

Precision Adjustable Shunt Regulator

FEATURES

- Trimmed Bandgap to 0.5% and 1.0%
- Wide Operating Current 160 μ A to 100mA
- Extended Temperature Range: 0°C to 105°C
- Low Temperature Coefficient 30 ppm/°C
- Offered in TO-92, SOIC, SOT-23-3
- Replacement for TL431 and AS2431L
- Low Cost Solution

APPLICATIONS

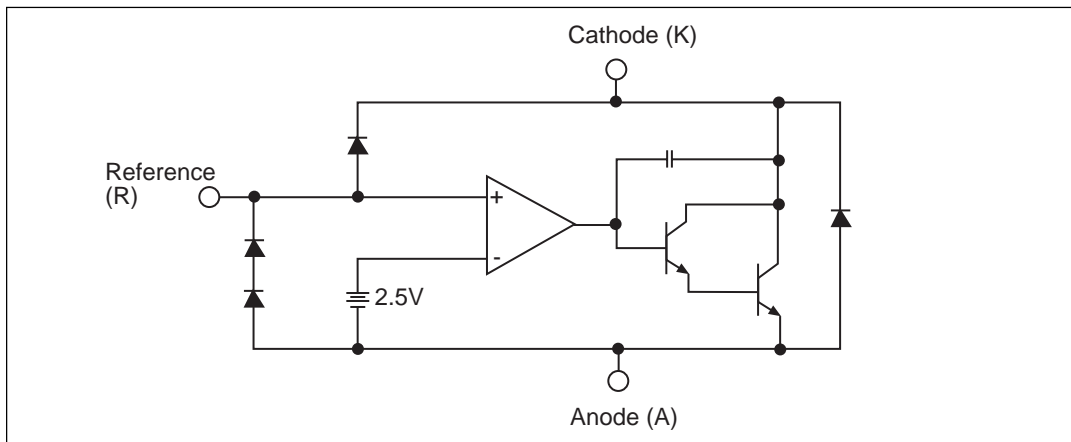
- Battery Operating Equipment
- Adjustable Supplies
- Switching Power Supplies
- Error Amplifiers
- Single Supply Amplifier
- Monitors / VCRs / TVs
- Personal Computers

DESCRIPTION

The SPX2431L is a 3-terminal adjustable shunt voltage regulator providing a highly accurate bandgap reference (0.5%) and extremely low operating current (100 μ A). The SPX2431L acts as an open-loop error amplifier with a 2.5V temperature compensated reference. The SPX2431L's thermal stability, wide operating current (100mA) and temperature range (0°C to 150°C) makes it suitable for a variety of applications. SPX2431LA tolerance of 0.5% is proven to be sufficient to overcome all the other errors in the system to virtually eliminate the need for trimming in the power supply manufacturer's assembly lines and contributes a significant cost savings.

In the standard shunt configuration, the combination of a low temperature coefficient, sharp turn on characteristics, low output impedance, and programmable output voltage makes this precision reference an excellent error amplifier. The SPX2431L is available in TO-92, SOIC-8, and SOT-23-3 package.

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Cathode-Anode Reverse Breakdown V_{KA}	20V
Anode-Cathode Forward Current, (<10ms) I_{AK}	1A
Operating Cathode Current I_{KA}	100mA
Reference Input Current I_{REF}	1.0mA
Continuous Power Dissipation at 25°C P_D	
TO-92	775mW
SOT-23	200 mW
SOIC-8	750mW

Junction Temperature T_J	150 °C
Storage Temperature T_{STG}	-65 to 150 °C
Lead Temperature (Soldering 10 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.

RECOMMENDED CONDITIONS

PARAMETER	SYMBOL	RATING	UNIT
Cathode Voltage	V_{KA}	V_{REF} to 20	V
Cathode Current	I_K	10	mA

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°.

ELECTRICAL CHARACTERISTICS

Electrical characteristics at 25°C $I_K = 10mA$ $V_K = V_{REF}$, unless otherwise specified.

