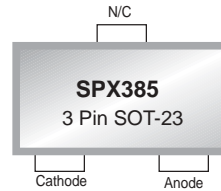


## Micropower Voltage Reference

### FEATURES

- Trimmed Bandgap ..... 1% and 2%
- Wide Operating Current ..... 20 $\mu$ A to 20mA
- Extended Temperature Range ... -40°C to +85°C
- Dynamic Impedance ..... 1 $\Omega$  max
- Offered in SOT-23, TO-92, SOIC, and SOT-89
- Improved Replacement for LM185/285/385-2.5V, AS385-2.5
- Temp Co 140ppm/°C



*Now Available in Lead Free Packaging*

Refer to page 4 for pinouts.

### APPLICATIONS

- Battery Operating Equipment
- Adjustable Supplies
- Switching Power Supplies
- Error Amplifiers
- Single Supply Amplifier
- Monitors / VCR / TV
- Personal Computers

### DESCRIPTION

The SPX385-2.5 is a micropower 2-terminal band-gap voltage reference with a very wide operating current range from 20 $\mu$ A to 20mA that provides a stable voltage. The high stability of this device is primarily the result of the low temperature coefficient Thin Film Resistor process and Laser Trimming of the output voltage at the wafer level.

The SPX385-2.5 is available in a SOT-23, TO-92, SOIC-8 and SOT-89 package with an operating temperature range of -40°C to 85°C. A 1.2 and 5 volt device is also available - SPX385-1.2 and SPX385-5.

### BLOCK DIAGRAM

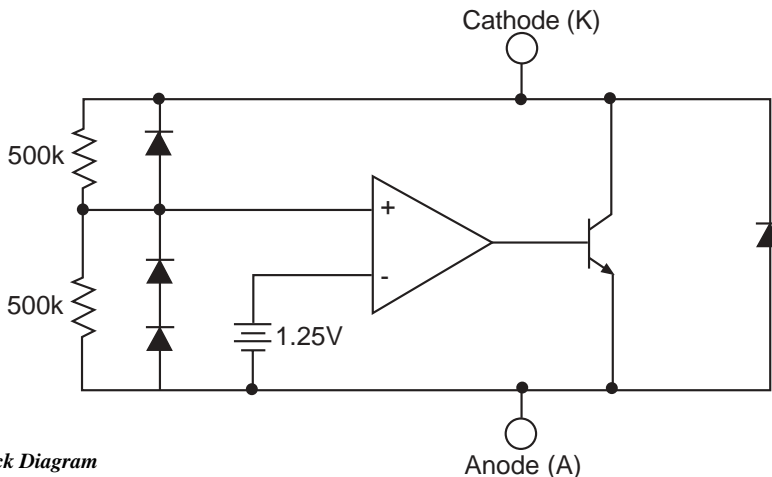


Figure 1: Block Diagram

## ABSOLUTE MAXIMUM RATINGS

Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Reverse Current ( $I_{R}$ )	30mA
Forward Current ( $I_{KA}$ )	10mA
Operating Temperature Range ( $T_A$ )	-40 to +85°C
Junction Temperature ( $T_J$ )	150°C
Storage Temperature ( $T_{STG}$ )	- 65 to 150°C
Lead Temperature (Soldering 10 sec.), $T_L$	300°C

## TYPICAL THERMAL RESISTANCES

PACKAGE	$\theta_{JA}$	$\theta_{JC}$	TYPICAL DERATING
TO-92	160°C/W	80°C/W	6.3 mW/°C
SOT-23	575°C/W	150°C/W	1.7 mW/°C
SOIC-8	175°C/W	45°C/W	5.7 mW/°C
SOT-89	110°C/W	8°C/W	9.1 mW/°C

Typical deratings of the thermal resistances are given for ambient temperature >25°.

## ELECTRICAL CHARACTERISTICS

$I_{IN} = 100\mu A$ ,  $T_A = 25^\circ C$ , unless otherwise specified.

