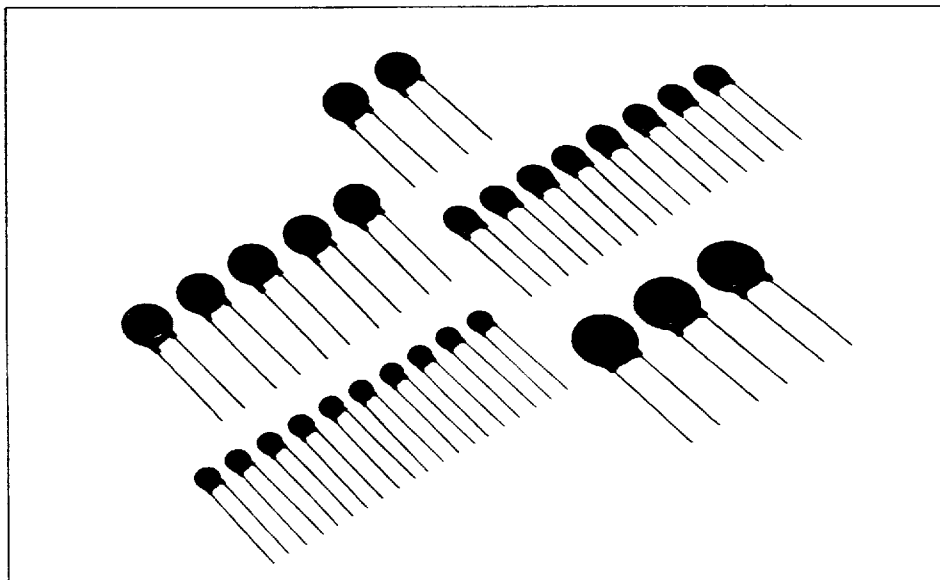


POWER PRODUCTS INTERNATIONAL LTD

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.

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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 $10^4\ \text{A}$, and show the resistance characteristics for the range under $1\ \mu\text{A}$ and over $10^4\ \text{A}$ 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).

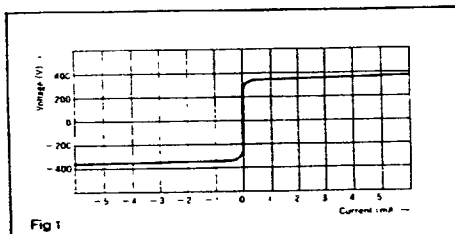


Fig 1

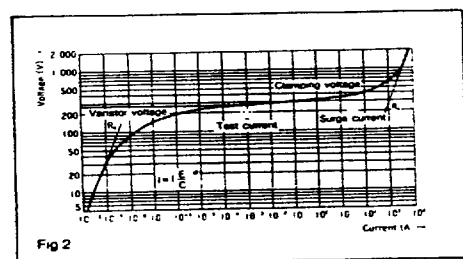


Fig 2

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

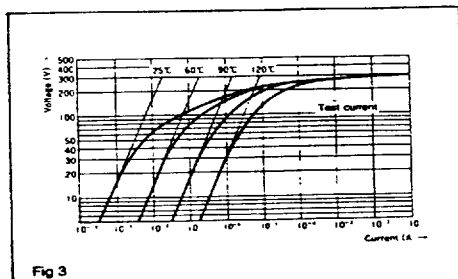


Fig 3

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

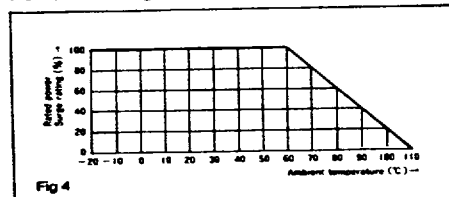
Power derating

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 μsec current waveform is used.

