General Information
Vishay Draloric

Ceramic RF-Power Capacitors

GENERAL DESCRIPTION:
The Ceramic RF-Power Capacitor can be defined as an electrical device consisting of a ceramic dielectric with conductive noble-metal electrodes, terminations and a protective coating. The spectrum of capacitance values extends from the lower picofarad range up to the nanofarad range. The rated voltages range from 636 V (peak) up to 40,000 V (peak). Typical frequencies of application range from 20KHz to 100MHz. These capacitors can be operated with DC and AC voltage both individually and in combination. The electrical power-handling capacity is largely determined by the three parameters, VOLTAGE, CURRENT and POWER. These parameters essentially depend on the CAPACITANCE, the OPERATING FREQUENCY and the AMBIENT TEMPERATURE.

APPLICATIONS:
Typical uses for ceramic RF-Power capacitors are:
- INDUCTIVE HEATING EQUIPMENT (Operating frequencies above 20KHz)
- DIELECTRIC HEATING EQUIPMENT (Operating frequencies above 5MHz)
- IMPEDANCE TUNING CIRCUITS
- RF FILTER and PULSE FORMING CIRCUITS
- DC VOLTAGE BLOCKING, RF-VOLTAGE DIVIDERS
- RADIO TRANSMITTING EQUIPMENT
- VOLTAGE MULTIPLIERS (Capacitor stacks)

ELECTRICAL PARAMETERS:
The electrical performance is determined by four parameters: CAPACITANCE, VOLTAGE, CURRENT and REACTIVE POWER.

CAPACITANCE:
Rated capacitance \( C_R \) is the nominal capacitance value.

CAPACITANCE MEASUREMENTS:
The capacitance of all Ceramic RF Power Capacitors - except where deviations are agreed upon in the ordering procedure - are measured under the following conditions:

MEASURING FREQUENCY:
Class 1-Ceramic dielectric \( (1 \pm 0.2) \text{ MHz or (100} \pm 20) \text{ kHz} \)
Class 2-Ceramic dielectric \( (1 \pm 0.2) \text{ kHz (Field strength max. 3kV}_{\text{RMS}} \text{ per millimeter)} \)

MEASURING VOLTAGE:
Class 1-Ceramic dielectric \( \leq 5.0V_{\text{RMS}} \)
Class 2-Ceramic dielectric \( \leq 1.2V_{\text{RMS}} \)

CLIMATIC CONDITIONS OF MEASUREMENTS:
Temperature \( (23 \pm 3)^\circ \text{C, for reference measurements (20} \pm 1)^\circ \text{C} \)
Relative humidity \( \leq 75\% \)

CAPACITANCE TOLERANCE:

CLASS 1 - CERAMIC DIELECTRIC

<table>
<thead>
<tr>
<th>TOLERANCE</th>
<th>( \pm 0.25pF )</th>
<th>( \pm 0.5pF )</th>
<th>( \pm 1pF )</th>
<th>( \pm 2pF )</th>
<th>( \pm 5% )</th>
<th>( \pm 10% )</th>
<th>( \pm 20% )</th>
</tr>
</thead>
<tbody>
<tr>
<td>CODE LETTER</td>
<td>C</td>
<td>D</td>
<td>F</td>
<td>G</td>
<td>J</td>
<td>K</td>
<td>M</td>
</tr>
<tr>
<td>Applicable Nominal Capacitance</td>
<td>(&lt; 10pF)</td>
<td>(\geq 10pF)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CLASS 2 - CERAMIC DIELECTRIC

<table>
<thead>
<tr>
<th>TOLERANCE</th>
<th>( \pm 5% )</th>
<th>( \pm 10% )</th>
<th>( \pm 20% )</th>
<th>(- 20 \pm 50% )</th>
<th>(- 20 \pm 80% )</th>
</tr>
</thead>
<tbody>
<tr>
<td>CODE LETTER</td>
<td>J</td>
<td>K</td>
<td>M</td>
<td>S</td>
<td>Z</td>
</tr>
</tbody>
</table>

Tolerances other than those stated in this catalog are subject to special agreement.
**RATED VOLTAGE:**
The rated voltage $U_R$ is either the peak value of the approximate sinusoidal AC voltage or the sum of both the DC voltage and the approximate sinusoidal AC voltage for which the capacitor has been designed. The rated voltage is stated in $KV_{peak}$ ($KV_p$) or $V_{peak}$ ($V_p$).

