1N957B Series

500 mW DO-35 Hermetically Sealed Glass Zener Voltage Regulators

This is a complete series of 500 mW Zener diodes with limits and excellent operating characteristics that reflect the superior capabilities of silicon–oxide passivated junctions. All this in an axial–lead hermetically sealed glass package that offers protection in all common environmental conditions.

Specification Features:

- Zener Voltage Range – 6.8 V to 75 V
- ESD Rating of Class 3 (>16 KV) per Human Body Model
- DO–204AH (DO–35) Package – Smaller than Conventional DO–204AA Package
- Double Slug Type Construction
- Metallurgical Bonded Construction

Mechanical Characteristics:

CASE: Double slug type, hermetically sealed glass

FINISH: All external surfaces are corrosion resistant and leads are readily solderable

MAXIMUM LEAD TEMPERATURE FOR SOLDERING PURPOSES: 230°C, 1/16″ from the case for 10 seconds

POLARITY: Cathode indicated by polarity band

MOUNTING POSITION: Any

MAXIMUM RATINGS (Note 1.)

Rating	Symbol	Value	Unit
Max. Steady State Power Dissipation @ $T_L \le 75°C$, 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

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

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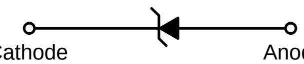
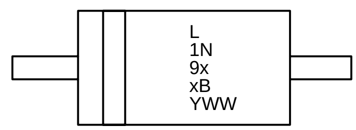


Cathode Anode

AXIAL LEAD
CASE 299
GLASS

MARKING DIAGRAM



L = Assembly Location
1N9xxB = Device Code (See Table Next Page)
Y = Year
WW = Work Week

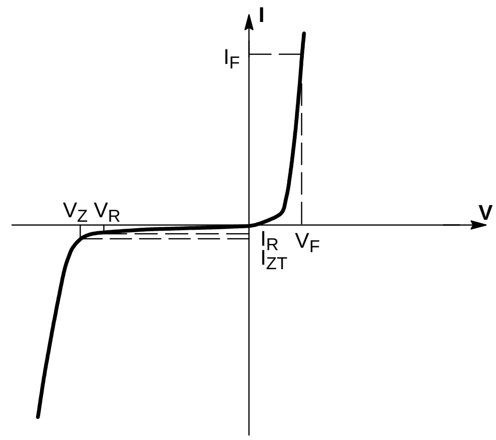
ORDERING INFORMATION

Device	Package	Shipping
1N9xxB	Axial Lead	3000 Units/Box
1N9xxBRL	Axial Lead	5000/Tape & Reel
1N9xxBRL2 *	Axial Lead	5000/Tape & Reel
1N9xxBRA1	Axial Lead	3000/Ammo Pack
1N9xxBTA	Axial Lead	5000/Ammo Pack
1N9xxBTA2 *	Axial Lead	5000/Tape & Reel
1N9xxBRR1 †	Axial Lead	3000/Tape & Reel
1N9xxBRR2 ‡	Axial Lead	3000/Tape & Reel

* The “2” suffix refers to 26 mm tape spacing.
† Polarity band **up** with cathode lead off first
‡ Polarity band **down** with cathode lead off first

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted, V_F = 1.5 V Max @ I_F = 200 mA for all types)

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



Zener Voltage Regulator

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted, V_F = 1.5 V Max @ I_F = 200 mA for all types)

Device (Note 2.)	**Device Marking**	**Zener Voltage** (Note 3.) V_Z (Volts) Min			**@ I_{ZT}**	**Zener Impedance** (Note 4.) Z_{ZT} @ I_{ZT}	Z_{ZK} @ I_{ZK}		**Leakage Current** I_R @ V_R		**I_{ZM}** (Note 5.)
		Min	**Nom**	**Max**	**mA**	**Ω**	**Ω**	**mA**	**μA**	**Volts**	**mA**
1N957B	1N957B	6.46	6.8	7.14	18.5	4.5	700	1.0	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	7.0	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
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
1N982B	1N982B	71.25	75	78.75	1.7	270	2000	0.25	5	56	4.1

2. **TOLERANCE AND VOLTAGE DESIGNATION**
   Tolerance designation – Device tolerance of ±5% is indicated by a “B” suffix.
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°C ± 1°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 the ac frequency = 60 Hz.
5. **MAXIMUM ZENER CURRENT RATINGS (I_{ZM})**
   Values shown are based on the JEDEC rating of 400 mW where the actual zener voltage (V_Z) is known at the operating point, the maximum zener current may be increased and is limited by the derating curve.

