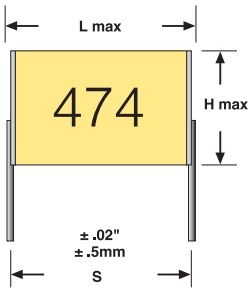
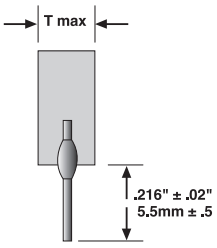
Capacitor Type

# RA


- **Efficient size**
- **Rugged construction**
- **Does not fail short – Self healing**
- **Low ESR/ESL**
- **No entrapped moisture or air in self-encased design**
- **No dissimilar metals to chemically degrade or attract moisture**
- **High dv/dt**
- **Wave solderable**
- **Operating temperature range: –55°C to +125°C**
- **Made in U.S.A.**




Electrical Schematic

Non-polarized

## 100 VDC / 80 VAC

| PF Code | Value µF | L MAX | T MAX | H MAX | S ±.02 (.5) | d | Max dv/dt (V/µs) | Case | Part Number |
|---|---|---|---|---|---|---|---|---|---|
| 224 | .22 | .350 (8.9) | .155 (3.9) | .280 (7.1) | .295 (7.5) | .025 (.6) | 75 | RA3 | 224K100RA3 _ _ |
| 474 | .47 | .350 (8.9) | .180 (4.6) | .305 (7.7) | .295 (7.5) | .025 (.6) | 65 | RA3 | 474K100RA3 _ _ |
| 105 | 1.0 | .450 (11.4) | .175 (4.4) | .285 (7.2) | .394 (10) | .025 (.6) | 35 | RA4 | 105K100RA4 _ _ |
| 225 | 2.2 | .350 (8.9) | .250 (6.3) | .350 (8.9) | .295 (7.5) | .025 (.6) | 25 | RA3 | **225K100RA3** _ _ |
| 225 | 2.2 | .450 (11.4) | .205 (5.2) | .285 (7.2) | .394 (10) | .025 (.6) | 25 | RA4 | **225K100RA4** _ _ |
| 335 | 3.3 | .450 (11.4) | .250 (6.3) | .350 (8.9) | .394 (10) | .025 (.6) | 25 | RA4 | **335K100RA4** _ _ |
| 405 | 4.0 | .450 (11.4) | .200 (5.1) | .380 (9.7) | .394 (10) | .032 (.8) | 20 | RA4 | **405K100RA4** _ _ |
| 505 | 5.0 | .450 (11.4) | .220 (5.6) | .480 (12.2) | .394 (10) | .032 (.8) | 20 | RA4 | **505K100RA4** _ _ |
| 106 | 10.0 | .650 (16.5) | .260 (6.6) | .460 (11.7) | .591 (15) | .032 (.8) | 13 | RA6 | **106K100RA6** _ _ |

## 250 VDC / 160 VAC

| PF Code | Value µF | L MAX | T MAX | H MAX | S ±.02 (.5) | d | Max dv/dt (V/µs) | Case | Part Number |
|---|---|---|---|---|---|---|---|---|---|
| 104 | .1 | .450 (11.4) | .160 (4.1) | .255 (6.5) | .394 (10) | .025 (.6) | 100 | RA4 | 104K250RA4 _ _ |
| 224 | .22 | .450 (11.4) | .190 (4.8) | .305 (7.7) | .394 (10) | .025 (.6) | 75 | RA4 | 224K250RA4 _ _ |
| 334 | .33 | .450 (11.4) | .250 (6.3) | .330 (8.4) | .394 (10) | .025 (.6) | 75 | RA4 | 334K250RA4 _ _ |
| 474 | .47 | .450 (11.4) | .210 (5.3) | .305 (7.7) | .394 (10) | .025 (.6) | 55 | RA4 | **474K250RA4** _ _ |
| 474 | .47 | .650 (16.5) | .230 (5.8) | .340 (8.6) | .591 (15) | .032 (.8) | 50 | RA6 | 474K250RA6 _ _ |
| 105 | 1.0 | .650 (16.5) | .240 (6.1) | .340 (8.6) | .591 (15) | .032 (.8) | 35 | RA6 | **105K250RA6** _ _ |

Dimensions in inches, metric (mm) in parenthesis.

