

## Micropower Voltage Reference

### FEATURES

- Operating Current from 20 $\mu$ A to 20mA.
- Low Temperature Coefficient.
- 1% and 2% Initial Tolerance.
- Low Dynamic Impedance.

### APPLICATIONS

- Portable, Battery-Powered Equipment.
- Instrumentation.
- Process Control.
- Energy Management.
- Product Testing.
- Automotive.
- Precision Audio Components.

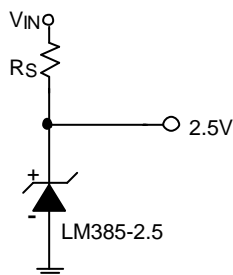
### DESCRIPTION

The LM385-2.5 is a micropower 2-terminal band-gap voltage reference, which can operate in a 20 $\mu$ A to 20mA current range, they feature exceptionally low dynamic impedance and good temperature stability. On-chip trimming is used to achieve tight voltage tolerance. Since the LM385-2.5 bandgap reference uses only transistors and resistors, low noise and good long-term stability result.

Careful design of the LM385-2.5 has made the device exceptionally tolerant of capacitive loading, making it easy to use in almost any reference application. The wide dynamic operating range allows for its use with widely varying supplies with excellent regulation.

The extremely low power drain of the LM385-2.5 makes it useful for micropower circuitry. This voltage reference can be used to make portable meters, regulators, or general purpose analog circuitry with battery life approaching shelf life. Further, the wide operating current allows it to replace older references with a tighter tolerance.

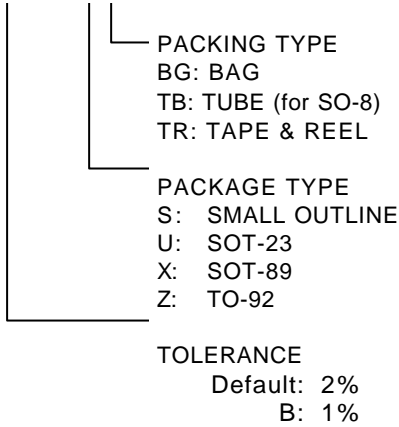
### TYPICAL APPLICATION CIRCUIT



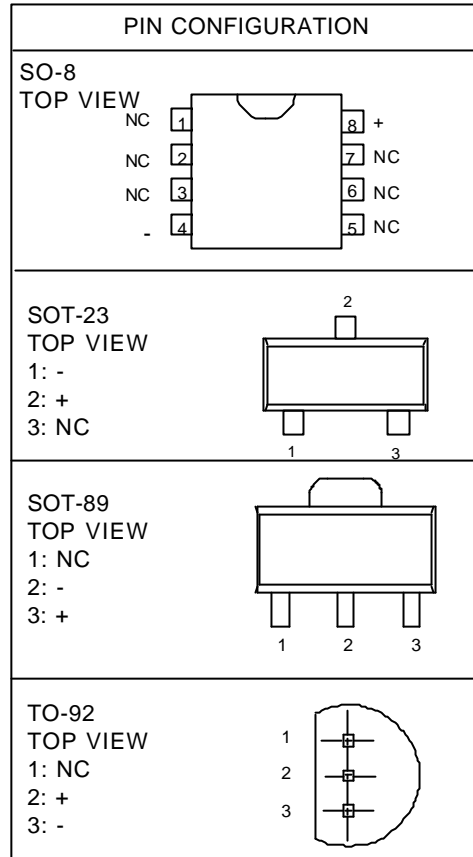
Precision 2.500V Voltage Reference

## ORDERING INFORMATION

LM385X-2.5CXXX



Example: LM385-2.5CSTR  
 → 2% version, in SO-8 Package & Taping & Reel Packing Type  
 (CS is not available in BAG packing type.)



## ABSOLUTE MAXIMUM RATINGS

Reverse Current .....	30mA
Forward Current .....	10mA
Operating Temperature Range. ....	0°C to 70°C
Storage Temperature .....	-65°C to 150°C

### Lead Temperature

TO-92 Package Soldering (10 seconds) .....	260°C
SO Package Vapor phase (60 seconds) .....	215°C

## TEST CIRCUIT

Refer to TYPICAL APPLICATION CIRCUIT.

