PROTECTIVE DEVICES Catalogue

KEKO

VARICON

2008/2009

Electronic version - .pdf

...not the biggest, simply the best!

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 operating 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 I_n
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 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/V_{app}, 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 maximum 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 disconnect.
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 applied, 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 - $a = \log (I_1 / I_n)/\log(V_1/V_n) = 1/\log(V_1/V_n)$, where : - I_n is reference current (1 mA) and V_n is varistor voltage - $I_1 = 10\ I_n$, V_1 is the voltage measured at I_1
Response Time	t_r	The time lag between application of a surge and varistor's "turn-on" conduction action
Varistor Voltage Temperature Coefficient	**TC**	(V_n at 125°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 varistor 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 (125 °C)

Contents : **Page**

Ordering Information

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

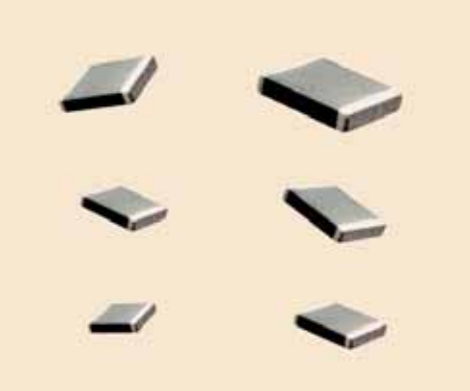
AV - Series Name : AV, ZV, ZVE, ZVX
20 - Maximum Continuous Working Voltage - V_{rms}
K - V_n Tolerance : K = ± 10 %, L = ± 15 %, M = ± 20 %
1210 - Chip Size : 0603, 0805, 1206, 1210, 1812, 2220, 3225
401 - Maximum Surge Current : 400 = 40A; 401 = 400 A
N - Barrier type end terminations suitable for Pb-free reflow soldering
- (no letter) AgPd end terminations suitable for Pb reflow soldering
R1 - Packaging : R1 = Reel 180 mm, R2 =Reel 330 mm, R3 = 180 mm-1000 pcs
yy - Special requirements

LOW VOLTAGE SMD VARICONS®
ZV SERIES

Description

ZV Series of low voltage varicons is designed to protect sensitive electronics 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 varicons cover a wide DC operating voltage range from 3 V to 170 V.

ZV varicons 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*
- *Varicons with lower or higher capacitance available upon request also Varicons with 100 % controlled capacitance value available upon request.*
- *6 Model sizes 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 or barrier type suitable for Pb-free soldering process - barrier type end terminations solderable with Pb-free solders according to JEDEC J-STD-020C and IEC60068-2-58.*
- *Ul1449, C22.2 - File E221545 Section8.* c US
- *RoHS conform components complying to 2002/95/EC and 2003/11/EC.*
- *AEC-Q200 qualified Grade 1.*

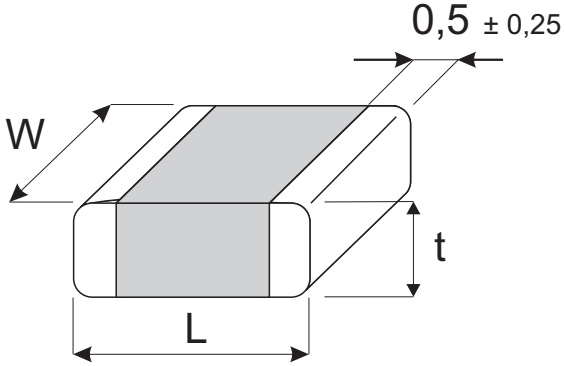
Applications

- *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 industryspec.*
- *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

	Units	Value
Continuous :		
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

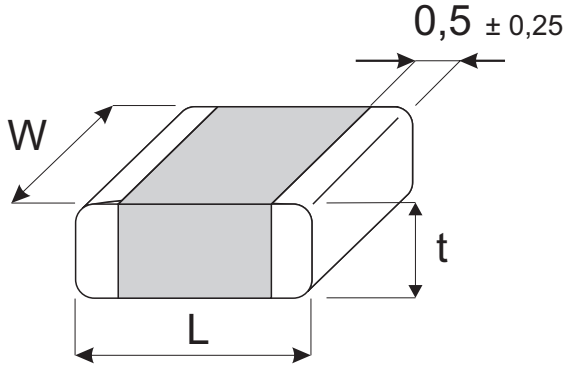
Device Ratings and Characteristics



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

Type	V_{rms} V	V_{dc} V	V_n 1 mA V	V_c V	I_c 8/20 µs A	W_{max} 10/1000 µs J	P max W	I_{max} 8/20 µs A	C_{typ} 1 kHz pF	L_{typ} 100 mA/nS nH	L mm	W mm	t max 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	1,05
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	1,25
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	1,35
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 20 K 0603 300 ..... ZV 95 K 2220 501

Type	V_{rms} V	V_{dc} V	V_n 1 mA V	V_c V	I_c 8/20 µs A	W_{max} 10/1000 µs J	P max W	I_{max} 8/20 µs A	C_{typ} 1 kHz pF	L_{typ} 100 mA/nS nH	L mm	W mm	t max 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

ESD SUPPRESSION VARICONS®
ZVE SERIES

Description

ZVE Varicons are designed to suppress ESD events, including those specified in IEC1000-4-2 or other standards used for Electromagnetic Compliance testing. The ZVE Series is typically applied to protect integrated circuits and other components at the circuit board level operating at 18 VDC or less.

Fabrication method, design and materials of these devices result in capacitance characteristics suitable for high frequency attenuation / low-pass filter circuit functions, providing suppression and filtering in a single device.

Features

- *Operating voltage range V_{dc} up to 18 V.*
- *+ 125 °C maximum continuous operating temperature*
- *4 Model sizes available... 0603, 0805, 1206, 1210.*
- *Short response time.*
- *Characterized for inductance and capacitance.*
- *Dimensional and weight savings on the board.*
- *Non-sensitive to mildly activated fluxes (see Soldering Recommendations, page 25).*
- *End termination : AgPd or barrier type suitable for Pb-free soldering process - barrier type end terminations solderable with Pb-free solders according to JEDEC J-STD-020C and IEC60068-2-58.*
- *No plastic coating guarantees better flammability rating.*
- *Available in tape and reel for automatic pick and place.*
- *Ul1449, C22.2 - File E221545 Section8.*
- *RoHS conform components complying to 2002/95/EC and 2003/11/EC.*
- *AEC-Q200 qualified Grade 1.*

Applications

- *Protection of Components and circuits sensitive to ESD transients occurring on power supply, control and signal lines.*

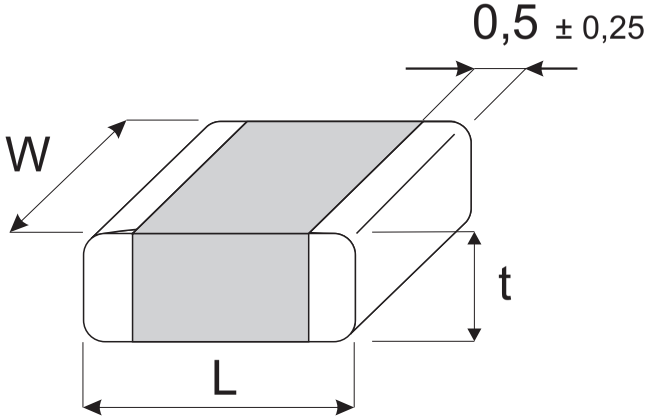
- *Suppression of ESD events such as specified in IEC 1000-4-2, MIL STD-883C, method 3015.7 or AEC-Q200-002 for Electromagnetic Compliance (EMC).*

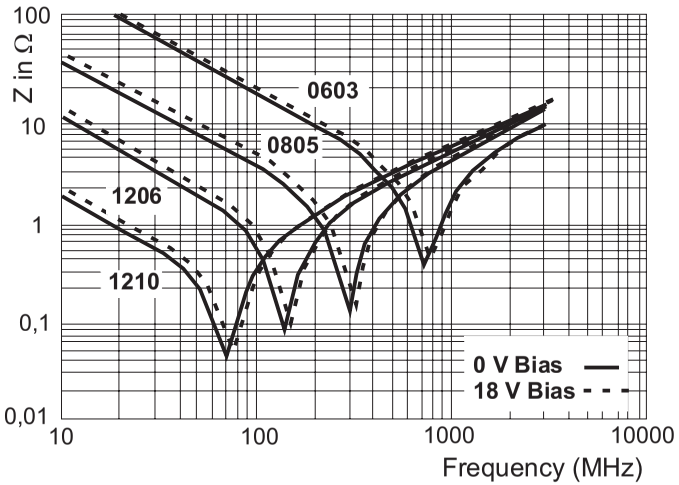
- *Used in mobile communication, computer/EDP products, medical products, hand held / portable devices, industrial equipment, including diagnostics port protection and I/O interfaces.*

Absolute Maximum Ratings

	Units	Value
Continuous :		
Steady State Applied Voltage :		
DC Voltage Range (V_{dc})	V	≤ 18
Transient :		
Peak Single Pulse Surge C urrent, 8/20 µs Waveform, (I_{max})	A	20, 30
Single Pulse Surge Energy, 10/1000 µs Waveform (W_{max})	J	0,05 to 0,1
Operating Ambient Temperature	°C	-55 to +125
Storage Temperature Range	°C	-55 to +150
Threshold Voltage Temperature Coefficient	%/°C	< +0.05
Response Time	ns	< 1
Climatic Category		55 / 125 / 56

Device Ratings and Characteristics





Capacitance - Frequency Characteristics

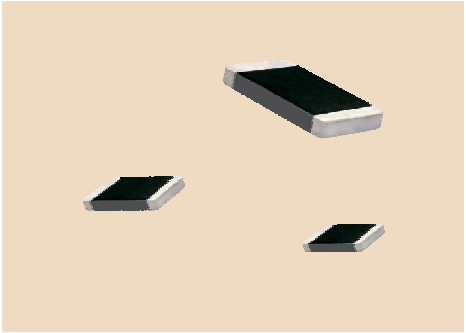
ZVE 14 S 0603.....ZVE 14 S 1210

Type	V_{rms} V	V_{dc} V	V_n 1 mA V	V_c 8/20 µs V	I_c 8/20 µs A	W_{max} 10/1000 µs J	P max W	C_{max} 1 MHz pF	L_{typ} 100 mA/nS nH	L (mm)	W (mm)	t max mm
ZVE 14 S 0603	14	18	22 to 28	50	2	0,05	0,003	75	< 1.0	1,6 ± 0,20	0,80 ± 0,10	0,95
ZVE 14 S 0805	14	18	22 to 28	50	2	0,10	0,004	100	< 1.5	2,0 ± 0,25	1,25 ± 0,20	0,95
ZVE 14 S 1206	14	18	22 to 28	50	2	0,10	0,004	200	< 1.8	3,2 ± 0,30	1,60 ± 0,20	1,20
ZVE 14 S 1210	14	18	22 to 28	50	2	0,10	0,004	400	< 3.5	3,2 ± 0,30	2,50 ± 0,25	1,30

LOW CAPACITANCE & LOW ENERGY VARICONS®
ZVX SERIES

Description

The ZVX Series are low-energy (0.1 J) varistor chips, designed specifically for the protection of I/O line drivers and other sensitive semiconductor gates from the damaging effects of high voltage, low energy transients such as ESD events. Unlike other competitive low-energy varistors, however, the ZVX Series offers all the protection features of standard varistor chips, *and* ***exceptionally low values of capacitance***. In these applications, as the frequency of data transfer increases, lower capacitance is required to eliminate possible skewing of the data signals due to capacitive loading.



In most cases, the 1KHz capacitance values of the ZVX Series are less than one half that of competition. Further, this series is offered in 0603, 0805 and 1206 sizes, with an expanded range of voltages from 3V to 38Vdc. The ZVX Series offers a circuit design engineer the greatest range of high-frequency, low energy SMD varicon chips available in the marketplace today.

