Axial Through-Hole Multilayer Ceramic Capacitors

Aximax, 400 Series, Axial, Conformally Coated, X8L Dielectric, 25 – 50 VDC (Commercial & Automotive Grade)

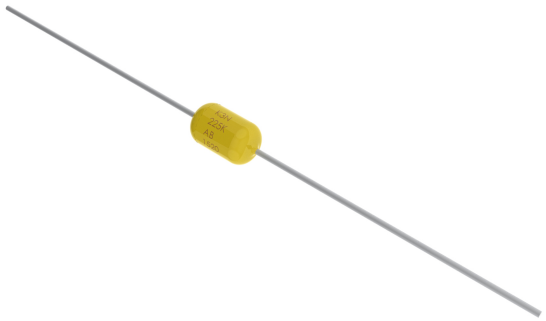
Overview

KEMET's Aximax conformally coated axial through-hole ceramic capacitors in X8L dielectric feature a 150°C maximum operating temperature and is considered "general purpose high temperature". These components are fixed, ceramic dielectric capacitors suited for high temperature bypass and decoupling applications or frequency discriminating circuits where Q and stability of capacitance characteristics are not critical. X8L exhibits a predictable change in capacitance with respect to time and voltage and boasts a minimal change in capacitance with reference to ambient temperature up to 125°C. Beyond 125°C X8L displays a wider variation in capacitance. Capacitance change is limited to ±15% from -55°C to +125°C and +15, -40% from 125°C to 150°C.

Driven by the demand for a more robust and reliable component, X8L dielectric capacitors were developed for critical applications where reliability 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.



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Ordering Information

C	410	C	105	K	3	N	5	T	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)
	410 430	C = Standard	Two significant digits and number of zeros	J = ±5% K = ±10% M = ±20%	3 = 25 V 5 = 50 V	N = X8L	5 = Multilayer	T = 100% Matte Sn H = SnPb (60/40)*	A = N/A	Blank = Bulk 7200 = 12" reel 7293 = Ammo pack 9170 = Automotive grade 9170 7200 = Auto 12" reel 9170 7293 = Auto ammo pack

[1] Additional capacitance Tolerance offerings may be available. Contact KEMET for details.

[2] Lead wire 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). KEMET does not recommend the usage of this termination for Automotive applications.

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

** Only available as Commercial Grade.*

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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[1]	Yes (with approval and sign off)	Yes	180 days Minimum
9170	Yes (without approval)	Yes	90 days Minimum

[1] 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:

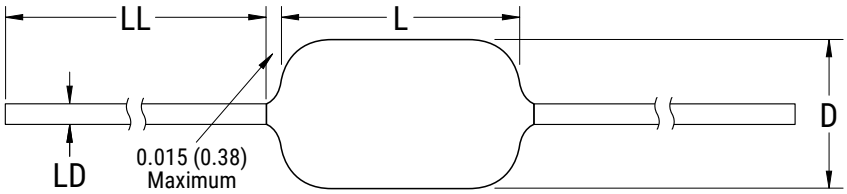
- To ensure that supplier can meet the manufacturability and quality requirements for the purchased parts.
- To provide the evidence that all customer engineering design record and specification requirements are properly understood and fulfilled by the manufacturing organization.
- To demonstrate that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

KEMET Automotive C-Spec	PPAP (Product Part Approval Process) Level				
	1	2	3	4	5
KEMET assigned[1]	●	●	●	●	●
9170			○		

[1] 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
○ Product family PPAP only

Dimensions – Inches (Millimeters)



Series	Style/ Size	L Length Maximum	D Diameter Maximum	LD Lead Diameter	LL Lead Length Minimum[1]
C41X	410	0.170 (4.32)	0.095 (2.41)	0.020+0.001/–0.003 (0.51+0.025/–0.076)	1.0 (25.4)
C43X	430	0.240 (6.10)	0.150 (3.81)		

[1] *Lead Length dimension only applicable for BULK packaging.*

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 25 V and 50 V
- Capacitance offerings ranging from 0.1 µF up to 2.2 µF
- Available capacitance tolerances of ±5%, ±10% and ±20%
- Commercial and Automotive (AEC-Q200) grades available
- 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 use 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.

