TAK CHEONG®

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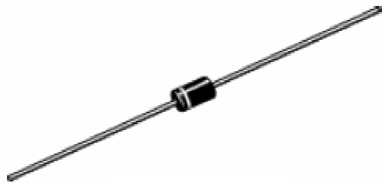
500 mW DO-35 Hermetically Sealed Glass Zener Voltage Regulators

Maximum Ratings (Note 1)

Rating	Symbol	Value	Units
Maximum Steady State Power Dissipation @TL≤75℃, Lead Length = 3/8”	P_D	500	mW
Derate Above 75℃		4.0	mW/℃
Operating and Storage Temperature Range	T_J, T_{stg}	-65 to +200	°C

Note 1: Some part number series have lower JEDEC registered ratings.



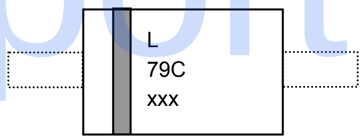
AXIAL LEAD
DO35

Specification Features:

- Zener Voltage Range = 2.4V to 200V
- ESD Rating of Clas 3 (>6 KV) per Human Body Model
- DO-35 Package (DO-204AH)
- Double Slug Type Construction
- Metallurgical Bonded Construction

Specification Features:

Case : Double slug type, hermetically sealed glass
Finish : All external surfaces are corrosion resistant and leads are readily solderable
Polarity : Cathode indicated by polarity band
Mounting: Any



L = Logo
79Cxxx = BZX79Cxxx Device Code

Maximum Lead Temperature for Soldering Purposes
230℃, 1/16” from the case for 10 seconds

Ordering Information

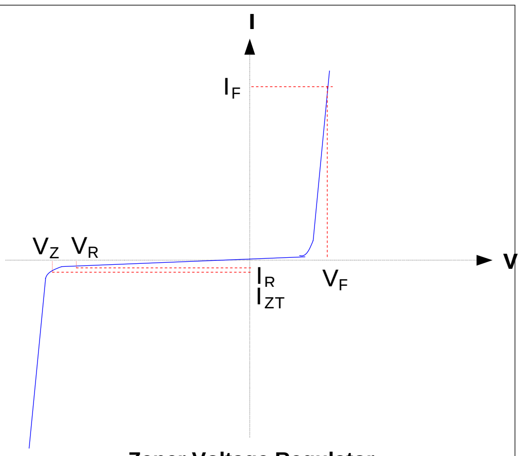
Device	Package	Quantity
BZX79Cxxx	Axial Lead	3000 Units / Box
BZX79CxxxRL	Axial Lead	5000 Units / Tape & Reel
BZX79CxxxRL2*	Axial Lead	5000 Units / Tape & Reel
BZX79CxxxRR1 !	Lead Form	3000 Units / Radial Tape & Reel
BZX79CxxxRR2 i	Lead Form	3000 Units / Radial Tape & Reel
BZX79CxxxTA	Axial Lead	5000 Units / Tape & Ammo
BZX79CxxxTA2*	Axial Lead	5000 Units / Tape & Ammo
BZX79CxxxRA1 !	Axial Lead	3000 Units / Radial Tape & Ammo
BZX79CxxxRA2 i	Axial Lead	3000 Units / Radial Tape & Ammo

* The “2” suffix refer to 26mm tape spacing.
! “1”: Polarity band **up** with cathode lead off first.
i “2”: Polarity band **down** with cathode lead off first.

Devices listed in **bold italic** are Tak Cheong **Preferred** devices. **Preferred** devices are recommended choices for future use and best overall value.

ELECTRICAL CHARACTERIZATION (T_A = 25°C unless otherwise noted, VF = 1.5V max @ I_F = 100mA for all types)

Symbol	Parameter
V_Z	Reverse Zener Voltage @ I_{ZT}
I_{ZT}	Reverse Current
Z_{ZT}	Maximum Zener Impedance @ I_{ZT}
θ V_{BR}	Temperature Coefficient of V_{BR} (Typical)
I_R	Reverse Leakage Current @ V_R
V_R	Reverse Voltage
I_F	Forward Current
V_F	Forward Voltage @ I_F
C	Capacitance (Typical)



Zener Voltage Regulator

ELECTRICAL CHARACTERIZATION (T_A = 25°C unless otherwise noted, VF = 1.5V max @ I_F = 100mA for all types)

