



# SPX4040

## Precision Micropower 2.5V Shunt Voltage Reference

### FEATURES

- Low temperature coefficient 100 ppm/°C
- Operating current range 100µA to 15 mA
- Low power, 250 mW @  $I_{in}=100$  mA
- Two terminal "Zener" operation
- Small package: SOT - 23, TO-92, and SO-8
- Fixed reverse breakdown voltage 2.5 Volt
- No output capacitance required
- Similar replacement for LM4040

### APPLICATIONS

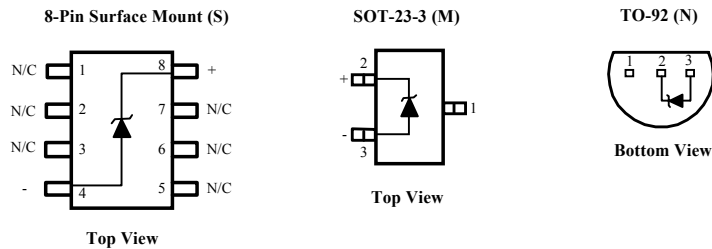
- Constant Current Source
- Digital Voltmeter
- Power Supply Monitor
- Precision Regulators
- Battery-Powered Equipment
- Instrumentation
- Automotive Electronics
- Data Acquisition Systems
- Energy Management

### PRODUCT DESCRIPTION

The SPX4040 is a two-terminal, temperature compensated, band-gap voltage reference, which provides a fixed 2.5V output for input currents between 100 µA to 15mA. The bandgap voltage (2.5V) is independently trimmed from the output voltage to achieve a very low tempco. This trimming technique process gives a very stable device over the full temperature range (A grade 50 ppm/ °C). The SPX4040 is available in the sub-miniature (3mm × 1.3mm) SOT-23, SO-8 surface mount package, or TO-92 package. The operating temperature is -40°C to 85°C.

The SPX4040 advanced design eliminates the need for an external stabilized capacitor while insuring stability with any capacitive load, making them easy to use.

### PIN CONNECTIONS



## ABSOLUTE MAXIMUM RATINGS

Reverse Current .....20mA  
 Forward Current .....10mA  
 Storage Temperature ..... -65°C to +150°C  
 Lead Temperature (Soldering) ..... 300°C

Power Dissipation at 25°C  
 M Package ..... 300mW  
 N Package ..... 550mW  
 S Package ..... 525mW  
 Temperature Range ..... -40°C ≤ T<sub>A</sub> ≤ +85°C

## ELECTRICAL CHARACTERISTICS (SPX4040-2.5V)

Electrical Characteristics at I<sub>IN</sub> = 1000μA, and T<sub>A</sub> = +25°C unless otherwise noted. . **Boldface limits apply over temperature**

Parameters	Conditions	SPX4040A2			SPX4040B2			Units
		Min	Typ	Max	Min	Typ	Max	
Reverse Breakdown Voltage	I <sub>R</sub> =500 μA		2.500			2.500		V
Reverse Breakdown Tolerance	I <sub>R</sub> =500 μA			±25 ±49			±25 ±49	mV mV
Output Impedance			0.60	2		0.60	2	Ω
Noise Voltage	0.1KHz≤f≤10Hz		15			15		μV p-p
Tempco	Note 1			50			100	ppm/°C
Turn-on Setting	0.1% of V <sub>OUT</sub>		30			30		μSec
Operating Current Range	Note 2	0.1		15	0.1		15	mA
Temp. Range		-40		85	-40		85	°C
Parameters	Conditions	SPX4040A3			SPX4040B3			Units
		Min	Typ	Max	Min	Typ	Max	
Reverse Breakdown Voltage	I <sub>R</sub> =500 μA		2.500			2.500		V
Reverse Breakdown Tolerance	I <sub>R</sub> =500 μA			±50 ±74			±50 ±74	mV mV
Output Impedance			0.60	2		0.60	2	Ω
Noise Voltage	0.1KHz≤f≤10Hz		15			15		μV p-p
Tempco	Note 1			50			100	ppm/°C
Turn-on Setting	0.1% of V <sub>OUT</sub>		30			30		μSec
Operating Current Range	Note 2	0.1		15	0.1		15	mA
Temp. Range		-40		85	-40		85	°C