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%(−55°C to 125°C) +15%, −40% (125°C to 150°C)
Aging Rate (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	250% of rated voltage (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 (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 ±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
X8L	25	All	5.0	±20%	10% of Initial Limit
	50		3.0		

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)		25	50
Voltage Code		3	5
Capacitance	Capacitance Tolerance	Capacitance Code (Available Capacitance)	
0.1µF	J = ±5% K = ±10% M = ±20%	104	104
0.12µF		124	124
0.15µF		154	154
0.18µF		184	184
0.22µF		224	224
0.27µF		274	
0.33µF		334	
0.39µF		394	
0.47µF		474	
0.56µF		564	
0.68µF		684	
Rated Voltage (VDC)		25	50
Voltage Code		3	5

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

C430 Style/Size (0.150" Diameter x 0.290" L)			
Rated Voltage (VDC)		25	50
Voltage Code		3	5
Capacitance	Capacitance Tolerance	Capacitance Code (Available Capacitance)	
0.33µF	J = ±5% K = ±10% M = ±20%		334
0.39µF			394
0.47µF			474
0.82µF		824	
1.0µF		105	
1.2µF		125	
1.5µF		155	
1.8µF		185	
2.2µF		225	
Rated Voltage (VDC)		25	50
Voltage Code		3	5

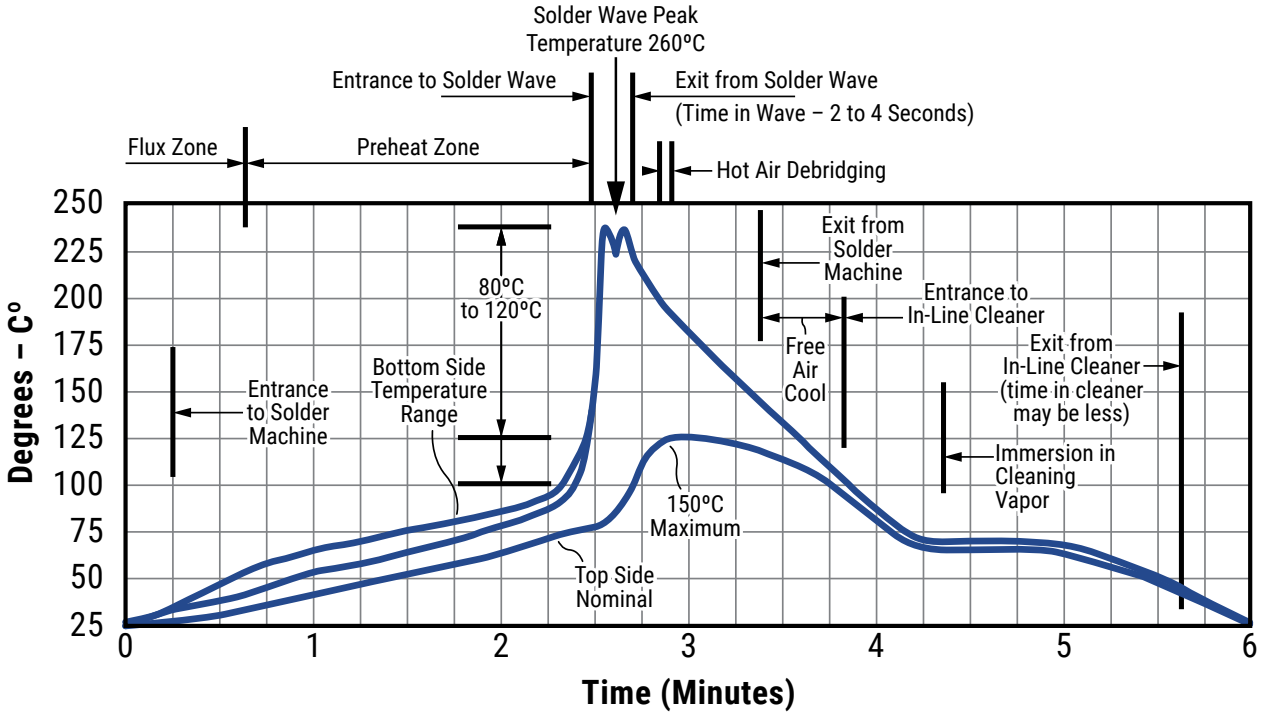
Soldering Process

Recommended Soldering Technique:

