

# Resin-Coated, Radial-Lead Solid Tantalum Capacitors



## FEATURES

- Terminations: standard SnPb, 100 % Tin available
- Large capacitance range
- Encapsulated in a hard orange epoxy resin
- Large variety of lead styles available
- Supplied on tape and reel or ammpack
- Low impedance and ESR at high frequencies



**RoHS\***  
COMPLIANT

## ELECTRICAL CHARACTERISTICS

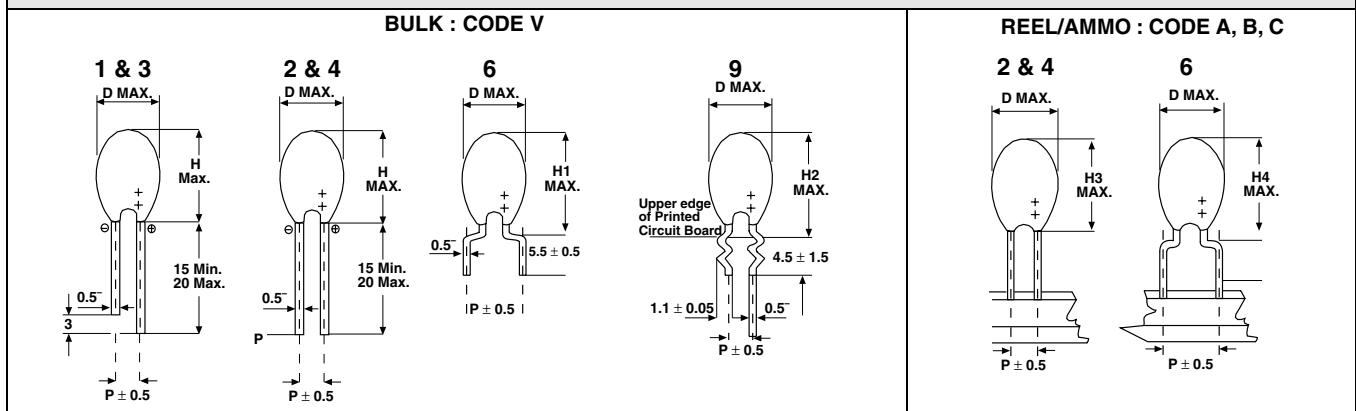
Operating Temperature: - 55 °C to + 85 °C: **Type 489D**  
 - 55 °C to + 125 °C: **Type 499D**

## APPLICATIONS

- Offer a very cost effective solution in the consumer, industrial and professional electronics markets. The capacitors are intended for high volume applications.

ORDERING INFORMATION							
489D	686	X0	6R3	D	2	A	E3
TYPE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT +85 °C	CASE CODE	LEAD STYLE	PACKAGING	RoHS COMPLIANT
489D Standard + 85 °C 499D Standard + 125 °C Low IL	Expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros following.	X0 = ± 20 % X9 = ± 10 %	Expressed by zeros if needed to complete the 3 digit block. A decimal point is indicated by an "R" (6R3 = 6.3 volts).	See Table Ratings and Case Codes	1, 2, 3, 4, 6, 9 See description on next page	A = Ammpack B = Reel pack, positive leader C = Reel pack, negative leader V = Bulk Pack	E3 = 100 % tin termination (RoHS compliant design) Blank = SnPb termination (standard design)

