# Micropower Voltage Reference

## FEATURES

- 20μA to 20mA Operating Range
- Guaranteed 1% Initial Voltage Tolerance
- Guaranteed 1Ω Dynamic Impedance
- Very Low Power Consumption

## APPLICATIONS

- Portable Meter References
- Portable Test Instruments
- Battery-Operated Systems
- Panel Meters
- Current Loop Instrumentation

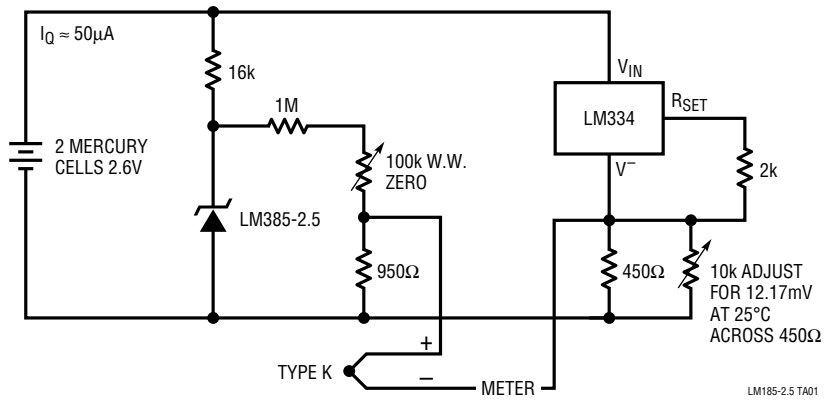
## DESCRIPTION

The LM185-2.5 is a two-terminal band gap reference diode that has been designed for applications which require precision performance with micropower operation. The device provides guaranteed operation specifications at currents as low as 20μA. The nominal voltage is 2.5V with both 1% and 2% tolerances available. Some additional features are: maximum dynamic impedance of 1Ω, low noise and excellent stability over time and temperature. The advanced design, processing and testing techniques make Linear's LM185-2.5 a superior choice over previous designs. A circuit for cold junction compensation of a thermocouple is shown below.

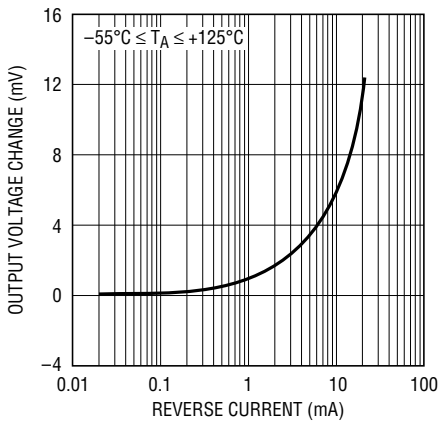
For applications requiring guaranteed temperature drift, see the LT1034 data sheet.

## TYPICAL APPLICATION

**Thermocouple Cold Junction Compensator**



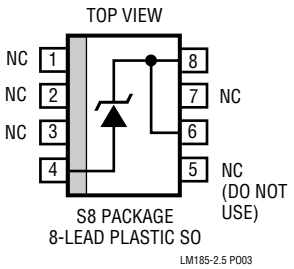

**Reverse Voltage Change**



## ABSOLUTE MAXIMUM RATINGS

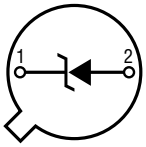
Reverse Breakdown Current ..... 30mA
Forward Current..... 10mA
Operating Temperature Range
LM185-2.5 ..... –55°C to 125°C
LM285-2.5 ..... –40°C to 85°C
LM385-2.5 ..... 0°C to 70°C
Storage Temperature Range
LM185-2.5 ..... –65°C to 150°C
LM285-2.5 ..... –65°C to 150°C
LM385-2.5 ..... –65°C to 150°C
Lead Temperature (Soldering, 10 sec.)..... 300°C

