Catalogue - PROTECTIVE DEVICES - Edition 2015

KEKOVARICON

Varistors

SMD, THD, High Energy

Varicons

Multilayer SMD and THD

Dual Function Varicons

Capacitors

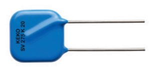
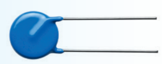
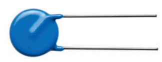
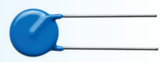
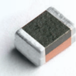
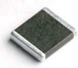
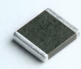
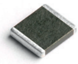
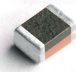
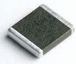
Safety class X and Y disc capacitors

High voltage disc capacitors

www.keko-varicon.si

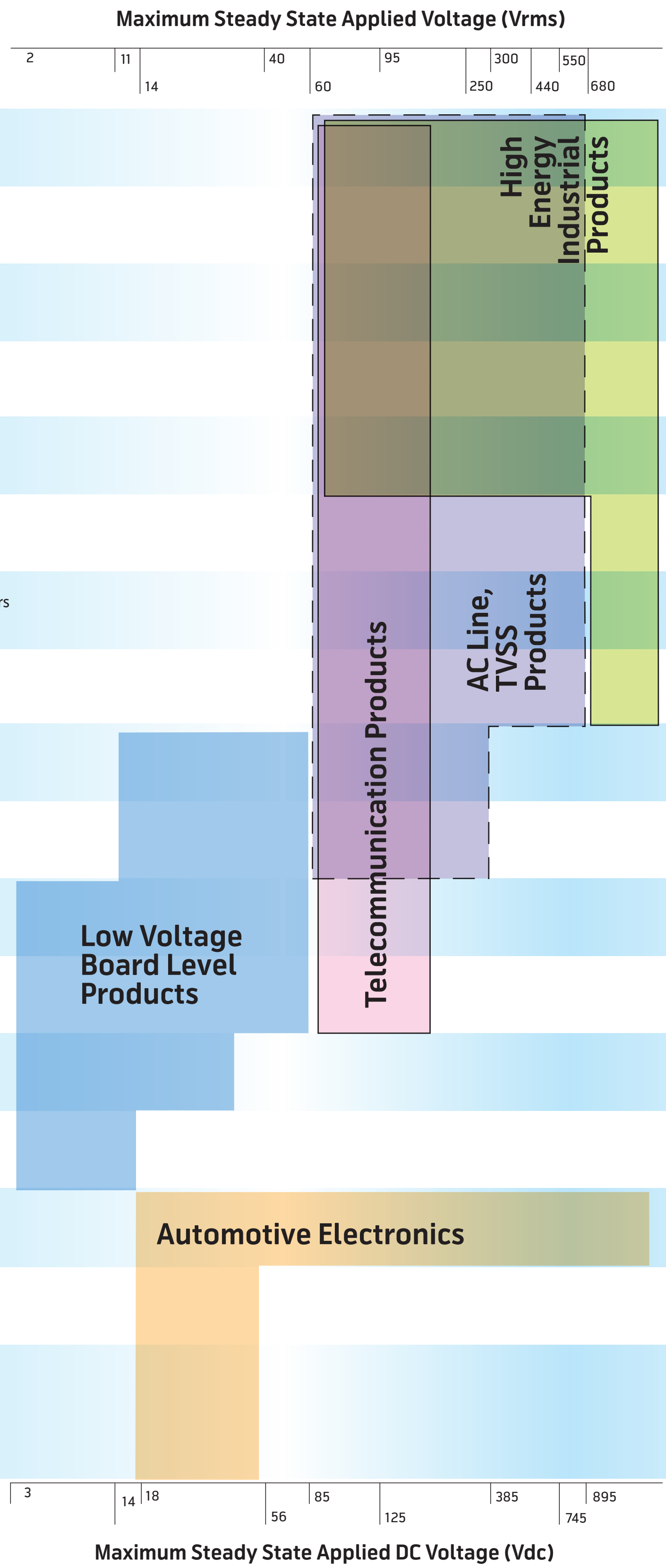
OVERVIEW OF PROTECTIVE DEVICES

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/cm^2, Wmax > 400 J/cm^3	**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/cm^2, Wmax > 400 J/cm^3	**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



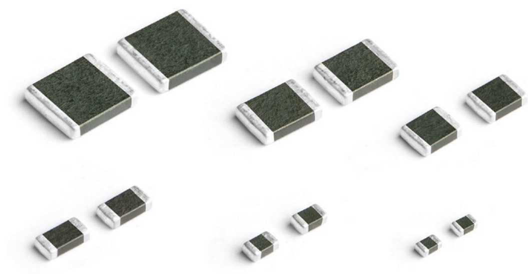
Series	Size (mm)	Package
ZOV Series Square Shaped High Energy Varistors	23, 25, 32, 40, 60	
ZOVR Series Round Shaped High Energy Varistors	25, 32, 40	
ZOVH / ZOVS Series High Energy Varistors for Class I Applications	40, 40 D2, 40 D3 (80,120)	
SV Series Special Medium Voltage Varistors	5, 7, 10, 14, 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 SMD VARISTORS - ZV SERIES

Description

The ZV series of low voltage varistors is designed to protect sensitive electronic devices against high voltage surges in the low voltage region. They offer excellent transient energy absorption due to improved energy volume distribution and power dissipation. Low voltage varistors cover a wide DC operating voltage range from 3 V to 170 V.

ZV varistors are typically applied to protect integrated circuits and other components at the circuit board level.



Features

- Operating voltage range V_{dc}......3 V to 170 V higher operating voltages available upon request.
- + 125 °C maximum continuous operating temperature
- Varistors with lower or higher capacitance, as well as varistors with a 100 % controlled capacitance value, are available upon request.
- 6 models sizes are available... 0603, 0805, 1206, 1210, 1812, 2220.
- Short response time.
- Broad range of current and energy handling capabilities
- Low clamping voltage – Uc.
- Non-sensitive to mildly activated fluxes (see Soldering Recommendations, page 25).
- End termination: AgPd, AgPdPt or barrier type suitable for Pb-free soldering process – barrier type and terminations solderable with Pb-free solders according to JEDEC J-STD-020C and IEC 60068-2-58.
- cULus UL 1499, 3rd edition & CSA C22.2 File E326499 Section 8.
- RoHS 2 compliant components according to 2011/65/EC and 2003/11/EC.
- AEC-Q200 qualified Grade 1.

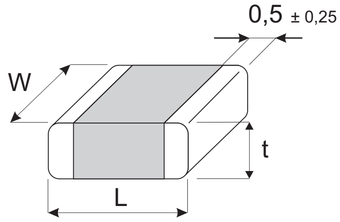
Applications

- Suppression of inductive switching or other transient events such as surge voltage at the circuit board level.
- ESD protection for components sensitive to IEC 1000-4-2, MIL-STD 883C Method 3015.7 and other industry spec.
- Replace larger surface mount TVS Zeners in many applications.
- Used to achieve electromagnetic compliance of end products.
- Provides on-board transient voltage protection of ICs and transistors.

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:		
Peak Single Pulse Surge Current, 8/20 µs Waveform (I_{max})	A	30 to 1200
Single Pulse Surge Energy, 10/1000 µs Waveform (W_{max})	J	0,1 to 12,2
Operating Ambient Temperature	°C	-55 to +125
Storage Temperature Range	°C	-55 to +150
Threshold Voltage Temperature Coefficient	%/°C	< + 0,05
Response Time	ns	< 2
Climatic Category		55 / 125 / 56

