

500 mW DO-35 Hermetically Sealed Glass Zener Voltage Regulators

Maximum Ratings (Note 1)

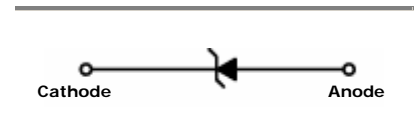
Rating	Symbol	Value	Units
Maximum Steady State Power Dissipation @TL≤75°C, Lead Length = 3/8"	P _D	500	mW
Derate Above 75°C		4.0	mW/°C
Operating and Storage Temperature Range	T _J , T _{stg}	-65 to +200	°C

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



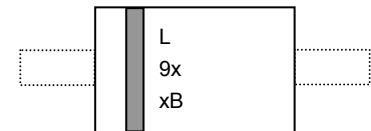
Specification Features:

- Zener Voltage Range = 6.8V to 100V
- 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
 9xxB = 1N9xxB Device Code

Maximum Lead Temperature for Soldering Purposes
 230°C, 1/16" from the case for 10 seconds

Ordering Information

Device	Package	Quantity
1N9xxB	Axial Lead	3000 Units / Box
1N9xxBRL	Axial Lead	5000 Units / Tape & Reel
1N9xxBRL2*	Axial Lead	5000 Units / Tape & Reel
1N9xxBRR1 !	Lead Form	3000 Units / Radial Tape & Reel
1N9xxBRR2 i	Lead Form	3000 Units / Radial Tape & Reel
1N9xxBTA	Axial Lead	5000 Units / Tape & Ammo
1N9xxBTA2*	Axial Lead	5000 Units / Tape & Ammo
1N9xxBRA1 !	Axial Lead	3000 Units / Radial Tape & Ammo
1N9xxBRA2 i	Axial Lead	3000 Units / Radial Tape & Ammo

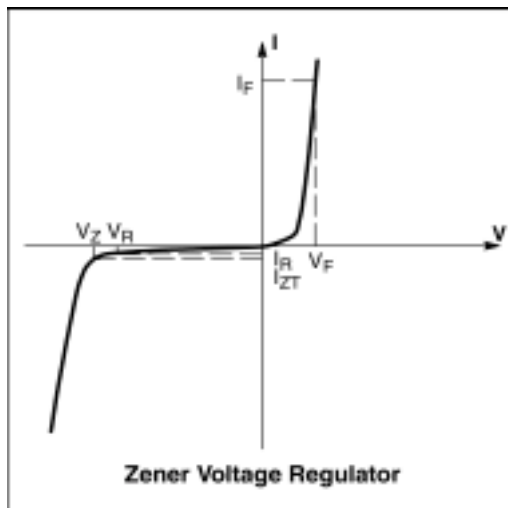
* The "2" suffix refer to 26mm tape spacing.
 ! "1": Polarity band **up** with cathode lead off first.
 i "2": Polarity band **down** with cathode lead off first.

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

1N957B through 1N992B Series

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted, $V_F = 1.5\text{ V Max @ } I_F = 200\text{mA}$ for all types)

Symbol	Parameter
V_Z	Reverse Zener Voltage @ I_{ZT}
I_{ZT}	Reverse Zener Current
Z_{ZT}	Maximum Zener Impedance @ I_{ZT}
I_{ZM}	Maximum DC Zener Current
I_R	Reverse Leakage Current @ V_R
V_R	Reverse Voltage
I_F	Forward Current
V_F	Forward Voltage @ I_F
I_{ZM}	Maximum DC Zener Current



ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted, $V_F = 1.5\text{ V Max @ } I_F = 200\text{mA}$ for all types)

