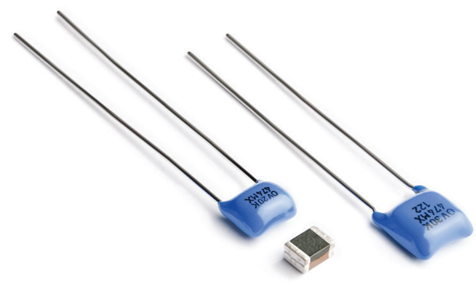
AUTOMOTIVE DUAL FUNCTION VARICON - OV SERIES

Description

The VARICON OV series is a series of dual function protective devices that protect against voltage surges in an automotive voltage region and against radio frequency noise. This component replaces two components – a low voltage varistor and a capacitor.

OV series varicons incorporate a varistor function in automotive applications in a voltage region (12 V, 24 V, 42 V) and a function of a radio-frequency filtering capacitor in a high capacitance range from 0,47 to 1,5 µF (higher values are available upon request), making them ideal for protection in automobile electronics applications.

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



Features

- Supply voltage ......12 V, 24 V and 42 V.
- Operating voltage V_{dc}......16, 20, 26, 38 and 56 V.
- Capacitance range C (pF).........0,47 to 1,5 µF (higher values are available upon request).
- Capacitor temperature characteristics.
- Protects against voltage transients and suppresses radio-frequency interference.
- Dimensional and weight saves on board
- 2 standard model sizes available ......7,5 x 9,0 and 8 x 12 mm (smaller model size is available upon request).
- THD and SMD components.
- Available in tape and reel for automatic insertion equipment.
- RoHS, GADSL, REACH.
- AEC-Q200 qualified Grade 1.

Absolute Maximum Ratings

Continuous:	Units	Value
Steady State Applied Voltage:		
DC Voltage Range (V_{dc})	V	16 to 56
AC Voltage Range (V_{rms})	V	14 to 40
Transient:		
Load Dump Energy (WDL)	J	6 to 12
Jump Start Capability (5 minutes), (V_{jump})	V	24 to 65
Non-Repetitive Surge Current, 8/20 µs Waveform (I_{max})	A	800 to 1200
Non-Repetitive Surge Energy, 10/1000 µs Waveform (W_{max})	J	2,4 to 10,5
Capacitance Range	nF	470 to 4700
Capacitor Temperature Characteristics		X7R
Operating Ambient Temperature	°C	-40 to +125
Storage Temperature Range	°C	-40 to +150
Threshold Voltage Temperature Coefficient	%/°C	< + 0,05
Insulation Resistance	GΩ	> 1
Isolation Voltage Capability	kV	> 1,25
Response Time	ns	< 25
Climatic Category		40 / 125 / 56

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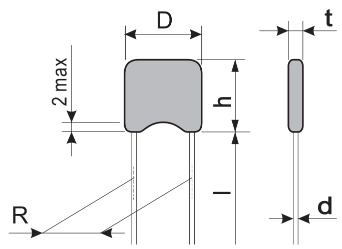
Device Ratings and Characteristics



