Catalogue - PROTECTIVE DEVICES - Edition 2015

KEKOVARICON

Varistors

SMD, THD, High Energy

Varicons

Multilayer SMD and THD

Dual Function Varicons

Capacitors

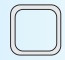
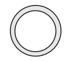
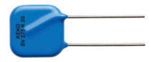
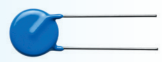
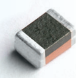
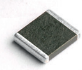
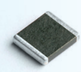
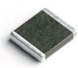
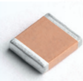
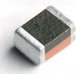
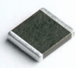
Safety class X and Y disc capacitors

High voltage disc capacitors

www.keko-varicon.si

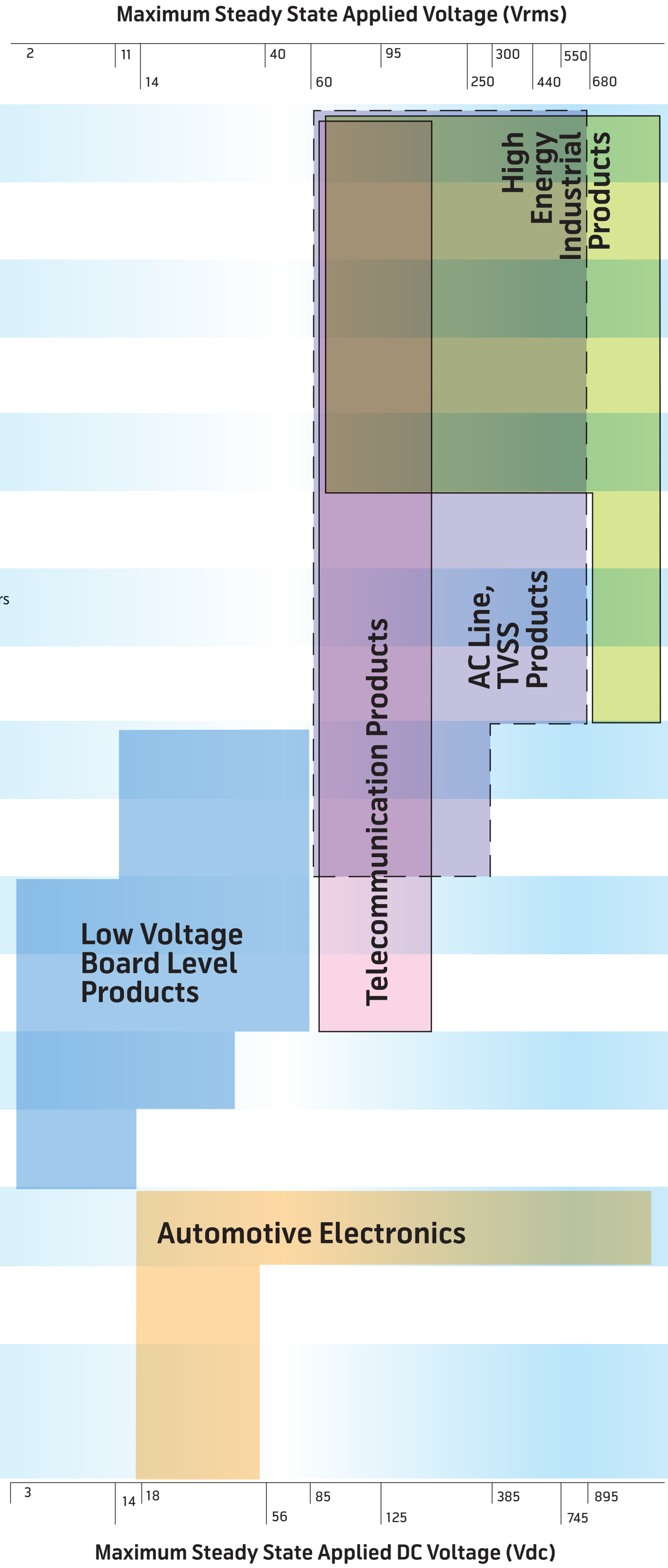
OVERVIEW OF PROTECTIVE DEVICES

Maximum Steady State Applied Voltage (Vrms): 2 | 11 | 14 | 40 | 60 | 95 | 250 | 300 | 440 | 550 | 680

Basic Electrical Parameters	Series	Size (mm)	Package
Imax = 13000 to 80000 A, Wmax = 90 to 4140 J Imax > 5500 A/cm², Wmax > 400 J/cm³	**ZOV Series** **Square Shaped** **High Energy Varistors**	23, 25, 32, 40, 60 	
Imax = 15000 to 40000 A, Wmax = 30 to 2590 J	**ZOVR Series** **Round Shaped** **High Energy Varistors**	25, 32, 40 	
Imax (8/20μs) up to 150 kA, Iimp (10/350μs) up to 25 kA Custom Design	**ZOVH / ZOVS Series** **High Energy Varistors** **for class I applications**	40, 40 D2, 40 D4 (80,120)	
Imax = 600 to 15000 A, Wmax = 4 to 815 J Imax > 5500 A/cm², Wmax > 400 J/cm³	**SV Series** **Special Medium** **Voltage Varistors**	5, 7, 10, 14, 20, 23	
Imax = 1750 to 15000 A, Wmax = 9 to 627 J	**CV+ Series** **Medium Voltage** Varistors	7,10, 14, 20, 23	
Imax = 400 to 6500 A, Wmax = 2,7 to 620 J	**CV Series** **Medium Voltage** Varistors	5, 7, 10, 14, 20	
KM – C = 10 to 15 nF, Class X1, 300 VAC KM – C = 1 to 10 nF, Class Y2, 300 VAC KZL, KZH – C = 330 to 4700 pF, Class X1/Y1/Y2, 300/500 VAC	**KM Series** **RFI Suppression Ceramic Capacitors** **KZ Series** **Safety Ceramic Capacitors**	330 pF to 10 nF	
C = 300pF to 10nF Vr = 1kV to 6kV	**KV Series** **High Voltage Disc** **Cermic Capacitors**	330 pF to 10 nF	
Imax = 100 to 1200 A, Wmax = 0,6 to 30 J	**PV Series** **Low & Medium** **Voltage Varistors**	3225 4032	
Imax = 100 to 1200 A, Wmax = 0,6 to 30 J	**DV Series** **Medium Voltage** Varicons	2220 3225 4032	
Imax = 1500 A, Wmax = 0,1 to 2,6 J C (@ 1kHz) = 10 nF to 1000 nF	**MV Series** **Low Voltage Dual Function Varicons**	5 	1210 
Imax = 20 to 2000 A, Wmax = 0,1 to 37,8 J	**ZV Series** **Low Voltage Varicons**	5, 7, 10, 14, 20 	0603, 0805, 1206, 1210, 1812, 2220 
Imax = 30 to 40 A Wmax = 1,0 J	**ZVX Series** **Low Capacitance & Low Energy** Varicons	0603, 0805, 1206	
tr < 1 ns, Wmax = 0,05 to 0,1 J	**ZVE Series** **ESD Suppression** Varicons	0603, 0805, 1206, 1210	
CL and C Series : C = 1pF to 4,7μF, V = from 16 V to 630 V X7R, C series: AgPd, Barrier End Terminations, Ni / Sn End terminations	**CL Series** **Through-Hole MLC Capacitor** C Series **SMD MLC Capacitor**	5, 6, 8, 9 	0603, 0805, 1206, 1210, 1812, 2220 
Imax = 800 to 1200 A, WLD = 6 to 12 J C (@ 1kHz) = 470 nF to 1500 nF Custom Design	**OV Series** Automotive **Dual Function** Varicons	8, 9 	1812, 2220 
Imax = 120 to 2000 A, WLD = 3 to 100 J Custom Design	**AV Series** Automotive Varicons	6, 8, 8, 11 	0805, 1206, 1210, 1812, 2220, 3225 

Maximum Steady State Applied DC Voltage (Vdc): 3 | 14 | 18 | 56 | 85 | 125 | 385 | 745 | 895

APPLICATION FIELDS



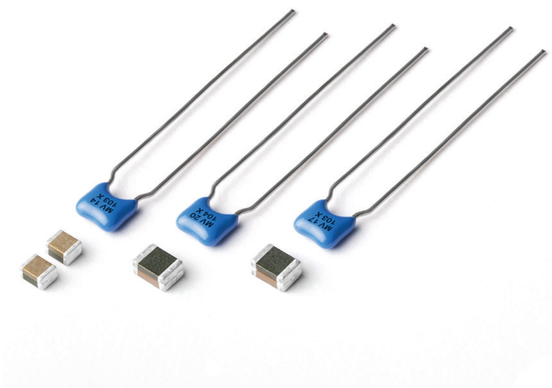
Series	Size (mm)	Package
ZOV Series Square Shaped High Energy Varistors	23, 25, 32, 40, 60	
ZOVR Series Round Shaped High Energy Varistors	25, 32, 40	
ZOVH / ZOVS Series High Energy Varistors for Class I Applications	40, 40 D2, 40 D3 (80,120)	
SV Series Special Medium Voltage Varistors	5, 7, 10, 14, 20, 23	
CV+ Series Medium Voltage Varistors	7,10, 14, 20, 23	
CV Series Medium Voltage Varistors	5, 7, 10, 14, 20	
KM Series RFI Suppression Ceramic Capacitors **KZ Series** Safety Ceramic Capacitors	330 pF to 10 nF	
KV Series High Voltage Disc Cermic Capacitors	330 pF to 10 nF	
PV Series Low & Medium Voltage Varistors	3225 4032	
DV Series Medium Voltage Varistors	2220 3225 4032	
MV Series Low Voltage Dual Function Varistors	5	1210
ZV Series Low Voltage Varistors	5, 7, 10, 14, 20	0603, 0805, 1206, 1210, 1812, 2220
ZVX Series Low Capacitance & Low Energy Varicons	0603, 0805, 1206	
ZVE Series ESD Suppression Varistors	0603, 0805, 1206, 1210	
CL Series Through-Hole MLC Capacitor **C Series** SMD MLC Capacitor	5, 6, 8, 9	0603, 0805, 1206, 1210, 1812, 2220
OV Series Automotive Dual Function Varistors	8, 9	1812, 2220
AV Series Automotive Varistors	6, 8, 8, 11	0805, 1206, 1210, 1812, 2220, 3225

LOW VOLTAGE DUAL FUNCTION VARICON – MV SERIES

Description

The VARICON MV series is series of dual function protective devices that protect against voltage surges in a low voltage region and against high frequency noise, replacing two components, those being a low voltage varistor and a capacitor.