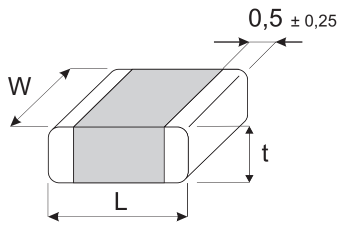
Device Ratings and Characteristics



ZV 2 M 0603 300....ZV 20 K 2220 122

Type	V_{rms}	V_{dc}	V_n 1 mA	V_c	I_c 8/20 µs	W_{max} 10/1000 µs	P max	I_{max} 8/20 µs	C_{typ} @ 1 kHz	L_{typ} 100 mA/ns	L	W	t max
	V	V	V	V	A	J	W	A	pF	nH	mm	mm	mm
ZV 2 M 0603 300	2	3	4	10	1	0,1	0,003	30	360	1,0	1,6 ± 0,20	0,80 ± 0,10	0,95
ZV 2 M 0805 101	2	3	4	10	1	0,1	0,005	100	930	1,5	2,0 ± 0,25	1,25 ± 0,20	0,80
ZV 2 M 1206 151	2	3	4	10	1	0,2	0,008	150	4000	1,8	3,2 ± 0,30	1,60 ± 0,20	0,85
ZV 4 M 0603 300	4	5,5	8	14	1	0,1	0,003	30	295	1,0	1,6 ± 0,20	0,80 ± 0,10	0,95
ZV 4 M 0805 101	4	5,5	8	14	1	0,1	0,005	100	695	1,5	2,0 ± 0,25	1,25 ± 0,20	0,80
ZV 4 M 1206 151	4	5,5	8	14	1	0,3	0,008	150	3300	1,8	3,2 ± 0,30	1,60 ± 0,20	0,85
ZV 4 M 1210 251	4	5,5	8	14	3	0,4	0,010	250	5000	1,8	3,2 ± 0,30	2,50 ± 0,25	0,85
ZV 4 M 1812 501	4	5,5	8	14	5	0,8	0,015	500	10000	2,5	4,7 ± 0,40	3,20 ± 0,30	1,25
ZV 4 M 2220 102	4	5,5	8	14	10	1,5	0,020	1000	19500	3,0	5,7 ± 0,50	5,00 ± 0,40	1,25
ZV 6 M 0603 300	6	8	11	21	1	0,1	0,003	30	260	1,0	1,6 ± 0,20	0,80 ± 0,10	0,95
ZV 6 M 0805 101	6	8	11	21	1	0,2	0,005	100	560	1,5	2,0 ± 0,25	1,25 ± 0,20	0,80
ZV 6 M 1206 151	6	8	11	21	1	0,5	0,008	150	2600	1,8	3,2 ± 0,30	1,60 ± 0,20	0,85
ZV 6 M 1210 301	6	8	11	21	3	0,8	0,010	300	4100	1,8	3,2 ± 0,30	2,50 ± 0,25	0,85
ZV 6 M 1812 501	6	8	11	21	5	1,0	0,015	500	7500	2,5	4,7 ± 0,40	3,20 ± 0,30	1,25
ZV 6 M 2220 122	6	8	11	21	10	3,8	0,020	1200	17000	3,0	5,7 ± 0,50	5,00 ± 0,40	1,25
ZV 8 L 0603 300	8	11	15	25	1	0,1	0,003	30	240	1,0	1,6 ± 0,20	0,80 ± 0,10	0,95
ZV 8 L 0805 121	8	11	15	25	1	0,2	0,005	120	475	1,5	2,0 ± 0,25	1,25 ± 0,20	0,80
ZV 8 L 1206 201	8	11	15	25	1	0,6	0,008	200	2000	1,8	3,2 ± 0,30	1,60 ± 0,20	0,85
ZV 8 L 1210 401	8	11	15	25	3	1,1	0,010	400	3400	1,8	3,2 ± 0,30	2,50 ± 0,25	0,85
ZV 8 L 1812 501	8	11	15	25	5	1,9	0,015	500	6300	2,5	4,7 ± 0,40	3,20 ± 0,30	1,25
ZV 8 L 2220 122	8	11	15	25	10	4,3	0,020	1200	15000	3,0	5,7 ± 0,50	5,00 ± 0,40	1,25
ZV 11 K 0603 300	11	14	18	33	1	0,2	0,003	30	210	1,0	1,6 ± 0,20	0,80 ± 0,10	0,95
ZV 11 K 0805 121	11	14	18	33	1	0,3	0,005	120	400	1,5	2,0 ± 0,25	1,25 ± 0,20	0,80
ZV 11 K 1206 201	11	14	18	33	1	0,6	0,008	200	1300	1,8	3,2 ± 0,30	1,60 ± 0,20	0,85
ZV 11 K 1210 401	11	14	18	33	3	1,3	0,010	400	2600	1,8	3,2 ± 0,30	2,50 ± 0,25	0,85
ZV 11 K 1812 801	11	14	18	33	5	2,0	0,015	800	5100	2,5	4,7 ± 0,40	3,20 ± 0,30	1,25
ZV 11 K 2220 122	11	14	18	33	10	5,5	0,020	1200	12000	3,0	5,7 ± 0,50	5,00 ± 0,40	1,25
ZV 14 K 0603 300	14	18	22	38	1	0,3	0,003	30	195	1,0	1,6 ± 0,20	0,80 ± 0,10	0,95
ZV 14 K 0805 121	14	18	22	38	1	0,4	0,005	120	355	1,5	2,0 ± 0,25	1,25 ± 0,20	0,80
ZV 14 K 1206 201	14	18	22	38	1	0,6	0,008	200	950	1,8	3,2 ± 0,30	1,60 ± 0,20	0,85
ZV 14 K 1210 401	14	18	22	38	3	1,6	0,010	400	2000	1,8	3,2 ± 0,30	2,50 ± 0,25	0,85
ZV 14 K 1812 801	14	18	22	38	5	2,4	0,015	800	4200	2,5	4,7 ± 0,40	3,20 ± 0,30	1,25
ZV 14 K 2220 122	14	18	22	38	10	6,0	0,020	1200	9400	3,0	5,7 ± 0,50	5,00 ± 0,40	1,25
ZV 17 K 0603 300	17	22	27	44	1	0,3	0,003	30	185	1,0	1,6 ± 0,20	0,80 ± 0,10	0,95
ZV 17 K 0805 121	17	22	27	44	1	0,4	0,005	120	315	1,5	2,0 ± 0,25	1,25 ± 0,20	0,80
ZV 17 K 1206 201	17	22	27	44	1	0,7	0,008	200	740	1,8	3,2 ± 0,30	1,60 ± 0,20	0,85
ZV 17 K 1210 401	17	22	27	44	3	1,8	0,010	400	1700	1,8	3,2 ± 0,30	2,50 ± 0,25	0,85
ZV 17 K 1812 801	17	22	27	44	5	2,8	0,015	800	3500	2,5	4,7 ± 0,40	3,20 ± 0,30	1,25
ZV 17 K 2220 122	17	22	27	44	10	7,5	0,020	1200	7700	3,0	5,7 ± 0,50	5,00 ± 0,40	1,25
ZV 20 K 0603 300	20	26	33	54	1	0,3	0,003	30	175	1,0	1,6 ± 0,20	0,80 ± 0,10	0,95
ZV 20 K 0805 121	20	26	33	54	1	0,4	0,005	120	290	1,5	2,0 ± 0,25	1,25 ± 0,20	1,05
ZV 20 K 1206 201	20	26	33	54	1	0,8	0,008	200	620	1,8	3,2 ± 0,30	1,60 ± 0,20	1,25
ZV 20 K 1210 401	20	26	33	54	3	2,0	0,010	400	1400	1,8	3,2 ± 0,30	2,50 ± 0,25	1,35
ZV 20 K 1812 801	20	26	33	54	5	3,0	0,015	800	3000	2,5	4,7 ± 0,40	3,20 ± 0,30	1,55
ZV 20 K 2220 122	20	26	33	54	10	8,0	0,020	1200	6500	3,0	5,7 ± 0,50	5,00 ± 0,40	1,45

