KEMET Organic Capacitor (KO-CAP®) – Automotive Grade

# T591, T598, T597, and T599 High Humidity and High Temperature Automotive Grade Polymer Electrolytic, 2.5 – 50 VDC

## Overview

KO-CAP Polymer Capacitors

The KEMET Organic Capacitor (KO-CAP) is a solid electrolytic capacitor with a conductive polymer cathode, capable of delivering very low ESR and an improved capacitance retention at high frequencies. KO-CAP combines the low ESR of the multilayer ceramic, the high capacitance of aluminum electrolytic and the volumetric efficiency of tantalum into a single surface mount package. Unlike liquid electrolyte-based capacitors, KO-CAP has a very long operational life and a high ripple current capabilities.

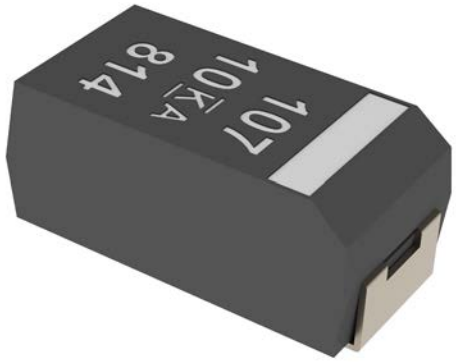
The T591/T597/T598/T599 High Humidity and High Temperature Polymer Electrolytic capacitors deliver higher capacitance and ESR stability under harsh environmental conditions. Enhancements to the design and selected material upgrades were introduced to deliver 500 hours (T591) or 1,000 hours (T598, T599) at 85°C/85% RH rated voltage and to fully comply with the AEC-Q200 qualification testing with maximum operational temperature life up to 125ºC and 150ºC respectively. These capacitors are manufactured in an ISO TS 16949 certified plants and are subjected to PPAP/PSW, as well as change control.

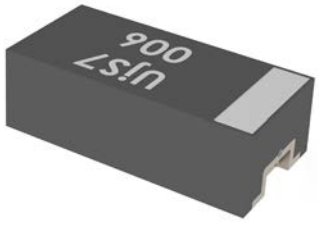
## Benefits

- Ultra low ESR
- Full compliance with AEC-Q200 qualification test plan (T597 FD 125°C, T598 125°C, T599 150°C)
- Qualification plan based on AEC–Q200 with 85°C/85% RH load specification limited to 500 hours (T591)
- Extended endurance test qualification for T598/T599 ($V_R$ < 16 V) , up to 2,000 hours 125°C
- TS 16949 certified plants
- Subject to PPAP/PSW and change control
- Meets or exceeds EIA standard 535BAAC
- Tape & Reel standard packaging per EIA 481
- Halogen-free epoxy and RoHS compliant

## Applications

Typical applications include decoupling and filtering in a variety of market segments, with special emphasis in automotive applications such as infotainment, ADAS, chassis and safety, as well as powertrain, where harsh conditions, such as high humidity and temperature, are a concern.



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## K-SIM

For a detailed analysis of specific part numbers, please visit ksim.kemet.com to access KEMET's K-SIM software. KEMET K-SIM is designed to simulate behavior of components with respect to frequency, ambient temperature, and DC bias levels.

## Ordering Information

### Standard Construction

| T | 59X | D | 107 | M | 010 | A | T | E025 | |
|---|---|---|---|---|---|---|---|---|---|
| Capacitor Class | Series | Case Size | Capacitance Code (pF) | Capacitance Tolerance | Rated Voltage (VDC) | Failure Rate/ Design | Termination Finish | ESR | Packaging (C-Spec) |
| T = Tantalum | 591 = 500 Hours load humidity<br>598 = AEC-Q200 qualified (125°C)<br>599 = AEC-Q200 qualified (150°C) | B<br>D<br>V<br>X | First two digits represent significant figures. Third digit specifies number of zeros. | M = ±20%<br>K = ±10% | 2R5 = 2.5<br>006 = 6.3<br>010 = 10<br>016 = 16<br>020 = 20<br>025 = 25<br>035 = 35<br>050 = 50 | A = N/A | T = 100% Tin (Sn) | Maximum ESR in mΩ,<br>025 = 25 mΩ | Blank = 7" Reel<br>7280 = 13" Reel |

### Face Down Construction

| T | 597 | S | 476 | M | 006 | A | P | E200 | |
|---|---|---|---|---|---|---|---|---|---|
| Capacitor Class | Series | Case Size | Capacitance Code (pF) | Capacitance Tolerance | Rated Voltage (VDC) | Failure Rate/ Design | Termination Finish | ESR | Packaging (C-Spec) |
| T = Tantalum | 597 = AEC-Q200 qualified (125°C) face down construction | P<br>S | First two digits represent significant figures. Third digit specifies number of zeros. | M = ±20% | 2R5 = 2.5<br>006 = 6.3<br>010 = 10 | A = N/A | P = Ni-Pd-Au | Maximum ESR in mΩ,<br>200 = 200 mΩ | Blank = 7" Reel |

## Performance Characteristics

| Item | Performance Characteristics |
|---|---|
| Operating Temperature | −55°C to 105°C/125°C/150°C |
| Rated Capacitance Range | 10 – 470 µF at 120 Hz/25°C |
| Capacitance Tolerance | K Tolerance (10%), M Tolerance (20%) |
| Rated Voltage Range | 2.5 – 50 V |
| DF (120 Hz) | Refer to Part Number Electrical Specification Table |
| ESR (100 kHz) | Refer to Part Number Electrical Specification Table |
| Leakage Current | ≤ 0.1 CV (µA) at rated voltage after 5 minutes<br>T597: ≤ 0.3 CV (µA) at rated voltage after 5 minutes |

## Environmental Compliance

RoHS compliant (6/6) according to Directive 2002/95/EC when ordered with 100% Sn solder. Halogen-free.

## Qualification

| Test | Condition | | Characteristics | | | |
|---|---|---|---|---|---|---|
| Endurance | 105°C at rated voltage, 2,000 hours<br>125°C at 2/3 rated voltage, 2,000 hours[*2]<br>150°C at 2/3 rated voltage, 1,000 hours (T599, $V_R$ > 16 V)<br>150°C at 2/3 rated votage, 2,000 hours (T599, $V_R$ < 16 V) | | Δ C/C | Within −20%/+10% of initial value | | |
| | | | DF | Within 2 x initial limit | | |
| | | | DCL | Within 2 x initial limit | | |
| | | | ESR | Within 2 x initial limit | | |
| Storage Life | 105°C at 0 volts, 2,000 hours<br>125°C at 0 volts, 1,000 hours[*2]<br>150°C at 0 volts, 1,000 hours (T599) | | Δ C/C | Within −20%/+10% of initial value | | |
| | | | DF | Within 2 x initial limit | | |
| | | | DCL | Within 2 x initial limit | | |
| | | | ESR | Within 2 x initial limit | | |
| Humidity | 85°C, 85% RH, load, 500 hours (T591)<br>85°C, 85% RH, load, 1,000 hours<br>(T597, T598, T599) | | Δ C/C | Within −5%/+35% of initial value | | |
| | | | DF | Within 1.5 x initial limits | | |
| | | | DCL | Within initial limit | | |
| | | | ESR | Within 2 x initial limit | | |
| Moisture Resistance[*1] | MIL−STD−202, Method 106,<br>65°C, 90 − 100% RH, no load, 10 cycles | | Δ C/C | Within −10%/+20% of initial value | | |
| | | | DF | Within initial limit | | |
| | | | DCL | Within initial limit | | |
| | | | ESR | Within 2 x initial limit | | |
| Temperature Cycling | JESD22, Test Method A104,<br>−55°C to +105°C/+125°C/+150°C[*2], 1,000 cycles | | Δ C/C | Within −20%/+10% of initial value | | |
| | | | DF | Within initial limits | | |
| | | | DCL | Within initial limit | | |
| | | | ESR | Within 2 x initial limits | | |
| Surge Voltage | 105°C, 1.32 x rated voltage, 1,000 cycles,<br>33 Ω in series<br>125°C/150°C, 1.32 x (0.67 x $V_R$), 1,000 cycles,<br>33 Ω in series[*2] | | Δ C/C | Within −20%/+10% of initial value | | |
| | | | DF | Within initial limits | | |
| | | | DCL | Within initial limits | | |
| | | | ESR | Within initial limits | | |
| Temperature Stability | Extreme temperature exposure at a succession of continuous steps at<br>+25°C, −55°C, +25°C, +85°C,<br>+105°C/+125°C/+150°C[*2], +25°C | | | +25°C | −55°C | +85°C | +105°C/+125°C/+150°C[*2] |
| | | Δ C/C | | IL[*3] | ±20% | ±20% | ±30%[*4] |
| | | DF | | IL | IL | 1.2 x IL | 1.5 x IL |
| | | DCL | | IL | N/A | 10 x IL | 10 x IL |
| Mechanical Shock/ Vibration | AEC−Q200 (MIL−STD−202, Method 213, Figure 1, Condition F.) | | Δ C/C | Within ±10% of initial value | | |
| | | | DF | Within initial limits | | |
| | AEC−Q200 (MIL−STD−202, Method 204, 5 G for 20 minutes/12 cycles each of 3 orientations.<br>Test from 10 − 2, 000 Hz.) | | ESR | Within initial limits | | |
| | | | DCL | Within initial limits | | |

[*1] *T598 only*

[*2] *Refer to part number specifications for individual temperature classification*

[*3] *IL = Initial limit*

[*4] *For T599 (≤ 16 V) apply −30%/+40%*

## Reliability

KO-CAP capacitors have an average failure rate of 0.5 %/1,000 hours at category voltage, $U_C$, and category temperature, $T_C$. These capacitors are qualified using industry test standards at $U_C$ and $T_C$. The minimum test time (1,000 hours or 2,000 hours) is dependent on the product.

The actual life expectancy of KO-CAP capacitors increases when application voltage, $U_A$, and application temperature, $T_A$, are lower than $U_C$ and $T_C$. As a general guideline, when $U_A < 0.9 * U_C$ and $T_A < 85°C$, the life expectancy will typically exceed the useful lifetime of most hardware (> 10 years).

The lifetime of a KO-CAP capacitor at a specific application voltage and temperature can be modeled using the equations below. A failure is defined as passing enough current to blow a 1-amp fuse. The calculation is an estimation based on empirical results and is not a guarantee.

$$VAF = \left(\frac{U_C}{U_A}\right)^n$$

where:
VAF = acceleration factor due to voltage, unitless
$U_C$ = category voltage, volt
$U_A$ = application voltage, volt
n = exponent, 16

$$TAF = e^{\left[\frac{E_a}{k}\left(\frac{1}{273+T_A} - \frac{1}{273+T_C}\right)\right]}$$

where:
TAF = acceleration factor due to temperature, unitless
$E_a$ = activation energy, 1.4 eV
k = Boltzmann's constant, 8.617E-5 eV/K
$T_A$ = application temperature, °C
$T_C$ = category temperature, °C

$$AF = VAF * TAF$$

where:
AF = acceleration factor, unitless
TAF = accerlation factor due to temperature, unitless
VAF = acceleration factor due to voltage, unitless

$$Life_{U_A,T_A} = Life_{U_C,T_C} * AF$$

where:
$Life_{UA, TA}$ = guaranteed life application voltage and temperature, years
$Life_{UC, TC}$ = guaranteed life category voltage and temperature, years
AF = acceleration factor, unitless