## LEAD STYLE CONFIGURATIONS AND DIMENSIONS (MAX) in millimeters



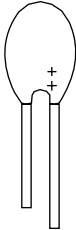
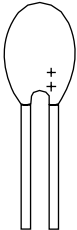
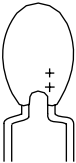
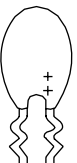
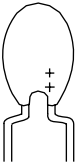
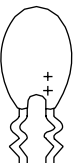
LEAD CASE	D	STYLES 1-2-3-4		STYLE 6		STYLE 9		STYLES 2-4		STYLE 6	
		P	H	P	H1	P	H2	P	H3	P	H4
A	3.7	2.5	7.0	5	11.0	5	10.0	2.5	7.0	5	11.0
B	4.0	2.5	7.5	5	11.5	5	10.5	2.5	7.5	5	11.5
C	4.5	2.5	8.0	5	12.0	5	11.0	2.5	8.0	5	12.0
D	5.0	2.5	9.0	5	13.0	5	12.0	2.5	9.0	5	13.0
E	5.5	2.5	10.0	5	14.0	5	13.0	2.5	10.0	5	14.0
F	6.0	2.5	11.0	5	15.0	5	14.0	2.5	11.0	5	15.0
H	6.5	2.5	12.0	5	16.0	5	15.0	2.5	12.0	5	16.0
M	10.0	5.0	14.5	-	-	5	18.0	5.0	14.5	-	-
N	11.0	5.0	16.0	-	-	5	19.0	-	-	-	-
R	12.0	5.0	19.0	-	-	5	22.0	-	-	-	-

\* Pb containing terminations are not RoHS compliant, exemptions may apply



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Vishay Sprague

LEAD STYLE	
<p><b>LEAD STYLE 1:</b> Straight leads, 2.5 mm Lead Space, Uneven Length</p> 	<p><b>LEAD STYLE 2:</b> Straight leads, 2.5 mm Lead Space, Even Length</p> 
<p><b>LEAD STYLE 3:</b> Straight leads, 5 mm Lead Space, Uneven Length</p> 	<p><b>LEAD STYLE 4:</b> Straight leads, 5 mm Lead Space, Even Length</p> 
<p><b>LEAD STYLE 6:</b> Shouldered leads, 5 mm Lead Space</p> 	<p><b>LEAD STYLE 9:</b> Snap-In leads, 5 mm Lead Space</p> 

STANDARD RATINGS, CASE CODES AND LEAD STYLE										
C <sub>R</sub> μF	RATED VOLTAGE U <sub>R</sub> AT + 85 °C								LEAD STYLE	
	3.0 V	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V	BULK	AMMO/REEL
0.10							A	A		
0.15							A	A		
0.22							A	A		
0.33							A	B		
0.47							A	B	1 - 2	
0.68							B	C	6 - 9	2 - 6
1.0						A	B	D		
1.5					A	B	C	E		
2.2				A	B	B	C	F		
3.3			A	B	C	C	D	F		
4.7		A	A	B	C	C	D	H		
6.8	A	A	B	C	D	D	E	N		
10	B	B	B	C	D	D	F	N	3 - 4 - 9	4
15	B	B	C	D	E	E	M	N		
22	C	C	C	D	F	H	M	N		
33	C	C	D	E	H	M	N			
47	D	D	D	F	M	M	N			
68	D	D	E	M	N	N				
100	E	E	M	N	N					
150	H	M	M	N						
220	M	M	N	R						
330	N	N	R							
470	N	R								
680	R	R								



