

## Overview

The KEMET Organic Capacitor (KO-CAP) is a tantalum capacitor with a Ta anode and Ta<sub>2</sub>O<sub>5</sub> dielectric. A conductive organic polymer replaces the traditionally used MnO<sub>2</sub> as the cathode plate of the capacitor. This results in very low ESR and improved capacitance retention at high frequency. The KO-CAP may also be operated at steady state voltages at up to 90% of rated voltage for part types with rated voltages of ≤ 10 volts and up to 80% of rated voltage for part types > 10 volts.

The T540 Series KO-CAP offers the same advantages as the T525 Series but is also designed for the Commercial Off-the-Shelf (COTS) requirements of defense and aerospace applications. This surface mount product offers a tin lead (SnPb) leadframe finish, surge current testing options and standard or low ESR levels.

## Benefits

- Polymer cathode technology
- 125°C maximum operating temperature
- High frequency capacitance retention
- Benign failure mode
- Capacitance: 4.7 μF to 680 μF
- Voltage: 2.5 V to 63 V
- Use at up to 90% of rated voltage (10% derating) for part types ≤ 10 V
- Use at up to 80% of rated voltage (20% derating) for part types > 10 V
- Surge current testing options
- Self-healing mechanism
- Volumetrically efficient
- Low ESR
- EIA standard case sizes

## Applications

Typical applications include decoupling and filtering in defense and aerospace applications that require low ESR or a benign failure mode.



## SPICE

For a detailed analysis of specific part numbers, please visit [www.kemet.com](http://www.kemet.com) for a free download of KEMET's SPICE software. The KEMET SPICE program is freeware intended to aid design engineers in analyzing the performance of these capacitors over frequency, temperature, ripple, and DC bias conditions.

## Ordering Information

| T               | 540                | D         | 107  | M                     | 10   | A                   | H   | 65  | 10                                    |                                    |
|-----------------|--------------------|-----------|--|-----------------------|--|---------------------|---|---|---------------------------------------|------------------------------------|
| Capacitor Class | Series             | Case Size | Capacitance Code (pF)  | Capacitance Tolerance | Voltage  | Failure Rate/Design | Lead Material                                   | Surge Option  | ESR                                   | Packaging (C-Spec)                 |
| T = Tantalum    | 540 = Polymer COTS | B, C, D   | First two digits represent significant figures. Third digit specifies number of zeros. | M = $\pm 20\%$        | 2R5 = 2.5 V<br>003 = 3 V<br>004 = 4 V<br>006 = 6.3 V<br>010 = 10 V<br>016 = 16 V<br>020 = 20 V<br>025 = 25 V<br>035 = 35 V<br>050 = 50 V<br>063 = 63 V | A = N/A             | H = Standard Solder Coated (SnPb 5% Pb minimum) | 65 = No Surge<br>66 = 10 cycles @ 25°C<br>67 = 10 cycles -55°C and 85°C | 10 = ESR - Standard<br>20 = ESR - Low | Blank = 7" Reel<br>7280 = 13" Reel |

## Performance Characteristics

| Item                    | Performance Characteristics   |
|-------------------------|---|
| Operating Temperature   | -55°C to 125°C *  |
| Rated Capacitance Range | 4.7 – 680 $\mu\text{F}$ @ 120 Hz/25°C                                   |
| Capacitance Tolerance   | M Tolerance (20%)   |
| Rated Voltage Range     | 2.5 – 63 V  |
| DF (120 Hz)             | $\leq 10\%$   |
| ESR (100 kHz)           | Refer to Part Number Electrical Specification Table                     |
| Leakage Current         | $\leq 0.1\text{C V}$ ( $\mu\text{A}$ ) at rated voltage after 5 minutes |

\* KEMET's Polymer COTS (T540/T541 Series) capacitors are rated for operation between -55°C and +125°C. Parametric electrical performance remains within stated specification limits after 1,000 hours of continuous operation and/or storage at +125°C. Long-term duty cycles or storage at or above +125°C may result in an increase in ESR performance outside of the stated specification limits.

## Qualification

| Test   | Condition  | Characteristics |                                   |       |          |          |
|--|--|-----------------|-----------------------------------|-------|----------|----------|
| Endurance  | 105°C @ rated voltage, 2,000 hours<br>125°C @ 2/3 rated voltage, 2,000 hours   | Δ C/C           | Within -20%/+10% of initial value |       |          |          |
|  |  | DF              | ≤ initial limit                   |       |          |          |
|  |  | DCL             | 1.25 x initial limit @ 125°C      |       |          |          |
|  |  | ESR             | 2 x initial limit                 |       |          |          |
| Storage Life                                       | 125°C @ 0 volts, 2,000 hours   | Δ C/C           | Within -20%/+10% of initial value |       |          |          |
|  |  | DF              | Within initial limits             |       |          |          |
|  |  | DCL             | Within 2.0 x initial limit        |       |          |          |
|  |  | ESR             | Within 2.0 x initial limit        |       |          |          |
| Humidity   | 60°C, 90% RH, 500 hours, rated voltage<br>60°C, 90% RH, 500 hours, no load   | Δ C/C           | Within -5%/+35% of initial value  |       |          |          |
|  |  | DF              | ≤ initial limit                   |       |          |          |
|  |  | DCL             | Within 3.0 x initial limit        |       |          |          |
| Temperature Stability                              | Extreme temperature exposure at a succession of continuous steps at +25°C, -55°C, +25°C, +85°C, +125°C, +25°C          |                 | +25°C                             | -55°C | +85°C    | +125°C   |
|  |  | Δ C/C           | IL*                               | ±20%  | ±20%     | ±30%     |
|  |  | DF              | IL                                | IL    | 1.2 x IL | 1.5 x IL |
|  |  | DCL             | IL                                | n/a   | 10 x IL  | 10 x IL  |
| Surge Voltage                                      | 105°C, 1.32 x rated voltage, 33 Ω resistance, 1,000 cycles   | Δ C/C           | Within -20%/+10% of initial value |       |          |          |
|  |  | DF              | Within initial limits             |       |          |          |
|  |  | DCL             | Within initial limits             |       |          |          |
|  |  | ESR             | Within initial limits             |       |          |          |
| Mechanical Shock/Vibration                         | MIL-STD-202, Method 213, Condition I, 100 G peak<br>MIL-STD-202, Method 204, Condition D, 10 Hz to 2,000 Hz, 20 G peak | Δ C/C           | Within ±10% of initial value      |       |          |          |
|  |  | DF              | Within initial limits             |       |          |          |
|  |  | DCL             | Within initial limits             |       |          |          |
| Additional Qualification Tests per MIL-PRF-55365/8 | Please contact KEMET for more information.   |                 |                                   |       |          |          |

