BZX79C2V4RL 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 – 2.4 V to 33 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 @ $T_L \leq 75°C$, 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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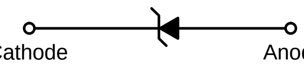
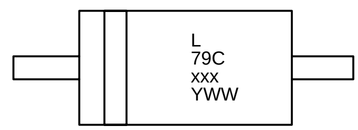


AXIAL LEAD
CASE 299
GLASS

MARKING DIAGRAM



L = Assembly Location
79Cxxx = Device Code (See Table Next Page)
Y = Year
WW = Work Week

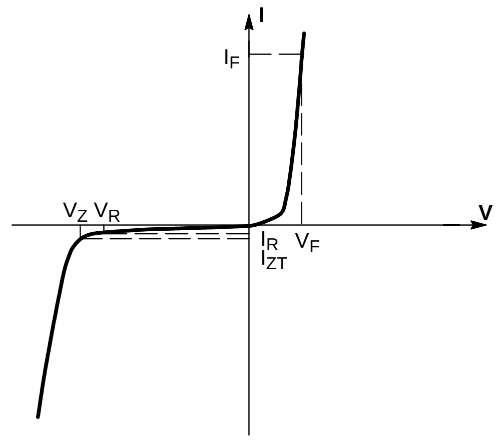
ORDERING INFORMATION

Device	Package	Shipping
BZX79CxxxRL	Axial Lead	5000/Tape & Reel
BZX79CxxxRL2*	Axial Lead	5000/Tape & Reel

* The “2” suffix refers to 26 mm tape spacing.

ELECTRICAL CHARACTERISTICS (T_L = 30°C unless otherwise noted, V_F = 1.5 V Max @ I_F = 100 mA for all types)

Symbol	Parameter
V_Z	Reverse Zener Voltage @ I_{ZT}
I_{ZT}	Reverse Current
Z_{ZT}	Maximum Zener Impedance @ I_{ZT}
ΘV_{BR}	Temperature Coefficient of V_{BR} (Typical)
I_R	Reverse Leakage Current (T_A = 25°C) @ V_R
V_R	Breakdown Voltage
I_F	Forward Current
V_F	Forward Voltage @ I_F
C	Capacitance (Typical)



Zener Voltage Regulator

ELECTRICAL CHARACTERISTICS (T_L = 30°C unless otherwise noted, V_F = 1.5 V Max @ I_F = 100 mA for all types)

Device (Note 2.)	**Device Marking**	**Zener Voltage** (Note 3.)				Z_{ZT} (Note 4.) @ I_{ZT} (f = 1.0 kHz)	**Leakage Current**		ΘV_{BR}		**C** V_Z = 0, f = 1.0 MHz
		V_Z (Volts)			@ I_{ZT}		I_R @ V_R		mV/°C		
		Min	**Nom**	**Max**	**mA**	**Ω**	**µA**	**Volts**	**Min**	**Max**	**pF**
BZX79C2V4RL	79C2V4	2.28	2.4	2.52	5	100	100	1	–3.5	0	255
BZX79C2V7RL	79C2V7	2.57	2.7	2.84	5	100	75	1	–3.5	0	230
BZX79C3V0RL	79C3V0	2.85	3.0	3.15	5	95	50	1	–3.5	0	215
BZX79C3V3RL	79C3V3	3.14	3.3	3.47	5	95	25	1	–3.5	0	200
BZX79C3V6RL	79C3V6	3.42	3.6	3.78	5	90	15	1	–3.5	0	185
BZX79C3V9RL	79C3V9	3.71	3.9	4.10	5	90	10	1	–3.5	0.3	175
BZX79C4V7RL	79C4V7	4.47	4.7	4.94	5	80	3	2	–3.5	0.2	130
BZX79C5V1RL	79C5V1	4.85	5.1	5.36	5	60	2	2	–2.7	1.2	110
BZX79C5V6RL	79C5V6	5.32	5.6	5.88	5	40	1	2	–2.0	2.5	95
BZX79C6V2RL	79C6V2	5.89	6.2	6.51	5	10	3	4	0.4	3.7	90
BZX79C6V8RL	79C6V8	6.46	6.8	7.19	5	15	2	4	1.2	4.5	85
BZX79C7V5RL	79C7V5	7.13	7.5	7.88	5	15	1	5	2.5	5.3	80
BZX79C8V2RL	79C8V2	7.79	8.2	8.61	5	15	0.7	5	3.2	6.2	75
BZX79C10RL	79C10	9.5	10	10.5	5	20	0.2	7	4.5	8.0	70
BZX79C12RL	79C12	11.4	12	12.6	5	25	0.1	8	6.0	10	65
BZX79C15RL	79C15	14.25	15	15.75	5	30	0.05	10.5	9.2	13	55
BZX79C16RL	79C16	15.2	16	16.8	5	40	0.05	11.2	10.4	14	52
BZX79C18RL	79C18	17.1	18	18.9	5	45	0.05	12.6	12.9	16	47
BZX79C22RL	79C22	20.9	22	23.1	5	55	0.05	15.4	16.4	20	34
BZX79C24RL	79C24	22.8	24	25.2	5	70	0.05	16.8	18.4	22	33
BZX79C27RL	79C27	25.65	27	28.35	5	80	0.05	18.9	–	23.5	30
BZX79C30RL	79C30	28.5	30	31.5	5	80	0.05	21	–	26	27
BZX79C33RL	79C33	31.35	33	34.65	5	80	0.05	23.1	–	29	25

