Catalogue - PROTECTIVE DEVICES - Edition 2015

KEKOVARICON

Varistors

SMD, THD, High Energy

Varicons

Multilayer SMD and THD

Dual Function Varicons

Capacitors

Safety class X and Y disc capacitors

High voltage disc capacitors

www.keko-varicon.si

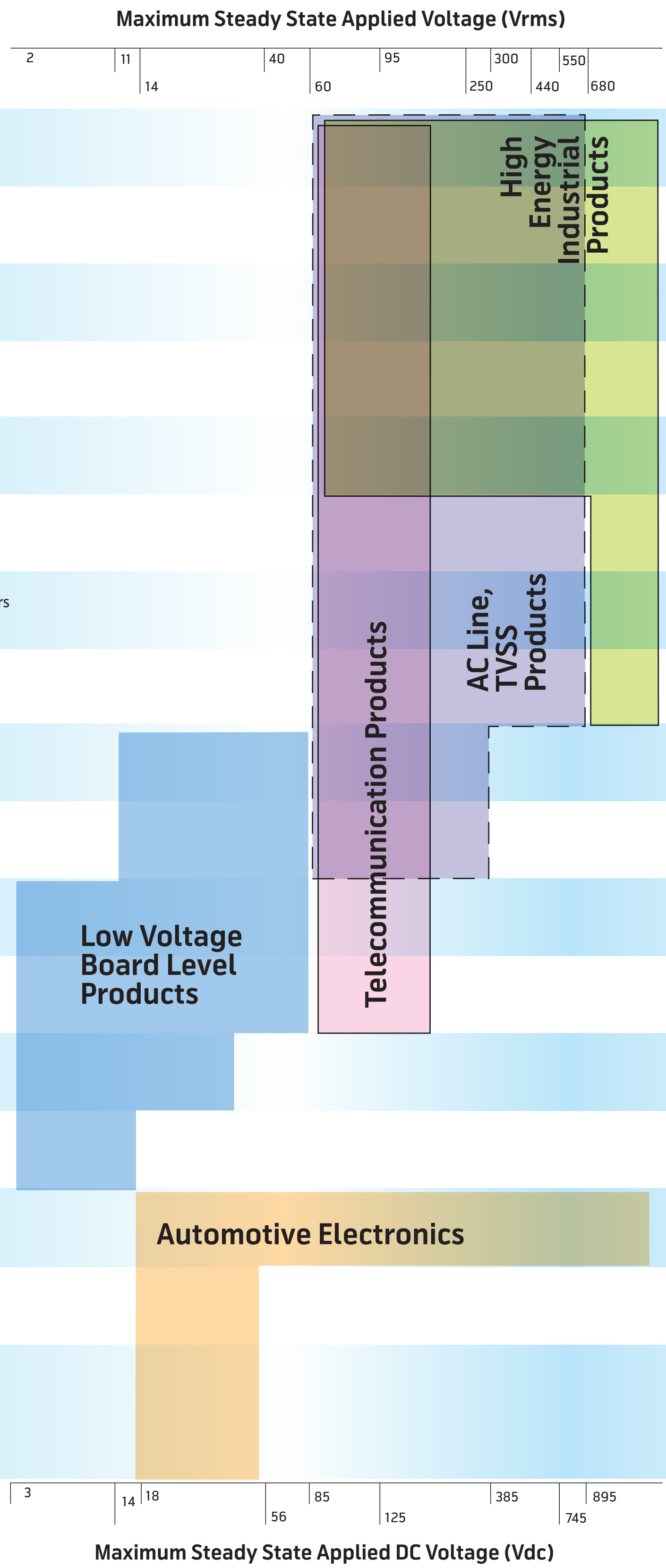
OVERVIEW OF PROTECTIVE DEVICES

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

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

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

APPLICATION FIELDS



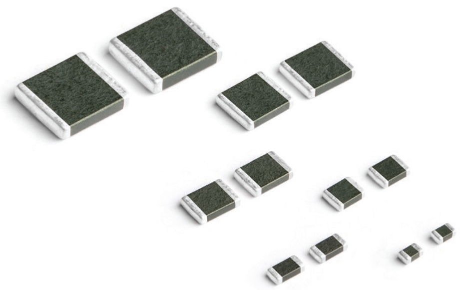
Series	Size (mm)	Package
ZOV Series Square Shaped High Energy Varistors	23, 25, 32, 40, 60	
ZOVR Series Round Shaped High Energy Varistors	25, 32, 40	
ZOVH / ZOVS Series High Energy Varistors for Class I Applications	40, 40 D2, 40 D3 (80,120)	
SV Series Special Medium Voltage Varistors	5, 7, 10, 14,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

AUTOMOTIVE VARISTORS - AV SERIES

Description

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

AV varistors offer excellent transient energy distribution. AV varistors require significantly less 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 50 J available upon request.
- + 125 °C maximum continuous operating temperature
- Automotive varistors with a lower or higher capacitance, as well as varistors with a 100 % controlled capacitance value, are available upon request.
- 6 model sizes available ...0805, 1206, 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 IEC 60068-2-58.
- RoHS 2 2011/65/EC, REACH, GADSL compliant.
- AEC-Q200 qualified Grade 1.

Absolute Maximum Ratings

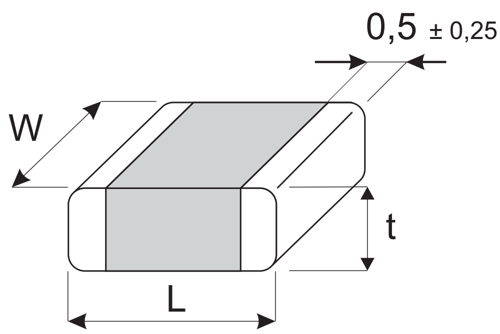
Continuous:	Units	Value
Steady State Applied Voltage:		
DC Voltage Range (V_{dc})	V	16 to 56
Transient:		
Load Dump Energy (WDL)	J	1 to 25 *
Jump Start Capability (5 minutes), (V_{jump})	V	24,5 to 65
Peak Single Pulse Surge Current, 8/20 µs Waveform (I_{max})	A	120 to 2000
Single Pulse Surge Energy, 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 50 J are available upon request.

Device Ratings and Characteristics

Dimensions

	L mm	W mm	t_{max} mm
0805	2,0 ± 0,25	1,25 ± 0,20	1,0
1206	3,2 ± 0,30	1,60 ± 0,20	1,2
1210	3,2 ± 0,30	2,50 ± 0,25	1,3
1812	4,7 ± 0,40	3,20 ± 0,30	1,3
2220	5,7 ± 0,50	5,00 ± 0,40	1,4
3225	8,0 ± 0,50	6,30 ± 0,40	1,5



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

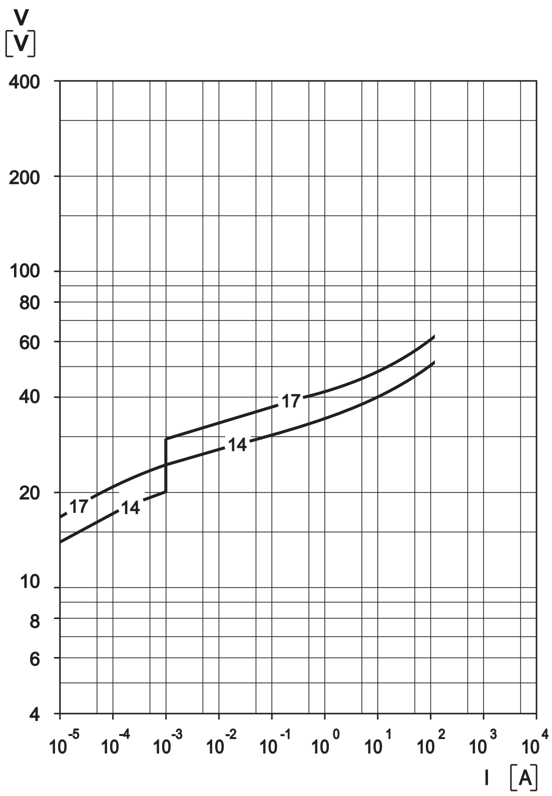
Type	V_{rms} V	V_{dc} V	V_n 1 mA V	V_{jump} 5 min V	V_c V	I_c 8/20 µs A	I_{max} 8/20 µs A	W_{max} 10/1000 µs J	WLD 10 x J	P max W	C_{typ} @ 1 kHz nF
12 V Power Supply											
AV 14 K 0805 121	14	16	24	24,5	40	1	120	0,3	1	0,008	0,44
AV 14 K 1206 201	14	16	24	24,5	40	1	200	0,6	1,5	0,008	1,00
AV 14 K 1210 401	14	16	24	24,5	40	2,5	400	1,6	3,	0,010	2,23
AV 14 K 1812 801	14	16	24	24,5	40	5	800	2,4	6	0,015	4,50
AV 14 K 2220 122	14	16	24	24,5	40	10	1200	5,8	12	0,030	10,00
AV 14 K 3225 202	14	16	24	24,5	40	20	2000	12,5	25	0,040	16,00
AV 17 K 0805 121	17	20	27	30	44	1	120	0,5	1	0,008	0,37
AV 17 K 1206 201	17	20	27	30	44	1	200	1,1	1,5	0,008	0,81
AV 17 K 1210 401	17	20	27	30	44	2,5	400	1,8	3	0,010	2,00
AV 17 K 1812 801	17	20	27	30	44	5	800	2,9	6	0,015	3,80
AV 17 K 2220 122	17	20	27	30	44	10	1200	7,2	12	0,030	8,00
AV 17 K 3225 202	17	20	27	30	44	20	2000	13,8	25	0,040	13,20
24 V Power Supply											
AV 20 K 1206 201	20	26	22	30	54	1	200	1,6	1,5	0,008	0,78
AV 20 K 1210 401	20	26	22	30	54	2,5	400	1,9	3	0,010	1,65
AV 20 K 1812 801	20	26	22	30	54	5	800	3,0	6	0,015	3,30
AV 20 K 2220 122	20	26	22	30	54	10	1200	8,0	12	0,030	7,00
AV 20 K 3225 202	20	26	22	30	54	20	2000	15,0	25	0,040	11,00
AV 30 K 1206 201	30	34	47	50	77	1	200	2,0	1,5	0,008	0,53
AV 30 K 1210 401	30	34	47	50	77	2,5	400	2,3	3	0,010	1,10
AV 30 K 1812 801	30	34	47	50	77	5	800	3,8	6	0,015	2,20
AV 30 K 2220 122	30	34	47	50	77	10	1200	10,0	12	0,030	6,50
AV 30 K 3225 202	30	34	47	50	77	20	2000	17,0	25	0,040	6,60
42 V Power Supply											
AV 40 K 1206 201	40	56	68	65	110	1	200	2,2	1,5	0,008	0,40
AV 40 K 1210 401	40	56	68	65	110	2,5	400	2,6	3	0,010	0,90
AV 40 K 1812 801	40	56	68	65	110	5	800	4,8	6	0,015	1,80
AV 40 K 2220 122	40	56	68	65	110	10	1200	10,5	12	0,030	5,50
AV 40 K 3225 202	40	56	68	65	110	20	2000	21	25	0,040	6,20