MV series varicons incorporate a varistor function in the DC voltage range from 3 to 125 V (up to 170 V upon request) and function as high frequency by-pass capacitors operating in the capacitance range from 10 nF to 1 μF. Lower capacitance values are also available. They are intended for protection of all sensitive electronic devices experiencing both voltage transients and high frequency noise produced by electromechanical devices, such as buzzers, relays, etc.



MV Varicons are square shaped components with in-line leads, which require very little mounting space, at least 30% less then the two components they replace. Dual function VARICONs are also available in SMD versions upon request – compliant with Pb-free soldering.

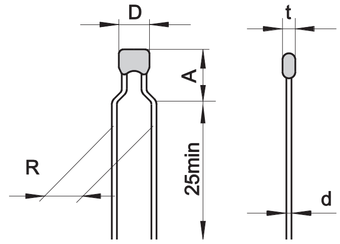
Features

- Operating voltage range V_{dc}......3 to 125 V (up to 170 V upon request).
- Operating voltage range V_{rms}......2 to 95 V (up to 130 V upon request).
- Capacitance range C (@ 1 kHz) ......10 nF to 1 μF (lower capacitance values are also available upon request).
- Capacitor temperature characteristics ....X7R.
- Protects against voltage transients and suppresses high frequency interference.
- Dimensional and weight saves on board.
- One standard model size available ...... 6 x 9 mm.
- THD and SMD components.
- Available in tape and reel for automatic pick and place.
- Lead free components.
- AEC-Q200 qualified Grade 1

Absolute Maximum Ratings

Continuous:	Units	Value
Steady State Applied Voltage:		
DC Voltage Range (V_{dc})	V	3 to 170
AC Voltage Range (V_{rms})	V	2 to 130
Transient:		
Non-Repetitive Surge Current, 8/20 μs Waveform (I_{max})	A	150
Non-Repetitive Surge Energy, 10/1000 μs Waveform (W_{max})	J	0,1 to 2,5
Capacitance Range	nF	10 to 1000
Capacitor Temperature Characteristics		X7R
Operating Ambient Temperature	°C	- 40 to + 125
Storage Temperature Range	°C	- 40 to +150
Threshold Voltage Temperature Coefficient	%/°C	< + 0,05
Insulation Resistance	GΩ	> 1
Isolation Voltage Capability	kV	> 1,25
Response Time	ns	< 25
Climatic Category		40 / 125 / 56

Device Ratings and Characteristics



MV 2 M 103 MX .... MV 95 K 105 MX

Type	V_{rms} V	V_{dc} V	V_n @ 1 mA V	V_c @ 1 A V	W_{max} 10/1000 µs J	P max W	I_{max} 8/20 µs A	C @ 1 kHz µF	D max mm	A max mm	R mm	d mm	t max mm
MV 2 M 103 MX	2	3	4	10	0,1	0,01	150	10	6	9	5	0,6	5,5
MV 2 M 104 MX	2	3	4	10	0,1	0,01	150	100	6	9	5	0,6	5,5
MV 2 M 105 MX	2	3	4	10	0,1	0,01	150	1000	6	9	5	0,6	5,5
MV 4 M 103 MX	4	5,5	8	14	0,2	0,01	150	10	6	9	5	0,6	5,5
MV 4 M 104 MX	4	5,5	8	14	0,2	0,01	150	100	6	9	5	0,6	5,5
MV 4 M 105 MX	4	5,5	8	14	0,2	0,01	150	1000	6	9	5	0,6	5,5
MV 6 M 103 MX	6	8	11	21	0,2	0,01	150	10	6	9	5	0,6	5,5
MV 6 M 104 MX	6	8	11	21	0,2	0,01	150	100	6	9	5	0,6	5,5
MV 6 M 105 MX	6	8	11	21	0,2	0,01	150	1000	6	9	5	0,6	5,5
MV 8 L 103 MX	8	11	15	25	0,3	0,01	150	10	6	9	5	0,6	5,5
MV 8 L 104 MX	8	11	15	25	0,3	0,01	150	100	6	9	5	0,6	5,5
MV 8 L 105 MX	8	11	15	25	0,3	0,01	150	1000	6	9	5	0,6	5,5
MV 11 K 103 MX	11	14	18	35	0,8	0,01	150	10	6	9	5	0,6	5,5
MV 11 K 104 MX	11	14	18	35	0,8	0,01	150	100	6	9	5	0,6	5,5
MV 11 K 105 MX	11	14	18	35	0,8	0,01	150	1000	6	9	5	0,6	5,5
MV 14 K 103 MX	14	18	22	38	0,9	0,01	150	10	6	9	5	0,6	5,5
MV 14 K 104 MX	14	18	22	38	0,9	0,01	150	100	6	9	5	0,6	5,5
MV 14 K 105 MX	14	18	22	38	0,9	0,01	150	1000	6	9	5	0,6	5,5
MV 17 K 103 MX	17	22	27	49	1,1	0,01	150	10	6	9	5	0,6	5,5
MV 17 K 104 MX	17	22	27	49	1,1	0,01	150	100	6	9	5	0,6	5,5
MV 17 K 105 MX	17	22	27	49	1,1	0,01	150	1000	6	9	5	0,6	5,5
MV 20 K 103 MX	20	26	33	54	1,3	0,01	150	10	6	9	5	0,6	5,5
MV 20 K 104 MX	20	26	33	54	1,3	0,01	150	100	6	9	5	0,6	5,5
MV 20 K 105 MX	20	26	33	54	1,3	0,01	150	1000	6	9	5	0,6	5,5
MV 25 K 103 MX	25	31	39	65	1,7	0,01	150	10	6	9	5	0,6	5,5
MV 25 K 104 MX	25	31	39	65	1,7	0,01	150	100	6	9	5	0,6	5,5
MV 25 K 105 MX	25	31	39	65	1,7	0,01	150	1000	6	9	5	0,6	5,5
MV 30 K 103 MX	30	38	47	77	2,0	0,01	150	10	6	9	5	0,6	5,5
MV 30 K 104 MX	30	38	47	77	2,0	0,01	150	100	6	9	5	0,6	5,5
MV 30 K 105 MX	30	38	47	77	2,0	0,01	150	1000	6	9	5	0,6	5,5
MV 35 K 103 MX	35	45	56	90	2,2	0,01	150	10	6	9	5	0,6	5,5
MV 35 K 104 MX	35	45	56	90	2,2	0,01	150	100	6	9	5	0,6	5,5
MV 35 K 105 MX	35	45	56	90	2,2	0,01	150	1000	6	9	5	0,6	5,5
MV 40 K 103 MX	40	56	68	110	2,3	0,01	150	10	6	9	5	0,6	5,5
MV 40 K 104 MX	40	56	68	110	2,3	0,01	150	100	6	9	5	0,6	5,5
MV 40 K 105 MX	40	56	68	110	2,3	0,01	150	1000	6	9	5	0,6	5,5
MV 50 K 103 MX	50	65	82	135	2,3	0,01	150	10	6	9	5	0,6	5,5
MV 50 K 104 MX	50	65	82	135	2,3	0,01	150	100	6	9	5	0,6	5,5
MV 50 K 105 MX	50	65	82	135	2,3	0,01	150	1000	6	9	5	0,6	5,5
MV 60 K 103 MX	60	85	100	165	2,3	0,01	150	10	6	9	5	0,6	5,5
MV 60 K 104 MX	60	85	100	165	2,3	0,01	150	100	6	9	5	0,6	5,5
MV 60 K 105 MX	60	85	100	165	2,3	0,01	150	1000	6	9	5	0,6	5,5
MV 95 K 103 MX	95	125	150	250	2,5	0,01	150	10	6	9	5	0,6	5,5
MV 95 K 104 MX	95	125	150	250	2,5	0,01	150	100	6	9	5	0,6	5,5
MV 95 K 105 MX	95	125	150	250	2,5	0,01	150	1000	6	9	5	0,6	5,5

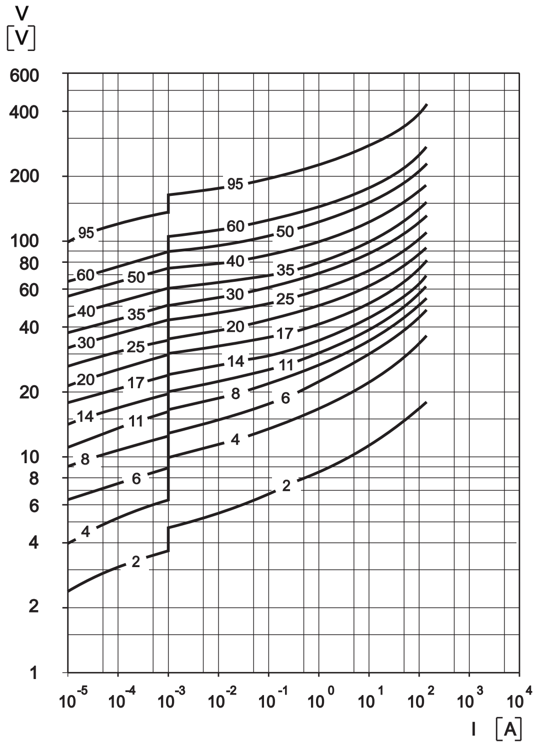
* X stand for X7R temperature characteristic.
Other capacitance values and voltages are also available upon request.

