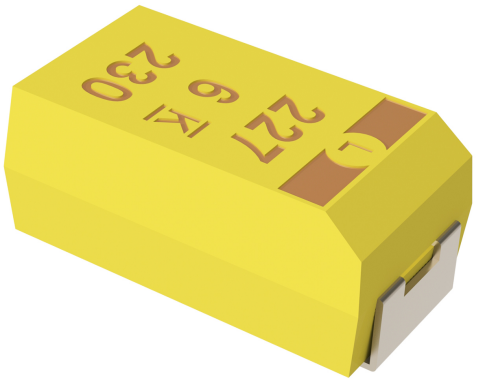
T489 Low DC Leakage MnO_2 Series

Overview

The KEMET T489 Series provides DC leakage current that is 25% lower than the commercial T491 Series. The T489 series also offers improved reliability, low ESR options and meets or exceeds the requirements of EIA standard 535BAAC. This series is classified as MSL (Mositure Sensitivity Level) 1 under J STD 020: unlimited floor life time at ≤30°C/85% RH. The T489 standard terminations are available in 100% matte tin and provide excellent wetting characteristics and compatibility with today's surface mount solder systems. Tin/lead (Sn/Pb) terminations are available upon request for any part number. Gold-plated terminations are also available for use with conductive epoxy attachment processes. Standard packaging of these devices is tape and reel in accordance with EIA 481. This system provides perfect compatibility with all tape-fed placement units.

Benefits

- DC Leakage at 0.0075 CV
- Improved reliability: 0.50%/1,000 hours, 85°C, rated voltage
- Low ESR options available
- Meets or exceeds EIA standard 535BAAC
- Taped and reeled per EIA 481
- Symmetrical, compliant terminations
- Laser-marked case
- Halogen-free epoxy
- Capacitance values of 0.1 µF to 470 µF
- Tolerances of ±10% and ±20%
- Voltage rating of 6.3 – 50 VDC
- RoHS Compliant and lead-free terminations
- Operating temperature range of -55˚C to +125˚C



Applications

Typical applications include decoupling and filtering in industrial and automotive high end applications.

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.

Ordering Information

T	489	B	156	M	16	A	T	E800
Capacitor Class	Series	Case Size	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Failure Rate/ Design	Lead Material	ESR
T = Tantalum	Low DC Leakage Series	A, B, C, D, X	First two digits represent significant figures. Third digit specifies number of zeros.	K = ±10% M = ±20%	006 = 6.3 V 010 = 10 V 016 = 16 V 020 = 20 V 025 = 25 V 035 = 35 V 050 = 50 V	A = N/A	T = 100% Matte Tin (Sn) Plated H = Standard Solder Coated (SnPb 5% Pb minimum) G = Gold Plated	Last three digits specify ESR in mΩ. (800 = 800 mΩ)

Performance Characteristics

Item	Performance Characteristics
Operating Temperature	-55°C to 125°C
Rated Capacitance Range	0.10 µF to 470 µF @ 120 Hz/25°C
Capacitance Tolerance	K Tolerance (±10%), M Tolerance (±20%)
Rated Voltage Range	6.3 – 50 V
DF(120 Hz)	Refer to Part Number Electrical Specification
ESR (100 kHz)	Refer to Part Number Electrical Specification
Leakage Current	≤ 0.0075 CV (µA) at rated voltage after 5 minutes
Reliability	0.50%/1,000 hours at 85°C, V_R with 0.1 Ω series resistance

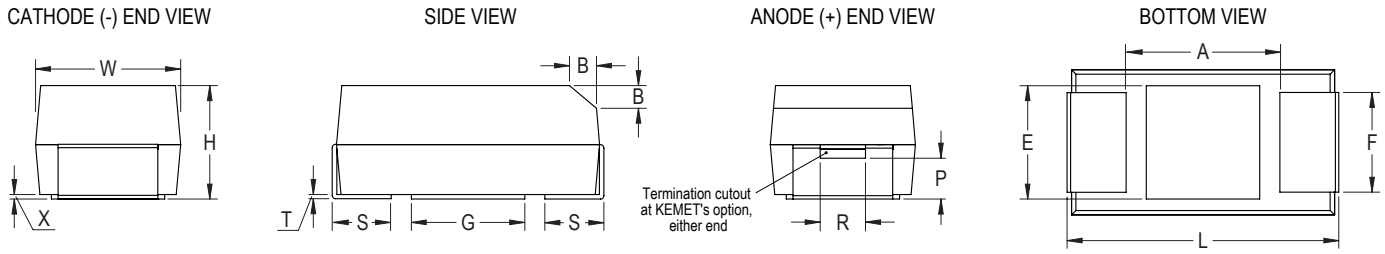
Qualification

Test	Condition		Characteristics			
Endurance	85°C @ rated voltage, 2,000 hours 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, -55C° 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. 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		

**IL = Initial limit*

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 (0.126 ±0.008)	1.6 ±0.2 (.063 ±0.008)	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)	0.8 (.31)	1.1 (.043)	1.3 (.051)
B	3528–21	3.5 ±02 (0.138 ±0.008)	2.8 ±0.2 (.110 ±0.008)	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)	1.1 (0.043)	1.8 (.071)	2.2 (.087)
C	6032–28	6.0 ±0.3 (0.236 ±0.03)	3.2 ±0.3 (.126 ±0.012)	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)	2.5(.098)	2.8 (.110)	2.4 (.094)
D	7343–31	7.3 ±0.3 (0.287 ±0.012)	4.3 ±0.3 (.169 ±0.012)	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 (0.287 ±0.012)	4.3 ±0.3 (.169 ±0.012)	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)