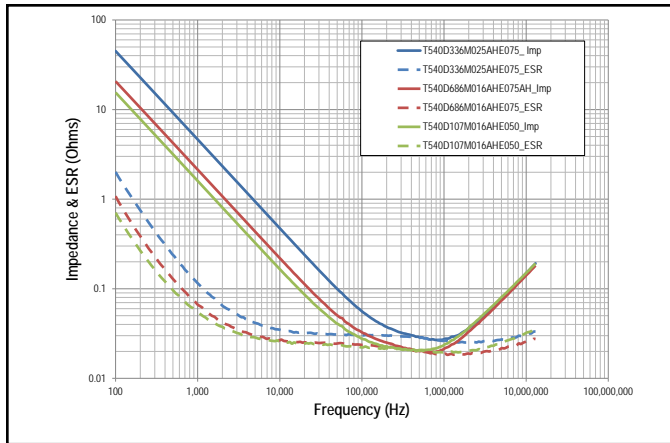
\*IL = Initial limit

## Certification

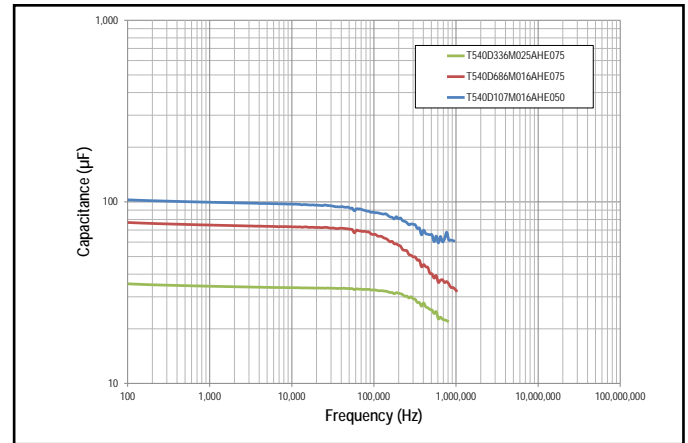
MIL-PRF-55365/8

## Electrical Characteristics

ESR vs. Frequency

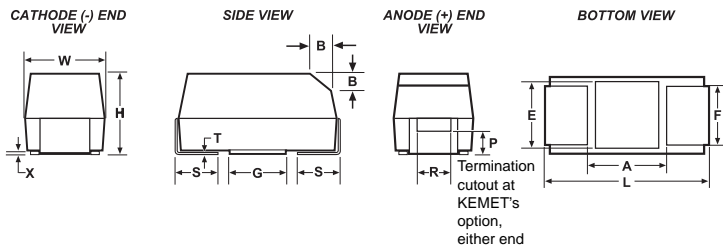


Capacitance vs. Frequency



## Dimensions – Millimeters (Inches)

Metric will govern



| Case Size |         | Component                  |                            |                            |                     |                     |                          |                            |            |            |             |            |            |            |
|-----------|---------|----------------------------|----------------------------|----------------------------|---------------------|---------------------|--------------------------|----------------------------|------------|------------|-------------|------------|------------|------------|
| KEMET     | EIA     | L*                         | W*                         | H*                         | F* ±0.1<br>±(0.004) | S* ±0.3<br>±(0.012) | B* ±0.15<br>(Ref) ±0.006 | X (Ref)                    | P (Ref)    | R (Ref)    | T (Ref)     | A (Min)    | G (Ref)    | E (Ref)    |
| B         | 3528-21 | 3.5 ±0.2<br>(0.138 ±0.008) | 2.8 ±0.2<br>(0.110 ±0.008) | 1.9 ±0.2<br>(0.075 ±0.008) | 2.2 (.087)          | 0.8 (.031)          | 0.4 (.016)               | 0.10 ±0.10<br>(.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<br>(0.236 ±0.012) | 3.2 ±0.3<br>(0.126 ±0.012) | 2.5 ±0.3<br>(0.098 ±0.012) | 2.2 (.087)          | 1.3 (.051)          | 0.5 (.020)               | 0.10 ±0.10<br>(.004 ±.004) | 0.9 (.035) | 1.0 (.039) | 0.13 (.005) | 2.5 (.098) | 2.8 (.110) | 2.4 (.095) |
| D         | 7343-31 | 7.3 ±0.3<br>(0.287 ±0.012) | 4.3 ±0.3<br>(0.169 ±0.012) | 2.8 ±0.3<br>(0.110 ±0.012) | 2.4 (.095)          | 1.3 (.051)          | 0.5 (.020)               | 0.10 ±0.10<br>(.004 ±.004) | 0.9 (.035) | 1.0 (.039) | 0.13 (.005) | 3.8 (.150) | 3.5 (.138) | 3.5 (.138) |

Notes: (Ref) – Dimensions provided for reference only. No dimensions are provided for B, P or R because low profile cases do not have a bevel or a notch.

\* MIL-PRF-55365/8 specified dimensions.

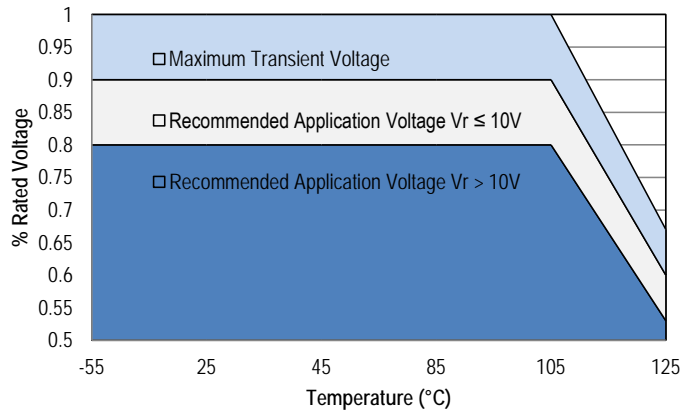
Table 1 – Ratings &amp; Part Number Reference