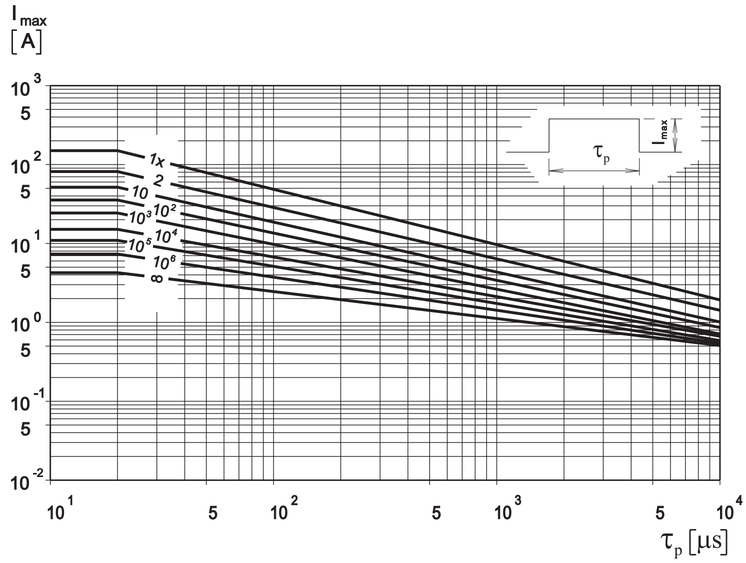
Protection Level

* With the worst-case condition in the tolerance region

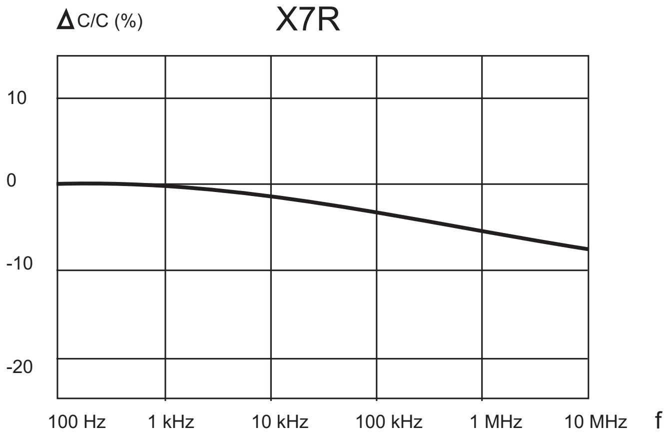
Pulse Rating Curves

MV 2 M...95 K

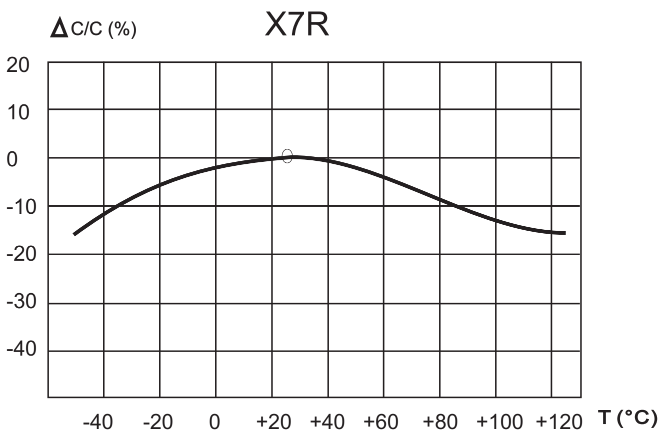




Capacitance – Frequency Characteristics



Capacitance – Temperature Characteristics

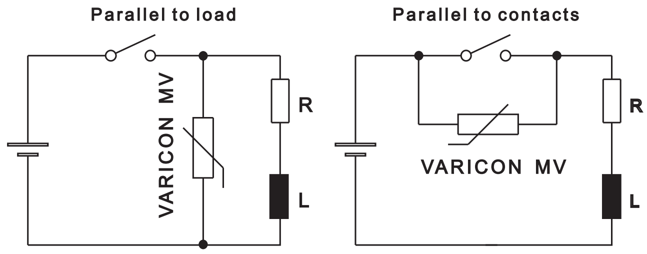


Application

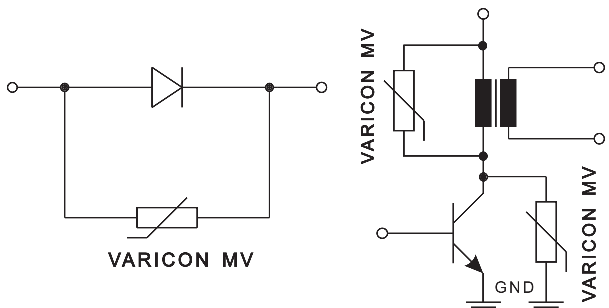
- Electrostatic Surge Absorption
- Relay Surge Suppression Effect and Relay reset Time
- Piezoelectric Buzzer Shock Noise Absorption

Application Circuits

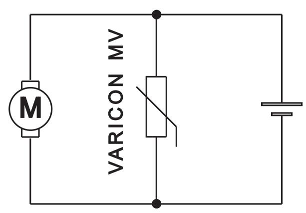
(a) Eliminating sparks from relay circuits
(there is no delay in operating time)



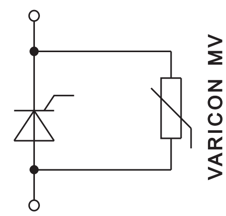
(b) Eliminating noise from micro motors



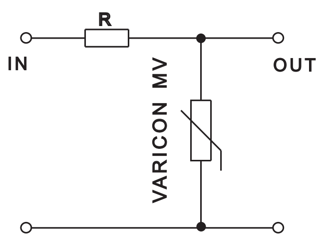
(c) Stabilizing voltages and absorbing line surges



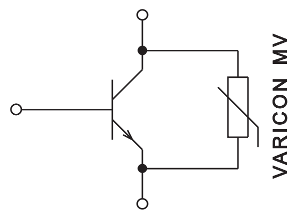
(d) Absorbing shock noise of piezzoelectric alarms



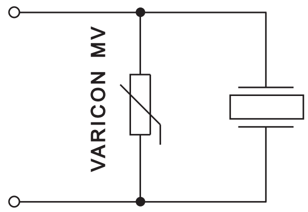
(e) Protecting semi conductive components
including transistors and diodes



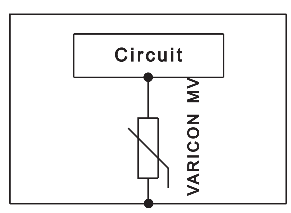
(f) Improved thyristor configuration
Eliminating vibration better than conventional circuits



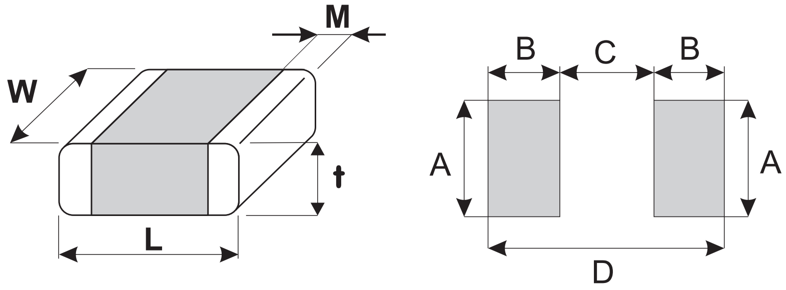
(g) Elimination of over-shooting from transistors



(h) Elimination of static electricity from circuits



Soldering Pad Configuration

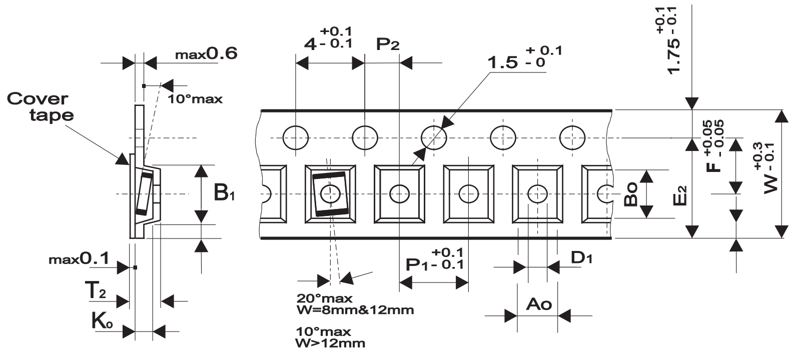


Size	L (mm)	W (mm)	M (mm)	t_{max} (mm)	A (mm)	B (mm)	C (mm)	D (mm)
1210	3,2 ± 0,30	2,50 ± 0,25	0,5 ± 0,25	2,5	2,8	1,2	2,1	4,5
1812	4,7 ± 0,40	3,20 ± 0,30	0,5 ± 0,25	3,0	3,6	1,5	3,2	6,2
2220	5,7 ± 0,50	5,00 ± 0,40	0,5 ± 0,25	3,0	5,5	1,5	4,2	7,2

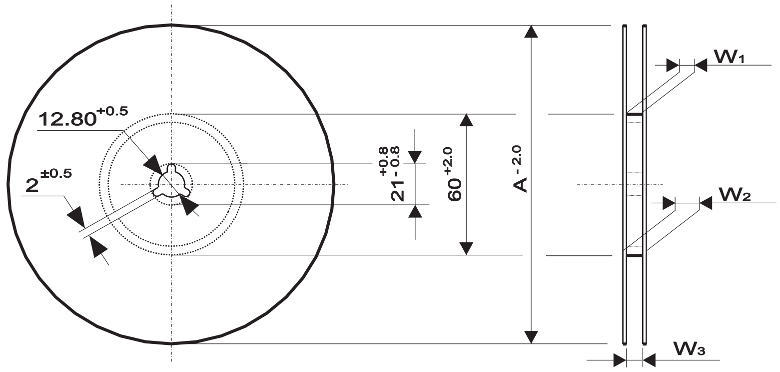
Tape and Reel Specification

Conforms to IEC Publication 286 - 3 Ed.4: 2007-06

Tape



Reel



Variable dimensions

Tape Size		8 mm	12 mm	
Size	Units	1210	1812	2220
Ao	(mm)	2,9	3,7	5,6
Bo	(mm)	3,7	5	6,25
Ko max	(mm)	*	*	*
B1 max	(mm)	4,35	8,2	8,2
D1 min	(mm)	0,3	1,5	1,5
E2 min	(mm)	6,25	10,25	10,25
P1	(mm)	4	8	8,
F	(mm)	3,5	5,5	5,5
W	(mm)	8,0	12,0	12,0
T2 max	(mm)	**	**	**
W1	(mm)	8,4+1,5	12,4+2	12,4+2
W2 max	(mm)	14,4	18,4	18,4
W3	(mm)	7,9...10,9	11,9...15,4	11,9...15,4
A	(mm)	180/330	180/330	180/330

*,** - the values for this parameter are depended on capacitance values. For detail information and technical data please contact the factory.

