MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

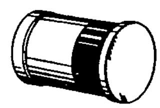
MLL4728 thru MLL4764

1.0 WATT HERMETICALLY SEALED GLASS SILICON ZENER DIODES

- Complete Voltage Range — 3.3 to 100 Volts
- Leadless Package for Surface Mount Technology
- Double Slug Type Construction
- Metallurgically Bonded Construction
- Oxide Passivated Die
- Available in 12 mm Tape and Reel
  T1 Cathode Facing Sprocket Holes
  T2 Anode Facing Sprocket Holes

LEADLESS GLASS ZENER DIODES

1.0 WATT
3.3–100 VOLTS



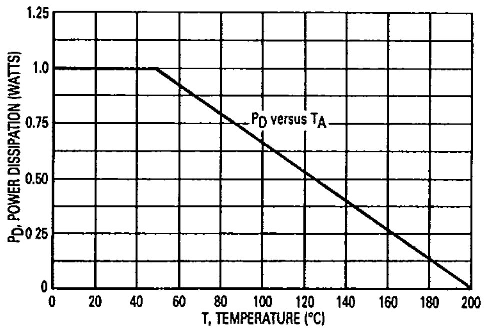
MAXIMUM RATINGS

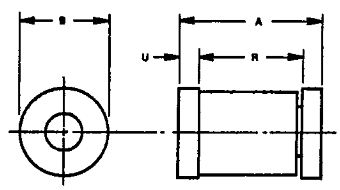
Rating	Symbol	Value	Unit
DC Power Dissipation @ $T_A \leq 50°C$ Derate above $T_A = 50°C$	P_D	1.0 6.67	W mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +200	°C

MECHANICAL CHARACTERISTICS

CASE: Double slug type, hermetically sealed glass
MAXIMUM TEMPERATURE FOR SOLDERING PURPOSES: 230°C, for 10 seconds
FINISH: All external surfaces are corrosion resistant and readily solderable
POLARITY: Cathode indicated by color band. When operated in zener mode, cathode will be positive with respect to anode
MOUNTING POSITION: Any

STEADY STATE POWER DERATING





DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	4.80	5.20	0.189	0.205
B	2.39	2.59	0.094	0.102
R	3.68	4.54	0.145	0.179
U	0.30	0.55	0.012	0.022

CASE 362B-01
GLASS

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MLL4728 thru MLL4764

ELECTRICAL CHARACTERISTICS
(T_A = 25°C unless otherwise noted. Based on dc measurements at thermal equilibrium; case temperature maintained at 30±2°C. V_F = 1.2 V max @ I_F = 200 mA for all types.)