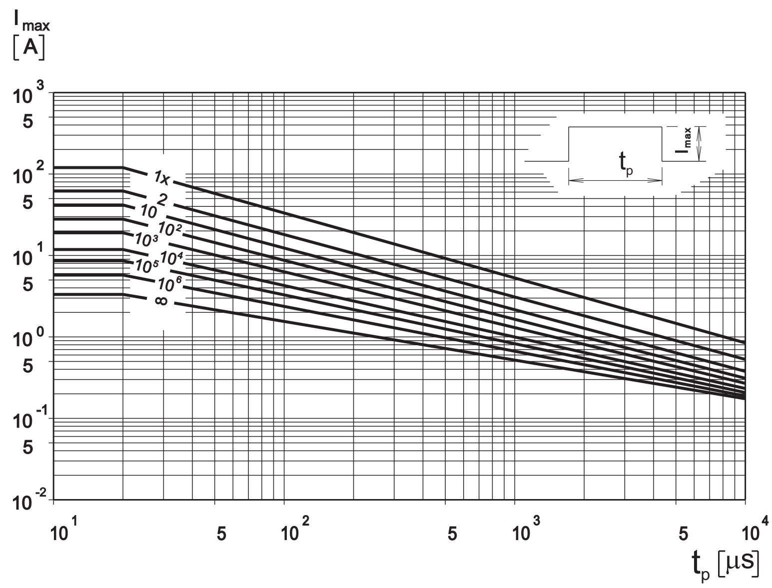
Protection Level

Pulse Rating Curves

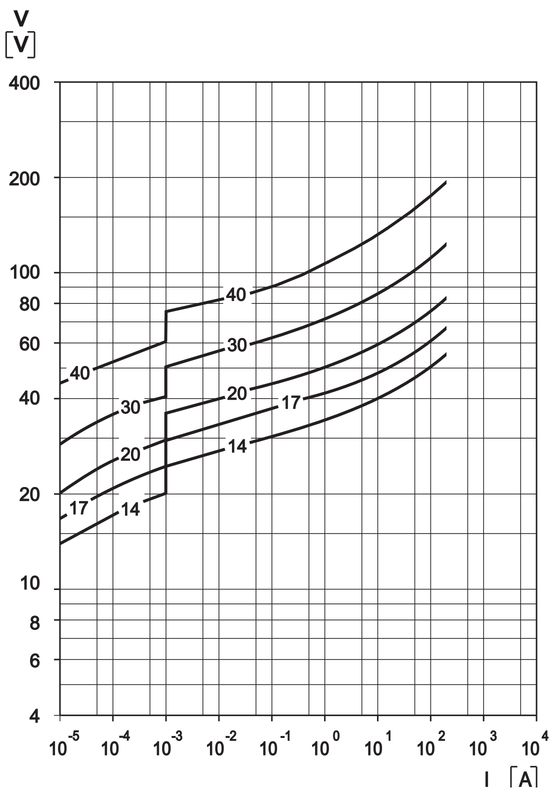
* In the most demanding conditions as per the tolerance region

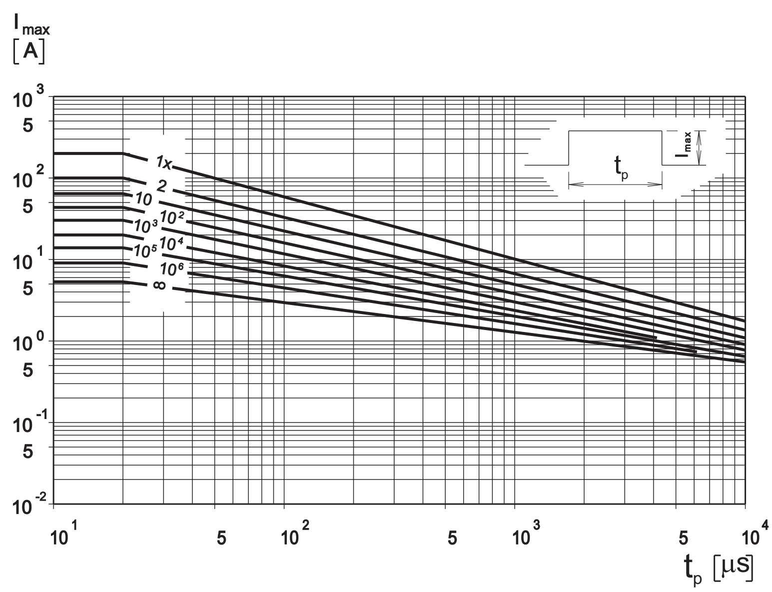
Model Size 0805
AV 14...17 K 0805 121





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



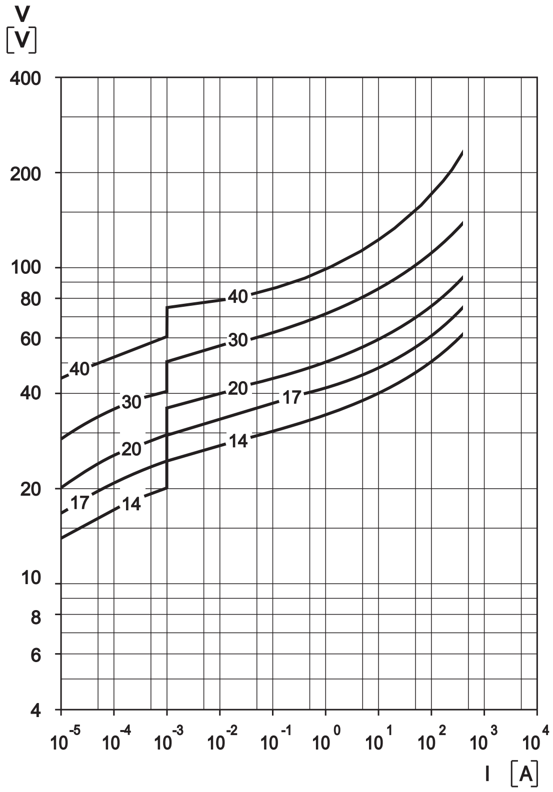


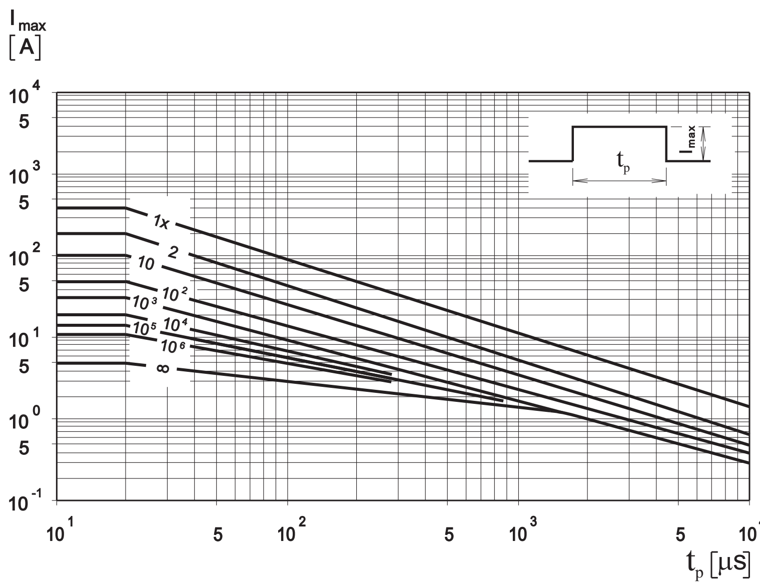
Protection Level

Pulse Rating Curves

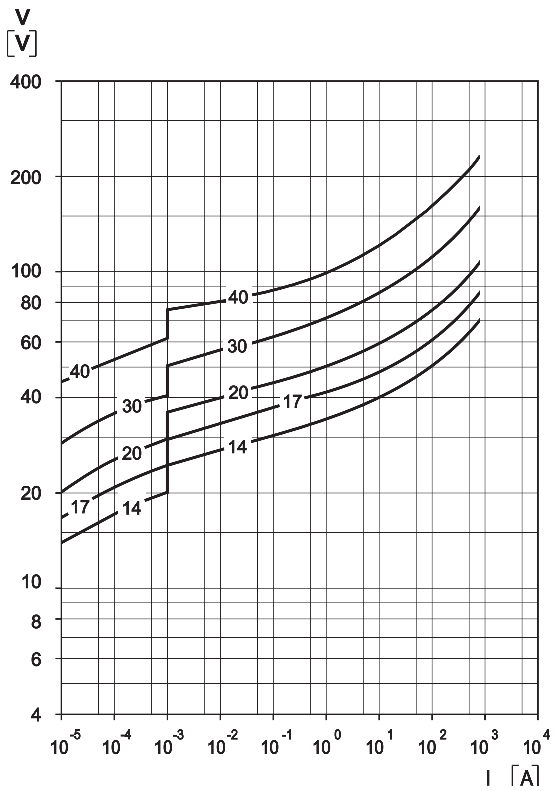
* In the most demanding conditions as per the tolerance region