** MIL–PRF–55365/8 specified dimensions*

Table 1 – Ratings & Part Number Reference

Rated Voltage	Rated Capacitance	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	Standard ESR		Low ESR	
VDC	µF	KEMET/EIA	(See below for part options)	µA @ +25°C Maximum/ 5 Minutes	% @ +25°C 120 Hz Maximum	mΩ @ +25°C 100 kHz Maximum	E-Spec Code	mΩ @ +25°C 100 kHz Maximum	E-Spec Code
6.3	10	B/3528-21	T489B106(1)006A(2)	0.5	6.0	3000	E3K0		
6.3	15	A/3216-18	T489A156(1)006A(2)	0.7	6.0	2030	E2K0	1500	E1K5
6.3	22	C/6032-28	T489C226(1)006A(2)	1.0	6.0	2000	E2K0		
6.3	47	B/3528-21	T489B476(1)006A(2)	2.1	6.0	1620	E1K6	500	E500
6.3	150	B/3528-21	T489B157(1)006A(2)	7.1	15.0	3000	E3K0		
6.3	100	C/6032-28	T489C107(1)006A(2)	4.5	6.0	440	E440		
6.3	150	C/6032-28	T489C157(1)006A(2)	6.8	8.0	500	E500	300	E300
6.3	100	D/7343-31	T489D107(1)006A(2)	4.7	8.0	800	E800		
6.3	150	D/7343-31	T489D157(1)006A(2)	6.8	6.0	400	E400	150	E150
6.3	220	D/7343-31	T489D227(1)006A(2)	9.9	8.0	360	E360	150	E150
6.3	470	X/7343-43	T489X477(1)006A(2)	21.0	8.0	250	E250	200	E200
10	2.2	A/3216-18	T489A225(1)010A(2)	0.3	6.0	7000	E7K0		
10	4.7	A/3216-18	T489A475(1)010A(2)	0.4	6.0	2900	E2K9		
10	6.8	A/3216-18	T489A685(1)010A(2)	0.5	6.0	2650	E2K6		
10	6.8	B/3528-21	T489B685(1)010A(2)	0.5	6.0	3000	E3K0		
10	10	A/3216-18	T489A106(1)010A(2)	0.8	6.0	2200	E2K2	1800	E1K8
10	15	B/3528-21	T489B156(1)010A(2)	1.1	6.0	2030	E2K0		
10	15	C/6032-28	T489C156(1)010A(2)	1.1	6.0	2000	E2K0		
10	22	B/3528-21	T489B226(1)010A(2)	1.7	6.0	1880	E1K8	700	E700
10	33	B/3528-21	T489B336(1)010A(2)	2.5	6.0	1000	E1K0	650	E650
10	33	C/6032-28	T489C336(1)010A(2)	2.5	6.0	590	E590		
10	33	D/7343-31	T489D336(1)010A(2)	2.5	6.0	1100	E1K1		
10	47	C/6032-28	T489C476(1)010A(2)	3.5	6.0	540	E540		
10	47	D/7343-31	T489D476(1)010A(2)	3.5	6.0	400	E400		
10	68	C/6032-28	T489C686(1)010A(2)	5.1	6.0	490	E490		
10	100	C/6032-28	T489C107(1)010A(2)	7.5	8.0	500	E500		
10	100	D/7343-31	T489D107(1)010A(2)	7.5	6.0	440	E440	150	E150
10	150	D/7343-31	T489D157(1)010A(2)	11.0	8.0	400	E400	150	E150
10	220	D/7343-31	T489D227(1)010A(2)	16.5	8.0	500	E500		
10	330	X/7343-43	T489X337(1)010A(2)	25.0	8.0	300	E300	100	E100
16	1	A/3216-18	T489A105(1)016A(2)	0.3	6.0	10000	E10K		
16	2.2	A/3216-18	T489A225(1)016A(2)	0.3	6.0	4550	E4K5	3500	E3K5
16	3.3	B/3528-21	T489B335(1)016A(2)	0.4	6.0	4500	E4K5		
16	4.7	B/3528-21	T489B475(1)016A(2)	0.6	6.0	3160	E3K1		
16	6.8	B/3528-21	T489B685(1)016A(2)	0.8	6.0	2650	E2K6		
16	6.8	C/6032-28	T489C685(1)016A(2)	0.8	6.0	2500	E2K5		
16	10	B/3528-21	T489B106(1)016A(2)	1.2	6.0	2200	E2K2		
16	10	C/6032-28	T489C106(1)016A(2)	1.2	6.0	2000	E2K0		
16	15	B/3528-21	T489B156(1)016A(2)	1.8	6.0	2030	E2K0	800	E800
16	22	B/3528-21	T489B226(1)016A(2)	2.6	6.0	1100	E1K1	600	E600
16	22	C/6032-28	T489C226(1)016A(2)	2.6	6.0	700	E700	350	E350
16	22	D/7343-31	T489D226(1)016A(2)	2.6	6.0	1100	E1K1		
16	33	C/6032-28	T489C336(1)016A(2)	4.0	6.0	590	E590		
16	47	C/6032-28	T489C476(1)016A(2)	5.6	6.0	540	E540	350	E350
16	47	D/7343-31	T489D476(1)016A(2)	5.6	6.0	540	E540	200	E200
16	68	D/7343-31	T489D686(1)016A(2)	8.2	6.0	490	E490	150	E150
16	100	D/7343-31	T489D107(1)016A(2)	12.0	6.0	440	E440	150	E150
16	150	D/7343-31	T489D157(1)016A(2)	18.0	12.0	700	E700		
20	1	A/3216-18	T489A105(1)020A(2)	0.3	4.0	6630	E6K6		
20	1.5	A/3216-18	T489A155(1)020A(2)	0.3	6.0	5460	E5K4		
VDC	µF	KEMET/EIA	(See below for part options)	µA @ +25°C Maximum/ 5 Minutes	% @ +25°C 120 Hz Maximum	mΩ @ +25°C 100 kHz Maximum	E-Spec Code	mΩ @ +25°C 100 kHz Maximum	E-Spec Code
Rated Voltage	Rated Capacitance	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	Standard ESR		Low ESR	