Package units

Series	Voltage range (V)	Chip Size					
		1210		1812		2220	
		Reel size		Reel size		Reel size	
		180	330	180	330	180	330
OV	all	***	***	***	***	***	***
MV	all	***	***	***	***	***	***

*** - the values are depended on varicons dimensions (parameter Ko and T2). For detail information and technical data please contact the factory.

Ordering Information

OV 20 K 474 MX 801 R L1 yy

OV - Series Name: MV, OV

20 - Maximum Continuous Operating Voltage - V_{rms}

K - V_n Tolerance: K = ± 10 %, L = ± 15%, M = ± 20 %

474 - Capacitance Code in pF: 474 = 470 nF

M - Capacitance Tolerance: K = ± 10 %, M = ± 20 %

X - Dielectric Type: X = X7R

1812 - Dimensions, only for SMD component

801 - Surge Current Code in A: 801 = 800 A

N - Barrier type, only for SMD component

R - Packaging: B = Bulk, R = reel, A = ammo

L1 - Lead Style: 1 = straight, only for Leaded component

yy - Special requirements

Varicon Marking

For OV Series

OV 20 K
474 MX
122

OV - Series Name

20 - V_{rms}

K - V_n Tolerance

474 - Capacitance Code

M - Capacitance Tolerance

X - Dielectric Ceramics Code

122 - Surge Current Code - does not exist for current code 801

For MV Series

MV 14
103 X

MV - Series Name

14 - V_{rms}

K - V_n Tolerance

103 - Capacitance Code

X - Dielectric Ceramics Code

SOLDERING RECOMMENDATIONS

Popular soldering techniques used for surface mounted components are Wave and Infrared Reflow processes. Both processes can be performed with Pb-containing or Pb-free solders. The termination options available for these soldering techniques are AgPd and Barrier Type End Terminations.

End termination	Designation	Recommended and Suitable for	Component RoHS Compliant
Ag/Pd	Series (ZV, AV, DV, C, ...)........ R1	Pb-containing soldering	Yes
Barrier Type End Termination	Series (ZV, AV, DV, C, ...)........ N R1	Pb-containing and Pb-free soldering	Yes
Ni Sn End Termination	Series (ZV, AV, ...) ...Ni R1	Pb-containing and Pb-free soldering v	Yes

Wave Soldering – this process is generally associated with discrete components mounted on the underside of printed circuit boards, or for large top-side components with bottom-side mounting tabs to be attached, such as the frames of transformers, relays, connectors, etc. SMD varistors to be wave soldered are first glued to the circuit board, usually with an epoxy adhesive. When all components on the PCB have been positioned and an appropriate time is allowed for adhesive curing, the completed assembly is then placed on a conveyor and run through a single, double wave process.

Infrared Reflow Soldering – these reflow processes are typically associated with top-side component placement. This technique utilizes a mixture of adhesive and solder compounds (and sometimes fluxes) that are blended into a paste. The paste is then screened onto PCB soldering pads specifically designed to accept a particular sized SMD component. The recommended solder paste wet layer thickness is 100 to 300 μm. Once the circuit board is fully populated with MD components, it is placed in a reflow environment, where the paste is heated to slightly above its eutectic temperature. When the solder paste reflows, the SMD components are attached to the solder pads.

Solder Fluxes – solder fluxes are generally applied to populated circuit boards to lean oxides form forming during the heating process and to facilitate the flowing of the solder. Solder fluxes can be either a part of the solder paste compound or can be separate materials, usually fluids. Recommended fluxes are:

- non-activated (R) fluxes, whenever possible
- mildly activated (RMA) fluxes of class L3CN
- class ORLO

Activated (RA), water soluble or strong acidic fluxes with a chlorine content > 0.2 wt. % are NOT RECOMMENDED. The use of such fluxes could create high leakage current paths along the body of the varistor components.

When a flux is applied prior to wave soldering, it is important to completely dry any residual flux solvents prior to the soldering process.

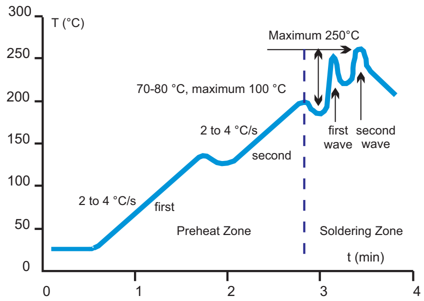


Fig. 1. Wave Soldering Temperature Profile for Pb-free and Pb-containing Soldering

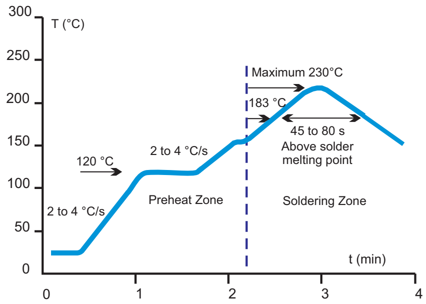


Fig. 2. Infrared Reflow Temperature Profile for Pb-containing Soldering

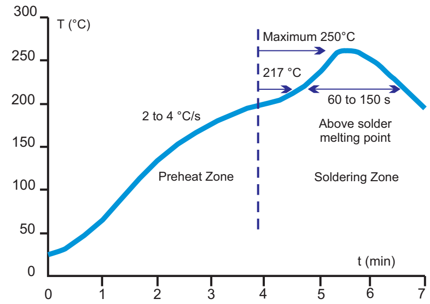


Fig. 3. Reflow Temperature Profile for Pb-free Soldering

Thermal Shock – to avoid the possibility of generating stresses in the varistor chip due to thermal shock, a preheat stage to within 100 °C of the peak soldering process temperature is recommended. Additionally, SMD varistors should not be subjected to a temperature gradient greater than 4 °C/sec., with an ideal gradient being 2 °C/sec. Peak temperatures should be controlled. Wave and Reflow soldering conditions for SMD varistors with Pb-containing solders are shown in Fig. 1 and 2 respectively, while Wave and Reflow soldering conditions for SMD varistors with Pb-free solders are shown in Fig, 1 and 3.

Whenever several different types of SMD components are being soldered, each having a specific soldering profile, the soldering profile with the least heat and the minimum amount of heating time is recommended. Once soldering has been completed, it is necessary to minimize the possibility of thermal shock by allowing the hot PCB to cool to less than 50 °C before cleaning.

Inspection Criteria – the inspection criteria to determine acceptable solder joints, when Wave or Infrared Reflow processes are used, will depend on several key variables, principally termination material process profiles.

Pb-contining Wave and IR Reflow Soldering – typical "before" and "after" soldering results for Silver/Palladium (AgPd) and Barrier Type End Terminations can be seen in Fig. 4. Both barrier type and silver/palladium terminated varistors form a reliable electrical contact and metallurgical bond between the end terminations and the solder pads. The bond between these two metallic surfaces is exceptionally strong and has been tested by both vertical pull and lateral (horizontal) push tests. The results, in both cases, exceed established industry standards for adhesion.

The solder joint appearance of a barrier type terminated versus a sliver/palladium terminated varistor will be slightly different. Solder fo$_{rms}$ a metallurgical junction with the thin tin-alloy (over the barrier layer), and due to its small volume "climbs" the outer surface of the terminations, the meniscus will be slightly lower. This optical appearance difference should be taken into consideration when programming visual inspection of the PCB after soldering.

