



VISHAY INTERTECHNOLOGY, INC.

# INTERACTIVE

## data book

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### SMD TANTALUM CAPACITORS

VISHAY SPRAGUE

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VSE-DB0006-1201e

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One of the World's Largest Manufacturers of  
**Discrete Semiconductors and Passive Components**



VISHAY INTERTECHNOLOGY, INC.



DATA BOOK

## SMD TANTALUM CAPACITORS

VISHAY SPRAGUE

Solid Tantalum Molded Chip Capacitors

Solid Tantalum Conformal Coated Chip Capacitors

Solid Tantalum Hi-Rel COTS Chip Capacitors

## SEMICONDUCTORS

### RECTIFIERS

- Schottky (single, dual)
- Standard, Fast and Ultra-Fast Recovery (single, dual)
- Bridge
- Superrectifier®
- Sinterglass Avalanche Diodes

### HIGH-POWER DIODES AND THYRISTORS

- High-Power Fast-Recovery Diodes
- Phase-Control Thyristors
- Fast Thyristors

### SMALL-SIGNAL DIODES

- Schottky and Switching (single, dual)
- Tuner/Capacitance (single, dual)
- Bandswitching
- PIN

### ZENER AND SUPPRESSOR DIODES

- Zener (single, dual)
- TVS (TRANSZORB®, Automotive, ESD, Arrays)

### FETs

- Low-Voltage TrenchFET® Power MOSFETs
- High-Voltage TrenchFET® Power MOSFETs
- High-Voltage Planar MOSFETs
- JFETs

### OPTOELECTRONICS

- IR Emitters and Detectors, and IR Receiver Modules
- Optocouplers and Solid-State Relays
- Optical Sensors
- LEDs and 7-Segment Displays
- Infrared Data Transceiver Modules
- Custom Products

### ICs

- Power ICs
- Analog Switches

### MODULES

- Power Modules (contain power diodes, thyristors, MOSFETs, IGBTs)

## PASSIVE COMPONENTS

### RESISTIVE PRODUCTS

- Film Resistors
  - Metal Film Resistors
  - Thin Film Resistors
  - Thick Film Resistors
  - Metal Oxide Film Resistors
  - Carbon Film Resistors
- Wirewound Resistors
- Power Metal Strip® Resistors
- Chip Fuses
- Variable Resistors
  - Cermet Variable Resistors
  - Wirewound Variable Resistors
  - Conductive Plastic Variable Resistors
- Networks/Arrays
- Non-Linear Resistors
  - NTC Thermistors
  - PTC Thermistors
  - Varistors

### MAGNETICS

- Inductors
- Transformers

### CAPACITORS

- Tantalum Capacitors
  - Molded Chip Tantalum Capacitors
  - Coated Chip Tantalum Capacitors
  - Solid Through-Hole Tantalum Capacitors
  - Wet Tantalum Capacitors
- Ceramic Capacitors
  - Multilayer Chip Capacitors
  - Disc Capacitors
- Film Capacitors
- Power Capacitors
- Heavy-Current Capacitors
- Aluminum Capacitors

# Surface Mount Solid Tantalum Capacitors

**Vishay Electronic GmbH**  
Geheimrat-Rosenthal-Straße  
D-95100 Selb  
Germany  
**Phone:** +49 9287 710  
**Fax:** +49 9287 70435  
**[www.vishay.com](http://www.vishay.com)**



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## Solid Tantalum Selector Guide

SOLID TANTALUM CHIPS				
PRODUCT	CHARACTERISTICS	VOLTAGE RANGE (V)	CAP. RANGE ( $\mu$ F)	DIMENSIONS L X W X H (mm)
298D	MICRO <span>TAN</span> <sup>®</sup> , Leadframeless, Molded, Commercial	2.5 WV <sub>DC</sub> to 50 WV <sub>DC</sub>	0.68 $\mu$ F to 220 $\mu$ F	1.6 x 0.85 x 0.80 to 2.0 x 1.25 x 0.85
TR8	MICRO <span>TAN</span> <sup>®</sup> , Leadframeless, Molded, Commercial, Low ESR	2.5 WV <sub>DC</sub> to 50 WV <sub>DC</sub>	0.68 $\mu$ F to 220 $\mu$ F	1.6 x 0.85 x 0.80 to 2.0 x 1.25 x 0.85
293D	TANTAMOUNT <sup>®</sup> , Molded, Commercial	4 WV <sub>DC</sub> to 50 WV <sub>DC</sub>	0.10 $\mu$ F to 680 $\mu$ F	3.2 x 1.6 x 1.6 to 7.3 x 4.3 x 4.0
593D	TANTAMOUNT <sup>®</sup> , Molded, Commercial, Low ESR	4 WV <sub>DC</sub> to 50 WV <sub>DC</sub>	0.47 $\mu$ F to 680 $\mu$ F	3.2 x 1.6 x 1.6 to 7.3 x 4.3 x 4.0
TR3	TANTAMOUNT <sup>®</sup> , Molded, Commercial, Low ESR, Surge Robust,	4 WV <sub>DC</sub> to 50 WV <sub>DC</sub>	0.47 $\mu$ F to 680 $\mu$ F	3.2 x 1.6 x 1.6 to 7.3 x 4.3 x 4.0
TP3	TANTAMOUNT <sup>®</sup> , Molded, Commercial, High Performance	4 WV <sub>DC</sub> to 50 WV <sub>DC</sub>	0.10 $\mu$ F to 470 $\mu$ F	3.2 x 1.6 x 1.6 to 7.3 x 4.3 x 4.0
893D	TANTAMOUNT <sup>®</sup> , Molded, Commercial, Built-In Fuse	6.3 WV <sub>DC</sub> to 50 WV <sub>DC</sub>	1.0 $\mu$ F to 220 $\mu$ F	6.0 x 3.2 x 2.5 to 7.3 x 4.3 x 4.0
TF3	TANTAMOUNT <sup>®</sup> , Molded, Commercial, Built-In Fuse	4 WV <sub>DC</sub> to 50 WV <sub>DC</sub>	0.47 $\mu$ F to 470 $\mu$ F	3.2 x 1.6 x 1.6 to 7.3 x 4.3 x 4.0
TH3	TANTAMOUNT <sup>®</sup> , Molded Case, High Temperature	6.3 WV <sub>DC</sub> to 50 WV <sub>DC</sub>	0.33 $\mu$ F to 220 $\mu$ F	3.2 x 1.6 x 1.6 to 7.3 x 4.3 x 4.0
TH5	HI TMP <sup>®</sup> Solid Tantalum Surface Mount TANTAMOUNT <sup>®</sup> , Molded Case, - 55 °C to + 200 °C, Very High Temperature	21 V <sub>DC</sub>	10 $\mu$ F	7.3 x 4.3 x 4.0
595D	TANTAMOUNT <sup>®</sup> , Conformal Coated	4 WV <sub>DC</sub> to 50 WV <sub>DC</sub>	0.10 $\mu$ F to 1500 $\mu$ F	2.2 x 1.1 x 1.1 to 7.3 x 6.0 x 3.5
594D	TANTAMOUNT <sup>®</sup> , Conformal Coated, Low ESR	4 WV <sub>DC</sub> to 50 WV <sub>DC</sub>	1 $\mu$ F to 1500 $\mu$ F	4.0 x 2.8 x 1.9 to 7.2 x 6.0 x 3.5
592D	TANTAMOUNT <sup>®</sup> , Conformal Coated, Low Profile	4 WV <sub>DC</sub> to 50 WV <sub>DC</sub>	1 $\mu$ F to 2200 $\mu$ F	3.7 x 1.8 x 1.5 to 14.5 x 7.37 x 2.5
591D	TANTAMOUNT <sup>®</sup> , Conformal Coated, Low Profile, Low ESR	4 WV <sub>DC</sub> to 35 WV <sub>DC</sub>	1.0 $\mu$ F to 1000 $\mu$ F	3.7 x 1.8 x 1.5 to 7.2 x 6.0 x 2.0
572D	TANTAMOUNT <sup>®</sup> , Conformal Coated, Low Profile	4 WV <sub>DC</sub> to 25 WV <sub>DC</sub>	2.2 $\mu$ F to 220 $\mu$ F	2.2 x 1.25 x 1.0 to 3.3 x 2.7 x 1.7
597D	TANTAMOUNT <sup>®</sup> , Conformal Coated, Ultra-Low ESR	4 WV <sub>DC</sub> to 63 WV <sub>DC</sub>	15 $\mu$ F to 1500 $\mu$ F	7.3 x 4.4 x 2.0 to 7.3 x 6.0 x 3.6
195D	TANTAMOUNT <sup>®</sup> , Conformal Coated	2 WV <sub>DC</sub> to 50 WV <sub>DC</sub>	0.10 $\mu$ F to 330 $\mu$ F	2.21 x 1.14 x 1.14 to 7.24 x 2.65 x 2.65
695D	TANTAMOUNT <sup>®</sup> , Conformal Coated	4 WV <sub>DC</sub> to 50 WV <sub>DC</sub>	0.10 $\mu$ F to 270 $\mu$ F	3.4 x 2.54 x 1.27 to 7.7 x 6.73 x 3.81



<b>SOLID TANTALUM CHIPS</b>				
<b>PRODUCT</b>	<b>CHARACTERISTICS</b>	<b>VOLTAGE RANGE (V)</b>	<b>CAP. RANGE (µF)</b>	<b>DIMENSIONS L X W X H (mm)</b>
194D	MIDGET®, Conformal Coated	4 WV <sub>DC</sub> to 50 WV <sub>DC</sub>	0.10 µF to 150 µF	2.54 x 1.27 x 1.27 to 7.24 x 3.81 x 2.79
T83	TANTAMOUNT®, Molded, Commercial, High-Rel COTS	4 WV <sub>DC</sub> to 50 WV <sub>DC</sub>	0.10 µF to 330 µF	3.2 x 1.6 x 1.6 to 7.3 x 4.3 x 4.0
T86	Solid Tantalum Surface Mount Capacitors TANTAMOUNT®, Molded Case, Hi-Rel COTS, Low ESR, Built-In-Fuse	4 V <sub>DC</sub> to 50 V <sub>DC</sub>	0.47 µF to 470 µF	6.0 x 3.2 x 2.5 to 7.3 x 4.3 x 4.0
T95	TANTAMOUNT®, Conformal Coated, Maximum C/V, High-Rel COTS	4 WV <sub>DC</sub> to 50 WV <sub>DC</sub>	0.1µF to 680 µF	2.2 x 1.1 x 1.1 to 7.24 x 2.65 x 2.65
CWR06	MIDGET® Solid Electrolyte , Conformal Coated, MIL-C-55365/4 Qualified	4 WV <sub>DC</sub> to 50 WV <sub>DC</sub>	0.10 µF to 100 µF	2.54 x 1.27 x 1.27 to 7.24 x 3.81 x 2.79
CWR11	TANTAMOUNT® Solid Electrolyte , Molded MIL-C-55365/8 Qualified	4 WV <sub>DC</sub> to 50 WV <sub>DC</sub>	0.10 µF to 100 µF	3.2 x 1.6 x 1.6 to 7.3 x 4.3 x 2.8
CWR16	Solid Tantalum Surface Mount Capacitors TANTAMOUNT® Conformal Coated, Extended Range, Military, MIL-PRF-55365/13 Qualified	4 V <sub>DC</sub> to 35 V <sub>DC</sub>	0.33 µF to 330 µF	2.54 x 1.27 x 1.27 to 7.24 x 3.81 x 2.79
T96	TANTAMOUNT®, Conformal Coated, High-Rel COTS, Built-In Fuse	4 WV <sub>DC</sub> to 50 WV <sub>DC</sub>	10 µF to 680 µF	7.2 x 6.0 x 2.0
T97	TANTAMOUNT®, Conformal Coated, Ultra Low ESR, High-Rel COTS	4 WV <sub>DC</sub> to 63 WV <sub>DC</sub>	15 µF to 1500 µF	7.3 x 4.4 x 2.0 to 7.3 x 6.0 x 3.6
T98	TANTAMOUNT®, Conformal Coated, Ultra Low ESR, High-Rel COTS, Built-In Fuse	4 WV <sub>DC</sub> to 63 WV <sub>DC</sub>	15 µF to 1500 µF	7.3 x 4.4 x 2.0 to 7.3 x 6.0 x 3.6
TM8	Solid Tantalum Chip Capacitors MICROTAN® High Reliability, Low DCL, Leadframeless Molded	2 WV <sub>DC</sub> to 40 WV <sub>DC</sub>	1 µF to 47 µF	1.14 x 0.66 x 0.61 to 5.6 x 3.5 x 1.27



## Electrolyte Selector Guide

COATED CHIPS					
TYPE	CAPACITANCE RANGE (μF)	VOLTAGE (V)	TEMPERATURE RANGE (°C)	CASE SIZE	STANDARD OR SPECIFICATION
595D	0.1 to 1500	4 to 50	- 55 to + 125	A, B, C, D, G, H, M, R, S, T	Similar to EIA, Maximum CV, 0805 Size
594D	1.0 to 1500	4 to 50	- 55 to + 125	B, C, D, R	Low ESR
592D	1.0 to 3300	4 to 35	- 55 to + 125	A, B, C, D, R, S, X	Low Profile; Maximum CV
591D	1.0 to 1000	4 to 35	- 55 to + 125	A, B, C, D, R	Low Profile; Low ESR
572D	2.2 to 220	4 to 35	- 55 to + 125	A, B, P, Q, S, T	Low Profile; Maximum CV; Single-Sided Anode
597D	22 to 1500	4 to 50	- 55 to + 125	E, F, R, V	Multi-Anode; Ultra Low ESR
695D	0.1 to 270	4 to 50	- 55 to + 125	A, B, D, E, F, G, H	MIL-C-556365/4
CWR06	0.1 to 100	4 to 50	- 55 to + 125	A, B, C, D, E, F, G, H	MIL-C-556365/4
CWR16	0.33 to 330	4 to 35	- 55 to + 125	A, B, C, D, E, F, G, H	MIL-PRF-556365/13
195D	0.1 to 330	2 to 50	- 55 to + 125	A, B, C, D, E, F, G, H, R, S, V, X, Y, Z	Conformal US and European Case Sizes
194D	0.1 to 150	4 to 50	- 55 to + 125	A, B, C, D, E, F, G, H	MIDGET® Conformal
T95	0.1 to 680	4 to 50	- 55 to + 125	A, B, C, D, R, V, X, Y, Z	Hi-Rel COTS; Standard and Low ESR
T96	10 to 680	4 to 50	- 55 to + 125	R	Hi-Rel COTS, Built-In Fuse
T97	15 to 1500	4 to 63	- 55 to + 125	E, F, R, V, Z	Ultra Low ESR, Hi-Rel COTS
T98	15 to 1500	4 to 63	- 55 to + 125	E, F, R, V, Z	Ultra Low ESR, Hi-Rel COTS; Built-In Fuse

MOLDED CHIPS					
TYPE	CAPACITANCE RANGE (μF)	VOLTAGE (V)	TEMPERATURE RANGE (°C)	CASE SIZE	STANDARD OR SPECIFICATION
293D	0.1 to 680	4 to 50	- 55 to + 125	A, B, C, D, E, P	Standard Type 793DX = CECC 30801-005 CTC3 = CECC 30801-009 CTC4 = CECC 30801-011 793DE = CECC 30801-801
593D	0.47 to 680	4 to 50	- 55 to + 125	A, B, C, D, E	Low ESR, 100 % Surged (B, C, D, E)
298D	1 to 47	4 to 16	- 55 to + 125	M, S	0805, 0603 sizes
TR3	0.47 to 680	4 to 50	- 55 to + 125	A, B, C, D, E	Low ESR, 100 % Surged (B, C, D, E)
T83	0.1 to 330	4 to 50	- 55 to + 125	A, B, C, D, E	Molded Hi-Rel COTS
T86	0.47 to 470	4 to 50	- 55 to + 125	C, D, E	Molded Hi-Rel COTS
893D	1.0 to 220	6.3 to 50	- 55 to + 125	C, D, E	Built - In Fuse
CWR11	0.1 to 100	4 to 50	- 55 to + 125	A, B, C, D	MIL-PRF-5536518
TH3	0.33 to 100	10 to 50	- 55 to + 125	A, B, C, D, E	Molded Extended Temperature
TP3	0.1 to 470	4 to 50	- 55 to + 125	A, B, C, D, E	Molded High Performance
TF3	0.47 to 470	4 to 50	- 55 to + 125	A, B, C, D, E	Built-In Fuse
TR8	0.68 to 220	2.5 to 50	- 55 to + 125	M, P	L-Shaped, Face Down Terminations, Leadframeless
TM8	1 to 47	2 to 40	- 55 to + 85	D, E, F, K, L, M, N, P, Q, R, T, W	Low DCL, Leadframeless



## Tantalum Capacitors

*"We are dedicated to partnership with our customers...assuring continuously improved quality of the products and services we offer..."*

About the manufacture of tantalum capacitors at Vishay Sprague...

Attention to customer requirements — to your requirements — keeps us on the leading edge of the quality revolution. We maintain total quality commitments throughout our operations.

The scope of our Quality System encompasses:

1. Product and Materials Development
2. Process Control
3. Training
4. Outgoing Quality Improvement
5. Customer Partnerships
6. Ship-To-Stock Programs
7. Our Quality System is Registered to ISO/QS 9000

### PRODUCT AND MATERIALS DEVELOPMENT

The work in our research and development facilities is focused on new materials and designs. Our scientists and engineers are recognized for their experience in this technology. Vishay Sprague, a pioneer in the field of tantalum capacitors, has introduced many important advances over the years.

### SUPPLIER PARTNERSHIPS

We are continuously working with suppliers to assure a thorough understanding of our quality requirements and the use of statistical methods as a tool for process control. We

expect our suppliers to be dedicated to the improvement of quality of our incoming materials, taking rigorous action to investigate and correct non-conformance whenever required.

Our suppliers are considered extensions of our tantalum processes.

### PROCESS CONTROL

Vishay Sprague ships millions of tantalum capacitors each month for aerospace and defense electronics, for computers and communications as well as for a virtually unlimited range of high-performance military, industrial and commercial equipment.

We are dedicated to defect prevention in all aspects of design and manufacturing. Rigorous action is taken to investigate the root cause of non-conformances and/or variation and to correct such situations.

Vishay Sprague is committed to the use of statistical techniques to reduce variation, independent of specification limit. This is one of the tools used to improve performance.

We perform a thorough analysis of critical process elements using statistical methods at key points. More and more process steps are being automated to assure consistency in manufacturing and conformance to design specifications.

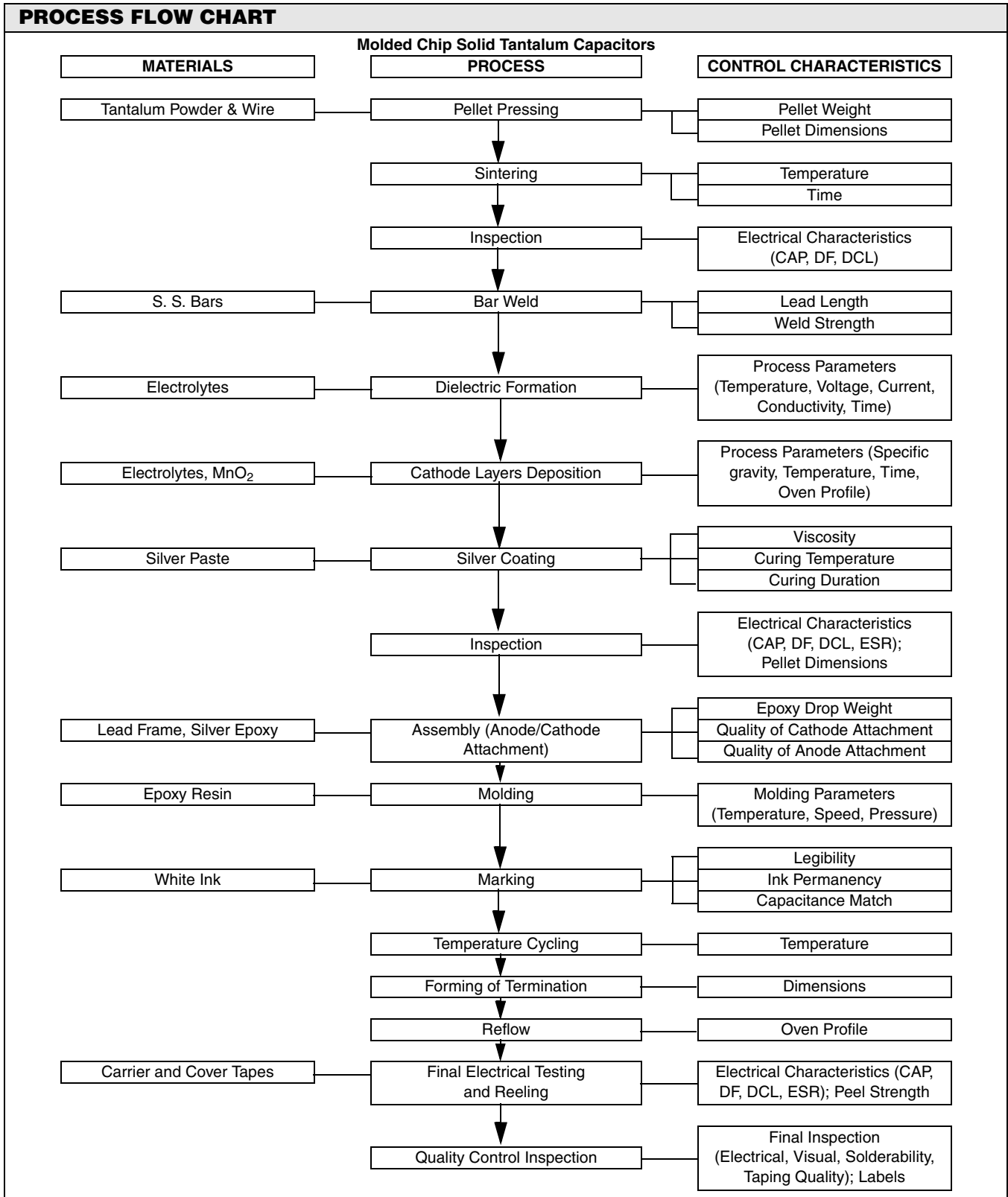
### TRAINING

A disciplined procedures approach is an essential part of our quality improvement program. This requires a commitment to provide all personnel with the skills and tools necessary to produce quality at the source. Employees are trained in company philosophy, statistical process control, capability studies, application of procedures and equipment operation.

Our training includes the analysis of statistical data from our processes to help us understand and control variations. As we train our operators in SPC and automate our processes, the rate of quality improvement accelerates accordingly.

### PROCESS FLOW CHARTS

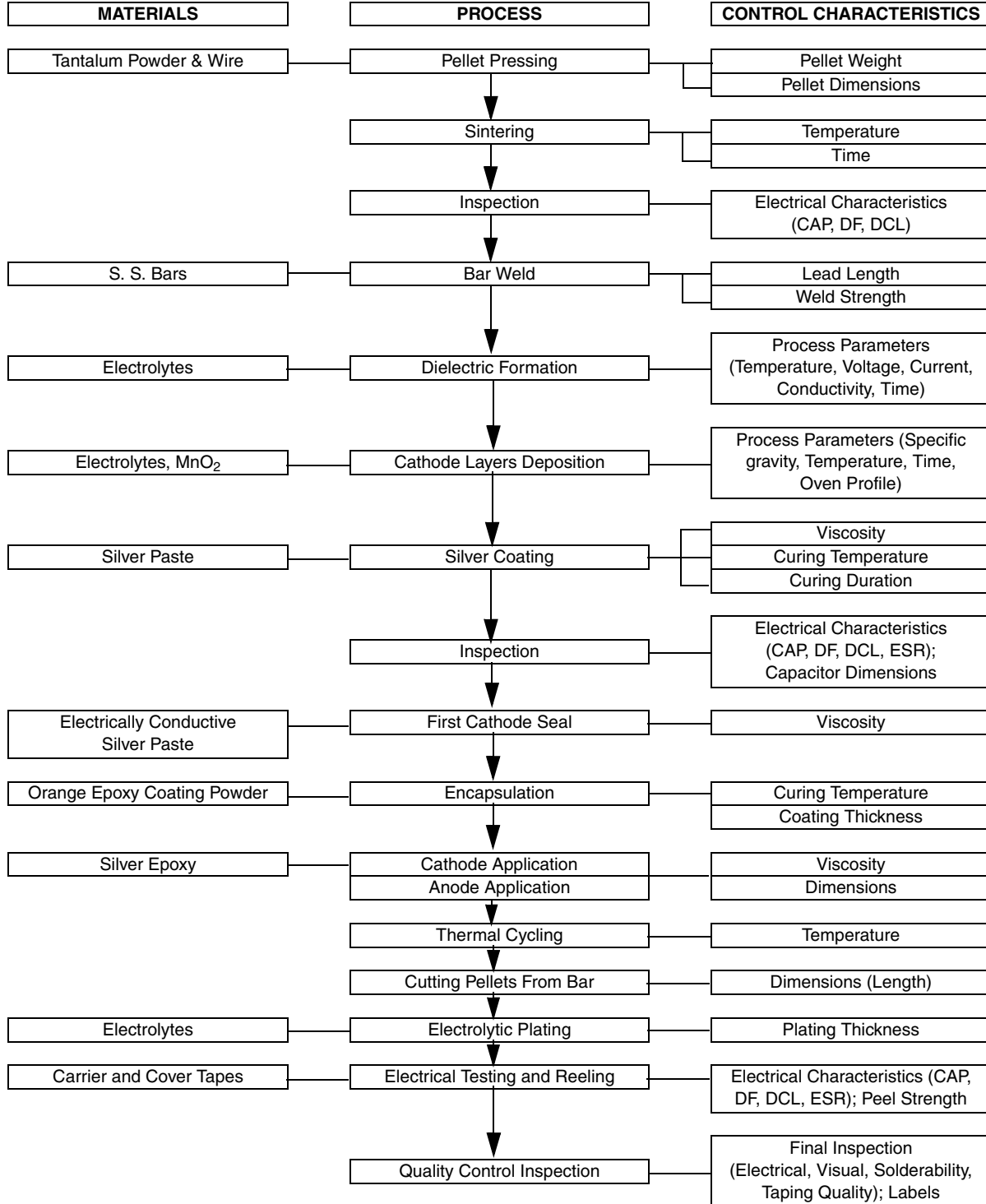
These charts identify basic manufacturing processes including the quality control points, where inspection is performed and SPC is used.





## PROCESS FLOW CHART

### Conformal Coated Solid Tantalum Capacitors







### **PARTS PER MILLION (PPM) PROGRAMS**

The collection of quality data and reporting of outgoing quality in PPM is not new to Vishay Sprague. In fact, Vishay Sprague provided leadership for the committee developing the EIA Standard for PPM measurement. And long before reporting outgoing quality in "Parts Per Million" was fashionable, Vishay Sprague had defined a program, was collecting data and reporting internally to assure quality improvement.

PPM performance, by product, is calculated by Quality Assurance from end-of-the-line electrical performance data. These data include all variations, whether minor or catastrophic, from internal standards that are stricter than those used by our customers. The result is that our customers' measurement of as-received quality in PPM is always more favorable than our own measurement.

Today, not all suppliers are using a standard method of PPM calculation. Consequently, when comparing reported PPM levels, it is essential that the method of calculation be understood. For example, calculations that include only catastrophic failures may produce very low reported PPM levels.

### **CUSTOMER PARTNERSHIPS**

We are currently involved with many major Ship-to-Stock programs. These programs rely on our history of providing materials that meet customer quality expectations, are delivered on time and at competitive prices.

This history, plus our proven dedication to continuous quality improvement and the use of statistical techniques to identify and reduce variation in our processes, provides customer confidence to eliminate incoming inspection, thereby reducing costs.

Our partnership also extends to in-depth applications engineering support. Our engineers work with customers to review their designs and in the selection of the most appropriate Vishay Sprague tantalum capacitors.

### **SHIP-TO-STOCK PROGRAMS**

Vishay Sprague provides a program for those customers who may not have identified their own Ship-to-Stock program. This program may be modified to suit specific needs.

### **QUARTERLY PPM REPORTS**

These reports express outgoing quality of each product type purchased and may be used for monitoring quality improvement.

### **SHIPPING CONTAINER ID**

We identify each container to assure that material proceeds directly to your stockroom and is not inspected when received. Vishay Sprague is responsible for its quality.



### **VISHAY SPRAGUE TANTALUMS SET NEW WORLD STANDARDS**

An extended family of Vishay Sprague solid tantalum chip capacitors sets new world performance standards! Vishay Sprague chips feature: extended ratings in conformal-coated and molded case lines; the highest capacitance in the smallest chip size; a fused chip and the highest temperature capability in the industry.

Extended ratings permit designers to specify smaller case codes -producing significant cost savings!

TANTAMOUNT® conformal-coated chips offer the highest capacitance in the smallest case codes.

TANTAMOUNT® molded-case tantalum chips conform to EIA 535BAAC. Type 293D extended ratings replace standard values with smaller case codes. Resistance to solder heat is specified at + 260 °C for 10 seconds.

CWR06 and CWR11 chips meet MIL-C-55365. Vishay Sprague tantalum chips are supplied taped and reeled to EIA-481 and IEC 286-3.

## Application Notes Guidelines for Surface Mounting of Tantalum Chip Capacitors

### INTRODUCTION

The increased use of surface mount components has led many users to revise their assembly procedures and specifications for printed circuit boards. This section will review basic principles and recommendations for mounting surface mount capacitors.

Capacitors can be attached by conventional soldering techniques such as vapor phase, infrared reflow, wave soldering and hot plate methods. Attachment with a soldering iron is not recommended due to the difficulty of controlling temperature and time at temperature.

### RECOMMENDED MOUNTING PAD GEOMETRIES

Proper mounting pad geometries are essential for successful solder connections. The dimensions are highly process sensitive and should be designed to minimize component rework due to unacceptable solder joints.

Recommended pad geometries are shown 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.

The ideal soldering pad should produce an ideal soldering fillet, a satisfactory electrical connection for the component on the board and a mechanically sound structure to handle the stresses which appear during mounting and subsequent use of the board.

It should be remembered that each assembly operation depends on manufacturing tolerances (tolerance of substrate itself and tolerance of placement of the substrate on the mounting equipment, tolerance of the pick-and-place machine itself, etc.). We estimate the total absolute value of this tolerance "e" is 0.010" [0.25].

### PAD LAYOUT FOR REFLOW SOLDERING

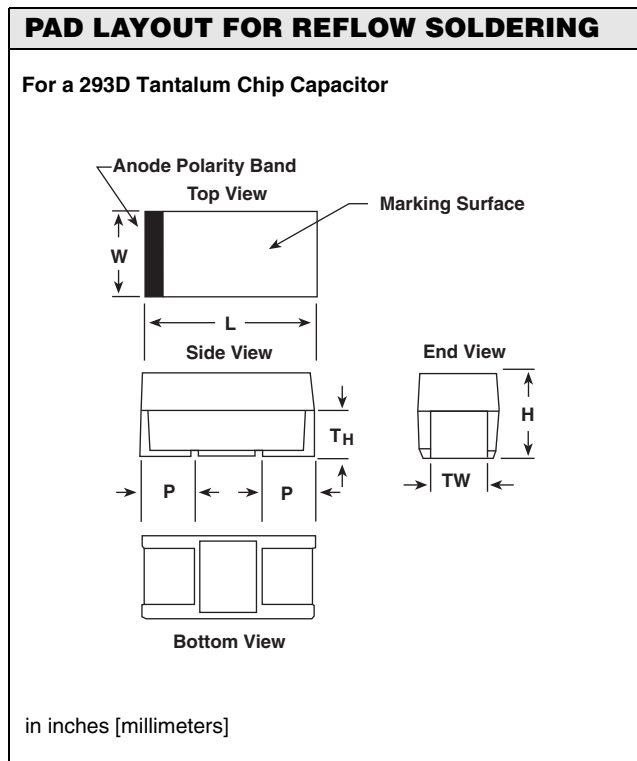
The "A" width of the pad is equal to the maximum width of the component connection plus the total tolerance of the entire system ( $e = \pm 0.010$ " [0.25]): manufacturing of substrates and pads, holding systems of the substrate on the equipment, alignment, repeatability of the chip placement, etc...

The "D" overall length of the pads is equal to the maximum length of the component plus the "E" zone, necessary to the formation of the soldering fillet. Here we may take into account the tolerance "e" of the system. During reflow, the component tends to center itself on the pads, so, some users don't take into account the tolerance of the system.

"D (minimum)" represents this dimension without the tolerance "e" factor and "D (nominal)" takes this factor into account.

The "C" length between the pads is a very critical dimension which has to be maintained; if not, "tombstoning" might occur. We may have to change the dimensions of the pads, however, the "C" dimension should be kept the same.

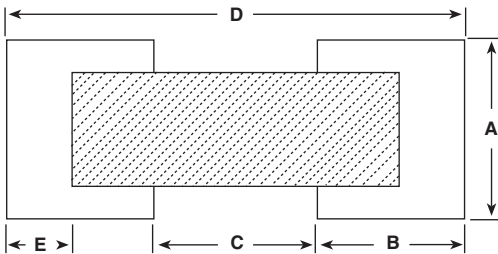
In the applicable EIA standards, there are recommendations concerning the "E" zone, the outside part of the pads used to form the soldering fillet ( $0.197 \leq E \leq 0.039$ " [1.0]). For the calculation of the "D (minimum)" value, we have chosen "E1" = 0.197" [0.5] and "E2" = 0.039" [1.0] for the "D (nominal)" value.



CASE	A	B	C	D
T <sub>W</sub> Max.	0.091 [2.3]	0.091 [2.3]	0.091 [2.3]	0.098 [2.5]
L Max.	0.134 [3.4]	0.146 [3.7]	0.248 [6.3]	0.299 [7.6]
L Nom.	0.126 [3.2]	0.138 [3.5]	0.236 [6.0]	0.287 [7.3]
P Max.	0.043 [1.1]	0.043 [1.1]	0.063 [1.6]	0.063 [1.6]
P Nom.	0.031 [0.8]	0.031 [0.8]	0.051 [1.3]	0.051 [1.3]
T <sub>H</sub> Min.	0.028 [0.7]	0.028 [0.7]	0.039 [1.0]	0.039 [1.0]

### PAD DIMENSIONS

For a 293D Tantalum Chip Capacitor



[Numbers in brackets indicate millimeters]

CASE	A	B	C	D
A (Min.)	0.071 [1.8]	0.110 [2.8]	0.110 [2.8]	0.118 [3.0]
B (Min.)	0.059 [1.5]	0.059 [1.5]	0.083 [2.1]	0.083 [2.1]
B (Nom.)	0.083 [2.1]	0.083 [2.1]	0.106 [2.7]	0.106 [2.7]
C	0.051 [1.3]	0.063 [1.6]	0.122 [3.1]	0.173 [4.4]
D (Min.)	0.173 [4.4]	0.185 [4.7]	0.287 [7.3]	0.339 [8.6]
D (Nom.)	0.220 [5.6]	0.232 [5.9]	0.335 [8.5]	0.386 [9.8]
E (Min.)	0.020 [0.5]	0.020 [0.5]	0.020 [0.5]	0.020 [0.5]
E (Nom.)	0.047 [1.2]	0.047 [1.2]	0.051 [1.3]	0.051 [1.3]

The calculation formula for the pad layout:

$$\begin{aligned}
 A \text{ (Min.)} &= Tw \text{ (Max.)} + 2e \\
 B \text{ (Min.)} &= [D \text{ (Min.)} - C]/2 \\
 B \text{ (Nom.)} &= [D \text{ (Nom.)} - C]/2 \\
 C &= L \text{ (Nom.)} - 2P \text{ (Nom.)} - e \\
 D \text{ (Min.)} &= L \text{ (Max.)} + 2 E1 \\
 D \text{ (Nom.)} &= L \text{ (Max.)} + 2 E2 + e \\
 E \text{ (Min.)} &= [D \text{ (Min.)} - L \text{ (Max.)}]/2 \\
 E \text{ (Nom.)} &= [D \text{ (Nom.)} - L \text{ (Nom.)}]/2
 \end{aligned}$$

### REFLOW SOLDER PROCESS

Two reflow processes are commonly used, vapor phase and infrared reflow. Both reflow solder processes require the application of solder paste prior to component placement.

The thickness of the soldering paste deposited or applied by screen printing is generally equal to 0.008" [0.2]. This thickness, related to the surface of the pad, determines the quantity of solder which will form the joint during the reflow. This reflow has to be sufficient to obtain an ideal solder fillet at a 45° angle.

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.

The Vapor Phase Reflow Solder Process uses fluorocarbon liquids, boiled to produce a vapor saturated atmosphere, at a temperature slightly higher than the boiling point of the liquid and high enough to reflow the solder.

The Infrared Reflow Solder Process uses heat energy produced by an infrared radiation source and by convection (natural or forced). In such a system, the heat time is dependent of the absorption coefficient of the material surfaces and of the thermal mass of all the components in relation to the surface available to the infrared radiation.

The temperature of the components in an infrared oven is not precisely defined and temperature measurements should be taken on the capacitors themselves when they are going through the oven. The temperature of small components may reach + 280 °C when they are soldered at the same time as larger ones. The parameters which act on the temperature of the components are:

- Time and power
- Mass of the component
- Size of the component
- Dimensions of the substrate
- Absorption coefficient of the surfaces
- Density of the components
- Wave length of the radiation source
- Ratio between radiated energy and convection energy

A standard profile of this process is given in the graph shown:

A preheat period is necessary for the evaporation of all the volatile solvents contained in the solder paste before the action of the flux. It initializes the action of the flux on the solder and also on the metallic surfaces of the component terminations and substrate.

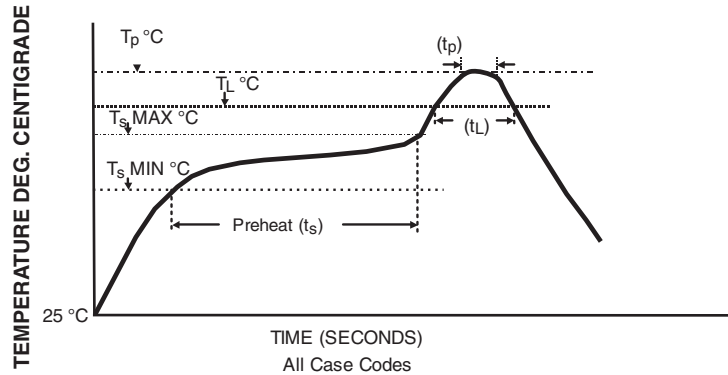
# Guidelines for Surface Mounting

Vishay Sprague

Application Notes Guidelines for  
Surface Mounting of Tantalum Chip Capacitors



## REFLOW SOLDER STANDARD TEMPERATURE PROFILE



## RECOMMENDED REFLOW PROFILES

TYPE	CASE CODE	T <sub>p</sub> Pb FREE	T <sub>p</sub> Sn/Pb	t <sub>p</sub>	T <sub>L</sub> Pb FREE	T <sub>L</sub> Sn/Pb	T <sub>s</sub> MIN Pb FREE	T <sub>s</sub> MIN Sn/Pb	T <sub>s</sub> MAX Pb FREE	T <sub>s</sub> MAX Sn/Pb	t <sub>s</sub> Pb FREE	t <sub>s</sub> Sn/Pb	t <sub>L</sub>
552D	ALL CASES	225 °C	225 °C	10	217 °C	183 °C	130 °C	130 °C	200 °C	160 °C	60 - 150	60 - 90	60
293D 593D 893D CWR11 TR3	ALL CASES	260 °C	240 °C	10	217 °C	183 °C	150 °C	100 °C	200 °C	150 °C	60 - 150	60 - 90	60
292D		260 °C	225 °C	10	217 °C	183 °C	150 °C	100 °C	200 °C	200 °C	60 - 150	60 - 90	60
298D		260 °C	225 °C	10	217 °C	183 °C	150 °C	100 °C	200 °C	150 °C	60 - 150	60 - 150	60
T83 T86 TH3	A,B,C,D,E	260 °C	240 °C	10	217 °C	183 °C	150 °C	100 °C	200 °C	150 °C	60 - 150	60 - 90	60
T96	R	245 °C	225 °C	10	217 °C	183 °C	150 °C	100 °C	200 °C	150 °C	60 - 150	60 - 150	60
T88	M,R	260 °C	225 °C	10	217 °C	183 °C	150 °C	100 °C	200 °C	150 °C	60 - 150	60 - 90	60
592D 591D T92	ALL	260 °C	225 °C	10	217 °C	183 °C	150 °C	100 °C	200 °C	150 °C	60 - 150	60 - 90	60
595D 594D	D R	245 °C	225 °C	10	217 °C	183 °C	150 °C	100 °C	200 °C	150 °C	60 - 150	60 - 90	60
	A,B,C,T, G,H,M,S	260 °C	225 °C	10	217 °C	183 °C	150 °C	100 °C	200 °C	150 °C	60 - 150	60 - 90	60
597D T97	F,E,R,V	245 °C	225 °C	10	217 °C	183 °C	150 °C	100 °C	200 °C	150 °C	60 - 150	60 - 90	60
572D	P,Q,S,A,B,T	260 °C	225 °C	10	217 °C	183 °C	150 °C	100 °C	200 °C	150 °C	60 - 150	60 - 90	60
695D	ALL	245 °C	225 °C	10	217 °C	183 °C	150 °C	100 °C	200 °C	150 °C	60 - 150	60 - 90	60
CWR06/ CC/EC	ALL	245 °C	225 °C	10	217 °C	183 °C	150 °C	100 °C	200 °C	150 °C	60 - 150	60 - 90	60
194D	ALL	245 °C	225 °C	10	217 °C	183 °C	150 °C	100 °C	200 °C	150 °C	60 - 150	60 - 90	60
195D	ALL	245 °C	225 °C	10	217 °C	183 °C	150 °C	100 °C	200 °C	150 °C	60 - 150	60 - 90	60
T95	B,C,S, V,X,Y	260 °C	225 °C	10	217 °C	183 °C	150 °C	100 °C	200 °C	150 °C	60 - 150	60 - 150	60
	D,R,Z	245 °C											

### RECOMMENDATIONS:

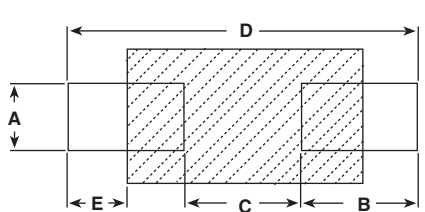
1. Preheat the substrate (to eliminate all traces of humidity on the substrate) before applying the solder paste - 4 hours at + 65 °C minimum.
2. In case of a double side mounting, do not clean the substrate after the first pass. This may induce a high humidity level which will affect the quality of the solder during the second pass through.
3. Minimal solder fillets are always preferable. Solder paste should not creep very high on the terminations.
4. Good fillets are produced by a good wetting of the terminations (verify the angles resulting from wetting).
5. The mechanical adhesion of the part on the substrate is primarily produced by the solder of the terminations directly in contact with the substrate.

### PAD LAYOUT FOR WAVE SOLDERING

The pad layout is similar to that for reflow soldering except for the "A" dimension, which is reduced by two-thirds because the components are completely dipped into the solder bath, providing enough material to achieve the solder fillet.

Processing should avoid too much solder in the termination zone in order to limit the mechanical stresses during the assembly and use of the component. Hot air flow wave soldering may help reduce the dimensions of the solder fillet.

The components are glued before soldering which prohibits movement during processing. The "D" dimension must include the tolerance of the system.

PAD DIMENSIONS				
For a Molded Tantalum Chip Capacitor				
				
[Numbers in brackets indicate millimeters]				
CASE	A	B	C	D
A (Min.)	0.047 [1.2]	0.075 [1.9]	0.075 [1.9]	0.079 [2.0]
B (Min.)	0.063 [1.6]	0.063 [1.6]	0.087 [2.2]	0.087 [2.2]
B (Nom.)	0.083 [2.1]	0.083 [2.1]	0.106 [2.7]	0.106 [2.7]
C	0.051 [1.3]	0.063 [1.6]	0.122 [3.1]	0.173 [4.4]
D (Min.)	0.181 [4.6]	0.193 [4.9]	0.295 [7.5]	0.346 [8.8]
D (Nom.)	0.220 [5.6]	0.232 [5.9]	0.335 [8.5]	0.386 [9.8]
E (Min.)	0.024 [0.6]	0.020 [0.5]	0.024 [0.6]	0.024 [0.6]
E (Nom.)	0.047 [1.2]	0.047 [1.2]	0.051 [1.3]	0.051 [1.3]

The calculation formula for the pad layout:

$$\begin{aligned}
 A \text{ (Min.)} &= (Tw \text{ (Max.)} + 2e \times 0.67) \\
 B \text{ (Min.)} &= [D \text{ (Min.)} - C]/2 \\
 B \text{ (Nom.)} &= [D \text{ (Nom.)} - C]/2 \\
 C &= L \text{ (Nom.)} - 2P \text{ (Nom.)} - e \\
 D \text{ (Min.)} &= L \text{ (Max.)} + 2 E_1 + e \\
 D \text{ (Nom.)} &= L \text{ (Max.)} + 2 E_2 + e \\
 E \text{ (Min.)} &= [D \text{ (Min.)} - L \text{ (Max.)}]/2 \\
 E \text{ (Nom.)} &= [D \text{ (Nom.)} - L \text{ (Nom.)}]/2
 \end{aligned}$$

### WAVE SOLDERING PROCESS

Wave soldering includes the five steps shown:

- Drying
- Fluxing
- Preheating
- Soldering

#### 1. Drying:

The goal of drying is to eliminate water from the substrate. This is dependent on prior steps, particularly on the storage conditions. It may be optional.

#### 2. Fluxing:

The goal of the fluxing operation is to improve the wetting by:

- Deoxidation of metallic parts,
- Decreasing the surface tension produced in contact with the solder wave,
- Preservation of the board from oxidation between the flux and the wave soldering operation.

The choice of the flux (resin, organic or inorganic) will determine cleaning solvents employed.

#### 3. Preheat:

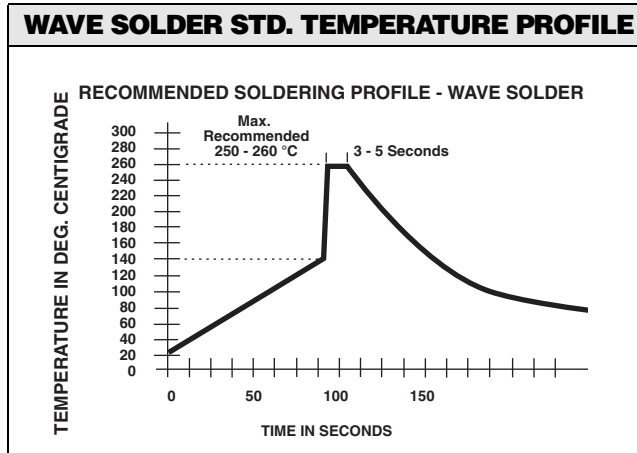
This step is intended:

- To evaporate the volatile products contained in the flux.
- To take the flux to its activation temperature,
- To limit the thermal shock, which acts on the boards and the components.

The preheating may be accomplished by hot air or infrared processes.

#### 4. Soldering:

The soldering of surface mounted components requires the use of a wave which insures sufficient flow of the solder between the components and which, however, minimize solder fillet and bridging. The graph indicates a standard temperature profile used in this process:



## RECOMMENDATIONS:

1. Preheat both substrate and components.
2. Do not use a standard wave normally used for boards with leaded components. These waves are not optimized for solder boards with surface mount components.
3. The temperature gradient between preheat and wave soldering must be smaller than + 100 °C.
4. Terminations must go through the wave simultaneously.
5. Optimal conditions: Travel through the wave from + 240 °C to + 250 °C for 3 to 5 seconds.
6. Verify that the upper side temperature of the board does not exceed + 150 °C.
7. Do not increase the wave temperature to improve solderability.
8. Do not increase the time to improve solderability.
9. Do not increase the temperature to reduce solder balls or bridges.
10. Check wave profiles frequently.
11. Use hot air at + 275 °C blowing on the solder joints immediately after the wave, in order to minimize bridging and to reduce the solder fillet size. Hot air should be applied to the substrate when the temperature is approx. + 230 °C.
12. Control cooling speed between 2 °C and 5 °C per second.

## REWORK AND REPAIR TECHNIQUES:

Occasionally rework or repair will be required. For example:

1. Repair to correct too much or not enough solder.
2. Realignment of the component when it has been misplaced in wet solder paste or in wet adhesive or even during the solder operation itself.
3. Replacement of the component because of placement error or failure.

The standards for visual inspection have to be defined very precisely for points 1 and 2. The following must be kept in mind:

- A) Are the risks of repair larger than the risks involved in not repairing?
- B) The repair process must yield products which will meet the standard specifications on a regular basis.
- C) Do not include repair in your process specification. Any repair must be an exception.

## ADDING SOLDER

If there is not enough solder, inspect for the cause:

1. Not enough solder or improper paste screening (reflow solder).
2. Shadowing of terminations in wave soldering due to the carrier tray, other components, a too close termination or a ripple in the solder wave.
3. Non-wetting of pads or terminations.

Use an iron with enough wattage. A good method of judgement is to control the time to reflow the solder: Less than 1 to 1.5 seconds, the tip temperature is excessive; more than 3 to 3.5 seconds, either the tip temperature is insufficient or the tip is cooling when applied to the circuit board. An iron which regulates the temperature is required. Apply a small amount of flux to the component termination and the pad layout (the new synthetic no residue fluxes are excellent). After tinning, the iron tip should be placed on the circuit pad at the edge furthest from the component. The operation must be done in 1.5 to 3 seconds. If it is necessary to keep the iron on longer than 3 seconds, the component should be replaced. The solder should be added at the solder iron tip and will flow from the pad to the termination of the component. Be careful not to add too much solder. Direct contact with the component may cause damage and subsequent failure.

## REMOVING SOLDER

Bridges, splatter and solder spikes are examples of excess solder conditions.

Our recommendations concerning the soldering iron apply here as well: time on the solder joint not to exceed 3 secs., do not touch the component or its termination. Use a copper braid solder wick or a vacuum solder pump to remove the excess solder. Use of hot gas nozzles or other complex tools should be restricted to removal of component itself.

## REALIGNMENT

This should be done rarely because it is usually preferable to replace the component. If misalignment appears after placement in molten solder paste, it is easy to correct by lifting the part with a vacuum nozzle and realigning it. But it is always better to correct the cause of the problem at the placement machine, solder paste screening, etc.

For wave soldering, an alignment defect is even easier to correct before curing of the adhesive. At that time, the part should be removed with most of the adhesive. Add new





# Guidelines for Surface Mounting

## Application Notes Guidelines for Surface Mounting of Tantalum Chip Capacitors

Vishay Sprague

adhesive and place a new part. Use of too much adhesive will result in definitive solder defects (open circuit). For misalignment noted after curing of the adhesive, the only solution is to replace it with a new part.

### REPLACEMENT

This operation must be done in less than 6 seconds in order not to damage the pad layout on the boards. Twisting and pulling forces are transmitted to the pads during the removal of a component. Again, strict temperature control is required. For parts glued with adhesive, the solder must first be removed by means of copper braid solder wicks or a vacuum pump. Replacement must be done with a new part, after a careful cleaning of the substrate.

### CLEANING

After mounting, components and boards are normally cleaned. Cleaning methods are the same for traditional leaded components but the geometry or the assembly of surface mount components make the cleaning more difficult to achieve. Most of the components (resistor or capacitor chips) have no cleaning stand offs and are applied directly on the board.

Commonly used are 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.

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.

### STANDARD TESTS

A number of standards (particularly CECC, IEC, MIL) have used tests which are applicable to surface mount components. The tables summarize common test conditions which are pertinent to soldering.

RESISTANCE TO SOLDER HEAT		
CONDITIONS		SIMULATED PROCESS
°C	SECONDS	
260 ± 5	10 ± 1	Double wave infrared
260 ± 5	5 ± 1	Single wave infrared
215 ± 3	40 ± 1	Vapor phase infrared

SOLDERABILITY AND LEACHING RESISTANCE			
PARAMETER TESTED	CONDITIONS		SIMULATED PROCESS
	°C	SECONDS	
Wetting	235 ± 5	2 ± 0.2	Wave
	215 ± 3	3 ± 0.3	Infrared Vapor phase Wave
Dewetting	260 ± 5	10 ± 1	
Leaching	260 ± 3	30 ± 1	Wave

CLEANING CONDITIONS			
PROCESS	CONDITIONS		CLEANING SOVENTS
Liquid	Boiling	40 - 80 °C/4 min.	<ul style="list-style-type: none"> <li>• Deionized water</li> <li>• Ethanol</li> <li>• Isopropanol</li> <li>• Halogenated Hydrocarbons</li> </ul>
	Ultrasonic	45 °C/2 min.	
	Steam	80 °C/30 sec.	
	Spray	45 °C/16 bar	

Vishay Sprague routinely tests to these and other test specifications. For information or assistance in selecting components for your particular application, consult your Vishay Sprague representative directly.

## Solid Tantalum Chip Capacitors

### **292D SERIES - COMMERCIAL MOLDED LEAD FRAMELESS**

The 292D is a solid tantalum lead frame-less molded surface mount chip capacitor featuring an 0805 footprint available in heights of 1.20 mm (0.047 inches) and 1.55 mm (0.061 inches). The ESR's for the 292D are the industry's lowest in the compact 0805 footprint series. It is optimized for DC-to-DC power conversion and noise filtering applications in high-end portable systems, handheld electronic products and hearing aids. The 0805 case offers wrap-around 100 % tin terminations and is surface-mountable simplifying the design and manufacturing process. 60/40 tin/lead and gold terminations are also available. Voltage rating options are 3, 4, 6.3, 10, 16 and 20 WVDC. Capacitance levels range from 3.3  $\mu\text{F}$  to 47  $\mu\text{F}$  in both 10 % and 20 % tolerance. The devices are rated for an extended - 55 °C to + 85 °C operating temperature range and a derating temperature of + 125 °C. Standard packaging of the 292D is tape and reel per EIA-481-C.

### **293D SERIES - INDUSTRIAL MOLDED**

The 293D series of solid molded tantalum capacitors was designed specifically for high volume, highly automated surface mount manufacturing processes. Available in six EIA standard case sizes and are optical character recognition qualified. The 293D series meets or exceeds EIA QC300801/US001 and 535BAAC. Standard lead termination finish is 100 % tin with 60/40 tin/lead and gold plating available as options. Voltage rating options are 4 WVDC to 50 WVDC with capacitances available from 0.10  $\mu\text{F}$  to 680  $\mu\text{F}$ . Both 10 % and 20 % tolerances are standard options. The devices are rated for an extended - 55 °C to + 85 °C operating temperature range and a derating temperature of + 125 °C. Standard packaging of the 293D is tape and reel per EIA-481-C.

### **593D SERIES - LOW ESR INDUSTRIAL MOLDED**

The 593D is a low ESR series of the popular 293D series, available in all case sizes with the exception of the P-case (EIA 2012). Capacitance offering range from 0.47  $\mu\text{F}$  to 680  $\mu\text{F}$ . Cases C, D, E are 100 % Surge Current tested. The devices are rated for an extended - 55 °C to + 85 °C operating temperature range and a derating temperature of + 125 °C. The devices are rated for an extended - 55 °C to + 85 °C operating temperature range and a derating temperature of + 125 °C. Standard packaging of the 593D is also tape and reel per EIA-481-C.

### **893D SERIES - FUSED COMMERCIAL MOLDED**

The 893D offers a built-in-fuse within the EIA standard cases: 6032, 7343 and 7343H. The fuse mechanism provides protection against damaging short circuit events and avoids costly repairs due to reverse installations. Capacitance ranges from 1  $\mu\text{F}$  to 220  $\mu\text{F}$  from 6 WVDC to

50 WVDC voltage ratings. Both 10 % and 20 % tolerances are standard options. Standard lead termination finish is 60/40, tin/lead with 100 % tin and gold plating as options. The devices are rated for an extended - 55 °C to + 85 °C operating temperature range and a derating temperature of + 125 °C. The devices are rated for an extended - 55 °C to + 85 °C operating temperature range and a derating temperature of + 125 °C. Standard packaging of the 893D is tape and reel per EIA-481-C.

### **CWR11 SERIES - MILITARY MOLDED**

The CWR11 is MIL-PRF-55365/8 approved. Available in EIA standard sizes: 3216, 3528, 6032 and 7343, they are molded solid tantalum available with Weibull Failure Rates B (0.1 %/1 k hrs.) and C (0.01 %/1 k hrs.) Capacitance ranges from 0.1  $\mu\text{F}$  to 100  $\mu\text{F}$  and voltage ratings from 4 WVDC to 50 WVDC. The devices are rated for an extended - 55 °C to + 85 °C operating temperature range and a derating temperature of + 125 °C. Tape and reeling per EIA-481-C is standard.

### **595D SERIES - COMMERCIAL CONFORMAL COATED CAPACITORS**

The 595D series of conformal coated capacitors offer higher CV benefits while being drop-in replacements for molded tantalum chip caps. They are available in a wide variety of case sizes and due to their construction and design, offer flexibility, in terms of meeting unique case size/ratings applications. The 595D series offers higher cap ratings per voltage with lower ESR and ESL than their molded tantalum counterparts. Both 10 % and 20 % tolerances are standard options. These are ideal for use in desktop PC's, notebook computers, cell phones, and other handheld electronic appliances. The devices are rated for an extended - 55 °C to + 85 °C operating temperature range and a derating temperature of + 125 °C.

Tape and reeling is per EIA-481-C. The series offers voltage ratings from 4 WVDC to 50 WVDC and capacitance from 0.10  $\mu\text{F}$  to 1500  $\mu\text{F}$ . 100 % Tin, 60/40 Tin/lead and gold terminations finishes are available.

### **594D SERIES - LOW ESR COMMERCIAL CONFORMAL COATED CAPACITORS**

The 594D series of conformal coated capacitors from Vishay is the Low ESR offering of the popular 595D series. With the same ratings and ranges, both series have 100 % tin terminations finish. 60/40, tin/lead and gold are available as options. Both 10 % and 20 % tolerances are standard options. The devices are rated for an extended - 55 °C to + 85 °C operating temperature range and a derating temperature of + 125 °C. Tape and reeling is per EIA-481-C. The series offers voltage ratings from 4 WVDC to 50 WVDC and capacitance from 0.10  $\mu\text{F}$  to 1500  $\mu\text{F}$ .





### **592D SERIES - LOW PROFILE COMMERCIAL CONFORMAL COATED CAPACITORS**

The low profile 592D series offers a wider range of case sizes and capacitance values that meet the requirements of lower profile commercial electronics. Case heights range from 1.2 mm to 2.5 mm, voltage ratings from 4 WVDC to 35 WVDC and capacitance ranging from 1  $\mu\text{F}$  to 2200  $\mu\text{F}$ . Both 10 % and 20 % tolerances are standard options. The devices are rated for an extended - 55  $^{\circ}\text{C}$  to + 85  $^{\circ}\text{C}$  operating temperature range and a derating temperature of + 125  $^{\circ}\text{C}$ . The 592D is ideal for telecommunications, and compact portable electronics. The large capacitance X-case offers a cost effective replacement for multiple lower value capacitors within a design. 100 % tin terminations are standard.

60/40 tin/lead and Gold are also available. Tape and reel packaging per EIA-481-C.

### **591D SERIES - LOW PROFILE, LOW ESR COMMERCIAL CONFORMAL COATED CAPACITORS**

The 591D series of conformal coated capacitors is the Low ESR offerings of the 592D. The 591D ESR's are among the industry's lowest for capacitors meeting the footprints of EIS 535BAAC and CECC 30801 molded chips, resulting in lower power consumption, while enabling thinner more space-efficient end products. ESR's range from 0.045  $\Omega$  to 0.100  $\Omega$  at 25  $^{\circ}\text{C}$ , 100 kHz. Capacitance offerings range from 1  $\mu\text{F}$  to 1000  $\mu\text{F}$ . 100 % tin terminations are standard.

60/40 tin/lead and gold are also available. The devices are rated for an extended - 55  $^{\circ}\text{C}$  to + 85  $^{\circ}\text{C}$  operating temperature range and a derating temperature of + 125  $^{\circ}\text{C}$ . Both 10 % and 20 % tolerances are standard options. Tape and reel packaging per EIA-481-C.

### **572D SERIES - LOW PROFILE, HIGH CAP, CONFORMAL COATED CAPACITORS**

The 572D series was designed primarily for the popular and rapidly growing wireless and handheld electronics market. With case sizes as small as 0805 and component height as low as 0.75 mm, this series is ideal for applications, where space is limited. ESR values range as low as 0.2  $\Omega$  at 25  $^{\circ}\text{C}$ , 100 kHz. Standard wrap-around termination of 100 % tin are available as well the 0805, P-case with a single-sided anode. Capacitance ranges from 4.7  $\mu\text{F}$  to 220  $\mu\text{F}$  with voltage ratings ranging from 4 WVDC to 35 WVDC. Both 10 % and 20 % tolerances are standard options. The devices are rated for an extended - 55  $^{\circ}\text{C}$  to + 85  $^{\circ}\text{C}$  operating temperature range and a derating temperature of + 125  $^{\circ}\text{C}$ . Tape and reeling per EIA-481-C.

### **597D SERIES - ULTRA LOW ESR, MULTI-ANODE, CONFORMAL COATED CAPACITORS**

The 597D series offers ESR's in the range of 13 m $\Omega$  to 35 m $\Omega$  and capacitance from 22  $\mu\text{F}$  to 1500  $\mu\text{F}$ . These

multi-anode capacitors provide increased reliability. The 597D series is used in filtering and decoupling within DC-to-DC conversion, line cards, mother boards and power supply applications in end product such as test equipment, PC's and base stations. Both 10 % and 20 % tolerances are standard options. Voltage ratings range from 4 WVDC to 63 WVDC. The devices are rated for an extended - 55  $^{\circ}\text{C}$  to + 85  $^{\circ}\text{C}$  operating temperature range and a derating temperature of + 125  $^{\circ}\text{C}$ . 100 % tin terminations are standard. Tape and reeling is per EIA-481-C.

### **195D SERIES - INDUSTRIAL CONFORMAL COATED CAPACITORS**

The 195D is available in US and European case sizes 7257, 3518, 3518, 3527 and 7227 in capacitances from 0.01  $\mu\text{F}$  to 330  $\mu\text{F}$ . Voltage ratings range from 4 WVDC to 50 WVDC, making the 195D suitable for telecommunications, computing and electronic appliances. The devices are rated for an extended - 55  $^{\circ}\text{C}$  to + 85  $^{\circ}\text{C}$  operating temperature range and a derating temperature of + 125  $^{\circ}\text{C}$ . Termination finish options include gold and 60/40 solder plating with 100 % tin as standard. Tape and reeling is per EIA-481-C.

### **194D SERIES - INDUSTRIAL CONFORMAL COATED MIDGET® CAPACITORS**

The 194D series has a minimal footprint case size range while offering capacitance from 0.1  $\mu\text{F}$  to 12  $\mu\text{F}$ . Both 10 % and 20 % tolerances are standard options. Voltage ratings range from 4 WVDC to 50 WVDC. Lead finish options include gold, 60/40 electroplated and hot solder dip finishes. The devices are rated for an extended - 55  $^{\circ}\text{C}$  to + 85  $^{\circ}\text{C}$  operating temperature range and a derating temperature of + 125  $^{\circ}\text{C}$ . Tape and reeling is per EIA-481-C.

### **695D SERIES - INDUSTRIAL CONFORMAL COATED CAPACITORS**

The 695D series is pad-compatible with the 194D and MIL-C-55365/4 (CWR06). With capacitor values from 0.1  $\mu\text{F}$  to 270  $\mu\text{F}$ , the 695D is available from 4 WVDC to 50 WVDC and 100 % tin terminations are standard. Both 10 % and 20 % tolerances are standard options. 60/40 solder plate and gold are available upon special request. The devices are rated for an extended - 55  $^{\circ}\text{C}$  to + 85  $^{\circ}\text{C}$  operating temperature range and a derating temperature of + 125  $^{\circ}\text{C}$ . Tape is compliant to EIA-481-C and reeling to IEC 286-3.

### **CWR06 SERIES - MILITARY MIDGET® SOLID TANTALUM**

The CWR06 series of conformal coated caps is qualified to MIL-C-55365/4. It is available in capacitance from 0.10  $\mu\text{F}$  to 100  $\mu\text{F}$  with Weibull failure rates, B,C and Exponential M & P and in 4 WVDC to 50 WVDC range. The devices are rated for an extended - 55  $^{\circ}\text{C}$  to + 85  $^{\circ}\text{C}$  operating temperature range and a derating temperature of + 125  $^{\circ}\text{C}$ . Standard termination finishes are 100 % tin also available are 50  $\mu\text{inch}$  gold plate, 60/40 tin/lead electroplated and hot solder dipped.



## **TR3 SERIES - ULTRA LOW ESR MOLDED TANTALUM CAPACITORS**

The TR3 series is pad-compatible with the 593D series. Capacitance ranges from 0.47  $\mu\text{F}$  to 680  $\mu\text{F}$  and voltage ratings from 4 WVDC to 50 WVDC. The ESR range begins at an ultra-low 35 mOhms to 5.5 Ohms and 100 % tin terminations are available. Both 10 % and 20 % tolerances are standard options. The TR3 is ideal for microprocessor bulk energy storage and DC to DC conversion applications in telecom, automotive, computer, industrial, commercial, medical and avionics end systems. Case sizes B, C, D, and E are 100 % Surge Current tested. The devices are rated for an extended - 55 °C to + 85 °C operating temperature range and a derating temperature of + 125 °C. Tape is compliant to EIA-481-C and reeling to IEC 286-3.

## **CC/EC SERIES - SOLID TANTALUM CONFORMAL COATED CHIP CAPACITORS**

The CC/EC series is pad-compatible with the CWR06 series. With 8 standard case codes, the CC/EC has a temperature operating range from - 55 °C to + 85 °C operating temperature range and a derating temperature of + 125 °C. CC/EC capacitors are 100 % low impedance power burned-in at + 85 °C. They are available with gold or solder dipped terminations and are packaged in 50 unit "Blister-Pack" trays or 8 mm or 12 mm tape and reel. CC/EC caps are primarily for medical, aerospace and military hybrid applications.

## **T83 SERIES - HI-REL COTS, MOLDED CASE TANTALUM CAPACITORS**

The T83 Hi-Rel COTS series is intended for Military and industrial high volume, highly automated surface mount manufacturing processes. Available in six EIA standard case sizes and are optical character recognition qualified. Standard lead termination finish is 60/40 tin/lead with 100 % tin available as an option. Voltage rating options are 4 WVDC to 50 WVDC with capacitances available from 0.10  $\mu\text{F}$  to 330  $\mu\text{F}$ . Both 10 % and 20 % tolerances are standard options. The devices are rated for an extended - 55 °C to + 85 °C operating temperature range and a derating temperature of + 125 °C. Standard packaging of the T83 is tape and reel per EIA-481-1.

## **CWR16 SERIES - MILITARY MIDGET® SOLID TANTALUM**

The CWR06 series of conformal coated caps is qualified to MIL-C-55365/13. It is available in capacitance from 0.33  $\mu\text{F}$  to 330  $\mu\text{F}$  with Weibull failure rates, B, C in a 4 WVDC to 35 WVDC range. The devices are rated for an extended - 55 °C to + 85 °C operating temperature range and derating temperature of + 125 °C. Standard termination finishes are 50  $\mu\text{inch}$  gold plate, 60/40 tin/lead electroplated and hot solder dipped.

## **T95 SERIES - HI-REL COTS, CONFORMAL COATED TANTALUM CAPACITORS**

The T95 Hi-Rel COTS series is designed for military and industrial users that demand a broader array of capacitance values, voltage ranges, and case sizes than what is available in MIL-SPEC offerings without sacrificing reliability. Lead terminations are available in 60/40, Sn/Pb and RoHS compliant matte tin. Voltage ratings are available from 4 WVDC to 50 WVDC volts with a cap range of 0.1  $\mu\text{F}$  to 680  $\mu\text{F}$ . Capacitance tolerances offered are both 10 % and 20 %. Device temperature ratings are from - 55 °C to + 85 °C, and up to + 125 °C with derating.

Standard packaging is tape and reel per EIA-481-C.

## **298D SERIES - MicroTan® MAP TECHNOLOGY, FACEDOWN TERMINATION MOLDED TANTALUM CAPACITORS**

The 298D series of solid tantalum capacitors (MicroTan®) uses Vishay's new MAP (Multi-Array Packaging) assembly and facedown termination technology and thus realizes a leap in volumetric capabilities producing capacitive rating from

1  $\mu\text{F}$  - 50 WVDC to 220  $\mu\text{F}$  - 4 WVDC. The 298D is designed primarily for consumer portable electronics. Since it does not produce micro-phonic noise associated with the piezo-electric effect found in High CV MLCCs it is ideal for use in audio/video circuits. The 298D offers 100 % matte tin and gold plated terminations, standard and is RoHS compliant. Operating temp range is - 55 °C to + 125 °C and is only available with 20 % cap tolerance. Tape and reel packaging is per EIA 481-C.

## **TH3 SERIES - MOLDED, EXTENDED TEMPERATURE - 150 °C**

The TH3 series is a high temperature version of Vishay's molded, solid tantalum capacitors, targeted for applications that require operating temperatures of up to + 150 °C. The TH3 is available in five standard EIA case sizes and offers 100 % matte tin, standard as well as Gold and Sn/Pb lead terminations. Capacitance ranges from 0.33  $\mu\text{F}$  to 100  $\mu\text{F}$  with voltages ranging from 10 WVDC to 50 WVDC. Tape and reel packaging is per EIA 481-C.



### **TP3, TF3, TR8 SERIES - MICROTAN® MAP TECHNOLOGY, LOW-ESR, FACEDOWN TERMINATION MOLDED TANTALUM CAPACITORS**

The TR8 series is the low-ESR version of the popular 298D series. With the 298D series already offering among the lowest ESR in the industry, the TR8 extends this advantage. As a member of the MicroTan® family, the TR8 uses Vishay's new MAP (Multi-Array Packaging) assembly and facedown termination technology and thus realizes a leap in volumetric capabilities producing capacitive rating from 1  $\mu$ F - 50 WVDC to 220  $\mu$ F - 4 WVDC. The TR8 is designed primarily for consumer portable electronics. Since it does not produce micro-phonic noise associated with the piezo-electric effect found in High CV MLCCs it is ideal for use in audio/video circuits. The 298D offers 100 % matte tin and gold plated terminations and is RoHS compliant. Operating temperature range is - 55 °C to + 125 °C and is only available with 20 % cap tolerance. Tape and reel packaging is per EIA 481-C.

### **T96 SERIES - HI-REL COTS, CONFORMAL COATED TANTALUM CAPACITORS WITH INTEGRATED FUSE**

The T96 Hi-Rel COTS series features an integrated fuse. Designed for safety critical military and aerospace applications, these products combine reliability performance and fail-safe operation with the popular ratings from the commercial 195D, 594D and 595D series. Lead terminations are available in 60/40 Sn/Pb and RoHS compliant matte tin. Voltage ratings are available from 4 WVDC to 63 WVDC volts with a cap range of 15  $\mu$ F to 1500  $\mu$ F. Capacitance tolerances offered are both 10 % and 20 %. Device temperature ratings are from - 55 °C to +85 °C, and up to + 125 °C with derating. Standard packaging is tape and reel per EIA-481-C.

### **T97 SERIES - HI-REL COTS, ULTRA-LOW ESR, CONFORMAL COATED TANTALUM CAPACITORS**

The T97 is the Hi-Rel COTS equivalent to the commercial 597D series. The T97 offers Hi-Rel screening patterned after MIL-PRF-55365 and is designed for military and industrial users that demand a broader array of capacitance values, voltage ranges, and case sizes than what is available in MIL-SPEC offerings without sacrificing reliability. With voltage ratings up to 63 V, these new high-capacitance high-voltage devices are perfect for avionics applications involving the aircraft +28 V DC power distribution system. Lead terminations are available in 60/40 Sn/Pb and RoHS compliant matte tin. Voltage ratings are available from 4 WVDC to 63 WVDC volts with a cap range of 15  $\mu$ F to 1500  $\mu$ F. Capacitance tolerances offered are both 10 % and 20 %. Device temperature ratings are from - 55 °C to + 85 °C, and up to + 125 °C with derating. Standard packaging is tape and reel per EIA-481-C.

### **T98 SERIES - HI-REL COTS, ULTRA-LOW ESR, CONFORMAL COATED TANTALUM CAPACITORS WITH INTEGRATED FUSE**

The T98 series is a Hi-Rel COTS product which features an integrated fuse for fail-safe operation. Designed for safety critical military and aerospace applications, these products combine reliability performance with the high-capacitance, high-voltage solutions of its commercial counterpart, the 597D. Lead terminations are available in 60/40 Sn/Pb and RoHS compliant matte tin. Voltage ratings are available from 4 WVDC to 63 WVDC volts with a cap range of 15  $\mu$ F to 1500  $\mu$ F. Capacitance tolerances offered are both 10 % and 20 %. Device temperature ratings are from - 55 °C to + 85 °C, and up to + 125 °C with derating. Standard packaging is tape and reel per EIA-481-C.



## Lead Elimination in Tantalum Capacitors

### VISHAY SPRAGUE TANTALUM CAPACITOR DIVISION, LEAD ELIMINATION PROGRAM

A recent draft report on the proposal for the European Parliament and Council directive on the restriction of the use of hazardous substances calls for an effective date of January 1, 2006 for total elimination in the use of lead in electrical and electronic equipment.

Japanese manufacturers have taken a very proactive approach and set their deadlines for banning lead use to the 2001 year-end.

While no specific regulation has been defined for the U.S., several major original equipment manufacturers have already taken the initiative to reduce/eliminate usage of lead in electronic components.

Following the industry trend, Vishay Sprague, a major Tantalum capacitor manufacturer, has made extensive efforts to convert all its major products to a lead (Pb)-free termination finish.

During the year 2000, Vishay Sprague performed technical assessment and qualification of lead (Pb)-free termination materials for currently manufactured and newly developed Tantalum capacitors.

This project has yielded the conclusion that pure tin plating is a viable option to satisfy the industry requirement for lead (Pb)-free termination finish.

All tested products have demonstrated acceptable solderability, solder joint strength, and did not support whisker growth.

In addition, reflow temperatures as high as 260 °C, associated with usage of lead (Pb)-free solder pastes, did not have a detrimental effect on the electrical performance of the tested capacitors.

Consequently, as of the first quarter of 2001, the manufacturing process for Conformal Coated Products (Series 195D, 572D, 591D, 592D, 594D, 595D, 597D and 695D), has been fully converted to pure tin plated terminations.

A new range of Molded Leadless Chips (Series 292D) has already been developed and introduced to the market in June 2001 with lead (Pb)-free terminations.

Vishay Sprague has recently completed the implementation of lead (Pb)-free terminations in Molded chips (Series 293D, 593D) in 2005.

In 2006, Vishay Sprague will implement lead (Pb)-free terminations in Solid Tantalum Leaded capacitors as well. (Series 109D, 135D, 138D, 150D, 152D, 173D, 199D, 299D, 489D, 499D, 790D and CECC Hermetic and Hi-Rel COTS).

Vishay Sprague will continue to support those customers who require products built to military or any other particular specifications which cannot currently be converted to lead (Pb)-free versions.

Vishay Sprague Tantalum Capacitor Division, Lead Elimination Program appreciates any feedback and is prepared to continue its efforts to measure up to customer expectations and industry standards.



SOLID TANTALUM CHIP CAPACITORS - SURFACE MOUNT										
MODEL	CECC MIL SPEC/ TYPE	OUTLINE DRAWING	CAPACITANCE RANGE (μF)	WORKING VOLTAGES (W <sub>VDC</sub> )	8 mm TAPE	12 mm TAPE	16 mm TAPE	24 mm TAPE	BLISTER PACK	PAGE
298D	-		1.0 to 220	4 to 25	M, P	-	-	-	-	44
293D 793DX CTC3 CTC4 793DE	- CECC 30801-005 CECC 30801-009 CECC 30801-011 CECC 30801-801		0.10 to 680	4 to 50	A, B, P	C, D, E	-	-	-	56
593D	-		0.47 to 680	4 to 50	A, B	C, D, E	-	-	-	67
TR3	-		0.47 to 680	4 to 50	A, B	C, D, E	-	-	-	72
TR8	-		1 to 220	4 to 16	P, M	-	-	-	-	
893D	-		1.0 to 220	6.3 to 50	-	C, D, E	-	-	-	88
TH3	-		0.35 to 100	10 to 50	A, B	C, D, E	-	-	-	92
TH5	-		10	21	E	-	-	-	-	
595D	-		0.10 to 1500	4 to 50	T, A, S	B, C, D, G, H, M, R	-	-	-	110
594D	-		1.0 to 1500	4 to 50	-	B, C, D, R	-	-	-	119
592D	-		1.0 to 3300	4 to 35	A	B, C, D, R	-	X	-	125
591D	-		1.0 to 1000	4 to 35	A	B, C, D, R	-	-	-	136
572D	-		2.2 to 220	4 to 35	P, Q, S, A	B, T	-	-	-	145
597D	-		22 to 1500	4 to 50	-	V	E, R, F	-	-	151
195D	-		0.10 to 330	2 to 50	C, S, V	R, X, Y, Z	-	-	-	156



SOLID TANTALUM CHIP CAPACITORS - SURFACE MOUNT										
MODEL	CECC MIL SPEC/ TYPE	OUTLINE DRAWING	CAPACITANCE RANGE (μF)	WORKING VOLTAGES (W <sub>VDC</sub> )	8 mm TAPE	12 mm TAPE	16 mm TAPE	24 mm TAPE	BLISTER PACK	PAGE
195D	-		0.10 to 100	2 to 50	A	B, D, E, F, G, H	-	-	-	156
695D	-		0.10 to 270	4 to 50	A	B, D, E, R, G	H	-	-	166
194D	CECC 30801-001		0.10 to 150	4 to 50	A	B, D, E, F	G, H	-	Y	173
T83	-		0.1 to 330	4 to 50	A, B	C, D, E	-	-	-	191
T86	-		0.47 to 470	4 to 50	C, D, E	-	-	-	-	
T95	-		0.1 to 680	4 to 50	-	B, C, D, R, S, V, X, Y, Z	-	-	-	199
T96	-		10 to 680	4 to 50	R	-	-	-	-	
T97	-		10 to 1500	4 to 75	E, F, R, V, Z, D, M, H, N	-	-	-	-	
T98	-		15 to 1500	4 to 63	E, F, R, V, Z, M, H	-	-	-	-	
TP3	-		0.10 to 470	4 to 50	A, B, C, D, E	-	-	-	-	
TF3	-		0.47 to 470	4 to 50	C, D, E	-	-	-	-	
TM8	-		1 to 47	2 to 40	P, Q, L, R, W	D, E, F, N, T	-	-	-	
CWR06	MIL-PRF-55365/4		0.10 to 100	4 to 50	A	B, C, D, E, F	G, H	-	-	204
CWR11	MIL-C-55365/8		0.10 to 100	4 to 50	A, B	D	-	-	-	210
CWR16	MIL-PRF-55365/13		0.33 to 330	4 to 35	A	B, C, D, E, F	G, H	-	-	



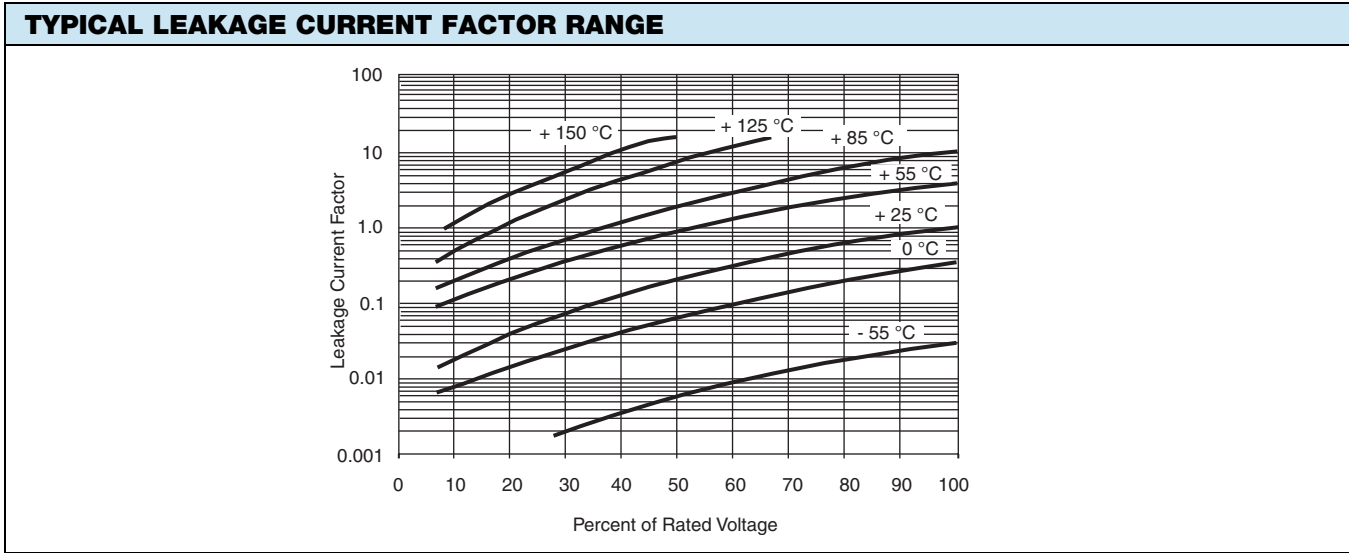
## Typical Performance Characteristics Tantalum Capacitors

CAPACITOR 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) 2 V <sub>RMS</sub> (max.) at + 25 °C using a capacitance bridge			
Dissipation factor	Limit per Standard Ratings table. Tested via bridge method, at 25 °C, 120 Hz			
ESR	Limit 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 0.01 CV or 0.5 μA, whichever is greater. <i>Note that the leakage current varies with temperature and applied voltage. See graph below for the appropriate adjustment factor.</i>			
Capacitance change by temperature	+ 12 % max. (at + 125 °C) + 10 % max. (at + 85 °C) - 10 % max. (at - 55 °C)		For capacitance value > 300 μF + 20 % max. (at + 125 °C) + 15 % max. (at + 85 °C) - 15 % max. (at - 55 °C)	
Reverse voltage	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 Vishay does not recommend 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		+ 125 °C	
	<b>RATED VOLTAGE (V)</b>	<b>SURGE VOLTAGE (V)</b>	<b>RATED VOLTAGE (V)</b>	<b>SURGE VOLTAGE (V)</b>
	4	5.2	2.7	3.4
	6.3	8	4	5
	10	13	7	8
	16	20	10	12
	20	26	13	16
	25	32	17	20
	35	46	23	28
	50	65	33	40
	50 <sup>(1)</sup>	60	33	40
63	76	42	50	

### Notes

- All information presented in this document reflects typical performance characteristics
- <sup>(1)</sup> Capacitance values 15 μF and higher





**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.

CAPACITOR PERFORMANCE CHARACTERISTICS							
ITEM	PERFORMANCE CHARACTERISTICS						
Surge voltage	<p>Post application of surge voltage (as specified in the table above) in series with a 33 Ω resistor at the rate of 30 s ON, 30 s OFF, for 1000 successive test cycles at 85 °C, capacitors meet the characteristics requirements listed below.</p> <table border="0"> <tr> <td>Capacitance change</td> <td>Within ± 10 % of initial value</td> </tr> <tr> <td>Dissipation factor</td> <td>Initial specified value or less</td> </tr> <tr> <td>Leakage current</td> <td>Initial specified value or less</td> </tr> </table>	Capacitance change	Within ± 10 % of initial value	Dissipation factor	Initial specified value or less	Leakage current	Initial specified value or less
Capacitance change	Within ± 10 % of initial value						
Dissipation factor	Initial specified value or less						
Leakage current	Initial specified value or less						
Surge current	<p>After subjecting parts in series with a 1 Ω resistor at the rate of 3 s CHARGE, 3 s DISCHARGE, and a cap bank of 100K μF for 3 successive test cycles at 25 °C, capacitors meet the characteristics requirements listed below.</p> <table border="0"> <tr> <td>Capacitance change</td> <td>Within ± 10 % of initial value</td> </tr> <tr> <td>Dissipation factor</td> <td>Initial specified value or less</td> </tr> <tr> <td>Leakage current</td> <td>Initial specified value or less</td> </tr> </table>	Capacitance change	Within ± 10 % of initial value	Dissipation factor	Initial specified value or less	Leakage current	Initial specified value or less
Capacitance change	Within ± 10 % of initial value						
Dissipation factor	Initial specified value or less						
Leakage current	Initial specified value or less						
Life test at + 85 °C	<p>Capacitors meet the characteristic requirements listed below. After 2000 h application of rated voltage at 85 °C.</p> <table border="0"> <tr> <td>Capacitance change</td> <td>Within ± 10 % of initial value</td> </tr> <tr> <td>Leakage current</td> <td>Shall not exceed 125 % of initial value</td> </tr> </table>	Capacitance change	Within ± 10 % of initial value	Leakage current	Shall not exceed 125 % of initial value		
Capacitance change	Within ± 10 % of initial value						
Leakage current	Shall not exceed 125 % of initial value						
Life test at + 125 °C	<p>Capacitors meet the characteristic requirements listed below. After 1000 h application 2/3 of rated voltage at 125 °C.</p> <table border="0"> <tr> <td>Capacitance change for parts with cap. ≤ 600 μF</td> <td>Within ± 10 % of initial value</td> </tr> <tr> <td>for parts with cap. &gt; 600 μF</td> <td>Within ± 20 % of initial value</td> </tr> <tr> <td>Leakage current</td> <td>Shall not exceed 125 % of initial value</td> </tr> </table>	Capacitance change for parts with cap. ≤ 600 μF	Within ± 10 % of initial value	for parts with cap. > 600 μF	Within ± 20 % of initial value	Leakage current	Shall not exceed 125 % of initial value
Capacitance change for parts with cap. ≤ 600 μF	Within ± 10 % of initial value						
for parts with cap. > 600 μF	Within ± 20 % of initial value						
Leakage current	Shall not exceed 125 % of initial value						





CAPACITOR ENVIRONMENTAL CHARACTERISTICS		
ITEM	CONDITION	ENVIRONMENTAL CHARACTERISTICS
Humidity tests	At 40 °C/90 % RH 1000 h, no voltage applied.	Capacitance change Cap. ≤ 600 µF      Within ± 10 % of initial value Cap. > 600 µF      Within ± 20 % of initial value Dissipation factor      Not to exceed 150 % of initial + 25 °C requirement
Temperature cycles	At - 55 °C/+ 125 °C, 30 min each, for 5 cycles.	Capacitance change Cap. ≤ 600 µF      Within ± 10 % of initial value Cap. > 600 µF      Within ± 20 % of initial value Dissipation factor      Initial specified value or less Leakage current      Initial specified value or less
Moisture resistance	MIL-STD-202, method 106 at rated voltage, 42 cycles.	Capacitance change Cap. ≤ 600 µF      Within ± 10 % of initial value Cap. > 600 µF      Within ± 20 % of initial value Dissipation factor      Initial specified value or less Leakage current      Initial specified value or less
Thermal shock	Capacitors are subjected to 5 cycles of the following: - 55 °C (+ 0 °C, - 5 °C) for 30 min, then + 25 °C (+ 10 °C, - 5 °C) for 5 min, then + 125 °C (+ 3 °C, - 0 °C) for 30 min, then + 25 °C (+ 10 °C, - 5 °C) for 5 min	Capacitance change Cap. ≤ 600 µF      Within ± 10 % of initial value Cap. > 600 µF      Within ± 20 % of initial value Dissipation factor      Initial specified value or less Leakage current      Initial specified value or less

MECHANICAL PERFORMANCE CHARACTERISTICS		
TEST CONDITION	CONDITION	POST TEST PERFORMANCE
Shear test	Apply a pressure load of 5 N for 10 s ± 1 s horizontally to the center of capacitor side body.	Capacitance change      Within ± 10 % of initial value Dissipation factor      Initial specified value or less Leakage current      Initial specified value or less  There shall be no mechanical or visual damage to capacitors post-conditioning.
Substrate bend	With parts soldered onto substrate test board, apply force to the test board for a deflection of 3 mm, for a total of 3 bends at a rate of 1 mm/s.	Capacitance change      Within ± 10 % of initial value Dissipation factor      Initial specified value or less Leakage current      Initial specified value or less
Vibration	MIL-STD-202, method 204, condition D, 10 Hz to 2000 Hz, 20 g peak	Capacitance change      Within ± 10 % of initial value Dissipation factor      Initial specified value or less Leakage current      Initial specified value or less  There shall be no mechanical or visual damage to capacitors post-conditioning.
Shock	MIL-STD-202, method 204, condition, 100 g peak	Capacitance change      Within ± 10 % of initial value Dissipation factor      Initial specified value or less Leakage current      Initial specified value or less  There shall be no mechanical or visual damage to capacitors post-conditioning.
Resistance to solder heat	<ul style="list-style-type: none"> <li>Recommended reflow profiles temperatures and durations are located within the Capacitor Series Guides</li> <li>Pb-free and lead-bearing series caps are backward and forward compatible</li> </ul>	Capacitance change      Within ± 10 % of initial value Dissipation factor      Initial specified value or less Leakage current      Initial specified value or less  There shall be no mechanical or visual damage to capacitors post-conditioning.
Solderability	MIL-STD-2002, method 208, ANSI/J-STD-002, test B. Applies only to solder and tin plated terminations. Does not apply to gold terminations.	Capacitance change      Within ± 10 % of initial value Dissipation factor      Initial specified value or less Leakage current      Initial specified value or less  There shall be no mechanical or visual damage to capacitors post-conditioning.
Resistance to solvents	MIL-STD-202, method 215	Capacitance change      Within ± 10 % of initial value Dissipation factor      Initial specified value or less Leakage current      Initial specified value or less  There shall be no mechanical or visual damage to capacitors post-conditioning.
Flammability	Encapsulant materials meet UL 94 V-0 with an oxygen index of 32 %.	

## Application Notes AC Ripple Current Calculations Solid Tantalum Capacitors

### INTRODUCTION

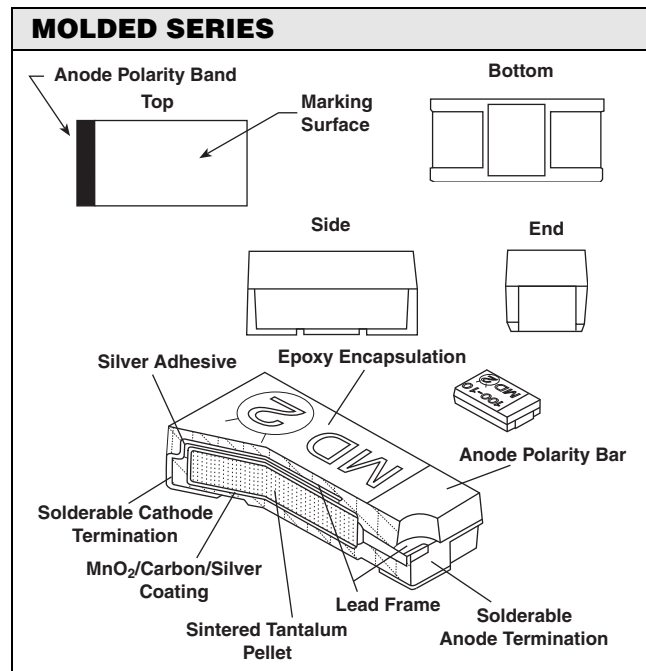
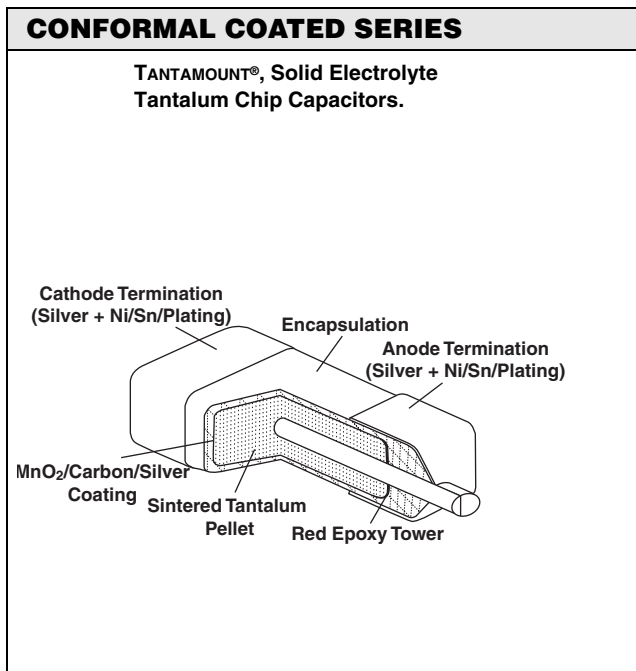
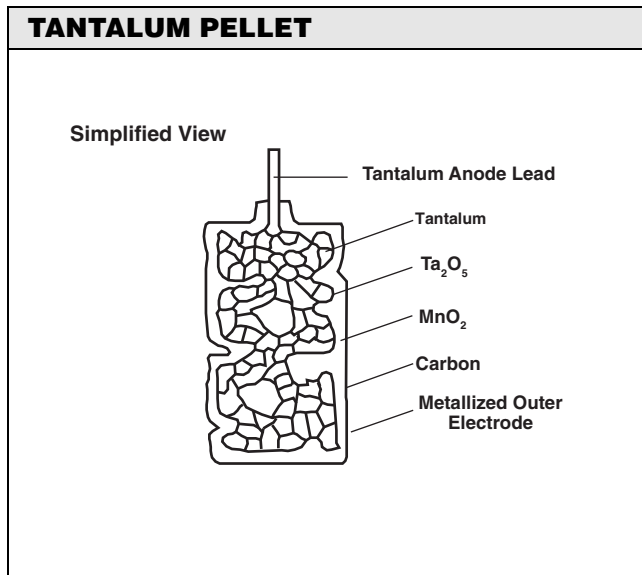
Solid tantalum capacitors are preferred for filtering applications in small power supplies and DC/DC converters in a broad range of military, industrial and commercial systems including computers, telecommunications, instruments and controls and automotive equipment. Solid tantalum capacitors are preferred for their high reliability, long life, extended shelf life, exceptional stability with temperature and their small size. Their voltage range is 4 to 50 volts for the most common types. Tantalum chip capacitors for surface mount applications are manufactured in very small sizes and are compatible with standard pick-and-place equipment.

The electronics industry has moved to smaller and smaller power supplies and higher switching frequencies, with an increased requirement for capacitors with smaller size and operating characteristics better suited to high frequencies. This application note briefly describes the construction of solid tantalum capacitors, the concept of Equivalent Series Resistance (ESR) and presents calculations for power dissipation and voltage limitations for both low and high frequency applications.

### CONSTRUCTION

The solid tantalum capacitor consists of a sintered tantalum pellet, the anode, on which a tantalum oxide dielectric is formed by electrolysis. The pellet is then coated with manganese dioxide for the cathode. Positive and negative terminations are attached to this pellet and the assembly may be conformally-coated or molded.

Looking closely at the internal structure of the pellet, we see that it is made of grains of tantalum powder sintered to each other. A solid tantalum capacitor is equivalent to many small capacitors in parallel, one for each grain of powder. This configuration produces a very large surface area, therefore a large capacitance in a relatively small volume.





### EQUIVALENT SERIES RESISTANCE (ESR)

A capacitor offers internal resistance to AC current, called the Equivalent Series Resistance (ESR). At lower frequencies, this is mainly the resistance of the dielectric. At higher frequencies, the resistance of the manganese dioxide in the voids between the grains is predominant. Because the resistivity of manganese dioxide is inversely proportional to temperature, the ESR of solid tantalum capacitors at high frequencies decreases as temperature increases.

### POWER DISSIPATION LIMITATION

When AC current is applied to a solid tantalum capacitor, the resistance (ESR) that opposes the flow of current results in heat generation, according to the formula:

$$(1) P = I^2 \times ESR$$

The power (P) dissipated in the capacitor results in an elevation of temperature. The allowable temperature rise of a capacitor due to power dissipation is determined by experience. For example, this value is + 20 °C maximum for molded chip capacitors. This in turn limits the power that the capacitor can dissipate.

### VOLTAGE LIMITATION

The power a capacitor can dissipate is also limited by the applied DC voltage. The operating voltage should not be allowed to rise above the rated voltage (nor should it drop below zero, since the solid tantalum capacitor is a polarized component). Assuming the capacitor is biased at half the rated voltage, which is the optimum use condition, the limiting value of the voltage is, for a sinusoidal waveform:

$$(2) V_{rms} = V_{pp}/2\sqrt{2} = R_v/2\sqrt{2}$$

Vrms for each value of Rv (Rated voltage) are:

RATED VOLTAGE	Vrms MAXIMUM
4	1.42
10	5.30
20	7.07
25	8.84
35	12.37
40	14.14
50	17.68

### CURRENT LIMITATION (LOW FREQUENCY)

To find the limiting current Irms, we divide Vrms by the impedance at the desired frequency.

$$(3) I_{rms} = V_{rms}/Z$$

using the formula:

$$(4) Z = \sqrt{X^2 + ESR^2}$$

where X is  $1/Cw + Lw$  ( $w = 2\pi f$ )

Since inductance of a solid tantalum capacitor is usually in the nanohenry range, the Lw factor becomes important only when the frequency is higher than a few megahertz. For filtering applications at 100 kHz and lower, the inductance factor will generally be ignored in the calculation. At 120 Hz, the impedance can be determined by calculation.

$$(5) Z = \sqrt{(1/2\pi fC)^2 + (DF/2\pi fC)^2} = (1/2\pi fC)\sqrt{(1 + DF^2)}$$

At 120 Hz, DF<sup>2</sup> is relatively small compared with 1 and the formula can be simplified to:

$$(6) Z = 1/2\pi fC$$

More generally, DF values of less than 10 % will not affect the final result by more than 1 %. It is important to use the lowest value for C, including the capacitance tolerance. At 120 Hz, the formula can be simplified to:

$$(7) I_{rms} = 0.266 \times CV$$

where Irms is the maximum permissible rms current in milliamperes, C the capacitance minus the capacitance tolerance in microfarads and V the rated voltage in volts. All above calculations assume the capacitor is properly biased at half the rated voltage. If this is not the case, Vrms becomes

$$(8) V_p/\sqrt{2}$$

where  $V_p = V_{rated} - V_{bias}$  or  $V_{bias}$ , whichever is lower.

# AC Ripple Current Calculations

Vishay Sprague

Application Notes AC Ripple Current  
Calculations Solid Tantalum Capacitors



## CURRENT LIMITATION (HIGH FREQUENCY)

At frequencies in the 10 kHz to several hundred kilohertz range, the power dissipation becomes the limiting factor. The following formula gives the maximum permissible ripple current for a sinusoidal wave form:

$$(9) I_{rms} = \sqrt{P_{max}/ESR}$$

$P_{max}$  is the maximum power dissipation the capacitor can tolerate. The ESR value in the formula is the maximum ESR of the capacitor at the required frequency. This can be determined by measuring capacitors and determining a maximum value by using the mean value and adding 3 or more standard deviations. Some manufacturers specify the maximum impedance at 100 kHz or 1 MHz. Either value may be used in ripple current calculations.

Power dissipation limits calculated for the most popular surface mount types of solid tantalum capacitors are:

### Molded Case Chip (293D):

CASE SIZE	MAXIMUM POWER AT + 25 °C (WATTS)
A	0.075
B	0.085
C	0.110
D	0.150
E	0.165

## ESR SCREENING

For parallel operation, the ESR spread can be minimized by screening. This reduces the risk of excess ripple current exposure to any one of the capacitors.

Some equipment will only measure impedance. An impedance limit can be calculated to insure that the ESR stays in the required range. Use the formula:

$$(10) Z_{max} = \sqrt{X_c^2 + ESR^2}$$

$$X_c = 1/C\omega$$

Impedance can be measured using an impedance meter and a fixture that is appropriate for the task. With the most sophisticated fixtures, several capacitors may be tested at the same time, reducing the test cycle time.

## CORRECTIVE FACTORS

The calculations for high frequency ripple current are shown in formula (9) for a sinusoidal waveform and an ambient temperature of + 25 °C. If the waveform is not sinusoidal, the ripple current limitations may differ.

Generally speaking, the ripple current limit calculated by formula (9) can be divided by the duty cycle of the signal. If the temperature is higher than + 25 °C, the ripple current limit should also be multiplied by the factors shown:

TEMPERATURE	MULTIPLYING FACTOR
+ 85 °C	0.9
+ 125 °C	0.4

## RIPPLE CURRENT/VOLTAGE CALCULATIONS EXAMPLE

As an example, we will determine the ripple voltage and power dissipation capability for a 1  $\mu$ F,  $\pm$  20 % tolerance, 35 volt, 293D capacitor.

At 120 Hz:

$$V_{rms} = R_v/2\sqrt{2} = 12.37 \text{ volts}$$

$$\begin{aligned} I_{rms} &= V_{rms}/Z \\ &= 12.37 \times 2 \times 3.14 \times 120 \times 0.8 \times 10^{-6} \\ &= 0.007 \text{ Amp.} \end{aligned}$$

If we used

$$I_{rms} = \sqrt{P_{max}/ESR}$$

$$\begin{aligned} \text{With ESR} &= DF/2pfC \\ &= (0.4/2 \times 3.14 \times 120 \times 0.8 \times 10^{-6}) \\ &= 66 \text{ ohms} \end{aligned}$$

$$\begin{aligned} I_{rms} &= P_{max}/ESR = \sqrt{0.080/66} \\ &= \sqrt{0.0035} \text{ Amp} \end{aligned}$$

At 120 Hz, the voltage is the limiting factor.

At 100 kHz:

$$I_{rms} = \sqrt{P_{max}/ESR}$$

At 100 kHz, the typical ESR for a 1  $\mu$ F/35 volts tantalum is:

$$ESR = \sqrt{1.5 \text{ ohms}} (Z = 3 \text{ ohms})$$

$$I_{rms} = 0.085/1.5 = 0.238 \text{ Amp.}$$

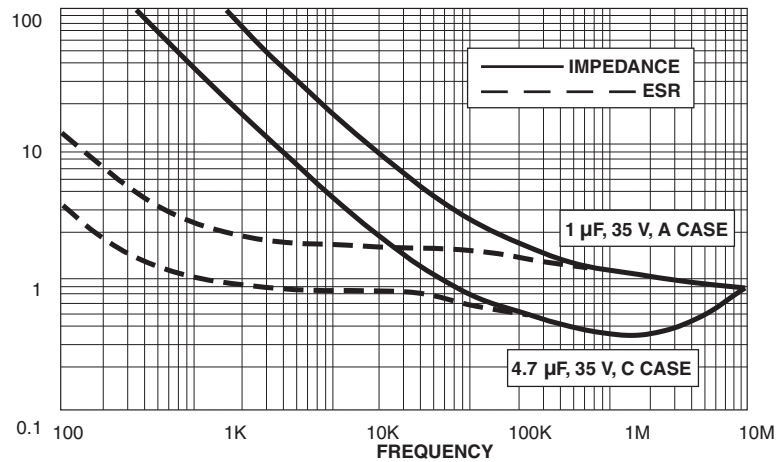
If we now look at the maximum ripple voltage, the above limitation translates into:

$$V_{rms} = Z \times I_{rms} = 3 \times 0.231 = 0.71 \text{ volts.}$$

At 100 kHz, the power dissipation is the limiting factor.



## TYPICAL CURVES OF IMPEDANCE AND ESR VS FREQUENCY



## CONCLUSIONS

The industry is moving towards smaller and smaller power supplies and DC/DC converters operating at higher frequencies. The three factors shown become more and more important in capacitor selection.

**1. Higher Switching Frequencies:** The switching frequency of power supplies has increased from the 10 kHz range a decade ago to the 100 kHz range and up today. The ESR of solid tantalum capacitors is either the same or lower at higher frequencies and impedance is at a minimum in the 100 kHz to megahertz range. Higher switching frequencies and the need for smaller sizes will increase the use of solid tantalum capacitors.

**2. Surface Mount Technology:** The application of surface mount technology not only reduces the size of power supplies and converters but also uses the substrate on which the components are mounted to dissipate some of the heat generated by the switching elements. Solid tantalum chip capacitors are well suited for this application. They have superior operating characteristics, do not leak electrolyte and are compatible with common automated surface assembly equipment.

**3. Tighter High Frequency Parameters:** The reduction of the maximum ESR of a solid tantalum capacitor may produce tradeoffs in size or DC characteristics. Rather than looking at lower ESR in terms of process average, it may be advisable to try to reduce ESR variation, producing a lower maximum ESR with a tighter distribution. This improvement may be achieved by using statistical process control, an approach already being implemented at Vishay Sprague Solid Tantalum manufacturing facilities.



# Molded Chip Capacitors

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# Guide for Molded Tantalum Capacitors

## 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	$\epsilon$ 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
<b>Tantalum Pentoxide</b>	<b>26</b>
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:

$$C = \frac{\epsilon A}{t}$$

where

C = Capacitance

$\epsilon$  = 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 TANTALUM CAPACITORS

Solid electrolyte capacitors contain manganese dioxide, which is formed on the tantalum pentoxide dielectric layer by impregnating the pellet with a solution of manganous nitrate. The pellet is then heated in an oven, and the manganous nitrate is converted to manganese dioxide.

The pellet is next coated with graphite, followed by a layer of metallic silver, which provides a conductive surface between the pellet and the Leadframe.

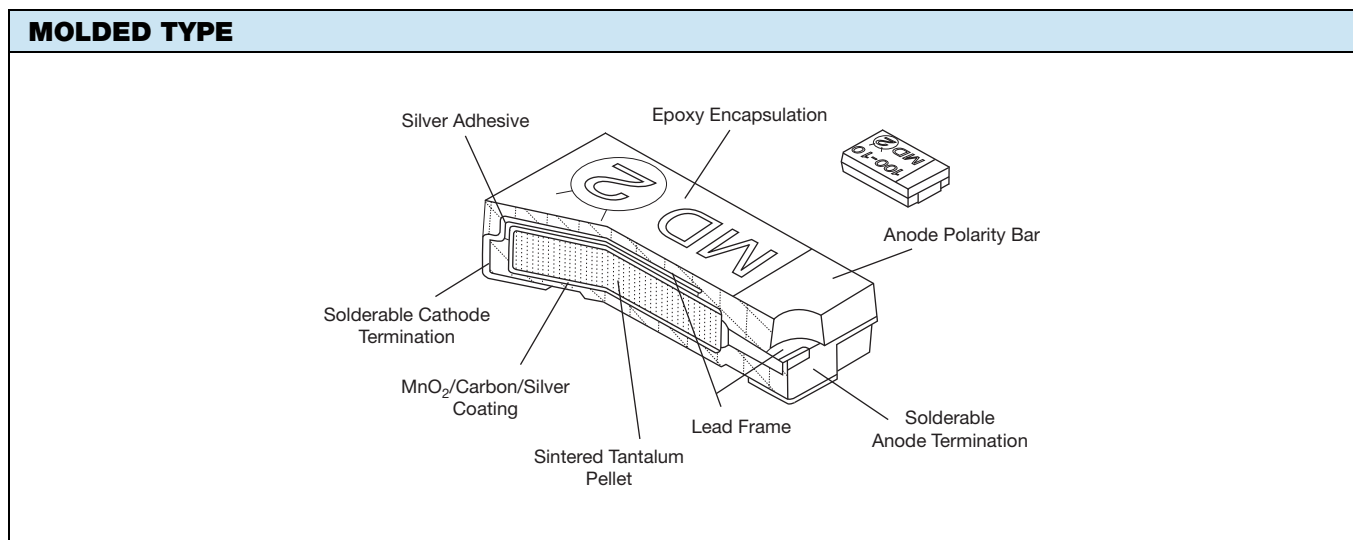
Molded Chip tantalum capacitor encases the element in plastic resins, such as epoxy materials. After assembly, the capacitors are tested and inspected to assure long life and reliability. It offers excellent reliability and high stability for consumer and commercial electronics with the added feature of low cost

Surface mount designs of "Solid Tantalum" capacitors use lead frames or lead frameless designs as shown in the accompanying drawings.



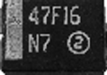
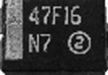




### TANTALUM CAPACITORS FOR ALL DESIGN CONSIDERATIONS

Solid electrolyte designs are the least expensive for a given rating and are used in many applications where their very small size for a given unit of capacitance is of importance. They will typically withstand up to about 10 % of the rated DC working voltage in a reverse direction. Also important are their good low temperature performance characteristics and freedom from corrosive electrolytes.

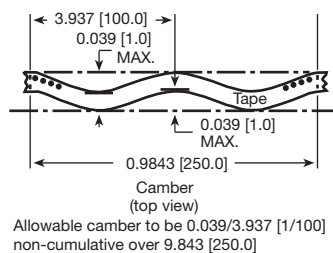
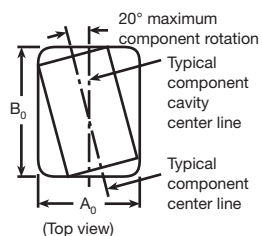
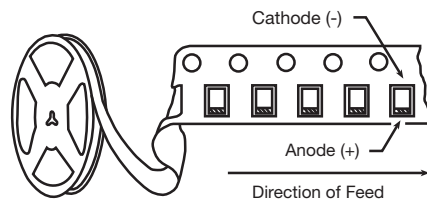
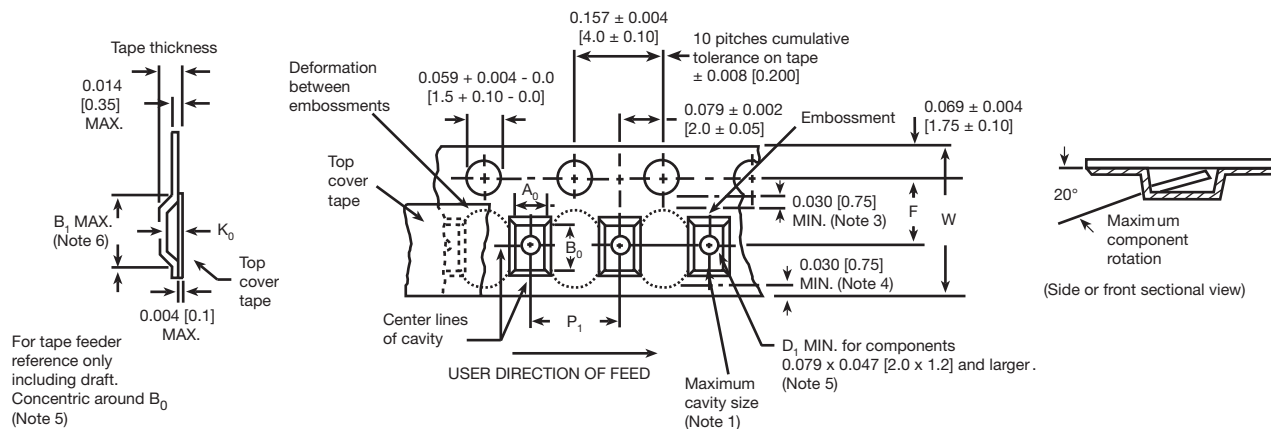
Vishay Sprague patented the original solid electrolyte capacitors and was the first to market them in 1956. Vishay Sprague has the broadest line of tantalum capacitors and has continued its position of leadership in this field. Data sheets covering the various types and styles of Vishay Sprague capacitors for consumer and entertainment electronics, industry, and military applications are available where detailed performance characteristics must be specified.