OV 14 K 474 MX 801 … OV 40 K 155 MX 122

Type	V_{rms} V	V_{dc} V	V_n @ 1 mA V	V_{jump} 5 min V	V_c V	I_c A	W_{max} 10/1000 µs J	WLD 10 x J	P max W	I_{max} 8/20 µs A	C @ 1 kHz µF	D max mm	h/A max mm
12 V Supply Voltage													
OV 14 K 474 MX 801	14	16	24	24,5	40	5	2,4	6	0,015	800	0,47	7,5	9
OV 14 K 105 MX 801	14	16	24	24,5	40	5	2,4	6	0,015	800	1,00	7,5	9
OV 14 K 155 MX 801	14	16	24	24,5	40	5	2,4	6	0,015	800	1,50	7,5	9
OV 14 K 474 MX 122	14	16	24	24,5	40	10	5,8	12	0,030	1200	0,47	8,0	12
OV 14 K 105 MX 122	14	16	24	24,5	40	10	5,8	12	0,030	1200	1,00	8,0	12
OV 14 K 155 MX 122	14	16	24	24,5	40	10	5,8	12	0,030	1200	1,50	8,0	12
OV 17 K 474 MX 801	17	20	27	30	44	5	2,8	6	0,015	800	0,47	7,5	9
OV 17 K 105 MX 801	17	20	27	30	44	5	2,8	6	0,015	800	1,00	7,5	9
OV 17 K 155 MX 801	17	20	27	30	44	5	2,8	6	0,015	800	1,50	7,5	9
OV 17 K 474 MX 122	17	20	27	30	44	10	7,4	12	0,030	1200	0,47	8,0	12
OV 17 K 105 MX 122	17	20	27	30	44	10	7,4	12	0,030	1200	1,00	8,0	12
OV 17 K 155 MX 122	17	20	27	30	44	10	7,4	12	0,030	1200	1,50	8,0	12
24 V Supply Voltage													
OV 20 K 474 MX 801	20	26	33	36	54	5	3,2	6	0,015	800	0,47	7,5	9
OV 20 K 105 MX 801	20	26	33	36	54	5	3,2	6	0,015	800	1,00	7,5	9
OV 20 K 155 MX 801	20	26	33	36	54	5	3,2	6	0,015	800	1,50	7,5	9
OV 20 K 474 MX 122	20	26	33	36	54	10	7,8	12	0,030	1200	0,47	8,0	12
OV 20 K 105 MX 122	20	26	33	36	54	10	7,8	12	0,030	1200	1,00	8,0	12
OV 20 K 155 MX 122	20	26	33	36	54	10	7,8	12	0,030	1200	1,50	8,0	12
OV 30 K 474 MX 801	30	38	47	50	77	5	4,5	6	0,015	800	0,47	7,5	9
OV 30 K 105 MX 801	30	38	47	50	77	5	4,5	6	0,015	800	1,00	7,5	9
OV 30 K 155 MX 801	30	38	47	50	77	5	4,5	6	0,015	800	1,50	7,5	9
OV 30 K 474 MX 122	30	38	47	50	77	10	10	12	0,030	1200	0,47	8,0	12
OV 30 K 105 MX 122	30	38	47	50	77	10	10	12	0,030	1200	1,00	8,0	12
OV 30 K 155 MX 122	30	38	47	50	77	10	10	12	0,030	1200	1,50	8,0	12
42 V Supply Voltage													
OV 40 K 474 MX 801	40	56	68	65	110	5	4,8	6	0,015	800	0,47	7,5	9
OV 40 K 105 MX 801	40	56	68	65	110	5	4,8	6	0,015	800	1,00	7,5	9
OV 40 K 155 MX 801	40	56	68	65	110	5	4,8	6	0,015	800	1,50	7,5	9
OV 40 K 474 MX 122	40	56	68	65	110	10	10,5	12	0,030	1200	0,47	8,0	12
OV 40 K 105 MX 122	40	56	68	65	110	10	10,5	12	0,030	1200	1,00	8,0	12
OV 40 K 155 MX 122	40	56	68	65	110	10	10,5	12	0,030	1200	1,50	8,0	12

* X stands for X7R temperature characteristics; Other capacitance values are also available