Device (Note 2.)	Device Marking	Zener Voltage (Note 3.)				Zener Impedance (Note 4.)			Leakage Current		I_{ZM} (Note 5.) (mA)
		V_Z (Volts)			@ I_{ZT}	Z_{ZT} @ I_{ZT}	Z_{ZK} @ I_{ZK}	I_R @ V_R			
		Min	Nom	Max	(mA)	(Ω)	(Ω)	(mA)	(μA)	(Volts)	
1N957B	1N957B	6.46	6.8	7.14	18.5	4.5	700	1	150	5.2	47
1N958B	1N958B	7.125	7.5	7.875	16.5	5.5	700	0.5	75	5.7	42
1N959B	1N959B	7.79	8.2	8.61	15	6.5	700	0.5	50	6.2	38
1N960B	1N960B	8.645	9.1	9.555	14	7.5	700	0.5	25	6.9	35
1N961B	1N961B	9.5	10	10.5	12.5	8.5	700	0.25	10	7.6	32
1N962B	1N962B	10.45	11	11.55	11.5	9.5	700	0.25	5	8.4	28
1N963B	1N963B	11.4	12	12.6	10.5	11.5	700	0.25	5	9.1	26
1N964B	1N964B	12.35	13	13.65	9.5	13	700	0.25	5	9.9	24
1N965B	1N965B	14.25	15	15.75	8.5	16	700	0.25	5	11.4	21
1N966B	1N966B	15.2	16	16.8	7.8	17	700	0.25	5	12.2	19
1N967B	1N967B	17.1	18	18.9	7	21	750	0.25	5	13.7	17
1N968B	1N968B	19	20	21	6.2	25	750	0.25	5	15.2	15
1N969B	1N969B	20.9	22	23.1	5.6	29	750	0.25	5	16.7	14
1N970B	1N970B	22.8	24	25.2	5.2	33	750	0.25	5	18.2	13
1N971B	1N971B	25.65	27	28.35	4.6	41	750	0.25	5	20.6	11
1N972B	1N972B	28.5	30	31.5	4.2	49	1000	0.25	5	22.8	10
1N973B	1N973B	31.35	33	34.65	3.8	58	1000	0.25	5	25.1	9.2
1N974B	1N974B	34.2	36	37.8	3.4	70	1000	0.25	5	27.4	8.5
1N975B	1N975B	37.05	39	40.95	3.2	80	1000	0.25	5	29.7	7.8
1N976B	1N976B	40.85	43	45.15	3	93	1500	0.25	5	32.7	7

2. TOLERANCE AND TYPE NUMBER DESIGNATION (V_Z)

The type numbers listed have a standard tolerance on the nominal zener voltage of $\pm 5\%$.

3. ZENER VOLTAGE (V_Z) MEASUREMENT

Nominal zener voltage is measured with the device junction in the thermal equilibrium at the lead temperature (T_L) at $30^\circ\text{C} \pm 1^\circ\text{C}$ and $3/8''$ lead length.

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.

5. MAXIMUM ZENER CURRENT RATINGS (I_{ZM})

Values shown are based on the JEDEC rating of 400mW where the actual zener voltage (V_Z) is known at the operating point, the zener current may be increased and is limited by the derating curve.

1N957B through 1N992B Series

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted, $V_F = 1.5\text{ V Max @ } I_F = 200\text{mA}$ for all types)

Device (Note 6.)	Device Marking	Zener Voltage (Note 7.)				Zener Impedance (Note 8.)			Leakage Current		I_{ZM} (Note 9.)
		V_Z (Volts)			@ I_{ZT}	Z_{ZT} @ I_{ZT}	Z_{ZK} @ I_{ZK}		I_R @ V_R		
		Min	Nom	Max	(mA)	(Ω)	(Ω)	(mA)	(μA)	(Volts)	(mA)
1N977B	1N977B	44.65	47	49.35	2.7	105	1500	0.25	5	35.8	6.4
1N978B	1N978B	48.45	51	53.55	2.5	125	1500	0.25	5	38.8	5.9
1N979B	1N979B	53.2	56	58.8	2.2	150	2000	0.25	5	42.6	5.4
1N980B	1N980B	58.9	62	65.1	2	185	2000	0.25	5	47.1	4.9
1N981B	1N981B	64.6	68	71.4	1.8	230	2000	0.25	5	51.7	4.5
1N982B	1N982B	71.25	75	78.75	1.7	270	2000	0.25	5	56	4.1
1N983B	1N983B	77.9	82	86.1	1.5	330	3000	0.25	5	62.2	3.7
1N984B	1N984B	86.45	91	95.55	1.4	400	3000	0.25	5	69.2	3.3
1N985B	1N985B	95	100	105	1.3	500	3000	0.25	5	76	3
1N986B	1N986B	104.5	110	115.5	1.1	750	4000	0.25	5	83.6	2.7
1N987B	1N987B	114	120	126	1	900	4500	0.25	5	91.2	2.5
1N988B	1N988B	123.5	130	136.5	0.95	1100	5000	0.25	5	98.8	2.3
1N989B	1N989B	142.5	150	157.5	0.85	1500	6000	0.25	5	114	2
1N990B	1N990B	152	160	168	0.8	1700	6500	0.25	5	121.6	1.9
1N991B	1N991B	171	180	189	0.68	2200	7100	0.25	5	136.8	1.7
1N992B	1N992B	190	200	210	0.65	2500	8000	0.25	5	152	1.5

6. TOLERANCE AND TYPE NUMBER DESIGNATION (V_Z)

The type numbers listed have a standard tolerance on the nominal zener voltage of $\pm 5\%$.

