MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

Order this data sheet
by 1N5908/D

1N5908
1N6373/ICTE-5
MPTE-5
thru
1N6389/ICTE-45,C
MPTE-45,C

1N6267,A/1.5KE6.8,A
thru
1N6303,A/1.5KE250,A

Zener Transient Voltage Suppressors Unidirectional and Bidirectional

Mosorb devices are designed to protect voltage sensitive components from high voltage, high energy transients. They have excellent clamping capability, high surge capability, low zener impedance and fast response time. These devices are Motorola's exclusive, cost-effective, highly reliable Surmetic axial leaded package and are ideally-suited for use in communication systems, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/consumer applications, to protect CMOS, MOS and Bipolar integrated circuits.

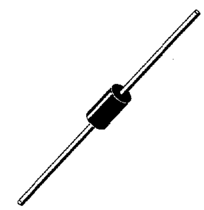
Specification Features:

- Standard Voltage Range — 6.2 to 250 V
- Peak Power — 1500 Watts @ 1 ms
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5 μA Above 10 V
- UL Recognition

Mechanical Characteristics:

CASE: Void-free, transfer-molded, thermosetting plastic
FINISH: All external surfaces are corrosion resistant and leads are readily solderable and weldable
POLARITY: Cathode indicated by polarity band. When operated in zener mode, will be positive with respect to anode
MOUNTING POSITION: Any

MOSORB
ZENER OVERVOLTAGE
TRANSIENT
SUPPRESSORS
6.2–250 VOLTS
1500 WATT PEAK POWER
5 WATTS STEADY STATE



CASE 41A-02
PLASTIC

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (1) @ $T_L \leq 25°C$	P_{PK}	1500	Watts
Steady State Power Dissipation @ $T_L \leq 75°C$, Lead Length = 3/8″ Derated above $T_L = 75°C$	P_D	5 50	Watts mW/°C
Forward Surge Current (2) @ $T_A = 25°C$	I_{FSM}	200	Amps
Operating and Storage Temperature Range	T_J, T_{stg}	– 65 to +175	°C

Lead temperature not less than 1/16″ from the case for 10 seconds: 230°C

NOTES: 1. Nonrepetitive current pulse per Figure 5 and derated above $T_A = 25°C$ per Figure 2.
2. 1/2 sine wave (or equivalent square wave), PW = 8.3 ms, duty cycle = 4 pulses per minute maximum.

MOTOROLA

Rev. 1
(Replaces DS7058)

Table 1.

*ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) V_F = 3.5 V max, I_F** = 100 A							
Device Note 1	Breakdown Voltage V_{BR}†† (Volts) Min	@ I_T (mA)	Maximum Reverse Stand-Off Voltage V_{RWM}*** (Volts)	Maximum Reverse Leakage @ V_{RWM} I_R (µA)	Maximum Reverse Voltage @ I_{RSM}† = 120 A (Clamping Voltage) V_{RSM} (Volts)	Clamping Voltage: Peak Pulse Current @ I_{pp1}† = 30 A V_{C1} (Volts max)	Clamping Voltage: Peak Pulse Current @ I_{pp2}† = 60 A V_{C2} (Volts max)
1N5908	6	1	5	300	8.5	7.6	8

NOTE 1: The 1N5908 is JEDEC registered as a unidirectional device only (no bidirectional option).

* Indicates JEDEC registered data.

** 1/2 sine wave (or equivalent square wave), PW = 8.3 ms, duty cycle = 4 pulses per minute maximum.

*** A transient suppressor is normally selected according to the maximum reverse stand-off voltage (V_{RWM}), which should be equal to or greater than the dc or continuous peak operating voltage level.

† Surge current waveform per Figure 5 and derate per Figure 2.

†† V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C.

Table 2.

*ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) V_F# = 3.5 V Max, I_F** = 100 A) (C suffix denotes standard back to back bidirectional versions. Test both polarities)

JEDEC Device Note 2	Device Note 2	Breakdown†† Voltage V_{BR} Volts Min	@ I_T (mA)	Maximum Reverse Stand-Off Voltage V_{RWM}*** (Volts)	Maximum Reverse Leakage @ V_{RWM} I_R (µA)	Maximum Reverse Surge Current I_{RSM}† (Amps)	Maximum Reverse Voltage @ I_{RSM}† (Clamping Voltage) V_{RSM} (Volts)	Clamping Voltage: Peak Pulse Current @ I_{pp1}† = 1 A V_{C1} (Volts max)	Clamping Voltage: Peak Pulse Current @ I_{pp2}† = 10 A V_{C2} (Volts max)
1N6373	ICTE-5/MPTE-5	6	1	5	300	160	9.4	7.1	7.5
1N6374	ICTE-8/MPTE-8	9.4	1	8	25	100	15	11.3	11.5
1N6382	ICTE-8C/MPTE-8C	9.4	1	8	25	100	15	11.4	11.6
1N6375	ICTE-10/MPTE-10	11.7	1	10	2	90	16.7	13.7	14.1
1N6383	ICTE-10C/MPTE-10C	11.7	1	10	2	90	16.7	14.1	14.5
1N6376	ICTE-12/MPTE-12	14.1	1	12	2	70	21.2	16.1	16.5
1N6384	ICTE-12C/MPTE-12C	14.1	1	12	2	70	21.2	16.7	17.1
1N6377	ICTE-15/MPTE-15	17.6	1	15	2	60	25	20.1	20.6
1N6385	ICTE-15C/MPTE-15C	17.6	1	15	2	60	25	20.8	21.4
1N6378	ICTE-18/MPTE-18	21.2	1	18	2	50	30	24.2	25.2
1N6386	ICTE-18C/MPTE-18C	21.2	1	18	2	50	30	24.8	25.5
1N6379	ICTE-22/MPTE-22	25.9	1	22	2	40	37.5	29.8	32
1N6387	ICTE-22C/MPTE-22C	25.9	1	22	2	40	37.5	30.8	32
1N6380	ICTE-36/MPTE-36	42.4	1	36	2	23	65.2	50.6	54.3
1N6388	ICTE-36C/MPTE-36C	42.4	1	36	2	23	65.2	50.6	54.3
1N6381	ICTE-45/MPTE-45	52.9	1	45	2	19	78.9	63.3	70
1N6389	ICTE-45C/MPTE-45C	52.9	1	45	2	19	78.9	63.3	70

NOTE 2: C suffix denotes standard back-to-back bidirectional versions. Test both polarities. JEDEC device types 1N6382 thru 1N6389 are registered as back to back bidirectional versions and do not require a C suffix. 1N6373 thru 1N6381 are registered as unidirectional devices only (no bidirectional option).

* Indicates JEDEC registered data.

** 1/2 sine wave (or equivalent square wave), PW = 8.3 ms, duty cycle = 4 pulses per minute maximum.

*** A transient suppressor is normally selected according to the maximum reverse stand-off voltage (V_{RWM}), which should be equal to or greater than the dc or continuous peak operating voltage level.

† Surge current waveform per Figure 5 and derate per Figure 2.

†† V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C.

\# V_F applies to Unidirectional devices only.

Table 3.