If the capacitor is operated above the lower limit frequency $f_u$, the rated voltage has to be restricted so the rated power will not be exceeded (see next page).

**RATED CURRENT:**
The rated current $I_R$ is the maximum effective value of the sinusoidal current for which the current paths of the capacitor are designed. This rated current is reached only at the upper frequency limit $f_o$ (see next page).

**RATED POWER:**
The rated power $Q_R$ is the reactive power for which the capacitor has been designed taking into account its dielectric losses. The rated power $Q_R$ ($KVA_r$) stated in the following charts refers to an ambient temperature of $30^\circ C$. When used without forced cooling, above $30^\circ C$, the rated power has to be reduced according to the following formula:

$$Q_N (\delta_A > 30^\circ C) = Q_N \text{ (catalog value)} \times \frac{100^\circ C - \delta_A}{70^\circ C}$$

Reactive power as a function of the ambient temperature:

The following formula can be applied to determine whether a capacitor is operated within the permissible limits of reactive power and rated current:

$$U_{RMS} \times 2 \times \pi \times f \times C \leq I_R$$
$$U_{RMS}^2 \times 2 \times \pi \times f \times C \leq Q_R$$
FREQUENCY:
The power handling capability of a capacitor with respect to voltage, power and current varies at different frequencies. Three frequency ranges can be defined in terms of the upper ($f_o$) and lower ($f_u$) limit frequencies. In each range one of the electrical parameters limits the maximum wattage of the capacitor.

$$ f_u = \frac{318 \cdot Q R}{U R^2 \cdot C} $$

$$ f_o = \frac{159 \cdot I R^2}{Q R \cdot C} $$

For several capacitors series, this can be seen from the diagrams on the individual datasheets. For other capacitors, charts showing the maximum permissible levels of voltage, power and current for continuous operation at 30°C ambient temperature can be provided on request.

INSULATION RESISTANCE:
The insulation resistance is the DC resistance of a capacitor, resulting under the conditions specified below, from the bulk resistivity of the dielectric material and the surface resistance. Within the range of the permissible operating temperatures, the bulk resistance of ceramic dielectric is extremely high so that mainly the surface resistance is measured.

<table>
<thead>
<tr>
<th>Limiting Values of the Insulation Resistance</th>
<th>CLASS 1 CAPACITORS</th>
<th>CLASS 2 CAPACITORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>min. $1 \cdot 10^{10}$ Ohm</td>
<td>min. $5 \cdot 10^{9}$ Ohm</td>
<td></td>
</tr>
</tbody>
</table>

INSULATION - RESISTANCE MEASURING CONDITIONS

MEASURING VOLTAGE:
Class 1- and Class 2-Ceramic dielectric 100V$_{DC}$

DURATION:

$(60 \pm 5)$ s

CLIMATIC CONDITIONS OF MEASUREMENTS:
Temperature $(23 \pm 3)^{\circ}$C, for reference measurements $(20 \pm 1)^{\circ}$C
Relative humidity $\leq 75\%$
DISSIPATION FACTOR:
The dissipation factor $\tan \delta$ is the effective to reactive ratio at a sinusoidal voltage of predetermined frequency. This ratio is dependant upon the dielectric material as well as on temperature and frequency. The curves below show the dissipation factor as a function of frequency and temperature for the preferred ceramic materials.

CLASS 1-CERAMIC DIELECTRIC (R 7, R 16, R 42 and R 85 typical)

CLASS 2-CERAMIC DIELECTRIC
DISSIPATION FACTOR - MEASURING CONDITIONS:
The dissipation factor of all Ceramic RF-Power Capacitors - except where deviations are agreed upon in the ordering procedure - are measured under the following conditions.

