

# Aximax, 400 Series, Axial, Conformally Coated, Ultra-Stable X8R Dielectric, 50 – 200 VDC (Commercial & Automotive Grade)

**KEMET**  
 CHARGED®

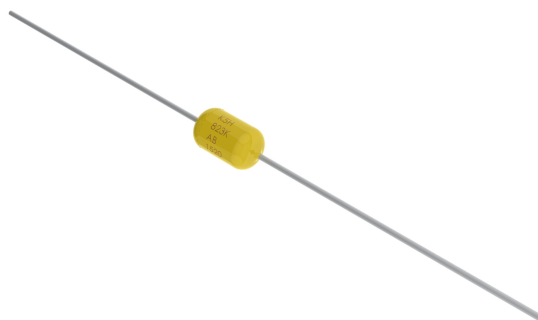
## Overview

KEMET's Aximax conformally coated axial through-hole ceramic capacitors in Ultra-Stable X8R dielectric feature a 150°C maximum operating temperature, offering the latest in high temperature dielectric technology and reliability for extreme temperature applications. It offers the same temperature capability as conventional X8R, but without the capacitance loss due to applied DC voltage. Ultra-Stable X8R exhibits no change in capacitance with respect to voltage and boasts a minimal change in capacitance with reference to ambient temperature. It is a suitable replacement for higher capacitance and larger footprint devices that fail to offer capacitance stability. Capacitance change with respect to temperature is limited to  $\pm 15\%$  from -55°C to 150°C.

Driven by the demand for a more robust and reliable component, the Ultra-Stable X8R dielectric Aximax through-hole capacitors were developed for critical applications where reliability and capacitance stability at higher operating temperatures are a concern. These capacitors are widely used in automotive circuits as well as general high temperature applications.

In addition to Commercial Grade, Automotive Grade devices are available and meet the demanding Automotive Electronics Council's AEC-Q200 qualification requirements.

These devices meet the flame test requirements outlined in UL Standard 94V-0.



## Ordering Information

| C       | 410         | C                     | 472                                        | J                                                                 | 5                            | H                    | 5              | T                                     | A            | 7200                                                                                                                                      |
|---------|-------------|-----------------------|--------------------------------------------|-------------------------------------------------------------------|------------------------------|----------------------|----------------|---------------------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Ceramic | Style /Size | Specification/ Series | Capacitance Code (pF)                      | Capacitance Tolerance <sup>1</sup>                                | Rated Voltage (VDC)          | Dielectric           | Design         | Lead Finish <sup>2</sup>              | Failure Rate | Packaging/Grade (C-Spec)                                                                                                                  |
|         | 410<br>430  | C = Standard          | Two significant digits and number of zeros | F = $\pm 1\%$<br>G = $\pm 2\%$<br>J = $\pm 5\%$<br>K = $\pm 10\%$ | 5 = 50<br>1 = 100<br>2 = 200 | H = Ultra-Stable X8R | 5 = Multilayer | T = 100% Matte Sn<br>H = SnPb (60/40) | A = N/A      | Blank = Bulk<br>7200 = 12" Reel<br>7293 = Ammo pack<br>9170 = Automotive grade<br>9170 7200 = Auto 12" Reel<br>9170 7293 = Auto Ammo pack |

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

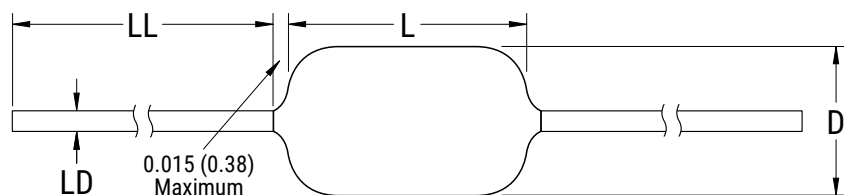
<sup>2</sup> Lead materials:

Standard: 100% matte tin (Sn) with nickel (Ni) underplate and steel core ("T" designation).

Alternative 1: 60% tin (Sn)/40% lead (Pb) finish with copper-clad steel core ("H" designation).

