

Overview

KEMET's Space Grade Series of capacitors are suitable for use by military/aerospace customers in high reliability space applications. This series meets the requirements of MIL-PRF-55365 as well as MIL-STD-1580. These capacitors incorporate an intensive testing and screening protocol which is customizable depending on specific customer requirements. The full part number allows for designation of Weibull grading level (C=0.01%/k hours),

surge current level (10 cycles -55°C and +85°C before and/or after Weibull grading), performance testing level (see chart for details on available options), ESR (low and standard), and termination finish (see description in each series). Fused versions are available for built-in circuit protection, as well as multi-anode designs for very low ESR values.

Benefits

- Internal fuse protects against damaging short circuit failure mode
- Standard case sizes B, C, D, X per EIA 535BAAC
- 100% surge current test available
- Optional gold-plated terminations
- Operating temperature range of -55°C to +125°C
- Fuse activation, 25°C: within 1 second at fault currents of 4 amps and higher
- Continuous current capability: 0.75 amps
- Post actuation resistance, 25°C: 10 MΩ, minimum
- Test tabs on side of case bypass the capacitor element to allow direct testing of the fuse assembly
- RoHS Compliant and lead-free terminations
- Weibull Grading C (0.01%/1,000 hours)
- Capacitance values of 0.15 μF to 470 μF
- Voltage rating of 4 – 50 VDC



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 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	496	X	227	M	010	C	T	2	A
Capacitor Class	Series	Case Size	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Failure Rate/Design	Lead Material	ESR	Testing
T = Tantalum	Fail Safe - Space Grade	B = 3528-21 C = 6032-28 D = 7343-31 X = 7343-43	First two digits represent significant figures. Third digit specifies number of zeros.	K = ±10% M = ±20%	004 = 4 V 006 = 6.3 V 010 = 10 V 016 = 16 V 020 = 20 V 025 = 25 V 035 = 35 V 050 = 50 V	C = .01%/1,000 hours	T = 100% Matte Tin (Sn) Plated H = Standard Solder Coated (SnPb 5% Pb minimum)	1 = ESR - Standard 2 = ESR - Low	A = Option A B = Option B C = Option C

Applications

Typical applications include decoupling and filtering in computing and telecommunications end applications, such as high-end servers requiring built-in fuse capability.

Performance Characteristics

Item	Performance Characteristics
Operating Temperature	-55°C to 125°C
Rated Capacitance Range	0.15 – 477 µF @ 120 Hz/25°C
Capacitance Tolerance	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	≤ 0.01CV (µA) at rated voltage after 5 minutes

Qualification

Test	Condition	Characteristics				
Endurance	85°C @ rated voltage, 2,000 hours 125°C @ 2/3 rated voltage, 2,000 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, 2,000 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, 1,000 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
Surge Voltage	25°C and 85°C, 1.32 x rated voltage 1,000 cycles. (125°C, 1.2 x rated voltage)	DCL	IL			
		ESR	n/a			
		DCL	10 x IL			
Mechanical Shock/Vibration	MIL-STD-202, Method 213, Condition I, 100 G peak. MIL-STD-202, Method 204, Condition D, 10 Hz to 2,000 Hz, 20 G peak	ΔC/C	Within ±10% of initial value			
		DF	Within initial limits			
		DCL	Within initial limits			

