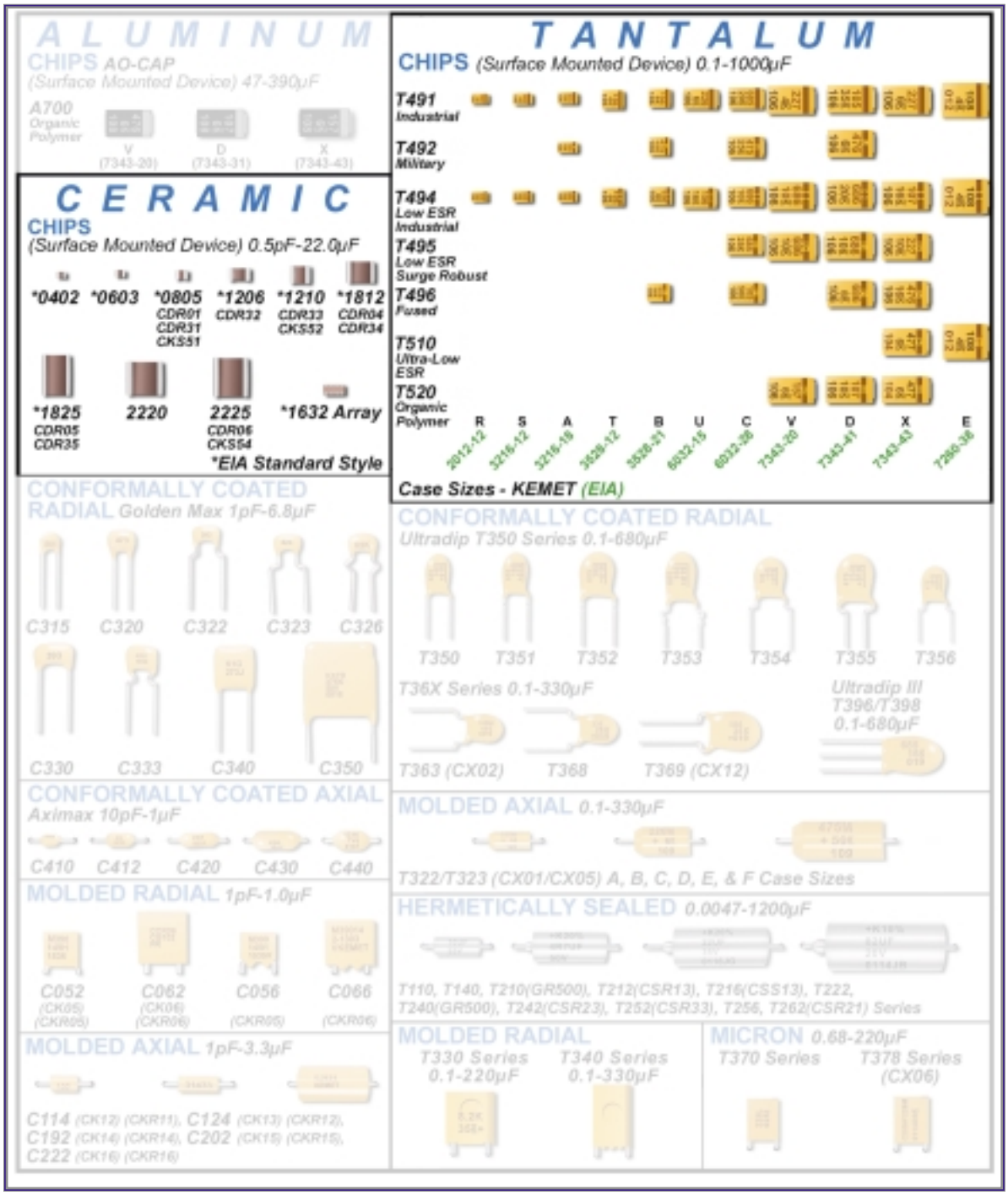
SURFACE MOUNT CAPACITORS



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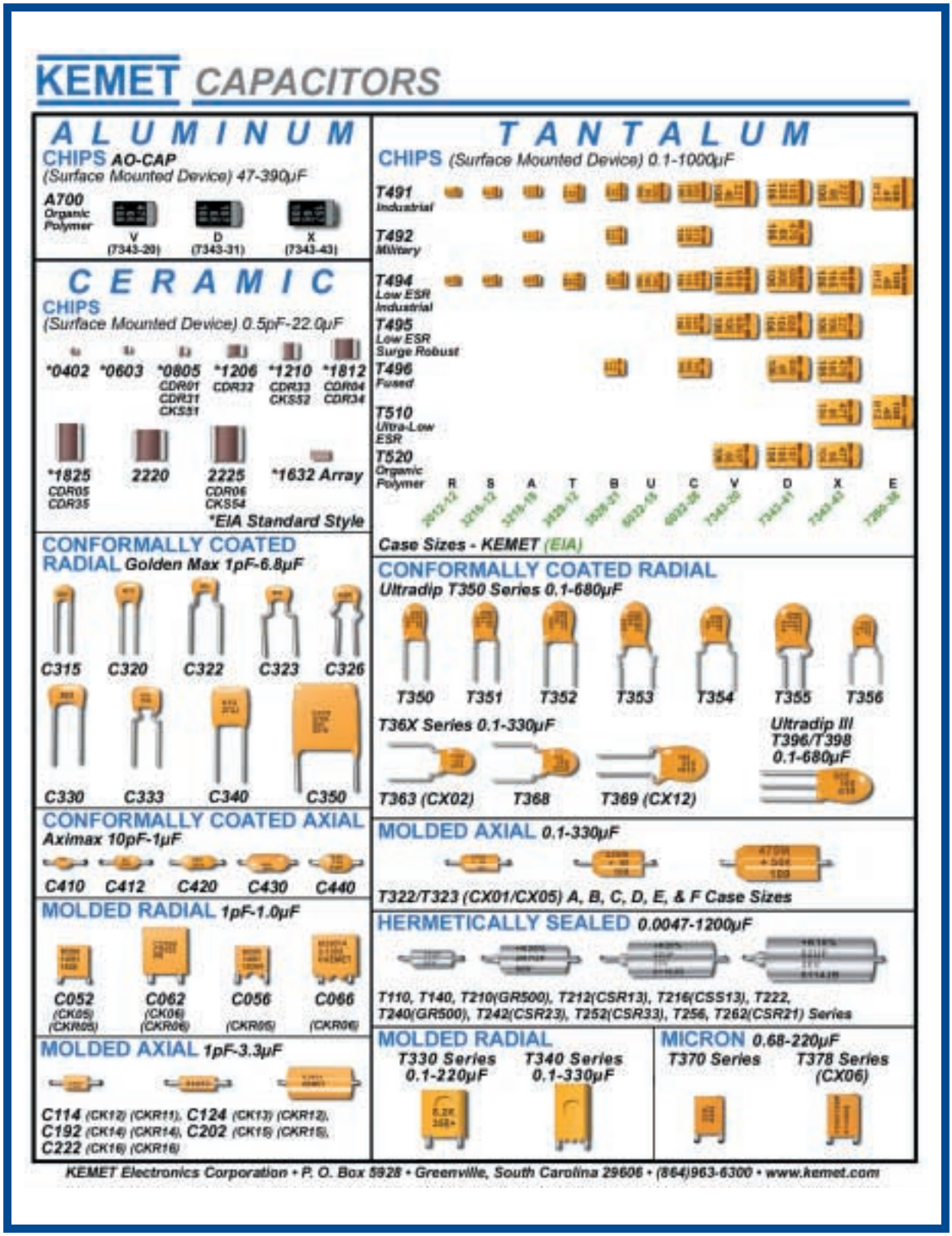

Parts shown are actual size
Due to ever changing technology, all series may not be depicted.

Kemet Electronics Corporation
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• FAX: 864-963-6521

INDEX

SOLID TANTALUM CHIP CAPACITORS

POLYMER TANTALUM CHIP CAPACITORS

CERAMIC CHIP CAPACITORS

Mil-PRF-123 and GR900 high-reliability ceramic chips are also available. Refer to KEMET Catalog F-3054 for detailed information.

TANTALUM & CERAMIC CHIP PACKAGING

Refer to F3235 for Aluminum Organic Polymer Surface Mount Products Available.
This catalog will contain the aluminum AO-CAP series in the next revision.

KEMET Electronics Corporation REGISTERED FIRM ISO 9001 A1168

ISO 9001 Registration
The quality management system for manufacture of solid tantalum chips for surface mount applications has satisfied the requirements of ISO 9001.

KEMET Electronics Corporation REGISTERED FIRM ISO 9001 A1685

ISO 9001 Registration
The quality management system for the manufacture of commercial ceramic chips for surface mount applications has satisfied the requirements of ISO 9001.

PRODUCT DESCRIPTION

KEMET's family of solid tantalum chip capacitors is designed and manufactured with the demanding requirements of surface mount technology in mind.

These devices extend the advantages of solid tantalum technology to today's surface mount circuit applications. Complementing multilayer ceramic chip convenience with capacitance ratings through 1000 µF, tantalum chip capacitors permit circuit designers to take full advantage of the benefits of surface mount technology.

T491 Series — Industrial

The leading choice in today's surface mount designs is the KEMET T491 Series. This product meets or exceeds the requirements of EIA standard 535BAAC. The physical outline and dimensions of this series conform to this global standard.

Four low profile case sizes have been added to the T491 family. The S/3216-12 and T/3528-12 case sizes have a maximum height of 1.2 mm. The U/6032-15 size has a maximum height of 1.5 mm, and the V/7343-20 has a maximum height of 2.0 mm.

This product was designed specifically for today's highly automated surface mount processes and equipment. This series uses the same proven solid tantalum KEMET technology acclaimed and respected throughout the world. Added to this is the latest in materials, processes and automation which result in a component unsurpassed worldwide in total performance and value.

The standard solder-coated terminations provide excellent wetting characteristics and compatibility with today's surface mount solder systems. Gold-plated terminations are also available for use with conductive epoxy attachment processes. The symmetrical terminations offer total compliancy to provide the thermal and mechanical stress relief required in today's technology. Lead frame attachments to the tantalum pellet are made via a microprocessor-controlled welding operation, and a high temperature silver epoxy adhesive system.

Standard packaging of these devices is tape and reel in accordance with EIA 481-1. This system provides perfect compatibility with all tape-fed placement units.

T492 Series — Military

KEMET is approved to MIL-PRF-55365/8 (CWR11), Weibull failure rate "D" level or 0.001% failures per 1,000 hours. This CWR11 product — designated as KEMET's T492 Series — is a precision-molded device, with compliant leadframe terminations and indelible laser marking. This is the military version of the global IEC/EIA standard represented by KEMET's T491 Series. Tape and reeling per EIA 481-1 is standard.

T494 Series — Low ESR, Industrial Grade

The T494 is a low ESR series that is available in all the same case sizes and CV ratings as the popular T491 series. The T494 offers low ESR performance with the economy of an industrial grade device. This series is targeted for output filtering and other applications that may benefit from improved efficiency due to low ESR.

T495 Series — Low ESR, Surge Robust

The low ESR, surge robust T495 series is an important member of KEMET's tantalum chip family. Designed primarily for output filtering in switch-mode power supplies and DC-to-DC converters, the standard CV T495 values are also an excellent choice for battery-to-ground input filter applications.

This series builds upon proven technology used for industrial grade tantalum chip capacitors to offer several important advantages: very low ESR, high ripple current capability, excellent capacitance stability, plus improved ability to withstand high inrush currents. These benefits are achieved through a combination of proprietary design, material, and process parameters, as well as high-stress, low impedance electrical conditioning performed prior to screening. Capacitance values range from 4.7µF to 470µF, in voltage ratings from 6 to 50.

T496 Series — Fused

KEMET also offers a "fail-safe" fused solid tantalum chip capacitor. The built-in fuse element provides excellent protection from damaging short circuit conditions in applications where high fault currents exist. Protection from costly circuit damage due to reversed installation is offered with this device. Package sizes include the EIA standard 3528-12, 6032-15, 7343-31, and 7343-43 case size. Capacitance values range from 0.15 µF to 470.0 µF, in voltage ratings from 6 to 50. Standard capacitance tolerances include ±20% and ±10%. Tape and reeling per EIA 481-1 is standard.

T510 Series — Ultra–Low ESR

The ultra-low ESR T510 Series is a breakthrough in solid tantalum capacitor technology. KEMET's T510 Series offers the industry's lowest ESR in the popular EIA 7343-43 case size. The ultra-low ESR and high ripple current capability make the T510 an ideal choice for SMPS filtering and power decoupling of today's high speed microprocessors.

KEMET has developed an innovative construction platform that incorporates multiple capacitor elements, in parallel, inside a single package. This unique assembly, combined with KEMET's superior processing technology, provides the best combination of high CV, low ESR, and small size in a user friendly, molded, surface mount package.

T520 SERIES — KO-CAP Polymer Tantalum

KEMET's newest tantalum chip product line is T520 Series KEMET Organic - KO - Capacitor. The KO-CAP is a Tantalum capacitor, with Ta anode and Ta2O5 dielectric. However, a conductive, organic, polymer replaces the MnO2 as the cathode plate of the capacitor. This results in very low ESR and improved cap retention at high frequency. The KO-CAP also exhibits a benign failure mode, which eliminates the ignition failures that can occur in standard MnO2 Tantalum types. Note also that KO-CAPs may be operated at voltages up to 80% of rated voltage with equivalent or better reliability than standard tantalums operated at 50% of rated voltage.

The new T520 series captures the best features of multilayer ceramic caps (low ESR and high frequency cap retention), aluminum electrolytics (benign failure mode), and proven solid tantalum technology (volumetric effficiency, surface mount capability, and no wearout mechanism). The KO-CAP can reduce component counts, eliminate through-hole assembly by replacing cumbersome leaded aluminum capacitors, and offer a more cost effective solution to high-cost high-cap ceramic capacitors. These benefits allow the designer to save both board space and money. See pages 32-39 for complete details.

COMPONENT PERFORMANCE CHARACTERISTICS

Introduction

KEMET solid tantalum capacitors are identified by the initial "T," followed by a unique "Series" number; for example, T491, T492, etc. Each Series denotes a general physical form and type of encapsulation, as well as limits on dimensions and certain electrical characteristics under standard conditions of 25°C, 50% relative humidity, and one atmosphere pressure. Specific requirements are set forth in the respective Product Series in this catalog. All series are 100% screened for leakage, capacitance, dissipation factor, and ESR. All Series are inspected to electrical limits using a minimum .1% AQL sampling plan, according to the Military Standard MIL-STD-105, even after 100% testing. This sampling plan, to the best of KEMET Electronics' knowledge, meets or exceeds the generally accepted industry standard for similar products. KEMET capacitors may also be supplied, with prior agreement, to meet specifications with requirements differing from those of KEMET catalogs.

ELECTRICAL

1. General Application Class

Solid tantalum capacitors are usually applied in circuits where the AC component is small compared to the DC component. Typical uses known to KEMET Electronics include blocking, by-passing, decoupling, and filtering. They are also used in timing circuits. If two of these polar capacitors are connected "back-to-back" (i.e., negative-to-negative or positive-to-positive), the pair may be used in AC applications (as a non-polar device).

2. Operating Temperature Range

• –55 °C to +125 °C

Voltage derating is specified in Section 5. Performance characteristics over this temperature range are presented within the following sections.

3. Non-Operating Temperature Range

• –55 °C to +125 °C

Tantalum capacitors do not lose capacitance from the "de-forming" effect as do liquid-electrolytic capacitors. Storage at high temperature may cause a small, temporary increase in leakage current (measured under standard conditions), but the original value is usually restored within a few minutes after application of rated voltage.

Tantalum chips are not hermetically sealed, therefore they do exhibit reversible changes in parameters with respect to relative humidity (RH). Capacitance increases with increasing humidity. The limiting change, reached upon establishment of equilibrium with the environment, is approximately -5% to +12% over the range from 25% to 95% RH, referred to the standard 50% RH. The amount of change is dependent upon size (capacitance and voltage rating, ie: CV product); small sizes might change no more than ±5%. Equilibrium at such extremes is seldom attained by plastic-cased capacitors, and the change in capacitance is consequently less. The rate of response to humidity changes increases with increasing temperature. Dissipation factor and ESR also increase with increasing RH.

DC leakage current may rise upon exposure to a combination of high temperature and high humidity, but is normally restored by voltage conditioning under standard conditions. The increase will be greater than that experienced under temperature influence alone because of conduction through absorbed water.

Tantalum chips may be affected by absorption of water on external insulating surfaces.The water film may also attract a layer of dust from the air, increasing the effect. The most sensitive parameter is leakage current.

4. Capacitance

• 0.1 µF to 1000 µF

Refer to part number tables for available capacitance ratings and tolerances by series.

Capacitance is measured at 120 Hz, up to 1.0 volt rms maximum and up to 2.5 volts DC maximum, at +25°C.DC bias causes only a small reduction in capacitance, up to about 2% when full rated voltage is applied. DC bias is not commonly used at room temperature, but is more commonly used at elevated temperatures. Capacitance decreases with increasing frequency.

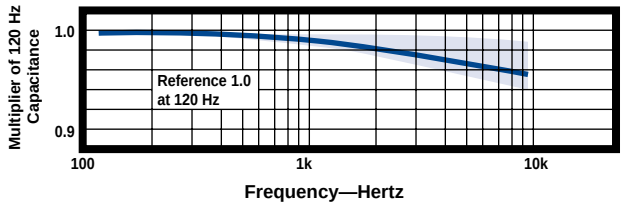


FIGURE 1 Typical Effect of Frequency upon Capacitance

Capacitance increases with increasing temperature.

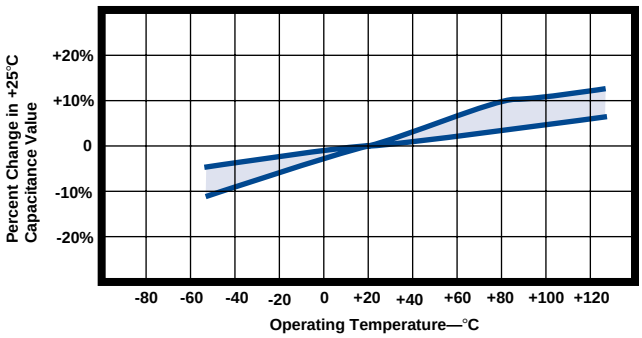


FIGURE 2 Typical Effect of Temperature upon Capacitance

COMPONENT PERFORMANCE CHARACTERISTICS (con't.)

TABLE 1 Maximum Capacitance Change with Temperature (ref: 25°C)

Ambient Temperature		
–55°C	+85°C	+125°C
–10%	+10%	*+12% or +15%

*+12% is standard. +15% applies to certain extended CV values as noted in part number tables.

5. Working DC Voltage (WVDC)

• 3 to 50 volts

Refer to part number tables for available voltage ratings by series.

These voltages are the maximum recommended peak DC operating voltages from –55°C to +85°C for continuous duty. These voltages are derated linearly above +85°C to 2/3 rated voltage for operation at +125°C (See Figure 3).

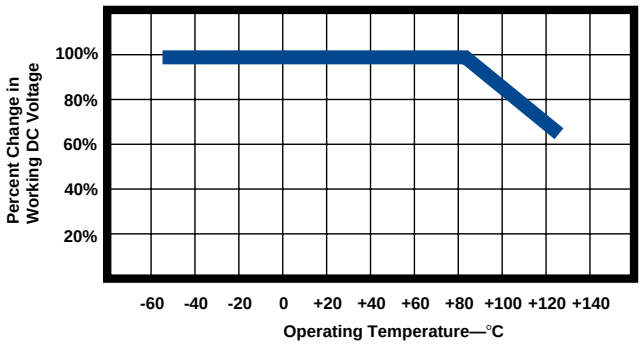


FIGURE 3 Working DC Voltage Change with Temperature

6. Surge Voltage

TABLE 2 Surge Voltage Ratings at +25°C, +85°C & +125°C

Rated Working Volts @ +25°C & +85°C	Surge Voltage @ +25°C & +85°C	Derated DC Volts @ +125°C	Surge Voltage @ +125°C
3	4	2	2.4
4	5.2	2.7	3.2
6	8	4	5
10	13	7	8
16	20	10	12
20	26	13	16
25	33	17	20
35	46	23	28
50	65	33	40

Surge voltage is the maximum voltage to which the capacitor can be subjected under transient conditions, including the sum of peak AC ripple, DC bias and any transients.

Surge voltage tests are performed at +25°C, +85°C and +125°C with the applicable surge voltage. The surge voltage is applied for 1000 cycles of 30 seconds at voltage through a 33 ohm series resistor and 30 seconds off voltage with the capacitor discharged through a 33 ohm resistor. Upon completing the test, the capacitors are allowed to stabilize at room temperature. Capacitance, DCL and DF are then tested:

a. Capacitance — within ± 5% of initial value
b. DC Leakage — within initial limit
c. Dissipation Factor — within initial limit

7. Reverse Voltage and Polarity

TABLE 3 Reverse Voltage Ratings

Temperature	Permissible Reverse Voltage
+25°C	**15% of Rated Voltage**
+85°C	**5% of Rated Voltage**
+125°C	**1% of Rated Voltage**

Solid tantalum capacitors are polarized devices and may be permanently damaged or destroyed if connected with the wrong polarity. The positive terminal is identified on the capacitor body by a stripe and a beveled edge. A small degree of transient reverse voltage is permissible for short periods per Table 3. The capacitors should not be operated continuously in reverse mode, even within these limits.

8. DC Leakage Current (DCL)

Refer to part number tables for maximum leakage current limits.

DC leakage current is the current that, after a one- to five-minute charging period, flows through a capacitor when voltage is applied. Leakage is measured at +25°C with full rated DC voltage applied to the capacitor through a 1000 ohm resistor in series with the capacitor.

DC leakage current increases with increasing temperature.

TABLE 4 Leakage Limit Multipliers at Specified Temperatures (ref: 25°C limits)

Ambient Temperature		
–55°C	+85°C	+125°C
N/A	10X	12X

COMPONENT PERFORMANCE CHARACTERISTICS (con't.)

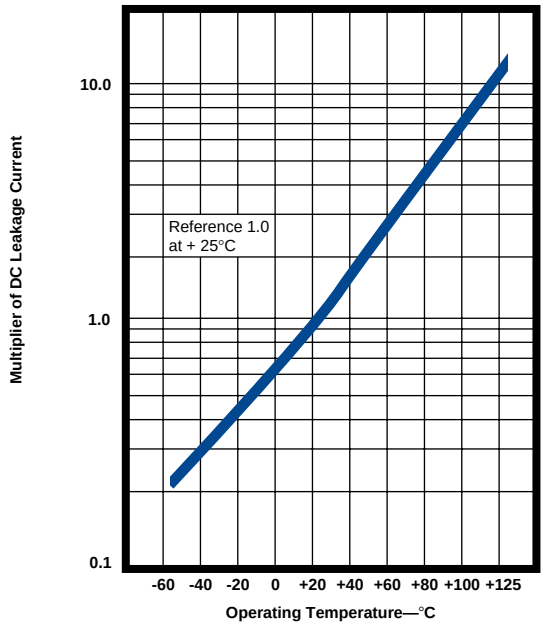


FIGURE 4 Typical Effect of Temperature upon DC Leakage Current

DC leakage current decreases with decreasing applied voltage.

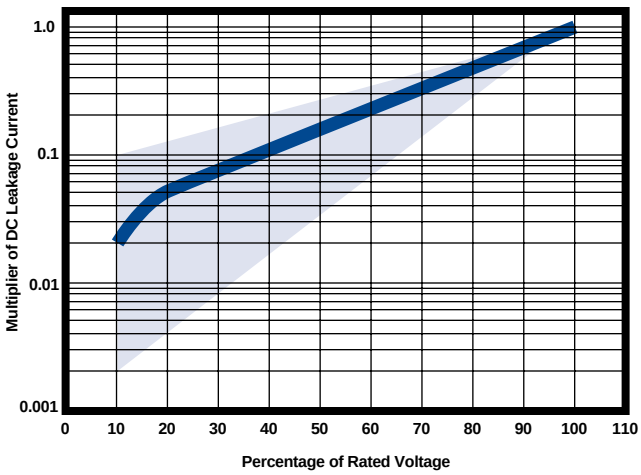


FIGURE 5 Typical Effect of Applied Voltage on DC Leakage Current.

9. Dissipation Factor (DF)

Refer to part number tables for maximum DF limits.

Dissipation factor is measured at 120 Hz, up to 1.0 volt rms maximum, and up to 2.0 volts DC maximum at +25°C. The application of DC bias causes a small reduction in DF, about 0.2% when full rated voltage is applied. DF increases with increasing frequency.

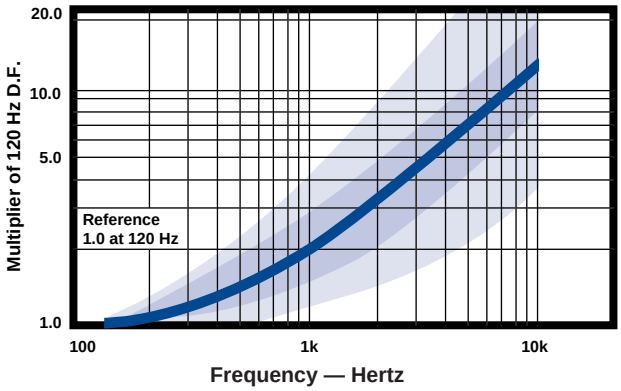


FIGURE 6 Typical Effect of Frequency upon Dissipation Factor

Dissipation factor is a very useful low frequency (120 Hz) measurement of the resistive component of a capacitor. It is the ratio of the equivalent series resistance (ESR) to the capacitive reactance, (X_C) and is usually expressed as a percentage. It is directly proportional to both capacitance and frequency. Dissipation factor loses its importance at higher frequencies, (above about 1 kHz), where impedance (Z) and equivalent series resistance (ESR) are the normal parameters of concern.

$$DF = \frac{R}{X_C} = 2\pi fCR$$

DF = Dissipation Factor
R = Equivalent Series Resistance (Ohms)
X_C = Capacitive Reactance (Ohms)
f = Frequency (Hertz)
C = Series Capacitance (Farads)

DF is also referred to as tan δ or "loss tangent." The "Quality Factor," "Q," is the reciprocal of DF.

DF increases with temperature above +25°C and may also increase at lower temperatures. Unfortunately, one general limit for DF cannot be specified for all capacitance/voltage combinations, nor can response to temperature be simply stated. DC bias is not commonly used at room temperature, but is more commonly used at elevated temperatures.

10. Equivalent Series Resistance (ESR) and Impedance (Z)

Equivalent Series Resistance (ESR) is the preferred high-frequency statement of the resistance unavoidably appearing in these capacitors. ESR is not a pure resistance, and it decreases with increasing frequency.

Total impedance of the capacitor is the vector sum of capacitive reactance (X_C) and ESR, below resonance; above resonance total impedance is the vector sum of inductive reactance (X_L) and ESR.

COMPONENT PERFORMANCE CHARACTERISTICS (con't.)

$$X_C = \frac{1 \text{ ohm}}{2\pi fC}$$

where:
f = frequency, Hertz
C = capacitance, Farad

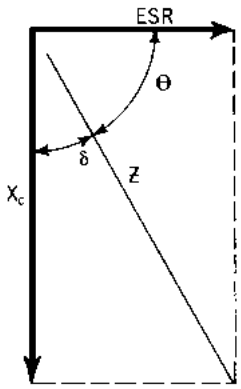


FIGURE 7a Total Impedance of the Capacitor Below Resonance

$$X_L = 2\pi fL$$

where:
f = frequency, Hertz
L = inductance, Henries

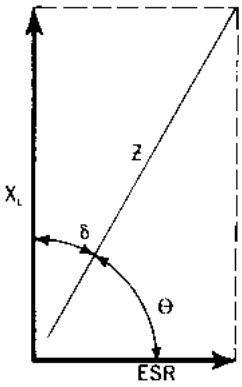


FIGURE 7b Total Impedance of the Capacitor Above Resonance

To understand the many elements of a capacitor, see Figure 8.

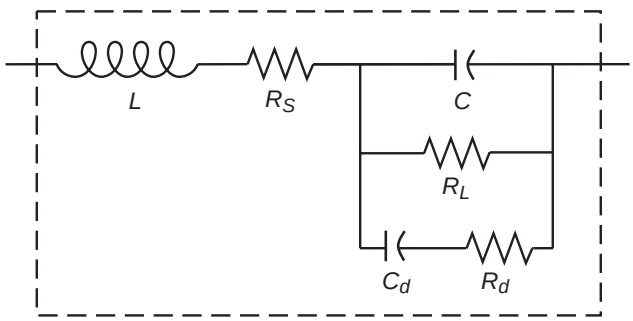


FIGURE 8 The Real Capacitor

A capacitor is a complex impedance consisting of many series and parallel elements, each adding to the complexity of the measurement system.

L — Represents lead wire and construction inductance. In most instances (especially in solid tantalum and monolithic ceramic capacitors) it is insignificant at the basic measurement frequencies of 120 and 1000 Hz.

R_S — Represents the actual ohmic series resistance in series with the capacitance. Lead wires and capacitor electrodes are contributing sources.

R_L — Capacitor Leakage Resistance. Typically it can reach 50,000 megohms in a tantalum capacitor. It can exceed 10^{12} ohms in monolithic ceramics and in film capacitors.

R_d — The dielectric loss contributed by dielectric absorption and molecular polarization. It becomes very significant in high frequency measurements and applications. Its value varies with frequency.

C_d — The inherent dielectric absorption of the solid tantalum capacitor which typically equates to 1-2% of the applied voltage.

As frequency increases, X_C continues to decrease according to its equation above. There is unavoidable inductance as well as resistance in all capacitors, and at some point in frequency, the reactance ceases to be capacitive and becomes inductive. This frequency is called the self-resonant point. In solid tantalum capacitors, the resonance is damped by the ESR, and a smooth, rather than abrupt, transition from capacitive to inductive reactance follows.

Typical ESR/Z frequency response curves are shown in Figures 9a and 9b. These curves are for selected ratings and represent typical T491 Series performance. Maximum limits for 100 kHz ESR are listed in the part number tables for each series. Note that the T494 Series offers low ESR and the T495 Series is specially designed for very low ESR performance. Refer to pages 21 and 24 for more information. See also KEMET's Newest Tantalum Chip family, the T510 Series, which offers the industry's lowest ESR ratings. See page 29.

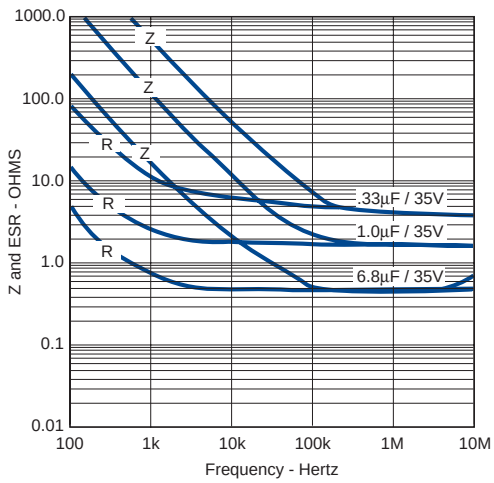


FIGURE 9a ESR & Impedance (Z) vs Frequency

COMPONENT PERFORMANCE CHARACTERISTICS (con't.)

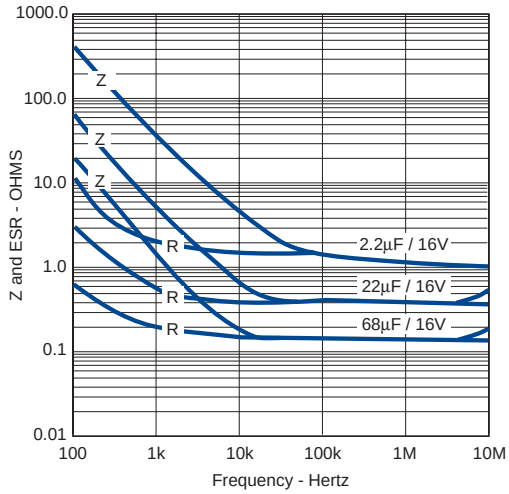


FIGURE 9b ESR & Impedance (z) vs Frequency

ESR and Z are also affected by temperature. At 100 kHz, ESR decreases with increasing temperature. The amount of change is influenced by the size of the capacitor and is generally more pronounced on smaller ratings.

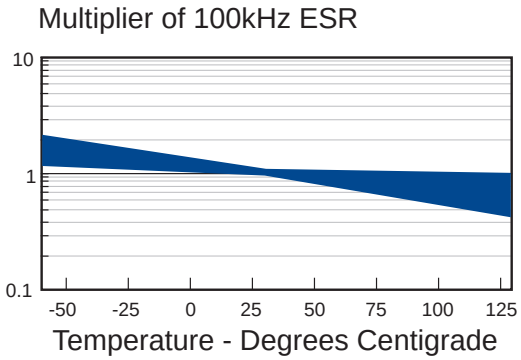


FIGURE 10 Typical Effect of Temperature on 100 kHz ESR

11. AC Power Dissipation

Power dissipation is a function of capacitor size and materials. Maximum power ratings have been established for all case sizes to prevent overheating. In actual use, the capacitor's ability to dissipate the heat generated at any given power level may be affected by a variety of circuit factors. These include board density, pad size, heat sinks and air circulation.

TABLE 5 Tantalum Chip Power Dissipation Ratings

Case Code		Maximum Power Dissipation Watts @ +25°C
KEMET	EIA	
R	2012-12	.025
S	3216-12	.060
T	3528-12	.070
U	6032-15	.090
V	7343-20	.125
A	3216-18	.075
B	3528-21	.085
C	6032-28	.110
D	7343-31	.150
X	7343-43	.165
E	7260-38	.200
T510X	7343-43	.270
T510E	7260-38	.285

12. AC Operation

Permissible AC ripple voltage and current are related to equivalent series resistance (ESR) and power dissipation capability.

Permissible AC ripple voltage which may be applied is limited by three criteria:

a. The positive peak AC voltage plus the DC bias voltage, if any, must not exceed the DC voltage rating of the capacitor.

b. The negative peak AC voltage, in combination with the bias voltage, if any, must not exceed the permissible reverse voltage ratings presented in Table 3.

c. The power dissipated in the ESR of the capacitor must not exceed the appropriate value specified in Table 5.

Actual power dissipated may be calculated from the following:

$P = I^2 R$

Substituting $I = \frac{E}{Z}$, $P = \frac{E^2 R}{Z^2}$

where:

I = rms ripple current (amperes)
E = rms ripple voltage (volts)
P = power (watts)
Z = impedance at specified frequency (ohms)
R = equivalent series resistance at specified frequency (ohms)

Using P max from Table 5, maximum allowable rms ripple current or voltage may be determined as follows:

$I\,(max) = \sqrt{P\,max/R}$ $E\,(max) = Z\sqrt{P\,max/R}$

These values should be derated at elevated temperatures as follows:

Temperature	Derating Factor
85°C	.9
125°C	.4

ENVIRONMENTAL

13. Temperature Stability

TABLE 6 Temperature Stability Limits

Step No.	Temp.	∆ Capacitance	Leakage Current	Dissipation Factor
1	+25°C	within specified tolerance	within original limit	within original limit
2	-55°C	within ± 10% of initial value	N/A	within original limit**
3	+25°C	within ± 5% of initial value	within original limit	within original limit
4	+ 85°C	within ± 10% of initial value	within 10X original limit	within original limit
5	+125°C	*within ± 12%or 15% of initial value	within 12X original limit	within original limit
6	+25°C	within ± 5% of initial value	within original limit	within original limit

*+12% is standard. +15% applies to certain extended CV values as noted in part number table.

**within 1.5x initial limit for extended cv values.

COMPONENT PERFORMANCE CHARACTERISTICS (con't.)

Mounted capacitors withstand extreme temperature testing at a succession of continuous steps at +25°C, -55°C, +25°C, +85°C, +125°C, +25°C, in the order stated. Capacitors shall be brought to thermal stability at each test temperature. Capacitance, DF and DCL are measured at each test temperature except that DCL is not measured at -55°C. DC bias of 2.0± 0.5 is recommended for the capacitance and D F requirements.

14. Thermal Shock

• Mil-Std-202, Method 107, Condition B

Minimum temperature -55°C, mounted

Post Test Performance:

a. Capacitance — within ±5% of initial value

b. DC Leakage — within initial limit

c. Dissipation Factor — within initial limit

15. Moisture Resistance

• Mil-Std-202, Method 106

Steps 7a and 7b excluded, rated voltage, 42 cycles, mounted

Post Test Performance:

a. Capacitance — within ±10% of initial value

b. DC Leakage — within initial limit

c. Dissipation Factor — within initial limit

16. Electrostatic Discharge (ESD)

- ***Human Body Model***
  2,000 ±50 volts, 1,500 ±5% ohms, 40 nanosecond pulse each polarity, 1 pulse each polarity, 5 seconds between pulses, +25°C.
- ***Charged Device Model***
  200 ± 5 volts, 0 ohms, 40 nanosecond pulse, each polarity, 9 pulses each polarity, 5 seconds between pulses, +25°C.

Product subjected to above test condition demonstrate no sensitivity to electrostatic discharge.

Post Test Performance:

a. Capacitance — within ± 5% of initial value

b. DC Leakage — within initial limit

c. Dissipation Factor — within initial limit

17. Long Term Stability

Within the general class of electrolytic capacitors, solid tantalum capacitors offer unusual stability of the three important parameters: capacitance, dissipation factor and leakage current. These solid-state devices are not subject to the effects of electrolysis, deforming or drying-out associated with liquid-electrolyte capacitors.

When stabilized for measurement at standard conditions, capacitance will typically change less than ±3% during a 10,000 hour life test +85°C. The same comparative change has been observed in shelf tests at +25°C extending for 50,000 hours. (Some of this change may stem from instrument or fixture error.)

Dissipation factor exhibits no typical trend. Data from 10,000 hour life test at +85°C show that initial limits (at standard conditions) are not exceeded at the conclusion of these tests.

Leakage current is more variable than capacitance or DF; in fact, leakage current typically exhibits a logarithmic dependence in several respects. Military Specifications permit leakage current (measured at standard conditions) to rise by a factor of four over 10,000 hour life tests. Typical behavior shows a lower rate of change, which may be negative or positive. Initial leakage currents are frequently so low (less than 0.1 nanoampere in the smallest CV capacitors, to about 10 microampere in the largest CV types) that changes of several orders of magnitude have no discernable effect on the usual circuit designs.

18. Failure Mode

Capacitor failure may be induced by exceeding the rated conditions of forward DC voltage, reverse DC voltage, surge current, power dissipation, or temperature. As with any practical device, these capacitors also possess an inherent, although low, failure rate when operated within the rated condition.

The dominant failure mode is by short-circuit. Minor parametric drifts are of no consequence in circuits suitable for solid tantalum capacitors. Catastrophic failure occurs as an avalanche in DC leakage current over a short (millisecond) time span. The failed capacitor, while called "short-circuited", may exhibit a DC resistance of 10 to 10^4 ohm.

If a failed capacitor is in an unprotected low-impedance circuit, continued flow of current through the capacitor may obviously produce severe overheating. The over-heated capacitor may damage the circuit board or nearby components. Protection against such occurrence is obtained by current-limiting devices or fuses provided by the circuit design. KEMET's T496 series offers a built-in fuse to convert the normal short circuit failure mode to an open circuit.

Fortunately, the inherent failure rate of KEMET solid tantalum capacitors is low, and this failure rate may be further improved by circuit design. Statistical failure rates are provided for military capacitors. Relating circuit conditions to failure rate is aided by the guides in the section following.

COMPONENT PERFORMANCE CHARACTERISTICS (con't.)

RELIABILITY

19. Reliability Prediction

Solid tantalum capacitors exhibit no degradation failure mode during shelf storage and show a constantly decreasing failure rate (i.e., absence of wearout mechanism) during life tests. This failure rate is dependent upon three important application conditions; DC voltage, temperature, and circuit impedance. Estimates of these respective effects are provided by the Reliability Nomograph (Figure 11) and the Circuit Impedance Reliability Factor Table (Table 7) following. The nomograph relates failure rate to voltage and temperature while the table relates failure rate to impedance. These estimates apply to steady-state DC conditions, and they assume usage within all other rated conditions.

Standard conditions, which produce a unity failure rate factor are rated voltage, +85°C, and 0.1 ohm-per-volt circuit impedance. While voltage and temperature are straightforward, there is sometimes difficulty in determining impedance. What is required is the circuit impedance seen by the capacitor. If several capacitors are connected in parallel, the impedance seen by each is lowered by the source of energy stored in the other capacitors. Energy is similarly stored in series inductors.

Failure rate is conventionally expressed in units of percent per thousand hours. As a sample calculation, suppose a particular batch of capacitors has a failure rate of 0.5% / Khr under standard conditions. What would be the predicted failure rate at 0.7 times rated voltage, 60°C and 0.8 Ω/V? The nomograph gives a factor of 7 x 10^{-4} and the table gives a factor of 0.3.

The failure rate estimate is then:
0.5 x 7 x 10^{-4} x 0.3 = 1.05 x 10^{-4}, or 0.0001%/Khr

TABLE 7 Circuit Impedance Reliability Factors

Circuit Impedance (ohms/volt)	Failure Rate Improvement (multiplying factors)
0.1	1.0
0.2	.8
0.4	.6
0.6	.4
0.8	.3
1.0	.2
2.0	.1
3 or greater	.07

Voltage "de-rating" is a common and useful approach to improved reliability. It can be pursued too far, however, when it leads to installation of higher voltage capacitors of much larger

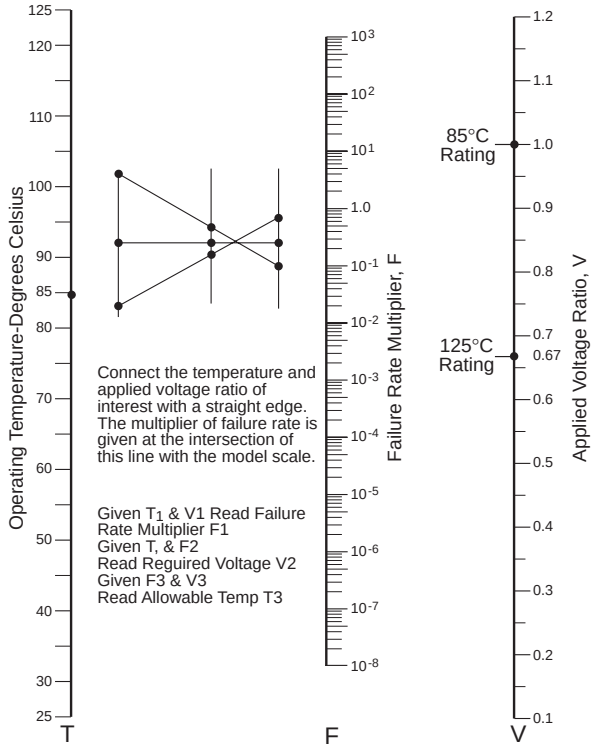


FIGURE 11 Reliability Nomograph

size. Inherent failure rate is roughly proportional to $CV^{1.6}$, where C is capacitance and V is rated voltage. The effect becomes particularly noticeable above 50-volt ratings. Additionally, those capacitors identified as "Extended Range" have higher inherent failure rates and should be specified with caution. It is possible to lose more via higher inherent failure rate than is gained by voltage derating. KEMET typically recommends 50% derating, especially in low impedance circuits.

