

- Operating Current Range . . . 20 μ A to 20 mA
- 1.5% and 3% Initial Voltage Tolerance
- Reference Impedance . . .
LM185 . . . 0.6 Ω Max at 25°C
LM385 . . . 1 Ω Max at 25°C
All Devices . . . 1.5 Ω Max Over Full Temperature Range
- Very Low Power Consumption
- Applications:
Portable Meter References
Portable Test Instruments
Battery-Operated Systems
Current-Loop Instrumentation
Panel Meters
- Designed to be Interchangeable with National LM185-2.5, LM285-2.5, and LM385-2.5

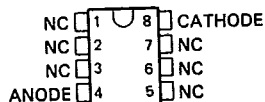
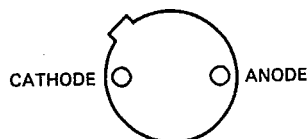
description

These micropower terminal bandgap voltage references operate over a 20- μ A to 20-mA current range and feature exceptionally low dynamic impedance and good temperature stability. On-chip trimming provides tight voltage tolerance. The LM185-2.5 series bandgap reference has low noise and good long-term stability.

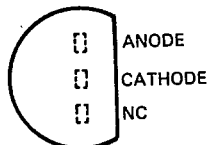
Careful design of the LM185-2.5 series has made the device exceptionally tolerant of capacitive loading, making it easy to use in almost any reference application. The wide dynamic operating temperature range allows its use with widely varying supplies with excellent regulation.

The extremely low-power drain of the LM185-2.5 series makes it useful for micropower circuitry. These voltage references can be used to make portable meters, regulators, or general-purpose analog circuitry with battery life approaching shelf life. Further, the wide operating current range allows them to replace older references with a tighter tolerance part.

The LM185-2.5 is characterized for operation over the full military temperature range of -55°C to 125°C. The LM285-2.5 is characterized for operation from -40°C to 85°C. The LM385-2.5 and LM385B-2.5 are characterized for operation from 0°C to 70°C.

**D PACKAGE
(TOP VIEW)****LD PACKAGE
(TOP VIEW)**

The anode is in electrical contact with the case.

**LP PACKAGE
(TOP VIEW)**

NC—No internal connection

symbol

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Data Sheets

PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS
INSTRUMENTS**

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LM185-2.5, LM285-2.5, LM385-2.5, LM385B-2.5
MICROPOWER VOLTAGE REFERENCES

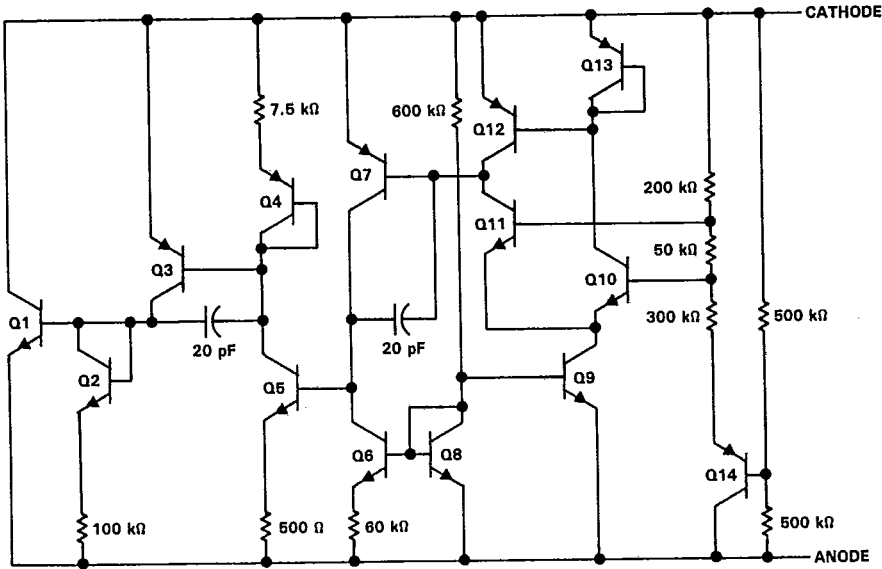
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AVAILABLE OPTIONS