SOLID TANTALUM CAPACITORS - MOLDED								
SERIES	293D	593D	893D	TF3	TP3	TR3	TH3	793DE/793DX/ CTC3/CTC4
PRODUCT IMAGE								
TYPE	TANTAMOUNT® Chip, Molded	TANTAMOUNT® Chip, Molded	TANTAMOUNT® Chip, Molded	TANTAMOUNT® Chip, Molded	TANTAMOUNT® Chip, Molded	TANTAMOUNT® Chip, Molded	TANTAMOUNT® Chip, Molded High Temperature	TANTAMOUNT® Chip, Molded, Industrial
FEATURES	Commercial, lead (Pb)-free, RoHS compliant	Commercial, low ESR, lead (Pb)-free, RoHS compliant	Commercial, built-in fuse, lead (Pb)-free, RoHS compliant	Commercial, built-in fuse, lead (Pb)-free, RoHS compliant	Commercial, high performance, lead (Pb)-free RoHS compliant	Commercial, very low ESR, lead (Pb)-free, RoHS compliant	Commercial, lead (Pb)-free RoHS compliant	Commercial, lead (Pb)-free RoHS compliant
TEMP. RANGE (°C)	- 55 °C to + 125 °C	- 55 °C to + 125 °C	- 55 °C to + 125 °C	- 55 °C to + 125 °C	- 55 °C to + 125 °C	- 55 °C to + 125 °C	- 55 °C to + 150 °C	- 55 °C to 125 °C
CAP. RANGE (µF)	0.10 µF to 680 µF	0.47 µF to 680 µF	1.0 µF to 220 µF	0.47 µF to 470 µF	0.1 µF to 330 µF	0.47 µF to 680 µF	0.33 µF to 100 µF	0.1 µF to 100 µF
VOLTAGE RANGE (V)	4 to 50	4 to 50	6.3 to 50	4 to 50	4 to 50	4 to 50	10 to 50	4 to 50
CAP. TOLERANCE (%)	± 20, ± 10	± 20, ± 10	± 20, ± 10	± 20, ± 10	± 20, ± 10	± 20, ± 10	± 20, ± 10	± 20, ± 10
LEAKAGE CURRENT (µA)	0.01 CV or 0.5 µA max.	0.01 CV or 0.5 µA max.	0.01 CV or 0.5 µA max.	0.01 CV or 0.5 µA max.	0.01 CV or 0.5 µA max.	0.01 CV or 0.5 µA max.	0.01 CV or 0.5 µA max.	0.01 CV or 0.5 µA max.
DISSIPATION FACTOR	4 to 15 max.	4 to 15 max.	6 to 8 max.	1.1 to 8 max.	4 to 15 max.	4 to 15 max.	4 to 8 max.	0.1 µF to 100 µF
CASE CODES	A, B, C, D, E, V	A, B, C, D, E	C, D, E	C, D, E	A, B, C, D, E	A, B, C, D, E, V	A, B, C, D, E	A, B, C, D
FAILURE RATE LEVEL	at 85 °C rated voltage 1 %/1000 h or better	at 85 °C rated voltage 1 %/1000 h or better	at 85 °C rated voltage 1 %/1000 h or better	at 85 °C rated voltage 1 %/1000 h or better	at 85 °C rated voltage 1 %/1000 h or better	at 85 °C rated voltage 1 %/1000 h or better	at 85 °C rated voltage 1 %/1000 h or better	at 85 °C rated voltage 1 %/1000 h or better

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



**Tape and Reel Specifications:** All case sizes 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 and recommended as the most cost effective packaging method.

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 and packaging orientation must be specified in the Vishay Sprague part number.

**Note**

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

CASE CODE	TAPE SIZE	$B_1$ (MAX.)	$D_1$ (MIN.)	F	$K_0$ (MAX.)	$P_1$	W
<b>293D - 593D - 893D - TR3 - TH3 - TF3 - TP3 - 793DE/793DX/CTC3/CTC4</b>							
A	8 mm	0.165 [4.2]	0.039 [1.0]	0.138 ± 0.002 [3.5 ± 0.05]	0.094 [2.4]	0.157 ± 0.004 [4.0 ± 1.0]	0.315 ± 0.012 [8.0 ± 0.30]
B							
C							
D	12 mm	0.32 [8.2]	0.059 [1.5]	0.217 ± 0.00 [5.5 ± 0.05]	0.177 [4.5]	0.315 ± 0.004 [8.0 ± 1.0]	0.472 ± 0.012 [12.0 ± 0.30]
E							
V							

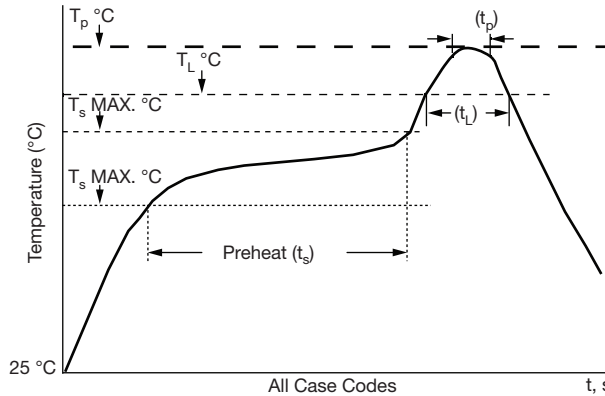


STANDARD PACKAGING QUANTITY			
SERIES	CASE CODE	QUANTITY (PCS/REEL)	
		7" REEL	13" REEL
293D 593D TR3 TH3 793DE/793DX/CTC3/CTC4 TP3	A	2000	9000
	B	2000	8000
	C	500	3000
	D	500	2500
	E	400	1500
893D TF3	C	500	3000
	D	500	2500
	E	400	1500
293D, TR3	V	500	2500

RECOMMENDED VOLTAGE DERATING GUIDELINES	
STANDARD CONDITIONS: FOR EXAMPLE: OUTPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.6
10	6.0
16	10
20	12
25	15
35	24
50	28
SEVERE CONDITIONS: FOR EXAMPLE: INPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24

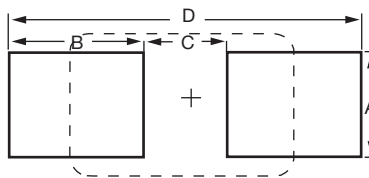
POWER DISSIPATION		
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR	
	293D	A
593D	B	0.085
893D	C	0.110
TR3	D	0.150
TH3	E	0.165
TP3		
TF3		
793DE/793DX/CTC3/CTC4	V	0.125

### 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>
293D 593D 893D TR3 TH3 TP3 TF3 793DE/ 793DX/ CTC3/ CTC4	260 °C	240 °C	10 s	217 °C	183 °C	150 °C	100 °C	200 °C	150 °C	60 s to 150 s	60 s to 90 s	60 s to 150 s

### PAD DIMENSIONS in inches [millimeters]



CASE CODE	A (MIN.)	B (NOM.)	C (NOM.)	D (NOM.)
<b>293D - 593D - 893D - TR3 - TH3 - TF3 - TP3 - 793DE/793DX/CTC3/CTC4</b>				
A	0.071 [1.80]	0.067 [1.70]	0.053 [1.35]	0.187 [4.75]
B	0.118 [3.00]	0.071 [1.80]	0.065 [1.65]	0.207 [5.25]
C	0.118 [3.00]	0.094 [2.40]	0.118 [3.00]	0.307 [7.80]
D	0.157 [4.00]	0.098 [2.50]	0.150 [3.80]	0.346 [8.80]
E	0.157 [4.00]	0.098 [2.50]	0.150 [3.80]	0.346 [8.80]
V	0.157 [4.00]	0.098 [2.50]	0.150 [3.80]	0.346 [8.80]



### 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 + 25 °C as given in the tables in the product datasheets (Power Dissipation).

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:

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

or, from the formula:

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

where,

P = Power dissipation in W at + 25 °C as given in the tables in the product datasheets (Power Dissipation).

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

Z = The capacitor impedance at the specified frequency

- The sum of the peak AC voltage plus the applied DC voltage shall not exceed the DC voltage rating of the capacitor.
- 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.
- Reverse Voltage:** Solid tantalum capacitors are not intended for use with reverse voltage applied. However, they have been shown to be capable of withstanding momentary reverse voltage peaks of up to 10 % of the DC rating at 25 °C and 5 % of the DC rating at + 85 °C.
- 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

- 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).

- 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).

- Attachment:**

- 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.

- 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.

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

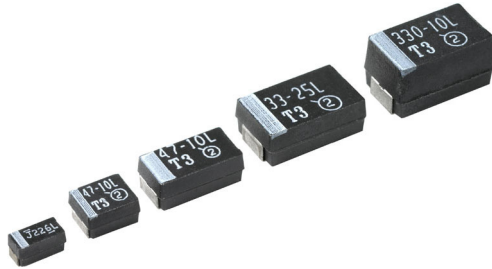
- Cleaning (Flux Removal) After Soldering:** Molded capacitors are compatible with all commonly used solvents such as TES, TMS, Prelete, Chlorethane, Terpene and aqueous cleaning media. However, CFC/ODS products are not used in the production of these devices and are not recommended. Solvents containing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

- 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.

- 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.

# Solid Tantalum Surface Mount Capacitors

## TANTAMOUNT<sup>®</sup>, Molded Case, Standard Industrial Grade


**FEATURES**

- Terminations: 100 % matte tin, standard, tin/lead available
- Compliant terminations
- Molded case available in six case codes
- Compatible with "High Volume" automatic pick and place equipment
- Optical character recognition qualified
- Meets IEC specification QC300801/US0001 and EIA535BAAC mechanical and performance requirements
- Compliant to RoHS Directive 2002/95/EC
- Moisture sensitivity level 1


**RoHS\***  
COMPLIANT

**Note**

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

**PERFORMANCE/ELECTRICAL CHARACTERISTICS**
[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)

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

**Capacitance Range:** 0.10 μF to 1000 μF

**Capacitance Tolerance:** ± 5 %, ± 10 %, ± 20 %

**100 % Surge Current Tested (D and E Case Codes)**

**Voltage Rating:** 4 V<sub>DC</sub> to 63 V<sub>DC</sub>

ORDERING INFORMATION					
293D	107	X9	010	D	2WE3
TYPE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	CASE CODE	TERMINATION AND PACKAGING
	This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow.	X0 = ± 20 % X9 = ± 10 % X5 = ± 5 % (special order)	This is expressed in V. To complete the three-digit block, zeros precede the voltage rating. A decimal point is indicated by an "R" (6R3 = 6.3 V).	See Ratings and Case Codes table	2TE3: Matte tin, 7" (178 mm) reel 2WE3: Matte tin, 13" (330 mm) reel 8T: Tin/lead, 7" (178 mm) reel 8W: Tin/lead, 13" (330 mm) reel

**Notes**

- We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size. Voltage substitutions will be marked with the higher voltage rating.
- We reserve the right to supply better series with more extensive screening.
- Dry pack is available per request, contact regional marketing.

DIMENSIONS in inches [millimeters]							
CASE CODE	EIA SIZE	L	W	H	P	T <sub>W</sub>	T <sub>H</sub> (MIN.)
A	3216-18	0.126 ± 0.008 [3.2 ± 0.20]	0.063 ± 0.008 [1.6 ± 0.20]	0.063 ± 0.008 [1.6 ± 0.20]	0.031 ± 0.012 [0.80 ± 0.30]	0.047 ± 0.004 [1.2 ± 0.10]	0.028 [0.70]
B	3528-21	0.138 ± 0.008 [3.5 ± 0.20]	0.110 ± 0.008 [2.8 ± 0.20]	0.075 ± 0.008 [1.9 ± 0.20]	0.031 ± 0.012 [0.80 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.028 [0.70]
C	6032-28	0.236 ± 0.012 [6.0 ± 0.30]	0.126 ± 0.012 [3.2 ± 0.30]	0.098 ± 0.012 [2.5 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.039 [1.0]
D	7343-31	0.287 ± 0.012 [7.3 ± 0.30]	0.169 ± 0.012 [4.3 ± 0.30]	0.110 ± 0.012 [2.8 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.094 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]
E	7343-43	0.287 ± 0.012 [7.3 ± 0.30]	0.169 ± 0.012 [4.3 ± 0.30]	0.157 ± 0.012 [4.0 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.094 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]
V	7343-20	0.287 ± 0.012 [7.3 ± 0.30]	0.169 ± 0.012 [4.3 ± 0.30]	0.079 max [2.0 max]	0.051 ± 0.012 [1.3 ± 0.30]	0.094 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]

RATINGS AND CASE CODES									
μF	4 V	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V	63 V
0.10						A	A	A	
0.15							A	A/B	
0.22							A	A/B	
0.33						A	A	A/B	
0.47			A		A	A	A/B	A/B/C	
0.68				A	A	A	A/B	B/C	
1.0			A	A	A/B	A/B	A/B	B/C	
1.5		A	A	A/B	A/B	A/B	B/C	B/C/D	
2.2	A	A	A/B	A/B	A/B	A/B/C	B/C	B/C/D	
3.3	A	A/B	A/B	A/B	A/B/C	A/B/C	B/C/D	C/D	
4.7	A/B	A/B	A/B/C	A/B/C	A/B/C	A/B/C/D	B/C/D	C/D/E	D
6.8	A/B	A/B	A/B/C	A/B/C	A/B/C	B/C/D	C/D	D/E	
10	A/B	A/B/C	A/B/C	A/B/C/D	B/C/D	B/C/D	C/D	D/E	E
15	A/B/C	A/B/C	A/B/C	B/C	B/C/D	B/C/D	D/E	E	
22	A/B/C	A/B/C	A/B/C/D	B/C/D	B/C/D	C/D/E/V	D/E		
33	A/B/C	A/B/C	B/C/D	B/C/D	C/D	D/E			
47	A/B/C	A/B/C/D	B/C/D	C/D/E	D/E	D/E			
68	B/C/D	B/C/D	B/C/D/E/V	D/E	D/E				
100	A/B/C/D	B/C/D/E	B/C/D/E/V	D/E	D/E				
120	D	D	E						
150	B/C/D	C/D/E	C/D/E	D/E					
220	B/C/D/E	C/D/E	D/E/V	E					
330	D/E	D/E	D/E						
470	D/E	D/E	E						
680	D/E	E							
1000	E	E							

### MARKING

**A Case**

"A" CASE VOLTAGE CODE	
VOLTS	CODE
4.0	G
6.3	J
10	A
16	C
20	D
25	E
35	V
50	T

**B, C, D, E, V Cases**

**Marking**  
 Capacitor marking includes an anode (+) polarity band, capacitance in microfarads and the voltage rating. "A" Case capacitors use a letter code for the voltage and EIA capacitance code.  
 The Vishay Sprague® trademark is included if space permits. Capacitors rated at 6.3 V are marked 6 V.  
 A manufacturing date code is marked on all capacitors.  
 Capacitors may bear a different marking scheme if a part with more extensive screening is substituted. These would include "R" for low ESR series (TR3) or "P" for professional series (TP3).  
 Call the factory for further explanation.





STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>4 V<sub>DC</sub> AT + 85 °C; 2.7 V<sub>DC</sub> AT + 125 °C</b>						
2.2	A	293D225(1)004A(2)	0.5	6	7.60	0.10
3.3	A	293D335(1)004A(2)	0.5	6	7.60	0.10
4.7	A	293D475(1)004A(2)	0.5	6	6.30	0.11
4.7	B	293D475(1)004B(2)	0.5	6	7.00	0.11
6.8	A	293D685(1)004A(2)	0.5	6	5.50	0.12
6.8	B	293D685(1)004B(2)	0.5	6	3.40	0.16
10	A	293D106(1)004A(2)	0.5	6	5.10	0.12
10	B	293D106(1)004B(2)	0.5	6	3.50	0.16
15	A	293D156(1)004A(2)	0.6	6	3.40	0.15
15	B	293D156(1)004B(2)	0.6	6	2.90	0.17
15	C	293D156(1)004C(2)	0.6	6	2.80	0.20
22	A	293D226(1)004A(2)	0.9	6	2.90	0.16
22	B	293D226(1)004B(2)	0.9	6	2.50	0.18
22	C	293D226(1)004C(2)	0.9	6	1.80	0.25
33	A	293D336(1)004A(2)	1.3	6	2.90	0.16
33	B	293D336(1)004B(2)	1.3	6	2.00	0.21
33	C	293D336(1)004C(2)	1.3	6	1.80	0.25
47	A	293D476(1)004A(2)	1.9	14	2.50	0.17
47	B	293D476(1)004B(2)	1.9	6	1.90	0.21
47	C	293D476(1)004C(2)	1.9	6	1.80	0.25
68	B	293D686(1)004B(2)	2.7	6	1.90	0.21
68	C	293D686(1)004C(2)	2.7	6	1.40	0.28
68	D	293D686(1)004D(2)	2.7	6	0.80	0.43
100	A	293D107X0004A(2)	10.0	30	2.50	0.22
100	B	293D107(1)004B(2)	4.0	8	1.80	0.22
100	C	293D107(1)004C(2)	4.0	6	0.80	0.37
100	D	293D107(1)004D(2)	4.0	6	0.70	0.46
120	D	293D127(1)004D(2)	4.8	6	0.60	0.51
150	B	293D157(1)004B(2)	6.0	14	1.60	0.23
150	C	293D157(1)004C(2)	6.0	12	0.70	0.40
150	D	293D157(1)004D(2)	6.0	8	0.60	0.50
220	B	293D227X0004B(2)	8.8	18	1.50	0.24
220	C	293D227(1)004C(2)	8.8	8	0.70	0.40
220	D	293D227(1)004D(2)	8.8	8	0.60	0.50
220	E	293D227(1)004E(2)	8.8	8	0.50	0.57
330	D	293D337(1)004D(2)	13.2	8	0.60	0.50
330	E	293D337(1)004E(2)	13.2	8	0.50	0.57
470	D	293D477(1)004D(2)	18.8	10	0.60	0.50
470	E	293D477(1)004E(2)	18.8	10	0.50	0.57
680	D	293D687X0004D(2)	27.2	25	0.20	0.87
680	E	293D687(1)004E(2)	27.2	12	0.50	0.57
1000	E	293D108X0004E(2)	40.0	20	0.50	0.57

**Note**

- Part number definitions:
  - Tolerance: X0, X9
  - Terminations and packaging: 2TE3, 2WE3, 8T, 8W
  - Lead (Pb)-free terminations and packaging codes: 2TE3, 2WE3



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT 125 °C</b>						
1.5	A	293D155(1)6R3A(2)	0.5	6	2.90	0.16
2.2	A	293D225(1)6R3A(2)	0.5	6	7.60	0.10
3.3	A	293D335(1)6R3A(2)	0.5	6	6.30	0.11
3.3	B	293D335(1)6R3B(2)	0.5	6	5.50	0.12
4.7	A	293D475(1)6R3A(2)	0.5	6	5.50	0.12
4.7	B	293D475(1)6R3B(2)	0.5	6	4.40	0.14
6.8	A	293D685(1)6R3A(2)	0.5	6	5.00	0.12
6.8	B	293D685(1)6R3B(2)	0.5	6	3.40	0.16
10	A	293D106(1)6R3A(2)	0.6	6	3.40	0.15
10	B	293D106(1)6R3B(2)	0.6	6	2.90	0.17
10	C	293D106(1)6R3C(2)	0.6	6	3.00	0.19
15	A	293D156(1)6R3A(2)	0.9	6	2.90	0.16
15	B	293D156(1)6R3B(2)	0.9	6	2.50	0.18
15	C	293D156(1)6R3C(2)	0.9	6	1.80	0.25
22	A	293D226(1)6R3A(2)	1.3	6	2.90	0.16
22	B	293D226(1)6R3B(2)	1.3	6	2.00	0.21
22	C	293D226(1)6R3C(2)	1.3	6	1.80	0.25
33	A	293D336(1)6R3A(2)	2.0	14	2.50	0.17
33	B	293D336(1)6R3B(2)	2.0	6	1.90	0.21
33	C	293D336(1)6R3C(2)	2.0	6	1.50	0.27
47	A	293D476(1)6R3A(2)	2.8	12	1.60	0.22
47	B	293D476(1)6R3B(2)	2.8	6	1.90	0.21
47	C	293D476(1)6R3C(2)	2.8	6	1.40	0.28
47	D	293D476(1)6R3D(2)	2.8	6	0.80	0.43
68	B	293D686(1)6R3B(2)	4.1	6	1.80	0.22
68	C	293D686(1)6R3C(2)	4.1	6	0.80	0.37
68	D	293D686(1)6R3D(2)	4.1	6	0.70	0.46
100	B	293D107(1)6R3B(2)	6.0	15	1.70	0.22
100	C	293D107(1)6R3C(2)	6.0	6	0.80	0.37
100	D	293D107(1)6R3D(2)	6.0	6	0.70	0.46
100	E	293D107(1)6R3E(2)	6.0	8	0.70	0.49
120	D	293D127(1)6R3D(2)	6.3	8	0.70	0.46
150	C	293D157(1)6R3C(2)	9.0	8	0.70	0.40
150	D	293D157(1)6R3D(2)	9.0	8	0.60	0.50
150	E	293D157(1)6R3E(2)	9.0	8	0.50	0.57
220	C	293D227(1)6R3C(2)	13.9	14	0.70	0.39
220	D	293D227(1)6R3D(2)	13.2	8	0.60	0.50
220	E	293D227(1)6R3E(2)	13.2	8	0.50	0.57
330	D	293D337(1)6R3D(2)	19.8	8	0.60	0.50
330	E	293D337(1)6R3E(2)	19.8	8	0.50	0.57
470	D	293D477(1)6R3D(2)	28.2	14	0.50	0.55
470	E	293E477(1)6R3E(2)	28.2	10	1.50	0.57
680	E	293D687(1)6R3E(2)	42.8	20	0.50	0.57
1000	E	293D108X06R3E(2)	63.0	30	0.40	0.64

**Note**

- Part number definitions:
  - Tolerance: X0, X9
  - Terminations and packaging: 2TE3, 2WE3, 8T, 8W
  - Lead (Pb)-free terminations and packaging codes: 2TE3, 2WE3



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT 125 °C</b>						
0.47	A	293D474(1)010A(2)	0.5	4	14.00	0.07
1.0	A	293D105(1)010A(2)	0.5	4	9.60	0.09
1.5	A	293D155(1)010A(2)	0.5	6	8.00	0.10
2.2	A	293D225(1)010A(2)	0.5	6	6.30	0.11
2.2	B	293D225(1)010B(2)	0.5	6	4.60	0.14
3.3	A	293D335(1)010A(2)	0.5	6	5.50	0.12
3.3	B	293D335(1)010B(2)	0.5	6	5.50	0.12
4.7	A	293D475(1)010A(2)	0.5	6	5.00	0.12
4.7	B	293D475(1)010B(2)	0.5	6	3.40	0.16
4.7	C	293D475(1)010C(2)	0.5	6	2.30	0.22
6.8	A	293D685(1)010A(2)	0.7	6	4.20	0.13
6.8	B	293D685(1)010B(2)	0.7	6	2.90	0.17
6.8	C	293D685(1)010C(2)	0.7	6	1.90	0.24
10	A	293D106(1)010A(2)	1.0	6	3.40	0.15
10	B	293D106(1)010B(2)	1.0	6	2.50	0.18
10	C	293D106(1)010C(2)	1.0	6	1.80	0.25
15	A	293D156(1)010A(2)	1.5	6	2.90	0.16
15	B	293D156(1)010B(2)	1.5	6	2.00	0.21
15	C	293D156(1)010C(2)	1.5	6	1.80	0.25
22	A	293D226(1)010A(2)	2.2	8	2.50	0.17
22	B	293D226(1)010B(2)	2.2	6	1.90	0.21
22	C	293D226(1)010C(2)	2.2	6	1.50	0.27
22	D	293D226(1)010D(2)	2.2	6	1.50	0.32
33	B	293D336(1)010B(2)	3.3	6	1.90	0.21
33	C	293D336(1)010C(2)	3.3	6	1.40	0.28
33	D	293D336(1)010D(2)	3.3	6	0.80	0.43
47	B	293D476(1)010B(2)	4.7	6	1.80	0.22
47	C	293D476(1)010C(2)	4.7	6	1.10	0.32
47	D	293D476(1)010D(2)	4.7	6	0.70	0.46
68	B	293D686(1)010B(2)	6.8	14	1.80	0.22
68	C	293D686(1)010C(2)	6.8	6	1.00	0.33
68	D	293D686(1)010D(2)	6.8	6	0.70	0.46
68	E	293D686(1)010E(2)	6.8	6	0.80	0.45
68	V	293D686(1)010V(3)	6.8	6	0.70	0.42
100	B	293D107X0010B(2)	10.0	25	2.50	0.18
100	C	293D107(1)010C(2)	10.0	8	0.90	0.35
100	D	293D107(1)010D(2)	10.0	8	0.60	0.50
100	E	293D107(1)010E(2)	10.0	8	0.70	0.49
100	V	293D107(1)010V(3)	10.0	8	0.70	0.42
120	E	293D127(1)010E(2)	12.0	6	1.00	0.41
150	C	293D157X0010C(2)	15.0	20	0.90	0.35
150	D	293D157(1)010D(2)	15.0	8	0.60	0.50
150	E	293D157(1)010E(2)	15.0	8	0.50	0.57
220	D	293D227(1)010D(2)	22.0	8	0.60	0.50

**Note**

- Part number definitions:
  - Tolerance: X0, X9
  - Terminations and packaging: 2TE3, 2WE3, 8T, 8W
  - Lead (Pb)-free terminations and packaging codes: 2TE3, 2WE3



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT 125 °C</b>						
220	E	293D227(1)010E(2)	22.0	8	0.50	0.57
220	V	293D227(1)010V(3)	30.0	12	0.50	0.50
330	D	293D337(1)010D(2)	33.0	15	0.50	0.57
330	E	293D337(1)010E(2)	33.0	10	0.50	0.57
470	E	293D477(1)010E(2)	47.0	15	0.50	0.57
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>						
0.68	A	293D684(1)016A(2)	0.5	4	10.40	0.08
1.0	A	293D105(1)016A(2)	0.5	4	9.30	0.09
1.5	A	293D155(1)016A(2)	0.5	6	6.70	0.11
1.5	B	293D155(1)016B(2)	0.5	6	6.40	0.12
2.2	A	293D225(1)016A(2)	0.5	6	5.90	0.11
2.2	B	293D225(1)016B(2)	0.5	6	4.60	0.14
3.3	A	293D335(1)016A(2)	0.5	6	5.00	0.12
3.3	B	293D335(1)016B(2)	0.5	6	3.50	0.16
4.7	A	293D475(1)016A(2)	0.8	6	5.00	0.12
4.7	B	293D475(1)016B(2)	0.8	6	2.90	0.17
4.7	C	293D475(1)016C(2)	0.8	6	2.90	0.19
6.8	A	293D685(1)016A(2)	1.1	6	4.20	0.13
6.8	B	293D685(1)016B(2)	1.1	6	2.50	0.18
6.8	C	293D685(1)016C(2)	1.1	6	1.90	0.24
10	A	293D106(1)016A(2)	1.6	6	3.00	0.16
10	B	293D106(1)016B(2)	1.6	6	2.00	0.21
10	C	293D106(1)016C(2)	1.6	6	1.80	0.25
10	D	293D106(1)016D(2)	2.5	6	1.20	0.35
15	B	293D156(1)016B(2)	2.4	6	2.00	0.21
15	C	293D156(1)016C(2)	2.4	6	1.50	0.27
22	B	293D226(1)016B(2)	3.5	6	1.90	0.21
22	C	293D226(1)016C(2)	3.5	6	1.40	0.28
22	D	293D226(1)016D(2)	3.5	6	0.80	0.43
33	B	293D336(1)016B(2)	5.3	6	1.80	0.22
33	C	293D336(1)016C(2)	5.3	6	1.10	0.32
33	D	293D336(1)016D(2)	5.3	6	0.70	0.46
47	C	293D476(1)016C(2)	7.5	6	1.00	0.33
47	D	293D476(1)016D(2)	7.5	6	0.70	0.46
47	E	293D476(1)016E(2)	7.5	6	0.80	0.45
68	D	293D686(1)016D(2)	10.9	6	0.60	0.50
68	E	293D686(1)016E(2)	10.9	6	0.80	0.45
100	D	293D107(1)016D(2)	16.0	8	0.60	0.50
100	E	293D107(1)016E(2)	16.0	8	0.60	0.52
150	D	293D157(1)016D(2)	24.0	8	0.60	0.50
150	E	293D157(1)016E(2)	24.0	8	0.50	0.57
220	E	293D227(1)016E(2)	35.2	14	0.50	0.57

Note

- Part number definitions:
  - Tolerance: X0, X9
  - Terminations and packaging: 2TE3, 2WE3, 8T, 8W
  - Lead (Pb)-free terminations and packaging codes: 2TE3, 2WE3



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>						
0.47	A	293D474(1)020A(2)	0.5	4	14.00	0.07
0.68	A	293D684(1)020A(2)	0.5	4	10.00	0.09
1.0	A	293D105(1)020A(2)	0.5	4	8.40	0.09
1.0	B	293D105(1)020B(2)	0.5	4	9.00	0.10
1.5	A	293D155(1)020A(2)	0.5	6	6.30	0.11
1.5	B	293D155(1)020B(2)	0.5	4.8	5.60	0.12
2.2	A	293D225(1)020A(2)	0.5	6	5.90	0.11
2.2	B	293D225(1)020B(2)	0.5	6	3.50	0.16
3.3	A	293D335(1)020A(2)	0.7	6	5.90	0.11
3.3	B	293D335(1)020B(2)	0.7	6	3.00	0.17
3.3	C	293D335(1)020C(2)	0.8	6	2.30	0.22
4.7	A	293D475(1)020A(2)	0.9	6	5.00	0.12
4.7	B	293D475(1)020B(2)	0.9	6	2.90	0.17
4.7	C	293D475(1)020C(2)	0.9	6	2.30	0.22
6.8	A	293D685(1)020A(2)	1.4	6	4.50	0.13
6.8	B	293D685(1)020B(2)	1.4	6	2.50	0.18
6.8	C	293D685(1)020C(2)	1.4	6	1.90	0.24
10	B	293D106(1)020B(2)	2.0	6	2.10	0.20
10	C	293D106(1)020C(2)	2.0	6	1.70	0.25
10	D	293D106(1)020D(2)	2.0	6	1.00	0.38
15	B	293D156(1)020B(2)	3.0	6	2.30	0.19
15	C	293D156(1)020C(2)	3.0	6	1.50	0.27
15	D	293D156(1)020D(2)	3.0	6	0.90	0.41
22	B	293D226(1)020B(2)	4.4	6	2.10	0.20
22	C	293D226(1)020C(2)	4.4	6	1.10	0.32
22	D	293D226(1)020D(2)	4.4	6	0.70	0.46
33	C	293D336(1)020C(2)	6.6	6	1.00	0.33
33	D	293D336(1)020D(2)	6.6	6	0.70	0.46
47	D	293D476(1)020D(2)	9.4	6	0.70	0.46
47	E	293D476(1)020E(2)	9.4	6	0.60	0.52
68	D	293D686(1)020D(2)	13.6	6	0.70	0.46
68	E	293D686(1)020E(2)	13.6	6	0.60	0.52
100	D	293D107(1)020D(2)	20.0	8	0.60	0.50
100	E	293D107(1)020E(2)	20.0	8	0.50	0.57
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>						
0.10	A	293D104(1)025A(2)	0.5	4	20.00	0.06
0.33	A	293D334(1)025A(2)	0.5	4	13.00	0.08
0.47	A	293D474(1)025A(2)	0.5	4	12.00	0.08
0.68	A	293D684(1)025A(2)	0.5	4	8.40	0.09
1.0	A	293D105(1)025A(2)	0.5	4	7.60	0.10
1.0	B	293D105(1)025B(2)	0.5	4	5.00	0.13
1.5	A	293D155(1)025A(2)	0.5	6	6.70	0.11
1.5	B	293D155(1)025B(2)	0.5	6	4.60	0.14
2.2	A	293D225(1)025A(2)	0.6	6	6.30	0.11

**Note**

- Part number definitions:
  - Tolerance: X0, X9
  - Terminations and packaging: 2TE3, 2WE3, 8T, 8W
  - Lead (Pb)-free terminations and packaging codes: 2TE3, 2WE3



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>						
2.2	B	293D225(1)025B(2)	0.6	6	3.80	0.15
2.2	C	293D225(1)025C(2)	0.6	6	3.20	0.19
3.3	A	293D335(1)025A(2)	0.8	6	6.00	0.14
3.3	B	293D335(1)025B(2)	0.8	6	3.10	0.17
3.3	C	293D335(1)025C(2)	0.8	6	2.30	0.22
4.7	A	293D475(1)025A(2)	1.2	6	5.50	0.12
4.7	B	293D475(1)025B(2)	1.2	6	2.80	0.17
4.7	C	293D475(1)025C(2)	1.2	6	2.00	0.24
4.7	D	293D475(1)025D(2)	1.2	6	1.30	0.34
6.8	B	293D685(1)025B(2)	1.7	6	2.40	0.19
6.8	C	293D685(1)025C(2)	1.7	6	1.70	0.25
6.8	D	293D685(1)025D(2)	1.7	6	1.10	0.37
10	B	293D106(1)025B(2)	2.5	6	2.30	0.19
10	C	293D106(1)025C(2)	2.5	6	1.50	0.27
10	D	293D106(1)025D(2)	2.5	6	1.00	0.39
15	B	293D156(1)025B(2)	3.8	6	2.20	0.20
15	C	293D156(1)025C(2)	3.8	6	1.20	0.30
15	D	293D156(1)025D(2)	3.8	6	0.80	0.43
22	C	293D226(1)025C(2)	5.5	6	1.20	0.30
22	D	293D226(1)025D(2)	5.5	6	0.70	0.46
22	E	293D226(1)025E(2)	5.5	6	0.80	0.45
22	V	293D226(1)025V(3)	5.5	6	0.70	0.42
33	D	293D336(1)025D(2)	8.3	6	0.70	0.46
33	E	293D336(1)025E(2)	8.3	6	0.60	0.52
47	D	293D476(1)025D(2)	11.8	8	0.70	0.46
47	E	293D476(1)025E(2)	11.8	6	0.60	0.52
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>						
0.10	A	293D104(1)035A(2)	0.5	4	20.00	0.06
0.15	A	293D154(1)035A(2)	0.5	4	18.00	0.07
0.22	A	293D224(1)035A(2)	0.5	4	15.00	0.07
0.33	A	293D334(1)035A(2)	0.5	4	13.00	0.08
0.47	A	293D474(1)035A(2)	0.5	4	10.00	0.09
0.47	B	293D474(1)035B(2)	0.5	4	8.00	0.10
0.68	A	293D684(1)035A(2)	0.5	4	7.60	0.10
0.68	B	293D684(1)035B(2)	0.5	4	6.50	0.11
1.0	A	293D105(1)035A(2)	0.5	4	7.50	0.10
1.0	B	293D105(1)035B(2)	0.5	4	5.00	0.13
1.5	B	293D155(1)035B(2)	0.5	6	4.20	0.14
1.5	C	293D155(1)035C(2)	0.5	6	3.80	0.17
2.2	B	293D225(1)035B(2)	0.8	6	3.80	0.15
2.2	C	293D225(1)035C(2)	0.8	6	2.90	0.20
3.3	B	293D335(1)035B(2)	1.2	6	3.50	0.16
3.3	C	293D335(1)035C(2)	1.2	6	2.10	0.23
3.3	D	293D335(1)035D(2)	1.2	6	1.70	0.30

**Note**

- Part number definitions:
  - Tolerance: X0, X9
  - Terminations and packaging: 2TE3, 2WE3, 8T, 8W
  - Lead (Pb)-free terminations and packaging codes: 2TE3, 2WE3



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>						
4.7	B	293D475(1)035B(2)	1.7	6	3.10	0.17
4.7	C	293D475(1)035C(2)	1.6	6	1.90	0.24
4.7	D	293D475(1)035D(2)	1.6	6	1.30	0.34
6.8	C	293D685(1)035C(2)	2.4	6	1.80	0.25
6.8	D	293D685(1)035D(2)	2.4	6	1.10	0.37
10	C	293D106(1)035C(2)	3.5	6	1.60	0.26
10	D	293D106(1)035D(2)	3.5	6	0.80	0.43
15	D	293D156(1)035D(2)	5.3	6	0.70	0.46
15	E	293D156(1)035E(2)	5.3	6	0.70	0.49
22	D	293D226(1)035D(2)	7.7	6	0.60	0.52
22	E	293D226(1)035E(2)	7.7	6	0.60	0.52
<b>50 V<sub>DC</sub> AT + 85 °C; 33 V<sub>DC</sub> AT + 125 °C</b>						
0.10	A	293D104(1)050A(2)	0.5	4	19.00	0.06
0.15	A	293D154(1)050A(2)	0.5	4	17.00	0.07
0.15	B	293D154(1)050B(2)	0.5	4	14.00	0.08
0.22	A	293D224(1)050A(2)	0.5	4	15.00	0.07
0.22	B	293D224(1)050B(2)	0.5	4	12.00	0.08
0.33	A	293D334(1)050A(2)	0.5	4	14.00	0.07
0.33	B	293D334(1)050B(2)	0.5	4	10.00	0.09
0.47	A	293D474(1)050A(2)	0.5	4	12.00	0.08
0.47	B	293D474(1)050B(2)	0.5	4	8.40	0.10
0.47	C	293D474(1)050C(2)	0.5	4	6.70	0.13
0.68	B	293D684(1)050B(2)	0.5	4	7.60	0.11
0.68	C	293D684(1)050C(2)	0.5	4	5.90	0.14
1.0	B	293D105(1)050B(2)	0.5	4	6.70	0.11
1.0	C	293D105(1)050C(2)	0.5	4	4.60	0.16
1.5	B	293D155(1)050B(2)	0.8	6	6.00	0.12
1.5	C	293D155(1)050C(2)	0.8	6	3.40	0.18
1.5	D	293D155(1)050D(2)	0.8	6	2.90	0.23
2.2	B	293D225(1)050B(2)	1.1	6	3.50	0.16
2.2	C	293D225(1)050C(2)	1.1	6	2.90	0.20
2.2	D	293D225(1)050D(2)	1.1	6	2.10	0.27
3.3	C	293D335(1)050C(2)	1.7	6	2.50	0.21
3.3	D	293D335(1)050D(2)	1.7	6	1.70	0.30
4.7	C	293D475(1)050C(2)	2.4	6	1.50	0.27
4.7	D	293D475(1)050D(2)	2.4	6	1.20	0.37
4.7	E	293D475(1)050E(2)	2.4	6	1.10	0.34
6.8	D	293D685(1)050D(2)	3.4	6	0.90	0.41
6.8	E	293D685(1)050E(2)	3.4	6	0.90	0.43
10	D	293D106(1)050D(2)	5.0	6	0.80	0.43
10	E	293D106(1)050E(2)	5.0	6	0.80	0.45
15	E	293D156(1)050E(2)	7.5	6	0.80	0.45
<b>63 V<sub>DC</sub> AT + 85 °C; 40 V<sub>DC</sub> AT + 125 °C</b>						
4.7	D	293D475(1)063D(2)	3.0	6	1.10	0.37
10	E	293D106(1)063E(2)	6.3	6	1.00	0.41

Note

- Part number definitions:
  - (1) Tolerance: X0, X9
  - (2) Terminations and packaging: 2TE3, 2WE3, 8T, 8W
  - (3) Lead (Pb)-free terminations and packaging codes: 2TE3, 2WE3





**RECOMMENDED VOLTAGE DERATING GUIDELINES** (for temperatures below + 85 °C)

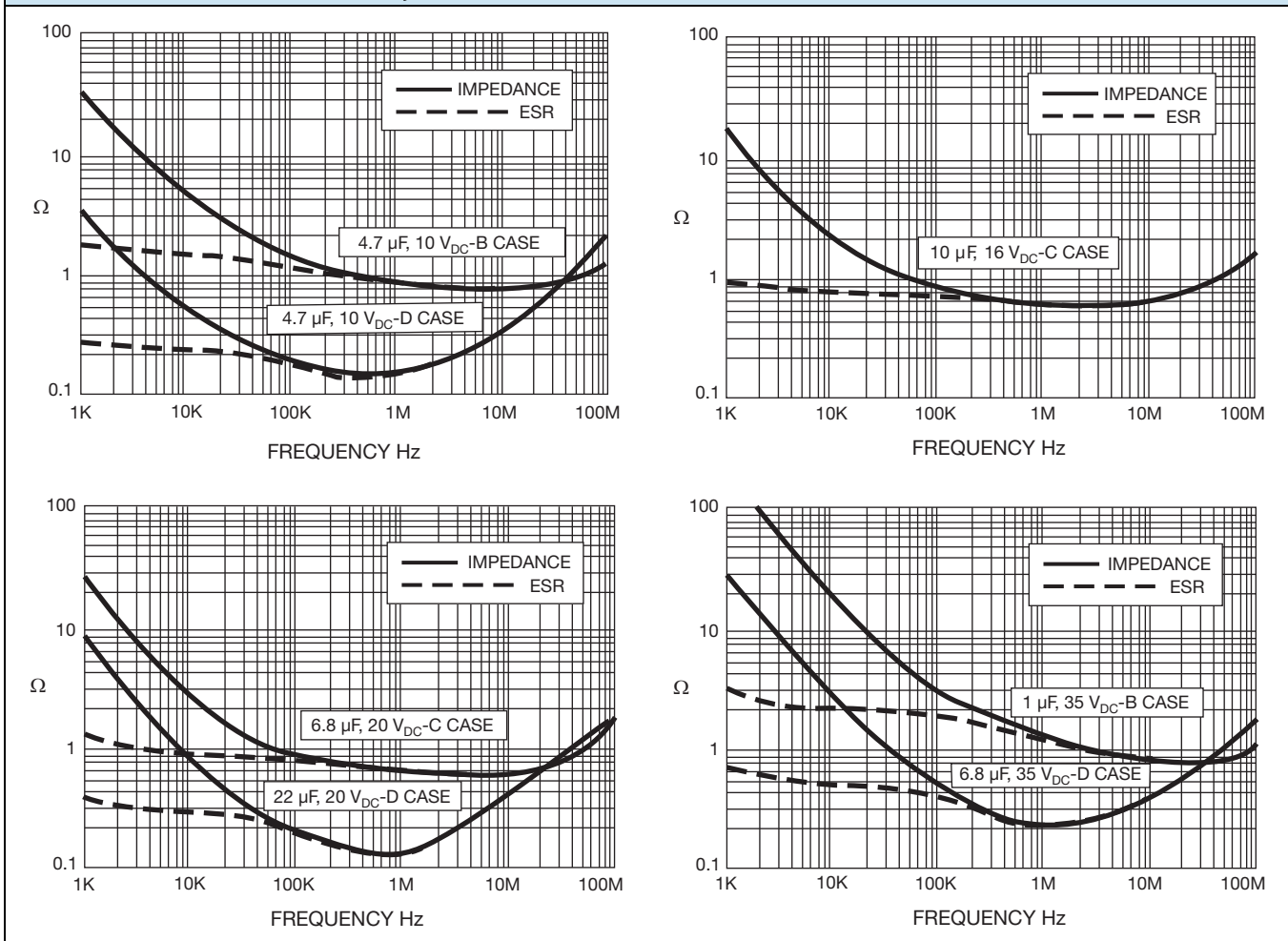
**STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS**

Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.6
10	6.0
16	10
20	12
25	15
35	24
50	28
63	36

**SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS**

Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24
63	31

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



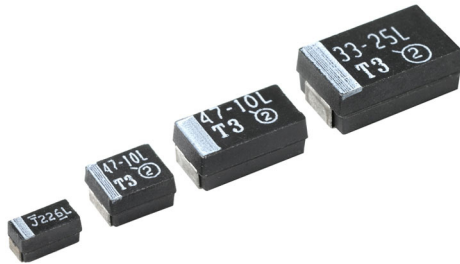


POWER DISSIPATION	
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
A	0.075
B	0.085
C	0.110
D	0.150
E	0.165
V	0.125

STANDARD PACKAGING QUANTITY		
CASE CODE	UNITS PER REEL	
	7" REEL	13" REEL
A	2000	9000
B	2000	8000
C	500	3000
D	500	2500
E	400	1500
V	1000	5000

PRODUCT INFORMATION	
Guide for Molded Tantalum Capacitors	<a href="http://www.vishay.com/doc?40074">www.vishay.com/doc?40074</a>
Pad Dimensions	
Packaging Dimensions	
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
SELECTOR GUIDES	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
FAQ	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

## Solid Tantalum Surface Mount Capacitors TANTAMOUNT<sup>®</sup> Molded Case, CECC Approved



### FEATURES

- Terminations: 100 % matte tin, standard, tin/lead available
- Compliant terminations
- Molded case available in four case codes
- Compatible with “High Volume” automatic pick and place equipment
- Optical character recognition qualified
- CECC  
30801/005 - 793DX  
30801/009 - CTC3  
30801/011 - CTC4  
30801/801 - 793DE



**RoHS\***  
COMPLIANT

### Note

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

### PERFORMANCE/ELECTRICAL CHARACTERISTICS

**Operating Temperature:** - 55 °C to + 125 °C

**Capacitance Range:** 0.10 µF to 100 µF

**Capacitance Tolerance:** ± 10 %, ± 20 %

**Voltage Rating:** 4 V<sub>DC</sub> to 50 V<sub>DC</sub>

ORDERING INFORMATION					
793DX TYPE	106 CAPACITANCE	X0 CAPACITANCE TOLERANCE	010 DC VOLTAGE RATING AT + 85 °C	B CASE CODE	2WE3 TERMINATION AND PACKAGING
793DE CTC3 CTC4	This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow.	X9 = ± 10 % X0 = ± 20 %	This is expressed in V. To complete the three-digit block, zeros precede the voltage rating. A decimal point is indicated by an “R” (6R3 = 6.3 V).	See Ratings and Case Codes table.	2TE3: Matte tin, 7" (178 mm) reel 2WE3: Matte tin, 13" (330 mm) reel 8T: Tin/lead, 7" (178 mm) reel 8W: Tin/lead, 13" (330 mm) reel

### Note

- We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size. Voltage substitutions will be marked with the higher voltage rating. Effective July 15, 2008, part numbers with solderable termination codes “2T” and “2W” may have either matte tin or tin/lead terminations. Codes 2TE3 and 2WE3 specify only matte tin terminations. Codes 8T and 8W specify only tin/lead terminations.

DIMENSIONS in inches [millimeters]							
CASE CODE	EIA SIZE	L	W	H	P	T <sub>w</sub>	T <sub>H</sub> (MIN.)
A	3216-18	0.126 ± 0.008 [3.2 ± 0.20]	0.063 ± 0.008 [1.6 ± 0.20]	0.063 ± 0.008 [1.6 ± 0.20]	0.031 ± 0.012 [0.80 ± 0.30]	0.047 ± 0.004 [1.2 ± 0.10]	0.028 [0.70]
B	3528-21	0.138 ± 0.008 [3.5 ± 0.20]	0.110 ± 0.008 [2.8 ± 0.20]	0.075 ± 0.008 [1.9 ± 0.20]	0.031 ± 0.012 [0.80 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.028 [0.70]
C	6032-28	0.236 ± 0.012 [6.0 ± 0.30]	0.126 ± 0.012 [3.2 ± 0.30]	0.098 ± 0.012 [2.5 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.039 [1.0]
D	7343-31	0.287 ± 0.012 [7.3 ± 0.30]	0.170 ± 0.012 [4.3 ± 0.30]	0.110 ± 0.012 [2.8 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.095 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]

RATINGS AND CASE CODES								
C <sub>R</sub> (μF)	RATED VOLTAGE U <sub>R</sub> (V) (+ 85 °C)							
	4 V	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V
	CATEGORY VOLTAGE U <sub>C</sub> (V) (+ 125 °C)							
	2.7 V	4 V	7 V	10 V	13 V	17 V	23 V	33 V
0.10							A	A
0.15							A	B
0.22							A	B
0.33							A	B
0.47						A	B	B
0.68					A	A <sup>(1)</sup>	B	C
1.0				A	A <sup>(1)</sup>		B	C
1.5			A	A <sup>(1)</sup>		B	C	D
2.2		A	A <sup>(1)</sup>		B	B <sup>(1)</sup>	C	D
3.3	A	A <sup>(1)</sup>		B	B <sup>(1)</sup>		C	D
4.7	A <sup>(1)</sup>		B	B <sup>(1)</sup>		C	D	D
6.8		B	B <sup>(1)</sup>		C		D	
10	B	B <sup>(1)</sup>		C		D	D	
15	B <sup>(1)</sup>		C		D	D		
22		C		D	D			
33	C		D	D				
47		D	D					
68	D	D						
100	D							

**Note**

(1) Available as 793DE part numbers only

MARKING																							
<p>Capacitance code, pF</p> <p>Indicates lead (Pb)-free</p> <p>V 104L</p> <p>Polarity band (+)</p> <p>Voltage Code</p> <p><b>A case</b></p>	<table border="1"> <thead> <tr> <th colspan="2">"A" CASE VOLTAGE CODE</th> </tr> <tr> <th>VOLTS</th> <th>CODE</th> </tr> </thead> <tbody> <tr><td>4.0</td><td>G</td></tr> <tr><td>6.3</td><td>J</td></tr> <tr><td>10</td><td>A</td></tr> <tr><td>16</td><td>C</td></tr> <tr><td>20</td><td>D</td></tr> <tr><td>25</td><td>E</td></tr> <tr><td>35</td><td>V</td></tr> <tr><td>50</td><td>T</td></tr> </tbody> </table>		"A" CASE VOLTAGE CODE		VOLTS	CODE	4.0	G	6.3	J	10	A	16	C	20	D	25	E	35	V	50	T	<p>Capacitance μF</p> <p>Voltage</p> <p>Indicates lead (Pb)-free</p> <p>22 10L</p> <p>Polarity band (+)</p> <p>Data code</p> <p>XX ②</p> <p>Vishay Sprague Logo</p> <p><b>B, C, D case</b></p>
	"A" CASE VOLTAGE CODE																						
VOLTS	CODE																						
4.0	G																						
6.3	J																						
10	A																						
16	C																						
20	D																						
25	E																						
35	V																						
50	T																						
<p><b>Marking:</b></p> <p>Capacitor marking includes an anode (+) polarity band, capacitance in microfarads and the voltage rating. "A" case size capacitors use a letter code for the voltage and EIA capacitance code.</p> <p>The Vishay Sprague® trademark is shown if space permits. Capacitors rated at 6.3 V shall be marked 6 V.</p> <p>A manufacturing date code is marked on all capacitors.</p> <p>Call the factory for further explanation.</p>																							



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 (Ω)	IMPEDANCE (Z) AT + 25 °C 100 kHz (Ω)	MAX. RIPPLE 100 kHz I <sub>RMS</sub> (A)
<b>4 V<sub>DC</sub> AT + 85 °C; 2.7 V<sub>DC</sub> AT + 125 °C</b>							
3.3	A	793DX335(1)004A(2)	0.5	6	7.6	9.0	0.10
3.3	A	793DE335(1)004A(2)	0.5	6	7.6	9.0	0.10
3.3	A	CTC3335(1)004A(2)	0.5	6	7.6	9.0	0.10
3.3	A	CTC4335(1)004A(2)	0.5	6	7.6	9.0	0.10
4.7	A	793DE475(1)004A(2)	0.5	6	6.3	8.0	0.11
10	B	793DX106(1)004B(2)	0.5	6	3.5	4.5	0.12
10	B	793DE106(1)004B(2)	0.5	6	3.5	4.5	0.12
10	B	CTC3106(1)004B(2)	0.5	6	3.5	4.5	0.12
10	B	CTC4106(1)004B(2)	0.5	6	3.5	4.5	0.12
15	B	793DE156(1)004B(2)	0.6	6	2.9	3.8	0.17
33	C	793DX336(1)004C(2)	1.3	6	1.8	2.4	0.25
33	C	793DE336(1)004C(2)	1.3	6	1.8	2.4	0.25
33	C	CTC3336(1)004C(2)	1.3	6	1.8	2.4	0.25
33	C	CTC4336(1)004C(2)	1.3	6	1.8	2.4	0.25
68	D	793DX686(1)004D(2)	2.7	6	0.8	1.3	0.43
68	D	793DE686(1)004D(2)	2.7	6	0.8	1.3	0.43
68	D	CTC3686(1)004D(2)	2.7	6	0.8	1.3	0.43
68	D	CTC4686(1)004D(2)	2.7	6	0.8	1.3	0.43
100	D	793DX107(1)004D(2)	4.0	6	0.7	1.0	0.46
100	D	793DE107(1)004D(2)	4.0	6	0.7	1.0	0.46
100	D	CTC3107(1)004D(2)	4.0	6	0.7	1.0	0.46
100	D	CTC4107(1)004D(2)	4.0	6	0.7	1.0	0.46
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT + 125 °C</b>							
2.2	A	793DX225(1)6R3A(2)	0.5	6	7.6	10.0	0.10
2.2	A	793DE225(1)6R3A(2)	0.5	6	7.6	10.0	0.10
2.2	A	CTC3225(1)6R3A(2)	0.5	6	7.6	10.0	0.10
2.2	A	CTC4225(1)6R3A(2)	0.5	6	7.6	10.0	0.10
3.3	A	793DE335(1)6R3A(2)	0.5	6	6.3	8.0	0.11
6.8	B	793DX685(1)6R3B(2)	0.5	6	3.4	4.5	0.16
6.8	B	793DE685(1)6R3B(2)	0.5	6	3.4	4.5	0.16
6.8	B	CTC3685(1)6R3B(2)	0.5	6	3.4	4.5	0.16
6.8	B	CTC4685(1)6R3B(2)	0.5	6	3.4	4.5	0.16
10	B	793DE106(1)6R3B(2)	0.6	6	2.9	3.8	0.17
22	C	793DX226(1)6R3C(2)	1.3	6	1.8	2.4	0.25
22	C	793DE226(1)6R3C(2)	1.3	6	1.8	2.4	0.25
22	C	CTC3226(1)6R3C(2)	1.3	6	1.8	2.4	0.25
22	C	CTC4226(1)6R3C(2)	1.3	6	1.8	2.4	0.25
47	D	793DX476(1)6R3D(2)	2.8	6	0.8	1.3	0.43
47	D	793DE476(1)6R3D(2)	2.8	6	0.8	1.3	0.43
47	D	CTC3476(1)6R3D(2)	2.8	6	0.8	1.3	0.43
47	D	CTC4476(1)6R3D(2)	2.8	6	0.8	1.3	0.43
68	D	793DX686(1)6R3D(2)	4.1	6	0.7	1.0	0.46
68	D	793DE686(1)6R3D(2)	4.1	6	0.7	1.0	0.46
68	D	CTC3686(1)6R3D(2)	4.1	6	0.7	1.0	0.46
68	D	CTC4686(1)6R3D(2)	4.1	6	0.7	1.0	0.46

Note

- Part number definitions:
  - (1) Tolerance: X0, X9
  - (2) Terminations and packaging: 2TE3, 2WE3, 8T, 8W



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 (Ω)	IMPEDANCE (Z) AT + 25 °C 100 kHz (Ω)	MAX. RIPPLE 100 kHz I <sub>RMS</sub> (A)
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT + 125 °C</b>							
1.5	A	793DX155(1)010A(2)	0.5	6	8.0	10.5	0.10
1.5	A	793DE155(1)010A(2)	0.5	6	8.0	10.5	0.10
1.5	A	CTC3155(1)010A(2)	0.5	6	8.0	10.5	0.10
1.5	A	CTC4155(1)010A(2)	0.5	6	8.0	10.5	0.10
2.2	A	793DE225(1)010A(2)	0.5	6	6.3	8.0	0.11
4.7	B	793DX475(1)010B(2)	0.5	6	3.4	4.5	0.16
4.7	B	793DE475(1)010B(2)	0.5	6	3.4	4.5	0.16
4.7	B	CTC3475(1)010B(2)	0.5	6	3.4	4.5	0.16
4.7	B	CTC4475(1)010B(2)	0.5	6	3.4	4.5	0.16
6.8	B	793DE685(1)010B(2)	0.7	6	2.9	3.8	0.17
15	C	793DX156(1)010C(2)	1.5	6	1.8	2.5	0.25
15	C	793DE156(1)010C(2)	1.5	6	1.8	2.5	0.25
15	C	CTC3156(1)010C(2)	1.5	6	1.8	2.5	0.25
15	C	CTC4156(1)010C(2)	1.5	6	1.8	2.5	0.25
33	D	793DX336(1)010D(2)	3.3	6	0.8	1.3	0.43
33	D	793DE336(1)010D(2)	3.3	6	0.8	1.3	0.43
33	D	CTC3336(1)010D(2)	3.3	6	0.8	1.3	0.43
33	D	CTC4336(1)010D(2)	3.3	6	0.8	1.3	0.43
47	D	793DX476(1)010D(2)	4.7	6	0.7	1.0	0.46
47	D	793DE476(1)010D(2)	4.7	6	0.7	1.0	0.46
47	D	CTC3476(1)010D(2)	4.7	6	0.7	1.0	0.46
47	D	CTC4476(1)010D(2)	4.7	6	0.7	1.0	0.46
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>							
1.0	A	793DX105(1)016A(2)	0.5	4	9.3	11.0	0.09
1.0	A	793DE105(1)016A(2)	0.5	4	9.3	11.0	0.09
1.0	A	CTC3105(1)016A(2)	0.5	4	9.3	11.0	0.09
1.0	A	CTC4105(1)016A(2)	0.5	4	9.3	11.0	0.09
1.5	A	793DE155(1)016A(2)	0.5	6	6.7	9.0	0.11
3.3	B	793DX335(1)016B(2)	0.5	6	3.5	5.0	0.16
3.3	B	793DE335(1)016B(2)	0.5	6	3.5	5.0	0.16
3.3	B	CTC3335(1)016B(2)	0.5	6	3.5	5.0	0.16
3.3	B	CTC4335(1)016B(2)	0.5	6	3.5	5.0	0.16
4.7	B	793DE475(1)016B(2)	0.8	6	2.9	4.0	0.17
10	C	793DX106(1)016C(2)	1.6	6	1.8	2.5	0.25
10	C	793DE106(1)016C(2)	1.6	6	1.8	2.5	0.25
10	C	CTC3106(1)016C(2)	1.6	6	1.8	2.5	0.25
10	C	CTC4106(1)016C(2)	1.6	6	1.8	2.5	0.25
22	D	793DX226(1)016D(2)	3.5	6	0.8	1.5	0.43
22	D	793DE226(1)016D(2)	3.5	6	0.8	1.5	0.43
22	D	CTC3226(1)016D(2)	3.5	6	0.8	1.5	0.43
22	D	CTC4226(1)016D(2)	3.5	6	0.8	1.5	0.43
33	D	793DX336(1)016D(2)	5.3	6	0.7	1.2	0.46
33	D	793DE336(1)016D(2)	5.3	6	0.7	1.2	0.46
33	D	CTC3336(1)016D(2)	5.3	6	0.7	1.2	0.46
33	D	CTC4336(1)016D(2)	5.3	6	0.7	1.2	0.46

Note

- Part number definitions:
  - (1) Tolerance: X0, X9
  - (2) Terminations and packaging: 2TE3, 2WE3, 8T, 8W



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 ( $\Omega$ )	IMPEDANCE (Z) AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>							
0.68	A	793DX684(1)020A(2)	0.5	4	10	13.0	0.09
0.68	A	793DE684(1)020A(2)	0.5	4	10	13.0	0.09
0.68	A	CTC3684(1)020A(2)	0.5	4	10	13.0	0.09
0.68	A	CTC4684(1)020A(2)	0.5	4	10	13.0	0.09
1.0	A	793DE105(1)020A(2)	0.5	4	8.4	11.0	0.09
2.2	B	793DX225(1)020B(2)	0.5	6	3.5	6.0	0.16
2.2	B	793DE225(1)020B(2)	0.5	6	3.5	6.0	0.16
2.2	B	CTC3225(1)020B(2)	0.5	6	3.5	6.0	0.16
2.2	B	CTC4225(1)020B(2)	0.5	6	3.5	6.0	0.16
3.3	B	793DE335(1)020B(2)	0.7	6	3.0	4.5	0.17
6.8	C	793DX685(1)020C(2)	1.4	6	1.9	2.5	0.24
6.8	C	793DE685(1)020C(2)	1.4	6	1.9	2.5	0.24
6.8	C	CTC3685(1)020C(2)	1.4	6	1.9	2.5	0.24
6.8	C	CTC4685(1)020C(2)	1.4	6	1.9	2.5	0.24
15	D	793DX156(1)020D(2)	3.0	6	0.9	1.5	0.41
15	D	793DE156(1)020D(2)	3.0	6	0.9	1.5	0.41
15	D	CTC3156(1)020D(2)	3.0	6	0.9	1.5	0.41
15	D	CTC4156(1)020D(2)	3.0	6	0.9	1.5	0.41
22	D	793DX226(1)020D(2)	4.4	6	0.7	1.2	0.46
22	D	793DE226(1)020D(2)	4.4	6	0.7	1.2	0.46
22	D	CTC3226(1)020D(2)	4.4	6	0.7	1.2	0.46
22	D	CTC4226(1)020D(2)	4.4	6	0.7	1.2	0.46
<b>25 V<sub>DC</sub> AT + 85 °C; 16 V<sub>DC</sub> AT + 125 °C</b>							
0.47	A	793DX474(1)025A(2)	0.5	4	12	14.0	0.08
0.47	A	793DE474(1)025A(2)	0.5	4	12	14.0	0.08
0.47	A	CTC3474(1)025A(2)	0.5	4	12	14.0	0.08
0.47	A	CTC4474(1)025A(2)	0.5	4	12	14.0	0.08
0.68	A	793DE474(1)025A(2)	0.5	4	8.4	11.0	0.09
1.5	B	793DX155(1)025A(2)	0.5	6	4.6	7.0	0.14
1.5	B	793DX155(1)025A(2)	0.5	6	4.6	7.0	0.14
1.5	B	CTC3155(1)025A(2)	0.5	6	4.6	7.0	0.14
1.5	B	CTC4155(1)025A(2)	0.5	6	4.6	7.0	0.14
2.2	B	793DE225(1)025B(2)	0.6	6	3.8	5.0	0.15
4.7	C	793DX475(1)025C(2)	1.2	6	2.0	2.8	0.24
4.7	C	793DE475(1)025C(2)	1.2	6	2.0	2.8	0.24
4.7	C	CTC3475(1)025C(2)	1.2	6	2.0	2.8	0.24
4.7	C	CTC4475(1)025C(2)	1.2	6	2.0	2.8	0.24
10	D	793DX106(1)025D(2)	2.5	6	1.0	1.5	0.39
10	D	793DE106(1)025D(2)	2.5	6	1.0	1.5	0.39
10	D	CTC3106(1)025D(2)	2.5	6	1.0	1.5	0.39
10	D	CTC4106(1)025D(2)	2.5	6	1.0	1.5	0.39
15	D	793DX156(1)025D(2)	3.8	6	0.8	1.2	0.43
15	D	793DE156(1)025D(2)	3.8	6	0.8	1.2	0.43
15	D	CTC3156(1)025D(2)	3.8	6	0.8	1.2	0.43
15	D	CTC4156(1)025D(2)	3.8	6	0.8	1.2	0.43

Note

- Part number definitions:
  - (1) Tolerance: X0, X9
  - (2) Terminations and packaging: 2TE3, 2WE3, 8T, 8W





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 ( $\Omega$ )	IMPEDANCE (Z) AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
35 V <sub>DC</sub> AT + 85 °C; 23 V <sub>DC</sub> AT + 125 °C							
0.10	A	793DX104(1)035A(2)	0.5	4	20	28.0	0.06
0.10	A	793DE104(1)035A(2)	0.5	4	20	28.0	0.06
0.10	A	CTC3104(1)035A(2)	0.5	4	20	28.0	0.06
0.10	A	CTC4104(1)035A(2)	0.5	4	20	28.0	0.06
0.15	A	793DX154(1)035A(2)	0.5	4	18	23.0	0.07
0.15	A	793DE154(1)035A(2)	0.5	4	18	23.0	0.07
0.15	A	CTC3154(1)035A(2)	0.5	4	18	23.0	0.07
0.15	A	CTC4154(1)035A(2)	0.5	4	18	23.0	0.07
0.22	A	793DX224(1)035A(2)	0.5	4	15	19.0	0.07
0.22	A	793DE224(1)035A(2)	0.5	4	15	19.0	0.07
0.22	A	CTC3224(1)035A(2)	0.5	4	15	19.0	0.07
0.22	A	CTC4224(1)035A(2)	0.5	4	15	19.0	0.07
0.33	A	793DX334(1)035A(2)	0.5	4	13	15.0	0.08
0.33	A	793DE334(1)035A(2)	0.5	4	13	15.0	0.08
0.33	A	CTC3334(1)035A(2)	0.5	4	13	15.0	0.08
0.33	A	CTC4334(1)035A(2)	0.5	4	13	15.0	0.08
0.47	B	793DX474(1)035B(2)	0.5	4	10	11.0	0.09
0.47	B	793DE474(1)035B(2)	0.5	4	10	11.0	0.09
0.47	B	CTC3474(1)035B(2)	0.5	4	10	11.0	0.09
0.47	B	CTC4474(1)035B(2)	0.5	4	10	11.0	0.09
0.68	B	793DX684(1)035B(2)	0.5	4	6.5	8.0	0.11
0.68	B	793DE684(1)035B(2)	0.5	4	6.5	8.0	0.11
0.68	B	CTC3684(1)035B(2)	0.5	4	6.5	8.0	0.11
0.68	B	CTC4684(1)035B(2)	0.5	4	6.5	8.0	0.11
1.0	B	793DX105(1)035B(2)	0.5	4	5.0	7.0	0.13
1.0	B	793DE105(1)035B(2)	0.5	4	5.0	7.0	0.13
1.0	B	CTC3105(1)035B(2)	0.5	4	5.0	7.0	0.13
1.0	B	CTC4105(1)035B(2)	0.5	4	5.0	7.0	0.13
1.5	C	793DX155(1)035C(2)	0.5	6	3.8	6.0	0.17
1.5	C	793DE155(1)035C(2)	0.5	6	3.8	6.0	0.17
1.5	C	CTC3155(1)035C(2)	0.5	6	3.8	6.0	0.17
1.5	C	CTC4155(1)035C(2)	0.5	6	3.8	6.0	0.17
2.2	C	793DX225(1)035C(2)	0.8	6	2.9	4.0	0.20
2.2	C	793DE225(1)035C(2)	0.8	6	2.9	4.0	0.20
2.2	C	CTC3225(1)035C(2)	0.8	6	2.9	4.0	0.20
2.2	C	CTC4225(1)035C(2)	0.8	6	2.9	4.0	0.20
3.3	C	793DX335(1)035C(2)	1.2	6	2.1	3.0	0.23
3.3	C	793DE335(1)035C(2)	1.2	6	2.1	3.0	0.23
3.3	C	CTC3335(1)035C(2)	1.2	6	2.1	3.0	0.23
3.3	C	CTC4335(1)035C(2)	1.2	6	2.1	3.0	0.23
4.7	D	793DX475(1)035D(2)	1.6	6	1.3	1.8	0.34
4.7	D	793DE475(1)035D(2)	1.6	6	1.3	1.8	0.34
4.7	D	CTC3475(1)035D(2)	1.6	6	1.3	1.8	0.34
4.7	D	CTC4475(1)035D(2)	1.6	6	1.3	1.8	0.34
6.8	D	793DX685(1)0035D(2)	2.4	6	1.1	1.5	0.37
6.8	D	793DE685(1)0035D(2)	2.4	6	1.1	1.5	0.37
6.8	D	CTC3685(1)0035D(2)	2.4	6	1.1	1.5	0.37
6.8	D	CTC4685(1)0035D(2)	2.4	6	1.1	1.5	0.37
10	D	793DX106(1)035D(2)	3.5	6	0.8	1.2	0.43
10	D	793DE106(1)035D(2)	3.5	6	0.8	1.2	0.43
10	D	CTC3106(1)035D(2)	3.5	6	0.8	1.2	0.43
10	D	CTC4106(1)035D(2)	3.5	6	0.8	1.2	0.43

Note

- Part number definitions:
  - Tolerance: X0, X9
  - Terminations and packaging: 2TE3, 2WE3, 8T, 8W



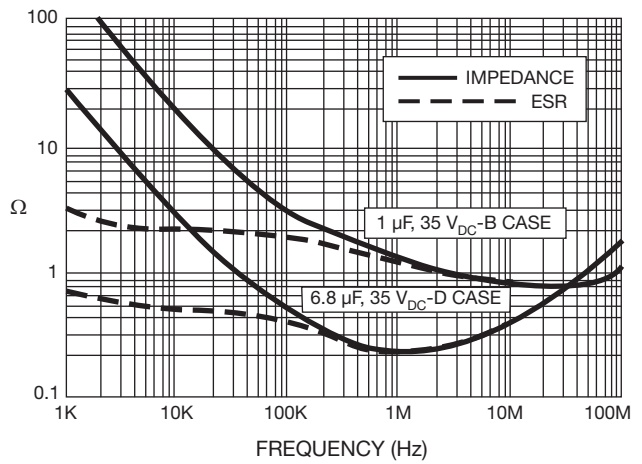
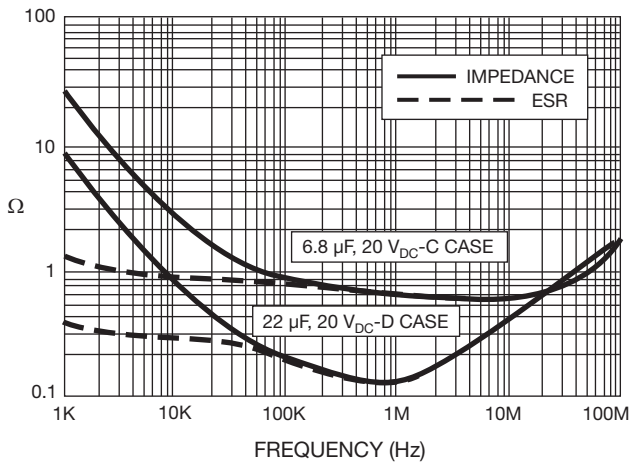
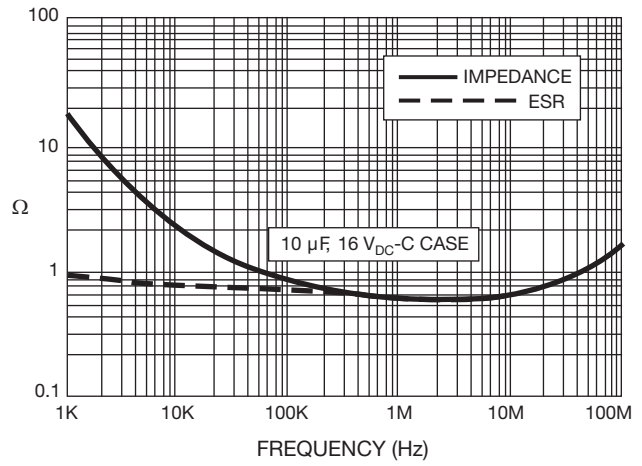
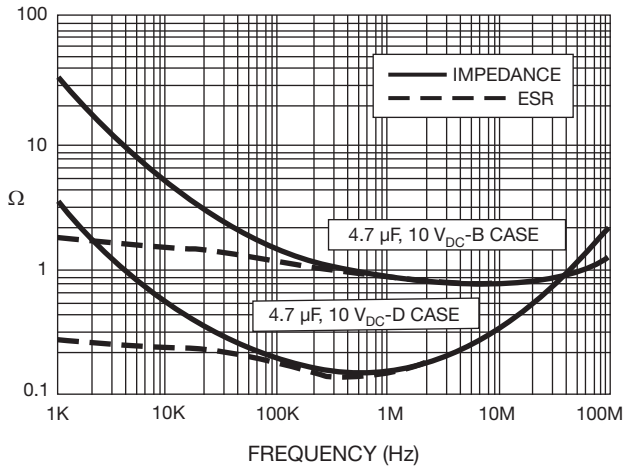
STANDARD RATINGS							
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	IMPEDANCE (Z) AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>50 V<sub>DC</sub> AT + 85 °C; 33 V<sub>DC</sub> AT + 125 °C</b>							
0.10	A	793DX104(1)050A(2)	0.5	4	19	27.0	0.06
0.10	A	793DE104(1)050A(2)	0.5	4	19	27.0	0.06
0.10	A	CTC3104(1)050A(2)	0.5	4	19	27.0	0.06
0.10	A	CTC4104(1)050A(2)	0.5	4	19	27.0	0.06
0.15	B	793DX154(1)050B(2)	0.5	4	14	22.0	0.08
0.15	B	793DE154(1)050B(2)	0.5	4	14	22.0	0.08
0.15	B	CTC3154(1)050B(2)	0.5	4	14	22.0	0.08
0.15	B	CTC4154(1)050B(2)	0.5	4	14	22.0	0.08
0.22	B	793DX224(1)0050B(2)	0.5	4	12	18.0	0.08
0.22	B	793DE224(1)0050B(2)	0.5	4	12	18.0	0.08
0.22	B	CTC3224(1)0050B(2)	0.5	4	12	18.0	0.08
0.22	B	CTC4224(1)0050B(2)	0.5	4	12	18.0	0.08
0.33	B	793DX334(1)050B(2)	0.5	4	10	14.0	0.09
0.33	B	793DE334(1)050B(2)	0.5	4	10	14.0	0.09
0.33	B	CTC3334(1)050B(2)	0.5	4	10	14.0	0.09
0.33	B	CTC4334(1)050B(2)	0.5	4	10	14.0	0.09
0.47	C	793DX474(1)050C(2)	0.5	4	6.7	9.0	0.13
0.47	C	793DE474(1)050C(2)	0.5	4	6.7	9.0	0.13
0.47	C	CTC3474(1)050C(2)	0.5	4	6.7	9.0	0.13
0.47	C	CTC4474(1)050C(2)	0.5	4	6.7	9.0	0.13
0.68	C	793DX684(1)050C(2)	0.5	4	5.9	7.0	0.14
0.68	C	793DE684(1)050C(2)	0.5	4	5.9	7.0	0.14
0.68	C	CTC3684(1)050C(2)	0.5	4	5.9	7.0	0.14
0.68	C	CTC4684(1)050C(2)	0.5	4	5.9	7.0	0.14
1.0	C	793DX105(1)050C(2)	0.5	4	4.6	6.0	0.16
1.0	C	793DE105(1)050C(2)	0.5	4	4.6	6.0	0.16
1.0	C	CTC3105(1)050C(2)	0.5	4	4.6	6.0	0.16
1.0	C	CTC4105(1)050C(2)	0.5	4	4.6	6.0	0.16
1.5	D	793DX155(1)050D(2)	0.8	6	2.9	5.0	0.25
1.5	D	793DE155(1)050D(2)	0.8	6	2.9	5.0	0.25
1.5	D	CTC3155(1)050D(2)	0.8	6	2.9	5.0	0.25
1.5	D	CTC4155(1)050D(2)	0.8	6	2.9	5.0	0.25
2.2	D	793DX225(1)050D(2)	1.1	6	2.1	3.5	0.27
2.2	D	793DE225(1)050D(2)	1.1	6	2.1	3.5	0.27
2.2	D	CTC3225(1)050D(2)	1.1	6	2.1	3.5	0.27
2.2	D	CTC4225(1)050D(2)	1.1	6	2.1	3.5	0.27
3.3	D	793DX335(1)0050D(2)	1.7	6	1.7	2.0	0.30
3.3	D	793DE335(1)0050D(2)	1.7	6	1.7	2.0	0.30
3.3	D	CTC3335(1)0050D(2)	1.7	6	1.7	2.0	0.30
3.3	D	CTC4335(1)0050D(2)	1.7	6	1.7	2.0	0.30
4.7	D	793DX475(1)050D(2)	2.4	6	1.2	1.5	0.37
4.7	D	793DE475(1)050D(2)	2.4	6	1.2	1.5	0.37
4.7	D	CTC3475(1)050D(2)	2.4	6	1.2	1.5	0.37
4.7	D	CTC4475(1)050D(2)	2.4	6	1.2	1.5	0.37

Note

- Part number definitions:
  - (1) Tolerance: X0, X9
  - (2) Terminations and packaging: 2TE3, 2WE3, 8T, 8W



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



## Solid Tantalum Surface Mount Capacitors TANTAMOUNT<sup>®</sup>, Molded Case, Low ESR



Effective September 2005, new capacitor ratings will not be added to the 593D series. All new ratings are available in the TR3 series. The TR3 series offers state-of-the-art low ESR for switch mode power supplies and DC/DC converters.

### PERFORMANCE/ELECTRICAL CHARACTERISTICS

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

**Note**

- Refer to Doc. 40088

### FEATURES

- Terminations: 100 % matte tin, standard, tin/lead available
- Compliant terminations
- Molded case available in five case codes
- Compatible with "High Volume" automatic pick and place equipment
- High ripple current carrying capability
- Low ESR
- Meets IEC specification QC300801/US0001 and EIA535BAAC mechanical and performance requirements
- Compliant to RoHS Directive 2002/95/EC
- Moisture sensitivity level 1



**RoHS\***  
COMPLIANT

**Note**

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

**Capacitance Range:** 0.47 µF to 680 µF

**Capacitance Tolerance:** ± 5 %, ± 10 %, ± 20 %

**100 % Surge Current Tested (B, C, D and E Case Sizes)**

**Voltage Rating:** 4 V<sub>DC</sub> to 50 V<sub>DC</sub>

ORDERING INFORMATION					
593D	107	X9	010	D	2WE3
TYPE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	CASE CODE	TERMINATION AND PACKAGING
	This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow	X0 = ± 20 % X9 = ± 10 % X5 = ± 5 %	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)	See Ratings and Case Codes table	2TE3: Matte tin, 7" (178 mm) reel 2WE3: Matte tin, 13" (330 mm) reel 8T: Tin/lead, 7" (178 mm) reel 8W: Tin/lead, 13" (330 mm) reel

**Notes**

- We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size. Voltage substitutions will be marked with the higher voltage rating. Effective July 15, 2008, part numbers with solderable termination codes 2T and 2W may have either matte or tin/lead terminations. Codes 2TE3 and 2WE3 specify only matte tin terminations. Codes 8T and 8W specify only tin/lead terminations.
- Dry pack is available per request, contact regional marketing.

DIMENSIONS in inches [millimeters]							
CASE CODE	EIA SIZE	L	W	H	P	T <sub>W</sub>	T <sub>H</sub> (MIN.)
A	3216-18	0.126 ± 0.008 [3.2 ± 0.20]	0.063 ± 0.008 [1.6 ± 0.20]	0.063 ± 0.008 [1.6 ± 0.20]	0.031 ± 0.012 [0.80 ± 0.30]	0.047 ± 0.004 [1.2 ± 0.10]	0.028 [0.70]
B	3528-21	0.138 ± 0.008 [3.5 ± 0.20]	0.110 ± 0.008 [2.8 ± 0.20]	0.075 ± 0.008 [1.9 ± 0.20]	0.031 ± 0.012 [0.80 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.028 [0.70]
C	6032-28	0.236 ± 0.012 [6.0 ± 0.30]	0.126 ± 0.012 [3.2 ± 0.30]	0.098 ± 0.012 [2.5 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.039 [1.0]
D	7343-31	0.287 ± 0.012 [7.3 ± 0.30]	0.170 ± 0.012 [4.3 ± 0.30]	0.110 ± 0.012 [2.8 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.095 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]
E	7343-43	0.287 ± 0.012 [7.3 ± 0.30]	0.170 ± 0.012 [4.3 ± 0.30]	0.158 ± 0.012 [4.0 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.095 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]

RATINGS AND CASE CODES								
μF	4 V	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V
0.47							A	
0.68							A	
1.0					A	A	A/B	B/C
1.5						A	B/C	B/C
2.2					A	A/B	B/C	C/D
3.3				A	A	B	C	C/D
4.7			A	A/B	A/B	B/C	C	E/D
6.8			A	A	B	C	C/D	D/E
10		A	A	A/B/C	B/C	C	C/D	D/E
15	A	A	A/B	B/C	B/C	C/D	D/E	
22	A	A/B	A/B/C	B/C	C/D	D	D/E	
33	A/B	A/B	B/C	B/C/D	C/D	D/E		
47	A/B	B/C	B/C/D	C/D	D/E	E		
68	B/C	B/C	C/D	D	D/E			
100	B/C	B/C/D	C/D	D/E	E			
150	B/C/D	C/D/E	D/E	E				
220	C/D	D/E	D/E					
330	D	D/E	E					
470	D/E	E						
680	E							

MARKING																							
<p><b>A Case</b></p>	<table border="1"> <thead> <tr> <th colspan="2">"A" CASE VOLTAGE CODE</th> </tr> <tr> <th>VOLTS</th> <th>CODE</th> </tr> </thead> <tbody> <tr><td>4.0</td><td>G</td></tr> <tr><td>6.3</td><td>J</td></tr> <tr><td>10</td><td>A</td></tr> <tr><td>16</td><td>C</td></tr> <tr><td>20</td><td>D</td></tr> <tr><td>25</td><td>E</td></tr> <tr><td>35</td><td>V</td></tr> <tr><td>50</td><td>T</td></tr> </tbody> </table>		"A" CASE VOLTAGE CODE		VOLTS	CODE	4.0	G	6.3	J	10	A	16	C	20	D	25	E	35	V	50	T	<p><b>B, C, D, E Cases</b></p>
	"A" CASE VOLTAGE CODE																						
VOLTS	CODE																						
4.0	G																						
6.3	J																						
10	A																						
16	C																						
20	D																						
25	E																						
35	V																						
50	T																						
<p><b>Marking</b></p> <p>Capacitor marking includes an anode (+) polarity band, capacitance in microfarads and the voltage rating. "A" Case capacitors use a letter code for the voltage and EIA capacitance code.</p> <p>The Vishay Sprague® trademark is included if space permits. Capacitors rated at 6.3 V are marked 6 V.</p> <p>A manufacturing date code is marked on all capacitors.</p> <p>Capacitors might bear a slightly different marking than the one shown above. For example, rating 22 μF 10 V could be marked either as 22-10L or 22R10.</p> <p>Call the factory for further explanation.</p>																							



STANDARD RATINGS							
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)	
<b>4 V<sub>DC</sub> AT + 85 °C; 2.7 V<sub>DC</sub> AT + 125 °C</b>							
15	A	593D156(1)004A(2)	0.6	6	1.500	0.22	
22	A	593D226(1)004A(2)	0.9	6	1.500	0.22	
33	A	593D336(1)004A(2)	1.3	6	1.500	0.22	
33	B	593D336(1)004B(2)	1.3	6	0.500	0.41	
47	A	593D476(1)004A(2)	1.9	14	0.800	0.31	
47	B	593D476(1)004B(2)	1.9	6	0.500	0.41	
68	B	593D686(1)004B(2)	2.7	6	0.500	0.41	
68	C	593D686(1)004C(2)	2.7	6	0.275	0.63	
100	B	593D107(1)004B(2)	4.0	8	0.450	0.43	
100	C	593D107(1)004C(2)	4.0	6	0.225	0.66	
150	B	593D157(1)004B(2)	6.0	14	0.500	0.41	
150	C	593D157(1)004C(2)	6.0	12	0.250	0.66	
150	D	593D157(1)004D(2)	6.0	8	0.150	1.00	
220	C	593D227(1)004C(2)	8.8	8	0.200	0.74	
220	D	593D227(1)004D(2)	8.8	8	0.150	1.00	
330	D	593D337(1)004D(2)	13.2	8	0.150	1.00	
470	D	593D477(1)004D(2)	18.8	10	0.125	1.10	
470	E	593D477(1)004E(2)	18.8	10	0.100	1.28	
680	E	593D687(1)004E(2)	27.2	12	0.100	1.28	
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT 125 °C</b>							
10	A	593D106(1)6R3A(2)	0.6	6	2.000	0.19	
15	A	593D156(1)6R3A(2)	0.9	6	2.000	0.19	
22	A	593D226(1)6R3A(2)	1.3	6	2.000	0.19	
22	B	593D226(1)6R3B(2)	1.3	6	0.600	0.38	
33	A	593D336(1)6R3A(2)	2.0	14	0.800	0.31	
33	B	593D336(1)6R3B(2)	2.0	6	0.600	0.38	
47	B	593D476(1)6R3B(2)	2.8	6	0.550	0.39	
47	C	593D476(1)6R3C(2)	2.8	6	0.300	0.61	
68	B	593D686(1)6R3B(2)	4.1	6	0.550	0.39	
68	C	593D686(1)6R3C(2)	4.1	6	0.275	0.63	
100	B	593D107(1)6R3B(2)	6.0	15	0.500	0.41	
100	C	593D107(1)6R3C(2)	6.0	6	0.250	0.66	
100	D	593D107(1)6R3D(2)	6.0	6	0.140	1.04	
150	C	593D157(1)6R3C(2)	9.0	8	0.200	0.74	
150	D	593D157(1)6R3D(2)	9.0	8	0.125	1.10	
150	E	593D157(1)6R3E(2)	9.0	8	0.100	1.28	
220	D	593D227(1)6R3D(2)	13.2	8	0.100	1.22	
220	E	593D227(1)6R3E(2)	13.2	8	0.100	1.28	
330	D	593D337(1)6R3D(2)	19.8	8	0.125	1.10	
330	E	593D337(1)6R3E(2)	19.8	8	0.100	1.28	
470	E	593D477(1)6R3E(2)	28.2	10	0.100	1.28	

**Note**

- Part number definitions:
  - Tolerance: X0, X9, X5
  - Terminations and packaging: 2TE3, 2WE3, 8T, 8W



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT 125 °C</b>						
4.7	A	593D475(1)010A(2)	0.5	6	3.000	0.16
6.8	A	593D685(1)010A(2)	0.7	6	3.000	0.16
10	A	593D106(1)010A(2)	1.0	6	2.000	0.19
15	A	593D156(1)010A(2)	1.5	6	2.000	0.19
15	B	593D156(1)010B(2)	1.5	6	0.700	0.35
22	A	593D226(1)010A(2)	2.2	8	1.500	0.22
22	B	593D226(1)010B(2)	2.2	6	0.700	0.35
22	C	593D226(1)010C(2)	2.2	6	0.345	0.56
33	B	593D336(1)010B(2)	3.3	6	0.600	0.38
33	C	593D336(1)010C(2)	3.3	6	0.300	0.61
47	B	593D476(1)010B(2)	4.7	6	0.600	0.38
47	C	593D476(1)010C(2)	4.7	6	0.300	0.61
47	D	593D476(1)010D(2)	4.7	6	0.200	0.87
68	C	593D686(1)010C(2)	6.8	6	0.275	0.63
68	D	593D686(1)010D(2)	6.8	6	0.150	1.00
100	C	593D107(1)010C(2)	10.0	8	0.200	0.74
100	D	593D107(1)010D(2)	10.0	6	0.100	1.22
150	D	593D157(1)010D(2)	15.0	8	0.100	1.22
150	E	593D157(1)010E(2)	15.0	8	0.100	1.28
220	D	593D227(1)010D(2)	22.0	8	0.125	1.10
220	E	593D227(1)010E(2)	22.0	8	0.100	1.28
330	E	593D337(1)010E(2)	33.0	10	0.100	1.28
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>						
3.3	A	593D335(1)016A(2)	0.5	6	3.500	0.15
4.7	A	593D475(1)016A(2)	0.8	6	2.500	0.17
4.7	B	593D475(1)016B(2)	0.8	6	1.500	0.24
6.8	A	593D685(1)016A(2)	1.1	6	3.000	0.16
10	A	593D106(1)016A(2)	1.6	6	1.700	0.21
10	B	593D106(1)016B(2)	1.6	6	0.800	0.33
10	C	593D106(1)016C(2)	1.6	6	0.450	0.49
15	B	593D156(1)016B(2)	2.4	6	0.800	0.33
15	C	593D156(1)016C(2)	2.4	6	0.400	0.52
22	B	593D226(1)016B(2)	3.5	6	0.700	0.35
22	C	593D226(1)016C(2)	3.5	6	0.350	0.56
33	B	593D336(1)016B(2)	5.3	6	0.700	0.35
33	C	593D336(1)016C(2)	5.3	6	0.300	0.61
33	D	593D336(1)016D(2)	4.2	4	0.225	0.82
47	C	593D476(1)016C(2)	7.5	6	0.300	0.61
47	D	593D476(1)016D(2)	7.5	6	0.150	1.00
68	D	593D686(1)016D(2)	10.9	6	0.150	1.00
100	D	593D107(1)016D(2)	16.0	8	0.125	1.10
100	E	593D107(1)016E(2)	16.0	8	0.100	1.28
150	E	593D157(1)016E(2)	24.0	8	0.100	1.28

**Note**

- Part number definitions:
  - Tolerance: X0, X9, X5
  - Terminations and packaging: 2TE3, 2WE3, 8T, 8W





STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>						
1.0	A	593D105(1)020A(2)	0.5	4	5.500	0.12
2.2	A	593D225(1)020A(2)	0.5	6	4.000	0.14
3.3	A	593D335(1)020A(2)	0.7	6	4.000	0.14
4.7	A	593D475(1)020A(2)	0.9	6	3.500	0.15
4.7	B	593D475(1)020B(2)	0.9	6	1.000	0.29
6.8	B	593D685(1)020B(2)	1.4	6	1.000	0.29
10	B	593D106(1)020B(2)	2.0	6	1.000	0.29
10	C	593D106(1)020C(2)	2.0	6	0.450	0.49
15	B	593D156(1)020B(2)	3.0	6	1.000	0.29
15	C	593D156(1)020C(2)	3.0	6	0.400	0.52
22	C	593D226(1)020C(2)	4.4	6	0.375	0.54
22	D	593D226(1)020D(2)	3.5	4	0.225	0.82
33	C	593D336(1)020C(2)	6.6	6	0.350	0.56
33	D	593D336(1)020D(2)	6.6	6	0.200	0.87
47	D	593D476(1)020D(2)	9.4	6	0.200	0.87
47	E	593D476(1)020E(2)	7.5	4	0.150	1.05
68	D	593D686(1)020D(2)	13.6	6	0.175	0.93
68	E	593D686(1)020E(2)	13.6	6	0.150	1.05
100	E	593D107(1)020E(2)	20.0	8	0.150	1.05
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>						
1.0	A	593D105(1)025A(2)	0.5	4	4.000	0.14
1.5	A	593D155(1)025A(2)	0.5	6	4.000	0.14
2.2	A	593D225(1)025A(2)	0.6	6	4.000	0.14
2.2	B	593D225(1)025B(2)	0.6	6	1.500	0.24
3.3	B	593D335(1)025B(2)	0.8	6	1.500	0.24
4.7	B	593D475(1)025B(2)	1.2	6	1.500	0.24
4.7	C	593D475(1)025C(2)	1.2	6	0.525	0.46
6.8	C	593D685(1)025C(2)	1.7	6	0.500	0.47
10	C	593D106(1)025C(2)	2.5	6	0.450	0.49
15	C	593D156(1)025C(2)	3.8	6	0.425	0.51
15	D	593D156(1)025D(2)	3.8	6	0.250	0.77
22	D	593D226(1)025D(2)	5.5	6	0.200	0.87
33	D	593D336(1)025D(2)	8.3	6	0.200	0.87
33	E	593D336(1)025E(2)	8.3	6	0.200	0.91
47	E	593D476(1)025E(2)	11.8	6	0.200	0.91
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>						
0.47	A	593D474(1)035A(2)	0.5	4	4.000	0.14
0.68	A	593D684(1)035A(2)	0.5	4	4.000	0.14
1.0	A	593D105(1)035A(2)	0.5	4	4.000	0.14
1.0	B	593D105(1)035B(2)	0.5	4	2.000	0.21
1.5	B	593D155(1)035B(2)	0.5	6	2.000	0.21
1.5	C	593D155(1)035C(2)	0.5	6	0.900	0.35

**Note**

- Part number definitions:
  - Tolerance: X0, X9, X5
  - Terminations and packaging: 2TE3, 2WE3, 8T, 8W



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>						
2.2	B	593D225(1)035B(2)	0.8	6	2.000	0.21
2.2	C	593D225(1)035C(2)	0.8	6	0.900	0.40
3.3	C	593D335(1)035C(2)	1.2	6	0.700	0.45
4.7	C	593D475(1)035C(2)	1.6	6	0.500	0.47
6.8	C	593D685(1)035C(2)	2.4	6	0.475	0.48
6.8	D	593D685(1)035D(2)	2.4	6	0.300	0.71
10	C	593D106(1)035C(2)	3.5	6	0.450	0.49
10	D	593D106(1)035D(2)	3.5	6	0.300	0.71
15	D	593D156(1)035D(2)	5.3	6	0.300	0.71
15	E	593D156(1)035E(2)	5.3	6	0.300	0.74
22	D	593D226(1)035D(2)	7.7	6	0.300	0.71
22	E	593D226(1)035E(2)	7.7	6	0.275	0.77
<b>50 V<sub>DC</sub> AT + 85 °C; 33 V<sub>DC</sub> AT + 125 °C</b>						
1.0	B	593D105(1)050B(2)	0.5	4	2.000	0.21
1.0	C	593D105(1)050C(2)	0.5	4	1.600	0.26
1.5	B	593D155(1)050B(2)	0.8	6	2.000	0.21
1.5	C	593D155(1)050C(2)	0.8	6	1.500	0.27
2.2	C	593D225(1)050C(2)	1.1	6	1.500	0.27
2.2	D	593D225(1)050D(2)	1.1	6	0.800	0.43
3.3	C	593D335(1)050C(2)	1.7	6	1.500	0.27
3.3	D	593D335(1)050D(2)	1.7	6	0.800	0.43
4.7	D	593D475(1)050D(2)	2.4	6	0.600	0.50
4.7	E	593D475(1)050E(2)	1.9	6	0.600	0.50
6.8	D	593D685(1)050D(2)	3.4	6	0.600	0.50
6.8	E	593D685(1)050E(2)	3.4	6	0.550	0.55
10	D	593D106(1)050D(2)	5.0	6	0.550	0.52
10	E	593D106(1)050E(2)	5.0	6	0.550	0.55

**Note**

- Part number definitions:
  - Tolerance: X0, X9, X5
  - Terminations and packaging: 2TE3, 2WE3, 8T, 8W

## Solid Tantalum Surface Mount Capacitors TANTAMOUNT<sup>®</sup>, Molded Case, Low ESR



### FEATURES

- Terminations: 100 % matte tin, standard tin/lead available
- Molded case available in seven case codes
- Compatible with "High Volume" automatic pick and place equipment
- Mounting: Surface mount
- High ripple current carrying capability
- Low ESR
- Meets EIA 535BAAC and IEC specification QC300801/US0001
- Compliant to RoHS Directive 2002/95/EC
- 100 % surge current tested (C, D, and E case sizes)
- Moisture sensitivity level 1



### Note

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

### PERFORMANCE CHARACTERISTICS

[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)

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

**Capacitance Range:** 0.47 μF to 1000 μF  
**Capacitance Tolerance:** ± 10 %, ± 20 %  
**Voltage Rating:** 4 V<sub>DC</sub> to 63 V<sub>DC</sub>

ORDERING INFORMATION						
TR3	D	107	K	010	C	0100
TYPE	CASE CODE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	TERMINATION AND PACKAGING	ESR
	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 V. To complete the three-digit block, zeros precede the voltage rating. A decimal point is indicated by an "R" (6R3 = 6.3 V).	C = Matte tin/7" (178 mm) reels D = Matte tin/13" (330 mm) reels E = Tin/lead/7" (178 mm) reels F = Tin/lead/13" (330 mm) reels	Maximum 100 kHz ESR in mΩ. See note below.

### Notes

- We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size. Voltage substitutions will be marked with the higher voltage rating. The EIA and CECC standards for low ESR solid tantalum chip capacitors, allow delta ESR of 1.25 times the datasheet limit after mounting.
- Dry pack is available per request, contact regional marketing.

DIMENSIONS in inches [millimeters]							
CASE CODE	EIA SIZE	L	W	H	P	T <sub>w</sub>	T <sub>H</sub> (MIN.)
A	3216-18	0.126 ± 0.008 [3.2 ± 0.20]	0.063 ± 0.008 [1.6 ± 0.20]	0.063 ± 0.008 [1.6 ± 0.20]	0.031 ± 0.012 [0.80 ± 0.30]	0.047 ± 0.004 [1.2 ± 0.10]	0.028 [0.70]
B	3528-21	0.138 ± 0.008 [3.5 ± 0.20]	0.110 ± 0.008 [2.8 ± 0.20]	0.075 ± 0.008 [1.9 ± 0.20]	0.031 ± 0.012 [0.80 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.028 [0.70]
C	6032-28	0.236 ± 0.012 [6.0 ± 0.30]	0.126 ± 0.012 [3.2 ± 0.30]	0.098 ± 0.012 [2.5 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.039 [1.0]
D	7343-31	0.287 ± 0.012 [7.3 ± 0.30]	0.170 ± 0.012 [4.3 ± 0.30]	0.110 ± 0.012 [2.8 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.094 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]
E	7343-43	0.287 ± 0.012 [7.3 ± 0.30]	0.169 ± 0.012 [4.3 ± 0.30]	0.157 ± 0.012 [4.0 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.094 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]
V	7343-20	0.287 ± 0.012 [7.3 ± 0.30]	0.169 ± 0.012 [4.3 ± 0.30]	0.079 max. [2.0 max.]	0.051 ± 0.012 [1.3 ± 0.30]	0.094 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]
W (1)	7361-38	0.287 ± 0.012 [7.3 ± 0.30]	0.236 ± 0.012 [6.0 ± 0.30]	0.138 ± 0.012 [3.5 ± 0.30]	0.047 ± 0.008 [1.2 ± 0.20]	0.122 ± 0.004 [3.1 ± 0.10]	0.069 [1.75]

### Note

(1) Preliminary values. Contact factory for availability.

RATINGS AND CASE CODES									
μF	4 V	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V	63 V
0.47							A		
0.68							A		
1.0					A	A	A/B	B/C	
1.5						A	B/C	B/C	
2.2			A	A	A	A/B	B/C	B/C/D	
3.3				A	A/B	A/B	B/C	C/D	
4.7			A	A/B	A/B	A/B/C	B/C/D	C/D/E	D
6.8			A	A/B	A/B	B/C	C/D/E	D/E	
10		A	A/B	A/B/C	B/C	B/C/D	C/D/E	D/E	E
15	A	A	A/B	B/C	B/C	B/C/D	D/E	E	
22	A	A/B	A/B/C	B/C/D	B/C/D	C/D/E/V	D/E		
33	A/B	A/B	B/C	B/C/D	C/D	D/E			
47	A/B	A/B/C	B/C/D	C/D	D/E	D/E			
68	B/C	B/C/D	B/C/D/E/V	D	D/E	W <sup>(1)</sup>			
100	A/B/C	B/C/D/V	B/C/D/E/V	D/E	D/E/W <sup>(1)</sup>	W <sup>(1)</sup>			
150	B/C/D	C/D/E	C/D/E	D/E	W <sup>(1)</sup>				
220	B/C/D	C/D/E	D/E/V	E					
330	D	D/E	D/E/W <sup>(1)</sup>						
470	D/E	D/E	E/W <sup>(1)</sup>						
680	D/E	E							
1000	E	E							

**Note**
<sup>(1)</sup> Preliminary values. Contact factory for availability.

MARKING				
<p><b>A Case</b></p>	<b>"A" CASE VOLTAGE CODE</b>		<p><b>B, C, D, E, V Cases</b></p>	
	<b>VOLTS</b>	<b>CODE</b>		
	4.0	G		
	6.3	J		
	10	A		
	16	C		
	20	D		
25	E			
35	V			
50	T			

**Marking**

Capacitor marking includes an anode (+) polarity band, capacitance in microfarads and the voltage rating. "A" Case capacitors use a letter code for the voltage and EIA capacitance code.

The Vishay Sprague® trademark is included if space permits. Capacitors rated at 6.3 V are marked 6 V.

A manufacturing date code is marked on all capacitors.

Call the factory for further explanation.



