

ELECTROLYTIC CAPACITORS

WZAEW

(ALUMINUM ELECTROLYTIC)

CAPACITANCE & VOLTAGE RANGE: 1nF TO >1F , 5V TO >500V

CHARACTERISTICS

- MOST ARE POLARIZED
- SELF-RESONANT FREQUENCY LIMITS USE TO $< 100 \text{ kHz}$ TYPICALLY
- WEAR-OUT MECHANISM - DRYING OUT - $\text{ESR} \uparrow$ $\text{TEMP} \uparrow$ ACCELERATES FAILURE
- SOAKAGE / DIELECTRIC ABSORPTION ISSUES
- LEAKAGE INCREASES DRAMATICALLY AT HIGH TEMPERATURE, CAPACITANCE CHANGE \propto TEMP
- RAPID CHARGE / DISCHARGE (I.E. FLASHES) NEED SPECIAL PARTS
- HIGH CAPACITANCE DENSITY

GOOD

- + POWER SUPPLY FILTERING
- + LOW / MED FREQUENCY BYPASSING
- + NON-CRITICAL TIMING
- + ENERGY STORAGE APPS
- + LOW FREQUENCY STAGE COUPLING

BAD

- CRITICAL TIMING CIRCUITS
- TRIGGERING CIRCUITS
- FREQ DETERMINING $\frac{1}{2}$ PHASE SHIFT CKTS
- RF

TANTALUM CAPACITORS

W2AEW

- ALL POLARIZED -

CAPACITANCE & VOLTAGE RANGE: 0.1 μ F to 1000 μ F, 2 - 50V

CHARACTERISTICS

- HIGHER CAPACITANCE DENSITY THAN AL-ELECTROLYTIC
- VERY INTOLERANT OF REVERSE BIAS - FAIL SPECTACULARLY
- NO "DRYING OUT" WEAROUT MECHANISM
- PRICIER THAN AL-ELECTROLYTIC
- LOWER VOLTAGE RANGES THAN AL-ELECT.
- LOW ESR
- REASONABLY STABLE VS TEMPERATURE

GOOD

- + POWER SUPPLY FILTERING
- + LOW / MED FREQ BYPASSING
- + ENERGY STORAGE
- + LONG DURATION TIMING (NON-CRITICAL)

BAD

- HIGH VOLTAGE APPS
- COST SENSITIVE APPS
- LARGE AC SIGNALS
- RF

CERAMIC CAPACITORS

W2AEW

- VERY POPULAR -

CAPACITANCE & VOLTAGE RANGE: < 1pF TO > 500µF, TO >> 1000V

CHARACTERISTICS

- NPO / COG (CLASS 1)

- < 1pF TO ≈ 1µF
- VERY STABLE W/ TEMPERATURE (+/- FEW %)
- TIGHT TOLERANCE

- X7R (CLASS 2) "GOOD COMPROMISE OF STABILITY / CAPACITANCE / DF"

- LARGER VALUES
- MODERATE VARIATION VS TEMP (+/- 15%)

- Y5V, Z5U (CLASS 2)

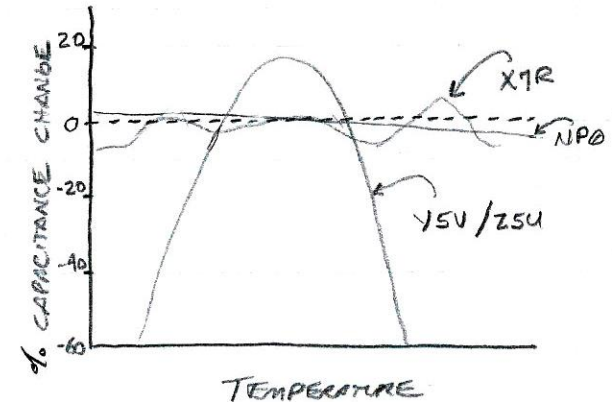
- EVEN LARGER VALUES
- BAD STABILITY VS. TEMP (+20%, -60/80%)
- HIGHER DF

- ALL ARE LOW COST

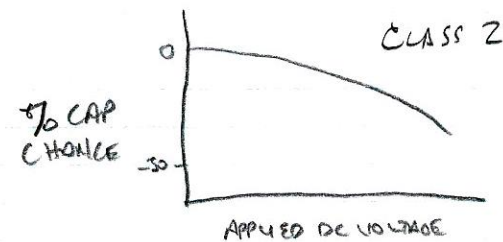
- LOW ESR / DF

- GOOD RF PERFORMANCE

- MICROPHONIC (CLASS 2)



- ALSO HAVE STRONG VOLTAGE DEPENDENCE



GOOD

- RF APPLICATIONS
- LOW COST
- BYPASS, COUPLING

BAD

- VCO / FILTER / FREQ GENERATION (NPO IS EXCEPTION)
- LOW FREQ FILTERING (POOR Y5V, Z5U CHARACTERISTICS)

FILM CAPACITORS

- MANY TYPES -

W2AEW

CAPACITANCE & VOLTAGE RANGES: $\approx 50\text{pF}$ TO $\approx 1000\mu\text{F}$, 10V TO $\gg 1000\text{V}$

CHARACTERISTICS:

- + TIGHT TOLERANCES
- + LOW LEAKAGE
- + LOW ABSORPTION
- + LOW ESR/DF
- + STABLE VS. TEMP & VOLTAGE
- MODERATE TO HIGH PRICE (WRT CERAMIC)
- RELATIVELY LARGE / LOW VOLUMETRIC EFFICIENCY
- METALIZED FILM / FILM & FOIL

- METALIZED FILM
 - HIGHEST DENSITY
 - SELF HEALING
- METAL FOIL + FILM
 - LOWER ESR
 - HIGHER AC CURRENTS

FILM TYPES

- POLYPROPYLENE (PP) - VERY COMMON - "ORANGE DROP"
 - LOW DISSIPATION FACTOR (DF), LOW ESR
 - LOW ABSORPTION (0.05%)
 - VERY STABLE VS. TEMPERATURE (+/- 4%)
- POLYESTER (PE) - MYLAR
 - MODERATELY STABLE VS. TEMP (5 TO 15%)
 - MODERATELY HIGHER DF + ABSORPTION
 - LOWER COST
- POLYSTYRENE (PS)
 - VERY STABLE VS. TEMP
 - VERY LOW DF & DA
 - HARDER TO FIND, PRICEY
- POLYCARBONATE (PC)
 - HIGH RELIABILITY
 - PRICEY
 - SIMILAR TO PP
- AND MORE...

GOOD

- + HIGH VOLTAGE APPS
- + STABLE VS. TEMP + VOLTAGE
- + LOW DF + DA
- + AUDIO TO RF APPS

BAD

- PHYSICALLY LARGE
- MORE \$ THAN CERAMIC
- MORE LIMITED PACKAGES

MICA CAPACITORS

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CAPACITANCE & VOLTAGE RANGE: 1pF to 10nF, $\geq 1000V$

CHARACTERISTICS

- VERY STABLE
- TIGHT TOLERANCE
- RF PERFORMANCE

GOOD

- RF APPLICATIONS
- FILTERS
- VCOS
- OSCILLATORS
- FREQUENCY GENERATION CKTS

BAD

- SMALLER VALUES
- LIMITED PACKAGE TYPES