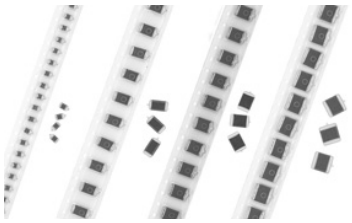
Organic Polymer, Low ESR, Surface Mount Tantalum Capacitors



FEATURES

- Conductive polymer cathode technology
- Low ESR
- No-ignition failure mode
- EIA standard case sizes
- 100 % surge current tested
- Terminations (2)- Lead (Pb)-free

Pb-free
RoHS COMPLIANT

PERFORMANCE CHARACTERISTICS

Operating Temperature: - 55 °C to + 105 °C

Capacitance Range: 47 µF to 2200 µF

Capacitance Tolerance: ± 20 % standard

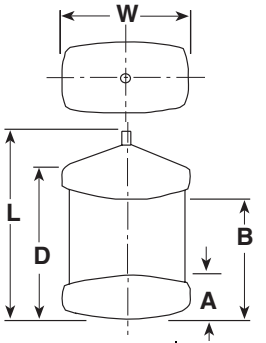
Voltage Rating: 4 WVDC to 6.3 WVDC

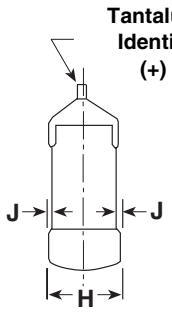
ORDERING INFORMATION

552D	337	X0	6R3	V	2	T	035
MODEL	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	CASE CODE	TERMINATION	REEL SIZE AND PACKAGING	ESR VALUE IN mΩ
	This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow.	**X0 =** ± **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 volts).	See Ratings and Case Codes Table.	2 = 100 % Tin	T = Tape and reel* **7" [178 mm] reel** W = 13" [330 mm] reel *Cathode nearest sprocket hole.	

Note: Preferred tolerance and reel sizes are in bold.

DIMENSIONS in inches [millimeters]





CASE CODE	L (Max.)	W	H (Max.)	A	B	D (Ref.)	J (Max.)
B	0.158 [4.0]	0.110 + 0.010 - 0.016 [2.8 + 0.3 - 0.4]	0.059 [1.5] Max.	0.031 ± 0.012 [0.8 ± 0.3]	0.097 ± 0.015 [2.5 ± 0.4]	0.127 [2.9]	0.004 [0.1]
M	0.158 [4.0]	0.110 + 0.010 - 0.016 [2.8 + 0.3 - 0.4]	0.047 [1.2] Max.	0.031 ± 0.012 [0.8 ± 0.3]	0.097 ± 0.015 [2.5 ± 0.4]	0.127 [2.9]	0.004 [0.1]
T	0.158 [4.0]	0.110 + 0.010 - 0.016 [2.8 + 0.3 - 0.4]	0.079 [2.0] Max.	0.031 ± 0.012 [0.8 ± 0.3]	0.097 ± 0.015 [2.5 ± 0.4]	0.127 [2.9]	0.004 [0.1]
U	0.281 [7.1]	0.126 ± 0.010 [3.2 ± 0.3]	0.079 [2.0] Max.	0.051 ± 0.012 [1.3 ± 0.3]	0.180 ± 0.025 [4.6 ± 0.6]	0.236 [6.0]	0.004 [0.1]
V	0.293 [7.5]	0.170 ± 0.010 [4.3 ± 0.3]	0.079 [2.0] Max.	0.051 ± 0.012 [1.3 ± 0.3]	0.180 ± 0.025 [4.6 ± 0.6]	0.253 [6.4]	0.004 [0.1]
W	0.287 [7.3]	0.236 ± 0.010 [6.0 ± 0.3]	0.079 [2.0] Max.	0.051 ± 0.012 [1.3 ± 0.3]	0.180 ± 0.025 [4.6 ± 0.6]	0.253 [6.4]	0.004 [0.1]
X	0.570 [14.5]	0.290 ± 0.010 [7.37 ± 0.25]	0.079 [2.0] Max.	0.051 ± 0.012 [1.3 ± 0.3]	0.470 ± 0.025 [11.9 ± 0.6]	0.520 [13.2]	0.004 [0.1]

RATINGS AND CASE CODES

µF	3 V		4 V		6.3 V		10 V	
	Std.	Ext.	Std.	Ext.	Std.	Ext.	Std.	Ext.
47						M		
100					B*	M*		
150					T*			
220			B*					
330			V		V	U*		
470					V			
680*					W*			
1000*					W*			
1500					X			
2200					X			

*Preliminary values, contact factory for availability.