PARAMETER	SYMBOL	FIGURE	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	UNITS
				SPX2431LA			SPX2431			
Reference Voltage	V_{REF}	2	$T_J = 0^\circ\text{C to } 150^\circ\text{C}$	2.490 2.469	2.503	2.515 2.536	2.470 2.449	2.495	2.520 2.541	V V
ΔV_{REF} with Temp.*	TC	2			0.07	0.20		0.07	0.20	mV/°C
Ratio of Change in V_{REF} to Cathode Voltage	$\frac{\Delta V_{REF}}{\Delta V_K}$	3	V_{REF} to 10V 10V to 20V	-2.7 -2.0	-1.01 -0.4	0.3	-2.7 -2.0	-1.01 -0.4	0.3	mV/V
Reference Input Current	I_{REF}	3			0.7	4.0		0.7	4.0	μA
I_{REF} Temp Deviation	ΔI_{REF}	3	$T_J = 0^\circ\text{C to } 105^\circ\text{C}$		0.4	1.2		0.4	1.2	μA
Min I_K for Regulation	$I_{K(MIN)}$	2				160			160	μA
Off State Leakage	$I_{K(OFF)}$	4	$V_{REF} = 0V,$ $V_{KA} = 20V$		0.04	500		0.04	500	nA
Dynamic Output Impedance	Z_{KA}	2	$f_z \leq 1\text{kHz}$ $I_K = 0.16$ to 100mA		0.15	0.5		0.15	0.5	Ω

Operating Range (T_J) = -40°C to 125°C.

*** See appropriate test circuit (Figure 2)**

CALCULATING AVERAGE TEMPERATURE COEFFICIENT (TC)

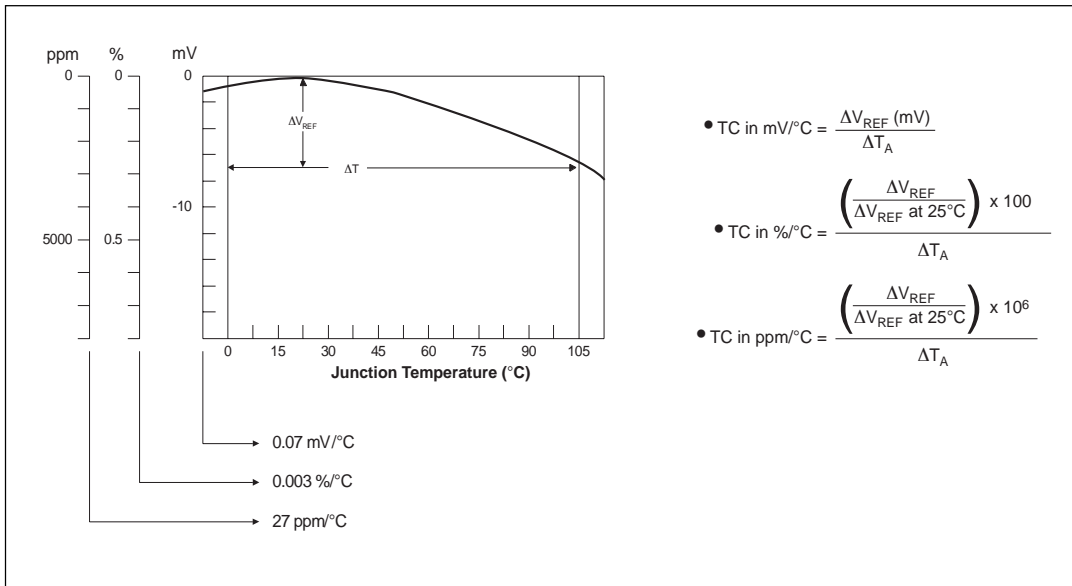


Figure 1. V_{REF} VS Temperature.