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>4 V<sub>DC</sub> AT + 85 °C; 2.7 V<sub>DC</sub> AT + 125 °C</b>						
15	A	TR3A156(1)004(2)1500	0.6	6	1.500	0.22
22	A	TR3A226(1)004(2)1500	0.9	6	1.500	0.22
33	A	TR3A336(1)004(2)1500	1.3	6	1.500	0.22
33	B	TR3B336(1)004(2)0500	1.3	6	0.500	0.41
47	A	TR3A476(1)004(2)0800	1.9	14	0.800	0.31
47	A	TR3A476(1)004(2)0500	1.9	14	0.500	0.39
47	B	TR3B476(1)004(2)0500	1.9	6	0.500	0.41
68	B	TR3B686(1)004(2)0500	2.7	6	0.500	0.41
68	C	TR3C686(1)004(2)0275	2.7	6	0.275	0.63
100	A	TR3A107M004(2)1000	10.0	30	1.000	0.27
100	B	TR3B107(1)004(2)0450	4.0	8	0.450	0.43
100	C	TR3C107(1)004(2)0225	4.0	6	0.225	0.70
150	B	TR3B157(1)004(2)0900	6.0	14	0.900	0.31
150	B	TR3B157(1)004(2)0500	6.0	14	0.500	0.41
150	B	TR3B157(1)004(2)0400	6.0	14	0.400	0.46
150	C	TR3C157(1)004(2)0250	6.0	12	0.250	0.66
150	D	TR3D157(1)004(2)0150	6.0	8	0.150	1.00
220	B	TR3B227M004(2)1100	8.8	18	1.100	0.28
220	B	TR3B227M004(2)0700	8.8	18	0.700	0.35
220	B	TR3B227M004(2)0500	8.8	18	0.500	0.41
220	B	TR3B227M004(2)0450	8.8	18	0.450	0.43
220	C	TR3C227(1)004(2)0200	8.8	8	0.200	0.74
220	D	TR3D227(1)004(3)0050	8.8	8	0.050	1.73
220	D	TR3D227(1)004(2)0150	8.8	8	0.150	1.00
220	D	TR3D227(1)004(2)0100	8.8	8	0.100	1.22
330	D	TR3D337(1)004(2)0100	13.2	8	0.100	1.22
330	D	TR3D337(1)004(3)0045	13.2	8	0.045	1.83
330	D	TR3D337(1)004(3)0035	13.2	8	0.035	2.07
330	D	TR3D337(1)004(2)0150	13.2	8	0.150	1.00
470	D	TR3D477(1)004(2)0125	18.8	10	0.125	1.10
470	D	TR3D477(1)004(2)0100	18.8	10	0.100	1.22
470	D	TR3D477(1)004(2)0060	18.8	10	0.060	1.58
470	D	TR3D477(1)004(3)0045	18.8	10	0.045	1.83
470	D	TR3D477(1)004(3)0035	18.8	10	0.035	2.07
470	E	TR3E477(1)004(2)0100	18.8	10	0.100	1.28
470	E	TR3E477(1)004(3)0045	18.8	10	0.045	1.91
470	E	TR3E477(1)004(3)0035	18.8	10	0.035	2.17
680	D	TR3D687M004(2)0100	27.2	25	0.100	1.22
680	D	TR3D687M004(3)0060	27.2	25	0.060	1.58
680	E	TR3E687(1)004(2)0100	27.2	12	0.100	1.28
1000	E	TR3E108M004(2)0100	40.0	20	0.100	1.28
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT 125 °C</b>						
10	A	TR3A106(1)6R3(2)2000	0.6	6	2.000	0.19
10	A	TR3A106(1)6R3(2)1500	0.6	6	1.500	0.22
15	A	TR3A156(1)6R3(2)2000	0.9	6	2.000	0.19
15	A	TR3A156(1)6R3(2)1000	0.9	6	1.000	0.27
22	A	TR3A226(1)6R3(2)3000	1.4	6	3.000	0.16
22	A	TR3A226(1)6R3(2)2000	1.4	6	2.000	0.19

**Notes**

- Part number definitions:
  - (1) Capacitance tolerance codes: K, M
  - (2) Terminations and packaging codes: C, D, E, F
  - (3) Lead (Pb)-free terminations and packaging codes: C, D
- (1) Preliminary values. Contact factory for availability



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT 125 °C</b>						
22	A	TR3A226(1)6R3(2)1000	1.4	6	1.000	0.27
22	A	TR3A226(1)6R3(2)0900	1.4	6	0.900	0.29
22	B	TR3B226(1)6R3(2)0600	1.4	6	0.600	0.38
33	A	TR3A336(1)6R3(2)2000	2.0	14	2.000	0.19
33	A	TR3A336(1)6R3(2)0800	2.0	14	0.800	0.31
33	A	TR3A336(1)6R3(2)0600	2.0	14	0.600	0.35
33	B	TR3B336(1)6R3(2)0450	2.0	6	0.450	0.43
33	B	TR3B336(1)6R3(2)0350	2.0	6	0.350	0.49
33	B	TR3B336(1)6R3(2)0600	2.0	6	0.600	0.38
33	B	TR3B336(1)6R3(2)0500	2.0	6	0.500	0.41
47	A	TR3A476(1)6R3(2)0800	3.0	12	0.800	0.31
47	B	TR3B476(1)6R3(2)0550	3.0	6	0.550	0.39
47	B	TR3B476(1)6R3(2)0500	3.0	6	0.500	0.41
47	B	TR3B476(1)6R3(2)0350	3.0	6	0.350	0.49
47	B	TR3B476(1)6R3(2)0250	3.0	6	0.250	0.58
47	C	TR3C476(1)6R3(2)0300	3.0	6	0.300	0.61
47	C	TR3C476(1)6R3(2)0250	3.0	6	0.250	0.66
68	B	TR3B686(1)6R3(2)0650	4.3	6	0.650	0.36
68	B	TR3B686(1)6R3(2)0550	4.3	6	0.550	0.39
68	B	TR3B686(1)6R3(2)0500	4.3	6	0.500	0.41
68	B	TR3B686(1)6R3(2)0350	4.3	6	0.350	0.49
68	B	TR3B686(1)6R3(2)0250	4.3	6	0.250	0.58
68	C	TR3C686(1)6R3(2)0275	4.3	6	0.275	0.63
68	C	TR3C686(1)6R3(2)0250	4.3	6	0.250	0.66
68	C	TR3C686(1)6R3(2)0200	4.3	6	0.200	0.74
68	D	TR3D686(1)6R3(2)0200	4.3	6	0.200	0.87
68	D	TR3D686(1)6R3(2)0175	4.3	4	0.175	0.93
100	B	TR3B107(1)6R3(2)1500	6.3	15	1.500	0.24
100	B	TR3B107(1)6R3(2)0500	6.3	15	0.500	0.41
100	B	TR3B107(1)6R3(2)0400	6.3	15	0.400	0.46
100	C	TR3C107(1)6R3(2)0300	6.3	6	0.300	0.61
100	C	TR3C107(1)6R3(2)0250	6.3	6	0.250	0.66
100	C	TR3C107(1)6R3(2)0150	6.3	6	0.150	0.86
100	C	TR3C107(1)6R3(2)0125	6.3	6	0.125	0.94
100	D	TR3D107(1)6R3(2)0150	6.3	6	0.150	1.00
100	D	TR3D107(1)6R3(2)0140	6.3	6	0.140	1.04
100	V	TR3V107(1)6R3(3)0200	6.3	8	0.200	0.79
100	V	TR3V107(1)6R3(3)0150	6.3	8	0.150	0.91
150	C	TR3C157(1)6R3(2)0300	9.4	8	0.300	0.61
150	C	TR3C157(1)6R3(2)0200	9.4	8	0.200	0.74
150	D	TR3D157(1)6R3(2)0150	9.4	8	0.150	1.00
150	D	TR3D157(1)6R3(2)0125	9.4	8	0.125	1.10
150	D	TR3D157(1)6R3(2)0075	9.4	8	0.075	1.41
150	D	TR3D157(1)6R3(2)0070	9.4	8	0.070	1.46
150	D	TR3D157(1)6R3(3)0050	9.4	8	0.050	1.73
150	E	TR3E157(1)6R3(2)0100	9.4	8	0.100	1.28
220	C	TR3C227(1)6R3(2)0300	13.9	14	0.300	0.61

Notes

- Part number definitions:
  - (1) Capacitance tolerance codes: K, M
  - (2) Terminations and packaging codes: C, D, E, F
  - (3) Lead (Pb)-free terminations and packaging codes: C, D
- (1) Preliminary values. Contact factory for availability



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT 125 °C</b>						
220	C	TR3C227(1)6R3(2)0250	13.9	14	0.250	0.66
220	C	TR3C227(1)6R3(2)0225	13.9	14	0.225	0.70
220	D	TR3D227(1)6R3(2)0150	13.9	8	0.150	1.00
220	D	TR3D227(1)6R3(2)0100	13.9	8	0.100	1.22
220	D	TR3D227(1)6R3(3)0050	13.9	8	0.050	1.73
220	E	TR3E227(1)6R3(2)0150	13.9	8	0.150	1.05
220	E	TR3E227(1)6R3(2)0100	13.9	8	0.100	1.28
330	D	TR3D337(1)6R3(2)0150	20.8	8	0.150	1.00
330	D	TR3D337(1)6R3(2)0125	20.8	8	0.125	1.10
330	D	TR3D337(1)6R3(2)0100	20.8	8	0.100	1.22
330	D	TR3D337(1)6R3(2)0060	20.8	8	0.060	1.58
330	D	TR3D337(1)6R3(3)0050	20.8	8	0.050	1.73
330	D	TR3D337(1)6R3(3)0045	20.8	8	0.045	1.83
330	D	TR3D337(1)6R3(3)0035	20.8	8	0.035	2.07
330	E	TR3E337(1)6R3(2)0150	20.8	8	0.150	1.05
330	E	TR3E337(1)6R3(2)0100	20.8	8	0.100	1.28
330	E	TR3E337(1)6R3(2)0050	20.8	8	0.050	1.82
470	D	TR3D477(1)6R3(2)0200	29.6	14	0.200	0.87
470	D	TR3D477(1)6R3(2)0150	29.6	14	0.150	1.00
470	D	TR3D477(1)6R3(2)0125	29.6	14	0.125	1.10
470	D	TR3D477(1)6R3(3)0100	29.6	14	0.100	1.22
470	E	TR3E477(1)6R3(2)0100	29.6	10	0.100	1.28
470	E	TR3E477(1)6R3(3)0065	29.6	10	0.065	1.59
470	E	TR3E477(1)6R3(3)0060	29.6	10	0.060	1.66
470	E	TR3E477(1)6R3(3)0050	29.6	10	0.050	1.82
680	E	TR3E687(1)6R3(2)0100	42.8	20	0.100	1.28
1000	E	TR3E108M6R3(2)0200	63.0	30	0.200	0.91
1000	E	TR3E108M6R3(2)0150	63.0	30	0.150	1.05
1000	E	TR3E108M6R3(3)0100	63.0	30	0.100	1.28
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT 125 °C</b>						
2.2	A	TR3A225(1)010(2)6800	0.5	6	6.800	0.11
2.2	A	TR3A225(1)010(2)6000	0.5	6	6.000	0.11
2.2	A	TR3A225(1)010(2)1800	0.5	6	1.800	0.20
4.7	A	TR3A475(1)010(2)3000	0.5	6	3.000	0.16
4.7	A	TR3A475(1)010(2)1500	0.5	6	1.500	0.22
4.7	A	TR3A475(1)010(2)1400	0.5	6	1.400	0.23
4.7	A	TR3A475(1)010(2)1000	0.5	6	1.000	0.27
6.8	A	TR3A685(1)010(2)1800	0.7	6	1.800	0.20
6.8	A	TR3A685(1)010(2)3000	0.7	6	3.000	0.16
10	A	TR3A106(1)010(2)2000	1.0	6	2.000	0.19
10	A	TR3A106(1)010(2)1800	1.0	6	1.800	0.20
10	A	TR3A106(1)010(2)1000	1.0	6	1.000	0.27
10	A	TR3A106(1)010(2)0900	1.0	6	0.900	0.29
10	B	TR3B106(1)010(2)1000	1.0	6	1.000	0.29
10	B	TR3B106(1)010(2)0800	1.0	6	0.800	0.33
10	B	TR3B106(1)010(2)0750	1.0	6	0.750	0.34
15	A	TR3A156(1)010(2)2000	1.5	6	2.000	0.19

Notes

- Part number definitions:
  - (1) Capacitance tolerance codes: K, M
  - (2) Terminations and packaging codes: C, D, E, F
  - (3) Lead (Pb)-free terminations and packaging codes: C, D
- (1) Preliminary values. Contact factory for availability





STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT 125 °C</b>						
15	A	TR3A156(1)010(2)1000	1.5	6	1.000	0.27
15	B	TR3B156(1)010(2)0600	1.5	6	0.600	0.38
15	B	TR3B156(1)010(2)0450	1.5	6	0.450	0.43
15	B	TR3B156(1)010(2)0700	1.5	6	0.700	0.35
22	A	TR3A226(1)010(2)1500	2.2	8	1.500	0.22
22	A	TR3A226(1)010(2)1000	2.2	8	1.000	0.27
22	A	TR3A226(1)010(2)0900	2.2	8	0.900	0.29
22	A	TR3A226(1)010(2)0800	2.2	8	0.800	0.31
22	B	TR3B226(1)010(2)1000	2.2	6	1.000	0.29
22	B	TR3B226(1)010(2)0700	2.2	6	0.700	0.35
22	B	TR3B226(1)010(2)0500	2.2	6	0.500	0.41
22	B	TR3B226(1)010(2)0400	2.2	6	0.400	0.46
22	C	TR3C226(1)010(2)0400	2.2	6	0.400	0.52
22	C	TR3C226(1)010(2)0345	2.2	6	0.345	0.56
22	C	TR3C226(1)010(2)0300	2.2	6	0.300	0.61
33	B	TR3B336(1)010(2)0425	3.3	6	0.425	0.45
33	B	TR3B336(1)010(2)1400	3.3	6	1.400	0.25
33	B	TR3B336(1)010(2)0650	3.3	6	0.650	0.36
33	B	TR3B336(1)010(2)0600	3.3	6	0.600	0.38
33	B	TR3B336(1)010(2)0500	3.3	6	0.500	0.41
33	B	TR3B336(1)010(2)0300	3.3	6	0.300	0.53
33	C	TR3C336(1)010(2)0375	3.3	6	0.375	0.54
33	C	TR3C336(1)010(2)0300	3.3	6	0.300	0.61
47	B	TR3B476(1)010(2)0600	4.7	6	0.600	0.38
47	B	TR3B476(1)010(2)0500	4.7	6	0.500	0.41
47	B	TR3B476(1)010(2)0350	4.7	6	0.350	0.49
47	B	TR3B476(1)010(2)0650	4.7	6	0.650	0.36
47	C	TR3C476(1)010(2)0200	4.7	6	0.200	0.74
47	C	TR3C476(1)010(2)0350	4.7	6	0.350	0.56
47	C	TR3C476(1)010(2)0300	4.7	6	0.300	0.61
47	D	TR3D476(1)010(2)0220	4.7	6	0.220	0.83
47	D	TR3D476(1)010(2)0200	4.7	6	0.200	0.87
47	D	TR3D476(1)010(2)0140	4.7	6	0.140	1.04
47	D	TR3D476(1)010(2)0135	4.7	6	0.135	1.05
47	D	TR3D476(1)010(2)0100	4.7	6	0.100	1.22
68	B	TR3B686(1)010(2)1500	6.8	14	1.500	0.24
68	B	TR3B686(1)010(2)0900	6.8	14	0.900	0.31
68	B	TR3B686(1)010(2)0750	6.8	14	0.750	0.34
68	B	TR3B686(1)010(2)0600	6.8	14	0.600	0.38
68	C	TR3C686(1)010(2)0200	6.8	6	0.200	0.74
68	C	TR3C686(1)010(2)0300	6.8	6	0.300	0.61
68	C	TR3C686(1)010(2)0275	6.8	6	0.275	0.63
68	C	TR3C686(1)010(2)0225	6.8	6	0.225	0.70
68	D	TR3D686(1)010(2)0200	6.8	6	0.200	0.87
68	D	TR3D686(1)010(2)0150	6.8	6	0.150	1.00
68	D	TR3D686(1)010(2)0100	6.8	6	0.100	1.22
68	D	TR3D686(1)010(3)0070	6.8	6	0.070	1.46

Notes

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  - (3) Lead (Pb)-free terminations and packaging codes: C, D
- (†) Preliminary values. Contact factory for availability



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT 125 °C</b>						
68	E	TR3E686(1)010(2)0150	6.8	4	0.150	1.05
68	V	TR3V686(1)010(3)0700	6.8	6	0.700	0.42
68	V	TR3V686(1)010(3)0300	6.8	6	0.300	0.65
68	V	TR3V686(1)010(3)0200	6.8	6	0.200	0.79
68	V	TR3V686(1)010(3)0140	6.8	6	0.140	0.94
68	V	TR3V686(1)010(3)0100	6.8	6	0.100	1.12
100	B	TR3B107M010(2)1400	10.0	25	1.400	0.25
100	C	TR3C107(1)010(2)0200	10.0	8	0.200	0.74
100	C	TR3C107(1)010(2)0150	10.0	8	0.150	0.86
100	C	TR3C107(1)010(2)0100	10.0	8	0.100	1.05
100	D	TR3D107(1)010(2)0150	10.0	6	0.150	1.00
100	D	TR3D107(1)010(2)0100	10.0	6	0.100	1.22
100	D	TR3D107(1)010(2)0080	10.0	6	0.080	1.37
100	D	TR3D107(1)010(3)0070	10.0	6	0.070	1.52
100	D	TR3D107(1)010(3)0065	10.0	6	0.065	1.46
100	D	TR3D107(1)010(3)0050	10.0	6	0.050	1.73
100	E	TR3E107(1)010(2)0125	10.0	6	0.125	1.15
100	E	TR3E107(1)010(2)0150	10.0	6	0.150	1.05
100	E	TR3E107(1)010(2)0100	10.0	6	0.100	1.28
100	V	TR3V107(1)010(3)0400	10.0	8	0.400	0.56
100	V	TR3V107(1)010(3)0200	10.0	8	0.200	0.79
100	V	TR3V107(1)010(3)0150	10.0	8	0.150	0.91
150	C	TR3C157M010(2)0500	15.0	20	0.500	0.47
150	D	TR3D157(1)010(2)0150	15.0	8	0.150	1.00
150	D	TR3D157(1)010(2)0100	15.0	8	0.100	1.22
150	D	TR3D157(1)010(2)0075	15.0	8	0.075	1.41
150	D	TR3D157(1)010(3)0070	15.0	8	0.070	1.46
150	D	TR3D157(1)010(3)0050	15.0	8	0.050	1.73
150	E	TR3E157(1)010(2)0100	15.0	8	0.100	1.28
150	E	TR3E157(1)010(2)0080	15.0	8	0.080	1.44
220	D	TR3D227(1)010(2)0150	22.0	8	0.150	1.00
220	D	TR3D227(1)010(2)0125	22.0	8	0.125	1.10
220	D	TR3D227(1)010(2)0100	22.0	8	0.100	1.22
220	D	TR3D227(1)010(3)0050	22.0	8	0.050	1.73
220	E	TR3E227(1)010(2)0150	22.0	8	0.150	1.05
220	E	TR3E227(1)010(2)0100	22.0	8	0.100	1.28
220	E	TR3E227(1)010(3)0070	22.0	8	0.070	1.54
220	E	TR3E227(1)010(3)0060	22.0	8	0.060	1.66
220	E	TR3E227(1)010(3)0050	22.0	8	0.050	1.82
220	V	TR3V227(1)010(3)0200	30.0	12	0.200	0.79
220	V	TR3V227(1)010(3)0150	30.0	12	0.150	0.91
330	D	TR3D337(1)010(2)0150	33.0	15	0.150	1.00
330	D	TR3D337(1)010(2)0125	33.0	15	0.125	1.10
330	D	TR3D337(1)010(2)0100	33.0	15	0.100	1.22
330	E	TR3E337(1)010(2)0100	33.0	10	0.100	1.28
330	E	TR3E337(1)010(3)0060	33.0	10	0.060	1.66
470	E	TR3E477(1)010(2)0200	47.0	15	0.200	0.91

Notes

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  - Lead (Pb)-free terminations and packaging codes: C, D
- Preliminary values. Contact factory for availability



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT 125 °C</b>						
470	E	TR3E477(1)010(2)0150	47.0	15	0.150	1.05
470	E	TR3E477(1)010(2)0100	47.0	15	0.100	1.28
470	E	TR3E477(1)010(3)0075	47.0	15	0.075	1.48
470	E	TR3E477(1)010(2)0060	47.0	15	0.060	1.66
470	E	TR3E477(1)010(2)0050	47.0	15	0.050	1.82
330	W <sup>(1)</sup>	TR3W337M010(2)0100	33.0	10	0.100	1.58
470	W <sup>(1)</sup>	TR3W477M010(2)0050	47.0	14	0.050	2.24
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>						
2.2	A	TR3A225(1)016(2)4000	0.5	6	4.000	0.14
2.2	A	TR3A225(1)016(2)3500	0.5	6	3.500	0.15
2.2	A	TR3A225(1)016(2)1800	0.5	6	1.800	0.20
3.3	A	TR3A335(1)016(2)4000	0.5	6	4.000	0.14
3.3	A	TR3A335(1)016(2)3500	0.5	6	3.500	0.15
4.7	A	TR3A475(1)016(2)3000	0.8	6	3.000	0.16
4.7	A	TR3A475(1)016(2)2500	0.8	6	2.500	0.17
4.7	A	TR3A475(1)016(2)2000	0.8	6	2.000	0.19
4.7	A	TR3A475(1)016(2)1500	0.8	6	1.500	0.22
4.7	B	TR3B475(1)016(2)1500	0.8	6	1.500	0.24
4.7	B	TR3B475(1)016(2)0800	0.8	6	0.800	0.33
6.8	A	TR3A685(1)016(2)3000	1.1	6	3.000	0.16
6.8	A	TR3A685(1)016(2)1500	1.1	6	1.500	0.22
6.8	B	TR3B685(1)016(2)1200	1.1	6	1.200	0.27
6.8	B	TR3B685(1)016(2)0600	1.1	6	0.600	0.38
10	A	TR3A106(1)016(2)1700	1.6	6	1.700	0.21
10	B	TR3B106(1)016(2)0800	1.6	6	0.800	0.33
10	B	TR3B106(1)016(2)0500	1.6	6	0.500	0.41
10	C	TR3C106(1)016(2)0600	1.6	6	0.600	0.43
10	C	TR3C106(1)016(2)0500	1.6	6	0.500	0.47
10	C	TR3C106(1)016(2)0450	1.6	6	0.450	0.49
15	B	TR3B156(1)016(2)0800	2.4	6	0.800	0.33
15	B	TR3B156(1)016(2)0500	2.4	6	0.500	0.41
15	C	TR3C156(1)016(2)0400	2.4	6	0.400	0.52
22	B	TR3B226(1)016(2)1000	3.5	6	1.000	0.29
22	B	TR3B226(1)016(2)0700	3.5	6	0.700	0.35
22	B	TR3B226(1)016(2)0600	3.5	6	0.600	0.38
22	B	TR3B226(1)016(2)0400	3.5	6	0.400	0.46
22	C	TR3C226(1)016(2)0375	3.5	6	0.375	0.54
22	C	TR3C226(1)016(2)0350	3.5	6	0.350	0.56
22	D	TR3D226(1)016(2)0250	3.5	6	0.250	0.77
33	B	TR3B336(1)016(2)0700	5.3	6	0.700	0.35
33	B	TR3B336(1)016(2)0500	5.3	6	0.500	0.41
33	B	TR3B336(1)016(2)0350	5.3	6	0.350	0.49
33	C	TR3C336(1)016(2)0300	5.3	6	0.300	0.61
33	C	TR3C336(1)016(2)0225	5.3	6	0.225	0.70
33	D	TR3D336(1)016(2)0250	5.3	6	0.250	0.77
33	D	TR3D336(1)016(2)0225	5.3	4	0.225	0.82
33	D	TR3D336(1)016(2)0150	5.3	6	0.150	1.00

**Notes**

- Part number definitions:
  - (1) Capacitance tolerance codes: K, M
  - (2) Terminations and packaging codes: C, D, E, F
  - (3) Lead (Pb)-free terminations and packaging codes: C, D
- (1) Preliminary values. Contact factory for availability



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>						
47	C	TR3C476(1)016(2)0500	7.5	6	0.500	0.47
47	C	TR3C476(1)016(2)0350	7.5	6	0.350	0.56
47	C	TR3C476(1)016(2)0300	7.5	6	0.300	0.61
47	D	TR3D476(1)016(2)0200	7.5	6	0.200	0.87
47	D	TR3D476(1)016(2)0150	7.5	6	0.150	1.00
47	D	TR3D476(1)016(2)0100	7.5	6	0.100	1.22
68	D	TR3D686(1)016(2)0150	10.9	6	0.150	1.00
68	D	TR3D686(1)016(2)0100	10.9	6	0.100	1.22
68	D	TR3D686(1)016(3)0070	10.9	6	0.070	1.46
100	D	TR3D107(1)016(2)0150	16.0	8	0.150	1.00
100	D	TR3D107(1)016(2)0125	16.0	8	0.125	1.10
100	D	TR3D107(1)016(2)0100	16.0	8	0.100	1.22
100	D	TR3D107(1)016(3)0075	16.0	8	0.075	1.41
100	E	TR3E107(1)016(2)0150	16.0	8	0.150	1.05
100	E	TR3E107(1)016(2)0125	16.0	8	0.125	1.15
100	E	TR3E107(1)016(2)0100	16.0	8	0.100	1.28
150	D	TR3D157(1)016(2)0400	24.0	8	0.400	0.61
150	D	TR3D157(1)016(2)0150	24.0	8	0.150	1.00
150	D	TR3D157(1)016(2)0125	24.0	8	0.125	1.10
150	D	TR3D157(1)016(2)0100	24.0	8	0.100	1.22
150	D	TR3D157(1)016(2)0085	24.0	8	0.085	1.33
150	D	TR3D157(1)016(3)0075	24.0	8	0.075	1.41
150	D	TR3D157(1)016(3)0060	24.0	8	0.060	1.58
150	E	TR3E157(1)016(2)0400	24.0	8	0.400	0.64
150	E	TR3E157(1)016(2)0150	24.0	8	0.150	1.05
150	E	TR3E157(1)016(2)0100	24.0	8	0.100	1.28
150	E	TR3E157(1)016(2)0075	24.0	8	0.075	1.48
150	E	TR3E157(1)016(2)0060	24.0	8	0.060	1.66
220	E	TR3E227(1)016(2)0150	35.2	14	0.150	1.05
220	E	TR3E227(1)016(2)0125	35.2	14	0.125	1.15
220	E	TR3E227(1)016(2)0100	35.2	14	0.100	1.28
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>						
1.0	A	TR3A105(1)020(2)5500	0.5	4	5.500	0.12
1.0	A	TR3A105(1)020(2)3000	0.5	4	3.000	0.16
2.2	A	TR3A225(1)020(2)4000	0.5	6	4.000	0.14
2.2	A	TR3A225(1)020(2)3000	0.5	6	3.000	0.16
3.3	A	TR3A335(1)020(2)4000	0.7	6	4.000	0.14
3.3	B	TR3B335(1)020(2)1300	0.7	6	1.300	0.26
4.7	A	TR3A475(1)020(2)3500	0.9	6	3.500	0.15
4.7	A	TR3A475(1)020(2)1800	0.9	6	1.800	0.20
4.7	B	TR3B475(1)020(2)1000	0.9	6	1.000	0.29
4.7	B	TR3B475(1)020(2)0750	0.9	6	0.750	0.34
6.8	A	TR3A685(1)020(2)3200	1.4	6	3.200	0.15
6.8	A	TR3A685(1)020(2)3000	1.4	6	3.000	0.16
6.8	A	TR3A685(1)020(2)2600	1.4	6	2.600	0.17
6.8	B	TR3B685(1)020(2)1000	1.4	6	1.000	0.29
6.8	B	TR3B685(1)020(2)0600	1.4	6	0.600	0.38
10	B	TR3B106(1)020(2)1000	2.0	6	1.000	0.29
10	B	TR3B106(1)020(2)0500	2.0	6	0.500	0.41
10	C	TR3C106(1)020(2)0700	2.0	6	0.700	0.40

**Notes**

- Part number definitions:
  - (1) Capacitance tolerance codes: K, M
  - (2) Terminations and packaging codes: C, D, E, F
  - (3) Lead (Pb)-free terminations and packaging codes: C, D
- (1) Preliminary values. Contact factory for availability



STANDARD RATINGS							
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)	
20 V <sub>DC</sub> AT + 85 °C; 13 V <sub>DC</sub> AT + 125 °C							
10	C	TR3C106(1)020(2)0500	2.0	6	0.500	0.47	
10	C	TR3C106(1)020(2)0475	2.0	6	0.475	0.48	
10	C	TR3C106(1)020(2)0450	2.0	6	0.450	0.49	
10	C	TR3C106(1)020(2)0400	2.0	6	0.400	0.52	
15	B	TR3B156(1)020(2)1000	3.0	6	1.000	0.29	
15	B	TR3B156(1)020(2)0500	3.0	6	0.500	0.41	
15	C	TR3C156(1)020(2)0400	3.0	6	0.400	0.52	
22	B	TR3B226(1)020(2)0800	4.4	6	0.800	0.33	
22	B	TR3B226(1)020(2)0600	4.4	6	0.600	0.38	
22	B	TR3B226(1)020(2)0400	4.4	6	0.400	0.46	
22	C	TR3C226(1)020(2)0400	4.4	6	0.400	0.52	
22	C	TR3C226(1)020(2)0375	4.4	6	0.375	0.54	
22	D	TR3D226(1)020(2)0300	4.4	6	0.300	0.71	
22	D	TR3D226(1)020(2)0225	3.5	4	0.225	0.82	
22	D	TR3D226(1)020(2)0200	4.4	6	0.200	0.87	
33	C	TR3C336(1)020(2)0350	6.6	6	0.350	0.56	
33	C	TR3C336(1)020(2)0300	6.6	6	0.300	0.61	
33	C	TR3C336(1)020(2)0200	6.6	6	0.200	0.74	
33	D	TR3C336(1)020(2)0400	6.6	6	0.400	0.61	
33	D	TR3D336(1)020(2)0250	6.6	6	0.250	0.77	
33	D	TR3D336(1)020(2)0200	6.6	6	0.200	0.87	
47	D	TR3D476(1)020(2)0200	9.4	6	0.200	0.87	
47	D	TR3D476(1)020(2)0175	9.4	6	0.175	0.93	
47	D	TR3D476(1)020(2)0150	9.4	6	0.150	1.00	
47	D	TR3D476(1)020(3)0100	9.4	6	0.100	1.22	
47	E	TR3E476(1)020(2)0150	9.4	6	0.150	1.05	
47	E	TR3E476(1)020(3)0125	9.4	6	0.125	1.15	
68	D	TR3D686(1)020(2)0200	13.6	6	0.200	0.87	
68	D	TR3D686(1)020(2)0175	13.6	6	0.175	0.93	
68	D	TR3D686(1)020(2)0150	13.6	6	0.150	1.00	
68	D	TR3D686(1)020(2)0115	13.6	6	0.115	1.14	
68	E	TR3E686(1)020(2)0200	13.6	6	0.200	0.91	
68	E	TR3E686(1)020(2)0150	13.6	6	0.150	1.05	
68	E	TR3E686(1)020(2)0125	13.6	6	0.125	1.15	
68	E	TR3E686(1)020(2)0120	13.6	6	0.120	1.17	
100	D	TR3D107(1)020(2)0200	20.0	8	0.200	0.87	
100	D	TR3D107(1)020(2)0150	20.0	8	0.150	1.00	
100	D	TR3D107(1)020(2)0100	20.0	8	0.100	1.22	
100	D	TR3D107(1)020(3)0085	20.0	8	0.085	1.33	
100	D	TR3D107(1)020(3)0080	20.0	8	0.080	1.37	
100	E	TR3E107(1)020(2)0200	20.0	8	0.200	0.91	
100	E	TR3E107(1)020(2)0150	20.0	8	0.150	1.05	
100	E	TR3E107(1)020(2)0100	20.0	8	0.100	1.28	
100	W <sup>(1)</sup>	TR3W107(1)020(3)0200	20.0	8	0.200	1.12	
100	W <sup>(1)</sup>	TR3W107(1)020(3)0100	20.0	8	0.100	1.58	
100	W <sup>(1)</sup>	TR3W107(1)020(3)0080	20.0	8	0.080	1.77	
100	W <sup>(1)</sup>	TR3W107(1)020(3)0060	20.0	8	0.060	2.04	
150	W <sup>(1)</sup>	TR3W157(1)020(3)0200	30.0	10	0.200	1.12	
150	W <sup>(1)</sup>	TR3W157(1)020(3)0150	30.0	10	0.150	1.29	
150	W <sup>(1)</sup>	TR3W157(1)020(3)0100	30.0	10	0.100	1.58	
150	W <sup>(1)</sup>	TR3W157(1)020(3)0080	30.0	10	0.080	1.77	

Notes

- Part number definitions:
  - Capacitance tolerance codes: K, M
  - Terminations and packaging codes: C, D, E, F
  - Lead (Pb)-free terminations and packaging codes: C, D
- Preliminary values. Contact factory for availability



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
25 V <sub>DC</sub> AT + 85 °C; 17 V <sub>DC</sub> AT + 125 °C						
1.0	A	TR3A105(1)025(2)4000	0.5	4	4.000	0.14
1.5	A	TR3A155(1)025(2)4000	0.5	6	4.000	0.14
1.5	A	TR3A155(1)025(2)3000	0.5	6	3.000	0.16
2.2	A	TR3A225(1)025(2)4000	0.6	6	4.000	0.14
2.2	B	TR3B225(1)025(2)1500	0.6	6	1.500	0.24
2.2	B	TR3B225(1)025(2)1200	0.6	6	1.200	0.27
2.2	B	TR3B225(1)025(2)0900	0.6	6	0.900	0.31
3.3	A	TR3A335(1)025(2)3500	0.8	6	3.500	0.15
3.3	A	TR3A335(1)025(2)3000	0.8	6	3.000	0.16
3.3	B	TR3B335(1)025(2)2000	0.8	6	2.000	0.21
3.3	B	TR3B335(1)025(2)1500	0.8	6	1.500	0.24
3.3	B	TR3B335(1)025(2)0750	0.8	6	0.750	0.34
4.7	A	TR3A475(1)025(2)3500	1.2	6	3.500	0.15
4.7	A	TR3A475(1)025(2)3000	1.2	6	3.000	0.16
4.7	B	TR3B475(1)025(2)1500	1.2	6	1.500	0.24
4.7	B	TR3B475(1)025(2)1000	1.2	6	1.000	0.29
4.7	B	TR3B475(1)025(2)0900	1.2	6	0.900	0.10
4.7	B	TR3B475(1)025(2)0700	1.2	6	0.700	0.35
4.7	C	TR3C475(1)025(2)0600	1.2	6	0.600	0.43
4.7	C	TR3C475(1)025(2)0525	1.2	6	0.525	0.46
6.8	B	TR3B685(1)025(2)2000	1.7	6	2.000	0.21
6.8	B	TR3B685(1)025(2)1500	1.7	6	1.500	0.24
6.8	B	TR3B685(1)025(2)1200	1.7	6	1.200	0.27
6.8	B	TR3B685(1)025(2)0700	1.7	6	0.700	0.35
6.8	B	TR3B685(1)025(3)0500	1.7	6	0.500	0.41
6.8	B	TR3B685(1)025(3)0400	1.7	6	0.400	0.46
6.8	C	TR3C685(1)025(2)0600	1.7	6	0.600	0.43
6.8	C	TR3C685(1)025(2)0500	1.7	6	0.500	0.47
10	B	TR3B106(1)025(2)1300	2.5	6	1.300	0.26
10	B	TR3B106(1)025(2)1100	2.5	6	1.100	0.28
10	B	TR3B106(1)025(2)0450	2.5	6	0.450	0.43
10	C	TR3C106(1)025(2)0600	2.5	6	0.600	0.43
10	C	TR3C106(1)025(2)0500	2.5	6	0.500	0.47
10	C	TR3C106(1)025(2)0450	2.5	6	0.450	0.49
10	C	TR3C106(1)025(2)0300	2.5	6	0.300	0.61
10	D	TR3D106(1)025(2)0400	2.5	6	0.400	0.61
10	D	TR3D106(1)025(2)0300	2.5	6	0.300	0.71
15	B	TR3B156(1)025(2)1000	3.8	6	1.000	0.29
15	B	TR3B156(1)025(2)0800	3.8	6	0.800	0.33
15	B	TR3B156(1)025(2)0600	3.8	6	0.600	0.38
15	C	TR3C156(1)025(2)0900	3.8	6	0.900	0.35
15	C	TR3C156(1)025(2)0425	3.8	6	0.425	0.51
15	D	TR3D156(1)025(2)0350	3.8	6	0.350	0.65
15	D	TR3D156(1)025(2)0275	3.8	6	0.275	0.74
15	D	TR3D156(1)025(2)0250	3.8	6	0.250	0.77
15	D	TR3D156(1)025(2)0200	3.8	6	0.200	0.87
22	C	TR3C226(1)025(2)1000	5.5	6	1.000	0.33

**Notes**

- Part number definitions:
  - (1) Capacitance tolerance codes: K, M
  - (2) Terminations and packaging codes: C, D, E, F
  - (3) Lead (Pb)-free terminations and packaging codes: C, D
- (†) Preliminary values. Contact factory for availability



STANDARD RATINGS							
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)	
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>							
22	C	TR3C226(1)025(2)0900	5.5	6	0.900	0.35	
22	C	TR3C226(1)025(2)0400	5.5	6	0.400	0.52	
22	C	TR3C226(1)025(2)0425	5.5	6	0.425	0.51	
22	C	TR3C226(1)025(2)0300	5.5	6	0.300	0.61	
22	C	TR3C226(1)025(2)0275	5.5	6	0.275	0.63	
22	C	TR3C226(1)025(2)0250	5.5	6	0.250	0.66	
22	D	TR3D226(1)025(2)0300	5.5	6	0.300	0.71	
22	D	TR3D226(1)025(2)0200	5.5	6	0.200	0.87	
22	E	TR3E226(1)025(2)0300	5.5	6	0.300	0.74	
22	E	TR3E226(1)025(2)0200	5.5	6	0.200	0.91	
22	V	TR3V226(1)025(3)0500	5.5	6	0.500	0.50	
22	V	TR3V226(1)025(3)0400	5.5	6	0.400	0.56	
22	V	TR3V226(1)025(3)0250	5.5	6	0.250	0.71	
33	D	TR3D336(1)025(2)0400	8.3	6	0.400	0.61	
33	D	TR3D336(1)025(2)0300	8.3	6	0.300	0.71	
33	D	TR3D336(1)025(2)0225	8.3	6	0.225	0.82	
33	D	TR3D336(1)025(2)0200	8.3	6	0.200	0.87	
33	E	TR3E336(1)025(2)0300	8.3	6	0.300	0.74	
33	E	TR3E336(1)025(2)0200	8.3	6	0.200	0.91	
33	E	TR3E336(1)025(2)0175	6.6	4	0.175	0.97	
47	D	TR3D476(1)025(2)0350	11.8	8	0.350	0.65	
47	D	TR3D476(1)025(2)0250	11.8	8	0.250	0.77	
47	D	TR3D476(1)025(2)0200	11.8	8	0.200	0.87	
47	D	TR3D476(1)025(2)0150	11.8	8	0.150	1.00	
47	D	TR3D476(1)025(3)0125	11.8	8	0.125	1.10	
47	D	TR3D476(1)025(3)0100	11.8	8	0.100	1.22	
47	E	TR3E476(1)025(2)0300	11.8	6	0.300	0.74	
47	E	TR3E476(1)025(2)0200	11.8	6	0.200	0.91	
47	E	TR3E476(1)025(2)0150	11.8	8	0.150	1.05	
47	E	TR3E476(1)025(3)0125	11.8	8	0.125	1.15	
47	E	TR3E476(1)025(3)0100	11.8	8	0.100	1.28	
68	W <sup>(1)</sup>	TR3W686M025(2)0095	17.0	6	0.095	1.62	
100	W <sup>(1)</sup>	TR3W107(1)025(3)0200	25.0	15	0.200	1.12	
100	W <sup>(1)</sup>	TR3W107(1)025(3)0150	25.0	15	0.150	1.29	
100	W <sup>(1)</sup>	TR3W107(1)025(3)0100	25.0	15	0.100	1.58	
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>							
0.47	A	TR3A474(1)035(2)4000	0.5	4	4.000	0.14	
0.68	A	TR3A684(1)035(2)6000	0.5	4	6.000	0.11	
0.68	A	TR3A684(1)035(2)4000	0.5	4	4.000	0.14	
1.0	A	TR3A105(1)035(2)6000	0.5	4	6.000	0.11	
1.0	A	TR3A105(1)035(2)4000	0.5	4	4.000	0.14	
1.0	A	TR3A105(1)035(2)3000	0.5	4	3.000	0.16	
1.0	B	TR3B105(1)035(2)2000	0.5	4	2.000	0.21	
1.0	B	TR3B105(1)035(2)1700	0.5	4	1.700	0.22	
1.0	B	TR3B105(1)035(2)1500	0.5	4	1.500	0.24	
1.5	B	TR3B155(1)035(2)3000	0.5	6	3.000	0.17	
1.5	B	TR3B155(1)035(2)2000	0.5	6	2.000	0.21	
1.5	C	TR3C155(1)035(2)2500	0.5	6	2.500	0.21	
1.5	C	TR3C155(1)035(2)0900	0.5	6	0.900	0.35	
2.2	B	TR3B225(1)035(2)2500	0.8	6	2.500	0.18	

**Notes**

- Part number definitions:
  - Capacitance tolerance codes: K, M
  - Terminations and packaging codes: C, D, E, F
  - Lead (Pb)-free terminations and packaging codes: C, D
- Preliminary values. Contact factory for availability





STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>						
2.2	B	TR3B225(1)035(2)2000	0.8	6	2.000	0.21
2.2	B	TR3B225(1)035(2)1500	0.8	6	1.500	0.24
2.2	C	TR3C225(1)035(2)1500	0.8	6	1.500	0.27
2.2	C	TR3C225(1)035(2)0900	0.8	6	0.900	0.35
3.3	B	TR3B335(1)035(2)1500	1.2	6	1.500	0.24
3.3	B	TR3B335(1)035(2)1000	1.2	6	1.000	0.29
3.3	C	TR3C335(1)035(2)0800	1.2	6	0.800	0.37
3.3	C	TR3C335(1)035(2)0700	1.2	6	0.700	0.40
3.3	C	TR3C335(1)035(2)0600	1.2	6	0.600	0.43
4.7	B	TR3B475(1)035(2)1500	1.6	6	1.500	0.24
4.7	B	TR3B475(1)035(2)1000	1.6	6	1.000	0.29
4.7	B	TR3B475(1)035(2)0700	1.6	6	0.700	0.35
4.7	C	TR3C475(1)035(2)0700	1.6	6	0.700	0.40
4.7	C	TR3C475(1)035(2)0600	1.6	6	0.600	0.43
4.7	C	TR3C475(1)035(2)0500	1.6	6	0.500	0.47
4.7	D	TR3D475(1)035(2)0700	1.6	6	0.700	0.46
6.8	C	TR3C685(1)035(2)0900	2.4	6	0.900	0.35
6.8	C	TR3C685(1)035(2)0475	2.4	6	0.475	0.48
6.8	D	TR3D685(1)035(2)0500	2.4	6	0.500	0.55
6.8	D	TR3D685(1)035(2)0400	2.4	6	0.400	0.61
6.8	D	TR3D685(1)035(2)0300	2.4	6	0.300	0.71
6.8	E	TR3E685(1)035(2)0300	2.4	4	0.300	0.74
10	C	TR3C106(1)035(2)1200	3.5	6	1.200	0.30
10	C	TR3C106(1)035(2)0450	3.5	6	0.450	0.49
10	D	TR3D106(1)035(2)0400	3.5	6	0.400	0.61
10	D	TR3D106(1)035(2)0300	3.5	6	0.300	0.71
10	D	TR3D106(1)035(2)0260	3.5	6	0.260	0.76
10	D	TR3D106(1)035(2)0250	3.5	6	0.250	0.77
10	D	TR3D106(1)035(2)0200	3.5	6	0.200	0.87
10	D	TR3D106(1)035(3)0135	3.5	6	0.135	1.05
10	D	TR3D106(1)035(3)0125	3.5	6	0.125	1.10
10	E	TR3E106(1)035(2)0250	3.5	6	0.250	0.81
10	E	TR3E106(1)035(2)0200	3.5	6	0.200	0.91
15	D	TR3D156(1)035(2)0350	5.3	6	0.350	0.65
15	D	TR3D156(1)035(2)0300	5.3	6	0.300	0.71
15	D	TR3D156(1)035(2)0260	5.3	6	0.260	0.76
15	D	TR3D156(1)035(2)0225	5.3	6	0.225	0.82
15	D	TR3D156(1)035(2)0200	5.3	6	0.200	0.87
15	D	TR3D156(1)035(2)0150	5.3	6	0.150	1.00
15	E	TR3E156(1)035(2)0300	5.3	6	0.300	0.74
15	E	TR3E156(1)035(2)0225	5.3	6	0.225	0.86
15	E	TR3E156(1)035(2)0200	5.3	6	0.200	0.91
15	E	TR3E156(1)035(2)0150	5.3	6	0.150	1.05
22	D	TR3D226(1)035(2)0400	7.7	6	0.400	0.61
22	D	TR3D226(1)035(2)0300	7.7	6	0.300	0.71
22	D	TR3D226(1)035(2)0275	7.7	6	0.275	0.74
22	D	TR3D226(1)035(2)0250	7.7	6	0.250	0.77

Notes

- Part number definitions:
  - (1) Capacitance tolerance codes: K, M
  - (2) Terminations and packaging codes: C, D, E, F
  - (3) Lead (Pb)-free terminations and packaging codes: C, D
- (†) Preliminary values. Contact factory for availability



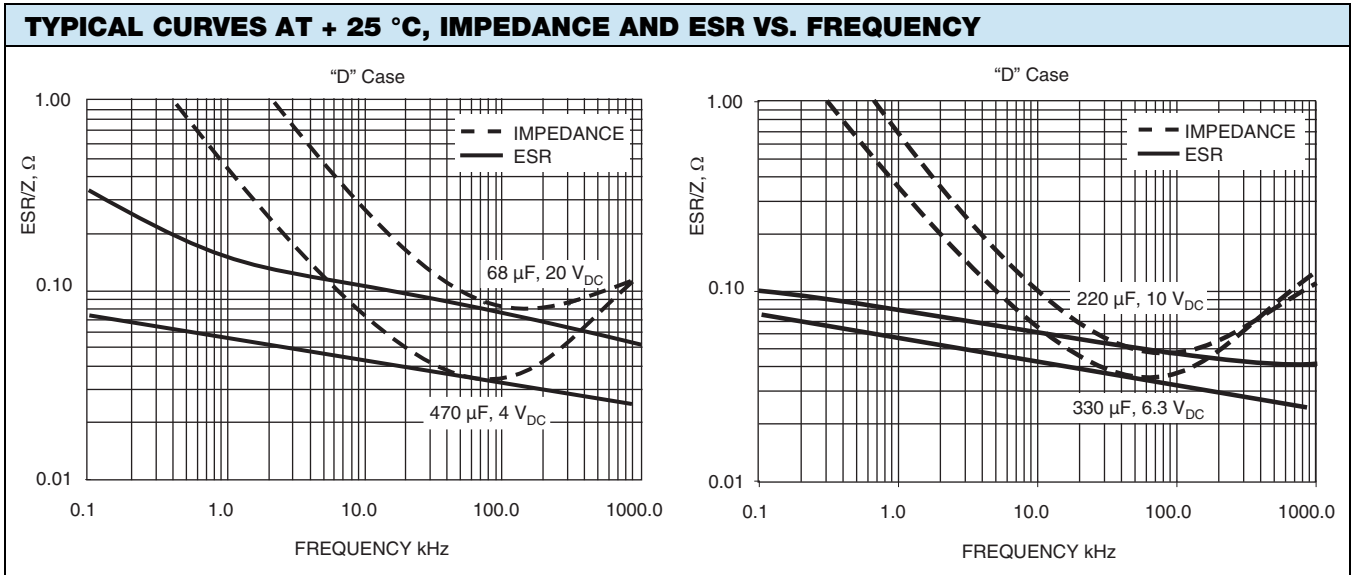
STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>						
22	D	TR3D226(1)035(2)0200	7.7	6	0.200	0.87
22	E	TR3E226(1)035(2)0300	7.7	6	0.300	0.74
22	E	TR3E226(1)035(2)0275	7.7	6	0.275	0.77
22	E	TR3E226(1)035(2)0260	7.7	6	0.260	0.80
22	E	TR3E226(1)035(2)0200	7.7	6	0.200	0.91
<b>50 V<sub>DC</sub> AT + 85 °C; 33 V<sub>DC</sub> AT + 125 °C</b>						
1.0	B	TR3B105(1)050(2)4000	0.5	4	4.000	0.15
1.0	B	TR3B105(1)050(2)2000	0.5	4	2.000	0.21
1.0	C	TR3C105(1)050(2)1600	0.5	4	1.600	0.26
1.5	B	TR3B155(1)050(2)2000	0.8	6	2.000	0.21
1.5	C	TR3C155(1)050(2)1500	0.8	6	1.500	0.27
2.2	B	TR3B225(1)050(2)2000	1.1	6	2.000	0.21
2.2	C	TR3C225(1)050(2)1500	1.1	6	1.500	0.27
2.2	D	TR3D225(1)050(2)0800	1.1	6	0.800	0.43
3.3	C	TR3C335(1)050(2)1500	1.7	6	1.500	0.27
3.3	D	TR3D335(1)050(2)0800	1.7	6	0.800	0.43
4.7	C	TR3C475(1)050(2)1000	2.4	6	1.000	0.33
4.7	C	TR3C475(1)050(2)0700	2.4	6	0.700	0.40
4.7	C	TR3C475(1)050(2)0500	2.4	6	0.500	0.47
4.7	D	TR3D475(1)050(2)0700	2.4	6	0.700	0.46
4.7	D	TR3D475(1)050(2)0600	2.4	6	0.600	0.50
4.7	D	TR3D475(1)050(2)0500	2.4	6	0.500	0.55
4.7	D	TR3D475(1)050(2)0300	2.4	6	0.300	0.71
4.7	E	TR3E475(1)050(2)0600	2.4	4	0.600	0.52
4.7	E	TR3E475(1)050(2)0300	2.4	4	0.300	0.74
6.8	D	TR3D685(1)050(2)0700	3.4	6	0.700	0.46
6.8	D	TR3D685(1)050(2)0600	3.4	6	0.600	0.50
6.8	D	TR3D685(1)050(2)0500	3.4	6	0.500	0.55
6.8	D	TR3D685(1)050(2)0300	3.4	6	0.300	0.71
6.8	E	TR3E685(1)050(2)0550	3.4	6	0.550	0.55
6.8	E	TR3E685(1)050(2)0500	3.4	6	0.500	0.57
10	D	TR3D106(1)050(2)0700	5.0	6	0.700	0.46
10	D	TR3D106(1)050(2)0550	5.0	6	0.550	0.52
10	D	TR3D106(1)050(2)0450	5.0	6	0.450	0.58
10	E	TR3E106(1)050(2)0700	5.0	6	0.700	0.49
10	E	TR3E106(1)050(2)0550	5.0	6	0.550	0.55
10	E	TR3E106(1)050(2)0500	5.0	6	0.500	0.57
10	E	TR3E106(1)050(2)0400	5.0	6	0.400	0.64
10	E	TR3E106(1)050(2)0300	5.0	6	0.300	0.74
15	E	TR3E156(1)050(2)0400	7.5	6	0.400	0.64
15	E	TR3E156(1)050(3)0300	7.5	6	0.300	0.74
<b>63 V<sub>DC</sub> AT + 85 °C; 40 V<sub>DC</sub> AT + 125 °C</b>						
4.7	D	TR3D475(1)063(2)0700	3.0	6	0.700	0.46
10	E	TR3E106(1)063(2)0600	6.3	6	0.600	0.52

**Notes**

- Part number definitions:
  - Capacitance tolerance codes: K, M
  - Terminations and packaging codes: C, D, E, F
  - Lead (Pb)-free terminations and packaging codes: C, D
- Preliminary values. Contact factory for availability



<b>RECOMMENDED VOLTAGE DERATING GUIDELINES</b> (for temperatures below + 85 °C)	
<b>STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS</b>	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.6
10	6.0
16	10
20	12
25	15
35	24
50	28
63	38
<b>SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS</b>	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24
63	32





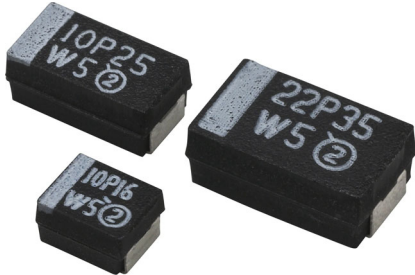
POWER DISSIPATION	
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
A	0.075
B	0.085
C	0.110
D	0.150
E	0.165
V	0.125
W	0.250

STANDARD PACKAGING QUANTITY		
CASE CODE	UNITS PER REEL	
	7" REEL	13" REEL
A	2000	9000
B	2000	8000
C	500	3000
D	500	2500
E	400	1500
V	1000	5000
W	500	2000

PRODUCT INFORMATION	
Guide for Molded Tantalum Capacitors	<a href="http://www.vishay.com/doc?40074">www.vishay.com/doc?40074</a>
Pad Dimensions	
Packaging Dimensions	
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
SELECTOR GUIDES	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
FAQ	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

# Solid Tantalum Surface Mount Capacitors

## TANTAMOUNT<sup>®</sup> Molded Case, High Performance


**FEATURES**

- Terminations: 100 % matte tin, standard, tin/lead available
- Molded case available in five case codes
- Compatible with "High Volume" automatic pick and place equipment
- High ripple current carrying capability
- Low ESR
- Meets EIA 535BAAC
- Compliant terminations
- 100 % surge current tested (B, C, D, and E case sizes)
- Mounting: Surface mount
- AEC-Q200 qualified
- Compliant to RoHS Directive 2002/95/EC
- Moisture sensitivity level 1

AUTOMOTIVE GRADE


**RoHS\***  
COMPLIANT

**Note**

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

**PERFORMANCE/ELECTRICAL CHARACTERISTICS**
[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)

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

**Capacitance Range:** 0.10 μF to 470 μF

**Capacitance Tolerance:** ± 10 %, ± 20 %

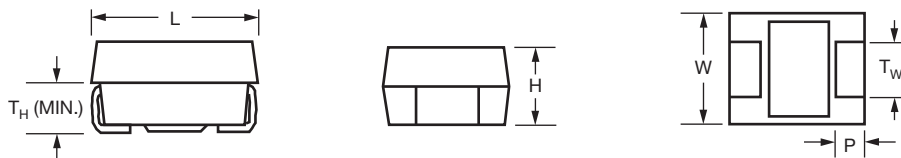
**Voltage Rating:** 4 V<sub>DC</sub> to 50 V<sub>DC</sub>

**ORDERING INFORMATION**

TP3	D	226	K	035	C	0500	AS
TYPE	CASE CODE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	TERMINATION/PACKAGING	ESR	SPECIFICATION OPTION
	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 V. To complete the three-digit block, zeros precede the voltage rating. A decimal point is indicated by an "R" (6R3 = 6.3 V)	C = Matte tin/7" (178 mm) reels D = Matte tin/13" (330 mm) reels E = Tin/lead/7" (178 mm) reels F = Tin/lead/13" (330 mm) reels	Maximum 100 kHz ESR 0500 = 500 mΩ 5000 = 5.0 Ω 10R0 = 10.0 Ω	AS = Standard

**Note**

- We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size. Voltage substitutions will be marked with the higher voltage rating.

**DIMENSIONS** in inches [millimeters]


CASE CODE	EIA SIZE	L	W	H	P	T <sub>w</sub>	T <sub>H</sub> (MIN.)
A	3216-18	0.126 ± 0.008 [3.2 ± 0.20]	0.063 ± 0.008 [1.6 ± 0.20]	0.063 ± 0.008 [1.6 ± 0.20]	0.031 ± 0.012 [0.80 ± 0.30]	0.047 ± 0.004 [1.2 ± 0.10]	0.028 [0.70]
B	3528-21	0.138 ± 0.008 [3.5 ± 0.20]	0.110 ± 0.008 [2.8 ± 0.20]	0.075 ± 0.008 [1.9 ± 0.20]	0.031 ± 0.012 [0.80 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.028 [0.70]
C	6032-28	0.236 ± 0.012 [6.0 ± 0.30]	0.126 ± 0.012 [3.2 ± 0.30]	0.098 ± 0.012 [2.5 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.039 [1.0]
D	7343-31	0.287 ± 0.012 [7.3 ± 0.30]	0.169 ± 0.012 [4.3 ± 0.30]	0.110 ± 0.012 [2.8 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.094 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]
E	7343-43	0.287 ± 0.012 [7.3 ± 0.30]	0.169 ± 0.012 [4.3 ± 0.30]	0.157 ± 0.012 [4.0 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.094 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]



RATINGS AND CASE CODES								
μF	4 V	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V
0.10							A (20.00, 10.00)	A (19.00, 10.00)
0.15								
0.22							A (15.00, 6.00)	A (15.00) B (12.00, 8.50)
0.33							A (13.00, 6.00)	B (10.00, 4.50)
0.47							A (12.00, 9.00)	A (10.00, 4.00) B (8.00, 2.50)
0.68					A (10.00, 8.00)	A (8.40) B (7.00, 5.00)	A (7.60, 4.00) B (6.50, 2.50)	
1.0				A (9.30, 6.00)	A (8.40, 5.50)	A (7.60, 4.00) B (5.00, 2.00)	A (7.50, 6.00, 4.00) B (5.00, 2.00)	B (6.70) C (4.60, 1.60)
1.5			A (8.00, 6.00)	A (6.70, 6.00)	A (6.30)	A (6.70, 4.00) B (4.60, 2.00)	B (4.20, 2.00) C (3.80)	
2.2		A (7.60, 6.00)	A (6.30)	A (5.90, 4.00) B (4.60, 2.50)	A (5.90, 4.00) B (3.50, 1.50)	A (6.30, 4.00) B (4.00; 3.80, 1.50) C (2.20)	B (3.80, 2.00) C (2.90, 0.90)	C (2.90, 1.50) D (2.10, 0.80)
3.3		A (6.30, 5.00)	A (5.50)	A (5.00, 4.00, 3.50) B (3.5, 2.0)	A (5.90, 4.00) B (3.00, 1.30)	B (3.10, 1.50) C (2.30, 1.00)	B (3.50) C (2.10, 0.70)	C (2.50, 1.50) D (1.70, 0.80)
4.7	A (6.30)	A (5.50, 3.50)	A (5.00, 4.50, 3.00, 2.00) B (3.40, 1.50)	A (5.00, 2.50, 2.00) B (2.90, 1.50)	A (5.00, 3.50) B (2.90, 1.00) C (2.30, 0.60)	B (2.80, 1.50) C (2.00, 0.525)	B (3.10, 1.50) C (1.90, 0.50) D (1.30, 0.45)	D (1.20, 0.60, 0.30)
6.8		A (5.00) B (3.40)	A (4.20, 3.00) B (2.90, 1.20)	A (4.20, 3.80, 3.00) B (2.50) C (1.90, 0.60)	B (2.50, 1.00) C (1.90, 0.55)	C (1.70, 0.50)	C (1.80, 0.475) D (1.8, 1.10, 0.30)	D (0.90, 0.60)
10		A (3.40, 2.00) B (2.90, 1.00)	A (3.40, 2.00) B (2.50, 0.60, 0.80) C (1.80, 0.55)	A (3.00, 1.70) B (2.00, 0.80) C (1.80, 0.45)	B (2.10, 2.5, 1.00) C (1.70, 0.50, 0.45)	C (1.50, 0.45) D (1.00, 0.30)	C (1.60, 0.45) D (0.80, 0.30, 0.135)	D (0.80, 0.55) E (0.80, 0.55, 0.30)
15		A (2.90, 2.00) B (2.50)	A (2.90, 2.00) B (2.00, 1.20, 0.70) C (1.80, 0.50)	B (2.00, 0.80) C (1.50, 0.40)	B (2.30, 1.00) C (1.50, 0.40) D (0.90, 0.30)	C (1.20, 0.425) D (0.80, 0.25)	D (0.70, 0.30, 0.26)	
22		A (2.90, 2.00) B (2.00, 0.60) C (1.80, 0.50)	A (2.50, 1.50) B (1.90, 0.60, 0.70) C (1.50, 0.40, 0.345, 0.245)	B (1.90, 0.70, 0.60) C (1.40, 0.8, 0.375, 0.35) D (0.80, 0.25)	C (1.10, 0.375) D (0.70, 0.225)	C (1.20, 0.40) D (0.70, 0.20)	D (0.60, 0.30, 0.20) E (0.60, 0.275)	
33	B (2.00) C (2.0, 1.80, 0.50)	A (2.50, 0.80) B (1.90, 0.60) C (1.50, 0.375)	B (1.90, 1.50, 0.60) C (1.40, 0.60, 0.30) D (0.80, 0.25)	C (1.10, 0.30) D (0.70, 0.225)	C (1.00, 0.35) D (0.70, 0.20)			
47		B (1.90, 0.60, 0.55, 0.50) C (1.40, 0.30) D (0.80, 0.20)	B (1.80, 0.60) C (1.10, 0.30) D (0.70, 0.20)	C (1.00, 0.30) D (0.70, 0.20, 0.15, 0.12)	D (0.70, 0.25, 0.20, 0.15) E (0.60, 0.15)	E (0.60, 0.20)		
68	B (1.4) C (1.4)	B (1.80, 0.55) C (0.80, 0.275) D (0.70, 0.20)	C (1.00, 0.275) D (0.70, 0.15)	D (0.60, 0.15)				
100		B (0.9, 1.7) C (0.80, 0.25) D (0.70, 0.13, 0.15, 0.14)	C (0.90, 0.25, 0.20) D (0.60, 0.10, 0.15)	D (0.60, 0.15, 0.125) E (0.60, 0.10)	E (0.50, 0.15)			
150		D (0.60, 0.15)	D (0.60, 0.10) E (0.50, 0.10)	E (0.50, 0.10)				
220		D (0.60, 0.10) E (0.50, 0.10)	D (0.60, 0.125) E (0.50, 0.10)	E (0.50, 0.10)				
330		D (0.60, 0.125) E (0.50, 0.10)						
470		E (0.50, 0.10)						

**Note**

- ESR limits in Ω shown in parenthesis

MARKING		
	<b>“A” CASE VOLTAGE CODE</b>	
	<b>VOLTS</b>	<b>CODE</b>
	4.0	G
	6.3	J
	10	A
	16	C
	20	D
	25	E
35	V	
50	T	
<b>Marking</b> Capacitor marking includes an anode (+) polarity band, capacitance in microfarads and the voltage rating. “A” Case capacitors use a letter code for the voltage and EIA capacitance code. The Vishay Sprague® trademark is included if space permits. Capacitors rated at 6.3 V are marked 6 V. A manufacturing date code is marked on all capacitors. Call the factory for further explanation.		

STANDARD RATINGS						
CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C (μA)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz (Ω)	MAX. RIPPLE 100 kHz I <sub>RMS</sub> (A)
<b>4 V<sub>DC</sub> AT + 85 °C; 2.7 V<sub>DC</sub> AT + 125 °C</b>						
4.7	A	TP3A475(1)004(2)6300AS	0.5	6	6.300	0.11
33	B	TP3B336(1)004(2)2000AS	1.3	6	2.000	0.21
33	C	TP3C336(1)004(2)2000AS	1.3	6	2.000	0.25
33	C	TP3C336(1)004(2)1800AS	1.3	6	1.800	0.25
33	C	TP3C336(1)004(2)0500AS	1.3	6	0.500	0.47
68	B	TP3B686(1)004(2)1400AS	2.7	6	1.400	0.28
68	C	TP3C686(1)004(2)1400AS	2.7	6	1.400	0.28
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT 125 °C</b>						
2.2	A	TP3A225(1)6R3(2)7600AS	0.5	6	7.600	0.10
2.2	A	TP3A225(1)6R3(2)6000AS	0.5	6	6.000	0.11
3.3	A	TP3A335(1)6R3(2)6300AS	0.5	6	6.300	0.11
3.3	A	TP3A335(1)6R3(2)5000AS	0.5	6	5.000	0.12
4.7	A	TP3A475(1)6R3(2)5500AS	0.5	6	5.500	0.12
4.7	A	TP3A475(1)6R3(2)3500AS	0.5	6	3.500	0.15
6.8	A	TP3A685(1)6R3(2)5000AS	0.5	6	5.000	0.12
6.8	B	TP3B685(1)6R3(2)3400AS	0.5	6	3.400	0.16
10	A	TP3A106(1)6R3(2)3400AS	0.6	6	3.400	0.15
10	A	TP3A106(1)6R3(2)2000AS	0.6	6	2.000	0.19
10	B	TP3B106(1)6R3(2)2900AS	0.6	6	2.900	0.17
10	B	TP3B106(1)6R3(2)1000AS	0.6	6	1.000	0.29
15	A	TP3A156(1)6R3(2)2900AS	0.9	6	2.900	0.16
15	A	TP3A156(1)6R3(2)2000AS	0.9	6	2.000	0.19
15	B	TP3B156(1)6R3(2)2500AS	0.9	6	2.500	0.18
22	A	TP3A226(1)6R3(2)2900AS	1.3	6	2.900	0.16
22	A	TP3A226(1)6R3(2)2000AS	1.3	6	2.000	0.19

**Note**

- Part number definitions:
  - Capacitance tolerance codes: K, M
  - Terminations and packaging codes: C, D, E, F
  - Lead (Pb)-free terminations and packaging codes: C, D





STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT 125 °C</b>						
22	B	TP3B226(1)6R3(2)2000AS	1.3	6	2.000	0.21
22	B	TP3B226(1)6R3(2)0600AS	1.3	6	0.600	0.38
22	C	TP3C226(1)6R3(2)1800AS	1.3	6	1.800	0.25
22	C	TP3C226(1)6R3(2)0500AS	1.3	6	0.500	0.47
33	A	TP3A336(1)6R3(2)2500AS	2.0	14	2.500	0.17
33	A	TP3A336(1)6R3(2)0800AS	2.0	14	0.800	0.31
33	B	TP3B336(1)6R3(2)1900AS	2.0	6	1.900	0.21
33	B	TP3B336(1)6R3(2)0600AS	2.0	6	0.600	0.38
33	C	TP3C336(1)6R3(2)1500AS	2.0	6	1.500	0.27
33	C	TP3C336(1)6R3(2)0375AS	2.0	6	0.375	0.54
47	B	TP3B476(1)6R3(2)1900AS	2.8	6	1.900	0.21
47	B	TP3B476(1)6R3(2)0600AS	2.8	6	0.600	0.38
47	B	TP3B476(1)6R3(2)0550AS	2.8	6	0.550	0.39
47	B	TP3B476(1)6R3(2)0500AS	2.8	6	0.500	0.41
47	C	TP3C476(1)6R3(2)1400AS	2.8	6	1.400	0.28
47	C	TP3C476(1)6R3(2)0300AS	2.8	6	0.300	0.61
47	D	TP3D476(1)6R3(2)0800AS	2.8	6	0.800	0.43
47	D	TP3D476(1)6R3(2)0200AS	2.8	6	0.200	0.87
68	B	TP3B686(1)6R3(2)1800AS	4.1	6	1.800	0.22
68	B	TP3B686(1)6R3(2)0550AS	4.1	6	0.550	0.39
68	C	TP3C686(1)6R3(2)0800AS	4.1	6	0.800	0.37
68	C	TP3C686(1)6R3(2)0275AS	4.1	6	0.275	0.63
68	D	TP3D686(1)6R3(2)0700AS	4.1	6	0.700	0.46
68	D	TP3D686(1)6R3(2)0200AS	4.1	6	0.200	0.87
100	B	TP3B107(1)6R3(2)0900AS	6.0	10	0.900	0.22
100	B	TP3B107(1)6R3(2)1700AS	6.0	10	1.700	0.22
100	C	TP3C107(1)6R3(2)0800AS	6.0	6	0.800	0.37
100	C	TP3C107(1)6R3(2)0250AS	6.0	6	0.250	0.66
100	D	TP3D107(1)6R3(2)0700AS	6.0	6	0.700	0.46
100	D	TP3D107(1)6R3(2)0150AS	6.0	6	0.150	1.00
100	D	TP3D107(1)6R3(2)0140AS	6.0	6	0.140	1.04
100	D	TP3D107(1)6R3(2)0130AS	6.0	6	0.130	1.07
150	D	TP3D157(1)6R3(2)0600AS	9.0	8	0.600	0.60
150	D	TP3D157(1)6R3(2)0150AS	9.0	8	0.150	1.10
220	D	TP3D227(1)6R3(2)0600AS	13.2	8	0.600	0.50
220	D	TP3D227(1)6R3(2)0100AS	13.2	8	0.100	1.22
220	E	TP3E227(1)6R3(2)0500AS	13.2	8	0.500	0.57
220	E	TP3E227(1)6R3(2)0100AS	13.2	8	0.100	1.28
330	D	TP3D337(1)6R3(2)0600AS	19.8	8	0.600	0.50
330	D	TP3D337(1)6R3(2)0125AS	19.8	8	0.125	1.10
330	E	TP3E337(1)6R3(2)0500AS	19.8	8	0.500	0.57
330	E	TP3E337(1)6R3(2)0100AS	19.8	8	0.100	1.28
470	E	TP3E477(1)6R3(2)0500AS	28.2	10	0.500	0.57
470	E	TP3E477(1)6R3(2)0100AS	28.2	10	0.100	1.28

**Note**

- Part number definitions:
  - Capacitance tolerance codes: K, M
  - Terminations and packaging codes: C, D, E, F
  - Lead (Pb)-free terminations and packaging codes: C, D



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT 125 °C</b>						
1.5	A	TP3A155(1)010(2)8000AS	0.5	6	8.000	0.10
1.5	A	TP3A155(1)010(2)6000AS	0.5	6	6.000	0.11
2.2	A	TP3A225(1)010(2)6300AS	0.5	6	6.300	0.11
3.3	A	TP3A335(1)010(2)5500AS	0.5	6	5.500	0.12
4.7	A	TP3A475(1)010(2)2000AS	0.5	6	2.000	0.19
4.7	A	TP3A475(1)010(2)5000AS	0.5	6	5.000	0.12
4.7	A	TP3A475(1)010(2)4500AS	0.5	6	4.500	0.13
4.7	A	TP3A475(1)010(2)3000AS	0.5	6	3.000	0.16
4.7	B	TP3B475(1)010(2)3400AS	0.5	6	3.400	0.16
4.7	B	TP3B475(1)010(2)1500AS	0.5	6	1.500	0.24
6.8	A	TP3A685(1)010(2)4200AS	0.7	6	4.200	0.13
6.8	A	TP3A685(1)010(2)3000AS	0.7	6	3.000	0.16
6.8	B	TP3B685(1)010(2)2900AS	0.7	6	2.900	0.17
6.8	B	TP3B685(1)010(2)1200AS	0.7	6	1.200	0.27
10	A	TP3A106(1)010(2)3400AS	1.0	6	3.400	0.15
10	A	TP3A106(1)010(2)2000AS	1.0	6	2.000	0.19
10	B	TP3B106(1)010(2)2500AS	1.0	6	2.500	0.18
10	B	TP3B106(1)010(2)0800AS	1.0	6	0.800	0.33
10	B	TP3B106(1)010(2)0600AS	1.0	6	0.600	0.38
10	C	TP3C106(1)010(2)1800AS	1.0	6	1.800	0.25
10	C	TP3C106(1)010(2)0550AS	1.0	6	0.550	0.45
15	A	TP3A156(1)010(2)2900AS	1.5	6	2.900	0.16
15	A	TP3A156(1)010(2)2000AS	1.5	6	2.000	0.19
15	B	TP3B156(1)010(2)2000AS	1.5	6	2.000	0.21
15	B	TP3B156(1)010(2)1200AS	1.5	6	1.200	0.27
15	B	TP3B156(1)010(2)0700AS	1.5	6	0.700	0.35
15	C	TP3C156(1)010(2)1800AS	1.5	6	1.800	0.25
15	C	TP3C156(1)010(2)0500AS	1.5	6	0.500	0.47
22	A	TP3A226(1)010(2)2500AS	2.2	8	2.500	0.17
22	A	TP3A226(1)010(2)1500AS	2.2	8	1.500	0.22
22	B	TP3B226(1)010(2)1900AS	2.2	6	1.900	0.21
22	B	TP3B226(1)010(2)0700AS	2.2	6	0.700	0.35
22	B	TP3B226(1)010(2)0600AS	2.2	6	0.600	0.38
22	C	TP3C226(1)010(2)1500AS	2.2	6	1.500	0.27
22	C	TP3C226(1)010(2)0400AS	2.2	6	0.400	0.52
22	C	TP3C226(1)010(2)0345AS	2.2	6	0.345	0.56
22	C	TP3C226(1)010(2)0245AS	2.2	6	0.245	0.67
33	B	TP3B336(1)010(2)1900AS	3.3	6	1.900	0.21
33	B	TP3B336(1)010(2)1500AS	3.3	6	1.500	0.24
33	B	TP3B336(1)010(2)0600AS	3.3	6	0.600	0.38
33	C	TP3C336(1)010(2)1400AS	3.3	6	1.400	0.28
33	C	TP3C336(1)010(2)0600AS	3.3	6	0.600	0.28
33	C	TP3C336(1)010(2)0300AS	3.3	6	0.300	0.61
33	D	TP3D336(1)010(2)0800AS	3.3	6	0.800	0.43

Note

- Part number definitions:
  - (1) Capacitance tolerance codes: K, M
  - (2) Terminations and packaging codes: C, D, E, F
  - (3) Lead (Pb)-free terminations and packaging codes: C, D



STANDARD RATINGS							
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)	
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT 125 °C</b>							
33	D	TP3D336(1)010(2)0250AS	3.3	6	0.250	0.77	
47	B	TP3B476(1)010(2)1800AS	4.7	6	1.800	0.22	
47	B	TP3B476(1)010(2)0600AS	4.7	6	0.600	0.38	
47	C	TP3C476(1)010(2)1100AS	4.7	6	1.100	0.32	
47	C	TP3C476(1)010(2)0300AS	4.7	6	0.300	0.61	
47	D	TP3D476(1)010(2)0700AS	4.7	6	0.700	0.46	
47	D	TP3D476(1)010(2)0200AS	4.7	6	0.200	0.87	
68	C	TP3C686(1)010(2)1000AS	6.8	6	1.000	0.33	
68	C	TP3C686(1)010(2)0275AS	6.8	6	0.275	0.63	
68	D	TP3D686(1)010(2)0700AS	6.8	6	0.700	0.46	
68	D	TP3D686(1)010(2)0150AS	6.8	6	0.150	1.00	
100	C	TP3C107(1)010(2)0900AS	10.0	8	0.900	0.35	
100	C	TP3C107(1)010(2)0250AS	10.0	8	0.250	0.66	
100	C	TP3C107(1)010(2)0200AS	10.0	8	0.200	0.74	
100	D	TP3D107(1)010(2)0600AS	10.0	8	0.600	0.50	
100	D	TP3D107(1)010(2)0150AS	10.0	8	0.150	1.00	
100	D	TP3D107(1)010(2)0100AS	10.0	8	0.100	1.22	
150	D	TP3D157(1)010(2)0600AS	15.0	8	0.600	0.50	
150	D	TP3D157(1)010(2)0100AS	15.0	8	0.100	1.22	
150	E	TP3E157(1)010(2)0500AS	15.0	8	0.500	0.57	
150	E	TP3E157(1)010(2)0100AS	15.0	8	0.100	1.28	
220	D	TP3D227(1)010(2)0600AS	22.0	8	0.600	0.50	
220	D	TP3D227(1)010(2)0125AS	22.0	8	0.125	1.10	
220	E	TP3E227(1)010(2)0500AS	22.0	8	0.500	0.57	
220	E	TP3E227(1)010(2)0100AS	22.0	8	0.100	1.28	
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>							
1.0	A	TP3A105(1)016(2)9300AS	0.5	4	9.300	0.09	
1.0	A	TP3A105(1)016(2)6000AS	0.5	4	6.000	0.11	
1.5	A	TP3A155(1)016(2)6700AS	0.5	6	6.700	0.11	
1.5	A	TP3A155(1)016(2)6000AS	0.5	6	6.000	0.11	
2.2	A	TP3A225(1)016(2)5900AS	0.5	6	5.900	0.11	
2.2	A	TP3A225(1)016(2)4000AS	0.5	6	4.000	0.14	
2.2	B	TP3B225(1)016(2)4600AS	0.5	6	4.600	0.14	
2.2	B	TP3B225(1)016(2)2500AS	0.5	6	2.500	0.18	
3.3	A	TP3A335(1)016(2)5000AS	0.5	6	5.000	0.12	
3.3	A	TP3A335(1)016(2)4000AS	0.5	6	4.000	0.14	
3.3	A	TP3A335(1)016(2)3500AS	0.5	6	3.500	0.15	
3.3	B	TP3B335(1)016(2)3500AS	0.5	6	3.500	0.16	
3.3	B	TP3B335(1)016(2)2000AS	0.5	6	2.000	0.21	
4.7	A	TP3A475(1)016(2)5000AS	0.8	6	5.000	0.12	
4.7	A	TP3A475(1)016(2)2500AS	0.8	6	2.500	0.17	
4.7	A	TP3A475(1)016(2)2000AS	0.8	6	2.000	0.19	
4.7	B	TP3B475(1)016(2)2900AS	0.8	6	2.900	0.17	
4.7	B	TP3B475(1)016(2)1500AS	0.8	6	1.500	0.24	

**Note**

- Part number definitions:
  - Capacitance tolerance codes: K, M
  - Terminations and packaging codes: C, D, E, F
  - Lead (Pb)-free terminations and packaging codes: C, D



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>						
6.8	A	TP3A685(1)016(2)4200AS	1.1	6	4.200	0.13
6.8	A	TP3A685(1)016(2)3800AS	1.1	6	3.800	0.14
6.8	A	TP3A685(1)016(2)3000AS	1.1	6	3.000	0.16
6.8	B	TP3B685(1)016(2)2500AS	1.1	6	2.500	0.18
6.8	C	TP3C685(1)016(2)1900AS	1.1	6	1.900	0.24
6.8	C	TP3C685(1)016(2)0600AS	1.1	6	0.600	0.43
10	A	TP3A106(1)016(2)3000AS	1.6	6	3.000	0.16
10	A	TP3A106(1)016(2)1700AS	1.6	6	1.700	0.21
10	B	TP3B106(1)016(2)2000AS	1.6	6	2.000	0.21
10	B	TP3B106(1)016(2)0800AS	1.6	6	0.800	0.33
10	C	TP3C106(1)016(2)1800AS	1.6	6	1.800	0.25
10	C	TP3C106(1)016(2)0450AS	1.6	6	0.450	0.49
15	B	TP3B156(1)016(2)2000AS	2.4	6	2.000	0.21
15	B	TP3B156(1)016(2)0800AS	2.4	6	0.800	0.33
15	C	TP3C156(1)016(2)1500AS	2.4	6	1.500	0.27
15	C	TP3C156(1)016(2)0400AS	2.4	6	0.400	0.52
22	B	TP3B226(1)016(2)1900AS	3.5	6	1.900	0.21
22	B	TP3B226(1)016(2)0700AS	3.5	6	0.700	0.35
22	B	TP3B226(1)016(2)0600AS	3.5	6	0.600	0.38
22	C	TP3C226(1)016(2)1400AS	3.5	6	1.400	0.28
22	C	TP3C226(1)016(2)0800AS	3.5	6	0.800	0.28
22	C	TP3C226(1)016(2)0375AS	3.5	6	0.375	0.54
22	C	TP3C226(1)016(2)0350AS	3.5	6	0.350	0.56
22	D	TP3D226(1)016(2)0800AS	3.5	6	0.800	0.43
22	D	TP3D226(1)016(2)0250AS	3.5	6	0.250	0.77
33	C	TP3C336(1)016(2)1100AS	5.3	6	1.100	0.32
33	C	TP3C336(1)016(2)0300AS	5.3	6	0.300	0.61
33	D	TP3D336(1)016(2)0700AS	5.3	6	0.700	0.46
33	D	TP3D336(1)016(2)0225AS	5.3	6	0.225	0.82
47	C	TP3C476(1)016(2)1000AS	7.5	6	1.000	0.33
47	C	TP3C476(1)016(2)0300AS	7.5	6	0.300	0.61
47	D	TP3D476(1)016(2)0700AS	7.5	6	0.700	0.46
47	D	TP3D476(1)016(2)0200AS	7.5	6	0.200	0.87
47	D	TP3D476(1)016(2)0150AS	7.5	6	0.150	1.00
47	D	TP3D476(1)016(2)0120AS	7.5	6	0.120	1.12
68	D	TP3D686(1)016(2)0600AS	10.9	6	0.600	0.50
68	D	TP3D686(1)016(2)0150AS	10.9	6	0.150	1.00
100	D	TP3D107(1)016(2)0600AS	16.0	8	0.600	0.50
100	D	TP3D107(1)016(2)0150AS	16.0	8	0.150	1.00
100	D	TP3D107(1)016(2)0125AS	16.0	8	0.125	1.10
100	E	TP3E107(1)016(2)0600AS	16.0	8	0.600	0.52
100	E	TP3E107(1)016(2)0100AS	16.0	8	0.100	1.28
150	E	TP3E157(1)016(2)0500AS	24.0	8	0.500	0.57
150	E	TP3E157(1)016(2)0100AS	24.0	8	0.100	1.28
220	E	TP3E227(1)016(2)0500AS	35.2	14	0.500	0.57
220	E	TP3E227(1)016(2)0100AS	35.2	14	0.100	1.28

Note

- Part number definitions:
  - (1) Capacitance tolerance codes: K, M
  - (2) Terminations and packaging codes: C, D, E, F
  - (3) Lead (Pb)-free terminations and packaging codes: C, D



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>						
0.68	A	TP3A684(1)020(2)10R0AS	0.5	4	10.000	0.09
0.68	A	TP3A684(1)020(2)8000AS	0.5	4	8.000	0.10
1.0	A	TP3A105(1)020(2)8400AS	0.5	4	8.400	0.09
1.0	A	TP3A105(1)020(2)5500AS	0.5	4	5.500	0.12
1.5	A	TP3A155(1)020(2)6300AS	0.5	6	6.300	0.11
2.2	A	TP3A225(1)020(2)5900AS	0.5	6	5.900	0.11
2.2	A	TP3A225(1)020(2)4000AS	0.5	6	4.000	0.14
2.2	B	TP3B225(1)020(2)3500AS	0.5	6	3.500	0.16
2.2	B	TP3B225(1)020(2)1500AS	0.5	6	1.500	0.24
3.3	A	TP3A335(1)020(2)5900AS	0.7	6	5.900	0.11
3.3	A	TP3A335(1)020(2)4000AS	0.7	6	4.000	0.14
3.3	B	TP3B335(1)020(2)3000AS	0.7	6	3.000	0.17
3.3	B	TP3B335(1)020(2)1300AS	0.7	6	1.300	0.26
4.7	A	TP3A475(1)020(2)5000AS	0.9	6	5.000	0.12
4.7	A	TP3A475(1)020(2)3500AS	0.9	6	3.500	0.15
4.7	B	TP3B475(1)020(2)2900AS	0.9	6	2.900	0.17
4.7	B	TP3B475(1)020(2)1000AS	0.9	6	1.000	0.29
4.7	C	TP3C475(1)020(2)2300AS	0.9	6	2.300	0.22
4.7	C	TP3C475(1)020(2)0600AS	0.9	6	0.600	0.43
6.8	B	TP3B685(1)020(2)2500AS	1.4	6	2.500	0.18
6.8	B	TP3B685(1)020(2)1000AS	1.4	6	1.000	0.29
6.8	C	TP3C685(1)020(2)1900AS	1.4	6	1.900	0.24
6.8	C	TP3C685(1)020(2)0550AS	1.4	6	0.550	0.45
10	B	TP3B106(1)020(2)2500AS	2.0	6	2.500	0.18
10	B	TP3B106(1)020(2)2100AS	2.0	6	2.100	0.20
10	B	TP3B106(1)020(2)1000AS	2.0	6	1.000	0.29
10	C	TP3C106(1)020(2)1700AS	2.0	6	1.700	0.25
10	C	TP3C106(1)020(2)0500AS	2.0	6	0.500	0.47
10	C	TP3C106(1)020(2)0450AS	2.0	6	0.450	0.49
15	B	TP3B156(1)020(2)2300AS	3.0	6	2.300	0.19
15	B	TP3B156(1)020(2)1000AS	3.0	6	1.000	0.29
15	C	TP3C156(1)020(2)1500AS	3.0	6	1.500	0.27
15	C	TP3C156(1)020(2)0400AS	3.0	6	0.400	0.52
15	D	TP3D156(1)020(2)0900AS	3.0	6	0.900	0.41
15	D	TP3D156(1)020(2)0300AS	3.0	6	0.300	0.71
22	C	TP3C226(1)020(2)1100AS	4.4	6	1.100	0.32
22	C	TP3C226(1)020(2)0375AS	4.4	6	0.375	0.54
22	D	TP3D226(1)020(2)0700AS	4.4	6	0.700	0.46
22	D	TP3D226(1)020(2)0225AS	4.4	6	0.225	0.82
33	C	TP3C336(1)020(2)1000AS	6.6	6	1.000	0.33
33	C	TP3C336(1)020(2)0350AS	6.6	6	0.350	0.56
33	D	TP3D336(1)020(2)0700AS	6.6	6	0.700	0.46
33	D	TP3D336(1)020(2)0200AS	6.6	6	0.200	0.87
47	D	TP3D476(1)020(2)0700AS	9.4	6	0.700	0.46

**Note**

- Part number definitions:
  - Capacitance tolerance codes: K, M
  - Terminations and packaging codes: C, D, E, F
  - Lead (Pb)-free terminations and packaging codes: C, D



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>						
47	D	TP3D476(1)020(2)0250AS	9.4	6	0.250	0.77
47	D	TP3D476(1)020(2)0200AS	9.4	6	0.200	0.87
47	D	TP3D476(1)020(2)0150AS	9.4	6	0.150	1.00
47	E	TP3E476(1)020(2)0600AS	9.4	6	0.600	0.52
47	E	TP3E476(1)020(2)0150AS	9.4	6	0.150	1.05
100	E	TP3E107(1)020(2)0500AS	20.0	8	0.500	0.57
100	E	TP3E107(1)020(2)0150AS	20.0	8	0.150	1.05
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>						
0.47	A	TP3A474(1)025(2)12R0AS	0.5	4	12.000	0.08
0.47	A	TP3A474(1)025(2)9000AS	0.5	4	9.000	0.09
0.68	A	TP3A684(1)025(2)8400AS	0.5	4	8.400	0.09
0.68	B	TP3B684(1)025(2)7000AS	0.5	4	7.000	0.11
0.68	B	TP3B684(1)025(2)5000AS	0.5	4	5.000	0.13
1.0	A	TP3A105(1)025(2)7600AS	0.5	4	7.600	0.10
1.0	A	TP3A105(1)025(2)4000AS	0.5	4	4.000	0.14
1.0	B	TP3B105(1)025(2)5000AS	0.5	4	5.000	0.13
1.0	B	TP3B105(1)025(2)2000AS	0.5	4	2.000	0.21
1.5	A	TP3A155(1)025(2)6700AS	0.5	6	6.700	0.11
1.5	A	TP3A155(1)025(2)4000AS	0.5	6	4.000	0.14
1.5	B	TP3B155(1)025(2)4600AS	0.5	6	4.600	0.14
1.5	B	TP3B155(1)025(2)2000AS	0.5	6	2.000	0.21
2.2	A	TP3A225(1)025(2)6300AS	0.6	6	6.300	0.11
2.2	A	TP3A225(1)025(2)4000AS	0.6	6	4.000	0.14
2.2	B	TP3B225(1)025(2)3800AS	0.6	6	3.800	0.15
2.2	B	TP3B225(1)025(2)1500AS	0.6	6	1.500	0.24
2.2	B	TP3B225(1)025(2)4000AS	0.6	6	4.000	0.24
2.2	C	TP3C225(1)025(2)2200AS	0.6	6	2.200	0.22
3.3	B	TP3B335(1)025(2)3100AS	0.8	6	3.100	0.17
3.3	B	TP3B335(1)025(2)1500AS	0.8	6	1.500	0.24
3.3	C	TP3C335(1)025(2)2300AS	0.8	6	2.300	0.22
3.3	C	TP3C335(1)025(2)1000AS	0.8	6	1.000	0.33
4.7	B	TP3B475(1)025(2)2800AS	1.2	6	2.800	0.17
4.7	B	TP3B475(1)025(2)1500AS	1.2	6	1.500	0.24
4.7	C	TP3C475(1)025(2)2000AS	1.2	6	2.000	0.24
4.7	C	TP3C475(1)025(2)0525AS	1.2	6	0.525	0.46
6.8	C	TP3C685(1)025(2)1700AS	1.7	6	1.700	0.25
6.8	C	TP3C685(1)025(2)0500AS	1.7	6	0.500	0.47
10	C	TP3C106(1)025(2)1500AS	2.5	6	1.500	0.27
10	C	TP3C106(1)025(2)0450AS	2.5	6	0.450	0.49
10	D	TP3D106(1)025(2)1000AS	2.5	6	1.000	0.39
10	D	TP3D106(1)025(2)0300AS	2.5	6	0.300	0.71
15	C	TP3C156(1)025(2)1200AS	3.8	6	1.200	0.30
15	C	TP3C156(1)025(2)0425AS	3.8	6	0.425	0.51
15	D	TP3D156(1)025(2)0800AS	3.8	6	0.800	0.43
15	D	TP3D156(1)025(2)0250AS	3.8	6	0.250	0.77
22	C	TP3C226(1)025(2)1200AS	5.5	6	1.200	0.30
22	C	TP3C226(1)025(2)0400AS	5.5	6	0.400	0.52
22	D	TP3D226(1)025(2)0700AS	5.5	6	0.700	0.46
22	D	TP3D226(1)025(2)0200AS	5.5	6	0.200	0.87
47	E	TP3E476(1)025(2)0600AS	11.8	6	0.600	0.52
47	E	TP3E476(1)025(2)0200AS	11.8	6	0.200	0.91

**Note**

- Part number definitions:
  - (1) Capacitance tolerance codes: K, M
  - (2) Terminations and packaging codes: C, D, E, F
  - (3) Lead (Pb)-free terminations and packaging codes: C, D



STANDARD RATINGS							
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)	
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>							
0.10	A	TP3A104(1)035(2)20R0AS	0.5	4	20.000	0.06	
0.10	A	TP3A104(1)035(2)10R0AS	0.5	4	10.000	0.09	
0.22	A	TP3A224(1)035(2)15R0AS	0.5	4	15.000	0.07	
0.22	A	TP3A224(1)035(2)6000AS	0.5	4	6.000	0.11	
0.33	A	TP3A334(1)035(2)13R0AS	0.5	4	13.000	0.08	
0.33	A	TP3A334(1)035(2)6000AS	0.5	4	6.000	0.11	
0.47	A	TP3A474(1)035(2)10R0AS	0.5	4	10.000	0.09	
0.47	A	TP3A474(1)035(2)4000AS	0.5	4	4.000	0.14	
0.47	B	TP3B474(1)035(2)8000AS	0.5	4	8.000	0.10	
0.47	B	TP3B474(1)035(2)2500AS	0.5	4	2.500	0.18	
0.68	A	TP3A684(1)035(2)7600AS	0.5	4	7.600	0.10	
0.68	A	TP3A684(1)035(2)4000AS	0.5	4	4.000	0.14	
0.68	B	TP3B684(1)035(2)6500AS	0.5	4	6.500	0.11	
0.68	B	TP3B684(1)035(2)2500AS	0.5	4	2.500	0.18	
1.0	A	TP3A105(1)035(2)7500AS	0.5	4	7.500	0.10	
1.0	A	TP3A105(1)035(2)6000AS	0.5	4	6.000	0.11	
1.0	A	TP3A105(1)035(2)4000AS	0.5	4	4.000	0.14	
1.0	B	TP3B105(1)035(2)5000AS	0.5	4	5.000	0.13	
1.0	B	TP3B105(1)035(2)2000AS	0.5	4	2.000	0.21	
1.5	B	TP3B155(1)035(2)4200AS	0.5	6	4.200	0.14	
1.5	B	TP3B155(1)035(2)2000AS	0.5	6	2.000	0.21	
1.5	C	TP3C155(1)035(2)3800AS	0.5	6	3.800	0.17	
2.2	B	TP3B225(1)035(2)3800AS	0.8	6	3.800	0.15	
2.2	B	TP3B225(1)035(2)2000AS	0.8	6	2.000	0.21	
2.2	C	TP3C225(1)035(2)2900AS	0.8	6	2.900	0.20	
2.2	C	TP3C225(1)035(2)0900AS	0.8	6	0.900	0.35	
3.3	B	TP3B335(1)035(2)3500AS	1.2	6	3.500	0.16	
3.3	C	TP3C335(1)035(2)2100AS	1.2	6	2.100	0.23	
3.3	C	TP3C335(1)035(2)0700AS	1.2	6	0.700	0.40	
4.7	B	TP3B475(1)035(2)3100AS	1.7	6	3.100	0.17	
4.7	B	TP3B475(1)035(2)1500AS	1.7	6	1.500	0.24	
4.7	C	TP3C475(1)035(2)1900AS	1.6	6	1.900	0.24	
4.7	C	TP3C475(1)035(2)0500AS	1.6	6	0.500	0.47	
4.7	D	TP3D475(1)035(2)1300AS	1.6	6	1.300	0.34	
4.7	D	TP3D475(1)035(2)0450AS	1.6	6	0.450	0.58	
6.8	C	TP3C685(1)035(2)1800AS	2.4	6	1.800	0.25	
6.8	C	TP3C685(1)035(2)0475AS	2.4	6	0.475	0.48	
6.8	D	TP3D685(1)035(2)1800AS	2.4	6	1.800	0.37	
6.8	D	TP3D685(1)035(2)1100AS	2.4	6	1.100	0.37	
6.8	D	TP3D685(1)035(2)0300AS	2.4	6	0.300	0.71	
10	C	TP3C106(1)035(2)1600AS	3.5	6	1.600	0.26	
10	C	TP3C106(1)035(2)0450AS	3.5	6	0.450	0.49	
10	D	TP3D106(1)035(2)0800AS	3.5	6	0.800	0.43	
10	D	TP3D106(1)035(2)0300AS	3.5	6	0.300	0.71	

**Note**

- Part number definitions:
  - (1) Capacitance tolerance codes: K, M
  - (2) Terminations and packaging codes: C, D, E, F
  - (3) Lead (Pb)-free terminations and packaging codes: C, D





STANDARD RATINGS							
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)	
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>							
10	D	TP3D106(1)035(2)0135AS	3.5	6	0.135	1.05	
15	D	TP3D156(1)035(2)0700AS	5.3	6	0.700	0.46	
15	D	TP3D156(1)035(2)0300AS	5.3	6	0.300	0.71	
15	D	TP3D156(1)035(2)0260AS	5.3	6	0.260	0.76	
22	D	TP3D226(1)035(2)0600AS	7.7	6	0.600	0.50	
22	D	TP3D226(1)035(2)0300AS	7.7	6	0.300	0.71	
22	D	TP3D226(1)035(2)0200AS	7.7	6	0.200	0.87	
22	E	TP3E226(1)035(2)0600AS	7.7	6	0.600	0.52	
22	E	TP3E226(1)035(2)0275AS	7.7	6	0.275	0.77	
<b>50 V<sub>DC</sub> AT + 85 °C; 33 V<sub>DC</sub> AT + 125 °C</b>							
0.10	A	TP3A104(1)050(2)19R0AS	0.5	4	19.000	0.06	
0.10	A	TP3A104(1)050(2)10R0AS	0.5	4	10.000	0.09	
0.22	A	TP3A224(1)050(2)15R0AS	0.5	4	15.000	0.07	
0.22	B	TP3B224(1)050(2)12R0AS	0.5	4	12.000	0.08	
0.22	B	TP3B224(1)050(2)8500AS	0.5	4	8.500	0.10	
0.33	B	TP3B334(1)050(2)10R0AS	0.5	4	10.000	0.09	
0.33	B	TP3B334(1)050(2)4500AS	0.5	4	4.500	0.14	
0.47	B	TP3B474(1)050(2)8400AS	0.5	4	8.400	0.10	
0.47	B	TP3B474(1)050(2)4000AS	0.5	4	4.000	0.15	
1.0	B	TP3B105(1)050(2)6700AS	0.5	4	6.700	0.11	
1.0	C	TP3C105(1)050(2)4600AS	0.5	4	4.600	0.16	
1.0	C	TP3C105(1)050(2)1600AS	0.5	4	1.600	0.26	
2.2	C	TP3C225(1)050(2)2900AS	1.1	6	2.900	0.20	
2.2	C	TP3C225(1)050(2)1500AS	1.1	6	1.500	0.27	
2.2	D	TP3D225(1)050(2)2100AS	1.1	6	2.100	0.27	
2.2	D	TP3D225(1)050(2)0800AS	1.1	6	0.800	0.43	
3.3	C	TP3C335(1)050(2)2500AS	1.7	6	2.500	0.21	
3.3	C	TP3C335(1)050(2)1500AS	1.7	6	1.500	0.27	
3.3	D	TP3D335(1)050(2)1700AS	1.7	6	1.700	0.30	
3.3	D	TP3D335(1)050(2)0800AS	1.7	6	0.800	0.43	
4.7	D	TP3D475(1)050(2)1200AS	2.4	6	1.200	0.37	
4.7	D	TP3D475(1)050(2)0600AS	2.4	6	0.600	0.50	
4.7	D	TP3D475(1)050(2)0300AS	2.4	6	0.300	0.71	
6.8	D	TP3D685(1)050(2)0900AS	3.4	6	0.900	0.41	
6.8	D	TP3D685(1)050(2)0600AS	3.4	6	0.600	0.50	
10	D	TP3D106(1)050(2)0800AS	5.0	6	0.800	0.43	
10	D	TP3D106(1)050(2)0550AS	5.0	6	0.550	0.52	
10	E	TP3E106(1)050(2)0800AS	5.0	6	0.800	0.45	
10	E	TP3E106(1)050(2)0550AS	5.0	6	0.550	0.55	
10	E	TP3E106(1)050(2)0300AS	5.0	6	0.300	0.74	

**Note**

- Part number definitions:
  - Capacitance tolerance codes: K, M
  - Terminations and packaging codes: C, D, E, F
  - Lead (Pb)-free terminations and packaging codes: C, D

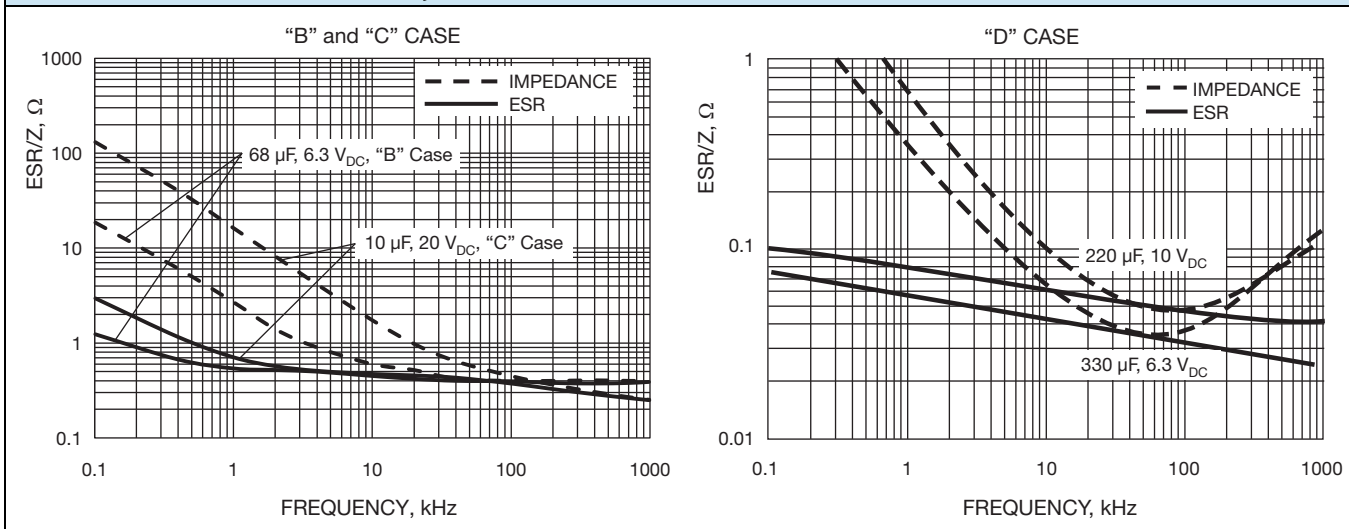
**RECOMMENDED VOLTAGE DERATING GUIDELINES** (for temperatures below + 85 °C)

**STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS**

Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.6
10	6.0
16	10
20	12
25	15
35	24
50	28

**SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS**

Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24

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

**POWER DISSIPATION**

CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
A	0.075
B	0.085
C	0.110
D	0.150
E	0.165



STANDARD PACKAGING QUANTITY		
CASE CODE	UNITS PER REEL	
	7" REEL	13" REEL
A	2000	9000
B	2000	8000
C	500	3000
D	500	2500
E	400	1500

PRODUCT INFORMATION	
Guide for Molded Tantalum Capacitors	<a href="http://www.vishay.com/doc?40074">www.vishay.com/doc?40074</a>
Pad Dimensions	
Packaging Dimensions	
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
SELECTOR GUIDES	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
FAQ	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

## Solid Tantalum Surface Mount Capacitors TANTAMOUNT® Molded Case, High Temperature


**FEATURES**

- Operating temperature up to 150 °C with 50 % voltage derating
- High reliability
- RoHS compliant terminations available: Matte tin (all cases) or gold (D/E cases)
- Standard EIA 535BAAC case sizes (A through E)
- AEC-Q200 qualified
- 100 % surge current tested (B, C, D, E case sizes)
- Compliant to RoHS Directive 2002/95/EC
- Moisture sensitivity level 1

AUTOMOTIVE GRADE


**RoHS\***  
COMPLIANT

**Note**

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

**PERFORMANCE/ELECTRICAL CHARACTERISTICS**
**Operating Temperature:** - 55 °C to + 150 °C

**Note**

- Refer to doc. 40088

**Capacitance Range:** 0.33 µF to 220 µF

**Capacitance Tolerance:** ± 10 %, ± 20 %

**Voltage Rating:** 6.3 V<sub>DC</sub> to 50 V<sub>DC</sub>

ORDERING INFORMATION						
TH3	D	106	K	035	C	0700
TYPE	CASE CODE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	TERMINATION AND PACKAGING	ESR
	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 V. To complete the three-digit block, zeros precede the voltage rating. A decimal point is indicated by an "R" (6R3 = 6.3 V)	A: Gold/7" (178 mm) reels <sup>(1)</sup> B: Gold/13" (330 mm) reels <sup>(1)</sup> C: Matte tin/7" (178 mm) reels D: Matte tin/13" (330 mm) reels E: Tin/lead/7" (178 mm) reels F: Tin/lead/13" (330 mm) reels	Maximum 100 kHz ESR 0500 = 500 mΩ 5000 = 5.0 Ω 10R0 = 10.0 Ω

**Notes**

- We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size. Voltage substitutions will be marked with the higher voltage rating.
- <sup>(1)</sup> Contact factory for availability

DIMENSIONS in inches [millimeters]							
CASE CODE	EIA SIZE	L	W	H	P	Tw	Th (MIN.)
A	3216-18	0.126 ± 0.008 [3.2 ± 0.20]	0.063 ± 0.008 [1.6 ± 0.20]	0.063 ± 0.008 [1.6 ± 0.20]	0.031 ± 0.012 [0.80 ± 0.30]	0.047 ± 0.004 [1.2 ± 0.10]	0.028 [0.70]
B	3528-21	0.138 ± 0.008 [3.5 ± 0.20]	0.110 ± 0.008 [2.8 ± 0.20]	0.075 ± 0.008 [1.9 ± 0.20]	0.031 ± 0.012 [0.80 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.028 [0.70]
C	6032-28	0.236 ± 0.012 [6.0 ± 0.30]	0.126 ± 0.012 [3.2 ± 0.30]	0.098 ± 0.012 [2.5 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.039 [1.0]
D	7343-31	0.287 ± 0.012 [7.3 ± 0.30]	0.170 ± 0.012 [4.3 ± 0.30]	0.110 ± 0.012 [2.8 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.095 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]
E	7343-43	0.287 ± 0.012 [7.3 ± 0.30]	0.170 ± 0.012 [4.3 ± 0.30]	0.158 ± 0.012 [4.0 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.095 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]

RATINGS AND CASE CODES							
μF	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V
0.33						A (11.0)	
0.47					A (8.5)		
1.0			A (6.5)	A (5.9)	A (5.2, 3.0) B (5.0)	A (6.6) B (4.4)	C (3.3)
1.5						B (4.2) C (3.3)	
2.2		A (4.6)	A (4.3)	A (5.9) B (3.5)	A (5.2) B (3.0)	B (2.5) C (2.2)	
3.3			A (3.4) B (3.0)	B (2.7) C (2.7)	B (3.0) C (2.0)	B (3.5, 2.5) C (1.7)	D (1.7)
4.7		A (2.9) B (2.7)	A (2.9) B (2.1)	A (5.0) B (2.9, 1.9) C (1.7)	A (5.0) B (2.8) C (1.6)	B (3.1) C (1.3) D (1.0)	C (1.5) D (0.9)
6.8			A (2.6, 2.0) B (1.8) C (1.7)	B (2.4) C (1.4)	C (1.8) D (0.9)	D (0.9)	
10	A (2.7)	A (3.4) B (1.8) C (1.7, 1.8)	B (2.0) C (1.4)	C (1.1)	C (1.1) D (0.9)	C (1.6) D (0.3, 0.7)	D (0.8) E (0.5)
15	B (1.8)	B (1.5, 1.8) C (1.4, 1.8)	B (2.0) C (1.0)	B (2.0) C (1.0) D (0.9)	B (2.0, 1.4) C (1.2) D (0.7)	D (0.7)	
22	B (1.5)	B (1.5) C (1.1)	B (1.9) C (1.0) D (0.8)	C (1.0) D (0.7)	D (0.6)	D (0.6, 0.3) E (0.5)	
33	B (1.7)	D (0.8)	C (0.9) D (0.6)	D (0.6)	D (0.5)		
47	B (1.8) C (0.8)	B (1.8) C (0.8, 0.5) D (0.6)	C (0.8) D (0.6)	D (0.7) E (0.6)	E (0.6)		
68	B (1.8)	C (0.8, 1.0) D (1.0, 0.6, 0.4)	D (0.6)	E (0.6)			
100		D (0.6)	D (0.6) E (0.6, 0.15)				
150		D (0.6)					
220		E (0.5)					

**Note**

- ESR limits in Ω are shown in parenthesis

MARKING																					
<p><b>A Case</b></p>	<b>"A" CASE VOLTAGE CODE</b> <table border="1"> <thead> <tr> <th>VOLTS</th> <th>CODE</th> </tr> </thead> <tbody> <tr> <td>4.0</td> <td>G</td> </tr> <tr> <td>6.3</td> <td>J</td> </tr> <tr> <td>10</td> <td>A</td> </tr> <tr> <td>16</td> <td>C</td> </tr> <tr> <td>20</td> <td>D</td> </tr> <tr> <td>25</td> <td>E</td> </tr> <tr> <td>35</td> <td>V</td> </tr> <tr> <td>50</td> <td>T</td> </tr> </tbody> </table>		VOLTS	CODE	4.0	G	6.3	J	10	A	16	C	20	D	25	E	35	V	50	T	<p><b>B, C, D, E Case</b></p>
	VOLTS	CODE																			
4.0	G																				
6.3	J																				
10	A																				
16	C																				
20	D																				
25	E																				
35	V																				
50	T																				
<b>Marking</b> Capacitor marking includes an anode (+) polarity band, capacitance in microfarads and the voltage rating. "A" case capacitors use a letter code for the voltage and EIA capacitance code. The Vishay Sprague® trademark is included if space permits. Capacitors rated at 6.3 V are marked 6 V. A manufacturing date code is marked on all capacitors. Call the factory for further explanation.																					



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 ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)	
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT + 125 °C; 3.15 V<sub>DC</sub> AT + 150 °C</b>							
10	A	TH3A106(1)6R3(2)2700	0.6	6	2.700	0.17	
15	B	TH3B156(1)6R3(2)1800	0.9	6	1.800	0.22	
22	B	TH3B226(1)6R3(2)1500	1.3	6	1.500	0.24	
33	B	TH3B336(1)6R3(2)1700	2.0	6	1.700	0.22	
47	B	TH3B476(1)6R3(2)1800	2.8	8	1.800	0.22	
47	C	TH3C476(1)6R3(2)0800	2.8	6	0.800	0.37	
68	B	TH3B686(1)6R3(2)1800	4.1	6	1.800	0.22	
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT + 125 °C; 5 V<sub>DC</sub> AT + 150 °C</b>							
2.2	A	TH3A225(1)010(2)4600	0.5	6	4.600	0.13	
4.7	A	TH3A475(1)010(2)2900	0.5	6	2.900	0.16	
4.7	B	TH3B475(1)010(2)2700	0.5	6	2.700	0.18	
10	A	TH3A106(1)010(2)3400	1.0	6	3.400	0.15	
10	B	TH3B106(1)010(2)1800	1.0	6	1.800	0.22	
10	C	TH3C106(1)010(2)1800	1.0	6	1.800	0.25	
10	C	TH3C106(1)010(2)1700	1.0	6	1.700	0.25	
15	B	TH3B156(1)010(2)1800	1.0	6	1.800	0.22	
15	B	TH3B156(1)010(2)1500	1.0	6	1.500	0.24	
15	C	TH3C156(1)010(2)1800	1.0	6	1.800	0.25	
15	C	TH3C156(1)010(2)1400	1.0	6	1.400	0.28	
22	B	TH3B226(1)010(2)1500	2.2	6	1.500	0.24	
22	C	TH3C226(1)010(2)1100	2.2	6	1.100	0.32	
33	D	TH3D336(1)010(3)0800	3.3	6	0.800	0.43	
47	B	TH3B476(1)010(2)1800	4.7	6	1.800	0.22	
47	C	TH3C476(1)010(2)0800	4.7	6	0.800	0.37	
47	C	TH3C476(1)010(2)0500	4.7	6	0.500	0.47	
47	D	TH3D476(1)010(3)0600	4.7	6	0.600	0.50	
68	C	TH3C686(1)010(2)1000	6.8	8	1.000	0.33	
68	C	TH3C686(1)010(2)0800	6.8	8	0.800	0.37	
68	D	TH3D686(1)010(3)1000	6.8	6	1.000	0.39	
68	D	TH3D686(1)010(3)0600	6.8	6	0.600	0.50	
68	D	TH3D686(1)010(3)0400	6.8	6	0.400	0.61	
100	D	TH3D107(1)010(3)0600	10.0	8	0.600	0.50	
150	D	TH3D157(1)010(3)0600	15.0	8	0.600	0.50	
220	E	TH3E227(1)010(3)0500	22.0	8	0.500	0.61	
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C; 8 V<sub>DC</sub> AT + 150 °C</b>							
1.0	A	TH3A105(1)016(2)6500	0.5	4	6.500	0.11	
2.2	A	TH3A225(1)016(2)4300	0.5	6	4.300	0.13	
3.3	A	TH3A335(1)016(2)3400	0.5	6	3.400	0.15	
3.3	B	TH3B335(1)016(2)3000	0.5	6	3.000	0.17	
4.7	A	TH3A475(1)016(2)2900	0.8	6	2.900	0.16	
4.7	B	TH3B475(1)016(2)2100	0.8	6	2.100	0.20	
6.8	A	TH3A685(1)016(2)2600	1.1	6	2.600	0.17	
6.8	A	TH3A685(1)016(2)2000	1.1	6	2.000	0.19	
6.8	B	TH3B685(1)016(2)1800	1.1	6	1.800	0.22	
6.8	C	TH3C685(1)016(2)1700	1.1	6	1.700	0.25	
10	B	TH3B106(1)016(2)2000	1.6	6	2.000	0.21	
10	C	TH3C106(1)016(2)1400	1.6	6	1.400	0.28	

**Note**

- Part number definitions:
  - (1) Capacitance tolerance: K, M
  - (2) Termination and packaging: C, D, E, F
  - (3) Termination and packaging: A, B, C, D, E, F



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 ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)	
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C; 8 V<sub>DC</sub> AT + 150 °C</b>							
15	B	TH3B156(1)016(2)2000	2.4	6	2.000	0.21	
22	B	TH3B226(1)016(2)1900	3.5	6	1.900	0.21	
22	C	TH3C226(1)016(2)1000	3.5	6	1.000	0.33	
22	D	TH3D226(1)016(3)0800	3.5	6	0.800	0.43	
33	C	TH3C336(1)016(2)0900	5.3	6	0.900	0.35	
33	D	TH3D336(1)016(3)0600	5.3	6	0.600	0.50	
47	C	TH3C476(1)016(2)0800	7.5	6	0.800	0.37	
47	D	TH3D476(1)016(3)0600	7.5	6	0.600	0.50	
68	D	TH3D686(1)016(3)0600	10.9	6	0.600	0.50	
100	D	TH3D107(1)016(3)0600	16.0	8	0.600	0.50	
100	E	TH3E107(1)016(3)0600	16.0	8	0.600	0.56	
100	E	TH3E107(1)016(3)0150	16.0	8	0.150	1.11	
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C; 10 V<sub>DC</sub> AT + 150 °C</b>							
1.0	A	TH3A105(1)020(2)5900	0.5	4	5.900	0.11	
2.2	A	TH3A225(1)020(2)5900	0.5	6	5.900	0.11	
2.2	B	TH3B225(1)020(2)3500	0.5	6	3.500	0.16	
3.3	B	TH3B335(1)020(2)2700	0.7	6	2.700	0.18	
3.3	C	TH3C335(1)020(2)2700	0.7	6	2.700	0.20	
4.7	A	TH3A475(1)020(2)5000	0.9	6	5.000	0.12	
4.7	B	TH3B475(1)020(2)2900	0.9	6	2.900	0.17	
4.7	B	TH3B475(1)020(2)1900	0.9	6	1.900	0.21	
4.7	C	TH3C475(1)020(2)1700	0.9	6	1.700	0.25	
10	C	TH3C106(1)020(2)1100	2.0	6	1.100	0.32	
15	C	TH3C156(1)016(2)1000	2.4	6	1.000	0.33	
15	B	TH3B156(1)020(2)2000	3.0	6	2.000	0.21	
15	C	TH3C156(1)020(2)1000	3.0	6	1.000	0.33	
15	D	TH3D156(1)020(3)0900	3.0	6	0.900	0.41	
22	C	TH3C226(1)020(2)1000	4.4	6	1.000	0.33	
22	D	TH3D226(1)020(3)0700	4.4	6	0.700	0.46	
33	D	TH3D336(1)020(3)0600	6.6	6	0.600	0.50	
47	D	TH3D476(1)020(3)0700	9.4	6	0.700	0.46	
47	E	TH3E476(1)020(3)0600	9.4	6	0.600	0.56	
68	E	TH3E686(1)020(3)0600	13.6	6	0.600	0.56	
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C; 12.5 V<sub>DC</sub> AT + 150 °C</b>							
0.47	A	TH3A474(1)025(2)8500	0.5	4	8.500	0.09	
1.0	A	TH3A105(1)025(2)5200	0.5	4	5.200	0.12	
1.0	A	TH3A105(1)025(2)3000	0.5	4	3.000	0.16	
1.0	B	TH3B105(1)025(2)5000	0.5	4	5.000	0.13	
2.2	A	TH3A225(1)025(2)5200	0.6	6	5.200	0.12	
2.2	B	TH3B225(1)025(2)3000	0.6	6	3.000	0.17	
3.3	B	TH3B335(1)025(2)3000	0.8	6	3.000	0.17	
3.3	C	TH3C335(1)025(2)2000	0.8	6	2.000	0.23	
4.7	A	TH3A475(1)025(2)5000	1.2	6	5.000	0.12	
4.7	B	TH3B475(1)025(2)2800	1.2	6	2.800	0.17	
4.7	C	TH3C475(1)025(2)1600	1.2	6	1.600	0.26	
6.8	B	TH3B685(1)025(2)2400	1.7	6	2.400	0.19	

**Note**

- Part number definitions:
  - (1) Capacitance tolerance: K, M
  - (2) Termination and packaging: C, D, E, F
  - (3) Termination and packaging: A, B, C, D, E, F



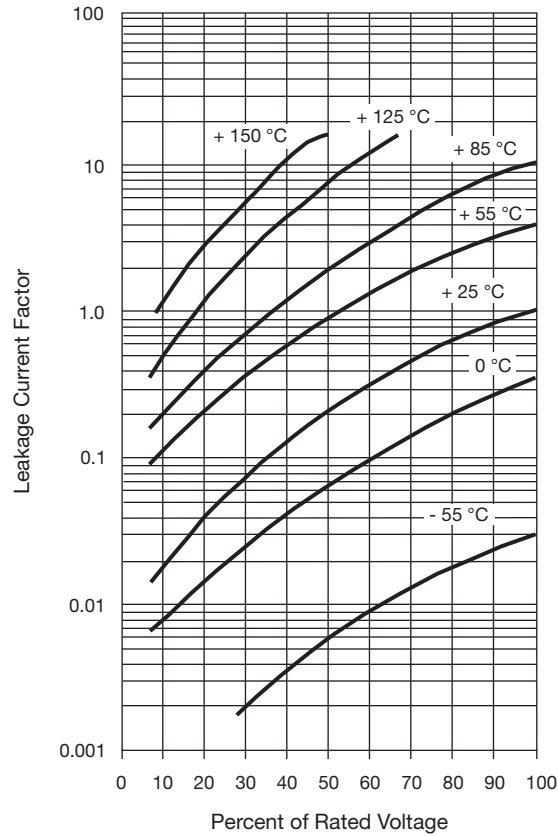


STANDARD RATINGS							
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)	
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C; 12.5 V<sub>DC</sub> AT + 150 °C</b>							
6.8	C	TH3C685(1)025(2)1400	1.7	6	1.400	0.28	
10	C	TH3C106(1)025(2)1100	2.5	6	1.100	0.32	
10	D	TH3D106(1)025(2)0900	2.5	6	0.900	0.41	
15	B	TH3B156(1)025(2)2000	3.8	6	2.000	0.21	
15	B	TH3B156(1)025(2)1400	3.8	6	1.400	0.25	
15	C	TH3C156(1)025(2)1200	3.8	6	1.200	0.30	
15	D	TH3D156(1)025(3)0700	3.8	6	0.700	0.46	
22	D	TH3D226(1)025(3)0600	5.5	6	0.600	0.50	
33	D	TH3D336(1)025(3)0500	8.3	6	0.500	0.55	
47	E	TH3E476(1)025(3)0600	11.8	6	0.600	0.56	
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C; 17.5 V<sub>DC</sub> AT + 150 °C</b>							
0.33	A	TH3A334(1)035(2)11R0	0.5	4	11.000	0.08	
1.0	A	TH3A105(1)035(2)6600	0.5	4	6.600	0.11	
1.0	B	TH3B105(1)035(2)4400	0.5	4	4.400	0.14	
1.5	B	TH3B155(1)035(2)4200	0.5	6	4.200	0.14	
1.5	C	TH3C155(1)035(2)3300	0.5	6	3.300	0.18	
2.2	B	TH3B225(1)035(2)2500	0.8	6	2.500	0.18	
2.2	C	TH3C225(1)035(2)2200	0.8	6	2.200	0.22	
3.3	B	TH3B335(1)035(2)3500	1.2	6	3.500	0.16	
3.3	B	TH3B335(1)035(2)2500	1.2	6	2.500	0.18	
3.3	C	TH3C335(1)035(2)1700	1.2	6	1.700	0.25	
4.7	B	TH3B475(1)035(2)3100	1.7	6	3.100	0.17	
4.7	C	TH3C475(1)035(2)1300	1.6	6	1.300	0.29	
4.7	D	TH3D475(1)035(3)1000	1.6	6	1.000	0.39	
6.8	C	TH3C685(1)035(2)1800	2.4	6	1.800	0.25	
6.8	D	TH3D685(1)035(3)0900	2.4	6	0.900	0.41	
10	C	TH3C106(1)035(2)1600	3.5	6	1.600	0.26	
10	D	TH3D106(1)035(3)0700	3.5	6	0.700	0.46	
10	D	TH3D106(1)035(3)0300	3.5	6	0.300	0.71	
15	D	TH3D156(1)035(3)0700	5.3	6	0.700	0.46	
22	D	TH3D226(1)035(3)0600	7.7	6	0.600	0.50	
22	D	TH3D226(1)035(3)0300	7.7	6	0.300	0.71	
22	E	TH3E226(1)035(3)0500	7.7	6	0.500	0.61	
<b>50 V<sub>DC</sub> AT + 85 °C; 33 V<sub>DC</sub> AT + 125 °C; 25 V<sub>DC</sub> AT + 150 °C</b>							
1.0	C	TH3C105(1)050(2)3300	0.5	4	3.300	0.18	
3.3	D	TH3D335(1)050(3)1700	1.7	6	1.700	0.30	
4.7	C	TH3C475(1)050(2)1500	2.4	6	1.500	0.27	
4.7	D	TH3D475(1)050(3)0900	2.4	6	0.900	0.41	
6.8	D	TH3D685(1)050(3)0900	3.4	6	0.900	0.41	
10	D	TH3D106(1)050(3)0800	5.0	6	0.800	0.43	
10	E	TH3E106(1)050(3)0500	5.0	6	0.500	0.61	

**Note**

- Part number definitions:
  - (1) Capacitance tolerance: K, M
  - (2) Termination and packaging: C, D, E, F
  - (3) Termination and packaging: A, B, C, D, E, F

**TYPICAL LEAKAGE CURRENT FACTOR**

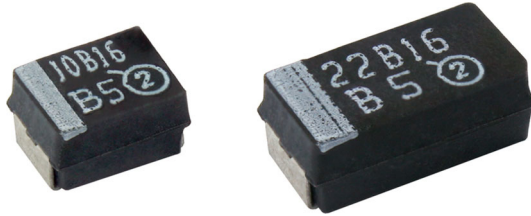


**Note**

- 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.
- At + 150 °C, the leakage current shall not exceed 15 times the value listed in the Standard Ratings table.