Additional lead finish options may be available. Contact KEMET for details

## Dimensions – Millimeters (Inches)



| Series | Style/Size | L<br>Length<br>Maximum | D<br>Diameter<br>Maximum | LD<br>Lead Diameter                       | LL<br>Lead Length<br>Minimum |
|--------|------------|------------------------|--------------------------|-------------------------------------------|------------------------------|
| C41X   | 410        | 0.170 (4.32)           | 0.095 (2.31)             | 0.020+0.001/-0.003<br>(0.51+0.025/-0.076) | 1.0 (25.4)                   |
| C43X   | 430        | 0.240 (6.10)           | 0.150 (3.81)             |                                           |                              |

## Benefits

- Axial through-hole form factor
- Conformally coated
- Operating temperature range of -55°C to +150°C
- Lead (Pb)-free, RoHS and REACH compliant
- DC voltage ratings of 50 V, 100 V and 200 V
- Capacitance offerings ranging from 10 pF up to 0.082 µF
- Available capacitance tolerances of ±1%, ±2%, ±5%, and 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°C to +150°C
- No capacitance decay with time
- Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated lead finish allowing for excellent solderability
- SnPb-plated lead finish option available upon request (60/40)
- Encapsulation meets flammability standard UL 94V-0

## Applications

Typical applications include decoupling, bypass and filtering in extreme environments such as down-hole oil exploration, under-hood automotive, aerospace and defense.

## 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 4, Performance & Reliability.

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, RoHS, and REACH compliant without exemptions (excluding SnPb termination finish option).

## Electrical Parameters/Characteristics

| Item                                                               | Parameters/Characteristics                                                              |
|--------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Operating Temperature Range                                        | -55°C to +150°C                                                                         |
| Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC) | ±15%                                                                                    |
| Aging Rate (Maximum % Capacitance Loss/Decade Hour)                | 0%                                                                                      |
| Dielectric Withstanding Voltage (DWV)                              | 250% of rated voltage<br>(5±1 seconds and charge/discharge not exceeding 50 mA)         |
| Dissipation Factor (DF) Maximum Limit at 25°C                      | 2.5%                                                                                    |
| 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 MQ-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 ±0.2 Vrms if capacitance ≤ 1,000 pF

1 kHz ±50 Hz and 1.0 ±0.2 Vrms 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 | Dissipation Factor (Maximum %) | Capacitance Shift | Insulation Resistance |
| Ultra-Stable X8R                                            | All              | All               | 2.5                            | 0.3% or ±0.25 pF  | 10% of Initial Limit  |

**Table 1A - C410 Style/Size (0.095" Diameter x 0.170" L), Capacitance Range Waterfall**

| C410 Style/Size (0.095" Diameter x 0.170" L) |                                           |                                          |     |     |  |
|----------------------------------------------|-------------------------------------------|------------------------------------------|-----|-----|--|
| Rated Voltage (VDC)                          |                                           | 50                                       | 100 | 200 |  |
| Voltage Code                                 |                                           | 5                                        | 1   | 2   |  |
| Capacitance                                  | Capacitance Tolerance                     | Capacitance Code (Available Capacitance) |     |     |  |
| 100pF                                        | F = ±1%<br>G = ±2%<br>J = ±5%<br>K = ±10% | 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 |  |
| 820pF                                        |                                           | 821                                      | 821 | 821 |  |
| 1000pF                                       |                                           | 102                                      | 102 | 102 |  |
| 1100pF                                       |                                           | 112                                      | 112 |     |  |
| 1200pF                                       |                                           | 122                                      | 122 |     |  |
| 1500pF                                       |                                           | 152                                      | 152 |     |  |
| 1800pF                                       |                                           | 182                                      | 182 |     |  |
| 2200pF                                       |                                           | 222                                      | 222 |     |  |
| 2700pF                                       |                                           | 272                                      | 272 |     |  |
| 3300pF                                       |                                           | 332                                      | 332 |     |  |
| 3900pF                                       |                                           | 392                                      | 392 |     |  |
| 4700pF                                       |                                           | 472                                      | 472 |     |  |
| 5100pF                                       |                                           | 512                                      | 512 |     |  |
| 5600pF                                       |                                           | 562                                      | 562 |     |  |
| 6200pF                                       |                                           | 622                                      | 622 |     |  |
| 6800pF                                       |                                           | 682                                      | 682 |     |  |
| 7500pF                                       |                                           | 752                                      | 752 |     |  |
| 8200pF                                       |                                           | 822                                      | 822 |     |  |
| 9100pF                                       |                                           | 912                                      | 912 |     |  |
| 0.01μF                                       |                                           | 103                                      | 103 |     |  |
| 0.012μF                                      |                                           | 123                                      | 123 |     |  |
| 0.015μF                                      |                                           | 153                                      | 153 |     |  |
| 0.018μF                                      |                                           | 183                                      |     |     |  |
| 0.022μF                                      |                                           | 223                                      |     |     |  |
| Rated Voltage (VDC)                          |                                           | 50                                       | 100 | 200 |  |
| Voltage Code                                 |                                           | 5                                        | 1   | 2   |  |

These products are protected under U.S. Patents 7172985 & 7670981, other patents pending, and any foreign counterparts.

