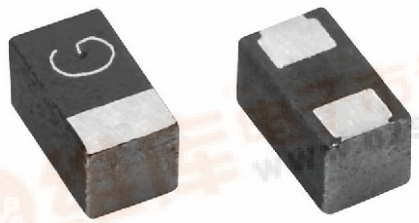
Solid Tantalum Chip Capacitors
MICROTAN™ Lead Frameless Molded



FEATURES

- 0805 and 0603 Footprint
- Lead (Pb)-free face-down terminations
- 8 mm tape and reel packaging available per EIA-481-1 and reeling per IEC 286-3 7" [178 mm] standard

Pb-free
RoHS COMPLIANT

PERFORMANCE CHARACTERISTICS

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

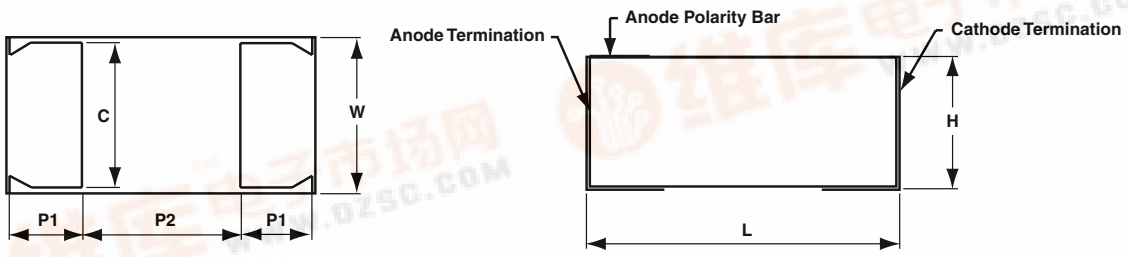
Capacitance Range: 1 µF to 220 µF
Capacitance Tolerance: ± 20 % standard
Voltage Range: 2.5 WVDC to 25 WVDC

ORDERING INFORMATION

298D	106	X0	010	M	2	T
MODEL	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.	**X0 = ± 20 %** 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	**2 = 100 % Tin** 4 = Gold Plated	T = Tape and Reel **7" [178 mm] Reel**

Note: Preferred Tolerance and Reel size 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	L	W	H	P1	P2	C
M	0.063 ± 0.004 [1.60 ± 0.1]	0.033 ± 0.004 [0.85 ± 0.1]	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]

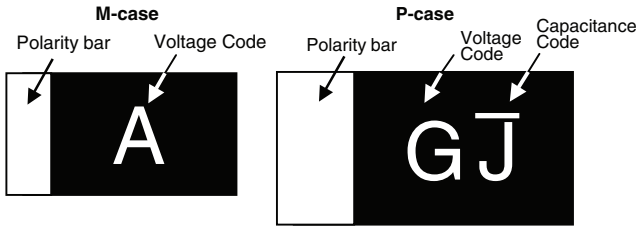
Solid Tantalum Chip Capacitors
MICROTAN™ Lead Frameless Molded

RATINGS AND CASE CODES

µF	2.5 V	4 V	6.3 V	10 V	16 V	25 V
1.0					M	M
2.2			M	M	M	
3.3						
4.7			M	M	M	P
6.8						
10		M	M	M		
15				M		
22		M	M			
33		M	M	P*		
47	M	M	P*	P		
100	M*	P*	P*			
220	P	P				

Note:
* Preliminary values, contact factory for availability.

MARKING



Volts	Code
4	G
6.3	J
10	A
16	C
20	D
25	E

CAP, µF	Code
33	n
47	s
68	w
100	$\overline{A}$
150	$\overline{E}$
220	$\overline{J}$

