# Tantalum Surface Mount Capacitors

## MIL-PRF (CWR Series)

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## Table of Contents

Page

Why Choose KEMET ..... 3

T409 Series CWR09 Style MIL–PRF–55365/4 ..... 5

T419 Series CWR19 Style MIL–PRF–55365/11 ..... 15

T429 Series CWR29 Style MIL–PRF–55365/11 ..... 26

T492 Series CWR11 Style MIL–PRF–55365/8 ..... 38

Packaging Information ..... 48

KEMET Corporation Sales Offices ..... 53

Other KEMET Resources ..... 54


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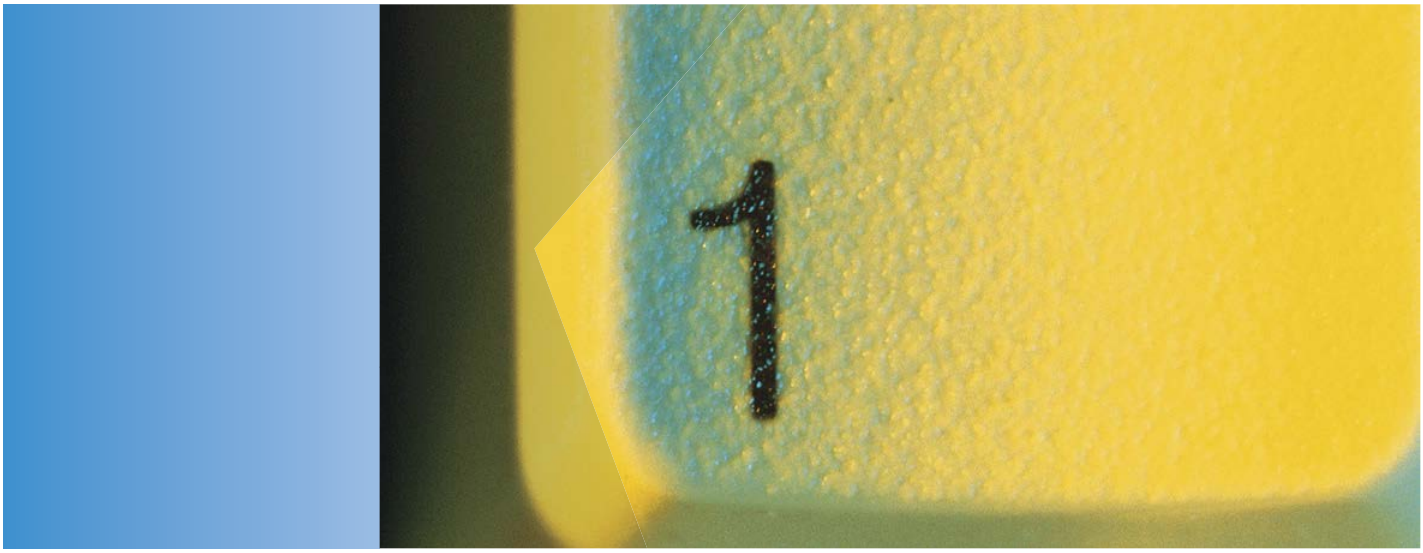

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KEMET Corporation is a leading global supplier of electronic components. We offer our customers the broadest selection of capacitor technologies in the industry across multiple dielectrics, along with an expanding range of electromechanical devices, and electromagnetic compatibility solutions. Our vision is to be the preferred supplier of electronic component solutions for customers demanding the highest standards of quality, delivery and service.


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# T409 Series CWR09 Style MIL–PRF–55365/4

## Overview

The KEMET T409 Series is approved to MIL–PRF–55365/4 (CWR09) with Weibull failure rates of B level (0.1% failures per 1,000 hours), C level (0.01% failures per 1,000 hours), D level (0.001% failures per 1,000 hours), or T level (0.01% failures per 1,000 hours, Option C surge current, DPA, Radiographic inspection, 100% visual inspection, DCL and ESR measurements within +3 standard deviations, and Group C inspection). This CWR09 product is a precision-molded device with compliant terminations and indelible laser marking. Tape and reeling per EIA 481–1 is standard.

## Benefits

- Established reliability options
- Taped and reeled per EIA 481–1
- Symmetrical, compliant terminations
- Laser-marked case
- 100% surge current test available on all case sizes
- Qualified to MIL–PRF–55365/4, Style CWR09
- Termination options B, C, H, K
- Weibull failure options B, C, D, and T
- Exponential failure rates M, P, R, S
- Voltage rating of 4 – 50 VDC
- Operating temperature range of -55˚C to +125˚C

## Applications

Typical applications include decoupling and filtering in Military and aerospace applications requiring CWR09 devices.

## Environmental Compliance

RoHS Compliant (6/6) according to Directive 2002/95/EC when ordered with 100% Sn Solder.

RoHS Compliant

## SPICE

For a detailed analysis of specific part numbers, please visit 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.


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## KEMET Ordering Information

| T | 409 | A | 225 | K | 004 | A | H | 4252 | 7280 |
|---|---|---|---|---|---|---|---|---|---|
| Capacitor Class | Series | Case Size | Capacitance Code (pF) | Capacitance Tolerance | Voltage | Failure Rate/Design | Lead Material | Surge | Packaging (C-Spec) |
| T = Tantalum | CWR 09 Established Reliability | A, B, C, D, E, F, G, H, X | First two digits represent significant figures. Third digit specifies number of zeros. | J = ±5%<br>K = ±10%<br>M = ±20% | 004 = 4 V<br>006 = 6.3 V<br>010 = 10 V<br>015 = 15 V<br>020 = 20 V<br>025 = 25 V<br>035 = 35 V<br>050 = 50 V | Weibull<br>A = non-ER<br>B = (0.1%/1,000 hours)<br>C = (0.01%/1,000 hours)<br>D = (0.001%/1,000 hours)<br>T = (0.01%/1,000 hours)<br>Exponential<br>M = (1.0%/1,000 hours)<br>P = (0.1%/1,000 hours)<br>R = (0.01%/1,000 hours)<br>S =(0.001%/1,000 hours) | C = Hot Solder Dipped<br>H = Standard Solder Coated (SnPb 5% Pb minimum)<br>B = Gold Plated<br>K = Solder Fused | 4250= 25°C after Weibull<br>4251 = -55°C and 85°C after Weibull<br>4252 = -55°C and 85°C before Weibull<br>TLVL = Weibull Grade Level "T" | Blank = 7" Reel<br>7280 = 13" Reel<br>7610 = Bag<br>7005 = Moisture bags |

## Defense MIL–PRF–55365/4 Ordering Information

| CWR09 | J | H | 105 | K | C | A |
|---|---|---|---|---|---|---|
| Capacitor Style | Voltage | Termination Finish | Capacitance Code (pF) | Capacitance Tolerance | Reliability Level | Surge Current Option |
| Per MIL–PRF–55365/4 | C = 4 V<br>D = 6 V<br>F = 10 V<br>H = 15 V<br>J = 20 V<br>K = 25 V<br>M = 35 V<br>N = 50 V | B = Gold Plated<br>C = Hot solder dipped<br>H = Solder Plated<br>K = Solder fused | First two digits represent significant figures. Third digit specifies number of zeros. | J = ±5%<br>K = ±10%<br>M = ±20% | Weibull<br>A = non-ER<br>B = (0.1%/1,000 hours)<br>C = (0.01%/1,000 hours)<br>D =(0.001%/1,000 hours)<br>T= T Level* (0.01%/1,000 hours)<br>Exponential<br>M = (1.0%/1,000 hours)<br>P = (0.1%/1,000 hours)<br>R = (0.01%/1,000 hours)<br>S =(0.001%/1,000 hours) | A = +25°C after Weibull<br>B = -55°C +85°C after Weibull<br>C = -55°C +85°C before Weibull |

** When T Level is ordered, no Surge Current Option is needed*

## Performance Characteristics

| Item | Performance Characteristics |
|---|---|
| Operating Temperature | -55°C to 125°C |
| Rated Capacitance Range | 0.1 – 100 µF @ 120 Hz/25°C |
| Capacitance Tolerance | J Tolerance (5%), K Tolerance (10%), M Tolerance (20%) |
| Rated Voltage Range | 4 – 50 V |
| DF (120 Hz) | Refer to Part Number Electrical Specification Table |
| ESR (100 kHz) | Refer to Part Number Electrical Specification Table |
| Leakage Current | ≤ 0.01 CV (µA) at rated voltage after 5 minutes |

## Qualification

| Test | Condition | | Characteristics | | | |
|---|---|---|---|---|---|---|
| Endurance | 85°C @ rated voltage, 2,000 hours<br>125°C @ 2/3 rated voltage, 2,000 hours | | Δ C/C | Within ±10% of initial value | | |
| | | | DF | Within initial limits | | |
| | | | DCL | Within 1.25 x initial limit | | |
| | | | ESR | Within initial limits | | |
| Storage Life | 125°C @ 0 volts, 2,000 hours | | Δ C/C | Within ±10% of initial value | | |
| | | | DF | Within initial limits | | |
| | | | DCL | Within 1.25 x initial limit | | |
| | | | ESR | Within initial limits | | |
| Thermal Shock | MIL–STD–202, Method 107, Condition B, mounted, -55°C to 125°C, 1,000 cycles | | Δ C/C | Within ±5% of initial value | | |
| | | | DF | Within initial limits | | |
| | | | DCL | Within 1.25 x initial limit | | |
| | | | ESR | Within initial limits | | |
| 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* | ±10% | ±10% | ±20% |
| | | DF | IL | IL | 1.5 x IL | 1.5 x IL |
| | | DCL | IL | n/a | 10 x IL | 12 x IL |
| Surge Voltage | 25°C and 85°C, 1.32 x rated voltage 1,000 cycles (125°C, 1.2 x rated voltage) | | Δ C/C | Within ±5% 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–55365/4 | Please contact KEMET for more information. | | | | | |

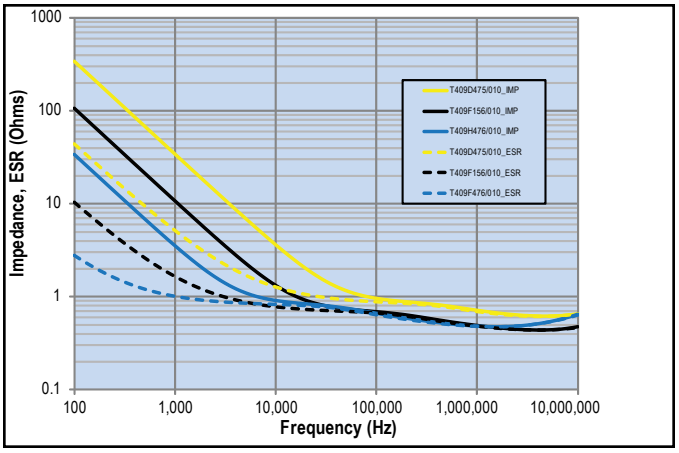
**IL = Initial limit*

## Certification

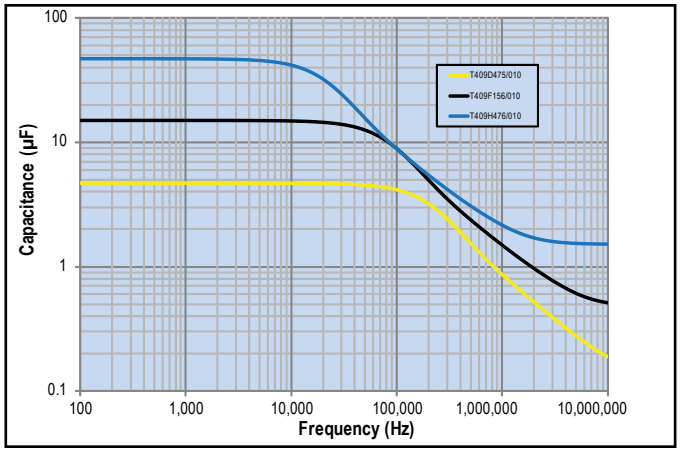
MIL–PRF–55365/4

## Electrical Characteristics

### ESR vs. Frequency

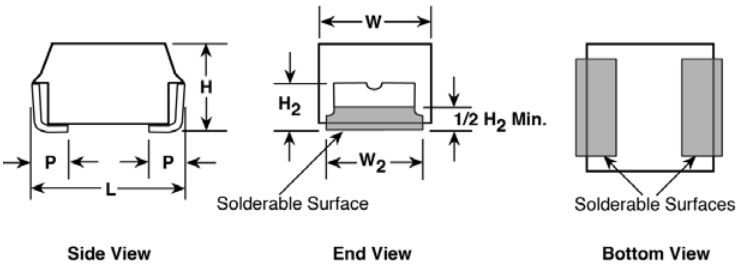



### Capacitance vs. Frequency




## Dimensions – Millimeters (Inches)

Metric will govern




| Case Size | Component | | | | | |
|---|---|---|---|---|---|---|
| KEMET | L* ±0.38 (0.015) | W* ±0.38 (0.015) | H* ±0.38 (0.015) | P +0.25 (0.010), -0.13 (0.005) | $W_2$ | $H_2$ Minimum |
| A | 2.54 (0.100) | 1.27 (0.050) | 1.27 (0.050) | 0.76 (0.030) | 1.27 ±0.13 (0.050 ±0.005) | 0.76 (0.030) |
| B | 3.81 (0.150) | 1.27 (0.050) | 1.27 (0.050) | 0.76 (0.030) | 1.27 ±0.13 (0.050 ±0.005) | 0.76 (0.030) |
| C | 5.08 (0.200) | 1.27 (0.050) | 1.27 (0.050) | 0.76 (0.030) | 1.27 ±0.13 (0.050 ±0.005) | 0.76 (0.030) |
| D | 3.81 (0.150) | 2.54 (0.100) | 1.27 (0.050) | 0.76 (0.030) | 2.41 +0.13, -0.25 (0.095 +0.005, -0.010) | 0.76 (0.030) |
| E | 5.08 (0.200) | 2.54 (0.100) | 1.27 (0.050) | 0.76 (0.030) | 2.41 +0.13, -0.25 (0.095 +0.005, -0.010) | 0.76 (0.030) |
| F | 5.59 (0.220) | 3.43 (0.135) | 1.78 (0.070) | 0.76 (0.030) | 3.30 ±0.13 (0.130 ±0.005) | 1.02 (0.040) |
| G | 6.73 (0.265) | 2.79 (0.110) | 2.79 (0.110) | 1.27 (0.050) | 2.67 ±0.13 (0.105 ±0.005) | 1.52 (0.060) |
| H | 7.24 (0.285) | 3.81 (0.150) | 2.79 (0.110) | 1.27 (0.050) | 3.68 +0.013, -0.51 (0.145 +0.005, -0.020) | 1.52 (0.060) |

*Note: When solder coated terminations are required, add an additional 0.38 mm (0.015 inch) to the above tolerances for "L", "W", "H", "P" ,"$W_2$" and "$H_2$"*

## Table 1 – Ratings & Part Number Reference

| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL–PRF–55365/4 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |
|---|---|---|---|---|---|---|---|---|
| V | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Maximum/5 Minutes | % @ +20°C 120 Hz Maximum | Ω @ +20°C 100 kHz Maximum | Reflow Temperature ≤ 260°C |
| 4 | 2.2 | A/1005 | T409A225(1)004(2)(3)(4) | CWR09C(3)225(1)(2)(5) | 1 | 6.0 | 8.0 | 1 |
| 4 | 4.7 | B/1505 | T409B475(1)004(2)(3)(4) | CWR09C(3)475(1)(2)(5) | 1.0 | 6.0 | 8.0 | 1 |
| 4 | 6.8 | C/2005 | T409C685(1)004(2)(3)(4) | CWR09C(3)685(1)(2)(5) | 1.0 | 6.0 | 5.5 | 1 |
| 4 | 10 | D/1510 | T409D106(1)004(2)(3)(4) | CWR09C(3)106(1)(2)(5) | 1.0 | 8.0 | 4.0 | 1 |
| 4 | 15 | E/2010 | T409E156(1)004(2)(3)(4) | CWR09C(3)156(1)(2)(5) | 1.0 | 8.0 | 3.5 | 1 |
| 4 | 33 | F/2214 | T409F336(1)004(2)(3)(4) | CWR09C(3)336(1)(2)(5) | 2.0 | 8.0 | 2.2 | 1 |
| 4 | 68 | G/2711 | T409G686(1)004(2)(3)(4) | CWR09C(3)686(1)(2)(5) | 3.0 | 10.0 | 1.1 | 1 |
| 4 | 100 | H/2915 | T409H107(1)004(2)(3)(4) | CWR09C(3)107(1)(2)(5) | 4.0 | 10.0 | 0.9 | 1 |
| 6 | 1.5 | A/1005 | T409A155(1)006(2)(3)(4) | CWR09D(3)155(1)(2)(5) | 1.0 | 6.0 | 8.0 | 1 |
| 6 | 3.3 | B/1505 | T409B335(1)006(2)(3)(4) | CWR09D(3)335(1)(2)(5) | 1.0 | 6.0 | 8.0 | 1 |
| 6 | 4.7 | C/2005 | T409C475(1)006(2)(3)(4) | CWR09D(3)475(1)(2)(5) | 1.0 | 6.0 | 5.5 | 1 |
| 6 | 6.8 | D/1510 | T409D685(1)006(2)(3)(4) | CWR09D(3)685(1)(2)(5) | 1.0 | 6.0 | 4.5 | 1 |
| 6 | 10 | E/2010 | T409E106(1)006(2)(3)(4) | CWR09D(3)106(1)(2)(5) | 1.0 | 8.0 | 3.5 | 1 |
| 6 | 22 | F/2214 | T409F226(1)006(2)(3)(4) | CWR09D(3)226(1)(2)(5) | 2.0 | 8.0 | 2.2 | 1 |
| 6 | 47 | G/2711 | T409G476(1)006(2)(3)(4) | CWR09D(3)476(1)(2)(5) | 3.0 | 10.0 | 1.1 | 1 |
| 6 | 68 | H/2915 | T409H686(1)006(2)(3)(4) | CWR09D(3)686(1)(2)(5) | 4.0 | 10.0 | 0.9 | 1 |
| 10 | 1 | A/1005 | T409A105(1)010(2)(3)(4) | CWR09F(3)105(1)(2)(5) | 1.0 | 6.0 | 10.0 | 1 |
| 10 | 2.2 | B/1505 | T409B225(1)010(2)(3)(4) | CWR09F(3)225(1)(2)(5) | 1.0 | 6.0 | 8.0 | 1 |
| 10 | 3.3 | C/2005 | T409C335(1)010(2)(3)(4) | CWR09F(3)335(1)(2)(5) | 1.0 | 6.0 | 5.5 | 1 |
| 10 | 4.7 | D/1510 | T409D475(1)010(2)(3)(4) | CWR09F(3)475(1)(2)(5) | 1.0 | 6.0 | 4.5 | 1 |
| 10 | 6.8 | E/2010 | T409E685(1)010(2)(3)(4) | CWR09F(3)685(1)(2)(5) | 1.0 | 6.0 | 3.5 | 1 |
| 10 | 15 | F/2214 | T409F156(1)010(2)(3)(4) | CWR09F(3)156(1)(2)(5) | 2.0 | 8.0 | 2.5 | 1 |
| 10 | 33 | G/2711 | T409G336(1)010(2)(3)(4) | CWR09F(3)336(1)(2)(5) | 3.0 | 10.0 | 1.1 | 1 |
| 10 | 47 | H/2915 | T409H476(1)010(2)(3)(4) | CWR09F(3)476(1)(2)(5) | 5.0 | 10.0 | 0.9 | 1 |
| 15 | 0.68 | A/1005 | T409A684(1)015(2)(3)(4) | CWR09H(3)684(1)(2)(5) | 1.0 | 6.0 | 12.0 | 1 |
| 15 | 1.5 | B/1505 | T409B155(1)015(2)(3)(4) | CWR09H(3)155(1)(2)(5) | 1.0 | 6.0 | 8.0 | 1 |
| 15 | 2.2 | C/2005 | T409C225(1)015(2)(3)(4) | CWR09H(3)225(1)(2)(5) | 1.0 | 6.0 | 5.5 | 1 |
| 15 | 3.3 | D/1510 | T409D335(1)015(2)(3)(4) | CWR09H(3)335(1)(2)(5) | 1.0 | 6.0 | 5.0 | 1 |
| 15 | 4.7 | E/2010 | T409E475(1)015(2)(3)(4) | CWR09H(3)475(1)(2)(5) | 1.0 | 6.0 | 4.0 | 1 |
| 15 | 10 | F/2214 | T409F106(1)015(2)(3)(4) | CWR09H(3)106(1)(2)(5) | 2.0 | 6.0 | 2.5 | 1 |
| 15 | 22 | G/2711 | T409G226(1)015(2)(3)(4) | CWR09H(3)226(1)(2)(5) | 4.0 | 6.0 | 1.1 | 1 |
| 15 | 33 | H/2915 | T409H336(1)015(2)(3)(4) | CWR09H(3)336(1)(2)(5) | 5.0 | 8.0 | 0.9 | 1 |
| 20 | 0.47 | A/1005 | T409A474(1)020(2)(3)(4) | CWR09J(3)474(1)(2)(5) | 1.0 | 8.0 | 14.0 | 1 |
| 20 | 0.68 | B/1505 | T409B684(1)020(2)(3)(4) | CWR09J(3)684(1)(2)(5) | 1.0 | 6.0 | 10.0 | 1 |
| 20 | 1 | B/1505 | T409B105(1)020(2)(3)(4) | CWR09J(3)105(1)(2)(5) | 1.0 | 6.0 | 12.0 | 1 |
| 20 | 1.5 | C/2005 | T409C155(1)020(2)(3)(4) | CWR09J(3)155(1)(2)(5) | 1.0 | 6.0 | 6.0 | 1 |
| 20 | 2.2 | D/1510 | T409D225(1)020(2)(3)(4) | CWR09J(3)225(1)(2)(5) | 1.0 | 6.0 | 5.0 | 1 |
| 20 | 3.3 | E/2010 | T409E335(1)020(2)(3)(4) | CWR09J(3)335(1)(2)(5) | 1.0 | 6.0 | 4.0 | 1 |
| 20 | 6.8 | F/2214 | T409F685(1)020(2)(3)(4) | CWR09J(3)685(1)(2)(5) | 2.0 | 6.0 | 2.4 | 1 |
| 20 | 15 | G/2711 | T409G156(1)020(2)(3)(4) | CWR09J(3)156(1)(2)(5) | 3.0 | 6.0 | 1.1 | 1 |
| 20 | 22 | H/2915 | T409H226(1)020(2)(3)(4) | CWR09J(3)226(1)(2)(5) | 4.0 | 6.0 | 0.9 | 1 |
| 25 | 0.33 | A/1005 | T409A334(1)025(2)(3)(4) | CWR09K(3)334(1)(2)(5) | 1.0 | 6.0 | 15.0 | 1 |
| 25 | 0.68 | B/1505 | T409B684(1)025(2)(3)(4) | CWR09K(3)684(1)(2)(5) | 1.0 | 6.0 | 7.5 | 1 |
| 25 | 1 | C/2005 | T409C105(1)025(2)(3)(4) | CWR09K(3)105(1)(2)(5) | 1.0 | 6.0 | 6.5 | 1 |
| 25 | 1.5 | D/1510 | T409D155(1)025(2)(3)(4) | CWR09K(3)155(1)(2)(5) | 1.0 | 6.0 | 6.5 | 1 |
| 25 | 2.2 | E/2010 | T409E225(1)025(2)(3)(4) | CWR09K(3)225(1)(2)(5) | 1.0 | 6.0 | 3.5 | 1 |
| 25 | 4.7 | F/2214 | T409F475(1)025(2)(3)(4) | CWR09K(3)475(1)(2)(5) | 2.0 | 6.0 | 2.5 | 1 |
| 25 | 6.8 | G/2711 | T409G685(1)025(2)(3)(4) | CWR09K(3)685(1)(2)(5) | 2.0 | 6.0 | 1.2 | 1 |
| V | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Maximum/5 Minutes | % @ +20°C 120 Hz Maximum | Ω @ +20°C 100 kHz Maximum | Reflow Temperature ≤ 260°C |
| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL-PRF-55365/4 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |

*(1) To complete KEMET/CWR part number, insert M for ±20%, K for ±10%, or J for ±5%. Designates capacitance tolerance.*

*(2) To complete KEMET/CWR part number, insert B (0.1%/1,000 Hours), C (0.01%/1,000 Hours), D (0.001%/1,000 Hours) or A = N/A. Designates reliability level.*

*(3) To complete KEMET/CWR part number, insert B = Gold Plated, C = Hot solder dipped, H = Solder plated or K = Solder Fused. Designates termination finish.*

*(4) To complete KEMET part number, insert 4250 = +25°C after Weibull, 4251 = -55°C +85°C after Weibull, or 4252 = -55°C +85°C before Weibull. Designates surge current option.*

*(5) To complete CWR part number, insert A = +25°C after Weibull, B = -55°C +85°C after Weibull, or C = -55°C +85°C before Weibull. Designates surge current option. Refer to Ordering Information for additional detail.*



Roll Over for Order Info.