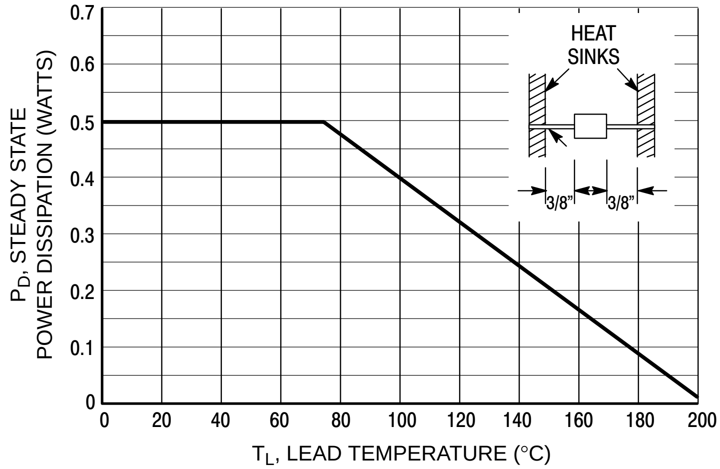


Figure 1. Steady State Power Derating

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.

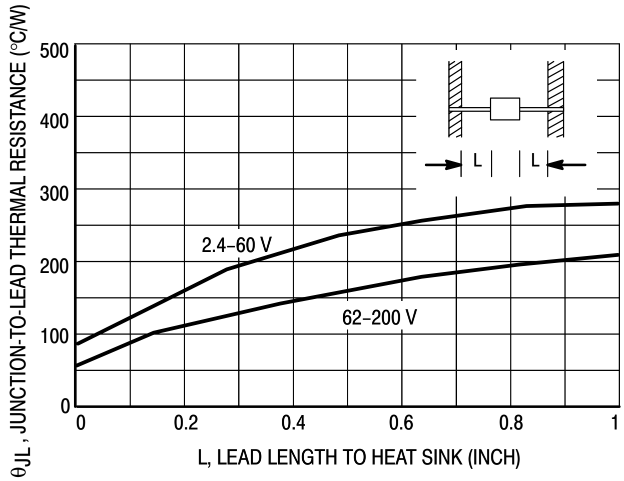


Figure 2. Typical Thermal Resistance

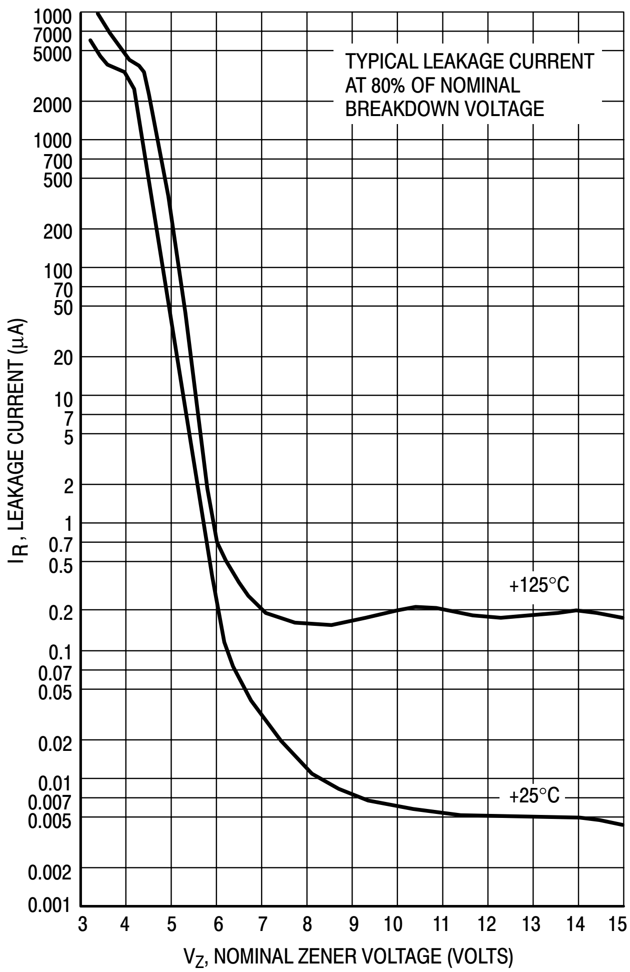


Figure 3. Typical Leakage Current