**ELECTRICAL CHARACTERISTICS** ( $T_A=25^\circ\text{C}$ , unless otherwise specified.)

PARAMETER	TEST CONDITIONS		SYMBOL	MIN.	TYP.	MAX.	UNIT
Reverse Breakdown Voltage	$I_R=100\mu\text{A}$	LM385B-2.5	$V_R$	2.475	2.500	2.525	V
		LM385-2.5		2.450	2.500	2.550	
Reverse Breakdown Voltage Change with Current	$20\mu\text{A} \leq I_R \leq 1\text{mA}$		$\Delta V_R$	2			mV
	$1\text{mA} \leq I_R \leq 20\text{mA}$		$\Delta V_R$	20			mV
Reverse Dynamic Impedance	$I_R=100\mu\text{A}$ , $f=20\text{Hz}$		$Z_R$	1			$\Omega$
Minimum Operating Current			$I_{R\text{MIN}}$	13 20			$\mu\text{A}$
Wideband Noise (rms)	$I_R=100\mu\text{A}$ , $10\text{Hz} \leq f \leq 10\text{KHz}$		$e_N$	120			$\mu\text{Vrms}$
Average Temperature Coefficient (Note)	$I_R=100\mu\text{A}$		$\alpha V_R$	100			ppm/ $^\circ\text{C}$
Long Term Stability	$I_R=100\mu\text{A}$ , $T=1000\text{Hrs}$ , $T_A=25^\circ\text{C}$		$\Delta V_R / \Delta t$	20			ppm

Note : The average temperature coefficient is defined as the maximum deviation of reverse breakdown voltage at all measured temperatures from  $T_{\text{MIN}}$  to  $T_{\text{MAX}}$ , divided by  $T_{\text{MAX}} - T_{\text{MIN}}$ . The measured temperatures are  $0^\circ\text{C}$ ,  $25^\circ\text{C}$ ,  $50^\circ\text{C}$  and  $70^\circ\text{C}$ .

