                                      | 911 | 911 | 911 | 911 |
| 1000pF   |                       | 102                                      | 102 | 102 | 102 | 102 |
| 1100pF   |                       | 112                                      | 112 | 112 | 112 | 112 |
| 1200pF   |                       | 122                                      | 122 | 122 | 122 | 122 |
| 1300pF   |                       | 132                                      | 132 | 132 | 132 | 132 |
| 1500pF   |                       | 152                                      | 152 | 152 | 152 | 152 |
| 1600pF   |                       | 162                                      | 162 | 162 | 162 | 162 |
| 1800pF   |                       | 182                                      | 182 | 182 | 182 | 182 |
| 2000pF   |                       | 202                                      | 202 | 202 | 202 | 202 |
| 2200pF   |                       | 222                                      | 222 | 222 | 222 | 222 |
| 2400pF   |                       | 242                                      | 242 | 242 | 242 | 242 |
| 2700pF   |                       | 272                                      | 272 | 272 | 272 | 272 |
| 3000pF   | F = ±1%               | 302                                      | 302 | 302 | 302 | 302 |
| 3300pF   | G = ±2%               | 332                                      | 332 | 332 | 332 | 332 |
| 3600pF   | J = ±5%               | 362                                      | 362 | 362 | 362 | 362 |
| 3900pF   | K = ±10%              | 392                                      | 392 | 392 | 392 | 392 |
| 4300pF   |                       | 432                                      | 432 | 432 | 432 | 432 |
| 4700pF   |                       | 472                                      | 472 | 472 | 472 | 472 |
| 5100pF   |                       | 512                                      | 512 | 512 | 512 | 512 |
| 5600pF   |                       | 562                                      | 562 | 562 | 562 | 562 |
| 6200pF   |                       | 622                                      | 622 | 622 | 622 | 622 |
| 6800pF   |                       | 682                                      | 682 | 682 | 682 | 682 |
| 7500pF   |                       | 752                                      | 752 | 752 | 752 | 752 |
| 8200pF   |                       | 822                                      | 822 | 822 | 822 | 822 |
| 9100pF   |                       | 912                                      | 912 | 912 | 912 | 912 |
| 0.01µF   |                       | 103                                      | 103 | 103 | 103 | 103 |
| 0.012µF  |                       | 123                                      | 123 | 123 | 123 | 123 |
| 0.015µF  |                       | 153                                      | 153 | 153 | 153 | 153 |
| 0.018µF  |                       | 183                                      | 183 | 183 | 183 | 183 |
| 0.022µF  |                       | 223                                      | 223 | 223 | 223 | 223 |
| 0.027µF  |                       | 273                                      | 273 | 273 | 273 | 273 |
| 0.033µF  |                       | 333                                      | 333 | 333 | 333 | 333 |
| 0.039µF  |                       | 393                                      | 393 | 393 | 393 | 393 |
| 0.047µF  |                       | 473                                      | 473 | 473 | 473 | 473 |
| 0.056µF  |                       | 563                                      | 563 | 563 |     |     |
| 0.068µF  |                       | 683                                      | 683 | 683 |     |     |
| 0.082µF  |                       | 823                                      | 823 | 823 |     |     |
| 0.100µF  |                       | 104                                      | 104 | 104 |     |     |
| 0.120µF  |                       | 124                                      | 124 |     |     |     |
| 0.150µF  |                       | 154                                      | 154 |     |     |     |
| 0.180µF  |                       | 184                                      |     |     |     |     |
| Rated Voltage (VDC)  |                       | 25                                       | 50  | 100 | 200 | 250 |
| Voltage Code   |                       | 3  | 5   | 1   | 2   | A   |

These products are protected under one or more of the following United States Patents and their non-US counterparts: US Pat. No. 7172985; U.S. Pat. No. 7670981.