MEASURING FREQUENCY:
Class 1-Ceramic dielectric (C < 1000pF): (1 ± 0.2) MHz or (100 ± 20) KHz
Class 1-Ceramic dielectric (C ≥ 1000pF): (300 ± 50) KHz
Class 2-Ceramic dielectric: (1 ± 0.2) KHz (Field strength max. 3KV_RMS per millimeter)

MEASURING VOLTAGE:
Class 1-Ceramic dielectric ≤ 10V_RMS
Class 2-Ceramic dielectric ≤ 5V_RMS

CLIMATIC CONDITIONS OF MEASUREMENTS:
Temperature (23 ± 3)°C, for reference measurements (20 ± 1)°C
Relative humidity ≤ 75%

CAPACITANCE “AGEING” OF CERAMIC CAPACITORS:
Following the final heat treatment, all Class 2 ceramic capacitors reduce their capacitance value approximately according to a logarithmic law due to their special crystalline construction. This change is called “ageing”. If the capacitors are heat treated for example when soldering, the capacity increases again to a higher value and the ageing process begins again. (Note: The level of this de-ageing is dependant on the temperature and the duration of the heat; an almost complete de-ageing is achieved at 150°C in one hour: These conditions also form the basis for reference measurements when testing). The capacitance change per time decade (ageing constant) differs with the various types of ceramic but typical values can be taken from the table below.

<table>
<thead>
<tr>
<th>CERAMIC DIELECTRIC</th>
<th>R 700</th>
<th>R 1400</th>
<th>R 2000</th>
<th>R 2000H</th>
<th>R 2005</th>
<th>R 3500</th>
<th>R 4000</th>
<th>R 6000</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGEING CONSTANT(K)</td>
<td>- 1%</td>
<td>- 2%</td>
<td>- 2%</td>
<td>- 3%</td>
<td>- 3%</td>
<td>- 4%</td>
<td>- 4%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CERAMIC DIELECTRIC</th>
<th>X7R</th>
<th>Y5U</th>
<th>Z5U</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGEING CONSTANT(K)</td>
<td>- 3%</td>
<td>- 3%</td>
<td>- 5%</td>
</tr>
</tbody>
</table>

\[
K = \frac{100 \cdot (C_{t1} - C_{t2})}{C_{t1} \cdot \log_{10} \frac{t1}{t2}}
\]

\[
C_t = C_{1000} \cdot \left(1 - k \cdot \log_{10} t\right)
\]

\[
C_{1000} = \text{Capacitance after start of aging (pF)}
\]

\[
k = \text{Ageing constant per decade (%)}
\]

\[
t = \text{Time passed since start of aging (h)}
\]

REFERENCE MEASUREMENT:
Due to ageing, it is necessary to quote an age for reference measurements which can be related to the capacitance with fixed tolerance. According to EN 130700, this time period is 1000 hours. If the shelf-life of the capacitor is known, the capacitance for t = 1000 hours can be calculated with the ageing constant. In order to avoid the influence of the ageing, it is important to de-age the capacitors before stress-testing.

The following protection is adopted (see also EN 130700):

De-ageing at 150°C, 1 hour
Storage for 24 hours at normal climate temperature
Initial measurement
Stress
De-ageing at 150°C, 1 hour
Storage for 24 hours at normal climate temperature
Final measurement
OPERATION CONDITIONS:
The user should ensure that the permissible operating conditions are not exceeded. Concerning the applied maximum voltage the following subjects should be taken in consideration.

- Harmonic modulation and parasitic frequencies
- Transient over-voltages
- Differences in capacitance and distribution of power when capacitors connected in series
- Assymetric HF fields

Concerning over-heating, the following subjects should be taken into consideration:

- Ambient temperature and radiation from other heat sources
- Differences in capacitance and distribution of power when capacitors connected in series
- RF induction fields and parasitic currents
- Humidity, condensation, moisture deposit

MOUNTING
The user should take care in the mechanical mounting to ensure that mechanical and thermal stresses are minimized. The connection to one electrode must be flexible in order to prevent the generation of physical forces which could damage the capacitor elements. Such forces are often generated by the dimensional differences resulting from the normal physical tolerances of the components.
The capacitor elements must not be used as a mechanical support for other devices or components. For further mounting guidelines see on the individual datasheets.