PARAMETER	CONDITIONS	SPX385A-2.5			SPX385-2.5			UNIT
		MIN.	TYP.	MAX	MIN.	TYP.	MAX.	
Reference Voltage		2.475	2.500	2.525	2.450	2.500	2.550	V
Dynamic Output Impedance	F = 20Hz $I_R = 100\mu A$		0.6	1.0		0.6	1.0	$\Omega$
Reference Voltage Change with $I_R$	$20\mu A \leq I_R \leq 20mA$		10	20		10	20	mV
Temperature Coefficient	Note 1		80	140		80	140	ppm/°C
Minimum Operating Current			15	20		15	20	$\mu A$
Output Wideband Noise	$10Hz \leq f \leq 10kHz$		120			120		$\mu Vrms$
Long Term Stability	T=1000Hr; $T_A = 25^\circ C \pm 0.1^\circ C$		60			60		ppm
Operating Temperature		-40		+85	-40		+85	°C

Note 1. Three-point measurement guarantees the error band over the specified temperature range.

## \*CALCULATING AVERAGE TEMPERATURE COEFFICIENT (TC)

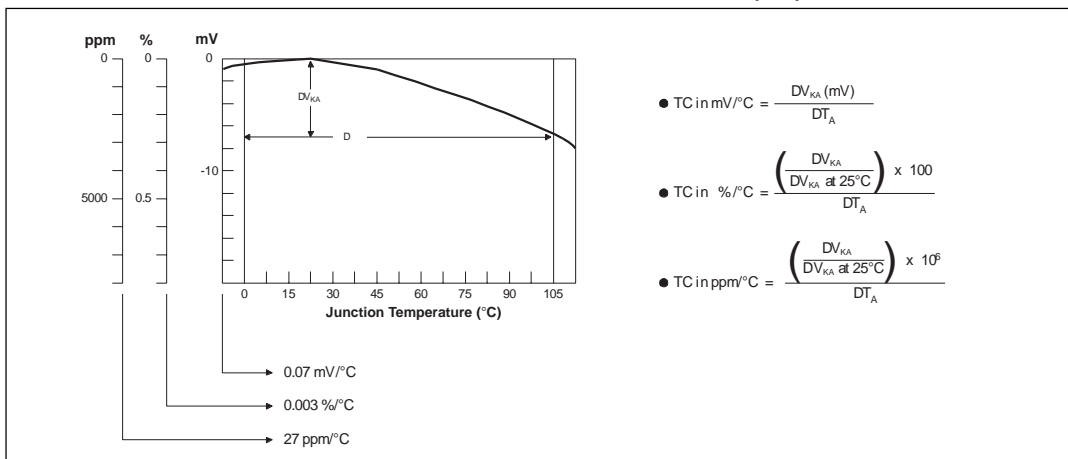


Figure 2.  $V_{KA}$  vs. Temperature

# TYPICAL PERFORMANCE CHARACTERISTICS

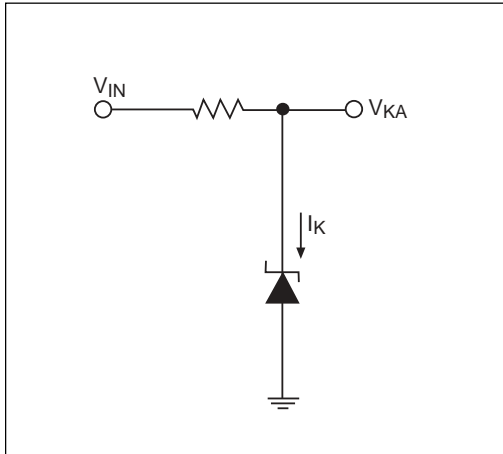


Figure 3. Test Circuit

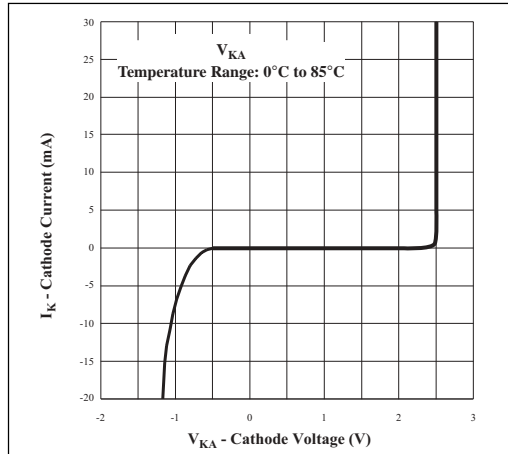


Figure 4. High Current Operating Characteristics

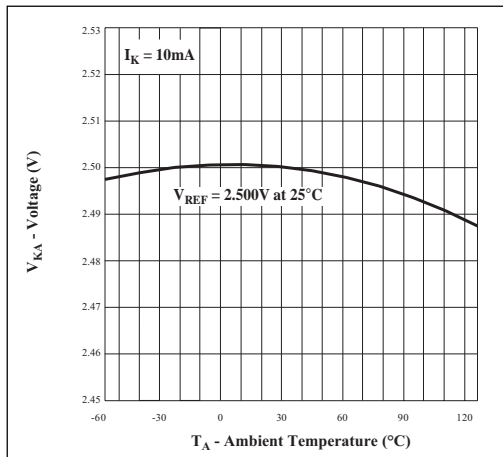


Figure 5. Reference Voltage vs. Ambient Temperature

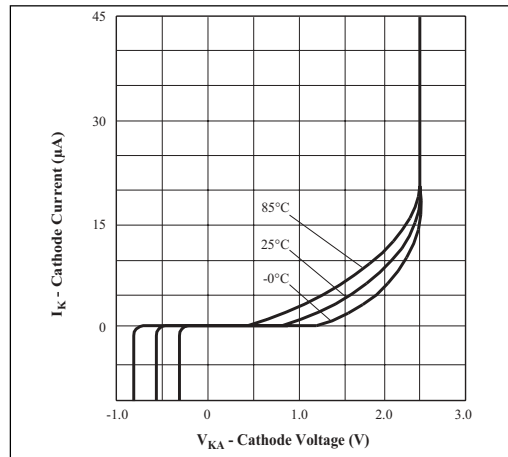


Figure 6. Low Current Operating Characteristics

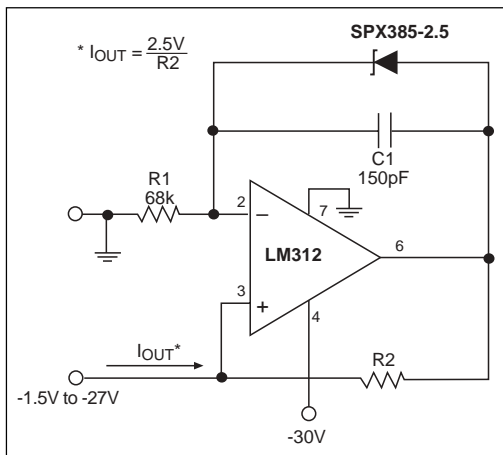


Figure 7a. Precision 1µA to 1mA Current Sink

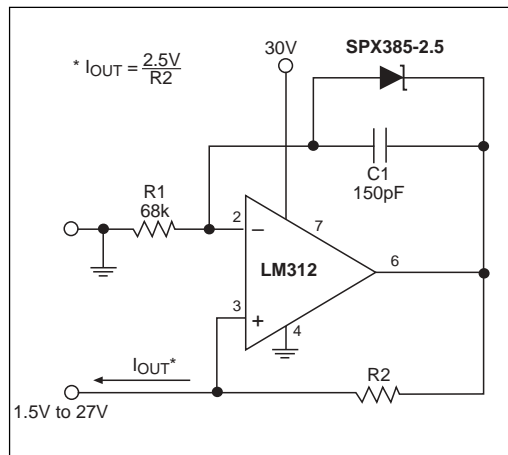


Figure 7b. Precision 1µA to 1mA Current Source

