TAK CHEONG®

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Components Industries, LLC for
Zener Technology and **Products**.

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

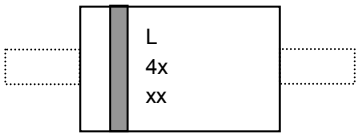
Specification Features:

- Zener Voltage Range = 1.8V to 43V
- 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

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



L = Logo
4xxx = 1N4xxx Device Code

Ordering Information

Device	Package	Quantity
1N4xxx	Axial Lead	3000 Units / Box
1N4xxxRL	Axial Lead	5000 Units / Tape & Reel
1N4xxxRL2*	Axial Lead	5000 Units / Tape & Reel
1N4xxxRR1 !	Lead Form	3000 Units / Radial Tape & Reel
1N4xxxRR2 i	Lead Form	3000 Units / Radial Tape & Reel
1N4xxxTA	Axial Lead	5000 Units / Tape & Ammo
1N4xxxTA2*	Axial Lead	5000 Units / Tape & Ammo
1N4xxxRA1 !	Axial Lead	3000 Units / Radial Tape & Ammo
1N4xxxRA2 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.

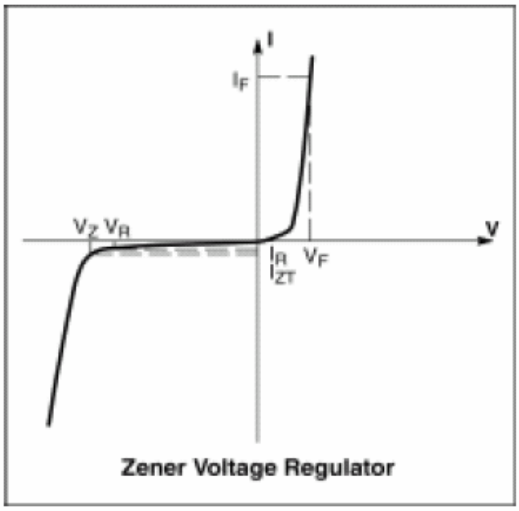
Devices listed in **bold italic** are Tak Cheong **Preferred** devices. **Preferred** devices are recommended choices for future use and best overall value.

1N4768 through 1N4717

Low level oxide passivated zener diodes for applications requiring extremely low operating currents, low leadage, and sharp breakdown,

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

Symbol	Parameter
V_Z	Reverse Zener Voltage @ I_{ZT}
I_{ZT}	Reverse Zener Current
ΔV_Z	Reverse Zener Voltage Change
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



Zener Voltage Regulator

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

Device (Note 2.)	Device Marking	Zener Voltage (Note 3.)				Leakage Current (Note 4.)		I_{ZM} (Note 5.)	ΔV_Z (Note 6.)
		VZ (Volts)			@ I_{ZT}	I_R @ V_R			
		Min	Nom	Max	(uA)	(uA Max)	(Volts)	(mA)	(Volts)
1N4678	1N4678	1.71	1.8	1.89	50	7.5	1	120	0.7
1N4679	1N4679	1.9	2	2.1	50	5	1	110	0.7
1N4680	1N4680	2.09	2.2	2.31	50	4	1	100	0.75
1N4681	1N4681	2.28	2.4	2.52	50	2	1	95	0.8
1N4682	1N4682	2.565	2.7	2.835	50	1	1	90	0.85
1N4683	1N4683	2.85	3	3.15	50	0.8	1	85	0.9
1N4684	1N4684	3.135	3.3	3.465	50	7.5	1.5	80	0.95
1N4685	1N4685	3.42	3.6	3.78	50	7.5	2	75	0.95
1N4686	1N4686	3.705	3.9	4.095	50	5	2	70	0.97
1N4687	1N4687	4.085	4.3	4.515	50	4	2	65	0.99
1N4688	**1N4688**	**4.465**	**4.7**	**4.935**	**50**	**10**	**3**	**60**	**0.99**
1N4689	1N4689	4.845	5.1	5.355	50	10	3	55	0.97
1N4690	1N4690	5.32	5.6	5.88	50	10	4	50	0.96
1N4691	1N4691	5.89	6.2	6.51	50	10	5	45	0.95
1N4692	1N4692	6.46	6.8	7.14	50	10	5.1	35	0.9

2. TOLERANCE AND TYPE NUMBER DESIGNATION (V_Z)
The type numbers listed have a standard tolerance on the nominal zener voltage of ±5%.

