Tanceram® MLCs for Smoothing & Decoupling Applications

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Historically, Tantalum capacitors have been used for smoothing and decoupling applications for switching power supplies, DC/DC converters, LCD drivers and general digital circuits. As the need grew for efficient power converters that operate at high frequencies, the design engineer needed components that dissipated less heat. For high frequency applications, a Tanceram®, chip capacitor is an excellent substitute for a Tantalum capacitor. Compared to a Tantalum capacitor, a Tanceram®, chip capacitor has a low ESR and low ESL at high frequencies. As a result, selecting a Tanceram®, capacitor with 1/2 to 1/10th the capacitance of a Tantalum will produce an impedance that is more than an order of magnitude lower than the Tantalum capacitor over the same high frequency range. The following example will compare the performance.

From 100 KHz to 70 MHz the typical 4.7uF Tanceram®, chip capacitor has a measured ESR from .05 to .02 Ohms while a typical 10uF Tantalum capacitor ESR measures from 1.2 to 0.8 Ohms. In this example, the Tanceram®, chip capacitor has a typical ESR that is 4% of the value of a comparable Tantalum capacitor over the frequency range of 100 KHz to 70 MHz. (See Figure 1.)

A typical 4.7uF Tanceram®, chip capacitor has low impedance from 100 KHz to 70 MHz. From Figure 2 the self-resonant frequency is approximately 3 MHz, for a remarkably low ESL of 600pH! Also, the lower impedance produces less heat in power conversion applications. Figure 3 shows the temperature rise vs. ripple current. From the example capacitor values, a Tanceram®, chip capacitor can handle approximately 3 times the ripple current to produce a comparable temperature rise.

Often, substituting a Tanceram®, chip capacitor to replace a Tantalum capacitor will reduce the circuit size and cost while providing superior performance. The Tantalum substitution guide on page 2 was developed based on the principals discussed above.

Typical performance curves for popular Tanceram® parts can be found on page 3 & 4.

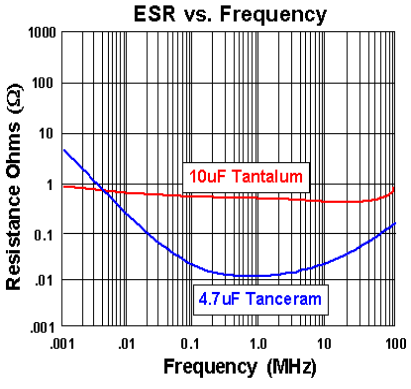


Figure 1

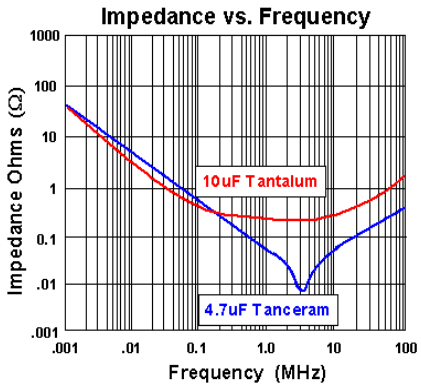


Figure 2

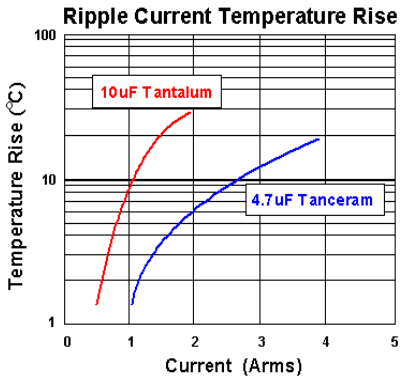


Figure 3

Tantalum Capacitor to X7R Dielectric Tanceram Replacement Guideline

Capacitance Value		Case Size				
Tantalum	Tanceram	0603	0805	1206	1210	1812
1.0 uF	0.22 uF		25 V			
2.2 uF	0.47 uF		16 V	50 V		
4.7 uF	1.0 uF		10 V	25 V	50 V	
10 uF	2.2 uF			16 V	25 V	
22 uF	4.7 uF				16 V	
47 uF	10 uF				10 V	

Tantalum Capacitor to X5R Dielectric Tanceram Replacement Guideline

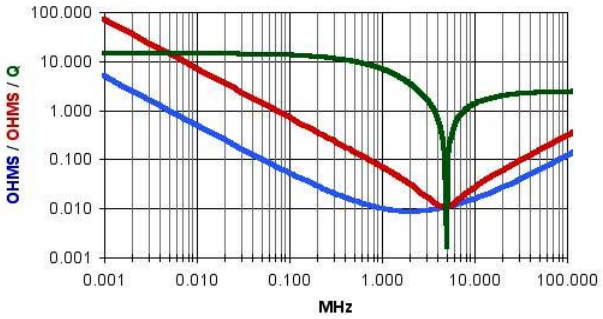
Capacitance Value		Case Size				
Tantalum	Tanceram	0603	0805	1206	1210	1812
1.0 uF	0.22 uF	16 V				
2.2 uF	0.47 uF	10 V				
4.7 uF	1.0 uF	10 V				
10 uF	2.2 uF	6.3 V	10 V			
22 uF	4.7 uF		6.3 V	10 V		
47 uF	10 uF		6.3 V	6.3 V	25 V	25 V
100 uF	22 uF			6.3 V		16 V
200 uF	47 uF					6.3 V
470 uF	100 uF					6.3 V