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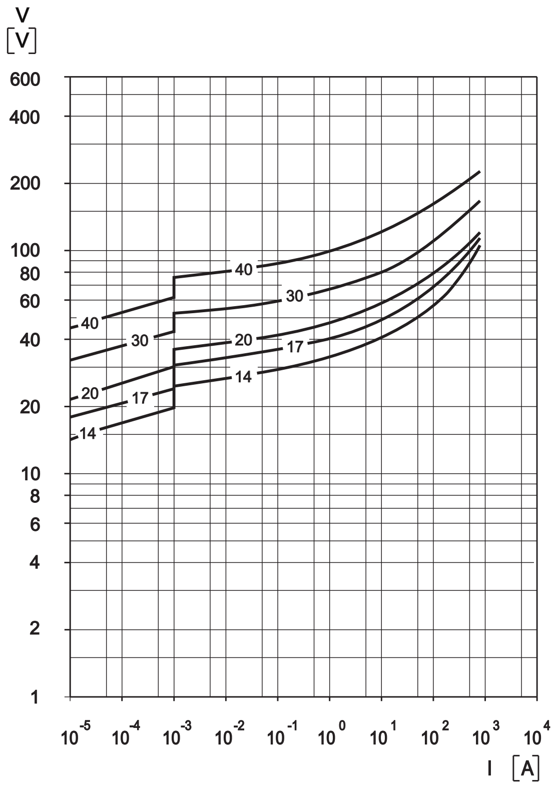
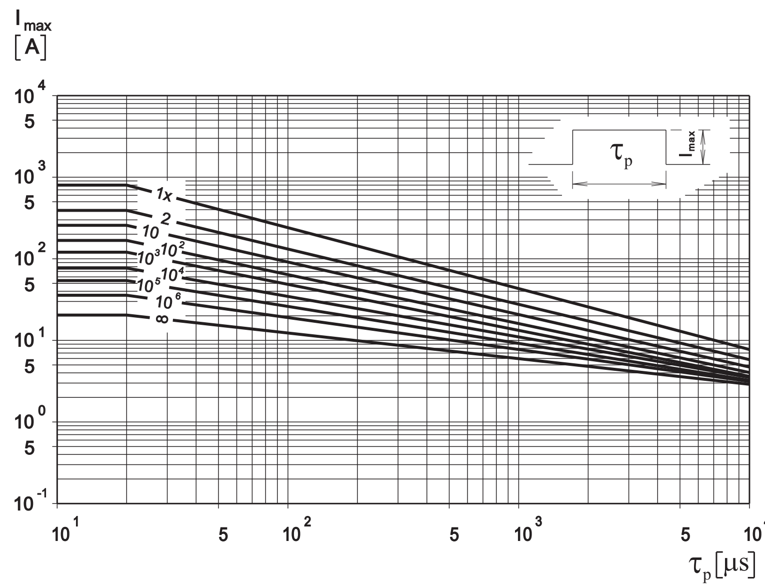
Protection Level

Pulse Rating Curves

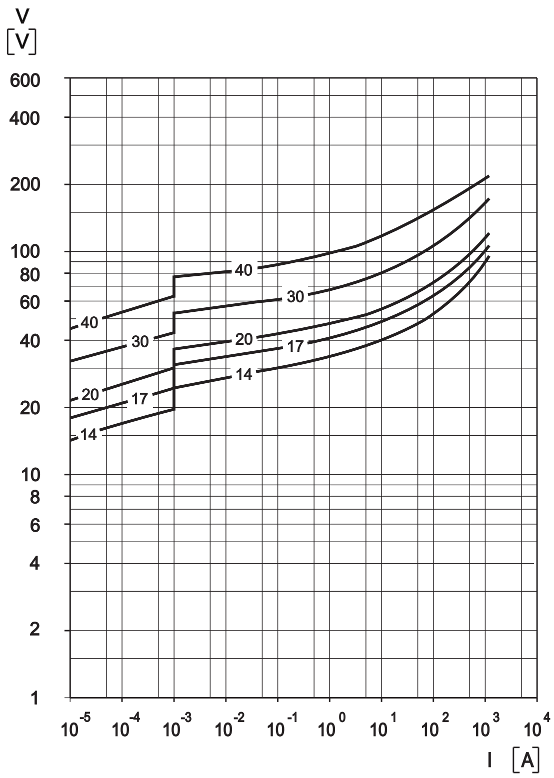
* In the most demanding conditions as per the tolerance region

