

Precision Micropower 2.5V Shunt Voltage Reference

FEATURES

- Trimmed Bandgap to 0.5% and 1%
- Wide Operating Current 160 μ A to 15mA
- Extended Temperature Range: -40°C to 85°C
- Low Temperature Coefficient 100 ppm/°C
- Offered in TO-92, SOIC, SOT-23-3
- Replacement in for LM4040

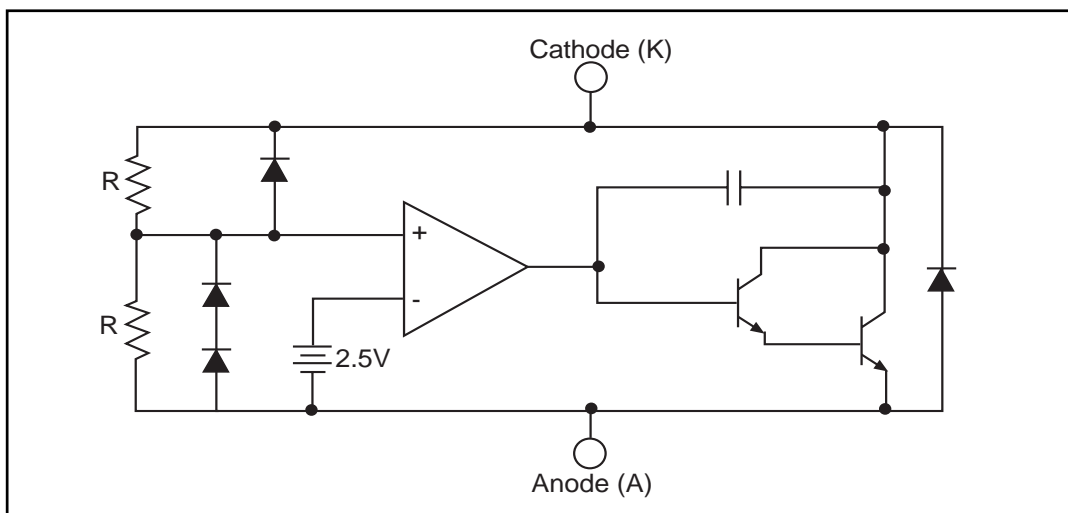
APPLICATIONS

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

DESCRIPTION

The SPX4040 is a 2-terminal, temperature compensated, bandgap voltage reference that provides a fixed 2.5V output for input currents between 160 μ A and 15mA. The bandgap voltage (2.5V) is independently trimmed from the output voltage to achieve a very low temperature coefficient. This trimming technique gives a stable device over the full temperature range (100ppm/°C).

The SPX4040 is available in TO-92, SOIC-8 and SOT-23-3 packages. The operating temperature range is -40°C to 85°C. The SPX4040 advanced design eliminates the need for an external stabilizing capacitor while ensuring stability with any capacitive load, making it easy to use.



ABSOLUTE MAXIMUM RATINGS

Anode-Cathode Forward Current, (<10ms) I_{AK}	10mA
Anode-Cathode Reverse Current I_{KA}	20mA
Continuous Power Dissipation at 25°C P_D	
TO-92	550mW
SOT-23	300 mW
SOIC-8	525mW
Junction Temperature T_J	150 °C
Storage Temperature T_{STG}	-65 to 150 °C
Lead Temperature (Soldering 5 sec.) T_L	300°C

NOTE: 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.

TYPICAL THERMAL RESISTANCES

PACKAGE	θ_{JA}	θ_{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

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

ELECTRICAL CHARACTERISTICS

Electrical characteristics at $I_N = 1000\mu A$ and $T_A = +25^\circ C$ unless otherwise specified.