## PACKAGE/ORDER INFORMATION



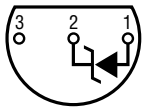
S8 PACKAGE
8-LEAD PLASTIC SO

ORDER PART NUMBER
LM285S8-2.5
LM385S8-2.5
LM385BS8-2.5
PART MARKING
2852
3852
3852B



H PACKAGE
2-LEAD TO-46 METAL CAN

ORDER PART NUMBER
LM185H-2.5
LM285H-2.5
LM385H-2.5
LM385BH-2.5
(NOTE 2)



Z PACKAGE
3-LEAD TO-92 PLASTIC

ORDER PART NUMBER
LM285Z-2.5
LM385Z-2.5
LM385BZ-2.5
(NOTE 2)

## ELECTRICAL CHARACTERISTICS (See Note 1)

| SYMBOL | PARAMETER | CONDITIONS | | LM185-2.5/285-2.5 MIN | LM185-2.5/285-2.5 TYP | LM185-2.5/285-2.5 MAX | LM385-2.5/385B-2.5 MIN | LM385-2.5/385B-2.5 TYP | LM385-2.5/385B-2.5 MAX | UNITS |
|---|---|---|---|---|---|---|---|---|---|---|
| $V_Z$ | Reverse Breakdown Voltage | $T_A$ = 25°C, 20µA ≤ $I_R$ ≤ 20mA | | | | | | | | |
| | | LM185-2.5/285-2.5 | | 2.462 | 2.500 | 2.538 | | | | V |
| | | LM385-2.5 | | | | | 2.425 | 2.500 | 2.575 | V |
| | | LM385B-2.5 (Note 2) | | | | | 2.462 | 2.500 | 2.538 | V |
| $\frac{\Delta V_Z}{\Delta Temp}$ | Average Temperature Coefficient | 20µA ≤ $I_R$ ≤ 20mA (Note 2) | | | 20 | | | 20 | | ppm/°C |
| $I_{MIN}$ | Minimum Operating Current | $T_{MIN} \le T_A \le T_{MAX}$ | ● | | 8 | 20 | | 8 | 20 | µA |
| $\frac{\Delta V_Z}{\Delta I_R}$ | Reverse Breakdown Voltage Change With Current | 20µA ≤ $I_R$ ≤ 1mA | | | | | | | | |
| | | $T_A$ = 25°C | | | | 1.0 | | | 2.0 | mV |
| | | $T_{MIN} \le T_A \le T_{MAX}$ | ● | | | 1.5 | | | 2.5 | mV |
| | | 1mA ≤ $I_R$ ≤ 20mA | | | | | | | | |
| | | $T_A$ = 25°C | | | | 10 | | | 20 | mV |
| | | $T_{MIN} \le T_A \le T_{MAX}$ | ● | | | 20 | | | 25 | mV |
| $r_Z$ | Reverse Dynamic Impedance | $I_R$ = 100µA (Note 3) | | | | | | | | |
| | | $T_A$ = 25°C | | | 0.2 | 0.6 | | 0.4 | 1.0 | Ω |
| | | $T_{MIN} \le T_A \le T_{MAX}$ | ● | | | 1.5 | | | 1.5 | Ω |
| $e_n$ | Wide Band Noise (RMS) | 10Hz ≤ f ≤ 10kHz, $I_R$ = 100µA | | | 120 | | | 120 | | µV |
| $\frac{\Delta V_Z}{\Delta Time}$ | Long Term Stability | $T_A$ = 25°C ± 0.1°C, $I_R$ = 100µA | | | 20 | | | 20 | | ppm/kHr |

The ● denotes specifications which apply over the operating temperature range.

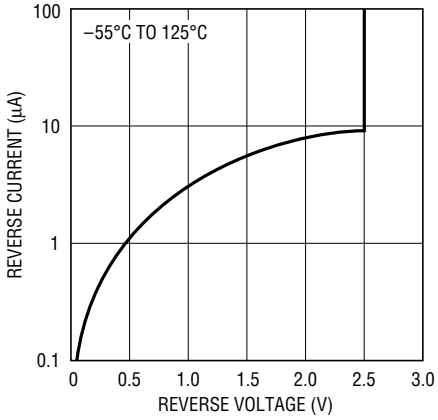
**Note 1:** All specifications are for $T_A$ = 25°C unless otherwise noted. For the LM185-2.5 $T_{MIN}$ = –55°C and $T_{MAX}$ = 125°C. For LM285-2.5, $T_{MIN}$ = –40°C and $T_{MAX}$ = 85°C. For LM385-2.5, $T_{MIN}$ = 0°C and $T_{MAX}$ = 70°C.