TEST CIRCUITS

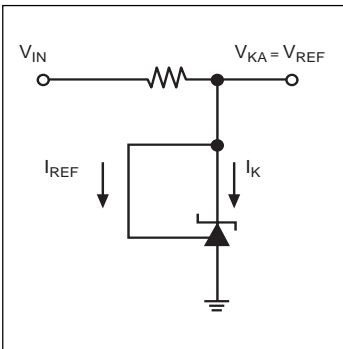


Figure 2. Test Circuit for $V_{KA} = V_{REF}$

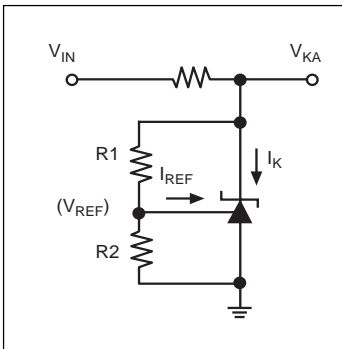


Figure 3. Test Circuit for $V_{KA} > V_{REF}$

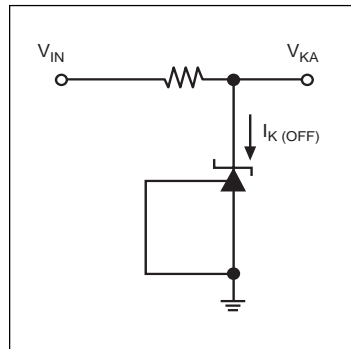


Figure 4. Test Circuit for I_{KOFF}

TYPICAL PERFORMANCE CHARACTERISTICS

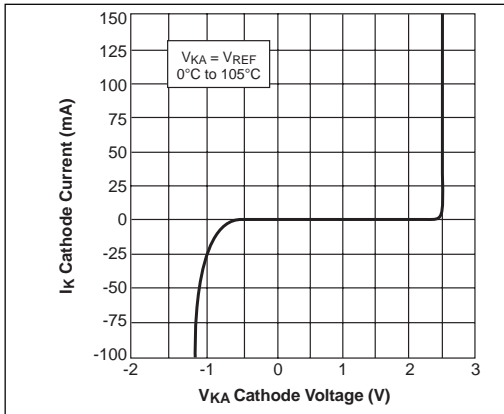


Figure 5. High Current Operating Characteristics

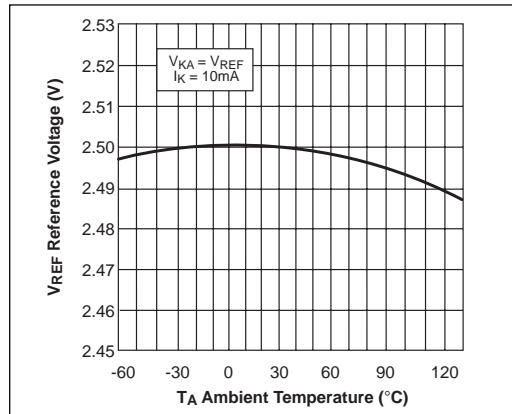


Figure 6. Reference Voltage VS Ambient Temperature

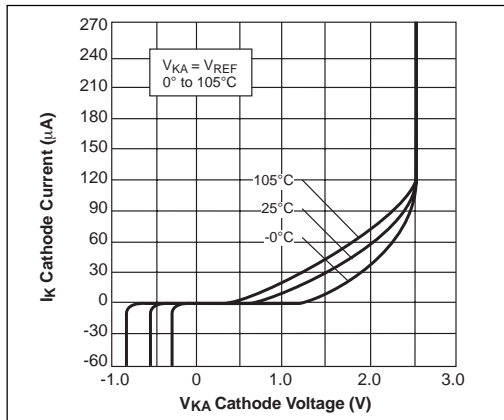


Figure 7. Low Current Operating Characteristics

