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RoHS

HALOGEN

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GREEN

(5-2008)

# vPolyTan<sup>TM</sup> Polymer Surface Mount Chip Capacitors, Low ESR, Leadframeless Molded Type, Hi-Rel Commercial Off-The-Shelf (COTS)



# PERFORMANCE / ELECTRICAL CHARACTERISTICS

Operating Temperature: -55 °C to +125 °C Capacitance Range: 15  $\mu$ F to 470  $\mu$ F Capacitance Tolerance:  $\pm$  20 % Voltage Rating: 16  $V_{DC}$  to 75  $V_{DC}$ 

#### **FEATURES**

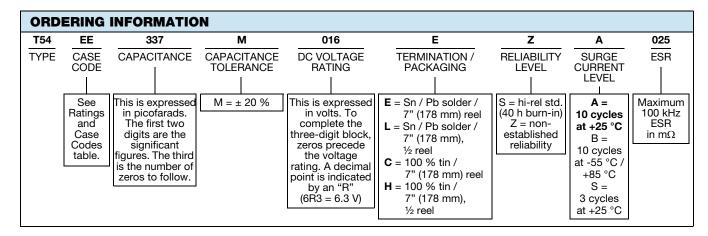
- Ultra-low ESR
- · High reliability processing including:
  - 100 % surge current tested
- Accelerated aging
- Thermal shock
- Statistical DC leakage screening at elevated temperature and voltage
- Molded case 7343 EIA size
- Terminations: wraparound
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

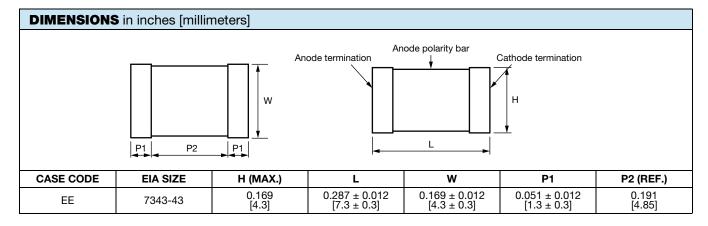
#### Note

\* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details

# APPLICATIONS

- Decoupling, smoothing, filtering
- Switch mode and point of load power supply
- Infrastructure equipment
- · Storage and networking





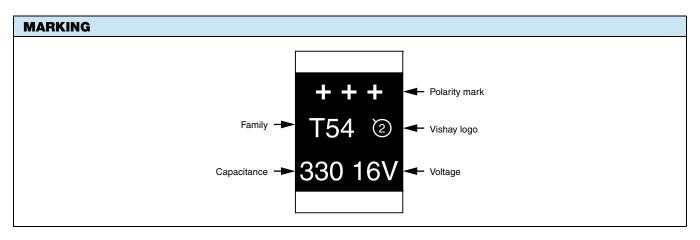
Revision: 15-Nov-2018 **1** Document Number: 40212 For technical questions, contact: polytech@vishay.com

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RATINGS AND CASE CODES (ESR m $\Omega$ )						
μF	16 V	30 V	35 V	50 V	63 V	75 V
15					EE (100)	EE (100) <sup>(1)</sup>
22				EE (100)	EE (100)	EE (100) <sup>(1)</sup>
47			EE (70)			
150		EE (150, 75)				
220	EE (25)					
330	EE (25)					
470	EE (25)					

#### Note

<sup>(1)</sup> Rating in development, contact factory for availability



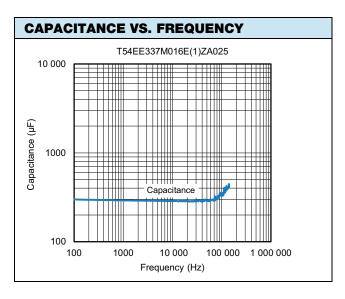
STANDARD RATINGS									
CAPACITANCE	INCE CASE DART NUMBER AT +25 °C AT +25 °C AT +25 °C	SE DART NUMBER		AT +25 °C	MAX. ESR AT +25 °C	MAX. RIPPLE, 100 kHz	HI TEMPERATURE LOAD 2/3 V <sub>R</sub>		MSL
(μ <b>F</b> )		100 kHz (mΩ)	I <sub>RMS</sub> (A)	TEMPERATURE (°C)	TIME (h)	WISE			
		16 \	/ <sub>DC</sub> AT +105	°C, 10 V <sub>DC</sub> A	T 125 °C				
220	EE	T54EE227M016(1)(2)(3)025	352	10	25	3.143	125	2000	3
330	EE	T54EE337M016(1)(2)(3)025	528	10	25	3.143	125	2000	3
470	EE	T54EE477M016(1)(2)(3)025	752	10	25	3.143	125	1000	3
		30 \	/ <sub>DC</sub> AT +105	°C, 20 V <sub>DC</sub> A	T 125 °C				
150	EE	T54EE157M030(1)(2)(3)150	450	10	150	1.283	125	2000	3
150	EE	T54EE157M030(1)(2)(3)075	450	10	75	1.815	125	2000	3
		35 \	/ <sub>DC</sub> AT +105	°C, 25 V <sub>DC</sub> A	T 125 °C				
47	EE	T54EE476M035(1)(2)(3)070	165	10	70	1.878	125	2000	3
		50 \	/ <sub>DC</sub> AT +105	°C, 33 V <sub>DC</sub> A	T 125 °C				
22	EE	T54EE226M050(1)(2)(3)100	110	10	100	1.572	125	1000	3
		63 \	/ <sub>DC</sub> AT +105	°C, 43 V <sub>DC</sub> A	T 125 °C				
15	EE	T54EE156M063(1)(2)(3)100	95	10	100	1.572	125	1000	3
22	EE	T54EE226M063(1)(2)(3)100	139	10	100	1.572	125	1000	3
	75 V <sub>DC</sub> AT +105 °C, 50 V <sub>DC</sub> AT 125 °C								
15	EE <sup>(1)</sup>	T54EE156M075(1)(2)(3)100	113	10	100	1.572	125	1000	3
22	EE <sup>(1)</sup>	T54EE226M075(1)(2)(3)100	165	10	100	1.572	125	1000	3