**Reliability Table 1 – Common Temperature Range Classifications**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 85°C ($T_R$)/ 85°C ($T_C$) | Rated voltage ($U_R$) | 2.5 | 4.0 | 6.3 | 8.0 | 10.0 | 12.5 | 16.0 | 20.0 | 25.0 | 35.0 | 50.0 | 63.0 | 75.0 |
| | Category voltage ($U_C$) | 2.5 | 4.0 | 6.3 | 8.0 | 10.0 | 12.5 | 16.0 | 20.0 | 25.0 | 35.0 | 50.0 | 63.0 | 75.0 |
| 105°C ($T_R$)/ 105°C ($T_C$) | Rated voltage ($U_R$) | 2.5 | 4.0 | 6.3 | 8.0 | 10.0 | 12.5 | 16.0 | 20.0 | 25.0 | 35.0 | 50.0 | 63.0 | 75.0 |
| | Category voltage ($U_C$) | 2.5 | 4.0 | 6.3 | 8.0 | 10.0 | 12.5 | 16.0 | 20.0 | 25.0 | 35.0 | 50.0 | 63.0 | 75.0 |
| 105°C ($T_R$)/ 125°C ($T_C$) | Rated voltage ($U_R$) | 2.5 | 4.0 | 6.3 | 8.0 | 10.0 | 12.5 | 16.0 | 20.0 | 25.0 | 35.0 | 50.0 | 63.0 | 75.0 |
| | Category voltage ($U_C$) | 1.7 | 2.7 | 4.2 | 5.4 | 6.7 | 8.4 | 10.7 | 13.4 | 16.8 | 23.5 | 33.5 | 42.2 | 50.3 |
| 105°C ($T_R$)/ 150°C ($T_C$) | Rated voltage ($U_R$) | 2.5 | 4.0 | 6.3 | 8.0 | 10.0 | 12.5 | 16.0 | 20.0 | 25.0 | 35.0 | 50.0 | 63.0 | 75.0 |
| | Category voltage ($U_C$) | 1.7 | 2.7 | 4.2 | 5.4 | 6.7 | 8.4 | 10.7 | 13.4 | 16.8 | 23.5 | 33.5 | 42.2 | 50.3 |

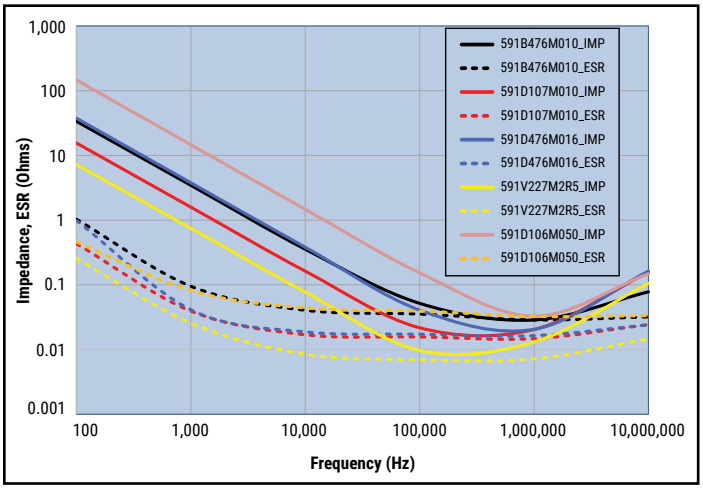
*Terms:*
*Category voltage, $U_C$ : Maximum recommended peak DC operating voltage for continuous operation at the category temperature, $T_C$.*
*Rated voltage, $U_R$ : Maximum recommended peak DC operating voltage for continuous operation up to the rated temperature, $T_R$.*
*Category temperature, $T_C$ : Maximum recommended operating temperature. Voltage derating may be required at $T_C$.*
*Rated temperature, $T_R$ : Maximum recommended operating temperature without voltage derating. $T_R$ is equal to or lower than $T_C$.*

## Certification

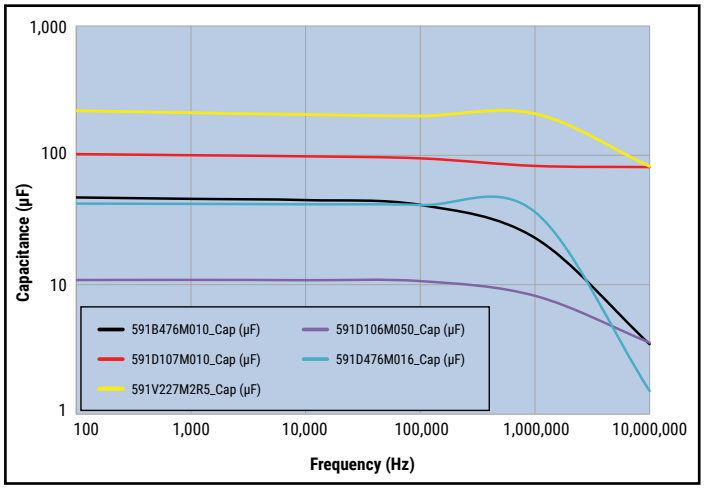
KEMET's internal qualification plan for this polymer electrolytic series of capacitors follows AEC-Q200 guidelines.
For T591 the humidity bias is limited to a maximum of 500 hours.
For T597 and T598 the qualification plan is fully compliant with AEC-Q200 with maximum operational temperature of 125°C.
For T599 the qualification plan is fully compliant with AEC-Q200 with maximum operational temperature of 150°C.