Features

- *Operating voltage range V_{dc}.....3 V to 38 V.*
- *+ 125 °C maximum continuous operating temperature*
- *3 Model sizes available... 0603, 0805, 1206.*
- ***Exceptionally low capacitance** ratings.*
- *Short response time.*
- *Inherent bi-directional clamping, low clamping voltages.*
- *Dimensional and weight savings on the board.*
- *Non-sensitive to mildly activated fluxes (see Soldering Recommendations, page 25).*
- *End termination : AgPd or barrier type suitable for Pb-free soldering process - barrier type end terminations solderable with Pb-free solders according to JEDEC J-STD-020C and IEC60068-2-58.*
- *No plastic coating guarantees better flammability rating.*
- *Ul1449, C22.2 - File E221545 Section8.*
- *RoHS conform components complying to 2002/95/EC and 2003/11/EC.*
- *AEC-Q200 qualified Grade 1.*

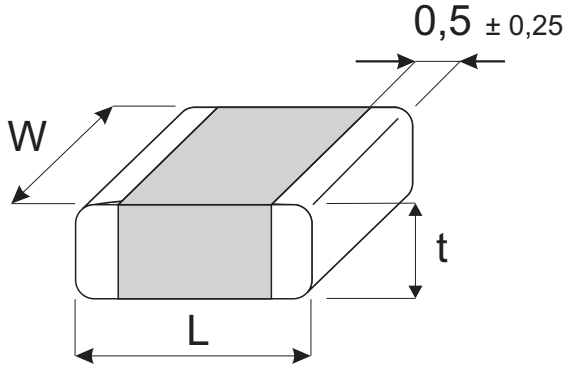
Applications

- *Suppression of inductive switching or other transient events such as surge voltage at the circuit board level*
- *Excellent for I/O line protection, operating at hi-speed data transfer rates, due to very low capacitance values*
- *ESD protection for components sensitive to IEC 1000-4-2, MIL-STD 883C Method 3015.7, AEC-Q200-002 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

	Units	Value
Continuous :		
Steady State Applied Voltage :		
DC Voltage Range (V_{dc})	V	3 to 38
AC Voltage Range (V_{rms})	V	2 to 30
Transient :		
Peak Single Pulse Surge Current, 8/20 µs Waveform, (I_{max})	A	30 to 40
Single Pulse Surge Energy, 10/1000 µs Waveform (W_{max})	J	0.1
Operating Ambient Temperature	°C	-55 to +125
Storage Temperature Range	°C	-55 to +150
Threshold Voltage Temperature Coefficient	%/°C	< + 0.05
Response Time	ns	< 1
Climatic Category		55 / 125 / 56

Device Ratings and Characteristics



ZVX 2 S 0603 300.....ZVX 30 S 1206 400

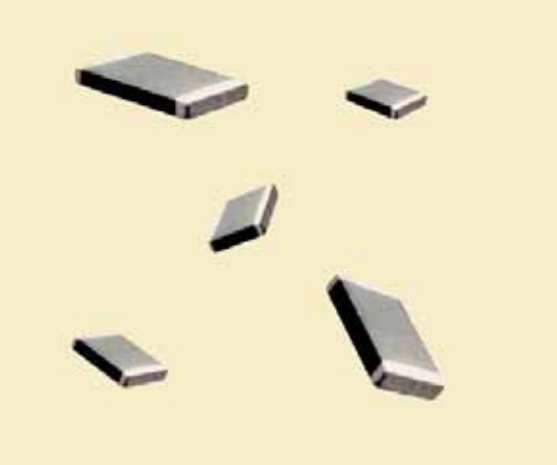
Type	V_{rms} V	V_{dc} V	V_n 1 mA V	V_c V	I_c 8/20 µs A	W_{max} 10/1000 µs J	P max W	I_{max} 8/20 µs A	C_{typ} 1kHz pF	L_{typ} 100 mA/nS nH	L mm	W mm	t max mm
ZVX 2 S 0603 300	2	3,3	4,1 - 6,0	10	1	0,1	0,003	30	200	1,0	1,6 ± 0,20	0,80 ± 0,10	0,9
ZVX 2 S 0805 400	2	3,3	4,1 - 6,0	10	1	0,1	0,005	40	500	1,5	2,0 ± 0,25	1,25 ± 0,20	1,0
ZVX 2 S 1206 400	2	3,3	4,1 - 6,0	10	1	0,1	0,008	40	840	1,8	3,2 ± 0,30	1,60 ± 0,20	1,0
ZVX 4 S 0603 300	4	5,6	7,6 - 9,3	15,5	1	0,1	0,003	30	165	1,0	1,6 ± 0,20	0,80 ± 0,10	0,9
ZVX 4 S 0805 400	4	5,6	7,6 - 9,3	15,5	1	0,1	0,005	40	340	1,5	2,0 ± 0,25	1,25 ± 0,20	1,0
ZVX 4 S 1206 400	4	5,6	7,6 - 9,3	15,5	1	0,1	0,008	40	720	1,8	3,2 ± 0,30	1,60 ± 0,20	1,0
ZVX 6 S 0603 300	6	9	11,0 - 14,0	20	1	0,1	0,003	30	145	1,0	1,6 ± 0,20	0,80 ± 0,10	0,9
ZVX 6 S 0805 400	6	9	11,0 - 14,0	20	1	0,1	0,005	40	290	1,5	2,0 ± 0,25	1,25 ± 0,20	1,0
ZVX 6 S 1206 400	6	9	11,0 - 14,0	20	1	0,1	0,008	40	620	1,8	3,2 ± 0,30	1,60 ± 0,20	1,0
ZVX 8 S 0603 300	8	12	14,0 - 18,3	25	1	0,1	0,003	30	135	1,0	1,6 ± 0,20	0,80 ± 0,10	0,9
ZVX 8 S 0805 400	8	12	14,0 - 18,3	25	1	0,1	0,005	40	275	1,5	2,0 ± 0,25	1,25 ± 0,20	1,0
ZVX 8 S 1206 400	8	12	14,0 - 18,3	25	1	0,1	0,008	40	540	1,8	3,2 ± 0,30	1,60 ± 0,20	1,0
ZVX 11 S 0603 300	11	14	16,5 - 20,3	30	1	0,1	0,003	30	120	1,0	1,6 ± 0,20	0,80 ± 0,10	0,9
ZVX 11 S 0805 400	11	14	16,5 - 20,3	30	1	0,1	0,005	40	200	1,5	2,0 ± 0,25	1,25 ± 0,20	1,0
ZVX 11 S 1206 400	11	14	16,5 - 20,3	30	1	0,1	0,008	40	500	1,8	3,2 ± 0,30	1,60 ± 0,20	1,0
ZVX 14 S 0603 300	14	18	22,9 - 28,0	40	1	0,1	0,003	30	110	1,0	1,6 ± 0,20	0,80 ± 0,10	0,9
ZVX 14 S 0805 400	14	18	22,9 - 28,0	40	1	0,1	0,005	40	165	1,5	2,0 ± 0,25	1,25 ± 0,20	1,0
ZVX 14 S 1206 400	14	18	22,9 - 28,0	40	1	0,1	0,008	40	250	1,8	3,2 ± 0,30	1,60 ± 0,20	1,0
ZVX 17 S 0603 300	17	22	25,2 - 31,3	48	1	0,1	0,003	30	100	1,0	1,6 ± 0,20	0,80 ± 0,10	0,9
ZVX 17 S 0805 400	17	22	25,2 - 31,3	48	1	0,1	0,005	40	145	1,5	2,0 ± 0,25	1,25 ± 0,20	1,0
ZVX 17 S 1206 400	17	22	25,2 - 31,3	48	1	0,1	0,008	40	210	1,8	3,2 ± 0,30	1,60 ± 0,20	1,0
ZVX 20 S 0603 300	20	26	31,0 - 38,0	58	1	0,1	0,003	30	100	1,0	1,6 ± 0,20	0,80 ± 0,10	0,9
ZVX 20 S 0805 400	20	26	31,0 - 38,0	58	1	0,1	0,005	40	140	1,5	2,0 ± 0,25	1,25 ± 0,20	1,0
ZVX 20 S 1206 400	20	26	31,0 - 38,0	58	1	0,1	0,008	40	200	1,8	3,2 ± 0,30	1,60 ± 0,20	1,0
ZVX 25 S 0603 300	25	30	37,0 - 46,9	65	1	0,1	0,003	30	90	1,0	1,6 ± 0,20	0,80 ± 0,10	0,9
ZVX 25 S 0805 400	25	30	37,0 - 46,9	65	1	0,1	0,005	40	110	1,5	2,0 ± 0,25	1,25 ± 0,20	1,0
ZVX 25 S 1206 400	25	30	37,0 - 46,9	65	1	0,1	0,008	40	180	1,8	3,2 ± 0,30	1,60 ± 0,20	1,0
ZVX 30 S 0603 300	30	38	42,3 - 51,7	77	1	0,1	0,003	30	80	1,0	1,6 ± 0,20	0,80 ± 0,10	0,9
ZVX 30 S 0805 400	30	38	42,3 - 51,7	77	1	0,1	0,005	40	100	1,5	2,0 ± 0,25	1,25 ± 0,20	1,0
ZVX 30 S 1206 400	30	38	42,3 - 51,7	77	1	0,1	0,008	40	165	1,8	3,2 ± 0,30	1,60 ± 0,20	1,0

AUTOMOTIVE VARICONS®
AV SERIES

Description

Almost all-electronic systems in an automobile, e.g. anti-block brake system, direct ignition system, airbag control system, wiper motors, etc. are susceptible to damage from destructive voltage transients. AV Varicons are transient suppressors with temperature independent suppression characteristics enabling protection from -55 °C to 125 °C.

AV Varicons offer excellent transient energy distribution. AV Varicons require significantly smaller space and pad area than silicon TVS diodes, offering greater circuit board layout flexibility for the designer.



Features

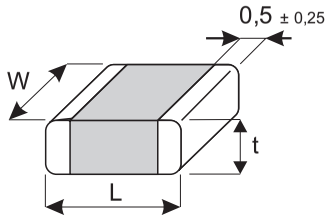
- *Supply voltage .....12 V, 24 V and 42 V*
- *Operating voltage range V_{dc} .....3 V to 170 V higher operating voltages available upon request.*
- *Load Dump Energy up to 50J available upon request.*
- *+ 125 °C maximum continuous operating temperature*
- *Automotive Varicons with lower or higher capacitance available upon request also Varicons with 100 % controlled capacitance value available upon request.*
- *6 Model sizes available... 0805, 1206, 1210, 1812, 2220, 3225.*
- *Leadless chip form near zero inductance guaranteeing the fastest speed of response to transient surges.*
- *Broad range of current and energy handling capabilities.*
- *Low clamping voltage - Uc.*
- *Absence of plastic coating guarantees better flammability rating.*
- *Non-sensitive to mildly activated fluxes (see Soldering Recommendations, page 25).*
- *End termination : AgPd or barrier type suitable for Pb-free soldering process - barrier type end terminations solderable with Pb-free solders according to JEDEC J-STD-020C and IEC60068-2-58.*
- *Ul1449, C22.2 - File E221545 Section8.*
- *RoHS conform components complying to 2002/95/EC and 2003/11/EC.*
- *AEC-Q200 qualified Grade 1.*

Absolute Maximum Ratings

	Units	Value
Continuous :		
Steady State Applied Voltage :		
DC Voltage Range (V_{dc})	V	16 to 56
Transient :		
Load Dump Energy, (WDL)	J	1 to 25 *
Jump Start Capability (5 minutes), (V_{jump})	V	24.5 to 65
Peak Single Pulse Surge Current, 8/20 µs Waveform, (I_{max})	A	120 to 2000
Single Pulse Surge Energy, 10/1000 µs Waveform (W_{max})	J	0.3 to 30
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