SOLDERING RECOMMENDATIONS (CAPACITORS WITH LEADS)
Mounting of the component should be achieved using SN 60/40 or silver bearing SN 62/36/2AG solder, whereby solder wire, cream or preforms are acceptable. Only a mildly active, resin flux should be used.
We recommend the use of a heat sink adjacent to the component body, if possible.
As ceramic capacitors are very sensitive to rapid changes in temperature (thermal shock), a pre-heat and post-heat cycle is strongly recommended.
Both the component and ground plate should be heated up to 120°C (Heat must not be applied directly to the ceramic body and the temperature on the component surface should not be allowed to increase faster than 100°C per minute).
After the pre-heat cycle, the mounting plate temperature should be raised to achieve solder flow. The solder flow state should be maintained for a minimum period (recommendation: less than 5s) and the tip temperature should be maintained for a minimum period (recommendation: less than 5s) and the tip temperature should be as low as possible (max. 260°C).
The assembly should be allowed to cool at a rate not exceeding 100°C per minute.

SOLDERING SPECIFICATIONS
Soldering test for capacitors with wire leads: (according to IEC 60068-2-20, solder bath method)

<table>
<thead>
<tr>
<th>SOLDERABILITY</th>
<th>RESISTANCE TO SOLDERING HEAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soldering Temperature</td>
<td>(235 ± 5)°C</td>
</tr>
<tr>
<td>Soldering Duration</td>
<td>(2 ± 0.5) sec</td>
</tr>
<tr>
<td>Distance from Component Body</td>
<td>≥ 2mm</td>
</tr>
</tbody>
</table>

CLEANING
The components should be cleaned with vapor degreasers, immediately following the soldering operation.
CERAMIC MATERIALS:
Ceramic dielectrics are inorganic materials, sintered at temperatures above 1000°C, and developed especially for the manufacture of capacitors.

Ceramic RF-power capacitors are subdivided into two classes, in accordance with recommendations of IEC (International Electrotechnical Commission) with respect to the chemical composition of the dielectric and electrical characteristics.

Class 1 or low-K (NDK) are mainly manufactured of titanium dioxide or magnesium silicate.

Class 2 or high-K capacitors (HDK) contain mostly alkaline earth titanates.

Listed in the tables below are general physical and electrical characteristics of the ceramic dielectric used.

### CLASS 1 CERAMIC MATERIALS

<table>
<thead>
<tr>
<th>ABBREVIATION FOR DIELECTRIC</th>
<th>R 7</th>
<th>R 16</th>
<th>R 16 HIGH Q</th>
<th>NP 0</th>
<th>R 42</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative Dielectric Constant $[\varepsilon_r]$</td>
<td>~ 7</td>
<td>~ 16</td>
<td>~ 17</td>
<td>~ 32</td>
<td>~ 40</td>
</tr>
<tr>
<td>Ceramic Type According to IEC 60672-3</td>
<td>C 221</td>
<td>C 320</td>
<td>C 320</td>
<td>C 320</td>
<td>C 331</td>
</tr>
<tr>
<td>Temperature Coefficient of the Capacitance $[10^{-6}/K]$</td>
<td>+ 130</td>
<td>+ 130</td>
<td>+ 115</td>
<td>+ 30</td>
<td>+ 30</td>
</tr>
<tr>
<td>Dissipation Factor $[10^{-3}]$</td>
<td>$\leq 0.5$ $[1\text{MHz}]$</td>
<td>$\leq 0.4$ $[1\text{MHz}]$</td>
<td>$\leq 0.15$ $[1\text{MHz}]$</td>
<td>$\leq 5$ $[1\text{MHz}]$</td>
<td>$\leq 0.5$ $[1\text{MHz}]$</td>
</tr>
<tr>
<td>Insulation Resistance $[\Omega]$</td>
<td>$\geq 10^{10}$</td>
<td>$\geq 10^{10}$</td>
<td>$\geq 10^{11}$</td>
<td>$\geq 10^{10}$</td>
<td>$\geq 10^{10}$</td>
</tr>
<tr>
<td>Permissible Temperature Range $[^\circ C]$</td>
<td>- 55 to + 100</td>
<td>- 55 to + 100</td>
<td>- 55 to + 100</td>
<td>- 55 to + 85</td>
<td>- 55 to + 100</td>
</tr>
<tr>
<td>Max. Relative Air Humidity [%]</td>
<td>75%</td>
<td>75%</td>
<td>75%</td>
<td>75%</td>
<td>75%</td>
</tr>
</tbody>
</table>

