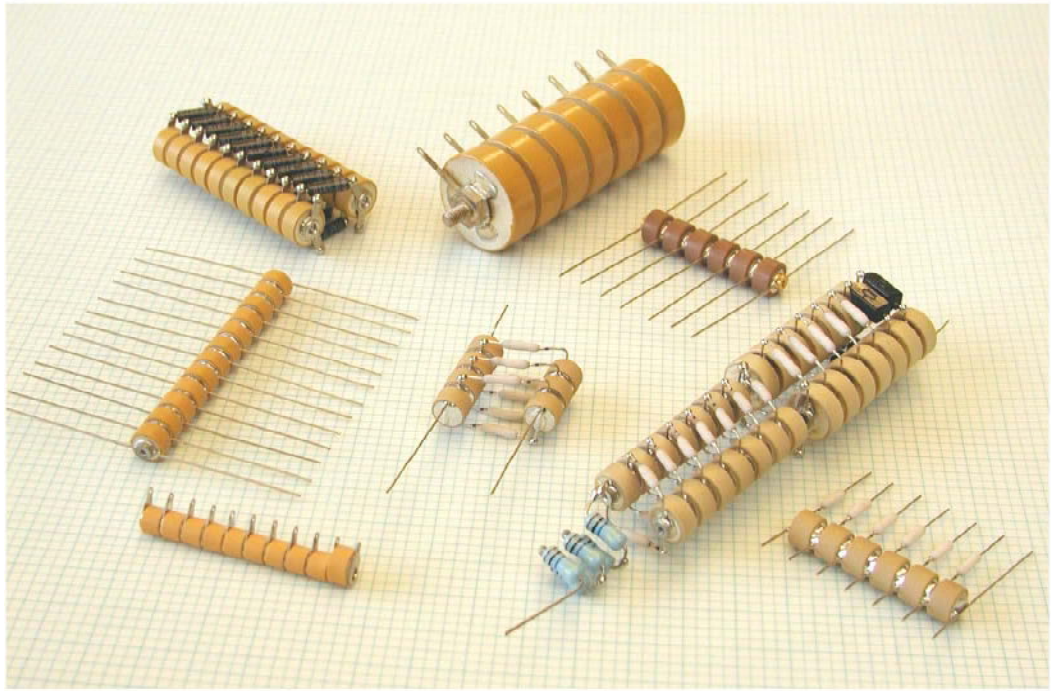
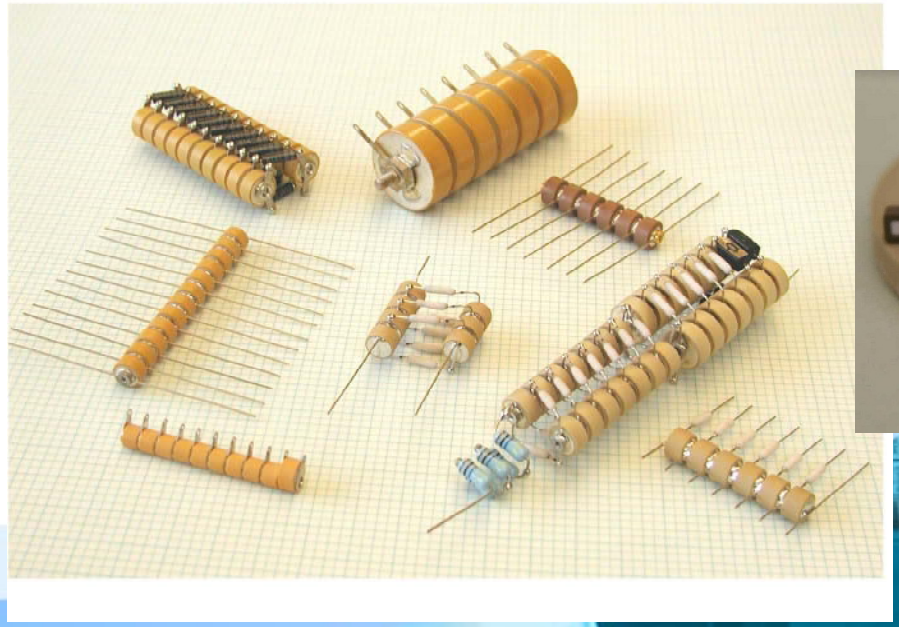
CAPACITOR STACKS, HIGH VOLTAGE CIRCUIT ARRAYS & VOLTAGE MULTIPLIER SETS



