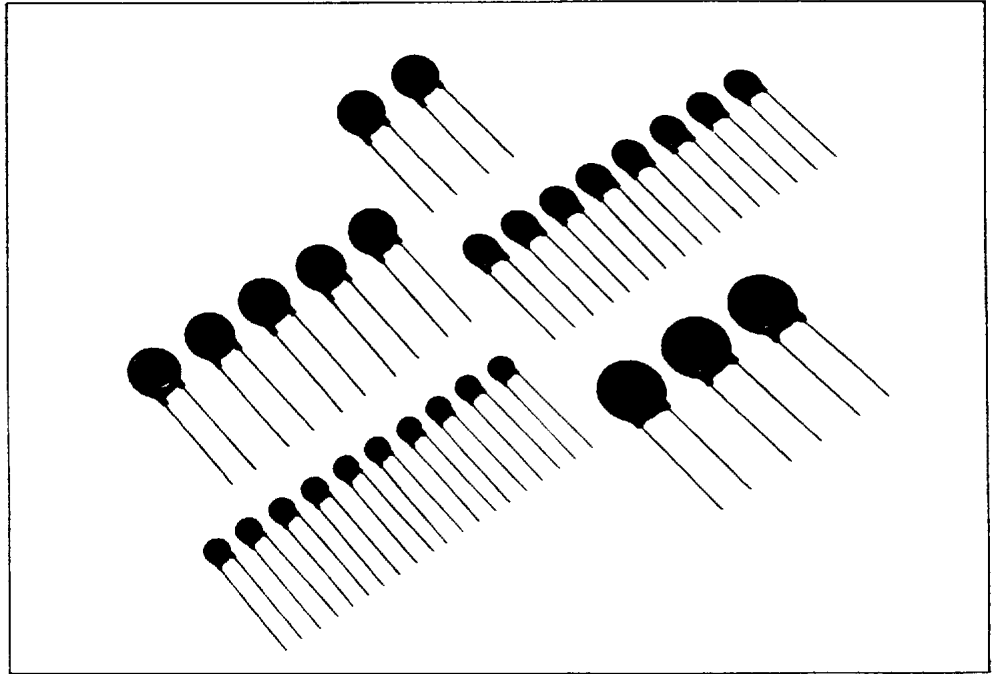


METAL OXIDE VARISTOR

ZENAMIC



ZENAMIC is the product name of a metal oxide varistor.

Features

- High energy absorption
- Excellent voltage clamping characteristics
- Symmetrical characteristics — for use on AC or DC
- Fast response
- Compact and robust construction
- Low idle power
- High surge current capability
- Specific types for PACE/paks and Solid State Relays

Applications

- For protection of all types of semiconductors
- Suppression of switching transients
- Voltage clipping, and circuit damping
- Absorption of surge voltages associated with lightning strikes
- Prolongation of contact life
- Protection in industrial switching circuits

Zenamic voltage suppressors are metal oxide varistors having a non-linear current-voltage characteristic which exhibits an almost constant voltage over a wide range of current. They are ideally suited to all transient voltage protection applications and their high clamping ratios and low steady state power consumption offer considerable circuit advantages over more traditional methods of protection.

Normally the Zenamic idles at a low current level at the nominal voltage. When a transient over-voltage occurs in the circuit, the Zenamic current increases rapidly, its voltage remaining virtually constant. The transient energy is thus absorbed by the Zenamic and the associated circuit impedances.

V-I characteristics

ZENAMIC has the forward-reverse symmetrical electrical characteristics as shown in the figure 1. The voltage-current curves show the varistor characteristics in the range $1 \mu\text{A}$ to 10^4 A , and show the resistance characteristics for the range under $1 \mu\text{A}$ and over 10^4 A in the figure 2. The voltage across terminals when test current (I_t : 1 mA) is applied to ZENAMIC is a standard varistor voltage (V_z), and the voltage across terminals when a standard surge (I_p) is applied represents the maximum suppression voltage (V_c).

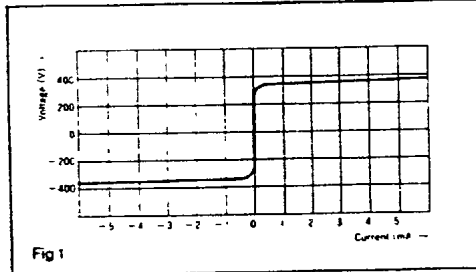


Fig 1

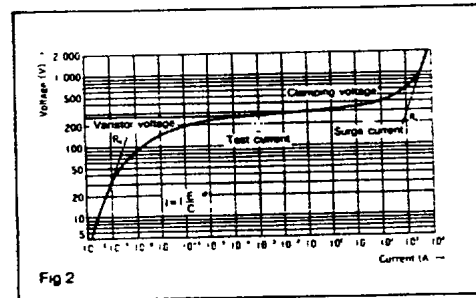


Fig 2

Temperature Characteristics

In the small current range, Zenamic features outstanding temperature characteristics. A shunt resistance R_p of metal oxide varistor has the temperature characteristics which is determined by the following equation.

$$R_p = A e^{E_g/2kT} \quad (2)$$

T: Absolute temperature
k: Boltzmann constant
A, E_g : constants

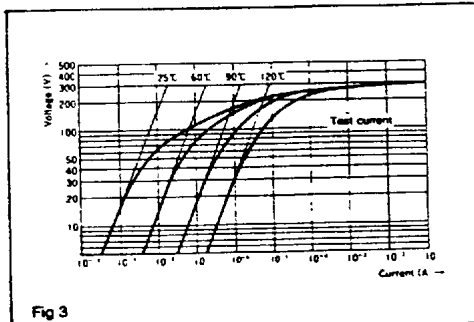


Fig 3

As shown in the figure 3, the temperature dependence characteristics are shown clearly in the low current area.

