

GENERAL DESCRIPTION

The SPX431L is a 3-terminal adjustable shunt voltage regulator providing a highly accurate bandgap reference. The SPX431L acts as an open-loop error amplifier with a 2.5V temperature compensation reference. The SPX431L'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. SPX431L 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 VREF and 20V with two external resistors. The SPX431L is available in TO-92, and SOT-89 packages.

APPLICATIONS

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

FEATURES

- **Tight Voltage Tolerance 0.5% at 10mA**
- **Wide Operating Current 1mA to 100mA**
- **Extended Temperature Range: 0°C to 105°C**
- **Low Temperature Coefficient 30 ppm/°C**
- **Improved Replacement in Performance for TL431 and AS431**
- **Low Cost Solution**

TYPICAL BLOCK DIAGRAM

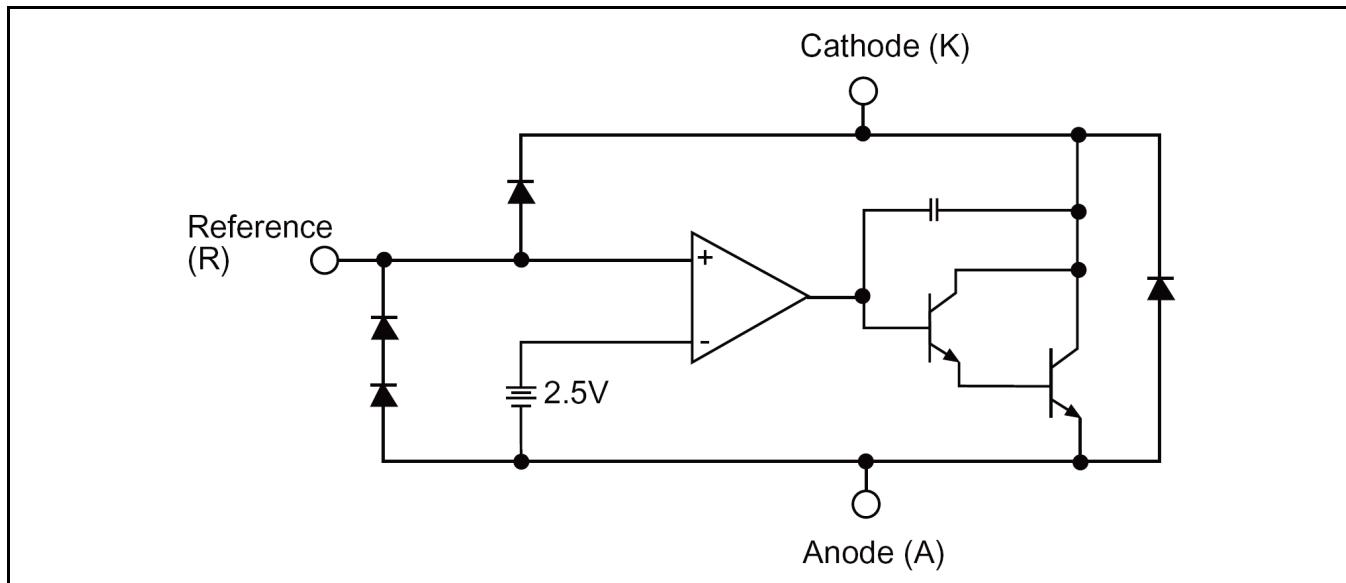


Fig. 1: SPX431L Precision Adjustable Shunt Regulator



A New Direction in Mixed-Signal

SPX431L

Precision Adjustable Shunt Regulator

ABSOLUTE MAXIMUM RATINGS

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time 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}	10mA
Continuous Power Dissipation at 25°C PD	
TO-92	775mW
SOT-89	1000mW
Storage Temperature T _{STG}	-65 to 150°C
Lead Temperature (Soldering 10 sec.) T _L	300°C

OPERATING RATINGS

Input Voltage Range V _{KA}	V _{REF} to 20V
Cathode Current I _K	10mA
Junction Temperature Range	150 °C
Thermal Resistance	
0 _{JA} (TO-92)	160°C/W
0 _{Jc} (TO-92)	80°C/W
Typical Derating (TO-92)	6.3 mW/°C
0 _{JA} (SOT-89)	110°C/W
0 _{Jc} (SOT-89)	8°C/W
Typical Derating (SOT-89)	9.1 mW/°C

ELECTRICAL SPECIFICATIONS

Specifications with standard type are for an Operating Junction Temperature of T_A = 25°C only; limits applying over the full Operating Junction Temperature range are denoted by a “•”. Minimum and Maximum limits are guaranteed through test, design, or statistical correlation. Typical values represent the most likely parametric norm at T_A = 25°C, and are provided for reference purposes only. Unless otherwise indicated, I_K = 10mA V_K = V_{REF}.