STANDARD RATINGS

CAPACITANCE (µF)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C (mA)	MAX. DF AT + 25 °C (%)	MAX. ESR AT 100 kHz (mΩ)	MAX. RIPPLE 100 kHz Irms (Amps)
4 WVDC AT + 85 °C, 3.3 WVDC AT + 105 °C, SURGE = 5.2 V AT + 85 °C, 4.3 V AT + 105 °C						
330	V	552D337X0004V2T025	132	12	25	2.4
220*	B*	552D227X0004B2T070*	88*	12*	70*	1.1*
6.3 WVDC AT + 85 °C, 5 WVDC AT + 105 °C, SURGE = 8 V AT + 85 °C, 5 V AT + 105 °C						
47	M	552D476X06R3M2T080	29.6	8	80	1.03
47	M	552D476X06R3M2T100	29.6	8	100	0.92
100*	**M***	**552D107X06R3M2T090***	**63***	**12***	**90***	**0.97***
100*	**M***	**552D107X06R3M2T070***	**63***	**12***	**70***	**1.1***
100*	B*	552D107X06R3B2T090*	63*	12*	90*	0.97*
100*	B*	552D107X06R3B2T070*	63*	12*	70*	1.1*
150*	T*	552D157X06R3T2T070*	95*	12*	70*	1.1*
150*	T*	552D157X06R3T2T050*	95*	12*	50*	1.3*
330*	U*	552D337X06R3U2T045*	208*	12*	45*	1.6*
330*	U*	552D337X06R3U2T030*	208*	12*	30*	1.9*
330	V	552D337X06R3V2T035	208	12	35	2
330	V	552D337X06R3V2T025	208	12	25	2.4
470	V	552D477X06R3V2T035	296	12	35	2
470*	V*	552D477X06R3V2T025*	296*	12*	25*	2.4*
680*	W*	552D687X06R3W2T035*	428*	12*	35*	2.2*
680*	W*	552D687X06R3W2T025*	428*	12*	25*	2.6*
1000*	W*	552D108X06R3W2T035*	630*	12*	35*	2.2*
1000*	W*	552D108X06R3W2T025*	630*	12*	25*	2.6*
1500	X	552D158X06R3X2T045	945	12	45	2.0
1500*	X*	552D158X06R3X2T035*	945*	12*	35*	2.3*
1500*	X*	552D158X06R3X2T025*	945*	12*	25*	2.7*
2200	X	552D228X06R3X2T035	1386	20	35	2.3
2200*	X*	552D228X06R3X2T025*	1386*	20*	25*	2.7*

*Preliminary values, contact factory for availability.

PERFORMANCE CHARACTERISTICS

1. **Operating Temperature:** Capacitors are designed to operate over the temperature range of - 55 °C to + 105 °C.

1.1 Capacitors may be operated to + 105 °C with voltage derating to 0.8 times the + 85 °C rating.

+ 85 °C RATING		+ 125 °C RATING	
WORKING VOLTAGE (V)	SURGE VOLTAGE (V)	WORKING VOLTAGE (V)	SURGE VOLTAGE (V)
6.3	8.0	5.0	6.5

2. **DC Working Voltage:** The DC working voltage is the maximum operating voltage for continuous duty at the rated temperature.

3 **Surge Voltage:** The surge DC rating is the maximum voltage to which the capacitors may be subjected under any conditions, including transients and peak ripple at the highest line voltage.

3.1 **Surge Voltage Test:** Capacitors shall withstand the surge voltage applied in series with a 33 ohm ± 5 % resistor at the rate of one-half minute on, one-half minute off, at + 85 °C, for 1000 successive test cycles.

3.2 Following the surge voltage test, the dissipation factor shall meet the initial requirements; the capacitance shall not have changed more than ± 20 %. The leakage current shall not exceed 150 % of the value listed in the Standard ratings Table.

4. **Capacitance Tolerance:** The capacitance of all capacitors shall be within the specified tolerance limits of the normal rating.