3. ZENER VOLTAGE (VZ) 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. REVERSE LEAKAGE CURREN (I_R)
Reverse leakage currents are guaranteed and measured at V_R shown on the table.

5. MAXIMUM ZENER CURRENT RATINGS (I_{ZM})
Maximum zener current ratings are based on maximum zener voltage of the individual units and JEDEC 250 mW rating.

6. MAXIMUM VOLTAGE CHANGE (ΔV_Z)
Voltage change is equal to the difference between V_Z at 100uA and at 10uA.

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

Device (Note 7.)	Device Marking	Zener Voltage (Note 8.) V_Z (Volts) Min	Nom	Max	@ I_{ZT} (μA)	Leakage Current (Note 9.) I_R @ V_R (μA Max)	(Volts)	I_{ZM} (Note 10.) (mA)	ΔV_Z (Note 11.) (Volts)
1N4693	1N4693	7.125	7.5	7.875	50	10	5.7	31.8	0.75
1N4694	1N4694	7.79	8.2	8.61	50	1	6.2	29	0.5
1N4695	1N4695	8.265	8.7	9.135	50	1	6.6	27.4	0.1
1N4696	1N4696	8.645	9.1	9.555	50	1	6.9	26.2	0.08
1N4697	1N4697	9.5	10	10.5	50	1	7.6	24.8	0.1
1N4698	1N4698	10.45	11	11.55	50	0.05	8.4	21.6	0.11
1N4699	1N4699	11.4	12	12.6	50	0.05	9.1	20.4	0.12
1N4700	1N4700	12.35	13	13.65	50	0.05	9.8	19	0.13
1N4701	1N4701	13.3	14	14.7	50	0.05	10.6	17.5	0.14
1N4702	1N4702	14.25	15	15.75	50	0.05	11.4	16.3	0.15
1N4703	1N4703	15.2	16	16.8	50	0.05	12.1	15.4	0.16
1N4704	1N4704	16.15	17	17.85	50	0.05	12.9	14.5	0.17
1N4705	1N4705	17.1	18	18.9	50	0.05	13.6	13.2	0.18
1N4706	1N4706	18.05	19	19.95	50	0.05	14.4	12.5	0.19
1N4707	1N4707	19	20	21	50	0.01	15.2	11.9	0.2
1N4708	1N4708	20.9	22	23.1	50	0.01	16.7	10.8	0.22
1N4709	1N4709	22.8	24	25.2	50	0.01	18.2	9.9	0.24
1N4710	1N4710	23.75	25	26.25	50	0.01	19	9.5	0.25
1N4711	1N4711	25.65	27	28.35	50	0.01	20.4	8.8	0.27
1N4712	1N4712	26.6	28	29.4	50	0.01	21.2	8.5	0.28
1N4713	1N4713	28.5	30	31.5	50	0.01	22.8	7.9	0.3
1N4714	1N4714	31.35	33	34.65	50	0.01	25	7.2	0.33
1N4715	1N4715	34.2	36	37.8	50	0.01	27.3	6.6	0.36
1N4716	1N4716	37.05	39	40.95	50	0.01	29.6	6.1	0.39
1N4717	1N4717	40.85	43	45.15	50	0.01	32.6	5.5	0.43

7. TOLERANCE AND TYPE NUMBER DESIGNATION (V_Z)
The type numbers listed have a standard tolerance on the nominal zener voltage of ±5%.

8. 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.

9. REVERSE LEAKAGE CURRENT (I_R)
Reverse leakage currents are guaranteed and measured at V_R shown on the table.

10. MAXIMUM ZENER CURRENT RATINGS (I_{ZM})
Maximum zener current ratings are based on maximum zener voltage of the individual units and JEDEC 250 mW rating.