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) MEASUREMENT**
   Reverse zener voltage is measured under pulse conditions such that T_J is no more than 2°C 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 the ac frequency = 1.0 kHz.

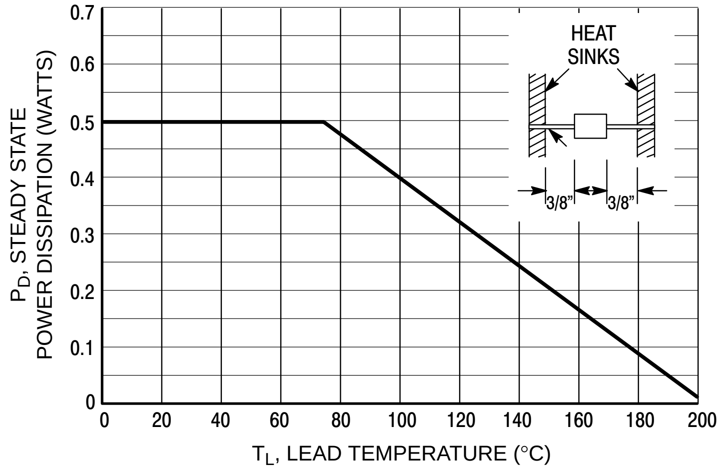


Figure 1. Steady State Power Derating

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.