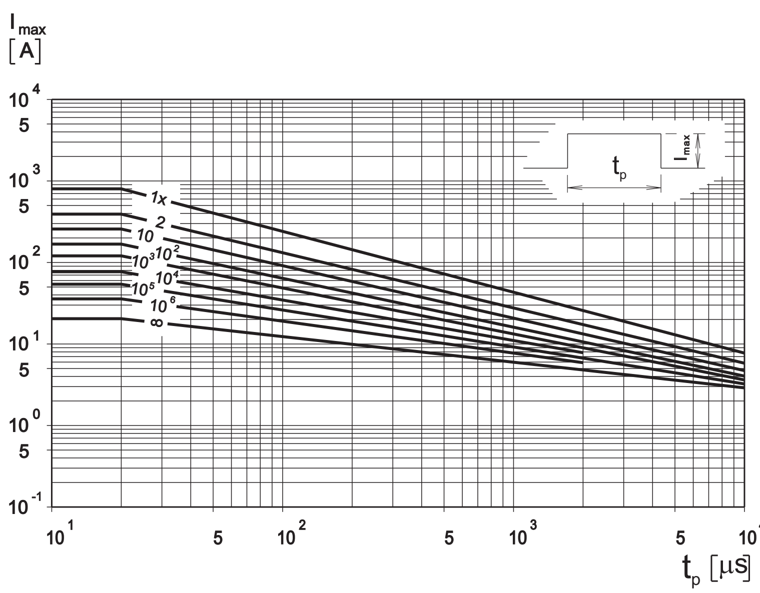
Model Size 1210
AV 14...40 K 1210 401





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



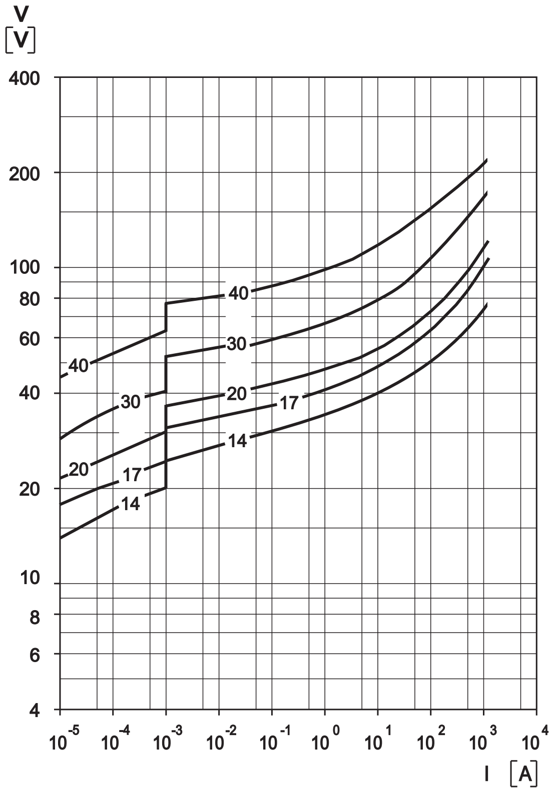


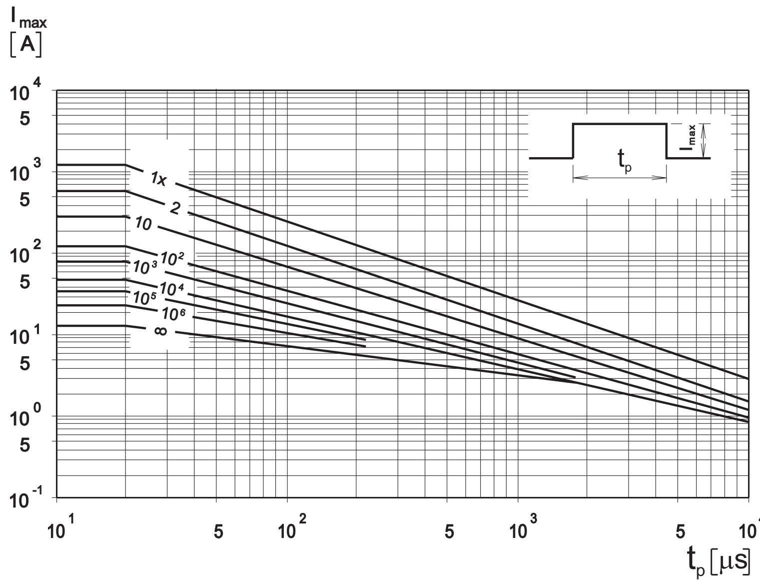
Protection Level

Pulse Rating Curves

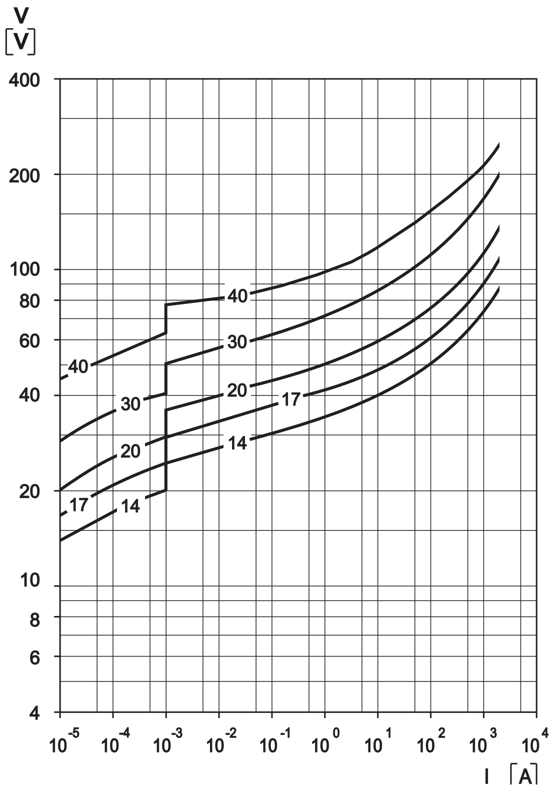
* In the most demanding conditions as per the tolerance region

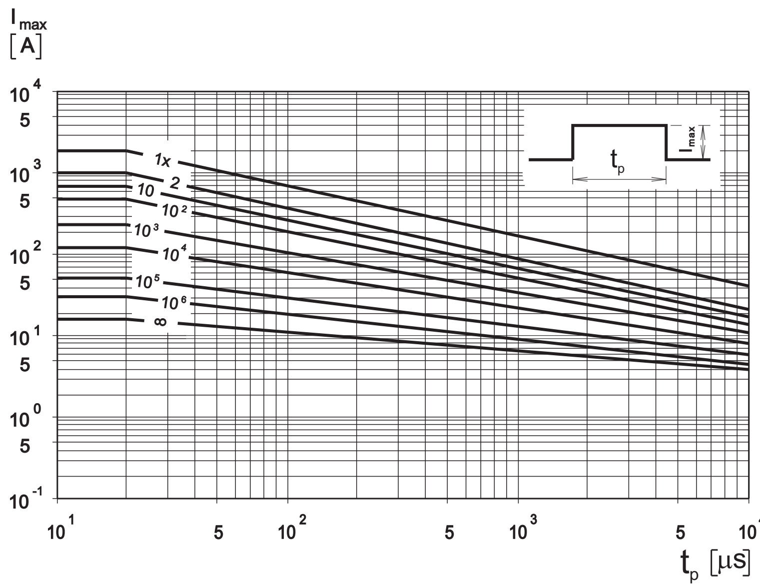
Model Size 2220
AV 14...40 K 2220 122





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





Reliability – Lifetime

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

The mean life of AV series components is a function of:

- Factor of Applied Voltage
- Ambient temperature.

Mean life is closely related to Failure rate (formula).
vMean 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, an intuitive corollary is that the rate changes over time versus the expected life cycle of a system.

Failure rate formula – calculation

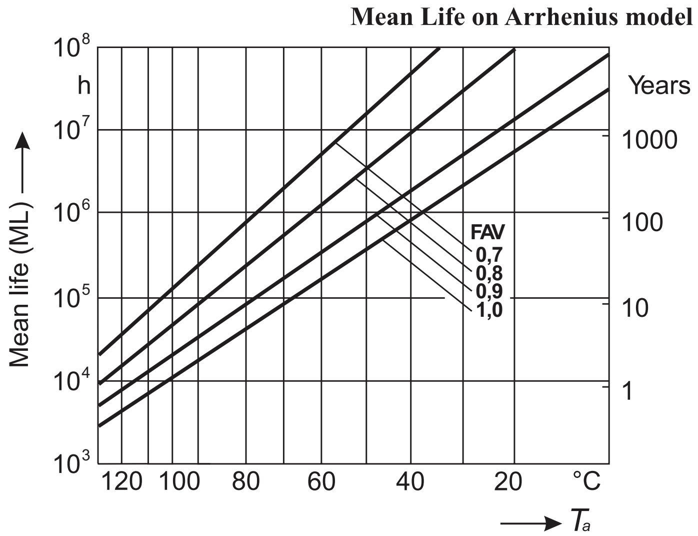
$$\Lambda = \frac{10^9}{ML\,[h]}\,[fit]$$