4.1 Capacitance measurements shall be made by means of polarized capacitance bridge. The polarizing voltage shall be of such magnitude that there shall be no reversal of polarity due to the AC component. The maximum voltage applied to capacitors during measurement shall be 2 volts rms at 120 Hz at + 25 °C. If the AC voltage applied is less than one-half volt rms, no DC bias is required. Accuracy of the bridge shall be within ± 2 %.

5. **Capacitance Change With Temperature:** The capacitance change with temperature shall not exceed the following percentage of the capacitance measured at + 25 °C:

- 55 °C	+ 85 °C	+ 105 °C
± 20 %	± 20 %	± 30 %

6. **Dissipation Factor:** The dissipation factor, determined from the expression $2\pi fRC$, shall not exceed values listed in the Standard Ratings Table.

6.1 Measurements shall be made by the bridge method at, or referred to, a frequency of 120 Hz and a temperature of + 25 °C.

7. **Leakage Current:** Capacitors shall be stabilized at the rated temperature for 30 minutes. Rated voltage shall be applied to capacitors for 5 minutes using a steady source of power (such as a regulated power supply) with 1000 ohm resistor connected in series with the capacitor under test to limit the charging current. Leakage current shall then be measured.

7.1 **At + 25 °C**, the leakage current shall not exceed the value listed in the Standard Ratings Table.

7.2 **At + 85 °C,** the leakage current shall not exceed 10 times the value listed in the Standard Ratings Table.

7.3 **At + 105 °C,** the leakage current , while measured at 0.8 times the rated voltage, shall not exceed 12 times the value listed in the Standard Ratings Table.

8. **ESR**

8.1 **ESR (Equivalent Series Resistance)** shall not exceed the values listed in the Ratings Table. Measurement shall be made by the bridge method at a frequency of 100 kHz and a temperature of + 25 °C.

9. **Life Test:** Capacitors shall withstand rated DC voltage applied at + 85 °C for 1000 hours.

9.1 Following the life test, the dissipation factor shall not exceed 1.5 times the value listed in the Standard Ratings Table; the capacitance change shall not exceed ± 20 %; the leakage current shall not exceed 0.1 CV (µA).

10. **Solderability:** Capacitors will meet the solderability requirements of ANSI/J-STD-002, Test B, Category 3.

11. **Resistance to Solder Heat:** Capacitors will with stand reflow soldering at + 240 °C + 5 °C for 10 seconds max. Capacitors should be allowed to remain at ambient conditions for a period of up to 24 hours prior to electrical measurements.

11.1 Following the resistance to solder heat test, capacitance, be within ± 20 % of the initial value, the dissipation factor and the DC leakage current shall not exceed the value listed in the Standard Ratings Table.

12. **Terminal Strength:** Per UEC-384-3, minimum of 5N shear force.

13. **Flammability:** Encapsulant materials meet UL94 V0.

14. **Capacitor Failure Mode:** The predominant failure mode for solid tantalum capacitors is increased leakage current resulting in a shorted circuit. Capacitor failure may result from excess forward or reverse DC voltage, surge current, ripple current, thermal shock or excessive temperature. The increase in leakage is caused by a breakdown of the Ta_2O_5 dielecric. For additional information on leakage failure of solid tantalum chip capacitors, refer to Vishay Sprague Technical Paper, “Leakage Failure Mode in Solid Tantalum Chip Capacitors.”

15. **Humidity Test:** Capacitors shall withstand 500 hours at + 60 °C, 90 % to 95 % relative humidity, with no voltage applied.

15.1 Following the humidity test, capacitance change shall not exceed - 20 % to + 40 % of the value listed in the Standard Ratings Table, dissipation factor shall not exceed 150 % of the initial requirement; leakage current shall not exceed 0.1 CV (µA).

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 2.4 (Power Dissipation)
R_{ESR} = 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 2.4 (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.

2.3 **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
+ 105 °C	0.4

2.4 **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.

CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (WATTS) IN FREE AIR
B, M, T	0.085
U	0.110
V	0.140
W	0.175
X	0.180

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 + 105 °C.