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_{rms} (A)	ΔC/C* (%)
2.5 WVDC AT + 85 °C, SURGE = 3.3 V. . . 1.6 WVDC AT + 125 °C, SURGE = 2.1 V							
47	M	298D476X02R5M2T	2.4	20	4.0	0.08	± 30
100	M	298D107X02R5M2T	25.0	40	2.5	0.100	± 30
220	P	298D227X02R5P2T	11.0	30	3.0	0.122	± 30
4 WVDC AT + 85 °C, SURGE = 5.2 V. . . 2.7 WVDC AT + 125 °C, SURGE = 3.4 V							
10	M	298D106X0004M2T	0.5	8.0	3.0	0.09	± 10
22	M	298D226X0004M2T	0.9	15	4.0	0.08	± 15
33	M	298D336X0004M2T	2.6	15	4.0	0.08	± 20
47	M	298D476X0004M2T	3.8	20	4.0	0.08	± 30
100	P	298D107X0004P2T	4.0	20	2.0	0.1	± 30
220	P	298D227X0004P2T	17.6	30	3.0	0.122	± 30
6.3 WVDC AT + 85 °C, SURGE = 8 V. . . 4 WVDC AT + 125 °C, SURGE = 5 V							
2.2	M	298D225X06R3M2T	0.5	10	5.0	0.07	± 10
4.7	M	298D475X06R3M2T	0.5	8.0	3.0	0.09	± 10
10	M	298D106X06R3M2T	0.6	8.0	3.0	0.09	± 10
22	M	298D226X06R3M2T	2.8	15	4.0	0.08	± 15
33	M	298D336X06R3M2T	4.2	20	4.0	0.08	± 30
47	P	298D476X06R3P2T	3.0	22	3.0	0.122	± 20
100	P	298D107X06R3P2T	6.3	20	2.0	0.150	± 20
10 WVDC AT + 85 °C, SURGE = 13 V. . . 7 WVDC AT + 125 °C, SURGE = 8 V							
2.2	M	298D225X0010M2T	0.5	10	10	0.05	± 10
4.7	M	298D475X0010M2T	0.5	6.0	4.0	0.08	± 15
10	M	298D106X0010M2T	1.0	8.0	4.0	0.08	± 15
15	M	298D156X0010M2T	1.5	12	4.0	0.08	± 20
33	P	298D336X0010P2T	3.3	10	2.0	0.150	± 10
47	P	298D476X0010P2T	4.7	22	3.0	0.122	± 20
16 WVDC AT + 85 °C, SURGE = 20 V. . . 10 WVDC AT + 125 °C, SURGE = 12 V							
1.0	M	298D105X0016M2T	0.5	6.0	12.0	0.045	± 15
2.2	M	298D225X0016M2T	0.5	10	12.0	0.045	± 15
4.7	M	298D475X0016M2T	0.8	8.0	6.0	0.06	± 15
25 WVDC AT + 85 °C, SURGE = 32 V. . . 17 WVDC AT + 125 °C, SURGE = 20 V							
1.0	M	298D105X0025M2T	0.5	6.0	10.0	0.05	± 10
4.7	P	298D475X0025P2T	1.2	6.0	4.0	0.106	± 10

Note
* See Performance Characteristics tables, page 41.

CAPACITORS PERFORMANCE CHARACTERISTICS

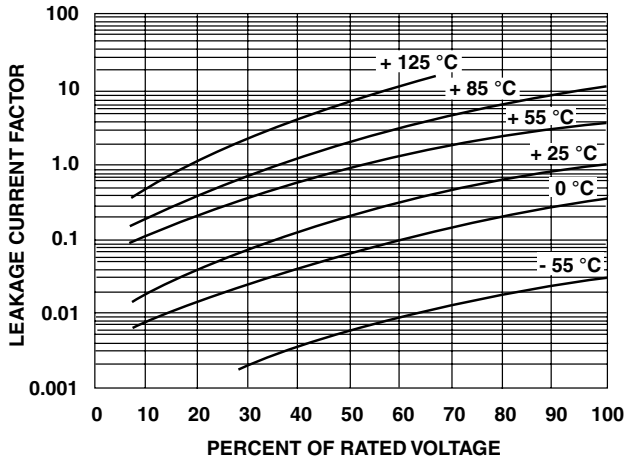
ELECTRICAL PERFORMANCE CHARACTERISTICS

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_{rms} at + 25 °C using a capacitance bridge
Dissipation Factor (at 120 Hz)	Limits per Standard Ratings Table. Tested via bridge method, at 25 °C, 120 Hz.
ESR (100 kHz)	Limits per Standard Ratings Table. Tested via bridge method, at 25 °C, 100 kHz.
Leakage Current	After application of rated voltage applied to capacitors for 5 minutes using a steady source of power with 1 kΩ resistor in series with the capacitor under test, leakage current at 25 °C is not more than described in. 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 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 1.0 at + 25 °C 0.9 at + 85 °C 0.4 at + 125 °C
Maximum Permissible Power Dissipation at 25 °C (W) in free air	M-Case: 0.025 P-Case: 0.045

