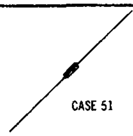
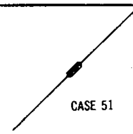
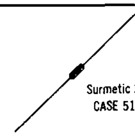
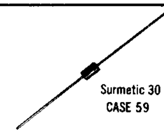
1N5262–1N5319

TYPE	MATERIAL	REPLACEMENT	PAGE NUMBER	IDENTIFICATION	RECTIFIERS: V_R (volts) / SIGNAL DIODES: PRV (volts)	V_F (volts) / V_F (volts) @	I_O (Amps) / I_F	I_R (mA) / I_R	I_{surge} (Amps) / t_{rr} (μs)	ZENER DIODES: V_Z (min) / REFERENCE DIODES: TC %/°C	V_Z (nom) * / V_Z (max) / V_Z	Tol V_Z % / T (min) °C	P_D / T (max) °C
1N5262	S		2-32	ZD							51*	10	500M
1N5262A	S		2-32	ZD							51*	10	500M
1N5262B	S		2-32	ZD							51*	5.0	500M
1N5263	S		2-32	ZD							56*	10	500M
1N5263A	S		2-32	ZD							56*	10	500M
1N5263B	S		2-32	ZD							56*	5.0	500M
1N5264	S		2-32	ZD							60*	10	500M
1N5264A	S		2-32	ZD							60*	10	500M
1N5264B	S		2-32	ZD							60*	5.0	500M
1N5265	S		2-32	ZD							62*	10	500M
1N5265A	S		2-32	ZD							62*	10	500M
1N5265B	S		2-32	ZD							62*	5.0	500M
1N5266	S		2-32	ZD							68*	10	500M
1N5266A	S		2-32	ZD							68*	10	500M
1N5266B	S		2-32	ZD							68*	5.0	500M
1N5267	S		2-32	ZD							75*	10	500M
1N5267A	S		2-32	ZD							75*	10	500M
1N5267B	S		2-32	ZD							75*	5.0	500M
1N5268	S		2-32	ZD							82*	10	500M
1N5268A	S		2-32	ZD							82*	10	500M
1N5268B	S		2-32	ZD							82*	5.0	500M
1N5269	S		2-32	ZD							87*	10	500M
1N5269A	S		2-32	ZD							87*	10	500M
1N5269B	S		2-32	ZD							87*	5.0	500M
1N5270	S		2-32	ZD							91*	10	500M
1N5270A	S		2-32	ZD							91*	10	500M
1N5270B	S		2-32	ZD							91*	5.0	500M
1N5271	S		2-32	ZD							100*	10	500M
1N5271A	S		2-32	ZD							100*	10	500M
1N5271B	S		2-32	ZD							100*	5.0	500M
1N5272	S		2-32	ZD							110*	10	500M
1N5272A	S		2-32	ZD							110*	10	500M
1N5272B	S		2-32	ZD							110*	5.0	500M
1N5273	S		2-32	ZD							120*	10	500M
1N5273A	S		2-32	ZD							120*	10	500M
1N5273B	S		2-32	ZD							120*	5.0	500M
1N5274	S		2-32	ZD							130*	10	500M
1N5274A	S		2-32	ZD							130*	10	500M
1N5274B	S		2-32	ZD							130*	5.0	500M
1N5275	S		2-32	ZD							140*	10	500M
1N5275A	S		2-32	ZD							140*	10	500M
1N5275B	S		2-32	ZD							140*	5.0	500M
1N5276	S		2-32	ZD							150*	10	500M
1N5276A	S		2-32	ZD							150*	10	500M
1N5276B	S		2-32	ZD							150*	5.0	500M
1N5277	S		2-32	ZD							160*	10	500M
1N5277A	S		2-32	ZD							160*	10	500M
1N5277B	S		2-32	ZD							160*	5.0	500M
1N5278	S		2-32	ZD							170*	10	500M
1N5278A	S		2-32	ZD							170*	10	500M
1N5278B	S		2-32	ZD							170*	5.0	500M
1N5279	S		2-32	ZD							180*	10	500M
1N5279A	S		2-32	ZD							180*	10	500M
1N5279B	S		2-32	ZD							180*	5.0	500M
1N5280	S		2-32	ZD							190*	10	500M
1N5280A	S		2-32	ZD							190*	10	500M
1N5280B	S		2-32	ZD							190*	5.0	500M
1N5281	S		2-32	ZD							200*	10	500M
1N5281A	S		2-32	ZD							200*	10	500M
1N5281B	S		2-32	ZD							200*	5.0	500M
1N5282	S			HS	55	1.3	500M	0.1*	0.004				
1N5283 thru 1N5314		Current Regulator Diodes, See Data Sheet on page 13-2											
1N5315	S			HS	75	0.49	0.1M	0.05*	0.004				
1N5316	S			HS	75	0.49	0.1M	0.05*	0.004				
1N5317	S			HS	55	1.17	500M	0.1*	0.004				
1N5318	S			HS	50	0.87	200M	0.1*	0.004				
1N5319	S			HS	25	1.0	100M	100*	0.004				