Power derating

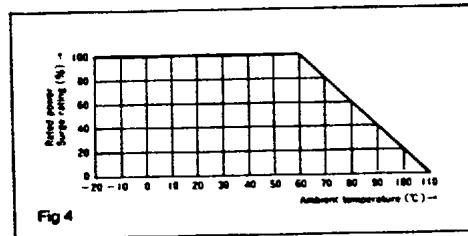


Fig 4

Surge waveform

A surge waveform varies according to the sources. An EXP waveform is used for surge testing of ZENAMIC, while a AC half-wave is used for the energy absorption test. The EXP waveform reaches its peak voltage (current) at $[t_a]$ as shown in the figure 5, and then decreases as time passes and reaches half of the peak voltage (current) at $[t_b]$. This type of the EXP waveform is shown as a $[t_a/t_b]$ voltage (current) waveform. For surge testing of ZENAMIC, the $8/20 \mu\text{sec}$ current waveform is used.

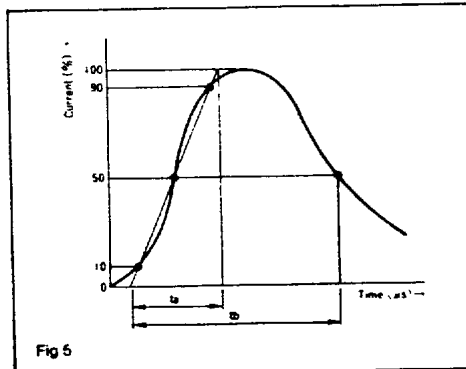
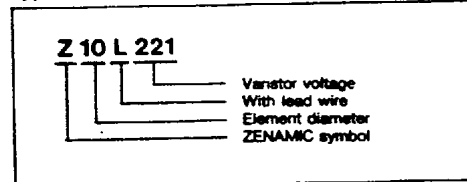


Fig 5

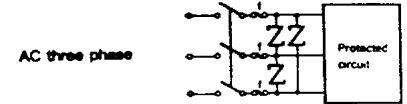
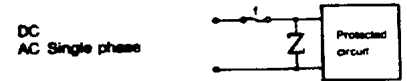
Type No.



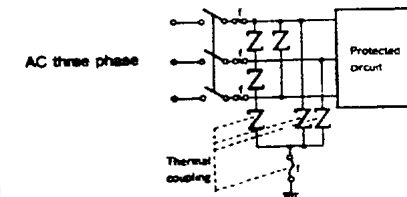
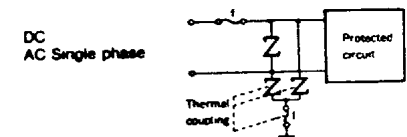
Application

A few examples show. Power lines and surge absorption units with error display (SA series).

Line to Line protection



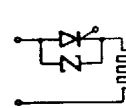
Line to Line and Line to Ground protection