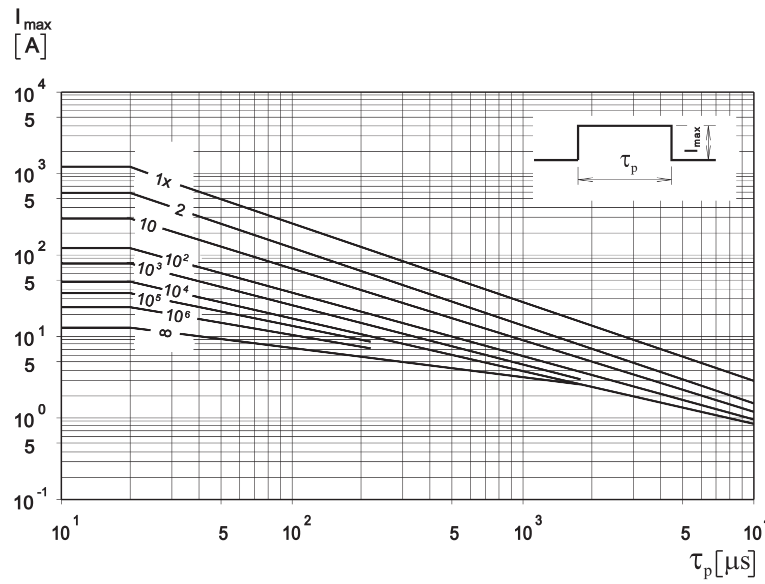
OV 14...40 K ... 801





OV 14...40 K ... 122





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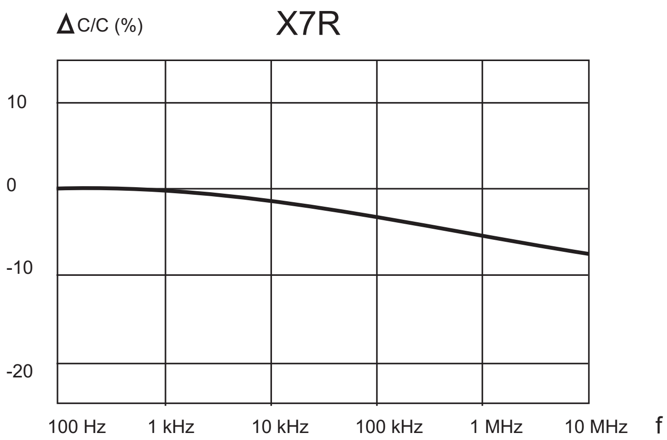
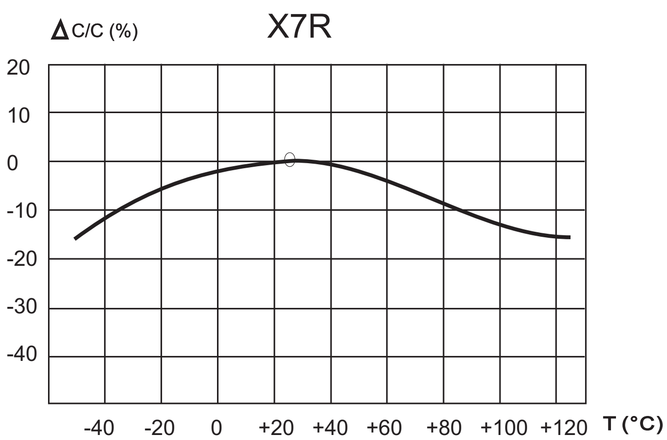
Capacitance – Frequency Characteristics

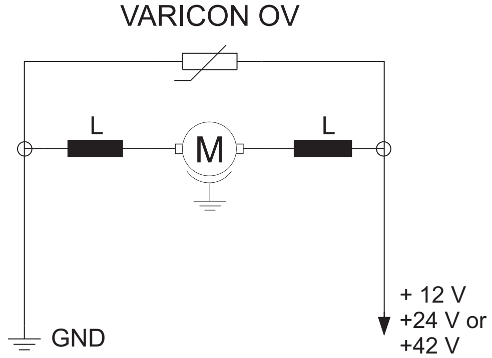


Capacitance – Temperature Characteristics



Application

Application Circuit



Provides for the elimination of transients and EMI noise in automotive electronics such as engine control, exhaust gas control, safety systems, etc. against disturbances caused by small motors used in automobiles. Most frequently, small motors in an automobile are those used for windscreen wipers, window mechanisms, seat adjustments and automatic door locking.