## ELECTRICAL CHARACTERISTICS (SPX4040-5.0V)

Electrical Characteristics at  $I_{IN} = 1000\mu A$ , and  $T_A = +25^\circ C$  unless otherwise noted. . **Boldface limits apply over temperature**

Parameters	Conditions	SPX4040A2			SPX4040B2			Units
		Min	Typ	Max	Min	Typ	Max	
Reverse Breakdown Voltage	$I_R=500\mu A$		5.000			5.000		V
Reverse Breakdown Tolerance	$I_R=500\mu A$			$\pm 50$ <b><math>\pm 98</math></b>			$\pm 50$ <b><math>\pm 98</math></b>	mV mV
Output Impedance			0.60	2		0.60	2	$\Omega$
Noise Voltage	$0.1KHz \leq f \leq 10Hz$		15			15		$\mu V$ p-p
Tempco	Note 1			50			100	ppm/ $^\circ C$
Turn-on Setting	0.1% of $V_{OUT}$		30			30		$\mu Sec$
Operating Current Range	Note 2	0.175		15	0.175		15	mA
Temp. Range		-40		85	-40		85	$^\circ C$
Parameters	Conditions	SPX4040A3			SPX4040B3			Units
		Min	Typ	Max	Min	Typ	Max	
Reverse Breakdown Voltage	$I_R=500\mu A$		5.000			5.000		V
Reverse Breakdown Tolerance	$I_R=500\mu A$			$\pm 100$ <b><math>\pm 148</math></b>			$\pm 100$ <b><math>\pm 148</math></b>	mV mV
Output Impedance			0.60	2		0.60	2	$\Omega$
Noise Voltage	$0.1KHz \leq f \leq 10Hz$		15			15		$\mu V$ p-p
Tempco	Note 1			50			100	ppm/ $^\circ C$
Turn-on Setting	0.1% of $V_{OUT}$		30			30		$\mu Sec$
Operating Current Range	Note 2	0.175		15	0.175		15	mA
Temp. Range		-40		85	-40		85	$^\circ C$

- Note:
- 1) Three-point measurement guarantees the error band over the specified temperature range.
  - 2) Optimum performance is obtained at currents below 1000  $\mu A$ .
  - 3) Limits are 100% production tested at 25 $^\circ C$ . Limits over temperature are guaranteed through correlation using statistical quality control.

## SPX4040 Applications Hints

This device is designed for stable operation and has no need of an external capacitor between pin 4 and 8. The reference remains stable if a bypass capacitor is used.

### SOT-23

The SPX4040 in the SOT-23 package has a parasitic Schottky diode between pin 3 and pin 1. Pin 1 of SOT-23 must float or be connected to pin 3.

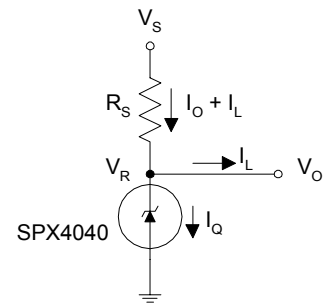
### Conventional Shunt Regulator

In a conventional shunt regulator application (see Figure 1), an external series resistor ( $R_S$ ) is connected between the supply voltage and the SPX4040.  $R_S$  determines the current that flows through the load ( $I_L$ ) and the reference ( $I_Q$ ). Since load current and supply voltage may vary,  $R_S$  should be small enough to supply at least the minimum acceptable  $I_Q$  to the reference even when the supply voltage is at its minimum and the load current is at its maximum value. When the supply voltage is at its maximum and  $I_L$  is at its minimum,  $R_S$  should be large enough so that the current flowing through the SPX4040 is less than 15mA

