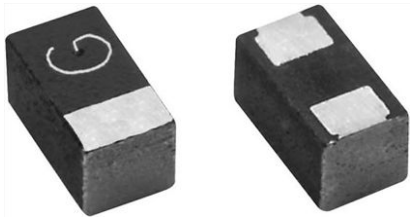
Solid Tantalum Chip Capacitors
MICROTAN® High Reliability, Low DCL, Leadframeless Molded



FEATURES

- High reliability solid surface mount tantalum capacitors
- Low DCL for extended battery life
- Small sizes for space constrained applications
- L-shaped face-down terminations for superior board mounting
- Suitable for medical implantable applications with additional screening
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912

Pb-free Available

RoHS* COMPLIANT

Note

* Lead (Pb)-containing terminations are not RoHS-compliant. Exemptions may apply.

PERFORMANCE CHARACTERISTICS

Operating Temperature: - 55 °C to + 125 °C (above 85 °C, voltage derating is required)

Capacitance Range: 1 µF to 47 µF

Capacitance Tolerance: ± 10 % and ± 20 % standard

Voltage Range: 2 V_{DC} to 40 V_{DC}

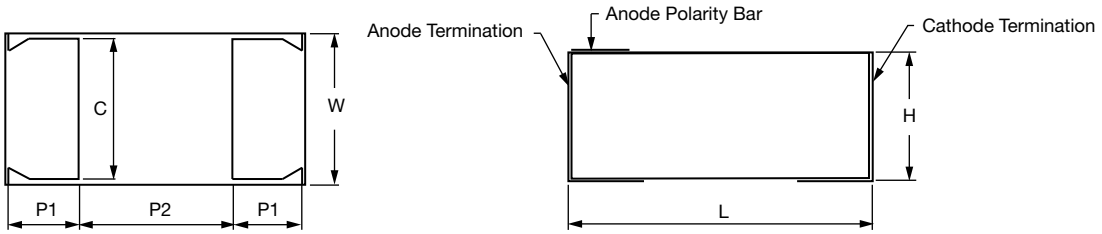
ORDERING INFORMATION

TM8	R	106	M	016	E	B	A
MODEL	CASE CODE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	TERMINATION/ PACKAGING	RELIABILITY LEVEL	SURGE CURRENT
	See Ratings and Case Codes table	This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow.	K = ± 10 % **M = ± 20 %**	This is expressed in volts. To complete the three-digit block, zeros precede the voltage rating. A decimal point is indicated by an "R" (6R3 = 6.3 V).	**E = Sn/Pb solder/ 7" (178 mm) reels** L = Sn/Pb solder/ 7" (178 mm) reels, ½ reel R = Sn/Pb solder/ 7" (178 mm) 300 pcs. qty. C = 100 % tin/ 7" (178 mm) reels H = 100 % tin/ 7" (178 mm) reels, ½ reel U = 100 % tin/ 7" (178 mm) 300 pcs. qty.	**B = 0.1 % weibull FRL** S = Hi-Rel std. (40 h burn-in) Z = Non-established reliability	**A = 10 cycles at 25 °C** B = 10 cycles at - 55 °C/+ 85 °C Z = None

Note

- Standard options are in bold

DIMENSIONS in inches [millimeters]



CASE CODE	L	W	H	P1	P2 (REF.)	C
K	0.045 ± 0.002 [1.14 ± 0.05]	0.026 ± 0.002 [0.66 ± 0.05]	0.024 max. [0.61 max.]	0.010 ± 0.004 [0.25 ± 0.1]	0.020 min. [0.51 min.]	0.015 ± 0.004 [0.38 ± 0.1]
M	0.063 ± 0.006 [1.60 ± 0.15]	0.033 ± 0.006 [0.84 ± 0.15]	0.033 ± 0.006 [0.84 ± 0.15]	0.020 ± 0.004 [0.51 ± 0.1]	0.019 min. [0.48 min.]	0.024 ± 0.004 [0.61 ± 0.1]

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DIMENSIONS in inches [millimeters]