VISHAY®

One of the World's Largest Manufacturers
of Discrete Semiconductors and Passive Components

CAPACITOR STACKS, HIGH VOLTAGE CIRCUIT ARRAYS & VOLTAGE MULTIPLIER SETS



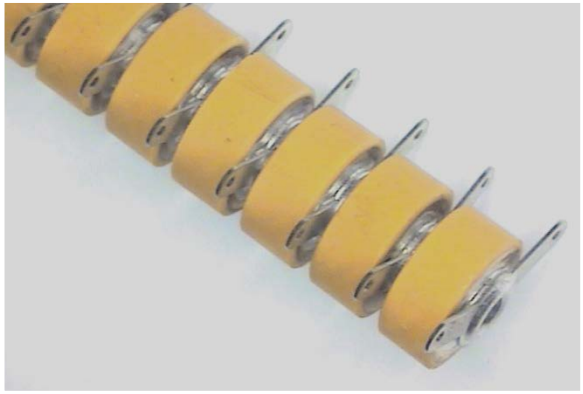
W. Zeitler OCT. 2010

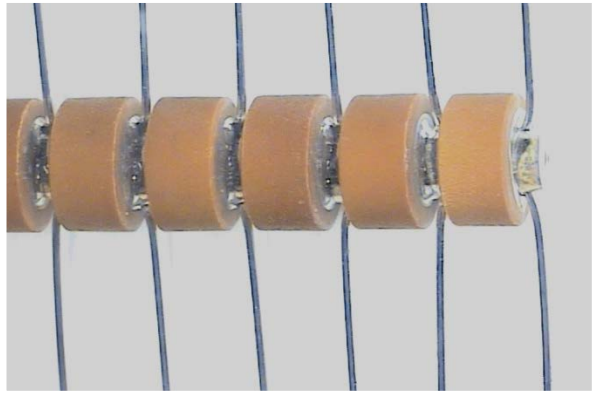
WHAT IS A CAPACITOR STACK

A number of ceramic capacitor discs are assembled together with intermediate fittings which allow the connection with HV diodes to be made.

Voltage ratings of individual discs range typically from 8KVDC to 10KVDC

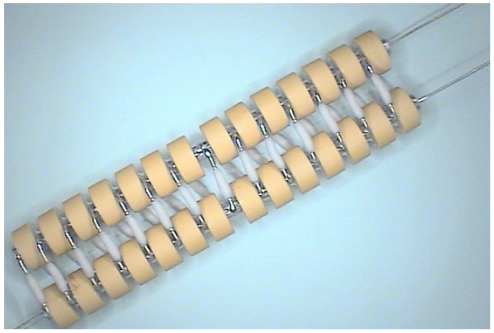
Output voltages in excess of 100KVDC can be produced depending on the number of stages.





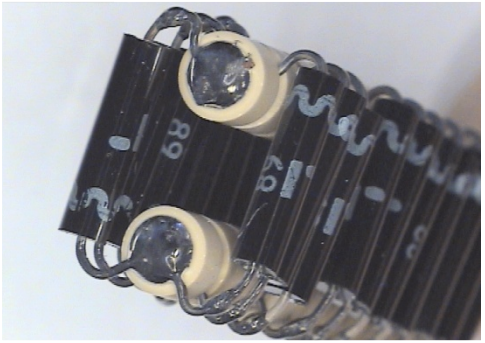
WHAT IS A VOLTAGE MULTIPLIER

Voltage multipliers are AC-to-DC power conversion devices, comprised of diodes and capacitor stacks, that produce a high potential DC voltage from a lower voltage AC source.