Tolerance: K (±10%) standard, J (±5%) available

RoHS part number information:
No suffix indicates RoHS-5 compliant standard part number. RoHS-5 product does not contain five of the RoHS banned materials (Hg, CrVI, Cd, PBB and PBDE) in levels exceeding the industry defined limits. Component lead wires are plated with Sn / Pb and match conventional SnPb board assembly requirements.
For a RoHS-6 compliant part, add a –FA suffix. RoHS-6 product does not contain any of the six RoHS banned materials (Hg, CrVI, Cd, PBB, PBDE and Pb) in levels exceeding the industry defined limits. Component lead wires are plated with Sn.

**400 VDC / 250 VAC**

| PF Code | Value µF | L MAX | T MAX | H MAX | S ±.02 (.5) | d | Max dv/dt (V/µs) | Case | Part Number |
|---|---|---|---|---|---|---|---|---|---|
| 224 | .22 | .650 (16.5) | .230 (5.8) | .340 (8.6) | .591 (15) | .032 (.8) | 65 | RA6 | 224K400RA6 _ _ |
| 474 | .47 | .650 (16.5) | .290 (7.4) | .440 (11.1) | .591 (15) | .032 (.8) | 120 | RA6 | 474K400RA6 _ _ |

**500 VDC / 250 VAC**

| PF Code | Value µF | L MAX | T MAX | H MAX | S ±.02 (.5) | d | Max dv/dt (V/µs) | Case | Part Number |
|---|---|---|---|---|---|---|---|---|---|
| 504 | .5 | .650 (16.5) | .280 (7.1) | .540 (13.7) | .591 (15) | .032 (.8) | 120 | RA6 | 504K500RA6 _ _ |

Dimensions in inches, metric (mm) in parenthesis.

Tolerance: K (±10%) standard, J (±5%) available

RoHS part number information:
No suffix indicates RoHS-5 compliant standard part number. RoHS-5 product does not contain five of the RoHS banned materials (Hg, CrVI, Cd, PBB and PBDE) in levels exceeding the industry defined limits. Component lead wires are plated with Sn / Pb and match conventional SnPb board assembly requirements.
For a RoHS-6 compliant part, add a –FA suffix. RoHS-6 product does not contain any of the six RoHS banned materials (Hg, CrVI, Cd, PBB, PBDE and Pb) in levels exceeding the industry defined limits. Component lead wires are plated with Sn.

## Electrical

**Capacitance Range:**
0.1 µF to 10.0 µF @ 1KHz

**Tolerance:**
Available in ± 5%, 10% (standard), 20%

**Voltage Range**:
100, 250, 400, 500 VDC

**Dissipation Factor:**
≤ 1.0 % @ 25°C, 1KHz

**Insulation Resistance:**
≥ 1,000 Megohms x µF.
Need not exceed 1,000 Megohms.

| Rated Voltage | ≤ 100 VDC | > 100 VDC |
|---|---|---|
| Test Voltage | 10 VDC | 100 VDC |

**Dielectric Strength:**
1.6 x RVDC, 2 seconds max.
(Bold P/Ns) 1.3 x RVDC, 2 seconds max.

**Self Inductance**:
2 to 6nh typical

**Temperature Range:**
-55°C to 125°C @ rated DC voltage.
(Bold P/Ns) –55°C to 125°C,
derate voltage 1.25% / °C above 85°C

## Performance

**Accelerated DC Voltage Life Test:**
1,000 Hours, 85°C, 1.25 × Rated VDC
Δ C/C ≤ 5%
DF ≤ 1.0%, 1KHz, 25°C
IR ≥ 1,000 Megohm x µF.
Need not exceed 1,000 Megohms

**Moisture Test:**
85°C / 85% RH / 21 days
Applied Voltage: zero bias
Δ C/C ≤ 7%
DF ≤ 1.0%, 1KHz, 25°C
IR ≥ 30% of initial limit

**Long Term Stability:**
After 2 years storage, standard environment Δ C/C ≤ 2%

## Physical

**Vibration:**
Mil Std 202 Method 204D

**Solder Resistance:**
260°C, 5 Sec. Δ C/C ≤ 2%

**Construction:**
Non-inductively constructed with metallized polyester dielectric (polyethylene terephthalate). Parallel plate–multilayer polymer (MLP) design.
Electrode: Aluminum metallization.