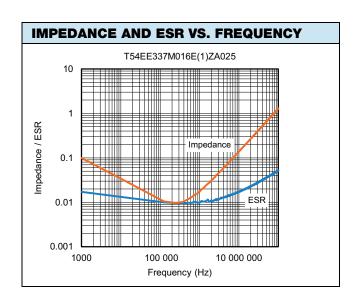
- Part number definitions:
  - (1) Termination and packaging: E, L, C, H (2) Reliability level: Z, S (3) Surge current: A, B, S
- (1) Rating in development, contact factory for availability

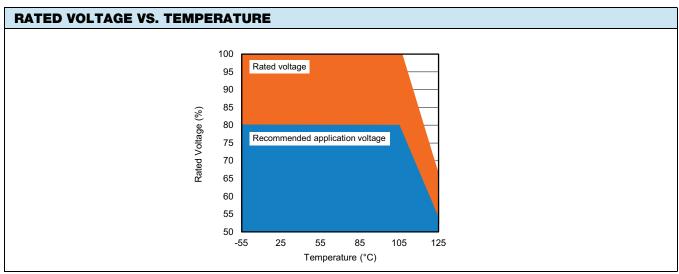
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RECOMMENDED VOLTAGE DERATING GUIDELINES						
CAPACITOR VOLTAGE RATING	OPERATION VOLTAGES FOR TEMPERATURES -55 °C TO +105 °C	OPERATION VOLTAGES FOR TEMPERATURES +105 °C TO +125 °C				
16	12.8	8.6				
25	20.0	13.5				
30	24.0	16.2				
35	28.0	18.9				
50	40.0	27.0				
63	50.4	34.0				
75	60.0	40.5				







POWER DISSIPATION	
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT +25 °C (W) IN FREE AIR
EE	0.247



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STANDARD PACKAGING QUANTITY						
CASE CODE	QUANTITY (PCS/REEL)					
CASE CODE	7" REEL	½ REEL				
EE	400	200				

ITEM	CONDITION	POST TEST PERFOR	RMANCE
Life test at +105 °C	2000 h application of rated voltage at 105 °C,	Capacitance change	Within ± 20 % of initial value
	MIL-STD-202 method 108	Dissipation factor	Within initial limits
		Leakage current	Shall not exceed 300 % of initial limit
Life test at +125 °C	2000 h application of 2/3 rated voltage at 125 °C,	Capacitance change	Within ± 20 % of initial value
	MIL-STD-202 method 108	Dissipation factor	Within initial limits
		Leakage current	Shall not exceed 300 % of initial limit
Shelf life test	2000 h no voltage applied at 105 °C,	Capacitance change	Within ± 20 % of initial value
at +105 °C	MIL-STD-202 method 108	Dissipation factor	Within initial limits
		Leakage current	Shall not exceed 300 % of initial limit
Humidity tests	At 60 °C / 90 % RH 500 h, no voltage applied	Capacitance change	-20 % to +40 % of initial value
		Dissipation factor	Within initial limit
		Leakage current	Shall not exceed 300 % of initial limit
Stability at low and	-55 °C	Capacitance change	Within -20 % to 0 % of initial value
high temperatures		Dissipation factor	Shall not exceed 150 % of initial limit
		Leakage current	n/a
	25 °C	Capacitance change	Within ± 20 % of initial value
		Dissipation factor	Within initial limit
		Leakage current	Within initial limit
	85 °C	Capacitance change	Within -0 % to +50 % of initial value
		Dissipation factor	Within initial limit
		Leakage current	Shall not exceed 1000 % of initial value
	105 °C	Capacitance change	Within -0 % to +50 % of initial value
		Dissipation factor	Within initial limit
		Leakage current	Shall not exceed 1000 % of initial limit
Surge voltage	105 °C, 1000 successive test cycles at 1.3 of	Capacitance change	Within ± 20 % of initial value
	rated voltage in series with a 33 $\Omega$ resistor at	Dissipation factor	Within initial limit
	the rate of 30 s ON, 30 s OFF	Leakage current	Shall not exceed 300 % of initial limit
Shock	MIL-STD-202, method 213, condition E,	Capacitance change	Within ± 20 % of initial value
(specified pulse)	1000 g peak	Dissipation factor	Within initial limit
		Leakage current	Shall not exceed 300 % of initial limit
Vibration	MIL-STD-202, method 204, condition D,	Capacitance change	Within ± 20 % of initial value
	10 Hz to 2000 Hz 20 <i>g</i> peak	Dissipation factor	Within initial limit
		Leakage current	Shall not exceed 300 % of initial limit
		There shall be no med post-conditioning.	chanical or visual damage to capacitors
Shear test	Apply a pressure load of 17.7 N for 10 s ± 1 s	Capacitance change	Within ± 20 % of initial value
	horizontally to the center of capacitor side body	Dissipation factor	Within initial limit
		Leakage current	Shall not exceed 300 % of initial limit

