Precision Adjustable Shunt Regulator

FEATURES

- Trimmed Bandgap Reference to 0.4%
- Wide Operating Current 1mA to 150mA
- Extended Temperature Range: -55°C to 125°C
- Low Temperature Coefficient 30 ppm/°C
- Offered in TO-92, SOIC, SOT-89, SOT-23-5
- Improved Replacement in Performance for LT1431
- Low Cost Solution

APPLICATIONS

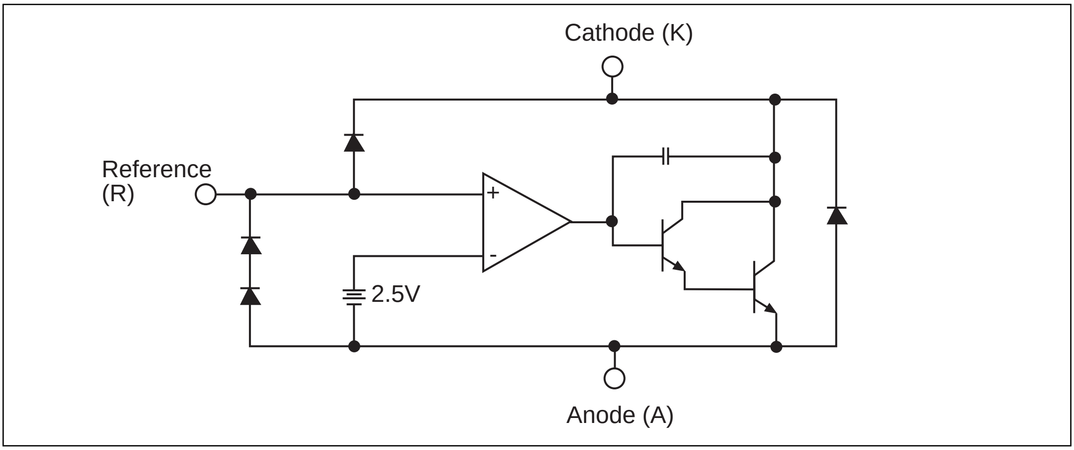
- Battery Operating Equipment
- Adjustable Supplies
- Switching Power Supplies
- Error Amplifiers
- Single Supply Amplifier
- Monitors / VCRs / TVs
- Personal Computers

DESCRIPTION

The SPX1431 is a 3-terminal adjustable shunt voltage regulator providing a highly accurate bandgap reference. The SPX1431 acts as an open-loop error amplifier with a 2.5V temperature compensation reference. The SPX1431's thermal stability, wide operating current (150mA) and temperature range (-55°C to 125°C) makes it suitable for a variety of applications that require a low cost, high performance solution. SPX1431 tolerance of 0.4% 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 contributes a significant cost savings.

The output voltage may be adjusted to any value between V_{REF} and 36 volts with two external resistors. The SPX1431 is available in TO-92, SOIC-8, SOT-89, and SOT-23-5 packages.

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Cathode-Anode Reverse Breakdown V_{KA} 37V
Anode-Cathode Forward Current, (<10ms) I_{AK} 1A
Operating Cathode Current I_{KA} 150mA
Reference Input Current I_{REF} 10mA
Continuous Power Dissipation at 25°C P_D
TO-92 .... 775mW
SOT-23 .... 200 mW
SOIC-8 .... 750mW
SOT-89 .... 1000mW

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 36	V
Cathode Current	I_K	10	mA

TYPICAL THERMAL RESISTANCES

PACKAGE	0_{JA}	0_{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
SOT-89	110°C/W	8°C/W	9.1mW/C°

