



# 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

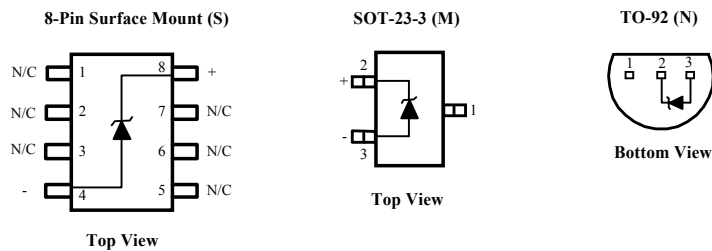
- Constant Current Source
- Digital Voltmeter
- Power Supply Monitor
- Precision Regulators
- Battery-Powered Equipment
- Instrumentation
- Automotive Electronics
- Data Acquisition Systems
- Energy Management

### 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.

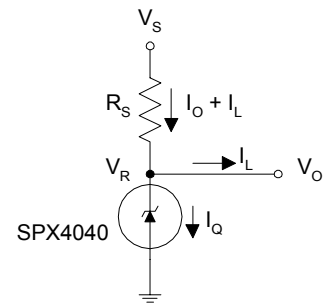
### Conventional Shunt Regulator

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

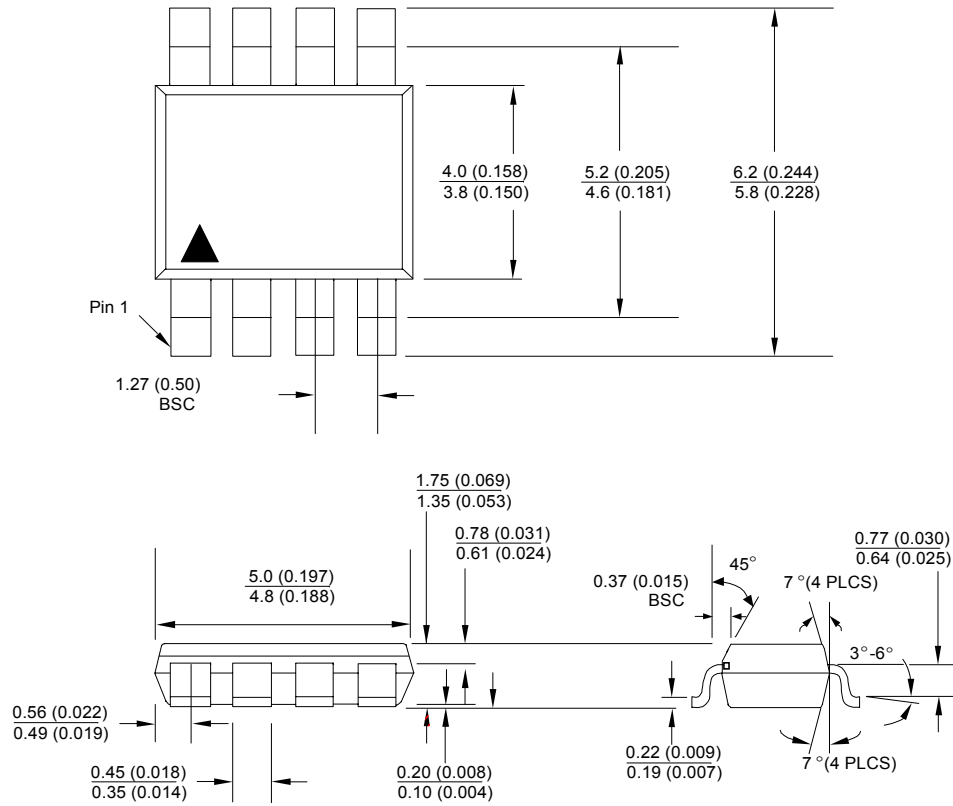
$R_S$  is determined by the supply voltage ( $V_S$ ), the load and operating current ( $I_L$  and  $I_Q$ ), reference's reverse breakdown voltage ( $V_R$ ).

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

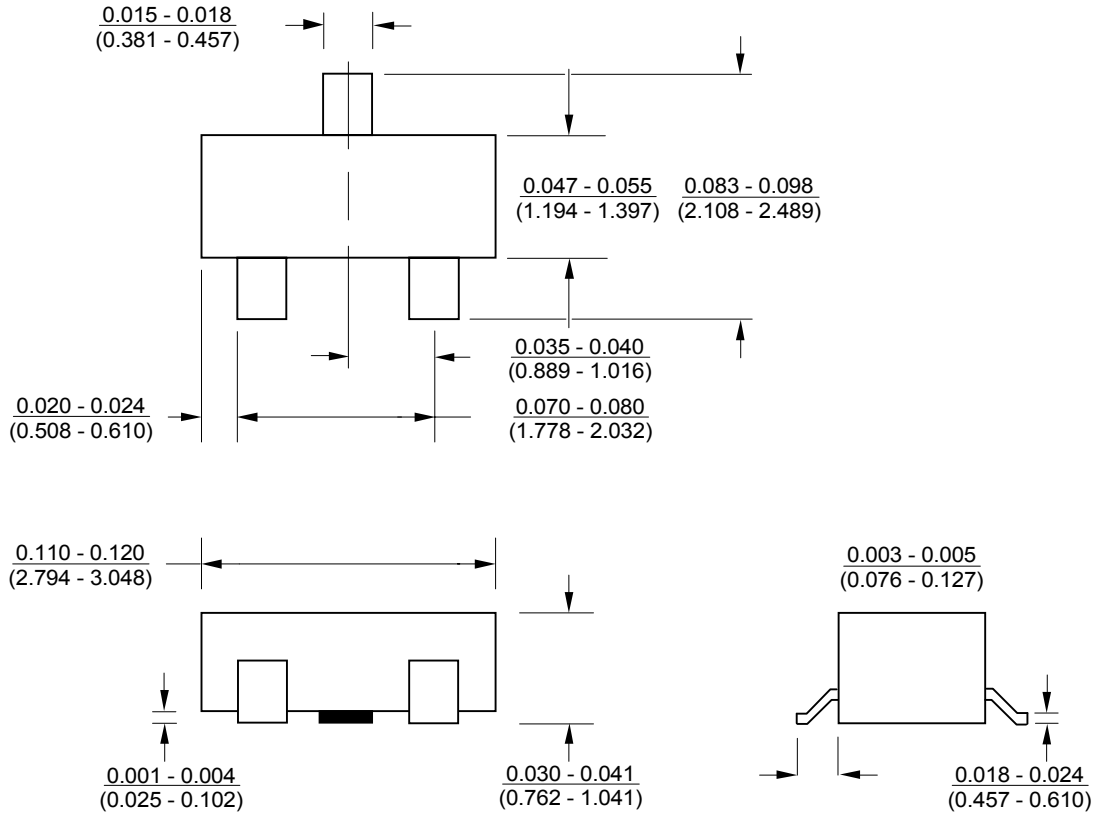
**Figure 1. SPX4040 Fixed Shunt Regulator Application**