Parameter	Min.	Typ.	Max.	Units	Conditions
SPX431LA					
Reference Voltage	2.490	2.503	2.515	V	
ΔVREF withTemp. ¹		0.07	0.20	mV/°C	
Ratio of Change in VREF to Cathode Voltage	-2.7 -2.0	-1.0 -0.4	0.3	mV/V	VREF to 10V VREF to 10V
Reference Input Current		0.7	4.0	µA	
IREF Temp Deviation		0.4	1.2	µA	TJ = 0°C to 105°C
Min IK for Regulation		0.4	1.0	mA	
Off State Leakage		0.04	1.0	µA	VREF = 0V, VKA = 20V
Dynamic Output Impedance		0.15	0.5	Ω	fz ≤ 1kHz Ik = 1 to 100mA
SPX431L					
Reference Voltage	2.470	2.495	2.520	V	
ΔVREF withTemp. ¹		0.07	0.20	mV/°C	
Ratio of Change in VREF to Cathode Voltage	-2.7 -2.0	-1.0 -0.4	0.3	mV/V	VREF to 10V VREF to 10V
Reference Input Current		0.7	4.0	µA	
IREF Temp Deviation		0.4	1.2	µA	TJ = 0°C to 105°C
Min IK for Regulation		0.4	1.0	mA	
Off State Leakage		0.04	1.0	µA	VREF = 0V, VKA = 20V
Dynamic Output Impedance		0.15	0.5	Ω	fz ≤ 1kHz Ik = 1 to 100mA
SPX431LC					
Reference Voltage	2.445	2.495	2.520	V	
ΔVREF withTemp. ¹		0.07	0.20	mV/°C	
Ratio of Change in VREF to Cathode Voltage	-2.7 -2.0	-1.0 -0.4	0.3	mV/V	VREF to 10V VREF to 10V
Reference Input Current		0.7	4.0	µA	
IREF Temp Deviation		0.4	1.2	µA	TJ = 0°C to 105°C



A New Direction in Mixed-Signal

SPX431L**Precision Adjustable Shunt Regulator**

Parameter	Min.	Typ.	Max.	Units		Conditions
Min IK for Regulation		0.4	1.0	mA		
Off State Leakage		0.04	1.0	µA		VREF = 0V, VKA = 20V
Dynamic Output Impedance		0.15	0.5	Ω		fz ≤ 1kHz Ik = 1 to 100mA

Note 1: See appropriate test circuit (Figures 25, 26, 27)

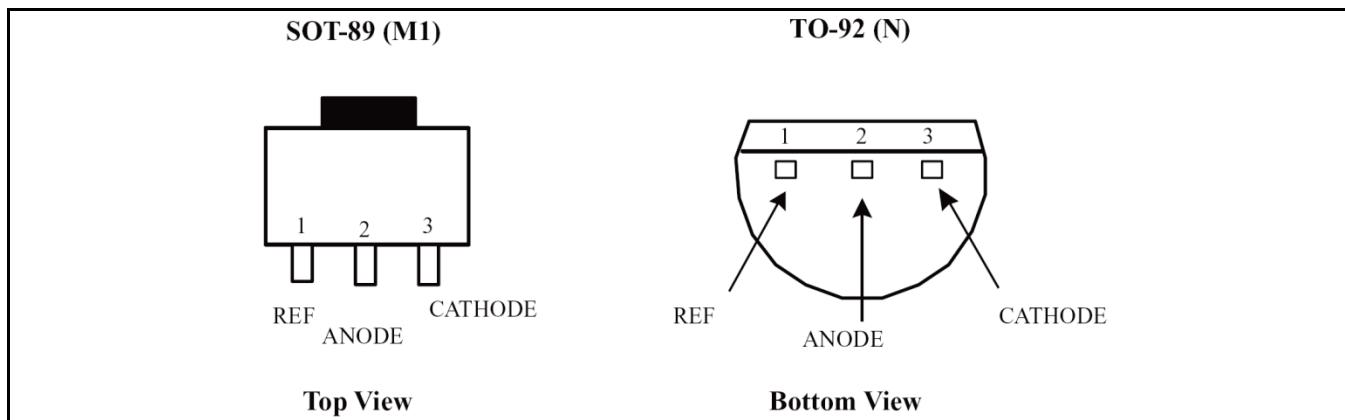
PIN ASSIGNMENT

Fig. 2: SPX431L Pin Assignment

PIN DESCRIPTION

Name	Pin Number	Description
NAME	1	Reference
NAME	2	Anode
NAME	3	Cathode

ORDERING INFORMATION

Part Number	Temperature Range	Marking	Package	Packing Quantity	Note 1	Note 2
SPX431LAN-L	0°C to 105°C	Sipex 431LAN 25 YYWWLX	TO-92-3	Bulk	Halogen Free	2.503V 0.5% Acc
SPX431LAN-L/TR				Tape & Reel		
SPX431LM1-L	0°C to 105°C	P011 YYWXXXX	SOT-89-3	Bulk	Halogen Free, bar on left side of marking denotes "L" lead free product	2.495V 1.0% Acc
SPX431LM1-L/TR				Tape & Reel		
SPX431LN-L	0°C to 105°C	Sipex 431LN 25 YYWWLX	TO-92-3	Bulk	Halogen Free	2.495V 1.0% Acc
SPX431LN-L/TR				Tape & Reel		