## Electrical Characteristics

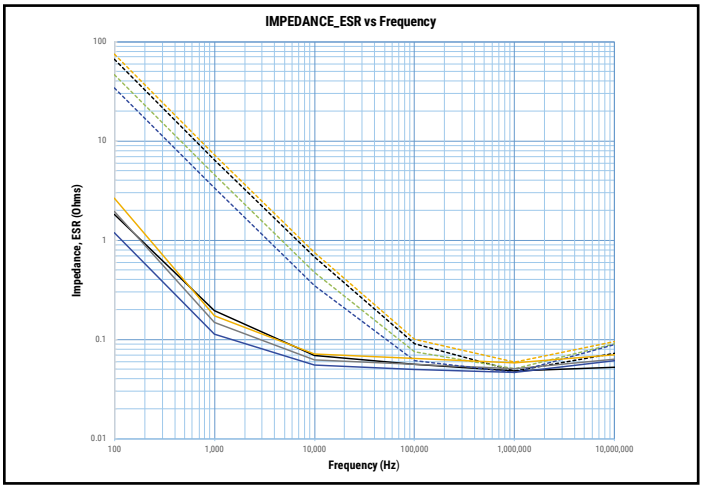
### ESR vs. Frequency – T591



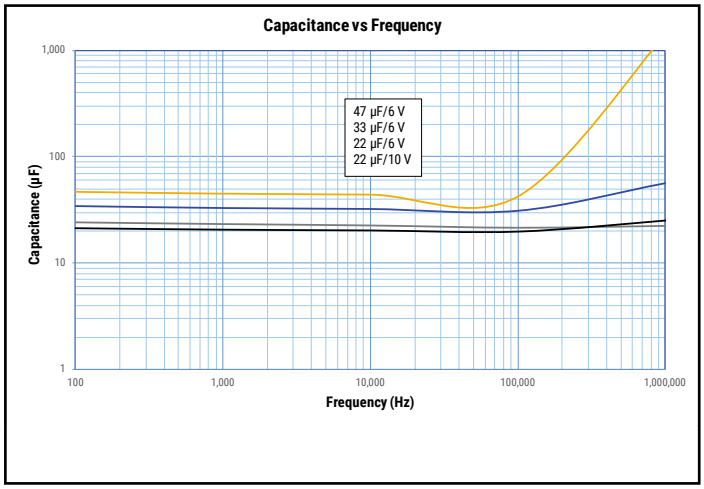

### Capacitance vs. Frequency – T591




### ESR vs. Frequency – T597

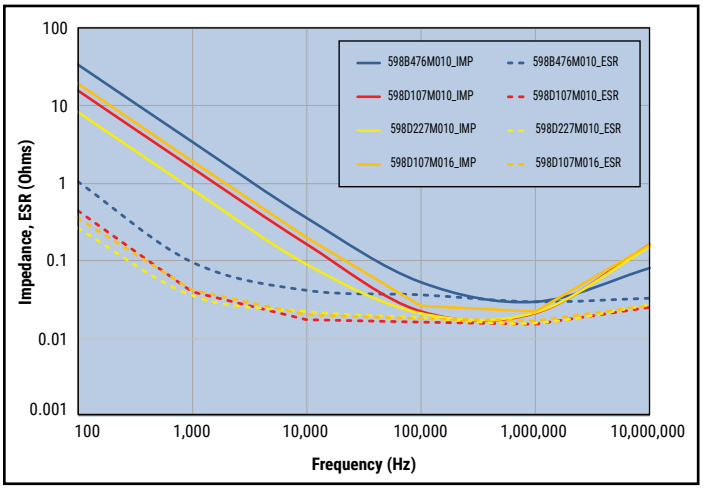



### Capacitance vs. Frequency – T597

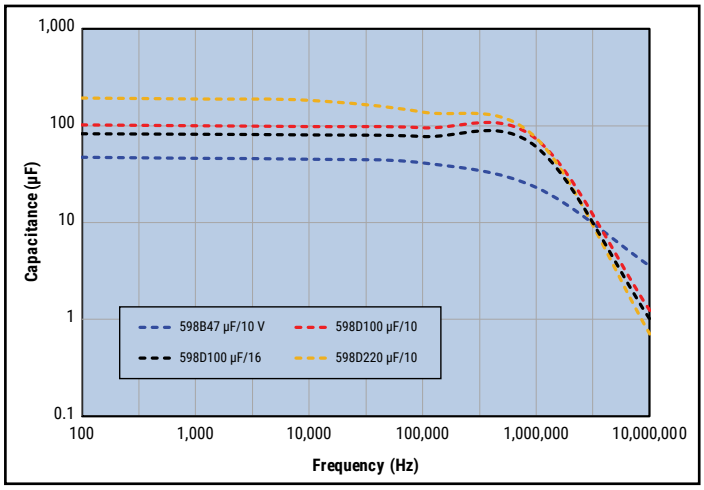


## Electrical Characteristics cont.

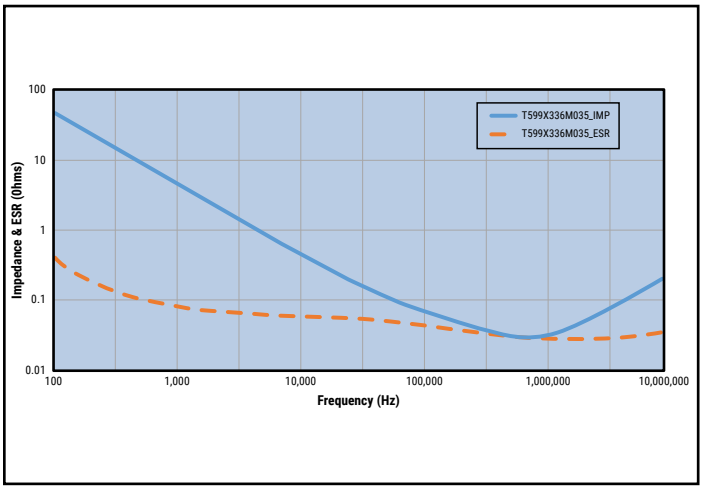
### ESR vs. Frequency – T598



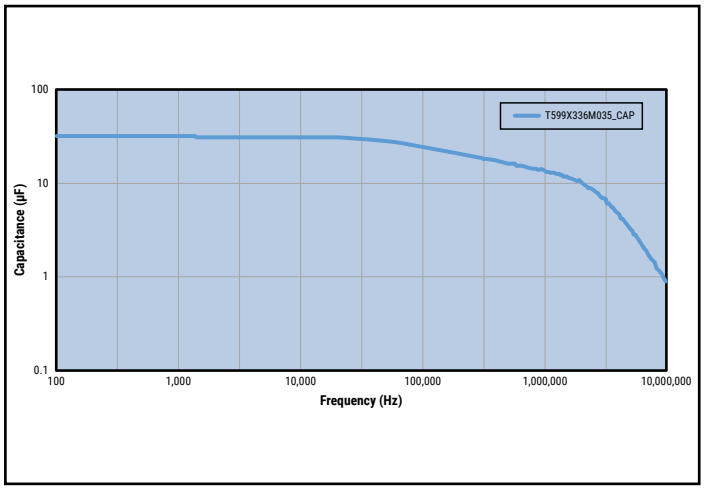

### Capacitance vs. Frequency – T598




### ESR vs. Frequency – T599




### Capacitance vs. Frequency – T599

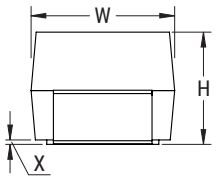


# Dimensions – Millimeters (Inches)

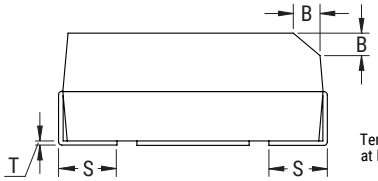
Metric will govern

## T591 / T598 / T599

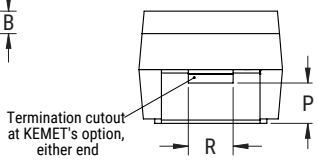
CATHODE (-) END VIEW



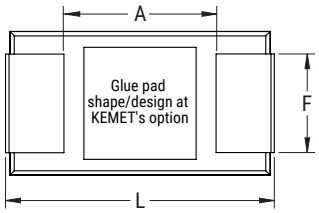

SIDE VIEW




ANODE (+) END VIEW




BOTTOM VIEW

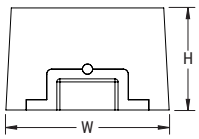



| Case Size | | Component Dimensions | | | | | | | | | | | Typical Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KEMET | EIA | L | W | H | F ±0.1 ±(0.004) | S ±0.3 ±(0.012) | B ±0.15 (Ref) ±0.006 | X (Ref) | P (Ref) | R (Ref) | T (Ref) | A (Minimum) | (mg) |
| B | 3528–21 | 3.5 ±0.2 (0.138 ±0.008) | 2.8 ±0.2 (0.110 ±0.008) | 1.9 ±0.2 (0.075 ±0.008) | 2.2 (0.087) | 0.8 (0.031) | 0.4 (0.016) | 0.10 ±0.10 (0.004 ±0.004) | 0.5 (0.020) | 1.0 (0.039) | 0.13 (0.005) | 1.1 (0.043) | 95 |
| D | 7343–31 | 7.3 ±0.3 (0.287 ±0.012) | 4.3 ±0.3 (0.169 ±0.012) | 2.8 ±0.3 (0.110 ±0.012) | 2.4 (0.094) | 1.3 (0.051) | 0.5 (0.020) | 0.10 ±0.10 (0.004 ±0.004) | 0.9 (0.035) | 1.0 (0.039) | 0.13 (0.005) | 3.8 (0.150) | 435 |
| V | 7343-20 | 7.3 ±0.3 (0.287 ±0.012) | 4.3 ±0.3 (0.169 ±0.012) | 1.9 ±0.1 (0.075 ±0.004) | 2.4 (0.094) | 1.3 (0.051) | N/A | 0.05 (0.002) | N/A | N/A | 0.13 (0.005) | 3.8 (0.150) | 274 |
| X | 7343-43 | 7.3 ±0.3 (0.287 ±0.012) | 4.3 ±0.3 (0.169 ±0.012) | 4.0 ±0.3 (0.157±0.012) | 2.4 (0.094) | 1.3 (0.051) | 0.5 (0.020) | 0.10 ±0.10 (0.004 ±0.004) | 1.7 (0.067) | 1.0 (0.039) | 0.13 (0.005) | 3.8 (0.150) | 554 |

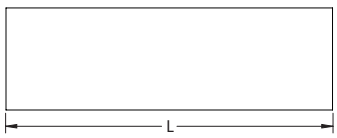
*Notes: Reference (Ref) – Dimensions provided for reference only. For low profile cases, no dimensions are provided for B, P, or R, because these cases do not have a bevel or a notch.*
*These weights are provided as reference. If exact weights are needed, please contact your KEMET sales representative.*

## T597

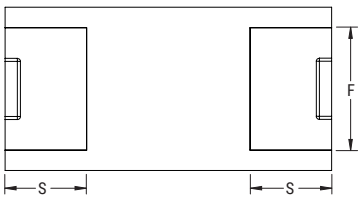
END VIEW




SIDE VIEW




BOTTOM VIEW




| Case Size | | Component Dimensions | | | | | Weight |
|---|---|---|---|---|---|---|---|
| KEMET | EIA | L | W | H | F ±0.1 (±0.004) | S ±0.2 (±0.008) | (mg) |
| P | 2012-10 | 2.0 ±0.2 (0.079±0.008) | 1.2 ±0.2 (0.047±0.008) | 0.9 ±0.1 (0.035±0.004) | 0.9 (0.035) | 0.55 (0.022) | 11.3 |
| S | 3216-12 | 3.2 ± 0.2 (0.126 ±0.008) | 1.6 ±0.2 (0.063 ±0.008) | 1.1 ±0.1 (0.043 ±0.004) | 1.2 (0.047) | 0.8 (0.031) | 26.2 |

## Table 1 – Ratings & Part Number Reference

| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | DC Leakage | DF | ESR | Maximum Allowable Ripple Current | MSL | Maximum Operating Temp | AEC-Q200 Qualified |
|---|---|---|---|---|---|---|---|---|---|---|
| VDC at 105°C | µF | KEMET/EIA | | µA at +25°C Max/5 Minutes | % at +25°C 120 Hz Max | mΩ at +25°C 100 kHz Max | (rms) mA at +45°C 100 kHz | Reflow Temp ≤ 260°C | °C | T598/T599 Only[1] |
| 105°C | | | | | | | | | | |
| 2.5 | 100 | B/3528-21 | T591B107M2R5ATE055 | 25 | 8 | 55 | 1,520 | 3 | 105 | |
| 2.5 | 100 | B/3528-21 | T591B107M2R5ATE070 | 25 | 8 | 70 | 1,347 | 3 | 105 | |
| 2.5 | 220 | B/3528-21 | T591B227M2R5ATE025 | 55 | 8 | 25 | 2,260 | 3 | 105 | |
| 2.5 | 220 | V/7343-20 | T591V227M2R5ATE009 | 55 | 10 | 9 | 4,558 | 3 | 105 | |
| 2.5 | 220 | V/7343-20 | T591V227M2R5ATE012 | 55 | 10 | 12 | 3,947 | 3 | 105 | |
| 2.5 | 220 | V/7343-20 | T591V227M2R5ATE015 | 55 | 10 | 15 | 3,531 | 3 | 105 | |
| 2.5 | 470 | D/7343-31 | T591D477M2R5ATE009 | 117.5 | 10 | 9 | 5,000 | 3 | 105 | |
| 4 | 100 | B/3528-21 | T591B107M004ATE070 | 40 | 10 | 70 | 1,347 | 3 | 105 | |
| 4 | 220 | V/7343-20 | T591V227M004ATE018 | 88 | 10 | 18 | 3,223 | 3 | 105 | |
| 4 | 220 | V/7343-20 | T591V227M004ATE025 | 88 | 10 | 25 | 2,735 | 3 | 105 | |
| 6.3 | 220 | B/3528-21 | T591B227M006ATE035 | 139 | 8 | 35 | 1,900 | 3 | 105 | |
| 125°C | | | | | | | | | | |
| 2.5 | 100 | B/3528-21 | T598B107M2R5ATE055 | 25 | 8 | 55 | 1,520 | 3 | 125 | • |
| 2.5 | 100 | B/3528-21 | T598B107M2R5ATE070 | 25 | 8 | 70 | 1,347 | 3 | 125 | • |
| 2.5 | 330 | V/7343-20 | T591V337M2R5ATE012 | 82.5 | 10 | 12 | 3,947 | 3 | 125 | |
| 2.5 | 330 | V/7343-20 | T591V337M2R5ATE025 | 82.5 | 10 | 25 | 2,735 | 3 | 125 | |
| 2.5 | 330 | D/7343-31 | T591D337M2R5ATE015 | 82.5 | 10 | 15 | 3,873 | 3 | 125 | |
| 2.5 | 330 | D/7343-31 | T591D337M2R5ATE018 | 82.5 | 10 | 18 | 3,536 | 3 | 125 | |
| 2.5 | 470 | D/7343-31 | T598D477M2R5ATE009 | 117.5 | 10 | 9 | 5,000 | 3 | 125 | • |
| 4 | 100 | B/3528-21 | T598B107M004ATE045 | 40 | 10 | 45 | 1,680 | 3 | 125 | • |
| 4 | 100 | B/3528-21 | T598B107M004ATE055 | 40 | 10 | 55 | 1,520 | 3 | 125 | • |
| 4 | 100 | B/3528-21 | T598B107M004ATE070 | 40 | 10 | 70 | 1,347 | 3 | 125 | • |
| 4 | 100 | B/3528-21 | T591B107M004ATE045 | 40 | 8 | 45 | 1,680 | 3 | 125 | |
| 4 | 100 | B/3528-21 | T591B107M004ATE055 | 40 | 8 | 55 | 1,520 | 3 | 125 | |
| 4 | 150 | B/3528-21 | T598B157M004ATE045 | 60 | 8 | 45 | 1,680 | 3 | 125 | • |
| 4 | 150 | B/3528-21 | T598B157M004ATE055 | 60 | 8 | 55 | 1,520 | 3 | 125 | • |
| 4 | 150 | B/3528-21 | T598B157M004ATE070 | 60 | 8 | 70 | 1,347 | 3 | 125 | • |
| 4 | 150 | B/3528-21 | T591B157M004ATE045 | 60 | 8 | 45 | 1,680 | 3 | 125 | |
| 4 | 150 | B/3528-21 | T591B157M004ATE055 | 60 | 8 | 55 | 1,520 | 3 | 125 | |
| 4 | 150 | B/3528-21 | T591B157M004ATE070 | 60 | 8 | 70 | 1,347 | 3 | 125 | |
| 4 | 330 | V/7343-20 | T598V337M004ATE025 | 132 | 10 | 25 | 2,735 | 3 | 125 | • |
| 4 | 330 | V/7343-20 | T598V337M004ATE045 | 132 | 10 | 45 | 2,039 | 3 | 125 | • |
| 4 | 330 | V/7343-20 | T591V337M004ATE025 | 132 | 10 | 25 | 2,735 | 3 | 125 | |
| 4 | 330 | V/7343-20 | T591V337M004ATE045 | 132 | 10 | 45 | 2,039 | 3 | 125 | |
| 6.3 | 33 | B/3528-21 | T598B336M006ATE070 | 20.8 | 8 | 70 | 1,347 | 3 | 125 | • |
| 6.3 | 33 | B/3528-21 | T598B336M006ATE080 | 20.8 | 8 | 80 | 1,260 | 3 | 125 | • |
| 6.3 | 33 | B/3528-21 | T591B336M006ATE070 | 20.8 | 8 | 70 | 1,347 | 3 | 125 | |
| 6.3 | 33 | B/3528-21 | T591B336M006ATE080 | 20.8 | 8 | 80 | 1,260 | 3 | 125 | |
| 6.3 | 47 | B/3528-21 | T598B476M006ATE070 | 29.6 | 8 | 70 | 1,347 | 3 | 125 | • |
| 6.3 | 47 | B/3528-21 | T591B476M006ATE070 | 29.6 | 8 | 70 | 1,347 | 3 | 125 | |
| 6.3 | 68 | B/3528-21 | T598B686M006ATE070 | 43 | 8 | 70 | 1,347 | 3 | 125 | • |
| 6.3 | 68 | B/3528-21 | T591B686M006ATE070 | 43 | 8 | 70 | 1,347 | 3 | 125 | |
| 6.3 | 100 | B/3528-21 | T598B107M006ATE045 | 63 | 8 | 45 | 1,680 | 3 | 125 | • |
| 6.3 | 100 | B/3528-21 | T598B107M006ATE055 | 63 | 8 | 55 | 1,520 | 3 | 125 | • |
| 6.3 | 100 | B/3528-21 | T598B107M006ATE070 | 63 | 8 | 70 | 1,347 | 3 | 125 | • |
| 6.3 | 100 | B/3528-21 | T591B107M006ATE045 | 63 | 8 | 45 | 1,680 | 3 | 125 | |
| 6.3 | 100 | B/3528-21 | T591B107M006ATE055 | 63 | 8 | 55 | 1,520 | 3 | 125 | |
| 6.3 | 100 | B/3528-21 | T591B107M006ATE070 | 63 | 8 | 70 | 1,347 | 3 | 125 | |
| 6.3 | 150 | B/3528-21 | T598B157M006ATE045 | 94.5 | 8 | 45 | 1,680 | 3 | 125 | • |
| VDC at 105°C | µF | KEMET/EIA | | µA at +25°C Max/5 Minutes | % at +25°C 120 Hz Max | mΩ at +25°C 100 kHz Max | mA at +45°C 100 kHz | Reflow Temp ≤ 260°C | °C | T598/T599 Only[1] |
| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | DC Leakage | DF | ESR | Maximum Allowable Ripple Current | MSL | Maximum Operating Temp | AEC–Q200 Qualified |