FAV – Factor of Applied Voltage

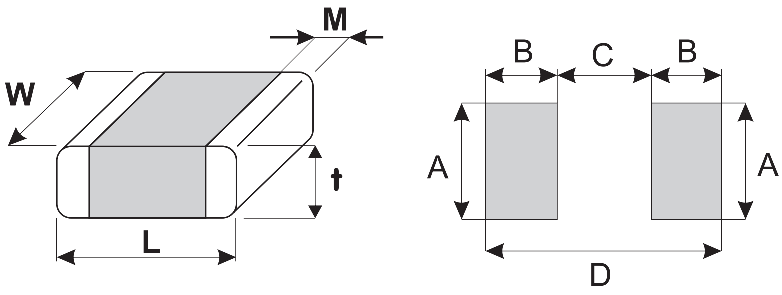
$$FAV = \frac{Vapl}{V_{max}}$$

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

AV 14 ... 40
Dimension 0805 ... 3225



Soldering Pad Configuration

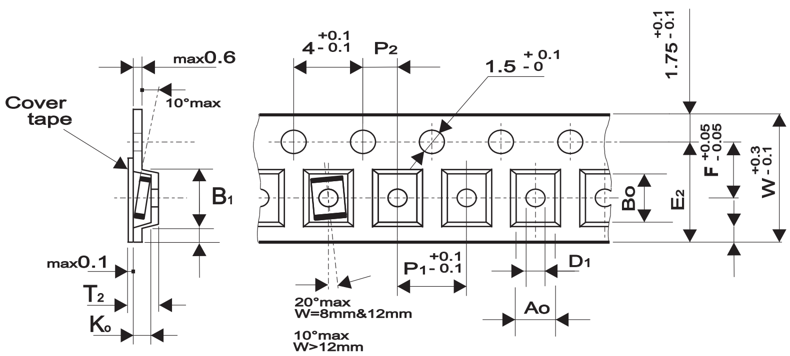


Size	L (mm)	W (mm)	M (mm)	t_{max} (mm)	A (mm)	B (mm)	C (mm)	D (mm)
0603	1,6 ± 0,20	0,80 ± 0,10	0,5 ± 0,25	1,0	1,0	1,0	0,6	2,6
0805	2,0 ± 0,25	1,25 ± 0,20	0,5 ± 0,25	1,1	1,4	1,2	1,0	3,4
1206	3,2 ± 0,30	1,60 ± 0,20	0,5 ± 0,25	1,6	1,8	1,2	2,1	4,5
1210	3,2 ± 0,30	2,50 ± 0,25	0,5 ± 0,25	1,8	2,8	1,2	2,1	4,5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

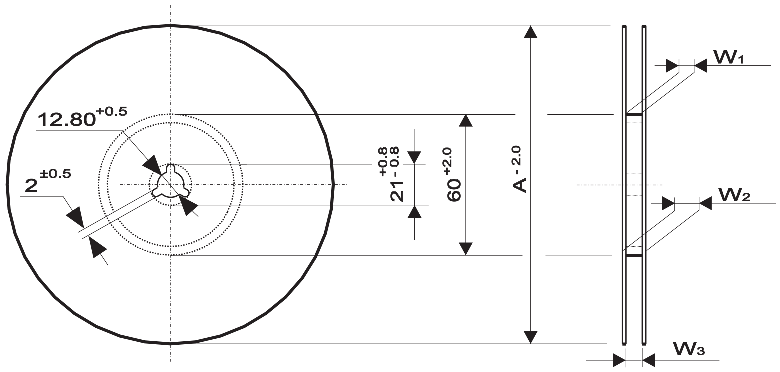
Tape and Reel Specification

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

		Chip Size													
Series	**Voltage range (V)**	**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.

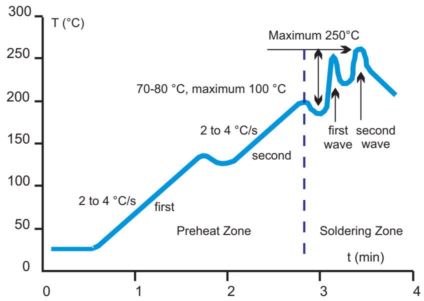


Fig. 1. Wave Soldering Temperature Profile for Pb-free and Pb-containing Soldering

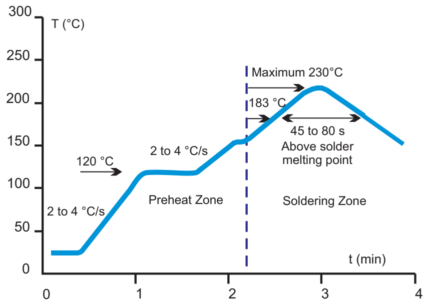


Fig. 2. Infrared Reflow Temperature Profile for Pb-containing Soldering

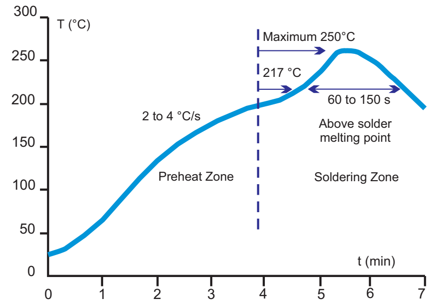


Fig. 3. Reflow Temperature Profile for Pb-free Soldering

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**

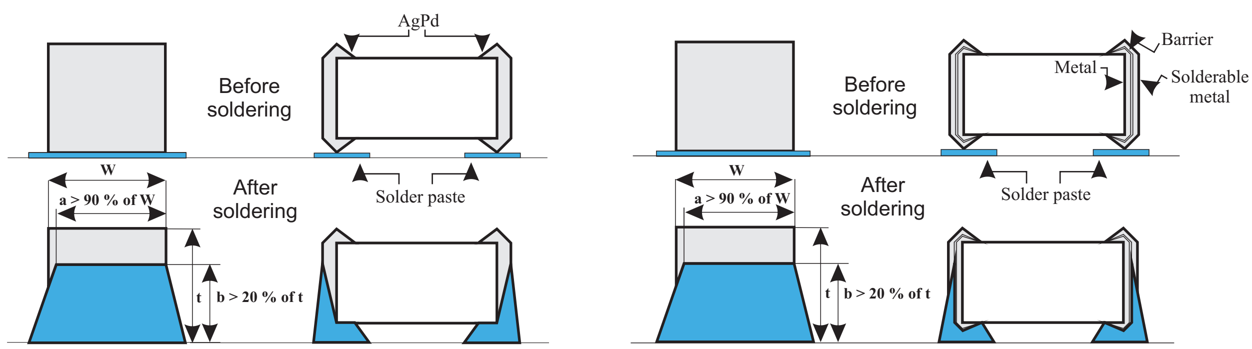


Fig. 4 Soldering Criterion in case of Wave and IR Reflow Pb-containing Soldering

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

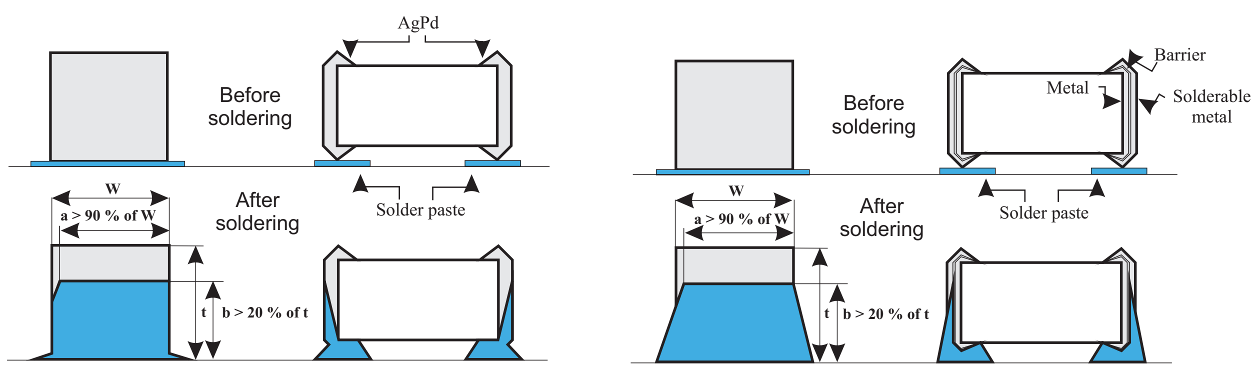


Fig. 5 Soldering Criterion in case of Wave and IR Reflow Pb-free Soldering

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, ORL0	L3CN, ORL0, R	L3CN, ORL0, R	L3CN, ORL0, R
Pb Solder	62Sn / 36Pb / 2 Ag			
Pb Soldering temperature (°C)	235 ± 5	235 ± 5	260 ± 5	235 ± 5
Pb-FREE Solder	Sn96 / Cu0,4-0,8 / 3-4Ag			
Pb-FREE Soldering temperature (°C)	250 ± 5	250 ± 5	280 ± 5	250 ± 5
Soldering time (s)	2	210	10	> 15
Burn-in conditions	V_{dcmax}, 48 h	-	-	-
Acceptance criterion	dVn < 5 %, i_{dc} must stay unchanged	> 95 % of end termination must be covered by solder	> 95 % of end termination must be intact and covered by solder	> 95 % of end termination must be intact and covered by solder

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

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

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

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

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	$\|\delta_{Vn}$ (1 mA)$\|$ < 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	$\|\delta_{Vn}$ (1 mA)$\|$ < 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	$\|\delta_{Vn}$ (1 mA)$\|$ < 10 % no visible damage
WLD Capability	WLD x 10	ISO 7637, Test pulse 5, 10 pulses at rate 1 per minute	$\|\delta_{Vn}$ (1 mA)$\|$ < 15 % no visible damage
V_{jump} Capability	V_{jump} 5 min	Increase of supply voltage to V ≥ V_{jump} for 1 minute	$\|\delta_{Vn}$ (1 mA)$\|$ < 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	$\|\delta_{Vn}$ (1 mA)$\|$ < 10 %
	Thermal Shock	CECC 42200, Test 4.12, Test Na, IEC 68-2-14, AEC-Q200 Test16, 5 cycles UCT/LCT, 30 minutes	$\|\delta_{Vn}$ (1 mA)$\|$ < 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.	$\|\delta_{Vn}$ (1 mA)$\|$ < 10 %
	Storage Test	IEC 68-2-2, Test Ba, AEC-Q200 Test 3, 1000 h at maximum storage temperature	$\|\delta_{Vn}$ (1 mA)$\|$ < 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	$\|\delta_{Vn}$ (1 mA)$\|$ < 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.	$\|\delta_{Vn}$ (1 mA)$\|$ < 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	$\|\delta_{Vn}$ (1 mA)$\|$ < 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	$\|\delta_{Vn}$ (1 mA)$\|$ < 10 % no visible damage
Electrical Transient Conduction	ISO-7637-1 Pulses	AEC-Q200 Teat 30: Test pulses 1 to 3. Also other pulses - freestyle.	$\|\delta_{Vn}$ (1 mA)$\|$ < 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)

AUTOMOTIVE VARISTORS - AV SERIES

Description

Almost all electronic systems in an automobile, e.g. anti-lock brake system, direct ignition system, airbag control system, wiper motors, etc. are susceptible to damage from destructive voltage transients.

