



# SPX4041

## Precision Micropower 1.24V Shunt Voltage Reference

### FEATURES

- Low temperature coefficient 50 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
- Output voltage tolerance  $\pm 0.5\%$

### APPLICATIONS

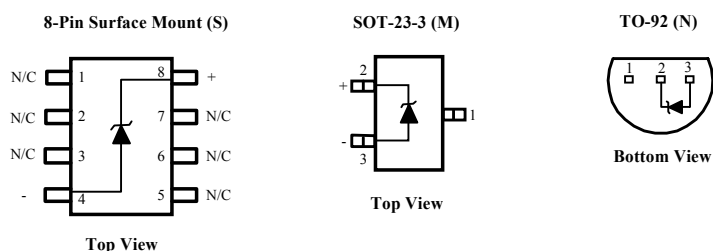
- Constant Current Source
- Digital Voltmeter
- Power Supply Monitor
- Precision Regulators
- Battery-Powered Equipment
- Instrumentation
- Automotive Electronics
- Data Acquisition Systems
- Energy Management

### PRODUCT DESCRIPTION

The SPX4041 is a two-terminal, temperature compensated, band-gap voltage reference, which provides a fixed 1.24V output for input currents between 500 µA to 5mA. The bandgap voltage (1.24V) is independently laser trimmed from the output voltage to achieve a very low tempco, then the output voltage is laser trimmed to 1.24 volts. This trimming technique and the low tempco (A grade 50 ppm/ °C) thin film resistor process gives a very stable device over the full temperature range. The SPX4041 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 SPX4041 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

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               | SPX4041A2 |      |            | SPX4041B2 |      |            | Units    |
|-----------------------------|--------------------------|-----------|------|------------|-----------|------|------------|----------|
|                             |                          | Min       | Typ  | Max        | Min       | Typ  | Max        |          |
| Reverse Breakdown Voltage   | I <sub>R</sub> =500 μA   |           | 1.24 |            |           | 1.24 |            | V        |
| Reverse Breakdown Tolerance | I <sub>R</sub> =500 μA   |           |      | ±25<br>±49 |           |      | ±25<br>±49 | mV<br>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                   | 0.5       |      | 5<br>15    | 0.5       |      | 5<br>15    | mA       |
| Temp. Range                 |                          | -40       |      | 85         | -40       |      | 85         | °C       |
| Parameters                  | Conditions               | SPX4041A3 |      |            | SPX4041B3 |      |            | Units    |
|                             |                          | Min       | Typ  | Max        | Min       | Typ  | Max        |          |
| Reverse Breakdown Voltage   | I <sub>R</sub> =500 μA   |           | 1.24 |            |           | 1.24 |            | V        |
| Reverse Breakdown Tolerance | I <sub>R</sub> =500 μA   |           |      | ±50<br>±74 |           |      | ±50<br>±74 | mV<br>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       |      | 5<br>15    | 0.1       |      | 5<br>15    | mA       |
| Temp. Range                 |                          | -40       |      | 85         | -40       |      | 85         | °C       |

Note:

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

## SPX4041 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 SPX4041 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.

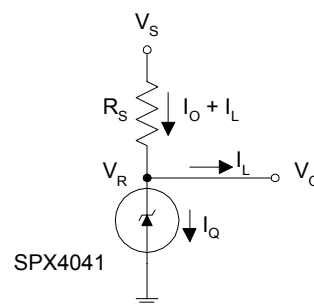
### Conventional Shunt Regulator

In a conventional shunt regulator application (see Figure 1), an external series resistor ( $R_S$ ) is connected between the supply voltage and the SPX4041.  $R_S$  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 SPX4041-x.x is less than 15mA