***ELECTRICAL CHARACTERISTICS** (T_A = 25°C unless otherwise noted) V_F# = 3.5 V Max, I_F** = 100 A

JEDEC Device	Device	Breakdown Voltage V_{BR}†† Volts Min	Breakdown Voltage V_{BR}†† Volts Nom	Breakdown Voltage V_{BR}†† Volts Max	@ I_T (mA)	Working Peak Reverse Voltage V_{RWM}*** (Volts)	Maximum Reverse Leakage @ V_{RWM} I_R (μA)	Maximum Reverse Surge Current I_{RSM}† (Amps)	Maximum Reverse Voltage @ I_{RSM} (Clamping Voltage V_{RSM} (Volts)	Maximum Temperature Coefficient of V_{BR} (%/°C)
1N6267	1.5KE6.8	6.12	6.8	7.48	10	5.5	1000	139	10.8	0.057
1N6267A	1.5KE6.8A	6.45	6.8	7.14	10	5.8	1000	143	10.5	0.057
1N6268	1.5KE7.5	6.75	7.5	8.25	10	6.05	500	128	11.7	0.061
1N6268A	1.5KE7.5A	7.13	7.5	7.88	10	6.4	500	132	11.3	0.061
1N6269	1.5KE8.2	7.38	8.2	9.02	10	6.63	200	120	12.5	0.065
1N6269A	1.5KE8.2A	7.79	8.2	8.61	10	7.02	200	124	12.1	0.065
1N6270	1.5KE9.1	8.19	9.1	10	1	7.37	50	109	13.8	0.068
1N6270A	1.5KE9.1A	8.65	9.1	9.55	1	7.78	50	112	13.4	0.068
1N6271	1.5KE10	9	10	11	1	8.1	10	100	15	0.073
1N6271A	1.5KE10A	9.5	10	10.5	1	8.55	10	103	14.5	0.073
1N6272	1.5KE11	9.9	11	12.1	1	8.92	5	93	16.2	0.075
1N6272A	1.5KE11A	10.5	11	11.6	1	9.4	5	96	15.6	0.075
1N6273	1.5KE12	10.8	12	13.2	1	9.72	5	87	17.3	0.078
1N6273A	1.5KE12A	11.4	12	12.6	1	10.2	5	90	16.7	0.078
1N6274	1.5KE13	11.7	13	14.3	1	10.5	5	79	19	0.081
1N6274A	1.5KE13A	12.4	13	13.7	1	11.1	5	82	18.2	0.081
1N6275	1.5KE15	13.5	15	16.5	1	12.1	5	68	22	0.084
1N6275A	1.5KE15A	14.3	15	15.8	1	12.8	5	71	21.2	0.084
1N6276	1.5KE16	14.4	16	17.6	1	12.9	5	64	23.5	0.086
1N6276A	1.5KE16A	15.2	16	16.8	1	13.6	5	67	22.5	0.086
1N6277	1.5KE18	16.2	18	19.8	1	14.5	5	56.5	26.5	0.088
1N6277A	1.5KE18A	17.1	18	18.9	1	15.3	5	59.5	25.2	0.088
1N6278	1.5KE20	18	20	22	1	16.2	5	51.5	29.1	0.09
1N6278A	1.5KE20A	19	20	21	1	17.1	5	54	27.7	0.09
1N6279	1.5KE22	19.8	22	24.2	1	17.8	5	47	31.9	0.092
1N6279A	1.5KE22A	20.9	22	23.1	1	18.8	5	49	30.6	0.092
1N6280	1.5KE24	21.6	24	26.4	1	19.4	5	43	34.7	0.094
1N6280A	1.5KE24A	22.8	24	25.2	1	20.5	5	45	33.2	0.094
1N6281	1.5KE27	24.3	27	29.7	1	21.8	5	38.5	39.1	0.096
1N6281A	1.5KE27A	25.7	27	28.4	1	23.1	5	40	37.5	0.096
1N6282	1.5KE30	27	30	33	1	24.3	5	34.5	43.5	0.097
1N6282A	1.5KE30A	28.5	30	31.5	1	25.6	5	36	41.4	0.097
1N6283	1.5KE33	29.7	33	36.3	1	26.8	5	31.5	47.7	0.098
1N6283A	1.5KE33A	31.4	33	34.7	1	28.2	5	33	45.7	0.098
1N6284	1.5KE36	32.4	36	39.6	1	29.1	5	29	52	0.099
1N6284A	1.5KE36A	34.2	36	37.8	1	30.8	5	30	49.9	0.099
1N6285	1.5KE39	35.1	39	42.9	1	31.6	5	26.5	56.4	0.1
1N6285A	1.5KE39A	37.1	39	41	1	33.3	5	28	53.9	0.1
1N6286	1.5KE43	38.7	43	47.3	1	34.8	5	24	61.9	0.101
1N6286A	1.5KE43A	40.9	43	45.2	1	36.8	5	25.3	59.3	0.101
1N6287	1.5KE47	42.3	47	51.7	1	38.1	5	22.2	67.8	0.101
1N6287A	1.5KE47A	44.7	47	49.4	1	40.2	5	23.2	64.8	0.101
1N6288	1.5KE51	45.9	51	56.1	1	41.3	5	20.4	73.5	0.102
1N6288A	1.5KE51A	48.5	51	53.6	1	43.6	5	21.4	70.1	0.102
1N6289	1.5KE56	50.4	56	61.6	1	45.4	5	18.6	80.5	0.103
1N6289A	1.5KE56A	53.2	56	58.8	1	47.8	5	19.5	77	0.103
1N6290	1.5KE62	55.8	62	68.2	1	50.2	5	16.9	89	0.104
1N6290A	1.5KE62A	58.9	62	65.1	1	53	5	17.7	85	0.104