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

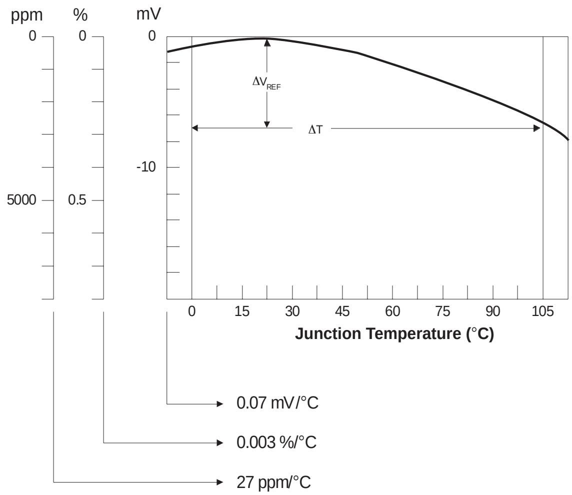
ELECTRICAL CHARACTERISTICS

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

PARAMETER	SYMBOL	FIGURE	CONDITIONS	MIN	TYP	MAX	UNITS
SPX1431							
Reference Voltage	V_{REF}	2 2	 T_J = 0°C to 105°C	2.490 2.465	2.500	2.510 2.535	V V
ΔV_{REF} withTemp.*	TC	2			0.07	0.20	mV/°C
Ratio of Change in V_{REF} to Cathode Voltage	$\frac{\Delta V_{REF}}{\Delta V_K}$	3	V_k = 3V to 36V	-2.0	-1.1		mV/V
Reference Input Current	I_{REF}	3			0.7	1.9	µA
I_{REF} Temp Deviation	ΔI_{REF}	3	T_J = 0°C to 105°C		0.4	1.2	µA
Min I_K for Regulation	$I_{K(MIN)}$	2			0.4	1	mA
Off State Leakage	$I_{K(OFF)}$	4	V_{REF} = 0V, V_{KA} = 36V		0.04	250	nA
Dynamic Output Impedance	Z_{KA}	2	$f_z \leq$ 1kHz I_K = 1 to 150mA		0.15	0.5	Ω

Operating Range (T_J) = - 55°C to 125°C.
**** See appropiate test circuit (Figure 2)***

CALCULATING AVERAGE TEMPERATURE COEFFICIENT (TC)



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

Figure 1. V_{REF} VS Temperature.