## Table 1 – Ratings & Part Number Reference cont'd

| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL–PRF–55365/4 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |
|---|---|---|---|---|---|---|---|---|
| V | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Maximum/5 Minutes | % @ +20°C 120 Hz Maximum | Ω @ +20°C 100 kHz Maximum | Reflow Temperature ≤ 260°C |
| 25 | 10 | G/2711 | T409G106(1)025(2)(3)(4) | CWR09K(3)106(1)(2)(5) | 3.0 | 6.0 | 1.4 | 1 |
| 25 | 15 | H/2915 | T409H156(1)025(2)(3)(4) | CWR09K(3)156(1)(2)(5) | 4.0 | 6.0 | 1.0 | 1 |
| 35 | 0.22 | A/1005 | T409A224(1)035(2)(3)(4) | CWR09M(3)224(1)(2)(5) | 1.0 | 6.0 | 18.0 | 1 |
| 35 | 0.47 | B/1505 | T409B474(1)035(2)(3)(4) | CWR09M(3)474(1)(2)(5) | 1.0 | 6.0 | 10.0 | 1 |
| 35 | 0.68 | C/2005 | T409C684(1)035(2)(3)(4) | CWR09M(3)684(1)(2)(5) | 1.0 | 6.0 | 8.0 | 1 |
| 35 | 1 | D/1510 | T409D105(1)035(2)(3)(4) | CWR09M(3)105(1)(2)(5) | 1.0 | 6.0 | 6.5 | 1 |
| 35 | 1.5 | E/2010 | T409E155(1)035(2)(3)(4) | CWR09M(3)155(1)(2)(5) | 1.0 | 6.0 | 4.5 | 1 |
| 35 | 3.3 | F/2214 | T409F335(1)035(2)(3)(4) | CWR09M(3)335(1)(2)(5) | 1.0 | 6.0 | 2.5 | 1 |
| 35 | 4.7 | G/2711 | T409G475(1)035(2)(3)(4) | CWR09M(3)475(1)(2)(5) | 2.0 | 6.0 | 1.5 | 1 |
| 35 | 6.8 | H/2915 | T409H685(1)035(2)(3)(4) | CWR09M(3)685(1)(2)(5) | 3.0 | 6.0 | 1.3 | 1 |
| 50 | 0.1 | A/1005 | T409A104(1)050(2)(3)(4) | CWR09N(3)104(1)(2)(5) | 1.0 | 6.0 | 22.0 | 1 |
| 50 | 0.15 | A/1005 | T409A154(1)050(2)(3)(4) | CWR09N(3)154(1)(2)(5) | 1.0 | 6.0 | 17.0 | 1 |
| 50 | 0.22 | B/1505 | T409B224(1)050(2)(3)(4) | CWR09N(3)224(1)(2)(5) | 1.0 | 6.0 | 14.0 | 1 |
| 50 | 0.33 | B/1505 | T409B334(1)050(2)(3)(4) | CWR09N(3)334(1)(2)(5) | 1.0 | 6.0 | 12.0 | 1 |
| 50 | 0.47 | C/2005 | T409C474(1)050(2)(3)(4) | CWR09N(3)474(1)(2)(5) | 1.0 | 6.0 | 8.0 | 1 |
| 50 | 0.68 | D/1510 | T409D684(1)050(2)(3)(4) | CWR09N(3)684(1)(2)(5) | 1.0 | 6.0 | 7.0 | 1 |
| 50 | 1 | E/2010 | T409E105(1)050(2)(3)(4) | CWR09N(3)105(1)(2)(5) | 1.0 | 6.0 | 6.0 | 1 |
| 50 | 1.5 | F/2214 | T409F155(1)050(2)(3)(4) | CWR09N(3)155(1)(2)(5) | 1.0 | 6.0 | 4.0 | 1 |
| 50 | 2.2 | F/2214 | T409F225(1)050(2)(3)(4) | CWR09N(3)225(1)(2)(5) | 2.0 | 6.0 | 2.5 | 1 |
| 50 | 3.3 | G/2711 | T409G335(1)050(2)(3)(4) | CWR09N(3)335(1)(2)(5) | 2.0 | 6.0 | 2.0 | 1 |
| 50 | 4.7 | H/2915 | T409H475(1)050(2)(3)(4) | CWR09N(3)475(1)(2)(5) | 3.0 | 6.0 | 1.5 | 1 |
| V | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Maximum/5 Minutes | % @ +20°C 120 Hz Maximum | Ω @ +20°C 100 kHz Maximum | Reflow Temperature ≤ 260°C |
| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL–PRF–55365/4 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |

*(1) To complete KEMET/CWR part number, insert M for ±20%, K for ±10%, or J for ±5%. Designates capacitance tolerance.*

*(2) To complete KEMET/CWR part number, insert failure rate letter per the Ordering Information found on page 2. Designates Reliability Level.*

*(3) To complete KEMET/CWR part number, insert B = Gold Plated, C = Hot solder dipped, H = Solder plated or K = Solder Fused. Designates termination finish.*

*(4) To complete KEMET part number, insert 4250 = +25°C after Weibull, 4251 = -55°C +85°C after Weibull, or 4252 = -55°C +85°C before Weibull. Designates surge current option.*

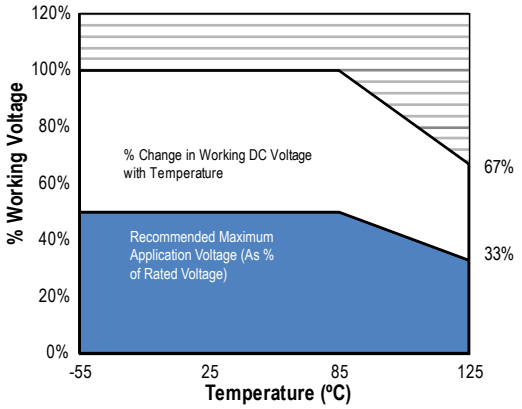
*(5) To complete CWR part number, insert A = +25°C after Weibull, B = -55°C +85°C after Weibull, or C = -55°C +85°C before Weibull. Designates surge current option. Refer to Ordering Information for additional detail.*



Roll Over for Order Info.

## Recommended Voltage Derating Guidelines

| | -55°C to 85°C | 85°C to 125°C |
|---|---|---|
| % Change in Working DC Voltage with Temperature | $V_R$ | 67% of $V_R$ |
| Recommended Maximum Application Voltage | 50% of $V_R$ | 33% of $V_R$ |




## 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.

| KEMET Case Code | EIA Case Code | Maximum Power Dissipation (P max) mWatts @ 25°C w/+20°C Rise |
|---|---|---|
| A | 1005 | 50 |
| B | 1505 | 70 |
| C | 2005 | 75 |
| D | 1510 | 80 |
| E | 2010 | 90 |
| F | 2214 | 100 |
| G | 2711 | 125 |
| H | 2915 | 150 |

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

| Temperature Compensation Multipliers for Maximum Power Dissipation | | |
|---|---|---|
| T ≤ 25°C | T ≤ 85°C | T ≤ 125°C |
| 1.00 | 0.90 | 0.40 |

*T= Environmental Temperature*

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

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

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

## Reverse Voltage

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

| Temperature | Permissible Transient Reverse Voltage |
|---|---|
| 25°C | 15% of Rated Voltage |
| 85°C | 5% of Rated Voltage |
| 125°C | 1% of Rated Voltage |

## Table 2 – Land Dimensions/Courtyard

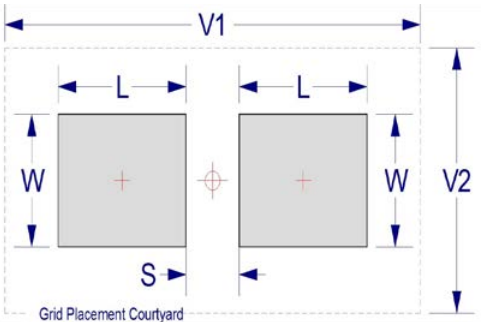
| KEMET | Metric Size Code | Density Level A: Maximum (Most) Land Protrusion (mm) | | | | | Density Level B: Median (Nominal) Land Protrusion (mm) | | | | | Density Level C: Minimum (Least) Land Protrusion (mm) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Case | EIA | L | W | S | V1 | V2 | L | W | S | V1 | V2 | L | W | S | V1 | V2 |
| A[1] | 1005 | 2.19 | 1.44 | 0.15 | 5.54 | 2.66 | 1.89 | 1.32 | 0.15 | 4.44 | 2.16 | 1.52 | 1.22 | 0.29 | 3.58 | 1.90 |
| B | 1505 | 2.30 | 1.44 | 1.20 | 6.80 | 2.66 | 1.90 | 1.32 | 1.40 | 5.70 | 2.16 | 1.52 | 1.22 | 1.56 | 4.84 | 1.90 |
| C | 2005 | 2.30 | 1.44 | 2.47 | 8.08 | 2.66 | 1.90 | 1.32 | 2.67 | 6.98 | 2.16 | 1.52 | 1.22 | 2.83 | 6.12 | 1.90 |
| D | 1510 | 2.30 | 2.58 | 1.20 | 6.80 | 3.92 | 1.90 | 2.46 | 1.40 | 5.70 | 3.42 | 1.52 | 2.36 | 1.56 | 4.84 | 3.16 |
| E | 2010 | 2.30 | 2.58 | 2.47 | 8.08 | 3.92 | 1.90 | 2.46 | 2.67 | 6.98 | 3.42 | 1.52 | 2.36 | 2.83 | 6.12 | 3.16 |
| F | 2214 | 2.30 | 3.47 | 2.98 | 8.58 | 4.82 | 1.90 | 3.35 | 3.18 | 7.48 | 4.32 | 1.52 | 3.25 | 3.34 | 6.62 | 4.06 |
| G | 2711 | 2.81 | 2.84 | 3.10 | 9.72 | 4.18 | 2.41 | 2.72 | 3.30 | 8.62 | 3.68 | 2.03 | 2.62 | 3.46 | 7.76 | 3.42 |
| H | 2915 | 2.81 | 3.84 | 3.61 | 10.24 | 5.20 | 2.41 | 3.72 | 3.81 | 9.14 | 4.70 | 2.03 | 3.62 | 3.97 | 8.28 | 4.44 |
| X | 2824 | 2.73 | 3.22 | 3.46 | 9.92 | 6.80 | 2.33 | 3.10 | 3.66 | 8.82 | 6.30 | 1.95 | 3.00 | 3.82 | 7.96 | 6.04 |

***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 desity 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] Land pattern geometry is too small for silkscreen outline.*



## 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.

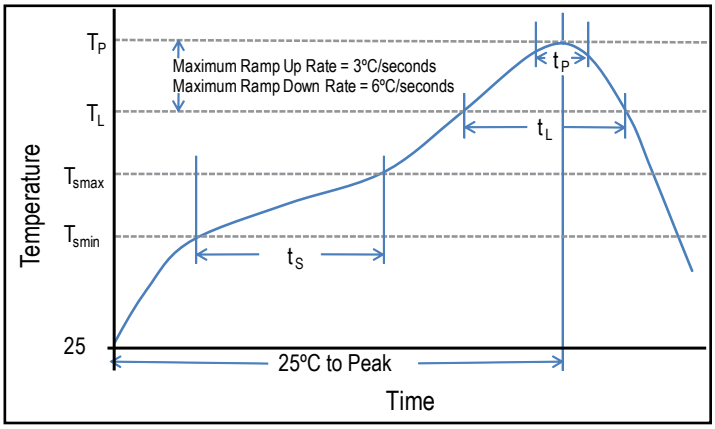
Note that although the X/7343–43 case size can withstand wave soldering, the tall profile (4.3 mm maximum) dictates care in wave process development.

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.

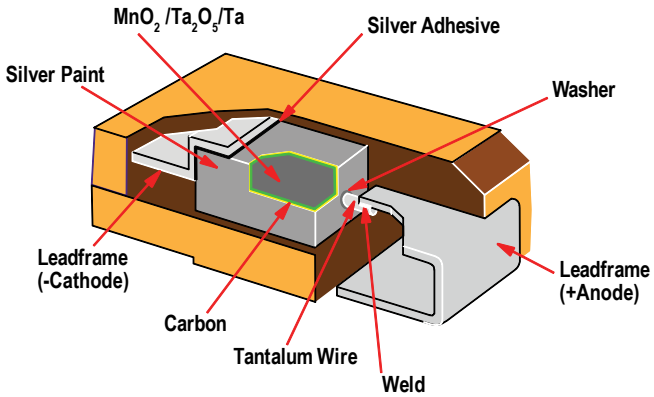
During typical reflow operations, a slight darkening of the gold-colored epoxy may be observed. This slight darkening is normal and not harmful to the product. Marking permanency is not affected by this change.

| 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 |

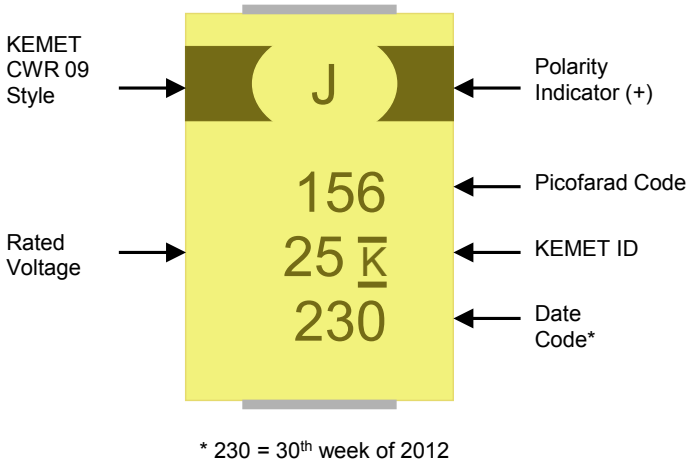
*Note: All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow.*
**Case Size D, E, P, Y, and X*
***Case Size A, B, C, H, I, K, M, R, S, T, U, V, W, and Z*




## Construction



## Capacitor Marking




* 230 = 30th week of 2012

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

## Storage

Tantalum chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature– reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 40ºC and maximum storage humidity not exceed 60% relative humidity. Temperature fluctuations should be minimized to avoid condensation on the parts and atmospheres should be free of chlorine and sulphur bearing compounds. For optimized solderability chip stock should be used promptly, preferably within three years of receipt.

# T419 Series CWR19 Style MIL–PRF–55365/11

## Overview

The KEMET T419 Series is approved to MIL–PRF–55365/11 (CWR19) with Weibull failure rates of B level (0.1% failures per 1,000 hours), C level (0.01% failures per 1,000 hours), D level (0.001% failures per 1,000 hours), or T level (0.01% failures per 1,000 hours, Option C surge current, DPA, Radiographic inspection, 100% visual inspection, DCL and ESR measurements within +3 standard deviations, and Group C inspection). This CWR19 product is a precision-molded device with compliant terminations and indelible laser marking. Tape and reeling per EIA 481–1 is standard.

## Benefits

- Established reliability options
- Taped and reeled per EIA 481–1
- Symmetrical, compliant terminations
- Laser-marked case
- 100% surge current test available on all case sizes
- Qualified to MIL–PRF–55365/11, Style CWR19
- Termination options B, C, H, K
- Weibull failure options B, C, D, and T
- Exponential failure rates M, P, R, S
- Voltage rating of 4 – 35 VDC
- Operating temperature range of -55˚C to +125˚C

## Applications

Typical applications include decoupling and filtering in Military and aerospace applications requiring CWR19 devices.

## Environmental Compliance

RoHS Compliant (6/6) according to Directive 2002/95/EC when ordered with 100% Sn Solder.

RoHS Compliant

## SPICE

For a detailed analysis of specific part numbers, please visit 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.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## KEMET Ordering Information

| T | 419 | A | 225 | K | 004 | A | H | 4251 | 7280 |
|---|---|---|---|---|---|---|---|---|---|
| Capacitor Class | Series | Case Size | Capacitance Code (pF) | Capacitance Tolerance | Voltage | Failure Rate/Design | Lead Material | Surge | Packaging (C-Spec) |
| T = Tantalum | CWR19 Established Reliability | A, B, C, D, E, F, G, H, X | First two digits represent significant figures. Third digit specifies number of zeros. | J = ±5%<br>K = ±10%<br>M = ±20% | 004 = 4 V<br>006 = 6.3 V<br>010 = 10 V<br>015 = 15 V<br>020 = 20 V<br>025 = 25 V<br>035 = 35 V | Weibull<br>A = non-ER<br>B = (0.1%/1,000 hours)<br>C = (0.01%/1,000 hours)<br>D = (0.001%/1,000 hours)<br>T = (0.01%/1,000 hours)<br>Exponential<br>M = (1.0%/1,000 hours)<br>P = (0.1%/1,000 hours)<br>R = (0.01%/1,000 hours)<br>S =(0.001%/1,000 hours) | C = Hot Solder Dipped<br>H = Standard Solder Coated (SnPb 5% Pb minimum)<br>B = Gold Plated<br>K = Solder Fused | Blank = No Surge<br>4250= 25°C after Weibull<br>4251 = -55°C and 85°C after Weibull<br>4252 = -55°C and 85°C before Weibull<br>TLVL = Weibull Grade Level "T" | Blank = 7" Reel<br>7280 = 13" Reel<br>7610 = Bag<br>7005 = Moisture bags |

## Defense MIL–PRF–55365/11 Ordering Information

| CWR19 | K | H | 225 | K | C | D | A |
|---|---|---|---|---|---|---|---|
| Capacitor Style | Voltage | Termination Finish | Capacitance Code (pF) | Capacitance Tolerance | Reliability Level | Case Code | Surge Current Option |
| Per MIL–PRF–55365/11 | C = 4 V<br>D = 6 V<br>F = 10 V<br>H = 15 V<br>J = 20 V<br>K = 25 V<br>M = 35 V | B = Gold Plated<br>C = Hot solder dipped<br>H = Solder Plated<br>K = Solder fused | First two digits represent significant figures. Third digit specifies number of zeros. | J = ±5%<br>K = ±10%<br>M = ±20% | Weibull<br>A = non-ER<br>B = (0.1%/1,000 hours)<br>C = (0.01%/1,000 hours)<br>D =(0.001%/1,000 hours)<br>T= T Level* (0.01%/1,000 hours)<br>Exponential<br>M = (1.0%/1,000 hours)<br>P = (0.1%/1,000 hours)<br>R = (0.01%/1,000 hours)<br>S =(0.001%/1,000 hours) | A, B, C, D, E, F, G, H, X | A = +25°C after Weibull<br>B = -55°C +85°C after Weibull<br>C = -55°C +85°C before Weibull<br>Z = None |

** When T Level is ordered, no Surge Current Option is needed*

## Performance Characteristics

| Item | Performance Characteristics |
|---|---|
| Operating Temperature | -55°C to 125°C |
| Rated Capacitance Range | 0.33 – 330 µF @ 120 Hz/25°C |
| Capacitance Tolerance | J Tolerance (5%), K Tolerance (10%), M Tolerance (20%) |
| Rated Voltage Range | 4 – 35 V |
| DF (120 Hz) | Refer to Part Number Electrical Specification Table |
| ESR (100 kHz) | Refer to Part Number Electrical Specification Table |
| Leakage Current | ≤ 0.01 CV (µA) at rated voltage after 5 minutes |

## Qualification

| Test | Condition | | Characteristics | | | |
|---|---|---|---|---|---|---|
| Endurance | 85°C @ rated voltage, 2,000 hours<br>125°C @ 2/3 rated voltage, 2,000 hours | | Δ C/C | Within ±10% of initial value | | |
| | | | DF | Within initial limits | | |
| | | | DCL | Within 1.25 x initial limit | | |
| | | | ESR | Within initial limits | | |
| Storage Life | 125°C @ 0 volts, 2,000 hours | | Δ C/C | Within ±10% of initial value | | |
| | | | DF | Within initial limits | | |
| | | | DCL | Within 1.25 x initial limit | | |
| | | | ESR | Within initial limits | | |
| Thermal Shock | MIL–STD–202, Method 107, Condition B, mounted, -55°C to 125°C, 1,000 cycles | | Δ C/C | Within ±5% of initial value | | |
| | | | DF | Within initial limits | | |
| | | | DCL | Within 1.25 x initial limit | | |
| | | | ESR | Within initial limits | | |
| 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* | ±10% | ±10% | ±20% |
| | | DF | IL | IL | 1.5 x IL | 1.5 x IL |
| | | DCL | IL | n/a | 10 x IL | 12 x IL |
| Surge Voltage | 25°C and 85°C, 1.32 x rated voltage 1,000 cycles (125°C, 1.2 x rated voltage) | | Δ C/C | Within ±5% 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–55365/11 | Please contact KEMET for more information. | | | | | |

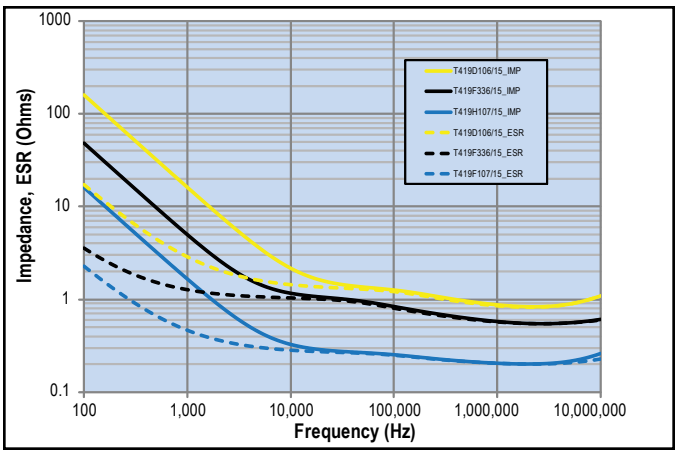
**IL = Initial limit*

## Certification

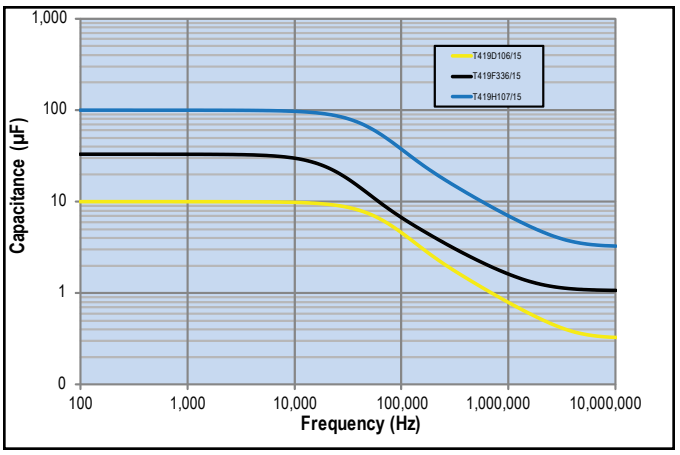
MIL–PRF–55365/11

## Electrical Characteristics

### ESR vs. Frequency

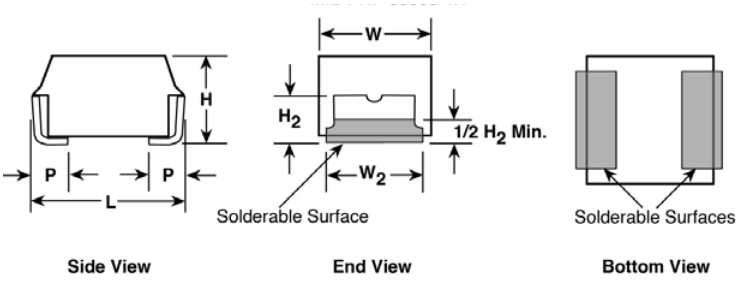



### Capacitance vs. Frequency




## Dimensions – Millimeters (Inches)

Metric will govern




| Case Size | Component | | | | | |
|---|---|---|---|---|---|---|
| KEMET | L* ±0.38 (0.015) | W* ±0.38 (0.015) | H* ±0.38 (0.015) | P +0.25 (0.010), -0.13 (0.005) | $W_2$ | $H_2$ Minimum |
| A | 2.54 (0.100) | 1.27 (0.050) | 1.27 (0.050) | 0.76 (0.030) | 1.27 ±0.13 (0.050 ±0.005) | 0.76 (0.030) |
| B | 3.81 (0.150) | 1.27 (0.050) | 1.27 (0.050) | 0.76 (0.030) | 1.27 ±0.13 (0.050 ±0.005) | 0.76 (0.030) |
| C | 5.08 (0.200) | 1.27 (0.050) | 1.27 (0.050) | 0.76 (0.030) | 1.27 ±0.13 (0.050 ±0.005) | 0.76 (0.030) |
| D | 3.81 (0.150) | 2.54 (0.100) | 1.27 (0.050) | 0.76 (0.030) | 2.41 +0.13, -0.25 (0.095 +.005, -0.010) | 0.76 (0.030) |
| E | 5.08 (0.200) | 2.54 (0.100) | 1.27 (0.050) | 0.76 (0.030) | 2.41 +0.13, -0.25 (0.095 +0.005, -0.010) | 0.76 (0.030) |
| F | 5.59 (0.220) | 3.43 (0.135) | 1.78 (0.070) | 0.76 (0.030) | 3.30 ±0.13 (0.130 ±0.005) | 1.02 (0.040) |
| G | 6.73 (0.265) | 2.79 (0.110) | 2.79 (0.110) | 1.27 (0.050) | 2.67 ±0.13 (0.105 ±0.005) | 1.52 (0.060) |
| H | 7.24 (0.285) | 3.81 (0.150) | 2.79 (0.110) | 1.27 (0.050) | 3.68 +0.013, -0.51 (0.145 +0.005, -0.020) | 1.52 (0.060) |
| X | 6.93 (0.273) | 5.41 (0.213) | 2.74 (0.108) | 1.19 (0.047) | 3.05 ±0.13 (0.120 ±0.005) | 1.22 (0.048) |

