Features

- Formerly a KEKOVARICON product
- Five model sizes available - 5, 7, 10, 14 and 20 mm
- Operating voltage range (V_{dc}) 3 V to 56 V
- Broad range of current and energy handling capability
- Low clamping voltage
- Available in tape and reel for automatic insertion equipment
- +125 °C maximum continuous operating temperature

ZV Series - Low Voltage Leaded Style Varistors

General Information

The ZV series of low voltage varistors is designed to protect sensitive electronic devices against high voltage and current surges in the low voltage region.

They offer excellent transient energy absorption due to improved energy volume distribution and power dissipation.

Low voltage varistors cover a wide DC operating voltage range from 3 V to 56 V.

Absolute Maximum Ratings

Parameter	Value	Units
Continuous:		
Steady State Applied Voltage		
DC Voltage Range (V_{dc})	3 to 56***	V
AC Voltage Range (V_{rms})	2 to 40***	V
Transient:		
Peak Single Pulse Surge Current, 8/20 μs Waveform (I_{max})	100 to 2000	A
Single Pulse Surge Energy, 10/1000 μs Waveform (W_{max})	0.1 to 37.8	J
Operating Ambient Temperature	-55 to +125	°C
Storage Temperature Range	-55 to +150	°C
Threshold Voltage Temperature Coefficient	< +0.05	%/°C
Insulation Resistance	>1	GΩ
Isolation Voltage Capability	>1.25	kV
Response Time	< 25	ns
Climatic Category	55 / 125 / 56	

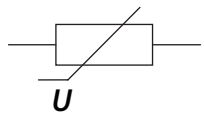
*** Higher operating voltages are available upon request.
Varistors with rated voltages of 2 to 8 V_{rms} are non-standard and available only upon request.

Agency Recognition

Standard	UL 1449
File Number	E326499**

**Not all rated voltages are UL recognized; check the file for details.

Varistor Symbol



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www.bourns.com

WARNING Cancer and Reproductive Harm - www.P65Warnings.ca.gov

*RoHS Directive 2015/863, Mar 31, 2015 and Annex.
Specifications are subject to change without notice.
Users should verify actual device performance in their specific applications.

Applications

- Suppression of inductive switching or other transient events such as surge voltage at the circuit board level
- Transient voltage protection for ICs and transistors
- Helps to achieve electromagnetic compliance of end products
- Replaces larger TVS zener diodes in many applications