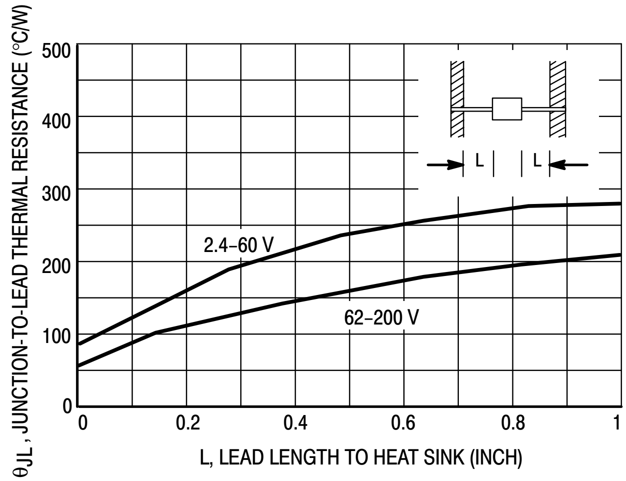


Figure 2. Typical Thermal Resistance

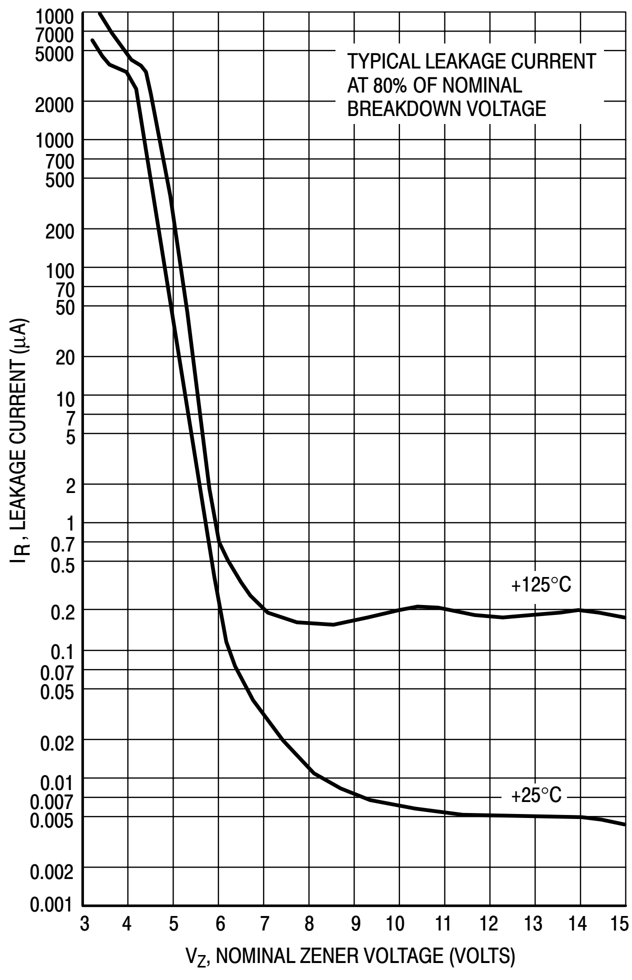


Figure 3. Typical Leakage Current

TEMPERATURE COEFFICIENTS

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

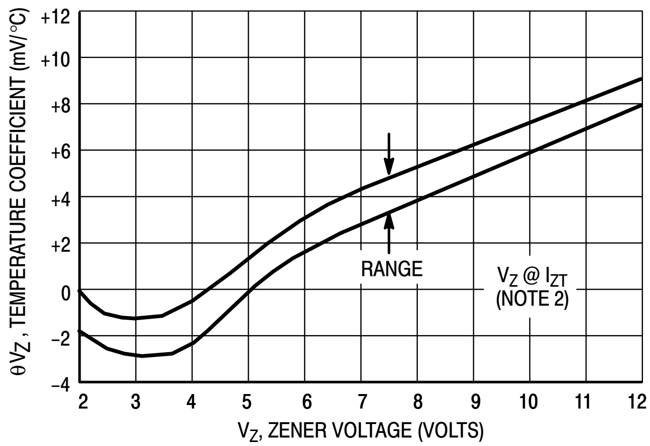