*Note: When solder coated terminations are required, add an additional 0.38 mm (0.015 inch) to the above tolerances for "L", "W", "H", "P" ,"$W_2$" and "$H_2$"*

## Table 1 – Ratings & Part Number Reference

| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL–PRF–55365/11 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |
|---|---|---|---|---|---|---|---|---|
| VDC | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Max/5 Min | % @ 20°C 120 Hz Max | Ω @ +20°C 100kHz Max | Reflow Temperature ≤ 260°C |
| 4 | 3.3 | A/1005 | T419A335(1)004(2)(3)(4) | CWR19C(3)335(1)(2)A(5) | 1.0 | 6.0 | 12.0 | 1 |
| 4 | 4.7 | A/1005 | T419A475(1)004(2)(3)(4) | CWR19C(3)475(1)(2)A(5) | 1.0 | 6.0 | 12.0 | 1 |
| 4 | 6.8 | A/1005 | T419A685(1)004(2)(3)(4) | CWR19C(3)685(1)(2)A(5) | 1.0 | 6.0 | 12.0 | 1 |
| 4 | 10 | B/1505 | T419B106(1)004(2)(3)(4) | CWR19C(3)106(1)(2)B(5) | 1.0 | 8.0 | 8.0 | 1 |
| 4 | 15 | B/1505 | T419B156(1)004(2)(3)(4) | CWR19C(3)156(1)(2)B(5) | 1.0 | 8.0 | 8.0 | 1 |
| 4 | 22 | B/1505 | T419B226(1)004(2)(3)(4) | CWR19C(3)226(1)(2)B(5) | 1.0 | 8.0 | 8.0 | 1 |
| 4 | 22 | D/1510 | T419D226(1)004(2)(3)(4) | CWR19C(3)226(1)(2)D(5) | 1.0 | 8.0 | 4.0 | 1 |
| 4 | 33 | D/1510 | T419D336(1)004(2)(3)(4) | CWR19C(3)336(1)(2)D(5) | 2.0 | 8.0 | 4.0 | 1 |
| 4 | 33 | E/2010 | T419E336(1)004(2)(3)(4) | CWR19C(3)336(1)(2)E(5) | 2.0 | 8.0 | 3.0 | 1 |
| 4 | 47 | E/2010 | T419E476(1)004(2)(3)(4) | CWR19C(3)476(1)(2)E(5) | 2.0 | 8.0 | 3.0 | 1 |
| 4 | 68 | E/2010 | T419E686(1)004(2)(3)(4) | CWR19C(3)686(1)(2)E(5) | 3.0 | 8.0 | 3.0 | 1 |
| 4 | 100 | F/2214 | T419F107(1)004(2)(3)(4) | CWR19C(3)107(1)(2)F(5) | 4.0 | 10.0 | 2.0 | 1 |
| 4 | 150 | G/2711 | T419G157(1)004(2)(3)(4) | CWR19C(3)157(1)(2)G(5) | 6.0 | 10.0 | 1.0 | 1 |
| 4 | 220 | H/2915 | T419H227(1)004(2)(3)(4) | CWR19C(3)227(1)(2)H(5) | 8.0 | 10.0 | 1.0 | 1 |
| 4 | 330 | H/2915 | T419H337(1)004(2)(3)(4) | CWR19C(3)337(1)(2)H(5) | 10.0 | 10.0 | 0.9 | 1 |
| 6 | 3.3 | A/1005 | T419A335(1)006(2)(3)(4) | CWR19D(3)335(1)(2)A(5) | 1.0 | 6.0 | 12.0 | 1 |
| 6 | 4.7 | A/1005 | T419A475(1)006(2)(3)(4) | CWR19D(3)475(1)(2)A(5) | 1.0 | 6.0 | 12.0 | 1 |
| 6 | 6.8 | B/1505 | T419B685(1)006(2)(3)(4) | CWR19D(3)685(1)(2)B(5) | 1.0 | 6.0 | 8.0 | 1 |
| 6 | 10 | B/1505 | T419B106(1)006(2)(3)(4) | CWR19D(3)106(1)(2)B(5) | 1.0 | 6.0 | 8.0 | 1 |
| 6 | 15 | B/1505 | T419B156(1)006(2)(3)(4) | CWR19D(3)156(1)(2)B(5) | 1.0 | 8.0 | 8.0 | 1 |
| 6 | 15 | D/1510 | T419D156(1)006(2)(3)(4) | CWR19D(3)156(1)(2)D(5) | 1.0 | 8.0 | 5.0 | 1 |
| 6 | 15 | E/2010 | T419E156(1)006(2)(3)(4) | CWR19D(3)156(1)(2)E(5) | 1.0 | 8.0 | 3.0 | 1 |
| 6 | 22 | D/1510 | T419D226(1)006(2)(3)(4) | CWR19D(3)226(1)(2)D(5) | 1.0 | 6.0 | 5.0 | 1 |
| 6 | 22 | E/2010 | T419E226(1)006(2)(3)(4) | CWR19D(3)226(1)(2)E(5) | 2.0 | 8.0 | 3.5 | 1 |
| 6 | 33 | E/2010 | T419E336(1)006(2)(3)(4) | CWR19D(3)336(1)(2)E(5) | 2.0 | 6.0 | 3.5 | 1 |
| 6 | 47 | F/2214 | T419F476(1)006(2)(3)(4) | CWR19D(3)476(1)(2)F(5) | 2.8 | 8.0 | 3.5 | 1 |
| 6 | 68 | F/2214 | T419F686(1)006(2)(3)(4) | CWR19D(3)686(1)(2)F(5) | 4.0 | 10.0 | 1.5 | 1 |
| 6 | 68 | G/2711 | T419G686(1)006(2)(3)(4) | CWR19D(3)686(1)(2)G(5) | 4.0 | 10.0 | 1.0 | 1 |
| 6 | 100 | G/2711 | T419G107(1)006(2)(3)(4) | CWR19D(3)107(1)(2)G(5) | 6.0 | 10.0 | 1.1 | 1 |
| 6 | 150 | G/2711 | T419G157(1)006(2)(3)(4) | CWR19D(3)157(1)(2)G(5) | 10.0 | 10.0 | 1.1 | 1 |
| 6 | 220 | H/2915 | T419H227(1)006(2)(3)(4) | CWR19D(3)227(1)(2)H(5) | 10.0 | 10.0 | 0.9 | 1 |
| 6 | 330 | H/2915 | T419H337(1)006(2)(3)(4) | CWR19D(3)337(1)(2)H(5) | 20.0 | 10.0 | 0.9 | 1 |
| 10 | 2.2 | A/1005 | T419A225(1)010(2)(3)(4) | CWR19F(3)225(1)(2)A(5) | 1.0 | 6.0 | 12.0 | 1 |
| 10 | 3.3 | A/1005 | T419A335(1)010(2)(3)(4) | CWR19F(3)335(1)(2)A(5) | 1.0 | 6.0 | 12.0 | 1 |
| 10 | 4.7 | B/1505 | T419B475(1)010(2)(3)(4) | CWR19F(3)475(1)(2)B(5) | 1.0 | 6.0 | 8.0 | 1 |
| 10 | 4.7 | C/2005 | T419C475(1)010(2)(3)(4) | CWR19F(3)475(1)(2)C(5) | 1.0 | 6.0 | 5.5 | 1 |
| 10 | 6.8 | B/1505 | T419B685(1)010(2)(3)(4) | CWR19F(3)685(1)(2)B(5) | 1.0 | 6.0 | 8.0 | 1 |
| 10 | 6.8 | C/2005 | T419C685(1)010(2)(3)(4) | CWR19F(3)685(1)(2)C(5) | 1.0 | 6.0 | 5.5 | 1 |
| 10 | 6.8 | D/1510 | T419D685(1)010(2)(3)(4) | CWR19F(3)685(1)(2)D(5) | 1.0 | 6.0 | 5.0 | 1 |
| 10 | 10 | B/1505 | T419B106(1)010(2)(3)(4) | CWR19F(3)106(1)(2)B(5) | 1.0 | 8.0 | 8.0 | 1 |
| 10 | 10 | C/2005 | T419C106(1)010(2)(3)(4) | CWR19F(3)106(1)(2)C(5) | 1.0 | 6.0 | 5.5 | 1 |
| 10 | 10 | D/1510 | T419D106(1)010(2)(3)(4) | CWR19F(3)106(1)(2)D(5) | 1.0 | 6.0 | 4.0 | 1 |
| 10 | 10 | E/2010 | T419E106(1)010(2)(3)(4) | CWR19F(3)106(1)(2)E(5) | 1.0 | 6.0 | 3.5 | 1 |
| 10 | 15 | D/1510 | T419D156(1)010(2)(3)(4) | CWR19F(3)156(1)(2)D(5) | 2.0 | 6.0 | 5.0 | 1 |
| 10 | 15 | E/2010 | T419E156(1)010(2)(3)(4) | CWR19F(3)156(1)(2)E(5) | 2.0 | 8.0 | 3.0 | 1 |
| 10 | 22 | E/2010 | T419E226(1)010(2)(3)(4) | CWR19F(3)226(1)(2)E(5) | 3.0 | 8.0 | 2.0 | 1 |
| 10 | 33 | F/2214 | T419F336(1)010(2)(3)(4) | CWR19F(3)336(1)(2)F(5) | 3.0 | 8.0 | 1.5 | 1 |
| 10 | 47 | F/2214 | T419F476(1)010(2)(3)(4) | CWR19F(3)476(1)(2)F(5) | 4.0 | 10.0 | 1.5 | 1 |
| 10 | 47 | G/2711 | T419G476(1)010(2)(3)(4) | CWR19F(3)476(1)(2)G(5) | 4.0 | 10.0 | 1.0 | 1 |
| VDC | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Max/5 Min | % @ 20°C 120 Hz Max | Ω @ +20°C 100kHz Max | Reflow Temperature ≤ 260°C |
| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL–PRF–55365/11 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |

*(1) To complete KEMET/CWR part number, insert M for ±20%, K for ±10%, or J for ±5%. Designates Capacitance tolerance.*

*(2) To complete KEMET/CWR part number, insert B (0.1%/1,000 Hours), C (0.01%/1,000 Hours), D (0.001%/1,000 Hours) or A = N/A. Designates Reliability Level.*

*(3) To complete KEMET/CWR part number, insert B = Gold Plated, C = Hot solder dipped, H = Solder plated or K = Solder Fused. Designates Termination Finish.*

*(4) To complete KEMET part number, insert 4250 = +25°C after Weibull, 4251 = -55°C +85°C after Weibull, or 4252 = -55°C +85°C before Weibull. Designates Surge current option.*

*(5) To complete CWR part number, insert A = +25°C after Weibull, B = -55°C +85°C after Weibull, C = -55°C +85°C before Weibull or Z = None. Designates Surge current option.*

*Refer to Ordering Information for additional detail.*



Roll Over for Order Info.

## Table 1 – Ratings & Part Number Reference cont'd

| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL–PRF–55365/11 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |
|---|---|---|---|---|---|---|---|---|
| VDC | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Max/5 Min | % @ 20°C 120 Hz Max | Ω @ +20°C 100kHz Max | Reflow Temperature ≤ 260°C |
| 10 | 68 | G/2711 | T419G686(1)010(2)(3)(4) | CWR19F(3)686(1)(2)G(5) | 6.0 | 10.0 | 1.1 | 1 |
| 10 | 100 | G/2711 | T419G107(1)010(2)(3)(4) | CWR19F(3)107(1)(2)G(5) | 10.0 | 10.0 | 1.1 | 1 |
| 10 | 100 | H/2915 | T419H107(1)010(2)(3)(4) | CWR19F(3)107(1)(2)H(5) | 10.0 | 10.0 | 0.9 | 1 |
| 10 | 150 | H/2915 | T419H157(1)010(2)(3)(4) | CWR19F(3)157(1)(2)H(5) | 15.0 | 10.0 | 0.9 | 1 |
| 10 | 150 | X/2824 | T419X157(1)010(2)(3)(4) | CWR19F(3)157(1)(2)X(5) | 15.0 | 10.0 | 0.9 | 1 |
| 10 | 220 | H/2915 | T419H227(1)010(2)(3)(4) | CWR19F(3)227(1)(2)H(5) | 20.0 | 10.0 | 0.9 | 1 |
| 15 | 1 | A/1005 | T419A105(1)015(2)(3)(4) | CWR19H(3)105(1)(2)A(5) | 1.0 | 6.0 | 15.0 | 1 |
| 15 | 1.5 | A/1005 | T419A155(1)015(2)(3)(4) | CWR19H(3)155(1)(2)A(5) | 1.0 | 6.0 | 15.0 | 1 |
| 15 | 2.2 | A/1005 | T419A225(1)015(2)(3)(4) | CWR19H(3)225(1)(2)A(5) | 1.0 | 6.0 | 15.0 | 1 |
| 15 | 3.3 | B/1505 | T419B335(1)015(2)(3)(4) | CWR19H(3)335(1)(2)B(5) | 1.0 | 6.0 | 9.0 | 1 |
| 15 | 4.7 | B/1505 | T419B475(1)015(2)(3)(4) | CWR19H(3)475(1)(2)B(5) | 1.0 | 6.0 | 5.0 | 1 |
| 15 | 4.7 | C/2005 | T419C475(1)015(2)(3)(4) | CWR19H(3)475(1)(2)C(5) | 1.0 | 6.0 | 5.5 | 1 |
| 15 | 4.7 | D/1510 | T419D475(1)015(2)(3)(4) | CWR19H(3)475(1)(2)D(5) | 1.0 | 6.0 | 6.0 | 1 |
| 15 | 6.8 | D/1510 | T419D685(1)015(2)(3)(4) | CWR19H(3)685(1)(2)D(5) | 1.0 | 6.0 | 6.0 | 1 |
| 15 | 6.8 | E/2010 | T419E685(1)015(2)(3)(4) | CWR19H(3)685(1)(2)E(5) | 1.0 | 8.0 | 3.0 | 1 |
| 15 | 10 | D/1510 | T419D106(1)015(2)(3)(4) | CWR19H(3)106(1)(2)D(5) | 2.0 | 6.0 | 6.0 | 1 |
| 15 | 10 | E/2010 | T419E106(1)015(2)(3)(4) | CWR19H(3)106(1)(2)E(5) | 2.0 | 6.0 | 4.0 | 1 |
| 15 | 15 | E/2010 | T419E156(1)015(2)(3)(4) | CWR19H(3)156(1)(2)E(5) | 2.0 | 6.0 | 4.0 | 1 |
| 15 | 15 | F/2214 | T419F156(1)015(2)(3)(4) | CWR19H(3)156(1)(2)F(5) | 2.0 | 8.0 | 3.0 | 1 |
| 15 | 22 | F/2214 | T419F226(1)015(2)(3)(4) | CWR19H(3)226(1)(2)F(5) | 3.0 | 8.0 | 3.0 | 1 |
| 15 | 33 | F/2214 | T419F336(1)015(2)(3)(4) | CWR19H(3)336(1)(2)F(5) | 5.0 | 6.0 | 3.0 | 1 |
| 15 | 33 | G/2711 | T419G336(1)015(2)(3)(4) | CWR19H(3)336(1)(2)G(5) | 6.0 | 8.0 | 1.1 | 1 |
| 15 | 47 | G/2711 | T419G476(1)015(2)(3)(4) | CWR19H(3)476(1)(2)G(5) | 10.0 | 8.0 | 1.1 | 1 |
| 15 | 47 | H/2915 | T419H476(1)015(2)(3)(4) | CWR19H(3)476(1)(2)H(5) | 10.0 | 8.0 | 0.9 | 1 |
| 15 | 68 | G/2711 | T419G686(1)015(2)(3)(4) | CWR19H(3)686(1)(2)G(5) | 10.0 | 8.0 | 1.1 | 1 |
| 15 | 68 | H/2915 | T419H686(1)015(2)(3)(4) | CWR19H(3)686(1)(2)H(5) | 10.0 | 8.0 | 0.9 | 1 |
| 15 | 100 | H/2915 | T419H107(1)015(2)(3)(4) | CWR19H(3)107(1)(2)H(5) | 15.0 | 10.0 | 0.9 | 1 |
| 20 | 0.68 | A/1005 | T419A684(1)020(2)(3)(4) | CWR19J(3)684(1)(2)A(5) | 1.0 | 6.0 | 15.0 | 1 |
| 20 | 1 | A/1005 | T419A105(1)020(2)(3)(4) | CWR19J(3)105(1)(2)A(5) | 1.0 | 6.0 | 15.0 | 1 |
| 20 | 1.5 | B/1505 | T419B155(1)020(2)(3)(4) | CWR19J(3)155(1)(2)B(5) | 1.0 | 6.0 | 9.0 | 1 |
| 20 | 2.2 | B/1505 | T419B225(1)020(2)(3)(4) | CWR19J(3)225(1)(2)B(5) | 1.0 | 6.0 | 9.0 | 1 |
| 20 | 3.3 | D/1510 | T419D335(1)020(2)(3)(4) | CWR19J(3)335(1)(2)D(5) | 1.0 | 6.0 | 6.0 | 1 |
| 20 | 4.7 | E/2010 | T419E475(1)020(2)(3)(4) | CWR19J(3)475(1)(2)E(5) | 1.0 | 6.0 | 6.0 | 1 |
| 20 | 6.8 | E/2010 | T419E685(1)020(2)(3)(4) | CWR19J(3)685(1)(2)E(5) | 2.0 | 6.0 | 5.0 | 1 |
| 20 | 10 | E/2010 | T419E106(1)020(2)(3)(4) | CWR19J(3)106(1)(2)E(5) | 2.0 | 6.0 | 5.0 | 1 |
| 20 | 10 | F/2214 | T419F106(1)020(2)(3)(4) | CWR19J(3)106(1)(2)F(5) | 2.0 | 6.0 | 3.0 | 1 |
| 20 | 15 | F/2214 | T419F156(1)020(2)(3)(4) | CWR19J(3)156(1)(2)F(5) | 3.0 | 6.0 | 3.0 | 1 |
| 20 | 22 | G/2711 | T419G226(1)020(2)(3)(4) | CWR19J(3)226(1)(2)G(5) | 4.0 | 6.0 | 2.5 | 1 |
| 20 | 33 | H/2915 | T419H336(1)020(2)(3)(4) | CWR19J(3)336(1)(2)H(5) | 6.0 | 8.0 | 0.9 | 1 |
| 20 | 47 | H/2915 | T419H476(1)020(2)(3)(4) | CWR19J(3)476(1)(2)H(5) | 10.0 | 8.0 | 0.9 | 1 |
| 20 | 47 | X/2824 | T419X476(1)020(2)(3)(4) | CWR19J(3)476(1)(2)X(5) | 10.0 | 8.0 | 0.9 | 1 |
| 25 | 0.47 | A/1005 | T419A474(1)025(2)(3)(4) | CWR19K(3)474(1)(2)A(5) | 1.0 | 6.0 | 15.0 | 1 |
| 25 | 1 | B/1505 | T419B105(1)025(2)(3)(4) | CWR19K(3)105(1)(2)B(5) | 1.0 | 6.0 | 10.0 | 1 |
| 25 | 2.2 | D/1510 | T419D225(1)025(2)(3)(4) | CWR19K(3)225(1)(2)D(5) | 1.0 | 6.0 | 6.0 | 1 |
| 25 | 3.3 | E/2010 | T419E335(1)025(2)(3)(4) | CWR19K(3)335(1)(2)E(5) | 1.0 | 6.0 | 4.0 | 1 |
| 25 | 6.8 | F/2214 | T419F685(1)025(2)(3)(4) | CWR19K(3)685(1)(2)F(5) | 2.0 | 6.0 | 3.0 | 1 |
| 25 | 15 | G/2711 | T419G156(1)025(2)(3)(4) | CWR19K(3)156(1)(2)G(5) | 4.0 | 6.0 | 1.4 | 1 |
| 25 | 22 | G/2711 | T419G226(1)025(2)(3)(4) | CWR19K(3)226(1)(2)G(5) | 6.0 | 6.0 | 1.4 | 1 |
| 25 | 22 | H/2915 | T419H226(1)025(2)(3)(4) | CWR19K(3)226(1)(2)H(5) | 6.0 | 6.0 | 0.9 | 1 |
| VDC | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Max/5 Min | % @ 20°C 120 Hz Max | Ω @ +20°C 100kHz Max | Reflow Temperature ≤ 260°C |
| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL–PRF–55365/11 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |

*(1) To complete KEMET/CWR part number, insert M for ±20%, K for ±10%, or J for ±5%. Designates Capacitance tolerance.*

*(2) To complete KEMET/CWR part number, insert B (0.1%/1,000 Hours), C (0.01%/1,000 Hours), D (0.001%/1,000 Hours) or A = N/A. Designates Reliability Level.*

*(3) To complete KEMET/CWR part number, insert B = Gold Plated, C = Hot solder dipped, H = Solder plated or K = Solder Fused. Designates Termination Finish.*

*(4) To complete KEMET part number, insert 4250 = +25°C after Weibull, 4251 = -55°C +85°C after Weibull, or 4252 = -55°C +85°C before Weibull. Designates Surge current option.*

*(5) To complete CWR part number, insert A = +25°C after Weibull, B = -55°C +85°C after Weibull, C = -55°C +85°C before Weibull or Z = None. Designates Surge current option.*

*Refer to Ordering Information for additional detail.*



Roll Over for Order Info.