TEMPERATURE COEFFICIENTS

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

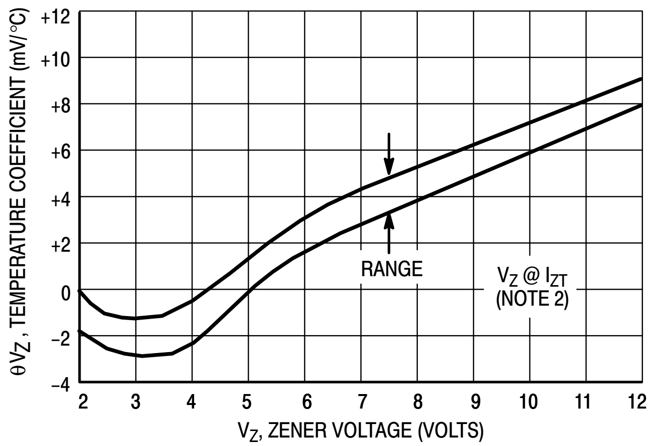


Figure 4a. Range for Units to 12 Volts

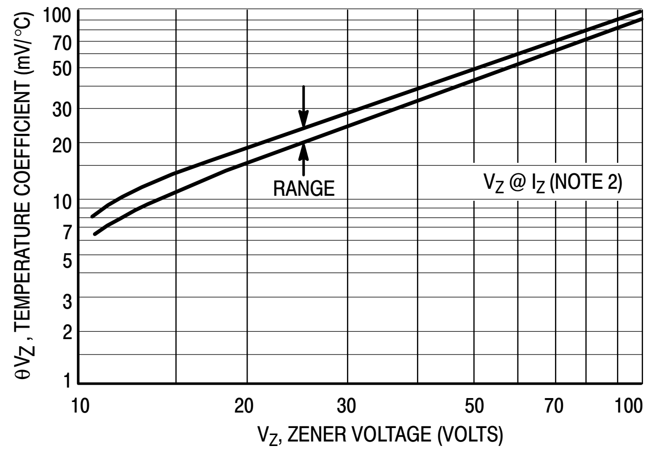


Figure 4b. Range for Units 12 to 100 Volts

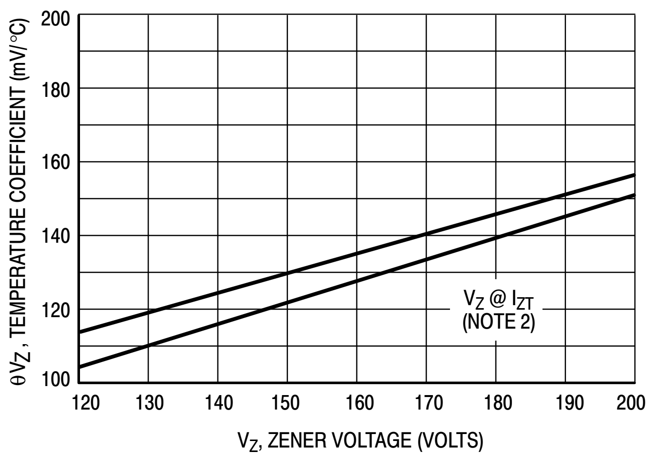