11. MAXIMUM VOLTAGE CHANGE (ΔV_Z)
Voltage change is equal to the difference between VZ at 100μA and at 10μA.

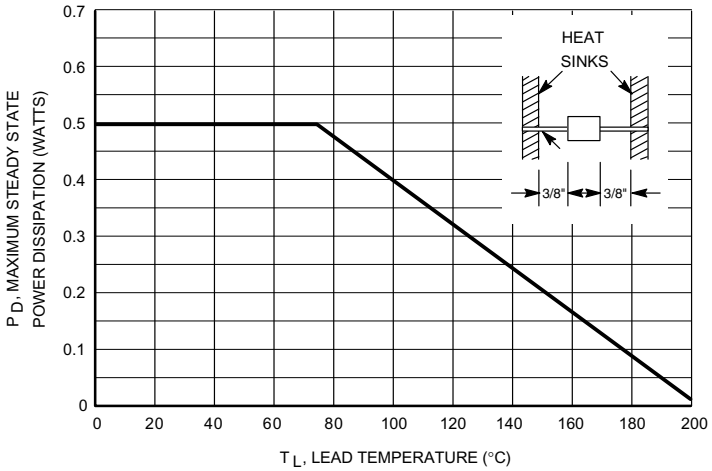


Figure 1. Steady State Power Derating

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.

