SPX4041

Precision 1.24V Shunt Voltage Reference

FEATURES
- Voltage Tolerance..... 1% and 2%
- Wide Operating Current.....100uA to 15mA
- Low Temperature Coefficient .....50 ppm/°C
- Fixed Reversed Breakdown Voltage..... 1.24V
- Offered in TO-92, SOIC, SOT-23-3
- No Output Capacitance Required
- Two Terminal "Zener" Operation
- Improved Replacement in Performance for TL431, AS4041

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

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 160µA to 15mA. The bandgap voltage (1.24V) is independently laser trimmed from the output voltage to achieve a very low temperature coefficient, then the output voltage is laser trimmed to 1.24 volts. This trimming technique and the low temperature coefficient (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, SOIC-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.

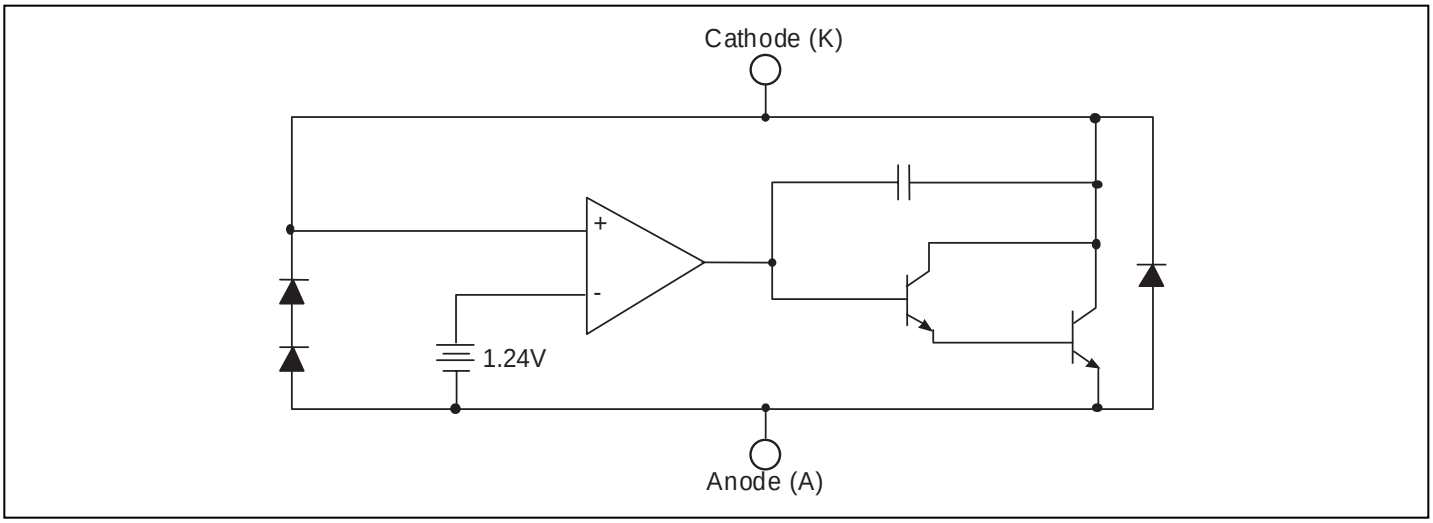


Figure 1. Block Diagram

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNITS
Anode-Cathode Forward Current	I_{AK}	10	mA
Reverse Current	I_{KA}	20	mA
Continuous Power Dissipation at 25° C	P_D		
TO-92		550	mW
SOT-23		300	mW
SOIC-8		525	mW
Junction Temperature	T_J	150	°C
Storage Temperature	T_{STG}	- 65 to 150	°C
Lead Temperature (Soldering 10 sec.)	T_L	300	°C
Operating Temperature Range	T_A	$-40°C \le T_A \le 85°C$	°C