Device (Note 2.)	Device Marking	V_Z @ I_{ZT} (Volts) (Note 3.) Min	Max	Max Zener Impedance (Note 4.) I_{ZT} @ I_{ZT} (Ω)	I_{ZT} (mA)	Leakage Current I_R @ V_R (uA)	(Volts)	θ V_{BR} (mV/℃) Min	Max	C V_Z=0, F=1.0MHz (pF)
BZX79C2V4	79C2V4	2.2	2.6	100	5	100	1	-3.5	0	255
BZX79C2V7	79C2V7	2.5	2.9	100	5	75	1	-3.5	0	230
BZX79C3V0	79C3V0	2.8	3.2	95	5	50	1	-3.5	0	215
BZX79C3V3	79C3V3	3.1	3.5	95	5	25	1	-3.5	0	200
BZX79C3V6	79C3V6	3.4	3.8	90	5	15	1	-3.5	0	185
BZX79C3V9	79C3V9	3.7	4.1	90	5	10	1	-3.5	0.3	175
BZX79C4V3	79C4V3	4	4.6	90	5	5	1	-3.5	1	160
BZX79C4V7	79C4V7	4.4	5	80	5	3	2	-3.5	0.2	130
BZX79C5V1	79C5V1	4.8	5.4	60	5	2	2	-2.7	1.2	110
BZX79C5V6	79C5V6	5.2	6	40	5	1	2	-2	2.5	95
BZX79C6V2	79C6V2	5.8	6.6	10	5	3	4	0.4	3.7	90
BZX79C6V8	79C6V8	6.4	7.2	15	5	2	4	1.2	4.5	85
BZX79C7V5	79C7V5	7	7.9	15	5	1	5	2.5	5.3	80
BZX79C8V2	79C8V2	7.7	8.7	15	5	0.7	5	3.2	6.2	75
BZX79C9V1	79C9V1	8.5	9.6	15	5	0.5	6	3.8	7	70
BZX79C10	79C10	9.4	10.6	20	5	0.2	7	4.5	8	70
BZX79C11	79C11	10.4	11.6	20	5	0.1	8	5.4	9	65
BZX79C12	79C12	11.4	12.7	25	5	0.1	8	6	10	65
BZX79C13	79C13	12.4	14.1	30	5	0.1	8	7	11	60
BZX79C15	79C15	13.8	15.6	30	5	0.05	10.5	9.2	13	55

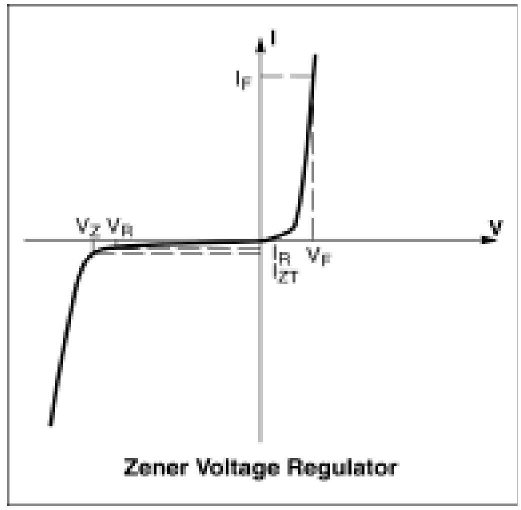
2. TOLERANCE AND VOLTAGE DESIGNATION
Tolerance designation – the type numbers listed have zener voltage min/max limits as shown.

3. REVERSE ZENER VOLTAGE (V_Z)
Reverse zener voltage is measured under pulse conditions such at T_J is no more than 2℃ above T_A.

4. ZENER IMPEDANCE (Z_Z) DERIVATION
Z_{ZT} and Z_{ZK} are measured by dividing the AC voltage drop across the device by the AC current applied. The specified limits are for $I_{Z(AC)}$ = 0.1 $I_{Z(DC)}$ with AC frequency = 60Hz.

ELECTRICAL CHARACTERISTICS (T_A = 25ºC unless otherwise noted. V_F = 1.5 V Max @ I_F = 100mA for all types)

Symbol	Parameter
V_Z	Reverse Zener Voltage @ I_{ZT}
I_{ZT}	Reverse Zener Current
Z_{ZT}	Maximum Zener Impedance @ I_{ZT}
θV_{BR}	Temperature Coefficient of V_{BR} (Typical)
I_R	Reverse Leakage Current @ V_R
V_R	Reverse Voltage
I_F	Forward Current
V_F	Forward Voltage @ I_F
C	Capacitance (Typical)



ELECTRICAL CHARACTERISTICS (T_A = 25c unless otherwise noted, V_F = 1.5 V Max @ I_F = 100mA for all types)

Device (Note 2.)	Device Marking	V_Z @ I_{ZT} (Volts) (Note 3.) Min	Max	Max Zener Impedance (Note 4) Z_{ZT} @ I_{ZT} (Ω)	I_{ZT} (mA)	Leakage Current I_R @ V_R (µA)	(Volts)	θV_{BR} (mV/ºC) Min	Max	C V_Z = 0, F = 1.0MHz (pF)
BZX79C2V4	79C2V4	2.2	2.6	100	5	100	1	-3.5	0	255
BZX79C2V7	79C2V7	2.5	2.9	100	5	75	1	-3.5	0	230
BZX79C3V0	79C3V0	2.8	3.2	95	5	50	1	-3.5	0	215
BZX79C3V3	79C3V3	3.1	3.5	95	5	25	1	-3.5	0	200
BZX7C3V6	7C3V6	3.4	3.8	90	5	15	1	-3.5	0	185
BZX79C3V9	79C3V9	3.7	4.1	90	5	10	1	-3.5	0.3	175
BZX79C4V3	79C4V3	4	4.6	90	5	5	1	-3.5	1	160
BZX79C4V7	79C4V7	4.4	5	80	5	3	2	-3.5	0.2	130
BZX79C5V1	79C5V1	4.8	5.4	60	5	2	2	-2.7	1.2	110
BZX79C5V6	79C5V6	5.2	6	40	5	1	2	-2	2.5	95
BZX79C6V2	79C6V2	5.8	6.6	10	5	3	4	0.4	3.7	90
BZX79C6V8	79C6V8	6.4	7.2	15	5	2	4	1.2	4.5	85
BZX79C7V5	79C7V5	7	7.9	15	5	1	5	2.5	5.3	8
BZX79C8V2	79C8V2	7.7	8.7	15	5	0.7	5	3.2	6.2	75
BZX79C9V1	79C9V1	8.5	9.6	15	5	0.5	6	3.8	7	70
BZX79C10	79C10	9.4	10.6	20	5	0.2	7	4.5	8	70
BZX79C11	79C11	10.4	11.6	20	5	0.1	8	5.4	9	65
BZX79C12	79C12	11.4	12.7	25	5	0.1	8	6	10	65
BZX79C13	79C13	12.4	14.1	30	5	0.1	8	7	11	60
BZX79C15	79C15	13.8	15.6	30	5	0.05	10.5	9.2	13	55

