

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

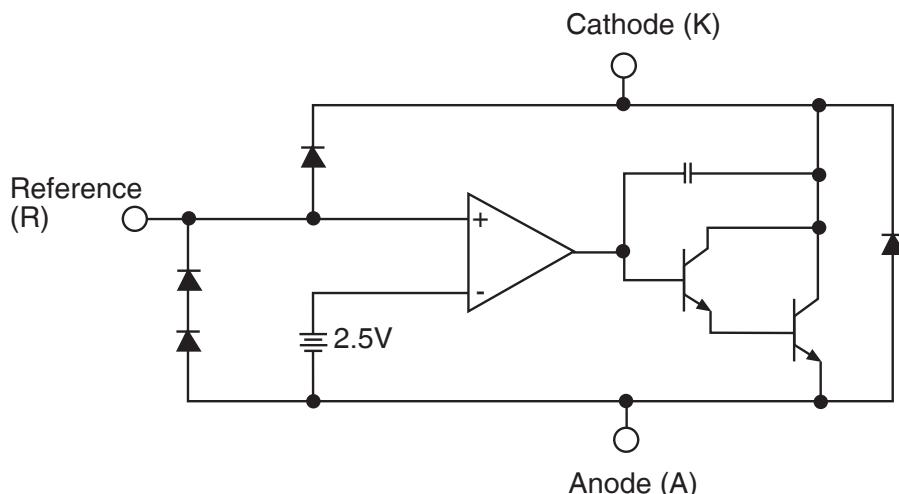
- Trimmed bandgap to 0.5% and 1.0%
- Wide operating current 1mA to 100mA
- Extended temperature range: 0°C to 105°C
- Low temperature coefficient: 30 ppm/°C
- Offered in 3 Pin SOT-23 (M)
- Replacement for TL431, AS2431
- Low noise output

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, ($< 10\text{ms}$) I_{AK} 1A

Operating Cathode Current I_K 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 $1.7\text{mW}^\circ\text{C}$

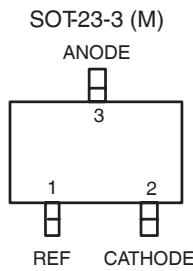
Typical deratings of the thermal resistances are given for ambient temperature $>25^\circ\text{C}$.

Electrical Characteristics

Electrical characteristics at 25°C , $I_K = 10\text{mA}$, $V_K = V_{REF}$, 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 | $T_J = 0^\circ\text{C}$ 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 | ΔV_{REF} | | V_{REF} to 10V | -2.7 | -1.01 | | -2.7 | -1.01 | | mV/V |
| | ΔV_K | 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 | $T_J = 0^\circ\text{C}$ to 105°C | | 0.4 | 1.2 | | 0.4 | 1.2 | μA |
| Min I_K for regulation | $I_K(\text{MIN})$ | 2 | | | 0.4 | 1.0 | | 0.4 | 1.0 | mA |
| Off state leakage | $I_K(\text{OFF})$ | 4 | $V_{REF} = 0\text{V}$, $V_{KA} = 20\text{V}$ | | 0.04 | | | 0.04 | 500 | nA |
| Dynamic output impedance | Z_{KA} | 2 | $f_Z \leq 1\text{kHz}$ $I_K = 1$ to 100mA | | 0.15 | 0.5 | | 0.15 | 0.5 | Ω |

Pin Configuration



Top View

Calculating Average Temperature Coefficient (TC)

