1N5913B Series

3 Watt DO-41 Surmetic™ 30 Zener Voltage Regulators

This is a complete series of 3 Watt Zener diodes with limits and excellent operating characteristics that reflect the superior capabilities of silicon–oxide passivated junctions. All this in an axial–lead, transfer–molded plastic package that offers protection in all common environmental conditions.

Specification Features:

- Zener Voltage Range – 3.3 V to 200 V
- ESD Rating of Class 3 (>16 KV) per Human Body Model
- Surge Rating of 98 W @ 1 ms
- Maximum Limits Guaranteed on up to Six Electrical Parameters
- Package No Larger than the Conventional 1 Watt Package

Mechanical Characteristics:

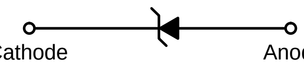
CASE: Void free, transfer–molded, thermosetting plastic
FINISH: All external surfaces are corrosion resistant and leads are readily solderable
MAXIMUM LEAD TEMPERATURE FOR SOLDERING PURPOSES: 230°C, 1/16″ from the case for 10 seconds
POLARITY: Cathode indicated by polarity band
MOUNTING POSITION: Any

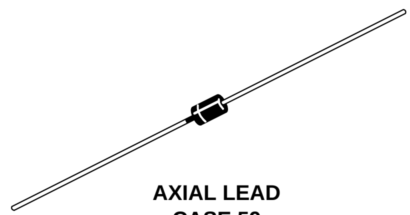
MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Max. Steady State Power Dissipation @ T_L = 75°C, Lead Length = 3/8″ Derate above 75°C	P_D	3 24	W mW/°C
Steady State Power Dissipation @ T_A = 50°C Derate above 50°C	P_D	1 6.67	W mW/°C
Operating and Storage Temperature Range	T_J, T_{stg}	–65 to +200	°C

ON Semiconductor™

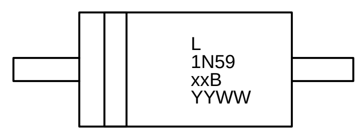
http://onsemi.com





AXIAL LEAD
CASE 59
PLASTIC

MARKING DIAGRAM



L	= Assembly Location
1N59xxB	= Device Code (See Table Next Page)
YY	= Year
WW	= Work Week

ORDERING INFORMATION

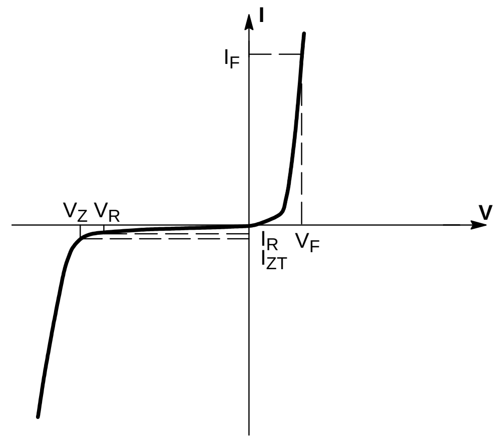
Device	Package	Shipping
1N59xxB	Axial Lead	2000 Units/Box
1N59xxBRL	Axial Lead	6000/Tape & Reel
1N59xxBRR1 †	Axial Lead	2000/Tape & Reel
1N59xxBRR2 ‡	Axial Lead	2000/Tape & Reel

† Polarity band **up** with cathode lead off first
‡ Polarity band **down** with cathode lead off first

Devices listed in ***bold, italic*** are ON Semiconductor **Preferred** devices. **Preferred** devices are recommended choices for future use and best overall value.

ELECTRICAL CHARACTERISTICS
(T_L = 30°C unless otherwise noted,
V_F = 1.5 V Max @ I_F = 200 mAdc for all types)

Symbol	Parameter
V_Z	Reverse Zener Voltage @ I_{ZT}
I_{ZT}	Reverse Current
Z_{ZT}	Maximum Zener Impedance @ I_{ZT}
I_{ZK}	Reverse Current
Z_{ZK}	Maximum Zener Impedance @ I_{ZK}
I_R	Reverse Leakage Current @ V_R
V_R	Breakdown Voltage
I_F	Forward Current
V_F	Forward Voltage @ I_F
I_{ZM}	Maximum DC Zener Current



Zener Voltage Regulator

ELECTRICAL CHARACTERISTICS (T_L = 30°C unless otherwise noted, V_F = 1.5 V Max @ I_F = 200 mAdc for all types)

