INDEX

KEMET

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

NOTICE

Any capacitor misapplied may fail and there by damage other circuit components. Please refer to application notes and recommendations in this catalog for a complete description of capacitor characteristics.

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 UL 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 UL 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.

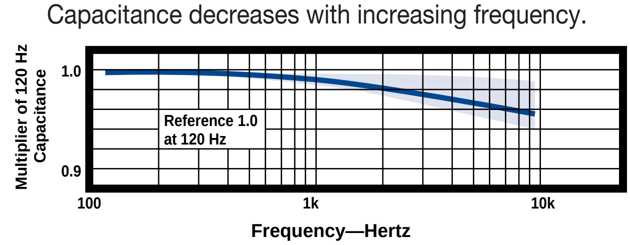


FIGURE 1 Typical Effect of Frequency upon Capacitance

Capacitance increases with increasing temperature.

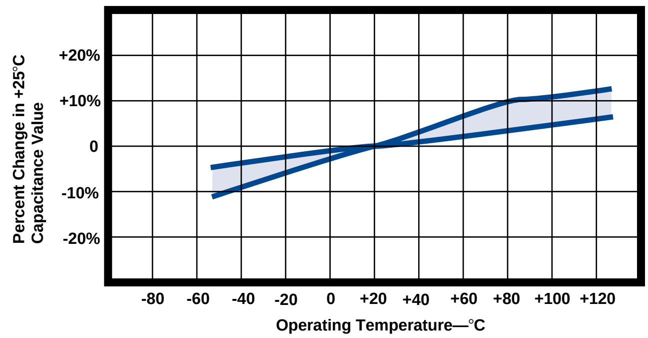


FIGURE 2 Typical Effect of Temperature upon Capacitance

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).

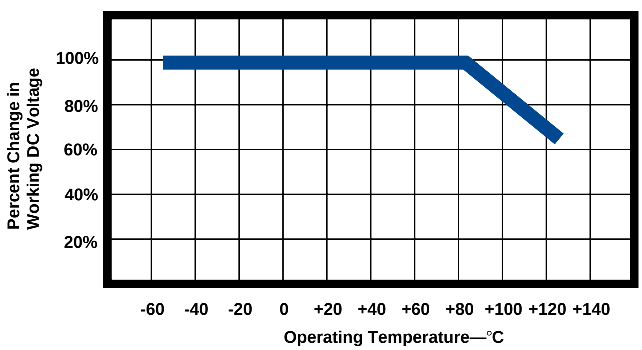


FIGURE 3 Working DC Voltage Change with Temperature

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.)

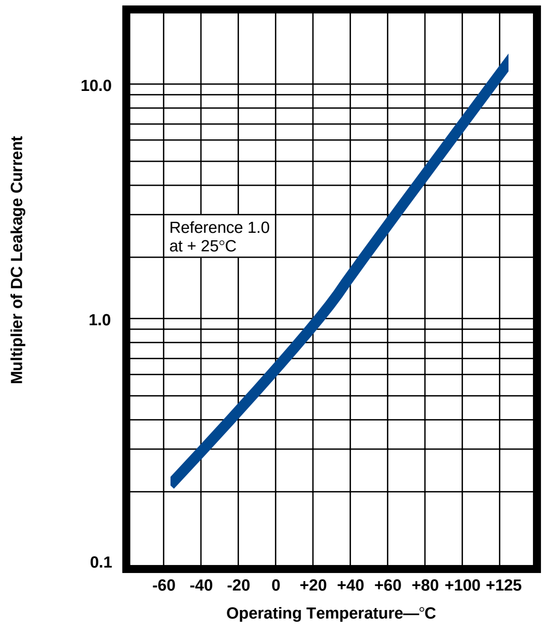


FIGURE 4 Typical Effect of Temperature upon DC Leakage Current

DC leakage current decreases with decreasing applied voltage.

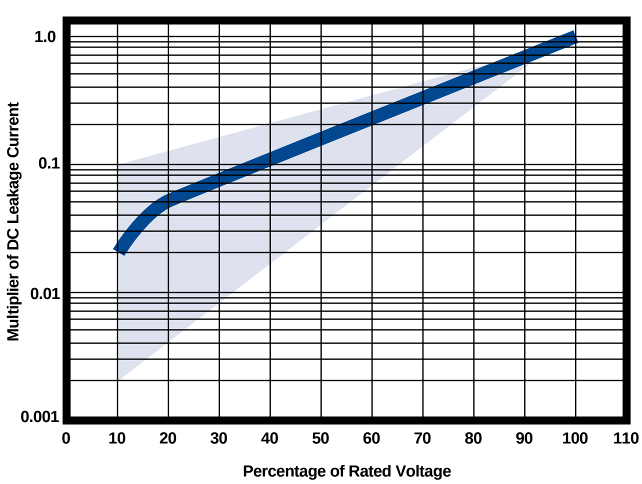


FIGURE 5 Typical Effect of Applied Voltage on DC Leakage Current.

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.

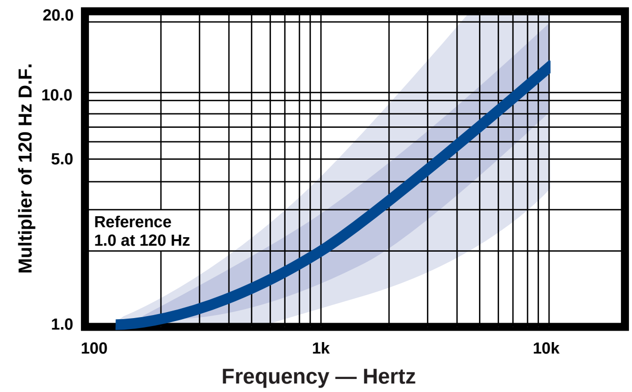


FIGURE 6 Typical Effect of Frequency upon Dissipation Factor

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

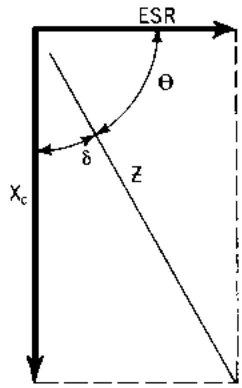


FIGURE 7a Total Impedance of the Capacitor Below Resonance

$X_L = 2\pi fL$

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

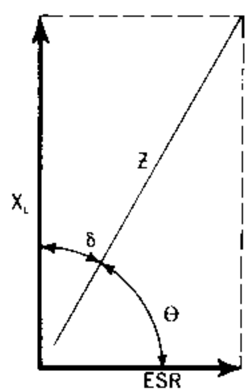


FIGURE 7b Total Impedance of the Capacitor Above Resonance

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

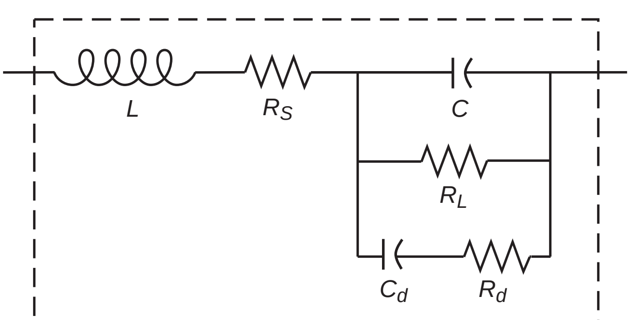


FIGURE 8 The Real Capacitor

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.

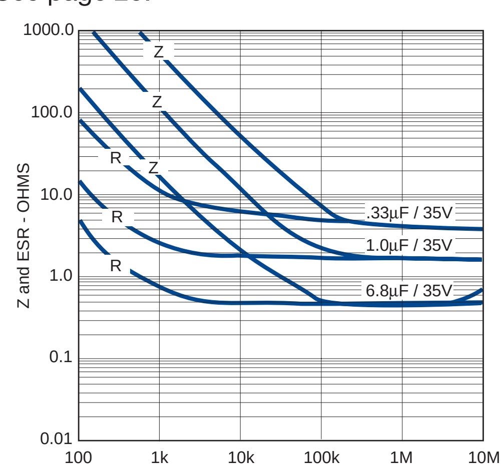


FIGURE 9a ESR & Impedance (Z) vs Frequency

COMPONENT PERFORMANCE CHARACTERISTICS (con't.)