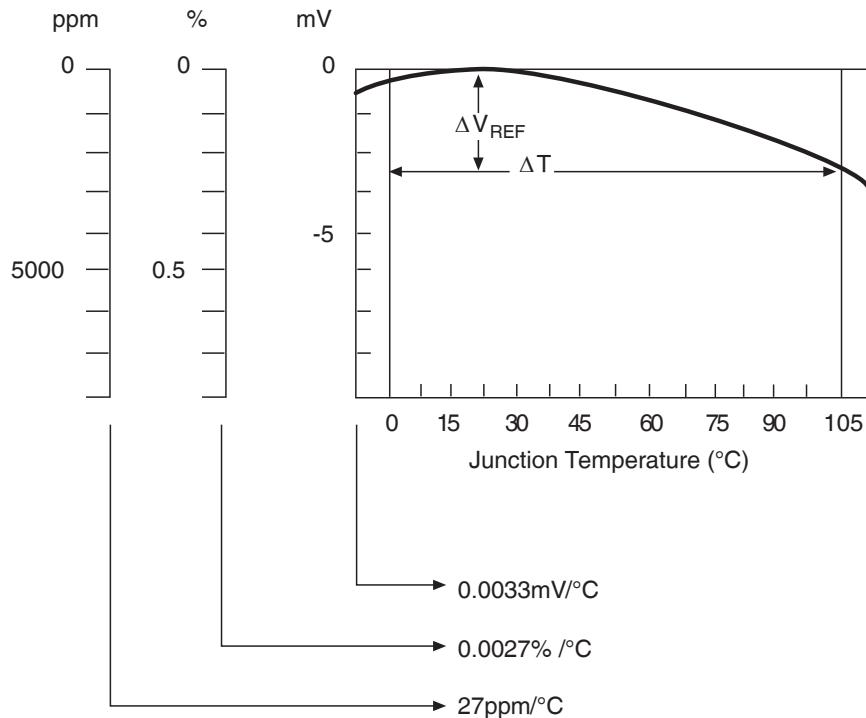


Figure 1: V_{REF} vs. Temperature

Test Circuits

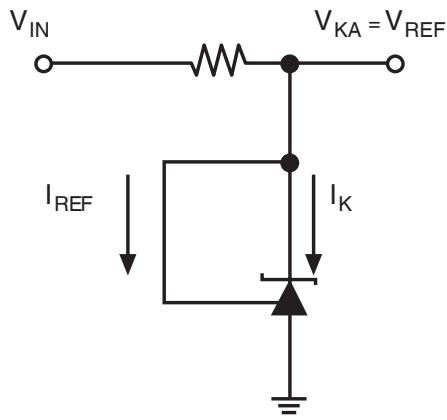


Figure 2: Test Circuit for $V_{KA} = V_{REF}$

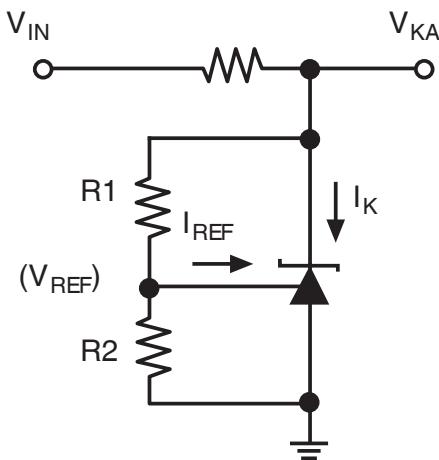


Figure 3: Test Circuit for $V_{KA} > V_{REF}$