PRODUCT INFORMATION	
Polymer Guide	www.vishay.com/doc?40076
Moisture Sensitivity	www.vishay.com/doc?40135
Infographic	www.vishay.com/doc?48084
Sample Board	www.vishay.com/doc?48073
FAQ	
Frequently Asked Questions	www.vishay.com/doc?42106



# Guide for Tantalum Solid Electrolyte Chip Capacitors with Polymer Cathode

#### INTRODUCTION

Tantalum electrolytic capacitors are the preferred choice in applications where volumetric efficiency, stable electrical parameters, high reliability, and long service life are primary considerations. The stability and resistance to elevated temperatures of the tantalum/tantalum oxide/manganese dioxide system make solid tantalum capacitors an appropriate choice for today's surface mount assembly technology.

Vishay Sprague has been a pioneer and leader in this field, producing a large variety of tantalum capacitor types for consumer, industrial, automotive, military, and aerospace electronic applications.

Tantalum is not found in its pure state. Rather, it is commonly found in a number of oxide minerals, often in combination with Columbium ore. This combination is known as "tantalite" when its contents are more than one-half tantalum. Important sources of tantalite include Australia, Brazil, Canada, China, and several African countries. Synthetic tantalite concentrates produced from tin slags in Thailand, Malaysia, and Brazil are also a significant raw material for tantalum production.

Electronic applications, and particularly capacitors, consume the largest share of world tantalum production. Other important applications for tantalum include cutting tools (tantalum carbide), high temperature super alloys, chemical processing equipment, medical implants, and military ordnance.

Vishay Sprague is a major user of tantalum materials in the form of powder and wire for capacitor elements and rod and sheet for high temperature vacuum processing.

#### THE BASICS OF TANTALUM CAPACITORS

Most metals form crystalline oxides which are non-protecting, such as rust on iron or black oxide on copper. A few metals form dense, stable, tightly adhering, electrically insulating oxides. These are the so-called "valve"metals and include titanium, zirconium, niobium, tantalum, hafnium, and aluminum. Only a few of these permit the accurate control of oxide thickness by electrochemical means. Of these, the most valuable for the electronics industry are aluminum and tantalum.

Capacitors are basic to all kinds of electrical equipment, from radios and television sets to missile controls and automobile ignitions. Their function is to store an electrical charge for later use.

Capacitors consist of two conducting surfaces, usually metal plates, whose function is to conduct electricity. They are separated by an insulating material or dielectric. The dielectric used in all tantalum electrolytic capacitors is tantalum pentoxide.

Tantalum pentoxide compound possesses high-dielectric strength and a high-dielectric constant. As capacitors are being manufactured, a film of tantalum pentoxide is applied to their electrodes by means of an electrolytic process. The film is applied in various thicknesses and at various voltages and although transparent to begin with, it takes on different colors as light refracts through it. This coloring occurs on the tantalum electrodes of all types of tantalum capacitors.

Rating for rating, tantalum capacitors tend to have as much as three times better capacitance/volume efficiency than aluminum electrolytic capacitors. An approximation of the capacitance/volume efficiency of other types of capacitors may be inferred from the following table, which shows the dielectric constant ranges of the various materials used in each type. Note that tantalum pentoxide has a dielectric constant of 26, some three times greater than that of aluminum oxide. This, in addition to the fact that extremely thin films can be deposited during the electrolytic process mentioned earlier, makes the tantalum capacitor extremely efficient with respect to the number of microfarads available per unit volume. The capacitance of any capacitor is determined by the surface area of the two conducting plates, the distance between the plates, and the dielectric constant of the insulating material between the plates.