Figure 4a. Range for Units to 12 Volts

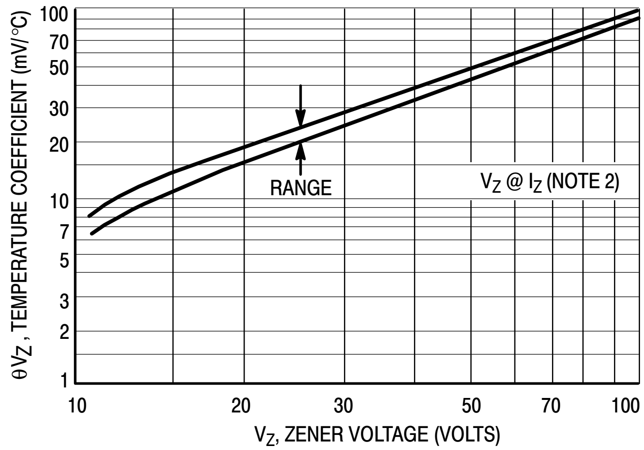


Figure 4b. Range for Units 12 to 100 Volts

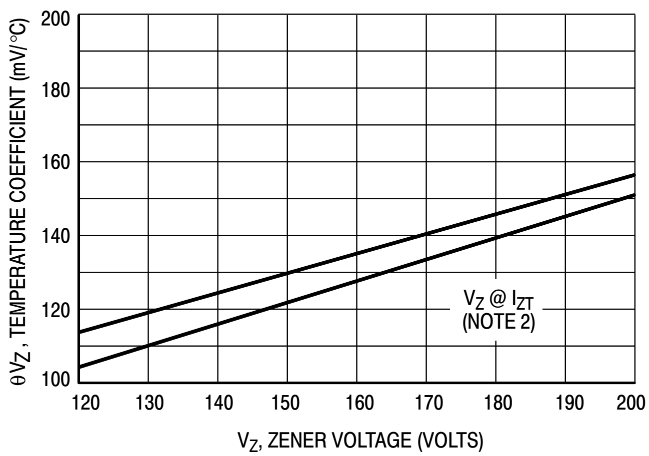


Figure 4c. Range for Units 120 to 200 Volts

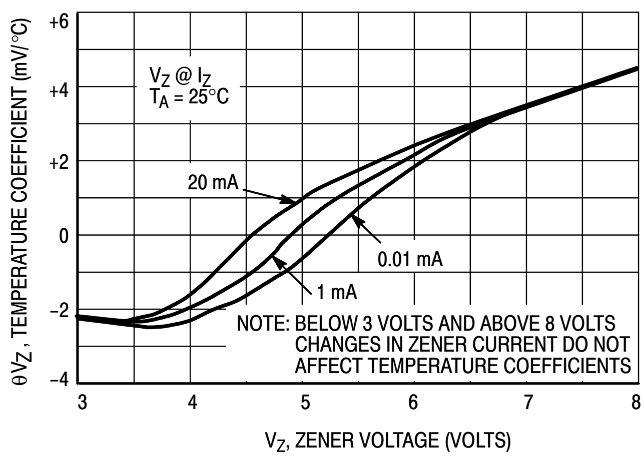


Figure 5. Effect of Zener Current