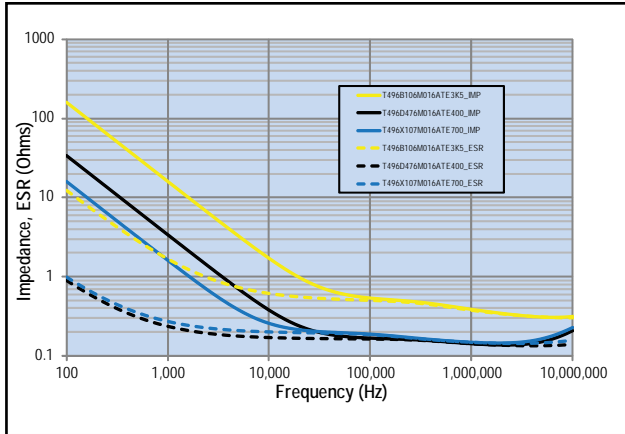
*IL = Initial Limit

Certification

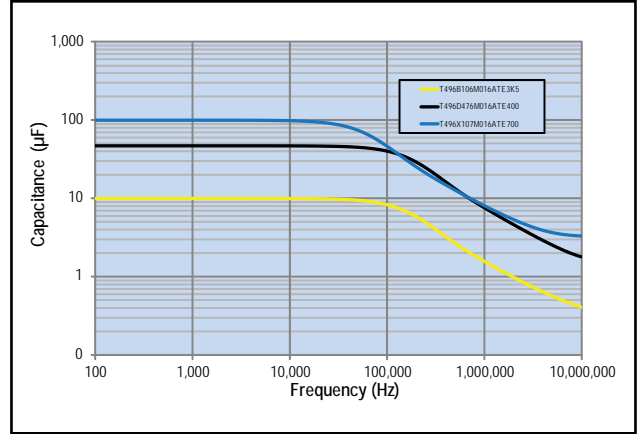
DSCC Drawing 04053

Electrical Characteristics

ESR vs. Frequency

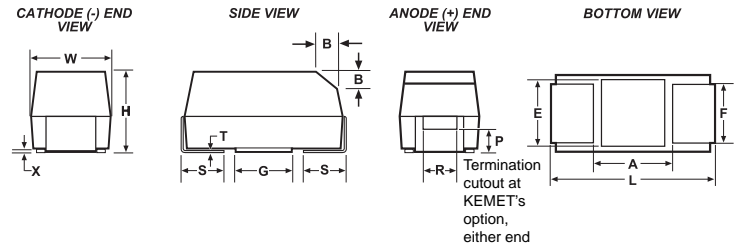


Capacitance vs. Frequency



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)
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)
X	7343-43	7.3 ± 0.3 (.287 ± .012)	4.3 ± 0.3 (.169 ± .012)	4.0 ± 0.3 (.157 ± .012)	2.4 (.094)	1.3 (.051)	0.5 (.020)	0.10 ± 0.10 (.004 ± .004)	1.7 (.067)	1.0 (.039)	0.13 (.005)	3.8 (.150)	3.5 (.138)	3.5 (.138)

Notes: (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	DC Leakage	DF	Standard ESR	Low ESR	Moisture Sensitivity
85°C	120Hz	KEMET/EIA	(See below for part options)	μAmps +20°C	+20°C 120Hz	+20°C 100kHz	+20°C 100kHz	Temp≤260°C
VDC	μF			max/5min	% Max	Ohms	Ohms	J-STD-020D
4	68	C	T496C686(1)004(2)(3)(4)(5)(6)	2.7	6	1.6	0.4	1
4	100	C	T496C107(1)004(2)(3)(4)(5)(6)	4	8	1.2	N/A	1
4	150	C	T496C157(1)004(2)(3)(4)(5)(6)	6	8	1.2	N/A	1
4	150	D	T496D157(1)004(2)(3)(4)(5)(6)	6	8	0.8	N/A	1
4	220	D	T496D227(1)004(2)(3)(4)(5)(6)	8.8	8	0.7	0.4	1
4	330	D	T496D337(1)004(2)(3)(4)(5)(6)	13.2	8	0.7	0.4	1
4	330	X	T496X337(1)004(2)(3)(4)(5)(6)	13.2	8	0.7	N/A	1
4	470	X	T496X477(1)004(2)(3)(4)(5)(6)	18.8	8	0.5	N/A	1
6.3	4.7	B	T496B475(1)006(2)(3)(4)(5)(6)	0.5	6	3.5	N/A	1
6.3	6.8	B	T496B685(1)006(2)(3)(4)(5)(6)	0.5	6	3.5	N/A	1
6.3	10	B	T496B106(1)006(2)(3)(4)(5)(6)	0.6	6	3.5	N/A	1
6.3	22	B	T496B226(1)006(2)(3)(4)(5)(6)	1.3	6	3.5	1.5	1
6.3	15	C	T496C156(1)006(2)(3)(4)(5)(6)	0.9	6	2	N/A	1
6.3	22	C	T496C226(1)006(2)(3)(4)(5)(6)	1.4	6	2	N/A	1
6.3	33	C	T496C336(1)006(2)(3)(4)(5)(6)	2	6	2	0.6	1
6.3	47	C	T496C476(1)006(2)(3)(4)(5)(6)	2.9	6	1.6	0.6	1
6.3	47	D	T496D476(1)006(2)(3)(4)(5)(6)	2.9	6	1	N/A	1
6.3	68	C	T496C686(1)006(2)(3)(4)(5)(6)	4.1	6	1.2	N/A	1
