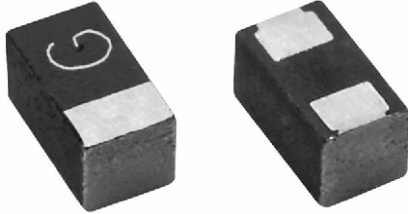


# Solid Tantalum Chip Capacitors

## 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 terminations for superior board mounting
- Suitable for medical implantable applications with additional screening
- Compliant to RoHS directive 2002/95/EC



**RoHS**  
COMPLIANT

### PERFORMANCE CHARACTERISTICS

**Operating Temperature:** - 55 °C to + 85 °C  
(to + 125 °C with voltage derating)

**Capacitance Range:** 1 μF to 47 μF

**Capacitance Tolerance:** ± 10 % and ± 20 % standard

**Voltage Range:** 2 WV<sub>DC</sub> to 40 WV<sub>DC</sub>

ORDERING INFORMATION							
TM8 MODEL	R CASE CODE	106 CAPACITANCE	M CAPACITANCE TOLERANCE	016 DC VOLTAGE RATING AT + 85 °C	E TERMINATION/ PACKAGING	B RELIABILITY LEVEL	A 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).	<b>E = Sn/Pb solder/ 7" (178 mm) reels</b> R = Sn/Pb solder/ 7" (178 mm) 300 pcs. qty. C = 100 % tin/ 7" (178 mm) reels U = 100 % tin/ 7" (178 mm) 300 pcs. qty.	<b>B = 0.1 % weibull FRL</b> S = Hi-Rel std. (40 h burn-in) Z = Non-established reliability	<b>A = 10 cycles at 25 °C</b> B = 10 cycles at - 55 °C/+ 85 °C Z = None

**Note**

- Standard options are in bold

DIMENSIONS in inches [millimeters]						
CASE	L	W	H	P1	P2 (REF.)	C
Q	0.100 ± 0.015 [2.54 ± 0.38]	0.053 ± 0.012 [1.35 ± 0.30]	0.050 ± 0.012 [1.27 ± 0.30]	0.031 + 0.004/- 0.006 [0.80 + 0.1/- 0.15]	0.038 ± 0.010 [0.96 ± 0.25]	0.046 + 0.009/- 0.001 [1.17 + 0.23/- 0.025]
D	0.150 ± 0.015 [3.8 ± 0.38]	0.100 ± 0.015 [2.54 ± 0.38]	0.050 ± 0.012 [1.27 ± 0.30]	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]
E	0.201 ± 0.015 [5.1 ± 0.38]	0.100 ± 0.015 [2.54 ± 0.38]	0.050 ± 0.012 [1.27 ± 0.30]	0.031 + 0.004/- 0.006 [0.80 + 0.1/- 0.15]	0.139 ± 0.010 [3.5 ± 0.25]	0.091 + 0.009/- 0.001 [2.3 + 0.23/- 0.025]
F	0.220 ± 0.015 [5.6 ± 0.38]	0.138 ± 0.012 [3.5 ± 0.3]	0.050 ± 0.012 [1.27 ± 0.30]	0.039 ± 0.005 [1.0 ± 0.13]	0.142 ± 0.010 [3.6 ± 0.25]	0.126 + 0.009/- 0.001 [3.2 + 0.23/- 0.025]
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]

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<b>DIMENSIONS</b> in inches [millimeters]						
<b>CASE</b>	<b>L</b>	<b>W</b>	<b>H</b>	<b>P1</b>	<b>P2 (REF.)</b>	<b>C</b>
L	0.081 ± 0.008 [2.05 ± 0.2]	0.051 ± 0.004 [1.3 ± 0.10]	0.04 max. [1.0 max.]	0.020 ± 0.004 [0.50 ± 0.1]	0.027 min. [0.70 min.]	0.035 + 0.009/- 0.01 [0.9+0.23/- 0.02]
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]
N	0.138 + 0.004/- 0.008 [3.505 + 0.101/- 0.203]	0.110 ± 0.004 [2.80 ± 0.1]	0.04 max. [1.0 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]
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]
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]
T	0.138 + 0.004/- 0.008 [3.505 + 0.101/- 0.203]	0.110 ± 0.004 [2.80 ± 0.1]	0.06 max. [1.52 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]
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]

<b>RATINGS AND CASE CODES</b>						
<b>F</b>	<b>6.3 V</b>	<b>10 V</b>	<b>16 V</b>	<b>20 V</b>	<b>25 V</b>	<b>40 V</b>
1.0		M	M	W	R	P
2.2						
3.3				R		
4.7		M			P	
7.5		L		N*		
10	M	R	R			
15	M					
22						
33						
47		T				

**Note**

\* Preliminary values, contact factory for availability.