| Rated Voltage | Rated Capacitance | Case Code/<br>Case Size | KEMET Part Number            | DC Leakage             | DF                         | ESR                            | Maximum Allowable Ripple Current (A) 100 kHz    |                       |
|---------------|-------------------|-------------------------|------------------------------|------------------------|----------------------------|--------------------------------|---|-----------------------|
|               |                   |                         |                              |                        |                            |                                | w/ΔT = 20°C<br>@ -55°C to 105°C                 | w/ΔT = 2°C<br>@ 125°C |
| V             | μF                | KEMET/EIA               | (See below for part options) | (μA) @ 25°C<br>Maximum | % @ 25°C<br>120 Hz Maximum | (mΩ) @ 25°C 100<br>kHz Maximum |   |                       |
| 2.5           | 330               | D/7343-31               | T540D337M2R5AH(1)10          | 83                     | 10                         | 25                             | 2.4   | 0.8                   |
| 2.5           | 470               | D/7343-31               | T540D477M2R5AH(1)10          | 118                    | 10                         | 25                             | 2.4   | 0.8                   |
| 2.5           | 680               | D/7343-31               | T540D687M2R5AH(1)10          | 170                    | 10                         | 25                             | 2.4   | 0.8                   |
| 3             | 100               | B/3528-21               | T540B107M003AH(1)10          | 30                     | 8                          | 80                             | 1   | 0.3                   |
| 3             | 150               | B/3528-21               | T540B157M003AH(1)10          | 45                     | 8                          | 80                             | 1   | 0.3                   |
| 3             | 330               | D/7343-31               | T540D337M003AH(1)10          | 99                     | 10                         | 25                             | 2.4   | 0.8                   |
| 3             | 470               | D/7343-31               | T540D477M003AH(1)10          | 141                    | 10                         | 25                             | 2.4   | 0.8                   |
| 3             | 680               | D/7343-31               | T540D687M003AH(1)10          | 204                    | 10                         | 25                             | 2.4   | 0.8                   |
| 4             | 68                | B/3528-21               | T540B686M004AH(1)10          | 28                     | 8                          | 80                             | 1   | 0.3                   |
| 4             | 100               | B/3528-21               | T540B107M004AH(1)10          | 40                     | 8                          | 80                             | 1   | 0.3                   |
| 4             | 220               | D/7343-31               | T540D227M004AH(1)10          | 88                     | 10                         | 25                             | 2.4   | 0.8                   |
| 4             | 330               | D/7343-31               | T540D337M004AH(1)10          | 132                    | 10                         | 25                             | 2.4   | 0.8                   |
| 4             | 470               | D/7343-31               | T540D477M004AH(1)20          | 188                    | 10                         | 25                             | 2.4   | 0.8                   |
| 4             | 470               | D/7343-31               | T540D477M004AH(1)10          | 188                    | 10                         | 40                             | 1.9   | 0.6                   |
| 6.3           | 33                | B/3528-21               | T540B336M006AH(1)10          | 21                     | 8                          | 80                             | 1   | 0.3                   |
| 6.3           | 47                | B/3528-21               | T540B476M006AH(1)10          | 30                     | 8                          | 80                             | 1   | 0.3                   |
| 6.3           | 68                | B/3528-21               | T540B686M006AH(1)10          | 43                     | 8                          | 80                             | 1   | 0.3                   |
| 6.3           | 150               | D/7343-31               | T540D157M006AH(1)10          | 95                     | 10                         | 25                             | 2.4   | 0.8                   |
| 6.3           | 220               | D/7343-31               | T540D227M006AH(1)10          | 139                    | 10                         | 25                             | 2.4   | 0.8                   |
| 6.3           | 330               | D/7343-31               | T540D337M006AH(1)20          | 208                    | 10                         | 25                             | 2.4   | 0.8                   |
| 6.3           | 330               | D/7343-31               | T540D337M006AH(1)10          | 208                    | 10                         | 40                             | 1.9   | 0.6                   |
| 10            | 22                | B/3528-21               | T540B226M010AH(1)10          | 22                     | 8                          | 80                             | 1   | 0.3                   |
| 10            | 33                | B/3528-21               | T540B336M010AH(1)10          | 33                     | 8                          | 80                             | 1   | 0.3                   |
| 10            | 100               | D/7343-31               | T540D107M010AH(1)20          | 100                    | 10                         | 25                             | 2.4   | 0.8                   |
| 10            | 100               | D/7343-31               | T540D107M010AH(1)10          | 100                    | 10                         | 55                             | 1.7   | 0.5                   |
| 10            | 150               | D/7343-31               | T540D157M010AH(1)20          | 150                    | 10                         | 25                             | 2.4   | 0.8                   |
| 10            | 150               | D/7343-31               | T540D157M010AH(1)10          | 150                    | 10                         | 55                             | 1.7   | 0.5                   |
| 10            | 220               | D/7343-31               | T540D227M010AH(1)10          | 220                    | 10                         | 25                             | 2.4   | 0.8                   |
| 16            | 47                | D/7343-31               | T540D476M016AH(1)20          | 76                     | 10                         | 35                             | 2.1   | 0.7                   |
| 16            | 47                | D/7343-31               | T540D476M016AH(1)10          | 76                     | 10                         | 65                             | 1.5   | 0.5                   |
| 16            | 68                | D/7343-31               | T540D686M016AH(1)10          | 109                    | 10                         | 75                             | 1.4   | 0.5                   |
| 16            | 100               | D/7343-31               | T540D107M016AH(1)10          | 160                    | 10                         | 50                             | 1.7   | 0.6                   |
| 20            | 22                | D/7343-31               | T540D226M020AH(1)10          | 44                     | 10                         | 75                             | 1.4   | 0.5                   |
| 20            | 33                | D/7343-31               | T540D336M020AH(1)10          | 66                     | 10                         | 75                             | 1.4   | 0.5                   |
| 20            | 47                | D/7343-31               | T540D476M020AH(1)10          | 94                     | 10                         | 75                             | 1.4   | 0.5                   |
| 25            | 6.8               | C/6032-28               | T540C685M025AH(1)10          | 17                     | 10                         | 150                            | 0.9   | 0.3                   |
| 25            | 10                | C/6032-28               | T540C106M025AH(1)10          | 25                     | 10                         | 150                            | 0.9   | 0.3                   |
| 25            | 15                | D/7343-31               | T540D156M025AH(1)20          | 38                     | 10                         | 75                             | 1.4   | 0.5                   |
| 25            | 15                | D/7343-31               | T540D156M025AH(1)10          | 38                     | 10                         | 100                            | 1.2   | 0.4                   |
| 25            | 22                | D/7343-31               | T540D226M025AH(1)10          | 55                     | 10                         | 75                             | 1.4   | 0.5                   |
| 25            | 33                | D/7343-31               | T540D336M025AH(1)10          | 83                     | 10                         | 75                             | 1.4   | 0.5                   |
| 35            | 15                | D/7343-31               | T540D156M035AH(1)20          | 53                     | 10                         | 75                             | 1.4   | 0.5                   |
| 35            | 15                | D/7343-31               | T540D156M035AH(1)10          | 53                     | 10                         | 100                            | 1.2   | 0.4                   |
| 50            | 10                | D/7343-31               | T540D106M050AH(1)20          | 50                     | 10                         | 100                            | 1.2   | 0.4                   |
| 50            | 10                | D/7343-31               | T540D106M050AH(1)10          | 50                     | 10                         | 125                            | 1.1   | 0.4                   |
| 63            | 4.7               | D/7343-31               | T540D475M063AH(1)20          | 30                     | 10                         | 100                            | 1.8   | 0.5                   |
| 63            | 4.7               | D/7343-31               | T540D475M063AH(1)10          | 30                     | 10                         | 120                            | 1.1   | 0.3                   |
| V             | μF                | KEMET/EIA               | (See below for part options) | (μA) @ 25°C<br>Maximum | % @ 25°C<br>120 Hz Maximum | (mΩ) @ 25°C 100<br>kHz Maximum | w/ΔT = 20°C<br>@ -55°C to 105°C                 | w/ΔT = 2°C<br>@ 125°C |
| Rated Voltage | Rated Capacitance | Case Code/<br>Case Size | KEMET Part Number            | DC Leakage             | DF                         | ESR                            | Maximum Allowable<br>Ripple Current (A) 100 kHz |                       |