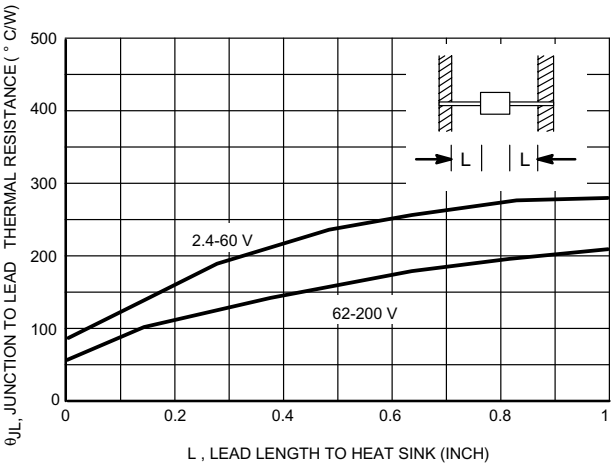


Figure 2. Typical Thermal Resistance

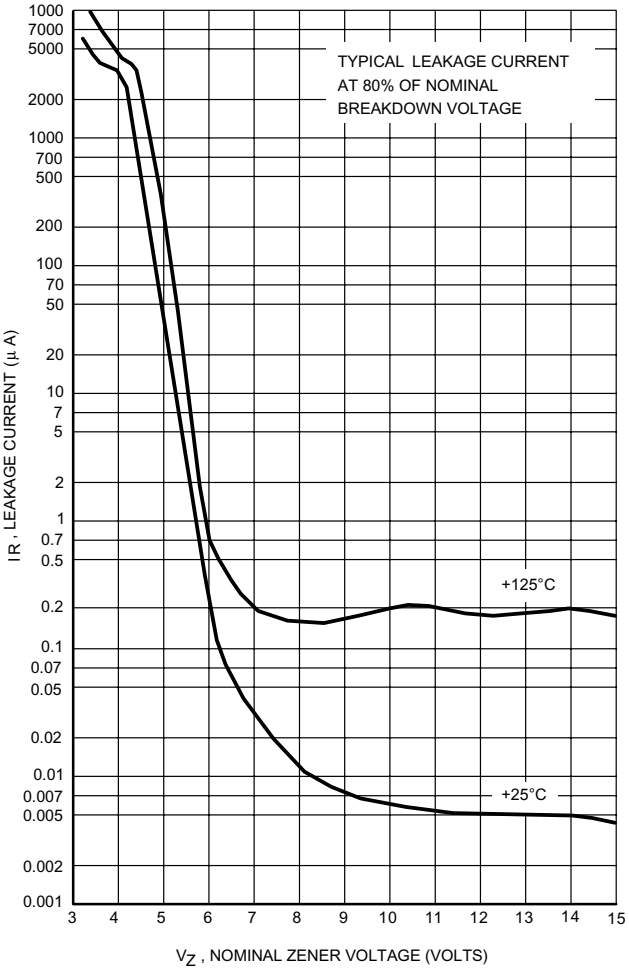


Figure 3. Typical Leakage Current

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

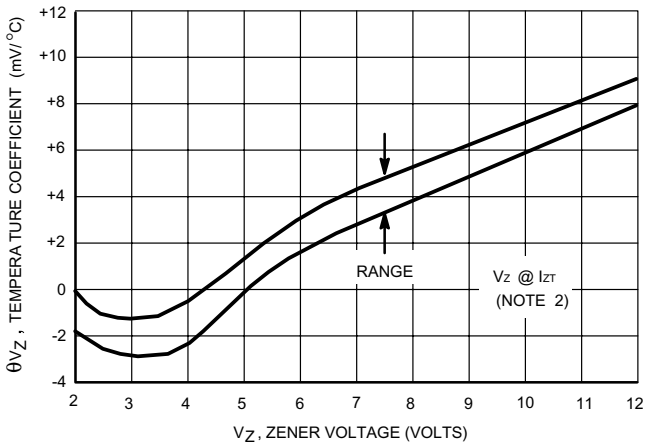


Figure 4a. Range for Units to 12 Volts

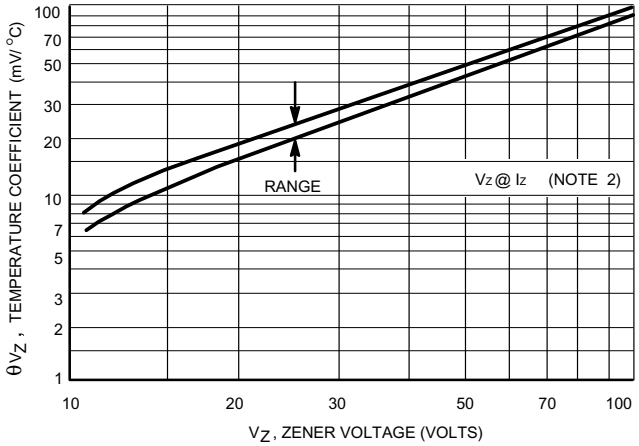