6.3	68	D	T496D686(1)006(2)(3)(4)(5)(6)	4.1	6	1	N/A	1
6.3	100	C	T496C107(1)006(2)(3)(4)(5)(6)	6	8	0.4	N/A	1
6.3	100	D	T496D107(1)006(2)(3)(4)(5)(6)	6	8	0.8	0.4	1
6.3	100	X	T496X107(1)006(2)(3)(4)(5)(6)	6	8	0.9	0.3	1
6.3	150	D	T496D157(1)006(2)(3)(4)(5)(6)	9	8	0.7	0.3	1
6.3	150	X	T496X157(1)006(2)(3)(4)(5)(6)	9	8	0.3	N/A	1
6.3	220	X	T496X227(1)006(2)(3)(4)(5)(6)	13.2	8	0.7	0.3	1
6.3	220	D	T496D227(1)006(2)(3)(4)(5)(6)	13.2	8	0.7	0.3	1
6.3	330	X	T496X337(1)006(2)(3)(4)(5)(6)	19.8	8	0.5	0.3	1
10	3.3	B	T496B335(1)010(2)(3)(4)(5)(6)	0.5	6	3.5	N/A	1
10	4.7	B	T496B475(1)010(2)(3)(4)(5)(6)	0.5	6	3.5	N/A	1
10	6.8	B	T496B685(1)010(2)(3)(4)(5)(6)	0.7	6	3.5	N/A	1
10	10	C	T496C106(1)010(2)(3)(4)(5)(6)	1	6	2	N/A	1
10	15	B	T496B156(1)010(2)(3)(4)(5)(6)	1.5	6	3.5	N/A	1
10	15	C	T496C156(1)010(2)(3)(4)(5)(6)	1.5	6	2	0.6	1
10	22	C	T496C226(1)010(2)(3)(4)(5)(6)	2.2	6	2	0.5	1
10	33	C	T496C336(1)010(2)(3)(4)(5)(6)	3.3	6	1.6	0.4	1
10	33	D	T496D336(1)010(2)(3)(4)(5)(6)	3.3	6	1	0.4	1
10	47	C	T496C476(1)010(2)(3)(4)(5)(6)	4.7	6	1.2	0.4	1
10	47	D	T496D476(1)010(2)(3)(4)(5)(6)	4.7	6	1	0.4	1
10	68	D	T496D686(1)010(2)(3)(4)(5)(6)	6.8	6	0.8	0.4	1
10	68	X	T496X686(1)010(2)(3)(4)(5)(6)	6.8	6	0.9	N/A	1
10	100	D	T496D107(1)010(2)(3)(4)(5)(6)	10	8	0.7	0.4	1
10	100	X	T496X107(1)010(2)(3)(4)(5)(6)	10	8	0.4	N/A	1
10	150	D	T496D157(1)010(2)(3)(4)(5)(6)	15	8	0.7	0.4	1
10	150	X	T496X157(1)010(2)(3)(4)(5)(6)	15	8	0.7	0.4	1
10	220	X	T496X227(1)010(2)(3)(4)(5)(6)	22	8	0.5	0.3	1
16	2.2	B	T496B225(1)016(2)(3)(4)(5)(6)	0.5	6	3.5	3.5	1
VDC	μF	KEMET/EIA	(See below for part options)	max/5min	% Max	Ohms	Ohms	J-STD-020D
85°C	120Hz			μAmps +20°C	+20°C 120Hz	+20°C 100kHz	+20°C 100kHz	Temp≤260°C
Rated voltage	Rated Cap	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	Standard ESR	Low ESR	Moisture Sensitivity

