

Axial, Molded, C0G Dielectric, 50 – 200 VDC (Commercial Grade)

Overview

KEMET's epoxy molded axial through-hole ceramic capacitors in C0G dielectric feature a 125°C maximum operating temperature. The Electronics Industries Alliance (EIA) characterizes C0G 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. C0G 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 ± 30 ppm/°C from -55°C to +125°C. These devices meet the flame test requirements outlined in UL Standard 94 V-0.

Benefits

- Axial through-hole form factor
- Molded case
- -55°C to +125°C operating temperature range
- DC voltage ratings of 50V, 100 V and 200 V
- Capacitance offerings ranging from 1.0 pF up to 0.10 μ F
- Available capacitance tolerances of ± 0.5 pF, $\pm 1\%$, $\pm 2\%$, $\pm 5\%$, and $\pm 10\%$
- 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°C to +125°C
- No capacitance decay with time
- Non-polar device, minimizing installation concerns
- SnPb-plated lead finish (60/40)
- Encapsulation meets flammability standard UL 94 V-0



Ordering Information

| C | 114 | C | 681 | F | 1 | G | 5 | C | A | 7200 |
|---------|---------------------------------|-----------------------|---|---|------------------------------------|------------|-------------------|--------------------------|--------------|---|
| Ceramic | Style /Size | Specification /Series | Capacitance Code (pF) | Capacitance Tolerance ¹ | Rated Voltage (VDC) | Dielectric | Design | Lead Finish ² | Failure Rate | Packaging /Grade (C-Spec) |
| | 114 124 192 202 222 | C = Standard | Two significant digits and number of zeros Use 9 for 1.0 – 9.9 pF Use 8 for 0.5 – 0.99 pF ex. 2.2 pF = 229 ex. 0.5 pF = 508 | D = ± 0.5 pF F = $\pm 1\%$ G = $\pm 2\%$ J = $\pm 5\%$ K = $\pm 10\%$ | 5 = 50 V 1 = 100 V 2 = 200 V | G = C0G | 5 = Multilayer | C = SnPb (60/40) | A = N/A | Blank = Bulk 7200 = 12" Reel 7293 = Ammo Pack |

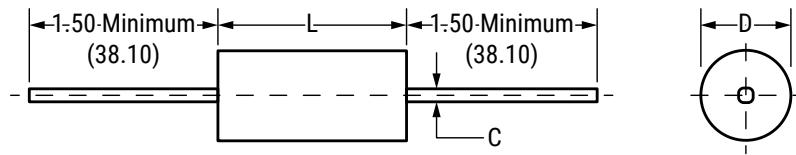
¹ Additional capacitance tolerance offerings may be available. Contact KEMET for details.

² Lead materials:

Standard: 60% tin (Sn)/40% lead (Pb) finish with 100% copper core ("C" designation).

Alternative lead materials and finishes may be available. Contact KEMET for details.

Dimensions – Inches (Millimeters)



| Series | Style/Size | L Length Maximum | D Diameter Maximum | LD Lead Diameter | LL Lead Length Minimum |
|--------|------------|--------------------------|-------------------------|--|------------------------------|
| C1XX | 114 | 0.160±0.010 (4.06±0.25) | 0.090±0.010 (2.29±0.25) | 0.020+0.0/-0.003 (0.51+0.0/-0.08) | 1.50 (38.10) |
| | 124 | 0.250±0.010 (6.35±0.25) | 0.090±0.010 (2.29±0.25) | | |
| | 192 | 0.390±0.010 (9.91±0.25) | 0.140±0.010 (3.56±0.25) | | |
| C2XX | 202 | 0.500±0.020 (12.70±0.51) | 0.250±0.015 (6.35±0.38) | 0.025+0.004/-0.001 (0.64+0.10/-0.025) | |
| | 222 | 0.690±0.030 (17.53±0.76) | 0.350±0.020 (8.89±0.51) | | |

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.

Qualification/Certification

Commercial Grade products are subject to internal qualification. Details regarding test methods and conditions are referenced in Table 2, Performance & Reliability.

Environmental Compliance

These devices do not meet RoHS criteria due to the concentration of Pb containment in the lead finish.