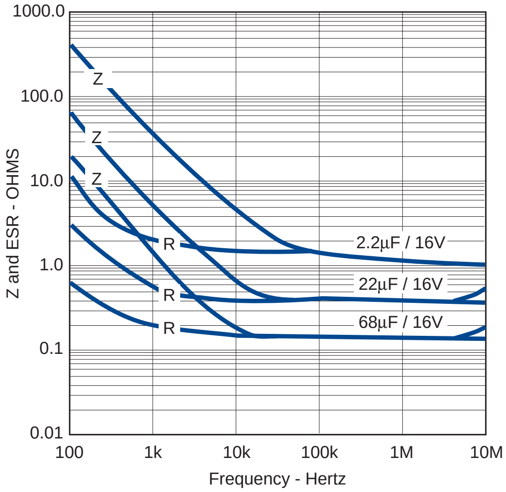


FIGURE 9b ESR & Impedance (z) vs Frequency

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.

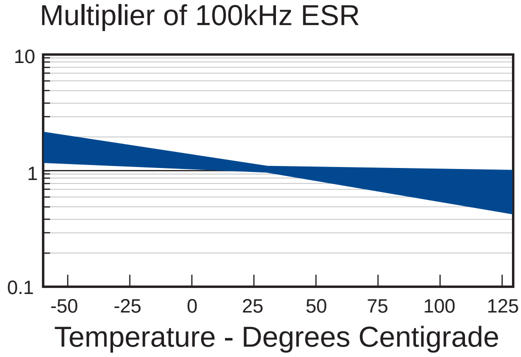


FIGURE 10 Typical Effect of Temperature on 100 kHz ESR

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 7×10^{-4} and the table gives a factor of 0.3.

The failure rate estimate is then:
$0.5 \times 7 \times 10^{-4} \times 0.3 = 1.05 \times 10^{-4}$, 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

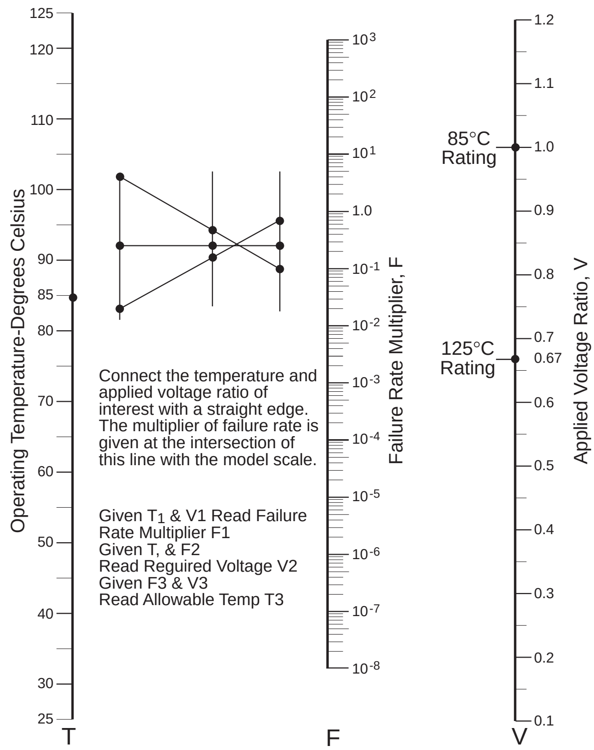


FIGURE 11 Reliability Nomograph

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

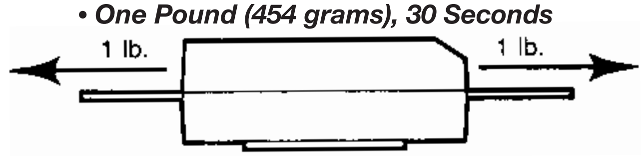
- ***Mil-Std-202, Method 213, Condition I, 100 G Peak***

Post Test Performance:

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

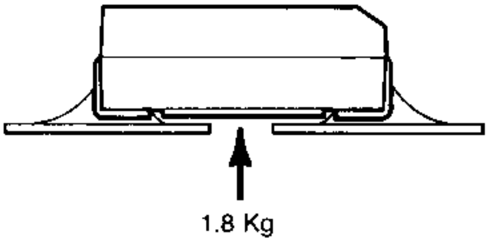
31. Terminal Strength

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



COMPONENT PERFORMANCE CHARACTERISTICS (con't.)

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

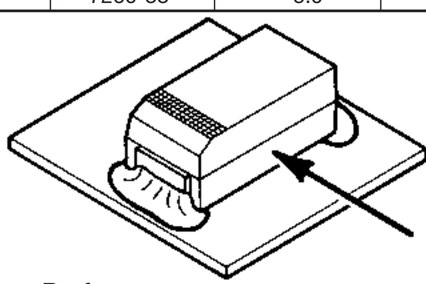


4 lb. (1.8 Kg)

- **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.

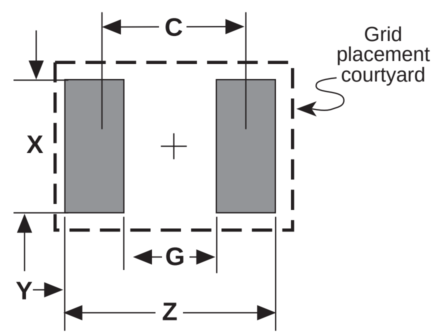


Figure 12

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.

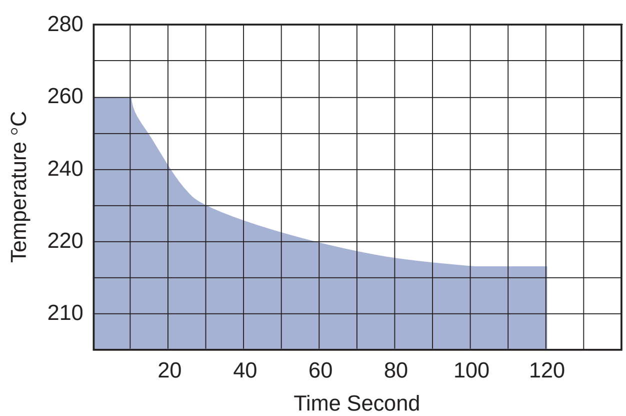


FIGURE 13 Time/Temperature Soldering Profile

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.

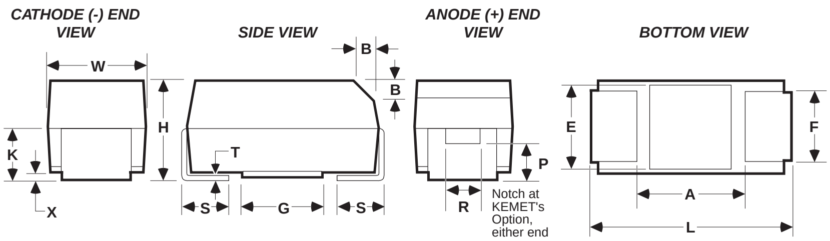
SOLID TANTALUM CHIP CAPACITORS

T491 SERIES - Precision Molded Chip

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)**

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

Failure Rate
A - Not Applicable

Voltage

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

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

(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%)

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

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

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

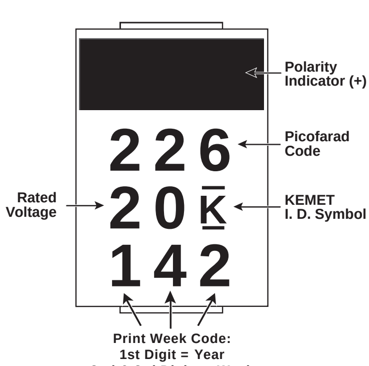
Higher voltage ratings, lower ESR, and tighter capacitance tolerance product may be substituted within the same size at KEMET's option. Voltage substitutions will be marked with the higher voltage rating.

