SPX2431

Precision Adjustable Shunt Regulator

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

APPLICATIONS
- Battery Operating Equipments
- Adjustable Supplies
- Switching Power Supplies
- Error Amplifiers
- Single Supply Amplifier
- Monitors / VCR / TV
- Personal Computers

PRODUCT 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.

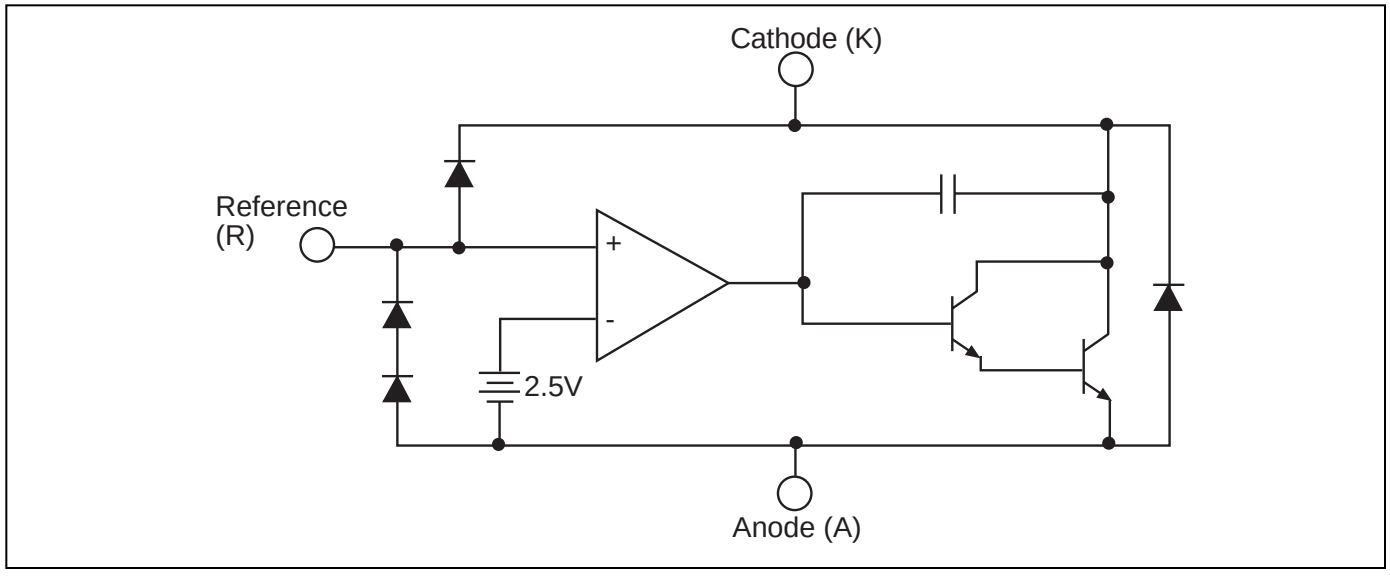


Figure 1. Block Diagram

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNITS
Cathode-Anode Reverse Breakdown	V_{KA}	20	V
Anode-Cathode Forward Current, (< 10ms)	I_{AK}	1	A
Operating Cathode Current	I_{KA}	100	mA
Reference Input Current	I_{REF}	1.0	mA
Continuous Power Dissipation at 25° C SOT-23	P_D	200	mW
Junction Temperature	T_J	150	°C
Storage Temperature	T_{STG}	- 65 to 150	°C
Lead Temperature (Soldering 10 sec.)	T_L	300	°C

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°C.