The AV series of leaded automotive varistors includes multilayer TH varistors. Automotive Varistors are intended for WLD applications typically requiring up to 50 J of energy, and disc automotive varistors for WLD applications requiring more than 50 J of energy.

Automotive varistors offer excellent transient energy absorption due to improved internal energy distribution. Compared to equivalent disc automotive varistors they offer better electrical characteristics realized in a much smaller size.

Features

- Supply voltage ......12 V, 24 V and 42 V.
- Broad range of current and energy handling capabilities realized with either type of construction (leaded multilayer and disc automotive varistors).
- +125 °C continuous operating temperature.
- +150 °C continuous operating temperature is available upon request.
- In-line leads in case of leaded varistors.
- Available in tape and reel for automatic insertion equipment.
- Lead free components.
- AEC-Q200 Grade 1 qualified.

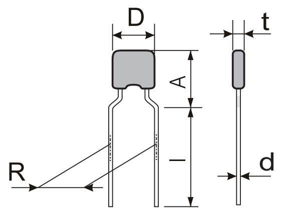
Absolute Maximum Ratings

Continuous:	Units	Value
Steady State Applied Voltage:		
DC Voltage Range (V_{dc})	V	18 to 56 *
Transient:		
Load Dump Energy, (WLD)	J	3 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	400 to 2000
Single Pulse Surge Energy, 10/1000 µs Waveform (W_{max})	J	1,6 to 76
Operating Ambient Temperature	°C	-55 to +125
Storage Temperature Range	°C	-55 to +150
Threshold Voltage Temperature Coefficient	%/°C	< + 0,05
Insulation Resistance	GΩ	> 1
Isolation Voltage Capability	kV	> 1,25
Response Time	ns	< 25
Climatic Category		55 / 125 / 56

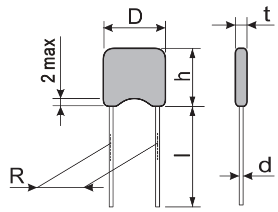
* Higher operating voltages are available upon request.

** Automotive varistors with WLD = 50 J and 100 J in the form of leaded multilayer or single layer disc varistors are available upon request.

Device Ratings and Characteristics



Size 602
WLD Code 003



Size 802, 902, 1103
WLD Code 006, 012, 025, 050

Dimensions

Size mm	**D** max mm	**R** mm	**d** mm	**h/A** max mm
602	7,0	5,0	0,6	7
802	8,0	5,0	0,6	9
902	9,0	5,0	0,6	12
1103	11,0	7,5	0,6	12

Dimesions "t" is in the table below.

AV 14 K 602 003....AV 40 D 40 100

Type	V_{rms} V	V_{dc} V	V_n @ 1 mA V	V_{jump} 5 min V	V_c V	I_c 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	**t** max mm
12 V Power Supply												
AV 14 K 602 003	14	16	24	24,5	40	2,5	400	1,6	3	0,010	2,5	4,5
AV 14 K 802 006	14	16	24	24,5	40	5	800	2,4	6	0,015	4,6	4,5
AV 14 K 902 012	14	16	24	24,5	40	5	1200	4,4	12	0,030	10,5	4,5
AV 14 K 902 025	14	16	24	24,5	40	10	2000	6,0	25	0,080	22,0	5,5
AV 14 K 1103 050	14	16	24	24,5	40	10	2000	13,2	50	0,100	29,0	6,5
AV 17 K 602 003	17	20	27	30	44	2,5	400	1,8	3	0,010	2,0	4,5
AV 17 K 802 006	17	20	27	30	44	5	800	2,9	6	0,015	4,0	4,5
AV 17 K 902 025	17	20	27	30	44	10	2000	7,2	25	0,080	18,0	5,5
AV 17 K 1103 050	17	20	27	30	44	10	2000	15,8	50	0,100	24,0	6,5
24 V Power Supply												
AV 20 K 602 003	20	26	33	30	54	2,5	400	1,9	3	0,010	1,8	4,5
AV 20 K 802 006	20	26	33	30	54	5	800	3,0	6	0,015	3,5	4,5
AV 20 K 902 025	20	26	33	30	54	10	2000	9,0	25	0,080	13,0	4,5
AV 20 K 1103 050	20	26	33	30	54	10	2000	17,0	50	0,100	18,0	6,5
AV 30 K 602 003	30	34	47	50	77	2,5	400	2,3	3	0,010	1,3	4,5
AV 30 K 802 006	30	34	47	50	77	5	800	3,8	6	0,015	2,0	4,5
AV 30 K 902 025	30	34	47	50	77	10	2000	18,0	25	0,080	12,0	4,5
42 V Power Supply												
AV 40 K 602 003	40	56	68	65	110	2,5	400	2,6	3	0,010	1,1	4,5
AV 40 K 802 006	40	56	68	65	110	5	800	4,8	6	0,015	1,8	4,5
AV 40 K 902 025	40	56	68	65	110	10	2000	18,0	25	0,080	6,6	4,5

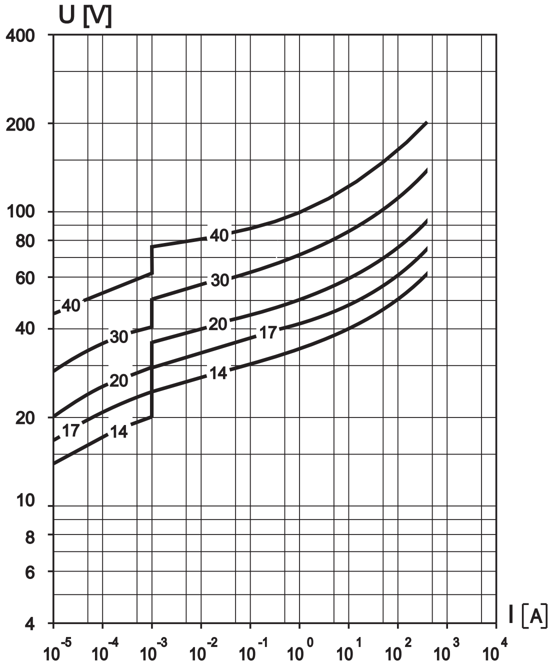
* - Types AV 35 are available upon request.