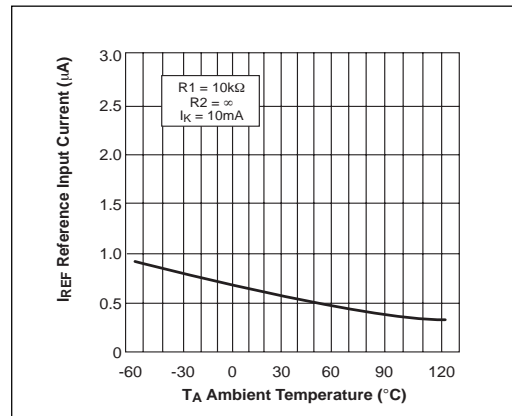


Figure 8. Reference Input Current VS Ambient Temperature

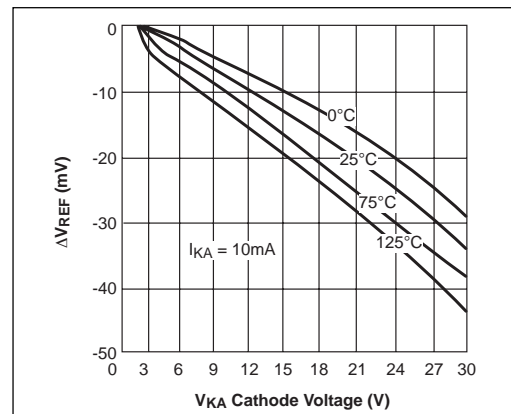


Figure 9. Reference Voltage Line Regulation VS Cathode Voltage and $T_{AMBIENT}$

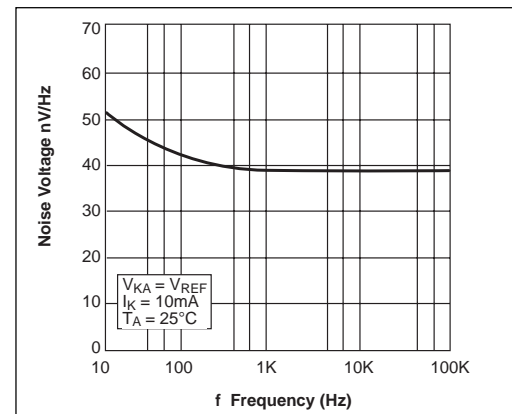


Figure 10. Noise Voltage VS Frequency

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

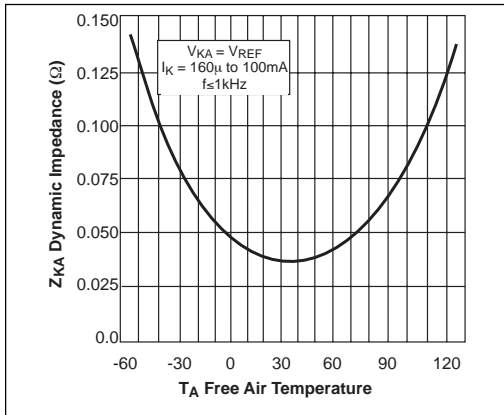


Figure 11. Low Frequency Dynamic Output Impedance VS $T_{AMBIENT}$

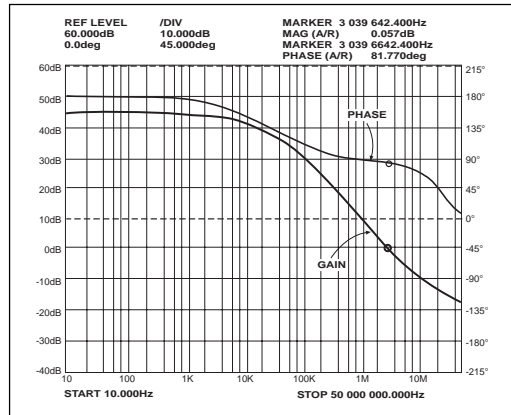


Figure 12. Small Signal Gain and Phase VS Frequency; $I_K = 10\text{mA}$, $T_A = 25^\circ\text{C}$