R—Rectifier, **RD**—Reference Diode, **ZD**—Zener Diode, **GP**—General Purpose, **HC**—High Conductance (≥ 20 mA @ ≤ 1 V), **HS**—High Speed Switch (Max t_{rr} < 0.3 μs), **CS**—High Conductance, High Speed Switch, **MS**—Medium Speed Switch, **PA**—Parametric Amplifier, **SP**—Special Purpose.

ZENER DIODE

IMPORTANT. . . The device type numbers listed below represent a basic profile of the industry's largest inventory of zener diodes. In addition to this wide selection of standard voltages and power ratings, special devices are readily obtainable. Such special devices include in-between voltages, closer tolerances, matched pairs, matched sets, etc., to satisfy any critical design requirement. FOR INFORMATION ON HOW TO OBTAIN SPECIAL DEVICES, SEE PAGE 2-4.

Nominal Zener Voltage (NOTE 6)	¼ WATT Cathode = Polarity Mark		400 MILLIWATT Cathode = Polarity Mark		500 MILLIWATT Cathode = Polarity Mark	1 WATT Cathode = Polarity Mark
	 CASE 51		 CASE 51		 Surmetic 20 CASE 51	 Surmetic 30 CASE 59
	INDUSTRIAL (NOTE 1)	INDUSTRIAL ±5% TOLERANCE	INDUSTRIAL (NOTE 2, 3)	* MIL-S-19500/127 (1N746A-759A 1N4370A-4372A) MIL-S-19500/117 (1N962B-992B)	INDUSTRIAL (NOTE 5)	INDUSTRIAL (NOTE 2)
2.4	1/4M2.4AZ		1N4370	1N4370A	1N5221	
2.7	1/4M2.7AZ		1N4371	1N4371A	1N5223	
3.0	1/4M3.0AZ		1N4372	1N4372A	1N5225	
3.3	1/4M3.3AZ		1N746	1N746A	1N5226	1N4728
3.6	1/4M3.6AZ		1N747	1N747A	1N5227	1N4729
3.9	1/4M3.9AZ		1N748	1N748A	1N5228	1N4730
4.3	1/4M4.3AZ		1N749	1N749A	1N5229	1N4731
4.7	1/4M4.7AZ		1N750	1N750A	1N5230	1N4732
5.1	1/4M5.1AZ		1N751	1N751A	1N5231	1N4733
5.6	1/4M5.6AZ		1N752	1N752A	1N5232	1N4734
6.2	1/4M6.2AZ		1N753	1N753A	1N5234	1N4735
6.8	1/4M6.8Z	1N4099	1N754 1N957	1N754A	1N5235	1N4736
7.5	1/4M7.5Z	1N4100	1N755 1N958	1N755A	1N5236	1N4737
8.2	1/4M8.2Z	1N4101	1N756 1N959	1N756A	1N5237	1N4738
9.1	1/4M9.1Z	1N4103	1N757 1N960	1N757A	1N5239	1N4739
10	1/4M10Z	1N4104	1N758 1N961	1N758A	1N5240	1N4740
11	1/4M11Z	1N4105	1N962	1N962B	1N5241	1N4721
12	1/4M12Z	1N4106	1N759 1N963	1N759A 1N963B	1N5242	1N4742
13	1/4M13Z	1N4107	1N964	1N964B	1N5243	1N4743
15	1/4M15Z	1N4109	1N965	1N965B	1N5245	1N4744
16	1/4M16Z	1N4110	1N966	1N966B	1N5246	1N4745
18	1/4M18Z	1N4112	1N967	1N967B	1N5248	1N4746
20	1/4M20Z	1N4114	1N968	1N968B	1N5250	1N4747
22	1/4M22Z	1N4115	1N969	1N969B	1N5251	1N4748
24	1/4M24Z	1N4116	1N970	1N970B	1N5252	1N4749
27	1/4M27Z	1N4118	1N971	1N971B	1N5254	1N4750
30	1/4M30Z	1N4120	1N972	1N972B	1N5256	1N4751
33	1/4M33Z	1N4121	1N973	1N973B	1N5257	1N4752
36	1/4M36Z	1N4122	1N974	1N974B	1N5258	1N4753
39	1/4M39Z	1N4123	1N975	1N975B	1N5259	1N4754
43	1/4M43Z	1N4124	1N976	1N976B	1N5260	1N4755
47	1/4M47Z	1N4125	1N977	1N977B	1N5261	1N4756
51	1/4M51Z	1N4126	1N978	1N978B	1N5262	1N4757
56	1/4M56Z	1N4127	1N979	1N979B	1N5263	1N4758
62	1/4M62Z	1N4129	1N980	1N980B	1N5265	1N4759
68	1/4M68Z	1N4130	1N981	1N981B	1N5266	1N4760
75	1/4M75Z	1N4131	1N982	1N982B	1N5267	1N4761
82	1/4M82Z	1N4132	1N983	1N983B	1N5268	1N4762
91	1/4M91Z	1N4134	1N984	1N984B	1N5270	1N4763
100	1/4M100Z	1N4135	1N985	1N985B	1N5271	1N4764
110	1/4M110Z		1N986	1N986B	1N5272	1M110ZS10
120	1/4M120Z		1N987	1N987B	1N5273	1M120ZS10
130	1/4M130Z		1N988	1N988B	1N5274	1M130ZS10
150	1/4M150Z		1N989	1N989B	1N5276	1M150ZS10
160	1/4M160Z		1N990	1N990B	1N5277	1M160ZS10
180	1/4M180Z		1N991	1N991B	1N5279	1M180ZS10
200	1/4M200Z		1N992	1N992B	1N5281	1M200ZS10