(1) To complete KEMET part number, insert 65 = None, 66 = 10 cycles +25°C, 67 = 10 cycles -55°C and +85°C. Designates surge current option.

Please refer to Ordering Information for additional details.

## Derating Guidelines



| Voltage Rating                            | Maximum Recommended Steady State Voltage | Maximum Recommended Transient Voltage (1 ms – 1 μs) | Maximum Recommended Steady State Voltage | Maximum Recommended Transient Voltage (1 ms – 1 μs) |
|---|--|---|--|---|
|   | -55°C to 105°C                           |   | 105°C to 125°C                           |   |
| $2\text{ V} \leq V_R \leq 10\text{ V}$    | 90% of $V_R$                             | $V_R$   | 60% of $V_R$                             | $V_R$   |
| $12.5\text{ V} \leq V_R \leq 63\text{ V}$ | 80% of $V_R$                             | $V_R$   | 54% of $V_R$                             | $V_R$   |

$V_R$  = Rated Voltage

## Ripple Current/Ripple Voltage

Permissible AC ripple voltage and current are related to equivalent series resistance (ESR) and the power dissipation capabilities of the device. Permissible AC ripple voltage which may be applied is limited by two criteria:

1. The positive peak AC voltage plus the DC bias voltage, if any, must not exceed the DC voltage rating of the capacitor.
2. The negative peak AC voltage in combination with bias voltage, if any, must not exceed the allowable limits specified for reverse voltage. See the Reverse Voltage section for allowable limits.

The maximum power dissipation by case size can be determined using the table at right. The maximum power dissipation rating stated in the table must be reduced with increasing environmental operating temperatures. Refer to the table below for temperature compensation requirements.

| Temperature Compensation Multipliers<br>for Maximum Power Dissipation |                  |                  |
|---|------------------|------------------|
| ≤ 45°C  | 45° C < T ≤ 85°C | 85°C < T ≤ 125°C |
| 1.00  | 0.70             | 0.25             |

T= Environmental Temperature

Using the P max of the device, the maximum allowable rms ripple current or voltage may be determined.

$$I(max) = \sqrt{P_{max}/R}$$

$$E(max) = \sqrt{P_{max} \cdot R}$$

I = rms ripple current (amperes)

E = rms ripple voltage (volts)

P max = maximum power dissipation (watts)

R = ESR at specified frequency (ohms)

| Case Code | EIA Case Code | Maximum Power Dissipation (P max)<br>mWatts @ 45°C<br>with +30°C Rise |
|-----------|---------------|---|
| T         | 3528-12       | 105   |
| M         | 3528-15       | 120   |
| A         | 3216-18       | 112   |
| B         | 3528-21       | 127   |
| U         | 6032-15       | 135   |
| L         | 6032-19       | 150   |
| C         | 6032-28       | 165   |
| W         | 7343-15       | 180   |
| V         | 7343-20       | 187   |
| D         | 7343-31       | 225   |
| Y         | 7343-40       | 241   |
| X         | 7343-43       | 247   |
| H         | 7360-20       | 187   |
| I         | 3216-10       | 95  |

The maximum power dissipation rating must be reduced with increasing environmental operating temperatures. Refer to the Temperature Compensation Multiplier table for details.

## Reverse Voltage

Polymer tantalum capacitors are polar devices and may be permanently damaged or destroyed if connected in the wrong polarity. These devices will withstand a small degree of transient voltage reversal for short periods as shown in the below table.

| Temperature | Permissible Transient Reverse Voltage |
|-------------|---------------------------------------|
| 25°C        | 15% of Rated Voltage                  |
| 55°C        | 10% of Rated Voltage                  |
| 85°C        | 5% of Rated Voltage                   |
| 105°C       | 3% of Rated Voltage                   |
| 125°C*      | 1% of Rated Voltage                   |