T _A	V _Z TOLERANCE	PACKAGE		
		SMALL OUTLINE (D)	METAL CAN (LD)	PLASTIC (LP)
0°C to 70°C	3%	LM385D-2.5		LM385LP-2.5
	1.5%	LM385BD-2.5		LM385BLP-2.5
-40°C to 85°C	1.5%	LM285D-2.5	LM285LD-2.5	LM285LP-2.5
-55°C to 125°C	1.5%		LM185LD-2.5	

The D package is available taped and reeled. Add the suffix R to the device type (i.e., LM385DR-2.5).

schematic



Component values shown are nominal.

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Data Sheets

LM185-2.5, LM285-2.5, LM385-2.5, LM385B-2.5
MICROPOWER VOLTAGE REFERENCES

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absolute maximum ratings over operating free-air temperature range

Reverse current	30 mA
Forward current	10 mA
Operating free-air temperature range: LM185-2.5	-55°C to 125°C
LM285-2.5	-40°C to 85°C
LM385-2.5, LM385B-2.5	0°C to 70°C
Storage temperature range	-65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D or LP package	260°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: LD package	300°C

electrical characteristics at specified free-air temperature

PARAMETER		TEST CONDITIONS	T _A [†]	LM185-2.5, LM285-2.5			LM385-2.5			LM385B-2.5			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
V _Z	Reference voltage	I _Z = 20 μA to 20 mA	25°C	2.462	2.5	2.538	2.425	2.5	2.575	2.462	2.5	2.538	V
α _{VZ}	Average temperature coefficient of reference voltage [‡]	I _Z = 20 μA to 20 mA	25°C	±20			±20			±20			ppm/°C
ΔV _Z	Change in reference voltage with current	I _Z = 20 μA to 1 mA	25°C	1			2			2			mV
			Full range	1.5			2.5			2.5			
		I _Z = 1 mA to 20 mA	25°C	10			20			20			
			Full range	20			25			25			
ΔV _Z /Δt	Long-term change in reference voltage	I _Z = 100 μA	25°C	±20			±20			±20			ppm/khr
I _Z (min)	Minimum reference current		Full range	8 20			8 20			8 20			μA
Z _Z	Reference impedance	I _Z = 100 μA	25°C	0.2 0.6			0.4 1			0.4 1			Ω
			Full range	1.5			1.5			1.5			
V _n	Broadband noise voltage	I _Z = 100 μA, f = 10 Hz to 10 kHz	25°C	120			120			120			μV

† Full range is -55°C to 125°C for the LM185M-2.5, -40°C to 85°C for the LM285-2.5, and 0°C to 70°C for the LM385-2.5 and LM385B-2.5.

‡ The average temperature coefficient of reference voltage is defined as the total change in reference voltage divided by the specified temperature range.

