Available on commercial versions

# 11.7 Volt Temperature Compensated Zener Reference Diodes

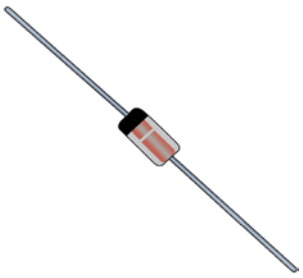
*Qualified per MIL-PRF-19500/157*

*Qualified Levels:*
*JAN, JANTX, JANTXV and JANS*
*(available on some part numbers)*

## DESCRIPTION

The popular 1N941-1 thru 1N945B-1 series of zero-TC reference diodes provides a selection of 11.7 V nominal voltages and temperature coefficients to as low as 0.0002 %/°C for minimal voltage change with temperature when operated at 7.5 mA. The "B" version of these glass, axial-leaded DO-35 reference diodes are also available in JAN, JANTX, JANTXV, and JANS military qualifications. Microsemi also offers numerous other Zener reference diode products for a variety of other voltages from 6.2 V to 200 V.

**Important:** For the latest information, visit our website http://www.microsemi.com.



**DO-35 (DO-204AH) Package**

Also available in:

**DO-213AA**
(surface mount)
1N941UR-1 thru 1N945BUR-1

## FEATURES

- JEDEC registered 1N941 thru 1N945 series.
- Standard reference voltage of 11.7 V +/- 5% with tighter reference tolerances of 1%, 2%, and 3% available on commercial level only.
- Internal metallurgical bond.
- JAN, JANTX, JANTXV, and JANS qualification per MIL-PRF-19500/157 available for 1N941B-1, 1N943B-1, 1N944B-1, and 1N945B-1.
- RoHS compliant versions available (commercial grade only).

## APPLICATIONS / BENEFITS

- Provides minimal voltage changes over a broad temperature range.
- For instrumentation and other circuit designs requiring a stable voltage reference.
- Maximum temperature coefficient selections available from 0.01 %/°C to 0.0005 %/°C.
- Flexible axial-lead mounting terminals.
- Non-sensitive to ESD per MIL-STD-750 method 1020.

## MAXIMUM RATINGS

| Parameters/Test Conditions | Symbol | Value | Unit |
|---|---|---|---|
| Power Dissipation @ $T_{A}$ = +25 °C and maximum current $I_{ZM}$ of 39 mA. (1, 2) | $P_D$ | 500 | mW |
| Junction and Storage Temp | $T_J$ and $T_{STG}$ | -55 to +175 | °C |
| Maximum Zener Current | $I_{ZM}$ | 39 | mA |
| Solder Temperature @ 10 s | $T_{SP}$ | 260 | °C |

**Notes:** 1. For optimum voltage-temperature stability, $I_Z$ = 7.5 mA (less than 95 mW in dissipated power).
2. Derate at 3.33 mW/°C above $T_A$ = +25 °C.

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## MECHANICAL and PACKAGING

- CASE: Hermetically sealed glass case with axial DO-35 (DO-204AH) package.
- TERMINALS: Tin-lead plated or RoHS compliant matte-tin plating available (on commercial grade only) and solderable per MIL-STD-750, method 2026.
- MARKING: Part number and cathode band.
- POLARITY: Reference diode to be operated with the banded end positive with respect to the opposite end.
- TAPE & REEL option: Standard per EIA-296. Consult factory for quantities. (Add "TR" suffix to part number.)
- WEIGHT: 0.2 grams.
- See Package Dimensions on the last page.

## PART NOMENCLATURE

*Applicable to: JAN, JANTX, JANTXV and JANS level 1N941B, 1N943B, 1N944B, and 1N945B only:*