<b>STANDARD RATINGS</b>					
$C_R$ ( $\mu$ F)	CASE CODE	TYPE PART NUMBER	489D MAX. DCL AT + 25 °C ( $\mu$ A)	499D MAX. DCL AT + 25 °C ( $\mu$ A)	489D, 499D MAX. DF, 100 Hz AT + 25 °C (%)
<b><math>U_R = 3</math> VOLT AT + 85 °C, SURGE = 4 V</b>			<b><math>U_C = 2</math> V AT + 125 °C, SURGE = 2.6 V (ONLY 499D)</b>		
6.8	A	489D685X(*)003A_ _	1.0	0.5	6
10.0	B	489D106X(*)003B_ _	1.0	0.5	8
15.0	B	489D156X(*)003B_ _	1.0	0.5	8
22.0	C	489D226X(*)003C_ _	1.0	0.5	8
33.0	C	489D336X(*)003C_ _	1.4	0.7	8
47.0	D	489D476X(*)003D_ _	2.1	1.1	8
68.0	D	489D686X(*)003D_ _	3.0	1.6	8
100.0	E	489D107X(*)003E_ _	4.5	2.4	10
150.0	H	489D157X(*)003H_ _	6.7	3.6	10
220.0	M	489D227X(*)003M_ _	9.9	5.2	10
330.0	N	489D337X(*)003N_ _	14.8	7.9	10
470.0	N	489D477X(*)003N_ _	21.1	11.2	12
680.0	R	489D687X(*)003R_ _	30.6	16.3	12
<b><math>U_R = 6.3</math> VOLT AT + 85 °C, SURGE = 8 V</b>			<b><math>U_C = 4</math> V AT + 125 °C, SURGE = 5.2 V (ONLY 499D)</b>		
4.7	A	489D475X(*)6R3A_ _	1.0	0.5	6
6.8	A	489D685X(*)6R3A_ _	1.0	0.5	6
10.0	B	489D106X(*)6R3B_ _	1.0	0.5	8
15.0	B	489D156X(*)6R3B_ _	1.4	0.7	8
22.0	C	489D226X(*)6R3C_ _	2.0	1.1	8
33.0	C	489D336X(*)6R3C_ _	3.1	1.6	8
47.0	D	489D476X(*)6R3D_ _	4.4	2.3	8
68.0	D	489D686X(*)6R3D_ _	6.4	3.4	8
100.0	E	489D107X(*)6R3E_ _	9.4	5.0	10
150.0	M	489D157X(*)6R3M_ _	14.1	7.5	10
220.0	M	489D227X(*)6R3M_ _	20.7	11.0	10
330.0	N	489D337X(*)6R3N_ _	31.1	16.6	10
470.0	R	489D477X(*)6R3R_ _	44.4	23.6	12
680.0	R	489D687X(*)6R3R_ _	64.2	34.2	12
<b><math>U_R = 10</math> VOLT AT + 85 °C, SURGE = 13 V</b>			<b><math>U_C = 7</math> V AT + 125 °C, SURGE = 8.6 V (ONLY 499D)</b>		
3.3	A	489D335X(*)010A_ _	1.0	0.5	6
4.7	A	489D475X(*)010A_ _	1.0	0.5	6
6.8	B	489D685X(*)010B_ _	1.0	0.5	6
10.0	B	489D106X(*)010B_ _	1.5	0.8	8
15.0	C	489D156X(*)010C_ _	2.2	1.2	8
22.0	C	489D226X(*)010C_ _	3.3	1.7	8
33.0	D	489D336X(*)010D_ _	4.9	2.6	8
47.0	D	489D476X(*)010D_ _	7.0	3.7	8
68.0	E	489D686X(*)010E_ _	10.2	5.4	8
100.0	M	489D107X(*)010M_ _	15.0	8.0	10
150.0	M	489D157X(*)010M_ _	22.5	12.0	10
220.0	N	489D227X(*)010N_ _	33.0	17.6	10
330.0	R	489D337X(*)010R_ _	49.5	26.4	10

489D Type part number 489D, 499D

(\*) Insert 0 for  $\pm 20\%$  tolerance or 9 for  $\pm 10\%$

\_ \_ Case code/lead style see case code table

<b>PACKAGING QUANTITIES</b>											
CASE CODE	A	B	C	D	E	F	H	M	N	R	
BULK	500							100			
AMMOPACK	2500		2000			1500		500			
REEL PACK	2500		2000			1500		500			