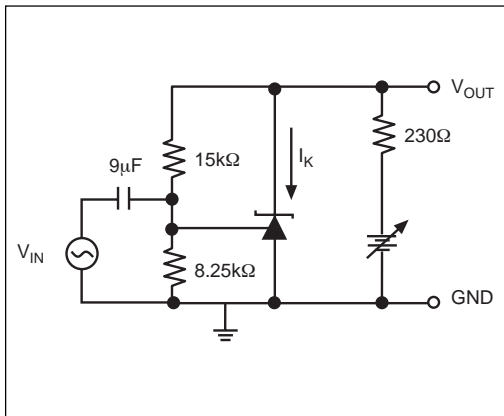


Figure 13. Test Circuit for Gain and Phase Frequency Response

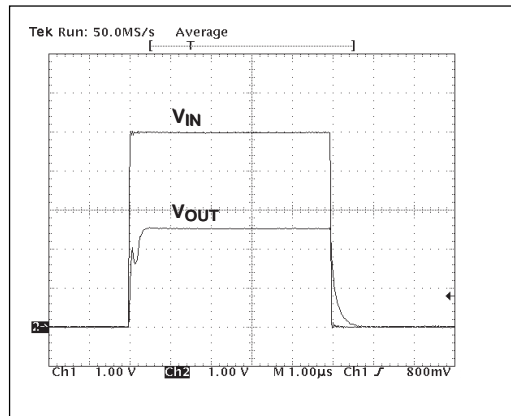


Figure 14. Frequency = 100kHz, $I_K = 10\text{mA}$, $T_A = 25^\circ\text{C}$

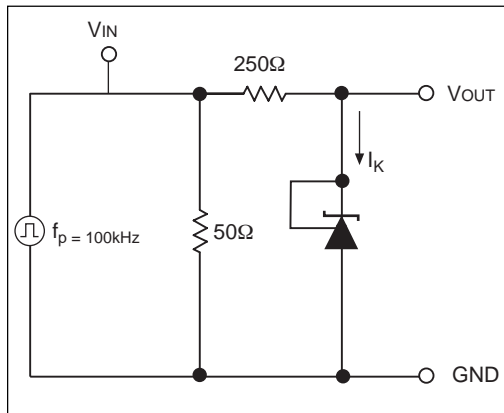


Figure 15. Test Circuit for Pulse Response

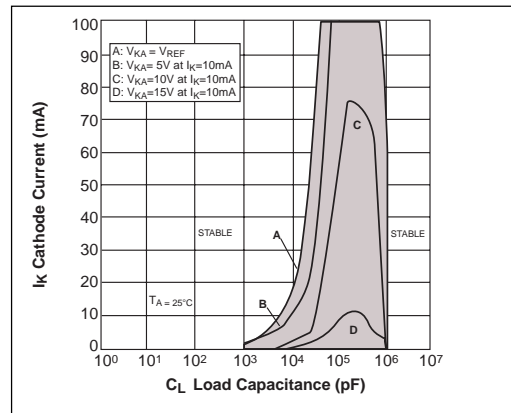


Figure 16. Stability Boundary Conditions

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

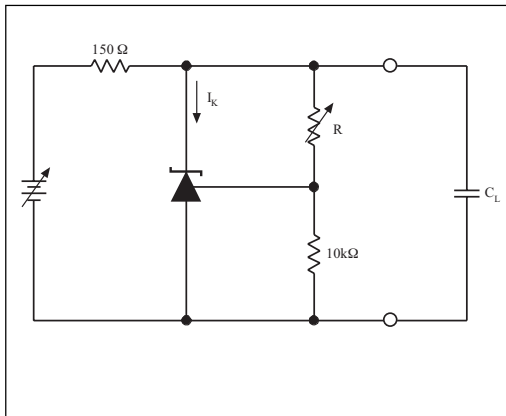


Figure 17. Test Circuit for Stability

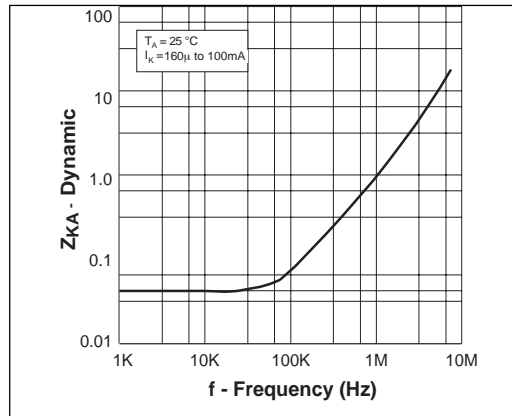


Figure 18. Dynamic Output Impedance $T_A = 25^\circ\text{C}$, $I_K = 160\mu\text{A}$ to 100mA