Device (Note 1)	Device Marking	Zener Voltage (Note 2)				Zener Impedance (Note 3)			Leakage Current		I_{ZM}
		V_Z (Volts)			@ I_{ZT}	Z_{ZT} @ I_{ZT}	Z_{ZK} @ I_{ZK}		I_R @ V_R		
		Min	Nom	Max	mA	Ω	Ω	mA	μA Max	Volts	mA
1N5913B	1N5913B	3.14	3.3	3.47	113.6	10	500	1	100	1	454
1N5917B	1N5917B	4.47	4.7	4.94	79.8	5	500	1	5	1.5	319
1N5919B	1N5919B	5.32	5.6	5.88	66.9	2	250	1	5	3	267
1N5920B	***1N5920B***	***5.89***	***6.2***	***6.51***	***60.5***	***2***	***200***	***1***	***5***	***4***	***241***
1N5921B	1N5921B	6.46	6.8	7.14	55.1	2.5	200	1	5	5.2	220
1N5923B	1N5923B	7.79	8.2	8.61	45.7	3.5	400	0.5	5	6.5	182
1N5924B	1N5924B	8.65	9.1	9.56	41.2	4	500	0.5	5	7	164
1N5925B	1N5925B	9.50	10	10.50	37.5	4.5	500	0.25	5	8	150
1N5926B	1N5926B	10.45	11	11.55	34.1	5.5	550	0.25	1	8.4	136
1N5927B	1N5927B	11.40	12	12.60	31.2	6.5	550	0.25	1	9.1	125
1N5929B	***1N5929B***	***14.25***	***15***	***15.75***	***25.0***	***9***	***600***	***0.25***	***1***	***11.4***	***100***
1N5930B	1N5930B	15.20	16	16.80	23.4	10	600	0.25	1	12.2	93
1N5931B	1N5931B	17.10	18	18.90	20.8	12	650	0.25	1	13.7	83
1N5932B	1N5932B	19.00	20	21.00	18.7	14	650	0.25	1	15.2	75
1N5933B	1N5933B	20.90	22	23.10	17.0	17.5	650	0.25	1	16.7	68
1N5934B	1N5934B	22.80	24	25.20	15.6	19	700	0.25	1	18.2	62
1N5935B	1N5935B	25.65	27	28.35	13.9	23	700	0.25	1	20.6	55
1N5936B	***1N5936B***	***28.50***	***30***	***31.50***	***12.5***	***28***	***750***	***0.25***	***1***	***22.8***	***50***
1N5937B	1N5937B	31.35	33	34.65	11.4	33	800	0.25	1	25.1	45
1N5938B	1N5938B	34.20	36	37.80	10.4	38	850	0.25	1	27.4	41
1N5940B	1N5940B	40.85	43	45.15	8.7	53	950	0.25	1	32.7	34
1N5941B	1N5941B	44.65	47	49.35	8.0	67	1000	0.25	1	35.8	31
1N5942B	1N5942B	48.45	51	53.55	7.3	70	1100	0.25	1	38.8	29
1N5943B	1N5943B	53.20	56	58.80	6.7	86	1300	0.25	1	42.6	26
1N5944B	1N5944B	58.90	62	65.10	6.0	100	1500	0.25	1	47.1	24
1N5945B	1N5945B	64.60	68	71.40	5.5	120	1700	0.25	1	51.7	22
1N5946B	1N5946B	71.25	75	78.75	5.0	140	2000	0.25	1	56	20
1N5947B	1N5947B	77.90	82	86.10	4.6	160	2500	0.25	1	62.2	18
1N5948B	1N5948B	86.45	91	95.55	4.1	200	3000	0.25	1	69.2	16
1N5950B	1N5950B	104.5	110	115.5	3.4	300	4000	0.25	1	83.6	13
1N5951B	1N5951B	114	120	126	3.1	380	4500	0.25	1	91.2	12
1N5952B	1N5952B	123.5	130	136.5	2.9	450	5000	0.25	1	98.8	11
1N5953B	1N5953B	142.5	150	157.5	2.5	600	6000	0.25	1	114	10
1N5954B	1N5954B	152	160	168	2.3	700	6500	0.25	1	121.6	9
1N5955B	***1N5955B***	***171***	***180***	***189***	***2.1***	***900***	***7000***	***0.25***	***1***	***136.8***	***8***
1N5956B	1N5956B	190	200	210	1.9	1200	8000	0.25	1	152	7

1. **TOLERANCE AND TYPE NUMBER DESIGNATION**
   Tolerance designation – device tolerance of ±5% are indicated by a “B” suffix.
2. **ZENER VOLTAGE (V_Z) MEASUREMENT**
   ON Semiconductor 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.
3. **ZENER IMPEDANCE (Z_Z) DERIVATION**
   The zener impedance is derived from 60 seconds 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}.