"YY" = Year (Last 2 digits) - "Y" = Year (Last Digit)

"WW" = Work Week

"L" = Lead free designator

"X" = Lot Number (example AA234567) - "XXX" = Lot Number (example AA234567)

No bottom marking

TYPICAL PERFORMANCE CHARACTERISTICS

Schematic and BOM from Application Information section of this datasheet. Resistor values are chosen such that the effect to I_{REF} is negligible.

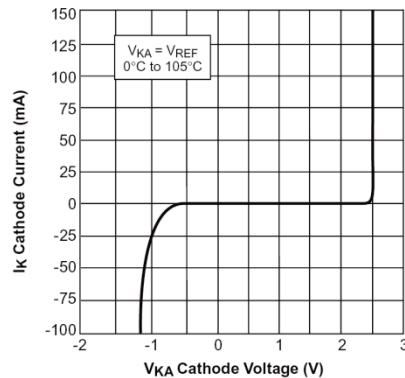


Fig. 3: High Current Operating Characteristics

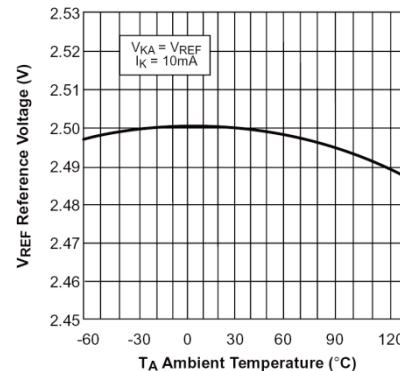


Fig. 4: Reference Voltage VS Ambient Temperature

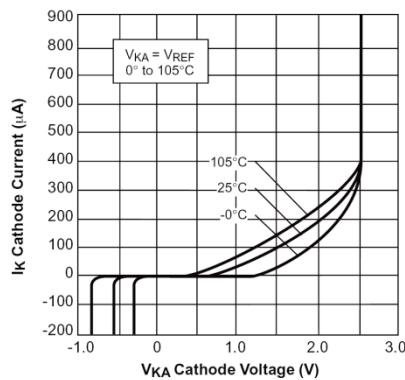


Fig. 5 Low Current Operating Characteristics.

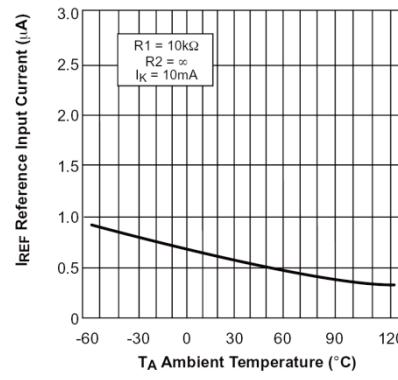


Fig. 6 Reference Input Current VS Ambient Temperature.

