SPX2431

Precision Adjustable Shunt Regulator

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 lines 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 a SOT-23-3 package.

FEATURES

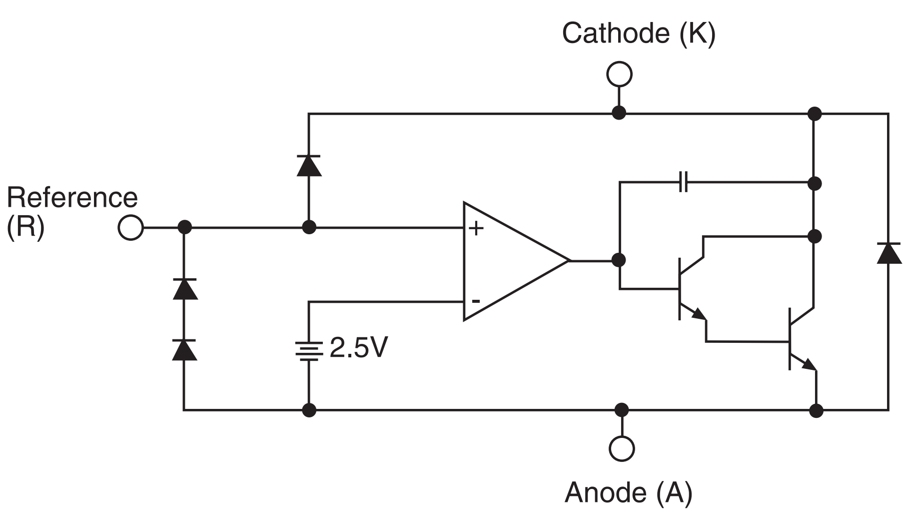
- Trimmed bandgap to 0.5% and 1.0%
- Wide operating current 1mA to 100mA
- Extended temperature range: 0°C to 105°C
- Low temperature coefficient: 30 ppm/°C
- Offered in 3 Pin SOT-23 (M)
- Replacement for TL431, AS2431
- Low noise output

APPLICATIONS

- Battery operating equipment
- Adjustable supplies
- Switching power supplies
- Error amplifiers
- Single supply amplifier
- Monitors / VCRs / TVs
- Personal computers

Ordering Information - Back Page

Functional Block Diagram



Absolute Maximum Ratings

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.

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

SOT-23 .... 200mW

Junction Temperature T_J ....150˚C

Storage Temperature T_{STG} ....-65˚C to 150˚C

Recommended Conditions

Cathode Voltage V_{KA} .... V_{REF} to 20V

Cathode Current I_K 10mA

Typical Thermal Resistances

SOT-23

Θ_{JA} .... 575˚C/W

Θ_{JC} .... 150˚C/W

Typical Derating......................... 1.7mW/˚C

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

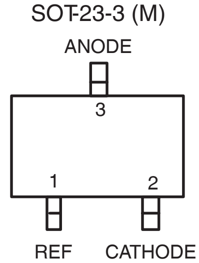
Electrical Characteristics

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

PARAMETERS	SYMBOL	FIGURE	CONDITIONS	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS
				SPX2431A			SPX2431			
Reference voltage	V_{REF}	2		2.487	2.500	2.513	2.474	2.500	2.526	V
		2	T_J = 0°C to 105°C	2.480		2.520	2.460		2.540	
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	$\frac{\Delta V_{REF}}{\Delta V_K}$		V_{REF} to 10V	-2.7	-1.01		-2.7	-1.01		mV/V
		3	10V to 20V	-2.0	-0.4	0.3	-2.0	-0.4	0.3	
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°C to 105°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} = 0V, V_{KA} = 20V		0.04			0.04	500	nA
Dynamic output impedance	Z_{KA}	2	$f_Z \leq$ 1kHz I_K = 1 to 100mA		0.15	0.5		0.15	0.5	Ω