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

(2) To complete KEMET part number, insert T = 100% Matte Tin (Sn) Plated, G = Gold Plated, H = Standard Solder coated (SnPb 5% Pb minimum). Designates Termination Finish.

Refer to Ordering Information for additional detail.

Higher voltage ratings and tighter tolerance product including ESR may be substituted within the same size at KEMET's option. Voltage substitution will be marked with the higher voltage rating. Substitutions can include better than series.

Table 1 – Ratings & Part Number Reference cont'd

Rated Voltage	Rated Capacitance	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	Standard ESR		Low ESR	
VDC	µF	KEMET/EIA	(See below for part options)	µA @ +25°C Maximum/ 5 Minutes	% @ +25°C 120 Hz Maximum	mΩ @ +25°C 100 kHz Maximum	E-Spec Code	mΩ @ +25°C 100 kHz Maximum	E-Spec Code
20	2.2	A/3216-18	T489A225(1)020A(2)	0.3	6.0	4550	E4K5		
20	3.3	A/3216-18	T489A335(1)020A(2)	0.5	6.0	3740	E3K7	3500	E3K5
20	3.3	B/3528-21	T489B335(1)020A(2)	0.5	6.0	3740	E3K7		
20	4.7	B/3528-21	T489B475(1)020A(2)	0.7	6.0	3160	E3K1		
20	6.8	B/3528-21	T489B685(1)020A(2)	1.0	6.0	2650	E2K6		
20	6.8	C/6032-28	T489C685(1)020A(2)	1.0	6.0	2000	E2K0		
20	10	B/3528-21	T489B106(1)020A(2)	1.5	6.0	2200	E2K2	1000	E1K0
20	10	C/6032-28	T489C106(1)020A(2)	1.5	6.0	800	E800	500	E500
20	15	C/6032-28	T489C156(1)020A(2)	2.3	6.0	720	E720	400	E400
20	15	D/7343-31	T489D156(1)020A(2)	2.3	6.0	1100	E1K1		
20	22	D/7343-31	T489D226(1)020A(2)	3.3	6.0	650	E650	300	E300
20	33	C/6032-28	T489C336(1)020A(2)	5.0	6.0	590	E590	300	E300
20	33	D/7343-31	T489D336(1)020A(2)	5.0	6.0	590	E590	250	E250
20	47	D/7343-31	T489D476(1)020A(2)	7.1	6.0	540	E540	200	E200
20	68	D/7343-31	T489D686(1)020A(2)	10.0	6.0	490	E490	200	E200
20	100	X/7343-43	T489X107(1)020A(2)	15.0	6.0	300	E300	150	E150
25	0.47	A/3216-18	T489A474(1)025A(2)	0.3	4.0	9530	E9K5	7000	E7K0
25	0.68	A/3216-18	T489A684(1)025A(2)	0.3	4.0	7980	E7K9		
25	1	A/3216-18	T489A105(1)025A(2)	0.3	4.0	6630	E6K6		
25	2.2	B/3528-21	T489B225(1)025A(2)	0.4	6.0	4550	E4K5		
25	3.3	B/3528-21	T489B335(1)025A(2)	0.6	6.0	3740	E3K7	2000	E2K0
25	4.7	B/3528-21	T489B475(1)025A(2)	0.9	6.0	3160	E3K1	1000	E1K0
25	6.8	B/3528-21	T489B685(1)025A(2)	1.3	6.0	1500	E1K5	1000	E1K0
25	6.8	C/6032-28	T489C685(1)025A(2)	1.3	6.0	1070	E1K0	600	E600
25	10	C/6032-28	T489C106(1)025A(2)	1.9	6.0	800	E800	600	E600
25	10	D/7343-31	T489D106(1)025A(2)	1.9	6.0	1200	E1K2		
25	15	C/6032-28	T489C156(1)025A(2)	2.8	6.0	720	E720		
25	15	D/7343-31	T489D156(1)025A(2)	2.8	6.0	720	E720	300	E300
25	22	D/7343-31	T489D226(1)025A(2)	4.1	6.0	650	E650	300	E300
25	33	D/7343-31	T489D336(1)025A(2)	6.2	6.0	590	E590	400	E400
25	47	D/7343-31	T489D476(1)025A(2)	8.8	6.0	540	E540	250	E250
35	0.1	A/3216-18	T489A104(1)035A(2)	0.3	4.0	20000	E20K		
35	0.22	A/3216-18	T489A224(1)035A(2)	0.3	4.0	13710	E13K		
35	0.33	A/3216-18	T489A334(1)035A(2)	0.3	4.0	11280	E11K		
35	1	A/3216-18	T489A105(1)035A(2)	0.3	4.0	6630	E6K6	3000	E3K0
35	1	B/3528-21	T489B105(1)035A(2)	0.3	4.0	3400	E3K4	2000	E2K0
35	1.5	B/3528-21	T489B155(1)035A(2)	0.4	6.0	5460	E5K4	2500	E2K5
35	2.2	B/3528-21	T489B225(1)035A(2)	0.6	6.0	4550	E4K5	2000	E2K0
35	3.3	B/3528-21	T489B335(1)035A(2)	0.9	6.0	3740	E3K7		
35	3.3	C/6032-28	T489C335(1)035A(2)	0.9	6.0	1840	E1K8	800	E800
35	4.7	C/6032-28	T489C475(1)035A(2)	1.2	6.0	1410	E1K4	600	E600
35	4.7	D/7343-31	T489D475(1)035A(2)	1.2	6.0	1500	E1K5		
35	6.8	C/6032-28	T489C685(1)035A(2)	1.8	6.0	1070	E1K0	600	E600
35	6.8	D/7343-31	T489D685(1)035A(2)	1.8	6.0	1300	E1K3		
35	10	C/6032-28	T489C106(1)035A(2)	2.6	6.0	800	E800	600	E600
35	10	D/7343-31	T489D106(1)035A(2)	2.6	6.0	800	E800	400	E400
35	15	D/7343-31	T489D156(1)035A(2)	3.9	6.0	720	E720	350	E350
35	22	D/7343-31	T489D226(1)035A(2)	5.8	6.0	650	E650	300	E300
50	0.22	A/3216-18	T489A224(1)050A(2)	0.3	4.0	7500	E7K5	7000	E7K0
50	0.33	A/3216-18	T489A334(1)050A(2)	0.3	4.0	7000	E7K0		
VDC	µF	KEMET/EIA	(See below for part options)	µA @ +25°C Maximum/ 5 Minutes	% @ +25°C 120 Hz Maximum	mΩ @ +25°C 100 kHz Maximum	E-Spec Code	mΩ @ +25°C 100 kHz Maximum	E-Spec Code
Rated Voltage	Rated Capacitance	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	Standard ESR		Low ESR	

