

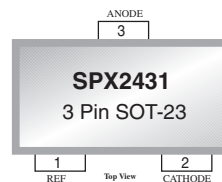
Precision Adjustable Shunt Regulator

FEATURES

- Trimmed Bandgap to 0.5% and 1.0%
- Wide Operating Current 1mA to 100mA
- Extended Temp. Range: 0°C to 105°C
- Low Temperature Coefficient 30 ppm/°C
- Offered in 3 Pin SOT-23 (M)
- Replacement for TL431, AS2431
- Low Noise Output

APPLICATIONS

- Battery Operating Equipment
- Adjustable Supplies
- Switching Power Supplies



Now Available in Lead Free Packaging

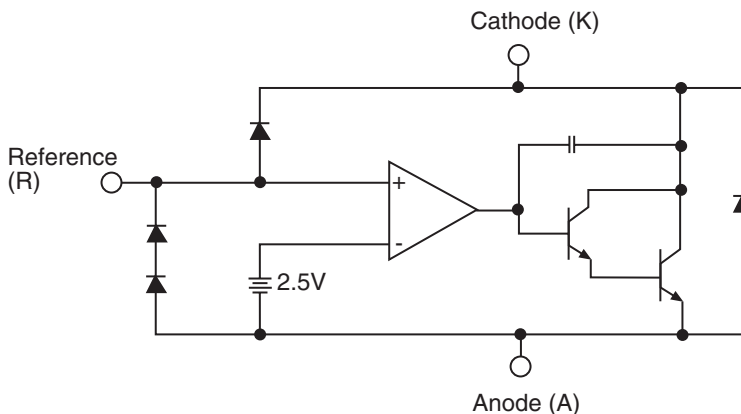
- Error Amplifiers
- Single Supply Amplifier
- Monitors / VCRs / TVs
- Personal Computers

DESCRIPTION

The SPX2431 is a 3-terminal adjustable shunt voltage regulator providing a highly accurate bandgap reference. The SPX2431 acts as an open-loop error amplifier with a 2.5V temperature compensation reference. The SPX2431's thermal stability, wide operating current (100mA) and temperature range (0°C to 105°C) makes it suitable for a variety of applications that require a low cost, high performance solution. SPX2431A tolerance of 0.5% is proven to be sufficient to overcome all of the other errors in the system to virtually eliminate the need for trimming in the power supply manufacturer's assembly line and contribute a significant cost savings.

The output voltage may be adjusted to any value between V_{REF} and 20 volts with two external resistors. 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 SPX2431 is available in SOT-23-3 package.

FUNCTIONAL 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 200 mW
 SOT-23 200 mW
 Junction Temperature T_J 150 °C
 Storage Temperature T_{STG} -65 to 150 °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
SOT-23	575°C/W	150°C/W	1.7 mW/°C

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

ELECTRICAL CHARACTERISTICS

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

PARAMETER	SYMBOL	FIGURE	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	UNITS
				SPX2431A			SPX2431			
Reference Voltage	V_{REF}	2	$T_J = 0^\circ\text{C to } 105^\circ\text{C}$	2.487	2.500	2.513	2.474	2.500	2.526	V
		2		2.480		2.520	2.460		2.540	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			0.4	1.0		0.4	1.0	mA
Off State Leakage	$I_{K(OFF)}$	4	$V_{REF} = 0\text{V},$ $V_{KA} = 20\text{V}$		0.04			0.04	500	nA
Dynamic Output Impedance	Z_{KA}	2	$f_z \leq 1\text{kHz}$ $I_K = 1 \text{ to } 100\text{mA}$		0.15	0.5		0.15	0.5	Ω

CALCULATING AVERAGE TEMPERATURE COEFFICIENT (TC)