# Solid Tantalum Surface Mount Capacitors

## TANTAMOUNT<sup>®</sup> Molded Case, High Temperature - 175 °C


**FEATURES**

- Operating temperature up to 175 °C with 50 % voltage derating
- RoHS compliant terminations available: Matte tin (all cases)
- Standard EIA 535BAAC case sizes
- 100 % surge current tested
- AEC-Q200 qualified
- Compliant to RoHS Directive 2002/95/EC

AUTOMOTIVE GRADE


**RoHS\***  
COMPLIANT

**Note**

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

**PERFORMANCE/ELECTRICAL CHARACTERISTICS**
[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)
**Operating Temperature:** - 55 °C to + 175 °C

**Capacitance Range:** 10 µF to 47 µF

**Capacitance Tolerance:** ± 10 %, ± 20 %

**Voltage Rating:** 6.3 V<sub>DC</sub> to 16 V<sub>DC</sub>

ORDERING INFORMATION						
TH4	C	226	K	016	C	1000
TYPE	CASE CODE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	TERMINATION AND PACKAGING	ESR
	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 V. To complete the three-digit block, zeros precede the voltage rating. A decimal point is indicated by an "R" (6R3 = 6.3 V)	C: Matte tin/7" (178 mm) reels D: Matte tin/13" (330 mm) reels	Maximum 100 kHz ESR 0500 = 500 mΩ 5000 = 5.0 Ω 10R0 = 10.0 Ω

**Note**

- We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size. Voltage substitutions will be marked with the higher voltage rating.

DIMENSIONS in inches [millimeters]							
CASE CODE	EIA SIZE	L	W	H	P	T <sub>w</sub>	T <sub>H</sub> (MIN.)
B	3528-21	0.138 ± 0.008 [3.5 ± 0.20]	0.110 ± 0.008 [2.8 ± 0.20]	0.075 ± 0.008 [1.9 ± 0.20]	0.031 ± 0.012 [0.80 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.028 [0.70]
C	6032-28	0.236 ± 0.012 [6.0 ± 0.30]	0.126 ± 0.012 [3.2 ± 0.30]	0.098 ± 0.012 [2.5 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.039 [1.0]

<b>RATINGS AND CASE CODES</b>			
$\mu\text{F}$	<b>6.3 V</b>	<b>10 V</b>	<b>16 V</b>
10	B (1.8)	B (1.8)	B (2.0)
22	B (1.5)	B (1.6) C (1.4)	B (1.9) C (1.4)
47	C (0.8)	C (0.5)	C (0.8)

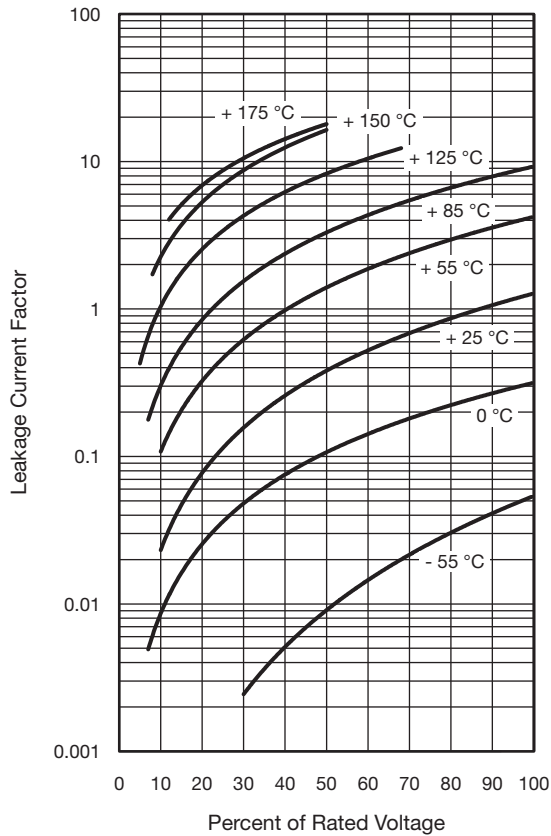
<b>MARKING</b>
<p><b>Marking</b></p> <p>Capacitor marking includes an anode (+) polarity band, capacitance in microfarads and the voltage rating. The Vishay Sprague® trademark is included if space permits. Capacitors rated at 6.3 V are marked 6 V. A manufacturing date code is marked on all capacitors. Call the factory for further explanation.</p>

<b>STANDARD RATINGS</b>							
<b>CAPACITANCE</b> ( $\mu\text{F}$ )	<b>CASE CODE</b>	<b>PART NUMBER</b>	<b>MAX. DC LEAKAGE</b> AT + 25 °C ( $\mu\text{A}$ )	<b>MAX. DF</b> AT + 25 °C 120 Hz (%)	<b>MAX. ESR</b> AT + 25 °C 100 kHz ( $\Omega$ )	<b>MAX. RIPPLE</b> AT + 25 °C 100 kHz $I_{\text{RMS}}$ (A)	
<b>6.3 V<sub>DC</sub> AT + 85 °C; 3 V<sub>DC</sub> AT 175 °C</b>							
10	B	TH4B106(1)6R3(2)1800	0.6	6.0	1.800	0.22	
22	B	TH4B226(1)6R3(2)1500	1.4	6.0	1.500	0.24	
47	C	TH4C476(1)6R3(2)0800	3.0	6.0	0.800	0.37	
<b>10 V<sub>DC</sub> AT + 85 °C; 5 V<sub>DC</sub> AT 175 °C</b>							
10	B	TH4B106(1)010(2)1800	1.0	4.5	1.800	0.22	
22	B	TH4B226(1)010(2)1600	2.2	6.0	1.600	0.23	
22	C	TH4C226(1)010(2)1400	2.2	6.0	1.400	0.28	
47	C	TH4C476(1)010(2)0500	4.7	4.5	0.500	0.47	
<b>16 V<sub>DC</sub> AT + 85 °C; 8 V<sub>DC</sub> AT + 175 °C</b>							
10	B	TH4B106(1)016(2)2000	1.6	6.0	2.000	0.21	
22	B	TH4B226(1)016(2)1900	3.5	6.0	1.900	0.21	
22	C	TH4C226(1)016(2)1400	3.5	6.0	1.400	0.28	
47	C	TH4C476(1)016(2)0800	7.5	6.0	0.800	0.37	

**Note**

- Part number definitions:
  - (1) Capacitance tolerance: K, M
  - (2) Termination and packaging: C, D

**TYPICAL LEAKAGE CURRENT FACTOR**



**Note**

- 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.
- At + 150 °C, the leakage current shall not exceed 15 times the value listed in the Standard Ratings table.
- At + 175 °C, the leakage current shall not exceed 18 times the value listed in the Standard Ratings table.

**RECOMMENDED VOLTAGE DERATING GUIDELINES (for temperature below + 85 °C)**

**STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS**

Capacitor Voltage Rating	Operating Voltage
6.3	3.6
10	6
16	10

**SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS**

Capacitor Voltage Rating	Operating Voltage
6.3	3.3
10	5
16	8

**Note**

- For temperatures above + 85 °C the same voltage derating ratio is recommended, but with respect to category voltage.  
 Up to + 85 °C: Category voltage = Rated voltage  
 At + 125 °C: Category voltage = 2/3 of rated voltage  
 At 150 °C/175 °C: Category voltage = 1/2 of rated voltage



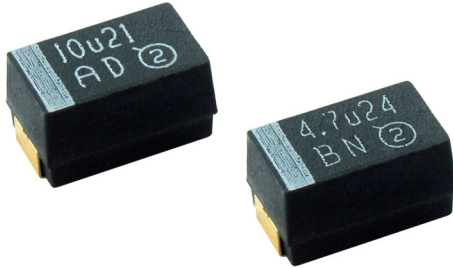
POWER DISSIPATION	
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
B	0.085
C	0.110

RIPPLE CURRENT FACTOR	
TEMPERATURE (°C)	DERATING FACTOR
25	1.0
85	0.9
125	0.4
150	0.3
175	0.2

STANDARD PACKAGING QUANTITY		
CASE CODE	UNITS PER REEL	
	7" REEL	13" REEL
B	2000	8000
C	500	3000

PRODUCT INFORMATION	
Guide for Molded Tantalum Capacitors	<a href="http://www.vishay.com/doc?40074">www.vishay.com/doc?40074</a>
Pad Dimensions	
Packaging Dimensions	
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
SELECTOR GUIDES	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
FAQ	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

# HI-TMP<sup>®</sup> Solid Tantalum Surface Mount TANTAMOUNT<sup>®</sup>, Molded Case, - 55 °C to + 200 °C, Very High Temperature


**FEATURES**

- Application voltage: 21 V at + 200 °C
- Operating temperature up to + 200 °C
- 500 h continuous operation at  $V_R$
- Gold plated terminations
- Standard EIA 535BAAC case size (E)
- 100 % surge current tested
- Compliant to RoHS Directive 2002/95/EC
- Moisture sensitivity level 1


**RoHS  
COMPLIANT**
**PERFORMANCE/ELECTRICAL CHARACTERISTICS**
**Operating Temperature:** - 55 °C to + 200 °C

**Note**

- Refer to doc. 40088

**Capacitance Range:** 10  $\mu$ F

**Capacitance Tolerance:**  $\pm 10 \%$ ,  $\pm 20 \%$ 
**Voltage Rating:** 21  $V_{DC}$ 

<b>ORDERING INFORMATION</b>						
TH5	E	106	K	021	B	1000
TYPE	CASE CODE	CAPACITANCE	CAPACITANCE TOLERANCE	APPLICATION VOLTAGE AT + 200 °C	TERMINATION/PACKAGING	ESR
	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 = $\pm 10 \%$ M = $\pm 20 \%$	This is expressed in V. To complete the three-digit block, zeros precede the voltage rating.	A = Gold/ 7" (178 mm) reels B = Gold/ 13" (330 mm), reels Other <sup>(1)</sup>	Maximum 100 kHz ESR 0500 = 500 m $\Omega$ 5000 = 5 $\Omega$ 10R0 = 10.0 $\Omega$

**Note**

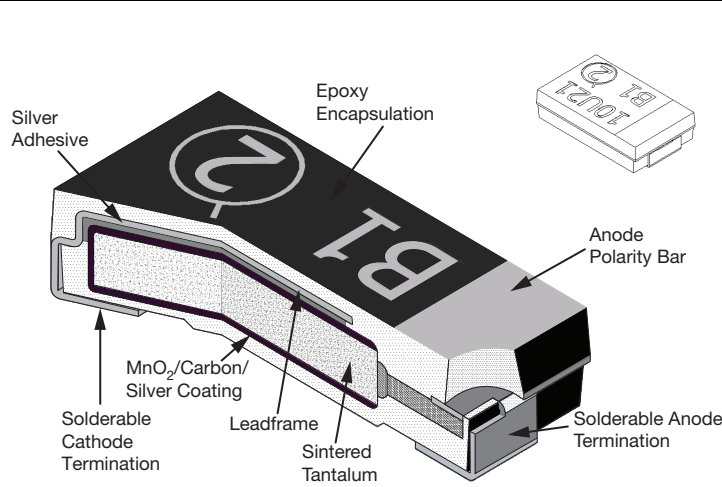
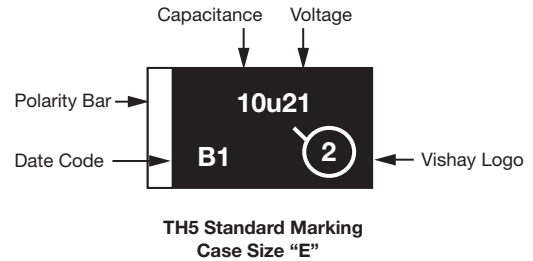
- <sup>(1)</sup> Other termination on request

<b>DIMENSIONS</b> in inches [millimeters]							
CASE CODE	EIA SIZE	L	W	H	P	$T_w$	$T_H$ (MIN.)
E	7343-43	0.287 $\pm$ 0.012 [7.3 $\pm$ 0.30]	0.170 $\pm$ 0.012 [4.3 $\pm$ 0.30]	0.158 $\pm$ 0.012 [4.0 $\pm$ 0.30]	0.051 $\pm$ 0.012 [1.3 $\pm$ 0.30]	0.095 $\pm$ 0.004 [2.4 $\pm$ 0.10]	0.039 [1.0]

**Note**

- TH5 series, 21 V capacitors have been designed for, and tested at, 21 V at + 200 °C for 500 h. As with all Tantalum capacitors, reliability and life may be extended by lower applied voltage.



**CONSTRUCTION AND MARKING**

**Gold Termination**

**Marking:**

Capacitor marking includes an anode (+) polarity band, capacitance in microfarads and the voltage rating.

The Vishay Sprague® trademark is included if space permits. A manufacturing date code is marked on all capacitors. Call the factory for further explanation.

**STANDARD RATINGS**

CAPACITANCE ( $\mu\text{F}$ )	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu\text{A}$ )	TYPICAL DC LEAKAGE AT + 200 °C ( $\mu\text{A}$ )	MAX. DF AT + 25 °C (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{\text{RMS}}$ (A)
<b>21 V<sub>DC</sub> AT + 200 °C</b>							
10	E	TH5E106(1)021(2)1000	2.1	120	6	1.000	0.41

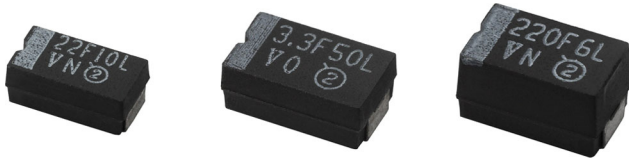
**Note**

- Part number definitions:
  - Capacitance tolerance codes: K, M
  - Terminations and packaging: A, B

**Note**

- TH5 series, 21 V capacitors have been designed for, and tested at, 21 V at + 200 °C for 500 h. As with all Tantalum capacitors, reliability and life may be extended by lower applied voltage.

## Solid Tantalum Chip Capacitors TANTAMOUNT<sup>®</sup>, Molded Case, Built-In-Fuse Miniature


**FEATURES**

- Terminations: 100 % matte tin standard, tin/lead available
- Molded package available in three case codes
- Compatible with "High Volume" automatic pick and place
- Electrically activated internal fuse
- Meets EIA 535BAAC and IEC specification QC300801/US0001
- Fuse activation at 25 °C: 0.1 s max. with 5 A min. applied current
- 100 % surge current tested (D and E case codes)
- Compliant to RoHS Directive 2002/95/EC
- Moisture sensitivity level 1


**RoHS\***  
COMPLIANT

**Note**

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

**PERFORMANCE CHARACTERISTICS**
[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)

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

**Capacitance Range:** 0.47 μF to 470 μF  
**Capacitance Tolerance:** ± 10 %, ± 20 %  
**100 % Surge Current Tested** (D and E case codes)  
**Voltage Rating:** 4 V<sub>DC</sub> to 50 V<sub>DC</sub>

ORDERING INFORMATION					
893D	106	X0	010	B	2WE3
TYPE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	CASE CODE	TERMINATION AND PACKAGING
	This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow	X9 = ± 10 % X0 = ± 20 %	This is expressed in V. To complete the three-digit block, zeros precede the voltage rating. A decimal point is indicated by an "R" (6R3 = 6.3 V)	See Ratings and Case Codes table	2TE3: Matte tin, 7" (178 mm) reel 2WE3: Matte tin, 13" (330 mm) reel 8T: Tin/lead, 7" (178 mm) reel 8W: Tin/lead, 13" (330 mm) reel

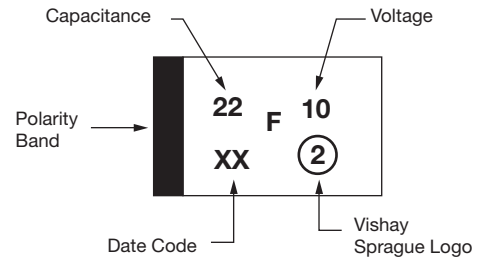
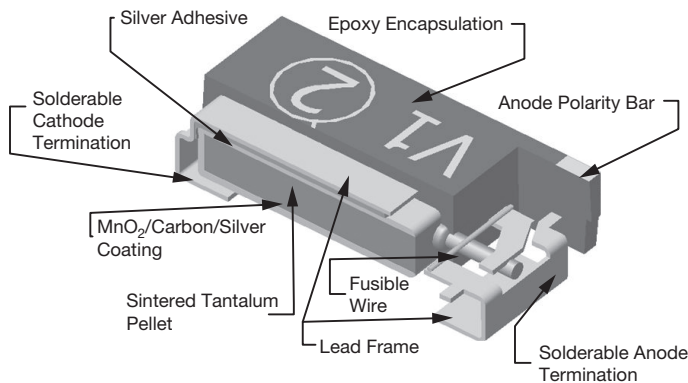
**Note**

- We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size. Voltage substitutions will be marked with the higher voltage rating. Effective July 15, 2008, part numbers with solderable termination codes "2T" and "2W" may have either matte tin or tin/lead terminations. Codes 2TE3 and 2WE3 specify only matte tin terminations. Codes 8T and 8W specify only tin/lead terminations.

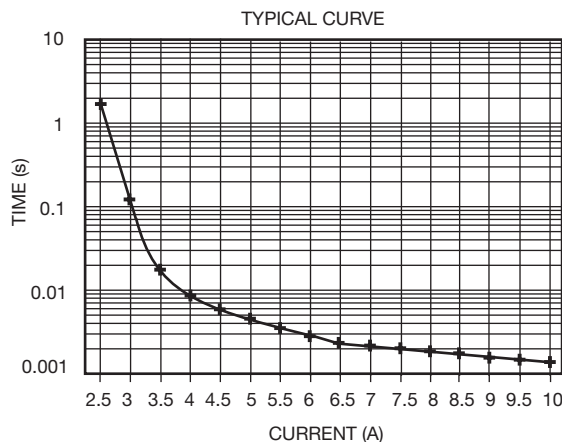
DIMENSIONS in inches [millimeters]							
CASE CODE	EIA SIZE	L	W	H	P	T <sub>W</sub>	T <sub>H</sub> (MIN.)
C	6032-28	0.236 ± 0.012 [6.0 ± 0.30]	0.126 ± 0.012 [3.2 ± 0.30]	0.098 ± 0.012 [2.5 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.039 [1.0]
D	7343-31	0.287 ± 0.012 [7.3 ± 0.30]	0.169 ± 0.012 [4.3 ± 0.30]	0.110 ± 0.012 [2.8 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.094 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]
E	7343-43	0.287 ± 0.012 [7.3 ± 0.30]	0.169 ± 0.012 [4.3 ± 0.30]	0.157 ± 0.012 [4.0 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.094 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]

**RATINGS AND CASE CODES**

$\mu\text{F}$	4 V	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V
0.47								C
0.68								C
1.0								C
1.5							C	C
2.2						C/D	C	C/D
3.3						C	C	C/D
4.7					C	C	C/D	D/E
6.8				C	C	C	D	D/E
10			C	C	C	C/D	D/E	
15		C	C	C	C/D	D	D/E	
22		C	C	C/D	D	D/E	E	
33		C	C/D	C/D	D/E	E		
47		C/D	C/D	D/E	E			
68	C	C/D	D/E	D	E			
100	C	D/E	D	E				
150	D	D	D/E	E				
220	D	D/E	E					
330	D/E	E						
470	E							

**CONSTRUCTION AND MARKING**

**Marking:**

Capacitors shall be marked with an anode polarity band, capacitance (in microfarads) and the rated DC working voltage, 85 °C. The capacitance voltage will be separated by the letter "F" indicating a fused capacitor. Units rated at 6.3 V shall be marked as 6 V.

**FUSE ACTIVATION**




STANDARD RATINGS						
CAPACITANCE ( $\mu\text{F}$ )	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu\text{A}$ )	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{\text{RMS}}$ (A)
<b>4 V<sub>DC</sub> AT + 85 °C; 2.7 V<sub>DC</sub> AT + 125 °C</b>						
68	C	893D686(1)004C(2)	2.7	6	1.4	0.28
100	C	893D107(1)004C(2)	4.0	8	0.8	0.37
150	D	893D157(1)004D(2)	6.0	8	0.6	0.50
220	D	893D227(1)004D(2)	8.8	8	0.6	0.50
330	D	893D337(1)004D(2)	13.2	15	0.6	0.50
330	E	893D337(1)004E(2)	13.2	8	0.5	0.57
470	E	893D477(1)004E(2)	18.8	16	0.5	0.57
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT + 125 °C</b>						
15	C	893D156(1)6R3C(2)	0.9	6	1.8	0.25
22	C	893D226(1)6R3C(2)	1.1	6	1.8	0.25
33	C	893D336(1)6R3C(2)	1.6	6	1.4	0.28
47	C	893D476(1)6R3C(2)	2.3	6	1.3	0.29
47	D	893D476(1)6R3D(2)	2.3	6	0.9	0.41
68	C	893D686(1)6R3C(2)	3.3	6	0.8	0.37
68	D	893D686(1)6R3D(2)	3.3	6	0.7	0.46
100	D	893D107(1)6R3D(2)	6.0	8	0.7	0.46
100	E	893D107(1)6R3E(2)	6.0	8	0.7	0.49
150	D	893D157(1)6R3D(2)	9.0	8	0.6	0.50
220	D	893D227(1)6R3D(2)	13.2	8	0.6	0.50
220	E	893D227(1)6R3E(2)	13.2	8	0.5	0.57
330	E	893D337(1)6R3E(2)	19.8	8	0.5	0.57
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT + 125 °C</b>						
10	C	893D106(1)010C(2)	1.0	6	1.8	0.25
15	C	893D156(1)010C(2)	1.5	6	1.8	0.25
22	C	893D226(1)010C(2)	2.2	6	1.4	0.28
33	C	893D336(1)010C(2)	3.3	6	1.3	0.29
33	D	893D336(1)010D(2)	3.3	6	0.9	0.41
47	C	893D476(1)010C(2)	4.7	6	1.0	0.33
47	D	893D476(1)010D(2)	4.7	6	0.7	0.46
68	D	893D686(1)010D(2)	6.8	6	0.7	0.46
68	E	893D686(1)010E(2)	6.8	6	0.7	0.49
100	D	893D107(1)010D(2)	10.0	8	0.6	0.50
150	D	893D157(1)010D(2)	15.0	8	0.6	0.50
150	E	893D157(1)010D(2)	15.0	8	0.5	0.57
220	E	893D227(1)010E(2)	22.0	8	0.5	0.57
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>						
6.8	C	893D685(1)016C(2)	1.1	6	2.0	0.23
10	C	893D106(1)016C(2)	1.6	6	1.8	0.25
15	C	893D156(1)016C(2)	2.4	6	1.4	0.28
22	C	893D226(1)016C(2)	3.5	6	1.3	0.29
22	D	893D226(1)016D(2)	3.5	6	0.9	0.41
33	C	893D336(1)016C(2)	5.3	6	1.0	0.33
33	D	893D336(1)016D(2)	5.3	6	0.7	0.46
47	D	893D476(1)016D(2)	7.5	6	0.7	0.46
47	E	893D476(1)016E(2)	7.5	6	0.7	0.49
68	D	893D686(1)016D(2)	10.9	6	0.6	0.50
100	E	893D107(1)016E(2)	16.0	8	0.6	0.52
150	E	893D157(1)016E(2)	24.0	10	0.4	0.64

**Note**

- Part number definitions:
  - Tolerance: X0, X9
  - Terminations and packaging: 2TE3, 2WE3, 8T, 8W



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>						
4.7	C	893D475(1)020C(2)	0.9	6	2.0	0.22
6.8	C	893D685(1)020C(2)	1.4	6	1.9	0.24
10	C	893D106(1)020C(2)	2.0	6	1.6	0.26
15	C	893D156(1)020C(2)	3.0	6	1.4	0.28
15	D	893D156(1)020D(2)	3.0	6	0.9	0.41
22	D	893D226(1)020D(2)	4.4	6	0.7	0.46
33	D	893D336(1)020D(2)	6.6	6	0.7	0.46
33	E	893D336(1)020E(2)	6.6	6	0.7	0.49
47	E	893D476(1)020E(2)	9.4	6	0.6	0.52
68	E	893D686(1)020E(2)	13.6	6	0.6	0.52
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>						
2.2	C	893D225(1)025C(2)	0.6	6	2.8	0.21
2.2	D	893D225(1)025D(2)	0.6	6	2.0	0.21
3.3	C	893D335(1)025C(2)	0.8	6	2.3	0.22
4.7	C	893D475(1)025C(2)	1.2	6	1.9	0.24
6.8	C	893D685(1)025C(2)	1.7	6	1.6	0.26
10	C	893D106(1)025C(2)	2.5	6	1.4	0.28
10	D	893D106(1)025D(2)	2.5	6	1.0	0.39
15	D	893D156(1)025D(2)	3.8	6	0.8	0.43
22	D	893D226(1)025D(2)	5.5	6	0.7	0.46
22	E	893D226(1)025E(2)	5.5	6	0.7	0.49
33	E	893D336(1)025E(2)	8.3	6	0.6	0.52
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>						
1.5	C	893D155(1)035C(2)	0.5	6	3.8	0.17
2.2	C	893D225(1)035C(2)	0.8	6	2.9	0.20
3.3	C	893D335(1)035C(2)	1.2	6	2.0	0.23
4.7	C	893D475(1)035C(2)	1.6	6	1.8	0.25
4.7	D	893D475(1)035D(2)	1.6	6	1.2	0.35
6.8	D	893D685(1)035D(2)	2.4	6	1.0	0.39
10	D	893D106(1)035D(2)	3.5	6	0.8	0.43
10	E	893D106(1)035E(2)	3.5	6	0.8	0.43
15	D	893D156(1)035D(2)	5.3	6	0.7	0.46
15	E	893D156(1)035E(2)	5.3	6	0.7	0.49
22	E	893D226(1)035E(2)	7.7	6	0.6	0.52
<b>50 V<sub>DC</sub> AT + 85 °C; 33 V<sub>DC</sub> AT + 125 °C</b>						
0.47	C	893D474(1)050C(2)	0.5	4	6.7	0.13
0.68	C	893D684(1)050C(2)	0.5	4	5.9	0.14
1.0	C	893D105(1)050C(2)	0.5	4	4.4	0.16
1.5	C	893D155(1)050C(2)	0.8	6	3.2	0.19
2.2	C	893D225(1)050C(2)	1.1	6	2.8	0.20
2.2	D	893D225(1)050D(2)	1.1	6	2.1	0.27
3.3	C	893D335(1)050C(2)	1.7	6	2.4	0.21
3.3	D	893D335(1)050D(2)	1.7	6	1.6	0.31
4.7	D	893D475(1)050D(2)	2.4	6	1.1	0.37
4.7	E	893D475(1)050E(2)	2.4	6	1.4	0.34
6.8	D	893D685(1)050D(2)	3.4	6	0.9	0.41
6.8	E	893D685(1)050E(2)	3.4	6	0.9	0.43

**Note**

- Part number definitions:
  - Tolerance: X0, X9
  - Terminations and packaging: 2TE3, 2WE3, 8T, 8W



<b>RECOMMENDED VOLTAGE DERATING GUIDELINES</b> (for temperatures below + 85 °C)	
<b>STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS</b>	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.6
10	6.0
16	10
20	12
25	15
35	24
50	28
<b>SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS</b>	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24

<b>POWER DISSIPATION</b>	
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
C	0.110
D	0.150
E	0.165

<b>STANDARD PACKAGING QUANTITY</b>		
CASE CODE	UNITS PER REEL	
	7" REEL	13" REEL
C	500	3000
D	500	2500
E	400	1500

<b>PRODUCT INFORMATION</b>	
Molded Guide • Pad Dimensions • Package Dimensions	<a href="http://www.vishay.com/doc?40074">www.vishay.com/doc?40074</a>
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
<b>SELECTOR GUIDES</b>	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
<b>FAQ</b>	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

## Low ESR Solid Tantalum Chip Capacitors, TANTAMOUNT<sup>®</sup> Molded Case, Built-In-Fuse



### FEATURES

- Terminations: 100 % matte tin, standard, tin/lead available
- Molded case available in three case codes
- Compatible with “High Volume” automatic pick and place equipment
- Mounting: Surface mount
- High ripple current carrying capability
- Low ESR
- Meets EIA 535BAAC
- 100 % surge current tested
- Compliant to RoHS Directive 2002/95/EC
- Moisture sensitivity level 1


**RoHS\***  
COMPLIANT

### Note

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

### PERFORMANCE/ELECTRICAL CHARACTERISTICS

[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)

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

**Capacitance Range:** 0.47 μF to 470 μF

**Capacitance Tolerance:** ± 10 %, ± 20 %

**Voltage Rating:** 4 V<sub>DC</sub> to 50 V<sub>DC</sub>

ORDERING INFORMATION						
TF3	E	477	M	004	E	0500
TYPE	CASE CODE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	TERMINATION/PACKAGING	ESR
	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 V. To complete the three-digit block, zeros precede the voltage rating. A decimal point is indicated by an “R” (6R3 = 6.3 V)	C = Matte tin/7" (178 mm) reels D = Matte tin/13" (330 mm) E = Tin/lead/7" (178 mm) reels F = Tin/lead/13" (330 mm)	Maximum 100 kHz ESR in mΩ

### Note

- We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size. Voltage substitutions will be marked with the higher voltage rating.

DIMENSIONS in inches [millimeters]							
CASE CODE	EIA SIZE	L	W	H	P	T <sub>W</sub>	T <sub>H</sub> (MIN.)
C	6032-28	0.236 ± 0.012 [6.0 ± 0.30]	0.126 ± 0.012 [3.2 ± 0.30]	0.098 ± 0.012 [2.5 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.039 [1.0]
D	7343-31	0.287 ± 0.012 [7.3 ± 0.30]	0.169 ± 0.012 [4.3 ± 0.30]	0.110 ± 0.012 [2.8 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.094 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]
E	7343-43	0.287 ± 0.012 [7.3 ± 0.30]	0.169 ± 0.012 [4.3 ± 0.30]	0.157 ± 0.012 [4.0 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.094 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]



RATINGS AND CASE CODES								
μF	4 V	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V
0.47								C
0.68								C
1.0								C
1.5							C	C
2.2						C	C	C/D
3.3						C	C	C/D
4.7					C	C	C/D	D/E
6.8				C	C	C	D	D/E
10			C	C	C	C/D	D/E	
15		C	C	C	C/D	D	D/E	
22		C	C	C/D	D	D/E	E	
33		C	C/D	C/D	D/E	E		
47		C/D	C/D	D/E	D/E			
68	C	C/D	D/E	D	E			
100	C	C/D/E	D/E	E				
150	C/D	D/E	D/E	E				
220	D	D/E	E					
330	D/E	E						
470	E							

### CONSTRUCTION AND MARKING

**C, D, E, Cases**

**Marking**  
 Capacitor marking includes an anode (+) polarity band, capacitance in microfarads and the voltage rating. The Vishay Sprague® trademark is included if space permits. Capacitors rated at 6.3 V are marked 6 V. A manufacturing date code is marked on all capacitors.



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>4 V<sub>DC</sub> AT + 85 °C; 2.7 V<sub>DC</sub> AT + 125 °C</b>						
68	C	TF3C686(1)004(2)1600	2.7	6	1.600	0.26
68	C	TF3C686(1)004(2)1400	2.7	6	1.400	0.28
68	C	TF3C686(1)004(2)0400	2.7	6	0.400	0.52
100	C	TF3C107(1)004(2)1200	4.0	8	1.200	0.30
100	C	TF3C107(1)004(2)0800	4.0	8	0.800	0.37
100	C	TF3C107(1)004(2)0400	4.0	8	0.400	0.52
150	C	TF3C157(1)004(2)1200	6.0	8	1.200	0.30
150	C	TF3C157(1)004(2)0800	6.0	8	0.800	0.37
150	C	TF3C157(1)004(2)0400	6.0	8	0.400	0.52
150	D	TF3D157(1)004(2)0800	6.0	8	0.800	0.43
150	D	TF3D157(1)004(2)0600	6.0	8	0.600	0.50
150	D	TF3D157(1)004(2)0300	6.0	8	0.300	0.71
220	D	TF3D227(1)004(2)0700	8.8	8	0.700	0.46
220	D	TF3D227(1)004(2)0600	8.8	8	0.600	0.50
220	D	TF3D227(1)004(2)0400	8.8	8	0.400	0.61
220	D	TF3D227(1)004(2)0300	8.8	8	0.300	0.71
330	D	TF3D337(1)004(2)0700	13.2	15	0.700	0.46
330	D	TF3D337(1)004(2)0600	13.2	15	0.600	0.50
330	D	TF3D337(1)004(2)0400	13.2	15	0.400	0.61
330	D	TF3D337(1)004(2)0300	13.2	15	0.300	0.71
330	E	TF3E337(1)004(2)0700	13.2	8	0.700	0.49
330	E	TF3E337(1)004(2)0500	13.2	8	0.500	0.57
330	E <sup>(1)</sup>	TF3E337(1)004(2)0250	13.2	8	0.250	0.81
470	E	TF3E477(1)004(2)0500	18.8	8	0.500	0.57
470	E	TF3E477(1)004(2)0250	18.8	8	0.250	0.81
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT + 125 °C</b>						
15	C	TF3C156(1)6R3(2)2000	0.9	6	2.000	0.23
15	C	TF3C156(1)6R3(2)1800	0.9	6	1.800	0.25
15	C	TF3C156(1)6R3(2)0600	0.9	6	0.600	0.43
22	C	TF3C226(1)6R3(2)2000	1.1	6	2.000	0.23
22	C	TF3C226(1)6R3(2)1800	1.1	6	1.800	0.25
22	C	TF3C226(1)6R3(2)0600	1.1	6	0.600	0.43
33	C	TF3C336(1)6R3(2)2000	1.6	6	2.000	0.23
33	C	TF3C336(1)6R3(2)1400	1.6	6	1.400	0.28
33	C	TF3C336(1)6R3(2)0600	1.6	6	0.600	0.43
47	C	TF3C476(1)6R3(2)1600	2.3	6	1.600	0.26
47	C	TF3C476(1)6R3(2)1300	2.3	6	1.300	0.29
47	C	TF3C476(1)6R3(2)0600	2.3	6	0.600	0.43
47	D	TF3D476(1)6R3(2)1000	2.3	6	1.000	0.39
47	D	TF3D476(1)6R3(2)0900	2.3	6	0.900	0.41
47	D	TF3D476(1)6R3(2)0450	2.3	6	0.450	0.58

**Notes**

- Part number definitions:
  - Capacitance tolerance codes: K, M
  - Terminations and packaging codes: C, D, E, F
- Preliminary values, contact factory for availability



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT + 125 °C</b>						
68	C	TF3C686(1)6R3(2)1200	3.3	6	1.200	0.30
68	C	TF3C686(1)6R3(2)0800	3.3	6	0.800	0.37
68	C <sup>(1)</sup>	TF3C686(1)6R3(2)0400	3.3	6	0.400	0.52
68	D	TF3D686(1)6R3(2)1000	3.3	6	1.000	0.39
68	D	TF3D686(1)6R3(2)0700	3.3	6	0.700	0.46
68	D	TF3D686(1)6R3(2)0350	3.3	6	0.350	0.65
100	C	TF3C107(1)6R3(2)0700	6.0	6	0.700	0.40
100	C	TF3C107(1)6R3(2)0400	6.0	6	0.400	0.52
100	C <sup>(1)</sup>	TF3C107(1)6R3(2)0350	6.0	6	0.350	0.56
100	D	TF3D107(1)6R3(2)0800	6.0	8	0.800	0.43
100	D	TF3D107(1)6R3(2)0700	6.0	8	0.700	0.46
100	D	TF3D107(1)6R3(2)0400	6.0	8	0.400	0.61
100	D	TF3D107(1)6R3(2)0350	6.0	8	0.350	0.65
100	E	TF3E107(1)6R3(2)0900	6.0	8	0.900	0.43
100	E	TF3E107(1)6R3(2)0700	6.0	8	0.700	0.49
100	E	TF3E107(1)6R3(2)0300	6.0	8	0.300	0.74
150	D	TF3D157(1)6R3(2)0700	9.0	8	0.700	0.46
150	D	TF3D157(1)6R3(2)0600	9.0	8	0.600	0.50
150	D	TF3D157(1)6R3(2)0300	9.0	8	0.300	0.71
150	E	TF3E157(1)6R3(2)0600	9.0	8	0.600	0.52
150	E	TF3E157(1)6R3(2)0300	9.0	8	0.300	0.74
220	D	TF3D227(1)6R3(2)0700	13.2	8	0.700	0.46
220	D	TF3D227(1)6R3(2)0600	13.2	8	0.600	0.50
220	D	TF3D227(1)6R3(2)0300	13.2	8	0.300	0.71
220	E	TF3E227(1)6R3(2)0700	13.2	8	0.700	0.49
220	E	TF3E227(1)6R3(2)0500	13.2	8	0.500	0.57
220	E	TF3E227(1)6R3(2)0300	13.2	8	0.300	0.74
220	E <sup>(1)</sup>	TF3E227(1)6R3(2)0250	13.2	8	0.250	0.81
330	E	TF3E337(1)6R3(2)0500	19.8	8	0.500	0.57
330	E	TF3E337(1)6R3(2)0300	19.8	8	0.300	0.74
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT + 125 °C</b>						
10	C	TF3C106(1)010(2)2000	1.0	6	2.000	0.23
10	C	TF3C106(1)010(2)1800	1.0	6	1.800	0.25
10	C <sup>(1)</sup>	TF3C106(1)010(2)0600	1.0	6	0.600	0.43
15	C	TF3C156(1)010(2)2000	1.5	6	2.000	0.23
15	C	TF3C156(1)010(2)1800	1.5	6	1.800	0.25
15	C	TF3C156(1)010(2)0600	1.5	6	0.600	0.43
22	C	TF3C226(1)010(2)2000	2.2	6	2.000	0.23
22	C	TF3C226(1)010(2)1400	2.2	6	1.400	0.28
22	C	TF3C226(1)010(2)0500	2.2	6	0.500	0.47
33	C	TF3C336(1)010(2)1600	3.3	6	1.600	0.26

**Notes**

- Part number definitions:
  - (1) Capacitance tolerance codes: K, M
  - (2) Terminations and packaging codes: C, D, E, F
- <sup>(1)</sup> Preliminary values, contact factory for availability



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT + 125 °C</b>						
33	C	TF3C336(1)010(2)1300	3.3	6	1.300	0.29
33	C	TF3C336(1)010(2)0400	3.3	6	0.400	0.52
33	D	TF3D336(1)010(2)1000	3.3	6	1.000	0.39
33	D	TF3D336(1)010(2)0900	3.3	6	0.900	0.41
33	D	TF3D336(1)010(2)0400	3.3	6	0.400	0.61
47	C	TF3C476(1)010(2)1200	4.7	6	1.200	0.30
47	C	TF3C476(1)010(2)1000	4.7	6	1.000	0.33
47	C <sup>(1)</sup>	TF3C476(1)010(2)0400	4.7	6	0.400	0.52
47	D	TF3D476(1)010(2)1000	4.7	6	1.000	0.39
47	D	TF3D476(1)010(2)0700	4.7	6	0.700	0.46
47	D	TF3D476(1)010(2)0400	4.7	6	0.400	0.61
47	D <sup>(1)</sup>	TF3D476(1)010(2)0350	4.7	6	0.350	0.65
68	D	TF3D686(1)010(2)0800	6.8	6	0.800	0.43
68	D	TF3D686(1)010(2)0700	6.8	6	0.700	0.46
68	D	TF3D686(1)010(2)0400	6.8	6	0.400	0.61
68	D	TF3D686(1)010(2)0350	6.8	6	0.350	0.65
68	E	TF3E686(1)010(2)0900	6.8	6	0.900	0.43
68	E	TF3E686(1)010(2)0700	6.8	6	0.700	0.49
68	E	TF3E686(1)010(2)0350	6.8	6	0.350	0.69
100	D	TF3D107(1)010(2)0700	10.0	8	0.700	0.46
100	D	TF3D107(1)010(2)0600	10.0	8	0.600	0.50
100	D	TF3D107(1)010(2)0400	10.0	8	0.400	0.61
100	D	TF3D107(1)010(2)0300	10.0	8	0.300	0.71
100	E	TF3E107(1)010(2)0600	10.0	8	0.600	0.52
100	E	TF3E107(1)010(2)0400	10.0	8	0.400	0.64
100	E	TF3E107(1)010(2)0300	10.0	8	0.300	0.74
150	D	TF3D157(1)010(2)0700	15.0	8	0.700	0.46
150	D	TF3D157(1)010(2)0600	15.0	8	0.600	0.50
150	D	TF3D157(1)010(2)0400	15.0	8	0.400	0.61
150	D	TF3D157(1)010(2)0300	15.0	8	0.300	0.71
150	E	TF3E157(1)010(2)0700	15.0	8	0.700	0.49
150	E	TF3E157(1)010(2)0500	15.0	8	0.500	0.57
150	E	TF3E157(1)010(2)0400	15.0	8	0.400	0.64
150	E	TF3E157(1)010(2)0250	15.0	8	0.250	0.81
220	E	TF3E227(1)010(2)0500	22.0	8	0.500	0.57
220	E	TF3E227(1)010(2)0300	22.0	8	0.300	0.74
220	E <sup>(1)</sup>	TF3E227(1)010(2)0250	22.0	8	0.250	0.81

**Notes**

- Part number definitions:
  - Capacitance tolerance codes: K, M
  - Terminations and packaging codes: C, D, E, F
- Preliminary values, contact factory for availability



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>						
6.8	C	TF3C685(1)016(2)2000	1.1	6	2.000	0.23
6.8	C	TF3C685(1)016(2)0600	1.1	6	0.600	0.43
10	C	TF3C106(1)016(2)2000	1.6	6	2.000	0.23
10	C	TF3C106(1)016(2)1800	1.6	6	1.800	0.25
10	C	TF3C106(1)016(2)0700	1.6	6	0.700	0.40
10	C	TF3C106(1)016(2)0600	1.6	6	0.600	0.43
15	C	TF3C156(1)016(2)2000	2.4	6	2.000	0.23
15	C	TF3C156(1)016(2)1400	2.4	6	1.400	0.28
15	C <sup>(1)</sup>	TF3C156(1)016(2)0600	2.4	6	0.600	0.43
22	C	TF3C226(1)016(2)1600	3.5	6	1.600	0.26
22	C	TF3C226(1)016(2)1300	3.5	6	1.300	0.29
22	C	TF3C226(1)016(2)1000	3.5	6	1.000	0.33
22	C	TF3C226(1)016(2)0700	3.5	6	0.700	0.40
22	D	TF3D226(1)016(2)1000	3.5	6	1.000	0.39
22	D	TF3D226(1)016(2)0900	3.5	6	0.900	0.41
22	D	TF3D226(1)016(2)0500	3.5	6	0.500	0.55
22	D	TF3D226(1)016(2)0450	3.5	6	0.450	0.58
33	C	TF3C336(1)016(2)1000	5.3	6	1.000	0.33
33	C	TF3C336(1)016(2)0500	5.3	6	0.500	0.47
33	D	TF3D336(1)016(2)1000	5.3	6	1.000	0.39
33	D	TF3D336(1)016(2)0700	5.3	6	0.700	0.46
33	D	TF3D336(1)016(2)0400	5.3	6	0.400	0.61
33	D	TF3D336(1)016(2)0350	5.3	6	0.350	0.65
47	D	TF3D476(1)016(2)0800	7.5	6	0.800	0.43
47	D	TF3D476(1)016(2)0700	7.5	6	0.700	0.46
47	D	TF3D476(1)016(2)0400	7.5	6	0.400	0.61
47	D	TF3D476(1)016(2)0350	7.5	6	0.350	0.65
47	E	TF3E476(1)016(2)0900	7.5	6	0.900	0.43
47	E	TF3E476(1)016(2)0700	7.5	6	0.700	0.49
47	E	TF3E476(1)016(2)0400	7.5	6	0.400	0.64
47	E	TF3E476(1)016(2)0350	7.5	6	0.350	0.69
68	D	TF3D686(1)016(2)0600	10.9	6	0.600	0.50
68	D	TF3D686(1)016(2)0300	10.9	6	0.300	0.71
100	E	TF3E107(1)016(2)0700	16.0	8	0.700	0.49
100	E	TF3E107(1)016(2)0600	16.0	8	0.600	0.52
100	E	TF3E107(1)016(2)0300	16.0	8	0.300	0.74
150	E	TF3E157(1)016(2)0400	16.0	8	0.400	0.64

**Notes**

- Part number definitions:
  - (1) Capacitance tolerance codes: K, M
  - (2) Terminations and packaging codes: C, D, E, F
- (1) Preliminary values, contact factory for availability



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>						
4.7	C	TF3C475(1)020(2)2000	0.9	6	2.000	0.23
4.7	C	TF3C475(1)020(2)1000	0.9	6	1.000	0.33
6.8	C	TF3C685(1)020(2)2000	1.1	6	2.000	0.23
6.8	C	TF3C685(1)020(2)1900	1.1	6	1.900	0.24
6.8	C	TF3C685(1)020(2)0600	1.1	6	0.600	0.43
10	C	TF3C106(1)020(2)2000	2.0	6	2.000	0.23
10	C	TF3C106(1)020(2)1600	2.0	6	1.600	0.26
10	C	TF3C106(1)020(2)0800	2.0	6	0.800	0.37
15	C	TF3C156(1)020(2)1400	3.0	6	1.400	0.28
15	C <sup>(1)</sup>	TF3C156(1)020(2)0500	3.0	6	0.500	0.47
15	D	TF3D156(1)020(2)1000	3.0	6	1.000	0.39
15	D	TF3D156(1)020(2)0900	3.0	6	0.900	0.41
15	D	TF3D156(1)020(2)0500	3.0	6	0.500	0.55
15	D	TF3D156(1)020(2)0450	3.0	6	0.450	0.58
22	D	TF3D226(1)020(2)1000	4.4	6	1.000	0.39
22	D	TF3D226(1)020(2)0700	4.4	6	0.700	0.46
22	D	TF3D226(1)020(2)0500	4.4	6	0.500	0.55
22	D	TF3D226(1)020(2)0350	4.4	6	0.350	0.65
33	D	TF3D336(1)020(2)0700	6.6	6	0.700	0.46
33	D	TF3D336(1)020(2)0400	6.6	6	0.400	0.61
33	D	TF3D336(1)020(2)0350	6.6	6	0.350	0.65
33	E	TF3E336(1)020(2)0900	6.6	6	0.900	0.43
33	E	TF3E336(1)020(2)0700	6.6	6	0.700	0.49
33	E	TF3E336(1)020(2)0400	6.6	6	0.400	0.64
33	E	TF3E336(1)020(2)0350	6.6	6	0.350	0.69
47	D	TF3D476(1)020(2)0600	9.4	6	0.600	0.50
47	D	TF3D476(1)020(2)0300	9.4	6	0.300	0.71
47	E	TF3E476(1)020(2)0600	9.4	6	0.600	0.52
47	E	TF3E476(1)020(2)0300	9.4	6	0.300	0.74
68	E	TF3E686(1)020(2)0600	13.6	6	0.600	0.52
68	E	TF3E686(1)020(2)0300	13.6	6	0.300	0.74
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>						
2.2	C	TF3C225(1)025(2)3500	0.9	6	3.500	0.18
2.2	C	TF3C225(1)025(2)2800	0.9	6	2.800	0.20
3.3	C	TF3C335(1)025(2)2500	0.9	6	2.500	0.21
3.3	C	TF3C335(1)025(2)2300	0.9	6	2.300	0.22
3.3	C	TF3C335(1)025(2)2100	0.9	6	2.100	0.23
3.3	C <sup>(1)</sup>	TF3C335(1)025(2)1200	0.9	6	1.200	0.30
4.7	C	TF3C475(1)025(2)2500	1.2	6	2.500	0.21
4.7	C	TF3C475(1)025(2)1900	1.2	6	1.900	0.24
4.7	C	TF3C475(1)025(2)1300	1.2	6	1.300	0.29

**Notes**

- Part number definitions:
  - Capacitance tolerance codes: K, M
  - Terminations and packaging codes: C, D, E, F
- <sup>(1)</sup> Preliminary values, contact factory for availability



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>						
4.7	C	TF3C475(1)025(2)1000	1.2	6	1.000	0.33
6.8	C	TF3C685(1)025(2)2000	1.7	6	2.000	0.23
6.8	C	TF3C685(1)025(2)1600	1.7	6	1.600	0.26
6.8	C	TF3C685(1)025(2)0600	1.7	6	0.600	0.43
10	C	TF3C106(1)025(2)1400	2.5	6	1.400	0.28
10	C	TF3C106(1)025(2)0600	2.5	6	0.600	0.43
10	D	TF3D106(1)025(2)1200	2.5	6	1.200	0.35
10	D	TF3D106(1)025(2)1000	2.5	6	1.000	0.39
10	D	TF3D106(1)025(2)0600	2.5	6	0.600	0.50
10	D	TF3D106(1)025(2)0500	2.5	6	0.500	0.55
15	D	TF3D156(1)025(2)1000	3.8	6	1.000	0.39
15	D	TF3D156(1)025(2)0800	3.8	6	0.800	0.43
15	D	TF3D156(1)025(2)0500	3.8	6	0.500	0.55
15	D	TF3D156(1)025(2)0400	3.8	6	0.400	0.61
22	D	TF3D226(1)025(2)0800	5.5	6	0.800	0.43
22	D	TF3D226(1)025(2)0700	5.5	6	0.700	0.46
22	D	TF3D226(1)025(2)0400	5.5	6	0.400	0.61
22	D	TF3D226(1)025(2)0350	5.5	6	0.350	0.65
22	E	TF3E226(1)025(2)0900	5.5	6	0.900	0.43
22	E	TF3E226(1)025(2)0700	5.5	6	0.700	0.49
22	E	TF3E226(1)025(2)0400	5.5	6	0.400	0.64
22	E	TF3E226(1)025(2)0350	5.5	6	0.350	0.69
33	E	TF3E336(1)025(2)0600	8.3	6	0.600	0.52
33	E	TF3E336(1)025(2)0300	8.3	6	0.300	0.74
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>						
1.5	C	TF3C155(1)035(2)4500	0.5	6	4.500	0.16
1.5	C	TF3C155(1)035(2)3800	0.5	6	3.800	0.17
1.5	C	TF3C155(1)035(2)2600	0.5	6	2.600	0.21
1.5	C <sup>(1)</sup>	TF3C155(1)035(2)1900	0.5	6	1.900	0.24
2.2	C	TF3C225(1)035(2)3500	0.8	6	3.500	0.18
2.2	C	TF3C225(1)035(2)2900	0.8	6	2.900	0.19
3.3	C	TF3C335(1)035(2)2500	1.2	6	2.500	0.21
3.3	C	TF3C335(1)035(2)2000	1.2	6	2.000	0.23
3.3	C <sup>(1)</sup>	TF3C335(1)035(2)0900	1.2	6	0.900	0.35
4.7	C	TF3C475(1)035(2)1800	1.6	6	1.800	0.25
4.7	C <sup>(1)</sup>	TF3C475(1)035(2)0900	1.6	6	0.900	0.35
4.7	D	TF3D475(1)035(2)1500	1.6	6	1.500	0.32
4.7	D	TF3D475(1)035(2)1200	1.6	6	1.200	0.35
4.7	D	TF3D475(1)035(2)0700	1.6	6	0.700	0.46
4.7	D	TF3D475(1)035(2)0600	1.6	6	0.600	0.50
6.8	D	TF3D685(1)035(2)1300	2.4	6	1.300	0.34

**Notes**

- Part number definitions:
  - (1) Capacitance tolerance codes: K, M
  - (2) Terminations and packaging codes: C, D, E, F
- (1) Preliminary values, contact factory for availability





STANDARD RATINGS						
CAPACITANCE ( $\mu\text{F}$ )	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu\text{A}$ )	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{\text{RMS}}$ (A)
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>						
6.8	D	TF3D685(1)035(2)1000	2.4	6	1.000	0.39
6.8	D	TF3D685(1)035(2)0750	2.4	6	0.750	0.45
6.8	D	TF3D685(1)035(2)0500	2.4	6	0.500	0.55
10	D	TF3D106(1)035(2)0800	3.5	6	0.800	0.43
10	D	TF3D106(1)035(2)0500	3.5	6	0.500	0.55
10	D <sup>(1)</sup>	TF3D106(1)035(2)0400	3.5	6	0.400	0.61
10	E	TF3E106(1)035(2)1000	3.5	6	1.000	0.41
10	E	TF3E106(1)035(2)0800	3.5	6	0.800	0.45
10	E	TF3E106(1)035(2)0500	3.5	6	0.500	0.57
10	E <sup>(1)</sup>	TF3E106(1)035(2)0400	3.5	6	0.400	0.64
15	D	TF3D156(1)035(2)0800	5.3	6	0.800	0.43
15	D	TF3D156(1)035(2)0500	5.3	6	0.500	0.55
15	D <sup>(1)</sup>	TF3D156(1)035(2)0400	5.3	6	0.400	0.61
15	E	TF3E156(1)035(2)0900	5.3	6	0.900	0.43
15	E	TF3E156(1)035(2)0700	5.3	6	0.700	0.49
15	E	TF3E156(1)035(2)0500	5.3	6	0.500	0.57
22	E	TF3E226(1)035(2)0600	7.7	6	0.600	0.52
22	E <sup>(1)</sup>	TF3E226(1)035(2)0300	7.7	6	0.300	0.74
<b>50 V<sub>DC</sub> AT + 85 °C; 33 V<sub>DC</sub> AT + 125 °C</b>						
0.47	C	TF3C474(1)050(2)8000	0.5	4	8.000	0.12
0.47	C	TF3C474(1)050(2)6700	0.5	4	6.700	0.13
0.47	C <sup>(1)</sup>	TF3C474(1)050(2)1900	0.5	4	1.900	0.24
0.68	C	TF3C684(1)050(2)7000	0.5	4	7.000	0.13
0.68	C	TF3C684(1)050(2)5900	0.5	4	5.900	0.14
0.68	C <sup>(1)</sup>	TF3C684(1)050(2)1700	0.5	4	1.700	0.25
1.0	C	TF3C105(1)050(2)5500	0.5	4	5.500	0.14
1.0	C	TF3C105(1)050(2)4400	0.5	4	4.400	0.16
1.0	C	TF3C105(1)050(2)2700	0.5	4	2.700	0.20
1.0	C <sup>(1)</sup>	TF3C105(1)050(2)2200	0.5	4	2.200	0.22
1.5	C	TF3C155(1)050(2)5000	0.8	6	5.000	0.15
1.5	C	TF3C155(1)050(2)3200	0.8	6	3.200	0.19
1.5	C <sup>(1)</sup>	TF3C155(1)050(2)2000	0.8	6	2.000	0.23
1.5	C <sup>(1)</sup>	TF3C155(1)050(2)1600	0.8	6	1.600	0.26
2.2	C	TF3C225(1)050(2)2800	1.1	6	2.800	0.20
2.2	C <sup>(1)</sup>	TF3C225(1)050(2)1400	1.1	6	1.400	0.28
2.2	D	TF3D225(1)050(2)2500	1.1	6	2.500	0.24
2.2	D	TF3D225(1)050(2)2100	1.1	6	2.100	0.27
2.2	D	TF3D225(1)050(2)0900	1.1	6	0.900	0.41
3.3	C	TF3C335(1)050(2)2400	1.7	6	2.400	0.21
3.3	C	TF3C335(1)050(2)1600	1.7	6	1.600	0.26
3.3	C <sup>(1)</sup>	TF3C335(1)050(2)1200	1.7	6	1.200	0.30

**Notes**

- Part number definitions:
  - Capacitance tolerance codes: K, M
  - Terminations and packaging codes: C, D, E, F
- <sup>(1)</sup> Preliminary values, contact factory for availability

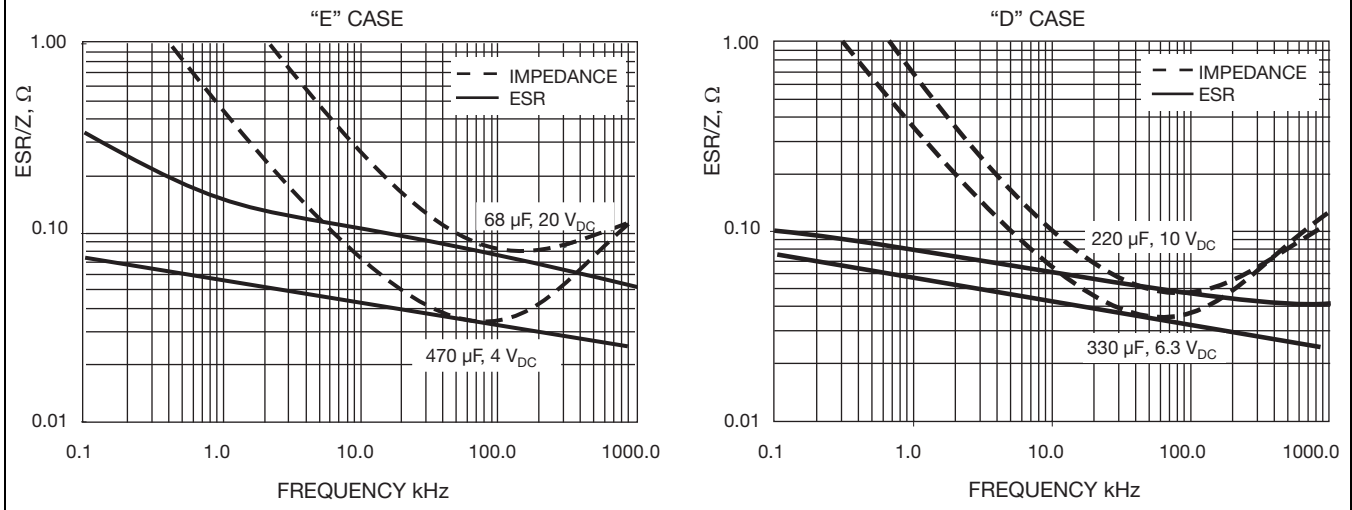


STANDARD RATINGS						
CAPACITANCE ( $\mu\text{F}$ )	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu\text{A}$ )	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{\text{RMS}}$ (A)
<b>50 V<sub>DC</sub> AT + 85 °C, 33 V<sub>DC</sub> AT + 125 °C</b>						
3.3	D	TF3D335(1)050(2)2000	1.7	6	2.000	0.27
3.3	D	TF3D335(1)050(2)1600	1.7	6	1.600	0.31
4.7	D	TF3D475(1)050(2)1100	2.4	6	1.100	0.37
4.7	E	TF3E475(1)050(2)1500	1.9	4	1.500	0.33
4.7	E	TF3E475(1)050(2)1100	1.9	4	1.100	0.39
6.8	D	TF3D685(1)050(2)0900	3.4	6	0.900	0.41
6.8	D <sup>(1)</sup>	TF3D685(1)050(2)0450	3.4	6	0.450	0.58
6.8	E	TF3E685(1)050(2)0900	3.4	6	0.900	0.43
6.8	E <sup>(1)</sup>	TF3E685(1)050(2)0450	3.4	6	0.450	0.61

**Notes**

- Part number definitions:
  - (1) Capacitance tolerance codes: K, M
  - (2) Terminations and packaging codes: C, D, E, F
- <sup>(1)</sup> Preliminary values, contact factory for availability

RECOMMENDED VOLTAGE DERATING GUIDELINES (for temperatures below + 85 °C)	
STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.6
10	6.0
16	10
20	12
25	15
35	24
50	28
SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24

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

**POWER DISSIPATION**

CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
C	0.110
D	0.150
E	0.165

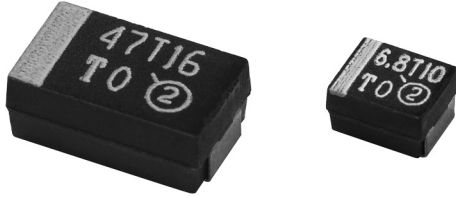
**STANDARD PACKAGING QUANTITY**

CASE CODE	UNITS PER REEL	
	7" REEL	13" REEL
C	500	3000
D	500	2500
E	400	1500

**PRODUCT INFORMATION**

Guide for Molded Tantalum Capacitors	<a href="http://www.vishay.com/doc?40074">www.vishay.com/doc?40074</a>
Pad Dimensions	
Package Dimensions	
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
<b>SELECTOR GUIDES</b>	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
<b>FAQ</b>	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

## Solid Tantalum Surface Mount TANTAMOUNT<sup>®</sup>, Molded Case, Hi-Rel COTS


**FEATURES**

- Terminations: 100 % matte tin and tin/lead
- Standard EIA 535BAAC case sizes (A through E)
- Weibull grading and surge current test options
- Standard and low ESR options
- Mounting: Surface mount
- Compliant to RoHS Directive 2002/95/EC
- Moisture sensitivity level 1


**RoHS\***  
COMPLIANT

**Note**

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

**PERFORMANCE/ELECTRICAL CHARACTERISTICS**
[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)

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

**Capacitance Range:** 0.1 μF to 470 μF

**Capacitance Tolerance:** ± 10 %, ± 20 %

**Voltage Rating:** 4 V<sub>DC</sub> to 63 V<sub>DC</sub>

ORDERING INFORMATION								
T83	D	107	K	010	E	A	A	S
TYPE	CASE CODE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	TERMINATION AND PACKAGING	RELIABILITY LEVEL	SURGE CURRENT	ESR
	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).	C: Matte tin/7" (178 mm) reels H: Matte tin/7" (178 mm), ½ reel E: Tin/lead /7" (178 mm) reel L: Tin/lead/7" (178 mm), ½ reel	A = 1.0 % B = 0.1 % C = 0.01 % S = Hi-Rel standard Z = Non-ER	A = 10 cycles at + 25 °C B = 10 cycles at - 55 °C/+ 85 °C Z = None S = 3 cycles at + 25 °C	S = Std L = Low

DIMENSIONS in inches (millimeters)							
CASE CODE	EIA SIZE	L	W	H	P	Tw	TH (MIN.)
A	3216-18	0.126 ± 0.008 [3.2 ± 0.20]	0.063 ± 0.008 [1.6 ± 0.20]	0.063 ± 0.008 [1.6 ± 0.20]	0.031 ± 0.012 [0.80 ± 0.30]	0.047 ± 0.004 [1.2 ± 0.10]	0.028 [0.70]
B	3528-21	0.138 ± 0.008 [3.5 ± 0.20]	0.110 ± 0.008 [2.8 ± 0.20]	0.075 ± 0.008 [1.9 ± 0.20]	0.031 ± 0.012 [0.80 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.028 [0.70]
C	6032-28	0.236 ± 0.012 [6.0 ± 0.30]	0.126 ± 0.012 [3.2 ± 0.30]	0.098 ± 0.012 [2.5 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.039 [1.0]
D	7343-31	0.287 ± 0.012 [7.3 ± 0.30]	0.169 ± 0.012 [4.3 ± 0.30]	0.110 ± 0.012 [2.8 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.094 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]
E	7343-43	0.287 ± 0.012 [7.3 ± 0.30]	0.169 ± 0.012 [4.3 ± 0.30]	0.157 ± 0.012 [4.0 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.094 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]

RATINGS AND CASE CODES									
μF	4 V	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V	63 V
0.10							A	A	
0.15							A	A/B	
0.22							A	B	
0.33						A	A	B	
0.47					A	A	A/B	B/C	
0.68				A	A	B	B	C	
1.0			A	A	A	A/B	A/B	B/C	
1.5		A	A	A	B	B	B/C	C/D	
2.2	A	A		B	A/B	A/B/C	B/C	C/D	
3.3	A	A	B	B	B	B/C	B/C	D	
4.7	A	A/B	A/B	A/B	A/B/C	B/C	C/D	D	D
6.8	B	B	B	C	C	C/D	C/D	E	
10	B	B	A/C	A/B/C	B/C	B/C/D	C/D	E	E
15	B	C	A/C	B	D	C/D	D		
22		A/C	A	B/D	C/D	D	D/E		
33	A/C	B/C	B/C/D	B/C/D	D	D/E			
47	B/C	B/C/D	B/C/D	C/D	D/E	D/E			
68	D	D	D	D	D/E				
100	B/D	B/D	C/D	D/E	E				
150	D	D/E	D	E					
220		C/D/E	D/E						
330	E	E	E						
470			E						

MARKING																						
<p>Indicates Hi-Rel COTS</p> <p>Capacitance Code, pF</p> <p>V 104T</p> <p>Polarity Band (+)</p> <p>Voltage Code</p> <p><b>A Case</b></p>	<table border="1"> <thead> <tr> <th colspan="2">"A" CASE VOLTAGE CODE</th> </tr> <tr> <th>VOLTS</th> <th>CODE</th> </tr> </thead> <tbody> <tr><td>4.0</td><td>G</td></tr> <tr><td>6.3</td><td>J</td></tr> <tr><td>10</td><td>A</td></tr> <tr><td>16</td><td>C</td></tr> <tr><td>20</td><td>D</td></tr> <tr><td>25</td><td>E</td></tr> <tr><td>35</td><td>V</td></tr> <tr><td>50</td><td>T</td></tr> </tbody> </table>		"A" CASE VOLTAGE CODE		VOLTS	CODE	4.0	G	6.3	J	10	A	16	C	20	D	25	E	35	V	50	T
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<p><b>Marking</b></p> <p>Capacitor marking includes an anode (+) polarity band, capacitance in microfarads and the voltage rating. "A" case capacitors use a letter code for the voltage and EIA capacitance code.</p> <p>The Vishay Sprague® trademark is included if space permits. Capacitors rated at 6.3 V are marked 6 V.</p> <p>A manufacturing date code is marked on all capacitors.</p> <p>Call the factory for further explanation.</p>																						



STANDARD RATINGS								
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	STD. (S) MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	LOW (L) MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	AVAILABLE RELIABILITY LEVELS	
<b>4 V<sub>DC</sub> AT + 85 °C; 2.7 V<sub>DC</sub> AT + 125 °C</b>								
2.2	A	T83A225(1)004(2)(6)(4)(5)	0.5	6	7.600	6.000	A, B, C, S, Z	
3.3	A	T83A335(1)004(2)(3)(4)(5)	0.5	6	7.600	4.000	A, B, S, Z	
4.7	A	T83A475(1)004(2)(6)(4)(5)	0.5	6	6.300	3.500	A, B, C, S, Z	
6.8	B	T83B685(1)004(2)(6)(4)(5)	0.5	6	4.500	2.000	A, B, C, S, Z	
10	B	T83B106(1)004(2)(6)(4)(5)	0.5	6	3.500	1.200	A, B, C, S, Z	
15	B	T83B156(1)004(2)(6)(4)(5)	0.6	6	2.900	1.200	A, B, C, S, Z	
33	A	T83A336(1)004(2)(3)(4)(5)	1.3	6	2.900	1.500	A, B, S, Z	
33	C	T83C336(1)004(2)(6)(4)(5)	1.3	6	1.800	0.500	A, B, C, S, Z	
47	B	T83B476(1)004(2)(3)(4)(5)	1.9	6	2.500	0.600	A, B, S, Z	
47	C	T83C476(1)004(2)(3)(4)(5)	1.9	6	1.800	0.400	A, B, S, Z	
68	D	T83D686(1)004(2)(6)(4)(5)	2.7	6	0.800	0.175	A, B, C, S, Z	
100	B	T83B107(1)004(2)(3)(4)(5)	4.0	6	1.800	0.450	A, B, S, Z	
100	D	T83D107(1)004(2)(6)(4)(5)	4.0	6	0.700	0.175	A, B, C, S, Z	
150	D	T83D157(1)004(2)(3)(4)(5)	6.0	8	0.600	0.150	A, B, S, Z	
330	E	T83E337(1)004(2)(3)(4)(5)	13.2	8	0.500	0.100	A, B, S, Z	
<b>6 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT + 125 °C</b>								
1.5	A	T83A155(1)6R3(2)(6)(4)(5)	0.5	6	8.000	6.000	A, B, C, S, Z	
2.2	A	T83A225(1)6R3(2)(6)(4)(5)	0.5	6	7.600	6.000	A, B, C, S, Z	
3.3	A	T83A335(1)6R3(2)(6)(4)(5)	0.5	6	6.300	5.000	A, B, C, S, Z	
4.7	A	T83A475(1)6R3(2)(3)(4)(5)	0.5	6	5.500	3.500	A, B, S, Z	
4.7	B	T83B475(1)6R3(2)(6)(4)(5)	0.5	6	3.400	1.800	A, B, C, S, Z	
6.8	B	T83B685(1)6R3(2)(6)(4)(5)	0.5	6	3.400	1.200	A, B, C, S, Z	
10	B	T83B106(1)6R3(2)(6)(4)(5)	0.6	6	2.900	1.000	A, B, C, S, Z	
15	C	T83C156(1)6R3(2)(6)(4)(5)	0.9	6	1.800	0.600	A, B, C, S, Z	
22	A	T83A226(1)6R3(2)(3)(4)(5)	1.3	6	2.900	2.000	A, B, S, Z	
22	C	T83C226(1)6R3(2)(6)(4)(5)	1.3	6	1.800	0.500	A, B, C, S, Z	
33	B	T83B336(1)6R3(2)(3)(4)(5)	2.0	6	1.900	0.600	A, B, S, Z	
33	C	T83C336(1)6R3(2)(3)(4)(5)	2.0	6	1.500	0.400	A, B, S, Z	
47	B	T83B476(1)6R3(2)(3)(4)(5)	2.8	6	2.000	0.550	A, B, S, Z	
47	C	T83C476(1)6R3(2)(3)(4)(5)	2.8	6	1.400	0.300	A, B, S, Z	
47	D	T83D476(1)6R3(2)(6)(4)(5)	2.8	6	0.800	0.200	A, B, C, S, Z	
68	D	T83D686(1)6R3(2)(6)(4)(5)	4.1	6	0.700	0.200	A, B, C, S, Z	
100	B	T83B107(1)6R3(2)(3)(4)(5)	6.0	15	1.700	0.700	A, B, S, Z	
100	D	T83D107(1)6R3(2)(3)(4)(5)	6.0	6	0.700	0.140	A, B, S, Z	
150	D	T83D157(1)6R3(2)(3)(4)(5)	9.0	8	0.600	0.125	A, B, S, Z	
150	E	T83E157(1)6R3(2)(3)(4)(5)	9.0	8	0.500	0.100	A, B, S, Z	
220	C	T83C227(1)6R3(2)(3)(4)(5)	13.9	14	0.700	0.300	A, B, S, Z	
220	D	T83D227(1)6R3(2)(3)(4)(5)	13.2	8	0.600	0.100	A, B, S, Z	
220	E	T83E227(1)6R3(2)(3)(4)(5)	13.2	8	0.500	0.100	A, B, S, Z	
330	E	T83E337(1)6R3(2)(3)(4)(5)	19.8	8	0.500	0.100	A, B, S, Z	

Note

- Part number definitions:
  - Capacitance tolerance: K, M
  - Termination and packaging: C, E, H, L
  - Reliability level: A, B, S, Z
  - Surge current: A, B, Z, S
  - ESR: L, S
  - Reliability level: A, B, C, S, Z
  - Reliability level: A, S, Z



STANDARD RATINGS							
CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C (μA)	MAX. DF AT + 25 °C 120 Hz (%)	STD. (S) MAX. ESR AT + 25 °C 100 kHz (Ω)	LOW (L) MAX. ESR AT + 25 °C 100 kHz (Ω)	AVAILABLE RELIABILITY LEVELS
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT + 125 °C</b>							
1.0	A	T83A105(1)010(2)(6)(4)(5)	0.5	4	9.300	6.000	A, B, C, S, Z
1.5	A	T83A155(1)010(2)(6)(4)(5)	0.5	6	8.000	6.000	A, B, C, S, Z
3.3	B	T83B335(1)010(2)(6)(4)(5)	0.5	6	3.500	2.500	A, B, C, S, Z
4.7	A	T83A475(1)010(2)(3)(4)(5)	0.5	6	5.000	3.000	A, B, S, Z
4.7	B	T83B475(1)010(2)(6)(4)(5)	0.5	6	3.400	1.500	A, B, C, S, Z
6.8	B	T83B685(1)010(2)(6)(4)(5)	0.7	6	2.900	1.200	A, B, C, S, Z
10	A	T83A106(1)010(2)(3)(4)(5)	1.0	6	3.400	2.000	A, B, S, Z
10	C	T83C106(1)010(2)(3)(4)(5)	1.0	6	1.800	0.550	A, B, S, Z
15	A	T83A156(1)010(2)(3)(4)(5)	1.5	6	2.900	2.000	A, B, S, Z
15	C	T83C156(1)010(2)(6)(4)(5)	1.5	6	1.800	0.500	A, B, C, S, Z
22	A	T83A226(1)010(2)(3)(4)(5)	2.2	8	2.500	1.500	A, B, S, Z
33	B	T83B336(1)010(2)(3)(4)(5)	3.3	6	1.900	0.600	A, B, S, Z
33	C	T83C336(1)010(2)(3)(4)(5)	3.3	6	1.400	0.350	A, B, S, Z
33	D	T83D336(1)010(2)(6)(4)(5)	3.3	6	0.800	0.250	A, B, S, Z
47	B	T83B476(1)010(2)(3)(4)(5)	4.7	6	1.800	0.600	A, B, S, Z
47	C	T83C476(1)010(2)(3)(4)(5)	4.7	6	1.100	0.300	A, B, S, Z
47	D	T83D476(1)010(2)(6)(4)(5)	4.7	6	0.700	0.200	A, B, C, S, Z
68	D	T83D686(1)010(2)(3)(4)(5)	6.8	6	0.700	0.150	A, B, S, Z
100	C	T83C107(1)010(2)(3)(4)(5)	10.0	8	0.900	0.200	A, B, S, Z
100	D	T83D107(1)010(2)(3)(4)(5)	10.0	8	0.600	0.100	A, B, S, Z
150	D	T83D157(1)010(2)(3)(4)(5)	15.0	8	0.600	0.100	A, B, S, Z
220	D	T83D227(1)010(2)(3)(4)(5)	22.0	8	0.600	0.360	A, B, S, Z
220	E	T83E227(1)010(2)(3)(4)(5)	22.0	8	0.500	0.100	A, B, S, Z
330	E	T83E337(1)010(2)(3)(4)(5)	33.0	10	0.500	0.100	A, B, S, Z
470	E	T83E477(1)010(2)(3)(4)(5)	47.0	15	0.500	0.100	A, B, S, Z
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>							
0.68	A	T83A684(1)016(2)(3)(4)(5)	0.5	4	11.000	8.000	A, B, S, Z
1.0	A	T83A105(1)016(2)(3)(4)(5)	0.5	4	9.300	6.000	A, B, S, Z
1.5	A	T83A155(1)016(2)(3)(4)(5)	0.5	6	6.700	6.000	A, B, S, Z
2.2	B	T83B225(1)016(2)(3)(4)(5)	0.5	6	4.600	2.500	A, B, S, Z
3.3	B	T83B335(1)016(2)(3)(4)(5)	0.5	6	3.500	2.000	A, B, S, Z
4.7	A	T83A475(1)016(2)(3)(4)(5)	0.8	6	5.000	3.500	A, B, S, Z
4.7	B	T83B475(1)016(2)(3)(4)(5)	0.8	6	2.900	1.500	A, B, S, Z
6.8	C	T83C685(1)016(2)(3)(4)(5)	1.1	6	1.900	0.600	A, B, S, Z
10	A	T83A106(1)016(2)(3)(4)(5)	1.6	6	3.000	1.700	A, B, S, Z
10	B	T83B106(1)016(2)(3)(4)(5)	1.6	6	2.800	0.800	A, B, S, Z

Note

- Part number definitions:
  - Capacitance tolerance: K, M
  - Termination and packaging: C, E, H, L
  - Reliability level: A, B, S, Z
  - Surge current: A, B, Z, S
  - ESR: L, S
  - Reliability level: A, B, C, S, Z
  - Reliability level: A, S, Z



STANDARD RATINGS							
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	STD. (S) MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	LOW (L) MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	AVAILABLE RELIABILITY LEVELS
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>							
10	C	T83C106(1)016(2)(3)(4)(5)	1.6	6	1.800	0.450	A, B, S, Z
15	B	T83B156(1)016(2)(3)(4)(5)	2.4	6	0.800	2.000	A, B, S, Z
22	B	T83B226(1)016(2)(3)(4)(5)	3.5	6	1.000	1.900	A, B, S, Z
22	D	T83D226(1)016(2)(3)(4)(5)	3.5	6	0.800	0.250	A, B, S, Z
33	B	T83B336(1)016(2)(3)(4)(5)	5.3	6	1.800	0.500	A, B, S, Z
33	C	T83C336(1)016(2)(3)(4)(5)	5.3	6	1.100	0.300	A, B, S, Z
33	D	T83D336(1)016(2)(3)(4)(5)	5.3	6	0.700	0.225	A, B, S, Z
47	C	T83C476(1)016(2)(3)(4)(5)	1.5	6	1.000	0.300	A, B, S, Z
47	D	T83D476(1)016(2)(3)(4)(5)	7.5	6	0.700	0.150	A, B, S, Z
68	D	T83D686(1)016(2)(3)(4)(5)	10.9	6	0.600	0.150	A, B, S, Z
100	D	T83D107(1)016(2)(3)(4)(5)	16.0	8	0.600	0.125	A, B, S, Z
100	E	T83E107(1)016(2)(3)(4)(5)	16.0	8	0.600	0.100	A, B, S, Z
150	E	T83E157(1)016(2)(3)(4)(5)	24.0	8	0.500	0.150	A, B, S, Z
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>							
0.47	A	T83A474(1)020(2)(3)(4)(5)	0.5	4	12.000	9.000	A, B, S, Z
0.68	A	T83A684(1)020(2)(6)(4)(5)	0.5	4	10.000	8.000	A, B, C, S, Z
1.0	A	T83A105(1)020(2)(6)(4)(5)	0.5	4	8.400	5.500	A, B, C, S, Z
1.5	B	T83B155(1)020(2)(3)(4)(5)	0.5	6	4.600	2.500	A, B, S, Z
2.2	A	T83A225(1)020(2)(3)(4)(5)	0.5	6	5.900	4.000	A, B, S, Z
2.2	B	T83B225(1)020(2)(6)(4)(5)	0.5	6	3.500	1.500	A, B, C, S, Z
3.3	B	T83B335(1)020(2)(6)(4)(5)	0.7	6	3.000	1.300	A, B, C, S, Z
4.7	A	T83A475(1)020(2)(3)(4)(5)	0.9	6	5.000	3.500	A, B, S, Z
4.7	B	T83B475(1)020(2)(3)(4)(5)	0.9	6	2.900	1.000	A, B, S, Z
4.7	C	T83C475(1)020(2)(3)(4)(5)	0.9	6	2.300	0.600	A, B, S, Z
6.8	C	T83C685(1)020(2)(6)(4)(5)	1.4	6	1.900	0.550	A, B, C, S, Z
10	B	T83B106(1)020(2)(3)(4)(5)	2.0	6	2.500	1.000	A, B, S, Z
10	C	T83C106(1)020(2)(3)(4)(5)	2.0	6	1.700	0.450	A, B, S, Z
15	D	T83D156(1)020(2)(6)(4)(5)	3.0	6	0.900	0.300	A, B, C, S, Z
22	C	T83C226(1)020(2)(3)(4)(5)	4.4	6	1.100	0.375	A, B, S, Z
22	D	T83D226(1)020(2)(6)(4)(5)	4.4	6	0.700	0.225	A, B, C, S, Z
33	D	T83D336(1)020(2)(3)(4)(5)	6.6	6	0.700	0.200	A, B, S, Z
47	D	T83D476(1)020(2)(3)(4)(5)	9.4	6	0.700	0.200	A, B, S, Z
47	E	T83E476(1)020(2)(3)(4)(5)	9.4	6	0.600	0.150	A, B, S, Z
68	D	T83D686(1)020(2)(3)(4)(5)	13.6	6	0.700	0.175	A, B, S, Z
68	E	T83E686(1)020(2)(3)(4)(5)	13.6	6	0.600	0.150	A, B, S, Z
100	E	T83E107(1)020(2)(3)(4)(5)	20.0	8	0.500	0.150	A, B, S, Z

**Note**

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





STANDARD RATINGS							
CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C (μA)	MAX. DF AT + 25 °C 120 Hz (%)	STD. (S) MAX. ESR AT + 25 °C 100 kHz (Ω)	LOW (L) MAX. ESR AT + 25 °C 100 kHz (Ω)	AVAILABLE RELIABILITY LEVELS
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>							
0.33	A	T83A334(1)025(2)(3)(4)(5)	0.5	4	14.000	10.000	A, B, S, Z
0.47	A	T83A474(1)025(2)(3)(4)(5)	0.5	4	12.000	9.000	A, B, S, Z
0.68	B	T83B684(1)025(2)(3)(4)(5)	0.5	4	7.000	5.000	A, B, S, Z
1.0	A	T83A105(1)025(2)(3)(4)(5)	0.5	4	6.100	3.200	A, B, S, Z
1.0	B	T83B105(1)025(2)(6)(4)(5)	0.5	4	5.000	2.000	A, B, C, S, Z
1.5	B	T83B155(1)025(2)(6)(4)(5)	0.5	6	4.600	2.000	A, B, C, S, Z
2.2	A	T83A225(1)025(2)(3)(4)(5)	0.6	6	6.300	4.000	A, B, S, Z
2.2	B	T83B225(1)025(2)(3)(4)(5)	0.6	6	3.800	2.300	A, B, S, Z
2.2	C	T83C225(1)025(2)(6)(4)(5)	0.6	6	2.900	1.000	A, B, C, S, Z
3.3	B	T83B335(1)025(2)(3)(4)(5)	0.8	6	3.100	1.500	A, B, S, Z
3.3	C	T83C335(1)025(2)(3)(4)(5)	0.8	6	2.300	1.000	A, B, S, Z
4.7	B	T83B475(1)025(2)(3)(4)(5)	1.2	6	2.800	1.500	A, B, S, Z
4.7	C	T83C475(1)025(2)(6)(4)(5)	1.2	6	2.000	0.525	A, B, C, S, Z
6.8	C	T83C685(1)025(2)(3)(4)(5)	1.7	6	1.700	0.500	A, B, S, Z
6.8	D	T83D685(1)025(2)(6)(4)(5)	1.7	6	1.200	0.350	A, B, C, S, Z
10	B	T83B106(1)025(2)(3)(4)(5)	2.5	6	2.300	1.300	A, B, S, Z
10	C	T83C106(1)025(2)(3)(4)(5)	2.5	6	1.500	0.450	A, B, S, Z
10	D	T83D106(1)025(2)(6)(4)(5)	2.5	6	1.000	0.300	A, B, C, S, Z
15	C	T83C156(1)025(2)(3)(4)(5)	3.8	6	1.200	0.430	A, B, S, Z
15	D	T83D156(1)025(2)(6)(4)(5)	3.8	6	0.800	0.250	A, B, C, S, Z
22	D	T83D226(1)025(2)(3)(4)(5)	5.5	6	0.700	0.200	A, B, S, Z
33	D	T83D336(1)025(2)(3)(4)(5)	8.3	6	0.700	0.300	A, B, S, Z
33	E	T83E336(1)025(2)(3)(4)(5)	8.3	6	0.600	0.200	A, B, S, Z
47	D	T83D476(1)025(2)(6)(4)(5)	11.8	8	0.700	0.350	A, B, C, S, Z
47	E	T83E476(1)025(2)(3)(4)(5)	11.8	6	0.600	0.300	A, B, S, Z
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>							
0.10	A	T83A104(1)035(2)(6)(4)(5)	0.5	4	20.000	10.000	A, B, C, S, Z
0.15	A	T83A154(1)035(2)(6)(4)(5)	0.5	4	18.000	6.000	A, B, C, S, Z
0.22	A	T83A224(1)035(2)(6)(4)(5)	0.5	4	15.000	6.000	A, B, C, S, Z
0.33	A	T83A334(1)035(2)(6)(4)(5)	0.5	4	13.000	6.000	A, B, C, S, Z
0.47	A	T83A474(1)035(2)(3)(4)(5)	0.5	4	10.000	4.000	A, B, S, Z
0.47	B	T83B474(1)035(2)(6)(4)(5)	0.5	4	8.000	0.800	A, B, C, S, Z
0.68	B	T83B684(1)035(2)(6)(4)(5)	0.5	4	6.500	2.500	A, B, C, S, Z
1.0	A	T83A105(1)035(2)(3)(4)(5)	0.5	4	7.500	6.000	A, B, S, Z
1.0	B	T83B105(1)035(2)(6)(4)(5)	0.5	4	5.000	2.000	A, B, C, S, Z
1.5	B	T83B155(1)035(2)(3)(4)(5)	0.5	6	4.200	3.000	A, B, S, Z
1.5	C	T83C155(1)035(2)(3)(4)(5)	0.5	6	3.800	1.500	A, B, S, Z
2.2	B	T83B225(1)035(2)(3)(4)(5)	0.8	6	3.800	2.300	A, B, S, Z
2.2	C	T83C225(1)035(2)(6)(4)(5)	0.8	6	2.900	0.900	A, B, C, S, Z

**Note**

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



STANDARD RATINGS							
CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C (μA)	MAX. DF AT + 25 °C 120 Hz (%)	STD. (S) MAX. ESR AT + 25 °C 100 kHz (Ω)	LOW (L) MAX. ESR AT + 25 °C 100 kHz (Ω)	AVAILABLE RELIABILITY LEVELS
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>							
3.3	B	T83B335(1)035(2)(3)(4)(5)	1.2	6	3.500	1.500	A, B, S, Z
3.3	C	T83C335(1)035(2)(6)(4)(5)	1.2	6	2.100	0.700	A, B, C, S, Z
4.7	C	T83C475(1)035(2)(3)(4)(5)	1.6	6	1.900	0.600	A, B, S, Z
4.7	D	T83D475(1)035(2)(3)(4)(5)	1.6	6	1.300	0.600	A, B, S, Z
6.8	C	T83C685(1)035(2)(3)(4)(5)	2.4	6	1.800	0.900	A, B, S, Z
6.8	D	T83D685(1)035(2)(6)(4)(5)	2.4	6	1.100	0.300	A, B, C, S, Z
10	C	T83C106(1)035(2)(3)(4)(5)	3.5	6	1.600	0.850	A, B, S, Z
10	D	T83D106(1)035(2)(3)(4)(5)	3.5	6	0.800	0.300	A, B, S, Z
15	D	T83D156(1)035(2)(3)(4)(5)	5.3	6	0.800	0.300	A, B, S, Z
22	D	T83D226(1)035(2)(3)(4)(5)	7.7	6	0.600	0.400	A, B, S, Z
22	E	T83E226(1)035(2)(3)(4)(5)	7.7	6	0.600	0.300	A, B, S, Z
<b>50 V<sub>DC</sub> AT + 85 °C; 33 V<sub>DC</sub> AT + 125 °C</b>							
0.10	A	T83A104(1)050(2)(6)(4)(5)	0.5	4	19.000	10.000	A, B, C, S, Z
0.15	A	T83A154(1)050(2)(3)(4)(5)	0.5	4	17.000	10.000	A, B, S, Z
0.15	B	T83B154(1)050(2)(3)(4)(5)	0.5	4	14.000	9.000	A, B, S, Z
0.22	B	T83B224(1)050(2)(6)(4)(5)	0.5	4	12.000	8.500	A, B, C, S, Z
0.33	B	T83B334(1)050(2)(6)(4)(5)	0.5	4	10.000	4.500	A, B, C, S, Z
0.47	B	T83B474(1)050(2)(3)(4)(5)	0.5	4	8.400	4.000	A, B, S, Z
0.47	C	T83C474(1)050(2)(3)(4)(5)	0.5	4	6.700	1.800	A, B, S, Z
0.68	C	T83C684(1)050(2)(6)(4)(5)	0.5	4	5.900	1.600	A, B, C, S, Z
1.0	B	T83B105(1)050(2)(3)(4)(5)	0.5	4	6.700	2.000	A, B, S, Z
1.0	C	T83C105(1)050(2)(6)(4)(5)	0.5	4	4.600	1.600	A, B, C, S, Z
1.5	C	T83C155(1)050(2)(3)(4)(5)	0.8	6	3.400	1.500	A, B, S, Z
1.5	D	T83D155(1)050(2)(6)(4)(5)	0.8	6	2.900	1.000	A, B, C, S, Z
2.2	C	T83C225(1)050(2)(3)(4)(5)	1.1	6	2.900	1.500	A, B, S, Z
2.2	D	T83D225(1)050(2)(6)(4)(5)	1.1	6	2.100	0.800	A, B, C, S, Z
3.3	D	T83D335(1)050(2)(6)(4)(5)	1.7	6	1.700	0.800	A, B, C, S, Z
4.7	D	T83D475(1)050(2)(6)(4)(5)	2.4	6	1.200	0.600	A, B, C, S, Z
6.8	E	T83E685(1)050(2)(3)(4)(5)	3.4	6	0.900	0.540	A, B, S, Z
10	E	T83E106(1)050(2)(3)(4)(5)	5.0	6	0.800	0.550	A, B, S, Z
<b>63 V<sub>DC</sub> AT + 85 °C; 41.6 V<sub>DC</sub> AT + 125 °C</b>							
4.7	D	T83D475(1)063(2)(7)(4)(5)	3.0	6	1.100	0.700	A, S, Z
10	E	T83E106(1)063(2)(7)(4)(5)	6.3	6	1.000	0.600	A, S, Z

Note

- Part number definitions:
  - Capacitance tolerance: K, M
  - Termination and packaging: C, E, H, L
  - Reliability level: A, B, S, Z
  - Surge current: A, B, Z, S
  - ESR: L, S
  - Reliability level: A, B, C, S, Z
  - Reliability level: A, S, Z



<b>RECOMMENDED VOLTAGE DERATING GUIDELINES</b> (for temperatures below + 85 °C)	
<b>STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS</b>	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24
63	32
<b>SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS</b>	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.6
10	6.0
16	10
20	12
25	15
35	24
50	28
63	38

<b>POWER DISSIPATION</b>	
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
A	0.075
B	0.085
C	0.110
D	0.150
E	0.165

<b>STANDARD PACKAGING QUANTITY</b>		
CASE CODE	UNITS PER REEL	
	7" FULL REEL	7" HALF REEL
A	2000	1000
B	2000	1000
C	500	250
D	500	250
E	400	200

<b>PRODUCT INFORMATION</b>	
COTS Guide for Tantalum Capacitors	<a href="http://www.vishay.com/doc?40083">www.vishay.com/doc?40083</a>
Pad Dimensions	
Packaging Dimensions	
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
<b>SELECTOR GUIDES</b>	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
<b>FAQ</b>	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

# Solid Tantalum Surface Mount TANTAMOUNT<sup>®</sup>, Molded Case, Hi-Rel COTS, Low ESR, Built-In-Fuse


**FEATURES**

- Terminations: 100 % matte tin, standard, tin/lead available
- Molded case available in three case sizes
- Compatible with "High Volume" automatic pick and place equipment
- High ripple current carrying capability
- Meets EIA 535BAAC case sizes
- Weibull grading and surge current test options per MIL-PRF-55365
- Standard and low ESR options
- Compliant to RoHS Directive 2002/95/EC
- Moisture sensitivity level 1


**RoHS\***  
COMPLIANT

**Note**

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

**PERFORMANCE CHARACTERISTICS**
[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)

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

**Capacitance Range:** 0.47 µF to 470 µF

**Capacitance Tolerance:** ± 10 %, ± 20 %

**Voltage Rating:** 4 V<sub>DC</sub> to 50 V<sub>DC</sub>

ORDERING INFORMATION								
T86	D	107	K	010	E	A	A	S
TYPE	CASE CODE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	TERMINATION/PACKAGING	RELIABILITY LEVEL	SURGE CURRENT	ESR
	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 V. To complete the three-digit block, zeros precede the voltage rating. A decimal point is indicated by an "R" (6R3 = 6.3 V).	C = Matte tin/ 7" (178 mm) reel H = Matte tin/ 7" (178 mm), 1/2 reel E = Tin/lead/ 7" (178 mm) reel L = Tin/lead/ 7" (178 mm), 1/2 reel	A = 1.0 % B = 0.1 % S = Hi-Rel standard Z = Non-ER	A = 10 cycles at + 25 °C B = 10 cycles at - 55 °C/+ 85 °C S = 3 cycles at + 25 °C	S = Std. L = Low

DIMENSIONS in inches [millimeters]							
CASE CODE	EIA SIZE	L	W	H	P	T <sub>w</sub>	T <sub>H</sub> (MIN.)
C	6032-28	0.236 ± 0.012 [6.0 ± 0.30]	0.126 ± 0.012 [3.2 ± 0.30]	0.098 ± 0.012 [2.5 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.039 [1.0]
D	7343-31	0.287 ± 0.012 [7.3 ± 0.30]	0.169 ± 0.012 [4.3 ± 0.30]	0.110 ± 0.012 [2.8 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.094 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]
E	7343-43	0.287 ± 0.012 [7.3 ± 0.30]	0.169 ± 0.012 [4.3 ± 0.30]	0.157 ± 0.012 [4.0 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.094 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]

<b>RATINGS AND CASE CODES</b>								
$\mu\text{F}$	4 V	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V
0.47								C
0.68								C
1.0								C
1.5							C	C
2.2						C	C	C/D
3.3						C	C	C/D
4.7					C	C	C/D	D
6.8				C	C	C	D	D/E
10			C	C	C	C/D	D/E	
15		C	C	C	C/D	D	D/E	
22		C	C	C/D	D	D/E	E	
33		C	C/D	C/D	D/E	E		
47		C/D	C/D	D/E	E			
68	C	C/D	D/E	D	E			
100	C	D/E	D	E				
150	D	D	D/E	E				
220	D	D/E	E					
330	D/E	E						
470	E							

### CONSTRUCTION AND MARKING

**C, D, E, Cases**

**Marking:**  
 Capacitor marking includes an anode (+) polarity band, capacitance in microfarads and the voltage rating. The Vishay Sprague® trademark is included if space permits. Capacitors rated at 6.3 V are marked 6 V. A manufacturing date code is marked on all capacitors. Capital letter "E" stands for lead (Pb)-free terminations small cap letter "e" stands for SnPb



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	STANDARD (S) MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	LOW (L) MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )
<b>4 V<sub>DC</sub> AT + 85 °C; 2.7 V<sub>DC</sub> AT + 125 °C</b>						
68	C	T86C686(1)004(2)(3)(4)(5)	2.7	8	1.40	0.40
100	C	T86C107(1)004(2)(3)(4)(5)	4.0	8	0.80	0.40
150	D	T86D157(1)004(2)(3)(4)(5)	6.0	8	0.60	0.30
220	D	T86D227(1)004(2)(3)(4)(5)	8.8	8	0.60	0.40
330	D	T86D337(1)004(2)(3)(4)(5)	13.2	15	0.60	0.30
330	E	T86E337(1)004(2)(3)(4)(5)	13.2	8	0.50	0.30
470	E	T86E477(1)004(2)(3)(4)(5)	18.8	16	0.50	0.25
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT + 125 °C</b>						
15	C	T86C156(1)6R3(2)(3)(4)(5)	0.9	6	1.80	0.60
22	C	T86C226(1)6R3(2)(3)(4)(5)	1.1	6	1.80	0.60
33	C	T86C336(1)6R3(2)(3)(4)(5)	1.6	6	1.40	0.60
47	C	T86C476(1)6R3(2)(3)(4)(5)	2.3	6	1.30	0.60
47	D	T86D476(1)6R3(2)(3)(4)(5)	2.3	6	0.90	0.45
68	C	T86C686(1)6R3(2)(3)(4)S	3.3	6	0.80	n/a
68	D	T86D686(1)6R3(2)(3)(4)(5)	3.3	6	0.70	0.35
100	D	T86D107(1)6R3(2)(3)(4)(5)	6.0	8	0.70	0.35
100	E	T86E107(1)6R3(2)(3)(4)(5)	6.0	8	0.70	0.30
150	D	T86D157(1)6R3(2)(3)(4)(5)	9.0	8	0.60	0.30
220	D	T86D227(1)6R3(2)(3)(4)(5)	13.2	8	0.60	0.30
220	E	T86E227(1)6R3(2)(3)(4)(5)	13.2	8	0.50	0.30
330	E	T86E337(1)6R3(2)(3)(4)(5)	19.8	8	0.50	0.30
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT + 125 °C</b>						
10	C	T86C106(1)010(2)(3)(4)S	1.0	6	1.80	n/a
15	C	T86C156(1)010(2)(3)(4)(5)	1.5	6	1.80	0.60
22	C	T86C226(1)010(2)(3)(4)(5)	2.2	6	1.40	0.50
33	C	T86C336(1)010(2)(3)(4)(5)	3.3	6	1.30	0.40
33	D	T86D336(1)010(2)(3)(4)(5)	3.3	6	0.90	0.40
47	C	T86C476(1)010(2)(3)(4)S	4.7	6	1.00	n/a
47	D	T86D476(1)010(2)(3)(4)(5)	4.7	6	0.70	0.40
68	D	T86D686(1)010(2)(3)(4)(5)	6.8	6	0.70	0.35
68	E	T86E686(1)010(2)(3)(4)(5)	6.8	6	0.70	0.35
100	D	T86D107(1)010(2)(3)(4)(5)	10.0	8	0.60	0.30
150	D	T86D157(1)010(2)(3)(4)(5)	15.0	8	0.60	0.30
150	E	T86E157(1)010(2)(3)(4)(5)	15.0	8	0.50	0.40
220	E	T86E227(1)010(2)(3)(4)(5)	22.0	8	0.50	0.30
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>						
6.8	C	T86C685(1)016(2)(3)(4)(5)	1.1	6	2.00	0.60
10	C	T86C106(1)016(2)(3)(4)(5)	1.6	6	1.80	0.70
15	C	T86C156(1)016(2)(3)(4)S	2.4	6	1.40	n/a

**Note**

- Part number definitions:
  - Capacitance tolerance codes: K, M
  - Terminations and packaging codes: C, H, E, L
  - Reliability level: A, B, S, Z
  - Surge current: A, B, S
  - ESR: L, S



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	STANDARD (S) MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	LOW (L) MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>						
22	C	T86C226(1)016(2)(3)(4)(5)	3.5	6	1.30	0.70
22	D	T86D226(1)016(2)(3)(4)(5)	3.5	6	0.90	0.45
33	C	T86C336(1)016(2)(3)(4)(5)	5.3	6	1.00	0.50
33	D	T86D336(1)016(2)(3)(4)(5)	5.3	6	0.70	0.35
47	D	T86D476(1)016(2)(3)(4)(5)	7.5	6	0.70	0.35
47	E	T86E476(1)016(2)(3)(4)(5)	7.5	6	0.70	0.35
68	D	T86D686(1)016(2)(3)(4)(5)	10.9	6	0.60	0.30
100	E	T86E107(1)016(2)(3)(4)(5)	16.0	8	0.60	0.30
150	E	T86E157(1)016(2)(3)(4)S	24.0	10	0.40	n/a
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>						
4.7	C	T86C475(1)020(2)(3)(4)(5)	0.9	6	2.00	1.00
6.8	C	T86C685(1)020(2)(3)(4)(5)	1.4	6	1.90	0.60
10	C	T86C106(1)020(2)(3)(4)(5)	2.0	6	1.60	0.80
15	C	T86C156(1)020(2)(3)(4)S	3.0	6	1.40	n/a
15	D	T86D156(1)020(2)(3)(4)(5)	3.0	6	0.90	0.45
22	D	T86D226(1)020(2)(3)(4)(5)	4.4	6	0.70	0.35
33	D	T86D336(1)020(2)(3)(4)(5)	6.6	6	0.70	0.40
33	E	T86E336(1)020(2)(3)(4)(5)	6.6	6	0.70	0.40
47	E	T86E476(1)020(2)(3)(4)(5)	9.4	6	0.60	0.30
68	E	T86E686(1)020(2)(3)(4)(5)	13.6	6	0.60	0.30
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>						
2.2	C	T86C225(1)025(2)(3)(4)S	0.6	6	2.80	n/a
3.3	C	T86C335(1)025(2)(3)(4)(5)	0.8	6	2.30	2.10
4.7	C	T86C475(1)025(2)(3)(4)(5)	1.2	6	1.90	1.00
6.8	C	T86C685(1)025(2)(3)(4)(5)	1.7	6	1.60	0.60
10	C	T86C106(1)025(2)(3)(4)(5)	2.5	6	1.40	0.60
10	D	T86D106(1)025(2)(3)(4)(5)	2.5	6	1.00	0.50
15	D	T86D156(1)025(2)(3)(4)(5)	3.8	6	0.80	0.40
22	D	T86D226(1)025(2)(3)(4)(5)	5.5	6	0.70	0.35
22	E	T86E226(1)025(2)(3)(4)(5)	5.5	6	0.70	0.35
33	E	T86E336(1)025(2)(3)(4)(5)	8.3	6	0.60	0.30
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>						
1.5	C	T86C155(1)035(2)(3)(4)(5)	0.5	6	3.80	2.60
2.2	C	T86C225(1)035(2)(3)(4)S	0.8	6	2.90	n/a
3.3	C	T86C335(1)035(2)(3)(4)S	1.2	6	2.00	n/a
4.7	C	T86C475(1)035(2)(3)(4)S	1.6	6	1.80	n/a
4.7	D	T86D475(1)035(2)(3)(4)(5)	1.6	6	1.20	0.60
6.8	D	T86D685(1)035(2)(3)(4)(5)	2.4	6	1.00	0.50
10	D	T86D106(1)035(2)(3)(4)(5)	3.5	6	0.80	0.50

**Note**

- Part number definitions:
  - Capacitance tolerance codes: K, M
  - Terminations and packaging codes: C, H, E, L
  - Reliability level: A, B, S, Z
  - Surge current: A, B, S
  - ESR: L, S



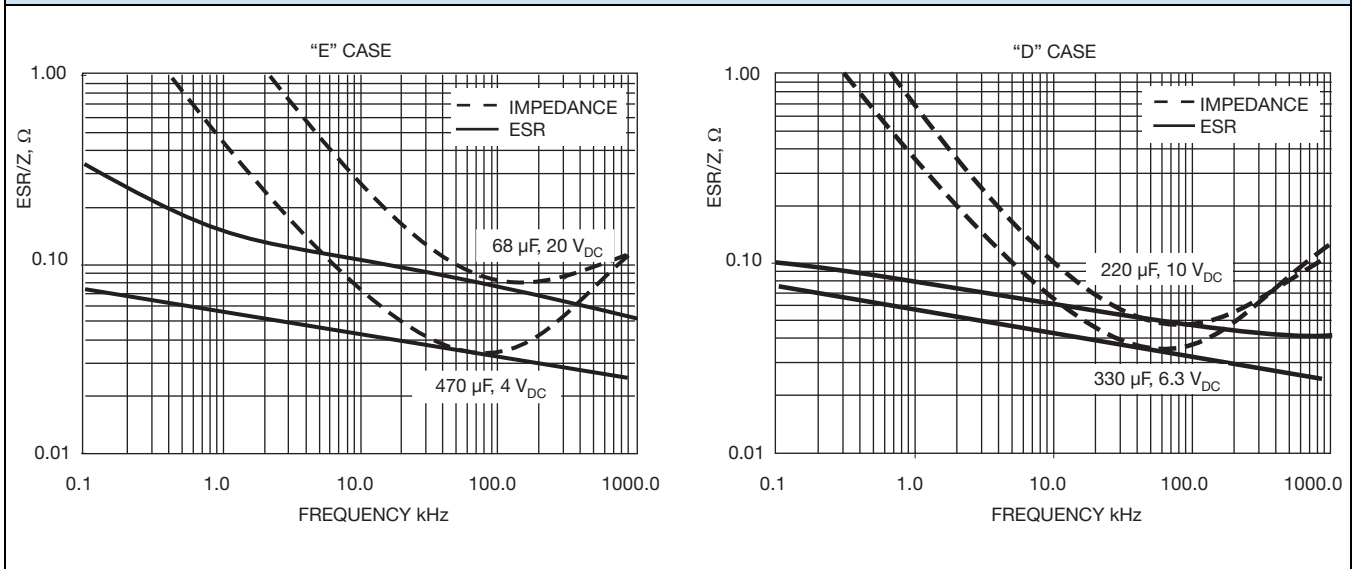
STANDARD RATINGS						
CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C (μA)	MAX. DF AT + 25 °C 120 Hz (%)	STANDARD (S) MAX. ESR AT + 25 °C 100 kHz (Ω)	LOW (L) MAX. ESR AT + 25 °C 100 kHz (Ω)
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>						
10	E	T86E106(1)035(2)(3)(4)(5)	3.5	6	0.80	0.50
15	D	T86D156(1)035(2)(3)(4)(5)	5.3	6	0.70	0.50
15	E	T86E156(1)035(2)(3)(4)(5)	5.3	6	0.70	0.50
22	E	T86E226(1)035(2)(3)(4)(5)	7.7	6	0.60	0.40
<b>50 V<sub>DC</sub> AT + 85 °C; 33 V<sub>DC</sub> AT + 125 °C</b>						
0.47	C	T86C474(1)050(2)(3)(4)S	0.5	4	6.70	n/a
0.68	C	T86C684(1)050(2)(3)(4)S	0.5	4	5.90	n/a
1.0	C	T86C105(1)050(2)(3)(4)(5)	0.5	4	4.40	2.70
1.5	C	T86C155(1)050(2)(3)(4)(5)	0.8	6	5.00	3.20
2.2	C	T86C225(1)050(2)(3)(4)S	1.1	6	2.80	n/a
2.2	D	T86D225(1)050(2)(3)(4)(5)	1.1	6	2.10	0.90
3.3	C	T86C335(1)050(2)(3)(4)(5)	1.7	6	2.40	1.60
3.3	D	T86D335(1)050(2)(3)(4)S	1.7	6	2.00	n/a
4.7	D	T86D475(1)050(2)(3)(4)S	2.4	6	1.10	n/a
6.8	D	T86D685(1)050(2)(3)(4)S	3.4	6	0.90	n/a
6.8	E	T86E685(1)050(2)(3)(4)S	3.4	6	0.90	n/a

**Note**

- Part number definitions:
  - Capacitance tolerance codes: K, M
  - Terminations and packaging codes: C, H, E, L
  - Reliability level: A, B, S, Z
  - Surge current: A, B, S
  - ESR: L, S

RECOMMENDED VOLTAGE DERATING GUIDELINES (for temperatures below + 85 °C)	
STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.6
10	6.0
16	10
20	12
25	15
35	24
50	28
SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24



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

**POWER DISSIPATION**

CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
C	0.110
D	0.150
E	0.165

**STANDARD PACKAGING QUANTITY**

CASE CODE	UNITS PER REEL	
	7" REEL	½ 7" REEL
C	500	250
D	500	250
E	400	200

**PRODUCT INFORMATION**

Molded Guide	
• Pad Dimensions	<a href="http://www.vishay.com/doc?40074">www.vishay.com/doc?40074</a>
• Package Dimensions	
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
<b>SELECTOR GUIDES</b>	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
<b>FAQ</b>	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

# Solid Tantalum Surface Mount Capacitors

## TANTAMOUNT<sup>®</sup> Molded Case, Military MIL-PRF-55365/8 Qualified


**FEATURES**

- Molded case available in four case codes
- Compatible with “High Volume” automatic pick and place equipment
- Weibull failure rate codes B, C, D and T
- Termination: (H) solder plate
- Surge current options A, B and C
- Mounting: Surface mount

**PERFORMANCE/ELECTRICAL CHARACTERISTICS**
[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)

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

**Capacitance Range:** 0.10 μF to 100 μF

**Capacitance Tolerance:** ± 5 %, ± 10 %, ± 20 %

**Voltage Rating:** 4 V<sub>DC</sub> to 50 V<sub>DC</sub>

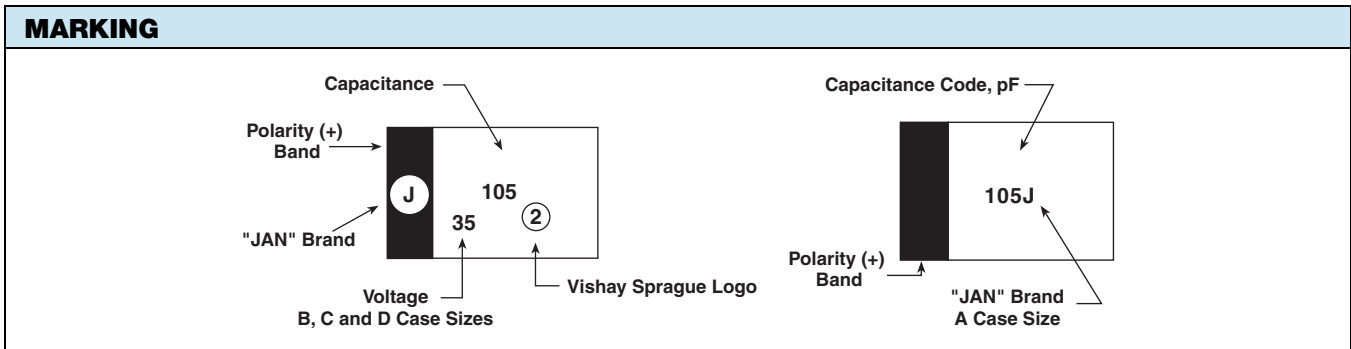
ORDERING INFORMATION							
CWR11	D	H	155	K	B	A	/HR
TYPE	VOLTAGE	TERMINATION FINISH	CAPACITANCE	CAPACITANCE TOLERANCE	FAILURE RATE %/1000 h	SURGE CURRENT (OPTIONAL)	PACKAGING OPTION
	C = 4 V D = 6 V F = 10 V H = 15 V J = 20 V K = 25 V M = 35 V N = 50 V	H = Solder plate	This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow.	J = ± 5 % K = ± 10 % M = ± 20 %	M = 1.0 P = 0.1 R = 0.01 S = 0.001 B = 0.1 C = 0.01 D = 0.001 T = 0.01 <sup>(1)</sup>	A = + 25 °C after Weibull B = - 55 °C/+ 85 °C after Weibull C = - 55 °C/+ 85 °C before Weibull	Blank = Full reel /PR = 100 pcs reel /HR = half reel /PT = Bulk, plastic tray

**Note**

<sup>(1)</sup> T level capacitors are recommended for “Space applications”

DIMENSIONS in inches [millimeters]							
CASE CODE	EIA SIZE	L	W	H	P	T <sub>W</sub>	T <sub>H</sub> MIN.
A	3216-18	0.126 ± 0.008 [3.2 ± 0.20]	0.063 ± 0.008 [1.6 ± 0.20]	0.063 ± 0.008 [1.6 ± 0.20]	0.031 ± 0.012 [0.80 ± 0.30]	0.047 ± 0.004 [1.2 ± 0.10]	0.028 [0.70]
B	3528-21	0.138 ± 0.008 [3.5 ± 0.20]	0.110 ± 0.008 [2.8 ± 0.20]	0.075 ± 0.008 [1.9 ± 0.20]	0.031 ± 0.012 [0.80 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.028 [0.70]
C	6032-28	0.236 ± 0.012 [6.0 ± 0.30]	0.126 ± 0.012 [3.2 ± 0.30]	0.098 ± 0.012 [2.5 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.087 ± 0.004 [2.2 ± 0.10]	0.039 [1.0]
D	7343-31	0.287 ± 0.012 [7.3 ± 0.30]	0.170 ± 0.012 [4.3 ± 0.30]	0.110 ± 0.012 [2.8 ± 0.30]	0.051 ± 0.012 [1.3 ± 0.30]	0.095 ± 0.004 [2.4 ± 0.10]	0.039 [1.0]

RATINGS AND CASE CODES								
μF	4 V	6 V	10 V	15 V	20 V	25 V	35 V	50 V
0.10							A	A
0.15							A	B
0.22							A	B
0.33						A	A	B
0.47					A	A	B	C
0.68				A	A	B	B	C
1.0			A	A	A	B	B	C
1.5		A	A	A	B	B	C	D
2.2	A	A	A	B	B	C	C	D
3.3		A	B	B	B	C	C	D
4.7	A	B	B	B	C	C	D	D
6.8	B	B	B		C	D	D	
10	B	B		C		D		
15	B	C	C		D	D		
22		C		D	D			
33	C		D	D				
47		D	D					
68	D	D						
100	D							



STANDARD RATINGS									
CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE (μA) AT			MAX. DF 120 Hz (%) AT			MAX. ESR AT + 25 °C 100 kHz (Ω)
			+ 25 °C	+ 85 °C	+ 125 °C	+ 25 °C	+ 85 °C + 125 °C	- 55 °C	
<b>4 V<sub>DC</sub> AT + 85 °C; 2.7 V<sub>DC</sub> AT + 125 °C</b>									
2.2	A	CWR11CH225(1)(2)(3)(4)	0.5	5.0	6.0	6	9	9	8.0
4.7	A	CWR11CH475(1)(2)(3)(4)	0.5	5.0	6.0	6	9	9	8.0
6.8	B	CWR11CH685(1)(2)(3)(4)	0.5	5.0	6.0	6	9	9	5.5
10	B	CWR11CH106(1)(2)(3)(4)	0.5	5.0	6.0	6	9	9	4.0
15	B	CWR11CH156(1)(2)(3)(4)	0.6	6.0	7.2	6	9	9	3.5
33	C	CWR11CH336(1)(2)(3)(4)	1.3	13.0	15.6	6	9	9	2.2
68	D	CWR11CH686(1)(2)(3)(4)	2.7	27.0	32.4	6	9	9	1.1
100	D	CWR11CH107(1)(2)(3)(4)	4.0	40.0	48.0	8	12	12	0.9
<b>6 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT + 125 °C</b>									
1.5	A	CWR11DH155(1)(2)(3)(4)	0.5	5.0	6.0	6	9	9	8.0
2.2	A	CWR11DH225(1)(2)(3)(4)	0.5	5.0	6.0	6	6	9	8.0
3.3	A	CWR11DH335(1)(2)(3)(4)	0.5	5.0	6.0	6	9	9	8.0

**Note**

- Part number definitions:
  - Capacitance tolerance: J, K, M
  - Failure rate: B, C, D, M, P, R, S, T  
Exponential failure rate levels M, P, R, and S are inactive for new design per MIL-PRF-55365  
Capacitors qualified to Weibull failure rate levels are substitutable for exponential failure rate levels
  - Surge current (optional): A, B, C
  - Packaging: Blank, /HR, /PR, /PT



STANDARD RATINGS									
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE ( $\mu$ A) AT			MAX. DF 120 Hz (%) AT			MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )
			+ 25 °C	+ 85 °C	+ 125 °C	+ 25 °C	+ 85 °C + 125 °C	- 55 °C	
<b>6 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT + 125 °C</b>									
4.7	B	CWR11DH475(1)(2)(3)(4)	0.5	5.0	6.0	6	9	9	5.5
6.8	B	CWR11DH685(1)(2)(3)(4)	0.5	5.0	6.0	6	6	9	4.5
10	B	CWR11DH106(1)(2)(3)(4)	0.6	6.0	7.2	6	9	9	3.5
15	C	CWR11DH156(1)(2)(3)(4)	0.9	9.0	10.8	6	6	9	3.0
22	C	CWR11DH226(1)(2)(3)(4)	1.4	14.0	16.8	6	9	9	2.2
47	D	CWR11DH476(1)(2)(3)(4)	2.8	28.0	33.6	6	6	9	1.1
68	D	CWR11DH686(1)(2)(3)(4)	4.3	43.0	51.6	6	9	9	0.9
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT + 125 °C</b>									
1.0	A	CWR11FH105(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	10.0
1.5	A	CWR11FH155(1)(2)(3)(4)	0.5	5.0	6.0	6	6	9	8.0
2.2	A	CWR11FH225(1)(2)(3)(4)	0.5	5.0	6.0	6	9	9	8.0
3.3	B	CWR11FH335(1)(2)(3)(4)	0.5	5.0	6.0	6	9	9	5.5
4.7	B	CWR11FH475(1)(2)(3)(4)	0.5	5.0	6.0	6	9	9	4.5
6.8	B	CWR11FH685(1)(2)(3)(4)	0.7	7.0	8.4	6	9	9	3.5
15	C	CWR11FH156(1)(2)(3)(4)	1.5	15.0	18.0	6	6	9	2.5
33	D	CWR11FH336(1)(2)(3)(4)	3.3	33.0	39.6	6	9	9	1.1
47	D	CWR11FH476(1)(2)(3)(4)	4.7	47.0	56.4	6	9	9	0.9
<b>15 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>									
0.68	A	CWR11HH684(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	12.0
1.0	A	CWR11HH105(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	10.0
1.5	A	CWR11HH155(1)(2)(3)(4)	0.5	5.0	6.0	6	9	9	8.0
2.2	B	CWR11HH225(1)(2)(3)(4)	0.5	5.0	6.0	6	9	9	5.5
3.3	B	CWR11HH335(1)(2)(3)(4)	0.5	5.0	6.0	6	8	9	5.0
4.7	B	CWR11HH475(1)(2)(3)(4)	0.7	7.0	8.4	6	9	9	4.0
10	C	CWR11HH106(1)(2)(3)(4)	1.6	16.0	19.2	6	8	9	2.5
22	D	CWR11HH226(1)(2)(3)(4)	3.3	33.0	39.6	6	8	9	1.1
33	D	CWR11HH336(1)(2)(3)(4)	5.3	53.0	63.6	6	9	9	0.9
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>									
0.47	A	CWR11JH474(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	14.0
0.68	A	CWR11JH684(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	12.0
1.0	A	CWR11JH105(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	10.0
1.5	B	CWR11JH155(1)(2)(3)(4)	0.5	5.0	6.0	6	9	9	6.0
2.2	B	CWR11JH225(1)(2)(3)(4)	0.5	5.0	6.0	6	8	9	5.0
3.3	B	CWR11JH335(1)(2)(3)(4)	0.7	7.0	8.4	6	9	9	4.0
4.7	C	CWR11JH475(1)(2)(3)(4)	1.0	10.0	12.0	6	8	9	3.0
6.8	C	CWR11JH685(1)(2)(3)(4)	1.4	14.0	16.8	6	9	9	2.4
15	D	CWR11JH156(1)(2)(3)(4)	3.0	30.0	36.0	6	8	9	1.1
22	D	CWR11JH226(1)(2)(3)(4)	4.4	44.0	52.8	6	9	9	0.9
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>									
0.33	A	CWR11KH334(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	15.0
0.47	A	CWR11KH474(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	14.0
0.68	B	CWR11KH684(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	7.5
1.0	B	CWR11KH105(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	6.5
1.5	B	CWR11KH155(1)(2)(3)(4)	0.5	5.0	6.0	6	8	9	6.5
2.2	C	CWR11KH225(1)(2)(3)(4)	0.6	6.0	7.2	6	9	9	3.5
3.3	C	CWR11KH335(1)(2)(3)(4)	0.9	9.0	10.8	6	8	9	3.5
4.7	C	CWR11KH475(1)(2)(3)(4)	1.2	12.0	14.4	6	9	9	2.5
6.8	D	CWR11KH685(1)(2)(3)(4)	1.7	17.0	20.4	6	9	9	1.4
10	D	CWR11KH106(1)(2)(3)(4)	2.5	25.0	30.0	6	8	9	1.2
15	D	CWR11KH156(1)(2)(3)(4)	3.8	38.0	45.6	6	9	9	1.0

**Note**

- Part number definitions:
  - (1) Capacitance tolerance: J, K, M
  - (2) Failure rate: B, C, D, M, P, R, S, T  
Exponential failure rate levels M, P, R, and S are inactive for new design per MIL-PRF-55365  
Capacitors qualified to Weibull failure rate levels are substitutable for exponential failure rate levels
  - (3) Surge current (optional): A, B, C
  - (4) Packaging: Blank, /HR, /PR, /PT



STANDARD RATINGS									
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE ( $\mu$ A) AT			MAX. DF 120 Hz (%) AT			MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )
			+ 25 °C	+ 85 °C	+ 125 °C	+ 25 °C	+ 85 °C + 125 °C	- 55 °C	
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>									
0.10	A	CWR11MH104(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	24.0
0.15	A	CWR11MH154(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	21.0
0.22	A	CWR11MH224(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	18.0
0.33	A	CWR11MH334(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	15.0
0.47	B	CWR11MH474(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	10.0
0.68	B	CWR11MH684(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	8.0
1.0	B	CWR11MH105(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	6.5
1.5	C	CWR11MH155(1)(2)(3)(4)	0.5	5.0	6.0	6	8	9	4.5
2.2	C	CWR11MH225(1)(2)(3)(4)	0.8	8.0	9.6	6	8	9	3.5
3.3	C	CWR11MH335(1)(2)(3)(4)	1.2	12.0	14.4	6	8	9	2.5
4.7	D	CWR11MH475(1)(2)(3)(4)	1.7	17.0	20.4	6	8	9	1.5
6.8	D	CWR11MH685(1)(2)(3)(4)	2.4	24.0	28.8	6	9	9	1.3
<b>50 V<sub>DC</sub> AT + 85 °C; 33 V<sub>DC</sub> AT + 125 °C</b>									
0.10	A	CWR11NH104(1)(2)(3)(4)	0.5	5.0	12.0	6	8	8	22.0
0.15	B	CWR11NH154(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	17.0
0.22	B	CWR11NH224(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	14.0
0.33	B	CWR11NH334(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	12.0
0.47	C	CWR11NH474(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	8.0
0.68	C	CWR11NH684(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	7.0
1.0	C	CWR11NH105(1)(2)(3)(4)	0.5	5.0	6.0	4	6	6	6.0
1.5	D	CWR11NH155(1)(2)(3)(4)	0.8	8.0	9.6	6	8	9	4.0
2.2	D	CWR11NH225(1)(2)(3)(4)	1.1	11.0	13.2	6	8	9	2.5
3.3	D	CWR11NH335(1)(2)(3)(4)	1.7	17.0	20.4	6	9	9	2.0
4.7	D	CWR11NH475(1)(2)(3)(4)	2.4	24.0	28.8	6	9	9	1.5

**Note**

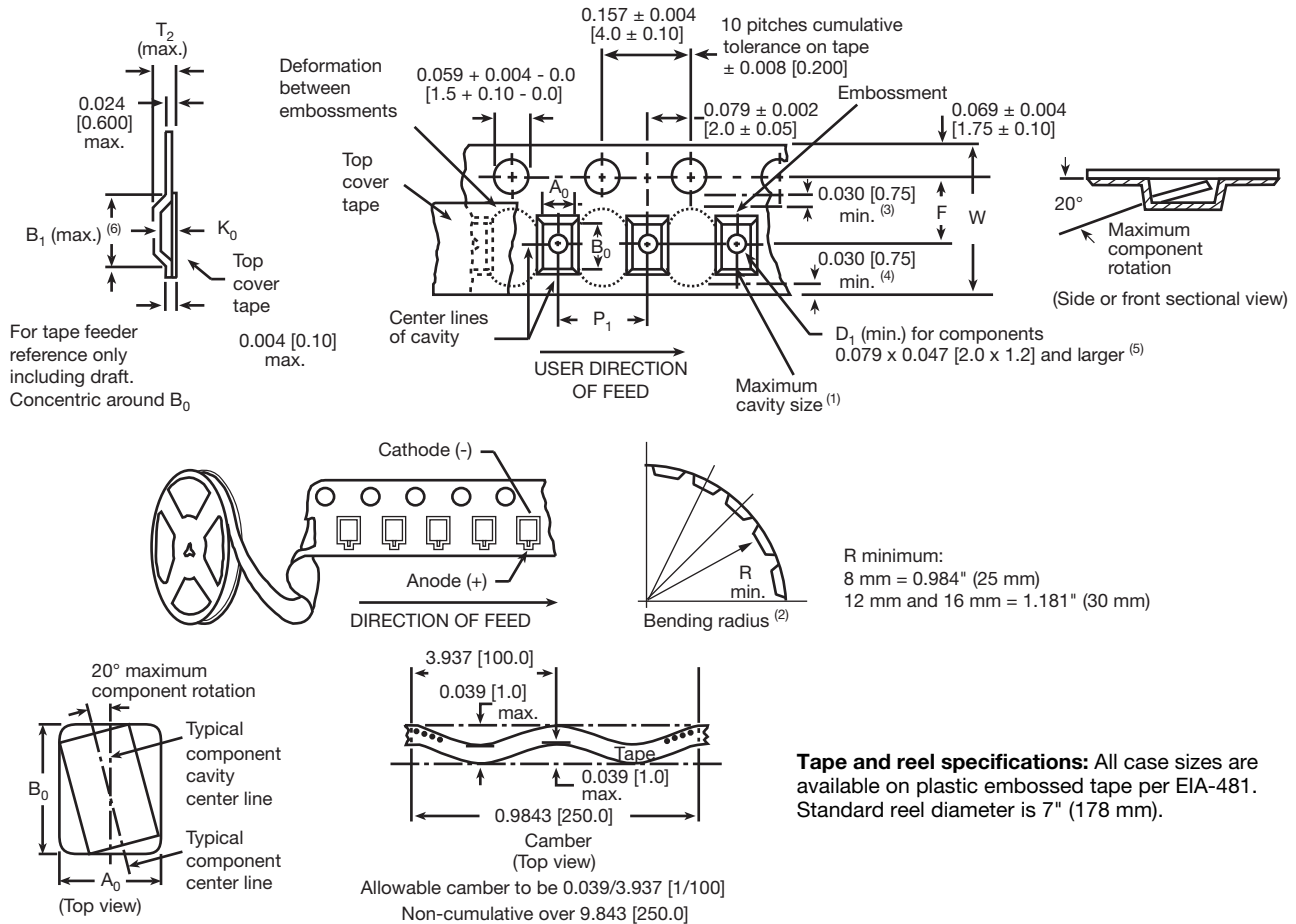
- Part number definitions:
  - (1) Capacitance tolerance: J, K, M
  - (2) Failure rate: B, C, D, M, P, R, S, T  
Exponential failure rate levels M, P, R, and S are inactive for new design per MIL-PRF-55365  
Capacitors qualified to Weibull failure rate levels are substitutable for exponential failure rate levels
  - (3) Surge current (optional): A, B, C
  - (4) Packaging: Blank, /HR, /PR, /PT

RECOMMENDED VOLTAGE DERATING GUIDELINES (for temperatures below + 85 °C)	
STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.0	3.6
10	6.0
15	10
20	12
25	15
35	24
50	28
SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.0	3.0
10	5.0
15	7.5
20	10
25	12
35	15
50	24

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

**Note**

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



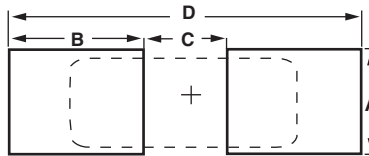
**Tape and reel specifications:** All case sizes are available on plastic embossed tape per EIA-481. Standard reel diameter is 7" (178 mm).