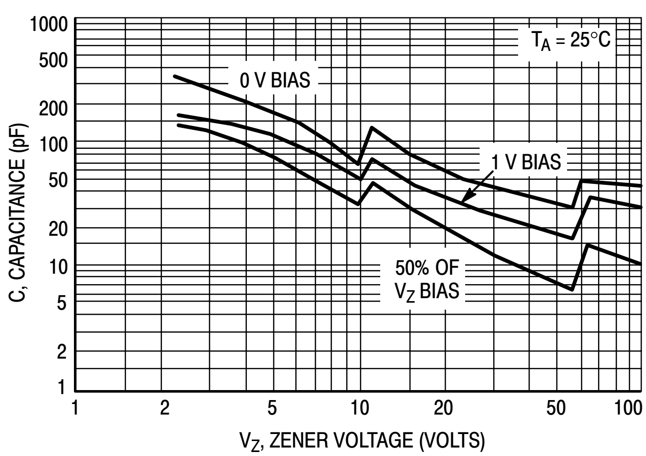


Figure 6a. Typical Capacitance 2.4–100 Volts

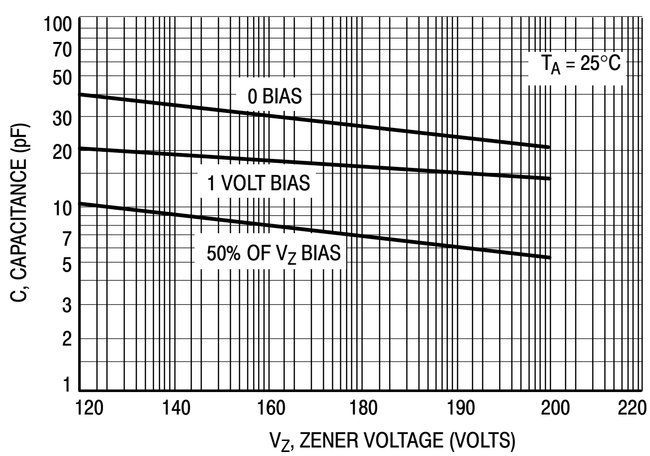


Figure 6b. Typical Capacitance 120–200 Volts

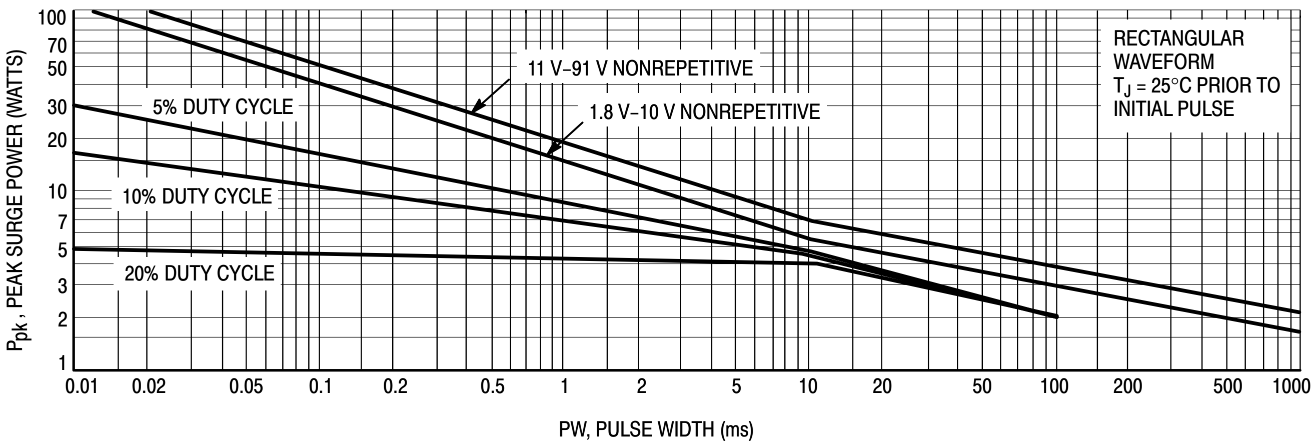


Figure 7a. Maximum Surge Power 1.8–91 Volts