7. ZENER VOLTAGE (V_Z) MEASUREMENT

Nominal zener voltage is measured with the device junction in the thermal equilibrium at the lead temperature (T_L) at $30^\circ\text{C} \pm 1^\circ\text{C}$ and $3/8"$ lead length.

8. 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.

9. MAXIMUM ZENER CURRENT RATINGS (I_{ZM})

Values shown are based on the JEDEC rating of 400mW where the actual zener voltage (V_Z) is known at the operating point, the zener current may be increased and is limited by the derating curve.

1N957B through 1N992B Series

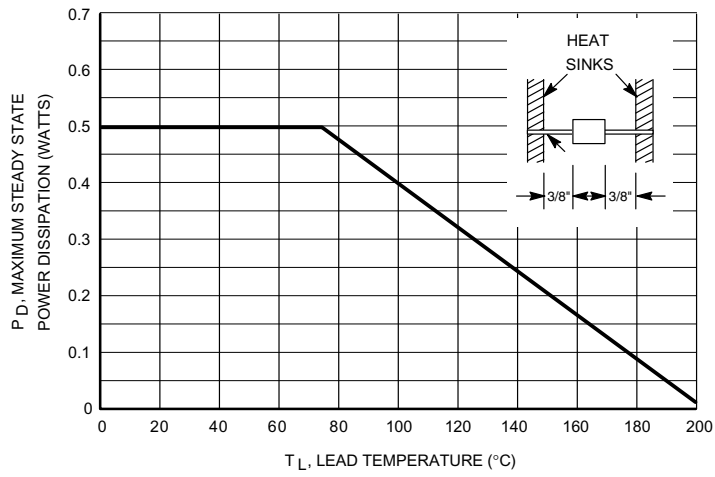


Figure 1. Steady State Power Derating

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 ($^{\circ}\text{C}/\text{W}$) 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 $40^{\circ}\text{C}/\text{W}$ 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.