COMPARISON OF CAPACITOR DIELECTRIC CONSTANTS				
DIELECTRIC	e DIELECTRIC CONSTANT			
Air or vacuum	1.0			
Paper	2.0 to 6.0			
Plastic	2.1 to 6.0			
Mineral oil	2.2 to 2.3			
Silicone oil	2.7 to 2.8			
Quartz	3.8 to 4.4			
Glass	4.8 to 8.0			
Porcelain	5.1 to 5.9			
Mica	5.4 to 8.7			
Aluminum oxide	8.4			
Tantalum pentoxide	26			
Ceramic	12 to 400K			

In the tantalum electrolytic capacitor, the distance between the plates is very small since it is only the thickness of the tantalum pentoxide film. As the dielectric constant of the tantalum pentoxide is high, the capacitance of a tantalum capacitor is high if the area of the plates is large:

$$C = \frac{eA}{t}$$

where

C = capacitance

e = dielectric constant

A = surface area of the dielectric

t = thickness of the dielectric

Tantalum capacitors contain either liquid or solid electrolytes. In solid electrolyte capacitors, a dry material (manganese dioxide) forms the cathode plate. A tantalum lead is embedded in or welded to the pellet, which is in turn connected to a termination or lead wire. The drawings show the construction details of the surface mount types of tantalum capacitors shown in this catalog.

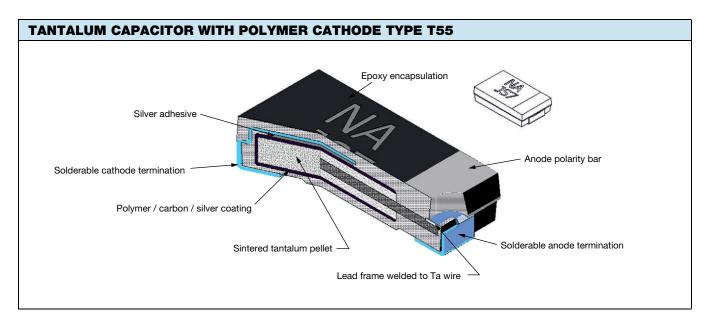


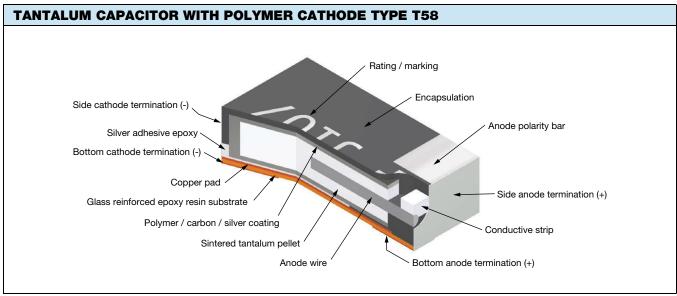
#### SOLID ELECTROLYTE POLYMER TANTALUM CAPACITORS

Solid electrolyte polymer capacitors utilize sintered tantalum pellets as anodes. Tantalum pentoxide dielectric layer is formed on the entire surface of anode, which is further impregnated with highly conductive polymer as cathode system.

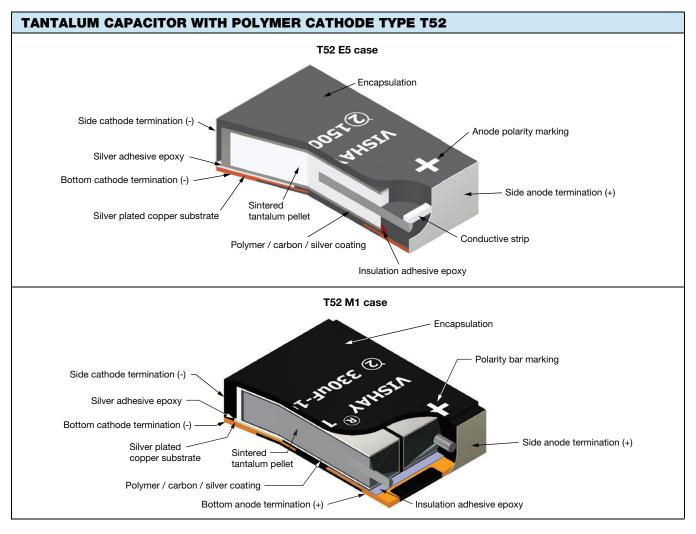
The conductive polymer layer is then coated with graphite, followed by a layer of metallic silver, which provides a conductive surface between the capacitor element and the outer termination (lead frame or other).