- (1) To complete KEMET part number, insert M for ±20%, K for ±10%. Designates Capacitance tolerance.
 - (2) To complete KEMET part number, insert C (0.01%/1,000 hours). Designates Reliability Level.
 - (3) To complete KEMET part number, insert H = Solder Plated or T = 100% Tin (Sn). Designates Termination Finish.
 - (4) To complete KEMET part number, insert 61 = None, 62 = 10 cycles +25°C, 63 = 10 cycles -55°C +85°C after Weibull, 64 = 10 cycles -55°C +85°C before Weibull or 65 = Both. Designates Surge current option.
 - (5) To complete KEMET part number, insert 1 = Standard ESR, 2 = Low ESR. Designates ESR option.
 - (6) To complete KEMET part number, insert A = Option 1, B = Option 2 or C = Option 3. Designates Test Option. See Space Grade Test Methods chart for more information.
- Refer to Ordering Information for additional detail.

Table 1 – Ratings & Part Number Reference cont'd

Rated voltage	Rated Cap	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	Standard ESR	Low ESR	Moisture Sensitivity
				μ Amps +20°C max/5min	+20°C 120Hz % Max	+20°C 100kHz Ohms	+20°C 100kHz Ohms	Temp \leq 260°C J-STD-020D
85°C VDC	120Hz μ F	KEMET/EIA	(See below for part options)					
16	3.3	B	T496B335(1)016(2)(3)(4)(5)(6)	0.5	6	3.5	2.1	1
16	4.7	B	T496B475(1)016(2)(3)(4)(5)(6)	0.8	6	3.5	1.6	1
16	6.8	C	T496C685(1)016(2)(3)(4)(5)(6)	1.1	6	2	0.6	1
16	10	C	T496C106(1)016(2)(3)(4)(5)(6)	1.6	6	2	0.7	1
16	15	C	T496C156(1)016(2)(3)(4)(5)(6)	2.4	6	2	0.6	1
16	22	C	T496C226(1)016(2)(3)(4)(5)(6)	3.6	6	1.6	1	1
16	22	D	T496D226(1)016(2)(3)(4)(5)(6)	3.6	6	1	0.5	1
16	33	D	T496D336(1)016(2)(3)(4)(5)(6)	5.3	6	1	0.4	1
16	47	D	T496D476(1)016(2)(3)(4)(5)(6)	7.5	6	0.8	0.4	1
16	47	X	T496X476(1)016(2)(3)(4)(5)(6)	7.5	6	0.9	0.4	1
16	68	D	T496D686(1)016(2)(3)(4)(5)(6)	10.9	8	0.4	N/A	1
20	1.5	B	T496B155(1)020(2)(3)(4)(5)(6)	0.5	6	5	N/A	1
20	2.2	B	T496B225(1)020(2)(3)(4)(5)(6)	0.5	6	3.5	1.6	1
20	4.7	C	T496C475(1)020(2)(3)(4)(5)(6)	1	6	2	N/A	1
20	6.8	C	T496C685(1)020(2)(3)(4)(5)(6)	1.4	6	2	0.6	1
20	10	C	T496C106(1)020(2)(3)(4)(5)(6)	2	6	2	0.8	1
20	15	C	T496C156(1)020(2)(3)(4)(5)(6)	3	6	0.5	N/A	1
20	15	D	T496D156(1)020(2)(3)(4)(5)(6)	3	6	1	0.5	1
20	22	D	T496D226(1)020(2)(3)(4)(5)(6)	4.4	6	1	0.5	1
20	33	D	T496D336(1)020(2)(3)(4)(5)(6)	6.6	6	0.4	0.4	1
20	33	X	T496X336(1)020(2)(3)(4)(5)(6)	6.6	6	0.9	0.4	1
25	0.68	B	T496B684(1)025(2)(3)(4)(5)(6)	0.5	4	6.5	N/A	1
25	1	B	T496B105(1)025(2)(3)(4)(5)(6)	0.5	4	5	3.5	1
25	1.5	B	T496B155(1)025(2)(3)(4)(5)(6)	0.5	6	5	1.6	1
25	2.2	C	T496C225(1)025(2)(3)(4)(5)(6)	0.6	6	3.5	N/A	1
25	3.3	C	T496C335(1)025(2)(3)(4)(5)(6)	0.9	6	2.5	2.1	1
25	4.7	B	T496B475(1)025(2)(3)(4)(5)(6)	1.2	6	4	N/A	1
25	4.7	C	T496C475(1)025(2)(3)(4)(5)(6)	1.2	6	2.5	1.3	1
25	6.8	C	T496C685(1)025(2)(3)(4)(5)(6)	1.7	6	2	0.6	1
25	10	D	T496D106(1)025(2)(3)(4)(5)(6)	2.5	6	1.2	0.6	1
25	15	C	T496C156(1)025(2)(3)(4)(5)(6)	3.8	6	0.75	N/A	1
25	15	D	T496D156(1)025(2)(3)(4)(5)(6)	3.8	6	1	0.5	1
25	22	D	T496D226(1)025(2)(3)(4)(5)(6)	5.5	6	0.8	0.4	1
25	22	X	T496X226(1)025(2)(3)(4)(5)(6)	5.5	6	0.9	0.4	1
35	0.47	B	T496B474(1)035(2)(3)(4)(5)(6)	0.5	4	8	2.6	1
35	0.68	B	T496B684(1)035(2)(3)(4)(5)(6)	0.5	4	6.5	N/A	1
35	1	B	T496B105(1)035(2)(3)(4)(5)(6)	0.5	4	5	3.1	1
35	1.5	C	T496C155(1)035(2)(3)(4)(5)(6)	0.5	6	4.5	2.6	1
35	2.2	C	T496C225(1)035(2)(3)(4)(5)(6)	0.8	6	3.5	1.6	1
35	3.3	C	T496C335(1)035(2)(3)(4)(5)(6)	1.2	6	2.5	0.9	1
35	4.7	D	T496D475(1)035(2)(3)(4)(5)(6)	1.7	6	1.5	0.7	1
35	6.8	D	T496D685(1)035(2)(3)(4)(5)(6)	2.4	6	1.3	0.75	1
35	10	D	T496D106(1)035(2)(3)(4)(5)(6)	3.5	6	0.5	N/A	1
35	10	X	T496X106(1)035(2)(3)(4)(5)(6)	3.5	6	1	0.5	1
35	15	D	T496D156(1)035(2)(3)(4)(5)(6)	5.3	6	0.5	N/A	1
35	15	X	T496X156(1)035(2)(3)(4)(5)(6)	5.3	6	0.9	0.9	1
VDC	μ F	KEMET/EIA	(See below for part options)	max/5min	% Max	Ohms	Ohms	J-STD-020D
85°C	120Hz			μ Amps +20°C	+20°C 120Hz	+20°C 100kHz	+20°C 100kHz	Temp \leq 260°C
Rated voltage	Rated Cap	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	Standard ESR	Low ESR	Moisture Sensitivity

(1) To complete KEMET part number, insert M for $\pm 20\%$, K for $\pm 10\%$. Designates Capacitance tolerance.

(2) To complete KEMET part number, insert C (0.01%/1,000 hours). Designates Reliability Level.

(3) To complete KEMET part number, insert H = Solder Plated or T = 100% Tin (Sn). Designates Termination Finish.

(4) To complete KEMET part number, insert 61 = None, 62 = 10 cycles +25°C, 63 = 10 cycles -55°C +85°C after Weibull, 64 = 10 cycles -55°C +85°C before Weibull or 65 = Both. Designates Surge current option.

(5) To complete KEMET part number, insert 1 = Standard ESR, 2 = Low ESR. Designates ESR option.

(6) To complete KEMET part number, insert A = Option 1, B = Option 2 or C = Option 3. Designates Test Option. See Space Grade Test Methods chart for more information.

Refer to Ordering Information for additional detail.