Type No. (Note 1)	Nominal Zener Voltage V_Z @ I_{ZT} Volts (Notes 2 and 3)	Test Current I_{ZT} mA	Maximum Zener Impedance (Note 4) Z_{ZT} @ I_{ZT} Ohms	Z_{ZK} @ I_{ZK} Ohms	I_{ZK} mA	Leakage Current I_R µA Max	V_R Volts	Surge Current @ T_A = 25°C i_r – mA (Note 5)
MLL4728	3.3	76	10	400	1.0	100	1.0	1380
MLL4729	3.6	69	10	400	1.0	100	1.0	1260
MLL4730	3.9	64	9.0	400	1.0	50	1.0	1190
MLL4731	4.3	58	9.0	400	1.0	10	1.0	1070
MLL4732	4.7	53	8.0	500	1.0	10	1.0	970
MLL4733	5.1	49	7.0	550	1.0	10	1.0	890
MLL4734	5.6	45	5.0	600	1.0	10	2.0	810
MLL4735	6.2	41	2.0	700	1.0	10	3.0	730
MLL4736	6.8	37	3.5	700	1.0	10	4.0	660
MLL4737	7.5	34	4.0	700	0.5	10	5.0	605
MLL4738	8.2	31	4.5	700	0.5	10	6.0	550
MLL4739	9.1	28	5.0	700	0.5	10	7.0	500
MLL4740	10	25	7.0	700	0.25	10	7.6	454
MLL4741	11	23	8.0	700	0.25	5.0	8.4	414
MLL4742	12	21	9.0	700	0.25	5.0	9.1	380
MLL4743	13	19	10	700	0.25	5.0	9.9	344
MLL4744	15	17	14	700	0.25	5.0	11.4	304
MLL4745	16	15.5	16	700	0.25	5.0	12.2	285
MLL4746	18	14	20	750	0.25	5.0	13.7	250
MLL4747	20	12.5	22	750	0.25	5.0	15.2	225
MLL4748	22	11.5	23	750	0.25	5.0	16.7	205
MLL4749	24	10.5	25	750	0.25	5.0	18.2	190
MLL4750	27	9.5	35	750	0.25	5.0	20.6	170
MLL4751	30	8.5	40	1000	0.25	5.0	22.8	150
MLL4752	33	7.5	45	1000	0.25	5.0	25.1	135
MLL4753	36	7.0	50	1000	0.25	5.0	27.4	125
MLL4754	39	6.5	60	1000	0.25	5.0	29.7	115
MLL4755	43	6.0	70	1500	0.25	5.0	32.7	110
MLL4756	47	5.5	80	1500	0.25	5.0	35.8	95
MLL4757	51	5.0	95	1500	0.25	5.0	38.8	90
MLL4758	56	4.5	110	2000	0.25	5.0	42.6	80
MLL4759	62	4.0	125	2000	0.25	5.0	47.1	70
MLL4760	68	3.7	150	2000	0.25	5.0	51.7	65
MLL4761	75	3.3	175	2000	0.25	5.0	56.0	60
MLL4762	82	3.0	200	3000	0.25	5.0	62.2	55
MLL4763	91	2.8	250	3000	0.25	5.0	69.2	50
MLL4764	100	2.5	350	3000	0.25	5.0	76.0	45

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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% on individual units is also available and is indicated by suffixing "A" to the standard type number.

NOTE 2. Special Selections† Available Include:

1. Nominal zener voltages between those shown.
2. Two or more units for series connection with specified tolerance on total voltage. Series matched sets make zener voltages in excess of 200 volts possible as well as providing lower temperature coefficients, lower dynamic impedance and greater power handling ability.
3. Nominal voltages at non-standard test currents.

NOTE 3. Zener Voltage (V_Z) Measurement — Nominal zener voltage is measured with the device junction in thermal equilibrium at the case temperature of 30°C ±2°C.

NOTE 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 $I_Z(ac) = 0.1 \times I_Z(dc)$ with the ac frequency = 1.0 kHz.

†For more information on special selections contact your nearest Motorola representative.

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:

Case Temperature, T_C, should be determined from:

$$T_C = \theta_{CA} P_D + T_A.$$

θ_{CA} is the case-to-ambient thermal resistance (°C/W) and P_D is the power dissipation. The value for θ_{CA} will vary and depends on the device mounting method. θ_{CA} is generally 200°C/W for the various clips and tie points in common use and for printed circuit board wiring.

The temperature of the case can also be measured using a thermocouple placed at the case end 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_C, the junction temperature may be determined by:

$$T_J = T_C + \Delta T_{JC}.$$

ΔT_{JC} is the increase in junction temperature above the case temperature and may be found by using:

$$\Delta T_{JC} = \theta_{JC} P_D.$$

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:

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

θ_{VZ}, the zener voltage temperature coefficient, is found from Figures 3 and 4.

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.

NOTE 5. Surge Current (I_r) Nonrepetitive — 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 Figures 4 and 6.

Surge limitations are given in Figure 6. 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 6 be exceeded.

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FIGURE 1 — TYPICAL LEAKAGE CURRENT

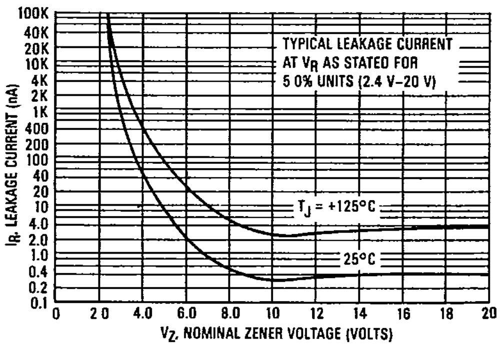

FIGURE 2 — TYPICAL LEAKAGE CURRENT

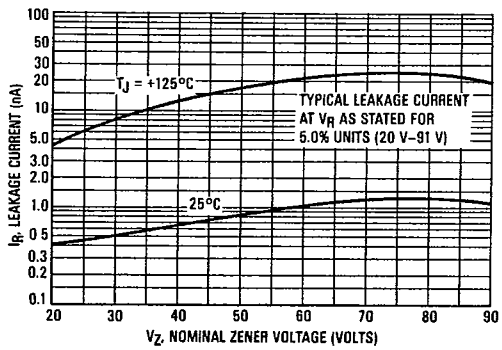

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FIGURE 3 — TEMPERATURE COEFFICIENTS @ I_{ZT}