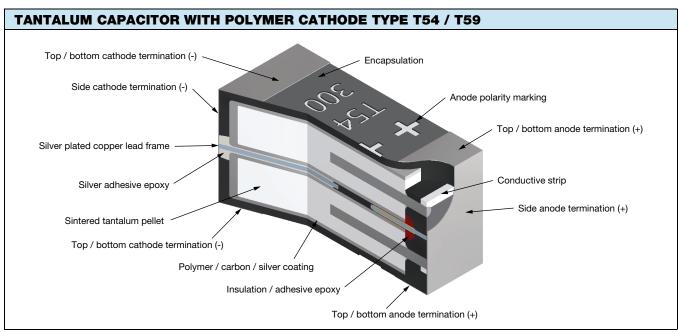
Molded chip polymer tantalum capacitor encases the element in plastic resins, such as epoxy materials. After assembly, the capacitors are tested and inspected to assure long life and reliability. It offers excellent reliability and high stability for variety of applications in electronic devices. Usage of conductive polymer cathode system provides very low equivalent series resistance (ESR), which makes the capacitors particularly suitable for high frequency applications.











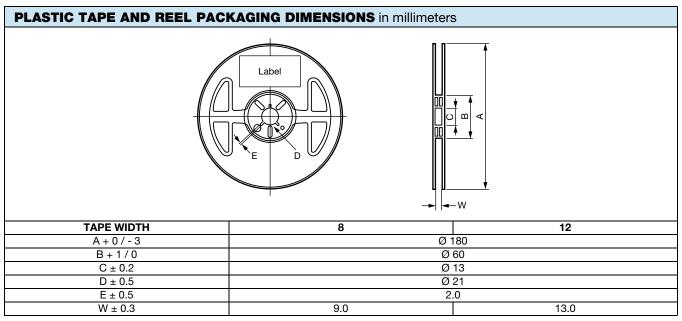


POLYMER CAPACITORS - MOLDED CASE				
SERIES	T55			
PRODUCT IMAGE	THE HEAD WEST			
TYPE	VPolyTan <sup>TM</sup> , molded case, high performance polymer			
FEATURES	High performance			
TEMPERATURE RANGE	-55 °C to +105 °C			
CAPACITANCE RANGE	3.3 μF to 1000 μF			
VOLTAGE RANGE	2.5 V to 63 V			
CAPACITANCE TOLERANCE	± 20 %			
LEAKAGE CURRENT	0.1 CV			
DISSIPATION FACTOR	8 % to 10 %			
ESR	12 m $\Omega$ to 500 m $\Omega$			
CASE SIZES	J, P, A, T, B, Z, V, D			
TERMINATION FINISH	Cases J, P: 100 % tin Case A: 100 % tin or Ni / Pd / Au Cases T, B, Z, V, D: Ni / Pd / Au			

POLYMER CAL	POLYMER CAPACITORS - LEADFRAMELESS MOLDED CASE						
SERIES	T52	T58	T59	T54			
PRODUCT IMAGE		# NO7		Tarage 1			
ТҮРЕ	vPolyTan <sup>TM</sup> polymer surface mount chip capacitors, low profile, leadframeless molded type	vPolyTan <sup>TM</sup> polymer surface mount chip capacitors, compact, leadframeless molded type	vPolyTan <sup>TM</sup> polymer surface mount chip capacitors, low ESR, leadframeless molded type	vPolyTan <sup>TM</sup> polymer surface mount chip capacitors, low ESR, leadframeless molded type, hi-rel commercial off-the-shelf (COTS)			
FEATURES	Low profile	Small case size	Multianode	Hi-rel COTS, multianode			
TEMPERATURE RANGE	-55 °C to +105 °C	-55 °C to +105 °C	-55 °C to +105 °C	-55 °C to +125 °C			
CAPACITANCE RANGE	47 μF to 1500 μF	1 μF to 330 μF	15 μF to 470 μF	15 μF to 470 μF			
VOLTAGE RANGE	10 V to 35 V	6.3 V to 35 V	16 V to 75 V	16 V to 75 V			
CAPACITANCE TOLERANCE	± 20 %	± 20 %	± 10 %, ± 20 % ± 20 %				
LEAKAGE CURRENT		0.1 CV					
DISSIPATION FACTOR	10 %	8 % to 14 %	10 %	10 %			
ESR	25 m $\Omega$ to 55 m $\Omega$	50 m $\Omega$ to 500 m $\Omega$	500 mΩ 25 mΩ to 150 mΩ 25 mΩ to 15				
CASE SIZES	E5, M1	MM, M0, W0, W9, A0, AA, B0, BB	EE	EE			
TERMINATION	100	% tin	100 % 1	in / lead			