## TYPICAL PERFORMANCE CHARACTERISTICS

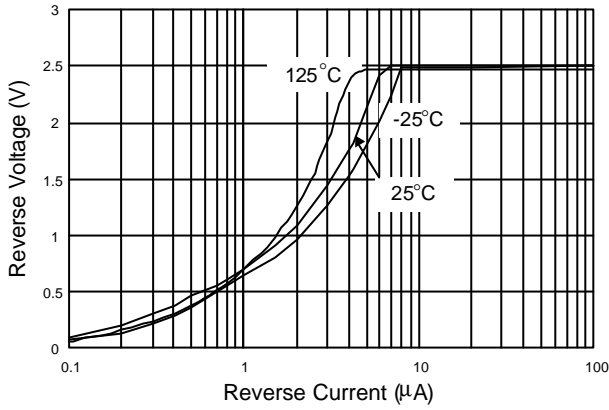


Fig. 1 Reverse Characteristics

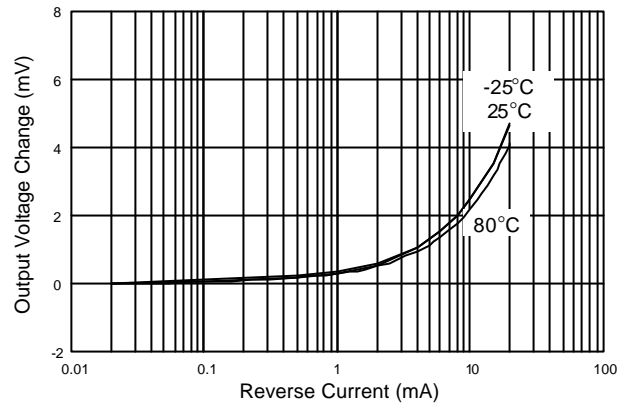


Fig. 2 Reverse Characteristics

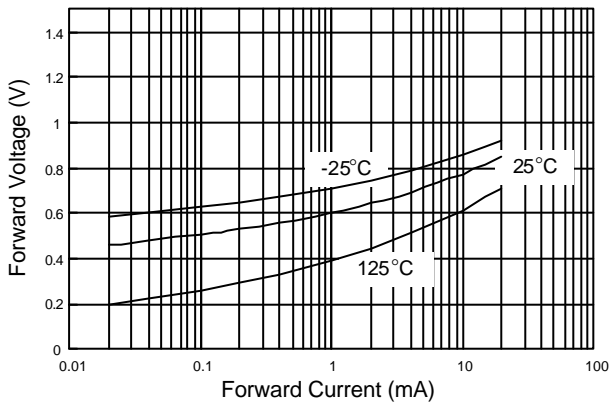


Fig. 3 Forward Characteristics

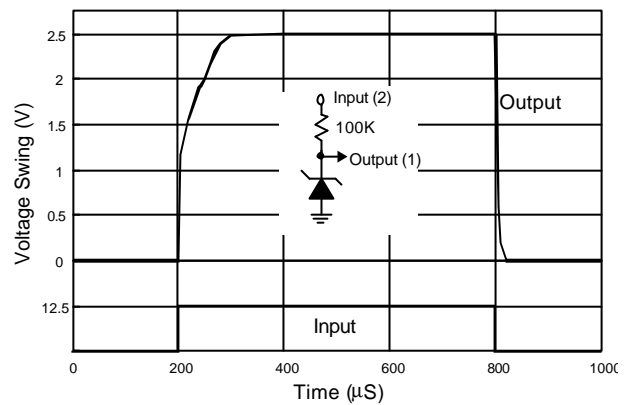


Fig. 4 Response Time

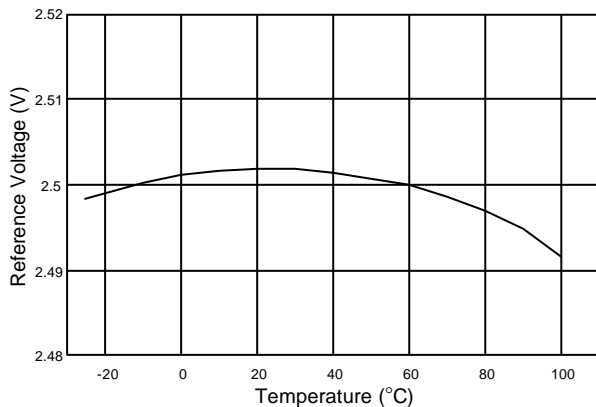


Fig. 5 Temperature Drift

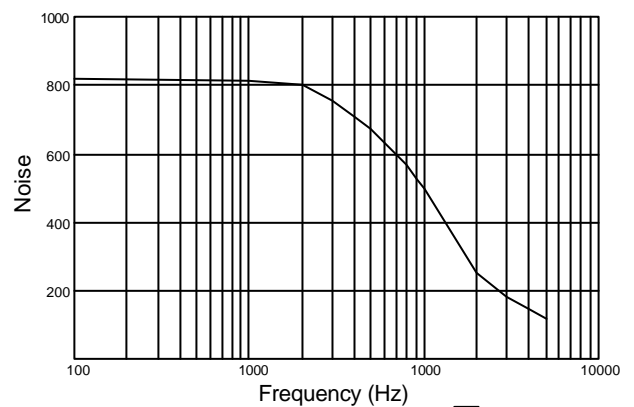
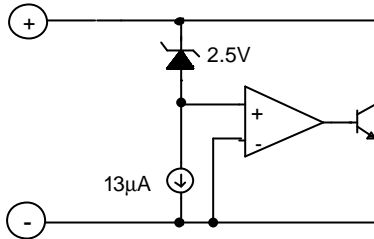


Fig. 6 Noise Voltage ( $nV/\sqrt{Hz}$ )

## ■ BLOCK DIAGRAM



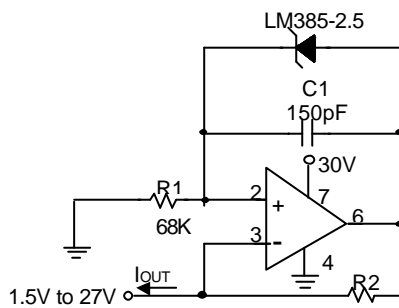
## ■ SYMBOL



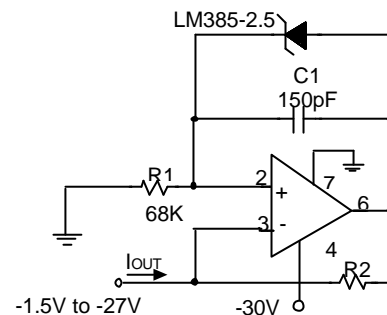
## ■ PIN DESCRIPTIONS

- PIN + - sinks current with a range from 20µA to 20mA for normal applications. And a stable positive voltage, relative to Pin-, occurs on Pin+.
- PIN - - Pin- sources current for normal application. The current value is the same as Pin+.
- PIN NC - Not connected.