TEST CIRCUITS

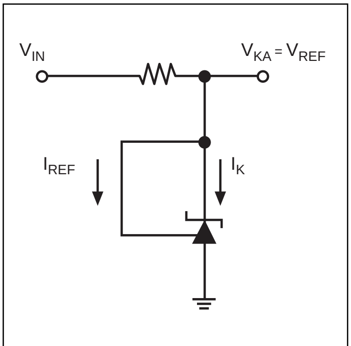


Figure 2. Test Circuit for $V_{KA} = V_{REF}$

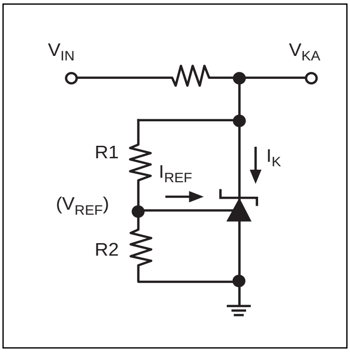


Figure 3. Test Circuit for $V_{KA} > V_{REF}$

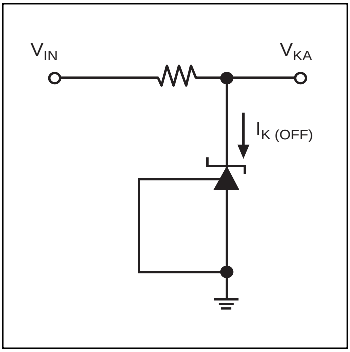


Figure 4. Test Circuit for I_{KOFF}

TYPICAL PERFORMANCE CHARACTERISTICS

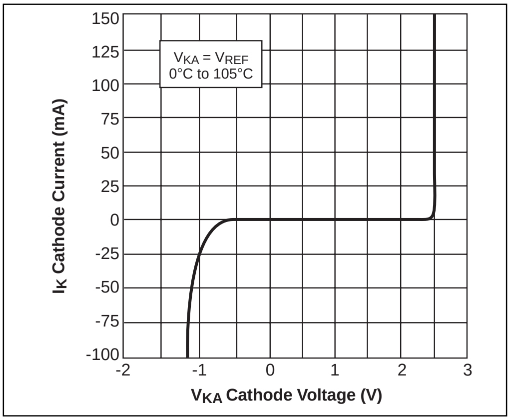


Figure 5. High Current Operating Characteristics

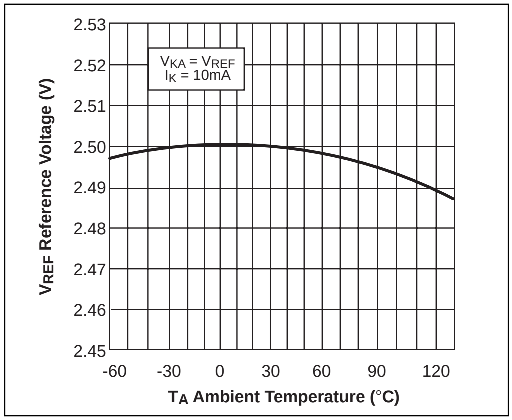


Figure 6. Reference Voltage VS Ambient Tempetature

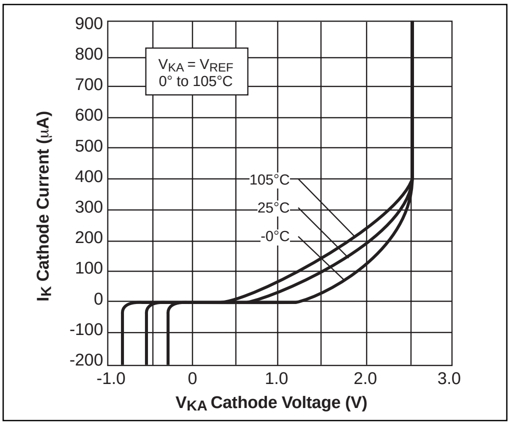


Figure 7. Low Current Operating Characteristics

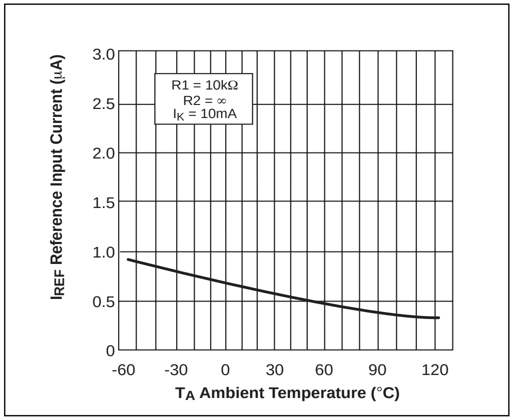


Figure 8. Reference Input Current VS Ambient Temperature

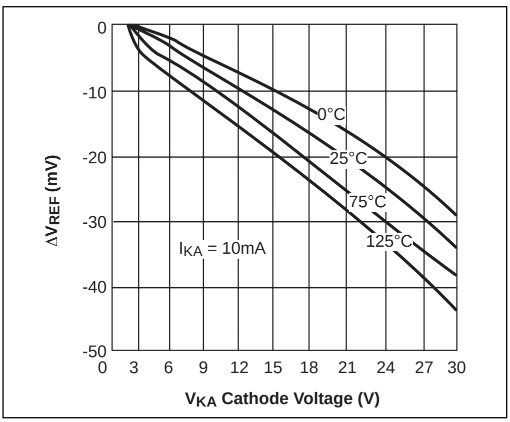