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
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

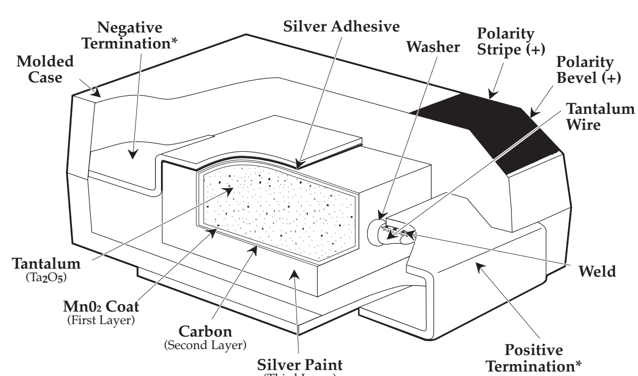
***Extended Values** ****6 Volt product equivalent to 6.3 volt product.**

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

CAPACITOR MARKINGS
T491 Series — All Case Sizes



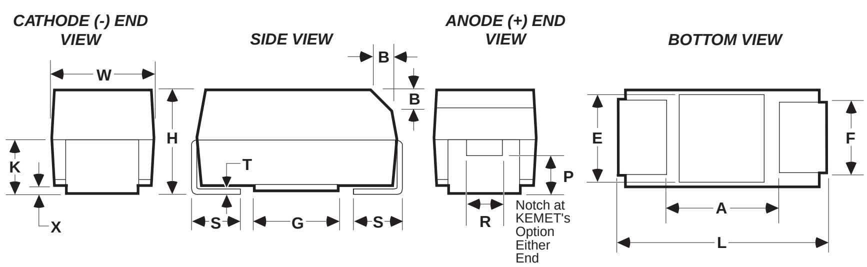
CONSTRUCTION



*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)**

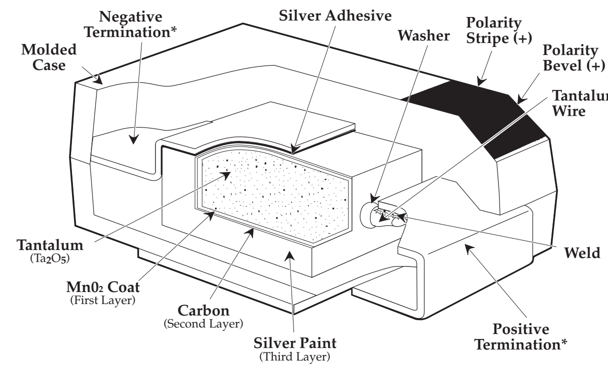
*Note on Failure Rates: Exponential failure rate levels M, P, R and S are inactive for new design per Mil-C-55365. Parts qualified to Weibull failure rate levels are substitutable for exponential failure rate levels.

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

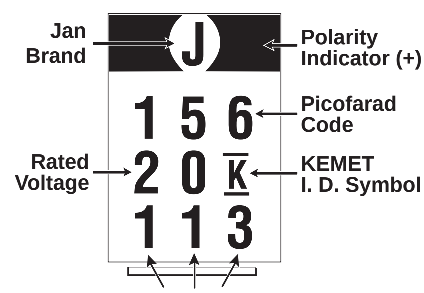
To complete Part Numbers:
(1) Insert "M" for ±20% tolerance, "K" for ±10% tolerance or "J" for ±5% tolerance.
(2) Insert Failure Rate Symbol: B (0.1%/1000 hours), C (0.01%/1000 hours) or D (0.001%/1000 hours).

CONSTRUCTION



*Termination Solder Coating 90 Sn/10Pb

CAPACITOR MARKINGS
T492 Series — All Case Sizes



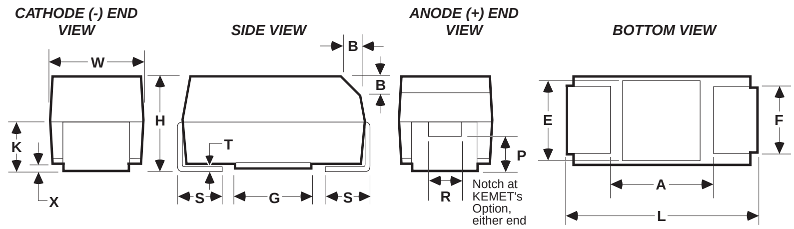
Print Week Code:
1st Digit = Year
2nd & 3rd Digits = Week
"113" = The 13th week of 2001

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 (Ref) ± 0.15 ± (.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 — T

Series — 494
T494 - Low ESR, Industrial Grade

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

Capacitance Picofarad Code — 105
First two digits represent significant figures.
Third digit specifies number of zeros to follow.

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

Voltage — 035

Failure Rate — A
A - Not Applicable

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

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

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.

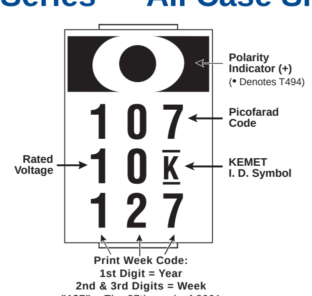
Higher voltage ratings, lower ESR, and tighter capacitance tolerance product may be substituted within the same size at KEMET's option. Voltage substitutions will be marked with the higher voltage rating.

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

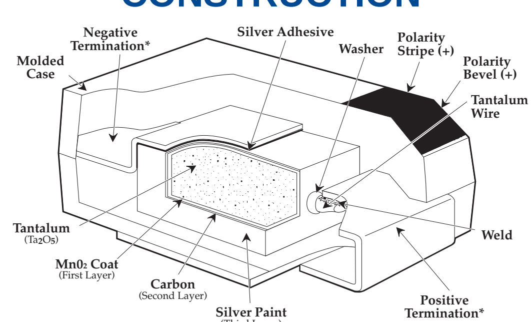
***Extended Values **6 Volt product equivalent to 6.3 volt product.**
#Maximum Capacitance Change @ 125°C=+15%. (All others = +12%)

Solid Tantalum Surface Mount

CAPACITOR MARKINGS
T494 Series — All Case Sizes



CONSTRUCTION

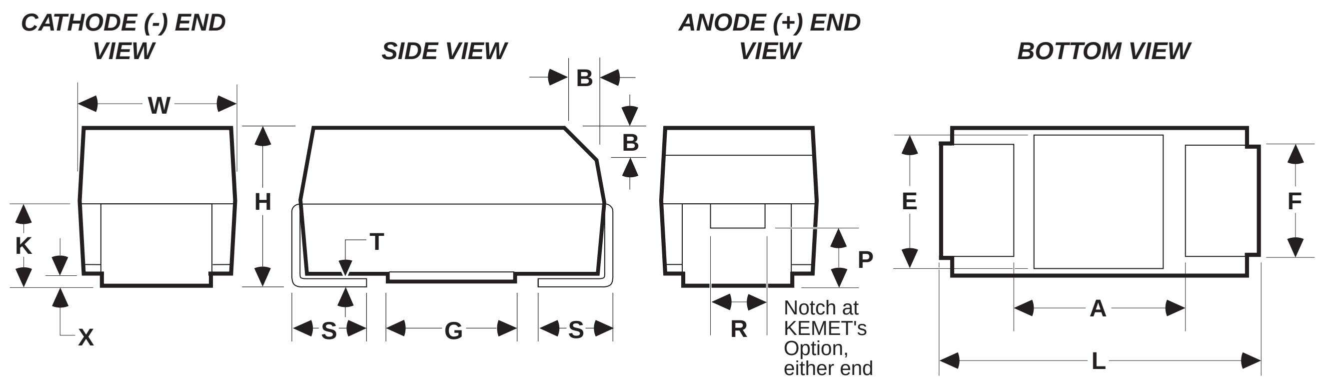


*Termination Solder Coating 90 Sn/10Pb

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.