Operating Temperature

+ 85 °C RATING		+ 125 °C RATING	
WORKING VOLTAGE	SURGE VOLTAGE	WORKING VOLTAGE	SURGE VOLTAGE
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

TYPICAL LEAKAGE CURRENT FACTOR RANGE



Notes

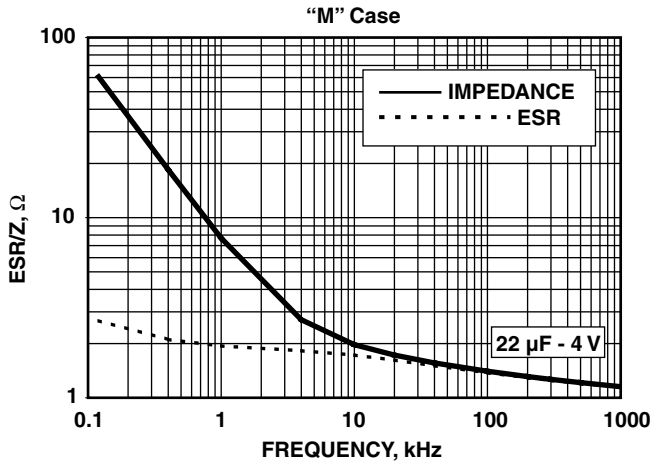
- **At + 25 °C,** the leakage current shall not exceed the value listed in the Standard Ratings Table.
- **At + 85 °C**, the leakage current shall not exceed 10 times the value listed in the Standard Ratings Table.
- **At + 125 °C**, the leakage current shall not exceed 12 times the value listed in the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

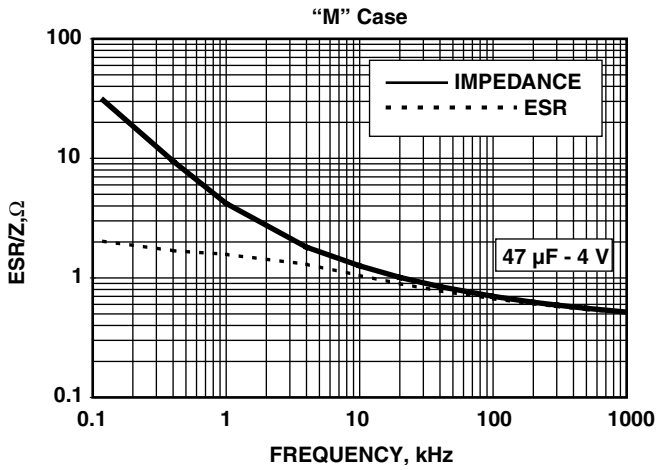
Solid Tantalum Chip Capacitors
MICROTAN™ Lead Frameless Molded

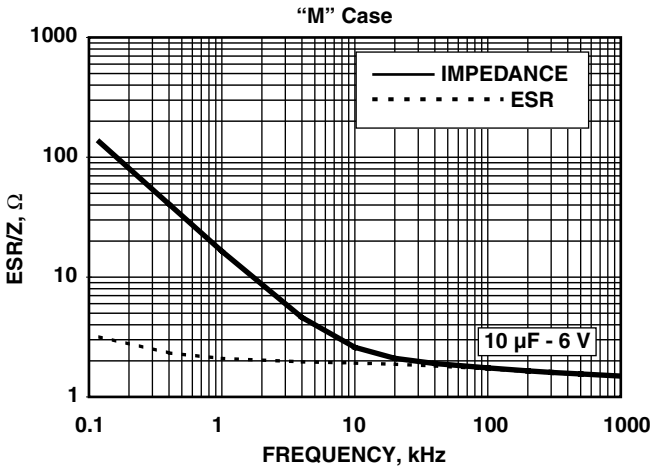
ENVIRONMENTAL PERFORMANCE CHARACTERISTICS			
ITEM	**CONDITION**	**POST TEST PERFORMANCE**	
Life Test at + 85 °C	1000 h application of rated voltage at 85 °C with a 3 Ω series resistance, MIL-STD 202G Method 108A	Capacitance Change Dissipation Factor Leakage Current	Refer to Standard Ratings Table Not 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