PARAMETERS	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	UNITS
		SPX4040A-2.5			SPX4040-2.5			
Reverse Breakdown Voltage	$I_R = 500 \mu A$	2.4875	2.500	2.5125	2.475	2.500	2.525	V
Reverse Breakdown Tolerance	$I_R = 500\mu A$ $-40^\circ C < T_A < 85^\circ C$			± 12 ± 29			± 25 ± 49	mV mV
Output Impedance			0.60	0.8		0.60	0.8	Ω
Noise Voltage	$0.1KHz \leq f \leq 10Hz$		15			15		μV p-p
Tempco	Note 1			100			100	ppm/°C
Turn-on Setting	1.0% of V_{OUT}		30			30		μSec
Operating Current Range	Note 2	0.16		15	0.16		15	mA
Temp. Range (ambient)		-40		85	-40		85	°C

Notes:

1. Three-point measurement guarantees the error band over the specified temperature range.
2. Optimum performance is obtained at current below 1000 μA .

CALCULATING AVERAGE TEMPERATURE COEFFICIENT (TC)

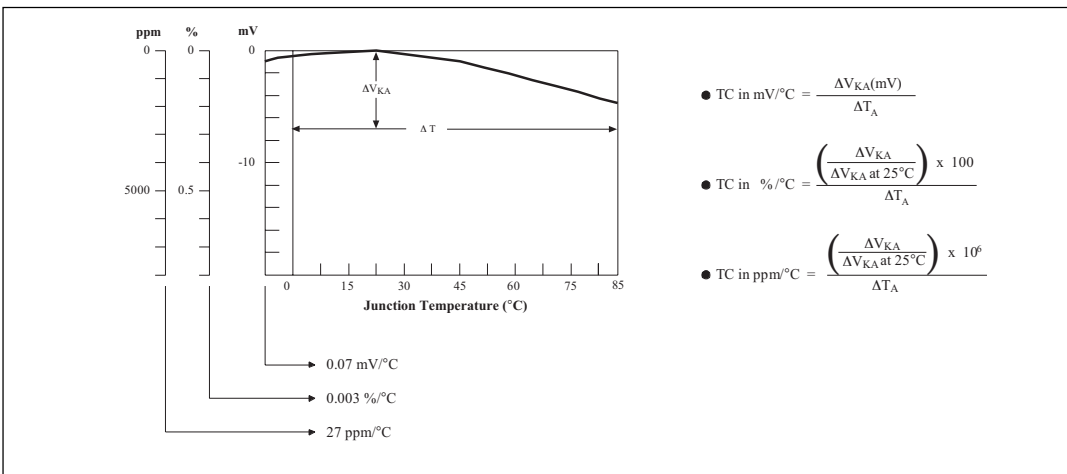


Figure 1. V_{KA} VS Temperature.