Figure 9. Reference Voltage Line Regulation VS Cathode Voltage and $T_{AMBIENT}$

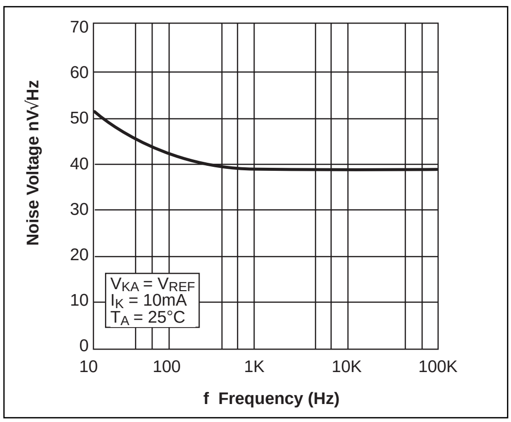


Figure 10. Noise Voltage VS Frequency

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

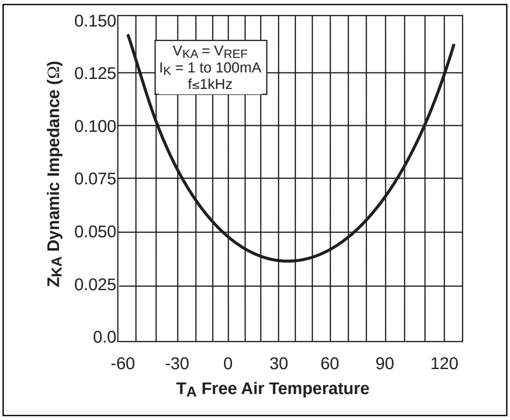


Figure 11. Low Frequency Dynamic Output Impedance VS $T_{AMBIENT}$

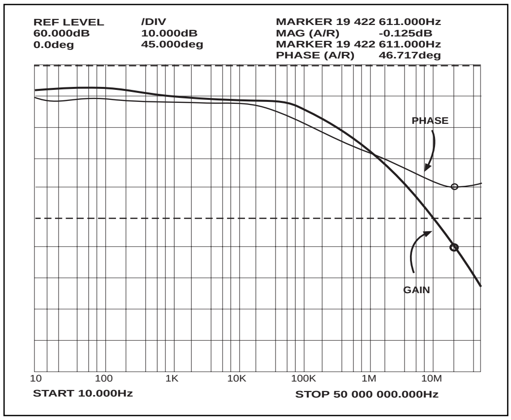


Figure 12. Small Signal Gain and Phase VS Frequency; I_K = 10mA, T_A = 25°C

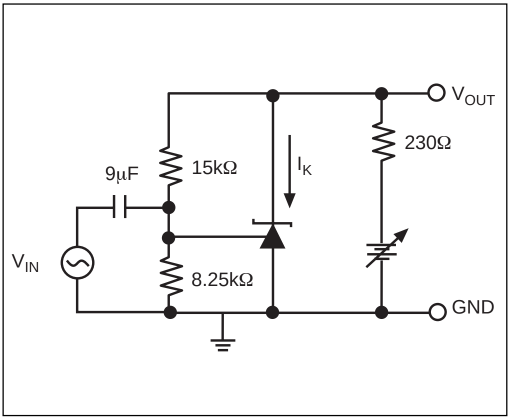


Figure 13. Test Circuit for Gain and Phase Frequency Response

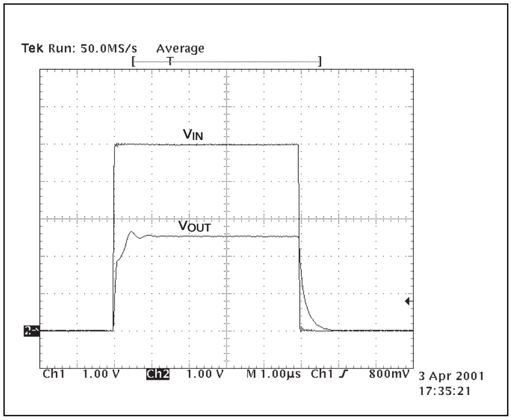


Figure 14. Frequency = 100kHz, I_K = 10mA, T_A = 25°C

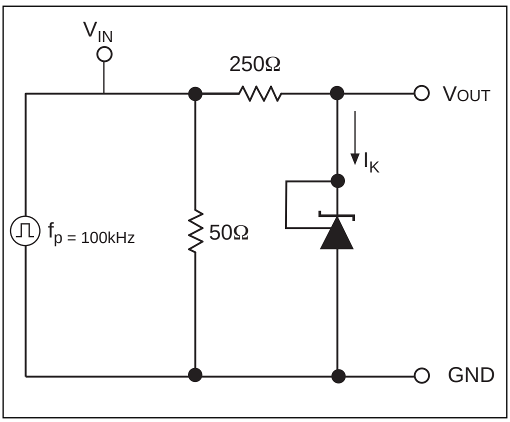


Figure 15. Test Circuit for Pulse Response