**Table 1D - C33X Style/Size (0.200" & 0.250" Lead Spacing), Capacitance Range Waterfall**

| C330, C331, C333, C335, C336 Style/Size (0.200" & 0.250" Lead Spacing) |   |  |       |       |       |
|--|---|--|-------|-------|-------|
| Rated Voltage (VDC)  |   | 50                                       | 100   | 200   | 250   |
| Voltage Code   |   | 5  | 1     | 2     | A     |
| Capacitance  | Capacitance Tolerance                     | Capacitance Code (Available Capacitance) |       |       |       |
| 1pF  | D = ±0.5pF                                | 109*                                     | 109*  | 109*  | 109*  |
| 1.1pF  |   | 119*                                     | 119*  | 119*  | 119*  |
| 1.2pF  |   | 129*                                     | 129*  | 129*  | 129*  |
| 1.3pF  |   | 139*                                     | 139*  | 139*  | 139*  |
| 1.5pF  |   | 159*                                     | 159*  | 159*  | 159*  |
| 1.6pF  |   | 169*                                     | 169*  | 169*  | 169*  |
| 1.8pF  |   | 189*                                     | 189*  | 189*  | 189*  |
| 2.0pF  |   | 209*                                     | 209*  | 209*  | 209*  |
| 2.2pF  |   | 229*                                     | 229*  | 229*  | 229*  |
| 2.4pF  |   | 249*                                     | 249*  | 249*  | 249*  |
| 2.7pF  |   | 279*                                     | 279*  | 279*  | 279*  |
| 3.0pF  |   | 309*                                     | 309*  | 309*  | 309*  |
| 3.3pF  |   | 339*                                     | 339*  | 339*  | 339*  |
| 3.6pF  |   | 369*                                     | 369*  | 369*  | 369*  |
| 3.9pF  |   | 39*9*                                    | 39*9* | 39*9* | 39*9* |
| 4.3pF  |   | 439*                                     | 439*  | 439*  | 439*  |
| 4.7pF  |   | 479*                                     | 479*  | 479*  | 479*  |
| 5.1pF  |   | 519*                                     | 519*  | 519*  | 519*  |
| 5.6pF  |   | 569*                                     | 569*  | 569*  | 569*  |
| 6.2pF  |   | 629*                                     | 629*  | 629*  | 629*  |
| 6.8pF  | 689*                                      | 689*                                     | 689*  | 689*  |       |
| 7.5pF  | 759*                                      | 759*                                     | 759*  | 759*  |       |
| 8.2pF  | 829*                                      | 829*                                     | 829*  | 829*  |       |
| 9.1pF  | 9*19*                                     | 9*19*                                    | 9*19* | 9*19* |       |
| 10pF   | F = ±1%<br>G = ±2%<br>J = ±5%<br>K = ±10% | 100*                                     | 100*  | 100*  | 100*  |
| 11pF   |   | 110*                                     | 110*  | 110*  | 110*  |
| 12pF   |   | 120*                                     | 120*  | 120*  | 120*  |
| 13pF   |   | 130*                                     | 130*  | 130*  | 130*  |
| 15pF   |   | 150*                                     | 150*  | 150*  | 150*  |
| 16pF   |   | 160*                                     | 160*  | 160*  | 160*  |
| 18pF   |   | 180*                                     | 180*  | 180*  | 180*  |
| 20pF   |   | 200*                                     | 200*  | 200*  | 200*  |
| 22pF   |   | 220*                                     | 220*  | 220*  | 220*  |
| 24pF   |   | 240*                                     | 240*  | 240*  | 240*  |
| 27pF   |   | 270*                                     | 270*  | 270*  | 270*  |
| 30pF   |   | 300*                                     | 300*  | 300*  | 300*  |
| 33pF   |   | 330*                                     | 330*  | 330*  | 330*  |
| 36pF   |   | 360*                                     | 360*  | 360*  | 360*  |
| 39pF   |   | 390*                                     | 390*  | 390*  | 390*  |
| 43pF   |   | 430*                                     | 430*  | 430*  | 430*  |
| 47pF   |   | 470*                                     | 470*  | 470*  | 470*  |
| 51pF   |   | 510*                                     | 510*  | 510*  | 510*  |
| 56pF   |   | 560*                                     | 560*  | 560*  | 560*  |
| 62pF   |   | 620*                                     | 620*  | 620*  | 620*  |
| 68pF   | 680*                                      | 680*                                     | 680*  | 680*  |       |
| 75pF   | 750*                                      | 750*                                     | 750*  | 750*  |       |
| 82pF   | 820*                                      | 820*                                     | 820*  | 820*  |       |
| 91pF   | 910*                                      | 910*                                     | 910*  | 910*  |       |
| 100pF  | 101*                                      | 101*                                     | 101*  | 101*  |       |
| 110pF  | 111*                                      | 111*                                     | 111*  | 111*  |       |
| 120pF  | 121*                                      | 121*                                     | 121*  | 121*  |       |
| 130pF  | 131*                                      | 131*                                     | 131*  | 131*  |       |
| 150pF  | 151*                                      | 151*                                     | 151*  | 151*  |       |
| 160pF  | 161*                                      | 161*                                     | 161*  | 161*  |       |
| 180pF  | 181*                                      | 181*                                     | 181*  | 181*  |       |
| 200pF  | 201*                                      | 201*                                     | 201*  | 201*  |       |
| 220pF  | 221*                                      | 221*                                     | 221*  | 221*  |       |
| Rated Voltage (VDC)  |   | 25                                       | 100   | 200   | 250   |
| Voltage Code   |   | 3  | 1     | 2     | A     |

These products are protected under one or more of the following United States Patents and their non-US counterparts: US Pat. No. 7172985; U.S. Pat. No. 7670981.

