Voltage Multiplier Assemblies

CeramTec
THE CERAMIC EXPERTS

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The CeramTec Group is a world leader in the design and manufacture of complex electronic ceramic components and assemblies used in a wide range of applications and cutting edge technologies. CeramTec UK specialises in the development and production of dielectric and ferroelectric materials and components. These series connected disc capacitors have been developed for use in low power voltage multipliers for high voltage DC generators. Requests for custom capacitor designs are invited.

APPLICATIONS INCLUDE

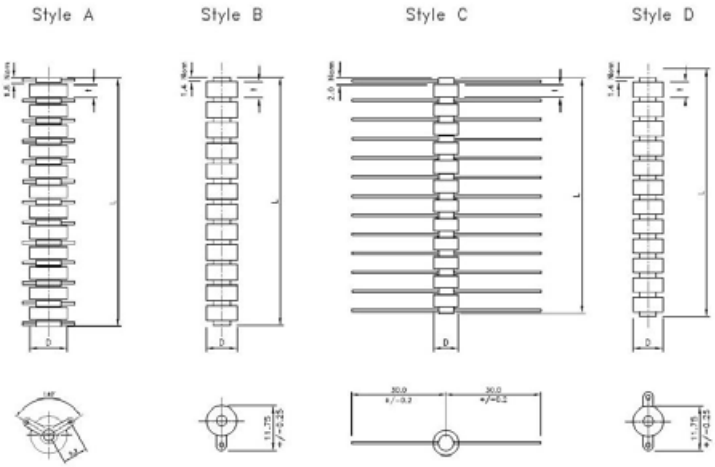
- X-Ray Power Supplies: Medical Diagnostics
- Power supplies for Electrostatic Paint Spraying Applications (Hand held Guns)
- General purpose low power multiplier circuits used in High Voltage Generators

FEATURES

- Disc DC voltage range 8-15kVdc
- Small Size / Robust construction
- Variety of disc dimension & ceramic dielectric materials resulting in a wide capacitance range
- Variety intermediate metal fittings available
- Number of individual capacitors per stack can be varied to meet customer requirements
- Output voltages in excess of 100kVDC can be produced depending on the number of stages in the stack assembly

Dielectric Material Specification						
Dielectric Reference	K1700	K2100	K2500	K3300	K3500	K3800
Dielectric Constant(ε_r) @ 1V/1kHz/20°C	1650	2100	2700	3150	3750	3800
Dissipation Factor @ 1V/1kHz/20°C	$\leq 15 \times 10^{-4}$	$\leq 170 \times 10^{-4}$	$\leq 20 \times 10^{-4}$	$\leq 200 \times 10^{-4}$	$\leq 100 \times 10^{-4}$	$\leq 150 \times 10^{-4}$
Insulation Resistance (Ω) @ 1000V 20°C	$\geq 1 \times 10^{11}$	$\geq 1 \times 10^{10}$	$\geq 1 \times 10^{11}$	$\geq 1 \times 10^{10}$	$\geq 1 \times 10^{10}$	$\geq 1 \times 10^{10}$
Ageing Rate (%) / Decade Hr	Negligible	-3	Negligible	-3	-3	-3
Temperature Coefficient of Capacitance (EIA Category)	Z5T	X7R	Z5U	Y5T	Y5U	X7R
Capacitance - DC Voltage Characteristic	See Curves					
Operating Temperature Range	Typical -25°C to + 85°C					
Capacitance - Temperature Characteristic	See Curves					

Outline Drawing:



Other 'Tag Styles' may be available upon request

Electrical Characteristics

Type No	Capa-citance (pF)/Disc 1V/1kHZ /20° C	Capa-citance Tolerance	Dielectric Reference	TCC (EIA category)	Voltage Rating / Disc kVDC	Style Refe-rence	No.of Discs in Stack	D (mm)	L (mm)	L2 (mm)	t (mm)
07592	250	+40% -0%	K3300	Y5T	10	B	12	8	66	±2	4
07845	250	+40% -0%	K3300	Y5T	10	B	9	8	49.5	±1	4
07895	250	+40% -0%	K3300	Y5T	10	A	11	8	65.5	Max	4
07903/000	250	±20%	K3300	Y5T	10	C	12	7.3	68	±2	4
07967	250	+40% -0%	K3300	Y5T	10	C	10	8	60	Max	4
07966	280	+40% -0%	K3800	X7R	10	D	12	7.3	57	±1.5	4
08024	320	±20%	K3800	X7R	10	C	9	7.3	60	Max	4
07954	330	±20%	K3300	Y5T	12	C	10	9.3	68	Max	5
07957	330	±20%	K3800	X7R	12	C	10	8	70	Max	4.65
08085	330	±20%	K3800	X7R	12	C	9	8	63.8	Max	4.65
07935	370	±20%	K2500	Z5U	8	B	12	10.5	69	±2	4.3
08069	370	±20%	K2500	Z5U	8	B	9	10.5	51.9	±2	4.3
07950	480	±20%	K3800	X7R	12	A	12	9.3	73.5	±2	4.5
07562	500	±20%	K2100	X7R	12	A	12	12	77	±2	4.5
07992	500	±20%	K2100	X7R	12	C	12	12	76	Max	4.5
07986	1100	±10%	K3800	X7R	8	A	12	14.15	66	±5	5
08064	1100	±10%	K3800	X7R	15	A	12	16.5	80	Max	5.9

Note: Rated voltage above assumes that the quality of the user encapsulation is sufficient to prevent external voltage flashover.

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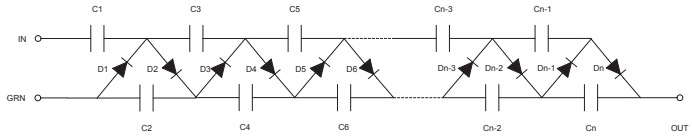
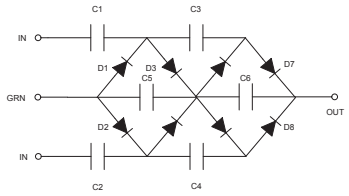
Typical Schematic Diagrams:



Half-Wave Series Multiplier



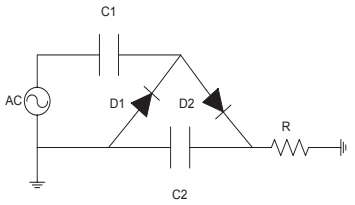
Full-Wave Multiplier

How Does It Work:

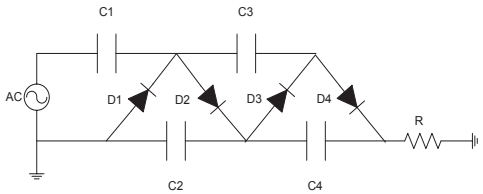
Voltage multipliers are AC/DC power conversion devices. They comprise 2off series capacitor stacks (Halfwave multiplier) or 3off series capacitor stacks (Full-wave multiplier) further interconnected with diodes. A high frequency source, typically 20-40kHz, supplies the AC input via a ferrite transformer. Output voltages up to 100kVdc (or higher) can be produced dependent on the number of capacitors/diodes in the stack.

How does it work:

For the voltage doubler circuit shown opposite the capacitor C1 is charged, via diode D1, to a voltage V_{pk} (equal to the peak of the AC input voltage) during the negative half cycle of the input voltage. During the positive half cycle the capacitor C2 is charged up to a voltage equal to the V_{pk}, via diode D2, plus the existing voltage on C1. Thus C2 charges to 2 x V_{pk}.



Following on again, 2off additional capacitors (C3 & C4) and diodes (D3 & D4) have been added to the circuit, however the 2off new capacitors C3 & C4 are not returned to ground as C1 & C2 were but to a point where the 'doubled' voltage was developed in the previous example. Higher voltages can be developed by increasing the number of capacitors and diodes in the stack. i.e. the output voltage = 2n x V_{pk} where n = number of capacitor/diode stages.