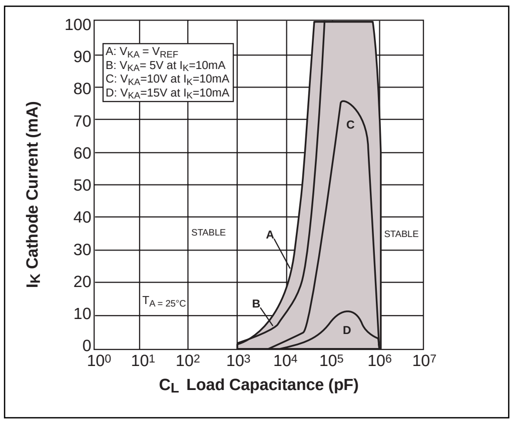


Figure 16. Stability Boundary Conditions

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

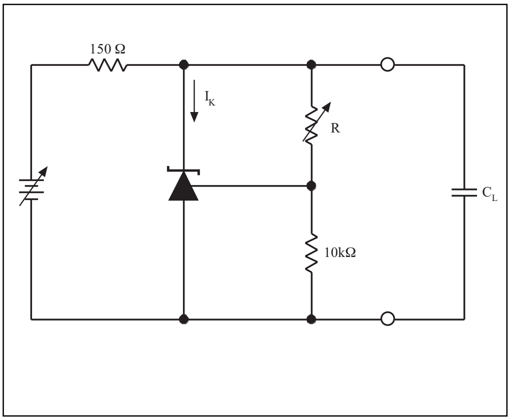


Figure 17. Test Circuit for Stability

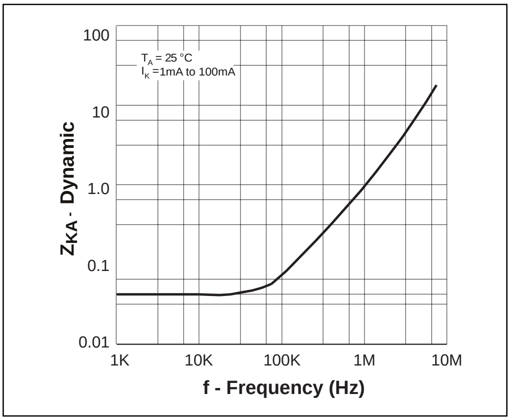


Figure 18. Dynamic Output Impedance T_A = 25°C, I_K = 1 to 100mA

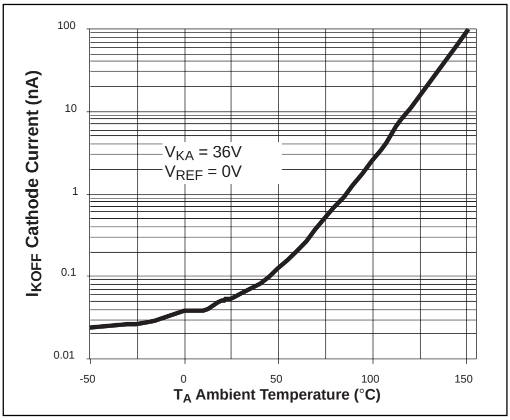


Figure 19. Off State Leakage

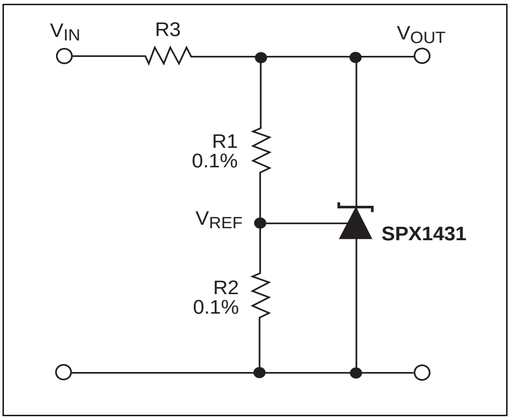


Figure 20. Shunt Regulator V_{OUT} = (1+R1/R2)V_{REF}

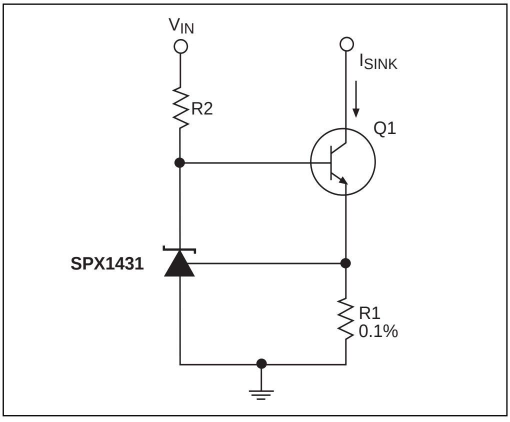


Figure 21. Constant Current, Sink, I_{SINK} = V_{REF}/R1

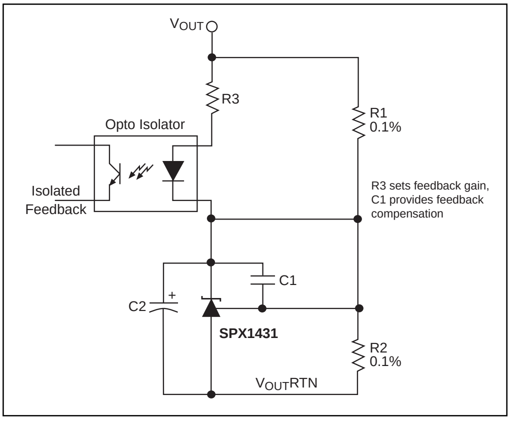


Figure 22. Reference Amplifier for Isolated Feedback in Off-Line DC-DC Converters

