

MOTOROLA SEMICONDUCTOR TECHNICAL DATA

T-11-13

Designer's Data Sheet
1.0 Watt Surmetic 30 Silicon Zener Diodes

... a complete series of 1.0 watt zener diodes with limits and operating characteristics that reflect the superior capabilities of silicon-oxide-passivated junctions. All this in an axial-lead, transfer-molded plastic package offering protection in all common environmental conditions.

- To 80 Watts Surge Rating @ 1.0 ms
- Maximum Limits Guaranteed on Six Electrical Parameters
- Package No Larger Than the Conventional 400 mW Package

Mechanical Characteristics:

CASE: Void-free, transfer-molded, thermosetting plastic

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

POLARITY: Cathode indicated by polarity band. When operated in zener mode, cathode will be positive with respect to anode

MOUNTING POSITION: Any

WEIGHT: 0.4 gram (approx)

**MZP4728 thru MZP4764
1M110ZS10 thru 1M200ZS10**

**1.0 WATT ZENER REGULATOR DIODES
3.3-200 VOLTS**

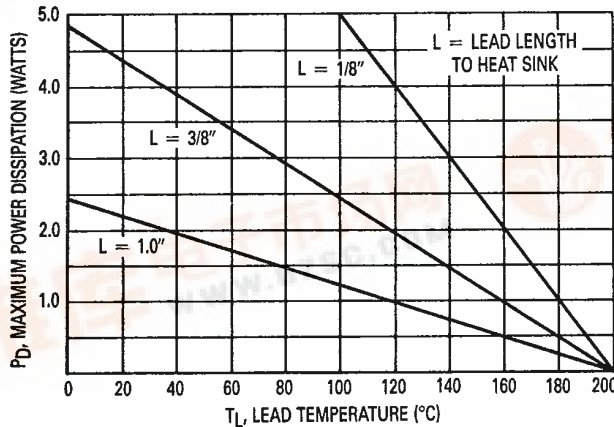
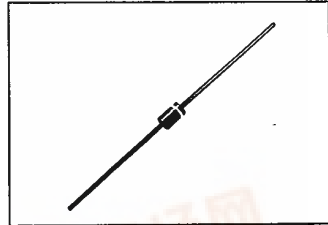


Figure 1. Power-Temperature Derating Curve

MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|--|----------------|-------------|-------------------------------------|
| *DC Power Dissipation @ $T_A = 50^\circ\text{C}$ Derate above 50°C | P_D | 1.0 6.67 | Watt $\text{mW}/^\circ\text{C}$ |
| DC Power Dissipation @ $T_L = 75^\circ\text{C}$ Lead Length = $3/8"$ Derate above 75°C | P_D | 3.0 24 | Watts $\text{mW}/^\circ\text{C}$ |
| *Operating and Storage Junction Temperature Range | T_J, T_{stg} | -65 to +200 | $^\circ\text{C}$ |

*Indicates JEDEC Registered Data for the 1N4728 Series

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

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OUTLINE DIMENSIONS

NOTES:
1. ALL RULES AND NOTES ASSOCIATED WITH JEDEC DO-41 OUTLINE SHALL APPLY.
2. POLARITY DENOTED BY CATHODE BAND.
3. LEAD DIAMETER NOT CONTROLLED WITHIN "F" DIMENSION.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|--------|-------|
| | MIN | MAX | MIN | MAX |
| A | 4.07 | 5.20 | 0.160 | 0.205 |
| B | 2.04 | 2.71 | 0.080 | 0.107 |
| D | 0.71 | 0.86 | 0.028 | 0.034 |
| F | — | 1.27 | — | 0.050 |
| K | 27.94 | — | 1.100 | — |

CASE 59-03 (DO-41)



