

## Adjustable Micropower Voltage Reference

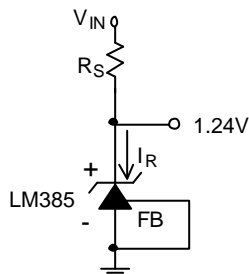
### ■ FEATURES

- Adjustable from 1.24V to 5.3V.
- Operating Current from 10 $\mu$ 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.

### ■ TYPICAL APPLICATION CIRCUIT



**Precision 1.24V Voltage Reference**

### ■ DESCRIPTION

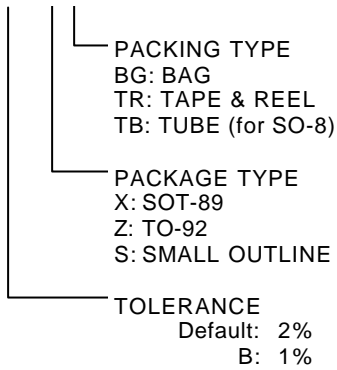
The LM385 is micropower 3-terminal adjustable band-gap voltage reference. Operating from 1.24V to 5.3V and over 10 $\mu$ A to 20mA current range. They feature exceptionally low dynamic impedance and good temperature stability. On-chip trimming is used to achieve tight voltage tolerance. Since the LM385 band-gap reference uses only transistors and resistors, low noise and good longterm stability result.

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

The extremely low power drain of the LM385 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 part.

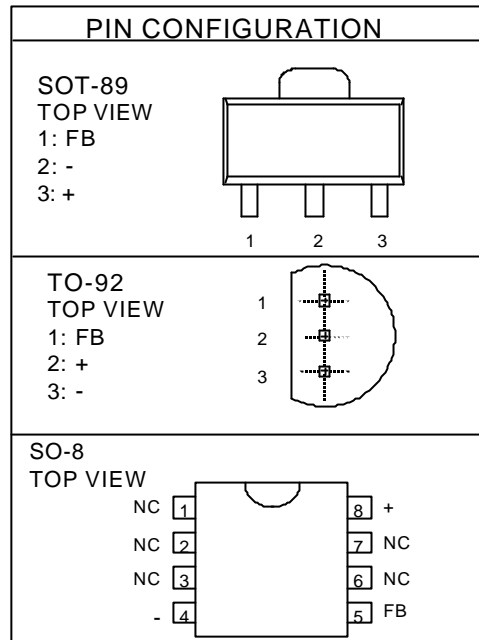
## ORDERING INFORMATION

LM385X-CXXX



Example: LM385-CXTR

- 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<sub>A</sub>=25°C, unless otherwise specified.)

PARAMETER	TEST CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	I <sub>R</sub> =100μA LM385B LM385	V <sub>R</sub>	1.228 1.215	1.240 1.240	1.252 1.265	V
Reverse Voltage Change with Current	I <sub>RMIN</sub> ≤ I <sub>R</sub> ≤ 1mA 1mA ≤ I <sub>R</sub> ≤ 20mA	ΔV <sub>R</sub>		0.2 5	1 15	mV
Minimum Operating Current	V <sub>OUT</sub> =1.24V V <sub>OUT</sub> =5.3V	I <sub>RMIN</sub>		7 35	11 55	μA
Dynamic Output Impedance	I <sub>R</sub> =100μA, f=100Hz I <sub>AC</sub> =0.1I <sub>R</sub> , V <sub>OUT</sub> =1.24V, V <sub>OUT</sub> =5.3V	Z <sub>R</sub>		0.4 1		Ω
Reference Voltage Change with Output Voltage	I <sub>R</sub> =100μA			2	5	mV
Feedback Current		I <sub>FB</sub>		8	20	nA
Output Wideband Noise	I <sub>R</sub> =100μA, 10Hz<f<10KHz V <sub>OUT</sub> =1.24V, V <sub>OUT</sub> =5.3V	e <sub>N</sub>		50 170		μV <sub>RMS</sub>
Average Temperature Coefficient (Note)	I <sub>R</sub> =100μA	αV <sub>R</sub>		100		ppm/°C
Long Term Stability	I <sub>R</sub> =100μA, T=1000Hrs, T <sub>A</sub> =25°C±0.1°C	ΔV <sub>R</sub> /Δt		20		ppm

Note : The average temperature coefficient is defined as the maximum deviation of reverse voltage at all measured temperatures from T<sub>MIN</sub> to T<sub>MAX</sub>, divided by T<sub>MAX</sub> - T<sub>MIN</sub>. The measured temperatures are 0°C, 25°C, 50°C and 70°C.