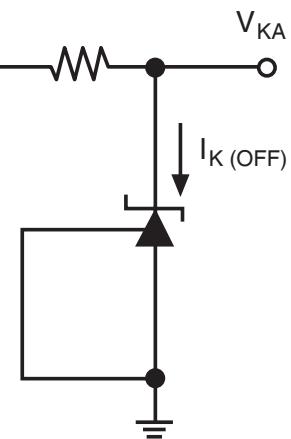
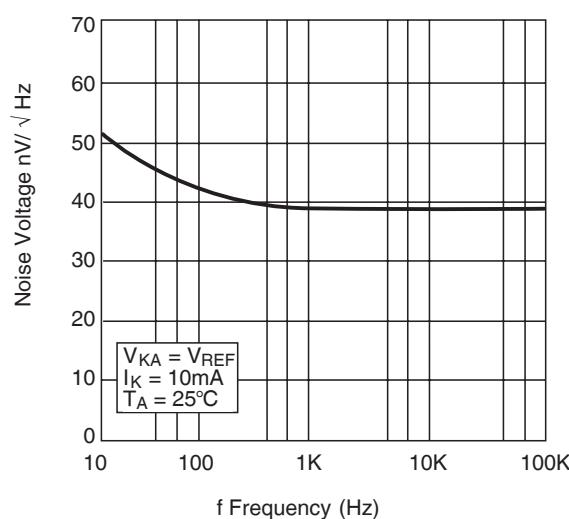
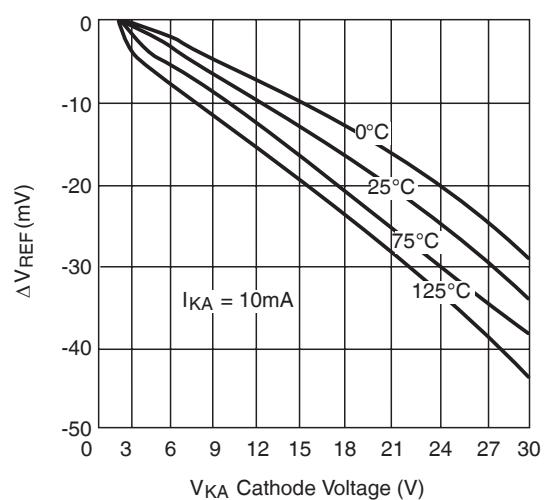
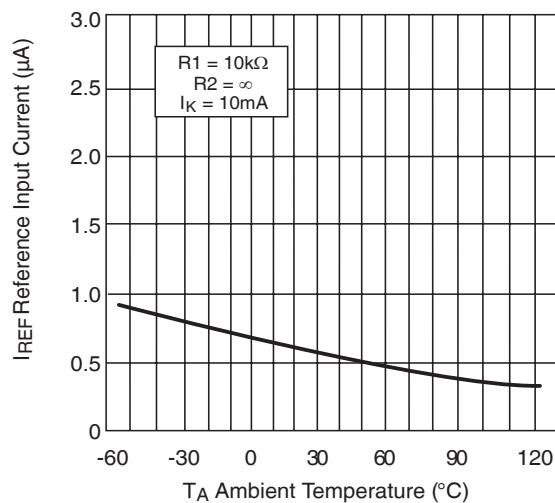
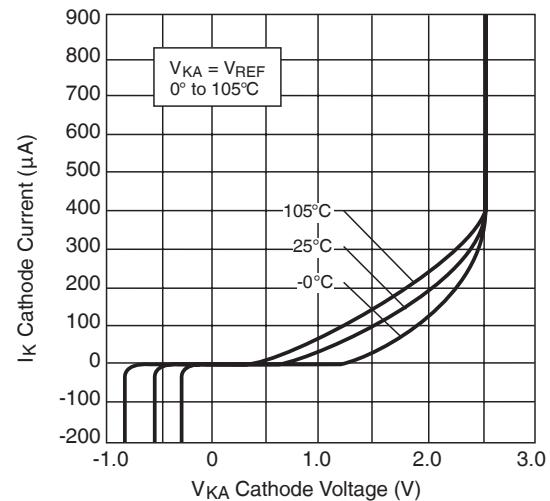
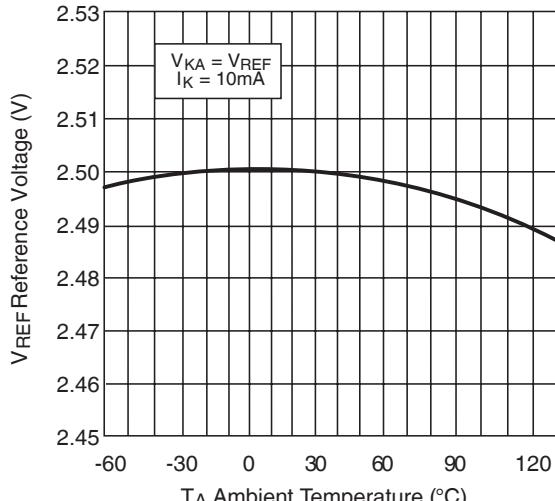
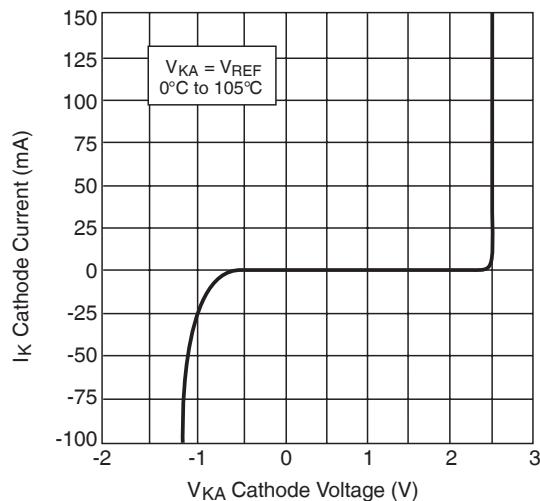


