

## Overview

The KEMET T492 series is approved to MIL-PRF-55365/8 (CWR11) with Weibull failure rates of B level (0.1% failures per 1000 hours), C level (0.01% failures per 1000 hours), or D level (0.001% failures per 1000 hours). 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-D is standard.

## Benefits

- Established reliability options
- Taped and reeled per EIA 481-D
- 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, and D
- 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

## SPICE

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

## Ordering Information

T	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	CWR 11 Established Reliability	A = 3216-18 B = 3528-21 C = 6032-28 D = 7343-31	First two digits represent significant figures. Third digit specifies number of zeros.	J = $\pm 5\%$ K = $\pm 10\%$ M = $\pm 20\%$	006 = 6.3V 010 = 10V 015 = 15V 020 = 20V 025 = 25V 035 = 35V 050 = 50V	A = N/A B = 0.1%/1000 hrs C = .01%/1000 hrs D = .001%/1000 hrs	C = Hot Solder Dipped H = Standard Solder Coated (SnPb 5% Pb minimum) B = Gold Plated K = Solder Fused	4250 = 25°C after Weibull 4251 = -55°C and 85°C after Weibull 4252 = -55°C and 85°C before Weibull

## Performance Characteristics

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

## Qualification

Test	Condition	Characteristics					
Endurance	85°C @ Rated Voltage, 2000 Hours. 125°C @ 2/3 Rated Voltage, 2000 Hours.	ΔC/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, 2000 Hours.	ΔC/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, 1000 cycles.	ΔC/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		
		ΔC/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 1000 cycles (125°C, 1.2 x Rated Voltage).	ΔC/C	Within ± 5% of initial value		
				DF	Within initial limits		
DCL	Within initial limits						
ESR	Within initial limits						
Mechanical Shock/Vibration	MIL-Std-202, Meth. 213, Cond. I, 100G Peak. MIL-Std-202, Meth. 204, Cond. D, 10Hz to 2000Hz, 20G Peak.	ΔC/C	Within ±10% of initial value				
		DF	Within initial limits				
		DCL	Within initial limits				

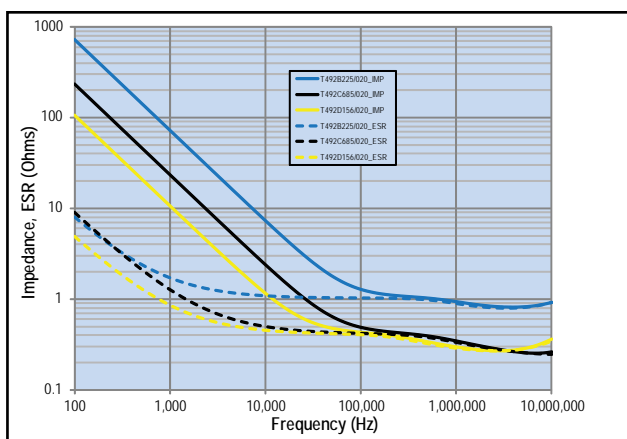
\*IL = Initial Limit

## Certification

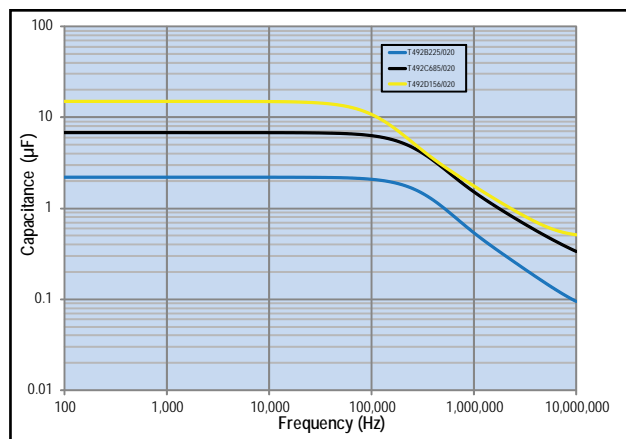
MIL-PRF-55365/8

## Electrical Characteristics

ESR vs. Frequency

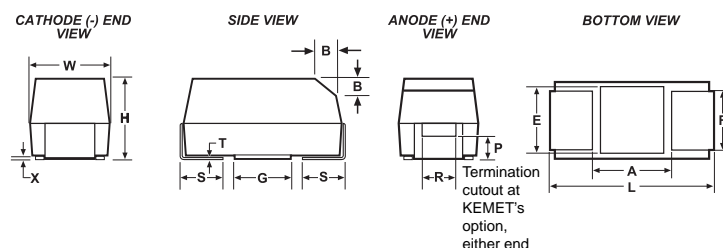


Capacitance vs. Frequency



## Dimensions – Millimeters (Inches)

Metric will govern



Case Size		Component												
KEMET	EIA	L*	W*	H*	F* ±0.1 ±(.004)	S* ±0.3 ±(.012)	B* ±0.15 (Ref) ±.006	X (Ref)	P (Ref)	R (Ref)	T (Ref)	A (Min)	G (Ref)	E (Ref)
A	3216-18	3.2 ± 0.2 (.126 ± .008)	1.6 ± 0.2 (.063 ± .008)	1.6 ± 0.2 (.063 ± .008)	1.2 (.047)	0.8 (.031)	0.4 (.016)	0.10 ± 0.10 (.004 ± .004)	0.4 (.016)	0.4 (.016)	0.13 (.005)	1.4 (.055)	1.1 (.043)	1.3 (.051)
B	3528-21	3.5 ± 0.2 (.138 ± .008)	2.8 ± 0.2 (.110 ± .008)	1.9 ± 0.2 (.075 ± .008)	2.2 (.087)	0.8 (.031)	0.4 (.016)	0.10 ± 0.10 (.004 ± .004)	0.5 (.020)	1.0 (.039)	0.13 (.005)	2.1 (.083)	1.8 (.071)	2.2 (.087)
C	6032-28	6.0 ± 0.3 (.236 ± .03)	3.2 ± 0.3 (.126 ± .012)	2.5 ± 0.3 (.098 ± .012)	2.2 (.087)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	0.9 (.035)	1.0 (.039)	0.13 (.005)	3.1 (.122)	2.8 (.110)	2.4 (.094)
D	7343-31	7.3 ± 0.3 (.287 ± .012)	4.3 ± 0.3 (.169 ± .012)	2.8 ± 0.3 (.110 ± .012)	2.4 (.094)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	0.9 (.035)	1.0 (.039)	0.13 (.005)	3.8 (.150)	3.5 (.138)	3.5 (.138)