**Table 1D - C33X Style/Size (0.200" & 0.250" Lead Spacing), Capacitance Range Waterfall cont.**

| C330, C331, C333, C335, C336 Style/Size (0.200" & 0.250" Lead Spacing) |                       |  |      |      |      |
|--|-----------------------|--|------|------|------|
| Rated Voltage (VDC)  |                       | 50                                       | 100  | 200  | 250  |
| Voltage Code   |                       | 5  | 1    | 2    | A    |
| Capacitance  | Capacitance Tolerance | Capacitance Code (Available Capacitance) |      |      |      |
| 240pF  |                       | 241*                                     | 241* | 241* | 241* |
| 270pF  |                       | 271*                                     | 271* | 271* | 271* |
| 300pF  |                       | 301*                                     | 301* | 301* | 301* |
| 330pF  |                       | 331*                                     | 331* | 331* | 331* |
| 360pF  |                       | 361*                                     | 361* | 361* | 361* |
| 390pF  |                       | 391*                                     | 391* | 391* | 391* |
| 430pF  |                       | 431*                                     | 431* | 431* | 431* |
| 470pF  |                       | 471*                                     | 471* | 471* | 471* |
| 510pF  |                       | 511*                                     | 511* | 511* | 511* |
| 560pF  |                       | 561*                                     | 561* | 561* | 561* |
| 620pF  |                       | 621*                                     | 621* | 621* | 621* |
| 680pF  |                       | 681*                                     | 681* | 681* | 681* |
| 750pF  |                       | 751*                                     | 751* | 751* | 751* |
| 820pF  |                       | 821*                                     | 821* | 821* | 821* |
| 910pF  |                       | 911*                                     | 911* | 911* | 911* |
| 1000pF   |                       | 102*                                     | 102* | 102* | 102* |
| 1100pF   |                       | 112*                                     | 112* | 112* | 112* |
| 1200pF   |                       | 122*                                     | 122* | 122* | 122* |
| 1300pF   |                       | 132*                                     | 132* | 132* | 132* |
| 1500pF   |                       | 152*                                     | 152* | 152* | 152* |
| 1600pF   |                       | 162*                                     | 162* | 162* | 162* |
| 1800pF   |                       | 182*                                     | 182* | 182* | 182* |
| 2000pF   |                       | 202*                                     | 202* | 202* | 202* |
| 2200pF   |                       | 222*                                     | 222* | 222* | 222* |
| 2400pF   |                       | 242*                                     | 242* | 242* | 242* |
| 2700pF   |                       | 272*                                     | 272* | 272* | 272* |
| 3000pF   | F = ±1%               | 302*                                     | 302* | 302* | 302* |
| 3300pF   | G = ±2%               | 332*                                     | 332* | 332* | 332* |
| 3600pF   | J = ±5%               | 362*                                     | 362* | 362* | 362* |
| 3900pF   | K = ±10%              | 392*                                     | 392* | 392* | 392* |
| 4300pF   |                       | 432*                                     | 432* | 432* | 432* |
| 4700pF   |                       | 472*                                     | 472* | 472* | 472* |
| 5100pF   |                       | 512*                                     | 512* | 512* | 512* |
| 5600pF   |                       | 562*                                     | 562* | 562* | 562* |
| 6200pF   |                       | 622*                                     | 622* | 622* | 622* |
| 6800pF   |                       | 682*                                     | 682* | 682* | 682* |
| 7500pF   |                       | 752*                                     | 752* | 752* | 752* |
| 8200pF   |                       | 822*                                     | 822* | 822* | 822* |
| 9100pF   |                       | 912*                                     | 912* | 912* | 912* |
| 0.01µF   |                       | 103*                                     | 103* | 103* | 103* |
| 0.012µF  |                       | 123*                                     | 123* | 123* | 123* |
| 0.015µF  |                       | 153*                                     | 153* | 153* | 153* |
| 0.018µF  |                       | 183*                                     | 183* | 183* | 183* |
| 0.022µF  |                       | 223*                                     | 223* | 223* | 223* |
| 0.027µF  |                       | 273*                                     | 273* | 273* | 273* |
| 0.033µF  |                       | 333*                                     | 333* | 333* | 333* |
| 0.039µF  |                       | 393*                                     | 393* | 393* | 393* |
| 0.047µF  |                       | 473*                                     | 473* | 473* | 473* |
| 0.056µF  |                       | 563*                                     | 563* | 563  | 563  |
| 0.068µF  |                       | 683*                                     | 683* | 683  | 683  |
| 0.082µF  |                       | 823*                                     | 823* | 823  | 823  |
| 0.100µF  |                       | 104*                                     | 104* | 104  | 104  |
| 0.120µF  |                       | 124*                                     | 124  |      |      |
| 0.150µF  |                       | 154*                                     | 154  |      |      |
| 0.180µF  |                       | 184                                      |      |      |      |
| 0.220µF  |                       | 224                                      |      |      |      |
| Rated Voltage (VDC)  |                       | 25                                       | 100  | 200  | 250  |
| Voltage Code   |                       | 3  | 1    | 2    | A    |