The relationships shown are particularly useful when the failure rate has been statistically determined for a given group of capacitors. The T492 Series is qualified under U.S. military specification MIL-PRF-55365. Failure rates as low as 0.001%/Khr are available for all capacitance/voltage values in given groups under this test program. The specifications and their accompanying Qualified Products Lists should be consulted for details.

For Series not covered by military specifications, an internal sampling program is operated by KEMET Quality Assurance. The confidence level chosen for reporting the data is 60%. However, the cost of sampling each batch produced is overwhelmingly prohibitive, and no claim is made concerning knowledge of failure rate for any particular lot shipped. It is demonstrated that average failure rate for all commercial Series is between .1 and 1%/Khr at standard conditions and 60% confidence after 2,000 hours testing, +85°C, and rated voltage and ≤ 1 ohm total series resistance.

COMPONENT PERFORMANCE CHARACTERISTICS (con't.)

20. Surge Current

All conventional reliability testing is conducted under steady-state DC voltage. Experience indicates that AC ripple, within the limits prescribed, has little effect on failure rate. Heavy surge currents are possible in some applications, however. Circuit impedance may be very low (below the recommended 0.1 ohm/volt) or there may be driving inductance to cause voltage "ringing." Surge current may appear during turn-on of equipment, for example. Failure rate under current-surge conditions may not be predictable from conventional life test data.

Capacitors are capable of withstanding a 4 ±1 second charge of rated voltage (±2%) through a total circuit resistance (excluding the capacitor) of 1 ±0.2 ohms at +25°C, followed by a 4 ±1 second discharge to a voltage below 1% of the rated voltage. This cycle is repeated consecutively three (3) times. Post test performance:

a. Capacitance — within ±5% of initial value
b. DC Leakage — within initial limit
c. Dissipation Factor — within initial limit

100% production surge current testing is performed on all Tantalum Chip series for case sizes C, D, E, X, U, V. The total test circuit resistance is ≤ 0.5 ohms. The applied voltage is 75% of rated voltage for all series except the T495 and T510 which are surged at 100% of rated voltage. Four surge cycles are applied. Parts not capable of surviving this test are removed at subsequent electrical screening.

21. Storage Life Test

- ***2,000 hours, +125°C, Unbiased, Mounted***

Post Test Performance:

a. Capacitance — within ±10% of initial value
b. DC Leakage — within initial limit
c. Dissipation Factor — within initial limit
d. Physical — no degradation of function

22. Standard Life Test

- ***2,000 hours, +85°C, Rated Voltage, Mounted***

Post Test Performance:

a. Capacitance — within ±10% of initial value
b. DC Leakage — within 125% of initial limit
c. Dissipation Factor — within initial limit
d. Physical — no degradation of function

23. High Temperature Life Test

- ***2,000 hours, +125°C, 2/3 Rated Voltage, Mounted***

Post Test Performance:

a. Capacitance — within ±10% of initial value
b. DC Leakage — within 125% of initial limit
c. Dissipation Factor — within initial limit
d. Physical — no degradation of function

MECHANICAL

24. Resistance to Solvents

- ***Mil-Std-202, Method 215***

Post Test Performance:

a. Capacitance — within ±5% of initial value
b. DC Leakage — within initial limit
c. Dissipation Factor -— within initial limit
d. Physical — no degradation of case, terminals or marking.

25. Fungus

- ***Mil-Std-810, Method 508***

26. Flammability

- ***UL94 VO Classification***

  Encapsulant materials meet this classification.

27. Resistance to Soldering Heat

- ***Wave Solder***
  +260 ±5°C, 10 Seconds
- ***Infrared Reflow***
  +230 ±5°C, 30 Seconds
- ***Vapor Phase Reflow***
  +215 ±5°C, 2 minutes

Post Test Performance:

a. Capacitance — within ±5% of Initial Value
b. DC Leakage — within Initial Limit
c. Dissipation Factor — within Initial Limit

28. Solderability

- ***Mil-Std-202, Method 208***
- ***ANSI/J-STD-002, Test B***

Applies to Solder and Tin Coated terminations only. Does not apply to optional gold-plated terminations.

29. Vibration

- ***Mil-Std-202, Method 204, Condition D, 10 Hz to 2,000 Hz, 20G Peak***

Post Test Performance:

a. Capacitance — within ± 5% of initial value
b. DC Leakage — within initial limit
c. Dissipation Factor — within initial limit

30. Shock

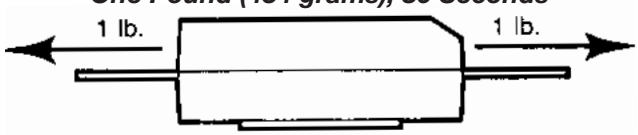
- ***Mil-Std-202, Method 213, Condition I, 100 G Peak***

Post Test Performance:

a. Capacitance — within ±5% of initial value
b. DC Leakage — within initial limit
c. Dissipation Factor — within initial limit

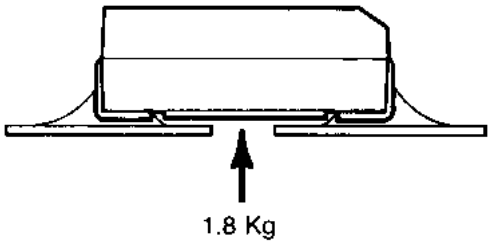
31. Terminal Strength

- **Pull Force**
  - ***One Pound (454 grams), 30 Seconds***



COMPONENT PERFORMANCE CHARACTERISTICS (con't.)

- **Tensile Force**
  - ***Four Pounds (1.8 kilograms), 60 Seconds***

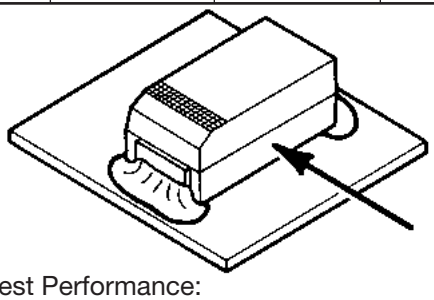


4 lb. (1.8 Kg)

- **Shear Force**

Table 8 Maximum Shear Loads

Case Code		Maximum Shear Loads	
KEMET	EIA	Kilograms	Pounds
R	2012-12	2.4	5.3
S	3216-12	3.2	7.0
T	3528-12	3.6	8.0
U	6032-15	4.5	10.0
V	7343-20	5.0	11.0
A	3216-18	3.2	7.0
B	3528-21	3.6	8.0
C	6032-28	4.5	10.0
D	7343-31	5.0	11.0
X	7343-43	5.0	11.0
E	7260-38	5.0	11.0



Post Test Performance:

a. Capacitance — within ±5% of initial value
b. DC Leakage — within initial limit
c. Dissipation Factor — within initial limit

APPLICATIONS

32. Handling

Automatic handling of encapsulated components is enhanced by the molded case which provides compatibility with all types of high speed pick and place equipment. Manual handling of these devices presents no unique problems. Care should be taken with your fingers, however, to avoid touching the solder-coated terminations as body oils, acids and salts will degrade the solderability of these terminations. Finger cots should be used whenever manually handling all solderable surfaces.

33. Termination Coating

The standard finish coating for all molded series is 90/10 Sn/Pb solder (Tin/Lead-solder coated).

For conductive adhesive attachment processes, a gold termination finish is available, at additional cost, on the T491, T494 and T495 Series only.The gold finish is not recommended for solder attachment.

For Pb-free soldering processes, we offer a 100% reflowed tin (Sn) termination finish.

34. Recommended Mounting Pad Geometries

Proper mounting pad geometries are essential for successful solder connections. These dimensions are highly process sensitive and should be designed to maximize the integrity of the solder joint, and to minimize component rework due to unacceptable solder joints.

Figure 12 illustrates pad geometry. Tables 9 & 10 provide recommended pad dimensions for both wave and reflow soldering techniques. These dimensions are intended to be a starting point for circuit board designers, to be fine tuned, if necessary, based upon the peculiarities of the soldering process and/or circuit board design.

Contact KEMET for Engineering Bulletin Number F-2100 entitled "Surface Mount Mounting Pad Dimensions and Considerations" for further details on this subject.

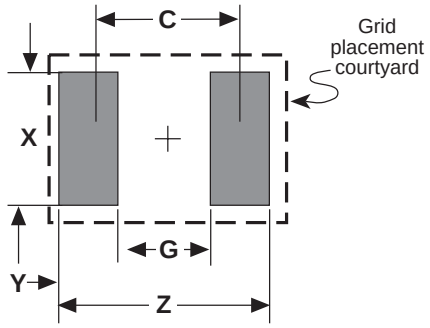


Figure 12

Table 9 – Land Pattern Dimensions for Reflow Solder

KEMET/EIA Size Code	Pad Dimensions - mm				
	Z	G	X	Y (ref)	C (ref)
R/2012-12	3.90	0.80	1.80	1.55	2.35
A/3216-18, S/3216-12	4.70	0.80	1.50	1.95	2.75
B/3528-21, T/3528-12	5.00	1.10	2.50	1.95	3.05
C/6032-28, U/6032-15	7.60	2.50	2.50	2.55	5.05
D/7343-31, V/7343-20, X/7343-43	8.90	3.80	2.70	2.55	6.35
E/7260-38	8.90	3.80	4.40	2.55	6.35

Table 10 – Land Pattern Dimensions for Wave Solder

KEMET/EIA Size Code	Pad Dimensions - mm				
	Z	G	X	Y (ref)	C (ref)
R/2012-12	4.30	0.80	1.26	1.75	2.55
A/3216-18, S/3216-12	5.10	0.80	1.10	2.15	2.95
B/3528-21, T/3528-12	5.40	1.10	1.80	2.15	3.25
C/6032-28, U/6032-15	8.00	2.50	1.80	2.75	5.25
D/7343-31, V/7343-20, X/7343-43	9.70	3.80	2.70	2.95	6.75
E/7260-38	9.70	3.80	4.40	2.95	6.75

COMPONENT PERFORMANCE CHARACTERISTICS (con't.)

35. Soldering

KEMET's families of surface mount tantalum capacitors are compatible with wave (single or dual) soldering and IR or vapor phase reflow techniques. Solder-coated terminations have excellent wetting characteristics for high integrity solder fillets. Preheating of these components is recommended to avoid extreme thermal stress. The maximum recommended preheat rate is 2°C per second. Figure 13 represents recommended maximum solder temperature / time combinations for these devices.

Note that although the X/7343-43 case size can withstand wave soldering, the tall profile (4.3mm maximum) dictates care in wave process development.

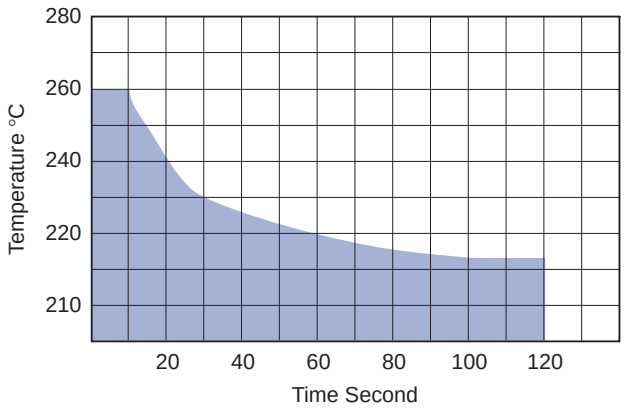


FIGURE 13 Time/Temperature Soldering Profile

Hand-soldering should be performed with care due to the difficulty in process control. If performed, care should be taken to avoid contact of the soldering iron to the molded case. The iron should be used to heat the solder pad, applying solder between the pad and the termination, until reflow occurs. The iron should be removed. "Wiping" the edges of a chip and heating the top surface is not recommended.

During typical reflow operations a slight darkening of the gold-colored epoxy may be observed. This slight darkening is normal and is not harmful to the product. Marking permanency is not affected by this change.

36. Washing

Standard washing techniques and solvents are compatible with all KEMET surface mount tantalum capacitors. Solvents such as Freon TMC and TMS, Trichlorethane, methylene chloride, prelete, and isopropyl alcohol are not harmful to these components.

If ultrasonic agitation is utilized in the cleaning process, care should be taken to minimize energy levels and exposure times to avoid damage to the terminations.

KEMET tantalum chips are also compatible with newer aqueous and semi-aqueous processes.

37. Encapsulations

Under normal circumstances, potting or encapsulation of KEMET tantalum chips is not required.

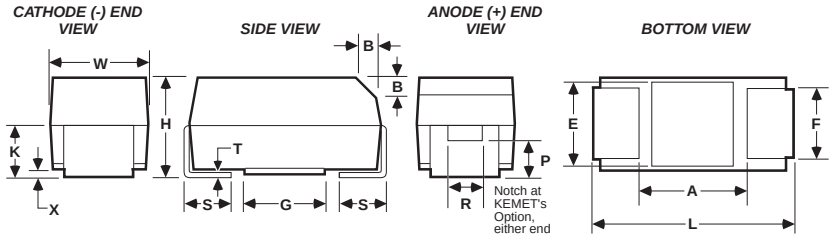
38. Storage Environment

Tantalum 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 degrees C, and maximum storage humidity not exceed 60% relative humidity. In addition, temperature fluctuations should be minimized to avoid condensation on the parts, and atmospheres should be free of chlorine and sulfur bearing compounds. For optimized solderability, chip stock should be used promptly, preferably within 1.5 years of receipt.

FEATURES

- Meets or Exceeds EIA Standard 535BAAC
- Taped and Reeled per EIA 481-1
- Symmetrical, Compliant Terminations
- Optional Gold-plated Terminations
- Laser-marked Case
- 100% Surge current test on C, D, E, U, V, X sizes
- Capacitance: 0.1 μF to 1000 μF
- Tolerance: ±10%, ±20%
- Voltage: 3-50 VDC
- Extended Range Values
- New Low Profile Case Sizes

CAPACITOR OUTLINE DRAWING



STANDARD T491 DIMENSIONS
Millimeters (inches)

CASE SIZE		COMPONENT													
KEMET	EIA	L*	W*	H*	K* ±0.20 ±(.008)	F* ±0.1 ±(.004)	S* ±0.3 ±(.012)	B ±0.15 (Ref) ±(.006)	X (Ref)	P (Ref)	R (Ref)	T (Ref)	A (Min)	G (Ref)	E (Ref)
A	3216-18	3.2 ± 0.2 (.126 ± .008)	1.6 ±0.2 (.063 ±.008)	1.6 ± 0.2 (.063 ± .008)	0.9 (.035)	1.2 (.047)	0.8 (.031)	0.4 (.016)	0.10 ± 0.10 (.004 ± .004)	0.4 (.016)	0.4 (.016)	0.13 (.005)	0.8 (.031)	1.1 (.043)	1.3 (.051)
B	3528-21	3.5 ± 0.2 (.138 ± .008)	2.8 ± 0.2 (.110 ± .008)	1.9 ± 0.2 (.075 ± .008)	1.1 (.043)	2.2 (.087)	0.8 (.031)	0.4 (.016)	0.10 ± 0.10 (.004 ± .004)	0.5 (.020)	1.0 (.039)	0.13 (.005)	1.1 (.043)	1.8 (.071)	2.2 (.087)
C	6032-28	6.0 ± 0.3 (.236 ± .012)	3.2 ± 0.3 (.126 ± .012)	2.5 ± 0.3 (.098 ± .012)	1.4 (.055)	2.2 (.087)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	0.9 (.035)	1.0 (.039)	0.13 (.005)	2.5 (.098)	2.8 (.110)	2.4 (.094)
D	7343-31	7.3 ± 0.3 (.287 ± .012)	4.3 ± 0.3 (.169 ± .012)	2.8 ± 0.3 (.110 ± .012)	1.5 (.059)	2.4 (.094)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	0.9 (.035)	1.0 (.039)	0.13 (.005)	3.8 (.150)	3.5 (.138)	3.5 (.138)
X	7343-43	7.3 ± 0.3 (.287 ± .012)	4.3 ± 0.3 (.169 ± .012)	4.0 ± 0.3 (.157 ± .012)	2.3 (.091)	2.4 (.094)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	1.7 (.067)	1.0 (.039)	0.13 (.005)	3.8 (.150)	3.5** (.138)	3.5** (.138)
E	7260-38	7.3 ± 0.3 (.287 ± .012)	6.0 ± 0.3 (.236 ± .012)	3.6 ± 0.2 (.142 ± .008)	2.3 (.091)	4.1 (.161)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	0.9 (.035)	1.0 (.039)	0.13 (.005)	3.8 (.150)	3.5 (.138)	3.5 (.138)

Notes: 1. Metric dimensions govern.
2. (Ref) - Dimensions provided for reference only.
* Mil-C-55365/8 Specified Dimensions
** Round Glue Pad: 2.9 ±0.1mm (0.114" ±0.004") in diameter at KEMET's option

LOW PROFILE T491 DIMENSIONS
Millimeters (inches)

CASE SIZE		COMPONENT										
KEMET	EIA	L	W	H Max.	K Min.	F ± 0.1	S ± 0.3	X (Ref)	T (Ref)	A (Min)	G (Ref)	E (Ref)
R	2012-12	2.0 ± 0.2 (.079 ± .008)	1.3 ± 0.2 (.051 ± .008)	1.2 (.047)	0.3 (.012)	0.9 (.035)	0.5 (.020)	0.05 (.002)	0.13 (.005)	0.8 (.031)	0.5 (.020)	0.8 (.031)
S	3216-12	3.2 ± 0.2 (.126 ± .008)	1.6 ± 0.2 (.063 ± .008)	1.2 (.047)	0.3 (.012)	1.2 (.047)	0.8 (.031)	0.05 (.002)	0.13 (.005)	0.8 (.031)	1.1 (.043)	1.3 (.051)
T	3528-12	3.5 ± 0.2 (.138 ± .008)	2.8 ± 0.2 (.110 ± .008)	1.2 (.047)	0.3 (.012)	2.2 (.087)	0.8 (.031)	0.05 (.002)	0.13 (.005)	1.1 (.043)	1.8 (.071)	2.2 (.087)
U	6032-15	6.0 ± 0.3 (.236 ± .012)	3.2 ± 0.3) (.126 ± .012)	1.5 (0.059)	0.5 (0.020)	2.2 (.087)	1.3 (.051)	0.05 (.002)	0.13 (.005)	2.5 (.098)	2.8 (.110)	2.4 (.094)
V	7343-20	7.3 ± 0.3 (.287 ± .012)	4.3 ± 0.3 (.169 ± .012)	2.0 (0.079)	1.1 (0.043)	2.4 (.094)	1.3 (.051)	0.05 (.002)	0.13 (.005)	3.8 (.150)	3.5 (.138)	3.5 (.138)

Notes: 1. Metric dimensions govern.
2. (Ref) - Dimensions provided for reference only.
3. No dimensions provided for B, P or R because low profile cases do not have a bevel or a notch.

T491 ORDERING INFORMATION

T 491 B 105 M 035 A S*

Tantalum

Series
T491 - Precision Molded

Case Size
A, B, C, D, E, R, S, T, U, V, X

Capacitance Picofarad Code
First two digits represent significant figures.
Third digit specifies number of zeros to follow.

***Part number example: T491B105M035AS (14 digits - no spaces)**

Capacitance Tolerance
M - ± 20%
K - ±10%

Voltage

Failure Rate
A - Not Applicable

Lead Material
S - Standard Solder -Coated (90% Sn/10% Pb)
G - Gold Plated (A, B, C, D, X only)
T - 100% Tin (Sn) Plated and Reflowed

T491 TANTALUM CHIP CAPACITANCE VALUES
Case Size by Capacitance and Voltage

Standard Capacitance Values

Capacitance		Rated Voltage @ +85°C							
µF	Code	4	6	10	16	20	25	35	50
0.10	104							A	A
0.15	154							A	B
0.22	224							A	B
0.33	334						A	A	B
0.47	474						A	A/B	C
0.68	684					A	A	B	C
1.0	105				A	S/A	B	B	C
1.5	155			A	A	S/A	B	B/C	D
2.2	225		A	A	S/A	A/B	B/C	C	D
3.3	335	A	A	S/A	A/B	B/T	C	C	D
4.7	475	A	S/A	A/B	A/B/T	B/C	C	C/D	D
6.8	685	S/A	A/B	A/B/T	B/C	C/U	C	D	X
10.0	106	A/B	A/B/T	B/C	B/C/U	C/U	D	D	
15.0	156	A/B/T	B/C	B/C/U	C/U	D	D	X	
22.0	226	B/C	B/C/U	C/U	C/D	D/V	D	X	
33.0	336	B/C/U	C/U	C/D/V	D	D	X		
47.0	476	C/U	C/D	D/V	D/V				
68.0	686	C/D	D	D/V		X			
100.0	107	D	D/V	D	X				
150.0	157	D/V	D	X					
220.0	227		X						
330.0	337								
470.0	477								
680.0	687								
1000.0	108								

Extended Capacitance Values

Capacitance		Rated Voltage @ +85°C								
µF	Code	3	4	6	10	16	20	25	35	50
0.10	104									
0.15	154									A
0.22	224									
0.33	334									
0.47	474									B
0.68	684								A	B
1.0	105							A	A	V
1.5	155							A		C
2.2	225					R			B	C
3.3	335						A	B		
4.7	475				R/S			B		
6.8	685			S	S	A	B		C	
10.0	106		R/S	R/S	T/A		B	C	C/V	
15.0	156		S	T/A	T/A	B	C	C	D	
22.0	226		T/A	T/A	B	U/B	C	V	D	
33.0	336	A	T/A	A/B	U/B	U/C	C	D	X	
47.0	476		A/B	U/B	U/C	C	D	X		
68.0	686		U/B	U/C	C	D	D			
100.0	107		U/C	C	V/C	D	X			
150.0	157		C	V/C	D	X				
220.0	227		V	V/D	D/X					
330.0	337		V/D	D/X	X					
470.0	477		D/X	X						
680.0	687		X							
1000.0	108		E							

Note that standard values are preferred. Extended values are available for use where size constraints exist. Note that standard values demonstrate inherently lower failure rates than extended values, especially in low impedance applications.

T491 RATINGS & PART NUMBER REFERENCE

Capacitance µF	Case Size	KEMET Part Number	DC Leakage µA @ 25°C Max	DF % @ +25°C 120 Hz Max	ESR Ω @ +25°C 100 kHz Max
3 Volt Rating at +85 °C (2 Volt Rating at +125 °C)					
#33.0	*A	T491A336(1)003AS	1.0	6.0	4.0
4 Volt Rating at +85 °C (2.7 Volt Rating at +125 °C)					
3.3	A	T491A335(1)004AS	0.5	6.0	8.0
4.7	A	T491A475(1)004AS	0.5	6.0	8.0
6.8	A	T491A685(1)004AS	0.5	6.0	6.0
6.8	S	T491S685(1)004AS	0.5	6.0	15.0
10.0	B	T491B106(1)004AS	0.5	6.0	3.5
10.0	A	T491A106(1)004AS	0.5	6.0	6.0
#10.0	*S	T491S106(1)004AS	0.5	6.0	15.0
#10.0	*R	T491R106M004AS	0.5	8.0	10.0
15.0	B	T491B156(1)004AS	0.6	6.0	3.5
15.0	A	T491A156(1)004AS	0.6	6.0	4.0
15.0	T	T491T156(1)004AS	0.6	6.0	5.0
#15.0	*S	T491S156M004AS	0.6	10.0	15.0
22.0	C	T491C226(1)004AS	0.9	6.0	1.8
22.0	B	T491B226(1)004AS	0.9	6.0	3.5
#22.0	*A	T491A226(1)004AS	0.9	6.0	4.0
#22.0	*T	T491T226(1)004AS	0.9	6.0	5.0
33.0	C	T491C336(1)004AS	1.3	6.0	1.8
33.0	U	T491U336(1)004AS	1.3	6.0	1.8
33.0	B	T491B336(1)004AS	1.3	6.0	3.5
#33.0	*A	T491A336(1)004AS	1.3	6.0	4.0
#33.0	*T	T491T336M004AS	1.3	8.0	5.0
47.0	C	T491C476(1)004AS	1.9	6.0	1.8
47.0	U	T491U476(1)004AS	1.9	6.0	1.8
#47.0	*B	T491B476(1)004AS	1.9	6.0	3.0
#47.0	*A	T491A476M004AS	1.9	12.0	2.5
68.0	D	T491D686(1)004AS	2.7	6.0	0.8
68.0	C	T491C686(1)004AS	2.7	6.0	1.6
#68.0	*U	T491U686(1)004AS	2.7	6.0	1.8
#68.0	*B	T491B686(1)004AS	2.7	6.0	3.5
100.0	D	T491D107(1)004AS	4.0	8.0	0.8
#100.0	*C	T491C107(1)004AS	4.0	8.0	1.2
#100.0	*U	T491U107(1)004AS	4.0	10.0	1.8
150.0	D	T491D157(1)004AS	6.0	8.0	0.8
150.0	V	T491V157(1)004AS	6.0	8.0	0.7
#150.0	*C	T491C157(1)004AS	6.0	8.0	1.2
#220.0	*V	T491V227(1)004AS	8.8	8.0	0.7
#330.0	*D	T491D337(1)004AS	13.2	8.0	0.7
#330.0	*V	T491V337M004AS	13.2	12.0	0.7
#470.0	*X	T491X477(1)004AS	18.8	8.0	0.5
#470.0	*D	T491D477(1)004AS	18.8	8.0	0.5
#680.0	*X	T491X687M004AS	27.2	12.0	0.5
#1000.0	*E	T491E108M004AS	40.0	15.0	0.2
****6 Volt Rating at +85 °C (4 Volt Rating at +125 °C)**					
2.2	A	T491A225(1)006AS	0.5	6.0	8.0
3.3	A	T491A335(1)006AS	0.5	6.0	8.0
4.7	A	T491A475(1)006AS	0.5	6.0	6.0
4.7	S	T491S475(1)006AS	0.5	6.0	15.0
6.8	B	T491B685(1)006AS	0.5	6.0	3.5
6.8	A	T491A685(1)006AS	0.5	6.0	6.0
#6.8	*S	T491S685(1)006AS	0.5	6.0	15.0
10.0	B	T491B106(1)006AS	0.6	6.0	3.5
10.0	A	T491A106(1)006AS	0.6	6.0	4.0
10.0	T	T491T106(1)006AS	0.6	6.0	5.0
#10.0	*S	T491S106M006AS	0.6	10.0	15.0
#10.0	*R	T491R106M006AS	0.6	8.0	10.0
15.0	C	T491C156(1)006AS	0.9	6.0	1.8
15.0	B	T491B156(1)006AS	0.9	6.0	3.5
#15.0	*A	T491A156(1)006AS	0.9	6.0	4.0
#15.0	*T	T491T156(1)006A5	0.9	6.0	5.0
22.0	C	T491C226(1)006AS	1.4	6.0	1.8
22.0	U	T491U226(1)006AS	1.4	6.0	1.8
22.0	B	T491B226(1)006AS	1.4	6.0	3.5
#22.0	*A	T491A226(1)006AS	1.4	6.0	4.0
#22.0	*T	T491T226M006AS	1.4	8.0	5.0
33.0	C	T491C336(1)006AS	2.0	6.0	1.8
33.0	U	T491U336(1)006AS	2.0	6.0	1.8
#33.0	*B	T491B336(1)006AS	2.0	6.0	3.0
#33.0	*A	T491A336M006AS	2.0	12.0	2.5
47.0	D	T491D476(1)006AS	2.9	6.0	0.8
47.0	C	T491C476(1)006AS	2.9	6.0	1.6
#47.0	*U	T491U476(1)006AS	2.9	6.0	1.8
#47.0	*B	T491B476(1)006AS	2.9	6.0	3.5
68.0	D	T491D686(1)006AS	4.1	6.0	0.8
#68.0	*C	T491C686(1)006AS	4.1	6.0	1.2
#68.0	*U	T491U686(1)006AS	4.1	10.0	1.8
100.0	D	T491D107(1)006AS	6.0	8.0	0.8
100.0	V	T491V107(1)006AS	6.0	8.0	0.7
#100.0	*C	T491C107(1)006AS	6.0	8.0	1.2
150.0	D	T491D157(1)006AS	9.0	8.0	0.7
#150.0	*C	T491C157M006AS	9.0	8.0	1.2
#150.0	*V	T491V157(1)006AS	9.0	8.0	0.7
220.0	X	T491X227(1)006AS	13.2	8.0	0.7
#220.0	*D	T491D227(1)006AS	13.2	8.0	0.7
#220.0	*V	T491V227M006AS	13.2	12.0	0.7
#330.0	*X	T491X337(1)006AS	19.8	8.0	0.5
#330.0	*D	T491D337(1)006AS	19.8	8.0	0.5
#470.0	*X	T491X477(1)006AS	28.2	10.0	0.5

Capacitance µF	Case Size	KEMET Part Number	DC Leakage µA @ 25°C Max	DF % @ +25°C 120 Hz Max	ESR Ω @ +25°C 100 kHz Max
10 Volt Rating at +85 °C (7 Volt Rating at +125 °C)					
1.5	A	T491A155(1)010AS	0.5	6.0	8.0
2.2	A	T491A225(1)010AS	0.5	6.0	8.0
3.3	A	T491A335(1)010AS	0.5	6.0	6.0
3.3	S	T491S335(1)010AS	0.5	6.0	15.0
4.7	B	T491B475(1)010AS	0.5	6.0	3.5
4.7	A	T491A475(1)010AS	0.5	6.0	6.0
#4.7	*S	T491S475(1)010AS	0.5	6.0	15.0
#4.7	*R	T491R475M010AS	0.5	8.0	10.0
6.8	B	T491B685(1)010AS	0.7	6.0	3.5
6.8	A	T491A685(1)010AS	0.7	6.0	6.0
6.8	T	T491T685(1)010AS	0.7	6.0	5.0
#6.8	*S	T491S685M010AS	0.7	10.0	15.0
10.0	C	T491C106(1)010AS	1.0	6.0	1.8
10.0	B	T491B106(1)010AS	1.0	6.0	3.5
#10.0	*A	T491A106(1)010AS	1.0	6.0	4.0
#10.0	*T	T491T106(1)010AS	1.0	6.0	5.0
15.0	C	T491C156(1)010AS	1.5	6.0	1.8
15.0	U	T491U156(1)010AS	1.5	6.0	1.8
15.0	B	T491B156(1)010AS	1.5	6.0	3.5
#15.0	*A	T491A156(1)010AS	1.5	8.0	6.0
#15.0	*T	T491T156M010AS	1.5	8.0	5.0
22.0	C	T491C226(1)010AS	2.2	6.0	1.8
22.0	U	T491U226(1)010AS	2.2	6.0	1.8
#22.0	*B	T491B226(1)010AS	2.2	6.0	3.0
33.0	D	T491D336(1)010AS	3.3	6.0	0.8
33.0	V	T491V336(1)010AS	3.3	6.0	0.7
33.0	C	T491C336(1)010AS	3.3	6.0	1.6
#33.0	*U	T491U336(1)010AS	3.3	6.0	1.8
#33.0	*B	T491B336(1)010AS	3.3	6.0	3.5
47.0	D	T491D476(1)010AS	4.7	6.0	0.8
47.0	V	T491V476(1)010AS	4.7	6.0	0.7
#47.0	*C	T491C476(1)010AS	4.7	6.0	1.2
#47.0	*U	T491U476(1)010AS	4.7	10.0	2.2
68.0	D	T491D686(1)010AS	6.8	6.0	0.8
68.0	V	T491V686(1)010AS	6.8	6.0	0.7
#68.0	*C	T491C686(1)010AS	6.8	6.0	1.2
100.0	D	T491D107(1)010AS	10.0	8.0	0.7
#100.0	*C	T491C107(1)010AS	10.0	8.0	1.2
#100.0	*V	T491V107(1)010AS	10.0	8.0	0.7
150.0	X	T491X157(1)010AS	15.0	8.0	0.7
#150.0	*D	T491D157(1)010AS	15.0	8.0	0.7
#220.0	*X	T491X227(1)010AS	22.0	8.0	0.5
#220.0	*D	T491D227(1)010AS	22.0	8.0	0.5
#330.0	*X	T491X337(1)010AS	33.0	10.0	0.5
16 Volt Rating at +85 °C (10 Volt Rating at +125 °C)					
1.0	A	T491A105(1)016AS	0.5	4.0	10.0
1.5	A	T491A155(1)016AS	0.5	6.0	8.0
2.2	A	T491A225(1)016AS	0.5	6.0	6.0
2.2	S	T491S225(1)016AS	0.5	6.0	15.0
#2.2	*R	T491R225M016AS	0.5	8.0	25.0
3.3	B	T491B335(1)016AS	0.5	6.0	3.5
3.3	A	T491A335(1)016AS	0.5	6.0	6.0
4.7	B	T491B475(1)016AS	0.8	6.0	3.5
4.7	A	T491A475(1)016AS	0.8	6.0	6.0
4.7	T	T491T475(1)016AS	0.8	6.0	5.0
6.8	C	T491C685(1)016AS	1.1	6.0	1.9
6.8	B	T491B685(1)016AS	1.1	6.0	3.5
#6.8	*A	T491A685(1)016AS	1.1	6.0	7.0
10.0	C	T491C106(1)016AS	1.6	6.0	1.8
10.0	U	T491U106(1)016AS	1.6	6.0	1.8
10.0	B	T491B106(1)016AS	1.6	6.0	3.5
15.0	C	T491C156(1)016AS	2.4	6.0	1.8
15.0	U	T491U156(1)016AS	2.4	6.0	1.8
#15.0	*B	T491B156(1)016AS	2.4	6.0	3.0
22.0	D	T491D226(1)016AS	3.6	6.0	0.8
22.0	C	T491C226(1)016AS	3.6	6.0	1.6
#22.0	*U	T491U226(1)016AS	3.5	10.0	3.0
#22.0	*B	T491B226(1)016AS	3.5	6.0	3.0
33.0	D	T491D336(1)016AS	5.3	6.0	0.8
#33.0	*C	T491C336(1)016AS	5.3	6.0	1.2
#33.0	*U	T491U336(1)016AS	5.3	12.0	3.0
47.0	D	T491D476(1)016AS	7.5	6.0	0.8
47.0	V	T491V476(1)016AS	7.5	6.0	0.7
#47.0	*C	T491C476(1)016AS	7.5	6.0	1.2
68.0	*D	T491D686(1)016AS	10.9	6.0	0.7
100.0	X	T491X107(1)016AS	16.0	8.0	0.7
#100.0	*D	T491D107(1)016AS	16.0	8.0	0.7
#150.0	*X	T491X157(1)016AS	24.0	8.0	0.5
20 Volt Rating at +85 °C (13 Volt Rating at +125 °C)					
0.68	A	T491A684(1)020AS	0.5	4.0	12.0
1.0	A	T491A105(1)020AS	0.5	4.0	10.0
1.0	S	T491S105(1)020AS	0.5	6.0	18.0

(1) To complete KEMET Part Number, insert M for ±20% tolerance or K for ± 10% tolerance.

#Maximum Capacitance Change @125°C=+15%. (All others =+12%)

Higher voltage ratings, lower ESR, and tighter capacitance tolerance product may be substituted within the same size at KEMET's option. Voltage substitutions will be marked with the higher voltage rating.

***Extended Values** ****6 Volt product equivalent to 6.3 volt product.**

T491 RATINGS & PART NUMBER REFERENCE

Capacitance µF	Case Size	KEMET Part Number	DC Leakage µA @ 25°C Max	DF % @ +25°C 120 Hz Max	ESR Ω @ +25°C 100 kHz Max
20 Volt Rating at +85 °C (13 Volt Rating at +125 °C) cont'd					
1.5	A	T491A155(1)020AS	0.5	6.0	8.0
1.5	S	T491S155(1)020AS	0.5	6.0	15.0
2.2	B	T491B225(1)020AS	0.5	6.0	3.5
2.2	A	T491A225(1)020AS	0.5	6.0	7.0
3.3	B	T491B335(1)020AS	0.7	6.0	3.5
#3.3	*A	T491A335(1)020AS	0.7	6.0	7.0
3.3	T	T491T335(1)020AS	0.7	6.0	5.0
4.7	C	T491C475(1)020AS	1.0	6.0	2.4
4.7	B	T491B475(1)020AS	1.0	6.0	3.5
6.8	C	T491C685(1)020AS	1.4	6.0	1.9
6.8	U	T491U685(1)020AS	1.4	6.0	1.9
#6.8	*B	T491B685(1)020AS	1.4	6.0	3.5
10.0	C	T491C106(1)020AS	2.0	6.0	1.8
10.0	U	T491U106(1)020AS	2.0	6.0	1.8
#10.0	*B	T491B106(1)020AS	2.0	6.0	3.0
15.0	D	T491D156(1)020AS	3.0	6.0	1.0
15.0	*C	T491C156(1)020AS	3.0	6.0	1.7
22.0	D	T491D226(1)020AS	4.4	6.0	0.8
22.0	V	T491V226(1)020AS	4.4	6.0	0.7
#22.0	*C	T491C226(1)020AS	4.4	6.0	1.2
33.0	D	T491D336(1)020AS	6.6	6.0	0.8
#33.0	*C	T491C336M020AS	6.6	6.0	1.2
47.0	*D	T491D476(1)020AS	9.4	6.0	0.7
68.0	X	T491X686(1)020AS	13.6	6.0	0.7
#68.0	*D	T491D686(1)020AS	13.6	8.0	0.7
#100.0	*X	T491X107(1)020AS	20.0	8.0	0.5
25 Volt Rating at +85 °C (17 Volt Rating at +125 °C)					
0.33	A	T491A334(1)025AS	0.5	4.0	15.0
0.47	A	T491A474(1)025AS	0.5	4.0	14.0
0.68	A	T491A684(1)025AS	0.5	4.0	10.0
1.0	B	T491B105(1)025AS	0.5	4.0	5.0
1.0	*A	T491A105(1)025AS	0.5	4.0	8.0
1.5	B	T491B155(1)025AS	0.5	6.0	5.0
1.5	*A	T491A155(1)025AS	0.5	6.0	10.0
2.2	C	T491C225(1)025AS	0.6	6.0	3.5
2.2	B	T491B225(1)025AS	0.6	6.0	4.5
3.3	C	T491C335(1)025AS	0.9	6.0	2.5
3.3	*B	T491B335(1)025AS	0.9	6.0	3.5
4.7	C	T491C475(1)025AS	1.2	6.0	2.4
#4.7	*B	T491B475M025AS	1.2	6.0	1.5
6.8	C	T491C685(1)025AS	1.7	6.0	1.9
10.0	D	T491D106(1)025AS	2.5	6.0	1.0
10.0	*C	T491C106(1)025AS	2.5	6.0	1.5
15.0	D	T491D156(1)025AS	3.8	6.0	1.0
#15.0	*C	T491C156(1)025AS	3.8	6.0	1.5
22.0	D	T491D226(1)025AS	5.5	6.0	0.8
22.0	*V	T491V226(1)025AS	5.5	6.0	0.7
33.0	X	T491X336(1)025AS	8.3	6.0	0.7
#33.0	*D	T491D336(1)025AS	8.3	6.0	0.7
#47.0	*X	T491X476(1)025AS	11.8	6.0	0.7

Capacitance µF	Case Size	KEMET Part Number	DC Leakage µA @ 25°C Max	DF % @ +25°C 120 Hz Max	ESR Ω @ +25°C 100 kHz Max
35 Volt Rating at +85 °C (23 Volt Rating at +125 °C)					
0.10	A	T491A104(1)035AS	0.5	4.0	20.0
0.15	A	T491A154(1)035AS	0.5	4.0	19.0
0.22	A	T491A224(1)035AS	0.5	4.0	18.0
0.33	A	T491A334(1)035AS	0.5	4.0	15.0
0.47	B	T491B474(1)035AS	0.5	4.0	8.0
0.47	A	T491A474(1)035AS	0.5	4.0	14.0
0.68	B	T491B684(1)035AS	0.5	4.0	6.5
0.68	*A	T491A684(1)035AS	0.5	4.0	10.0
1.0	B	T491B105(1)035AS	0.5	4.0	5.0
1.0	*A	T491A105(1)035AS	0.5	4.0	10.0
1.5	C	T491C155(1)035AS	0.5	6.0	4.5
1.5	B	T491B155(1)035AS	0.5	6.0	5.0
2.2	C	T491C225(1)035AS	0.8	6.0	3.5
2.2	*B	T491B225(1)035AS	0.8	6.0	4.0
3.3	C	T491C335(1)035AS	1.2	6.0	2.5
4.7	D	T491D475(1)035AS	1.7	6.0	1.5
4.7	C	T491C475(1)035AS	1.7	6.0	2.5
6.8	D	T491D685(1)035AS	2.4	6.0	1.3
6.8	*C	T491C685(1)035AS	2.4	6.0	2.0
10.0	D	T491D106(1)035AS	3.5	6.0	1.0
#10.0	*C	T491C106M035AS	3.5	6.0	2.0
#10.0	*V	T491V106(1)035AS	3.5	6.0	2.0
15.0	X	T491X156(1)035AS	5.3	6.0	0.9
15.0	*D	T491D156(1)035AS	5.3	6.0	0.8
22.0	X	T491X226(1)035AS	7.7	6.0	0.7
#22.0	*D	T491D226M035AS	7.7	6.0	0.7
#33.0	*X	T491X336(1)035AS	11.6	6.0	0.6
50 Volt Rating at +85 °C (33 Volt Rating at +125 °C)					
0.10	A	T491A104(1)050AS	0.5	4.0	20.0
0.15	B	T491B154(1)050AS	0.5	4.0	16.0
0.15	*A	T491A154(1)050AS	0.5	4.0	19.0
0.22	B	T491B224(1)050AS	0.5	4.0	14.0
0.33	B	T491B334(1)050AS	0.5	4.0	10.0
0.47	C	T491C474(1)050AS	0.5	4.0	8.0
0.47	*B	T491B474(1)050AS	0.5	4.0	9.0
0.68	C	T491C684(1)050AS	0.5	4.0	7.0
0.68	*B	T491B684(1)050AS	0.5	4.0	8.0
1.0	C	T491C105(1)050AS	0.5	4.0	5.5
1.0	*V	T491V105M050AS	0.5	4.0	6.0
1.5	D	T491D155(1)050AS	0.8	6.0	3.5
1.5	*C	T491C155(1)050AS	0.8	6.0	4.5
2.2	D	T491D225(1)050AS	1.1	6.0	2.5
2.2	*C	T491C225(1)050AS	1.1	6.0	3.5
3.3	D	T491D335(1)050AS	1.7	6.0	2.0
4.7	D	T491D475(1)050AS	2.4	6.0	1.5
6.8	X	T491X685(1)050AS	3.5	6.0	1.0

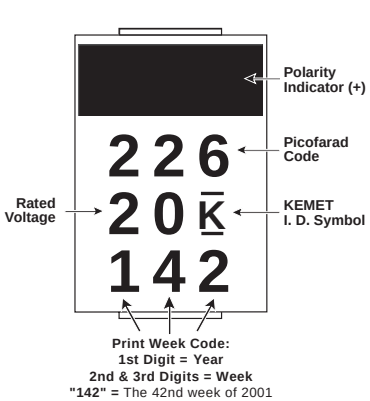
(1) To complete KEMET Part Number, insert M for ±20% tolerance or K for ±10% tolerance.