**JAN 1N941 B -1**

**Reliability Level**
JAN = JAN Level
JANTX = JANTX Level
JANTXV = JANTXV Level
JANS = JANS Level

**JEDEC type number**
(See Electrical Characteristics table)

**Metallurgically Bonded**

**Temperature Coefficient range of -55 °C to +150 °C**

*Applicable to: commercial level 1N941 thru 1N945B:*

**1N941 A -1 -1% (e3)**

**JEDEC type number**
(See Electrical Characteristics table)

**Temperature Coefficient range:**
A = -55 °C to +100 °C
B = -55 °C to +150 °C
Blank = 0 °C to +75 °C

**RoHS Compliance**
e3 = RoHS compliant (available on commercial grade only)
Blank = non-RoHS compliant

**Tighter Reference Tolerance**
1%
2%
3%
Blank = 5%

**Metallurgically Bonded**

| SYMBOLS & DEFINITIONS | |
|---|---|
| **Symbol** | **Definition** |
| $I_R$ | Reverse Current: The maximum reverse (leakage) current that will flow at the specified voltage and temperature. |
| $I_Z$, $I_{ZT}$, $I_{ZK}$ | Regulator Current: The dc regulator current ($I_Z$), at a specified test point ($I_{ZT}$), near breakdown knee ($I_{ZK}$). |
| $I_{ZM}$ | Maximum Regulator (Zener) Current: The maximum rated dc current for the specified power rating. |
| $V_Z$ | Zener Voltage: The Zener voltage the device will exhibit at a specified current ($I_Z$) in its breakdown region. |
| $V_{ZT}$ | Zener Voltage Temperature. |
| $Z_{ZT}$ or $Z_{ZK}$ | Dynamic Impedance: The small signal impedance of the diode when biased to operate in its breakdown region at a specified rms current modulation (typically 10% of $I_{ZT}$ or $I_{ZK}$) and superimposed on $I_{ZT}$ or $I_{ZK}$ respectively. |

## ELECTRICAL CHARACTERISTICS @ 25 °C unless otherwise specified

| JEDEC TYPE NUMBER (Note 4) | ZENER VOLTAGE $V_Z$ @ $I_{ZT}$ (Note 3) | ZENER TEST CURRENT $I_{ZT}$ | MAXIMUM ZENER IMPEDANCE $Z_{ZT}$ @ $I_{ZT}$ (Note 1) | MAXIMUM REVERSE CURRENT $I_R$ @ 8 V | VOLTAGE TEMPERATURE STABILITY $\Delta V_{ZT}$ MAXIMUM (Note 2 & 3) | TEMPERATURE RANGE | EFFECTIVE TEMPERATURE COEFFICIENT $\alpha_{VZ}$ |
|---|---|---|---|---|---|---|---|
| | **Volts** | **mA** | **Ohms** | **µA** | **mV** | **°C** | **% / °C** |
| **1N941-1** | 11.12 - 12.28 | 7.5 | 30 | 15 | 88 | 0 to +75 | 0.01 |
| **1N941A-1** | 11.12 - 12.28 | 7.5 | 30 | 15 | 181 | -55 to +100 | 0.01 |
| **1N941B-1** | 11.12 - 12.28 | 7.5 | 30 | 15 | 239 | -55 to +150 | 0.01 |
| **1N942-1** | 11.12 - 12.28 | 7.5 | 30 | 15 | 44 | 0 to +75 | 0.005 |
| **1N942A-1** | 11.12 - 12.28 | 7.5 | 30 | 15 | 90 | -55 to +100 | 0.005 |
| **1N942B-1** | 11.12 - 12.28 | 7.5 | 30 | 15 | 120 | -55 to +150 | 0.005 |
| **1N943-1** | 11.12 - 12.28 | 7.5 | 30 | 15 | 18 | 0 to +75 | 0.002 |
| **1N943A-1** | 11.12 - 12.28 | 7.5 | 30 | 15 | 36 | -55 to +100 | 0.002 |
| **1N943B-1** | 11.12 - 12.28 | 7.5 | 30 | 15 | 47 | -55 to +150 | 0.002 |
| **1N944-1** | 11.12 - 12.28 | 7.5 | 30 | 15 | 9 | 0 to +75 | 0.001 |
| **1N944A-1** | 11.12 - 12.28 | 7.5 | 30 | 15 | 18 | -55 to +100 | 0.001 |
| **1N944B-1** | 11.12 - 12.28 | 7.5 | 30 | 15 | 24 | -55 to +150 | 0.001 |
| **1N945-1** | 11.12 - 12.28 | 7.5 | 30 | 15 | 4 | 0 to +75 | 0.0005 |
| **1N945A-1** | 11.12 - 12.28 | 7.5 | 30 | 15 | 9 | -55 to +100 | 0.0005 |
| **1N945B-1** | 11.12 - 12.28 | 7.5 | 30 | 15 | 12 | -55 to +150 | 0.0005 |

*JEDEC Registered Data.