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

\* MIL-C-55365/8 specified dimensions

**Table 1 – Ratings & Part Number Reference**

Rated Voltage	Rated Cap	Case Code/ Case Size	KEMET Part Number	MIL-C-55365/4F Part Number	DC Leakage	DF	ESR	Moisture Sensitivity
85°C VDC	120Hz µF	KEMET/EIA	(See below for part options)	(See below for part options)	µAmps +20°C max/5min	+20°C 120Hz % Max	+20°C 100kHz Ohms	Temp≤260°C J-STD-020D
4	2.2	A/3216-18	T492A225(1)004(2)(3)(4)	CWR11C(6)225(1)(2)(5)	0.1	6.0	8.0	1.0
4	4.7	A/3216-18	T492A475(1)004(2)(3)(4)	CWR11C(6)475(1)(2)(5)	0.2	6.0	8.0	1.0
4	6.8	B/3528-21	T492B685(1)004(2)(3)(4)	CWR11C(6)685(1)(2)(5)	0.3	6.0	5.5	1.0
4	10	B/3528-21	T492B106(1)004(2)(3)(4)	CWR11C(6)106(1)(2)(5)	0.4	6.0	4.0	1.0
4	15	B/3528-21	T492B156(1)004(2)(3)(4)	CWR11C(6)156(1)(2)(5)	0.6	6.0	3.5	1.0
4	33	C/6032-28	T492C336(1)004(2)(3)(4)	CWR11C(6)336(1)(2)(5)	1.3	6.0	2.2	1.0
4	68	D/7343-31	T492D686(1)004(2)(3)(4)	CWR11C(6)686(1)(2)(5)	2.7	6.0	1.1	1.0
4	100	D/7343-31	T492D107(1)004(2)(3)(4)	CWR11C(6)107(1)(2)(5)	4.0	8.0	0.9	1.0
6.3	1.5	A/3216-18	T492A155(1)006(2)(3)(4)	CWR11D(6)155(1)(2)(5)	0.1	6.0	8.0	1.0
6.3	2.2	A/3216-18	T492A225(1)006(2)(3)(4)	CWR11D(6)225(1)(2)(5)	0.1	6.0	8.0	1.0
6.3	3.3	A/3216-18	T492A335(1)006(2)(3)(4)	CWR11D(6)335(1)(2)(5)	0.2	6.0	8.0	1.0
6.3	4.7	B/3528-21	T492B475(1)006(2)(3)(4)	CWR11D(6)475(1)(2)(5)	0.3	6.0	5.5	1.0
6.3	6.8	B/3528-21	T492B685(1)006(2)(3)(4)	CWR11D(6)685(1)(2)(5)	0.4	6.0	4.5	1.0
6.3	10	B/3528-21	T492B106(1)006(2)(3)(4)	CWR11D(6)106(1)(2)(5)	0.6	6.0	3.5	1.0
6.3	15	C/6032-28	T492C156(1)006(2)(3)(4)	CWR11D(6)156(1)(2)(5)	0.9	6.0	3.0	1.0
6.3	22	C/6032-28	T492C226(1)006(2)(3)(4)	CWR11D(6)226(1)(2)(5)	1.4	6.0	2.2	1.0
6.3	47	D/7343-31	T492D476(1)006(2)(3)(4)	CWR11D(6)476(1)(2)(5)	3.0	6.0	1.1	1.0
6.3	68	D/7343-31	T492D686(1)006(2)(3)(4)	CWR11D(6)686(1)(2)(5)	4.3	6.0	0.9	1.0
10	1	A/3216-18	T492A105(1)010(2)(3)(4)	CWR11F(6)105(1)(2)(5)	0.1	4.0	10.0	1.0
10	1.5	A/3216-18	T492A155(1)010(2)(3)(4)	CWR11F(6)155(1)(2)(5)	0.2	6.0	8.0	1.0
10	2.2	A/3216-18	T492A225(1)010(2)(3)(4)	CWR11F(6)225(1)(2)(5)	0.2	6.0	8.0	1.0
10	3.3	B/3528-21	T492B335(1)010(2)(3)(4)	CWR11F(6)335(1)(2)(5)	0.3	6.0	5.5	1.0
10	4.7	B/3528-21	T492B475(1)010(2)(3)(4)	CWR11F(6)475(1)(2)(5)	0.5	6.0	4.5	1.0
10	6.8	B/3528-21	T492B685(1)010(2)(3)(4)	CWR11F(6)685(1)(2)(5)	0.7	6.0	3.5	1.0
10	15	C/6032-28	T492C156(1)010(2)(3)(4)	CWR11F(6)156(1)(2)(5)	1.5	6.0	2.5	1.0
10	33	D/7343-31	T492D336(1)010(2)(3)(4)	CWR11F(6)336(1)(2)(5)	3.3	6.0	1.1	1.0
10	47	D/7343-31	T492D476(1)010(2)(3)(4)	CWR11F(6)476(1)(2)(5)	4.7	6.0	0.9	1.0
15	0.68	A/3216-18	T492A684(1)015(2)(3)(4)	CWR11H(6)684(1)(2)(5)	0.1	4.0	12.0	1.0
15	1	A/3216-18	T492A105(1)015(2)(3)(4)	CWR11H(6)105(1)(2)(5)	0.2	4.0	10.0	1.0
15	1.5	A/3216-18	T492A155(1)015(2)(3)(4)	CWR11H(6)155(1)(2)(5)	0.2	6.0	8.0	1.0
15	2.2	B/3528-21	T492B225(1)015(2)(3)(4)	CWR11H(6)225(1)(2)(5)	0.3	6.0	5.5	1.0
15	3.3	B/3528-21	T492B335(1)015(2)(3)(4)	CWR11H(6)335(1)(2)(5)	0.5	6.0	5.0	1.0
15	4.7	B/3528-21	T492B475(1)015(2)(3)(4)	CWR11H(6)475(1)(2)(5)	0.7	6.0	4.0	1.0
15	10	C/6032-28	T492C106(1)015(2)(3)(4)	CWR11H(6)106(1)(2)(5)	1.5	6.0	2.5	1.0
15	22	D/7343-31	T492D226(1)015(2)(3)(4)	CWR11H(6)226(1)(2)(5)	3.3	6.0	1.1	1.0
15	33	D/7343-31	T492D336(1)015(2)(3)(4)	CWR11H(1)336(1)(2)(5)	5.0	6.0	0.9	1.0
20	0.47	A/3216-18	T492A474(1)020(2)(3)(4)	CWR11J(6)474(1)(2)(5)	0.1	4.0	14.0	1.0
20	0.68	A/3216-18	T492A684(1)020(2)(3)(4)	CWR11J(6)684(1)(2)(5)	0.1	4.0	12.0	1.0
20	1	A/3216-18	T492A105(1)020(2)(3)(4)	CWR11J(6)105(1)(2)(5)	0.2	4.0	10.0	1.0
20	1.5	B/3528-21	T492B155(1)020(2)(3)(4)	CWR11J(6)155(1)(2)(5)	0.3	6.0	6.0	1.0
20	2.2	B/3528-21	T492B225(1)020(2)(3)(4)	CWR11J(6)225(1)(2)(5)	0.4	6.0	5.0	1.0
20	3.3	B/3528-21	T492B335(1)020(2)(3)(4)	CWR11J(6)335(1)(2)(5)	0.7	6.0	4.0	1.0
20	4.7	C/6032-28	T492C475(1)020(2)(3)(4)	CWR11J(6)475(1)(2)(5)	0.9	6.0	3.0	1.0
VDC	µF	KEMET/EIA	(see below for part options)	(see below for part options)	max/5min	% Max	Ohms	J-STD-020D
85°C	120Hz				µAmps +20°C	+20°C 120Hz	+20°C 100kHz	Temp≤260°C
Rated Voltage	Rated Cap	Case Code/ Case Size	KEMET Part Number	MIL-C-55365/4F 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%/1000Hrs), C (0.01%/1000Hrs), D (0.001%/1000Hrs) 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.