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<b>STANDARD RATINGS</b>					
<b>C<sub>R</sub> (μF)</b>	<b>CASE CODE</b>	<b>TYPE PART NUMBER</b>	<b>489D MAX. DCL AT + 25 °C (μA)</b>	<b>499D MAX. DCL AT + 25 °C (μA)</b>	<b>489D, 499D MAX. DF, 100 Hz AT + 25 °C (%)</b>
<b>U<sub>R</sub> = 16 VOLT AT + 85 °C, SURGE = 20 V</b>			<b>U<sub>C</sub> = 10 V AT + 125 °C, SURGE = 13 V (ONLY 499D)</b>		
2.2	A	489D225X(*)016A__	1.0	0.5	6
3.3	B	489D335X(*)016B__	1.0	0.5	6
4.7	B	489D475X(*)016B__	1.1	0.6	6
6.8	C	489D685X(*)016C__	1.6	0.8	6
10.0	C	489D106X(*)016C__	2.4	1.2	8
15.0	D	489D156X(*)016D__	3.6	1.9	8
22.0	D	489D226X(*)016D__	5.2	2.8	8
33.0	E	489D336X(*)016E__	7.9	4.2	8
47.0	F	489D476X(*)016F__	11.2	6.0	8
68.0	M	489D686X(*)016M__	16.3	8.7	8
100.0	N	489D107X(*)016N__	24.0	12.8	10
150.0	N	489D157X(*)016N__	36.0	19.2	10
220.0	R	489D227X(*)016R__	52.8	28.1	10
<b>U<sub>R</sub> = 20 VOLT AT + 85 °C, SURGE = 26 V</b>			<b>U<sub>C</sub> = 13 V AT + 125 °C, SURGE = 16 V (ONLY 499D)</b>		
1.5	A	489D155X(*)020A__	1.0	0.5	4
2.2	B	489D225X(*)020B__	1.0	0.5	6
3.3	C	489D335X(*)020C__	1.0	0.5	6
4.7	C	489D475X(*)020C__	1.4	0.7	6
6.8	D	489D685X(*)020D__	2.0	1.0	6
10.0	D	489D106X(*)020D__	3.0	1.6	8
15.0	E	489D156X(*)020E__	4.5	2.4	8
22.0	F	489D226X(*)020F__	6.6	3.5	8
33.0	H	489D336X(*)020H__	9.9	5.2	8
47.0	M	489D476X(*)020M__	14.1	7.5	8
68.0	N	489D686X(*)020N__	20.4	10.8	8
100.0	N	489D107X(*)020N__	30.0	16.0	10
<b>U<sub>R</sub> = 25 VOLT AT + 85 °C, SURGE = 32 V</b>			<b>U<sub>C</sub> = 17 V AT + 125 °C, SURGE = 21 V (ONLY 499D)</b>		
1.0	A	489D105X(*)025A__	1.0	0.5	4
1.5	B	489D155X(*)025B__	1.0	0.5	4
2.2	B	489D225X(*)025B__	1.0	0.5	6
3.3	C	489D335X(*)025C__	1.2	0.6	6
4.7	C	489D475X(*)025C__	1.7	0.9	6
6.8	D	489D685X(*)025D__	2.5	1.3	6
10.0	D	489D106X(*)025D__	3.7	2.0	8
15.0	E	489D156X(*)025E__	5.6	3.0	8
22.0	H	489D226X(*)025H__	8.2	4.4	8
33.0	M	489D336X(*)025M__	12.3	6.6	8
47.0	M	489D476X(*)025M__	17.6	9.4	8
68.0	N	489D686X(*)025N__	25.5	13.6	8

489D Type part number 489D, 499D  
 (\*) Insert 0 for ± 20 % tolerance or 9 for ± 10 %  
 \_\_ Case code/lead style see case code table



