AMERICAN CAPACITOR CORPORATION

ENGINEERING DATA SHEET

SUPERMETALLIZED POLYPULSE CAPACITORS SERIES Z

SUPERMETALLIZED POLYPULSE CAPACITORS FOR SWITCHING POWER SUPPLIES

SuperMetallized **POLYPULSE** capacitors have been developed by American Capacitor specifically for **SWITCHING POWER SUPPLY** applications. They are used for input filtering, high frequency transformer DC blocking and output filtering.

SuperMetallized **POLYPULSE** capacitors are dry-section non-polar metallized film dielectric with special high current end terminations resulting in **VERY LOW ESR** values and **VERY HIGH DV/DT** ratings.

SuperMetallized **POLYPULSE** capacitors are significantly smaller than metallized polypropylene capacitors and have a 100% voltage rating from **-55°C to +125°C**. Peak currents of more than **10 TIMES** those of metallized polypropylene are achieved without degrading the end termination. Capacitance change with temperature is 4 times better than with polypropylene.

Very high **DV/DT** ratings are achieved for the more critical higher frequencies (200KHz) where time is important.

Maximum **RMS** currents are limited by the self induced heating. If this heat is conducted out through the leads or physical contact to the body of the capacitor, then higher current ratings are possible. Leads, therefore, should be as short as possible and capacitor temperature should be checked for temperature rise. If the temperature rise is greater than 5 degrees C, then a higher current rated capacitor is needed.

SuperMetallized **POLYPULSE** capacitors are available in Axial Wrap and Fill (ZW series), Radial Wrap and Fill (ZV series) and also in epoxy case, both Axial Epoxy Case (ZE series) and Radial Epoxy Case (ZF series).

MILITARY APPLICATIONS should use the ZL series, which are Hermetically sealed in round metal tubes built to MIL C 83421.

OTHER APPLICATIONS include TV deflection, tuning, and fly-back, snubber networks and high speed inverters.

SPECIAL CONFIGURATIONS, other capacitance values and voltages ranging from **10 VOLTS to 30,000 VOLTS** are readily available.

*** RATED FOR 200 KHz OPERATION**
*** HIGH CURRENTS - UP TO 20 AMPS RMS**
*** VERY HIGH PEAKS - UP TO 4425 AMPS**
*** SPECIAL DESIGNS AVAILABLE OVER 100 AMPS RMS**

There have been a lot of questions regarding ESR and the importance of it in high frequency applications. ESR is simply a measure of the total lossiness of a capacitor which includes the leads, electrodes, dielectric losses, leakage (IR) and most important, the end spray connecting the leads to the metallized film. As you can see from the ESR/DF formulas, it really doesn't matter if ESR or DF is used because they both measure the same losses and one can be calculated from the other.

The two most common errors in the industry today are checking ESR/DF at 1KHz and not checking to see if the ESR/DF changes after the end spray is stressed by current. ESR/DF measurements at 1KHz do not have sufficient resolution, therefore, they are not applicable. The end spray is the most critical operation in the manufacturing of this type of capacitor and is responsible for 90% of the field failures. So American Capacitor has devised a test to check this connection.

American Capacitor performs a 100% pulse test (current strength) 1000 times on each capacitor and measures the ESR/DF both before and after the pulse test. This is the most important test of all for high frequency capacitors because no matter how low the ESR is initially, if it increases after the end spray is stressed, it will ultimately fail in the power supply. American Capacitor recommends that Switching Power Supply manufacturers perform the test in their AQL receiving inspection and during qualification testing.

American Capacitor uses a Gen Rad model 1689 Precision RLC Digibridge with programmable test frequencies (12Hz to 100KHz) and a basic accuracy of .02%. The 1689 can read capacitance and either DF or ESR directly at the programmed frequency, which we recommend be set at 100KHz.