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

(2) To complete KEMET part number, insert T = 100% Matte Tin (Sn) Plated, G = Gold Plated, H = Standard Solder coated (SnPb 5% Pb minimum). Designates Termination Finish.

Refer to Ordering Information for additional detail.

Higher voltage ratings and tighter tolerance product including ESR may be substituted within the same size at KEMET's option. Voltage substitution will be marked with the higher voltage rating. Substitutions can include better than series.

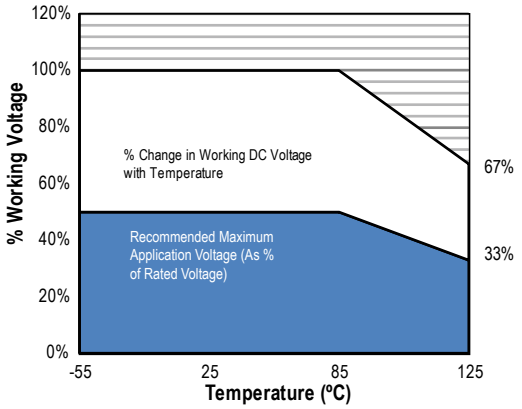
Table 1 – Ratings & Part Number Reference cont'd

Rated Voltage	Rated Capacitance	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	Standard ESR		Low ESR	
VDC	µF	KEMET/EIA	(See below for part options)	µA @ +25°C Maximum/ 5 Minutes	% @ +25°C 120 Hz Maximum	mΩ @ +25°C 100 kHz Maximum	E-Spec Code	mΩ @ +25°C 100 kHz Maximum	E-Spec Code
50	0.68	B/3528-21	T489B684(1)050A(2)	0.3	4.0	4000	E4K0	2000	E2K0
50	1	C/6032-28	T489C105(1)050A(2)	0.4	4.0	3000	E3K0		
50	1.5	C/6032-28	T489C155(1)050A(2)	0.6	6.0	2500	E2K5	1500	E1K5
50	2.2	C/6032-28	T489C225(1)050A(2)	0.8	6.0	1700	E1K7	1000	E1K0
50	2.2	D/7343-31	T489D225(1)050A(2)	0.8	4.5	2000	E2K0	1200	E1K2
50	3.3	D/7343-31	T489D335(1)050A(2)	1.2	4.5	1100	E1K1	800	E800
50	4.7	D/7343-31	T489D475(1)050A(2)	1.8	4.5	900	E900	600	E600
50	6.8	D/7343-31	T489D685(1)050A(2)	2.6	4.5	700	E700		
VDC	µF	KEMET/EIA	(See below for part options)	µA @ +25°C Maximum/ 5 Minutes	% @ +25°C 120 Hz Maximum	mΩ @ +25°C 100 kHz Maximum	E-Spec Code	mΩ @ +25°C 100 kHz Maximum	E-Spec Code
Rated Voltage	Rated Capacitance	Case Code/ Case Size	KEMET Part Number	DC Leakage	DF	Standard ESR		Low ESR	

(1) To complete KEMET part number, insert M for ±20% or K for ±10%. Designates Capacitance tolerance.
(2) To complete KEMET part number, insert T = 100% Matte Tin (Sn) Plated, G = Gold Plated, H = Standard Solder coated (SnPb 5% Pb minimum). Designates Termination Finish.
Refer to Ordering Information for additional detail.
Higher voltage ratings and tighter tolerance product including ESR may be substituted within the same size at KEMET's option. Voltage substitution will be marked with the higher voltage rating. Substitutions can include better than series.

