Dielectric Characteristics

Capacitor Selection
Multilayer capacitors (MLC) and single layer capacitors are categorized by performance with temperature. Component selection is typically determined by dielectric performance, electrical environment and temperature stability.
In determining the proper component for a specific application, the following information should be considered.

Dielectric Type
There are three basic dielectric classes (characteristics) available:

<table>
<thead>
<tr>
<th>DIELECTRIC PROPERTIES</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BP (NPO and COG)</td>
<td>Ultra Stable Effects on electrical properties are minimal with temperature, frequency or time. Used in applications which require stable performance.</td>
</tr>
<tr>
<td>BQ, BR, BX and X7R</td>
<td>Stable Effects on electrical properties predictably change with temperature, voltage, frequency and time. Selected for applications where blocking, coupling, by-passing and frequency discriminating elements are used. Offers higher capacitance than Class I (COG).</td>
</tr>
<tr>
<td>ZSU and Y5V</td>
<td>General Purpose Exhibits a greater variation of properties with temperature. Dielectric constant is higher than Class I and Class II dielectrics. Extremely high capacitance per unit volume and used in general performance applications.</td>
</tr>
</tbody>
</table>

Dielectric Characteristics

NPO (COG)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Temperature Range</td>
<td>-55°C to 125°C</td>
</tr>
<tr>
<td>Temperature Coefficient</td>
<td>0 ± 30 ppm/°C</td>
</tr>
<tr>
<td>Dissipation Factor</td>
<td>.001 (0.1%) max. @ 25°C</td>
</tr>
<tr>
<td>Insulation Resistance</td>
<td>25°C 10⁶ Megohms</td>
</tr>
<tr>
<td>125°C</td>
<td>10⁵ Megohms</td>
</tr>
<tr>
<td>Dielectric Withstanding Voltage</td>
<td>201 to 500V, 1.5 x VDCW</td>
</tr>
<tr>
<td></td>
<td>&gt;500V, 1.2 VDCW, or 750V*</td>
</tr>
<tr>
<td>Aging Rate</td>
<td>0% per decade hour</td>
</tr>
<tr>
<td>Test Parameters</td>
<td>1 KHz, 1.0 ± 0.2 VRMS, 25°C</td>
</tr>
</tbody>
</table>

* Whichever is greater

Capacitor Size
The capacitor body size impacts its utility to the design requirements in respect to capacitance value and voltage rating. Typically smaller units are less expensive and provide for greater space savings. Because mass affects the thermal response of the chips, size should be considered when selecting the attachment method to the circuit.

TERMINATION MATERIAL

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Recommended Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver Palladium</td>
<td>Nonmagnetic application requirements. Recommended for conductive epoxy and leaded attachment methods. For soldering applications, use solder reflow below 230°C.</td>
</tr>
<tr>
<td>Silver</td>
<td>Most ductile of the available termination methods. Used in applications which will be leaded, to minimize thermal stresses.</td>
</tr>
</tbody>
</table>

Temperature Coefficient

![Temperature Coefficient Graph](https://via.placeholder.com/150)

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Dielectric Characteristics

Dielectric Characteristics Continued

**X7R**
- **Operating Temperature Range**: -55°C to 125°C
- **Temperature Coefficient**: ± 15% ΔC max.
- **Dissipation Factor**: 0.025 (2.5%) max. @ 25°C
- **Insulation Resistance**: 25°C: 10^6 Meghoms
  125°C: 10^5 Meghoms
- **Dielectric Withstanding Voltage**: 50 to 200V, 2.5 x VDCW
  201 to 500V, 1.5 x VDCW, or 500V*
  >500V, 1.2 VDCW, or 750V*
- **Aging Rate**: <2.0% per decade hour
- **Test Parameters**: 1 KHz, 1.0 VRMS ± 0.2 VRMS, 25°C

**BX**
- **Operating Temperature Range**: -55°C to 125°C
- **Temperature Coefficient**: ± 15% - 25% ΔC max.
- **Temperature Voltage Coefficient**: + 15% - 25% ΔC max.
- **Dissipation Factor**: 0.025 (2.5%) max. @ 25°C
- **Insulation Resistance**: 25°C: 10^6 Meghoms
  125°C: 10^5 Meghoms
- **Dielectric Withstanding Voltage**: 50 to 200V, 2.5 x VDCW
  201 to 500V, 1.5 x VDCW, or 500V*
  >500V, 1.2 VDCW, or 750V*
- **Aging Rate**: 2.0% per decade hour
- **Test Parameters**: 1 KHz, 1.0 VRMS ± 0.2 VRMS, 25°C

**Z5U**
- **Operating Temperature Range**: 10°C to 85°C
- **Temperature Coefficient**: + 22% - 56% ΔC max.
- **Dissipation Factor**: 0.030 (3.0%) max. @ 25°C
- **Insulation Resistance**: 25°C: 10^6 Meghoms
- **Dielectric Withstanding Voltage**: 50 to 200V, 2.5 x VDCW
  250V, 1.5 x VDCW
- **Aging Rate**: <2.0% per decade hour
- **Test Parameters**: 1 KHz, 0.5 VRMS ± 0.1 VRMS, 25°C

**Y5V**
- **Operating Temperature Range**: -30°C to 85°C
- **Temperature Coefficient**: + 22% - 82% ΔC max.
- **Dissipation Factor**: 0.050 (5.0%) max. @ 25°C
- **Insulation Resistance**: 25°C: 10^5 Meghoms
- **Dielectric Withstanding Voltage**: 50 to 200V, 2.5 x VDCW
  250V, 1.5 x VDCW
- **Aging Rate**: <2.0% per decade hour
- **Test Parameters**: 1 KHz, 1.0 VRMS ± 0.2 VRMS, 25°C

* Whichever is greater