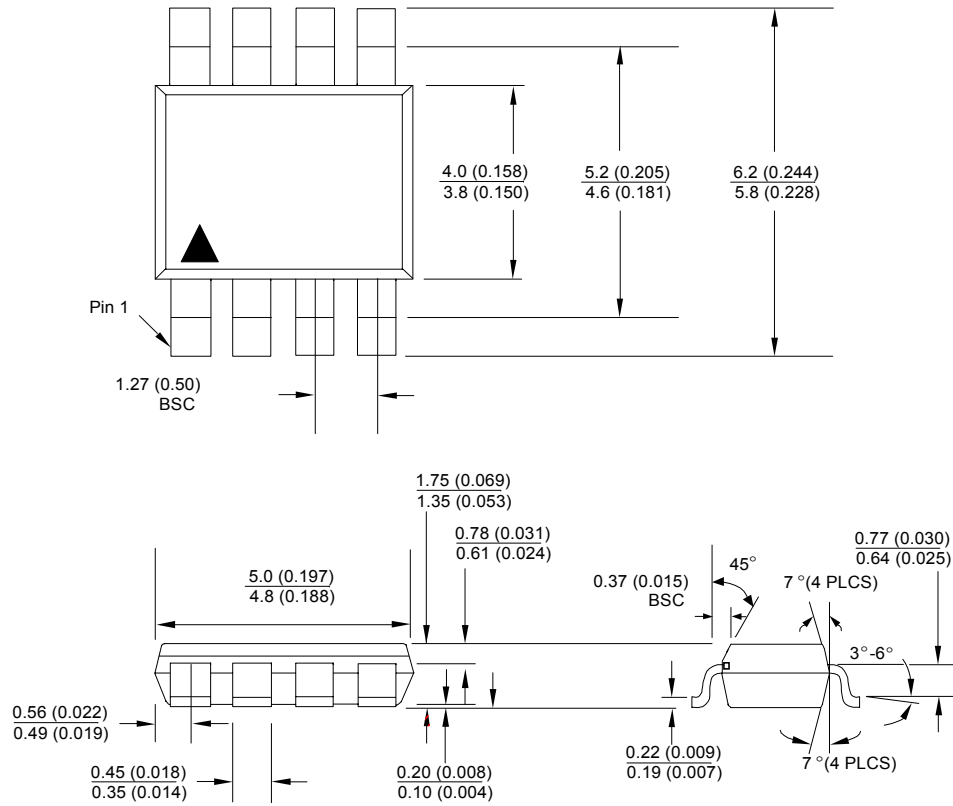
$R_S$  is determined by the supply voltage ( $V_S$ ), the load and operating current ( $I_L$  and  $I_Q$ ), reference's reverse breakdown voltage ( $V_R$ ).

$$R_S = (V_S - V_R)/(I_L + I_Q)$$

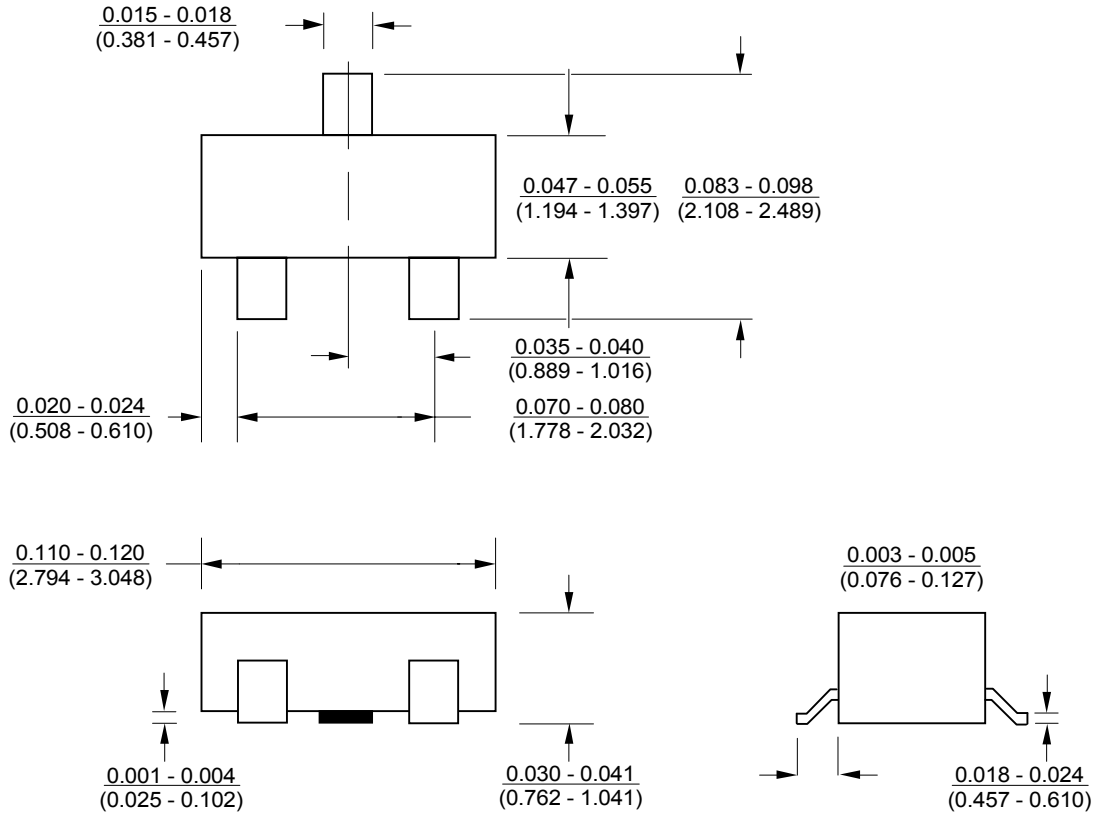
**Figure 1. SPX4040 Fixed Shunt Regulator Application**