*(1) To complete KEMET part number, insert M for ±20% or K for ±10%. Designates capacitance tolerance.*
*[1] T598 = AEC-Q200 qualified. T599 AEC-Q200 qualified 150°C and T591 = limited to 500 hours at 85°C/85% RH load.*
*Refer to Ordering Information for additional detail.*

## Table 1 – Ratings & Part Number Reference cont.

| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | DC Leakage | DF | ESR | Maximum Allowable Ripple Current | MSL | Maximum Operating Temp | AEC-Q200 Qualified |
|---|---|---|---|---|---|---|---|---|---|---|
| VDC at 105°C | µF | KEMET/EIA | | µA at +25°C Max/5 Minutes | % at +25°C 120 Hz Max | mΩ at +25°C 100 kHz Max | (rms) mA at +45°C 100 kHz | Reflow Temp ≤ 260°C | °C | T598/T599 Only[1] |
| 125°C | | | | | | | | | | |
| 6.3 | 150 | B/3528-21 | T598B157M006ATE055 | 94.5 | 8 | 55 | 1,520 | 3 | 125 | • |
| 6.3 | 150 | B/3528-21 | T598B157M006ATE070 | 94.5 | 8 | 70 | 1,347 | 3 | 125 | • |
| 6.3 | 150 | B/3528-21 | T591B157M006ATE045 | 94.5 | 8 | 45 | 1,680 | 3 | 125 | |
| 6.3 | 150 | B/3528-21 | T591B157M006ATE055 | 94.5 | 8 | 55 | 1,520 | 3 | 125 | |
| 6.3 | 150 | B/3528-21 | T591B157M006ATE070 | 94.5 | 8 | 70 | 1,347 | 3 | 125 | |
| 6.3 | 150 | V/7343-20 | T598V157M006ATE025 | 94.5 | 10 | 25 | 2,735 | 3 | 125 | • |
| 6.3 | 150 | V/7343-20 | T598V157M006ATE045 | 94.5 | 10 | 45 | 2,039 | 3 | 125 | • |
| 6.3 | 150 | V/7343-20 | T591V157M006ATE025 | 94.5 | 10 | 25 | 2,735 | 3 | 125 | |
| 6.3 | 150 | V/7343-20 | T591V157M006ATE045 | 94.5 | 10 | 45 | 2,039 | 3 | 125 | |
| 6.3 | 150 | D/7343-31 | T598D157M006ATE025 | 94.5 | 10 | 25 | 3,000 | 3 | 125 | • |
| 6.3 | 150 | D/7343-31 | T598D157M006ATE045 | 94.5 | 10 | 45 | 2,236 | 3 | 125 | • |
| 6.3 | 150 | D/7343-31 | T591D157M006ATE025 | 94.5 | 10 | 25 | 3,000 | 3 | 125 | |
| 6.3 | 150 | D/7343-31 | T591D157M006ATE045 | 94.5 | 10 | 45 | 2,236 | 3 | 125 | |
| 6.3 | 220 | B/3528-21 | T591B227M006ATE045 | 139 | 8 | 45 | 1,680 | 3 | 125 | |
| 6.3 | 220 | B/3528-21 | T591B227M006ATE070 | 139 | 8 | 70 | 1,347 | 3 | 125 | |
| 6.3 | 220 | D/7343-31 | T598D227M006ATE025 | 139 | 10 | 25 | 3,000 | 3 | 125 | • |
| 6.3 | 220 | D/7343-31 | T598D227M006ATE040 | 139 | 10 | 40 | 2,372 | 3 | 125 | • |
| 6.3 | 220 | D/7343-31 | T598D227M006ATE080 | 139 | 10 | 80 | 1,677 | 3 | 125 | • |
| 6.3 | 220 | D/7343-31 | T591D227M006ATE025 | 139 | 10 | 25 | 3,000 | 3 | 125 | |
| 6.3 | 220 | D/7343-31 | T591D227M006ATE040 | 139 | 10 | 40 | 2,372 | 3 | 125 | |
| 6.3 | 220 | D/7343-31 | T591D227M006ATE080 | 139 | 10 | 80 | 1,677 | 3 | 125 | |
| 6.3 | 220 | V/7343-20 | T598V227M006ATE025 | 139 | 10 | 25 | 2,735 | 3 | 125 | • |
| 6.3 | 220 | V/7343-20 | T598V227M006ATE045 | 139 | 10 | 45 | 2,039 | 3 | 125 | • |
| 6.3 | 220 | V/7343-20 | T591V227M006ATE025 | 139 | 10 | 25 | 2,735 | 3 | 125 | |
| 6.3 | 220 | V/7343-20 | T591V227M006ATE045 | 139 | 10 | 45 | 2,039 | 3 | 125 | |
| 6.3 | 330 | D/7343-31 | T598D337M006ATE025 | 208 | 10 | 25 | 3,000 | 3 | 125 | • |
| 6.3 | 330 | D/7343-31 | T598D337M006ATE040 | 208 | 10 | 40 | 2,372 | 3 | 125 | • |
| 6.3 | 330 | D/7343-31 | T598D337M006ATE080 | 208 | 10 | 80 | 1,677 | 3 | 125 | • |
| 6.3 | 330 | D/7343-31 | T591D337M006ATE025 | 208 | 10 | 25 | 3,000 | 3 | 125 | |
| 6.3 | 330 | D/7343-31 | T591D337M006ATE040 | 208 | 10 | 40 | 2,372 | 3 | 125 | |
| 6.3 | 330 | D/7343-31 | T591D337M006ATE080 | 208 | 10 | 80 | 1,677 | 3 | 125 | |
| 10 | 33 | B/3528-21 | T598B336M010ATE070 | 33 | 8 | 70 | 1,347 | 3 | 125 | • |
| 10 | 33 | B/3528-21 | T598B336M010ATE080 | 33 | 8 | 80 | 1,260 | 3 | 125 | • |
| 10 | 33 | B/3528-21 | T591B336M010ATE070 | 33 | 8 | 70 | 1,347 | 3 | 125 | |
| 10 | 33 | B/3528-21 | T591B336M010ATE080 | 33 | 8 | 80 | 1,260 | 3 | 125 | |
| 10 | 47 | B/3528-21 | T598B476M010ATE070 | 47 | 8 | 70 | 1,347 | 3 | 125 | • |
| 10 | 47 | B/3528-21 | T591B476M010ATE070 | 47 | 8 | 70 | 1,347 | 3 | 125 | |
| 10 | 100 | D/7343-31 | T598D107M010ATE025 | 100 | 10 | 25 | 3,000 | 3 | 125 | • |
| 10 | 100 | D/7343-31 | T598D107M010ATE040 | 100 | 10 | 40 | 2,372 | 3 | 125 | • |
| 10 | 100 | D/7343-31 | T598D107M010ATE080 | 100 | 10 | 80 | 1,677 | 3 | 125 | • |
| 10 | 100 | D/7343-31 | T591D107M010ATE025 | 100 | 10 | 25 | 3,000 | 3 | 125 | |
| 10 | 100 | D/7343-31 | T591D107M010ATE040 | 100 | 10 | 40 | 2,372 | 3 | 125 | |
| 10 | 100 | D/7343-31 | T591D107M010ATE080 | 100 | 10 | 80 | 1,677 | 3 | 125 | |
| 10 | 100 | V/7343-20 | T598V107M010ATE025 | 100 | 10 | 25 | 2,735 | 3 | 125 | • |
| 10 | 100 | V/7343-20 | T598V107M010ATE045 | 100 | 10 | 45 | 2,039 | 3 | 125 | • |
| 10 | 100 | V/7343-20 | T591V107M010ATE025 | 100 | 10 | 25 | 2,735 | 3 | 125 | |
| 10 | 100 | V/7343-20 | T591V107M010ATE045 | 100 | 10 | 45 | 2,039 | 3 | 125 | |
| 10 | 150 | D/7343-31 | T598D157M010ATE025 | 150 | 10 | 25 | 3,000 | 3 | 125 | • |
| 10 | 150 | D/7343-31 | T598D157M010ATE045 | 150 | 10 | 45 | 2,236 | 3 | 125 | • |
| VDC at 105°C | µF | KEMET/EIA | | µA at +25°C Max/5 Minutes | % at +25°C 120 Hz Max | mΩ at +25°C 100 kHz Max | mA at +45°C 100 kHz | Reflow Temp ≤ 260°C | °C | T598/T599 Only[1] |
| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | DC Leakage | DF | ESR | Maximum Allowable Ripple Current | MSL | Maximum Operating Temp | AEC–Q200 Qualified |

*(1) To complete KEMET part number, insert M for ±20% or K for ±10%. Designates capacitance tolerance.*
*[1] T598 = AEC-Q200 qualified. T599 AEC-Q200 qualified 150°C and T591 = limited to 500 hours at 85°C/85% RH load.*
*Refer to Ordering Information for additional detail.*