** Types for Maximum Load Dump Energy (WLD) of 50J are available upon request.*

Device Ratings and Characteristics



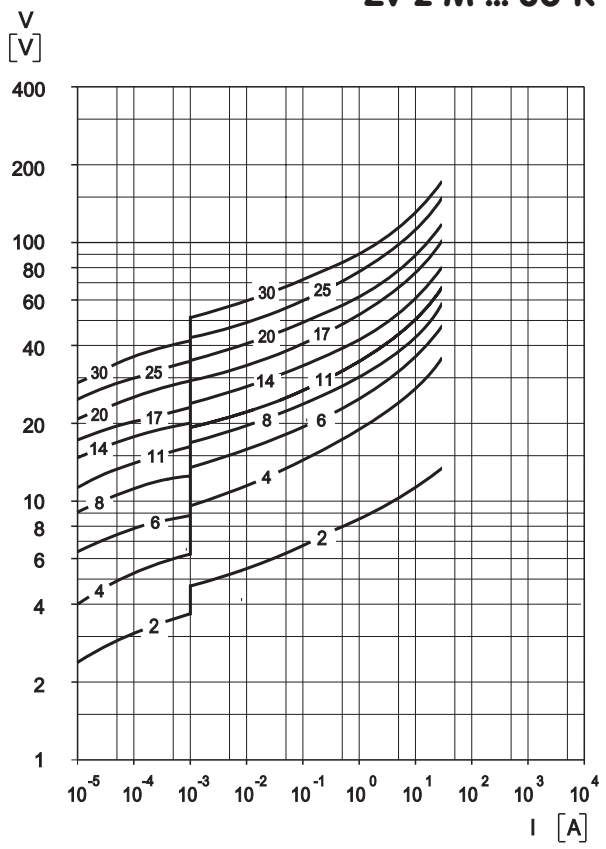
AV 14 K 0805 121.....AV 40 K 3225 202

Type	V_{rms} V	V_{dc} V	V_n 1 mA V	V_{jump} 5 min V	V_c V	I_c 8/20 µs A	I_{max} 8/20 µs A	W_{max} 10/1000 µs J	WLD 10 x J	P max W	C_{typ} 1 kHz nF	L mm	W mm	t max mm
12 V Power Supply														
AV 14 K 0805 121	14	16	24	24,5	40	1	120	0,3	1	0,008	0,44	2,0 ± 0,25	1,25± 0,20	1,0
AV 14 K 1206 201	14	16	24	24,5	40	1	200	0,6	1,5	0,008	1,00	3,2 ± 0,30	1,60 ± 0,20	1,2
AV 14 K 1210 401	14	16	24	24,5	40	2,5	400	1,6	3	0,010	2,35	3,2 ± 0,30	2,50 ± 0,25	1,3
AV 14 K 1812 801	14	16	24	24,5	40	5	800	2,4	6	0,015	4,50	4,7 ± 0,40	3,20 ± 0,30	1,3
AV 14 K 2220 122	14	16	24	24,5	40	10	1200	5,8	12	0,030	10,00	5,7 ± 0,50	5,00 ± 0,40	1,4
AV 14 K 3225 202	14	16	24	24,5	40	20	2000	12,5	25	0,040	16,00	8,0 ± 0,50	6,30 ± 0,40	1,5
AV 17 K 0805 121	17	20	27	30	44	1	120	0,5	1	0,008	0,37	2,0 ± 0,25	1,25± 0,20	1,0
AV 17 K 1206 201	17	20	27	30	44	1	200	1,1	1,5	0,008	0,81	3,2 ± 0,30	1,60 ± 0,20	1,2
AV 17 K 1210 401	17	20	27	30	44	2,5	400	1,8	3	0,010	2,00	3,2 ± 0,30	2,50 ± 0,25	1,3
AV 17 K 1812 801	17	20	27	30	44	5	800	2,9	6	0,015	3,80	4,7 ± 0,40	3,20 ± 0,30	1,3
AV 17 K 2220 122	17	20	27	30	44	10	1200	7,2	12	0,030	8,00	5,7 ± 0,50	5,00 ± 0,40	1,4
AV 17 K 3225 202	17	20	27	30	44	20	2000	13,8	25	0,040	13,20	8,0 ± 0,50	6,30 ± 0,40	1,5
24 V Power Supply														
AV 20 K 1206 201	20	26	33	30	54	1	200	1,6	1,5	0,008	0,78	3,2 ± 0,30	1,60 ± 0,20	1,2
AV 20 K 1210 401	20	26	33	30	54	2,5	400	1,9	3	0,010	1,65	3,2 ± 0,30	2,50 ± 0,25	1,3
AV 20 K 1812 801	20	26	33	30	54	5	800	3,0	6	0,015	3,30	4,7 ± 0,40	3,20 ± 0,30	1,3
AV 20 K 2220 122	20	26	33	30	54	10	1200	8,0	12	0,030	7,00	5,7 ± 0,50	5,00 ± 0,40	1,4
AV 20 K 3225 202	20	26	33	30	54	20	2000	15,0	25	0,040	11,00	8,0 ± 0,50	6,30 ± 0,40	1,5
AV 30 K 1206 201	30	34	47	50	77	1	200	2,0	1,5	0,008	0,53	3,2 ± 0,30	1,60 ± 0,20	1,2
AV 30 K 1210 401	30	34	47	50	77	2,5	400	2,3	3	0,010	1,10	3,2 ± 0,30	2,50 ± 0,25	1,3
AV 30 K 1812 801	30	34	47	50	77	5	800	3,8	6	0,015	2,20	4,7 ± 0,40	3,20 ± 0,30	1,3
AV 30 K 2220 122	30	34	47	50	77	10	1200	10,0	12	0,030	6,50	5,7 ± 0,50	5,00 ± 0,40	1,4
AV 30 K 3225 202	30	34	47	50	77	20	2000	17,0	25	0,040	6,60	8,0 ± 0,50	6,30 ± 0,40	1,5
42 V Power Supply														
AV 40 K 1206 201	40	56	68	65	110	1	200	2,2	1,5	0,008	0,40	3,2 ± 0,30	1,6 ± 0,20	1,2
AV 40 K 1210 401	40	56	68	65	110	2,5	400	2,6	3	0,010	0,90	3,2 ± 0,30	2,5 ± 0,25	1,3
AV 40 K 1812 801	40	56	68	65	110	5	800	4,8	6	0,015	1,80	4,7 ± 0,40	3,2 ± 0,30	1,3
AV 40 K 2220 122	40	56	68	65	110	10	1200	10,5	12	0,030	5,50	5,7 ± 0,50	5,00 ± 0,40	1,4
AV 40 K 3225 202	40	56	68	65	110	20	2000	21	25	0,040	6,20	8,0 ± 0,50	6,30 ± 0,40	1,5