(continued)

FOR BIDIRECTIONAL APPLICATIONS — USE C OR CA SUFFIX ON 1.5KE SERIES

Table 3. (continued)

***ELECTRICAL CHARACTERISTICS — continued** (T_A = 25°C unless otherwise noted) V_F# = 3.5 V Max, I_F** = 100 A

JEDEC Device	Device	Breakdown Voltage V_{BR}†† Volts Min	Nom	Max	@ I_T (mA)	Working Peak Reverse Voltage V_{RWM}*** (Volts)	Maximum Reverse Leakage @ V_{RWM} I_R (μA)	Maximum Reverse Surge Current I_{RSM}† (Amps)	Maximum Reverse Voltage @ I_{RSM} (Clamping Voltage) V_{RSM} (Volts)	Maximum Temperature Coefficient of V_{BR} (%/°C)
1N6291	1.5KE68	61.2	68	74.8	1	55.1	5	15.3	98	0.104
1N6291A	1.5KE68A	64.6	68	71.4	1	58.1	5	16.3	92	0.104
1N6292	1.5KE75	67.5	75	82.5	1	60.7	5	13.9	108	0.105
1N6292A	1.5KE75A	71.3	75	78.8	1	64.1	5	14.6	103	0.105
1N6293	1.5KE82	73.8	82	90.2	1	66.4	5	12.7	118	0.105
1N6293A	1.5KE82A	77.9	82	86.1	1	70.1	5	13.3	113	0.105
1N6294	1.5KE91	81.9	91	100	1	73.7	5	11.4	131	0.106
1N6294A	1.5KE91A	86.5	91	95.5	1	77.8	5	12	125	0.106
1N6295	1.5KE100	90	100	110	1	81	5	10.4	144	0.106
1N6295A	1.5KE100A	95	100	105	1	85.5	5	11	137	0.106
1N6296	1.5KE110	99	110	121	1	89.2	5	9.5	158	0.107
1N6296A	1.5KE110A	105	110	116	1	94	5	9.9	152	0.107
1N6297	1.5KE120	108	120	132	1	97.2	5	8.7	173	0.107
1N6297A	1.5KE120A	114	120	126	1	102	5	9.1	165	0.107
1N6298	1.5KE130	117	130	143	1	105	5	8	187	0.107
1N6298A	1.5KE130A	124	130	137	1	111	5	8.4	179	0.107
1N6299	1.5KE150	135	150	165	1	121	5	7	215	0.108
1N6299A	1.5KE150A	143	150	158	1	128	5	7.2	207	0.108
1N6300	1.5KE160	144	160	176	1	130	5	6.5	230	0.108
1N6300A	1.5KE160A	152	160	168	1	136	5	6.8	219	0.108
1N6301	1.5KE170	153	170	187	1	138	5	6.2	244	0.108
1N6301A	1.5KE170A	162	170	179	1	145	5	6.4	234	0.108
1N6302	1.5KE180	162	180	198	1	146	5	5.8	258	0.108
1N6302A	1.5KE180A	171	180	189	1	154	5	6.1	246	0.108
1N6303	1.5KE200	180	200	220	1	162	5	5.2	287	0.108
1N6303A	1.5KE200A	190	200	210	1	171	5	5.5	274	0.108
	1.5KE220	198	220	242	1	175	5	4.3	344	0.109
	1.5KE220A	209	220	231	1	185	5	4.6	328	0.109
	1.5KE250	225	250	275	1	202	5	5	360	0.109
	1.5KE250A	237	250	263	1	214	5	5	344	0.109