TYPICAL PERFORMANCE CHARACTERISTICS

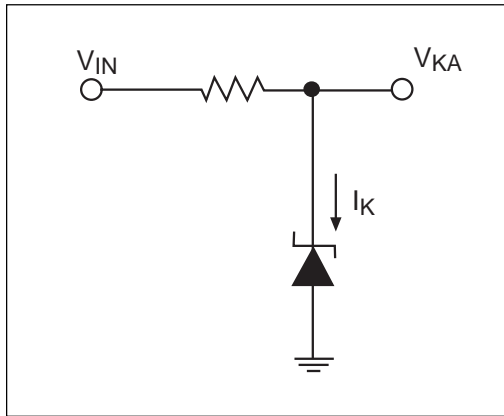


Figure 2. Test Circuit for $I_{K\text{ REVERSE}}$, $V_{KA} = 2.5V$

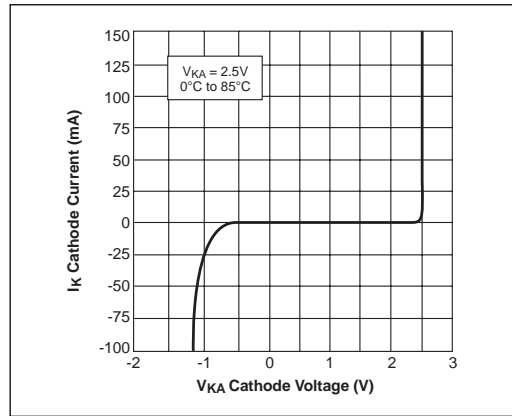


Figure 3. High Current Operating Characteristics

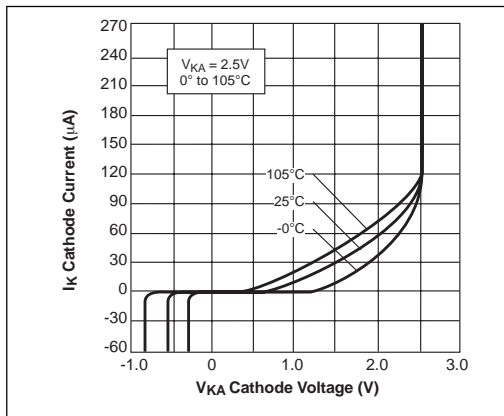


Figure 4. Low Current Operating Characteristics

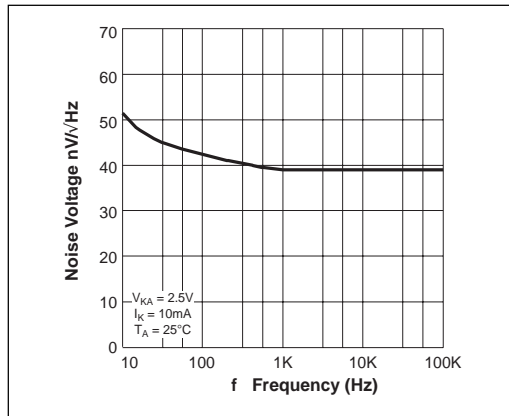


Figure 5. Noise Voltage VS Frequency

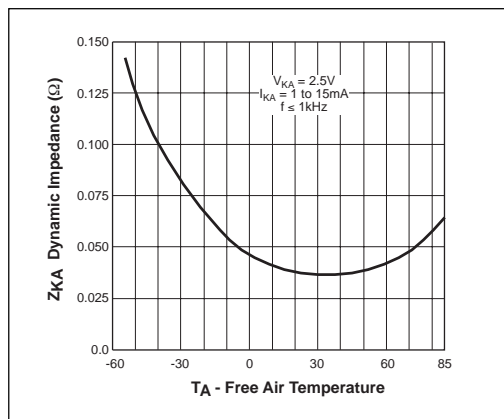


Figure 6. Low Frequency Dynamic Output Impedance VS. T_{AMBIENT}

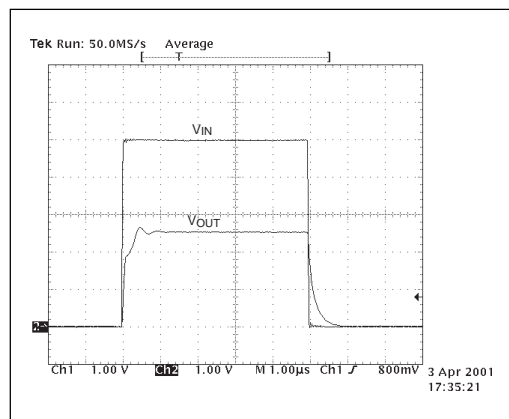


Figure 7. Frequency = 100kHz, $I_K = 10mA$, $T_A = 25^\circ C$

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

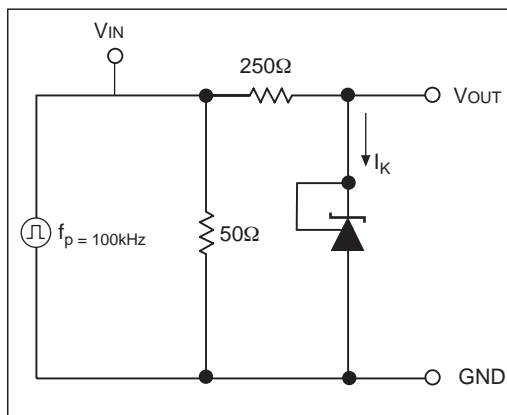


Figure 8. Test Circuit for Pulse Response

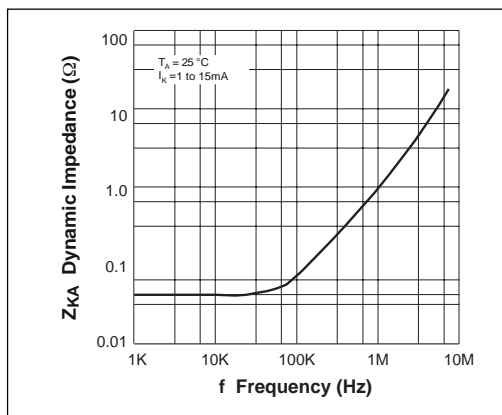


Figure 9. Dynamic Output Impedance $T_A = 25^\circ\text{C}$, $I_K = 1$ to 15mA

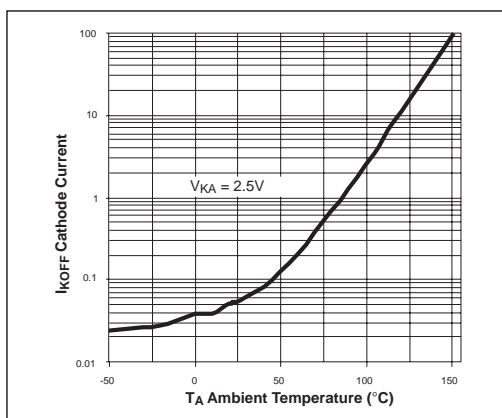


Figure 10. Off State Leakage

APPLICATION INFORMATION

This device is designed for stable operation and has no need of an external capacitor between pins 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 11), 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).