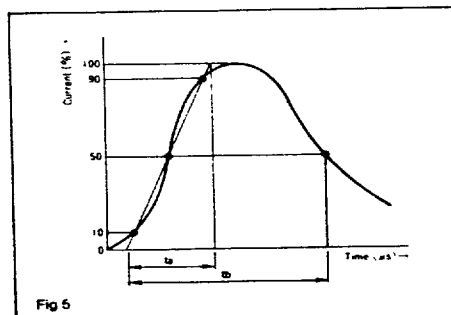


Fig 5

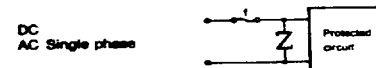
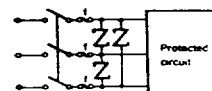
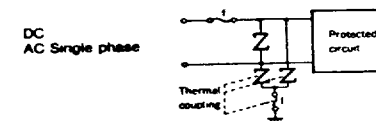
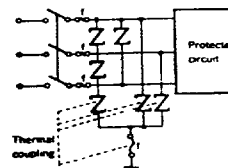
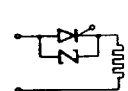
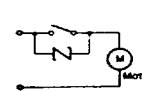
Type No.**Z 10 L 221**

Z: Varistor voltage
 10: With lead wire
 L: Element diameter
 221: ZENAMIC symbol

Application

A few example show.

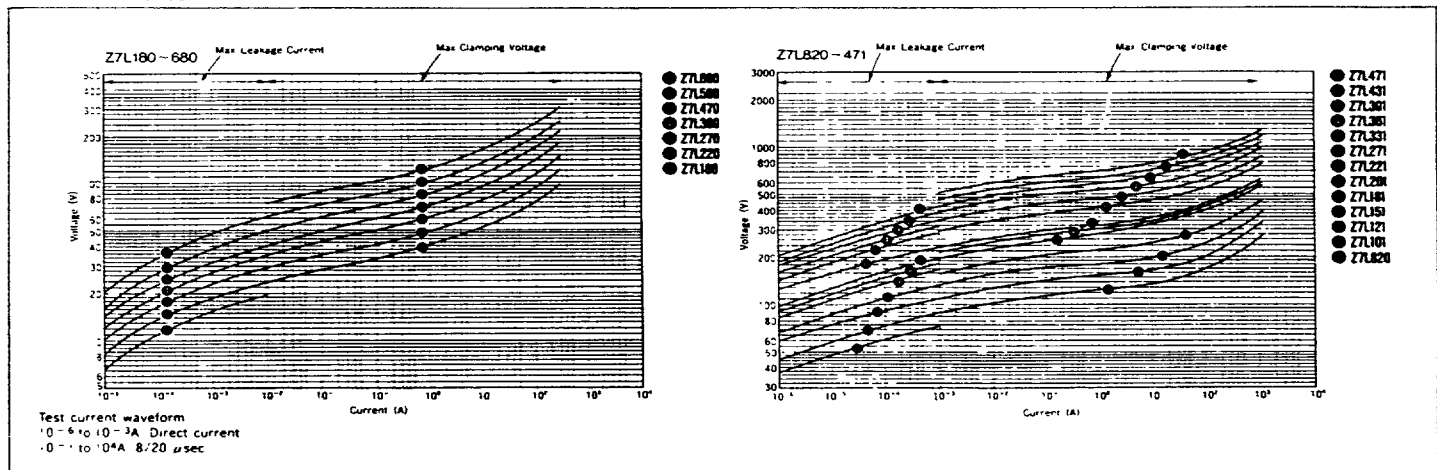
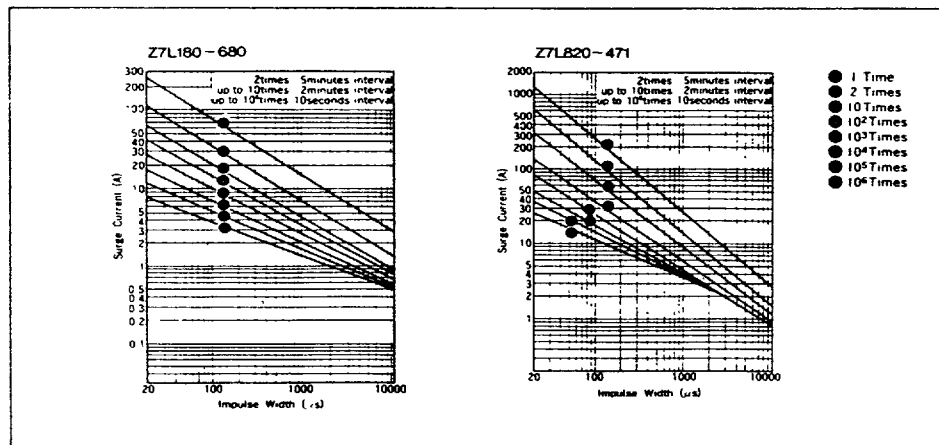
Power lines and surge absorption units with error display (SA series).