**Table 1B - C430 Style/Size (0.150" Diameter x 0.290" L), Capacitance Range Waterfall**

| C430 Style/Size (0.150" Diameter x 0.260" L) |                                           |                                          |     |     |
|----------------------------------------------|-------------------------------------------|------------------------------------------|-----|-----|
| Rated Voltage (VDC)                          |                                           | 50                                       | 100 | 200 |
| Voltage Code                                 |                                           | 5                                        | 1   | 2   |
| Capacitance                                  | Capacitance Tolerance                     | Capacitance Code (Available Capacitance) |     |     |
| 1100pF                                       | F = ±1%<br>G = ±2%<br>J = ±5%<br>K = ±10% |                                          |     | 112 |
| 1200pF                                       |                                           |                                          |     | 122 |
| 1500pF                                       |                                           |                                          |     | 152 |
| 1800pF                                       |                                           |                                          |     | 182 |
| 2200pF                                       |                                           |                                          |     | 222 |
| 2700pF                                       |                                           |                                          |     | 272 |
| 0.018μF                                      |                                           |                                          | 183 |     |
| 0.022μF                                      |                                           |                                          | 223 |     |
| 0.027μF                                      |                                           |                                          | 273 |     |
| 0.033μF                                      |                                           |                                          | 333 |     |
| 0.039μF                                      |                                           |                                          | 393 |     |
| 0.047μF                                      |                                           |                                          | 473 |     |
| 0.056μF                                      |                                           |                                          | 563 |     |
| 0.068μF                                      |                                           |                                          | 683 |     |
| 0.082μF                                      |                                           |                                          | 823 |     |
| Rated Voltage (VDC)                          |                                           | 50                                       | 100 | 200 |
| Voltage Code                                 |                                           | 5                                        | 1   | 2   |

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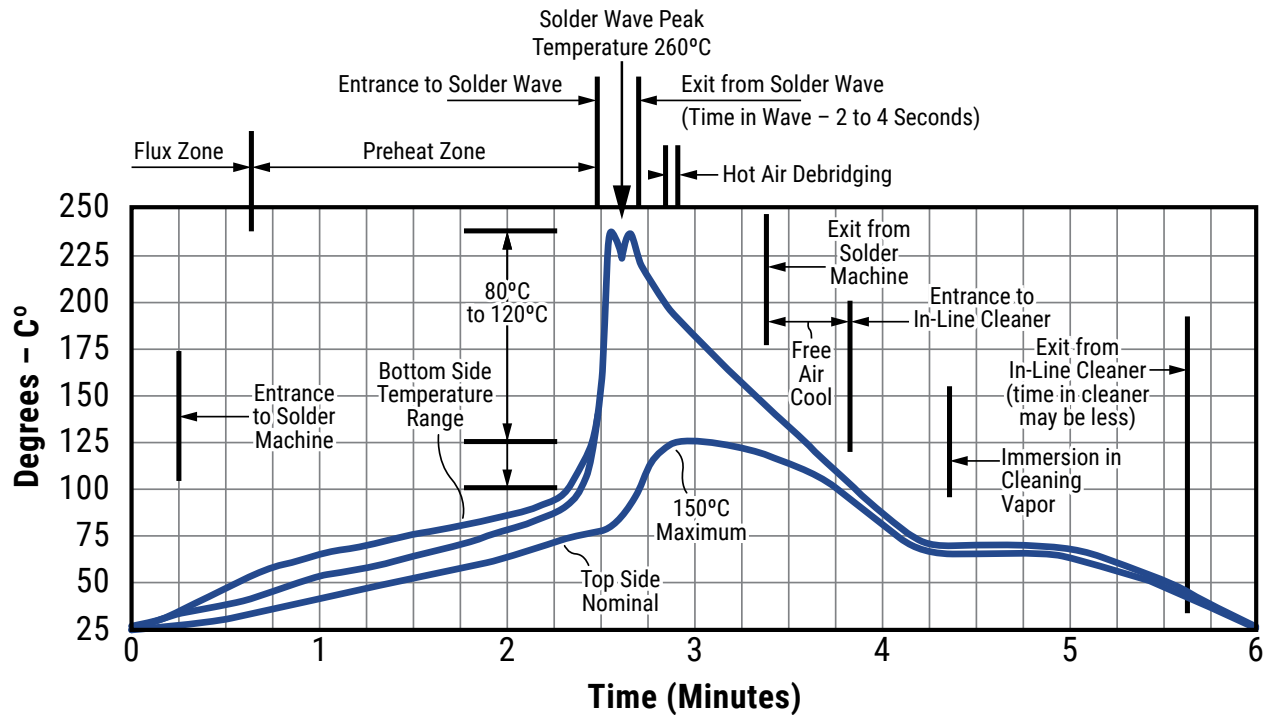
## Soldering Process