Figure 4b. Range for Units 12 to 100 Volts

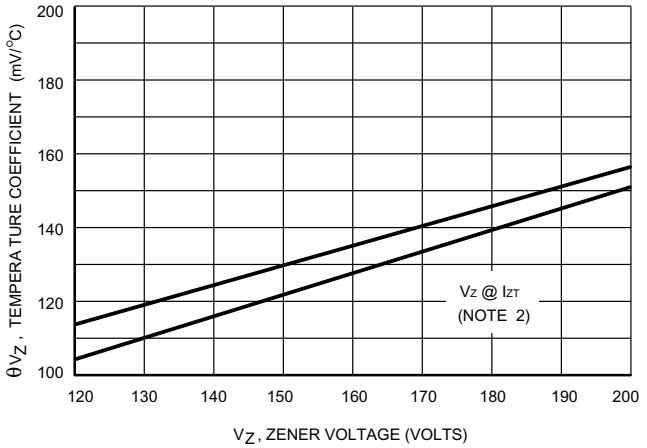


Figure 4c. Range for Units 120 to 200 Volts

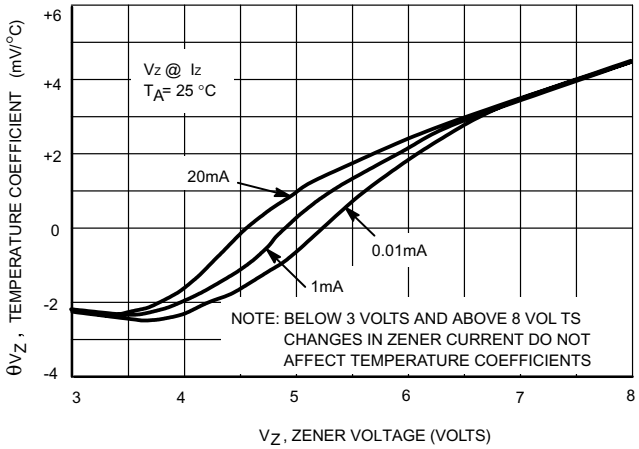


Figure 5. Effect of Zener Current

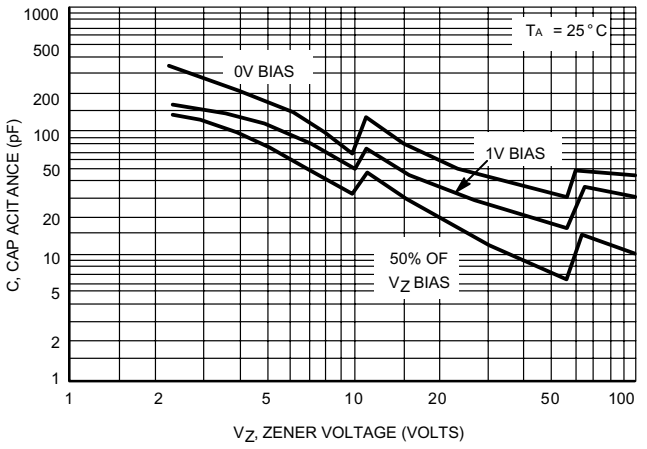


Figure 6a. Typical Capacitance 2.4-100 Volts

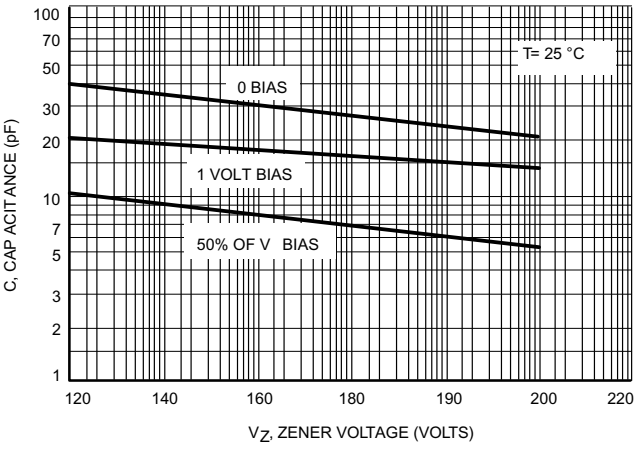