**Notes**

- $A_0$ ,  $B_0$ ,  $K_0$ , 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°.
- 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.
- 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.
- 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.
- 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.
- $B_1$  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	$P_1$	$T_2$ (max.)	W
A, B	8 mm	0.165 [4.2]	0.039 [1.0]	0.138 ± 0.002 [3.5 ± 0.05]	0.157 ± 0.004 [4.0 ± 0.1]	0.094 [2.4]	0.315 ± 0.012 [8.0 ± 0.30]
C, D	12 mm	0.323 [8.2]	0.059 [1.5]	0.217 ± 0.002 [5.5 ± 0.05]	0.315 ± 0.004 [8.0 ± 1.0]	0.177 [4.5]	0.472 ± 0.012 [12.0 ± 0.30]

**PAD DIMENSIONS** in inches [millimeters]


CASE CODE	A (min.)	B (nom.)	C (nom.)	D (nom.)
A	0.071 [1.80]	0.067 [1.70]	0.053 [1.35]	0.187 [4.75]
B	0.118 [3.00]	0.071 [1.80]	0.065 [1.65]	0.207 [5.25]
C	0.118 [3.00]	0.094 [2.40]	0.118 [3.00]	0.307 [7.80]
D	0.157 [4.00]	0.098 [2.50]	0.150 [3.80]	0.346 [8.80]

**POWER DISSIPATION**

CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
A	0.075
B	0.085
C	0.110
D	0.150

**STANDARD PACKAGING QUANTITY**

CASE CODE	UNITS PER REEL			BULK, PLASTIC TRAY QUANTITIES
	7" REEL	HALF 7" REEL (/HR)	PARTIAL 7" REEL (/PR)	
A	2000	1000	100	50
B	2000	1000	100	50
C	500	250	100	50
D	500	250	100	50

**Notes**

- Bulk capacitors are shipped in plastic trays
- T level capacitors are only shipped in tape and reel/or waffle packaging  
Contact factory for waffle pack quantities

**PRODUCT INFORMATION**

COTS Guide	<a href="http://www.vishay.com/doc?40083">www.vishay.com/doc?40083</a>
Pad Dimensions	
Packaging Dimensions	
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
<b>SELECTOR GUIDES</b>	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
<b>FAQ</b>	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>



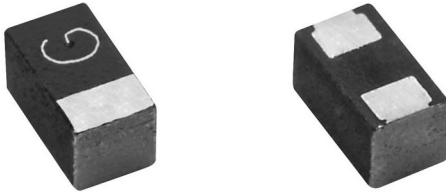
# Molded Leadframeless Chip Capacitors

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# Solid Tantalum Chip Capacitors MICROTAN™ Leadframeless Molded


**FEATURES**

- Small sizes include 0603 and 0402 footprint
- Lead (Pb)-free L-shaped terminations
- 8 mm tape and reel packaging available per EIA-481 and reeling per IEC 60286-3 7" [178 mm] standard
- Mounting: Surface mount
- Compliant to RoHS Directive 2002/95/EC



**RoHS**  
COMPLIANT  
**GREEN**  
(5-2008)\*\*

**Note**

\*\* Please see document "Vishay Material Category Policy":

[www.vishay.com/doc?99902](http://www.vishay.com/doc?99902)

**PERFORMANCE CHARACTERISTICS**

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

**Capacitance Range:** 1 µF to 330 µF

**Capacitance Tolerance:** ± 20 % standard, ± 10 % available

**Voltage Range:** 2.5 V<sub>DC</sub> to 50 V<sub>DC</sub>

ORDERING INFORMATION						
298D	335	X0	010	M	2	T
TYPE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	CASE CODE	TERMINATION	REEL SIZE AND PACKAGING
	This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow.	<b>X0 = ± 20 %</b> <b>X9 = ± 10 %</b>	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).	See Ratings and Case Codes table	<b>2 = 100 % tin</b> 4 = Gold plated	T = Tape and reel <b>7" [178 mm] reel</b>

**Note**

- Preferred tolerance and reel sizes are in **bold**. We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size. Voltage substitutions will be marked with the higher voltage rating.

DIMENSIONS in inches [millimeters]						
CASE CODE	L	W	H	P1	P2 (REF.)	C
K	0.039 + 0.008 [1.0 + 0.2]	0.02 + 0.008 [0.5 + 0.2]	0.024 max. [0.6 max.]	0.01 ± 0.004 [0.25 ± 0.1]	0.02 [0.5]	0.015 ± 0.004 [0.38 ± 0.1]
M	0.063 ± 0.008 [1.60 ± 0.2]	0.033 ± 0.008 [0.85 ± 0.2]	0.031 ± 0.004 [0.80 ± 0.1]	0.020 ± 0.004 [0.50 ± 0.1]	0.024 [0.60]	0.024 ± 0.004 [0.60 ± 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	0.094 ± 0.004 [2.4 ± 0.1]	0.057 ± 0.004 [1.45 ± 0.1]	0.043 ± 0.004 [1.10 ± 0.1]	0.020 ± 0.004 [0.50 ± 0.1]	0.057 [1.40]	0.035 ± 0.004 [0.90 ± 0.1]
Q	0.126 ± 0.008 [3.2 ± 0.2]	0.063 ± 0.008 [1.6 ± 0.2]	0.039 max. [1.0 max.]	0.031 ± 0.004 [0.80 ± 0.1]	0.063 [1.60]	0.047 ± 0.004 [1.20 ± 0.1]
A	0.126 ± 0.008 [3.2 ± 0.2]	0.063 ± 0.008 [1.6 ± 0.2]	0.063 ± 0.008 [1.6 ± 0.2]	0.031 ± 0.004 [0.80 ± 0.1]	0.063 [1.60]	0.047 ± 0.004 [1.20 ± 0.1]
B <sup>(1)</sup>	0.138 ± 0.008 [3.5 ± 0.2]	0.112 ± 0.008 [2.8 ± 0.2]	0.08 max. [2.0 max.]	0.031 ± 0.008 [0.80 ± 0.2]	0.077 [1.95]	0.094 ± 0.004 [2.4 ± 0.1]

**Note**

<sup>(1)</sup> Preliminary values, contact factory for availability

RATINGS AND CASE CODES									
$\mu\text{F}$	2.5 V	4 V	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V
1.0			K <sup>(1)</sup>	K <sup>(1)</sup>	K <sup>(1)</sup> /M		M/R		P
1.5				M					
2.2			K <sup>(1)</sup> /M	K <sup>(1)</sup> /M	M			P	
3.3			M	M					
4.7		K	M	M/P	M <sup>(1)</sup> /P	P	P		
10		K/M	K <sup>(1)</sup> /M	M	R		A		
15		K	M	M					
22		M	M	M <sup>(1)</sup>					
33		M	M	P					
47	M	M	R/P	P					
100		P	P/Q <sup>(1)</sup> /A <sup>(1)</sup>	Q <sup>(1)</sup>					
220	P	P/Q							
330			B <sup>(1)</sup>						

**Note**

<sup>(1)</sup> Preliminary values, contact factory for availability.

MARKING					
<p>M-Case</p>	VOLTAGE CODE		CAPACITANCE CODE		<p>P, R-Case</p>
	V	CODE	CAP, $\mu\text{F}$	CODE	
	2.5	e	0.68	$\bar{w}$	<p>A, Q-Case</p>
	4.0	G	1.0	A	
	6.3	J	2.2	J	
	10	A	3.3	N	
	16	C	4.7	S	
	20	D	6.8	W	
	25	E	10	$\alpha$	
	35	V	15	e	
	50	T	22	j	
			33	n	
			47	s	
			68	w	
			100	$\bar{A}$	
			150	$\bar{E}$	
			220	$\bar{J}$	
<p>B-Case</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 ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>2.5 V<sub>DC</sub> AT + 85 °C; 1.6 V<sub>DC</sub> AT + 125 °C</b>						
47	M	298D476X02R5M(2)T	2.4	20	4.00	0.080
220	P	298D227X02R5P(2)T	11.0	30	3.00	0.122
<b>4 V<sub>DC</sub> AT + 85 °C; 2.7 V<sub>DC</sub> AT + 125 °C</b>						
4.7	K	298D475X0004K(2)T	0.5	15	20.00	0.027
10	K	298D106X0004K(2)T	4.0	50	20.00	0.027
10	M	298D106(1)004M(2)T	0.5	8	5.00	0.071
15	K	298D156X0004K(2)T	10.0	50	20.00	0.027
22	M	298D226X0004M(2)T	0.9	15	4.00	0.080
33	M	298D336X0004M(2)T	2.6	30	4.00	0.080
47	M	298D476X0004M(2)T	3.8	40	7.50	0.080
100	P	298D107X0004P(2)T	4.0	30	2.00	0.100
220	P	298D227X0004P(2)T	17.6	30	3.00	0.122
220	Q	298D227X0004Q(2)T	88.0	80	15.00	0.061
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT + 125 °C</b>						
1.0	K <sup>(1)</sup>	298D105X06R3K(2)T	0.5	6	20.00	0.027
2.2	K <sup>(1)</sup>	298D225X06R3K(2)T	0.5	8	20.00	0.027
2.2	M	298D225(1)6R3M(2)T	0.5	10	5.00	0.070
3.3	M	298D335(1)6R3M(2)T	0.5	8	6.00	0.090
4.7	M	298D475(1)6R3M(2)T	0.5	8	3.00	0.090
10	K <sup>(1)</sup>	298D106X06R3K(2)T	10.0	50	20.00	0.027
10	M	298D106X06R3M(2)T	0.6	8	5.00	0.071
15	M	298D156X06R3M(2)T	1.0	20	7.00	0.060
22	M	298D226X06R3M(2)T	2.8	20	5.50	0.067
33	M	298D336X06R3M(2)T	4.2	30	7.50	0.058
47	R	298D476X06R3R2T	3.0	25	3.00	2.070
47	P	298D476X06R3P(2)T	3.0	22	3.00	0.122
100	P	298D107X06R3P(2)T	6.3	30	2.00	0.150
100	Q <sup>(1)</sup>	298D107X06R3Q(2)T	6.3	30	1.10	0.220
100	A <sup>(1)</sup>	298D107X06R3A(2)T	6.3	20	1.00	0.270
330	B <sup>(1)</sup>	298D337X06R3B(2)T	104.0	30	1.00	0.290
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT + 125 °C</b>						
1.0	K <sup>(1)</sup>	298D105X0010K(2)T	0.5	6	20.00	0.027
1.5	M	298D155(1)010M(2)T	0.5	6	14.00	0.040
2.2	K <sup>(1)</sup>	298D225X0010K(2)T	0.5	8	15.00	0.027
2.2	M	298D225X0010M(2)T	0.5	10	10.00	0.050
3.3	M	298D335(1)010M(2)T	0.5	8	6.00	0.090
4.7	M	298D475(1)010M(2)T	0.5	6	5.00	0.071

**Notes**

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "9"; for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2", for gold plated specify "4"
- <sup>(1)</sup> Preliminary values, contact factory for availability



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 ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
4.7	P	298D475(1)010P(2)T	0.5	6	4.00	0.106
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT + 125 °C</b>						
10	M	298D106X0010M(2)T	1.0	20	7.50	0.058
15	M	298D156X0010M(2)T	1.5	30	7.50	0.058
22	M <sup>(1)</sup>	298D226X0010M(2)T	22.0	40	10.00	0.050
33	P	298D336X0010P(2)T	3.3	20	4.00	0.150
47	P	298D476X0010P(2)T	4.7	22	3.00	0.122
100	Q <sup>(1)</sup>	298D107X0010Q(2)T	100	75	15.00	0.060
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>						
1.0	K <sup>(1)</sup>	298D105X0016K(2)T	3.0	10	20.00	0.027
1.0	M	298D105(1)016M(2)T	0.5	6	12.00	0.045
2.2	M	298D225(1)016M(2)T	0.5	10	12.00	0.045
4.7	M <sup>(1)</sup>	298D475X0016M(2)T	0.8	8	6.00	0.060
4.7	P	298D475(1)016P(2)T	0.8	6	4.00	0.106
10	R	298D106(1)016R(2)T	1.6	8	8.00	0.075
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>						
4.7	P	298D475(1)020P(2)T	1.0	6	4.00	0.106
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>						
1.0	M	298D105X0025M(2)T	0.5	6	10.00	0.050
1.0	R	298D105(1)025R(2)T	0.5	6	10.00	0.067
4.7	P	298D475(1)025P(2)T	1.2	6	4.00	0.106
10	A	298D106X0025A(2)T	2.5	10	3.50	0.146
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>						
2.2	P	298D225X0035P(2)T	0.8	8	8.00	0.075
<b>50 V<sub>DC</sub> AT + 85 °C; 33 V<sub>DC</sub> AT + 125 °C</b>						
1.0	P	298D105X0050P(2)T	0.5	8	8.00	0.075

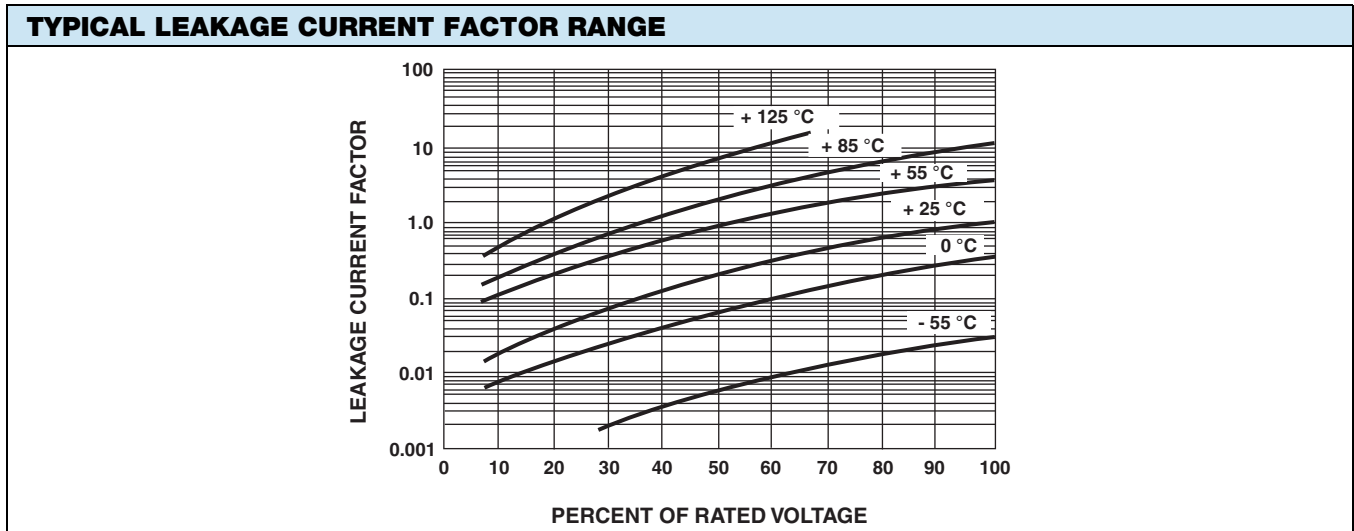
**Notes**

- Part number definitions:
  - (1) Tolerance: For 10 % tolerance, specify "9"; for 20 % tolerance, change to "X0"
  - (2) Termination: For 100 % tin specify "2", for gold plated specify "4"
- <sup>(1)</sup> Preliminary values, contact factory for availability



**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 %, tested via bridge method, at 25 °C, 120 Hz			
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 5 % of the DC rating at + 85 °C 1 % of the DC rating at + 125 °C Vishay does not recommend 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>+ 125 °C RATING</b>	
	<b>RATED VOLTAGE (V)</b>	<b>SURGE VOLTAGE (V)</b>	<b>RATED VOLTAGE (V)</b>	<b>SURGE VOLTAGE (V)</b>
	2.5	3.3	1.7	2.2
	4.0	5.2	2.7	3.4
	6.3	8.0	4.0	5.0
	10	13	7.0	8.0
	16	20	10	12
	20	26	13	16
	25	32	17	20
35	46	23	28	
50	65	33	40	



**Notes**

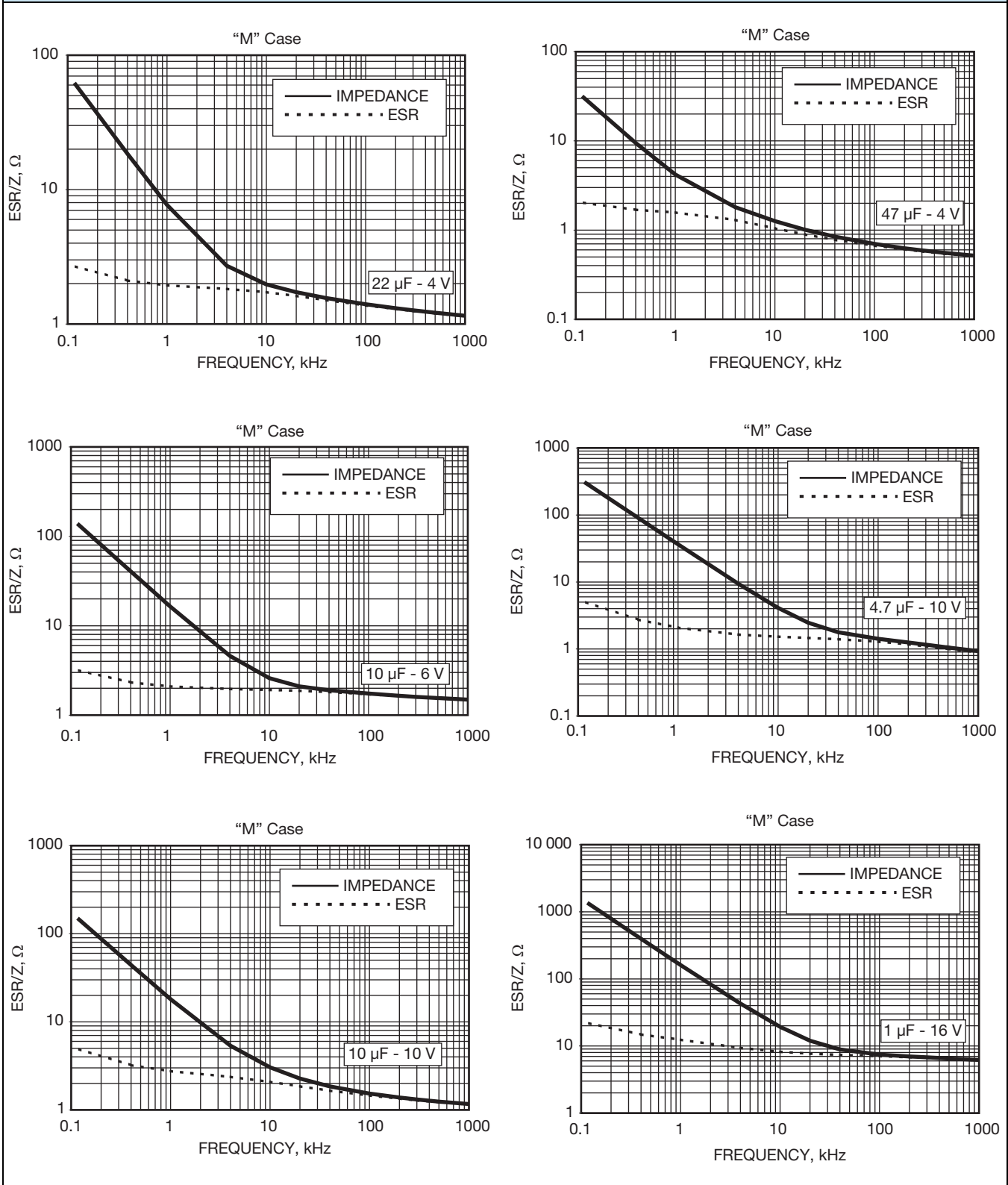
- At + 25 °C, the leakage current shall not exceed the value listed in the Standard Ratings table
- At + 85 °C, the leakage current shall not exceed 10 times the value listed in the Standard Ratings table
- At + 125 °C, the leakage current shall not exceed 12 times the value listed in the Standard Ratings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



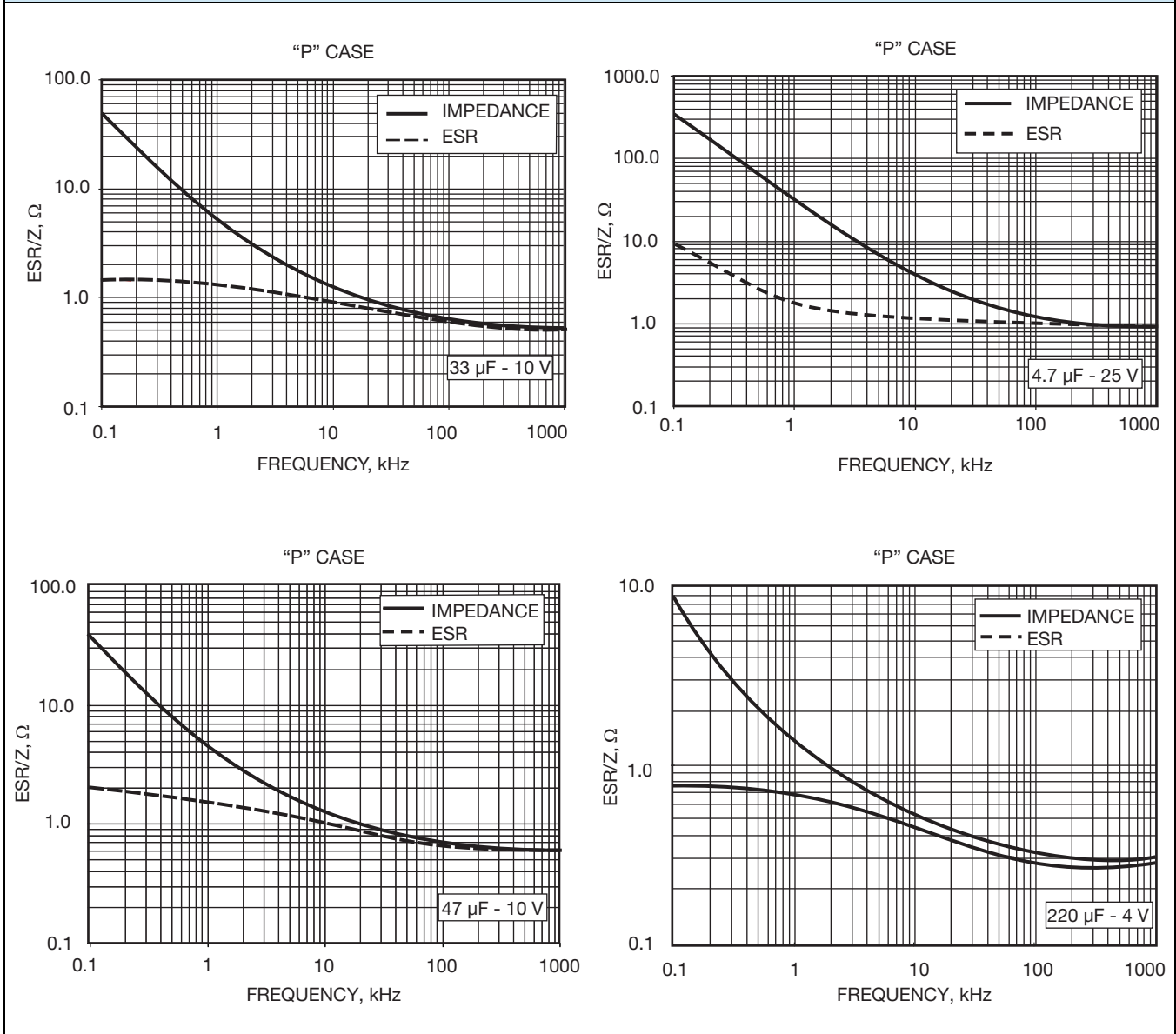
ENVIRONMENTAL PERFORMANCE CHARACTERISTICS		
ITEM	CONDITION	POST TEST PERFORMANCE
Life Test at + 85 °C	1000 h application of rated voltage at 85 °C with a 3 Ω series resistance, MIL-STD-202 method 108A	Capacitance change ± 30 % Dissipation factor Not to exceed 150 % of initial Leakage current Not to exceed 200 % of initial
Humidity Test	At 40 °C/90 % RH 500 h, no voltage applied. MIL-STD-202 method 103B	Capacitance change ± 30 % Dissipation factor Not to exceed 150 % of initial Leakage current Not to exceed 200 % of initial
Thermal Shock	At - 55 °C/+ 125 °C, 30 min each, for 5 cycles. MIL-STD-202 method 107G	Capacitance change ± 30 % Dissipation factor Not to exceed 150 % of initial Leakage current Not to exceed 200 % of initial

MECHANICAL PERFORMANCE CHARACTERISTICS		
ITEM	CONDITION	POST TEST PERFORMANCE
Terminal Strength	Apply a pressure load of 5 N for 10 s ± 1 s horizontally to the center of capacitor side body. AEC Q-200 rev. C method 006	There shall be no visual damage when viewed at 20 x magnification and the component shall meet the original electrical requirements.
Vibration	MIL-STD-202, method 204D, 10 Hz to 2000 Hz, 20 g peak	Capacitance change ± 10 % Dissipation factor Initial specified value or less Leakage current Initial specified value or less ESR Initial specified value or less There shall be no mechanical or visual damage to capacitors post-conditioning.
Shock	MIL-STD-202, method 213B, condition I, 100 g peak	Capacitance change ± 10 % Dissipation factor Initial specified value or less Leakage current Initial specified value or less ESR Initial specified value or less There shall be no mechanical or visual damage to capacitors post-conditioning.
Resistance to Solder Heat	MIL-STD-202, method 210F, condition K	Capacitance change ± 30 % Dissipation factor Not to exceed 150 % of initial Leakage current Not to exceed 200 % of initial There shall be no mechanical or visual damage to capacitors post-conditioning.
Solderability	MIL-STD-202, method 208H, ANSI/J-STD-002, Test B. Applies only to solder and tin plated terminations. Does not apply to gold terminations.	All terminations shall exhibit a continuous solder coating free from defects for a minimum of 95 % of the critical area of any individual lead.
Resistance to Solvents	MIL-STD-202, method 215D	Marking has to remain legible, no degradation of encapsulation material.
Flammability	Encapsulation materials meet UL 94 V-0 with an oxygen index of 32 %	

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

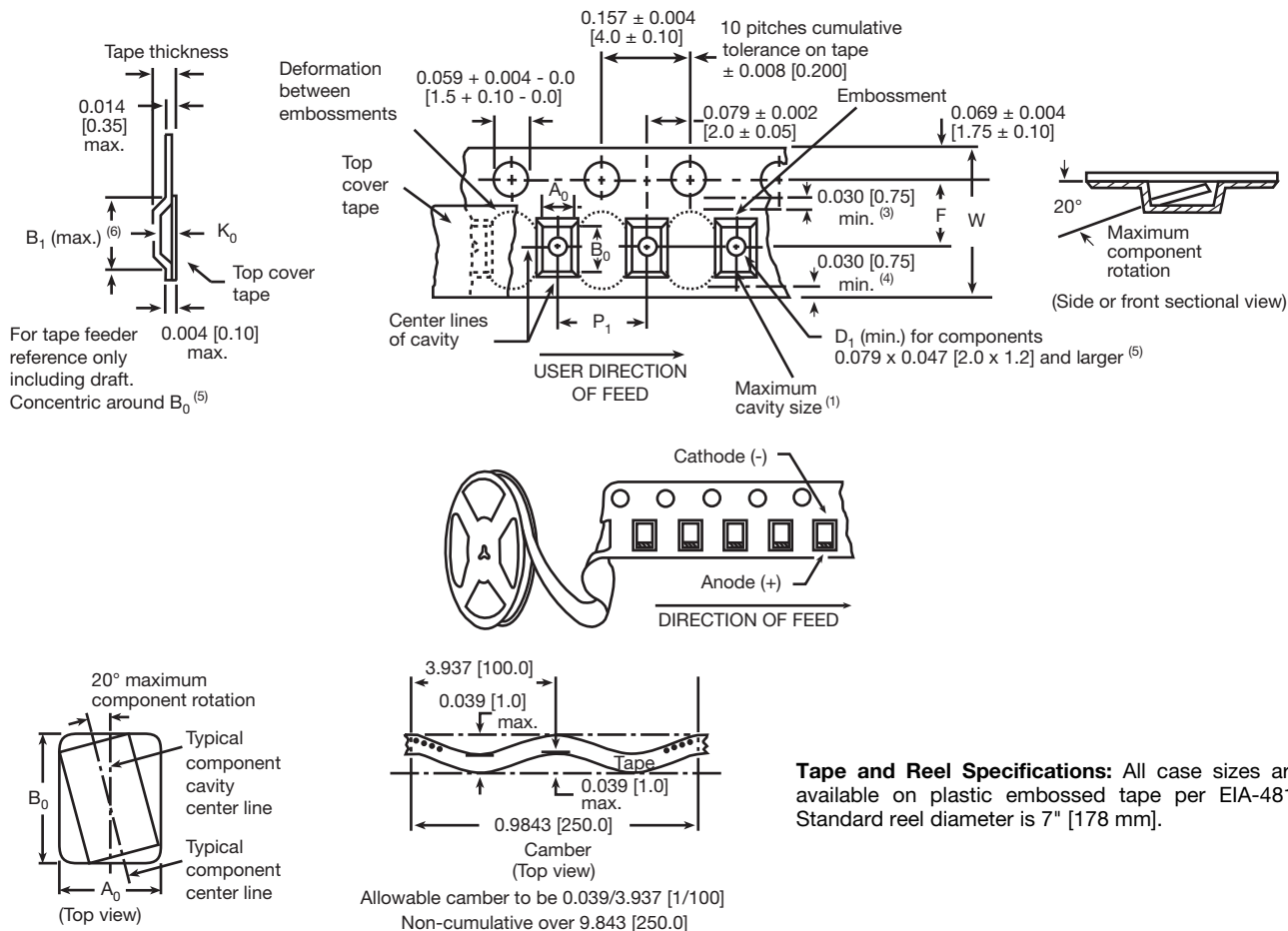


**TYPICAL CURVES AT + 25 °C, IMPEDANCE AND ESR VS. FREQUENCY**





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



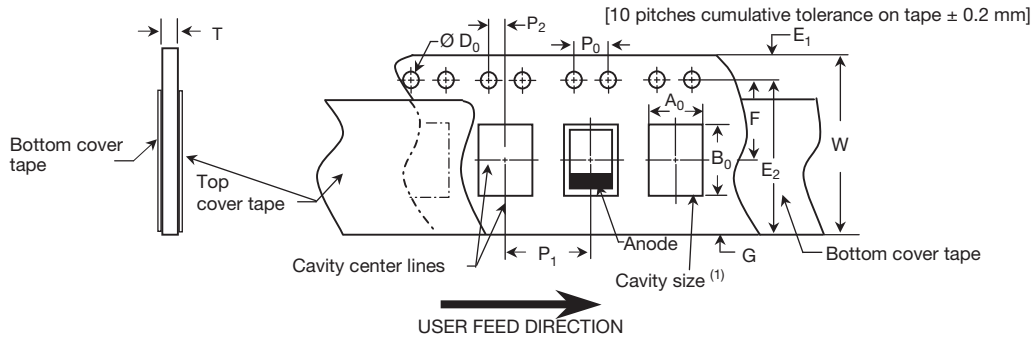
**Tape and Reel Specifications:** All case sizes are available on plastic embossed tape per EIA-481. Standard reel diameter is 7" [178 mm].

**Notes**

- Metric dimensions will govern. Dimensions in inches are rounded and for reference only.
- $A_0$ ,  $B_0$ ,  $K_0$ , 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  $20^\circ$ .
- 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.
- 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.
- 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.
- 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.
- $B_1$  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
P, R	8 mm	0.108 [2.75]	0.039 [1.0]	$0.138 \pm 0.002$ [3.5 ± 0.05]	0.054 [1.37]	$0.157 \pm 0.004$ [4.0 ± 1.0]	$0.315 + 0.0118/- 0.0039$ [8.0 + 0.30/- 0.10]
A, Q	8 mm	0.165 [4.2]	0.039 [1.0]	$0.138 \pm 0.002$ [3.5 ± 0.05]	0.094 [2.4]	$0.157 \pm 0.004$ [4.0 ± 1.0]	$0.315 \pm 0.012$ [8.0 ± 0.30]

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


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]

**Note**

(1) 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°.

**STANDARD PACKAGING QUANTITY**

CASE CODE	QUANTITY (pcs/reel)
	7" REEL
K	5000
M	4000
R	2500
P	3000
Q <sup>(1)</sup>	2500
A	2000
B <sup>(1)</sup>	2000

**Note**

(1) Preliminary values, contact factory for availability.

**RECOMMENDED VOLTAGE DERATING GUIDELINES** (for temperatures below + 85 °C)

STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
2.5	1.5
4.0	2.5
6.3	3.6
10	6.0
16	10
20	12
25	15
35	24
50	28
SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
2.5	1.5
4.0	2.5
6.3	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24

POWER DISSIPATION	
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
K	0.015
M	0.025
R	0.045
P	0.045
Q <sup>(1)</sup>	0.055
A	0.075
B <sup>(1)</sup>	0.085

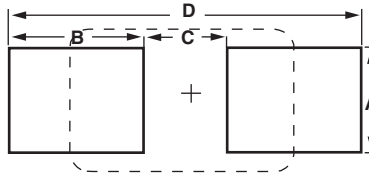
**Note**

<sup>(1)</sup> Preliminary values, contact factory for availability.

RECOMMENDED REFLOW PROFILES		
PROFILE FEATURE	SnPb EUTECTIC ASSEMBLY	LEAD (Pb)-FREE ASSEMBLY
<b>PREHEAT AND SOAK</b>		
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 90 s	60 s to 150 s
<b>RAMP UP</b>		
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 ( $T_p$ ) max.	235 °C	260 °C
Time ( $t_p$ ) within 5 °C of the peak max. temperature	20 s	30 s
<b>RAMP DOWN</b>		
Ramp-down rate ( $T_p$ to $T_L$ )	6 °C/s maximum	
Time from 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]
R	0.059 [1.50]	0.031 [0.80]	0.039 [1.0]	0.102 [2.60]
P	0.063 [1.60]	0.031 [0.80]	0.047 [1.20]	0.110 [2.00]
Q <sup>(1)</sup>	0.071 [1.80]	0.067 [1.70]	0.053 [1.35]	0.187 [4.75]
A	0.071 [1.80]	0.067 [1.70]	0.053 [1.35]	0.187 [4.75]
B <sup>(1)</sup>	0.118 [3.00]	0.071 [1.80]	0.065 [1.65]	0.207 [5.25]

**Note**

<sup>(1)</sup> Preliminary values, contact factory for availability.

**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 watts at + 25 °C (see paragraph number 5 and the table Power Dissipation)

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 watts at + 25 °C (see paragraph number 5 and the table 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.

- 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, 5 % of the DC rating at + 85 °C, and 1 % of the DC rating at + 125 °C.

- 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

- 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.)

- 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).

- 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

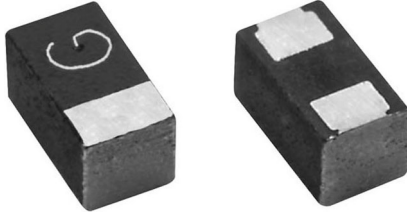
containing methylene chloride or other epoxy solvents should be avoided since these will attack the epoxy encapsulation material.

- 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.

<b>PRODUCT INFORMATION</b>	
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
<b>SELECTOR GUIDES</b>	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
<b>FAQ</b>	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

# Solid Tantalum Chip Capacitors

## MICROTAN™ Low ESR, Leadframeless Molded


**FEATURES**

- Lead (Pb)-free face-down terminations
- Mounting: Surface mount
- 8 mm tape and reel packaging available per EIA-481 and reeling per IEC 60286-3 7" [178 mm] standard
- Low ESR
- Compliant to RoHS Directive 2002/95/EC



**RoHS**  
COMPLIANT  
**GREEN**  
[5-2008]\*\*

**Note**

\*\* Please see document "Vishay Material Category Policy":  
[www.vishay.com/doc?99902](http://www.vishay.com/doc?99902)

**PERFORMANCE CHARACTERISTICS**

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

**Capacitance Range:** 1 µF to 220 µF

**Capacitance Tolerance:** ± 20 % standard, ± 10 % available

**Voltage Range:** 4 V<sub>DC</sub> to 16 V<sub>DC</sub>

**ORDERING INFORMATION**

TR8 TYPE	M CASE CODE	106 CAPACITANCE	M CAPACITANCE TOLERANCE	6R3 DC VOLTAGE RATING AT + 85 °C	C TERMINATION	2000 ESR
	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).	C = 100 % tin 7" [178 mm] reel	Maximum 100 kHz ESR in (mΩ) <sup>(1)</sup>

**Notes**

- We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size. Voltage substitutions will be marked with the higher voltage rating.
- (1) The EIA and CECC standards for low ESR solid tantalum chip capacitors, allow delta ESR of 1.25 times the datasheet limit after mounting.



**DIMENSIONS** in inches [millimeters]

CASE CODE	L	W	H	P1	P2	C
M	0.063 ± 0.008 [1.60 ± 0.2]	0.033 ± 0.008 [0.85 ± 0.2]	0.031 ± 0.004 [0.80 ± 0.1]	0.020 ± 0.004 [0.50 ± 0.1]	0.024 ± 0.004 [0.60 ± 0.1]	0.024 ± 0.004 [0.60 ± 0.1]
P	0.094 ± 0.004 [2.4 ± 0.1]	0.057 ± 0.004 [1.45 ± 0.1]	0.043 ± 0.004 [1.10 ± 0.1]	0.020 ± 0.004 [0.50 ± 0.1]	0.057 ± 0.004 [1.40 ± 0.1]	0.035 ± 0.004 [0.90 ± 0.1]

RATINGS AND CASE CODES				
μF	4 V	6.3 V	10 V	16 V
1.0				M
4.7				M <sup>(1)</sup>
10		M	M	
15			M	
22		M		
33	M	M		
47	M		P <sup>(1)</sup>	
220	P			

**Note**

(1) Preliminary values, contact factory for availability

MARKING					
M-Case	VOLTAGE CODE		CAPACITANCE CODE		P-Case
	V	CODE	CAP, μF	CODE	
	4.0	G	33	n	
	6.3	J	47	s	
	10	A	68	w	
	16	C	100	$\bar{A}$	
	20	D	150	$\bar{E}$	
	25	E	220	J	

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 (Ω)	MAX. RIPPLE 100 kHz I <sub>RMS</sub> (A)	ΔC/C <sup>(2)</sup> (%)
<b>4 V<sub>DC</sub> AT + 85 °C; 2.7 V<sub>DC</sub> AT + 125 °C</b>							
33	M	TR8M336M004C1500	2.6	30	1.50	0.129	± 20
47	M	TR8M476M004C1500	3.8	40	1.50	0.129	± 30
220	P	TR8P227(1)004C1000	17.6	30	1.00	0.212	± 30
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT + 125 °C</b>							
10	M	TR8M106(1)6R3C2000	0.6	8	2.00	0.112	± 10
22	M	TR8M226M6R3C1500	2.8	20	1.50	0.129	± 15
33	M	TR8M336M6R3C1500	4.2	30	1.50	0.129	± 30
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT + 125 °C</b>							
10	M	TR8M106M010C2000	1.0	20	2.00	0.112	± 15
15	M	TR8M156(1)010C3000	1.5	30	3.00	0.091	± 20
47	P	TR8P476M010C0800 <sup>(1)</sup>	4.7	22	0.80	0.237	± 20
47	P	TR8P476M010C1000	4.7	22	1.00	0.212	± 20
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>							
1.0	M	TR8M105(1)016C9500	0.5	6.0	9.50	0.05	± 15
4.7	M	TR8M475M016C4000 <sup>(1)</sup>	0.8	8.0	4.00	0.08	± 15

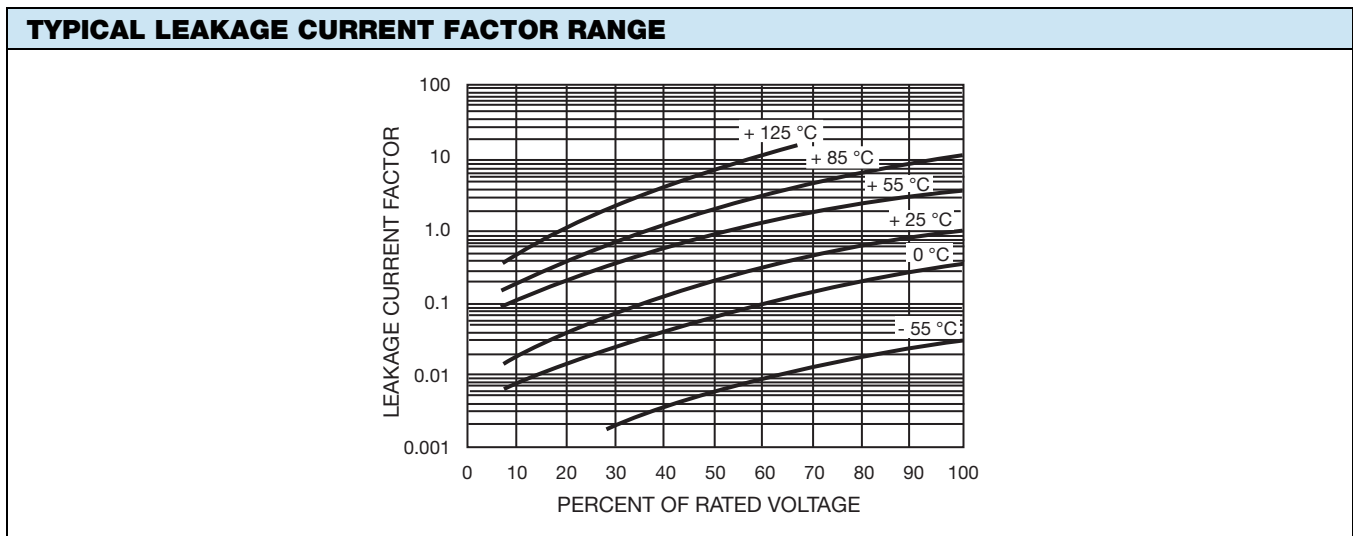
**Notes**

- Part number definition:
  - (1) Tolerance: For 10 % tolerance, specify "K"; for 20 % tolerance, change to "M"
- (1) Preliminary values, contact factory for availability
- (2) See Performance Characteristics tables



**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) 2 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 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 5 % of the DC rating at + 85 °C Vishay does not recommend 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>+ 125 °C RATING</b>	
	<b>WORKING VOLTAGE (V)</b>	<b>SURGE VOLTAGE (V)</b>	<b>WORKING VOLTAGE (V)</b>	<b>SURGE VOLTAGE (V)</b>
	4.0	5.2	2.7	3.4
	6.3	8.0	4.0	5.0
	10	13	7.0	8.0
	16	20	10	12
	20	26	13	16
	25	32	17	20
	35	46	23	28
50	65	33	40	



**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.

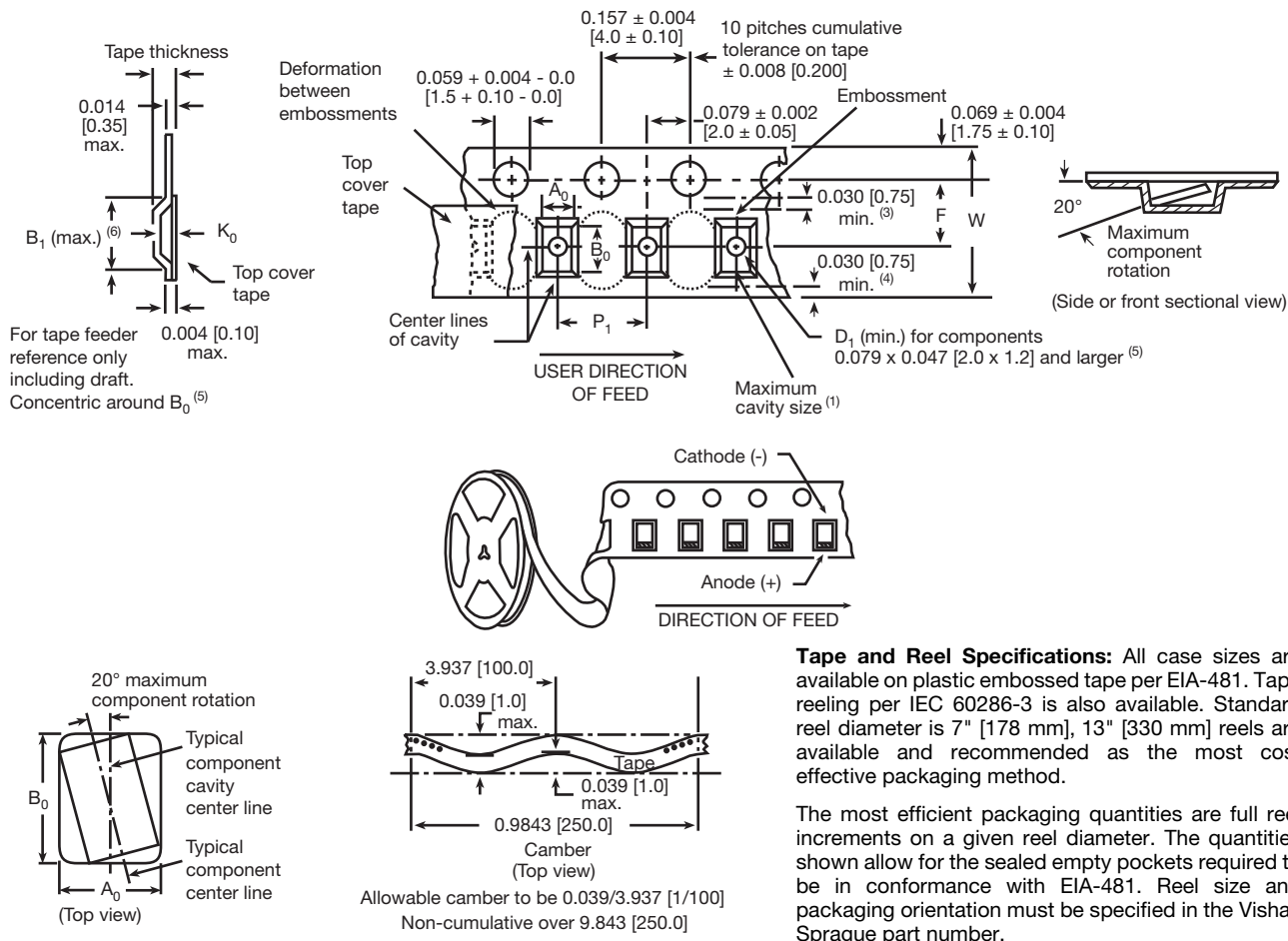




ENVIRONMENTAL PERFORMANCE CHARACTERISTICS			
ITEM	CONDITION	POST TEST PERFORMANCE	
Life Test at + 85 °C	1000 h application of rated voltage at 85 °C with a 3 Ω series resistance, MIL-STD 202G method 108A	Capacitance change Dissipation factor Leakage current	Refer to Standard Ratings table Not to exceed 150 % of initial Not to exceed 200 % of initial
Humidity Tests	At 40 °C/90 % RH 500 h, no voltage applied MIL-STD 202G method 103B	Capacitance change Dissipation factor Leakage current	Refer to Standard Ratings table Not to exceed 150 % of initial Not to exceed 200 % of initial
Thermal Shock	At - 55 °C/+ 125 °C, 30 min each, for 5 cycles. MIL-STD 202G method 107G	Capacitance change Dissipation factor Leakage current	Refer to Standard Ratings table Not to exceed 150 % of initial Not to exceed 200 % of initial

MECHANICAL PERFORMANCE CHARACTERISTICS			
ITEM	CONDITION	POST TEST PERFORMANCE	
Terminal Strength	Apply a pressure load of 5 N for 10 s ± 1 s horizontally to the center of capacitor side body. AEC-Q200 rev. C method 006	Capacitance change Dissipation factor Leakage current	Refer to Standard Ratings table Initial specified value or less Initial specified value or less
Substrate Bending (Board Flex)	With parts soldered onto substrate test board, apply force to the test board for a deflection of 1 mm. AEC-Q200 rev. C method 005	Capacitance change Dissipation factor Leakage current	Refer to Standard Ratings table Initial specified value or less Initial specified value or less
Vibration	MIL-STD-202G, method 204D, 10 Hz to 2000 Hz, 20 g Peak	Capacitance change Dissipation factor Leakage current	Refer to Standard Ratings table Initial specified value or less Initial specified value or less
Shock	MIL-STD-202G, method 213B, condition I, 100 g peak	Capacitance change Dissipation factor Leakage current	Refer to Standard Ratings table Initial specified value or less Initial specified value or less
Resistance to Solder Heat	At 260 °C, for 10 s, reflow	Capacitance change Dissipation factor Leakage current	Refer to Standard Ratings table Not to exceed 150 % of initial Not to exceed 200 % of initial
Solderability	MIL-STD-202G, method 208H, ANSI/J-STD-002, Test B. Applies only to solder and tin plated terminations. Does not apply to gold terminations.	There shall be no mechanical or visual damage to capacitors post-conditioning.	
Resistance to Solvents	MIL-STD-202, method 215D	There shall be no mechanical or visual damage to capacitors post-conditioning.	
Flammability	Encapsulation materials meet UL 94 V-0 with an oxygen index of 32 %.		

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

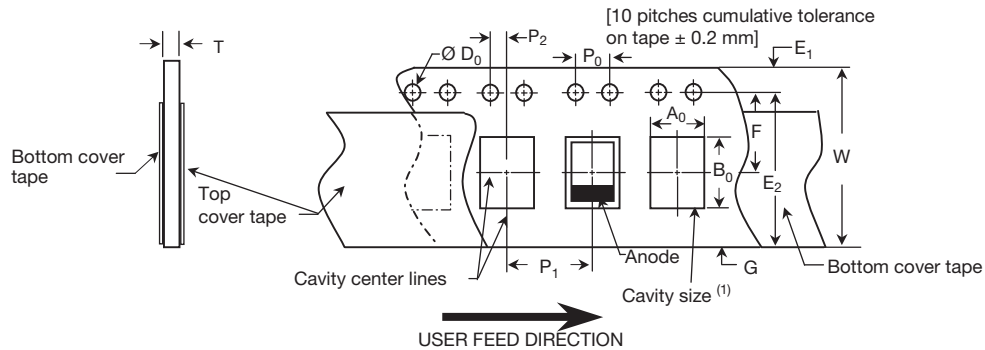


**Notes**

- 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  $20^\circ$ .
- (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
P	8 mm	0.108 [2.75]	0.039 [1.0]	$0.138 \pm 0.002$ [3.5 ± 0.05]	0.054 [1.37]	$0.157 \pm 0.004$ [4.0 ± 1.0]	$0.315 + 0.0118/- 0.0039$ [8.0 + 0.30/- 0.10]

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


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
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]

**Note**

- (1) 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°.

**STANDARD PACKAGING QUANTITY**

CASE CODE	QUANTITY (PCS/REEL)
	7" REEL
M	4000
P	3000

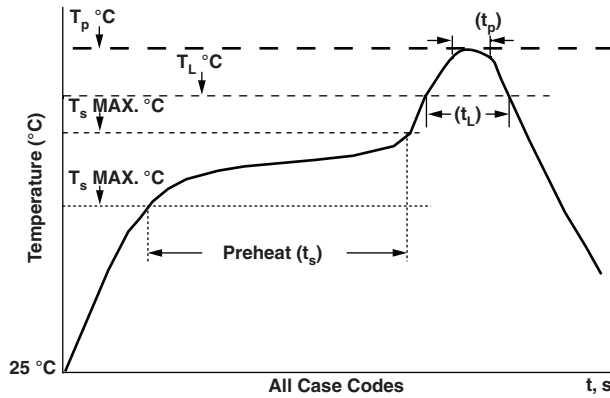
**RECOMMENDED VOLTAGE DERATING GUIDELINES**
**STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS**

Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.6
10	6.0
16	10
20	12
25	15
35	24
50	28

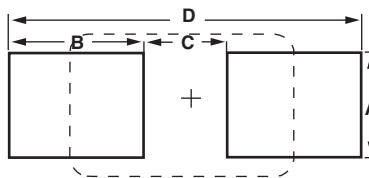
**SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS**

Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24

POWER DISSIPATION	
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
M	0.025
P	0.045

**RECOMMENDED REFLOW PROFILES**


$T_P$ lead (Pb)-free	$T_P$ Sn/Pb	$t_p$	$T_L$ lead (Pb)-free	$T_L$ Sn/Pb	$T_S$ MIN. lead (Pb)-free	$T_S$ MIN. Sn/Pb	$T_S$ MAX. lead (Pb)-free	$t_s$ MAX. Sn/Pb	$t_s$ MAX. lead (Pb)-free	$T_S$ Sn/Pb	$t_L$
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.)
M	0.039 [1.00]	0.028 [0.70]	0.024 [0.60]	0.080 [2.00]
P	0.063 [1.60]	0.031 [0.80]	0.047 [1.20]	0.110 [2.80]



GUIDE TO APPLICATION

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

I\_RMS = sqrt(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(P / R\_ESR)

or, from the formula:

V\_RMS = I\_RMS \* 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:

Table with 2 columns: TEMPERATURE and DERATING FACTOR. Rows: + 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 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 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.

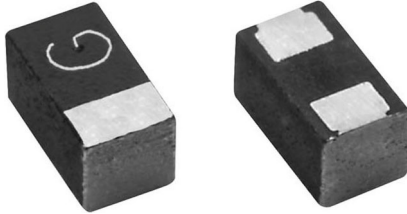
8.1 When using ultrasonic cleaning, the board may resonate if the output power is too high. This vibration can cause cracking or a decrease in the adherence of the termination. Do not exceed 9W/I at 40 kHz for 2 min.

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.

Table with 2 columns: PRODUCT INFORMATION and URL. Rows: Moisture Sensitivity (www.vishay.com/doc?40135), SELECTOR GUIDES, Solid Tantalum Selector Guide (www.vishay.com/doc?49053), Solid Tantalum Chip Capacitors (www.vishay.com/doc?40091), FAQ, Frequently Asked Questions (www.vishay.com/doc?40110)

# Solid Tantalum Chip Capacitors

## MICROTAN<sup>®</sup> 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 V<sub>DC</sub> to 40 V<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> 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>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 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]
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]	0.028 min. [0.70 min.]	0.035 + 0.009/- 0.001 [0.9 + 0.23/- 0.02]

<b>DIMENSIONS</b> 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]
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]

<b>RATINGS AND CASE CODES</b>							
μF	2 V	6.3 V	10 V	16 V	20 V	25 V	40 V
1.0			M	M	M/W	R	P
2.2				M			
3.3			M		R		
4.7			M			P	
7.5			L		N		
10	K <sup>(1)</sup>	M	R	R			
15		M					
47			T				

**Note**

<sup>(1)</sup> Preliminary values, contact factory for availability.

<b>MARKING</b>	
<p><b>M-Case</b></p>	<p><b>P-Case</b></p>
<p><b>K-Case</b></p>	<p><b>N, T-Case</b></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. ( $\Omega$ )	AVAILABLE RELIABILITY LEVELS
<b>2 V<sub>DC</sub> AT + 85 °C; 1.4 V<sub>DC</sub> AT + 125 °C</b>						
10	K <sup>(1)</sup>	TM8K106M002(2)(4)(6)	0.50	20	20.0	Z
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT + 125 °C</b>						
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
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT + 125 °C</b>						
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	L	TM8L755(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
47	T	TM8T476(1)010(2)(3)(5)	2.35	8	1.0	Z, S, B
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>						
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
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>						
1.0	M	TM8M105(1)020(2)(3)(5)	0.10	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
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>						
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
<b>40 V<sub>DC</sub> AT + 85 °C; 27 V<sub>DC</sub> AT + 125 °C</b>						
1.0	P	TM8P105(1)040(2)(3)(5)	0.20	8	10.0	Z, S, B

**Notes**

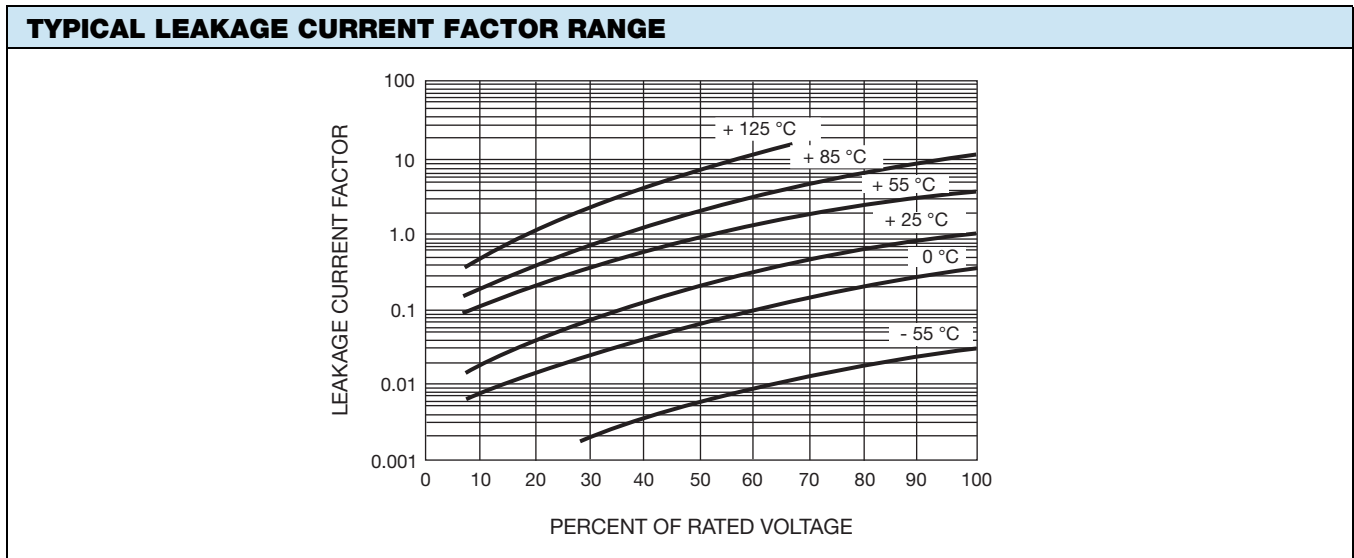
- Part number definitions:
  - (1) Capacitance tolerance: K, M
  - (2) Termination and Packaging: E, C, H, L, U, R
  - (3) Reliability level: Z, S, B
  - (4) Reliability level: Z only
  - (5) Surge current: Z, A, B
  - (6) Surge current: Z only
- (1) Preliminary ratings: contact factory for availability





**CAPACITORS PERFORMANCE CHARACTERISTICS**

<b>ELECTRICAL PERFORMANCE CHARACTERISTICS</b>	
<b>ITEM</b>	<b>PERFORMANCE CHARACTERISTICS</b>
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 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	<b>+ 85 °C RATING</b>
	<b>WORKING VOLTAGE (V)</b>
	2
	4
	6.3
	10
	15
	16
	20
	25
40	
<b>+ 125 °C RATING</b>	
<b>WORKING VOLTAGE (V)</b>	
1.3	
2.7	
4	
7	
10	
10	
13	
17	
27	

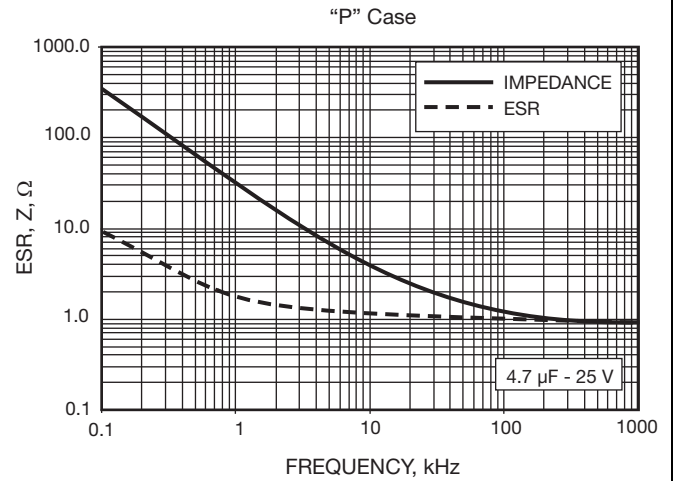
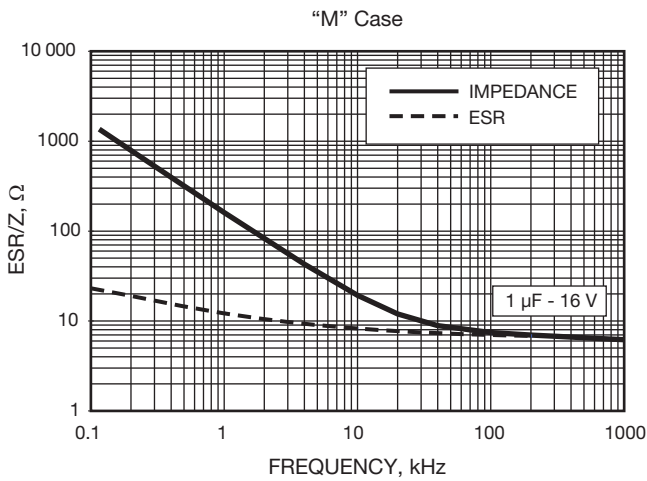
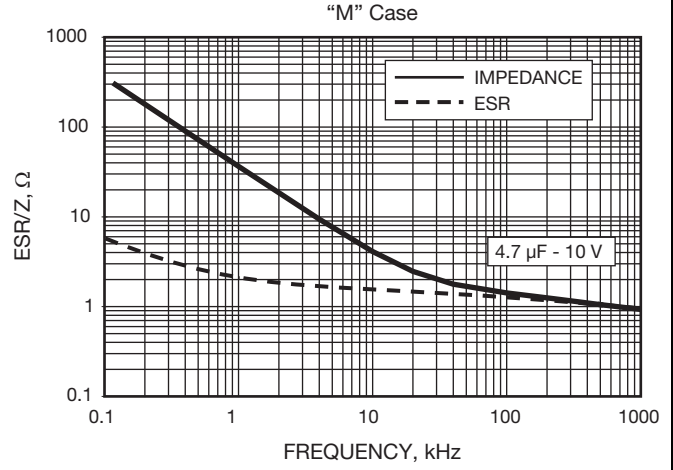
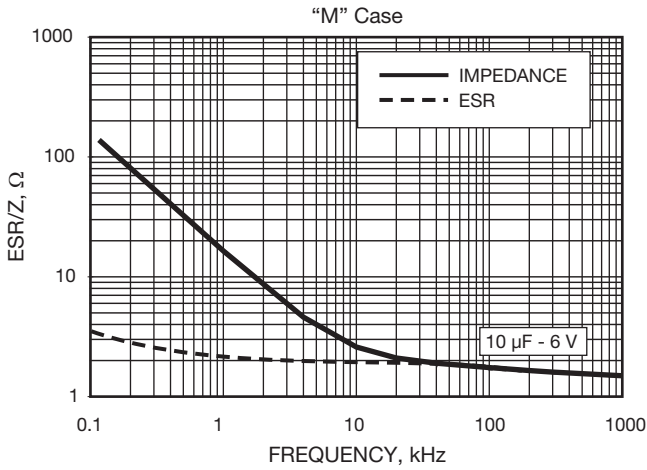


**Notes**

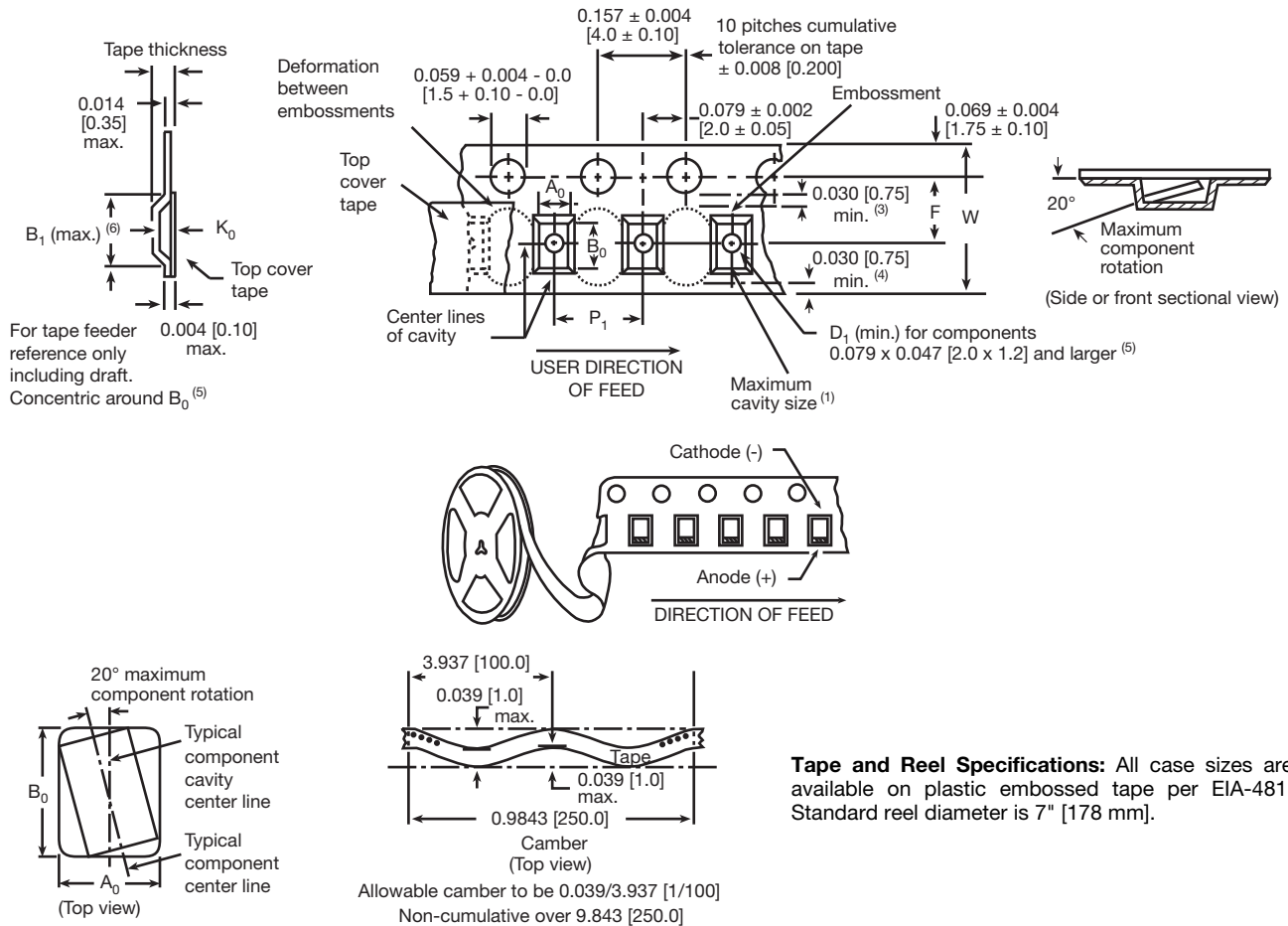
- **At + 25 °C**, the leakage current shall not exceed the value listed in the Standard Ratings table
- **At + 85 °C**, the leakage current shall not exceed 10 times the value listed in the Standard Ratings table
- **At + 125 °C**, the leakage current shall not exceed 12 times the value listed in the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



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



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



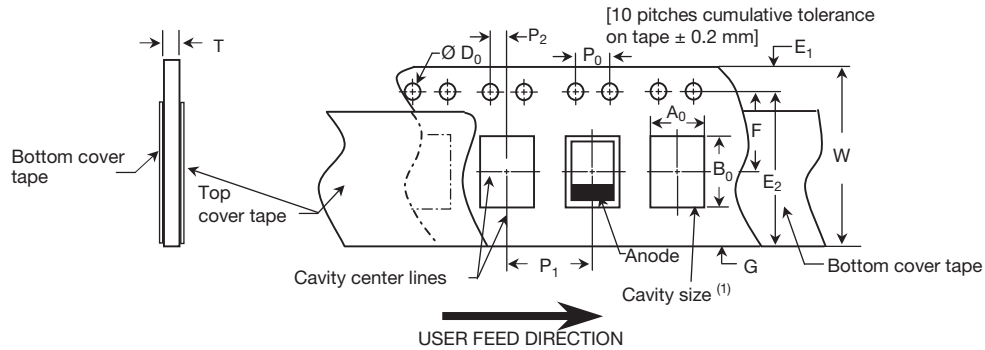
**Tape and Reel Specifications:** All case sizes are available on plastic embossed tape per EIA-481. Standard reel diameter is 7" [178 mm].

**Notes**

- Metric dimensions will govern. Dimensions in inches are rounded and for reference only.
- (1) A<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 sprocket hole to either the outward deformation 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<sub>1</sub> dimension is a reference dimension tape feeder clearance only.

**CARRIER TAPE DIMENSIONS** in inches [millimeters]

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
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)
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)
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)

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

**TAPE SIZE: 8 mm**

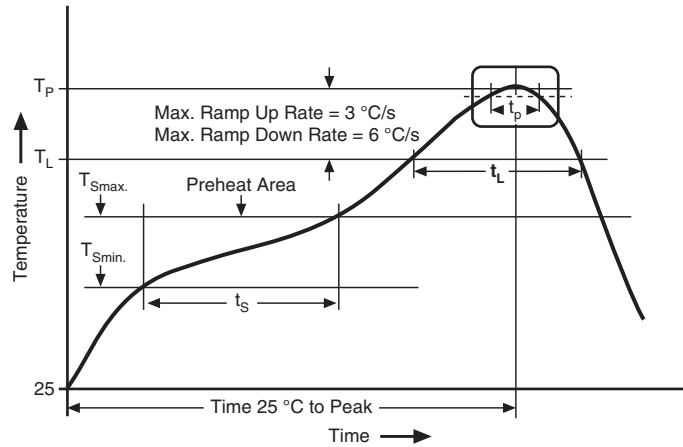
CASE CODE	A <sub>0</sub>	B <sub>0</sub>	D <sub>0</sub>	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	E	F	W	T
K	0.033 ± 0.002 [0.85 ± 0.05]	0.053 ± 0.002 [1.35 ± 0.05]	0.06 ± 0.004 [1.5 ± 0.1]	0.157 ± 0.004 [4.0 ± 0.1]	0.078 ± 0.004 [2.0 ± 0.1]	0.079 ± 0.002 [2.0 ± 0.05]	0.069 ± 0.004 [1.75 ± 0.1]	0.0138 ± 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
	L	2500	1250	300
	W	2500	1250	300
	R	2500	1250	300
	P	3000	1500	300
	N	2500	1250	300
	T	2500	1250	300

**POWER DISSIPATION**

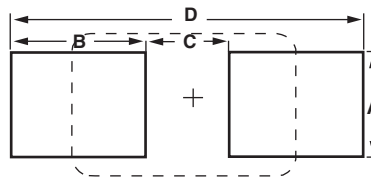
SERIES	CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
TM8	K	0.015
	M	0.025
	L	0.035
	W	0.040
	R	0.045
	P	0.045
	N	0.075
	T	0.084

**RECOMMENDED REFLOW PROFILES**


PROFILE FEATURE	SnPb EUTECTIC ASSEMBLY	LEAD (Pb)-FREE ASSEMBLY
<b>PREHEAT AND SOAK</b>		
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	
<b>RAMP UP</b>		
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
<b>RAMP DOWN</b>		
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)	0.24 (0.60)	0.080 (2.00)
L	0.059 (1.50)	0.031 (0.80)	0.039 (1.00)	0.102 (2.60)
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)
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)

**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<sub>ESR</sub> = 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<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 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.



# Conformal Coated Chip Capacitors

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# Guide for Conformal Coated Tantalum Capacitors

## 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	$\epsilon$ 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
<b>Tantalum Pentoxide</b>	<b>26</b>
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:

$$C = \frac{\epsilon A}{t}$$

where

C = Capacitance

$\epsilon$  = 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 TANTALUM CAPACITORS

Solid electrolyte capacitors contain manganese dioxide, which is formed on the tantalum pentoxide dielectric layer by impregnating the pellet with a solution of manganous nitrate. The pellet is then heated in an oven, and the manganous nitrate is converted to manganese dioxide.

The pellet is next coated with graphite, followed by a layer of metallic silver, which provides a conductive surface between the pellet and the can in which it will be enclosed. After assembly, the capacitors are tested and inspected to assure long life and reliability. It offers excellent reliability and high stability for consumer and commercial electronics with the added feature of low cost.

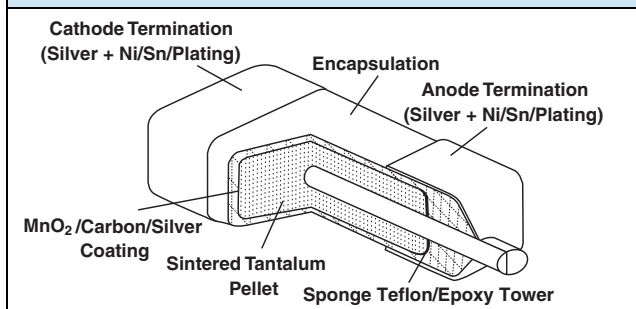
Surface mount designs of "Solid Tantalum" capacitors use lead frames or lead frameless designs as shown in the accompanying drawings.

### TANTALUM CAPACITORS FOR ALL DESIGN CONSIDERATIONS

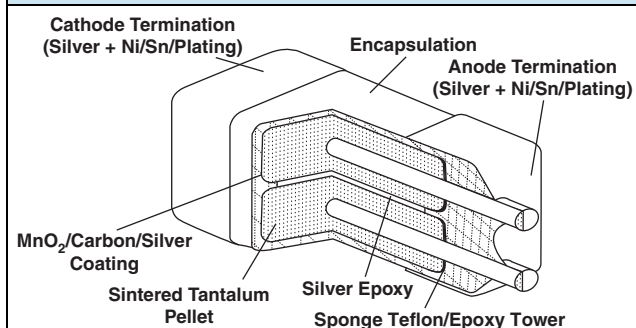
Solid electrolyte designs are the least expensive for a given rating and are used in many applications where their very small size for a given unit of capacitance is of importance. They will typically withstand up to about 10 % of the rated DC working voltage in a reverse direction. Also important are their good low temperature performance characteristics and freedom from corrosive electrolytes.

Vishay Sprague patented the original solid electrolyte capacitors and was the first to market them in 1956. Vishay Sprague has the broadest line of tantalum capacitors and has continued its position of leadership in this field. Data sheets covering the various types and styles of Vishay Sprague capacitors for consumer and entertainment electronics, industry, and military applications are available where detailed performance characteristics must be specified.

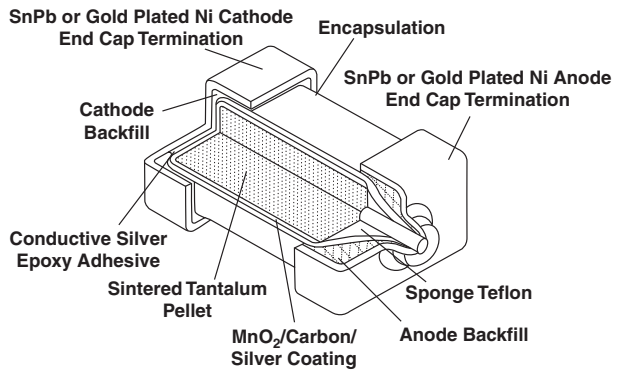
#### TYPE 195D, 572D, 591D, 592D/W, 594D, 595D, 695D, T95



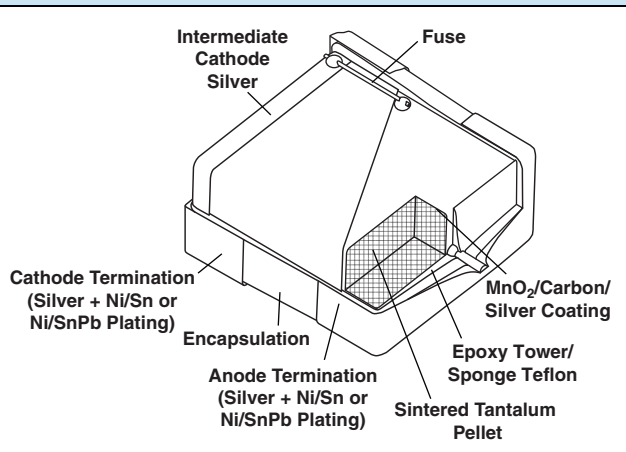
#### TYPE 597D/T97



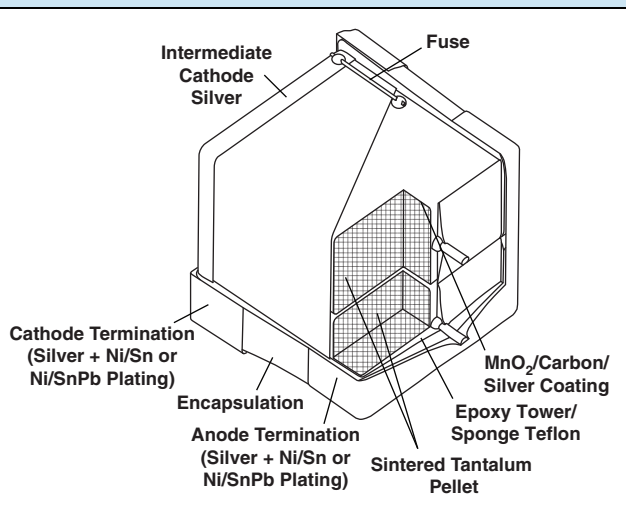
#### TYPE 194D



#### TYPE T96













#### TYPE T98











## COMMERCIAL PRODUCTS

SOLID TANTALUM CAPACITORS - CONFORMAL COATED					
SERIES	592D	592W	591D	595D	594D
PRODUCT IMAGE					
TYPE	Surface mount TANTAMOUNT® chip, conformal coated				
FEATURES	Low profile, maximum CV	Low profile, robust design for use in pulsed applications	Low profile, low ESR, maximum CV	Maximum CV	Low ESR, maximum CV
TEMPERATURE RANGE	- 55 °C to + 125 °C				
CAPACITANCE RANGE	1 µF to 2200 µF	330 µF to 2200 µF	1 µF to 1500 µF	0.1 µF to 1500 µF	1 µF to 1500 µF
VOLTAGE RANGE	4 V to 50 V	6 V to 10 V	4 V to 50 V	4 V to 50 V	4 V to 50 V
CAPACITANCE TOLERANCE	± 10 %, ± 20 %	± 20 %	± 10 %, ± 20 %	± 10 %, ± 20 %	± 10 %, ± 20 %
LEAKAGE CURRENT	0.01 CV or 0.5 µA, whichever is greater				
DISSIPATION FACTOR	4 % to 50 %	14 % to 45 %	4 % to 50 %	4 % to 20 %	4 % to 20 %
CASE CODES	S, A, B, C, D, R, M, X	C, M, X	A, B, C, D, R, M	T, S, A, B, C, D, G, M, R	B, C, D, R
TERMINATION	100 % matte tin standard, tin/lead and gold plated available	100 % matte tin	100 % matte tin standard, tin/lead and gold plated available		

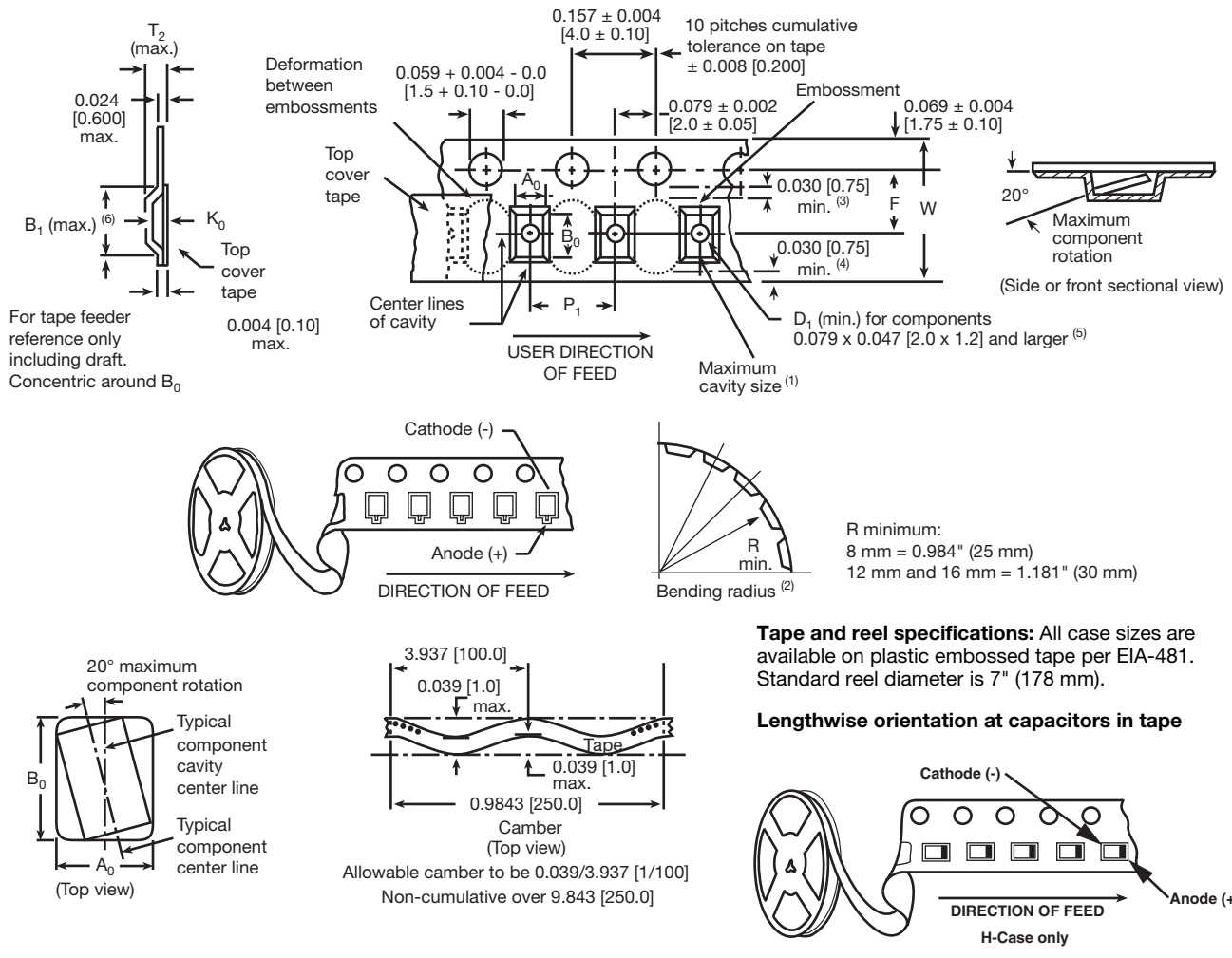
SOLID TANTALUM CAPACITORS - CONFORMAL COATED					
SERIES	597D	572D	695D	195D	194D
PRODUCT IMAGE					
TYPE	TANTAMOUNT® chip, conformal coated				
FEATURES	Ultra low ESR, maximum CV, multi-anode	Low profile, maximum CV	Pad compatible with 194D and CWR06	US and European case sizes	Industrial version of CWR06/CWR16
TEMPERATURE RANGE	- 55 °C to + 125 °C				
CAPACITANCE RANGE	10 µF to 1500 µF	2.2 µF to 220 µF	0.1 µF to 270 µF	0.1 µF to 330 µF	0.1 µF to 330 µF
VOLTAGE RANGE	4 V to 75 V	4 V to 35 V	4 V to 50 V	2 V to 50 V	4 V to 50 V
CAPACITANCE TOLERANCE	± 10 %, ± 20 %				
LEAKAGE CURRENT	0.01 CV or 0.5 µA, whichever is greater				
DISSIPATION FACTOR	6 % to 20 %	4 % to 25 %	4 % to 8 %	4 % to 8 %	4 % to 10 %
CASE CODES	V, D, E, R, F, Z, M, H	P, Q, S, A, B, T	A, B, D, E, F, G, H	C, S, V, X, Y, Z, R, A, B, D, E, F, G, H	A, B, C, D, E, F, G, H
TERMINATION	100 % matte tin standard, tin/lead solder plated available	100 % matte tin standard, gold plated available	100 % matte tin standard, tin/lead and gold plated available		Gold plated standard; tin/lead solder plated and hot solder dipped available



## HIGH RELIABILITY PRODUCTS

SOLID TANTALUM CAPACITORS - CONFORMAL COATED						
SERIES	CWR06	CWR16	T95	T96	T97	T98
PRODUCT IMAGE						
TYPE	TANTAMOUNT® chip, conformal coated		TANTAMOUNT® chip, Hi-Rel COTS, conformal coated			
FEATURES	MIL-PRF-55365/4 qualified	MIL-PRF-55365/13 qualified	High reliability, maximum CV	High reliability, built in fuse, maximum CV	High reliability, ultra low ESR, maximum CV, multi-anode	High reliability, ultra low ESR, maximum CV, built in fuse, multi-anode
TEMPERATURE RANGE	- 55 °C to + 125 °C					
CAPACITANCE RANGE	0.10 µF to 100 µF	0.33 µF to 330 µF	0.15 µF to 680 µF	10 µF to 680 µF	10 µF to 1500 µF	22 µF to 1500 µF
VOLTAGE RANGE	4 V to 50 V	4 V to 35 V	4 V to 50 V	4 V to 50 V	4 V to 75 V	4 V to 63 V
CAPACITANCE TOLERANCE	± 5 %, ± 10 %, ± 20 %	± 5 %, ± 10 %, ± 20 %	± 10 %, ± 20 %	± 10 %, ± 20 %	± 10 %, ± 20 %	± 10 %, ± 20 %
LEAKAGE CURRENT	0.01 CV or 1.0 µA, whichever is greater		0.01 CV or 0.5 µA, whichever is greater			
DISSIPATION FACTOR	6 % to 10 %	6 % to 10 %	4 % to 14 %	6 % to 14 %	6 % to 20 %	6 % to 10 %
CASE CODES	A, B, C, D, E, F, G, H	A, B, C, D, E, F, G, H	A, B, C, D, R, S, V, X, Y, Z	R	V, E, F, R, Z, D, M, H, N	V, E, F, R, Z, M, H
TERMINATION	Gold plated; tin/lead solder plated; hot solder dipped		100 % matte tin, tin/lead solder plated			

## TAPE AND REEL PACKAGING in inches [millimeters]



### Notes

- Metric dimensions will govern. Dimensions in inches are rounded and for reference only.
- <sup>(1)</sup>  $A_0$ ,  $B_0$ ,  $K_0$ , 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°.
- <sup>(2)</sup> 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.
- <sup>(3)</sup> 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.
- <sup>(4)</sup> 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.
- <sup>(5)</sup> 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.
- <sup>(6)</sup>  $B_1$  dimension is a reference dimension tape feeder clearance only.



CARRIER TAPE DIMENSIONS in inches [millimeters]						
TAPE WIDTH	W	D <sub>0</sub>	P <sub>2</sub>	F	E <sub>1</sub>	E <sub>2</sub> min.
8 mm	0.315 + 0.012/- 0.004 [8.0 + 0.3/- 0.1]	0.059 + 0.004/- 0 [1.5 + 0.1/- 0]	0.078 ± 0.0019 [2.0 ± 0.05]	0.14 ± 0.0019 [3.5 ± 0.05]	0.324 ± 0.004 [1.75 ± 0.1]	0.246 [6.25]
12 mm	0.479 + 0.012/- 0.004 [12.0 + 0.3/- 0.1]			0.216 ± 0.0019 [5.5 ± 0.05]		0.403 [10.25]
16 mm	0.635 + 0.012/- 0.004 [16.0 + 0.3/- 0.1]		0.078 ± 0.004 [2.0 ± 0.1]	0.295 ± 0.004 [7.5 ± 0.1]		0.570 [14.25]
24 mm	0.945 ± 0.012 [24.0 ± 0.3]		0.453 ± 0.004 [11.5 ± 0.1]	0.876 [22.25]		

CARRIER TAPE DIMENSIONS in inches [millimeters]					
TYPE	CASE CODE	TAPE WIDTH W IN mm	P <sub>1</sub>	K <sub>0</sub> max.	B <sub>1</sub> max.
592D 592W 591D	A	8	0.157 ± 0.004 [4.0 ± 0.10]	0.058 [1.47]	0.149 [3.78]
	B	12		0.088 [2.23]	0.166 [4.21]
	C	12	0.315 ± 0.004 [8.0 ± 0.10]	0.088 [2.23]	0.290 [7.36]
	D	12		0.088 [2.23]	0.300 [7.62]
	M	16		0.091 [2.30]	0.311 [7.90]
	R	12		0.088 [2.23]	0.296 [7.52]
	S	8	0.157 ± 0.004 [4.0 ± 0.10]	0.058 [1.47]	0.139 [3.53]
	T	12	0.088 [2.23]	0.166 [4.21]	
X	24	0.472 ± 0.004 [12.0 ± 0.10]	0.011 [2.72]	0.594 [15.1]	
595D 594D	A	8	0.157 ± 0.004 [4.0 ± 0.10]	0.063 [1.60]	0.152 [3.86]
	B	12		0.088 [2.23]	0.166 [4.21]
	C	12	0.315 ± 0.004 [8.0 ± 0.10]	0.118 [2.97]	0.290 [7.36]
	D	12		0.119 [3.02]	0.296 [7.52]
	G	12		0.111 [2.83]	0.234 [5.95]
	H	12		0.098 [2.50]	0.232 [5.90]
	M	12	0.157 ± 0.004 [4.0 ± 0.10]	0.085 [2.15]	0.152 [3.85]
	R	12	0.315 ± 0.004 [8.0 ± 0.10]	0.148 [3.78]	0.296 [7.52]
	S	8	0.157 ± 0.004 [4.0 ± 0.10]	0.058 [1.47]	0.149 [3.78]
	T	8		0.054 [1.37]	0.093 [2.36]
695D	A	8	0.157 ± 0.004 [4.0 ± 0.10]	0.058 [1.47]	0.139 [3.53]
	B	12		0.059 [1.50]	0.189 [4.80]
	D	12		0.063 [1.62]	0.191 [4.85]
	E	12		0.074 [1.88]	0.239 [6.07]
	F	12	0.315 ± 0.004 [8.0 ± 0.10]	0.075 [1.93]	0.259 [6.58]
	G	12	0.157 ± 0.004 [4.0 ± 0.10]	0.109 [2.77]	0.301 [7.65]
	H	16	0.315 ± 0.004 [8.0 ± 0.10]	0.124 [3.15]	0.31 [7.87]



<b>CARRIER TAPE DIMENSIONS</b> in inches [millimeters]					
<b>TYPE</b>	<b>CASE CODE</b>	<b>TAPE WIDTH W IN mm</b>	<b>P<sub>1</sub></b>	<b>K<sub>0</sub> max.</b>	<b>B<sub>1</sub> max.</b>
195D	A	8	0.157 ± 0.004 [4.0 ± 0.10]	0.058 [1.47]	0.139 [3.53]
	B	12		0.059 [1.50]	0.189 [4.80]
	C	8		0.054 [1.37]	0.093 [2.36]
	D	12		0.067 [1.70]	0.179 [4.55]
	E	12		0.074 [1.88]	0.239 [6.07]
	F	12	0.315 ± 0.004 [8.0 ± 0.10]	0.076 [1.93]	0.259 [6.58]
	G	12	0.157 ± 0.004 [4.0 ± 0.10]	0.109 [2.77]	0.301 [7.65]
	H <sup>(1)</sup>	12	0.472 ± 0.004 [12.0 ± 0.1]	0.122 [3.11]	0.163 [4.14]
	R	12	0.315 ± 0.004 [8.0 ± 0.10]	0.149 [3.78]	0.296 [7.52]
	S	8	0.157 ± 0.004 [4.0 ± 0.10]	0.058 [1.47]	0.149 [3.78]
	V	8		0.060 [1.52]	0.150 [3.80]
	X	12		0.069 [1.75]	0.296 [7.52]
	Y	12		0.089 [2.26]	0.296 [7.52]
	Z	12		0.114 [2.89]	0.288 [7.31]
572D	A	8	0.157 ± 0.004 [4.0 ± 0.10]	0.058 [1.47]	0.149 [3.78]
	B	12		0.087 [2.20]	0.166 [4.21]
	P	8		0.043 [1.10]	0.102 [2.60]
	P	8		0.052 [1.32]	0.106 [2.70]
	Q	8		0.054 [1.37]	0.140 [3.55]
	S	8		0.058 [1.47]	0.149 [3.78]
	T	12		0.061 [1.55]	0.164 [4.16]
194D CWR06 CWR16	A	8	0.157 ± 0.004 [4.0 ± 0.10]	0.069 [1.75]	0.139 [3.53]
	B	12		0.073 [1.85]	0.189 [4.80]
	C	12		0.069 [1.75]	0.244 [6.20]
	D	12		0.068 [1.72]	0.191 [4.85]
	E	12	0.074 [1.88]	0.239 [6.07]	
	F	12	0.315 ± 0.004 [8.0 ± 0.10]	0.091 [2.31]	0.262 [6.65]
	G	16	0.134 [3.40]	0.289 [7.34]	
	H	16	0.129 [3.28]	0.319 [8.10]	
597D T97	D	16	0.317 ± 0.004 [8.0 ± 0.10]	0.150 [3.80]	0.313 [7.95]
	E	16		0.173 [4.40]	0.343 [8.70]
	F	16	0.476 ± 0.004 [12.0 ± 0.1]	0.205 [5.20]	0.309 [7.85]
	H	16		0.224 [5.70]	0.313 [7.95]
	M	16		0.193 [4.90]	0.339 [8.60]
	N	16		0.283 [7.20]	0.323 [8.20]
	R	16	0.159 [4.05]	0.313 [7.95]	
	V	12	0.317 ± 0.004 [8.0 ± 0.10]	0.088 [2.23]	0.300 [7.62]
	Z	16	0.476 ± 0.004 [12.0 ± 0.1]	0.239 [6.06]	0.311 [7.90]
T95	A	8	0.157 ± 0.004 [4.0 ± 0.10]	0.063 [1.60]	0.152 [3.86]
	B	12		0.088 [2.23]	0.166 [4.21]
	C	12		0.117 [2.97]	0.290 [7.36]
	D	12	0.317 ± 0.004 [8.0 ± 0.10]	0.119 [3.02]	0.296 [7.52]
	R	12		0.149 [3.78]	0.296 [7.52]
	S	8	0.157 ± 0.004 [4.0 ± 0.10]	0.058 [1.47]	0.149 [3.78]
	V	8		0.060 [1.52]	0.150 [3.80]
	X	12		0.069 [1.75]	0.296 [7.52]
	Y	12		0.089 [2.26]	0.296 [7.52]
Z	12	0.114 [2.89]		0.288 [7.31]	
T96	R	16	0.476 ± 0.004 [12.0 ± 0.1]	0.159 [4.05]	0.313 [7.95]
T98	F	16	0.476 ± 0.004 [12.0 ± 0.1]	0.239 [6.06]	0.311 [7.90]
	M	16		0.193 [4.90]	0.339 [8.60]
	Z	16		0.272 [6.90]	0.307 [7.80]

**Note**

<sup>(1)</sup> H case only, packaging code T: Lengthwise orientation at capacitors in tape.