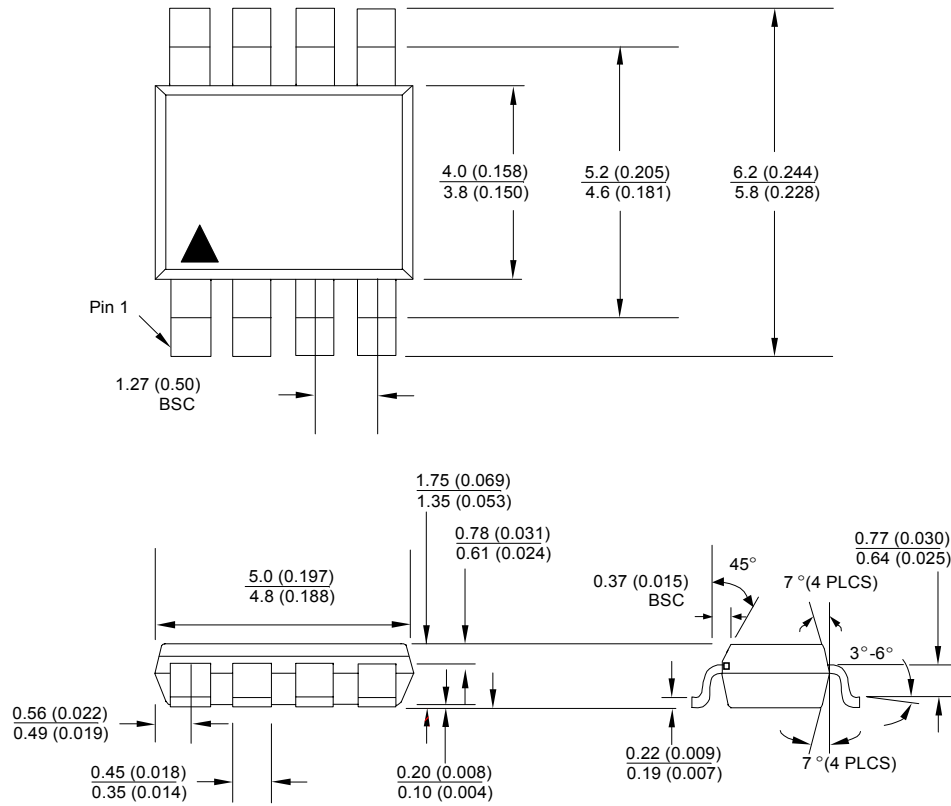
$R_S$  is determined by the supply voltage ( $V_S$ ), the load and operating current ( $I_L$  and  $I_Q$ ), reference's reverse breakdown voltage ( $V_R$ ).

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

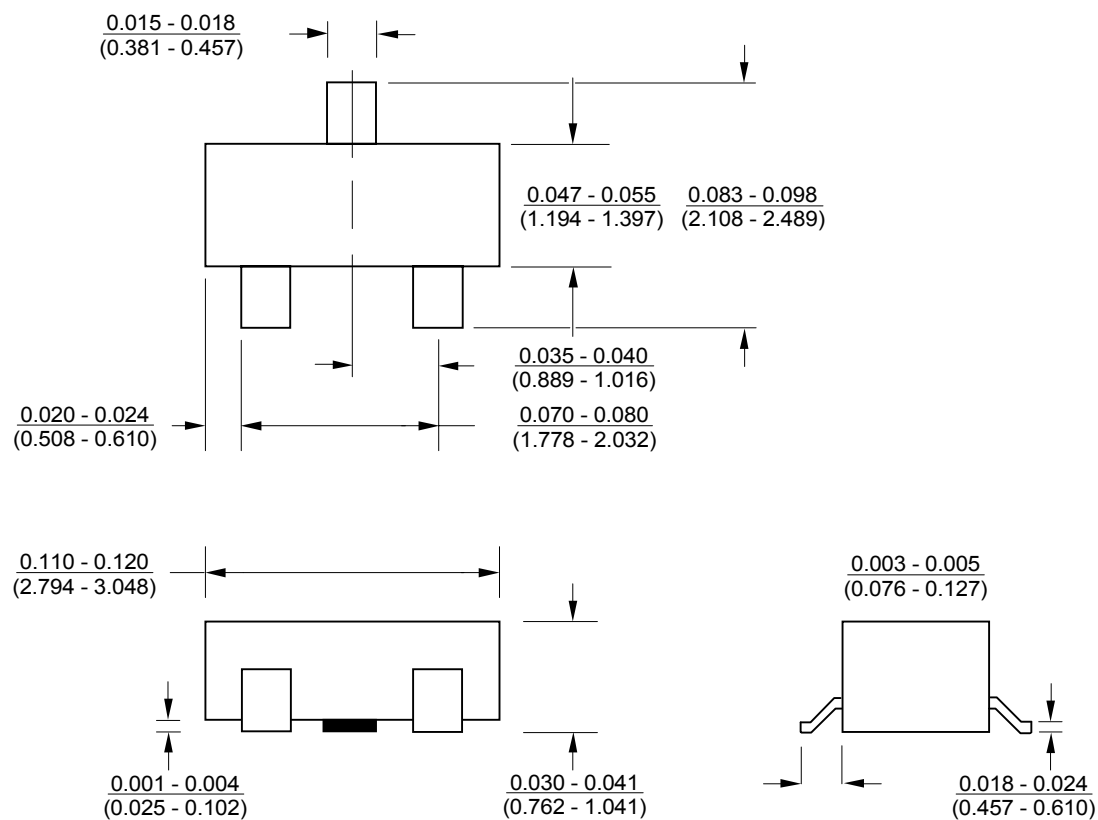
**Figure 1. SPX4041 Fixed Shunt Regulator Application**