- Solder Wave
- Hand Soldering (Manual)

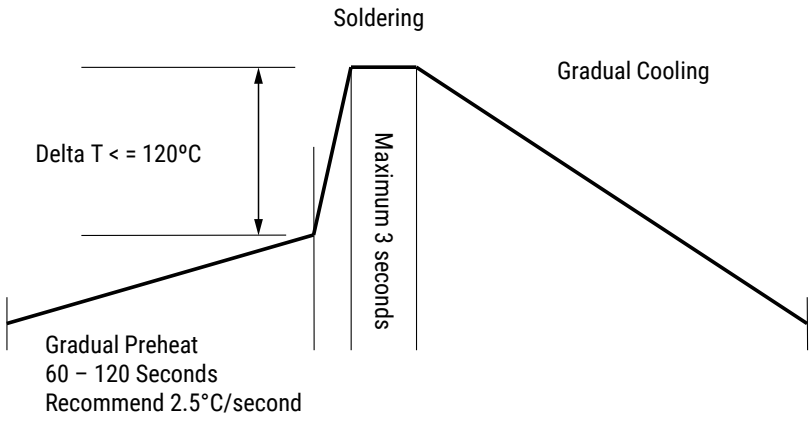
Recommended Soldering Profile:

- 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

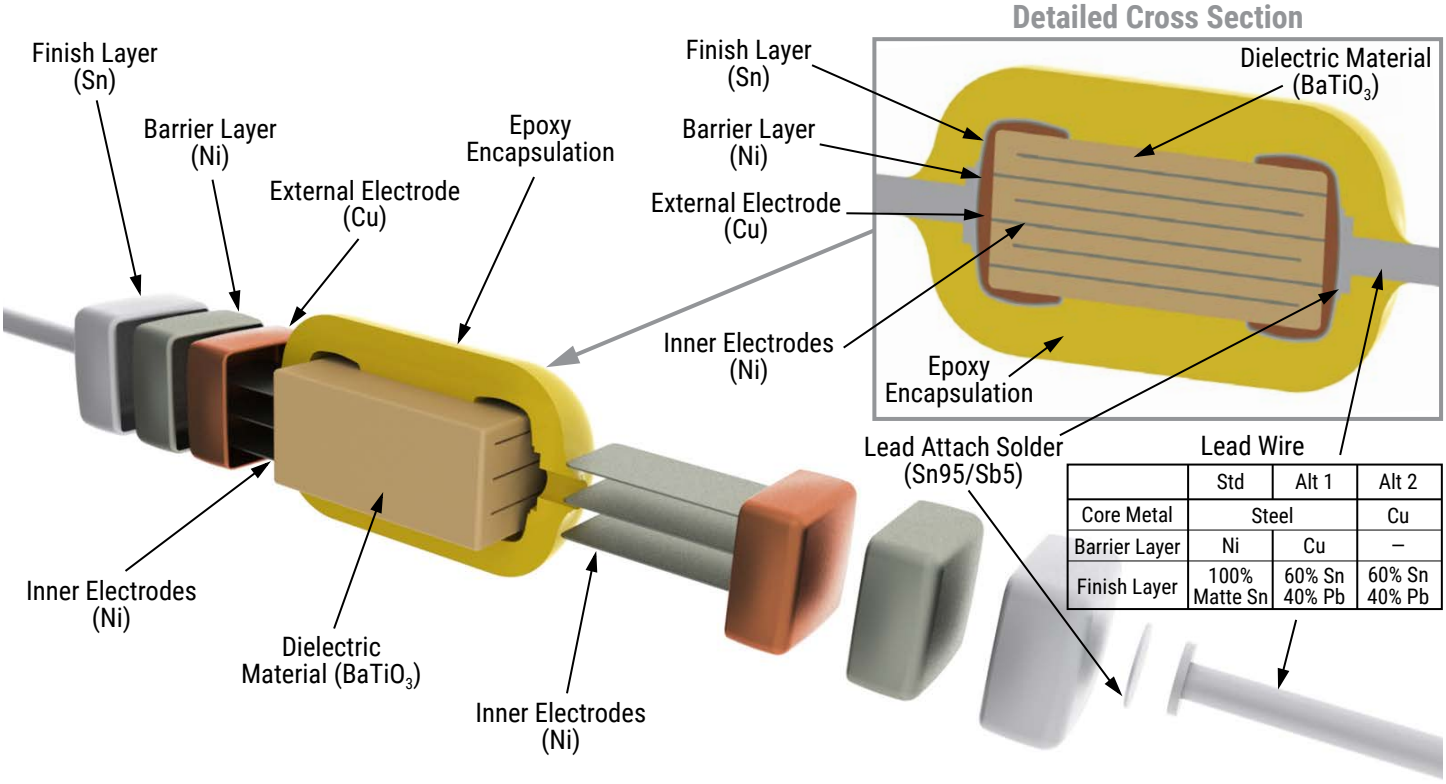
Stress	Reference	Test or Inspection Method
Solderability	J–STD–002	Magnification 50 X. Conditions:
		a) Method A, at 235°C, Category 3
Temperature Cycling	JESD22 Method JA–104	5 cycles (–55°C to +150°C), measurement at 24 hours ±2 hours after test conclusion.
Biased Humidity	MIL–STD–202 Method 103	Load 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 (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.