Figure 4c. Range for Units 120 to 200 Volts

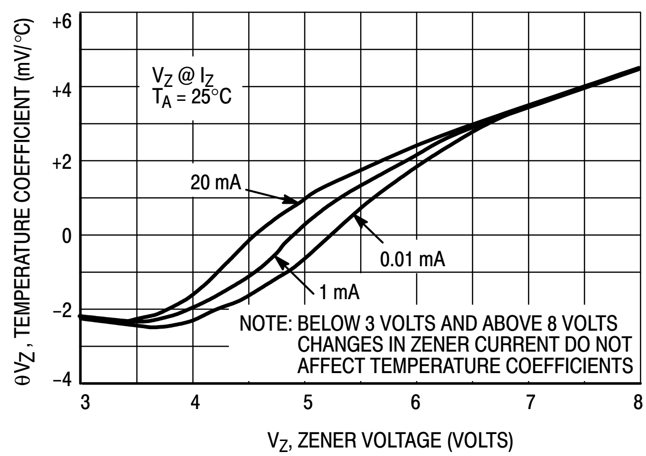


Figure 5. Effect of Zener Current

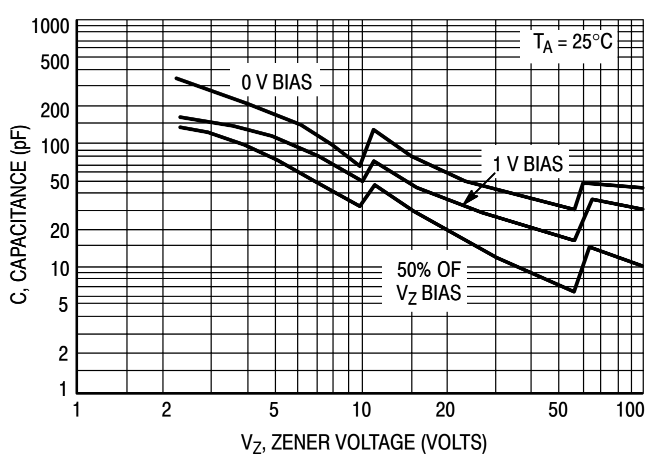


Figure 6a. Typical Capacitance 2.4–100 Volts

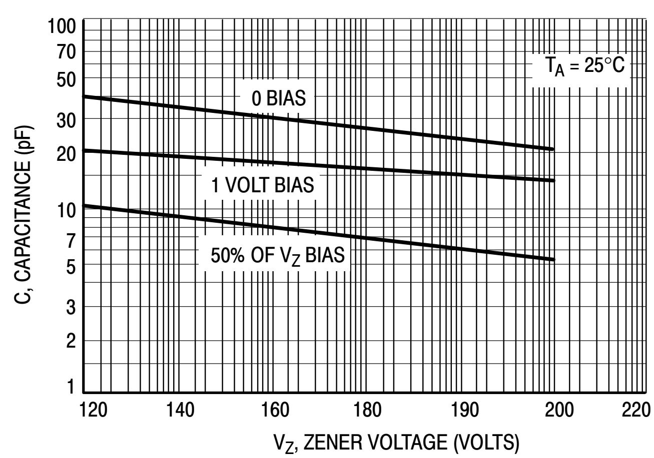


Figure 6b. Typical Capacitance 120–200 Volts