## TYPICAL PERFORMANCE CHARACTERISTICS

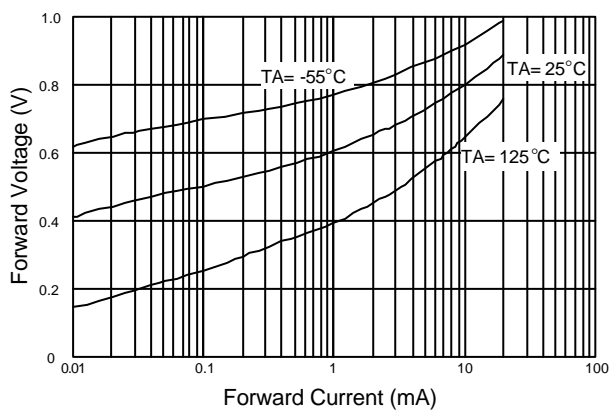


Fig. 1 Forward characteristics

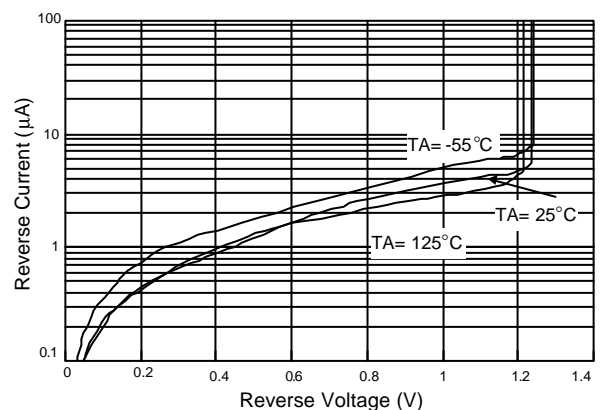


Fig. 2 Reverse Characteristics

## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

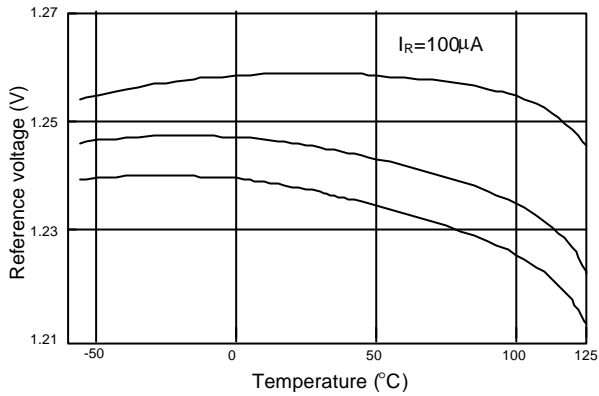


Fig. 3 Temperature Drift of 3 Representative Units

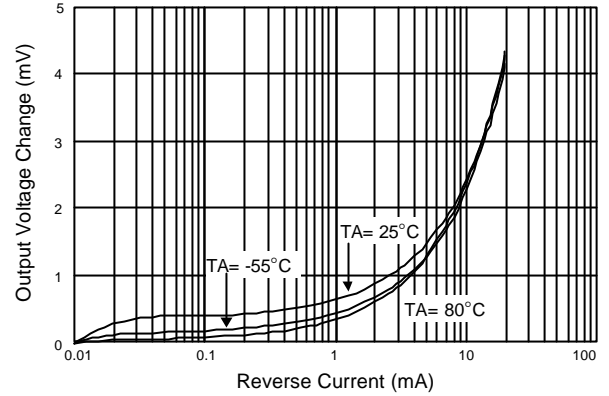