### CLASS 1 CERAMIC MATERIALS

<table>
<thead>
<tr>
<th>ABBREVIATION FOR DIELECTRIC</th>
<th>R 85 (N 750)</th>
<th>R 230</th>
<th>N 2200</th>
<th>N 3300</th>
<th>N 5600</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative Dielectric Constant $[\varepsilon_r]$</td>
<td>~ 90</td>
<td>~ 230</td>
<td>~ 225</td>
<td>~ 310</td>
<td>~ 475</td>
</tr>
<tr>
<td>Ceramic Type according to IEC 60672-3</td>
<td>C 310</td>
<td>C 340</td>
<td>C 340</td>
<td>C 340</td>
<td>C 340</td>
</tr>
<tr>
<td>Temperature Coefficient of the Capacitance $[10^{-6}/K]$</td>
<td>- 650</td>
<td>- 750</td>
<td>- 1700</td>
<td>- 2800</td>
<td>- 4600</td>
</tr>
<tr>
<td>Dissipation Factor $[10^{-3}]$</td>
<td>$\leq 0.5$ $[1\text{MHz}]$</td>
<td>$\leq 0.5$ $[1\text{MHz}]$</td>
<td>$\leq 1.5$ $[1\text{MHz}]$</td>
<td>$\leq 2$ $[1\text{MHz}]$</td>
<td>$\leq 2$ $[1\text{MHz}]$</td>
</tr>
<tr>
<td>Insulation Resistance $[\Omega]$</td>
<td>$\geq 10^{10}$</td>
<td>$\geq 10^{10}$</td>
<td>$\geq 10^{10}$</td>
<td>$\geq 10^{10}$</td>
<td>$\geq 10^{10}$</td>
</tr>
<tr>
<td>Permissible Temperature Range $[^\circ C]$</td>
<td>- 55 to + 100</td>
<td>- 25 to + 100</td>
<td>- 55 to + 100</td>
<td>- 25 to + 85</td>
<td>- 25 to + 85</td>
</tr>
<tr>
<td>Max. Relative Air Humidity [%]</td>
<td>75%</td>
<td>75%</td>
<td>75%</td>
<td>75%</td>
<td>75%</td>
</tr>
</tbody>
</table>
### CLASS 2 CERAMIC MATERIALS

<table>
<thead>
<tr>
<th>ABBREVIATION FOR DIELECTRIC</th>
<th>R 700</th>
<th>R 1400</th>
<th>R 2000</th>
<th>R 2000 H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative Dielectric Constant $[\varepsilon_r]$</td>
<td>$\sim 720$</td>
<td>$\sim 1500$</td>
<td>$\sim 2200$</td>
<td>$\sim 2200$</td>
</tr>
<tr>
<td>Ceramic Type According to IEC 60672-3</td>
<td>C 350</td>
<td>C 350</td>
<td>C 351</td>
<td>C 351</td>
</tr>
<tr>
<td>Temperature Dependance</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Dissipation Factor $[10^{-3}]$</td>
<td>$\leq 25$ [1KHz]</td>
<td>$\leq 25$ [1KHz]</td>
<td>$\leq 25$ [1KHz]</td>
<td>$\leq 5$ [1KHz]</td>
</tr>
<tr>
<td>Insulation Resistance $[\Omega]$</td>
<td>$\geq 10^{10}$</td>
<td>$\geq 10^{10}$</td>
<td>$\geq 10^{10}$</td>
<td>$\geq 10^{10}$</td>
</tr>
<tr>
<td>Permissible Temperature Range $[^{\circ}C]$</td>
<td>-25 to +85</td>
<td>-25 to +85</td>
<td>-25 to +85</td>
<td>-25 to +85</td>
</tr>
<tr>
<td>Max. Relative Air Humidity [%]</td>
<td>75%</td>
<td>75%</td>
<td>75%</td>
<td>75%</td>
</tr>
</tbody>
</table>

* See curves on next page for temperature dependance of capacitance for these Class 2 ceramic materials.