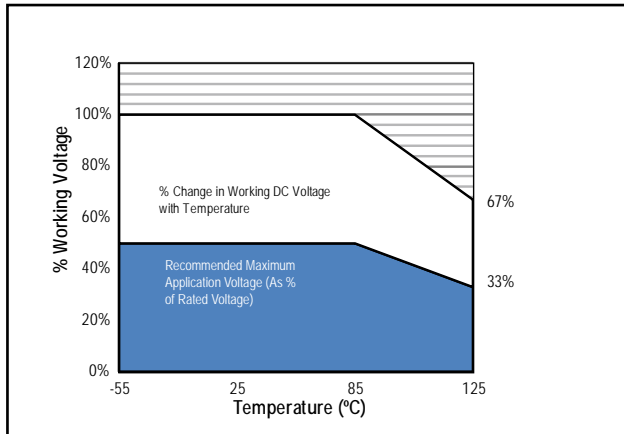
**Table 1 – Ratings & Part Number Reference con't**

Rated Voltage	Rated Cap	Case Code/ Case Size	KEMET Part Number	MIL-C-55365/4F Part Number	DC Leakage	DF	ESR	Moisture Sensitivity
85°C VDC	120Hz µF	KEMET/EIA	(See below for part options)	(See below for part options)	µAmps +20°C max/5min	+20°C 120Hz % Max	+20°C 100kHz Ohms	Temp≤260°C J-STD-020D
20	6.8	C/6032-28	T492C685(1)020(2)(3)(4)	CWR11J(6)685(1)(2)(5)	1.4	6.0	2.4	1.0
20	15	D/7343-31	T492D156(1)020(2)(3)(4)	CWR11J(6)156(1)(2)(5)	3.0	6.0	1.1	1.0
20	22	D/7343-31	T492D226(1)020(2)(3)(4)	CWR11J(6)226(1)(2)(5)	4.4	6.0	0.9	1.0
25	0.33	A/3216-18	T492A334(1)025(2)(3)(4)	CWR11K(6)334(1)(2)(5)	0.1	4.0	15.0	1.0
25	0.47	A/3216-18	T492A474(1)025(2)(3)(4)	CWR11K(6)474(1)(2)(5)	0.1	4.0	14.0	1.0
25	0.68	B/3528-21	T492B684(1)025(2)(3)(4)	CWR11K(6)684(1)(2)(5)	0.2	4.0	7.5	1.0
25	1	B/3528-21	T492B105(1)025(2)(3)(4)	CWR11K(6)105(1)(2)(5)	0.3	4.0	6.5	1.0
25	1.5	B/3528-21	T492B155(1)025(2)(3)(4)	CWR11K(6)155(1)(2)(5)	0.4	6.0	6.5	1.0
25	2.2	C/6032-28	T492C225(1)025(2)(3)(4)	CWR11K(6)225(1)(2)(5)	0.6	6.0	3.5	1.0
25	3.3	C/6032-28	T492C335(1)025(2)(3)(4)	CWR11K(6)335(1)(2)(5)	0.8	6.0	3.5	1.0
25	4.7	C/6032-28	T492C475(1)025(2)(3)(4)	CWR11K(6)475(1)(2)(5)	1.2	6.0	2.5	1.0
25	6.8	D/7343-31	T492D685(1)025(2)(3)(4)	CWR11K(6)685(1)(2)(5)	1.7	6.0	1.4	1.0
25	10	D/7343-31	T492D106(1)025(2)(3)(4)	CWR11K(6)106(1)(2)(5)	2.5	6.0	1.2	1.0
25	15	D/7343-31	T492D156(1)025(2)(3)(4)	CWR11K(6)156(1)(2)(5)	3.8	6.0	1.0	1.0
35	0.1	A/3216-18	T492A104(1)035(2)(3)(4)	CWR11M(6)104(1)(2)(5)	0.0	4.0	24.0	1.0
35	0.15	A/3216-18	T492A154(1)035(2)(3)(4)	CWR11M(6)154(1)(2)(5)	0.1	4.0	21.0	1.0
35	0.22	A/3216-18	T492A224(1)035(2)(3)(4)	CWR11M(6)224(1)(2)(5)	0.1	4.0	18.0	1.0
35	0.33	A/3216-18	T492A334(1)035(2)(3)(4)	CWR11M(6)334(1)(2)(5)	0.1	4.0	15.0	1.0
35	0.47	B/3528-21	T492B474(1)035(2)(3)(4)	CWR11M(6)474(1)(2)(5)	0.2	4.0	10.0	1.0
35	0.68	B/3528-21	T492B684(1)035(2)(3)(4)	CWR11M(6)684(1)(2)(5)	0.2	4.0	8.0	1.0
35	1	B/3528-21	T492B105(1)035(2)(3)(4)	CWR11M(6)105(1)(2)(5)	0.4	4.0	6.5	1.0
35	1.5	C/6032-28	T492C155(1)035(2)(3)(4)	CWR11M(6)155(1)(2)(5)	0.5	6.0	4.5	1.0