Figure 4: Test Circuit for I_{KOFF}

Typical Performance Characteristics



Typical Performance Characteristics (continued)

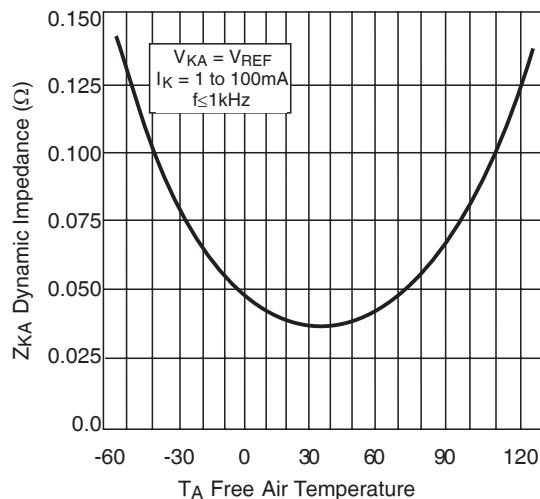


Figure 11: Low Frequency Dynamic Output Impedance vs. $T_{AMBIENT}$

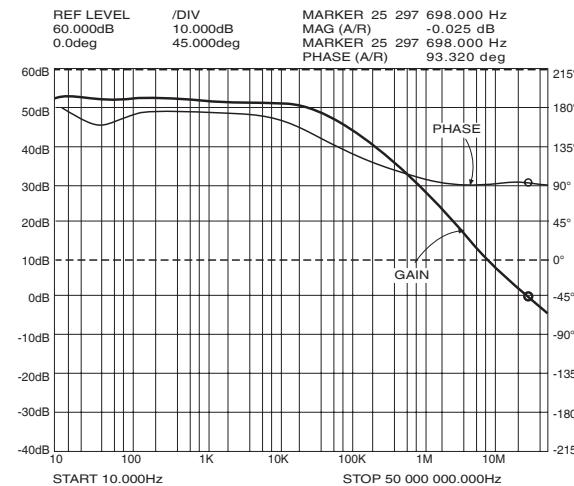


Figure 12. Small Signal Gain and Phase vs. Frequency; $I_K = 10\text{mA}$, $T_A = 25^\circ\text{C}$