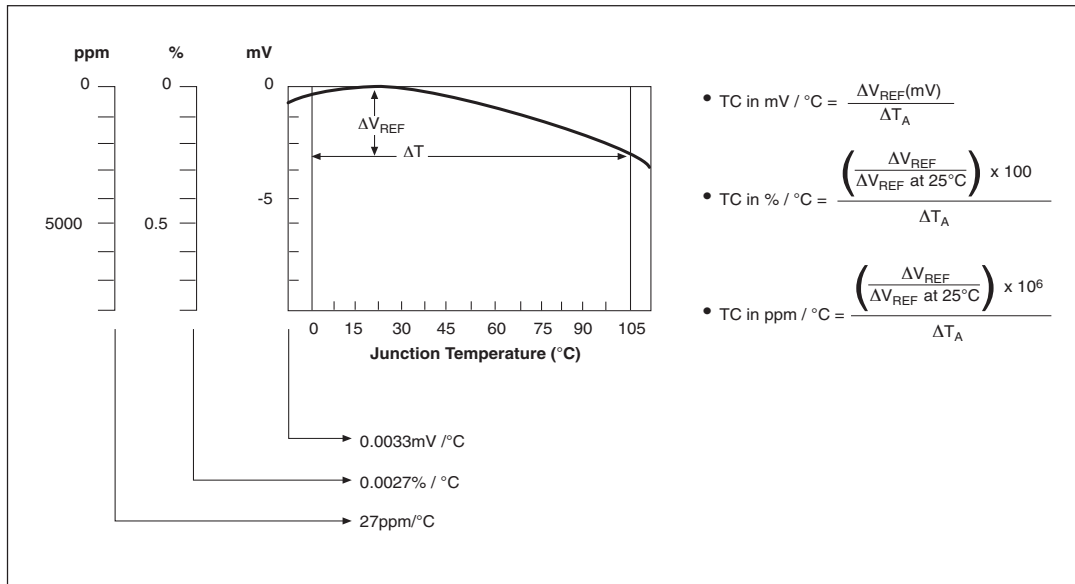


Figure 1. V_{REF} VS Temperature

TEST CIRCUITS

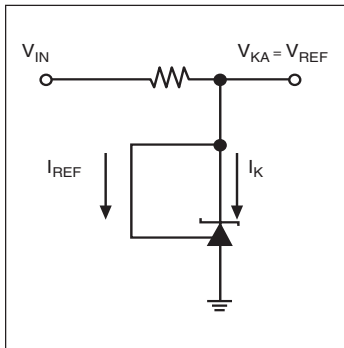


Figure 2. Test Circuit for $V_{KA} = V_{REF}$

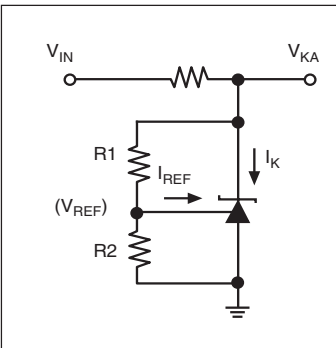


Figure 3. Test Circuit for $V_{KA} > V_{REF}$

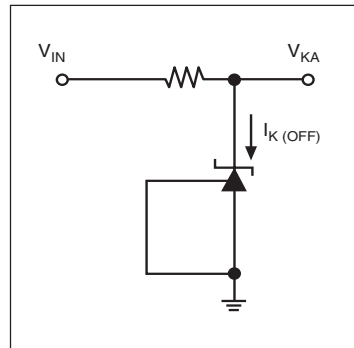


Figure 4. Test Circuit for I_{KOFF}

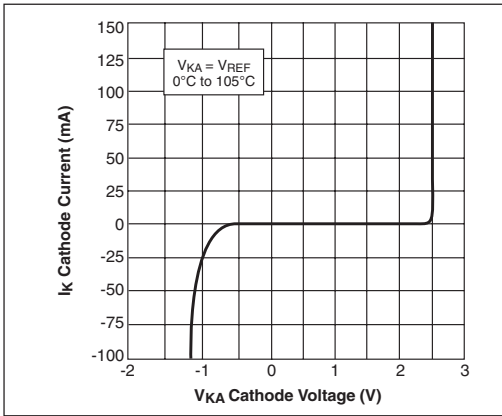