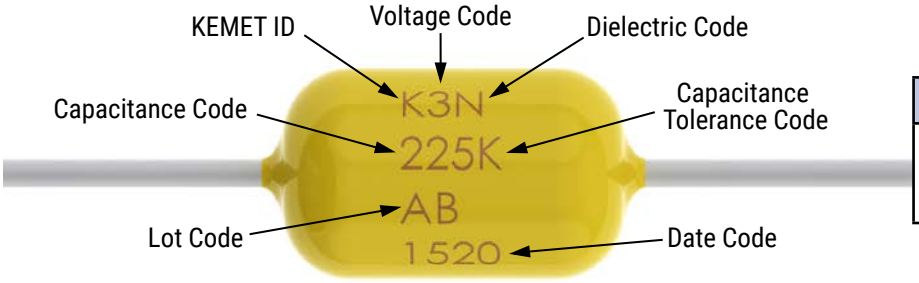
KEMET recommends storing the un-mounted capacitors in their original packaging, in a location away from direct sunlight, and where the temperature and relative humidity do not exceed 40 degrees centigrade and 70% respectively. For optimum solderability, capacitor stock should be used promptly, preferably 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



	Std	Alt 1	Alt 2
Core Metal	Steel		Cu
Barrier Layer	Ni	Cu	–
Finish Layer	100% Matte Sn	60% Sn 40% Pb	60% Sn 40% Pb

Marking



15	20
Manufacturing Year: 15 = 2015	Manufacturing Week: 20 = Week 20 (of mfg. calendar year)

Packaging Quantities

Style/ Size	Standard Bulk Quantity	Ammo Pack Quantity Maximum	Reel Quantity Maximum (12" Reel)
410	300/Box	4,000	5,000
430	200/Box	2,000	2,500

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., C410C104Z5U5TA7200.