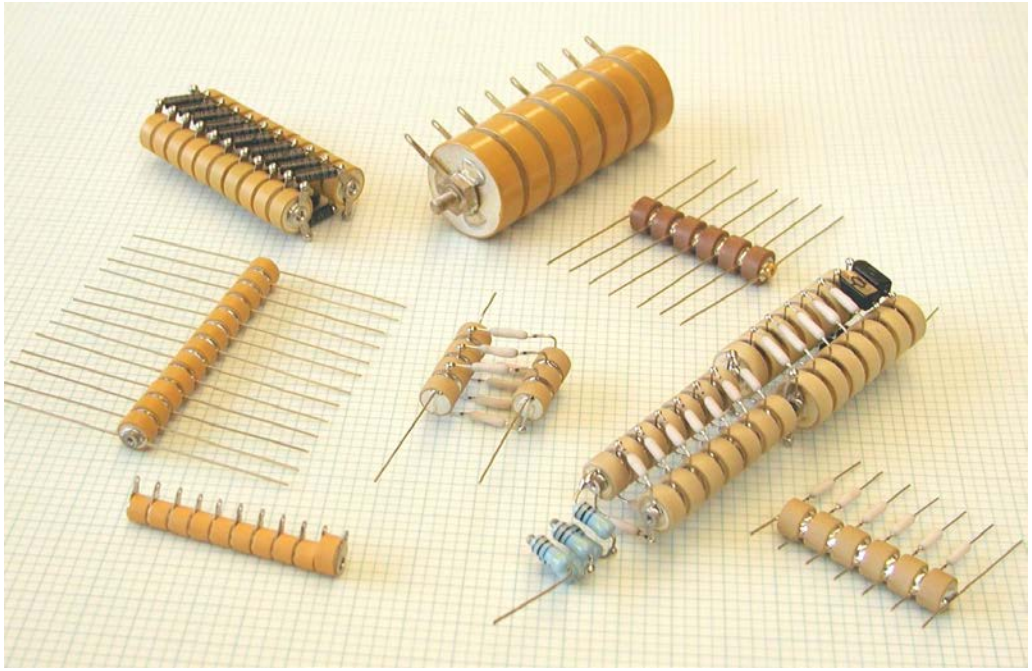
Multipliers are build up of multiple stacks, up to a maximum of 14 stages

Each stage is comprised of one diode and one capacitor.



VOLTAGE MULTIPLIER – CUSTOMS DESIGNS

A variety of intermediate metal fittings are available and the number of capacitors in each stack can be varied to meet customers individual requirements

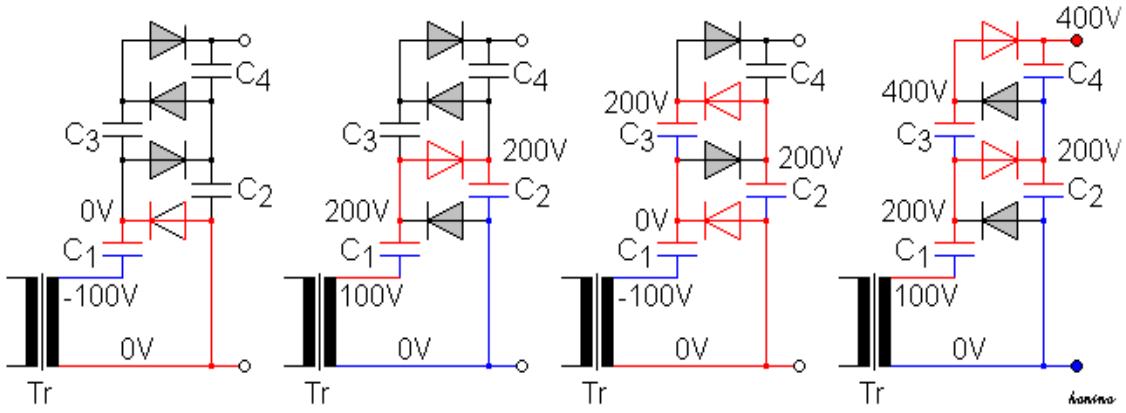


HOW DOES A MULTIPLIER WORK

Assuming that the peak voltage of the AC source is +Us, we can describe the working of the cascade as follows:

(1) Negative peak: The C1 capacitor charges through diode D1 to 0V
(2) Positive peak: The potential of C1 adds with that of the source, thus C2 charges to 2Us through D2.
(3) Negative peak: The potential of C1 drops to 0V and allows C3 to be charged through D3 to 2Us.
(4) Positive peak: The potential of C1 rises to 2Us (analogously to step 2), C4 charges to 2Us through D4.