Figure 5. High Current Operating Characteristics

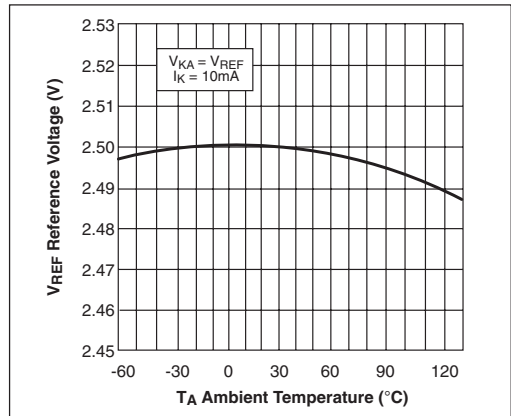


Figure 6. Reference Voltage VS Ambient Temperature

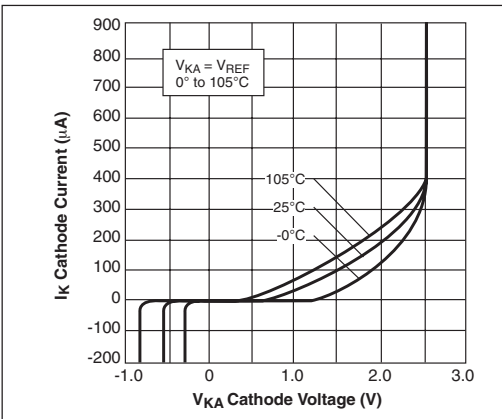


Figure 7. Low Current Operating Characteristics

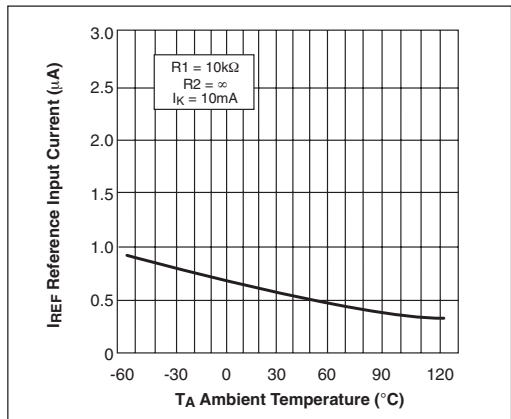


Figure 8. Reference Input Current VS Ambient Temperature

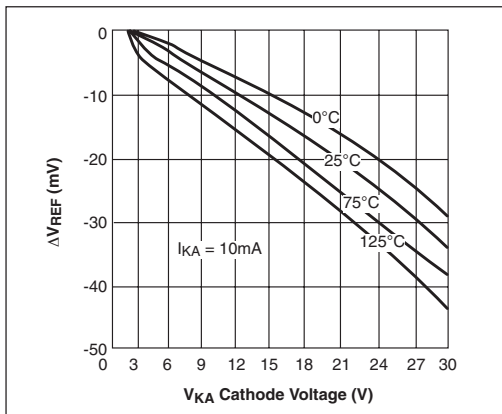


