

Micropower Voltage Reference

FEATURES

- Operating Current from 10 μ A to 20mA.
- Low Temperature Coefficient.
- Low Voltage Reference: 1.235V.
- 1% and 2% Initial Tolerance.

APPLICATIONS

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

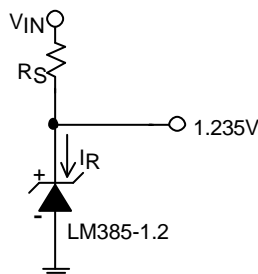
DESCRIPTION

The LM385-1.2 is a micropower 2-terminal bandgap voltage reference. Operating over a 10 μ A to 20mA current range, it features exceptionally low dynamic impedance and good temperature stability. On-chip trimming is used to achieve tight voltage tolerance. Since the LM385-1.2 bandgap reference uses only bipolar transistors and resistors, low noise and good long term stability result.

Careful design of the LM385-1.2 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 LM385-1.2 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.

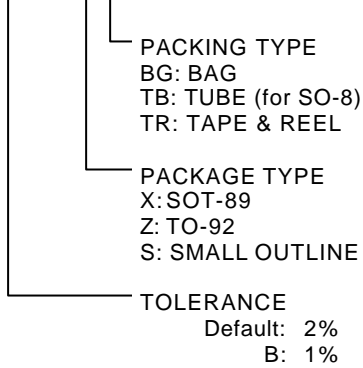
TYPICAL APPLICATION CIRCUIT



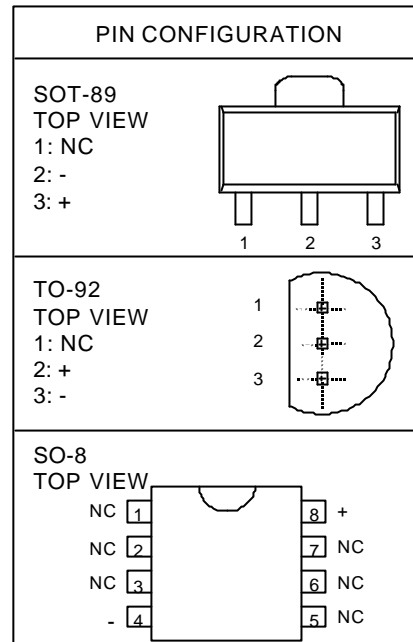
Precision 1.235V Voltage Reference

ORDERING INFORMATION

LM385X-1.2CXXX



Example: LM385-1.2CXTR
 → 2% version, in SOT-89 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-1.2	1.222	1.235	1.248	V
		LM385-1.2	1.210	1.235	1.260	
Reverse Breakdown Voltage Change with Current	$10\mu\text{A} \leq I_R \leq 1\text{mA}$	ΔV_R			1	mV
	$1\text{mA} \leq I_R \leq 20\text{mA}$	ΔV_R			20	mV
Reverse Dynamic Impedance	$I_R=100\mu\text{A}, f=20\text{Hz}$	Z_R			1	Ω
Minimum Operating Current		$I_{R\text{MIN}}$		8	15	μA
Wideband Noise (rms)	$I_R=100\mu\text{A},$ $10\text{Hz} \leq f \leq 10\text{KHz}$	e_N		60		μVrms
Average Temperature Coefficient (Note)	$I_R=100\mu\text{A}$	αV_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_{MIN} to T_{MAX} , divided by $T_{\text{MAX}} - T_{\text{MIN}}$. The measured temperatures are 0°C , 25°C , 50°C and 70°C .