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TYPICAL CHARACTERISTICS†

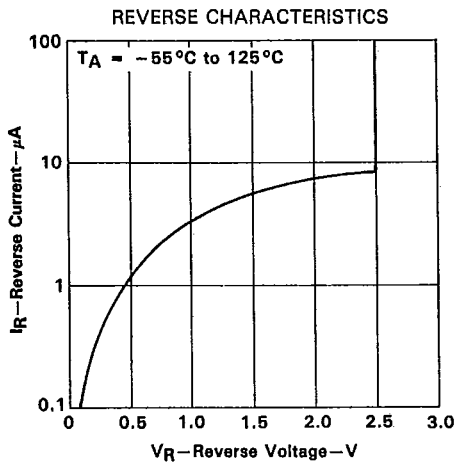


FIGURE 1

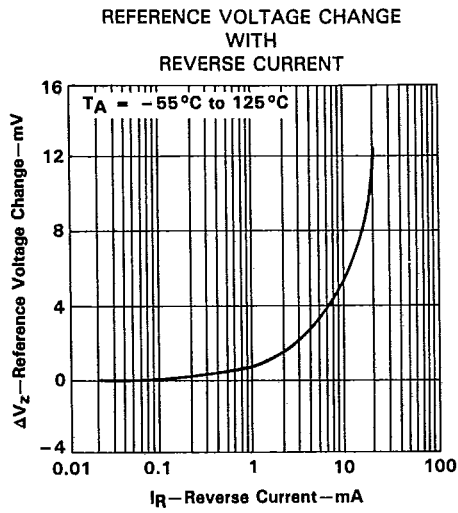


FIGURE 2

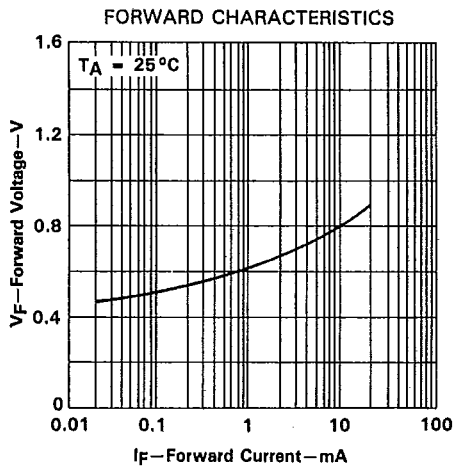


FIGURE 3

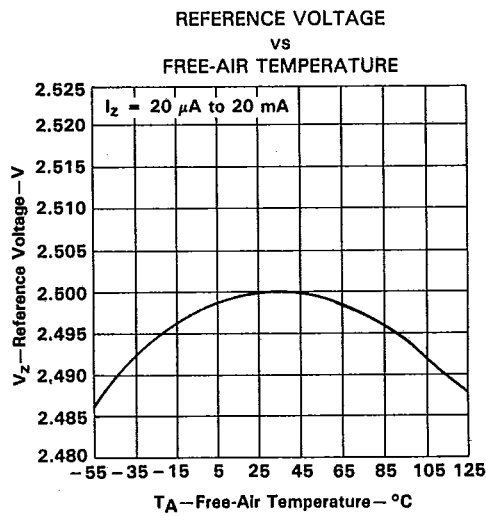


FIGURE 4

†Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

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TYPICAL CHARACTERISTICS

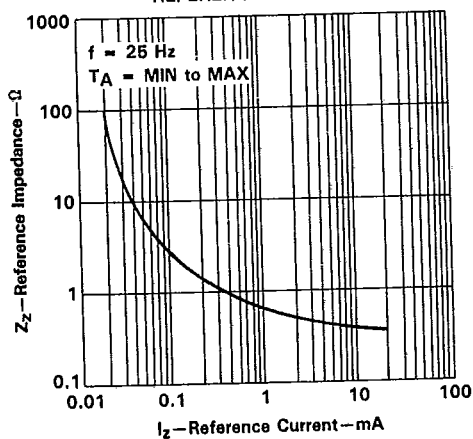
REFERENCE IMPEDANCE
vs
REFERENCE CURRENT