Device Ratings and Characteristics



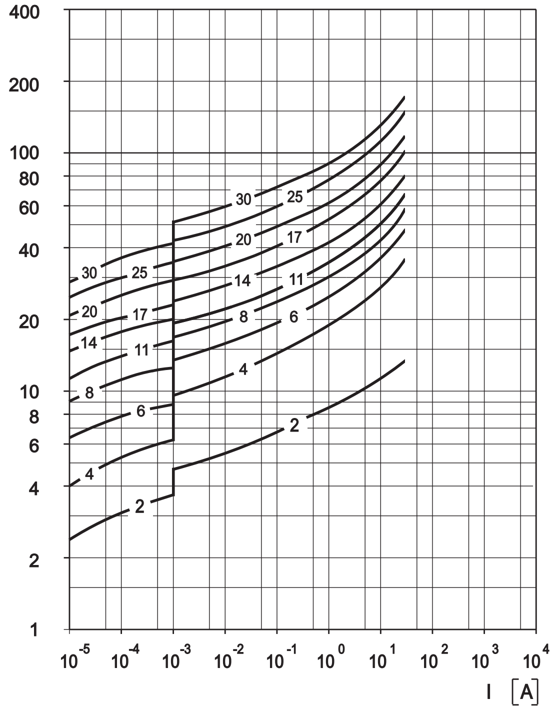
ZV 25 K 0603 300....ZV 130 K 2220 501

Type	V_{rms}	V_{dc}	V_n 1 mA	V_c	I_c 8/20 µs	W_{max} 10/1000 µs	P max	I_{max} 8/20 µs	C_{typ} @ 1 kHz	L_{typ} 100 mA/ns	L	W	t max
	V	V	V	V	A	J	W	A	pF	nH	mm	mm	mm
ZV 25 K 0603 300	25	31	39	65	1	0,1	0,003	30	165	1,0	1,6 ± 0,20	0,80 ± 0,10	0,95
ZV 25 K 0805 121	25	31	39	65	1	0,2	0,005	120	260	1,5	2,0 ± 0,25	1,25 ± 0,20	1,05
ZV 25 K 1206 201	25	31	39	65	1	1,0	0,008	200	510	1,8	3,2 ± 0,30	1,60 ± 0,20	1,25
ZV 25 K 1210 401	25	31	39	65	3	1,8	0,010	400	1060	1,8	3,2 ± 0,30	2,50 ± 0,25	1,45
ZV 25 K 1812 801	25	31	39	65	5	3,9	0,015	800	2300	2,5	4,7 ± 0,40	3,20 ± 0,30	1,55
ZV 25 K 2220 122	25	31	39	65	10	9,5	0,020	1200	5000	3,0	5,7 ± 0,50	5,00 ± 0,40	1,45
ZV 30 K 0603 300	30	38	47	77	1	0,1	0,003	30	160	1,0	1,6 ± 0,20	0,80 ± 0,10	0,95
ZV 30 K 0805 121	30	38	47	77	1	0,2	0,005	120	230	1,5	2,0 ± 0,25	1,25 ± 0,20	1,05
ZV 30 K 1206 201	30	38	47	77	1	1,2	0,008	200	450	1,8	3,2 ± 0,30	1,60 ± 0,20	1,25
ZV 30 K 1210 301	30	38	47	77	3	2,1	0,010	300	850	1,8	3,2 ± 0,30	2,50 ± 0,25	1,45
ZV 30 K 1812 801	30	38	47	77	5	4,4	0,015	800	1800	2,5	4,7 ± 0,40	3,20 ± 0,30	1,55
ZV 30 K 2220 122	30	38	47	77	10	12,2	0,020	1200	4000	3,0	5,7 ± 0,50	5,00 ± 0,40	1,45
ZV 35 K 1206 121	35	45	56	90	1	0,6	0,008	120	400	1,8	3,2 ± 0,30	1,60 ± 0,20	1,25
ZV 35 K 1210 251	35	45	56	90	3	2,2	0,010	250	670	1,8	3,2 ± 0,30	2,50 ± 0,25	1,45
ZV 35 K 1812 601	35	45	56	90	5	4,2	0,015	600	1340	2,5	4,7 ± 0,40	3,20 ± 0,30	1,55
ZV 35 K 2220 102	35	45	56	90	10	7,6	0,020	1000	3000	3,0	5,7 ± 0,50	5,00 ± 0,40	1,45
ZV 40 K 1206 121	40	56	68	110	1	0,8	0,008	120	370	1,8	3,2 ± 0,30	1,60 ± 0,20	1,25
ZV 40 K 1210 251	40	56	68	110	3	2,4	0,010	250	570	1,8	3,2 ± 0,30	2,50 ± 0,25	1,45
ZV 40 K 1812 601	40	56	68	110	5	4,8	0,015	600	1000	2,5	4,7 ± 0,40	3,20 ± 0,30	1,55
ZV 40 K 2220 102	40	56	68	110	10	9,2	0,020	1000	2200	3,0	5,7 ± 0,50	5,00 ± 0,40	1,45
ZV 50 K 1206 121	50	65	82	135	1	0,8	0,008	120	340	1,8	3,2 ± 0,30	1,60 ± 0,20	1,65
ZV 50 K 1210 251	50	65	82	135	3	1,7	0,010	250	470	1,8	3,2 ± 0,30	2,50 ± 0,25	1,75
ZV 50 K 1812 401	50	65	82	135	5	4,8	0,015	400	710	2,5	4,7 ± 0,40	3,20 ± 0,30	1,85
ZV 50 K 2220 801	50	65	82	135	10	5,8	0,020	800	1500	3,0	5,7 ± 0,50	5,00 ± 0,40	1,85
ZV 60 K 1206 121	60	85	100	165	1	0,9	0,008	120	330	1,8	3,2 ± 0,30	1,60 ± 0,20	1,65
ZV 60 K 1210 251	60	85	100	165	3	2,2	0,010	250	390	1,8	3,2 ± 0,30	2,50 ± 0,25	1,75
ZV 60 K 1812 401	60	85	100	165	5	5,8	0,015	400	580	2,5	4,7 ± 0,40	3,20 ± 0,30	1,85
ZV 60 K 2220 801	60	85	100	165	10	6,2	0,020	800	1000	3,0	5,7 ± 0,50	5,00 ± 0,40	1,85
ZV 75 K 1206 121	75	100	120	200	1	0,9	0,008	120	240	1,8	3,2 ± 0,30	1,60 ± 0,20	1,70
ZV 75 K 1210 251	75	100	120	200	3	2,2	0,010	250	330	1,8	3,2 ± 0,30	2,50 ± 0,25	1,80
ZV 75 K 1812 401	75	100	120	200	5	5,8	0,015	400	440	2,5	4,7 ± 0,40	3,20 ± 0,30	1,90
ZV 75 K 2220 801	75	100	120	200	10	6,2	0,020	800	700	3,0	5,7 ± 0,50	5,00 ± 0,40	1,90
ZV 95 K 1210 201	95	125	150	250	3	2,6	0,010	200	240	1,8	3,2 ± 0,30	2,50 ± 0,25	1,80
ZV 95 K 1812 301	95	125	150	250	5	5,2	0,015	300	340	2,5	4,7 ± 0,40	3,20 ± 0,30	1,90
ZV 95 K 2220 501	95	125	150	250	10	7,4	0,020	500	600	3,0	5,7 ± 0,50	5,00 ± 0,40	1,90
ZV 115 K 1210 201	115	150	180	300	3	2,6	0,010	200	200	1,8	3,2 ± 0,30	2,50 ± 0,25	1,80
ZV 115 K 1812 301	115	150	180	300	5	5,2	0,015	300	310	2,5	4,7 ± 0,40	3,20 ± 0,30	1,90
ZV 115 K 2220 501	115	150	180	300	10	7,4	0,020	500	560	3,0	5,7 ± 0,50	5,00 ± 0,40	1,90
ZV 130 K 1210 201	130	170	205	340	3	2,6	0,010	200	150	1,8	3,2 ± 0,30	2,50 ± 0,25	1,80
ZV 130 K 1812 301	130	170	205	340	5	5,2	0,015	300	240	2,5	4,7 ± 0,40	3,20 ± 0,30	1,90
ZV 130 K 2220 501	130	170	205	340	10	7,4	0,020	500	500	3,0	5,7 ± 0,50	5,00 ± 0,40	1,90