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 (Max % Cap Loss/Decade Hour) | 0% |
| Dielectric Withstanding Voltage | 250% of rated voltage (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 (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_{rms} ±0.2 V if capacitance ≤ 1,000 pF

1 kHz ±50 Hz and 1.0 V_{rms} ±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."

Post Environmental Limits

| High Temperature Life, Biased Humidity, Moisture Resistance | | | | |
|---|------------------|-------------------|--------|-------------------|
| Dielectric | Rated DC Voltage | Capacitance Value | DF (%) | Capacitance Shift |
| COG | All | All | 0.5 | 0.3% or ±0.25 pF |

Table 1A – C114 Style/Size (0.090" Diameter x 0.160" L), Capacitance Range Waterfall

| C114 Style/Size (0.090" Diameter x 0.160" L) | | | | |
|--|---|--|-----|-----|
| Rated Voltage (VDC) | | 50 | 100 | 200 |
| Voltage Code | | 5 | 1 | 2 |
| Capacitance | Capacitance Tolerance | Capacitance Code (Available Capacitance) | | |
| 1pF | D = ±0.5pF | 109 | 109 | 109 |
| 1.5pF | | 159 | 159 | 159 |
| 2.2pF | | 229 | 229 | 229 |
| 2.7pF | | 279 | 279 | 279 |
| 3.3pF | | 339 | 339 | 339 |
| 3.9pF | | 399 | 399 | 399 |
| 4.7pF | | 479 | 479 | 479 |
| 5.6pF | | 569 | 569 | 569 |
| 6.8pF | | 689 | 689 | 689 |
| 8.2pF | | 829 | 829 | 829 |
| 10pF | J = ±5% K = ±10% | 100 | 100 | 100 |
| 12pF | | 120 | 120 | 120 |
| 15pF | | 150 | 150 | 150 |
| 18pF | | 180 | 180 | 180 |
| 22pF | | 220 | 220 | 220 |
| 27pF | G = ±2% J = ±5% K = ±10% | 270 | 270 | 270 |
| 33pF | | 330 | 330 | 330 |
| 39pF | | 390 | 390 | 390 |
| 47pF | | 470 | 470 | 470 |
| 56pF | | 560 | 560 | 560 |
| 68pF | F = ±1% G = ±2% J = ±5% K = ±10% | 680 | 680 | 680 |
| 82pF | | 820 | 820 | 820 |
| 100pF | | 101 | 101 | 101 |
| 120pF | | 121 | 121 | 121 |
| 150pF | | 151 | 151 | 151 |
| 180pF | | 181 | 181 | 181 |
| 220pF | | 221 | 221 | 221 |
| 270pF | | 271 | 271 | 271 |
| 330pF | | 331 | 331 | 331 |
| 390pF | | 391 | 391 | 391 |
| 470pF | 471 | 471 | 471 | |
| 560pF | 561 | 561 | 561 | |
| 680pF | 681 | 681 | 681 | |
| Rated Voltage (VDC) | | 50 | 100 | 200 |
| Voltage Code | | 5 | 1 | 2 |

Table 1B – C124 Style/Size (0.090" Diameter x 0.250" L), Capacitance Range Waterfall

| C124 Style/Size (0.090" Diameter x 0.250" L) | | | | |
|--|---|--|-----|-----|
| Rated Voltage (VDC) | | 50 | 100 | 200 |
| Voltage Code | | 5 | 1 | 2 |
| Capacitance | Capacitance Tolerance | Capacitance Code (Available Capacitance) | | |
| 390pF | F = ±1% G = ±2% J = ±5% K = ±10% | 391 | 391 | 391 |
| 470pF | | 471 | 471 | 471 |
| 560pF | | 561 | 561 | 561 |
| 680pF | | | | |
| 820pF | | 821 | 821 | |
| 1000pF | | 102 | 102 | |
| Rated Voltage (VDC) | | 50 | 100 | 200 |
| Voltage Code | | 5 | 1 | 2 |