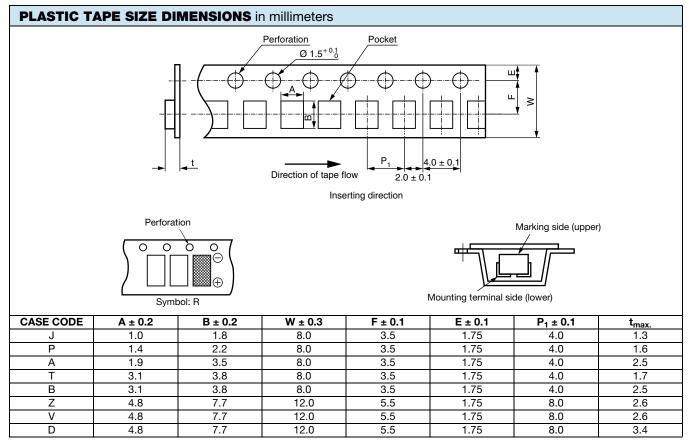


## **MOLDED CAPACITORS, T55 TYPE**



#### Note

• A reel diameter of 330 mm is also applicable

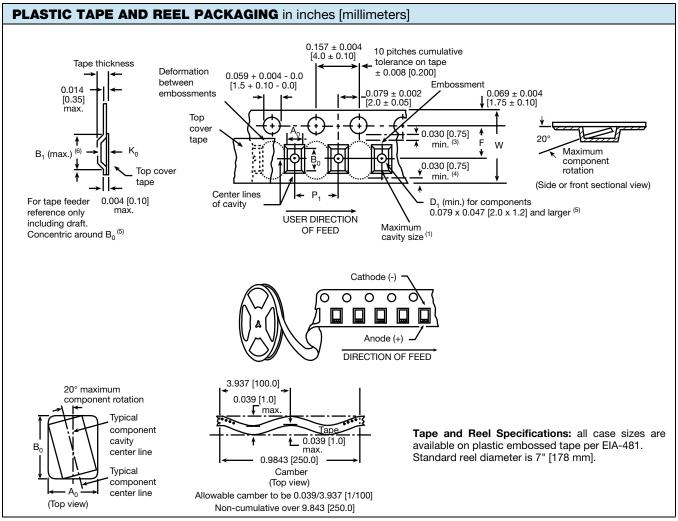


#### Note

· A reel diameter of 330 mm is also applicable



### LEADFRAMELESS MOLDED CAPACITORS, ALL TYPES



- · Metric dimensions will govern. Dimensions in inches are rounded and for reference only.
- (1) A<sub>0</sub>, B<sub>0</sub>, K<sub>0</sub>, 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<sub>0</sub>, B<sub>0</sub>, K<sub>0</sub>) 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 embossment. Dimensions of embossment location shall be applied independent of each other.
- (6) B<sub>1</sub> dimension is a reference dimension tape feeder clearance only.

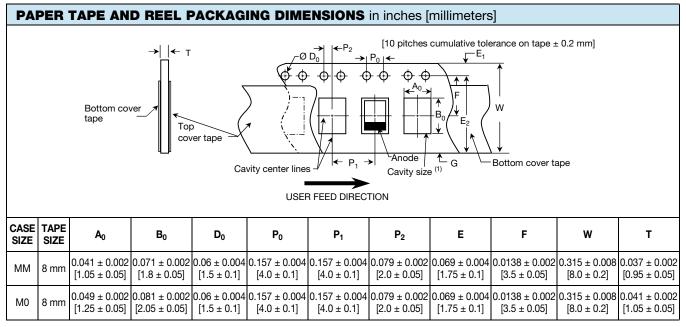


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CARRIER T	CARRIER TAPE DIMENSIONS in inches [millimeters]						
CASE CODE	TAPE SIZE	B <sub>1</sub> (MAX.) <sup>(1)</sup>	D <sub>1</sub> (MIN.)	F	K <sub>0</sub> (MAX.)	P <sub>1</sub>	w
E5	12 mm	0.329 [8.35]	0.059 [1.5]	0.217 ± 0.002 [5.50 ± 0.05]	0.071 [1.8]	0.315 ± 0.004 [8.0 ± 0.10]	0.476 ± 0.008 [12.1 ± 0.20]
MM <sup>(2)</sup>	8 mm	0.075 [1.91]	0.02 [0.5]	0.138 [3.5]	0.043 [1.10]	0.157 [4.0]	0.315 [8.0]
M1	12 mm	0.32 [8.2]	0.059 [1.5]	0.217 ± 0.002 [5.5 ± 0.05]	0.094 [2.39]	0.315 ± 0.04 [8.0 ± 1.0]	0.472 + 0.012 / - 0.004 [12.0 + 0.3 / - 0.10]
W9	8 mm	0.126 [3.20]	0.030 [0.75]	0.138 [3.5]	0.045 [1.15]	0.157 [4.0]	0.315 [8.0]
WO	8 mm	0.126 [3.20]	0.030 [0.75]	0.138 [3.5]	0.045 [1.15]	0.157 [4.0]	0.315 [8.0]
A0	8 mm	-	0.02 [0.5]	0.138 [3.5]	0.049 [1.25]	0.157 [4.0]	0.315 [8.0]
AA	8 mm	0.154 [3.90]	0.039 [1.0]	0.138 [3.5]	0.079 [2.00]	0.157 [4.0]	0.315 [8.0]
В0	12 mm	0.181 [4.61]	0.059 [1.5]	0.217 [5.5]	0.049 [1.25]	0.157 [4.0]	0.315 [8.0]
BB	8 mm	0.157 [4.0]	0.039 [1.0]	0.138 [3.5]	0.087 [2.22]	0.157 [4.0]	0.315 [8.0]
EE	12 mm	0.32 [8.2]	0.059 [1.5]	0.217 ± 0.002 [5.5 ± 0.05]	0.175 [4.44]	0.315 ± 0.04 [8.0 ±1.0]	0.472 + 0.012 / - 0.004 [12.0 + 0.3 / - 0.10]