## Table 1 – Ratings & Part Number Reference cont'd

| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL–PRF–55365/11 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |
|---|---|---|---|---|---|---|---|---|
| VDC | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Max/5 Min | % @ 20°C 120 Hz Max | Ω @ +20°C 100 kHz Max | Reflow Temperature ≤ 260°C |
| 25 | 22 | X/2824 | T419X226(1)025(2)(3)(4) | CWR19K(3)226(1)(2)X(5) | 6.0 | 6.0 | 0.9 | 1 |
| 25 | 33 | H/2915 | T419H336(1)025(2)(3)(4) | CWR19K(3)336(1)(2)H(5) | 10.0 | 8.0 | 0.9 | 1 |
| 25 | 33 | X/2824 | T419X336(1)025(2)(3)(4) | CWR19K(3)336(1)(2)X(5) | 10.0 | 8.0 | 0.9 | 1 |
| 35 | 0.33 | A/1005 | T419A334(1)035(2)(3)(4) | CWR19M(3)334(1)(2)A(5) | 1.0 | 6.0 | 22.0 | 1 |
| 35 | 6.8 | G/2711 | T419G685(1)035(2)(3)(4) | CWR19M(3)685(1)(2)G(5) | 3.0 | 6.0 | 1.5 | 1 |
| 35 | 10 | H/2915 | T419H106(1)035(2)(3)(4) | CWR19M(3)106(1)(2)H(5) | 4.0 | 8.0 | 0.9 | 1 |
| 35 | 15 | X/2824 | T419X156(1)035(2)(3)(4) | CWR19M(3)156(1)(2)X(5) | 6.0 | 6.0 | 0.9 | 1 |
| VDC | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Max/5 Min | % @ 20°C 120 Hz Max | Ω @ +20°C 100 kHz Max | Reflow Temperature ≤ 260°C |
| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL–PRF–55365/11 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |

*(1) To complete KEMET/CWR part number, insert M for ±20%, K for ±10%, or J for ±5%. Designates Capacitance tolerance.*

*(2) To complete KEMET/CWR part number, insert failure rate letter per the Ordering Information found on page 2. Designates Reliability Level.*

*(3) To complete KEMET/CWR part number, insert B = Gold Plated, C = Hot solder dipped, H = Solder plated or K = Solder Fused. Designates Termination Finish.*

*(4) To complete KEMET part number, insert 4250 = +25°C after Weibull, 4251 = -55°C +85°C after Weibull, or 4252 = -55°C +85°C before Weibull. Designates Surge current option.*

*(5) To complete CWR part number, insert A = +25°C after Weibull, B = -55°C +85°C after Weibull, C = -55°C +85°C before Weibull or Z = None. Designates Surge current option.*

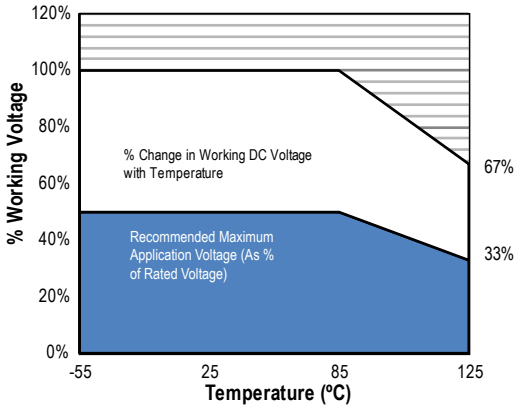
*Refer to Ordering Information for additional detail.*



Roll Over for Order Info.

## Recommended Voltage Derating Guidelines

| | -55°C to 85°C | 85°C to 125°C |
|---|---|---|
| % Change in Working DC Voltage with Temperature | $V_R$ | 67% of $V_R$ |
| Recommended Maximum Application Voltage | 50% of $V_R$ | 33% of $V_R$ |




## 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.

| KEMET Case Code | EIA Case Code | Maximum Power Dissipation (P max) mWatts @ 25°C w/+20°C Rise |
|---|---|---|
| A | 1005 | 50 |
| B | 1505 | 70 |
| C | 2005 | 75 |
| D | 1510 | 80 |
| E | 2010 | 90 |
| F | 2214 | 100 |
| G | 2711 | 125 |
| H | 2915 | 150 |

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

| Temperature Compensation Multipliers for Maximum Power Dissipation | | |
|---|---|---|
| T ≤ 25°C | T ≤ 85°C | T ≤ 125°C |
| 1.00 | 0.90 | 0.40 |

*T= Environmental Temperature*

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

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

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

## Reverse Voltage

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

| Temperature | Permissible Transient Reverse Voltage |
|---|---|
| 25°C | 15% of Rated Voltage |
| 85°C | 5% of Rated Voltage |
| 125°C | 1% of Rated Voltage |

## Table 2 – Land Dimensions/Courtyard

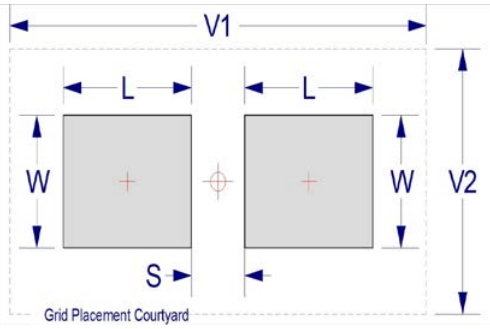
| KEMET | Metric Size Code | Density Level A: Maximum (Most) Land Protrusion (mm) | | | | | Density Level B: Median (Nominal) Land Protrusion (mm) | | | | | Density Level C: Minimum (Least) Land Protrusion (mm) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Case | EIA | L | W | S | V1 | V2 | L | W | S | V1 | V2 | L | W | S | V1 | V2 |
| A[1] | 1005 | 2.19 | 1.44 | 0.15 | 5.54 | 2.66 | 1.89 | 1.32 | 0.15 | 4.44 | 2.16 | 1.52 | 1.22 | 0.29 | 3.58 | 1.90 |
| B | 1505 | 2.30 | 1.44 | 1.20 | 6.80 | 2.66 | 1.90 | 1.32 | 1.40 | 5.70 | 2.16 | 1.52 | 1.22 | 1.56 | 4.84 | 1.90 |
| C | 2005 | 2.30 | 1.44 | 2.47 | 8.08 | 2.66 | 1.90 | 1.32 | 2.67 | 6.98 | 2.16 | 1.52 | 1.22 | 2.83 | 6.12 | 1.90 |
| D | 1510 | 2.30 | 2.58 | 1.20 | 6.80 | 3.92 | 1.90 | 2.46 | 1.40 | 5.70 | 3.42 | 1.52 | 2.36 | 1.56 | 4.84 | 3.16 |
| E | 2010 | 2.30 | 2.58 | 2.47 | 8.08 | 3.92 | 1.90 | 2.46 | 2.67 | 6.98 | 3.42 | 1.52 | 2.36 | 2.83 | 6.12 | 3.16 |
| F | 2214 | 2.30 | 3.47 | 2.98 | 8.58 | 4.82 | 1.90 | 3.35 | 3.18 | 7.48 | 4.32 | 1.52 | 3.25 | 3.34 | 6.62 | 4.06 |
| G | 2711 | 2.81 | 2.84 | 3.10 | 9.72 | 4.18 | 2.41 | 2.72 | 3.30 | 8.62 | 3.68 | 2.03 | 2.62 | 3.46 | 7.76 | 3.42 |
| H | 2915 | 2.81 | 3.84 | 3.61 | 10.24 | 5.20 | 2.41 | 3.72 | 3.81 | 9.14 | 4.70 | 2.03 | 3.62 | 3.97 | 8.28 | 4.44 |
| X | 2824 | 2.73 | 3.22 | 3.46 | 9.92 | 6.80 | 2.33 | 3.10 | 3.66 | 8.82 | 6.30 | 1.95 | 3.00 | 3.82 | 7.96 | 6.04 |

***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 desity 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] Land pattern geometry is too small for silkscreen outline.*



## 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.

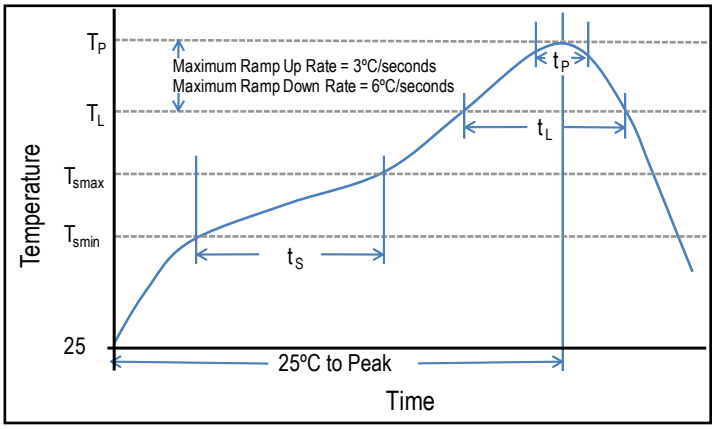
Note that although the X/7343–43 case size can withstand wave soldering, the tall profile (4.3 mm maximum) dictates care in wave process development.

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.

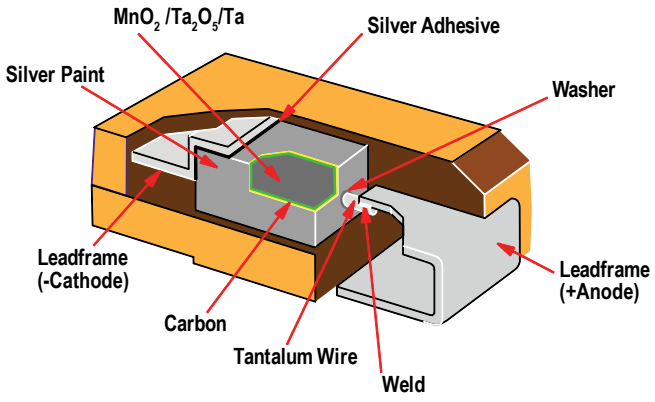
During typical reflow operations, a slight darkening of the gold-colored epoxy may be observed. This slight darkening is normal and not harmful to the product. Marking permanency is not affected by this change.

| 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 |

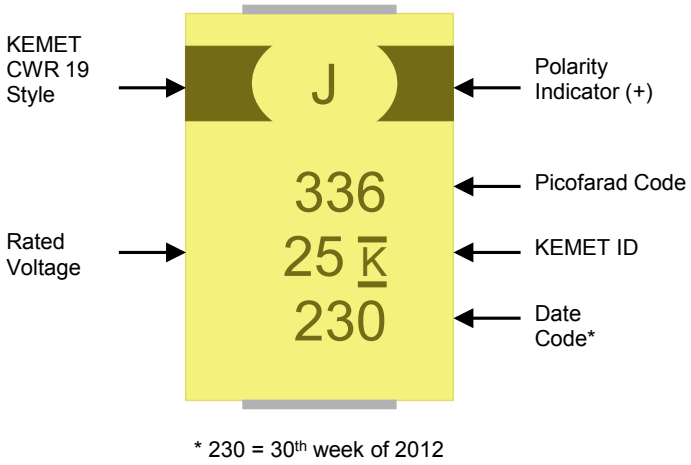
*Note: All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow.*
**Case Size D, E, P, Y, and X*
***Case Size A, B, C, H, I, K, M, R, S, T, U, V, W, and Z*




## Construction



## Capacitor Marking




* 230 = 30th week of 2012

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

## Storage

Tantalum chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature– reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 40ºC and maximum storage humidity not exceed 60% relative humidity. Temperature fluctuations should be minimized to avoid condensation on the parts and atmospheres should be free of chlorine and sulphur bearing compounds. For optimized solderability chip stock should be used promptly, preferably within three years of receipt.

# T429 Series CWR29 Style MIL–PRF–55365/11

## Overview

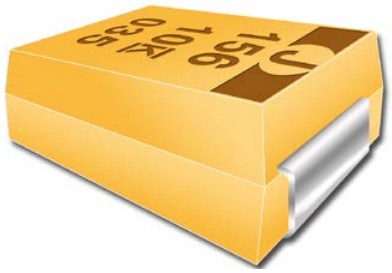
The KEMET T429 Series is approved to MIL–PRF–55365/11 (CWR290) with Weibull failure rates of B level (0.1% failures per 1,000 hours), C level (0.01% failures per 1,000 hours), D level (0.001% failures per 1,000 hours), or T level (0.01% failures per 1,000 hours, Option C surge current, DPA, Radiographic inspection, 100% visual inspection, DCL and ESR measurements within +3 standard deviations, and Group C inspection). This CWR29 product is a precision-molded device with compliant terminations and indelible laser marking. Tape and reeling per EIA 481–1 is standard.

## Benefits

- Established reliability options
- Taped and reeled per EIA 481–1
- Symmetrical, compliant terminations
- Laser-marked case
- 100% surge current test available on all case sizes
- Qualified to MIL–PRF–55365/11, Style CWR29
- Termination options B, C, H, K
- Weibull failure options B, C, D, and T
- Exponential failure rates M, P, R, S
- Voltage rating of 4 – 50 VDC
- Operating temperature range of -55˚C to +125˚C

## Applications

Typical applications include decoupling and filtering in military and aerospace applications requiring CWR29 devices.



## Environmental Compliance

RoHS Compliant (6/6) according to Directive 2002/95/EC when ordered with 100% Sn Solder.

RoHS Compliant

## SPICE

For a detailed analysis of specific part numbers, please visit 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.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## KEMET Ordering Information

| T | 429 | A | 225 | K | 004 | A | H | 4251 | 7280 |
|---|---|---|---|---|---|---|---|---|---|
| Capacitor Class | Series | Case Size | Capacitance Code (pF) | Capacitance Tolerance | Voltage | Failure Rate/Design | Lead Material | Surge | Packaging (C-Spec) |
| T = Tantalum | CWR29 Established Reliability | A, B, C, D, E, F, G, H, X | First two digits represent significant figures. Third digit specifies number of zeros. | J = ±5%<br>K = ±10%<br>M = ±20% | 004 = 4 V<br>006 = 6.3 V<br>010 = 10 V<br>015 = 15 V<br>020 = 20 V<br>025 = 25 V<br>035 = 35 V<br>050 = 50 V | Weibull<br>A = non-ER<br>B = (0.1%/1,000 hours)<br>C = (0.01%/1,000 hours)<br>D =(0.001%/1,000 hours)<br>T = (0.01%/1,000 hours)<br>Exponential<br>M = (1.0%/1,000 hours)<br>P = (0.1%/1,000 hours)<br>R = (0.01%/1,000 hours)<br>S =(0.001%/1,000 hours) | C = Hot Solder Dipped<br>H = Standard Solder Coated (SnPb 5% Pb minimum)<br>B = Gold Plated<br>K = Solder Fused | Blank = No surge<br>4250= 25°C after Weibull<br>4251 = -55°C and 85°C after Weibull<br>4252 = -55°C and 85°C before Weibull<br>TLVL= Weibull Grade Level "T" | Blank = 7" Reel<br>7280 = 13" Reel<br>7610 = Bag<br>7005 = Moisture bags |

## Defense MIL–PRF–55365/11 Ordering Information

| CWR29 | K | H | 225 | K | C | D | A |
|---|---|---|---|---|---|---|---|
| Capacitor Style | Voltage | Termination Finish | Capacitance Code (pF) | Capacitance Tolerance | Reliability Level | Case Code | Surge Current Option |
| Per MIL–PRF–55365/11 | C = 4 V<br>D = 6 V<br>F = 10 V<br>H = 15 V<br>J = 20 V<br>K = 25 V<br>M = 35 V<br>N = 50 V | B = Gold Plated<br>C = Hot solder dipped<br>H = Solder Plated<br>K = Solder fused | First two digits represent significant figures. Third digit specifies number of zeros. | J = ±5%<br>K = ±10%<br>M = ±20% | Weibull<br>A = non-ER<br>B = (0.1%/1,000 hours)<br>C = (0.01%/1,000 hours)<br>D =(0.001%/1,000 hours)<br>T = T Level* (0.01%/1,000 hours)<br>Exponential<br>M = (1.0%/1,000 hours)<br>P = (0.1%/1,000 hours)<br>R = (0.01%/1,000 hours)<br>S =(0.001%/1,000 hours) | A, B, C, D, E, F, G, H, X | A = +25°C after Weibull<br>B = -55°C +85°C after Weibull<br>C = -55°C +85°C before Weibull<br>Z = None |

** When T Level is ordered, no Surge Current Option is needed*

## Performance Characteristics

| Item | Performance Characteristics |
|---|---|
| Operating Temperature | -55°C to 125°C |
| Rated Capacitance Range | 0.1 – 330 µF @ 120 Hz/25°C |
| Capacitance Tolerance | J Tolerance (5%), K Tolerance (10%), M Tolerance (20%) |
| Rated Voltage Range | 4 – 50 V |
| DF (120 Hz) | Refer to Part Number Electrical Specification Table |
| ESR (100 kHz) | Refer to Part Number Electrical Specification Table |
| Leakage Current | ≤ 0.01 CV (µA) at rated voltage after 5 minutes |

## Qualification

| Test | Condition | | Characteristics | | | |
|---|---|---|---|---|---|---|
| Endurance | 85°C @ rated voltage, 2,000 hours<br>125°C @ 2/3 rated voltage, 2,000 hours | | Δ C/C | Within ±10% of initial value | | |
| | | | DF | Within initial limits | | |
| | | | DCL | Within 1.25 x initial limit | | |
| | | | ESR | Within initial limits | | |
| Storage Life | 125°C @ 0 volts, 2,000 hours | | Δ C/C | Within ±10% of initial value | | |
| | | | DF | Within initial limits | | |
| | | | DCL | Within 1.25 x initial limit | | |
| | | | ESR | Within initial limits | | |
| Thermal Shock | MIL–STD–202, Method 107, Condition B, mounted, -55°C to 125°C, 1,000 cycles | | Δ C/C | Within ±5% of initial value | | |
| | | | DF | Within initial limits | | |
| | | | DCL | Within 1.25 x initial limit | | |
| | | | ESR | Within initial limits | | |
| 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* | ±10% | ±10% | ±20% |
| | | DF | IL | IL | 1.5 x IL | 1.5 x IL |
| | | DCL | IL | n/a | 10 x IL | 12 x IL |
| Surge Voltage | 25°C and 85°C, 1.32 x rated voltage 1,000 cycles (125°C, 1.2 x rated voltage) | | Δ C/C | Within ±5% 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–55365/11 | Please contact KEMET for more information. | | | | | |

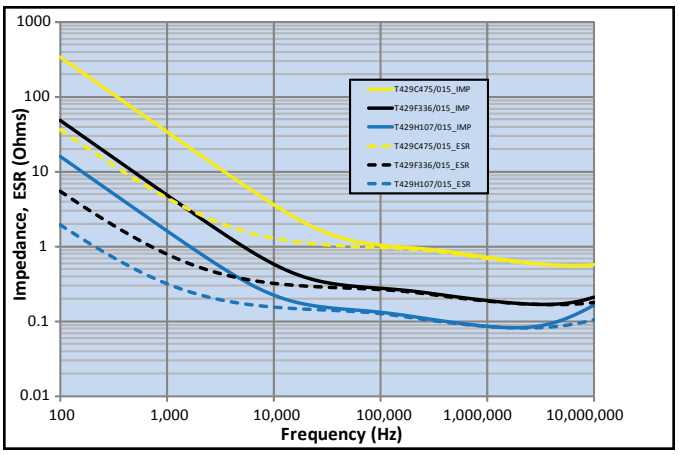
**IL = Initial limit*

## Certification

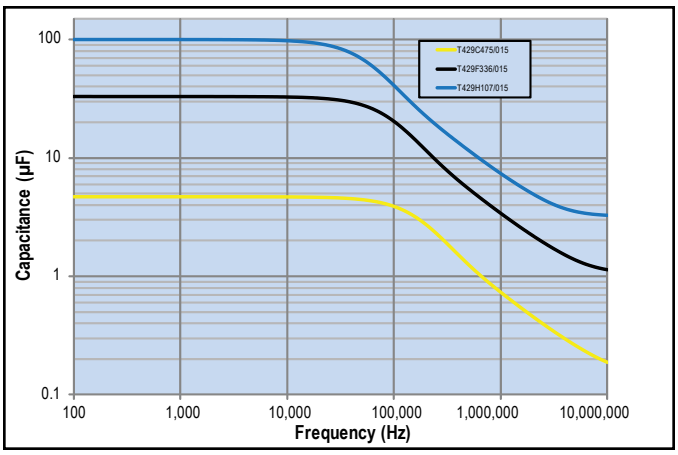
MIL–PRF–55365/11

## Electrical Characteristics

### ESR vs. Frequency

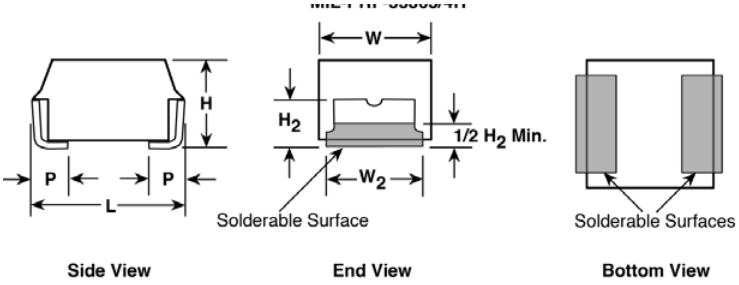



### Capacitance vs. Frequency




## Dimensions – Millimeters (Inches)

Metric will govern




| Case Size | Component | | | | | |
|---|---|---|---|---|---|---|
| KEMET | L* ±0.38 (0.015) | W* ±0.38 (0.015) | H* ±0.38 (0.015) | P +0.25 (0.010), -0.13 (0.005) | $W_2$ | $H_2$ Minimum |
| A | 2.54 (0.100) | 1.27 (0.050) | 1.27 (0.050) | 0.76 (0.030) | 1.27 ±0.13 (0.050 ±0.005) | 0.76 (0.030) |
| B | 3.81 (0.150) | 1.27 (0.050) | 1.27 (0.050) | 0.76 (0.030) | 1.27 ±0.13 (0.050 ±0.005) | 0.76 (0.030) |
| C | 5.08 (0.200) | 1.27 (0.050) | 1.27 (0.050) | 0.76 (0.030) | 1.27 ±0.13 (0.050 ±0.005) | 0.76 (0.030) |
| D | 3.81 (0.150) | 2.54 (0.100) | 1.27 (0.050) | 0.76 (0.030) | 2.41 +0.13, -0.25 (0.095 +0.005, -0.010) | 0.76 (0.030) |
| E | 5.08 (0.200) | 2.54 (0.100) | 1.27 (0.050) | 0.76 (0.030) | 2.41 +0.13, -0.25 (0.095 +0.005, -0.010) | 0.76 (0.030) |
| F | 5.59 (0.220) | 3.43 (0.135) | 1.78 (0.070) | 0.76 (0.030) | 3.30 ±0.13 (0.130 ±0.005) | 1.02 (0.040) |
| G | 6.73 (0.265) | 2.79 (0.110) | 2.79 (0.110) | 1.27 (0.050) | 2.67 ±0.13 (0.105 ±0.005) | 1.52 (0.060) |
| H | 7.24 (0.285) | 3.81 (0.150) | 2.79 (0.110) | 1.27 (0.050) | 3.68 +0.013, -0.51 (0.145 +0.005, -0.020) | 1.52 (0.060) |
| X | 6.93 (0.273) | 5.41 (0.213) | 2.74 (0.108) | 1.19 (0.047) | 3.05 ±0.13 (0.120 ±0.005) | 1.22 (0.048) |

*Note: When solder coated terminations are required, add an additional 0.38 mm (0.015 inch) to the above tolerances for "L", "W", "H", "P" ,"$W_2$" and "$H_2$"*