## Table 1 – Ratings & Part Number Reference cont.

| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | DC Leakage | DF | ESR | Maximum Allowable Ripple Current | MSL | Maximum Operating Temp | AEC-Q200 Qualified |
|---|---|---|---|---|---|---|---|---|---|---|
| VDC at 105°C | µF | KEMET/EIA | | µA at +25°C Max/5 Minutes | % at +25°C 120 Hz Max | mΩ at +25°C 100 kHz Max | (rms) mA at +45°C 100 kHz | Reflow Temp ≤ 260°C | °C | T598/T599 Only[1] |
| 125°C | | | | | | | | | | |
| 10 | 150 | D/7343-31 | T591D157M010ATE025 | 150 | 10 | 25 | 3,000 | 3 | 125 | |
| 10 | 150 | D/7343-31 | T591D157M010ATE045 | 150 | 10 | 45 | 2,236 | 3 | 125 | |
| 10 | 150 | V/7343-20 | T598V157M010ATE025 | 150 | 10 | 25 | 2,735 | 3 | 125 | • |
| 10 | 150 | V/7343-20 | T598V157M010ATE045 | 150 | 10 | 45 | 2,236 | 3 | 125 | • |
| 10 | 150 | V/7343-20 | T591V157M010ATE025 | 150 | 10 | 25 | 2,735 | 3 | 125 | |
| 10 | 150 | V/7343-20 | T591V157M010ATE045 | 150 | 10 | 45 | 2,236 | 3 | 125 | |
| 10 | 220 | D/7343-31 | T598D227M010ATE025 | 220 | 10 | 25 | 3,000 | 3 | 125 | • |
| 10 | 220 | D/7343-31 | T598D227M010ATE040 | 220 | 10 | 40 | 2,372 | 3 | 125 | • |
| 10 | 220 | D/7343-31 | T598D227M010ATE080 | 220 | 10 | 80 | 1,677 | 3 | 125 | • |
| 10 | 220 | D/7343-31 | T591D227M010ATE025 | 220 | 10 | 25 | 3,000 | 3 | 125 | |
| 10 | 220 | D/7343-31 | T591D227M010ATE040 | 220 | 10 | 40 | 2,372 | 3 | 125 | |
| 10 | 220 | D/7343-31 | T591D227M010ATE080 | 220 | 10 | 80 | 1,677 | 3 | 125 | |
| 16 | 47 | D/7343-31 | T598D476M016ATE070 | 75.2 | 10 | 70 | 1,793 | 3 | 125 | • |
| 16 | 47 | D/7343-31 | T591D476M016ATE070 | 75.2 | 10 | 70 | 1,793 | 3 | 125 | |
| 16 | 100 | D/7343-31 | T598D107M016ATE050 | 160 | 10 | 50 | 2,121 | 3 | 125 | • |
| 16 | 100 | D/7343-31 | T591D107M016ATE050 | 160 | 10 | 50 | 2,121 | 3 | 125 | |
| 16 | 150 | D/7343-31 | T598D157M016ATE065 | 240 | 10 | 65 | 1,900 | 3 | 125 | • |
| 16 | 150 | D/7343-31 | T591D157M016ATE065 | 240 | 10 | 65 | 1,900 | 3 | 125 | |
| 20 | 47 | D/7343-31 | T591D476M020ATE050 | 94 | 10 | 50 | 2,121 | 3 | 125 | |
| 20 | 68 | D/7343-31 | T591D686M020ATE040 | 136 | 10 | 40 | 2,372 | 3 | 125 | |
| 20 | 68 | D/7343-31 | T591D686M020ATE050 | 136 | 10 | 50 | 2,121 | 3 | 125 | |
| 25 | 22 | D/7343-31 | T591D226M025ATE060 | 55 | 10 | 60 | 1,936 | 3 | 125 | |
| 25 | 33 | D/7343-31 | T598D336M025ATE060 | 82.5 | 10 | 60 | 1,936 | 3 | 125 | • |
| 25 | 33 | D/7343-31 | T591D336M025ATE060 | 82.5 | 10 | 60 | 1,936 | 3 | 125 | |
| 25 | 47 | D/7343-31 | T598D476M025ATE060 | 117.5 | 10 | 60 | 1,936 | 3 | 125 | • |
| 35 | 2.2 | B/3528-21 | T598B225M035ATE150 | 7.7 | 8 | 150 | 920 | 3 | 125 | • |
| 35 | 2.2 | B/3528-21 | T591B225M035ATE150 | 7.7 | 8 | 150 | 920 | 3 | 125 | |
| 35 | 2.2 | B/3528-21 | T598B225M035ATE200 | 7.7 | 8 | 200 | 797 | 3 | 125 | • |
| 35 | 2.2 | B/3528-21 | T591B225M035ATE200 | 7.7 | 8 | 200 | 797 | 3 | 125 | |
| 35 | 3.3 | B/3528-21 | T598B335M035ATE150 | 11.6 | 8 | 150 | 920 | 3 | 125 | • |
| 35 | 3.3 | B/3528-21 | T591B335M035ATE150 | 11.6 | 8 | 150 | 920 | 3 | 125 | |
| 35 | 3.3 | B/3528-21 | T598B335M035ATE200 | 11.6 | 8 | 200 | 797 | 3 | 125 | • |
| 35 | 3.3 | B/3528-21 | T591B335M035ATE200 | 11.6 | 8 | 200 | 797 | 3 | 125 | |
| 35 | 4.7 | B/3528-21 | T598B475M035ATE200 | 16.5 | 8 | 200 | 797 | 3 | 125 | • |
| 35 | 4.7 | B/3528-21 | T591B475M035ATE200 | 16.5 | 8 | 200 | 797 | 3 | 125 | |
| 35 | 10 | D/7343-31 | T598D106M035ATE120 | 35 | 10 | 120 | 1,369 | 3 | 125 | • |
| 35 | 10 | D/7343-31 | T591D106M035ATE120 | 35 | 10 | 120 | 1,369 | 3 | 125 | |
| 35 | 10 | V/7343-20 | T598V106M035ATE120 | 35 | 10 | 120 | 1,248 | 3 | 125 | • |
| 35 | 10 | V/7343-20 | T591V106M035ATE120 | 35 | 10 | 120 | 1,248 | 3 | 125 | |
| 35 | 15 | D/7343-31 | T598D156M035ATE065 | 52.5 | 10 | 65 | 1,900 | 3 | 125 | • |
| 35 | 22 | D/7343-31 | T598D226M035ATE065 | 77 | 10 | 65 | 1,900 | 3 | 125 | • |
| 35 | 33 | D/7343-31 | T598D336M035ATE065 | 115.5 | 10 | 65 | 1,900 | 3 | 125 | • |
| 35 | 33 | D/7343-31 | T591D336M035ATE065 | 115.5 | 10 | 65 | 1,900 | 3 | 125 | |
| 35 | 33 | X/7343-43 | T598X336M035ATE065 | 115.5 | 10 | 65 | 1,949 | 3 | 125 | • |
| 50 | 1.5 | B/3528-21 | T598B155(1)050ATE200 | 7.5 | 8 | 200 | 797 | 3 | 125 | • |
| 50 | 1.5 | B/3528-21 | T591B155(1)050ATE200 | 7.5 | 8 | 200 | 797 | 3 | 125 | |
| 50 | 2.2 | B/3528-21 | T598B225M050ATE150 | 11 | 8 | 150 | 920 | 3 | 125 | • |
| 50 | 2.2 | B/3528-21 | T598B225M050ATE200 | 11 | 8 | 200 | 797 | 3 | 125 | • |
| 50 | 2.2 | B/3528-21 | T591B225M050ATE150 | 11 | 8 | 150 | 920 | 3 | 125 | |
| VDC at 105°C | µF | KEMET/EIA | | µA at +25°C Max/5 Minutes | % at +25°C 120 Hz Max | mΩ at +25°C 100 kHz Max | mA at +45°C 100 kHz | Reflow Temp ≤ 260°C | °C | T598/T599 Only[1] |
| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | DC Leakage | DF | ESR | Maximum Allowable Ripple Current | MSL | Maximum Operating Temp | AEC–Q200 Qualified |

*(1) To complete KEMET part number, insert M for ±20% or K for ±10%. Designates capacitance tolerance.*
*[1] T598 = AEC-Q200 qualified. T599 AEC-Q200 qualified 150°C and T591 = limited to 500 hours at 85°C/85% RH load.*
*Refer to Ordering Information for additional detail.*

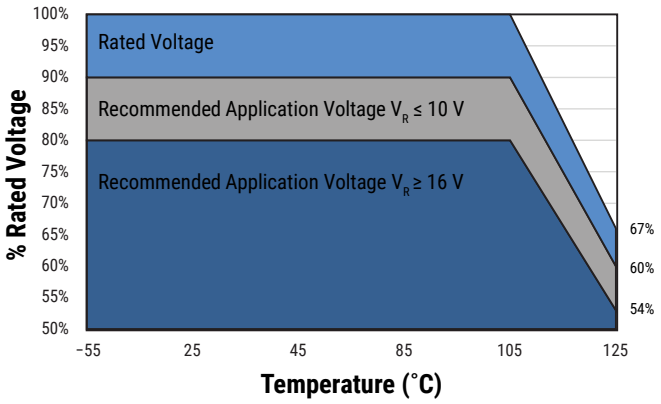
## Table 1 – Ratings & Part Number Reference cont.

| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | DC Leakage | DF | ESR | Maximum Allowable Ripple Current | MSL | Maximum Operating Temp | AEC-Q200 Qualified |
|---|---|---|---|---|---|---|---|---|---|---|
| VDC at 105°C | µF | KEMET/EIA | | µA at +25°C Max/5 Minutes | % at +25°C 120 Hz Max | mΩ at +25°C 100 kHz Max | (rms) mA at +45°C 100 kHz | Reflow Temp ≤ 260°C | °C | T598/T599 Only[1] |
| 125°C | | | | | | | | | | |
| 50 | 2.2 | B/3528-21 | T591B225M050ATE200 | 11 | 8 | 200 | 797 | 3 | 125 | |
| 50 | 10 | D/7343-31 | T598D106M050ATE090 | 50 | 10 | 90 | 1,581 | 3 | 125 | • |
| 50 | 10 | D/7343-31 | T591D106M050ATE090 | 50 | 10 | 90 | 1,581 | 3 | 125 | |
| 150°C | | | | | | | | | | |
| 4 | 33 | B/3528-21 | T599B336M004ATE070 | 13.2 | 8 | 70 | 1,347 | 3 | 150 | • |
| 4 | 33 | B/3528-21 | T599B336M004ATE090 | 13.2 | 8 | 90 | 1,188 | 3 | 150 | • |
| 4 | 47 | B/3528-21 | T599B476M004ATE070 | 18.8 | 8 | 70 | 1,347 | 3 | 150 | • |
| 4 | 47 | B/3528-21 | T599B476M004ATE090 | 18.8 | 8 | 90 | 1,188 | 3 | 150 | • |
| 4 | 68 | B/3528-21 | T599B686M004ATE070 | 27.2 | 8 | 70 | 1,347 | 3 | 150 | • |
| 4 | 68 | B/3528-21 | T599B686M004ATE090 | 27.2 | 8 | 90 | 1,188 | 3 | 150 | • |
| 4 | 150 | D/7343-31 | T599D157M004ATE025 | 60 | 10 | 25 | 3,000 | 3 | 150 | • |
| 4 | 150 | D/7343-31 | T599D157M004ATE045 | 60 | 10 | 45 | 2,236 | 3 | 150 | • |
| 6.3 | 33 | B/3528-21 | T599B336M006ATE070 | 20.8 | 8 | 70 | 1,347 | 3 | 150 | • |
| 6.3 | 33 | B/3528-21 | T599B336M006ATE090 | 20.8 | 8 | 90 | 1,188 | 3 | 150 | • |
| 6.3 | 47 | B/3528-21 | T599B476M006ATE070 | 29.6 | 8 | 70 | 1,347 | 3 | 150 | • |
| 6.3 | 47 | B/3528-21 | T599B476M006ATE090 | 29.6 | 8 | 90 | 1,188 | 3 | 150 | • |
| 6.3 | 150 | D/7343-31 | T599D157M006ATE025 | 94.5 | 10 | 25 | 3,000 | 3 | 150 | • |
| 6.3 | 150 | D/7343-31 | T599D157M006ATE045 | 94.5 | 10 | 45 | 2,236 | 3 | 150 | • |
| 10 | 33 | B/3528-21 | T599B336M010ATE070 | 33 | 8 | 70 | 1,347 | 3 | 150 | • |
| 10 | 33 | B/3528-21 | T599B336M010ATE090 | 33 | 8 | 90 | 1,188 | 3 | 150 | • |
| 10 | 33 | B/3528-21 | T599B336M010ATE150 | 33 | 8 | 150 | 920 | 3 | 150 | • |
| 35 | 33 | X/7343-43 | T599X336M035ATE065 | 115.5 | 10 | 65 | 1949 | 3 | 150 | • |
| Facedown Construction | | | | | | | | | | |
| 2.5 | 100 | S/3216-12 | T597S107M2R5APE100 | 75 | 10 | 100 | 770 | 3 | 125 | • |
| 6.3 | 22 | P/2012-10 | T597P226M006APE200 | 41.6 | 10 | 200 | 354 | 3 | 125 | • |
| 6.3 | 33 | S/3216-12 | T597S336M006APE100 | 62.4 | 10 | 100 | 770 | 3 | 125 | • |
| 6.3 | 33 | S/3216-12 | T597S336M006APE200 | 62.4 | 10 | 200 | 570 | 3 | 125 | • |
| 6.3 | 47 | S/3216-12 | T597S476M006APE100 | 88.8 | 10 | 100 | 770 | 3 | 125 | • |
| 6.3 | 47 | S/3216-12 | T597S476M006APE200 | 88.8 | 10 | 200 | 570 | 3 | 125 | • |
| 10 | 22 | S/3216-12 | T597S226M010APE200 | 66 | 10 | 200 | 570 | 3 | 125 | • |
| VDC at 105°C | µF | KEMET/EIA | | µA at +25°C Max/5 Minutes | % at +25°C 120 Hz Max | mΩ at +25°C 100 kHz Max | mA at +45°C 100 kHz | Reflow Temp ≤ 260°C | °C | T598/T599 Only[1] |
| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | DC Leakage | DF | ESR | Maximum Allowable Ripple Current | MSL | Maximum Operating Temp | AEC–Q200 Qualified |