#### **Notes**

- (1) For reference only
- (2) Standard packaging of MM case is with paper tape. Plastic tape is available per request



#### Note

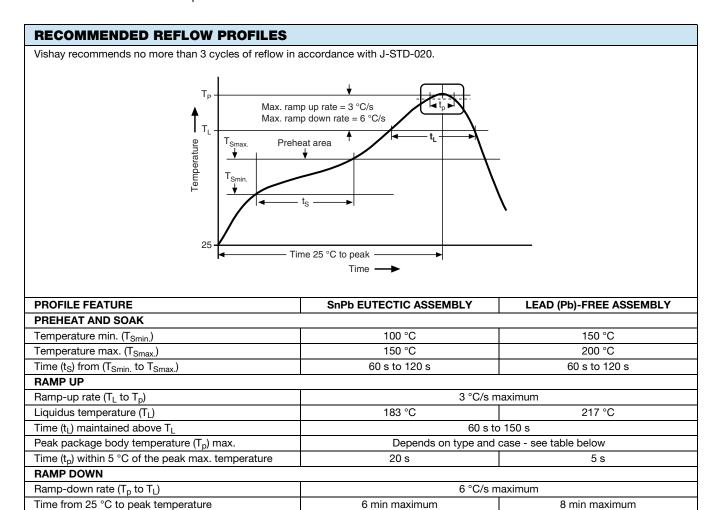
<sup>(1)</sup> A<sub>0</sub>, B<sub>0</sub> are determined by the maximum dimensions to the ends of the terminals extending from the component body and / or the body dimensions of the component. The clearance between the ends of the terminals or body of the component to the sides and depth of the cavity (A<sub>0</sub>, B<sub>0</sub>) 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°



#### **PACKING AND STORAGE**

Polymer capacitors meet moisture sensitivity level rating (MSL) of 3 or 4 as specified in IPC/JEDEC® J-STD-020 and are dry packaged in moisture barrier bags (MBB) per J-STD-033. Standard Ratings table defines MSL level for each particular family. Level 3 specifies a floor life (out of bag) of 168 hours and level 4 specifies a floor life of 72 hours at 30 °C maximum and 60 % relative humidity (RH). Unused capacitors should be re-sealed in the MBB with fresh desiccant. A moisture strip (humidity indicator card) is included in the bag to assure dryness. To remove excess moisture, capacitors can be dried at 40 °C (standard "dry box" conditions).

For detailed recommendations please refer to J-STD-033.

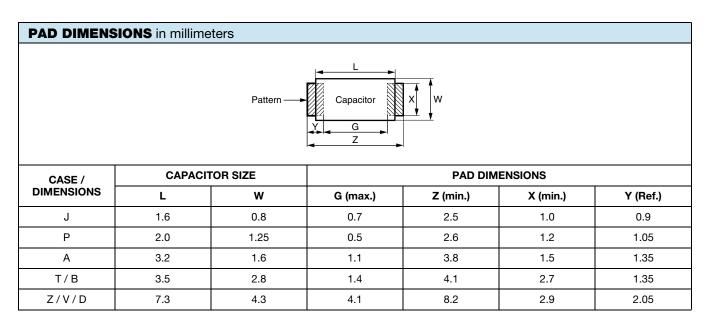


PEAK PACKAGE BODY TEMPERATURE (Tp) MAXIMUM							
TYPE	CASE CODE PEAK PACKAGE BODY TEMPERATURE (T <sub>P</sub> ) MAX.					CASE CODE	TEMPERATURE (T <sub>P</sub> ) MAX.
ITPE	CASE CODE	SnPb EUTECTIC ASSEMBLY	LEAD (Pb)-FREE ASSEMBLY				
T55	J, P, A, T, B, Z, V, D		260 °C				
T52	E5, M1	n/a	260 °C				
T58	MM, M0, W9, W0, A0, AA, B0, BB		260 °C				
T59	EE	220 °C	250 °C				
T54	EE	220 °C	250 °C				