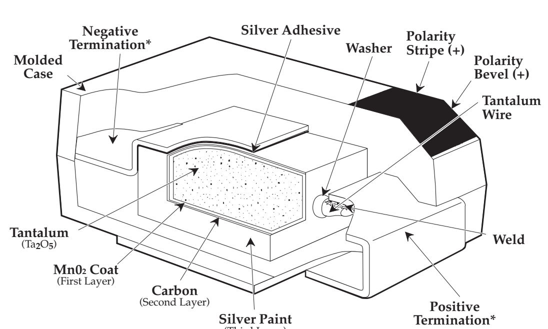
LOW PROFILE T495 DIMENSIONS

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)

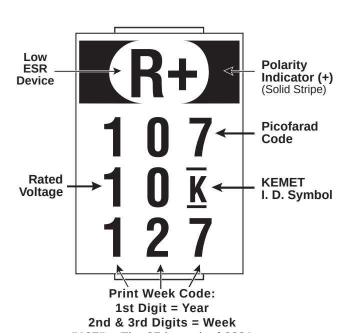
Notes: 1. Metric dimensions govern.
2. (Ref) - Dimensions provided for reference only.
3. No dimensions provided for B, P or R because low profile cases do not have a bevel or a notch.

CONSTRUCTION



*Termination Solder Coating 90 Sn/10Pb

CAPACITOR MARKINGS



KEMET Electronics Corporation, P.O. Box 5928, Greenville, S.C. 29606, (864) 963-6300

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** — T
- **Series** — 495: **T495** - Low ESR, Surge Robust
- **Case Size** — X: C, D, V, X
- **Capacitance Picofarad Code** — 107: First two digits represent significant figures. Third digit specifies number of zeros to follow.
- **Capacitance Tolerance** — M: **M** - ± 20%, **K** - ± 10%
- **Voltage** — 010
- **Failure Rate** — A: **A** - Not Applicable
- **Lead Material** — S*: **S** - Standard Solder-Coated, **G** - Gold Plated

Solid Tantalum Surface Mount

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*						

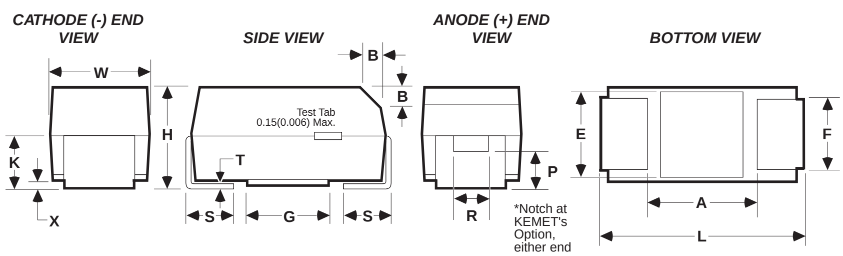
Note that standard values are preferred, especially where high surge currents are possible. Extended values are available to increase capacitance and reduce ESR. Note that standard CV values demonstrate inherently lower failure rates than extended CV values, especially in low impedance applications.

*** 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 — T

Series — 496
T496 - Precision Molded, Fail-safe

Case Size — B
B, C, D, X

Capacitance Picofarad Code — 105
First two digits represent significant figures.
Third digit specifies number of zeros to follow.

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

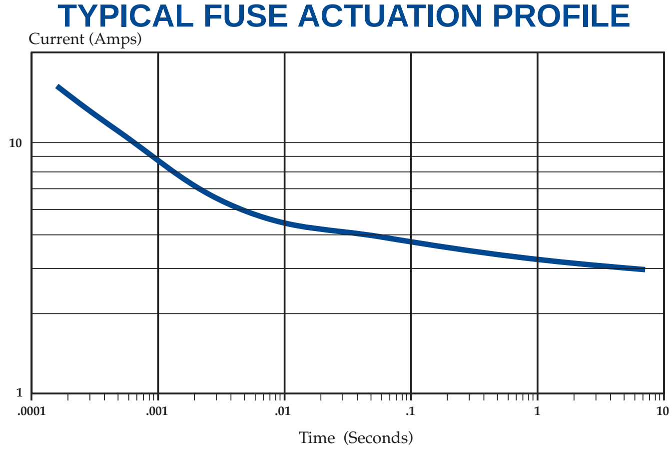
Voltage — 025

Failure Rate — A
A - Not Applicable

Lead Material — S*
S - Standard Solder -Coated

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

TYPICAL FUSE ACTUATION PROFILE



T496 RATINGS & PART NUMBER REFERENCE

Capaci-tance 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

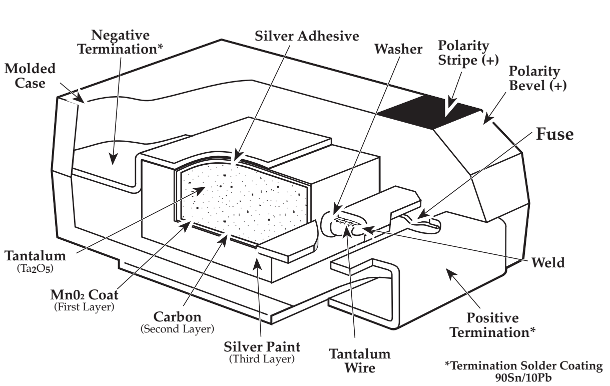
** Note: 6V rating equivalent to 6.3 rating *Extended Ratings
# Maximum capacitance change @ 125°C = +15% (all others =12%)

Capaci-tance 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

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

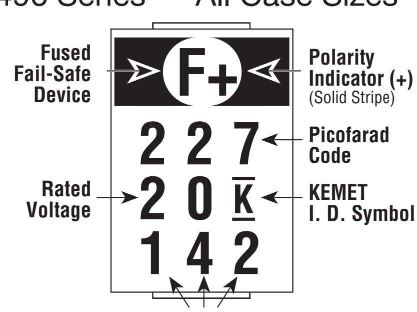
Higher voltage ratings and tighter capacitance tolerance product may be substituted within the same size at KEMET's option. Voltage substitutions will be marked with the higher voltage rating.

T496 SERIES CONSTRUCTION



CAPACITOR MARKINGS

T496 Series — All Case Sizes

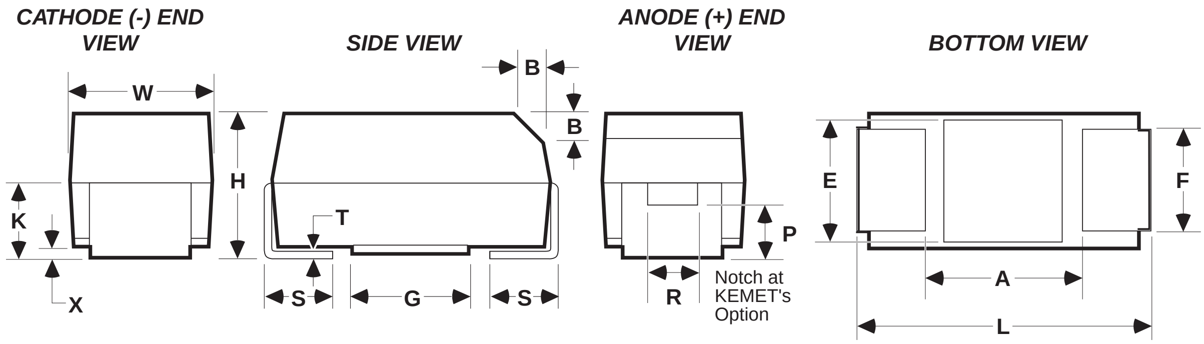


Print Week Code:
1st Digit = Year
2nd & 3rd Digits = Week
"142" = The 42nd week of 2001

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 (Ref) ± 0.15 ± (.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.