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

Parameter	Symbol	Test Conditions	Test Circuit	SPX2431A			SPX2431			Unit
				Min	Typ	Max	Min	Typ	Max	
Reference Voltage	V_{REF}		1	2.487	2.500	2.513	2.474	2.500	2.526	V
		T_J = 0°C to 105°C	1	2.480		2.520	2.460		2.540	V
ΔV_{REF} with Temp.*	TC		1		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
		10V to 20V	2	-2	-0.4	0.3	-2.0	-0.4	0.3	
Reference Input Current	I_{REF}		2		0.7	4		0.7	4	µA
I_{REF} Temp Deviation	ΔI_{REF}	T_J = 0°C to 105°C	2		0.4	1.2		0.4	1.2	µA
Min I_K for Regulation	$I_{K(MIN)}$		1		0.4	1		0.4	1	mA
Off State Leakage	$I_{K(OFF)}$	V_{REF} = 0V, V_{KA} = 20V	3		0.04			0.04	500	nA
Dynamic Output Impedance	Z_{KA}	f_Z = 1kHz, I_K = 1 to 100mA	1		0.15	0.5		0.15	0.5	Ω

Operating Temperature Range (T_J) = -40°C to 125°C
see appropriate test circuit (Figure 3)

*CALCULATING AVERAGE TEMPERATURE COEFFICIENT (TC)