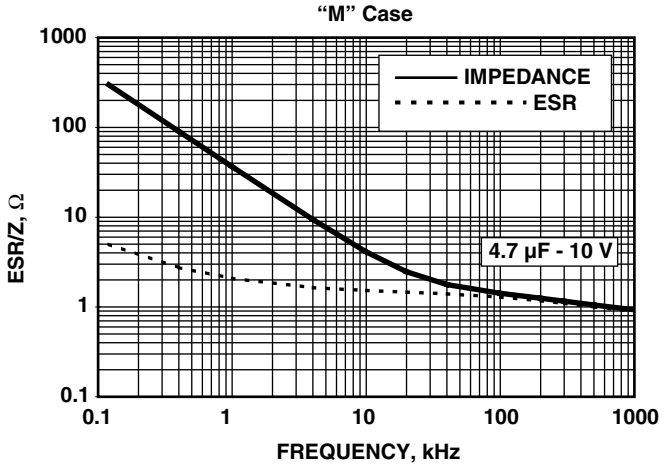
MECHANICAL PERFORMANCE CHARACTERISTICS			
TEST CONDITION	**CONDITION**	**POST TEST PERFORMANCE**	
Terminal Strength	Apply a pressure load of 5 N for 10 ± 1 s horizontally to the center of capacitor side body. AECQ-200 rev. C Method 006	Capacitance Change Dissipation Factor Leakage Current There shall be no mechanical or visual damage to capacitors post-conditioning.	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. AECQ-200 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 There shall be no mechanical or visual damage to capacitors post-conditioning.	Refer to Standard Ratings Table Initial specified value or less Initial specified value or less
Shock	Mil-Std-202G, Method 213B, Condition I, 100G Peak	Capacitance Change Dissipation Factor Leakage Current There shall be no mechanical or visual damage to capacitors post-conditioning.	Refer to Standard Ratings Table Initial specified value or less Initial specified value or less
Resistance to Solder Heat	At 260 °C, for 10 seconds, reflow	Capacitance Change Dissipation Factor Leakage Current There shall be no mechanical or visual damage to capacitors post-conditioning.	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 UL94 VO with an oxygen index of 32 %.		