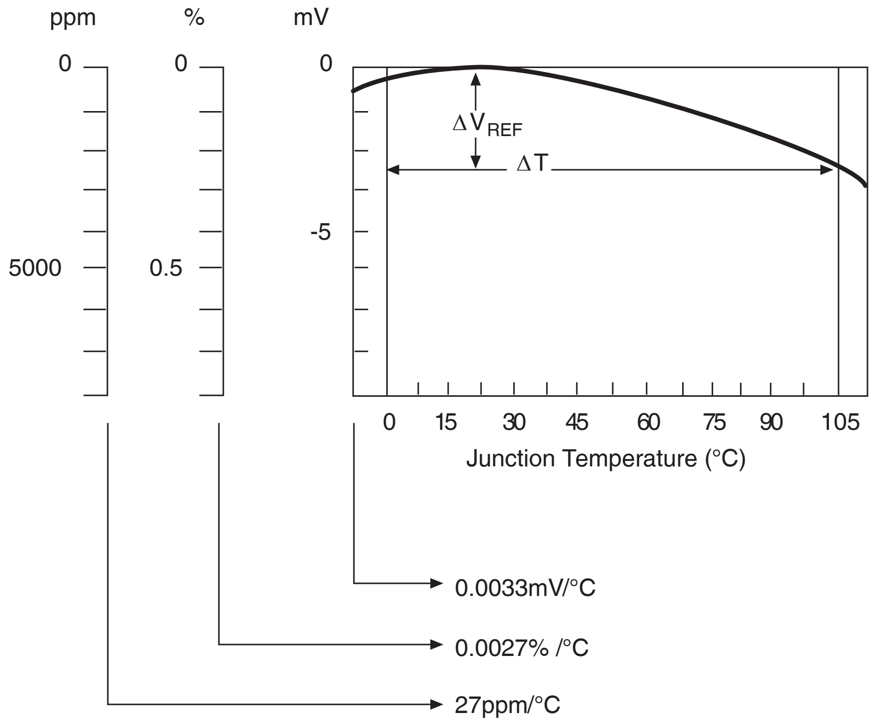
Pin Configuration

SOT-23-3 (M)



Top View

Calculating Average Temperature Coefficient (TC)



- TC in mV /°C = $\dfrac{\Delta V_{REF}(mV)}{\Delta T_A}$
- TC in % /°C = $\dfrac{\left(\dfrac{\Delta V_{REF}}{\Delta V_{REF} \text{ at } 25°C}\right) \times 100}{\Delta T_A}$
- TC in ppm /°C = $\dfrac{\left(\dfrac{\Delta V_{REF}}{\Delta V_{REF} \text{ at } 25°C}\right) \times 10^6}{\Delta T_A}$