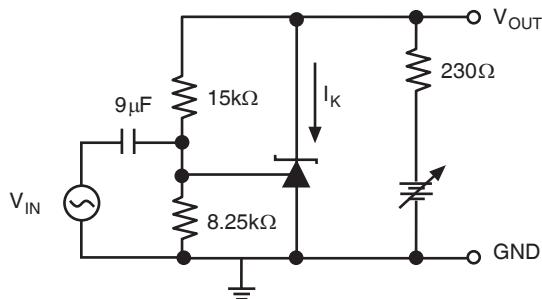


Figure 13. Test Circuit for Gain and Phase Frequency Response

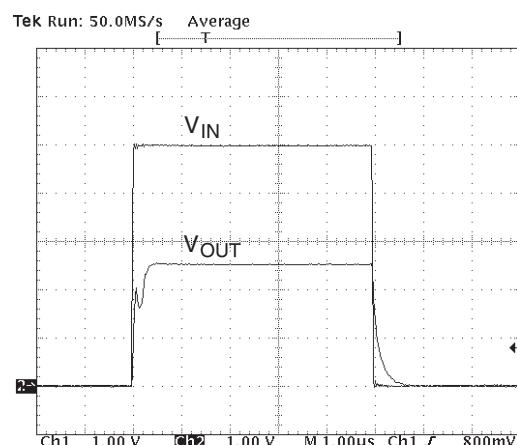


Figure 14. Frequency = 100kHz, $I_K = 10\text{mA}$, $T_A = 25^\circ\text{C}$

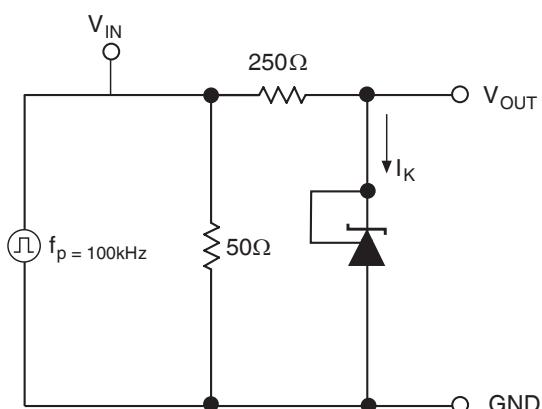


Figure 15. Test Circuit for Pulse Response

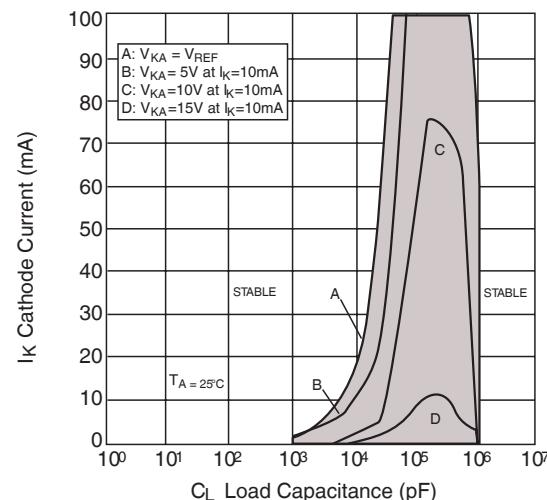


Figure 16. Stability Boundary Conditions

Typical Performance Characteristics (continued)