Figure 6b. Typical Capacitance 120-200 Volts

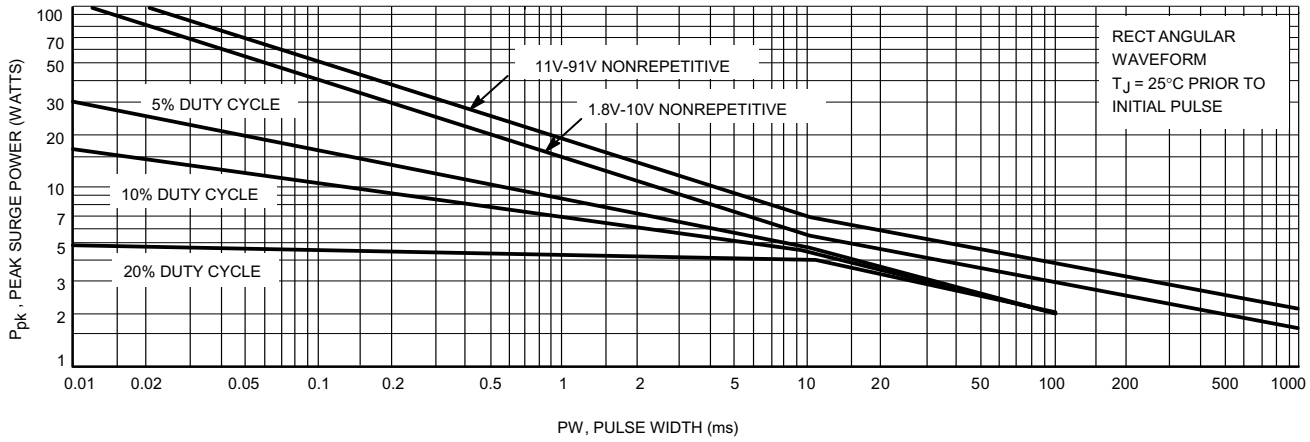


Figure 7a. Maximum Surge Power 1.8-91 Volts

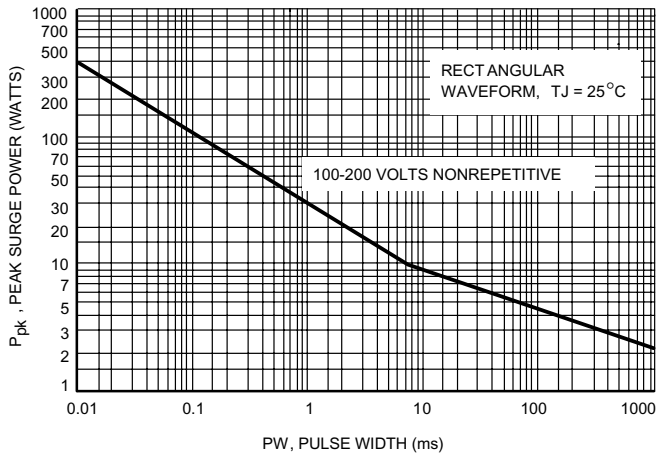


Figure 7b. Maximum Surge Power DO-35 100-200Volts

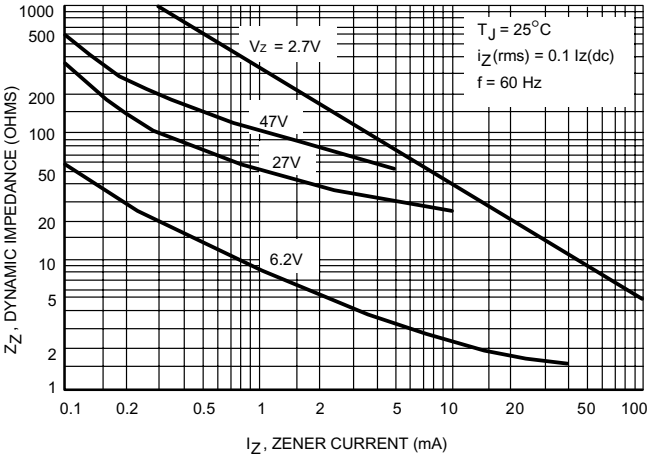


Figure 8. Effect of Zener Current on Zener Impedance