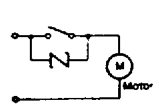
Switching surge protection



Semiconductor protection



Contact spark suppression

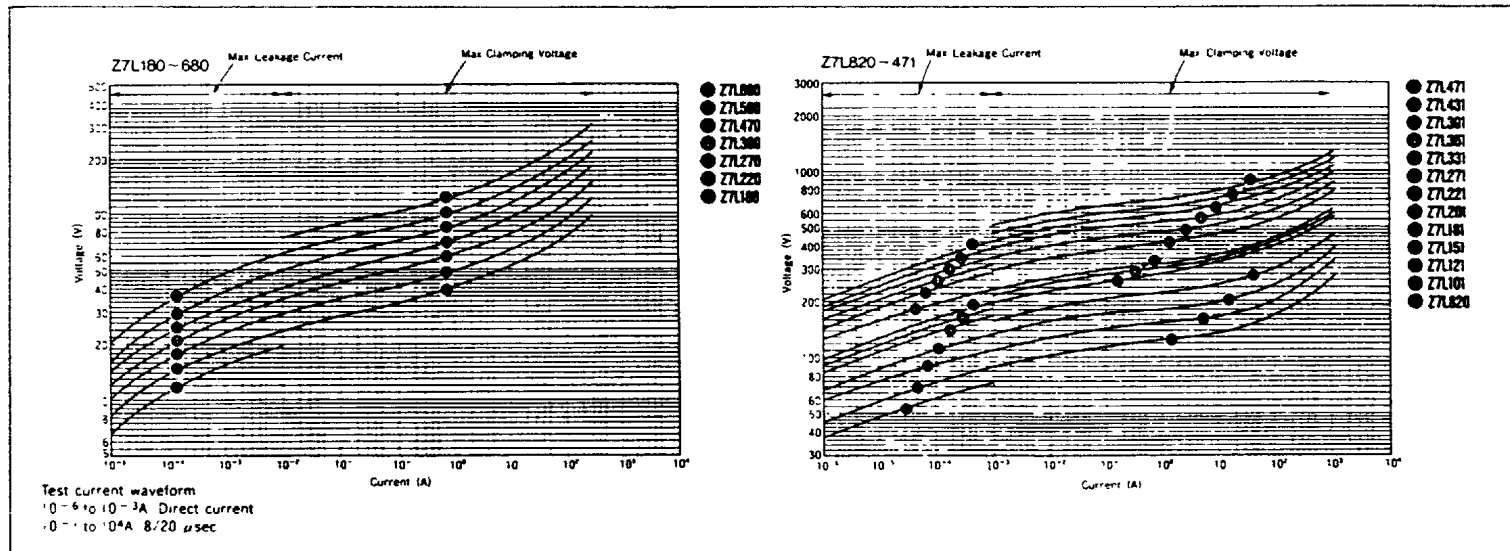


Z7L Series

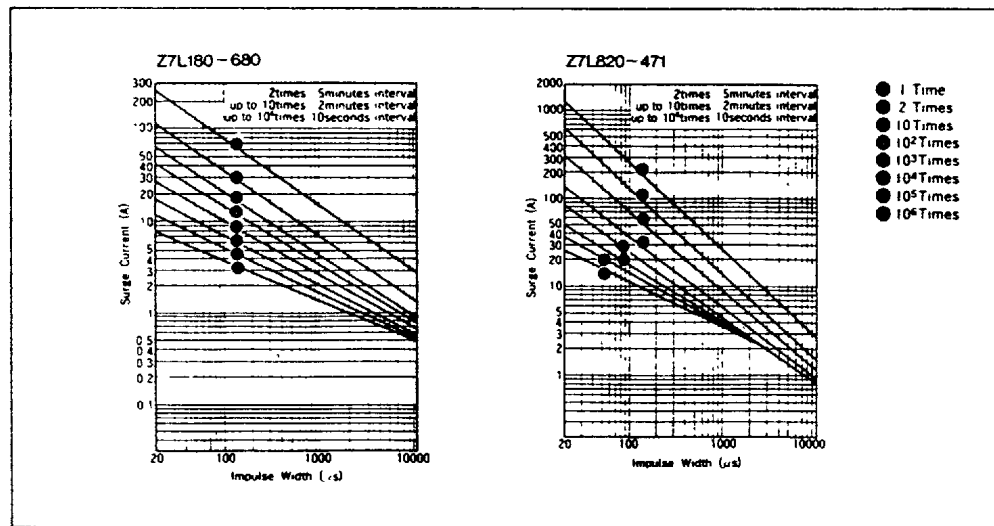
Specifications

Type No.	Varistor voltage V_{1mA} (V)		Maximum allowable voltage		Maximum clamping voltage	Rated wattage	Energy (2ms)	Withstanding Surge current (8/20 μ s)		Typical capacitance (@ 1kHz)
			AC	DC				1 Time	2 Times	
	Min	Max	V_{rms}	V	V	W	J			pF
Z7L180	18 (16~20)		11	14	36 at 2.5A	0.02	0.8	250A	125A	3,500
Z7L220	22 (20~24)		14	18	43		0.9			2,800
Z7L270	27 (24~30)		17	22	53		1.0			2,000
Z7L330	33 (30~36)		20	26	65		1.2			1,500
Z7L390	39 (35~43)		25	31	77		1.5			1,350
Z7L470	47 (42~52)		30	38	93		1.8			1,150
Z7L560	56 (50~62)		35	45	110		2.2			950
Z7L680	68 (61~75)		40	56	135	2.5	700			
Z7L820	82 (74~90)		50	65	135 at 10A	0.25	3.5	1200A	600A	550
Z7L101	100 (90~110)		60	85	165		4.0			500
Z7L121	120 (108~132)		75	100	200		5.0			450
Z7L151	150 (135~165)		95	125	250		6.0			350
Z7L181	180 (162~198)		110	145	300		10.0			300
* Z7L201	200 (185~225)		130	170	340		10.0			250
* Z7L221	220 (198~242)		140	180	380		10.0			250
* Z7L271	270 (247~303)		175	225	455		12.0			170
* Z7L331	330 (297~363)		210	275	550		15.0			150
* Z7L361	360 (324~396)		230	300	595		15.0			130
* Z7L381	380 (351~429)		250	320	650		17.0			130
* Z7L431	430 (387~473)		275	350	710		20.0			110
* Z7L471	470 (423~517)		300	385	775		20.0			100

V-I characteristics



Surge Life Time Ratings (Relation between impulse width and surge repetition time)