Figure 1: V_{REF} vs. Temperature

Test Circuits

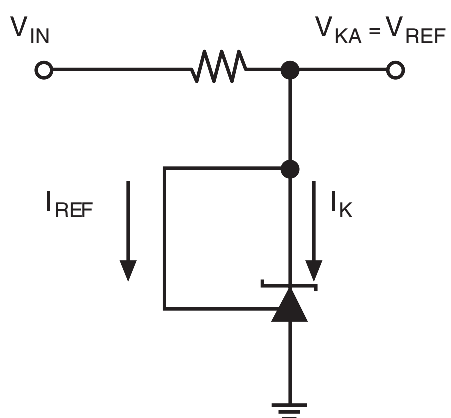


Figure 2: Test Circuit for $V_{KA} = V_{REF}$

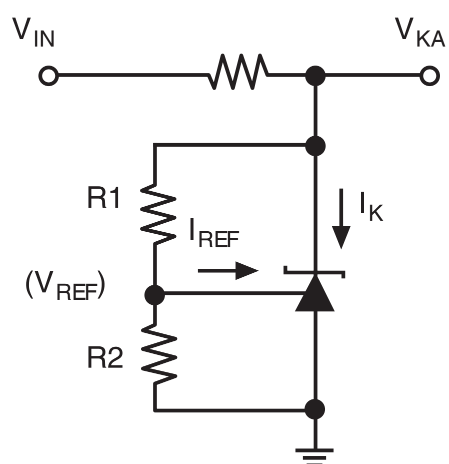


Figure 3: Test Circuit for $V_{KA} > V_{REF}$

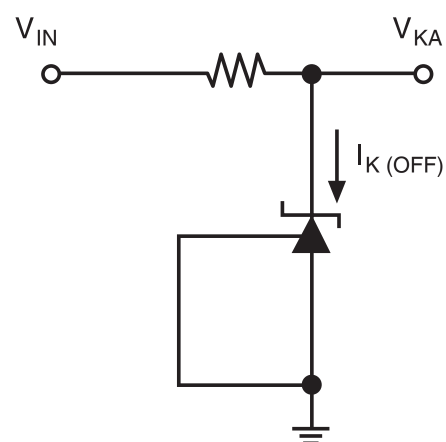


Figure 4: Test Circuit for I_{KOFF}

Typical Performance Characteristics

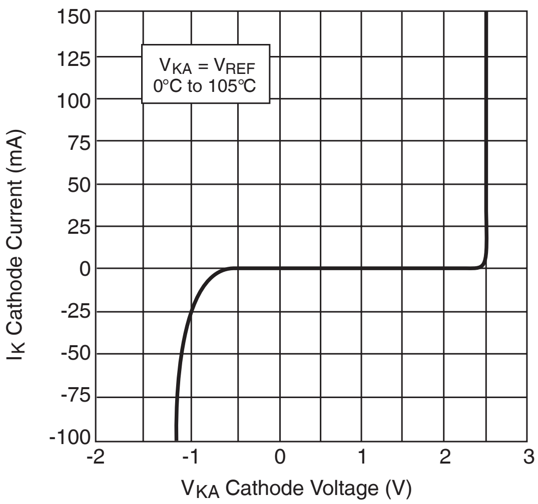


Figure 5: High Current Operating Characteristics

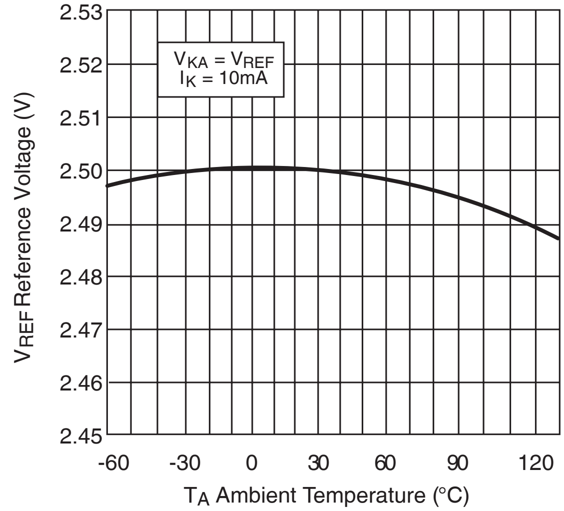