CASE CODE	L	W	H	P1	P2 (REF.)	C
W	0.081 ± 0.006 [2.06 ± 0.15]	0.053 ± 0.006 [1.35 ± 0.15]	0.047 max. [1.2 max.]	0.020 ± 0.004 [0.51 ± 0.1]	0.028 min. [0.71 min.]	0.035 ± 0.004 [0.90 ± 0.1]
R	0.081 ± 0.006 [2.06 ± 0.15]	0.053 ± 0.006 [1.35 ± 0.15]	0.058 ± 0.004 [1.47 ± 0.10]	0.020 ± 0.004 [0.51 ± 0.1]	0.028 min. [0.71 min.]	0.035 ± 0.004 [0.90 ± 0.1]
P	0.096 ± 0.006 [2.45 ± 0.15]	0.059 ± 0.006 [1.5 ± 0.15]	0.049 max. [1.25 max.]	0.020 ± 0.004 [0.51 ± 0.1]	0.043 min. [1.1 min.]	0.035 ± 0.004 [0.90 ± 0.1]
A	0.126 ± 0.008 [3.2 ± 0.2]	0.063 ± 0.008 [1.6 ± 0.2]	0.071 [1.8]	0.031 ± 0.004 [0.8 ± 0.1)	0.063 min. [1.60 min.]	0.047 ± 0.004 [1.2 ± 0.1]
N	0.138 ± 0.004 [3.5 ± 0.1]	0.110 ± 0.004 [2.80 ± 0.1]	0.047 max. [1.2 max.]	0.0335 ± 0.004 [0.85 ± 0.1]	0.065 min. [1.65 min.]	0.094 ± 0.004 [2.4 ± 0.10]
T	0.138 + 0.004/- 0.008 [3.505 + 0.101/- 0.203]	0.110 ± 0.004 [2.80 ± 0.10]	0.063 max. [1.57 max.]	0.031 + 0.004/- 0.006 [0.80 + 0.1/- 0.15]	0.088 ± 0.010 [2.24 ± 0.25]	0.091 + 0.009/- 0.001 [2.3 + 0.23/- 0.025]

RATINGS AND CASE CODES

µF	2 V	6.3 V	10 V	16 V	20 V	25 V	40 V
0.68					M		
1.0			M	M	M/W	R	P
2.2				M			
3.3			M		R		
4.7			M			P	
7.5			W		N		
10	K	M	R	R	A		
15		M	R				
22			A				
47			T				

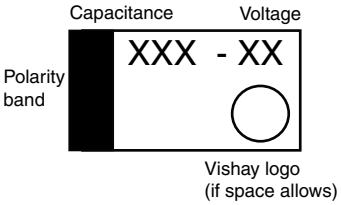
MARKING

M-Case

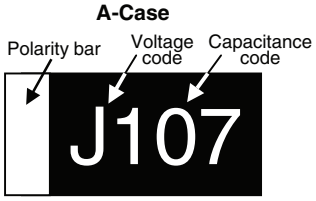
P, R, W-Case

K-Case

N, T-Case



A-Case



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STANDARD RATINGS

CAPACITANCE (µF)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C (µA)	MAX. DF AT + 25 °C (%)	MAX. ESR AT + 25 °C 100 kHz STD. (Ω)	AVAILABLE RELIABILITY LEVELS
2 V_{DC} AT + 85 °C; 1.4 V_{DC} AT + 125 °C						
10	K	TM8K106M002(2)(4)(6)	0.50	20	20.0	Z
6.3 V_{DC} AT + 85 °C; 4 V_{DC} AT + 125 °C						
10	M	TM8M106(1)6R3(2)(3)(5)	0.32	8	5.0	Z, S, B
15	M	TM8M156(1)6R3(2)(3)(5)	0.47	8	5.0	Z, S, B
10 V_{DC} AT + 85 °C; 7 V_{DC} AT + 125 °C						
1.0	M	TM8M105(1)010(2)(3)(5)	0.20	6	12.0	Z, S, B
3.3	M	TM8M335(1)010(2)(3)(5)	0.20	8	6.0	Z, S, B
4.7	M	TM8M475(1)010(2)(3)(5)	0.24	8	6.0	Z, S, B
7.5	W	TM8W755(1)010(2)(3)(5)	0.38	8	8.0	Z, S, B
10	R	TM8R106(1)010(2)(3)(5)	0.50	8	6.0	Z, S, B
15	R	TM8R156(1)010(2)(3)(5)	0.75	8	5.0	Z, S, B
22	A	TM8A226(1)010(2)(3)(5)	1.10	8	1.5	Z, S, B
47	T	TM8T476(1)010(2)(3)(5)	2.35	8	1.0	Z, S, B
16 V_{DC} AT + 85 °C; 10 V_{DC} AT + 125 °C						
1.0	M	TM8M105(1)016(2)(3)(5)	0.20	6	12.0	Z, S, B
2.2	M	TM8M225(1)016(2)(3)(5)	0.20	10	10.0	Z, S, B
10	R	TM8R106(1)016(2)(3)(5)	0.80	8	6.0	Z, S, B
20 V_{DC} AT + 85 °C; 13 V_{DC} AT + 125 °C						
0.68	M	TM8M684(1)020(2)(3)(5)	0.20	6	20.0	Z, S, B
1.0	M	TM8M105(1)020(2)(3)(5)	0.20	6	12.0	Z, S, B
1.0	W	TM8W105(1)020(2)(3)(5)	0.20	8	8.0	Z, S, B
3.3	R	TM8R335(1)020(2)(3)(5)	0.33	8	8.0	Z, S, B
7.5	N	TM8N755(1)020(2)(3)(5)	0.75	8	6.0	Z, S, B
10	A	TM8A106(1)020(2)(3)(5)	1.00	8	3.0	Z, S, B
25 V_{DC} AT + 85 °C; 17 V_{DC} AT + 125 °C						
1.0	R	TM8R105(1)025(2)(3)(5)	0.20	6	10.0	Z, S, B
4.7	P	TM8P475(1)025(2)(3)(5)	0.59	6	6.0	Z, S, B
40 V_{DC} AT + 85 °C; 27 V_{DC} AT + 125 °C						
1.0	P	TM8P105(1)040(2)(3)(5)	0.20	8	10.0	Z, S, B