2. TOLERANCE AND VOLTAGE DESIGNATION
Tolerance designation – the type numbers listed have zener voltage min/max limits as shown.

3. REVERSE ZENER VOLTAGE (V_Z)
Reverse zener voltage is measured under pulse conditions such that T_J is no more than 2ºC above T_A.

4. ZENER IMPEDANCE (Z_Z) DERIVATION
Z_{ZT} and Z_{ZK} are measured by dividing the AC voltage drop across the device by the AC current applied. The specified limits are for $I_{Z(AC)}$ = 0.1 $I_{Z(DC)}$ with AC frequency = 60Hz.

ELECTRICAL CHARACTERISTICS (T_A = 25c unless otherwise noted, V_F = 1.5 V Max @ I_F = 100mA for all types)

Device (Note 2.)	Device Marking	V_Z @ I_{ZT} (Volts) (Note 3.) Min	Max	Max Zener Impedance (Note 4) Z_{ZT} @ I_{ZT} (Ω)	I_{ZT} (mA)	Leakage Current I_R @ V_R (µA)	(Volts)	θV_{BR} (mV/ºC) Min	Max	C V_Z = 0, F = 1.0MHz (pF)
BZX79C16	79C16	15.3	17.1	40	5	0.05	11.2	10.4	14	52
BZX79C18	79C18	16.8	19.1	45	5	0.05	12.6	12.9	16	47
BZX79C20	79C20	18.8	21.2	55	5	0.05	14	14.4	18	36
BZX79C22	79C22	20.8	23.3	55	5	0.05	15.4	16.4	20	34
BZX79C24	79C24	22.8	25.6	70	5	0.05	16.8	18.4	22	33
BZX79C27	79C27	25.1	28.9	80	2	0.05	18.9		23.5	30
BZX79C30	79C30	28	32	80	2	0.05	21		26	27
BZX79C33	79C33	31	35	80	2	0.05	23.1		29	25
BZX79C36	79C36	34	38	90	2	0.05	25.2		31	23
BZX79C39	79C39	37	41	130	2	0.05	27.3		34	21
BZX79C43	79C43	40	46	150	2	0.05	30.1		37	21
BZX79C47	79C47	44	50	170	2	0.05	32.9		40	19
BZX79C51	79C51	48	54	180	2	0.05	35.7		44	19
BZX79C56	79C56	52	60	200	2	0.05	39.2		47	18
BZX79C62	79C62	58	66	215	2	0.05	43.4		51	17
BZX79C68	79C68	64	72	240	2	0.05	47.6		56	17
BZX79C75	79C75	70	79	255	2	0.05	52.5		60	16.5
BZX79C82	79C82	77	87	280	2	0.1	62	46	95	29
BZX79C91	79C91	85	96	300	2	0.1	69	51	107	28
BZX79C100	79C100	94	106	500	1	0.1	76	57	119	27
BZX79C110	79C110	104	116	650	1	0.1	84	63	131	26
BZX79C120	79C120	114	127	800	1	0.1	91	69	144	24
BZX79C130	79C130	124	141	950	1	0.1	99	75	158	23
BZX79C150	79C150	138	156	1250	1	0.1	114	87	185	21
BZX79C160	79C160	153	171	1400	1	0.1	122	93	200	20
BZX79C180	79C180	168	191	1700	1	0.1	137	105	228	18
BZX79C200	79C200	188	212	2000	1	0.1	152	120	255	17

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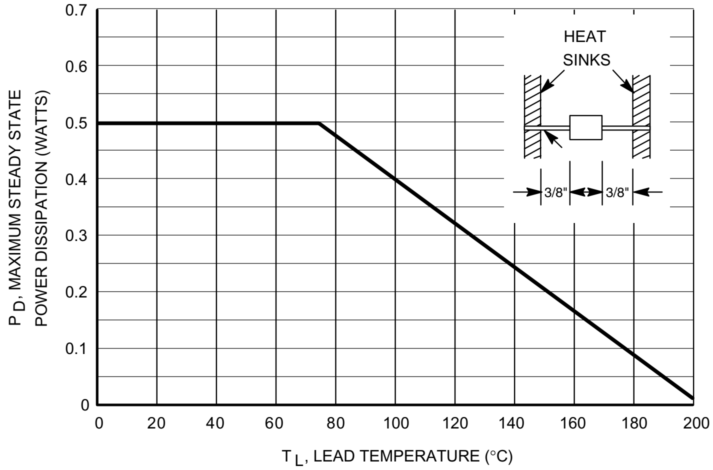

Figure 1. Steady State Power Derating

APPLICATION NOTE - ZENER VOLTAGE

Since the actual voltage available from a given zener diode is temperature dependent, it is necessary to determine junction temperature under any set of operating conditions in order to calculate its value. The following procedure is recommended:

Lead Temperature, T_L, should be determined from:

$$T_L = \theta_{LA} P_D + T_A.$$

θ_{LA} is the lead-to-ambient thermal resistance (°C/W) and P_D is the power dissipation. The value for θ_{LA} will vary and depends on the device mounting method. θ_{LA} is generally 30 to 40°C/W for the various clips and tie points in common use and for printed circuit board wiring.