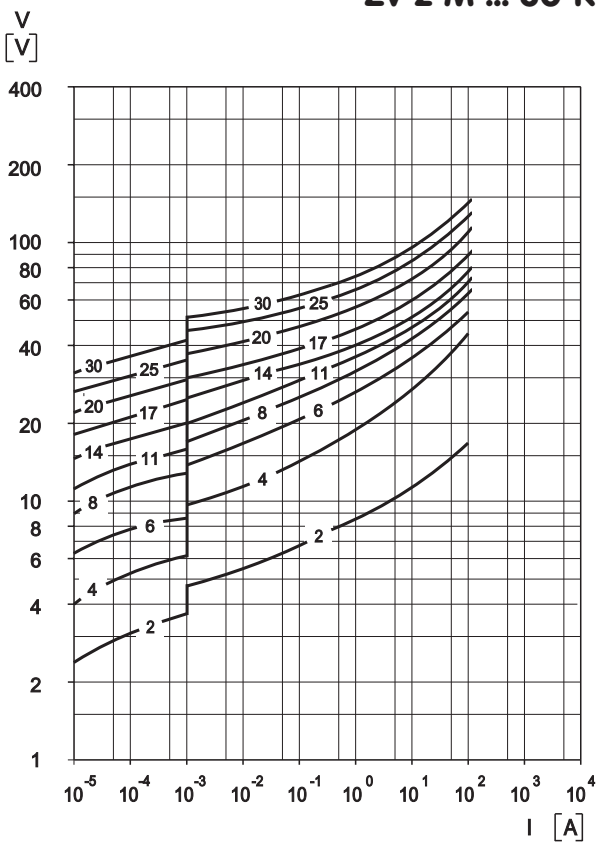
Protection Level

with the worst-case condition in the tolerance region

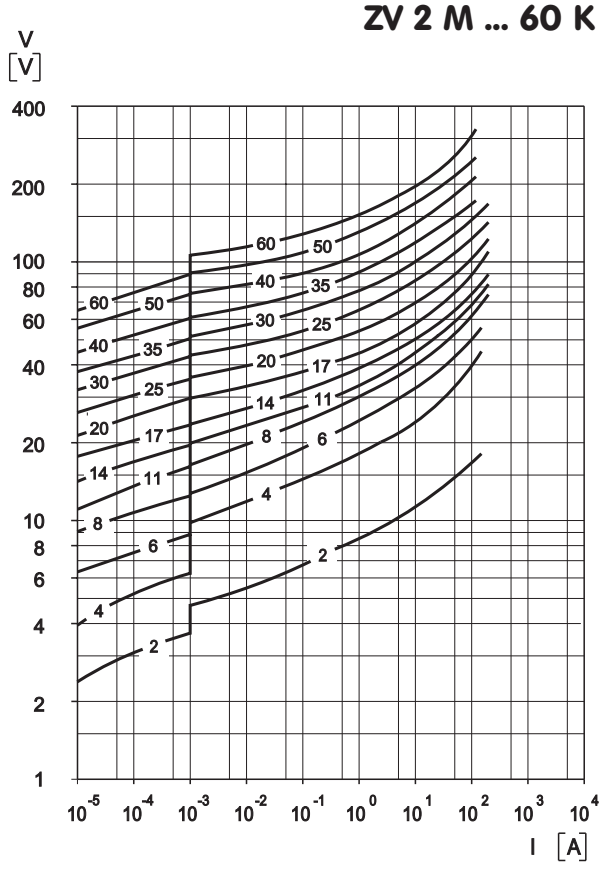
Model Size 0603
ZV 2 M ... 30 K



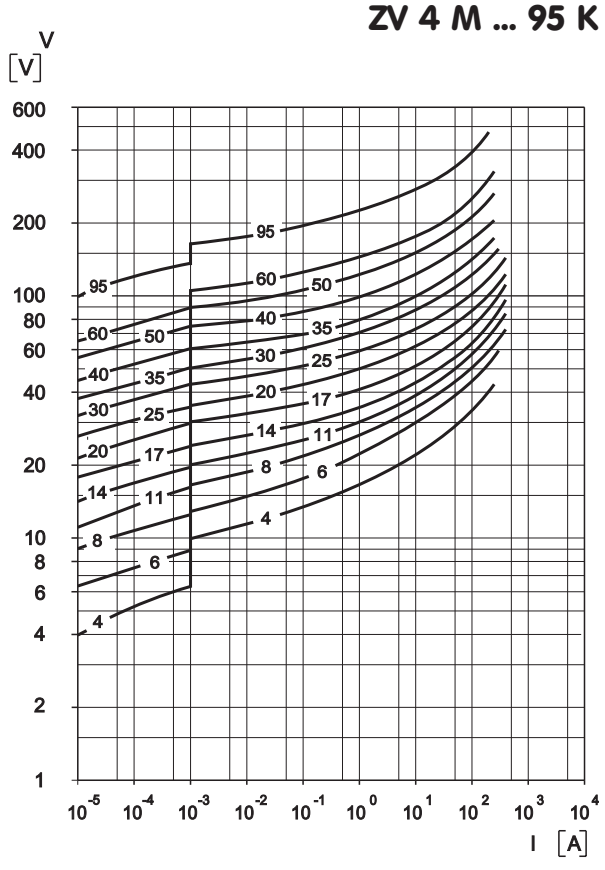
Model Size 0805
ZV 2 M ... 30 K



Model Size 1206
ZV 2 M ... 60 K



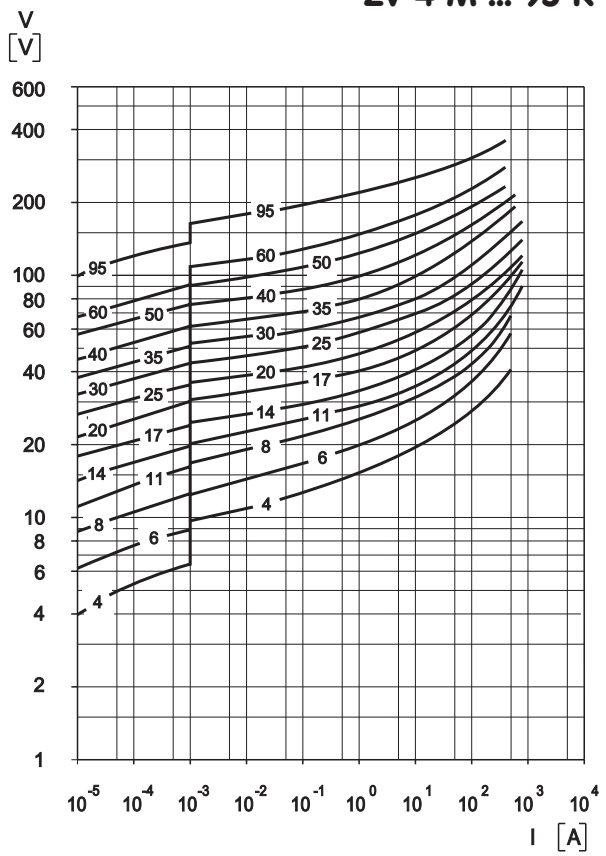
Model Size 1210
ZV 4 M ... 95 K



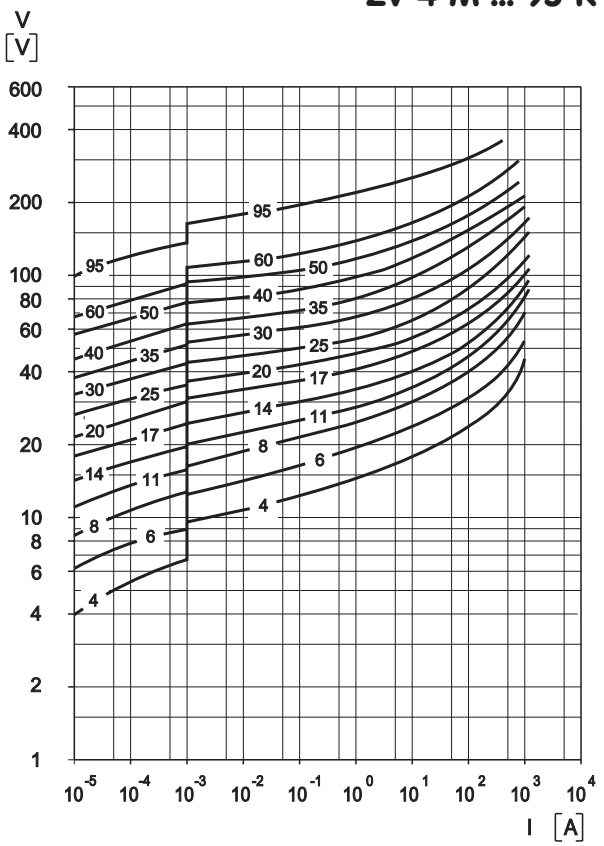
Protection Level

with the worst-case condition in the tolerance region

Model Size 1812
ZV 4 M ... 95 K

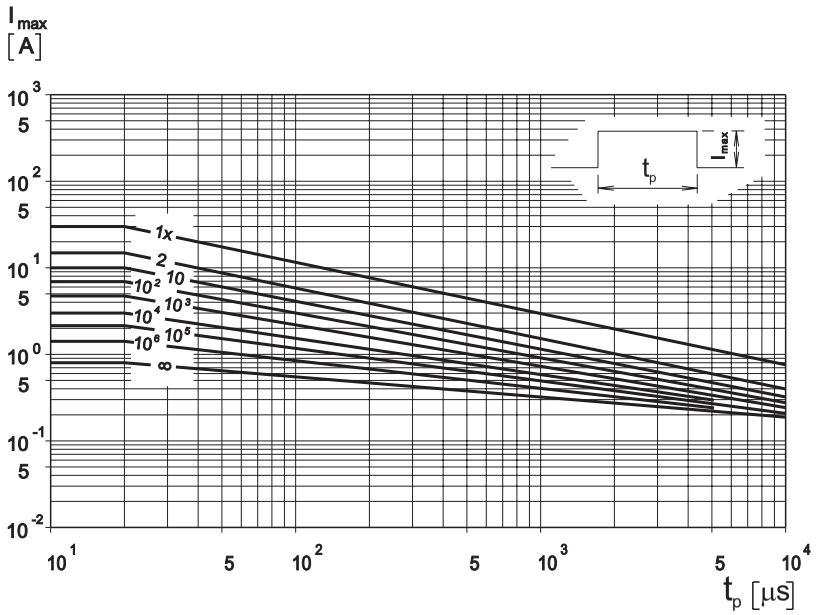


Model Size 2220
ZV 4 M ... 95 K

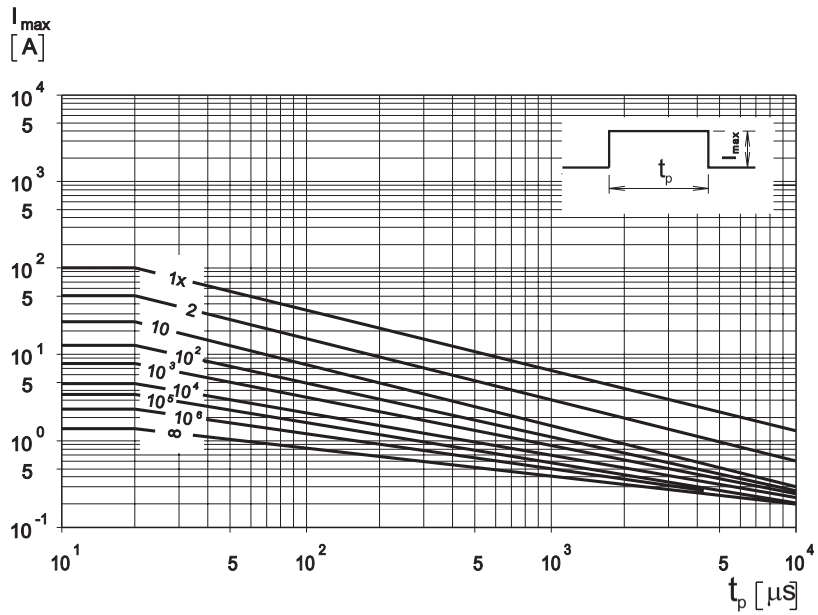


Pulse Rating Curves

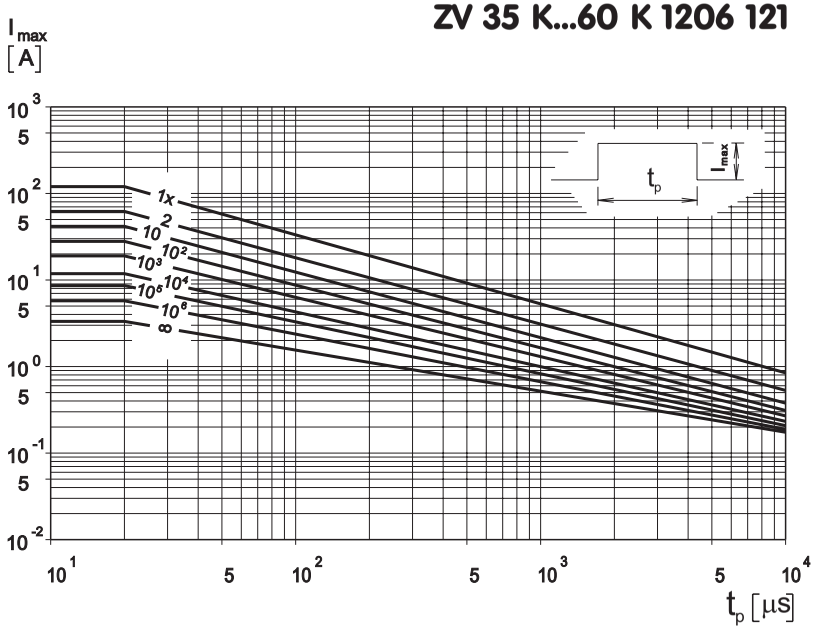
ZV 2 M...30 K 0603 300



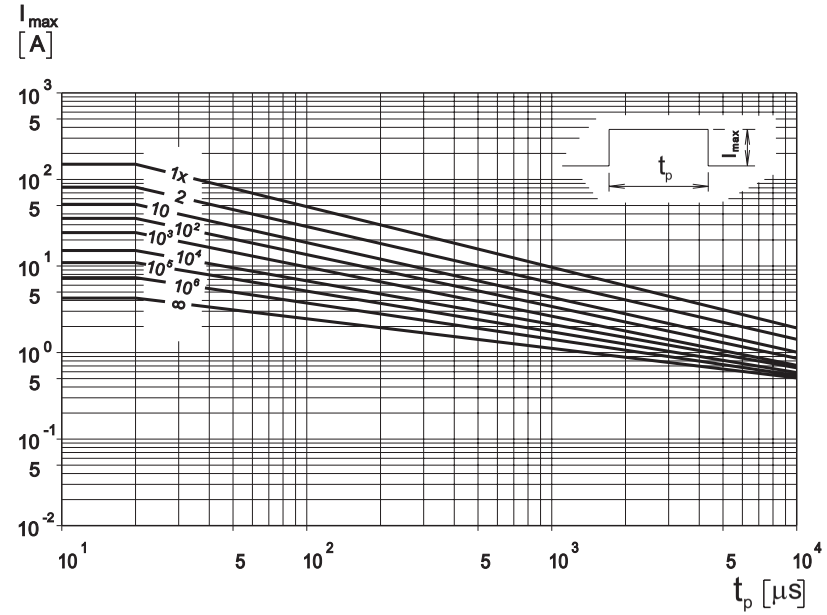
ZV 2 M...6 M 0805 101



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

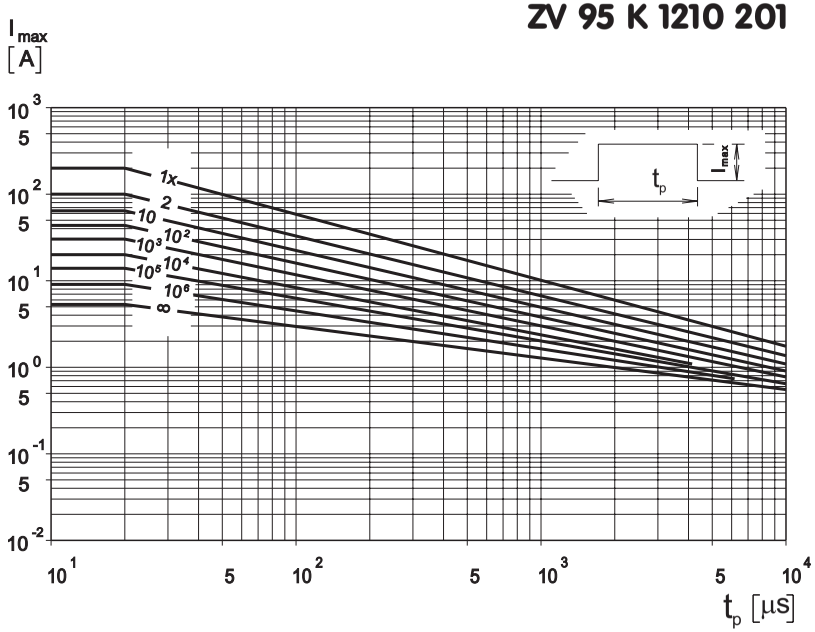


ZV 2 M...6 M 1206 151

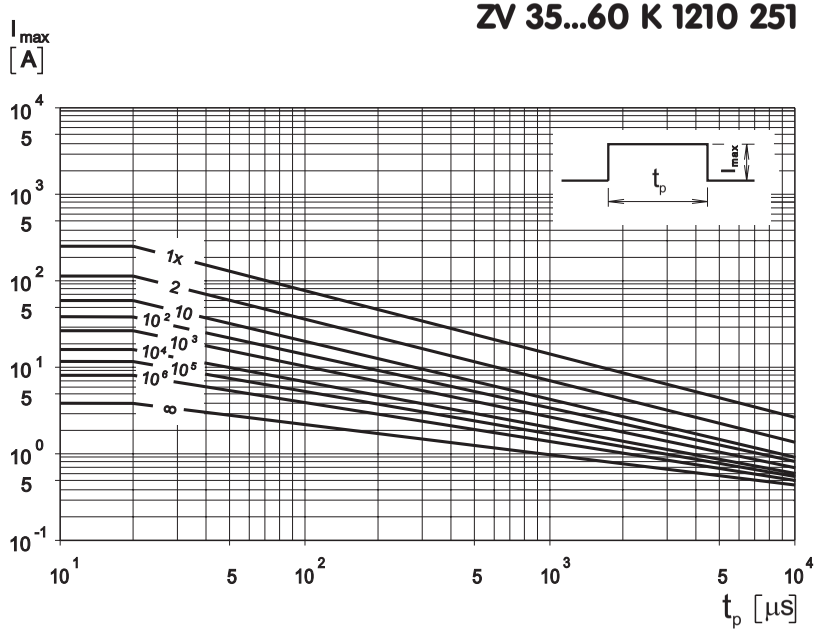


Pulse Rating Curves

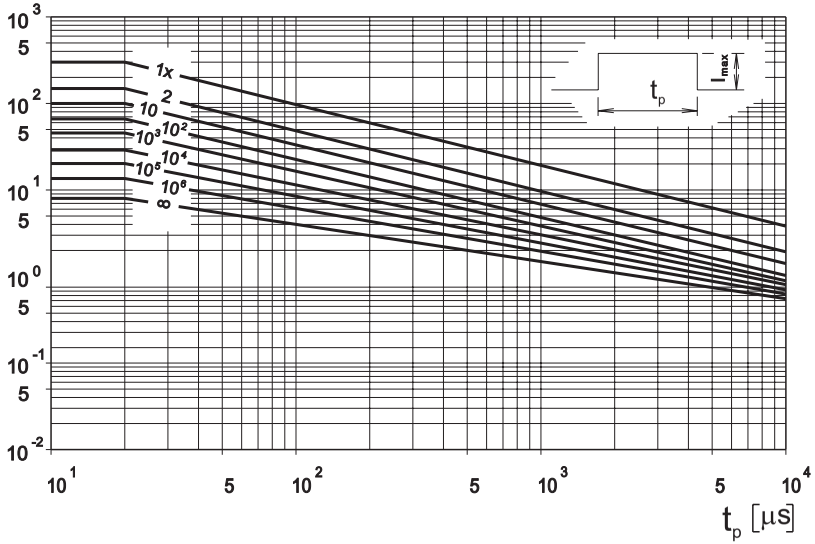
ZV 8 L...30 1206 201
ZV 95 K 1210 201



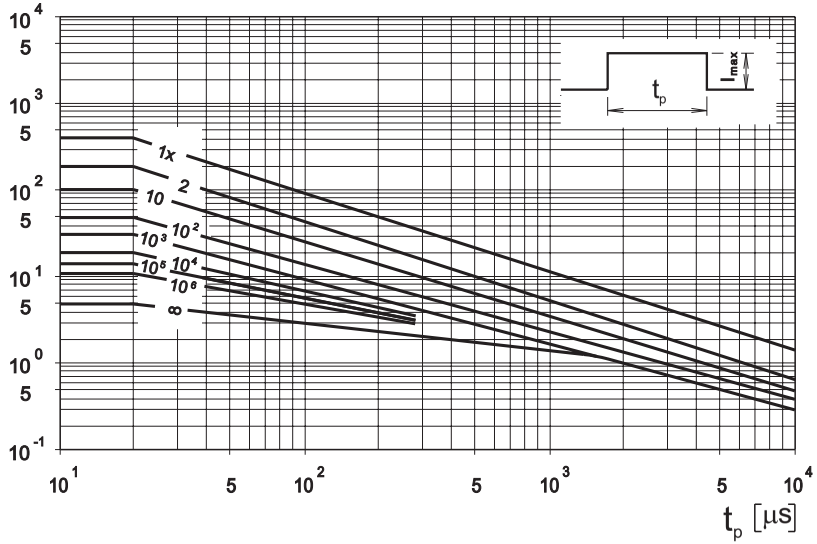
ZV 4 M 1210 251
ZV 35...60 K 1210 251



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

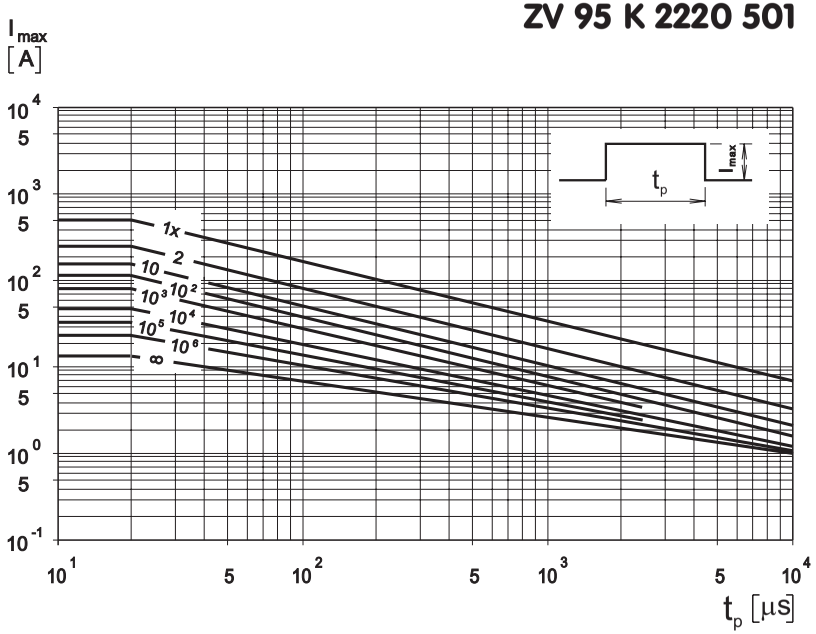


ZV 8 L...25 K 1210 401
ZV 50 K...60 K 1812 401