FOR BIDIRECTIONAL APPLICATIONS — USE C OR CA SUFFIX ON 1.5KE SERIES

* Indicates JEDEC registered data.

** 1/2 sine wave (or equivalent square wave), PW = 8.3 ms, duty cycle = 4 pulses per minute maximum.

*** A transient suppressor is normally selected according to the maximum reverse stand-off voltage (V_{RWM}), which should be equal to or greater than the dc or continuous peak operating voltage level.

† Surge current waveform per Figure 5 and derate per Figure 2.

†† V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C.

\# V_F applies to Non-C suffix devices only.

CLIPPER BIDIRECTIONAL DEVICES

1. Clipper-bidirectional devices are available in the 1.5KEXX series and are designated with a "C" or a "CA" suffix; for example, 1.5KE18CA. Contact your nearest Motorola representative.
2. Clipper-bidirectional part numbers are tested in both directions to electrical parameters in above table (except for V_F which does not apply).
3. The 1N6267 thru 1N6303 series are JEDEC registered devices and the registration does not include "C" and "CA" suffixes. To order clipper-bidirectional devices one must add C or CA to the 1.5KE device title.

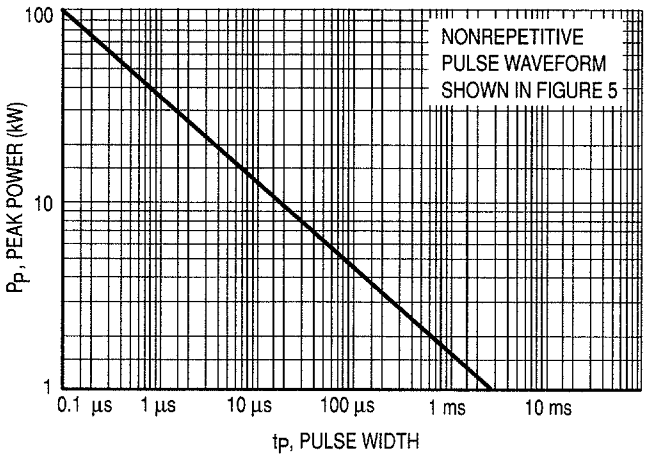


Figure 1. Pulse Rating Curve

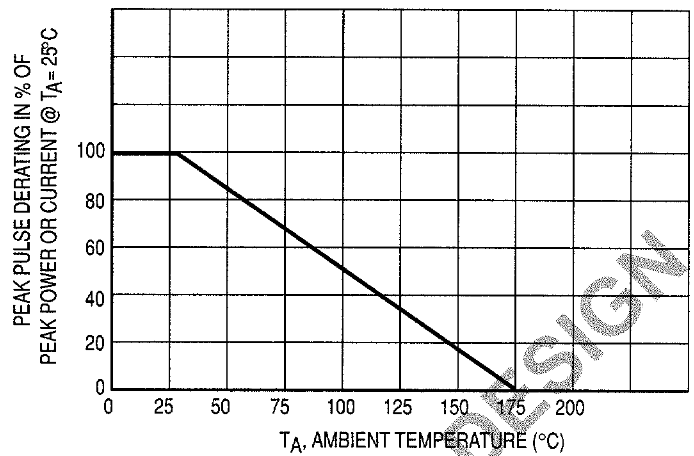


Figure 2. Pulse Derating Curve

1N6373, ICTE-5, MPTE-5
thru
1N6389, ICTE-45, C, MPTE-45, C

1N6267, A/1.5KE6.8, A
thru
1N6303, A/1.5KE200, A

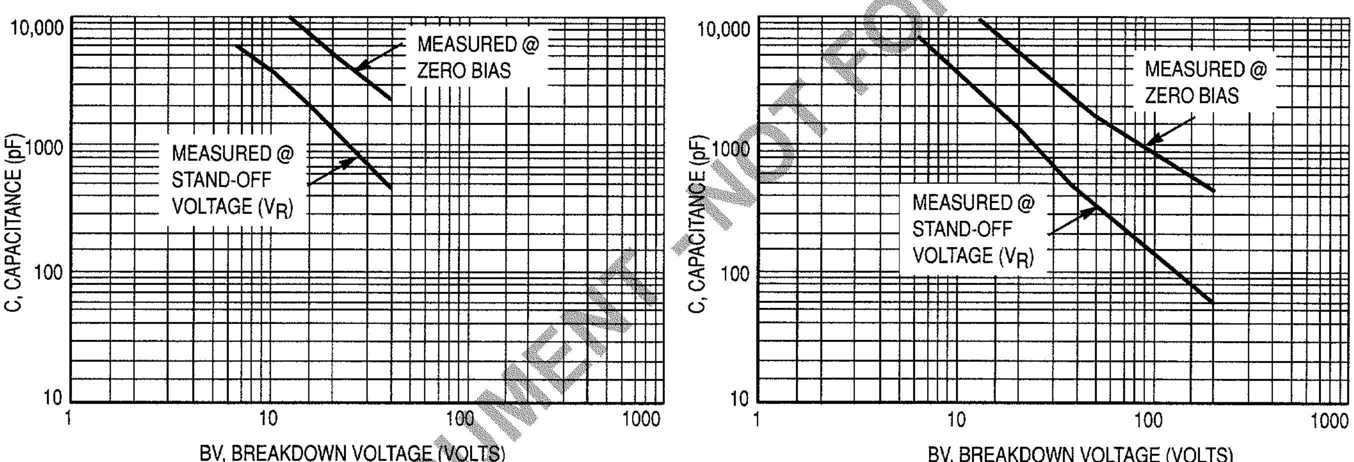


Figure 3. Capacitance versus Breakdown Voltage

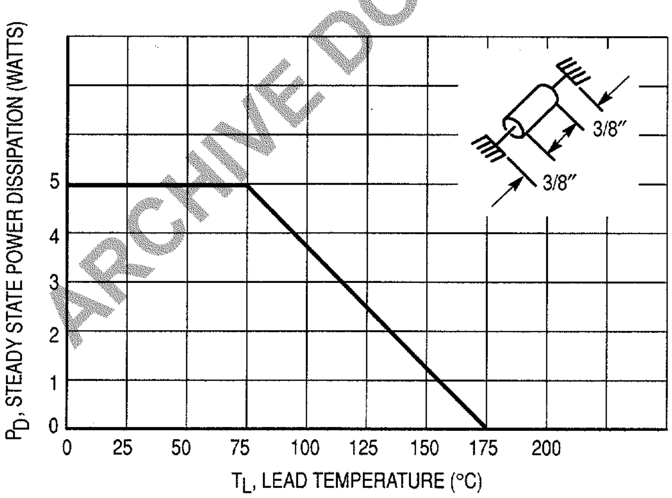


Figure 4. Steady State Power Derating

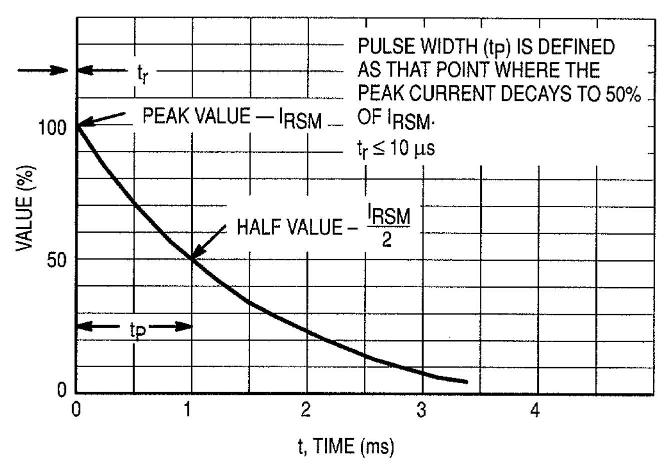
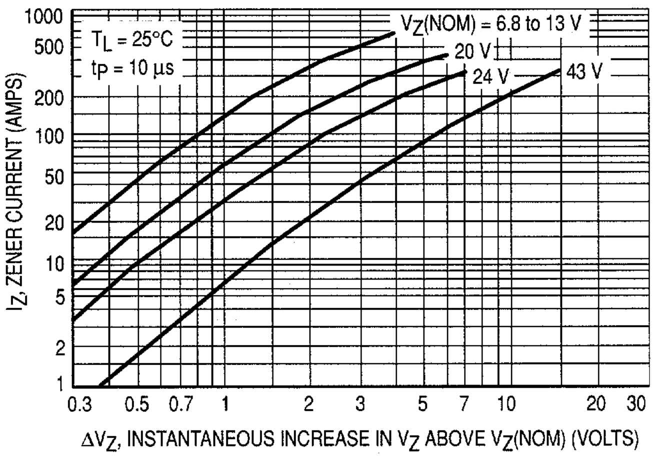