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

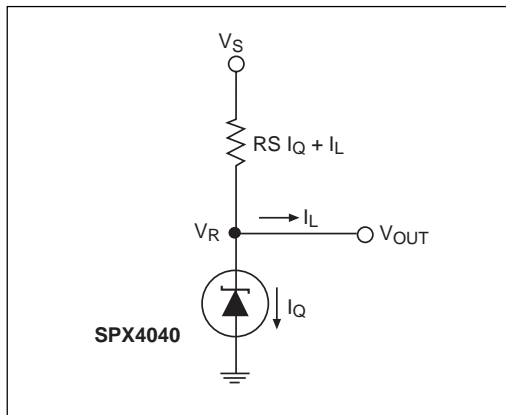


Figure 11. SPX4040 Fixed Shunt Regulator Application

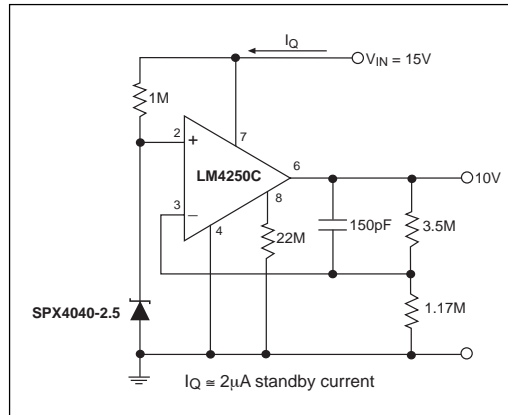


Figure 12. Micropower 10V Reference

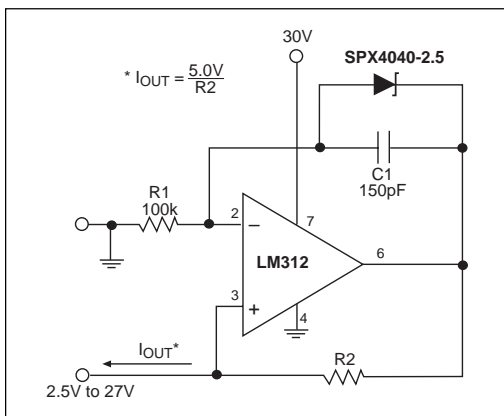