35	2.2	C/6032-28	T492C225(1)035(2)(3)(4)	CWR11M(6)225(1)(2)(5)	0.8	6.0	3.5	1.0
35	3.3	C/6032-28	T492C335(1)035(2)(3)(4)	CWR11M(6)335(1)(2)(5)	1.2	6.0	2.5	1.0
35	4.7	D/7343-31	T492D475(1)035(2)(3)(4)	CWR11M(6)475(1)(2)(5)	1.6	6.0	1.5	1.0
35	6.8	D/7343-31	T492D685(1)035(2)(3)(4)	CWR11M(6)685(1)(2)(5)	2.4	6.0	1.3	1.0
50	0.1	A/3216-18	T492A104(1)050(2)(3)(4)	CWR11N(6)104(1)(2)(5)	0.1	6.0	22.0	1.0
50	0.15	B/3528-21	T492B154(1)050(2)(3)(4)	CWR11N(6)154(1)(2)(5)	0.1	4.0	17.0	1.0
50	0.22	B/3528-21	T492B224(1)050(2)(3)(4)	CWR11N(6)224(1)(2)(5)	0.1	4.0	14.0	1.0
50	0.33	B/3528-21	T492B334(1)050(2)(3)(4)	CWR11N(6)334(1)(2)(5)	0.2	4.0	12.0	1.0
50	0.47	C/6032-28	T492C474(1)050(2)(3)(4)	CWR11N(6)474(1)(2)(5)	0.2	4.0	8.0	1.0
50	0.68	C/6032-28	T492C684(1)050(2)(3)(4)	CWR11N(6)684(1)(2)(5)	0.3	4.0	7.0	1.0
50	1	C/6032-28	T492C105(1)050(2)(3)(4)	CWR11N(6)105(1)(2)(5)	0.5	4.0	6.0	1.0
50	1.5	D/7343-31	T492D155(1)050(2)(3)(4)	CWR11N(6)155(1)(2)(5)	0.8	6.0	4.0	1.0
50	2.2	D/7343-31	T492D225(1)050(2)(3)(4)	CWR11N(6)225(1)(2)(5)	1.1	6.0	2.5	1.0
50	3.3	D/7343-31	T492D335(1)050(2)(3)(4)	CWR11N(6)335(1)(2)(5)	1.7	6.0	2.0	1.0
50	4.7	D/7343-31	T492D475(1)050(2)(3)(4)	CWR11N(6)475(1)(2)(5)	2.4	6.0	1.5	1.0
VDC	µF	KEMET/EIA	(see below for part options)	(see below for part options)	max/5min	% Max	Ohms	J-STD-020D
85°C	120Hz	KEMET/EIA	(see below for part options)	(see below for part options)	µAmps +20°C	+20°C 120Hz	+20°C 100kHz	Temp≤260°C
Rated Voltage	Rated Cap	Case Code/ Case Size	KEMET Part Number	MIL-C-55365/4F 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%/1000Hrs), C (0.01%/1000Hrs), D (0.001%/1000Hrs) 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.

## Recommended Voltage Derating Guidelines



## Ripple Current/Ripple Voltage

Case Code		Maximum Power Dissipation (Pmax) mWatts @ 25°C w/+20°C Rise
KEMET	EIA	
A	3216-18	75
B	3528-21	85
C	6032-28	110
D	7343-31	150
X	7343-43	165
E	7260-38	200
R	2012-12	25
S	3216-12	60
T	3528-12	70
U	6032-15	90
V	7343-20	125
T510X	7343-43	270
T510E	7260-38	285

Temperature Compensation Multipliers for Maximum Power Dissipation		
≤25°C	85°C	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.