Silver Palladium (AgPd) End Terminations **Barrier Type End Terminations and Ni Sn End Terminations**

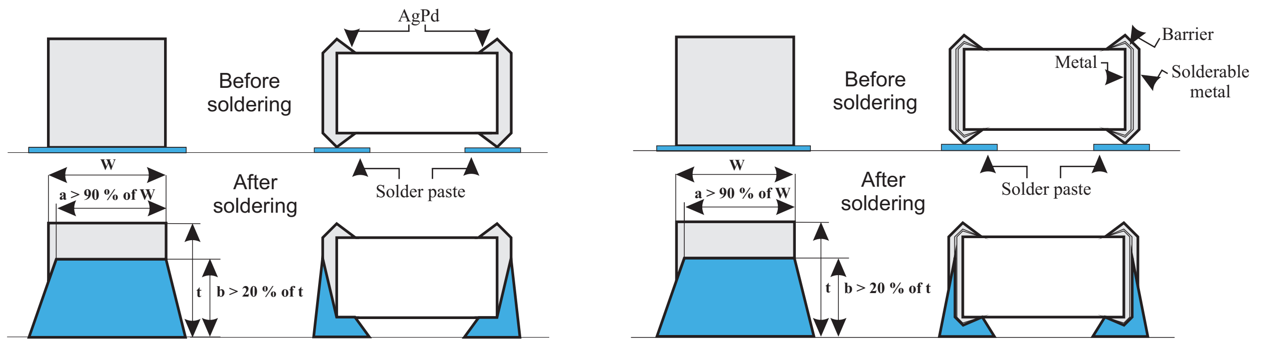


Fig. 4 Soldering Criterion in case of Wave and IR Reflow Pb-containing Soldering

Silver Palladium (AgPd) End Terminations **Barrier Type End Terminations and Ni Sn End Terminationsv**

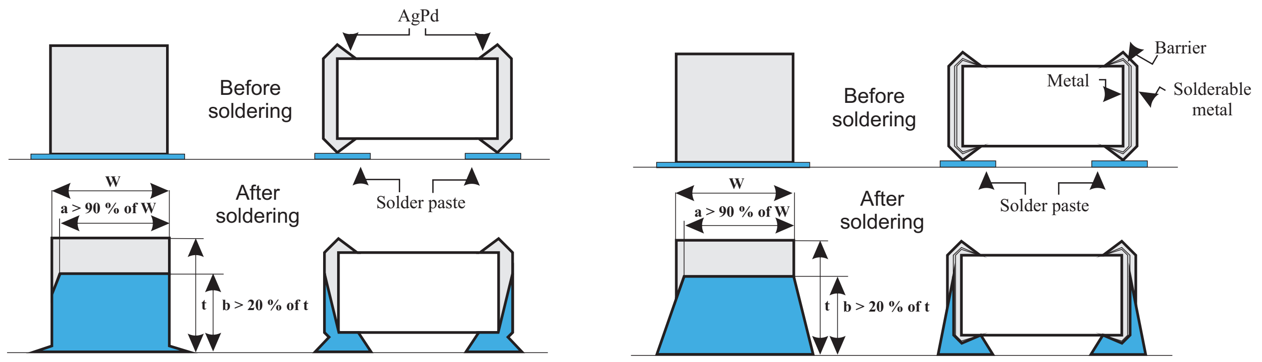


Fig. 5 Soldering Criterion in case of Wave and IR Reflow Pb-free Soldering

Pb-free Wave and IR Reflow Soldering – typical "before" and "after" soldering results for Silver/Palladium (AgPd) and Barrier Type End Terminations are given in A phenomenon knows as "mirror" or "negative" meniscus results will appear in the case of Silver/Palladium terminated varistors. Solder fo$_{rms}$ a metallurgical junction with the entire volume of the end termination, i.e. it diffuses from pad to end termination across the inner side, forming a "mirror" or "negative meniscus. The height of the solder penetration can be clearly seen on the end termination and is always 30% higher than the chip height.

Since barrier type terminations on KEKO-VARICON chips do not require the use of problematic nickel and tin-alloy electroplating processes, these varistors are truly considered environmentally friendly.

Solder Test and Retained Samples – reflow soldering test based on J-STD-020D.1 and soldering test by dipping based on IEC 60068-2 for Pb-free solders are preformed on each production lot as shown in the following chart. Test results and accompanying samples are retained for a minimum of two (2) years. The solderability of a specific lot can be checked at any time within this period should a customer require this information.

Test	Resistance to flux	Solderability	Static leaching (simulation of Reflow Soldering)	Dynamic leaching (simunation of Wave Soldering)
Parameter				
Soldering method	dipping	dipping	dipping	dipping with agitation
Flux	L3CN, ORLO	L3CN, ORLO, R	L3CN, ORLO, R	L3CN, ORLO, R
Pb Solder	62Sn / 36Pb / 2 Ag			
Pb Soldering temperature (°C)	235 ± 5	235 ± 5	260 ± 5	235 ± 5
Pb-FREE Solder	Sn96 / Cu0,4-0,8 / 3-4Ag			
Pb-FREE Soldering temperature (°C)	250 ± 5	250 ± 5	280 ± 5	250 ± 5
Soldering time (s)	2	210	10	> 15
Burn-in conditions	V_{dcmax}, 48 h	-	-	-
Acceptance criterion	dVn < 5 %, i_{dc} must stay unchanged	> 95 % of end termination must be covered by solder	> 95 % of end termination must be intact and covered by solder	> 95 % of end termination must be intact and covered by solder

Rework Criteria Soldering Iron – unless absolutely necessary, the use of soldering irons is NOT recommended for reworking varstor chips. If no other means of rework is available, the following criteria must be strictly followed:

- Do not allow the tip of the iron to directly contact the top of the chip
- Do not exceed the following soldering iron specifications:
  Outp ut Power: 30 Watts maximum
  Temperature of Soldering Iron Tip: 280 °C maximum
  Soldering Time: 10 Seconds maximum

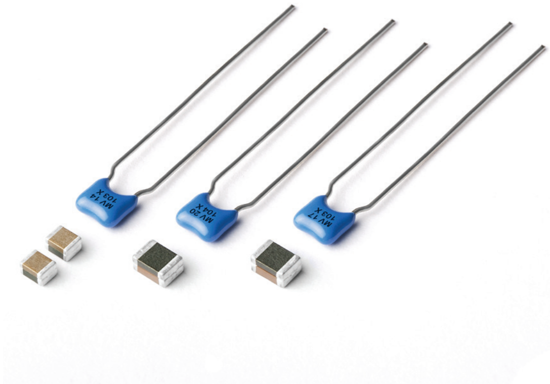
Storage Conditions – SMD varistors should be used within 1 year of purchase to avoid possible soldering problems caused by oxidized terminals. The storage environment should be controlled, with humidity less than 40% and temperature between -25 and 45 °C. Varistor chips should always be stored in their original packaged unit.

Where varistor chips have been in storage for more than 1 year, and where there is evidence of solderability difficulties, KEKO-VARICON can "refresh" the terminations to eliminate these problems.

LOW VOLTAGE DUAL FUNCTION VARICON – MV SERIES

Description

The VARICON MV series is series of dual function protective devices that protect against voltage surges in a low voltage region and against high frequency noise, replacing two components, those being a low voltage varistor and a capacitor.



MV series varicons incorporate a varistor function in the DC voltage range from 3 to 125 V (up to 170 V upon request) and function as high frequency by-pass capacitors operating in the capacitance range from 10 nF to 1 µF. Lower capacitance values are also available. They are intended for protection of all sensitive electronic devices experiencing both voltage transients and high frequency noise produced by electromechanical devices, such as buzzers, relays, etc.

MV Varicons are square shaped components with in-line leads, which require very little mounting space, at least 30% less then the two components they replace. Dual function VARICONs are also available in SMD versions upon request – compliant with Pb-free soldering.

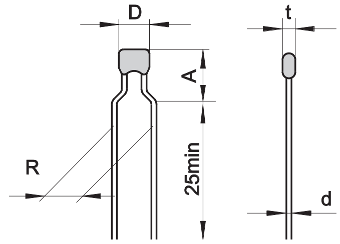
Features

- Operating voltage range V_{dc}......3 to 125 V (up to 170 V upon request).
- Operating voltage range V_{rms}......2 to 95 V (up to 130 V upon request).
- Capacitance range C (@ 1 kHz) ......10 nF to 1 µF (lower capacitance values are also available upon request).
- Capacitor temperature characteristics ....X7R.
- Protects against voltage transients and suppresses high frequency interference.
- Dimensional and weight saves on board.
- One standard model size available ...... 6 x 9 mm.
- THD and SMD components.
- Available in tape and reel for automatic pick and place.
- Lead free components.
- AEC-Q200 qualified Grade 1

Absolute Maximum Ratings

Continuous:	Units	Value
Steady State Applied Voltage:		
DC Voltage Range (V_{dc})	V	3 to 170
AC Voltage Range (V_{rms})	V	2 to 130
Transient:		
Non-Repetitive Surge Current, 8/20 µs Waveform (I_{max})	A	150
Non-Repetitive Surge Energy, 10/1000 µs Waveform (W_{max})	J	0,1 to 2,5
Capacitance Range	nF	10 to 1000
Capacitor Temperature Characteristics		X7R
Operating Ambient Temperature	°C	- 40 to + 125
Storage Temperature Range	°C	- 40 to +150
Threshold Voltage Temperature Coefficient	%/°C	< + 0,05
Insulation Resistance	GΩ	> 1
Isolation Voltage Capability	kV	> 1,25
Response Time	ns	< 25
Climatic Category		40 / 125 / 56