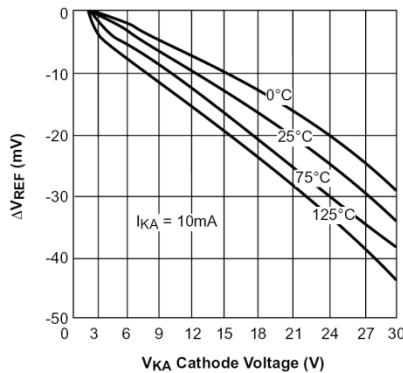


Fig. 7 Reference Voltage Line Regulation VS Cathode Voltage and T_AMBIENT

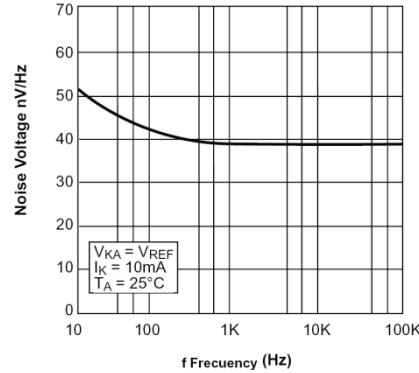


Fig. 8 Noise Voltage VS Frequency

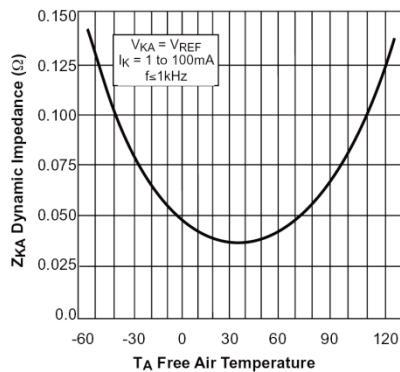


Fig. 9 Low Frequency Dynamic Output Impedance
VS TAMBIENT

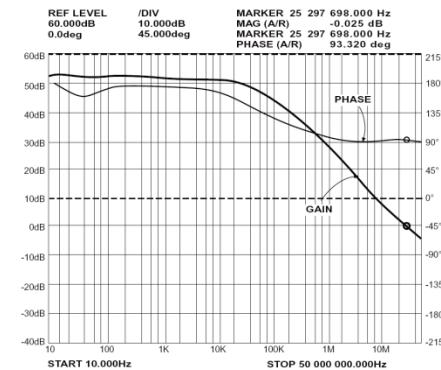


Fig. 10 Small Signal Gain and Phase VS Frequency;
I_K = 10mA, TA = 25°C

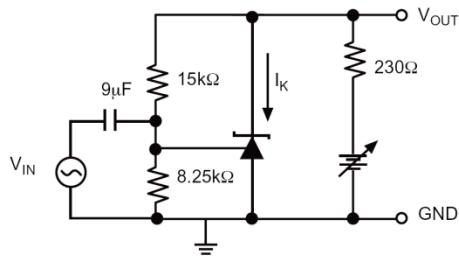


Fig. 11 Test Circuit for Gain and Phase Frequency
Response

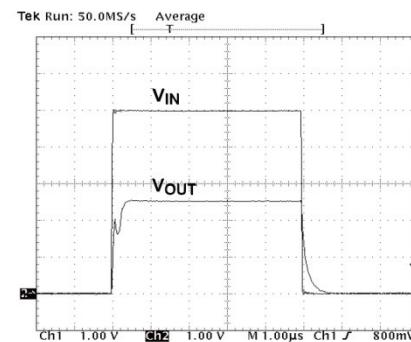


Fig. 2 Fz = 100kHz, I_K = 10mA, TA = 25°C

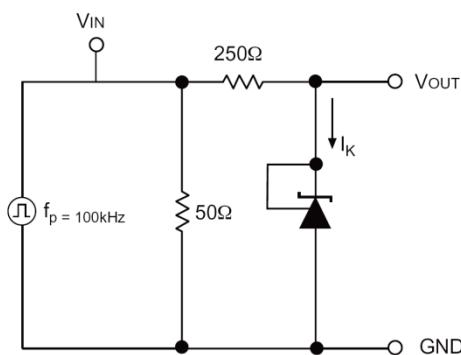


Fig. 33 Test Circuit for Pulse Response

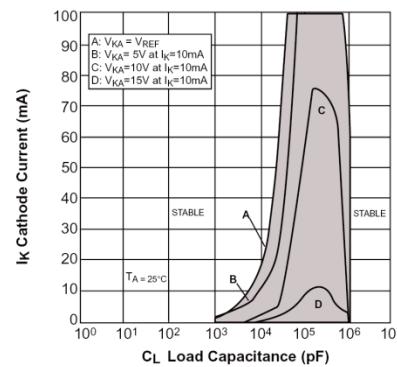