## ■ APPLICATION EXAMPLES

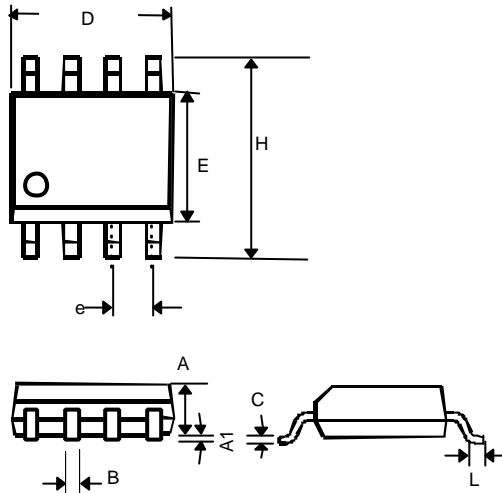


$$I_{OUT} = \frac{2.5V}{R2}$$

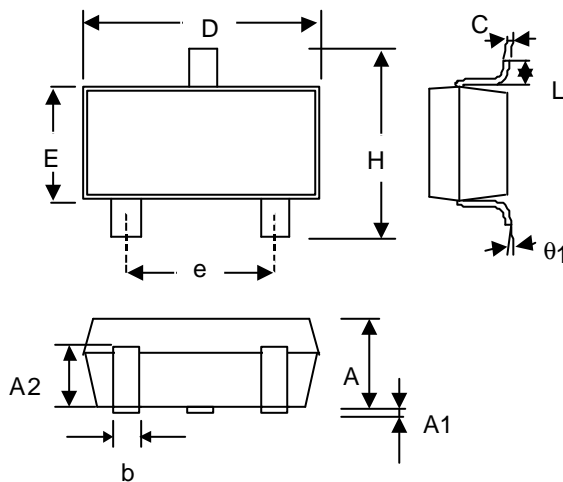


$$I_{OUT} = \frac{2.5V}{R2}$$

**Fig. 7 Precision 1mA to 1mA Current Source**

**PHYSICAL DIMENSIONS**
**8 LEAD PLASTIC SO (unit: mm)**


SYMBOL	MIN	MAX
A	1.35	1.75
A1	0.10	0.25
B	0.33	0.51
C	0.19	0.25
D	4.80	5.00
E	3.80	4.00
e	1.27(TYP)	
H	5.80	6.20
L	0.40	1.27

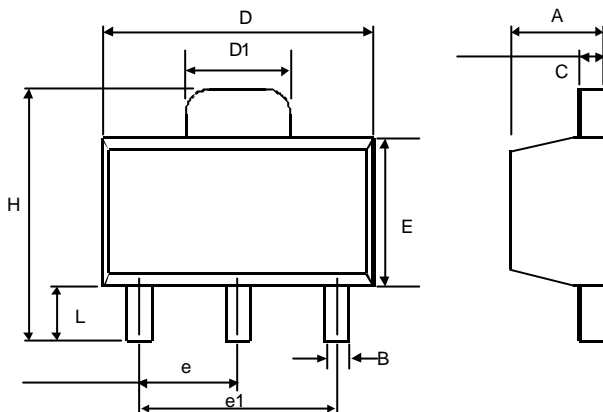
**SOT-23 (unit: mm)**


SYMBOL	MIN	MAX
A	1.00	1.30
A1	—	0.10
A2	0.70	0.90
b	0.35	0.50
C	0.10	0.25
D	2.70	3.10
E	1.40	1.80
e	1.90 (TYP)	
H	2.60	3.00
L	0.37	—
1	1°	9°

**SOT-23 MARKING**

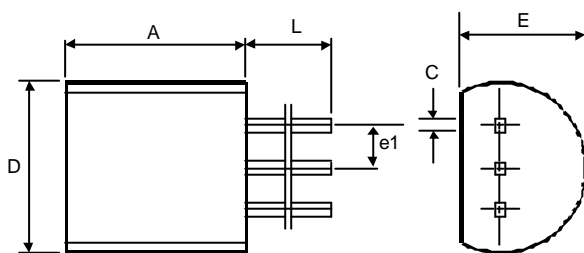
Part No.	Marking
LM385-25CU	A1A2
LM385B-25CU	A1B2

● SOT-89 (unit: mm)



SYMBOL	MIN	MAX
A	1.40	1.60
B	0.36	0.48
C	0.35	0.44
D	4.40	4.60
D1	1.62	1.83
E	2.29	2.60
e	1.50 (TYP.)	
e1	3.00 (TYP.)	
H	3.94	4.25
L	0.89	1.20

● TO-92 (unit: mm)



SYMBOL	MIN	MAX
A	4.32	5.33
C	0.38 (TYP.)	
D	4.40	5.20
E	3.17	4.20
e1	1.27 (TYP.)	
L	12.7	-