**Case:**
Polyester tape wrap.

**Marking:**
Parts are continuously marked ITW and pf code. ITW, capacitance, tolerance and working voltage are printed on container.

**Packaging:**
Bulk Packaging Standard

# Angstor® Capacitor Application Notes

ITW Paktron developed the highly advanced Interleaf® Technology method of capacitor manufacturing to improve device electrical properties and stability in actual use conditions. As opposed to the conventional winding method, Interleaf® Technology uses a high laminating pressure, linear stacking technology. The resulting capacitor chip is a construction hybrid resembling a multilayer ceramic capacitor in cross section, while offering all the fail-safe advantages of a stacked plastic film capacitor. We refer to the resultant parts as MLP or multilayer polymer. The Angstor® Capacitor (or RA Style) is a self-encased, metallized film capacitor which features small size, high dv/dt capability and very low ESR at high frequency.

Intended for thru-hole and wired applications, the units feature all aluminum electrodes and terminals that are pulse welded to the lead wires. The units are back impregnated with a microcrystalline polymer sealant, and require no external coatings for moisture protection. The internal layers are heavily laminated to eliminate air from the core material which improves high frequency response compared to competitive units. Operating temperature limit is extended to125 degrees C.

## The following are a few examples of applications wherein the Angstor's unique features have proven desirable:

### HIGH FREQUENCY SWITCHING POWER INPUTS

As the modern power converter broke the 100 KHz switching frequency barrier, the ripple voltage and RFI control components changed drastically. On the input side of 48 volt converters, a low ESR and ESL capacitor is needed in the pi filter network to control EMI generated by the switching MOSFET. Metallized film capacitors should be used because of the voltage bias and due to the unit's ability to "clear" during a high voltage event, rather than short out like a common MLC capacitor. Electrolytic (aluminum and tantalum) capacitors are not useful because of their extremely high parasitic resistance and inductance. Under ripple voltage the Angstor is stable, while ceramic capacitors increase in loss factor, creating incremental $I^2R$ losses.

### LINE AND DATA LINE NOISE SUPPRESSION

A 250 volt Angstor will not lose value due to the bias voltage and can be used on higher voltage lines as a differential noise bypass for RFI control. High input dv/dt up to 100 volts per micro second can be handled. In modems, the Angstor is a space efficient alternative to other input current control devices. Since the capacitor body is "plastic" there exists no piezoelectric emf due to input di/dt.