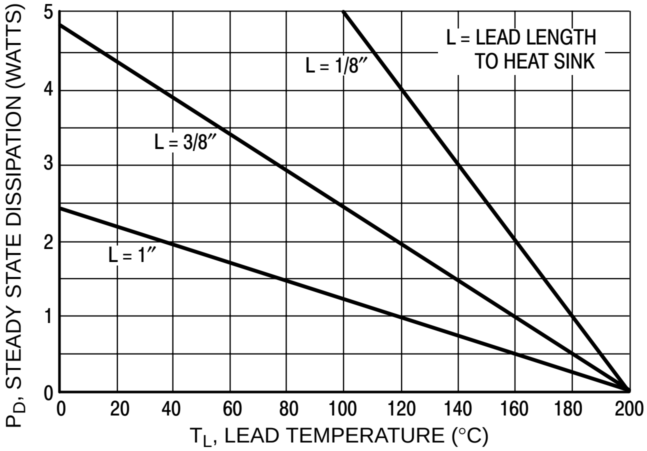


Figure 1. Power Temperature Derating Curve

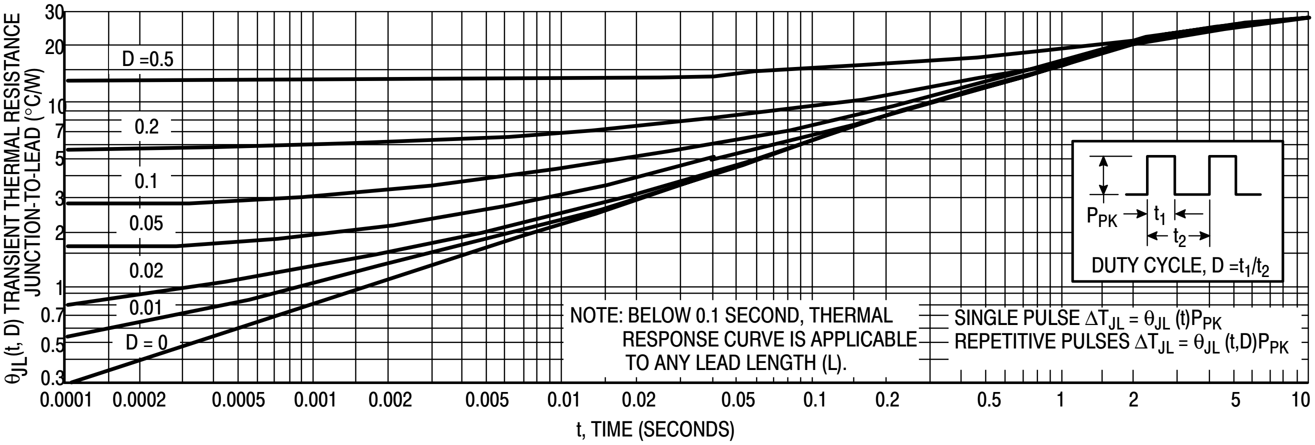


Figure 2. Typical Thermal Response L, Lead Length = 3/8 Inch

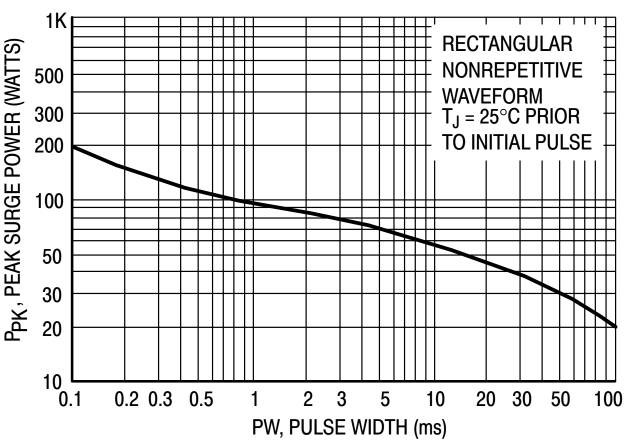


Figure 3. Maximum Surge Power

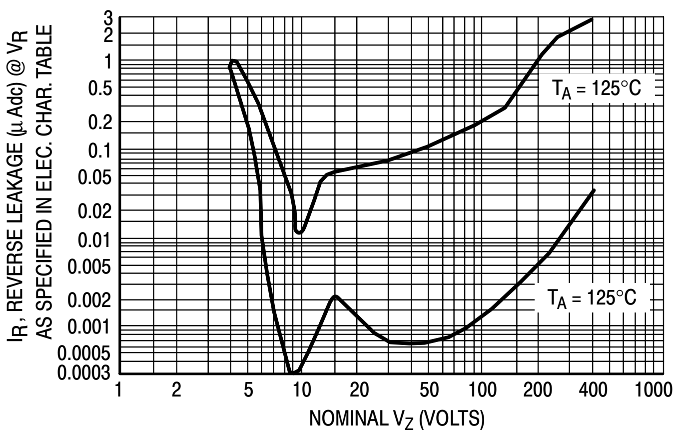