FIGURE 5

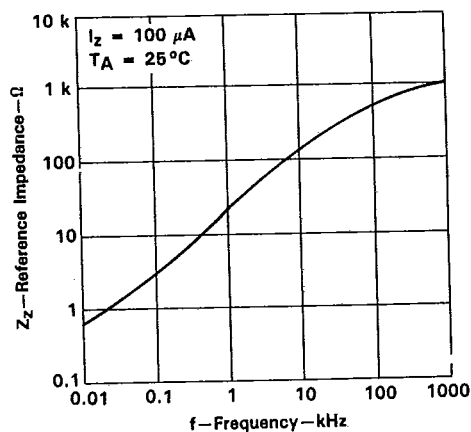
REFERENCE IMPEDANCE
vs
FREQUENCY

FIGURE 6

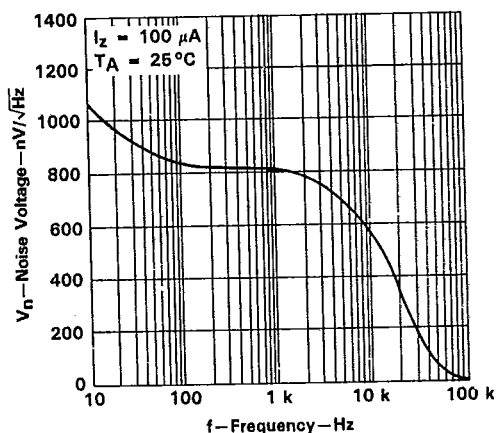
NOISE VOLTAGE
vs
FREQUENCY

FIGURE 7

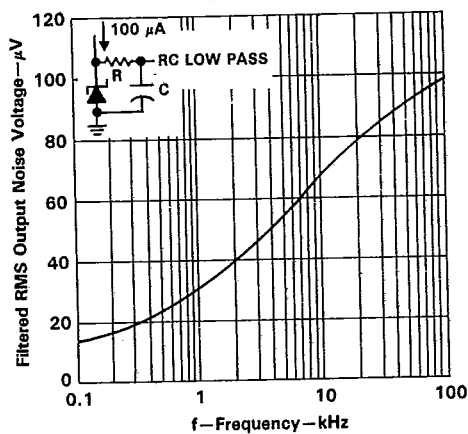
FILTERED RMS OUTPUT NOISE VOLTAGE
vs
FREQUENCY

FIGURE 8

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Data Sheets

LM185-2.5, LM285-2.5, LM385-2.5, LM385B-2.5
MICROPOWER VOLTAGE REFERENCE

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TYPICAL CHARACTERISTICS

TRANSIENT RESPONSE

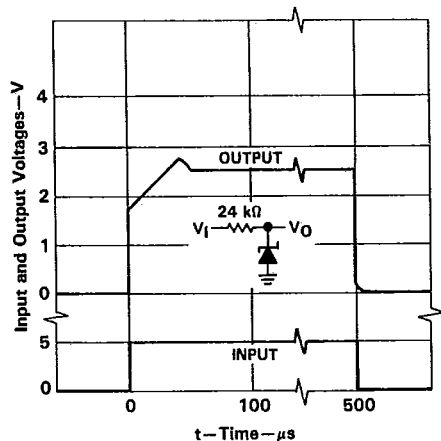


FIGURE 9

TYPICAL APPLICATION DATA

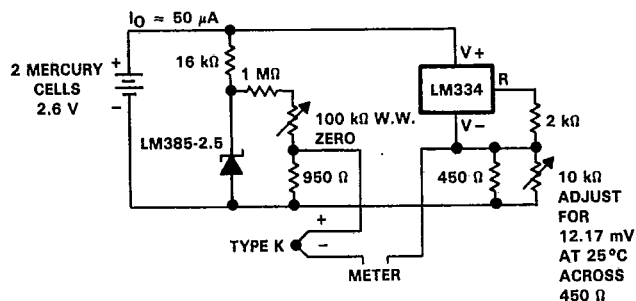


FIGURE 10. THERMOCOUPLE COLD-JUNCTION COMPENSATOR

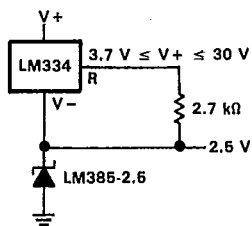


FIGURE 11. OPERATION OVER A WIDE SUPPLY RANGE

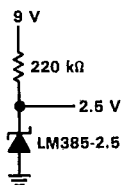


FIGURE 12. REFERENCE FROM A 9-V BATTERY