Device Ratings and Characteristics



MV 2 M 103 MX .... MV 95 K 105 MX

Type	V_{rms}	V_{dc}	V_n @ 1 mA	V_c @ 1 A	W_{max} 10/1000 µs	P max	I_{max} 8/20 µs	C @ 1 kHz	D max	A max	R	d	t max
	V	V	V	V	J	W	A	µF	mm	mm	mm	mm	mm
MV 2 M 103 MX	2	3	4	10	0,1	0,01	150	10	6	9	5	0,6	5,5
MV 2 M 104 MX	2	3	4	10	0,1	0,01	150	100	6	9	5	0,6	5,5
MV 2 M 105 MX	2	3	4	10	0,1	0,01	150	1000	6	9	5	0,6	5,5
MV 4 M 103 MX	4	5,5	8	14	0,2	0,01	150	10	6	9	5	0,6	5,5
MV 4 M 104 MX	4	5,5	8	14	0,2	0,01	150	100	6	9	5	0,6	5,5
MV 4 M 105 MX	4	5,5	8	14	0,2	0,01	150	1000	6	9	5	0,6	5,5
MV 6 M 103 MX	6	8	11	21	0,2	0,01	150	10	6	9	5	0,6	5,5
MV 6 M 104 MX	6	8	11	21	0,2	0,01	150	100	6	9	5	0,6	5,5
MV 6 M 105 MX	6	8	11	21	0,2	0,01	150	1000	6	9	5	0,6	5,5
MV 8 L 103 MX	8	11	15	25	0,3	0,01	150	10	6	9	5	0,6	5,5
MV 8 L 104 MX	8	11	15	25	0,3	0,01	150	100	6	9	5	0,6	5,5
MV 8 L 105 MX	8	11	15	25	0,3	0,01	150	1000	6	9	5	0,6	5,5
MV 11 K 103 MX	11	14	18	35	0,8	0,01	150	10	6	9	5	0,6	5,5
MV 11 K 104 MX	11	14	18	35	0,8	0,01	150	100	6	9	5	0,6	5,5
MV 11 K 105 MX	11	14	18	35	0,8	0,01	150	1000	6	9	5	0,6	5,5
MV 14 K 103 MX	14	18	22	38	0,9	0,01	150	10	6	9	5	0,6	5,5
MV 14 K 104 MX	14	18	22	38	0,9	0,01	150	100	6	9	5	0,6	5,5
MV 14 K 105 MX	14	18	22	38	0,9	0,01	150	1000	6	9	5	0,6	5,5
MV 17 K 103 MX	17	22	27	49	1,1	0,01	150	10	6	9	5	0,6	5,5
MV 17 K 104 MX	17	22	27	49	1,1	0,01	150	100	6	9	5	0,6	5,5
MV 17 K 105 MX	17	22	27	49	1,1	0,01	150	1000	6	9	5	0,6	5,5
MV 20 K 103 MX	20	26	33	54	1,3	0,01	150	10	6	9	5	0,6	5,5
MV 20 K 104 MX	20	26	33	54	1,3	0,01	150	100	6	9	5	0,6	5,5
MV 20 K 105 MX	20	26	33	54	1,3	0,01	150	1000	6	9	5	0,6	5,5
MV 25 K 103 MX	25	31	39	65	1,7	0,01	150	10	6	9	5	0,6	5,5
MV 25 K 104 MX	25	31	39	65	1,7	0,01	150	100	6	9	5	0,6	5,5
MV 25 K 105 MX	25	31	39	65	1,7	0,01	150	1000	6	9	5	0,6	5,5
MV 30 K 103 MX	30	38	47	77	2,0	0,01	150	10	6	9	5	0,6	5,5
MV 30 K 104 MX	30	38	47	77	2,0	0,01	150	100	6	9	5	0,6	5,5
MV 30 K 105 MX	30	38	47	77	2,0	0,01	150	1000	6	9	5	0,6	5,5
MV 35 K 103 MX	35	45	56	90	2,2	0,01	150	10	6	9	5	0,6	5,5
MV 35 K 104 MX	35	45	56	90	2,2	0,01	150	100	6	9	5	0,6	5,5
MV 35 K 105 MX	35	45	56	90	2,2	0,01	150	1000	6	9	5	0,6	5,5
MV 40 K 103 MX	40	56	68	110	2,3	0,01	150	10	6	9	5	0,6	5,5
MV 40 K 104 MX	40	56	68	110	2,3	0,01	150	100	6	9	5	0,6	5,5
MV 40 K 105 MX	40	56	68	110	2,3	0,01	150	1000	6	9	5	0,6	5,5
MV 50 K 103 MX	50	65	82	135	2,3	0,01	150	10	6	9	5	0,6	5,5
MV 50 K 104 MX	50	65	82	135	2,3	0,01	150	100	6	9	5	0,6	5,5
MV 50 K 105 MX	50	65	82	135	2,3	0,01	150	1000	6	9	5	0,6	5,5
MV 60 K 103 MX	60	85	100	165	2,3	0,01	150	10	6	9	5	0,6	5,5
MV 60 K 104 MX	60	85	100	165	2,3	0,01	150	100	6	9	5	0,6	5,5
MV 60 K 105 MX	60	85	100	165	2,3	0,01	150	1000	6	9	5	0,6	5,5
MV 95 K 103 MX	95	125	150	250	2,5	0,01	150	10	6	9	5	0,6	5,5
MV 95 K 104 MX	95	125	150	250	2,5	0,01	150	100	6	9	5	0,6	5,5
MV 95 K 105 MX	95	125	150	250	2,5	0,01	150	1000	6	9	5	0,6	5,5

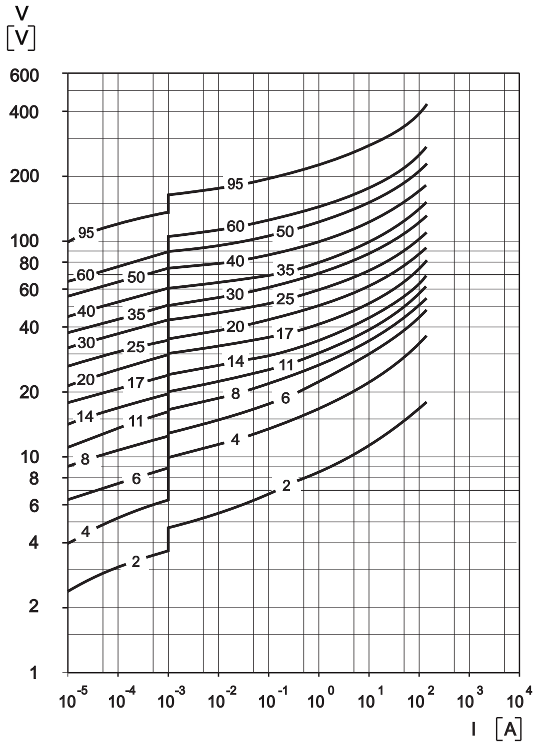
* X stand for X7R temperature characteristic.
Other capacitance values and voltages are also available upon request.

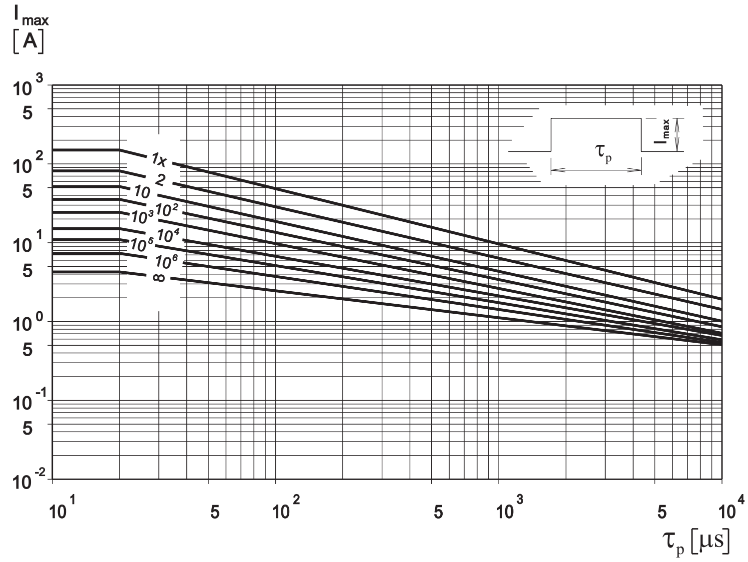
Protection Level

* With the worst-case condition in the tolerance region

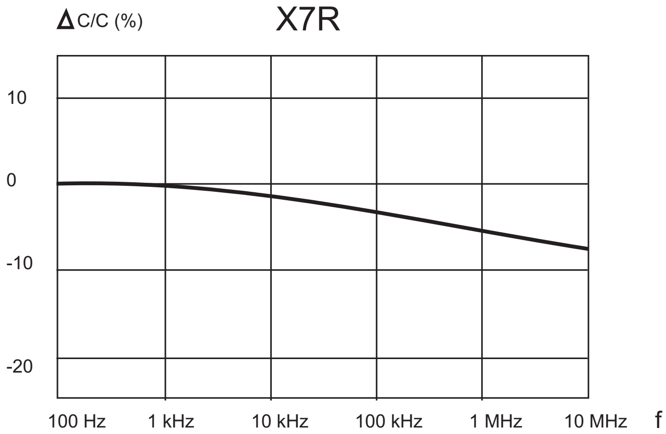
Pulse Rating Curves

MV 2 M...95 K

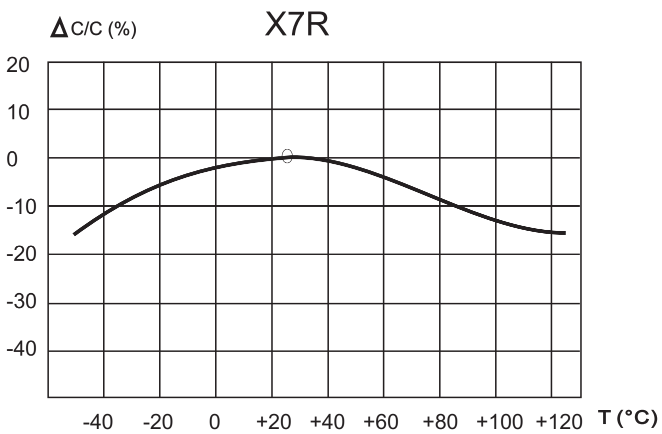




Capacitance – Frequency Characteristics



Capacitance – Temperature Characteristics

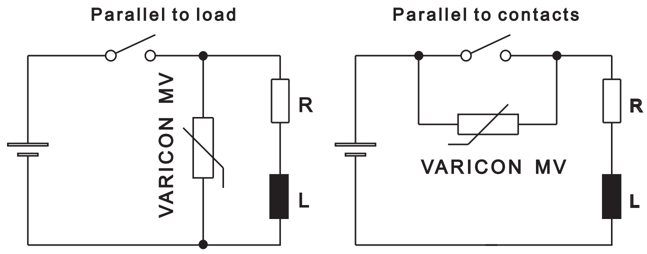


Application

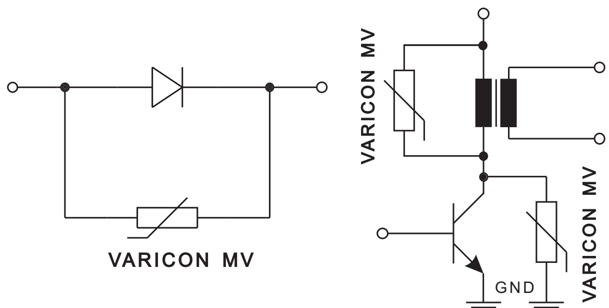
- Electrostatic Surge Absorption
- Relay Surge Suppression Effect and Relay reset Time
- Piezoelectric Buzzer Shock Noise Absorption