## TYPICAL PERFORMANCE CHARACTERISTICS

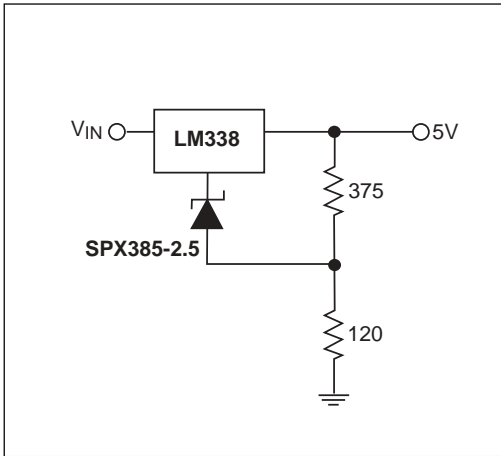


Figure 8. Improving Regulation of Adjustable Regulators

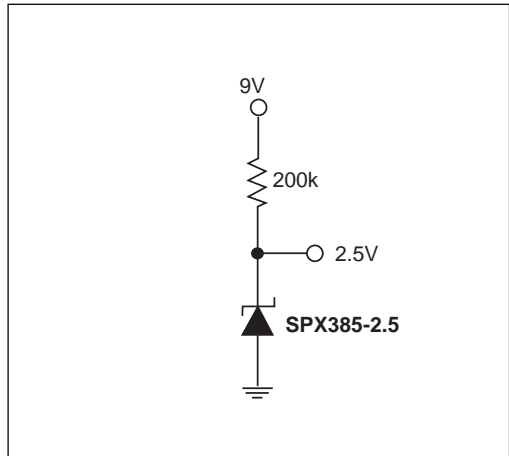


Figure 9. Micropower Reference from 9V Battery

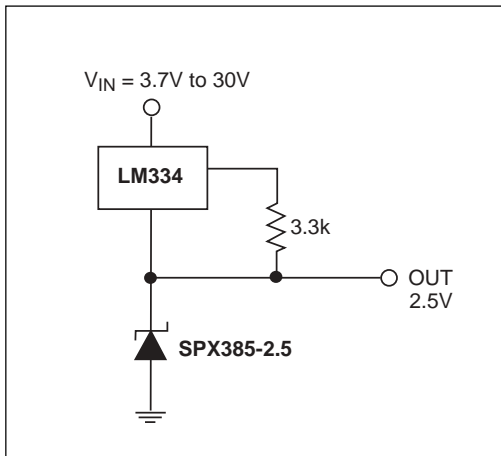


Figure 10. Wide Input Range Reference

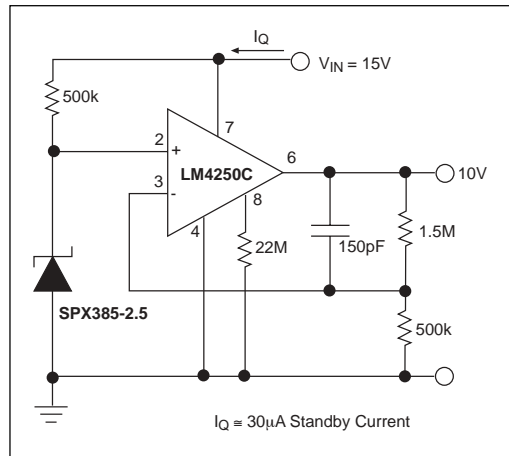
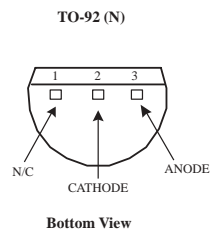
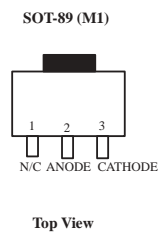
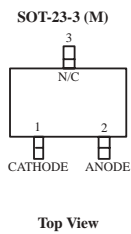
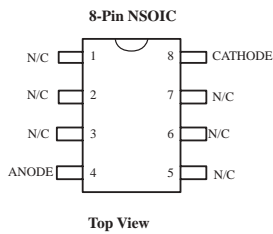
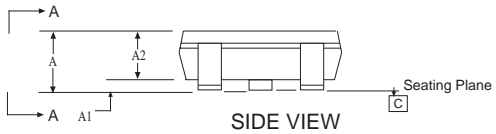
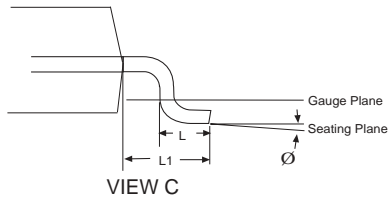
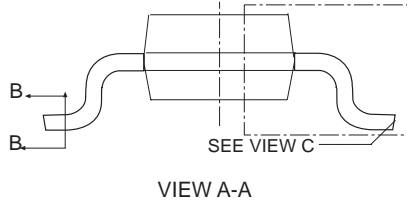
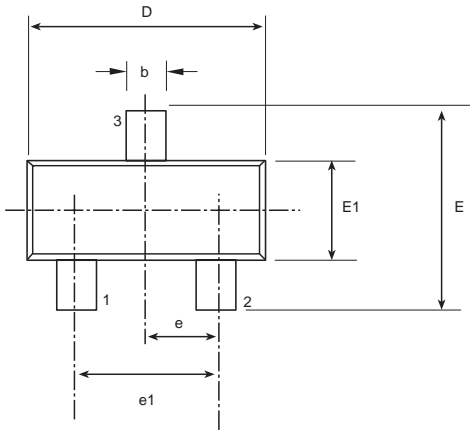