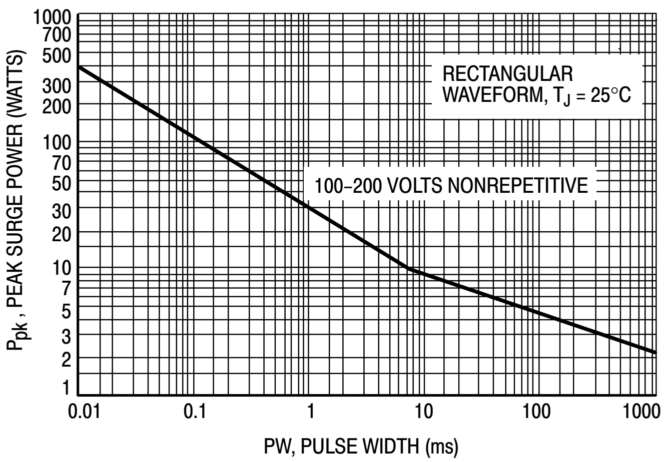


Figure 7b. Maximum Surge Power DO-204AH 100–200 Volts

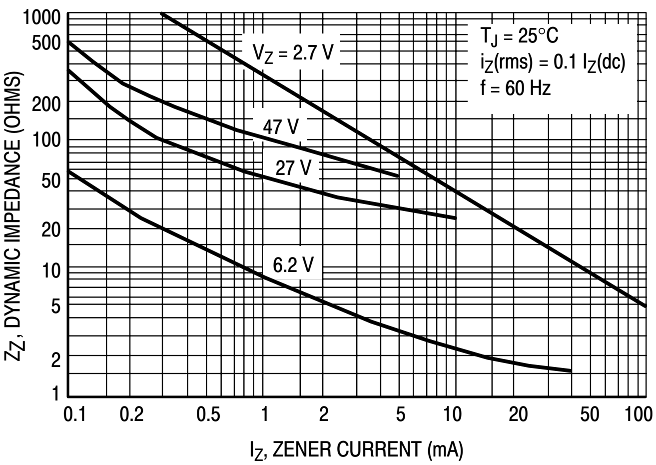


Figure 8. Effect of Zener Current on Zener Impedance

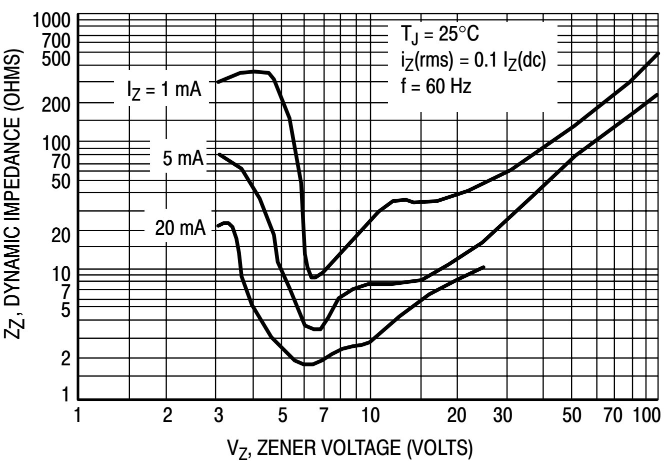


Figure 9. Effect of Zener Voltage on Zener Impedance