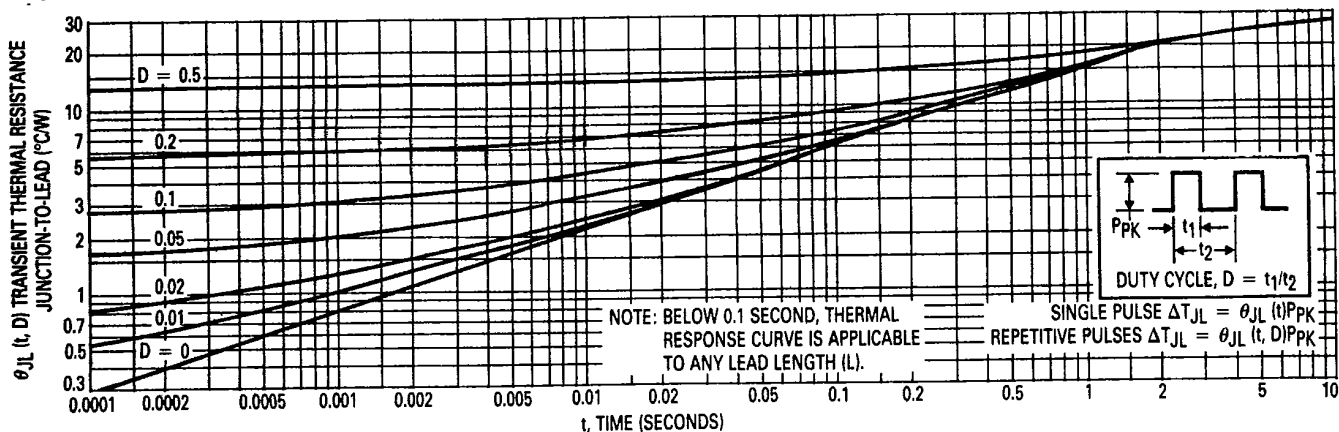


Figure 2. Typical Thermal Response L, Lead Length = 3/8 Inch

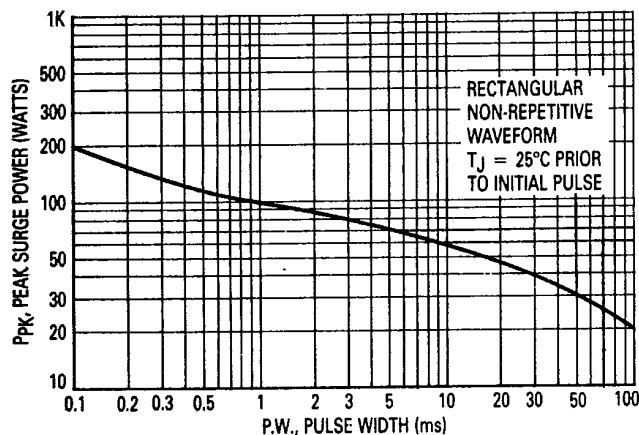


Figure 3. Maximum Surge Power

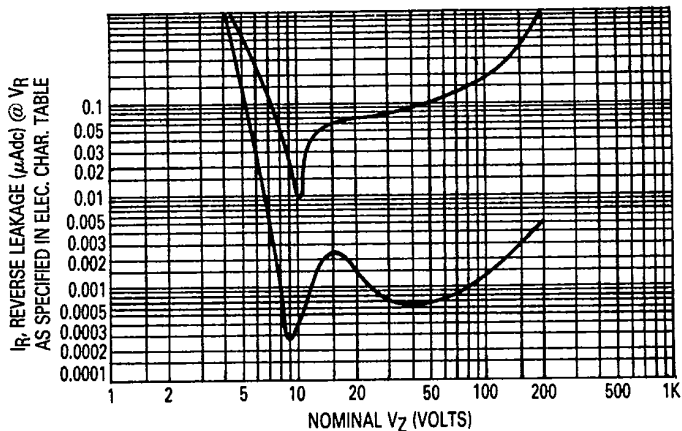


Figure 4. Typical Reverse Leakage

APPLICATION NOTE:

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 $30\text{--}40^{\circ}\text{C}/\text{W}$ 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 a train of power pulses ($L = 3/8$ inch) or from Figure 10 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 (ΔT_J) may be estimated. Changes in voltage, V_Z , can then be found from:

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

θ_{VZ} , the zener voltage temperature coefficient, is found from Figures 5 and 6.

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.

Data of Figure 2 should not be used to compute surge capability. Surge limitations are given in Figure 3. 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 3 be exceeded.