***Extended Values** ****6 Volt product equivalent to 6.3 volt product.**

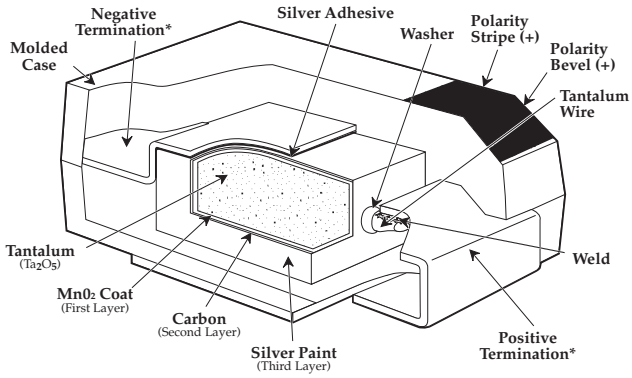
#Maximum Capacitance Change @ 125°C=+15%. (All others = +12%)

Higher voltage ratings, lower ESR, and tighter capacitance tolerance product may be substituted within the same size at KEMET's option. Voltage substitutions will be marked with the higher voltage rating.

CAPACITOR MARKINGS
T491 Series — All Case Sizes



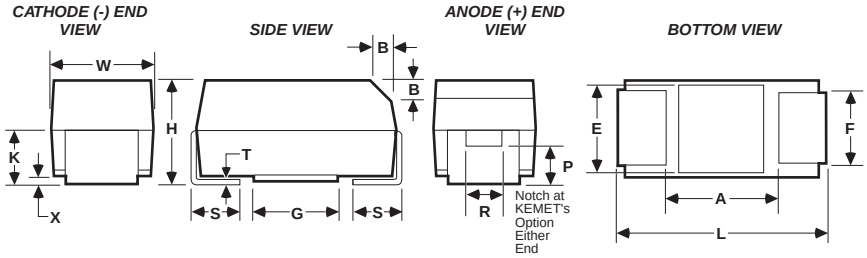
CONSTRUCTION



*Termination Solder Coating 90 Sn/10Pb

- Established reliability military version of Industrial Grade T491 series
- Taped and reeled per EIA 481-1
- Precision-molded, laser-marked case
- Symmetrical, compliant terminations
- 100% Surge Current test on C, D sizes
- Qualified to MIL-PRF-55365/8, Style CWR11:
  - Termination Code H, solder-plated
  - Weibull failure rate codes B, C and D
  - Capacitance values and voltages as shown in following part number table. (Contact KEMET for latest qualification status)

T492 OUTLINE DRAWINGS



DIMENSIONS – Millimeters (Inches)

CASE SIZE		COMPONENT													
KEMET	EIA	L*	W*	H*	K* ±0.20 ±(.008)	F* ±-0.1 ±(.004)	S* ±0.3 ±(.012)	B ±0.15 (Ref) ± (.006)	X (Ref)	P (Ref)	R (Ref)	T (Ref)	A (Min)	G (Ref)	E (Ref)
A	3216-18	3.2 ± 0.2 (.126 ± .008)	1.6 ± 0.2 (.063 ± .008)	1.6 ± 0.2 (.063 ± .008)	0.9 (.035)	1.2 (.047)	0.8 (.031)	0.4 (.016)	0.10 ± 0.10 (.004 ± .004)	0.4 (.016)	0.4 (.016)	0.13 (.005)	0.8 (.031)	1.1 (.043)	1.3 (.051)
B	3528-21	3.5 ± 0.2 (.138 ± .008)	2.8 ± 0.2 (.110 ± .008)	1.9 ± 0.2 (.075 ± .008)	1.1 (.043)	2.2 (.087)	0.8 (.031)	0.4 (.016)	0.10 ± 0.10 (.004 ± .004)	0.5 (.020)	1.0 (.039)	0.13 (.005)	1.1 (.043)	1.8 (.071)	2.2 (.087)
C	6032-28	6.0 ± 0.3 (.236 ± .012)	3.2 ± 0.3 (.126 ± .012)	2.5 ± 0.3 (.098 ± .012)	1.4 (.055)	2.2 (.087)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	0.9 (.035)	1.0 (.039)	0.13 (.005)	2.5 (.098)	2.8 (.110)	2.4 (.094)
D	7343-31	7.3 ± 0.3 (.287 ± .012)	4.3± 0.3 (.169 ± .012)	2.8 ± 0.3 (.110 ± .012)	1.5 (.059)	2.4 (.094)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	0.9 (.035)	1.0 (.039)	0.13 (.005)	3.8 (.150)	3.5 (.138)	3.5 (.138)

Notes: 1. Metric dimensions govern.
2. (Ref) - Dimensions provided for reference only.

* Mil-C-55365/8 Specified Dimensions

ORDERING INFORMATION — MIL-PRF-55365 Part Number

CWR11 M H 105 K B

Style
Capacitors, Chip, Fixed,Tantalum, Established Reliability, (encapsulated)

Voltage
D = 6V J = 20V
F = 10V K = 25V
H = 15V M = 35V

Termination Finish Code
H = Solder Plated

Failure Rate Symbol*
(*See Note Below)
B (0.1%/1000 hrs.)
C (0.01%/1000 hrs.)
D (0.001%/1000 hrs.)

Capacitance Tolerance
M - ± 20%
K - ± 10%
J - ± 5%

Capacitance Picofarad Code
First two digits represent significant figures.
Third digit specifies number of zeros to follow.

T492 SERIES ORDERING INFORMATION — KEMET Part Number

T 492 B 105 K 035 B S*

Tantalum

Series
T492 - Precision Molded, Style CWR11

Case Size
A, B, C, D

Capacitance Picofarad Code
First two digits represent significant figures.
Third digit specifies number of zeros to follow.

Lead Material
S - Standard Solder -Coated

Failure Rate Symbol*
(*See Note Below)
B (0.1%/1000 hrs.)
C (0.01%/1000 hrs.)
D (0.001%/1000 hrs.)

Voltage

Capacitance Tolerance
M - ± 20%
K - ± 10%
J - ± 5%

*** Part Number Example: T492B105K035BS (14 digits - no spaces)**

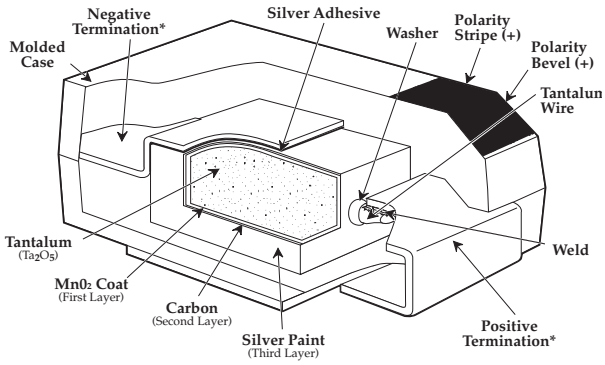
*Note on Failure Rates: Exponential failure rate levels M, P, R and S are inactive for new design per Mil-C-55365. Parts qualified to Weibull failure rate levels are substitutable for exponential failure rate levels.

T492 (CWR11) RATINGS AND PART NUMBER REFERENCE

Capacitance µF	Case Size	KEMET Part Number	Mil-C-55365/8 Part Number	DC Leakage µA @ +25°C Max	DF % @ +25°C 120 Hz Max	ESR Ω @ +25°C 100kHz Max
6 Volt Rating at +85°C (4 Volt Rating at +125°C)						
1.5	A	T492A155(1)006(2)S	CWR11DH155(1)(2)	0.5	6.0	8.0
2.2	A	T492A225(1)006(2)S	CWR11DH225(1)(2)	0.5	6.0	8.0
3.3	A	T492A335(1)006(2)S	CWR11DH335(1)(2)	0.5	6.0	8.0
4.7	B	T492B475(1)006(2)S	CWR11DH475(1)(2)	0.5	6.0	5.5
6.8	B	T492B685(1)006(2)S	CWR11DH685(1)(2)	0.5	6.0	4.5
10.0	B	T492B106(1)006(2)S	CWR11DH106(1)(2)	0.6	6.0	3.5
15.0	C	T492C156(1)006(2)S	CWR11DH156(1)(2)	0.9	6.0	3.0
22.0	C	T492C226(1)006(2)S	CWR11DH226(1)(2)	1.4	6.0	2.2
47.0	D	T492D476(1)006(2)S	CWR11DH476(1)(2)	2.8	6.0	1.1
10 Volt Rating at +85°C (7 Volt Rating at 125°C)						
1.0	A	T492A105(1)010(2)S	CWR11FH105(1)(2)	0.5	4.0	10.0
1.5	A	T492A155(1)010(2)S	CWR11FH155(1)(2)	0.5	6.0	8.0
2.2	A	T492A225(1)010(2)S	CWR11FH225(1)(2)	0.5	6.0	8.0
3.3	B	T492B335(1)010(2)S	CWR11FH335(1)(2)	0.5	6.0	5.5
4.7	B	T492B475(1)010(2)S	CWR11FH475(1)(2)	0.5	6.0	4.5
6.8	B	T492B685(1)010(2)S	CWR11FH685(1)(2)	0.7	6.0	3.5
15.0	C	T492C156(1)010(2)S	CWR11FH156(1)(2)	1.5	6.0	2.5
33.0	D	T492D336(1)010(2)S	CWR11FH336(1)(2)	3.3	6.0	1.1
15 Volt Rating at +85°C (10 Volt Rating at +125°C)						
0.68	A	T492A684(1)015(2)S	CWR11HH684(1)(2)	0.5	4.0	12.0
1.0	A	T492A105(1)015(2)S	CWR11HH105(1)(2)	0.5	4.0	10.0
1.5	A	T492A155(1)015(2)S	CWR11HH155(1)(2)	0.5	6.0	8.0
2.2	B	T492B225(1)015(2)S	CWR11HH225(1)(2)	0.5	6.0	5.5
3.3	B	T492B335(1)015(2)S	CWR11HH335(1)(2)	0.5	6.0	5.0
4.7	B	T492B475(1)015(2)S	CWR11HH475(1)(2)	0.7	6.0	4.0
10.0	C	T492C106(1)015(2)S	CWR11HH106(1)(2)	1.6	6.0	2.5
22.0	D	T492D226(1)015(2)S	CWR11HH226(1)(2)	3.3	6.0	1.1
20 Volt Rating at +85°C (13 Volt Rating at +125°C)						
0.47	A	T492A474(1)020(2)S	CWR11JH474(1)(2)	0.5	4.0	14.0
0.68	A	T492A684(1)020(2)S	CWR11JH684(1)(2)	0.5	4.0	12.0
1.0	A	T492A105(1)020(2)S	CWR11JH105(1)(2)	0.5	4.0	10.0
1.5	B	T492B155(1)020(2)S	CWR11JH155(1)(2)	0.5	6.0	6.0
2.2	B	T492B225(1)020(2)S	CWR11JH225(1)(2)	0.5	6.0	5.0
3.3	B	T492B335(1)020(2)S	CWR11JH335(1)(2)	0.7	6.0	4.0
4.7	C	T492C475(1)020(2)S	CWR11JH475(1)(2)	1.0	6.0	3.0
6.8	C	T492C685(1)020(2)S	CWR11JH685(1)(2)	1.4	6.0	2.4
15.0	D	T492D156(1)020(2)S	CWR11JH156(1)(2)	3.0	6.0	1.1
25 Volt Rating at +85°C (17 Volt Rating at +125°C)						
0.33	A	T492A334(1)025(2)S	CWR11KH334(1)(2)	0.5	4.0	15.0
0.47	A	T492A474(1)025(2)S	CWR11KH474(1)(2)	0.5	4.0	14.0
0.68	B	T492B684(1)025(2)S	CWR11KH684(1)(2)	0.5	4.0	7.5
1.0	B	T492B105(1)025(2)S	CWR11KH105(1)(2)	0.5	4.0	6.5
1.5	B	T492B155(1)025(2)S	CWR11KH155(1)(2)	0.5	6.0	6.5
2.2	C	T492C225(1)025(2)S	CWR11KH225(1)(2)	0.6	6.0	3.5
3.3	C	T492C335(1)025(2)S	CWR11KH335(1)(2)	0.9	6.0	3.5
4.7	C	T492C475(1)025(2)S	CWR11KH475(1)(2)	1.2	6.0	2.5
6.8	D	T492D685(1)025(2)S	CWR11KH685(1)(2)	1.7	6.0	1.4
10.0	D	T492D106(1)025(2)S	CWR11KH106(1)(2)	2.5	6.0	1.2
35 Volt Rating at +85°C (23 Volt Rating at +125°C)						
0.10	A	T492A104(1)035(2)S	CWR11MH104(1)(2)	0.5	4.0	24.0
0.15	A	T492A154(1)035(2)S	CWR11MH154(1)(2)	0.5	4.0	21.0
0.22	A	T492A224(1)035(2)S	CWR11MH224(1)(2)	0.5	4.0	18.0
0.33	A	T492A334(1)035(2)S	CWR11MH334(1)(2)	0.5	4.0	15.0
0.47	B	T492B474(1)035(2)S	CWR11MH474(1)(2)	0.5	4.0	10.0
0.68	B	T492B684(1)035(2)S	CWR11MH684(1)(2)	0.5	4.0	8.0
1.0	B	T492B105(1)035(2)S	CWR11MH105(1)(2)	0.5	4.0	6.5
1.5	C	T492C155(1)035(2)S	CWR11MH155(1)(2)	0.5	6.0	4.5
2.2	C	T492C225(1)035(2)S	CWR11MH225(1)(2)	0.8	6.0	3.5
3.3	C	T492C335(1)035(2)S	CWR11MH335(1)(2)	1.2	6.0	2.5
4.7	D	T492D475(1)035(2)S	CWR11MH475(1)(2)	1.7	6.0	1.5

To complete Part Numbers:
(1) Insert "M" for ±20% tolerance, "K" for ±10% tolerance or "J" for ±5% tolerance.
(2) Insert Failure Rate Symbol: B (0.1%/1000 hours), C (0.01%/1000 hours) or D (0.001%/1000 hours).

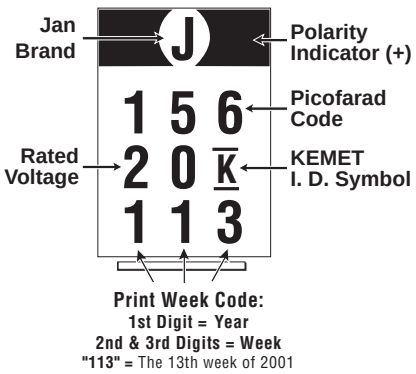
CONSTRUCTION



*Termination Solder Coating 90 Sn/10Pb

CAPACITOR MARKINGS

T492 Series — All Case Sizes



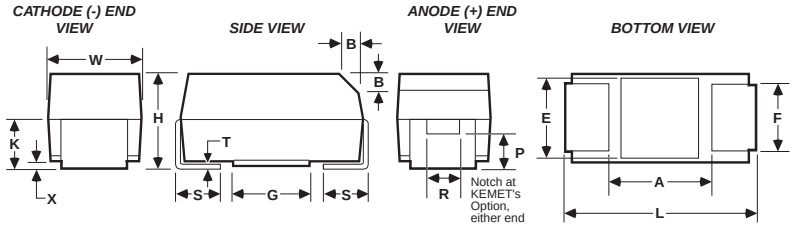
Print Week Code:
1st Digit = Year
2nd & 3rd Digits = Week
"113" = The 13th week of 2001

Note on Failure Rates: *Exponential failure rate levels M, P, R and S are inactive for new design per MIL-C-55365. Parts qualified to Weibull failure rate levels are substitutable for exponential failure rate levels.*
Note: ESR limits are per Mil-C-55365/8

FEATURES

- Low ESR values in EIA 535BAAC sizes
- Taped and Reeled per EIA 481-1
- Symmetrical, Compliant Terminations
- Optional Gold-plated Terminations
- Laser-marked Case
- 100% Surge Current test on C, D, E, U, V, X sizes
- Capacitance: 0.1 µF to 1000 µF
- Tolerance: ±10%, ±20%
- Voltage: 3-50 VDC
- Extended Range Values
- New Low Profile Case Sizes

CAPACITOR OUTLINE DRAWING



STANDARD T494 DIMENSIONS
Millimeters (inches)

CASE SIZE		COMPONENT													
KEMET	EIA	L*	W*	H*	K* ±0.20 ±(.008)	F* ±0.1 ±(.004)	S* ±0.3 ±(.012)	B ±0.15 (Ref) ±(.006)	X (Ref)	P (Ref)	R (Ref)	T (Ref)	A (Min)	G (Ref)	E (Ref)
A	3216-18	3.2 ± 0.2 (.126 ± .008)	1.6 ±0.2 (.063 ±.008)	1.6 ± 0.2 (.063 ± .008)	0.9 (.035)	1.2 (.047)	0.8 (.031)	0.4 (.016)	0.10 ± 0.10 (.004 ± .004)	0.4 (.016)	0.4 (.016)	0.13 (.005)	0.8 (.031)	1.1 (.043)	1.3 (.051)
B	3528-21	3.5 ± 0.2 (.138 ± .008)	2.8 ± 0.2 (.110 ± .008)	1.9 ± 0.2 (.075 ± .008)	1.1 (.043)	2.2 (.087)	0.8 (.031)	0.4 (.016)	0.10 ± 0.10 (.004 ± .004)	0.5 (.020)	1.0 (.039)	0.13 (.005)	1.1 (.043)	1.8 (.071)	2.2 (.087)
C	6032-28	6.0 ± 0.3 (.236 ± .012)	3.2 ± 0.3 (.126 ± .012)	2.5 ± 0.3 (.098 ± .012)	1.4 (.055)	2.2 (.087)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	0.9 (.035)	1.0 (.039)	0.13 (.005)	2.5 (.098)	2.8 (.110)	2.4 (.094)
D	7343-31	7.3 ± 0.3 (.287 ± .012)	4.3 ± 0.3 (.169 ± .012)	2.8 ± 0.3 (.110 ± .012)	1.5 (.059)	2.4 (.094)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	0.9 (.035)	1.0 (.039)	0.13 (.005)	3.8 (.150)	3.5 (.138)	3.5 (.138)
X	7343-43	7.3 ± 0.3 (.287 ± .012)	4.3 ± 0.3 (.169 ± .012)	4.0 ± 0.3 (.157 ± .012)	2.3 (.091)	2.4 (.094)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	1.7 (.067)	1.0 (.039)	0.13 (.005)	3.8 (.150)	3.5** (.138)	3.5** (.138)
E	7260-38	7.3 ± 0.3 (.287 ± .012)	6.0 ± 0.3 (.236 ± .012)	3.6 ± 0.2 (.142 ± .008)	2.3 (.091)	4.1 (.161)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	0.9 (.035)	1.0 (.039)	0.13 (.005)	3.8 (.150)	3.5 (.138)	3.5 (.138)

Notes: 1. Metric dimensions govern.
2. (Ref) - Dimensions provided for reference only.
* Mil-C-55365/8 Specified Dimensions
** Round Glue Pad: 2.9 ±0.1mm (0.114" ±0.004") in diameter at KEMET's option

LOW PROFILE T494 DIMENSIONS
Millimeters (inches)

CASE SIZE		COMPONENT										
KEMET	EIA	L	W	H Max.	K Min.	F ± 0.1	S ± 0.3	X (Ref	T (Ref)	A (Min)	G (Ref)	E (Ref)
R	2012-12	2.0 ± 0.2 (.079 ± .008)	1.3 ± 0.2 (.051 ± .008)	1.2 (.047)	0.3 (.012)	0.9 (.035)	0.5 (.020)	0.05 (.002)	0.13 (.005)	0.8 (.031)	0.5 (.020)	0.8 (.031)
S	3216-12	3.2 ± 0.2 (.126 ± .008)	1.6 ± 0.2 (.063 ± .008)	1.2 (.047)	0.3 (.012)	1.2 (.047)	0.8 (.031)	0.05 (.002)	0.13 (.005)	0.8 (.031)	1.1 (.043)	1.3 (.051)
T	3528-12	3.5 ± 0.2 (.138 ± .008)	2.8 ± 0.2 (.110 ± .008)	1.2 (.047)	0.3 (.012)	2.2 (.087)	0.8 (.031)	0.05 (.002)	0.13 (.005)	1.1 (.043)	1.8 (.071)	2.2 (.087)
U	6032-15	6.0 ± 0.3 (.236 ± .012)	3.2 ± 0.3) (.126 ± .012)	1.5 (0.059)	0.5 (0.020)	2.2 (.087)	1.3 (.051)	0.05 (.002)	0.13 (.005)	2.5 (.098)	2.8 (.110)	2.4 (.094)
V	7343-20	7.3 ± 0.3 (.287 ± .012)	4.3 ± 0.3 (.169 ± .012)	2.0 (0.079)	1.1 (0.043)	2.4 (.094)	1.3 (.051)	0.05 (.002)	0.13 (.005)	3.8 (.150)	3.5 (.138)	3.5 (.138)

Notes: 1. Metric dimensions govern.
2. (Ref) - Dimensions provided for reference only.
3. No dimensions provided for B, P or R because low profile cases do not have a bevel or a notch.

T494 ORDERING INFORMATION

T 494 B 105 M 035 A S*

Tantalum

Series
T494 - Low ESR, Industrial Grade

Case Size
A, B, C, D, E, R, S, T, U, V, X

Capacitance Picofarad Code
First two digits represent significant figures.
Third digit specifies number of zeros to follow.

***Part number example: T494B105M035AS (14 digits - no spaces)**

Capacitance Tolerance
M - ± 20%
K - ±10%

Voltage

Failure Rate
A - Not Applicable

Lead Material
S - Standard Solder -Coated (90% Sn/10% Pb)
G - Gold Plated (A, B, C, D, X only)
T - 100% Tin (Sn) Plated and Reflowed

T494 RATINGS & PART NUMBER REFERENCE

Capacitance µF	Case Size	KEMET Part Number	DC Leakage µA @ 25°C Max	DF % @ +25°C 120 Hz Max	ESR Ω @ +25°C 100 kHz Max
3 Volt Rating at +85 °C (2 Volt Rating at +125 °C)					
#33.0	*A	T494A336(1)003AS	1.0	6.0	2.0
4 Volt Rating at +85 °C (2.7 Volt Rating at +125 °C)					
3.3	A	T494A335(1)004AS	0.5	6.0	4.0
4.7	A	T494A475(1)004AS	0.5	6.0	3.5
6.8	A	T494A685(1)004AS	0.5	6.0	3.0
6.8	S	T494S685(1)004AS	0.5	6.0	7.0
10.0	B	T494B106(1)004AS	0.5	6.0	1.2
10.0	A	T494A106(1)004AS	0.5	6.0	2.0
#10.0	*S	T494S106(1)004AS	0.5	6.0	9.0
#10.0	*R	T494R106M004AS	0.5	8.0	6.0
15.0	B	T494B156(1)004AS	0.6	6.0	1.2
15.0	A	T494A156(1)004AS	0.6	6.0	1.5
15.0	T	T494T156(1)004AS	0.6	6.0	2.0
#15.0	*S	T494S156M004AS	0.6	10.0	9.0
22.0	C	T494C226(1)004AS	0.9	6.0	0.5
22.0	B	T494B226(1)004AS	0.9	6.0	0.6
#22.0	*A	T494A226(1)004AS	0.9	6.0	1.5
#22.0	*T	T494T226(1)004AS	0.9	6.0	2.5
33.0	C	T494C336(1)004AS	1.3	6.0	0.5
33.0	U	T494U336(1)004AS	1.3	6.0	0.6
33.0	B	T494B336(1)004AS	1.3	6.0	0.5
#33.0	*A	T494A336(1)004AS	1.3	6.0	3.0
#33.0	*T	T494T336M004AS	1.3	8.0	3.5
47.0	C	T494C476(1)004AS	1.9	6.0	0.5
47.0	U	T494U476(1)004AS	1.9	6.0	0.6
#47.0	*B	T494B476(1)004AS	1.9	6.0	0.5
#47.0	*A	T494A476M004AS	1.9	12.0	2.0
68.0	D	T494D686(1)004AS	2.7	6.0	0.20
68.0	C	T494C686(1)004AS	2.7	6.0	0.25
#68.0	*U	T494U686(1)004AS	2.7	6.0	0.60
#68.0	*B	T494B686(1)004AS	2.7	6.0	2.00
100.0	D	T494D107(1)004AS	4.0	8.0	0.20
#100.0	*C	T494C107(1)004AS	4.0	8.0	0.20
#100.0	*U	T494U107(1)004AS	4.0	10.0	1.00
150.0	D	T494D157(1)004AS	6.0	8.0	0.15
150.0	V	T494V157(1)004AS	6.0	8.0	0.20
#150.0	*C	T494C157(1)004AS	6.0	8.0	0.30
#220.0	*V	T494V227(1)004AS	8.8	8.0	0.30
#330.0	*D	T494D337(1)004AS	13.2	8.0	0.15
#330.0	*V	T494V337M004AS	13.2	12.0	0.30
#470.0	*X	T494X477(1)004AS	18.8	8.0	0.15
#470.0	*D	T494D477(1)004AS	18.8	8.0	0.15
#680.0	*X	T494X687M004AS	27.2	12.0	0.10
#1000.0	*E	T494E108M004AS	40.0	15.0	0.08
6 Volt Rating at +85 °C (4 Volt Rating at +125 °C)					
2.2	A	T494A225(1)006AS	0.5	6.0	6.0
3.3	A	T494A335(1)006AS	0.5	6.0	6.0
4.7	A	T494A475(1)006AS	0.5	6.0	3.5
4.7	S	T494S475(1)006AS	0.5	6.0	8.0
6.8	B	T494B685(1)006AS	0.5	6.0	1.2
6.8	A	T494A685(1)006AS	0.5	6.0	2.0
#6.8	*S	T494S685(1)006AS	0.5	6.0	9.0
10.0	B	T494B106(1)006AS	0.6	6.0	1.0
10.0	A	T494A106(1)006AS	0.6	6.0	2.0
10.0	T	T494T106(1)006AS	0.6	6.0	1.2
#10.0	*S	T494S106M006AS	0.6	10.0	9.0
#10.0	*R	T494R106M006AS	0.6	8.0	6.0
15.0	C	T494C156(1)006AS	0.9	6.0	0.6
15.0	B	T494B156(1)006AS	0.9	6.0	0.7
#15.0	*A	T494A156(1)006AS	0.9	6.0	2.0
#15.0	*T	T494T156(1)006AS	0.9	6.0	2.5
22.0	C	T494C226(1)006AS	1.4	6.0	0.5
22.0	U	T494U226(1)006AS	1.4	6.0	0.8
22.0	B	T494B226(1)006AS	1.4	6.0	0.6
#22.0	*A	T494A226(1)006AS	1.4	6.0	3.0
#22.0	*T	T494T226M006AS	1.4	8.0	3.5
33.0	C	T494C336(1)006AS	2.0	6.0	0.3
33.0	U	T494U336(1)006AS	2.0	6.0	0.6
#33.0	*B	T494B336(1)006AS	2.0	6.0	0.6
#33.0	*A	T494A336M006AS	2.0	12.0	2.0
47.0	D	T494D476(1)006AS	2.9	6.0	0.22
47.0	C	T494C476(1)006AS	2.9	6.0	0.25
#47.0	*U	T494U476(1)006AS	2.9	6.0	0.60
#47.0	*B	T494B476(1)006AS	2.9	6.0	2.00
68.0	D	T494D686(1)006AS	4.1	6.0	0.20
#68.0	*C	T494C686(1)006AS	4.1	6.0	0.20
#68.0	*U	T494U686(1)006AS	4.1	10.0	1.00
100.0	D	T494D107(1)006AS	6.0	8.0	0.15
100.0	V	T494V107(1)006AS	6.0	8.0	0.20
#100.0	*C	T494C107(1)006AS	6.0	8.0	0.30
150.0	D	T494D157(1)006AS	9.0	8.0	0.15
#150.0	*C	T494C157M006AS	9.0	8.0	0.30
#150.0	*V	T494V157(1)006AS	9.0	8.0	0.30

(1) To complete KEMET Part Number, insert M for ±20% tolerance or K for ±10% tolerance.

Capacitance µF	Case Size	KEMET Part Number	DC Leakage µA @ 25°C Max	DF % @ +25°C 120 Hz Max	ESR Ω @ +25°C 100 kHz Max
6 Volt Rating at +85 °C (4 Volt Rating at +125 °C) cont'd.					
220.0	X	T494X227(1)006AS	13.2	8.0	0.15
#220.0	*D	T494D227(1)006AS	13.2	8.0	0.15
#220.0	*V	T494V227M006AS	13.2	12.0	0.3
#330.0	*X	T494X337(1)006AS	19.8	8.0	0.15
#330.0	*D	T494D337(1)006AS	19.8	8.0	0.15
#470.0	*X	T494X477(1)006AS	28.2	10.0	0.10
10 Volt Rating at +85 °C (7 Volt Rating at +125 °C)					
1.5	A	T494A155(1)010AS	0.5	6.0	6.0
2.2	A	T494A225(1)010AS	0.5	6.0	6.0
3.3	A	T494A335(1)010AS	0.5	6.0	4.0
3.3	S	T494S335(1)010AS	0.5	6.0	9.0
4.7	B	T494B475(1)010AS	0.5	6.0	1.5
4.7	A	T494A475(1)010AS	0.5	6.0	3.0
#4.7	*S	T494S475(1)010AS	0.5	6.0	9.0
#4.7	*R	T494R475M010AS	0.5	8.0	8.0
6.8	B	T494B685(1)010AS	0.7	6.0	1.2
6.8	A	T494A685(1)010AS	0.7	6.0	3.0
6.8	T	T494T685(1)010AS	0.7	6.0	2.0
#6.8	*S	T494S685M010AS	0.7	10.0	9.0
10.0	C	T494C106(1)010AS	1.0	6.0	0.6
10.0	B	T494B106(1)010AS	1.0	6.0	0.8
#10.0	*A	T494A106(1)010AS	1.0	6.0	2.0
#10.0	*T	T494T106(1)010AS	1.0	6.0	3.5
15.0	C	T494C156(1)010AS	1.5	6.0	0.5
15.0	U	T494U156(1)010AS	1.5	6.0	0.8
15.0	B	T494B156(1)010AS	1.5	6.0	0.7
#15.0	*A	T494A156(1)010AS	1.5	8.0	4.0
#15.0	*T	T494T156M010AS	1.5	8.0	3.5
22.0	C	T494C226(1)010AS	2.2	6.0	0.4
22.0	U	T494U226(1)010AS	2.2	6.0	0.8
#22.0	*B	T494B226(1)010AS	2.2	6.0	0.7
33.0	D	T494D336(1)010AS	3.3	6.0	0.25
33.0	V	T494V336(1)010AS	3.3	6.0	0.30
33.0	C	T494C336(1)010AS	3.3	6.0	0.30
#33.0	*U	T494U336(1)010AS	3.3	6.0	0.60
#33.0	*B	T494B336(1)010AS	3.3	6.0	2.00
47.0	D	T494D476(1)010AS	4.7	6.0	0.22
47.0	V	T494V476(1)010AS	4.7	6.0	0.30
#47.0	*C	T494C476(1)010AS	4.7	6.0	0.30
#47.0	*U	T494U476(1)010AS	4.7	10.0	1.20
68.0	D	T494D686(1)010AS	6.8	6.0	0.20
#68.0	*C	T494C686(1)010AS	6.8	6.0	0.30
68.0	V	T494V686(1)010AS	6.8	6.0	0.30
100.0	D	T494D107(1)010AS	10.0	8.0	0.15
#100.0	*C	T494C107(1)010AS	10.0	8.0	0.30
#100.0	*V	T494V107(1)010AS	10.0	8.0	0.40
150.0	X	T494X157(1)010AS	15.0	8.0	0.15
#150.0	*D	T494D157(1)010AS	15.0	8.0	0.15
#220.0	*X	T494X227(1)010AS	22.0	8.0	0.15
#220.0	*D	T494D227(1)010AS	22.0	8.0	0.15
#330.0	X	T494X337(1)010AS	33.0	10.0	0.10
16 Volt Rating at +85 °C (10 Volt Rating at +125 °C)					
1.0	A	T494A105(1)016AS	0.5	4.0	6.0
1.5	A	T494A155(1)016AS	0.5	6.0	6.0
2.2	A	T494A225(1)016AS	0.5	6.0	4.0
2.2	S	T494S225(1)016AS	0.5	6.0	10.0
#2.2	*R	T494R225M016AS	0.5	8.0	20.0
3.3	B	T494B335(1)016AS	0.5	6.0	2.0
3.3	A	T494A335(1)016AS	0.5	6.0	4.0
4.7	B	T494B475(1)016AS	0.8	6.0	1.5
4.7	A	T494A475(1)016AS	0.8	6.0	3.0
4.7	T	T494T475(1)016AS	0.8	6.0	3.0
6.8	C	T494C685(1)016AS	1.1	6.0	0.8
6.8	B	T494B685(1)016AS	1.1	6.0	1.2
#6.8	*A	T494A685(1)016AS	1.1	6.0	3.0
10.0	C	T494C106(1)016AS	1.6	6.0	0.6
10.0	U	T494U106(1)016AS	1.6	6.0	1.0
10.0	B	T494B106(1)016AS	1.6	6.0	0.8
15.0	C	T494C156(1)016AS	2.4	6.0	0.4
15.0	U	T494U156(1)016AS	2.4	6.0	0.8
#15.0	*B	T494B156(1)016AS	2.4	6.0	0.8
22.0	D	T494D226(1)016AS	3.6	6.0	0.25
22.0	C	T494C226(1)016AS	3.6	6.0	0.35
#22.0	*U	T494U226(1)016AS	3.5	10.0	1.80
#22.0	*B	T494B226(1)016AS	3.5	6.0	1.00

Higher voltage ratings, lower ESR, and tighter capacitance tolerance product may be substituted within the same size at KEMET's option. Voltage substitutions will be marked with the higher voltage rating.
***Extended Values** ****6 Volt product equivalent to 6.3 volt product.**

T494 RATINGS & PART NUMBER REFERENCE

Capacitance µF	Case Size	KEMET Part Number	DC Leakage µA @ 25°C Max	DF % @ +25°C 120 Hz Max	ESR Ω @ +25°C 100 kHz Max
16 Volt Rating at +85°C (10 Volt Rating at +125°C) cont'd.					
33.0	D	T494D336(1)016AS	5.3	6.0	0.25
#33.0	*C	T494C336(1)016AS	5.3	6.0	0.30
#33.0	*U	T494U336(1)016AS	5.3	12.0	2.20
47.0	D	T494D476(1)016AS	7.5	6.0	0.20
47.0	V	T494V476(1)016AS	7.5	6.0	0.30
#47.0	*C	T494C476(1)016AS	7.5	6.0	0.50
68.0	*D	T494D686(1)016AS	10.9	6.0	0.15
100.0	X	T494X107(10)16AS	16.0	8.0	0.15
#100.0	*D	T494D107(1)016AS	16.0	8.0	0.15
#150.0	*X	T494X157(1)016AS	24.0	8.0	0.15
20 Volt Rating at +85°C (13 Volt Rating at +125°C)					
0.68	A	T494A684(1)020AS	0.5	4.0	8.0
1.0	A	T494A105(1)020AS	0.5	4.0	5.5
1.0	S	T494S105(1)020AS	0.5	6.0	10.0
1.5	A	T494A155(1)020AS	0.5	6.0	4.5
1.5	S	T494S155(1)020AS	0.5	6.0	9.0
2.2	B	T494B225(1)020AS	0.5	6.0	1.5
2.2	A	T494A225(1)020AS	0.5	6.0	4.0
3.3	B	T494B335(1)020AS	0.7	6.0	1.3
#3.3	*A	T494A335(1)020AS	0.7	6.0	4.0
3.3	T	T494T335(1)020AS	0.7	6.0	4.0
4.7	C	T494C475(1)020AS	1.0	6.0	0.6
4.7	B	T494B475(1)020AS	1.0	6.0	1.0
6.8	C	T494C685(1)020AS	1.4	6.0	0.6
6.8	U	T494U685(1)020AS	1.4	6.0	1.4
#6.8	*B	T494B685(1)020AS	1.4	6.0	1.0
10.0	C	T494C106(1)020AS	2.0	6.0	0.5
10.0	U	T494U106(1)020AS	2.0	6.0	0.8
#10.0	*B	T494B106(1)020AS	2.0	6.0	1.0
15.0	D	T494D156(1)020AS	3.0	6.0	0.35
15.0	*C	T494C156(1)020AS	3.0	6.0	0.40
22.0	D	T494D226(1)020AS	4.4	6.0	0.30
22.0	V	T494V226(1)020AS	4.4	6.0	0.40
#22.0	*C	T494C226(1)020AS	4.4	6.0	0.40
33.0	D	T494D336(1)020AS	6.6	6.0	0.25
#33.0	*C	T494C336M020AS	6.6	6.0	0.4
47.0	*D	T494D476(1)020AS	9.4	6.0	0.20
68.0	X	T494X686(1)020AS	13.6	6.0	0.20
#68.0	*D	T494D686(1)020AS	13.6	8.0	0.20
#100.0	*X	T494X107(1)020AS	20.0	8.0	0.15
25 Volt Rating at +85°C (17 Volt Rating at +125°C)					
0.33	A	T494A334(1)025AS	0.5	4.0	10.0
0.47	A	T494A474(1)025AS	0.5	4.0	9.0
0.68	A	T494A684(1)025AS	0.5	4.0	6.0
1.0	B	T494B105(1)025AS	0.5	4.0	2.0
1.0	*A	T494A105(1)025AS	0.5	4.0	4.0
1.5	B	T494B155(1)025AS	0.5	6.0	1.5
1.5	*A	T494A155(1)025AS	0.5	6.0	5.0
2.2	C	T494C225(1)025AS	0.6	6.0	2.2
2.2	B	T494B225(1)025AS	0.6	6.0	1.2
3.3	C	T494C335(1)025AS	0.9	6.0	1.2
3.3	*B	T494B335(1)025AS	0.9	6.0	2.0

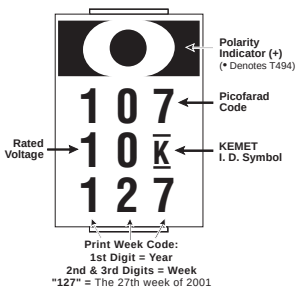
(1) To complete KEMET Part Number, insert M for ±20% tolerance or K for ±10% tolerance.

Higher voltage ratings, lower ESR, and tighter capacitance tolerance product may be substituted within the same size at KEMET's option. Voltage substitutions will be marked with the higher voltage rating.

Capacitance µF	Case Size	KEMET Part Number	DC Leakage µA @ 25°C Max	DF % @ +25°C 120 Hz Max	ESR Ω @ +25°C 100 kHz Max
25 Volt Rating at +85°C (17 Volt Rating at +125°C) cont'd					
4.7	C	T494C475(1)025AS	1.2	6.0	0.6
#4.7	*B	T494B475M025AS	1.2	6.0	1.0
6.8	C	T494C685(1)025AS	1.7	6.0	0.6
10.0	D	T494D106(1)025AS	2.5	6.0	0.4
10.0	*C	T494C106(1)025AS	2.5	6.0	0.6
15.0	D	T494D156(1)025AS	3.8	6.0	0.35
#15.0	*C	T494C156(1)025AS	3.8	6.0	0.90
22.0	D	T494D226(1)025AS	5.5	6.0	0.30
22.0	*V	T494V226(1)025AS	5.5	6.0	0.50
33.0	X	T494X336(1)025AS	8.3	6.0	0.30
#33.0	*D	T494D336(1)025AS	8.3	6.0	0.40
#47.0	*X	T494X476(1)025AS	11.8	6.0	0.30
35 Volt Rating at +85°C (23 Volt Rating at +125°C)					
0.10	A	T494A104(1)035AS	0.5	4.0	10.0
0.15	A	T494A154(1)035AS	0.5	4.0	6.0
0.22	A	T494A224(1)035AS	0.5	4.0	6.0
0.33	A	T494A334(1)035AS	0.5	4.0	6.0
0.47	B	T494B474(1)035AS	0.5	4.0	2.5
0.47	A	T494A474(1)035AS	0.5	4.0	4.0
0.68	B	T494B684(1)035AS	0.5	4.0	2.5
0.68	*A	T494A684(1)035AS	0.5	4.0	6.0
1.0	B	T494B105(1)035AS	0.5	4.0	2.0
1.0	*A	T494A105(1)035AS	0.5	4.0	6.0
1.5	C	T494C155(1)035AS	0.5	6.0	2.5
1.5	B	T494B155(1)035AS	0.5	6.0	3.0
2.2	C	T494C225(1)035AS	0.8	6.0	1.5
2.2	*B	T494B225(1)035AS	0.8	6.0	2.5
3.3	C	T494C335(1)035AS	1.2	6.0	0.8
4.7	D	T494D475(1)035AS	1.7	6.0	0.7
4.7	C	T494C475(1)035AS	1.7	6.0	0.7
6.8	D	T494D685(1)035AS	2.4	6.0	0.5
6.8	*C	T494C685(1)035AS	2.4	6.0	0.9
10.0	D	T494D106(1)035AS	3.5	6.0	0.4
#10.0	*C	T494C106M035AS	3.5	6.0	1.2
#10.0	*V	T494V106(1)035AS	3.5	6.0	0.8
15.0	X	T494X156(1)035AS	5.3	6.0	0.30
15.0	*D	T494D156(1)035AS	5.3	6.0	0.35
#22.0	X	T494X226(1)035AS	7.7	6.0	0.30
22.0	*D	T494D226M035AS	7.7	6.0	0.40
#33.0	*X	T494X336(1)035AS	11.6	6.0	0.30
50 Volt Rating at +85°C (33 Volt Rating at +125°C)					
0.10	A	T494A104(1)050AS	0.5	4.0	10.0
0.15	B	T494B154(1)050AS	0.5	4.0	10.0
0.15	*A	T494A154(1)050AS	0.5	4.0	10.0
0.22	B	T494B224(1)050AS	0.5	4.0	10.0
0.33	B	T494B334(1)050AS	0.5	4.0	2.5
0.47	C	T494C474(1)050AS	0.5	4.0	1.8
0.47	*B	T494B474(1)050AS	0.5	4.0	2.0
0.68	C	T494C684(1)050AS	0.5	4.0	1.6
0.68	*B	T494B684(1)050AS	0.5	4.0	3.0
1.0	C	T494C105(1)050AS	0.5	4.0	1.6
#1.0	*V	T494V105M050AS	0.5	4.0	4.0
1.5	D	T494D155(1)050AS	0.8	6.0	1.0
1.5	*C	T494C155(1)050AS	0.8	6.0	1.5
2.2	D	T494D225(1)050AS	1.1	6.0	0.8
2.2	*C	T494C225(1)050AS	1.1	6.0	1.5
3.3	D	T494D335(1)050AS	1.7	6.0	0.8
4.7	D	T494D475(1)050AS	2.4	6.0	0.6
6.8	X	T494X685(1)050AS	3.5	6.0	0.5

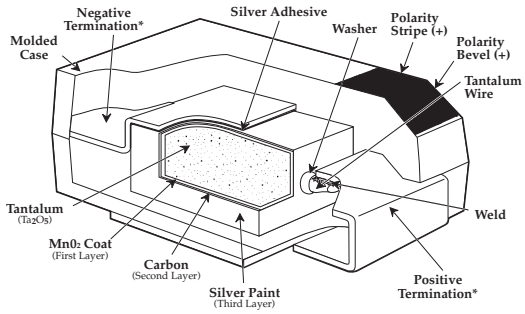
***Extended Values** ****6 Volt product equivalent to 6.3 volt product.**
#Maximum Capacitance Change @ 125°C=+15%. (All others = +12%)

CAPACITOR MARKINGS
T494 Series — All Case Sizes



Print Week Code:
1st Digit = Year
2nd & 3rd Digits = Week
"127" = The 27th week of 2001

CONSTRUCTION



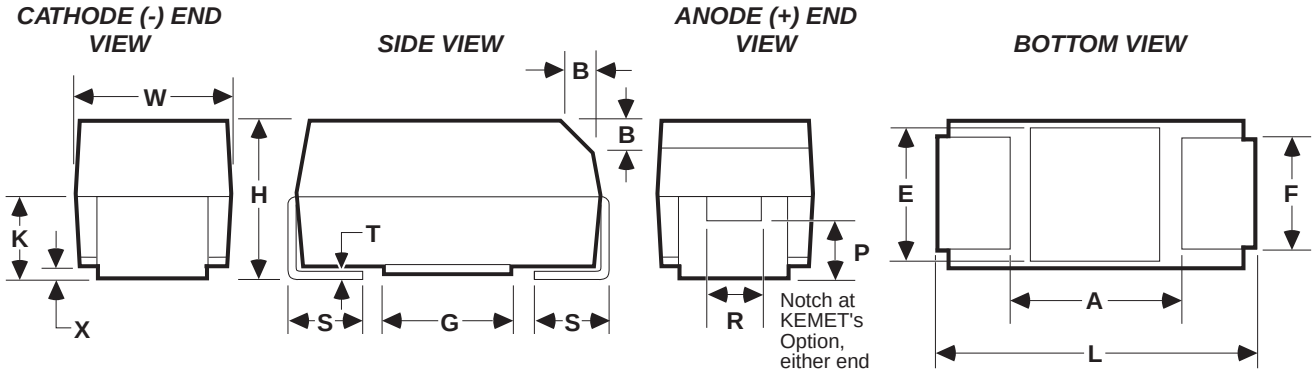
*Termination Solder Coating 90 Sn/10Pb

Solid Tantalum Surface Mount

FEATURES

- Designed for very low ESR
- High ripple current capability
- High surge current capability
- 100% accelerated steady-state aging
- 100% Surge Current test
- New Extended Values for Low ESR
- Low Equivalent Series Inductance (<2.5nH ESL)
- Precision-molded, laser-marked case
- Symmetrical, compliant terminations
- Taped and reeled per EIA 481-1

OUTLINE DRAWING



STANDARD T495 DIMENSIONS

Millimeters (Inches)

CASE SIZE		COMPONENT													
KEMA	EIA	L	W	H	K ±0.20 ±(.008)	F ±0.1 ±(.004)	S ±0.3 ±(.012)	B ±0.15 (Ref) ±(.006)	X (Ref)	P (Ref)	R (Ref)	T (Ref)	A (Min)	G (Ref)	E (Ref)
C	6032-28	6.0 ± 0.3 (.236 ± .012)	3.2 ± 0.3 (.126 ± .012)	2.5 ± 0.3 (.098 ± .012)	1.4 (.055)	2.2 (.087)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	0.9 (.035)	1.0 (.039)	0.13 (.005)	2.5 (.098)	2.8 (.110)	2.4 (.094)
D	7343-31	7.3 ± 0.3 (.287 ± .012)	4.3 ± 0.3 (.169 ± .012)	2.8 ± 0.3 (.110 ± .012)	1.5 (.059)	2.4 (.094)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	0.9 (.035)	1.0 (.039)	0.13 (.005)	3.8 (.150)	3.5 (.138)	3.5 (.138)
X	7343-43	7.3 ± 0.3 (.287 ± .012)	4.3 ± 0.3 (.169 ± .012)	4.0 ± 0.3 (.157 ± .012)	2.3 (.091)	2.4 (.094)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	1.7 (.067)	1.0 (.039)	0.13 (.005)	3.8 (.150)	3.5* (.138)	3.5* (.138)

Notes: 1. Metric dimensions govern.
2. (Ref) - Dimensions provided for reference only.
* Round Glue Pad; 2.9 ±0.1mm (0.114" ±0.004") in diameter at KEMET's option.