Notes

- Part number definitions:
  (1) Capacitance tolerance: K, M
  (2) Termination and packaging: E, C, H, U, R
  (3) Reliability level: Z, S, B
  (4) Reliability level: Z only
  (5) Surge current: Z, A, B
  (6) Surge current: Z only

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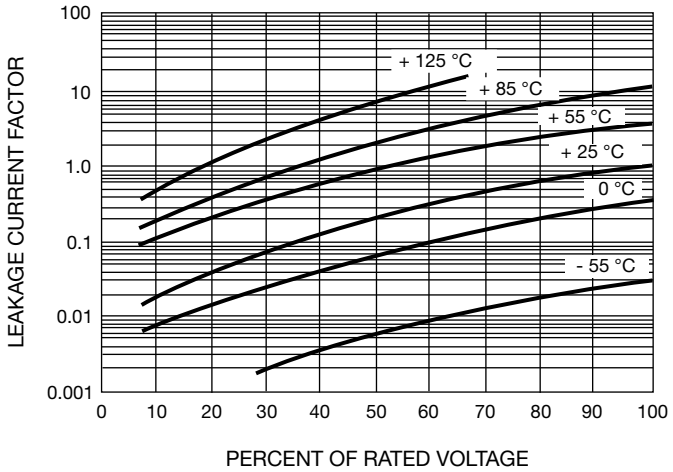
CAPACITORS PERFORMANCE CHARACTERISTICS

ELECTRICAL PERFORMANCE CHARACTERISTICS

ITEM	PERFORMANCE CHARACTERISTICS	
Category temperature range	- 55 °C to + 85 °C (to + 125 °C with voltage derating)	
Capacitance tolerance	± 20 %, ± 10 % (at 120 Hz) 1 V_{RMS} at + 25 °C using a capacitance bridge	
Dissipation factor (at 120 Hz)	Limits per Standard Ratings table. Tested via bridge method, at 25 °C, 120 Hz.	
ESR (100 kHz)	Limits per Standard Ratings table. Tested via bridge method, at 25 °C, 100 kHz.	
Leakage current	After application of rated voltage applied to capacitors for 5 min using a steady source of power with 1 kΩ resistor in series with the capacitor under test, leakage current at 25 °C is not more than described in Standard Ratings table. Note that the leakage current varies with temperature and applied voltage. See graph below for the appropriate adjustment factor.	
Reverse voltage	Capacitors are capable of withstanding peak voltages in the reverse direction equal to: 10 % of the DC rating at + 25 °C or 5 % of the DC rating at + 85 °C. Vishay does not recommended intentional or repetitive application of reverse voltage.	
Temperature derating	If capacitors are to be used at temperatures above + 25 °C, the permissible rms ripple current or voltage shall be calculated using the derating factors: 1.0 at + 25 °C 0.9 at + 85 °C 0.4 at + 125 °C	
Operating temperature	**+ 85 °C RATING**	**+ 125 °C RATING**
	WORKING VOLTAGE (V)	**WORKING VOLTAGE (V)**
	2	1.3
	4	2.7
	6.3	4
	10	7
	15	10
	16	10
	20	13
	25	17
	40	27