**NOTES:**

1. Measured by superimposing 0.75 mA ac rms on 7.5 mA dc @ 25 °C.
2. The maximum allowable change observed over the entire temperature range i.e., the diode voltage will not exceed the specified mV change at any discrete temperature between the established limits.
3. Voltage measurements to be performed 15 seconds after application of dc current.
4. The 1N941B-1, 1N943B-1, 1N944B-1, and 1N945B-1 only are military qualified to MIL-PRF-19500/157 up to the JANS level.

## GRAPHS

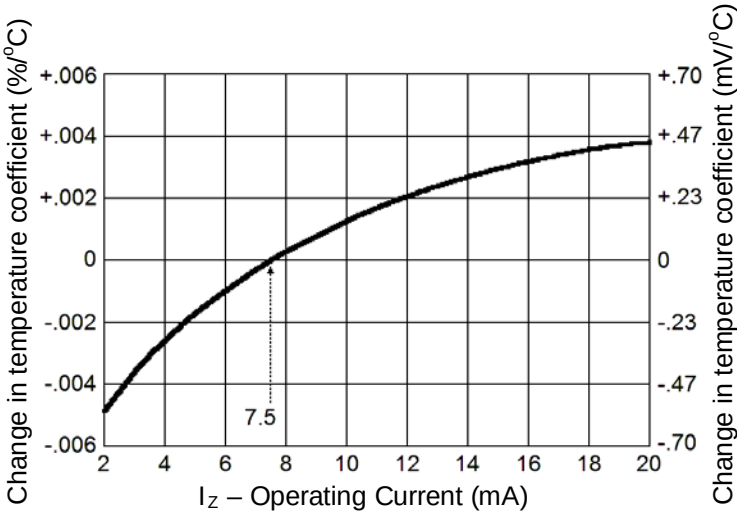



**FIGURE 1**
TYPICAL CHANGE OF TEMPERATURE COEFFICIENT
WITH CHANGE IN OPERATING CURRENT

*The curve shown in Figure 1 is typical of the diode series and greatly simplifies the estimation of the Temperature Coefficient (TC) when the diode is operated at currents other than 7.5 mA.*

*EXAMPLE: A diode in this series is operated at a current of 7.5 mA and has specified Temperature Coefficient (TC) limits of +/-0.002 %/°C. To obtain the typical Temperature Coefficient limits for this same diode operated at a current of 6.0mA, the new TC limits (%/°C) can be estimated using the graph in Figure 1.*

*At a test current of 6.0 mA the change in Temperature Coefficient (TC) is approximately –0.0009 %.°C. The algebraic sum of +/-0.002 %°C and –0.0009 %/°C gives the new estimated limits of +0.0011 %/oC and -0.0029 %/oC.*

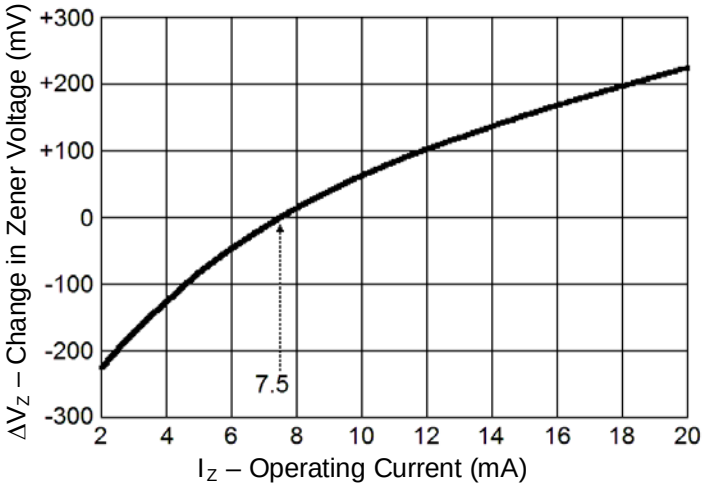



**FIGURE 2**
TYPICAL CHANGE OF ZENER VOLTAGE
WITH CHANGE IN OPERATING CURRENT

*This curve in Figure 2 illustrates the change of diode voltage arising from the effect of impedance. It is in effect, an exploded view of the Zener operating region of the I-V characteristic.*

*In conjunction with Figure 1, this curve can be used to estimate total voltage regulation under conditions of both varying temperature and current.*