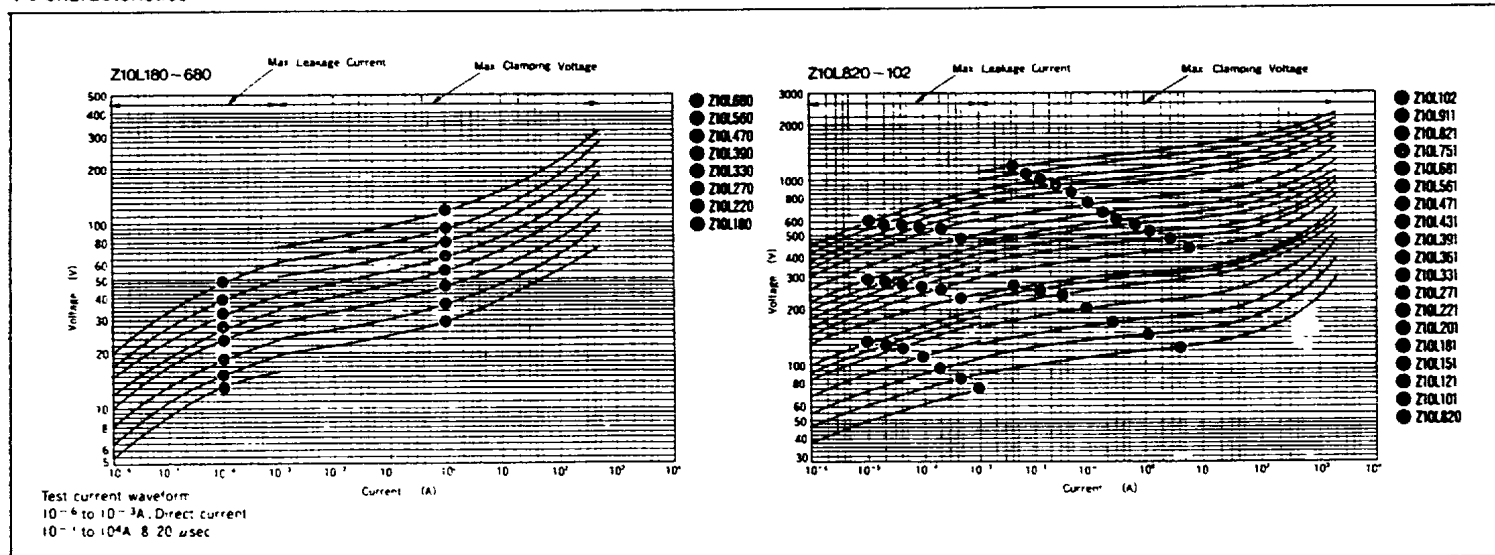
- 1 Operating temperature range -40 to 85 °C
- 2 Storage temperature range -40 to 125 °C
- 3 * UL approved model