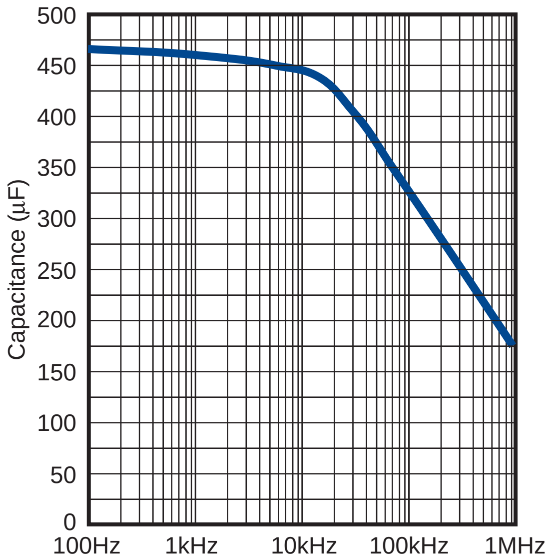
Lead Material
S - Standard Solder -Coated

Failure Rate
A - Not Applicable

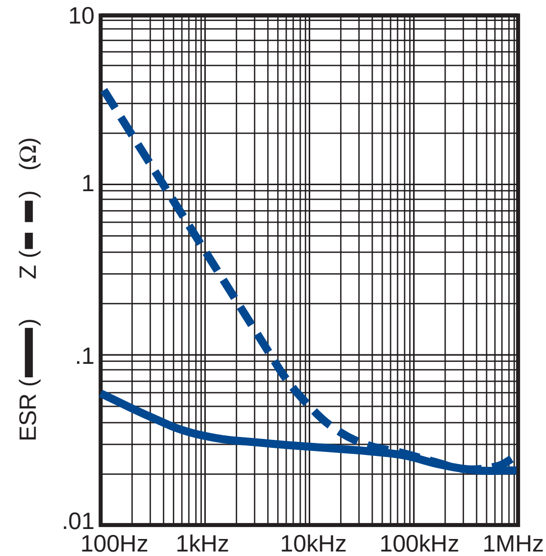
Voltage

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

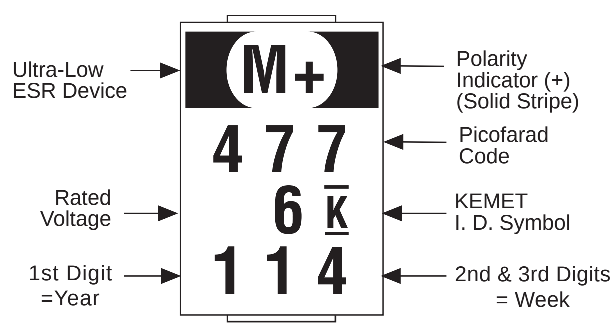
TYPICAL CAP FREQUENCY SCAN @25°C
T510X477M006AS



TYPICAL ESR/Z FREQUENCY SCAN @25°C
T510X477M006AS

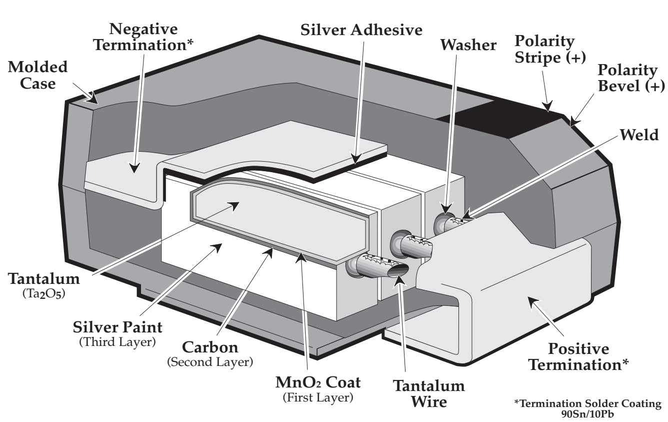


CAPACITOR MARKINGS

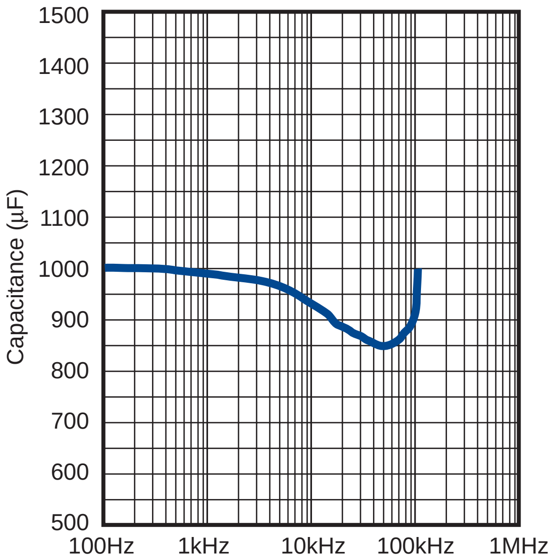


"114" = The 14th week
of 2001.

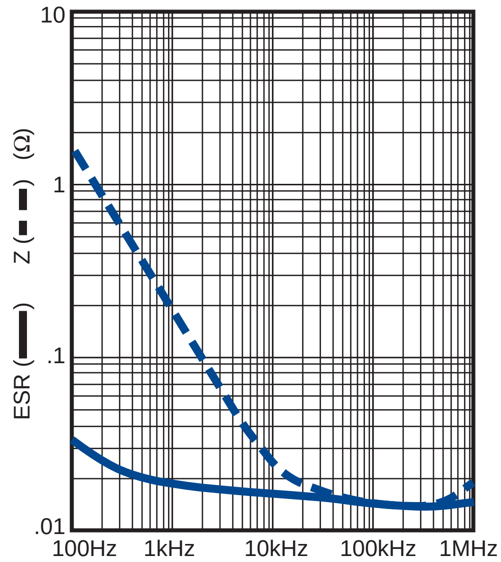
T510 SERIES CONSTRUCTION



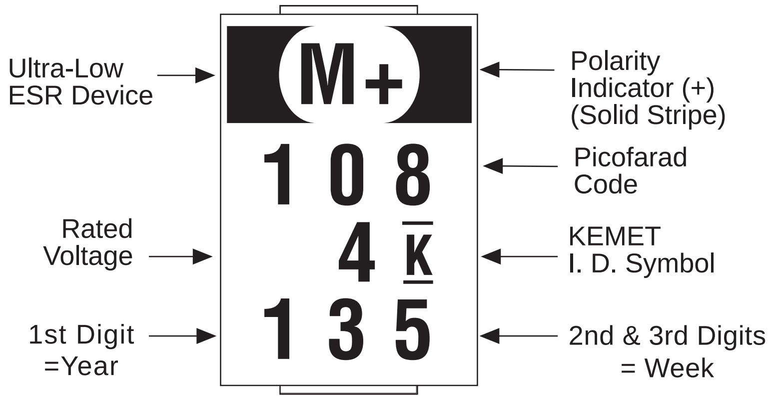
TYPICAL CAP FREQUENCY SCAN @ 25°C T510E108M004AS



TYPICAL ESR/Z FREQUENCY SCAN @ 25°C T510E108M004AS

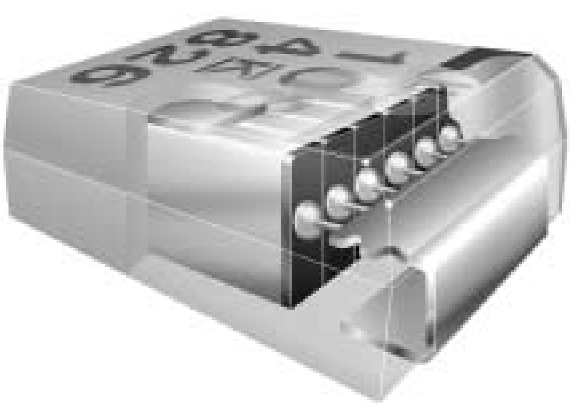


CAPACITOR MARKINGS



"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 85°C, 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.