**Note 2:** For very low initial tolerance, consult LT1004 data sheet. The LT1004 is a low cost, pin for pin substitution device. For guaranteed temperature coefficient consult the LT1034-2.5 data sheet.

**Note 3:** Guaranteed but not tested.

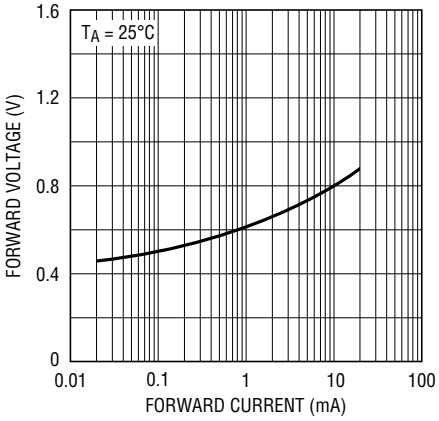
# TYPICAL PERFORMANCE CHARACTERISTICS

**Reverse Characteristics**



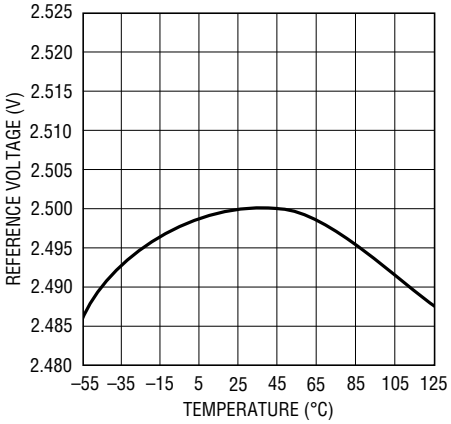

LM185-2.5 • TPC01

**Forward Characteristics**



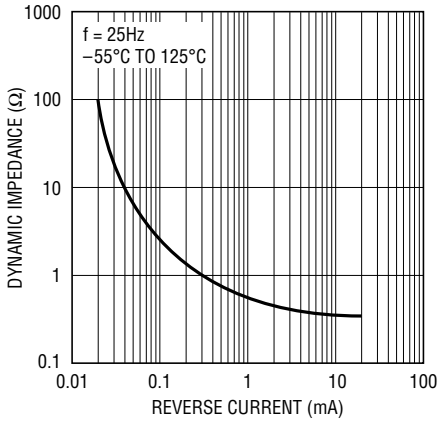

LM185-2.5 • TPC02

**Temperature Drift**



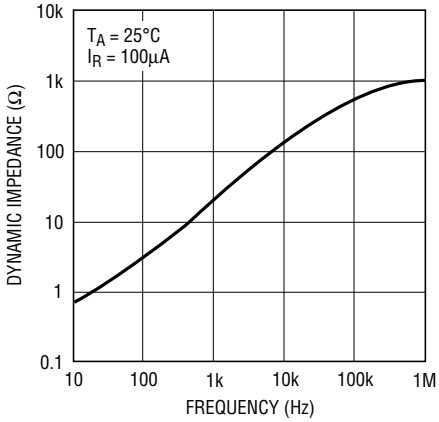

LM185-2.5 • TPC03