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

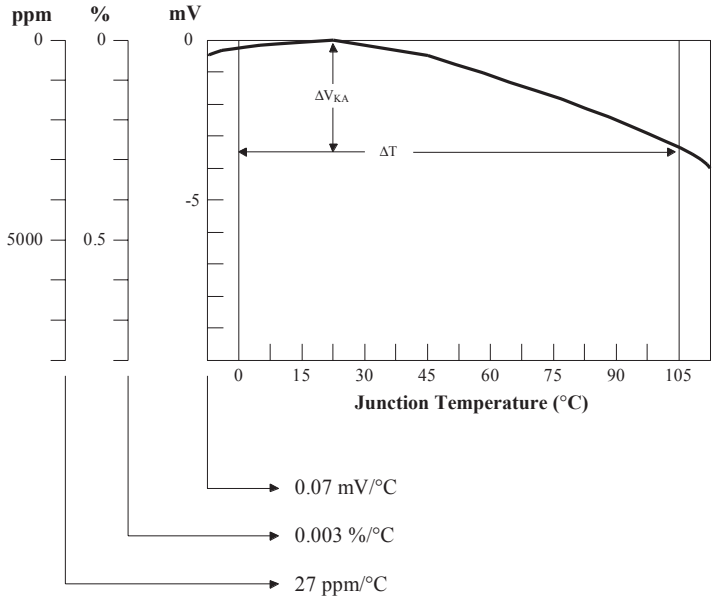
PACKAGE	θ_{JA}	θ_{JC}	TYPICAL DERATING
TO-92	160 °C/W	80 °C/W	6.3 mW/°C
SOT-23	575 °C/W	150 °C/W	1.7 mW/°C
SOIC-8	175 °C/W	45 °C/W	5.7 mW/°C

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

ELECTRICAL CHARACTERISTICS at I_{IN} = 1000µA, and T_A = +25°C unless otherwise noted.

Parameters	Conditions	SPX4041A Min	SPX4041A Typ	SPX4041A Max	SPX4041 Min	SPX4041 Typ	SPX4041 Max	Units
Reverse Breakdown Voltage	I_R=500µA		1.24			1.24		V
Reverse Breakdown Tolerance	I_R=500µA -40°C <T_A <85°C			±12 ±29			±25 ±49	mV mV
Dynamic Output Impedance			0.60	2		0.60	2	Ω
Noise Voltage	0.1kHz≤ f ≤10Hz		15			15		µV p-p
Temperature Coefficient	Note 1			100			100	ppm/°C
Turn-on Setting	0.1% of V_{OUT}		30			30		µSec
Temperature Range (T_A)		-40		85	-40		85	°C
Operating Current Range	Note 2	0.5		5 15	0.5		5 15	mA

*CALCULATING AVERAGE TEMPERATURE COEFFICIENT (TC)



$$\bullet \text{ TC in mV/°C} = \frac{\Delta V_{KA}(mV)}{\Delta T_A}$$

$$\bullet \text{ TC in \%/°C} = \frac{\left(\frac{\Delta V_{KA}}{\Delta V_{KA} \text{ at } 25°C}\right) \times 100}{\Delta T_A}$$

$$\bullet \text{ TC in ppm/°C} = \frac{\left(\frac{\Delta V_{KA}}{\Delta V_{KA} \text{ at } 25°C}\right) \times 10^6}{\Delta T_A}$$