These products are protected under one or more of the following United States Patents and their non-US counterparts: US Pat. No. 7172985; U.S. Pat. No. 7670981.

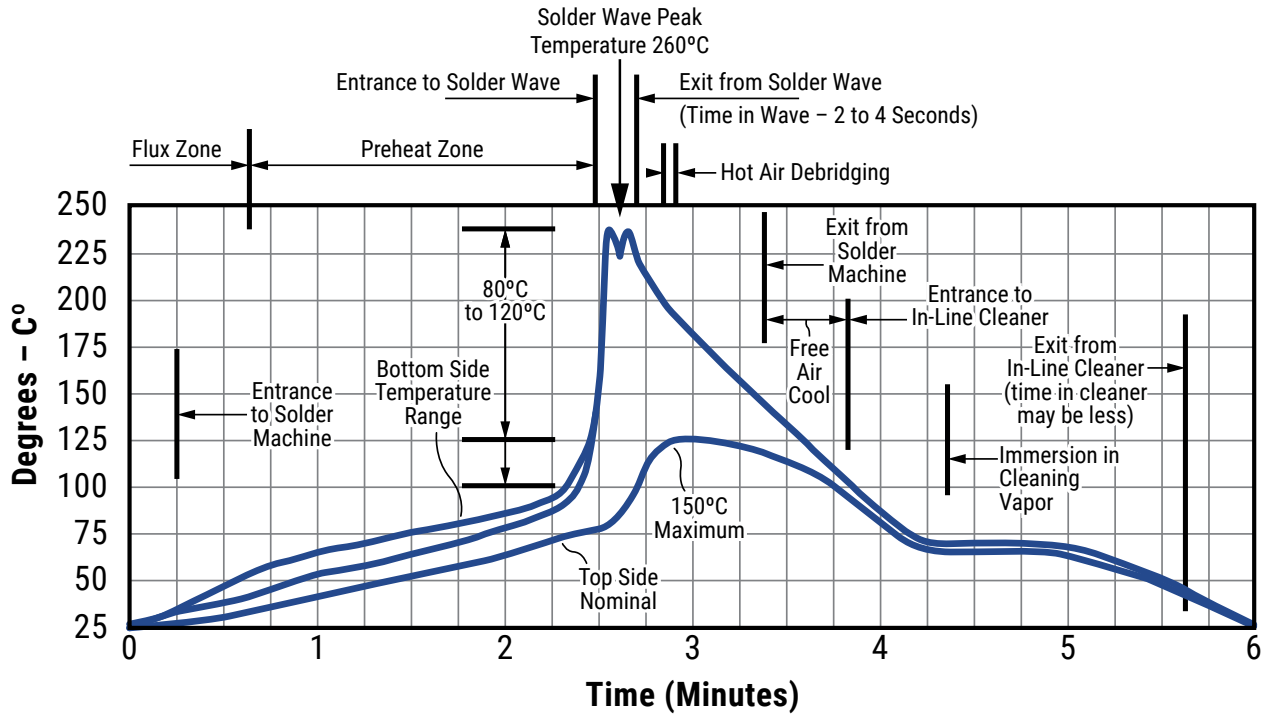
## Soldering Process

### Recommended Soldering Technique:

- Solder Wave
- Hand Soldering (Manual)