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

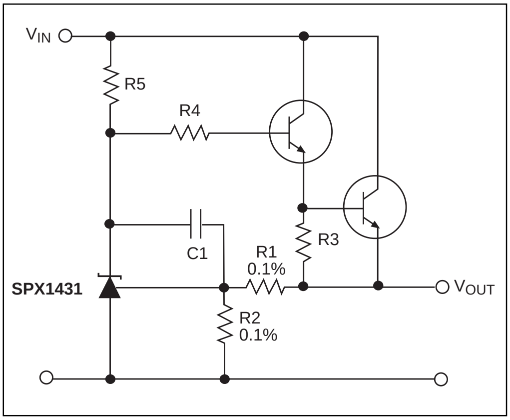


Figure 23. Precision High Current Series Regulator
$V_{OUT} = (1+R1/R2)V_{REF}$

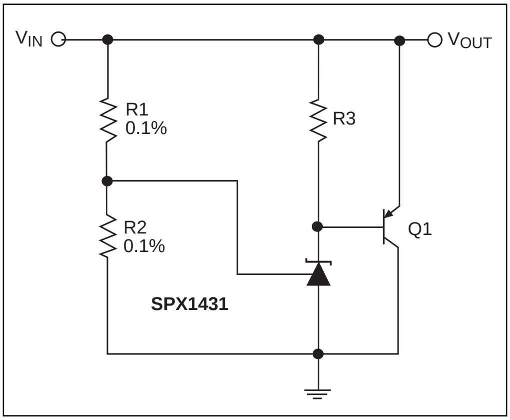


Figure 24. High Current Shunt Regulator
$V_{OUT} = (1+R1/R2)V_{REF}$

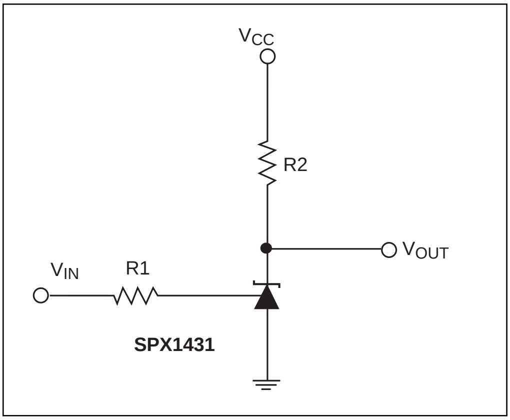
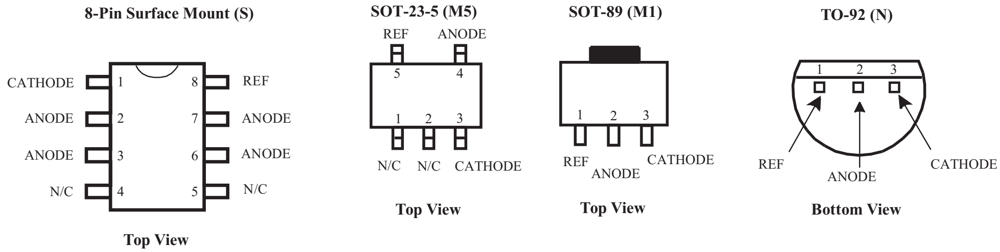


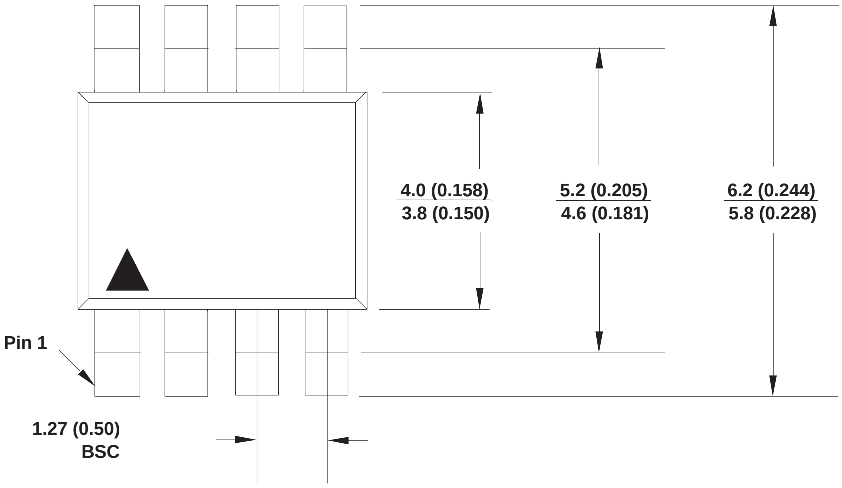
Figure 25. Single Supply Comparator with Temperature Compensated Threshold. ***V_{IN} threshold = 2.5V***