### ABBREVIATION FOR DIELECTRIC

<table>
<thead>
<tr>
<th>ABBREVIATION FOR DIELECTRIC</th>
<th>R 2005</th>
<th>R 3500</th>
<th>R 4000</th>
<th>R 6000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative Dielectric Constant $[\varepsilon_r]$</td>
<td>$\sim 2600$</td>
<td>$\sim 3600$</td>
<td>$\sim 3800$</td>
<td>$\sim 6300$</td>
</tr>
<tr>
<td>Ceramic Type According to IEC 60672-3</td>
<td>C 351</td>
<td>KER 350</td>
<td>C 351</td>
<td>C 351</td>
</tr>
<tr>
<td>Temperature Dependance</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Dissipation Factor $[10^{-3}]$</td>
<td>$\leq 25$ [1KHz]</td>
<td>$\leq 25$ [1KHz]</td>
<td>$\leq 25$ [1KHz]</td>
<td>$\leq 25$ [1KHz]</td>
</tr>
<tr>
<td>Insulation Resistance $[\Omega]$</td>
<td>$\geq 10^{10}$</td>
<td>$\geq 5 \cdot 10^9$</td>
<td>$\geq 5 \cdot 10^9$</td>
<td>$\geq 5 \cdot 10^9$</td>
</tr>
<tr>
<td>Permissible Temperature Range $[^{\circ}C]$</td>
<td>-25 to +85</td>
<td>-25 to +85</td>
<td>-25 to +85</td>
<td>-25 to +85</td>
</tr>
<tr>
<td>Max. Relative Air Humidity [%]</td>
<td>75%</td>
<td>75%</td>
<td>75%</td>
<td>75%</td>
</tr>
</tbody>
</table>

### ABBREVIATION FOR DIELECTRIC

<table>
<thead>
<tr>
<th>ABBREVIATION FOR DIELECTRIC</th>
<th>X7R</th>
<th>Y5U</th>
<th>Z5U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative Dielectric Constant $[\varepsilon_r]$</td>
<td>-4500</td>
<td>-8500</td>
<td>-5000</td>
</tr>
<tr>
<td>Ceramic Type According to EIA 198</td>
<td>II</td>
<td>III</td>
<td>III</td>
</tr>
<tr>
<td>Temperature Dependance</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Dissipation Factor $[10^{-3}]$</td>
<td>$\leq 20$ [1KHz]</td>
<td>$\leq 20$ [1KHz]</td>
<td>$\leq 20$ [1KHz]</td>
</tr>
<tr>
<td>Insulation Resistance $[\Omega]$</td>
<td>$\geq 10^{11}$</td>
<td>$\geq 10^{11}$</td>
<td>$\geq 10^{11}$</td>
</tr>
<tr>
<td>Permissible Temperature Range $[^{\circ}C]$</td>
<td>-30 to +85</td>
<td>-30 to +85</td>
<td>-30 to +85</td>
</tr>
</tbody>
</table>
TEMPERATURE DEPENDENCY OF THE CAPACITANCE WITH CLASS 2 CAPACITORS

$C_{20}$: Capacitance at 20°C without DC  Measuring frequency: 1KHz  Measuring voltage: $\leq 1.2V_{RMS}$
DC-VOLTAGE DEPENDENCY OF CAPACITANCE (TYPICAL VALUES)

The capacitance of Class 1 capacitors scarcely changes when DC-voltage is applied. The relative capacitance change of Class 2 ceramic dielectric vs. applied field strength is given in the curves below.

