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MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

T-11-13

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

MZP4728 thru MZP4764
1M110ZS10 thru 1M200ZS10

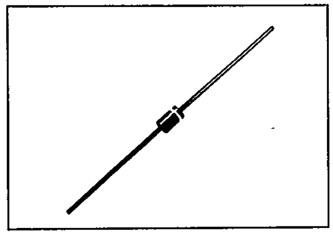
1.0 WATT ZENER REGULATOR DIODES 3.3–200 VOLTS

. . . 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)



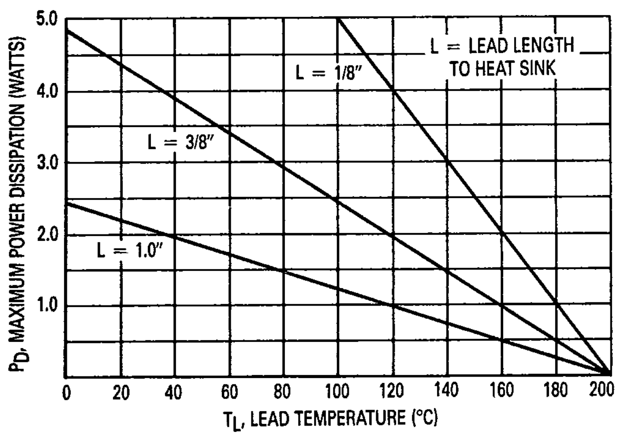
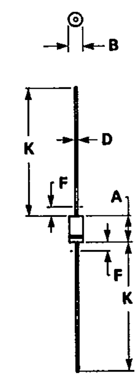


Figure 1. Power-Temperature Derating Curve

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 MIN	MILLIMETERS MAX	INCHES MIN	INCHES 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)

MAXIMUM RATINGS

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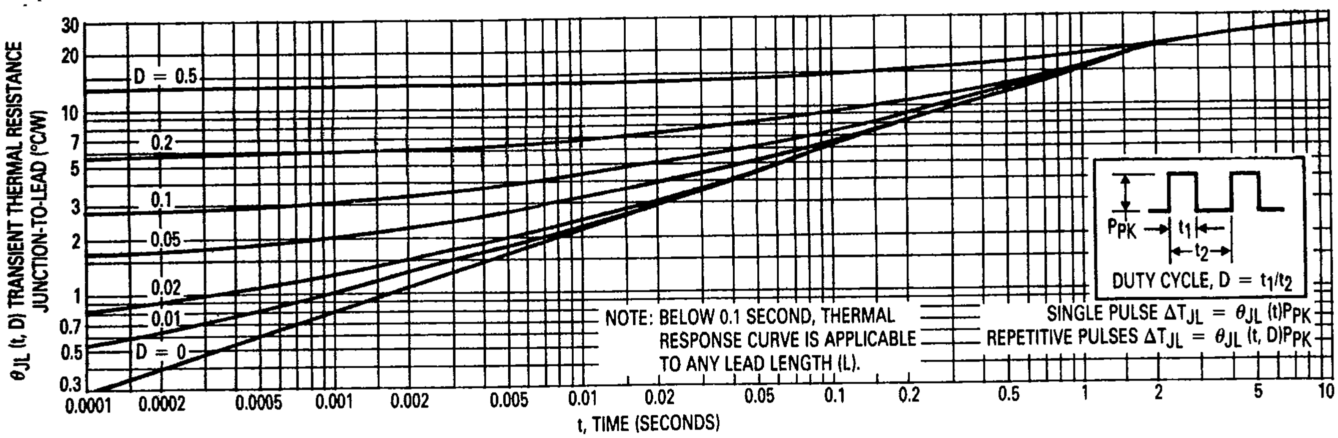