Application Circuits

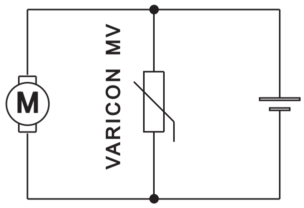
(a) Eliminating sparks from relay circuits
(there is no delay in operating time)



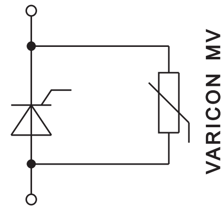
(b) Eliminating noise from micro motors



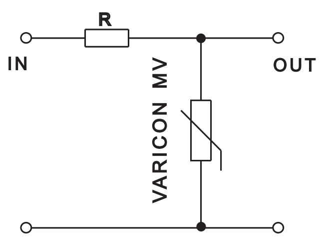
(c) Stabilizing voltages and absorbing line surges



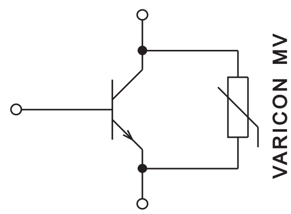
(d) Absorbing shock noise of piezzoelectric alarms



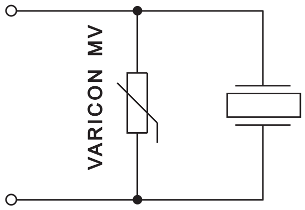
(e) Protecting semi conductive components
including transistors and diodes



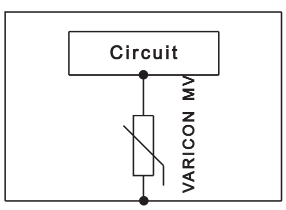
(f) Improved thyristor configuration
Eliminating vibration better than conventional circuits



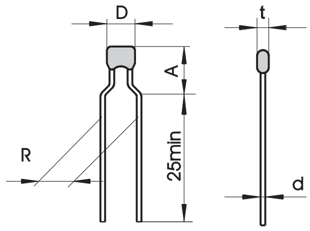
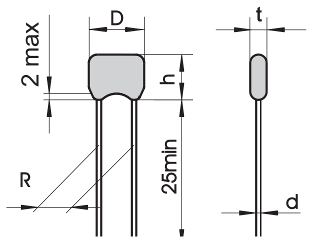
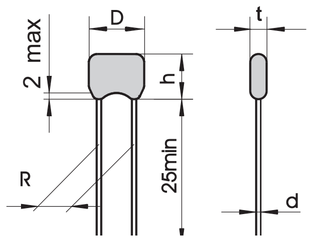
(g) Elimination of over-shooting from transistors



(h) Elimination of static electricity from circuits

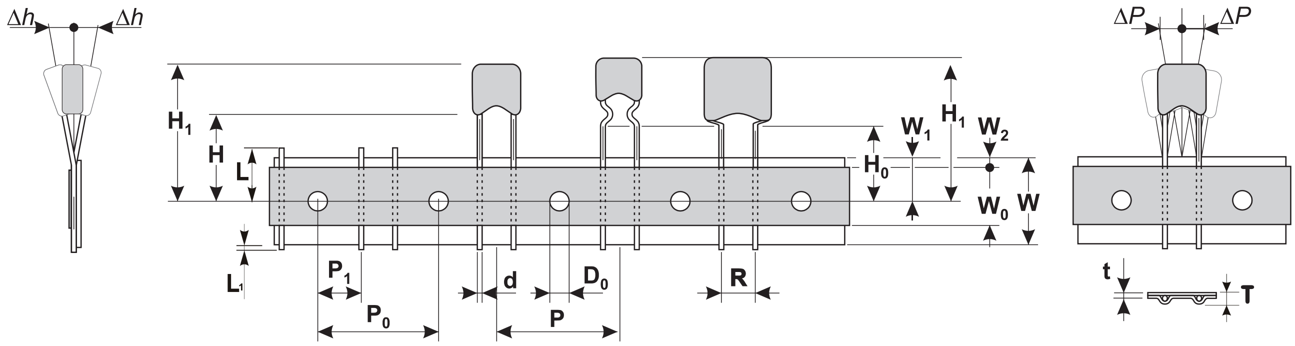


Lead Styles

Type	R (mm)	h (mm)	A (mm)	Version 1	Version 5
MV 2 M....95 K 103...105 MX	5		9		
OV 14...40 K 474...155 MX 801	5	9			
OV 14...40 K 474...155 MX 122	5	12			

Tape and Reel Specification

Conforms to IEC Publication 286-2 Ed.3: 2008-03



Symbol	Parameter	Dimension (mm)
W	Carrier tape with	18 +1,0/-0,5
Wo	Hold down tape width	5 min
W1	Sprocket hole position	9 +0,75/-0,5
W2	Distance between the upper edges of the carrier tape and hold-down tape	3 max
T	Total tape thickness	1,5 max
t	Tape thickness	0,9 max
P	Pitch of component	12,7 ± 1,0
Po	Feed hole pitch	12,7 ± 0,3
P1	Feed hole center to pitch	3,85 ± 0,7
R	Lead Spacing	5 +0,5/-0,2
ΔP	Component alignment	± 1,3 max
Δh	Component alignment	± 2 max
d	Wire diameter	0,6 max
Do	Feed hole diameter	4 ± 0,2
H	Height from tape center to comp. base	18 +2,0/-0,0
Ho	Seating plane height	16 ± 0,5
H1	Component height	32,2 max
L	Protrusion - cut out	11 max
L1	Protrusion - cut off	0,5 max

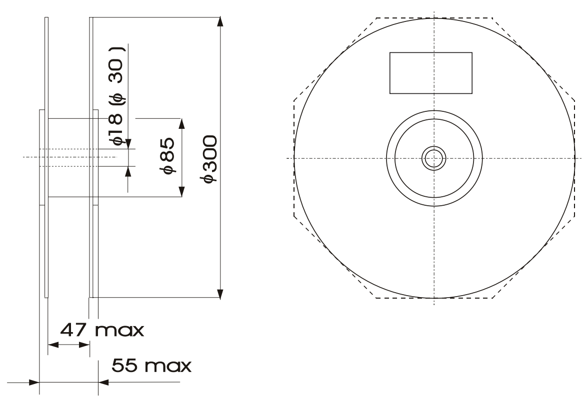
* - given tabel is only for products with R=5mm, for other Lead Spacing dimensions please contact the factory for data.

Unit Package

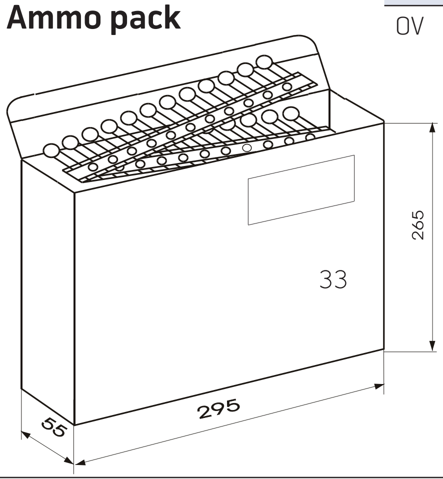
Series	B	R	A
MV	1500	1500	1500
OV	1000	1000	1000

Packaging

Reel



Ammo pack



Ordering Information

OV 20 K 474 MX 801 R L1 yy

OV - Series Name: MV, OV

20 - Maximum Continuous Operating Voltage - V_{rms}

K - V_n Tolerance: K = ± 10 %, L = ± 15%, M = ± 20 %

474 - Capacitance Code in pF: 474 = 470 nF

M - Capacitance Tolerance: K = ± 10 %, M = ± 20 %

X - Dielectric Type: X = X7R

1812 - Dimensions, only for SMD component

801 - Surge Current Code in A: 801 = 800 A

N - Barrier type, only for SMD component

R - Packaging: B = Bulk, R = reel, A = ammo

L1 - Lead Style: 1 = straight, only for Leaded component

yy - Special requirements

Varicon Marking

For OV Series

OV 20 K
474 MX
122

OV - Series Name

20 - V_{rms}

K - V_n Tolerance

474 - Capacitance Code

M - Capacitance Tolerance

X - Dielectric Ceramics Code

122 - Surge Current Code - does not exist for current code 801

For MV Series

MV 14
103 X

MV - Series Name

14 - V_{rms}

K - V_n Tolerance

103 - Capacitance Code

X - Dielectric Ceramics Code

SOLDERING RECOMMENDATIONS

Popular soldering techniques used for surface mounted components are Wave and Infrared Reflow processes. Both processes can be performed with Pb-containing or Pb-free solders. The termination options available for these soldering techniques are AgPd and Barrier Type End Terminations.

End termination	Designation	Recommended and Suitable for	Component RoHS Compliant
Ag/Pd	Series (ZV, AV, DV, C, ...)........ R1	Pb-containing soldering	Yes
Barrier Type End Termination	Series (ZV, AV, DV, C, ...)........ N R1	Pb-containing and Pb-free soldering	Yes
Ni Sn End Termination	Series (ZV, AV, ...) ...Ni R1	Pb-containing and Pb-free soldering v	Yes

Wave Soldering – this process is generally associated with discrete components mounted on the underside of printed circuit boards, or for large top-side components with bottom-side mounting tabs to be attached, such as the frames of transformers, relays, connectors, etc. SMD varistors to be wave soldered are first glued to the circuit board, usually with an epoxy adhesive. When all components on the PCB have been positioned and an appropriate time is allowed for adhesive curing, the completed assembly is then placed on a conveyor and run through a single, double wave process.