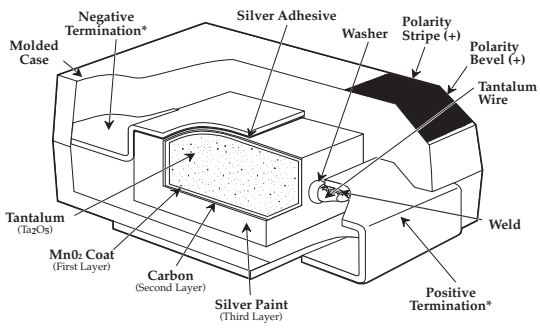
LOW PROFILE T495 DIMENSIONS

Millimeters (Inches)

CASE SIZE		COMPONENT										
KEMET	EIA	L	W	H Max.	K Min.	F ± 0.1	S ± 0.3	X (Ref	T (Ref)	A (Min)	G (Ref)	E (Ref)
V	7343-20	7.3 ± 0.3 (.287 ± .012)	4.3 ± 0.3 (.169 ± .012)	2.0 (0.079)	1.1 (0.043)	2.4 (.094)	1.3 (.051)	0.05 (.002)	0.13 (.005)	3.8 (.150)	3.5 (.138)	3.5 (.138)

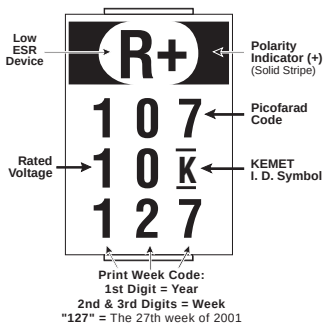
Notes: 1. Metric dimensions govern.
2. (Ref) - Dimensions provided for reference only.
3. No dimensions provided for B, P or R because low profile cases do not have a bevel or a notch.

CONSTRUCTION



*Termination Solder Coating 90 Sn/10Pb

CAPACITOR MARKINGS



T495 RATINGS & PART NUMBER REFERENCE

Cap. µF	Case Size	KEMET Part Number	DC Leakage µA @ 25°C Max	DF % @ 25°C 120Hz Max	ESR mΩ @ 25°C 100 kHz Max	Ripple Current mA rms at 25°C 100 kHz, max 25°C	85°C	125°C
6/6.3 Volt Rating @ +85°C (4 Volt Rating at +125°C)								
68.0	D	T495D686(1)006AS	3.3	4.0	175	926	833	370
100.0	*C	T495C107(1)006AS	6.0	8.0	150	856	770	342
100.0	*V	T495V107(1)006AS	6.0	8.0	150	913	822	365
150.0	X	T495X157(1)006AS	7.2	6.0	100	1285	1156	514
220.0	*D	T495D227(1)006AS	13.2	8.0	100	1225	1102	490
220.0	*X	T495X227(1)006AS	13.2	8.0	100	1285	1156	514
330.0	*X	T495X337(1)006AS	19.8	8.0	100	1285	1156	514
330.0	*X	T495X337(1)006AS 4823	19.8	8.0	65	1593	1434	637
470.0	*X	T495X477(1)006AS	28.2	10.0	65	1593	1434	637
470.0	*X	T495X477(1)006AS 4823	28.2	10.0	50	1816	1634	726
10 Volt Rating @ +85°C (7 Volt Rating at +125°C)								
22.0	C	T495C226(1)010AS	2.2	6.0	345	565	508	226
47.0	D	T495D476(1)010AS	3.8	4.0	200	866	780	346
68.0	*C	T495C686(1)010AS	6.8	6.0	225	700	630	280
68.0	*V	T495V686(1)010AS	6.8	6.0	140	945	850	378
68.0	D	T495D686(1)010AS	6.8	6.0	150	1000	900	400
68.0	X	T495X686(1)010AS	5.4	4.0	150	1049	944	420
100.0	*V	T495V107(1)010AS	10.0	8.0	150	913	822	365
100.0	*D	T495D107(1)010AS	10.0	8.0	100	1225	1102	490
100.0	*D	T495D107(1)010AS 4823	10.0	8.0	80	1369	1232	548
100.0	X	T495X107(1)010AS	8.0	6.0	100	1285	1156	514
150.0	*D	T495D157(1)010AS	15.0	8.0	100	1225	1102	490
150.0	*X	T495X157(1)010AS	15.0	8.0	100	1285	1156	514
150.0	*X	T495X157(1)010AS 4823	15.0	8.0	85	1393	1254	557
220.0	*X	T495X227(1)010AS	22.0	8.0	100	1285	1156	514
220.0	*X	T495X227(1)010AS 4823	22.0	8.0	70	1535	1382	614
16 Volt Rating @ +85°C (10 Volt Rating at +125°C)								
33.0	*C	T495C336(1)016AS	5.3	6.0	275	632	569	253
33.0	D	T495D336(1)016AS	4.2	4.0	225	816	735	326
47.0	*D	T495D476(1)016AS	7.5	6.0	150	1000	900	400
100.0	*D	T495D107(1)016AS	16.0	8.0	125	1095	986	438
100.0	*X	T495X107(1)016AS	16.0	8.0	100	1285	1156	514
100.0	*X	T495X107(1)016AS 4823	16.0	8.0	80	1436	1293	574
20 Volt Rating @ +85°C (13 Volt Rating at +125°C)								
15.0	D	T495D156(1)020AS	2.4	4.0	275	738	665	295
22.0	D	T495D226(1)020AS	3.5	4.0	225	816	735	326
33.0	*D	T495D336(1)020AS	6.6	6.0	200	866	780	346
47.0	X	T495X476(1)020AS	7.5	4.0	150	1049	944	420
68.0	*X	T495X686(1)020AS	13.6	6.0	150	1049	944	420
25 Volt Rating @ +85°C (17 Volt Rating at +125°C)								
6.8	C	T495C685(1)025AS	1.7	6.0	500	469	422	188
10.0	*C	T495C106(1)025AS	2.5	6.0	450	494	445	198
15.0	D	T495D156(1)025AS	3.8	6.0	275	738	665	295
15.0	X	T495X156(1)025AS	3.0	4.0	200	908	817	363
22.0	*D	T495D226(1)025AS	5.5	6.0	200	866	780	346
22.0	X	T495X226(1)025AS	4.4	4.0	225	856	771	343
33.0	X	T495X336(1)025AS	6.6	4.0	175	971	874	388
35 Volt Rating @ +85°C (23 Volt Rating at +125°C)								
4.7	*C	T495C475(1)035AS	1.7	6.0	600	428	385	171
6.8	X	T495X685(1)035AS	1.9	4.0	300	742	667	297
10.0	D	T495D106(1)035AS	3.5	6.0	300	707	636	283
10.0	X	T495X106(1)035AS	2.8	4.0	250	812	731	325
15.0	*D	T495D156(1)035AS	5.3	6.0	300	707	636	283
15.0	*X	T495X156(1)035AS	5.3	6.0	225	856	771	343
22.0	*X	T495X226(1)035AS	7.7	6.0	275	775	697	410
33.0	*X	T495X336(1)035AS	11.6	6.0	250	812	731	325
50 Volt Rating @ +85°C (33 Volt Rating at +125°C)								
4.7	X	T495X475(1)050AS	1.9	4.0	300	742	667	297

(1) To complete KEMET Part Number, insert M for ±20% or K for ±10% tolerance.

Higher voltage ratings and tighter capacitance tolerance product may be substituted within the same size at KEMET's option. Voltage substitutions will be marked with the higher voltage rating.

***Extended Values** ****6 Volt product equivalent to 6.3 volt product.**

T495 Series – ORDERING INFORMATION

T 495 X 107 M 010 A S*

Tantalum

Series
T495 - Low ESR, Surge Robust

Case Size
C, D, V, X

Capacitance Picofarad Code
First two digits represent significant figures.
Third digit specifies number of zeros to follow.

Capacitance Tolerance
M - ± 20%
K - ± 10%

Voltage

Failure Rate
A - Not Applicable

Lead Material
S - Standard Solder-Coated
G - Gold Plated

T495 TANTALUM CHIP CAPACITANCE VALUES

Case Size and Max. ESR (mΩ) by Capacitance & Voltage

Standard Capacitance Values

Capacitance		Rated Voltage @ +85°C						
µF	Code	6	10	16	20	25	35	50
4.7	475							X,300
6.8	685					C,500	X,300	
10.0	106						D,300 X,250	
15.0	156				D,275	D,275 X,200		
22.0	226		C,345		D,225	X,225		
33.0	336			D,225		X,175		
47.0	476		D,200		X,150			
68.0	686	D,175	D,150 X,150					
100.0	107		X,100					
150.0	157	X,100						
220.0	227							
330.0	337							

Extended Capacitance Values

Capacitance		Rated Voltage @ +85°C						
µF	Code	6	10	16	20	25	35	50
4.7	475						C,600	
6.8	685							
10.0	106					C,450		
15.0	156						D,300 X,225	
22.0	226					D,200	X,275	
33.0	336			C,275	D,200		X,250	
47.0	476			D,150				
68.0	686		C, 225 V, 140		X,150			
100.0	107	V,150 C,150	V, 150 D, 100 X, 80*	D, 125 X, 100 X, 80*				
150.0	157		D, 100 X, 100 X, 85*					
220.0	227	D,100 X,100	X,100 X,70*					
330.0	337	X,100 X,65*						
470.0	477	X,65 X,50*						

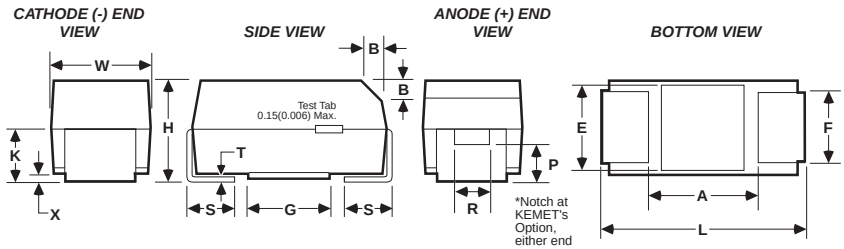
Note that standard values are preferred, especially where high surge currents are possible. Extended values are available to increase capacitance and reduce ESR. Note that standard CV values demonstrate inherently lower failure rates than extended CV values, especially in low impedance applications.

*** Super Low ESR limits available with part number suffix 4823.**

FEATURES

- Built-in fuse protects against damaging short circuit failure mode
- Precision-molded, laser-marked case
- Symmetrical, compliant terminations
- Taped and reeled per EIA 481-1
- Case geometry and footprints equivalent to Industrial Grade T491 Series. (Case sizes B, C, D and X only)
- 100% Surge Current test on C, D, X sizes
- Patented fuse assembly
- Fuse actuation, 25°C: within 1 second at fault currents of 4 amps and higher.
- Continuous current capability: 0.75 amps
- Post-actuation resistance, 25°C: 10 megohms minimum
- Test tabs on the sides of the case bypass the capacitor element to allow direct testing of the fuse assembly.

OUTLINE DRAWINGS



DIMENSIONS — Millimeters (Inches)

CASE SIZE		COMPONENT													
KEMET	EIA	L	W	H	K ± 0.20 ± (.008)	F ± 0.1 ± (.004)	S ± 0.3 ± (.012)	B ± 0.15 (Ref) ± (.006)	X (Ref)	P (Ref)	R (Ref)	T (Ref)	A (Min)	G (Ref)	E (Ref)
B	3528-21	3.5 ± 0.2 (.138 ± .008)	2.8 ± 0.2 (.110 ± .008)	1.9 ± 0.2 (.075 ± .008)	1.1 (.043)	2.2 (.087)	0.8 (.031)	0.4 (.016)	0.10 ± 0.10 (.004 ± .004)	0.5 (.020)	1.0 (.039)	0.13 (.005)	1.1 (.043)	1.8 (.071)	2.2 (.087)
C	6032-28	6.0 ± 0.3 (.236 ± .012)	3.2 ± 0.3 (.126 ± .012)	2.5 ± 0.3 (.098 ± .012)	1.4 (.055)	2.2 (.087)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	0.9 (.035)	1.0 (.039)	0.13 (.005)	2.5 (.098)	2.8 (.110)	2.4 (.094)
D	7343-31	7.3 ± 0.3 (.287 ± .012)	4.3 ± 0.3 (.169 ± .012)	2.8 ± 0.3 (.110 ± .012)	1.5 (.059)	2.4 (.094)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	0.9 (.035)	1.0 (.039)	0.13 (.005)	3.8 (.150)	3.5 (.138)	3.5 (.138)
X	7343-43	7.3 ± 0.3 (.287 ± .012)	4.3 ± 0.3 (.169 ± .012)	4.0 ± 0.3 (.157 ± .012)	2.3 (.091)	2.4 (.094)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	1.7 (.067)	1.0 (.039)	0.13 (.005)	3.8 (.150)	3.5* (.138)	3.5* (.138)

Notes: 1. Metric dimensions govern.
2. (Ref) - Dimensions provided for reference only.
* Round glue pad: 2.9 ± 0.1mm (.114" ± .004") in diameter at KEMET's option.

T496 Series – ORDERING INFORMATION

T 496 B 105 M 025 A S*

Tantalum

Series
T496 - Precision Molded, Fail-safe

Case Size
B, C, D, X

Capacitance Picofarad Code
First two digits represent significant figures.
Third digit specifies number of zeros to follow.

Capacitance Tolerance
M - ± 20%
K - ± 10%

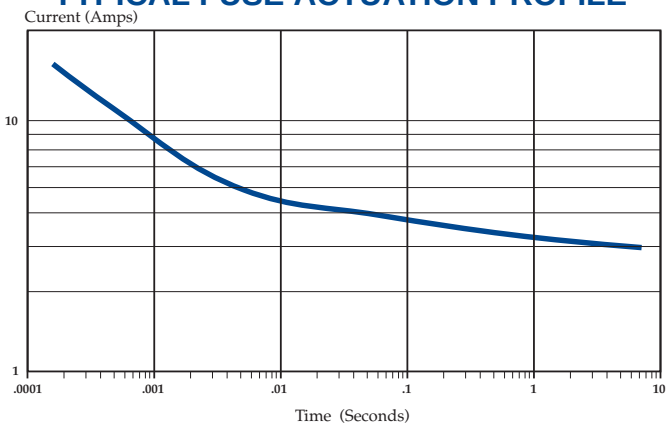
Voltage

Failure Rate
A - Not Applicable

Lead Material
S - Standard Solder -Coated

*** Part Number Example: T496B105M025AS (14 digits - no spaces)**

TYPICAL FUSE ACTUATION PROFILE



T496 RATINGS & PART NUMBER REFERENCE

Capacitance µF	Case Size	KEMET Part Number	DCL µA @ +25°C Max.	DF % @ +25°C 120 Hz. Max.	ESR Ω @ +25°C 100 kHz Max.
4 Volt Rating at +85°C (2.7 Volt Rating at +125°C)					
68.0	*C	T496C686(1)004AS	2.7	6.0	1.6
100.0	*C	T496C107(1)004AS	4.0	8.0	1.2
150.0	D	T496D157(1)004AS	6.0	8.0	0.8
220.0	*D	T496D227(1)004AS	8.8	8.0	0.7
#330.0	*D	T496D337(1)004AS	13.2	8.0	0.7
330.0	*X	T496X337(1)004AS	13.2	8.0	0.7
#470.0	*X	T496X477(1)004AS	18.8	8.0	0.5
****6 Volt Rating at +85°C (4 Volt Rating at +125°C)**					
4.7	B	T496B475(1)006AS	0.5	6.0	3.5
6.8	B	T496B685(1)006AS	0.5	6.0	3.5
10.0	B	T496B106(1)006AS	0.6	6.0	3.5
22.0	B	T496B226(1)006AS	1.3	6.0	3.5
15.0	C	T496C156(1)006AS	0.9	6.0	2.0
22.0	C	T496C226(1)006AS	1.4	6.0	2.0
33.0	C	T496C336(1)006AS	2.0	6.0	2.0
47.0	D	T496D476(1)006AS	2.9	6.0	1.0
47.0	*C	T496C476(1)006AS	2.9	6.0	1.6
68.0	D	T496D686(1)006AS	4.1	6.0	1.0
#68.0	*C	T496C686(1)006AS	4.1	6.0	1.2
100.0	X	T496X107(1)006AS	6.0	8.0	0.9
100.0	D	T496D107(1)006AS	6.0	8.0	0.8
150.0	*D	T496D157(1)006AS	9.0	8.0	0.7
#220.0	*D	T496D227(1)006AS	13.2	8.0	0.7
220.0	*X	T496X227(1)006AS	13.2	8.0	0.7
#330.0	*X	T496X337(1)006AS	19.8	8.0	0.5
10 Volt Rating at +85°C (7 Volt Rating at + 125°C)					
3.3	B	T496B335(1)010AS	0.5	6.0	3.5
4.7	B	T496B475(1)010AS	0.5	6.0	3.5
6.8	B	T496B685(1)010AS	0.7	6.0	3.5
15.0	B	T496B156(1)010AS	1.5	6.0	3.5
10.0	C	T496C106(1)010AS	1.0	6.0	2.0
15.0	C	T496C156(1)010AS	1.5	6.0	2.0
22.0	C	T496C226(1)010AS	2.2	6.0	2.0
33.0	D	T496D336(1)010AS	3.3	6.0	1.0
33.0	*C	T496C336(1)010AS	3.3	6.0	1.6
47.0	D	T496D476(1)010AS	4.7	6.0	1.0
#47.0	*C	T496C476(1)010AS	4.7	6.0	1.2
68.0	X	T496X686(1)010AS	6.8	6.0	0.9
68.0	D	T496D686(1)010AS	6.8	6.0	0.8
100.0	D	T496D107(1)010AS	10.0	8.0	0.7
150.0	*X	T496X157(1)010AS	15.0	8.0	0.7
#150.0	*D	T496D157(1)010AS	15.0	8.0	0.7
#220.0	*X	T496X227(1)010AS	22.0	8.0	0.5
16 Volt Rating at +85°C (10 Volt Rating at +125°C)					
2.2	B	T496B225(1)016AS	0.5	6.0	3.5
3.3	B	T496B335(1)016AS	0.5	6.0	3.5
4.7	B	T496B475(1)016AS	0.8	6.0	3.5
10.0	B	T496B106(1)016AS	1.6	6.0	3.5
6.8	C	T496C685(1)016AS	1.1	6.0	2.0
10.0	C	T496C106(1)016AS	1.6	6.0	2.0
15.0	C	T496C156(1)016AS	2.4	6.0	2.0
22.0	D	T496D226(1)016AS	3.6	6.0	1.0
22.0	*C	T496C226(1)016AS	3.6	6.0	1.6
33.0	D	T496D336(1)016AS	5.3	6.0	1.0
47.0	X	T496X476(1)016AS	7.5	6.0	0.9
47.0	D	T496D476(1)016AS	7.5	6.0	0.8
100.0	*X	T496X107(1)016AS	16.0	8.0	0.7

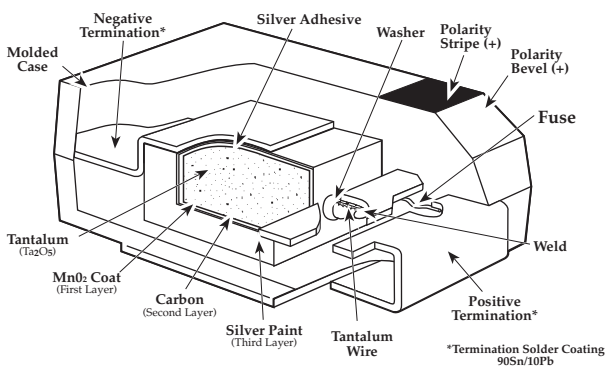
Capacitance µF	Case Size	KEMET Part Number	DCL µA @ +25°C Max.	DF % @ +25°C 120 Hz. Max.	ESR Ω @ +25°C 100 kHz Max.
20 Volt Rating at +85°C (13 Volt Rating at +125°C)					
1.5	B	T496B155(1)020AS	0.5	6.0	5.0
2.2	B	T496B225(1)020AS	0.5	6.0	3.5
3.3	B	T496B335(1)020AS	0.7	6.0	3.5
4.7	C	T496C475(1)020AS	1.0	6.0	2.0
6.8	C	T496C685(1)020AS	1.4	6.0	2.0
10.0	C	T496C106(1)020AS	2.0	6.0	2.0
15.0	D	T496D156(1)020AS	3.0	6.0	1.0
22.0	D	T496D226(1)020AS	4.4	6.0	1.0
33.0	X	T496X336(1)020AS	6.6	6.0	0.9
25 Volt Rating at +85°C (17 Volt Rating at +125°C)					
0.68	B	T496B684(1)025AS	0.5	4.0	6.5
1.0	B	T496B105(1)025AS	0.5	4.0	5.0
1.5	B	T496B155(1)025AS	0.5	6.0	5.0
2.2	C	T496C225(1)025AS	0.6	6.0	3.5
3.3	C	T496C335(1)025AS	0.9	6.0	2.5
4.7	C	T496C475(1)025AS	1.2	6.0	2.5
6.8	C	T496C685(1)025AS	1.7	6.0	2.0
10.0	D	T496D106(1)025AS	2.5	6.0	1.2
15.0	D	T496D156(1)025AS	3.8	6.0	1.0
22.0	X	T496X226(1)025AS	5.5	6.0	0.9
22.0	D	T496D226(1)025AS	5.5	6.0	0.8
35 Volt Rating at +85°C (23 Volt Rating at +125°C)					
0.47	B	T496B474(1)035AS	0.5	4.0	8.0
0.68	B	T496B684(1)035AS	0.5	4.0	6.5
1.0	B	T496B105(1)035AS	0.5	4.0	5.0
1.5	C	T496C155(1)035AS	0.5	6.0	4.5
2.2	C	T496C225(1)035AS	0.8	6.0	3.5
3.3	C	T496C335(1)035AS	1.2	6.0	2.5
4.7	D	T496D475(1)035AS	1.7	6.0	1.5
6.8	D	T496D685(1)035AS	2.4	6.0	1.3
10.0	X	T496X106(1)035AS	3.5	6.0	1.0
15.0	*X	T496X156(1)035AS	5.3	6.0	0.9
50 Volt Rating at +85°C (33 Volt Rating at +125°C)					
0.15	B	T496B154(1)050AS	0.5	4.0	16.0
0.22	B	T496B224(1)050AS	0.5	4.0	14.0
0.33	B	T496B334(1)050AS	0.5	4.0	10.0
0.47	C	T496C474(1)050AS	0.5	4.0	8.0
0.68	C	T496C684(1)050AS	0.5	4.0	7.0
1.0	C	T496C105(1)050AS	0.5	4.0	5.5
1.5	C	T496C155(1)050AS	0.8	6.0	5.0
2.2	D	T496D225(1)050AS	1.1	6.0	2.5
3.3	D	T496D335(1)050AS	1.7	6.0	2.0
4.7	X	T496X475(1)050AS	2.4	6.0	1.5

** Note: 6V rating equivalent to 6.3 rating *Extended Ratings
# Maximum capacitance change @ 125°C = +15% (all others =12%)

(1) To complete KEMET Part Number, insert M for ±20% tolerance or K for ±10% tolerance.

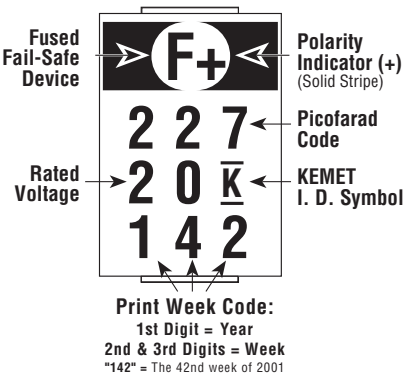
Higher voltage ratings and tighter capacitance tolerance product may be substituted within the same size at KEMET's option. Voltage substitutions will be marked with the higher voltage rating.

T496 SERIES CONSTRUCTION



CAPACITOR MARKINGS

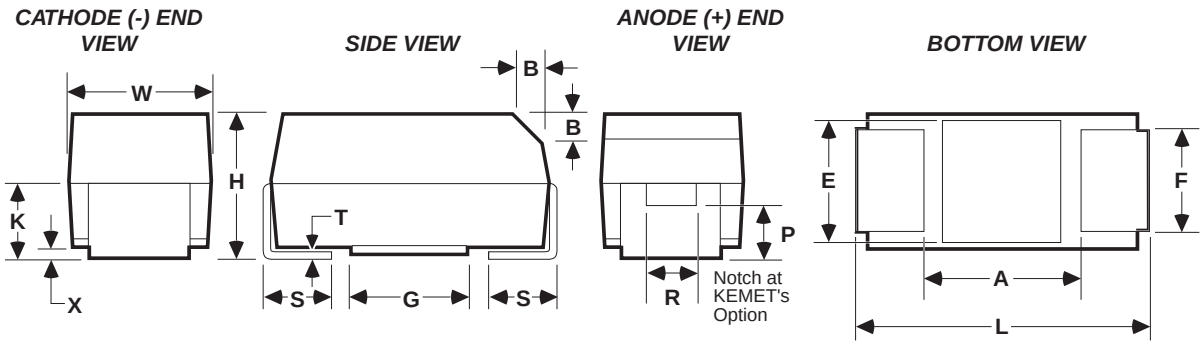
T496 Series — All Case Sizes



FEATURES

- Ultra Low ESR < 30 mΩ
- New E/7260 Case with ESR < 18 mΩ
- Up to 4 Amps ripple current
- 100% accelerated steady-state aging
- 100% Surge current test
- Precision - molded, laser-marked case
- Symmetrical compliant terminations
- Taped and reeled per EIA 481-1

OUTLINE DRAWING



DIMENSIONS - Millimeters (Inches)

CASE SIZE		COMPONENT													
KEMET	EIA	L	W	H	K ± 0.20 ± (.008)	F ± 0.1 ± (.004)	S ± 0.3 ± (.012)	B ± 0.15 (Ref) ± (.006)	X (Ref)	P (Ref)	R (Ref)	T (Ref)	A (Min)	G (Ref)	E (Ref)
X	7343-43	7.3 ± 0.3 (.287 ± .012)	4.3 ± 0.3 (.169 ± .012)	4.0 ± 0.3 (.157 ± .012)	2.3 (.091)	2.4 (.094)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	0.9 (.035)	1.0 (.039)	0.13 (.005)	3.8 (.150)	3.5 (.138)	3.5 (.138)
E	7260-38	7.3 ± 0.3 (.287 ± .012)	6.0 ± 0.3 (.236 ± .012)	3.6 ± 0.2 (.142 ± .008)	2.3 (.091)	4.1 (.161	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	0.9 (.035)	1.0 (.039)	0.13 (.005)	3.8 (.150)	3.5 (.138)	3.5 (.138)

Notes: Metric Dimensions govern
(Ref) - Dimensions provided for reference only.

T510 RATINGS & PART NUMBER REFERENCE

Cap. µF	Case Size	KEMET Part Number	DC Leakage µA @ 25°C Max	DF % @ 25°C 120Hz Max	ESR mΩ @ 25°C 100 kHz Max	Ripple Current A rms @ 25°C 100 kHz, max		
						25°C	85°C	125°C
4 Volt Rating at +85°C (2.7 Volt Rating at 125°C)								
680	X	T510X687(1)004AS	27.2	6.0	30	3.0	2.7	1.2
1,000	E	T510E108(1)004AS	40.0	6.0	18	4.0	3.6	1.6
1,000	E	T510E108(1)004AS4115	40.0	6.0	10	5.3	4.8	2.1
6/6.3 Volt Rating at +85°C (4 Volt Rating at 125°C)								
470	X	T510X477(1)006AS	28.2	6.0	30	3.0	2.7	1.2
680	E	T510E687(1)006AS	40.8	6.0	23	3.5	3.2	1.4
680	E	T510E687(1)006AS4115	40.8	6.0	12	4.8	4.3	1.9
10 Volt Rating at +85°C (7 Volt Rating at 125°C)								
330	X	T510X337(1)010AS	33.0	6.0	35	2.8	2.5	1.1

(1) To complete the KEMET part number, insert "K" – ±10% or "M" – ±20% capacitance tolerance.

T510 ORDERING INFORMATION

T 510 X 477 M 006 A S

Tantalum

Series
T510 - Ultra-Low ESR

Case Size
X, E

Capacitance Picofarad Code
First two digits represent significant figures.
Third digit specifies number of zeros to follow.

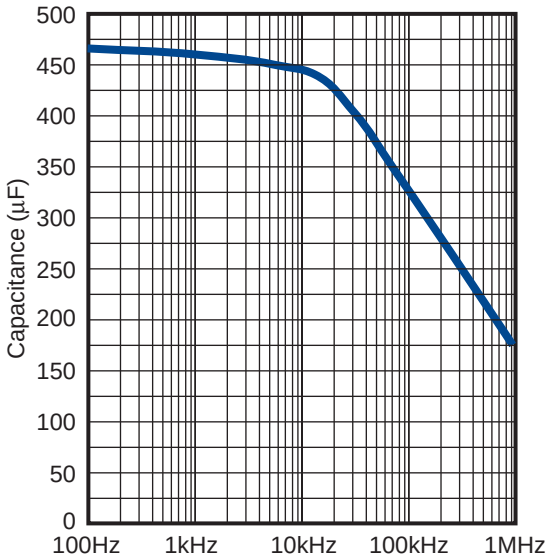
Capacitance Tolerance
M - ± 20%
K - ± 10%

Voltage

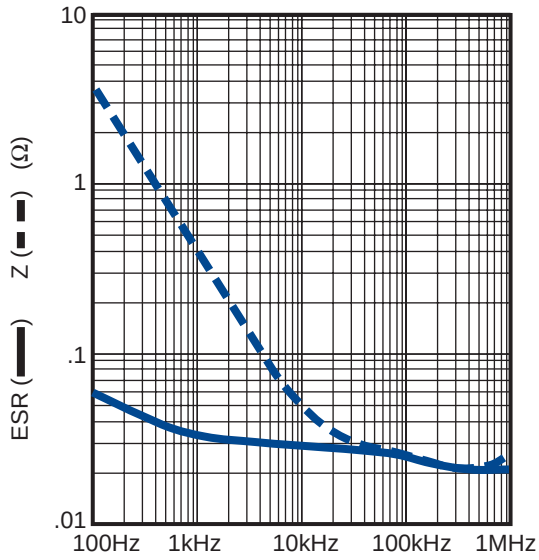
Failure Rate
A - Not Applicable

Lead Material
S - Standard Solder -Coated

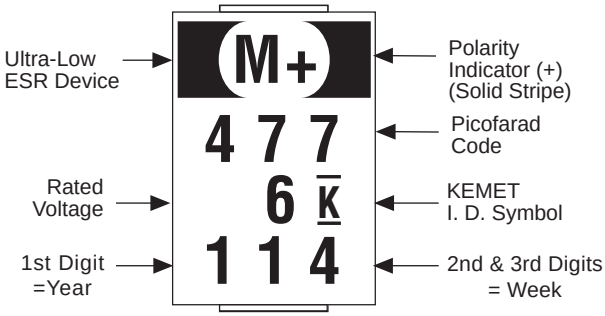
TYPICAL CAP FREQUENCY SCAN @25˚C
T510X477M006AS



TYPICAL ESR/Z FREQUENCY SCAN @25˚C
T510X477M006AS

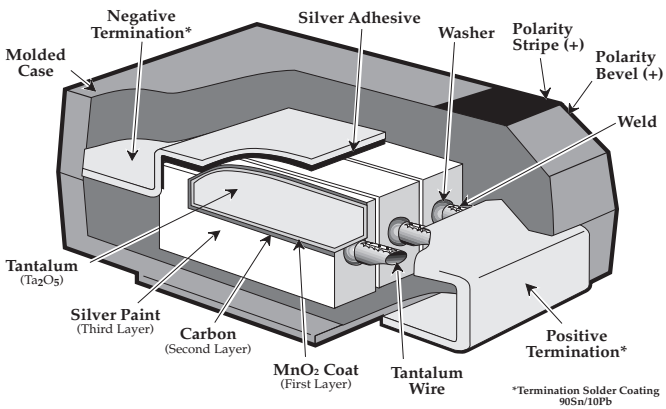


CAPACITOR MARKINGS

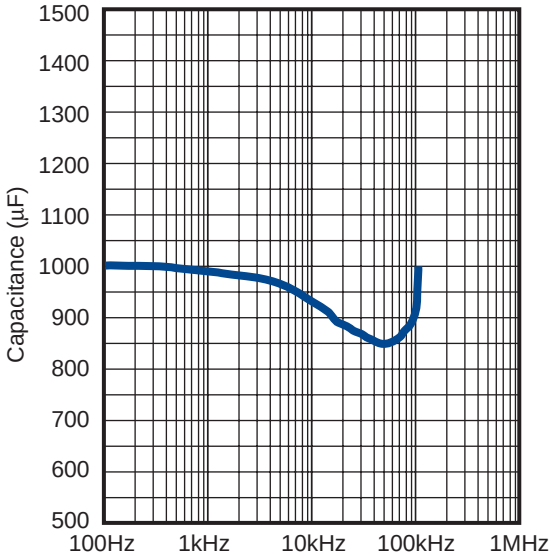


"114" = The 14th week of 2001.

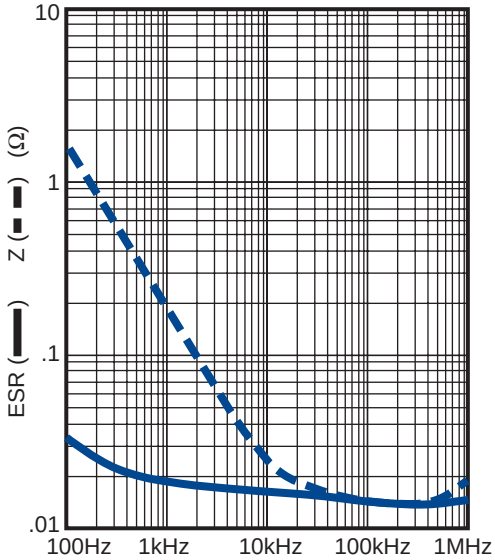
T510 SERIES CONSTRUCTION



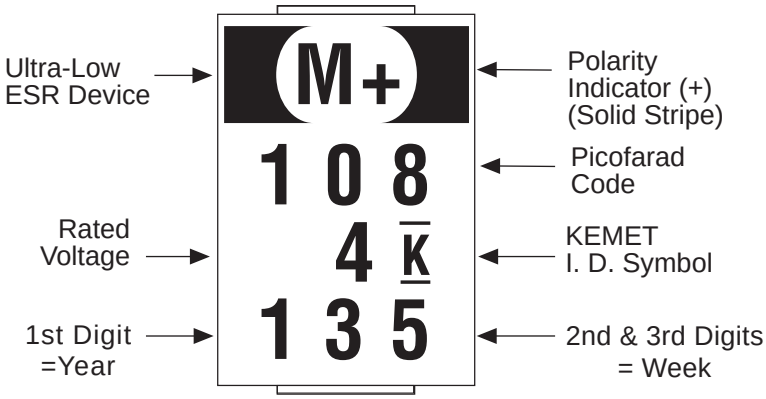
TYPICAL CAP FREQUENCY SCAN @ 25°C
T510E108M004AS



TYPICAL ESR/Z FREQUENCY SCAN @ 25°C
T510E108M004AS



CAPACITOR MARKINGS



"135" = The 35th week of 2001.

T510E SERIES CONSTRUCTION

COMPONENT PERFORMANCE CHARACTERISTICS

Introduction

KEMET has developed a new type of tantalum capacitor that replaces the solid manganese dioxide electrode with a solid conductive polymer. This product is named the KO-CAP for ***K***EMET ***O***rganic ***Cap***acitor. The basic family is the T520 series. A separate detail of performance characteristics is presented here as there are some differences between the polymer tantalums and the standard MnO2 types. Like all KEMET tantalum chips, the T520 series is 100% screened for all electrical parameters: Capacitance @ 120 Hz, Dissipation Factor (DF) @ 120 Hz, ESR @ 100 kHZ and DC Leakage. It is also 100% surge current tested at full rated voltage through a low impedance circuit. The advantages of the polymer include very low ESR and elimination of the potentially catastrophic failure mode that may occur with standard tantalum capacitors in a high surge current application. Although the natural T520 series failure mechanism is a short circuit, it does not exhibit an explosive failure mode.

ELECTRICAL

1. Operating Temperature Range

- ***-55ºC to +105ºC***

Above 85ºC, the voltage rating is reduced linearly from 1.0 x rated voltage to 0.8 x rated voltage at 105ºC.

2. Non-Operating Temperature Range

- ***-55ºC to +105ºC***

3. Capacitance and Tolerance

- ***68µF to 470µF***
- ***±20% Tolerance***

Capacitance is measured at 120 Hz, up to 1.0 volt rms maximum and up to 2.5V DC maximum. DC bias causes only a small reduction in capacitance, up to about 2% when full rated voltage is applied. DC bias is not commonly used for room temperature measurements but is more commonly used when measuring at temperature extremes.

Capacitance does decrease with increasing frequency, but not nearly as much or as quickly as standard tantalums. Figure 1 compares the frequency induced cap roll-off between the KO-CAP and traditional MnO2 types. Capacitance also increases with increasing temperature. See section 12 for temperature coefficients.

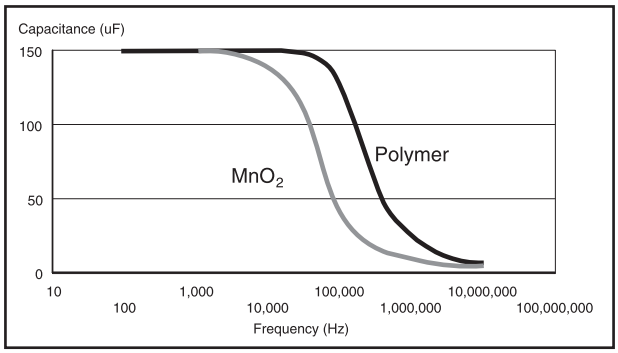


FIGURE 1

4. Voltage Ratings

- ***4V-10V DC Rated Voltage***

This is the maximum peak DC operating voltage from -55ºC to +85ºC for continuous duty. Above 85ºC, this voltage is derated linearly to 0.8 times the rated voltage for operation at 105ºC.

- ***Surge Voltage Ratings***

Surge voltage is the maximum voltage to which the part can be subjected under transient conditions including the sum of peak AC ripple, DC bias and any transients. Surge voltage capability is demonstrated by application of 1000 cycles of the relevant voltage, at 25ºC, 85ºC or 105ºC. The parts are charged through a 33 ohm resistor for 30 seconds and then discharged through a 33 ohm resistor for 30 seconds for each cycle.

• Voltage Ratings • Table 1

Rated Voltage	Surge Voltage	Derated Voltage	Derated Surge Voltage
-55ºC to +85ºC		+105ºC	
4V	5.2V	3.3V	4.3V
6.3V	8V	5V	6.5V
10V	13V	8V	10.4V

5. Reverse Voltage Rating & Polarity

Polymer tantalum capacitors are polar devices and may be permanently damaged or destroyed if connected in the wrong polarity. The positive terminal is identified by a laser-marked stripe and may also include a beveled edge. These capacitors will withstand a small degree of transient voltage reversal for short periods as shown in the following table. Please note that these parts may not be operated continuously in reverse, even within these limits.

Table 2

Temperature	Permissible Transient Reverse Voltage
25ºC	15% of Rated Voltage
55ºC	10% of Rated Voltage
85ºC	5% of Rated Voltage
105ºC	3% of Rated Voltage

6. DC Leakage Current

Because of the high conductivity of the polymer, the KO-CAP family has higher leakage currents than traditional MnO2 type Tantalum caps. The DC Leakage limits at 25ºC are calculated as 0.1 x C x V, where C is cap in µF and V is rated voltage in Volts. Limits for all part numbers are listed in the ratings tables.

DC Leakage current is the current that flows through the capacitor dielectric after a five minute charging period at rated voltage. Leakage is measured at 25ºC with full rated voltage applied to the capacitor through a 1000 ohm resistor in series with the capacitor.