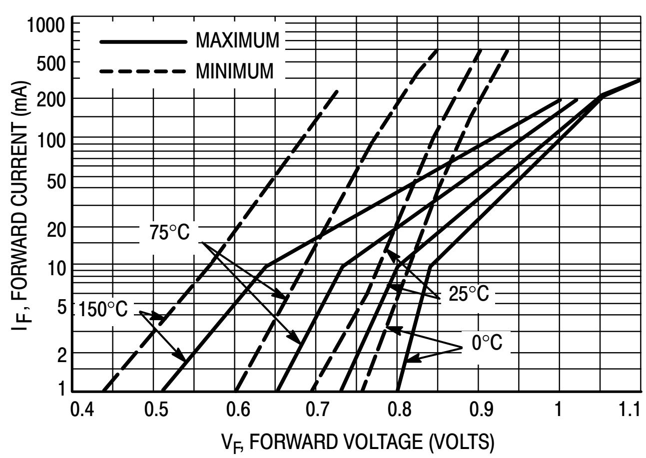


Figure 10. Typical Forward Characteristics

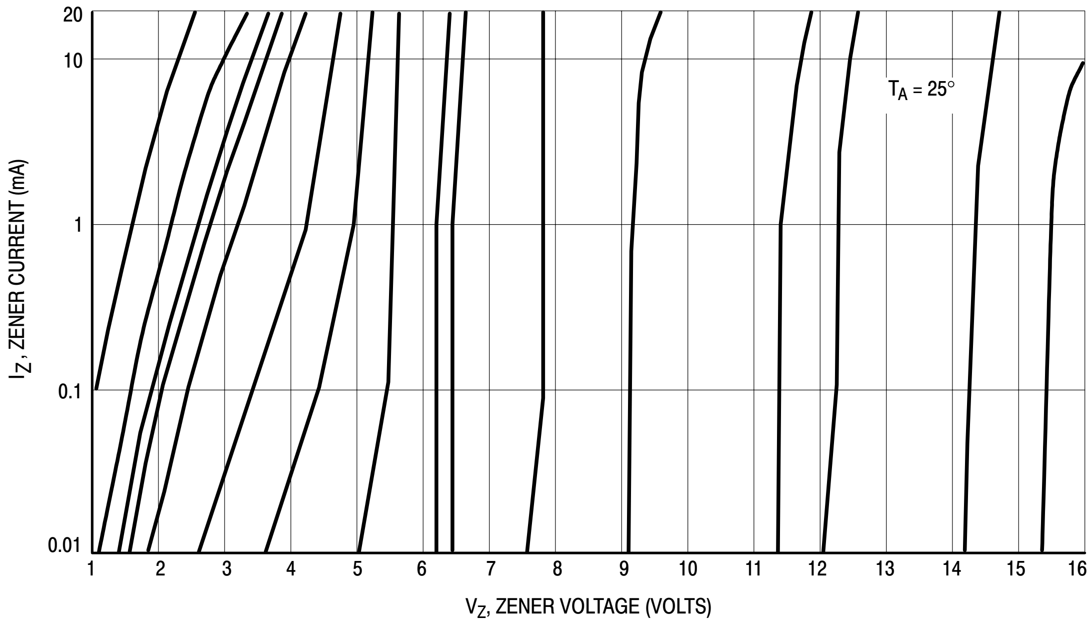


Figure 11. Zener Voltage versus Zener Current — V_Z = 1 thru 16 Volts

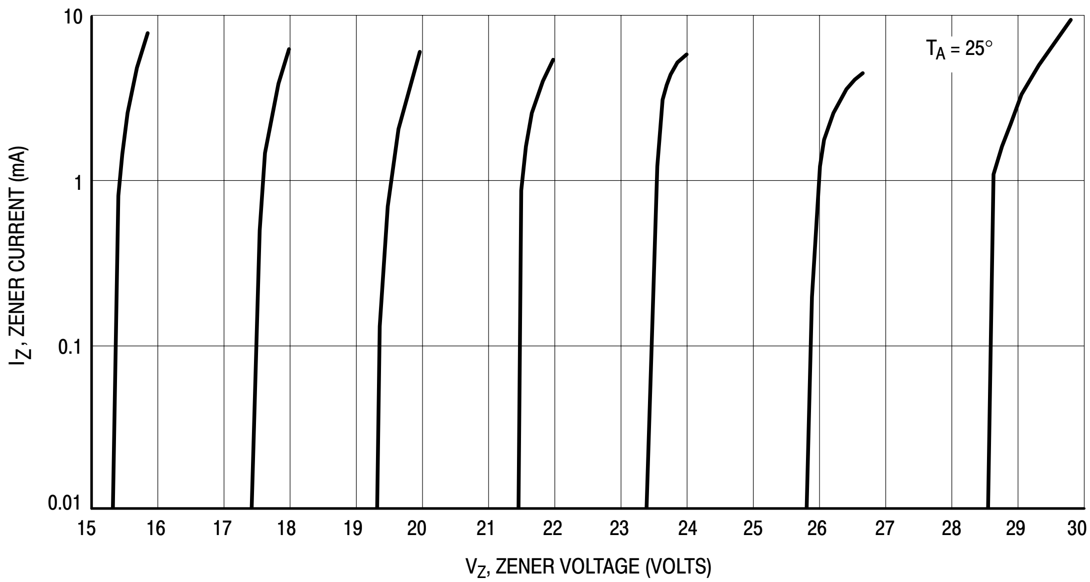