Figure 4. Typical Reverse Leakage

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)

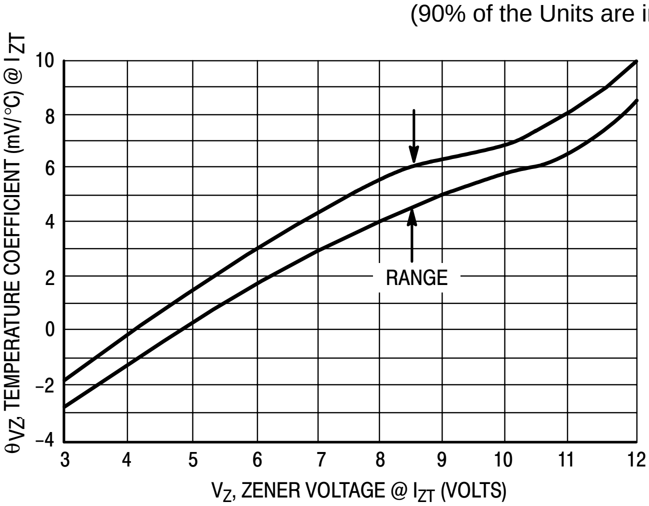


Figure 5. Units To 12 Volts

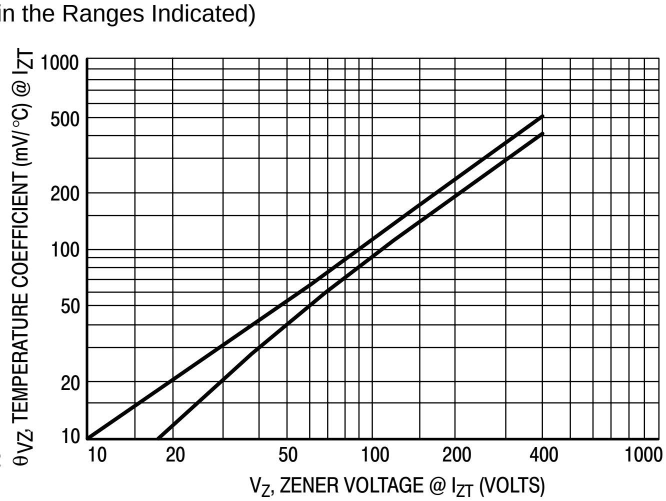


Figure 6. Units 10 To 400 Volts

ZENER VOLTAGE versus ZENER CURRENT

(Figures 7, 8 and 9)