Figure 11. Precision Micropower 10V Reference

## PACKAGE PINOUTS

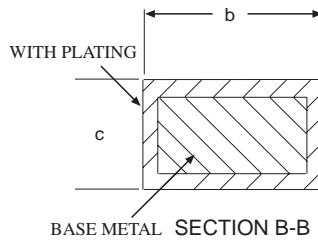


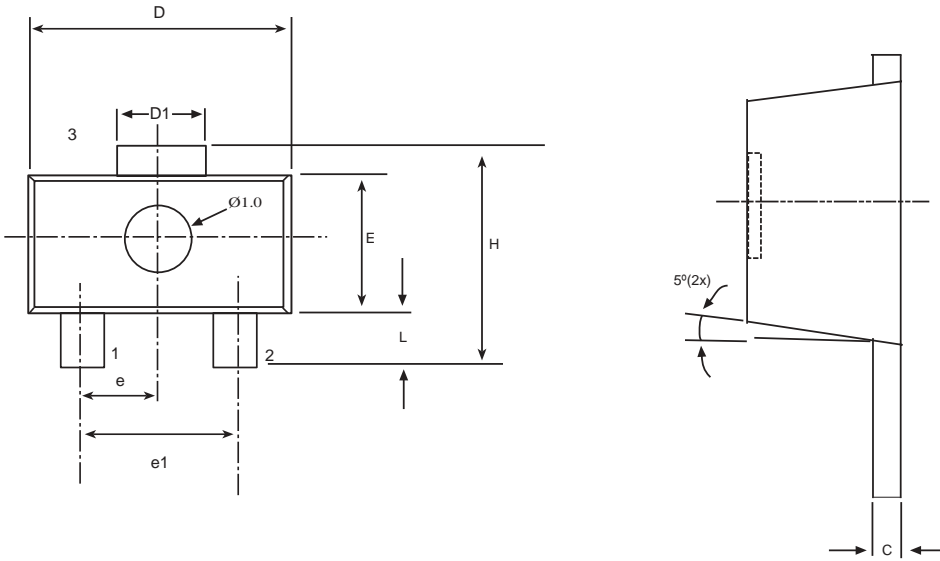
# PACKAGE: 3 PIN SOT-23



3 Pin SOT-23 JEDEC TO-236 (AB) Variation			
SYMBOL	MIN	NOM	MAX
A	0.89	-	1.12
A1	0.01	-	0.1
A2	0.88	0.95	1.02
b	0.3	-	0.5
c	0.08	-	0.2
D	2.8	2.9	3.04
e	0.95 BSC		
e1	1.90 BSC		
E	0.95	-	2.64
E1	1.2	1.3	1.4
L	0.4	0.5	0.6
L1	0.54 REF		
Ø	0°	-	8°