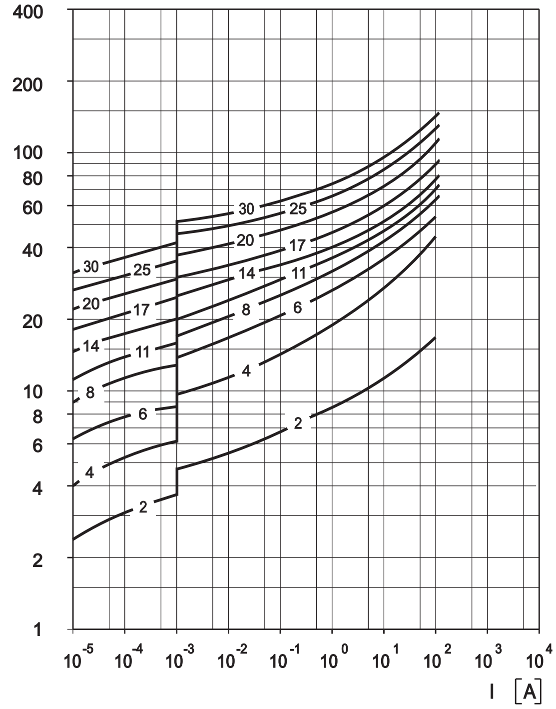
Protection Level

* With the worst-case condition in the tolerance region

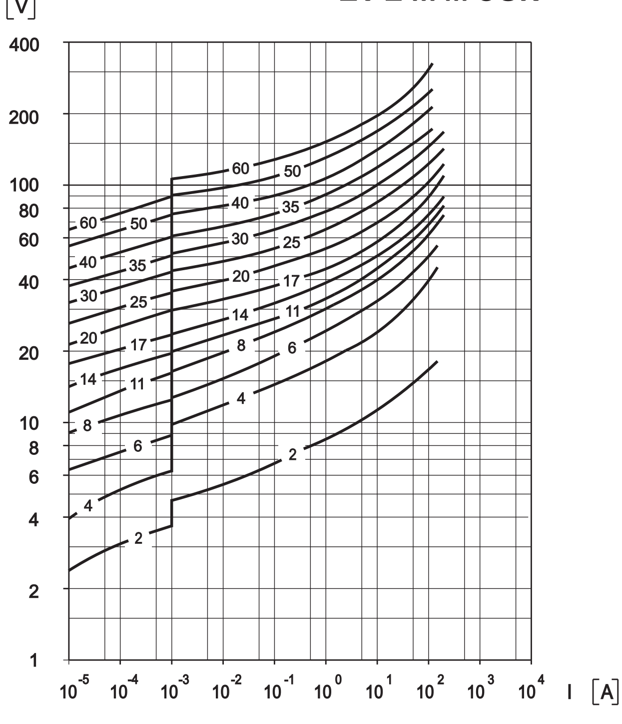
Model Size 0603
ZV 2 M ... 30K



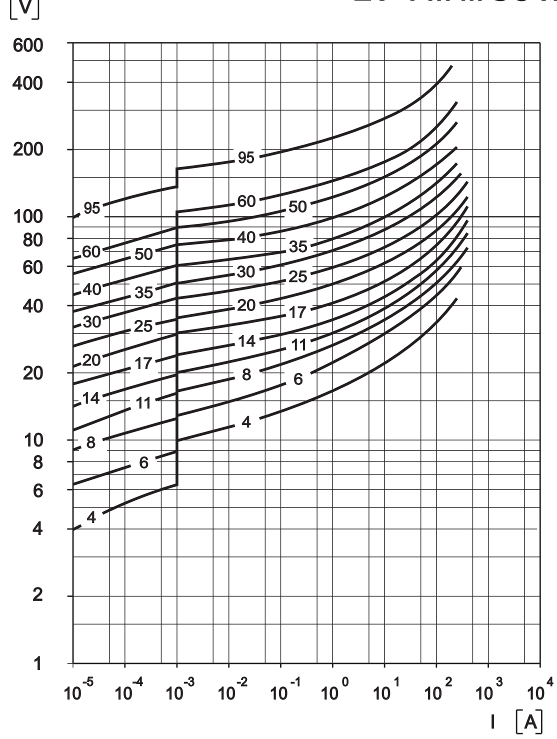
Model Size 0805
ZV 2 M ... 30 K



Model Size 1206
ZV 2 M ... 60K



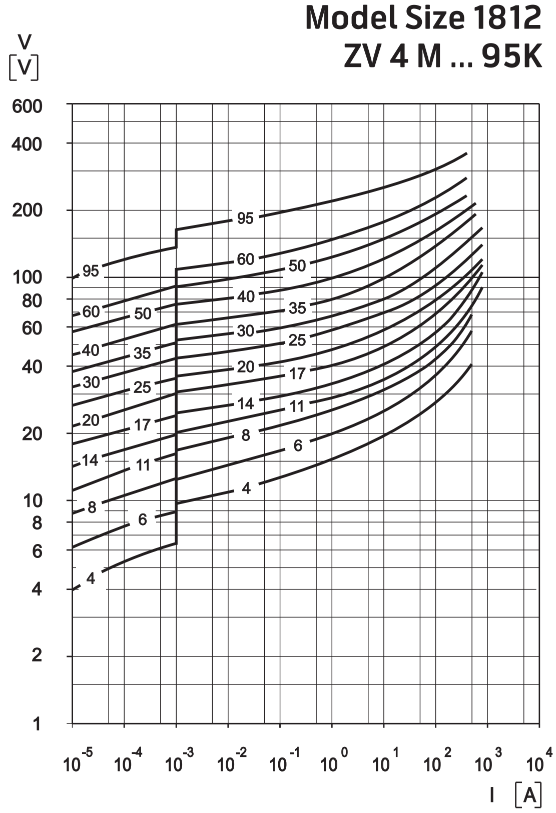
Model Size 1210
ZV 4 M ... 95 K



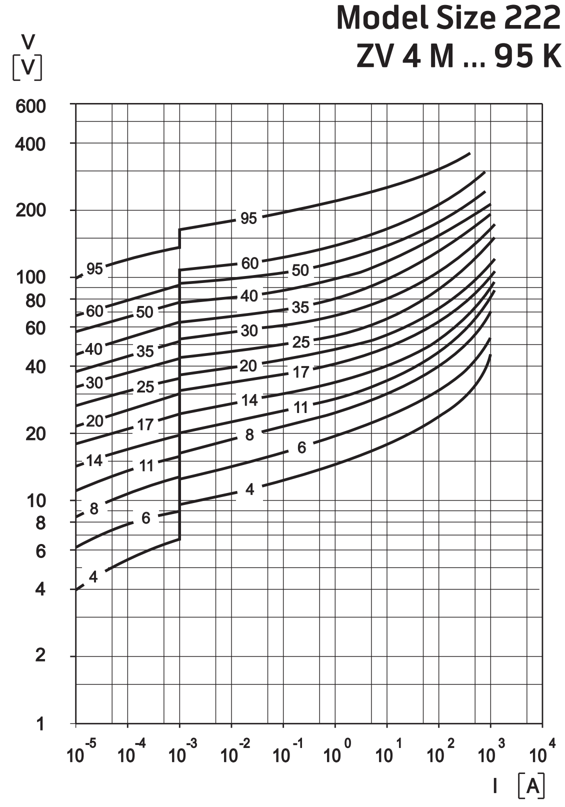
Protection Level

* With the worst-case condition in the tolerance region