<b>STANDARD RATINGS</b>					
<b>C<sub>R</sub> (μF)</b>	<b>CASE CODE</b>	<b>TYPE PART NUMBER</b>	<b>489D MAX. DCL AT + 25 °C (μA)</b>	<b>499D MAX. DCL AT + 25 °C (μA)</b>	<b>489D, 499D MAX. DF, 100 Hz AT + 25 °C (%)</b>
<b>U<sub>R</sub> = 35 VOLT AT + 85 °C, SURGE = 46 V</b>			<b>U<sub>C</sub> = 23 V AT + 125 °C, SURGE = 28 V (ONLY 499D)</b>		
0.10	A	489D104X(*)035A__	1.0	0.5	4
0.15	A	489D154X(*)035A__	1.0	0.5	4
0.22	A	489D224X(*)035A__	1.0	0.5	4
0.33	A	489D334X(*)035A__	1.0	0.5	4
0.47	A	489D474X(*)035A__	1.0	0.5	4
0.68	B	489D684X(*)035B__	1.0	0.5	4
1.0	B	489D105X(*)035B__	1.0	0.5	4
1.5	C	489D155X(*)035C__	1.0	0.5	4
2.2	C	489D225X(*)035C__	1.1	0.6	6
3.3	D	489D335X(*)035D__	1.7	0.9	6
4.7	D	489D475X(*)035D__	2.4	1.3	6
6.8	E	489D685X(*)035E__	3.5	1.9	6
10.0	F	489D106X(*)035F__	5.2	2.8	8
15.0	M	489D156X(*)035M__	7.8	4.2	8
22.0	M	489D226X(*)035M__	11.5	6.1	8
33.0	N	489D336X(*)035N__	17.3	9.2	8
47.0	N	489D476X(*)035N__	24.6	13.1	8
<b>U<sub>R</sub> = 50 VOLT AT + 85 °C, SURGE = 65 V</b>			<b>U<sub>C</sub> = 33 V AT + 125 °C, SURGE = 40 V (ONLY 499D)</b>		
0.10	A	489D104X(*)050A__	1.0	0.5	4
0.15	A	489D154X(*)050A__	1.0	0.5	4
0.22	A	489D224X(*)050A__	1.0	0.5	4
0.33	B	489D334X(*)050B__	1.0	0.5	4
0.47	B	489D474X(*)050B__	1.0	0.5	4
0.68	C	489D684X(*)050C__	1.0	0.5	4
1.0	D	489D105X(*)050D__	1.0	0.5	4
1.5	E	489D155X(*)050E__	1.1	0.6	4
2.2	F	489D225X(*)050F__	1.6	0.8	6
3.3	F	489D335X(*)050F__	2.4	1.3	6
4.7	H	489D475X(*)050H__	3.5	1.8	6
6.8	N	489D685X(*)050N__	5.1	2.7	6
10.0	N	489D106X(*)050N__	7.5	4.0	8
15.0	N	489D156X(*)050N__	11.2	6.0	8
22.0	N	489D226X(*)050N__	16.5	8.8	8

489D Type part number 489D, 499D

(\*) Insert 0 for ± 20 % tolerance or 9 for ± 10 %

\_\_ Case code/lead style see case code table



**PERFORMANCE CHARACTERISTICS**

- Operating Temperature:** - 55 °C to + 85 °C with rated DC voltage  $U_R$  applied. + 85 °C to + 125 °C with linear voltage derating to category voltage  $U_C$  for 499D only (see general information)
- Capacitance and Tolerance:** Capacitance measured at 100 Hz and + 25 °C shall be within the specified tolerance limits of the nominal rating. Capacitance measurement shall be made by means of a polarized capacitance bridge. No polarizing voltage is required. The maximum voltage applied during measurements shall be 0.5 volt rms at 100 Hz and + 25 °C.
- Reverse Voltage:** These capacitors are capable of withstanding peak voltage in the reverse direction equal to:  
15 % of the rated DC voltage at + 20 °C  
10 % of the rated DC voltage at + 25 °C  
5 % of the rated DC voltage at + 85 °C
- Surge Voltage:**

DC rated voltage at + 85 °C (V)	3	6.3	10	16	20	25	35	50
DC surge voltage at + 85 °C (V)	4	8	13	20	26	32	46	65
DC rated voltage at + 125 °C. (V)*	2	4	7	10	13	17	23	33
DC surge voltage at + 125 °C. (V)*	2.6	5.2	8.6	13	16	21	28	40

\* For 499D

Capacitors shall withstand the surge voltage applied in series with a 1000 ohm ( $\pm 5\%$ ) resistor, at the rate of one half-minute on, five and a half-minute off for 1000 successive test cycles at + 85 °C. After test, capacitance change shall not exceed 10 % of initial value, dissipation factor and DC leakage current shall meet initial requirements at + 25 °C - Table 2.