Figure 2. V_{REF} vs. Temperature

TYPICAL PERFORMANCE CHARACTERISTICS

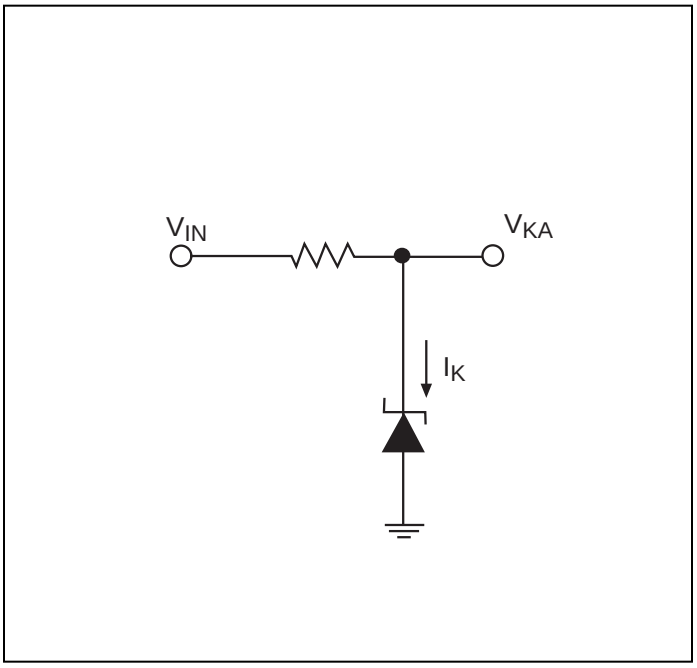


Figure 3. Test Circuit

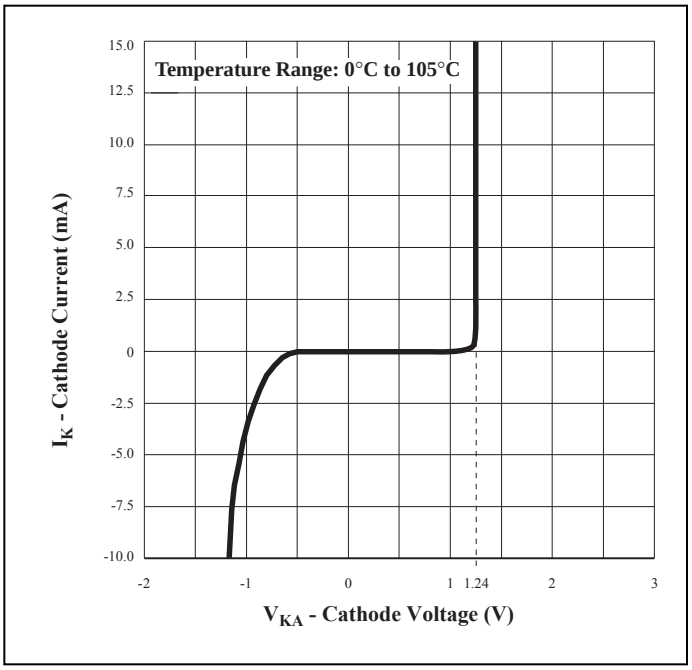


Figure 4. High Current Operating Characteristics

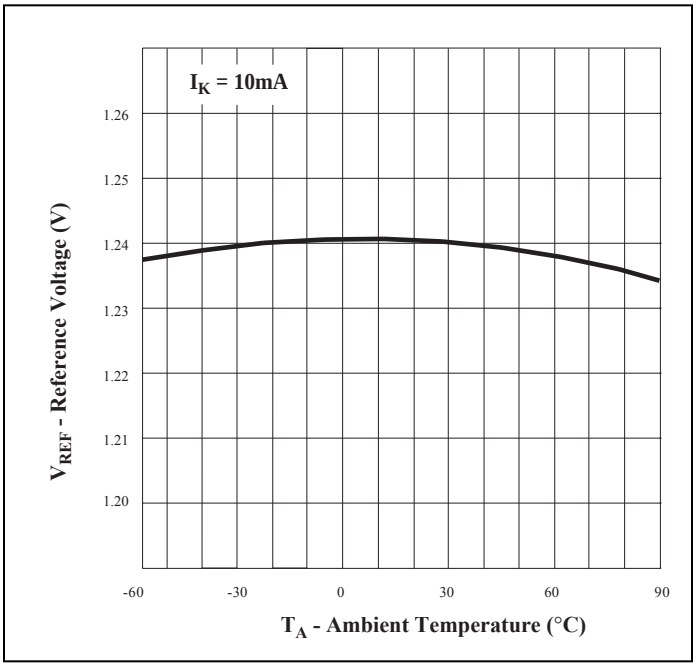


Figure 5. Reference Voltage vs. Ambient Temperature

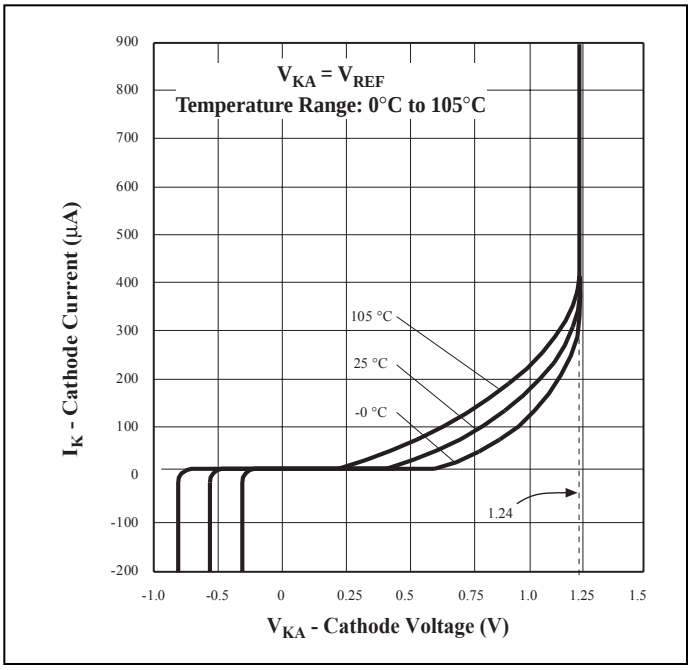


Figure 6. Low Current Operating Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS

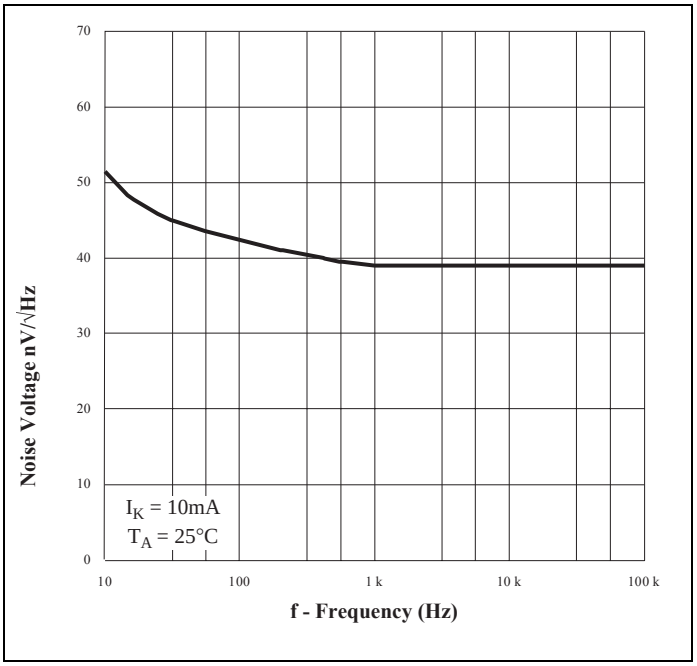


Figure 7. Noise Voltage vs. Frequency

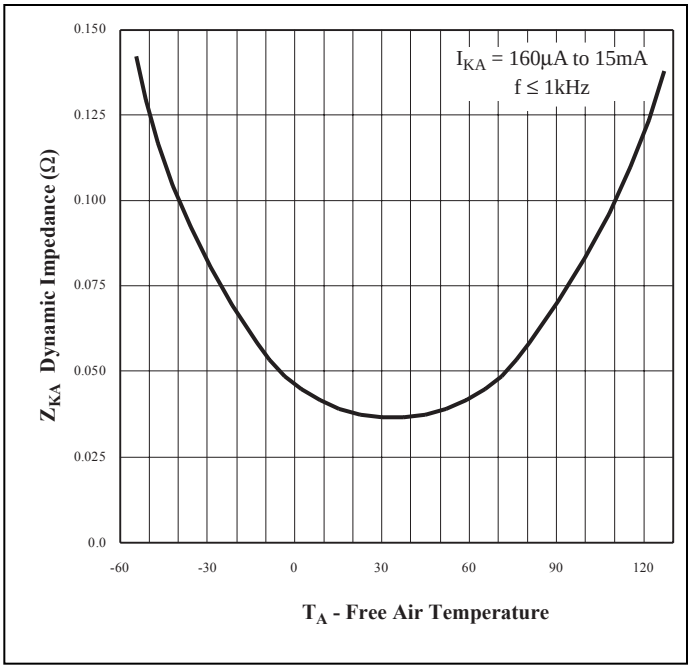


Figure 8. Low Frequency Dynamic Output Impedance vs. $T_{AMBIENT}$

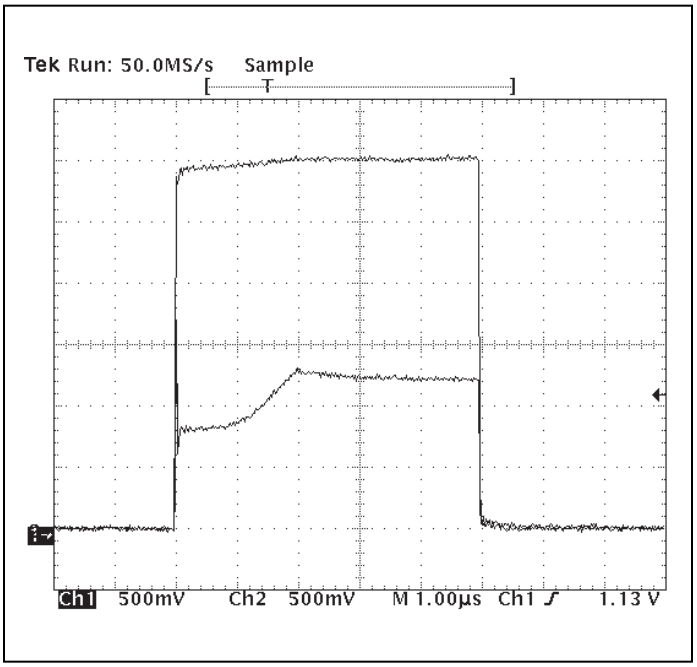


Figure 9a. Frequency = 100kHz, I_K = 10mA, T_A = 25°C

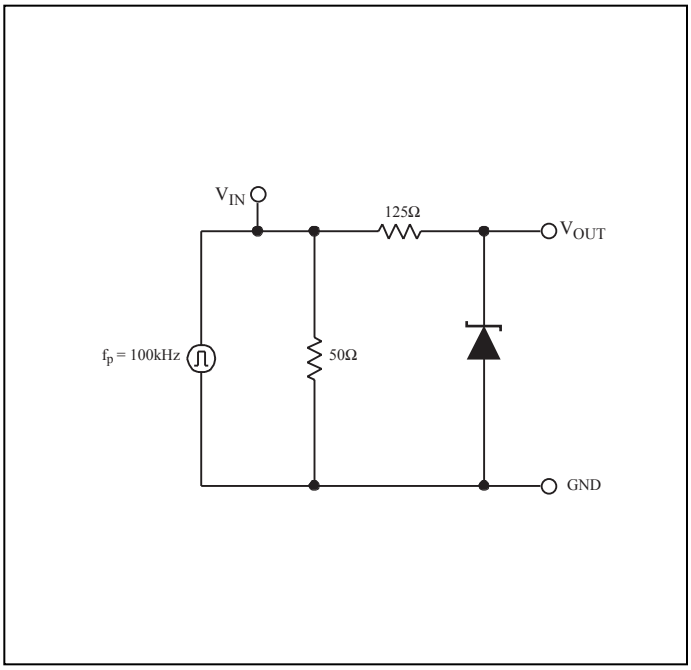


Figure 9b. Test Circuit for Pulse Response

APPLICATION INFORMATION

This device is designed for stable operation and has no need of an external capacitor. 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 11), an external series resister (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 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).