Fig. 44 Stability Boundary Conditions

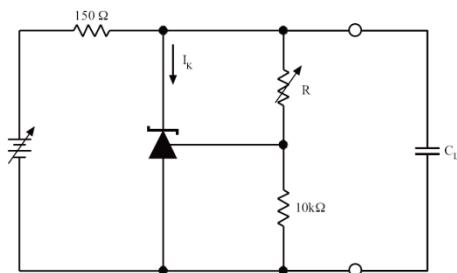


Fig. 55 Test Circuit for Stability

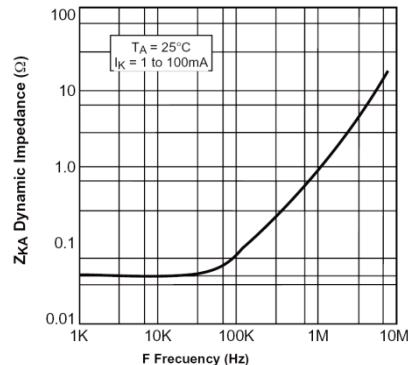


Fig. 66 Dynamic Output Impedance $T_A = 25^\circ C$,
 $I_K = 1$ to 100 mA

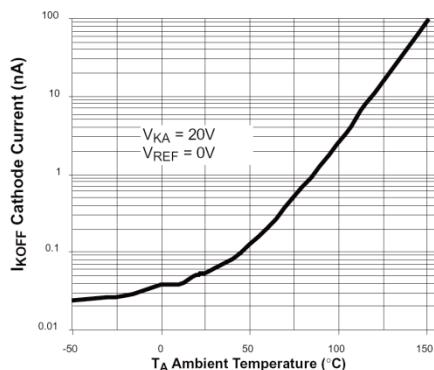


Fig. 77 Off State Leakage

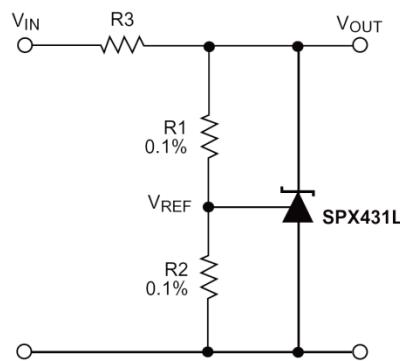


Fig. 88 Shunt Regulator $V_{OUT} = (1+R_1/R_2)V_{REF}$

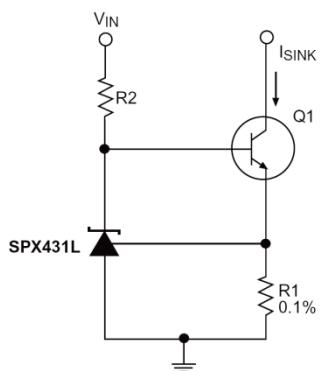


Fig. 199 Constant Current Sink, $I_{SINK} = V_{REF}/R_1$

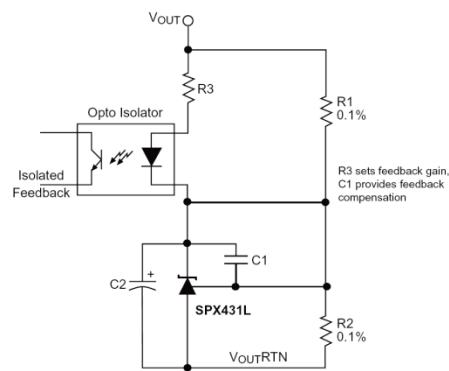


Fig. 100 Reference Amplifier for Isolated Feedback in
Off-Line DC-DC Converters

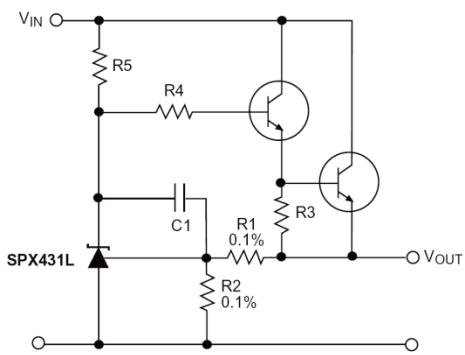
Precision Adjustable Shunt Regulator