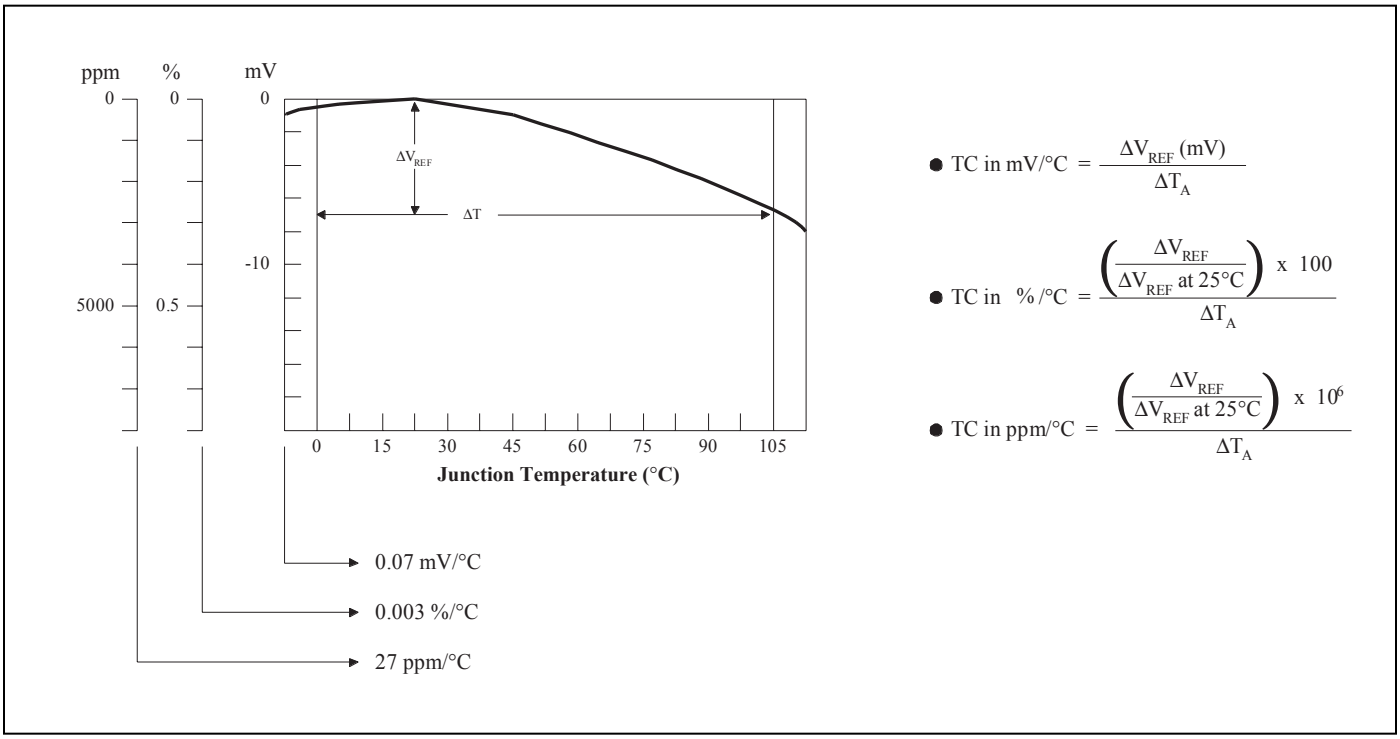


Figure 2. V_{REF} vs. Temperature

TEST CIRCUITS

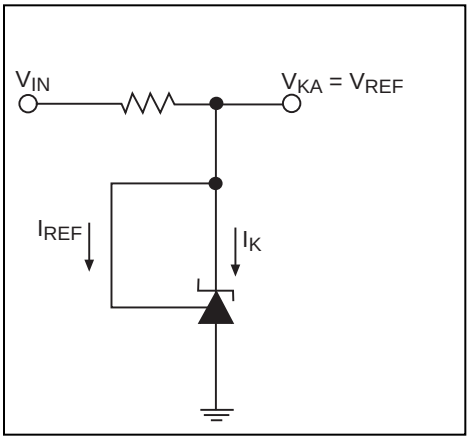


Figure 3a. Test Circuit for $V_{KA} = V_{REF}$

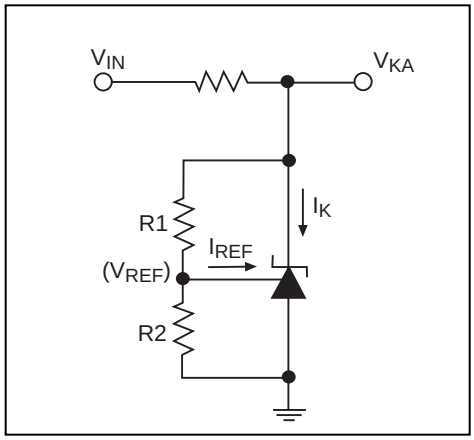


Figure 3b. Test Circuit for $V_{KA} > V_{REF}$

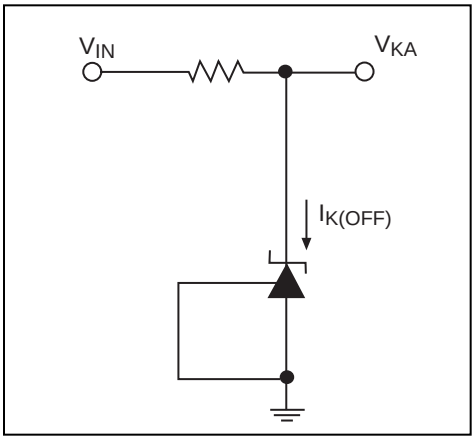


Figure 3c. Test Circuit for I_{KOFF}