ZV Series - Low Voltage Leaded Style Varistors

BOURNS®

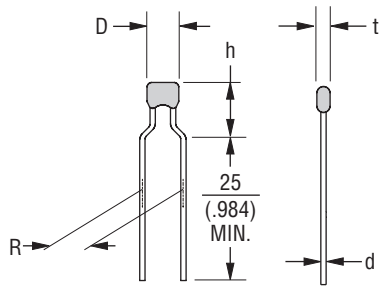
Device Ratings

Model	V_{rms}	V_{dc}	V_n @ 1 mA	V_c	I_c	W_{max} 10/1000 μs	P max.	I_{max} 8/20 μs	C typ. @ 1 kHz
	V	V	V	V	A	J	W	A	pF
ZV 11 K 5	11	14	18	33	1	0.3	0.005	100	480
ZV 11 K 7	11	14	18	33	2.5	0.8	0.008	250	1400
ZV 11 K 10	11	14	18	33	5	1.7	0.010	500	2420
ZV 11 K 14	11	14	18	33	10	3.3	0.015	1000	5000
ZV 11 K 20	11	14	18	33	20	10.5	0.020	2000	9270
ZV 14 K 5	14	18	22	38	1	0.4	0.005	100	377
ZV 14 K 7	14	18	22	38	2.5	0.9	0.008	250	1050
ZV 14 K 10	14	18	22	38	5	2.2	0.010	500	1770
ZV 14 K 14	14	18	22	38	10	4.2	0.015	1000	3850
ZV 14 K 20	14	18	22	38	20	12	0.020	2000	7670
ZV 17 K 5	17	22	27	44	1	0.5	0.005	100	335
ZV 17 K 7	17	22	27	44	2.5	1.2	0.008	250	850
ZV 17 K 10	17	22	27	44	5	2.6	0.010	500	1370
ZV 17 K 14	17	22	27	44	10	5.2	0.015	1000	3050
ZV 17 K 20	17	22	27	44	20	14.2	0.020	2000	6600
ZV 20 K 5	20	26	33	54	1	0.6	0.005	100	325
ZV 20 K 7	20	26	33	54	2.5	1.4	0.008	250	790
ZV 20 K 10	20	26	33	54	5	3.2	0.010	500	1090
ZV 20 K 14	20	26	33	54	10	6.4	0.015	1000	2490
ZV 20 K 20	20	26	33	54	20	18.2	0.020	2000	5670
ZV 25 K 5	25	31	39	65	1	0.7	0.005	100	315
ZV 25 K 7	25	31	39	65	2.5	1.6	0.008	250	790
ZV 25 K 10	25	31	39	65	5	3.8	0.010	500	870
ZV 25 K 14	25	31	39	65	10	7.2	0.015	1000	1890
ZV 25 K 20	25	31	39	65	20	22.4	0.020	2000	4670
ZV 30 K 5	30	38	47	77	1	0.9	0.005	100	315
ZV 30 K 7	30	38	47	77	2.5	2.2	0.008	250	790
ZV 30 K 10	30	38	47	77	5	4.4	0.010	500	770
ZV 30 K 14	30	38	8	77	10	9.4	0.015	1000	1530
ZV 30 K 20	30	38	47	77	20	25.8	0.020	2000	3870
ZV 35 K 5	35	45	56	90	1	1.2	0.005	100	315
ZV 35 K 7	35	45	56	90	2.5	2.6	0.008	250	790
ZV 35 K 10	35	45	56	90	5	5.4	0.010	500	680
ZV 35 K 14	35	45	56	90	10	10.2	0.015	1000	1260
ZV 35 K 20	35	45	56	90	20	33.4	0.020	2000	3470
ZV 40 K 5	40	56	68	110	1	1.4	0.005	100	315
ZV 40 K 7	40	56	68	110	2.5	3.2	0.008	250	790
ZV 40 K 10	40	56	68	110	5	6.4	0.010	500	660
ZV 40 K 14	40	56	68	110	10	13.4	0.015	1000	1070
ZV 40 K 20	40	56	68	110	20	37.8	0.020	2000	3130

Product Dimensions

Model	D max.	t max.	R	d	h max.
ZV 11 K 5	6.0 (.236)	3.5 (.138)	5.0 (.197)	0.6 (.024)	7.0 (.276)
ZV 11 K 7	7.0 (.276)	3.5 (.138)	5.0 (.197)	0.6 (.024)	8.0 (.315)
ZV 11 K 10	7.0 (.276)	3.5 (.138)	5.0 (.197)	0.6 (.024)	9.0 (.354)
ZV 11 K 14	8.0 (.315)	3.5 (.138)	5.0 (.197)	0.6 (.024)	12.0 (.472)
ZV 11 K 20	9.0 (.354)	3.5 (.138)	5.0 (.197)	0.6 (.024)	12.0 (.472)
ZV 14 K 5	6.0 (.236)	3.5 (.138)	5.0 (.197)	0.6 (.024)	7.0 (.276)
ZV 14 K 7	7.0 (.276)	3.5 (.138)	5.0 (.197)	0.6 (.024)	8.0 (.315)
ZV 14 K 10	7.0 (.276)	3.5 (.138)	5.0 (.197)	0.6 (.024)	9.0 (.354)
ZV 14 K 14	8.0 (.315)	3.5 (.138)	5.0 (.197)	0.6 (.024)	12.0 (.472)
ZV 14 K 20	9.0 (.354)	3.5 (.138)	5.0 (.197)	0.6 (.024)	12.0 (.472)
ZV 17 K 5	6.0 (.236)	3.5 (.138)	5.0 (.197)	0.6 (.024)	7.0 (.276)
ZV 17 K 7	7.0 (.276)	3.5 (.138)	5.0 (.197)	0.6 (.024)	8.0 (.315)
ZV 17 K 10	7.0 (.276)	3.5 (.138)	5.0 (.197)	0.6 (.024)	9.0 (.354)
ZV 17 K 14	8.0 (.315)	3.5 (.138)	5.0 (.197)	0.6 (.024)	12.0 (.472)
ZV 17 K 20	9.0 (.354)	3.5 (.138)	5.0 (.197)	0.6 (.024)	12.0 (.472)
ZV 20 K 5	6.0 (.236)	4.5 (.177)	5.0 (.197)	0.6 (.024)	7.0 (.276)
ZV 20 K 7	7.0 (.276)	4.5 (.177)	5.0 (.197)	0.6 (.024)	8.0 (.315)
ZV 20 K 10	7.0 (.276)	4.5 (.177)	5.0 (.197)	0.6 (.024)	9.0 (.354)
ZV 20 K 14	8.0 (.315)	4.5 (.177)	5.0 (.197)	0.6 (.024)	12.0 (.472)
ZV 20 K 20	9.0 (.354)	4.5 (.177)	5.0 (.197)	0.6 (.024)	12.0 (.472)
ZV 25 K 5	6.0 (.236)	4.5 (.177)	5.0 (.197)	0.6 (.024)	7.0 (.276)
ZV 25 K 7	7.0 (.276)	4.5 (.177)	5.0 (.197)	0.6 (.024)	8.0 (.315)
ZV 25 K 10	7.0 (.276)	4.5 (.177)	5.0 (.197)	0.6 (.024)	9.0 (.354)
ZV 25 K 14	8.0 (.315)	4.5 (.177)	5.0 (.197)	0.6 (.024)	12.0 (.472)
ZV 25 K 20	9.0 (.354)	4.5 (.177)	5.0 (.197)	0.6 (.024)	12.0 (.472)
ZV 30 K 5	6.0 (.236)	4.5 (.177)	5.0 (.197)	0.6 (.024)	7.0 (.276)
ZV 30 K 7	7.0 (.276)	4.5 (.177)	5.0 (.197)	0.6 (.024)	8.0 (.315)
ZV 30 K 10	7.0 (.276)	4.5 (.177)	5.0 (.197)	0.6 (.024)	9.0 (.354)
ZV 30 K 14	8.0 (.315)	4.5 (.177)	5.0 (.197)	0.6 (.024)	12.0 (.472)
ZV 30 K 20	9.0 (.354)	4.5 (.177)	5.0 (.197)	0.6 (.024)	12.0 (.472)