Figure 5. Pulse Waveform

1N6373, ICTE-5, MPTE-5
thru
1N6389, ICTE-45, C, MPTE-45, C



1N6267, A/1.5KE6.8, A
thru
1N6303, A/1.5KE200, A

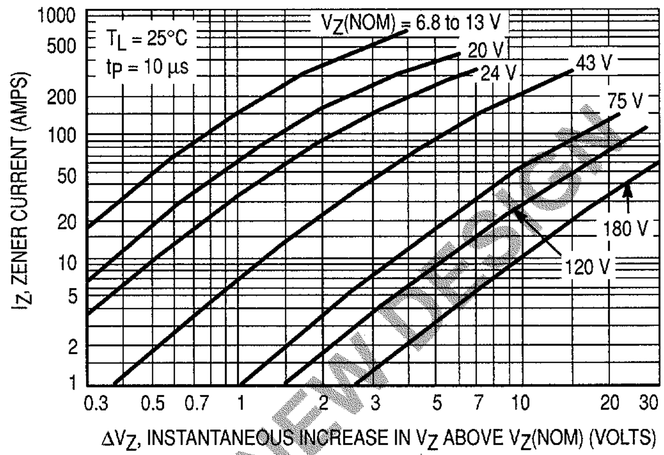


Figure 6. Dynamic Impedance

APPLICATION NOTE

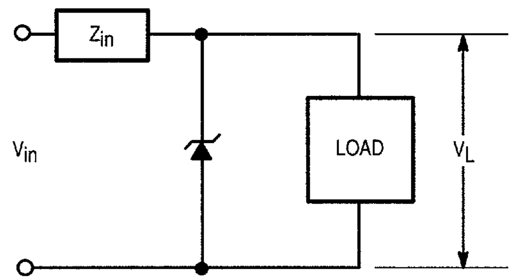
RESPONSE TIME

In most applications, the transient suppressor device is placed in parallel with the equipment or component to be protected. In this situation, there is a time delay associated with the capacitance of the device and an overshoot condition associated with the inductance of the device and the inductance of the connection method. The capacitance affect is of minor importance in the parallel protection scheme because it only produces a time delay in the transition from the operating voltage to the clamp voltage as shown in Figure A.