Figure 13. Precision 1μA to mA Current Source

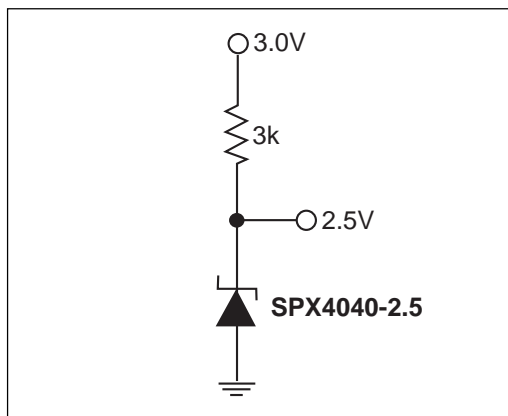


Figure 14. Reference from 3.0V Battery

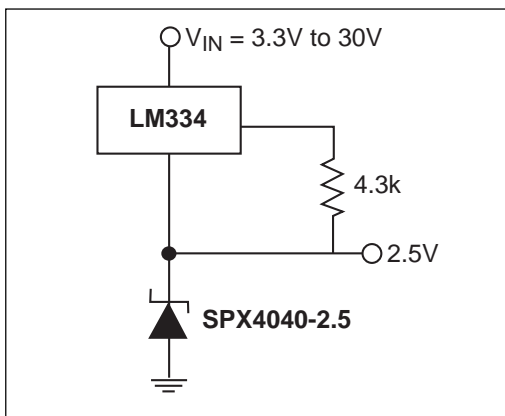
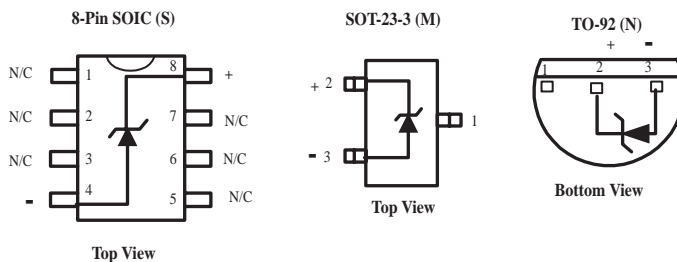
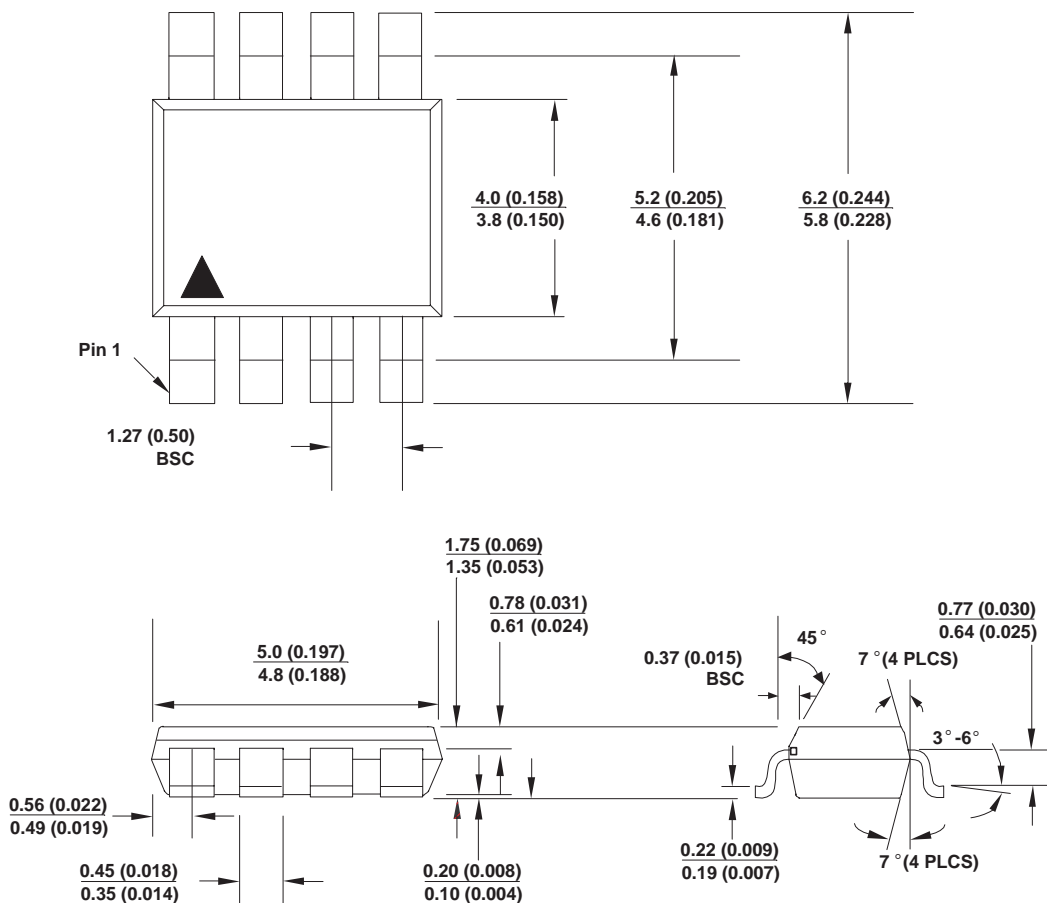