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

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

*I* = rms ripple current (amperes)

*E* = rms ripple voltage (volts)

*P*<sub>max</sub> = maximum power dissipation(watts)

*R* = ESR 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	X	Y	C	V1	V2	X	Y	C	V1	V2	X	Y	C	V1
A	3216-18		1.35	2.15	1.45	6.10	2.80	1.25	1.75	1.35	5.00	2.30	1.15	1.35	1.25	4.10	2.00
B	3528-21		2.35	2.15	1.45	6.10	4.00	2.25	1.75	1.35	5.00	3.50	2.15	1.35	1.25	4.10	3.20
C	6032-28		2.35	2.65	2.60	8.90	4.40	2.25	2.25	2.50	7.80	3.90	2.15	1.85	2.40	6.90	3.60
D	7343-31		2.55	3.75	2.70	10.20	5.50	2.45	3.35	2.60	9.10	5.00	2.35	2.95	2.50	8.20	4.70

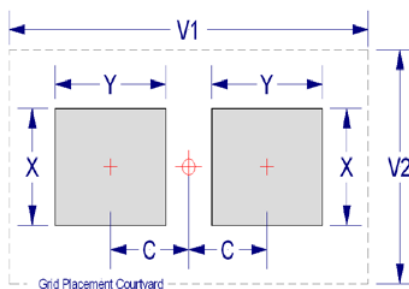
**Density Level A:** For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes.

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

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

<sup>1</sup> Height of these chips may create problems in wave soldering.

<sup>2</sup> 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.

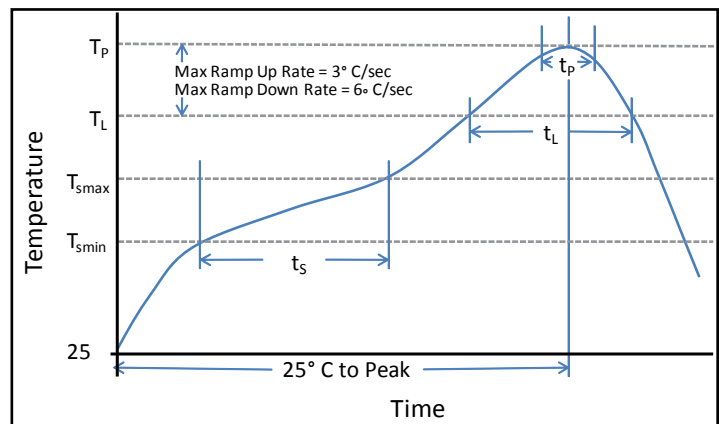
During typical reflow operations, a slight darkening of the gold-colored epoxy may be observed. This slight darkening is normal and is not harmful to the product. Marking permanency is not affected by this change.

Profile Feature	SnPb Assembly	Pb-Free Assembly
<b>Preheat/Soak</b>		
Temperature Min ( $T_{Smin}$ )	100°C	150°C
Temperature Max ( $T_{Smax}$ )	150°C	200°C
Time ( $t_s$ ) from $T_{Smin}$ to $T_{Smax}$	60–120 sec	60–120 sec
Ramp-up Rate ( $T_L$ to $T_p$ )	3°C/sec max	3°C/sec max
Liquidous Temperature ( $T_L$ )	183°C	217°C
Time Above Liquidous ( $t_L$ )	60–150 sec	60–150 sec
Peak Temperature ( $T_p$ )	220°C* 235°C**	250°C* 260°C**
Time within 5°C of Max Peak Temperature ( $t_p$ )	20 sec max	30 sec max
Ramp-down Rate ( $T_p$ to $T_L$ )	6°C/sec max	6°C/sec max
Time 25°C to Peak Temperature	6 minutes max	8 minutes max

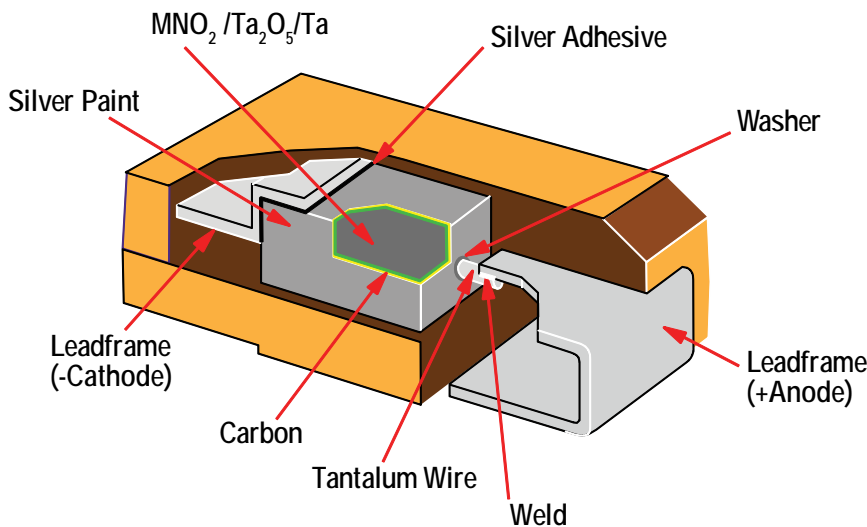
Note: All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow.

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

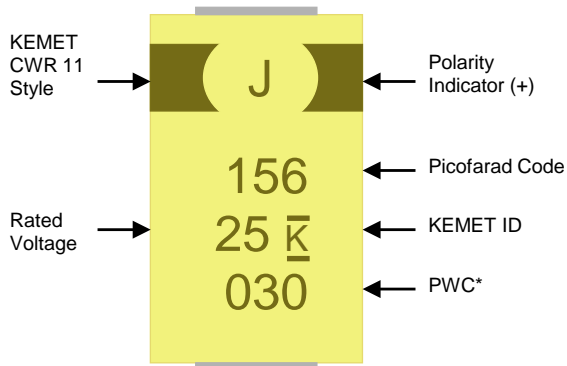
\*\*Case Size A, B, C, H, I, K, M, R, S, T, U, V, W and Z