\[ \frac{\Delta C}{C_0} \]
\[ \% \]

\[ \begin{array}{ccc}
R 700 & R 1400 & R 2000 \\
\begin{array}{c}
\Delta C \\
(\%)
\end{array}
&
\begin{array}{c}
\Delta C \\
(\%)
\end{array}
&
\begin{array}{c}
\Delta C \\
(\%)
\end{array}
\end{array} \]

\[ 0 \quad 1000 \quad 2000 \quad 3000 \quad 4000 \]

\[ \text{FIELD STRENGTH } E \left( \frac{\text{V}}{\text{mm}} \right) \]

\[ \begin{array}{ccc}
R 2005 & R 2000H & R 3500 \\
\begin{array}{c}
\Delta C \\
(\%)
\end{array}
&
\begin{array}{c}
\Delta C \\
(\%)
\end{array}
&
\begin{array}{c}
\Delta C \\
(\%)
\end{array}
\end{array} \]

\[ 0 \quad 1000 \quad 2000 \quad 3000 \quad 4000 \]

\[ \text{FIELD STRENGTH } E \left( \frac{\text{V}}{\text{mm}} \right) \]

\[ \begin{array}{ccc}
R 4000 & R 6000 \\
\begin{array}{c}
\Delta C \\
(\%)
\end{array}
&
\begin{array}{c}
\Delta C \\
(\%)
\end{array}
\end{array} \]

\[ 0 \quad 1000 \quad 2000 \quad 3000 \quad 4000 \]

\[ \text{FIELD STRENGTH } E \left( \frac{\text{V}}{\text{mm}} \right) \]

\[ \begin{array}{ccc}
X75, Y5U & Z5U \\
\begin{array}{c}
\text{Percent Capacitance Decrease}
\end{array}
&
\begin{array}{c}
\text{Percent Capacitance Decrease}
\end{array}
\end{array} \]

\[ 0 \quad 25 \quad 50 \quad 75 \quad 100 \]

\[ \text{PERCENT RATED D.C. VOLTAGE} \]

\[ \text{PERCENT RATED D.C. VOLTAGE} \]
QUALITY CONTROL AND TESTING:
The quality of our RF-power capacitors is assured by numerous tests carried out at every stage of production. The finished capacitors are subjected to the individual 100% tests given below.

CAPACITANCE:
Class 1 ceramics at 0.1MHz, with 20\text{V}_{\text{RMS}}, (25 \pm 5)^\circ \text{C}
Class 2 ceramics at 1KHz, with \leq 5\text{V}_{\text{RMS}}, (25 \pm 5)^\circ \text{C}

DISSIPATION FACTOR:
Class 1 ceramics (C_R < 1000pF) at 1MHz, with 10\text{V}_{\text{RMS}}, (25 \pm 5)^\circ \text{C}
Class 1 ceramics (C_R \geq 1000pF) at 300KHz, with 10\text{V}_{\text{RMS}}, (25 \pm 5)^\circ \text{C}
Class 2 ceramics at 1KHz, with \leq 5\text{V}_{\text{RMS}}, (25 \pm 5)^\circ \text{C}

INSULATION RESISTANCE:
at 100\text{V}_{\text{DC}}, (25 \pm 5)^\circ \text{C}

DIELECTRIC WITHSTANDING:
Standard test with 200\% U_R, AC 50Hz, 5 minutes. (As repeated test admissible only once with a step-up voltage reduced by 10\% for three minutes).

RF-HEATING TEST
This 100\% test is carried out with Watercooled Pot Capacitors, Multilayer Power Capacitors and those components made from R 230 dielectric only.
The units are tested in the tank circuit of a RF-test generator with at least 130\% to 150\% rated power for 5 to 10 minutes.
For all other types, this RF-power test is subject to special agreement.
For details of Watercooled Capacitors see individual datasheets.

VISUAL CONTROL AND DIMENSIONS:

OUTLINE DRAWINGS:
All dimensions are given in millimeters and inches (in brackets).
As a result of continual efforts to improve mechanical design, components supplied may vary in detail from those described or illustrated in the outline drawings of this catalog.

STANDARDS AND SPECIFICATIONS:

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