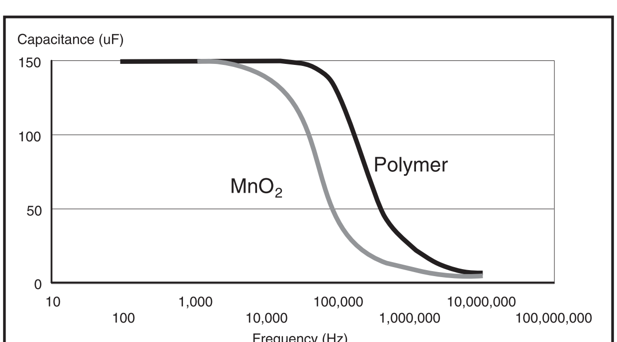


FIGURE 1

4. Voltage Ratings

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

This is the maximum peak DC operating voltage from -55°C to +85°C for continuous duty. Above 85°C, 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 25°C, 85°C or 105°C. 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

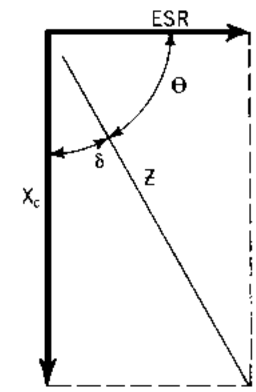


FIGURE 2a Total Impedance of the Capacitor Below Resonance

$$X_L = 2\pi fL$$

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

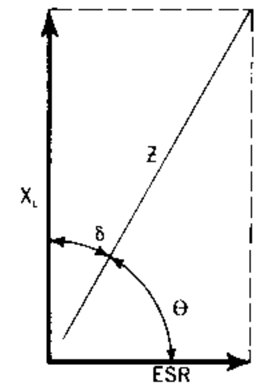


FIGURE 2b Total Impedance of the Capacitor Above Resonance

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

COMPONENT PERFORMANCE CHARACTERISTICS

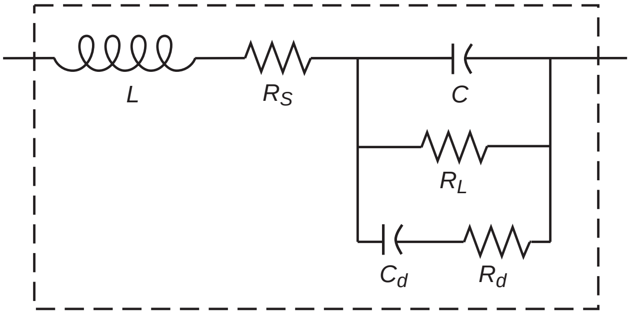


FIGURE 3 The Real Capacitor

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

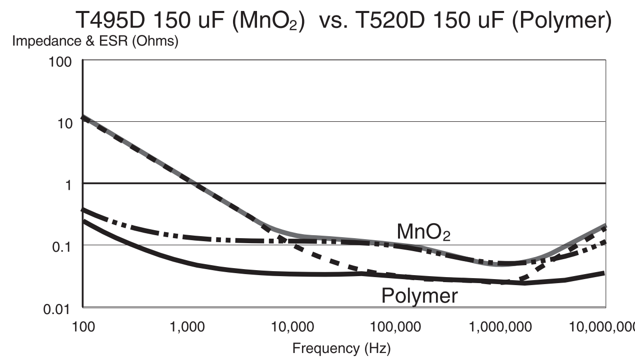


FIGURE 4

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 @ +25ºC
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
85ºC	.9
105ºC	.4

ENVIRONMENTAL

12. Temperature Stability

Mounted capacitors withstand extreme temperature testing at a succession of continuous steps at +25ºC, -55ºC, +25ºC, +85ºC, +105ºC, +25ºC 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 -55ºC.

Table 4

Acceptable limits are as follows:

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

13. Standard Life Test

- ***85ºC, 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

- ***105ºC, 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

- ***105ºC, 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 -55ºC
Maximum temperature is +105ºC
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

- ***85ºC, 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 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

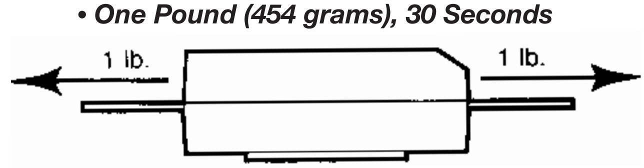
27. Shock

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

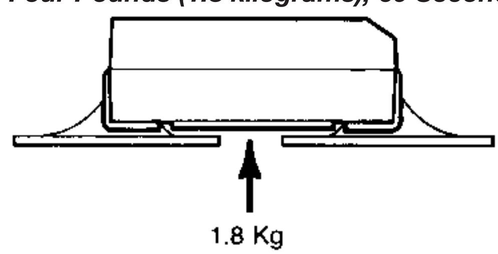
Post Test Performance:
a. Capacitance — within ±10% of initial value
b. DC Leakage — within initial limit
c. Dissipation Factor — within initial limit
d. ESR - within initial limit

28. Terminal Strength

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



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



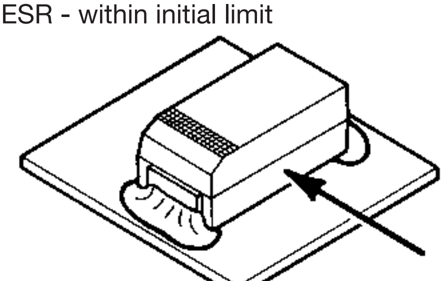
4 lb. (1.8 Kg)

- **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.

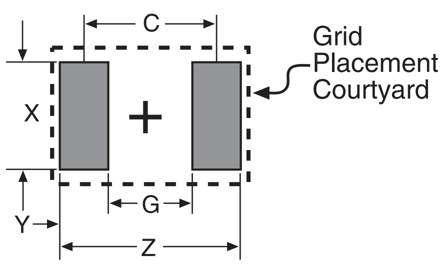


Figure 5

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 2°C 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

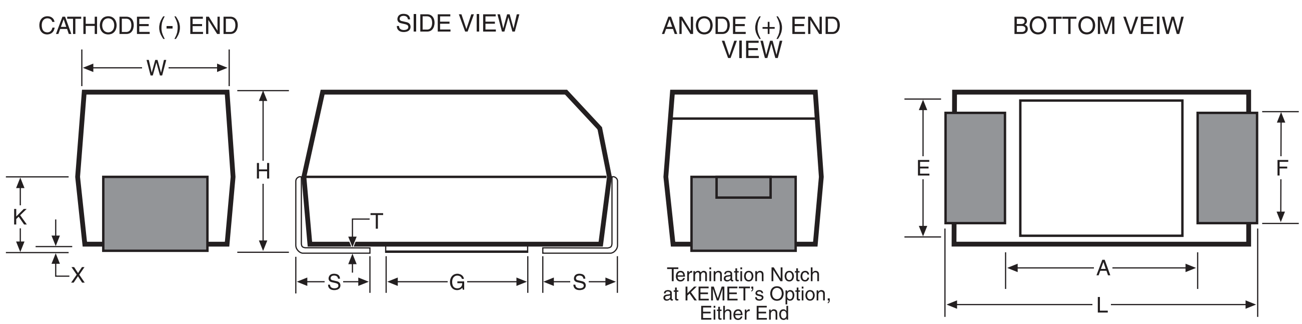
Tantalum chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will 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		L	W	H	K ±0.20	F ±0.1	S ±0.3	X(Ref)	T(Ref)	A(Min)	G(ref)	E(ref)
KEMET	EIA											
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

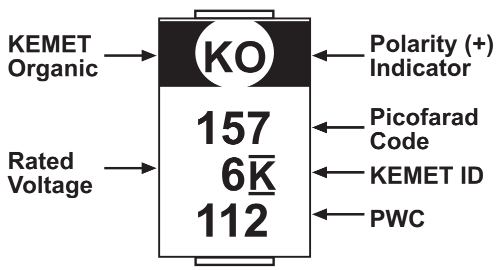
Cap µF (±20%)	Case Size	KEMET Part Number	DC Leakage µA +25ºC Max	DF % 120 Hz + 25ºC Max	ESR mΩ 100kHz 25º Max	Ripple Current A rms 100 kHz Max		
						25ºC	85ºC	105ºC
4 Volt Rating at +85ºC (3.3 Volt Rating at 105ºC)								
220	V/7343-20	T520V227M004AS	88	10%	45	1.7	1.5	0.7
220	V/7343-20	T520V227M004AS4350	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