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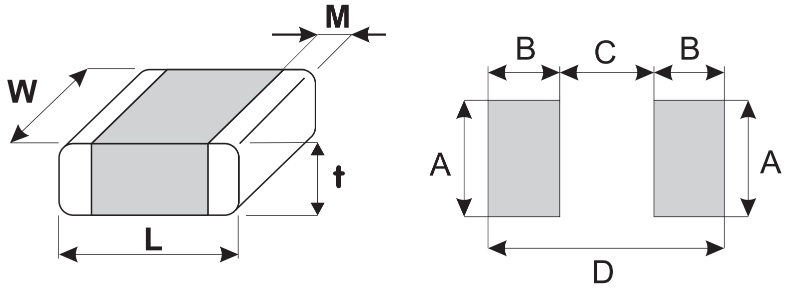
Soldering Pad Configuration



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

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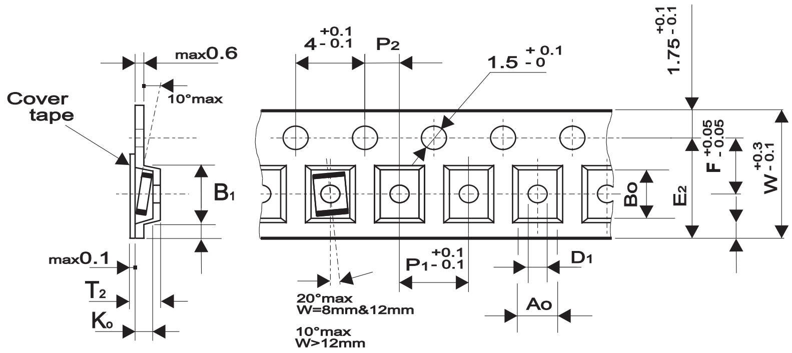
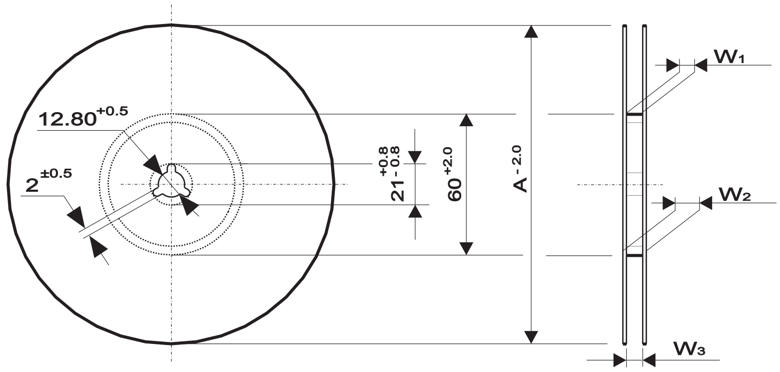
Tape and Reel Specification

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

Tape



Reel



Variable dimensions

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

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

Package units

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

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

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Ordering Information

OV 20 K 474 MX 801 R L1 yy

OV - Series Name: MV, OV

20 - Maximum Continuous Operating Voltage - V_{rms}

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

474 - Capacitance Code in pF: 474 = 470 nF

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

X - Dielectric Type: X = X7R

1812 - Dimensions, only for SMD component

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

N - Barrier type, only for SMD component

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

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

yy - Special requirements

Varicon Marking

For OV Series

OV 20 K
474 MX
122

OV - Series Name

20 - V_{rms}

K - V_n Tolerance

474 - Capacitance Code

M - Capacitance Tolerance

X - Dielectric Ceramics Code

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

For MV Series

MV 14
103 X

MV - Series Name

14 - V_{rms}

K - V_n Tolerance

103 - Capacitance Code

X - Dielectric Ceramics Code

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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.

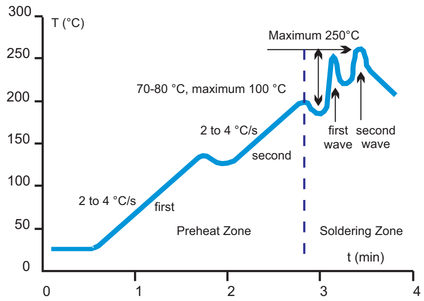

Fig. 1. Wave Soldering Temperature Profile for Pb-free and Pb-containing Soldering