Line to Line protection**AC three phase****Line to Line and Line to Ground protection****AC three phase****Switching surge protection****Semiconductor protection****Contact spark suppression**

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Z7L Series**Specifications**

Type No.	Varistor voltage V_{max} (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
Z7L580	56 (50 ~ 62)		35	45	110	0.25	2.2	1200A	600A	950
Z7L680	68 (61 ~ 75)		40	56	135		2.5			700
Z7LB20	82 (74 ~ 90)		50	65	135 at 10A		3.5			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	0.25	10.0	1200A	600A	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
Z7L391	390 (351 ~ 429)		250	320	650	0.25	17.0	1200A	600A	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

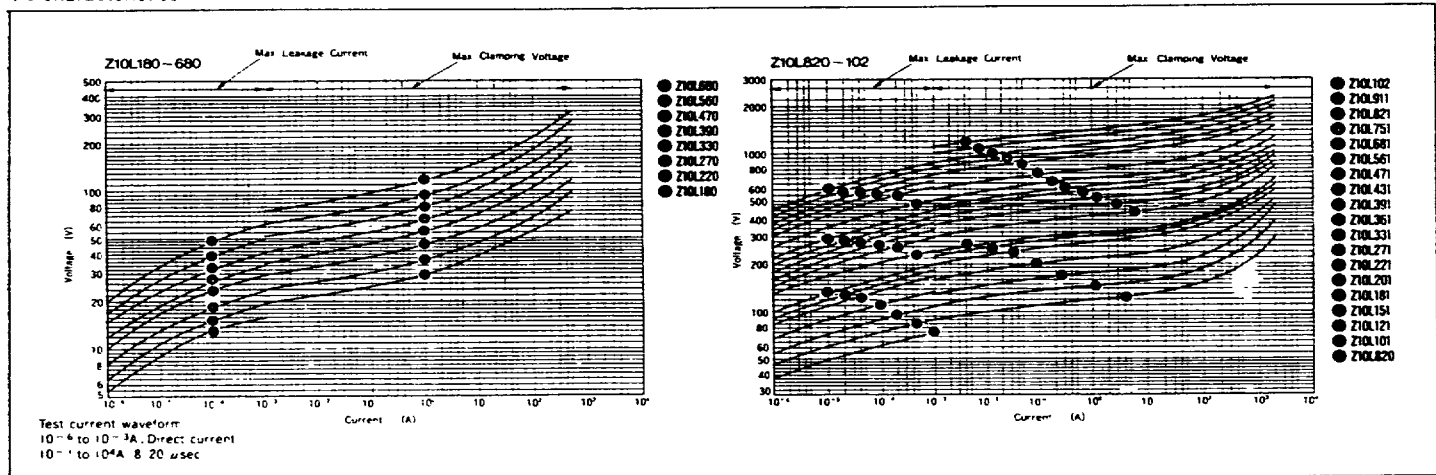
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Z10L Series