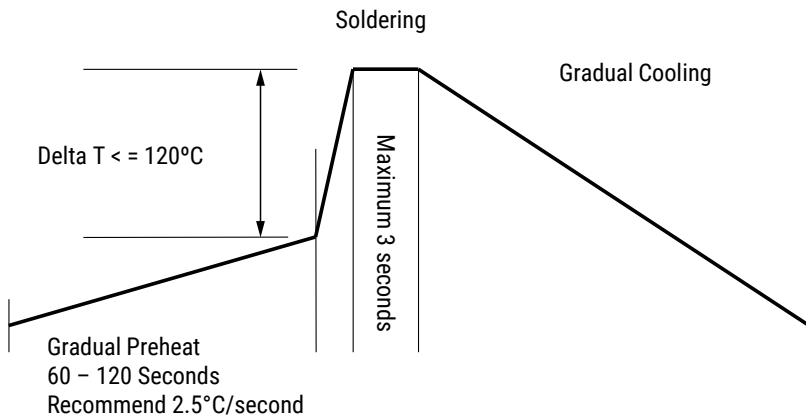
### Recommended Soldering Profile:

- Optimum Wave Solder Profile



- Hand Soldering (Manual)

### Manual Solder Profile with Pre-heating

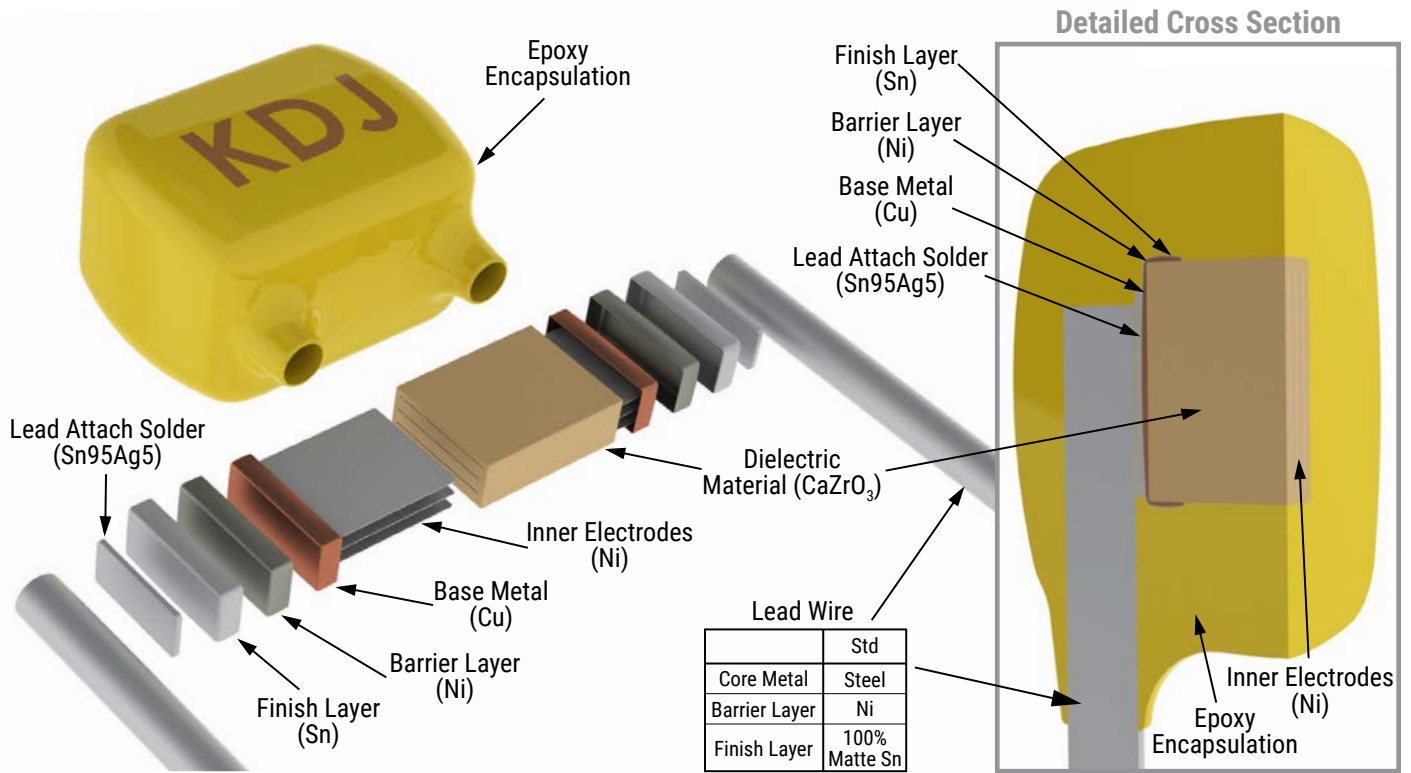


## Storage & Handling

The un-mounted storage life of a leaded ceramic capacitor is dependent upon storage and atmospheric conditions as well as packaging materials. While the ceramic chips enveloped under the epoxy coating themselves are quite robust in most environments, solderability of the wire lead on the final epoxy-coated product 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 and exposure to direct sunlight – reels may soften or warp, and tape peel force may increase.