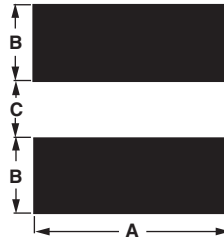
**PAD DIMENSIONS** in inches [millimeters]



CASE CODE	WIDTH (A)	PAD METALLIZATION (B)	SEPARATION (C)
<b>592D/W - 591D</b>			
A	0.075 [1.9]	0.050 [1.3]	0.050 [1.3]
B	0.118 [3.0]	0.059 [1.5]	0.059 [1.5]
C	0.136 [3.5]	0.090 [2.3]	0.122 [3.1]
D	0.180 [4.6]	0.090 [2.3]	0.134 [3.4]
M, R	0.240 [6.1]	Anode pad: 0.095 [2.4] Cathode pad: 0.067 [1.7]	0.118 [3.0]
S	0.067 [1.7]	0.032 [0.8]	0.043 [1.1]
X	0.310 [7.9]	0.120 [3.0]	0.360 [9.2]
y	0.310 [7.9]	0.122 [3.1]	0.036 [9.14]
<b>595D - 594D</b>			
T	0.059 [1.5]	0.028 [0.7]	0.024 [0.6]
S	0.067 [1.7]	0.032 [0.8]	0.043 [1.1]
A	0.820 [2.1]	0.050 [1.3]	0.050 [1.3]
B	0.118 [3.0]	0.059 [1.5]	0.059 [1.5]
C	0.136 [3.5]	0.090 [2.3]	0.122 [3.1]
D	0.180 [4.6]	0.090 [2.3]	0.134 [3.4]
G	0.156 [4.05]	0.090 [2.3]	0.082 [2.1]
M	0.110 [2.8]	0.087 [2.2]	0.134 [3.4]
R	0.248 [6.3]	0.090 [2.3]	0.140 [3.6]
<b>195D</b>			
A	0.067 [1.7]	0.043 [1.1]	0.028 [0.7]
B	0.063 [1.6]	0.047 [1.2]	0.047 [1.2]
C	0.059 [1.5]	0.031 [0.8]	0.024 [0.6]
D	0.090 [2.3]	0.055 [1.4]	0.047 [1.2]
E	0.090 [2.3]	0.055 [1.4]	0.079 [2.0]
F	0.140 [3.6]	0.063 [1.6]	0.087 [2.2]
G	0.110 [2.8]	0.059 [1.5]	0.126 [3.2]
H	0.154 [3.9]	0.063 [1.6]	0.140 [3.6]
N	0.244 [6.2]	0.079 [2.0]	0.118 [3.0]
R	0.248 [6.3]	0.090 [2.3]	0.140 [3.6]
S	0.079 [2.0]	0.039 [1.0]	0.039 [1.0]
V	0.114 [2.9]	0.039 [1.0]	0.039 [1.0]
X	0.118 [3.0]	0.067 [1.7]	0.122 [3.1]
Y	0.118 [3.0]	0.067 [1.7]	0.122 [3.1]
Z	0.118 [3.0]	0.067 [1.7]	0.122 [3.1]

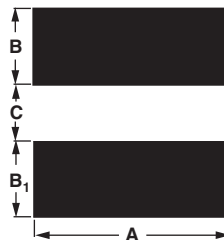


## PAD DIMENSIONS in inches [millimeters]



CASE CODE	WIDTH (A)	PAD METALLIZATION (B)	SEPARATION (C)
<b>CWR06/CWR16 - 194D - 695D</b>			
A	0.065 [1.6]	0.50 [1.3]	0.040 [1.0]
B	0.065 [1.6]	0.70 [1.8]	0.055 [1.4]
C	0.065 [1.6]	0.70 [1.8]	0.120 [3.0]
D	0.115 [2.9]	0.70 [1.8]	0.070 [1.8]
E	0.115 [2.9]	0.70 [1.8]	0.120 [3.0]
F	0.150 [3.8]	0.70 [1.8]	0.140 [3.6]
G	0.125 [3.2]	0.70 [1.8]	0.170 [4.3]
H	0.165 [4.2]	0.90 [2.3]	0.170 [4.3]
<b>T95</b>			
B	0.120 [3.0]	0.059 [1.5]	0.059 [1.5]
C	0.136 [3.5]	0.090 [2.3]	0.120 [3.1]
D	0.180 [4.6]	0.090 [2.3]	0.136 [3.47]
R	0.248 [6.3]	0.090 [2.3]	0.140 [3.6]
S	0.080 [2.03]	0.040 [1.02]	0.040 [1.02]
V	0.114 [2.9]	0.040 [1.02]	0.040 [1.02]
X, Y, Z	0.114 [2.9]	0.065 [1.65]	0.122 [3.1]
<b>T96</b>			
R	0.248 [6.3]	0.090 [2.3]	0.140 [3.6]
<b>597D - T97 - T98</b>			
E, V	0.196 [4.9]	0.090 [2.3]	0.140 [3.6]
F, R, Z	0.260 [6.6]	0.090 [2.3]	0.140 [3.6]
M, H, N	0.284 [7.2]	0.090 [2.3]	0.140 [3.6]

## PAD DIMENSIONS in inches [millimeters]



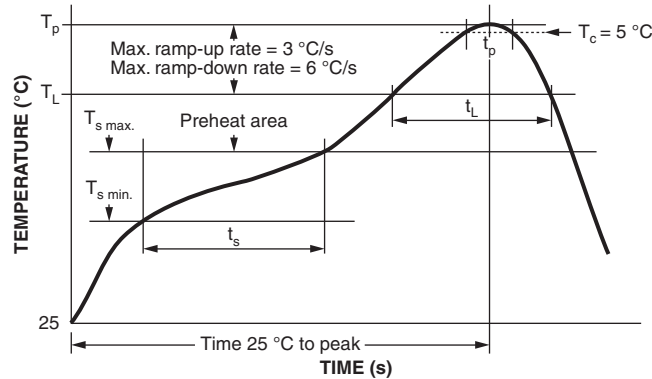
CASE CODE	WIDTH (A)	PAD METALLIZATION (B)	PAD METALLIZATION (B <sub>1</sub> )	SEPARATION (C)
<b>572D</b>				
A	0.079 [2.0]	0.039 [1.0]	0.035 [0.9]	0.047 [1.2]
Q	0.079 [2.0]	0.039 [1.0]	0.035 [0.9]	0.047 [1.2]
S	0.079 [2.0]	0.039 [1.0]	0.035 [0.9]	0.047 [1.2]
B	0.110 [2.8]	0.039 [1.0]	0.035 [0.9]	0.055 [1.4]
P	0.055 [1.4]	0.024 [0.6]	0.024 [0.6]	0.035 [0.9]
T	0.110 [2.8]	0.035 [0.9]	0.031 [0.8]	0.055 [1.4]





## RECOMMENDED REFLOW PROFILES

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



PROFILE FEATURE	SnPb EUTECTIC ASSEMBLY	LEAD (Pb)-FREE ASSEMBLY
<b>Preheat/soak</b>		
Temperature min. ( $T_{s \text{ min.}}$ )	100 °C	150 °C
Temperature max. ( $T_{s \text{ max.}}$ )	150 °C	200 °C
Time ( $t_s$ ) from ( $T_{s \text{ min.}}$ to $T_{s \text{ max.}}$ )	60 s to 120 s	60 s to 120 s
<b>Ramp-up</b>		
Ramp-up rate ( $T_L$ to $T_p$ )	3 °C/s max.	3 °C/s max.
Liquidous temperature ( $T_L$ )	183 °C	217 °C
Time ( $t_L$ ) maintained above $T_L$	60 s to 150 s	60 s to 150 s
Peak package body temperature ( $T_p$ )	Depends on type and case – see table below	
Time ( $t_p$ )* within 5 °C of the specified classification temperature ( $T_c$ )	20 s	30 s
<b>Ramp-down</b>		
Ramp-down rate ( $T_p$ to $T_L$ )	6 °C/s max.	6 °C/s max.
Time 25 °C to peak temperature	6 min max.	8 min max.

## PEAK PACKAGE BODY TEMPERATURE ( $T_p$ )

TYPE/CASE CODE	PEAK PACKAGE BODY TEMPERATURE ( $T_p$ )	
	SnPb EUTECTIC PROCESS	LEAD (Pb)-FREE PROCESS
591D/592D - all cases, except X25H, M and R cases	235 °C	260 °C
591D/592D - X25H, M and R cases	220 °C	250 °C
594D/595D - all cases except C, D and R	235 °C	260 °C
594D/595D - C, D and R case	220 °C	250 °C
572D all cases	n/a	260 °C
T95 B, S, V, X, Y cases	235 °C	260 °C
T95 C, D, R and Z cases	220 °C	250 °C
T96 R case	220 °C	250 °C
195D all cases, except G, H, R and Z	235 °C	260 °C
195D G, H, R and Z cases	220 °C	250 °C
695D all cases, except G and H cases	235 °C	260 °C
695D G, H cases	220 °C	250 °C
597D, T97, T98 all cases, except V case	220 °C	250 °C
597D, T97, T98 V case	230 °C	260 °C
194D all cases, except H and G cases	235 °C	260 °C
194D H and G cases	220 °C	250 °C



## 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 + 25 °C as given in the tables in the product datasheets (Power Dissipation).

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:

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

or, from the formula:

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

where,

P = Power dissipation in W at + 25 °C as given in the tables in the product datasheets (Power Dissipation).

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

Z = The capacitor impedance at the specified frequency

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

- Reverse Voltage:** Solid tantalum capacitors are not intended for use with reverse voltage applied. However, they have been shown to be capable of withstanding momentary reverse voltage peaks of up to 10 % of the DC rating at 25 °C and 5 % of the DC rating at + 85 °C.

- 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

- 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 derating factor (see paragraph 4)).

- Attachment:**

- Soldering:** Capacitors can be attached by conventional soldering techniques, convection, infrared reflow, wave soldering and hot plate methods. The soldering profile chart shows typical recommended time/temperature conditions for soldering. Preheating is recommended to reduce thermal stress. The recommended maximum preheat rate is 2 °C/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.

- Recommended Mounting Pad Geometries:** The nib must have sufficient clearance to avoid electrical contact with other components. The width dimension indicated is the same as the maximum width of the capacitor. This is to minimize lateral movement.

- Cleaning (Flux Removal) After Soldering:** TANTAMOUNT<sup>®</sup> 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.

# Solid Tantalum Chip Capacitors, TANTAMOUNT<sup>®</sup>, Conformal Coated



## FEATURES

- 8 mm, 12 mm, 16 mm tape and reel packaging available per EIA-481 and reeling per IEC 60286-3, 7" [178 mm] standard
- Mounting: Surface mount
- Compliant to RoHS Directive 2002/95/EC


**RoHS\***  
COMPLIANT

### Note

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

## PERFORMANCE CHARACTERISTICS

[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)

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

**Capacitance Range:** 0.10  $\mu$ F to 330  $\mu$ F

**Capacitance Tolerance:**  $\pm$  10 %,  $\pm$  20 % standard

**Voltage Rating:** 4  $V_{DC}$  to 50  $V_{DC}$

ORDERING INFORMATION						
194D	225	X0	004	A	2	T
TYPE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	CASE CODE	TERMINATION	PACKAGING
	This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow.	<b>X0 = <math>\pm</math> 20 %</b> <b>X9 = <math>\pm</math> 10 %</b> <b>X5 = <math>\pm</math> 5 %</b> special order	This is expressed in volts. To complete the three-digit block, zeros precede the voltage rating	See Ratings and Case Codes table	<b>2 = Gold plated (50 <math>\mu</math> inch minimum standard (RoHS compliant))</b> 8 = 60/40 solder plated 7 = Hot solder dipped	<b>T = T/R (full reel)</b> <b>7" [178 mm] reel standard</b> H = T/R (half reel) 7" [178 mm] B = Bulk

### Note

- Preferred tolerance and reel sizes are in bold.
- We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size.

DIMENSIONS in inches [millimeters]						
CASE CODE	W	L	H	P	T <sub>1</sub>	T <sub>2</sub> MAX.
A	0.050 $\pm$ 0.015 [1.27 $\pm$ 0.38]	0.100 $\pm$ 0.015 [2.54 $\pm$ 0.38]	0.050 $\pm$ 0.015 [1.27 $\pm$ 0.38]	0.030 $\pm$ 0.005 [0.76 $\pm$ 0.13]	0.005 [0.13]	0.015 [0.38]
B	0.050 $\pm$ 0.015 [1.27 $\pm$ 0.38]	0.150 $\pm$ 0.015 [3.81 $\pm$ 0.38]	0.050 $\pm$ 0.015 [1.27 $\pm$ 0.38]	0.030 $\pm$ 0.005 [0.76 $\pm$ 0.13]	0.005 [0.13]	0.015 [0.38]
C	0.050 $\pm$ 0.015 [1.27 $\pm$ 0.38]	0.200 $\pm$ 0.015 [5.08 $\pm$ 0.38]	0.050 $\pm$ 0.015 [1.27 $\pm$ 0.38]	0.030 $\pm$ 0.005 [0.76 $\pm$ 0.13]	0.005 [0.13]	0.015 [0.38]
D	0.100 $\pm$ 0.015 [2.54 $\pm$ 0.38]	0.150 $\pm$ 0.015 [3.81 $\pm$ 0.38]	0.050 $\pm$ 0.015 [1.27 $\pm$ 0.38]	0.030 $\pm$ 0.005 [0.76 $\pm$ 0.13]	0.005 [0.13]	0.015 [0.38]
E	0.100 $\pm$ 0.015 [2.54 $\pm$ 0.38]	0.200 $\pm$ 0.015 [5.08 $\pm$ 0.38]	0.050 $\pm$ 0.015 [1.27 $\pm$ 0.38]	0.030 $\pm$ 0.005 [0.76 $\pm$ 0.13]	0.005 [0.13]	0.015 [0.38]
F	0.135 $\pm$ 0.015 [3.43 $\pm$ 0.38]	0.220 $\pm$ 0.015 [5.59 $\pm$ 0.38]	0.070 $\pm$ 0.015 [1.78 $\pm$ 0.38]	0.030 $\pm$ 0.005 [0.76 $\pm$ 0.13]	0.005 [0.13]	0.015 [0.38]
G	0.110 $\pm$ 0.015 [2.79 $\pm$ 0.38]	0.265 $\pm$ 0.015 [6.73 $\pm$ 0.38]	0.110 $\pm$ 0.015 [2.79 $\pm$ 0.38]	0.050 $\pm$ 0.005 [1.27 $\pm$ 0.13]	0.005 [0.13]	0.015 [0.38]
H	0.150 $\pm$ 0.015 [3.81 $\pm$ 0.38]	0.285 $\pm$ 0.015 [7.24 $\pm$ 0.38]	0.110 $\pm$ 0.015 [2.79 $\pm$ 0.38]	0.050 $\pm$ 0.005 [1.27 $\pm$ 0.13]	0.005 [0.13]	0.015 [0.38]

### Note

- When solder coated terminations are required, add 0.015" [0.381 mm] to termination dimension tolerances



RATINGS AND CASE CODES								
μF	4 V	6 V	10 V	15 V	20 V	25 V	35 V	50 V
0.10							A	A
0.15							A	A
0.22							A	B
0.33						A	B	B
0.47					A	A/B	B	C
0.68				A	A/B	B	C	D
1.0			A	A/B	A/B	A/C	D	E
1.5		A	A/B	A/B	B/C	D	E	F
2.2	A	A/B	A/B	A/B/C	C/D	E	F	F
3.3	A/B	A/B	A/B/C	C/D	D/E	F	F	G
4.7	B	A/B/C	B/C/D	D/E	E/F	F	F/G	H
6.8	B/C	C/D	D/E	E/F	F	F/G	G/H	H
10	C/D	D/E	C/E/F	E/F	E/F/G	F/G	G/H	
15	D/E	E/F	E/F	F/G	F/G	H	H	
22	E/F	F	F/G	F/G	G/H	H		
33	F	F/G	F/G	F/G/H	H	H		
47	F/G	F/G	G/H	G/H				
68	F/G	G/H	H	H				
100	H	H	H					
120	H	H	H					
150	H	H						
330	H	H						

STANDARD RATINGS				
CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C (μA)	MAX. DF AT + 25 °C 120 Hz (%)
<b>4 V<sub>DC</sub> AT + 85 °C, SURGE = 5 V; 2.7 V<sub>DC</sub> AT + 125 °C, SURGE = 3.4 V</b>				
2.2	A	194D225(1)004A(2)(3)	0.5	6
3.3	A	194D335(1)004A(2)(3)	0.5	6
3.3	B	194D335(1)004B(2)(3)	0.5	6
4.7	B	194D475(1)004B(2)(3)	0.5	6
6.8	B	194D685(1)004B(2)(3)	0.5	6
6.8	C	194D685(1)004C(2)(3)	0.5	6
10	C	194D106(1)004C(2)(3)	0.5	6
10	D	194D106(1)004D(2)(3)	0.5	6
15	D	194D156(1)004D(2)(3)	0.6	6
15	E	194D156(1)004E(2)(3)	0.6	6
22	E	194D226(1)004E(2)(3)	0.9	6
22	F	194D226(1)004F(2)(3)	0.9	6
33	F	194D336(1)004F(2)(3)	1.3	6
47	F	194D476(1)004F(2)(3)	1.9	6
47	G	194D476(1)004G(2)(3)	1.9	6
68	F	194D686(1)004F(2)(3)	2.7	6
68	G	194D686(1)004G(2)(3)	2.7	6
100	H	194D107(1)004H(2)(3)	4.0	8
120	H	194D127(1)004H(2)(3)	4.8	8
150	H	194D157(1)004H(2)(3)	6.0	8
330	H	194D337(1)004H(2)(3)	13.2	10

**Notes**

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0", for 5 % tolerance specify "X5" (special order)
  - Termination: For gold plated specify "2", for solder plated 60/40 specify "8", for hot solder dipped specify "7"
  - Packaging code: For 7" reels specify "T", for half of 7" reels specify "H", for bulk specify "B"
- 5 % tolerance is not available for the 0.33 μF/50 V design



STANDARD RATINGS				
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)
<b>6 V<sub>DC</sub> AT + 85 °C, SURGE = 8 V; 4 V<sub>DC</sub> AT + 125 °C, SURGE = 5 V</b>				
1.5	A	194D155(1)006A(2)(3)	0.5	6
2.2	A	194D225(1)006A(2)(3)	0.5	6
2.2	B	194D225(1)006B(2)(3)	0.5	6
3.3	A	194D335(1)006A(2)(3)	0.5	6
3.3	B	194D335(1)006B(2)(3)	0.5	6
4.7	A	194D475(1)006A(2)(3)	0.5	6
4.7	B	194D475(1)006B(2)(3)	0.5	6
4.7	C	194D475(1)006C(2)(3)	0.5	6
6.8	C	194D685(1)006C(2)(3)	0.5	6
6.8	D	194D685(1)006D(2)(3)	0.5	6
10	D	194D106(1)006D(2)(3)	0.6	6
10	E	194D106(1)006E(2)(3)	0.6	6
15	E	194D156(1)006E(2)(3)	1.0	6
15	F	194D156(1)006F(2)(3)	1.0	6
22	F	194D226(1)006F(2)(3)	1.4	6
33	F	194D336(1)006F(2)(3)	2.1	6
33	G	194D336(1)006G(2)(3)	2.1	6
47	F	194D476(1)006F(2)(3)	3.0	6
47	G	194D476(1)006G(2)(3)	3.0	6
68	G	194D686(1)006G(2)(3)	4.3	6
68	H	194D686(1)006H(2)(3)	4.3	6
100	H	194D107(1)006H(2)(3)	6.0	8
120	H	194D127(1)006H(2)(3)	7.2	8
150	H	194D157(1)006H(2)(3)	9.0	8
330	H	194D337(1)006H(2)(3)	20.0	10
<b>10 V<sub>DC</sub> AT + 85 °C, SURGE = 13 V; 7 V<sub>DC</sub> AT + 125 °C, SURGE = 9 V</b>				
1.0	A	194D105(1)010A(2)(3)	0.5	4
1.5	A	194D155(1)010A(2)(3)	0.5	6
1.5	B	194D155(1)010B(2)(3)	0.5	6
2.2	A	194D225(1)010A(2)(3)	0.5	6
2.2	B	194D225(1)010B(2)(3)	0.5	6
3.3	A	194D335(1)010A(2)(3)	0.5	6
3.3	B	194D335(1)010B(2)(3)	0.5	6
3.3	C	194D335(1)010C(2)(3)	0.5	6
4.7	B	194D475(1)010B(2)(3)	0.5	6
4.7	C	194D475(1)010C(2)(3)	0.5	6
4.7	D	194D475(1)010D(2)(3)	0.5	6
6.8	D	194D685(1)010D(2)(3)	0.7	6
6.8	E	194D685(1)010E(2)(3)	0.7	6
10	C	194D106(1)010C(2)(3)	1.0	6
10	E	194D106(1)010E(2)(3)	1.0	6
10	F	194D106(1)010F(2)(3)	1.0	6
15	E	194D156(1)010E(2)(3)	1.5	6
15	F	194D156(1)010F(2)(3)	1.5	6
22	F	194D226(1)010F(2)(3)	2.2	6
22	G	194D226(1)010G(2)(3)	2.2	6

**Notes**

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0", for 5 % tolerance specify "X5" (special order)
  - Termination: For gold plated specify "2", for solder plated 60/40 specify "8", for hot solder dipped specify "7"
  - Packaging code: For 7" reels specify "T", for half of 7" reels specify "H", for bulk specify "B"
- 5 % tolerance is not available for the 0.33  $\mu$ F/50 V design



STANDARD RATINGS				
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)
<b>10 V<sub>DC</sub> AT + 85 °C, SURGE = 13 V; 7 V<sub>DC</sub> AT + 125 °C, SURGE = 9 V</b>				
33	F	194D336(1)010F(2)(3)	3.3	6
33	G	194D336(1)010G(2)(3)	3.3	6
47	G	194D476(1)010G(2)(3)	4.7	6
47	H	194D476(1)010H(2)(3)	4.7	6
68	H	194D686(1)010H(2)(3)	6.8	6
100	H	194D107(1)010H(2)(3)	10.0	8
120	H	194D127(1)010H(2)(3)	12.0	8
<b>15 V<sub>DC</sub> AT + 85 °C, SURGE = 20 V; 10 V<sub>DC</sub> AT + 125 °C, SURGE = 12 V</b>				
0.68	A	194D684(1)015A(2)(3)	0.5	4
1.0	A	194D105(1)015A(2)(3)	0.5	4
1.0	B	194D105(1)015B(2)(3)	0.5	4
1.5	A	194D155(1)015A(2)(3)	0.5	6
1.5	B	194D155(1)015B(2)(3)	0.5	6
2.2	A	194D225(1)015A(2)(3)	0.5	6
2.2	B	194D225(1)015B(2)(3)	0.5	6
2.2	C	194D225(1)015C(2)(3)	0.5	6
3.3	C	194D335(1)015C(2)(3)	0.5	6
3.3	D	194D335(1)015D(2)(3)	0.5	6
4.7	D	194D475(1)015D(2)(3)	0.7	6
4.7	E	194D475(1)015E(2)(3)	0.7	6
6.8	E	194D685(1)015E(2)(3)	1.1	6
6.8	F	194D685(1)015F(2)(3)	1.1	6
10	E	194D106(1)015E(2)(3)	1.6	6
10	F	194D106(1)015F(2)(3)	1.6	6
15	F	194D156(1)015F(2)(3)	2.4	6
15	G	194D156(1)015G(2)(3)	2.4	6
22	F	194D226(1)015F(2)(3)	3.5	6
22	G	194D226(1)015G(2)(3)	3.5	6
33	F	194D336(1)015F(2)(3)	5.3	6
33	G	194D336(1)015G(2)(3)	5.3	6
33	H	194D336(1)015H(2)(3)	5.3	6
47	G	194D476(1)015G(2)(3)	10.0	8
47	H	194D476(1)015H(2)(3)	7.0	6
68	H	194D686(1)015H(2)(3)	10.0	6
<b>20 V<sub>DC</sub> AT + 85 °C, SURGE = 26 V; 13 V<sub>DC</sub> AT + 125 °C, SURGE = 16 V</b>				
0.47	A	194D474(1)020A(2)(3)	0.5	4
0.68	A	194D684(1)020A(2)(3)	0.5	4
0.68	B	194D684(1)020B(2)(3)	0.5	4
1.0	A	194D105(1)020A(2)(3)	0.5	4
1.0	B	194D105(1)020B(2)(3)	0.5	4
1.5	B	194D155(1)020B(2)(3)	0.5	6
1.5	C	194D155(1)020C(2)(3)	0.5	6
2.2	C	194D225(1)020C(2)(3)	0.5	6
2.2	D	194D225(1)020D(2)(3)	0.5	6
3.3	D	194D335(1)020D(2)(3)	0.7	6
3.3	E	194D335(1)020E(2)(3)	0.7	6

**Notes**

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0", for 5 % tolerance specify "X5" (special order)
  - Termination: For gold plated specify "2", for solder plated 60/40 specify "8", for hot solder dipped specify "7"
  - Packaging code: For 7" reels specify "T", for half of 7" reels specify "H", for bulk specify "B"
- 5 % tolerance is not available for the 0.33  $\mu$ F/50 V design



STANDARD RATINGS				
CAPACITANCE ( $\mu\text{F}$ )	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu\text{A}$ )	MAX. DF AT + 25 °C 120 Hz (%)
<b>20 V<sub>DC</sub> AT + 85 °C, SURGE = 26 V; 13 V<sub>DC</sub> AT + 125 °C, SURGE = 16 V</b>				
4.7	E	194D475(1)020E(2)(3)	0.9	6
4.7	F	194D475(1)020F(2)(3)	0.9	6
6.8	F	194D685(1)020F(2)(3)	1.4	6
10	E	194D106(1)020E(2)(3)	2.0	6
10	F	194D106(1)020F(2)(3)	2.0	6
10	G	194D106(1)020G(2)(3)	2.0	6
15	F	194D156(1)020F(2)(3)	3.0	6
15	G	194D156(1)020G(2)(3)	3.0	6
22	G	194D226(1)020G(2)(3)	4.0	8
22	H	194D226(1)020H(2)(3)	4.4	6
33	H	194D336(1)020H(2)(3)	6.6	6
<b>25 V<sub>DC</sub> AT + 85 °C, SURGE = 32 V; 17 V<sub>DC</sub> AT + 125 °C, SURGE = 20 V</b>				
0.33	A	194D334(1)025A(2)(3)	0.5	4
0.47	A	194D474(1)025A(2)(3)	0.5	4
0.47	B	194D474(1)025B(2)(3)	0.5	4
0.68	B	194D684(1)025B(2)(3)	0.5	4
1.0	A	194D105(1)025A(2)(3)	0.5	6
1.0	C	194D105(1)025C(2)(3)	0.5	4
1.5	D	194D155(1)025D(2)(3)	0.5	6
2.2	E	194D225(1)025E(2)(3)	0.6	6
3.3	F	194D335(1)025F(2)(3)	0.8	6
4.7	F	194D475(1)025F(2)(3)	1.2	6
6.8	F	194D685(1)025F(2)(3)	1.7	6
6.8	G	194D685(1)025G(2)(3)	1.7	6
10	F	194D106(1)025F(2)(3)	2.5	6
10	G	194D106(1)025G(2)(3)	2.5	6
15	H	194D156(1)025H(2)(3)	3.8	6
22	H	194D226(1)025H(2)(3)	5.5	6
33	H	194D336(1)025H(2)(3)	10.0	8
<b>35 V<sub>DC</sub> AT + 85 °C, SURGE = 46 V; 23 V<sub>DC</sub> AT + 125 °C, SURGE = 28 V</b>				
0.10	A	194D104(1)035A(2)(3)	0.5	4
0.15	A	194D154(1)035A(2)(3)	0.5	4
0.22	A	194D224(1)035A(2)(3)	0.5	4
0.33	B	194D334(1)035B(2)(3)	0.5	4
0.47	B	194D474(1)035B(2)(3)	0.5	4
0.68	C	194D684(1)035C(2)(3)	0.5	4
1.0	D	194D105(1)035D(2)(3)	0.5	4
1.5	E	194D155(1)035E(2)(3)	0.5	6
2.2	F	194D225(1)035F(2)(3)	0.8	6
3.3	F	194D335(1)035F(2)(3)	1.2	6
4.7	F	194D475(1)035F(2)(3)	1.6	6
4.7	G	194D475(1)035G(2)(3)	1.6	6
6.8	G	194D685(1)035G(2)(3)	2.4	6
6.8	H	194D685(1)035H(2)(3)	2.4	6
10	G	194D106(1)035G(2)(3)	3.5	6
10	H	194D106(1)035H(2)(3)	3.5	6
15	H	194D156(1)035H(2)(3)	5.3	6

**Notes**

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0", for 5 % tolerance specify "X5" (special order)
  - Termination: For gold plated specify "2", for solder plated 60/40 specify "8", for hot solder dipped specify "7"
  - Packaging code: For 7" reels specify "T", for half of 7" reels specify "H", for bulk specify "B"
- 5 % tolerance is not available for the 0.33  $\mu\text{F}/50\text{ V}$  design



STANDARD RATINGS				
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)
<b>50 V<sub>DC</sub> AT + 85 °C, SURGE = 65 V; 33 V<sub>DC</sub> AT + 125 °C, SURGE = 38 V</b>				
0.10	A	194D104(1)050A(2)(3)	0.5	4
0.15	A	194D154(1)050A(2)(3)	0.5	4
0.22	B	194D224(1)050B(2)(3)	0.5	4
0.33 <sup>(1)</sup>	B	194D334(1)050B(2)(3)	0.5	4
0.47	C	194D474(1)050C(2)(3)	0.5	4
0.68	D	194D684(1)050D(2)(3)	0.5	4
1.0	E	194D105(1)050E(2)(3)	0.5	4
1.5	F	194D155(1)050F(2)(3)	0.8	6
2.2	F	194D225(1)050F(2)(3)	1.1	6
3.3	G	194D335(1)050G(2)(3)	1.7	6
4.7	H	194D475(1)050H(2)(3)	2.4	6
6.8	H	194D685(1)050H(2)(3)	3.4	6

**Notes**

- Part number definitions:

(1) Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0", for 5 % tolerance specify "X5" (special order)

(2) Termination: For gold plated specify "2", for solder plated 60/40 specify "8", for hot solder dipped specify "7"

(3) Packaging code: For 7" reels specify "T", for half of 7" reels specify "H", for bulk specify "B"

<sup>(1)</sup> 5 % tolerance is not available for the 0.33  $\mu$ F/50 V design

RECOMMENDED VOLTAGE DERATING GUIDELINES (for temperatures below + 85 °C)	
STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.0	3.4
10	6.0
16	10
20	12
25	15
35	24
50	28
SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.0	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24





POWER DISSIPATION	
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
A	0.060
B	0.075
C	0.075
D	0.085
E	0.095
F	0.110
G	0.120
H	0.150

STANDARD PACKAGING QUANTITY			
CASE CODE	QUANTITY (pcs/reel)		BULK, PLASTIC TRAY QUANTITY
	7" FULL REEL	7" HALF REEL	
A	2500	1250	75
B	2500	1250	75
C	2500	1250	75
D	2500	1250	75
E	2500	1250	75
F	1000	500	75
G	600	300	60
H	600	300	50

PRODUCT INFORMATION	
Conformal Coated Guide	<a href="http://www.vishay.com/doc?40150">www.vishay.com/doc?40150</a>
Pad Dimensions	
Package Dimensions	
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
SELECTOR GUIDES	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
FAQ	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

# Solid Tantalum Chip Capacitors TANTAMOUNT<sup>®</sup>, Conformal Coated



## FEATURES

- 8 mm, 12 mm tape packaging to EIA-481 reeling per IEC 60286-3.  
7" (178 mm) standard 13" (330 mm) available
- US and European case sizes available
- Mounting: Surface mount
- Terminations: 100 % tin (2) standard, tin/lead available
- Compliant to RoHS Directive 2002/95/EC



### Note

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

## PERFORMANCE/ELECTRICAL CHARACTERISTICS

[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)

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

**Capacitance Range:** 0.1 μF to 330 μF

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

**Voltage Rating:** 2 V<sub>DC</sub> to 50 V<sub>DC</sub>

ORDERING INFORMATION						
195D	106	X0	004	S	2	T
TYPE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	CASE CODE	TERMINATION	PACKAGING
This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow.	<b>X0 = ± 20 %</b> X9 = ± 10 % X5 = ± 5 % (Special order)	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).	See Ratings and Case Codes table	Style 2 is standard <b>2 = 100 % tin</b> 4 = Gold plated 8 = Solder plated (60/40) Special order	<b>T = Tape and reel</b> <b>7" [178 mm] reel standard.</b> <b>For H case size lengthwise</b> <b>W = Tape and reel</b> <b>13" [330 mm] reel available</b> See Standard Packaging Quantity table	

### Note

- Preferred tolerance and reel sizes are in bold.  
We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size.

DIMENSIONS in inches [millimeters]								
CASE CODE	L	W	H	A	B	C (MIN.)	D (REF.)	J (MAX.)
STANDARD CASE CODES								
C	0.087 max. [2.21 max.]	0.045 ± 0.010 [1.14 ± 0.25]	0.045 ± 0.010 [1.14 ± 0.25]	0.016 ± 0.008 [0.40 ± 0.20]	0.042 ± 0.010 [1.07 ± 0.25]	-	0.063 [1.60]	0.004 [0.10]
S	0.143 max. [3.63 max.]	0.072 ± 0.008 [1.83 ± 0.20]	0.048 ± 0.008 [1.22 ± 0.20]	0.023 ± 0.010 [0.58 ± 0.25]	0.085 ± 0.015 [2.16 ± 0.37]	-	0.114 [2.90]	0.004 [0.10]
V	0.143 max. [3.63 max.]	0.104 ± 0.010 [2.65 ± 0.25]	0.051 ± 0.010 [1.30 ± 0.25]	0.023 ± 0.010 [0.58 ± 0.25]	0.085 ± 0.015 [2.16 ± 0.37]	-	0.114 [2.90]	0.004 [0.10]
X	0.285 max. [7.24 max.]	0.104 ± 0.010 [2.65 ± 0.25]	0.051 ± 0.010 [1.30 ± 0.25]	0.039 ± 0.020 [1.00 ± 0.50]	0.200 ± 0.027 [5.08 ± 0.69]	-	0.244 [6.20]	0.004 [0.10]
Y	0.285 max. [7.24 max.]	0.104 ± 0.010 [2.65 ± 0.25]	0.069 ± 0.010 [1.75 ± 0.25]	0.039 ± 0.020 [1.00 ± 0.50]	0.200 ± 0.027 [5.08 ± 0.69]	-	0.244 [6.20]	0.004 [0.10]
Z	0.285 max. [7.24 max.]	0.104 ± 0.010 [2.65 ± 0.25]	0.104 ± 0.010 [2.65 ± 0.25]	0.039 ± 0.020 [1.00 ± 0.50]	0.200 ± 0.027 [5.08 ± 0.69]	-	0.244 [6.20]	0.004 [0.10]
R	0.283 max. [7.20 max.]	0.236 + 0.012/- 0.024 [6.0 + 0.30/- 0.60]	0.138 ± 0.012 [3.50 ± 0.30]	0.051 ± 0.012 [1.30 ± 0.30]	0.181 ± 0.025 [4.60 ± 0.60]	-	0.244 [6.20]	0.004 [0.10]
EUROPEAN CASE CODES								
A	0.110 ± 0.008 [2.80 ± 0.20]	0.0591 ± 0.012 [1.5 ± 0.30]	0.055 max. [1.40 max.]	0.028 ± 0.012 [0.70 ± 0.30]	0.063 ± 0.012 [1.60 ± 0.30]	0.012 [0.3]	-	-
B	0.165 ± 0.008 [4.20 ± 0.20]	0.055 ± 0.012 [1.4 ± 0.30]	0.063 max. [1.6 max.]	0.031 ± 0.012 [0.80 ± 0.30]	0.098 ± 0.012 [2.50 ± 0.30]	0.012 [0.3]	-	-
D	0.165 ± 0.008 [4.20 ± 0.20]	0.083 ± 0.012 [2.1 ± 0.30]	0.063 max. [1.6 max.]	0.031 ± 0.012 [0.80 ± 0.30]	0.098 ± 0.012 [2.50 ± 0.30]	0.02 [0.5]	-	-
E	0.217 ± 0.012 [5.50 ± 0.30]	0.083 ± 0.012 [2.1 ± 0.30]	0.067 max. [1.70 max.]	0.039 ± 0.012 [1.00 ± 0.30]	0.126 ± 0.012 [3.20 ± 0.30]	0.031 [0.8]	-	-
F	0.197 ± 0.012 [5.0 ± 0.30]	0.130 ± 0.012 [3.3 ± 0.30]	0.079 max. [2.00 max.]	0.039 ± 0.012 [1.00 ± 0.30]	0.142 ± 0.012 [3.60 ± 0.30]	0.031 [0.8]	-	-
G	0.276 ± 0.012 [7.00 ± 0.30]	0.102 ± 0.012 [2.6 ± 0.30]	0.110 max. [2.80 max.]	0.039 ± 0.012 [1.00 ± 0.30]	0.177 ± 0.012 [4.5 ± 0.30]	0.031 [0.8]	-	-
H	0.307 ± 0.012 [7.80 ± 0.30]	0.146 ± 0.012 [3.7 ± 0.30]	0.118 max. [3.0 max.]	0.039 ± 0.012 [1.00 ± 0.30]	0.197 ± 0.012 [5.00 ± 0.30]	0.031 [0.8]	-	-

**Note**

- The anode termination (D less B) will be a minimum of 0.010" (0.25 mm), C case = 0.005" (0.131 mm) minimum



RATINGS AND CASE CODES											
μF	2 V	4 V	6.3 V	10 V	15 V	16 V	20 V	25 V	35 V	40 V	50 V
0.10									A	A	A/C
0.15									A	A	A/C
0.22				S					A	A	B/C/S
0.33								A	B/C	B	B/S
0.47					A	A	A	C	B/S	B	D/V
0.68					A	A	C	B/S	D/S	D	D/V
1.0				A/S	B	B/C	B/S	S	D/S	D	E/X
1.5			A	C	B	B/S	S	D/S	E/V	E	F/X
2.2		A	C	B/S		S	D/S	E/V	F/X	F	F/Y
3.3	A	C	B/S	S	D	D/S	E/V	X	F/Y	F	G/Z
4.7	A	B/S	S	D/S	E	E/V	X	F/X	G/Z	G	H/Z
6.8	A	S	D/S	E/V		X	F/X	G/Y	H/Z	H	R
10	A	D/S	E/V	X	F	F/X	Y	G/Y	Z		R
15		E/V	X	F/X		Y	G/Z	H/Z	R		
22		X	F/X	Y	G	G/Y/Z	H/Z	R	R		
33		F/X	Y	G/Z	H	H/Z	R	R			
47		Y	G/Y	H/Z		R	R				
68		G/Y	H/Z	R		R					
100		H/Z	Z	H/R							
120		R	R	R							
150		R	R	R							
180		R	R								
220		R	R								
330		R									

STANDARD RATINGS					
CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C (μA)	MAX. DF AT + 25 °C 120 Hz (%)	
<b>2 V<sub>DC</sub> AT + 85 °C, 1.2 V<sub>DC</sub> AT + 125 °C</b>					
3.3	A	195D335(1)002A(2)(3)	0.5	8	
4.7	A	195D475(1)002A(2)(3)	0.5	8	
6.8	A	195D685(1)002A(2)(3)	0.5	8	
10	A	195D106(1)002A(2)(3)	0.6	8	
<b>4 V<sub>DC</sub> AT + 85 °C, 2.7 V<sub>DC</sub> AT + 125 °C</b>					
2.2	A	195D225(1)004A(2)(3)	0.5	8	
3.3	C	195D335(1)004C(2)(3)	0.5	6	
4.7	B	195D475(1)004B(2)(3)	0.5	8	
4.7	S	195D475(1)004S(2)(3)	0.5	6	
6.8	S	195D685(1)004S(2)(3)	0.5	6	
10	D	195D106(1)004D(2)(3)	0.5	8	
10	S	195D106(1)004S(2)(3)	0.5	6	
15	E	195D156(1)004E(2)(3)	0.6	8	
15	V	195D156(1)004V(2)(3)	0.6	6	
22	X	195D226(1)004X(2)(3)	0.9	6	

**Note**

- Part number definitions:
  - (1) Tolerance: For 10 % tolerance, specify "X9", for 20 % tolerance, change to "X0"
  - (2) Termination: For 100 % tin specify "2", for gold plated specify "4", for solder plated 60/40 specify "8"
  - (3) Packaging code: For 7" reels specify "T", for 13" reels specify "W"



STANDARD RATINGS				
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)
<b>4 V<sub>DC</sub> AT + 85 °C, 2.7 V<sub>DC</sub> AT + 125 °C</b>				
33	F	195D336(1)004F(2)(3)	1.3	8
33	X	195D336(1)004X(2)(3)	1.3	6
47	Y	195D476(1)004Y(2)(3)	1.9	6
68	G	195D686(1)004G(2)(3)	2.7	8
68	Y	195D686(1)004Y(2)(3)	2.7	6
100	H	195D107(1)004H(2)(3)	4.0	8
100	Z	195D107(1)004Z(2)(3)	4.0	8
120	R	195D127(1)004R(2)(3)	4.8	8
150	R	195D157(1)004R(2)(3)	6.0	8
180	R	195D187(1)004R(2)(3)	7.2	8
220	R	195D227(1)004R(2)(3)	8.8	8
330	R	195D337(1)004R(2)(3)	13.2	8
<b>6.3 V<sub>DC</sub> AT + 85 °C, 4 V<sub>DC</sub> AT + 125 °C</b>				
1.5	A	195D155(1)6R3A(2)(3)	0.5	8
2.2	C	195D225(1)6R3C(2)(3)	0.5	6
3.3	B	195D335(1)6R3B(2)(3)	0.5	8
3.3	S	195D335(1)6R3S(2)(3)	0.5	6
4.7	S	195D475(1)6R3S(2)(3)	0.5	6
6.8	D	195D685(1)6R3D(2)(3)	0.5	8
6.8	S	195D685(1)6R3S(2)(3)	0.5	6
10	E	195D106(1)6R3E(2)(3)	0.6	8
10	V	195D106(1)6R3V(2)(3)	0.6	6
15	X	195D156(1)6R3X(2)(3)	0.9	6
22	F	195D226(1)6R3F(2)(3)	1.3	8
22	X	195D226(1)6R3X(2)(3)	1.3	6
33	Y	195D336(1)6R3Y(2)(3)	2.0	6
47	G	195D476(1)6R3G(2)(3)	2.8	8
47	Y	195D476(1)6R3Y(2)(3)	2.8	6
68	H	195D686(1)6R3H(2)(3)	4.1	8
68	Z	195D686(1)6R3Z(2)(3)	4.1	6
100	Z	195D107(1)6R3Z(2)(3)	6.0	8
120	R	195D127(1)6R3R(2)(3)	7.2	8
150	R	195D157(1)6R3R(2)(3)	9.0	8
180	R	195D187(1)6R3R(2)(3)	10.8	8
220	R	195D227(1)6R3R(2)(3)	13.2	8
<b>10 V<sub>DC</sub> AT + 85 °C, 7 V<sub>DC</sub> AT + 125 °C</b>				
0.22	S	195D224(1)010S(2)(3)	0.5	4
1.0	A	195D105(1)010A(2)(3)	0.5	6
1.0	S	195D105(1)010S(2)(3)	0.4	6
1.5	C	195D155(1)010C(2)(3)	0.5	6
2.2	B	195D225(1)010B(2)(3)	0.5	6
2.2	S	195D225(1)010S(2)(3)	0.5	6
3.3	S	195D335(1)010S(2)(3)	0.5	6
4.7	D	195D475(1)010D(2)(3)	0.5	6
4.7	S	195D475(1)010S(2)(3)	0.5	6
6.8	E	195D685(1)010E(2)(3)	0.7	6
6.8	V	195D685(1)010V(2)(3)	0.7	6

**Note**

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9", for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2", for gold plated specify "4", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T", for 13" reels specify "W"



STANDARD RATINGS				
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)
<b>10 V<sub>DC</sub> AT + 85 °C, 7 V<sub>DC</sub> AT + 125 °C</b>				
10	X	195D106(1)010X(2)(3)	1.0	6
15	F	195D156(1)010F(2)(3)	1.5	6
15	X	195D156(1)010X(2)(3)	1.5	6
22	Y	195D226(1)010Y(2)(3)	2.2	6
33	G	195D336(1)010G(2)(3)	3.3	6
33	Z	195D336(1)010Z(2)(3)	3.0	6
47	H	195D476(1)010H(2)(3)	4.7	6
47	Z	195D476(1)010Z(2)(3)	4.7	6
68	R	195D686(1)010R(2)(3)	6.8	6
100	H	195D107(1)010H(2)(3)	8.0	7
100	R	195D107(1)010R(2)(3)	10.0	8
120	R	195D127(1)010R(2)(3)	12.0	8
150	R	195D157(1)010R(2)(3)	15.0	8
<b>15 V<sub>DC</sub> AT + 85 °C, 10 V<sub>DC</sub> AT + 125 °C</b>				
0.47	A	195D474(1)015A(2)(3)	0.5	6
0.68	A	195D684(1)015A(2)(3)	0.5	6
1.0	B	195D105(1)015B(2)(3)	0.5	6
1.5	B	195D155(1)015B(2)(3)	0.5	6
3.3	D	195D335(1)015D(2)(3)	0.5	6
4.7	E	195D475(1)015E(2)(3)	0.7	6
10	F	195D106(1)015F(2)(3)	1.5	6
22	G	195D226(1)015G(2)(3)	3.3	6
33	H	195D336(1)015H(2)(3)	5.0	6
<b>16 V<sub>DC</sub> AT + 85 °C, 10 V<sub>DC</sub> AT + 125 °C</b>				
0.47	A	195D474(1)016A(2)(3)	0.5	6
0.68	A	195D684(1)016A(2)(3)	0.5	6
1.0	B	195D105(1)016B(2)(3)	0.5	6
1.0	C	195D105(1)016C(2)(3)	0.5	4
1.5	B	195D155(1)016B(2)(3)	0.5	6
1.5	S	195D155(1)016S(2)(3)	0.5	6
2.2	S	195D225(1)016S(2)(3)	0.5	6
3.3	D	195D335(1)016D(2)(3)	0.5	6
3.3	S	195D335(1)016S(2)(3)	0.5	6
4.7	E	195D475(1)016E(2)(3)	0.7	6
4.7	V	195D475(1)016V(2)(3)	0.7	6
6.8	X	195D685(1)016X(2)(3)	1.0	6
10	F	195D106(1)016F(2)(3)	1.5	6
10	X	195D106(1)016X(2)(3)	1.5	6
15	Y	195D156(1)016Y(2)(3)	2.3	6
22	G	195D226(1)016G(2)(3)	3.3	6
22	Y	195D226(1)016Y(2)(3)	3.2	6
22	Z	195D226(1)016Z(2)(3)	3.3	6
33	H	195D336(1)016H(2)(3)	5.0	6
33	Z	195D336(1)016Z(2)(3)	5.0	6
47	R	195D476(1)016R(2)(3)	7.1	6
68	R	195D686(1)016R(2)(3)	10.2	6

**Note**

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9", for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2", for gold plated specify "4", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T", for 13" reels specify "W"



STANDARD RATINGS				
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)
<b>20 V<sub>DC</sub> AT + 85 °C, 13 V<sub>DC</sub> AT + 125 °C</b>				
0.47	A	195D474(1)020A(2)(3)	0.5	6
0.68	C	195D684(1)020C(2)(3)	0.5	4
1.0	B	195D105(1)020B(2)(3)	0.5	6
1.0	S	195D105(1)020S(2)(3)	0.5	4
1.5	S	195D155(1)020S(2)(3)	0.5	6
2.2	D	195D225(1)020D(2)(3)	0.5	6
2.2	S	195D225(1)020S(2)(3)	0.5	6
3.3	E	195D335(1)020E(2)(3)	0.7	6
3.3	V	195D335(1)020V(2)(3)	0.7	6
4.7	X	195D475(1)020X(2)(3)	0.9	6
6.8	F	195D685(1)020F(2)(3)	1.4	6
6.8	X	195D685(1)020X(2)(3)	1.4	6
10	Y	195D106(1)020Y(2)(3)	2.0	6
15	G	195D156(1)020G(2)(3)	3.0	6
15	Z	195D156(1)020Z(2)(3)	3.0	6
22	H	195D226(1)020H(2)(3)	4.4	6
22	Z	195D226(1)020Z(2)(3)	4.4	6
33	R	195D336(1)020R(2)(3)	6.6	6
47	R	195D476(1)020R(2)(3)	9.4	6
<b>25 V<sub>DC</sub> AT + 85 °C, 17 V<sub>DC</sub> AT + 125 °C</b>				
0.33	A	195D334(1)025A(2)(3)	0.5	6
0.47	C	195D474(1)025C(2)(3)	0.5	4
0.68	B	195D684(1)025B(2)(3)	0.5	6
0.68	S	195D684(1)025S(2)(3)	0.5	4
1.0	S	195D105(1)025S(2)(3)	0.5	4
1.5	D	195D155(1)025D(2)(3)	0.5	6
1.5	S	195D155(1)025S(2)(3)	0.5	6
2.2	E	195D225(1)025E(2)(3)	0.6	6
2.2	V	195D225(1)025V(2)(3)	0.6	6
3.3	X	195D335(1)025X(2)(3)	0.8	6
4.7	F	195D475(1)025F(2)(3)	1.2	6
4.7	X	195D475(1)025X(2)(3)	1.2	6
6.8	G	195D685(1)025G(2)(3)	1.7	6
6.8	Y	195D685(1)025Y(2)(3)	1.7	6
10	G	195D106(1)025G(2)(3)	2.5	6
10	Y	195D106(1)025Y(2)(3)	2.5	6
15	H	195D156(1)025H(2)(3)	3.8	6
15	Z	195D156(1)025Z(2)(3)	3.8	6
22	R	195D226(1)025R(2)(3)	5.5	6
33	R	195D336(1)025R(2)(3)	8.3	6

**Note**

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9", for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2", for gold plated specify "4", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T", for 13" reels specify "W"



STANDARD RATINGS				
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)
<b>35 V<sub>DC</sub> AT + 85 °C, 23 V<sub>DC</sub> AT + 125 °C</b>				
0.10	A	195D104(1)035A(2)(3)	0.5	6
0.15	A	195D154(1)035A(2)(3)	0.5	6
0.22	A	195D224(1)035A(2)(3)	0.5	6
0.33	B	195D334(1)035B(2)(3)	0.5	6
0.33	C	195D334(1)035C(2)(3)	0.5	4
0.47	B	195D474(1)035B(2)(3)	0.5	6
0.47	S	195D474(1)035S(2)(3)	0.5	4
0.68	D	195D684(1)035D(2)(3)	0.5	6
0.68	S	195D684(1)035S(2)(3)	0.5	4
1.0	D	195D105(1)035D(2)(3)	0.5	6
1.0	S	195D105(1)035S(2)(3)	0.5	4
1.5	E	195D155(1)035E(2)(3)	0.5	6
1.5	V	195D155(1)035V(2)(3)	0.5	6
2.2	F	195D225(1)035F(2)(3)	0.8	6
2.2	X	195D225(1)035X(2)(3)	0.8	6
3.3	F	195D335(1)035F(2)(3)	1.2	6
3.3	Y	195D335(1)035Y(2)(3)	1.2	6
4.7	G	195D475(1)035G(2)(3)	1.6	6
4.7	Z	195D475(1)035Z(2)(3)	1.6	6
6.8	H	195D685(1)035H(2)(3)	2.4	6
6.8	Z	195D685(1)035Z(2)(3)	2.4	6
10	Z	195D106(1)035Z(2)(3)	3.5	6
15	R	195D156(1)035R(2)(3)	5.3	6
22	R	195D226(1)035R(2)(3)	7.7	6
<b>40 V<sub>DC</sub> AT + 85 °C, 23 V<sub>DC</sub> TO 25 V<sub>DC</sub> AT + 125 °C</b>				
0.10	A	195D104(1)040A(2)(3)	0.5	6
0.15	A	195D154(1)040A(2)(3)	0.5	6
0.22	A	195D224(1)040A(2)(3)	0.5	6
0.33	B	195D334(1)040B(2)(3)	0.5	6
0.47	B	195D474(1)040B(2)(3)	0.5	6
0.68	D	195D684(1)040D(2)(3)	0.5	6
1.0	D	195D105(1)040D(2)(3)	0.5	6
1.5	E	195D155(1)040E(2)(3)	0.5	6
2.2	F	195D225(1)040F(2)(3)	0.8	6
3.3	F	195D335(1)040F(2)(3)	1.2	6
4.7	G	195D475(1)040G(2)(3)	1.6	6
6.8	H	195D685(1)040H(2)(3)	2.4	6
<b>50 V<sub>DC</sub> AT + 85 °C, 33 V<sub>DC</sub> AT + 125 °C</b>				
0.10	A	195D104(1)050A(2)(3)	0.5	6
0.10	C	195D104(1)050C(2)(3)	0.5	4
0.15	A	195D154(1)050A(2)(3)	0.5	6
0.15	C	195D154(1)050C(2)(3)	0.5	4
0.22	B	195D224(1)050B(2)(3)	0.5	6
0.22	C	195D224(1)050C(2)(3)	0.5	4
0.22	S	195D224(1)050S(2)(3)	0.4	4
0.33	B	195D334(1)050B(2)(3)	0.5	6
0.33	S	195D334(1)050S(2)(3)	0.5	4

**Note**

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9", for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2", for gold plated specify "4", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T", for 13" reels specify "W"





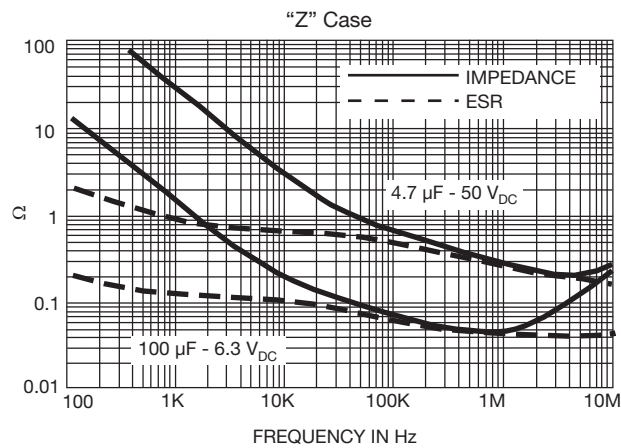
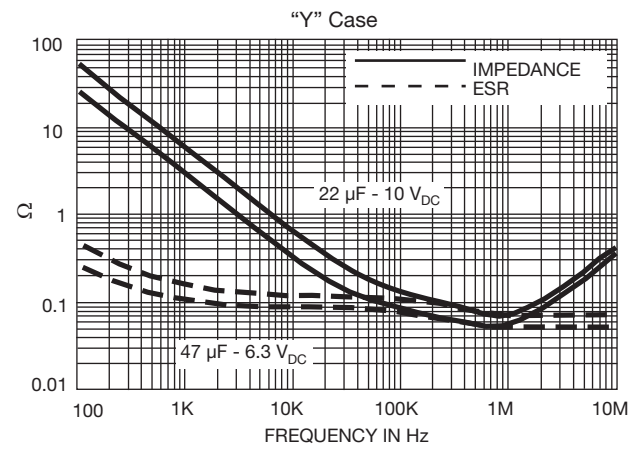
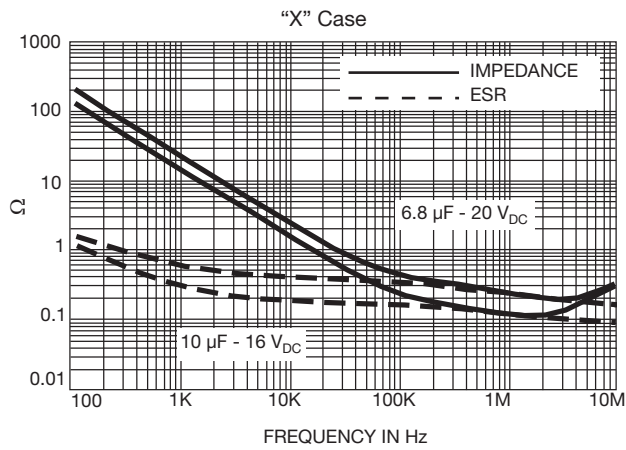
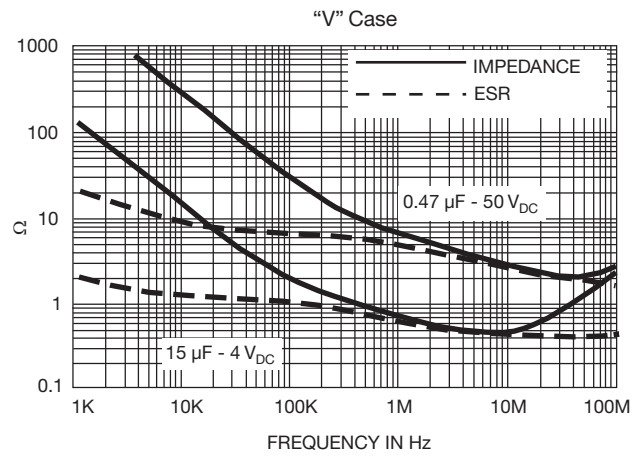
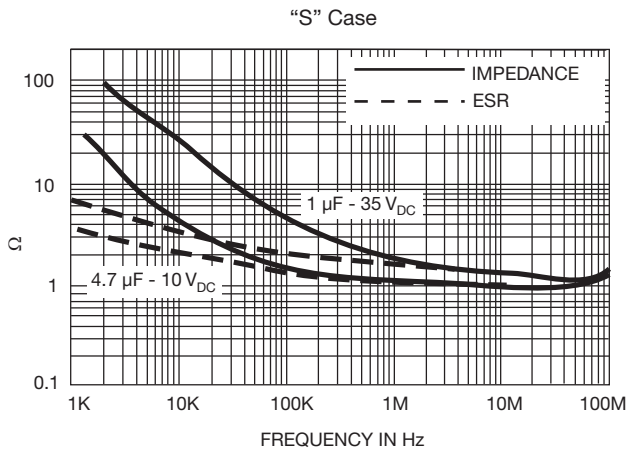
STANDARD RATINGS				
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)
50 V <sub>DC</sub> AT + 85 °C, 33 V <sub>DC</sub> AT + 125 °C				
0.47	D	195D474(1)050D(2)(3)	0.5	6
0.47	V	195D474(1)050V(2)(3)	0.5	4
0.68	D	195D684(1)050D(2)(3)	0.5	6
0.68	V	195D684(1)050V(2)(3)	0.5	4
1.0	E	195D105(1)050E(2)(3)	0.5	6
1.0	X	195D105(1)050X(2)(3)	0.5	4
1.5	F	195D155(1)050F(2)(3)	0.8	6
1.5	X	195D155(1)050X(2)(3)	0.8	6
2.2	F	195D225(1)050F(2)(3)	1.1	6
2.2	Y	195D225(1)050Y(2)(3)	1.1	6
3.3	G	195D335(1)050G(2)(3)	1.7	6
3.3	Z	195D335(1)050Z(2)(3)	1.7	6
4.7	H	195D475(1)050H(2)(3)	2.4	6
4.7	Z	195D475(1)050Z(2)(3)	2.4	6
6.8	R	195D685(1)050R(2)(3)	3.4	6
10	R	195D106(1)050R(2)(3)	5.0	6

**Note**

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9", for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2", for gold plated specify "4", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T", for 13" reels specify "W"

RECOMMENDED VOLTAGE DERATING GUIDELINES (for temperature below + 85 °C)	
STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
2.0	1.2
4.0	2.5
6.3	3.6
10	6
15/16	9
20	12
25	15
35	24
40	26
50	28
SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
2.0	1.0
4.0	2.5
6.3	3.3
10	5.0
15/16	7.5
20	10
25	12
35	15
40	20
50	24

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



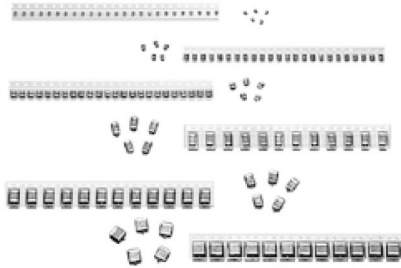


POWER DISSIPATION	
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
A	0.040
B	0.050
C	0.030
D	0.080
E	0.090
F	0.110
G	0.120
H	0.140
R	0.250
S	0.080
V	0.095
X	0.110
Y	0.120
Z	0.135

STANDARD PACKAGING QUANTITY		
CASE CODE	UNITS PER REEL	
	7" REEL	13" REEL
A	2500	n/a
B	2000	n/a
C	2500	10 000
D	2000	n/a
E	2000	n/a
F	700	n/a
G	1400	n/a
H	400	n/a
R	600	n/a
S	2500	10 000
V	2500	10 000
X	200	10 000
Y	1500	7500
Z	1500	5000

PRODUCT INFORMATION	
Conformal Coated Guide	<a href="http://www.vishay.com/doc?40150">www.vishay.com/doc?40150</a>
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
SELECTOR GUIDES	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
FAQ	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

# Solid Tantalum Chip Capacitors, TANTAMOUNT<sup>®</sup>, Conformal Coated



## FEATURES

- Pad compatible with 194D and MIL-PRF-55365/4 (CWR06)
- 8 mm, 12 mm 16 mm tape to EIA-481 and reeling per IEC 286-3. 7" [178 mm] standard 13" [330 mm] available
- Mounting: Surface mount
- Terminations: 100 % tin (2) standard, tin/lead available
- Compliant to RoHS Directive 2002/95/EC



## Note

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

## PERFORMANCE CHARACTERISTICS

[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)

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

**Capacitance Range:** 1.0 µF to 270 µF

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

**Voltage Rating:** 4 V<sub>DC</sub> to 50 V<sub>DC</sub>

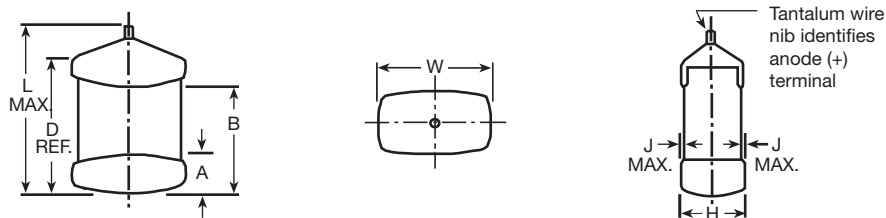
## ORDERING INFORMATION

695D	475	X0	004	A	2	T
TYPE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	CASE CODE	TERMINATION	REEL SIZE AND PACKAGING
	This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow.	<b>X0 = ± 20 %</b> <b>X9 = ± 10 %</b>	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).	See Ratings and Case Codes table	<b>2 = 100 % tin</b> 4 = Gold plated 8 = Solder plated (60/40) Special order	<b>T = Tape and reel</b> <b>7" [178 mm] reel</b> W = 13" [330 mm] reel See tape and reel specifications

## Notes

- Preferred tolerance and reel sizes are in bold
- We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size.

## DIMENSIONS in inches [millimeters]



CASE CODE	L (MAX.)	D (REF.)	W	H	A	B	J (MAX.)
A	0.134 [3.4]	0.100 [2.54]	0.050 ± 0.015 [1.27 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.023 ± 0.010 [0.584 ± 0.25]	0.067 ± 0.015 [1.70 ± 0.38]	0.004 [0.10]
B	0.185 [4.7]	0.150 [3.81]	0.050 ± 0.015 [1.27 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.040 ± 0.015 [1.02 ± 0.38]	0.120 ± 0.015 [3.05 ± 0.38]	0.004 [0.10]
D	0.185 [4.7]	0.140 [3.56]	0.095 ± 0.015 [2.41 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.040 ± 0.015 [1.02 ± 0.38]	0.110 ± 0.020 [2.79 ± 0.51]	0.004 [0.10]
E	0.236 [6.0]	0.200 [5.08]	0.095 ± 0.015 [2.41 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.040 ± 0.015 [1.02 ± 0.38]	0.170 ± 0.020 [4.32 ± 0.51]	0.004 [0.10]
F	0.236 [6.0]	0.220 [5.59]	0.135 ± 0.015 [3.43 ± 0.38]	0.070 ± 0.015 [1.78 ± 0.38]	0.040 ± 0.015 [1.02 ± 0.38]	0.185 ± 0.020 [4.70 ± 0.51]	0.004 [0.10]
G	0.300 [7.6]	0.260 [6.60]	0.100 ± 0.015 [2.54 ± 0.38]	0.100 ± 0.015 [2.54 ± 0.38]	0.040 ± 0.015 [1.02 ± 0.38]	0.220 ± 0.020 [5.59 ± 0.51]	0.004 [0.10]
H	0.303 [7.7]	0.265 [6.73]	0.150 ± 0.015 [3.81 ± 0.38]	0.110 ± 0.015 [2.79 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.220 ± 0.020 [5.59 ± 0.51]	0.004 [0.10]

## Note

- The anode termination (D less B) will be a minimum of 0.25 mm (0.010").



RATINGS AND CASE CODES								
μF	4 V	6 V	10 V	15 V	20 V	25 V	35 V	50 V
0.10								A
0.15								A
0.22							A	B
0.33							A	B
0.47						A	B	D
0.68						A	B	D
1.0					A	B	D	D
1.5				A	B	D	D	E
2.2				A	B	D	E	F
3.3			A	B	D	D	F	F
4.7	A	A	B	D	D	E	F	G
6.8	B	B	D	D	E	F	F	H
10	B	D	D	D	F	F	G	H
15	D	D	D	E	F	G	H	
22	D	D	E	F	G	H		
33	E	E	F	F	G	H		
47	F	F	F	G	H			
68	F	F	G	H				
100	F	G	G	H				
120	G	G	H					
150	G	H	H					
180	H	H						
220	H	H						
270	H							

STANDARD RATINGS							
CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C (μA)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz (Ω)	MAX. RIPPLE 100 kHz I <sub>RMS</sub> (A)	
4 V <sub>DC</sub> AT + 85 °C; 2.7 V <sub>DC</sub> AT + 125 °C							
4.7	A	695D475(1)004A(2)(3)	0.5	6	11.000	0.07	
6.8	B	695D685(1)004B(2)(3)	0.5	6	9.000	0.09	
10	B	695D106(1)004B(2)(3)	0.5	6	8.500	0.09	
15	D	695D156(1)004D(2)(3)	0.6	6	2.200	0.20	
22	D	695D226(1)004D(2)(3)	0.9	6	2.000	0.21	
33	E	695D336(1)004E(2)(3)	1.3	6	1.500	0.25	
47	F	695D476(1)004F(2)(3)	1.9	6	1.000	0.33	
68	F	695D686(1)004F(2)(3)	2.7	6	0.900	0.35	
100	F	695D107(1)004F(2)(3)	4.0	8	0.900	0.35	
120	G	695D127(1)004G(2)(3)	4.8	8	0.700	0.41	
150	G	695D157(1)004G(2)(3)	6.0	8	0.650	0.43	
180	H	695D187(1)004H(2)(3)	7.2	8	0.400	0.61	
220	H	695D227(1)004H(2)(3)	8.8	8	0.350	0.65	
270	H	695D277(1)004H(2)(3)	10.8	8	0.350	0.65	

**Note**

- Part number definitions:
  - (1) Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"
  - (2) Termination: For 100 % tin specify "2"; for gold plated specify "4", for solder plated 60/40 specify "8"
  - (3) Packaging code: For 7" reels specify "T", for 13" reels specify "W"



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>6 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT + 125 °C</b>						
4.7	A	695D475(1)006A(2)(3)	0.5	6	11.000	0.07
6.8	B	695D685(1)006B(2)(3)	0.5	6	9.000	0.07
10	D	695D106(1)006D(2)(3)	0.6	6	8.500	0.10
15	D	695D156(1)006D(2)(3)	0.9	6	2.200	0.20
22	D	695D226(1)006D(2)(3)	1.3	6	2.000	0.32
33	E	695D336(1)006E(2)(3)	2.0	6	1.500	0.25
47	F	695D476(1)006F(2)(3)	2.8	6	1.000	0.33
68	F	695D686(1)006F(2)(3)	4.1	6	0.900	0.35
100	G	695D107(1)006G(2)(3)	6.0	8	0.900	0.37
120	G	695D127(1)006G(2)(3)	7.2	8	0.700	0.41
150	H	695D157(1)006H(2)(3)	9.0	8	0.650	0.48
180	H	695D187(1)006H(2)(3)	10.8	8	0.400	0.61
220	H	695D227(1)006H(2)(3)	13.2	8	0.350	0.65
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT + 125 °C</b>						
3.3	A	695D335(1)010A(2)(3)	0.5	6	11.500	0.07
4.7	B	695D475(1)010B(2)(3)	0.5	6	10.600	0.08
6.8	D	695D685(1)010D(2)(3)	0.7	6	2.600	0.18
10	D	695D106(1)010D(2)(3)	1.0	6	2.500	0.18
15	D	695D156(1)010D(2)(3)	1.5	6	2.200	0.2
22	E	695D226(1)010E(2)(3)	2.2	6	2.000	0.22
33	F	695D336(1)010F(2)(3)	3.3	6	1.200	0.3
47	F	695D476(1)010F(2)(3)	4.7	6	1.000	0.33
68	G	695D686(1)010G(2)(3)	6.8	6	0.750	0.4
100	G	695D107(1)010G(2)(3)	10	8	0.750	0.4
120	H	695D127(1)010H(2)(3)	12	8	0.450	0.58
150	H	695D157(1)010H(2)(3)	15	8	0.400	0.61
<b>15 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>						
1.5	A	695D155(1)015A(2)(3)	0.5	6	14.000	0.07
2.2	A	695D225(1)015A(2)(3)	0.5	6	12.000	0.07
3.3	B	695D335(1)015B(2)(3)	0.5	6	10.800	0.08
4.7	D	695D475(1)015D(2)(3)	0.7	6	2.800	0.17
6.8	D	695D685(1)015D(2)(3)	1.0	6	2.600	0.18
10	D	695D106(1)015D(2)(3)	1.5	6	2.500	0.18
15	E	695D156(1)015E(2)(3)	2.3	6	2.300	0.20
22	F	695D226(1)015F(2)(3)	3.3	6	1.400	0.28
33	F	695D336(1)015F(2)(3)	5.0	6	1.200	0.30
47	G	695D476(1)015G(2)(3)	7.1	6	0.800	0.39
68	H	695D686(1)015H(2)(3)	10.2	6	0.500	0.55
100	H	695D107(1)015H(2)(3)	15.0	8	0.450	0.58

**Note**

- Part number definitions:
  - (1) Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"
  - (2) Termination: For 100 % tin specify "2"; for gold plated specify "4", for solder plated 60/40 specify "8"
  - (3) Packaging code: For 7" reels specify "T", for 13" reels specify "W"



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>						
1.0	A	695D105(1)020A(2)(3)	0.5	4	15.000	0.06
1.5	B	695D155(1)020B(2)(3)	0.5	6	12.000	0.08
2.2	B	695D225(1)020B(2)(3)	0.5	6	11.000	0.08
3.3	D	695D335(1)020D(2)(3)	0.7	6	3.000	0.17
4.7	D	695D475(1)020D(2)(3)	0.9	6	2.800	0.17
6.8	E	695D685(1)020E(2)(3)	1.4	6	2.550	0.19
10	F	695D106(1)020F(2)(3)	2.0	6	1.800	0.25
15	F	695D156(1)020F(2)(3)	3.0	6	1.500	0.27
22	G	695D226(1)020G(2)(3)	4.4	6	0.900	0.37
33	G	695D336(1)020G(2)(3)	6.6	6	0.800	0.39
47	H	695D476(1)020H(2)(3)	9.4	6	0.500	0.55
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>						
0.47	A	695D474(1)025A(2)(3)	0.5	4	17.000	0.06
0.68	A	695D684(1)025A(2)(3)	0.5	4	15.000	0.06
1.0	B	695D105(1)025B(2)(3)	0.5	4	13.000	0.08
1.5	D	695D155(1)025D(2)(3)	0.5	6	4.200	0.14
2.2	D	695D225(1)025D(2)(3)	0.6	6	3.500	0.16
3.3	D	695D335(1)025D(2)(3)	0.8	6	3.000	0.17
4.7	E	695D475(1)025E(2)(3)	1.2	6	2.750	0.19
6.8	F	695D685(1)025F(2)(3)	1.7	6	2.000	0.23
10	F	695D106(1)025F(2)(3)	2.5	6	1.800	0.25
15	G	695D156(1)025G(2)(3)	3.8	6	1.000	0.35
22	H	695D226(1)025H(2)(3)	5.5	6	0.700	0.46
33	H	695D336(1)025H(2)(3)	8.3	6	0.800	0.50
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>						
0.22	A	695D224(1)035A(2)(3)	0.5	4	20.000	0.05
0.33	A	695D334(1)035A(2)(3)	0.5	4	18.000	0.06
0.47	B	695D474(1)035B(2)(3)	0.5	4	15.000	0.07
0.68	B	695D684(1)035B(2)(3)	0.5	4	14.000	0.07
1.0	D	695D105(1)035D(2)(3)	0.5	4	8.000	0.10
1.5	D	695D155(1)035D(2)(3)	0.5	6	4.200	0.14
2.2	E	695D225(1)035E(2)(3)	0.8	6	4.000	0.15
3.3	F	695D335(1)035F(2)(3)	1.2	6	3.200	0.19
4.7	F	695D475(1)035F(2)(3)	1.6	6	2.700	0.20
6.8	F	695D685(1)035F(2)(3)	2.4	6	2.000	0.23
10	G	695D106(1)035G(2)(3)	3.5	6	1.300	0.30
15	H	695D156(1)035H(2)(3)	5.3	6	0.800	0.43

**Note**

- Part number definitions:

(1) Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"

(2) Termination: For 100 % tin specify "2"; for gold plated specify "4", for solder plated 60/40 specify "8"

(3) Packaging code: For 7" reels specify "T", for 13" reels specify "W"



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>50 V<sub>DC</sub> AT + 85 °C; 33 V<sub>DC</sub> AT + 125 °C</b>						
0.10	A	695D104(1)050A(2)(3)	0.5	4	32.000	0.04
0.15	A	695D154(1)050A(2)(3)	0.5	4	30.000	0.04
0.22	B	695D224(1)050B(2)(3)	0.5	4	18.000	0.06
0.33	B	695D334(1)050B(2)(3)	0.5	4	16.000	0.07
0.47	D	695D474(1)050D(2)(3)	0.5	4	9.000	0.10
0.68	D	695D684(1)050D(2)(3)	0.5	4	8.500	0.10
1.0	D	695D105(1)050D(2)(3)	0.5	4	8.000	0.10
1.5	E	695D155(1)050E(2)(3)	0.8	6	5.500	0.13
2.2	F	695D225(1)050F(2)(3)	1.1	6	3.900	0.17
3.3	F	695D335(1)050F(2)(3)	1.7	6	3.200	0.19
4.7	G	695D475(1)050G(2)(3)	2.4	6	2.500	0.22
6.8	H	695D685(1)050H(2)(3)	3.4	6	1.200	0.35
10	H	695D106(1)050H(2)(3)	5.0	6	1.000	0.39

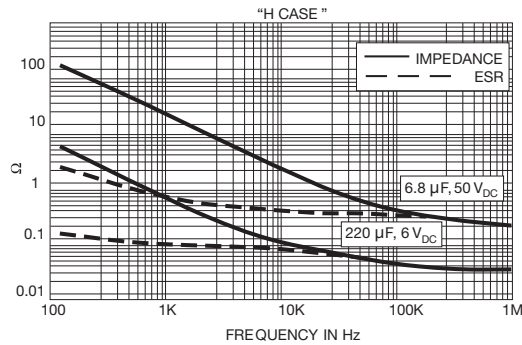
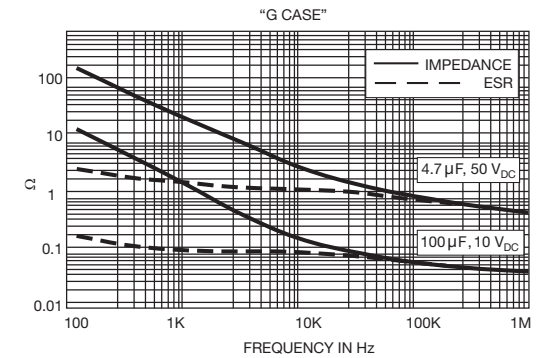
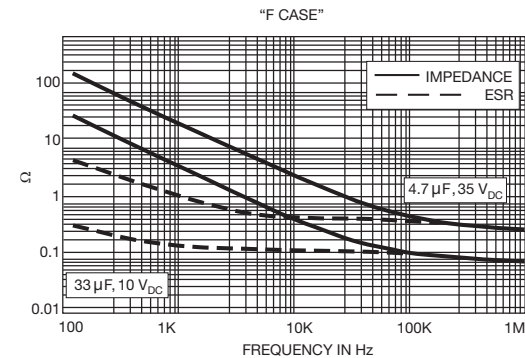
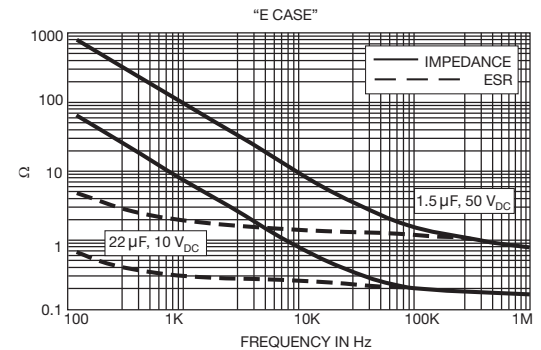
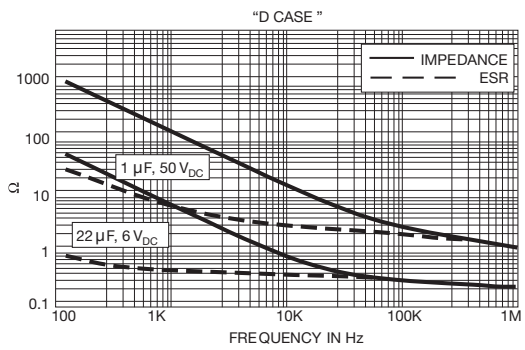
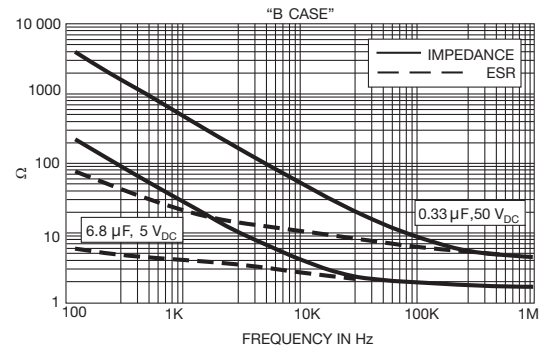
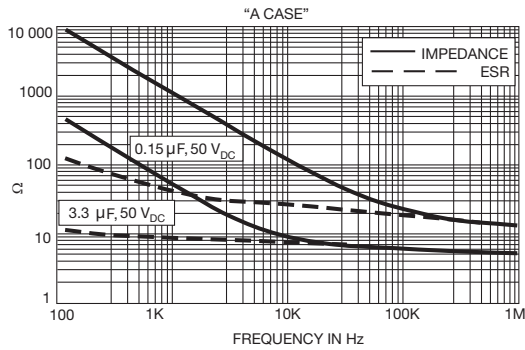
**Note**

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2"; for gold plated specify "4", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T", for 13" reels specify "W"

RECOMMENDED VOLTAGE DERATING GUIDELINES (for temperatures below + 85 °C)	
STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.0	3.6
10	6.0
15	9.0
20	12
25	15
35	24
50	28
SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.0	3.0
10	5.0
15	7.5
20	10
25	12
35	15
50	24



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



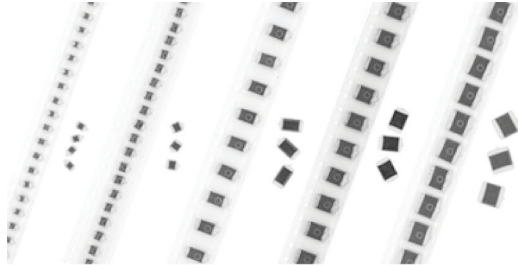


POWER DISSIPATION	
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
A	0.060
B	0.075
D	0.085
E	0.095
F	0.110
G	0.120
H	0.150

STANDARD PACKAGING QUANTITY		
CASE CODE	UNITS PER REEL	
	7" REEL	13" REEL
A	2500	10 000
B	2500	10 000
D	2500	10 000
E	2500	10 000
F	1000	4000
G	1500	5000
H	600	2500

PRODUCT INFORMATION	
Conformal Coated Guide	<a href="http://www.vishay.com/doc?40150">www.vishay.com/doc?40150</a>
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
SELECTOR GUIDES	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
FAQ	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

## Solid Tantalum Chip Capacitors TANTAMOUNT<sup>®</sup>, Low Profile, Low ESR, Conformal Coated, Maximum CV



### FEATURES

- New robust ratings for pulsed applications
- New case size offerings
- 1.2 mm to 2 mm height
- Terminations: 100 % matte tin (2) standard, tin/lead available
- Mounting: Surface mount
- Very low ESR
- 8 mm, 12 mm tape and reel packaging available per EIA-481 and reeling per IEC 60286-3  
7" [178 mm] standard  
13" [330 mm] available
- Footprint compatible with EIA 535BAAC and CECC30801 molded chips
- See also 592W for additional ratings designs for pulsed applications
- Compliant to RoHS Directive 2002/95/EC


**RoHS\***  
COMPLIANT

### Note

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

### PERFORMANCE CHARACTERISTICS

[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)

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

**Capacitance Range:** 1 µF to 1000 µF

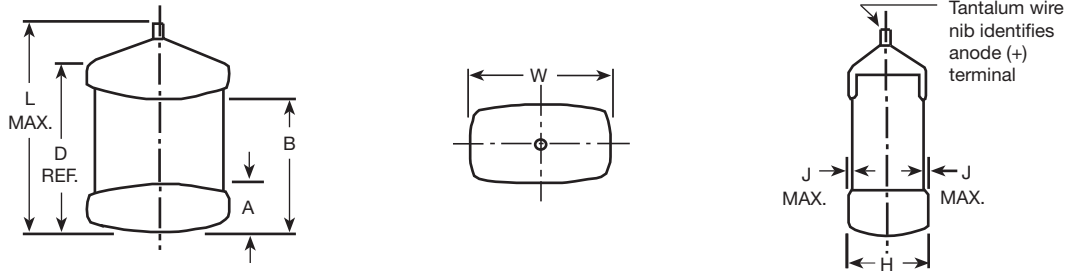
**Capacitance Tolerance:** ± 10 %, ± 20 % standard

**Voltage Rating:** 4 V<sub>DC</sub> to 50 V<sub>DC</sub>

ORDERING INFORMATION							
591D	106	X0	010	B	2	T	15H
TYPE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	CASE CODE	TERMINATION	REEL SIZE AND PACKAGING	SUFFIX
	This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow.	<b>X0 = ± 20 %</b> X9 = ± 10 %	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).	See Ratings and Case Codes table	<b>2 = 100 % tin</b> 4 = Gold plated 8 = Solder plated 60/40 Special order	<b>T = Tape and reel</b> <b>7" [178 mm] reel</b> W = 13" [330 mm] reel	Maximum height (mm) see Standard Ratings table

### Note

- Preferred tolerance and reel sizes are in bold.  
We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size.

**DIMENSIONS** in inches [millimeters]


CASE CODE	L MAX.	W	A	B	D REF.	J MAX.
A	0.146 [3.7]	0.071 ± 0.012 [1.8 ± 0.3]	0.031 ± 0.012 [0.8 ± 0.3]	0.087 ± 0.016 [2.2 ± 0.4]	0.114 [2.9]	0.004 [0.1]
B	0.157 [4.0]	0.110 ± 0.012 [2.8 ± 0.3]	0.031 ± 0.012 [0.8 ± 0.3]	0.098 ± 0.016 [2.5 ± 0.4]	0.138 [3.5]	0.004 [0.1]
C	0.28 [7.1]	0.126 ± 0.012 [3.2 ± 0.3]	0.051 ± 0.012 [1.3 ± 0.3]	0.173 ± 0.024 [4.4 ± 0.6]	0.236 [6.0]	0.004 [0.1]
D	0.295 [7.5]	0.169 ± 0.012 [4.3 ± 0.3]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.6]	0.252 [6.4]	0.004 [0.1]
M	0.295 [7.5]	0.248 ± 0.012 [6.3 ± 0.3]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.6]	0.264 [6.7]	0.004 [0.1]
R	0.283 [7.2]	0.236 + 0.012/- 0.024 [6.0 + 0.3/- 0.6]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.6]	0.244 [6.2]	0.004 [0.1]

**Notes**

- The anode termination (D less B) will be a minimum of 0.012" [0.3 mm]
- For package height, please refer to specific rating in the "Standard Ratings" table

**RATINGS AND CASE CODES**

μF	4 V	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V
1.0							A/B	B
1.5							B	
2.2					A	A/B	B/C	
3.3						B/C	B/C/D	
4.7			A	A	A/B	C	B	C
6.8			A	A/B	B/C	C/D	D/R	
10		A	A/B	B/C	B/D	B/D/R	R	
15		A/B	B	B/D	C	R		
22	A/B	A/B	A/B/C	C/D	D/R			
33	B	A/B/C	C/D	C/D/R	R			
47	B/C	B/C/D	D/R	C/R				
68	B/C/D	D/R	C/D/R	C/D		R		
100	D/R	B/C/D/R	B/C/D	C/D				
120		C						
150	C/R	C/D/R	C/D	D/R				
220	C/D	C/D/R	D/R	R				
330	C/D	C/D/R	D/R					
470	C/D/R	C/D/R						
680	D/R	R						
1000	R	R						
1500		M						



STANDARD RATINGS							
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	HEIGHT MAX. (mm)	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>4 V<sub>DC</sub> AT + 85 °C; 2.7 V<sub>DC</sub> AT + 125 °C</b>							
22	A	591D226(1)004A(2)(3)15H	1.5	0.9	6	1.200	0.22
22	B	591D226(1)004B(2)(3)15H	1.5	0.9	6	0.800	0.32
33	B	591D336(1)004B(2)(3)15H	1.5	1.3	6	0.800	0.32
47	B	591D476(1)004B(2)(3)15H	1.5	1.9	6	0.800	0.32
47	C	591D476(1)004C(2)(3)15H	1.5	1.9	6	0.200	0.71
68	B	591D686(1)004B(2)(3)15H	1.5	2.7	6	0.800	0.32
68	C	591D686(1)004C(2)(3)15H	1.5	2.7	6	0.180	0.75
68	D	591D686(1)004D(2)(3)15H	1.5	2.7	6	0.140	0.94
100	D	591D107(1)004D(2)(3)15H	1.5	4.0	8	0.130	0.98
100	R	591D107(1)004R(2)(3)15H	1.5	4.0	8	0.110	1.17
150	C	591D157(1)004C(2)(3)15H	1.5	6.0	8	0.150	0.82
150	R	591D157(1)004R(2)(3)15H	1.5	6.0	8	0.100	1.22
220	C	591D227(1)004C(2)(3)20H	2.0	8.8	8	0.075	1.21
220	D	591D227(1)004D(2)(3)15H	1.5	8.8	8	0.100	1.12
330	C	591D337(1)004C(2)(3)20H	2.0	13.2	8	0.070	1.25
330	D	591D337(1)004D(2)(3)20H	2.0	13.2	8	0.060	1.53
470	C	591D477(1)004C(2)(3)20H	2.0	18.8	8	0.070	1.25
470	D	591D477(1)004D(2)(3)20H	2.0	18.8	8	0.060	1.53
470	R	591D477(1)004R(2)(3)20H	2.0	18.8	10	0.045	1.97
680	D	591D687(1)004D(2)(3)20H	2.0	27.2	12	0.085	1.28
680	R	591D687(1)004R(2)(3)20H	2.0	27.2	12	0.045	1.97
1000	R	591D108(1)004R(2)(3)20H	2.0	40.0	14	0.050	1.87
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT + 125 °C</b>							
10	A	591D106(1)6R3A(2)(3)15H	1.5	0.6	6	1.900	0.18
15	A	591D156(1)6R3A(2)(3)15H	1.5	0.9	6	1.300	0.21
15	B	591D156(1)6R3B(2)(3)15H	1.5	0.9	6	0.800	0.32
22	A	591D226(1)6R3A(2)(3)13H	1.3	1.4	6	0.800	0.26
22	B	591D226(1)6R3B(2)(3)15H	1.5	1.4	6	0.800	0.32
33	A	591D336(1)6R3A(2)(3)15H	1.5	2.1	6	1.000	0.24
33	B	591D336(1)6R3B(2)(3)15H	1.5	2.1	6	0.800	0.32
33	C	591D336(1)6R3C(2)(3)15H	1.5	2.1	6	0.200	0.71
47	B	591D476(1)6R3B(2)(3)15H	1.5	3.0	8	0.800	0.32
47	C	591D476(1)6R3C(2)(3)15H	1.5	3.0	6	0.200	0.71
47	D	591D476(1)6R3D(2)(3)15H	1.5	3.0	6	0.140	0.94
68	D	591D686(1)6R3D(2)(3)15H	1.5	4.3	6	0.130	0.98
68	R	591D686(1)6R3R(2)(3)15H	1.5	4.3	6	0.110	1.17
100	B	591D107(1)6R3B(2)(3)15H	1.5	6.3	8	0.500	0.40
100	C	591D107(1)6R3C(2)(3)15H	1.5	6.3	8	0.190	0.73
100	D	591D107(1)6R3D(2)(3)15H	1.5	6.3	8	0.150	0.91
100	R	591D107(1)6R3R(2)(3)15H	1.5	6.3	8	0.100	1.22
120	C	591D127(1)6R3C(2)(3)20H	2.0	7.2	8	0.100	1.05
150	C	591D157(1)6R3C(2)(3)20H	2.0	9.5	8	0.080	1.17
150	D	591D157(1)6R3D(2)(3)15H	1.5	9.5	8	0.120	1.02
150	R	591D157(1)6R3R(2)(3)15H	1.5	9.5	8	0.140	1.04
220	C	591D227(1)6R3C(2)(3)20H	2.0	13.9	8	0.075	1.21
220	D	591D227(1)6R3D(2)(3)20H	2.0	13.9	8	0.065	1.47
220	R	591D227(1)6R3R(2)(3)15H	1.5	13.9	8	0.150	1.00

**Note**

- Part number definitions:
  - (1) Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"
  - (2) Termination: For 100 % tin specify "2", for gold plated specify "4", for solder plated 60/40 specify "8"
  - (3) Packaging code: For 7" reels specify "T", for 13" reels specify "W"



STANDARD RATINGS							
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	HEIGHT MAX. (mm)	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT + 125 °C</b>							
330	C	591D337(1)6R3C(2)(3)20H	2.0	20.8	8	0.070	1.25
330	D	591D337(1)6R3D(2)(3)20H	2.0	20.8	8	0.060	1.53
330	R	591D337(1)6R3R(2)(3)20H	2.0	20.8	8	0.045	1.97
470	C	591D477X06R3C(2)(3)16H	1.6	29.6	14	0.080	1.12
470	C	591D477(1)6R3C(2)(3)20H	2.0	29.6	10	0.060	1.35
470	D	591D477(1)6R3D(2)(3)20H	2.0	29.6	10	0.085	1.28
470	R	591D477(1)6R3R(2)(3)20H	2.0	29.6	10	0.045	1.97
680	R	591D687(1)6R3R(2)(3)16H	1.6	42.8	10	0.060	1.60
680	R	591D687(1)6R3R(2)(3)20H	2.0	42.8	10	0.060	1.71
1000	R	591D108(1)6R3R(2)(3)20H	2.0	63.0	29	0.075	1.53
1500	M	591D158X06R3M(2)(3)20H	2.0	95.0	50	0.060	1.87
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT + 125 °C</b>							
4.7	A	591D475(1)010A(2)(3)15H	1.5	0.5	6	4.000	0.12
6.8	A	591D685(1)010A(2)(3)15H	1.5	0.7	6	4.000	0.12
10	A	591D106(1)010A(2)(3)15H	1.5	1.0	6	1.300	0.21
10	B	591D106(1)010B(2)(3)15H	1.5	1.0	6	0.850	0.31
15	B	591D156(1)010B(2)(3)15H	1.5	1.5	6	0.800	0.32
22	A	591D226(1)010A(2)(3)13H	1.3	2.2	6	0.800	0.27
22	A	591D226(1)010A(2)(3)15H	1.5	2.2	6	0.900	0.26
22	B	591D226(1)010B(2)(3)15H	1.5	2.2	6	0.800	0.32
22	C	591D226(1)010C(2)(3)15H	1.5	2.2	6	0.200	0.71
33	C	591D336(1)010C(2)(3)15H	1.5	3.3	6	0.200	0.71
33	D	591D336(1)010D(2)(3)15H	1.5	3.3	6	0.140	0.94
47	D	591D476(1)010D(2)(3)15H	1.5	4.7	6	0.140	0.94
47	R	591D476(1)010R(2)(3)15H	1.5	4.7	6	0.120	1.12
68	C	591D686(1)010C(2)(3)15H	1.5	6.8	6	0.190	0.73
68	D	591D686(1)010D(2)(3)15H	1.5	6.8	6	0.130	0.98
68	R	591D686(1)010R(2)(3)15H	1.5	6.8	6	0.110	1.17
100	B	591D107(1)010B(2)(3)20H	2.0	10.0	14	0.250	0.57
100	C	591D107(1)010C(2)(3)20H	2.0	10.0	8	0.085	1.14
100	D	591D107(1)010D(2)(3)15H	1.5	10.0	8	0.130	0.98
150	C	591D157(1)010C(2)(3)15H	1.5	15.0	8	0.083	1.10
150	C	591D157(1)010C(2)(3)20H	2.0	15.0	8	0.080	1.17
150	D	591D157(1)010D(2)(3)15H	1.5	15.0	8	0.120	1.02
150	D	591D157(1)010D(2)(3)20H	2.0	15.0	8	0.075	1.37
220	D	591D227(1)010D(2)(3)20H	2.0	22.0	8	0.065	1.47
220	R	591D227(1)010R(2)(3)20H	2.0	22.0	8	0.055	1.78
330	D	591D337(1)010D(2)(3)20H	2.0	33.0	8	0.060	1.53
330	R	591D337(1)010R(2)(3)18H	1.8	33.0	8	0.050	1.81
330	R	591D337(1)010R(2)(3)20H	2.0	33.0	8	0.050	1.87

Note

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2", for gold plated specify "4", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T", for 13" reels specify "W"



STANDARD RATINGS							
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	HEIGHT MAX. (mm)	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>							
4.7	A	591D475(1)016A(2)(3)15H	1.5	0.8	6	1.750	0.19
6.8	A	591D685(1)016A(2)(3)15H	1.5	1.1	6	1.750	0.19
6.8	B	591D685(1)016B(2)(3)15H	1.5	1.1	6	0.900	0.30
10	B	591D106(1)016B(2)(3)15H	1.5	1.6	6	0.800	0.32
10	C	591D106(1)016C(2)(3)15H	1.5	1.6	6	0.500	0.45
15	B	591D156(1)016B(2)(3)15H	1.5	2.4	6	0.700	0.34
15	D	591D156(1)016D(2)(3)15H	1.5	2.4	6	0.250	0.71
22	C	591D226(1)016C(2)(3)15H	1.5	3.5	6	0.240	0.65
22	D	591D226(1)016D(2)(3)15H	1.5	3.5	6	0.180	0.83
33	C	591D336(1)016C(2)(3)15H	1.5	5.3	6	0.180	0.75
33	D	591D336(1)016D(2)(3)15H	1.5	5.3	6	0.170	0.86
33	R	591D336(1)016R(2)(3)15H	1.5	5.3	6	0.140	1.04
47	C	591D476(1)016C(2)(3)20H	2.0	7.5	6	0.180	0.78
47	R	591D476(1)016R(2)(3)15H	1.5	7.5	6	0.130	1.07
68	C	591D686(1)016C(2)(3)20H	2.0	10.9	6	0.100	1.05
68	D	591D686(1)016D(2)(3)20H	2.0	10.9	6	0.080	1.32
100	C	591D107(1)016C(2)(3)20H	2.0	16.0	8	0.100	1.05
100	D	591D107(1)016D(2)(3)15H	1.5	16.0	8	0.100	1.12
100	D	591D107(1)016D(2)(3)20H	2.0	16.0	8	0.075	1.37
150	D	591D157(1)016D(2)(3)20H	2.0	24.0	8	0.060	1.53
150	R	591D157(1)016R(2)(3)20H	2.0	24.0	8	0.060	1.71
220	R	591D227(1)016R(2)(3)20H	2.0	35.2	10	0.075	1.53
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>							
2.2	A	591D225(1)020A(2)(3)15H	1.5	0.5	6	4.000	0.12
4.7	A	591D475(1)020A(2)(3)15H	1.5	0.9	6	1.900	0.18
4.7	B	591D475(1)020B(2)(3)15H	1.5	0.9	6	1.600	0.22
6.8	B	591D685(1)020B(2)(3)15H	1.5	1.4	6	1.600	0.22
6.8	C	591D685(1)020C(2)(3)15H	1.5	1.4	6	0.400	0.50
10	B	591D106(1)020B(2)(3)15H	1.5	2.0	6	1.500	0.23
10	D	591D106(1)020D(2)(3)15H	1.5	2.0	6	0.270	0.68
15	C	591D156(1)020C(2)(3)15H	1.5	3.0	6	0.300	0.58
22	D	591D226(1)020D(2)(3)15H	1.5	4.4	6	0.200	0.79
22	R	591D226(1)020R(2)(3)15H	1.5	4.4	6	0.140	1.04
33	R	591D336(1)020R(2)(3)15H	1.5	6.6	6	0.140	1.04
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>							
2.2	A	591D225(1)025A(2)(3)15H	1.5	0.6	6	5.000	0.11
2.2	B	591D225(1)025B(2)(3)15H	1.5	0.6	6	3.800	0.15
3.3	B	591D335(1)025B(2)(3)15H	1.5	0.8	6	3.700	0.15
3.3	C	591D335(1)025C(2)(3)15H	1.5	0.8	6	1.000	0.32
4.7	C	591D475(1)025C(2)(3)15H	1.5	1.2	6	0.800	0.35
6.8	C	591D685(1)025C(2)(3)15H	1.5	1.7	6	0.750	0.37
6.8	D	591D685(1)025D(2)(3)15H	1.5	1.7	6	0.650	0.44
10	B	591D106X0025B(2)(3)15H	1.5	2.5	6	1.000	0.28
10	D	591D106(1)025D(2)(3)15H	1.5	2.5	6	0.600	0.46
10	R	591D106(1)025R(2)(3)15H	1.5	2.5	6	0.240	0.79
15	R	591D156(1)025R(2)(3)15H	1.5	3.8	6	0.200	0.87
68	R	591D686(1)025R(2)(3)20H	2.0	17.0	8	0.175	1.00

**Note**

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2", for gold plated specify "4", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T", for 13" reels specify "W"



STANDARD RATINGS							
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	HEIGHT MAX. (mm)	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>							
1.0	A	591D105(1)035A(2)(3)15H	1.5	0.5	4	5.000	0.11
1.0	B	591D105(1)035B(2)(3)15H	1.5	0.5	4	4.400	0.13
1.5	B	591D155(1)035B(2)(3)15H	1.5	0.5	4	3.800	0.15
2.2	B	591D225(1)035B(2)(3)15H	1.5	0.8	6	4.000	0.14
2.2	C	591D225(1)035C(2)(3)15H	1.5	0.8	6	2.000	0.22
3.3	B	591D335(1)035B(2)(3)15H	1.5	1.2	6	3.500	0.15
3.3	C	591D335(1)035C(2)(3)15H	1.5	1.2	6	1.900	0.23
3.3	D	591D335(1)035D(2)(3)15H	1.5	1.2	6	1.500	0.29
4.7	B	591D475(1)035B(2)(3)15H	1.5	1.6	6	0.800	0.32
6.8	D	591D685(1)035D(2)(3)15H	1.5	2.4	6	0.950	0.36
6.8	R	591D685(1)035R(2)(3)15H	1.5	2.4	6	0.750	0.45
10	R	591D106(1)035R(2)(3)15H	1.5	3.5	6	0.600	0.50
<b>50 V<sub>DC</sub> AT + 85 °C; 33 V<sub>DC</sub> AT + 125 °C</b>							
1.0	B	591D155(1)050B(2)(3)15H	1.5	0.8	6	6.500	0.11
4.7	C	591D475(1)050C(2)(3)20H	2.0	23.5	6	6.000	0.14

**Note**

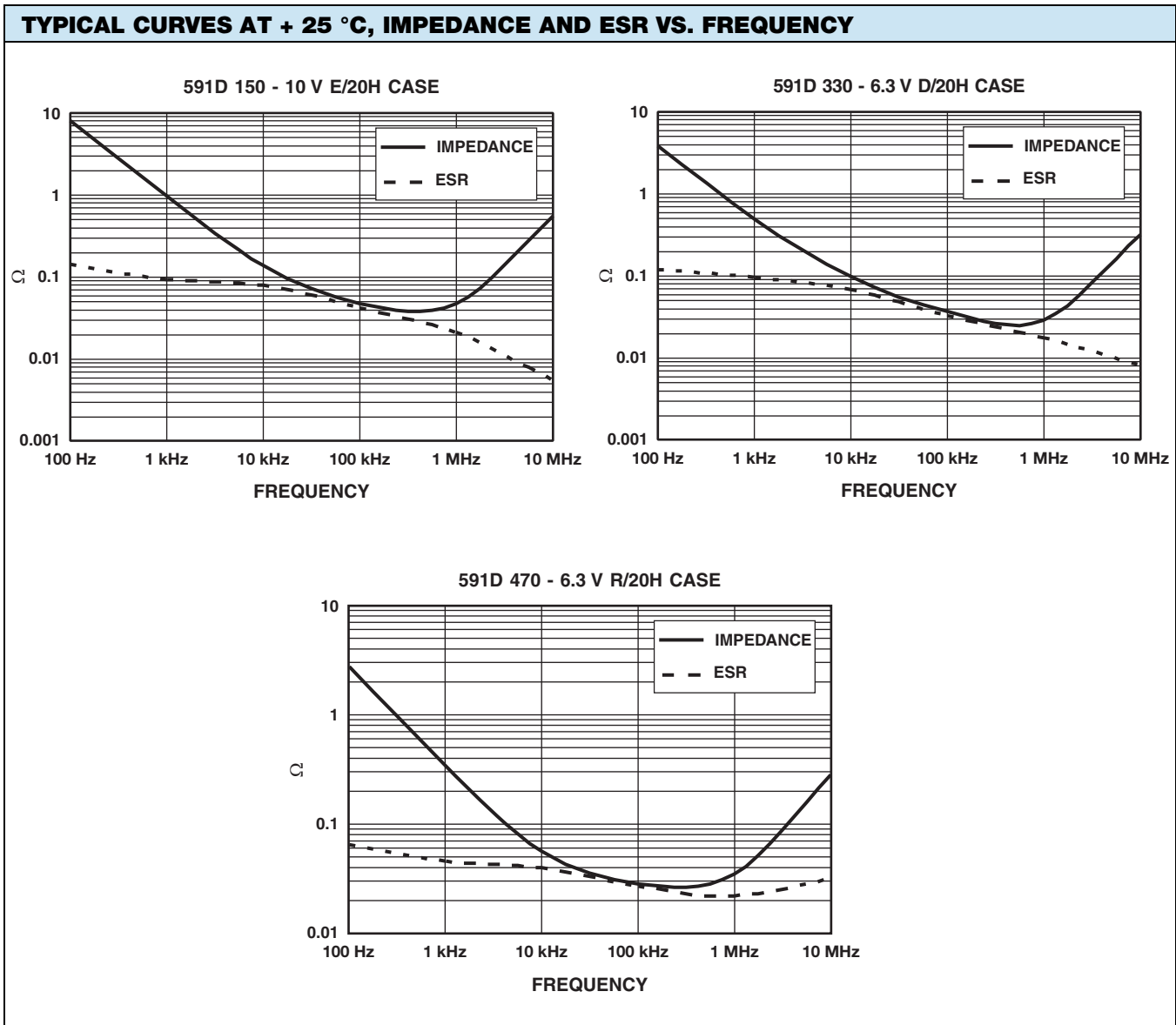
- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2", for gold plated specify "4", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T", for 13" reels specify "W"

RECOMMENDED VOLTAGE DERATING GUIDELINES (for temperatures below + 85 °C)	
STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.6
10	6.0
16	10
20	12
25	15
35	24
50	28
SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24



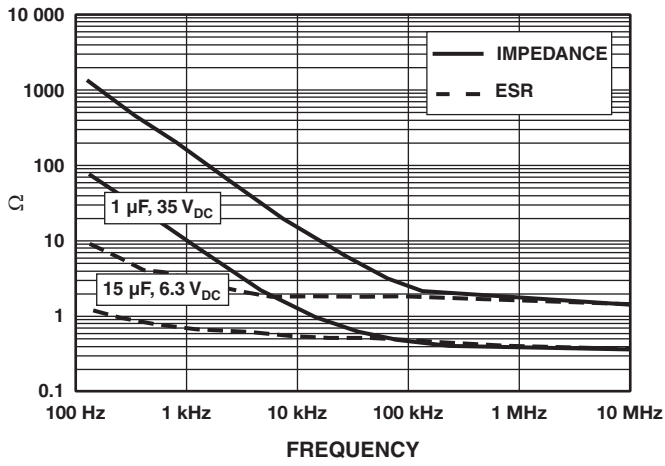


CASE CODE/PART NUMBER X-REF	
OLD	NEW
A2_	A2_15H
B2_	B2_15H
C2_	C2_15H
D2_	D2_15H
R2_	R2_15H
U2_	C2_20H
V2_	D2_20H
W2_	R2_20H

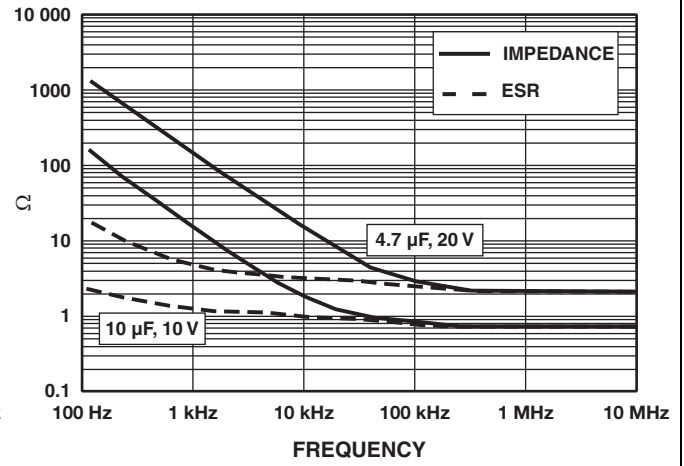


**TYPICAL CURVES AT + 25 °C, IMPEDANCE AND ESR VS. FREQUENCY**

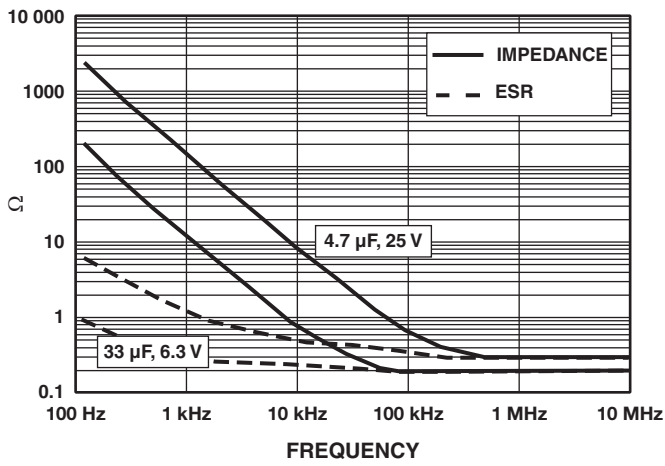
“A” CASE



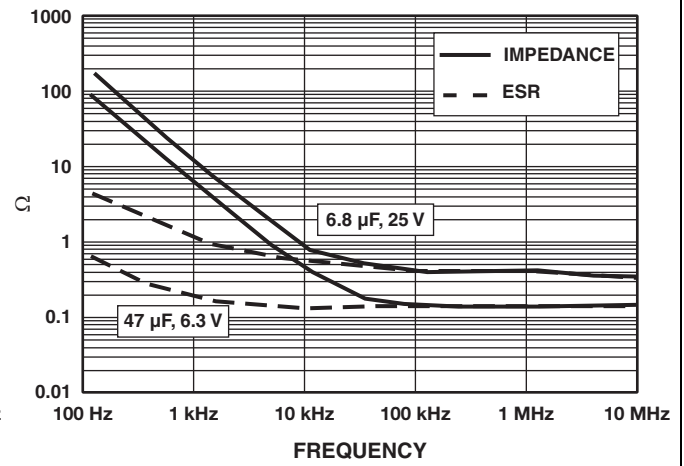
“B” CASE



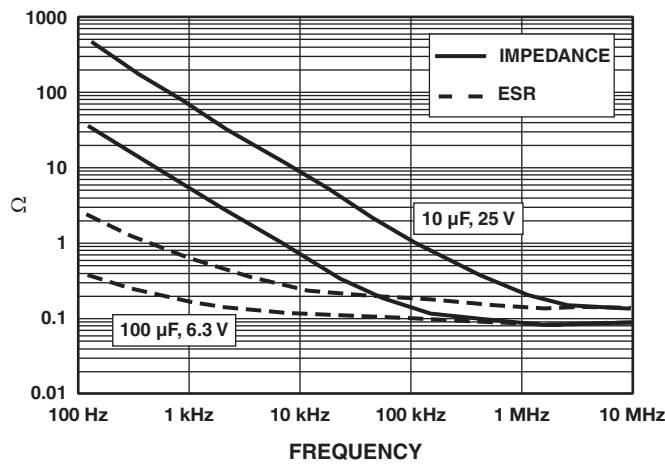
“C” CASE



“D” CASE



“R” CASE



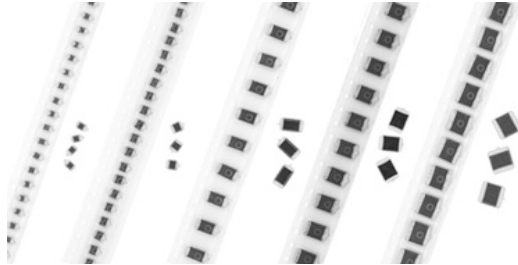


POWER DISSIPATION		
CASE CODE	HEIGHT	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
A	13H	0.055
A	15H	0.060
B	15H	0.080
B	20H	0.085
C	15H	0.100
C	16H	0.100
C	20H	0.110
D	15H	0.125
D	20H	0.140
M	20H	0.175
R	15H	0.150
R	16H	0.155
R	18H	0.165
R	20H	0.175

STANDARD PACKAGING QUANTITY			
CASE CODE	HEIGHT	UNITS PER REEL	
		7" REEL	13" REEL
A	Any	2500	10 000
B	Any	2000	8000
C	Any	1000	4000
D	Any	1000	4000
M	20H	1000	2500
R	15H	1000	4000
R	16H; 18H; 20H	1000	2500

PRODUCT INFORMATION	
Conformal Coated Guide <ul style="list-style-type: none"> <li>Recommended Pad Layouts</li> <li>Carrier Tape Information</li> <li>Reflow Profiles</li> </ul>	<a href="http://www.vishay.com/doc?40150">www.vishay.com/doc?40150</a>
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
SELECTOR GUIDES	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
FAQ	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

## Solid Tantalum Chip Capacitors TANTAMOUNT<sup>®</sup>, Low Profile, Low ESR, Conformal Coated, Maximum CV



### FEATURES

- New robust ratings for pulsed applications
- 1.0 mm to 2.5 mm height
- Terminations: 100 % matte tin (2) standard, tin/lead available
- Mounting: Surface mount
- 8 mm, 12 mm tape and reel packaging available per EIA 481 and reeling per IEC 60286-3  
7" [178 mm] standard  
13" [330 mm] available
- Case code compatibility with EIA 535BAAC and CECC30801 molded chips
- See also 592W for additional ratings designs for pulsed applications
- Compliant to RoHS Directive 2002/95/EC


**RoHS\***  
COMPLIANT

### Note

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

### PERFORMANCE CHARACTERISTICS

[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)

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

**Capacitance Range:** 1 µF to 2200 µF

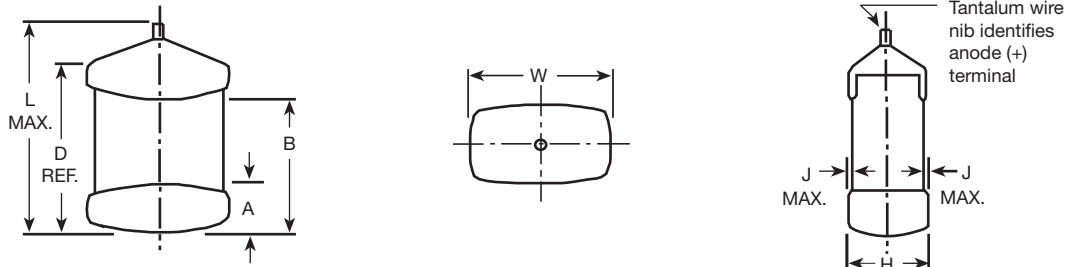
**Capacitance Tolerance:** ± 10 %, ± 20 % standard

**Voltage Rating:** 4 V<sub>DC</sub> to 50 V<sub>DC</sub>

ORDERING INFORMATION							
592D	106	X0	010	B	2	T	15H
TYPE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	CASE CODE	TERMINATION	REEL SIZE AND PACKAGING	SUFFIX
	This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow.	<b>X0 = ± 20 %</b> X9 = ± 10 %	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).	See Ratings and Case Codes table	<b>2 = 100 % tin</b> 4 = Gold plated 8 = Solder plated 60/40 Special order	<b>T = Tape and reel</b> <b>7" [178 mm] reel</b> W = 13" [330 mm] reel	Maximum height (mm) see Standard Ratings table

### Note

- Preferred tolerance and reel sizes are in bold. We reserve the right to substitute form-fit-function replacement products with higher voltage rating, tighter capacitance tolerance or lower ESR (e.g., 591D series).