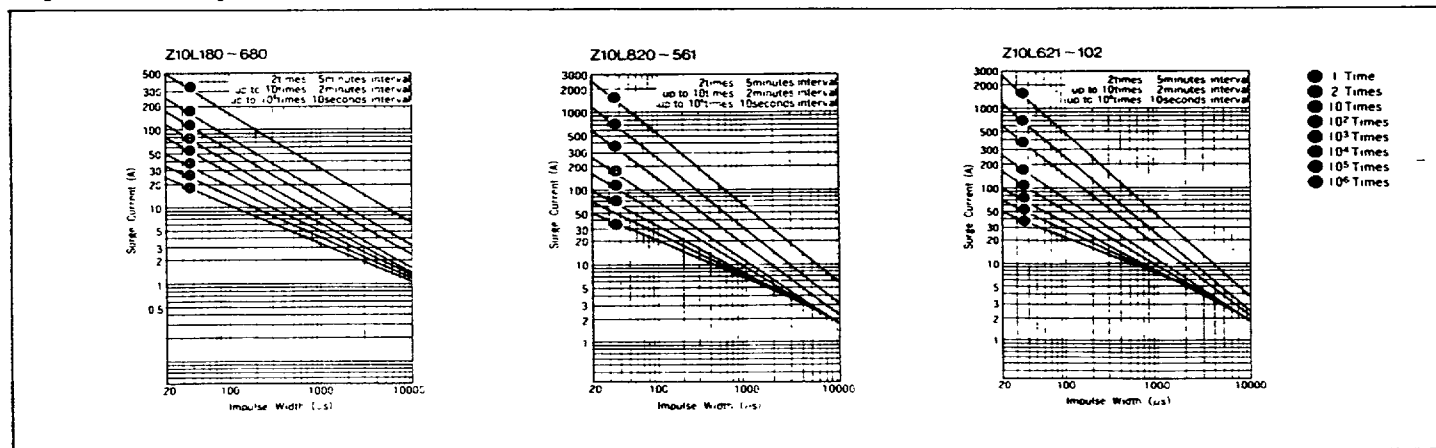
Specifications

Type No.	Varistor voltage V_{1mA} (V)		Maximum allowable voltage		Maximum clamping voltage V	Rated voltage W	Energy (2ms) J	Withstanding surge current (8/20 μ s)		Typical capacitance (@ 1kHz) pF
	Min	Max	AC V_{rms}	DC V				1 Time	2 Times	
Z10L180	18 (16~20)	20	11	14	36 at 5A	0.05	1.5	500A	250A	7,500
Z10L220	22 (20~24)	24	14	18	43		2.0			6,000
Z10L270	27 (24~30)	30	17	22	53		2.5			4,000
Z10L330	33 (30~36)	36	20	26	65		3.0			3,000
Z10L390	39 (35~43)	43	25	31	77		3.5			2,800
Z10L470	47 (42~52)	52	30	38	93		4.5			2,200
Z10L560	56 (50~62)	62	35	45	110		5.5			1,800
Z10L680	68 (61~75)	75	40	56	135		6.5			1,300
Z10L820	82 (74~90)	90	60	85	135 at 25A	0.4	8	2500A	1250A	1,800
Z10L101	100 (90~110)	110	60	85	165		10			1,400
Z10L121	120 (108~132)	132	75	100	200		12			1,100
Z10L151	150 (135~165)	165	95	125	250		16			900
Z10L181	180 (162~198)	198	110	145	300		18			700
Z10L201	200 (185~225)	225	130	170	340		20			500
Z10L221	220 (198~242)	242	140	180	360		23			450
Z10L271	270 (247~303)	303	175	225	455		30			350
Z10L331	330 (297~363)	363	210	275	550		33			330
Z10L361	360 (324~396)	396	230	300	595		35			300
Z10L391	390 (351~429)	429	250	320	650		40			270
Z10L431	430 (387~473)	473	275	350	710		45			250
Z10L471	470 (423~517)	517	300	385	775		45			230
Z10L561	560 (504~616)	616	350	460	925		45			150
Z10L681	680 (612~748)	748	420	560	1,120		50			130
Z10L751	750 (675~825)	825	460	615	1,240		50			120
Z10L821	820 (738~902)	902	510	670	1,355		55			110
Z10L911	910 (819~1,001)	1,001	550	745	1,500		60			100
Z10L102	1,000 (900~1,100)	1,100	625	825	1,650		65			90