Model Size 1812
ZV 4 M ... 95K

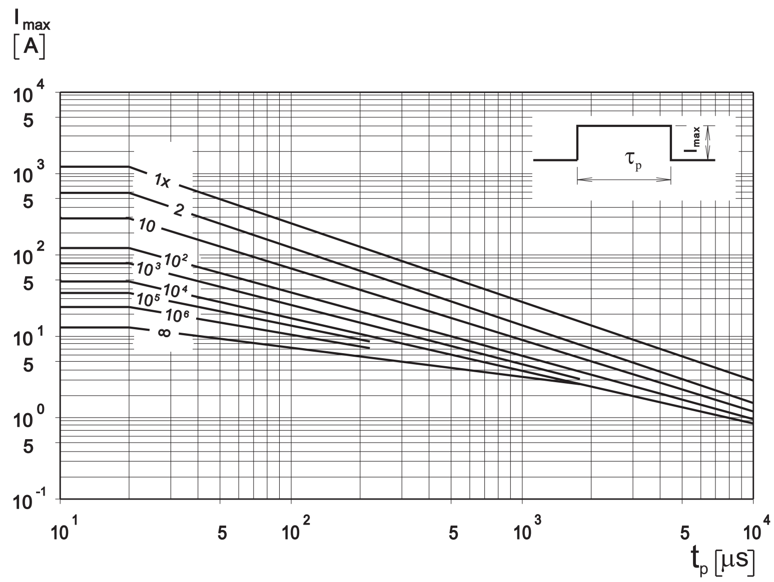


Model Size 222
ZV 4 M ... 95 K



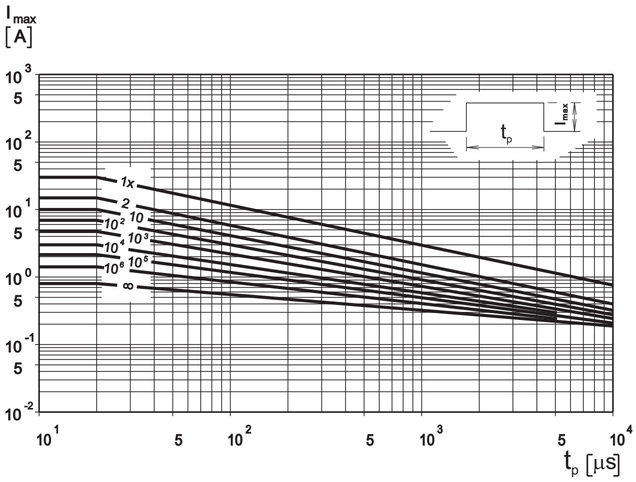
Pulse Rating Curves

ZV 6 M ... 30 K 2220 122

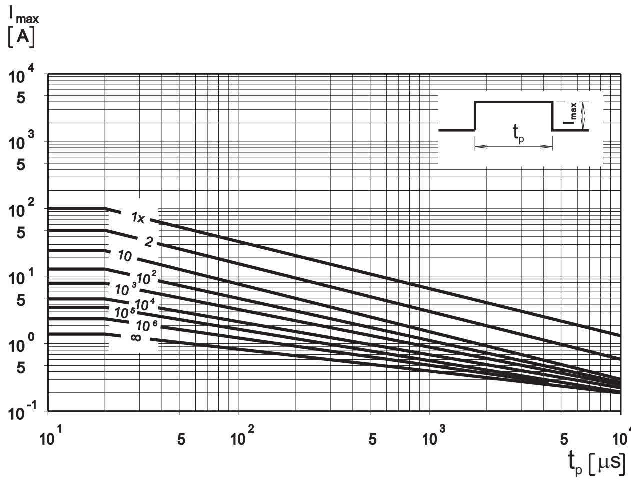


Pulse Rating Curves

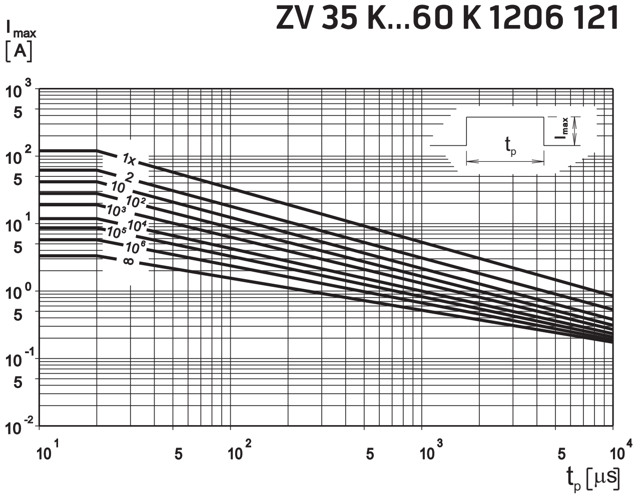
ZV 2 M...30 K 0603 300



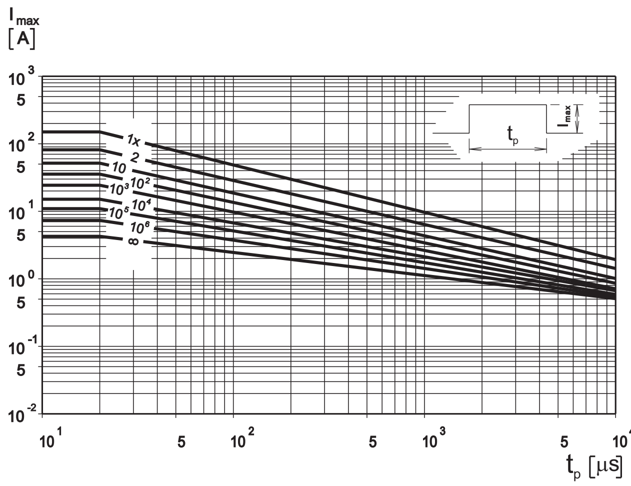
ZV 2 M...6 M 0805 101



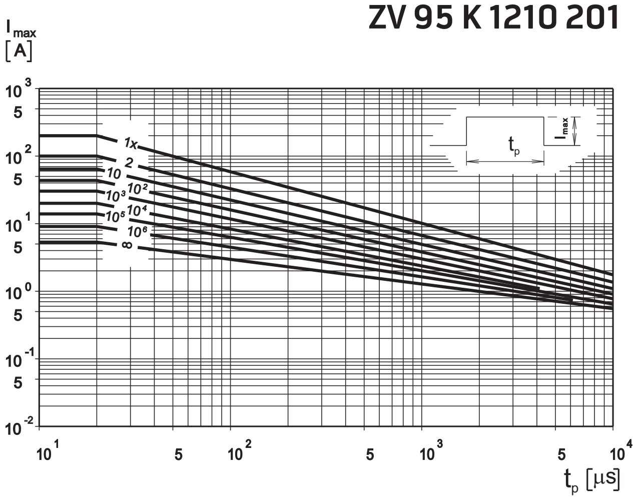
ZV 8 L...30 K 0805 121
ZV 35 K...60 K 1206 121