COMPONENT PERFORMANCE CHARACTERISTICS

DC Leakage current does increase with temperature. The limits for 85°C @ Rated Voltage and 105°C @ 0.8 x Rated Voltage are both 10 times the 25°C limit.

7. Surge Current Capability

Certain applications may induce heavy surge currents when circuit impedance is very low (<0.1 ohm per volt). Driving inductance may also cause voltage ringing. Surge currents may appear as transients during turn-on of equipment.

The KO-CAP has a very high tolerance for surge current. And although the failure mechanism is a short circuit, they do not explode as may occur with standard tantalums in such applications.

The T520 series receives 100% screening for surge current in our production process. Capacitors are surged 4 times at full rated voltage applied through a total circuit resistance of <0.5 ohms. Failures are removed during subsequent electrical testing.

8. Dissipation Factor (DF)

Refer to part number tables for maximum DF limits.

Dissipation factor is measured at 120 Hz, up to 1.0 volt rms maximum, and up to 2.5 volts DC maximum at +25°C. The application of DC bias causes a small reduction in DF, about 0.2% when full rated voltage is applied. DF increases with increasing frequency.

Dissipation factor is the ratio of the equivalent series resistance (ESR) to the capacitive reactance, (X_C) and is usually expressed as a percentage. It is directly proportional to both capacitance and frequency. Dissipation factor loses its importance at higher frequencies, (above about 1 kHz), where impedance (Z) and equivalent series resistance (ESR) are the normal parameters of concern.

$$DF = \frac{R}{X_C} = 2\pi f CR$$

DF= Dissipation Factor
R= Equivalent Series Resistance (Ohms)
X_C= Capacitive Reactance (Ohms)
f= Frequency (Hertz)
C= Series Capacitance (Farads)

DF is also referred to as tan δ or "loss tangent." The "Quality Factor," "Q," is the reciprocal of DF.

9. Equivalent Series Resistance (ESR) and Impedance (Z)

The Equivalent Series Resistance (ESR) of the KO-CAP is much lower than standard Tantalum caps because the polymer cathode has much higher conductivity. ESR is not a pure resistance, and it decreases with increasing frequency.

Total impedance of the capacitor is the vector sum of capacitive reactance (X_C) and ESR, below resonance; above resonance total impedance is the vector sum of inductive reactance (X_L) and ESR.

$$X_C = \frac{1 \text{ ohm}}{2\pi fC}$$

where:
f = frequency, Hertz
C = capacitance, Farad

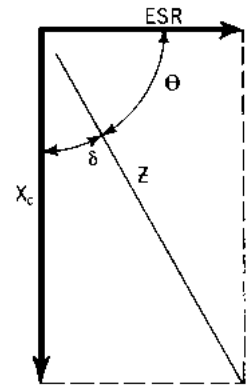


FIGURE 2a Total Impedance of the Capacitor Below Resonance

$$X_L = 2\pi fL$$

where:
f = frequency, Hertz
L = inductance, Henries

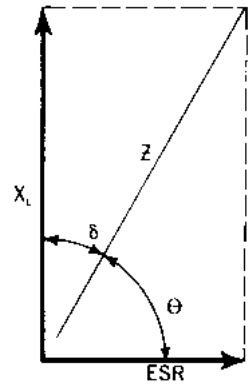


FIGURE 2b Total Impedance of the Capacitor Above Resonance

To understand the many elements of a capacitor, see Figure 3.

COMPONENT PERFORMANCE CHARACTERISTICS

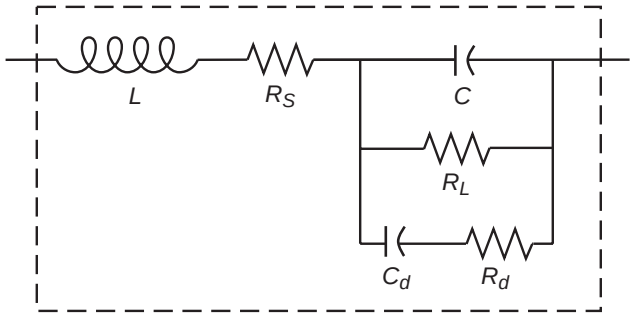


FIGURE 3 The Real Capacitor

A capacitor is a complex impedance consisting of many series and parallel elements, each adding to the complexity of the measurement system.

L — Represents lead wire and construction inductance. In most instances (especially in solid tantalum and monolithic ceramic capacitors) it is insignificant at the basic measurement frequencies of 120 and 1000 Hz.

R_S — Represents the actual ohmic series resistance in series with the capacitance. Lead wires and capacitor electrodes are contributing sources.

R_L — Capacitor Leakage Resistance. Typically it can reach 50,000 megohms in a tantalum capacitor. It can exceed 10^{12} ohms in monolithic ceramics and in film capacitors.

R_d — The dielectric loss contributed by dielectric absorption and molecular polarization. It becomes very significant in high frequency measurements and applications. Its value varies with frequency.

C_d — The inherent dielectric absorption of the solid tantalum capacitor which typically equates to 1-2% of the applied voltage.

As frequency increases, X_C continues to decrease according to its equation above. There is unavoidable inductance as well as resistance in all capacitors, and at some point in frequency, the reactance ceases to be capacitive and becomes inductive. This frequency is called the self-resonant point. In solid tantalum capacitors, the resonance is damped by the ESR, and a smooth, rather than abrupt, transition from capacitive to inductive reactance follows.

Figure 4 compares the frequency response of a KO-CAP to a standard Tantalum chip. See also frequency curves shown in the T520 section, p.39. Maximum limits for 100 kHz ESR are listed in the part number tables for each series.

ESR and Impedance

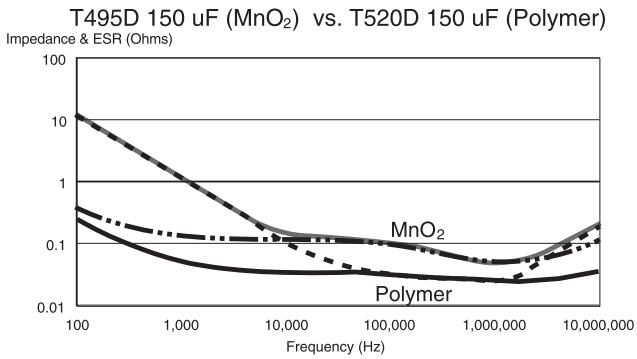


FIGURE 4

10. AC Power Dissipation

Power dissipation is a function of capacitor size and materials. Maximum power ratings have been established for all case sizes to prevent overheating. In actual use, the capacitor's ability to dissipate the heat generated at any given power level may be affected by a variety of circuit factors. These include board density, pad size, heat sinks and air circulation.

Table 3
Tantalum Chip Power Dissipation Ratings

Case Code		Maximum Power Dissipation
KEMET	EIA	Watts @ +25°C
V	7343-20	0.125
D	7343-31	0.150
X	7343-43	0.165

11. AC Operation

Permissible AC ripple voltage and current are related to equivalent series resistance (ESR) and power dissipation capability.

Permissible AC ripple voltage which may be applied is limited by three criteria:

a. The positive peak AC voltage plus the DC bias voltage, if any, must not exceed the DC voltage rating of the capacitor.

b. The negative peak AC voltage, in combination with bias voltage, if any, must not exceed the permissible reverse voltage ratings presented in Section 5.

c. The power dissipated in the ESR of the capacitor must not exceed the appropriate value specified in Section 10.

COMPONENT PERFORMANCE CHARACTERISTICS

Actual power dissipated may be calculated from the following:

$P = I^2R$

Substituting $I = \frac{E}{Z}$, $P = \frac{E^2R}{Z^2}$

where:

I = rms ripple current (amperes)
E = rms ripple voltage (volts)
P = power (watts)
Z = impedance at specified frequency (ohms)
R = equivalent series resistance at specified frequency (ohms)

Using P max from Table 3, maximum allowable rms ripple current or voltage may be determined as follows:

$I(max) = \sqrt{P\ max/R}$ $E(max) = Z\sqrt{P\ max/R}$

These values should be derated at elevated temperatures as follows:

Temperature	Derating Factor
85°C	.9
105°C	.4

ENVIRONMENTAL

12. Temperature Stability

Mounted capacitors withstand extreme temperature testing at a succession of continuous steps at +25°C, -55°C, +25°C, +85°C, +105°C, +25°C in that order. Capacitors are allowed to stabilize at each temperature before measurement. Cap, DF, and DCL are measured at each temperature except DC Leakage is not measured at -55°C.

Table 4

Acceptable limits are as follows:

Step	Temp.	ΔCap	DCL	DF
1	+25°C	Specified Tolerance	Catalog Limit	Catalog Limit
2	-55°C	±20% of initial value	N/A	Catalog Limit
3	+25°C	±10% of initial value	Catalog Limit	Catalog Limit
4	+85°C	±20% of initial value	10x Catalog Limit	1.2x Catalog Limit
5	+105°C	±30% of initial value	10x Catalog Limit	1.5x Catalog Limit
6	+25°C	±10% of initial value	Catalog Limit	Catalog Limit

13. Standard Life Test

- ***85°C, Rated Voltage, 2000 Hours***

Post Test Performance:

a. Capacitance: within ±10% of initial value
b. DF: within initial limit
c. DC Leakage: within initial limit
d. ESR: within initial limit

14. High Temperature Life Test

- ***105°C, 0.8 x Rated Voltage, 2000 hours***

Post Test Performance:

a. Capacitance: within ±10% of initial value
b. DF: within initial limit
c. DC Leakage: within 1.25 x initial limit
d. ESR: within 2 x initial limit

15. Storage Life Test

- ***105°C, 0VDC, 2000 Hours***

Post Test Perfomance:

a. Capacitance: within ±10% of initial value
b. DF: within initial limit
c. DC Leakage: within 1.25 x initial limit
d. ESR: within 2 x initial limit

16. Thermal Shock

- ***Mil-Std-202, Method 107, Condition B***

Minimum temperature is -55°C
Maximum temperature is +105°C
500 Cycles
Post Test Performance:

a. Capacitance: within ±10% of initial value
b. DF: within initial limit
c. DC Leakage: within initial limit
d. ESR: within 2 x initial limit

17. Moisture Resistance

- ***Mil-Std-202, Method 106***

Steps 7a and 7b excluded, 0V, 21 cycles
Post Test Performance:

a. Capacitance: within ±20% of initial value
b. DF: within initial limit
c. DC Leakage: within initial limit
d. ESR: within 2 x initial limit

18. Load Humidity

- ***85°C, 85% RH, Rated Voltage, 500 Hours***

Post Test Performance:

a. Capacitance: within ±20% of initial value
b. DF: within initial limit
c. DC Leakage: within 5 x initial limit
d. ESR: within 2 x initial limit

19. ESD

- **Polymer tantalum capacitors are not sensitive to Electro-Static Discharge (ESD).**

20. Failure Mechanism and Reliability

The normal failure mechanism is dielectric breakdown. Dielectric failure can result in high DC Leakage current and may proceed to the level of a short circuit. With sufficient time to charge, healing may occur by one of two potential mechanisms. The polymer adjacent to the dielectric fault site may overheat and vaporize, disconnecting the fault site from the circuit. The polymer may also

COMPONENT PERFORMANCE CHARACTERISTICS

oxidize into a more resistive material that plugs the defect site in the dielectric and reduces the flow of current.

Capacitor failure may be induced by exceeding the rated conditions of forward DC voltage, reverse DC voltage, surge current, power dissipation or temperature. Excessive environmental stress, such as prolonged or high temperature reflow processes may also trigger dielectric failure.

Failure rates may be improved in application by derating the voltage applied to the capacitor. KEMET recommends that KO-CAPs be derated to 80% or less of the rated voltage in application.

KO-CAPs exhibit a benign failure mode in that they do not fail catastophically even under typical fault conditions. If a shorted capacitor is allowed to pass unlimited current, it may overheat and the case may discolor. But this is distinctly different from the explosive "ignition" that may occur with standard MnO2 cathode tantalums. Replacement of the MnO2 by the polymer removes the oxygen that fuels ignition during a failure event.

MECHANICAL

21. Resistance to Solvents
- ***Mil-Std-202, Method 215***

Post Test Performance:
a. Capacitance — within ±10% of initial value
b. DC Leakage — within initial limit
c. Dissipation Factor — within initial limit
d. ESR — within initial limit
e. Physical — no degradation of case, terminals or marking

22. Fungus
- ***Mil-Std-810, Method 508***

23. Flammability
- ***UL94 VO Classification***

Encapsulant materials meet this classifaction

24. Resistance to Soldering Heat
- ***Maximum Reflow***
  +240 ±5ºC, 10 seconds
- ***Typical Reflow***
  +230 ±5ºC, 30 seconds

Post Test Performance:
a. Capacitance — within ±10% of initial value
b. DC Leakage — within initial limit
c. Dissipation Factor — within initial limit
d. ESR — within initial limit

25. Solderability
- ***Mil-Std-202, Method 208***
- ***ANSI/J-STD-002, Test B***

Applies to Solder Coated terminations only.

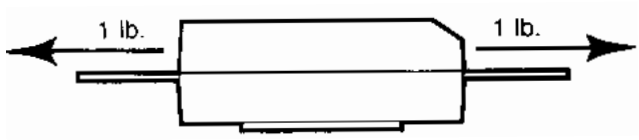
26. Vibration
- ***Mil-Std-202, Method 204, Condition D, 10 Hz to 2,000 Hz, 20G Peak***

Post Test Performance:
a. Capacitance — within ±10% of initial value
b. DC Leakage — within initial limit
c. Dissipation Factor — within initial limit
d. ESR — within initial limit

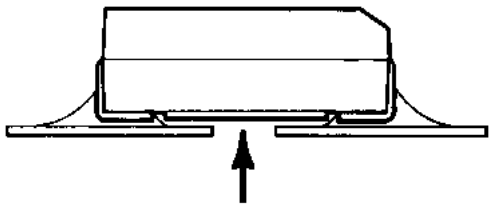
27. Shock
- ***Mil-Std-202, Method 213, Condition I, 100 G Peak***

Post Test Performance:
a. Capacitance — within ±10% of initial value
b. DC Leakage — within initial limit
c. Dissipation Factor — within initial limit
d. ESR - within initial limit

28. Terminal Strength
- **Pull Force**
  - ***One Pound (454 grams), 30 Seconds***



- **Tensile Force**
  - ***Four Pounds (1.8 kilograms), 60 Seconds***



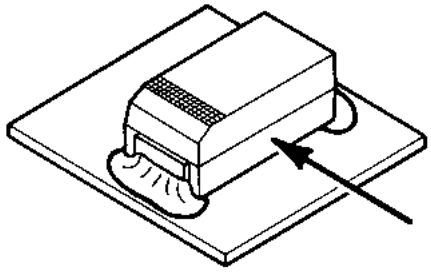
4 lb. (1.8 Kg)

- **Shear Force**

Table 5 Maximum Shear Loads

Case Code		Maximum Shear Loads	
KEMET	EIA	Kilograms	Pounds
V	7343-20	5.0	11.0
D	7343-31	5.0	11.0
X	7343-43	5.0	11.0

Post Test Performance:
a. Capacitance — within ±5% of initial value
b. DC Leakage — within initial limit
c. Dissipation Factor — within initial limit
d. ESR - within initial limit



COMPONENT PERFORMANCE CHARACTERISTICS

APPLICATIONS

29. Handling

Automatic handling of encapsulated components is enhanced by the molded case which provides compatibility with all types of high speed pick and place equipment. Manual handling of these devices presents no unique problems. Care should be taken with your fingers, however, to avoid touching the solder-coated terminations as body oils, acids and salts will degrade the solderability of these terminations. Finger cots should be used whenever manually handling all solderable surfaces.

30. Termination Coating

The standard finish coating is 90/10 Sn/Pb solder (Tin/Lead-solder coated).

31. Recommended Mounting Pad Geometries

Proper mounting pad geometries are essential for successful solder connections. These dimensions are highly process sensitive and should be designed to maximize the intergrity of the solder joint, and to minimize component rework due to unacceptable solder joints.

Figure 5 illustrates pad geometry. The table provides recommended pad dimensions for reflow soldering techniques. These dimensions are intended to be a starting point for circuit board designers, to be fine tuned, if necessary, based upon the peculiarities of the soldering process and/or circuit board design.

Contact KEMET for Engineering Bulletin Number F-2100 entitled “Surface Mount Mounting Pad Dimensions and Considerations” for further details on this subject.

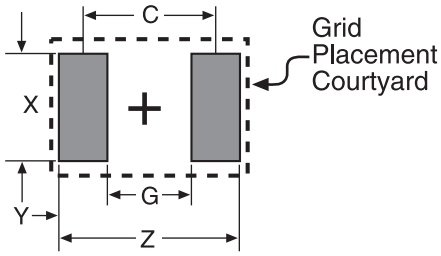


Figure 5

Table 6 - Land Pattern Dimensions for Reflow Solder

KEMET/EIA Size Code	Pad Dimensions				
	Z	G	X	Y (ref)	C (ref)
D/7343-31, V/7343-20, X/7343-43	8.90	3.80	2.70	2.55	6.35

32. Soldering

The T520 KO-CAP family has been designed for reflow solder processes. They are not recommended for wave solder. Solder-coated terminations have excellent wetting characteristics for high integrity solder fillets. Preheating of these components is recommended to avoid extreme thermal stress. The maximum recommended preheat rate is 2ºC per second.

Hand-soldering should be avoided. If necessary, it should be performed with care due to the difficulty in process control. Care should be taken to avoid contact of the soldering iron to the molded case. The iron should be used to heat the solder pad, applying solder between the pad and the termination, until reflow occurs. The iron should be removed. “Wiping” the edges of a chip and heating the top surface is not recommended.

During typical reflow operations a slight darkening of the gold-colored epoxy may be observed. This slight darkening is normal and is not harmful to the product. Marking permanency is not affected by this change.

33. Washing

Standard washing techniques and solvents are compatible with all KEMET surface mount tantalum capacitors. Solvents such as Freon TMC and TMS, Trichlorethane, methylene chloride, prelete, and isopropyl alcohol are not harmful to these components. Please note that we are not endorsing the use of banned or restricted solvents. We are simply stating that they would not be harmful to the components.

If ultrasonic agitation is utilized in the cleaning process, care should be taken to minimize energy levels and exposure times to avoid damage to the terminations.

KEMET tantalum chips are also compatible with newer aqueous and semi-aqueous processes. Contact KEMET for Engineering Bulletin F-2109 entitled “Alternative Surface Mount Cleaning Processes” for further details on this subject.

34. Encapsulations

Under normal circumstances, potting or encapsulation of KEMET tantalum chips is not required.

35. Storage Environment

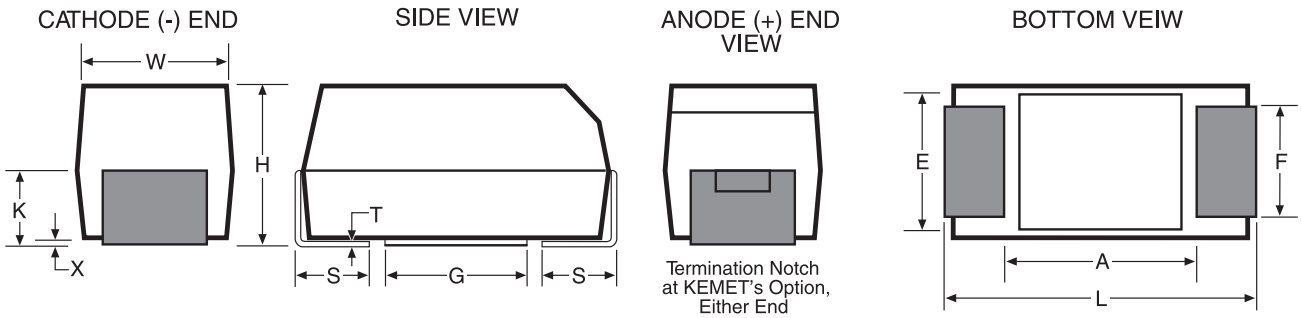
Tantalum chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will 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 degrees C, and the maximum storage humidity not exceed 60% relative humidity. In addition, temperature fluctuations should be minimized to avoid condensation on the parts, and atmospheres should be free of chlorine and sulfur bearing compounds. For optimized solderability, chip stock should be used promptly, preferably within 1.5 years of receipt.

Features

- Polymer Cathode Technology
- Low ESR
- High Frequency Cap Retention
- No-Ignition Failure Mode
- Capacitance 68 to 470µF (±20%)
- Voltage 4V to 10V
- EIA Standard Case Sizes
- 100% Surge Current Tested

Outline Drawing

Outline Drawing



Dimensions - Millimeters

Case Size												
KEMET	EIA	L	W	H	K ±0.20	F ±0.1	S ±0.3	X(Ref)	T(Ref)	A(Min)	G(ref)	E(ref)
V	7343-20	7.3 ± 0.3	4.3 ± 0.3	1.9 ± 0.1	1.1	2.4	1.3	0.05	0.13	3.8	3.5	3.5
D	7343-31	7.3 ± 0.3	4.3 ± 0.3	2.8 ± 0.3	1.5	2.4	1.3	0.10 ± 0.10	0.13	3.8	3.5	3.5
X	7343-43	7.3 ± 0.3	4.3 ± 0.3	4.0 ± 0.3	2.3	2.4	1.3	0.10 ± 0.10	0.13	3.8	3.5	3.5

T520 Ratings & Part Number Reference

Cap µF (±20%)	Case Size	KEMET Part Number	DC Leakage µA +25ºC Max	DF % 120 Hz + 25ºC Max	ESR mΩ 100kHz 25º Max	Ripple Current A rms 100 kHz Max		
						25ºC	85ºC	105ºC
4 Volt Rating at +85ºC (3.3 Volt Rating at 105ºC)								
220	V/7343-20	T520V227M004AS	88	10%	45	1.7	1.5	0.7
220	V/7343-20	T520V227M004AS4350	88	10%	30	2.0	1.8	0.8
470	D/7343-31	T520D477M004AS	188	10%	40	1.9	1.7	0.8
6.3 Volt Rating at 85ºC (5 Volt Rating at 105ºC)								
150	V/7343-20	T520V157M006AS	95	10%	45	1.7	1.5	0.7
150	D/7343-31	T520D157M006AS	95	10%	45	1.8	1.6	0.7
220	D/7343-31	T520D227M006AS	139	10%	50	1.7	1.6	0.7
220	D/7334-31	T520D227M006AS4350	88	10%	40	1.9	1.7	0.8
330	D/7343-31	T520D337M006AS	208	10%	45	1.8	1.6	0.7
330	D/7343-31	T520D337M006AS4350	132	10%	40	1.9	1.7	0.8
470	X/7343-43	T520X477M006AS	296	10%	40	2.0	1.8	0.8
470	X/7343-43	T520X477M006AS4350	296	10%	35	2.2	2.0	0.9
10 Volt Rating at +85ºC (8 Volt Rating at 105ºC)								
68	V/7343-20	T520V686M010AS	68	10%	60	1.4	1.2	0.5
100	D/7343-31	T520D107M010AS	100	10%	80	1.4	1.2	0.5
100	D/7343-31	T520D107M010AS4350	100	10%	55	1.7	1.5	0.7
150	D/7343-31	T520D157M010AS	150	10%	55	1.7	1.5	0.7
150	D/7343-31	T520D157M010AS4350	150	10%	40	1.9	1.7	0.8
330	X/7343-43	T520X337M010AS	330	10%	40	2.0	1.8	0.8

T520 Ordering Information

T 520 V 157 M 006 A S

Tantalum

Series
T520 - Low ESR Polymer

Case Size
V, D, X

Capacitance Picofarad Code
First two digits represent significant figures.
Third digit specifies number of zeros to follow

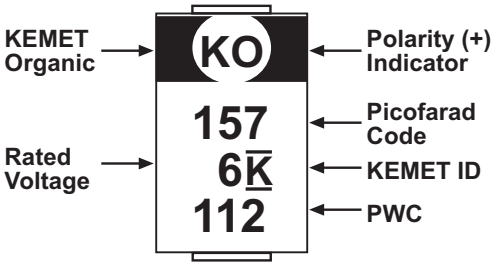
Capacitance Tolerance
M - ± 20%

Voltage

Failure Rate
A - Not Applicable

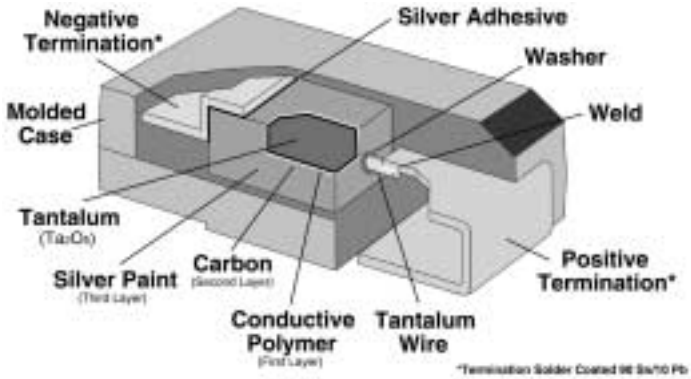
Lead Material
S - Standard Solder Coated

Component Marking



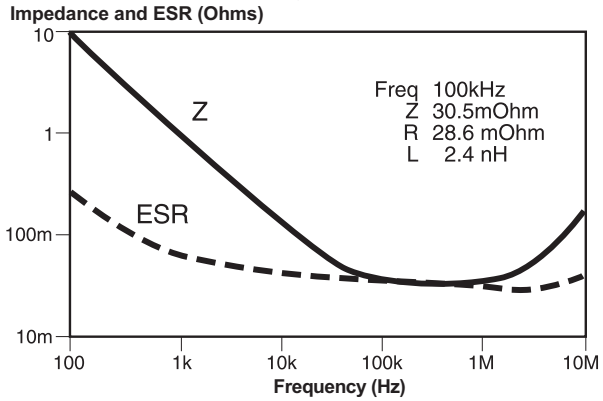
112 = 12th week of 2001

T520 Series Construction

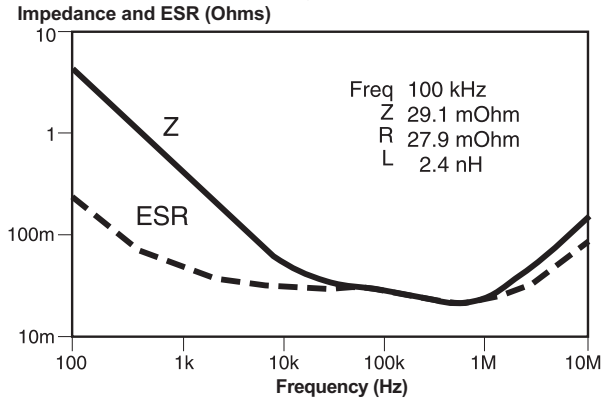


Typical Frequency Response Curves

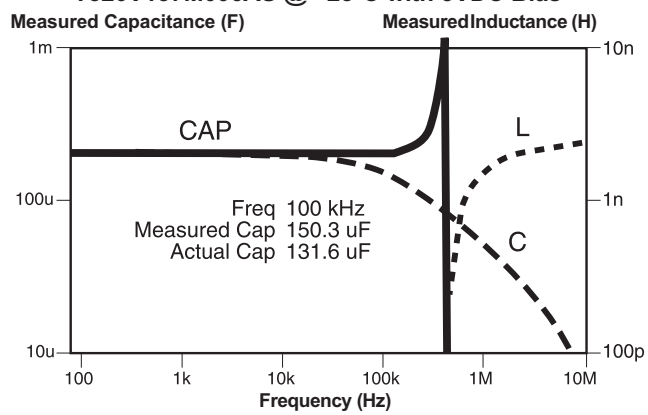
T520V157M006AS @ +25ºC with 3VDC Bias



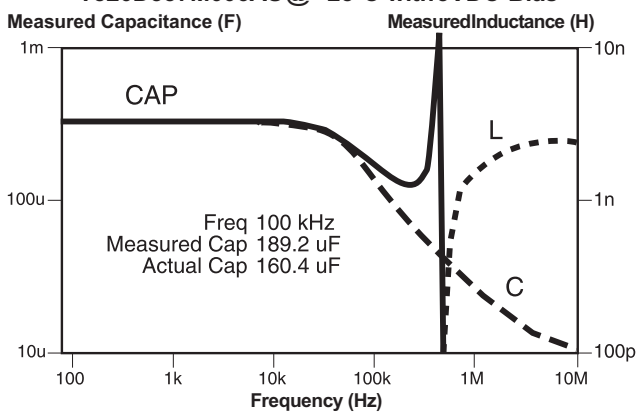
T520D337M006AS @ +25ºC with 3VDC Bias



T520V157M006AS @ +25ºC with 3VDC Bias



T520D337M006AS @ +25ºC with 3VDC Bias



INTRODUCTION

Ceramic chips consist of formulated ceramic dielectric materials which have been fabricated into thin layers, interspersed with metal electrodes alternately exposed on opposite edges of the laminated structure. The entire structure is then fired at high temperature to produce a monolithic block which provides high capacitance values in a small physical volume. After firing, conductive terminations are applied to opposite ends of the chip to make contact with the exposed electrodes. Standard end terminations use a nickel barrier layer and a tin overplate to provide excellent solderability for the customer.

KEMET multilayer ceramic chip capacitors are produced in plants designed specifically for chip capacitor manufacture. The process features a high degree of mechanization as well as precise controls over raw materials and process conditions. Manufacturing is supplemented by extensive Technology, Engineering and Quality Assurance programs.

KEMET ceramic chip capacitors are offered in the five most popular temperature characteristics. These are designated by the Electronics Industies Association (EIA) as the ultra-stable C0G (also known as NP0, military version BP), the stable X7R (military BX or BR), the stable X5R, and the general purpose Z5U and Y5V. A wide range of sizes are available. KEMET multilayer ceramic chip capacitors are available in KEMET's tape and reel packaging, compatible with automatic placement equipment. Bulk cassette packaging is also available (0805,0603 and 0402 only) for those pick and place machines requiring its use.

ELECTRICAL CHARACTERISTICS

1. Working Voltage:

Refers to the maximum continuous DC working voltage permissible across the entire operating temperature range. The reliability of multilayer ceramic capacitors is not extremely sensitive to voltage, and brief applications of voltage above rated will not result in immediate failure. However, reliability will be degraded by sustained exposure to voltages above rated.

2. Temperature Characteristics:

Within the EIA classifications, various temperature characteristics are identified by a three-symbol code; for example: C0G, X7R, X5R, Z5U and Y5V.

For Class I temperature compensating dielectrics (includes C0G), the first symbol designates the significant figures of the temperature coefficient in PPM per degree Celsius, the second designates the multiplier to be applied, and the third designates the tolerance in PPM per degrees Celsius. EIA temperature characteristic codes for Class I dielectrics are shown in Table 1.

Table 1 – EIA Temperature Characteristic Codes for Class I Dielectrics

Significant Figure of Temperature Coefficient		Multiplier Applied to Temperature Coefficient		Tolerance of Temperature Coefficient	
PPM per Degree C	Letter Symbol	Multi-plier	Number Symbol	PPM per Degree C	Letter Symbol
0.0	C	-1	0	± 30	G
0.3	B	-10	1	± 60	H
0.9	A	-100	2	± 120	J
1.0	M	-1000	3	± 250	K
1.5	P	-10000	4	± 500	L

KEMET supplies the C0G characteristic.

For Class II and III dielectrics (including X7R, X5R, Z5U & Y5V), the first symbol indicates the lower limit of the operating temperature range, the second indicates the upper limit of the operating temperature range, and the third indicates the maximum capacitance change allowed over the operating temperature range. EIA type designation codes for Class II and III dielectrics are shown in Table 2.

Table 2 – EIA Temperature Characteristic Codes for Class II & III Dielectrics

Low Temperature Rating		High Temperature Rating		Maximum Capacitance Shift		
Degree Celsius	Letter Symbol	Degree Celsius	Number Symbol	Percent	Letter Symbol	EIA Class
+10C	Z	+45C	2	± 1.0%	A	II
-30C	Y	+65C	4	± 1.5%	B	II
-55C	X	+85C	5	± 2.2%	C	II
		+105C	6	± 3.3%	D	II
		+125C	7	± 4.7%	E	II
		+150C	8	± 7.5%	F	II
		+200C	9	± 10.0%	P	II
				± 15.0%	R	II
				± 22.0%	S	III
				+ 22/-33%	T	III
				+22/-56%	U	III
				+22/-82%	V	III

KEMET supplies the X7R, X5R, Z5U and Y5V characteristics.

3. Capacitance Tolerance:

See tables on pages 47-50.

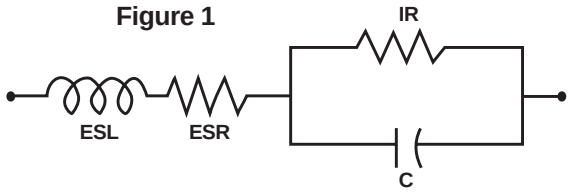
4. Capacitance:

Within specified tolerance when measured per Table 3.

The standard unit of capacitance is the farad. For practical capacitors, capacitance is usually expressed in microfarads (10^{-6} farad), nanofarads (10^{-9} farad), or picofarads (10^{-12} farad). Standard measurement conditions are listed in Table 3 - Specified Electrical Limits.

Like all other practical capacitors, multilayer ceramic capacitors also have resistance and inductance. A simplified schematic for the single frequency equivalent circuit is shown in Figure 1. At high frequency more complex models apply - see KEMET SPICE models at www.kemet.com for details.

Figure 1



C = Capacitance
ESR = Equivalent Series Resistance
ESL = Equivalent Series Inductance
IR = Insulation Resistance

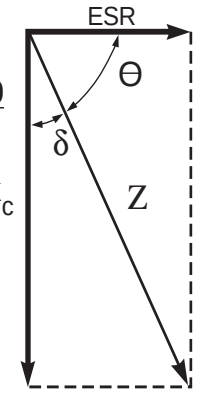
5. Dissipation Factor: Measured under same conditions as capacitance. (See Table 3)

Dissipation factor (DF) is a measure of the losses in a capacitor under AC application. It is the ratio of the equivalent series resistance to the capacitive reactance, and is usually expressed in percent. It is normally measured simultaneously with capacitance, and under the same conditions. The vector diagram below illustrates the relationship between DF, ESR and impedance. The reciprocal of the dissipation factor is called the "Q" or quality factor. For convenience, the "Q" factor is often used for very low values of dissipation factor especially when measured at high frequencies. DF is sometimes called the "loss tangent" or "tangent δ", as shown in Figure 2.

Figure 2

$$DF(\%) = \frac{ESR \times 100}{X_C}$$

$$X_C = \frac{1}{2\pi fC}$$



6. Impedance:

Since the parallel resistance (IR) is normally very high, the total impedance of the capacitor can be approximated by:

Figure 3

$$Z = \sqrt{ESR^2 + (X_L - X_C)^2}$$

Where: Z = Total Impedance

ESR = Equivalent Series Resistance

X_C = Capacitive Reactance = $1/(2\pi fC)$

X_L = Inductive Reactance = $(2\pi f)(ESL)$

The variation of a capacitor's impedance with frequency determines its effectiveness in many applications. At high frequency more detailed models apply - see KEMET SPICE models for such instances.

7. Insulation Resistance: Measured after 2 minutes electrification at 25°C and rated voltage: Limits per Table 3.

Insulation Resistance is the measure of a capacitor to resist the flow of DC leakage current. It is sometimes referred to as "leakage resistance". Insulation resistance (IR) is the DC resistance measured across the terminals of a capacitor, represented by the parallel resistance (IR) shown in Figure 1. For a given dielectric type, electrode area increases with capacitance, resulting in a decrease in the insulation resistance. Consequently, insulation resistance limits are usually specified as the "RC" (IR x C) product, in terms of ohm-farads or megohm-micro-farads. The insulation resistance for a specific capacitance value is determined by dividing this product by the capacitance. However, as the nominal capacitance values become small, the insulation resistance calculated from the RC product

Table 3 – Specified Electrical Limits

Parameter	Temperature Characteristics			
	C0G	X7R/X5R	Z5U	Y5V
Capacitance & Dissipation Factor: Measured at following conditions: C0G – 1kHz and 1 vrms if capacitance >1000 pF 1MHz and 1 vrms if capacitance ≤1000 pF X7R/X5R/Y5V – 1kHz and 1 vrms* if capacitance ≤ 10 µF X7R/X5R/Y5V – 120Hz and 0.5 vrms if capacitance > 10 µF Z5U – 1kHz and 0.5 vrms Y5V – 1kHz and 1 vrms DF Limits: 50 - 200 volts – 25 volts – 16 volts – 6.3/10 volts –	 0.10% 0.10% -------- --------	 2.5% 3.5% 3.5% 5.0%	 4.0% 4.0% -------	 5.0% 7.0% 7.0% 10.0%
Dielectric Strength: At 2.5 times rated DC voltage	Pass Subsequent IR Test			
Insulation Resistance (IR): At rated DC voltage, whichever of the two is smaller. To get IR limit, divide MΩ–µF value by the capacitance and compare to GΩ limit. Select the lower of the two limits.	1,000 MΩ – µF or 100 GΩ (100,000 MΩ)	1,000 MΩ – µF or 100 GΩ (100,000 MΩ)	100 MΩ – µF or 10 GΩ (10,000 MΩ)	100 MΩ – µF or 10 G (≥16 volt) 50 MΩ – µF or 10G (≤10v) (10,000 MΩ)
Temperature: Range, °C Capacitance Change (without DC voltage)	-55 to +125 0 ± 30 ppm/°C	X7R: -55 to +125 ±15% X5R: -55 to +85 ±15%	+10 to +85 +22% -56%	-30 to +85 +22% -82%

***Note: Some values measured at ½ volt, see X7R Table for specific details on pages 48 and 49.**

reaches values which are impractical. Consequently, IR specifications usually include both a minimum RC product and a maximum limit based on the IR calculated from that value. For example, a typical IR specification might read "1,000 megohm-microfarads or 100 gigohms, whichever is less". The DC leakage current may be calculated by dividing the applied voltage by the insulation resistance (Ohm's Law).

8. Dielectric Withstanding Voltage:

250% of rated voltage for 5 seconds with current limited to 50mA at 25°C. Limits per Table 3.

Dielectric withstanding voltage (DWV) is the peak DC voltage which a capacitor is designed to withstand without damage for short periods of time. All KEMET multilayer ceramic surface mount capacitors will withstand a DC test voltage of 2.5 x the rated voltage for 60 seconds.

KEMET specification limits for all electrical characteristics at standard measurement conditions are shown in Table 3. Variations in these properties caused by changing conditions (temperature, voltage, frequency, and time) are covered in the following sections.

9. Aging Rate:

Maximum % Capacitance Loss/Decade Hour
C0G - 0%
X7R - 2.0%
X5R - 2.5%
Z5U - 7.0%
Y5V - 7.0%
Actual rates may be lower. Consult factory for details.

The capacitance of Class II and III dielectric changes with time as well as with temperature, voltage and frequency. The change with time as known as "aging". It is caused by gradual realignment of the crystalline structure of the ceramic dielectric material as it is cooled below its Curie temperature, which produces a loss of capacitance with time. The aging process is predictable and follows a logarithmic decay.

The aging process is reversible. If the capacitor is heated to a temperature above its Curie point for some period of time, de-aging will occur and the capacitor will regain the capacitance lost during the aging process. The amount of de-aging depends on both the elevated temperature and the length of time at that temperature. Exposure to 150°C for one-half hour is sufficient to return the capacitor to its initial value.

Because the capacitance changes rapidly immediately after de-aging, capacitance measurements are usually delayed for at least 10 - 24 hours after the de-aging process, which is often referred to as the "last heat". In addition, manufacturers utilize the aging rates to set factory test limits which will bring the capacitance within the specified tolerance at some future time, to allow for customer receipt and use.

10. Effect of Temperature:

Both capacitance and dissipation factor are affected by variations in temperature. The maximum capacitance change with temperature is defined by the temperature characteristic.

However, this only defines an "envelope" bounded by the upper and lower operating temperatures and the minimum and maximum capacitance values. Within this "envelope", the variation with temperature depends upon the specific dielectric formulation.

Insulation resistance decreases with temperature. Typically, the insulation resistance limit at maximum rated temperature is 10% of the 25°C value.

11. Effect of Voltage:

C0G ceramic capacitors are not affected by variations in applied AC or DC voltages. For Class II and III ceramic capacitors (including X7R, X5R, Z5U and Y5V), variations in voltage affect the capacitance and dissipation factor. The application of DC voltages higher than 5 vdc reduces both the capacitance and dissipation factor. The application of AC voltages up to 10-20 vac tends to increase both capacitance and dissipation factor. At higher AC voltages, both capacitance and dissipation factor begin to decrease.

Typical curves showing the effect of applied AC and DC voltage are shown in Figure 7 for KEMET X7R capacitors, and Figure 8 for KEMET Z5U. See SPICE models on the KEMET website for further information.

12. Effect of Frequency:

Frequency affects both capacitance and dissipation factor. Typical curves for KEMET multilayer ceramic capacitors are shown in Figures 4, 5 and 6.

The variation of impedance with frequency is an important consideration in the application of multilayer ceramic capacitors. Total impedance of the capacitor is the vector summation of the capacitive reactance, the inductive reactance, and the ESR, as illustrated in Figure 2. As frequency increases, the capacitive reactance decreases. However, the series inductance (L) shown in Figure 1 produces some inductive reactance, which increases with frequency. At some frequency, the impedance ceases to be capacitive and becomes inductive. This point, at the bottom of the V-shaped impedance versus frequency curves, is the self-resonant frequency. At the self-resonant frequency, the reactance is zero, and the

impedance consists of the ESR only. At high frequency more detailed models apply - See KEMET SPICE models for such instances.

Typical impedance versus frequency curves for KEMET multilayer ceramic capacitors are shown in Figures 4, 5 and 6.

ENVIRONMENTAL AND PHYSICAL

13. Thermal Shock:
EIA-198, Method 202, Condition B (5 cycles -55° to + 125°C).

14. Life Test:
EIA-198, Method 201, 1000 hours at 200% of rated voltage at 125°C. (Except 85°C for Z5U and Y5V).
See Table 4 on page 44 for limits.

15. Humidity Test:
EIA-198, Method 206, (Except 1000 hours,85°C, 85% RH, Rated Voltage).
See Table 4 on page 44 for limits.

16. Moisture Resistance:
EIA-198, Method 204, Condition B (20 cycles with 50 volts applied.
See Table 4 on page 44 for limits.

17. Solderability:
EIA-198, Method 301 (245°, 5 secs, Sn62 solder) 95% smooth solder on terminations.

18. Resistance to Soldering Heat:
EIA-198, Method 302, Condition B (260°C, 10 seconds) no leaching of nickel barrier.

19. Terminal Strength:
EIA-198, Method 303, Condition D .

RELIABILITY

20. A well constructed multilayer ceramic capacitor chip is extremely reliable and, for all practical purposes, has no wearout mechanism when used within the maximum voltage and temperature ratings. Most failures occur as a result of mechanical or thermal damage during mounting on the board, or during subsequent testing. Capacitor failure may also be induced by sustained operation at voltages that exceed the rated DC voltage, voltage spikes or transients that exceed the dielectric's voltage capability, sustained operation at temperatures above the maximum rated temperature, internal defects, or excessive temperature rise due to power dissipation. As with any practical device, multilayer ceramic capacitors also possess an inherent, although low, failure rate when operated within rated conditions. The primary failure mode is by short-circuit or low insulation resistance, resulting from cracks or from dielectric breakdown at a defect site. KEMET monitors reliability with a periodic sampling program for selected values. Results are available in our FIT (Failure in Time) report for commercial chips.