NOTES:

1. No suffix is 20% tolerance; "10" suffix is ±10% tolerance and "5" suffix is ±5% tolerance.
2. No suffix denotes ±10% tolerance. "A" suffix is ±5 tolerance. (1N4370-4372, 1N746-759; 1N3821-30, 1N3993-4000, 1N4728-64)
3. No suffix is ±20% tolerance; "A" suffix is ±10% tolerance, and "B" suffix is ±5% tolerance. (1N957-992; 1N3016-3051; 1N3785-3820; 1N2970&R-3015&R; 1N4549&R-4556&R; 1N4557&R-4564&R; 1N2804&R-2846&R; 1N3305&R-3350&R)

1N5221 thru 1N5281 series

P_D = 500 mW
V_Z = 2.4-200 V

CASE 51
(DO-7)

500 Milliwatt surmetic 20 silicon zener diodes-a complete new series of Zener Diodes in the popular DO-7 case with higher ratings, tighter limits, better operating characteristics and a full set of designers' curves 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.

MAXIMUM RATINGS

Junction and Storage Temperature: −65 to +200°C

Lead Temperature not less than 1/16″ from the case for 10 seconds: 230°C

DC Power Dissipation: 500 mW @ T_L = 75°C, Lead Length = 3/8″
(Derate 4.0 mW/°C above 75°C)

Surge Power: 10 Watts (Non-recurrent square wave @ PW = 8.3 ms, T_J = 55°C, Figure 16)

MECHANICAL CHARACTERISTICS

CASE: Void free, transfer molded, thermosetting plastic.

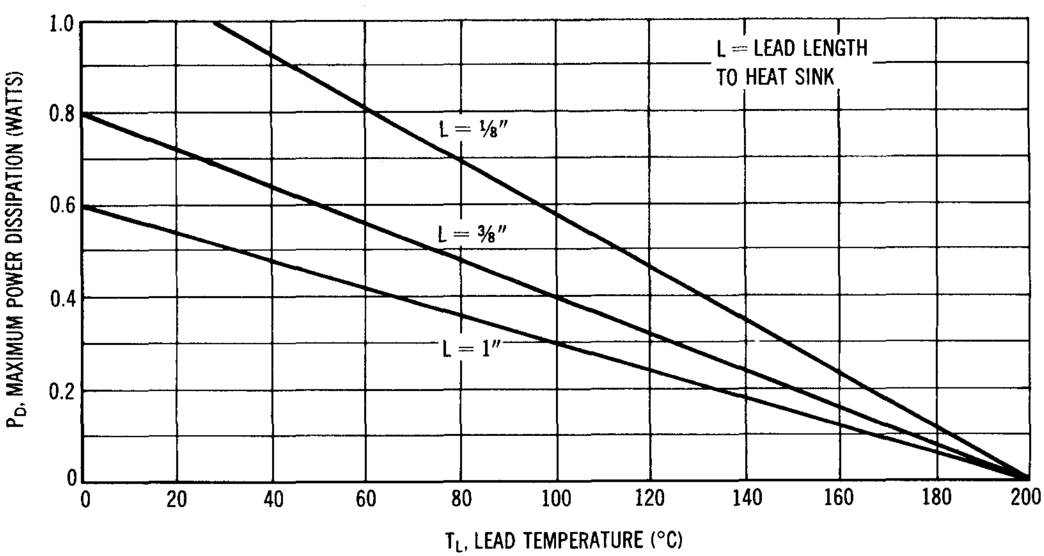
FINISH: All external surfaces are corrosion resistant. Leads are readily solderable and weldable.