The temperature of the lead can also be measured using a thermocouple placed on the lead as close as possible to the tie point. The thermal mass connected to the tie point is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady-state conditions are achieved. Using the measured value of T_L, the junction temperature may be determined by:

$$T_J = T_L + \Delta T_{JL}.$$

ΔT_{JL} is the increase in junction temperature above the lead temperature and may be found from Figure 2 for dc power:

$$\Delta T_{JL} = \theta_{JL} P_D.$$

For worst-case design, using expected limits of I_Z, limits of P_D and the extremes of $T_J(\Delta T_J)$ may be estimated. Changes in voltage, V_Z, can then be found from:

$$\Delta V = \theta_{VZ} T_J.$$

θ_{VZ}, the zener voltage temperature coefficient, is found from Figures 4 and 5.

Under high power-pulse operation, the zener voltage will vary with time and may also be affected significantly by the zener resistance. For best regulation, keep current excursions as low as possible.

Surge limitations are given in Figure 7. They are lower than would be expected by considering only junction temperature, as current crowding effects cause temperatures to be extremely high in small spots, resulting in device degradation should the limits of Figure 7 be exceeded.

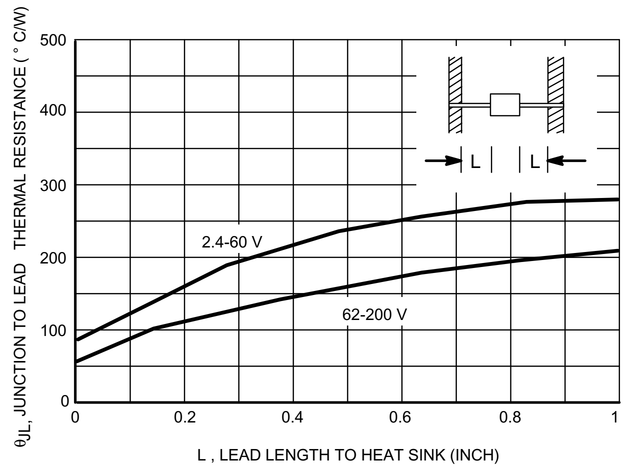

Figure 2. Typical Thermal Resistance

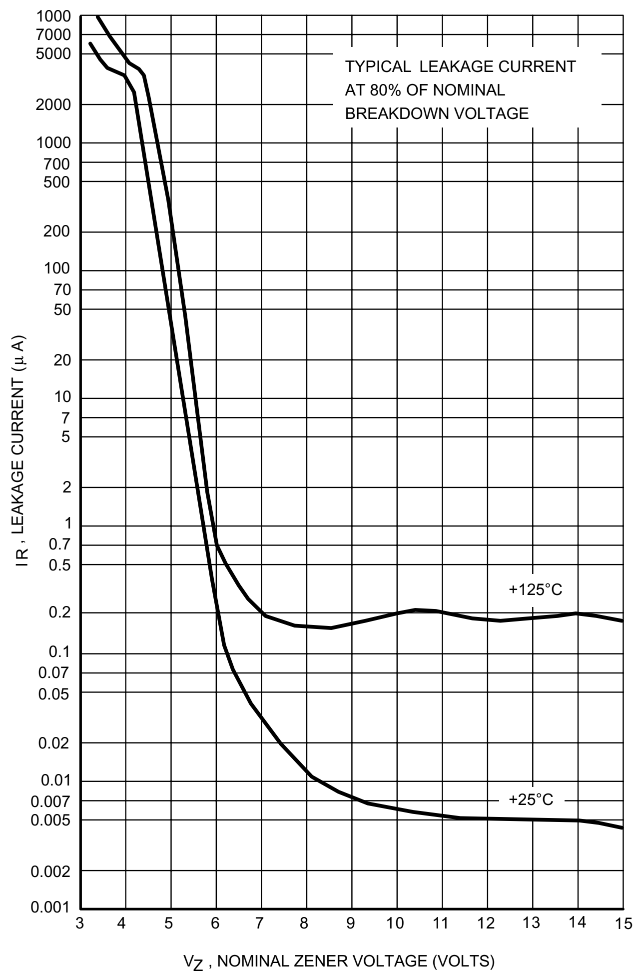

Figure 3. Typical Leakage Current

TEMPERATURE COEFFICIENTS

(-55°C to +150°C temperature range; 90% of the units are in the ranges indicated.)