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

KEMET Series and 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

Temperature Compensation Multipliers for Maximum Ripple Current		
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)
Pmax = maximum power dissipation (watts)
R = ESR at specified frequency (ohms)
Z = Impedance at specified frequency (ohms)

Reverse Voltage

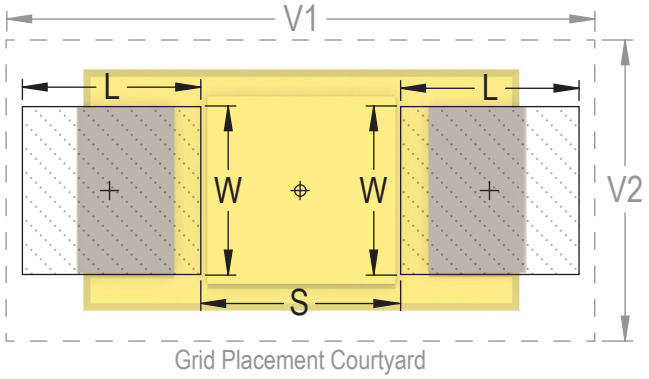
Solid tantalum capacitors are polar devices and may be permanently damaged or destroyed if connected with the wrong polarity. The positive terminal is identified on the capacitor body by a stripe plus in some cases a beveled edge. A small degree of transient reverse voltage is permissible for short periods 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
X[1]	7343–43	2.55	2.77	3.67	10.22	5.60	2.43	2.37	3.87	9.12	5.10	2.33	1.99	4.03	8.26	4.84

Density Level A: *For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes.*
Density Level B: *For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes.*
Density Level C: *For high component 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.

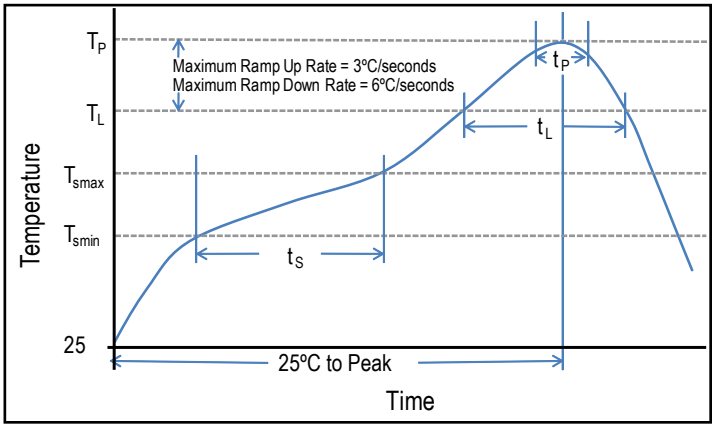
Please note that although the X/7343–43 case size can withstand wave soldering, the tall profile (4.3 mm maximum) dictates care in wave process development.

Hand soldering should be performed with care due to the difficulty in process control. If performed, care should be taken to avoid contact of the soldering iron to the molded case. The iron should be used to heat the solder pad, applying solder between the pad and the termination, until reflow occurs. Once reflow occurs, the iron should be removed immediately. "Wiping" the edges of a chip and heating the top surface is not recommended.

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

Profile Feature	SnPb Assembly	Pb-Free Assembly
Preheat/Soak		
Temperature Minimum (T_{Smin})	100°C	150°C
Temperature Maximum (T_{Smax})	150°C	200°C
Time (t_s) from T_{smin} to T_{smax})	60 – 120 seconds	60 – 120 seconds
Ramp-up Rate (T_L to T_P)	3°C/seconds maximum	3°C/seconds maximum
Liquidous Temperature (T_L)	183°C	217°C
Time Above Liquidous (t_L)	60 – 150 seconds	60 – 150 seconds
Peak Temperature (T_P)	220°C* 235°C**	250°C* 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

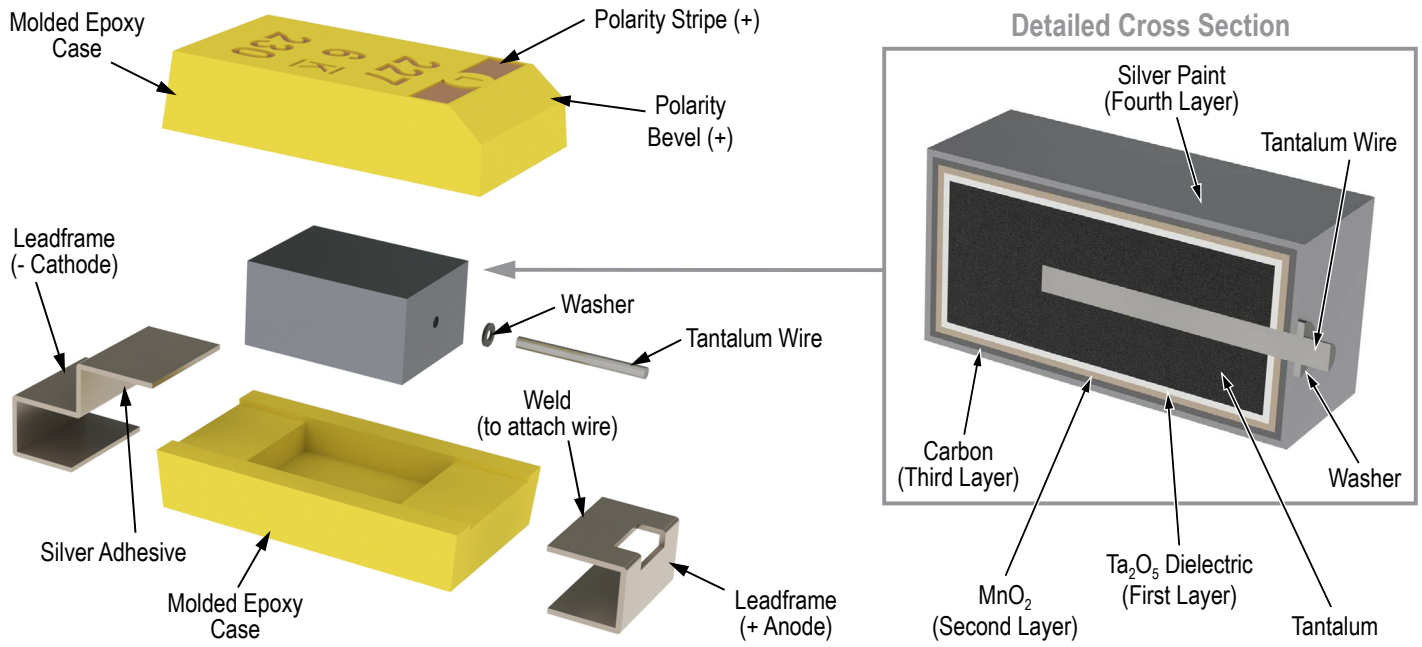
Note: All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow.
**Case Size D, E, P, Y, and X*
***Case Size A, B, C, H, I, K, M, R, S, T, U, V, W, and Z*