4. **Recommended rated working voltage guidelines:**

APPLICATION VOLTAGE (V)	RECOMMENDED CAPACITOR VOLTAGE RATING (V)
3.2	4.0
5.0	6.3
8.0	10
12.8	16
20	25

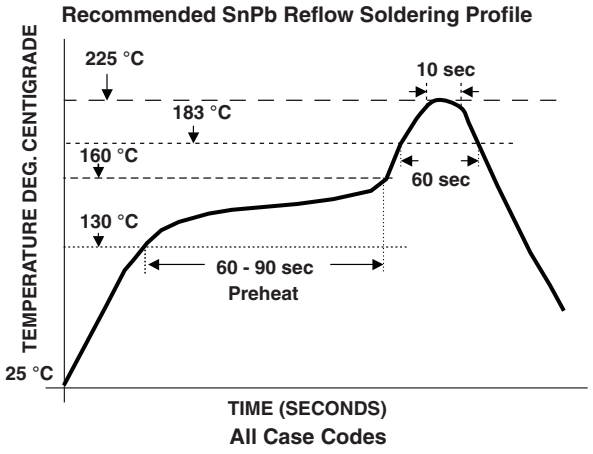
5. **Printed Circuit Board Materials:** Type 552D is compatible with commonly used printed circuit board materials (alumina substrates, FR4, FR5, G10, PTFE-fluorocarbon and porcelanized steel).

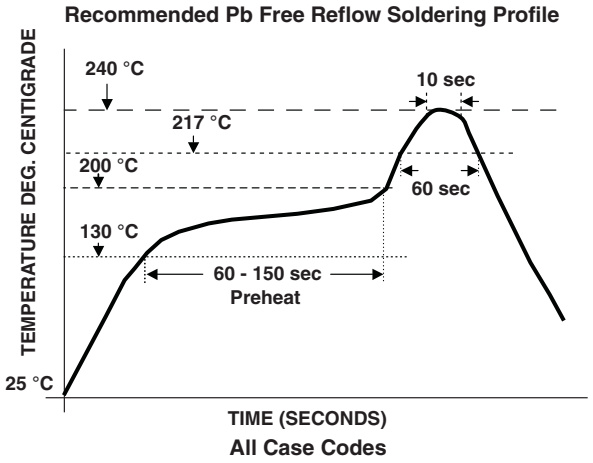
6. **Attachment:**

6.1 **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.

6.2. **Soldering:** Capacitors can be attached by conventional soldering techniques - vapor phase, infrared reflow, wave soldering and hot plate methods. The Soldering Profile charts show recommended time/temperature conditions for soldering. Attachment with a soldering iron is not recommended due to the difficulty of controlling temperature and time at temperature. If hand soldering is necesary, the soldering iron must never come in contact with the capacitor.

RECOMMENDED REFLOW SOLDERING PROFILE

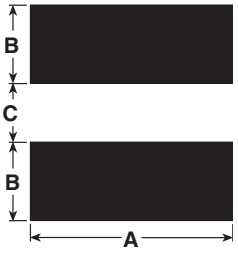




7. **Recommended Mounting Pad Geometries:** Proper mounting pad geometries are essential for successful solder connections. These dimensions are highly process sensitive and should be designed to minimize component rework due to unacceptable solder joints. The dimensional configurations shown are the 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.

REFLOW SOLDER PADS*

in inches [millimeters]