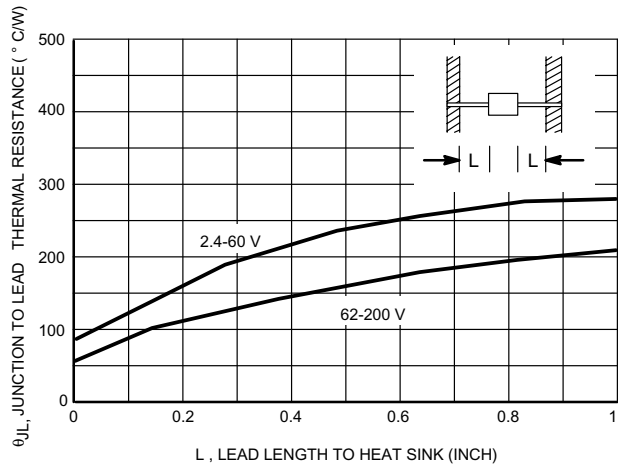


Figure 2. Typical Thermal Resistance

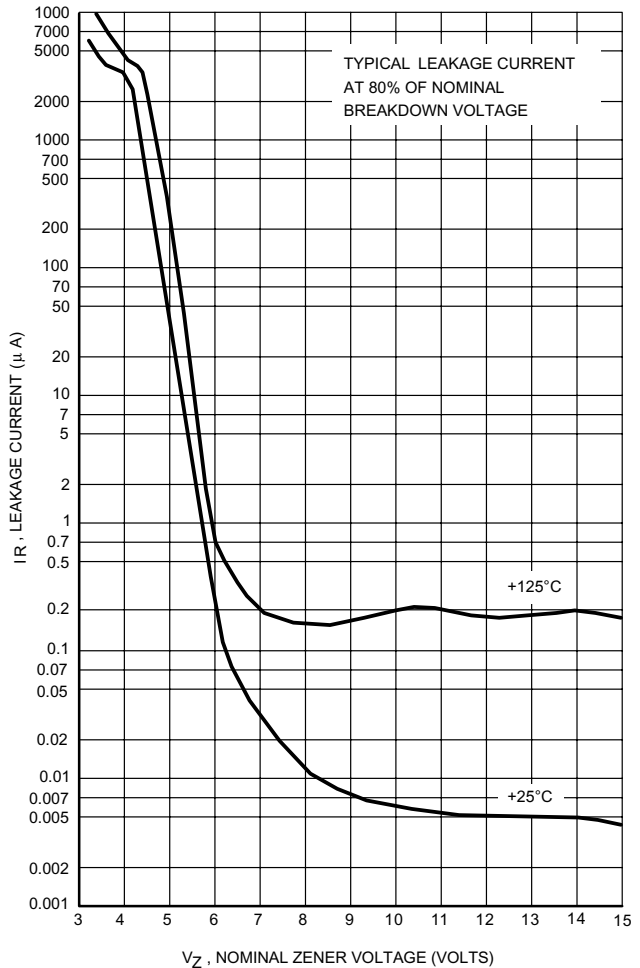


Figure 3. Typical Leakage Current

1N957B through 1N992B Series

TEMPERATURE COEFFICIENTS

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

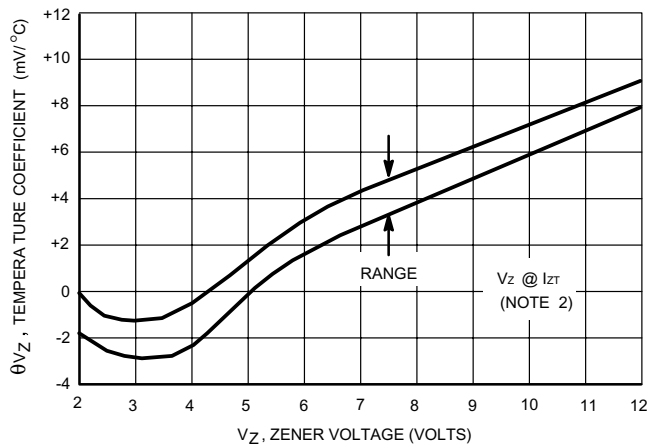


Figure 4a. Range for Units to 12 Volts