Infrared Reflow Soldering – these reflow processes are typically associated with top-side component placement. This technique utilizes a mixture of adhesive and solder compounds (and sometimes fluxes) that are blended into a paste. The paste is then screened onto PCB soldering pads specifically designed to accept a particular sized SMD component. The recommended solder paste wet layer thickness is 100 to 300 μm. Once the circuit board is fully populated with MD components, it is placed in a reflow environment, where the paste is heated to slightly above its eutectic temperature. When the solder paste reflows, the SMD components are attached to the solder pads.

Solder Fluxes – solder fluxes are generally applied to populated circuit boards to lean oxides form forming during the heating process and to facilitate the flowing of the solder. Solder fluxes can be either a part of the solder paste compound or can be separate materials, usually fluids. Recommended fluxes are:

- non-activated (R) fluxes, whenever possible
- mildly activated (RMA) fluxes of class L3CN
- class ORLO

Activated (RA), water soluble or strong acidic fluxes with a chlorine content > 0.2 wt. % are NOT RECOMMENDED. The use of such fluxes could create high leakage current paths along the body of the varistor components.

When a flux is applied prior to wave soldering, it is important to completely dry any residual flux solvents prior to the soldering process.

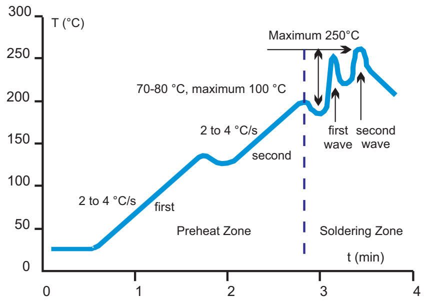


Fig. 1. Wave Soldering Temperature Profile for Pb-free and Pb-containing Soldering

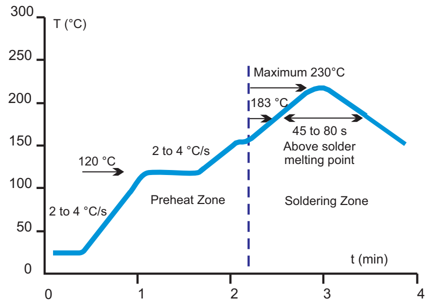


Fig. 2. Infrared Reflow Temperature Profile for Pb-containing Soldering

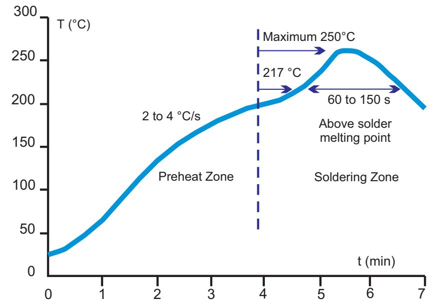


Fig. 3. Reflow Temperature Profile for Pb-free Soldering

Pb-free Wave and IR Reflow Soldering – typical “before” and “after” soldering results for Silver/Palladium (AgPd) and Barrier Type End Terminations are given in A phenomenon knows as “mirror” or “negative” meniscus results will appear in the case of Silver/Palladium terminated varistors. Solder fo$_{rms}$ a metallurgical junction with the entire volume of the end termination, i.e. it diffuses from pad to end termination across the inner side, forming a “mirror” or “negative meniscus. The height of the solder penetration can be clearly seen on the end termination and is always 30% higher than the chip height.

Since barrier type terminations on KEKO-VARICON chips do not require the use of problematic nickel and tin-alloy electroplating processes, these varistors are truly considered environmentally friendly.

Solder Test and Retained Samples – reflow soldering test based on J-STD-020D.1 and soldering test by dipping based on IEC 60068-2 for Pb-free solders are preformed on each production lot as shown in the following chart. Test results and accompanying samples are retained for a minimum of two (2) years. The solderability of a specific lot can be checked at any time within this period should a customer require this information.

Test	Resistance to flux	Solderability	Static leaching (simulation of Reflow Soldering)	Dynamic leaching (simunation of Wave Soldering)
Parameter				
Soldering method	dipping	dipping	dipping	dipping with agitation
Flux	L3CN, ORL0	L3CN, ORL0, R	L3CN, ORL0, R	L3CN, ORL0, R
Pb Solder	62Sn / 36Pb / 2 Ag			
Pb Soldering temperature (°C)	235 ± 5	235 ± 5	260 ± 5	235 ± 5
Pb-FREE Solder	Sn96 / Cu0,4-0,8 / 3-4Ag			
Pb-FREE Soldering temperature (°C)	250 ± 5	250 ± 5	280 ± 5	250 ± 5
Soldering time (s)	2	210	10	> 15
Burn-in conditions	V_{dcmax}, 48 h	-	-	-
Acceptance criterion	dVn < 5 %, i_{dc} must stay unchanged	> 95 % of end termination must be covered by solder	> 95 % of end termination must be intact and covered by solder	> 95 % of end termination must be intact and covered by solder

Rework Criteria Soldering Iron – unless absolutely necessary, the use of soldering irons is NOT recommended for reworking varstor chips. If no other means of rework is available, the following criteria must be strictly followed:

- Do not allow the tip of the iron to directly contact the top of the chip
- Do not exceed the following soldering iron specifications:
  Outp ut Power: 30 Watts maximum
  Temperature of Soldering Iron Tip: 280 °C maximum
  Soldering Time: 10 Seconds maximum

Storage Conditions – SMD varistors should be used within 1 year of purchase to avoid possible soldering problems caused by oxidized terminals. The storage environment should be controlled, with humidity less than 40% and temperature between -25 and 45 °C. Varistor chips should always be stored in their original packaged unit.

Where varistor chips have been in storage for more than 1 year, and where there is evidence of solderability difficulties, KEKO-VARICON can “refresh” the terminations to eliminate these problems.

Terminology

Term	Symbol	Definition
Rated AC Voltage	V_{rms}	Maximum continuous sinusoidal AC voltage (<5% total harmonic distortion) which may be applied to the component under continuous operation conditions at 25 °C
Rated DC Voltage	V_{dc}	Maximum continuous DC voltage (<5% ripple) which may be applied to the component under continuous operating conditions at 25 °C
Supply Voltage	V	The voltage by which the system is designated and to which certain operating characteristics of the system are referred; V_{rms} = 1,1 x V
Leakage Current	I_{dc}	The current passing through the varistor at V_{dc} and at 25 °C or at any other specified temperature
Varistor Voltage	V_n	Voltage across the varistor measured at a given reference current In
Reference Current	I_n	Reference current = 1 mA DC
Clamping Voltage Protection Level	V_c	The peak voltage developed across the varistor under standard atmospheric conditions, when passing an 8/20 µs class current pulse
Class Current	I_c	A peak value of current which is 1/10 of the maximum peak current for 100 pulses at two per minute for the 8/20 µs pulse
Voltage Clamping Ratio	V_c/V_{app}	A figure of merit measure of the varistor clamping effectiveness as defined by the symbols V_c/ Vapp, where (V_{app} = V_{rms} or V_{dc})
Jump Start Transient	V_{jump}	The jump start transient results from the temporary application of an overvoltage in excess of the rated battery voltage. The circuit power supply may be subjected to a temporary overvoltage condition due to the voltage regulation failing or it may be deliberately generated when it becomes necessary to boost start the car.
Rated Single Pulse Transient Energy	W_{max}	Energy which may be dissipated for a single 10/1000 µs pulse of a miaximum rated current, with rated AC voltage or rated DC voltage also applied, without causing device failure
Load Dump Transient	WLD	Load Dump is a transient which occurs in automotive environment. It is an exponentially decaying positive voltage which occurs in the event of a battery disconect while the alternator is still generating charging current with other loads remaining on the alternator circuit at the time of battery disconect.
Rated Peak Single Pulse Transient Current	I_{max}	Maximum peak current which may be applied for a single 8/20 µs pulse, with, rated line voltage also applies, without causing device failure
Rated Transient Average Power Dissipation	P	Maximum average power which may be dissipated due to a group of pulses occurring within a specified isolated time period, without causing device failure at 25 °C
Capacitance	C	Capacitance between two terminals of the varistor measured at @ 1 kHz
Non-linearity Exponent	α	A measure of varistor nonlinearity between two given operating currents, I_n and I_1, as described by I = k V exp(a), where: - k is a device constant, - $I_1 < I < i_n$ and - a 0 log $(I_1/I_n)/\log(V_1/V_n) = 1/\log(V1/V_n)$, where: - I_n is reference current (1 mA) and V_n is varistor voltage - I_1 = 10 In, V_1 is the voltage measured at I_1
Response Time	tr	The time lag between application of a surge and varistor's "turn-on" conduction action
Varistor Voltage Temperature Coefficient	TC	(V_n at 85 °C - V_n at 25 °C) / (V_n at 25 °C) x 60 °C) x 100
Insulation Resistance	IR	Minimum resistance between shorted terminals and varistor surface
Isolation Voltage		The maximum peak voltage which may be applied under continuous operating conditions between the varistro terminations and any conducting mounting surface
Operating Temperature		the range of ambient temperature for which the varistor is designed to operate continuously as defined by the temperature limits of its climatic category
Climatic Category	LCT/UCT/ DHD	UCT = Upper Category Temperature - the maximum ambient temperature for which a varistor has been designed to operate continuously, LCT = Lower Category Temperature - the minimum ambient temperature at which a varistor has been designed to operate continuously DHD = Dump Heat Test Duration
Storage Temperature		Storage temperature range without voltage applied
Current/Energy Derating		Derating of maximum values when operated above UCT (85 °C for PV and 125 °C for DV)

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