\*For series rated to 125°C

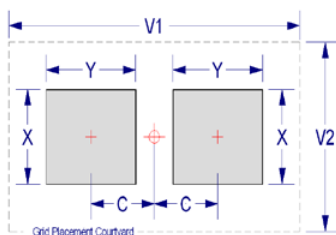
### Table 2 – Land Dimensions/Courtyard

| KEMET<br>Case | Metric<br>Size<br>Code<br>EIA | Density Level A:<br>Maximum (Most)<br>Land Protrusion (mm) |      |      |       |      | Density Level B:<br>Median (Nominal)<br>Land Protrusion (mm) |      |      |      |      | Density Level C:<br>Minimum (Least)<br>Land Protrusion (mm) |      |      |      |      |
|---------------|-------------------------------|--|------|------|-------|------|--|------|------|------|------|---|------|------|------|------|
|               |                               | X  | Y    | C    | V1    | V2   | X  | Y    | C    | V1   | V2   | X   | Y    | C    | V1   | V2   |
| B             | 3528-21                       | 2.35   | 2.15 | 1.45 | 6.10  | 4.00 | 2.25   | 1.75 | 1.35 | 5.00 | 3.50 | 2.15  | 1.35 | 1.25 | 4.10 | 3.20 |
| C             | 6032-25                       | 2.35   | 2.65 | 2.60 | 8.90  | 4.40 | 2.25   | 2.25 | 2.50 | 7.80 | 3.90 | 2.15  | 1.85 | 2.40 | 6.90 | 3.60 |
| D             | 7343-31                       | 2.55   | 3.75 | 2.70 | 10.20 | 5.50 | 2.45   | 3.35 | 2.60 | 9.10 | 5.00 | 2.35  | 2.95 | 2.50 | 8.20 | 4.70 |

*Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes.*

*Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes.*

*Density Level C: For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC Standard 7351 (IPC-7351).*





## Soldering Process

KEMET’s families of surface mount capacitors are compatible with wave (single or dual), convection, IR, or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET’s recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J–STD–020D standard for moisture sensitivity testing. The devices can safely withstand a maximum of three reflow passes at these conditions.

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

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. Once reflow occurs, the iron should be removed immediately. “Wiping” the edges of a chip and heating the top surface is not recommended.

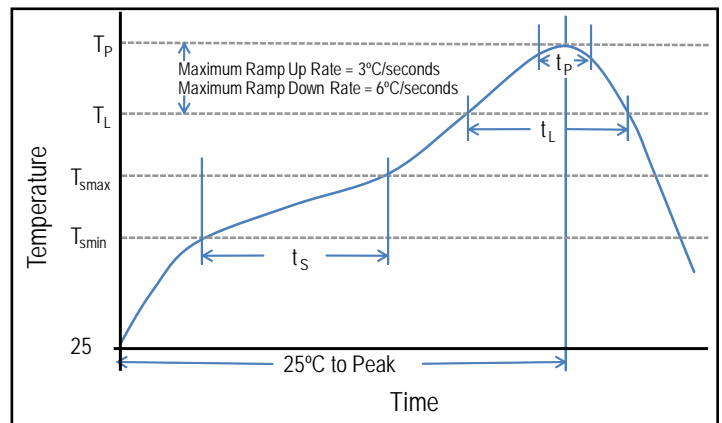
During typical reflow operations, a slight darkening of the gold-colored epoxy may be observed. This slight darkening is normal and not harmful to the product. Marking permanency is not affected by this change.

| Profile Feature                                       | SnPb Assembly       | Pb-Free Assembly    |
|---|---------------------|---------------------|
| Preheat/Soak  |                     |                     |
| Temperature Minimum ( $T_{smin}$ )                    | 100°C               | 150°C               |
| Temperature Maximum ( $T_{smax}$ )                    | 150°C               | 200°C               |
| Time ( $t_s$ ) from $T_{smin}$ to $T_{smax}$          | 60 – 120 seconds    | 60 – 120 seconds    |
| Ramp-up Rate ( $T_L$ to $T_p$ )                       | 3°C/seconds maximum | 3°C/seconds maximum |
| Liquidous Temperature ( $T_L$ )                       | 183°C               | 217°C               |
| Time Above Liquidous ( $t_l$ )                        | 60 – 150 seconds    | 60 – 150 seconds    |
| Peak Temperature ( $T_p$ )                            | 220°C*<br>235°C**   | 250°C*<br>260°C**   |
| Time within 5°C of Maximum Peak Temperature ( $t_p$ ) | 20 seconds maximum  | 30 seconds maximum  |
| Ramp-down Rate ( $T_p$ to $T_L$ )                     | 6°C/seconds maximum | 6°C/seconds maximum |
| Time 25°C to Peak Temperature                         | 6 minutes maximum   | 8 minutes maximum   |

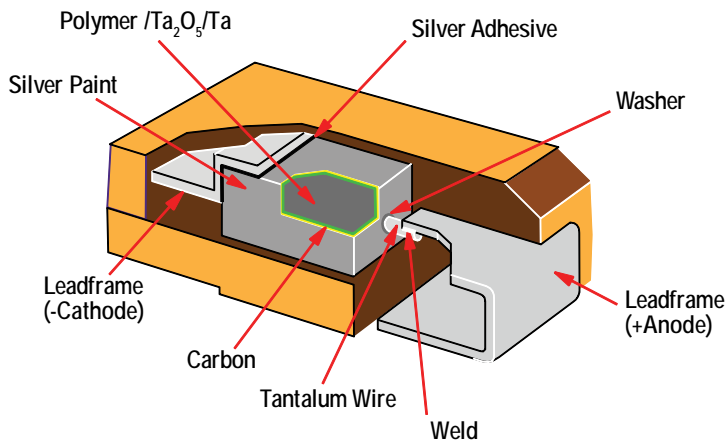
Note: All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow.

\*Case Size D, E, P, Y, and X

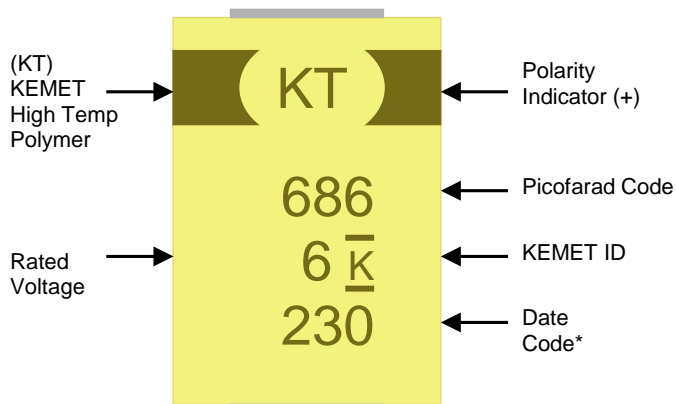
\*\*Case Size A, B, C, H, I, K, M, R, S, T, U, V, W, and Z