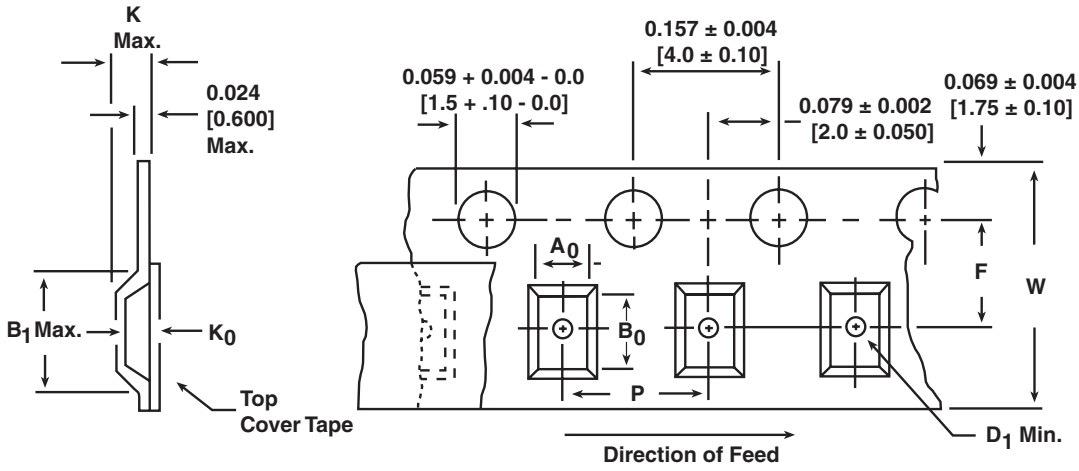


CASE CODE	WIDTH (A)	PAD METALIZATION (B)	SEPARATION (C)
B, M, T	0.110 [2.8]	0.085 [2.15]	0.065 [1.65]
U	0.110 [2.8]	0.106 [2.7]	0.124 [3.15]
V	0.180 [4.6]	0.090 [2.3]	0.145 [3.7]
W	0.245 [6.3]	0.090 [2.3]	0.145 [3.7]
X	0.310 [7.9]	0.120 [3.0]	0.360 [9.2]

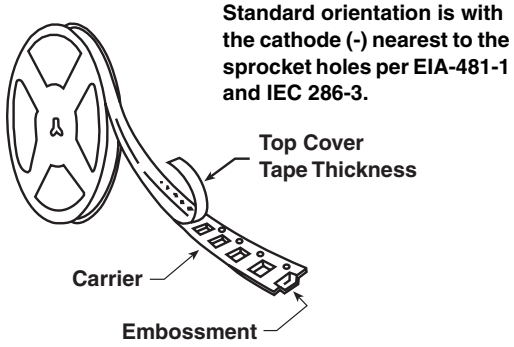
8. **Cleaning (Flux Removal) After Soldering:** The 552D is compatible with all commonly used solvents such as TES, TMS, Prelete, Chlorethane, Terpene and aqueous cleaning media. However, CFC/ODS products are not used in the production of these devices and are not recommended. Solvents containing methylene 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 9 W/L AT 40 kHz for 2 minutes.

TAPE AND REEL PACKAGING in inches [millimeters]

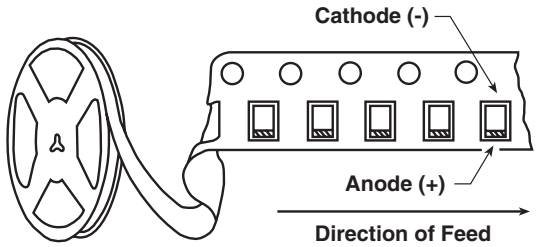


TAPE SIZE	B_1 (MAX.)	D_1 (MIN.)	F	K (MAX.)	P	W	$A_0B_0K_0$
12 mm	0.323 [8.2]	0.059 [1.5]	0.217 ± 0.002 [5.5 ± 0.05]	0.177 [4.5]	0.315 ± 0.004 [8.0 ± 1.0]	0.472 ± 0.012 [12.0 ± 0.30]	**Notes:** $A_0B_0K_0$ are determined by component size. The clearance between the component and the cavity must be within 0.002" [0.05 mm] minimum to 0.020" [0.50 mm] maximum for 8 mm tape and 0.002" [0.05 mm] minimum to 0.026" [0.65 mm] maximum for 12 mm tape.
24 mm	0.791 [20.1]	0.059 [1.5]	0.453 ± 0.004 [12.0 ± 0.1]	0.177 [4.5]	0.315 ± 0.004 [8.0 ± 1.0]	0.642 Max [16.3] Max	



Tape and Reel Specifications: All case codes are available on plastic embossed tape per EIA-481-1. Tape reeling per IEC 286-3 is also available. Standard reel diameter is 7" [178 mm]. 13" [330 mm] reels are available.

The most efficient packaging quantities are full reel increments on a given reel diameter. The quantities shown allow for the sealed empty pockets required to be in conformance with EIA-481-1. Reel size must be specified in the Vishay Sprague® part number.



CASE CODE	TAPE WIDTH	COMPONENT PITCH	UNITS PER REEL	
			7" [178] REEL	13" [330] REEL
B, M, T	8 mm	4 mm	2000	8000
U	12 mm	8 mm	1000	4000
V	12 mm	8 mm	1000	4000
W	12 mm	8 mm	500	-
X	24 mm	12 mm	500	-