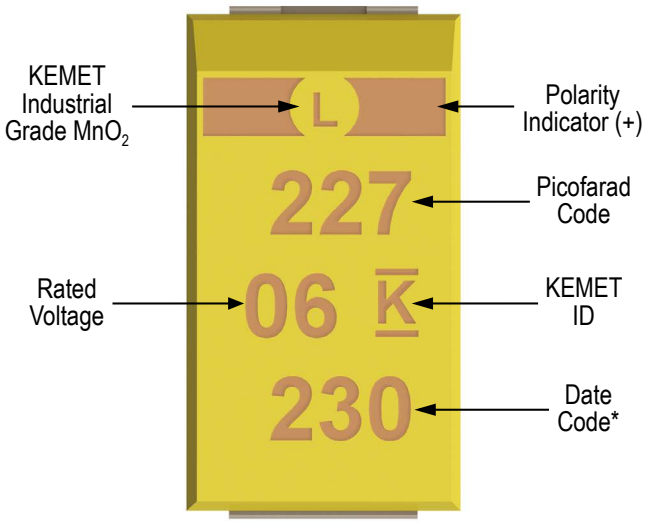
Storage

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.

Construction



Capacitor Marking



* 230 = 30th week of 2012

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

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*: Embossed Carrier Taping of Surface Mount Components for Automatic Handling. This packaging system is compatible with all tape-fed automatic pick-and-place systems.

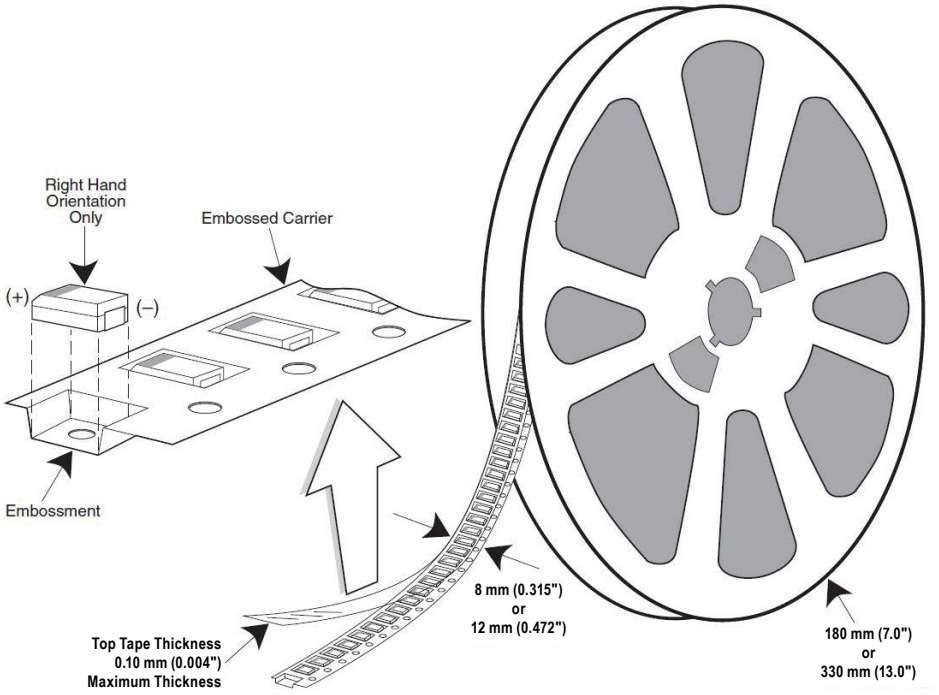


Table 3 – Packaging Quantity

Case Code		Tape Width (mm)	7" Reel*	13" Reel*
KEMET	EIA			
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
Q	7343-12	12	1,000	3,000
Y	7343-40	12	500	2,000
X	7343-43	12	500	2,000
E/T428P	7360-38	12	500	2,000
H	7360-20	12	1,000	2,500