Z10L Series

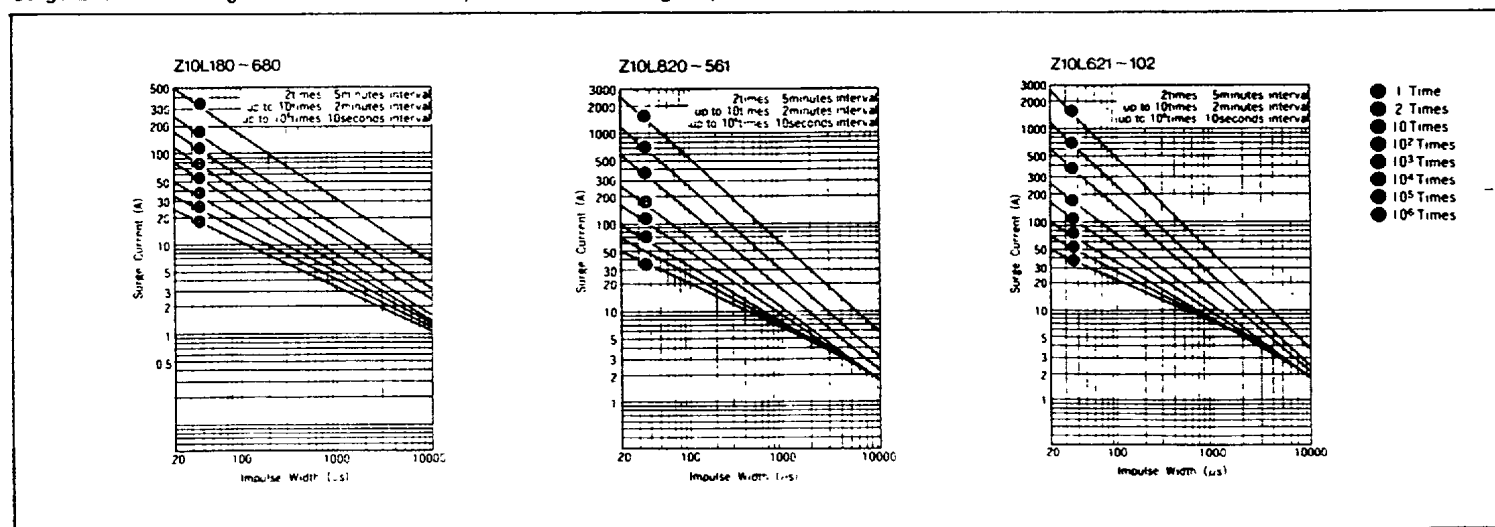
Specifications

Type No.	Varistor voltage V_{1mA} (V)		Maximum allowable voltage		Maximum clamping voltage	Rated wattage	Energy (Jms)	Withstanding Surge Current (8/20 μ s)		Typical capacitance (@ 1kHz)
			AC	DC				1 Time	2 Times	
	Min	Max	V_{rms}	V	V	W	J			pF
Z10L180	18	16 ~ 20	11	14	36 at 5A	0.05	1.5	500A	250A	7,500
Z10L220	22	20 ~ 24	14	18	43		2.0			6,000
Z10L270	27	24 ~ 30	17	22	53		2.5			4,000
Z10L330	33	30 ~ 36	20	26	65		3.0			3,000
Z10L390	39	35 ~ 43	25	31	77		3.5			2,600
Z10L470	47	42 ~ 52	30	38	93		4.5			2,200
Z10L560	56	50 ~ 62	35	45	110		5.5			1,800
Z10L680	68	61 ~ 75	40	56	135	0.4	6.5	2500A	1250A	1,300
Z10L820	82	74 ~ 90	50	65	135 at 25A		8			1,800
Z10L101	100	90 ~ 110	60	85	165		10			1,400
Z10L121	120	108 ~ 132	75	100	200		12			1,100
Z10L151	150	135 ~ 165	95	125	250		16			900
Z10L181	180	162 ~ 198	110	145	300		18			700
Z10L201	200	185 ~ 225	130	170	340		20			500
Z10L221	220	198 ~ 242	140	180	350		23			450
Z10L271	270	247 ~ 303	175	225	455		30			350
Z10L331	330	297 ~ 363	210	275	560		33			330
Z10L361	360	324 ~ 396	230	300	565		35			300
Z10L391	390	351 ~ 429	250	320	650		40			270
Z10L431	430	387 ~ 473	275	350	710		45			250
Z10L471	470	423 ~ 517	300	385	775		45			230
Z10L561	560	504 ~ 516	350	460	925		45			150
Z10L681	680	612 ~ 748	420	560	1,120		45			130
Z10L751	750	675 ~ 825	460	615	1,240		50			120
Z10L821	820	738 ~ 902	510	670	1,355		55			110
Z10L911	910	819 ~ 1,001	550	745	1,500		60			100
Z10L102	1,000	900 ~ 1,100	625	825	1,650		65			80

V-I characteristics



Surge Life Time Ratings (Relation between impulse width and surge repetition time)



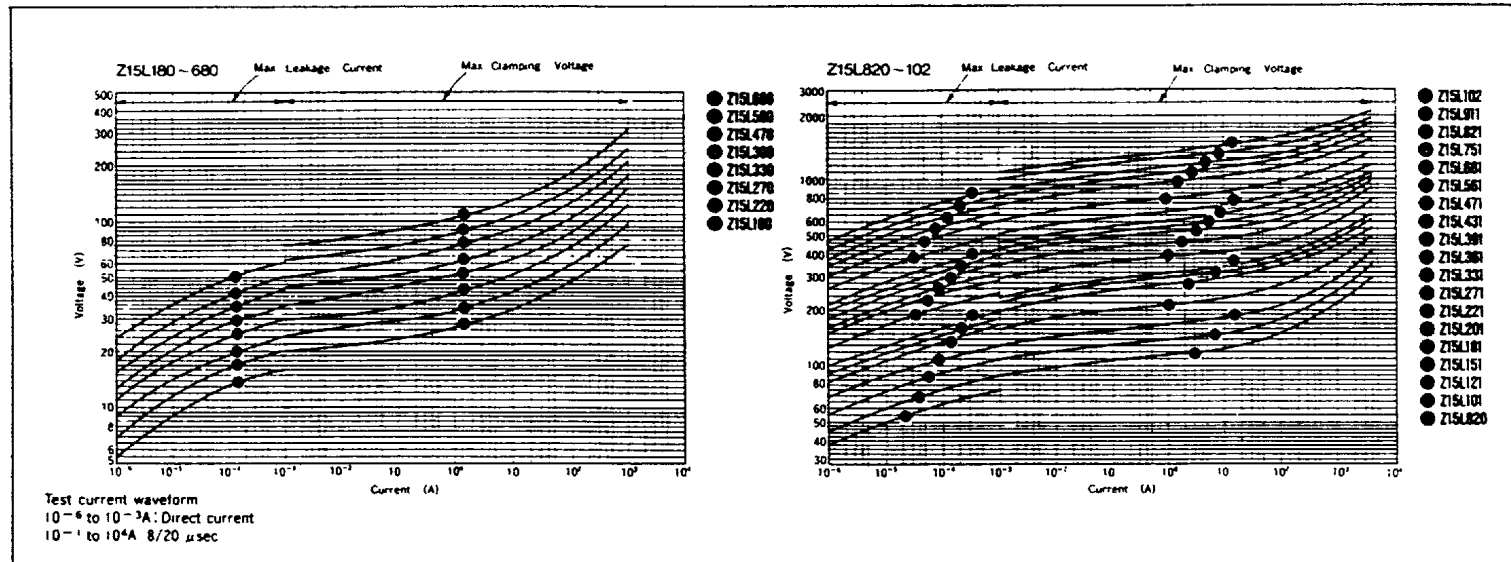
1. Operating temperature range -40 to 85 °C
2. Storage temperature range -40 to 125 °C
3. *: UL approved model