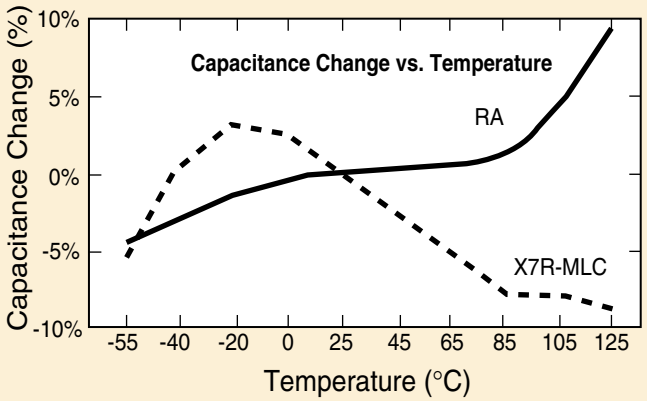
### EMI/RFI SUPPRESSION

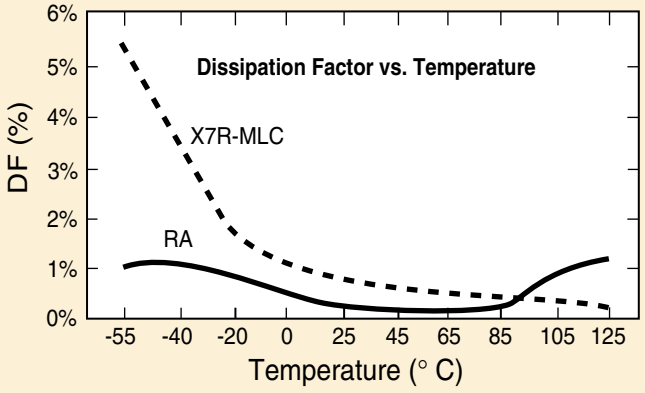
Noise suppression is required on a variety of motors and field effect devices close to the offending source to minimize RFI on the voltage bus. Noise or transients emanating from switched state motors or inductors require a low ESR capacitor as part of the filtering arrangement. The Angstor is an excellent choice for these 12, 36 and 48 volt bus-rails because of its small size compared to other film capacitors and better ESR and reliability than ceramic capacitors. As the automotive bus voltage rises from 12 to 36/42 volts, this technology will replace many ceramic and tantalum capacitors because of its enhanced voltage coefficient (stability).

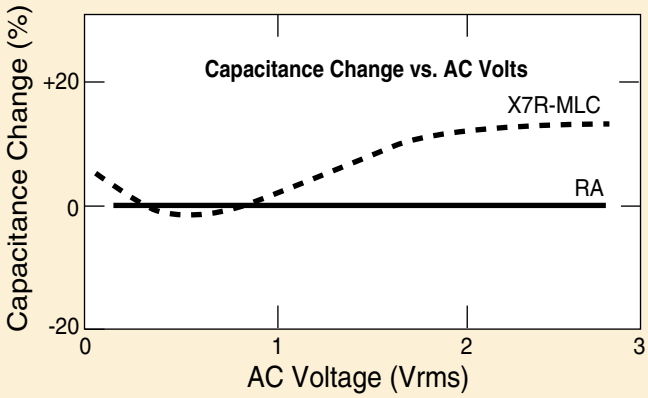
### GRACEFUL AGING

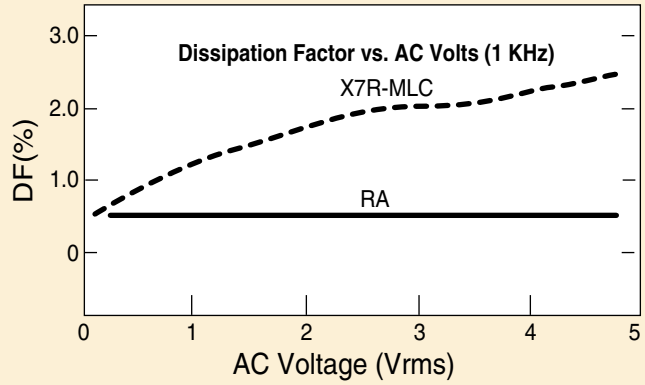
There exists no chemical interactions within the MLP Capacitor to effect long term life. The parts are suitable for 10 to 20 year life applications due to their stability and inherently low loss. The polymer dielectric becomes more crystalline over long periods of time, which can gradually lower the capacitance value. The thin-film metallized electrodes are capable of "self healing" under high voltage events. This feature avoids the shorting, cracking and rapid heat generation problem often found in ceramic capacitors.

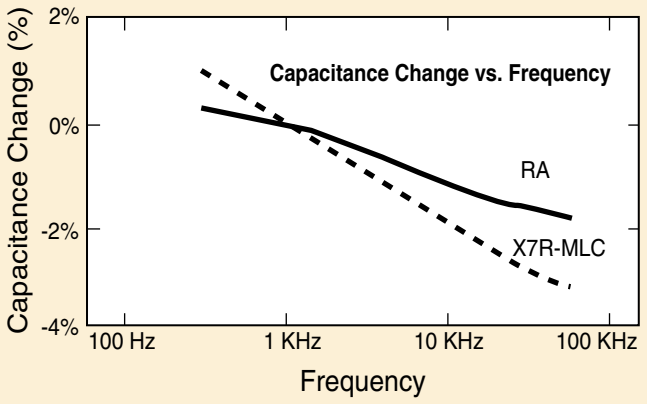
# Typical Performance Curves
## Comparison of Multilayer Polymer (RA) vs. Multilayer Ceramic (X7R)