TYPICAL LEAKAGE CURRENT FACTOR RANGE



Notes

- **At + 25 °C,** the leakage current shall not exceed the value listed in the Standard Ratings table
- **At + 85 °C,** the leakage current shall not exceed 10 times the value listed in the Standard Ratings table
- **At + 125 °C,** the leakage current shall not exceed 12 times the value listed in the Standard Ratings table

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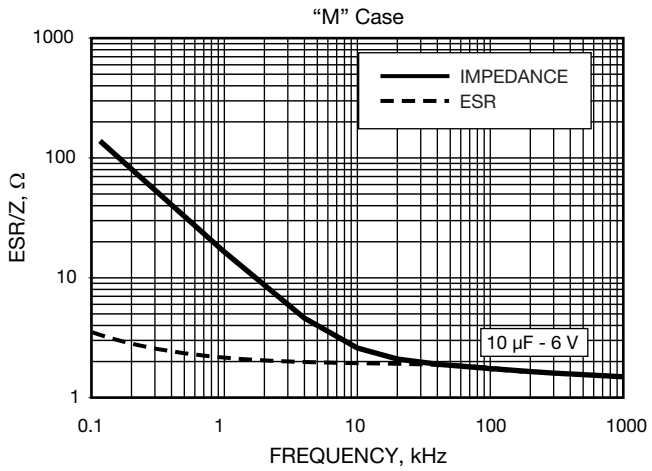
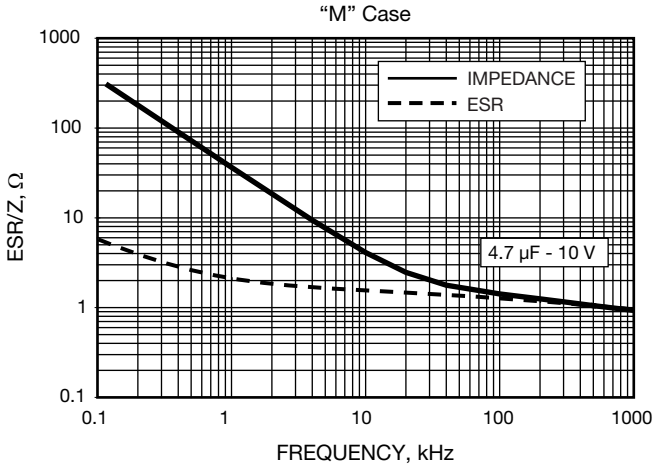
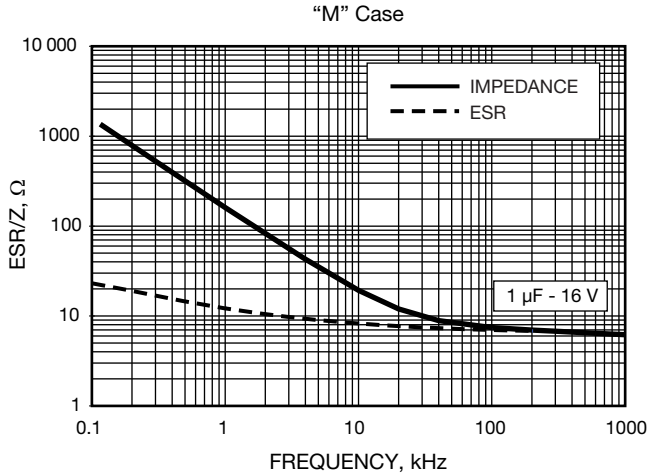
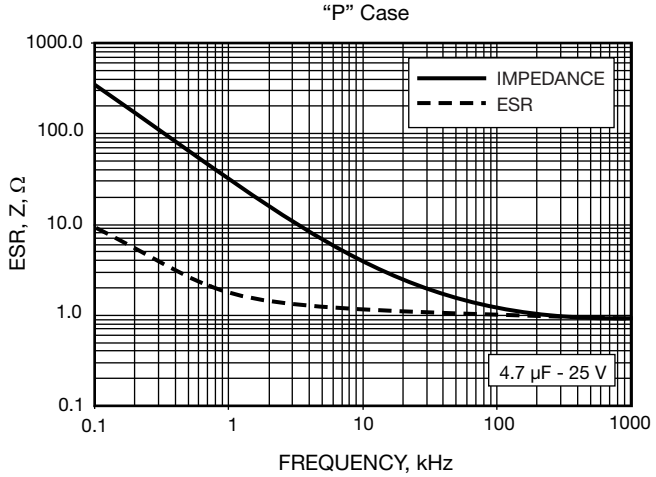
TYPICAL CURVES AT + 25 °C, IMPEDANCE AND ESR VS. FREQUENCY