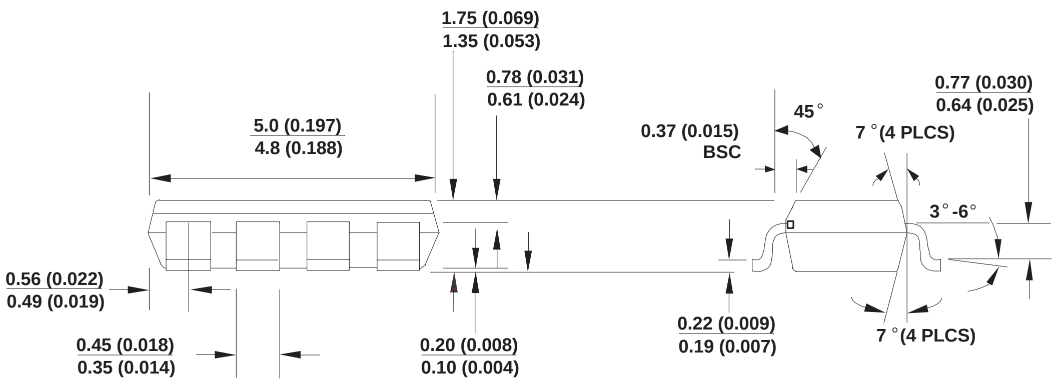
**** Resistor values are chosen such that the effect to I_{REF} is negligible.***

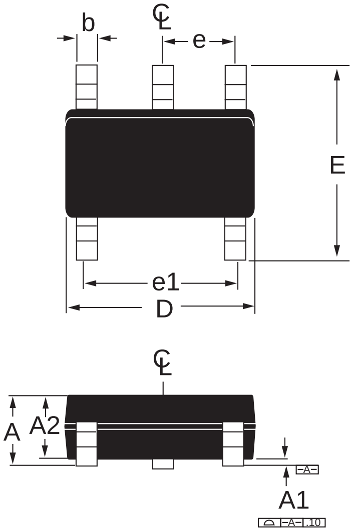
PACKAGES

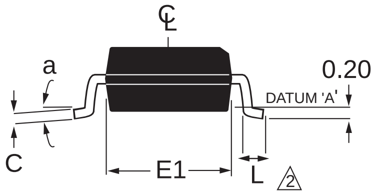


PACKAGE: 8 PIN PLASTIC SMALL OUTLINE (SOIC) (NARROW)



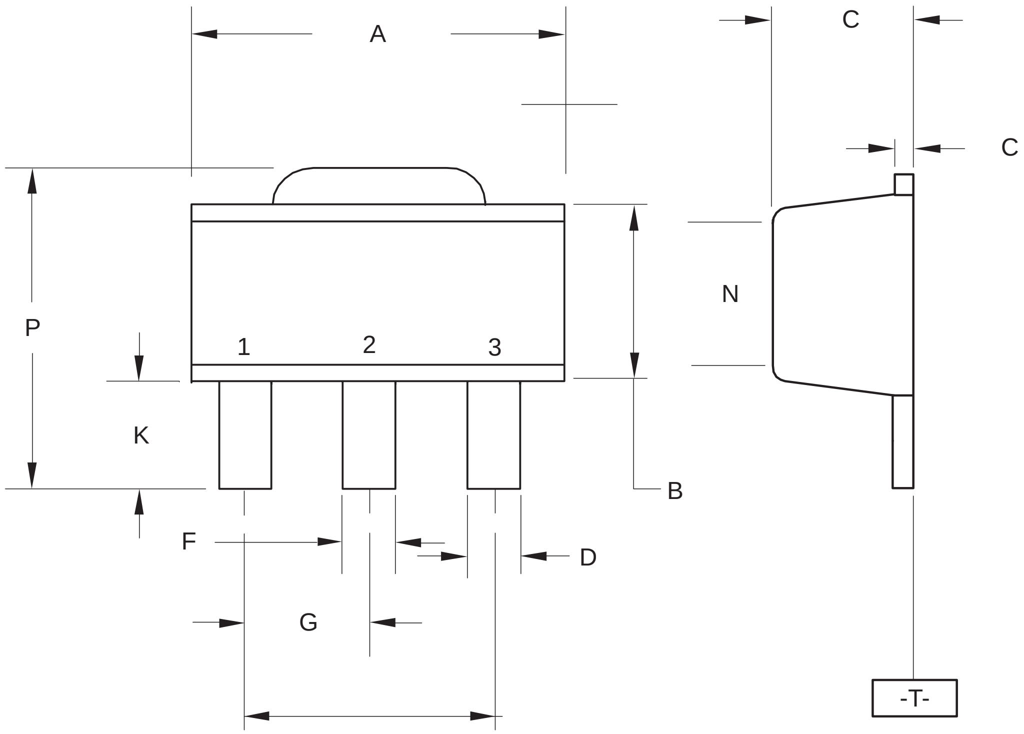






SYMBOL	MIN	MAX
A	**0.90**	**1.45**
A1	**0.00**	**0.15**
A2	**0.90**	**1.30**
b	**0.25**	**0.50**
C	**0.09**	**0.20**
D	**2.80**	**3.10**
E	**2.60**	**3.00**
E1	**1.50**	**1.75**
L	**0.35**	**0.55**
e	**0.95ref**	
e1	**1.90ref**	
a	**0°**	**10°**