Continued on next page



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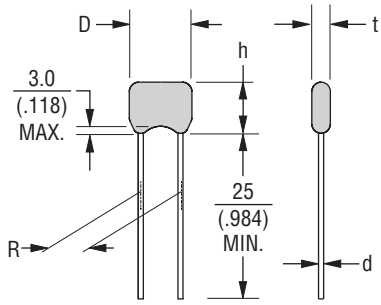
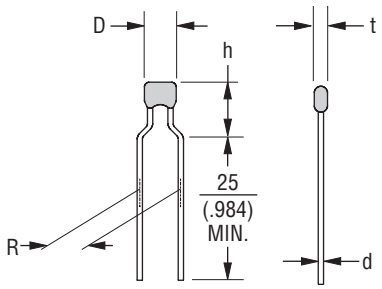


Size 14, 20

Product Dimensions (Continued)

Model	D max.	t max.	R	d	h max.
ZV 35 K 5	6.0 (.236)	4.5 (.177)	5.0 (.197)	0.6 (.024)	7.0 (.276)
ZV 35 K 7	7.0 (.276)	4.5 (.177)	5.0 (.197)	0.6 (.024)	8.0 (.315)
ZV 35 K 10	7.0 (.276)	4.5 (.177)	5.0 (.197)	0.6 (.024)	9.0 (.354)
ZV 35 K 14	8.0 (.315)	4.5 (.177)	5.0 (.197)	0.6 (.024)	12.0 (.472)
ZV 35 K 20	9.0 (.354)	4.5 (.177)	5.0 (.197)	0.6 (.024)	12.0 (.472)
ZV 40 K 5	6.0 (.236)	4.5 (.177)	5.0 (.197)	0.6 (.024)	7.0 (.276)
ZV 40 K 7	7.0 (.276)	4.5 (.177)	5.0 (.197)	0.6 (.024)	8.0 (.315)
ZV 40 K 10	7.0 (.276)	4.5 (.177)	5.0 (.197)	0.6 (.024)	9.0 (.354)
ZV 40 K 14	8.0 (.315)	4.5 (.177)	5.0 (.197)	0.6 (.024)	12.0 (.472)
ZV 40 K 20	9.0 (.354)	4.5 (.177)	5.0 (.197)	0.6 (.024)	12.0 (.472)



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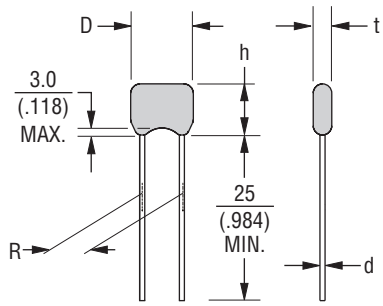


Size 14, 20

How to Order

ZV14K20RL1yy

- Series Designator
  - ZV = ZV Series
- Maximum Continuous Working Voltage (V_{rms})
- V_n Tolerance
  - K = ±10 %, L = ±15 %, M =±20 %
- Model Size (mm)
  - • 5 • 14
  - • 7 • 20
  - • 10
- Packaging
  - R = Reel
  - B = Bulk
  - A = Ammo Pack (available only upon request)
- Lead Style
  - 1 = Straight
  - 5 = Crimped
- Special Requirements
  - • yy

Instructions for Creating Orderable Part Number:

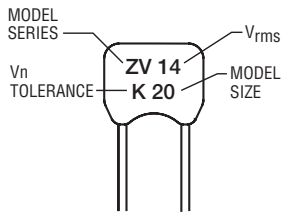
1) Start with base part number in characteristics table (example: ZV14K20).