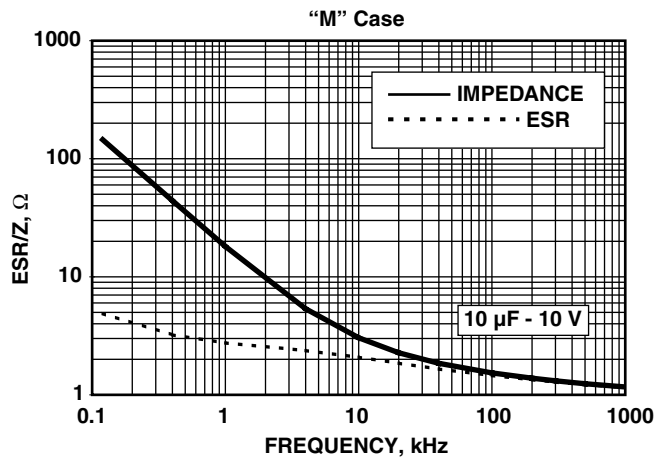
TYPICAL CURVES AT + 25 °C, IMPEDANCE AND ESR VS. FREQUENCY

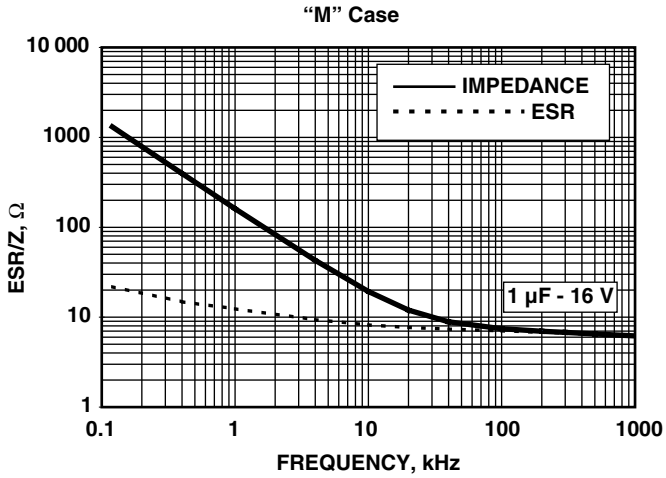






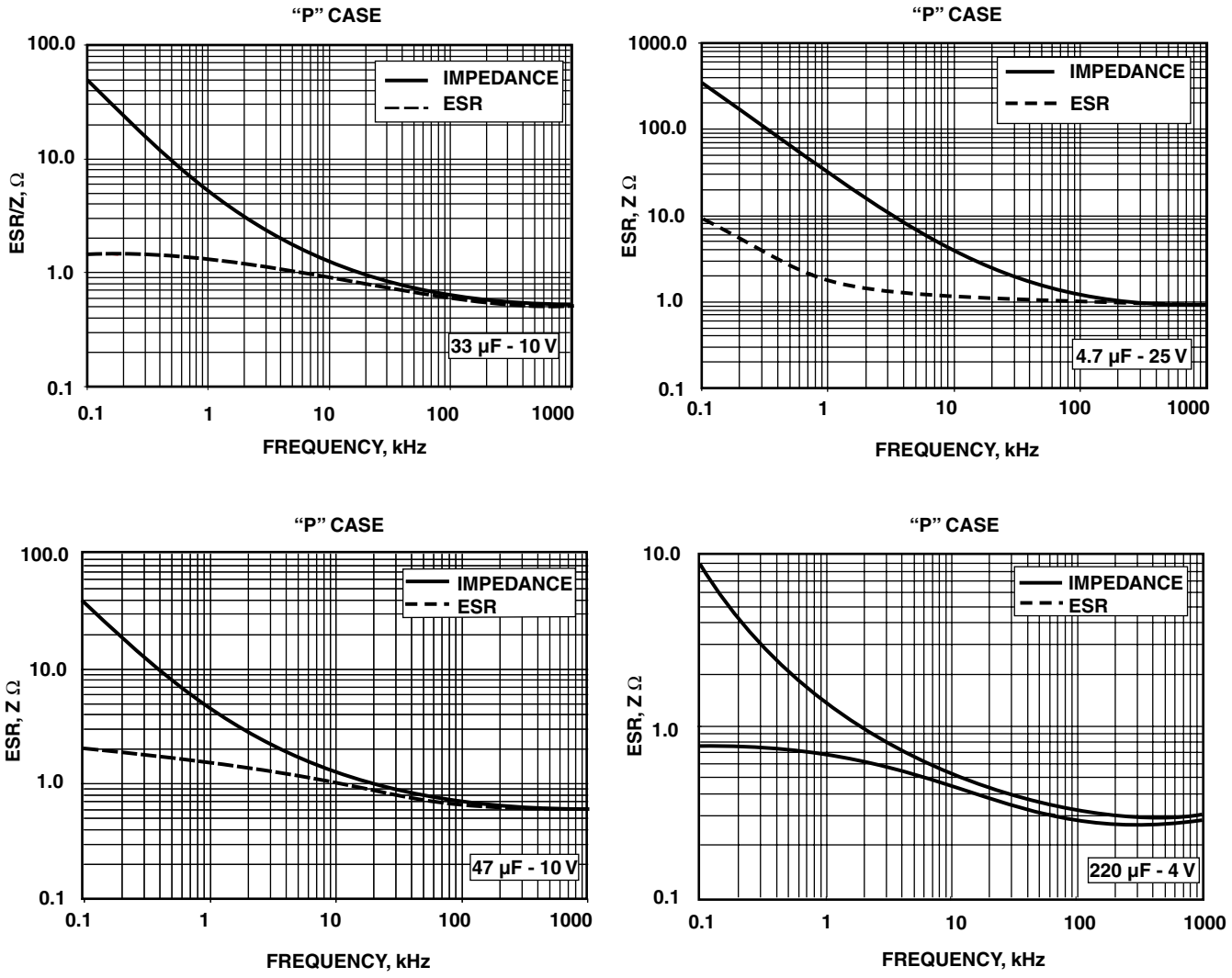






Solid Tantalum Chip Capacitors
MICROTAN™ Lead Frameless Molded

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



Notice

Specifications of the products displayed herein are subject to change without notice. Vishay Intertechnology, Inc., or anyone on its behalf, assumes no responsibility or liability for any errors or inaccuracies.

Information contained herein is intended to provide a product description only. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document. Except as provided in Vishay's terms and conditions of sale for such products, Vishay assumes no liability whatsoever, and disclaims any express or implied warranty, relating to sale and/or use of Vishay products including liability or warranties relating to fitness for a particular purpose, merchantability, or infringement of any patent, copyright, or other intellectual property right.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications. Customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Vishay for any damages resulting from such improper use or sale.