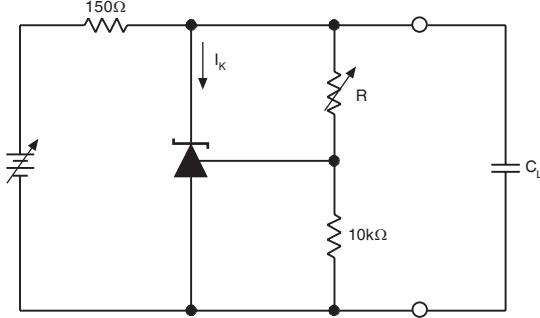


Figure 17: Test Circuit for Stability

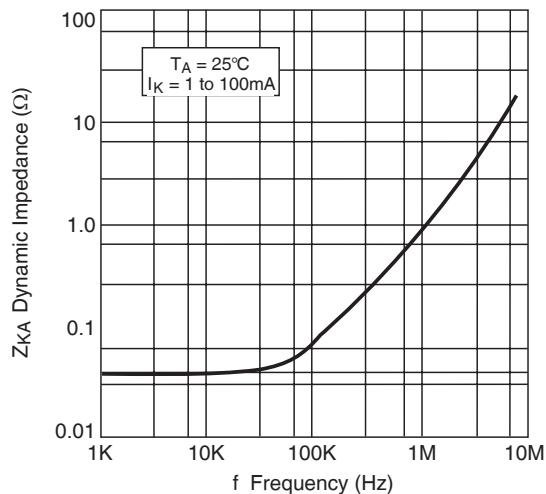
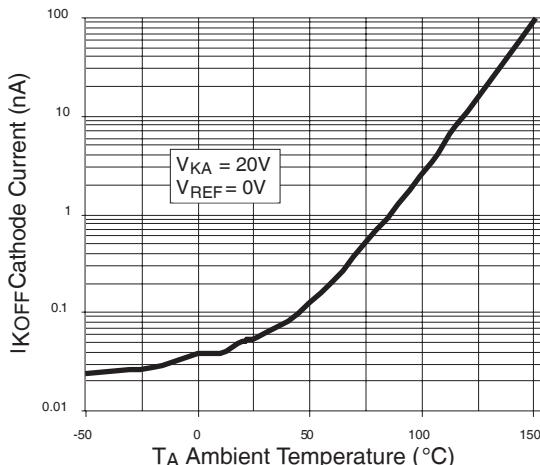
Figure 18: Dynamic Output Impedance $T_A = 25^\circ\text{C}$, $I_K = 1$ to 100mA 

Figure 19: Off State Leakage

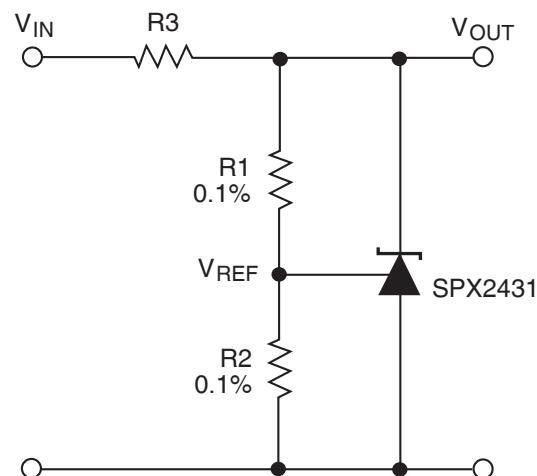
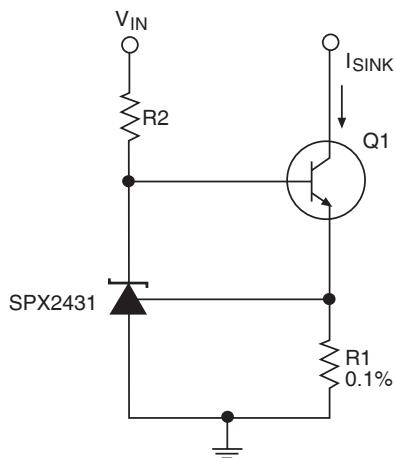
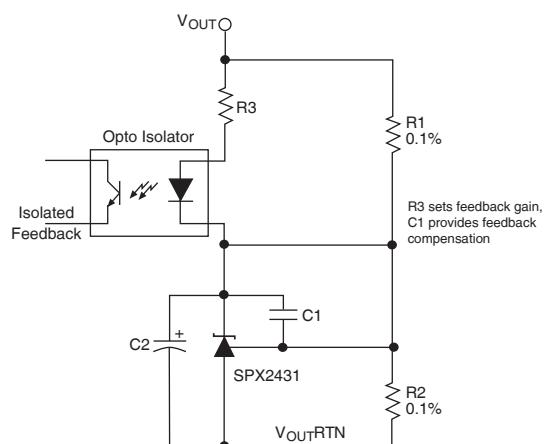
Figure 20: Shunt Regulator $V_{\text{OUT}} = (1 + R_1/R_2)V_{\text{REF}}$ Figure 21: Constant Current, Sink, $I_{\text{SINK}} = V_{\text{REF}}/R_1$ 

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

Typical Performance Characteristics (continued)