## Construction



## Capacitor Marking



\* 230 = 30<sup>th</sup> week of 2012

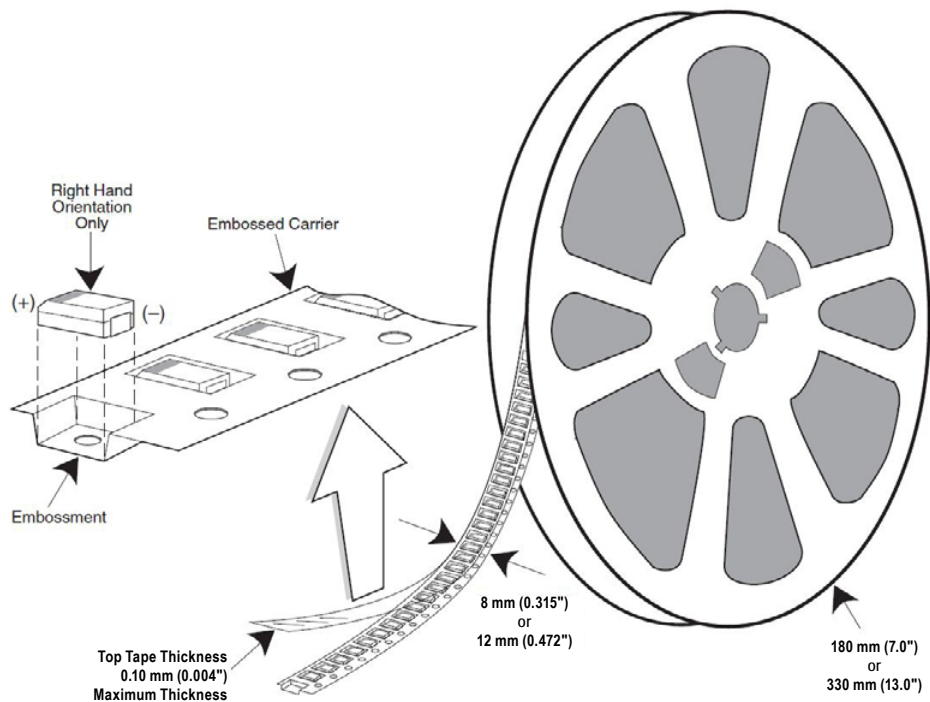
| Date Code *  |  |
|--|--|
| 1 <sup>st</sup> digit = Last number of Year                  | 9 = 2009<br>0 = 2010<br>1 = 2011<br>2 = 2012<br>3 = 2013<br>4 = 2014               |
| 2 <sup>nd</sup> and 3 <sup>rd</sup> digit = Week of the Year | 01 = 1 <sup>st</sup> week of the Year to<br>52 = 52 <sup>nd</sup> week of the Year |

## Storage

All KO-CAP series are shipped in moisture barrier bags with a desiccant and moisture indicator card. These series are classified as MSL3 (Moisture Sensitivity Level 3). Product contained within the moisture barrier bags should be stored in normal working environments with temperatures not to exceed 40°C and humidity not in excess of 60% RH.

## Tape & Reel Packaging Information

KEMET's molded tantalum and aluminum chip capacitor families are packaged in 8 and 12 mm plastic tape on 7" and 13" reels in accordance with *EIA Standard 481-1: Embossed Carrier Taping of Surface Mount Components for Automatic Handling*. This packaging system is compatible with all tape-fed automatic pick-and-place systems.

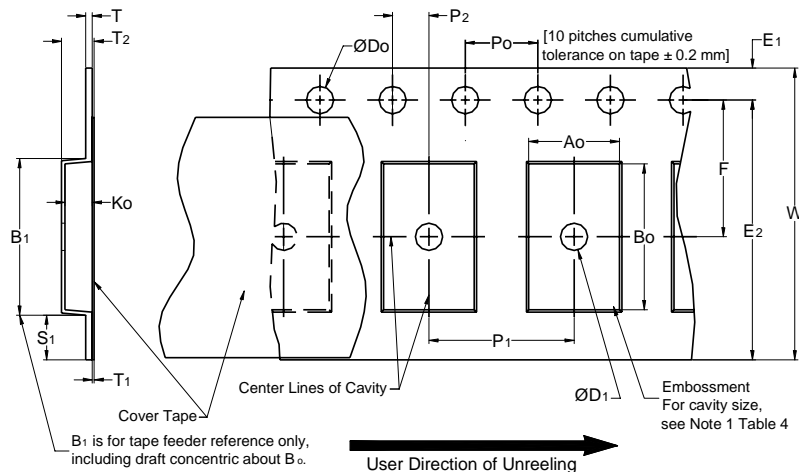


**Table 3 – Packaging Quantity**

| Case Code |         | Tape Width (mm) | 7" Reel* | 13" Reel* |
|-----------|---------|-----------------|----------|-----------|
| KEMET     | EIA     |                 |          |           |
| I         | 3216-10 | 8               | 3,000    | 12,000    |
| S         | 3216-12 | 8               | 2,500    | 10,000    |
| T         | 3528-12 | 8               | 2,500    | 10,000    |
| M         | 3528-15 | 8               | 2,000    | 8,000     |
| U         | 6032-15 | 12              | 1,000    | 5,000     |
| L         | 6032-19 | 12              | 1,000    | 5,000     |
| W         | 7343-15 | 12              | 1,000    | 3,000     |
| Z         | 7343-17 | 12              | 1,000    | 3,000     |
| 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     |
| Y         | 7343-40 | 12              | 500      | 2,000     |
| X         | 7343-43 | 12              | 500      | 2,000     |
| E/T428P   | 7360-38 | 12              | 500      | 2,000     |
| H         | 7360-20 | 12              | 1,000    | 2,500     |

\* No C-Spec required for 7" reel packaging. C-7280 required for 13" reel packaging.