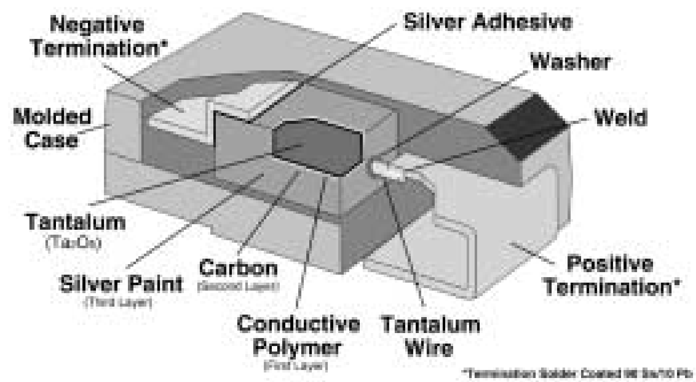
- **Tantalum** — T
- **Series** — T520 - Low ESR Polymer
- **Case Size** — V, D, X
- **Capacitance Picofarad Code** — First two digits represent significant figures. Third digit specifies number of zeros to follow
- **Capacitance Tolerance** — M - ± 20%
- **Voltage**
- **Failure Rate** — A - Not Applicable
- **Lead Material** — S - Standard Solder Coated

Component Marking



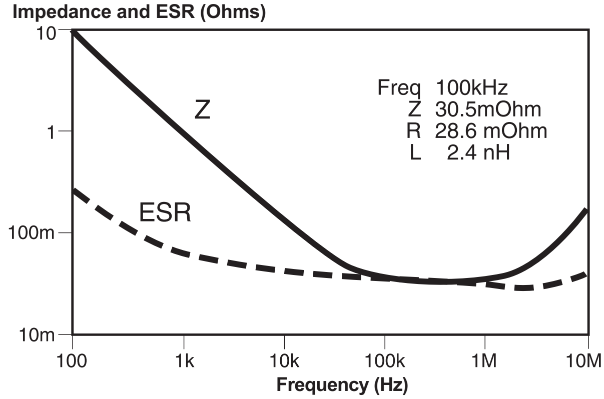
112 = 12th week of 2001

T520 Series Construction

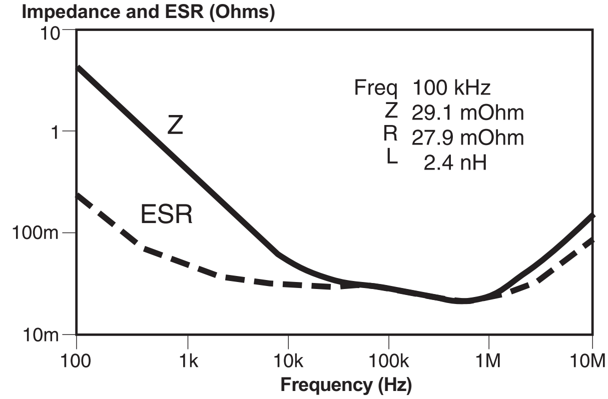


Typical Frequency Response Curves

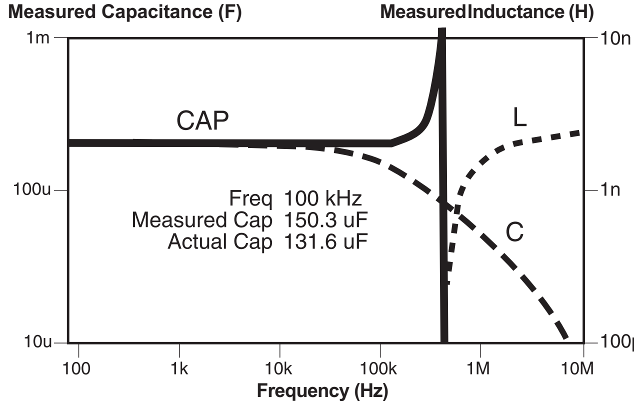
T520V157M006AS @ +25ºC with 3VDC Bias



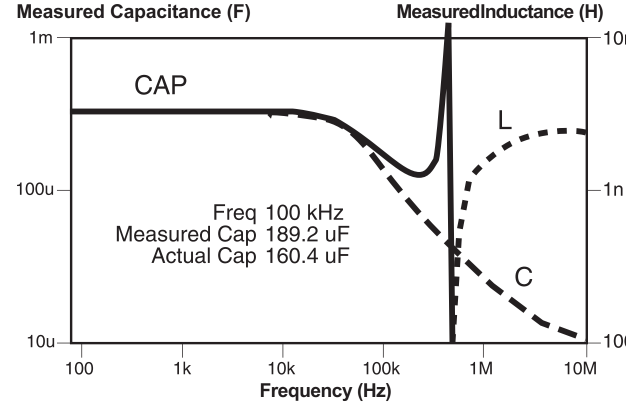
T520D337M006AS @ +25ºC with 3VDC Bias



T520V157M006AS @ +25ºC with 3VDC Bias

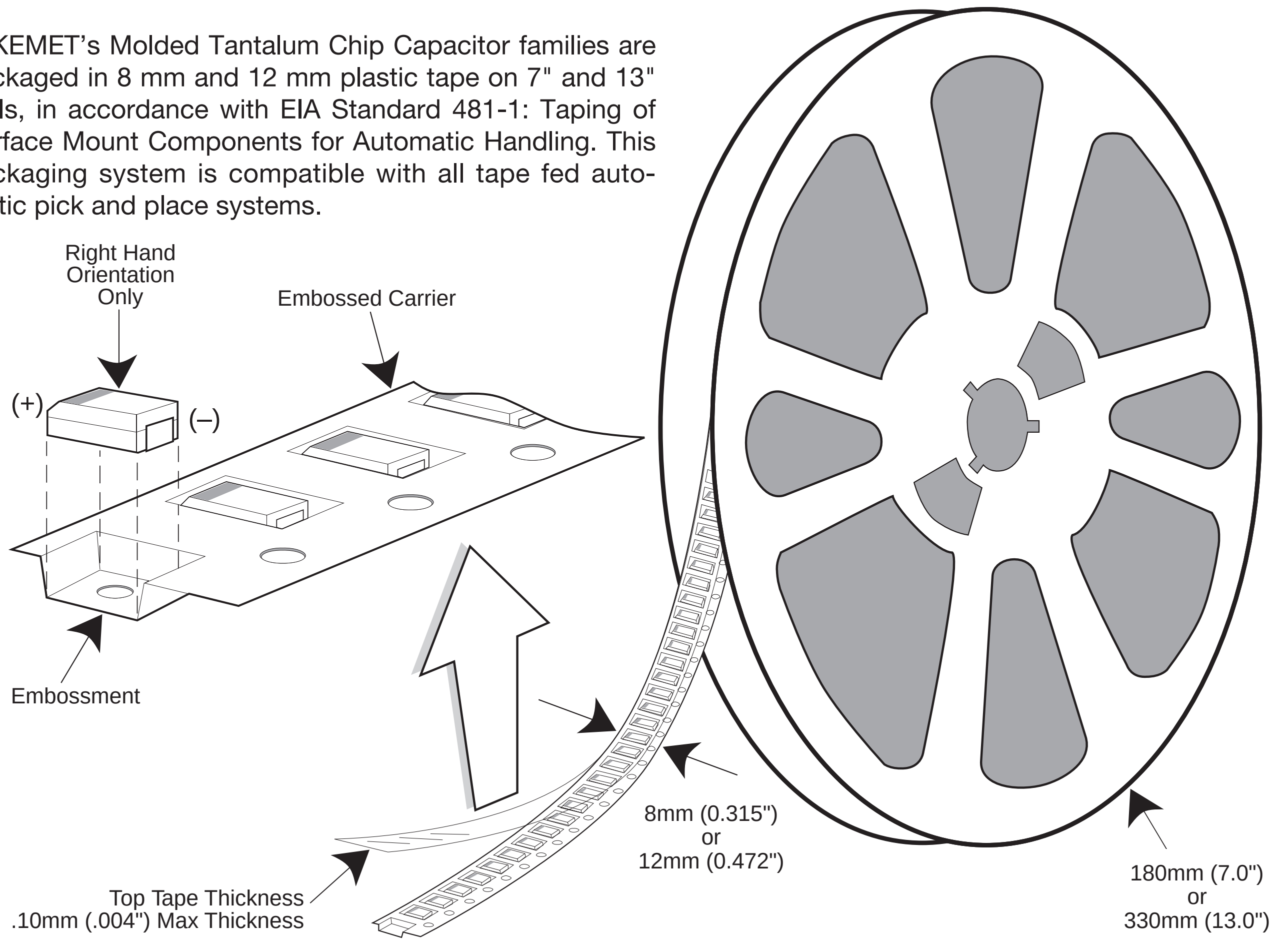


T520D337M006AS @ +25ºC with 3VDC Bias



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.

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

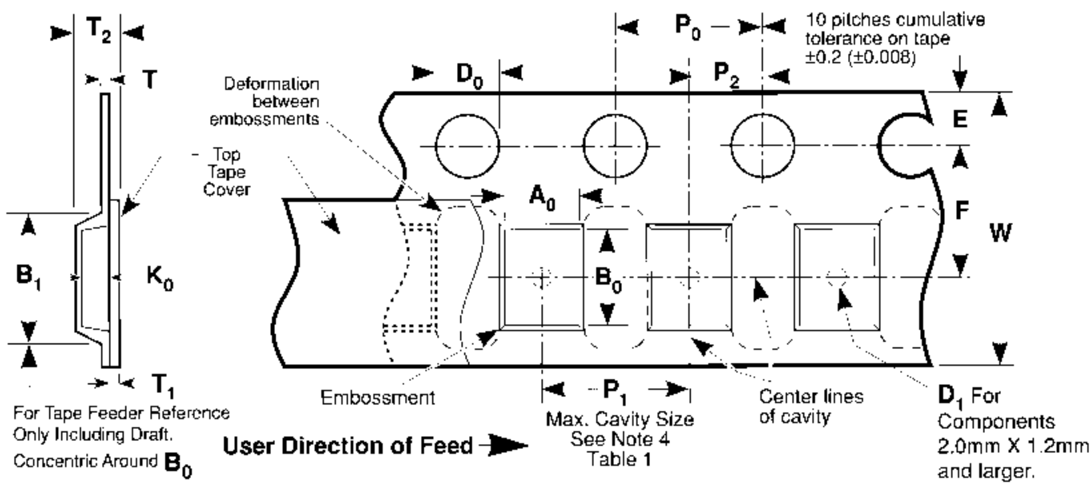