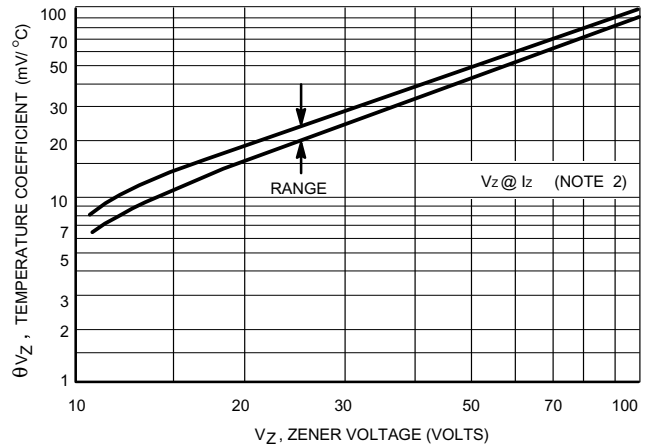


Figure 4b. Range for Units 12 to 100 Volts

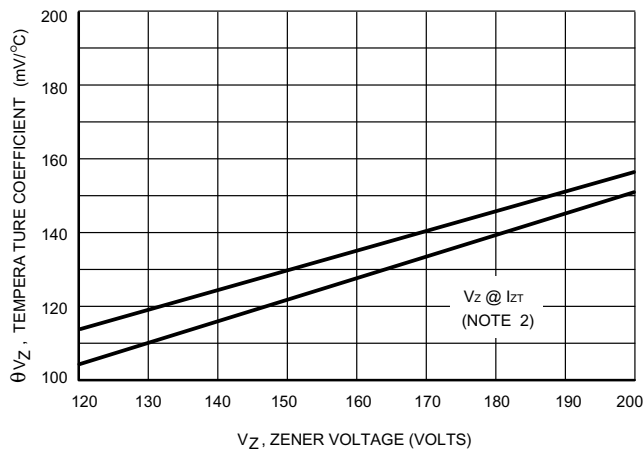


Figure 4c. Range for Units 120 to 200 Volts

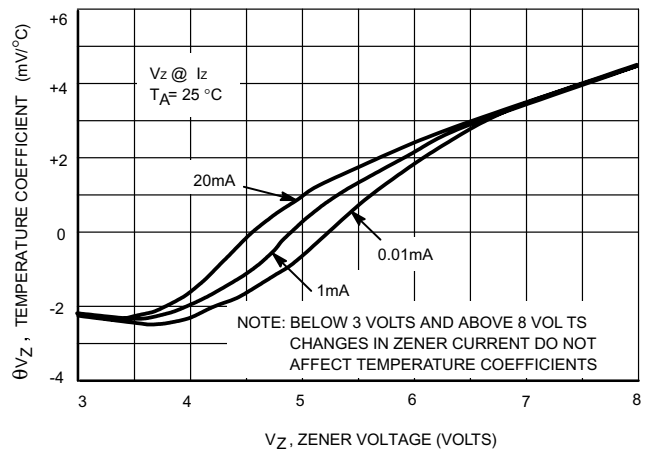


Figure 5. Effect of Zener Current

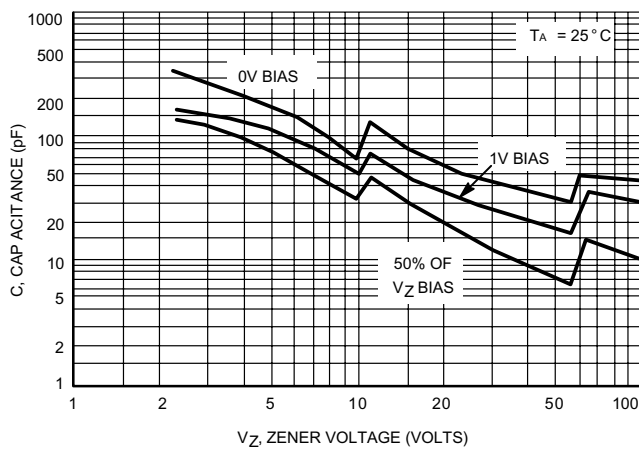


Figure 6a. Typical Capacitance 2.4-100 Volts

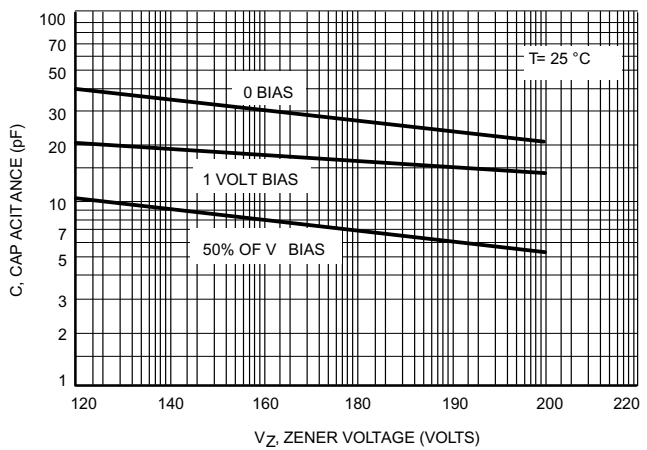