Figure 6: Reference Voltage vs. Ambient Temperature

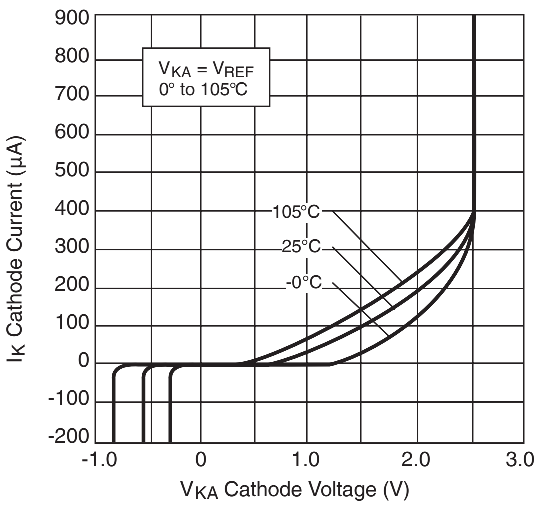


Figure 7: Low Current Operating Characteristics

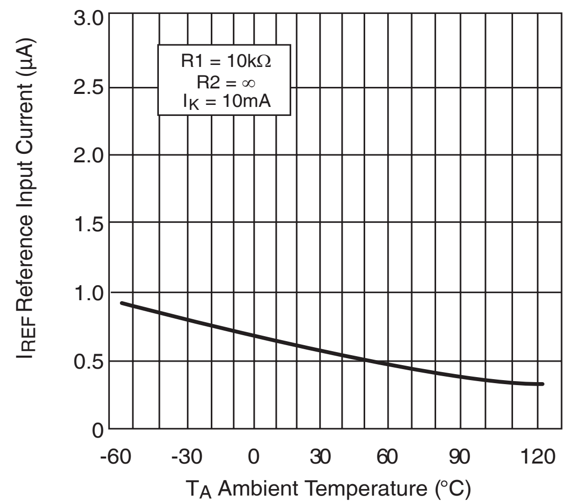


Figure 8: Reference Input Current vs. Ambient Temperature

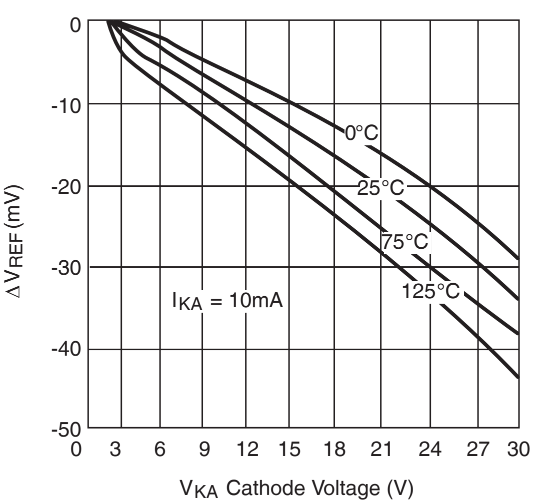


Figure 9: Reference Voltage Line Regulation vs. Cathode Voltage and $T_{AMBIENT}$

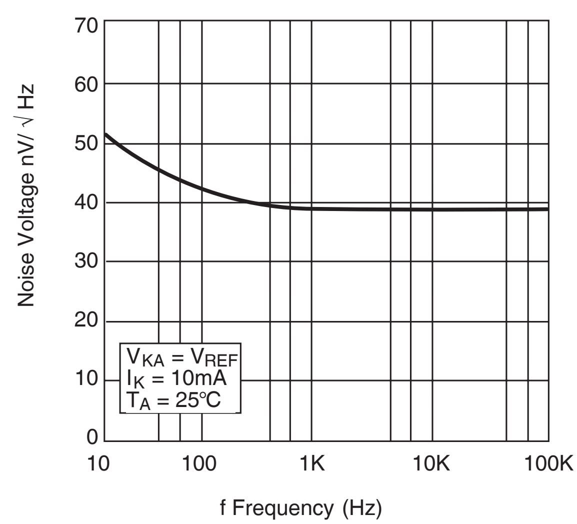


Figure 10: Noise Voltage vs. Frequency

Typical Performance Characteristics (continued)