The total over temperature tolerance for the different grades follows:

LM385B-1.2: $\pm 1.70\% = \pm 1.0\% \pm 100\text{ppm}/^\circ\text{C} \times 70^\circ\text{C}$

LM385-1.2: $\pm 2.7\% = \pm 2.0\% \pm 100\text{ppm}/^\circ\text{C} \times 70^\circ\text{C}$

TYPICAL PERFORMANCE CHARACTERISTICS

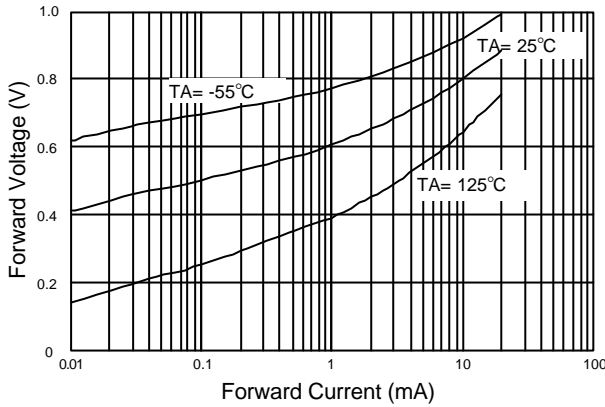


Fig. 1 Forward characteristics

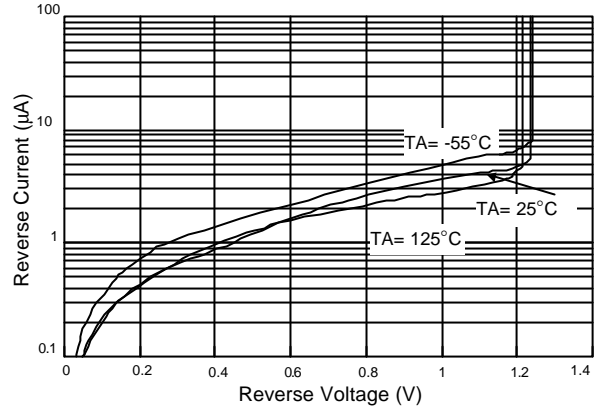


Fig. 2 Reverse Characteristics

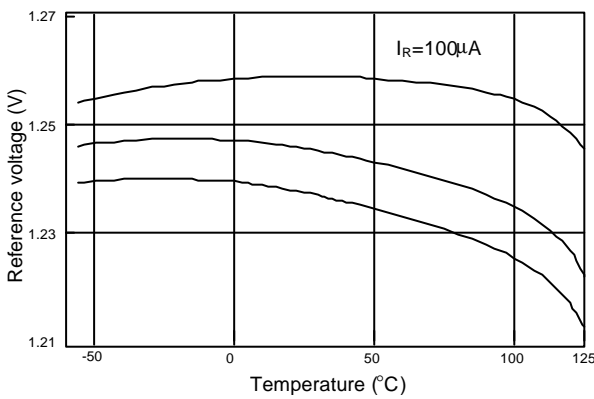


Fig. 3 Temperature Drift of 3 Representative Units