Tantalum Capacitor to Y5V Dielectric Tanceram Replacement Guideline

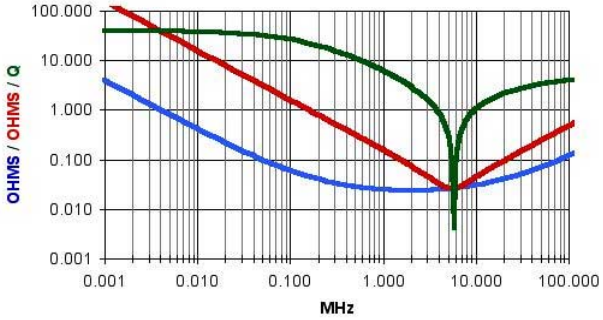
Capacitance Value		Case Size				
Tantalum	Tanceram	0603	0805	1206	1210	1812
1.0 uF	0.47 uF	16 V	50 V			
2.2 uF	1.0 uF	10 V	50 V			
4.7 uF	2.2 uF	6.3 V	16 V	50 V		
10 uF	4.7 uF		10 V	25 V	50 V	
22 uF	10 uF		6.3 V	10 V	25 V	
47 uF	22 uF			10 V	10 V	
100 uF	47 uF				6.3 V	10 V
200 uF	100 uF				6.3 V	6.3 V

Typical Performance Curves for Tanceram® X7R/X5R Capacitors

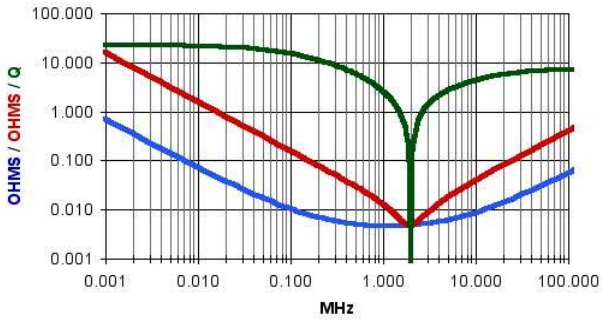
6R3R14X225MV4 (0603, X5R, 2.2uF, 6.3V)
Typical ESR = Blue, Impedance = Red, Q = Green



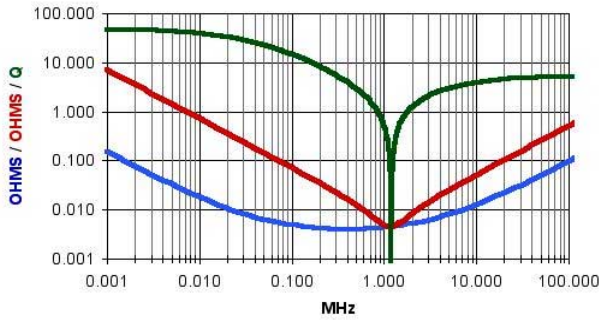
100R15W105MV4 (0805, X7R, 1uF, 10V)
Typical ESR = Blue, Impedance = Red, Q = Green



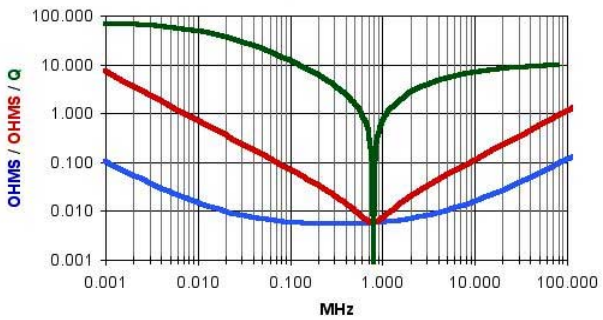
6R3R15X106MV4 (0805, X5R, 10uF, 6.3V)
Typical ESR = Blue, Impedance = Red, Q = Green



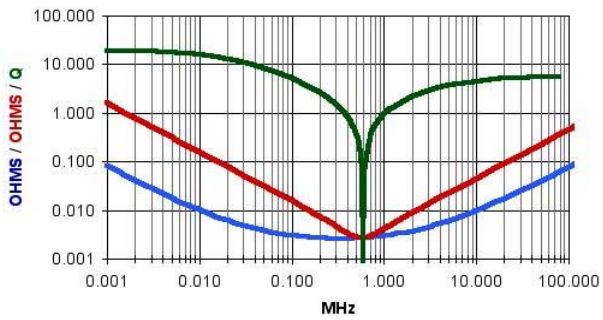
6R3R18X226MV4 (1206, X5R, 22uF, 6.3V)
Typical ESR = Blue, Impedance = Red, Q = Green