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

MOUNTING POSITION: Any.

WEIGHT: 0.18 gram (approximately).

FIGURE 1 — POWER-TEMPERATURE DERATING CURVE



1N5221 thru 1N5281 series (continued)

ELECTRICAL CHARACTERISTICS ($T_A = 25°C$ unless otherwise noted. Based on dc measurements at thermal equilibrium; lead length = 3/8"; thermal resistance of heat sink = 30°C/W) V_F = **1.1 Max @ I_F = 200 mA for all types.**

JEDEC Type No. (Note 1)	Nominal Zener Voltage V_Z @ I_{ZT} Volts (Note 2)	Test Current I_{ZT} mA	Max Zener Impedance A & B Suffix Only		Max Reverse Leakage Current A & B Suffix Only			Max Reverse Leakage Current Non-Suffix	Max Zener Voltage Temp. Coeff. (A & B Suffix Only) θ_{VZ} (%/°C) (Note 3)
			Z_{ZT} @ I_{ZT} Ohms	Z_{ZK} @ I_{ZK} = 0.25 mA Ohms	I_R μA	@ V_R Volts A	V_R Volts B	I_R @ V_R Used For Suffix A μA	
1N5221	2.4	20	30	1200	100	0.95	1.0	200	-0.085
1N5222	2.5	20	30	1250	100	0.95	1.0	200	-0.085
1N5223	2.7	20	30	1300	75	0.95	1.0	150	-0.080
1N5224	2.8	20	30	1400	75	0.95	1.0	150	-0.080
1N5225	3.0	20	29	1600	50	0.95	1.0	100	-0.075
1N5226	3.3	20	28	1600	25	0.95	1.0	100	-0.070
1N5227	3.6	20	24	1700	15	0.95	1.0	100	-0.065
1N5228	3.9	20	23	1900	10	0.95	1.0	75	-0.060
1N5229	4.3	20	22	2000	5.0	0.95	1.0	50	±0.055
1N5230	4.7	20	19	1900	5.0	1.9	2.0	50	±0.030
1N5231	5.1	20	17	1600	5.0	1.9	2.0	50	±0.030
1N5232	5.6	20	11	1600	5.0	2.9	3.0	50	+0.038
1N5233	6.0	20	7.0	1600	5.0	3.3	3.5	50	+0.038
1N5234	6.2	20	7.0	1000	5.0	3.8	4.0	50	+0.045
1N5235	6.8	20	5.0	750	3.0	4.8	5.0	30	+0.050
1N5236	7.5	20	6.0	500	3.0	5.7	6.0	30	+0.058
1N5237	8.2	20	8.0	500	3.0	6.2	6.5	30	+0.062
1N5238	8.7	20	8.0	600	3.0	6.2	6.5	30	+0.065
1N5239	9.1	20	10	600	3.0	6.7	7.0	30	+0.068
1N5240	10	20	17	600	3.0	7.6	8.0	30	+0.075
1N5241	11	20	22	600	2.0	8.0	8.4	30	+0.076
1N5242	12	20	30	600	1.0	8.7	9.1	10	+0.077
1N5243	13	9.5	13	600	0.5	9.4	9.9	10	+0.079
1N5244	14	9.0	15	600	0.1	9.5	10	10	+0.082
1N5245	15	8.5	16	600	0.1	10.5	11	10	+0.082
1N5246	16	7.8	17	600	0.1	11.4	12	10	+0.083
1N5247	17	7.4	19	600	0.1	12.4	13	10	+0.084
1N5248	18	7.0	21	600	0.1	13.3	14	10	+0.085
1N5249	19	6.6	23	600	0.1	13.3	14	10	+0.086
1N5250	20	6.2	25	600	0.1	14.3	15	10	+0.086
1N5251	22	5.6	29	600	0.1	16.2	17	10	+0.087
1N5252	24	5.2	33	600	0.1	17.1	18	10	+0.088
1N5253	25	5.0	35	600	0.1	18.1	19	10	+0.089
1N5254	27	4.6	41	600	0.1	20	21	10	+0.090
1N5255	28	4.5	44	600	0.1	20	21	10	+0.091
1N5256	30	4.2	49	600	0.1	22	23	10	+0.091
1N5257	33	3.8	58	700	0.1	24	25	10	+0.092
1N5258	36	3.4	70	700	0.1	26	27	10	+0.093
1N5259	39	3.2	80	800	0.1	29	30	10	+0.094
1N5260	43	3.0	93	900	0.1	31	33	10	+0.095
1N5261	47	2.7	105	1000	0.1	34	36	10	+0.095
1N5262	51	2.5	125	1100	0.1	37	39	10	+0.096
1N5263	56	2.2	150	1300	0.1	41	43	10	+0.096
1N5264	60	2.1	170	1400	0.1	44	46	10	+0.097
1N5265	62	2.0	185	1400	0.1	45	47	10	+0.097
1N5266	68	1.8	230	1600	0.1	49	52	10	+0.097
1N5267	75	1.7	270	1700	0.1	53	56	10	+0.098
1N5268	82	1.5	330	2000	0.1	59	62	10	+0.098
1N5269	87	1.4	370	2200	0.1	65	68	10	+0.099
1N5270	91	1.4	400	2300	0.1	66	69	10	+0.099
1N5271	100	1.3	500	2600	0.1	72	76	10	+0.110
1N5272	110	1.1	750	3000	0.1	80	84	10	+0.110
1N5273	120	1.0	900	4000	0.1	86	91	10	+0.110
1N5274	130	0.95	1100	4500	0.1	94	99	10	+0.110
1N5275	140	0.90	1300	4500	0.1	101	106	10	+0.110
1N5276	150	0.85	1500	5000	0.1	108	114	10	+0.110
1N5277	160	0.80	1700	5500	0.1	116	122	10	+0.110
1N5278	170	0.74	1900	5500	0.1	123	129	10	+0.110
1N5279	180	0.68	2200	6000	0.1	130	137	10	+0.110
1N5280	190	0.66	2400	6500	0.1	137	144	10	+0.110
1N5281	200	0.65	2500	7000	0.1	144	152	10	+0.110

