MLCCs

VS.

FILM CAPS

A Comparison Guide

Basic comparative analysis of the differences between Film Capacitors and NP0/C0G Multi-Layer Ceramic Capacitors. This quick guide is a tool to help engineers determine which type of capacitor will be best suited for their specific application.

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Actively Redefining Surface Mount Passives

Advantages & Disadvantages of NP0/C0G vs. Film Capacitors

Note: There are many types of Film Caps so this comparison chart is not inclusive of all Film Caps but designed to give a general & brief comparison of the basic types. We found specifications vary from manufacture to manufacture for the same type of Film Capacitors so comparison results will vary somewhat but we believe them to be consistent overall. NP0/C0G cap specifications do NOT vary from manufacturer to manufacturer giving them yet one more comparison advantage – consistent specifications from all manufacturers. SMT NP0/C0G capacitors & Film Capacitors along with specific component characteristics and types will ultimately have to be decided by the engineer depending on the application.

	NP0/C0G	FILM CAPS
ADVANTAGES	• Better volumetric efficiency [Example: able to save 50-60%+ on board space when using a 0603 – 1000pF in ceramic vs. 1206 – 1000pF in Film] • More cost effective solutions for most applications when comparing smaller case sizes (0402-1206) and same capacitance values versus Film Capacitors • More Standard EIA case sizes available as well as much smaller sizes available; 0201 with maximum capacitance of 100pF in 50V and 0402 – 1000pF in 50V. • Capacitance ranges & rated voltage approaching film caps capabilities. Now have 0402 – 1000pF in 50V, 0603 in 3900pF in 50V, 0805 in 0.022uF in 50V, and 1206 - 0.1uF in 25V – All NP0! • D.F and Q specifications much better than film capacitors {PET/PEN ~ 0.8% @ 1kHz; 3.0 @ 100kHz / PPS is 0.1% @ 1kHz to 0.5% @ 100kHz} NP0 D.F. specifications is 0.1% maximum or a Q > 1000 @ 1kHz • Better dv/dt rates. NP0/C0G can handle up to 4000+ Vdc/µs while typical dv/dt rates for Film caps are in the 2200V/ µs range. This is due to ceramic material formulation(CaZrO3) and grain size of the NP0/C0G dielectric •No humidity or moisture failures due to MSL (moisture sensitivity level) Level of 1 (NP0 ceramic material is impervious to humidity) • Breakdown voltages better than PET and PEN films (similar to PPS Films)	• Higher overall capacitance offerings with higher rated voltage offerings within the same capacitance values depending on Film types. Unable to achieve same capacitance values in ceramic NP0(>0.1uF) due to standard EIA case size requirements. Can not make a ceramic taller or higher than the width specification • Dielectric absorption down to 0.05% for PPS film PEN & PET films are 0.8% and ~ 0.3-0.5% respectively • Good for Low lock- up times (PLL filtering) & A/D converters (dual slope converters) • Self healing capabilities except PPS Films • Intrinsic elasticity – more flexible and less susceptible to mechanical stress fractures
DISADVANTAGES	• Dielectric absorption ~ 0.5% • Lower overall capacitance & voltage ratings offerings. Depending on size, overlaps occur in the 0603 case size and capacitance of 1000pF & 50V. 1206 case sizes have many overlapping values depending on film type {1000pF in 50V up to 0.082uF in 50V} • Less mechanically flexible making it more susceptible to board flex stress fractures	• Limited exposure to high temperatures in manufacturing creating process issues & possible board failures depending on type of film. [issues typically occur when extended times exceed their reflow recommendations and when T > 220C and above which may cause the capacitor to warp or melt. Typical failure modes in Film capacitors are usually an open status. • More susceptible to physical damage due to exposure to chemicals or cleaning agents such as Toluene, Xylene & Trichlorethylene • Lead free soldering compatibility issues • More Odd & Non standard EIA case sizes offerings. • Possible mechanical deformation in reflow due to lower maximum temperature limits with lower time exposure thresholds • More susceptible to humidity failures since MSL (moisture sensitivity level) Levels are >1 • Not as desirable or cost effective in digital applications when accuracy is not needed (bypassing) as compared to accurate continuous analog applications • Recommended using a no clean flux with a Halogen content lower than 0.1% or damage could occur to the capacitor. Other fluxes are typically safe to use.

Definitions: PPS = Polyphenylene Sulfide PEN = Polyethylene Naphtalate PET = Polyester

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