Z15L Series

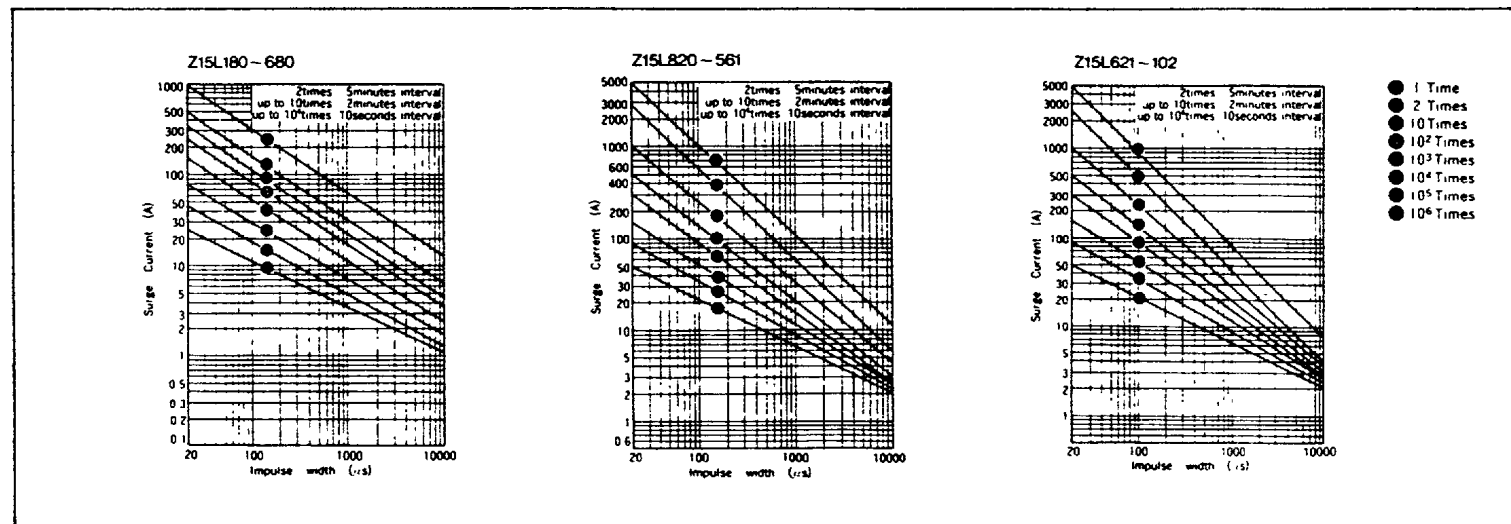
Specifications

Type No.	Varistor voltage V_{1mA} (V)		Maximum allowable voltage		Maximum clamping voltage	Rated wattage	Energy (2ms)	Withstanding Surge current (8/20 μ s)		Typical capacitance (1kHz)
			AC	DC						
	Min	Max	V_{rms}	V	V	W	J	1 Time	2 Times	pF
Z15L180	18	(16~20)	11	14	36 at 10A	0.1	3.5	1000A	500A	18,000
Z15L220	22	(20~24)	14	18	43		4.0			15,000
Z15L270	27	(24~30)	17	22	53		5.0			10,000
Z15L330	33	(30~36)	20	26	65		6.0			7,500
Z15L390	39	(35~43)	25	31	77		7.0			6,500
Z15L470	47	(42~52)	30	38	93		8.5			5,500
Z15L560	56	(50~62)	36	45	110	0.6	10.0	4500A	2500A	4,500
Z15L680	68	(61~75)	40	56	135		12.0			3,300
Z15L820	82	(74~90)	50	65	135 at 50A		14			2,900
Z15L101	100	(90~110)	60	85	165		18			2,400
Z15L121	120	(108~132)	75	100	200		20			1,900
Z15L151	150	(135~165)	95	125	250		25			1,500
Z15L181	180	(162~198)	110	145	300		30			1,200
Z15L201	200	(185~225)	130	170	340		35			1,000
Z15L221	220	(198~242)	140	180	360		40			1,000
Z15L271	270	(247~303)	175	225	455		50			750
Z15L331	330	(297~363)	210	275	550		60			650
Z15L361	360	(324~396)	230	300	595		65			550
Z15L391	390	(351~429)	250	320	650		70			500
Z15L431	430	(387~473)	275	350	710		75			450
Z15L471	470	(423~517)	300	385	775		80			400
Z15L561	560	(504~616)	350	460	925		80			300
Z15L681	680	(612~748)	420	560	1,120		90			250
Z15L751	750	(675~825)	480	615	1,240		100			230
Z15L821	820	(738~902)	510	670	1,355		110			200
Z15L911	910	(819~1,001)	550	745	1,500		120			180
Z15L102	1,000	(900~1,100)	625	825	1,650		130			150

V-I characteristics



Surge Life Time Ratings (Relation between impulse width and surge repetition time)