## Table 1 – Ratings & Part Number Reference

| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL–PRF–55365/11 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |
|---|---|---|---|---|---|---|---|---|
| VDC | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Max/5 Min | % @ +20°C 120 Hz Max | Ω @ +20°C 100 kHz Max | Reflow Temperature ≤ 260°C |
| 4 | 2.2 | A/1005 | T429A225(1)004(2)(3)(4) | CWR29C(3)225(1)(2)A(5) | 1.0 | 6.0 | 4.0 | 1 |
| 4 | 3.3 | A/1005 | T429A335(1)004(2)(3)(4) | CWR29C(3)335(1)(2)A(5) | 1.0 | 6.0 | 6.0 | 1 |
| 4 | 4.7 | A/1005 | T429A475(1)004(2)(3)(4) | CWR29C(3)475(1)(2)A(5) | 1.0 | 6.0 | 6.0 | 1 |
| 4 | 4.7 | B/1505 | T429B475(1)004(2)(3)(4) | CWR29C(3)475(1)(2)B(5) | 1.0 | 6.0 | 3.2 | 1 |
| 4 | 6.8 | A/1005 | T429A685(1)004(2)(3)(4) | CWR29C(3)685(1)(2)A(5) | 1.0 | 6.0 | 6.0 | 1 |
| 4 | 6.8 | C/2005 | T429C685(1)004(2)(3)(4) | CWR29C(3)685(1)(2)C(5) | 1.0 | 6.0 | 2.2 | 1 |
| 4 | 10 | B/1505 | T429B106(1)004(2)(3)(4) | CWR29C(3)106(1)(2)B(5) | 1.0 | 8.0 | 3.2 | 1 |
| 4 | 10 | D/1510 | T429D106(1)004(2)(3)(4) | CWR29C(3)106(1)(2)D(5) | 1.0 | 8.0 | 1.3 | 1 |
| 4 | 15 | B/1505 | T429B156(1)004(2)(3)(4) | CWR29C(3)156(1)(2)B(5) | 1.0 | 8.0 | 3.2 | 1 |
| 4 | 15 | E/2010 | T429E156(1)004(2)(3)(4) | CWR29C(3)156(1)(2)E(5) | 1.0 | 8.0 | 1.0 | 1 |
| 4 | 22 | B/1505 | T429B226(1)004(2)(3)(4) | CWR29C(3)226(1)(2)B(5) | 1.0 | 8.0 | 3.2 | 1 |
| 4 | 22 | D/1510 | T429D226(1)004(2)(3)(4) | CWR29C(3)226(1)(2)D(5) | 1.0 | 8.0 | 1.3 | 1 |
| 4 | 33 | D/1510 | T429D336(1)004(2)(3)(4) | CWR29C(3)336(1)(2)D(5) | 2.0 | 8.0 | 1.3 | 1 |
| 4 | 33 | E/2010 | T429E336(1)004(2)(3)(4) | CWR29C(3)336(1)(2)E(5) | 2.0 | 8.0 | 0.9 | 1 |
| 4 | 33 | F/2214 | T429F336(1)004(2)(3)(4) | CWR29C(3)336(1)(2)F(5) | 2.0 | 8.0 | 0.6 | 1 |
| 4 | 47 | E/2010 | T429E476(1)004(2)(3)(4) | CWR29C(3)476(1)(2)E(5) | 2.0 | 8.0 | 0.9 | 1 |
| 4 | 68 | E/2010 | T429E686(1)004(2)(3)(4) | CWR29C(3)686(1)(2)E(5) | 3.0 | 8.0 | 0.9 | 1 |
| 4 | 68 | G/2711 | T429G686(1)004(2)(3)(4) | CWR29C(3)686(1)(2)G(5) | 3.0 | 10.0 | 0.275 | 1 |
| 4 | 100 | F/2214 | T429F107(1)004(2)(3)(4) | CWR29C(3)107(1)(2)F(5) | 4.0 | 10.0 | 0.55 | 1 |
| 4 | 100 | H/2915 | T429H107(1)004(2)(3)(4) | CWR29C(3)107(1)(2)H(5) | 4.0 | 10.0 | 0.18 | 1 |
| 4 | 150 | G/2711 | T429G157(1)004(2)(3)(4) | CWR29C(3)157(1)(2)H(5) | 6.0 | 10.0 | 0.25 | 1 |
| 4 | 220 | H/2915 | T429H227(1)004(2)(3)(4) | CWR29C(3)227(1)(2)H(5) | 8.0 | 10.0 | 0.20 | 1 |
| 4 | 330 | H/2915 | T429H337(1)004(2)(3)(4) | CWR29C(3)337(1)(2)H(5) | 10.0 | 10.0 | 0.18 | 1 |
| 6 | 1.5 | A/1005 | T429A155(1)006(2)(3)(4) | CWR29D(3)155(1)(2)A(5) | 1.0 | 6.0 | 4.0 | 1 |
| 6 | 3.3 | A/1005 | T429A335(1)006(2)(3)(4) | CWR29D(3)335(1)(2)A(5) | 1.0 | 6.0 | 6.0 | 1 |
| 6 | 3.3 | B/1505 | T429B335(1)006(2)(3)(4) | CWR29D(3)335(1)(2)B(5) | 1.0 | 6.0 | 3.2 | 1 |
| 6 | 4.7 | A/1005 | T429A475(1)006(2)(3)(4) | CWR29D(3)475(1)(2)A(5) | 1.0 | 6.0 | 6.0 | 1 |
| 6 | 4.7 | C/2005 | T429C475(1)006(2)(3)(4) | CWR29D(3)475(1)(2)C(5) | 1.0 | 6.0 | 2.2 | 1 |
| 6 | 6.8 | B/1505 | T429B685(1)006(2)(3)(4) | CWR29D(3)685(1)(2)B(5) | 1.0 | 6.0 | 3.2 | 1 |
| 6 | 6.8 | D/1510 | T429D685(1)006(2)(3)(4) | CWR29D(3)685(1)(2)D(5) | 1.0 | 6.0 | 1.5 | 1 |
| 6 | 10 | B/1505 | T429B106(1)006(2)(3)(4) | CWR29D(3)106(1)(2)B(5) | 1.0 | 6.0 | 3.2 | 1 |
| 6 | 10 | E/2010 | T429E106(1)006(2)(3)(4) | CWR29D(3)106(1)(2)E(5) | 1.0 | 8.0 | 1.0 | 1 |
| 6 | 15 | B/1505 | T429B156(1)006(2)(3)(4) | CWR29D(3)156(1)(2)B(5) | 1.0 | 8.0 | 3.2 | 1 |
| 6 | 15 | D/1510 | T429D156(1)006(2)(3)(4) | CWR29D(3)156(1)(2)D(5) | 1.0 | 8.0 | 1.7 | 1 |
| 6 | 15 | E/2010 | T429E156(1)006(2)(3)(4) | CWR29D(3)156(1)(2)E(5) | 1.0 | 8.0 | 0.9 | 1 |
| 6 | 22 | D/1510 | T429D226(1)006(2)(3)(4) | CWR29D(3)226(1)(2)D(5) | 1.0 | 6.0 | 1.7 | 1 |
| 6 | 22 | E/2010 | T429E226(1)006(2)(3)(4) | CWR29D(3)226(1)(2)E(5) | 2.0 | 8.0 | 1.0 | 1 |
| 6 | 22 | F/2214 | T429F226(1)006(2)(3)(4) | CWR29D(3)226(1)(2)F(5) | 2.0 | 8.0 | 0.6 | 1 |
| 6 | 33 | E/2010 | T429E336(1)006(2)(3)(4) | CWR29D(3)336(1)(2)E(5) | 2.0 | 6.0 | 1.0 | 1 |
| 6 | 47 | F/2214 | T429F476(1)006(2)(3)(4) | CWR29D(3)476(1)(2)F(5) | 3.0 | 8.0 | 1.0 | 1 |
| 6 | 47 | G/2711 | T429G476(1)006(2)(3)(4) | CWR29D(3)476(1)(2)G(5) | 3.0 | 10.0 | 0.275 | 1 |
| 6 | 68 | F/2214 | T429F686(1)006(2)(3)(4) | CWR29D(3)686(1)(2)F(5) | 4.0 | 10.0 | 0.4 | 1 |
| 6 | 68 | G/2711 | T429G686(1)006(2)(3)(4) | CWR29D(3)686(1)(2)G(5) | 4.0 | 10.0 | 0.25 | 1 |
| 6 | 68 | H/2915 | T429H686(1)006(2)(3)(4) | CWR29D(3)686(1)(2)H(5) | 4.0 | 10.0 | 0.18 | 1 |
| 6 | 100 | G/2711 | T429G107(1)006(2)(3)(4) | CWR29D(3)107(1)(2)G(5) | 6.0 | 10.0 | 0.275 | 1 |
| 6 | 150 | G/2711 | T429G157(1)006(2)(3)(4) | CWR29D(3)157(1)(2)G(5) | 10.0 | 10.0 | 0.275 | 1 |
| 6 | 220 | H/2915 | T429H227(1)006(2)(3)(4) | CWR29D(3)227(1)(2)H(5) | 10.0 | 10.0 | 0.18 | 1 |
| 6 | 330 | H/2915 | T429H337(1)006(2)(3)(4) | CWR29D(3)337(1)(2)H(5) | 20.0 | 10.0 | 0.18 | 1 |
| VDC | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Max/5 Min | % @ +20°C 120 Hz Max | Ω @ +20°C 100 kHz Max | Reflow Temperature ≤ 260°C |
| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL-PRF-55365/11 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |

*(1) To complete KEMET/CWR part number, insert M for ±20%, K for ±10%, or J for ±5%. Designates Capacitance tolerance.*

*(2) To complete KEMET/CWR part number, insert failure rate letter per the Ordering Information found on page 2. Designates Reliability Level.*

*(3) To complete KEMET/CWR part number, insert B = Gold Plated, C = Hot solder dipped, H = Solder plated or K = Solder Fused. Designates Termination Finish.*

*(4) To complete KEMET part number, insert 4250 = +25°C after Weibull, 4251 = -55°C +85°C after Weibull, or 4252 = -55°C +85°C before Weibull. Designates Surge current option.*

*(5) To complete CWR part number, insert A = +25°C after Weibull, B = -55°C +85°C after Weibull, C = -55°C +85°C before Weibull or Z = None. Designates Surge current option.*

*Refer to Ordering Information for additional detail.*



Roll Over for Order Info.

## Table 1 – Ratings & Part Number Reference cont'd

| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL–PRF–55365/11 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |
|---|---|---|---|---|---|---|---|---|
| VDC | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Max/5 Min | % @ +20°C 120 Hz Max | Ω @ +20°C 100 kHz Max | Reflow Temperature ≤ 260°C |
| 10 | 1 | A/1005 | T429A105(1)010(2)(3)(4) | CWR29F(3)105(1)(2)A(5) | 1.0 | 6.0 | 5.0 | 1 |
| 10 | 2.2 | A/1005 | T429A225(1)010(2)(3)(4) | CWR29F(3)225(1)(2)A(5) | 1.0 | 6.0 | 6.0 | 1 |
| 10 | 2.2 | B/1505 | T429B225(1)010(2)(3)(4) | CWR29F(3)225(1)(2)B(5) | 1.0 | 6.0 | 3.2 | 1 |
| 10 | 3.3 | A/1005 | T429A335(1)010(2)(3)(4) | CWR29F(3)335(1)(2)A(5) | 1.0 | 6.0 | 6.0 | 1 |
| 10 | 3.3 | C/2005 | T429C335(1)010(2)(3)(4) | CWR29F(3)335(1)(2)C(5) | 1.0 | 6.0 | 2.2 | 1 |
| 10 | 4.7 | B/1505 | T429B475(1)010(2)(3)(4) | CWR29F(3)475(1)(2)B(5) | 1.0 | 6.0 | 3.2 | 1 |
| 10 | 4.7 | C/2005 | T429C475(1)010(2)(3)(4) | CWR29F(3)475(1)(2)C(5) | 1.0 | 6.0 | 2.2 | 1 |
| 10 | 4.7 | D/1510 | T429D475(1)010(2)(3)(4) | CWR29F(3)475(1)(2)D(5) | 1.0 | 6.0 | 1.5 | 1 |
| 10 | 6.8 | B/1505 | T429B685(1)010(2)(3)(4) | CWR29F(3)685(1)(2)B(5) | 1.0 | 6.0 | 3.2 | 1 |
| 10 | 6.8 | C/2005 | T429C685(1)010(2)(3)(4) | CWR29F(3)685(1)(2)C(5) | 1.0 | 6.0 | 2.2 | 1 |
| 10 | 6.8 | D/1510 | T429D685(1)010(2)(3)(4) | CWR29F(3)685(1)(2)D(5) | 1.0 | 6.0 | 1.7 | 1 |
| 10 | 6.8 | E/2010 | T429E685(1)010(2)(3)(4) | CWR29F(3)685(1)(2)E(5) | 1.0 | 6.0 | 1.0 | 1 |
| 10 | 10 | B/1505 | T429B106(1)010(2)(3)(4) | CWR29F(3)106(1)(2)B(5) | 1.0 | 8.0 | 3.2 | 1 |
| 10 | 10 | C/2005 | T429C106(1)010(2)(3)(4) | CWR29F(3)106(1)(2)C(5) | 1.0 | 6.0 | 2.2 | 1 |
| 10 | 10 | D/1510 | T429D106(1)010(2)(3)(4) | CWR29F(3)106(1)(2)D(5) | 1.0 | 6.0 | 1.3 | 1 |
| 10 | 10 | E/2010 | T429E106(1)010(2)(3)(4) | CWR29F(3)106(1)(2)E(5) | 1.0 | 6.0 | 1.0 | 1 |
| 10 | 15 | D/1510 | T429D156(1)010(2)(3)(4) | CWR29F(3)156(1)(2)D(5) | 2.0 | 6.0 | 1.7 | 1 |
| 10 | 15 | E/2010 | T429E156(1)010(2)(3)(4) | CWR29F(3)156(1)(2)E(5) | 2.0 | 8.0 | 0.9 | 1 |
| 10 | 15 | F/2214 | T429F156(1)010(2)(3)(4) | CWR29F(3)156(1)(2)F(5) | 2.0 | 8.0 | 0.7 | 1 |
| 10 | 22 | E/2010 | T429E226(1)010(2)(3)(4) | CWR29F(3)226(1)(2)E(5) | 3.0 | 8.0 | 0.6 | 1 |
| 10 | 33 | F/2214 | T429F336(1)010(2)(3)(4) | CWR29F(3)336(1)(2)F(5) | 3.0 | 8.0 | 0.4 | 1 |
| 10 | 33 | G/2711 | T429G336(1)010(2)(3)(4) | CWR29F(3)336(1)(2)G(5) | 3.0 | 10.0 | 0.275 | 1 |
| 10 | 47 | F/2214 | T429F476(1)010(2)(3)(4) | CWR29F(3)476(1)(2)F(5) | 4.0 | 10.0 | 0.4 | 1 |
| 10 | 47 | G/2711 | T429G476(1)010(2)(3)(4) | CWR29F(3)476(1)(2)G(5) | 4.0 | 10.0 | 0.25 | 1 |
| 10 | 47 | H/2915 | T429H476(1)010(2)(3)(4) | CWR29F(3)476(1)(2)H(5) | 5.0 | 10.0 | 0.18 | 1 |
| 10 | 68 | G/2711 | T429G686(1)010(2)(3)(4) | CWR29F(3)686(1)(2)G(5) | 6.0 | 10.0 | 0.275 | 1 |
| 10 | 100 | G/2711 | T429G107(1)010(2)(3)(4) | CWR29F(3)107(1)(2)G(5) | 10.0 | 10.0 | 0.275 | 1 |
| 10 | 100 | H/2915 | T429H107(1)010(2)(3)(4) | CWR29F(3)107(1)(2)H(5) | 10.0 | 10.0 | 0.18 | 1 |
| 10 | 150 | H/2915 | T429H157(1)010(2)(3)(4) | CWR29F(3)157(1)(2)H(5) | 15.0 | 10.0 | 0.18 | 1 |
| 10 | 150 | X/2824 | T429X157(1)010(2)(3)(4) | CWR29F(3)157(1)(2)X(5) | 15.0 | 10.0 | 0.065 | 1 |
| 10 | 220 | H/2915 | T429H227(1)010(2)(3)(4) | CWR29F(3)227(1)(2)H(5) | 20.0 | 10.0 | 0.18 | 1 |
| 15 | 0.68 | A/1005 | T429A684(1)015(2)(3)(4) | CWR29H(3)684(1)(2)A(5) | 1.0 | 6.0 | 6.0 | 1 |
| 15 | 1 | A/1005 | T429A105(1)015(2)(3)(4) | CWR29H(3)105(1)(2)A(5) | 1.0 | 6.0 | 7.5 | 1 |
| 15 | 1.5 | A/1005 | T429A155(1)015(2)(3)(4) | CWR29H(3)155(1)(2)A(5) | 1.0 | 6.0 | 7.5 | 1 |
| 15 | 1.5 | B/1505 | T429B155(1)015(2)(3)(4) | CWR29H(3)155(1)(2)B(5) | 1.0 | 6.0 | 3.2 | 1 |
| 15 | 2.2 | A/1005 | T429A225(1)015(2)(3)(4) | CWR29H(3)225(1)(2)A(5) | 1.0 | 6.0 | 7.5 | 1 |
| 15 | 2.2 | C/2005 | T429C225(1)015(2)(3)(4) | CWR29H(3)225(1)(2)C(5) | 1.0 | 6.0 | 2.2 | 1 |
| 15 | 3.3 | B/1505 | T429B335(1)015(2)(3)(4) | CWR29H(3)335(1)(2)B(5) | 1.0 | 6.0 | 3.6 | 1 |
| 15 | 3.3 | D/1510 | T429D335(1)015(2)(3)(4) | CWR29H(3)335(1)(2)D(5) | 1.0 | 6.0 | 1.7 | 1 |
| 15 | 4.7 | B/1505 | T429B475(1)015(2)(3)(4) | CWR29H(3)475(1)(2)B(5) | 1.0 | 6.0 | 2.0 | 1 |
| 15 | 4.7 | C/2005 | T429C475(1)015(2)(3)(4) | CWR29H(3)475(1)(2)C(5) | 1.0 | 6.0 | 2.2 | 1 |
| 15 | 4.7 | D/1510 | T429D475(1)015(2)(3)(4) | CWR29H(3)475(1)(2)D(5) | 1.0 | 6.0 | 2.0 | 1 |
| 15 | 4.7 | E/2010 | T429E475(1)015(2)(3)(4) | CWR29H(3)475(1)(2)E(5) | 1.0 | 6.0 | 1.2 | 1 |
| 15 | 6.8 | D/1510 | T429D685(1)015(2)(3)(4) | CWR29H(3)685(1)(2)D(5) | 1.0 | 6.0 | 2.0 | 1 |
| 15 | 6.8 | E/2010 | T429E685(1)015(2)(3)(4) | CWR29H(3)685(1)(2)E(5) | 1.0 | 8.0 | 0.9 | 1 |
| 15 | 10 | D/1510 | T429D106(1)015(2)(3)(4) | CWR29H(3)106(1)(2)D(5) | 2.0 | 6.0 | 2.0 | 1 |
| 15 | 10 | E/2010 | T429E106(1)015(2)(3)(4) | CWR29H(3)106(1)(2)E(5) | 2.0 | 6.0 | 1.2 | 1 |
| 15 | 10 | F/2214 | T429F106(1)015(2)(3)(4) | CWR29H(3)106(1)(2)F(5) | 2.0 | 6.0 | 0.667 | 1 |
| VDC | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Max/5 Min | % @ +20°C 120 Hz Max | Ω @ +20°C 100 kHz Max | Reflow Temperature ≤ 260°C |
| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL-PRF-55365/11 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |

*(1) To complete KEMET/CWR part number, insert M for ±20%, K for ±10%, or J for ±5%. Designates Capacitance tolerance.*

*(2) To complete KEMET/CWR part number, insert failure rate letter per the Ordering Information found on page 2. Designates Reliability Level.*

*(3) To complete KEMET/CWR part number, insert B = Gold Plated, C = Hot solder dipped, H = Solder plated or K = Solder Fused. Designates Termination Finish.*

*(4) To complete KEMET part number, insert 4250 = +25°C after Weibull, 4251 = -55°C +85°C after Weibull, or 4252 = -55°C +85°C before Weibull. Designates Surge current option.*

*(5) To complete CWR part number, insert A = +25°C after Weibull, B = -55°C +85°C after Weibull, C = -55°C +85°C before Weibull or Z = None. Designates Surge current option.*

*Refer to Ordering Information for additional detail.*



Roll Over for Order Info.

## Table 1 – Ratings & Part Number Reference cont'd

| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL–PRF–55365/11 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |
|---|---|---|---|---|---|---|---|---|
| VDC | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Max/5 Min | % @ +20°C 120 Hz Max | Ω @ +20°C 100 kHz Max | Reflow Temperature ≤ 260°C |
| 15 | 15 | E/2010 | T429E156(1)015(2)(3)(4) | CWR29H(3)156(1)(2)E(5) | 2.0 | 6.0 | 1.2 | 1 |
| 15 | 15 | F/2214 | T429F156(1)015(2)(3)(4) | CWR29H(3)156(1)(2)F(5) | 2.0 | 8.0 | 0.8 | 1 |
| 15 | 22 | F/2214 | T429F226(1)015(2)(3)(4) | CWR29H(3)226(1)(2)F(5) | 3.0 | 8.0 | 0.8 | 1 |
| 15 | 22 | G/2711 | T429G226(1)015(2)(3)(4) | CWR29H(3)226(1)(2)G(5) | 4.0 | 6.0 | 0.3 | 1 |
| 15 | 33 | F/2214 | T429F336(1)015(2)(3)(4) | CWR29H(3)336(1)(2)F(5) | 5.0 | 6.0 | 0.8 | 1 |
| 15 | 33 | G/2711 | T429G336(1)015(2)(3)(4) | CWR29H(3)336(1)(2)G(5) | 6.0 | 8.0 | 0.3 | 1 |
| 15 | 33 | H/2915 | T429H336(1)015(2)(3)(4) | CWR29H(3)336(1)(2)H(5) | 5.0 | 8.0 | 0.2 | 1 |
| 15 | 47 | G/2711 | T429G476(1)015(2)(3)(4) | CWR29H(3)476(1)(2)G(5) | 10.0 | 8.0 | 0.3 | 1 |
| 15 | 47 | H/2915 | T429H476(1)015(2)(3)(4) | CWR29H(3)476(1)(2)H(5) | 10.0 | 8.0 | 0.2 | 1 |
| 15 | 68 | G/2711 | T429G686(1)015(2)(3)(4) | CWR29H(3)686(1)(2)G(5) | 10.0 | 8.0 | 0.3 | 1 |
| 15 | 68 | H/2915 | T429H686(1)015(2)(3)(4) | CWR29H(3)686(1)(2)H(5) | 10.0 | 8.0 | 0.2 | 1 |
| 15 | 100 | H/2915 | T429H107(1)015(2)(3)(4) | CWR29H(3)107(1)(2)H(5) | 15.0 | 10.0 | 0.2 | 1 |
| 20 | 0.47 | A/1005 | T429A474(1)020(2)(3)(4) | CWR29J(3)474(1)(2)A(5) | 1.0 | 8.0 | 7.5 | 1 |
| 20 | 0.68 | A/1005 | T429A684(1)020(2)(3)(4) | CWR29J(3)684(1)(2)A(5) | 1.0 | 6.0 | 7.5 | 1 |
| 20 | 0.68 | B/1505 | T429B684(1)020(2)(3)(4) | CWR29J(3)684(1)(2)B(5) | 1.0 | 6.0 | 5.6 | 1 |
| 20 | 1 | A/1005 | T429A105(1)020(2)(3)(4) | CWR29J(3)105(1)(2)A(5) | 1.0 | 6.0 | 7.5 | 1 |
| 20 | 1 | B/1505 | T429B105(1)020(2)(3)(4) | CWR29J(3)105(1)(2)B(5) | 1.0 | 6.0 | 4.8 | 1 |
| 20 | 1.5 | B/1505 | T429B155(1)020(2)(3)(4) | CWR29J(3)155(1)(2)B(5) | 1.0 | 6.0 | 3.6 | 1 |
| 20 | 1.5 | C/2005 | T429C155(1)020(2)(3)(4) | CWR29J(3)155(1)(2)C(5) | 1.0 | 6.0 | 2.4 | 1 |
| 20 | 2.2 | B/1505 | T429B225(1)020(2)(3)(4) | CWR29J(3)225(1)(2)B(5) | 1.0 | 6.0 | 3.6 | 1 |
| 20 | 2.2 | D/1510 | T429D225(1)020(2)(3)(4) | CWR29J(3)225(1)(2)D(5) | 1.0 | 6.0 | 1.7 | 1 |
| 20 | 3.3 | D/1510 | T429D335(1)020(2)(3)(4) | CWR29J(3)335(1)(2)D(5) | 1.0 | 6.0 | 2.0 | 1 |
| 20 | 3.3 | E/2010 | T429E335(1)020(2)(3)(4) | CWR29J(3)335(1)(2)E(5) | 1.0 | 6.0 | 1.2 | 1 |
| 20 | 4.7 | E/2010 | T429E475(1)020(2)(3)(4) | CWR29J(3)475(1)(2)E(5) | 1.0 | 6.0 | 1.7 | 1 |
| 20 | 6.8 | E/2010 | T429E685(1)020(2)(3)(4) | CWR29J(3)685(1)(2)E(5) | 2.0 | 6.0 | 1.5 | 1 |
| 20 | 6.8 | F/2214 | T429F685(1)020(2)(3)(4) | CWR29J(3)685(1)(2)F(5) | 2.0 | 6.0 | 0.7 | 1 |
| 20 | 10 | E/2010 | T429E106(1)020(2)(3)(4) | CWR29J(3)106(1)(2)E(5) | 2.0 | 6.0 | 1.5 | 1 |
| 20 | 10 | F/2214 | T429F106(1)020(2)(3)(4) | CWR29J(3)106(1)(2)F(5) | 2.0 | 6.0 | 0.8 | 1 |
| 20 | 15 | F/2214 | T429F156(1)020(2)(3)(4) | CWR29J(3)156(1)(2)F(5) | 3.0 | 6.0 | 0.8 | 1 |
| 20 | 15 | G/2711 | T429G156(1)020(2)(3)(4) | CWR29J(3)156(1)(2)G(5) | 3.0 | 6.0 | 0.275 | 1 |
| 20 | 22 | G/2711 | T429G226(1)020(2)(3)(4) | CWR29J(3)226(1)(2)G(5) | 4.0 | 6.0 | 0.625 | 1 |
| 20 | 22 | H/2915 | T429H226(1)020(2)(3)(4) | CWR29J(3)226(1)(2)H(5) | 4.0 | 6.0 | 0.18 | 1 |
| 20 | 33 | H/2915 | T429H336(1)020(2)(3)(4) | CWR29J(3)336(1)(2)H(5) | 6.0 | 8.0 | 0.18 | 1 |
| 20 | 47 | H/2915 | T429H476(1)020(2)(3)(4) | CWR29J(3)476(1)(2)H(5) | 10.0 | 8.0 | 0.18 | 1 |
| 20 | 47 | X/2824 | T429X476(1)020(2)(3)(4) | CWR29J(3)476(1)(2)X(5) | 10.0 | 8.0 | 0.11 | 1 |
| 25 | 0.33 | A/1005 | T429A334(1)025(2)(3)(4) | CWR29K(3)334(1)(2)A(5) | 1.0 | 6.0 | 7.5 | 1 |
| 25 | 0.47 | A/1005 | T429A474(1)025(2)(3)(4) | CWR29K(3)474(1)(2)A(5) | 1.0 | 6.0 | 7.5 | 1 |
| 25 | 0.68 | B/1505 | T429B684(1)025(2)(3)(4) | CWR29K(3)684(1)(2)B(5) | 1.0 | 6.0 | 4.0 | 1 |
| 25 | 1 | B/1505 | T429B105(1)025(2)(3)(4) | CWR29K(3)105(1)(2)B(5) | 1.0 | 6.0 | 4.0 | 1 |
| 25 | 1 | C/2005 | T429C105(1)025(2)(3)(4) | CWR29K(3)105(1)(2)C(5) | 1.0 | 6.0 | 2.6 | 1 |
| 25 | 1.5 | D/1510 | T429D155(1)025(2)(3)(4) | CWR29K(3)155(1)(2)D(5) | 1.0 | 6.0 | 1.7 | 1 |
| 25 | 2.2 | D/1510 | T429D225(1)025(2)(3)(4) | CWR29K(3)225(1)(2)D(5) | 1.0 | 6.0 | 2.0 | 1 |
| 25 | 2.2 | E/2010 | T429E225(1)025(2)(3)(4) | CWR29K(3)225(1)(2)E(5) | 1.0 | 6.0 | 1.0 | 1 |
| 25 | 3.3 | E/2010 | T429E335(1)025(2)(3)(4) | CWR29K(3)335(1)(2)E(5) | 1.0 | 6.0 | 1.2 | 1 |
| 25 | 4.7 | F/2214 | T429F475(1)025(2)(3)(4) | CWR29K(3)475(1)(2)F(5) | 2.0 | 6.0 | 0.7 | 1 |
| 25 | 6.8 | F/2214 | T429F685(1)025(2)(3)(4) | CWR29K(3)685(1)(2)F(5) | 2.0 | 6.0 | 0.8 | 1 |
| 25 | 6.8 | G/2711 | T429G685(1)025(2)(3)(4) | CWR29K(3)685(1)(2)G(5) | 2.0 | 6.0 | 0.3 | 1 |
| 25 | 10 | G/2711 | T429G106(1)025(2)(3)(4) | CWR29K(3)106(1)(2)G(5) | 3.0 | 6.0 | 0.35 | 1 |
| VDC | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Max/5 Min | % @ +20°C 120 Hz Max | Ω @ +20°C 100 kHz Max | Reflow Temperature ≤ 260°C |
| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL-PRF-55365/11 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |

