

ALTERNATIVE SOLUTIONS

Using Panasonic Capacitor Technology to Replace Tantalums

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Breaking Away from the Tantalum Trap

In today's market there is an increasing need for stable voltage in countless applications, particularly for the computers and digital equipment that use powerful microprocessors such as CPUs, ASICs and LSIs. These processors deal with massive volumes of data and require large scale integration and faster clock speeds that call for more load current and in turn, lower operating voltages.

The components industry is under pressure to provide solutions that manage the risk of unstable power. Various capacitor technologies are employed in voltage regulators such as tantalum capacitors, aluminum capacitors and for low ESR (equivalent series resistance), polymer capacitors and multilayer ceramic capacitors (MLCC).

Tantalum Ore: Supply and Conflict Issues

The first technology mentioned above, tantalum capacitors, uses a rare metal (tantalum) as its primary material. This tantalum, which is scarce in nature, is often procured from mines in the Eastern region of the Democratic Republic of Congo and surrounding countries that are controlled by non-government military groups, or unlawful military factions. The 2010 Wall Street Reform and Consumer Protection Act discourages the use of tantalum, as well as many other minerals, since it is deemed a conflict mineral. Given its scarcity and political mining issues, tantalum has suffered from cyclical shortages. Our industry has seen such shortages in 1997, 2000 and 2008. And, according to industry resources, we are headed for yet another shortage due to the unstable supply of tantalum ore.

Breaking Away from Tantalum Capacitors

To solve this cyclical shortage, and resulting inevitable price increase, now is the time to break away from the tantalum trap. Other types of capacitors have found their way into applications that typically used tantalums. For instance, MLCCs replaced the smaller capacitance tantalums, larger capacitance tantalums were replaced by aluminum capacitors, and in the low ESR arena polymer aluminum capacitors are regarded as an excellent substitute.

With an abundant supply of material, aluminum capacitors are one viable option and include a range of products from aluminum polymer capacitors to surface mount (SMT) aluminum capacitors. Polymer aluminum capacitors use polymer as a solid electrolyte, and they boast ESR values as low as 3 mohm at 100 KHz. Polymer offers 10,000 times better conductivity than the electrolyte found in wet aluminum technology, and 1,000 times more than MnO₂ used in tantalum technology. Polymer aluminum capacitors have available capacitance ranges from a few microfarads to 560 uF. In addition, they also offer stable capacitance against frequency and temperature changes.

SMT aluminum capacitors cover an extensive CV range from 6.3 to 450 V/0.1 to 6800 uF and are available for general purpose to low impedance. State-of-the-art SMT aluminum capacitors use high-conductivity electrolyte, achieving 60 mohm (100 KHz) ESR, which surpasses regular tantalums.

When rethinking the entrenched use of tantalum capacitors and viewing capacitor selection from a new perspective, engineers will be able to achieve better designs and reduce costs at the same time.

Look to
Panasonic and
its wide variety
of capacitor
solutions for your
next design need!