The inductive affects in the device are due to actual turn-on time (time required for the device to go from zero current to full current) and lead inductance. This inductive affect produces an overshoot in the voltage across the equipment or component being protected as shown in Figure B. Minimizing this overshoot is very important in the application, since the main purpose for adding a transient suppressor is to clamp voltage spikes. These devices have excellent response time, typically in the picosecond range and negligible inductance. However, external inductive effects could produce unacceptable overshoot. Proper circuit layout, minimum lead lengths and placing the suppressor device as close as possible to the equipment or components to be protected will minimize this overshoot.

Some input impedance represented by Z_{in} is essential to prevent overstress of the protection device. This impedance should be as high as possible, without restricting the circuit operation.

TYPICAL PROTECTION CIRCUIT



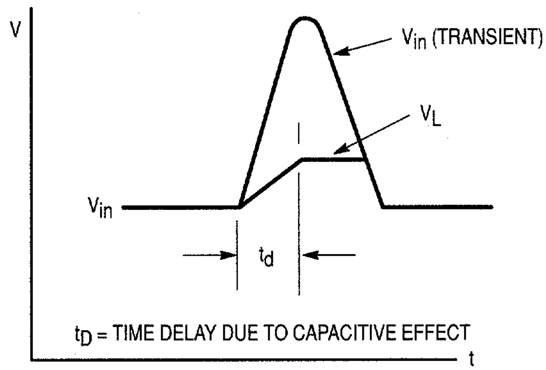


Figure A.

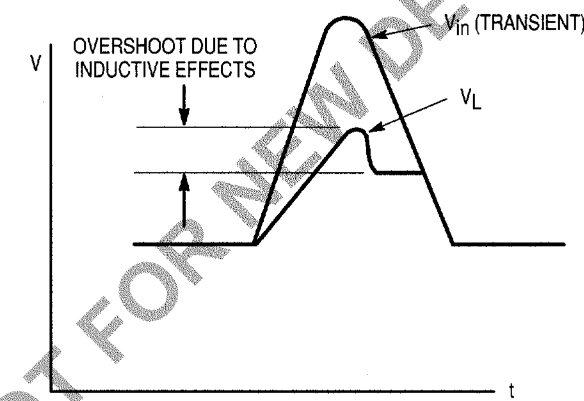


Figure B.

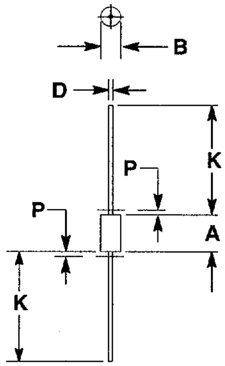
UL RECOGNITION*

The entire series has *Underwriters Laboratory Recognition* for the classification of protectors (QVGV2) under the UL standard for safety 497B. Many competitors only have one or two devices recognized or have recognition in a non-protective category. Some competitors have no recognition at all. With the UL497B recognition, our parts successfully passed several tests including Strike Voltage Breakdown test, Endurance Conditioning, Temperature test, Dielectric Voltage-Withstand test, Discharge test and several more.

Whereas, some competitors have only passed a flammability test for the package material therefore, we have been recognized for much more to be included in their Protector category.

*Applies to 1.5KE6.8,A,C,CA thru 1.5KE250,A,C,CA

OUTLINE DIMENSIONS



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. LEAD FINISH AND DIAMETER UNCONTROLLED IN DIM P.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	9.14	9.52	0.360	0.375
B	4.83	5.21	0.190	0.205
D	0.97	1.07	0.038	0.042
K	25.40	—	1.000	—
P	—	1.27	—	0.050

CASE 41A-02

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