Fig. 111 Precision High Current Series Regulator

$$V_{OUT} = (1 + R_1/R_2)V_{REF}$$

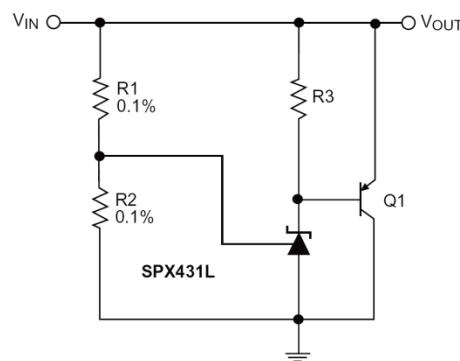


Fig. 122 High Current Shunt regulator

$$V_{OUT} = (1 + R_1/R_2)V_{REF}$$

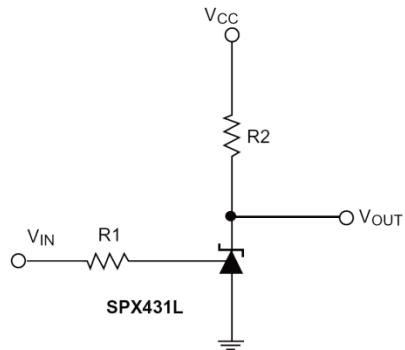
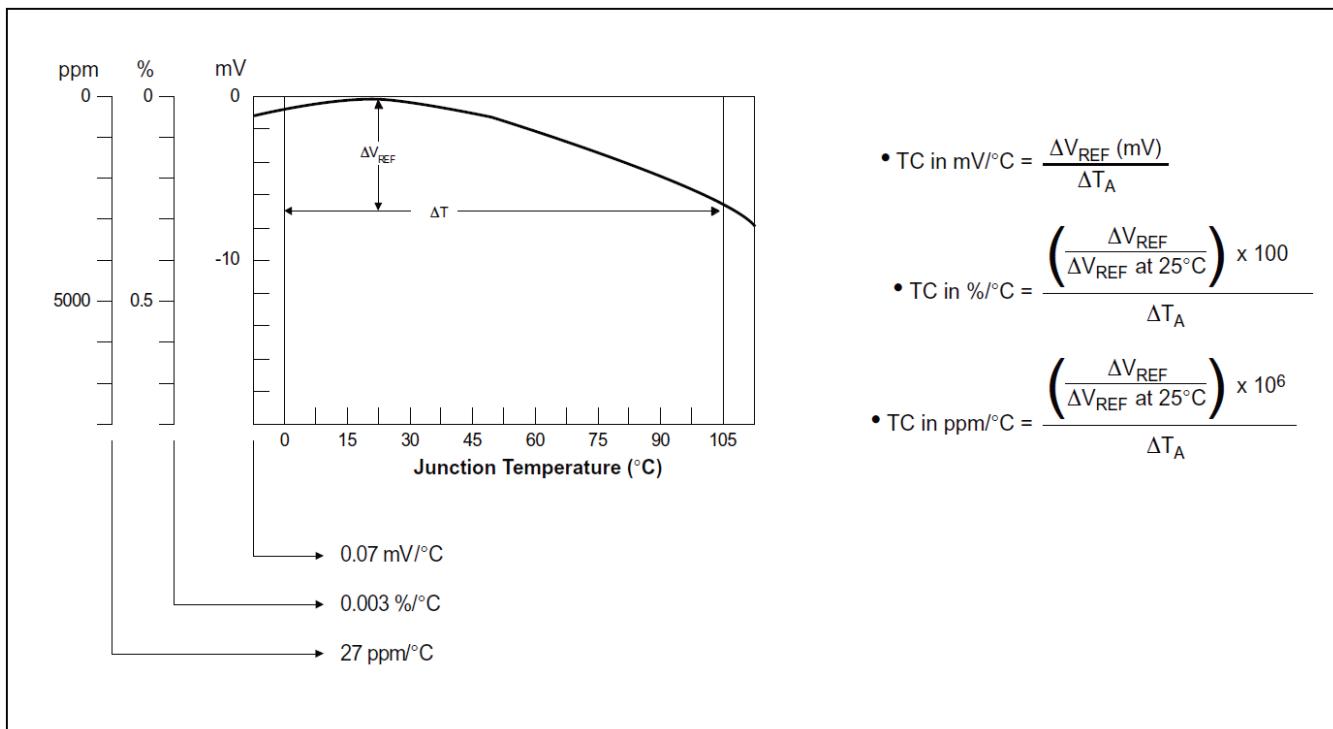


Fig. 133 Single Supply Comparator with Temperature

Compensated Threshold. V_{IN} threshold = 2.5V.

APPLICATION INFORMATION

CALCULATING AVERAGE TEMPERATURE COEFFICIENT (TC)



$$\bullet \text{ TC in } mV/^{\circ}C = \frac{\Delta V_{REF} \text{ (mV)}}{\Delta T_A}$$

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

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

Fig. 24: V_{REF} VS Temperature.