Tantalum Alternatives Cross Reference

Tantalum Capacitors							Panasonic SMT Low ESR Aluminum Electrolytic				
Rated voltage (V)	Cap(uF)	Size code / ESR(Ω)					Recommendation 1				
		B	C	V	D	E	EEE-FK Series				
		3528-21	6032-28	7343-20	7343-31	7343-43	P/N	Size	R.V.(V)	Cap.(uF)	ESR(Ω)
4 (Circuit voltage 2.0V max.)	100	0.65	0.20	-	0.20	-	EEEFKJ101UAR	C(5x5.8)	6.3	100	0.70
	150	1.00	0.30	0.20	0.15	-	EEEFK1A151AP	D(6.3x5.8)	10	220	0.36
	220	0.40	-	0.30	-	-	EEEFK0J221AP	D(6.3x5.8)	6.3	220	0.36
	330	-	0.09	0.30	0.15	-	EEEFKJ331XAP	D8(6.3x7.7)	6.3	330	0.34
	470	-	-	-	0.15	0.15	EEEFK0J471AP	F(8x10)	6.3	470	0.16
	680	-	-	-	0.15	0.10	EEEFK1A681AP	F(8x10)	10	680	0.16
	1000	-	-	-	-	0.10	EEEFK0J102AP	G(10x10)	6.3	1000	0.08
6.3 (Circuit voltage 2.5V-3.3V)	47	0.50	0.25	-	0.22	-	EEEFK1C470AP	D(6.3x5.8)	16	47	0.36
	68	0.65	0.20	-	0.20	-	EEEFKJ101UAR	C(5x5.8)	6.3	100	0.70
	100	1.50	0.30	0.20	0.15	-	EEEFKJ101UAR	C(5x5.8)	6.3	100	0.70
	150	-	0.30	0.30	0.15	-	EEEFK1A151AP	D(6.3x5.8)	10	220	0.36
	220	-	0.30	0.30	0.15	0.15	EEEFK0J221AP	D(6.3x5.8)	6.3	220	0.36
	330	-	-	-	0.15	0.15	EEEFKJ331XAP	D8(6.3x7.7)	6.3	330	0.34
	470	-	-	-	0.15	0.10	EEEFK0J471AP	F(8x10)	6.3	470	0.16
10 (Circuit voltage 3.3V-5V)	22	0.70	0.40	-	-	-	EEEFK1C220AR	C(5x5.8)	16	22	0.70
	47	0.65	0.30	0.30	0.22	-	EEEFK0C470UAR	C(5x5.8)	16	47	0.70
	68	1.50	0.30	0.30	0.20	-	EEEFK1C680AP	D(6.3x5.8)	16	68	0.36
	100	-	0.20	0.40	0.15	-	EEEFK1C101AP	D(6.3x5.8)	16	100	0.36
	150	-	0.70	0.30	0.15	0.15	EEEFK1A151AP	D(6.3x5.8)	10	150	0.36
	220	-	-	0.50	0.15	0.15	EEEFKA221XAP	D8(6.3x7.7)	10	220	0.34
	330	-	-	-	0.15	0.10	EEEFK1A331AP	F(8x10)	10	330	0.16
470	-	-	-	0.10	0.10	EEEFK1A471AP	F(8x10)	10	470	0.16	
16 (Circuit voltage 5V-8V)	10	0.80	0.60	-	-	-	EEEFK1V100AR	C(5x5.8)	35	10	0.70
	22	1.00	0.35	-	0.25	-	EEEFK1C220AR	C(5x5.8)	16	22	0.70
	33	-	0.30	-	0.25	-	EEEFK1V330AP	D(6.3x5.8)	35	33	0.36
	47	-	0.50	0.30	0.20	-	EEEFK1C470AP	D(6.3x5.8)	16	47	0.36
	68	-	1.00	0.50	0.15	-	EEEFK1C680AP	D(6.3x5.8)	16	68	0.36
	100	-	-	0.50	0.15	-	EEEFK1C101AP	D(6.3x5.8)	16	100	0.36
	150	-	-	-	0.40	0.15	EEEFK1C151XAP	D8(6.3x7.7)	16	150	0.34
220	-	-	-	-	0.40	EEEFK221XAP	D8(6.3x7.7)	16	220	0.34	
25	10	3.00	0.60	-	0.40	-	EEEFK1E100AR	B(4x5.8)	25	10	.135
	22	-	1.00	0.50	0.30	-	EEEFK1E220AR	C(5x5.8)	25	22	0.70
	33	-	1.00	-	0.40	0.30	EEEFKE330UAR	C(5x5.8)	25	33	0.70
	47	-	-	-	0.20	0.30	EEEFK1E470AP	D(6.3x5.8)	25	47	0.36
	68	-	-	-	0.50	0.30	EEEFK1E680AP	D(6.3x5.8)	25	68	0.36
	100	-	-	-	-	0.25	EEEFKE101XAP	D8(6.3x7.7)	25	100	0.34
	150	-	-	-	-	-					
220	-	-	-	-	-						
35	10	-	1.20	0.80	0.40	-	EEEFKV100UAR	B(4x5.8)	35	10	.135
	22	-	-	-	0.40	0.30	EEEFK1V220AR	C(5x5.8)	35	22	0.70
	33	-	-	-	0.60	0.60	EEEFK1V330AP	D(6.3x5.8)	35	33	0.36
	47	-	-	-	-	0.50	EEEFK1V470AP	D(6.3x5.8)	35	47	0.36
	68	-	-	-	-	-					
	100	-	-	-	-	-					
	150	-	-	-	-	-					
220	-	-	-	-	-						
50	10	-	-	-	0.70	0.40	EEEFK1H100P	D(6.3x5.8)	50	10	0.88
	22	-	-	-	-	0.50	EEEFK1H220XP	D8(6.3x7.7)	50	22	0.68
	33	-	-	-	-	-					
	47	-	-	-	-	-					
	68	-	-	-	-	-					
	100	-	-	-	-	-					
	150	-	-	-	-	-					
220	-	-	-	-	-						