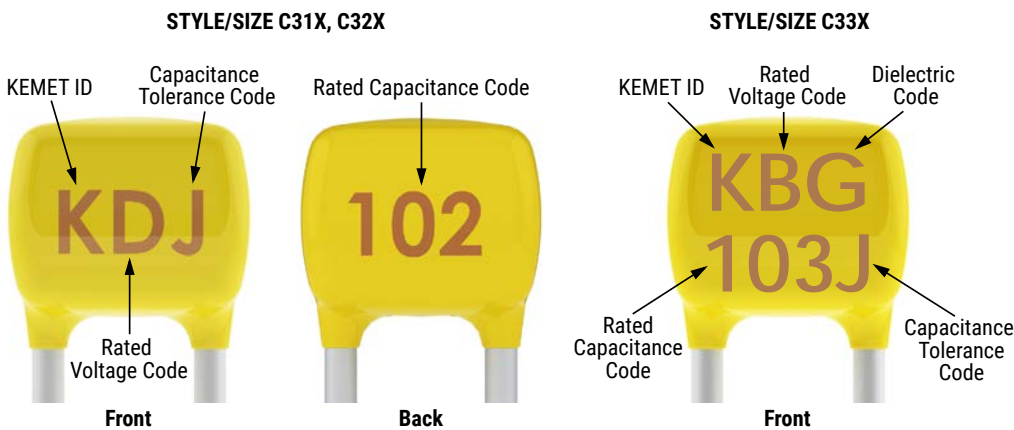
KEMET recommends storing the un-mounted capacitors in their original packaging, in a location away from direct sunlight, and where the temperature and relative humidity do not exceed 40 degrees centigrade and 70% respectively. For optimum solderability, capacitor stock should be used promptly, preferably within 18 months of receipt. For applications requiring pre-tinning of components, storage life may be extended if solderability is verified. Before cleaning, bonding or molding these devices, it is important to verify that your process does not affect product quality and performance. KEMET recommends testing and evaluating the performance of a cleaned, bonded or molded product prior to implementing and/or qualifying any of these processes.

## Construction



## Capacitor Marking

These capacitors shall be stamped or laser marked with KEMET's trademark, rated voltage, rated capacitance and capacitance tolerance. Dielectric information will be included only when the body size of the component allows. Marking will be supplied on one or both sides of the coated capacitor body. All marking shall be legible to allow for clear identification of the component. Marking appears in legible contrast. An example of the marking format and content is illustrated below.





## Packaging Quantities

| Series | Standard Bulk Quantity | Ammo Pack Quantity Maximum |     | Reel Quantity Maximum (12" Reel) |
|--------|------------------------|----------------------------|-----|----------------------------------|
| 315    | 500/Bag                | 2500                       |     | 2500                             |
| 316    |                        |                            |     |                                  |
| 317    |                        |                            |     |                                  |
| 318    |                        |                            |     |                                  |
| 320    |                        |                            |     |                                  |
| 321    |                        | N/A                        | N/A |                                  |
| 322    |                        | 2500                       |     |                                  |
| 323    |                        |                            |     |                                  |
| 324    |                        |                            |     |                                  |
| 325    |                        |                            |     |                                  |
| 326    |                        |                            |     |                                  |
| 327    |                        |                            |     |                                  |
| 328    |                        |                            |     |                                  |
| 330    | 250/Bag                | 1500                       |     |                                  |
| 331    |                        | N/A                        | N/A |                                  |
| 333    |                        | 1500                       |     |                                  |
| 335    |                        |                            |     |                                  |
| 336    |                        |                            |     |                                  |

## Tape & Reel Packaging Information

KEMET offers standard reeling of Molded and Conformally Coated Radial Led Capacitors in accordance with EIA standard 468. Parts are taped to a tagboard carrier strip, and wound on a reel as shown in Figure 1. Kraft paper interleafing is inserted between the layers of capacitors on the reel. Ammopack is also available, with the same lead tape configuration and package quantities.