Fig. 4 Reverse Characteristics

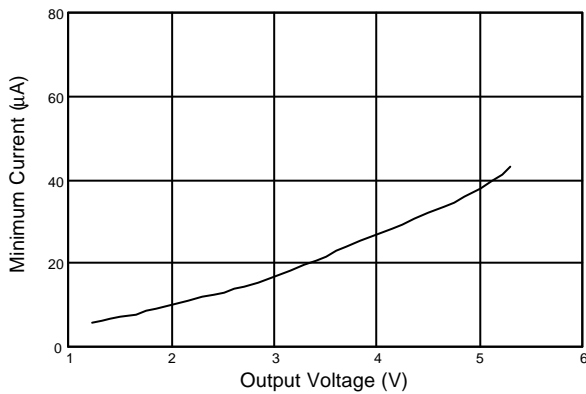


Fig. 5 Minimum Operating Current

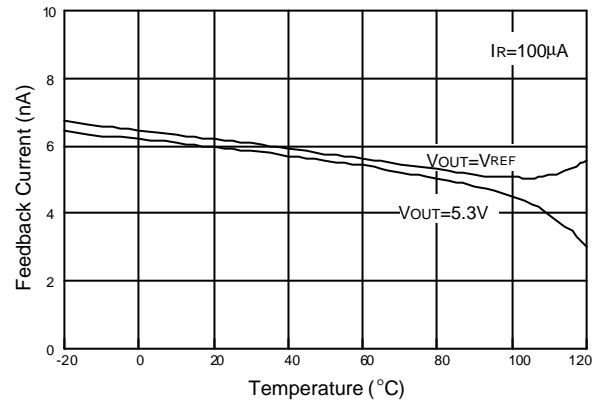


Fig. 6 Feedback Current

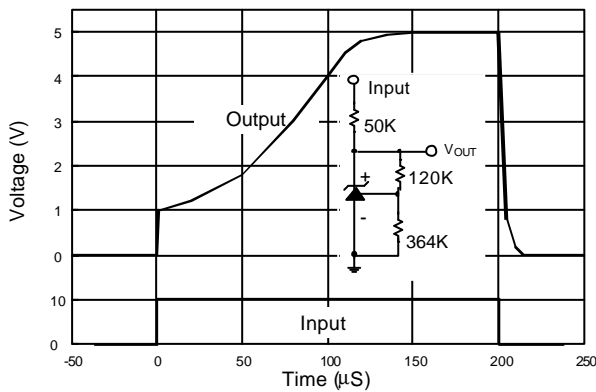


Fig. 7 Response Time

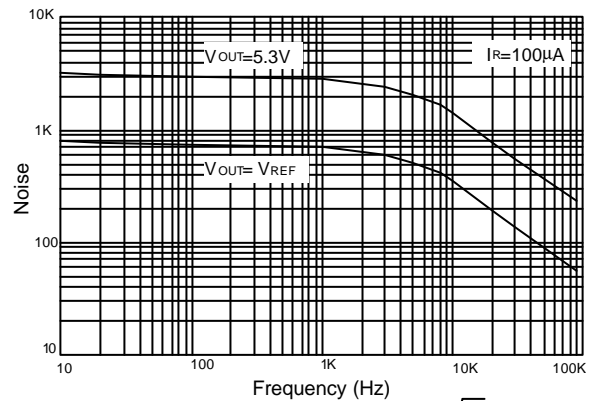
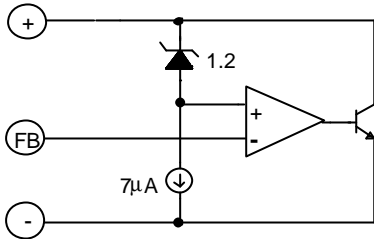
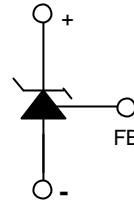


Fig. 8 Output Noise Voltage ( $nV/\sqrt{Hz}$ )