## Construction



## Capacitor Marking



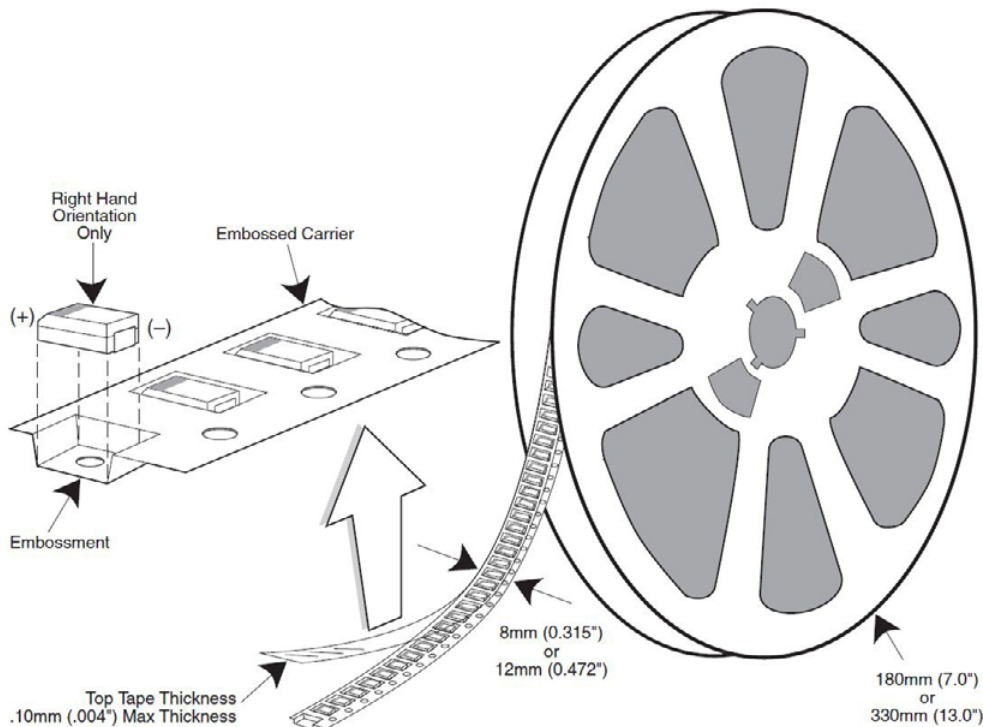
\* 030 = 30<sup>th</sup> week of 2010

## 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 40°C, and maximum storage humidity not exceed 60% relative humidity. In addition, temperature fluctuations should be minimized to avoid condensation on the parts, and atmospheres should be free of chlorine and 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 mm and 12 mm plastic tape on 7" and 13" reels, in accordance with EIA Standard 481-D: Taping of Surface Mount Components for Automatic Handling. This packaging system is compatible with all tape fed automatic pick and place systems.

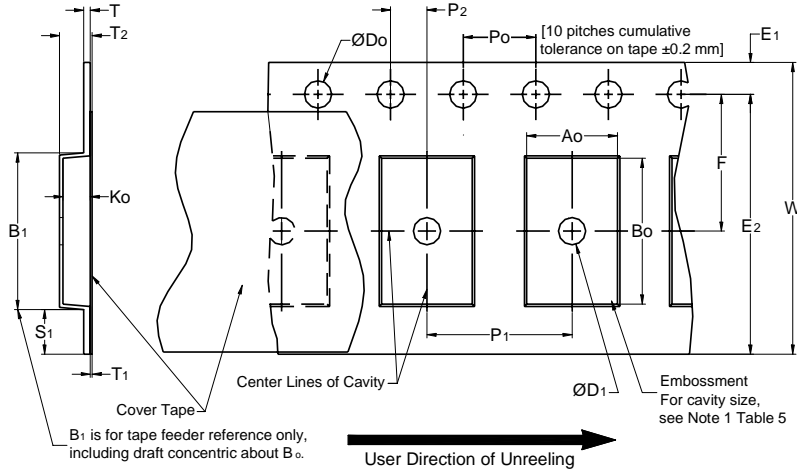


**Table 3 – Packaging Quantity**

Case Code		Tape Width-mm	7" Reel*	13" Reel*
KEMET	EIA			
R	2012-12	8	2,500	10,000
I	3216-10	8	3,000	12,000
S	3216-12	8	2,500	10,000
T	3528-12	8	2,500	10,000
M	3528-15	8	2,000	8,000
U	6032-15	12	1,000	5,000
L	6032-19	12	1,000	5,000
W	7343-15	12	1,000	3,000
Z	7343-17	12	1,000	3,000
V	7343-20	12	1,000	3,000
A	3216-18	8	2,000	9,000
B	3528-21	8	2,000	8,000
C	6032-28	12	500	3,000
D	7343-31	12	500	2,500
Y	7343-40	12	500	2,000
X	7343-43	12	500	2,000
E	7260-38	12	500	2,000

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

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



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

Metric will govern

Constant Dimensions — Millimeters (Inches)									
Tape Size	$D_0$	$D_1$ Min. Note 1	$E_1$	$P_0$	$P_2$	R Ref. Note 2	$S_1$ Min. Note 3	T Max.	$T_1$ Max.
8mm	$1.5 +0.10/-0.0$ (0.059 +0.004/-0.0)	1.0 (0.039)	$1.75 \pm 0.10$ (0.069 ± 0.004)	$4.0 \pm 0.10$ (0.157 ± 0.004)	$2.0 \pm 0.05$ (0.079 ± 0.002)	25.0 (0.984)	0.600 (0.024)	0.600 (0.024)	0.100 (0.004)
12mm		1.5 (0.059)				30 (1.181)			
16mm									
Variable Dimensions — Millimeters (Inches)									
Tape Size	Pitch	$B_1$ Max. Note 4	$E_2$ Min.	F	$P_1$	$T_2$ Max	W Max	$A_0, B_0$ & $K_0$	
8mm	Single (4mm)	4.35 (0.171)	6.25 (0.246)	$3.5 \pm 0.05$ (0.138 ± 0.002)	$4.0 \pm 0.10$ (0.157 ± 0.004)	2.5 (0.098)	8.3 (0.327)	Note 5	
12mm	Single (4mm) & Double (8mm)	8.2 (0.323)	10.25 (0.404)	$5.5 \pm 0.05$ (0.217 ± 0.002)	$8.0 \pm 0.10$ (0.315 ± 0.004)	4.6 (0.181)	12.3 (0.484)		
16mm	Triple (12mm)	12.1 (0.476)	14.25 (0.561)	$5.5 \pm 0.05$ (0.217 ± 0.002)	$8.0 \pm 0.10$ (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 Document 481 paragraph 4.3 (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 12mm tapes and 10° maximum for 16mm tapes (see Figure 3).
  - (d) lateral movement of the component is restricted to 0.5 mm maximum for 8mm and 12mm wide tape and to 1.0mm maximum for 16mm tape (see Figure 4).
  - (e) see Addendum in EIA Document 481 for standards relating to more precise taping requirements.