Table 1C – C192 Style/Size (0.140" Diameter x 0.390" L), Capacitance Range Waterfall

| C192 Style/Size (0.140" Diameter x 0.390" L) | | | | | |
|--|---|--|-----|-----|--|
| Rated Voltage (VDC) | | 50 | 100 | 200 | |
| Voltage Code | | 5 | 1 | 2 | |
| Capacitance | Capacitance Tolerance | Capacitance Code (Available Capacitance) | | | |
| 680pF | F = ±1% G = ±2% J = ±5% K = ±10% | 681 | 681 | 681 | |
| 820pF | | 821 | 821 | 821 | |
| 1000pF | | 102 | 102 | 102 | |
| 1200pF | | 122 | 122 | 122 | |
| 1500pF | | 152 | 152 | 152 | |
| 1800pF | | 182 | 182 | 182 | |
| 2200pF | | 222 | 222 | 222 | |
| 2700pF | | 272 | 272 | 272 | |
| 3300pF | | 332 | 332 | 332 | |
| 2700pF | | 272 | 272 | 272 | |
| 3300pF | | 332 | 332 | 332 | |
| 3900pF | | 392 | 392 | 392 | |
| 4700pF | | 472 | 472 | 472 | |
| 5600pF | | 562 | 562 | | |
| 6800pF | | 682 | 682 | | |
| 8200pF | | 822 | 822 | | |
| Rated Voltage (VDC) | | 50 | 100 | 200 | |
| Voltage Code | | 5 | 1 | 2 | |

Table 1D – C202 Style/Size (0.250" Diameter x 0.500" L), Capacitance Range Waterfall

| C202 Style/Size (0.250" Diameter x 0.500" L) | | | | |
|--|---|--|-----|-----|
| Rated Voltage (VDC) | | 50 | 100 | 200 |
| Voltage Code | | 5 | 1 | 2 |
| Capacitance | Capacitance Tolerance | Capacitance Code (Available Capacitance) | | |
| 5600pF | F = ±1% G = ±2% J = ±5% K = ±10% | 562 | 562 | 562 |
| 6800pF | | 682 | 682 | 682 |
| 8200pF | | 822 | 822 | 822 |
| 0.01μF | | 103 | 103 | 103 |
| 0.012μF | | 123 | 123 | 123 |
| 0.015μF | | 153 | 153 | 153 |
| 0.018μF | | 183 | 183 | 183 |
| 0.022μF | | 223 | 223 | 223 |
| 0.027μF | | 273 | 273 | 273 |
| 0.033μF | | 333 | 333 | 333 |
| Rated Voltage (VDC) | | 50 | 100 | 200 |
| Voltage Code | | 5 | 1 | 2 |

Table 1E – C222 Style/Size (0.350" Diameter x 0.690" L), Capacitance Range Waterfall

| C222 Style/Size (0.350" Diameter x 0.690" L) | | | | |
|--|---|--|-----|-----|
| Rated Voltage (VDC) | | 50 | 100 | 200 |
| Voltage Code | | 5 | 1 | 2 |
| Capacitance | Capacitance Tolerance | Capacitance Code (Available Capacitance) | | |
| 0.027μF | F = ±1% G = ±2% J = ±5% K = ±10% | 273 | 273 | 273 |
| 0.033μF | | 333 | 333 | 333 |
| 0.039μF | | 393 | 393 | 393 |
| 0.047μF | | 473 | 473 | 473 |
| 0.056μF | | 563 | 563 | 563 |
| 0.068μF | | 683 | 683 | 683 |
| 0.082μF | | 823 | 823 | 823 |
| 0.1μF | | 104 | 104 | 104 |
| Rated Voltage (VDC) | | 50 | 100 | 200 |
| Voltage Code | | 5 | 1 | 2 |