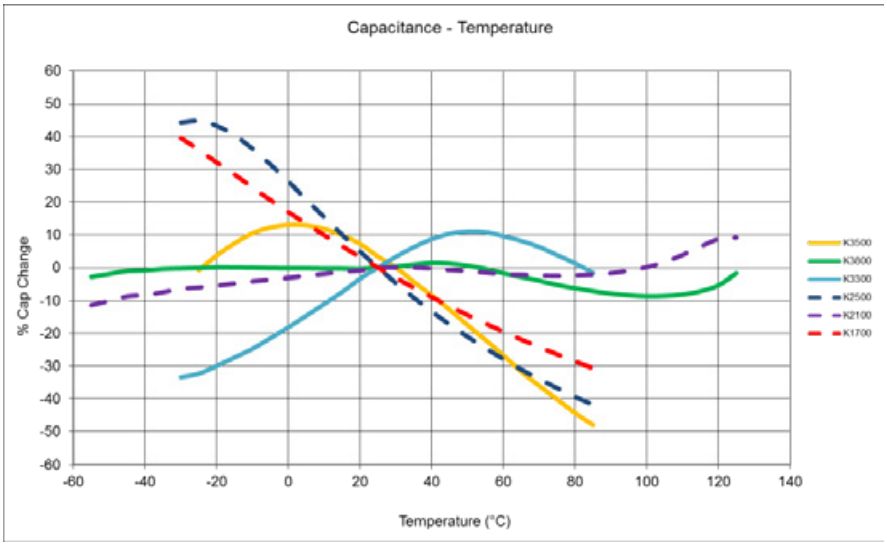
The above assumes the use of ideal components i.e. capacitors have no losses / diodes exhibit zero resistance in conducting mode and infinite resistance when not conducting/infinite load resistance, in practice the output voltage will be somewhat reduced.

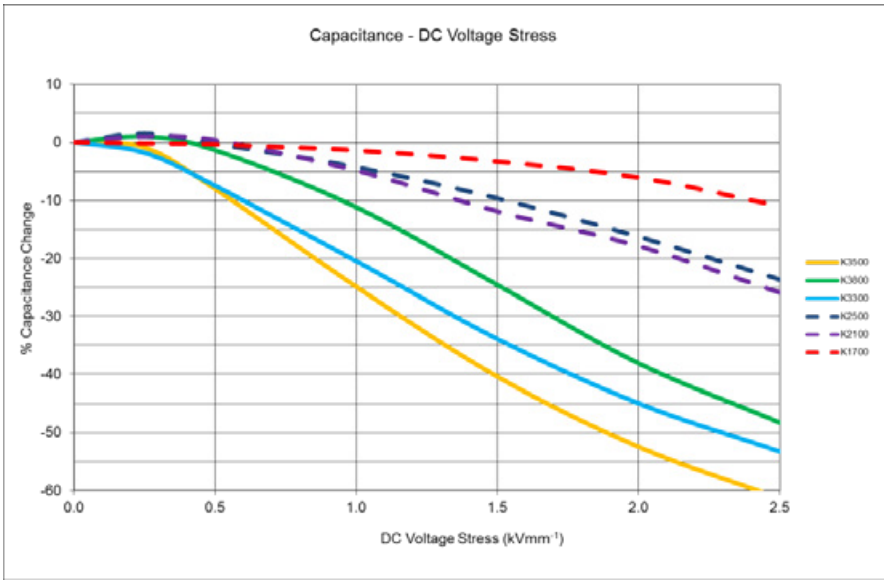
CUSTOM DESIGNS

- Dielectric Material – see Material specification table
- Standard Disc Diameters (mm) : 7.3, 8, 9.3, 10.5, 12, 14 & 16.5
- Typical Disc thickness : 4-5 mm
- No of capacitors per stack : Up to 14 off
- Metalwork types – see Styles A,B,C & D.

- Enquiries invited for custom designs.

Characteristic Curves:





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