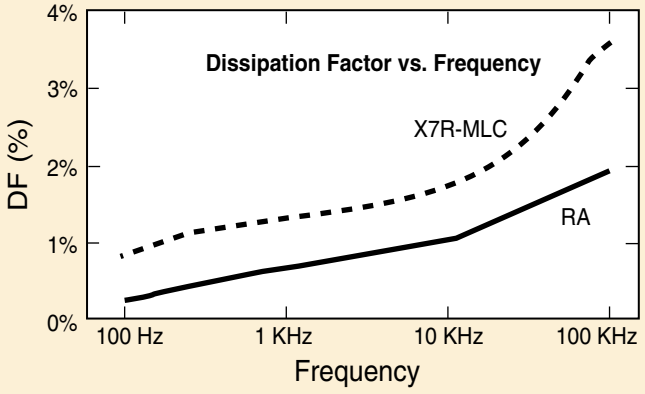


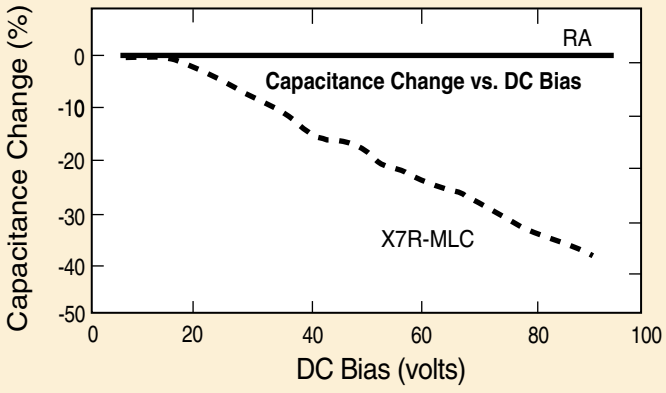



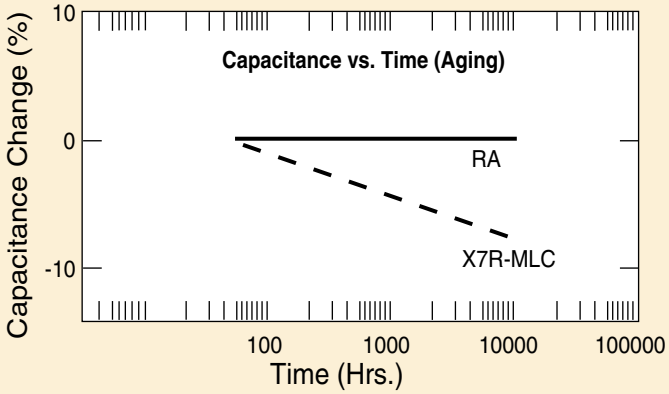



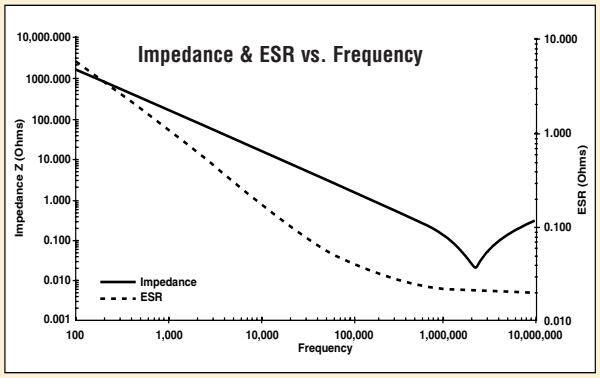



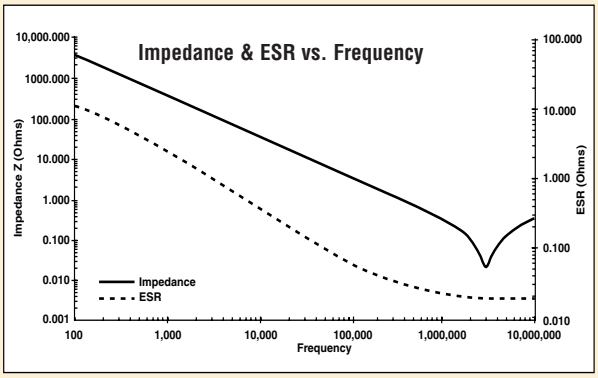



# Typical Performance Curves
# Selected High Value "Power" Capacitors

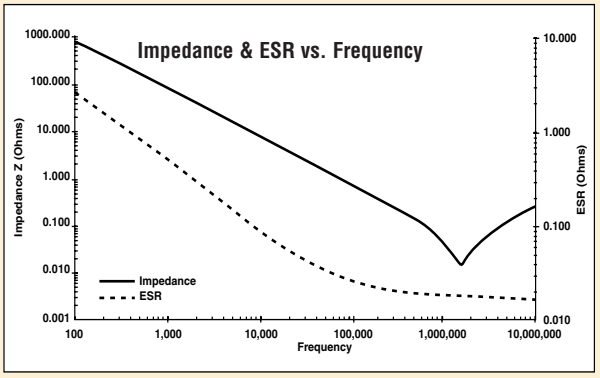