NOTE 1 — TOLERANCE AND VOLTAGE DESIGNATION

Tolerance designation — The JEDEC type numbers shown indicate a tolerance of ±10% with guaranteed limits on only V_Z, I_R and V_F as shown in the above table. Units with guaranteed limits on all six parameters are indicated by suffix "A" for ±10% tolerance and suffix "B" for ±5.0% units.

Non-Standard voltage designation — To designate units with zener voltages other than those assigned JEDEC numbers, the type number should be used.

EXAMPLE:

0.5 M 90 Z S 5

0.5 Watt
Manufacturer
Nominal Voltage
Zener Diodes
Surmetic
Tolerance (±%)

NOTE 2 — SPECIAL SELECTIONS AVAILABLE INCLUDE:

1 — Nominal zener voltages between those shown.

2 — **Matched sets: (Standard Tolerances are ±5.0%, ±3.0%, ±2.0%, ±1.0%) depending on voltage per device.**

a. 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.

b. Two or more units matched to one another with any specified tolerance.

3 — Tight voltage tolerances: 1.0%, 2.0%, 3.0%.

NOTE 3 — TEMPERATURE COEFFICIENT (θ_{VZ})

Test conditions for temperature coefficient are as follows:

a. I_{ZT} = 7.5 mA, T_1 = 25°C,
T_2 = 125°C (1N5221A, B thru 1N5242A, B.)

b. I_{ZT} = Rated I_{ZT}, T_1 = 25°C,
T_2 = 125°C (1N5243A, B thru 1N5281A, B.)

Device to be temperature stabilized with current applied prior to reading breakdown voltage at the specified ambient temperature.

1N5221 thru 1N5281 series *(continued)*

TYPICAL REVERSE CHARACTERISTICS FOR SELECTED ZENER DIODES

Curves marked T_A were obtained from dc measurements at thermal equilibrium; lead length = 3/8"; thermal resistance of heat sink = 30°C/W.
Curves marked T_J were obtained from pulse tests; mounting conditions are not a factor.

$V_{Z(Nominal)}$ = 3.3 Volts

FIGURE 2

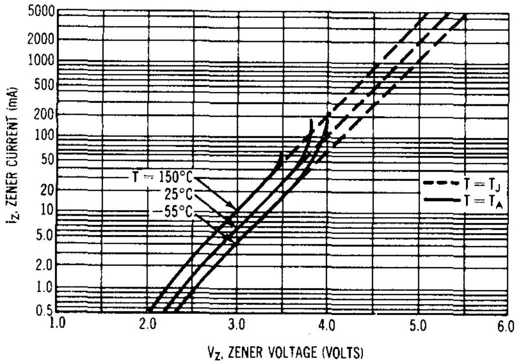
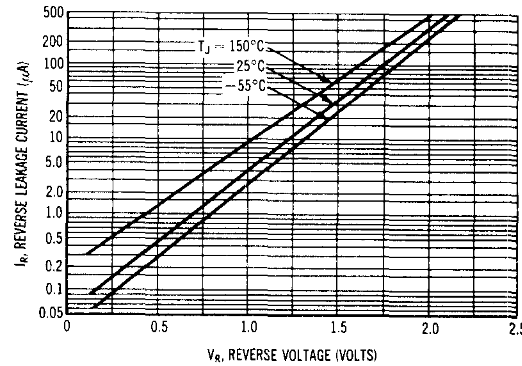