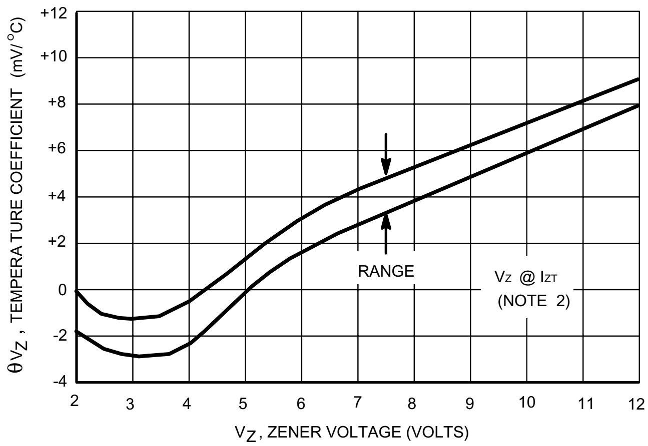

Figure 4a. Range for Units to 12 Volts

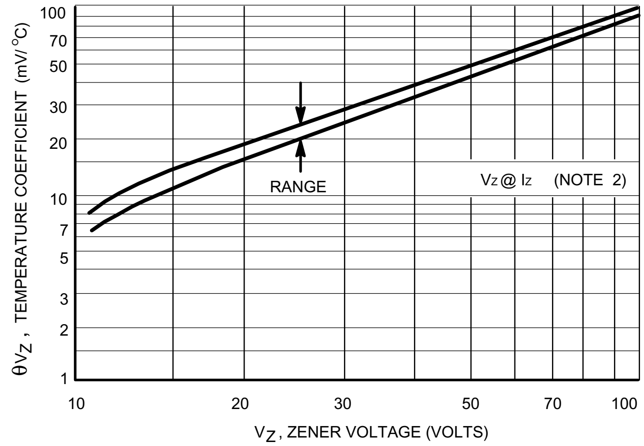

Figure 4b. Range for Units 12 to 100 Volts

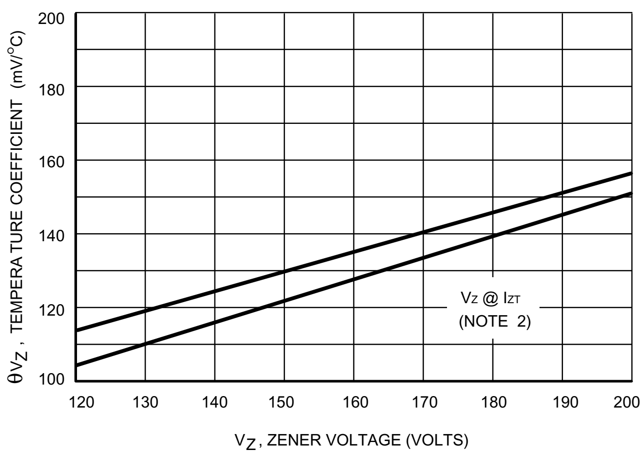

Figure 4c. Range for Units 120 to 200 Volts

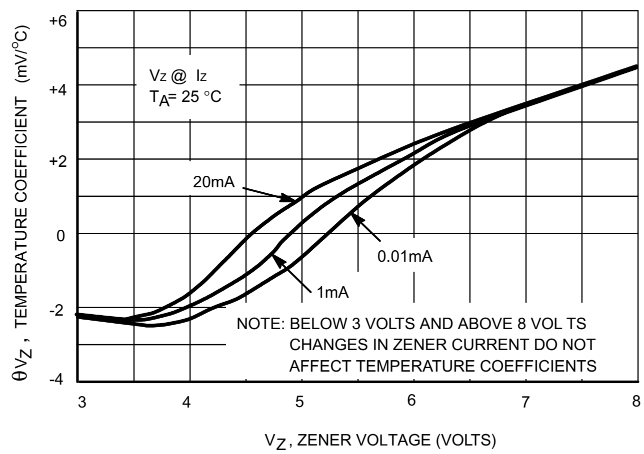

Figure 5. Effect of Zener Current

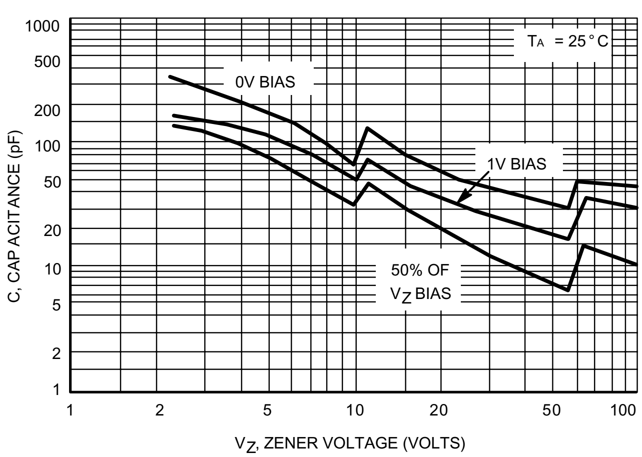