Figure 2. Typical Thermal Response L, Lead Length = 3/8 Inch

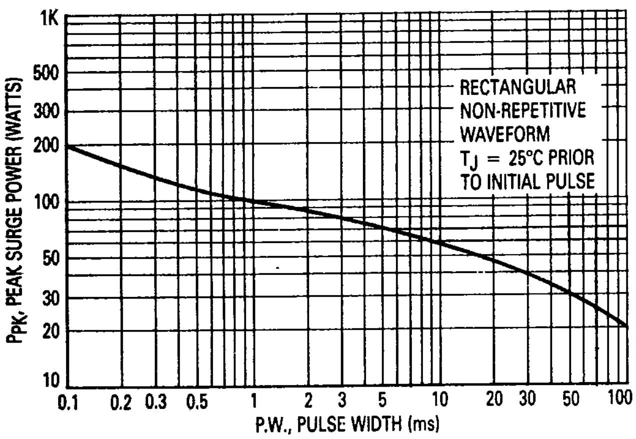

Figure 3. Maximum Surge Power

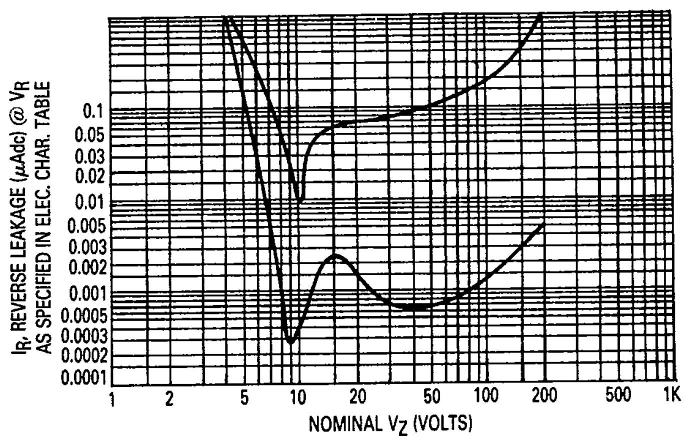

Figure 4. Typical Reverse Leakage

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 (°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 30–40°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 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)

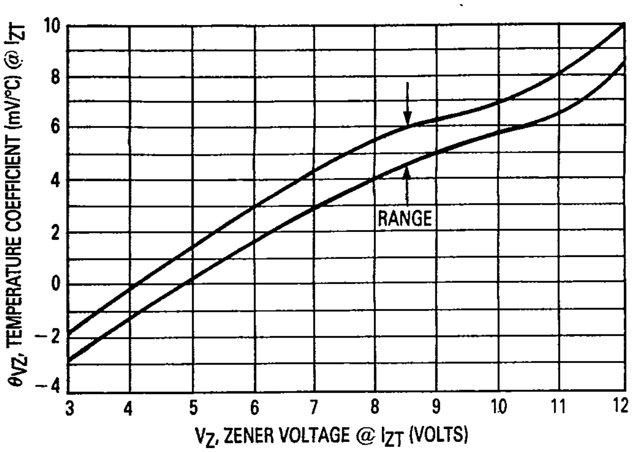

Figure 5. Units To 12 Volts

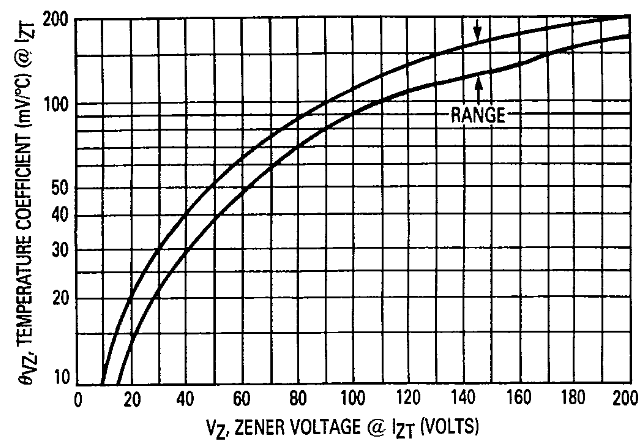

Figure 6. Units 10 To 200 Volts

ZENER VOLTAGE versus ZENER CURRENT

(Figures 7, 8 and 9)