### Recommended Soldering Technique:

- Solder Wave
- Hand Soldering (Manual)

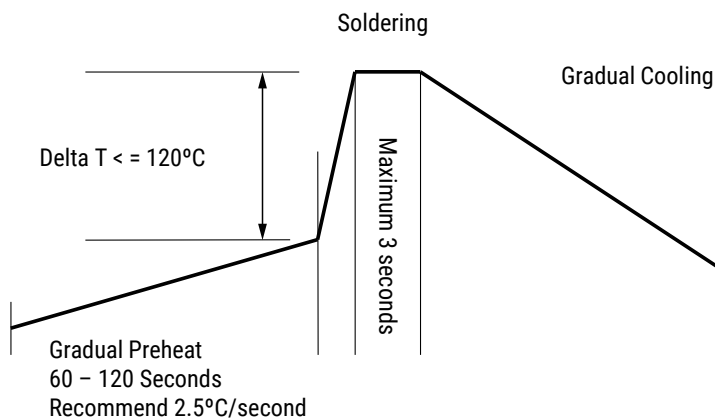
### Recommended Soldering Profile:

- 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**

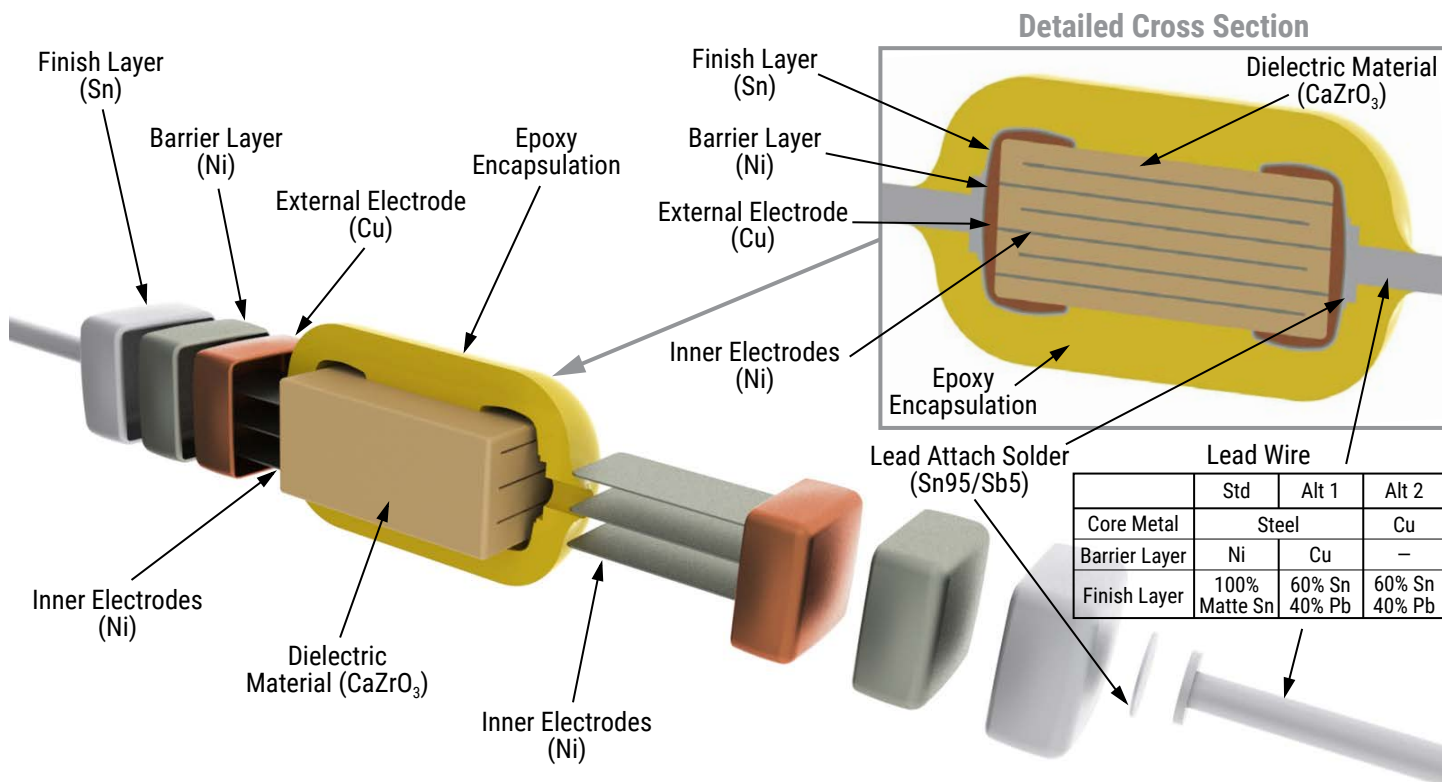
| Stress                       | Reference                       | Test or Inspection Method                                                                                                                                                                                                                        |
|------------------------------|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Solderability                | J-STD-002                       | Magnification 50 X. Conditions:                                                                                                                                                                                                                  |
|                              |                                 | a) Method A, at 235°C, Category 3                                                                                                                                                                                                                |
| Temperature Cycling          | JESD22 Method JA-104            | 5 cycles (-55°C to +150°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/+150°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 150°C 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 preheat of samples. Note: single wave solder – procedure 2.                                                                                                                                                                      |
| Terminal Strength            | MIL-STD-202 Method 211          | Conditions A (454g), Condition C (227g)                                                                                                                                                                                                          |
| Mechanical Shock             | MIL-STD-202 Method 213          | Figure 1 of Method 213, Condition C.                                                                                                                                                                                                             |
| Resistance to Solvents       | MIL-STD-202 Method 215          | Add aqueous wash chemical – OKEM Clean or equivalent.                                                                                                                                                                                            |