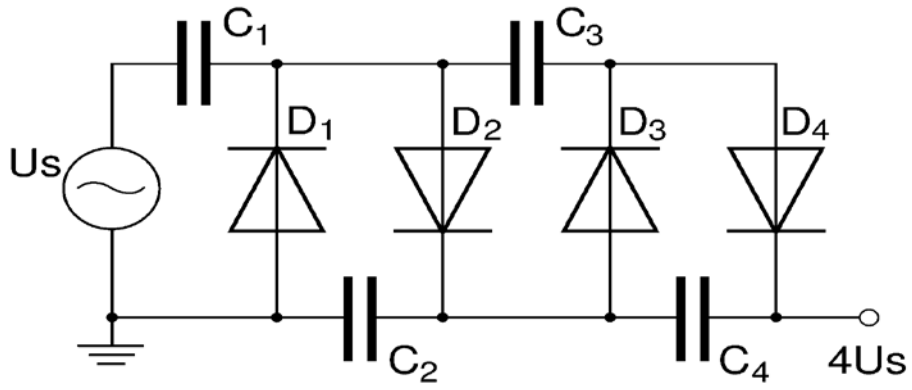
The output voltage (the sum of voltages under C2 and C4) raises till 4Us.
In reality more cycles are required for C4 to reach the full voltage.
Adding more segments analogous to C1-D1-D2-C2, output voltage increases to (n)Us (n = number of stages).



VOLTAGE MULTIPLIER - CONSTRUCTION

HALF-PULSE SERIES MULTIPLIER

'VILLARD CIRCUIT'



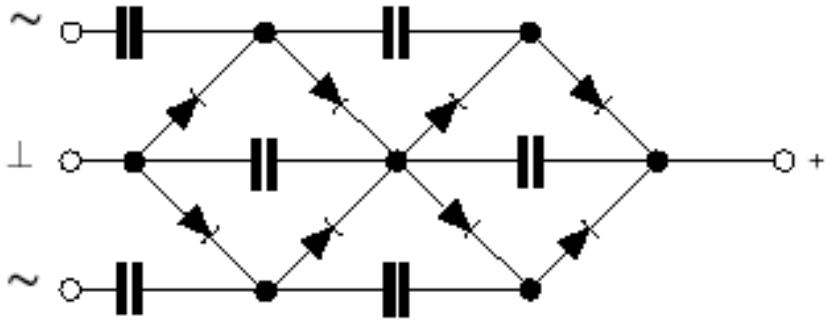
- Most common circuit
- Very versatile
- Uniform stress/stage on capacitors & diodes
- Small dimensions possible

VOLTAGE MULTIPLIER - CONSTRUCTION

FULL-PULSE MULTIPLIER

'DELON' OR 'GREINACHER' CIRCUIT

- High power capability
- Uniform component stress
- Highly efficient



VOLTAGE MULTIPLIERS - MAIN FEATURES

OUTPUT VOLTAGE depends of the number of stages the input Voltage
CURRENT depends of the capacitance value of the disc and the frequency

REQUIREMENTS TO THE DIELECTRIC

Low DISSIPATION FACTOR available over a broad frequency range
High Stability of the CAPACITANCE over a broad frequency range
High INSULATION RESISTANCE
High DIELECTRIC STRENGTH
High PHYSICAL STRENGTH of the electrode areas