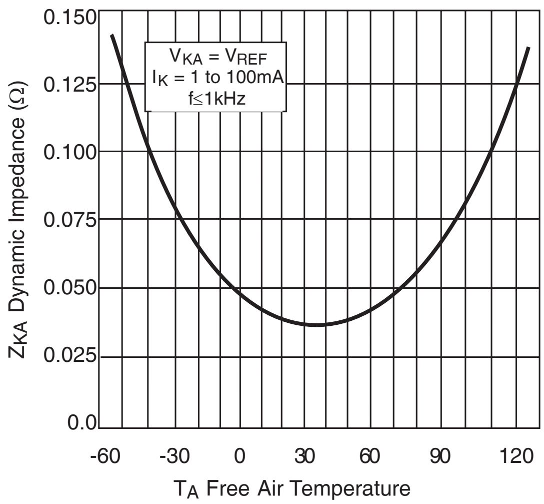


Figure 11: Low Frequency Dynamic Output Impedance vs. $T_{AMBIENT}$

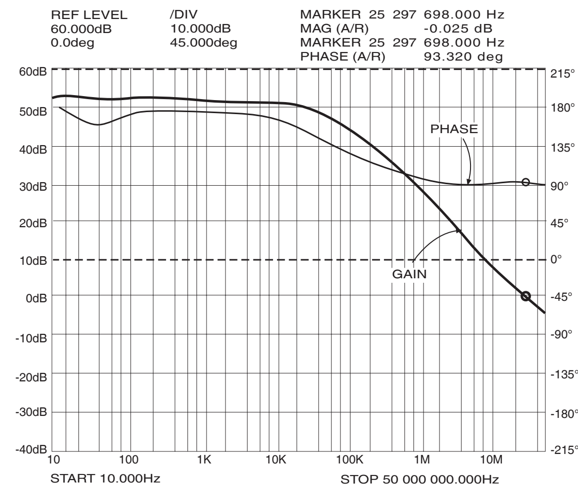


Figure 12. Small Signal Gain and Phase vs. Frequency; I_K = 10mA, T_A = 25˚C

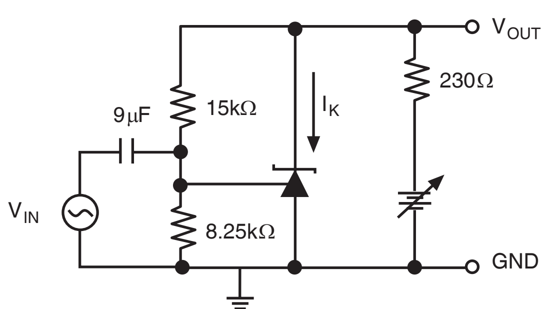


Figure 13. Test Circuit for Gain and Phase Frequency Response

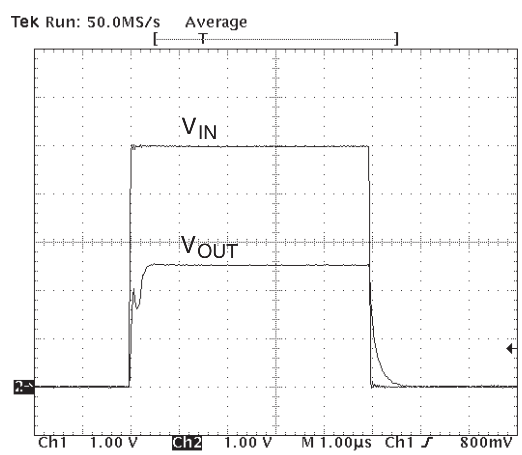


Figure 14. Frequency = 100kHz, I_K = 10mA, T_A = 25˚C

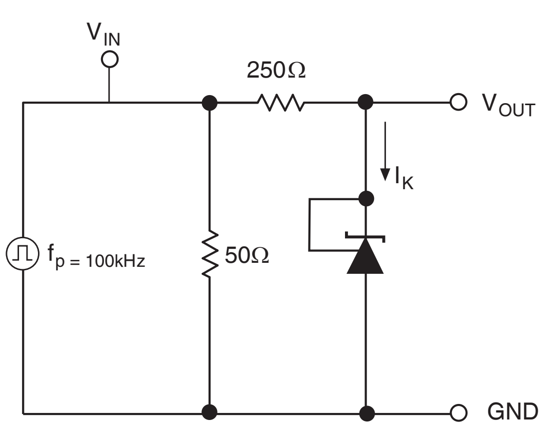


Figure 15. Test Circuit for Pulse Response

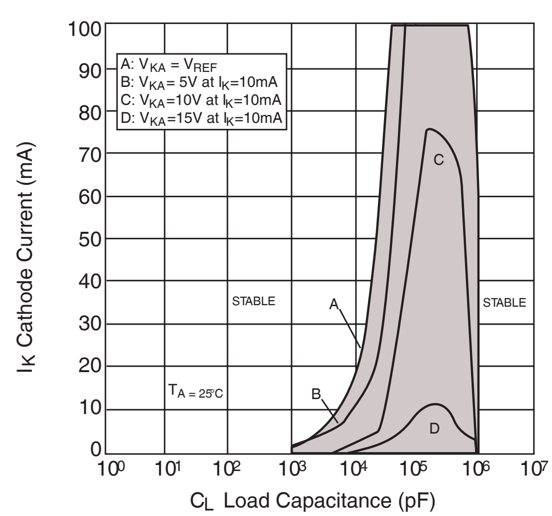


Figure 16. Stability Boundry Conditions

Typical Performance Characteristics (continued)