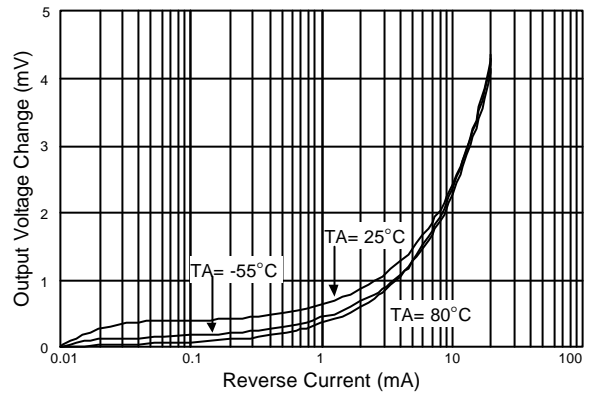


Fig. 4 Reverse Characteristics

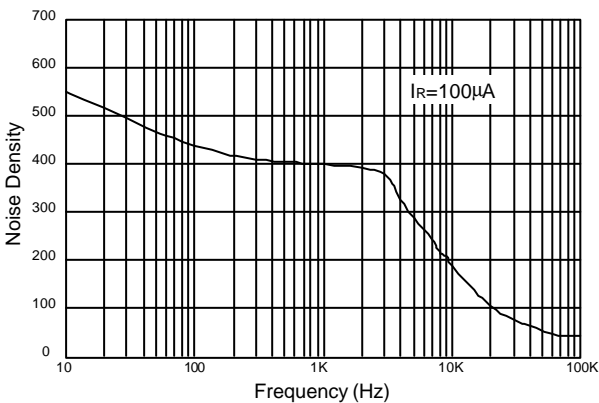


Fig. 5 Output Noise Voltage (nV/\sqrt{Hz})

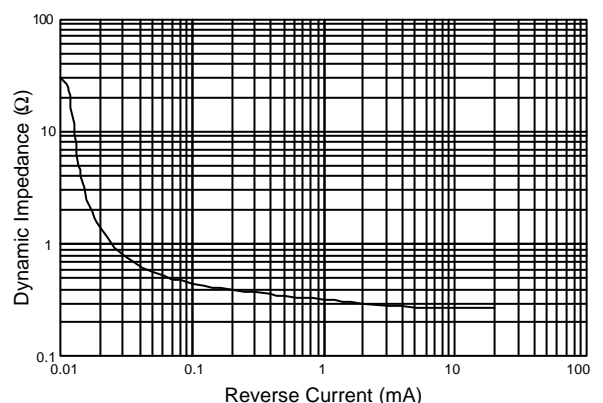


Fig. 6 Reverse Characteristics

■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

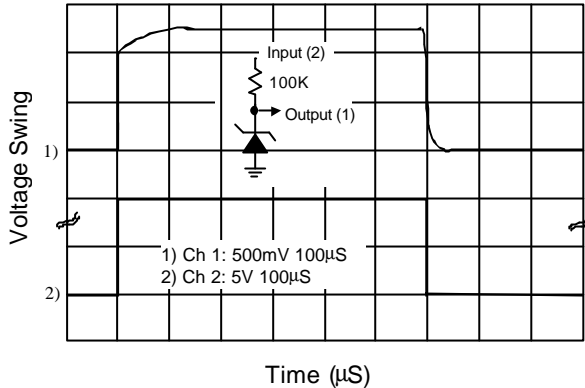
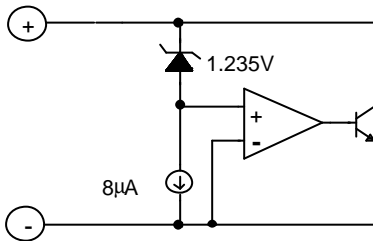


Fig. 7 Response Time

■ 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

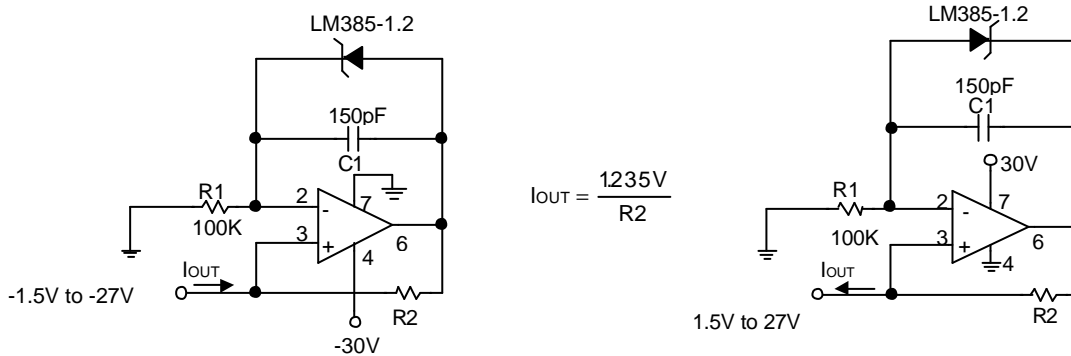


Fig. 8 Precision 1mA to 1mA Current Source

APPLICATION EXAMPLES (Continued)