TEMPERATURE COEFFICIENT RANGES
(90% of the Units are in the Ranges Indicated)

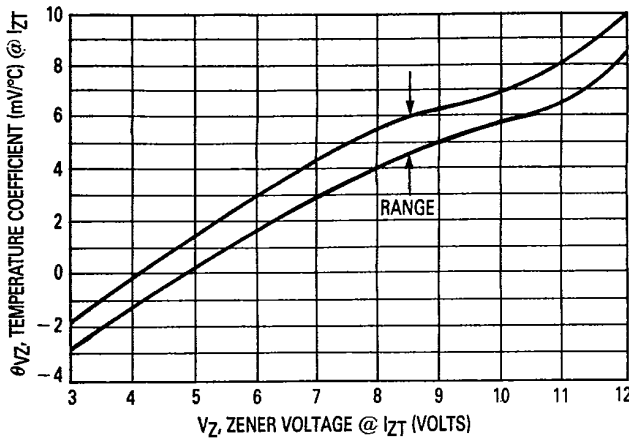


Figure 5. Units To 12 Volts

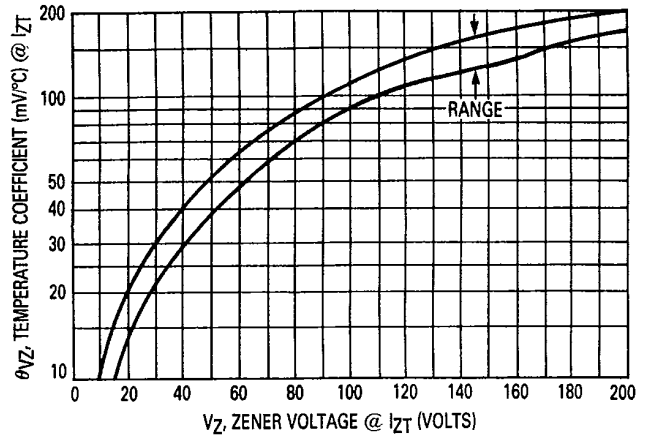


Figure 6. Units 10 To 200 Volts

ZENER VOLTAGE versus ZENER CURRENT
(Figures 7, 8 and 9)