Figure 6b. Typical Capacitance 120-200 Volts

1N957B through 1N992B Series

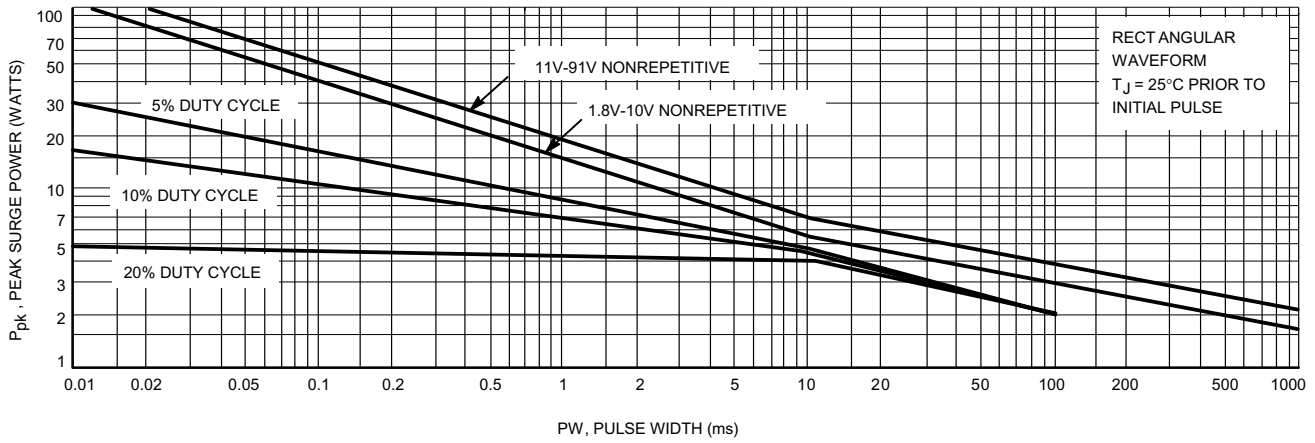


Figure 7a. Maximum Surge Power 1.8-91 Volts

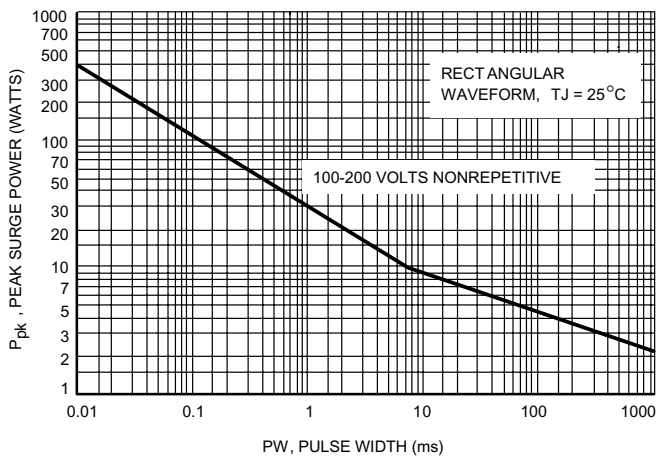


Figure 7b. Maximum Surge Power DO-35 100-200Volts

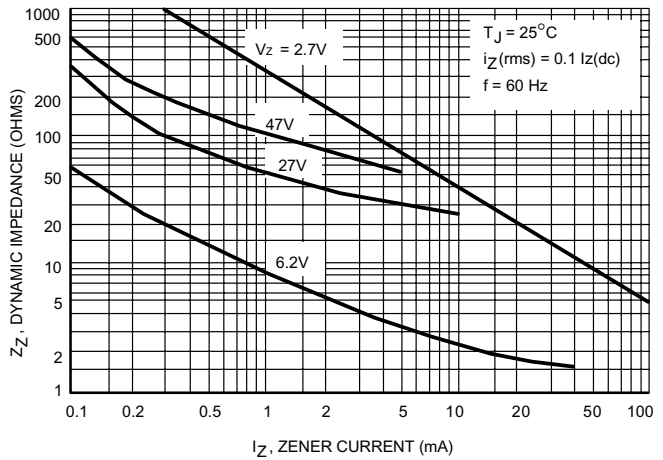


Figure 8. Effect of Zener Current on Zener Impedance