Paper (50 lb.) test minimum is inserted between the layers of capacitors wound on reels for component pitch ≤ 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 ± 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

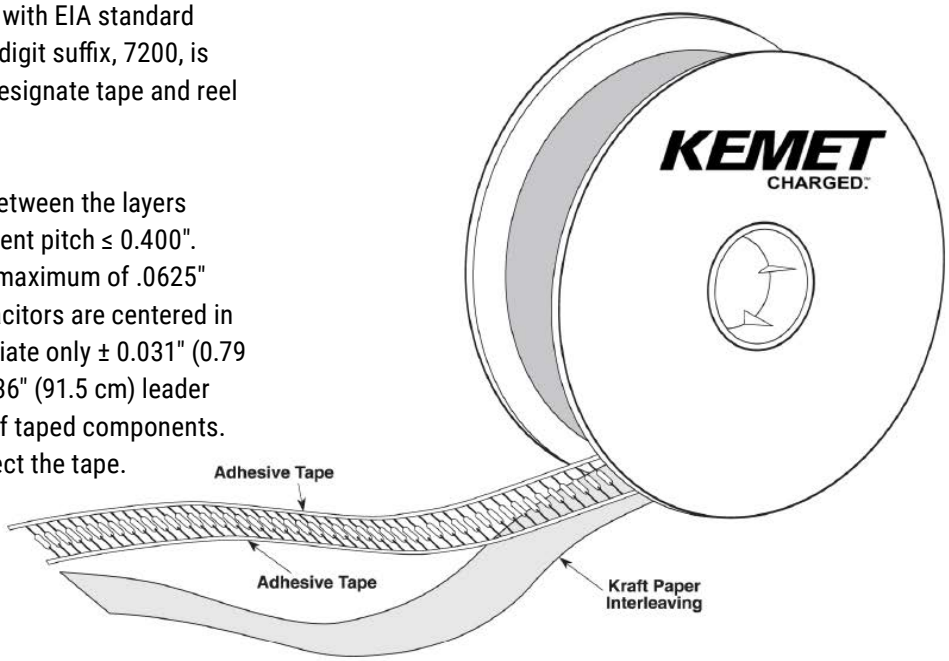


Figure 2

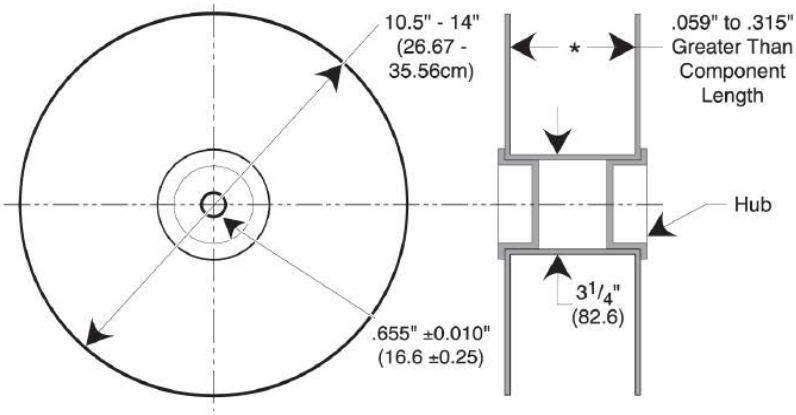


Figure 3

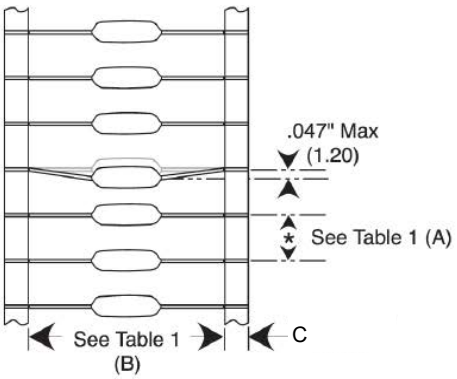


Table 3 – Ceramic Axial Tape and Reel Dimensions

Metric will govern

Dimensions – Millimeters (Inches)			
Axial Capacitor Body Diameter	A ±0.5 (0.020)	B ±1.5 (0.059)[1]	C ±0.70 (0.028)
0.0 to 5.0 (0.0 to 0.197)	5.0 (0.197)	52.4 (2.062)	6.35 (0.250)

Symbol Reference Table	
A	Component Pitch
B	Inside Tape Spacing
C	Tape Width

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

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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 indicted or that other measures may not be required.

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