Table 1 – Ratings & Part Number Reference cont'd

Rated voltage	Rated Cap	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	Standard ESR	Low ESR	Moisture Sensitivity
				μ Amps +20°C max/5min	+20°C 120Hz % Max	+20°C 100kHz Ohms	+20°C 100kHz Ohms	Temp \leq 260°C J-STD-020D
85°C VDC	120Hz μ F	KEMET/EIA	(See below for part options)					
50	0.15	B	T496B154(1)050(2)(3)(4)(5)(6)	0.5	4	16	N/A	1
50	0.22	B	T496B224(1)050(2)(3)(4)(5)(6)	0.5	4	14	10	1
50	0.33	B	T496B334(1)050(2)(3)(4)(5)(6)	0.5	4	10	2.6	1
50	0.47	C	T496C474(1)050(2)(3)(4)(5)(6)	0.5	4	8	1.9	1
50	0.68	C	T496C684(1)050(2)(3)(4)(5)(6)	0.5	4	7	1.7	1
50	1	C	T496C105(1)050(2)(3)(4)(5)(6)	0.5	4	5.5	2.7	1
50	1.5	C	T496C155(1)050(2)(3)(4)(5)(6)	0.8	6	5	2	1
50	2.2	D	T496D225(1)050(2)(3)(4)(5)(6)	1.1	6	2.5	0.9	1
50	3.3	D	T496D335(1)050(2)(3)(4)(5)(6)	1.7	6	2	1	1
50	4.7	D	T496D475(1)050(2)(3)(4)(5)(6)	2.4	6	0.4	N/A	1
50	4.7	X	T496X475(1)050(2)(3)(4)(5)(6)	2.4	6	1.5	0.4	1
VDC	μ F	KEMET/EIA	(See below for part options)	max/5min	% Max	Ohms	Ohms	J-STD-020D
85°C	120Hz			μ Amps +20°C	+20°C 120Hz	+20°C 100kHz	+20°C 100kHz	Temp \leq 260°C
Rated voltage	Rated Cap	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	Standard ESR	Low ESR	Moisture Sensitivity

(1) To complete KEMET part number, insert M for \pm 20%, K for \pm 10%. Designates Capacitance tolerance.

(2) To complete KEMET part number, insert C (0.01%/1,000 hours). Designates Reliability Level.

(3) To complete KEMET part number, insert H = Solder Plated or T = 100% Tin (Sn). Designates Termination Finish.

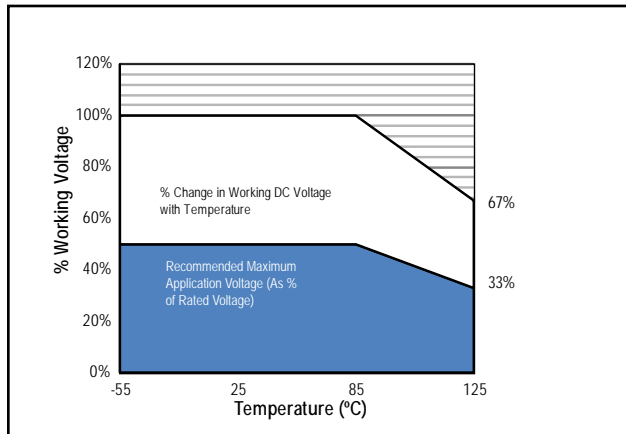
(4) To complete KEMET part number, insert 61 = None, 62 = 10 cycles +25°C, 63 = 10 cycles -55°C +85°C after Weibull, 64 = 10 cycles -55°C +85°C before Weibull or 65 = Both. Designates Surge current option.

(5) To complete KEMET part number, insert 1 = Standard ESR, 2 = Low ESR. Designates ESR option.

(6) To complete KEMET part number, insert A = Option 1, B = Option 2 or C = Option 3. Designates Test Option. See Space Grade Test Methods chart for more information.

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 max = 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
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
X ¹	7343-43	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

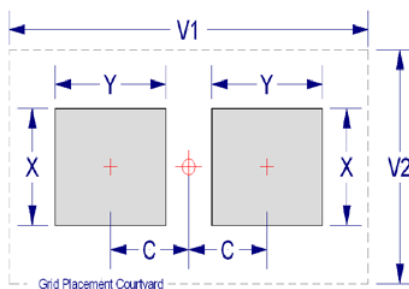
Density Level A: For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes.

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).

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.

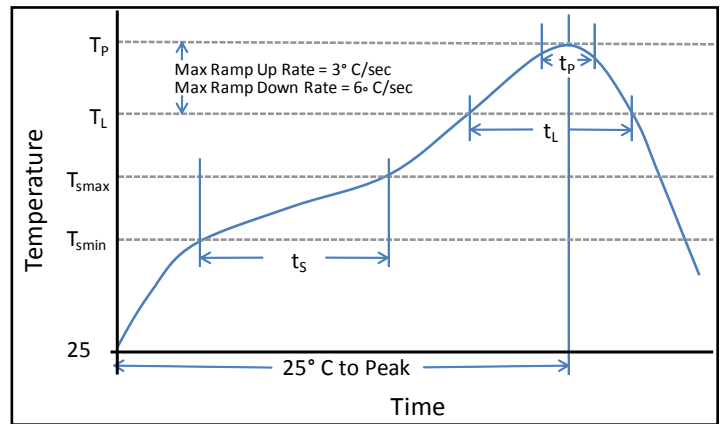
During typical reflow operations, a slight darkening of the gold-colored epoxy may be observed. This slight darkening is normal and is not harmful to the product. Marking permanency is not affected by this change.