2) Add Packaging: R (example part number becomes ZV14K20R).

3) Add Lead Style: L1 (example part number becomes ZV14K20RL1).

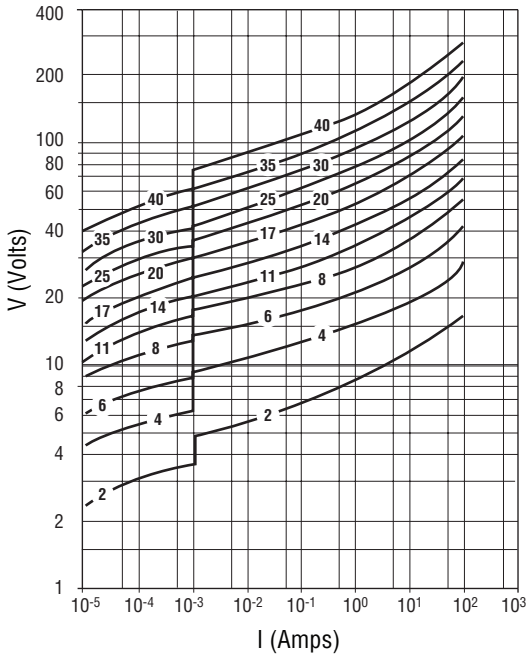
4) Part number can have no spaces or lower case letters.

Typical Part Marking

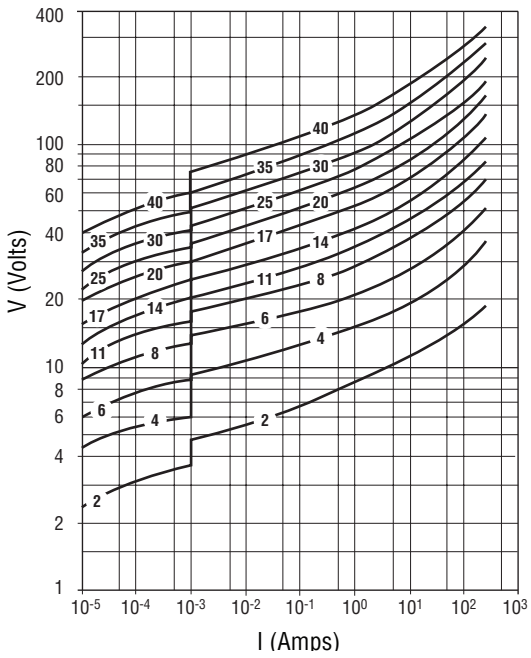


Protection Level

Model Size 5 (ZV 2 M 5 ~ ZV 40 K 5)

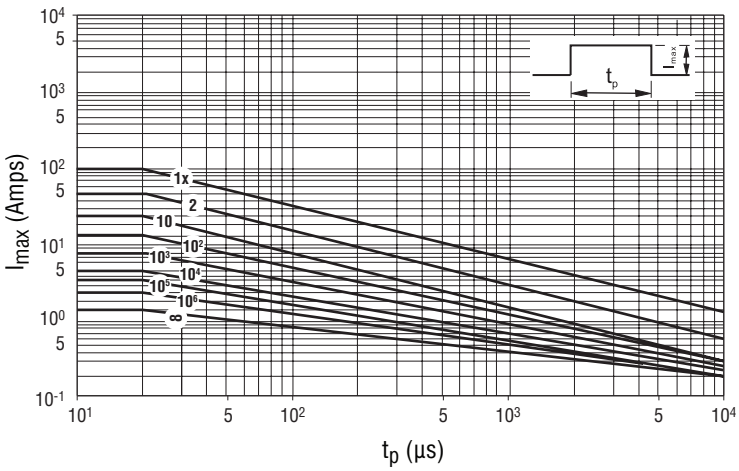


Model Size 7 (ZV 2 M 7 ~ ZV 40 K 7)

