High Voltage Ceramic Capacitors

Type HP/HW

Type HD/HE

SELECTION GUIDE

Main Signal Component	Application	Series	Type	Size	Finish
Pulses AC or DC	High Energy Pulses or AC or DC	Molded discs with connections	HP	30 40 50 60	Epoxy potted
		Uncoated discs with connections	HW	30 40 50 60	Uncoated
AC	AC Voltage dividers at line frequency	Molded discs with connectors	HD	30 40 60	Epoxy potted
		Uncoated discs with connectors	HE	30 40 60	Uncoated

GENERAL CHARACTERISTICS

HIGH VOLTAGE / AC USES

- The main applications include live line indicators, AC dividers, grading systems for power distribution network, protection for HV switches and power circuit breakers. Coupling, by-passing high frequency circuits also use HV ceramic disc capacitors.
- These applications require:
  - a high internal resistance.
  - a high dielectric strength.
  - low or moderate losses at working frequencies (from 50 Hz up to 10 kHz).

  The active power (or losses) being:

  $Wa = 2\Pi FC \cdot tg\ \delta \cdot V^2 = k\ (C \cdot tg\ \delta)\ (F \cdot V^2)$

  This shows that improved performances are obtained when:
  - Good dielectric properties (low tg δ) and
  - No long term overvoltage are present and
  - Capacitors free of “partial discharge” (corona) effect, up to rated rms voltage.

  TPC is able to perform “discharge free test” and may guarantee a rate as low as 5 picocoulombs at V_{rms} upon request.
- High voltage capacitors for AC uses are mainly made of type II dielectrics. Most of these materials except strontium titanate exhibit a significant non-linearity. Consequently, the capacitance value depends on the voltage across the component and on the frequency of the applied signal.

HIGH ENERGY PULSES

- Laser pulses circuitry, high energy/high voltage test equipment (HV accelerators, physics research) require products especially adapted to their specific requirements.
- Because of the high energy involved, the design of the capacitors have to provide:
  - a very low ESR (equivalent series resistance) to minimize the lossed energy.

$$W = \int^{ip} (ESR \cdot I^2)\ di$$

  - a very low ESL (equivalent series inductance) to keep the correct pulse shape.

    Typically due to the design of the electrodes, the products exhibit:
    - ESR: ~ 10 mΩ
    - ESL: < 30 nH
    - peak current up to 50 kA
  - a high withstanding of very large $\frac{dV}{dt}$ or short signal rise time.
  - a high energy density J

    $J = \frac{1}{2}\ k\ \varepsilon_o\ \varepsilon_r\ E^2$ (with E = V/m)

    even under high electric field, (implying that ε_r is very little voltage dependent).

    Through the use of almost linear or non-voltage dependent capacitors, the stored energy can reach 50 to 100 J/liter for the HP/HW products.
- To ensure these properties, traditional ferroelectric type II capacitors cannot be used due to their electrostrictive and piezoelectric properties. The capacitors use quasi “paraelectric”, strontium-based, ceramic material.
- The main applications are coupling, decoupling, multipliers circuits, HV DC power supplies, high voltage dividers.