Figure 9. Reference Voltage Line Regulation VS Cathode Voltage and $T_{AMBIENT}$

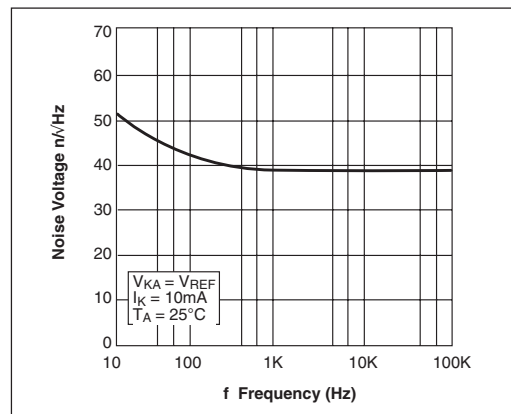


Figure 10. Noise Voltage VS Frequency

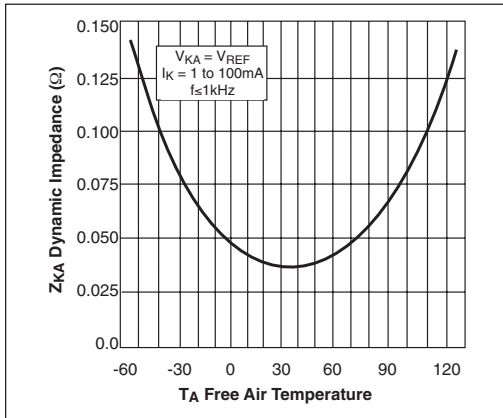


Figure 11. Low Frequency Dynamic Output Impedance VS $T_{AMBIENT}$

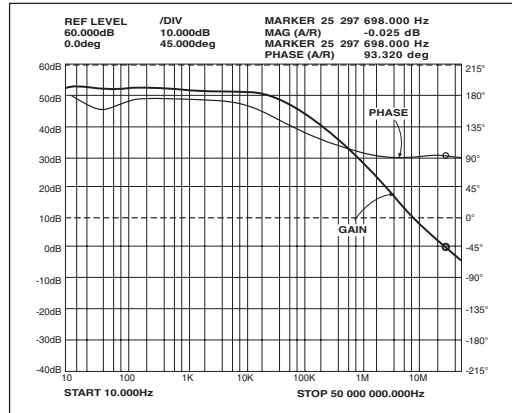


Figure 12. Small Signal Gain and Phase VS Frequency; $I_K = 10mA$, $T_A = 25^\circ C$