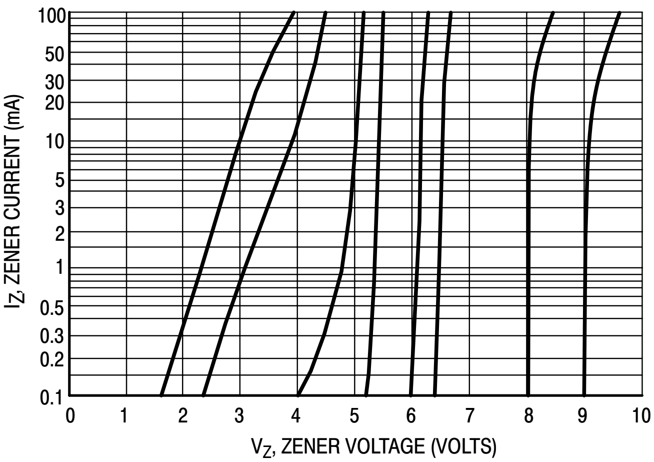


Figure 7. V_Z = 3.3 thru 10 Volts

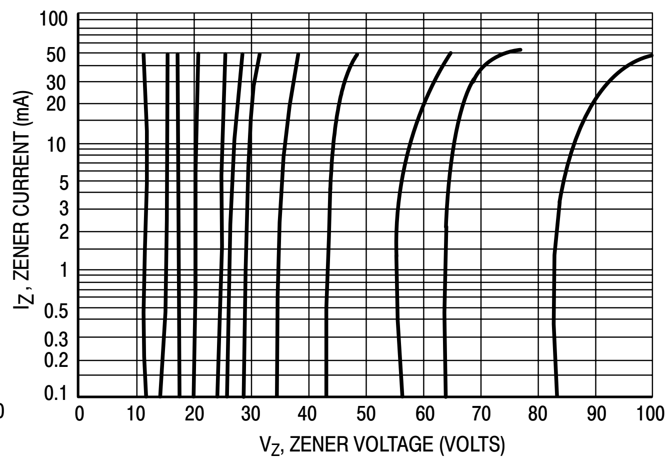


Figure 8. V_Z = 12 thru 82 Volts

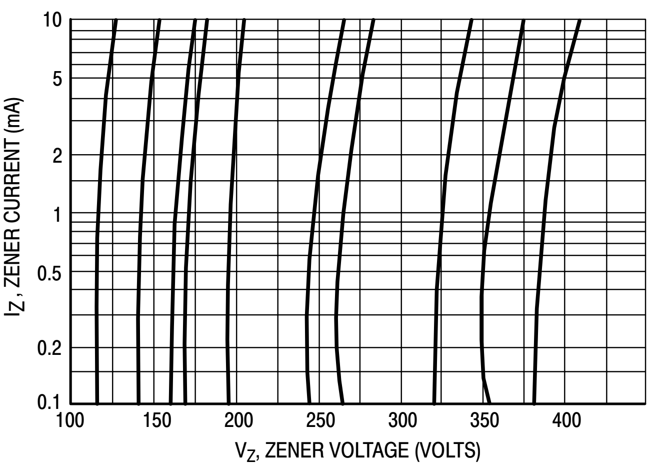


Figure 9. V_Z = 100 thru 400 Volts

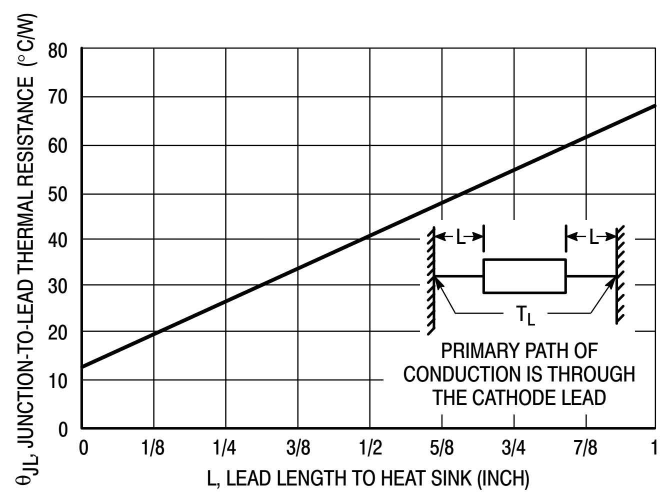


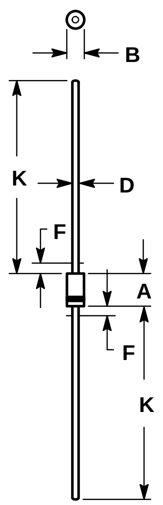
Figure 10. Typical Thermal Resistance

OUTLINE DIMENSIONS

Zener Voltage Regulators – Axial Leaded

3 Watt DO–41 Surmetic™ 30

PLASTIC DO–41
CASE 59–10
ISSUE R



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 59–04 OBSOLETE, NEW STANDARD 59–09.
4. 59–03 OBSOLETE, NEW STANDARD 59–10.
5. ALL RULES AND NOTES ASSOCIATED WITH JEDEC DO–41 OUTLINE SHALL APPLY
6. POLARITY DENOTED BY CATHODE BAND.
7. LEAD DIAMETER NOT CONTROLLED WITHIN F DIMENSION.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.161	0.205	4.10	5.20
B	0.079	0.106	2.00	2.70
D	0.028	0.034	0.71	0.86
F	---	0.050	---	1.27
K	1.000	---	25.40	---

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PUBLICATION ORDERING INFORMATION

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