## Packaging Information Performance Notes

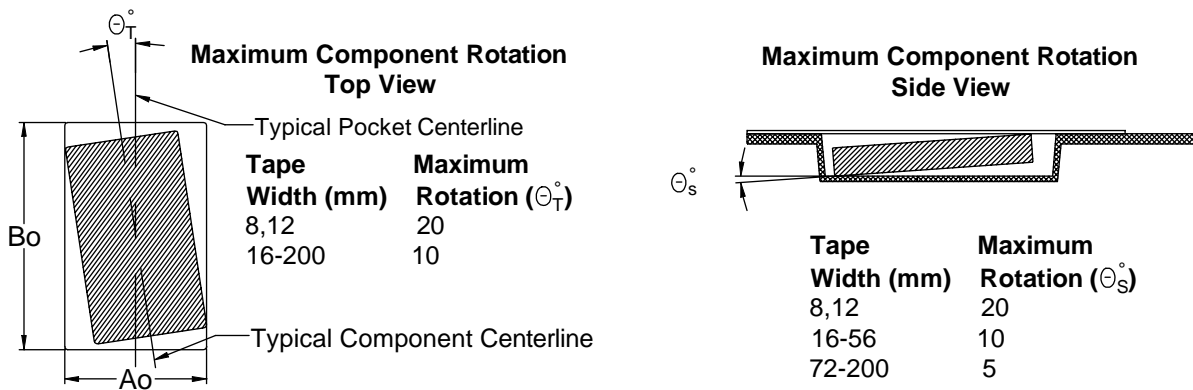
1. **Cover Tape Break Force:** 1.0 Kg minimum.
2. **Cover Tape Peel Strength:** The total peel strength of the cover tape from the carrier tape shall be:

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

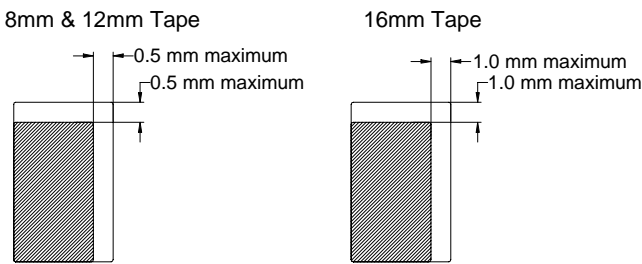
The direction of the pull shall be opposite the direction of the carrier tape travel. The pull angle of the carrier tape shall be 165° to 180° from the plane of the carrier tape. During peeling, the carrier and/or cover tape shall be pulled at a velocity of 300±10 mm/minute.

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

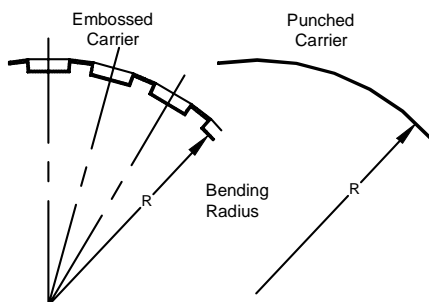
## Figure 2 – Maximum Component Rotation