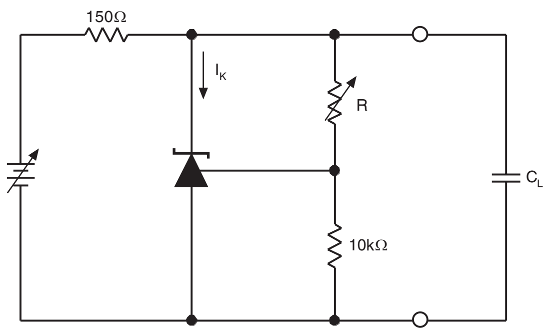


Figure 17: Test Circuit for Stability

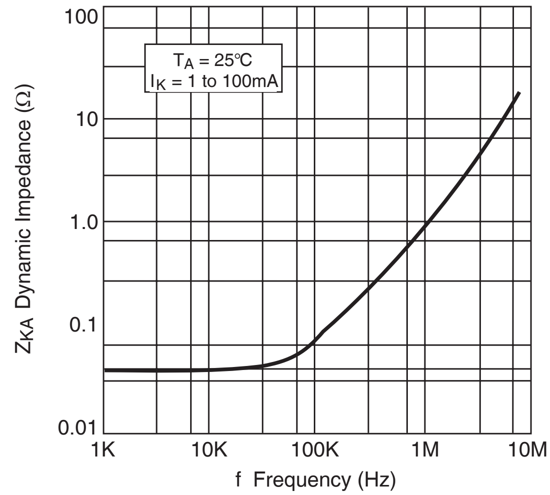


Figure 18: Dynamic Output Impedance T_A = 25˚C, I_K = 1 to 100mA

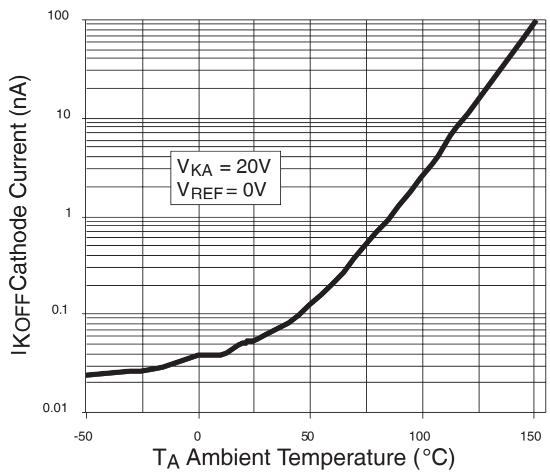


Figure 19: Off State Leakage

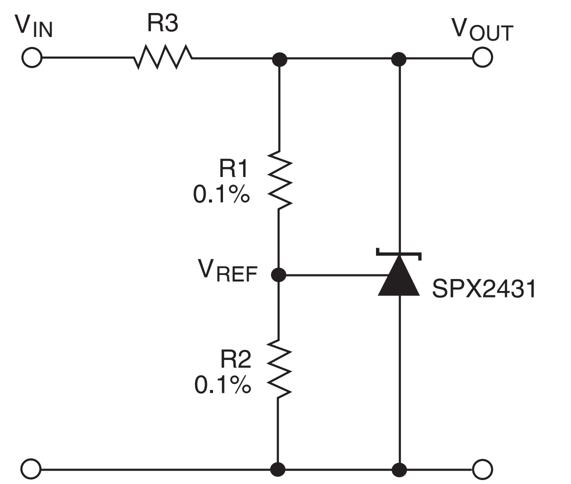


Figure 20: Shunt Regulator V_{OUT} = (1+R1/R2)V_{REF}

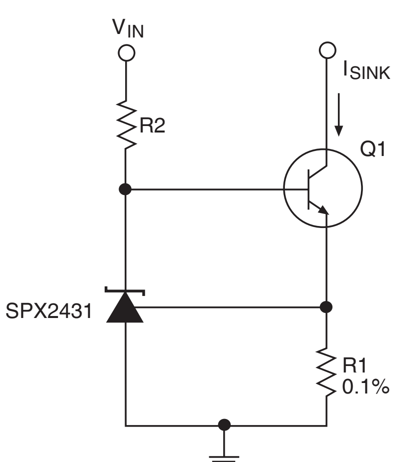


Figure 21: Constant Current, Sink, I_{SINK} = V_{REF}/R1

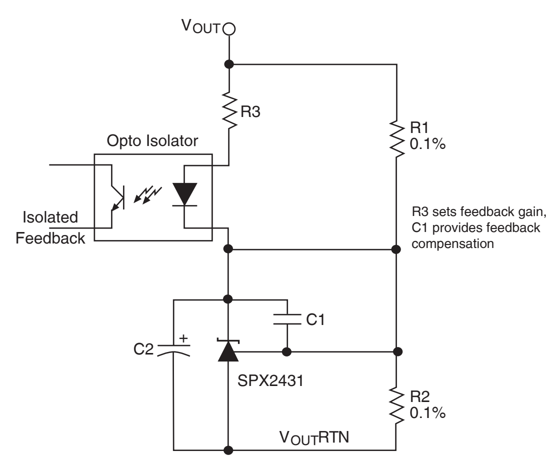


Figure 22: Reference Amplifier for Isolated Feedback in Off-Line DC-DC Converters

Typical Performance Characteristics (continued)