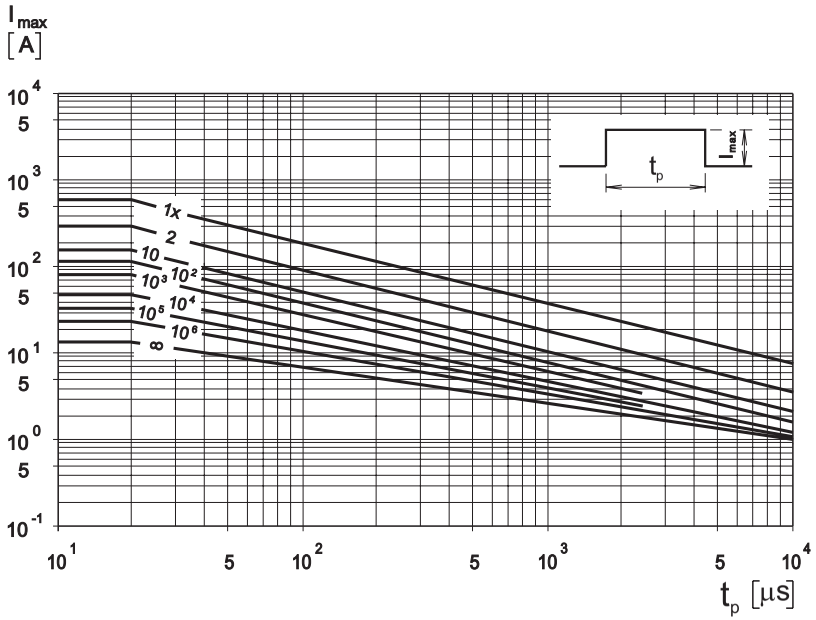


Pulse Rating Curves

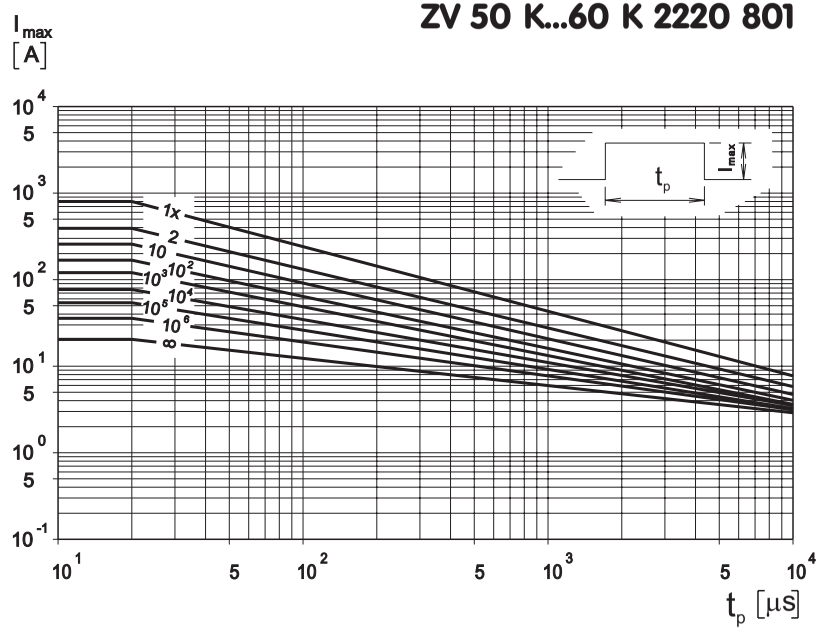
ZV 4 M...8 L 1812 501
ZV 95 K 2220 501



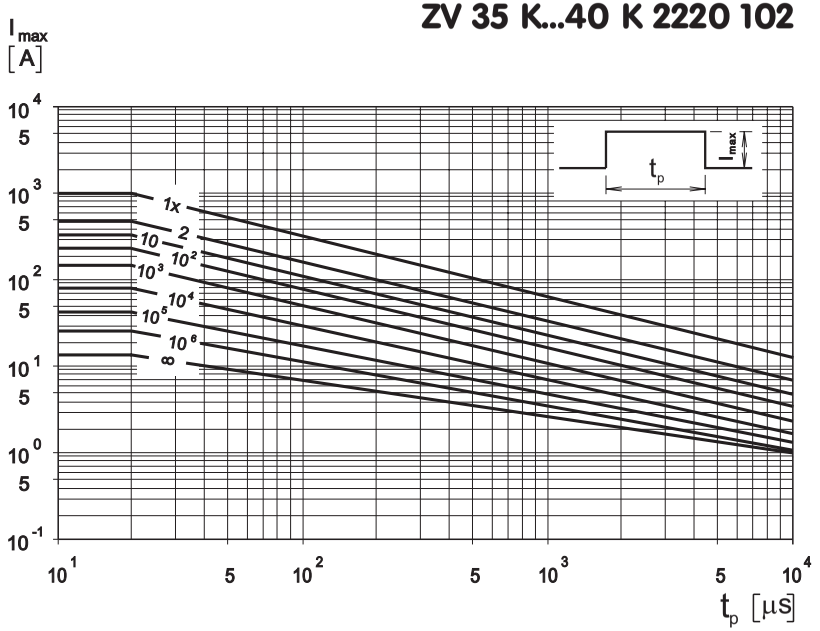
ZV 35 K...40 K 1812 601



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

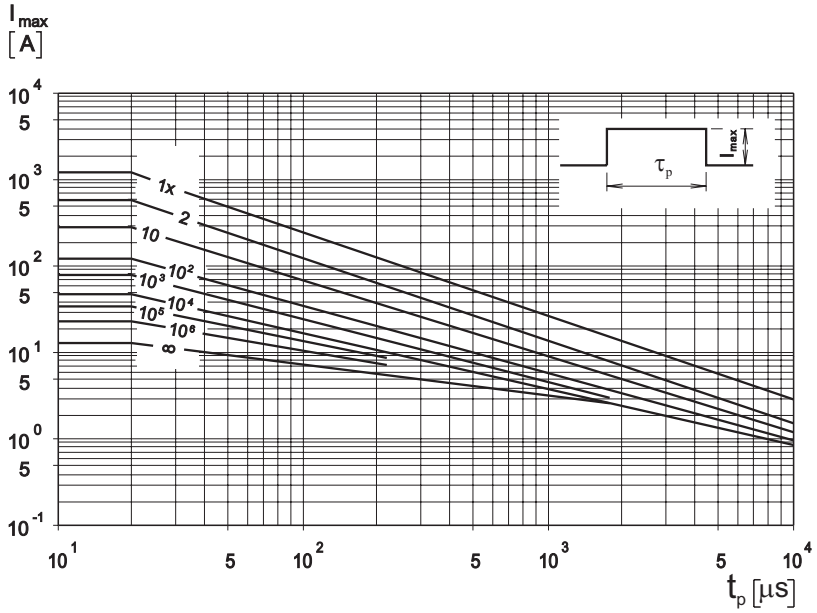


ZV 4 M 2220 102
ZV 35 K...40 K 2220 102



Pulse Rating Curves

ZV 6 M...30 K 2220 122

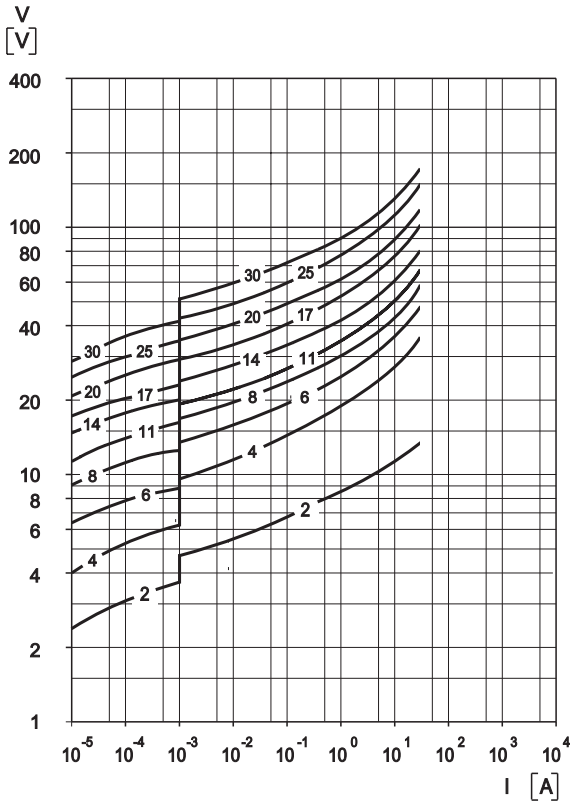


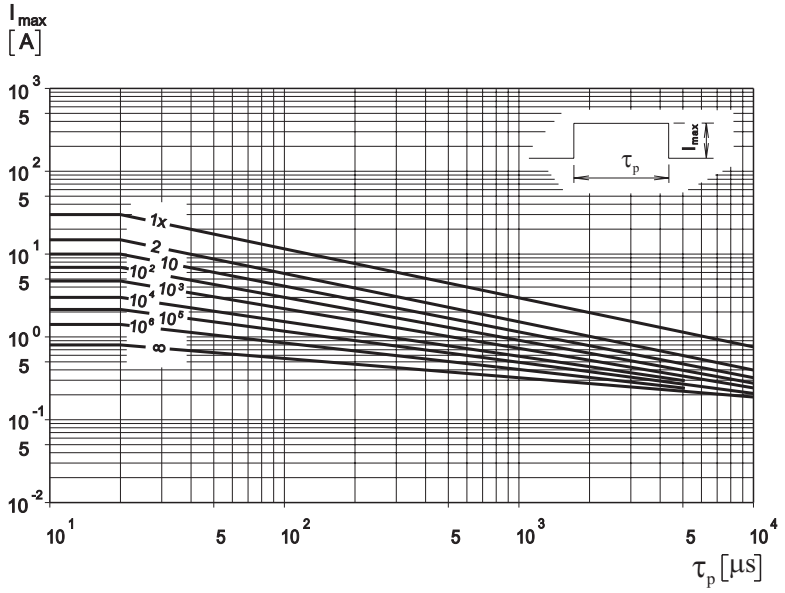
Protection Level

with the worst-case condition in the tolerance region

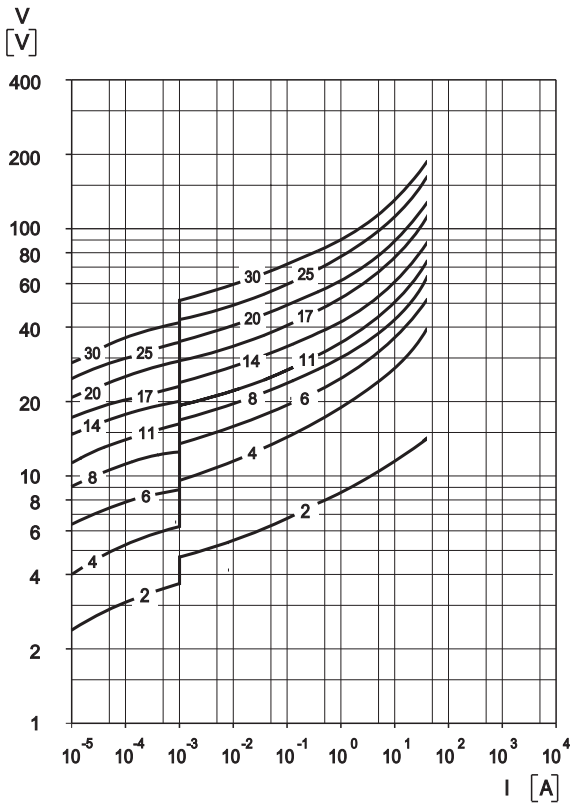
Pulse Rating Curves

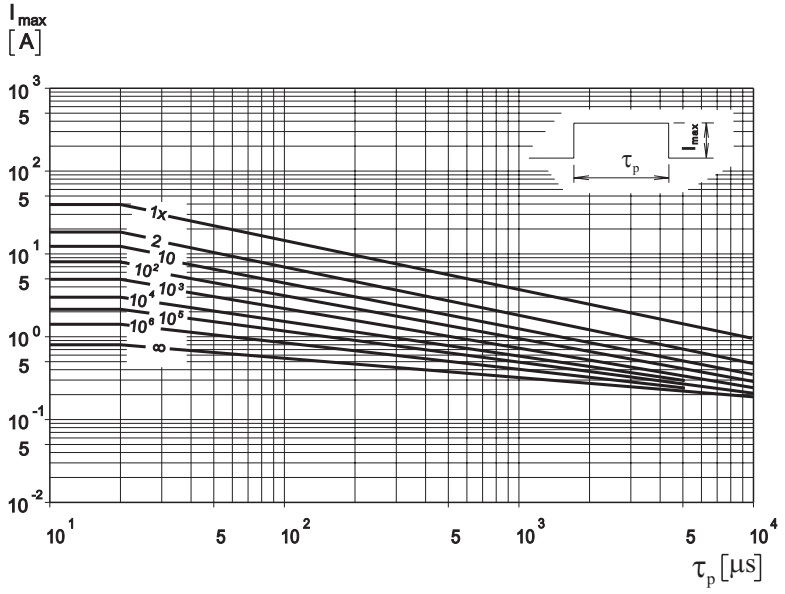
Model Size 0603
ZVX 2 ... 30 S





Model Size 0805
ZVX 2 ... 30 S



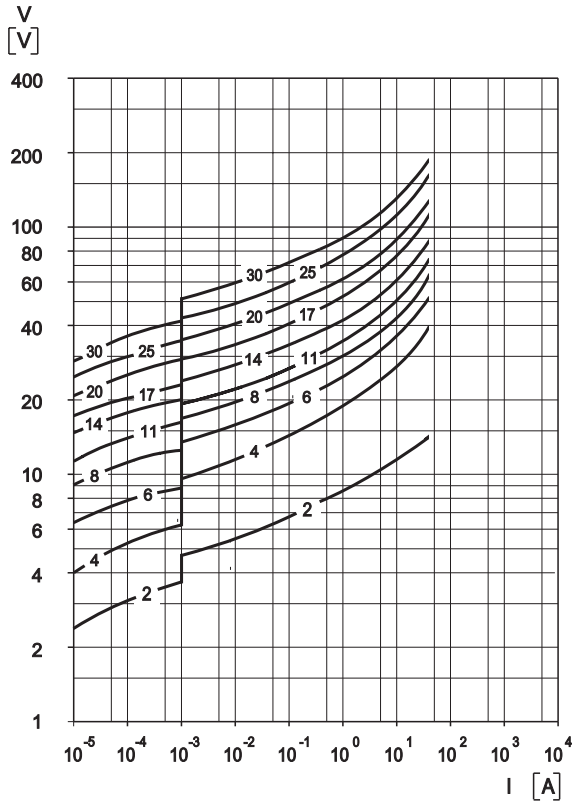


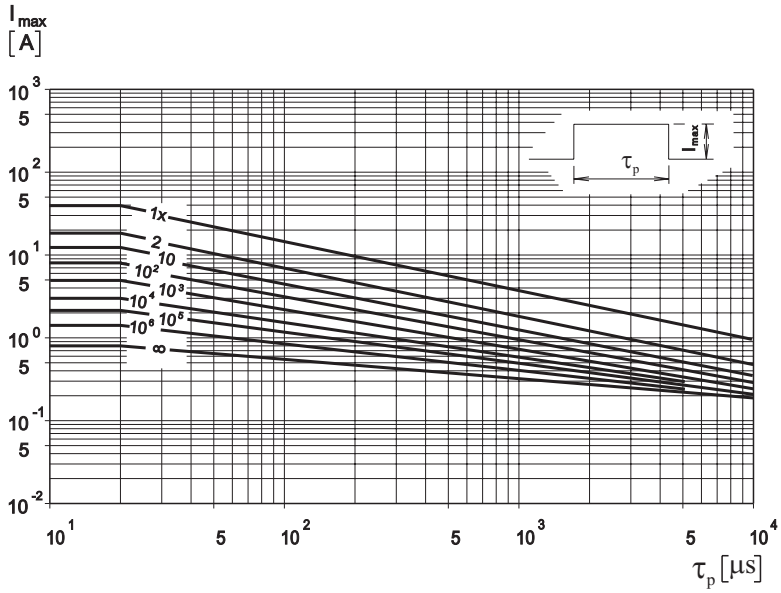
Protection Level

with the worst-case condition in the tolerance region

Pulse Rating Curves

Model Size 1206
ZVX 2....30 S



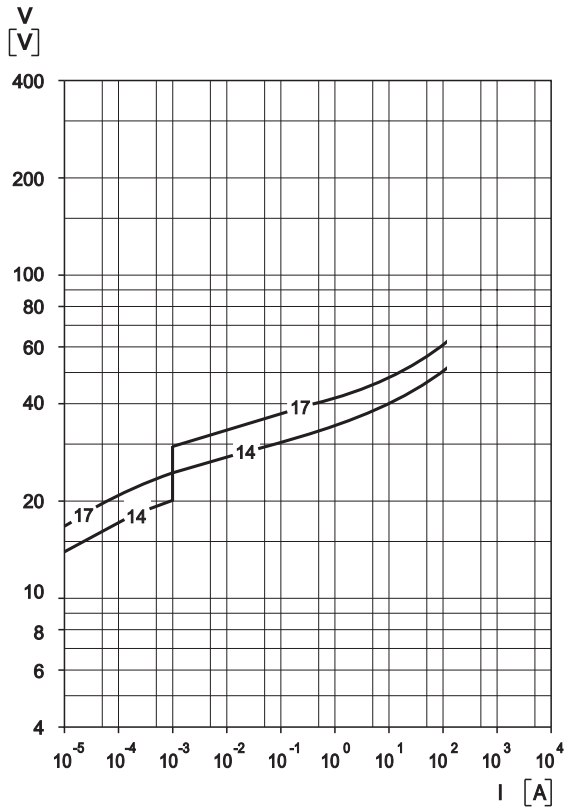


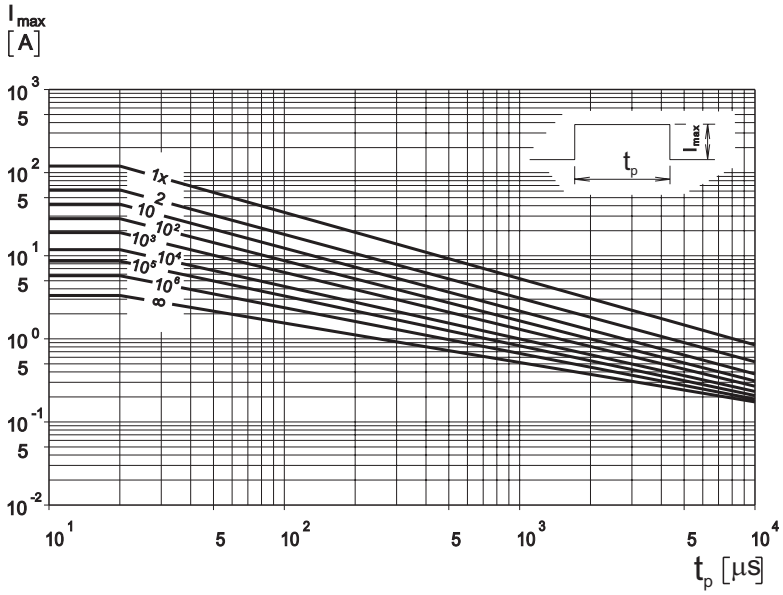
Protection Level

with the worst-case condition in the tolerance region

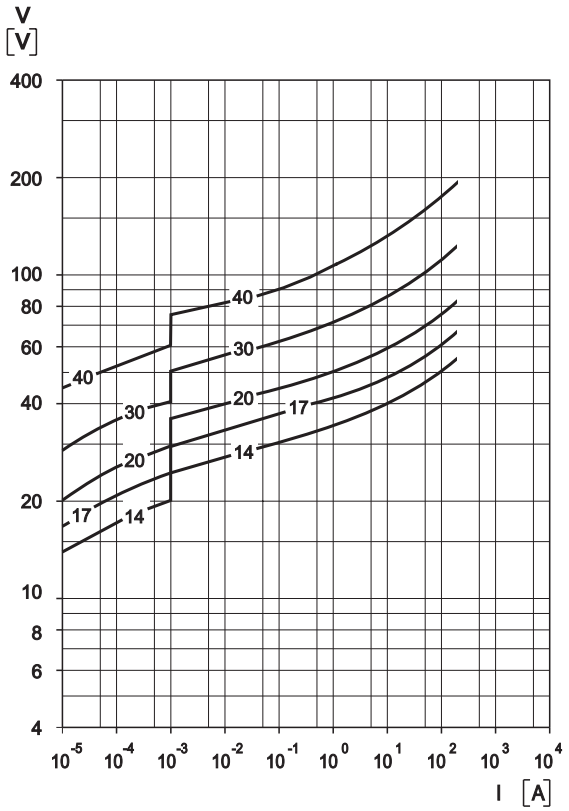
Pulse Rating Curves

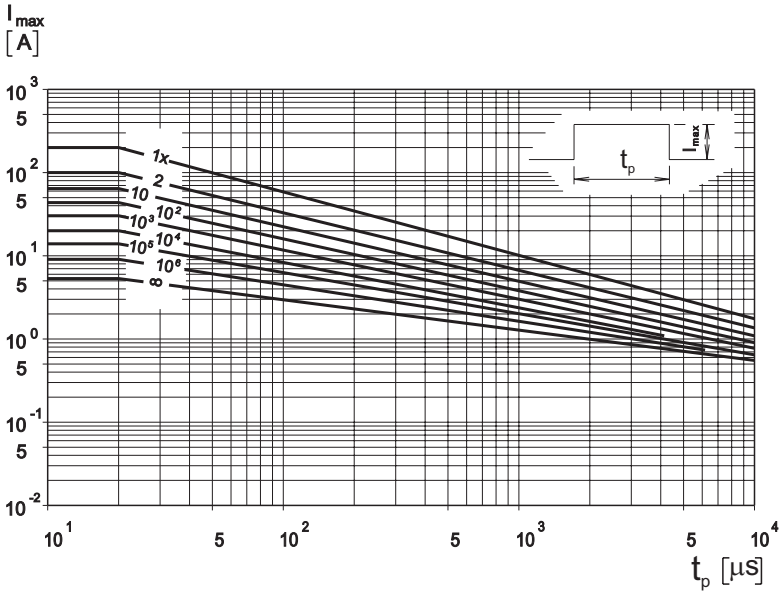
Model Size 0805
AV 14...17 K 0805 121





Model Size 1206