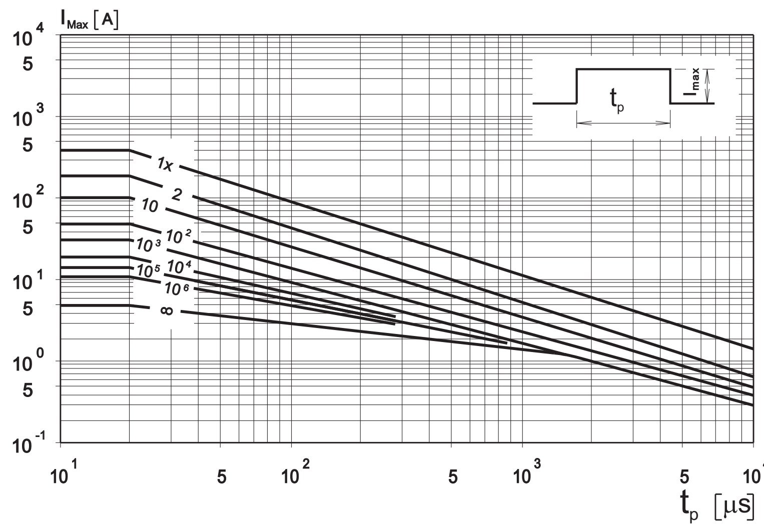
Protection Level

* With the worst-case condition in the tolerance region

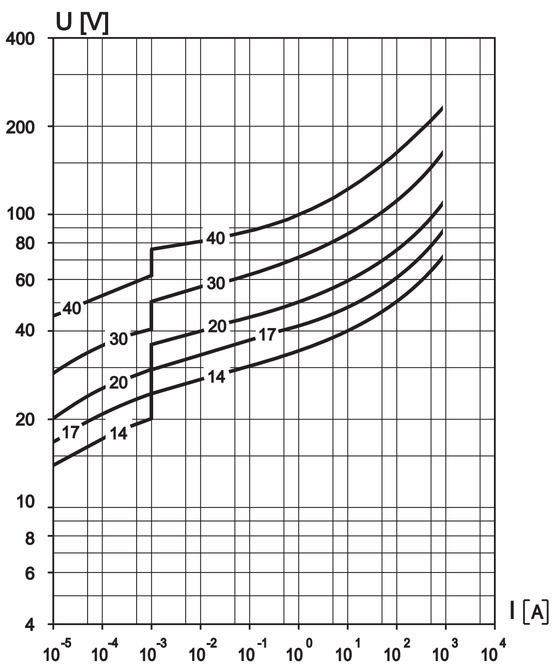
Pulse Rating Curves

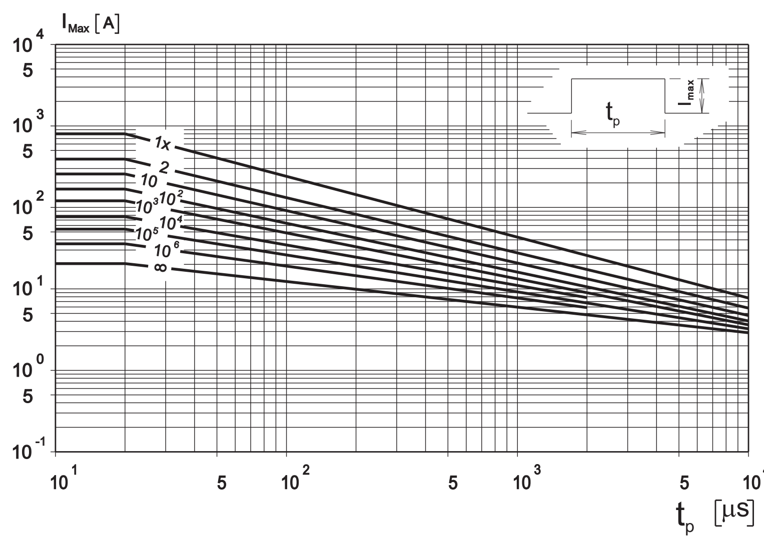
Model Size 60
AV 14...40 K...003





Model Size 80
AV 14...40 K...006



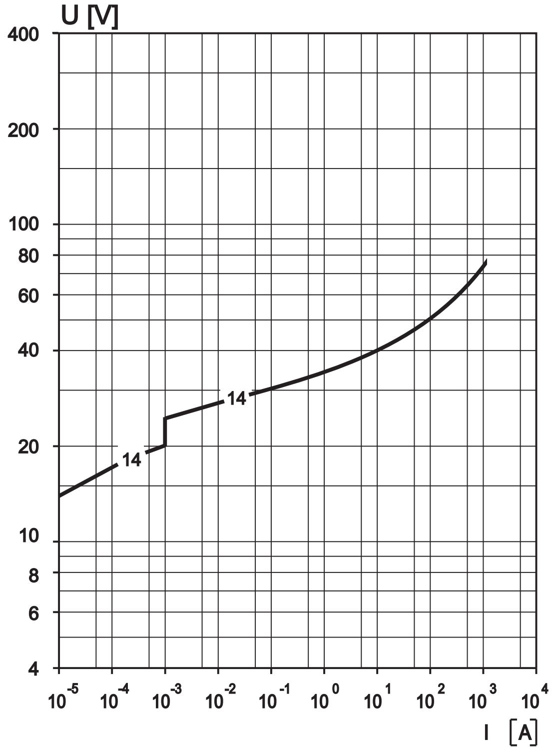


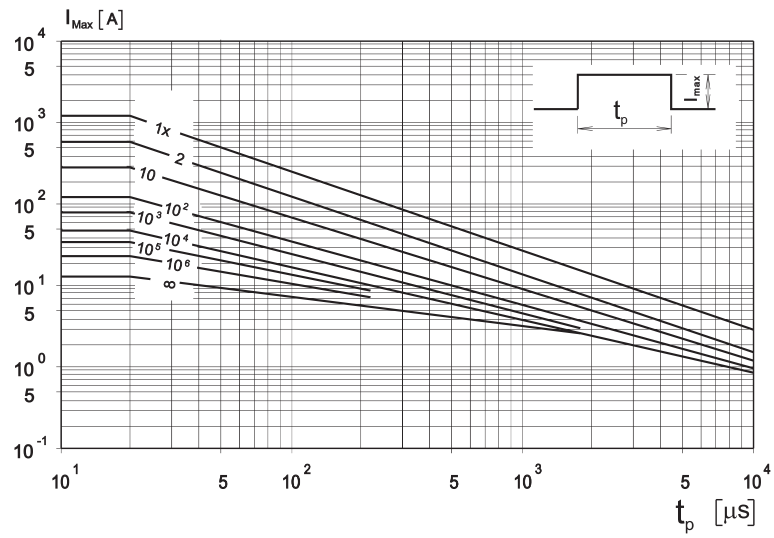
Protection Level

Pulse Rating Curves

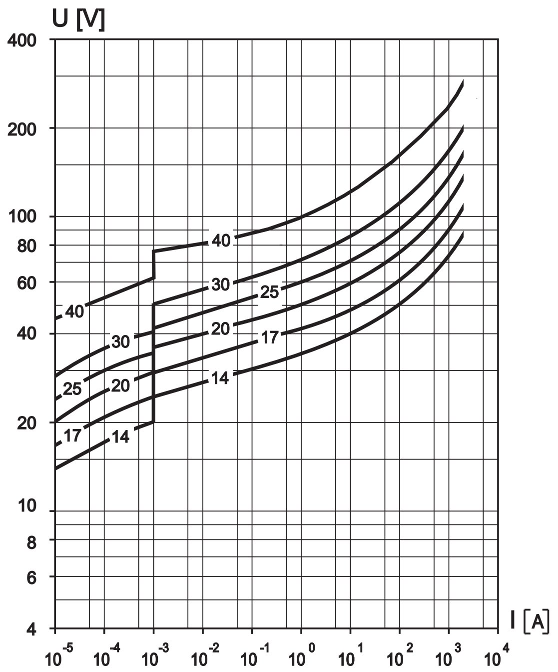
* With the worst-case condition in the tolerance region

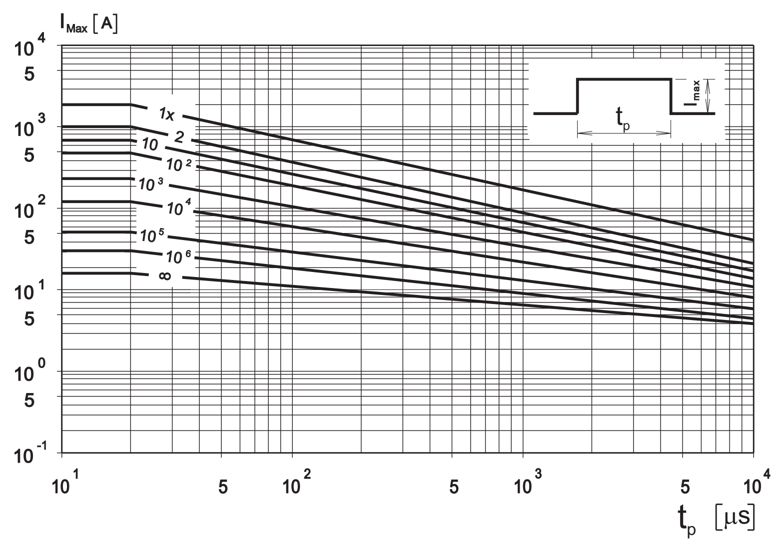
Model Size 90
AV 14 K 902 012



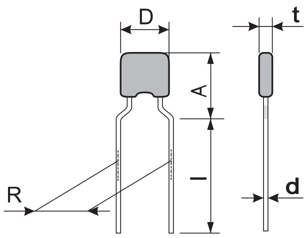
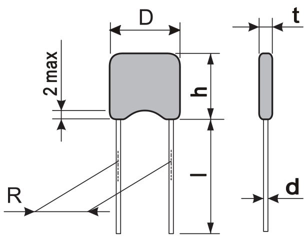
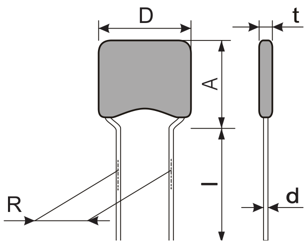
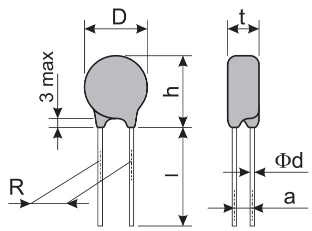
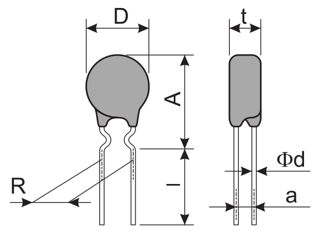
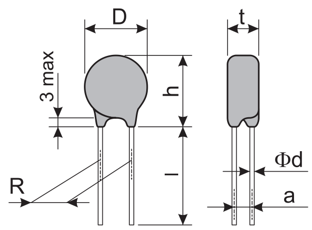
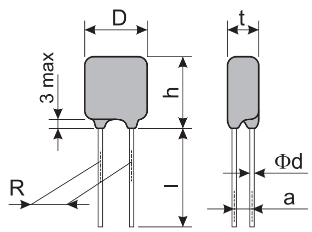
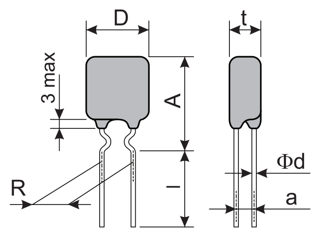
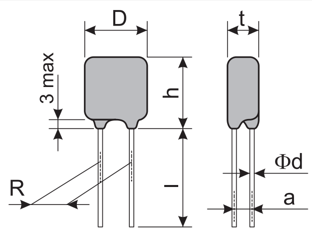


Model Size 90, 110
AV 14 ... 20 K ... 025...50
AV 25...40 K...050...100





Lead Styles

Type	R (mm)	h_{max} (mm)	A_{max} (mm)	Version 1	Version 5
ZV 2...40 K 5 ZV 2...40 K 7 ZV 2...40 K 10 AV 14...40 K 602 003	5 5 5 5		7 8 9 7		
ZV 4...40 K14 AV 14...40 K 802 006	5 5	9 9	12 9		
ZV 4...40 K 20 AV 14...40 K 902 012...025 AV 14...20 K 1103 050	5 5 7,5		12 12 12		
CV 50...300 K 5 CV 50...300 K 7 CV+ 60...275 K 7	5 5 5	9,5 11,5 11,5	12,5 14,5 14,5		
CV 50...680 K 10 CV 50...680 K 14 CV 50...680 K 20 CV+ 60...550 K 10 CV+ 60...550 K 14 CV+ 60...550 K 20 CV+ 130...550 K 23	7,5 7,5 10 7,5 7,5 10 10	15 20 26 15 20 26 27			
SV 60...300 K 5 SV 60...300 K 7	5 5	9,5 11,5	12,5 14,5		
SV 60...550 K 10 SV 60...550 K 14 SV 60...550 K 20 SV 130...550 K 23	7,5 7,5 10 10	15 19 26 27			

Ordering Information

ZV Series

ZV 40 K 20 R L1 YY

ZV - Series Name
40 - Maximum Continuous Working Voltage - V_{rms}
K V_n Tolerance: K = ± 10 %, L = ± 15%, M = ± 20 %
20 - Size: 5, 7, 10, 14, 20
R - Packaging: R = Reel, A = Ammo Pack, B = Bulk
L1 - Lead Style; 1 = straight, 5 = crimped
YY - Special requirements