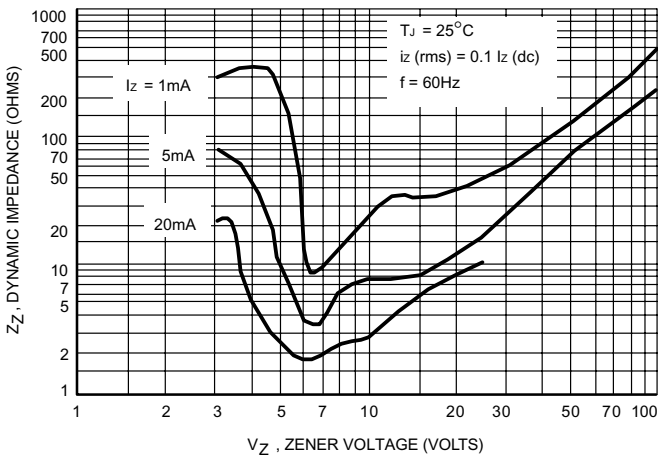


Figure 9. Effect of Zener Voltage on Zener Impedance

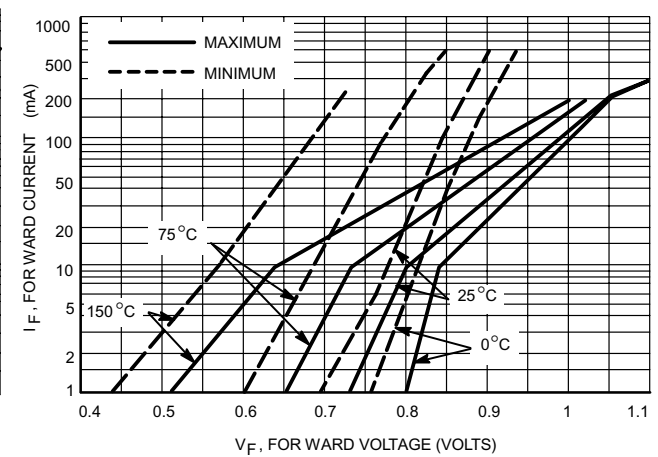


Figure 10. Typical Forward Characteristics

1N957B through 1N992B Series

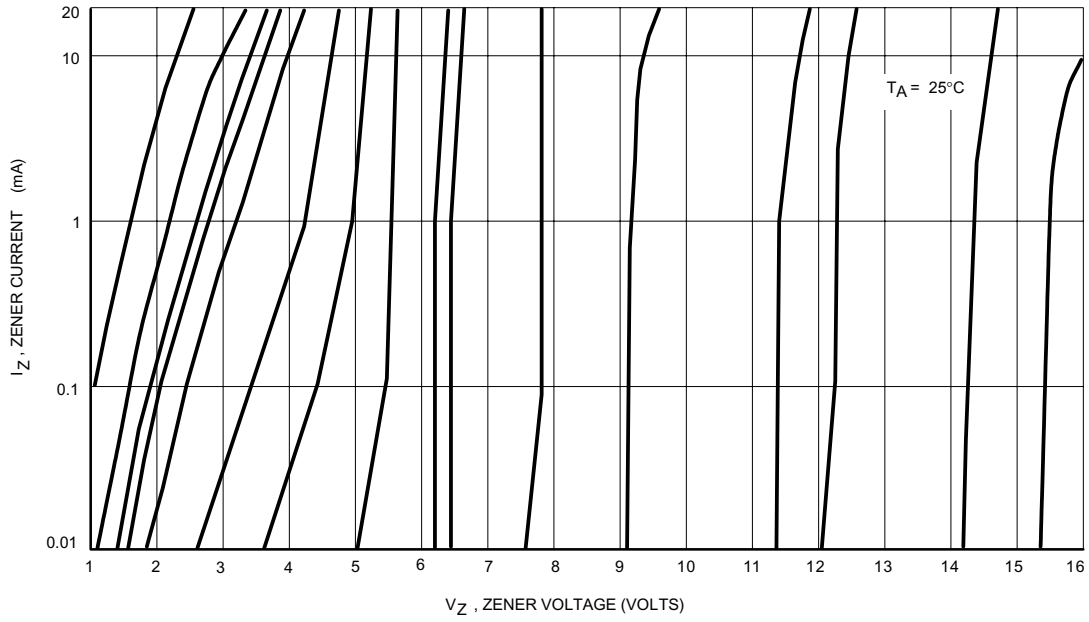


Figure 1 1. Zener Voltage versus Zener Current - $V_Z = 1$ thru 16 Volts