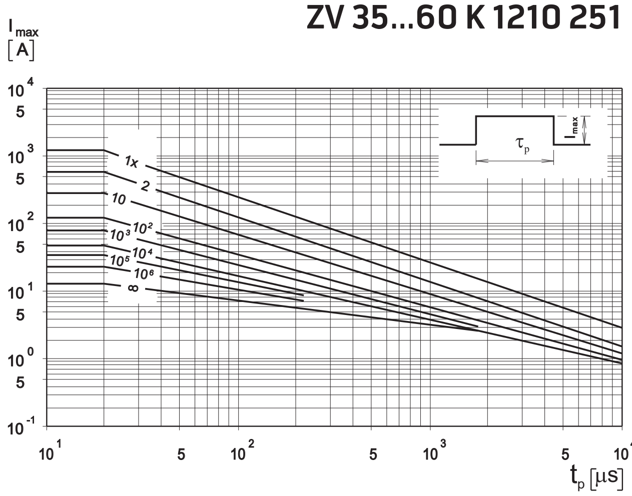
ZV 2 M...6 M 1206 151



ZV 8 L...30 1206 201
ZV 95 K 1210 201

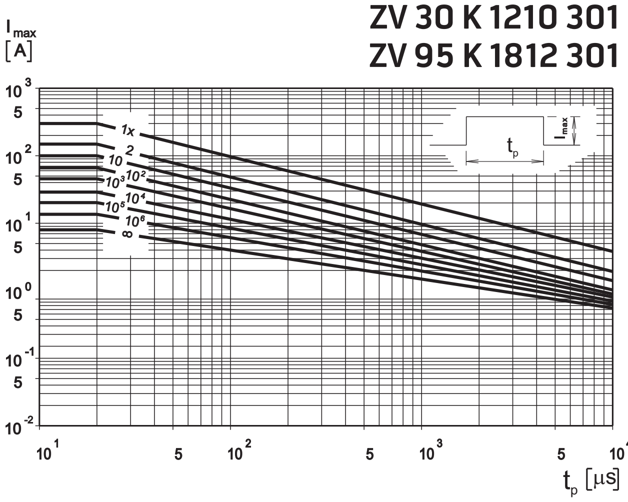


ZV 4 M 1210 251
ZV 35...60 K 1210 251

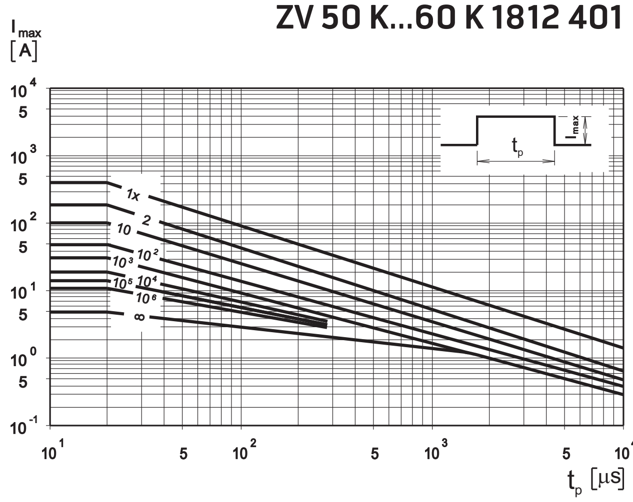


Pulse Rating Curves

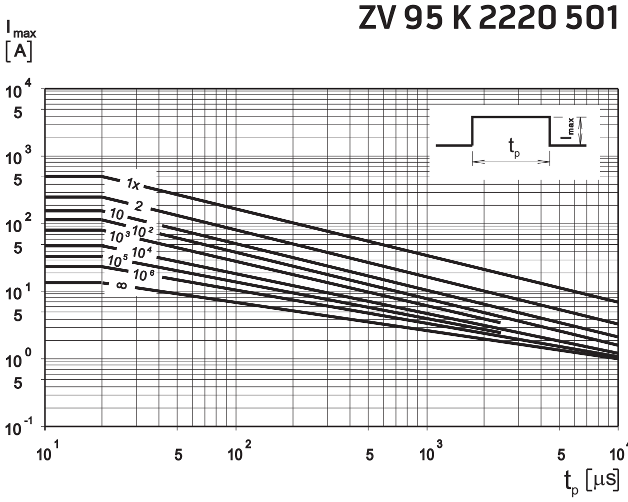
ZV 6 M 1210 301
ZV 30 K 1210 301
ZV 95 K 1812 301



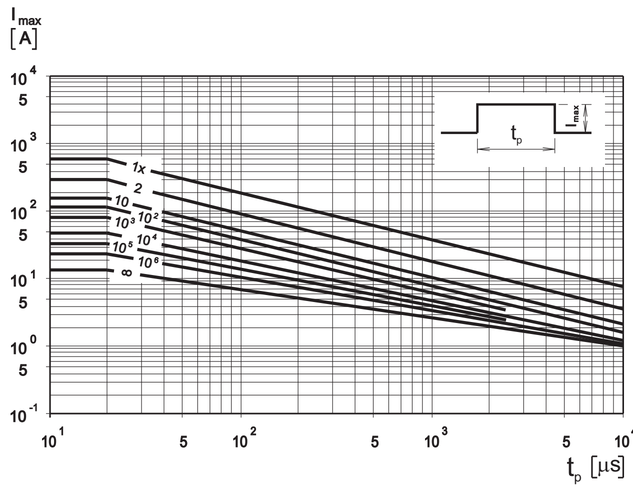
ZV 8 L...25 K 1210 401
ZV 50 K...60 K 1812 401



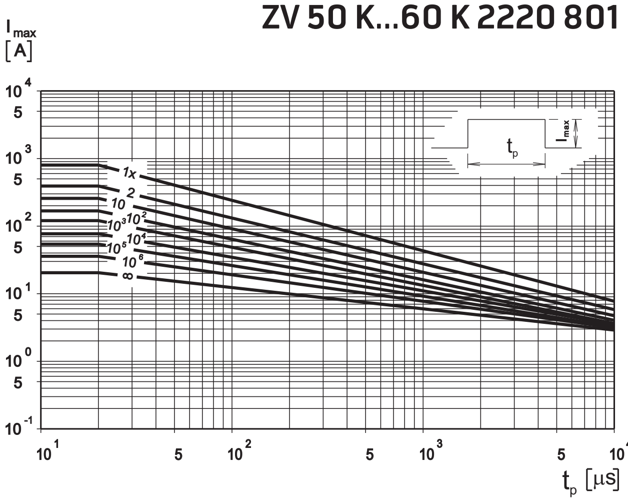
ZV 4 M...8 L 1812 501
ZV 95 K 2220 501



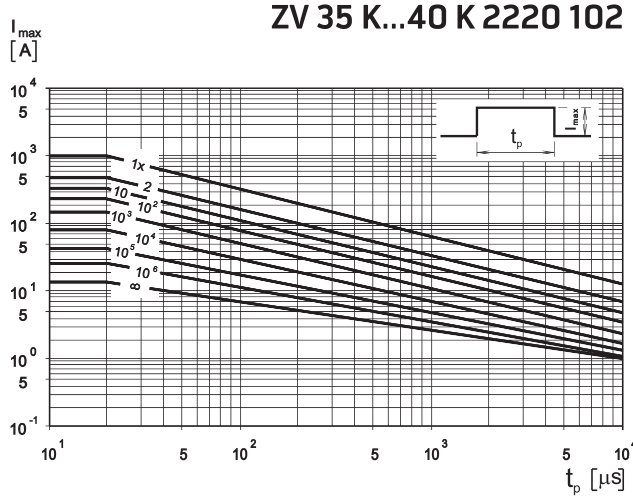
ZV 35 K...40 K 1812 601



ZV 11 K...30 K 1812 801
ZV 50 K...60 K 2220 801



ZV 4 M 2220 102
ZV 35 K...40 K 2220 102



Reliability – Lifetime

In general, **reliability** is the ability of a component to perform and maintain its functions in routine circumstances, as well as in hostile or unexpected circumstances.

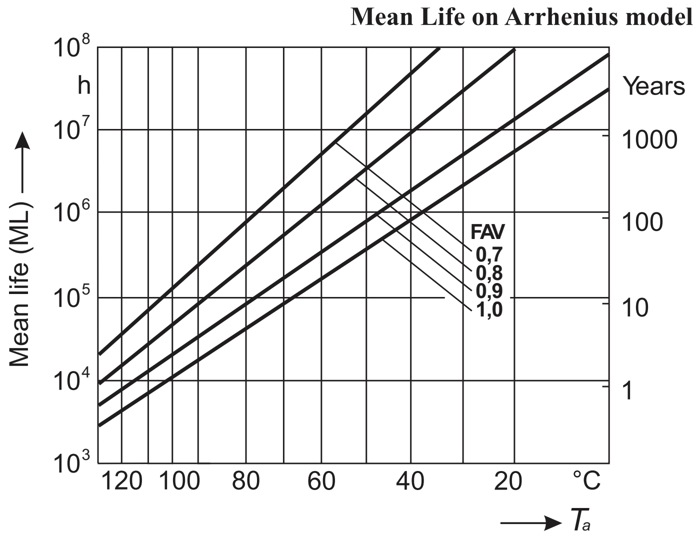
The Mean life of ZV series components is a function of:

- - Factor of Applied Voltage
- - Ambient temperature.

Mean life is closely related to Failure rate (formula).
Mean life (ML) is the arithmetic mean (average) time to failure of a component.

Failure rate is the frequency with which an engineered system or component fails, expressed for example in failures per hour. Failure rate is usually time dependent, and an intuitive corollary is that the rate changes over time versus the expected life cycle of a system.

ZV 2 … 130
Dimension 0603 … 2220



Failure rate formula – calculation

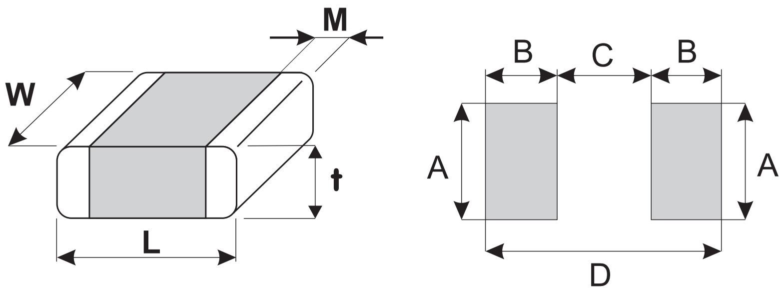
$$\Lambda = \frac{10^9}{ML\,[h]}\ [fit]$$