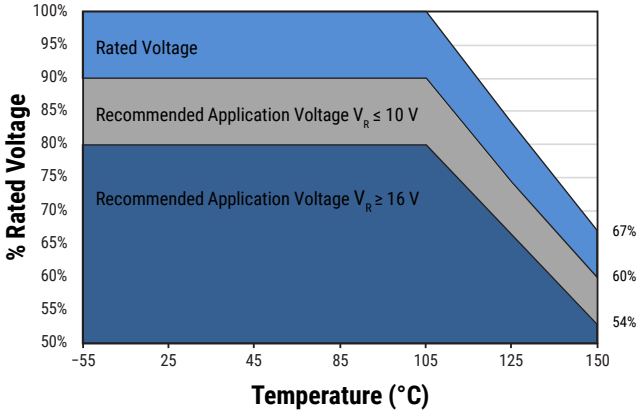
*(1) To complete KEMET part number, insert M for ±20% or K for ±10%. Designates capacitance tolerance.*
*[1] T598 = AEC-Q200 qualified. T599 AEC-Q200 qualified 150°C and T591 = limited to 500 hours at 85°C/85% RH load.*
*Refer to Ordering Information for additional detail.*
***Part Numbers marked in blue font are "Under Development." Engineering samples available upon request.***

## Derating Guidelines

125°C




150°C




### Recommended Application Voltage

KO-CAPs are solid state capacitors that demonstrate no wearout mechanism when operated within their recommended guidelines. While the KO-CAP can be operated at full rated voltage, most circuit designers seek a minimum level of assurance in long term reliability, which should be demonstrated with data. A voltage derating can provide the desired level of demonstrated reliability based on industry accepted acceleration models. Since most applications do require long term reliability, KEMET recommends that designers consider a voltage derating, according the graph above, for the maximum steady state voltage.

| Voltage Rating | Maximum Recommended Steady State Voltage | | |
|---|---|---|---|
| | −55°C to 105°C | 105°C to 125°C (T598) | 105°C to 150°C (T599) |
| 2.5 V ≤ $V_R$ ≤ 10 V | 90% of $V_R$ | 60% of $V_R$ | 60% of $V_R$ |
| $V_R$ ≥ 16 V | 80% of $V_R$ | 54% of $V_R$ | 54% of $V_R$ |

*$V_R$ = 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.

| Case Code | EIA Case Code | Maximum Power Dissipation (Pmax) mWatts at 45°C with +30°C Rise |
|---|---|---|
| B | 3528-21 | 127 |
| D | 7343-31 | 225 |
| P | 2012-10 | 25 |
| S | 3216-12 | 60 |
| V | 7343-20 | 187 |
| X | 7343-43 | 247 |

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

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

*I = rms ripple current (amperes)*
*E = rms ripple voltage (volts)*
*Pmax = maximum power dissipation (watts)*
*R = ESR at specified frequency (ohms)*
*Z = Impedance at specified frequency (ohms)*

| Temperature Compensation Multipliers for Maximum Ripple Current | | | | |
|---|---|---|---|---|
| T ≤ 45°C | 45°C < T ≤ 85°C | 85°C < T ≤ 105°C | T ≤ 125°C | T ≤ 150°C |
| 1.00 | 0.70 | 0.25 | 0.25 | 0.20 |

*T = Environmental temperature*

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

## Surge Voltage

Surge voltage is the maximum voltage (peak value) which may be applied to the capacitor. The surge voltage must not be applied for periodic charging and discharging in course of normal operation and cannot be part of the application voltage. Surge voltage capability is demonstrated by application of 1,000 cycles at operating temperature. The parts are charged through a 33 Ohm resistor for 30 seconds and then discharged though a 33 Ohm resistor for each cycle.

| Rated Voltage (V) | Surge Voltage (V) | Category Voltage (V) | Category Surge Voltage (V) | Category Voltage (V) | Category Surge Voltage (V) |
|---|---|---|---|---|---|
| –55°C to 105°C | | up to 125°C | | up to 150°C* | |
| 2.5 | 3.3 | 1.7 | 2.2 | 1.7 | 2.2 |
| 6.3 | 8.2 | 4.2 | 5.5 | 4.2 | 5.5 |
| 10 | 13 | 6.7 | 8.7 | 6.7 | 8.7 |
| 16 | 20.8 | 10.7 | 13.9 | 10.7 | 13.9 |
| 20 | 26 | 13.4 | 17.4 | 13.4 | 17.4 |
| 25 | 32.5 | 16.8 | 21.8 | 16.8 | 21.8 |
| 35 | 45.5 | 23.5 | 30.5 | 23.5 | 30.5 |
| 50 | 65 | 33.5 | 43.6 | 33.5 | 43.6 |

**T599 Only*

## Reverse Voltage

Polymer electrolytic 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 |
| 150°C** | 1% of rated voltage |

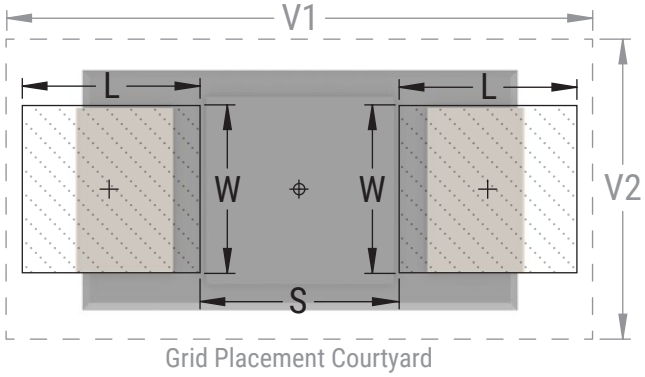
**For series rated to 125°C*
*** For series rated to 150°C*

## Table 2 – Land Dimensions/Courtyard

T591 / T598 / T599

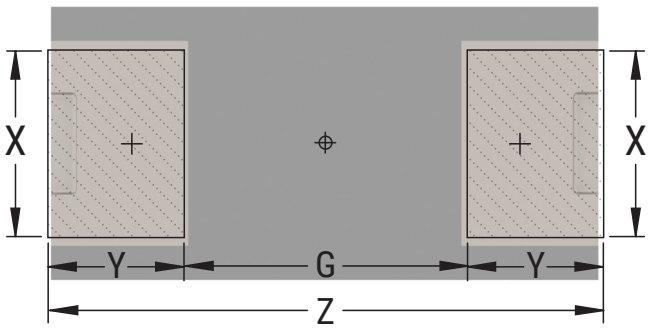
| KEMET | Metric Size Code | Density Level A: Maximum (Most) Land Protrusion (mm) | | | | | Density Level B: Median (Nominal) Land Protrusion (mm) | | | | | Density Level C: Minimum (Least) Land Protrusion (mm) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Case | EIA | W | L | S | V1 | V2 | W | L | S | V1 | V2 | W | L | S | V1 | V2 |
| B | 3528–21 | 2.35 | 2.21 | 0.92 | 6.32 | 4.00 | 2.23 | 1.80 | 1.12 | 5.22 | 3.50 | 2.13 | 1.42 | 1.28 | 4.36 | 3.24 |
| D | 7343–31 | 2.55 | 2.77 | 3.67 | 10.22 | 5.60 | 2.43 | 2.37 | 3.87 | 9.12 | 5.10 | 2.33 | 1.99 | 4.03 | 8.26 | 4.84 |
| V | 7343–21 | 2.55 | 2.77 | 3.67 | 10.22 | 5.60 | 2.43 | 2.37 | 3.87 | 9.12 | 5.10 | 2.33 | 1.99 | 4.03 | 8.26 | 4.84 |
| X[1] | 7343–43 | 2.55 | 2.77 | 3.67 | 10.22 | 5.60 | 2.43 | 2.37 | 3.87 | 9.12 | 5.10 | 2.33 | 1.99 | 4.03 | 8.26 | 4.84 |

***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).*
[1] *Height of these chips may create problems in wave soldering.*
[2] *Land pattern geometry is too small for silkscreen outline.*




T597

| KEMET | Metric Size Code | Dimensions (mm) Minimum – Maximum | | | |
|---|---|---|---|---|---|
| Case | EIA | G | Z | X | Y |
| I | 3216–10 | 1.00 – 1.65 | 3.25 – 3.80 | 1.1 – 1.30 | 0.8 – 1.40 |
| S | 3216-12 | 1.00 – 1.65 | 3.25 – 3.80 | 1.1 – 1.30 | 0.8 – 1.40 |
| P | 2012–10 | 0.40 – 1.05 | 2.05 – 2.60 | 0.80 – 1.00 | 0.5 – 1.1 |



## Soldering Process

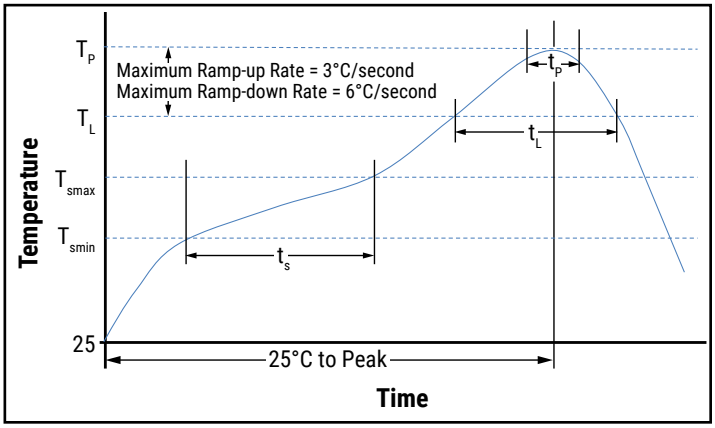
KEMET's families of surface mount capacitors are compatible with wave (single or dual), convection, IR, or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for convection and IR reflow reflect the profile 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.

| 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/second maximum | 3°C/second 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/second maximum | 6°C/second 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.*
** For Case Size height > 2.5 mm*
*** For Case Size height ≤ 2.5 mm*



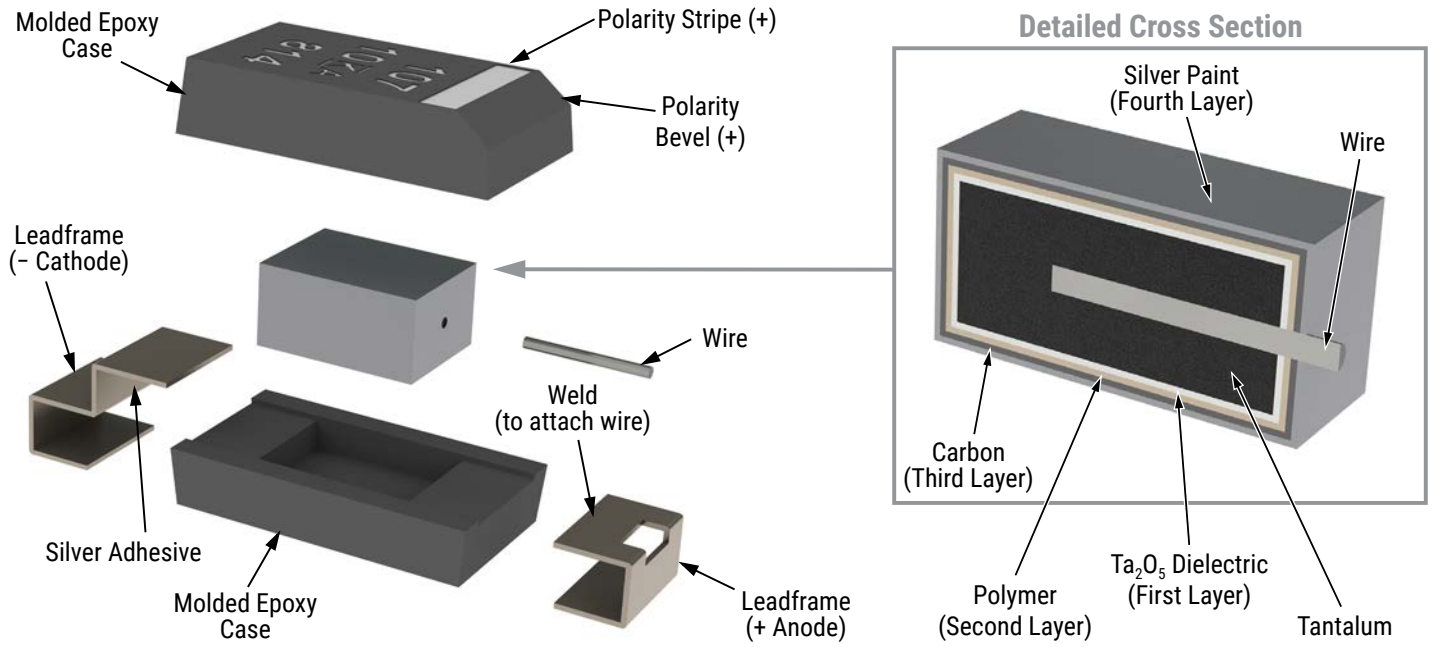

## Storage

All KO-CAP capacitors are shipped in moisture barrier bags (MBBs) with desiccant and humidity indicator card (HIC). These parts are classified as moisture sensitivity level 3 (MSL3) per IPC/JEDEC J-STD-020 and packaged per IPC/JEDEC J–STD–033, MSL3 specifies a floor time of 168 H at 30°C maximum temperature and 60% relative humidity. Unused capacitors should be sealed in a MBB with fresh desiccant.