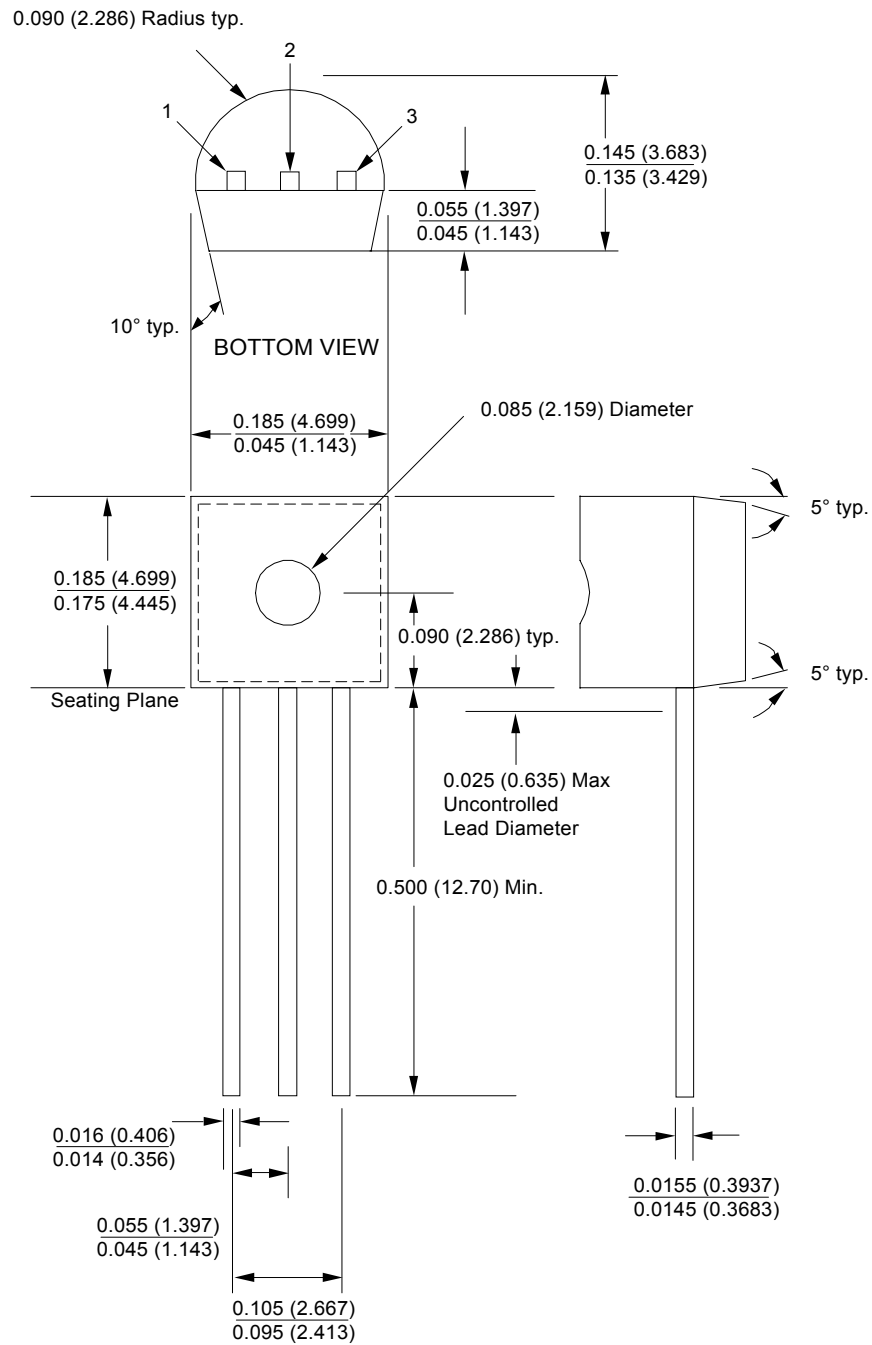
PACKAGE DRAWING  
8-PIN SOIC (S)