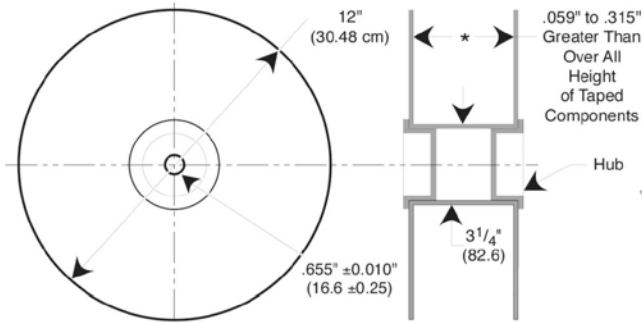
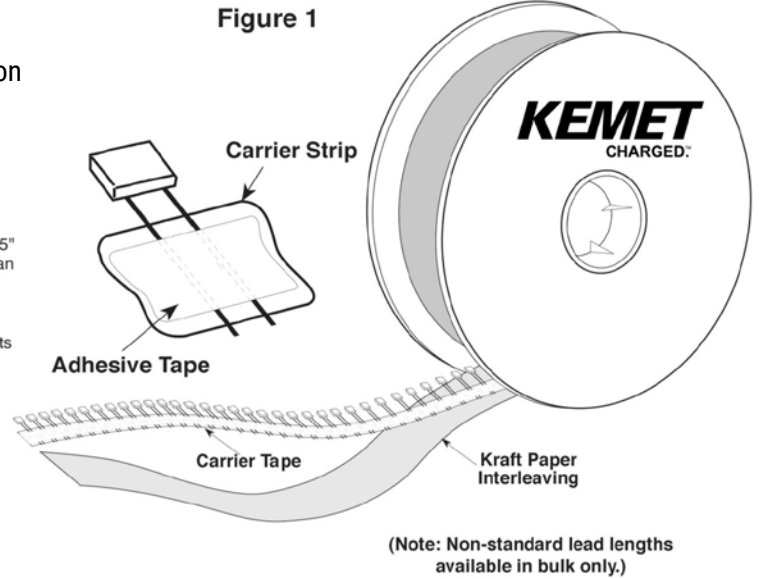


Figure 3: Standard Reel



(Note: Non-standard lead lengths available in bulk only)

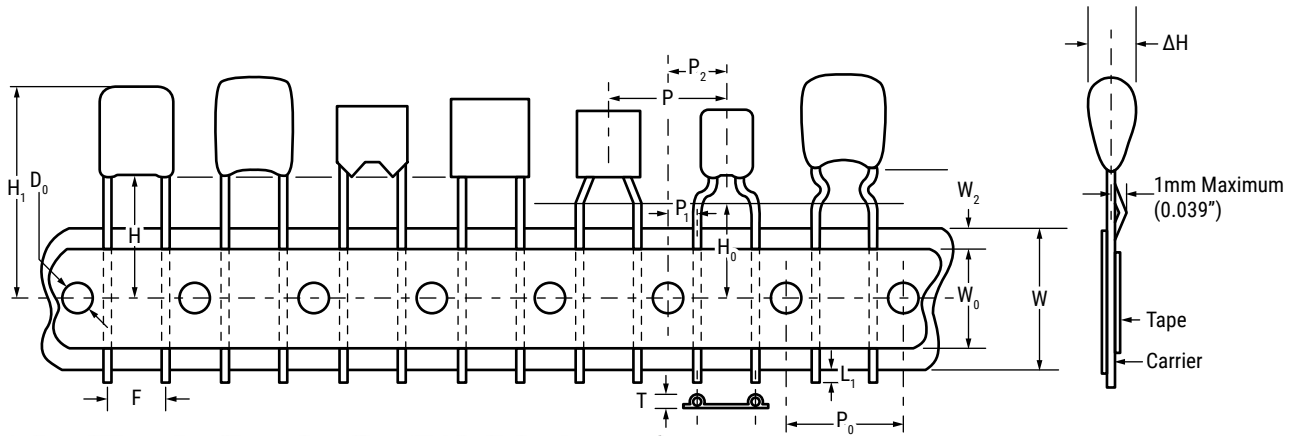


Figure 2: Lead Tape Configuration (See Table Below)

## Ceramic Radial Tape and Reel Dimensions

Metric will govern

| Constant Dimensions – Millimeters (Inches) |                       |                            |                  |                     |                |                                     |                  |                  |
|--|-----------------------|----------------------------|------------------|---------------------|----------------|-------------------------------------|------------------|------------------|
| $D_0$<br>±0.2 (0.008)                      | $P_0$<br>±0.3 (0.012) | $\Delta H$<br>±0.2 (0.008) | $L_1$<br>Maximum | $t$<br>±0.2 (0.008) | $T$<br>Maximum | $W$<br>+1.0/-0.5<br>(+0.039/-0.020) | $W_0$<br>Minimum | $W_2$<br>Maximum |
| 4.00 (0.157)                               | 12.7 (0.500)          | 4.0 (0.157)                | 1.0 (0.039)      | 0.7 (0.051)         | 1.5 (0.059)    | 18.0 (0.709)                        | 5.0 (0.197)      | 3.0 (0.118)      |