TYPICAL APPLICATION

X-RAY EQUIPMENT

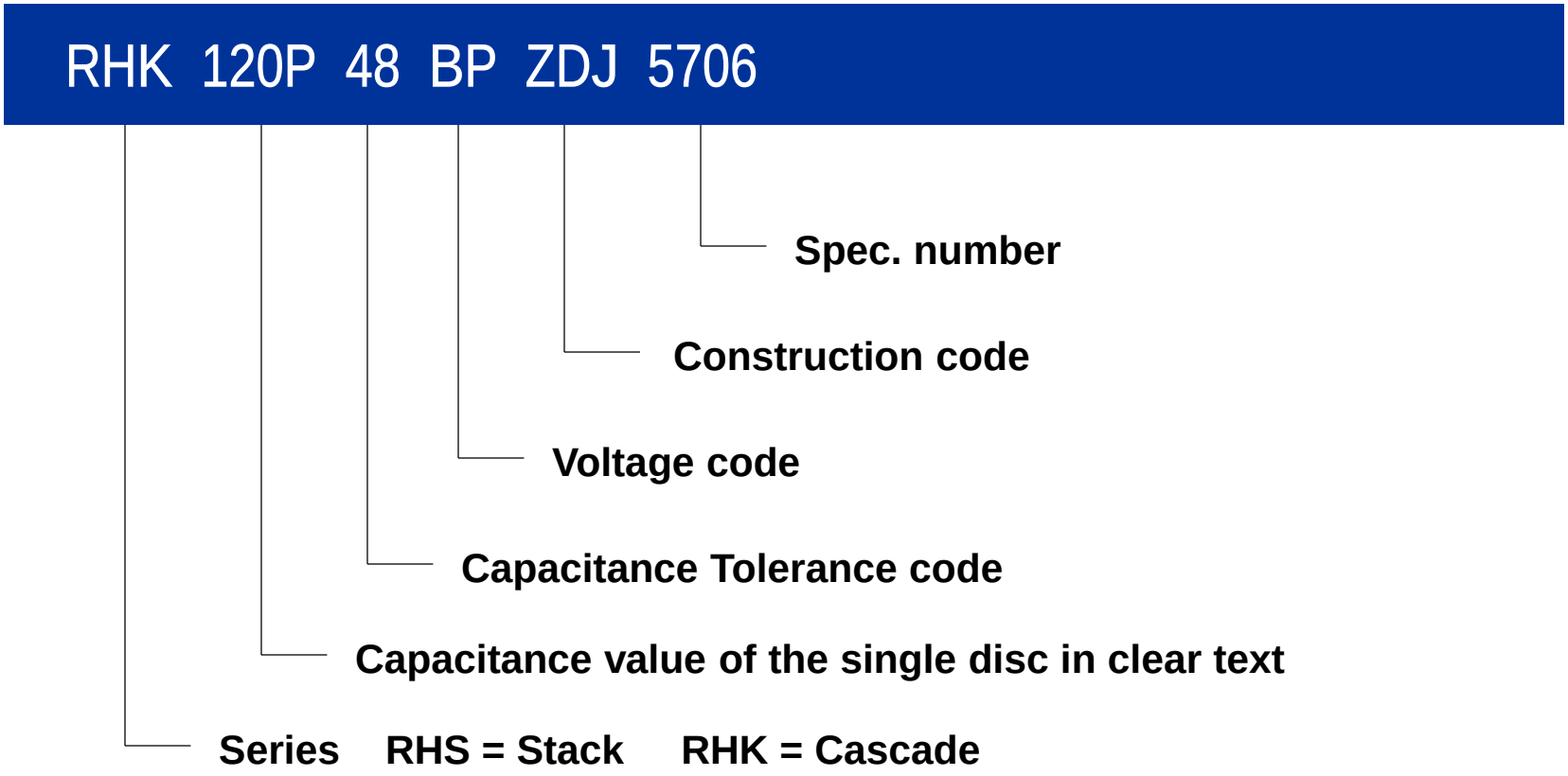
in Medical Diagnosis Equipment

in Dentistry Application

Industrial X-Ray for Material Control

ELECTROSTATIC POWDER COATING EQUIPMENT

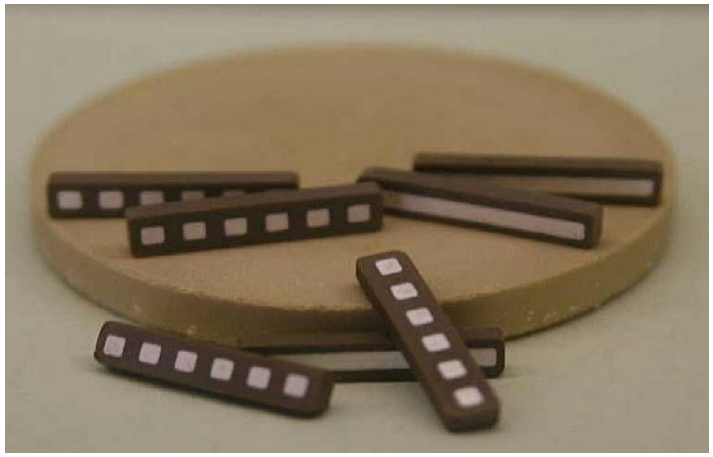
CASCADE - PARTNUMBERING SYSTEM



WHAT IS A VOLTAGE MULTIPLIER ARRAY

Beside ‘Discrete’ stacks the multiplier can build up as ARRAY
on a ceramic substrate plate

A number of capacitor noble metal electrodes are printed on both sides
of a ceramic substrate.