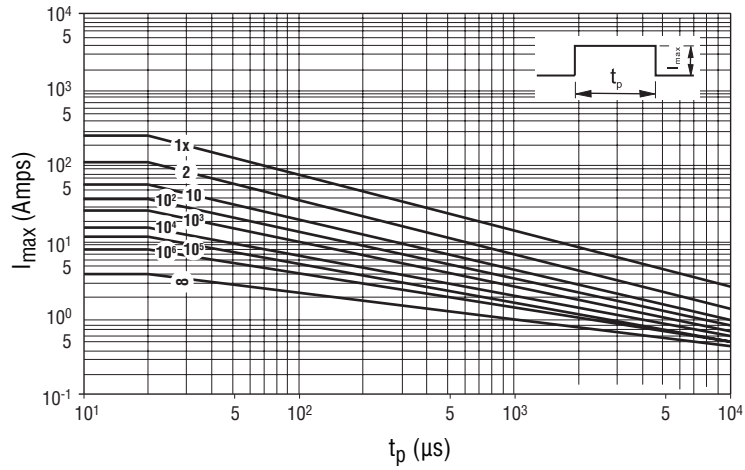


Pulse Rating Curves

Model Size 5 (ZV 2 M 5 ~ ZV 40 K 5)

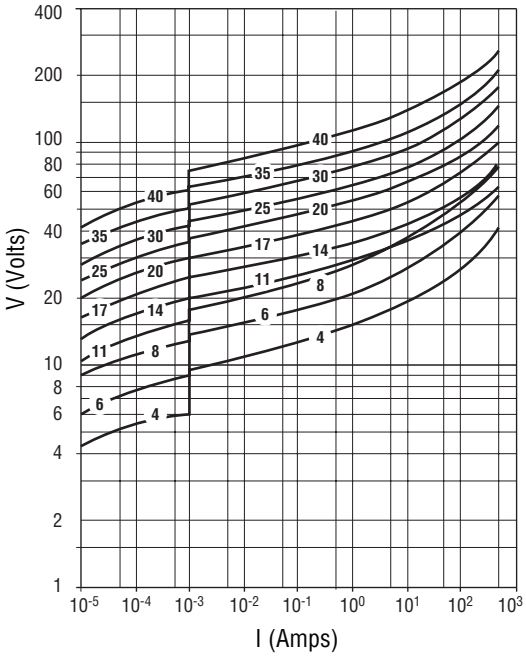


Model Size 7 (ZV 2 M 7 ~ ZV 40 K 7)

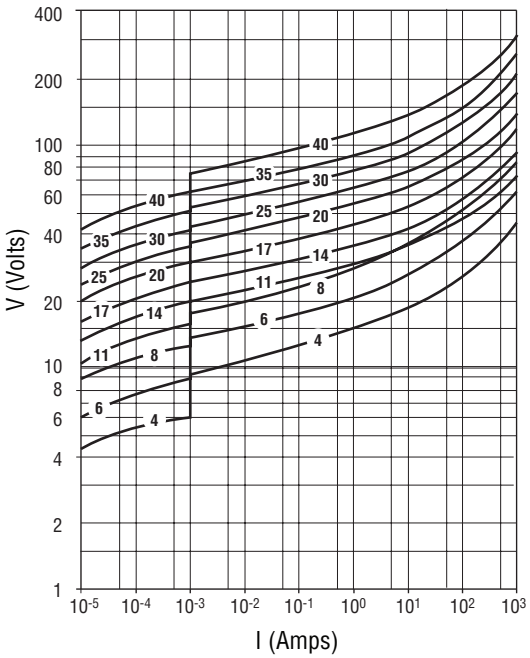


Protection Level

Model Size 10 (ZV 4 M 10 ~ ZV 40 K 10)

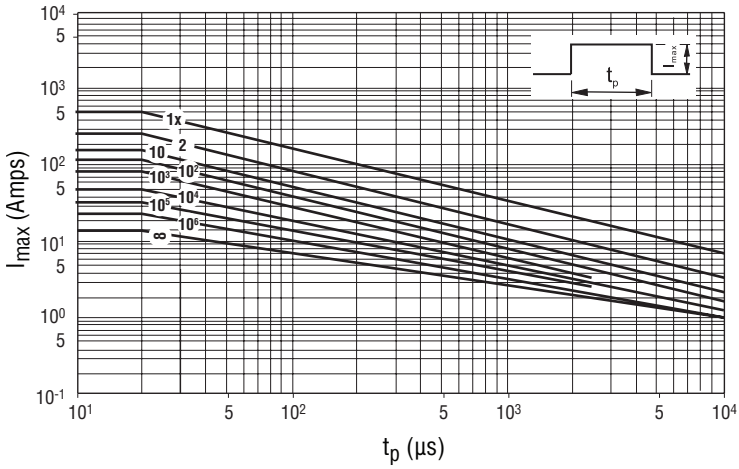


Model Size 14 (ZV 4 M 14 ~ ZV 40 K 14)