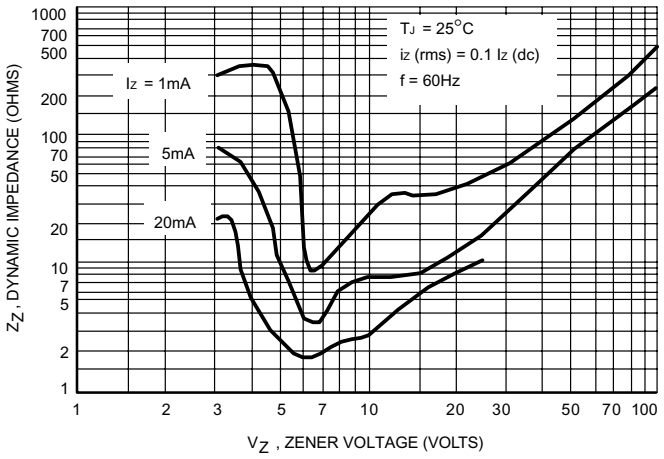


Figure 9. Effect of Zener Voltage on Zener Impedance

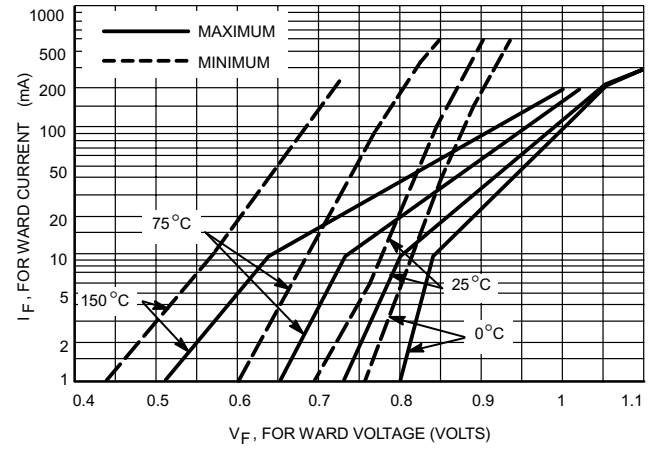


Figure 10. Typical Forward Characteristics

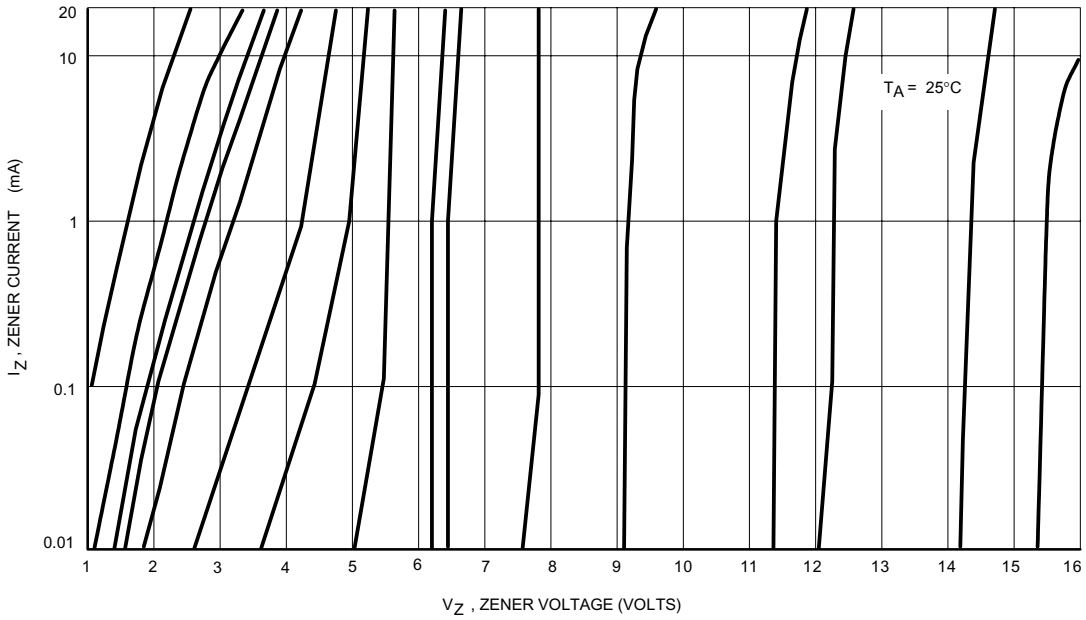


Figure 1 1. Zener Voltage versus Zener Current - V_Z = 1 thru 16 Volts