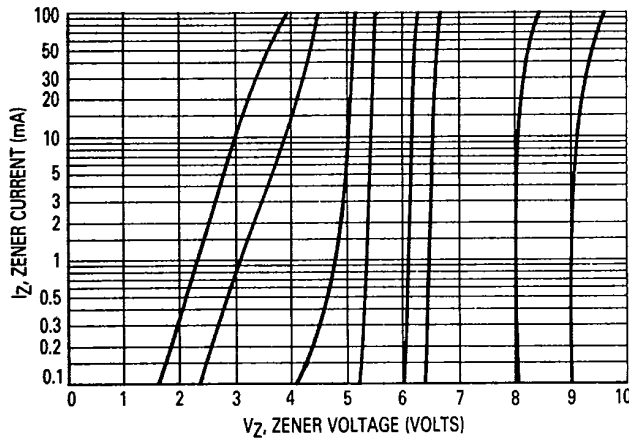


Figure 7. $V_Z = 3.9$ thru 10 Volts

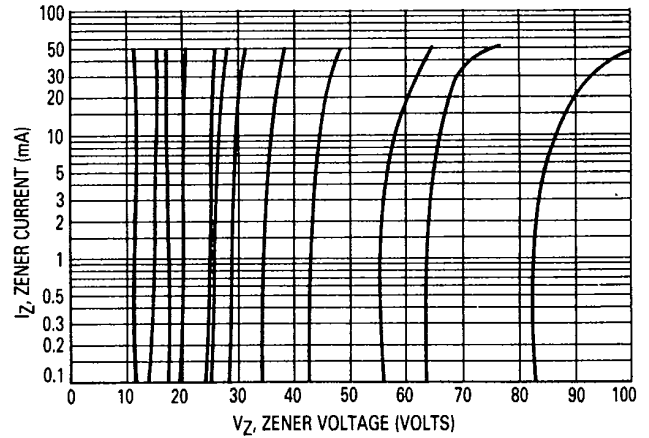


Figure 8. $V_Z = 12$ thru 82 Volts

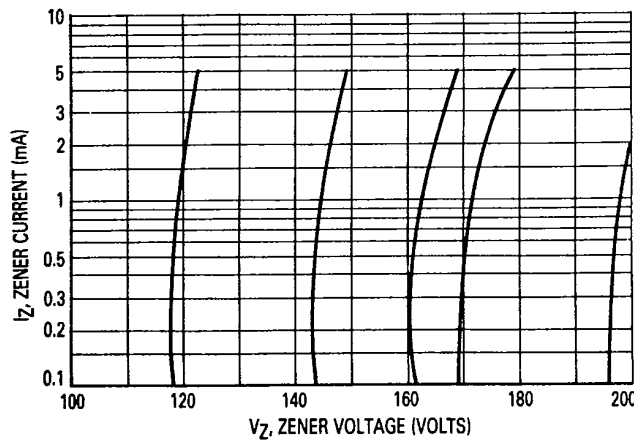


Figure 9. $V_Z = 100$ thru 200 Volts

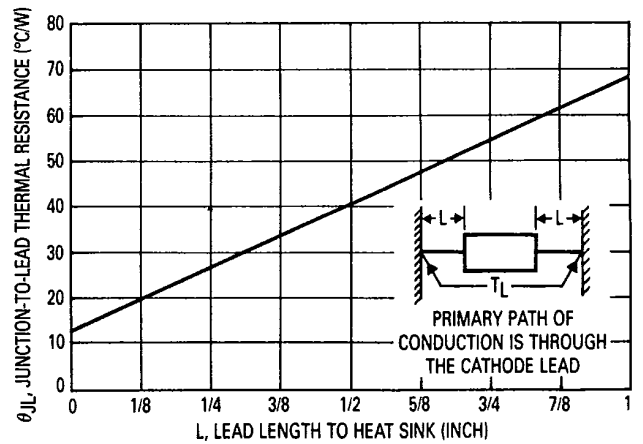


Figure 10. Typical Thermal Resistance

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

| Motorola Type No. (Note 1) | *Nominal Zener Voltage V _Z @ I _{ZT} Volts (Note 2) | *Test Current I _{ZT} mA | *Max Zener Impedance (Note 3) | | | *Leakage Current | | *Surge Current @ T _A = 25°C I _r - mA (Note 4) |
|----------------------------|--|----------------------------------|--|--|--------------------|-------------------------|----------------------|---|
| | | | Z _{ZT} @ I _{ZT} Ohms | Z _{ZK} @ I _{ZK} Ohms | I _{ZK} mA | I _R Max @ μA | V _R Volts | |
| MZP4728 | 3.3 | 76 | 10 | 400 | 1.0 | 100 | 1.0 | 1380 |
| MZP4729 | 3.6 | 69 | 10 | 400 | 1.0 | 100 | 1.0 | 1260 |
| MZP4730 | 3.9 | 64 | 9.0 | 400 | 1.0 | 50 | 1.0 | 1190 |
| MZP4731 | 4.3 | 58 | 9.0 | 400 | 1.0 | 10 | 1.0 | 1070 |
| MZP4732 | 4.7 | 53 | 8.0 | 500 | 1.0 | 10 | 1.0 | 970 |
| MZP4733 | 5.1 | 49 | 7.0 | 550 | 1.0 | 10 | 1.0 | 890 |
| MZP4734 | 5.6 | 45 | 5.0 | 600 | 1.0 | 10 | 2.0 | 810 |
| MZP4735 | 6.2 | 41 | 2.0 | 700 | 1.0 | 10 | 3.0 | 730 |
| MZP4736 | 6.8 | 37 | 3.5 | 700 | 1.0 | 10 | 4.0 | 660 |
| MZP4737 | 7.5 | 34 | 4.0 | 700 | 0.5 | 10 | 5.0 | 605 |
| MZP4738 | 8.2 | 31 | 4.5 | 700 | 0.5 | 10 | 6.0 | 550 |
| MZP4739 | 9.1 | 28 | 5.0 | 700 | 0.5 | 10 | 7.0 | 500 |
| MZP4740 | 10 | 25 | 7.0 | 700 | 0.25 | 10 | 7.6 | 454 |
| MZP4741 | 11 | 23 | 8.0 | 700 | 0.25 | 5.0 | 8.4 | 414 |
| MZP4742 | 12 | 21 | 9.0 | 700 | 0.25 | 5.0 | 9.1 | 380 |
| MZP4743 | 13 | 19 | 10 | 700 | 0.25 | 5.0 | 9.9 | 344 |
| MZP4744 | 15 | 17 | 14 | 700 | 0.25 | 5.0 | 11.4 | 304 |
| MZP4745 | 16 | 15.5 | 16 | 700 | 0.25 | 5.0 | 12.2 | 285 |
| MZP4746 | 18 | 14 | 20 | 750 | 0.25 | 5.0 | 13.7 | 250 |
| MZP4747 | 20 | 12.5 | 22 | 750 | 0.25 | 5.0 | 15.2 | 225 |
| MZP4748 | 22 | 11.5 | 23 | 750 | 0.25 | 5.0 | 16.7 | 205 |
| MZP4749 | 24 | 10.5 | 25 | 750 | 0.25 | 5.0 | 18.2 | 190 |
| MZP4750 | 27 | 9.5 | 35 | 750 | 0.25 | 5.0 | 20.6 | 170 |
| MZP4751 | 30 | 8.5 | 40 | 1000 | 0.25 | 5.0 | 22.8 | 150 |
| MZP4752 | 33 | 7.5 | 45 | 1000 | 0.25 | 5.0 | 25.1 | 135 |
| MZP4753 | 36 | 7.0 | 50 | 1000 | 0.25 | 5.0 | 27.4 | 125 |
| MZP4754 | 39 | 6.5 | 60 | 1000 | 0.25 | 5.0 | 29.7 | 115 |
| MZP4755 | 43 | 6.0 | 70 | 1500 | 0.25 | 5.0 | 32.7 | 110 |
| MZP4756 | 47 | 5.5 | 80 | 1500 | 0.25 | 5.0 | 35.8 | 95 |
| MZP4757 | 51 | 5.0 | 95 | 1500 | 0.25 | 5.0 | 38.8 | 90 |
| MZP4758 | 56 | 4.5 | 110 | 2000 | 0.25 | 5.0 | 42.6 | 80 |
| MZP4759 | 62 | 4.0 | 125 | 2000 | 0.25 | 5.0 | 47.1 | 70 |
| MZP4760 | 68 | 3.7 | 150 | 2000 | 0.25 | 5.0 | 51.7 | 65 |
| MZP4761 | 75 | 3.3 | 175 | 2000 | 0.25 | 5.0 | 56 | 60 |
| MZP4762 | 82 | 3.0 | 200 | 3000 | 0.25 | 5.0 | 62.2 | 55 |
| MZP4763 | 91 | 2.8 | 250 | 3000 | 0.25 | 5.0 | 69.2 | 50 |
| MZP4764 | 100 | 2.5 | 350 | 3000 | 0.25 | 5.0 | 76 | 45 |
| 1M110ZS10 | 110 | 2.3 | 450 | 4000 | 0.25 | 5.0 | 83.6 | — |
| 1M120ZS10 | 120 | 2.0 | 550 | 4500 | 0.25 | 5.0 | 91.2 | — |
| 1M130ZS10 | 130 | 1.9 | 700 | 5000 | 0.25 | 5.0 | 98.8 | — |
| 1M150ZS10 | 150 | 1.7 | 1000 | 6000 | 0.25 | 5.0 | 114 | — |
| 1M160ZS10 | 160 | 1.6 | 1100 | 6500 | 0.25 | 5.0 | 121.6 | — |
| 1M180ZS10 | 180 | 1.4 | 1200 | 7000 | 0.25 | 5.0 | 136.8 | — |
| 1M200ZS10 | 200 | 1.2 | 1500 | 8000 | 0.25 | 5.0 | 152 | — |