## Ceramic Radial Tape and Reel Dimensions cont.

Metric will govern

| Variable Dimensions – Millimeters (Inches) |  |                   |                                |                               |                         |  |                         |
|--|--|-------------------|--------------------------------|-------------------------------|-------------------------|--|-------------------------|
| F<br>±0.78 (0.030) <sup>1</sup>            | P <sub>1</sub><br>±0.30 (0.012) <sup>1</sup> | P<br>±0.3 (0.012) | P <sub>2</sub><br>±1.3 (0.051) | H                             |                         | H <sub>0</sub>                         |                         |
|  |  |                   |                                | Straight Lead Configuration   |                         | Formed Lead Configuration <sup>2</sup> |                         |
|  |  |                   |                                | Packaging C-Spec <sup>3</sup> |                         |  |                         |
|  |  |                   |                                | 7301/7305                     | 7303/7317               | 7301/7305                              | 7303/7317               |
| 2.54 (0.100)                               | 5.08 (0.200)                                 | 12.7 (0.500)      | 6.35 (0.250)                   | 16.0±0.5<br>(0.630±0.020)     | 18.0 (0.709)<br>Minimum | 16.0±0.5<br>(0.630±0.020)              | 18.0 (0.709)<br>Minimum |
| 4.32 (0.170)                               | 3.89 (0.153)                                 | 12.7 (0.500)      | 6.35 (0.250)                   |                               |                         |  |                         |
| 5.08 (0.200)                               | 3.81 (0.150)                                 | 12.7 (0.500)      | 6.35 (0.250)                   |                               |                         |  |                         |
| 5.59 (0.220)                               | 3.25 (0.128)                                 | 12.7 (0.500)      | 6.35 (0.250)                   |                               |                         |  |                         |
| 6.98 (0.275)                               | 2.54 (0.100)                                 | 12.7 (0.500)      | 6.35 (0.250)                   |                               |                         |  |                         |
| 7.62 (0.300)                               | 2.24 (0.088)                                 | 12.7 (0.500)      | 6.35 (0.250)                   |                               |                         |  |                         |
| 9.52 (0.375)                               | 7.62 (0.300)                                 | 12.7 (0.500)      | 6.35 (0.250)                   |                               |                         |  |                         |
| 10.16 (0.400)                              | 7.34 (0.290)                                 | 25.4 (1.000)      | N/A                            |                               |                         |  |                         |
| 12.06 (0.475)                              | 6.35 (0.250)                                 | 25.4 (1.000)      | N/A                            |                               |                         |  |                         |
| 14.60 (0.575)                              | 5.08 (0.200)                                 | 25.4 (1.000)      | N/A                            |                               |                         |  |                         |
| 17.14 (0.675)                              | 3.81 (0.15)                                  | 25.4 (1.000)      | N/A                            |                               |                         |  |                         |

<sup>1</sup> Measured at the egress from the carrier tape, on the component side.

<sup>2</sup> Formed lead configuration includes: "shoulder bend", "inside kink", "outside kink", and "snap-in". For more information regarding available lead configurations see "Dimensions" section of this document.

<sup>3</sup> The "Packaging C-Spec" is a 4 digit code which identifies the packaging type, lead length and/or lead material. 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.

| Symbol Reference Table |   |
|------------------------|---|
| D <sub>0</sub>         | Sprocket Hole Diameter                        |
| P <sub>0</sub>         | Sprocket Hole Pitch                           |
| P                      | Component Pitch                               |
| F                      | Lead Spacing                                  |
| P <sub>1</sub>         | Sprocket Hole Center to Lead Center           |
| P <sub>2</sub>         | Sprocket Hole Center To Component Center      |
| H                      | Height to Seating Plane (Straight Leads Only) |
| H <sub>0</sub>         | Height to Seating Plane (Formed Leads Only)   |
| H <sub>1</sub>         | Component Height Above Tape Center            |
| ΔH                     | Component Alignment                           |
| L <sub>1</sub>         | Lead Protrusion                               |
| t                      | Composite Tape Thickness                      |
| W                      | Carrier Tape Width                            |
| W <sub>0</sub>         | Hold-Down Tape Width                          |
| W <sub>2</sub>         | Hold-Down Tape Location                       |

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