<b>MARKING</b>	
<p align="center"><b>M-Case</b></p> <p align="center">Polarity Bar    Voltage Code</p> <p align="center"><b>K-Case</b></p>	<p align="center"><b>P-Case</b></p> <p align="center">Polarity Bar    Voltage Code    Capacitance Code</p> <p align="center"><b>D, E, F, N, T-Case</b></p> <p align="center">Capacitance    Voltage</p> <p align="center">Polarity band</p> <p align="center">Vishay logo (if space allows)</p>



STANDARD RATINGS					
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C (%)	MAX. ESR AT + 25 °C 100 kHz STD. ( $\Omega$ )
<b>6.3 WV<sub>DC</sub> AT + 85 °C, 4 WV<sub>DC</sub> AT + 125 °C</b>					
10	M	TM8M106(1)6R3(2)(3)(5)	0.32	8	5.0
15	M	TM8M156(1)6R3(2)(3)(5)	0.47	8	5.0
<b>10 WV<sub>DC</sub> AT + 85 °C, 7 WV<sub>DC</sub> AT + 125 °C</b>					
1.0	M	TM8M105(1)010(2)(3)(5)	0.20	6	12.0
4.7	M	TM8M475(1)010(2)(3)(5)	0.24	8	6.0
7.5	L	TM8L755(1)010(2)(3)(5)	0.38	8	8.0
10	R	TM8R106(1)010(2)(3)(5)	0.50	8	6.0
47	T	TM8T476(1)010(2)(3)(5)	2.35	8	1.0
<b>16 WV<sub>DC</sub> AT + 85 °C, 10 WV<sub>DC</sub> AT + 125 °C</b>					
1.0	M	TM8M105(1)016(2)(3)(5)	0.20	6	12.0
10	R	TM8R106(1)016(2)(3)(5)	0.80	8	6.0
<b>20 WV<sub>DC</sub> AT + 85 °C, 13 WV<sub>DC</sub> AT + 125 °C</b>					
1.0	W	TM8W105(1)020(2)(3)(5)	0.20	8	8.0
3.3	R	TM8R335(1)020(2)(3)(5)	0.33	8	8.0
7.5	N	TM8N755(1)020(2)(3)(5)*	0.93	8	8.0
<b>25 WV<sub>DC</sub> AT + 85 °C, 17 WV<sub>DC</sub> AT + 125 °C</b>					
1.0	R	TM8R105(1)025(2)(3)(5)	0.20	6	10.0
4.7	P	TM8P475(1)025(2)(3)(5)	0.59	6	6.0
<b>40 WV<sub>DC</sub> AT + 85 °C, 27 WV<sub>DC</sub> AT + 125 °C</b>					
1.0	P	TM8P105(1)040(2)(3)(5)	0.20	8	10.0

**Notes**

- (1) Capacitance tolerance: K, M
- (2) Termination and Packaging: E, C
- (3) Reliability level: Z, S, B
- (4) Reliability level: Z only
- (5) Surge current: Z, A, B
- (6) Surge current: Z only
- \* Preliminary ratings: contact factory for availability