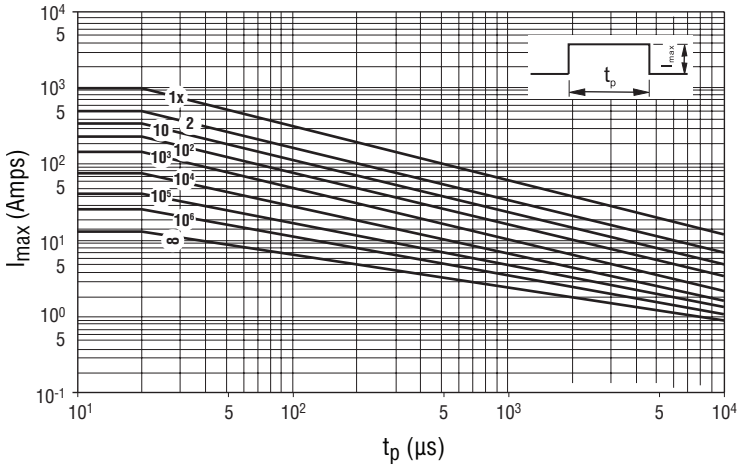


Pulse Rating Curves

Model Size 10 (ZV 4 M 10 ~ ZV 40 K 10)

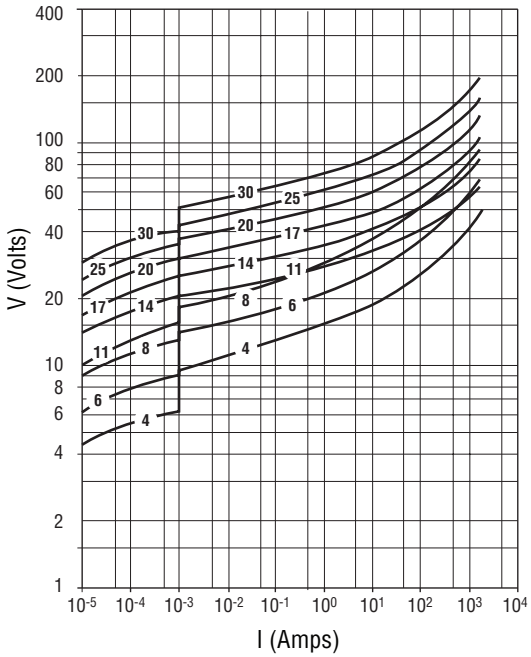


Model Size 14 (ZV 4 M 14 ~ ZV 40 K 14)



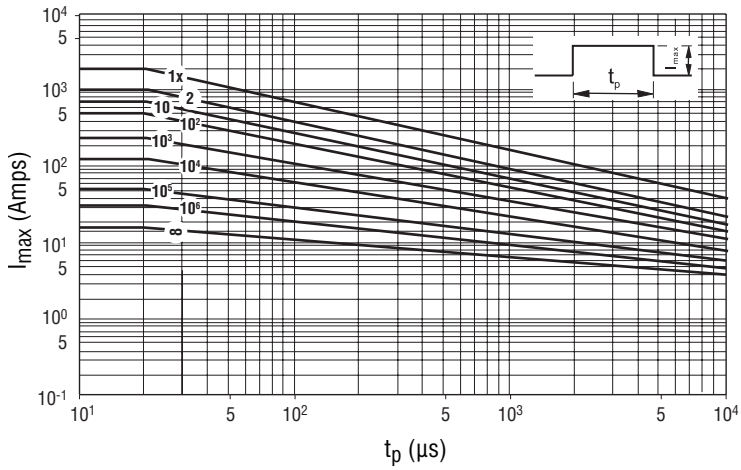
Protection Level

Model Size 20 (ZV 4 M 20 ~ ZV 40 K 20)



Pulse Rating Curves

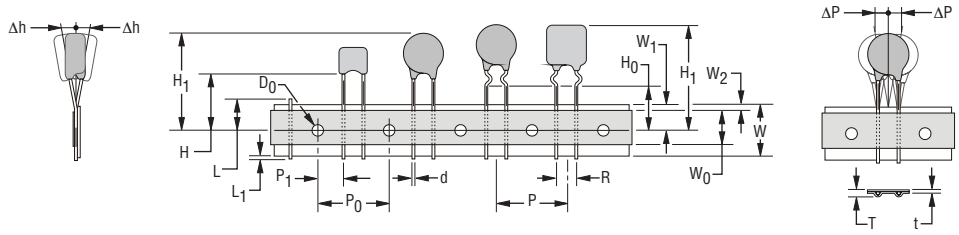
Model Size 20 (ZV 4 M 20 ~ ZV 40 K 20)