100S43X226MV4 (1812, X5R, 22uF, 10V)
Typical ESR = Blue, Impedance = Red, Q = Green

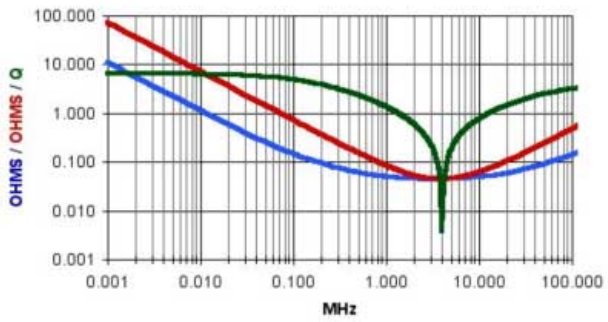


6R3S43X107MV4 (1812, X5R, 100uF, 6.3V)
Typical ESR = Blue, Impedance = Red, Q = Green

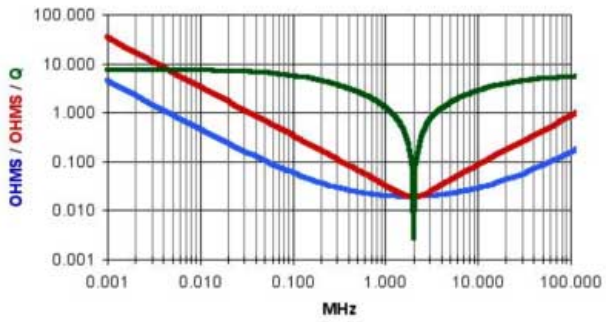


Typical Performance Curves for Tanceram® Y5V Capacitors

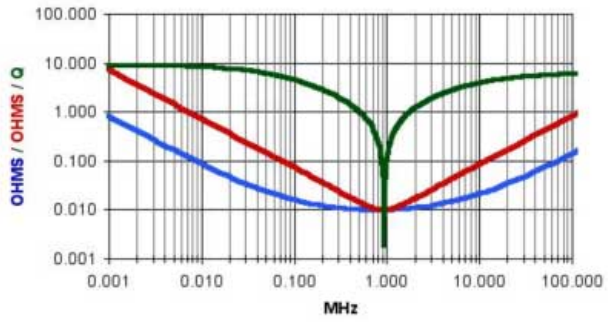
6R3R14Y225ZV4 (0603, Y5V, 2.2uF, 6.3V)
Typical ESR = Blue, Impedance = Red, Q = Green



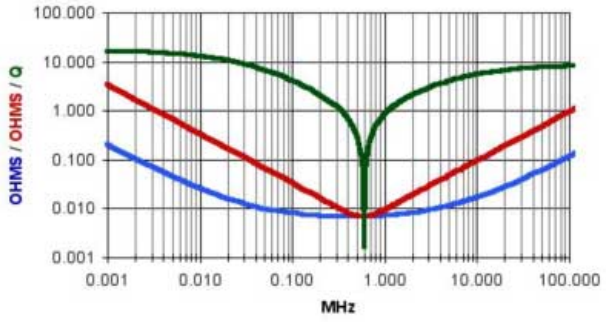
100R15Y475ZV4 (0805, Y5V, 4.7uF, 10V)
Typical ESR = Blue, Impedance = Red, Q = Green



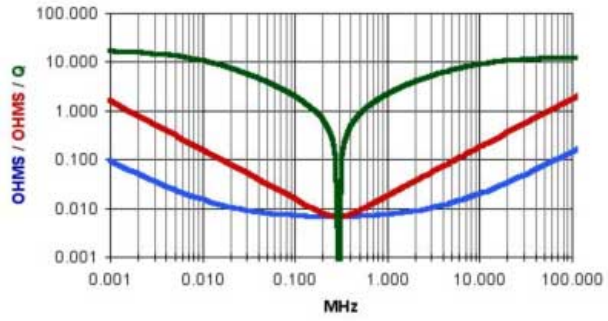
100R18Y226ZV4 (1206, Y5V, 22uF, 10V)
Typical ESR = Blue, Impedance = Red, Q = Green



100S43Y476ZV4 (1812, Y5V, 47uF, 10V)
Typical ESR = Blue, Impedance = Red, Q = Green



6R3S43Y107ZV4 (1812, Y5V, 100uF, 6.3V)
Typical ESR = Blue, Impedance = Red, Q = Green



6R3S41Y107ZV4 (1210, Y5U, 100uF, 6.3V)
Typical ESR = Blue, Impedance = Red, Q = Green