AV Series

AV 20 K 802 006 R L1 YY

AV - Series Name
20 - Maximum Continuous Working Voltage - V_{rms}
K - V_n Tolerance: K = ± 10 %, S = special
80 - Size: 60, 80, 90, 110; 80 = 8 mm
2 - Leas spacing Code: 2 = 5 mm, 3 = 7,5 mm
006 - WLD - Load Dump Energy Code: 006 = 6 J
R - Packaging: R = Reel, A = Ammo Pack, B = Bulk
L1 - Lead Style; 1 = straight, 5 = crimped
YY - Special requirements

CV / CV+ / SV Series

CV 130 K 14 R L1 YY

CV - Series Name
130 - Maximum Continuous Working Voltage - V_{rms}
K - V_n Tolerance: K = ± 10 %, J = ± 5%, S = special
14 - Size: 5, 7, 10, 14, 20, 23
R - Packaging: R = Reel, A = Ammo Pack, B = Bulk
L1 - Lead Style; 1 = straight, 5 = crimped
YY - Speciaa requirements

Varistor Marking for ZV / AV / CV / CV+ / SV Series

For Model Size 5, 7

14Z5

14 - V_{rms}
Z - the first letter of Series Name ZV
5 - Model Size: 5, 7

For Model Size 10, 14

ZV 40
K10

40 - V_{rms}
K - V_n Tolerance
10 - Model Size: 10, 14

For Model Size 20

KEKO
ZV 11
K20

KEKO - Tradename
ZV - Series Name
11 - V_{rms}
K - V_n Tolerance
20 - Model Size: 20

For Model Size 602

20A
003

20 - V_{rms}
A - the first letter of Series Name AV
003 - WLD Code: 003

For Model Size 802

AV 17
K 006

AV - Series Name
17 - V_{rms}
K - V_n Tolerance
006 - WLD Code: 006

For Model Size 902,1103

KEKO
AV 30
K 100

KEKO - Tradename
AV - Series Name
30 - V_{rms}
K - V_n Tolerance
100 - WLD Code: 012, 025, 050, 100

For Model Size 5

CV
130K5

130 - V_{rms}
CV - Series Name
K - V_n Tolerance
5 - Model Size: 5

For Model Size 7, 10, 14, 20, 23

KEKO
CV 300 K 20
XX

KEKO - Tradename
CV - Series Name: Cv, Cv+, SV
300 - V_{rms}
K - V_n Tolerance
20 - Model Size: 7, 10, 14, 20, 23
xx - Approvals

Packaging

Reel

V	5				7				10				14				20					23	
	ZV	AV/ 602	SV	CV/ CV+	ZV	AV/ 802	SV	CV/ CV+	ZV	AV/ 902	SV	CV/ CV+	ZV	AV/ 1103	SV	CV/ CV+	ZV	AV 20	AV 40	SV	CV/ CV+	SV	CV/ CV+
2	1500				1500				1500				1500				1500						
4	1500				1500				1500				1500				1500						
6	1500				1500				1500				1500				1500						
8	1500				1500				1500				1500				1500						
11	1500			1800	1500			1500	1500				1500				1500						
14	1500	1500		1800	1500	1500		1500	1500	1500		1300	1500	1300			1500						
17	1500	1500		1800	1500	1500		1500	1500	1300		1300	1500	1300			1500						
20	1500	1500		1500	1500	1500		1500	1500	1300		1300	1500	1300			1500						
25	1500	1300		1500	1500	1300		1500	1500	1300		1300	1500				1500	500	400				
30	1500	1300		1500	1500	1300		1500	1500	1300		1300	1500				1500	500	400				
35	1500	1300		1500	1500	1300		1500	1500	1300		1300	1500				1500	500	400				
40	1500	1300		1500	1500	1300		1500	1500	1300		1300	1500				1500	500	400				
50				1500				1500				1300				700					600		
60			1500	1500			1500	1500			1300	1300			600	700				600	600		
75			1300	1500			1300	1500			1300	1300			600	700				600	600		
95			1300	1500			1300	1000			1200	1300			600	600				500	600		
115			1300	1300			1300	1000			1200	1000			500	600				500	500		
130			1300	1300			1300	1000			1200	1000			500	600				500	500	150	250
140			1300	1200			1300	1000			1200	1000			500	600				500	500	150	250
150			1200	1200			1200	1000			1000	1000			500	600				500	500	150	250
175			1200	1200			1200	1000			1000	1000			500	500				500	500	150	250
230			1000	1000			1000	1000			1000	1000			500	500				500	400	150	150
250			1000	1000			1000	1000			900	800			400	400				400	400	150	150
275			1000	1000			1000	1000			900	800			400	400				400	400	150	150
300				900			900	1000			800	800			400	400				400	400	100	150
320											800	800			400	400				300	400	100	150
385											700	700			300	400				300	300	100	150
420											700	700			300	300				300	300	100	150
460											600	600			300	300				300	300	100	150
510											600	600			300	300				300	300	100	150
550*											600	600			300	300				300	300	100	150

* For voltages to 680 - same as for 550.

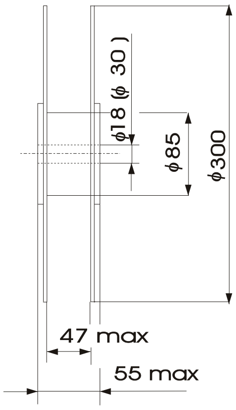
Ammo

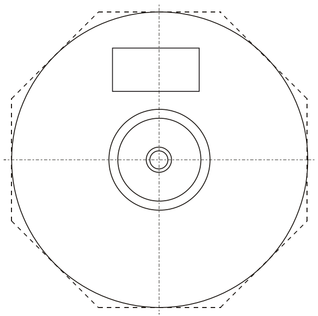
V	5				7				10				14				20					23	
	ZV	AV/ 602	SV	CV/ CV+	ZV	AV/ 802	SV	CV/ CV+	ZV	AV/ 902	SV	CV/ CV+	ZV	AV/ 1103	SV	CV/ CV+	ZV	AV 20	AV 40	SV	CV/ CV+	SV	CV/ CV+
2	2000				2000				2000				2000				2000						
4	2000				2000				2000				2000				2000						
6	2000				2000				2000				2000				2000						
8	2000				2000				2000				2000				2000						
11	2000			2000	2000			2000	2000				2000				2000						
14	2000	2000		2000	2000	2000		2000	2000	1800		1800	2000	1500			2000						
17	2000	2000		2000	2000	2000		2000	2000	1800		1800	2000	1800			2000						
20	1800	2000		2000	1800	2000		2000	1800	1800		1800	1800	1800			1800						
25	1800	1800		2000	1800	1800		2000	1800	1800		1800	1800				1800	600	400				
30	1800	1800		2000	1800	1800		2000	1800	1800		1500	1800				1800	600	400				
35	1800	1800		2000	1800	1800		2000	1800	1800		1500	1800				1800	600	400				
40	1800	1800		1800	1800	1800		1800	1800	1800		1500	1800				1800	600	400				
50				2000				2000				1800				800					700		
60			1800	2000			1800	2000			1600	1600			800	800				700	700		
75			1800	2000			1800	2000			1600	1600			800	800				700	700		
95			1600	1800			1600	1800			1500	1600			700	700				700	700		
115			1600	1600			1600	1600			1300	1500			700	700				600	600		
130			1600	1600			1600	1600			1300	1300			700	700				600	600	150	250
140			1600	1600			1600	1600			1300	1300			700	700				600	600	150	250
150			1500	1500			1500	1500			1300	1300			700	700				600	600	150	250
175			1500	1500			1500	1500			1300	1300			600	600				600	600	150	250
230			1200	1200			1200	1200			1200	1200			600	600				500	500	150	150
250			1200	1200			1200	1200			1000	1000			500	500				500	500	150	150
275			1200	1200			1200	1200			1000	1000			500	500				500	500	150	150
300				1000			1000	1000			1000	1000			500	500				500	500	100	150
320											1000	1000			500	500				400	400	100	150
385											900	900			400	400				400	400	100	150
420											900	800			400	400				400	400	100	150
460											800	800			400	400				400	400	100	150
510											800	800			400	400				300	400	100	150
550*											700	700			300	400				300	400	100	150

* For voltages to 680 - same as for 550.