21. Storage and Handling:

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

MISAPPLICATION

22. Ceramic capacitors, like any other capacitors, may fail if they are misapplied. Some misapplications include mechanical damage, such as impact or excessive flexing of the circuit board. Others include severe mounting or rework cycles that may also introduce thermal shock. Still others include exposure to excessive voltage, current or temperature. If the dielectric layer of the capacitor is damaged by misapplication, the circuit may fail. The electrical energy of the circuit can be released as heat, which may damage the circuit board and other components as well.

ADDITIONAL INFORMATION

23. Detailed application information can be found in KEMET Engineering Bulletins.

F-2100	Surface Mount-Mounting Pad Dimensions and Considerations
F-2102	Reflow Soldering Process
F-2105	Wave Solder Process
F-2103	Surface Mount Repair
F-2110	Capacitance Monitoring while Flex Testing

For analysis of high frequency applications, KEMET has SPICE models of most chip capacitors. Models may be downloaded from KEMET's website www.kemet.com.

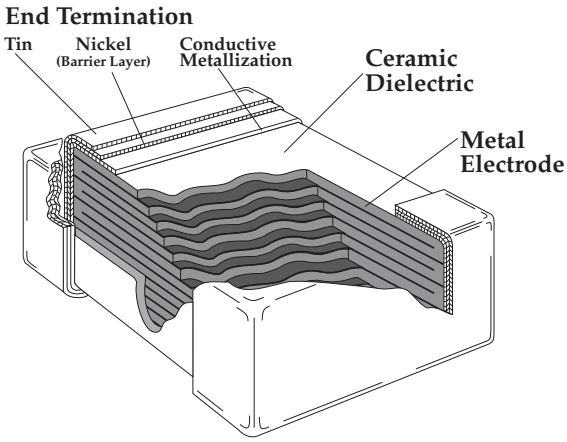
Additional information is also available - See your KEMET representative for details or post your questions to KEMET's homepage on the web http://www.kemet.com.

TABLE 4 – ENVIRONMENTAL LIMITS

Body	Rated DC Voltage	Initial DF (%)	IR (GΩ or ΩF) whichever is less	DF (%) Post Life/ Hum/Moisture Resistance	Cap Shift (% or pf, whichever is greater) Post Life/ Hum/Moisture Resistance	IR (GΩ or ΩF) whichever is less Post Life/ Hum/Moisture Resistance
C0G	200*	0.1	100/1000	0.5	0.3% or ± 0.25 pf	10/100
	100	0.1	100/1000	0.5	0.3% or ± 0.25 pf	10/100
	50	0.1	100/1000	0.5	0.3% or ± 0.25 pf	10/100
	25	0.1	100/1000	0.5	0.3% or ± 0.25 pf	10/100
	16	0.1	100/1000	0.5	0.3% or ± 0.25 pf	10/100
X7R/X5R	200*	2.5	100/1000	3.0	± 20%	10/100
	100	2.5	100/1000	3.0	± 20%	10/100
	50	2.5	100/1000	3.0	± 20%	10/100
	25	3.5	100/1000	5.0	± 20%	10/100
	16	3.5	100/1000	5.0	± 20%	10/100
	6.3/10	5.0	100/1000	7.5	± 20%	10/100
Z5U	100	4.0	10/100	5.0	± 30%	1/10
	50	4.0	10/100	5.0	± 30%	1/10
	25	4.0	10/100	7.5	± 30%	1/10
Y5V	100	5.0	10/100	7.5	± 30%	1/10
	50	5.0	10/100	7.5	± 30%	1/10
	25	7.0	10/100	10.0	± 30%	1/10
	16	7.0	10/100	10.0	± 30%	1/10
	6.3/10	10.0	10/50	15.0	± 30%	1/5

*200 Volt limits not currently included in EIA-198.

CONSTRUCTION



TYPICAL PERFORMANCE CURVES
(See SPICE models for specific ratings.)

EFFECT OF FREQUENCY

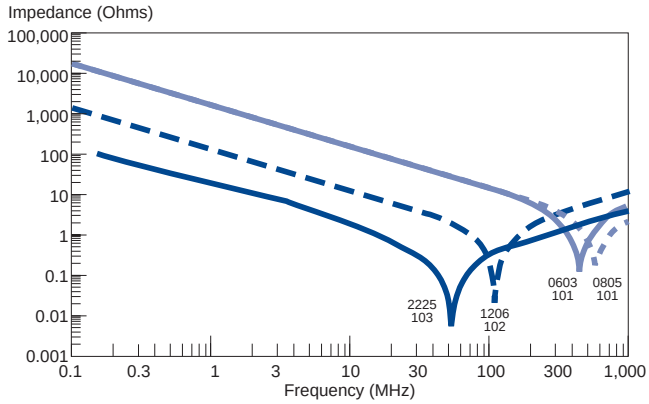


FIGURE 4. Impedance versus Frequency C0G Dielectric

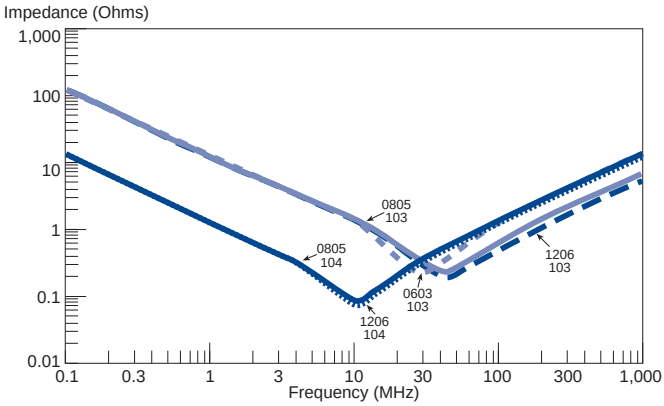


FIGURE 5 Impedance versus Frequency X7R Dielectric

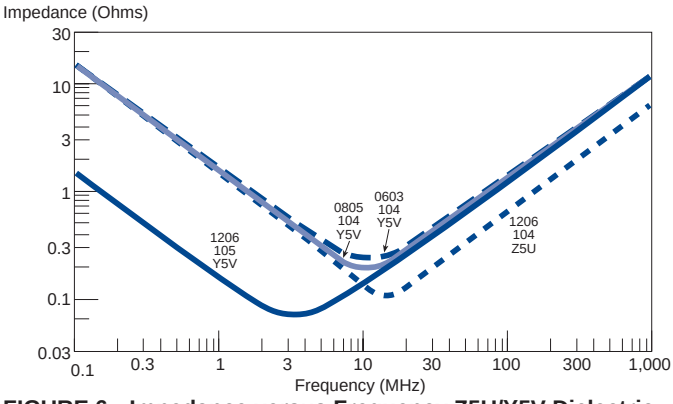


FIGURE 6. Impedance versus Frequency Z5U/Y5V Dielectric

EFFECT OF VOLTAGE

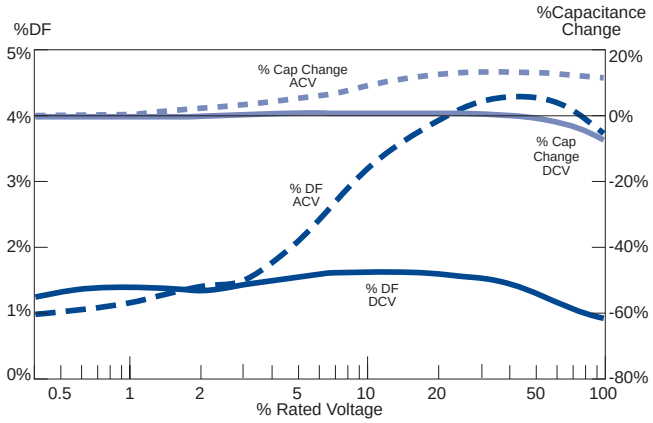


FIGURE 7. X7R Capacitance & DF versus Applied AC/DC Voltages

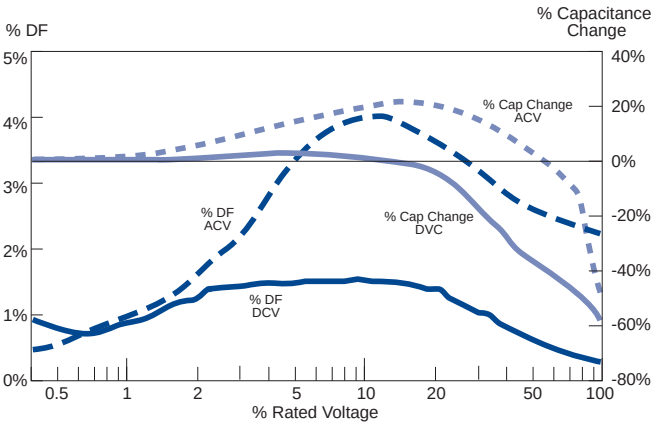
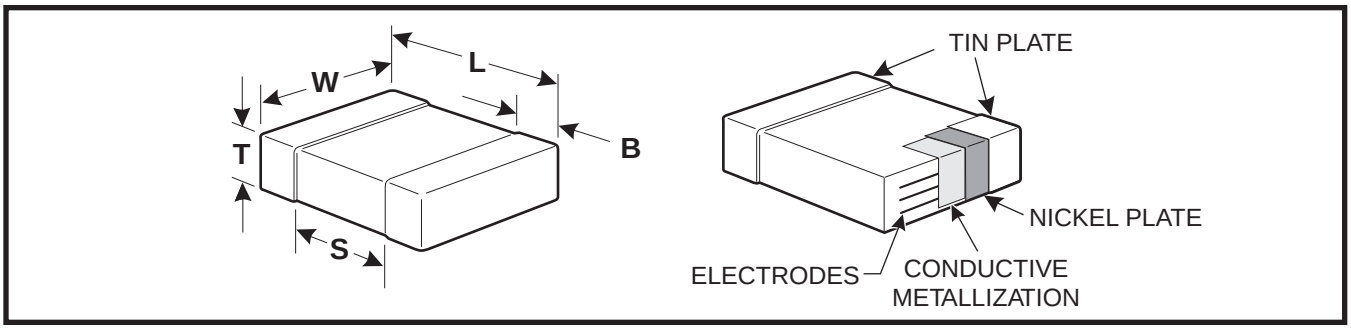


FIGURE 8. Z5U Capacitance & DF versus Applied AC/DC Voltages

FEATURES

- C0G (NP0), X7R, X5R, Z5U and Y5V Dielectrics
- 10, 16, 25, 50, 100 and 200 Volts
- Standard End Metalization: Tin-plate over nickel barrier
- Available Capacitance Tolerances: ±0.10 pF; ±0.25 pF; ±0.5 pF; ±1%; ±2%; ±5%; ±10%; ±20%; and +80%-20%
- Tape and reel packaging per EIA481-1. (See page 59 for specific tape and reel information.) Bulk Cassette packaging (0402, 0603, 0805 only) per IEC60286-6 and EIAJ 7201.

CAPACITOR OUTLINE DRAWINGS



DIMENSIONS—MILLIMETERS AND (INCHES)

EIA SIZE CODE	METRIC SIZE CODE (Ref only)	L # LENGTH	W # WIDTH	T (EIA) # THICKNESS MAX.	B BANDWIDTH	S MIN. SEPARATION	MOUNTING TECHNIQUE
0402*	1005	1.0 (.04) ± .05(.002)	0.5 (.02) ± .05 (.002)	0.55 (.022)	0.20 (0.008)-0.40 (0.016)	0.3 (.012)	Solder Reflow
0603*	1608	1.6 (.063) ± 0.15 (.006)	0.8 (.032) ± 0.15 (.006)	0.9 (.035)	0.35 (.014) ±0.15 (.006)	0.7 (.028)	Solder Wave † or Solder Reflow
0805*	2012	2.0 (.079) ± 0.2 (.008)	1.25 (.049) ± 0.2 (.008)	1.3 (.051)	0.5 (.02) ±.25 (.010)	0.75 (.030)	
1206*	3216	3.2 (.126) ± 0.2 (.008)	1.6 (.063) ± 0.2 (.008)	1.5 (.059)	0.5 (.02) ±.25 (.010)	N/A	
1210*	3225	3.2 (.126) ± 0.2 (.008)	2.5 (.098) ± 0.2 (.008)	1.7 (.067)	0.5 (.02) ±.25 (.010)	N/A	
1812	4532	4.5 (.177) ± 0.3 (.012)	3.2 (.126) ± 0.3 (.012)	1.7 (.067)	0.6 (.024) ±.35 (.014)	N/A	Solder Reflow
1825*	4564	4.5 (.177) ± 0.3 (.012)	6.4 (.252) ± 0.4 (.016)	1.7 (.067)	0.6 (.024) ±.35 (.014)	N/A	
2220	5650	5.6 (.220) ± 0.4 (.016)	5.0 (.197) ± 0.4 (.016)	1.8 (.071)	0.6 (.024) ±.35 (.014)	N/A	
2225	5664	5.6 (.220) ± 0.4 (.016)	6.3 (.248) ± 0.4 (.016)	2.0 (.079)	0.6 (.024) ±.35 (.014)	N/A	

* Note: Indicates EIA Preferred Case Sizes (Tightened tolerances apply for 0402, 0603, and 0805 packaged in bulk cassette, see page 63.)
#Note: These thicknesses are EIA maximums. Most chips are considerably thinner. Consult factory for details. Also, some extended values may be slightly thicker than EIA maximums.
† For extended value 1210 case size – solder reflow only.

CAPACITOR ORDERING INFORMATION (Standard Chips - For Military see page 53)

C 0805 C 103 K 5 R A C*

CERAMIC

SIZE CODE

SPECIFICATION
C - Standard

CAPACITANCE CODE
Expressed in Picofarads (pF)
First two digits represent significant figures.
Third digit specifies number of zeros. (Use 9 for 1.0 through 9.9pF. Use 8 for 0.5 through 0.99pF)
(Example: 2.2pF = 229 or 0.50 pF = 508)

CAPACITANCE TOLERANCE

B – ±0.10pF	J – ±5%
C – ±0.25pF	K – ±10%
D – ±0.5pF	M – ±20%
F – ±1%	P – (GMV) – special order only
G – ±2%	Z – +80%, -20%

VOLTAGE

1 - 100V	3 - 25V
2 - 200V	4 - 16V
5 - 50V	8 - 10V
	9 - 6.3V

TEMPERATURE CHARACTERISTIC
Designated by Capacitance Change Over Temperature Range
G – C0G (NP0) (±30 PPM/°C)
R – X7R (±15%) (-55°C + 125°C)
P– X5R (±15%) (-55°C + 85°C)
U – Z5U (+22%, -56%) (+10°C + 85°C)
V – Y5V (+22%, -82%) (-30°C + 85°C)

FAILURE RATE LEVEL
A- Not Applicable

END METALLIZATION
C-Standard
(Tin-plated nickel barrier)

*** Part Number Example: C0805C103K5RAC (14 digits - no spaces)**

C0G CAPACITANCE RANGE – 0402, 0603, 0805, 1206

CAP. PF	CAP. TOL.	C0402*				C0603*						C0805*						C1206*					
		10V	16V	25V	50V	10V	16V	25V	50V	100V	200V	10V	16V	25V	50V	100V	200V	10V	16V	25V	50V	100V	200V
.50	C,D	508	508	508	508	508	508	508	508	508	508	508	508	508	508	508	508						
.75	C,D	758	758	758	758	758	758	758	758	758	758	758	758	758	758	758	758						
1.0	C,D	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109
1.1	C,D	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119
1.2	C,D	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
1.3	C,D	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139
1.5	C,D	159	159	159	159	159	159	159	159	159	159	159	159	159	159	159	159	159	159	159	159	159	159
1.6	C,D	169	169	169	169	169	169	169	169	169	169	169	169	169	169	169	169	169	169	169	169	169	169
1.8	C,D	189	189	189	189	189	189	189	189	189	189	189	189	189	189	189	189	189	189	189	189	189	189
2.0	C,D	209	209	209	209	209	209	209	209	209	209	209	209	209	209	209	209	209	209	209	209	209	209
2.2	C,D	229	229	229	229	229	229	229	229	229	229	229	229	229	229	229	229	229	229	229	229	229	229
2.4	C,D	249	249	249	249	249	249	249	249	249	249	249	249	249	249	249	249	249	249	249	249	249	249
2.7	C,D K,M	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279
3.0	C,D K,M	309	309	309	309	309	309	309	309	309	309	309	309	309	309	309	309	309	309	309	309	309	309
3.3	C,D K,M	339	339	339	339	339	339	339	339	339	339	339	339	339	339	339	339	339	339	339	339	339	339
3.6	C,D K,M	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369
3.9	C,D K,M	399	399	399	399	399	399	399	399	399	399	399	399	399	399	399	399	399	399	399	399	399	399
4.3	C,D K,M	439	439	439	439	439	439	439	439	439	439	439	439	439	439	439	439	439	439	439	439	439	439
4.7	C,D K,M	479	479	479	479	479	479	479	479	479	479	479	479	479	479	479	479	479	479	479	479	479	479
5.1	C,D K,M	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519
5.6	C,D J,K,M	569	569	569	569	569	569	569	569	569	569	569	569	569	569	569	569	569	569	569	569	569	569
6.2	C,D J,K,M	629	629	629	629	629	629	629	629	629	629	629	629	629	629	629	629	629	629	629	629	629	629
6.8	C,D J,K,M	689	689	689	689	689	689	689	689	689	689	689	689	689	689	689	689	689	689	689	689	689	689
7.5	C,D J,K,M	759	759	759	759	759	759	759	759	759	759	759	759	759	759	759	759	759	759	759	759	759	759
8.2	C,D J,K,M	829	829	829	829	829	829	829	829	829	829	829	829	829	829	829	829	829	829	829	829	829	829
9.1	C,D J,K,M	919	919	919	919	919	919	919	919	919	919	919	919	919	919	919	919	919	919	919	919	919	919
10	C,D J,K,M	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
11	C,D J,K,M	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110
12	C,D J,K,M	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
13	C,D J,K,M	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130
15	C,D G,J,K,M	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
16	C,D G,J,K,M	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
18	C,D G,J,K,M	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180
20	C,D G,J,K,M	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
22	C,D G,J,K,M	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220
24	C,D G,J,K,M	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240
27	D,F,G,J,K,M	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270
30	D,F,G,J,K,M	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300
33	D,F,G,J,K,M	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330
36	D,F,G,J,K,M	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360
39	D,F,G,J,K,M	390	390	390	390	390	390	390	390	390	390	390	390	390	390	390	390	390	390	390	390	390	390
43	D,F,G,J,K,M	430	430	430	430	430	430	430	430	430	430	430	430	430	430	430	430	430	430	430	430	430	430
47	D,F,G,J,K,M	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470
51	D,F,G,J,K,M	510	510	510	510	510	510	510	510	510	510	510	510	510	510	510	510	510	510	510	510	510	510
56	F,G,J,K,M	560	560	560	560	560	560	560	560	560	560	560	560	560	560	560	560	560	560	560	560	560	560
62	F,G,J,K,M	620	620	620	620	620	620	620	620	620	620	620	620	620	620	620	620	620	620	620	620	620	620
68	F,G,J,K,M	680	680	680	680	680	680	680	680	680	680	680	680	680	680	680	680	680	680	680	680	680	680
75	F,G,J,K,M	750	750	750		750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750
82	F,G,J,K,M	820	820	820		820	820	820	820	820	820	820	820	820	820	820	820	820	820	820	820	820	820
91	F,G,J,K,M	910	910	910		910	910	910	910	910		910	910	910	910	910	910	910	910	910	910	910	910
100	F,G,J,K,M	101	101	101		101	101	101	101	101		101	101	101	101	101	101	101	101	101	101	101	101
110	F,G,J,K,M					111	111	111	111	111		111	111	111	111	111	111	111	111	111	111	111	111
120	F,G,J,K,M					121	121	121	121	121		121	121	121	121	121	121	121	121	121	121	121	121
130	F,G,J,K,M					131	131	131	131	131		131	131	131	131	131	131	131	131	131	131	131	131
150	F,G,J,K,M					151	151	151	151	151		151	151	151	151	151	151	151	151	151	151	151	151
160	F,G,J,K,M					161	161	161	161	161		161	161	161	161	161	161	161	161	161	161	161	161
180	F,G,J,K,M					181	181	181	181	181		181	181	181	181	181	181	181	181	181	181	181	181
200	F,G,J,K,M					201	201	201	201			201	201	201	201	201	201	201	201	201	201	201	201
220	F,G,J,K,M					221	221	221	221			221	221	221	221	221	221	221	221	221	221	221	221
240	F,G,J,K,M					241	241	241	241			241	241	241	241	241	241	241	241	241	241	241	241
270	F,G,J,K,M					271	271	271	271			271	271	271	271	271	271	271	271	271	271	271	271
300	F,G,J,K,M					301	301	301	301			301	301	301	301	301	301	301	301	301	301	301	301
330	F,G,J,K,M					331	331	331	331			331	331	331	331	331	331	331	331	331	331	331	331
360	F,G,J,K,M					361	361	361	361			361	361	361	361	361	361	361	361	361	361	361	361
390	F,G,J,K,M					391	391	391	391			391	391	391	391	391	391	391	391	391	391	391	391
430	F,G,J,K,M					431	431	431	431			431	431	431	431	431	431	431	431	431	431	431	431
470	F,G,J,K,M					471	471	471	471			471	471	471	471	471	471	471	471	471	471	471	471
510	F,G,J,K,M					511	511	511	511			511	511	511	511	511		511	511	511	511	511	511
560	F,G,J,K,M					561	561	561				561	561	561	561	561		561	561	561	561	561	561
620	F,G,J,K,M					621	621	621				621	621	621	621	621		621	621	621	621	621	621
680	F,G,J,K,M					681	681	681				681	681	681	681	681		681	681	681	681	681	681
750	F,G,J,K,M					751	751	751				751	751	751	751	751		751	751	751	751	751	751
820	F,G,J,K,M					821	821	821				821	821	821	821	821		821	821	821	821	821	821
910	F,G,J,K,M					911	911	911				911	911	911	911	911		911	911	911	911	911	911
1000	F,G,J,K,M					102	102	102				102	102	102	102	102		102	102	102	102	102	102
1100	F,G,J,K,M											112	112	112	112			112	112	112	112	112	112
1200	F,G,J,K,M											122	122	122	122			122	122	122	122	122	122
1300	F,G,J,K,M											132	132	132	132			132	132	132	132	132	132
1500	F,G,J,K,M											152	152	152	152			152	152	152	152	152	152
1600	F,G,J,K,M											162	162	162	162			162	162	162	162	162	162
1800	F,G,J,K,M											182	182	182	182			182	182	182	182	182	182
2000	F,G,J,K,M											202	202	202				202	202	202	202	202	
2200	F,G,J,K,M											222	222	222				222	222	222	222	222	
2400	F,G,J,K,M											242	242	242				242	242	242	242	242	
2700	F,G,J,K,M											272	272	272				272	272	272	272	272	
3000	F,G,J,K,M											302	302	302				302	302	302	302	302	
3300	F,G,J,K,M											332	332	332				332	332	332	332	332	
3600	F,G,J,K,M											362	362	362				362	362	362	362	362	
3900	F,G,J,K,M											392	392	392				392	392	392	392	392	
4300	F,G,J,K,M																	432	432	432	432		
4700	F,G,J,K,M																	472	472	472	472		
5100	F,G,J,K,M																	512	512	512	512		
5600	F,G,J,K,M																	562	562	562	562		
6200	F,G,J,K,M																	622	622	622			
6800	F,G,J,K,M																	682	682	682			
7500	F,G,J,K,M																	752	752	752			
8200	F,G,J,K,M																	822	822	822			
9100	F,G,J,K,M																	912	912	912			
10,000	F,G,J,K,M																	103	103	103			

*** Indicates EIA preferred chip sizes.**
NOTE: For non-standard capacitance values or voltages, contact your local KEMET sales representative.
50 Volt Ceramic Chips can be used in 63 volt applications.

C0G CAPACITANCE RANGE – 1210, 1812, 1825, 2220, 2225

CAP. PF	CAP. TOL.	C1210*			C1812*			C1825*			C2220			C2225		
		50V	100V	200V	50V	100V	200V	50V	100V	200V	50V	100V	200V	50V	100V	200V
10	C,D J,K,M	100	100	100												
12	C,D J,K,M	120	120	120												
15	C,D G,J,K,M	150	150	150												
18	C,D G,J,K,M	180	180	180												
22	C,D G,J,K,M	220	220	220												
27	D,F,G,J,K,M	270	270	270												
33	D,F,G,J,K,M	330	330	330												
39	D,F,G,J,K,M	390	390	390												
47	D,F,G,J,K,M	470	470	470												
56	F,G,J,K,M	560	560	560												
68	F,G,J,K,M	680	680	680												
82	F,G,J,K,M	820	820	820												
100	F,G,J,K,M	101	101	101												
120	F,G,J,K,M	121	121	121												
150	F,G,J,K,M	151	151	151												
180	F,G,J,K,M	181	181	181												
220	F,G,J,K,M	221	221	221												
270	F,G,J,K,M	271	271	271												
330	F,G,J,K,M	331	331	331												
390	F,G,J,K,M	391	391	391												
470	F,G,J,K,M	471	471	471	471	471	471									
560	F,G,J,K,M	561	561	561	561	561	561									
680	F,G,J,K,M	681	681	681	681	681	681									
820	F,G,J,K,M	821	821	821	821	821	821									
1000	F,G,J,K,M	102	102	102	102	102	102									
1200	F,G,J,K,M	122	122	122	122	122	122									
1500	F,G,J,K,M	152	152	152	152	152	152									
1800	F,G,J,K,M	182	182	182	182	182	182									
2200	F,G,J,K,M	222	222	222	222	222	222									
2700	F,G,J,K,M	272	272	272	272	272	272									
3300	F,G,J,K,M	332	332	332	332	332	332									
3900	F,G,J,K,M	392	392		392	392	392	392	392	392						
4700	F,G,J,K,M	472	472		472	472	472	472	472	472				472	472	472
5600	F,G,J,K,M	562	562		562	562	562	562	562	562				562	562	562
6800	F,G,J,K,M	682	682		682	682	682	682	682	682	682	682		682	682	682
8200	F,G,J,K,M	822			822	822		822	822	822	822	822		822	822	822
10,000	F,G,J,K,M	103			103	103		103	103	103	103	103		103	103	103
12,000	F,G,J,K,M	123						123	123	123	123	123		123	123	123
15,000	F,G,J,K,M							153	153		153	153		153	153	153
18,000	F,G,J,K,M							183	183		183	183		183	183	
22,000	F,G,J,K,M							223	223		223			223	223	
27,000	F,G,J,K,M							273	273		273			273	273	
33,000	F,G,J,K,M													333		

X7R CAPACITANCE RANGE – 0402, 0603, 0805, 1206

CAP. PF	CAP. TOL.	C0402*					C0603*							C0805*							C1206*						
		6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V	100V	200V	6.3V	10V	16V	25V	50V	100V	200V	6.3V	10V	16V	25V	50V	100V	200V
150	K,M,J	151	151	151	151	151																					
180	K,M,J	181	181	181	181	181	181	181	181	181	181	181	181														
220	K,M,J	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221							
270	K,M,J	271	271	271	271	271	271	271	271	271	271	271	271	271	271	271	271	271	271	271							
330	K,M,J	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331							
390	K,M,J	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391							
470	K,M,J	471	471	471	471	471	471	471	471	471	471	471	471	471	471	471	471	471	471	471							
560	K,M,J	561	561	561	561	561	561	561	561	561	561	561	561	561	561	561	561	561	561	561							
680	K,M,J	681	681	681	681	681	681	681	681	681	681	681	681	681	681	681	681	681	681	681							
820	K,M,J	821	821	821	821	821	821	821	821	821	821	821	821	821	821	821	821	821	821	821							
1000	K,M,J	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
1200	K,M,J	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122
1500	K,M,J	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152
1800	K,M,J	182	182	182	182		182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182
2200	K,M,J	222	222	222	222		222	222	222	222	222	222	222	222	222	222	222	222	222	222	222	222	222	222	222	222	222
2700	K,M,J	272	272	272	272		272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272
3300	K,M,J	332	332	332	332		332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332
3900	K,M,J	392	392	392	392		392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392
4700	K,M,J	472	472	472	472		472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472
5600	K,M,J	562	562	562	562		562	562	562	562	562	562		562	562	562	562	562	562	562	562	562	562	562	562	562	562
6800	K,M,J	682	682	682	682		682	682	682	682	682	682		682	682	682	682	682	682	682	682	682	682	682	682	682	682
8200	K,M,J	822	822	822	822		822	822	822	822	822	822		822	822	822	822	822	822		822	822	822	822	822	822	822
10,000	K,M,J	103	103	103	103		103	103	103	103	103			103	103	103	103	103	103		103	103	103	103	103	103	103
12,000	K,M,J						123	123	123	123	123#			123	123	123	123	123	123		123	123	123	123	123	123	123
15,000	K,M,J						153	153	153	153	153#			153	153	153	153	153	153		153	153	153	153	153	153	153
18,000	K,M,J						183	183	183	183	183#			183	183	183	183	183	183		183	183	183	183	183	183	183
22,000	K,M,J						223	223	223	223	223#			223	223	223	223	223	223		223	223	223	223	223	223	223
27,000	K,M,J						273	273	273	273				273	273	273	273	273			273	273	273	273	273	273	
33,000	K,M,J						333	333	333	333				333	333	333	333	333			333	333	333	333	333	333	
39,000	K,M,J						393	393	393	393				393	393	393	393	393			393	393	393	393	393	393	
47,000	K,M,J						473	473	473	473				473	473	473	473	473			473	473	473	473	473	473	
56,000	K,M,J						563	563	563	563				563	563	563	563	563#			563	563	563	563	563	563	
68,000	K,M,J						683	683	683	683				683	683	683	683	683#			683	683	683	683	683	683	
82,000	K,M,J						823	823	823	823				823	823	823	823	823#			823	823	823	823	823	823	
100,000	K,M,J						104#	104#	104#	104#				104	104	104	104	104#			104	104	104	104	104	104	
120,000	K,M,J						124#	124#	124#					124	124	124	124				124	124	124	124	124		
150,000	K,M,J						154#	154#	154#					154	154	154	154				154	154	154	154	154		
180,000	K,M,J						184#	184#	184#					184	184	184	184				184	184	184	184	184#		
220,000	K,M,J						224#	224#	224#					224	224	224	224				224	224	224	224	224#		
270,000	K,M,J													274	274	274	274				274	274	274	274			
330,000	K,M,J													334	334	334	334				334	334	334	334			
390,000	K,M,J													394	394	394	394				394	394	394	394			
470,000	K,M,J													474	474	474	474				474	474	474	474			
560,000	K,M,J													564	564	564					564	564	564	564			
680,000	K,M,J													684	684	684					684	684	684	684			
820,000	K,M,J													824	824	824					824	824	824	824			
1,000,000	K,M,J													105	105	105					105@	105@	105@	105@			
1,200,000	K,M,J																				125@	125@	125@				
1,500,000	K,M,J																				155@	155@	155@				
1,800,000	K,M,J																				185@	185@	185@				
2,200,000	K,M,J																				225@	225@	225@				

* Indicates EIA preferred chip sizes.
NOTE: For non-standard capacitance values or voltages, contact your local KEMET sales representative.
X7R dielectric - Extended Range Values - Cap and DF measured @ 0.5 Vrms.
@ maximum thickness 1.7mm

X7R CAPACITANCE RANGE – 1210, 1812, 1825, 2220, 2225

CAP.	CAP.	C1210*							C1812*			C1825*			C2220			C2225		
PF	TOL.	6.3V	10V	16V	25V	50V	100V	200V	50V	100V	200V	50V	100V	200V	50V	100V	200V	50V	100V	200V
2200	K,M,J	222	222	222	222	222	222	222												
2700	K,M,J	272	272	272	272	272	272	272												
3300	K,M,J	332	332	332	332	332	332	332												
3900	K,M,J	392	392	392	392	392	392	392												
4700	K,M,J	472	472	472	472	472	472	472												
5600	K,M,J	562	562	562	562	562	562	562												
6800	K,M,J	682	682	682	682	682	682	682	682	682	682									
8200	K,M,J	822	822	822	822	822	822	822	822	822	822									
10,000	K,M,J	103	103	103	103	103	103	103	103	103	103									
12,000	K,M,J	123	123	123	123	123	123	123	123	123	123									
15,000	K,M,J	153	153	153	153	153	153	153	153	153	153									
18,000	K,M,J	183	183	183	183	183	183	183	183	183	183									
22,000	K,M,J	223	223	223	223	223	223	223	223	223	223	223	223	223						
27,000	K,M,J	273	273	273	273	273	273	273	273	273	273	273	273	273						
33,000	K,M,J	333	333	333	333	333	333	333	333	333	333	333	333	333						
39,000	K,M,J	393	393	393	393	393	393	393	393	393	393	393	393	393						
47,000	K,M,J	473	473	473	473	473	473	473	473	473	473	473	473	473				473	473	473
56,000	K,M,J	563	563	563	563	563	563	563	563	563	563	563	563	563				563	563	563
68,000	K,M,J	683	683	683	683	683	683	683	683	683	683	683	683	683				683	683	683
82,000	K,M,J	823	823	823	823	823	823	823	823	823	823	823	823	823				823	823	823
100,000	K,M,J	104	104	104	104	104	104	104	104	104	104	104	104	104				104	104	104
120,000	K,M,J	124	124	124	124	124	124		124	124	124	124	124	124				124	124	124
150,000	K,M,J	154	154	154	154	154	154		154	154	154	154	154	154				154	154	154
180,000	K,M,J	184	184	184	184	184			184	184	184	184	184	184				184	184	184
220,000	K,M,J	224	224	224	224	224			224	224		224	224	224				224	224	224
270,000	K,M,J	274	274	274	274	274#			274	274		274	274	274	274	274	274	274	274	274
330,000	K,M,J	334	334	334	334	334#			334	334		334	334	334	334	334	334	334	334	334
390,000	K,M,J								394			394	394	394	394	394	394	394	394	394
470,000	K,M,J								474			474	474		474	474		474	474	474
560,000	K,M,J								564			564	564		564	564		564	564	
680,000	K,M,J								684			684	684		684	684		684	684	
820,000	K,M,J								824			824			824	824		824	824	
1,000,000	K,M,J								105			105			105			105	105	
1,200,000	K,M,J											125			125			125		
1,500,000	K,M,J											155			155			155		
1,800,000	K,M,J											185			185			185		
2,200,000	K,M,J											225			225			225		

*** Indicates EIA preferred chip sizes.**
NOTE: For non-standard capacitance values or voltages, contact your local KEMET sales representative.
50 Volt Ceramic Chips can be used for 63 volt applications.
Extended Range Values – Cap and DF measured @ 0.5 Vrms.

X5R CAPACITANCE RANGE

Cap.	Cap.	C1206				C1210				
pF	Tol.	6.3V	10V	16V	25V	6.3V	10V	16V	25V	50V
100,000	K,M				104					
150,000	K,M				154					
180,000	K,M				184					
220,000	K,M				224					
270,000	K,M				274					
330,000	K,M				334					
470,000	K,M				474					
680,000	K,M				684					
1,000,000	K,M				105			105+	105+	105+
1,500,000	K,M	155	155	155						
1,800,000	K,M	185	185	185						
2,200,000	K,M	225	225	225						
2,700,000	K,M	275	275	275						
3,300,000	K,M	335	335	335						
4,700,000	K,M	***475***	***475***	***475***		475+	475+			
6,800,000	K,M					685+	685+			
10,000,000	K,M					106+	***106+***			

NOTE: For non-standard capacitance values or voltages, contact your local KEMET sales representative.
+ Reflow only
Values in Bold Italics: C1206 - 1.91mm max. thickness; C1210 - 2.50mm max. thickness

Z5U CAPACITANCE RANGE

(KEMET's Z5U also meets Y5V Characteristics)

CAP. PF	CAP TOL	C0805*		C1206*		C1210*		C1812*		C1825*		C2225	
		50V	100V	50V	100V	50V	100V	50V	100V	50V	100V	50V	100V
6800	M,Z	682	682										
8200	M,Z	822	822										
10,000	M,Z	103	103	103	103								
12,000	M,Z	123		123	123								
15,000	M,Z	153		153	153								
18,000	M,Z	183		183	183								
22,000	M,Z	223		223	223								
27,000	M,Z	273		273	273								
33,000	M,Z	333		333	333								
39,000	M,Z	393		393	393								
47,000	M,Z	473		473	473	473	473						
56,000	M,Z	563		563	563	563	563						
68,000	M,Z	683		683	683	683	683						
82,000	M,Z	823		823	823	823	823	823	823				
100,000	M,Z	104		104	104	104	104	104	104				
120,000	M,Z			124		124	124	124	124				
150,000	M,Z			154		154	154	154	154				
180,000	M,Z			184		184		184		184	184		
220,000	M,Z			224		224		224		224	224		
270,000	M,Z					274		274		274	274		
330,000	M,Z					334		334		334	334	334	334
390,000	M,Z					394		394		394	394	394	394
470,000	M,Z					474		474		474		474	474
560,000	M,Z					564		564		564		564	
680,000	M,Z					684		684		684		684	
820,000	M,Z					824		824		824		824	
1,000,000	M,Z					105		105		105		105	
1,200,000	M,Z									125		125	
1,500,000	M,Z									155		155	
1,800,000	M,Z											185	
2,200,000	M,Z											225	

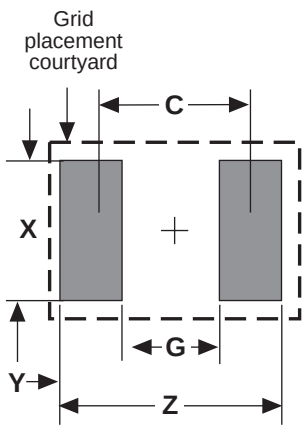
NOTE: For non-standard capacitance values or voltages, contact your local KEMET sales representative.
50 Volt Ceramic Chips can be used for 63 volt applications.
*** EIA preferred chip sizes**

Y5V CAPACITANCE RANGE

Cap. pF	Cap. Tol.	C0603				C0805					C1206					C1210				
		6.3V	10V	16V	25V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V
22,000	Z									223					223					
33,000	Z									333					333					
47,000	Z									473					473					
68,000	Z									683					683					
100,000	Z	104	104	104	104					104					104					
150,000	Z	154	154	154	154															
220,000	Z	224	224	224	224	224	224	224	224											
330,000	Z	334	334	334	334	334	334	334	334											
470,000	Z					474	474	474	474					474						
680,000	Z					684	684	684	684					684						
1,000,000	Z					105	105	105	105					105						
1,500,000	Z					***155***	***155***	***155***			155	155	155						224+	224+
2,200,000	Z					***225***	***225***	***225***			225	225	225						334+	334+
3,300,000	Z										335	335	335						474+	474+
4,700,000	Z										475	475	475			475+	475+	475+	684+	684+
6,800,000	Z										***685***	***685***				685+	685+	685+	105+	105+
10,000,000	Z										***106***	***106***				106+	106+	106+		
15,000,000	Z															***156+***	***156+***			
22,000,000	Z															***226+***	***226+***			

NOTE: For non-standard capacitance values or voltages, contact your local KEMET sales representative.
50 Volt Ceramic Chips can be used for 63 volt applications.
*** EIA preferred chip sizes**
\+ Reflow only
Values in Bold Italics: C0805 - 1.40mm max. thickness; C1206 - 1.91mm max. thickness; C1210 - 2.50mm max. thickness

SURFACE MOUNT LAND DIMENSIONS - CERAMIC CHIP CAPACITORS - MM



	Reflow Solder					Wave Solder				
Dimension	Z	G	X	Y(ref)	C(ref)	Z	G	X	Y(ref)	Smin
0402	2.14	0.28	0.74	0.93	1.21	Not Recommended				
0603	2.78	0.68	1.08	1.05	1.73	3.18	0.68	0.80	1.25	1.93
0805	3.30	0.70	1.60	1.30	2.00	3.70	0.70	1.10	1.50	2.20
1206	4.50	1.50	2.00	1.50	3.00	4.90	1.50	1.40	1.70	3.20
1210	4.50	1.50	2.90	1.50	3.00	4.90	1.50	2.00	1.70	3.20
1812	5.90	2.30	3.70	1.80	4.10	6.30	2.30	2.60	2.00	4.30
1825	5.90	2.30	6.90	1.80	4.10	Not Recommended				
2220	7.00	3.30	5.50	1.85	5.15					
2225	7.00	3.30	6.80	1.85	5.15					

Calculation Formula
Z = Lmin + 2Jt + Tt
G = Smax - 2Jh -Th
X = Wmin + 2Js + Ts
Tt, Th, Ts = Combined tolerances

FEATURES

- Four individual capacitors inside one 1206 monolithic structure
- Saves board and inventory space
- One placement instead of four - less costly
- Easier to handle and solder than 4 smaller chips
- Tape and reel per EIA 481-1

Capacitor Outline Drawing

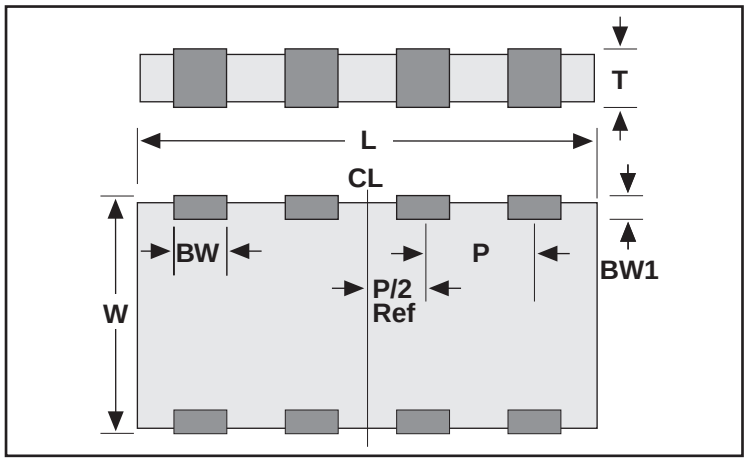


Table 1
EIA Dimensions – Millimeters (Inches)

Size Code	Length L	Width W	Thickness T (max.)	Bandwidth BW	Bandwidth BW1	Pitch P
1632	3.2 (0.126) ± 0.2 (0.008)	1.6 (.063) ± 0.2 (.008)	0.7 - 1.35 (0.027 - 0.053)	0.40 (0.016) ± 0.2 (0.008)	0.1 - 0.5 (0.004 - 0.020)	0.8 (0.031) ± 0.1 (0.004)

Notes:
1. Metric is controlling - English for reference only.
2. Pitch (P) tolerances are non-cumulative along the package.
3. Thickness (T) depends on capacitance.

Ceramic Array Ordering Information

C 1632 C 103 K 5 R A C

CERAMIC

EIA SIZE CODE
Ceramic chip array

SPECIFICATION
C - Standard

CAPACITANCE CODE
Expressed in Picofarads (pF)
First two digits represent significant figures.
Third digit specifies number of zeros. (Use 9 for 1.0 thru 9.9pF. (Example: 2.2pF = 229

CAPACITANCE TOLERANCE
K – ±10%: M – ±20% Standard Tolerances
Contact factory for any special requirements.