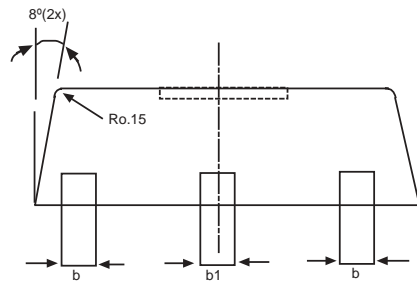
Note: Dimensions in (mm)



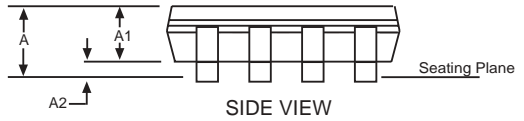
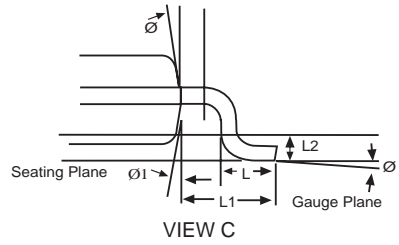
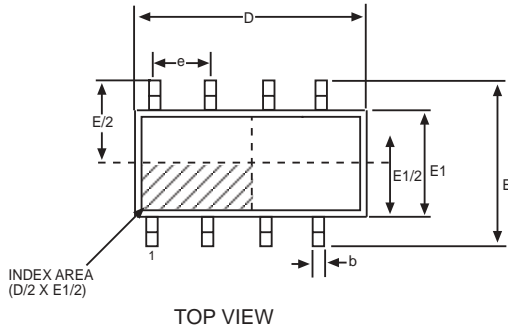


3 Pin SOT-89			
SYMBOL	MIN	NOM	MAX
b	0.36	0.42	0.48
L	0.8	-	1.2
b1	0.41	0.47	0.53
C	0.38	0.4	0.43
D	4.4	4.5	4.6
D1	1.4	1.6	1.75
H	3.94	-	4.25
E	2.4	2.5	2.6
e	1.45	1.5	1.55
e1	2.9	3	3.1

Note: Dimensions in (mm)

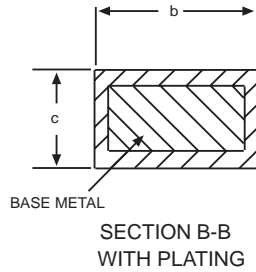
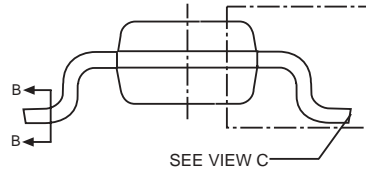


# PACKAGE: 8 PIN NSOIC

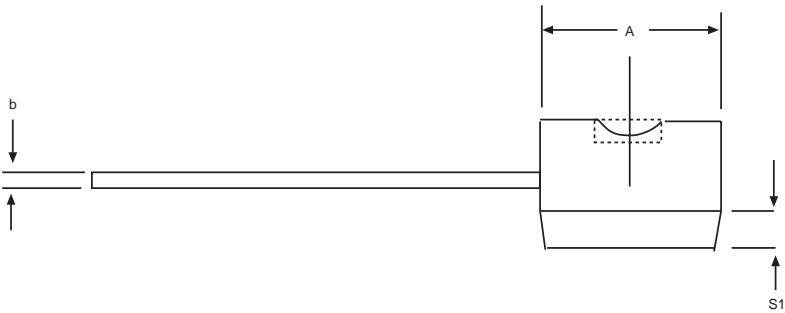
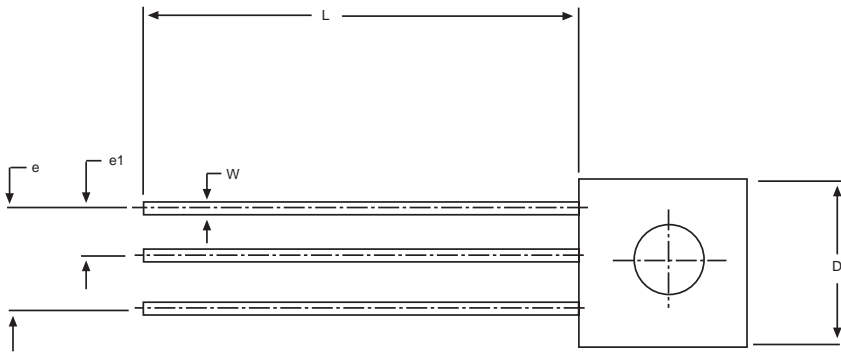