**Reverse Dynamic Impedance**



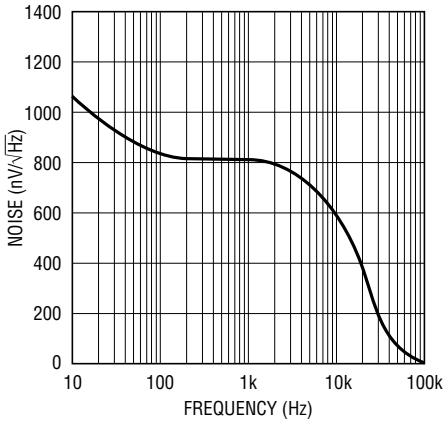

LM185-2.5 • TPC05

**Reverse Dynamic Impedance**



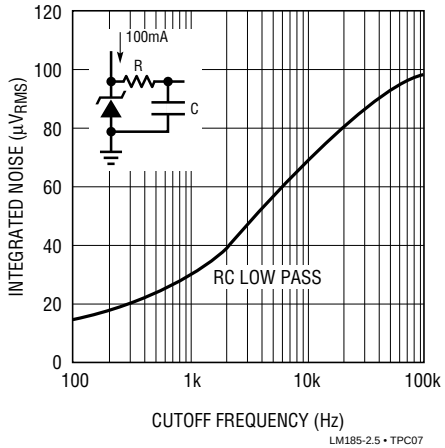

LM185-2.5 • TPC05

**Noise Voltage**



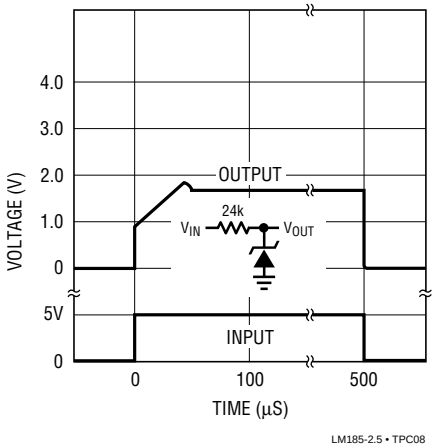

LM185-2.5M • TPC06

**Filtered Output Noise**



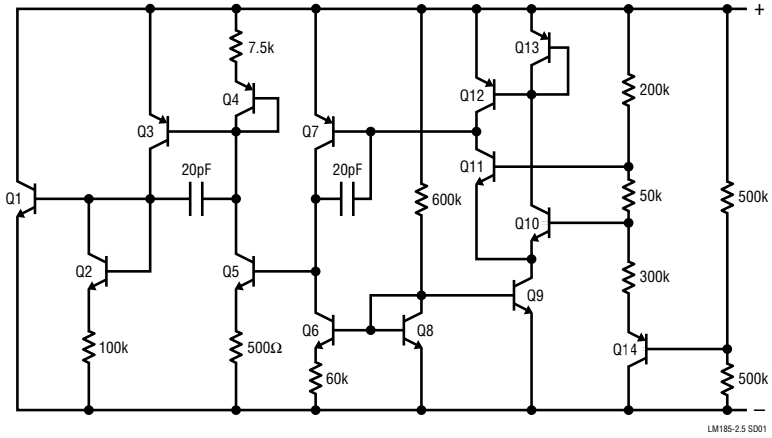

LM185-2.5 • TPC07

**Response Time**

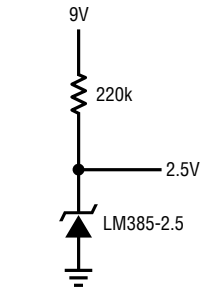



LM185-2.5 • TPC08

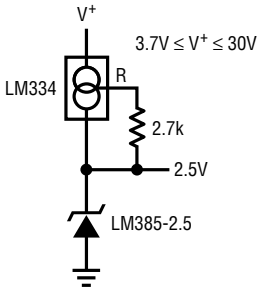
## SCHEMATIC DIAGRAM




## TYPICAL APPLICATIONS




REFERENCE FROM
A 9V BATTERY



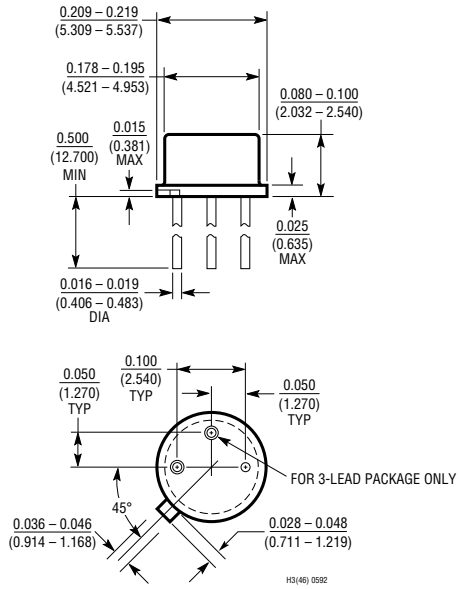

OPERATION OVER A