Packaging Specifications - Tape

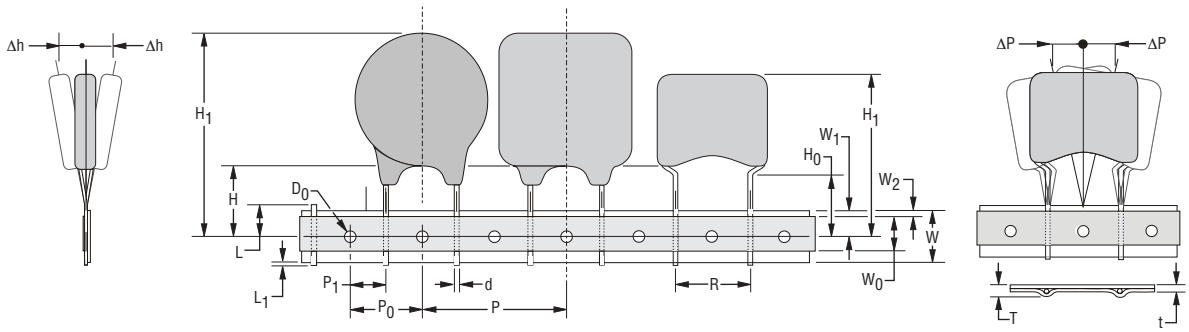
Conforms to IES Publication 286-2 Ed. 3: 2008-03

Dimension R = 5 mm



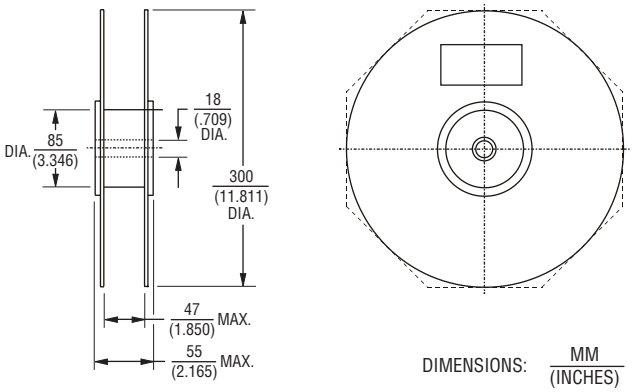
Dimensions on Next Page

Dimension R = 7.5 mm & 10 mm

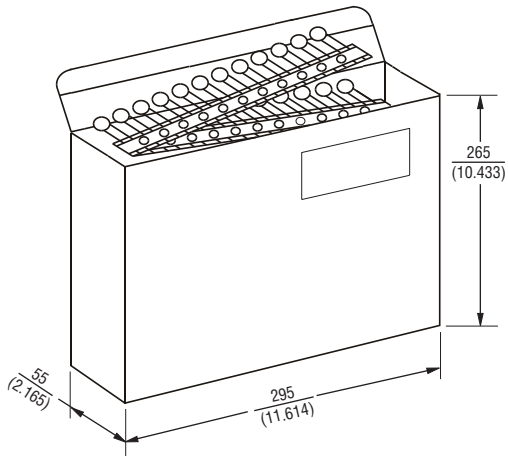


Dimensions on Next Page

Reel



Ammo Pack (Available upon Special Request)



Packaging Specifications - Tape (Continued)

Symbol	Parameter	Model Size				
		5	7	10	14	20
W	Carrier tape width	18 +1.0/-0.5 (.709 +.039/-0.020)				
W_0	Hold down tape width	5 (.197) MIN.				
W_1	Sprocket hole position	9 +0.75/-0.5 (.354 +.030/-.020)				
W_2	Distance between the upper edges of the carrier tape and hold down tape	3 (.118) MAX.				
T	Total tape thickness	1.5 (.059) MAX.		1.7 (.067) MAX.		1.9 (.075) MAX.
t	Tape thickness	0.9 (.035) MAX.				
P	Pitch of component	12.7 ± 1.0 (.500 ± .039)			25.4 ± 1.0 (1.00 ± .039)	
P_0	Feed hole pitch	12.7 ± 0.3 (.500 ± .012)				
P_1	Feed hole center to pitch	3.85 ± 0.7 (.152 ± .028)		8.95 ± 0.7 (.352 ± .028)		7.7 ± 0.7 (.303 ± .028)
R	Lead spacing	5 +0.5/-0.2 (.197 +.020/-.008)		7.5 +0.5/-0.2 (.295 +.020/-.008)		10 +0.5/-0.2 (.394 +.020/-.008)
ΔP	Component alignment	±1.3 (±.051) MAX.				
Δh	Component alignment	±2 (±.079) MAX.				
d	Wire diameter	0.6 (.024) MAX.		0.8 (.031) MAX.		1.0 (.039) MAX.
D_0	Feed hold diameter	4 ± 0.2 (.157 ± .008)				
H	Height from tape center to component base	18 +2.0/-0.0 (.709 +.079/0)				
H_0	Seating plane height	16 ± 0.5 (.630 ± .020)				
H_1	Component height	32.2 (1.268) MAX.		46.5 (1.831) MAX.		
L	Protrusion - cut out	11 (.433) MAX.				
L_1	Protrusion - cut off	0.5 (.020) MAX.				