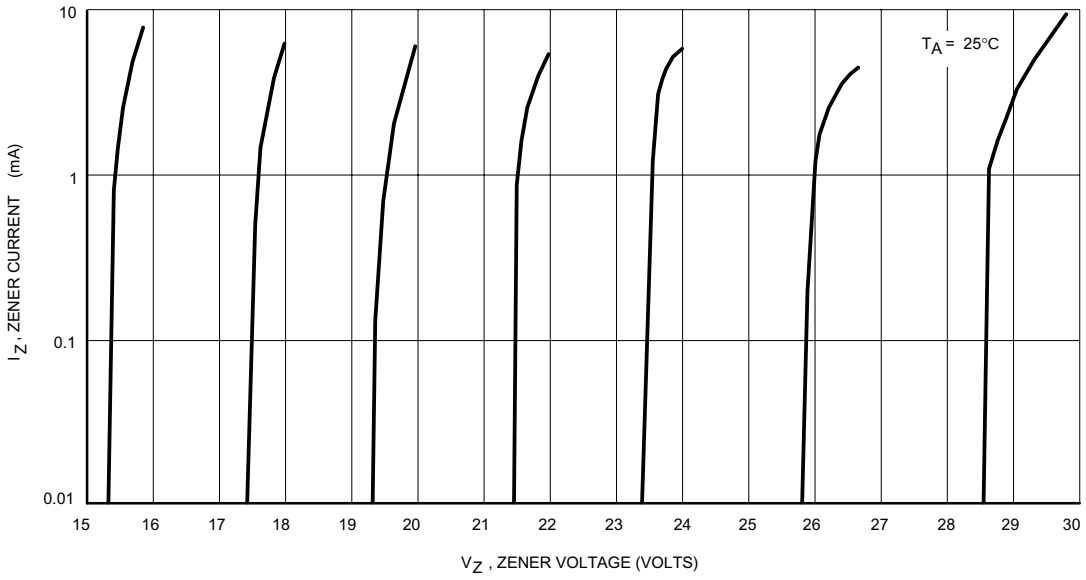


Figure 12. Zener Voltage versus Zener Current - V_Z = 15 thru 30 Volts

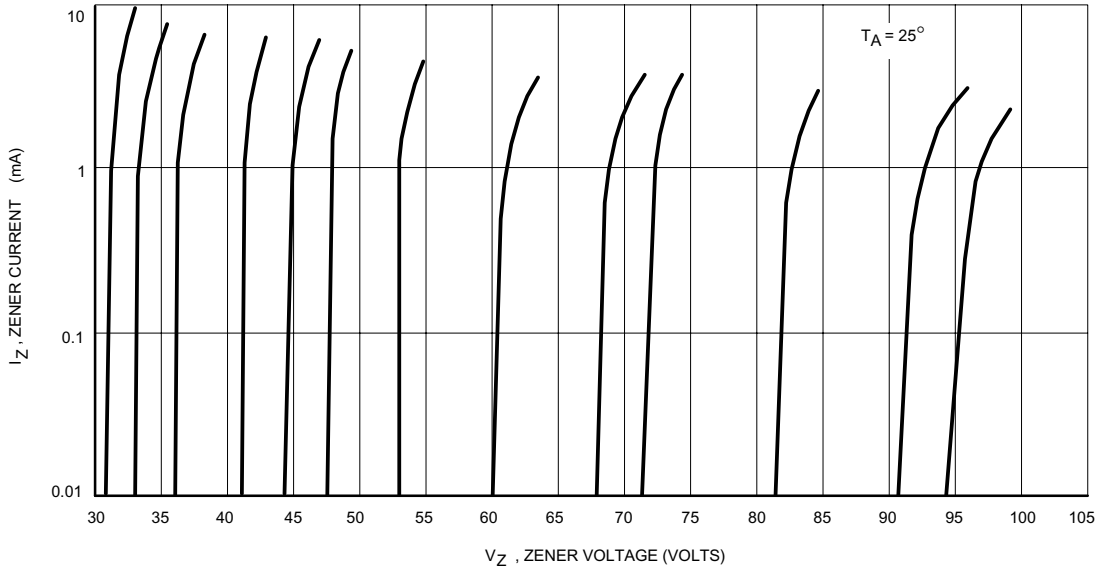


Figure 13. Zener Voltage versus Zener Current - V_Z = 30 thru 105 Volts

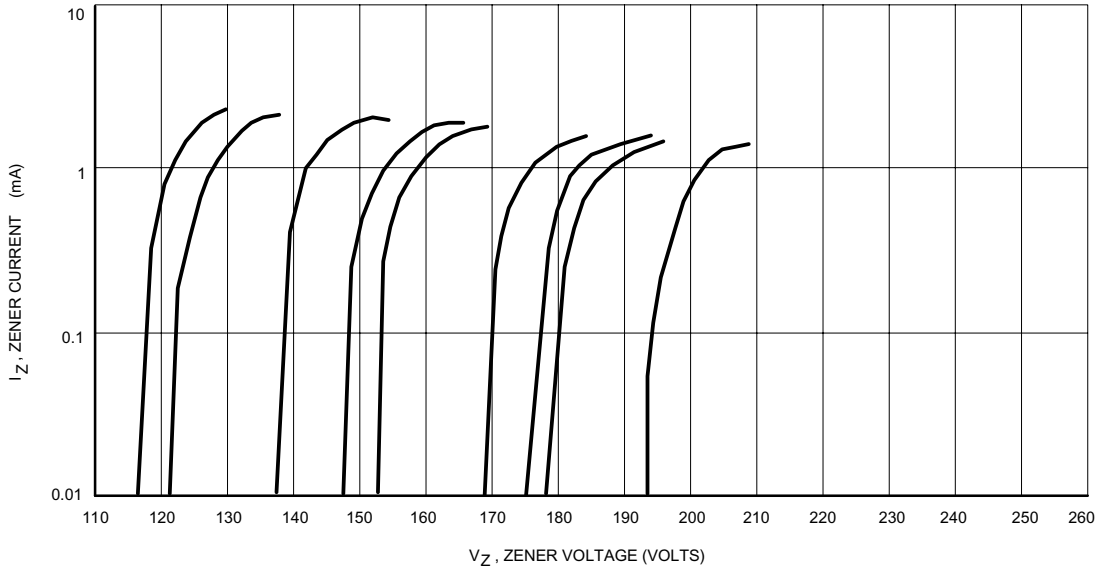


Figure 14. Zener Voltage versus Zener Current - V_Z = 110 thru 220 Volts