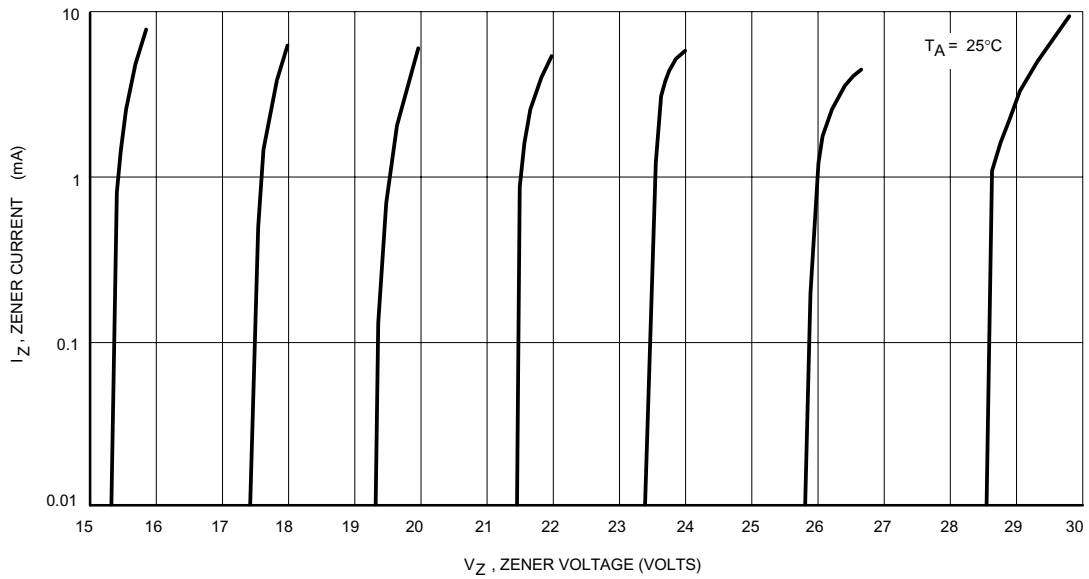


Figure 12. Zener Voltage versus Zener Current - $V_Z = 15$ thru 30 Volts

1N957B through 1N992B Series

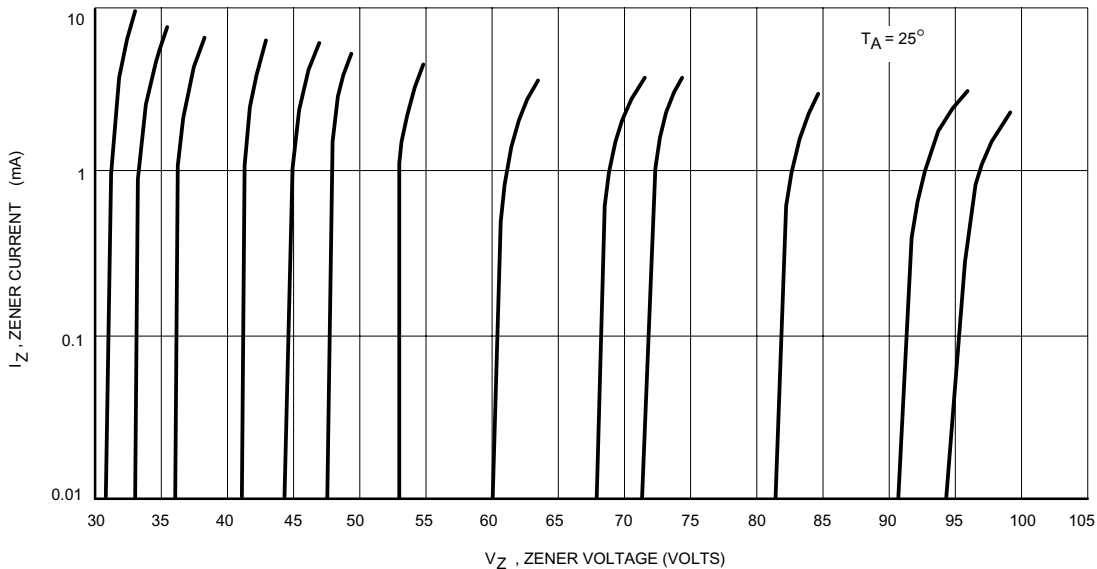


Figure 13. Zener Voltage versus Zener Current - $V_Z = 30$ thru 105 Volts

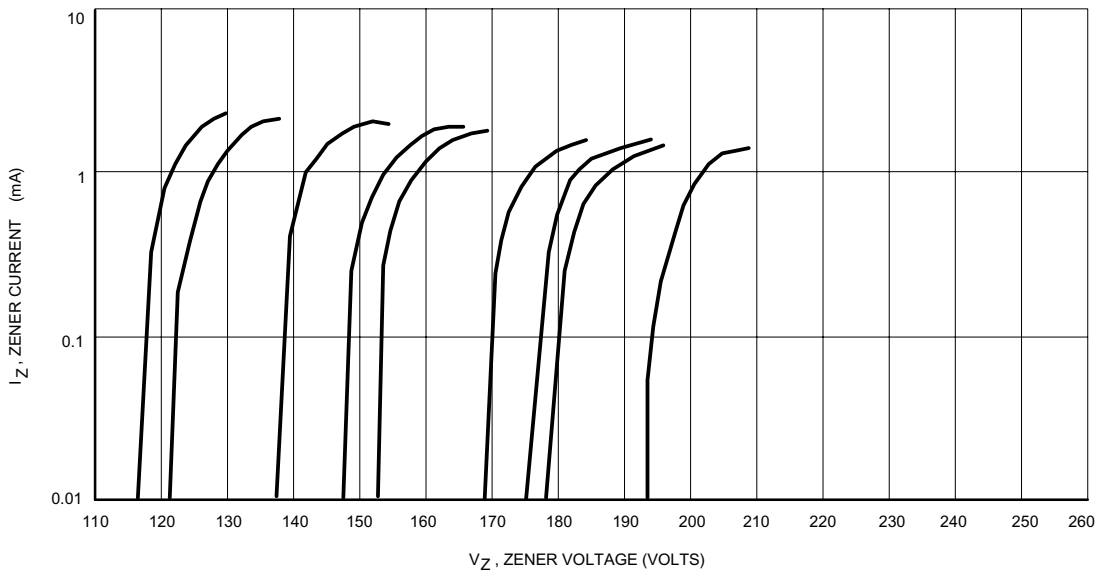


Figure 14. Zener Voltage versus Zener Current - $V_Z = 110$ thru 220 Volts