## Storage & Handling

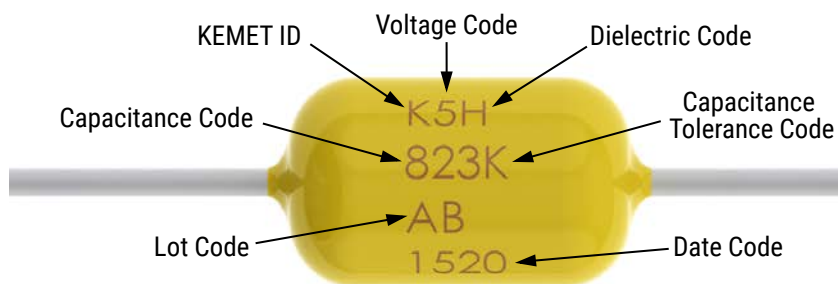
The un-mounted storage life of a through-hole (lead) ceramic capacitor is dependent upon storage and atmospheric conditions as well as packaging materials. While the ceramic chips enveloped under the epoxy coating themselves are quite robust in most environments, solderability of the wire lead on the 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



## Marking



| 15                               | 20                                                             |
|----------------------------------|----------------------------------------------------------------|
| Manufacturing Year:<br>15 = 2015 | Manufacturing Week:<br>20 = Week 20<br>(of mfg. calendar year) |

## Packaging Quantities

| Style/<br>Size | Standard Bulk<br>Quantity | Ammo Pack<br>Quantity<br>Maximum | Reel Quantity<br>Maximum<br>(12" Reel) |
|----------------|---------------------------|----------------------------------|----------------------------------------|
| 410            | 300/Box                   | 4000                             | 5000                                   |
| 430            | 200/Box                   | 2000                             | 2500                                   |