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SUPERMETALLIZED POLYPULSE CAPACITORS

PULSE OPERATION: Capacitors subjected to DC pulses or non-sinusoidal voltages with fast rise or drop times (High DV/DT) will be exposed to high current. This current must be limited to within the maximum peak current allowed. These peak currents refer to an unlimited number of pulses charging or discharging the capacitors.

$$R = \frac{V}{CX} \qquad I = \frac{V}{R} \qquad I = CX$$

I = Current in amps
C = Capacitance in microfarads
R = Minimum necessary resistance in ohms
V = Voltage
X = DV/DT in maximum volts per microsecond

CAPACITANCE: Measured at +25°C and 1000 Hz
Ref: MIL STD 202 Method 305

DISSIPATION FACTOR: Shall be less than 2.0% at 100 KHz and +25°C for < 5.0 mfd.
Ref: MIL STD 202 Method 305

INSULATION RESISTANCE: Shall be greater than 100,000 megohms/microfarads, but need not exceed 200,000 megohms measured at +25°C and electrified at 100 VDC for two minutes maximum.
Ref: MIL STD 202 Method 302

DIELECTRIC STRENGTH: Terminal to terminal 150% of the rated DC voltage.
Ref: MIL STD 202 Method 301

CURRENT STRENGTH: The discharge of the DC rated voltage (need not exceed 200VDC) through a 2 milliohm mercury relay 1000 times shall result in no significant change of ESR.

EQUIVALENT SERIES RESISTANCE: Maximum ESR in milliohms measured at 100KHz and +25°C. See limits in table.

CAPACITANCE CHANGE: Maximum capacitance change with temperature is 1% @ +85°C and 2% @ +125°C

OPERATING TEMPERATURE: No voltage derating from -55°C to +125°C.

AC VOLTAGE: The sum of the DC and Peak AC voltage applied to the capacitor should not exceed the rated DC voltage, nor should the RMS voltage exceed 220VAC.

I RMS: The maximum RMS ripple current in amps @ 20-200KHz and +25°C. See limits in table. Derate current 10% for every 25°C increase in temperature above 25°C.

I PEAK: The maximum peak current in amps @ +25°C for non-repetitive pulses or where the pulse time off is sufficient to allow cooling so overheating will not result. See limits in table.

DV/DT: Is the maximum allowed change in volts per microsecond at the rated voltage. See limits in table.

LEADS: Tin plated copper wire.

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SUPERMETALLIZED POLYPULSE

SERIES ZW3

WRAP & FILL, OVAL
REGULAR SERIES

100VDC

Cap Rating	Part #	T +.05 Max	W +.05 Max	L +.05 Max	Leads AWG	ESR	IRMS	IPEAK	DV/DT
.10 µf	ZW3D104K	.16	.27	.40	22	159	1	150	1500
.22 µf	ZW3D224K	.16	.27	.53	22	72	2	154	702
.33 µf	ZW3D334K	.20	.31	.53	22	48	3	232	702
.47 µf	ZW3D474K	.19	.30	.65	20	34	4	216	460
.68 µf	ZW3D684K	.24	.36	.65	20	24	6	313	460
1.0 µf	ZW3D105K	.30	.42	.65	20	16	9	460	460
2.0 µf	ZW3D205K	.43	.57	.65	20	13	10	922	460
3.0 µf	ZW3D305K	.55	.70	.65	20	11	13	1384	460
5.0 µf	ZW3D505K	.55	.70	.97	18	10	15	1364	272
10.0 µf	ZW3D106K	.65	.84	1.17	18	9	20	1935	194
20.0 µf	ZW3D206K	.78	.93	1.68	18	7	20	2448	122
30.0 µf	ZW3D306K	.93	1.15	1.68	18	6	20	3673	122