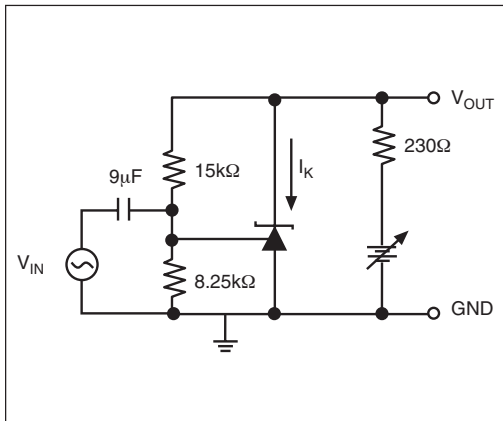


Figure 13. Test Circuit for Gain and Phase Frequency Response

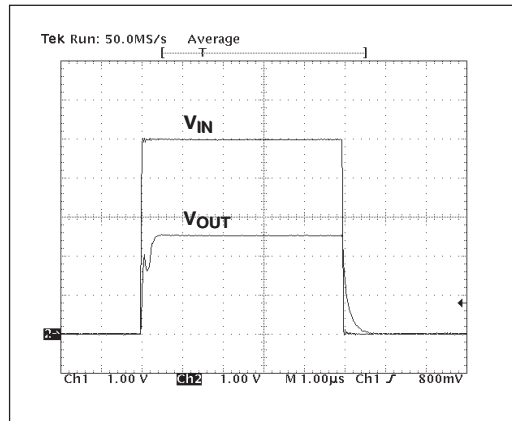


Figure 14. Frequency = 100kHz, $I_K = 10mA$, $T_A = 25^\circ C$

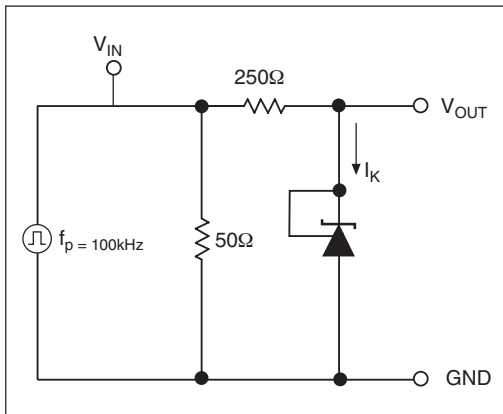


Figure 15. Test Circuit for Pulse Response

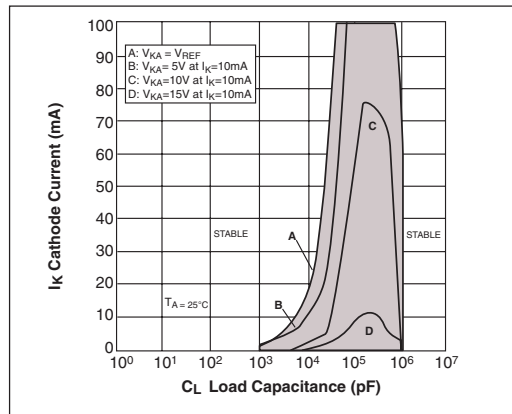


Figure 16. Stability Boundary Conditions

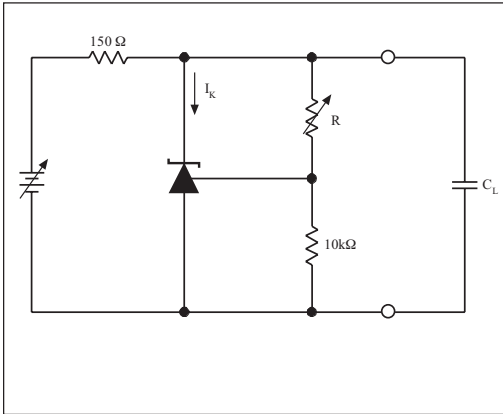


Figure 17. Test Circuit for Stability

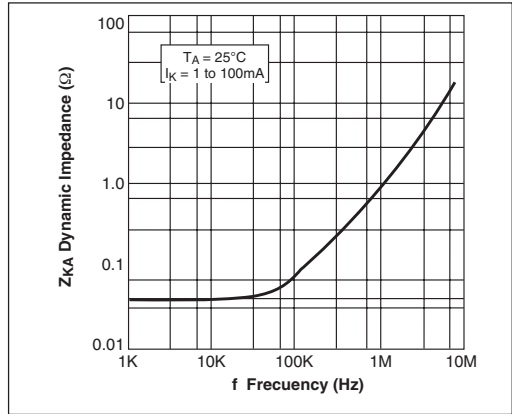