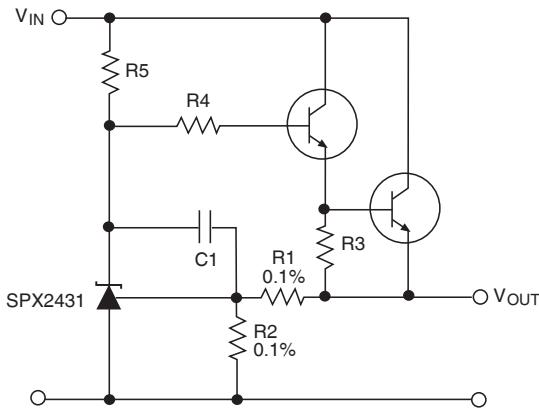


Figure 23: Precision High Current Series Regulator
 $V_{OUT} = (1+R_1/R_2)V_{REF}$

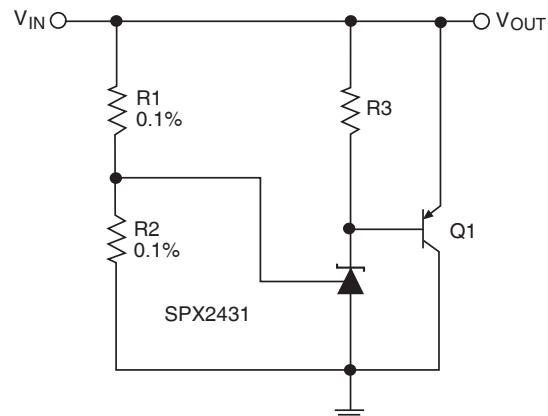


Figure 24: High Current Shunt Regulator
 $V_{OUT} = (1+R_1/R_2)V_{REF}$

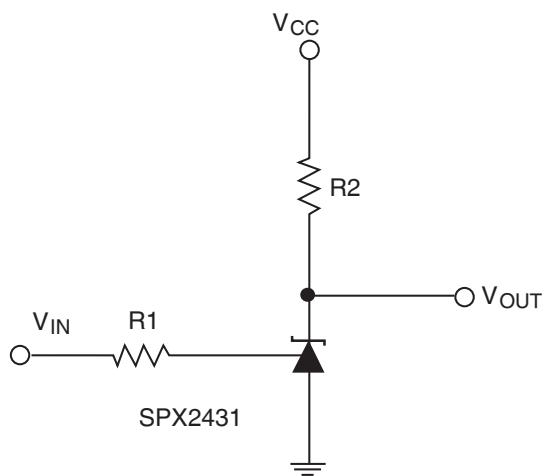
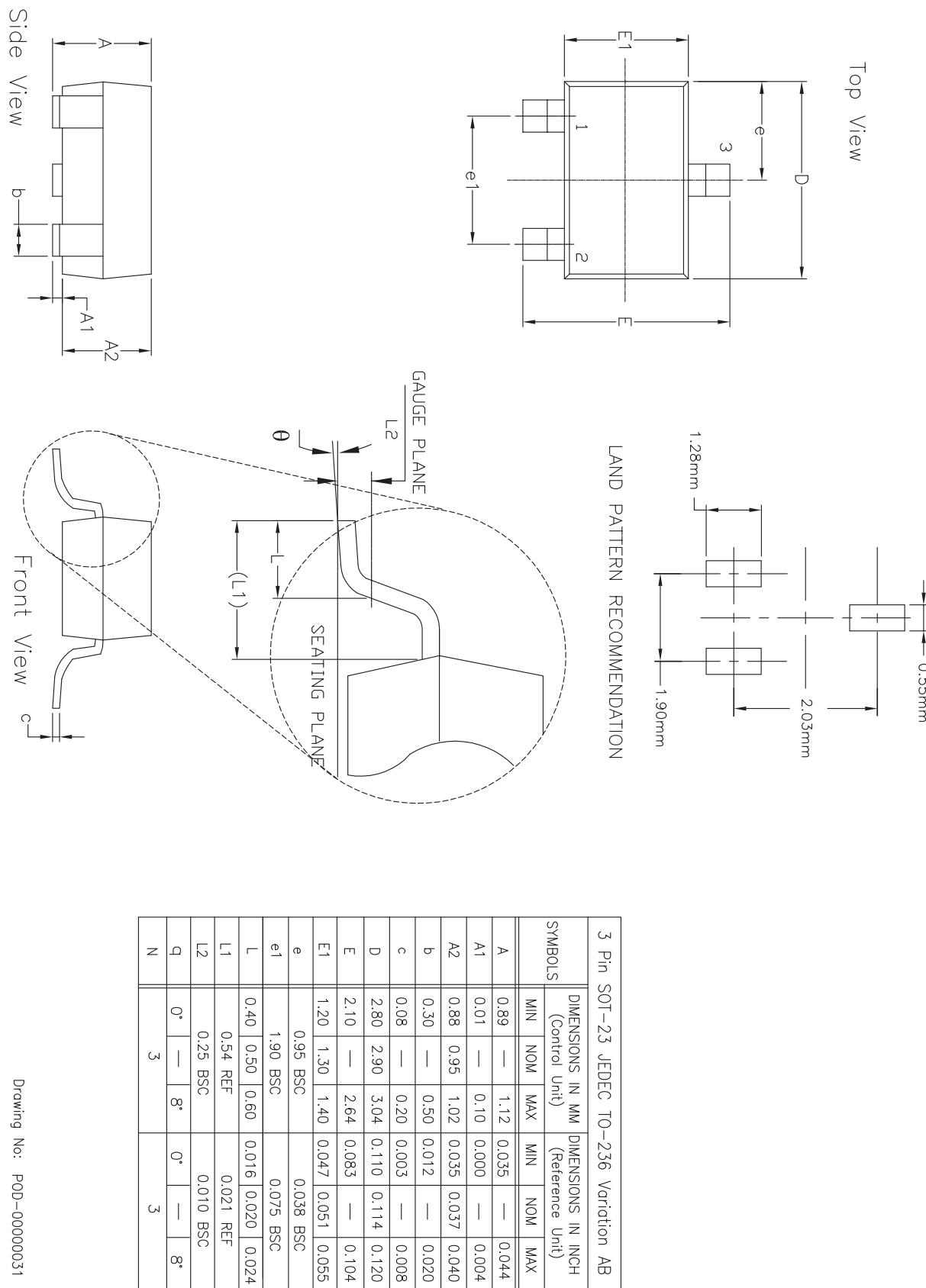