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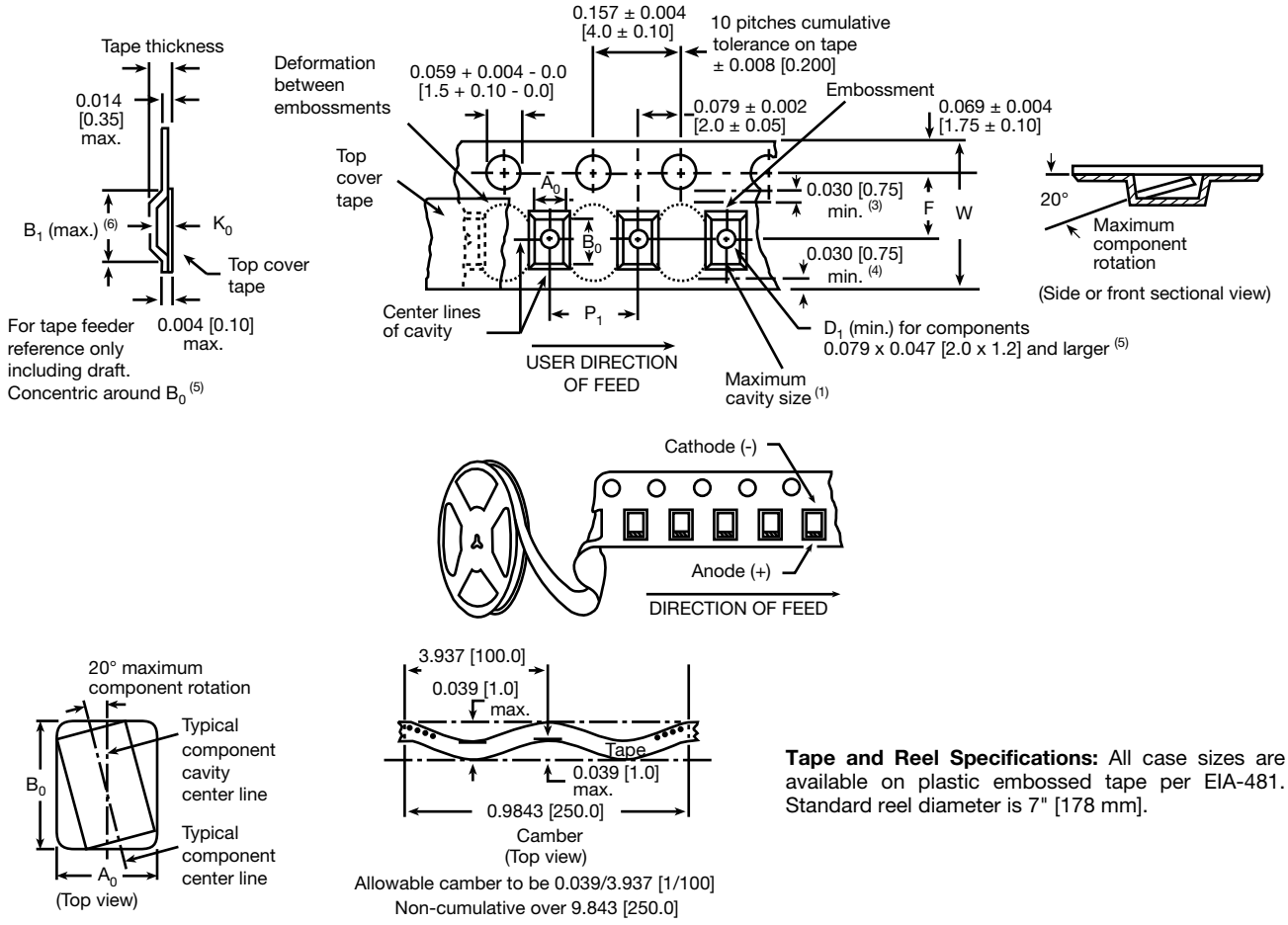
PLASTIC TAPE AND REEL PACKAGING in inches [millimeters]



Tape and Reel Specifications: All case sizes are available on plastic embossed tape per EIA-481. Standard reel diameter is 7" [178 mm].