Figure 18. Dynamic Output Impedance $T_A = 25^\circ\text{C}$, $I_K = 1$ to 100mA

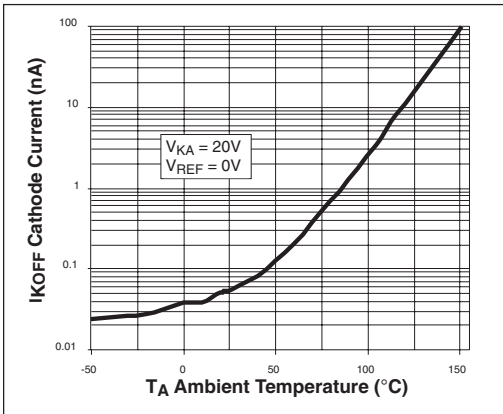


Figure 19. Off State Leakage

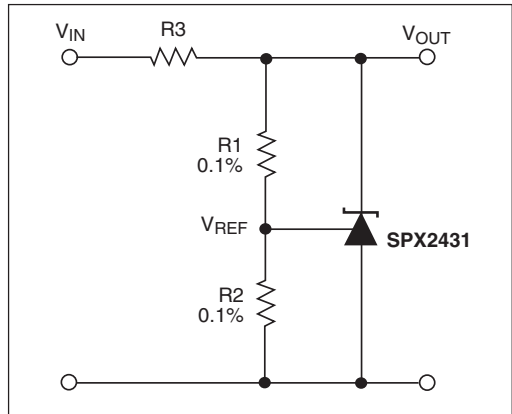


Figure 20. Shunt Regulator $V_{OUT} = (1 + R1/R2)V_{REF}$

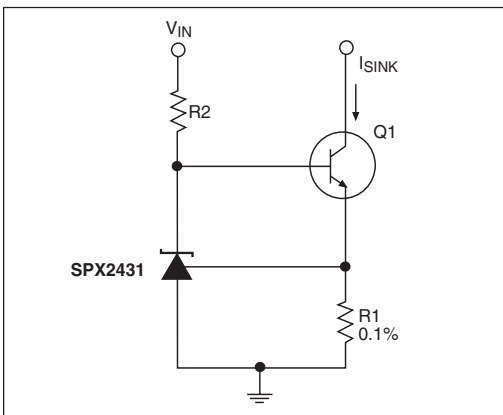


Figure 21. Constant Current, Sink, $I_{SINK} = V_{REF}/R1$

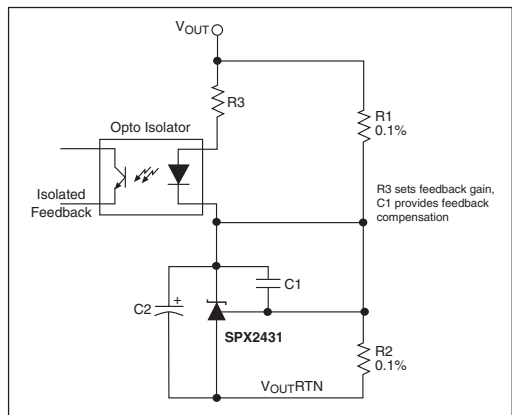


Figure 22. Reference Amplifier for Isolated Feedback in Off-Line DC-DC Converters