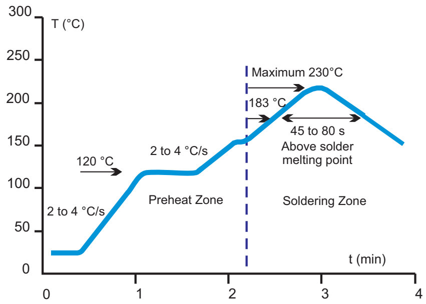

Fig. 2. Infrared Reflow Temperature Profile for Pb-containing Soldering

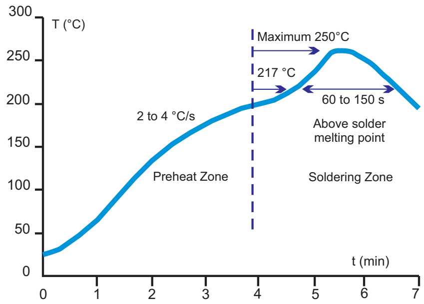

Fig. 3. Reflow Temperature Profile for Pb-free Soldering

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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**

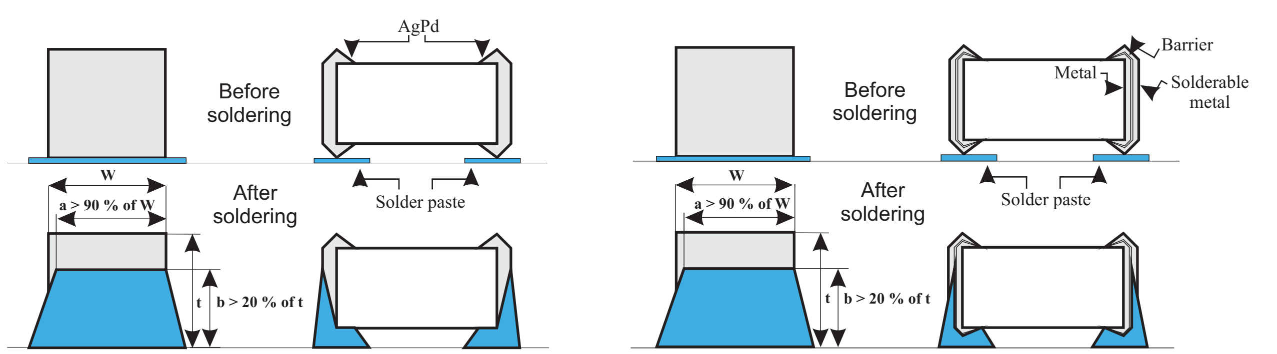

Fig. 4 Soldering Criterion in case of Wave and IR Reflow Pb-containing Soldering

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

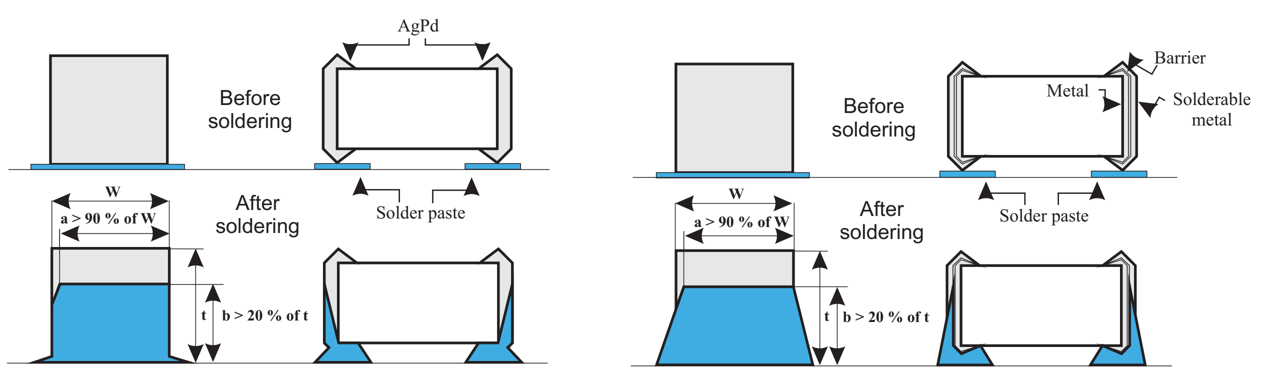

Fig. 5 Soldering Criterion in case of Wave and IR Reflow Pb-free Soldering

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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.

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Terminology

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

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