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

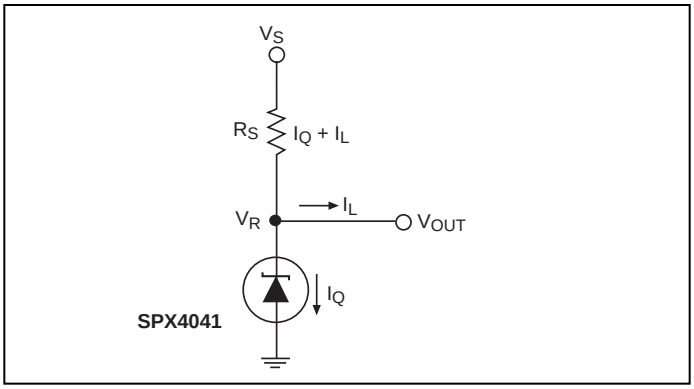


Figure 11. SPX4041 Fixed Shunt Regulator Application

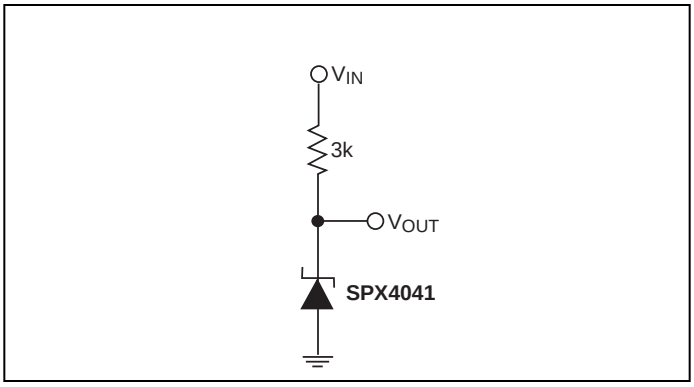


Figure 12. 1.24V Reference

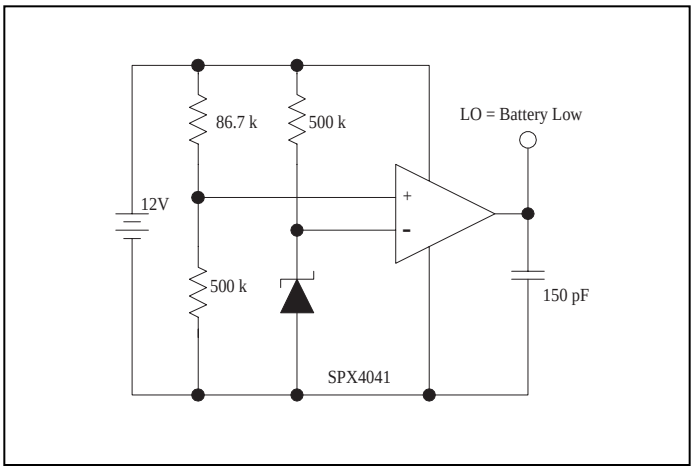


Figure 13a. Low battery Detector

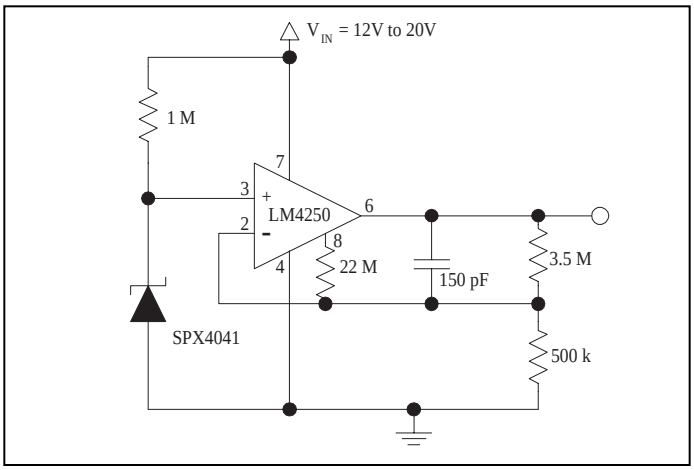
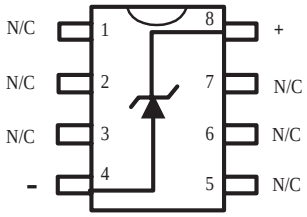


Figure 13b. Micropower 10V Reference

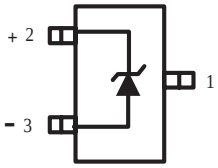
PACKAGES

8-Pin SOIC (S)



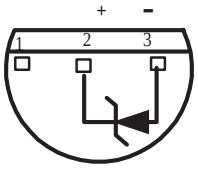
Top View

SOT-23-3 (M)



Top View

TO-92 (N)



Bottom View

ORDERING INFORMATION

Ordering No.	Accuracy	Output Voltage	Packages
SPX4041AM	1.0%	1.24V	3-Pin SOT-23
SPX4041AS	1.0%	1.24V	8-Pin SOIC
SPX4041AN	1.0%	1.24V	3-Pin TO-92
SPX4041M	2.0%	1.24V	3-Pin SOT-23
SPX4041S	2.0%	1.24V	8-Pin SOIC
SPX4041N	2.0%	1.24V	3-Pin TO-92

SIGNAL PROCESSING EXCELLENCE

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