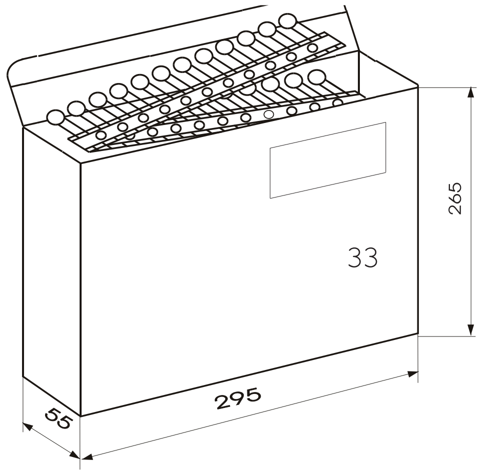
Packaging

Reel





Ammo pack



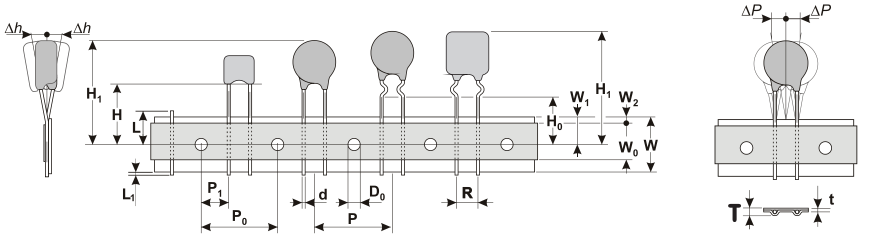
Package units

Bulk

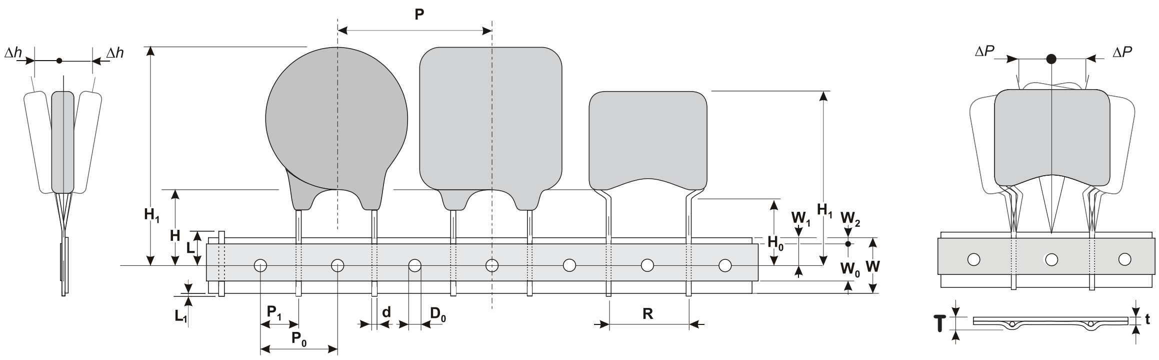
V	5				7				10				14				20					23	
	ZV	AV/ 602	SV	CV/ CV+	ZV	AV/ 802	SV	CV/ CV+	ZV	AV/ 902	SV	CV/ CV+	ZV	AV/ 1103	SV	CV/ CV+	ZV	AV 20	AV 40	SV	CV/ CV+	SV	CV/ CV+
2	1500				1500				1500				1000				1000						
4	1500				1500				1500				1000				1000						
6	1500				1500				1500				1000				1000						
8	1500				1500				1500				1000				1000						
11	1500			1500	1500			1500	1500				1000				1000						
14	1500	1500		1500	1500	1500		1500	1500	1000		600	1000	800			1000						
17	1500	1500		1500	1500	1500		1500	1500	1000		600	1000	800			1000						
20	1500	1500		1500	1500	1500		1500	1500	1000		600	1000	800			1000						
25	1500	1500		1500	1500	1500		1500	1500	1000		600	1000				1000	300	300				
30	1500	1500		1500	1500	1500		1500	1500	1000		600	1000				1000	300	300				
35	1500	1500		1500	1500	1500		1500	1500	1000		600	1000				1000	300	300				
40	1500	1500		1500	1500	1500		1500	1500	1000		600	1000				1000	300	300				
50				1500				1500				600				400					300		
60			1300	1500			1000	1500			500	600			400	400				250	300		
75			1300	1500			1000	1500			500	600			400	400				250	300		
95			1300	1500			900	1000			500	600			400	400				250	300		
115			1300	1500			900	1000			400	500			400	400				250	300		
130			1300	1500			900	1000			400	500			400	400				250	300	150	250
140			1300	1500			900	1000			400	500			400	400				250	300	150	250
150			1300	1500			900	1000			400	500			400	400				250	300	150	250
175			1300	1500			900	1000			400	500			400	400				250	300	150	250
230			900	1000			900	1000			400	500			250	300				250	200	150	150
250			900	1000			900	1000			400	500			250	300				250	200	150	150
275			900	1000			900	1000			400	500			250	300				250	200	150	150
300				1000			900	1000			400	500			250	300				150	200	100	150
320											400	500			250	300				150	200	100	150
385											300	400			250	300				150	200	100	150
420											300	400			250	300				150	200	100	150
460											300	400			250	300				150	200	100	150
510											300	400			250	300				150	200	100	150
550*											300	400			250	300				150	200	100	150

Protection Level

Customs to IES Publication 286-2 Ed.3: 2008-03



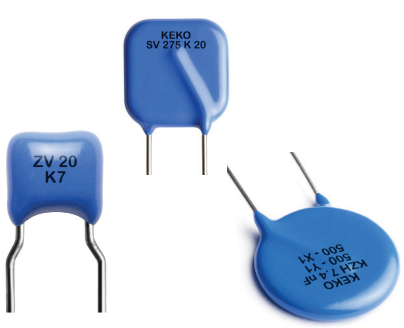
R = 5 mm

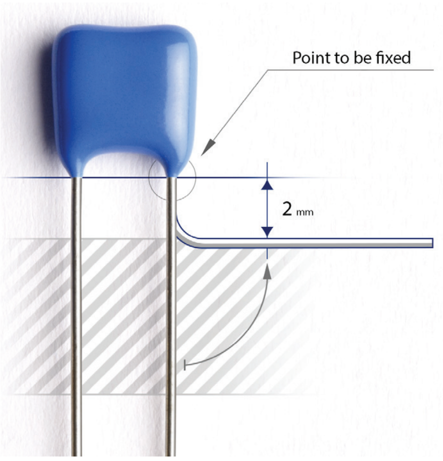


R = 7,5 mm, 10 mm

Symbol	Parameter	Model Size				
		Φ 5	Φ 7	Φ 10	Φ 14	Φ 20
		602 / 802 / 902		1103		
		Dimension (mm)				
W	Carrier tape with	18 +1,0/-0,5	18 +1,0/-0,5	18 +1,0/-0,5	18 +1,0/-0,5	18 +1,0/-0,5
Wo	Hold down tape width	5 min	5 min	5 min	5 min	5 min
W1	Sprocket hole position	9 +0,75/-0,5	9 +0,75/-0,5	9 +0,75/-0,5	9 +0,75/-0,5	9 +0,75/-0,5
W2	Distance between the upper edges of the carrier tape and hold-down tape	3 max	3 max	3 max	3 max	3 max
T	Total tape thickness	1,5 max	1,5 max	1,7 max	1,7 max	1,9 max
t	Tape thickness	0,9 max	0,9 max	0,9 max	0,9 max	0,9 max
P	Pitch of component	12,7 ± 1,0	12,7 ± 1,0	12,7 ± 1,0	25,4 ± 1,0	25,4 ± 1,0
Po	Feed hole pitch	12,7 ± 0,3	12,7 ± 0,3	12,7 ± 0,3	12,7 ± 0,3	12,7 ± 0,3
P1	Feed hole center to pitch	3,85 ± 0,7	3,85 ± 0,7	8,95 ± 0,7	8,95 ± 0,7	7,7 ± 0,7
R	Lead Spacing	5 +0,5/-0,2	5 +0,5/-0,2	7,5 +0,5/-0,2	7,5 +0,5/-0,2	10 +0,5/-0,2
ΔP	Component alignment	± 1,3 max	± 1,3 max	± 1,3 max	± 1,3 max	± 1,3 max
Δh	Component alignment	± 2 max	± 2 max	± 2 max	± 2 max	± 2 max
d	Wire diameter	0,6 max	0,6 max	0,8 max	0,8 max	1 max
Do	Feed hole diameter	4 ± 0,2	4 ± 0,2	4 ± 0,2	4 ± 0,2	4 ± 0,2
H	Height from tape center to comp. base	18 +2,0/-0,0	18 +2,0/-0,0	18 +2,0/-0,0	18 +2,0/-0,0	18 +2,0/-0,0
Ho	Seating plane height	16 ± 0,5	16 ± 0,5	16 ± 0,5	16 ± 0,5	16 ± 0,5
H1	Component height	32,2 max	32,2 max	46,5 max	46,5 max	46,5 max
L	Protrusion - cut out	11 max	11 max	11 max	11 max	11 max
L1	Protrusion - cut off	0,5 max	0,5 max	0,5 max	0,5 max	0,5 max

ASSEMBLY RECOMMENDATIONS FOR TH COMPONENTS





Very often before soldering through-hole components, their leads get bent. It is important not to damage the component during lead bending. Typical damage incurred during bending is cracks in epoxy parts, which can lead to increased humidity sensitivity of a component and consequentially to a shorter life time.

In order to avoid epoxy parts damage it is necessary to:

- fix the most sensitive point (epoxy parts) of a component body

- bend the wire at least 2 mm below the end of epoxy parts

Other potential damage to a component which can lead to component failure or a shorter life time is thermal shock during manual soldering with a soldering iron. This can occur in the case when a soldering iron is placed too close to one point of the component body and most often it happens if the solder joint is too close to the varistor body.

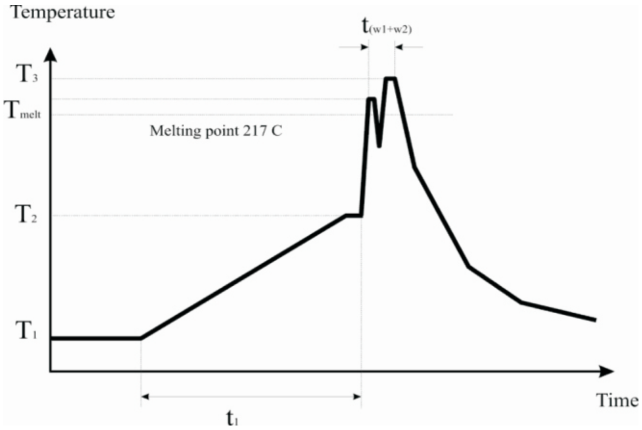
° Resistance to Soldering Heat

In the case of automatic wave soldering, it is important to provide sufficient resistance to soldering heat. In order to prevent any potential problems KEKO VARICON decided to introduce their own internal standard for testing the resistance to soldering heat of through-hole components: 300 °C, 10s.

° Pb-free Wave Soldering Profile Recommendations

Recommended soldering profiles for all above components are in accordance with JEDEC standard curves (J-STD-020D) and therefore compatible with the new Pb-free process.

° lead-fee Wave Soldering Profile



Pb-free wave soldering profile requirements for soldering heat resistance of components

Parameters	Symbol	Specification
preheating temparture gradient		4°C/s max.
Preheating time	t1	2 to 5 min
Min. preheating temperature	T1	130 °C
Max. preheating temperature	T2	180 °C
Melting temperature/point	T_{meltv}	217 °C
Time in wave soldering phase (w_1+w_2)	t_{w1+w2}	10s
Max. wave temperature (w_1+w_2)	T_3	265 °C +0/-5 °C
Cooling tempeature gradient		6° C/s max.
Tempearature jump form T_2 to T_3 (w_1)	$T_{3(w1)}$ - T_2	120 °C max
Time from 25°C to T_3 (wave temperature)		8 min max.

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)

KEKO VARICON

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