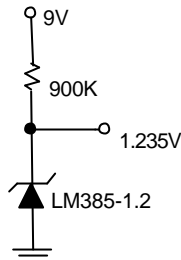


Fig. 9 Micropower Reference from 9V Battery

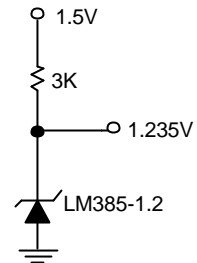


Fig. 10 Reference from 1.5V Battery

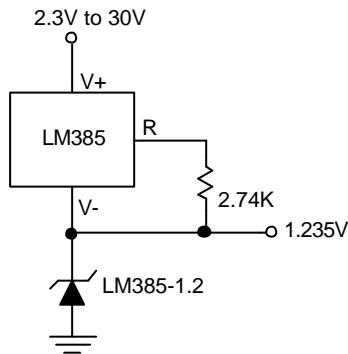
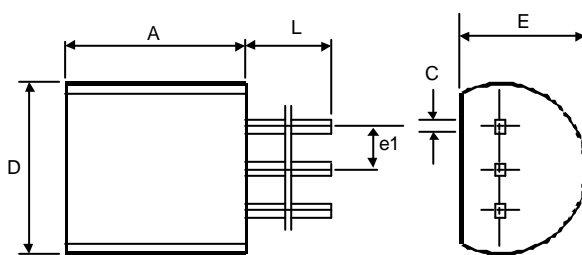


Fig. 11 Operation over a wide Supply Range

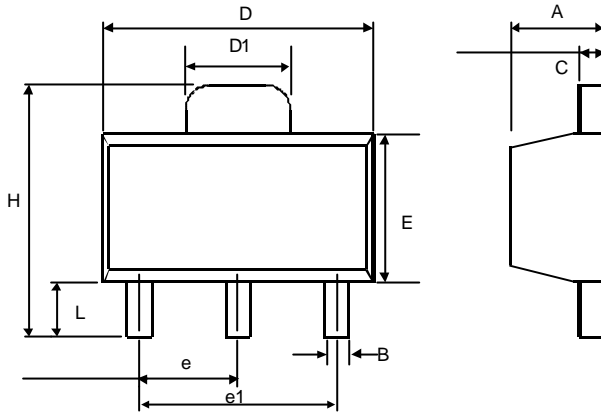
PHYSICAL DIMENSIONS

- 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	-

● SOT-89 (unit: mm)

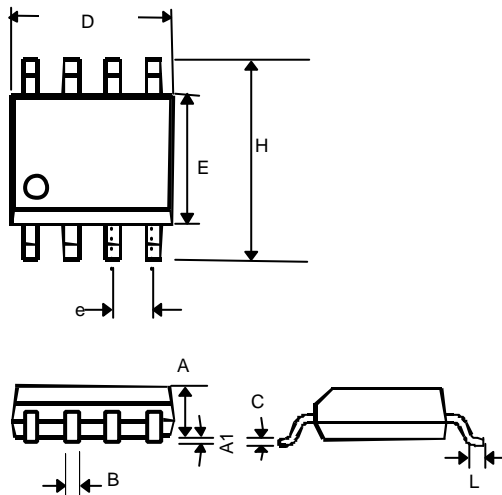


SYMBOL	MIN	MAX
A	1.40	1.60
B	0.36	0.48
C	0.35	0.44
D	4.40	4.60
D1	1.62	1.83
E	2.29	2.60
e	1.50 (TYP.)	
e1	3.00 (TYP.)	
H	3.94	4.25
L	0.89	1.20

● SOT-89 Marking

Part No.	Marking
LM385-12CX	AI12
LM385B-12CX	AIB12

● 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