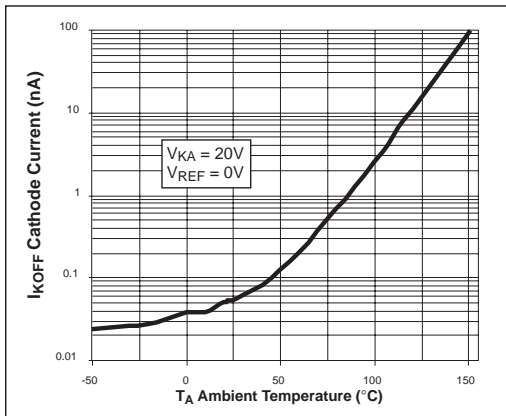


Figure 19. Off State Leakage

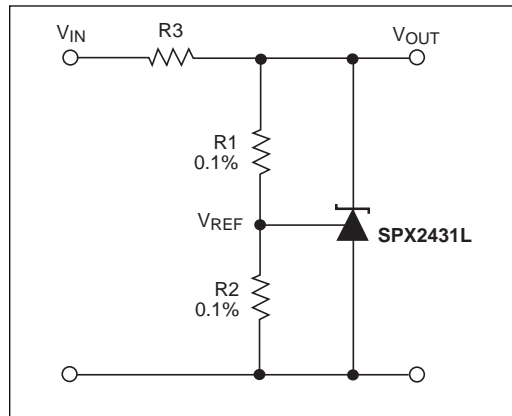


Figure 20. Shunt Regulator $V_{OUT} = (1 + R1/R2)V_{REF}$

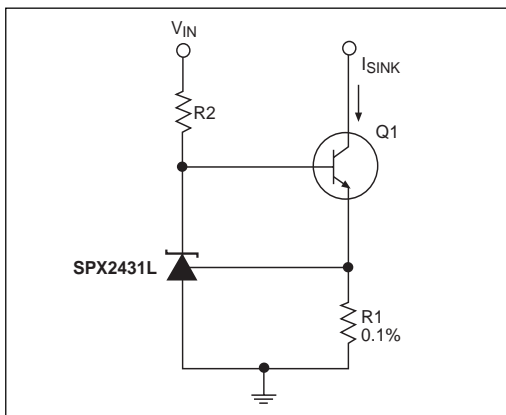


Figure 21. Constant Current Sink, $I_{SINK} = V_{REF}/R1$

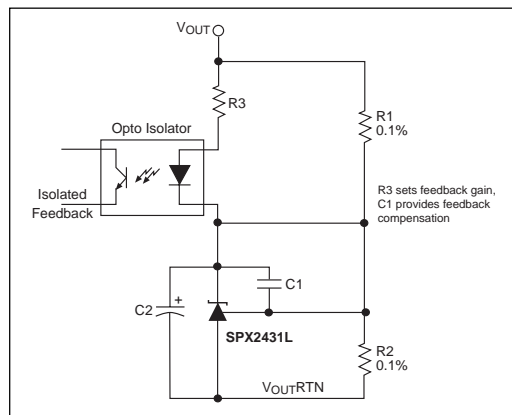


Figure 22. Reference Amplifier for Isolated Feedback in Off-Line DC-DC Converters

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

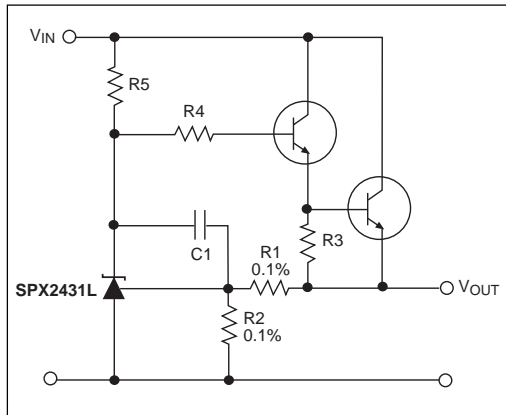


Figure 23. Precision High Current Series Regulator
 $V_{OUT} = (1+R1/R2)V_{REF}$

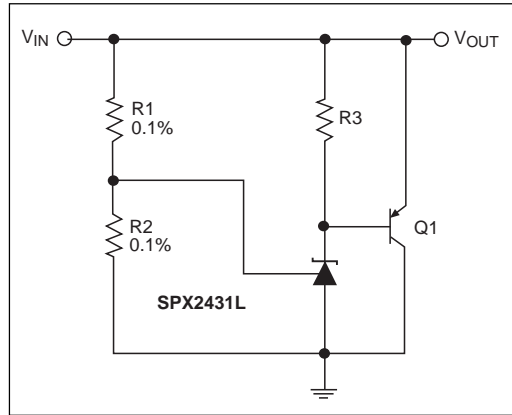


Figure 24. High Current Shunt Regulator
 $V_{OUT} = (1+R1/R2)V_{REF}$

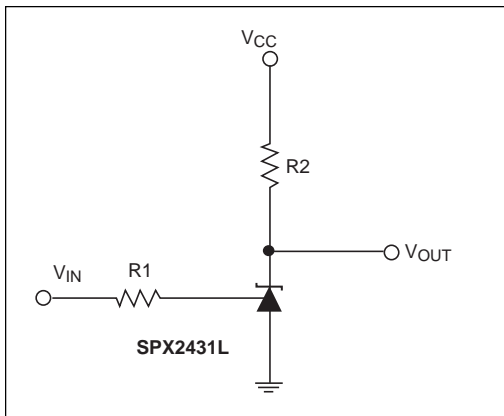
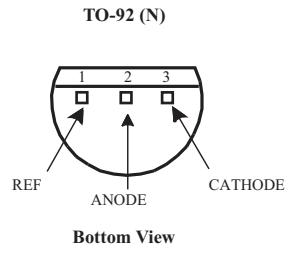
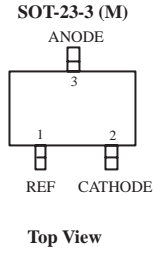
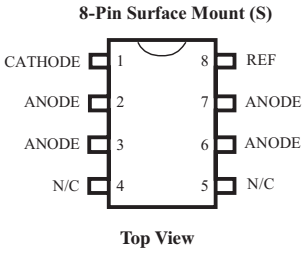