DIMENSIONS: MM (INCHES)

Packaging Quantities

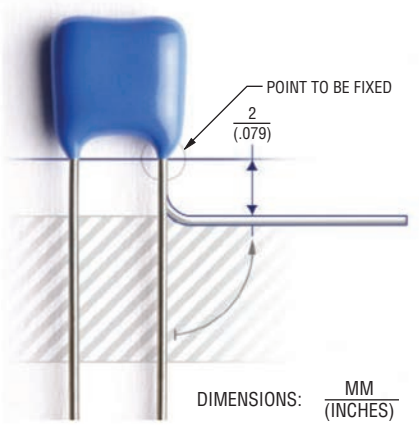
Bulk

V	5	7	10	14	20
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	1000	1000
14	1500	1500	1500	1000	1000
17	1500	1500	1500	1000	1000
20	1500	1500	1500	1000	1000
25	1500	1500	1500	1000	1000
30	1500	1500	1500	1000	1000
35	1500	1500	1500	1000	1000
40	1500	1500	1500	1000	1000

Reel

V	5	7	10	14	20
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	1500	1500	1500	1500
14	1500	1500	1500	1500	1500
17	1500	1500	1300	1500	1500
20	1500	1500	1300	1500	1500
25	1300	1300	1300	1500	1500
30	1300	1300	1300	1500	1500
35	1300	1300	1300	1500	1500
40	1300	1300	1300	1500	1500

Assembly Recommendations for Through-Hole Components



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

In order to avoid epoxy 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 lifetime is thermal shock during manual soldering with a soldering iron. This can occur when a soldering iron is placed too close to one point of the component body and it happens most often when the solder joint is too close to the varistor body.

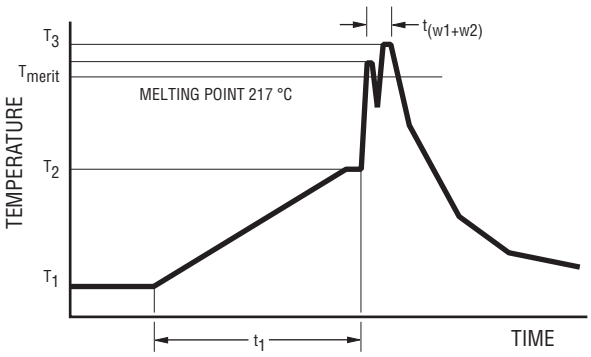
Resistance to Soldering Heat

In the case of automatic wave soldering, it is important to provide sufficient resistance to soldering heat. In order to prevent any potential problems, internal standards were introduced for testing the resistance to soldering heat of through-hole components: 300 °C, 10 seconds.

Pb-free Wave Soldering Profile Recommendations

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

Lead-free Wave Soldering Profile - Pb-free wave profile requirements for soldering heat resistance of components



Parameter	Symbol	Specification
Preheating temperature gradient		4 °C/sec. max.
Preheating time	t_1	2 to 5 min.
Min. preheating temperature	T_1	130 °C
Max. preheating temperature	T_2	180 °C
Melting temperature/point	T_{meltv}	217 °C
Time in wave soldering phase (w_1+w_2)	t_{w1+w2}	10 sec.
Max. wave temperature (w_1+w_2)	T_s	265 °C +0/-5 °C
Cooling temperature gradient		6° C/sec. max.
Temperature jump from 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.

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 (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 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/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 environments. It is an exponentially decaying positive voltage which occurs in the event of a battery disconnect 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 @ 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_r 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	tr	The time lag between application of a surge and varistor's "turn-on" conduction action
Varistor Voltage Temperature Coefficient	TC	(V_n @ 85 °C - V_n @ 25 °C) / (V_n @ 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	LCT & UCT = Lower and Upper Category Temperature - the minimum and maximum ambient temperatures for 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

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