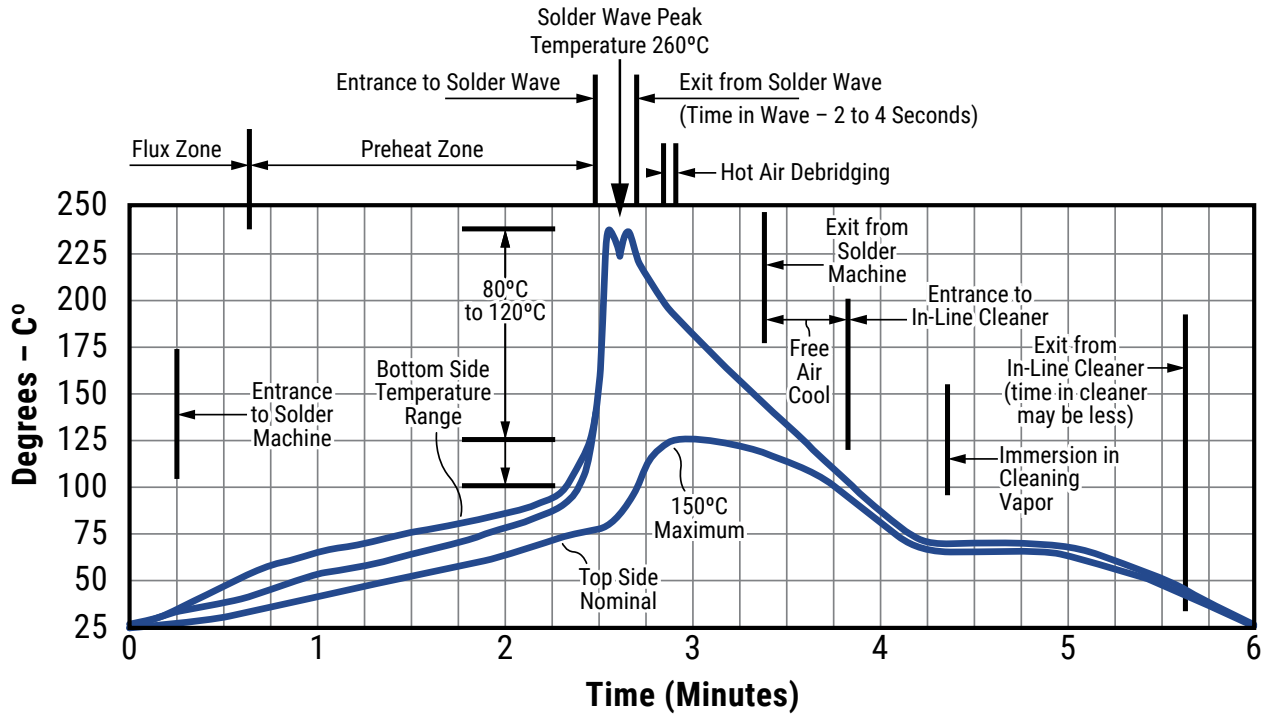
Soldering Process

Recommended Soldering Technique:

- Solder Wave
- Hand Soldering (Manual)

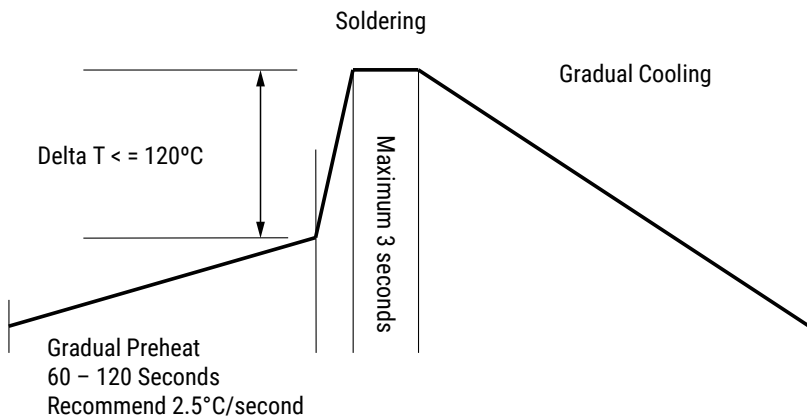
Recommended Soldering Profile:

- Optimum Wave Solder Profile



- Hand Soldering (Manual)

Manual Solder Profile with Pre-heating



KEMET recommends following the guidelines and techniques outlined in technical bulletins F2103 and F9207.