Panasonic SMT Low ESR Aluminum Electrolytic					Panasonic SP-Cap Polymer Aluminum								
Recommendation 2					Recommendation 1				Recommendation 2				
EEE-FP Series					(1/2 capacitance of Ta)				(Same capacitance of Ta)				
P/N	Size	R.V.(V)	Cap.(uF)	ESR(Ω)	P/N	R.V.(V)	Cap.(uF)	ESR(Ω)	P/N	R.V.(V)	Cap.(uF)	ESR(Ω)	
EEFFP0J101AP	D(6.3x5.8)	6.3	100	0.26	EEFCD0D101ER	2	100	0.018	-				
EEFFP0J221AP	D(6.3x5.8)	6.3	220	0.26	EEFCD0D101ER	2	100	0.018	EEFCD0D151ER	2	150	0.018	
EEFFP0J221AP	D(6.3x5.8)	6.3	220	0.26	EEFCD0D101ER	2	100	0.018	EEFCD0D221ER	2	220	0.018	
EEFFPJ331XAP	D8(6.3x7.7)	6.3	330	0.16	EEFCD0D151ER	2	150	0.018	EEFCX0D331R	2	330	0.015	
EEFFP0J471AP	F(8x10)	6.3	470	0.08	EEFCD0D221ER	2	220	0.018	EEFCX0D471R	2	470	0.015	
EEFFP1A681AP	F(8x10)	10.0	680	0.08	EEFCX0D331R	2	330	0.015	-				
EEFFP0J102AP	G(10x10)	6.3	1000	0.06	EEFCX0D471R	2	470	0.015	-				
EEFFP0J470AR	C(5x5.8)	6.3	47	0.36	EEFCD0J220ER	6.3	22	0.040	EEFCD0J470ER	6.3	47	0.018	
EEFFP0J101AP	D(6.3x5.8)	6.3	100	0.26	EEFCD0J330ER	6.3	33	0.028	EEFCD0G680ER	4	68	0.018	
EEFFP0J101AP	D(6.3x5.8)	6.3	100	0.26	EEFCD0J470ER	6.3	47	0.018	EEFCD0G101ER	4	100	0.018	
EEFFP0J221AP	D(6.3x5.8)	6.3	220	0.26	EEFCD0G820ER	4	82	0.018	EEFCX0G151R	4	150	0.015	
EEFFP0J221AP	D(6.3x5.8)	6.3	220	0.26	EEFCD0G101ER	4	100	0.018	EEFCX0G221R	4	220	0.015	
EEFFPJ331XAP	D8(6.3x7.7)	6.3	330	0.16	EEFCX0G151R	4	150	0.015	-				
EEFFP0J471AP	F(8x10)	6.3	470	0.08	EEFCX0G221R	4	220	0.015	-				
EEFFP1C220AR	C(4x5.8)	16	22	0.36	EEFCD0J100ER	6.3	10	0.055	EEFCD0J220ER	6.3	22	0.040	
EEFFP1C470AP	D(6.3x5.8)	16	47	0.26	EEFCD0J220ER	6.3	22	0.040	EEFCD0J470ER	6.3	47	0.018	
EEFFP1C680AP	D(6.3x5.8)	16	68	0.26	EEFCD0J330ER	6.3	33	0.028	EEFCD0J680ER	6.3	68	0.018	
EEFFP1C101AP	D(6.3x5.8)	16	100	0.26	EEFCD0J470ER	6.3	47	0.018	EEFCX0J101R	6.3	100	0.015	