200VDC

Cap Rating	Part #	T +.05 Max	W +.05 Max	L +.05 Max	Leads AWG	ESR	IRMS	IPEAK	DV/DT
.10 µf	ZW3E104K	.15	.27	.53	22	159	1	100	1003
.22 µf	ZW3E224K	.24	.36	.53	22	72	2	220	1003
.33 µf	ZW3E334K	.30	.42	.53	22	48	3	330	1003
.47 µf	ZW3E474K	.24	.36	.78	20	34	4	230	489
.68 µf	ZW3E684K	.30	.43	.78	20	23	6	333	489
1.0 µf	ZW3E105K	.38	.50	.78	20	19	9	489	489
1.2 µf	ZW3E125K	.42	.54	.78	20	18	9	586	489
2.0 µf	ZW3E205K	.55	.69	.78	20	16	11	980	489
2.2 µf	ZW3E225K	.58	.73	.78	20	15	12	1077	489
3.0 µf	ZW3E305K	.60	.75	.97	20	11	15	1168	390
3.3 µf	ZW3E335K	.64	.78	.97	20	11	15	1285	390
5.0 µf	ZW3E505K	.66	.82	1.17	18	10	17	1381	276
10.0 µf	ZW3E106K	.83	1.02	1.45	18	9	20	2142	214
20.0 µf	ZW3E206K	1.07	1.29	1.68	18	6	20	3498	175
30.0 µf	ZW3E306K	1.21	1.44	2.00	18	6	20	4425	147

400VDC

Cap Rating	Part #	T +.05 Max	W +.05 Max	L +.05 Max	Leads AWG	ESR	IRMS	IPEAK	DV/DT
.10 µf	ZW3G104K	.21	.32	.65	22	159	1	105	1050
.22 µf	ZW3G224K	.27	.39	.78	22	72	2	171	779
.33 µf	ZW3G334K	.27	.55	.78	22	48	3	258	779
.47 µf	ZW3G474K	.36	.52	.97	20	34	4	292	621
.68 µf	ZW3G684K	.41	.66	.97	20	23	6	423	621
1.0 µf	ZW3G105K	.45	.60	1.17	20	19	9	441	441
2.0 µf	ZW3G205K	.58	.75	1.45	18	14	13	685	342
3.0 µf	ZW3G305K	.73	.90	1.45	18	11	15	1027	342
5.0 µf	ZW3G505K	.85	1.04	1.68	18	10	20	1340	268

Catalog Part Numbers above are for 10% tolerances, for other tolerances change the last letter (K) to the correct letter.
M = 20%, J = 5%, H = 3%, G = 2%, F = 1% . Other capacitance values, tolerances and sizes are available.
T = Thickness , W = Width , L = Length ALL DIMENSIONS ARE IN INCHES, ALL DIMENSIONS ARE + .05" MAXIMUM.

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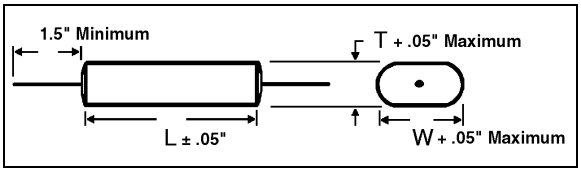
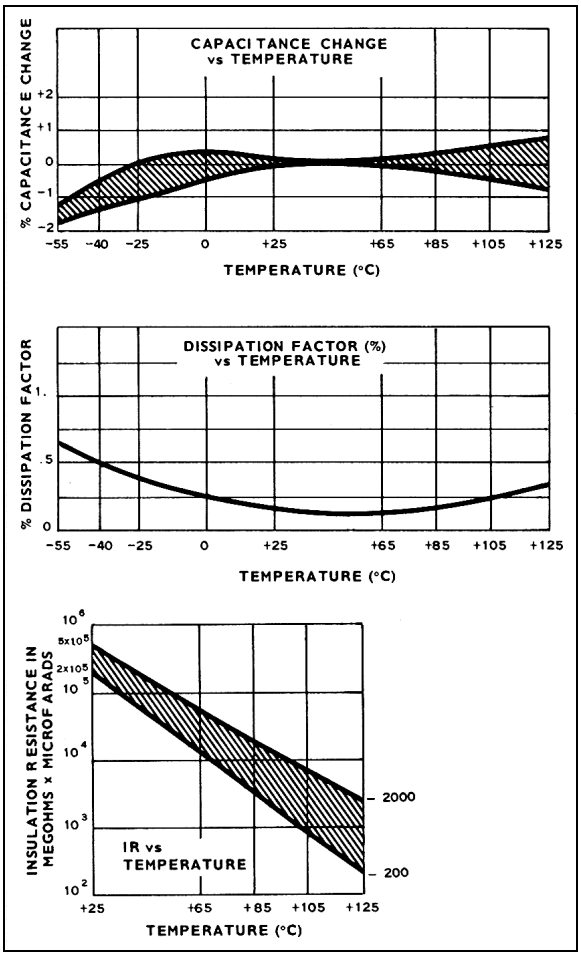
SUPERMETALLIZED POLYPULSE CAPACITORS
PARAMETRIC TREND CURVES AND APPLICATION NOTES