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

Figure 1 – Embossed (Plastic) Carrier Tape Dimensions

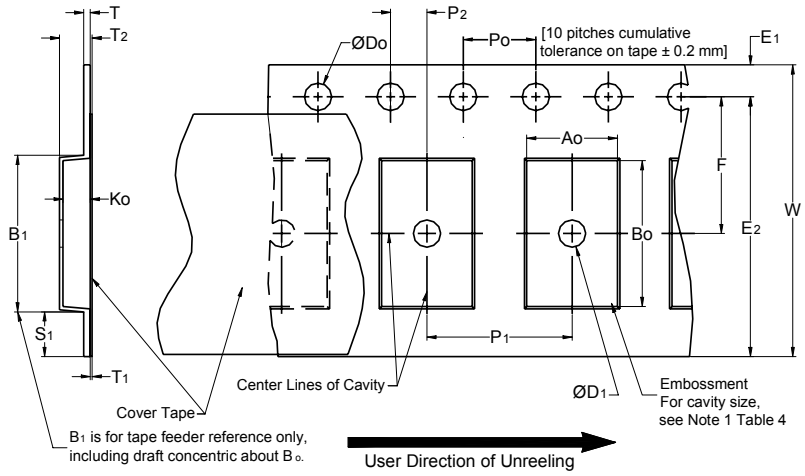


Table 4 – Embossed (Plastic) Carrier Tape Dimensions

Metric will govern

Constant Dimensions — Millimeters (Inches)									
Tape Size	D_0	D_1 Minimum 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					2.0 ±0.1 (0.079 ±0.059)				

Variable Dimensions — Millimeters (Inches)								
Tape Size	Pitch	B_1 Maximum Note 4	E_2 Minimum	F	P_1	T_2 Maximum	W Maximum	A_0, B_0 & K_0
8 mm	Single (4 mm)	4.35 (0.171)	6.25 (0.246)	3.5 ±0.05 (0.138 ±0.002)	2.0 ±0.05 or 4.0 ±0.10 (0.079 ±0.002 or 0.157 ±0.004)	2.5 (0.098)	8.3 (0.327)	Note 5
12 mm	Single (4 mm) & Double (8 mm)	8.2 (0.323)	10.25 (0.404)	5.5 ±0.05 (0.217 ±0.002)	2.0 ±0.05 (0.079 ±0.002) or 4.0 ±0.10 (0.157 ±0.004) or 8.0 ±0.10 (0.315 ±0.004)	4.6 (0.181)	12.3 (0.484)	
16 mm	Triple (12 mm)	12.1 (0.476)	14.25 (0.561)	7.5±0.10 (0.295 ±0.004)	4.0 ±0.10 (0.157 ±0.004) to 12.0 ±0.10 (0.472 ±0.004)	8.0 (0.315)	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 4).

3. If S_1 < 1.0 mm, there may not be enough area for cover tape to be properly applied (see EIA Standard 481–D, paragraph 4.3, section b).