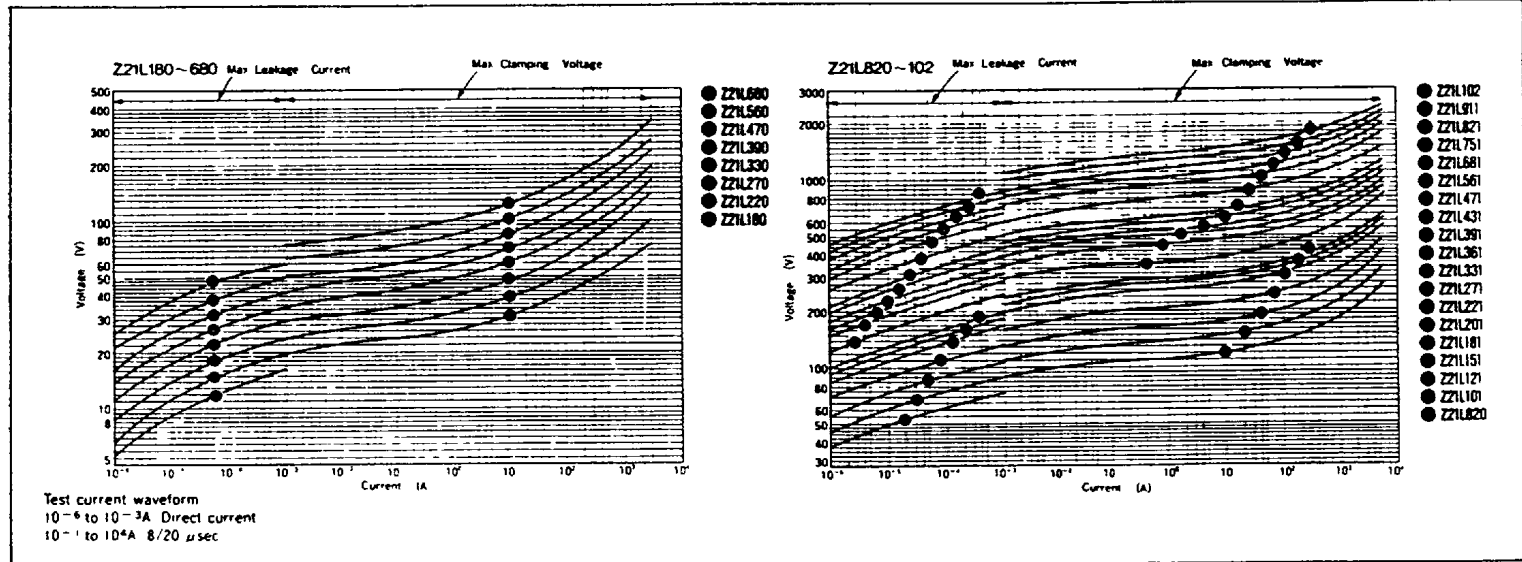
1. Operating temperature range: -40 to 85°C
2. Storage temperature range: -40 to 125°C
3. *: UL approved model