FAV – Factor of Applied Voltage

$$FAV = \frac{V_{apl}}{V_{max}}$$

Vapl … applied voltage
V_{max} … maximum operating voltage

Soldering Pad Configuration

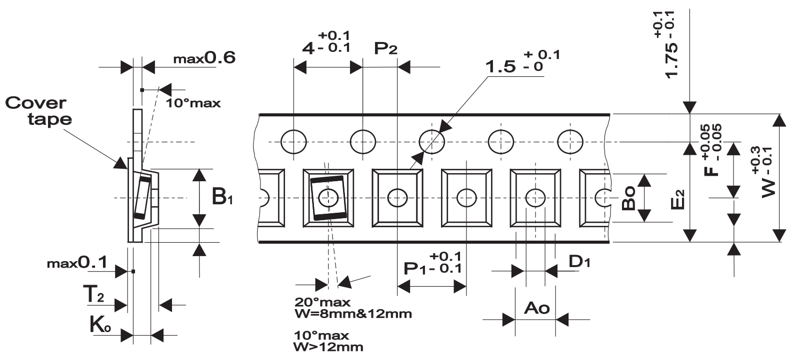


Size	L (mm)	W (mm)	M (mm)	t_{max} (mm)	A (mm)	B (mm)	C (mm)	D (mm)
0603	1,6 ± 0,20	0,80 ± 0,10	0,5 ± 0,25	1,0	1,0	1,0	0,6	2,6
0805	2,0 ± 0,25	1,25 ± 0,20	0,5 ± 0,25	1,1	1,4	1,2	1,0	3,4
1206	3,2 ± 0,30	1,60 ± 0,20	0,5 ± 0,25	1,6	1,8	1,2	2,1	4,5
1210	3,2 ± 0,30	2,50 ± 0,25	0,5 ± 0,25	1,8	2,8	1,2	2,1	4,5
1812	4,7 ± 0,40	3,20 ± 0,30	0,5 ± 0,25	1,9	3,6	1,5	3,2	6,2
2220	5,7 ± 0,50	5,00 ± 0,40	0,5 ± 0,25	1,9	5,5	1,5	4,2	7,2
3225	8,0 ± 0,50	6,30 ± 0,40	0,5 ± 0,25	2,0	6,8	1,5	6,5	9,5

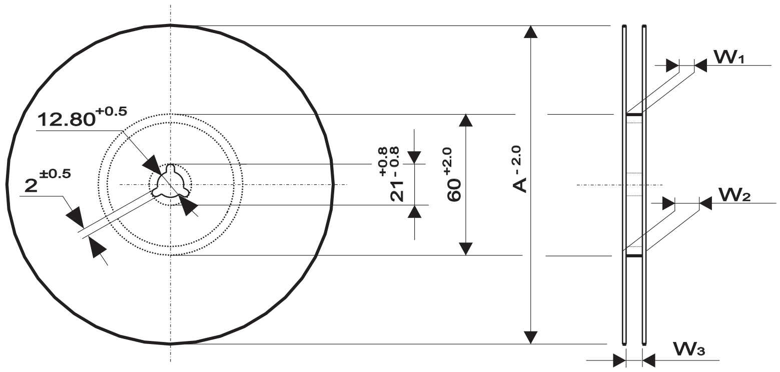
Tape and Reel Specification

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

Tape



Reel



Variable dimensions

Tape Size		8 mm				12 mm		16 mm	
Size	**Units**	**0603**	**0805**	**1206**	**1210**	**1812**	**2220**	**3225**	**4032**
Ao	(mm)	1,2	1,6	1,9	2,9	3,75	5,6	7	8,6
Bo	(mm)	1,9	2,4	3,75	3,7	5	6,25	8,7	10,8
Ko max	(mm)	1,1	1,1	1,8	2	2	2	3,7	3,7
B1 max	(mm)	4,35	4,35	4,35	4,35	8,2	8,2	12,1	12,1
D1 min	(mm)	0,3	0,3	0,3	0,3	1,5	1,5	1,5	1,5
E2 min	(mm)	6,25	6,25	6,25	6,25	10,25	10,25	14,25	14,25
P1	(mm)	4	4	4	4	8	8	12	12
F	(mm)	3,5	3,5	3,5	3,5	5,5	5,5	7,5	7,5
W	(mm)	8,0	8,0	8,0	8,0	12,0	12,0	16,0	16,0
T2 max	(mm)	3,5	3,5	3,5	3,5	6,5	6,5	9,5	9,5
W1	(mm)	8,4+1,5	8,4+1,5	8,4+1,5	8,4+1,5	12,4+2	12,4+2	16,4+2	16,4+2
W2 max	(mm)	14,4	14,4	14,4	14,4	18,4	18,4	22,4	22,4
W3	(mm)	7,9...10,9	7,9...10,9	7,9...10,9	7,9...10,9	11,9...15,4	11,9...15,4	15,9...19,4	15,9...19,4
A	(mm)	180/330	180/330	180/330	180/330	180/330	180/330	330	330

Package units

Series	Voltage range (V)	Chip Size 0603 Reel size		0805 Reel size		1206 Reel size		1210 Reel size		1812 Reel size		2220 Reel size		3225 Reel size	4032 Reel size
		180	**330**	**180**	**330**	**180**	**330**	**180**	**330**	**180**	**330**	**180**	**330**	**330**	**330**
ZVE	14	4000	15000	4000	15000	4000	15000	4000	15000						
ZV / ZVX	2 to 14	4000	15000	4000	15000	4000	15000	4000	15000	1500	6000	1500	5000		
	17	3500	14000	3500	14000	2500	14000	2500	14000	1500	6000	1500	5000		
	20 to 40	3500	14000	3500	14000	2500	10000	2500	9000	1000	4000	1000	4000		
	50 to 130					2000	8000	2000	8000	1000	4000	1000	4000		
AV	14			3500	15000	2500	15000	2500	15000	1000	6000	1000	4000	2500	2500
	17			3500	14000	2500	14000	2500	14000	1000	6000	1000	4000	2500	2500
	20 to 40				14000	2500	10000	2500	9000	1000	4000	1000	4000	2500	2500

Ordering Information

AV 20 K 1210 401 N R1 yy
AV 20 K 1210 401 Ni R1 yy

AV - Series Name: AV, ZV, ZVE, ZVX

20 - Maximum Continuous Working Voltage - V_{rms}

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

1210 - Chip Size: 0603, 0805, 1206, 1210, 1812, 2220, 3225

401 - Maximum Surge Current: 400 = 40 A; 401 = 400 A

N - Barrier type end terminations suitable for Pb-fee reflow soldering
- (no letter) AgPd end terminations suitable for Pb reflow soldering

Ni - Ni Sn barrier type end terminations - suitable for Pb and Pb-Free reflow soldering

R1 - Packaging: R1 = Reel 180 mm, R2 = Reel 330 mm, R3 = 180 mm-1000 pcs

yy - Special requirements

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.

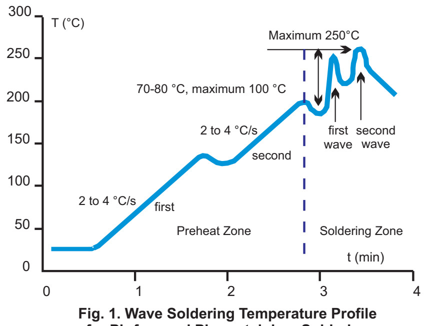


Fig. 1. Wave Soldering Temperature Profile for Pb-free and Pb-containing Soldering