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

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

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

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

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

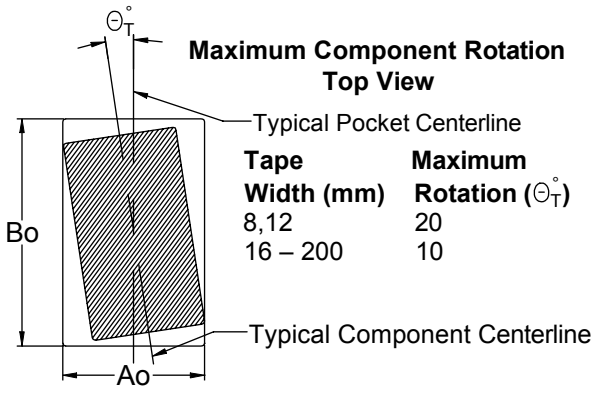
Packaging Information Performance Notes

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



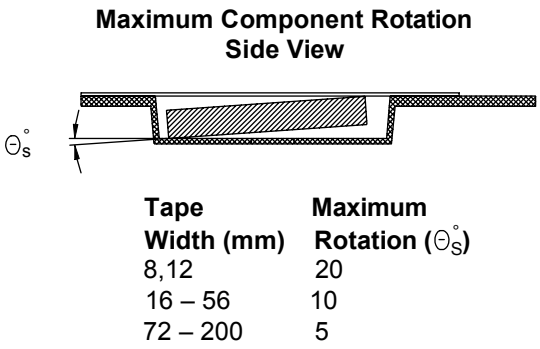


Figure 3 – Maximum Lateral Movement

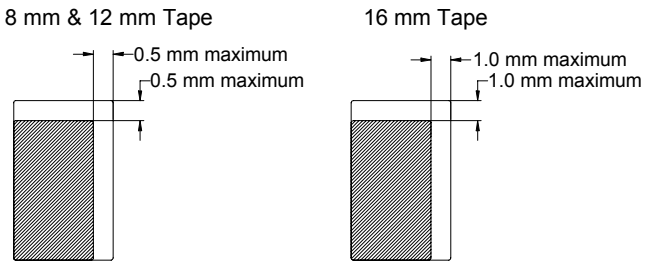


Figure 4 – Bending Radius

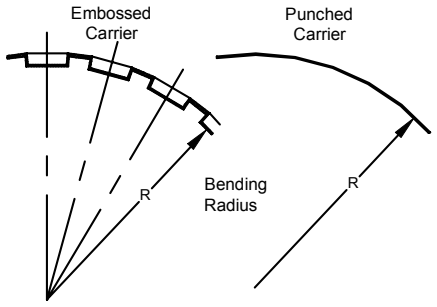
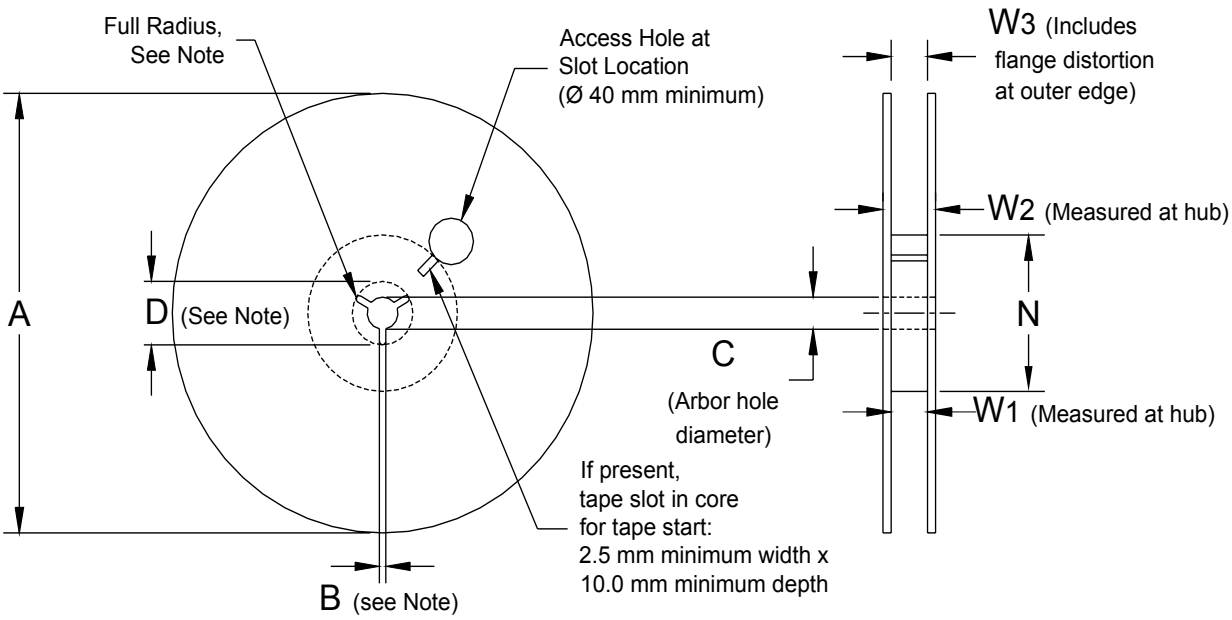


Figure 5 – Reel Dimensions



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	W_1	W_2 Maximum	W_3
8 mm	50 (1.969)	8.4 +1.5/-0.0 (0.331 +0.059/-0.0)	14.4 (0.567)	Shall accommodate tape width without interference
12 mm		12.4 +2.0/-0.0 (0.488 +0.078/-0.0)	18.4 (0.724)	
16 mm		16.4 +2.0/-0.0 (0.646 +0.078/-0.0)	22.4 (0.882)	

Figure 6 – Tape Leader & Trailer Dimensions

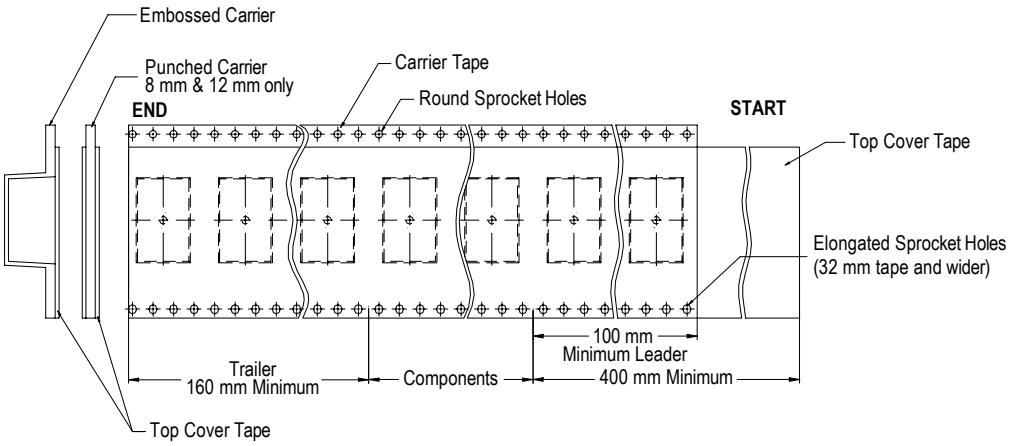
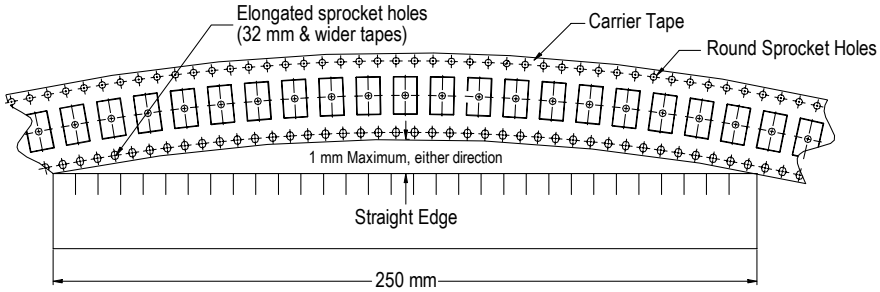


Figure 7 – Maximum Camber



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