AV 14...40 K 1206 201



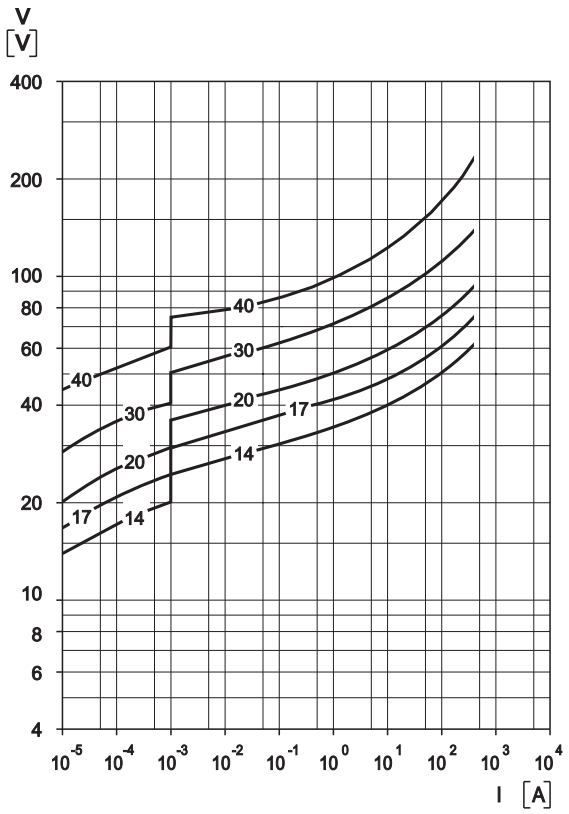


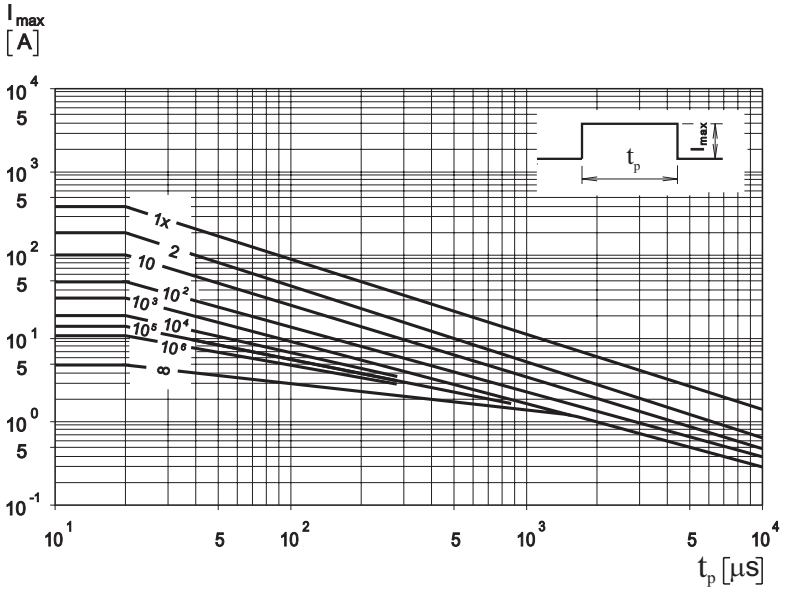
Protection Level

with the worst-case condition in the tolerance region

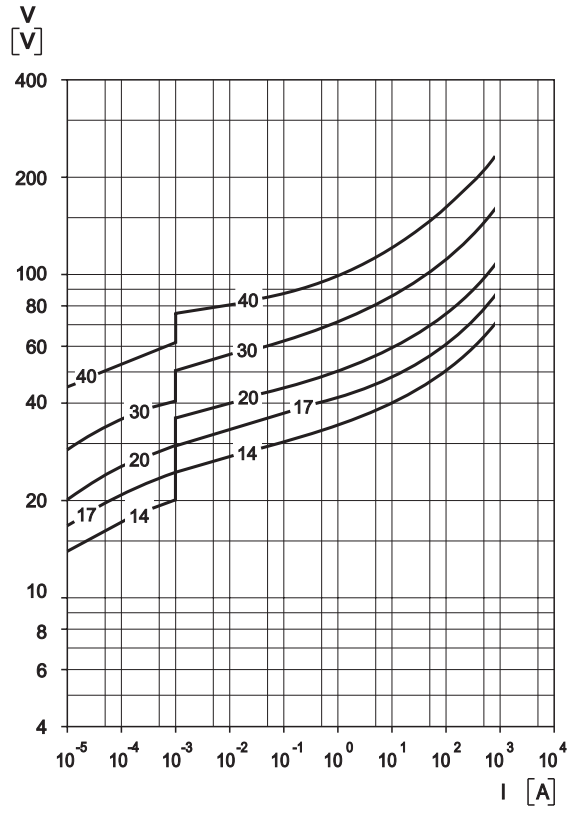
Pulse Rating Curves

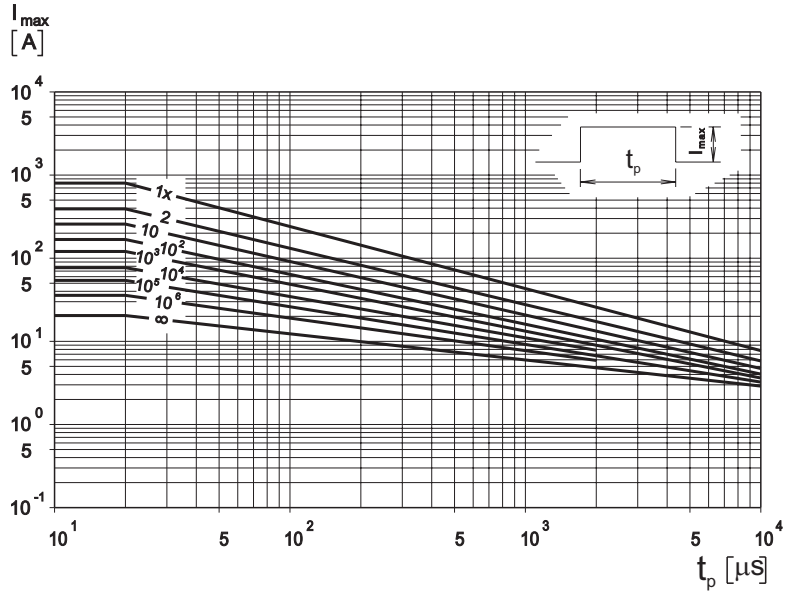
Model Size 1210
AV 14...40 K 1210 401





Model Size 1812
AV 14...40 K 1812 801



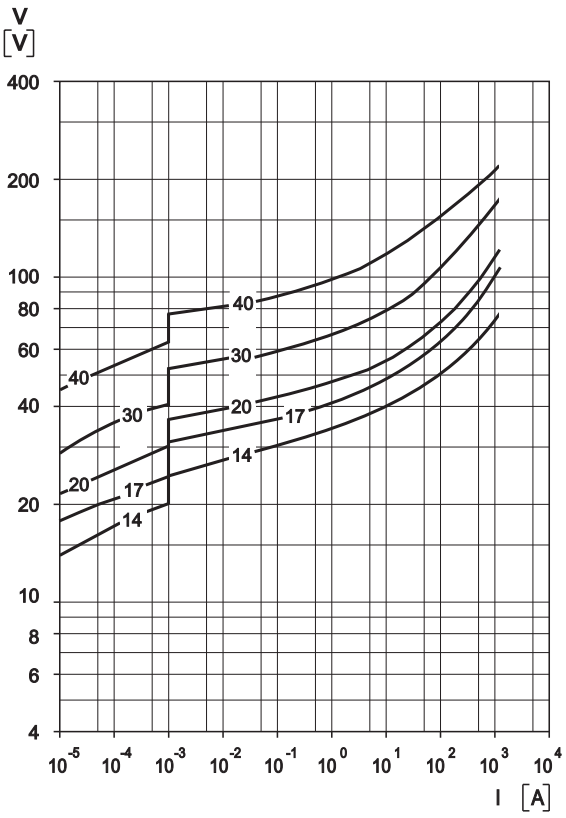


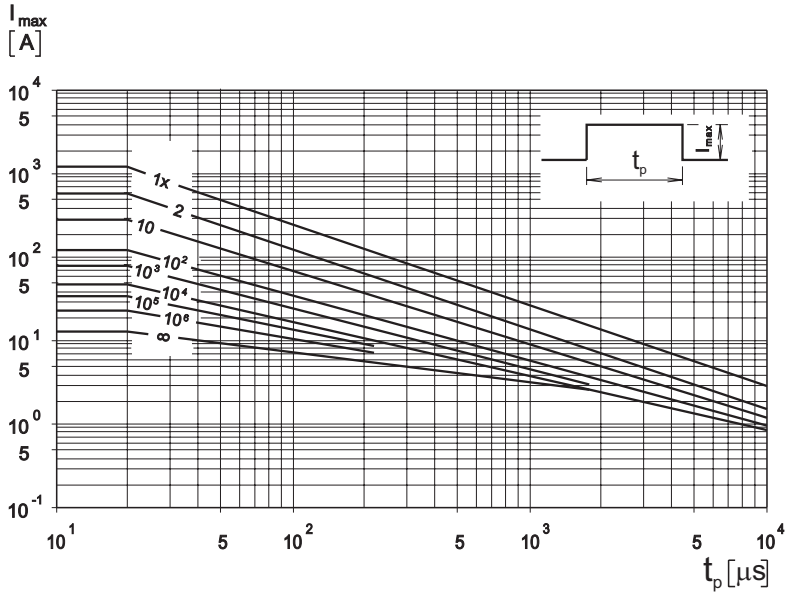
Protection Level

with the worst-case condition in the tolerance region

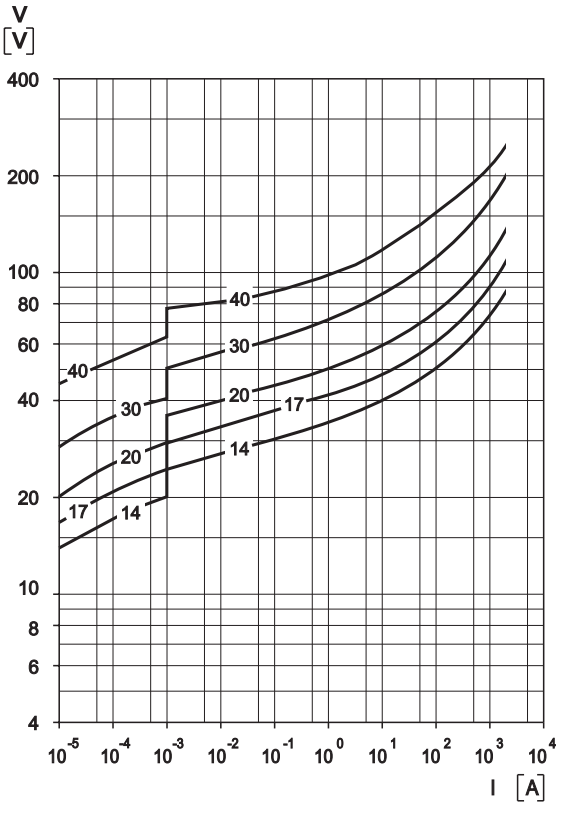
Pulse Rating Curves

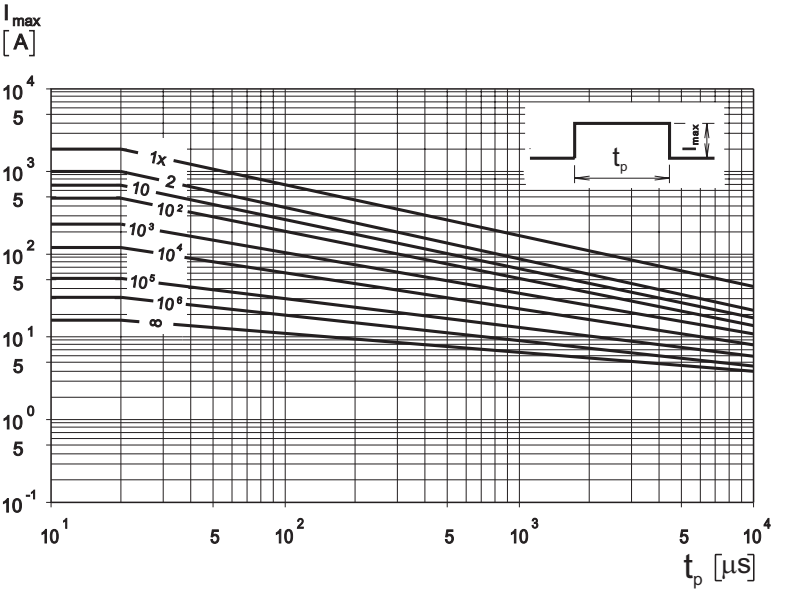
Model Size 2220
AV 14...40 K 2220 122





Model Size 3225
AV 14...40 K 3225 202





SOLDERING RECOMMENDATIONS

Popular soldering techniques used for surface mount 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-contaning and Pb-free soldering	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 by an epoxy adhesive. When the PCB has been fully populated and an appropriate time is allowed for adhesive curing, the completed assembly is then placed on a conveyor and run through a single or 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 (an 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. Recommended solder paste wet layer thickness is 