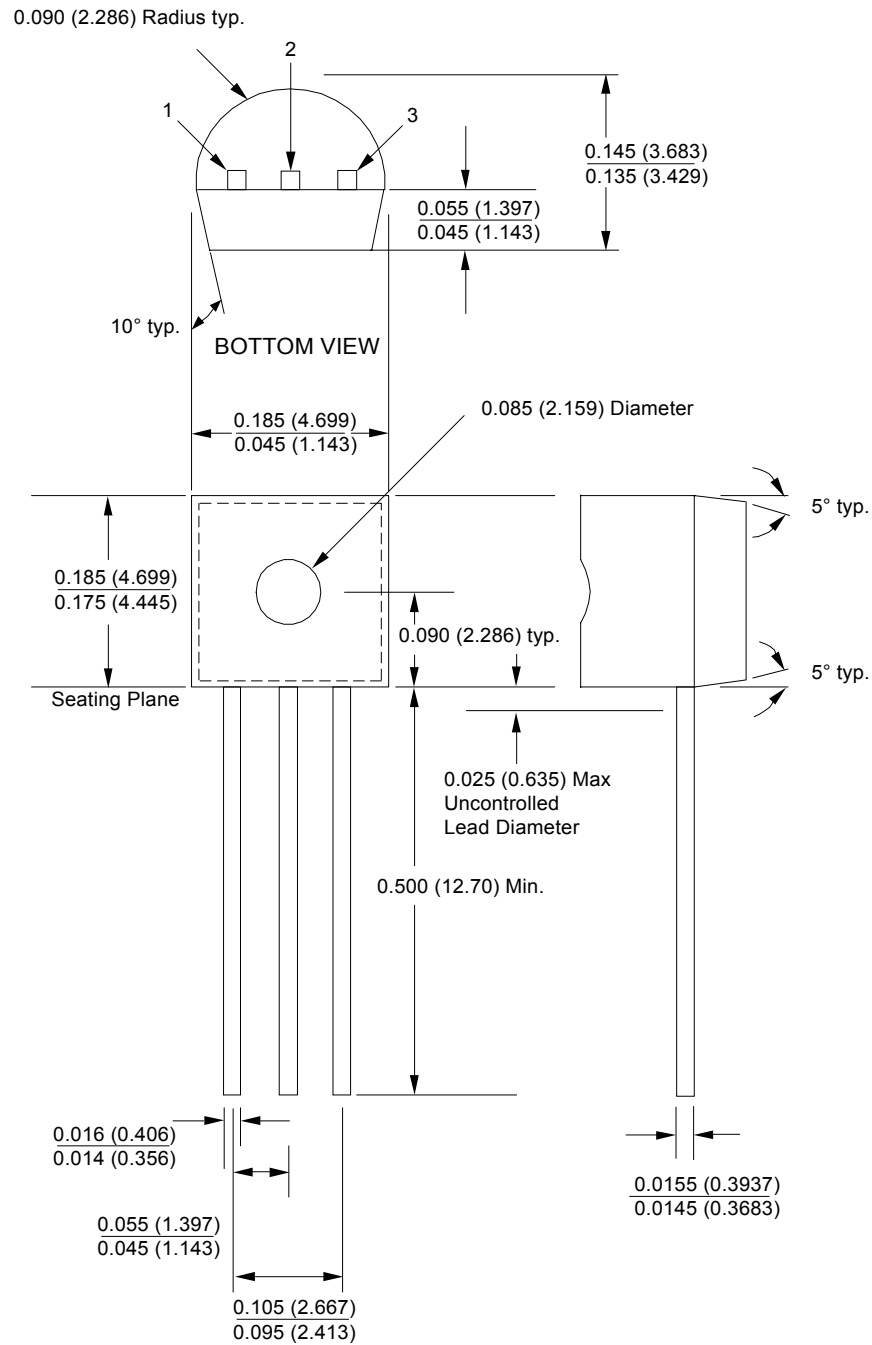
**DRAWING PACKAGE**  
**8-PIN SOIC (S)**



DRAWING PACKAGE  
SOT-23-3L (M)



## DRAWING PACKAGE TO-92 (N)



## ORDERING INFORMATION

| Ordering No. | Temp Coef. | Output Accuracy | Packages      |
|--------------|------------|-----------------|---------------|
| SPX4041AN-2  | 100ppm     | 1%              | 3 Lead TO-92  |
| SPX4041AN-3  | 100ppm     | 2%              | 3 Lead TO-92  |
| SPX4041BN-2  | 150ppm     | 1%              | 3 Lead TO-92  |
| SPX4041BN-3  | 150ppm     | 2%              | 3 Lead TO-92  |
| SPX4041AM-2  | 100ppm     | 1%              | 3 Lead SOT-23 |
| SPX4041AM-3  | 100ppm     | 2%              | 3 Lead SOT-23 |
| SPX4041BM-2  | 150ppm     | 1%              | 3 Lead SOT-23 |
| SPX4041BM-3  | 150ppm     | 2%              | 3 Lead SOT-23 |
| SPX4041AS-2  | 100ppm     | 1%              | 8 Lead SOIC   |
| SPX4041AS-3  | 100ppm     | 2%              | 8 Lead SOIC   |
| SPX4041BS-2  | 150ppm     | 1%              | 8 Lead SOIC   |
| SPX4041BS-3  | 150ppm     | 2%              | 8 Lead SOIC   |



SIGNAL PROCESSING EXCELLENCE

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