8 Pin NSOIC JEDEC MO-012 (AA) Variation			
SYMBOL	MIN	NOM	MAX
A	1.35	-	1.75
A1	0.1	-	0.25
A2	1.25	-	1.65
b	0.31	-	0.51
c	0.17	-	0.24
D	4.90 BSC		
E	6.00 BSC		
E1	3.90 BSC		
e	1.27 BSC		
L	0.4	-	1.27
L1	1.04 REF		
L2	0.25 BSC		
Ø	0°	-	8°
Ø1	5°	-	15°

Note: Dimensions in (mm)

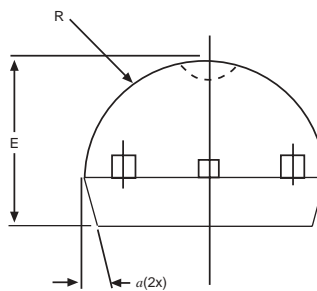


**PACKAGE: 3 PIN TO-92**



3 Pin TO-92			
SYMBOL	MIN	NOM	MAX
A	0.17	-	0.195
b	0.014	-	0.02
E	0.13	-	0.155
e	0.95	-	0.105
e1	0.045	-	0.055
L	0.5	-	0.61
R	0.085	-	0.095
S1	0.045	-	0.06
W	0.016	-	0.022
D	0.175	-	0.195
a	4°	-	6°

Note: Dimensions in (inches)





Part Number	Accuracy	Output Voltage	Package Type
SPX385AM-2.5	1.0%	2.5V	3-Pin SOT-23
SPX385AM-2.5/TR	1.0%	2.5V	3-Pin SOT-23
SPX385AM1-2.5	1.0%	2.5V	3-Pin SOT-89
SPX385AM1-2.5/TR	1.0%	2.5V	3-Pin SOT-89
SPX385AS-2.5	1.0%	2.5V	8-Pin NSOIC
SPX385AS-2.5/TR	1.0%	2.5V	8-Pin NSOIC
SPX385AN-2.5	1.0%	2.5V	3-Pin TO-92
SPX385AN-2.5/TR	1.0%	2.5V	3-Pin TO-92
SPX385M-2.5	2.0%	2.5V	3-Pin SOT-23
SPX385M-2.5/TR	2.0%	2.5V	3-Pin SOT-23
SPX385M1-2.5	2.0%	2.5V	3-Pin SOT-89
SPX385M1-2.5/TR	2.0%	2.5V	3-Pin SOT-89
SPX385S-2.5	2.0%	2.5V	8-Pin NSOIC
SPX385S-2.5/TR	2.0%	2.5V	8-Pin NSOIC
SPX385N-2.5	2.0%	2.5V	3-Pin TO-92
SPX385N-2.5/TR	2.0%	2.5V	3-Pin TO-92

Available in lead free packaging. To order add "-L" suffix to part number.

Example: SPX385S-2.5/TR = standard; SPX385S-L-2.5/TR = lead free

/TR = Tape and Reel

Pack quantity is 2000 for TO-92 and 2500 for SOT-23, SOT-89 and NSOIC.



## Exar Corporation

**Headquarters and  
Sales Office:**  
48720 Kato Road  
Fremont, CA 94538  
main: 510-668-7000  
fax: 510-668-7030

Exar Corporation reserves the right to make changes to any products described herein. Exar does not assume any liability arising out of the application or use of any product or circuit described herein; neither does it convey any license under its patent rights nor the rights of others.