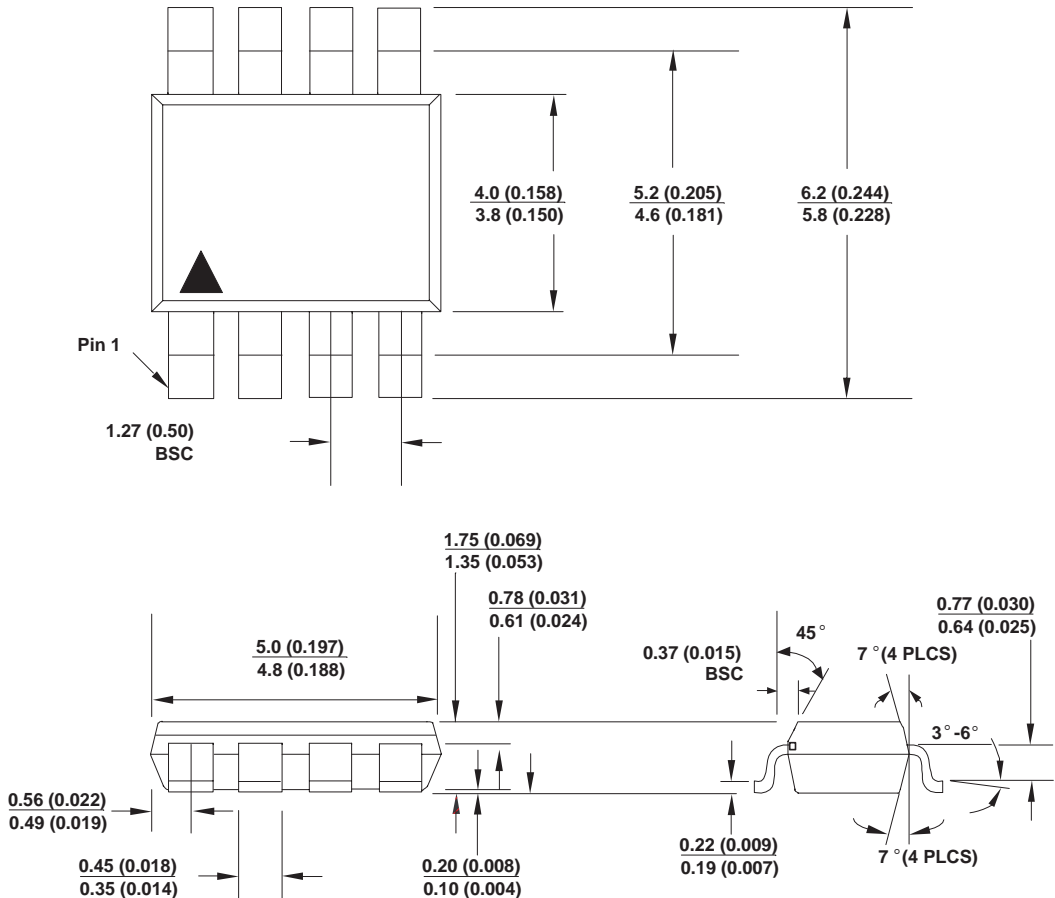
Figure 25. Single Supply Comparator with Temperature Compensated Threshold. V_{IN} threshold = 2.5V

** Resistor values are chosen such that the effect to I_{REF} is negligible.*

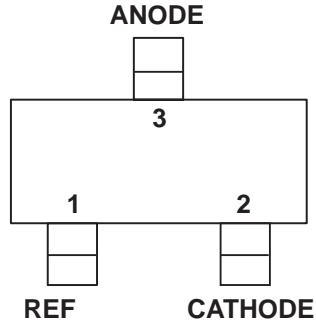
PACKAGES



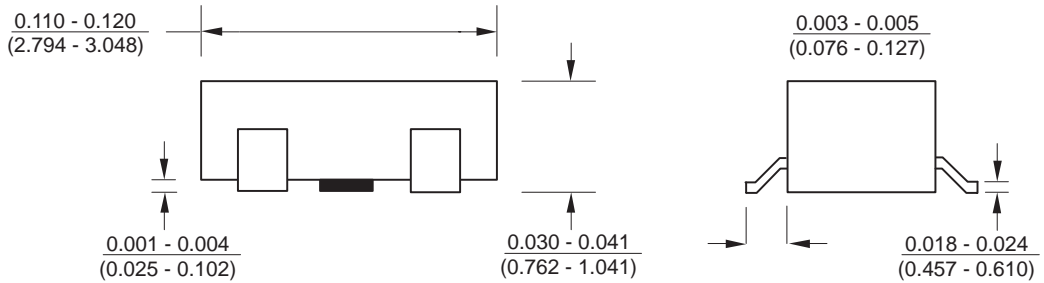
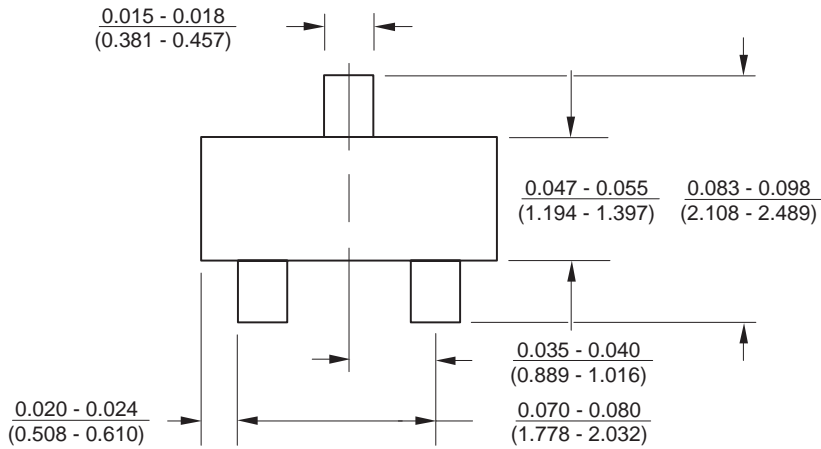
PACKAGE: 8 PIN PLASTIC SMALL OUTLINE (SOIC) (NARROW)