Figure 6a. Typical Capacitance 2.4-100 Volts

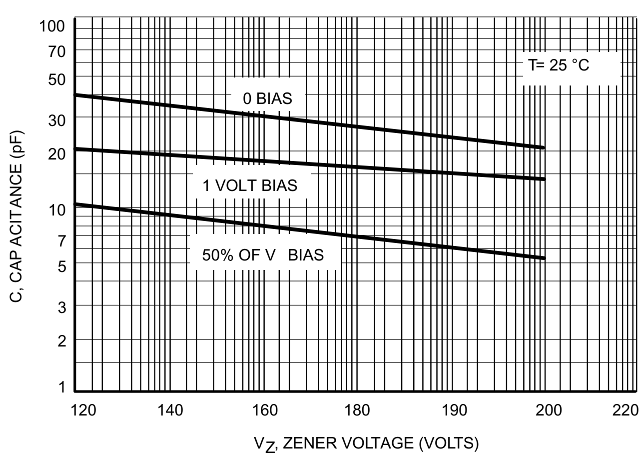

Figure 6b. Typical Capacitance 120-200 Volts

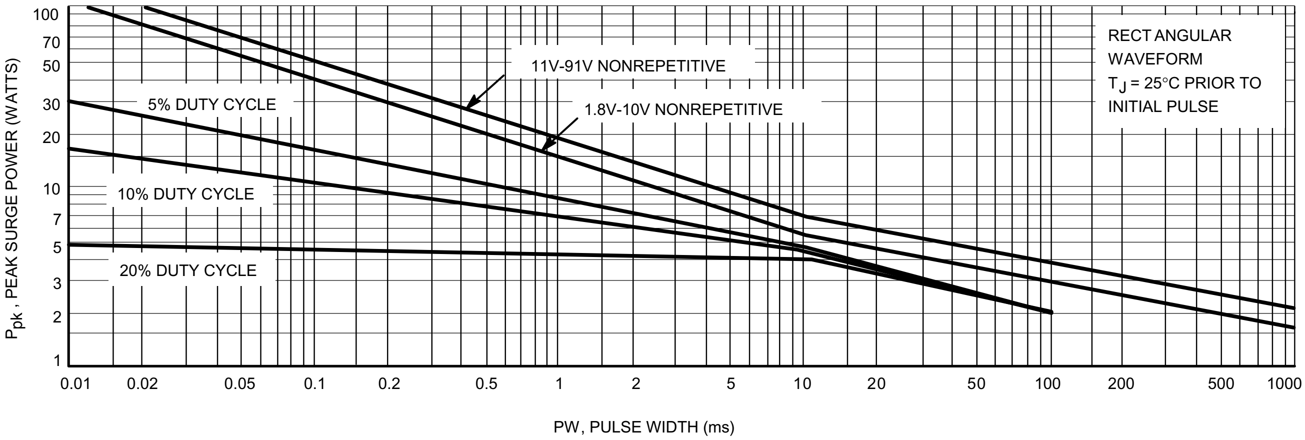

Figure 7a. Maximum Surge Power 1.8-91 Volts

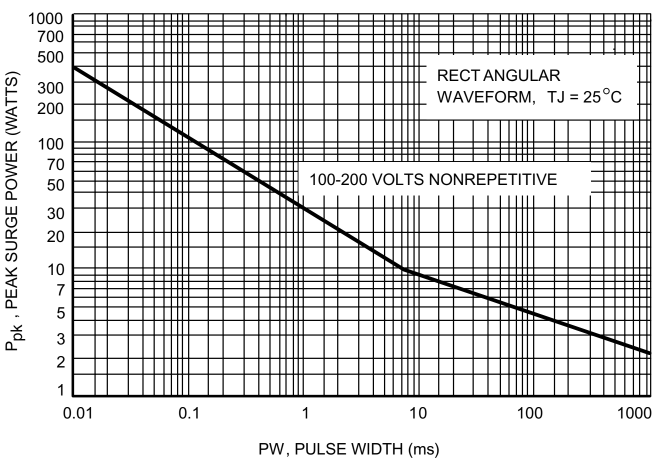

Figure 7b. Maximum Surge Power DO-35 100-200Volts

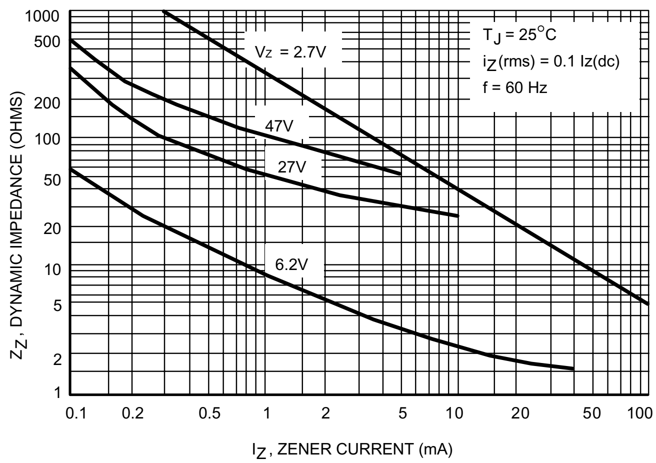