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

a — RANGE FOR UNITS TO 12 VOLTS **b — RANGE FOR UNITS 12 TO 100 VOLTS**

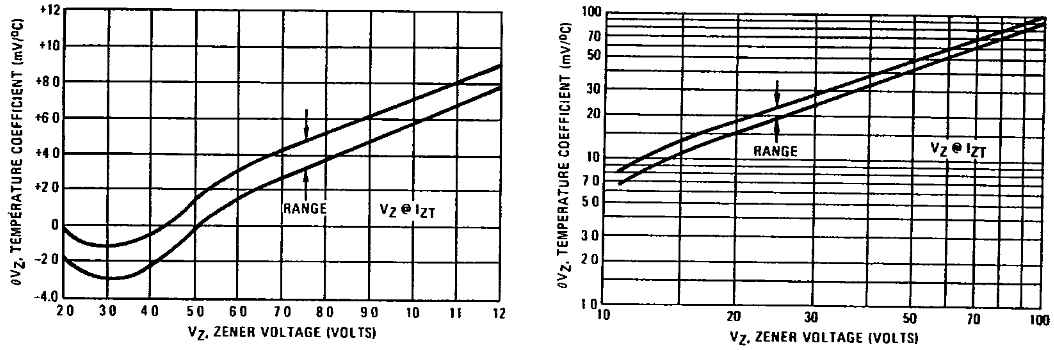


FIGURE 4 — EFFECT OF ZENER CURRENT

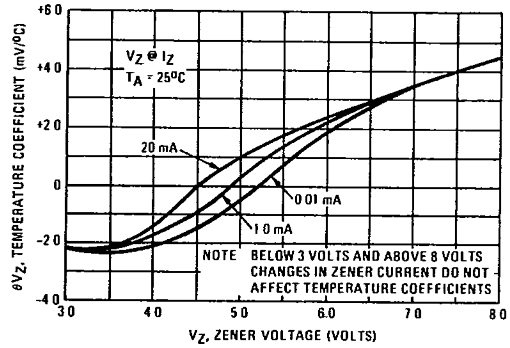


FIGURE 5 — TYPICAL CAPACITANCE

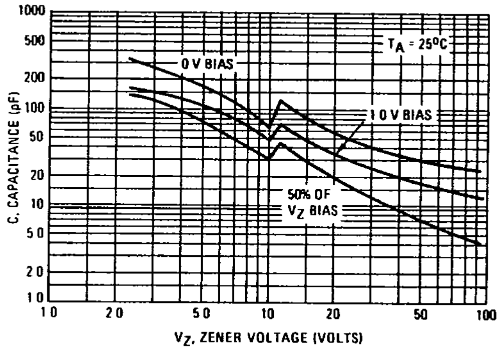
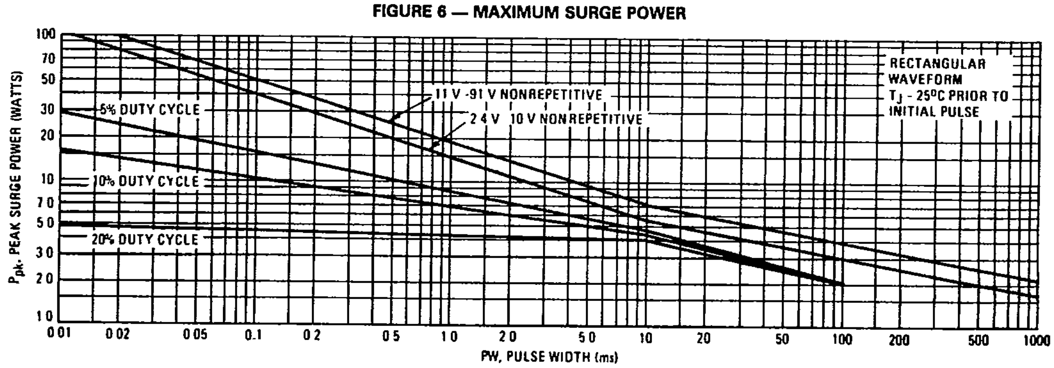


FIGURE 6 — MAXIMUM SURGE POWER



This graph represents 90 percentil data points.
For worst-case design characteristics, multiply surge power by 2/3.