DRAWING PACKAGE  
SOT-23-3L (M)



PACKAGE DRAWING  
TO-92 (N)



## ORDERING INFORMATION

Ordering No.	Temp Coef	Output Accuracy	Reverse Breakdown Voltage	Packages
SPX4040A2N-2.5	100ppm	1%	2.5V	3 Lead TO-92
SPX4040A2N-5.0	100ppm	1%	5.0V	3 Lead TO-92
SPX4040B2N-2.5	150ppm	1%	2.5V	3 Lead TO-92
SPX4040B2N-5.0	150ppm	1%	5.0V	3 Lead TO-92
SPX4040A3N-2.5	100ppm	2%	2.5V	3 Lead TO-92
SPX4040A3N-5.0	100ppm	2%	5.0V	3 Lead TO-92
SPX4040B3N-2.5	150ppm	2%	2.5V	3 Lead TO-92
SPX4040B3N-5.0	150ppm	2%	5.0V	3 Lead TO-92
SPX4040A2S-2.5	100ppm	1%	2.5V	8 Lead SOIC
SPX4040A2S-5.0	100ppm	1%	5.0V	8 Lead SOIC
SPX4040B2S-2.5	150ppm	1%	2.5V	8 Lead SOIC
SPX4040B2S-5.0	150ppm	1%	5.0V	8 Lead SOIC
SPX4040A3S-2.5	100ppm	2%	2.5V	8 Lead SOIC
SPX4040A3S-5.0	100ppm	2%	5.0V	8 Lead SOIC
SPX4040B3S-2.5	150ppm	2%	2.5V	8 Lead SOIC
SPX4040B3S-5.0	150ppm	2%	5.0V	8 Lead SOIC
SPX4040A2M-2.5	100ppm	1%	2.5V	3 Lead SOT-23
SPX4040A2M-5.0	100ppm	1%	5.0V	3 Lead SOT-23
SPX4040B2M-2.5	150ppm	1%	2.5V	3 Lead SOT-23
SPX4040B2M-5.0	150ppm	1%	5.0V	3 Lead SOT-23
SPX4040A3M-2.5	100ppm	2%	2.5V	3 Lead SOT-23
SPX4040A3M-5.0	100ppm	2%	5.0V	3 Lead SOT-23
SPX4040B3M-2.5	150ppm	2%	2.5V	3 Lead SOT-23
SPX4040B3M-5.0	150ppm	2%	5.0V	3 Lead SOT-23



SIGNAL PROCESSING EXCELLENCE

### Sipex Corporation

**Headquarters and Main Offices:**  
22 Linnell Circle  
Billerica, MA 01821  
TEL: (978) 667-8700  
FAX: (978) 670-9001  
e-mail: sales@sipex.com

233 South Hillview Drive  
Milpitas, CA 95035  
TEL: (408) 935-7600  
FAX: (408) 934-7500

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