NOTE 1 — TOLERANCE AND TYPE NUMBER DESIGNATION

The type numbers listed have a standard tolerance on the nominal zener voltage of ±10%. A standard tolerance of ±5% is indicated by adding an "A" suffix to the MZP type numbers. A "C" suffix would indicate a ±2% tolerance and a "D" suffix would indicate a ±1% tolerance. The tolerance on the 1M type numbers is indicated by the digits following ZS in the part number. 10 indicates 10%, 5 indicates 5%, 2 indicates 2% and 1 indicates 1%.

NOTE 2 — ZENER VOLTAGE (V_Z) MEASUREMENT

Motorola guarantees the zener voltage when measured at 90 seconds while maintaining the lead temperature (T_L) at 30°C ±1°C, 3/8" from the diode body.


NOTE 3 — ZENER IMPEDANCE (Z_Z) DERIVATION

The zener impedance is derived from the 60 cycle ac voltage, which results when an ac current having an rms value equal to 10% of the dc zener current (I_{ZT} or I_{ZK}) is superimposed on I_{ZT} or I_{ZK}.

NOTE 4 — SURGE CURRENT (I_r) NON-REPETITIVE

The rating listed in the electrical characteristics table is maximum peak, non-repetitive, reverse surge current of 1/2 square wave or equivalent sine wave pulse of 1/120 second duration superimposed on the test current, I_{ZT}, per JEDEC registration, however, actual device capability is as described in Figure 3.

*Indicates JEDEC Registered Data for the 1N4728 Series

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