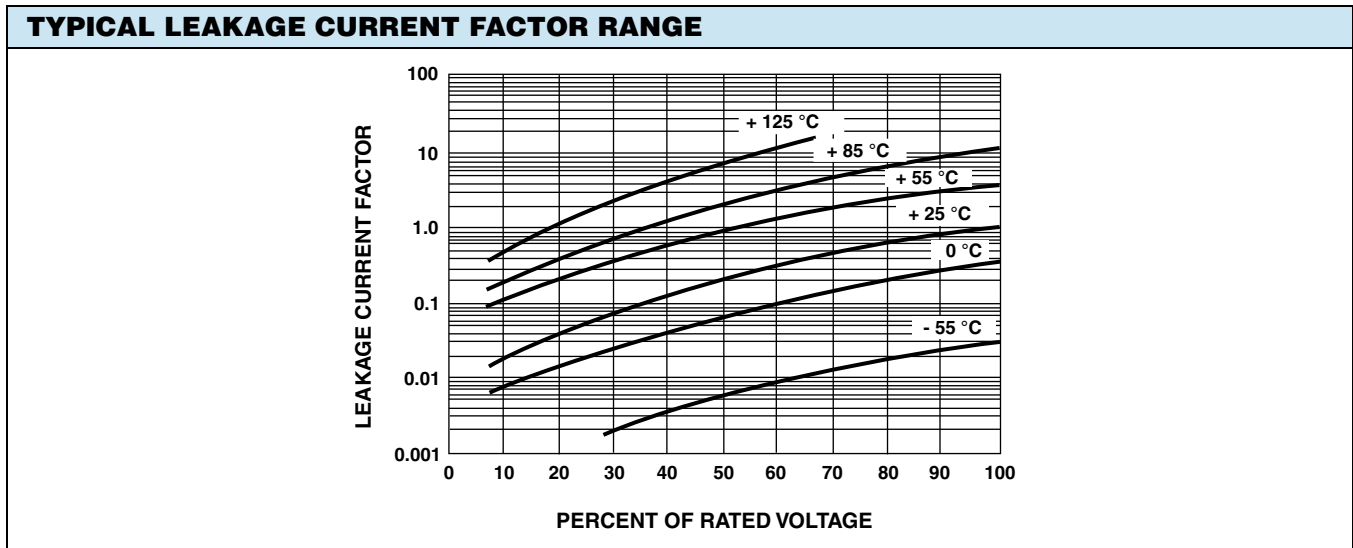


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**CAPACITORS PERFORMANCE CHARACTERISTICS**

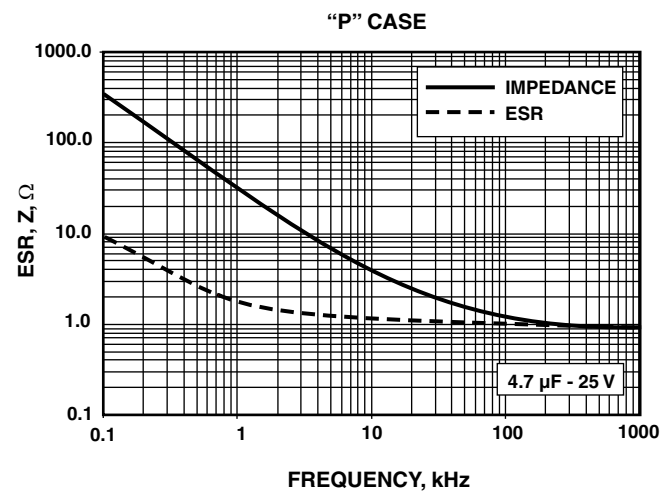
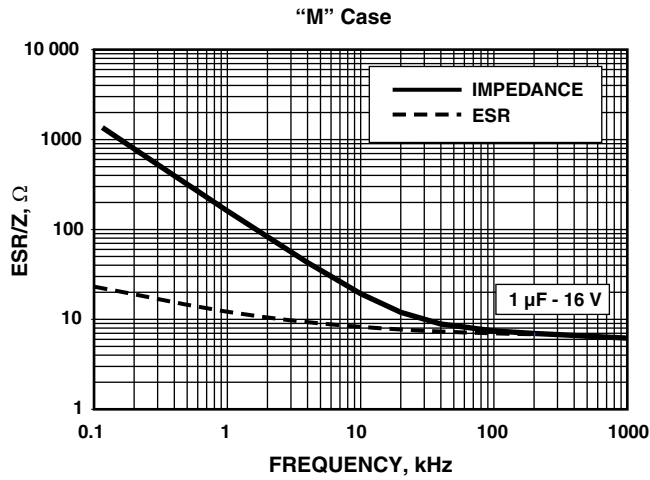
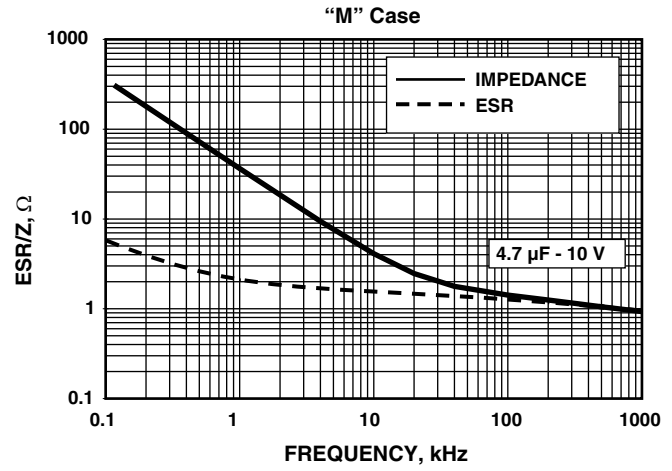
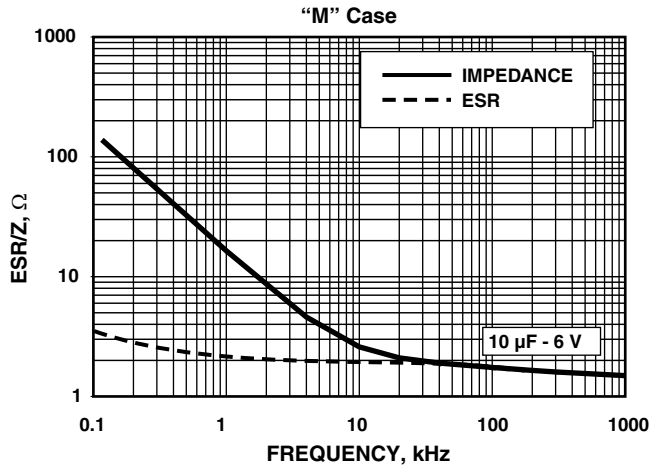
ELECTRICAL PERFORMANCE CHARACTERISTICS	
ITEM	PERFORMANCE CHARACTERISTICS
Category Temperature Range	- 55 °C to + 85 °C (to + 125 °C with voltage derating)
Capacitance Tolerance	± 20 %, ± 10 % (at 120 Hz) 1 V <sub>rms</sub> at + 25 °C using a capacitance bridge
Dissipation Factor (at 120 Hz)	Limits per 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 minutes 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	<b>+ 85 °C RATING</b>
	<b>WORKING VOLTAGE (V)</b>
	2
	4
	6.3
	10
	15
	16
	20
	25
<b>+ 125 °C RATING</b>	
<b>WORKING VOLTAGE (V)</b>	
1.3	
2.7	
4	
7	
10	
10	
13	
17	
27	