## 1.0 μF 100 VDC RA4



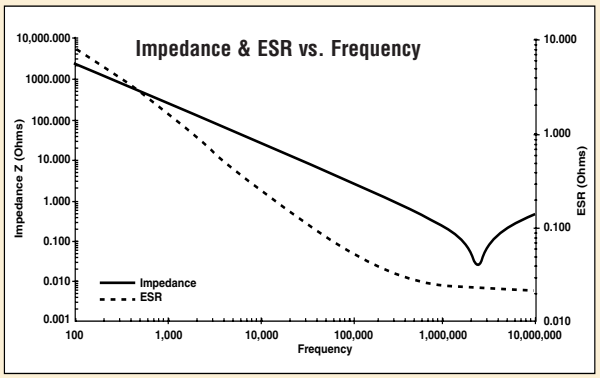

## .47 μF 250 VDC RA4



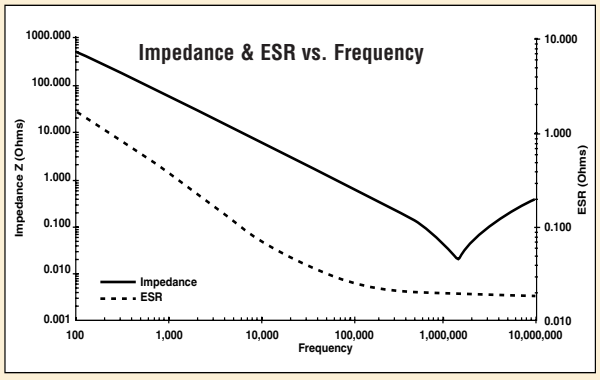

## 2.2 μF 100 VDC RA4



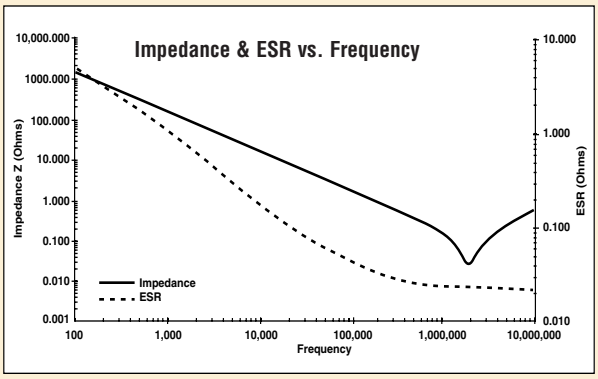

## .47 μF 400 VDC RA6




## 3.3 μF 100 VDC RA4

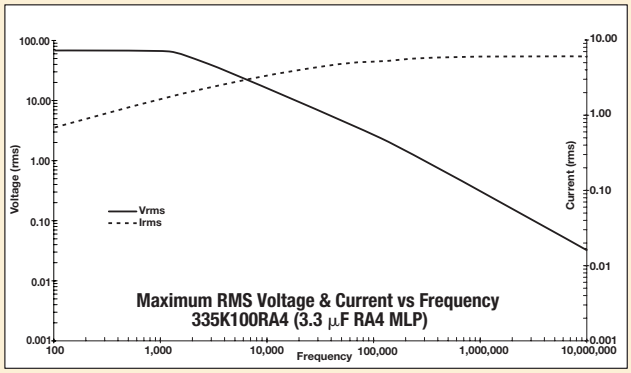



## 1.0 μF 250 VDC RA6

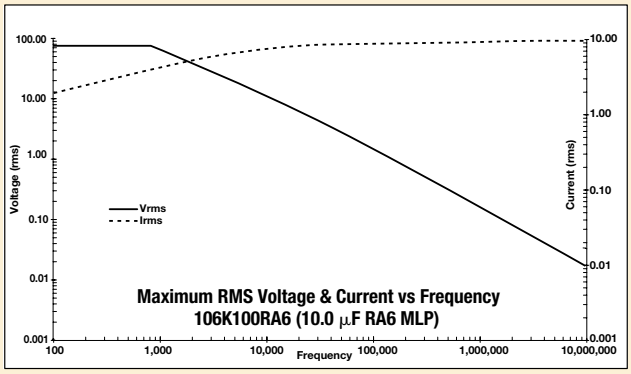