*(1) To complete KEMET/CWR part number, insert M for ±20%, K for ±10%, or J for ±5%. Designates Capacitance tolerance.*

*(2) To complete KEMET/CWR part number, insert failure rate letter per the Ordering Information found on page 2. Designates Reliability Level.*

*(3) To complete KEMET/CWR part number, insert B = Gold Plated, C = Hot solder dipped, H = Solder plated or K = Solder Fused. Designates Termination Finish.*

*(4) To complete KEMET part number, insert 4250 = +25°C after Weibull, 4251 = -55°C +85°C after Weibull, or 4252 = -55°C +85°C before Weibull. Designates Surge current option.*

*(5) To complete CWR part number, insert A = +25°C after Weibull, B = -55°C +85°C after Weibull, C = -55°C +85°C before Weibull or Z = None. Designates Surge current option.*

*Refer to Ordering Information for additional detail.*



Roll Over for Order Info.

## Table 1 – Ratings & Part Number Reference cont'd

| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL–PRF–55365/11 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |
|---|---|---|---|---|---|---|---|---|
| VDC | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Max/5 Min | % @ +20°C 120 Hz Max | Ω @ +20°C 100 kHz Max | Reflow Temperature ≤ 260°C |
| 25 | 15 | G/2711 | T429G156(1)025(2)(3)(4) | CWR29K(3)156(1)(2)G(5) | 4.0 | 6.0 | 0.35 | 1 |
| 25 | 15 | H/2915 | T429H156(1)025(2)(3)(4) | CWR29K(3)156(1)(2)H(5) | 4.0 | 6.0 | 0.2 | 1 |
| 25 | 22 | G/2711 | T429G226(1)025(2)(3)(4) | CWR29K(3)226(1)(2)G(5) | 6.0 | 6.0 | 0.35 | 1 |
| 25 | 22 | H/2915 | T429H226(1)025(2)(3)(4) | CWR29K(3)226(1)(2)H(5) | 6.0 | 6.0 | 0.18 | 1 |
| 25 | 22 | X/2824 | T429X226(1)025(2)(3)(4) | CWR29K(3)226(1)(2)X(5) | 6.0 | 6.0 | 0.16 | 1 |
| 25 | 33 | H/2915 | T429H336(1)025(2)(3)(4) | CWR29K(3)336(1)(2)H(5) | 10.0 | 8.0 | 0.18 | 1 |
| 25 | 33 | X/2824 | T429X336(1)025(2)(3)(4) | CWR29K(3)336(1)(2)X(5) | 10.0 | 8.0 | 0.13 | 1 |
| 35 | 0.22 | A/1005 | T429A224(1)035(2)(3)(4) | CWR29M(3)224(1)(2)A(5) | 1.0 | 6.0 | 12.0 | 1 |
| 35 | 0.33 | A/1005 | T429A334(1)035(2)(3)(4) | CWR29M(3)334(1)(2)A(5) | 1.0 | 6.0 | 12.0 | 1 |
| 35 | 0.47 | B/1505 | T429B474(1)035(2)(3)(4) | CWR29M(3)474(1)(2)B(5) | 1.0 | 6.0 | 6.8 | 1 |
| 35 | 0.68 | C/2005 | T429C684(1)035(2)(3)(4) | CWR29M(3)684(1)(2)C(5) | 1.0 | 6.0 | 4.0 | 1 |
| 35 | 1 | D/1510 | T429D105(1)035(2)(3)(4) | CWR29M(3)105(1)(2)D(5) | 1.0 | 6.0 | 2.2 | 1 |
| 35 | 1.5 | E/2010 | T429E155(1)035(2)(3)(4) | CWR29M(3)155(1)(2)E(5) | 1.0 | 6.0 | 1.3 | 1 |
| 35 | 3.3 | F/2214 | T429F335(1)035(2)(3)(4) | CWR29M(3)335(1)(2)F(5) | 1.0 | 6.0 | 0.7 | 1 |
| 35 | 4.7 | G/2711 | T429G475(1)035(2)(3)(4) | CWR29M(3)475(1)(2)G(5) | 2.0 | 6.0 | 0.375 | 1 |
| 35 | 6.8 | F/2214 | T429F685(1)035(2)(3)(4) | CWR29M(3)685(1)(2)F(5) | 3.0 | 6.0 | 0.375 | 1 |
| 35 | 6.8 | H/2915 | T429H685(1)035(2)(3)(4) | CWR29M(3)685(1)(2)H(5) | 3.0 | 6.0 | 0.5 | 1 |
| 35 | 10 | H/2915 | T429H106(1)035(2)(3)(4) | CWR29M(3)106(1)(2)H(5) | 4.0 | 8.0 | 0.5 | 1 |
| 35 | 15 | X/2824 | T429X156(1)035(2)(3)(4) | CWR29M(3)156(1)(2)X(5) | 6.0 | 6.0 | 0.19 | 1 |
| 50 | 0.1 | A/1005 | T429A104(1)050(2)(3)(4) | CWR29N(3)104(1)(2)A(5) | 1.0 | 6.0 | 12.0 | 1 |
| 50 | 0.15 | A/1005 | T429A154(1)050(2)(3)(4) | CWR29N(3)154(1)(2)A(5) | 1.0 | 6.0 | 12.0 | 1 |
| 50 | 0.22 | B/1505 | T429B224(1)050(2)(3)(4) | CWR29N(3)224(1)(2)B(5) | 1.0 | 6.0 | 6.8 | 1 |
| 50 | 0.33 | B/1505 | T429B334(1)050(2)(3)(4) | CWR29N(3)334(1)(2)B(5) | 1.0 | 6.0 | 4.8 | 1 |
| 50 | 0.47 | C/2005 | T429C474(1)050(2)(3)(4) | CWR29N(3)474(1)(2)C(5) | 1.0 | 6.0 | 3.2 | 1 |
| 50 | 0.68 | D/1510 | T429D684(1)050(2)(3)(4) | CWR29N(3)684(1)(2)D(5) | 1.0 | 6.0 | 2.3 | 1 |
| 50 | 1 | E/2010 | T429E105(1)050(2)(3)(4) | CWR29N(3)105(1)(2)E(5) | 1.0 | 6.0 | 1.7 | 1 |
| 50 | 1.5 | F/2214 | T429F155(1)050(2)(3)(4) | CWR29N(3)155(1)(2)F(5) | 1.0 | 6.0 | 1.1 | 1 |
| 50 | 2.2 | F/2214 | T429F225(1)050(2)(3)(4) | CWR29N(3)225(1)(2)F(5) | 2.0 | 6.0 | 0.7 | 1 |
| 50 | 3.3 | G/2711 | T429G335(1)050(2)(3)(4) | CWR29N(3)335(1)(2)G(5) | 2.0 | 6.0 | 0.5 | 1 |
| 50 | 4.7 | H/2915 | T429H475(1)050(2)(3)(4) | CWR29N(3)475(1)(2)H(5) | 3.0 | 6.0 | 0.5 | 1 |
| VDC | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Max/5 Min | % @ +20°C 120 Hz Max | Ω @ +20°C 100 kHz Max | Reflow Temperature ≤ 260°C |
| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL-PRF-55365/11 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |

*(1) To complete KEMET/CWR part number, insert M for ±20%, K for ±10%, or J for ±5%. Designates Capacitance tolerance.*

*(2) To complete KEMET/CWR part number, insert failure rate letter per the Ordering Information found on page 2. Designates Reliability Level.*

*(3) To complete KEMET/CWR part number, insert B = Gold Plated, C = Hot solder dipped, H = Solder plated or K = Solder Fused. Designates Termination Finish.*

*(4) To complete KEMET part number, insert 4250 = +25°C after Weibull, 4251 = -55°C +85°C after Weibull, or 4252 = -55°C +85°C before Weibull. Designates Surge current option.*

*(5) To complete CWR part number, insert A = +25°C after Weibull, B = -55°C +85°C after Weibull, C = -55°C +85°C before Weibull or Z = None. Designates Surge current option.*

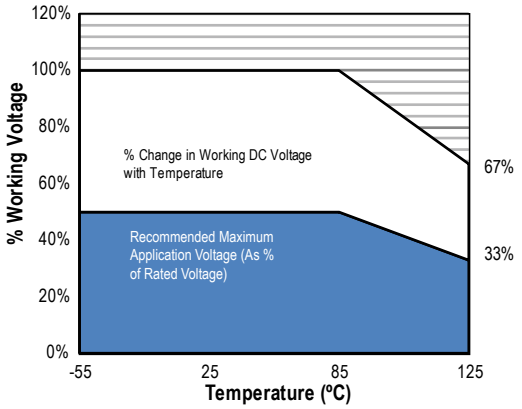
*Refer to Ordering Information for additional detail.*



Roll Over for Order Info.

## Recommended Voltage Derating Guidelines

| | -55°C to 85°C | 85°C to 125°C |
|---|---|---|
| % Change in Working DC Voltage with Temperature | $V_R$ | 67% of $V_R$ |
| Recommended Maximum Application Voltage | 50% of $V_R$ | 33% of $V_R$ |




## 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.

| KEMET Case Code | EIA Case Code | Maximum Power Dissipation (P max) mWatts @ 25°C w/+20°C Rise |
|---|---|---|
| A | 1005 | 50 |
| B | 1505 | 70 |
| C | 2005 | 75 |
| D | 1510 | 80 |
| E | 2010 | 90 |
| F | 2214 | 100 |
| G | 2711 | 125 |
| H | 2915 | 150 |

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

| Temperature Compensation Multipliers for Maximum Power Dissipation | | |
|---|---|---|
| T ≤ 25°C | T ≤ 85°C | T ≤ 125°C |
| 1.00 | 0.90 | 0.40 |

*T= Environmental Temperature*

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

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

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

## Reverse Voltage

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

| Temperature | Permissible Transient Reverse Voltage |
|---|---|
| 25°C | 15% of Rated Voltage |
| 85°C | 5% of Rated Voltage |
| 125°C | 1% of Rated Voltage |

## Table 2 – Land Dimensions/Courtyard

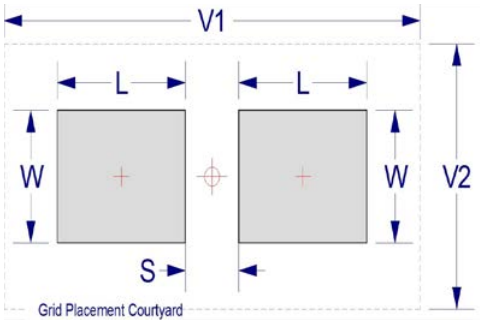
| KEMET | Metric Size Code | Density Level A: Maximum (Most) Land Protrusion (mm) | | | | | Density Level B: Median (Nominal) Land Protrusion (mm) | | | | | Density Level C: Minimum (Least) Land Protrusion (mm) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Case | EIA | L | W | S | V1 | V2 | L | W | S | V1 | V2 | L | W | S | V1 | V2 |
| A[1] | 1005 | 2.19 | 1.44 | 0.15 | 5.54 | 2.66 | 1.89 | 1.32 | 0.15 | 4.44 | 2.16 | 1.52 | 1.22 | 0.29 | 3.58 | 1.90 |
| B | 1505 | 2.30 | 1.44 | 1.20 | 6.80 | 2.66 | 1.90 | 1.32 | 1.40 | 5.70 | 2.16 | 1.52 | 1.22 | 1.56 | 4.84 | 1.90 |
| C | 2005 | 2.30 | 1.44 | 2.47 | 8.08 | 2.66 | 1.90 | 1.32 | 2.67 | 6.98 | 2.16 | 1.52 | 1.22 | 2.83 | 6.12 | 1.90 |
| D | 1510 | 2.30 | 2.58 | 1.20 | 6.80 | 3.92 | 1.90 | 2.46 | 1.40 | 5.70 | 3.42 | 1.52 | 2.36 | 1.56 | 4.84 | 3.16 |
| E | 2010 | 2.30 | 2.58 | 2.47 | 8.08 | 3.92 | 1.90 | 2.46 | 2.67 | 6.98 | 3.42 | 1.52 | 2.36 | 2.83 | 6.12 | 3.16 |
| F | 2214 | 2.30 | 3.47 | 2.98 | 8.58 | 4.82 | 1.90 | 3.35 | 3.18 | 7.48 | 4.32 | 1.52 | 3.25 | 3.34 | 6.62 | 4.06 |
| G | 2711 | 2.81 | 2.84 | 3.10 | 9.72 | 4.18 | 2.41 | 2.72 | 3.30 | 8.62 | 3.68 | 2.03 | 2.62 | 3.46 | 7.76 | 3.42 |
| H | 2915 | 2.81 | 3.84 | 3.61 | 10.24 | 5.20 | 2.41 | 3.72 | 3.81 | 9.14 | 4.70 | 2.03 | 3.62 | 3.97 | 8.28 | 4.44 |
| X | 2824 | 2.73 | 3.22 | 3.46 | 9.92 | 6.80 | 2.33 | 3.10 | 3.66 | 8.82 | 6.30 | 1.95 | 3.00 | 3.82 | 7.96 | 6.04 |

***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 desity 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] Land pattern geometry is too small for silkscreen outline.*



## 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.

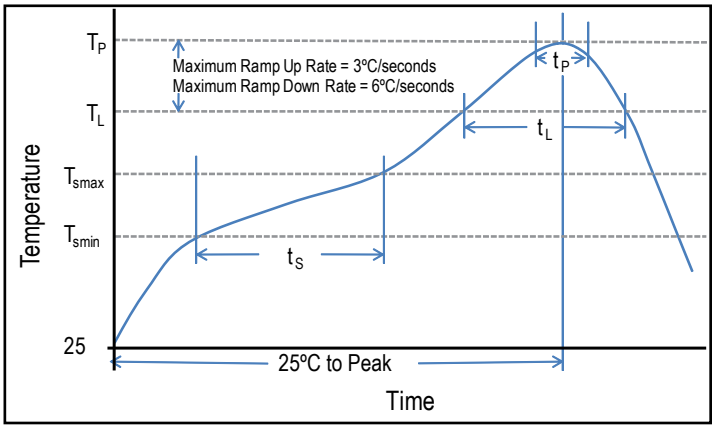
Note that although the X/7343–43 case size can withstand wave soldering, the tall profile (4.3 mm maximum) dictates care in wave process development.

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.

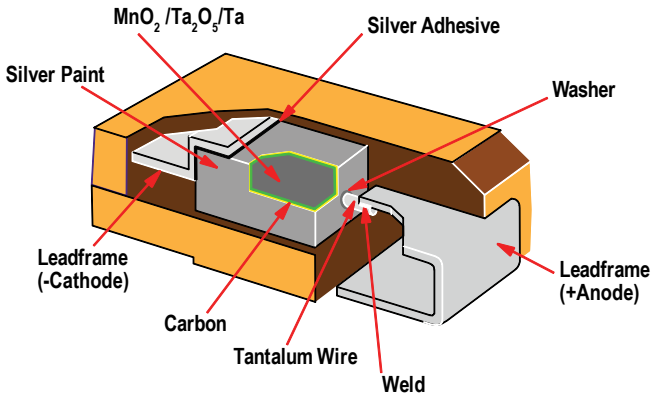
During typical reflow operations, a slight darkening of the gold-colored epoxy may be observed. This slight darkening is normal and not harmful to the product. Marking permanency is not affected by this change.

| 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 |

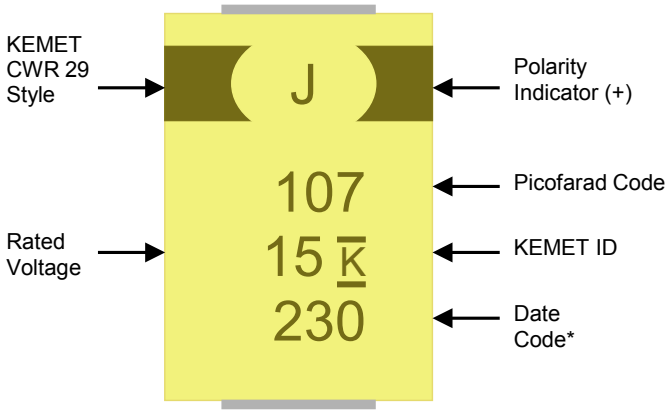
*Note: All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow.*
**Case Size D, E, P, Y, and X*
***Case Size A, B, C, H, I, K, M, R, S, T, U, V, W, and Z*




## Construction



## Capacitor Marking




* 230 = 30th week of 2012

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

## Storage

Tantalum chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature– reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 40ºC and maximum storage humidity not exceed 60% relative humidity. Temperature fluctuations should be minimized to avoid condensation on the parts and atmospheres should be free of chlorine and sulphur bearing compounds. For optimized solderability chip stock should be used promptly, preferably within three years of receipt.

# T492 Series CWR11 Style MIL–PRF–55365/8

## Overview

The KEMET T492 Series is approved to MIL–PRF–55365/8 (CWR11) with Weibull failure rates of B level (0.1% failures per 1,000 hours), C level (0.01% failures per 1,000 hours), D level (0.001% failures per 1,000 hours), or T level (0.01% failures per 1,000 hours, Option C surge current, DPA, Radiographic inspection, 100% visual inspection, DCL and ESR measurements within +3 standard deviations, and Group C inspection). This CWR11 product is a precision-molded device with compliant terminations and indelible laser marking. This is the military version of the global IEC/EIA standard represented by KEMET's T491 Series. Tape and reeling per EIA 481–1 is standard.

## Benefits

- Established reliability options
- Taped and reeled per EIA 481–1
- Symmetrical, compliant terminations
- Laser-marked case
- 100% surge current test available on all case sizes
- Qualified to MIL–PRF–55365/8, Style CWR11
- Termination options B, C, H, K
- Weibull failure options B, C, D, and T
- Exponential failure rates M, P, R, S
- Voltage rating of 4 – 50 VDC
- Operating temperature range of -55˚C to +125˚C

## Applications

Typical applications include decoupling and filtering in military and aerospace applications requiring CWR11 devices.

## Environmental Compliance

RoHS Compliant (6/6) according to Directive 2002/95/EC when ordered with 100% Sn Solder.