VOLTAGE MULTIPLIER ARRAYS

FEATURES

- small dimensions
- a wide range of Ceramic dielectric materiels are available
- Individually customer layouts or circuit designs can be offered on demand

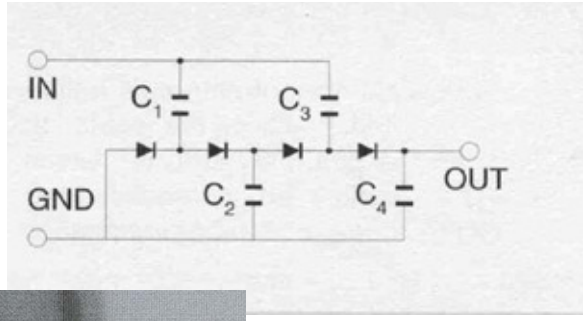
APPLICATION

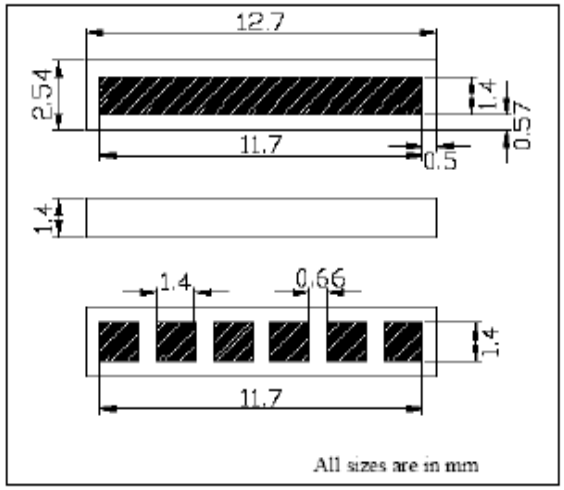
- voltage multiplier sets
- surge protection

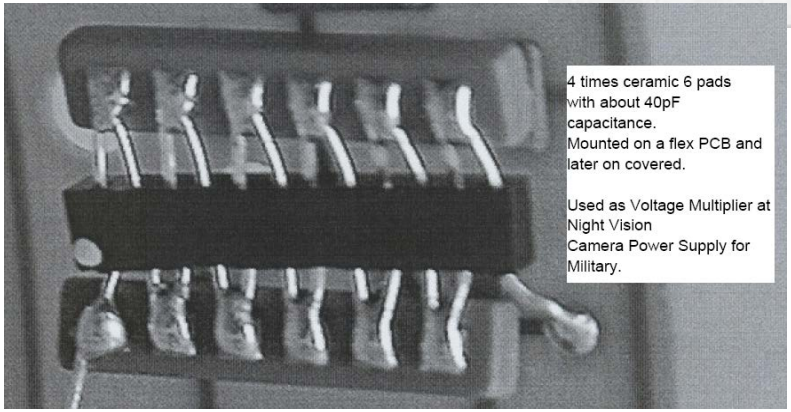
SAMPLE: 6KV CAPACITOR ARRAY

Custom designed High voltage Array up to 6 kV

Application: HV-circuit with one common electrode







VOLTAGE MULTIPLIER ARRAYS

CERAMIC DIELECTRIC RANGE

Electrical						
Dielectric		X7R	Y5R	X5U	N750	N4700
Temp.Coefficient						
Operating Temp.		-55 to +125C				
Dielectric strength		1.2 times Rated Voltage				
DF		<2,5%	<2,5%	<2,5%	0.30%	0.30%
IR		100G-Ohm	100G-Ohm	100G-Ohm	100G-Ohm	100G-Ohm
Pads		6	6	6	6	6

Rated voltage 6kV	Met size	1.4	1.4	1.4	1.4	1.4
	Thickness (mm)	1.4	1.4	1.4	1	1.2
	C-Value (pF)	**60**	**40**	**100**	**5**	**40**

Rated voltage 4kV	Met size	1.4	1.4	1.4		1.4
	Thickness (mm)	1	1	1		0.8
	C-Value (pF)	**80**	**56**	**120**		**56**

Rated voltage 2kV	Met size	1.4	1.4	1.4		1.4
	Thickness (mm)	0.6	0.6	0.6		0.6
	C-Value (pF)	**120**	**100**	**200**		**75**

Other designs with different dimensions or Capacitance values are available on request

ARRAY - PARTNUMBERING SYSTEM