# Typical Performance Curves
# Selected High Value "Power" Capacitors

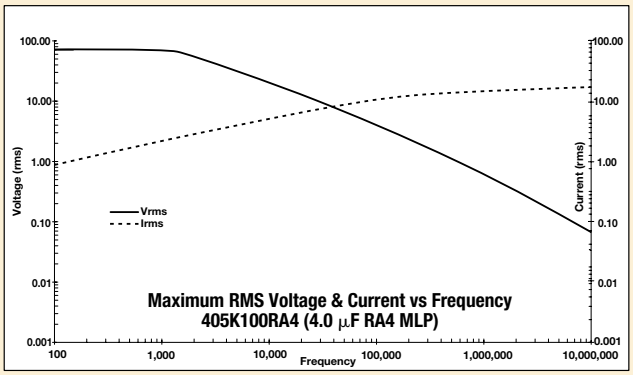
## 3.3 μF 100 VDC RA4



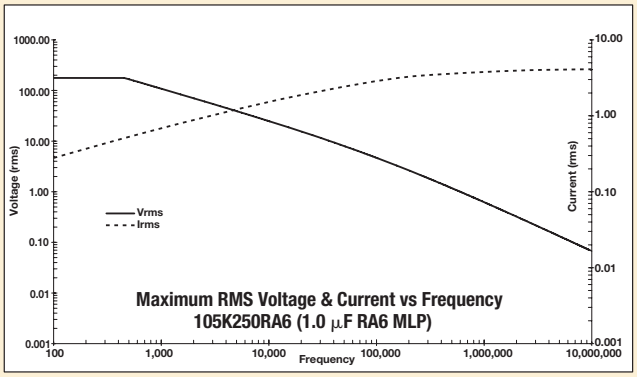

## 10.0 μF 100 VDC RA6



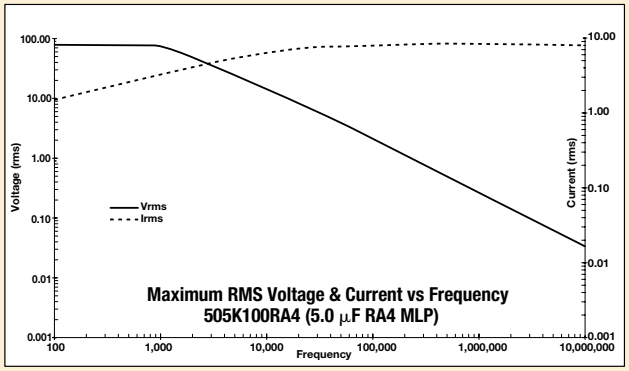

## 4.0 μF 100 VDC RA4




## 1.0 μF 250 VDC RA6




## 5.0 μF 100 VDC RA4




## .47 μF 400 VDC RA6