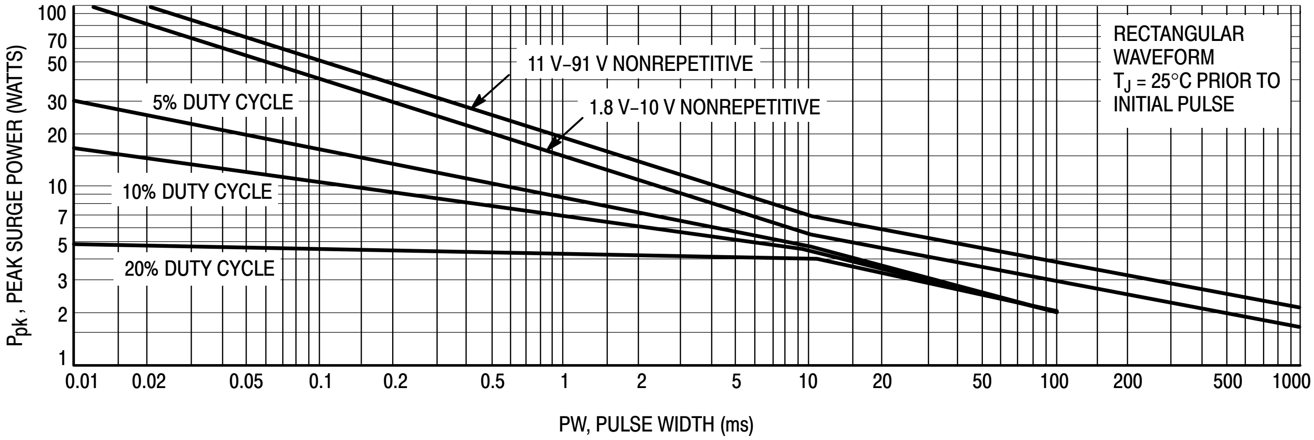


Figure 7a. Maximum Surge Power 1.8–91 Volts

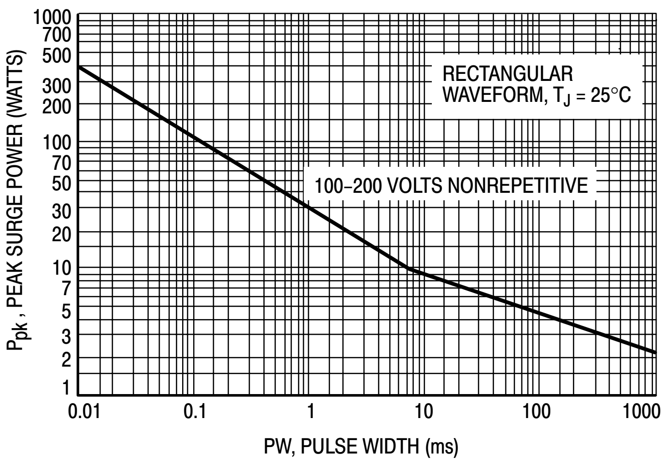


Figure 7b. Maximum Surge Power DO-204AH 100–200 Volts

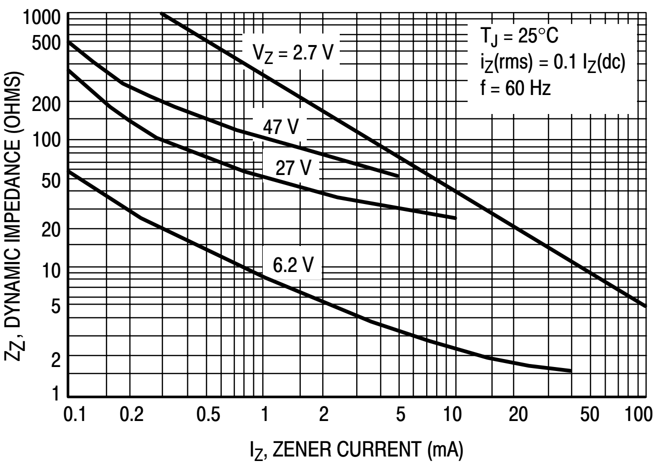


Figure 8. Effect of Zener Current on Zener Impedance

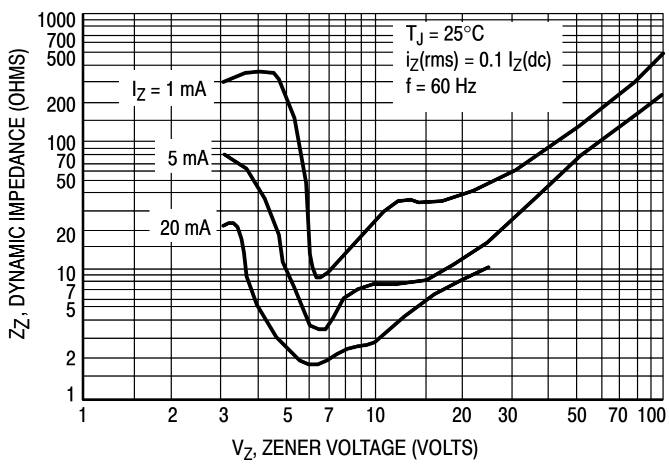