- Stability at low and high temperatures:**  
489D - Table 2A

TEMP.	CAPACITANCE CHANGE	DC LEAKAGE CURRENT*	DISSIPATION FACTOR AT 100 Hz	
- 55 °C	- 10 % of initial value	-----	$C_R \leq 1.5 \mu F$	4 % max
+ 25 °C	-----	$0.015 C_R \times U_R$ or 1 $\mu A$ , whichever is greater	$1.5 \mu F < C_R < 10 \mu F$	6 % max
+ 85 °C	+ 10 % of initial value	$0.15 C_R \times U_R$ or 10 $\mu A$ , whichever is greater	$10 \mu F < C_R < 100 \mu F$	8 % max
			$100 \mu F \leq C_R \leq 330 \mu F$	10 % max
			$330 \mu F < C_R$	12 % max

499D - Table 2B

TEMP.	CAPACITANCE CHANGE	DC LEAKAGE CURRENT*	DISSIPATION FACTOR AT 100 Hz	
- 55 °C	- 10 % of initial value	-----	$C_R \leq 1.5 \mu F$	4 % max
+ 25 °C	-----	$0.008 C_R \times U_R$ or 0.5 $\mu A$ , whichever is greater	$1.5 \mu F < C_R < 10 \mu F$	6 % max
+ 85 °C	+ 10 % of initial value	$0.08 C_R \times U_R$ or 5 $\mu A$ , whichever is greater	$10 \mu F < C_R < 100 \mu F$	8 % max
+ 125 °C**	+ 10 % of initial value	$0.1 C_R \times U_R$ or 6.25 $\mu A$ , whichever is greater	$100 \mu F \leq C_R \leq 330 \mu F$	10 % max
			$330 \mu F < C_R$	12 % max

\* Rated voltage applied for 5 minutes with a series resistor of 1000 ohm

\*\* Only for 499 D

- Life Test:** After 2000 hours at + 85 °C with rated DC voltage applied, or after 1000 hours at + 125 °C. With derated DC voltage\*, capacitors shall meet the requirements in table below. (\*only for 499D)

Capacitance change	Within $\pm 10\%$ of initial value
DC leakage current	Within initial requirements at + 25 °C
Dissipation factor	Within initial requirements at + 25 °C

- Humidity Test:** After 21 days (504 hours) \* at + 40 °C, 90 to 95 % of relative humidity (per IEC 68-2-3) with no voltage applied, capacitors shall meet the requirements in table below.

Capacitance change	Within $\pm 5\%$ of initial value
DC leakage current	Within initial requirements at + 25 °C - Table 2
Dissipation factor	Within initial requirements at + 25 °C - Table 2

\* Humidity test is 56 days (1350 hours) for 499D

- Marking:** The capacitors shall be marked with the rated capacitance and the rated DC working voltage. A code may be used for both capacitance and voltage. Units rated at 6.3 volts are usually marked as 6 volts. The package shall be marked with full Vishay Sprague part number, date code and quantity.

**GUIDE TO APPLICATION**

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

$$I_{\text{rms}} = \sqrt{\frac{P}{R_{\text{ESR}}}}$$

where,

P = Power Dissipation in Watts at + 25 °C as given below

RESR = 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:

$$V_{\text{rms}} = \sqrt{\frac{P}{R_{\text{ESR}}}} \times Z$$

where,

Z = The capacitor Impedance at the specified frequency.

3. **AC ripple current or voltage derating factor:** 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 in the table below:

TEMPERATURE	DERATING FACTOR
+ 25 °C	1.0
+ 55 °C	0.9
+ 85 °C	0.8
+ 125 °C	0.4

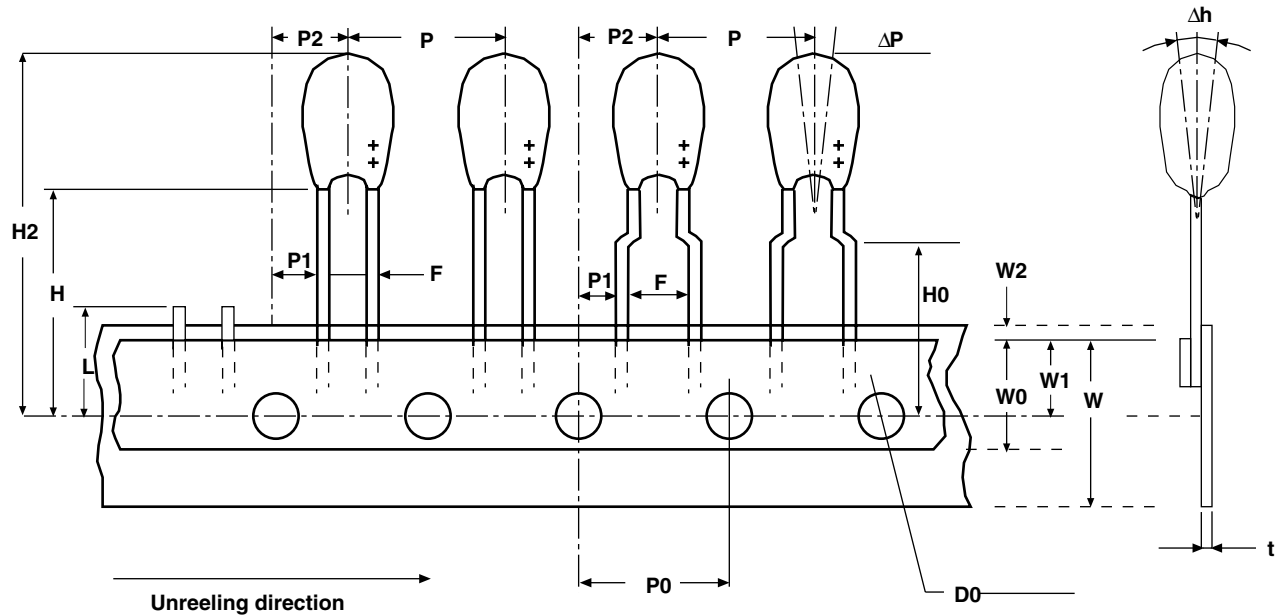
4. **Power dissipation:** Power dissipation will be affected by the heat sinking capability of the mounting surface. Non-sinusoidal ripple current may produce heating effects which differ from those shown in the following table. It is important that the equivalent  $I_{\text{RMS}}$  value be established when calculating permissible operating levels.

CASE CODE	POWER DISSIPATION AT + 25 °C (WATTS)
A	0.080
B	0.090
C	0.100
D	0.110
E	0.120
F	0.130
H	0.140
M	0.150
N	0.160
R	0.180

5. **Cleaning:** These capacitors are compatible with all commonly used solvents, such as TES, TMS, Prelete and Chloretane. Solvents containing methylene chloride or other epoxy solvents should be avoided since these will attack the epoxy encapsulation material.

**TAPE AND REEL PACKAGING** in millimeters

(meets IEC 286-2)



Dimensions for components on tape and tolerances:

DESIGNATION	SYMBOL	DIMENSIONS (mm)	
Pitch of component	P	12.7 ± 1.0	
Feed hole pitch	P0	12.7 ± 0.3	
Tape width	W	18 (+ 1/- 0.5)	
Hold down tape width	W0	5.0	
Hole position	W1	9 (+ 0.75/- 0.5)	
Hold down tape position	W2	0 (+ 3/- 0)	
Overall component height	H1	32 max	
Component alignment	ΔP	± 1.3 max	
Feed hole diameter	D0	4.0 ± 0.3	
Tape thickness	t	0.5 ± 0.2	
Component alignment	ΔH	0 ± 2	
Length of snapped leads	L	11 max	
Lead clinch height	H0	16.0 ± 0.5	
Lead wire spacing	F	2.5 <sup>+0.6</sup> <sub>-0.1</sub>	5 <sup>+0.6</sup> <sub>-0.1</sub>
Feed hole center to wire center	P1	5.1 ± 0.7	3.65 ± 0.7
Hole center to component center	P2	6.35 ± 1.3	6.35 ± 1.3
Component height	H	18 ± 1	





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