Notes

- Metric dimensions will govern. Dimensions in inches are rounded and for reference only.

(1) A_0, B_0, K_0, are determined by the maximum dimensions to the ends of the terminals extending from the component body and/or the body dimensions of the component. The clearance between the ends of the terminals or body of the component to the sides and depth of the cavity (A_0, B_0, K_0) must be within 0.002" (0.05 mm) minimum and 0.020" (0.50 mm) maximum. The clearance allowed must also prevent rotation of the component within the cavity of not more than 20°.

(2) Tape with components shall pass around radius "R" without damage. The minimum trailer length may require additional length to provide "R" minimum for 12 mm embossed tape for reels with hub diameters approaching N minimum.

(3) This dimension is the flat area from the edge of the sprocket hole to either outward deformation of the carrier tape between the embossed cavities or to the edge of the cavity whichever is less.

(4) This dimension is the flat area from the edge of the carrier tape opposite the sprocket holes to either the outward deformation of the carrier tape between the embossed cavity or to the edge of the cavity whichever is less.

(5) The embossed hole location shall be measured from the sprocket hole controlling the location of the embossement. Dimensions of embossement location shall be applied independent of each other.

(6) B_1 dimension is a reference dimension tape feeder clearance only.

CARRIER TAPE DIMENSIONS in inches [millimeters]

CASE CODE	TAPE SIZE	B_1 (MAX.)	D_1 (MIN.)	F	K_0 (MAX.)	P_1	W
W	8 mm	0.112 [2.85]	0.039 [1.0]	0.138 [3.5]	0.053 [1.35]	0.157 [4.0]	0.315 [8.0]
R	8 mm	0.112 [2.85]	0.039 [1.0]	0.138 [3.5]	0.066 [1.68]	0.157 [4.0]	0.315 [8.0]
P	8 mm	0.108 [2.75]	0.039 [1.0]	0.138 [3.5]	0.054 [1.37]	0.157 [4.0]	0.315 [8.0]
A	8 mm	0.165 [4.2]	0.039 [1.0]	0.138 [3.5]	0.094 [2.4]	0.157 [4.0]	0.315 [8.0]
N	12 mm	0.150 [3.8]	0.059 [1.5]	0.216 [5.5]	0.047 [1.2]	0.157 [4.0]	0.472 [12.0]
T	12 mm	0.150 [3.8]	0.059 [1.5]	0.216 [5.5]	0.063 [1.60]	0.157 [4.0]	0.472 [12.0]

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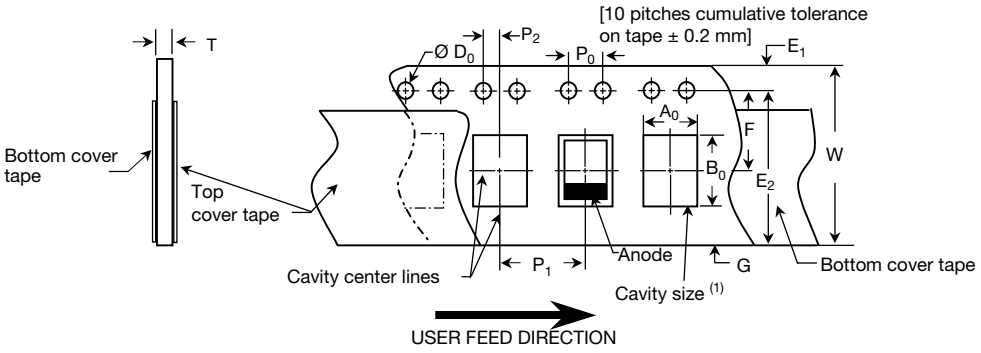
PAPER TAPE AND REEL PACKAGING in inches [millimeters]



TAPE SIZE: 8 mm

CASE CODE	A_0	B_0	D_0	P_0	P_1	P_2	E	F	W	T
K	0.033 ± 0.002 [0.85 ± 0.05]	0.053 ± 0.002 [1.35 ± 0.05]	0.06 ± 0.004 [1.5 ± 0.1]	0.157 ± 0.004 [4.0 ± 0.1]	0.078 ± 0.004 [2.0 ± 0.1]	0.079 ± 0.002 [2.0 ± 0.05]	0.069 ± 0.004 [1.75 ± 0.1]	0.0138 ± 0.002 [3.5 ± 0.05]	0.315 ± 0.008 [8.0 ± 0.2]	0.03 ± 0.002 [0.75 ± 0.05]
M	0.041 ± 0.002 [1.05 ± 0.05]	0.071 ± 0.002 [1.8 ± 0.05]	0.06 ± 0.004 [1.5 ± 0.1]	0.157 ± 0.004 [4.0 ± 0.1]	0.157 ± 0.004 [4.0 ± 0.1]	0.079 ± 0.002 [2.0 ± 0.05]	0.069 ± 0.004 [1.75 ± 0.1]	0.0138 ± 0.002 [3.5 ± 0.05]	0.315 ± 0.008 [8.0 ± 0.2]	0.037 ± 0.002 [0.95 ± 0.05]