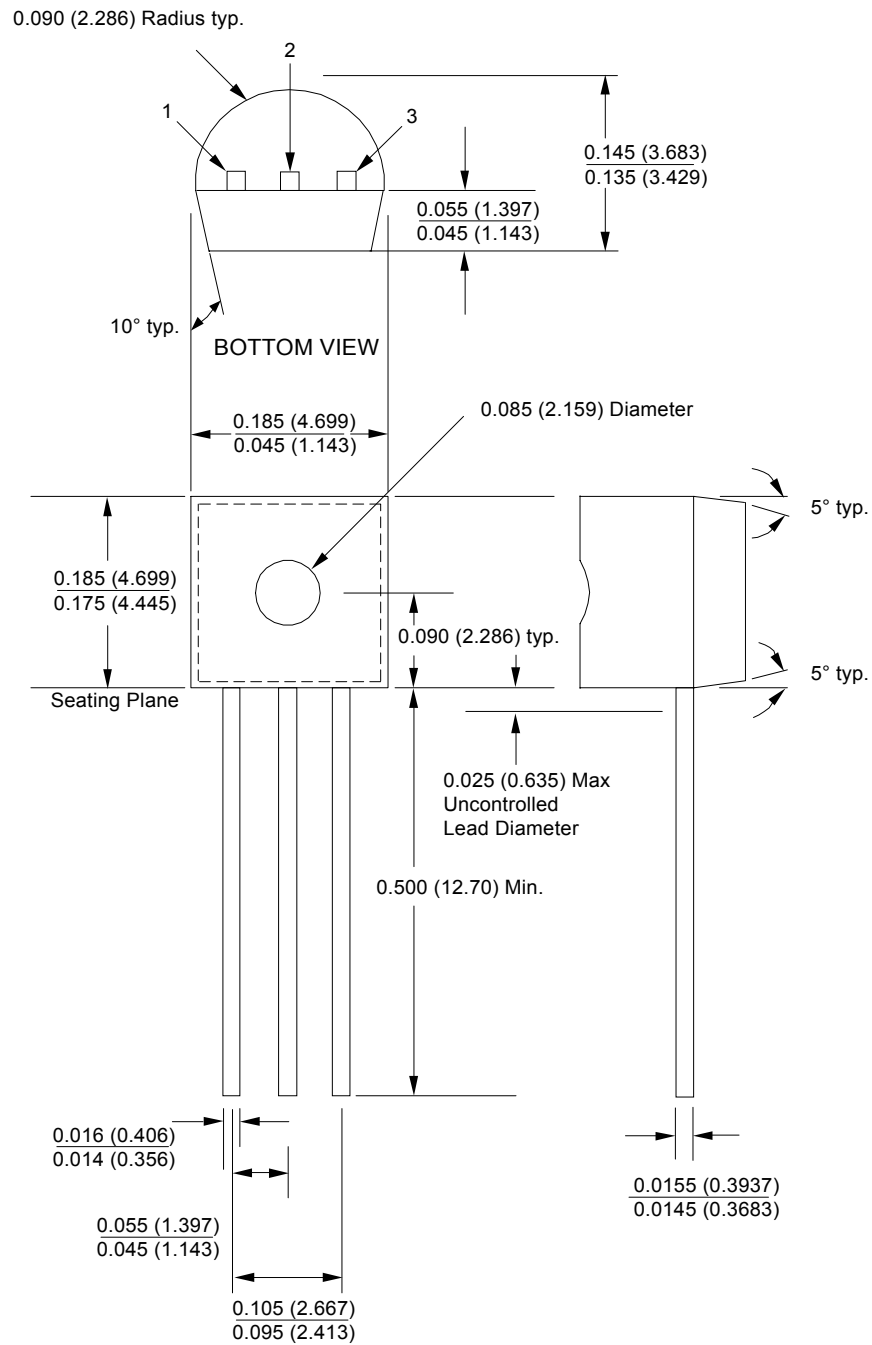
PACKAGE DRAWING  
8-PIN SOIC (S)



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

Sipex Corporation reserves the right to make changes to any products described herein. Sipex 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.