## 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

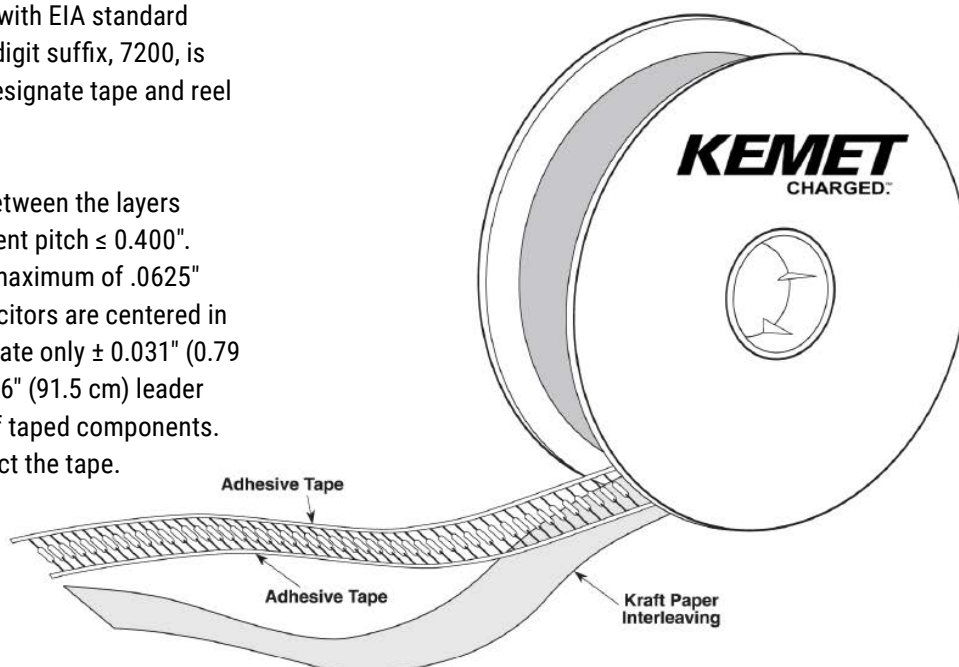


Figure 2

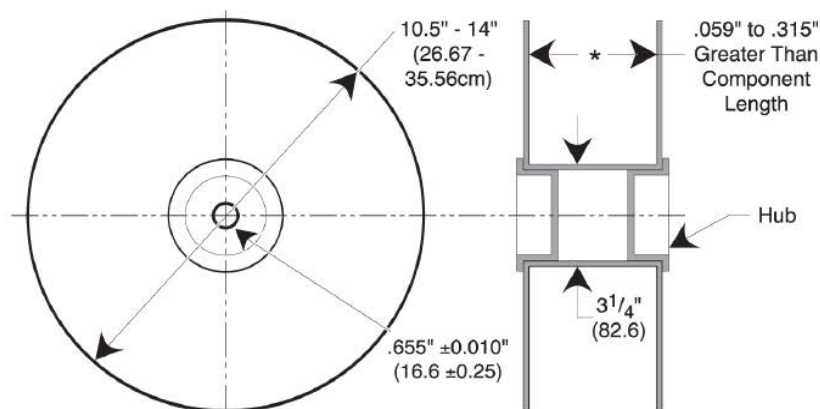
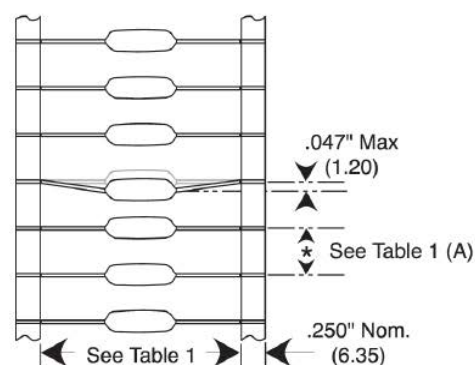


Figure 3



**Table 3 – Ceramic Axial Tape and Reel Dimensions**

Metric will govern

| Dimensions – Millimeters (Inches) |                   |                    |
|-----------------------------------|-------------------|--------------------|
| Axial Capacitor Body Diameter     | A<br>±0.5 (0.020) | B<br>±1.5 (0.059)* |
| 0.0 to 5.0<br>(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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## Disclaimer

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Although KEMET designs and manufactures its products to the most stringent quality and safety standards, given the current state of the art, isolated component failures may still occur. Accordingly, customer applications which require a high degree of reliability or safety should employ suitable designs or other safeguards (such as installation of protective circuitry or redundancies) in order to ensure that the failure of an electrical component does not result in a risk of personal injury or property damage.

Although all product-related warnings, cautions and notes must be observed, the customer should not assume that all safety measures are indicated or that other measures may not be required.