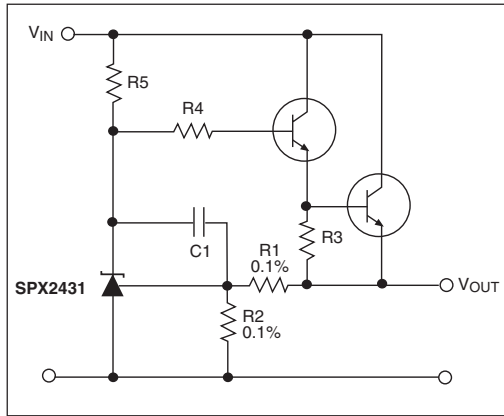


Figure 23. Precision High Current Series Regulator
 $V_{OUT} = (1+R1/R2)V_{REF}$

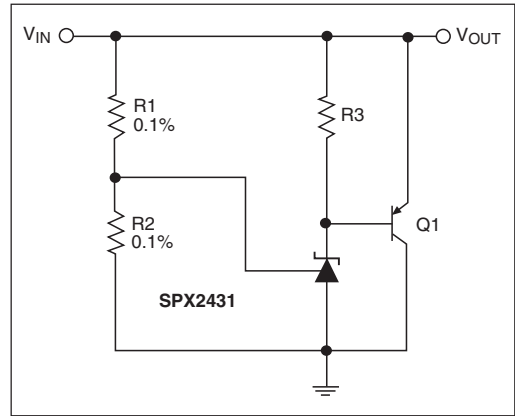


Figure 24. High Current Shunt Regulator
 $V_{OUT} = (1+R1/R2)V_{REF}$

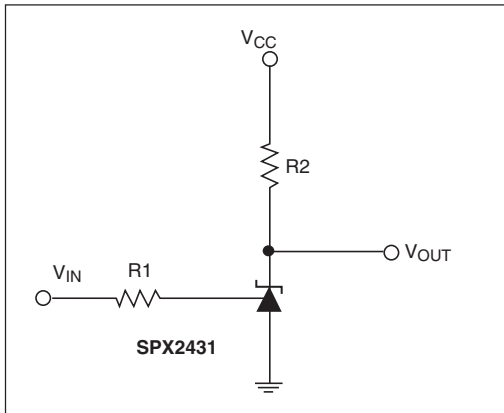
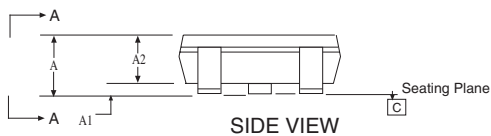
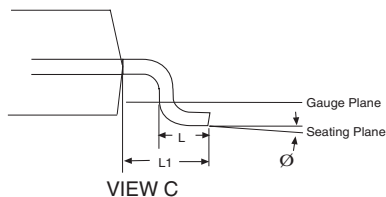
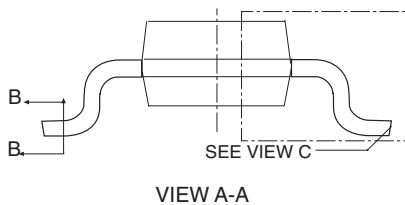
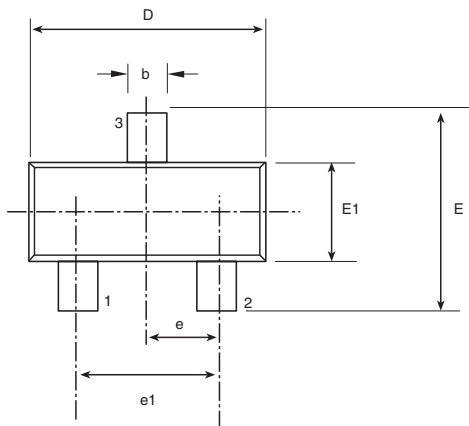


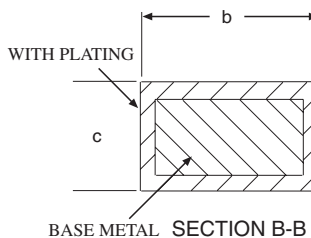
Figure 25. Single Supply Comparator with Temperature Compensated Threshold. V_{IN} Threshold = 2.5V

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



3 Pin SOT-23 JEDEC TO-236 (AB) Variation			
SYMBOL	MIN	NOM	MAX
A	0.89	-	1.12
A1	0.01	-	0.1
A2	0.88	0.95	1.02
b	0.3	-	0.5
c	0.08	-	0.2
D	2.8	2.9	3.04
e	0.95 BSC		
e1	1.90 BSC		
E	0.95	-	2.64
E1	1.2	1.3	1.4
L	0.4	0.5	0.6
L1	0.54 REF		
Ø	0°	-	8°

Note: Dimensions in (mm)



PART NUMBER	ACC	OUTPUT VOLTAGE	PACKAGES
SPX2431AM	0.5%	2.5V	3 Pin SOT-23
SPX2431AM/TR	0.5%	2.5V	3 Pin SOT-23
SPX2431M	1.0%	2.5V	3 Pin SOT-23
SPX2431M/TR	1.0%	2.5V	3 Pin SOT-23

/TR = Tape and Reel

Pack quantity is 2,500 for SOT-23.

Available in lead free packaging. To order add "-L" suffix to part number.

Example: SPX2431AM/TR = standard; SPX2431AM-L/TR = lead free

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ANALOG EXCELLENCE

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**Headquarters and
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22 Linnell Circle
Billerica, MA 01821
TEL: (978) 667-8700
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e-mail: sales@sipex.com

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Email service@ameya360.com

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Email mkt@ameya360.com