Table 1 — EMBOSSED TAPE DIMENSIONS (Metric will govern)

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)	

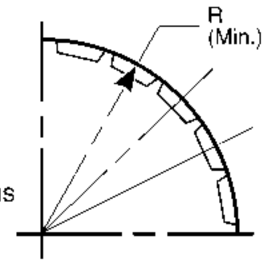
Variable Dimensions — Millimeters (Inches)

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)	

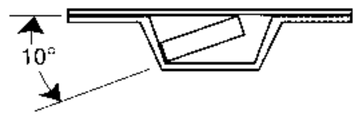
NOTES

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.)

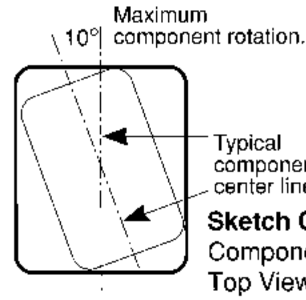
Tantalum & Embossed Carrier Tape Configuration (cont.)



Sketch A: Bending Radius See Note 3 Table 1

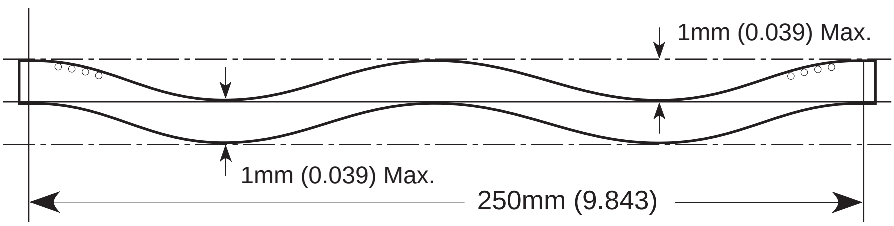


Sketch B: Max. Component Rotation Front Cross Sectional View



Sketch C: Max. Component Rotation Top View

Sketch D: Tape Camber (Top View)



Allowable camber to be 1 mm/250 mm.

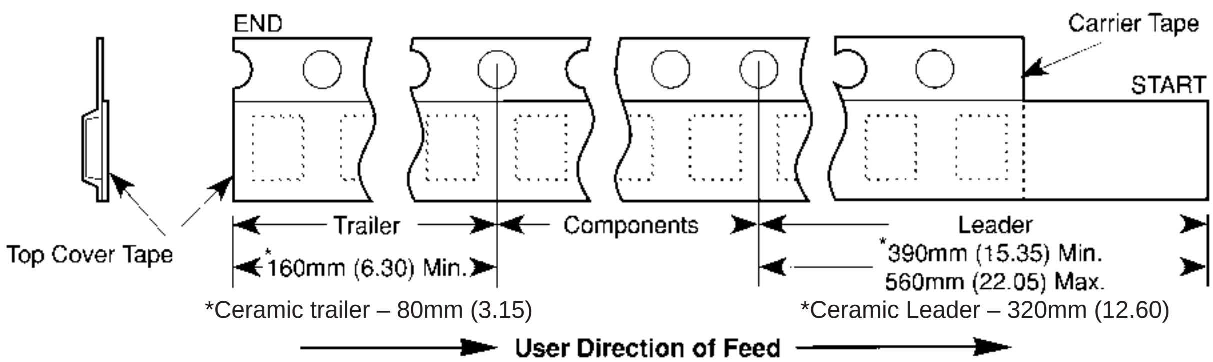


Figure 2: Tape Leader & Trailer Dimensions (Metric Dimensions Will Govern)

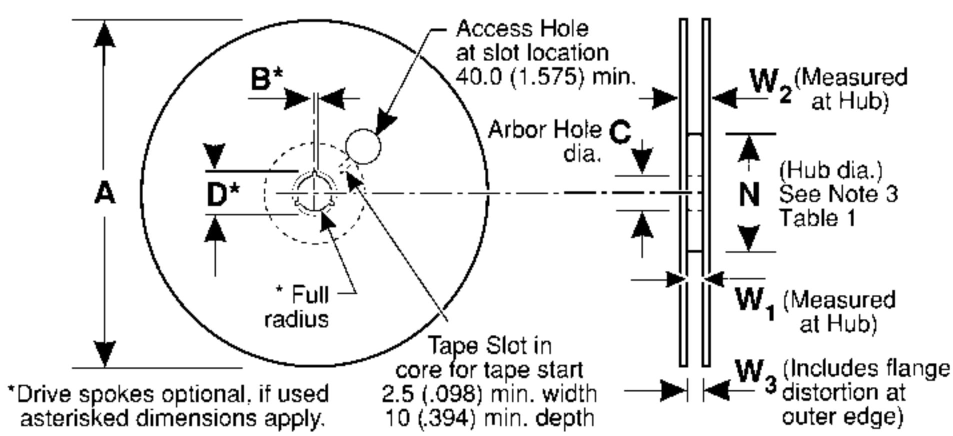


Figure 3: Reel Dimensions (Metric Dimensions will govern)

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)