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

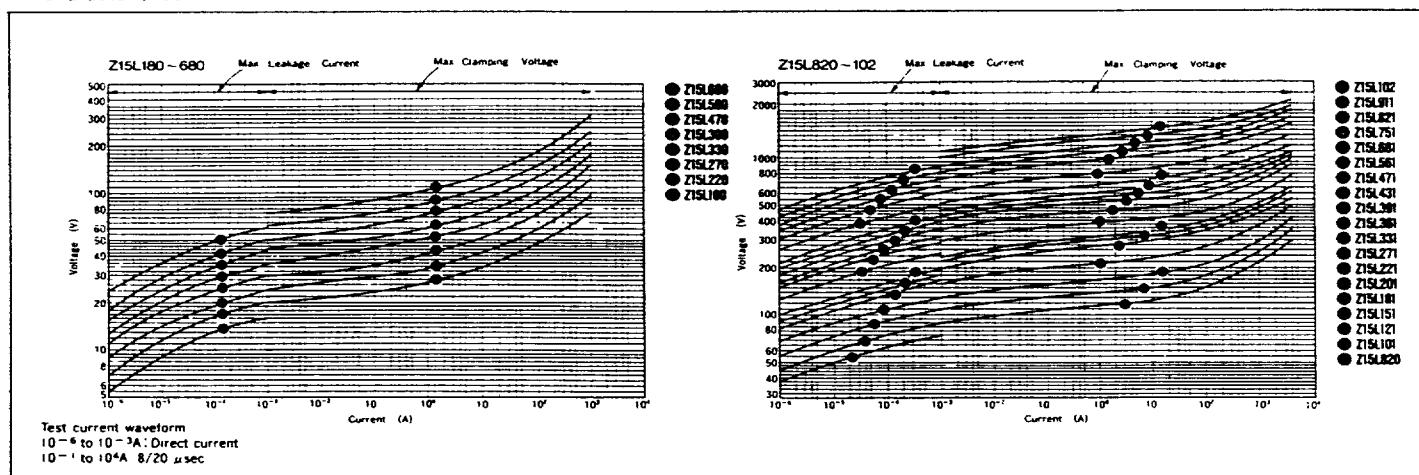
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Z15L Series

