

## Component Characteristics Substitution Guide: Capacitors

### » Capacitance Value (uF or pF):

Substitution Rule: In many cases increasing to higher capacitance value is acceptable

- i.e... 2200uF part can be considered for use in place of 1500uF part
- i.e... 3.3uF part can be considered for use in place of 2.2uF part
- i.e... 0.22uF part can be considered for use in place of 0.1uF part

### » Capacitance Tolerance (% or ±pF):

Substitution Rule: A component with a tighter (better) tolerance can replace a looser tolerance component

- i.e... ±1%(F) tolerance part can replace ±2%(G), ±5%(J) or ±10% (K) tolerance part
- i.e... ±2%(G) tolerance part can replace ±5%(J), ±10% (K) or ±20% (M) tolerance part
- i.e... ±5%(J) tolerance part can replace ± 10%(K) or ±20% (M) tolerance part
- i.e... ±10%(K) tolerance part can replace ±20%(M) or +80%/-20%(Z) tolerance part
- i.e... ±20%(M) tolerance part can replace +80%/-20%(Z) tolerance part

### » Voltage Ratings (VDC or VAC):

Substitution Rule: A component with a higher voltage rating may be used in place of, or as a substitute for, a lower voltage rated component

- i.e... 1000V rated part can replace 500V, 250V or 100V rated part
- i.e... 500V rated part can replace 250V , 100V or 50V rated part
- i.e... 250V rated part can replace 100V, 50V or 25V rated part
- i.e... 100V rated part can replace 50V or 25V rated part
- i.e... 50V rated part can replace 25V or 16V rated part
- i.e... 25V rated part can replace 16V or 10V rated part
- i.e... 16V rated part can replace 10V or 6.3V rated part
- i.e... 10V rated part can replace 6.3V or 4V rated part

### » Component Size (Radial Leaded Styles):

Substitution Rule: In many cases a smaller size component may be acceptable... if lead spacing is same and electrical specifications differences are acceptable

- i.e... a smaller diameter size taped part could be considered to replace a larger diameter size taped part
- i.e... 5mm, 7mm or 9mm height size could be considered to replace a larger 7, 9 or 11mm height size
- i.e... 10mm diameter size could be considered to replace a 12mm diameter size (same LS = 5.0mm)

### » Temperature Rating (Electrolytic or Ceramic Capacitors):

Substitution Rule: A component with a higher (better) temperature rating can replace a lower temperature rated component.

- i.e...an +125°C rated part can replace a +105°C (NACT replaces NACEW / NACZ )
- i.e...an +125°C rated part can replace a +85°C (NMC "X7R" replaces "X7R" or "Y5V")
- i.e...an +105°C rated part can replace a +85°C (NRWA or NRSZ replaces NRSA / NRSS ... NACEW / NACZ replaces NACE)

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### » **"TC" - Temperature Coefficient: (Ceramic Capacitors)**

Substitution Rule: A component with a more stable (better) temperature coefficient (TC) can replace a less temperature stable TC component.

- i.e...an X7R ceramic can replace X5R or Y5V ceramic part
- i.e...an NPO ceramic can replace a X7R or X5R or Y5V ceramic

### » **"DF" - Dissipation Factor:**

Substitution Rule: A component with a lower DF (%) can replace a higher DF (%) component.

- i.e... NPO part can replace X7R or Z5U / Y5V part
- i.e... X7R part can replace Z5U / Y5V part
- i.e... NACZ series can replace NACE
- i.e... NRSA series can replace NRSS

### » **"ESR" - Equivalent Series Resistance (ohm) & "Z" - Impedance (ohm):**

Substitution Rule: A component with a lower ESR or Z (ohm) can replace a higher ESR or Z (ohm) component.

- i.e... NTP series part can replace NTC series part
- i.e... NACZ & NACZF series can replace NACEW or NACE
- i.e... NRSX series can replace NRSZ or NRSY

### » **Ripple Current Rating (mA):**

Substitution Rule: A component with a higher ripple current rating (mArms) can replace a lower ripple current rated component.

- i.e... NTP series part can replace NTC series part
- i.e... NACZ & NACK series can replace NACEW or NACE
- i.e... NRSX series can replace NRSZ or NRSY

### » **Leakage Current Rating (uA): (Electrolytic Capacitors)**

Substitution Rule: A component with a lower leakage current rating (uA) can replace a higher leakage current rated component.

- i.e... NACL series part can replace NACE series part
- i.e... NLE-L series can replace NRSA or NRSS

### » **"IR" - Insulation Resistance (ohm or meg-ohm): (Electrostatic Capacitors)**

Substitution Rule: A component with a higher insulation resistance (ohm or meg-ohm) can replace a lower insulation resistance rated component.

- i.e... NPO series part can replace X7R/ Y5V/Z5U part
- i.e... X7R series part can replace Y5V/Z5U part

### » **Capacitor Type: (Electrolytic vs. Electrostatic)**

Substitution Rules:

+Circuit application will determine if electrolytic (polarized) capacitor could be considered for replacement or alternate to electrostatic capacitor.

+ Electrostatic capacitors (non-polarized) can be considered as possible replacment for electrolytic type capacitors

- i.e... NMC series part could replace NTC or NSP series part

Electrolytic	Electrostatic
Aluminum & Tantalum E-caps	Ceramic & Film Capacitors