100 to 300 μm. Once the circuit board is fully populated with SMD 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 prevent oxides from 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 chlorine content > 0.2 wt.% are ***NOT RECOMMENDED***. 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.

Solders - recommended solders are Pb-free (Sn96 / Cu0,4-0,8/ Ag3-4) or Pb-containing (62Sn / 36Pb / 2Ag) ones.

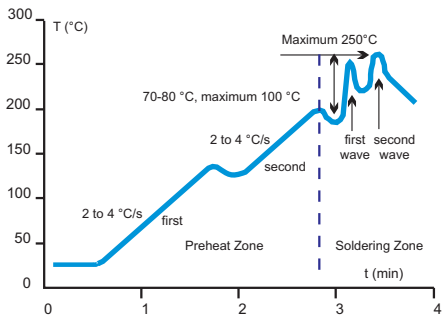


Fig. 1. Wave Soldering Temperature Profile for Pb-free and Pb-containing Soldering

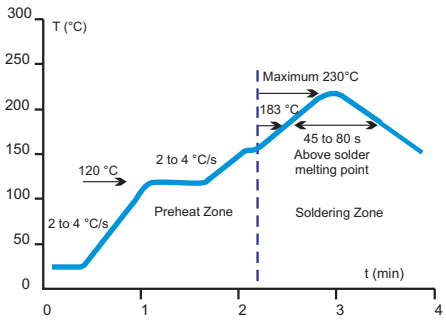


Fig. 2. Infrared Reflow Temperature Profile for Pb-containing Soldering

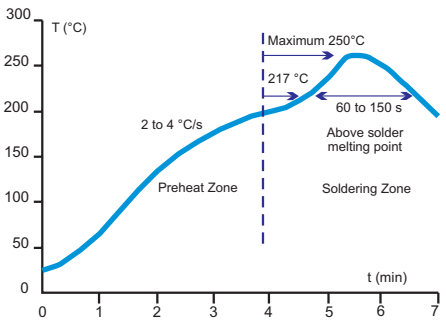


Fig. 3. Reflow Temperature Profile for Pb-free Soldering

Thermal Shock - to avoid the possibility of generating stresses in the varistor chip due to thermal shock, a preheat stage to within 100 ^{0}C of the peak soldering process temperature is recommended. Additionally, SMD varistors should not be subjected to a temperature gradient greater than 4 ^{0}C/sec, with an ideal gradient being 2 ^{0}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 a hot PCB to cool to less than 50 ^{0}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 materials and process profiles.