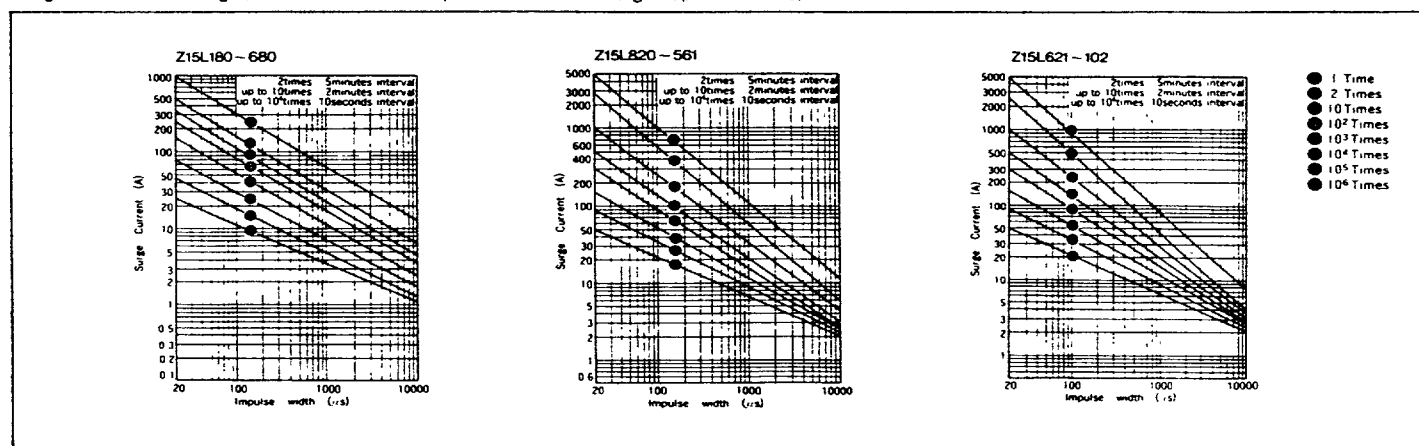
Specifications

Type No.	Varistor voltage V_{max} (V)		Maximum allowable voltage		Maximum clamping voltage V	Rated wattage W	Energy (2ms) J	Withstanding Surge current (8/20 μ s)		Typical capacitance (Φ 1kHz) pF
	Min	Max	AC V_{rms}	DC V				1 Time	2 Times	
Z15L180	18 (16~20)	20	11	14	38 at 10A		3.5			18,000
Z15L220	22 (20~24)	24	17	18	43		4.0			15,000
Z15L270	27 (24~30)	30	22	22	53		5.0			10,000
Z15L330	33 (30~36)	36	20	26	65		6.0			7,500
Z15L360	36 (35~43)	43	25	31	77	0.1	7.0	1000A	500A	6,500
Z15L470	47 (42~52)	52	30	38	93		8.5			5,500
Z15L560	56 (50~62)	62	35	45	110		10.0			4,500
Z15L680	68 (61~75)	75	40	56	135		12.0			3,300
Z15L820	82 (74~90)	90	50	65	135 at 50A		14			2,900
Z15L101	100 (90~110)	110	60	85	165		18			2,400
Z15L121	120 (108~132)	132	75	100	200		20			1,900
Z15L151	150 (135~165)	165	95	125	250		25			1,500
Z15L181	180 (162~198)	198	110	145	300		30			1,200
Z15L201	200 (185~225)	225	130	170	340		35			1,000
Z15L221	220 (198~242)	242	140	180	360		40			1,000
Z15L271	270 (247~303)	303	175	225	455		50			750
Z15L331	330 (297~363)	363	210	275	550	0.6	60	4500A	2500A	650
Z15L361	360 (324~396)	396	230	300	595		65			550
Z15L391	390 (351~429)	429	250	320	650		70			500
Z15L431	430 (387~473)	473	275	350	710		75			450
Z15L471	470 (423~517)	517	300	385	775		80			400
Z15L561	560 (504~616)	616	350	460	925		80			300
Z15L681	680 (612~748)	748	420	560	1,120		80			250
Z15L751	750 (675~825)	825	490	615	1,240		100			230
Z15L821	820 (738~902)	902	510	670	1,355		110			200
Z15L911	910 (819~1,001)	1,001	550	745	1,500		120			180
Z15L102	1,000 (900~1,100)	1,100	625	825	1,650		130			150