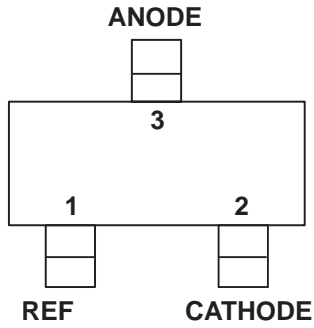
Figure 15. Wide Input Range Reference

PACKAGES

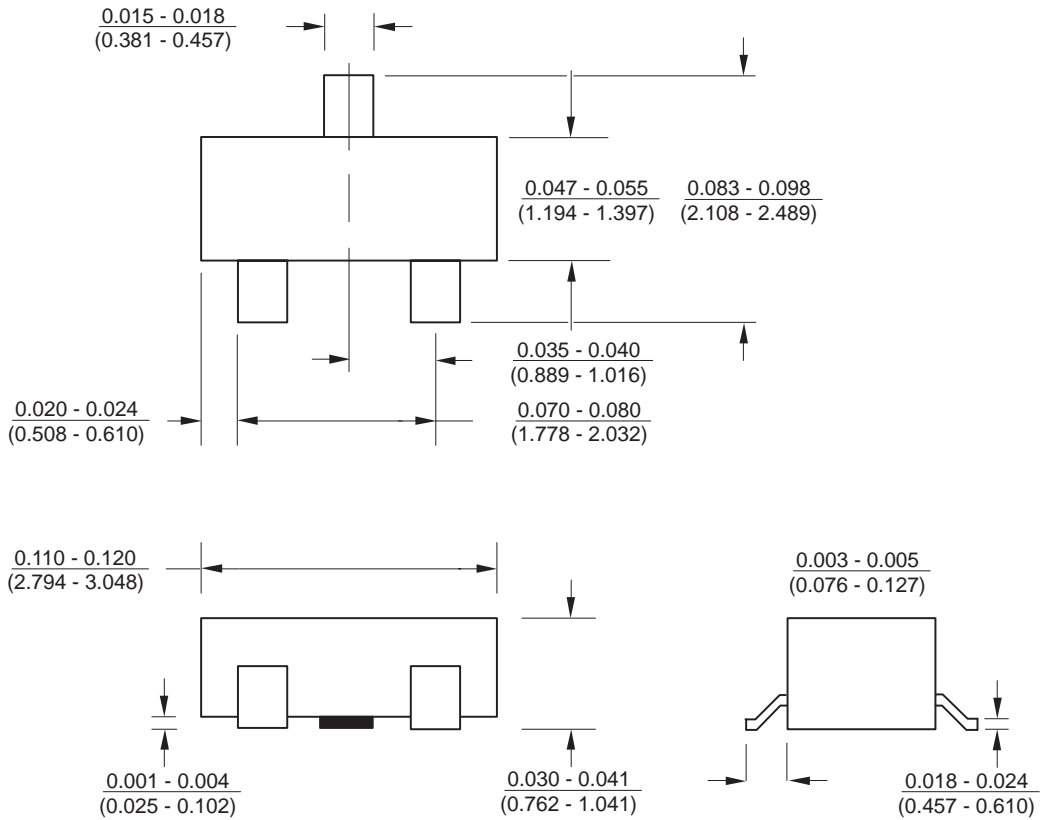


PACKAGE: 8 PIN PLASTIC SMALL OUTLINE (SOIC) (NARROW)