**Figure 1 – Embossed (Plastic) Carrier Tape Dimensions**



**Table 4 – Embossed (Plastic) Carrier Tape Dimensions**

Metric will govern

| Constant Dimensions — Millimeters (Inches) |   |                         |                                    |                                   |                                   |                       |                         |                    |                  |
|--|---|-------------------------|------------------------------------|-----------------------------------|-----------------------------------|-----------------------|-------------------------|--------------------|------------------|
| Tape Size                                  | $D_0$                                   | $D_1$ Minimum<br>Note 1 | $E_1$                              | $P_0$                             | $P_2$                             | R Reference<br>Note 2 | $S_1$ Minimum<br>Note 3 | T Maximum          | $T_1$ Maximum    |
| 8 mm                                       | $1.5 +0.10/-0.0$<br>(0.059 +0.004/-0.0) | 1.0<br>(0.039)          | $1.75 \pm 0.10$<br>(0.069 ± 0.004) | $4.0 \pm 0.10$<br>(0.157 ± 0.004) | $2.0 \pm 0.05$<br>(0.079 ± 0.002) | 25.0<br>(0.984)       | 0.600<br>(0.024)        | 0.600<br>(0.024)   | 0.100<br>(0.004) |
| 12 mm                                      |   | 1.5<br>(0.059)          |                                    |                                   |                                   | 30<br>(1.181)         |                         |                    |                  |
| 16 mm                                      |   |                         |                                    |                                   |                                   |                       |                         |                    |                  |
| Variable Dimensions — Millimeters (Inches) |   |                         |                                    |                                   |                                   |                       |                         |                    |                  |
| Tape Size                                  | Pitch                                   | $B_1$ Maximum<br>Note 4 | $E_2$ Minimum                      | F                                 | $P_1$                             | $T_2$ Maximum         | W Maximum               | $A_0, B_0$ & $K_0$ |                  |
| 8 mm                                       | Single (4 mm)                           | 4.35<br>(0.171)         | 6.25<br>(0.246)                    | $3.5 \pm 0.05$<br>(0.138 ± 0.002) | $4.0 \pm 0.10$<br>(0.157 ± 0.004) | 2.5<br>(0.098)        | 8.3<br>(0.327)          | Note 5             |                  |
| 12 mm                                      | Single (4 mm) &<br>Double (8 mm)        | 8.2<br>(0.323)          | 10.25<br>(0.404)                   | $5.5 \pm 0.05$<br>(0.217 ± 0.002) | $8.0 \pm 0.10$<br>(0.315 ± 0.004) | 4.6<br>(0.181)        | 12.3<br>(0.484)         |                    |                  |
| 16 mm                                      | Triple (12 mm)                          | 12.1<br>(0.476)         | 14.25<br>(0.561)                   | $5.5 \pm 0.05$<br>(0.217 ± 0.002) | $8.0 \pm 0.10$<br>(0.315 ± 0.004) | 4.6<br>(0.181)        | 16.3<br>(0.642)         |                    |                  |

- 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.
- The tape, with or without components, shall pass around R without damage (see Figure 5).
- If  $S_1 < 1.0$  mm, there may not be enough area for cover tape to be properly applied (see EIA Standard 481–D, paragraph 4.3, section b).
- $B_1$  dimension is a reference dimension for tape feeder clearance only.
- The cavity defined by  $A_0$ ,  $B_0$  and  $K_0$  shall surround the component with sufficient clearance that:
  - the component does not protrude above the top surface of the carrier tape.
  - the component can be removed from the cavity in a vertical direction without mechanical restriction, after the top cover tape has been removed.
  - rotation of the component is limited to 20° maximum for 8 and 12 mm tapes and 10° maximum for 16 mm tapes (see Figure 2).
  - lateral movement of the component is restricted to 0.5 mm maximum for 8 mm and 12 mm wide tape and to 1.0 mm maximum for 16 mm tape (see Figure 3).
  - see Addendum in EIA Standard 481–D for standards relating to more precise taping requirements.

## Packaging Information Performance Notes

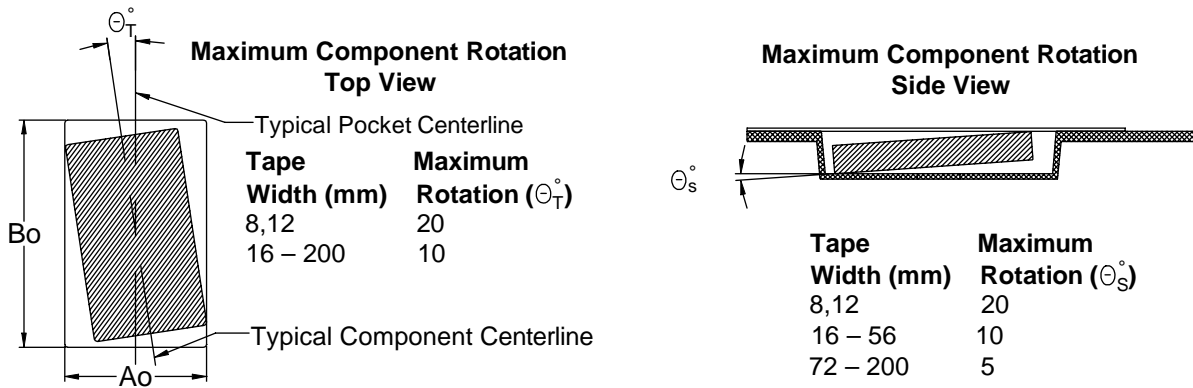
- 1. Cover Tape Break Force:** 1.0 Kg minimum.
- 2. Cover Tape Peel Strength:** The total peel strength of the cover tape from the carrier tape shall be:

| Tape Width   | Peel Strength                    |
|--------------|----------------------------------|
| 8 mm         | 0.1 to 1.0 Newton (10 to 100 gf) |
| 12 and 16 mm | 0.1 to 1.3 Newton (10 to 130 gf) |

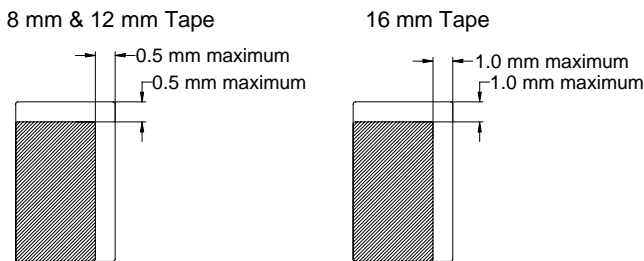
The direction of the pull shall be opposite the direction of the carrier tape travel. The pull angle of the carrier tape shall be 165° to 180° from the plane of the carrier tape. During peeling, the carrier and/or cover tape shall be pulled at a velocity of 300 ±10 mm/minute.

- 3. Labeling:** Bar code labeling (standard or custom) shall be on the side of the reel opposite the sprocket holes. Refer to EIA Standards 556 and 624.