V-I characteristics



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

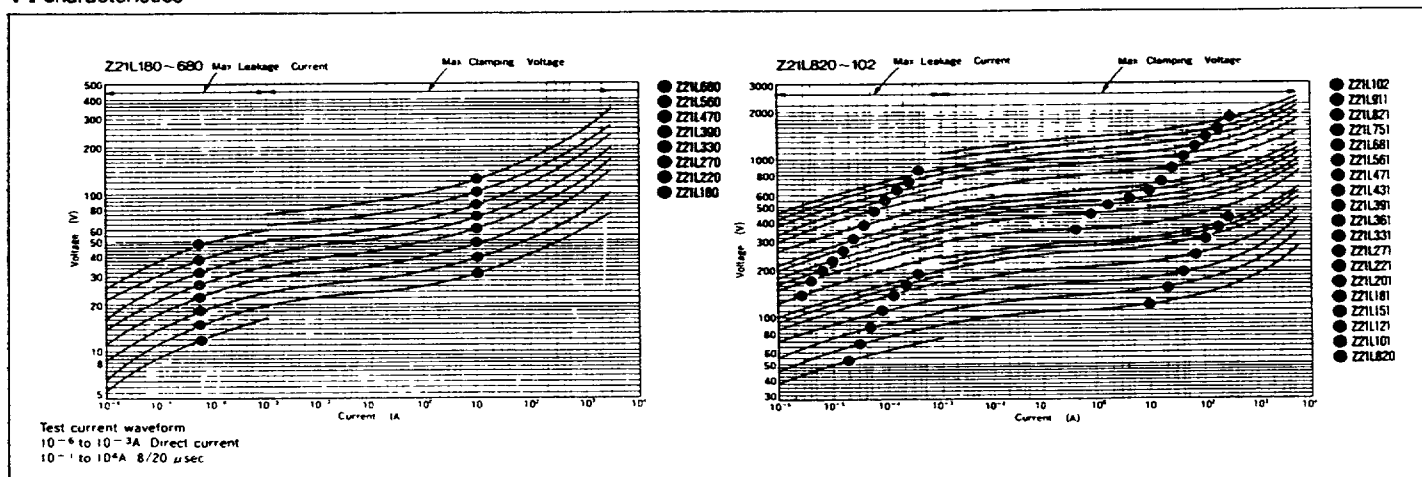
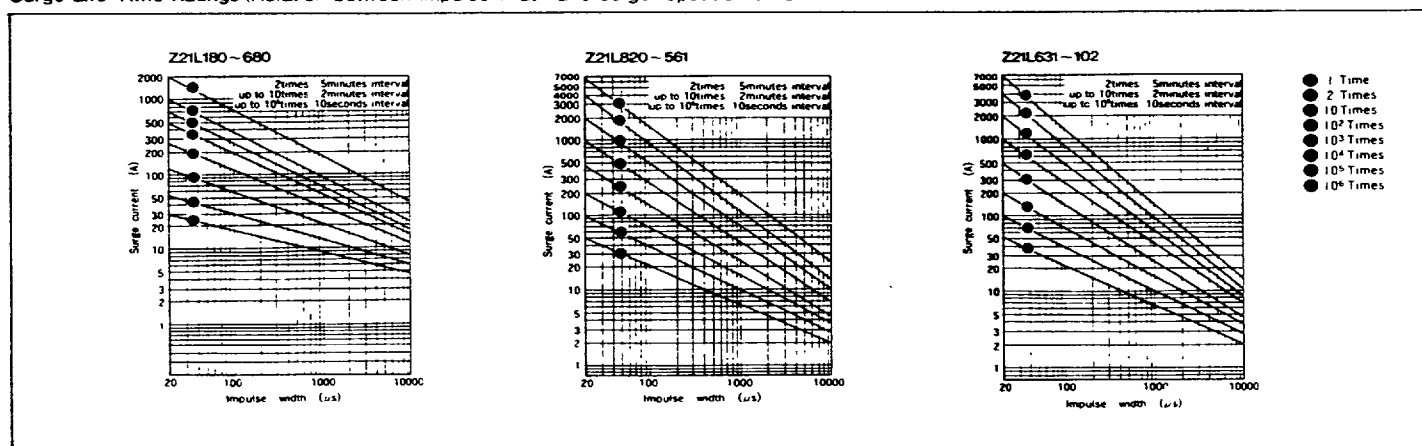


1. Operating temperature range: -40 to 85°C
2. Storage temperature range: -40 to 125°C
3. *: UL approved model

T-11-25

Z21L Series**Specifications**

Type No.	Varistor voltage V_{VMA} (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 Time	
	Min	Max	Vrms	V	V	W	J			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)		36	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		70			2,000
Z21L221	220 (198~242)		140	180	360		75			2,000
Z21L271	270 (247~303)		175	225	455		90			1,800
Z21L331	330 (297~363)		210	275	550		110	6500A	4000A	1,400
Z21L361	360 (324~396)		230	300	595	1.0	120			1,000
Z21L391	390 (351~429)		250	320	650		130			800
Z21L431	430 (387~473)		275	350	710		140			900
Z21L471	470 (423~517)		300	385	775		150			900
Z21L561	560 (504~616)		350	460	925		160			800
Z21L591	590 (512~748)		420	560	1,120		175			460
Z21L751	750 (675~825)		460	615	1,240		190			400
Z21L821	820 (738~902)		510	670	1,355		215			350
Z21L911	910 (819~1,001)		550	745	1,500		230			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