Figure 9. Effect of Zener Voltage on Zener Impedance

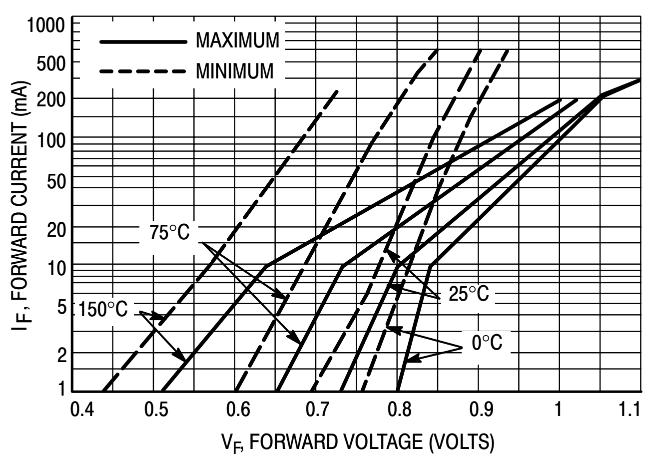


Figure 10. Typical Forward Characteristics

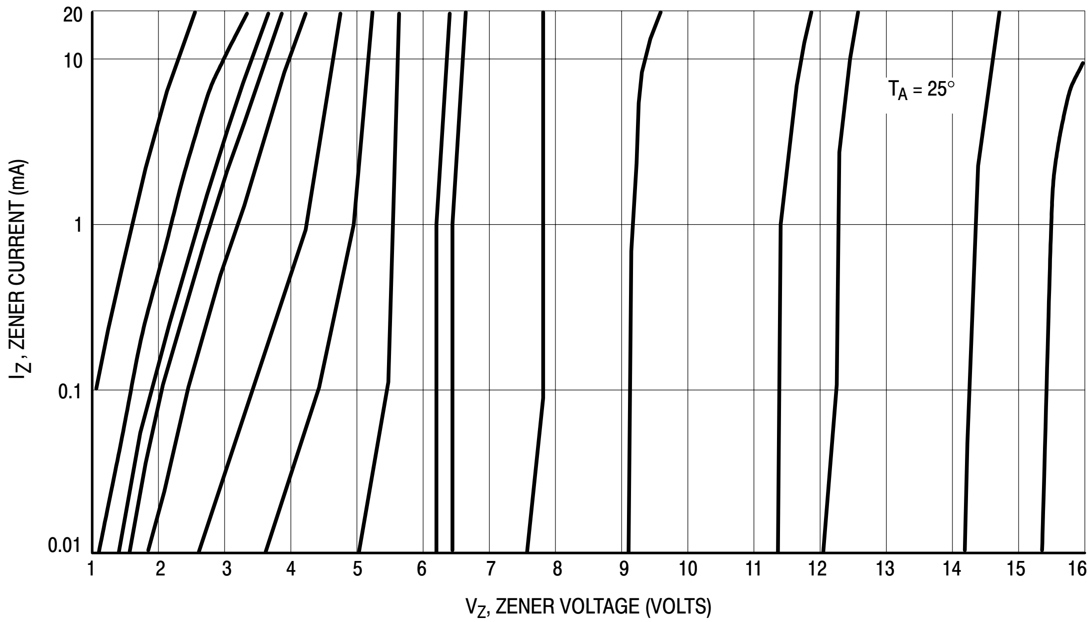


Figure 11. Zener Voltage versus Zener Current — V_Z = 1 thru 16 Volts

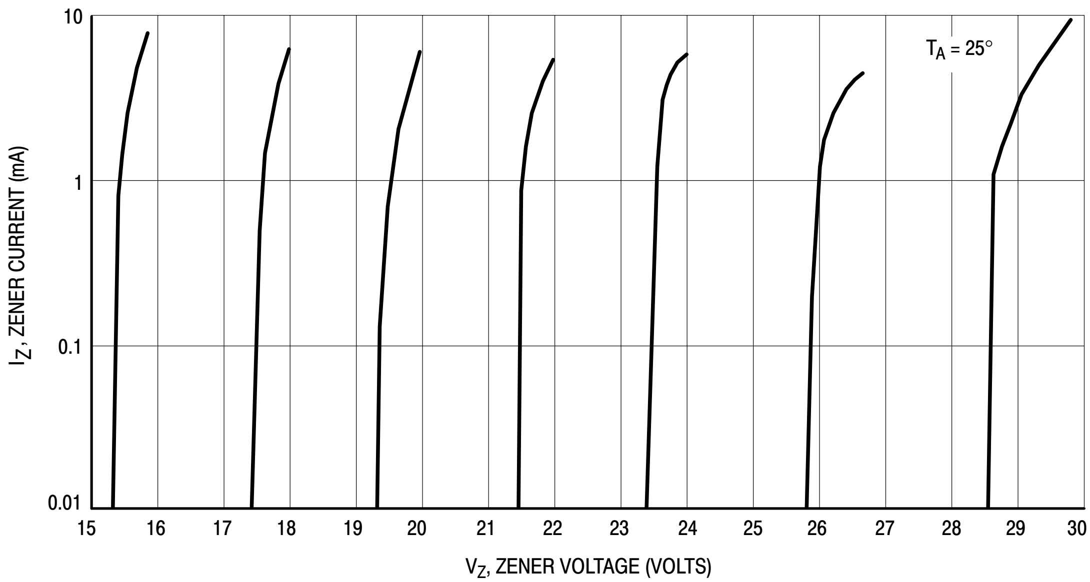