Profile Feature	SnPb Assembly	Pb-Free Assembly
Preheat/Soak		
Temperature 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_i 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

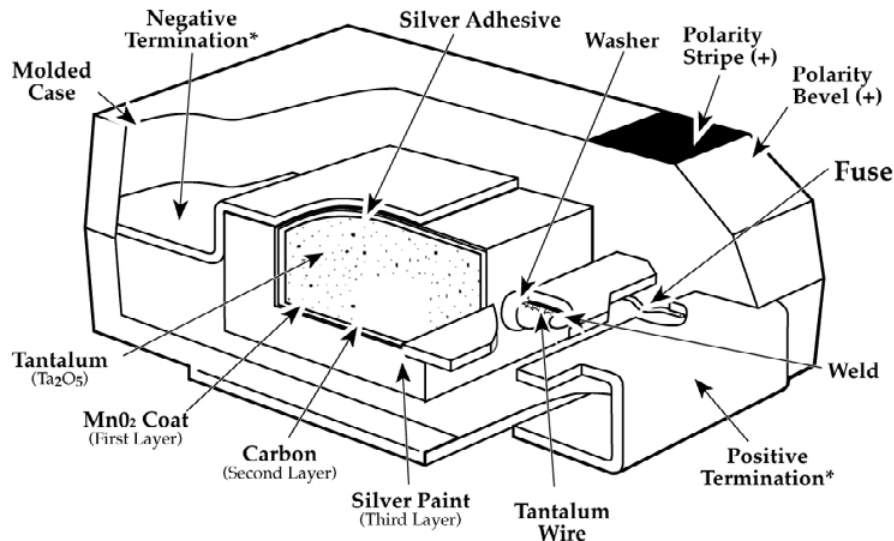
Note: All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow.

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

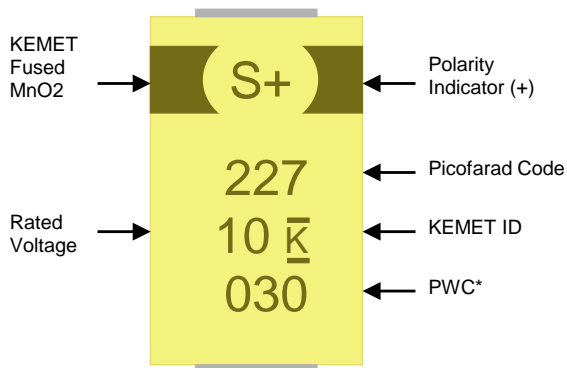
**Case Size A, B, C, H, I, K, M, R, S, T, U, V, W and Z



Construction



Capacitor Marking



* 030 = 30th 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. 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–D: Taping of Surface Mount Components for Automatic Handling. This packaging system is compatible with all tape fed automatic pick and place systems

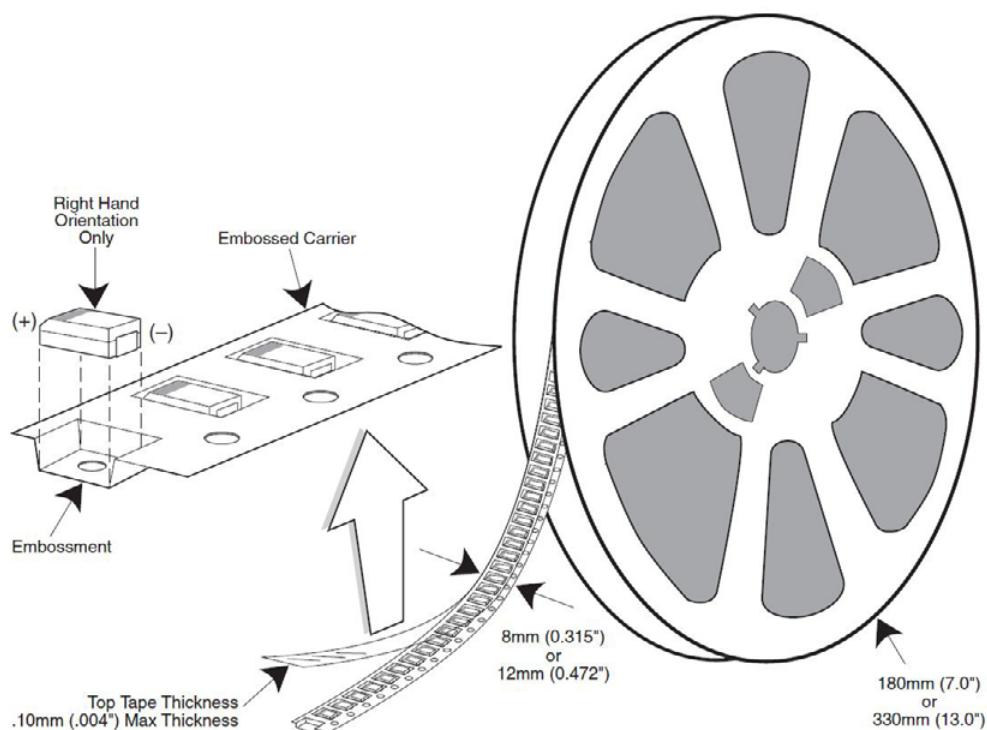


Table 3 – Packaging Quantity

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
H	7260-20	12	1,000	3,000
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