FIGURE 3



$V_{Z(Nominal)}$ = 5.1 Volts

FIGURE 4

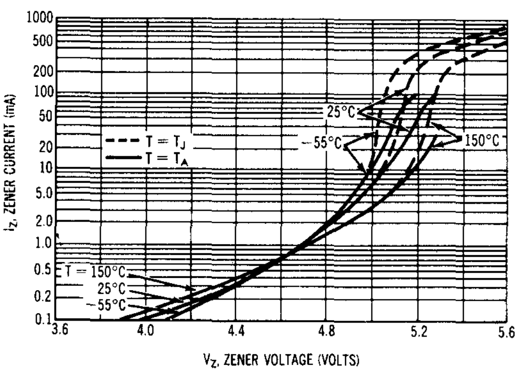
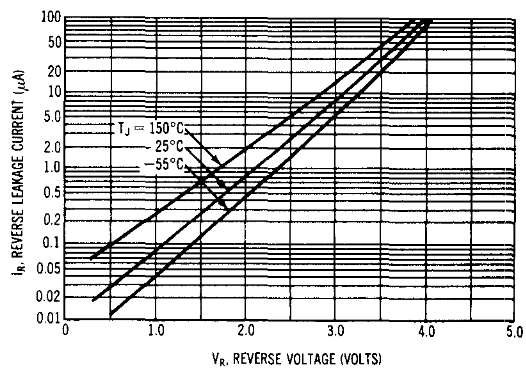


FIGURE 5



$V_{Z(Nominal)}$ = 27 Volts

FIGURE 6

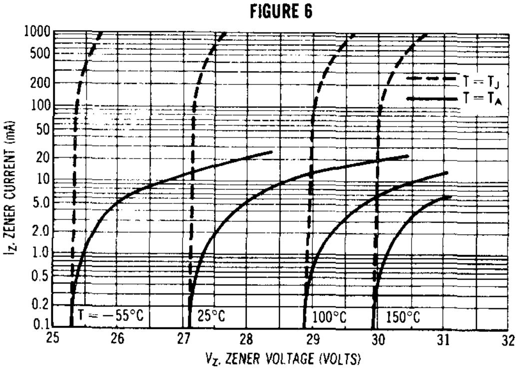
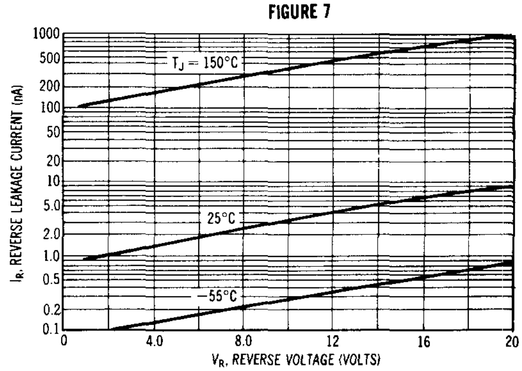


FIGURE 7



1N5221 thru 1N5281 series (continued)

TEMPERATURE COEFFICIENTS AND VOLTAGE REGULATION

(90% of the units are in the ranges indicated)