Table 2 – Performance & Reliability: Test Methods and Conditions

| Stress | Reference | Test or Inspection Method |
|------------------------------|---------------------------------|--|
| Solderability | J-STD-002 | Magnification 50 X. Conditions: |
| | | a) Method B, 4 hours at 155°C, dry heat at 235°C |
| | | b) Method B at 215°C category 3 |
| | | c) Method D, category 3 at 260°C |
| Temperature Cycling | JESD22 Method JA-104 | 1,000 cycles (-55°C to +125°C), Measurement at 24 hours. +/-2 hours after test conclusion. |
| Biased Humidity | MIL-STD-202 Method 103 | Load Humidity: 1,000 hours 85°C/85% RH and Rated Voltage. Add 100 K ohm resistor. Measurement at 24 hours. +/-2 hours after test conclusion. |
| | | Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours. +/-2 hours after test conclusion. |
| Moisture Resistance | MIL-STD-202 Method 106 | t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours. +/-2 hours after test conclusion. |
| Thermal Shock | MIL-STD-202 Method 107 | -55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air. |
| High Temperature Life | MIL-STD-202 Method 108 /EIA-198 | 1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied. |
| Storage Life | MIL-STD-202 Method 108 | 150°C, 0 VDC, for 1,000 hours. |
| Vibration | MIL-STD-202 Method 204 | 5 g for 20 minutes, 12 cycles each of 3 orientations. Note: Use 8"X5" PCB .031" thick 7 secure points on one long side and 2 secure points at corners of opposite sides. Parts mounted within 2" from any secure point. Test from 10–2,000 Hz. |
| Resistance to Soldering Heat | MIL-STD-202 Method 210 | Condition B. No pre-heat of samples. Note: single wave solder - procedure 2. |
| Terminal Strength | MIL-STD-202 Method 211 | Conditions A (2.3kg or 5 lbs) |
| Mechanical Shock | MIL-STD-202 Method 213 | Figure 1 of Method 213, Condition F. |
| Resistance to Solvents | MIL-STD-202 Method 215 | Add aqueous wash chemical, OKEM Clean or equivalent. |

Storage & Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature-reels may soften or warp, and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 40°C, and maximum storage humidity not exceed 70% relative humidity. Temperature fluctuations should be minimized to avoid condensation on the parts, and atmospheres should be free of chlorine and sulfur bearing compounds. For optimized solderability, chip stock should be used promptly, preferably within 1.5 years of receipt.

Packaging Details

| Lead Spacing | Component Pitch (P1) |
|---------------|----------------------|
| 0.100 (2.54) | 5.08 |
| 0.200 (5.08) | 3.81 |
| 0.400 (10.16) | 7.62 |
| 0.170 (4.32) | |
| 0.220 (5.59) | |
| 0.275 (6.98) | |
| 0.300 (7.62) | |
| 0.375 (9.52) | |
| 0.475 (12.06) | |
| 0.575 (14.60) | |
| 0.675 (17.14) | |

Packaging Quantities

| Style/Size | Standard Bulk Quantity | Ammo Pack Quantity Maximum | Reel Quantity Maximum (12" Reel) |
|------------|------------------------|----------------------------|----------------------------------|
| 114 | 200/Box | N/A | 5000 |
| 124 | 200/Box | | 5000 |
| 192 | 100/Box | | 3000 |
| 202 | 25/Box | | 500 |
| 222 | 10/Tray | | 300 |

Marking

| | | |
|------|---|------------------------------------|
| KCOG | — | KEMET, Temperature Characteristic |
| 101J | — | Capacitance, Capacitance Tolerance |
| 200V | — | Voltage |
| 0812 | — | Date Code |

Tape & Reel Packaging Information

KEMET offers standard reeling of molded and conformally coated axial leaded ceramic capacitors for automatic insertion or lead forming machines in accordance with EIA standard 296. KEMET’s internal specification four-digit suffix, 7200, is placed at the end of the part number to designate tape and reel packaging, e.g., C410C104Z5U5CA7200.

Paper (50 lb.) test minimum is inserted between the layers of capacitors wound on reels for component pitch $\leq 0.400"$. Capacitor lead length may extend only a maximum of $.0625"$ (1.59 mm) beyond the tapes’ edges. Capacitors are centered in a row between the two tapes and will deviate only $\pm 0.031"$ (0.79 mm) from the row center. A minimum of 36" (91.5 cm) leader tape is provided at each finished length of taped components. Universal splicing clips are used to connect the tape.