WIDE SUPPLY RANGE

LM185-2.5 TA03

## PACKAGE DESCRIPTION

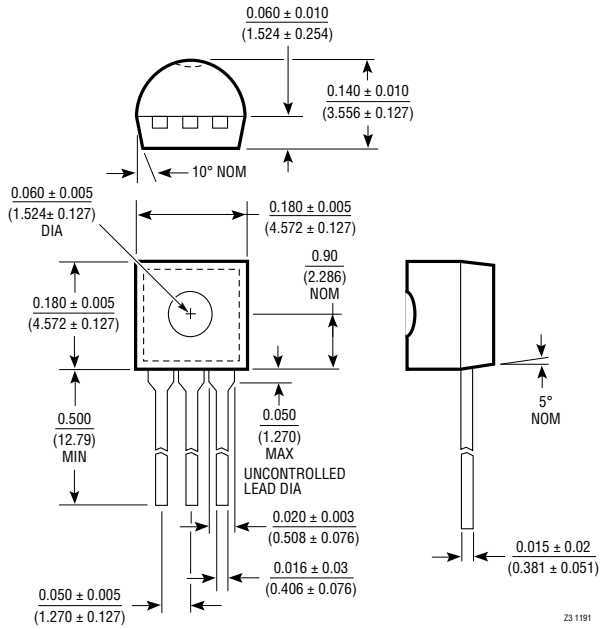
**Dimensions in inches (millimeters) unless otherwise noted.**

### H Package, 2-Lead TO-46 Metal Can



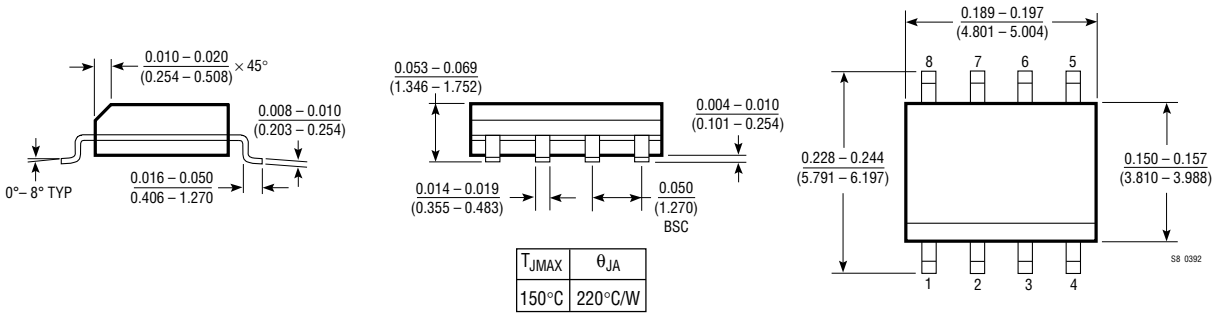

| $T_{JMAX}$ | $\theta_{JA}$ | $\theta_{JC}$ |
|---|---|---|
| 150°C | 440°C/W | 80°CW |

### Z package, 3-Lead TO-92 Plastic




| $T_{JMAX}$ | $\theta_{JA}$ |
|---|---|
| 100°C | 160°C/W |

### S8 package, 8-Lead Plastic SOIC




| $T_{JMAX}$ | $\theta_{JA}$ |
|---|---|
| 150°C | 220°C/W |



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LT/GP 0892 1K REV B