FIGURE 8 — RANGE FOR UNITS TO 12 VOLTS

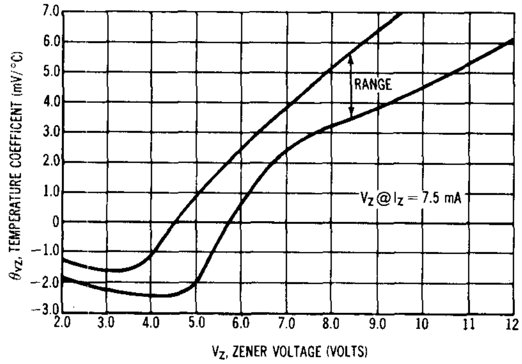


FIGURE 9 — RANGE FOR UNITS 12 TO 200 VOLTS

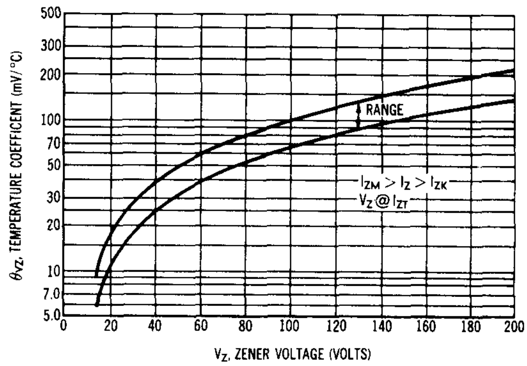


FIGURE 10 — EFFECT OF ZENER CURRENT

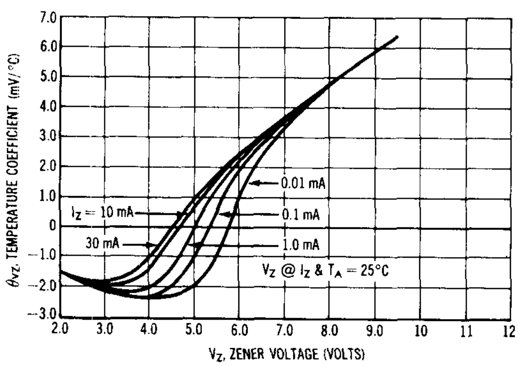
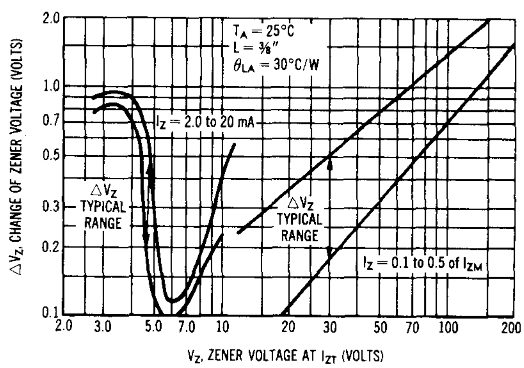


FIGURE 11 — VOLTAGE REGULATION



TYPICAL ZENER IMPEDANCE

FIGURE 12 — EFFECT OF ZENER CURRENT

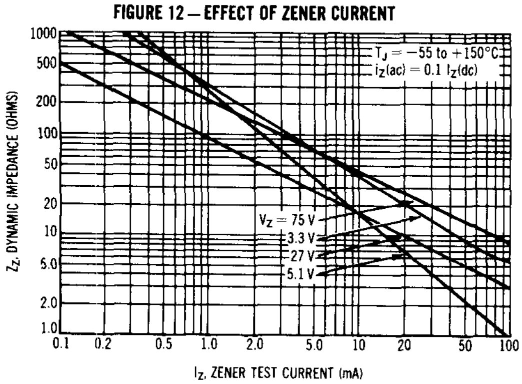
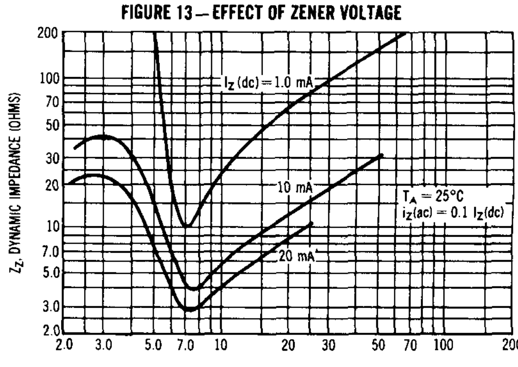


FIGURE 13 — EFFECT OF ZENER VOLTAGE



1N5221 thru 1N5281 Series (continued)