**DIMENSIONS** in inches [millimeters]


CASE CODE	L MAX.	W	A	B	D REF.	J MAX.
A	0.146 [3.7]	0.071 ± 0.012 [1.8 ± 0.3]	0.031 ± 0.012 [0.8 ± 0.3]	0.087 ± 0.016 [2.2 ± 0.4]	0.114 [2.9]	0.004 [0.1]
B	0.157 [4.0]	0.110 ± 0.012 [2.8 ± 0.3]	0.031 ± 0.012 [0.8 ± 0.3]	0.098 ± 0.016 [2.5 ± 0.4]	0.138 [3.5]	0.004 [0.1]
C	0.28 [7.1]	0.126 ± 0.012 [3.2 ± 0.3]	0.051 ± 0.012 [1.3 ± 0.3]	0.173 ± 0.024 [4.4 ± 0.6]	0.236 [6.0]	0.004 [0.1]
D	0.295 [7.5]	0.169 ± 0.012 [4.3 ± 0.3]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.6]	0.252 [6.4]	0.004 [0.1]
M	0.295 [7.5]	0.248 ± 0.012 [6.3 ± 0.3]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.6]	0.264 [6.7]	0.004 [0.1]
R	0.283 [7.2]	0.236 + 0.012/- 0.024 [6.0 + 0.3/- 0.6]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.6]	0.244 [6.2]	0.004 [0.1]
S	0.138 [3.5]	0.063 ± 0.012 [1.6 ± 0.3]	0.031 ± 0.012 [0.8 ± 0.3]	0.079 ± 0.012 [2.0 ± 0.3]	0.087 [2.2]	0.004 [0.1]
X	0.571 [14.5]	0.290 + 0.010/- 0.020 [7.37 + 0.25/- 0.5]	0.051 ± 0.016 [1.3 ± 0.4]	0.469 ± 0.024 [11.9 ± 0.6]	0.52 [13.2]	0.004 [0.1]

**Notes**

- The anode termination (D less B) will be a minimum of 0.012" [0.3 mm]
- For package height, please refer to specific rating in the "Standard Ratings" table

**RATINGS AND CASE CODES**

μF	4 V	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V
1.0							A/B	B
1.5							B	
2.2					A	A/B	B/C	C
3.3						B/C	C/D	C
4.7			A	A	A/B	C	B/C/D/R	C/R
6.8			A	A/B	B/C	C/D	D/R	R
10		A	A/B	B/C	B/C/D	B/D/R	R	R
15		A/B	B	B/C/D	C/D/R	R		
22	A/B	A/B	A/B/C	B/C/D	B/D/R			
33	B	A/B/C/S	C/D	B/C/D/R	R			
47	C	A/B/C/D	B/D/R	B/C/R				
68	B/C/D	B/C/D/R	B/C/D/R	C/D		R		
100	A/B/C/D/R	B/C/D/R	B/C/D/R	C/D				
120		C						
150	B/C/D/R	C/D/R	C/D	D/R				
220	C/D/R	C/D/R	D/R	R				
330	C/D	C/D/R	D/R					
470	C/D/R	C/D/R						
680	D/R	R	X					
1000	R	R/X						
1500	X	M/R/X						
2200	X	X						



STANDARD RATINGS							
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	HEIGHT MAX. (mm)	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>4 V<sub>DC</sub> AT + 85 °C; 2.7 V<sub>DC</sub> AT + 125 °C</b>							
22	A	592D226(1)004A(2)(3)15H	1.5	0.9	6	2.400	0.16
22	B	592D226(1)004B(2)(3)15H	1.5	0.9	6	1.600	0.22
33	B	592D336(1)004B(2)(3)15H	1.5	1.3	6	1.600	0.22
47	C	592D476(1)004C(2)(3)15H	1.5	1.9	6	0.400	0.50
68	B	592D686(1)004B(2)(3)15H	1.5	2.7	6	1.400	0.24
68	C	592D686(1)004C(2)(3)15H	1.5	2.7	6	0.350	0.53
68	D	592D686(1)004D(2)(3)15H	1.5	2.7	6	0.270	0.68
100	A	592D107(1)004A(2)(3)12H	1.2	4.0	24	1.000	0.23
100	B	592D107(1)004B(2)(3)20H	2.0	4.0	8	0.450	0.42
100	C	592D107(1)004C(2)(3)15H	1.5	4.0	8	0.450	0.47
100	D	592D107(1)004D(2)(3)15H	1.5	4.0	8	0.350	0.60
100	R	592D107(1)004R(2)(3)15H	1.5	4.0	8	0.260	0.76
150	B	592D157(1)004B(2)(3)20H	2.0	6.0	8	0.450	0.42
150	C	592D157(1)004C(2)(3)15H	1.5	6.0	8	0.450	0.47
150	D	592D157(1)004D(2)(3)15H	1.5	6.0	8	0.360	0.59
150	R	592D157(1)004R(2)(3)15H	1.5	6.0	8	0.250	0.77
220	C	592D227(1)004C(2)(3)20H	2.0	8.8	8	0.200	0.74
220	D	592D227(1)004D(2)(3)15H	1.5	8.8	8	0.200	0.79
220	R	592D227(1)004R(2)(3)15H	1.5	8.8	8	0.190	0.89
330	C	592D337(1)004C(2)(3)20H	2.0	13.2	8	0.120	0.96
330	D	592D337(1)004D(2)(3)20H	2.0	13.2	8	0.120	1.02
470	C	592D477(1)004C(2)(3)20H	2.0	18.8	8	0.100	1.05
470	D	592D477(1)004D(2)(3)14H	1.4	18.8	8	0.140	0.93
470	D	592D477(1)004D(2)(3)15H	1.5	18.8	8	0.140	0.94
470	D	592D477(1)004D(2)(3)20H	2.0	18.8	8	0.100	1.18
470	R	592D477(1)004R(2)(3)20H	2.0	18.8	10	0.100	1.32
680	D	592D687(1)004D(2)(3)20H	2.0	27.2	12	0.100	1.18
680	R	592D687(1)004R(2)(3)20H	2.0	27.2	12	0.100	1.32
1000	R	592D108(1)004R(2)(3)20H	2.0	40.0	14	0.200	0.94
1500	X	592D158(1)004X(2)(3)20H	2.0	60.0	20	0.040	2.09
2200	X	592D228(1)004X(2)(3)20H	2.0	88.0	25	0.055	1.78
2200	X	592D228(1)004X(2)(3)25H	2.5	88.0	25	0.040	2.12
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT + 125 °C</b>							
10	A	592D106(1)6R3A(2)(3)15H	1.5	0.6	6	2.700	0.15
15	A	592D156(1)6R3A(2)(3)15H	1.5	0.9	6	2.500	0.15
15	B	592D156(1)6R3B(2)(3)15H	1.5	0.9	6	1.700	0.22
22	A	592D226(1)6R3A(2)(3)10H	1.0	1.4	12	4.000	0.11
22	A	592D226(1)6R3A(2)(3)13H	1.3	1.4	6	1.500	0.19
22	A	592D226(1)6R3A(2)(3)15H	1.5	1.4	6	1.500	0.20
22	B	592D226(1)6R3B(2)(3)15H	1.5	1.4	6	1.500	0.23
33	A	592D336(1)6R3A(2)(3)15H	1.5	2.1	6	1.700	0.19
33	B	592D336(1)6R3B(2)(3)15H	1.5	2.1	6	1.400	0.24
33	C	592D336(1)6R3C(2)(3)15H	1.5	2.1	6	0.400	0.50
33	S	592D336(1)6R3S(2)(3)12H	1.2	2.1	10	2.000	0.17
47	A	592D476(1)6R3A(2)(3)13H	1.3	2.7	14	2.000	0.16
47	A	592D476(1)6R3A(2)(3)15H	1.5	2.7	14	2.000	0.17
47	B	592D476(1)6R3B(2)(3)12H	1.2	3.0	8	1.400	0.23
47	B	592D476(1)6R3B(2)(3)15H	1.5	3.0	8	1.400	0.24

**Note**

- Part number definitions:
  - (1) Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"
  - (2) Termination: For 100 % tin specify "2", for gold plated specify "4", for solder plated 60/40 specify "8"
  - (3) Packaging code: For 7" reels specify "T", for 13" reels specify "W"



STANDARD RATINGS							
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	HEIGHT MAX. (mm)	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
6.3 V <sub>DC</sub> AT + 85 °C; 4 V <sub>DC</sub> AT + 125 °C							
47	C	592D476(1)6R3C(2)(3)15H	1.5	3.0	6	0.400	0.50
47	D	592D476(1)6R3D(2)(3)15H	1.5	3.0	6	0.300	0.65
68	B	592D686(1)6R3B(2)(3)13H	1.3	4.3	8	0.600	0.35
68	B	592D686(1)6R3B(2)(3)15H	1.5	4.3	8	0.600	0.37
68	B	592D686(1)6R3B(2)(3)20H	2.0	4.3	6	0.500	0.40
68	C	592D686(1)6R3C(2)(3)14H	1.4	3.9	6	0.380	0.51
68	C	592D686(1)6R3C(2)(3)15H	1.5	4.3	6	0.380	0.51
68	D	592D686(1)6R3D(2)(3)15H	1.5	4.3	6	0.270	0.68
68	R	592D686(1)6R3R(2)(3)15H	1.5	4.3	6	0.200	0.87
100	B	592D107(1)6R3B(2)(3)15H	1.5	6.3	8	1.000	0.28
100	B	592D107(1)6R3B(2)(3)20H	2.0	6.3	8	0.450	0.42
100	C	592D107(1)6R3C(2)(3)15H	1.5	6.3	8	0.380	0.51
100	D	592D107(1)6R3D(2)(3)15H	1.5	6.3	8	0.260	0.69
100	R	592D107(1)6R3R(2)(3)15H	1.5	6.3	8	0.200	0.87
120	C	592D127(1)6R3C(2)(3)20H	2.0	7.2	8	0.200	0.74
150	C	592D157(1)6R3C(2)(3)20H	2.0	9.5	8	0.190	0.76
150	D	592D157(1)6R3D(2)(3)15H	1.5	9.5	8	0.250	0.71
150	R	592D157(1)6R3R(2)(3)15H	1.5	9.5	8	0.200	0.87
220	C	592D227(1)6R3C(2)(3)18H	1.8	13.9	8	0.150	0.86
220	C	592D227(1)6R3C(2)(3)20H	2.0	13.9	8	0.150	0.86
220	D	592D227(1)6R3D(2)(3)15H	1.5	13.9	8	0.220	0.75
220	D	592D227(1)6R3D(2)(3)20H	2.0	13.9	8	0.120	1.08
220	R	592D227(1)6R3R(2)(3)15H	1.5	13.9	8	0.180	0.91
330	C	592D337(1)6R3C(2)(3)16H	1.6	20.8	10	0.150	0.82
330	C	592D337(1)6R3C(2)(3)20H	2.0	20.8	8	0.100	1.05
330	D	592D337(1)6R3D(2)(3)15H	1.5	20.8	8	0.120	1.02
330	D	592D337(1)6R3D(2)(3)16H	1.6	20.8	8	0.120	1.04
330	D	592D337(1)6R3D(2)(3)19H	1.9	20.8	8	0.100	1.18
330	D	592D337(1)6R3D(2)(3)20H	2.0	20.8	8	0.100	1.18
330	R	592D337(1)6R3R(2)(3)12H	1.2	20.8	10	0.180	0.87
330	R	592D337(1)6R3R(2)(3)15H	1.5	20.8	8	0.180	0.91
330	R	592D337(1)6R3R(2)(3)20H	2.0	20.8	8	0.100	1.32
470	C	592D477(1)6R3C(2)(3)16H	1.6	29.6	14	0.200	0.71
470	C	592D477(1)6R3C(2)(3)20H	2.0	29.6	10	0.100	1.05
470	D	592D477(1)6R3D(2)(3)20H	2.0	29.6	10	0.100	1.18
470	R	592D477(1)6R3R(2)(3)16H	1.6	29.6	10	0.120	1.37
470	R	592D477(1)6R3R(2)(3)20H	2.0	29.6	10	0.100	1.32
680	R	592D687(1)6R3R(2)(3)16H	1.6	42.8	10	0.100	1.25
680	R	592D687(1)6R3R(2)(3)20H	2.0	42.8	10	0.100	1.32
1000	R	592D108(1)6R3R(2)(3)20H	2.0	63.0	29	0.200	0.94
1000	R	592D108(1)6R3R(2)(3)22H	2.2	63.0	29	0.200	0.96
1000	X	592D108(1)6R3X(2)(3)20H	2.0	63.0	16	0.040	2.09
1500	M	592D158X06R3M(2)(3)20H	2.0	95.0	50	0.090	1.39
1500	R	592D158X06R3R(2)(3)20H	2.0	95.0	50	0.120	1.21
1500	X	592D158(1)6R3X(2)(3)16H	1.6	95.0	25	0.045	1.94
1500	X	592D158(1)6R3X(2)(3)20H	2.0	95.0	25	0.045	1.97
1500	X	592D158(1)6R3X(2)(3)25H	2.5	95.0	20	0.035	2.27
2200	X	592D228(1)6R3X(2)(3)20H	2.0	139.0	35	0.055	1.78
2200	X	592D228(1)6R3X(2)(3)21H	2.1	139.0	35	0.055	1.79
2200	X	592D228(1)6R3X(2)(3)22H	2.2	139.0	35	0.055	1.79

Note

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2", for gold plated specify "4", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T", for 13" reels specify "W"



STANDARD RATINGS							
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	HEIGHT MAX. (mm)	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT + 125 °C</b>							
4.7	A	592D475(1)010A(2)(3)15H	1.5	0.5	6	6.000	0.10
6.8	A	592D685(1)010A(2)(3)15H	1.5	0.7	6	6.000	0.10
10	A	592D106(1)010A(2)(3)15H	1.5	1.0	6	2.600	0.15
10	B	592D106(1)010B(2)(3)15H	1.5	1.0	6	1.700	0.22
15	B	592D156(1)010B(2)(3)15H	1.5	1.5	6	1.600	0.22
22	A	592D226(1)010A(2)(3)13H	1.3	2.2	6	1.500	0.19
22	B	592D226(1)010B(2)(3)13H	1.3	2.2	6	1.500	0.22
22	B	592D226(1)010B(2)(3)15H	1.5	2.2	6	1.500	0.23
22	C	592D226(1)010C(2)(3)15H	1.5	2.2	6	0.400	0.50
33	C	592D336(1)010C(2)(3)15H	1.5	3.3	6	0.400	0.50
33	D	592D336(1)010D(2)(3)15H	1.5	3.3	6	0.300	0.65
47	B	592D476(1)010B(2)(3)20H	2.0	4.7	6	0.500	0.40
47	D	592D476(1)010D(2)(3)15H	1.5	4.7	6	0.270	0.68
47	R	592D476(1)010R(2)(3)15H	1.5	4.7	6	0.200	0.87
68	B	592D686(1)010B(2)(3)20H	2.0	6.8	6	0.450	0.42
68	C	592D686(1)010C(2)(3)15H	1.5	6.8	6	0.240	0.65
68	D	592D686(1)010D(2)(3)15H	1.5	6.8	6	0.270	0.68
68	R	592D686(1)010R(2)(3)15H	1.5	6.8	6	0.200	0.87
100	B	592D107(1)010B(2)(3)20H	2.0	10.0	14	0.400	0.45
100	C	592D107(1)010C(2)(3)20H	2.0	10.0	8	0.190	0.76
100	D	592D107(1)010D(2)(3)13H	1.3	10.0	8	0.100	1.10
100	D	592D107(1)010D(2)(3)15H	1.5	10.0	8	0.100	1.12
100	R	592D107(1)010R(2)(3)15H	1.5	10.0	6	0.220	0.83
150	C	592D157(1)010C(2)(3)15H	1.5	15.0	8	0.170	0.77
150	C	592D157(1)010C(2)(3)20H	2.0	15.0	8	0.170	0.80
150	D	592D157(1)010D(2)(3)15H	1.5	15.0	8	0.250	0.71
150	D	592D157(1)010D(2)(3)20H	2.0	15.0	8	0.140	1.00
220	D	592D227(1)010D(2)(3)19H	1.9	22.0	8	0.120	1.08
220	D	592D227(1)010D(2)(3)20H	2.0	22.0	8	0.120	1.08
220	R	592D227(1)010R(2)(3)20H	2.0	22.0	8	0.100	1.32
330	D	592D337(1)010D(2)(3)20H	2.0	33.0	8	0.100	1.18
330	R	592D337(1)010R(2)(3)20H	2.0	33.0	8	0.100	1.32
680	X	592D687(1)010X(2)(3)20H	2.0	100.0	15	0.070	1.58
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>							
4.7	A	592D475(1)016A(2)(3)15H	1.5	0.8	6	3.500	0.13
6.8	A	592D685(1)016A(2)(3)15H	1.5	1.1	6	3.300	0.13
6.8	B	592D685(1)016B(2)(3)15H	1.5	1.1	6	1.800	0.21
10	B	592D106(1)016B(2)(3)15H	1.5	1.6	6	1.600	0.22
10	C	592D106(1)016C(2)(3)15H	1.5	1.6	6	1.000	0.32
15	B	592D156(1)016B(2)(3)15H	1.5	2.4	6	1.400	0.24
15	C	592D156(1)016C(2)(3)15H	1.5	2.4	6	1.300	0.28

Note

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2", for gold plated specify "4", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T", for 13" reels specify "W"





STANDARD RATINGS							
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	HEIGHT MAX. (mm)	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>							
15	D	592D156(1)016D(2)(3)15H	1.5	2.4	6	0.500	0.50
22	B	592D226(1)016B(2)(3)20H	2.0	3.5	6	0.600	0.37
22	C	592D226(1)016C(2)(3)15H	1.5	3.5	6	0.300	0.58
22	D	592D226(1)016D(2)(3)15H	1.5	3.5	6	0.400	0.56
33	B	592D336(1)016B(2)(3)20H	2.0	5.3	6	0.600	0.37
33	C	592D336(1)016C(2)(3)15H	1.5	5.3	6	0.250	0.63
33	D	592D336(1)016D(2)(3)15H	1.5	5.3	6	0.300	0.65
33	R	592D336(1)016R(2)(3)15H	1.5	5.3	6	0.270	0.75
47	B	592D476(1)016B(2)(3)20H	2.0	7.5	6	0.720	0.33
47	C	592D476(1)016C(2)(3)16H	1.6	7.5	6	0.250	0.63
47	C	592D476(1)016C(2)(3)20H	2.0	7.5	6	0.250	0.66
47	R	592D476(1)016R(2)(3)15H	1.5	7.5	6	0.250	0.77
68	C	592D686(1)016C(2)(3)12H	1.2	10.9	6	0.500	0.43
68	C	592D686(1)016C(2)(3)15H	1.5	10.9	6	0.500	0.45
68	C	592D686(1)016C(2)(3)20H	2.0	10.9	6	0.250	0.66
68	D	592D686(1)016D(2)(3)20H	2.0	10.9	6	0.170	0.91
100	C	592D107(1)016C(2)(3)20H	2.0	16.0	8	0.150	0.86
100	C	592D107(1)016C(2)(3)20H	2.0	16.0	8	0.150	0.86
100	D	592D107(1)016D(2)(3)15H	1.5	16.0	8	0.150	0.91
100	D	592D107(1)016D(2)(3)20H	2.0	16.0	8	0.150	0.97
150	D	592D157(1)016D(2)(3)20H	2.0	24.0	8	0.100	1.18
150	R	592D157(1)016R(2)(3)20H	2.0	24.0	8	0.100	1.32
220	R	592D227(1)016R(2)(3)20H	2.0	35.2	10	0.120	1.21
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>							
2.2	A	592D225(1)020A(2)(3)15H	1.5	0.5	6	6.000	0.10
4.7	A	592D475(1)020A(2)(3)15H	1.5	0.9	6	3.800	0.13
4.7	B	592D475(1)020B(2)(3)15H	1.5	0.9	6	3.200	0.16
6.8	B	592D685(1)020B(2)(3)15H	1.5	1.4	6	3.100	0.16
6.8	C	592D685(1)020C(2)(3)15H	1.5	1.4	6	1.100	0.30
10	B	592D106(1)020B(2)(3)15H	1.5	2.0	6	3.000	0.16
10	C	592D106(1)020C(2)(3)15H	1.5	2.0	6	1.300	0.28
10	D	592D106(1)020D(2)(3)15H	1.5	2.0	6	0.500	0.50
15	C	592D156(1)020C(2)(3)15H	1.5	3.0	6	0.600	0.41
15	D	592D156(1)020D(2)(3)15H	1.5	3.0	6	1.260	0.31
15	R	592D156(1)020R(2)(3)15H	1.5	3.0	6	0.400	0.61
22	B	592D226(1)020B(2)(3)20H	2.0	4.4	6	0.600	0.37
22	D	592D226(1)020D(2)(3)15H	1.5	4.4	6	0.400	0.56
22	R	592D226(1)020R(2)(3)15H	1.5	4.4	6	0.280	0.73
33	R	592D336(1)020R(2)(3)15H	1.5	6.6	6	0.280	0.73

**Note**

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2", for gold plated specify "4", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T", for 13" reels specify "W"



STANDARD RATINGS							
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	HEIGHT MAX. (mm)	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>							
2.2	A	592D225(1)025A(2)(3)15H	1.5	0.6	6	8.000	0.09
2.2	B	592D225(1)025B(2)(3)15H	1.5	0.6	6	6.000	0.12
3.3	B	592D335(1)025B(2)(3)15H	1.5	0.8	6	5.600	0.12
3.3	C	592D335(1)025C(2)(3)15H	1.5	0.8	6	2.000	0.22
4.7	C	592D475(1)025C(2)(3)15H	1.5	1.2	6	1.600	0.25
6.8	C	592D685(1)025C(2)(3)15H	1.5	1.7	6	1.300	0.28
6.8	D	592D685(1)025D(2)(3)15H	1.5	1.7	6	1.300	0.31
10	B	592D106X0025B(2)(3)15H	1.5	2.5	6	2.000	0.20
10	D	592D106(1)025D(2)(3)15H	1.5	2.5	6	1.200	0.32
10	R	592D106(1)025R(2)(3)15H	1.5	2.5	6	0.480	0.56
15	R	592D156(1)025R(2)(3)15H	1.5	3.8	6	0.400	0.61
68	R	592D686(1)025R(2)(3)20H	2.0	17.0	8	0.230	0.87
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>							
1.0	A	592D105(1)035A(2)(3)15H	1.5	0.5	4	10.000	0.08
1.0	B	592D105(1)035B(2)(3)15H	1.5	0.5	4	6.500	0.11
1.5	B	592D155(1)035B(2)(3)15H	1.5	0.5	4	4.200	0.14
2.2	B	592D225(1)035B(2)(3)15H	1.5	0.8	6	6.000	0.12
2.2	C	592D225(1)035C(2)(3)15H	1.5	0.8	6	3.500	0.17
3.3	C	592D335(1)035C(2)(3)15H	1.5	1.2	6	3.200	0.18
3.3	D	592D335(1)035D(2)(3)15H	1.5	1.2	6	2.100	0.24
4.7	B	592D475(1)035B(2)(3)15H	1.5	1.6	6	1.600	0.22
4.7	C	592D475(1)035C(2)(3)15H	1.5	1.6	6	2.800	0.19
4.7	D	592D475(1)035D(2)(3)15H	1.5	1.6	6	1.800	0.26
4.7	R	592D475(1)035R(2)(3)15H	1.5	1.6	6	1.300	0.34
6.8	D	592D685(1)035D(2)(3)15H	1.5	2.4	6	1.300	0.31
6.8	R	592D685(1)035R(2)(3)15H	1.5	2.4	6	1.200	0.35
10	R	592D106(1)035R(2)(3)15H	1.5	3.5	6	1.200	0.35
<b>50 V<sub>DC</sub> AT + 85 °C; 33 V<sub>DC</sub> AT + 125 °C</b>							
1.0	B	592D105(1)050B(2)(3)15H	1.5	0.8	6	6.500	0.11
2.2	C	592D225(1)050C(2)(3)15H	1.5	1.1	6	0.800	0.35
3.3	C	592D335(1)050C(2)(3)15H	1.5	1.7	6	0.800	0.35
4.7	C	592D475(1)050C(2)(3)20H	2.0	2.4	6	0.800	0.37
4.7	R	592D475(1)050R(2)(3)15H	1.5	2.4	6	0.700	0.50
6.8	R	592D685(1)050R(2)(3)15H	1.5	3.4	6	0.700	0.50
10	R	592D106(1)050R(2)(3)20H	2.0	5.0	6	0.700	0.50

**Note**

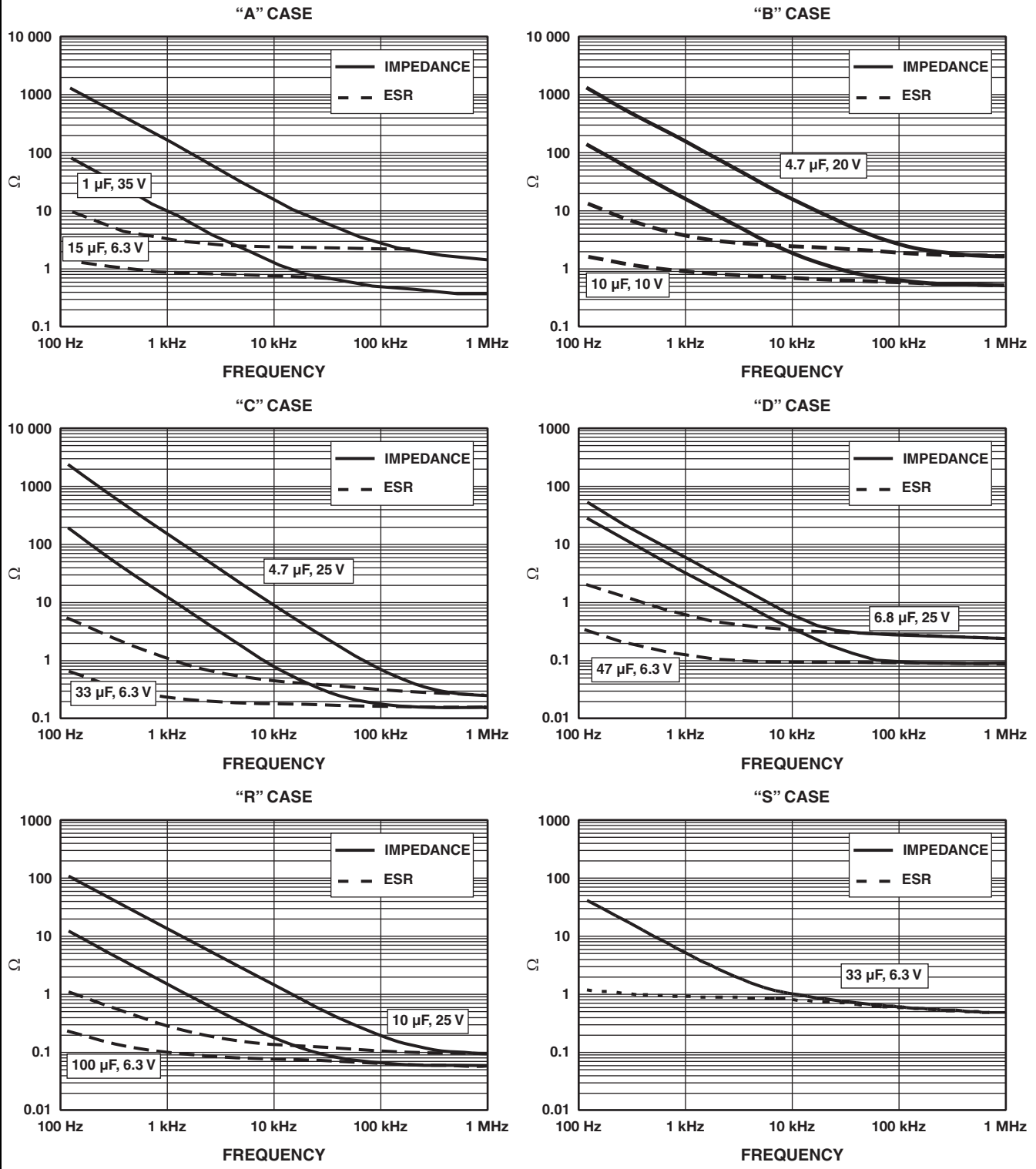
- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2", for gold plated specify "4", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T", for 13" reels specify "W"

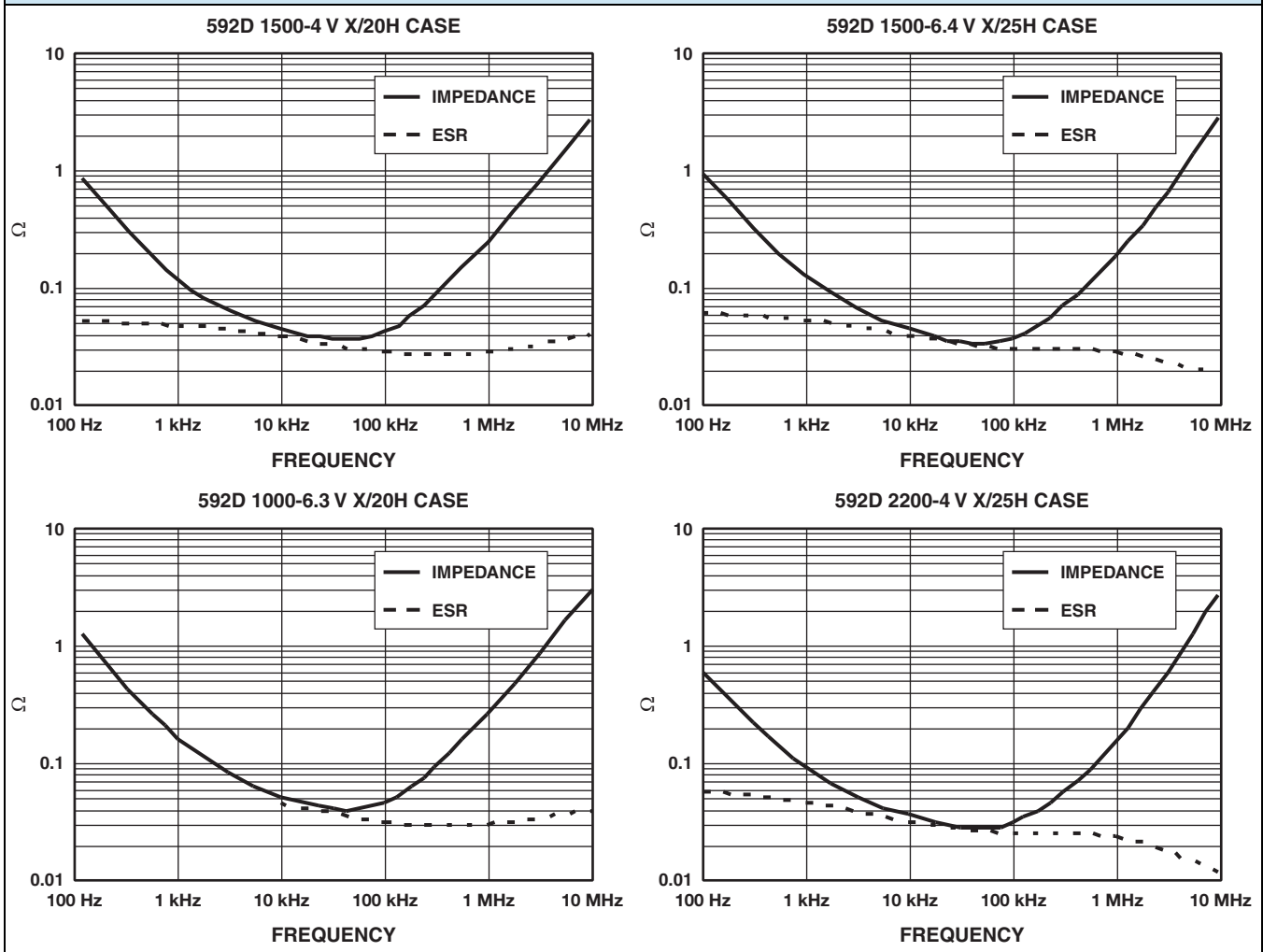


<b>RECOMMENDED VOLTAGE DERATING GUIDELINES</b> (for temperatures below + 85 °C)	
<b>STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS</b>	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.6
10	6.0
16	10
20	12
25	15
35	24
50	28
<b>SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS</b>	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24

<b>CASE CODE/PART NUMBER X-REF</b>	
OLD	NEW
A2_	A2_15H
B2_	B2_15H
C2_	C2_15H
D2_	D2_15H
R2_	R2_15H
S2_	S2_13H
T2_	B2_20H
U2_	C2_20H
V2_	D2_20H
W2_	R2_20H
X2_	X2_20H
Y2_	X2_25H

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



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

**POWER DISSIPATION**

CASE CODE	HEIGHT	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
A	10H	0.050
A	12H	0.055
A	13H	0.055
A	15H	0.060
B	12H	0.075
B	13H	0.075
B	15H	0.080
B	20H	0.085
C	12H	0.095
C	14H	0.100
C	15H	0.100
C	16H	0.100
C	18H	0.110
C	20H	0.110
D	13H	0.120



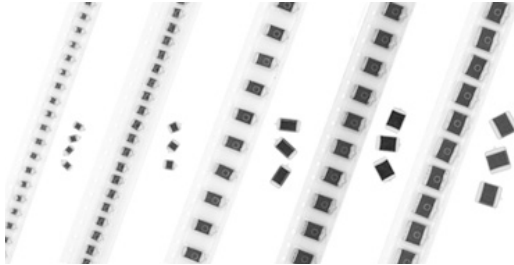
POWER DISSIPATION		
CASE CODE	HEIGHT	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
D	14H	0.120
D	15H	0.125
D	16H	0.130
D	19H	0.140
D	20H	0.140
M	20H	0.175
R	12H	0.135
R	15H	0.150
R	16H	0.155
R	20H	0.175
R	22H	0.185
S	12H	0.060
X	16H	0.170
X	20H	0.175
X	21H	0.175
X	22H	0.175
X	25H	0.180

STANDARD PACKAGING QUANTITY			
CASE CODE	HEIGHT	UNITS PER REEL	
		7" REEL	13" REEL
A	Any	2500	10 000
B	Any	2000	8000
C	Any	1000	4000
D	Any	1000	4000
M	20H	1000	2500
R	15H	1000	4000
R	16H; 18H; 20H	1000	2500
S	12H	2500	10 000
X	Any	500	n/a

PRODUCT INFORMATION	
Conformal Coated Guide • Recommended Pad Layouts • Carrier Tape Information • Reflow Profiles	<a href="http://www.vishay.com/doc?40150">www.vishay.com/doc?40150</a>
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
SELECTOR GUIDES	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
FAQ	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

# Solid Tantalum Chip Capacitors TANTAMOUNT<sup>®</sup>, Low Profile, Conformal Coated

Application Specific Pulse Capacitor for Wireless Modems



## FEATURES

- Robust design for use in wireless modem applications
- Designed specifically for pulsed operation
- 100 % surge current tested
- Compliant to RoHS Directive 2002/95/EC



## PERFORMANCE CHARACTERISTICS

[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)

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

**Capacitance Tolerance:** ± 20 % standard

**Capacitance Range:** 330 µF to 2200 µF

**Voltage Rating:** 6.3 V<sub>DC</sub> to 10 V<sub>DC</sub>

ORDERING INFORMATION							
592W	757	X0	010	M	2	T	20H
TYPE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	CASE CODE	TERMINATION	REEL SIZE AND PACKAGING	SUFFIX
	This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow.	<b>X0 ± 20 %</b>	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).	See Ratings and Case Codes table	2 = 100 % tin	<b>T = 7" [178 mm] reel</b>	Maximum height (mm) see dimensions

### Note

- Preferred tolerance and reel sizes are in bold.  
We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size.

DIMENSIONS in inches [millimeters]								
CASE CODE	SUFFIX	H	L MAX.	W	A	B	D REF.	J MAX.
C	16H	0.063 [1.6] max.	0.280 [7.1]	0.126 ± 0.012 [3.2 ± 0.3]	0.051 ± 0.012 [1.3 ± 0.3]	0.173 ± 0.024 [4.4 ± 0.6]	0.236 [6.0]	0.004 [0.1]
	20H	0.079 [2.0] max.						
M	20H	0.063 [1.6] max.	0.295 [7.5]	0.248 ± 0.012 [6.3 ± 0.3]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.6]	0.264 [6.7]	0.004 [0.1]
		0.079 [2.0] max.						
X	16H	0.063 [1.6] max.	0.571 [14.5]	0.290 ± 0.010/- 0.020 [7.37 + 0.25/- 0.5]	0.051 ± 0.016 [1.3 ± 0.4]	0.469 ± 0.024 [11.9 ± 0.6]	0.520 [13.2]	0.004 [0.1]
	20H	0.079 [2.0] max.						



RATINGS AND CASE CODES			
μF	6.3 V	8.2 V	10 V
330			C_2.0 <sup>(1)</sup>
470	C_1.6	C_2.0 <sup>(1)</sup>	
680			
750			M_2.0
1000			X_2.0 <sup>(1)</sup>
1500		M_2.0 <sup>(1)</sup>	
2200	X_1.6 <sup>(1)</sup>		

**Note**

<sup>(1)</sup> Preliminary value, contact factory for availability

STANDARD RATINGS						
CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. HEIGHT (mm)	MAX. DCL AT + 25 °C (μA)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz (Ω)
<b>6.3 V<sub>DC</sub>; 4.0 V<sub>DC</sub> AT + 85 °C; 2.5 V<sub>DC</sub> AT + 125 °C</b>						
470	C	592W477X06R3C2T16H	1.6	30	14	0.200
2200	X <sup>(1)</sup>	592W228X06R3X2T16H	1.6	139	45	0.070
<b>8.2 V<sub>DC</sub>; 5.2 V<sub>DC</sub> AT + 85 °C, 3.3 V<sub>DC</sub> AT 125 °C</b>						
470	C <sup>(1)</sup>	592W477X08R2C2T20H	2.0	57	20	0.100
1500	M <sup>(1)</sup>	592W158X08R2M2T20H	2.0	125	45	0.090
<b>10 V<sub>DC</sub>; 6.3 V<sub>DC</sub> AT + 85 °C, 4 V<sub>DC</sub> AT 125 °C</b>						
330	C <sup>(1)</sup>	592W337X0010C2T20H	2.0	33	20	0.100
750	M	592W757X0010M2T20H	2.0	75	35	0.100
1000	X <sup>(1)</sup>	592W108X0010X2T20H	2.0	100	35	0.080

**Note**

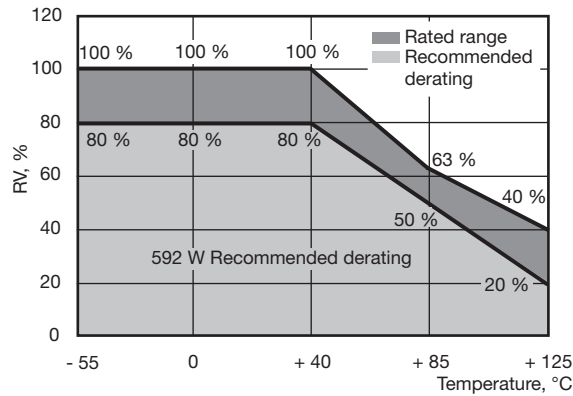
<sup>(1)</sup> Preliminary value, contact factory for availability

ELECTRICAL PERFORMANCE CHARACTERISTICS						
ITEM	PERFORMANCE CHARACTERISTICS					
Category temperature range	- 55 °C to + 125 °C (with voltage derating)					
Capacitance tolerance	± 20 %, ± 10 % (at 120 Hz) 2 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 RV 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.					
Operation temperatures	Rated voltage	- 55 °C/+ 40 °C	10 V	8.2 V	6.3 V	4.0 V
	Category voltage	+ 40 °C/+ 85 °C	6.3 V	5.2 V	4.0 V	2.5 V
	Category voltage	+ 85 °C/+ 125 °C	4 V	3.3 V	2.5 V	1.6 V





**VOLTAGE VS. TEMPERATURE RATING**



**POWER DISSIPATION**

CASE CODE	HEIGHT	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
C	16H	0.100
C	20H	0.110
M	20H	0.175
X	16H	0.170
X	20H	0.175

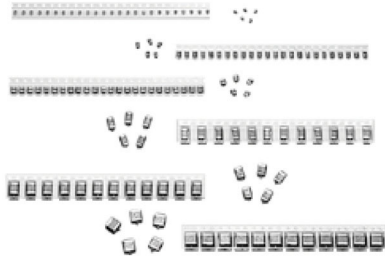
**STANDARD PACKAGING QUANTITY**

CASE CODE	HEIGHT	UNITS PER REEL, 7" REEL
C	Any	1000
M	Any	1000
X	Any	500

**PRODUCT INFORMATION**

Conformal Coated Guide	<a href="http://www.vishay.com/doc?40150">www.vishay.com/doc?40150</a>
Pad Dimensions	Link to specified table in Application Guidelines
Packaging Dimensions	
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
<b>SELECTOR GUIDES</b>	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
<b>FAQ</b>	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

# Solid Tantalum Chip Capacitors, TANTAMOUNT<sup>®</sup>, Conformal Coated, Maximum CV, Low ESR



## FEATURES

- Large capacitance rating range
- Mounting: Surface mount
- Lowest ESR for a surface mount tantalum chip capacitor
- Terminations: 100 % tin (2) standard; tin/lead available
- 8 mm, 12 mm tape and reel packaging available per EIA 481 and reeling per IEC 60286-3. 7" [178 mm] standard. 13" [330 mm] available.
- Case code compatibility with EIA 535BAAC and CECC 30801 molded chips
- Compliant to RoHS Directive 2002/95/EC


**RoHS\***  
COMPLIANT

## Note

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

## PERFORMANCE CHARACTERISTICS

[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)

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

**Capacitance Range:** 1.0 µF to 1500 µF

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

**Voltage Rating:** 4 V<sub>DC</sub> to 50 V<sub>DC</sub>

**Equivalent Series Resistance:** ESR readings measured at 100 kHz, + 25 °C from 3500 mΩ to 30 mΩ

ORDERING INFORMATION						
594D	477	X0	004	R	2	T
TYPE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	CASE CODE	TERMINATION	REEL SIZE AND PACKAGING
This is expressed in pF. The first two digits are the significant figures. The third is the number of zeros to follow.		<b>X0 = ± 20 %</b> <b>X9 = ± 10 %</b>	This is expressed in V. To complete the three-digit block, zeros precede the voltage rating. A decimal point is indicated by an "R" (6R3 = 6.3 V).	See Ratings and Case Code table	<b>2 = 100 % tin</b> 4 = Gold plated 8 = Solder plated (60/40) Special order	<b>Tape and reel</b> <b>T = 7" [178 mm] reel</b> W = 13" [330 mm] reel

## Note

- Preferred tolerances and reel sizes are in bold. We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size.

DIMENSIONS in inches [millimeters]							
CASE CODE	L <sub>MAX.</sub>	W	H	A	B	D <sub>REF.</sub>	J <sub>MAX.</sub>
B	0.157 [4.0]	0.110 + 0.012/- 0.016 [2.8 + 0.3/- 0.4]	0.075 + 0.012/- 0.024 [1.9 + 0.3/- 0.6]	0.031 ± 0.012 [0.8 ± 0.3]	0.098 ± 0.016 [2.5 ± 0.4]	0.138 [3.5]	0.004 [0.1]
C	0.280 [7.1]	0.126 ± 0.012 [3.2 ± 0.3]	0.098 ± 0.012 [2.5 ± 0.3]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.6]	0.236 [6.0]	0.004 [0.1]
D	0.295 [7.5]	0.169 + 0.012/- 0.024 [4.3 + 0.3/- 0.6]	0.110 ± 0.012 [2.8 ± 0.3]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.6]	0.252 [6.4]	0.004 [0.1]
R	0.283 [7.2]	0.236 + 0.012/- 0.024 [6.0 + 0.3/- 0.6]	0.138 + 0.012/- 0.016 [3.5 + 0.3/- 0.4]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.6]	0.244 [6.2]	0.004 [0.1]

## Note

- The anode termination (D less B) will be a minimum of 0.012" [0.3 mm]



RATINGS AND CASE CODES								
μF	4 V	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V
1.0								B
2.2							B	
3.3						B		
4.7					B		B	C
6.8					B		C	D
10					B	B		
15			B	B		C	C/D	R
22		B	B	B	B/C	C	D/R	
33	B		B	B/C		D	R	
47			B	B/C	C/D	D/R	R	
68		B	B/C	C/D	D	D/R		
100	B	B	B/C	C/D	D	R		
120		C	C	R	R			
150	B/C		C/D	D				
180			D	R				
220		C/D	C/D/R	R				
270	D							
330	C	C/D	D/R	R				
390		R						
470	C/R	D/R	R					
680	D	R	R					
1000		R						
1500	R							

STANDARD RATINGS						
CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C (μA)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz (Ω)	MAX. RIPPLE 100 kHz I <sub>RMS</sub> (A)
<b>4 V<sub>DC</sub> AT + 85 °C, 2.7 V<sub>DC</sub> AT + 125 °C</b>						
33	B	594D336(1)004B(2)(3)	1.30	6	0.380	0.47
100	B	594D107(1)004B(2)(3)	4.00	8	0.300	0.53
150	B	594D157(1)004B(2)(3)	6.00	8	0.250	0.58
150	C	594D157(1)004C(2)(3)	6.00	8	0.080	1.17
270	D	594D277(1)004D(2)(3)	10.80	8	0.060	1.58
330	C	594D337(1)004C(2)(3)	13.20	8	0.080	1.17
470	C	594D477(1)004C(2)(3)	18.80	10	0.075	1.21
470	R	594D477(1)004R(2)(3)	18.80	10	0.045	2.36
680	D	594D687(1)004D(2)(3)	27.20	12	0.060	1.58
1500	R	594D158(1)004R(2)(3)	60.00	20	0.030	2.89
<b>6.3 V<sub>DC</sub> AT + 85 °C, 4 V<sub>DC</sub> AT + 125 °C</b>						
22	B	594D226(1)6R3B(2)(3)	1.40	6	0.380	0.47
68	B	594D686(1)6R3B(2)(3)	4.30	6	0.319	0.52
100	B	594D107(1)6R3B(2)(3)	6.30	8	0.250	0.58

**Note**

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2", for gold plated specify "4", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T", for 13" reels specify "W".



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>6.3 V<sub>DC</sub> AT + 85 °C, 4 V<sub>DC</sub> AT + 125 °C</b>						
120	C	594D127(1)6R3C(2)(3)	7.60	8	0.085	1.14
220	C	594D227(1)6R3C(2)(3)	13.90	8	0.080	1.17
220	D	594D227(1)6R3D(2)(3)	13.90	8	0.065	1.52
330	C	594D337(1)6R3C(2)(3)	20.80	8	0.080	1.17
330	D	594D337(1)6R3D(2)(3)	20.80	8	0.060	1.58
390	R	594D397(1)6R3R(2)(3)	24.60	8	0.045	2.36
470	D	594D477(1)6R3D(2)(3)	29.60	8	0.060	1.58
470	R	594D477(1)6R3R(2)(3)	29.60	10	0.050	2.24
680	R	594D687(1)6R3R(2)(3)	42.80	10	0.045	2.36
1000	R	594D108(1)6R3R(2)(3)	63.00	16	0.030	2.89
<b>10 V<sub>DC</sub> AT + 85 °C, 7 V<sub>DC</sub> AT + 125 °C</b>						
15	B	594D156(1)010B(2)(3)	1.50	6	0.500	0.41
22	B	594D226(1)010B(2)(3)	2.20	6	0.500	0.41
33	B	594D336(1)010B(2)(3)	3.30	6	0.500	0.41
47	B	594D476(1)010B(2)(3)	4.70	6	0.400	0.46
68	B	594D686(1)010B(2)(3)	6.80	6	0.350	0.49
68	C	594D686(1)010C(2)(3)	6.80	6	0.100	1.05
100	B	594D107(1)010B(2)(3)	10.00	12	0.250	0.58
100	C	594D107(1)010C(2)(3)	10.00	8.0	0.095	1.08
120	C	594D127(1)010C(2)(3)	12.00	7.0	0.095	1.08
150	C	594D157(1)010C(2)(3)	15.00	8.0	0.090	1.11
150	D	594D157(1)010D(2)(3)	15.00	8	0.075	1.41
180	D	594D187(1)010D(2)(3)	18.00	7	0.090	1.29
220	C	594D227(1)010C(2)(3)	22.00	8	0.100	1.05
220	D	594D227(1)010D(2)(3)	22.00	8	0.065	1.52
220	R	594D227(1)010R(2)(3)	22.00	8	0.065	1.96
330	D	594D337(1)010D(2)(3)	33.00	8	0.065	1.52
330	R	594D337(1)010R(2)(3)	33.00	8	0.045	2.36
470	R	594D477(1)010R(2)(3)	47.00	8	0.045	2.36
680	R	594D687(1)010R(2)(3)	68.00	14	0.045	2.36
<b>16 V<sub>DC</sub> AT + 85 °C, 10 V<sub>DC</sub> AT + 125 °C</b>						
15	B	594D156(1)016B(2)(3)	2.40	6	0.550	0.39
22	B	594D226(1)016B(2)(3)	3.50	6	0.500	0.41
33	B	594D336(1)016B(2)(3)	5.30	6	0.500	0.41
33	C	594D336(1)016C(2)(3)	5.30	6	0.150	0.86
47	B	594D476(1)016B(2)(3)	7.50	6	0.720	0.34
47	C	594D476(1)016C(2)(3)	7.50	6	0.110	1.00
68	C	594D686(1)016C(2)(3)	10.90	6	0.123	0.95
68	D	594D686(1)016D(2)(3)	10.90	6	0.095	1.26
100	C	594D107(1)016C(2)(3)	16.00	8	0.080	1.17
100	D	594D107(1)016D(2)(3)	16.00	8	0.075	1.41
120	R	594D127(1)016R(2)(3)	19.20	8	0.080	1.77
150	D	594D157(1)016D(2)(3)	24.00	8	0.085	1.33
180	R	594D187(1)016R(2)(3)	28.80	8	0.055	2.13
220	R	594D227(1)016R(2)(3)	35.20	8	0.055	2.13
330	R	594D337(1)016R(2)(3)	52.80	14	0.055	2.13

**Note**

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2", for gold plated specify "4", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T", for 13" reels specify "W".



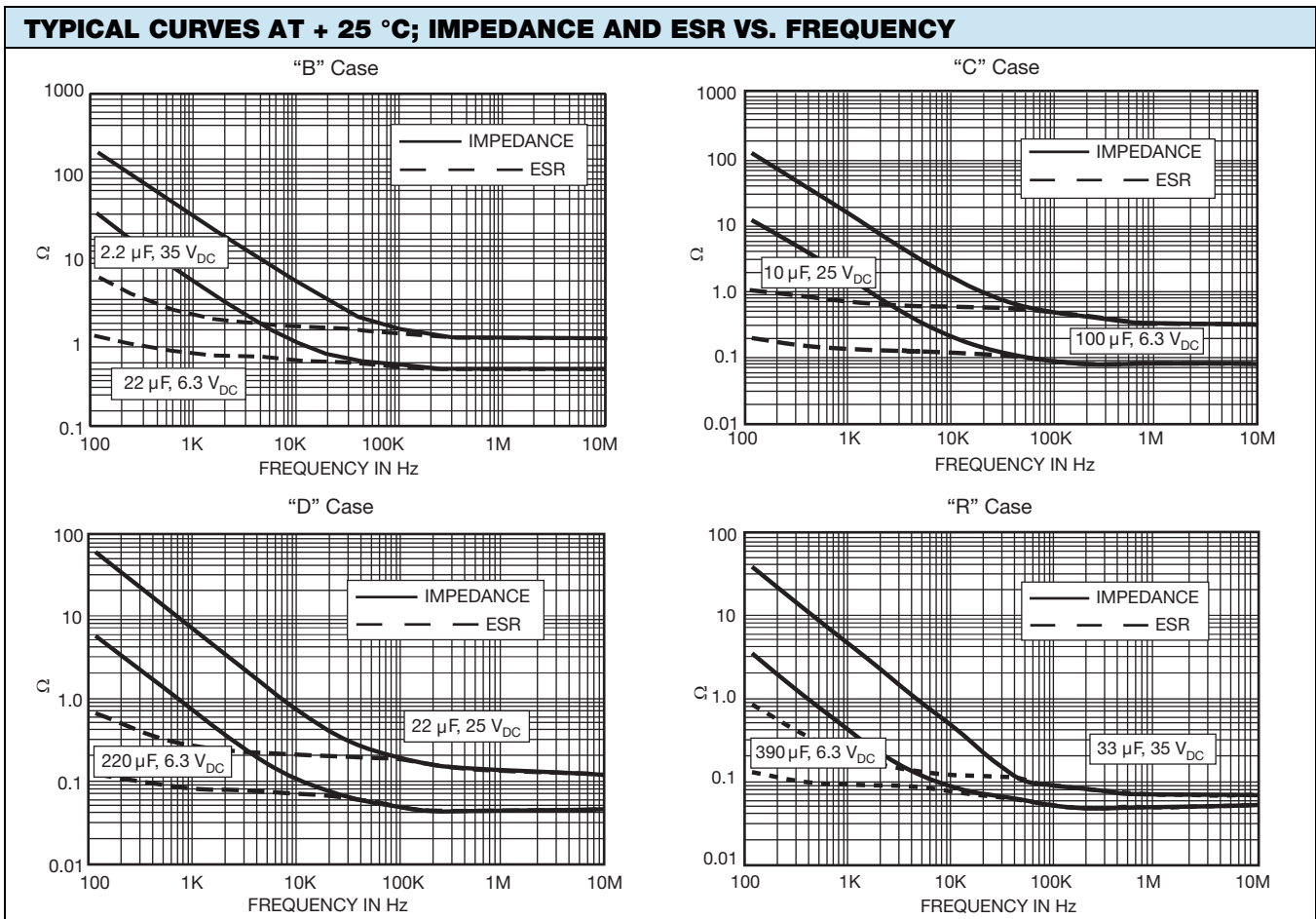
STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>20 V<sub>DC</sub> AT + 85 °C, 13 V<sub>DC</sub> AT + 125 °C</b>						
4.7	B	594D475(1)020B(2)(3)	0.90	6	0.900	0.31
6.8	B	594D685(1)020B(2)(3)	1.40	6	0.900	0.31
10	B	594D106(1)020B(2)(3)	2.00	6	0.850	0.32
22	B	594D226(1)020B(2)(3)	4.40	6	0.600	0.38
22	C	594D226(1)020C(2)(3)	4.40	6	0.150	0.86
47	C	594D476(1)020C(2)(3)	9.40	6	0.140	0.89
47	D	594D476(1)020D(2)(3)	9.40	6	0.095	1.26
68	D	594D686(1)020D(2)(3)	13.60	6	0.132	1.07
100	D	594D107(1)020D(2)(3)	20.00	8	0.085	1.33
120	R	594D127(1)020R(2)(3)	24.00	8	0.080	1.77
<b>25 V<sub>DC</sub> AT + 85 °C, 17 V<sub>DC</sub> AT + 125 °C</b>						
3.3	B	594D335(1)025B(2)(3)	0.80	6	1.500	0.24
10	B	594D106(1)025B(2)(3)	2.50	6	0.900	0.31
15	C	594D156(1)025C(2)(3)	3.80	6	0.220	0.71
22	C	594D226(1)025C(2)(3)	5.50	6	0.200	0.74
33	D	594D336(1)025D(2)(3)	8.30	6	0.130	1.07
47	D	594D476(1)025D(2)(3)	11.80	6	0.130	1.07
47	R	594D476(1)025R(2)(3)	11.80	6	0.099	1.59
68	D	594D686(1)025D(2)(3)	17.00	8	0.200	0.87
68	R	594D686(1)025R(2)(3)	17.00	6	0.095	1.62
100	R	594D107(1)025R(2)(3)	25.00	8	0.090	1.67
<b>35 V<sub>DC</sub> AT + 85 °C, 23 V<sub>DC</sub> AT + 125 °C</b>						
2.2	B	594D225(1)035B(2)(3)	0.80	6	1.700	0.22
4.7	B	594D475(1)035B(2)(3)	1.60	6	1.400	0.25
6.8	C	594D685(1)035C(2)(3)	2.40	6	0.430	0.51
15	C	594D156(1)035C(2)(3)	5.30	6	0.400	0.52
15	D	594D156(1)035D(2)(3)	5.30	6	0.270	0.75
22	D	594D226(1)035D(2)(3)	7.70	6	0.270	0.75
22	R	594D226(1)035R(2)(3)	7.70	6	0.220	1.07
33	R	594D336(1)035R(2)(3)	11.60	6	0.200	1.12
47	R	594D476(1)035R(2)(3)	16.60	6	0.200	1.12
<b>50 V<sub>DC</sub> AT + 85 °C, 33 V<sub>DC</sub> AT + 125 °C</b>						
1.0	B	594D105(1)050B(2)(3)	0.50	4	3.500	0.16
4.7	C	594D475(1)050C(2)(3)	2.40	6	0.800	0.37
6.8	D	594D685(1)050D(2)(3)	3.40	6	0.450	0.58
15	R	594D156(1)050R(2)(3)	7.50	6	0.350	0.85

**Note**

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2", for gold plated specify "4", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T", for 13" reels specify "W".



RECOMMENDED VOLTAGE DERATING GUIDELINES (for temperature below + 85 °C)	
STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.6
10	6.0
16	10
20	12
25	15
35	24
50	28
SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24



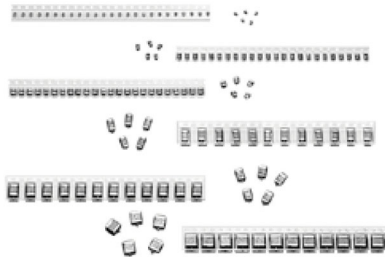


POWER DISSIPATION	
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
B	0.085
C	0.110
D	0.150
R	0.250

STANDARD PACKAGING QUANTITY		
CASE CODE	UNITS PER REEL	
	7" REEL	13" REEL
B	2000	8000
C	500	3000
D	500	3000
R	600	n/a

PRODUCT INFORMATION	
Conformal Coated Guide	<a href="http://www.vishay.com/doc?40150">www.vishay.com/doc?40150</a>
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
SELECTOR GUIDES	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
FAQ	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

# Solid Tantalum Chip Capacitors TANTAMOUNT<sup>®</sup>, Conformal Coated, Maximum CV


**FEATURES**

- Large capacitance rating range
- Terminations: 100 % tin (2) standard tin/lead available
- Mounting: Surface mount
- 8 mm, 12 mm tape and reel packaging available per EIA 481 and reeling per IEC 60286-3. 7" [178 mm] standard. 13" [330 mm] available.
- Case code compatibility with EIA 535BAAC and CECC 30801 molded chips
- Compliant to RoHS Directive 2002/95/EC


**RoHS\***  
COMPLIANT

**Note**

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

**PERFORMANCE CHARACTERISTICS**
[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)
**Operating Temperature:** - 55 °C to + 85 °C  
(To + 125 °C with voltage derating)

**Capacitance Range:** 0.1 μF to 1500 μF

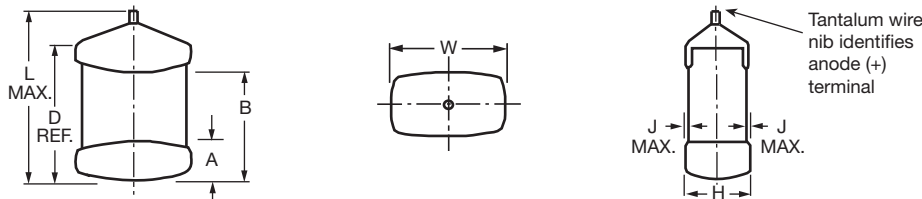
**Capacitance Tolerance:** ± 10 %, ± 20 % standard

**Voltage Rating:** 4 V<sub>DC</sub> to 50 V<sub>DC</sub>

ORDERING INFORMATION						
595D	106	X0	010	A	2	T
TYPE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	CASE CODE	TERMINATION	REEL SIZE AND PACKAGING
	This is expressed in pF. The first two digits are the significant figures. The third is the number of zeros to follow.	<b>X0 = ± 20 %</b> <b>X9 = ± 10 %</b>	This is expressed in V. To complete the three-digit block, zeros precede the voltage rating. A decimal point is indicated by an "R" (6R3 = 6.3 V).	See Ratings and Case Codes table	<b>2 = 100 % tin</b> <b>4 = Gold plated</b> <b>8 = Solder plated (60/40)</b> Special order	<b>Tape and reel</b> <b>T = 7" [178 mm] reel</b> <b>W = 13" [330 mm] reel</b>

**Note**

- Preferred tolerances and reel sizes are in bold. We reserve the right to substitute form-fit-function replacement products with higher voltage rating, tighter capacitance tolerance, lower ESR (e.g., 594D series), or increased reliability screening (T95 series).

**DIMENSIONS** in inches [millimeters]


CASE CODE	L MAX.	W	H	A	B	D REF.	J MAX.
T	0.087 [2.2]	0.043 ± 0.012 [1.1 ± 0.3]	0.043 ± 0.012 [1.1 ± 0.3]	0.016 ± 0.008 [0.4 ± 0.2]	0.042 ± 0.001 [1.07 ± 0.25]	0.063 [1.6]	0.004 [0.1]
S	0.134 [3.4]	0.067 ± 0.008 [1.7 ± 0.2]	0.051 ± 0.008 [1.3 ± 0.3]	0.031 ± 0.012 [0.8 ± 0.3]	0.079 ± 0.012 [2.0 ± 0.3]	0.087 [2.2]	0.004 [0.1]
A	0.146 [3.7]	0.071 ± 0.012 [1.8 ± 0.3]	0.055 ± 0.012 [1.4 ± 0.3]	0.031 ± 0.012 [0.8 ± 0.3]	0.087 ± 0.016 [2.2 ± 0.4]	0.115 [2.9]	0.004 [0.1]
M	0.142 [3.6]	0.106 ± 0.012 [2.7 ± 0.3]	0.067 ± 0.012 [1.7 ± 0.3]	0.031 ± 0.012 [0.8 ± 0.3]	0.079 ± 0.012 [2.0 ± 0.3]	0.253 [6.4]	0.004 [0.1]
B	0.157 [4.0]	0.110 + 0.012/- 0.016 [2.8 + 0.3/- 0.4]	0.075 + 0.012/- 0.024 [1.9 + 0.3/- 0.6]	0.031 ± 0.012 [0.8 ± 0.3]	0.098 ± 0.016 [2.5 ± 0.4]	0.138 [3.5]	0.004 [0.1]
C	0.280 [7.1]	0.126 ± 0.012 [3.2 ± 0.3]	0.098 ± 0.012 [2.5 ± 0.3]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.6]	0.236 [6.0]	0.004 [0.1]
G	0.220 [5.6]	0.144 ± 0.016 [3.65 ± 0.4]	0.087 [2.2 max.]	0.051 ± 0.012 [1.3 ± 0.3]	0.134 ± 0.016 [3.4 ± 0.4]	0.236 [6.0]	0.004 [0.1]
D	0.295 [7.5]	0.169 + 0.012/- 0.024 [4.3 + 0.3/- 0.6]	0.110 ± 0.012 [2.8 ± 0.3]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.6]	0.252 [6.4]	0.004 [0.1]
R	0.283 [7.2]	0.236 + 0.012/- 0.024 [6.0 + 0.3/- 0.6]	0.138 + 0.012/- 0.016 [3.5 + 0.3/- 0.4]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.6]	0.244 [6.2]	0.004 [0.1]

**Note**

- The anode termination (D less B) will be a minimum of 0.012" [0.3 mm]. T case = 0.005" [0.13 mm] minimum.





RATINGS AND CASE CODES								
µF	4 V	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V
0.10								T
0.15								T
0.22								T/A
0.33							T	A
0.47						T	A	A
0.68					T		A	A/B
1.0					T	A	A	A/B
1.5				T		A	A/B	B/C
2.2			T	T/A	A	A/B	B	B/C
3.3		T/A	A	T	A	B	B/C	C
4.7	T	A	T/A	A	A/B	B/C	B/C	C
6.8	T	T	A	A	A/B	B	C	C/D
10	T		A	A/B	B	B/C	D	D/R
15	A	A	A/B	A/B	B	C	C/D	R
22		A/B	A/B	M/B	B/C	C/D	D/R	R
33	A/B	S/A/B	A/B	B/C		C/D	R	
47	A	A/B	B/C	B/C	C/D	D/R	R	
68	A	A/B	B/C	C/D	C/D	D/R		
100	A/B	M/B/C	B/C/D	C/D	D/R	R		
120	C	C	C/D	R	R			
150	B/C	D	C/D	D/R	R			
180	D	D	D/R	R	R			
220	C/D	C/G/D	C/D/R	R				
270	C/D		R					
330	C	C/D/R	D/R	R				
390	D	R	R					
470	C/R	D/R	R					
560		R						
680	D	R	R					
1000	R	R						
1500	R							

STANDARD RATINGS						
CAPACITANCE (µF)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C (µA)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz (Ω)	MAX. RIPPLE 100 kHz I <sub>RMS</sub> (A)
4 V <sub>DC</sub> AT + 85 °C, 2.7 V <sub>DC</sub> AT + 125 °C						
4.7	T	595D475(1)004T(2)(3)	0.5	6	7.80	0.06
6.8	T	595D685(1)004T(2)(3)	0.5	6	7.80	0.06
10	T	595D106(1)004T(2)(3)	0.5	6	7.80	0.06
15	A	595D156(1)004A(2)(3)	0.6	6	1.40	0.23
33	A	595D336(1)004A(2)(3)	1.3	6	1.40	0.23
33	B	595D336(1)004B(2)(3)	1.3	6	0.47	0.43
47	A	595D476(1)004A(2)(3)	1.9	6	1.40	0.23
68	A	595D686(1)004A(2)(3)	2.7	6	1.30	0.24
100	A	595D107(1)004A(2)(3)	4.0	12	0.60	0.35
100	B	595D107(1)004B(2)(3)	4.0	8	0.45	0.43
120	C	595D127(1)004C(2)(3)	4.8	8	0.19	0.76
150	B	595D157(1)004B(2)(3)	6.0	8	0.45	0.43
150	C	595D157(1)004C(2)(3)	6.0	8	0.18	0.78
180	D	595D187(1)004D(2)(3)	7.2	8	0.14	1.04
220	C	595D227(1)004C(2)(3)	8.8	8	0.18	0.78
220	D	595D227(1)004D(2)(3)	8.8	8	0.14	1.04
270	C	595D277(1)004C(2)(3)	10.8	8	0.17	0.80

**Note**

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2"; for gold plated specify "4", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T", for 13" reels specify "W"



STANDARD RATINGS						
CAPACITANCE ( $\mu\text{F}$ )	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu\text{A}$ )	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{\text{RMS}}$ (A)
<b>4 V<sub>DC</sub> AT + 85 °C, 2.7 V<sub>DC</sub> AT + 125 °C</b>						
270	D	595D277(1)004D(2)(3)	10.8	8	0.13	1.07
330	C	595D337(1)004C(2)(3)	13.2	8	0.17	0.80
390	D	595D397(1)004D(2)(3)	15.6	8	0.13	1.07
470	C	595D477(1)004C(2)(3)	18.8	10	0.16	0.83
470	R	595D477(1)004R(2)(3)	18.8	10	0.13	1.39
680	D	595D687(1)004D(2)(3)	27.2	12	0.13	1.07
1000	R	595D108(1)004R(2)(3)	40.0	16	0.07	1.89
1500	R	595D158(1)004R(2)(3)	60.0	20	0.07	1.89
<b>6.3 V<sub>DC</sub> AT + 85 °C, 4 V<sub>DC</sub> AT + 125 °C</b>						
3.3	A	595D335(1)6R3A(2)(3)	0.2	6	3.80	0.14
3.3	T	595D335(1)6R3T(2)(3)	0.5	6	8.50	0.06
4.7	A	595D475(1)6R3A(2)(3)	0.3	6	3.80	0.14
6.8	T	595D685(1)6R3T(2)(3)	0.5	6	8.50	0.06
15	A	595D156(1)6R3A(2)(3)	0.9	6	1.70	0.21
22	A	595D226(1)6R3A(2)(3)	1.4	6	1.70	0.21
22	B	595D226(1)6R3B(2)(3)	1.4	6	0.57	0.39
33	S	595D336(1)6R3S(2)(3)	2.1	8	1.30	0.21
33	A	595D336(1)6R3A(2)(3)	2.1	6	1.70	0.21
33	B	595D336(1)6R3B(2)(3)	2.1	5	0.57	0.39
47	A	595D476(1)6R3A(2)(3)	2.8	6	1.50	0.22
47	B	595D476(1)6R3B(2)(3)	2.8	5	0.57	0.39
68	A	595D686(1)6R3A(2)(3)	4.3	12	0.50	0.39
68	B	595D686(1)6R3B(2)(3)	4.3	6	0.55	0.39
100	M	595D107(1)6R3M(2)(3)	6.3	14	0.40	0.49
100	B	595D107(1)6R3B(2)(3)	6.3	8	0.55	0.39
100	C	595D107(1)6R3C(2)(3)	6.3	8	0.20	0.74
120	C	595D127(1)6R3C(2)(3)	7.6	8	0.19	0.76
150	D	595D157(1)6R3D(2)(3)	9.5	8	0.50	0.55
180	D	595D187(1)6R3D(2)(3)	11.3	8	0.14	1.04
220	C	595D227(1)6R3C(2)(3)	13.9	8	0.18	0.78
220	G	595D227(1)6R3G(2)(3)	13.9	8	0.18	0.80
220	D	595D227(1)6R3D(2)(3)	13.9	8	0.14	1.04
330	C	595D337(1)6R3C(2)(3)	20.8	8	0.17	0.80
330	D	595D337(1)6R3D(2)(3)	20.8	8	0.14	1.04
330	R	595D337(1)6R3R(2)(3)	20.8	8	0.13	1.39
390	R	595D397(1)6R3R(2)(3)	24.6	8	0.13	1.39
470	D	595D477(1)6R3D(2)(3)	29.6	8	0.13	1.07
470	R	595D477(1)6R3R(2)(3)	29.6	10	0.12	1.44
560	R	595D567(1)6R3R(2)(3)	35.3	10	0.11	1.51
680	R	595D687(1)6R3R(2)(3)	42.8	10	0.09	1.67
1000	R	595D108(1)6R3R(2)(3)	63.0	16	0.07	1.89

**Note**

- Part number definitions:

(1) Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"

(2) Termination: For 100 % tin specify "2"; for gold plated specify "4", for solder plated 60/40 specify "8"

(3) Packaging code: For 7" reels specify "T", for 13" reels specify "W"



STANDARD RATINGS						
CAPACITANCE ( $\mu\text{F}$ )	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu\text{A}$ )	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{\text{RMS}}$ (A)
<b>10 V<sub>DC</sub> AT + 85 °C, 7 V<sub>DC</sub> AT + 125 °C</b>						
2.2	T	595D225(1)010T(2)(3)	0.5	6	8.60	0.06
3.3	A	595D335(1)010A(2)(3)	0.5	6	3.80	0.14
4.7	T	595D475(1)010T(2)(3)	0.5	6	8.60	0.06
4.7	A	595D475(1)010A(2)(3)	0.5	6	3.60	0.14
6.8	A	595D685(1)010A(2)(3)	0.7	6	3.60	0.14
10	A	595D106(1)010A(2)(3)	1.0	6	1.90	0.20
15	A	595D156(1)010A(2)(3)	1.5	6	1.80	0.20
15	B	595D156(1)010B(2)(3)	1.5	6	0.67	0.36
22	A	595D226(1)010A(2)(3)	2.2	6	1.80	0.20
22	B	595D226(1)010B(2)(3)	2.2	6	1.90	0.21
33	A	595D336(1)010A(2)(3)	3.3	8	3.00	0.16
33	B	595D336(1)010B(2)(3)	3.3	6	1.90	0.21
47	B	595D476(1)010B(2)(3)	4.7	6	0.65	0.36
47	C	595D476(1)010C(2)(3)	4.7	6	0.30	0.61
68	B	595D686(1)010B(2)(3)	6.8	6	0.65	0.36
68	C	595D686(1)010C(2)(3)	6.8	6	0.24	0.68
100	B	595D107(1)010B(2)(3)	10.0	12	0.40	0.46
100	C	595D107(1)010C(2)(3)	10.0	8	0.20	0.74
100	D	595D107(1)010D(2)(3)	8.0	7	0.15	1.00
120	C	595D127(1)010C(2)(3)	12.0	7	0.22	0.71
120	D	595D127(1)010D(2)(3)	12.0	8	0.14	1.04
150	C	595D157(1)010C(2)(3)	15.0	8	0.22	0.71
150	D	595D157(1)010D(2)(3)	15.0	8	0.14	1.04
180	D	595D187(1)010D(2)(3)	18.0	7	0.38	0.63
180	R	595D187(1)010R(2)(3)	18.0	8	0.13	1.39
220	C	595D227(1)010C(2)(3)	22.0	8	0.20	0.74
220	D	595D227(1)010D(2)(3)	22.0	8	0.14	1.04
220	R	595D227(1)010R(2)(3)	22.0	8	0.13	1.39
270	R	595D277(1)010R(2)(3)	27.0	8	0.13	1.39
330	D	595D337(1)010D(2)(3)	33.0	8	0.14	1.04
330	R	595D337(1)010R(2)(3)	33.0	8	0.13	1.39
390	R	595D397(1)010R(2)(3)	39.0	8	0.12	1.44
470	R	595D477(1)010R(2)(3)	47.0	8	0.12	1.44
680	R	595D687(1)010R(2)(3)	68.0	14	0.09	1.67
<b>16 V<sub>DC</sub> AT + 85 °C, 10 V<sub>DC</sub> AT + 125 °C</b>						
1.5	T	595D155(1)016T(2)(3)	0.5	6	8.70	0.06
2.2	T	595D225(1)016T(2)(3)	0.5	6	8.70	0.06
2.2	A	595D225(1)016A(2)(3)	0.4	5	3.90	0.14
3.3	T	595D335(1)016T(2)(3)	0.5	6	8.60	0.06
4.7	A	595D475(1)016A(2)(3)	0.8	6	2.90	0.16
6.8	A	595D685(1)016A(2)(3)	1.1	6	2.80	0.16
10	A	595D106(1)016A(2)(3)	1.6	6	2.50	0.17
10	B	595D106(1)016B(2)(3)	1.6	6	0.76	0.33
15	A	595D156(1)016A(2)(3)	2.4	6	2.40	0.18
15	B	595D156(1)016B(2)(3)	2.4	6	0.75	0.34

**Note**

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2"; for gold plated specify "4", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T", for 13" reels specify "W"



STANDARD RATINGS						
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{RMS}$ (A)
<b>16 V<sub>DC</sub> AT + 85 °C, 10 V<sub>DC</sub> AT + 125 °C</b>						
22	M	595D226(1)016M(2)(3)	3.5	6	0.50	0.44
22	B	595D226(1)016B(2)(3)	3.5	6	0.75	0.34
33	B	595D336(1)016B(2)(3)	5.3	6	0.72	0.34
33	C	595D336(1)016C(2)(3)	5.3	6	0.29	0.62
47	B	595D476(1)016B(2)(3)	7.5	6	0.72	0.34
47	C	595D476(1)016C(2)(3)	7.5	6	0.28	0.63
68	C	595D686(1)016C(2)(3)	10.9	6	0.26	0.65
68	D	595D686(1)016D(2)(3)	10.9	6	0.14	1.04
100	C	595D107(1)016C(2)(3)	16.0	8	0.27	0.64
100	D	595D107(1)016D(2)(3)	16.0	8	0.14	1.04
120	R	595D127(1)016R(2)(3)	19.2	8	0.14	1.34
150	D	595D157(1)016D(2)(3)	24.0	8	0.14	1.04
150	R	595D157(1)016R(2)(3)	24.0	8	0.13	1.39
180	R	595D187(1)016R(2)(3)	28.8	8	0.13	1.39
220	R	595D227(1)016R(2)(3)	35.2	8	0.12	1.44
330	R	595D337(1)016R(2)(3)	52.8	14	0.11	1.51
<b>20 V<sub>DC</sub> AT + 85 °C, 13 V<sub>DC</sub> AT + 125 °C</b>						
0.68	T	595D684(1)020T(2)(3)	0.5	4	10.80	0.05
1.0	T	595D105(1)020T(2)(3)	0.5	4	9.00	0.06
2.2	A	595D225(1)020A(2)(3)	0.5	6	3.80	0.14
3.3	A	595D335(1)020A(2)(3)	0.7	6	3.80	0.14
4.7	A	595D475(1)020A(2)(3)	0.9	6	3.10	0.16
4.7	B	595D475(1)020B(2)(3)	0.9	6	0.95	0.30
6.8	A	595D685(1)020A(2)(3)	1.4	6	3.00	0.16
6.8	B	595D685(1)020B(2)(3)	1.4	6	0.95	0.30
10	B	595D106(1)020B(2)(3)	2.0	6	1.00	0.29
15	B	595D156(1)020B(2)(3)	3.0	6	1.00	0.29
22	B	595D226(1)020B(2)(3)	4.4	6	0.90	0.31
22	C	595D226(1)020C(2)(3)	4.4	6	0.38	0.54
47	C	595D476(1)020C(2)(3)	9.4	6	0.35	0.56
47	D	595D476(1)020D(2)(3)	9.4	6	0.19	0.89
68	C	595D686(1)020C(2)(3)	13.6	6	0.19	0.76
68	D	595D686(1)020D(2)(3)	13.6	6	0.19	0.89
100	D	595D107(1)020D(2)(3)	20.0	8	0.18	0.91
100	R	595D107(1)020R(2)(3)	20.0	8	0.14	1.34
120	R	595D127(1)020R(2)(3)	24.0	8	0.14	1.34
150	R	595D157(1)020R(2)(3)	30.0	8	0.14	1.34
180	R	595D187(1)020R(2)(3)	36.0	8	0.14	1.34
<b>25 V<sub>DC</sub> AT + 85 °C, 17 V<sub>DC</sub> AT + 125 °C</b>						
0.47	T	595D474(1)025T(2)(3)	0.5	4	13.50	0.05
1.0	A	595D105(1)025A(2)(3)	0.4	4	4.20	0.13
1.5	A	595D155(1)025A(2)(3)	0.5	6	3.80	0.14
2.2	A	595D225(1)025A(2)(3)	0.6	6	3.80	0.14
2.2	B	595D225(1)025B(2)(3)	0.6	6	2.30	0.19
3.3	B	595D335(1)025B(2)(3)	0.8	6	1.90	0.21

**Note**

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2"; for gold plated specify "4", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T", for 13" reels specify "W"



STANDARD RATINGS						
CAPACITANCE ( $\mu\text{F}$ )	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C ( $\mu\text{A}$ )	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )	MAX. RIPPLE 100 kHz $I_{\text{RMS}}$ (A)
<b>25 V<sub>DC</sub> AT + 85 °C, 17 V<sub>DC</sub> AT + 125 °C</b>						
4.7	B	595D475(1)025B(2)(3)	1.2	6	1.80	0.22
4.7	C	595D475(1)025C(2)(3)	1.3	5	0.68	0.40
6.8	B	595D685(1)025B(2)(3)	1.7	6	1.50	0.24
10	B	595D106(1)025B(2)(3)	2.5	6	1.50	0.24
10	C	595D106(1)025C(2)(3)	2.5	6	0.57	0.44
15	C	595D156(1)025C(2)(3)	3.8	6	0.56	0.44
22	C	595D226(1)025C(2)(3)	5.5	6	0.50	0.47
22	D	595D226(1)025D(2)(3)	5.5	6	0.28	0.73
33	C	595D336(1)025C(2)(3)	8.3	6	0.45	0.49
33	D	595D336(1)025D(2)(3)	8.3	6	0.27	0.75
47	D	595D476(1)025D(2)(3)	11.8	6	0.26	0.76
47	R	595D476(1)025R(2)(3)	11.8	6	0.20	1.12
68	D	595D686(1)025D(2)(3)	17.0	8	0.26	0.76
68	R	595D686(1)025R(2)(3)	17.0	6	0.20	1.12
100	R	595D107(1)025R(2)(3)	25.0	8	0.20	1.12
<b>35 V<sub>DC</sub> AT + 85 °C, 23 V<sub>DC</sub> AT + 125 °C</b>						
0.33	T	595D334(1)035T(2)(3)	0.5	4	14.40	0.05
0.47	A	595D474(1)035A(2)(3)	0.5	4	4.30	0.13
0.68	A	595D684(1)035A(2)(3)	0.5	4	4.20	0.13
1.0	A	595D105(1)035A(2)(3)	0.5	4	4.10	0.14
1.5	A	595D155(1)035A(2)(3)	0.5	6	3.80	0.14
1.5	B	595D155(1)035B(2)(3)	0.5	6	2.80	0.17
2.2	B	595D225(1)035B(2)(3)	0.8	6	2.30	0.19
3.3	B	595D335(1)035B(2)(3)	1.2	6	2.40	0.19
3.3	C	595D335(1)035C(2)(3)	1.2	6	0.75	0.38
4.7	B	595D475(1)035B(2)(3)	1.6	6	2.20	0.20
4.7	C	595D475(1)035C(2)(3)	1.6	6	0.66	0.41
6.8	C	595D685(1)035C(2)(3)	2.4	6	0.63	0.42
10	D	595D106(1)035D(2)(3)	3.5	6	0.43	0.59
15	C	595D156(1)035C(2)(3)	5.3	6	0.60	0.43
15	D	595D156(1)035D(2)(3)	5.3	6	0.41	0.60
22	D	595D226(1)035D(2)(3)	7.7	6	0.32	0.68
22	R	595D226(1)035R(2)(3)	7.7	6	0.28	0.94
33	R	595D336(1)035R(2)(3)	11.6	6	0.28	0.94
47	R	595D476(1)035R(2)(3)	16.5	6	0.28	0.94
<b>50 V<sub>DC</sub> AT + 85 °C, 33 V<sub>DC</sub> AT + 125 °C</b>						
0.10	T	595D104(1)050T(2)(3)	0.5	4	22.50	0.04
0.15	T	595D154(1)050T(2)(3)	0.5	4	18.00	0.04
0.22	T	595D224(1)050T(2)(3)	0.5	4	15.30	0.04
0.22	A	595D224(1)050A(2)(3)	0.5	4	9.00	0.09
0.33	A	595D334(1)050A(2)(3)	0.5	4	8.10	0.10

**Note**

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  - Termination: For 100 % tin specify "2"; for gold plated specify "4", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T", for 13" reels specify "W"



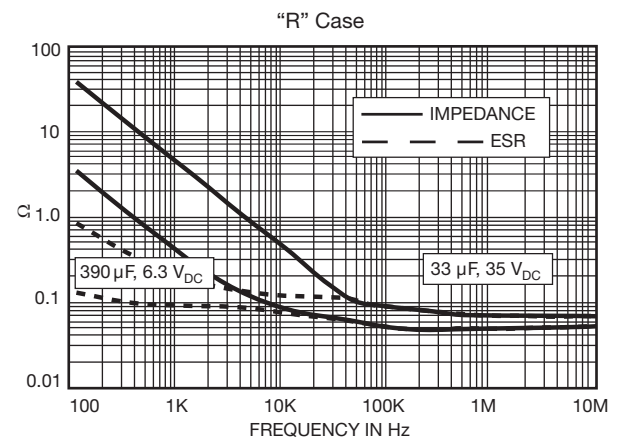
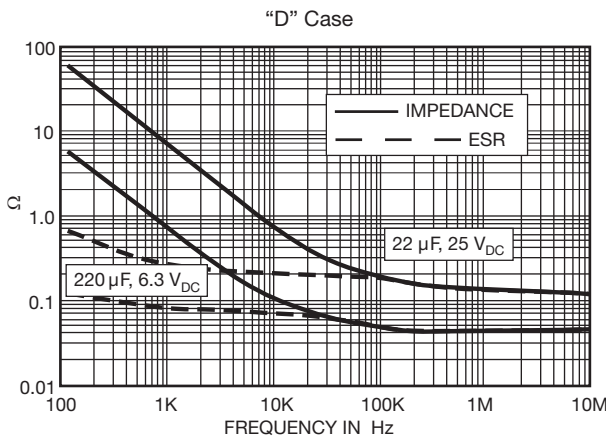
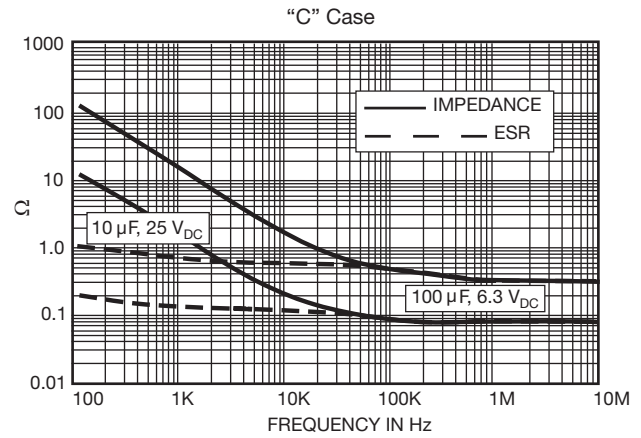
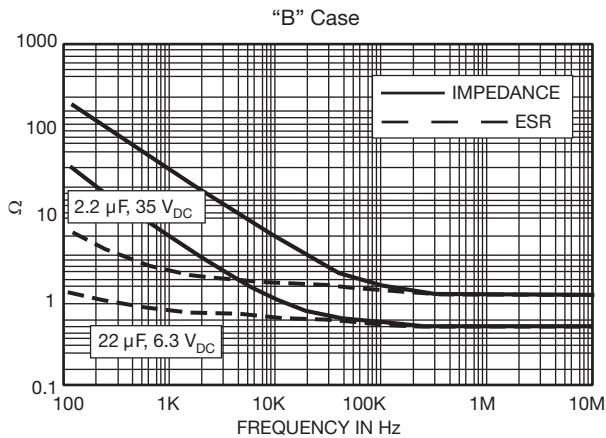
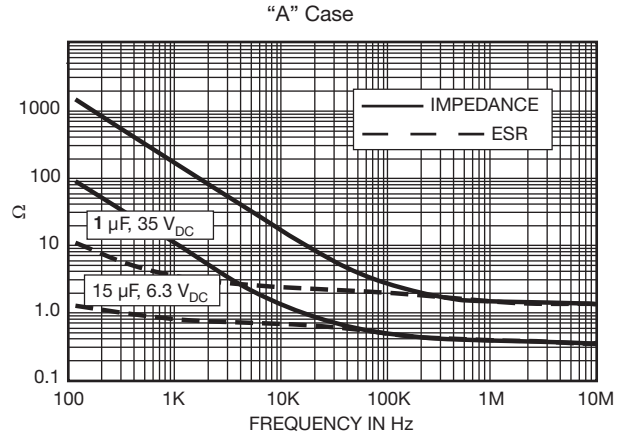
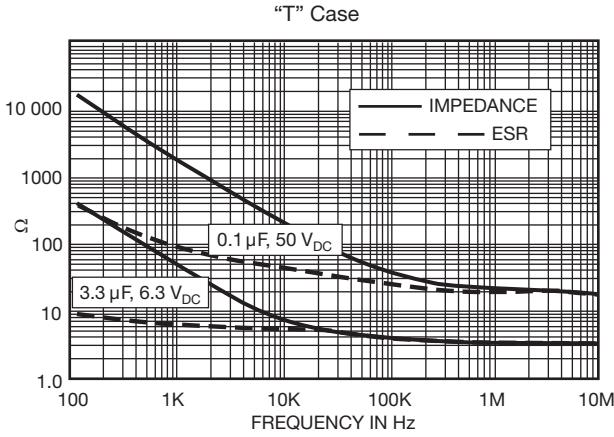
STANDARD RATINGS						
CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C (μA)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz (Ω)	MAX. RIPPLE 100 kHz I <sub>RMS</sub> (A)
50 V <sub>DC</sub> AT + 85 °C, 33 V <sub>DC</sub> AT + 125 °C						
0.47	A	595D474(1)050A(2)(3)	0.5	4	7.20	0.10
0.68	A	595D684(1)050A(2)(3)	0.5	4	6.10	0.11
0.68	B	595D684(1)050B(2)(3)	0.5	4	5.40	0.13
1.0	A	595D105(1)050A(2)(3)	0.5	4	6.00	0.11
1.0	B	595D105(1)050B(2)(3)	0.5	4	5.00	0.13
1.5	B	595D155(1)050B(2)(3)	0.8	6	4.10	0.14
1.5	C	595D155(1)050C(2)(3)	0.8	6	1.80	0.25
2.2	B	595D225(1)050B(2)(3)	1.1	6	3.20	0.16
2.2	C	595D225(1)050C(2)(3)	1.1	6	1.70	0.25
3.3	C	595D335(1)050C(2)(3)	1.7	6	1.60	0.26
4.7	C	595D475(1)050C(2)(3)	2.4	6	1.40	0.28
6.8	C	595D685(1)050C(2)(3)	3.4	6	1.30	0.29
6.8	D	595D685(1)050D(2)(3)	3.4	6	0.82	0.43
10	D	595D106(1)050D(2)(3)	5.0	6	0.80	0.43
10	R	595D106(1)050R(2)(3)	5.0	6	0.65	0.62
15	R	595D156(1)050R(2)(3)	7.5	6	0.40	0.79
22	R	595D226(1)050R(2)(3)	11.0	6	0.39	0.80

**Note**

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2"; for gold plated specify "4", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T", for 13" reels specify "W"

RECOMMENDED VOLTAGE DERATING GUIDELINES (for temperature below + 85 °C)	
STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.6
10	6.0
16	10
20	12
25	15
35	24
50	28
SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24

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





POWER DISSIPATION	
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
A	0.075
B	0.085
C	0.110
D	0.150
G	0.115
M	0.095
R	0.250
S	0.060
T	0.030

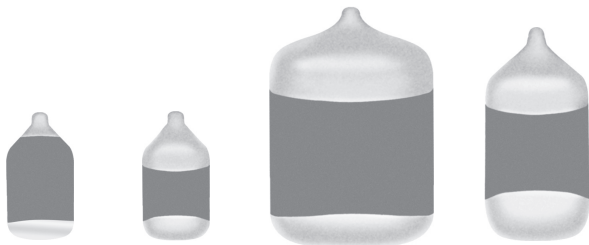
STANDARD PACKAGING QUANTITY		
CASE CODE	UNITS PER REEL	
	7" REEL	13" REEL
A	2000	9000
B	2000	8000
C	500	3000
D	500	2500
G	500	2500
M	2000	8000
R	600	n/a
S	2500	10 000
T	2500	10 000

PRODUCT INFORMATION	
Conformal Coated Guide	<a href="http://www.vishay.com/doc?40150">www.vishay.com/doc?40150</a>
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
SELECTOR GUIDES	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
FAQ	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>



# Solid Tantalum Chip Capacitors

## TANTAMOUNT<sup>®</sup>, Low Profile, Conformal Coated, Maximum CV



P case top P case bottom B and T cases Q, S, and A cases

Images not to scale

**FEATURES**

- P case offers single-sided lead (Pb)-free terminations
- Wraparound lead (Pb)-free terminations: Q, S, A, B, and T cases
- 8 mm and 12 mm tape and reel packaging available per EIA-481 and reeling per IEC 60286-3 7" [178 mm] standard 13" [330 mm] available
- Mounting: Surface mount
- Compliant to RoHS Directive 2002/95/EC


**RoHS**  
COMPLIANT

**PERFORMANCE CHARACTERISTICS**
[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)
**Operating Temperature:** - 55 °C to + 85 °C  
(to + 125 °C with voltage derating)

**Capacitance Range:** 2.2 μF to 220 μF

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

**Voltage Rating:** 4 V<sub>DC</sub> to 35 V<sub>DC</sub>
**ORDERING INFORMATION**

572D	336	X0	6R3	A	2	T
TYPE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	CASE CODE	TERMINATION	REEL SIZE AND PACKAGING
	This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow.	<b>X0 = ± 20 %</b> <b>X9 = ± 10 %</b>	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).	See Ratings and Case Codes table	<b>2 = 100 % tin</b> <b>4 = Gold plated</b>	<b>T = Tape and reel</b> <b>7" [178 mm] reel</b> <b>W = 13" [330 mm] reel</b>

**Notes**

- Preferred tolerance and reel sizes are in bold
- We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size

**DIMENSIONS** in inches [millimeters]

CASE CODE	L (MAX.)	W	H	A	B	C	D (REF.)
P	0.087 ± 0.012 [2.2 ± 0.3]	0.049 ± 0.012 [1.25 ± 0.3]	0.039 ± 0.008 [1.0 ± 0.2]	0.024 ± 0.012 [0.6 ± 0.3]	0.031 ± 0.012 [0.8 ± 0.3]	0.031 ± 0.012 [0.8 ± 0.3]	0.008 [0.2]
Q	0.126 ± 0.008 [3.2 ± 0.2]	0.063 ± 0.008 [1.6 ± 0.2]	0.031 ± 0.008 [0.8 ± 0.2]	0.031 ± 0.008 [0.8 ± 0.2]	0.047 ± 0.008 [1.2 ± 0.2]	0.031 ± 0.008 [0.8 ± 0.2]	0.008 [0.2]
S	0.126 ± 0.012 [3.2 ± 0.3]	0.063 ± 0.012 [1.6 ± 0.3]	0.039 ± 0.008 [1.0 ± 0.2]	0.031 ± 0.012 [0.8 ± 0.3]	0.047 ± 0.012 [1.2 ± 0.3]	0.031 ± 0.012 [0.8 ± 0.3]	0.008 [0.2]
A	0.126 ± 0.012 [3.2 ± 0.3]	0.067 ± 0.012 [1.7 ± 0.3]	0.051 ± 0.012 [1.3 ± 0.3]	0.031 ± 0.012 [0.8 ± 0.3]	0.047 ± 0.012 [1.2 ± 0.3]	0.031 ± 0.012 [0.8 ± 0.3]	0.008 [0.2]
B	0.130 ± 0.012 [3.3 ± 0.3]	0.106 ± 0.012 [2.7 ± 0.3]	0.067 ± 0.012 [1.7 ± 0.3]	0.031 ± 0.012 [0.8 ± 0.3]	0.047 ± 0.012 [1.2 ± 0.3]	0.043 ± 0.012 [1.1 ± 0.3]	0.008 [0.2]
T	0.138 ± 0.008 [3.5 ± 0.2]	0.106 ± 0.008 [2.7 ± 0.2]	0.039 ± 0.008 [1.0 ± 0.2]	0.031 ± 0.008 [0.8 ± 0.2]	0.047 ± 0.008 [1.2 ± 0.2]	0.043 ± 0.008 [1.1 ± 0.2]	0.008 [0.2]



RATINGS AND CASE CODES						
μF	4 V	6.3 V	10 V	16 V	25 V	35 V
2.2					Q	A
4.7					A/S	
10			P	P	A	
22				A/B/T		
33		A/P/Q/S	A/P/S			
47		Q/S	S			
68		S	B			
100		A/B/S/T	B/T			
220	B/S/T	B				

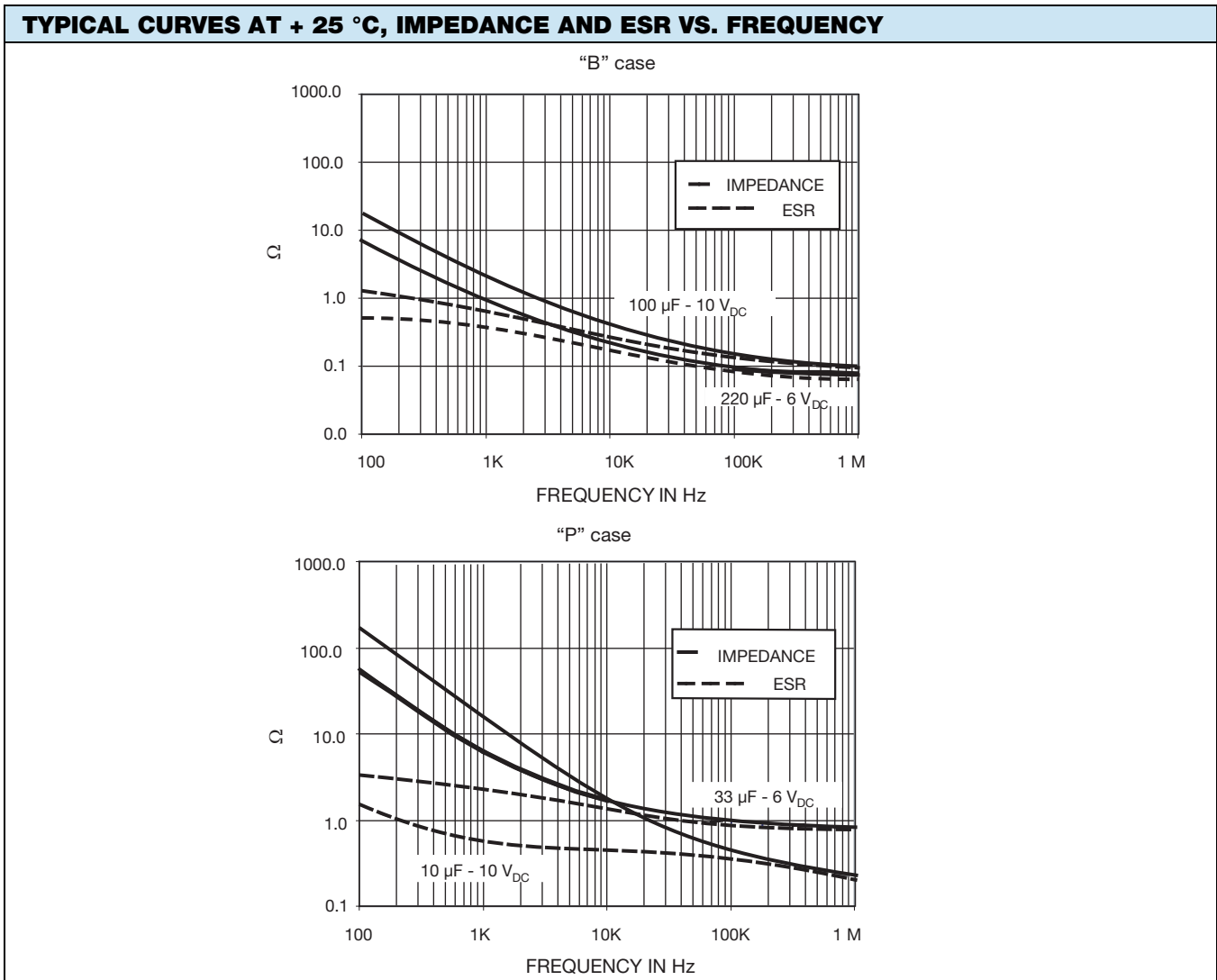
STANDARD RATINGS						
CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C (μA)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz (Ω)	MAX. RIPPLE 100 kHz I <sub>RMS</sub> (A)
<b>4 V<sub>DC</sub> AT+ 85 °C, 2.7 V<sub>DC</sub> AT + 125 °C</b>						
220	B	572D227(1)004B(2)(3)	8.8	16	0.2	0.63
220	S	572D227X0004S(2)(3)	8.8	25	0.8	0.26
220	T	572D227X0004T(2)(3)	8.8	26	0.6	0.37
<b>6.3 V<sub>DC</sub> AT+ 85 °C, 4 V<sub>DC</sub> AT + 125 °C</b>						
33	A	572D336(1)6R3A(2)(3)	2.1	8	0.8	0.29
33	P	572D336X06R3P(2)(3)	2.1	14	1.5	0.13
33	Q	572D336(1)6R3Q(2)(3)	2.1	10	2.0	0.17
33	S	572D336(1)6R3S(2)(3)	2.1	10	1.4	0.24
47	Q	572D476X06R3Q(2)(3)	3.0	10	1.1	0.22
47	S	572D476(1)6R3S(2)(3)	3.0	10	0.9	0.25
68	S	572D686(1)6R3S(2)(3)	4.3	12	0.9	0.26
100	A	572D107(1)6R3A(2)(3)	6.3	14	0.8	0.36
100	B	572D107(1)6R3B(2)(3)	6.3	14	0.4	0.45
100	S	572D107X06R3S(2)(3)	6.3	20	1.0	0.24
100	T	572D107(1)6R3T(2)(3)	6.3	14	0.6	0.36
220	B	572D227(1)6R3B(2)(3)	13.9	16	0.2	0.63
<b>10 V<sub>DC</sub> AT+ 85 °C, 7 V<sub>DC</sub> AT + 125 °C</b>						
10	P	572D106(1)010P(2)(3)	1.0	8	3.0	0.09
33	A	572D336(1)010A(2)(3)	3.3	10	0.8	0.29
33	P	572D336X0010P(2)(3)	3.3	25	4.0	0.08
33	S	572D336X0010S(2)(3)	3.3	10	1.1	0.23
47	S	572D476X0010S(2)(3)	4.7	14	1.1	0.23
68	B	572D686(1)010B(2)(3)	6.8	6	0.45	0.42
100	B	572D107(1)010B(2)(3)	10	14	0.4	0.45
100	T	572D107X0010T(2)(3)	10	18	0.5	0.40
<b>16 V<sub>DC</sub> AT + 85 °C, 10 V<sub>DC</sub> AT + 125 °C</b>						
10	P	572D106(1)016P(2)(3)	1.6	10	4.0	0.08
22	A	572D226(1)016A(2)(3)	3.5	8	1.4	0.22
22	B	572D226(1)016B(2)(3)	3.5	6	0.5	0.45
22	T	572D226(1)016T(2)(3)	3.5	8	1.1	0.27
<b>25 V<sub>DC</sub> AT + 85 °C, 17 V<sub>DC</sub> AT + 125 °C</b>						
2.2	Q	572D225(1)025Q(2)(3)	0.65	6	5.0	0.10
4.7	A	572D475(1)025A(2)(3)	1.2	8	2.8	0.15
4.7	S	572D475(1)025S(2)(3)	1.2	8	4.0	0.12
10	A	572D106(1)025A(2)(3)	2.5	10	3.5	0.15
<b>35 V<sub>DC</sub> AT + 85 °C, 23 V<sub>DC</sub> AT + 125 °C</b>						
2.2	A	572D225(1)035A(2)(3)	0.8	6	3.0	0.12

**Note**

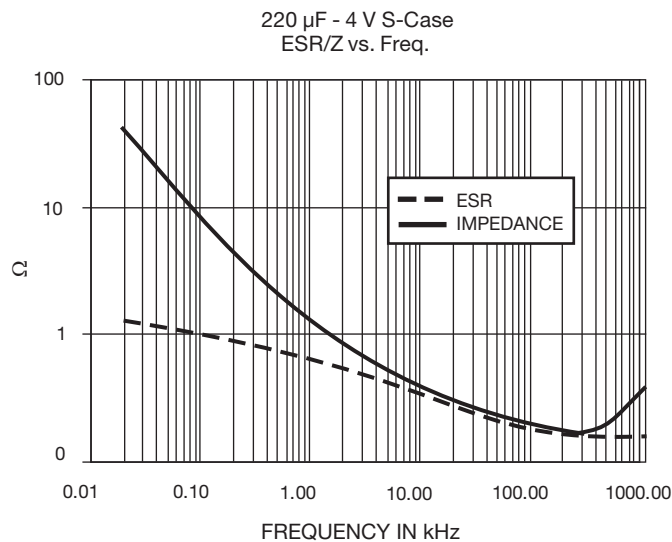
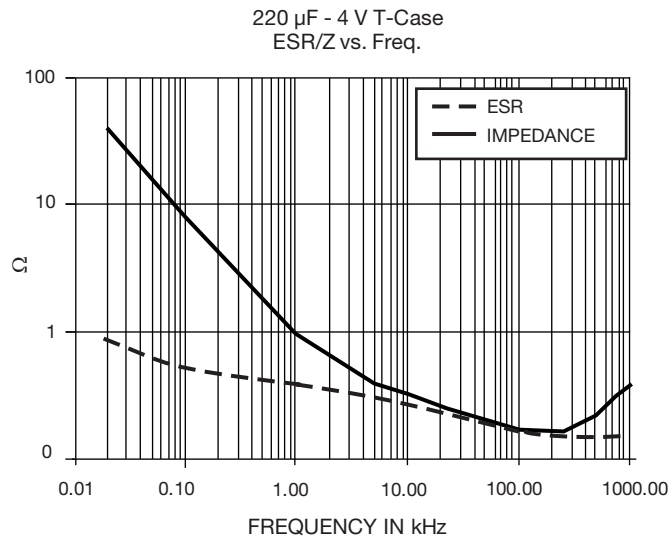
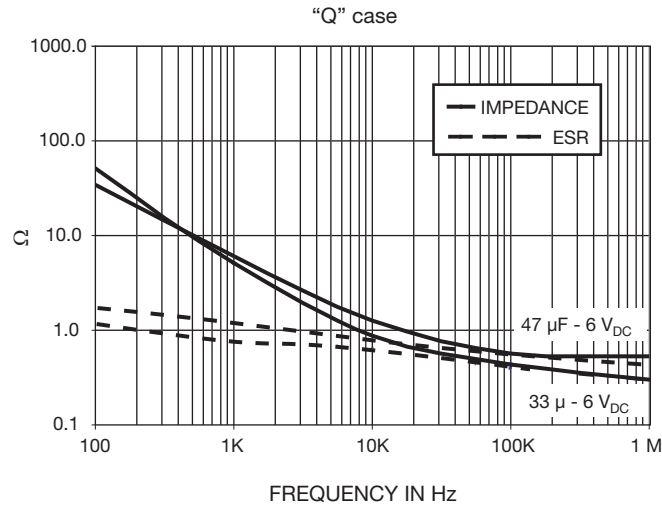
- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9"; for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2", for gold plated specify "4"
  - Packaging code: For 7" reels specify "T", for 13" reel specify "W"



<b>RECOMMENDED VOLTAGE DERATING GUIDELINES</b> (for temperatures below + 85 °C)	
<b>STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS</b>	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.6
10	6.0
16	10
25	15
35	24
<b>SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS</b>	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.3
10	5.0
16	8.0
25	12
35	15



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



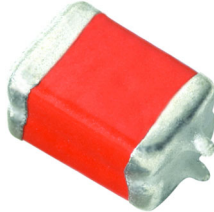


POWER DISSIPATION	
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
P	0.025
Q	0.055
S	0.060
A	0.065
B/T	0.080

STANDARD PACKAGING QUANTITY		
CASE CODE	UNITS PER REEL	
	7" REEL	13" REEL
A	2500	10 000
B	2000	10 000
P	3000	10 000
Q	2500	10 000
S	2500	10 000
T	1500	8000

PRODUCT INFORMATION	
Conformal Coated Guide <ul style="list-style-type: none"> <li>• Recommended Pad Layouts</li> <li>• Carrier Tape Information</li> <li>• Reflow Profiles</li> </ul>	<a href="http://www.vishay.com/doc?40150">www.vishay.com/doc?40150</a>
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
SELECTOR GUIDES	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
FAQ	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

# Solid Tantalum Chip Capacitors, TANTAMOUNT<sup>®</sup>, Ultra-Low ESR, Conformal Coated, Maximum CV


**FEATURES**

- New case size offerings
- Low profile case: V case (2 mm)
- Terminations: 100 % tin (2) standard; tin/lead available
- Extremely low ESR
- Mounting: Surface mount
- Ripple current up to 4.1 A
- Compliant to RoHS Directive 2002/95/EC


**RoHS\***  
COMPLIANT

**Note**

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

**PERFORMANCE CHARACTERISTICS**
[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)
**Operating Temperature:** - 55 °C to + 85 °C  
(To + 125 °C with voltage derating)

**Capacitance Range:** 10 µF to 1500 µF

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

**Voltage Rating:** 4 V<sub>DC</sub> to 75 V<sub>DC</sub>

ORDERING INFORMATION						
597D	687	X0	6R3	E	2	T
TYPE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	CASE CODE	TERMINATION	REEL SIZE AND PACKAGING
	This is expressed in pF. The first two digits are the significant figures. The third is the number of zeros to follow.	<b>X0 = ± 20 %</b> <b>X9 = ± 10 %</b>	This is expressed in V. To complete the three-digit block, zeros precede the voltage rating. A decimal point is indicated by an "R" (6R3 = 6.3 V).	See Ratings and Case Codes table	<b>2 = 100 % tin</b> <b>8 = Solder plated (60/40) special order</b>	<b>T = Tape and reel</b> <b>7" [178 mm] reel</b>

**Note**

- Preferred tolerance and reel sizes are in bold. We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size.