STANDARD PACKAGING QUANTITY

SERIES	CASE CODE	QUANTITY (PCS/REEL)		
		7" REEL	½ REEL	SMALL REEL
TM8	K	5000	2500	300
	M	4000	2000	300
	W	2500	1250	300
	R	2500	1250	300
	P	3000	1500	300
	A	2000	1000	300
	N	2500	1250	300
	T	2500	1250	300

POWER DISSIPATION

SERIES	CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
TM8	K	0.015
	M	0.025
	W	0.040
	R	0.045
	P	0.045
	A	0.075
	N	0.075
	T	0.084

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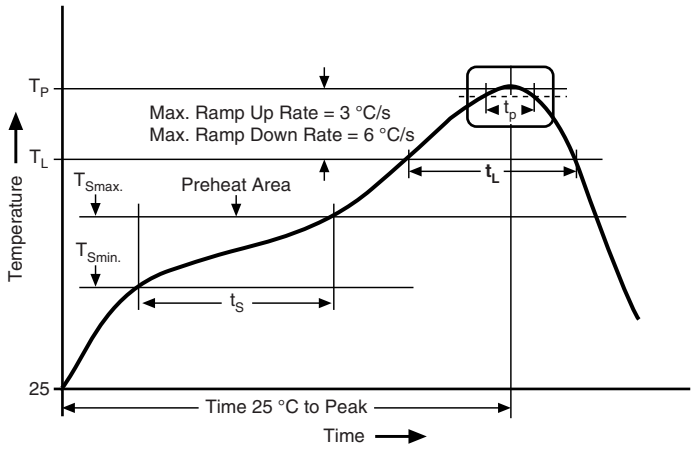
RECOMMENDED REFLOW PROFILES

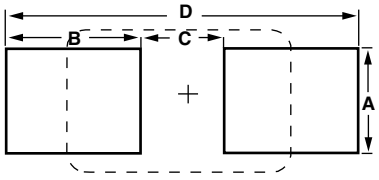


PROFILE FEATURE	SnPb EUTECTIC ASSEMBLY	LEAD (Pb)-FREE ASSEMBLY
PREHEAT AND SOAK		
Temperature min. ($T_{Smin.}$)	100 °C	150 °C
Temperature max. ($T_{Smax.}$)	150 °C	200 °C
Time (t_S) from ($T_{Smin.}$ to $T_{Smax.}$)	60 s to 120 s	
RAMP UP		
Ramp-up rate (T_L to T_p)	3 °C/s maximum	
Liquidous temperature (T_L)	183 °C	217 °C
Time (t_L) maintained above T_L	60 s to 150 s	
Peak package body temperature (T_p)	225 °C	260 °C
Time (t_p) within 5 °C of the specified classification temperature (T_C)	20 s	30 s
RAMP DOWN		
Ramp-down rate (T_p to T_L)	6 °C/s maximum	
Time 25 °C to peak temperature	6 min maximum	8 min maximum

Note

- Capacitors should withstand reflow profile as per J-STD-020 standard

PAD DIMENSIONS in inches [millimeters]



CASE CODE	A (MIN.)	B (NOM.)	C (NOM.)	D (NOM.)
K	0.028 [0.70]	0.018 [0.45]	0.024 [0.60]	0.059 [1.50]
M	0.039 [1.00]	0.028 [0.70]	0.024 [0.60]	0.080 [2.00]
W	0.059 [1.50]	0.031 [0.80]	0.039 [1.00]	0.102 [2.60]
R	0.059 [1.50]	0.031 [0.80]	0.039 [1.00]	0.102 [2.60]
P	0.063 [1.60]	0.031 [0.80]	0.047 [1.20]	0.110 [2.80]
A	0.071 [1.80]	0.067 [1.70]	0.053 [1.35]	0.187 [4.75]
N	0.118 [3.00]	0.067 [1.70]	0.051 [1.30]	0.185 [4.70]
T	0.118 [3.00]	0.067 [1.70]	0.051 [1.30]	0.185 [4.70]