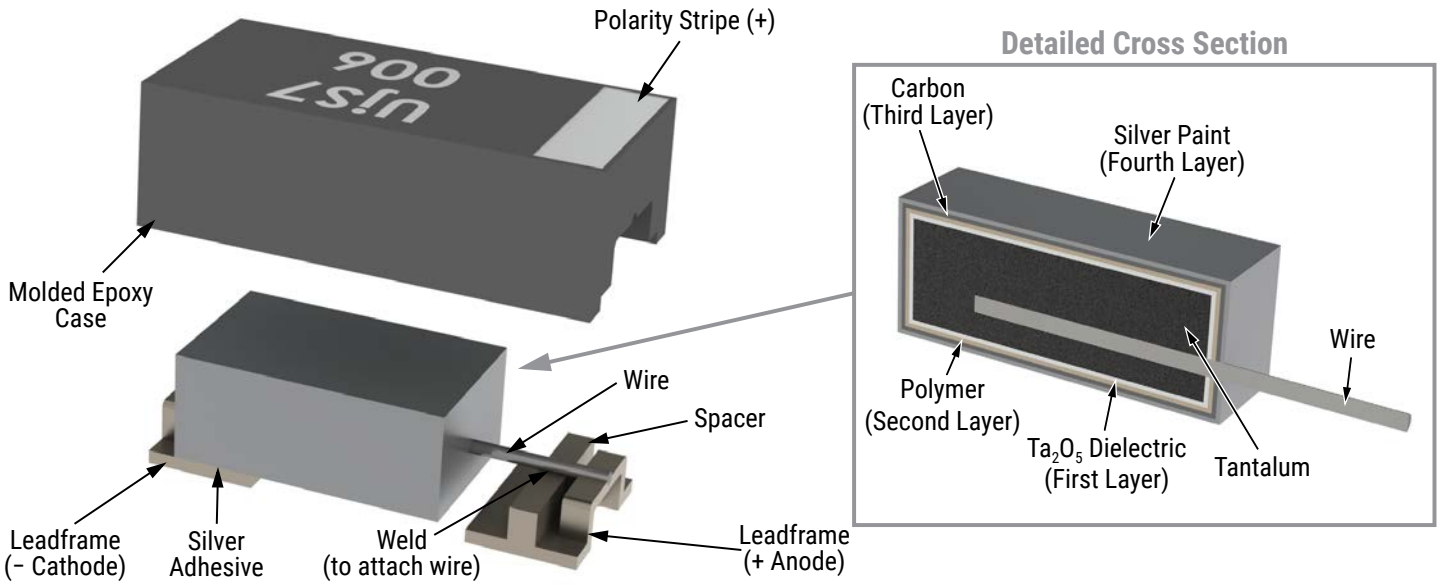
Calculated shelf life in sealed bag:
– 12 months from bag seal date in a storage environment of < 40°C and humidity < 90% RH
– 24 months from bag seal date in a storage environment of < 30°C and humidity < 70% RH
If baking is required, refer to IPC/JEDEC J–STD–033 for bake procedure.

## Construction

### T591 / T598 / T599

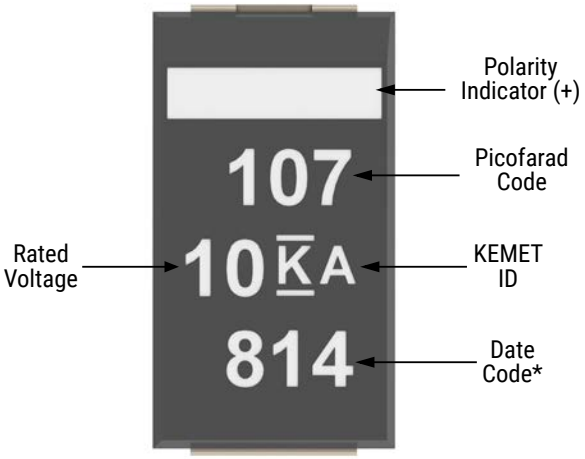



### T597



## Capacitor Marking

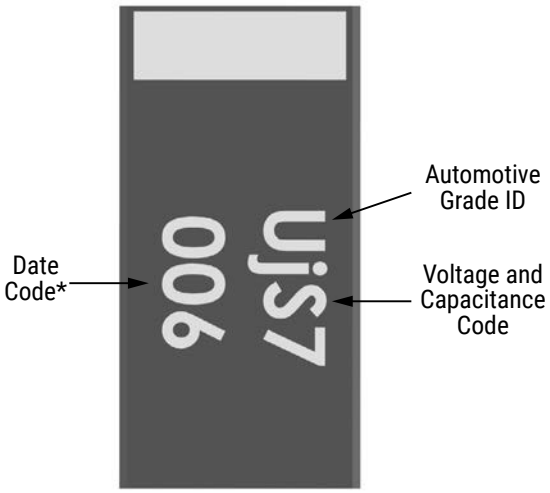
### T591/ T598 / T599




* 822 = 14th week of 2018

| Date Code * | |
|---|---|
| 1st digit = Last number of year | 6 = 2016<br>7 = 2017<br>8 = 2018<br>9 = 2019<br>0 = 2020 |
| 2nd and 3rd digit = Week of the year | 01 = 1st week of the year to<br>52 = 52nd week of the year |

### T597




* 008 = 6th week of 2020

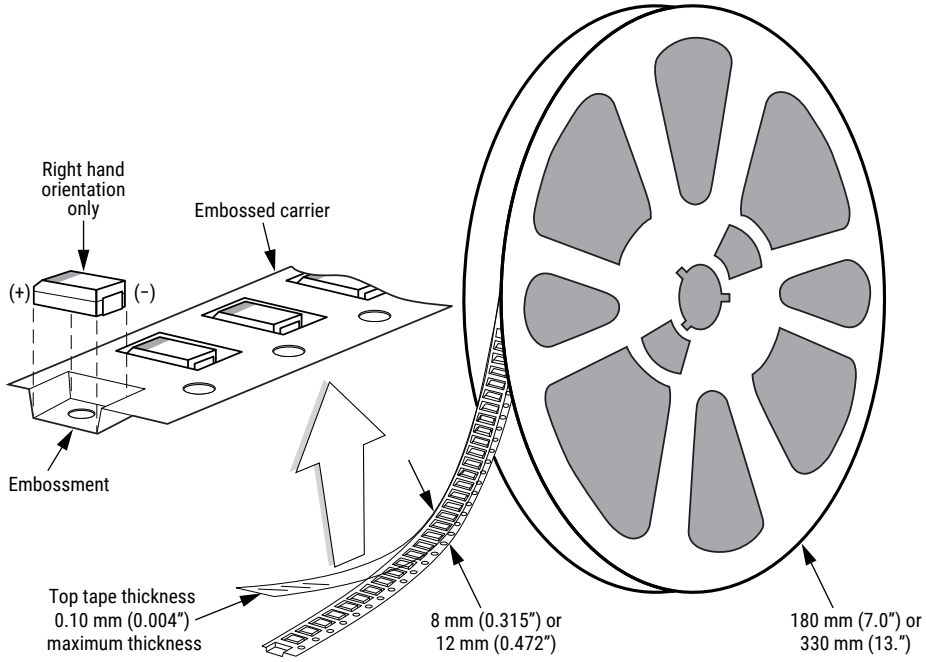
| Voltage Code | | |
|---|---|---|
| e | j | A |
| 2.5 V | 6.3 V | 10 V |

| Capacitance Code | | | |
|---|---|---|---|
| J7 | N7 | S7 | A8 |
| 22 | 33 | 47 | 100 |

| Date Code * | |
|---|---|
| 1st digit = Last number of year | 8 = 2018<br>9 = 2019<br>0 = 2020 |
| 2nd and 3rd digit = Week of the year | 01 = 1st week of the year to<br>52 = 52nd week of the year |

## Tape & Reel Packaging Information

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

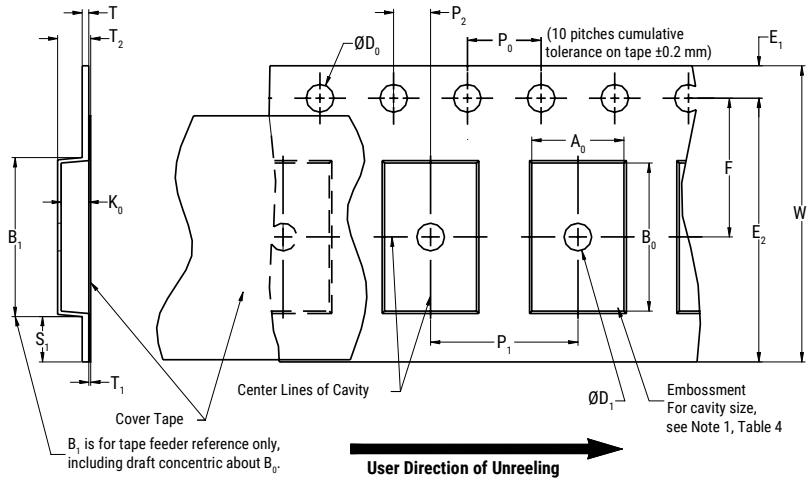



## Table 3 – Packaging Quantity

| Case Code | | Tape Width (mm) | 7" Reel* | 13" Reel* |
|---|---|---|---|---|
| KEMET | EIA | | | |
| P | 2012-10 | 8 | 3,000 | N/A |
| R | 2012-12 | 8 | 2,500 | 10,000 |
| I | 3216-10 | 8 | 3,000 | N/A |
| S | 3216-12 | 8 | 3,000 | N/A |
| A | 3216-18 | 8 | 2,000 | N/A |
| T | 3528-12 | 8 | 3,000 | 10,000 |
| M | 3528-15 | 8 | 2,500 | 8,000 |
| B | 3528-21 | 8 | 2,000 | 8,000 |
| U | 6032-15 | 12 | 1,000 | 5,000 |
| L | 6032-19 | 12 | 1,000 | 3,000 |
| C | 6032-28 | 12 | 500 | 3,000 |
| Q | 7343-12 | 12 | 1,000 | 3,000 |
| W | 7343-15 | 12 | 1,000 | 3,000 |
| Z | 7343-17 | 12 | 1,000 | 3,000 |
| V | 7343-19 | 12 | 1,000 | 3,000 |
| D | 7343-31 | 12 | 500 | 2,500 |
| Y | 7343-40 | 12 | 500 | 2,000 |
| X | 7343-43 | 12 | 500 | 2,000 |
| J | 7360-15 | 12 | 1,000 | 3,000 |
| H | 7360-20 | 12 | 1,000 | 3,000 |
| O | 7360-43 | 12 | 250 | 1,000 |