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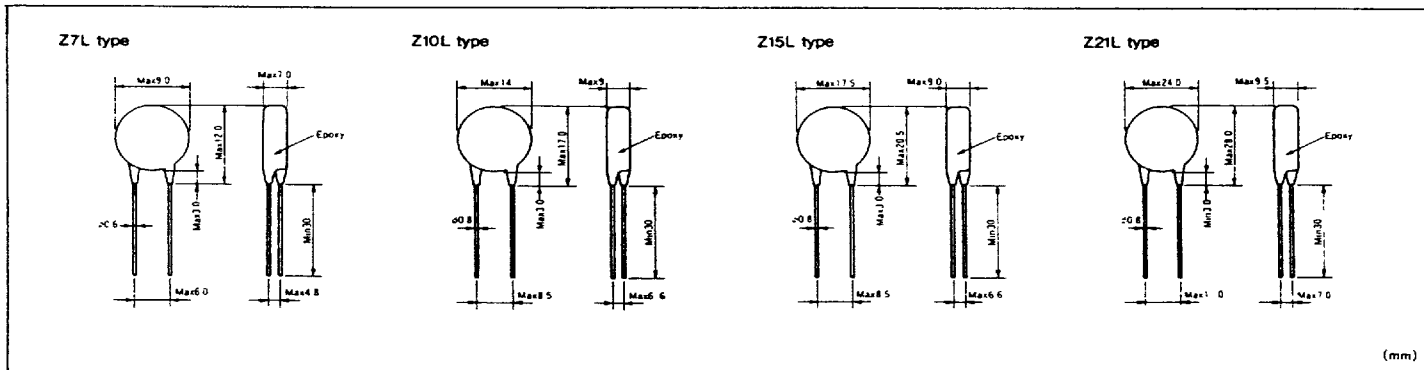
Z25 M, Z33 M Series

Specifications

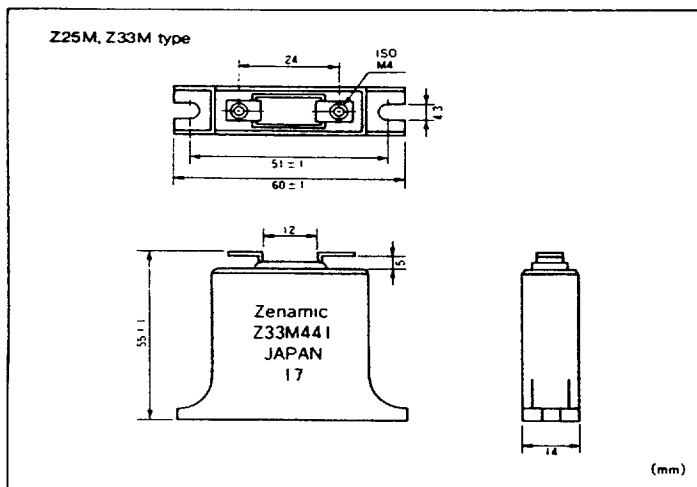
Type No.	Varistor voltage V_{1mA} (V)		Maximum allowable voltage		Maximum clamping voltage	Rated wattage	Energy (2ms)	Withstanding Surge Current (5/20 μ s)		Typical capacitance (@1kHz)
			AC	DC						
	Min	Max	V _{AC}	V _{DC}	V	W	J	1 Time	2 Times	pF
Z25M221S	220 (187 ~ 253)		120	165	380 at 100A		125			3,300
Z25M271S	270 (229 ~ 310.5)		150	210	465		155			2,200
Z25M331S	330 (280.5 ~ 379.5)		175	245	570		185			1,900
Z25M391S	390 (331.5 ~ 448.5)		210	295	675		215			1,700
Z25M441S	440 (374 ~ 506)		240	335	780		225			1,500
Z25M471S	470 (399.5 ~ 540.5)		250	350	810	1.0	235	15000A	10000A	1,500
Z25M561S	560 (478 ~ 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 ~ 310.5)		150	210	465		255			4,200
Z33M331S	330 (280.5 ~ 379.5)		175	245	570		310			3,700
Z33M391S	390 (331.5 ~ 448.5)		210	295	675		360			3,200
Z33M441S	440 (374 ~ 506)		240	335	780		370			2,800
Z33M471S	470 (399.5 ~ 540.5)		250	350	810	1.2	385	25000A	20000A	2,600
Z33M561S	560 (478 ~ 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

1. Operating temperature range: -40 to 85 °C
2. Storage temperature range: -40 to 125 °C

Dimensions



Dimensions



Taping