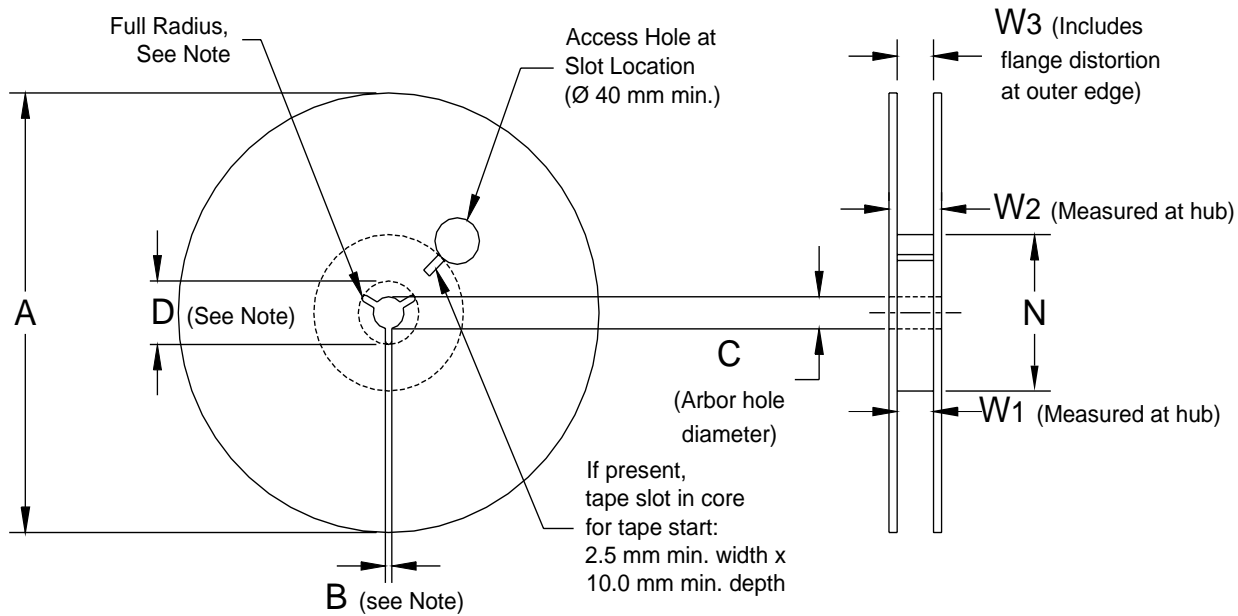
## Figure 3 – Maximum Lateral Movement



## Figure 4 – Bending Radius



**Figure 5 – Reel Dimensions**

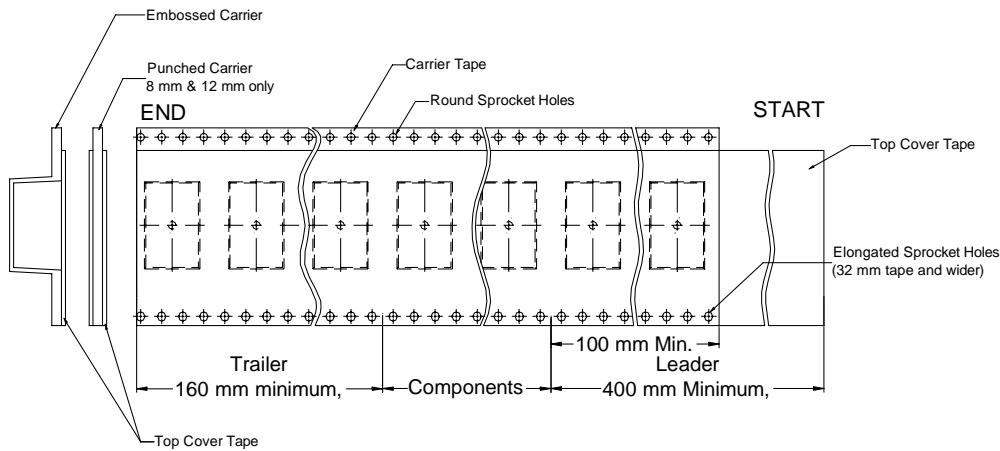


**Table 5 – Reel Dimensions**

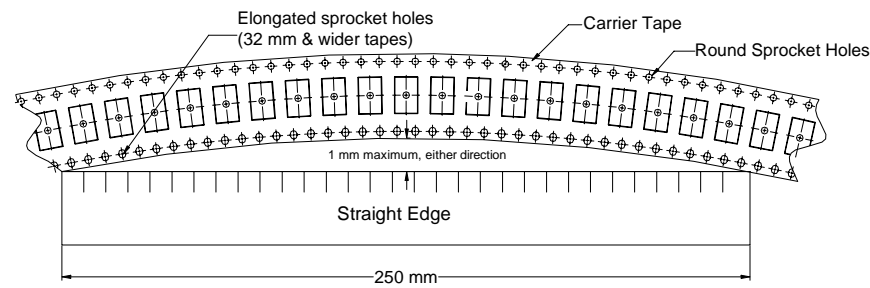
Metric will govern

Constant Dimensions — Millimeters (Inches)				
Tape Size	A	B Min	C	D Min
8mm	178 ± 0.20 (7.008 ± 0.008)	1.5 (0.059)	13.0 +0.5/-0.2 (0.521 +0.02/-0.008)	20.2 (0.795)
12mm	or			
16mm	330 ± 0.20 (13.000 ± 0.008)			
Variable Dimensions — Millimeters (Inches)				
Tape Size	N Min	W <sub>1</sub>	W <sub>2</sub> Max	W <sub>3</sub>
8mm	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
12mm		12.4 +2.0/-0.0 (0.488 +0.078/-0.0)	18.4 (0.724)	
16mm		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**



## KEMET Corporation World Headquarters

2835 KEMET Way  
Simpsonville, SC 29681

Mailing Address:  
P.O. Box 5928  
Greenville, SC 29606

www.kemet.com  
Tel: 864-963-6300  
Fax: 864-963-6521

### Corporate Offices

Fort Lauderdale, FL  
Tel: 954-766-2800

## North America

### Southeast

Lake Mary, FL  
Tel: 407-855-8886

### Northeast

Wilmington, MA  
Tel: 978-658-1663

West Chester, PA  
Tel: 610-692-4642

### Central

Schaumburg, IL  
Tel: 847-882-3590

Carmel, IN  
Tel: 317-706-6742

### West

Milpitas, CA  
Tel: 408-433-9950

### Mexico

Zapopan, Jalisco  
Tel: 52-33-3123-2141

## Europe

### Southern Europe

Geneva, Switzerland  
Tel: 41-22-715-0100

Paris, France  
Tel: 33-1-4646-1009

Sasso Marconi, Italy  
Tel: 39-051-939111

Milan, Italy  
Tel: 39-02-57518176

Rome, Italy  
Tel: 39-06-23231718

Madrid, Spain  
Tel: 34-91-804-4303

### Central Europe

Landsberg, Germany  
Tel: 49-8191-3350800

Dortmund, Germany  
Tel: 49-2307-3619672

Kwidzyn, Poland  
Tel: 48-55-279-7025

### Northern Europe

Bishop's Stortford, United Kingdom  
Tel: 44-1279-757201

Weymouth, United Kingdom  
Tel: 44-1305-830747

Coatbridge, Scotland  
Tel: 44-1236-434455

Färjestaden, Sweden  
Tel: 46-485-563934

Espoo, Finland  
Tel: 358-9-5406-5000

## Asia

### Northeast Asia

Hong Kong  
Tel: 852-2305-1168

Shenzhen, China  
Tel: 86-755-2518-1306

Beijing, China  
Tel: 86-10-5829-1711

Shanghai, China  
Tel: 86-21-6447-0707

Taipei, Taiwan  
Tel: 886-2-27528585

### Southeast Asia

Singapore  
Tel: 65-6586-1900

Penang, Malaysia  
Tel: 60-4-6430200

Bangalore, India  
Tel: 91-806-53-76817

*Note: KEMET reserves the right to modify minor details of internal and external construction at any time in the interest of product improvement. KEMET does not assume any responsibility for infringement that might result from the use of KEMET Capacitors in potential circuit designs. KEMET is a registered trademark of KEMET Electronics Corporation.*



## Other KEMET Resources

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

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

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

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

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

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