FIGURE 14 — TYPICAL THERMAL RESPONSE

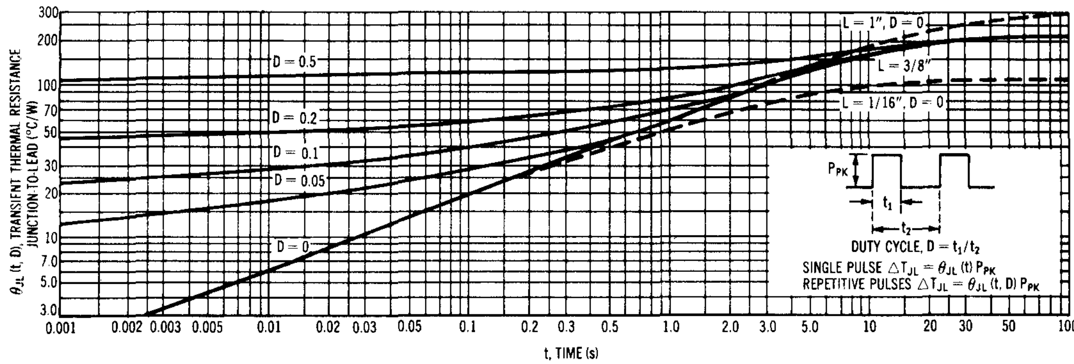


FIGURE 15 — TYPICAL THERMAL RESISTANCE

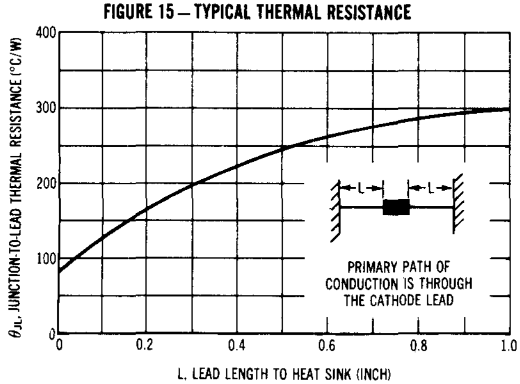
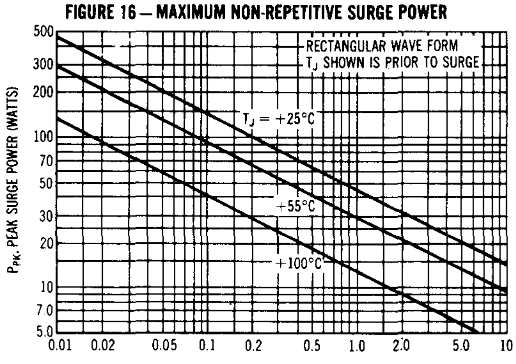


FIGURE 16 — MAXIMUM NON-REPETITIVE SURGE POWER



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 and P_D is the power dissipation. θ_{LA} is generally 30-40°C/W for the various clips and tie points in common use and for printed circuit board wiring.

Junction Temperature, T_J, may be found from:

$$T_J = T_L + \Delta T_{JL}$$

ΔT_{JL} is the increase in junction temperature above the lead temperature and may be found from Figure 14 for a train of power pulses or from Figure 15 for dc power.

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 8, 9, and 10.

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, use short leads, especially to the cathode, and keep current excursions as low as possible.

Data of Figure 14 should not be used to compute surge capability. Surge limitations are given in Figure 16. 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 16 be exceeded.

1N5221 thru 1N5281 Series (continued)

FIGURE 17 — TYPICAL CAPACITANCE

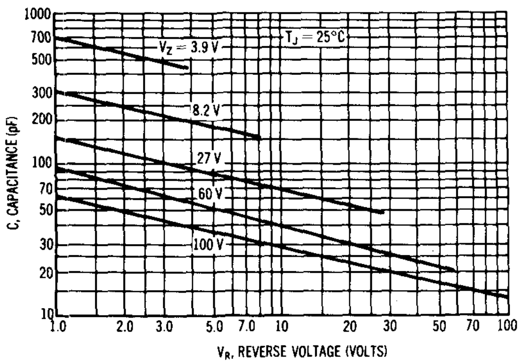


FIGURE 18 — TYPICAL FORWARD CHARACTERISTICS

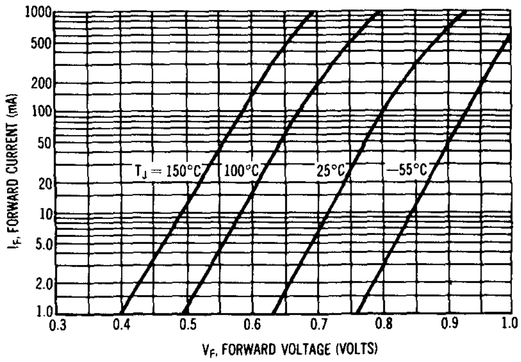


FIGURE 19 — TYPICAL NOISE DENSITY

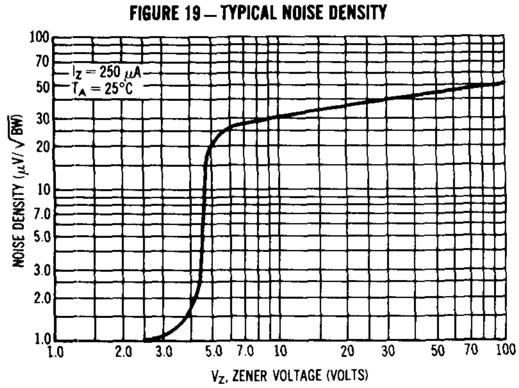
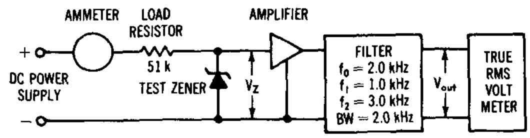


FIGURE 20 — NOISE DENSITY MEASUREMENT METHOD



$$\text{NOISE DENSITY (VOLTS PER SQUARE ROOT BANDWIDTH)} = \frac{V_{out}}{\text{OVERALL GAIN}\sqrt{BW}}$$

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. The data of Figure 19 and the formula can also be used to find noise for any system bandwidth.