TYPICAL PERFORMANCE CHARACTERISTICS

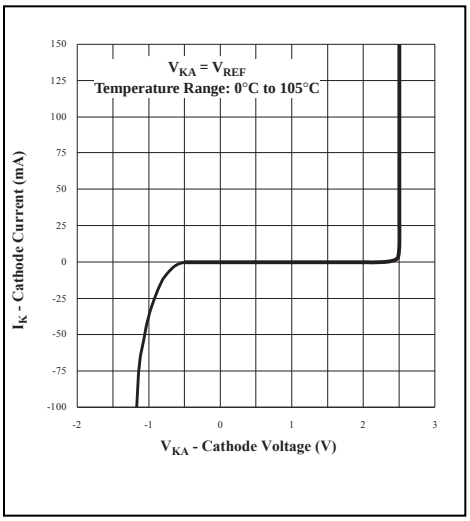


Figure 4. High Current Operating Characteristics

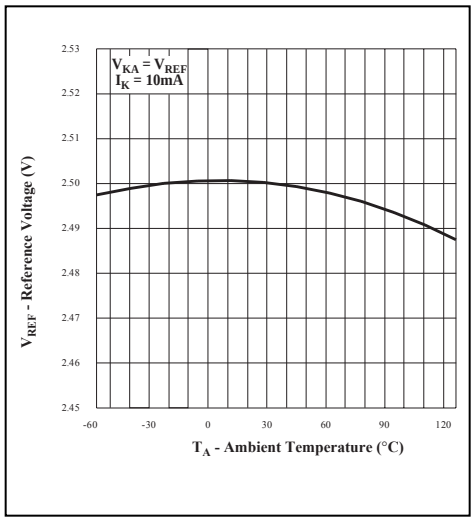


Figure 5. Reference Voltage vs. Ambient Temperature

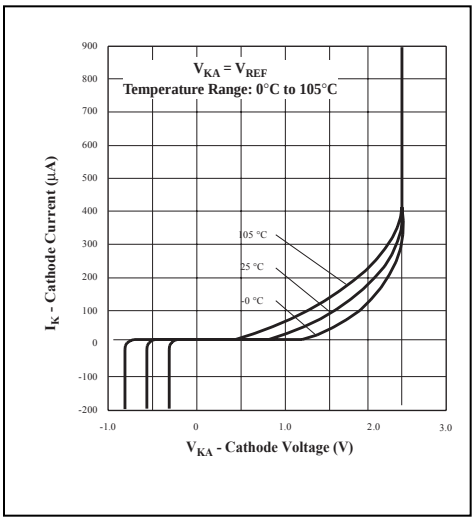


Figure 6. Low Current Operating Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS

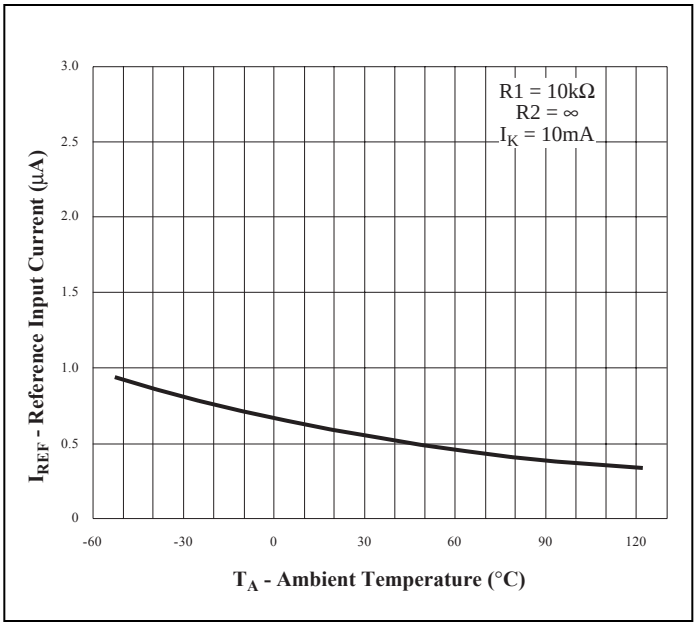


Figure 7. Reference Input Current vs. Ambient Temperature

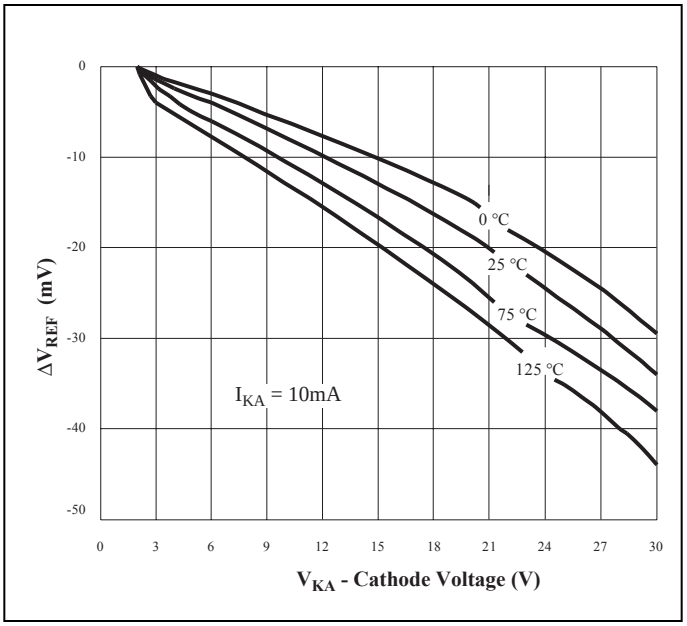


Figure 8. Reference Voltage Line Regulation vs. Cathode Voltage and $T_{AMBIENT}$