Figure 8. Effect of Zener Current on Zener Impedance

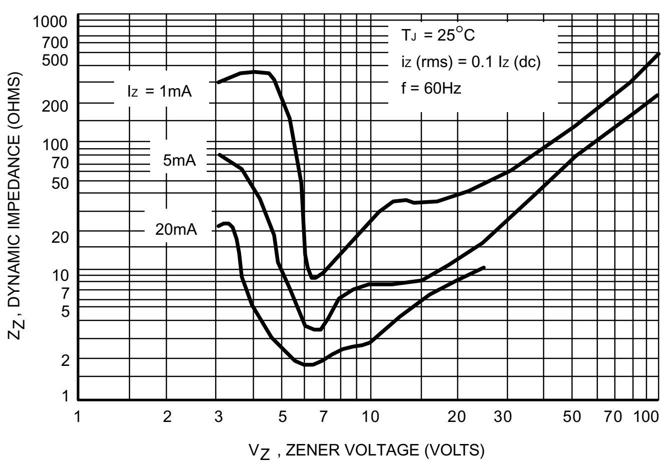

Figure 9. Effect of Zener Voltage on Zener Impedance

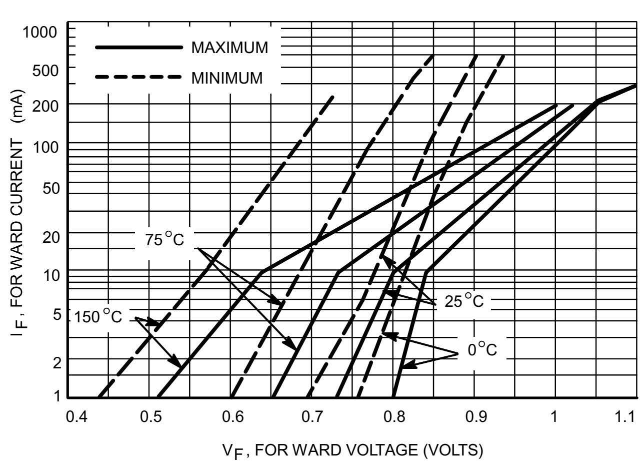

Figure 10. Typical Forward Characteristics

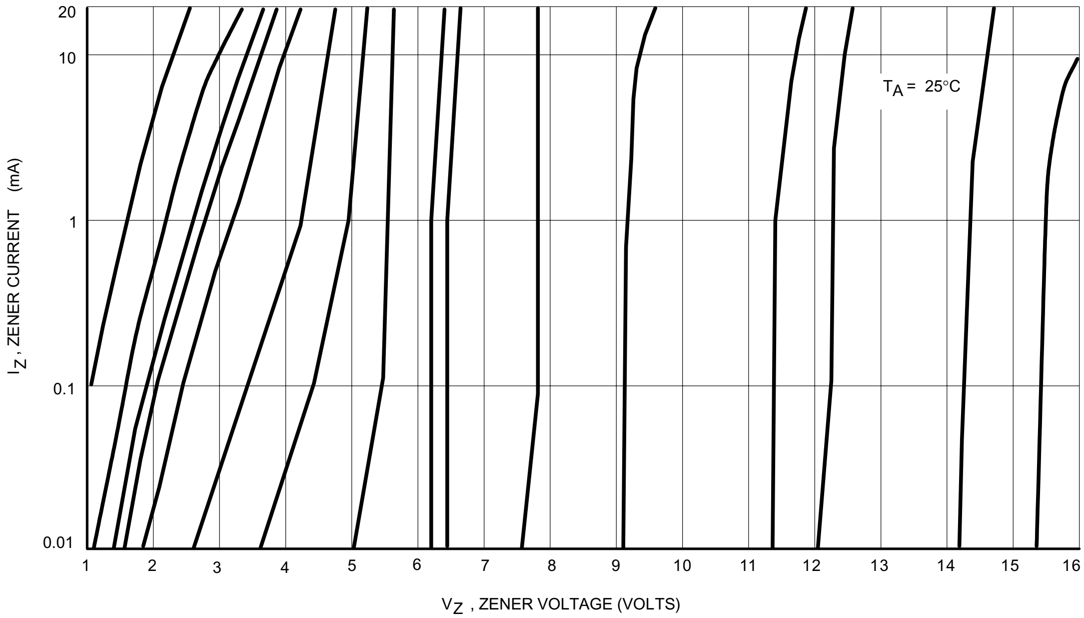

Figure 1 1. Zener Voltage versus Zener Current - V_Z = 1 thru 16 Volts