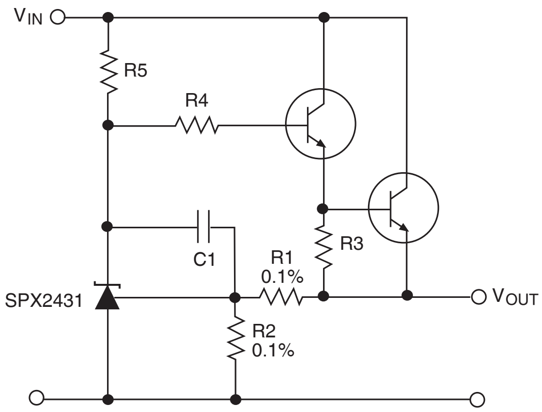


Figure 23: Precision High Current Series Regulator
$V_{OUT} = (1+R1/R2)V_{REF}$

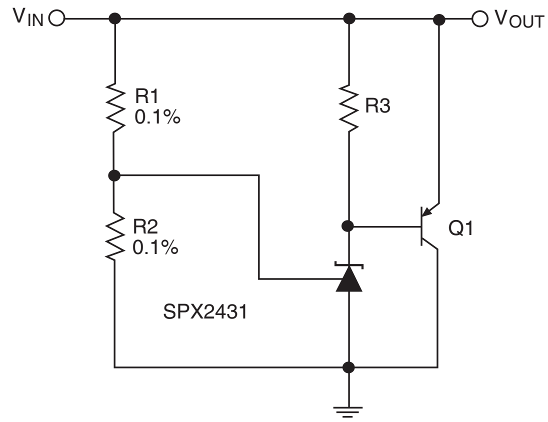


Figure 24: High Current Shunt Regulator
$V_{OUT} = (1+R1/R2)V_{REF}$

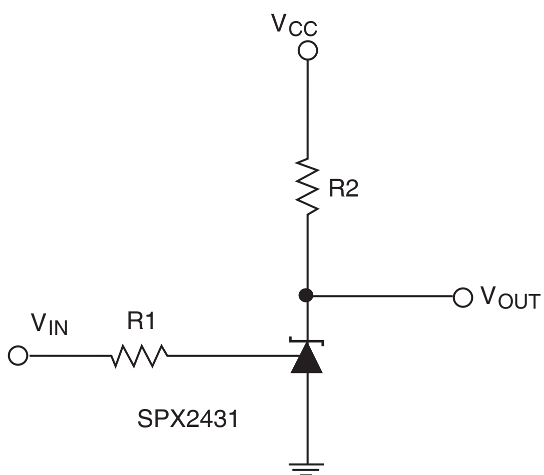
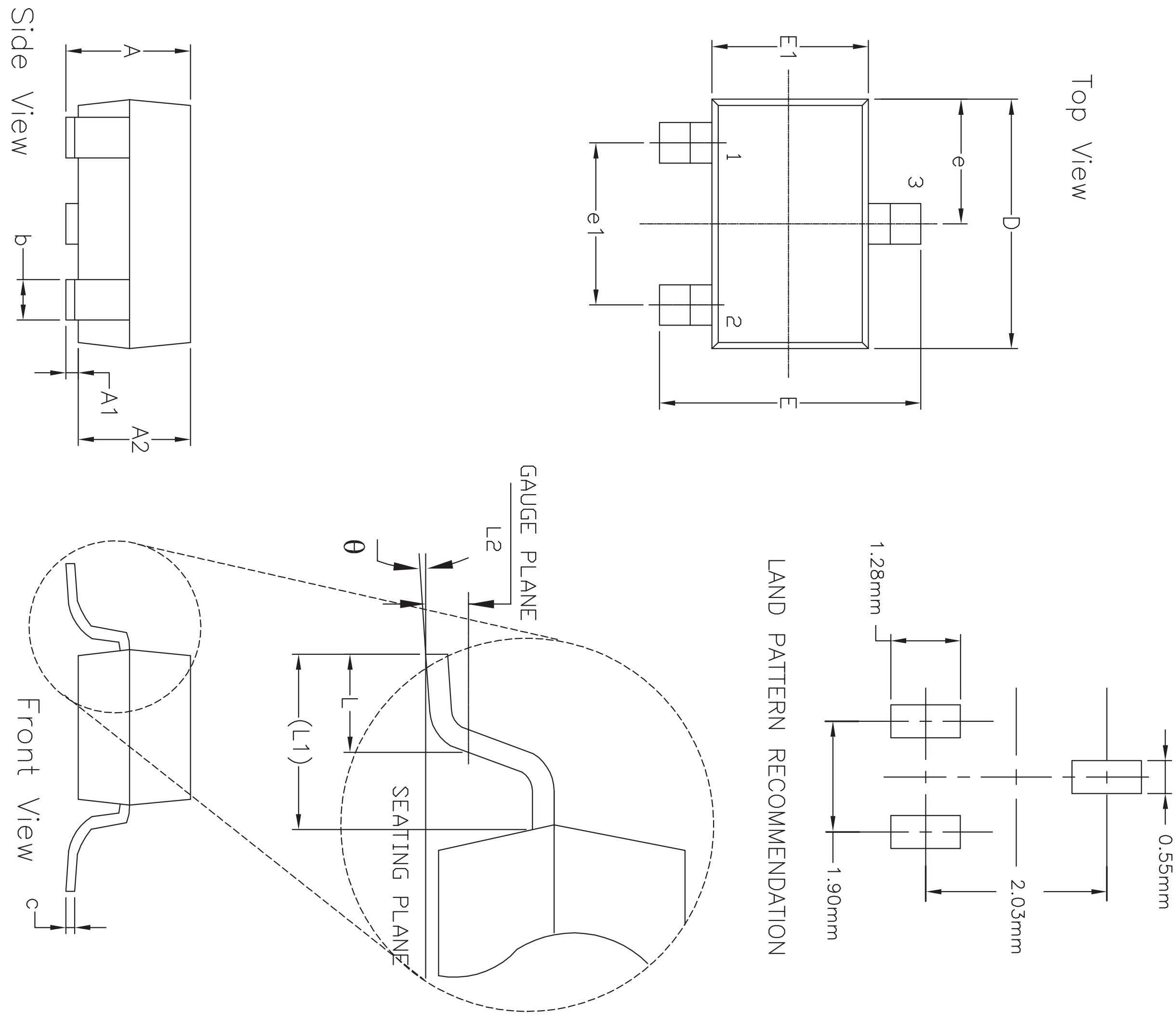