## ■ 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

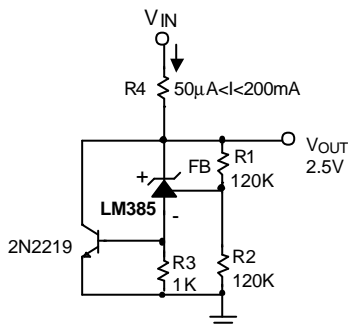


Fig. 9 200mA Shunt Regulator

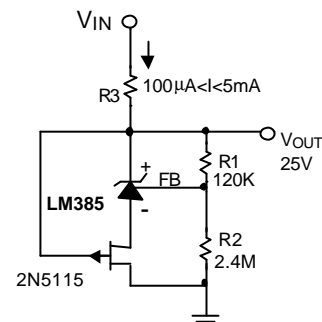


Fig. 10 25V Low Current Shunt Regulator

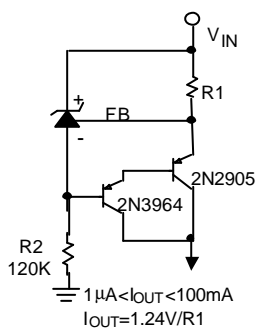


Fig. 11 Current Source

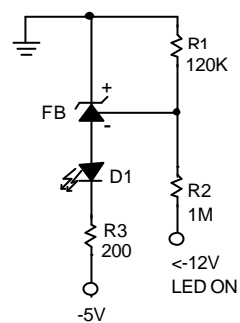


Fig. 12 Voltage Level Detector

## APPLICATION EXAMPLES (Continued)

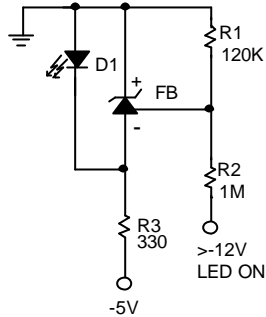
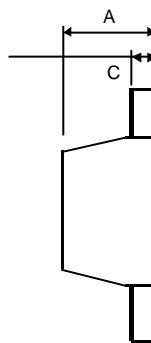
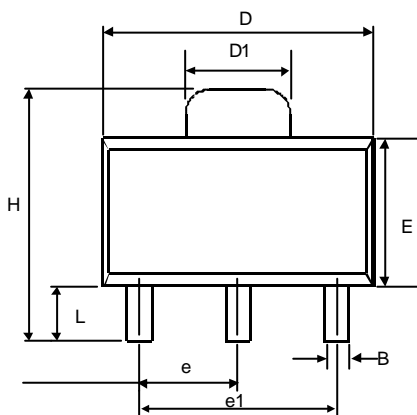


Fig. 13 Voltage Level Detector

## PHYSICAL DIMENSIONS

- SOT-89 (unit: mm)

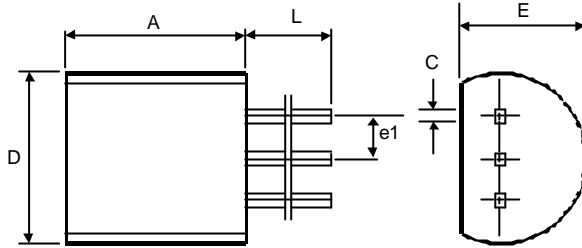


SYMBOL	MIN	MAX
A	1.40	1.60
B	0.36	0.48
C	0.35	0.44
D	4.40	4.60
D1	1.62	1.83
E	2.29	2.60
e	1.50 (TYP.)	
e1	3.00 (TYP.)	
H	3.94	4.25
L	0.89	1.20

- SOT-89 Marking

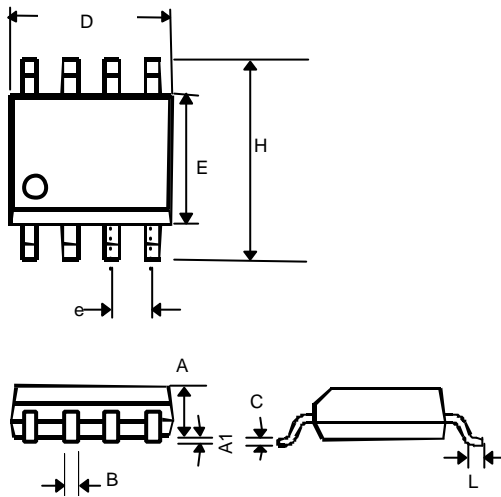
Part No.	Marking
LM385CX	AI01
LM385BCX	AIB01

● 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	-

● 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