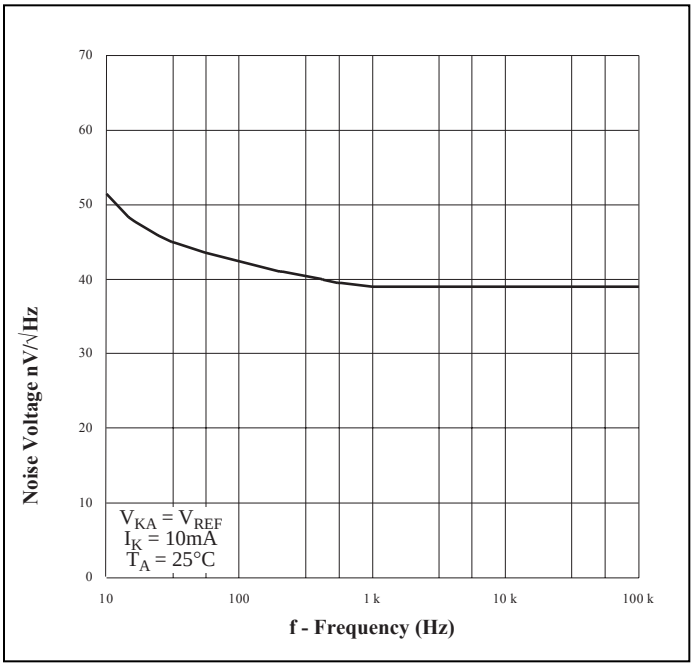


Figure 9. Noise Voltage vs. Frequency

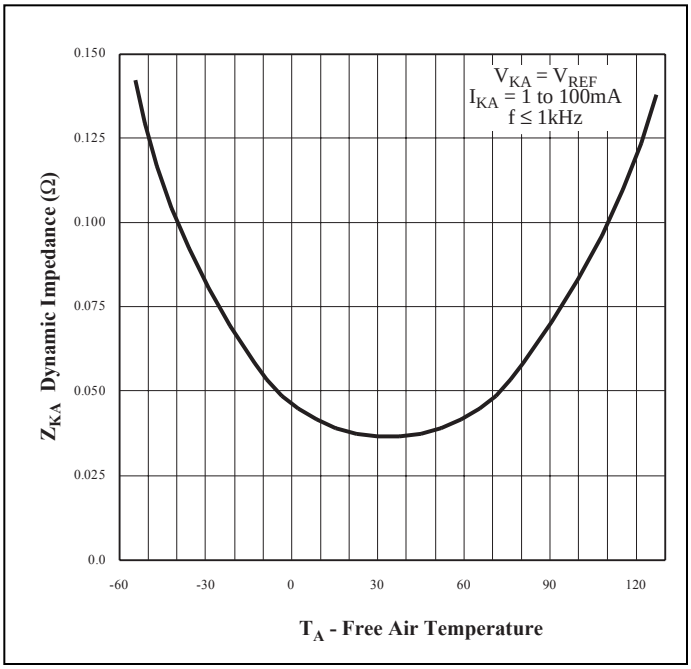


Figure 10. Low Frequency Dynamic Output Impedance vs. $T_{AMBIENT}$

TYPICAL PERFORMANCE CHARACTERISTICS

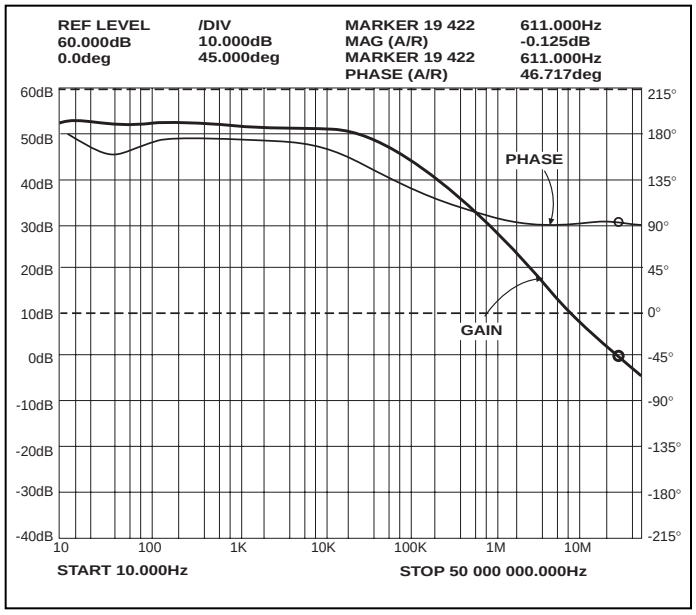


Figure 11a. Small Signal Gain and Phase vs. Frequency; T_A = 25°C

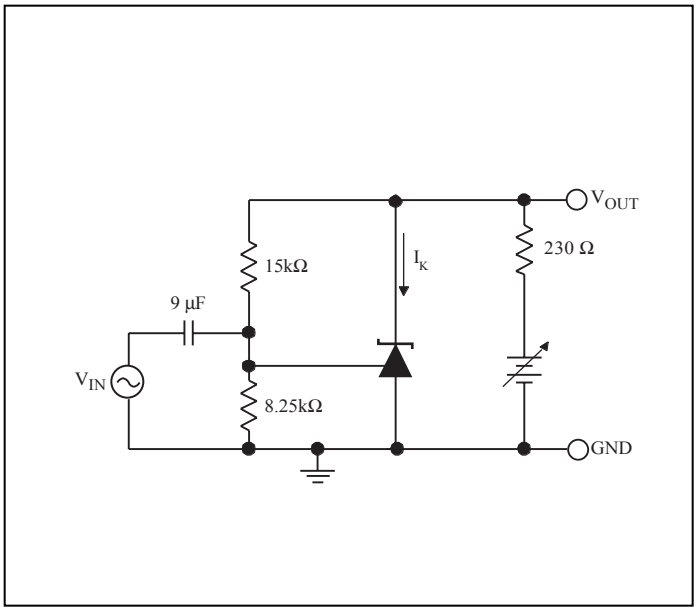