SERIES **ZW3**

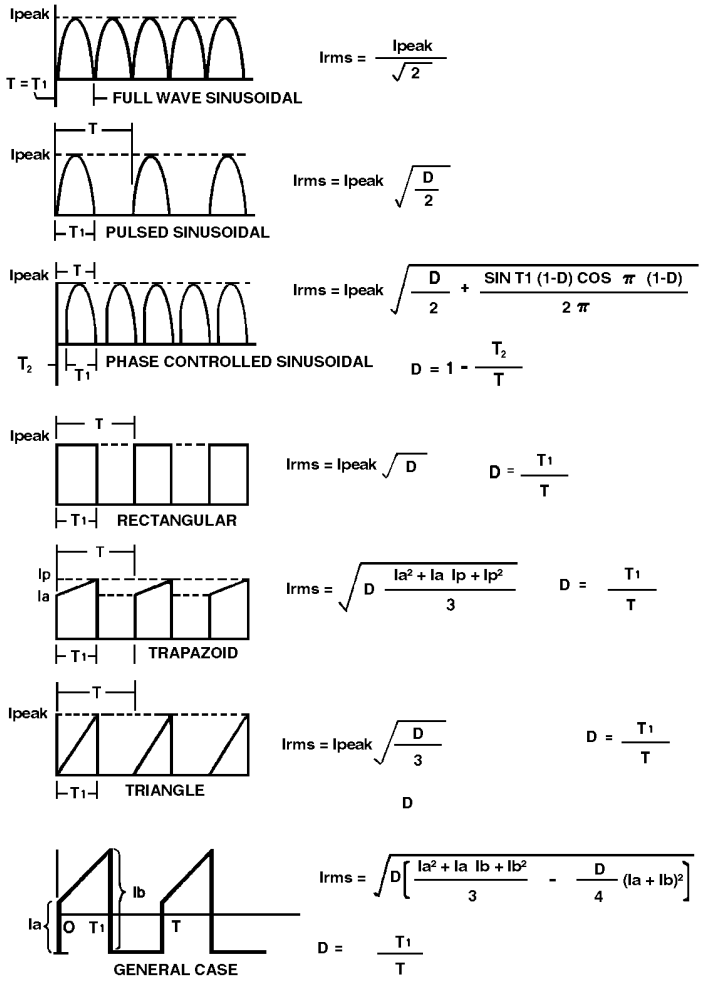
ZW3 series WRAP & FILL OVAL



PARAMETRIC TREND CURVES



CALCULATION FACTORS FOR CURRENT WAVE FORMS



SPECIAL CASES

1) D = 1 — $I_{rms} = \frac{I_b - I_a}{\sqrt{12}}$

2) Ia = Ib — $I_{rms} = I_a \sqrt{D - D^2}$

3) Ia = O — $I_{rms} = I_b \sqrt{\frac{D}{3} - \frac{D^2}{4}}$

ESR/DF FORMULAS

$$ESR = \frac{DF}{2\pi FC}$$

$$DF = 2\pi FC(ESR)$$

DF = Dissipation Factor
ESR = Equivalent Series Resistance in Ohms
F = Frequency in Hz (c.p.s.)
C = Capacitance in Farads

TOLERANCE TABLE

Code		Tolerance
F	=	± 1% ♦
G	=	± 2% ♦
J	=	± 5%
K	=	± 10%
M	=	± 20%
P	=	GMV
X	=	Special

♦ Temperature Stabilized

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