RoHS Compliant

## SPICE

For a detailed analysis of specific part numbers, please visit 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.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## KEMET Ordering Information

| T | 492 | D | 156 | K | 020 | A | C | 4251 |
|---|---|---|---|---|---|---|---|---|
| Capacitor Class | Series | Case Size | Capacitance Code (pF) | Capacitance Tolerance | Voltage | Failure Rate/Design | Lead Material | Surge (C-Spec) |
| T = Tantalum | CWR11 Established Reliability | A, B, C, D | First two digits represent significant figures. Third digit specifies number of zeros. | J = ±5%<br>K = ±10%<br>M = ±20% | 006 = 6.3 V<br>010 = 10 V<br>015 = 15 V<br>020 = 20 V<br>025 = 25 V<br>035 = 35 V<br>050 = 50 V | Weibull<br>A = non-ER<br>B = (0.1%/1,000 hours)<br>C = (0.01%/1,000 hours)<br>D = (0.001%/1,000 hours)<br>T = (0.01%/1,000 hours)<br>Exponential<br>M = (1.0%/1,000 hours)<br>P = (0.1%/1,000 hours)<br>R = (0.01%/1,000 hours)<br>S =(0.001%/1,000 hours | C = Hot Solder Dipped<br>H = Standard Solder Coated (SnPb 5% Pb minimum)<br>B = Gold Plated<br>K = Solder Fused | 4250= 25°C after Weibull<br>4251 = -55°C and 85°C after Weibull<br>4252 = -55°C and 85°C before Weibull<br>TLVL= Weibull Grade Level "T" |

## Defense MIL–PRF–55365/8 Ordering Information

| CWR11 | M | H | 105 | K | B | A |
|---|---|---|---|---|---|---|
| Capacitor Style | Voltage | Termination Finish | Capacitance Code (pF) | Capacitance Tolerance | Reliability Level | Surge Current Option |
| Per MIL–PRF–55365/8 | C = 4 V<br>D = 6 V<br>F = 10 V<br>H = 15 V<br>J = 20 V<br>K = 25 V<br>M = 35 V<br>N = 50 V | B = Gold Plated<br>C = Hot solder dipped<br>H = Solder Plated<br>K = Solder fused | First two digits represent significant figures. Third digit specifies number of zeros. | J = ±5%<br>K = ±10%<br>M = ±20% | Weibull<br>A = non-ER<br>B = (0.1%/1,000 hours)<br>C = (0.01%/1,000 hours)<br>D =(0.001%/1,000 hours)<br>T= T Level* (0.01%/1,000 hours)<br>Exponential<br>M = (1.0%/1,000 hours)<br>P = (0.1%/1,000 hours)<br>R = (0.01%/1,000 hours)<br>S =(0.001%/1,000 hours | A = +25°C after Weibull<br>B = -55°C +85°C after Weibull<br>C = -55°C +85°C before Weibull<br>Z = None |

** When T Level is ordered, no Surge Current Option is needed*

## Performance Characteristics

| Item | Performance Characteristics |
|---|---|
| Operating Temperature | -55°C to 125°C |
| Rated Capacitance Range | 0.1 – 100 µF @ 120 Hz/25°C |
| Capacitance Tolerance | J Tolerance (5%), K Tolerance (10%), M Tolerance (20%) |
| Rated Voltage Range | 4 – 50 V |
| DF (120 Hz) | Refer to Part Number Electrical Specification Table |
| ESR (100 kHz) | Refer to Part Number Electrical Specification Table |
| Leakage Current | ≤ 0.01 CV (µA) at rated voltage after 5 minutes |

## Qualification

| Test | Condition | | Characteristics | | | |
|---|---|---|---|---|---|---|
| Endurance | 85°C @ rated voltage, 2,000 hours<br>125°C @ 2/3 rated voltage, 2,000 hours | | Δ C/C | Within ±10% of initial value | | |
| | | | DF | Within initial limits | | |
| | | | DCL | Within 1.25 x initial limit | | |
| | | | ESR | Within initial limits | | |
| Storage Life | 125°C @ 0 volts, 2,000 hours | | Δ C/C | Within ±10% of initial value | | |
| | | | DF | Within initial limits | | |
| | | | DCL | Within 1.25 x initial limit | | |
| | | | ESR | Within initial limits | | |
| Thermal Shock | MIL–STD–202, Method 107, Condition B, mounted, -55°C to 125°C, 1,000 cycles | | Δ C/C | Within ±5% of initial value | | |
| | | | DF | Within initial limits | | |
| | | | DCL | Within 1.25 x initial limit | | |
| | | | ESR | Within initial limits | | |
| 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* | ±10% | ±10% | ±20% |
| | | DF | IL | IL | 1.5 x IL | 1.5 x IL |
| | | DCL | IL | n/a | 10 x IL | 12 x IL |
| Surge Voltage | 25°C and 85°C, 1.32 x rated voltage 1,000 cycles (125°C, 1.2 x rated voltage) | | Δ C/C | Within ±5% 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. | | | | | |

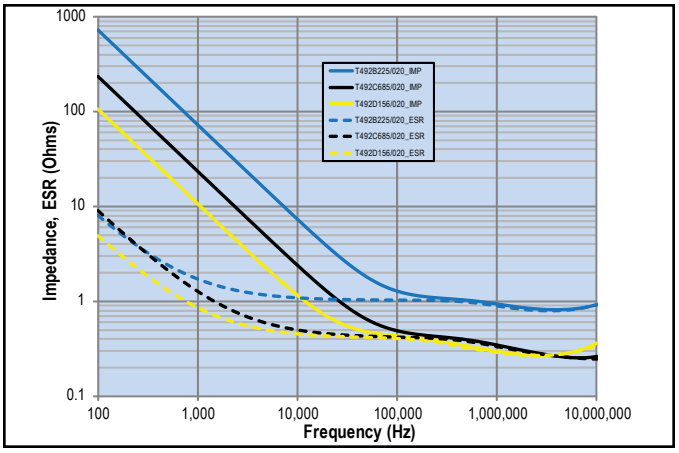
**IL = Initial Limit*

## Certification

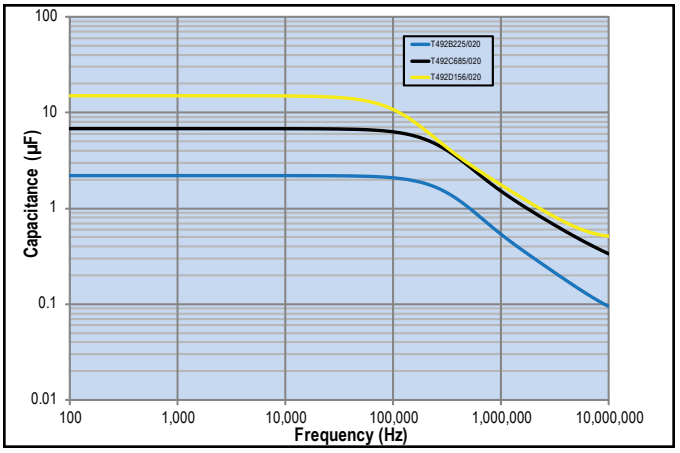
MIL–PRF–55365/8

## Electrical Characteristics

### ESR vs. Frequency

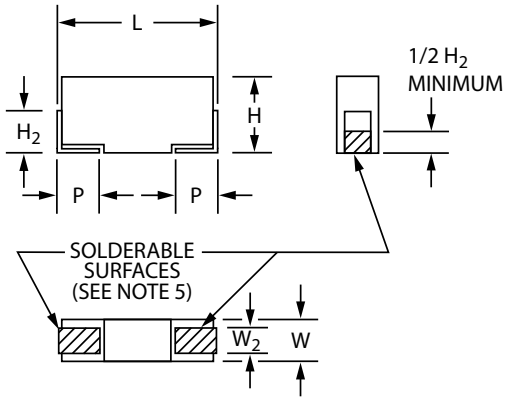



### Capacitance vs. Frequency




## Dimensions – Millimeters (Inches)

Metric will govern




| Case Size | Component | | | | | |
|---|---|---|---|---|---|---|
| KEMET | H* | $H_2$ Minimum | L | P +/- 0.3 (0.012) | W | $W_2$ +/- 0.1 (0.004) |
| A | 1.6 ±0.2 (0.063 ±0.008) | 0.7 (0.028) | 3.2 ± 0.2 (0.126 ±0.008) | 0.8 (0.031) | 1.6 ±0.2 (0.063 ±0.008) | 1.2 (0.047) |
| B | 1.9 ±0.2 (0.075 ±0.008) | 0.7 (0.028) | 3.5 ± 02 (0.138 ± .008) | 0.8 (0.031) | 2.8 ±0.2 (0.110 ±0.008) | 2.2 (0.087) |
| C | 2.5 ±0.3 (0.098 ±0.012) | 1.0 (0.039) | 6.0 ± 0.3 (0.236 ±0.03) | 1.3 (0.051) | 3.2 ±0.3 (0.126 ±0.012) | 2.2 (0.087) |
| D | 2.8 ±0.3 (0.110 ±0.012) | 1.0 (0.039) | 7.3 ± 0.3 (0.287 ±0.012) | 1.3 (0.051) | 4.3 ±0.3 (0.169 ±0.012) | 2.4 (0.094) |

*Note: When solder coated terminations are required, add an additional 0.38 mm (0.015 inch) to the above tolerances for "L", "W", "H", "P" ,"$W_2$" and "$H_2$"*

## Table 1 – Ratings & Part Number Reference

| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL–PRF–55365/8 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |
|---|---|---|---|---|---|---|---|---|
| VDC | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Max/5 Min | % @ +20°C 120 Hz Max | Ω @ +20°C 100 kHz Max | Reflow Temperature ≤ 260°C |
| 4 | 2.2 | A/3216-18 | T492A225(1)004(2)(3)(4) | CWR11C(6)225(1)(2)(5) | 0.5 | 6.0 | 8.0 | 1 |
| 4 | 4.7 | A/3216-18 | T492A475(1)004(2)(3)(4) | CWR11C(6)475(1)(2)(5) | 0.5 | 6.0 | 8.0 | 1 |
| 4 | 6.8 | B/3528-21 | T492B685(1)004(2)(3)(4) | CWR11C(6)685(1)(2)(5) | 0.5 | 6.0 | 5.5 | 1 |
| 4 | 10 | B/3528-21 | T492B106(1)004(2)(3)(4) | CWR11C(6)106(1)(2)(5) | 0.5 | 6.0 | 4.0 | 1 |
| 4 | 15 | B/3528-21 | T492B156(1)004(2)(3)(4) | CWR11C(6)156(1)(2)(5) | 0.6 | 6.0 | 3.5 | 1 |
| 4 | 33 | C/6032-28 | T492C336(1)004(2)(3)(4) | CWR11C(6)336(1)(2)(5) | 1.3 | 6.0 | 2.2 | 1 |
| 4 | 68 | D/7343-31 | T492D686(1)004(2)(3)(4) | CWR11C(6)686(1)(2)(5) | 2.7 | 6.0 | 1.1 | 1 |
| 4 | 100 | D/7343-31 | T492D107(1)004(2)(3)(4) | CWR11C(6)107(1)(2)(5) | 4.0 | 8.0 | 0.9 | 1 |
| 6 | 1.5 | A/3216-18 | T492A155(1)006(2)(3)(4) | CWR11D(6)155(1)(2)(5) | 0.5 | 6.0 | 8.0 | 1 |
| 6 | 2.2 | A/3216-18 | T492A225(1)006(2)(3)(4) | CWR11D(6)225(1)(2)(5) | 0.5 | 6.0 | 8.0 | 1 |
| 6 | 3.3 | A/3216-18 | T492A335(1)006(2)(3)(4) | CWR11D(6)335(1)(2)(5) | 0.5 | 6.0 | 8.0 | 1 |
| 6 | 4.7 | B/3528-21 | T492B475(1)006(2)(3)(4) | CWR11D(6)475(1)(2)(5) | 0.5 | 6.0 | 5.5 | 1 |
| 6 | 6.8 | B/3528-21 | T492B685(1)006(2)(3)(4) | CWR11D(6)685(1)(2)(5) | 0.5 | 6.0 | 4.5 | 1 |
| 6 | 10 | B/3528-21 | T492B106(1)006(2)(3)(4) | CWR11D(6)106(1)(2)(5) | 0.6 | 6.0 | 3.5 | 1 |
| 6 | 15 | C/6032-28 | T492C156(1)006(2)(3)(4) | CWR11D(6)156(1)(2)(5) | 0.9 | 6.0 | 3.0 | 1 |
| 6 | 22 | C/6032-28 | T492C226(1)006(2)(3)(4) | CWR11D(6)226(1)(2)(5) | 1.3 | 6.0 | 2.2 | 1 |
| 6 | 47 | D/7343-31 | T492D476(1)006(2)(3)(4) | CWR11D(6)476(1)(2)(5) | 2.8 | 6.0 | 1.1 | 1 |
| 6 | 68 | D/7343-31 | T492D686(1)006(2)(3)(4) | CWR11D(6)686(1)(2)(5) | 4.1 | 6.0 | 0.9 | 1 |
| 10 | 1 | A/3216-18 | T492A105(1)010(2)(3)(4) | CWR11F(6)105(1)(2)(5) | 0.5 | 4.0 | 10.0 | 1 |
| 10 | 1.5 | A/3216-18 | T492A155(1)010(2)(3)(4) | CWR11F(6)155(1)(2)(5) | 0.5 | 6.0 | 8.0 | 1 |
| 10 | 2.2 | A/3216-18 | T492A225(1)010(2)(3)(4) | CWR11F(6)225(1)(2)(5) | 0.5 | 6.0 | 8.0 | 1 |
| 10 | 3.3 | B/3528-21 | T492B335(1)010(2)(3)(4) | CWR11F(6)335(1)(2)(5) | 0.5 | 6.0 | 5.5 | 1 |
| 10 | 4.7 | B/3528-21 | T492B475(1)010(2)(3)(4) | CWR11F(6)475(1)(2)(5) | 0.5 | 6.0 | 4.5 | 1 |
| 10 | 6.8 | B/3528-21 | T492B685(1)010(2)(3)(4) | CWR11F(6)685(1)(2)(5) | 0.7 | 6.0 | 3.5 | 1 |
| 10 | 15 | C/6032-28 | T492C156(1)010(2)(3)(4) | CWR11F(6)156(1)(2)(5) | 1.5 | 6.0 | 2.5 | 1 |
| 10 | 33 | D/7343-31 | T492D336(1)010(2)(3)(4) | CWR11F(6)336(1)(2)(5) | 3.3 | 6.0 | 1.1 | 1 |
| 10 | 47 | D/7343-31 | T492D476(1)010(2)(3)(4) | CWR11F(6)476(1)(2)(5) | 4.7 | 6.0 | 0.9 | 1 |
| 15 | 0.68 | A/3216-18 | T492A684(1)015(2)(3)(4) | CWR11H(6)684(1)(2)(5) | 0.5 | 4.0 | 12.0 | 1 |
| 15 | 1 | A/3216-18 | T492A105(1)015(2)(3)(4) | CWR11H(6)105(1)(2)(5) | 0.5 | 4.0 | 10.0 | 1 |
| 15 | 1.5 | A/3216-18 | T492A155(1)015(2)(3)(4) | CWR11H(6)155(1)(2)(5) | 0.5 | 6.0 | 8.0 | 1 |
| 15 | 2.2 | B/3528-21 | T492B225(1)015(2)(3)(4) | CWR11H(6)225(1)(2)(5) | 0.5 | 6.0 | 5.5 | 1 |
| 15 | 3.3 | B/3528-21 | T492B335(1)015(2)(3)(4) | CWR11H(6)335(1)(2)(5) | 0.5 | 6.0 | 5.0 | 1 |
| 15 | 4.7 | B/3528-21 | T492B475(1)015(2)(3)(4) | CWR11H(6)475(1)(2)(5) | 0.7 | 6.0 | 4.0 | 1 |
| 15 | 10 | C/6032-28 | T492C106(1)015(2)(3)(4) | CWR11H(6)106(1)(2)(5) | 1.5 | 6.0 | 2.5 | 1 |
| 15 | 22 | D/7343-31 | T492D226(1)015(2)(3)(4) | CWR11H(6)226(1)(2)(5) | 3.3 | 6.0 | 1.1 | 1 |
| 15 | 33 | D/7343-31 | T492D336(1)015(2)(3)(4) | CWR11H(1)336(1)(2)(5) | 5.0 | 6.0 | 0.9 | 1 |
| 20 | 0.47 | A/3216-18 | T492A474(1)020(2)(3)(4) | CWR11J(6)474(1)(2)(5) | 0.5 | 4.0 | 14.0 | 1 |
| 20 | 0.68 | A/3216-18 | T492A684(1)020(2)(3)(4) | CWR11J(6)684(1)(2)(5) | 0.5 | 4.0 | 12.0 | 1 |
| 20 | 1 | A/3216-18 | T492A105(1)020(2)(3)(4) | CWR11J(6)105(1)(2)(5) | 0.5 | 4.0 | 10.0 | 1 |
| 20 | 1.5 | B/3528-21 | T492B155(1)020(2)(3)(4) | CWR11J(6)155(1)(2)(5) | 0.5 | 6.0 | 6.0 | 1 |
| 20 | 2.2 | B/3528-21 | T492B225(1)020(2)(3)(4) | CWR11J(6)225(1)(2)(5) | 0.5 | 6.0 | 5.0 | 1 |
| 20 | 3.3 | B/3528-21 | T492B335(1)020(2)(3)(4) | CWR11J(6)335(1)(2)(5) | 0.7 | 6.0 | 4.0 | 1 |
| 20 | 4.7 | C/6032-28 | T492C475(1)020(2)(3)(4) | CWR11J(6)475(1)(2)(5) | 0.9 | 6.0 | 3.0 | 1 |
| 20 | 6.8 | C/6032-28 | T492C685(1)020(2)(3)(4) | CWR11J(6)685(1)(2)(5) | 1.4 | 6.0 | 2.4 | 1 |
| 20 | 15 | D/7343-31 | T492D156(1)020(2)(3)(4) | CWR11J(6)156(1)(2)(5) | 3.0 | 6.0 | 1.1 | 1 |
| 20 | 22 | D/7343-31 | T492D226(1)020(2)(3)(4) | CWR11J(6)226(1)(2)(5) | 4.4 | 6.0 | 0.9 | 1 |
| VDC | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Max/5 Min | % @ +20°C 120 Hz Max | Ω @ +20°C 100 kHz Max | Reflow Temperature ≤ 260°C |
| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL–PRF–55365/8 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |

*Other part number options:*

*(1) To complete KEMET/CWR part number, insert M for ±20%, K for ±10%, or J for ±5%. Designates Capacitance tolerance.*

*(2) To complete KEMET/CWR part number, insert B (0.1%/1,000 Hours), C (0.01%/1,000 Hours), D (0.001%/1,000 Hours) or A = N/A. Designates Reliability Level.*

*(3) To complete KEMET part number, insert B = Gold Plated, C = Hot solder dipped, H or S = Solder Plated or K = Solder Fused. Designates Termination Finish.*

*(4) To complete KEMET part number, insert 4250 = +25°C after Weibull, 4251 = -55°C +85°C after Weibull, or 4252 = -55°C +85°C before Weibull. Designates Surge current option.*

*(5) To complete CWR part number, insert A = +25°C after Weibull, B = -55°C +85°C after Weibull, C = -55°C +85°C before Weibull or Z = None. Designates Surge current option.*

*(6) To complete CWR part number, insert B = Gold Plated, C = Hot Solder Dipped, H = Solder Plated or K = Solder Fused. Designates Termination Finish. Refer to Ordering Information for additional detail.*



Roll Over for Order Info.

## Table 1 – Ratings & Part Number Reference cont'd

| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL–PRF–55365/8 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |
|---|---|---|---|---|---|---|---|---|
| VDC | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Max/5 Min | % @ +20°C 120 Hz Max | Ω @ +20°C 100 kHz Max | Reflow Temperature ≤ 260°C |
| 25 | 0.68 | B/3528-21 | T492B684(1)025(2)(3)(4) | CWR11K(6)684(1)(2)(5) | 0.5 | 4.0 | 7.5 | 1 |
| 25 | 1 | B/3528-21 | T492B105(1)025(2)(3)(4) | CWR11K(6)105(1)(2)(5) | 0.5 | 4.0 | 6.5 | 1 |
| 25 | 1.5 | B/3528-21 | T492B155(1)025(2)(3)(4) | CWR11K(6)155(1)(2)(5) | 0.5 | 6.0 | 6.5 | 1 |
| 25 | 2.2 | C/6032-28 | T492C225(1)025(2)(3)(4) | CWR11K(6)225(1)(2)(5) | 0.6 | 6.0 | 3.5 | 1 |
| 25 | 3.3 | C/6032-28 | T492C335(1)025(2)(3)(4) | CWR11K(6)335(1)(2)(5) | 0.8 | 6.0 | 3.5 | 1 |
| 25 | 4.7 | C/6032-28 | T492C475(1)025(2)(3)(4) | CWR11K(6)475(1)(2)(5) | 1.2 | 6.0 | 2.5 | 1 |
| 25 | 6.8 | D/7343-31 | T492D685(1)025(2)(3)(4) | CWR11K(6)685(1)(2)(5) | 1.7 | 6.0 | 1.4 | 1 |
| 25 | 10 | D/7343-31 | T492D106(1)025(2)(3)(4) | CWR11K(6)106(1)(2)(5) | 2.5 | 6.0 | 1.2 | 1 |
| 25 | 15 | D/7343-31 | T492D156(1)025(2)(3)(4) | CWR11K(6)156(1)(2)(5) | 3.8 | 6.0 | 1.0 | 1 |
| 35 | 0.1 | A/3216-18 | T492A104(1)035(2)(3)(4) | CWR11M(6)104(1)(2)(5) | 0.5 | 4.0 | 24.0 | 1 |
| 35 | 0.15 | A/3216-18 | T492A154(1)035(2)(3)(4) | CWR11M(6)154(1)(2)(5) | 0.5 | 4.0 | 21.0 | 1 |
| 35 | 0.22 | A/3216-18 | T492A224(1)035(2)(3)(4) | CWR11M(6)224(1)(2)(5) | 0.5 | 4.0 | 18.0 | 1 |
| 35 | 0.33 | A/3216-18 | T492A334(1)035(2)(3)(4) | CWR11M(6)334(1)(2)(5) | 0.5 | 4.0 | 15.0 | 1 |
| 35 | 0.47 | B/3528-21 | T492B474(1)035(2)(3)(4) | CWR11M(6)474(1)(2)(5) | 0.5 | 4.0 | 10.0 | 1 |
| 35 | 0.68 | B/3528-21 | T492B684(1)035(2)(3)(4) | CWR11M(6)684(1)(2)(5) | 0.5 | 4.0 | 8.0 | 1 |
| 35 | 1 | B/3528-21 | T492B105(1)035(2)(3)(4) | CWR11M(6)105(1)(2)(5) | 0.5 | 4.0 | 6.5 | 1 |
| 35 | 1.5 | C/6032-28 | T492C155(1)035(2)(3)(4) | CWR11M(6)155(1)(2)(5) | 0.5 | 6.0 | 4.5 | 1 |
| 35 | 2.2 | C/6032-28 | T492C225(1)035(2)(3)(4) | CWR11M(6)225(1)(2)(5) | 0.8 | 6.0 | 3.5 | 1 |
| 35 | 3.3 | C/6032-28 | T492C335(1)035(2)(3)(4) | CWR11M(6)335(1)(2)(5) | 1.2 | 6.0 | 2.5 | 1 |
| 35 | 4.7 | D/7343-31 | T492D475(1)035(2)(3)(4) | CWR11M(6)475(1)(2)(5) | 1.6 | 6.0 | 1.5 | 1 |
| 35 | 6.8 | D/7343-31 | T492D685(1)035(2)(3)(4) | CWR11M(6)685(1)(2)(5) | 2.4 | 6.0 | 1.3 | 1 |
| 50 | 0.1 | A/3216-18 | T492A104(1)050(2)(3)(4) | CWR11N(6)104(1)(2)(5) | 0.5 | 6.0 | 22.0 | 1 |
| 50 | 0.15 | B/3528-21 | T492B154(1)050(2)(3)(4) | CWR11N(6)154(1)(2)(5) | 0.5 | 4.0 | 17.0 | 1 |
| 50 | 0.22 | B/3528-21 | T492B224(1)050(2)(3)(4) | CWR11N(6)224(1)(2)(5) | 0.5 | 4.0 | 14.0 | 1 |
| 50 | 0.33 | B/3528-21 | T492B334(1)050(2)(3)(4) | CWR11N(6)334(1)(2)(5) | 0.5 | 4.0 | 12.0 | 1 |
| 50 | 0.47 | C/6032-28 | T492C474(1)050(2)(3)(4) | CWR11N(6)474(1)(2)(5) | 0.5 | 4.0 | 8.0 | 1 |
| 50 | 0.68 | C/6032-28 | T492C684(1)050(2)(3)(4) | CWR11N(6)684(1)(2)(5) | 0.5 | 4.0 | 7.0 | 1 |
| 50 | 1 | C/6032-28 | T492C105(1)050(2)(3)(4) | CWR11N(6)105(1)(2)(5) | 0.5 | 4.0 | 6.0 | 1 |
| 50 | 1.5 | D/7343-31 | T492D155(1)050(2)(3)(4) | CWR11N(6)155(1)(2)(5) | 0.8 | 6.0 | 4.0 | 1 |
| 50 | 2.2 | D/7343-31 | T492D225(1)050(2)(3)(4) | CWR11N(6)225(1)(2)(5) | 1.1 | 6.0 | 2.5 | 1 |
| 50 | 3.3 | D/7343-31 | T492D335(1)050(2)(3)(4) | CWR11N(6)335(1)(2)(5) | 1.7 | 6.0 | 2.0 | 1 |
| 50 | 4.7 | D/7343-31 | T492D475(1)050(2)(3)(4) | CWR11N(6)475(1)(2)(5) | 2.4 | 6.0 | 1.5 | 1 |
| VDC | µF | KEMET/EIA | (See below for part options) | (See below for part options) | µA @ +20°C Max/5 Min | % @ +20°C 120 Hz Max | Ω @ +20°C 100 kHz Max | Reflow Temperature ≤ 260°C |
| Rated Voltage | Rated Cap | Case Code/ Case Size | KEMET Part Number | MIL–PRF–55365/8 Part Number | DC Leakage | DF | ESR | Moisture Sensitivity |

*(1) To complete KEMET/CWR part number, insert M for ±20%, K for ±10%, or J for ±5%. Designates Capacitance tolerance.*

*Other part number options:*

*(1) To complete KEMET/CWR part number, insert M for ±20%, K for ±10%, or J for ±5%. Designates Capacitance tolerance.*

*(2) To complete KEMET/CWR part number, insert B (0.1%/1,000 Hours), C (0.01%/1,000 Hours), D (0.001%/1,000 Hours) or A = N/A. Designates Reliability Level.*

*(3) To complete KEMET part number, insert B = Gold Plated, C = Hot solder dipped, H or S = Solder Plated or K = Solder Fused. Designates Termination Finish.*

*(4) To complete KEMET part number, insert 4250 = +25°C after Weibull, 4251 = -55°C +85°C after Weibull, or 4252 = -55°C +85°C before Weibull. Designates Surge current option.*

*(5) To complete CWR part number, insert A = +25°C after Weibull, B = -55°C +85°C after Weibull, C = -55°C +85°C before Weibull or Z = None. Designates Surge current option.*

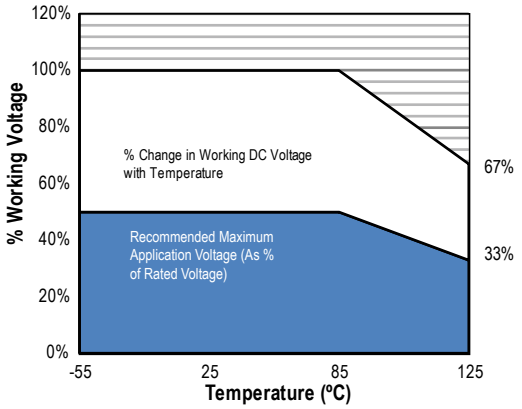
*(6) To complete CWR part number, insert B = Gold Plated, C = Hot Solder Dipped, H = Solder Plated or K = Solder Fused. Designates Termination Finish. Refer to Ordering Information for additional detail.*



Roll Over for Order Info.