DIMENSIONS in inches [millimeters]							
CASE CODE	L (MAX.)	W	H	A	B	D (REF.)	J (MAX.)
V	0.299 [7.6]	0.173 ± 0.016 [4.4 ± 0.4]	0.079 [2.0 max.]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.6]	0.252 [6.4]	0.004 [0.1]
D	0.299 [7.6]	0.173 ± 0.016 [4.4 ± 0.4]	0.138 [3.5 max.]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.6]	0.252 [6.4]	0.004 [0.1]
E	0.299 [7.6]	0.173 ± 0.016 [4.4 ± 0.4]	0.157 ± 0.016 [4.0 ± 0.4]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.6]	0.252 [6.4]	0.004 [0.1]
R	0.299 [7.6]	0.238 ± 0.016 [6.0 ± 0.4]	0.142 ± 0.016 [3.6 ± 0.4]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.6]	0.244 [6.2]	0.004 [0.1]
F	0.299 [7.6]	0.238 ± 0.016 [6.0 ± 0.4]	0.185 ± 0.016 [4.7 ± 0.4]	0.055 ± 0.016 [1.4 ± 0.4]	0.181 ± 0.024 [4.6 ± 0.6]	0.244 [6.2]	0.004 [0.1]
Z	0.299 [7.6]	0.238 ± 0.016 [6.0 ± 0.4]	0.236 ± 0.016 [6.0 ± 0.4]	0.055 ± 0.016 [1.4 ± 0.4]	0.181 ± 0.024 [4.6 ± 0.6]	0.244 [6.2]	0.004 [0.1]
M	0.315 [8]	0.260 + 0.016/- 0.024 [6.6 + 0.4/- 0.6]	0.142 ± 0.016 [3.6 ± 0.4]	0.051 ± 0.012 [1.3 ± 0.3]	0.197 ± 0.024 [5.0 ± 0.6]	0.260 [6.6]	0.004 [0.1]
H	0.315 [8]	0.260 + 0.016/- 0.024 [6.6 + 0.4/- 0.6]	0.205 ± 0.016 [5.2 ± 0.4]	0.055 ± 0.016 [1.4 ± 0.4]	0.197 ± 0.024 [5.0 ± 0.6]	0.260 [6.6]	0.004 [0.1]

**Note**

- The anode termination (D less B) will be a minimum of 0.012" [0.3 mm]



RATINGS AND CASE CODES										
µF	4 V	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V	63 V	75 V
10									D	R <sup>(1)</sup>
15								E/R	R	
22								R	F	
33								F		
47							R	Z		
68						R	F			
100						F	F			
150						F				
220				E	R	M				
330		V	E	F	H					
470	V	E	E	H						
680	E	E	R							
1000	E/R	R	F							
1500	R									
2200										

**Note**

(1) Preliminary values, contact factory for availability

STANDARD RATINGS						
CAPACITANCE (µF)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C (µA)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz (mΩ)	MAX. RIPPLE 100 kHz I <sub>RMS</sub> (A)
<b>4 V<sub>DC</sub> AT + 85 °C; 2.7 V<sub>DC</sub> AT + 125 °C</b>						
470	V	597D477(1)004V(2)(3)	19	8	60	2.2
680	E	597D687(1)004E(2)(3)	27	6	25	2.9
1000	E	597D108(1)004E(2)(3)	40	8	20	3.3
1000	R	597D108(1)004R(2)(3)	40	8	18	3.7
1500	R	597D158(1)004R(2)(3)	60	8	24	2.9
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT + 125 °C</b>						
330	V	597D337(1)6R3V(2)(3)	21	8	56	2.0
470	E	597D477(1)6R3E(2)(3)	30	6	30	2.7
680	E	597D687(1)6R3E(2)(3)	43	6	25	2.9
1000	R	597D108(1)6R3R(2)(3)	63	8	31	2.8
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT + 125 °C</b>						
330	E	597D337(1)010E(2)(3)	33	6	35	2.5
470	E	597D477(1)010E(2)(3)	47	6	28	2.8
680	R	597D687(1)010R(2)(3)	68	6	28	3.0
1000	F	597D108(1)010F(2)(3)	100	20	120	1.4
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>						
220	E	597D227(1)016E(2)(3)	35	8	60	2.3
330	F	597D337(1)016F(2)(3)	53	10	100	1.6
470	H	597D477(1)016H(2)(3)	75	14	100	1.4
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>						
220	R	597D227(1)020R(2)(3)	44	8	80	1.8
330	H	597D337(1)020H(2)(3)	66	10	100	1.6
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>						
68	R	597D686(1)025R(2)(3)	17	6	100	1.6
100	F	597D107(1)025F(2)(3)	25	8	100	1.6

**Notes**

- Part number definitions:
  - Tolerance: For 10 % tolerance, specify "X9", for 20 % tolerance, change to "X0"
  - Termination: For 100 % tin specify "2", for solder plated 60/40 specify "8"
  - Packaging code: For 7" reels specify "T"
- Preliminary values, contact factory for availability



STANDARD RATINGS						
CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C (μA)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz (mΩ)	MAX. RIPPLE 100 kHz I <sub>RMS</sub> (A)
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>						
150	F	597D157(1)025F(2)(3)	38	8	80	1.8
220	M	597D227(1)025M(2)(3)	55	8	100	1.6
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>						
47	R	597D476(1)035R(2)(3)	17	6	100	1.6
68	F	597D686(1)035F(2)(3)	24	6	100	1.6
100	F	597D107X0035F(2)(3)	35	8	100	1.6
<b>50 V<sub>DC</sub> AT + 85 °C; 33 V<sub>DC</sub> AT + 125 °C</b>						
15	E	597D156(1)050E(2)(3)	8	6	300	0.9
15	R	597D156(1)050R(2)(3)	8	6	250	1.0
22	R	597D226(1)050R(2)(3)	11	6	220	1.1
33	F	597D336(1)050F(2)(3)	17	6	150	1.3
47	Z	597D476(1)050Z(2)(3)	24	6	240	1.1
<b>63 V<sub>DC</sub> AT + 85 °C; 42 V<sub>DC</sub> AT + 125 °C</b>						
10	D	597D106(1)063D(2)(3)	10	6	400	0.6
15	R	597D156(1)063R(2)(3)	10	6	400	0.8
22	F	597D226(1)063F(2)(3)	14	6	250	1.0
<b>75 V<sub>DC</sub> AT + 85 °C; 50 V<sub>DC</sub> AT + 125 °C</b>						
10	R <sup>(1)</sup>	597D106(1)075R(2)(3)	8	6	500	0.7

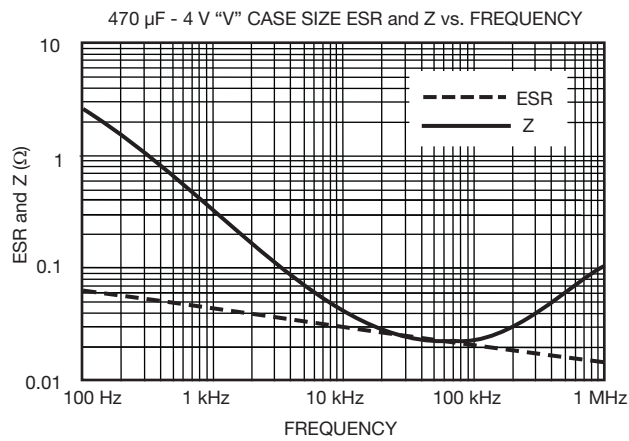
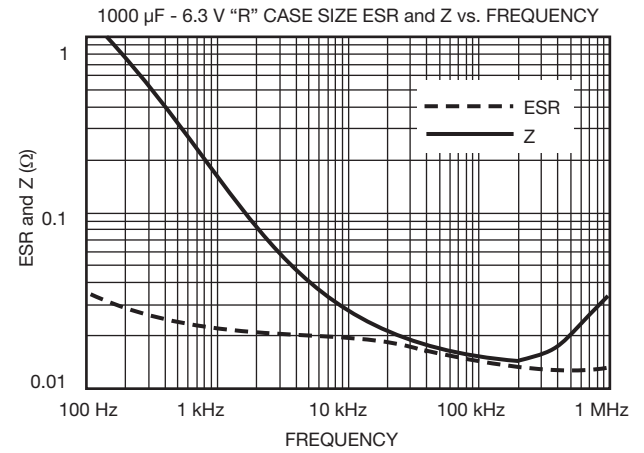
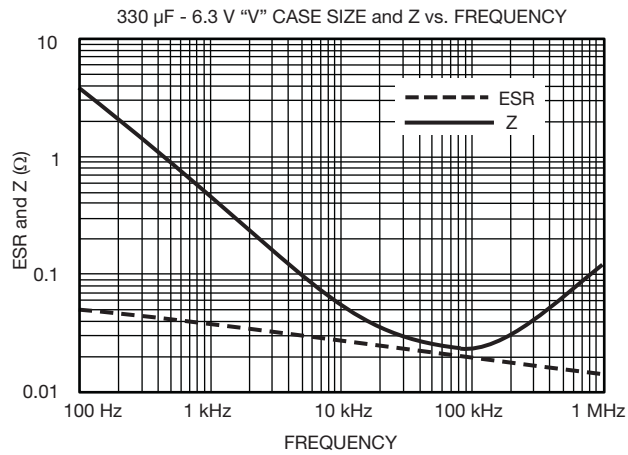
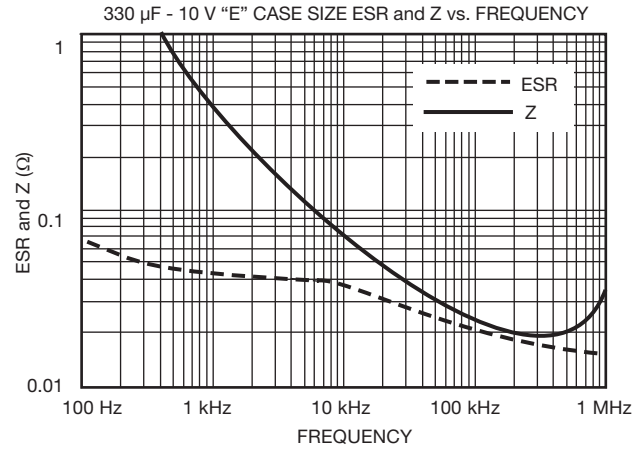
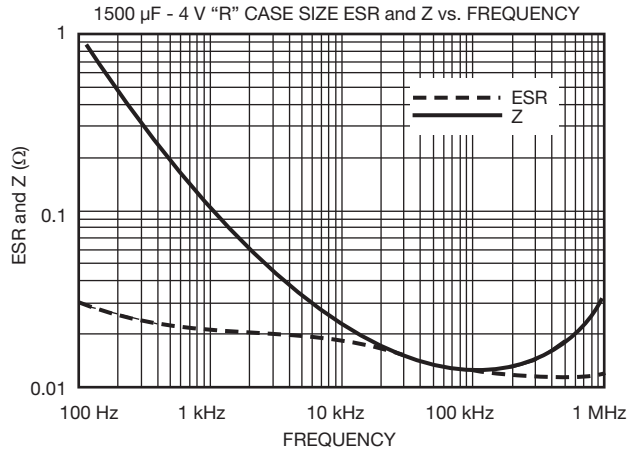
**Notes**

- Part number definitions:
  - (1) Tolerance: For 10 % tolerance, specify "X9", for 20 % tolerance, change to "X0"
  - (2) Termination: For 100 % tin specify "2", for solder plated 60/40 specify "8"
  - (3) Packaging code: For 7" reels specify "T"
- (1) Preliminary values, contact factory for availability

RECOMMENDED VOLTAGE DERATING GUIDELINES (for temperature below + 85 °C)	
STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.6
10	6.0
16	10
20	12
25	15
35	24
50	28
63	37.8
75	45
SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24
63	32
75	37



**TYPICAL CURVES**



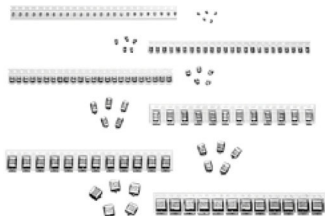


<b>POWER DISSIPATION</b>	
<b>CASE CODE</b>	<b>MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR</b>
V	0.141
D	0.215
E	0.240
R, F, M	0.250
Z	0.265
H	0.265

<b>STANDARD PACKAGING QUANTITY</b>	
<b>CASE CODE</b>	<b>UNITS PER 7" REEL</b>
V	1000
D	400
E	500
R	300
F	250
Z	250
M	200
H	200

<b>PRODUCT INFORMATION</b>	
Conformal Coated Guide	<a href="http://www.vishay.com/doc?40150">www.vishay.com/doc?40150</a>
Pad Dimensions	
Packaging Dimensions	
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
<b>SELECTOR GUIDES</b>	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
<b>FAQ</b>	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

# Solid Tantalum Chip Capacitors, TANTAMOUNT<sup>®</sup>, Hi-Rel COTS, Conformal Coated



## FEATURES

- High reliability; Weibull grading available
- Surge current testing per MIL-PRF-55365 options available
- Standard and low ESR options
- Terminations: SnPb, standard. 100 % tin available
- Compliant to RoHS Directive 2002/95/EC
- Mounting: Surface mount


**RoHS\***  
COMPLIANT

### Note

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

## PERFORMANCE/ELECTRICAL CHARACTERISTICS

[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)

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

**Capacitance Range:** 0.15 μF to 680 μF

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

**Voltage Rating:** 4 V<sub>DC</sub> to 50 V<sub>DC</sub>

ORDERING INFORMATION								
T95	D	107	K	010	E	A	A	S
TYPE	CASE CODE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	TERMINATION AND PACKAGING	RELIABILITY LEVEL	SURGE CURRENT	ESR
	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) ½ reel C: 100 % tin/ 7" (178 mm) reels H: 100 % tin/ 7" (178 mm) ½ reel	A = 1.0 % Weibull B = 0.1 % Weibull (1) C = 0.01 % Weibull (1) S = Hi-rel standard burn-in Z = Non-established reliability	A = 10 cycles at + 25 °C B = 10 cycles at - 55 °C/+ 85 °C S = 3 cycles at + 25 °C	S = Std. L = Low

### Note

(1) Weibull 0.1 % and 0.01 % may not be available on all ratings. See detailed notes in ratings table or contact marketing for availability

DIMENSIONS in inches [millimeters]							
CASE CODE	L (MAX.)	W	H	A	B	D (REF.)	J (MAX.)
A	0.146 [3.7]	0.072 ± 0.012 [1.83 ± 0.3]	0.056 ± 0.012 [1.4 ± 0.3]	0.031 ± 0.012 [0.8 ± 0.3]	0.085 ± 0.016 [2.2 ± 0.40]	0.114 [2.9]	0.004 [0.10]
B	0.157 [4.0]	0.110 + 0.012/- 0.016 [2.8 + 0.3/- 0.4]	0.075 + 0.012/- 0.024 [1.9 + 0.3/- 0.6]	0.031 ± 0.012 [0.8 ± 0.3]	0.098 ± 0.016 [2.5 ± 0.40]	0.138 [3.5]	0.004 [0.10]
C	0.280 [7.1]	0.126 ± 0.012 [3.2 ± 0.3]	0.098 ± 0.012 [2.5 ± 0.3]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.60]	0.236 [6.0]	0.004 [0.10]
D	0.295 [7.5]	0.169 ± 0.012 [4.3 ± 0.3]	0.110 ± 0.012 [2.8 ± 0.3]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.60]	0.252 [6.0]	0.004 [0.10]



DIMENSIONS in inches [millimeters]							
CASE CODE	L (MAX.)	W	H	A	B	D (REF.)	J (MAX.)
R	0.283 max. [7.20 max.]	0.236 + 0.012/- 0.024 [6.0 + 0.30/- 0.60]	0.138 ± 0.012 [3.50 ± 0.30]	0.051 ± 0.012 [1.30 ± 0.30]	0.181 ± 0.024 [4.60 ± 0.60]	0.244 [6.20]	0.004 [0.10]
S	0.143 max. [3.63 max.]	0.072 ± 0.008 [1.83 ± 0.20]	0.048 ± 0.008 [1.22 ± 0.20]	0.023 ± 0.010 [0.58 ± 0.25]	0.085 ± 0.015 [2.16 ± 0.37]	0.114 [2.90]	0.004 [0.10]
V	0.143 max. [3.63 max.]	0.104 ± 0.010 [2.65 ± 0.25]	0.051 ± 0.010 [1.30 ± 0.25]	0.023 ± 0.010 [0.58 ± 0.25]	0.085 ± 0.015 [2.16 ± 0.37]	0.114 [2.90]	0.004 [0.10]
X	0.285 max. [7.24 max.]	0.104 ± 0.010 [2.65 ± 0.25]	0.051 ± 0.010 [1.30 ± 0.25]	0.039 ± 0.020 [1.00 ± 0.50]	0.200 ± 0.027 [5.08 ± 0.69]	0.244 [6.20]	0.004 [0.10]
Y	0.285 max. [7.24 max.]	0.104 ± 0.010 [2.65 ± 0.25]	0.069 ± 0.010 [1.75 ± 0.25]	0.039 ± 0.020 [1.00 ± 0.50]	0.200 ± 0.027 [5.08 ± 0.69]	0.244 [6.20]	0.004 [0.10]
Z	0.285 max. [7.24 max.]	0.104 ± 0.010 [2.65 ± 0.25]	0.104 ± 0.010 [2.65 ± 0.25]	0.039 ± 0.020 [1.00 ± 0.50]	0.200 ± 0.027 [5.08 ± 0.69]	0.244 [6.20]	0.004 [0.10]

**Note**

- The anode termination (D less B) will be a minimum of 0.010" (0.25 mm)

RATINGS AND CASE CODES								
µF	4 V	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V
0.15							S	
0.22							S	
0.33							S	
0.47							S	
0.68						S	S	
1.0						S	S	
1.5					S	S	V	
2.2				S	S	V	X	
3.3			S	S	V	X		
4.7		S	S	V	X		Y	C
6.8	S	S	V	A/X	X	Y	Z	C/D
10	S	V	X	X	Y	C/Y	Z	
15	V	X	B/X	B/Y	Z	Z	R	R
22	X	X	Y	B/Z	Z		R	R
33	X		Z	Z		D/R	R	
47	Y	Y	Z		R	D/R	R	
68	Y	Z		R		D/R		
100	Z		R	C/D	R	R		
120			D/R		R			
150			D/R	D	R			
180				R	R			
220			D/R	R				
270	D							
330	R	C	D/R	R				
390		R						
470		D	R					
680		R	R					



STANDARD RATINGS							
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	STD. (S) MAX. ESR AT + 25 °C 100 kHz <sup>(1)</sup> ( $\Omega$ )	LOW (L) MAX. ESR AT + 25 °C 100 kHz <sup>(1)</sup> ( $\Omega$ )	AVAILABLE RELIABILITY LEVELS
<b>4 V<sub>DC</sub> AT + 85 °C; 2.7 V<sub>DC</sub> AT + 125 °C</b>							
6.8	S	T95S685(1)004(2)(3)(4)L	0.5	6		2.000	A, S, Z
10	S	T95S106(1)004(2)(3)(4)L	0.5	6		2.000	A, S, Z
15	V	T95V156(1)004(2)(3)(4)L	0.6	6		1.500	A, S, Z
22	X	T95X226(1)004(2)(3)(4)L	0.9	6		1.000	A, S, Z
33	X	T95X336(1)004(2)(3)(4)L	1.3	6		1.000	A, S, Z
47	Y	T95Y476(1)004(2)(3)(4)L	1.9	6		0.600	A, S, Z
68	Y	T95Y686(1)004(2)(3)(4)L	2.7	6		0.600	A, S, Z
100	Z	T95Z107(1)004(2)(3)(4)L	4.0	6		0.400	A, S, Z
270	D	T95D277(1)004(2)(3)(4)(5)	10.8	8	0.13	0.060	A, S, Z
330	R	T95R337(1)004(2)(3)(4)(5)	13.2	8	0.13	0.080	A, S, Z
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT 125 °C</b>							
4.7	S	T95S475(1)6R3(2)(3)(4)L	0.5	6		2.000	A, S, Z
6.8	S	T95S685(1)6R3(2)(3)(4)L	0.5	6		2.000	A, S, Z
10	V	T95V106(1)6R3(2)(3)(4)L	0.6	6		1.500	A, S, Z
15	X	T95X156(1)6R3(2)(3)(4)L	0.9	6		1.000	A, S, Z
22	X	T95X226(1)6R3(2)(3)(4)L	1.4	6		1.000	A, S, Z
47	Y	T95Y476(1)6R3(2)(3)(4)L	2.8	6		0.600	A, S, Z
100	Z	T95Z107(1)6R3(2)(3)(4)L	6.0	6		0.400	A, S, Z
180	R	T95R187(1)6R3(2)(3)(4)(5)	10.8	8	0.130	0.080	A, S, Z
220	D	T95R227(1)6R3(2)(6)(4)(5)	22.0	8	0.140	0.065	A, B, S, Z
220	R	T95R227(1)6R3(2)(3)(4)(5)	13.2	8	0.130	0.080	A, S, Z
330	C	T95C337(1)6R3(2)(7)(4)(5)	20.8	8	0.080	0.170	A, B, C, S, Z
390	R	T95R397(1)6R3(2)(3)(4)(5)	23.4	8	0.130	0.045	A, S, Z
470	D	T95D477(1)6R3(2)(3)(4)(5)	28.2	10	0.130	0.060	A, S, Z
680	R	T95R687(1)6R3(2)(3)(4)(5)	40.8	12	0.090	0.045	A, S, Z
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT 125 °C</b>							
3.3	S	T95S335(1)010(2)(3)(4)L	0.5	6		2.500	A, S, Z
4.7	S	T95S475(1)010(2)(3)(4)L	0.5	6		2.000	A, S, Z
6.8	V	T95V685(1)010(2)(3)(4)L	0.7	6		2.000	A, S, Z
10	X	T95X106(1)010(2)(3)(4)L	1.0	6		1.500	A, S, Z
15	B	T95B156(1)010(2)(6)(4)(5)	1.5	6	0.750	0.550	A, B, S, Z
15	X	T95X156(1)010(2)(3)(4)L	1.5	6		1.000	A, S, Z
22	Y	T95Y226(1)010(2)(6)(4)L	2.2	6		0.600	A, B, S, Z
33	Z	T95Z336(1)010(2)(6)(4)L	3.3	6		0.400	A, B, S, Z
47	Z	T95Z476(1)010(2)(3)(4)L	4.7	6		0.400	A, S, Z
100	R	T95R107(1)010(2)(3)(4)(5)	10.0	8	0.140	0.075	A, S, Z
120	D	T95D127(1)010(2)(7)(4)(5)	12.0	8	0.140	0.085	A, B, C, S, Z
120	R	T95R127(1)010(2)(6)(4)(5)	12.0	8	0.140	0.070	A, B, S, Z
150	D	T95D157(1)010(2)(3)(4)(5)	15.0	8	0.140	0.075	A, S, Z
150	R	T95R157(1)010(2)(3)(4)(5)	15.0	8	0.130	0.065	A, S, Z
220	D	T95D227(1)010(2)(6)(4)(5)	22.0	8	0.140	0.065	A, B, S, Z
220	R	T95R227(1)010(2)(3)(4)(5)	22.0	8	0.130	0.055	A, S, Z
330	D	T95D337(1)010(2)(7)(4)(5)	33.0	8	0.140	0.065	A, B, C, S, Z
330	R	T95R337(1)010(2)(3)(4)(5)	33.0	8	0.130	0.045	A, S, Z
470	R	T95R477(1)010(2)(6)(4)(5)	47.0	8	0.130	0.045	A, B, S, Z
680	R	T95R687(1)010(2)(6)(4)(5)	68.0	14	0.090		A, B, S, Z

**Notes**

- Part number definitions:
  - (1) Capacitance tolerance: K, M
  - (2) Termination and packaging: C, E, H, L
  - (3) Reliability level: A, S, Z
  - (4) Surge current: A, B, S
  - (5) ESR: L, S
  - (6) Reliability level: A, B, S, Z
  - (7) Reliability level: A, B, C, S, Z
- (1) Empty cells: Not available



STANDARD RATINGS							
CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C (μA)	MAX. DF AT + 25 °C 120 Hz (%)	STD. (S) MAX. ESR AT + 25 °C 100 kHz (1) (Ω)	LOW (L) MAX. ESR AT + 25 °C 100 kHz (1) (Ω)	AVAILABLE RELIABILITY LEVELS
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>							
2.2	S	T95S225(1)016(2)(3)(4)L	0.5	6		3.500	A, S, Z
3.3	S	T95S335(1)016(2)(3)(4)L	0.5	6		2.500	A, S, Z
4.7	V	T95V475(1)016(2)(3)(4)L	0.8	6		2.000	A, S, Z
6.8	A	T95A685(1)016(2)(3)(4)(5)	1.1	6	2.800	0.800	A, S, Z
6.8	X	T95X685(1)016(2)(3)(4)L	1.1	6		1.500	A, S, Z
10	X	T95X106(1)016(2)(3)(4)L	1.6	6		1.500	A, S, Z
15	B	T95B156(1)016(2)(3)(4)(5)	2.4	6	0.75	0.550	A, S, Z
15	Y	T95Y156(1)016(2)(6)(4)L	2.4	6		0.600	A, B, S, Z
22	B	T95B226(1)016(2)(6)(4)(5)	3.5	6	0.75	0.500	A, B, S, Z
22	Z	T95Z226(1)016(2)(3)(4)L	3.5	6		0.400	A, S, Z
33	Z	T95Z336(1)016(2)(3)(4)L	5.3	6		0.400	A, S, Z
68	R	T95R686(1)016(2)(3)(4)(5)	10.9	6	0.600	0.095	A, S, Z
100	C	T95C107(1)016(2)(6)(4)(5)	16.0	8	0.600	0.090	A, B, S, Z
100	D	T95D107(1)016(2)(6)(4)(5)	16.0	8	0.140	0.080	A, B, S, Z
150	D	T95D157(1)016(2)(6)(4)(5)	24.0	8	0.140	0.085	A, B, S, Z
180	R	T95R187(1)016(2)(6)(4)(5)	28.8	8	0.130	0.055	A, B, S, Z
220	R	T95R227(1)016(2)(6)(4)(5)	35.2	8	0.120	0.055	A, B, S, Z
330	R	T95R337(1)016(2)(6)(4)(5)	52.8	14	0.110	0.055	A, B, S, Z
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>							
1.5	S	T95S155(1)020(2)(3)(4)L	0.5	6		3.500	A, S, Z
2.2	S	T95S225(1)020(2)(3)(4)L	0.5	6		3.500	A, S, Z
3.3	V	T95V335(1)020(2)(3)(4)L	0.7	6		3.000	A, S, Z
4.7	X	T95X475(1)020(2)(3)(4)L	0.9	6		1.500	A, S, Z
6.8	X	T95X685(1)020(2)(3)(4)L	1.4	6		1.500	A, S, Z
10	Y	T95Y106(1)020(2)(3)(4)L	2.0	6		1.000	A, S, Z
15	Z	T95Z156(1)020(2)(3)(4)L	3.0	6		0.600	A, S, Z
22	Z	T95Z226(1)020(2)(3)(4)L	4.4	6		0.400	A, S, Z
47	R	T95R476(1)020(2)(3)(4)L	9.4	6	0.200	0.110	A, S, Z
100	R	T95R107(1)020(2)(6)(4)S	20.0	8	0.140		A, B, S, Z
120	R	T95R127(1)020(2)(6)(4)(5)	24.0	8	0.140	0.080	A, B, S, Z
150	R	T95R157(1)020(2)(3)(4)(5)	30.0	8	0.140	0.075	A, S, Z
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>							
0.68	S	T95S684(1)025(2)(3)(4)L	0.5	4		5.000	A, S, Z
1.0	S	T95S105(1)025(2)(3)(4)L	0.5	4		3.500	A, S, Z
1.5	S	T95S155(1)025(2)(3)(4)L	0.5	6		3.500	A, S, Z
2.2	V	T95V225(1)025(2)(3)(4)L	0.6	6		2.000	A, S, Z
4.7	X	T95X475(1)025(2)(3)(4)L	1.2	6		1.500	A, S, Z
6.8	Y	T95Y685(1)025(2)(3)(4)L	1.7	6		1.000	A, S, Z
10	C	T95C106(1)025(2)(3)(4)(5)	2.5	6	0.57	0.280	A, S, Z
10	Y	T95Y106(1)025(2)(3)(4)L	2.5	6		1.000	A, S, Z
15	Z	T95Z156(1)025(2)(3)(4)L	3.8	6		0.600	A, S, Z
33	D	T95D336(1)025(2)(3)(4)(5)	8.3	6	0.260	0.130	A, S, Z
33	R	T95R336(1)025(2)(3)(4)(5)	8.3	6	0.250	0.130	A, S, Z
47	D	T95D476(1)025(2)(6)(4)(5)	11.8	6	0.260	0.130	A, B, S, Z
47	R	T95R476(1)025(2)(3)(4)(5)	11.8	6	0.200	0.108	A, S, Z
68	D	T95D686(1)025(2)(6)(4)(5)	17.0	8	0.260	0.200	A, B, S, Z
68	R	T95R686(1)025(2)(6)(4)(5)	17.0	6	0.200	0.095	A, B, S, Z
100	R	T95R107(1)025(2)(6)(4)(5)	25.0	8	0.200	0.090	A, B, S, Z

**Notes**

- Part number definitions:
  - (1) Capacitance tolerance: K, M
  - (2) Termination and packaging: C, E, H, L
  - (3) Reliability level: A, S, Z
  - (4) Surge current: A, B, S
  - (5) ESR: L, S
  - (6) Reliability level: A, B, S, Z
  - (7) Reliability level: A, B, C, S, Z
- (1) Empty cells: Not available



STANDARD RATINGS							
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C ( $\mu$ A)	MAX. DF AT + 25 °C 120 Hz (%)	STD. (S) MAX. ESR AT + 25 °C 100 kHz <sup>(1)</sup> ( $\Omega$ )	LOW (L) MAX. ESR AT + 25 °C 100 kHz <sup>(1)</sup> ( $\Omega$ )	AVAILABLE RELIABILITY LEVELS
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>							
0.15	S	T95S154(1)035(2)(3)(4)L	0.5	4		18.000	A, S, Z
0.22	S	T95S224(1)035(2)(3)(4)L	0.5	4		15.000	A, S, Z
0.33	S	T95S334(1)035(2)(3)(4)L	0.5	4		12.000	A, S, Z
0.47	S	T95S474(1)035(2)(3)(4)L	0.5	4		9.000	A, S, Z
0.68	S	T95S684(1)035(2)(3)(4)L	0.5	4		5.000	A, S, Z
1.0	S	T95S105(1)035(2)(3)(4)L	0.5	4		3.500	A, S, Z
1.5	V	T95V155(1)035(2)(3)(4)L	0.5	6		3.000	A, S, Z
2.2	X	T95X225(1)035(2)(3)(4)L	0.8	6		2.000	A, S, Z
4.7	Y	T95Y475(1)035(2)(3)(4)L	1.6	6		0.800	A, S, Z
6.8	Z	T95Z685(1)035(2)(6)(4)L	2.4	6		0.800	A, B, S, Z
10	Z	T95Z106(1)035(2)(3)(4)L	3.5	6		0.600	A, S, Z
15	D	T95D156(1)035(2)(3)(4)(5)	5.3	6	0.410	0.270	A, S, Z
15	R	T95R156(1)035(2)(3)(4)(5)	5.3	6	0.380	0.190	A, S, Z
22	R	T95R226(1)035(2)(3)(4)(5)	7.7	6	0.280	0.240	A, S, Z
33	R	T95R336(1)035(2)(3)(4)(5)	11.6	6	0.280	0.200	A, S, Z
47	R	T95R476(1)035(2)(6)(4)(5)	16.5	6	0.280	0.320	A, B, S, Z
<b>50 V<sub>DC</sub> AT + 85 °C; 33 V<sub>DC</sub> AT + 125 °C</b>							
4.7	C	T95C475(1)050(2)(6)(4)(5)	2.4	6	1.400	0.800	A, B, S, Z
6.8	C	T95C685(1)050(2)(6)(4)(5)	3.4	6	1.300	0.700	A, B, S, Z
6.8	D	T95D685(1)050(2)(3)(4)(5)	3.4	6	0.820	0.450	A, S, Z
10	R	T95R106(1)050(2)(6)(4)(5)	5.0	6	0.650	0.500	A, B, S, Z
15	R	T95R156(1)050(2)(3)(4)(5)	7.5	6	0.400	0.350	A, S, Z
22	R	T95R226(1)050(2)(3)(4)(5)	11.0	6	0.390	0.300	A, S, Z

**Notes**

- Part number definitions:
  - (1) Capacitance tolerance: K, M
  - (2) Termination and packaging: C, E, H, L
  - (3) Reliability level: A, S, Z
  - (4) Surge current: A, B, S
  - (5) ESR: L, S
  - (6) Reliability level: A, B, S, Z
  - (7) Reliability level: A, B, C, S, Z
- (1) Empty cells: Not available

<b>RECOMMENDED VOLTAGE DERATING GUIDELINES</b> (for temperatures below + 85 °C)	
<b>STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS</b>	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.6
10	6.0
16	10
20	12
25	15
35	24
50	28
<b>SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS</b>	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24



POWER DISSIPATION	
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
A	0.075
B	0.085
C	0.110
D	0.150
R	0.250
S	0.080
V	0.095
X	0.110
Y	0.120
Z	0.135

STANDARD PACKAGING QUANTITY		
CASE CODE	UNITS PER REEL	
	7" FULL REEL	7" HALF REEL
A	2000	1000
B	2000	1000
C	500	250
D	500	250
R	600	300
S	2500	1250
V	2500	1250
X	2000	1000
Y	1500	750
Z	1500	750

PRODUCT INFORMATION	
Conformal Coated Guide	<a href="http://www.vishay.com/doc?40150">www.vishay.com/doc?40150</a>
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
SELECTOR GUIDES	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
FAQ	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>



# TANTAMOUNT® Low ESR, Hi-Rel COTS, Built in Fuse Conformal Coated



## FEATURES

- High reliability design with reliability screening available
- Surge current testing per MIL-PRF-55365 options available
- Standard and low ESR options
- Terminations: SnPb, standard. 100 % tin available
- Circuit protection for mission or safety critical systems
- Fuse characteristics: Guaranteed fuse protection at 9 A, 100 ms
- Mounting: Surface mount
- Compliant to RoHS Directive 2002/95/EC


**RoHS\***  
COMPLIANT

## Note

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

## PERFORMANCE/ELECTRICAL CHARACTERISTICS

[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)

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

**Capacitance Range:** 10 µF to 680 µF

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

**Voltage Rating:** 4 V<sub>DC</sub> to 50 V<sub>DC</sub>

## ORDERING INFORMATION

T96	R	107	K	010	E	S	A	S
TYPE	CASE CODE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	TERMINATION AND PACKAGING	RELIABILITY LEVEL	SURGE CURRENT	ESR
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) ½ reel C: 100 % tin/ 7" (178 mm) reels H: 100 % tin/ 7" (178 mm) ½ reel	S = 40 h burn-in Z = Non-established reliability	A = 10 cycles at + 25 °C B = 10 cycles at - 55 °C/+ 85 °C S = 3 cycles at + 25 °C	S = Std L = Low	

## DIMENSIONS in inches [millimeters]

CASE CODE	L (MAX.)	W	H1	H	F (REF.)	D (REF.)	J (MAX.)
R	0.295 [7.5]	0.243 + 0.012/- 0.024 [6.2 + 0.3/- 0.6]	0.156 ± 0.012 [4.0 ± 0.3]	0.146 ± 0.012 [3.7 ± 0.3]	0.079 [2.0]	0.248 [6.3]	0.004 [0.1]

## Note

- The anode termination (D less B) will be a minimum of 0.010" (0.25 mm)



RATINGS AND CASE CODES								
CAP. (μF)	4 V	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V
10								R
15							R	R
22							R	R
33						R	R	
47					R		R	
68				R		R		
100			R		R	R		
120			R		R			
150			R		R			
180		R		R				
220		R	R	R				
330	R		R	R				
390		R						
470			R					
680		R	R					

STANDARD RATINGS							
CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C (μA)	MAX. DF AT + 25 °C 120 Hz (%)	STD. (S) MAX. ESR AT + 25 °C 100 kHz (Ω)	LOW (L) MAX. ESR AT + 25 °C 100 kHz (Ω)	AVAILABLE RELIABILITY LEVELS
<b>4 V<sub>DC</sub> AT + 85 °C; 2.7 V<sub>DC</sub> AT + 125 °C</b>							
330	R	T96R337(1)004(2)(3)(4)(5)	13.2	8	0.230	0.180	S, Z
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT 125 °C</b>							
180	R	T96R187(1)6R3(2)(3)(4)(5)	10.8	8	0.230	0.180	S, Z
220	R	T96R227(1)6R3(2)(3)(4)(5)	13.2	8	0.230	0.180	S, Z
390	R	T96R397(1)6R3(2)(3)(4)(5)	23.4	8	0.230	0.145	S, Z
680	R	T96R687(1)6R3(2)(3)(4)(5)	40.8	12	0.190	0.145	S, Z
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT 125 °C</b>							
100	R	T96R107(1)010(2)(3)(4)(5)	10.0	8	0.240	0.175	S, Z
120	R	T96R127(1)010(2)(3)(4)(5)	12.0	8	0.240	0.170	S, Z
150	R	T96R157(1)010(2)(3)(4)(5)	15.0	8	0.230	0.165	S, Z
220	R	T96R227(1)010(2)(3)(4)(5)	22.0	8	0.230	0.155	S, Z
330	R	T96R337(1)010(2)(3)(4)(5)	33.0	8	0.230	0.155	S, Z
470	R	T96R477(1)010(2)(3)(4)(5)	47.0	10	0.220	0.145	S, Z
680	R	T96R687(1)010(2)(3)(4)(5)	68.0	14	0.190	0.145	S, Z
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>							
68	R	T96R686(1)016(2)(3)(4)(5)	10.9	6	0.700	0.195	S, Z
180	R	T96R187(1)016(2)(3)(4)(5)	28.8	8	0.230	0.155	S, Z
220	R	T96R227(1)016(2)(3)(4)(5)	35.2	8	0.220	0.155	S, Z
330	R	T96R337(1)016(2)(3)(4)(5)	52.8	14	0.210	0.155	S, Z

**Note**

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



STANDARD RATINGS							
CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. DC LEAKAGE AT + 25 °C (μA)	MAX. DF AT + 25 °C 120 Hz (%)	STD. (S) MAX. ESR AT + 25 °C 100 kHz (Ω)	LOW (L) MAX. ESR AT + 25 °C 100 kHz (Ω)	AVAILABLE RELIABILITY LEVELS
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>							
47	R	T96R476(1)020(2)(3)(4)(5)	9.4	6	0.300	0.210	S, Z
100	R	T96R107(1)020(2)(3)(4)(5)	20.0	8	0.240	0.170	S, Z
120	R	T96R127(1)020(2)(3)(4)(5)	24.0	8	0.240	0.180	S, Z
150	R	T96R157(1)020(2)(3)(4)(5)	30.0	8	0.240	0.175	S, Z
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>							
33	R	T96R336(1)025(2)(3)(4)(5)	8.3	6	0.350	0.230	S, Z
68	R	T96R686(1)025(2)(3)(4)(5)	17.0	6	0.300	0.195	S, Z
100	R	T96R107(1)025(2)(3)(4)(5)	25.0	8	0.300	0.190	S, Z
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>							
15	R	T96R156(1)035(2)(3)(4)(5)	5.3	6	0.480	0.290	S, Z
22	R	T96R226(1)035(2)(3)(4)(5)	7.7	6	0.380	0.340	S, Z
33	R	T96R336(1)035(2)(3)(4)(5)	11.6	6	0.380	0.300	S, Z
47	R	T96R476(1)035(2)(3)(4)(5)	16.5	6	0.350	0.270	S, Z
<b>50 V<sub>DC</sub> AT + 85 °C; 33 V<sub>DC</sub> AT + 125 °C</b>							
10	R	T96R106(1)050(2)(3)(4)(5)	5.0	6	0.750	0.600	S, Z
15	R	T96R156(1)050(2)(3)(4)(5)	7.5	6	0.500	0.450	S, Z
22	R	T96R226(1)050(2)(3)(4)(5)	11.0	6	0.490	0.400	S, Z

**Note**

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

RECOMMENDED VOLTAGE DERATING GUIDELINES (for temperature below + 85 °C)	
STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.6
10	6.0
16	10
20	12
25	15
35	24
50	28
SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24



POWER DISSIPATION	
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
R	0.250

STANDARD PACKAGING QUANTITY		
CASE CODE	UNITS PER REEL	
	7" FULL REEL	7" HALF REEL
R	300	150

PRODUCT INFORMATION	
Conformal Coated Guide	<a href="http://www.vishay.com/doc?40150">www.vishay.com/doc?40150</a>
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
SELECTOR GUIDES	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
FAQ	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

## Solid Tantalum Chip Capacitors TANTAMOUNT<sup>®</sup>, Hi-Rel COTS, Ultra-Low ESR, Conformal Coated Case


**FEATURES**

- High reliability; Weibull failure rate grading available
- Surge current testing per MIL-PRF-55365 options available
- Ultra-low ESR
- Tin/lead (SnPb) termination available
- Mounting: Surface mount
- Compliant to RoHS Directive 2002/95/EC


**RoHS<sup>\*</sup>**  
COMPLIANT

**Note**

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

**PERFORMANCE CHARACTERISTICS**
[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)
**Operating Temperature:** - 55 °C to + 85 °C  
(To + 125 °C with voltage derating)

**Capacitance Range:** 10 µF to 1500 µF

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

**Voltage Rating:** 4 V<sub>DC</sub> to 75 V<sub>DC</sub>

ORDERING INFORMATION							
T97	R	227	K	020	E	S	A
TYPE	CASE CODE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	TERMINATION/PACKAGING (available options are series dependent)	RELIABILITY LEVEL	SURGE CURRENT
	See Ratings and Case Code table	This is expressed in µF. 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) reel L = Sn/Pb solder/ 7" (178 mm), 1/2 reel C = 100 % tin/ 7" (178 mm), reel H = 100 % tin/ 7" (178 mm), 1/2 reel	A = 1.0 % Weibull B = 0.1 % Weibull <sup>(1)</sup> S = 40 h burn-in Z = Non-established reliability	A = 10 cycles at + 25 °C B = 10 cycles at - 55 °C/ + 85 °C S = 3 cycles at 25 °C

**Notes**

- <sup>(1)</sup> Available on select ratings. See "Standard Ratings" table.
- We reserve the right to supply higher voltage ratings and tighter capacitance tolerance capacitors in the same case size.

DIMENSIONS in inches [millimeters]							
CASE CODE	L (MAX.)	W	H	A	B	D (REF.)	J (MAX.)
V	0.299 [7.6]	0.173 ± 0.016 [4.4 ± 0.4]	0.079 [2.0 max.]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.6]	0.252 [6.4]	0.004 [0.1]
D	0.299 [7.6]	0.173 ± 0.016 [4.4 ± 0.4]	0.138 [3.5 max.]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.6]	0.252 [6.4]	0.004 [0.1]
E	0.299 [7.6]	0.173 ± 0.016 [4.4 ± 0.4]	0.157 ± 0.016 [4.0 ± 0.4]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.6]	0.252 [6.4]	0.004 [0.1]
R	0.299 [7.6]	0.238 ± 0.016 [6.0 ± 0.4]	0.142 ± 0.016 [3.6 ± 0.4]	0.051 ± 0.012 [1.3 ± 0.3]	0.181 ± 0.024 [4.6 ± 0.6]	0.244 [6.2]	0.004 [0.1]
F	0.299 [7.6]	0.238 ± 0.016 [6.0 ± 0.4]	0.185 ± 0.016 [4.7 ± 0.4]	0.055 ± 0.016 [1.4 ± 0.4]	0.181 ± 0.024 [4.6 ± 0.6]	0.244 [6.2]	0.004 [0.1]
Z	0.299 [7.6]	0.238 ± 0.016 [6.0 ± 0.4]	0.236 ± 0.016 [6.0 ± 0.4]	0.055 ± 0.016 [1.4 ± 0.4]	0.181 ± 0.024 [4.6 ± 0.6]	0.244 [6.2]	0.004 [0.1]
M	0.315 [8]	0.260 + 0.016/- 0.024 [6.6 + 0.4/- 0.6]	0.142 ± 0.016 [3.6 ± 0.4]	0.051 ± 0.012 [1.3 ± 0.3]	0.197 ± 0.024 [5.0 ± 0.6]	0.260 [6.6]	0.004 [0.1]
H	0.315 [8]	0.260 + 0.016/- 0.024 [6.6 + 0.4/- 0.6]	0.205 ± 0.016 [5.2 ± 0.4]	0.055 ± 0.016 [1.4 ± 0.4]	0.197 ± 0.024 [5.0 ± 0.6]	0.260 [6.6]	0.004 [0.1]
N	0.315 [8.0]	0.259 + 0.016/- 0.024 [6.6 + 0.4/- 0.6]	0.252 ± 0.016 [6.4 ± 0.4]	0.056 ± 0.017 [1.4 ± 0.4]	0.196 ± 0.025 [5.0 ± 0.6]	0.259 [6.6]	0.004 [0.1]

**Note**

- The anode termination (D less B) will be a minimum of 0.012" [0.3 mm]



RATINGS AND CASE CODES										
µF	4 V	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V	63 V	75 V
10									D	R <sup>(1)</sup>
15								E/R	R	
22								R	F	
33								F		
47							R	Z/N		
68						R	F			
100						F	F			
150						F				
220				E	R	M				
330		V	E	F	H/F					
470	V	E	E	H						
680	E	E	R							
1000	E/R	R	F							
1500	R									

Note

(1) Contact factory for availability

STANDARD RATINGS								
CAPACITANCE (µF)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C (µA)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz (mΩ)	MAX. RIPPLE 100 kHz I <sub>RMS</sub> (A)	AVAILABLE RELIABILITY LEVELS	
<b>4 V<sub>DC</sub> AT + 85 °C; 2.7 V<sub>DC</sub> AT + 125 °C</b>								
470	V	T97V477(1)004(2)(4)(5)	19	8	60	2.2	A, B, S, Z	
680	E	T97E687(1)004(2)(4)(5)	27	6	25	2.9	A, B, S, Z	
1000	E	T97E108(1)004(2)(4)(5)	40	8	20	3.3	A, B, S, Z	
1000	R	T97R108(1)004(2)(4)(5)	40	8	18	3.7	A, B, S, Z	
1500	R	T97R158(1)004(2)(4)(5)	60	8	24	2.9	A, B, S, Z	
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT + 125 °C</b>								
330	V	T97V337(1)6R3(2)(4)(5)	21	8	56	2.0	A, B, S, Z	
470	E	T97E477(1)6R3(2)(4)(5)	30	6	30	2.7	A, B, S, Z	
680	E	T97E687(1)6R3(2)(4)(5)	43	6	25	2.9	A, B, S, Z	
1000	R	T97R108(1)6R3(2)(4)(5)	63	8	31	2.8	A, B, S, Z	
<b>10 V<sub>DC</sub> AT + 85 °C; 7 WV<sub>DC</sub> AT + 125 °C</b>								
330	E	T97E337(1)010(2)(4)(5)	33	6	35	2.5	A, B, S, Z	
470	E	T97E477(1)010(2)(4)(5)	47	6	28	2.8	A, B, S, Z	
680	R	T97R687(1)010(2)(6)(5)	68	6	28	3	S, Z	
1000	F	T97F108(1)010(2)(3)(5)	100	20	120	1.4	A, S, Z	
<b>16 WV<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>								
220	E	T97E227(1)016(2)(4)(5)	35	8	60	2.3	A, B, S, Z	
330	F	T97F337(1)016(2)(4)(5)	53	10	100	1.6	A, B, S, Z	
470	H	T97H477(1)016(2)(4)(5)	75	14	100	1.4	A, B, S, Z	
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>								
220	R	T97R227(1)020(2)(4)(5)	44	8	80	1.8	A, B, S, Z	
330	F	T97F337(1)020(2)(6)(5)	66	10	100	1.6	S, Z	
330	H	T97H337(1)020(2)(4)(5)	66	10	100	1.6	A, B, S, Z	
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>								
68	R	T97R686(1)025(2)(4)(5)	17	6	100	1.6	A, B, S, Z	
100	F	T97F107(1)025(2)(4)(5)	25	8	100	1.6	A, B, S, Z	

Notes

- Part number definitions:
  - Capacitance tolerance: K, M
  - Termination and packaging: C, E, H, L
  - Reliability level: A, S, Z
  - Reliability level: A, B, S, Z
  - Surge current: A, B, S
  - Reliability level: S, Z
- Contact factory for availability



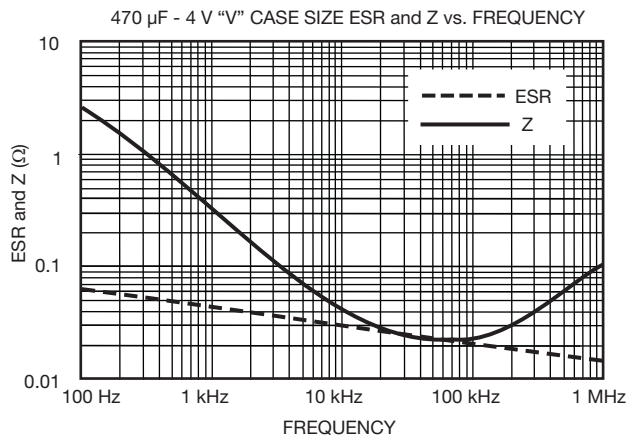
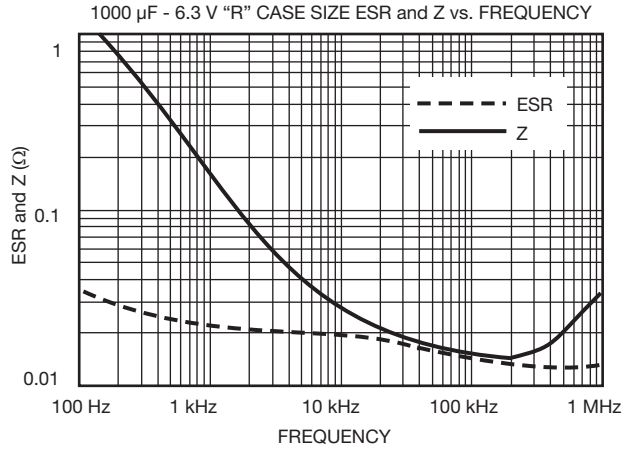
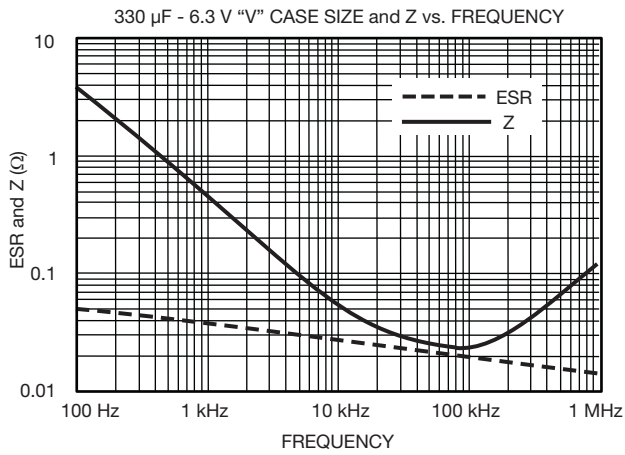
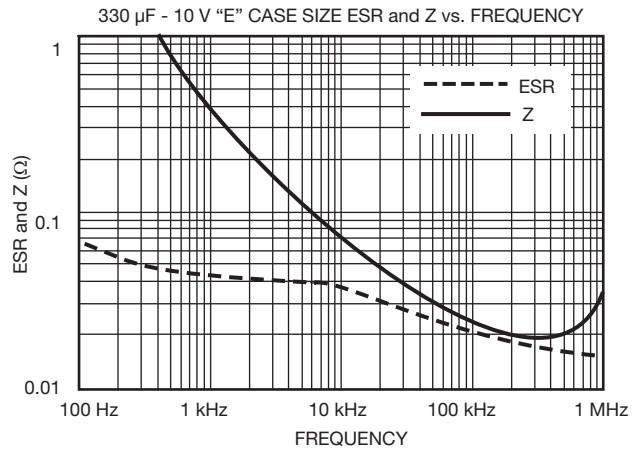
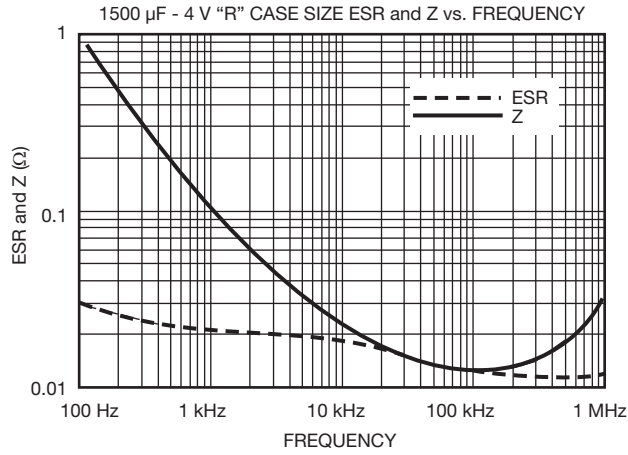
STANDARD RATINGS							
CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. DCL AT + 25 °C (μA)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz (mΩ)	MAX. RIPPLE 100 kHz I <sub>RMS</sub> (A)	AVAILABLE RELIABILITY LEVELS
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>							
150	F	T97F157(1)025(2)(4)(5)	38	8	80	1.8	A, B, S, Z
220	M	T97M227(1)025(2)(3)(5)	55	8	100	1.6	A, S, Z
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>							
47	R	T97R476(1)035(2)(4)(5)	17	6	100	1.6	A, B, S, Z
68	F	T97F686(1)035(2)(3)(5)	24	6	100	1.6	A, S, Z
100	F	T97F107M035(2)(3)(5)	35	8	100	1.6	A, S, Z
<b>50 V<sub>DC</sub> AT + 85 °C; 33 V<sub>DC</sub> AT + 125 °C</b>							
15	E	T97E156(1)050(2)(4)(5)	8	6	300	0.9	A, B, S, Z
15	R	T97R156(1)050(2)(4)(5)	8	6	250	1	A, B, S, Z
22	R	T97R226(1)050(2)(4)(5)	11	6	220	1.1	A, B, S, Z
33	F	T97F336(1)050(2)(3)(5)	17	6	150	1.3	A, S, Z
47	Z	T97Z476(1)050(2)(6)(5)	24	6	240	1.1	S, Z
47	N	T97N476(1)050(2)(4)(5)	24	6	150	1.4	A, B, S, Z
<b>63 V<sub>DC</sub> AT + 85 °C; 42 V<sub>DC</sub> AT + 125 °C</b>							
10	D	T97D106(1)063(2)(3)(5)	10	6	400	0.6	A, S, Z
15	R	T97R156(1)063(2)(6)(5)	10	6	400	0.8	S, Z
22	F	T97F226(1)063(2)(3)(5)	14	6	250	1.0	A, S, Z
<b>75 V<sub>DC</sub> AT + 85 °C; 50 V<sub>DC</sub> AT + 125 °C</b>							
10	R <sup>(1)</sup>	T97R106(1)075(2)(6)(5)	8	6	500	0.7	S, Z

**Notes**

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

RECOMMENDED VOLTAGE DERATING GUIDELINES (for temperatures below + 85 °C)	
STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.6
10	6.0
16	10
20	12
25	15
35	24
50	28
63	37.8
75	45
SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24
63	32
75	37

**TYPICAL CURVES**







POWER DISSIPATION	
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
V	0.141
D	0.215
E	0.240
R, F, M	0.250
Z	0.265
H	0.265
N	0.280

STANDARD PACKAGING QUANTITY		
CASE CODE	UNITS PER REEL	
	7" FULL REEL	7" HALF REEL
V	1000	500
D	400	200
E	500	250
R	300	150
F	250	125
Z	250	125
M	200	100
H	200	100
N	200	100

PRODUCT INFORMATION	
Conformal Coated Guide	<a href="http://www.vishay.com/doc?40150">www.vishay.com/doc?40150</a>
Pad Dimensions	
Packaging Dimensions	
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
SELECTOR GUIDES	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
FAQ	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

# TANTAMOUNT® Low ESR, Hi-Rel COTS, Built in Fuse Conformal Coated


**FEATURES**

- High reliability design with reliability screening available
- Surge current testing per MIL-PRF-55365 options available
- Ultra-low ESR
- Mounting: Surface mount
- Terminations: SnPb, standard. 100 % tin available
- Circuit protection for mission or safety critical systems
- Fuse characteristics: Guaranteed fuse protection at 9 A, 100 ms
- Compliant to RoHS Directive 2002/95/EC


**RoHS\***  
COMPLIANT

**Note**

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

**PERFORMANCE CHARACTERISTICS**
[www.vishay.com/doc?40088](http://www.vishay.com/doc?40088)
**Operating Temperature:** - 55 °C to + 85 °C  
(to + 125 °C with voltage derating)

**Capacitance Range:** 22 µF to 1500 µF

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

**Voltage Rating:** 4 V<sub>DC</sub> to 63 V<sub>DC</sub>

ORDERING INFORMATION							
T98	R	227	K	020	E	S	A
TYPE	CASE CODE	CAPACITANCE	CAPACITANCE TOLERANCE	DC VOLTAGE RATING AT + 85 °C	TERMINATION/PACKAGING (available options are series dependent)	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) reel L = Sn/Pb solder/7" (178 mm), 1/2 reel C = 100 % tin/7" (178 mm), reel H = 100 % tin/7" (178 mm), 1/2 reel	S = 40 h burn-in Z = Non-established reliability	A = 10 cycles at + 25 °C B = 10 cycles at - 55 °C / + 85 °C S = 3 cycles at 25 °C

DIMENSIONS in inches [millimeters]							
CASE CODE	L	W	H1	H	f (REF.)	D (REF.)	J (MAX.)
V	0.299 ± 0.012 [7.6 ± 0.3]	0.181 ± 0.016 [4.6 ± 0.4]	0.099 max. [2.5 max.]	0.087 [2.2] max.	0.079 [2.0]	0.256 [6.5]	0.004 [0.1]
E	0.299 ± 0.012 [7.6 ± 0.3]	0.181 ± 0.016 [4.6 ± 0.4]	0.177 ± 0.016 [4.5 ± 0.4]	0.165 ± 0.016 [4.2 ± 0.4]	0.079 [2.0]	0.256 [6.5]	0.004 [0.1]
R	0.299 ± 0.012 [7.6 ± 0.3]	0.246 ± 0.016/- 0.024 [6.2 ± 0.4/- 0.6]	0.162 ± 0.016 [4.1 ± 0.4]	0.150 ± 0.016 [3.8 ± 0.4]	0.079 [2.0]	0.248 [6.3]	0.004 [0.1]
F	0.299 ± 0.012 [7.6 ± 0.3]	0.246 ± 0.016 [6.2 ± 0.4]	0.207 ± 0.016 [5.3 ± 0.4]	0.193 ± 0.016 [4.9 ± 0.4]	0.079 [2.0]	0.248 [6.3]	0.004 [0.1]
Z	0.299 ± 0.012 [7.6 ± 0.3]	0.246 ± 0.016 [6.2 ± 0.4]	0.258 ± 0.016 [6.6 ± 0.4]	0.244 ± 0.016 [6.2 ± 0.4]	0.079 [2.0]	0.248 [6.3]	0.004 [0.1]
M	0.327 [8.3] max.	0.268 ± 0.016 [6.8 ± 0.4]	0.161 ± 0.016 [4.1 ± 0.4]	0.150 ± 0.016 [3.8 ± 0.4]	0.079 [2.0]	0.248 [6.3]	0.004 [0.1]
H	0.315 ± 0.012 [8.0 ± 0.3]	0.268 ± 0.016 [6.8 ± 0.4]	0.224 ± 0.016 [5.7 ± 0.4]	0.213 ± 0.016 [5.4 ± 0.4]	0.079 [2.0]	0.264 [6.7]	0.004 [0.1]



RATINGS AND CASE CODES									
μF	4 V	6.3 V	10 V	16 V	20 V	25 V	35 V	50 V	63 V
22									F
47							R	Z	
68						R			
100									
150						F			
220				E	R	M			
330			E		F/H <sup>(1)</sup>				
470	V	E	E						
680	E	E	R						
1000	E/R	R							
1500	R								
2200									

**Note**

<sup>(1)</sup> Preliminary rating. Contact factory for availability.

STANDARD RATINGS						
CAPACITANCE (μF)	CASE CODE	PART NUMBER <sup>(1)</sup>	MAX. DCL AT + 25 °C (μA)	MAX. DF AT + 25 °C 120 Hz (%)	MAX. ESR AT + 25 °C 100 kHz (mΩ)	MAX. RIPPLE 100 kHz I <sub>RMS</sub> (A)
<b>4 V<sub>DC</sub> AT + 85 °C; 2.7 V<sub>DC</sub> AT + 125 °C</b>						
470	V	T98V477(1)004(2)(3)(4)	19	8	130	1.0
680	E	T98E687(1)004(2)(3)(4)	27	6	125	1.3
1000	E	T98E108(1)004(2)(3)(4)	40	8	120	1.3
1000	R	T98R108(1)004(2)(3)(4)	40	8	118	1.5
1500	R	T98R158(1)004(2)(3)(4)	60	8	115	1.5
<b>6.3 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT + 125 °C</b>						
470	E	T98E477(1)6R3(2)(3)(4)	30	6	130	1.3
680	E	T98E687(1)6R3(2)(3)(4)	43	6	125	1.3
1000	R	T98R108(1)6R3(2)(3)(4)	63	8	120	1.4
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT + 125 °C</b>						
330	E	T98E337(1)010(2)(3)(4)	33	6	135	1.3
470	E	T98E477(1)010(2)(3)(4)	47	6	128	1.3
680	R	T98R687(1)010(2)(3)(4)	68	6	128	1.4
<b>16 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>						
220	E	T98E227(1)016(2)(3)(4)	35	8	160	1.2
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>						
220	R	T98R227(1)020(2)(3)(4)	44	8	180	1.2
330	F	T98F337(1)020(2)(3)(4)	66	10	200	1.1
330	H <sup>(1)</sup>	T98H337(1)020(2)(3)(4)	66	10	200	1.2
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>						
68	R	T98R686(1)025(2)(3)(4)	17	6	200	1.1
150	F	T98F157(1)025(2)(3)(4)	38	8	180	1.2
220	M	T98M227M025(2)(3)(4)	55	8	200	1.1
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>						
47	R	T98R476(1)035(2)(3)(4)	17	6	200	1.1
<b>50 V<sub>DC</sub> AT + 85 °C; 33 V<sub>DC</sub> AT + 125 °C</b>						
47	Z	T98Z476(1)050(2)(3)(4)	24	6	245	1.0
<b>63 V<sub>DC</sub> AT + 85 °C; 42 V<sub>DC</sub> AT + 125 °C</b>						
22	F	T98F226(1)063(2)(3)(4)	14	6	350	0.8

**Notes**

<sup>(1)</sup> Contact factory for availability

• Part number definitions:

(1) Capacitance tolerance: K, M

(2) Termination and packaging: C, E, H, L

(3) Reliability level: S, Z

(4) Surge current: A, B, S



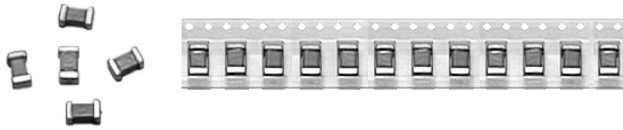
<b>RECOMMENDED VOLTAGE DERATING GUIDELINES</b> (for temperatures below + 85 °C)	
<b>STANDARD CONDITIONS. FOR EXAMPLE: OUTPUT FILTERS</b>	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.6
10	6.0
16	10
20	12
25	15
35	24
50	28
63	37.8
<b>SEVERE CONDITIONS. FOR EXAMPLE: INPUT FILTERS</b>	
Capacitor Voltage Rating	Operating Voltage
4.0	2.5
6.3	3.3
10	5.0
16	8.0
20	10
25	12
35	15
50	24
63	32

<b>POWER DISSIPATION</b>	
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
V	0.140
E	0.215
R	0.250
F	0.250
Z	0.265
M	0.250
H	0.265

<b>STANDARD PACKAGING QUANTITY</b>		
CASE CODE	UNITS PER REEL	
	7" FULL REEL	7" HALF REEL
V	TBD	
E	TBD	
R	300	150
F	250	125
Z	150	75
M	200	100
H	TBD	

<b>PRODUCT INFORMATION</b>	
Conformal Coated Guide	<a href="http://www.vishay.com/doc?40150">www.vishay.com/doc?40150</a>
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
<b>SELECTOR GUIDES</b>	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
<b>FAQ</b>	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

# Solid Tantalum Surface Mount Capacitors TANTAMOUNT® Conformal Coated, Military MIL-PRF-55365/4 Qualified


**FEATURES**

- Weibull failure rates B, C, D, T  
Exponential failure rates M, P, R, S
- Tape and reel available per EIA 481
- Termination finishes available; gold plate, solder plated and hot solder dipped
- Mounting: Surface mount
- Compliant to RoHS Directive 2002/95/EC


**RoHS\***  
COMPLIANT

**Note**

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

**PERFORMANCE CHARACTERISTICS**

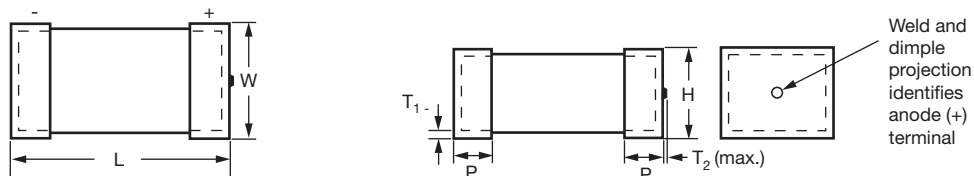
**Operating Temperature:** - 55 °C to + 125 °C  
(above 85 °C, voltage derating is required)  
**Capacitance Range:** 0.10 µF to 100 µF

**Capacitance Tolerance:** ± 5 %, ± 10 %, ± 20 %  
**Voltage Rating:** 4 V<sub>DC</sub> to 50 V<sub>DC</sub>

ORDERING INFORMATION							
CWR06	D	B	155	K	B	A	/TR
TYPE	VOLTAGE	TERMINATION FINISH	CAPACITANCE	CAPACITANCE TOLERANCE	FAILURE RATE %/1000 h	SURGE CURRENT (OPTIONAL)	PACKAGING
	C = 4 V D = 6 V F = 10 V H = 15 V J = 20 V K = 25 V M = 35 V N = 50 V	B = Gold C = Hot solder dipped H = Solder plate	This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow.	J = ± 5 % K = ± 10 % M = ± 20 %	M = 1.0 P = 0.1 R = 0.01 S = 0.001 B = 0.1 C = 0.01 D = 0.001 <sup>(1)</sup> T = 0.01 <sup>(2)</sup>	A = 10 cycles at + 25 °C B = 10 cycles at - 55 °C and + 85 °C C = 10 cycles at - 55 °C and + 85 °C (before Weibull grading)	Blank = Bulk, plastic tray /FA = Waffle pack /PR = 100 pcs reel /HR = Half reel /TR = Full reel

**Notes**

- (1) Contact marketing for availability of Weibull D failure rate for 50 V ratings
- (2) T level capacitors are recommended for "space applications"

**DIMENSIONS in inches [millimeters]**


CASE CODE	L	W	H	P	T <sub>1</sub>	T <sub>2</sub> (max.)
A	0.100 ± 0.015 [2.54 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.030 ± 0.005 [0.76 ± 0.13]	0.005 [0.13]	0.015 [0.38]
B	0.150 ± 0.015 [3.81 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.030 ± 0.005 [0.76 ± 0.13]	0.005 [0.13]	0.015 [0.38]
C	0.200 ± 0.015 [5.08 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.030 ± 0.005 [0.76 ± 0.13]	0.005 [0.13]	0.015 [0.38]
D	0.150 ± 0.015 [3.81 ± 0.38]	0.100 ± 0.015 [2.54 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.030 ± 0.005 [0.76 ± 0.13]	0.005 [0.13]	0.015 [0.38]
E	0.200 ± 0.015 [5.08 ± 0.38]	0.100 ± 0.015 [2.54 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.030 ± 0.005 [0.76 ± 0.13]	0.005 [0.13]	0.015 [0.38]
F	0.220 ± 0.015 [5.59 ± 0.38]	0.135 ± 0.015 [3.43 ± 0.38]	0.070 ± 0.015 [1.78 ± 0.38]	0.030 ± 0.005 [0.76 ± 0.13]	0.005 [0.13]	0.015 [0.38]
G	0.265 ± 0.015 [6.73 ± 0.38]	0.110 ± 0.015 [2.79 ± 0.38]	0.110 ± 0.015 [2.79 ± 0.38]	0.050 ± 0.005 [1.27 ± 0.13]	0.005 [0.13]	0.015 [0.38]
H	0.285 ± 0.015 [7.24 ± 0.38]	0.150 ± 0.015 [3.81 ± 0.38]	0.110 ± 0.015 [2.79 ± 0.38]	0.050 ± 0.005 [1.27 ± 0.13]	0.005 [0.13]	0.015 [0.38]

**Note**

- When solder coated terminations are required, add 0.015" [0.38 mm] to termination dimension tolerances



RATINGS AND CASE CODES								
μF	4 V	6 V	10 V	15 V	20 V	25 V	35 V	50 V
0.10								A
0.15								A
0.22							A	B
0.33						A		B
0.47					A		B	C
0.68				A	B	B	C	D
1.0			A		B	C	D	E
1.5		A		B	C	D	E	F
2.2	A		B	C	D	E		F
3.3		B	C	D	E		F	G
4.7	B	C	D	E		F	G	H
6.8	C	D	E		F	G	H	
10	D	E		F		G		
15	E		F		G	H		
22		F		G	H			
33	F		G	H				
47		G	H					
68	G	H						
100	H							

STANDARD RATINGS									
CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. DCL (μA) AT			MAX. DF (%) AT			MAX. ESR AT + 25 °C 100 kHz (Ω)
			+ 25 °C	+ 85 °C	+ 125 °C	+ 25 °C	+ 85 °C + 125 °C	- 55 °C	
<b>4 V<sub>DC</sub> AT + 85 °C; 2.7 V<sub>DC</sub> AT + 125 °C</b>									
2.2	A	CWR06C(1)225(2)(3)(4)(5)	1.0	10	12	6	8	8	8.0
4.7	B	CWR06C(1)475(2)(3)(4)(5)	1.0	10	12	6	8	8	8.0
6.8	C	CWR06C(1)685(2)(3)(4)(5)	1.0	10	12	6	8	8	5.5
10	D	CWR06C(1)106(2)(3)(4)(5)	1.0	10	12	8	8	10	4.0
15	E	CWR06C(1)156(2)(3)(4)(5)	1.0	10	12	8	10	12	3.5
33	F	CWR06C(1)336(2)(3)(4)(5)	2.0	20	24	8	10	12	2.2
68	G	CWR06C(1)686(2)(3)(4)(5)	3.0	30	36	10	12	12	1.1
100	H	CWR06C(1)107(2)(3)(4)(5)	4.0	40	48	10	12	12	0.9
<b>6 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT + 125 °C</b>									
1.5	A	CWR06D(1)155(2)(3)(4)(5)	1.0	10	12	6	8	8	8.0
3.3	B	CWR06D(1)335(2)(3)(4)(5)	1.0	10	12	6	8	8	8.0
4.7	C	CWR06D(1)475(2)(3)(4)(5)	1.0	10	12	6	8	8	5.5
6.8	D	CWR06D(1)685(2)(3)(4)(5)	1.0	10	12	6	8	8	4.5
10	E	CWR06D(1)106(2)(3)(4)(5)	1.0	10	12	8	10	12	3.5
22	F	CWR06D(1)226(2)(3)(4)(5)	2.0	20	24	8	10	12	2.2
47	G	CWR06D(1)476(2)(3)(4)(5)	3.0	30	36	10	12	12	1.1
68	H	CWR06D(1)686(2)(3)(4)(5)	4.0	40	48	10	12	12	0.9

**Notes**

- (1) Termination finish: B, C, H
  - (2) Capacitance tolerance: J, K, M
  - (3) Failure rate: B, C, D, M, P, R, S, T
  - (4) Surge current (optional): A, B, C
  - (5) Packaging: Blank, /FA, /HR, /PR, /TR
- \* 5 % tolerance is not available for the 0.33 μF/50 V design



STANDARD RATINGS									
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL ( $\mu$ A) AT			MAX. DF (%) AT			MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )
			+ 25 °C	+ 85 °C	+ 125 °C	+ 25 °C	+ 85 °C + 125 °C	- 55 °C	
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT + 125 °C</b>									
1.0	A	CWR06F(1)105(2)(3)(4)(5)	1.0	10	12	6	8	8	12.0
2.2	B	CWR06F(1)225(2)(3)(4)(5)	1.0	10	12	6	8	8	8.0
3.3	C	CWR06F(1)335(2)(3)(4)(5)	1.0	10	12	6	8	8	5.5
4.7	D	CWR06F(1)475(2)(3)(4)(5)	1.0	10	12	6	8	8	4.5
6.8	E	CWR06F(1)685(2)(3)(4)(5)	1.0	10	12	6	8	8	3.5
15	F	CWR06F(1)156(2)(3)(4)(5)	2.0	20	24	8	8	10	2.5
33	G	CWR06F(1)336(2)(3)(4)(5)	3.0	30	36	10	12	12	1.1
47	H	CWR06F(1)476(2)(3)(4)(5)	5.0	50	60	10	12	12	0.9
<b>15 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>									
0.68	A	CWR06H(1)684(2)(3)(4)(5)	1.0	10	12	6	8	8	12.0
1.5	B	CWR06H(1)155(2)(3)(4)(5)	1.0	10	12	6	8	8	8.0
2.2	C	CWR06H(1)225(2)(3)(4)(5)	1.0	10	12	6	8	8	5.5
3.3	D	CWR06H(1)335(2)(3)(4)(5)	1.0	10	12	6	8	8	5.0
4.7	E	CWR06H(1)475(2)(3)(4)(5)	1.0	10	12	6	8	8	4.0
10	F	CWR06H(1)106(2)(3)(4)(5)	2.0	20	24	6	8	8	2.5
22	G	CWR06H(1)226(2)(3)(4)(5)	4.0	40	48	6	8	8	1.1
33	H	CWR06H(1)336(2)(3)(4)(5)	5.0	50	60	8	8	10	0.9
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>									
0.47	A	CWR06J(1)474(2)(3)(4)(5)	1.0	10	12	8	8	10	16.0
0.68	B	CWR06J(1)684(2)(3)(4)(5)	1.0	10	12	6	8	8	14.0
1.0	B	CWR06J(1)105(2)(3)(4)(5)	1.0	10	12	6	8	8	12.0
1.5	C	CWR06J(1)155(2)(3)(4)(5)	1.0	10	12	6	8	8	6.0
2.2	D	CWR06J(1)225(2)(3)(4)(5)	1.0	10	12	6	8	8	5.0
3.3	E	CWR06J(1)335(2)(3)(4)(5)	1.0	10	12	6	8	8	4.0
6.8	F	CWR06J(1)685(2)(3)(4)(5)	2.0	20	24	6	8	8	2.4
15	G	CWR06J(1)156(2)(3)(4)(5)	3.0	30	36	6	8	8	1.1
22	H	CWR06J(1)226(2)(3)(4)(5)	4.0	40	48	6	8	8	0.9
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>									
0.33	A	CWR06K(1)334(2)(3)(4)(5)	1.0	10	12	6	8	8	15.0
0.68	B	CWR06K(1)684(2)(3)(4)(5)	1.0	10	12	6	8	8	10.0
1.0	C	CWR06K(1)105(2)(3)(4)(5)	1.0	10	12	6	8	8	6.5
1.5	D	CWR06K(1)155(2)(3)(4)(5)	1.0	10	12	6	8	8	6.5
2.2	E	CWR06K(1)225(2)(3)(4)(5)	1.0	10	12	6	8	8	3.5
4.7	F	CWR06K(1)475(2)(3)(4)(5)	2.0	20	24	6	8	8	2.5
6.8	G	CWR06K(1)685(2)(3)(4)(5)	2.0	20	24	6	8	8	1.2
10	G	CWR06K(1)106(2)(3)(4)(5)	3.0	30	36	6	8	8	1.4
15	H	CWR06K(1)156(2)(3)(4)(5)	4.0	40	48	6	8	8	1.0

**Notes**

- (1) Termination finish: B, C, H
- (2) Capacitance tolerance: J, K, M
- (3) Failure rate: B, C, D, M, P, R, S, T
- (4) Surge current (optional): A, B, C
- (5) Packaging: Blank, /FA, /HR, /PR, /TR

\* 5 % tolerance is not available for the 0.33  $\mu$ F/50 V design



STANDARD RATINGS									
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL ( $\mu$ A) AT			MAX. DF (%) AT			MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )
			+ 25 °C	+ 85 °C	+ 125 °C	+ 25 °C	+ 85 °C + 125 °C	- 55 °C	
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>									
0.22	A	CWR06M(1)224(2)(3)(4)(5)	1.0	10	12	6	8	8	24.0
0.47	B	CWR06M(1)474(2)(3)(4)(5)	1.0	10	12	6	8	8	17.0
0.68	C	CWR06M(1)684(2)(3)(4)(5)	1.0	10	12	6	8	8	10.0
1.0	D	CWR06M(1)105(2)(3)(4)(5)	1.0	10	12	6	8	8	6.5
1.5	E	CWR06M(1)155(2)(3)(4)(5)	1.0	10	12	6	8	8	4.5
3.3	F	CWR06M(1)335(2)(3)(4)(5)	1.0	10	12	6	8	8	2.5
4.7	G	CWR06M(1)475(2)(3)(4)(5)	2.0	20	24	6	8	8	1.5
6.8	H	CWR06M(1)685(2)(3)(4)(5)	3.0	30	36	6	8	8	1.3
<b>50 V<sub>DC</sub> AT + 85 °C; 33 V<sub>DC</sub> AT + 125 °C</b>									
0.10	A	CWR06N(1)104(2)(3)(4)(5)	1.0	10	12	6	8	8	75.0
0.15	A	CWR06N(1)154(2)(3)(4)(5)	1.0	10	12	6	8	8	25.0
0.22	B	CWR06N(1)224(2)(3)(4)(5)	1.0	10	12	6	8	8	17.0
0.33 *	B	CWR06N(1)334(2)(3)(4)(5)	1.0	10	12	6	8	8	12.0
0.47	C	CWR06N(1)474(2)(3)(4)(5)	1.0	10	12	6	8	8	8.0
0.68	D	CWR06N(1)684(2)(3)(4)(5)	1.0	10	12	6	8	8	7.0
1.0	E	CWR06N(1)105(2)(3)(4)(5)	1.0	10	12	6	8	8	6.0
1.5	F	CWR06N(1)155(2)(3)(4)(5)	1.0	10	12	6	8	8	4.0
2.2	F	CWR06N(1)225(2)(3)(4)(5)	2.0	20	24	6	8	8	2.5
3.3	G	CWR06N(1)335(2)(3)(4)(5)	2.0	20	24	6	8	8	2.0
4.7	H	CWR06N(1)475(2)(3)(4)(5)	3.0	30	36	6	8	8	1.5

**Notes**

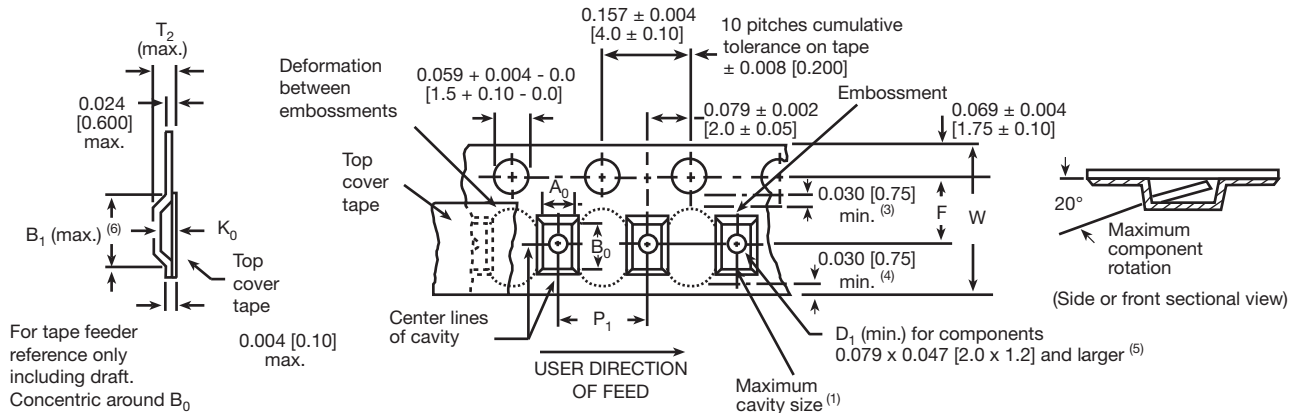
- (1) Termination finish: B, C, H  
(2) Capacitance tolerance: J, K, M  
(3) Failure rate: B, C, D, M, P, R, S, T  
(4) Surge current (optional): A, B, C  
(5) Packaging: Blank, /FA, /HR, /PR, /TR  
\* 5 % tolerance is not available for the 0.33  $\mu$ F/50 V design



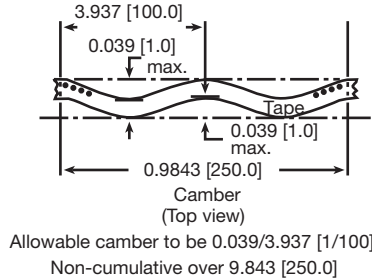
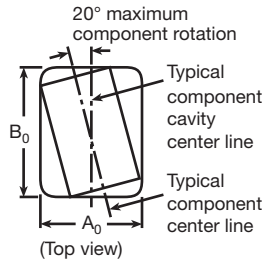
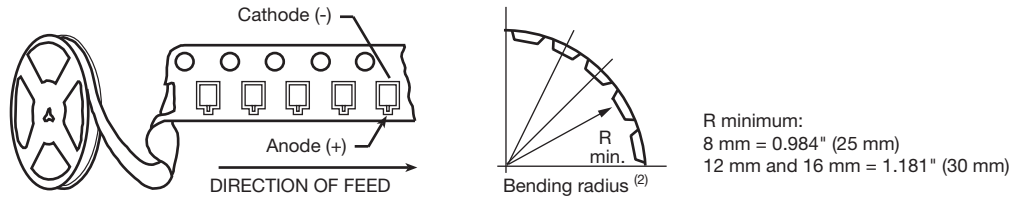
**TAPE AND REEL PACKAGING** in inches [millimeters]

**Note**

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



For tape feeder reference only including draft. Concentric around  $B_0$



**Tape and reel specifications:** All case sizes are available on plastic embossed tape per EIA-481. Standard reel diameter is 7" (178 mm).

**Notes**

- $A_0$ ,  $B_0$ ,  $K_0$ , 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°.
- 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.
- 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.
- 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.
- 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.
- $B_1$  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	$P_1$	$T_2$ (max.)	W
A	8 mm	0.179 [4.55]	0.039 [1.0]	0.138 ± 0.002 [3.5 ± 0.05]	0.157 ± 0.004 [4.0 ± 0.1]	0.098 [2.5]	0.315 ± 0.004 [8.0 ± 0.10]
B, C, D, E	12 mm	0.323 [8.2]	0.059 [1.5]	0.217 ± 0.002 [5.5 ± 0.05]	0.157 ± 0.004 [4.0 ± 0.1]	0.256 [6.5]	0.472 ± 0.012 [12.0 ± 0.30]
F	12 mm double pitch	0.323 [8.2]	0.059 [1.5]	0.217 ± 0.002 [5.5 ± 0.05]	0.315 ± 0.004 [8.0 ± 0.10]	0.256 [6.5]	0.472 ± 0.012 [12.0 ± 0.30]
G, H	16 mm	0.476 [12.1]	0.059 [1.5]	0.295 ± 0.004 [7.5 ± 0.1]	0.315 ± 0.004 [8.0 ± 0.10]	0.315 [8.0]	0.642 max. [16.3] max.



STANDARD PACKAGING QUANTITY				
CASE CODE	QUANTITY (PCS/REEL)			BULK, PLASTIC TRAY QUANTITY (PCS)
	7", FULL REEL (/TR)	7", HALF REEL (/HR)	7", PARTIAL REEL (/PR)	
A, B, C, D, E	2500	1250	100	75
F	1000	500	100	75
G	600	300	100	60
H	600	300	100	50

**Notes**

- (1) Bulk capacitors are shipped in plastic trays
- (2) T level capacitors are only shipped in tape and reel/or waffle packaging. Contact factory for waffle pack quantities

**PAD DIMENSIONS** in inches [millimeters]



CASE CODE	WIDTH (A)	PAD METALLIZATION (B)	SEPARATION (C)
A	0.065 [1.6]	0.050 [1.3]	0.040 [1.0]
B	0.065 [1.6]	0.070 [1.8]	0.055 [1.4]
C	0.065 [1.6]	0.070 [1.8]	0.120 [3.0]
D	0.115 [2.9]	0.070 [1.8]	0.070 [1.8]
E	0.115 [2.9]	0.070 [1.8]	0.120 [3.0]
F	0.150 [3.8]	0.070 [1.8]	0.140 [3.6]
G	0.125 [3.2]	0.070 [1.8]	0.170 [4.3]
H	0.165 [4.2]	0.090 [2.3]	0.170 [4.3]

**POWER DISSIPATION**

CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
A	0.060
B, C	0.075
D, E	0.085
F	0.110
G	0.120
H	0.150

**PRODUCT INFORMATION**

Conformal Coated Guide	<a href="http://www.vishay.com/doc?40150">www.vishay.com/doc?40150</a>
Pad Dimensions	
Package Dimensions	
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
<b>SELECTOR GUIDES</b>	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
<b>FAQ</b>	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>

# Solid Tantalum Surface Mount Capacitors

## TANTAMOUNT® Conformal Coated, Extended Range, Military, MIL-PRF-55365/13 Qualified


**FEATURES**

- Weibull failure rates B, C, T
- Tape and reel available per EIA 481
- Termination finishes available; gold plate, solder plated, and hot solder dipped
- Mounting: Surface mount
- Compliant to RoHS Directive 2002/95/EC


**RoHS\***  
COMPLIANT

**Note**

\* 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:** 0.33 µF to 330 µF

**Capacitance Tolerance:** ± 5 %, ± 10 %, ± 20 %

**Voltage Rating:** 4 V<sub>DC</sub> to 35 V<sub>DC</sub>

ORDERING INFORMATION								
CWR16	D	B	335	K	B	A	A	/TR
TYPE	VOLTAGE	TERMINATION FINISH	CAPACITANCE	CAPACITANCE TOLERANCE	FAILURE RATE %/1000 h	CASE CODE	SURGE CURRENT	PACKAGING
	C = 4 V D = 6 V F = 10 V H = 15 V J = 20 V K = 25 V M = 35 V	B = Gold H = Solder plated C = Hot solder dipped	This is expressed in picofarads. The first two digits are the significant figures. The third is the number of zeros to follow.	J = ± 5 % K = ± 10 % M = ± 20 %	B = 0.1 C = 0.01 T = 0.01 <sup>(1)</sup>	A B C D E F G H	A = 10 cycles at + 25 °C B = 10 cycles at - 55 °C and + 85 °C C = 10 cycles at - 55 °C and + 85 °C (before Weibull grading) Z = No surge current	Blank = Bulk, plastic tray /FA = Waffle pack /PR = 100 pcs reel /HR = Half reel /TR = Full reel

**Note**

(1) T level capacitors are recommended for "space applications"

DIMENSIONS in inches [millimeters]						
CASE CODE	L	W	H	P	T <sub>1</sub>	T <sub>2</sub> (max.)
A	0.100 ± 0.015 [2.54 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.030 ± 0.005 [0.76 ± 0.13]	0.005 [0.13]	0.015 [0.38]
B	0.150 ± 0.015 [3.81 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.030 ± 0.005 [0.76 ± 0.13]	0.005 [0.13]	0.015 [0.38]
C	0.200 ± 0.015 [5.08 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.030 ± 0.005 [0.76 ± 0.13]	0.005 [0.13]	0.015 [0.38]
D	0.150 ± 0.015 [3.81 ± 0.38]	0.100 ± 0.015 [2.54 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.030 ± 0.005 [0.76 ± 0.13]	0.005 [0.13]	0.015 [0.38]
E	0.200 ± 0.015 [5.08 ± 0.38]	0.100 ± 0.015 [2.54 ± 0.38]	0.050 ± 0.015 [1.27 ± 0.38]	0.030 ± 0.005 [0.76 ± 0.13]	0.005 [0.13]	0.015 [0.38]
F	0.220 ± 0.015 [5.59 ± 0.38]	0.135 ± 0.015 [3.43 ± 0.38]	0.070 ± 0.015 [1.78 ± 0.38]	0.030 ± 0.005 [0.76 ± 0.13]	0.005 [0.13]	0.015 [0.38]
G	0.265 ± 0.015 [6.73 ± 0.38]	0.110 ± 0.015 [2.79 ± 0.38]	0.110 ± 0.015 [2.79 ± 0.38]	0.050 ± 0.005 [1.27 ± 0.13]	0.005 [0.13]	0.015 [0.38]
H	0.285 ± 0.015 [7.24 ± 0.38]	0.150 ± 0.015 [3.81 ± 0.38]	0.110 ± 0.015 [2.79 ± 0.38]	0.050 ± 0.005 [1.27 ± 0.13]	0.005 [0.13]	0.015 [0.38]

**Note**

- When solder coated terminations are required, add 0.015" [0.38 mm] to termination dimension tolerance



RATINGS AND CASE CODES							
μF	4 V	6 V	10 V	15 V	20 V	25 V	35 V
0.33							A
0.47						A	
0.68					A		
1.0				A	A	B	
1.5				A	B		
2.2			A	A	B	D	
3.3	A	A	A	B	D	E	
4.7	A	A	B, C	B, C, D	E		
6.8	A	B	B, C, D	D, E	E	F	G
10	B	B	B, C, D, E	D, E	E, F		H
15	B	B, D, E	D, E	E, F	F	G	H
22	B, D	D, E	E	F	G	G, H	
33	D, E	E	F	F, G	H	H	
47	E	F	F, G	G, H	H		
68	E	F, G	G	G, H			
100	F	G	G, H	H			
150	G	G	H				
220	H	H	H				
330	H	H					

STANDARD RATINGS									
CAPACITANCE (μF)	CASE CODE	PART NUMBER	MAX. DCL (μA) AT			MAX. DF (%) AT			MAX. ESR AT + 25 °C 100 kHz (Ω)
			+ 25 °C	+ 85 °C	+ 125 °C	+ 25 °C	+ 85 °C + 125 °C	- 55 °C	
4 V <sub>DC</sub> AT + 85 °C; 2.7 V <sub>DC</sub> AT + 125 °C									
3.3	A	CWR16C(1)335(2)(3)A(4)(5)	1	10	12	6	8	8	12
4.7	A	CWR16C(1)475(2)(3)A(4)(5)	1	10	12	6	8	8	12
6.8	A	CWR16C(1)685(2)(3)A(4)(5)	1	10	12	6	8	8	12
10	B	CWR16C(1)106(2)(3)B(4)(5)	1	10	12	8	10	10	8
15	B	CWR16C(1)156(2)(3)B(4)(5)	1	10	12	8	10	10	8
22	B	CWR16C(1)226(2)(3)B(4)(5)	1	10	12	8	10	10	8
22	D	CWR16C(1)226(2)(3)D(4)(5)	1	10	12	8	10	12	4
33	D	CWR16C(1)336(2)(3)D(4)(5)	2	20	24	8	10	12	4
33	E	CWR16C(1)336(2)(3)E(4)(5)	2	20	24	8	10	12	3
47	E	CWR16C(1)476(2)(3)E(4)(5)	2	20	24	8	10	12	3
68	E	CWR16C(1)686(2)(3)E(4)(5)	3	30	36	8	10	12	3
100	F	CWR16C(1)107(2)(3)F(4)(5)	4	40	48	10	12	12	2
150	G	CWR16C(1)157(2)(3)G(4)(5)	6	60	72	10	12	12	1
220	H	CWR16C(1)227(2)(3)H(4)(5)	8	80	96	10	12	12	1
330	H	CWR16C(1)337(2)(3)H(4)(5)	10	100	120	10	12	12	0.9

**Note**

- Part number definitions:
  - Termination finish: B, C, H
  - Capacitance tolerance: J, K, M
  - Failure rate: B, C, T
  - Surge current: A, B, C, Z
  - Packaging: Blank, /FA, /HR, /PR, /TR



STANDARD RATINGS									
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL ( $\mu$ A) AT			MAX. DF (%) AT			MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )
			+ 25 °C	+ 85 °C	+ 125 °C	+ 25 °C	+ 85 °C + 125 °C	- 55 °C	
<b>6 V<sub>DC</sub> AT + 85 °C; 4 V<sub>DC</sub> AT + 125 °C</b>									
3.3	A	CWR16D(1)335(2)(3)A(4)(5)	1	10	12	6	8	8	12
4.7	A	CWR16D(1)475(2)(3)A(4)(5)	1	10	12	6	8	8	12
6.8	B	CWR16D(1)685(2)(3)B(4)(5)	1	10	12	6	8	8	8
10	B	CWR16D(1)106(2)(3)B(4)(5)	1	10	12	6	8	8	8
15	B	CWR16D(1)156(2)(3)B(4)(5)	1	10	12	8	10	10	8
15	D	CWR16D(1)156(2)(3)D(4)(5)	1	10	12	8	10	12	5
15	E	CWR16D(1)156(2)(3)E(4)(5)	1	10	12	8	10	12	3
22	D	CWR16D(1)226(2)(3)D(4)(5)	1	10	12	6	8	8	5
22	E	CWR16D(1)226(2)(3)E(4)(5)	2	20	24	8	10	12	3.5
33	E	CWR16D(1)336(2)(3)E(4)(5)	2	20	24	6	8	8	3.5
47	F	CWR16D(1)476(2)(3)F(4)(5)	3	30	36	8	10	12	3.5
68	F	CWR16D(1)686(2)(3)F(4)(5)	4	40	48	10	12	12	1.5
68	G	CWR16D(1)686(2)(3)G(4)(5)	4	40	48	10	12	12	1
100	G	CWR16D(1)107(2)(3)G(4)(5)	6	60	72	10	12	12	1.1
150	G	CWR16D(1)157(2)(3)G(4)(5)	10	100	120	10	12	12	1.1
220	H	CWR16D(1)227(2)(3)H(4)(5)	10	100	120	10	12	12	0.9
330	H	CWR16D(1)337(2)(3)H(4)(5)	20	200	240	10	12	12	0.9
<b>10 V<sub>DC</sub> AT + 85 °C; 7 V<sub>DC</sub> AT + 125 °C</b>									
2.2	A	CWR16F(1)225(2)(3)A(4)(5)	1	10	12	6	8	8	12
3.3	A	CWR16F(1)335(2)(3)A(4)(5)	1	10	12	6	8	8	12
4.7	B	CWR16F(1)475(2)(3)B(4)(5)	1	10	12	6	8	8	8
4.7	C	CWR16F(1)475(2)(3)C(4)(5)	1	10	12	6	8	8	5.5
6.8	B	CWR16F(1)685(2)(3)B(4)(5)	1	10	12	6	8	8	8
6.8	C	CWR16F(1)685(2)(3)C(4)(5)	1	10	12	6	8	8	5.5
6.8	D	CWR16F(1)685(2)(3)D(4)(5)	1	10	12	6	8	8	5
10	B	CWR16F(1)106(2)(3)B(4)(5)	1	10	12	8	10	10	8
10	C	CWR16F(1)106(2)(3)C(4)(5)	1	10	12	6	8	8	5.5
10	D	CWR16F(1)106(2)(3)D(4)(5)	1	10	12	6	8	8	4
10	E	CWR16F(1)106(2)(3)E(4)(5)	1	10	12	6	8	8	3.5
15	D	CWR16F(1)156(2)(3)D(4)(5)	1	10	12	6	8	8	5
15	E	CWR16F(1)156(2)(3)E(4)(5)	2	20	24	8	10	10	3
22	E	CWR16F(1)226(2)(3)E(4)(5)	3	30	36	8	10	10	2
33	F	CWR16F(1)336(2)(3)F(4)(5)	3	30	36	8	10	10	1.5
47	F	CWR16F(1)476(2)(3)F(4)(5)	4	40	48	10	12	12	1.5
47	G	CWR16F(1)476(2)(3)G(4)(5)	4	40	48	10	12	12	1
68	G	CWR16F(1)686(2)(3)G(4)(5)	6	60	72	10	12	12	1.1
100	G	CWR16F(1)107(2)(3)G(4)(5)	10	100	120	10	12	12	1.1
100	H	CWR16F(1)107(2)(3)H(4)(5)	10	100	120	10	12	12	0.9
150	H	CWR16F(1)157(2)(3)H(4)(5)	15	150	180	10	12	12	0.9
220	H	CWR16F(1)227(2)(3)H(4)(5)	20	200	240	10	12	12	0.9

**Note**

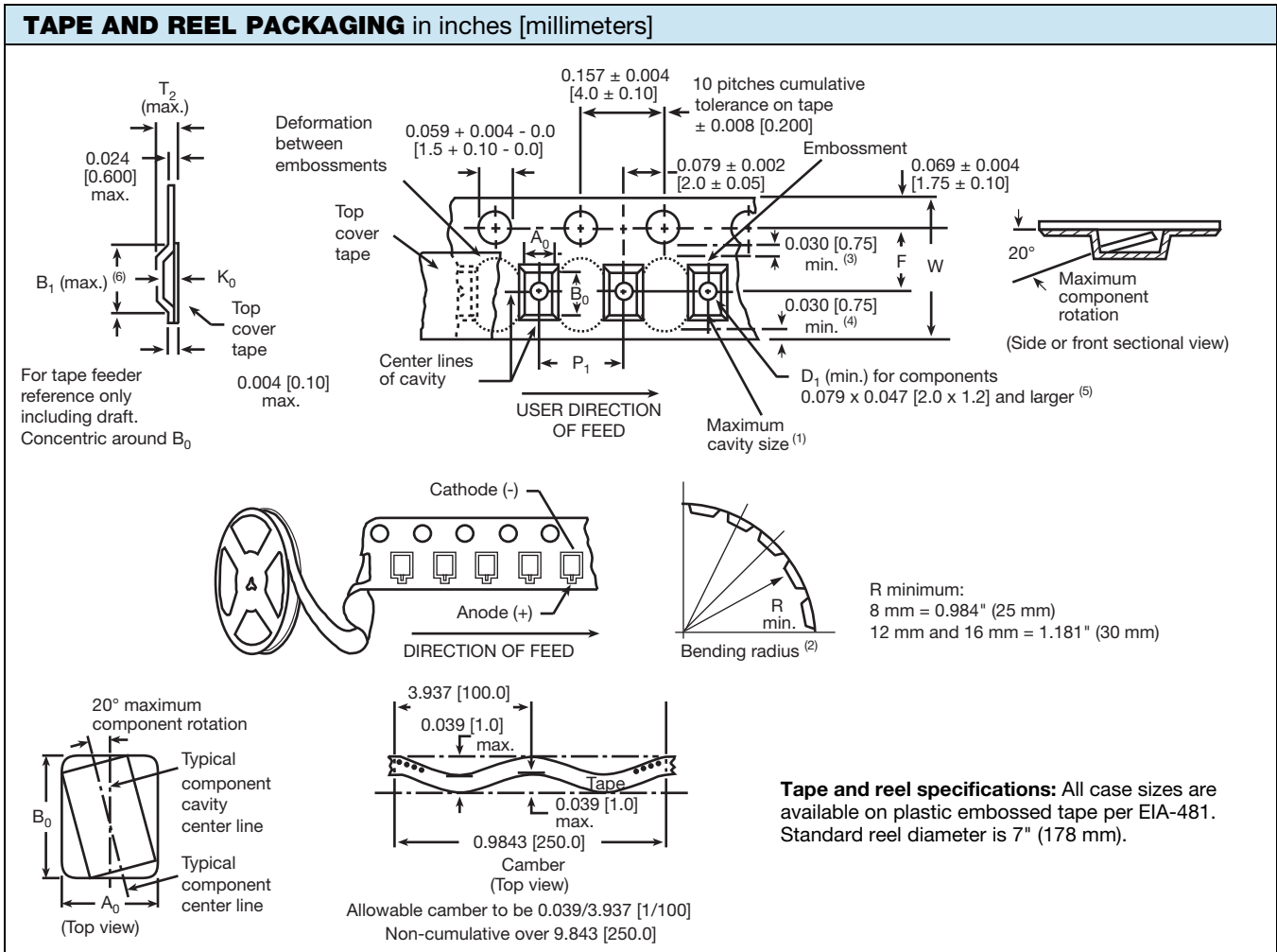
- Part number definitions:
  - Termination finish: B, C, H
  - Capacitance tolerance: J, K, M
  - Failure rate: B, C, T
  - Surge current: A, B, C, Z
  - Packaging: Blank, /FA, /HR, /PR, /TR



STANDARD RATINGS									
CAPACITANCE ( $\mu$ F)	CASE CODE	PART NUMBER	MAX. DCL ( $\mu$ A) AT			MAX. DF (%) AT			MAX. ESR AT + 25 °C 100 kHz ( $\Omega$ )
			+ 25 °C	+ 85 °C	+ 125 °C	+ 25 °C	+ 85 °C + 125 °C	- 55 °C	
<b>15 V<sub>DC</sub> AT + 85 °C; 10 V<sub>DC</sub> AT + 125 °C</b>									
1.0	A	CWR16H(1)105(2)(3)A(4)(5)	1	10	12	6	8	8	15
1.5	A	CWR16H(1)155(2)(3)A(4)(5)	1	10	12	6	8	8	15
2.2	A	CWR16H(1)225(2)(3)A(4)(5)	1	10	12	6	8	8	15
3.3	B	CWR16H(1)335(2)(3)B(4)(5)	1	10	12	6	8	8	9
4.7	B	CWR16H(1)475(2)(3)B(4)(5)	1	10	12	6	8	8	5
4.7	C	CWR16H(1)475(2)(3)C(4)(5)	1	10	12	6	8	8	5.5
4.7	D	CWR16H(1)475(2)(3)D(4)(5)	1	10	12	6	8	8	6
6.8	D	CWR16H(1)685(2)(3)D(4)(5)	1	10	12	6	8	8	6
6.8	E	CWR16H(1)685(2)(3)E(4)(5)	1	10	12	8	10	12	3
10	D	CWR16H(1)106(2)(3)D(4)(5)	2	20	24	6	8	8	6
10	E	CWR16H(1)106(2)(3)E(4)(5)	2	20	24	6	8	8	4
15	E	CWR16H(1)156(2)(3)E(4)(5)	2	20	24	6	8	8	4
15	F	CWR16H(1)156(2)(3)F(4)(5)	2	20	24	8	10	10	3
22	F	CWR16H(1)226(2)(3)F(4)(5)	3	30	36	8	10	10	3
33	F	CWR16H(1)336(2)(3)F(4)(5)	5	50	60	6	8	8	3
33	G	CWR16H(1)336(2)(3)G(4)(5)	6	60	72	8	10	10	1.1
47	G	CWR16H(1)476(2)(3)G(4)(5)	10	100	120	8	10	10	1.1
47	H	CWR16H(1)476(2)(3)H(4)(5)	10	100	120	8	10	10	0.9
68	G	CWR16H(1)686(2)(3)G(4)(5)	10	100	120	8	10	10	1.1
68	H	CWR16H(1)686(2)(3)H(4)(5)	10	100	120	8	10	10	0.9
100	H	CWR16H(1)107(2)(3)H(4)(5)	15	150	180	10	12	12	0.9
<b>20 V<sub>DC</sub> AT + 85 °C; 13 V<sub>DC</sub> AT + 125 °C</b>									
0.68	A	CWR16J(1)684(2)(3)A(4)(5)	1	10	12	6	8	8	15
1.0	A	CWR16J(1)105(2)(3)A(4)(5)	1	10	12	6	8	8	15
1.5	B	CWR16J(1)155(2)(3)B(4)(5)	1	10	12	6	8	8	9
2.2	B	CWR16J(1)225(2)(3)B(4)(5)	1	10	12	6	8	8	9
3.3	D	CWR16J(1)335(2)(3)D(4)(5)	1	10	12	6	8	8	6
4.7	E	CWR16J(1)475(2)(3)E(4)(5)	1	10	12	6	8	8	6
6.8	E	CWR16J(1)685(2)(3)E(4)(5)	2	20	24	6	8	8	5
10	E	CWR16J(1)106(2)(3)E(4)(5)	2	20	24	6	8	8	5
10	F	CWR16J(1)106(2)(3)F(4)(5)	2	20	24	6	8	8	3
15	F	CWR16J(1)156(2)(3)F(4)(5)	3	30	36	6	8	8	3
22	G	CWR16J(1)226(2)(3)G(4)(5)	4	40	48	8	10	10	2.5
33	H	CWR16J(1)336(2)(3)H(4)(5)	6	60	72	8	10	10	0.9
47	H	CWR16J(1)476(2)(3)H(4)(5)	10	100	120	8	10	10	0.9
<b>25 V<sub>DC</sub> AT + 85 °C; 17 V<sub>DC</sub> AT + 125 °C</b>									
0.47	A	CWR16K(1)474(2)(3)A(4)(5)	1	10	12	6	8	8	15
1.0	B	CWR16K(1)105(2)(3)B(4)(5)	1	10	12	6	8	8	10
2.2	D	CWR16K(1)225(2)(3)D(4)(5)	1	10	12	6	8	8	6
3.3	E	CWR16K(1)335(2)(3)E(4)(5)	1	10	12	6	8	8	4
6.8	F	CWR16K(1)685(2)(3)F(4)(5)	2	20	24	6	8	8	3
15	G	CWR16K(1)156(2)(3)G(4)(5)	4	40	48	6	8	8	1.4
22	G	CWR16K(1)226(2)(3)G(4)(5)	6	60	72	6	8	8	1.4
22	H	CWR16K(1)226(2)(3)H(4)(5)	6	60	72	6	8	8	0.9
33	H	CWR16K(1)336(2)(3)H(4)(5)	10	100	120	8	10	10	0.9
<b>35 V<sub>DC</sub> AT + 85 °C; 23 V<sub>DC</sub> AT + 125 °C</b>									
0.33	A	CWR16M(1)334(2)(3)A(4)(5)	1	10	12	6	8	8	22
6.8	G	CWR16M(1)685(2)(3)G(4)(5)	3	30	36	6	8	8	1.5
10	H	CWR16M(1)106(2)(3)H(4)(5)	4	40	48	8	10	10	0.9
15	H	CWR16M(1)156(2)(3)H(4)(5)	6	60	72	6	8	8	0.9

**Note**

- Part number definitions:
  - Termination finish: B, C, H
  - Capacitance tolerance: J, K, M
  - Failure rate: B, C, T
  - Surge current: A, B, C, Z
  - Packaging: Blank, /FA, /HR, /PR, /TR



**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.

<b>CARRIER TAPE DIMENSIONS</b> in inches [millimeters]							
CASE CODE	TAPE SIZE	$B_1$ (max.)	$D_1$ (min.)	F	$P_1$	$T_2$ (max.)	W
A	8 mm	0.179 [4.55]	0.039 [1.0]	0.138 ± 0.002 [3.5 ± 0.05]	0.157 ± 0.004 [4.0 ± 0.1]	0.098 [2.5]	0.315 ± 0.004 [8.0 ± 0.10]
B, C, D, E	12 mm	0.323 [8.2]	0.059 [1.5]	0.217 ± 0.002 [5.5 ± 0.05]	0.157 ± 0.004 [4.0 ± 0.1]	0.256 [6.5]	0.472 ± 0.012 [12.0 ± 0.30]
F	12 mm double pitch	0.323 [8.2]	0.059 [1.5]	0.217 ± 0.002 [5.5 ± 0.05]	0.315 ± 0.004 [8.0 ± 0.10]	0.256 [6.5]	0.472 ± 0.012 [12.0 ± 0.30]
G, H	16 mm	0.476 [12.1]	0.059 [1.5]	0.295 ± 0.004 [7.5 ± 0.1]	0.315 ± 0.004 [8.0 ± 0.10]	0.315 [8.0]	0.642 max. [16.3] max.



<b>STANDARD PACKAGING QUANTITY</b>				
CASE CODE	QUANTITY (PCS/REEL)			BULK, PLASTIC TRAY QUANTITY (PCS)
	7", FULL REEL (/TR)	7", HALF REEL (/HR)	7", PARTIAL REEL (/PR)	
A, B, C, D, E	2500	1250	100	75
F	1000	500	100	75
G	600	300	100	60
H	600	300	100	50

**Notes**

- Bulk capacitors are shipped in plastic trays
- T level capacitors are only shipped in tape and reel/or waffle packaging. Contact factory for waffle pack quantities.

<b>PAD DIMENSIONS</b> in inches [millimeters]			
CASE CODE	WIDTH (A)	PAD METALLIZATION (B)	SEPARATION (C)
A	0.065 [1.6]	0.50 [1.3]	0.040 [1.0]
B	0.065 [1.6]	0.70 [1.8]	0.055 [1.4]
C	0.065 [1.6]	0.70 [1.8]	0.120 [3.0]
D	0.115 [2.9]	0.70 [1.8]	0.070 [1.8]
E	0.115 [2.9]	0.70 [1.8]	0.120 [3.0]
F	0.150 [3.8]	0.70 [1.8]	0.140 [3.6]
G	0.125 [3.2]	0.70 [1.8]	0.170 [4.3]
H	0.165 [4.2]	0.90 [2.3]	0.170 [4.3]

<b>POWER DISSIPATION</b>	
CASE CODE	MAXIMUM PERMISSIBLE POWER DISSIPATION AT + 25 °C (W) IN FREE AIR
A	0.060
B, C	0.075
D, E	0.085
F	0.110
G	0.120
H	0.150

<b>PRODUCT INFORMATION</b>	
Conformal Coated Guide	<a href="http://www.vishay.com/doc?40150">www.vishay.com/doc?40150</a>
Pad Dimensions	
Package Dimensions	
Moisture Sensitivity	<a href="http://www.vishay.com/doc?40135">www.vishay.com/doc?40135</a>
<b>SELECTOR GUIDES</b>	
Solid Tantalum Selector Guide	<a href="http://www.vishay.com/doc?49053">www.vishay.com/doc?49053</a>
Solid Tantalum Chip Capacitors	<a href="http://www.vishay.com/doc?40091">www.vishay.com/doc?40091</a>
<b>FAQ</b>	
Frequently Asked Questions	<a href="http://www.vishay.com/doc?40110">www.vishay.com/doc?40110</a>





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ONE GREENWICH PLACE  
SHELTON, CT 06484  
UNITED STATES  
PH: +1-402-563-6866  
FAX: +1-402-563-6296

### ASIA

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#### SINGAPORE

VISHAY INTERTECHNOLOGY  
ASIA PTE LTD.  
37A TAMPINES STREET 92 #07-00  
SINGAPORE 528886  
PH: +65-6788-6668  
FAX: +65-6788-0988

#### P.R. CHINA

VISHAY CHINA CO., LTD.  
15D, SUN TONG INFOPORT PLAZA  
55 HUAI HAI WEST ROAD  
SHANGHAI 200030  
P.R. CHINA  
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FAX: +86-21-5258 7979

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VISHAY JAPAN CO., LTD.  
SHIBUYA PRESTIGE BLDG. 4F  
3-12-22, SHIBUYA  
SHIBUYA-KU  
TOKYO 150-0002  
JAPAN  
PH: +81-3-5466-7150  
FAX: +81-3-5466-7160

### EUROPE

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#### GERMANY

VISHAY ELECTRONIC GMBH  
GEHEIMRAT-ROSENTHAL-STR. 100  
95100 SELB  
GERMANY  
PH: +49-9287-71-0  
FAX: +49-9287-70435

#### FRANCE

VISHAY S.A.  
199, BLVD DE LA MADELEINE  
06003 NICE, CEDEX 1  
FRANCE  
PH: +33-4-9337-2727  
FAX: +33-4-9337-2726

#### UNITED KINGDOM

VISHAY LTD.  
SUITE 6C, TOWER HOUSE  
ST. CATHERINE'S COURT  
SUNDERLAND ENTERPRISE PARK  
SUNDERLAND SR5 3XJ  
UNITED KINGDOM  
PH: +44-191-516-8584  
FAX: +44-191-549-9556



**World Headquarters**

Vishay Intertechnology, Inc.  
63 Lancaster Avenue  
Malvern, PA 19355-2143  
United States

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