Pb-contining Wave and IR Reflow Soldering - typical "before" and "after" soldering results for Silver/Palladium (AgPd) and Barrier Type End Terminations are given 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 silver/palladium terminated varistor will be slightly different. Solder forms a metallurgical junction with the thin tin-alloy (over the barrier layer), and due to its small volume "climbs" the outer surface of the termination, forming a classical meniscus. Due the surface tension characteristics of silver/palladium 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.

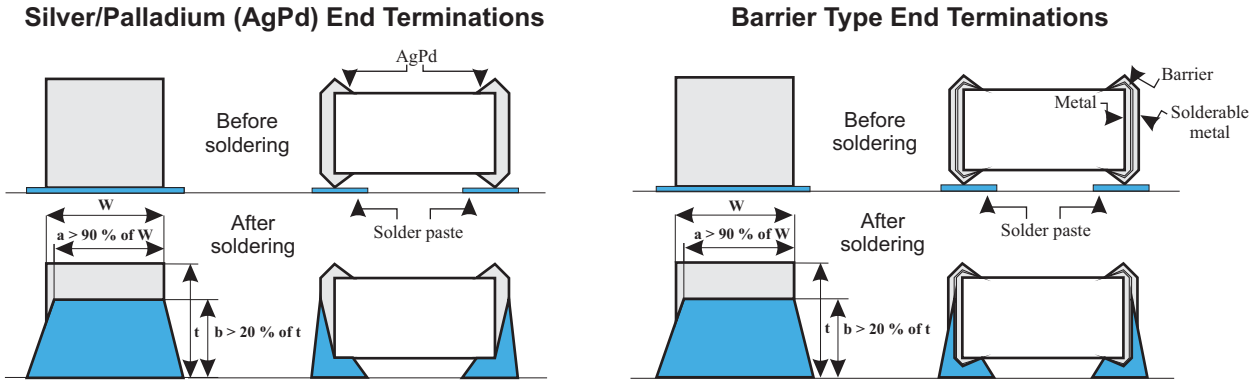


Fig. 4. Soldering Criterion in case of Wave and IR Reflow Pb-containing Soldering

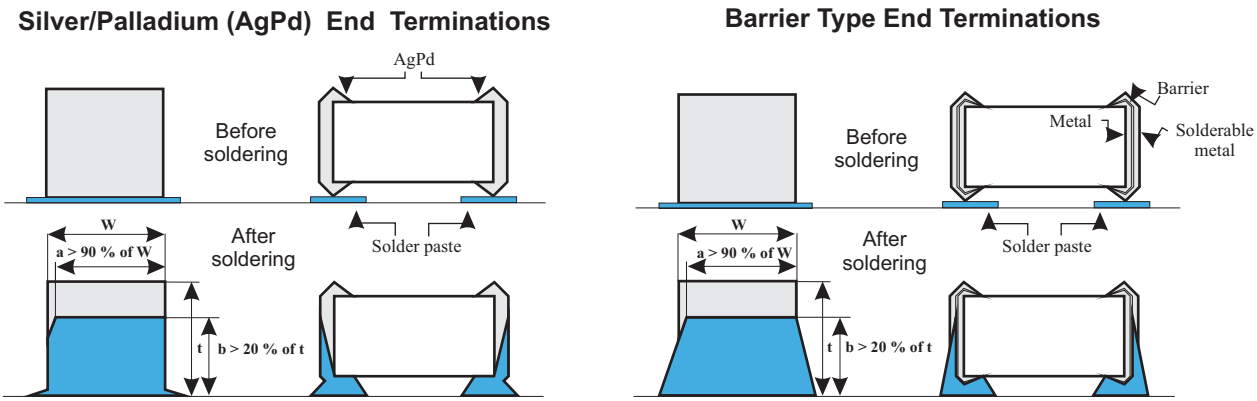


Fig. 5. Soldering Criterion in case of Wave and IR Reflow Pb-free Soldering

Pb-free Wave and IR Reflow Soldeirng - typical “before” and “after” soldering results for Silver/Palladium (AgPd) and Barrier Type End Terminations are given in Fig. 5. Barrier type varistor terminations provide standard meniscus and are recommended for Pb-free soldering.

A phenomenon known as “mirror” or “negative” meniscus results will appear in case of Silver/Palladium termiinated varistors. Solder forms 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 higher than 30% of 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 Tests 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. Solderability of a specific lot can be checked at any time within this period should a customer require this information.

Test / Parameter	Resistance to flux	Solderability	Static leaching (simulation of Reflow Soldering)	Dynamic leaching (simulation of Wave Soldering)
Soldering method	dipping	dipping	dipping	dipping with agitation
Flux	L3CN, ORL0	L3CN, ORL0, R	L3CN, ORL0, R	L3CN, ORL0, R
Pb Solder	96,5Sn / 3,5Ag			
Pb Soldering temperature (^{0}C)	235 ± 5	235 ± 5	260 ± 5	235 ± 5
Pb-FREE Solder	Sn96 / Cu0,4-0,8 / 3-4Ag			
Pb-FREE Soldering temperature (^{0}C)	250 ± 5	250 ± 5	280 ± 5	250 ± 5
Soldering time (s)	2	2	10	> 15
Burn-in conditions	Vdcmax, 48 h	-	-	-
Acceptance criterion	dVn < 5 %, Idc 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 varistor chips. If no other means of rework is available, the following criteria must be strictly followed:

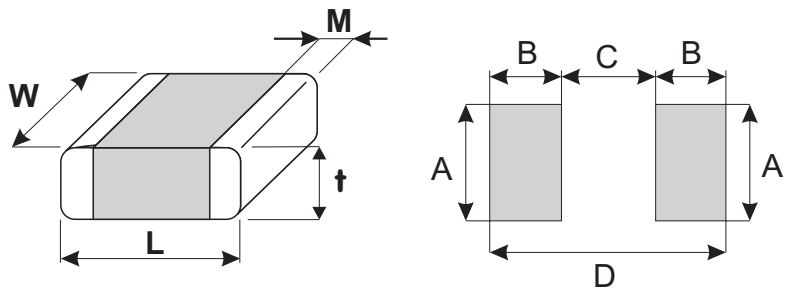
- Do not allow the tip of the iron to directly contact the top of the chip
- Do not exceed the following soldering iron specifications:

Output 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.

Soldering Pad Configuration

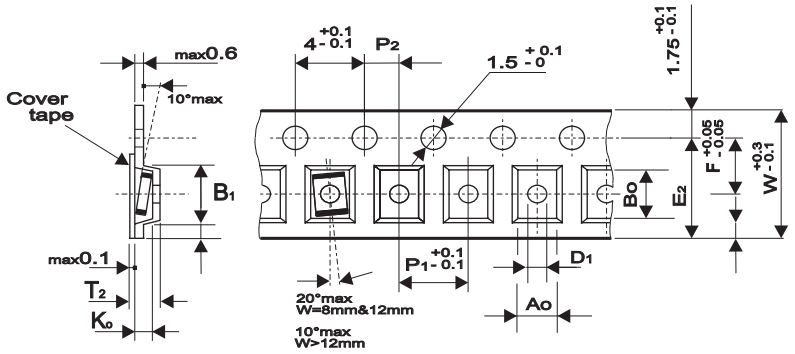


Size	L	W	M	tmax	A	B	C	D
	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
0603	1,6 ± 0,20	0,80 ± 0,10	0,5 ± 0,25	1,0	1,0	1,0	0,6	2,6
0805	2,0 ± 0,25	1,25 ± 0,20	0,5 ± 0,25	1,1	1,4	1,2	1,0	3,4
1206	3,2 ± 0,30	1,60 ± 0,20	0,5 ± 0,25	1,6	1,8	1,2	2,1	4,5
1210	3,2 ± 0,30	2,50 ± 0,25	0,5 ± 0,25	1,8	2,8	1,2	2,1	4,5
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

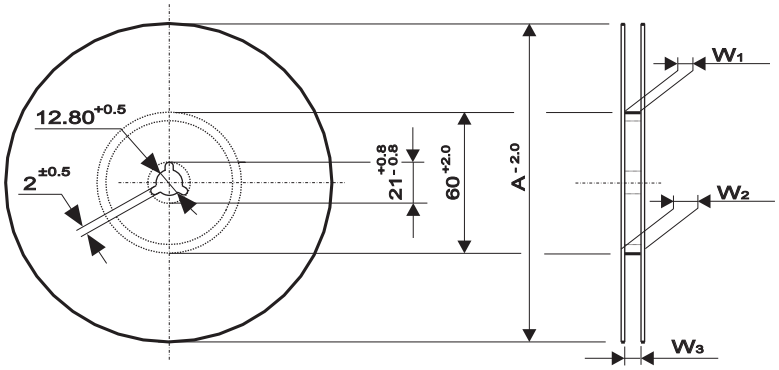
Tape and Reel Specification

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		0805		1206		1210		1812		2220		3225	4032
		Reel size		Reel size		Reel size		Reel size		Reel size		Reel size		Reel size	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

Reliability Testing Procedures

Varistor testing procedures comply with CECC 42200, IEC 1051-2 and AEC-Q200.
Testing results are available 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	$\lvert\delta V_n$ (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	$\lvert\delta V_n$ (1 mA)$\rvert$ < 10 % no visible damage
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 pulse every 2 minutes at maximum peak current for 10 pulses	$\lvert\delta V_n$ (1 mA)$\rvert$ < 10 % no visible damage
WLD Capability	WLD x 10	ISO 7637, Test pulse 5, 10 pulses at rate 1 per minute	$\lvert\delta V_n$ (1 mA)$\rvert$ < 15 % no visible damage
Vjump Capability	V_{jump} 5 min	Increase of supply voltage to V ≥ V_{jump} for 1 minute	$\lvert\delta V_n$ (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, 16 h, 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	$\lvert\delta V_n$ (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	$\lvert\delta V_n$ (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.	$\lvert\delta V_n$ (1 mA)$\rvert$ < 10 %
	Storage Test	IEC 68-2-2, Test Ba, AEC-Q200 Test3, 1000 h at maximum storage temperature	$\lvert\delta V_n$ (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 and reflow method	$\lvert\delta V_n$ (1 mA)$\rvert$ < 5 %
	Terminal Strength	JIS-C-6429, App. 1, 18N for 60 s - same for AEC-Q200 Test22	no visual damage
	Board Flex	JIS-C-6429, App. 2, 2 mm min AEC-Q200 Test21 - Board flex: 2mm flex min..	$\lvert\delta V_n$ (1 mA)$\rvert$ < 2 % no visual damage
	Vibration	CECC 42200, Test 4.15., Test Fc, IEC 68-2-6, AEC-Q200 Test14. Frequency range 10 to 55 Hz (AEC : 10-2000Hz) Amplitude 0.75 m/s² or 98 m/s² (AEC :5g's for 20minutes) Total duration 6 h (3 x 2 h) (AEC : 12cycles each of 3 directions) Waveshape - half sine	$\lvert\delta V_n$ (1 mA)$\rvert$ < 10 % no visible damage
	Mechanical Shock	CECC 42200, Test 4.14, Test Ea, IEC 68-2-27, AEC-Q200 Test13. Acceleration = 490 m/s² (AEC : MIL-STD-202-Method 213), Pulse duration = 11 ms, Waveshape - half sine Number of shocks = 3 x 6	$\lvert\delta V_n$ (1 mA)$\rvert$ < 10 % no visible damage
Electrical Transient Conduction	ISO-7637-1 Pulses	AEC-Q200 Teat30 : Test pulses 1 to 3. Also other pulses - freestyle.	$\lvert\delta V_n$ (1 mA)$\rvert$ < 10 % no visible damage

Protective Device Programme

Leaded Varistors

- **AV Series** - Leaded(TH) Automotive Varistors
- **ZV Series** - Leaded(TH) Low Voltage Varistors
- **CV Series** - Medium Voltage Disc Varistors
- **CV+ Series** - Extended Medium Voltage Disc Varistors
- **SV Series** - Special Medium Voltage Varistors
  - *Standard Types*
  - *Full Custom Parameter Designed Types*

High Energy Varistors

- **ZOV Series** - Square Shaped High Energy Varistors
  - *Standard Types*
  - *Full Custom Parameter Designed Types*
  - *Stacked High Energy Varistor Blocks*
- **ZOVR Series** - Round Shaped High Energy Varistors
- **ZOVS Series** - Stacked High Energy Varistors

SMD Varistors

- **PV Series** - SMD Plastic Encapsulated Varistors
- **DV Series** - Low Profile Medium Voltage SMD Varistors

SMD Varicons

- **ZV Series** - SMD Low Voltage Varicons
- **ZVE Series** - ESD Suppression Varicons
- **ZVX Series** - Low Capacitance & Low Energy Varicons
- **AV Series** - SMD Automotive Varicons

Dual Function Varicons

- **MV Series** - Dual Function Low Voltage Varicons (SMD and TH)
- **OV Series** - Dual Function Automotive Varicons (SMD and TH)

Ceramic Capacitors

- **KM Series** - RFI Suppression Capacitors
- **KZ Series** - Safety Capacitors
- **KV Series** - High Voltage Capacitors
- **C Series** - SMD multilayer Capacitors
- **CL Series** - Leaded(TH) multilayer Capacitors

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