**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

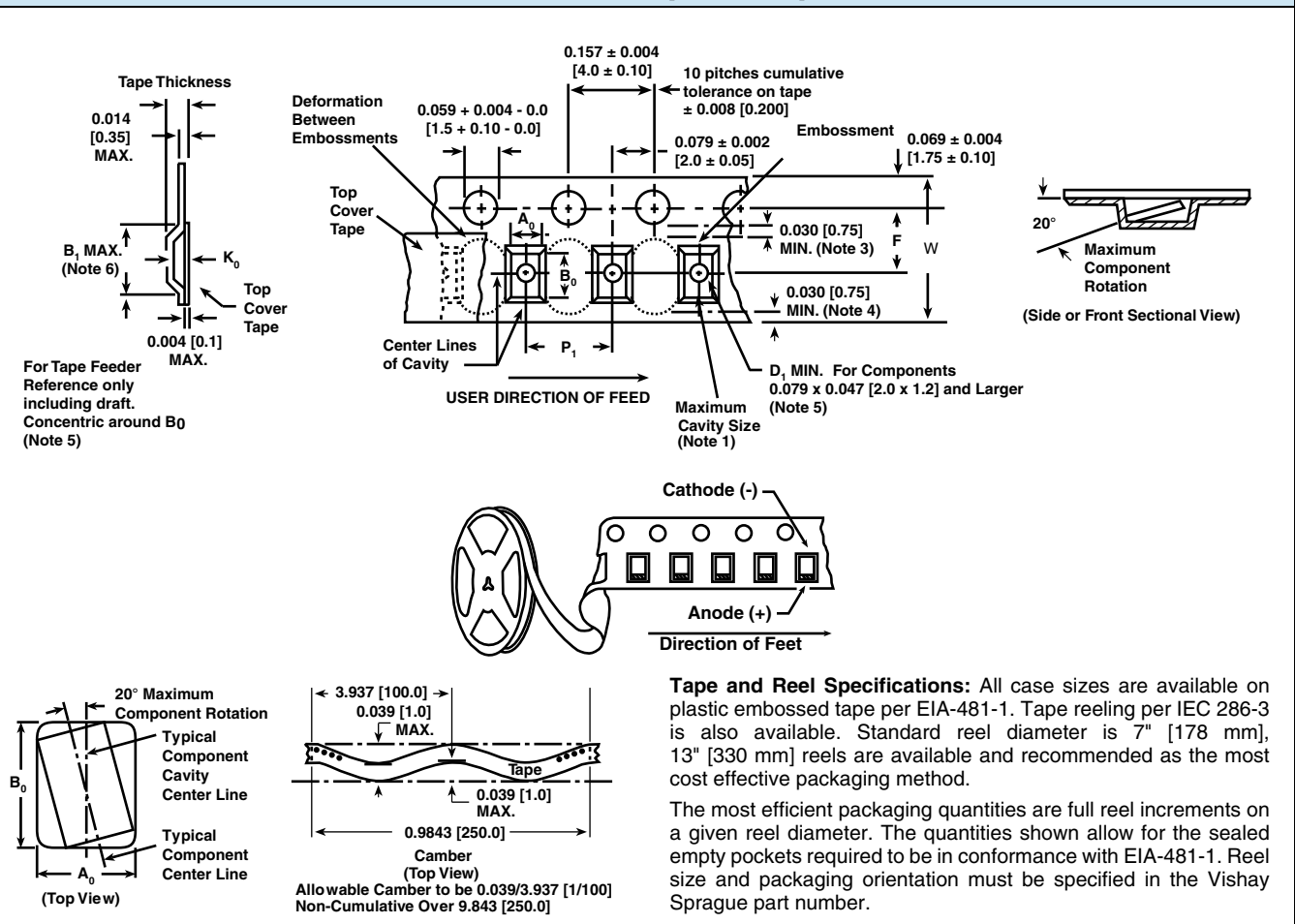
**TYPICAL CURVES AT + 25 °C, IMPEDANCE AND ESR VS. FREQUENCY**



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**PLASTIC TAPE AND REEL PACKAGING** in inches [millimeters]



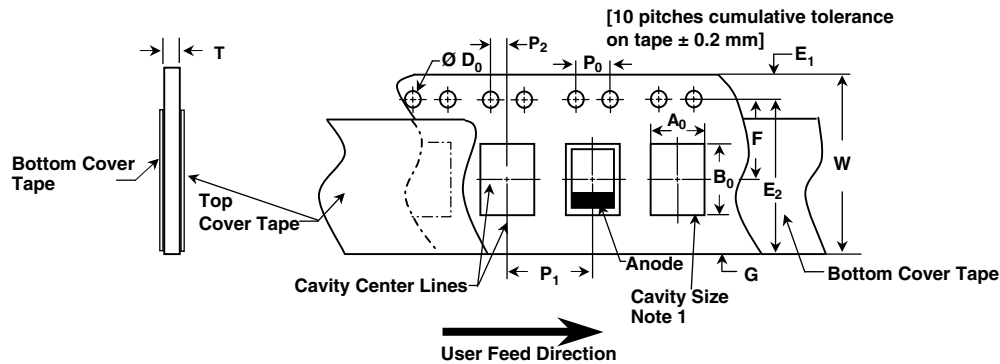
**Note**

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

CASE CODE	TAPE SIZE	B <sub>1</sub> (MAX.)	D <sub>1</sub> (MIN.)	F	K <sub>0</sub> (MAX.)	P <sub>1</sub>	W
<b>TM8</b>							
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)
Q	8 mm	0.135 (3.43)	0.039 (1.0)	0.138 (3.5)	0.065 (1.65)	0.157 (4.0)	0.315 (8.0)
L	8 mm	0.094 (2.4)	0.039 (1.0)	0.138 (3.5)	0.047 (1.2)	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)
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)
D	12 mm	0.154 (3.9)	0.059 (1.5)	0.216 (5.5)	0.051 (1.3)	0.157 (4.0)	0.472 (12.0)
E	12 mm	0.235 (5.97)	0.059 (1.5)	0.216 (5.5)	0.070 (1.78)	0.157 (4.0)	0.472 (12.0)
F	12 mm	0.231 (5.88)	0.059 (1.5)	0.216 (5.5)	0.060 (1.53)	0.157 (4.0)	0.472 (12.0)
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]



TM8

CASE SIZE	TAPE SIZE	A <sub>0</sub>	B <sub>0</sub>	D <sub>0</sub>	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	E	F	W	T
K	8 mm	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	8 mm	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**