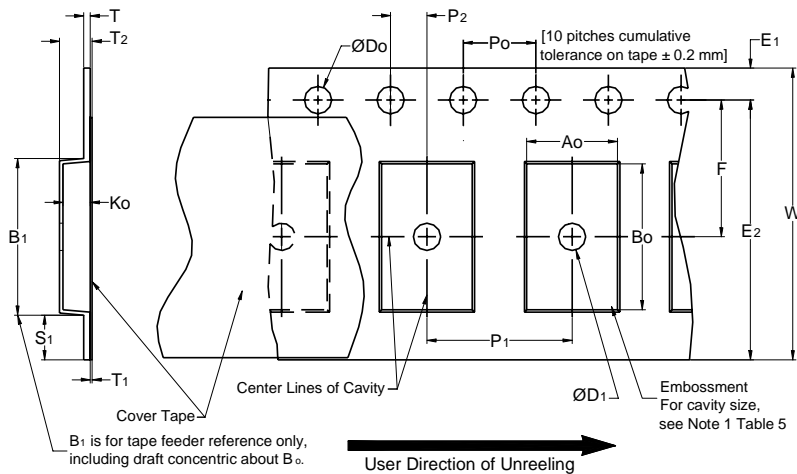


Table 4 – Embossed (Plastic) Carrier Tape Dimensions

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.
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 Max. Note 4	E ₂ Min.	F	P ₁	T ₂ Max	W Max	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)		

- The embossment hole location shall be measured from the sprocket hole controlling the location of the embossment. Dimensions of embossment location and hole location shall be applied independent of each other.
- The tape with or without components shall pass around R without damage (see Figure 5).
- If S₁ < 1.0 mm, there may not be enough area for cover tape to be properly applied (see EIA Standard 481, paragraph 4.3, section b).
- B₁ dimension is a reference dimension for tape feeder clearance only.
- The cavity defined by A₀, B₀ and K₀ shall surround the component with sufficient clearance that:
 - the component does not protrude above the top surface of the carrier tape.
 - the component can be removed from the cavity in a vertical direction without mechanical restriction, after the top cover tape has been removed.
 - rotation of the component is limited to 20° maximum for 8 and 12 mm tapes and 10° maximum for 16 mm tapes (see Figure 3).
 - 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 4).
 - see Addendum in EIA Standard 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
8 mm	0.1 to 1.0 Newton (10 to 100gf)
12 and 16 mm	0.1 to 1.3 Newton (10 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 Standards 556 and 624.