Figure 25: Single Supply Comparator with Temperature Compensated Threshold. V_{IN} Threshold = 2.5V

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

Mechanical Dimensions

SOT-23-3



3 Pin SOT-23 JEDEC TO-236 Variation AB						
SYMBOLS	DIMENSIONS IN MM (Control Unit)			DIMENSIONS IN INCH (Reference Unit)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.89	—	1.12	0.035	—	0.044
A1	0.01	—	0.10	0.000	—	0.004
A2	0.88	0.95	1.02	0.035	0.037	0.040
b	0.30	—	0.50	0.012	—	0.020
c	0.08	—	0.20	0.003	—	0.008
D	2.80	2.90	3.04	0.110	0.114	0.120
E	2.10	—	2.64	0.083	—	0.104
E1	1.20	1.30	1.40	0.047	0.051	0.055
e	0.95 BSC			0.038 BSC		
e1	1.90 BSC			0.075 BSC		
L	0.40	0.50	0.60	0.016	0.020	0.024
L1	0.54 REF			0.021 REF		
L2	0.25 BSC			0.010 BSC		
q	0°	—	8°	0°	—	8°
N	3			3		

Drawing No: POD-00000031
Revision: A

Ordering Information[1]

Part Number	Operating Temperature Range	Lead-Free	Package	Packaging Method	Accuracy	Output Voltage
SPX2431AM-L/TR	0°C to 105°C	Yes[2]	3-pin SOT-23	Tape and Reel	0.5%	2.5V
SPX2431M-L/TR					1.0%	

NOTE:

1. Refer to www.exar.com/SPX2431 for most up-to-date Ordering Information.
2. Visit www.exar.com for additional information on Environmental Rating.

Revision History

Revision	Date	Description
1A	11/17/2017	Added MaxLinear logo. Updated format and ordering information table from previous revision dated 1/19/05. Pinout moved to page 2. Corrected typo for E min in mechanical dimensions.

MAXLINEAR

Corporate Headquarters:
5966 La Place Court
Suite 100
Carlsbad, CA 92008
Tel.:+1 (760) 692-0711
Fax: +1 (760) 444-8598
www.maxlinear.com

High Performance Analog:
1060 Rincon Circle
San Jose, CA 95131
Tel.: +1 (669) 265-6100
Fax: +1 (669) 265-6101
Email: powertechsupport@exar.com
www.exar.com