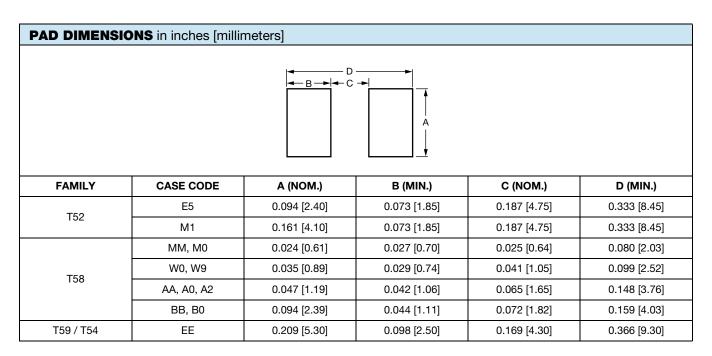
- T52, T55, and T58 capacitors are process sensitive. PSL classification to JEDEC J-STD-075: R4G
- T54 and T59 capacitors with 100 % tin termination are process sensitive. PSL classification to JEDEC J-STD-075: R6G



## **MOLDED CAPACITORS, T55 TYPE**



### LEADFRAMELESS MOLDED CAPACITORS, ALL TYPES





# GUIDE TO APPLICATION

 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 W at +45 °C as given in the tables in the product datasheets.

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

 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:

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

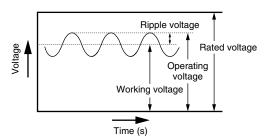
where,

P = power dissipation in W at +45 °C as given in the tables in the product datasheets.

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

Z = The capacitor impedance at the specified frequency.

2.1 The tantalum capacitors must be used in such a condition that the sum of the working voltage and ripple voltage peak values does not exceed the rated voltage as shown in figure below.



3. **Temperature Derating:** power dissipation is affected by the heat sinking capability of the mounting surface. If these capacitors are to be operated at temperatures above +45 °C, the permissible ripple current (or voltage) shall be calculated using the derating coefficient as shown in the table below:

MAXIMUM RIPPLE CURRENT TEMPERATURE DERATING FACTOR	
≤ 45 °C	1.0
55 °C	0.8
85 °C	0.6
105 °C	0.4

4. Reverse Voltage: the capacitors are not intended for use with reverse voltage applied. However, they are capable of withstanding momentary reverse voltage peaks, which must not exceed the following values:
At 25 °C: 10 % of the rated voltage or 1 V, whichever

At 25  $^{\circ}\text{C}$ : 10 % of the rated voltage or 1 V, whichever is smaller.

At 85  $^{\circ}\text{C}\text{:}$  5 % of the rated voltage or 0.5 V, whichever is smaller.

At 105  $^{\circ}\text{C}$ : 3 % of the rated voltage or 0.3 V, whichever is smaller.

#### 5. Mounting Precautions:

5.1 Limit Pressure on Capacitor Installation with Mounter: pressure must not exceed 4.9 N with a tool end diameter of 1.5 mm when applied to the capacitors using an absorber, centering tweezers, or similar (maximum permitted pressurization time: 5 s). An excessively low absorber setting position would result in not only the application of undue force to the capacitors but capacitor and other component scattering, circuit board wiring breakage, and / or cracking as well, particularly when the capacitors are mounted together with other chips having a height of 1 mm or less.

#### 5.2 Flux Selection

- 5.2.1 Select a flux that contains a minimum of chlorine and amine.
- 5.2.2 After flux use, the chlorine and amine in the flux remain must be removed.
- 5.3 Cleaning After Mounting: the following solvents are usable when cleaning the capacitors after mounting. Never use a highly active solvent.
  - Halogen organic solvent (HCFC225, etc.)
  - Alcoholic solvent (IPA, ethanol, etc.)
  - Petroleum solvent, alkali saponifying agent, water, etc.

Circuit board cleaning must be conducted at a temperature of not higher than 50 °C and for an immersion time of not longer than 30 minutes. When an ultrasonic cleaning method is used, cleaning must be conducted at a frequency of 48 kHz or lower, at an vibrator output of 0.02 W/cm³, at a temperature of not higher than 40 °C, and for a time of 5 minutes or shorter.

- Care must be exercised in cleaning process so that the mounted capacitor will not come into contact with any cleaned object or the like or will not get rubbed by a stiff brush or similar. If such precautions are not taken particularly when the ultrasonic cleaning method is employed, terminal breakage may occur.
- When performing ultrasonic cleaning under conditions other than stated above, conduct adequate advance checkout.



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