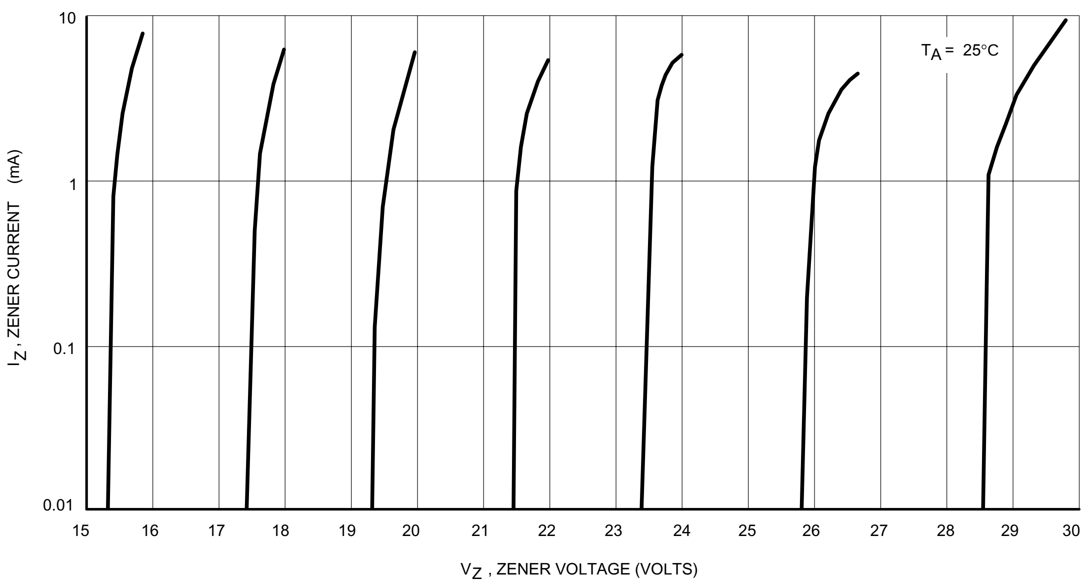

Figure 12. Zener Voltage versus Zener Current - V_Z = 15 thru 30 Volts

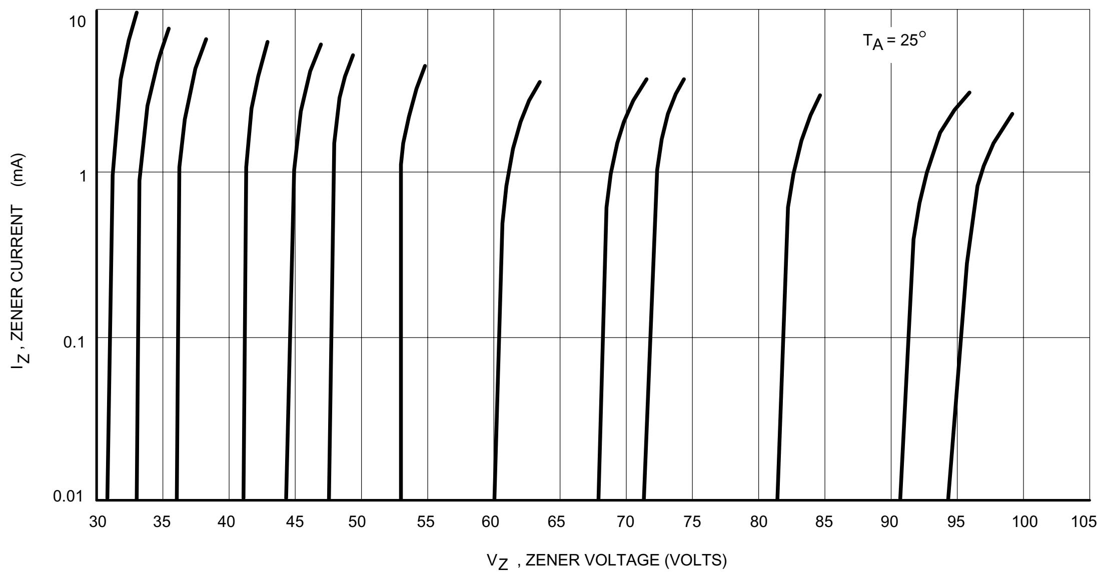

Figure 13. Zener Voltage versus Zener Current - V_Z = 30 thru 105 Volts

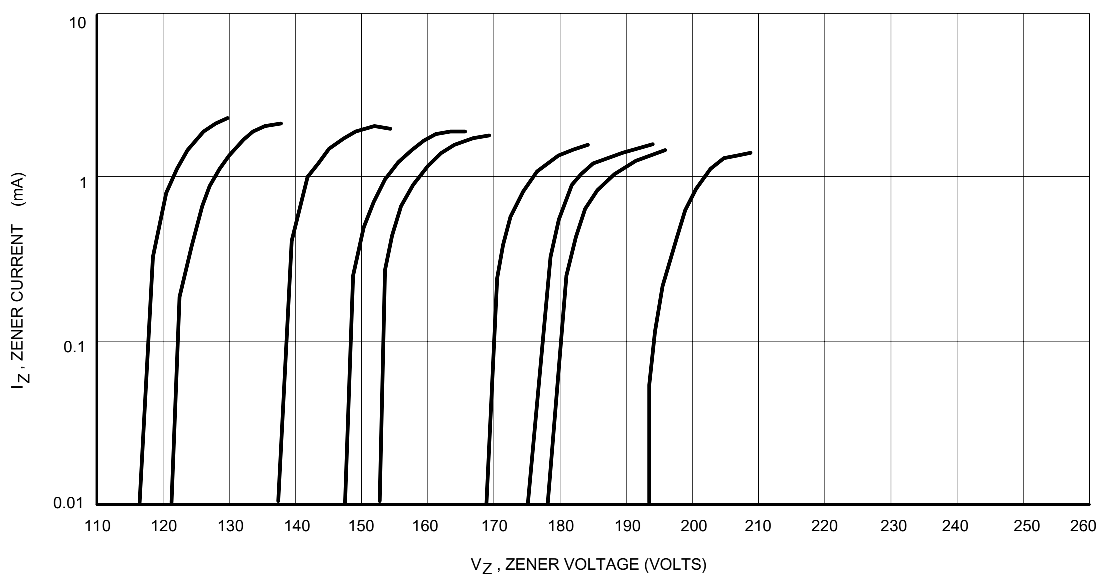

Figure 14. Zener Voltage versus Zener Current - V_Z = 110 thru 220 Volts