## Recommended Voltage Derating Guidelines

| | -55°C to 85°C | 85°C to 125°C |
|---|---|---|
| % Change in Working DC Voltage with Temperature | $V_R$ | 67% of $V_R$ |
| Recommended Maximum Application Voltage | 50% of $V_R$ | 33% of $V_R$ |




## 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.

| KEMET Case Code | EIA Case Code | Maximum Power Dissipation (P max) mWatts @ 25°C w/+20°C Rise |
|---|---|---|
| A | 3216–18 | 75 |
| B | 3528–21 | 85 |
| C | 6032–28 | 110 |
| D | 7343–31 | 150 |
| X | 7343–43 | 165 |
| E | 7360–38 | 200 |
| S | 3216–12 | 60 |
| T | 3528–12 | 70 |
| U | 6032–15 | 90 |
| V | 7343–20 | 125 |
| T510X | 7343–43 | 270 |
| T510E | 7360–38 | 285 |

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

| Temperature Compensation Multipliers for Maximum Power Dissipation | | |
|---|---|---|
| T ≤ 25°C | T ≤ 85°C | T ≤ 125°C |
| 1.00 | 0.90 | 0.40 |

*T= Environmental Temperature*

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

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

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

## Reverse Voltage

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

| Temperature | Permissible Transient Reverse Voltage |
|---|---|
| 25°C | 15% of Rated Voltage |
| 85°C | 5% of Rated Voltage |
| 125°C | 1% of Rated Voltage |

## Table 2 – Land Dimensions/Courtyard

| 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 |
| A | 3216–18 | 1.35 | 2.20 | 0.62 | 6.02 | 2.80 | 1.23 | 1.80 | 0.82 | 4.92 | 2.30 | 1.13 | 1.42 | 0.98 | 4.06 | 2.04 |
| 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 |
| C | 6032–25 | 2.35 | 2.77 | 2.37 | 8.92 | 4.50 | 2.23 | 2.37 | 2.57 | 7.82 | 4.00 | 2.13 | 1.99 | 2.73 | 6.96 | 3.74 |
| 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 |
| L | 6032-19 | 2.35 | 2.77 | 2.37 | 8.92 | 4.50 | 2.23 | 2.37 | 2.57 | 7.82 | 4.00 | 2.13 | 1.99 | 2.73 | 6.96 | 3.74 |
| M | 3528-15 | 2.35 | 2.20 | 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 |
| H | 7360-20 | 4.25 | 2.77 | 3.67 | 10.22 | 7.30 | 4.13 | 2.37 | 3.87 | 9.12 | 6.80 | 4.03 | 1.99 | 4.03 | 8.26 | 6.54 |
| E[1] | 7360–38 | 4.25 | 2.77 | 3.67 | 10.22 | 7.30 | 4.13 | 2.37 | 3.87 | 9.12 | 6.80 | 4.03 | 1.99 | 4.03 | 8.26 | 6.54 |
| Q | 7343-12 | 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 |
| R[2] | 2012-12 | 1.05 | 1.83 | 0.15 | 4.82 | 2.50 | 0.93 | 1.50 | 0.22 | 3.72 | 2.00 | 0.83 | 1.12 | 0.38 | 2.86 | 1.74 |
| S[2] | 3216–12 | 1.35 | 2.20 | 0.62 | 6.02 | 2.80 | 1.23 | 1.80 | 0.82 | 4.92 | 2.30 | 1.13 | 1.42 | 0.98 | 4.06 | 2.04 |
| T | 3528–12 | 2.35 | 2.20 | 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 |
| U | 6032–15 | 2.35 | 2.77 | 2.37 | 8.92 | 4.50 | 2.23 | 2.37 | 2.57 | 7.82 | 4.00 | 2.13 | 1.99 | 2.73 | 6.96 | 3.74 |
| V | 7343–20 | 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 |
| W | 7343–15 | 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 |
| Y[1] | 7343–40 | 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 |

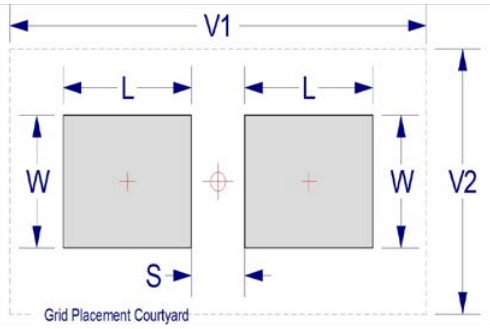
***Density Level A:*** *For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes.*

***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 desity 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.*



## 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.

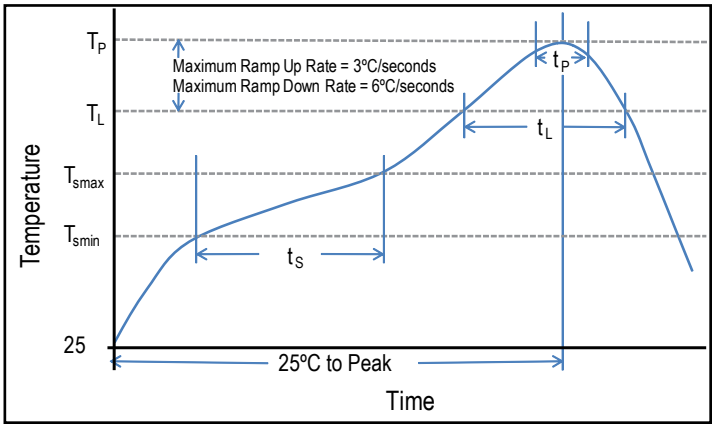
Note that although the X/7343–43 case size can withstand wave soldering, the tall profile (4.3 mm maximum) dictates care in wave process development.

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 occurred, the iron should be removed immediately. "Wiping" the edges of a chip and heating the top surface is not recommended.

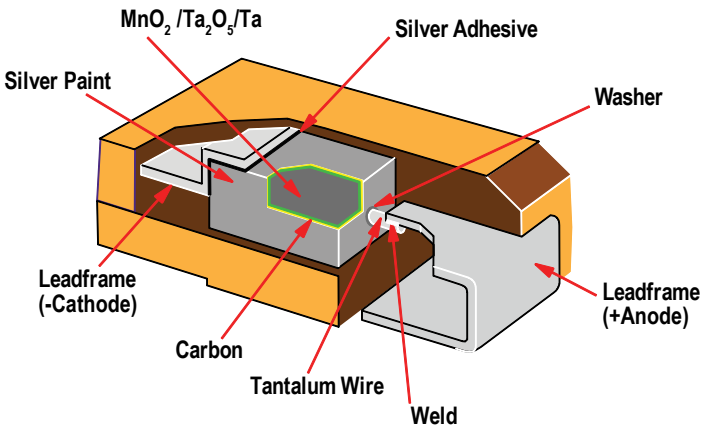
During typical reflow operations, a slight darkening of the gold-colored epoxy may be observed. This slight darkening is normal and is not harmful to the product. Marking permanency is not affected by this change.

| 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 |

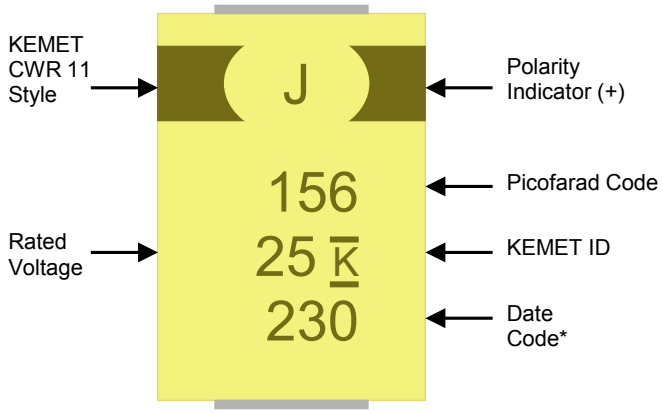
*Note: All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow.*
**Case Size D, E, P, Y and X*
***Case Size A, B, C, H, I, K, M, R, S, T, U, V, W and Z*




## Construction



## Capacitor Marking




* 230 = 30th week of 2012

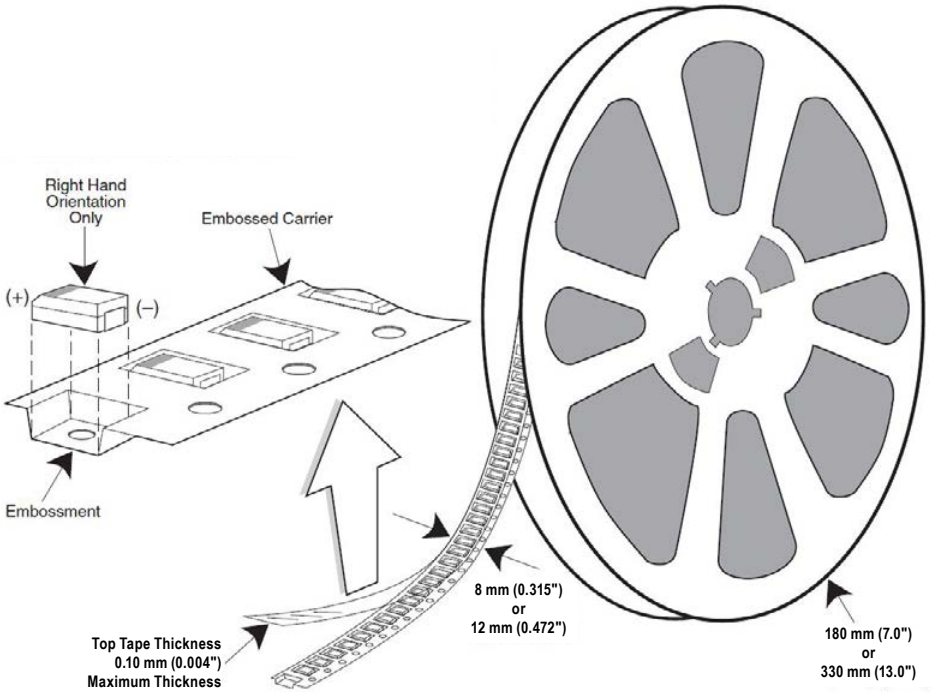
| Date Code * | |
|---|---|
| 1st digit = Last number of Year | 9 = 2009<br>0 = 2010<br>1 = 2011<br>2 = 2012<br>3 = 2013<br>4 = 2014 |
| 2nd and 3rd digit = Week of the Year | 01 = 1st week of the Year to<br>52 = 52nd week of the Year |

## Storage

Tantalum chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature– reels may soften or warp and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 40ºC and maximum storage humidity not exceed 60% relative humidity. Temperature fluctuations should be minimized to avoid condensation on the parts and atmospheres should be free of chlorine and sulphur bearing compounds. For optimized solderability chip stock should be used promptly, preferably within three years of receipt.

## Tape & Reel Packaging Information

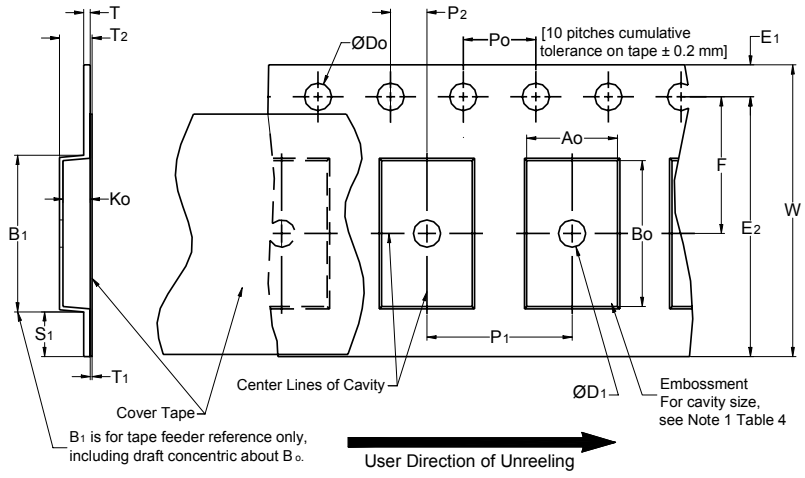
KEMET's molded tantalum and aluminum chip capacitor families are packaged in 8 and 12 mm plastic tape on 7" and 13" reels in accordance with *EIA Standard 481–1*: Embossed Carrier Taping of Surface Mount Components for Automatic Handling. This packaging system is compatible with all tape-fed automatic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




## Table 3 – Packaging Quantity

| KEMET Case Codes | | Tape Width (mm) | Tape and Reel Dimensions | |
|---|---|---|---|---|
| | | | 180 mm (7" diameter) | 330 mm (13" diameter) |
| A | 1005 | 8 | 2500 | 9500 |
| B | 1505 | 12 | 2500 | 9500 |
| C | 2005 | 12 | 2500 | 9500 |
| D | 1510 | 12 | 2500 | 9500 |
| E | 2010 | 12 | 2500 | 9500 |
| F | 2214 | 12 | 500 | 3500 |
| G | 2711 | 12 | 500 | 2500 |
| H | 2915 | 12 | 500 | 2500 |
| X | 2824 | 12 | 500 | 2500 |

## 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) | | | |
| 16 mm | | | | | | | | | |

| 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) | 4.0 ±0.10 (0.157 ±0.004) | 2.5 (0.098) | 8.3 (0.327) | Note 5 |
| 12 mm | Single (4 mm) & Double (8 mm) | 8.2 (0.323) | 10.25 (0.404) | 5.5 ±0.05 (0.217 ±0.002) | 8.0 ±0.10 (0.315 ±0.004) | 4.6 (0.181) | 12.3 (0.484) | |
| 16 mm | Triple (12 mm) | 12.1 (0.476) | 14.25 (0.561) | 5.5 ±0.05 (0.217 ±0.002) | 8.0 ±0.10 (0.315 ±0.004) | 4.6 (0.181) | 16.3 (0.642) | |

*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 5).*

*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 and 10° maximum for 16 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 and to 1.0 mm maximum for 16 mm tape (see Figure 3).*

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

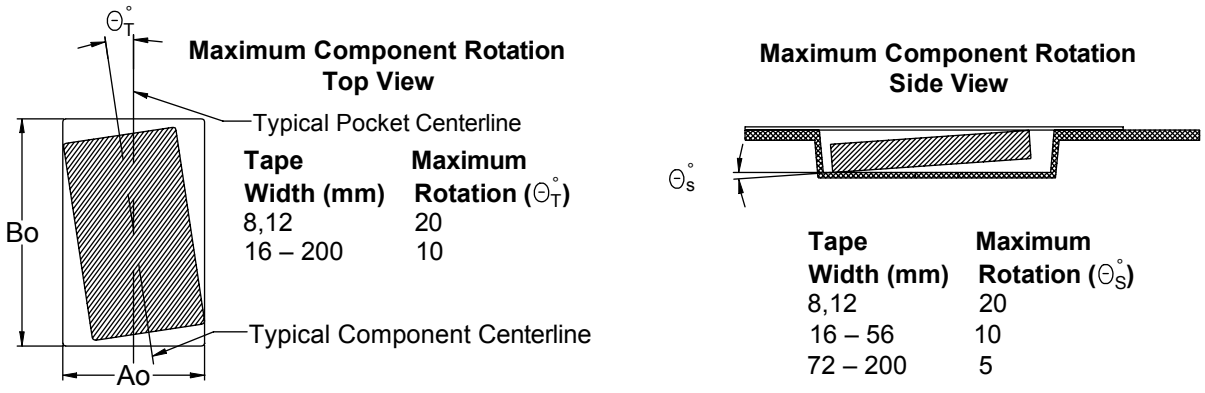
## Packaging Information Performance Notes

**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:

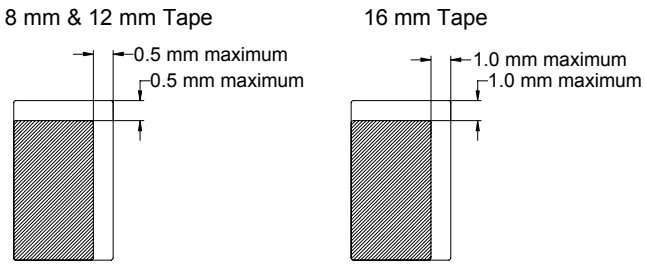
| Tape Width | Peel Strength |
|---|---|
| 8 mm | 0.1 to 1.0 Newton (10 to 100 gf) |
| 12 and 16 mm | 0.1 to 1.3 Newton (10 to 130 gf) |

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.*

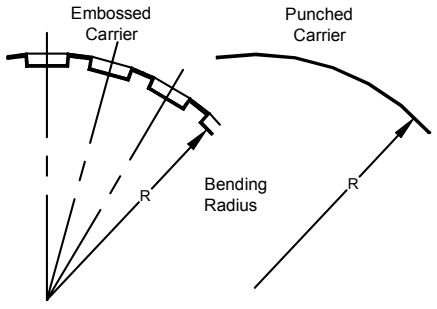
## Figure 2 – Maximum Component Rotation



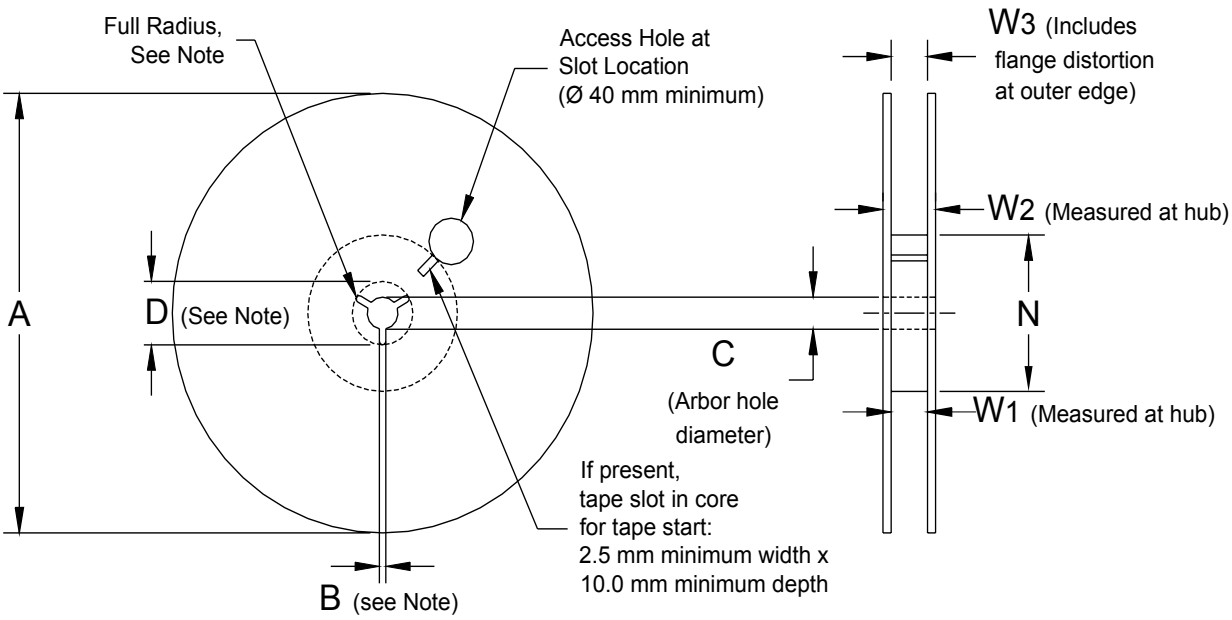

## Figure 3 – Maximum Lateral Movement




## Figure 4 – Bending Radius



## Figure 5 – Reel Dimensions




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

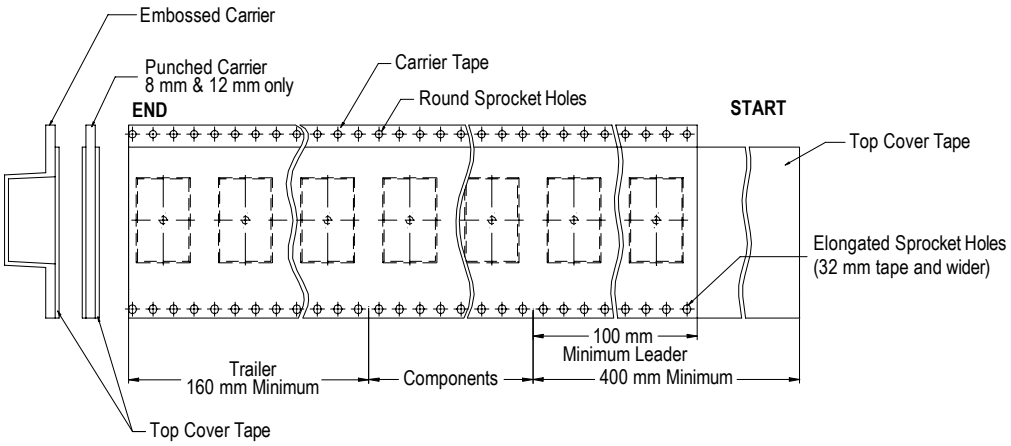
## Table 5 – Reel Dimensions

Metric will govern

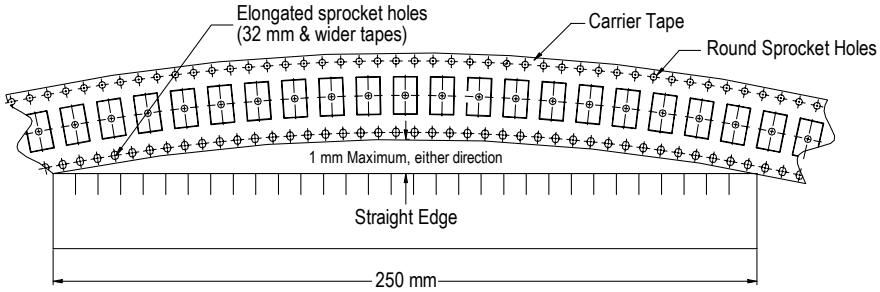
| Constant Dimensions — Millimeters (Inches) | | | | |
|---|---|---|---|---|
| Tape Size | A | B Minimum | C | D Minimum |
| 8 mm | 178 ±0.20 (7.008 ±0.008) or 330 ±0.20 (13.000 ±0.008) | 1.5 (0.059) | 13.0 +0.5/-0.2 (0.521 +0.02/-0.008) | 20.2 (0.795) |
| 12 mm | | | | |
| 16 mm | | | | |

| Variable Dimensions — Millimeters (Inches) | | | | |
|---|---|---|---|---|
| Tape Size | N Minimum | W1 | W2 Maximum | W3 |
| 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) | |
| 16 mm | | 16.4 +2.0/-0.0 (0.646 +0.078/-0.0) | 22.4 (0.882) | |

## Figure 6 – Tape Leader & Trailer Dimensions




## Figure 7 – Maximum Camber



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## Other KEMET Resources

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

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

| Product Request | |
|---|---|
| Resource | Location |
| Sample Request | http://www.kemet.com/sample |
| Engineering Kit Request | http://www.kemet.com/kits |

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

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# KEMET Production System

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