Figure 1

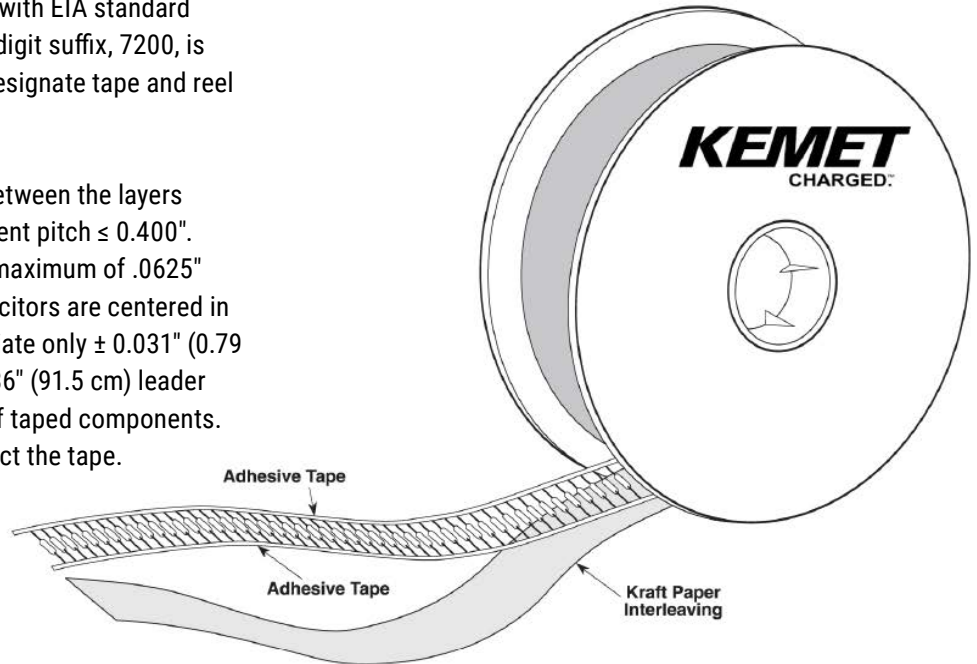


Figure 2

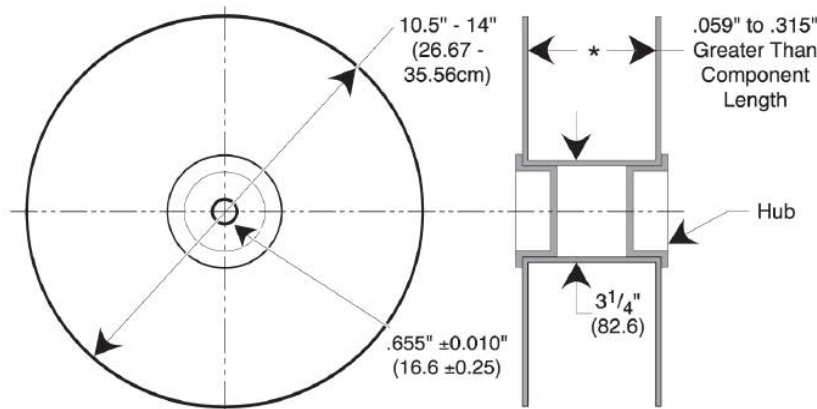


Figure 3

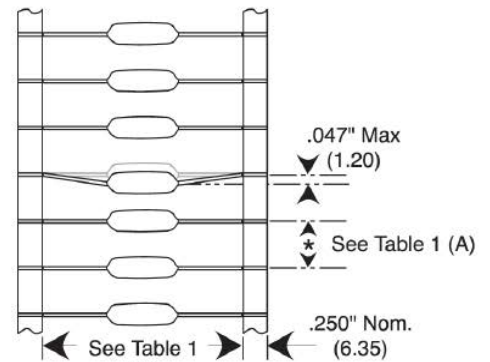


Table 3 – Ceramic Axial Tape and Reel Dimensions

Metric will govern

| Dimensions – Millimeters (Inches) | | |
|-----------------------------------|-------------------|--------------------|
| Axial Capacitor Body Diameter | A | B |
| | ± 0.5 (0.020) | ± 1.5 (0.059)* |
| 0.0 to 5.0 (0.0 to 0.197) | 5.0 (0.197) | 52.4 (2.062) |

| Symbol Reference Table | |
|------------------------|---------------------|
| A | Component Pitch |
| B | Inside Tape Spacing |

* Inside tape spacing dimension (B) is determined by the body diameter of the capacitor.

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