** 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 Note 1 | $E_1$ | $P_0$ | $P_2$ | R Reference Note 2 | $S_1$ Minimum Note 3 | T Maximum | $T_1$ Maximum |
| 8 mm | 1.5 +0.10/−0.0 (0.059 +0.004/−0.0) | 1.0 (0.039) | 1.75 ±0.10 (0.069 ±0.004) | 4.0 ±0.10 (0.157 ±0.004) | 2.0 ±0.05 (0.079 ±0.002) | 25.0 (0.984) | 0.600 (0.024) | 0.600 (0.024) | 0.100 (0.004) |
| 12 mm | | 1.5 (0.059) | | | | 30 (1.181) | | | |

| Variable Dimensions — Millimeters (Inches) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Tape Size | Pitch | $B_1$ Maximum 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 (0.171) | 6.25 (0.246) | 3.5 ±0.05 (0.138 ±0.002) | 2.0 ±0.05 or 4.0 ±0.10 (0.079 ±0.002 or 0.157 ±0.004) | 2.5 (0.098) | 8.3 (0.327) | Note 5 |
| 12 mm | Single (4 mm) and Double (8 mm) | 8.2 (0.323) | 10.25 (0.404) | 5.5 ±0.05 (0.217 ±0.002) | 2.0 ±0.05 (0.079 ±0.002) or 4.0 ±0.10 (0.157 ±0.004) or 8.0 ±0.10 (0.315 ±0.004) | 4.6 (0.181) | 12.3 (0.484) | |

*1. 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.*

*2. The tape, with or without components, shall pass around R without damage (see Figure 4).*

*3. 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).*

*4. $B_1$ dimension is a reference dimension for tape feeder clearance only.*

*5. The cavity defined by $A_0$, $B_0$ and $K_0$ shall surround the component with sufficient clearance that:*

*(a) the component does not protrude above the top surface of the carrier tape.*

*(b) the component can be removed from the cavity in a vertical direction without mechanical restriction, after the top cover tape has been removed.*

*(c) rotation of the component is limited to 20° maximum for 8 and 12 mm tapes (see Figure 2).*

*(d) lateral movement of the component is restricted to 0.5 mm maximum for 8 mm and 12 mm wide tape (see Figure 3).*

*(e) see Addendum in EIA Standard 481–D for standards relating to more precise taping requirements.*

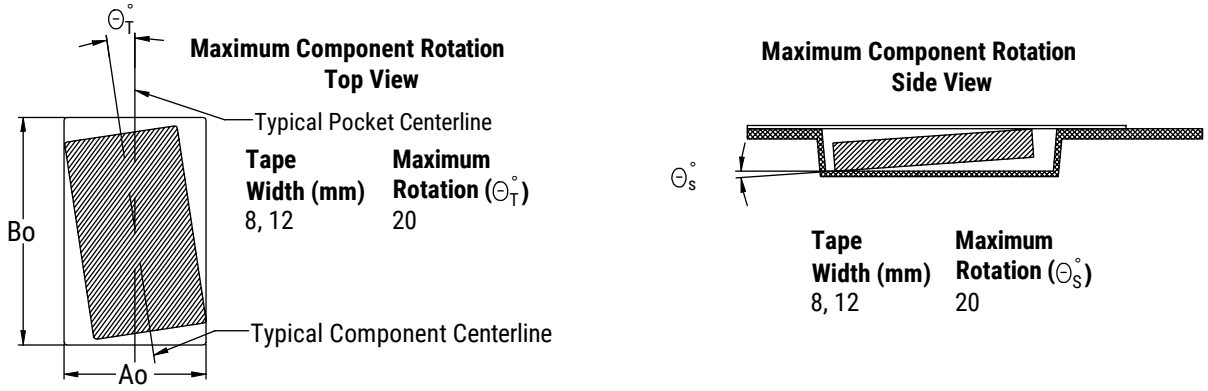
## Packaging Information Performance Notes

**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:

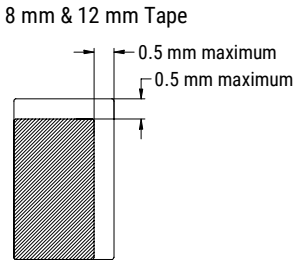
| Tape Width | Peel Strength |
|---|---|
| 8 mm | 0.1 to 1.0 newton (10 to 100 gf) |
| 12 mm | 0.1 to 1.3 newton (10 to 130 gf) |

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*.

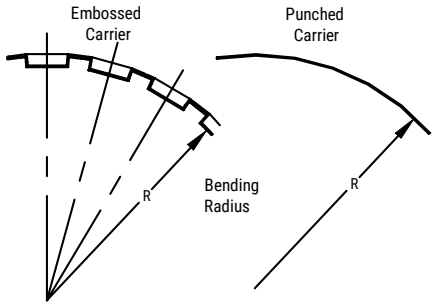
## Figure 2 – Maximum Component Rotation



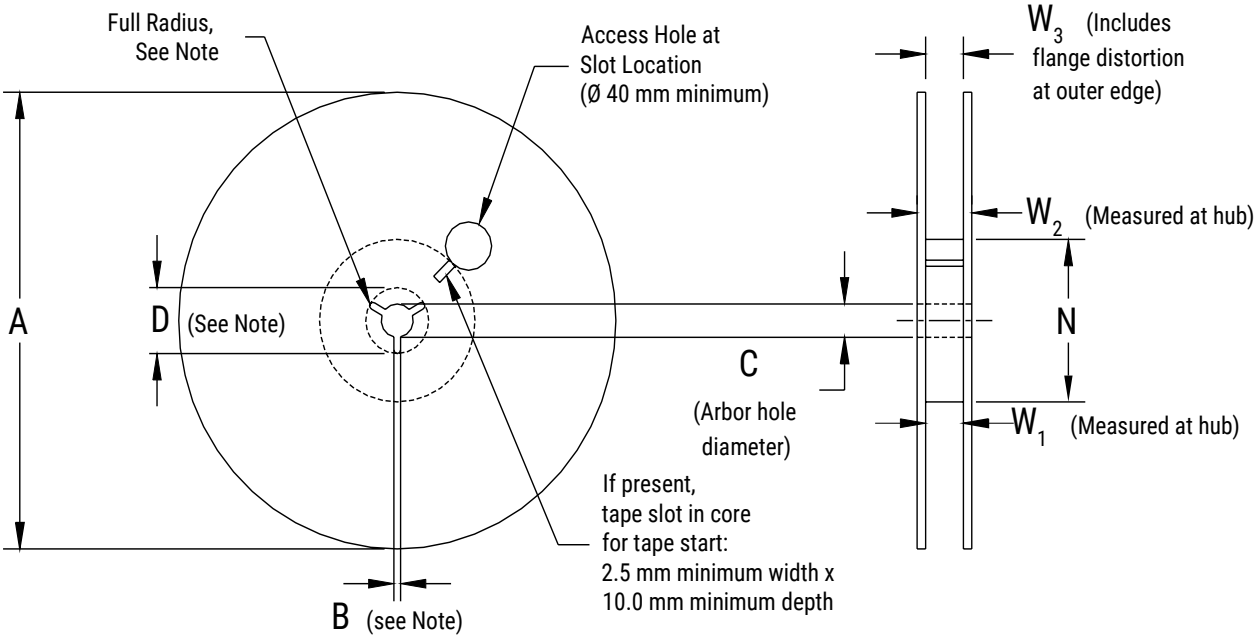

## Figure 3 – Maximum Lateral Movement




## Figure 4 – Bending Radius



## Figure 5 – Reel Dimensions




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

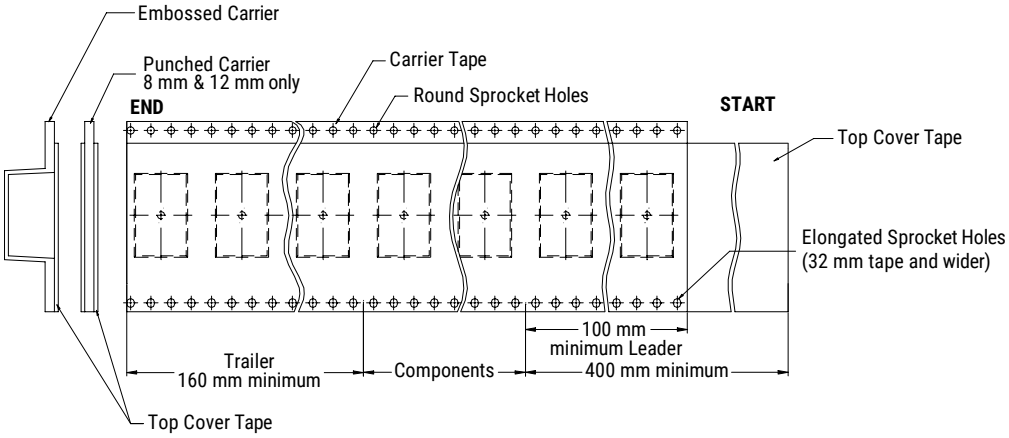
## Table 5 – Reel Dimensions

Metric will govern

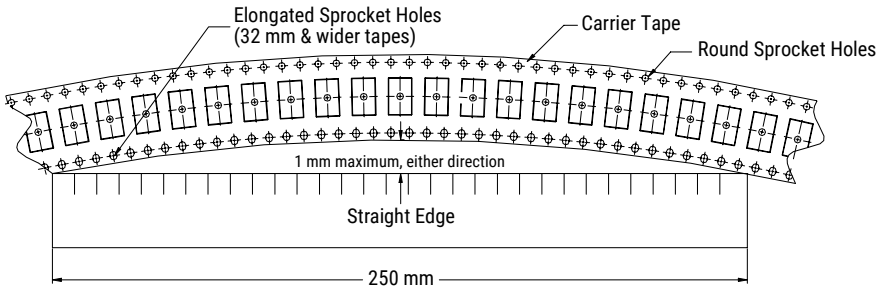
| Constant Dimensions — Millimeters (Inches) | | | | |
|---|---|---|---|---|
| Tape Size | A | B Minimum | C | D Minimum |
| 8 mm | 178 ±0.20 (7.008 ±0.008) or 330 ±0.20 (13.000 ±0.008) | 1.5 (0.059) | 13.0 +0.5/−0.2 (0.521 +0.02/−0.008) | 20.2 (0.795) |
| 12 mm | | | | |

| Variable Dimensions — Millimeters (Inches) | | | | |
|---|---|---|---|---|
| Tape Size | N Minimum | $W_1$ | $W_2$ Maximum | $W_3$ |
| 8 mm | 50 (1.969) | 8.4 +1.5/−0.0 (0.331 +0.059/−0.0) | 14.4 (0.567) | Shall accommodate tape width without interference |
| 12 mm | | 12.4 +2.0/−0.0 (0.488 +0.078/−0.0) | 18.4 (0.724) | |

## Figure 6 – Tape Leader & Trailer Dimensions




## Figure 7 – Maximum Camber



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

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

*KEMET is a registered trademark of KEMET Electronics Corporation.*

LifeElectronics
Живое партнерство

**ООО «ЛайфЭлектроникс»** **“LifeElectronics” LLC**

*ИНН 7805602321 КПП 780501001 Р/С 40702810122510004610 ФАКБ "АБСОЛЮТ БАНК" (ЗАО) в г.Санкт-Петербурге К/С 30101810900000000703 БИК 044030703*

*Компания «Life Electronics» занимается поставками электронных компонентов импортного и отечественного производства от производителей и со складов крупных дистрибьюторов Европы, Америки и Азии.*

*С конца 2013 года компания активно расширяет линейку поставок компонентов по направлению коаксиальный кабель, кварцевые генераторы и конденсаторы (керамические, пленочные, электролитические), за счёт заключения дистрибьюторских договоров*

*Мы предлагаем:*

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- *Специальные условия для постоянных клиентов.*
- *Подбор аналогов.*
- *Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.*

- *Приемлемые сроки поставки, возможна ускоренная поставка.*
- *Доставку товара в любую точку России и стран СНГ.*
- *Комплексную поставку.*
- *Работу по проектам и поставку образцов.*
- *Формирование склада под заказчика.*

- *Сертификаты соответствия на поставляемую продукцию (по желанию клиента).*
- *Тестирование поставляемой продукции.*
- *Поставку компонентов, требующих военную и космическую приемку.*
- *Входной контроль качества.*
- *Наличие сертификата ISO.*

*В составе нашей компании организован Конструкторский отдел, призванный помогать разработчикам, и инженерам.*

*Конструкторский отдел помогает осуществить:*

- *Регистрацию проекта у производителя компонентов.*
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- *Защиту от снятия компонента с производства.*
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