TEST CIRCUITS

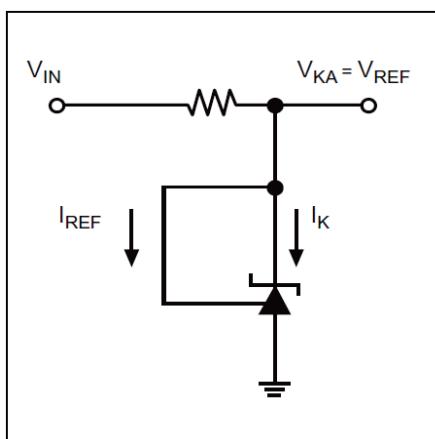


Fig. 25: Test Circuit for $V_{KA} = V_{REF}$

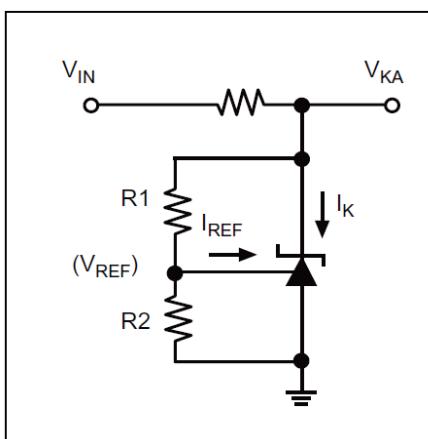


Fig. 26: Test Circuit for $V_{KA} > V_{REF}$

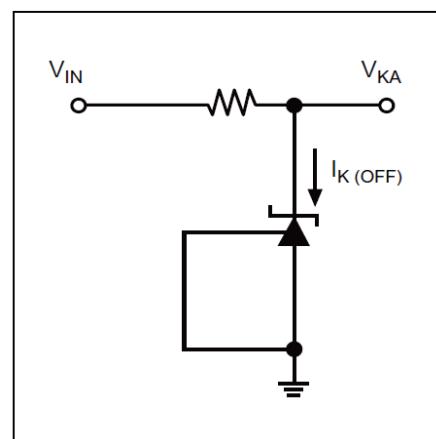


Fig. 27: Test Circuit for $I_{K(OFF)}$



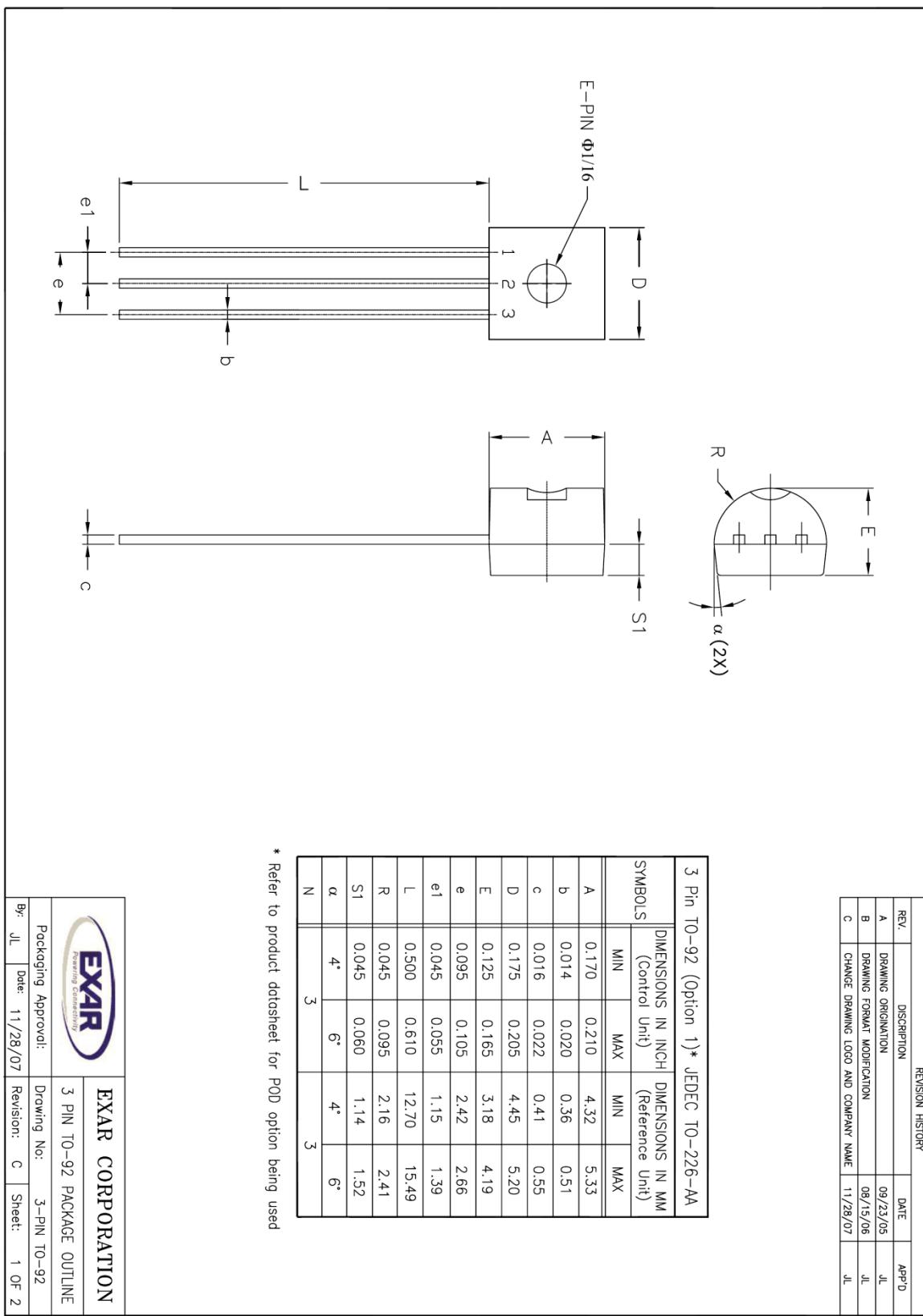
A New Direction in Mixed-Signal

SPX431L

Precision Adjustable Shunt Regulator

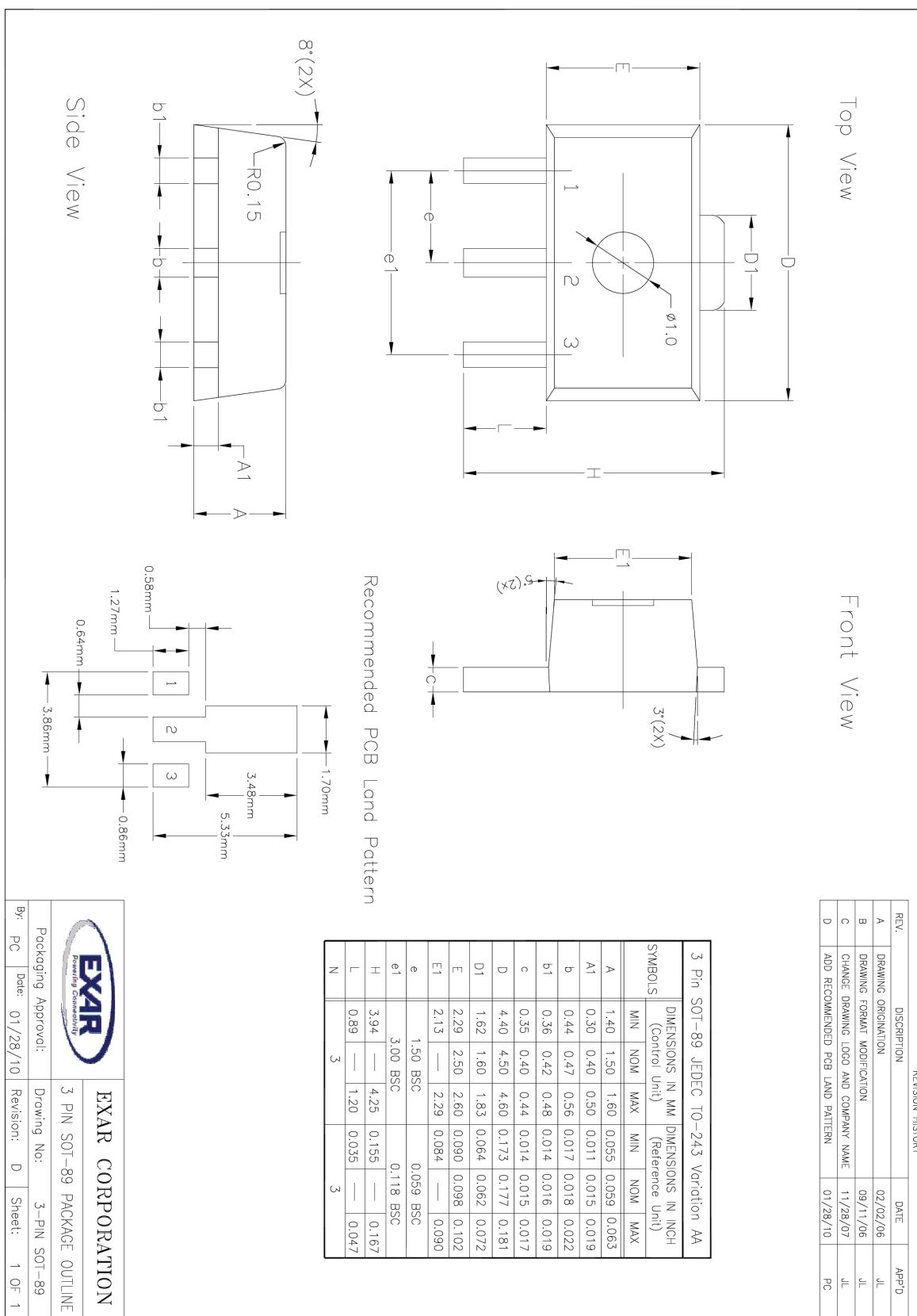
PACKAGE SPECIFICATION

3 PIN TO-92





A New Direction in Mixed-Signal

SPX431L**Precision Adjustable Shunt Regulator****PACKAGE SPECIFICATION****3 PIN SOT-89**

REV.	DESCRIPTION	DATE	APPROD
A	DRAWING ORIGINATOR	02/02/06	JL
B	DRAWING FORMAT MODIFICATION	09/11/06	JL
C	CHANGE DRAWING LOGO AND COMPANY NAME	11/28/07	JL
D	ADD RECOMMENDED PCB LAND PATTERN	01/28/10	PC



A New Direction in Mixed-Signal

SPX431L

Precision Adjustable Shunt Regulator

REVISION HISTORY

Revision	Date	Description
2.0.0	06/12/2012	Reformatted Datasheet. Corrected Package Drawing
2.0.1	07/19/2013	Update package marking information and updated corporate logo.

FOR FURTHER ASSISTANCE

Email:

customersupport@exar.com

Exar Technical Documentation:

<http://www.exar.com/TechDoc/default.aspx?>



A New Direction in Mixed-Signal

EXAR CORPORATION

HEADQUARTERS AND SALES OFFICES

48720 Kato Road

Fremont, CA 94538 – USA

Tel.: +1 (510) 668-7000

Fax: +1 (510) 668-7030

www.exar.com

NOTICE

EXAR Corporation reserves the right to make changes to the products contained in this publication in order to improve design, performance or reliability. EXAR Corporation assumes no responsibility for the use of any circuits described herein, conveys no license under any patent or other right, and makes no representation that the circuits are free of patent infringement. Charts and schedules contained here in are only for illustration purposes and may vary depending upon a user's specific application. While the information in this publication has been carefully checked; no responsibility, however, is assumed for inaccuracies.

EXAR Corporation 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 EXAR Corporation 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 EXAR Corporation is adequately protected under the circumstances.

Reproduction, in part or whole, without the prior written consent of EXAR Corporation is prohibited.



OCEAN CHIPS

Океан Электроники

Поставка электронных компонентов

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибутором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибутором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: ocean@oceanchips.ru

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А