PACKAGE: 3 Lead SOT-89



STYLE 1
PIN 1. BASE
2. COLLECTOR
3. EMITTER

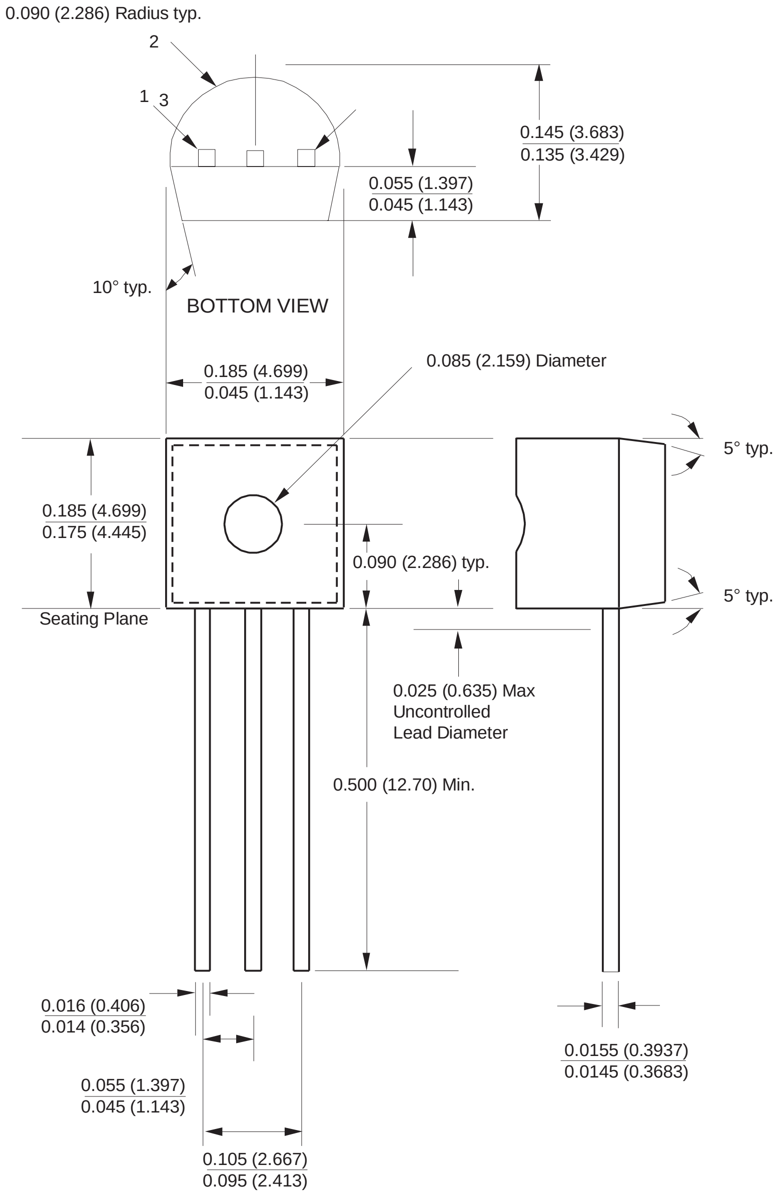
STYLE 2
PIN 1. ANODE
2. CATHODE
3. NO CONNECTION

STYLE 3
PIN 1. GATE
2. ANODE
3. CATHODE

STYLE 4
PIN 1. DRAIN
2. GATE
3. SOURCE

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.40	4.60	0.174	0.181
B	2.29	2.60	0.091	0.102
C	140	160	0.056	0.062
D	0.36	0.48	0.015	0.018
E	1.62	1.80	0.064	0.070
F	0.44	0.53	0.018	0.020
G	150 BSC		0.059 BSC	
J	0.35	0.44	0.014	0.017
K	0.80	1.04	0.032	0.040
L	300 BSC		0.118 BSC	
N	2.04	2.28	0.081	0.089
P	3.94	4.25	0.156	0.167

PACKAGE: TO-92



ORDERING INFORMATION

PART NUMBER	ACCURACY	OUTPUT VOLTAGE	PACKAGES
SPX1431M5	0.4%	2.5V	5-Pin SOT-23
SPX1431M1	0.4%	2.5V	3-Pin SOT-89
SPX1431S	0.4%	2.5V	8-Pin SOIC
SPX1431N	0.4%	2.5V	3-Pin TO-92

Sipex Corporation

SIGNAL PROCESSING EXCELLENCE

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