EEFFPC151XAP	D8(6.3x7.7)	16	150	0.16	EEFCD0J680ER	6.3	68	0.018	EEFCX0J151R	6.3	150	0.015	
EEFFPA221XAP	D8(6.3x7.7)	10	220	0.16	EEFCX0J101R	6.3	100	0.015	-				
EEFFP1A331AP	F(8x10)	10	330	0.08	EEFCX0J151R	6.3	150	0.015	-				
EEFFP1A471AP	F(8x10)	10	470	0.08	EEFCX0G221R	4	220	0.015	-				
EEFFP1C220AR	C(4x5.8)	16	10	0.36	EEFCD1A220ER	10	22	0.025	EEFCD0J100ER	6.3	10	0.055	
EEFFP1E330AP	D(6.3x5.8)	25	33	0.26	EEFCD1A220ER	10	22	0.025	EEFCD0J220ER	6.3	22	0.040	
EEFFP1E330AP	D(6.3x5.8)	25	33	0.26	EEFCD1A220ER	10	22	0.025	EEFCD0J330ER	6.3	33	0.028	
EEFFP1C470AP	D(6.3x5.8)	16	47	0.26	EEFCD1A220ER	10	22	0.025	EEFCD0J470ER	6.3	47	0.018	
EEFFPC101XAP	D8(6.3x7.7)	16	100	0.16	EEFCD1A330ER	10	33	0.025	EEFCD0J680ER	6.3	68	0.018	
EEFFPC101XAP	D8(6.3x7.7)	16	100	0.16	EEFCD0J470ER	6.3	47	0.018	EEFCX0J101R	6.3	100	0.015	
EEFFPC151XAP	D8(6.3x7.7)	16	150	0.16	EEFCD0J680ER	6.3	68	0.018	EEFCX0J151R	6.3	150	0.015	
EEFFPC221XAP	D8(6.3x7.7)	16	220	0.16	EEFCX0J101R	6.3	100	0.015	-				
EEFFP1E100AR	B(4x5.8)	25	10	0.85									
EEFFP1E220AR	C(5x5.8)	25	22	0.36									
EEFFPE330UAR	C(5x5.8)	25	33	0.36									
EEFFP1E470AP	D(6.3x5.8)	25	47	0.26									
EEFFP1E680AP	D(6.3x5.8)	25	68	0.26									
EEFFPE101XAP	D8(6.3x7.7)	25	100	0.18									
EEFFPV100UAR	B(4x5.8)	35	10	0.85									
EEFFP1V220AR	C(5x5.8)	35	22	0.36									
EEFFP1V330AP	D(6.3x5.8)	35	33	0.26									
EEFFP1V470AP	D(6.3x5.8)	35	47	0.26									

Two Options From Panasonic Electronic Components To Help You Avoid The Tantalum Trap

Use this cross references to choose a Tantalum Alternative Solution.

- SMT Aluminum Electrolytics
- SP-Caps

A local Panasonic Sales Representative is available to work with you on Tantalum alternative designs.
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