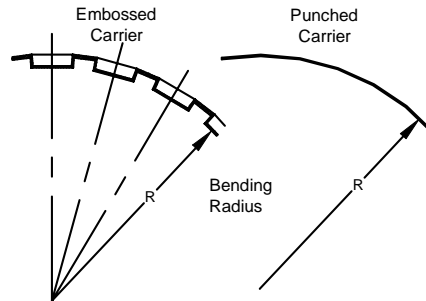
**Figure 2 – Maximum Component Rotation**



**Figure 3 – Maximum Lateral Movement**



**Figure 4 – Bending Radius**



**Figure 5 – Reel Dimensions**



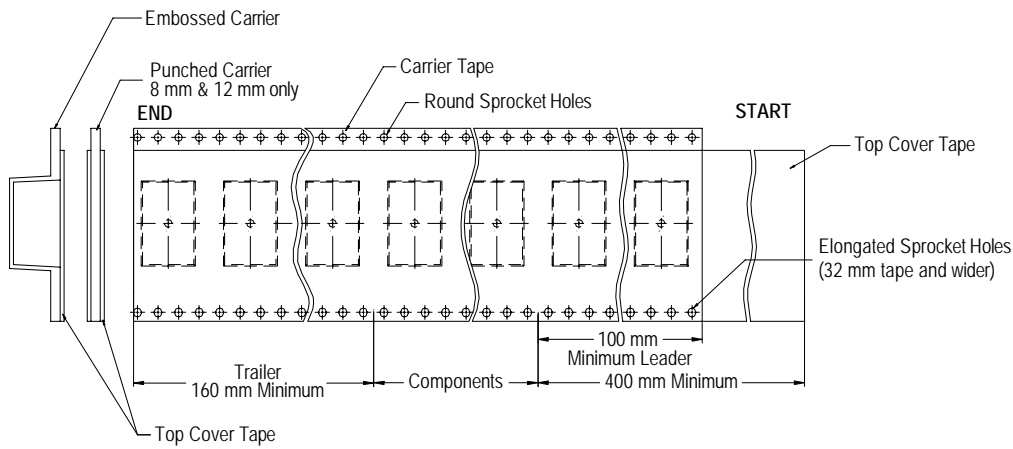
Note: Drive spokes optional; if used, dimensions B and D shall apply.

**Table 5 – Reel Dimensions**

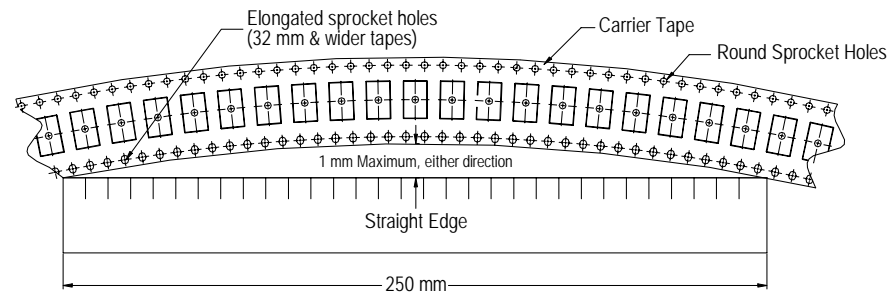
Metric will govern

| Constant Dimensions — Millimeters (Inches) |   |                                       |  |   |
|--|---|---------------------------------------|--|---|
| Tape Size                                  | A   | B Minimum                             | C                                      | D Minimum   |
| 8 mm                                       | 178 ±0.20<br>(7.008 ±0.008)<br>or<br>330 ±0.20<br>(13.000 ±0.008) | 1.5<br>(0.059)                        | 13.0 +0.5/-0.2<br>(0.521 +0.02/-0.008) | 20.2<br>(0.795)                                   |
| 12 mm                                      |   |                                       |  |   |
| 16 mm                                      |   |                                       |  |   |
| Variable Dimensions — Millimeters (Inches) |   |                                       |  |   |
| Tape Size                                  | N Minimum   | W <sub>1</sub>                        | W <sub>2</sub> Maximum                 | W <sub>3</sub>                                    |
| 8 mm                                       | 50<br>(1.969)   | 8.4 +1.5/-0.0<br>(0.331 +0.059/-0.0)  | 14.4<br>(0.567)                        | Shall accommodate tape width without interference |
| 12 mm                                      |   | 12.4 +2.0/-0.0<br>(0.488 +0.078/-0.0) | 18.4<br>(0.724)                        |   |
| 16 mm                                      |   | 16.4 +2.0/-0.0<br>(0.646 +0.078/-0.0) | 22.4<br>(0.882)                        |   |

**Figure 6 – Tape Leader & Trailer Dimensions**



**Figure 7 – Maximum Camber**



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| Tools                          |   |
|--------------------------------|---|
| Resource                       | Location  |
| Configure A Part: CapEdge      | <a href="http://capacitoredge.kemet.com">http://capacitoredge.kemet.com</a> |
| SPICE & FIT Software           | <a href="http://www.kemet.com/spice">http://www.kemet.com/spice</a>         |
| Search Our FAQs: KnowledgeEdge | <a href="http://www.kemet.com/keask">http://www.kemet.com/keask</a>         |
| Electrolytic LifeCalculator    | <a href="http://www.kemet.com:8080/elc">http://www.kemet.com:8080/elc</a>   |

| Product Information                                  |   |
|--|---|
| Resource   | Location  |
| Products   | <a href="http://www.kemet.com/products">http://www.kemet.com/products</a>                 |
| Technical Resources (Including Soldering Techniques) | <a href="http://www.kemet.com/technicalpapers">http://www.kemet.com/technicalpapers</a>   |
| RoHS Statement                                       | <a href="http://www.kemet.com/rohs">http://www.kemet.com/rohs</a>                         |
| Quality Documents                                    | <a href="http://www.kemet.com/qualitydocuments">http://www.kemet.com/qualitydocuments</a> |

| Product Request         |   |
|-------------------------|---|
| Resource                | Location  |
| Sample Request          | <a href="http://www.kemet.com/sample">http://www.kemet.com/sample</a> |
| Engineering Kit Request | <a href="http://www.kemet.com/kits">http://www.kemet.com/kits</a>     |

| Contact            |   |
|--------------------|---|
| Resource           | Location  |
| Website            | <a href="http://www.kemet.com">www.kemet.com</a>                                    |
| Contact Us         | <a href="http://www.kemet.com/contact">http://www.kemet.com/contact</a>             |
| Investor Relations | <a href="http://www.kemet.com/ir">http://www.kemet.com/ir</a>                       |
| Call Us            | 1-877-MyKEMET   |
| Twitter            | <a href="http://twitter.com/kemetcapacitors">http://twitter.com/kemetcapacitors</a> |

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