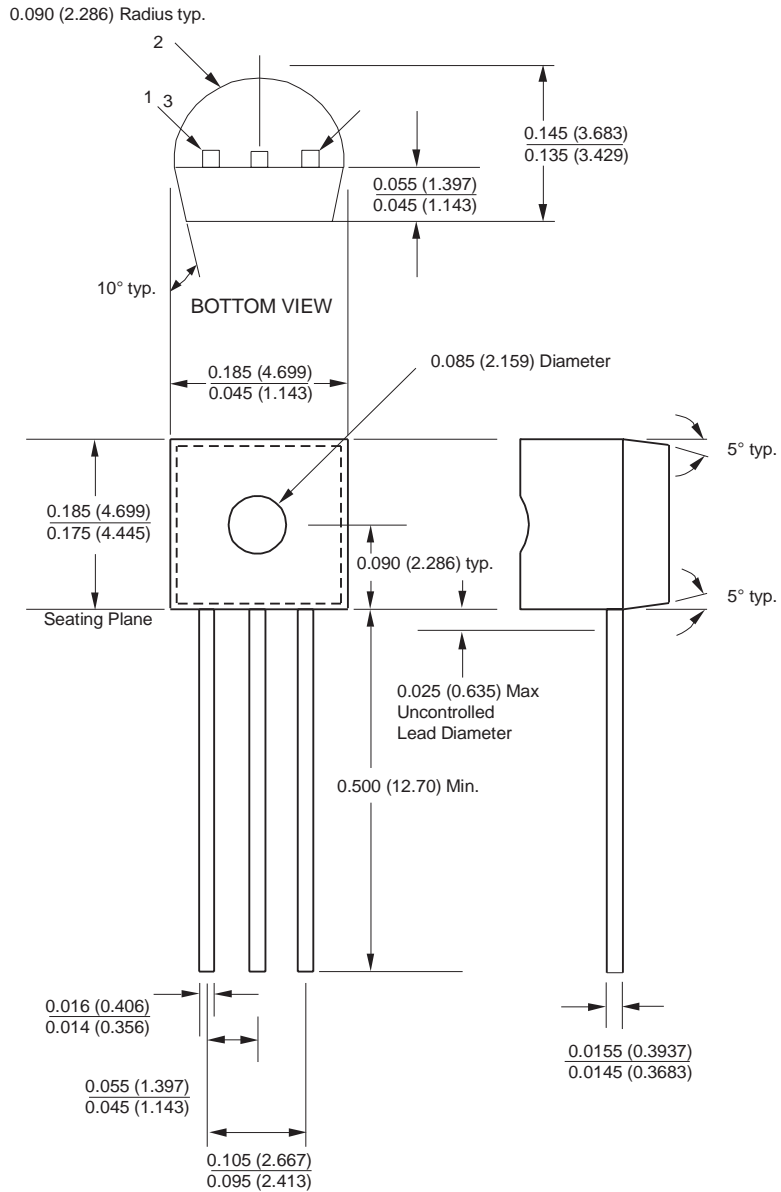
PACKAGE: SOT23-3 (M)



Top View



PACKAGE: TO-92



ORDERING INFORMATION

PART NUMBER	ACC	OUTPUT VOLTAGE	PACKAGES
SPX2431LAM	0.5%	2.503V	3-Pin SOT-23
SPX2431LAS	0.5%	2.503V	8-Pin SOIC
SPX2431LAN	0.5%	2.503V	3-Pin TO-92
SPX2431LM	1.0%	2.495V	3-Pin SOT-23
SPX2431LS	1.0%	2.495V	8-Pin SOIC
SPX2431LN	1.0%	2.495V	3-Pin TO-92



SIGNAL PROCESSING EXCELLENCE

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