Figure 12. Zener Voltage versus Zener Current — V_Z = 15 thru 30 Volts

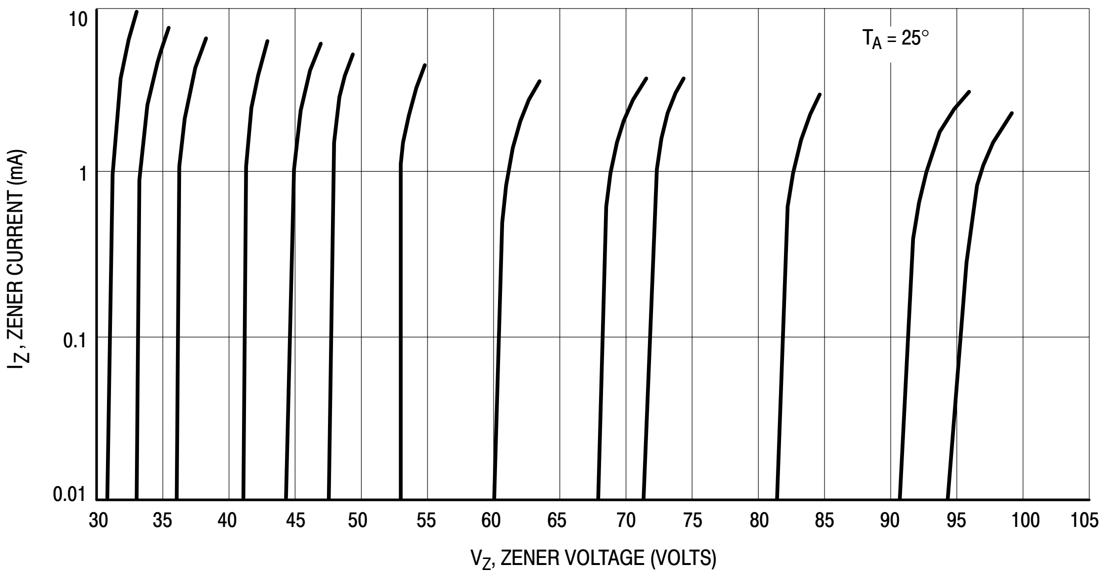


Figure 13. Zener Voltage versus Zener Current — V_Z = 30 thru 105 Volts

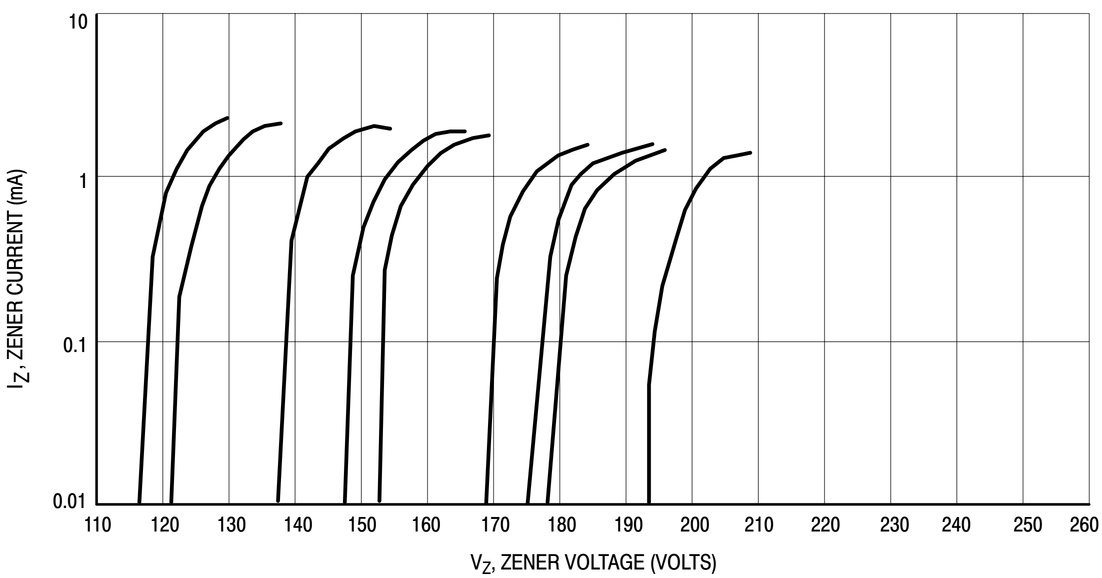


Figure 14. Zener Voltage versus Zener Current — V_Z = 110 thru 220 Volts