Figure 25: Single Supply Comparator with Temperature Compensated Threshold. V_{IN} Threshold = 2.5V

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

Mechanical Dimensions

SOT-23-3



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. |



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

The content of this document is furnished for informational use only, is subject to change without notice, and should not be construed as a commitment by MaxLinear, Inc.. MaxLinear, Inc. assumes no responsibility or liability for any errors or inaccuracies that may appear in the informational content contained in this guide. Complying with all applicable copyright laws is the responsibility of the user. Without limiting the rights under copyright, no part of this document may be reproduced into, stored in, or introduced into a retrieval system, or transmitted in any form or by any means (electronic, mechanical, photocopying, recording, or otherwise), or for any purpose, without the express written permission of MaxLinear, Inc.

Maxlinear, Inc. does not recommend the use of any of its products in life support applications where the failure or malfunction of the product can reasonably be expected to cause failure of the life support system or to significantly affect its safety or effectiveness. Products are not authorized for use in such applications unless MaxLinear, Inc. receives, in writing, assurances to its satisfaction that: (a) the risk of injury or damage has been minimized; (b) the user assumes all such risks; (c) potential liability of MaxLinear, Inc. is adequately protected under the circumstances.

MaxLinear, Inc. may have patents, patent applications, trademarks, copyrights, or other intellectual property rights covering subject matter in this document. Except as expressly provided in any written license agreement from MaxLinear, Inc., the furnishing of this document does not give you any license to these patents, trademarks, copyrights, or other intellectual property.

Company and product names may be registered trademarks or trademarks of the respective owners with which they are associated.

© 2017 MaxLinear, Inc. All rights reserved