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FIGURE 7 — EFFECT OF ZENER CURRENT ON ZENER IMPEDANCE

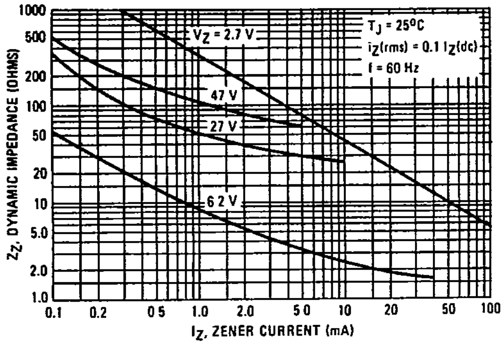


FIGURE 8 — EFFECT OF ZENER VOLTAGE ON ZENER IMPEDANCE

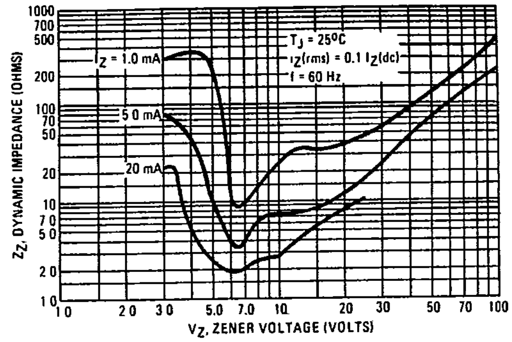


FIGURE 9 — TYPICAL NOISE DENSITY

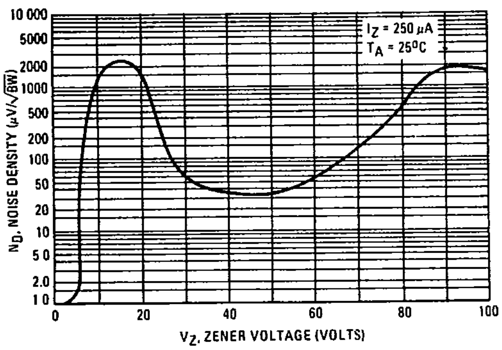
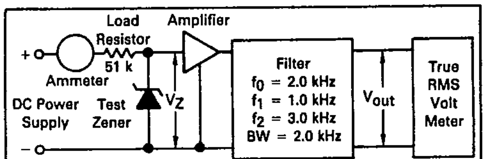


FIGURE 10 — NOISE DENSITY MEASUREMENT METHOD



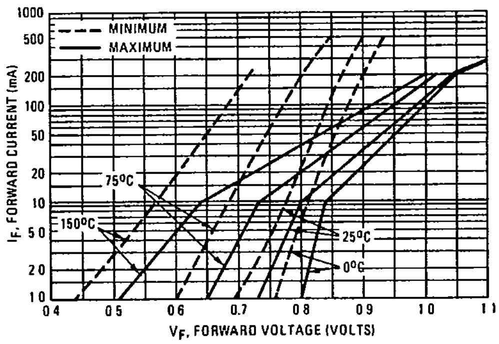
Noise Density (Volts Per Square Root Bandwidth) $= \dfrac{V_{out}}{\text{Overall Gain}\ \sqrt{BW}}$

Where: BW = Filter Bandwidth (Hz)

V_{out} = Output Noise (Volts RMS)

The input voltage and load resistance are high so that the zener diode is driven from a constant current source. The amplifier is low noise so that the amplifier noise is negligible compared to that of the test zener. The filter bandpass is known so that the noise density can be calculated from the formula shown.

FIGURE 11 — TYPICAL FORWARD CHARACTERISTICS



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