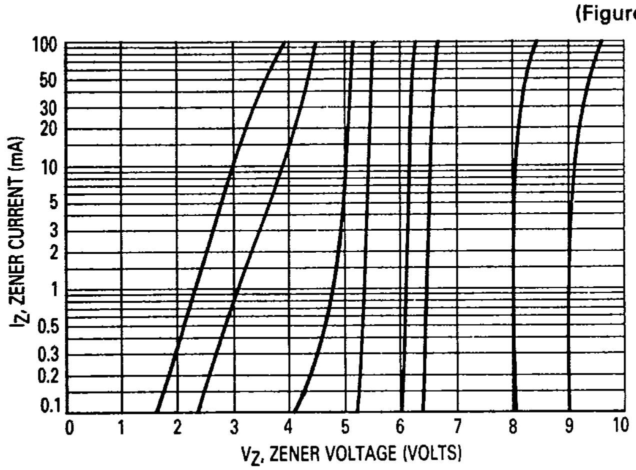

Figure 7. V_Z = 3.9 thru 10 Volts

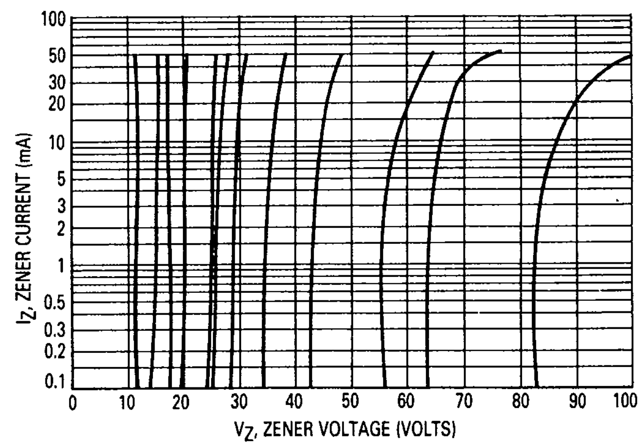

Figure 8. V_Z = 12 thru 82 Volts

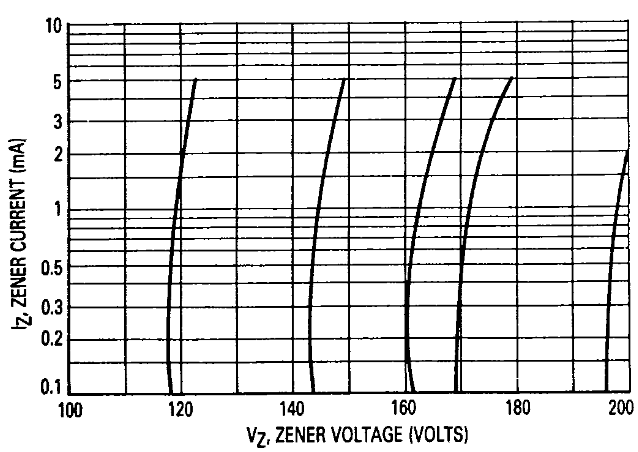

Figure 9. V_Z = 100 thru 200 Volts

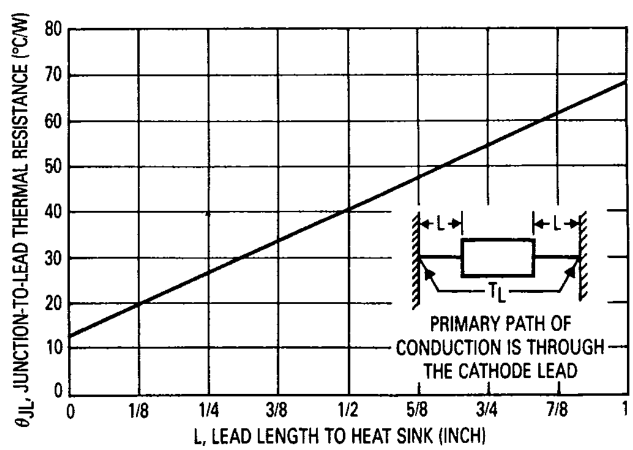

Figure 10. Typical Thermal Resistance

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 µA Max @	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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