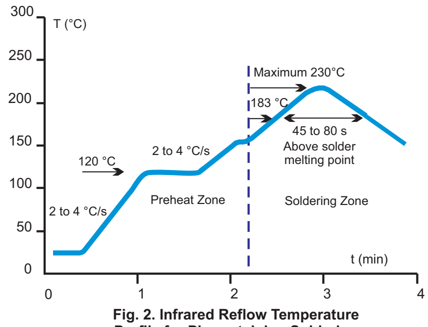


Fig. 2. Infrared Reflow Temperature Profile for Pb-containing Soldering

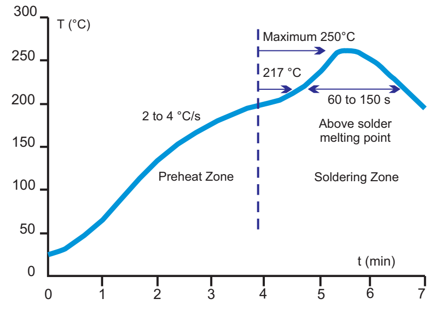


Fig. 3. Reflow Temperature Profile for Pb-free Soldering

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**

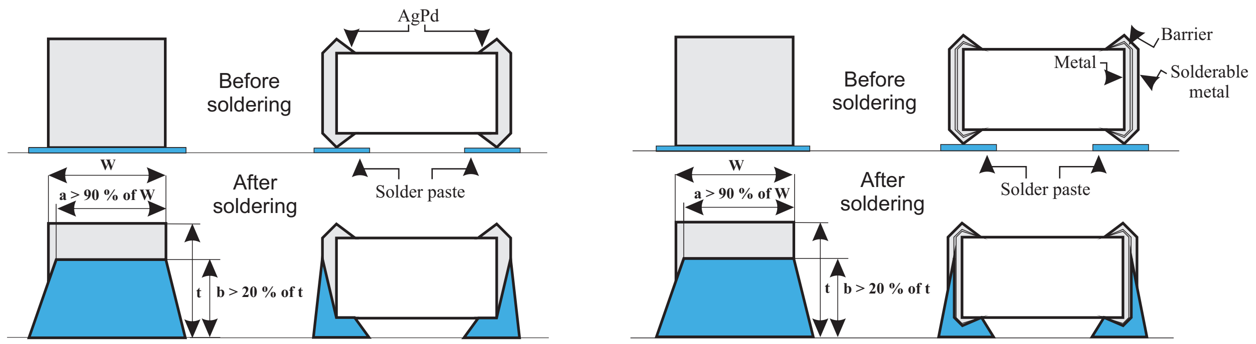


Fig. 4 Soldering Criterion in case of Wave and IR Reflow Pb-containing Soldering

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

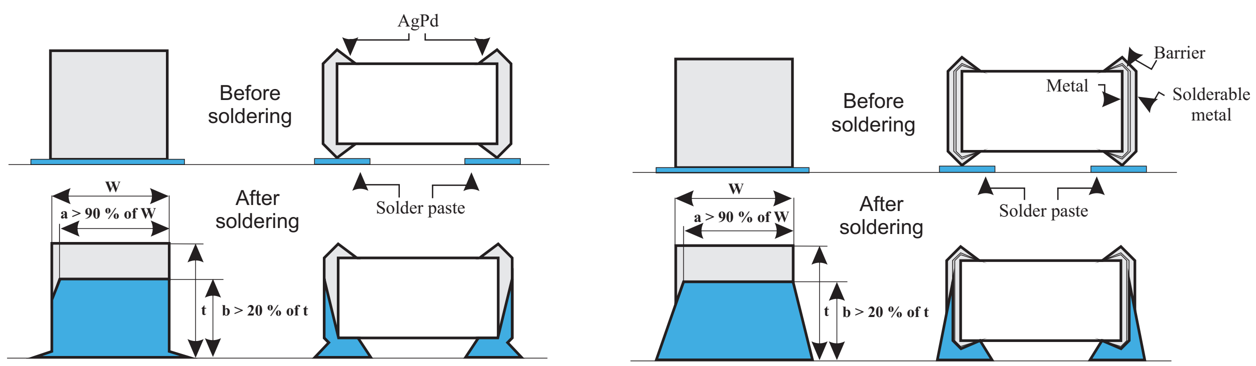


Fig. 5 Soldering Criterion in case of Wave and IR Reflow Pb-free Soldering

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.

Reliability Testing Procedures

Varistor testing procedures comply with CECC 42200, IEC 1051-1/2 and AEC-Q200.
Testing results are avialable upon customer request. Special tests can be performed upon customer request.

Reliability Parameter	Test	Tested according to	Condition to be satisfied after testing
AC/DC Bias Reliability	AC/DC Life Test	CECC 42200, Test 4.20 or IEC 1051-1, Test 4.20., AEC-Q200 Test8 - 1000 h at UCT	$\lvert\delta_{Vn}$ (1 mA)$\rvert$ < 10 %
Pulse Current Capability	I_{max} 8/20 μs	CECC 42200, Test C 2.1 or IEC 1051-1, Test 4.5. 10 pulses in the same direction at 2 pulses per minute at maximum peak current for 10 pulses	$\lvert\delta_{Vn}$ (1 mA)$\rvert$ < 10 % no visible damagev
Pulse Energy Capability	W_{max} 10/1000 μs	CECC 42200, Test C 2.1 or IEC 1051-1, Test 4.5. 10 pulses in the same direction at 1 pulses every 2 minutes at maximum peak current for 10 pulses	$\lvert\delta_{Vn}$ (1 mA)$\rvert$ < 10 % no visible damage
WLD Capability	WLD x 10	ISO 7637, Test pulse 5, 10 pulses at rate 1 per minute	$\lvert\delta_{Vn}$ (1 mA)$\rvert$ < 15 % no visible damage
V_{jump} Capability	V_{jump} 5 min	Increase of supply voltage to $V \geq V_{jump}$ for 1 minute	$\lvert\delta_{Vn}$ (1 mA)$\rvert$ < 15 % no visible damage
Environmental and Storage Reliability	Climatic Sequence	CECC 42200, Test 4.16 or IEC 1051-1, Test 4.17. a) Dry heat, 16h, UCT, Test Ba, IEC 68-2-2 b) Damp heat, cyclic, the first cycle: 55 °C, 93 % RH, 24 h, Test Db 68-2-4 c) Cold, LCT, 2 h, Test Aa, IEC 68-2-1 d) Damp heat cyclic, remaining 5 cycles: 55 °C, 93 % RH, 24 h/cycle, Test Bd, IEC 68-2-30	$\lvert\delta_{Vn}$ (1 mA)$\rvert$ < 10 %
	Thermal Shock	CECC 42200, Test 4.12, Test Na, IEC 68-2-14, AEC-Q200 Test16, 5 cycles UCT/LCT, 30 minutes	$\lvert\delta_{Vn}$ (1 mA)$\rvert$ < 10 % no visible damage
	Steady State Damp Heat	CECC 42200, Test 4.17, Test Ca, IEC 68-2-3, AEC-Q200 Test 6, 56 days, 40 °C, 93% RH. AEC-Q200 Test7: Bias, Rh, T all at 85.	$\lvert\delta_{Vn}$ (1 mA)$\rvert$ < 10 %
	Storage Test	IEC 68-2-2, Test Ba, AEC-Q200 Test 3, 1000 h at maximum storage temperature	$\lvert\delta_{Vn}$ (1 mA)$\rvert$ < 5 %
Mechanical Reliability	Solderability	CECC 42200, Test 4.10.1, Test Ta, IEC 68-2-20 solder bath and reflow method	Solderable at shipment and after 2 year of storage, criteria > 95% must be covered by solder for reflow meniscus
	Resistance to Soldering Heat	CECC 42200, Test 4.10.2, Test Tb, IEC 68-2-20 solder bath nad reflow method	$\lvert\delta_{Vn}$ (1 mA)$\rvert$ < 5 %
	Terminal Strength	JIS-C-6429, App. 1, 18N for 60 s - same for AEC-Q200 Test 22	no visual damage
	Board Flex	JIS-C-6429, App. 2, 2 mm min. AEC-Q200 test 21 - Board flex: 2 mm flex min.	$\lvert\delta_{Vn}$ (1 mA)$\rvert$ < 2 % no visible damage
	Vibration	CECC 42200, Test 4.15, Test Fc, IEC 68-2-6, AEC-Q200 Test 14. Frequency range 10 to 55 Hz (AEC: 10-2000Hz) Amplitude 0.75 m/s2 or 98 m/s2 (AEC: 5 g's for 20 minutes) Total duration 6 h (3x2h) (AEC: 12 cycles each of 3 directions) Waveshape - half sine	$\lvert\delta_{Vn}$ (1 mA)$\rvert$ < 10 % no visible damage
	Mechanical Shock	CECC 42200, Test 4.14, Test Ea, IEC 68-2-27, AEC-Q200 Test 13. Acceleration = 490 m/s2 (AEC: MIL-STD-202-Method 213), Pulse duration = 11 ms, Waveshape - half sine; Number of shocks = 3x6	$\lvert\delta_{Vn}$ (1 mA)$\rvert$ < 10 % no visible damage
Electrical Transient Conduction	ISO-7637-1 Pulses	AEC-Q200 Teat 30: Test pulses 1 to 3. Also other pulses - freestyle.	$\lvert\delta_{Vn}$ (1 mA)$\rvert$ < 10 % no visible damage

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)

KEKOVARICON

Grajski trg 15, SI-8360 Zuzemberk, SLOVENIA
Phone: + 386 7 3885 178
Fax: + 386 7 3885 166
E-mail: info@keko-varicon.si

www.keko-varicon.si