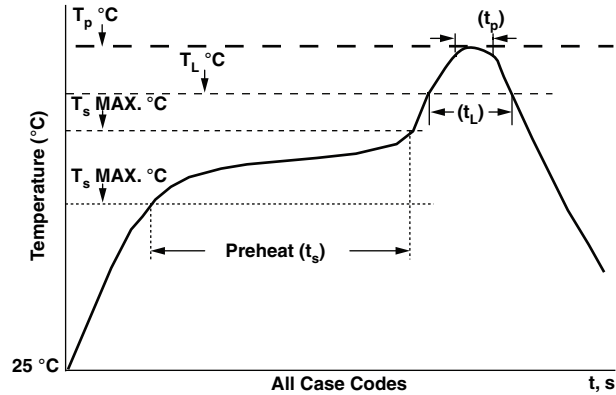
SERIES	CASE CODE	QTY (PCS/REEL)		
		7" REEL	1/2 REEL	SMALL REEL
TM8	K	5000	2500	300
	M	4000	2000	300
	P	3000	1500	300
	Q	4000	2000	300
	D	2500	1250	300
	E	2500	1250	300
	F	2500	1250	300
	L	2500	1250	300
	N	2500	1250	300
	R	2500	1250	300
T	2500	1250	300	
W	2500	1250	300	

**POWER DISSIPATION**

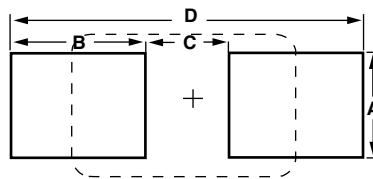
SERIES	CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
TM8	K	0.015
	M	0.025
	P	0.045
	Q	0.045
	D	0.084
	E	0.090
	F	0.110
	L	0.035
	N	0.075
	R	0.045
T	0.084	
W	0.040	

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**RECOMMENDED REFLOW PROFILES**


TYPE	T <sub>P</sub> lead (Pb)-free	T <sub>P</sub> Sn/Pb	t <sub>P</sub>	T <sub>L</sub> lead (Pb)-free	T <sub>L</sub> Sn/Pb	T <sub>S</sub> MIN. lead (Pb)-free	T <sub>S</sub> MIN. Sn/Pb	T <sub>S</sub> MAX. lead (Pb)-free	T <sub>S</sub> MAX. Sn/Pb	t <sub>S</sub> lead (Pb)-free	t <sub>S</sub> Sn/Pb	t <sub>L</sub>
<b>TM8</b>	260 °C	225 °C	10	217 °C	183 °C	150 °C	100 °C	200 °C	150 °C	60 to 150	60 to 90	60

**PAD DIMENSIONS** in inches [millimeters]


CASE CODE	A (MIN.)	B (NOM.)	C (NOM.)	D (NOM.)
<b>TM8</b>				
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)	0.24 (0.60)	0.080 (2.00)
P	0.063 (1.60)	0.031 (0.80)	0.047 (1.20)	0.110 (2.80)
Q	0.065 (1.60)	0.050 (1.30)	0.040 (1.00)	0.142 (3.60)
D	0.115 (2.90)	0.070 (1.80)	0.070 (1.80)	0.213 (5.40)
E	0.115 (2.90)	0.070 (1.80)	0.120 (3.00)	0.260 (6.60)
F	0.150 (3.80)	0.070 (1.80)	0.140 (3.60)	0.283 (7.20)
L	0.059 (1.50)	0.031 (0.80)	0.039 (1.00)	0.102 (2.60)
N	0.118 (3.00)	0.067 (1.70)	0.051 (1.30)	0.185 (4.70)
R	0.059 (1.50)	0.031 (0.80)	0.039 (1.00)	0.102 (2.60)
T	0.118 (3.00)	0.067 (1.70)	0.051 (1.30)	0.185 (4.70)
W	0.059 (1.50)	0.031 (0.80)	0.039 (1.00)	0.102 (2.60)





**GUIDE TO APPLICATION**

1. **A-C 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 as given in the table in paragraph number 5 (power dissipation).

R<sub>ESR</sub> = The capacitor equivalent series resistance at the specified frequency.

2. **A-C 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 as given in the table in paragraph number 5 (power dissipation).

R<sub>ESR</sub> = 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<sub>rms</sub> 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 porcelainized 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 second. 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, Chloroethane, 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 minutes.

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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