## GRAPHS

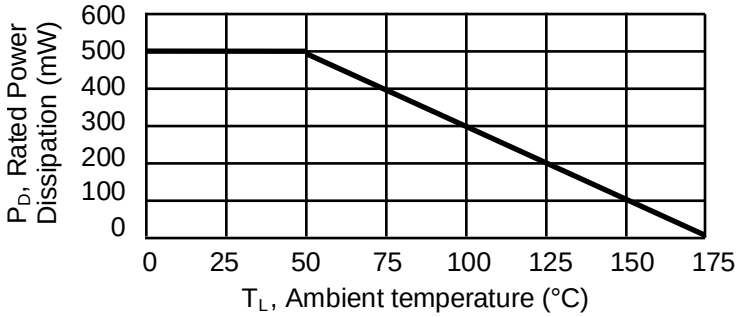



**FIGURE 3**
POWER DERATING CURVE

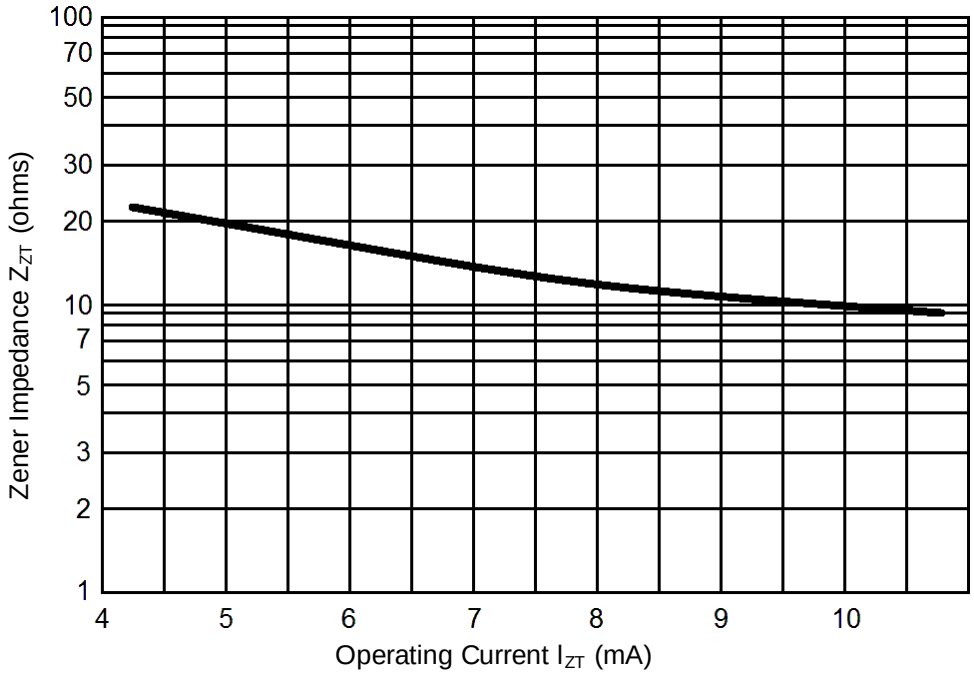
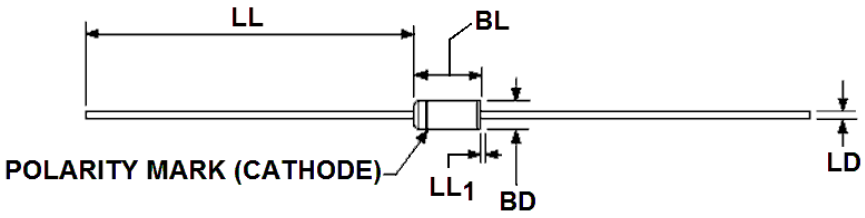



**FIGURE 4**
TYPICAL ZENER IMPEDANCE VS. OPERATING CURRENT

## PACKAGE DIMENSIONS




| Symbol | Dimensions | | | | Notes |
|---|---|---|---|---|---|
| | Inch | | Millimeters | | |
| | Min | Max | Min | Max | |
| BD | 0.600 | 0.107 | 1.52 | 2.72 | 3 |
| BL | 0.120 | 0.300 | 3.05 | 7.62 | 3 |
| LD | 0.018 | 0.023 | 0.46 | 0.58 | |
| LL | 1.000 | 1.500 | 25.40 | 38.10 | |
| $LL_1$ | | 0.050 | | 1.27 | 4 |

**NOTES:**

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Package contour optional within BD and length BL. Heat slugs, if any, shall be included within this cylinder but shall not be subject to minimum limit of BD.
4. Within this zone, lead diameter may vary to allow for lead finishes and irregularities, other than heat slugs.
5. In accordance with ASME Y14.5M, diameters are equivalent to ΦX symbology.