VOLTAGE
5 = 50v; 3 = 25v; 4 = 16v; 8=10v

TEMPERATURE CHARACTERISTIC
Designated by Capacitance Change Over Temperature Range
G – C0G (NP0) (±30 PPM/°C)
R – X7R (±15%)

FAILURE RATE LEVEL
A- Not Applicable

END METALLIZATION
C-Standard
(Tin-plated nickel barrier)

Table 2a
C0G Dielectric – Capacitance Range

Capacitance Values (pF)	KEMET Part Number	Capacitance Tolerance	10V 16V	25V	50V	100V	200V
10	C1632C100(1)(2)GAC	K,M	100	100	100	100	100
12	C1632C120(1)(2)GAC	K,M	120	120	120	120	120
15	C1632C150(1)(2)GAC	K,M	150	150	150	150	150
18	C1632C180(1)(2)GAC	K,M	180	180	180	180	180
22	C1632C220(1)(2)GAC	K,M	220	220	220	220	220
27	C1632C270(1)(2)GAC	K,M	270	270	270	270	270
33	C1632C330(1)(2)GAC	K,M	330	330	330	330	330
39	C1632C390(1)(2)GAC	K,M	390	390	390	390	390
47	C1632C470(1)(2)GAC	K,M	470	470	470	470	470
56	C1632C560(1)(2)GAC	K,M	560	560	560	560	560
68	C1632C680(1)(2)GAC	K,M	680	680	680	680	680
82	C1632C820(1)(2)GAC	K,M	820	820	820	820	820
100	C1632C101(1)(2)GAC	K,M	101	101	101	101	
120	C1632C121(1)(2)GAC	K,M	121	121	121	121	
150	C1632C151(1)(2)GAC	K,M	151	151	151	151	
180	C1632C181(1)(2)GAC	K,M	181	181	181	181	
220	C1632C221(1)(2)GAC	K,M	221	221	221		
270	C1632C271(1)(2)GAC	K,M	271	271	271		
330	C1632C331(1)(2)GAC	K,M	331	331	331		
390	C1632C391(1)(2)GAC	K,M	391	391	391		
470	C1632C471(1)(2)GAC	K,M	471	471	471		

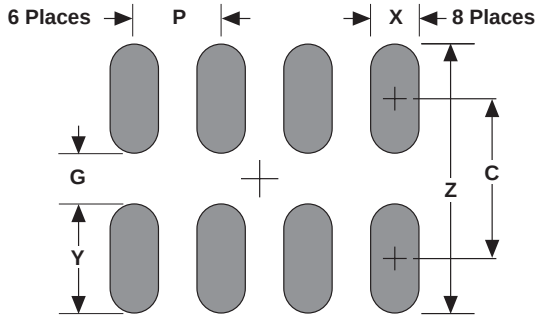
(1) To complete the KEMET part number, insert the alpha code for the tolerance desired.
K = ±10% and M = ±20% – standard tolerance. Contact factory for any special requirements.
(2) To complete the KEMET part number, insert appropriate number for voltage desired:
"5" = 50 volts, "3" = 25 volts, "4" = 16 volts, and "8" = 10 volts.

Table 2b
X7R Dielectric – Capacitance Range

Capacitance Values (pF)	KEMET Part Number	Capacitance Tolerance	10V 16V	25V	50V	100V	200V
330	C1632C331(1)(2)RAC	K,M	331	331	331	331	331
390	C1632C391(1)(2)RAC	K,M	391	391	391	391	391
470	C1632C471(1)(2)RAC	K,M	471	471	471	471	471
560	C1632C561(1)(2)RAC	K,M	561	561	561	561	561
680	C1632C681(1)(2)RAC	K,M	681	681	681	681	
820	C1632C821(1)(2)RAC	K,M	821	821	821	821	
1000	C1632C102(1)(2)RAC	K,M	102	102	102	102	
1200	C1632C122(1)(2)RAC	K,M	122	122	122	122	
1500	C1632C152(1)(2)RAC	K,M	152	152	152	152	
1800	C1632C182(1)(2)RAC	K,M	182	182	182	182	
2200	C1632C222(1)(2)RAC	K,M	222	222	222	222	
2700	C1632C272(1)(2)RAC	K,M	272	272	272	272	
3300	C1632C332(1)(2)RAC	K,M	332	332	332	332	
3900	C1632C392(1)(2)RAC	K,M	392	392	392	392	
4700	C1632C472(1)(2)RAC	K,M	472	472	472	472	
5600	C1632C562(1)(2)RAC	K,M	562	562	562		
6800	C1632C682(1)(2)RAC	K,M	682	682	682		
8200	C1632C822(1)(2)RAC	K,M	822	822	822		
10,000	C1632C103(1)(2)RAC	K,M	103	103	103		
12,000	C1632C123(1)(2)RAC	K,M	123	123	123		
15,000	C1632C153(1)(2)RAC	K,M	153	153	153		
18,000	C1632C183(1)(2)RAC	K,M	183	183	183		
22,000	C1632C223(1)(2)RAC	K,M	223	223	223		
27,000	C1632C273(1)(2)RAC	K,M	273				
33,000	C1632C333(1)(2)RAC	K,M	333				
39,000	C1632C393(1)(2)RAC	K,M	393				
47,000	C1632C473(1)(2)RAC	K,M	473				
56,000	C1632C563(1)(2)RAC	K,M	563				
68,000	C1632C683(1)(2)RAC	K,M	683				
82,000	C1632C823(1)(2)RAC	K,M	823				
100,000	C1632C104(1)(2)RAC	K,M	104				

(1) To complete the KEMET part number, insert the alpha code for the tolerance desired:
K = ±10% and M = ±20% – standard tolerances. Contact factory for any special requirements.
(2) To complete the KEMET part number, insert appropriate number for voltage desired:
"5" = 50 volts, "3" = 25 volts, "4" = 16 volts, and "8" = 10 volts.

1632 Ceramic Array Land Pattern Layout



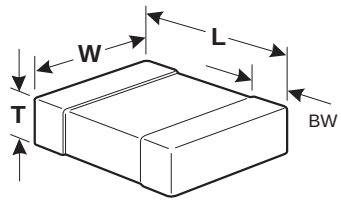
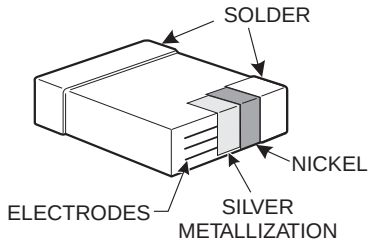
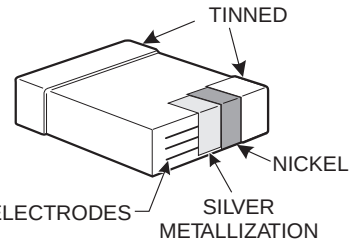
Additional pad dimension information is available in KEMET Technical Bulletin F-2100.

Land Pattern Dimensions - Ceramic Chip Capacitor Arrays - mm

	Reflow Solder				
Dimension 3216	Z 2.80	G 0.40	X 0.52	Y(ref) 1.20	C(ref) 1.60

Calculation Formula
Z = Lmin + 2Jt + Tt
G = Smax - 2Jh -Th
X = Wmin + 2Js + Ts
Tt, Th, Ts = Combined tolerances

CAPACITOR OUTLINE DRAWINGS

CHIP DIMENSIONS	"SOLDERGUARD I" *	"SOLDERGUARD II"
		
	Military Designation - "S" or "U" KEMET Designation - "H"	Military Designation - "W" or "Y" KEMET Designation - "C"

DIMENSIONS—MILLIMETERS AND (INCHES)

STYLE	KEMET SIZE CODE	L	W	T MIN.	T MAX.	BW
CDR01	C0805	2.03 ±.38 (.080 ±.015)	1.27 ±.38 (.050 ±.015)	.56 (.022)	1.40 (.055)	.51 ± 0.25 (.020 ±.010)
CDR02	C1805	4.57 .±38 (.180 ±.015)	1.27 ±.38 (.050 ±.015)	.56 (.022)	1.40 (.055)	.51 ± 0.25 (.020 ±.010)
CDR03	C1808	4.57 ±.38 (.180 ±.015)	2.03 ±.38 (.080 ±.015)	.56 (.022)	2.03 (.080)	.51 ± 0.25 (.020 ±.010)
CDR04	C1812	4.57 ±.38 (.180 ±.015)	3.18 ±.38 (.125 ±.015)	.56 (.022)	2.03 (.080)	.51 ± 0.25 (.020 ±.010)
CDR05	C1825	$4.57^{+.51}_{-.38}$ (.180 +.020 −.015)	$6.35^{+.51}_{-.38}$ (.250 +.020 −.015)	.51 (.020)	2.03 (.080)	.51 ± 0.25 (.020 ±.010)
CDR06	C2225	5.72 ±.51 (.225 ±.020)	6.35 ±.51 (.250 ±.020)	.51 (.020)	2.03 (.080)	.51 ± 0.25 (.020 ±.010)
CDR31	C0805	2.00 ±.20 (.078 ±.008)	1.25 ±.20 (.049 ±.008)		1.30 (.051)	.50 ± 0.20 (.020 ±.008)
CDR32	C1206	3.20 ±.20 (.125 ±.008)	1.60 ±.20 (.062 ±.008)		1.30 (.051)	.50 ± 0.20 (.020 ±.008)
CDR33	C1210	3.20 ±.25 (.125 ±.010)	2.50 ±.25 (.098 ±.010)		1.50 (.059)	.50 ± 0.25 (.020 ±.010)
CDR34	C1812	4.50 ±.25 (.176 ±.010)	3.20 ±.25 (.125 ±.010)		1.50 (.059)	.50 ± 0.25 (.020 ±.010)
CDR35	C1825	4.50 ±.30 (.176 ±.012)	6.40 ±.30 (.250 ±.012)		1.50 (.059)	.50 ± 0.30 (.020 ±.012)

Note: For Solderguard I (MIL-C55681 "S" or "U" Endmets), the length, width and thickness positive tolerances (including bandwidth) cited above are allowed to increase by the following amounts:

	Length	Width/Thickness
CDR01	0.51MM (.020)	0.38MM (.015)
CDR02-06	0.64MM (.025)	0.38MM (.015)
CDR31-35	0.60MM (.023)	0.30MM (.012)

MIL-PRF-55681 PART NUMBER ORDERING INFORMATION

CDR01 B P 101 B K S M

STYLE & SIZE CODE
STYLE
C — Ceramic
D — Dielectric, Fixed Chip
R — Established Reliability

RATED TEMPERATURE
–55°C to +125°C

DIELECTRICS
P — ± 30 PPM/°C—WITH OR WITHOUT VOLTAGE
X — ± 15%—without voltage
+ 15%, –25%—with voltage

CAPACITANCE
Expressed in picofarads (pF).
First 2 digits represent significant figures and the last digit specifies the number of zeros to follow.
Example: 103 — 10,000 picofarads. When nominal value is less than 10 pF, the letter "R" is used to indicate the decimal point.
Example: 1R0 — 1.0 pF; R75 — 0.75; 0R5 — 0.5 pF.

FAILURE RATE LEVEL (%/1000 hrs.)
M — 1.0 R — 0.01
P — 0.1 S — 0.001

TERMINATION FINISH
S — Solder Coated, Final (SolderGuard I)
U — Base Metalization—Barrier Metal—Solder Coated (SolderGuard I)
W — Base Metalization—Barrier Metal—Tinned Tin or (Tin/Lead Alloy) SolderGuard II
Y — Base Metalization Barrier Metal—Tinned (100% Tin) Solderguard II

CAPACITANCE TOLERANCE

B	C	D	F	J	K	M
±.1 pF	±.25 pF	±.5 pF	±1%	±5%	±10%	±20%

RATED VOLTAGE
A — 50; B — 100

KEMET/MIL-PRF-55681 PART NUMBER EQUIVALENTS

C 0805 P 101 K 1 G M C*

CERAMIC

SIZE CODE
See Table Above

SPECIFICATION
P-MIL-PRF-55681 = CDR01-CDR06
N-MIL-PRF-55681 = CDR31-CDR35

CAPACITANCE CODE
Expressed in picofarads (pF).
First two digits represent significant figures.
Third digit specifies number of zeros. (Use 9 for 1.0 thru 9.9 pF. Example: 2.2 pF –229)

CAPACITANCE TOLERANCE

B	C	D	F	J	K	M
±.1 pF	±.25 pF	±.5 pF	±1%	±5%	±10%	±20%

END METALIZATION
C — SolderGuard II (Military equiv: Y, W)
H — SolderGuard I (Military equiv: S, U)

FAILURE RATE (%/1,000 hrs.)
M — 1.0 R — 0.01
P — 0.1 S — 0.001

VOLTAGE TEMPERATURE CHARACTERISTIC
Designated by Capacitance Change Over Temperature Range
G — BP (C0G/NP0) (±30 PPM/°C)
X — BX (±15% Without Voltage +15% — 25% With Voltage)

VOLTAGE
1 — 100V, 5 — 50V

*** Part Number Example: C0805P101K1GMC (14 digits - no spaces)**

RATINGS & PART NUMBER REFERENCE

CHARACTERISTIC	CAP. pF	AVAIL. TOL.	KEMET CAPACITORS	MIL-PRF-55681 PART NUMBER
100 Volt — C0805 SIZE (MILITARY CDR01)				
BP	10	J,K	C0805P100(3)1G(4)C	CDR01BP100B(3)W(4)
	12	J	C0805P120J1G(4)C	CDR01BP120BJW(4)
	15	J,K	C0805P150(3)1G(4)C	CDR01BP150B(3)W(4)
	18	J	C0805P180J1G(4)C	CDR01BP180BJW(4)
	22	J,K	C0805P220(3)1G(4)C	CDR01BP220B(3)W(4)
	27	J	C0805P270J1G(4)C	CDR01BP270BJW(4)
	33	J,K	C0805P330(3)1G(4)C	CDR01BP330B(3)W(4)
	39	J	C0805P390J1G(4)C	CDR01BP390BJW(4)
	47	J,K	C0805P470(3)1G(4)C	CDR01BP470B(3)W(4)
	56	J	C0805P560J1G(4)C	CDR01BP560BJW(4)
	68	J,K	C0805P680(3)1G(4)C	CDR01BP680B(3)W(4)
	82	J	C0805P820J1G(4)C	CDR01BP820BJW(4)
	100	J,K	C0805P101(3)1G(4)C	CDR01BP101B(3)W(4)
BP or BX	120	J,K	C0805P121(3)1(2)(4)C	CDR01B(1)121B(3)W(4)
	150	J,K	C0805P151(3)1(2)(4)C	CDR01B(1)151B(3)W(4)
	180	J,K	C0805P181(3)1(2)(4)C	CDR01B(1)181B(3)W(4)
BX	220	K,M	C0805P221(3)1X(4)C	CDR01BX221B(3)W(4)
	270	K	C0805P271K1X(4)C	CDR01BX271BKW(4)
	330	K,M	C0805P331(3)1X(4)C	CDR01BX331B(3)W(4)
	390	K	C0805P391K1X(4)C	CDR01BX391BKW(4)
	470	K,M	C0805P471(3)1X(4)C	CDR01BX471B(3)W(4)
	560	K	C0805P561K1X(4)C	CDR01BX561BKW(4)
	680	K,M	C0805P681(3)1X(4)C	CDR01BX681B(3)W(4)
	820	K	C0805P821K1X(4)C	CDR01BX821BKW(4)
	1,000	K,M	C0805P102(3)1X(4)C	CDR01BX102B(3)W(4)
	1,200	K	C0805P122K1X(4)C	CDR01BX122BKW(4)
	1,500	K,M	C0805P152(3)1X(4)C	CDR01BX152B(3)W(4)
	1,800	K	C0805P182K1X(4)C	CDR01BX182BKW(4)
	2,200	K,M	C0805P222(3)1X(4)C	CDR01BX222B(3)W(4)
	2,700	K	C0805P272K1X(4)C	CDR01BX272BKW(4)
	3,300	K,M	C0805P332(3)1X(4)C	CDR01BX332B(3)W(4)
50 Volt — C0805 SIZE (MILITARY CDR01)				
BX	3,900	K	C0805P392K5X(4)C	CDR01BX392AKW(4)
	4,700	K,M	C0805P472(3)5X(4)C	CDR01BX472A(3)W(4)
100 Volt — C1805 SIZE (MILITARY CDR02)				
BP	220	J,K	C1805P221(3)1G(4)C	CDR02BP221B(3)W(4)
	270	J	C1805P271J1G(4)C	CDR02BP271BJW(4)
BX	3,900	K	C1805P392K1X(4)C	CDR02BX392BKW(4)
	4,700	K,M	C1805P472(3)1X(4)C	CDR02BX472B(3)W(4)
	5,600	K	C1805P562K1X(4)C	CDR02BX562BKW(4)
	6,800	K,M	C1805P682(3)1X(4)C	CDR02BX682B(3)W(4)
	8,200	K	C1805P822K1X(4)C	CDR02BX822BKW(4)
	10,000	K,M	C1805P103(3)1X(4)C	CDR02BX103B(3)W(4)
50 Volt — C1805 SIZE (MILITARY CDR02)				
BX	12,000	K	C1805P123K5X(4)C	CDR02BX123AKW(4)
	15,000	K,M	C1805P153(3)5X(4)C	CDR02BX153A(3)W(4)
	18,000	K	C1805P183K5X(4)C	CDR02BX183AKW(4)
	22,000	K,M	C1805P223(3)5X(4)C	CDR02BX223A(3)W(4)
100 Volt — C1808 SIZE (MILITARY CDR03)				
BP	330	J,K	C1808P331(3)1G(4)C	CDR03BP331B(3)W(4)
	390	J	C1808P391J1G(4)C	CDR03BP391BJW(4)
	470	J,K	C1808P471(3)1G(4)C	CDR03BP471B(3)W(4)

CHARACTERISTIC	CAP. pF	AVAIL. TOL.	KEMET CAPACITORS	MIL-PRF-55681 PART NUMBER
100 Volt — C1808 SIZE (MILITARY CDR03) (Cont'd)				
BP	560	J	C1808P561J1G(4)C	CDR03BP561BJW(4)
	680	J,K	C1808P681(3)1G(4)C	CDR03BP681B(3)W(4)
	820	J	C1808P821J1G(4)C	CDR03BP821BJW(4)
	1,000	J,K	C1808P102(3)1G(4)C	CDR03BP102B(3)W(4)
BX	12,000	K	C1808P123K1X(4)C	CDR03BX123BKW(4)
	15,000	K,M	C1808P153(3)1X(4)C	CDR03BX153B(3)W(4)
	18,000	K	C1808P183K1X(4)C	CDR03BX183BKW(4)
	22,000	K,M	C1808P223(3)1X(4)C	CDR03BX223B(3)W(4)
	27,000	K	C1808P273K1X(4)C	CDR03BX273BKW(4)
	33,000	K,M	C1808P333(3)1X(4)C	CDR03BX333B(3)W(4)
50 Volt — C1808 SIZE (MILITARY CDR03)				
BX	39,000	K	C1808P393K5X(4)C	CDR03BX393AKW(4)
	47,000	K,M	C1808P473(3)5X(4)C	CDR03BX473A(3)W(4)
	56,000	K	C1808P563K5X(4)C	CDR03BX563AKW(4)
	68,000	K,M	C1808P683(3)5X(4)C	CDR03BX683A(3)W(4)
100 Volt — C1812 SIZE (MILITARY CDR04)				
BP	1,200	J	C1812P122J1G(4)C	CDR04BP122BJW(4)
	1,500	J,K	C1812P152(3)1G(4)C	CDR04BP152B(3)W(4)
	1,800	J	C1812P182J1G(4)C	CDR04BP182BJW(4)
	2,200	J,K	C1812P222(3)1G(4)C	CDR04BP222B(3)W(4)
	2,700	J	C1812P272J1G(4)C	CDR04BP272BJW(4)
	3,300	J,K	C1812P332(3)1G(4)C	CDR04BP332B(3)W(4)
BX	39,000	K	C1812P393K1X(4)C	CDR04BX393BKW(4)
	47,000	K,M	C1812P473(3)1X(4)C	CDR04BX473B(3)W(4)
	56,000	K	C1812P563K1X(4)C	CDR04BX563BKW(4)
50 Volt — C1812 SIZE (MILITARY CDR04)				
BX	82,000	K	C1812P823K5X(4)C	CDR04BX823AKW(4)
	100,000	K,M	C1812P104(3)5X(4)C	CDR04BX104A(3)W(4)
	120,000	K	C1812P124K5X(4)C	CDR04BX124AKW(4)
	150,000	K,M	C1812P154(3)5X(4)C	CDR04BX154A(3)W(4)
	180,000	K	C1812P184K5X(4)C	CDR04BX184AKW(4)
100 Volt — C1825 SIZE (MILITARY CDR05)				
BP	3,900	J,K	C1825P392(3)1G(4)C	CDR05BP392B(3)W(4)
	4,700	J,K	C1825P472(3)1G(4)C	CDR05BP472B(3)W(4)
	5,600	J,K	C1825P562(3)1G(4)C	CDR05BP562B(3)W(4)
BX	68,000	K,M	C1825P683(3)1X(4)C	CDR05BX683B(3)W(4)
	82,000	K	C1825P823K1X(4)C	CDR05BX823BKW(4)
	100,000	K,M	C1825P104(3)1X(4)C	CDR05BX104B(3)W(4)
	120,000	K	C1825P124K1X(4)C	CDR05BX124BKW(4)
	150,000	K,M	C1825P154(3)1X(4)C	CDR05BX154B(3)W(4)
50 Volt — C1825 SIZE (MILITARY CDR05)				
BX	220,000	K,M	C1825P224(3)5X(4)C	CDR05BX224A(3)W(4)
	270,000	K	C1825P274K5X(4)C	CDR05BX274AKW(4)
	330,000	K,M	C1825P334(3)5X(4)C	CDR05BX334A(3)W(4)
100 Volt — C2225 SIZE (MILITARY CDR06)				
BP	6,800	J,K	C2225P682(3)1G(4)C	CDR06BP682B(3)W(4)
	8,200	J,K	C2225P822(3)1G(4)C	CDR06BP822B(3)W(4)
	10,000	J,K	C2225P103(3)1G(4)C	CDR06BP103B(3)W(4)
50 Volt — C2225 SIZE (MILITARY CDR06)				
BX	390,000	K	C2225P394K5X(4)C	CDR06BX394AKW(4)
	470,000	K,M	C2225P474(3)5X(4)C	CDR06BX474A(3)W(4)

(1) To complete Part Number for Dielectric, insert P or X symbol – as defined by Military specification.
(2) To complete Part Number for Dielectric, insert G or X symbol. ("G" for Military "BP," or "X" for Military "BX.")
(3) To complete Part Number, insert Capacitance Tolerance Symbol (when applicable) as available in MIL-PRF-55681: B – ±0.1 pF, C – ±0.25 pF, D – ±0.5pF, F – ±1%, J – ±5%, K – ±10%, M – ±20%. **NOTE: Available tolerances are listed in columns above.**
(4) To complete Part Number, insert Failure Rate Symbol: M –1.0%; P –0.1%; R –0.01%; S –.001%.

Note: All MIL-PRF-55681 and KEMET Part Numbers tabulated above assume use of Solderguard II (MIL-PRF-55681 "W"; KEMET "C") end metalization. If MIL-PRF-55681 "U" or "S" (KEMET "H") or MIL-PRF-55681 "Y" (KEMET "C") is required, please change designators accordingly.

RATINGS & PART NUMBER REFERENCE

CAP. pF	AVAIL. TOL.	KEMET CAPACITORS	MIL-PRF-55681 PART NUMBER
100 Volt — BP — C0805 SIZE (MILITARY CDR31)			
1.0	B,C	C0805N109(3)1G(4)C	CDR31BP1R0B(3)W(4)
1.1	B,C	C0805N119(3)1G(4)C	CDR31BP1R1B(3)W(4)
1.2	B,C	C0805N129(3)1G(4)C	CDR31BP1R2B(3)W(4)
1.3	B,C	C0805N139(3)1G(4)C	CDR31BP1R3B(3)W(4)
1.5	B,C	C0805N159(3)1G(4)C	CDR31BP1R5B(3)W(4)
1.6	B,C	C0805N169(3)1G(4)C	CDR31BP1R6B(3)W(4)
1.8	B,C	C0805N189(3)1G(4)C	CDR31BP1R8B(3)W(4)
2.0	B,C	C0805N209(3)1G(4)C	CDR31BP2R0B(3)W(4)
2.2	B,C	C0805N229(3)1G(4)C	CDR31BP2R2B(3)W(4)
2.4	B,C	C0805N249(3)1G(4)C	CDR31BP2R4B(3)W(4)
2.7	B,C,D	C0805N279(3)1G(4)C	CDR31BP2R7B(3)W(4)
3.0	B,C,D	C0805N309(3)1G(4)C	CDR31BP3R0B(3)W(4)
3.3	B,C,D	C0805N339(3)1G(4)C	CDR31BP3R3B(3)W(4)
3.6	B,C,D	C0805N369(3)1G(4)C	CDR31BP3R6B(3)W(4)
3.9	B,C,D	C0805N399(3)1G(4)C	CDR31BP3R9B(3)W(4)
4.3	B,C,D	C0805N439(3)1G(4)C	CDR31BP4R3B(3)W(4)
4.7	B,C,D	C0805N479(3)1G(4)C	CDR31BP4R7B(3)W(4)
5.1	B,C,D	C0805N519(3)1G(4)C	CDR31BP5R1B(3)W(4)
5.6	B,C,D	C0805N569(3)1G(4)C	CDR31BP5R6B(3)W(4)
6.2	B,C,D	C0805N629(3)1G(4)C	CDR31BP6R2B(3)W(4)
6.8	B,C,D	C0805N689(3)1G(4)C	CDR31BP6R8B(3)W(4)
7.5	B,C,D	C0805N759(3)1G(4)C	CDR31BP7R5B(3)W(4)
8.2	B,C,D	C0805N829(3)1G(4)C	CDR31BP8R2B(3)W(4)
9.1	B,C,D	C0805N919(3)1G(4)C	CDR31BP9R1B(3)W(4)
10	F,J,K	C0805N100(3)1G(4)C	CDR31BP100B(3)W(4)
11	F,J,K	C0805N110(3)1G(4)C	CDR31BP110B(3)W(4)
12	F,J,K	C0805N120(3)1G(4)C	CDR31BP120B(3)W(4)
13	F,J,K	C0805N130(3)1G(4)C	CDR31BP130B(3)W(4)
15	F,J,K	C0805N150(3)1G(4)C	CDR31BP150B(3)W(4)
16	F,J,K	C0805N160(3)1G(4)C	CDR31BP160B(3)W(4)
18	F,J,K	C0805N180(3)1G(4)C	CDR31BP180B(3)W(4)
20	F,J,K	C0805N200(3)1G(4)C	CDR31BP200B(3)W(4)
22	F,J,K	C0805N220(3)1G(4)C	CDR31BP220B(3)W(4)
24	F,J,K	C0805N240(3)1G(4)C	CDR31BP240B(3)W(4)
27	F,J,K	C0805N270(3)1G(4)C	CDR31BP270B(3)W(4)
30	F,J,K	C0805N300(3)1G(4)C	CDR31BP300B(3)W(4)
33	F,J,K	C0805N330(3)1G(4)C	CDR31BP330B(3)W(4)
36	F,J,K	C0805N360(3)1G(4)C	CDR31BP360B(3)W(4)
39	F,J,K	C0805N390(3)1G(4)C	CDR31BP390B(3)W(4)
43	F,J,K	C0805N430(3)1G(4)C	CDR31BP430B(3)W(4)
47	F,J,K	C0805N470(3)1G(4)C	CDR31BP470B(3)W(4)
51	F,J,K	C0805N510(3)1G(4)C	CDR31BP510B(3)W(4)
56	F,J,K	C0805N560(3)1G(4)C	CDR31BP560B(3)W(4)
62	F,J,K	C0805N620(3)1G(4)C	CDR31BP620B(3)W(4)
68	F,J,K	C0805N680(3)1G(4)C	CDR31BP680B(3)W(4)
75	F,J,K	C0805N750(3)1G(4)C	CDR31BP750B(3)W(4)
82	F,J,K	C0805N820(3)1G(4)C	CDR31BP820B(3)W(4)
91	F,J,K	C0805N910(3)1G(4)C	CDR31BP910B(3)W(4)
100	F,J,K	C0805N101(3)1G(4)C	CDR31BP101B(3)W(4)
110	F,J,K	C0805N111(3)1G(4)C	CDR31BP111B(3)W(4)
120	F,J,K	C0805N121(3)1G(4)C	CDR31BP121B(3)W(4)
130	F,J,K	C0805N131(3)1G(4)C	CDR31BP131B(3)W(4)
150	F,J,K	C0805N151(3)1G(4)C	CDR31BP151B(3)W(4)
160	F,J,K	C0805N161(3)1G(4)C	CDR31BP161B(3)W(4)
180	F,J,K	C0805N181(3)1G(4)C	CDR31BP181B(3)W(4)
200	F,J,K	C0805N201(3)1G(4)C	CDR31BP201B(3)W(4)
220	F,J,K	C0805N221(3)1G(4)C	CDR31BP221B(3)W(4)
240	F,J,K	C0805N241(3)1G(4)C	CDR31BP241B(3)W(4)
270	F,J,K	C0805N271(3)1G(4)C	CDR31BP271B(3)W(4)
300	F,J,K	C0805N301(3)1G(4)C	CDR31BP301B(3)W(4)
330	F,J,K	C0805N331(3)1G(4)C	CDR31BP331B(3)W(4)
360	F,J,K	C0805N361(3)1G(4)C	CDR31BP361B(3)W(4)
390	F,J,K	C0805N391(3)1G(4)C	CDR31BP391B(3)W(4)
430	F,J,K	C0805N431(3)1G(4)C	CDR31BP431B(3)W(4)
470	F,J,K	C0805N471(3)1G(4)C	CDR31BP471B(3)W(4)
50 Volt — BP — C0805 SIZE (MILITARY CDR31)			
510	F,J,K	C0805N511(3)5G(4)C	CDR31BP511A(3)W(4)
560	F,J,K	C0805N561(3)5G(4)C	CDR31BP561A(3)W(4)
620	F,J,K	C0805N621(3)5G(4)C	CDR31BP621A(3)W(4)
680	F,J,K	C0805N681(3)5G(4)C	CDR31BP681A(3)W(4)
100 Volt — BX — C0805 SIZE (MILITARY CDR31)			
470	K,M	C0805N471(3)1X(4)C	CDR31BX471B(3)W(4)
560	K,M	C0805N561(3)1X(4)C	CDR31BX561B(3)W(4)
680	K,M	C0805N681(3)1X(4)C	CDR31BX681B(3)W(4)
820	K,M	C0805N821(3)1X(4)C	CDR31BX821B(3)W(4)
1,000	K,M	C0805N102(3)1X(4)C	CDR31BX102B(3)W(4)
1,200	K,M	C0805N122(3)1X(4)C	CDR31BX122B(3)W(4)
1,500	K,M	C0805N152(3)1X(4)C	CDR31BX152B(3)W(4)
1,800	K,M	C0805N182(3)1X(4)C	CDR31BX182B(3)W(4)
2,200	K,M	C0805N222(3)1X(4)C	CDR31BX222B(3)W(4)
2,700	K,M	C0805N272(3)1X(4)C	CDR31BX272B(3)W(4)
3,300	K,M	C0805N332(3)1X(4)C	CDR31BX332B(3)W(4)
3,900	K,M	C0805N392(3)1X(4)C	CDR31BX392B(3)W(4)
4,700	K,M	C0805N472(3)1X(4)C	CDR31BX472B(3)W(4)
50 Volt — BX — C0805 SIZE (MILITARY CDR31)			
5,600	K,M	C0805N562(3)5X(4)C	CDR31BX562A(3)W(4)
6,800	K,M	C0805N682(3)5X(4)C	CDR31BX682A(3)W(4)
8,200	K,M	C0805N822(3)5X(4)C	CDR31BX822A(3)W(4)
10,000	K,M	C0805N103(3)5X(4)C	CDR31BX103A(3)W(4)
12,000	K,M	C0805N123(3)5X(4)C	CDR31BX123A(3)W(4)
15,000	K,M	C0805N153(3)5X(4)C	CDR31BX153A(3)W(4)
18,000	K,M	C0805N183(3)5X(4)C	CDR31BX183A(3)W(4)

(1) To complete Part Number for Dielectric, insert P or X symbol – as defined by Military specification.
(2) To complete Part Number for Dielectric, insert G or X symbol. ("G" for Military "BP," or "X" for Military "BX.")
(3) To complete Part Number, insert Capacitance Tolerance Symbol (when applicable) as available in MIL-PRF-55681: B – ±0.1 pF, C – ±0.25 pF. D – ±0.5pF, F – ±1%, J – ±5%, K – ±10%, M – ±20%. **NOTE: Available tolerances are listed in columns above.**
(4) To complete Part Number, insert Failure Rate Symbol: M –1.0%; P –0.1%; R –0.01%; S –.001%.

Note: All MIL-PRF-55681 and KEMET Part Numbers tabulated above assume use of Solderguard II (MIL-PRF-55681 "W"; KEMET "C") end metallization. If MIL-PRF-55681 "U" or "S" (KEMET "H") or MIL-PRF-55681 "Y" (KEMET "C") is required, please change designators accordingly.

MARKING

See page 63 for MIL-PRF-55681 Marking

RATINGS & PART NUMBER REFERENCE

CAP. pF	AVAIL. TOL.	KEMET CAPACITORS	MIL-PRF-55681 PART NUMBER
100 Volt — BP — C1206 SIZE (MILITARY CDR32)			
1.0	B,C	C1206N109(3)1G(4)C	CDR32BP1R0B(3)W(4)
1.1	B,C	C1206N119(3)1G(4)C	CDR32BP1R1B(3)W(4)
1.2	B,C	C1206N129(3)1G(4)C	CDR32BP1R2B(3)W(4)
1.3	B,C	C1206N139(3)1G(4)C	CDR32BP1R3B(3)W(4)
1.5	B,C	C1206N159(3)1G(4)C	CDR32BP1R5B(3)W(4)
1.6	B,C	C1206N169(3)1G(4)C	CDR32BP1R6B(3)W(4)
1.8	B,C	C1206N189(3)1G(4)C	CDR32BP1R8B(3)W(4)
2.0	B,C	C1206N209(3)1G(4)C	CDR32BP2R0B(3)W(4)
2.2	B,C	C1206N229(3)1G(4)C	CDR32BP2R2B(3)W(4)
2.4	B,C	C1206N249(3)1G(4)C	CDR32BP2R4B(3)W(4)
2.7	B,C,D	C1206N279(3)1G(4)C	CDR32BP2R7B(3)W(4)
3.0	B,C,D	C1206N309(3)1G(4)C	CDR32BP3R0B(3)W(4)
3.3	B,C,D	C1206N339(3)1G(4)C	CDR32BP3R3B(3)W(4)
3.6	B,C,D	C1206N369(3)1G(4)C	CDR32BP3R6B(3)W(4)
3.9	B,C,D	C1206N399(3)1G(4)C	CDR32BP3R9B(3)W(4)
4.3	B,C,D	C1206N439(3)1G(4)C	CDR32BP4R3B(3)W(4)
4.7	B,C,D	C1206N479(3)1G(4)C	CDR32BP4R7B(3)W(4)
5.1	B,C,D	C1206N519(3)1G(4)C	CDR32BP5R1B(3)W(4)
5.6	B,C,D	C1206N569(3)1G(4)C	CDR32BP5R6B(3)W(4)
6.2	B,C,D	C1206N629(3)1G(4)C	CDR32BP6R2B(3)W(4)
6.8	B,C,D	C1206N689(3)1G(4)C	CDR32BP6R8B(3)W(4)
7.5	B,C,D	C1206N759(3)1G(4)C	CDR32BP7R5B(3)W(4)
8.2	B,C,D	C1206N829(3)1G(4)C	CDR32BP8R2B(3)W(4)
9.1	B,C,D	C1206N919(3)1G(4)C	CDR32BP9R1B(3)W(4)
10	F,J,K	C1206N100(3)1G(4)C	CDR32BP100B(3)W(4)
11	F,J,K	C1206N110(3)1G(4)C	CDR32BP110B(3)W(4)
12	F,J,K	C1206N120(3)1G(4)C	CDR32BP120B(3)W(4)
13	F,J,K	C1206N130(3)1G(4)C	CDR32BP130B(3)W(4)
15	F,J,K	C1206N150(3)1G(4)C	CDR32BP150B(3)W(4)
16	F,J,K	C1206N160(3)1G(4)C	CDR32BP160B(3)W(4)
18	F,J,K	C1206N180(3)1G(4)C	CDR32BP180B(3)W(4)
20	F,J,K	C1206N200(3)1G(4)C	CDR32BP200B(3)W(4)
22	F,J,K	C1206N220(3)1G(4)C	CDR32BP220B(3)W(4)
24	F,J,K	C1206N240(3)1G(4)C	CDR32BP240B(3)W(4)
27	F,J,K	C1206N270(3)1G(4)C	CDR32BP270B(3)W(4)
30	F,J,K	C1206N300(3)1G(4)C	CDR32BP300B(3)W(4)
33	F,J,K	C1206N330(3)1G(4)C	CDR32BP330B(3)W(4)
36	F,J,K	C1206N360(3)1G(4)C	CDR32BP360B(3)W(4)
39	F,J,K	C1206N390(3)1G(4)C	CDR32BP390B(3)W(4)
43	F,J,K	C1206N430(3)1G(4)C	CDR32BP430B(3)W(4)
47	F,J,K	C1206N470(3)1G(4)C	CDR32BP470B(3)W(4)
51	F,J,K	C1206N510(3)1G(4)C	CDR32BP510B(3)W(4)
56	F,J,K	C1206N560(3)1G(4)C	CDR32BP560B(3)W(4)
62	F,J,K	C1206N620(3)1G(4)C	CDR32BP620B(3)W(4)
68	F,J,K	C1206N680(3)1G(4)C	CDR32BP680B(3)W(4)
75	F,J,K	C1206N750(3)1G(4)C	CDR32BP750B(3)W(4)
82	F,J,K	C1206N820(3)1G(4)C	CDR32BP820B(3)W(4)
91	F,J,K	C1206N910(3)1G(4)C	CDR32BP910B(3)W(4)
100	F,J,K	C1206N101(3)1G(4)C	CDR32BP101B(3)W(4)
110	F,J,K	C1206N111(3)1G(4)C	CDR32BP111B(3)W(4)
120	F,J,K	C1206N121(3)1G(4)C	CDR32BP121B(3)W(4)
130	F,J,K	C1206N131(3)1G(4)C	CDR32BP131B(3)W(4)
150	F,J,K	C1206N151(3)1G(4)C	CDR32BP151B(3)W(4)
160	F,J,K	C1206N161(3)1G(4)C	CDR32BP161B(3)W(4)
180	F,J,K	C1206N181(3)1G(4)C	CDR32BP181B(3)W(4)
200	F,J,K	C1206N201(3)1G(4)C	CDR32BP201B(3)W(4)
220	F,J,K	C1206N221(3)1G(4)C	CDR32BP221B(3)W(4)
240	F,J,K	C1206N241(3)1G(4)C	CDR32BP241B(3)W(4)
270	F,J,K	C1206N271(3)1G(4)C	CDR32BP271B(3)W(4)
300	F,J,K	C1206N301(3)1G(4)C	CDR32BP301B(3)W(4)
330	F,J,K	C1206N331(3)1G(4)C	CDR32BP331B(3)W(4)
360	F,J,K	C1206N361(3)1G(4)C	CDR32BP361B(3)W(4)
390	F,J,K	C1206N391(3)1G(4)C	CDR32BP391B(3)W(4)
430	F,J,K	C1206N431(3)1G(4)C	CDR32BP431B(3)W(4)
470	F,J,K	C1206N471(3)1G(4)C	CDR32BP471B(3)W(4)
510	F,J,K	C1206N511(3)1G(4)C	CDR32BP511B(3)W(4)
560	F,J,K	C1206N561(3)1G(4)C	CDR32BP561B(3)W(4)
620	F,J,K	C1206N621(3)1G(4)C	CDR32BP621B(3)W(4)
680	F,J,K	C1206N681(3)1G(4)C	CDR32BP681B(3)W(4)
750	F,J,K	C1206N751(3)1G(4)C	CDR32BP751B(3)W(4)
820	F,J,K	C1206N821(3)1G(4)C	CDR32BP821B(3)W(4)
910	F,J,K	C1206N911(3)1G(4)C	CDR32BP911B(3)W(4)
1,000	F,J,K	C1206N102(3)1G(4)C	CDR32BP102B(3)W(4)
50 Volt — BP — C1206 SIZE (MILITARY CDR32)			
1,100	F,J,K	C1206N112(3)5G(4)C	CDR32BP112A(3)W(4)
1,200	F,J,K	C1206N122(3)5G(4)C	CDR32BP122A(3)W(4)
1,300	F,J,K	C1206N132(3)5G(4)C	CDR32BP132A(3)W(4)
1,500	F,J,K	C1206N152(3)5G(4)C	CDR32BP152A(3)W(4)
1,600	F,J,K	C1206N162(3)5G(4)C	CDR32BP162A(3)W(4)
1,800	F,J,K	C1206N182(3)5G(4)C	CDR32BP182A(3)W(4)
2,000	F,J,K	C1206N202(3)5G(4)C	CDR32BP202A(3)W(4)
2,200	F,J,K	C1206N222(3)5G(4)C	CDR32BP222A(3)W(4)
100 Volt — BX — C1206 SIZE (MILITARY CDR32)			
4,700	K,M	C1206N472(3)1X(4)C	CDR32BX472B(3)W(4)
5,600	K,M	C1206N562(3)1X(4)C	CDR32BX562B(3)W(4)
6,800	K,M	C1206N682(3)1X(4)C	CDR32BX682B(3)W(4)
8,200	K,M	C1206N822(3)1X(4)C	CDR32BX822B(3)W(4)
10,000	K,M	C1206N103(3)1X(4)C	CDR32BX103B(3)W(4)
12,000	K,M	C1206N123(3)1X(4)C	CDR32BX123B(3)W(4)
15,000	K,M	C1206N153(3)1X(4)C	CDR32BX153B(3)W(4)
50 Volt — BX — C1206 SIZE (MILITARY CDR32)			
18,000	K,M	C1206N183(3)5X(4)C	CDR32BX183A(3)W(4)
22,000	K,M	C1206N223(3)5X(4)C	CDR32BX223A(3)W(4)
27,000	K,M	C1206N273(3)5X(4)C	CDR32BX273A(3)W(4)
33,000	K,M	C1206N333(3)5X(4)C	CDR32BX333A(3)W(4)
39,000	K,M	C1206N393(3)5X(4)C	CDR32BX393A(3)W(4)

(1) To complete Part Number for Dielectric, insert P or X symbol – as defined by Military specification.
(2) To complete Part Number for Dielectric, insert G or X symbol. ("G" for Military "BP," or "X" for Military "BX.")
(3) To complete Part Number, insert Capacitance Tolerance Symbol (when applicable) as available in MIL-PRF-55681: B – ±0.1 pF, C – ±0.25 pF. D – ±0.5pF, F – ±1%, J – ±5%, K – ±10%, M – ±20%. **NOTE: Available tolerances are listed in columns above.**
(4) To complete Part Number, insert Failure Rate Symbol: M –1.0%; P –0.1%; R –0.01%; S –.001%.

Note: All MIL-PRF-55681 and KEMET Part Numbers tabulated above assume use of Solderguard II (MIL-PRF-55681 "W"; KEMET "C") end metalization. If MIL-PRF-55681 "U" or "S" (KEMET "H") or MIL-PRF-55681 "Y" (KEMET "C") is required, please change designators accordingly.