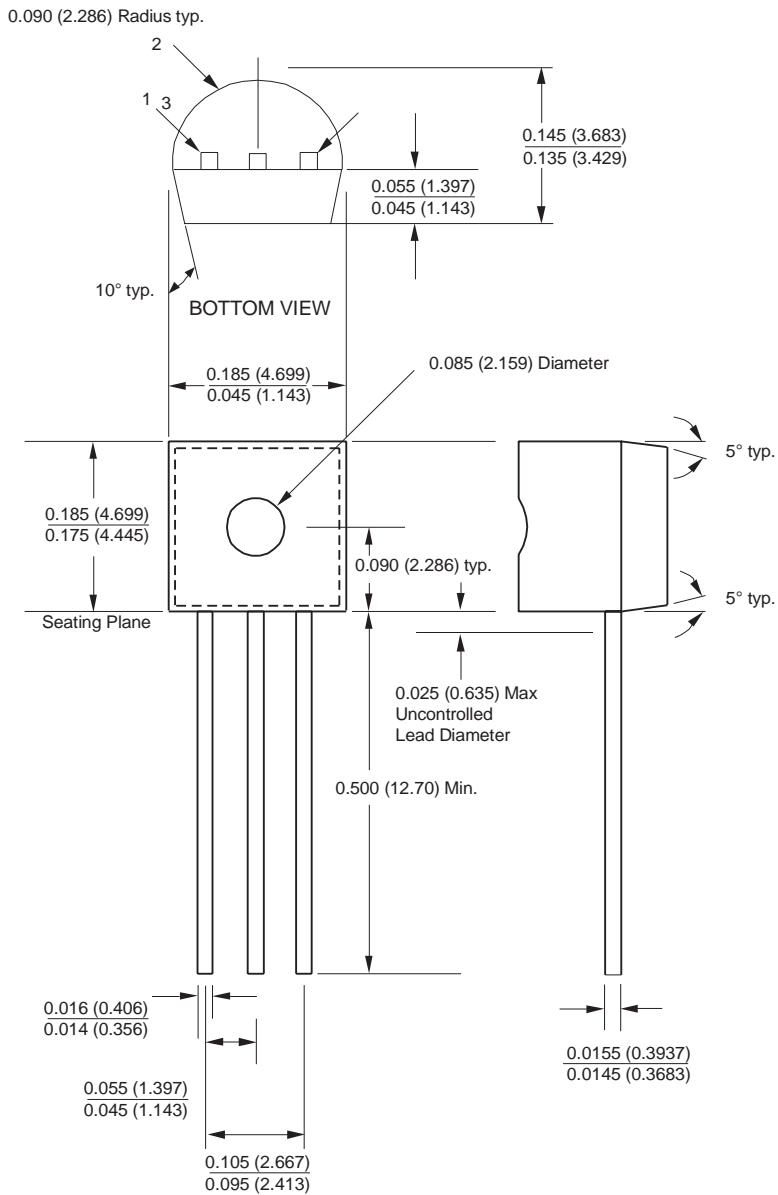




Top View



PACKAGE: TO-92



ORDERING INFORMATION

PART NUMBER	ACC	OUTPUT VOLTAGE	PACKAGES
SPX4040AM-2.5	0.5%	2.5V	3-Pin SOT-23
SPX4040AS-2.5	0.5%	2.5V	8-Pin SOIC
SPX4040AN-2.5	0.5%	2.5V	3-Pin TO-92
SPX4040M-2.5	1.0%	2.5V	3-Pin SOT-23
SPX4040S-2.5	1.0%	2.5V	8-Pin SOIC
SPX4040N-2.5	1.0%	2.5V	3-Pin TO-92



SIGNAL PROCESSING EXCELLENCE

Sipex Corporation

Headquarters and Sales Office

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

Sales Office

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

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