Figure 12. Zener Voltage versus Zener Current — V_Z = 15 thru 30 Volts

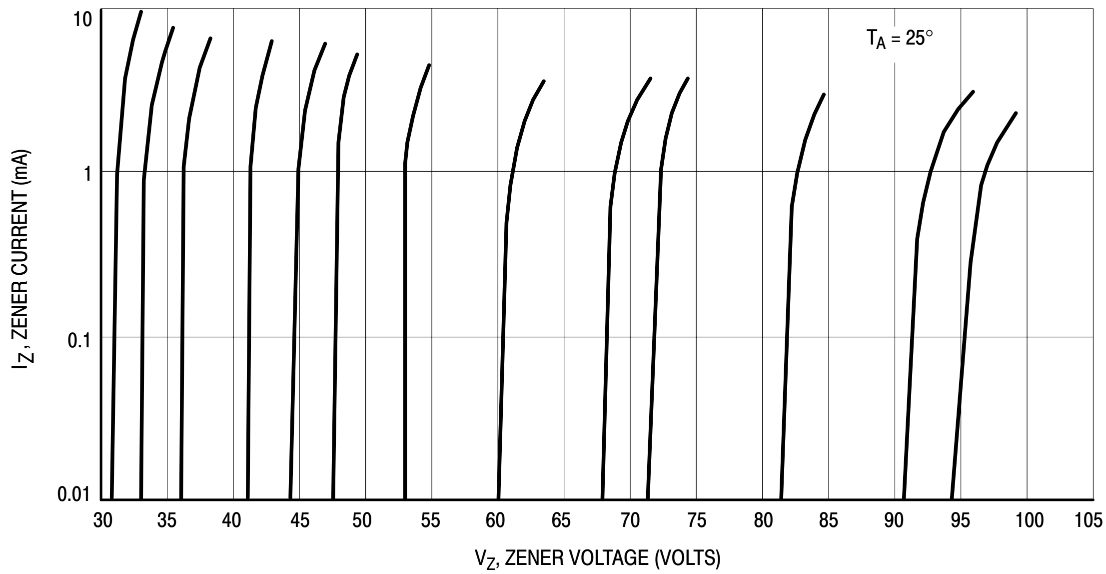


Figure 13. Zener Voltage versus Zener Current — V_Z = 30 thru 105 Volts

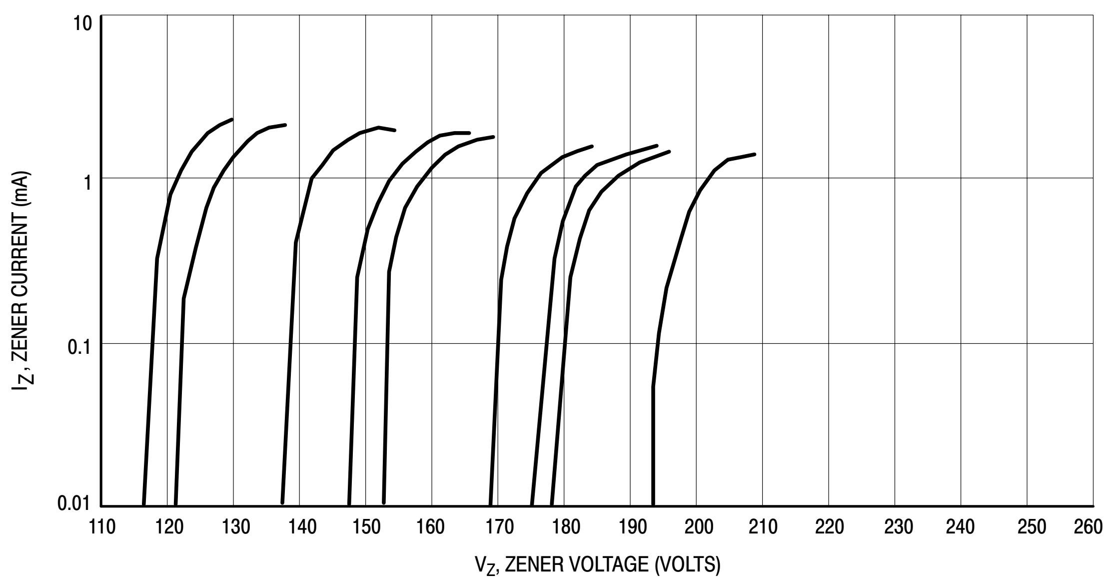


Figure 14. Zener Voltage versus Zener Current — V_Z = 110 thru 220 Volts