RATINGS & PART NUMBER REFERENCE

CAP. pF	AVAIL. TOL.	KEMET CAPACITORS	MIL-PRF-55681 PART NUMBER
100 Volt — BP — C1210 SIZE (MILITARY CDR33)			
1,000	F,J,K	C1210N102(3)1G(4)C	CDR33BP102B(3)W(4)
1,100	F,J,K	C1210N112(3)1G(4)C	CDR33BP112B(3)W(4)
1,200	F,J,K	C1210N122(3)1G(4)C	CDR33BP122B(3)W(4)
1,300	F,J,K	C1210N132(3)1G(4)C	CDR33BP132B(3)W(4)
1,500	F,J,K	C1210N152(3)1G(4)C	CDR33BP152B(3)W(4)
1,600	F,J,K	C1210N162(3)1G(4)C	CDR33BP162B(3)W(4)
1,800	F,J,K	C1210N182(3)1G(4)C	CDR33BP182B(3)W(4)
2,000	F,J,K	C1210N202(3)1G(4)C	CDR33BP202B(3)W(4)
2,200	F,J,K	C1210N222(3)1G(4)C	CDR33BP222B(3)W(4)
50 Volt — BP — C1210 SIZE (MILITARY CDR33)			
2,400	F,J,K	C1210N242(3)5G(4)C	CDR33BP242A(3)W(4)
2,700	F,J,K	C1210N272(3)5G(4)C	CDR33BP272A(3)W(4)
3,000	F,J,K	C1210N302(3)5G(4)C	CDR33BP302A(3)W(4)
3,300	F,J,K	C1210N332(3)5G(4)C	CDR33BP332A(3)W(4)
100 Volt — BX — C1210 SIZE (MILITARY CDR33)			
15,000	K,M	C1210N153(3)1X(4)C	CDR33BX153B(3)W(4)
18,000	K,M	C1210N183(3)1X(4)C	CDR33BX183B(3)W(4)
22,000	K,M	C1210N223(3)1X(4)C	CDR33BX223B(3)W(4)
27,000	K,M	C1210N273(3)1X(4)C	CDR33BX273B(3)W(4)
50 Volt — BX — C1210 SIZE (MILITARY CDR33)			
39,000	K,M	C1210N393(3)5X(4)C	CDR33BX393A(3)W(4)
47,000	K,M	C1210N473(3)5X(4)C	CDR33BX473A(3)W(4)
56,000	K,M	C1210N563(3)5X(4)C	CDR33BX563A(3)W(4)
68,000	K,M	C1210N683(3)5X(4)C	CDR33BX683A(3)W(4)
82,000	K,M	C1210N823(3)5X(4)C	CDR33BX823A(3)W(4)
100,000	K,M	C1210N104(3)5X(4)C	CDR33BX104A(3)W(4)
100 Volt — BP — C1812 SIZE (MILITARY CDR34)			
2,200	F,J,K	C1812N222(3)1G(4)C	CDR34BP222B(3)W(4)
2,400	F,J,K	C1812N242(3)1G(4)C	CDR34BP242B(3)W(4)
2,700	F,J,K	C1812N272(3)1G(4)C	CDR34BP272B(3)W(4)
3,000	F,J,K	C1812N302(3)1G(4)C	CDR34BP302B(3)W(4)
3,300	F,J,K	C1812N332(3)1G(4)C	CDR34BP332B(3)W(4)
3,600	F,J,K	C1812N362(3)1G(4)C	CDR34BP362B(3)W(4)
3,900	F,J,K	C1812N392(3)1G(4)C	CDR34BP392B(3)W(4)
4,300	F,J,K	C1812N432(3)1G(4)C	CDR34BP432B(3)W(4)
4,700	F,J,K	C1812N472(3)1G(4)C	CDR34BP472B(3)W(4)
50 Volt — BP — C1812 SIZE (MILITARY CDR34)			
5,100	F,J,K	C1812N512(3)5G(4)C	CDR34BP512A(3)W(4)
5,600	F,J,K	C1812N562(3)5G(4)C	CDR34BP562A(3)W(4)
6,200	F,J,K	C1812N622(3)5G(4)C	CDR34BP622A(3)W(4)
6,800	F,J,K	C1812N682(3)5G(4)C	CDR34BP682A(3)W(4)
7,500	F,J,K	C1812N752(3)5G(4)C	CDR34BP752A(3)W(4)
8,200	F,J,K	C1812N822(3)5G(4)C	CDR34BP822A(3)W(4)
9,100	F,J,K	C1812N912(3)5G(4)C	CDR34BP912A(3)W(4)
10,000	F,J,K	C1812N103(3)5G(4)C	CDR34BP103A(3)W(4)

CAP. pF	AVAIL. TOL.	KEMET CAPACITORS	MIL-PRF-55681 PART NUMBER
100 Volt — BX — C1812 SIZE (MILITARY CDR34)			
27,000	K,M	C1812N273(3)1X(4)C	CDR34BX273B(3)W(4)
33,000	K,M	C1812N333(3)1X(4)C	CDR34BX333B(3)W(4)
39,000	K,M	C1812N393(3)1X(4)C	CDR34BX393B(3)W(4)
47,000	K,M	C1812N473(3)1X(4)C	CDR34BX473B(3)W(4)
56,000	K,M	C1812N563(3)1X(4)C	CDR34BX563B(3)W(4)
50 Volt — BX — C1812 SIZE (MILITARY CDR34)			
100,000	K,M	C1812N104(3)5X(4)C	CDR34BX104A(3)W(4)
120,000	K,M	C1812N124(3)5X(4)C	CDR34BX124A(3)W(4)
150,000	K,M	C1812N154(3)5X(4)C	CDR34BX154A(3)W(4)
180,000	K,M	C1812N184(3)5X(4)C	CDR34BX184A(3)W(4)
100 Volt — BP — C1825 SIZE (MILITARY CDR35)			
4,700	F,J,K	C1825N472(3)1G(4)C	CDR35BP472B(3)W(4)
5,100	F,J,K	C1825N512(3)1G(4)C	CDR35BP512B(3)W(4)
5,600	F,J,K	C1825N562(3)1G(4)C	CDR35BP562B(3)W(4)
6,200	F,J,K	C1825N622(3)1G(4)C	CDR35BP622B(3)W(4)
6,800	F,J,K	C1825N682(3)1G(4)C	CDR35BP682B(3)W(4)
7,500	F,J,K	C1825N752(3)1G(4)C	CDR35BP752B(3)W(4)
8,200	F,J,K	C1825N822(3)1G(4)C	CDR35BP822B(3)W(4)
9,100	F,J,K	C1825N912(3)1G(4)C	CDR35BP912B(3)W(4)
10,000	F,J,K	C1825N103(3)1G(4)C	CDR35BP103B(3)W(4)
50 Volt — BP — C1825 SIZE (MILITARY CDR35)			
11,000	F,J,K	C1825N113(3)5G(4)C	CDR35BP113A(3)W(4)
12,000	F,J,K	C1825N123(3)5G(4)C	CDR35BP123A(3)W(4)
13,000	F,J,K	C1825N133(3)5G(4)C	CDR35BP133A(3)W(4)
15,000	F,J,K	C1825N153(3)5G(4)C	CDR35BP153A(3)W(4)
16,000	F,J,K	C1825N163(3)5G(4)C	CDR35BP163A(3)W(4)
18,000	F,J,K	C1825N183(3)5G(4)C	CDR35BP183A(3)W(4)
20,000	F,J,K	C1825N203(3)5G(4)C	CDR35BP203A(3)W(4)
22,000	F,J,K	C1825N223(3)5G(4)C	CDR35BP223A(3)W(4)
100 Volt — BX — C1825 SIZE (MILITARY CDR35)			
56,000	K,M	C1825N563(3)1X(4)C	CDR35BX563B(3)W(4)
68,000	K,M	C1825N683(3)1X(4)C	CDR35BX683B(3)W(4)
82,000	K,M	C1825N823(3)1X(4)C	CDR35BX823B(3)W(4)
100,000	K,M	C1825N104(3)1X(4)C	CDR35BX104B(3)W(4)
120,000	K,M	C1825N124(3)1X(4)C	CDR35BX124B(3)W(4)
150,000	K,M	C1825N154(3)1X(4)C	CDR35BX154B(3)W(4)
50 Volt — BX — C1825 SIZE (MILITARY CDR35)			
180,000	K,M	C1825N184(3)5X(4)C	CDR35BX184A(3)W(4)
220,000	K,M	C1825N224(3)5X(4)C	CDR35BX224A(3)W(4)
270,000	K,M	C1825N274(3)5X(4)C	CDR35BX274A(3)W(4)
330,000	K,M	C1825N334(3)5X(4)C	CDR35BX334A(3)W(4)
390,000	K,M	C1825N394(3)5X(4)C	CDR35BX394A(3)W(4)
470,000	K,M	C1825N474(3)5X(4)C	CDR35BX474A(3)W(4)

(1) To complete Part Number for Dielectric, insert P or X symbol – as defined by Military specification.
(2) To complete Part Number for Dielectric, insert G or X symbol. ("G" for Military "BP," or "X" for Military "BX.")
(3) To complete Part Number, insert Capacitance Tolerance Symbol (when applicable) as available in MIL-PRF-55681: B – ±0.1 pF, C – ±0.25 pF, D – ±0.5pF, F – ±1%, J – ±5%, K – ±10%, M – ±20%. **NOTE: Available tolerances are listed in columns above.**
(4) To complete Part Number, insert Failure Rate Symbol: M –1.0%; P –0.1%; R –0.01%; S –.001%.

Note: All MIL-PRF-55681 and KEMET Part Numbers tabulated above assume use of Solderguard II (MIL-PRF-55681 "W"; KEMET "C") end metallization. If MIL-PRF-55681 "U" or "S" (KEMET "H") or MIL-PRF-55681 "Y" (KEMET "C") is required, please change designators accordingly.

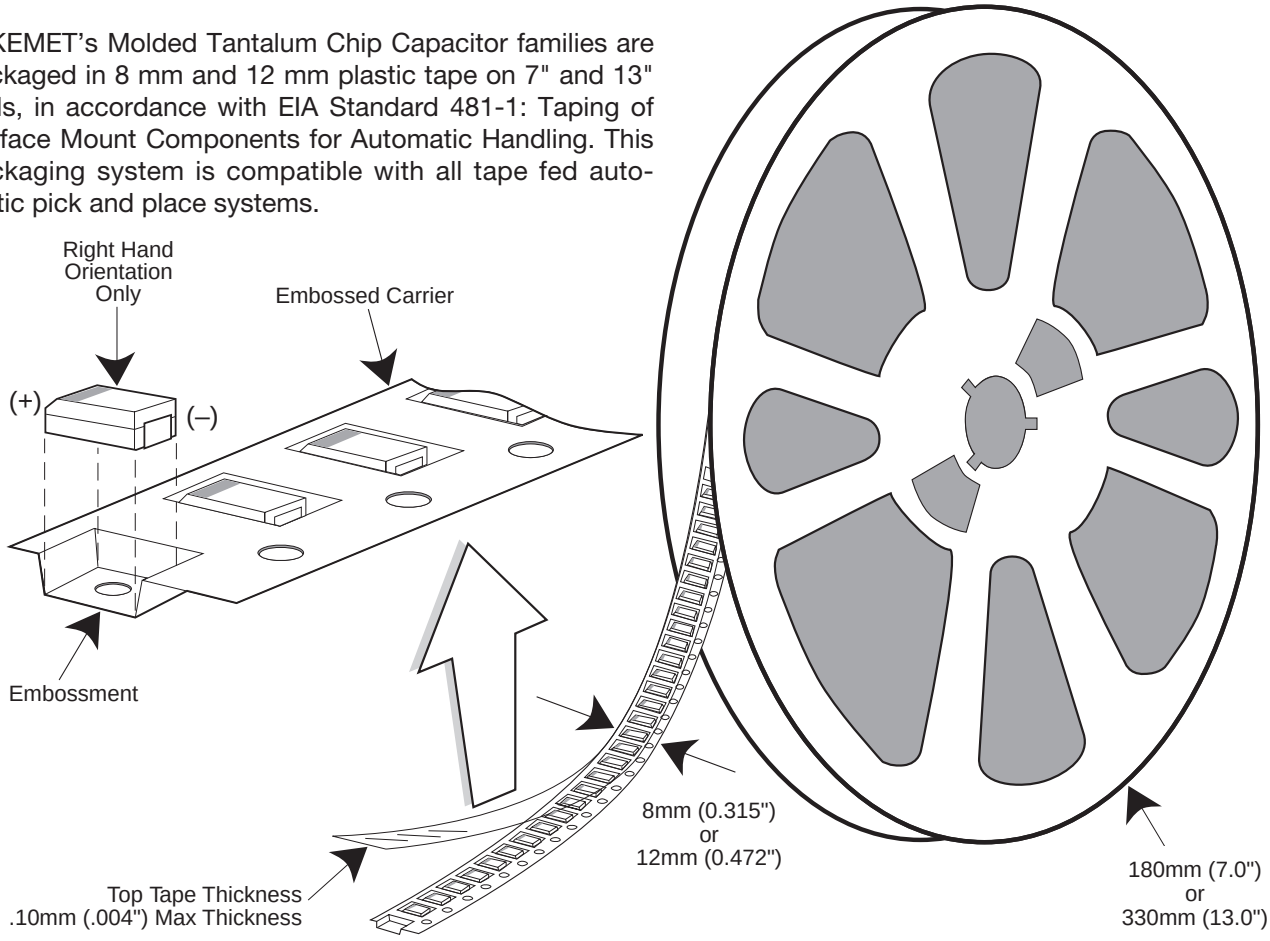
MIL-PRF-55681 MAXIMUM INDIVIDUAL PACKAGING QUANTITIES

CHIP SIZE	REELED	BULK - STD BAG	BULK - ANTI-STATIC BAG	CHIP SIZE	REELED	BULK - STD BAG	BULK - ANTI-STATIC BAG
C0805	2,500	25,000	10,000	C1808	2,500	7,500	3,000
C1206	2,500	25,000	10,000	C1812	1,100	7,500	3,000
C1210	2,500	25,000	10,000	C1825	1,100	7,500	1,000
C1805	2,500	7,500	3,000	C2225	1,100	5,000	1,000

MIL-PRF-55681 chips available in 7" reels only.

Tape & Reel Packaging

KEMET's Molded Tantalum Chip Capacitor families are packaged in 8 mm and 12 mm plastic tape on 7" and 13" reels, in accordance with EIA Standard 481-1: Taping of Surface Mount Components for Automatic Handling. This packaging system is compatible with all tape fed automatic pick and place systems.



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

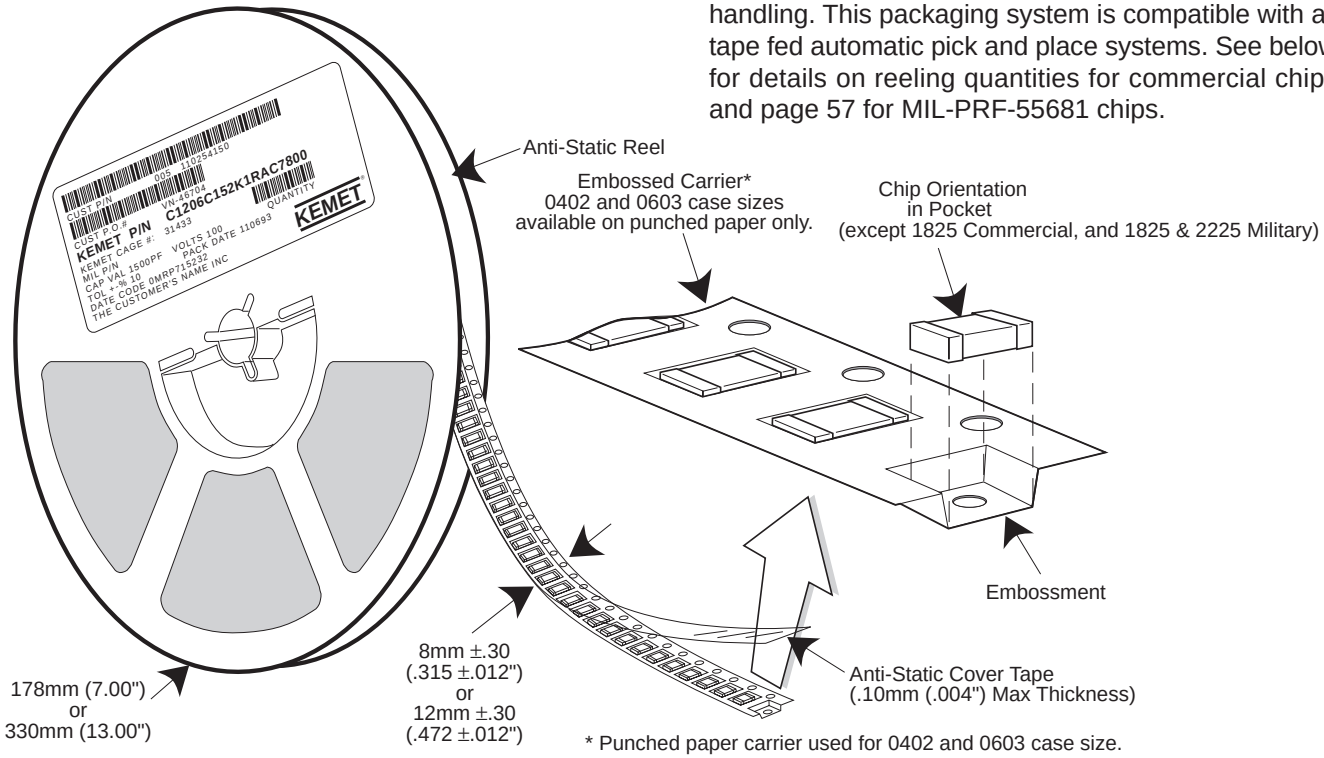
QUANTITIES PACKAGED PER REEL

Case Code		Tape Width-mm	7" Reel*	13" Reel*
KEMET	EIA			
R	2012-12	8	2,500	10,000
S	3216-12	8	2,500	10,000
T	3528-12	8	2,500	10,000
U	6032-15	12	1,000	5,000
V	7343-20	12	1,000	3,000
A	3216-18	8	2,000	9,000
B	3528-21	8	2,000	8,000
C	6032-28	12	500	3,000
D	7343-31	12	500	2,500
X	7343-43	12	500	2,000
E	7260-38	12	500	2,000

* No c-spec required for 7" reel packaging. C-7280 required for 13" reel packaging.

Tape and Reel Packaging

KEMET offers Multilayer Ceramic Chip Capacitors packaged in 8mm and 12mm plastic tape on 7" and 13" reels in accordance with EIA standard 481-1: Taping of surface mount components for automatic handling. This packaging system is compatible with all tape fed automatic pick and place systems. See below for details on reeling quantities for commercial chips and page 57 for MIL-PRF-55681 chips.



* Punched paper carrier used for 0402 and 0603 case size.

TABLE 1 - Commercial Standard Reeling Description

Tape and Reeling in Accordance with EIA 481-1 – Minimum Shipping Quantity: 1 Full Reel

Ceramic Chip Case Size/ All Dielectrics	Tape Type	Tape Width	Qty. Per 7" Reel (2) (Note Exceptions)	Qty. Per 13" Reel (2)
0402	Punched Paper (2) (4)	8 mm	10,000	50,000
0603	Punched Paper (2) (4)	8 mm	4,000	10,000
0805, 1206, 1210	Embossed Plastic (1) (2) (3)	8 mm	4,000	10,000
1812, 1825, 2220, 2225	Embossed Plastic (1) (2)	12 mm	1,000	4,000

Notes: 1. Cover Tape on embossed tape is anti-static.
2. All reels are anti-static.
3. Punched paper tape is also available for selected ratings in 0805, 1206 & 1210.
4. All standard paper tape is 4 mm pitch (distance between chips), except for 0402, which is 2 mm pitch.

TABLE 2 - Paper Tape Reeling

Dielec-tric	Volts	0402	0603	0805	1206	1210
C0G	50	All	All	508-122	109-272	100-622(2)
	100	–	All	508-821	109-122	100-182
	200	–	All	109-391	109-561	100-122
					122	
X7R	6.3/10	All	All	221-224	102-564	222-274(1)
	16	All	All	221-333	102-564	222-274(1)
				124-224		
	25	–	All	221-333	102-564	222-274(1)
				124-224		
	50	All	All	221-333	102-104	222-274(1)
	100	–	All	221-123	102-333	222-683
	200	–	All	221-682	102-223	222-393
Z5U	50	–	–	682-104	103-224	–
	100	–	–	682-103	103-393	–
Y5V	6.3/10/16	–	All	223-684	224-105	224-225
	25	–	All	223-474	224-105	224-105
	50	–	–	223-104	–	–

Capacitance codes that can be reeled in paper tape are listed above.
Note: 7" reels contain 4,000 chips in paper tape (10,000 for 0402 in 2 mm pitch)
13" reels contain 10,000 chips in paper tape (50,000 for 0402 in 2 mm pitch)
(1) Paper Tape is not available for 154-224 capacitance values
(2) Paper Tape is not available for 472 capacitance value

TABLE 3 - Exceptions to Standard Quantities Per 7" Reel

Case Size/ Dielectric	Qty. Per 7" Reel	6.3 Volts	10 Volts	16 Volts	25 Volts	50 Volts	100 Volts	200 Volts
0805/C0G	2,500					≥222	≥122	≥561
0805/X7R	2,500	≥334	≥334	≥334	≥334	≥334		
0805/Y5V	2,500			≥824				
1206/C0G	2,500					≥562	≥182*	≥102
								≥182
1206/X7R	2,500		≥824#	≥824	≥824	≥154		
1206/Y5V	2,500		≥185	≥185				
1210/C0G	2,500					≥103	≥392	≥152
1210/X7R	2,500						≥154	≥823
1210/Y5V	2,500		≥335	≥335				
1210/Y5V	2,000		≥106					
1210/X5R	2,000		≥106					

When 7" reels are ordered, cap codes equal to or higher than those in the above table will be packaged at 2,500 pieces per reel, due to the increased thickness of these higher ratings (includes any chip greater than 0.041" (1.04mm) in nominal plus tolerance thickness).
1206/125 X7R 10 volts is an exception - reeled at 4,000 per reel.
* 1206/272 C0G 100 volts is an exception - reeled at 4,000 per reel.
Note: 1210/Y5V/X5R - 13" reels - 8000 per reel
For MIL-PRF-55681 reeling see page 57.

Performance Notes

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

Tape Width	Peel Strength
8 mm	0.1 Newton to 1.0 Newton (10g to 100g)
12 mm	0.1 Newton to 1.3 Newton (10g to 130g)

   The direction of the pull shall be opposite the direction of the carrier tape travel. The pull angle of the carrier tape shall be 165° to 180° from the plane of the carrier tape. During peeling, the carrier and/or cover tape shall be pulled at a velocity of 300 ±10 mm/minute.
3. **Reel Sizes:** Molded tantalum capacitors are available on either 180 mm (7") reels (standard) or 330 mm (13") reels (with C-7280). Note that 13" reels are preferred.
4. **Labeling:** Bar code labeling (standard or custom) shall be on the side of the reel opposite the sprocket holes. Refer to EIA-556.

Embossed Carrier Tape Configuration: Figure 1

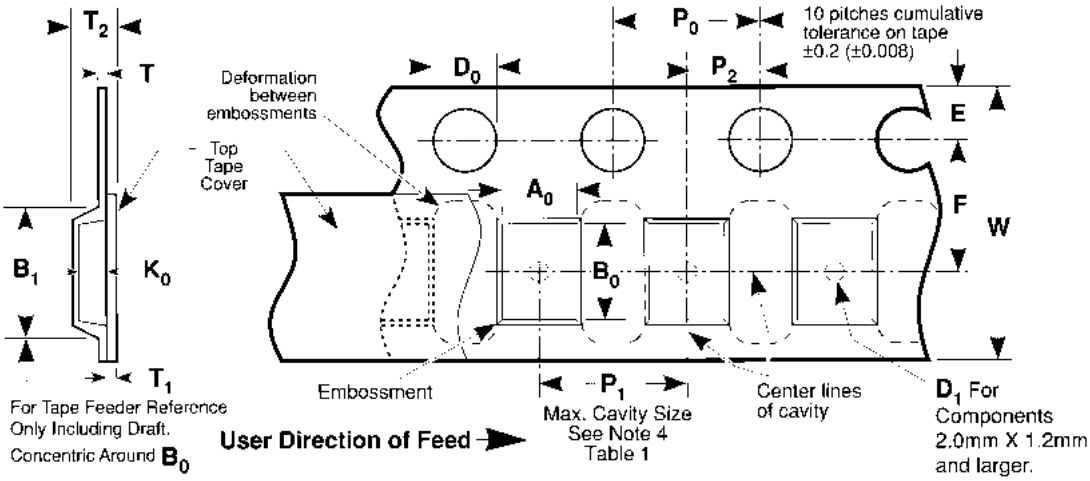


Table 1 — EMBOSSED TAPE DIMENSIONS (Metric will govern)

Constant Dimensions — Millimeters (Inches)							
Tape Size	**D_0**	**E**	**P_0**	**P_2**	**T Max**	**T_1 Max**	
8 mm and 12 mm	1.5 +0.10 -0.0 (0.059 +0.004, -0.0)	1.75 ±0.10 (0.069 ±0.004)	4.0 ±0.10 (0.157 ±0.004)	2.0 ±0.05 (0.079 ±0.002)	0.600 (0.024)	0.100 (0.004)	

Variable Dimensions — Millimeters (Inches)									
Tape Size	**Pitch**	**B_1 Max. Note 1**	**D_1 Min. Note 2**	**F**	**P_1**	**R Min. Note 3**	**T_2 Max**	**W**	**$A_0B_0K_0$ Note 4**
8 mm	Single (4 mm)	4.4 (0.173)	1.0 (0.039)	3.5 ±0.05 (0.138 ±0.002)	4.0 ±0.10 (0.157 ±0.004)	25.0 (0.984)	2.5 (0.098)	8.0 +0.3 -0.1 (0.315 +0.012, -0.004)	
12 mm	Double (8 mm)	8.2 (0.323)	1.5 (0.059)	5.5 ±0.05 (0.217 ±0.002)	8.0 ±0.10 (0.315 ±0.004)	30.0 (1.181)	4.6 (0.181)	12.0 ±0.30 (0.472 ±0.012)	

NOTES

1. B1 dimension is a reference dimension for tape feeder clearance only.
2. The embossment hole location shall be measured from the sprocket hole controlling the location of the embossment. Dimensions of embossment location and hole location shall be applied independent of each other.
3. Tape with components shall pass around radius "R" without damage (see sketch A). The minimum trailer length (Fig. 2) may require additional length to provide R min. for 12 mm embossed tape for reels with hub diameters approaching N min. (Table 2)
4. The cavity defined by A_0, B_0, and K_0 shall be configured to surround the part with sufficient clearance such that the chip does not protrude beyond the sealing plane of the cover tape, the chip can be removed from the cavity in a vertical direction without mechanical restriction, rotation of the chip is limited to 20 degrees maximum in all 3 planes, and lateral movement of the chip is restricted to 0.5 mm maximum in the pocket (not applicable to vertical clearance.)

Tantalum & Embossed Carrier Tape Configuration (cont.)

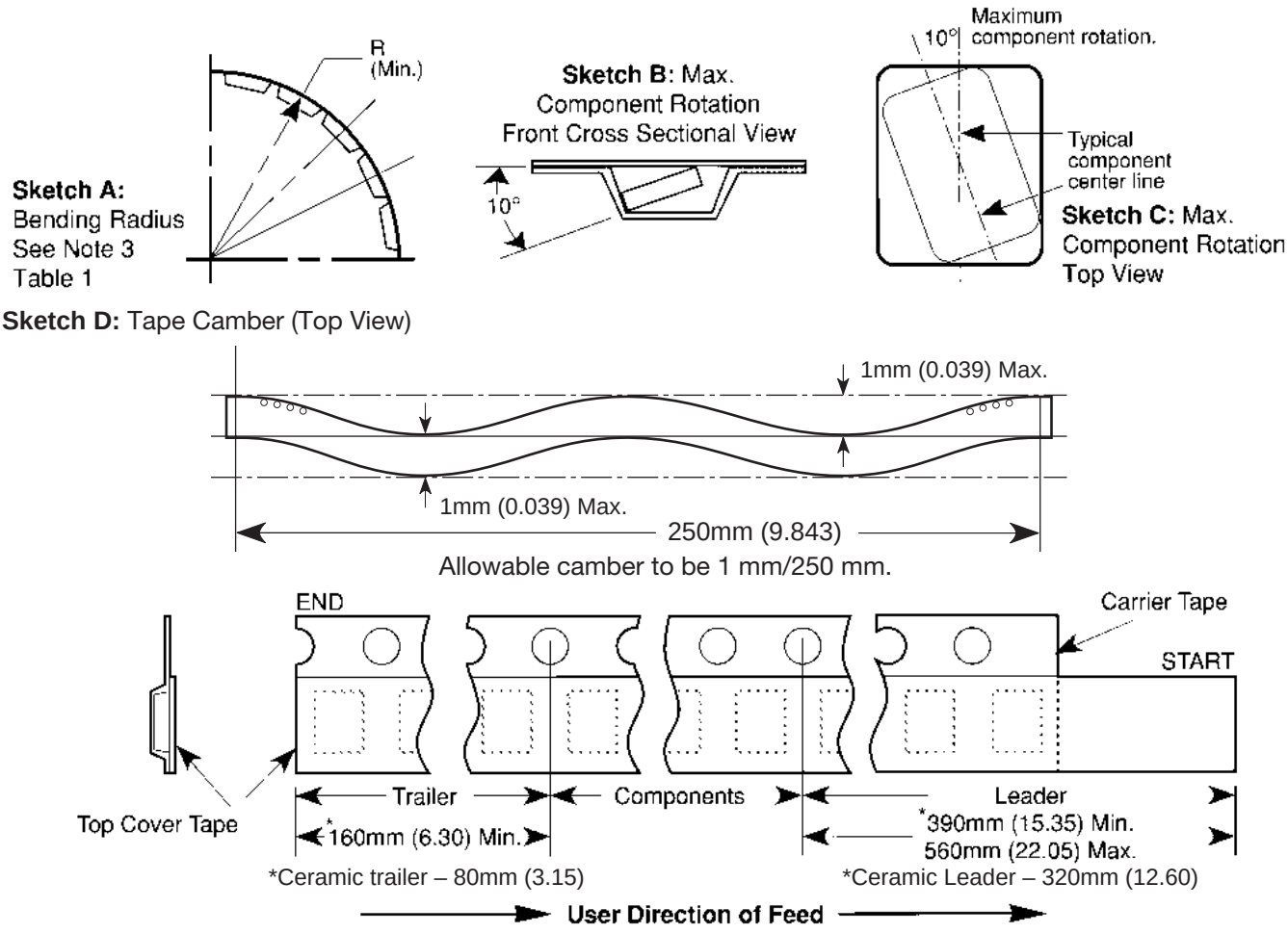


Figure 2: Tape Leader & Trailer Dimensions (Metric Dimensions Will Govern)

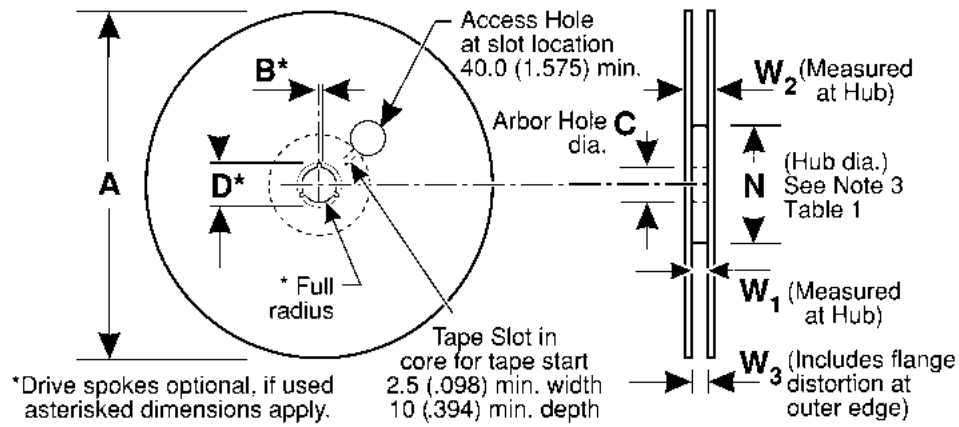


Figure 3: Reel Dimensions (Metric Dimensions will govern)

Table 2 – REEL DIMENSIONS (Metric will govern)

Tape Size	A Max	B* Min	C	D* Min	N Min	W_1	W_2 Max	W_3
8 mm	330.0 (12.992)	1.5 (0.059)	13.0 ± 0.20 (0.512 ± 0.008)	20.2 (0.795)	50.0 (1.969) See Note 3 Table 1	8.4 +1.5, -0.0 (0.331 +0.059, -0.0)	14.4 (0.567)	7.9 Min (0.311) 10.9 Max (0.429)
12 mm	330.0 (12.992)	1.5 (0.059)	13.0 ± 0.20 (0.512 ± 0.008)	20.2 (0.795)		12.4 +2.0, -0.0 (0.488 +0.078, -0.0)	18.4 (0.724)	11.9 Min (0.469) 15.4 Max (0.606)

Punched Carrier (Paper Tape) Configuration (Ceramic Chips Only):

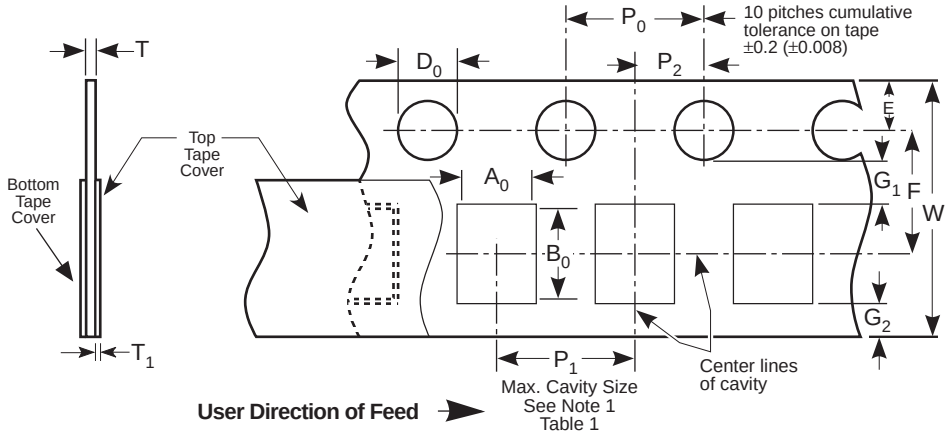


Table 1: 8 & 12mm Punched Tape
(Metric Dimensions Will Govern)

Constant Dimensions - Millimeters (Inches)

Tape Size	D_0	E	P_0	P_2	T_1	G_1	G_2	R Min.
8mm and 12mm	1.5 +0.10, -0.0 (.059 +0.004, -0.0)	1.75 ±0.10 (.069 ±0.004)	4.0 ± 0.10 (.157 ± 0.004)	2.0 ± 0.05 (.079 ± 0.002)	0.10 (.004) Max.	0.75 (.030) Min.	0.75 (.030) Min.	25 (.984) See Note 2 Table 1

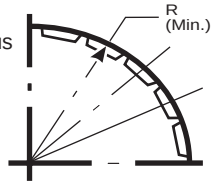
Table 1: 8 & 12mm Punched Tape
(Metric Dimensions Will Govern)

Variable Dimensions - Millimeters (Inches)

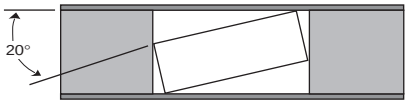
Tape Size	P_1	F	W	A_0B_0	T
8mm 1/2 Pitch	2.0 ± 0.10 (.079 ±.004) See Requirements Section 3.3 (d)	3.5 ± 0.05 (.138 ± .002)	8.0 + 0.3, - 0.1 (.315 + .012, -.004)	See Note 1 Table 1	1.1mm (.043) Max. for Paper Base Tape and 1.6mm (.063) Max. for Non-Paper Base Compositions. See Note 3.
8mm	4.0 ± 0.10 (0.157 ± .004)				
12mm	4.0 ± 0.10 (0.157 ± .004)	5.5 ± 0.05 (.217 ± .002)	12.0 ± 0.3 (.472 ± .012)		
12mm Double Pitch	8.0 ± 0.10 (0.315 ± .004)				

Note:
1. A_0, B_0 and T determined by the maximum dimensions to the ends of the terminals extending from the body and/or the body dimensions of the component. The clearance between the ends of the terminals or body of the component to the sides and depth of the cavity (A_0, B_0 and T) must be within 0.05mm (.002) minimum and 0.50mm (.020) maximum. The clearance allowed must also prevent rotation of the component within the cavity of not more than 20 degrees (see sketches A and B).
2. Tape with components shall pass around radius "R" without damage.
3. KEMET nominal thicknesses are: 0402 = 0.6mm and all others 0.95mm minimum.

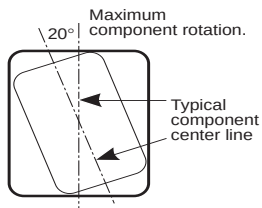
Sketch A:
Bending Radius
See Note 2
Table 1



Sketch B:
Max. Component Rotation - Front Cross Sectional View



Sketch C:
Component Rotation - Top View



Bulk Cassette Packaging (Ceramic Chips only)

(Meets Dimensional Requirements IEC-286-6 and EIAJ 7201)

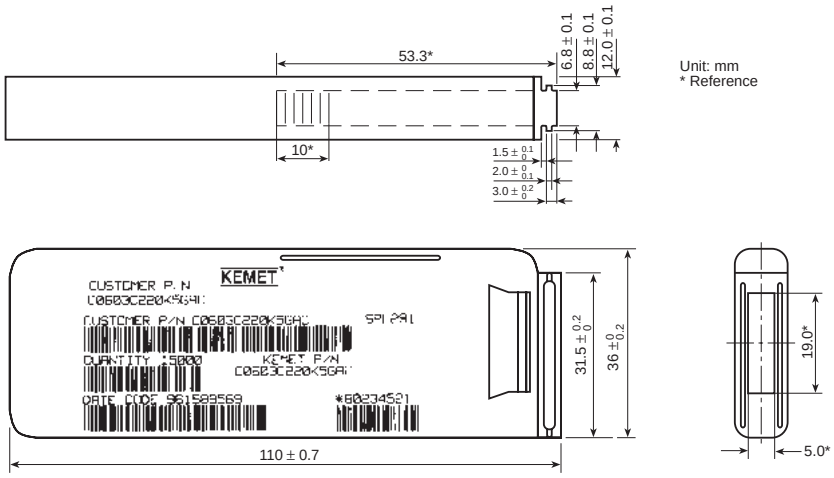


Table 2 – Capacitance Values Available In Bulk Cassette Packaging

Case Size	Dielectric	Voltage	Min. Cap Value	Max. Cap Value
0402	All	All	All	All
0603	All	All	All	All
0805	C0G	200 100 50	109 109 109	181 331 102
	X7R	200 100 50 25 16	221 221 221 221 221	392 103 273 104 104
	Y5V	25 16	104 104	224 224

Table 1 – Capacitor Dimensions for Bulk Cassette Packaging – Millimeters

Metric Size Code	EIA Size Code	Length L	Width W	Thickness T	Bandwidth B	Minimum Separation S	Number of Pcs/Cassette
1005	0402	1.0 ± 0.05	0.5 ± 0.05	0.5 ± .05	0.2 to 0.4	0.3	50,000
1608	0603	1.6 ± 0.07	0.8 ± 0.07	0.8 ± .07	0.2 to 0.5	0.7	15,000
2012	0805	2.0 ± 0.10	1.25 ± 0.10	0.6 ± .10	0.5 to 0.75	0.75	10,000

Terminations: KEMET nickel barrier layer with a tin overplate.

CAPACITOR MARKING TABLE (Marking Optional - Not Available for 0402 Size or Y5V Dielectric)

Alpha Character \ Numeral	Capacitance (pF) For Various Numeral Identifiers								
	9	0	1	2	3	4	5	6	7
A	0.10	1.0	10	100	1000	10,000	100,000	1,000,000	10,000,000
B	0.11	1.1	11	110	1100	11,000	110,000	1,100,000	11,000,000
C	0.12	1.2	12	120	1200	12,000	120,000	1,200,000	12,000,000
D	0.13	1.3	13	130	1300	13,000	130,000	1,300,000	13,000,000
E	0.15	1.5	15	150	1500	15,000	150,000	1,500,000	15,000,000
F	0.16	1.6	16	160	1600	16,000	160,000	1,600,000	16,000,000
G	0.18	1.8	18	180	1800	18,000	180,000	1,800,000	18,000,000
H	0.20	2.0	20	200	2000	20,000	200,000	2,000,000	20,000,000
J	0.22	2.2	22	220	2200	22,000	220,000	2,200,000	22,000,000
K	0.24	2.4	24	240	2400	24,000	240,000	2,400,000	24,000,000
L	0.27	2.7	27	270	2700	27,000	270,000	2,700,000	27,000,000
M	0.30	3.0	30	300	3000	30,000	300,000	3,000,000	30,000,000
N	0.33	3.3	33	330	3300	33,000	330,000	3,300,000	33,000,000
P	0.36	3.6	36	360	3600	36,000	360,000	3,600,000	36,000,000
Q	0.39	3.9	39	390	3900	39,000	390,000	3,900,000	39,000,000
R	0.43	4.3	43	430	4300	43,000	430,000	4,300,000	43,000,000
S	0.47	4.7	47	470	4700	47,000	470,000	4,700,000	47,000,000
T	0.51	5.1	51	510	5100	51,000	510,000	5,100,000	51,000,000
U	0.56	5.6	56	560	5600	56,000	560,000	5,600,000	56,000,000
V	0.62	6.2	62	620	6200	62,000	620,000	6,200,000	62,000,000
W	0.68	6.8	68	680	6800	68,000	680,000	6,800,000	68,000,000
X	0.75	7.5	75	750	7500	75,000	750,000	7,500,000	75,000,000
Y	0.82	8.2	82	820	8200	82,000	820,000	8,200,000	82,000,000
Z	0.91	9.1	91	910	9100	91,000	910,000	9,100,000	91,000,000
a	0.25	2.5	25	250	2500	25,000	250,000	2,500,000	25,000,000
b	0.35	3.5	35	350	3500	35,000	350,000	3,500,000	35,000,000
d	0.40	4.0	40	400	4000	40,000	400,000	4,000,000	40,000,000
e	0.45	4.5	45	450	4500	45,000	450,000	4,500,000	45,000,000
f	0.50	5.0	50	500	5000	50,000	500,000	5,000,000	50,000,000
m	0.60	6.0	60	600	6000	60,000	600,000	6,000,000	60,000,000
n	0.70	7.0	70	700	7000	70,000	700,000	7,000,000	70,000,000
t	0.80	8.0	80	800	8000	80,000	800,000	8,000,000	80,000,000
y	0.90	9.0	90	900	9000	90,000	900,000	9,000,000	90,000,000

Laser marking is available as an extra-cost option for most KEMET ceramic chips. Such marking is two sided, and includes a $\overline{K}$ to identify KEMET, followed by two characters (per EIA-198 - see table below) to identify the capacitance value. Note that marking is not available for size 0402 nor for any Y5V chip. In addition, the 0603 marking option is limited to the $\overline{K}$ only.

	$\overline{K}$A3	

Example shown is 1,000 pF capacitor.

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