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GUIDE TO APPLICATION

1. **AC Ripple Current:** The maximum allowable ripple current shall be determined from the formula:

$$I_{RMS} = \sqrt{\frac{P}{R_{ESR}}}$$

where,

P = Power dissipation in watts at + 25 °C (see paragraph number 5 and the table Power Dissipation)

R_{ESR} = The capacitor equivalent series resistance at the specified frequency

2. **AC Ripple Voltage:** The maximum allowable ripple voltage shall be determined from the formula:

$$V_{RMS} = Z\sqrt{\frac{P}{R_{ESR}}}$$

or, from the formula:

$$V_{RMS} = I_{RMS} \times Z$$

where,

P = Power dissipation in watts at + 25 °C (see paragraph number 5 and the table Power Dissipation)

R_{ESR} = The capacitor equivalent series resistance at the specified frequency

Z = The capacitor impedance at the specified frequency

2.1 The sum of the peak AC voltage plus the applied DC voltage shall not exceed the DC voltage rating of the capacitor.

2.2 The sum of the negative peak AC voltage plus the applied DC voltage shall not allow a voltage reversal exceeding 10 % of the DC working voltage at + 25 °C.

3. **Reverse Voltage:** These capacitors are capable of withstanding peak voltages in the reverse direction equal to 10 % of the DC rating at + 25 °C, 5 % of the DC rating at + 85 °C and 1 % of the DC rating at + 125 °C.

4. **Temperature Derating:** If these capacitors are to be operated at temperatures above + 25 °C, the permissible RMS ripple current or voltage shall be calculated using the derating factors as shown:

TEMPERATURE	DERATING FACTOR
+ 25 °C	1.0
+ 85 °C	0.9
+ 125 °C	0.4

5. **Power Dissipation:** Power dissipation will be affected by the heat sinking capability of the mounting surface. Non-sinusoidal ripple current may produce heating effects which differ from those shown. It is important that the equivalent I_{RMS} value be established when calculating permissible operating levels. (Power Dissipation calculated using + 25 °C temperature rise.)

6. **Printed Circuit Board Materials:** Molded capacitors are compatible with commonly used printed circuit board materials (alumina substrates, FR4, FR5, G10, PTFE-fluorocarbon and porcelanized steel).

7. **Attachment:**

7.1 **Solder Paste:** The recommended thickness of the solder paste after application is 0.007" ± 0.001" [0.178 mm ± 0.025 mm]. Care should be exercised in selecting the solder paste. The metal purity should be as high as practical. The flux (in the paste) must be active enough to remove the oxides formed on the metallization prior to the exposure to soldering heat. In practice this can be aided by extending the solder preheat time at temperatures below the liquidous state of the solder.

7.2 **Soldering:** Capacitors can be attached by conventional soldering techniques; vapor phase, convection reflow, infrared reflow, wave soldering and hot plate methods. The Soldering Profile charts show recommended time/temperature conditions for soldering. Preheating is recommended. The recommended maximum ramp rate is 2 °C per s. Attachment with a soldering iron is not recommended due to the difficulty of controlling temperature and time at temperature. The soldering iron must never come in contact with the capacitor.

7.2.1 **Backward and Forward Compatibility:** Capacitors with SnPb or 100 % tin termination finishes can be soldered using SnPb or lead (Pb)-free soldering processes.

8. **Cleaning (Flux Removal) After Soldering:** Molded capacitors are compatible with all commonly used solvents such as TES, TMS, Prelete, Chlorethane, Terpene and aqueous cleaning media. However, CFC/ODS products are not used in the production of these devices and are not recommended. Solvents containing methylene chloride or other epoxy solvents should be avoided since these will attack the epoxy encapsulation material.

8.1 When using ultrasonic cleaning, the board may resonate if the output power is too high. This vibration can cause cracking or a decrease in the adherence of the termination. Do not exceed 9W/l at 40 kHz for 2 min.

9. **Recommended Mounting Pad Geometries:** Proper mounting pad geometries are essential for successful solder connections. These dimensions are highly process sensitive and should be designed to minimize component rework due to unacceptable solder joints. The dimensional configurations shown are the recommended pad geometries for both wave and reflow soldering techniques. These dimensions are intended to be a starting point for circuit board designers and may be fine tuned if necessary based upon the peculiarities of the soldering process and/or circuit board design.

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