Figure 2 – Maximum Component Rotation

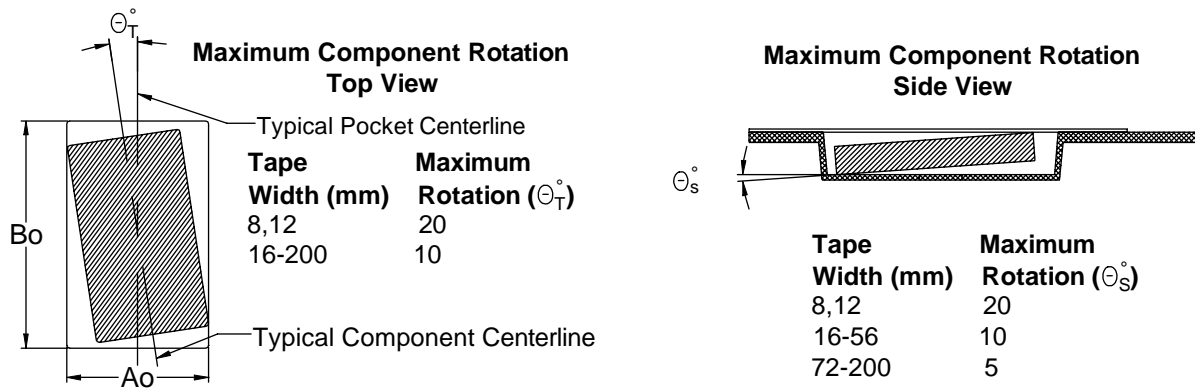


Figure 3 – Maximum Lateral Movement

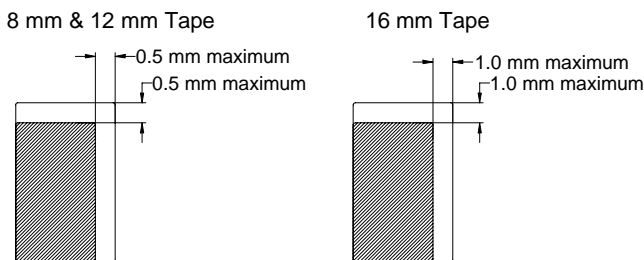


Figure 4 – Bending Radius

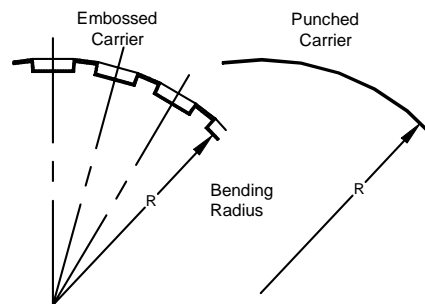
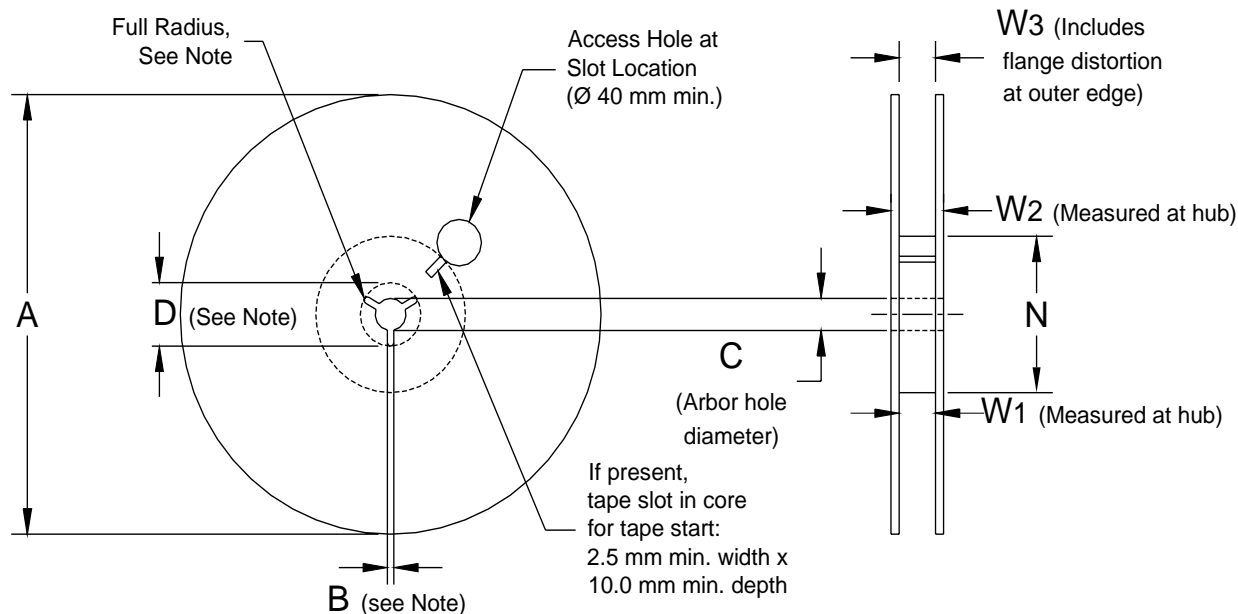


Figure 5 – Reel Dimensions



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 Min	C	D Min
8 mm	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)
12 mm	or			
16 mm	330 ± 0.20 (13.000 ± 0.008)			
Variable Dimensions — Millimeters (Inches)				
Tape Size	N Min	W ₁	W ₂ Max	W ₃
8 mm	50 (1.969)	8.4 +1.5/-0.0 (0.331 +0.059/-0.0)	14.4 (0.567)	Shall accommodate tape width without interference
12 mm		12.4 +2.0/-0.0 (0.488 +0.078/-0.0)	18.4 (0.724)	
16 mm		16.4 +2.0/-0.0 (0.646 +0.078/-0.0)	22.4 (0.882)	

Figure 6 – Tape Leader & Trailer Dimensions

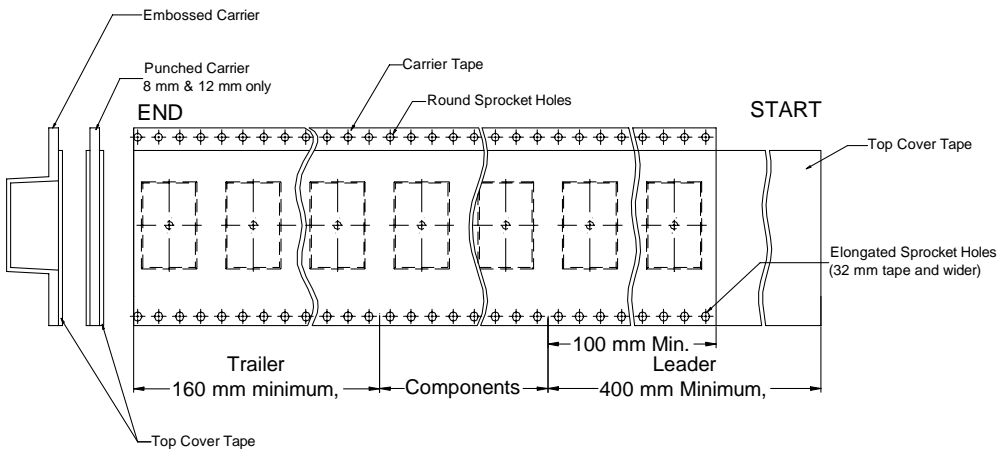
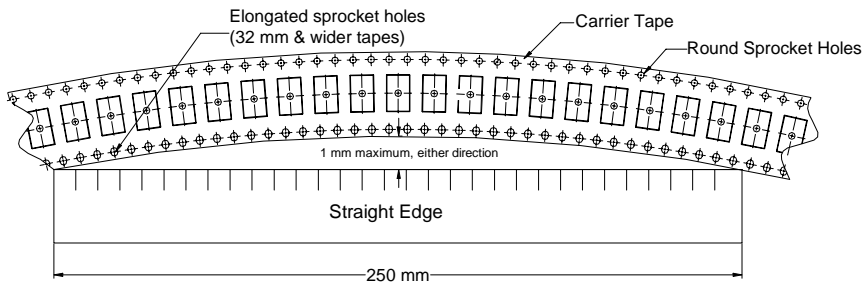


Figure 7 – Maximum Camber



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Milan, Italy
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Northeast Asia

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

Taipei, Taiwan
Tel: 886-2-27528585

Southeast Asia

Singapore
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Penang, Malaysia
Tel: 60-4-6430200

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

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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

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

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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.