Z21L Series

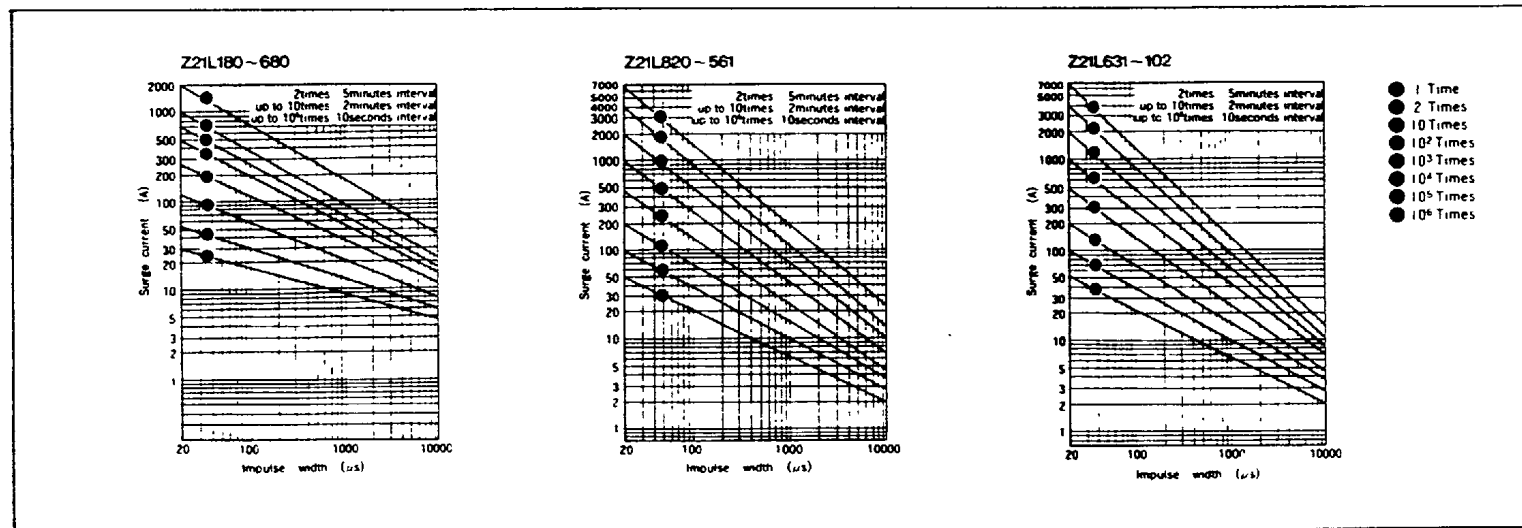
Specifications

Type No.	Varistor voltage V_{ma} (V)		Maximum allowable voltage		Maximum clamping voltage	Rated wattage	Energy (Jms)	Withstanding surge current (8/20 μ s)		Typical capacitance (@ 1kHz)
			AC	DC						
	Min	Max	V_{rms}	V	V	W	J	1 Time	2 Time	pF
Z21L180	18 (16 ~ 20)		11	14	36 at 20A		10			37,000
Z21L220	22 (20 ~ 24)		14	18	43		13			30,000
Z21L270	27 (24 ~ 30)		17	22	53		15			22,000
Z21L330	33 (30 ~ 36)		20	26	65		20			17,000
Z21L390	39 (35 ~ 43)		25	31	77	0.2	24	2000A	1000A	15,000
Z21L470	47 (42 ~ 52)		30	38	93		30			13,000
Z21L560	56 (50 ~ 62)		35	45	110		35			11,000
Z21L680	68 (61 ~ 75)		40	56	135		40			7,000
Z21L820	82 (74 ~ 90)		50	65	135 at 100A		27			5,500
Z21L101	100 (90 ~ 110)		60	85	165		30			4,800
Z21L121	120 (108 ~ 132)		75	100	200		40			3,800
Z21L151	150 (135 ~ 165)		95	125	250		50			3,000
Z21L181	180 (162 ~ 198)		110	145	300		65			2,500
Z21L201	200 (185 ~ 225)		130	170	340		75			2,000
Z21L221	220 (198 ~ 242)		140	180	380		80			1,800
Z21L271	270 (247 ~ 303)		175	225	455		110			1,400
Z21L331	330 (297 ~ 363)		210	275	550		120	6500A	4000A	1,200
Z21L361	360 (324 ~ 396)		230	300	595	1.0	130			1,000
Z21L391	390 (351 ~ 429)		250	320	650		140			900
Z21L431	430 (387 ~ 473)		275	350	710		150			800
Z21L471	470 (423 ~ 517)		300	385	775		160			700
Z21L561	560 (504 ~ 616)		350	460	925		175			600
Z21L681	680 (612 ~ 748)		420	560	1,120		190			460
Z21L751	750 (675 ~ 825)		460	615	1,240		215			400
Z21L821	820 (738 ~ 902)		510	670	1,355		230			350
Z21L911	910 (819 ~ 1,001)		550	745	1,500					320
Z21L102	1,000 (900 ~ 1,100)		625	825	1,650					

V-I characteristics



Surge Life Time Ratings (Relation between impulse width and surge repetition time)



1. Operating temperature range: -40 to 85 °C
2. Storage temperature range: -40 to 125 °C
- 3 * : UL approved model

25-

Type No.	Varistor voltage V_{1mA} (V)		Maximum allowable voltage		Maximum clamping voltage	Rated wattage	Energy (Jms)	Withstanding surge current (8/20 μ s)		Typical capacitance (@1kHz)
			AC	DC						
	Min	Max	V_{rms}	V	V	W	J	1 Time	2 Times	pF
Z25M221S	220 (187 ~ 253)		120	165	380 at 100A		125			3,300
Z25M271S	270 (229.5 ~ 310.5)		150	210	465		156			2,200
Z25M331S	330 (280.5 ~ 379.5)		175	245	570		186			1,800
Z25M391S	390 (331.5 ~ 448.5)		210	296	675		215			1,700
Z25M441S	440 (374 ~ 506)		240	335	760		225			1,500
Z25M471S	470 (399.5 ~ 540.5)		250	350	810	1.0	235	15000A	10000A	1,500
Z25M561S	560 (476 ~ 644)		300	420	970		260			1,400
Z25M681S	680 (578 ~ 782)		365	510	1,175		280			1,250
Z25M821S	820 (697 ~ 943)		440	615	1,415		330			800
Z25M102S	1000 (850 ~ 1,150)		520	730	1,725		375			500
Z33M221S	220 (187 ~ 253)		120	165	380 at 100A		200			5,500
Z33M271S	270 (229.5 ~ 310.5)		150	210	465		256			4,200
Z33M331S	330 (280.5 ~ 379.5)		175	245	570		310			3,700
Z33M391S	390 (331.5 ~ 448.5)		210	296	675		360			3,200
Z33M441S	440 (374 ~ 506)		240	335	760		370			2,800
Z33M471S	470 (399.5 ~ 540.5)		250	350	810	1.2	395	25000A	20000A	2,800
Z33M561S	560 (476 ~ 644)		300	420	970		425			2,200
Z33M681S	680 (578 ~ 782)		365	510	1,175		460			1,800
Z33M821S	820 (697 ~ 943)		440	615	1,415		580			1,500
Z33M102S	1000 (850 ~ 1,150)		520	730	1,725		620			1,000

2 Storage temperature range. -40 to 125°C

Technical drawings of four types of electrical components: Z7L, Z10L, Z15L, and Z21L. Each type is shown in two views: a side view and a cross-sectional view. The side view shows a circular top with a diameter dimension (Max 9.0, Max 14, Max 17.5, Max 24.0) and a height dimension (Max 12.0, Max 17.0, Max 20.5, Max 28.0). The cross-sectional view shows the internal structure, including a central hole with a diameter dimension (Max 6.0, Max 8.5, Max 6.6, Max 7.0) and a height dimension (Max 3.0, Max 6.6, Max 6.6, Max 7.0). The components are labeled 'Epoxy' and 'Min 30'.

Technical drawings of the Z33M44I electronic component, showing dimensions in millimeters (mm).

Top View Dimensions:

- Overall width: 60 ± 1
- Distance between mounting holes: 51 ± 1
- Distance from mounting hole to center: 24
- Mounting hole diameter: 4.3
- Label: **150 MA**

Side View Dimensions:

- Overall height: 55 ± 1
- Top flange width: 12
- Top flange thickness: 1.5

Bottom View Dimensions:

- Bottom flange width: 14

Component Label: Zenamic Z33M44I JAPAN 17

[illegible]