Figure 11b. Test Circuit for Gain and Phase Frequency Response

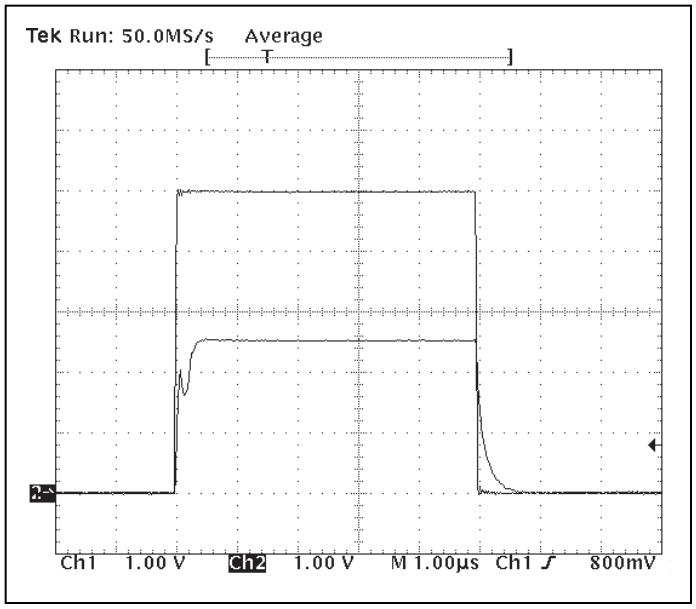


Figure 12a. Frequency = 100kHz, I_K = 10mA, T_A = 25°C

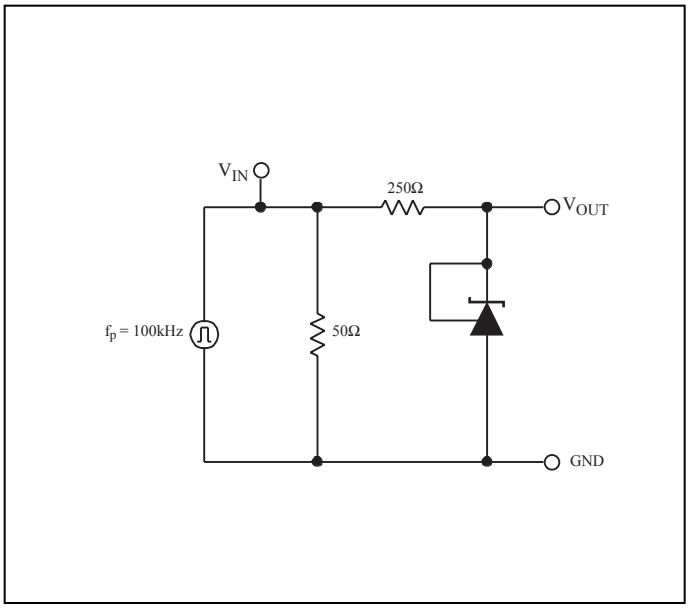


Figure 12b. Test Circuit for Pulse Response

TYPICAL PERFORMANCE CHARACTERISTICS

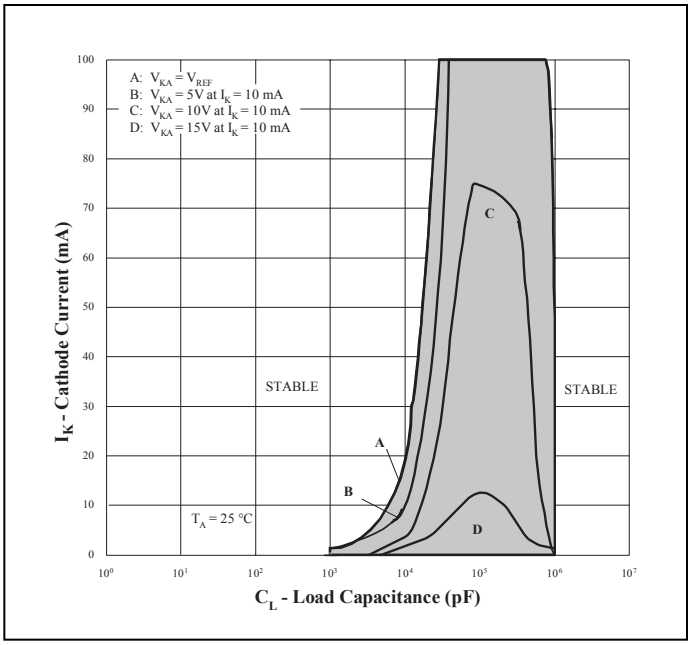


Figure 13a. Stability Boundary Conditions

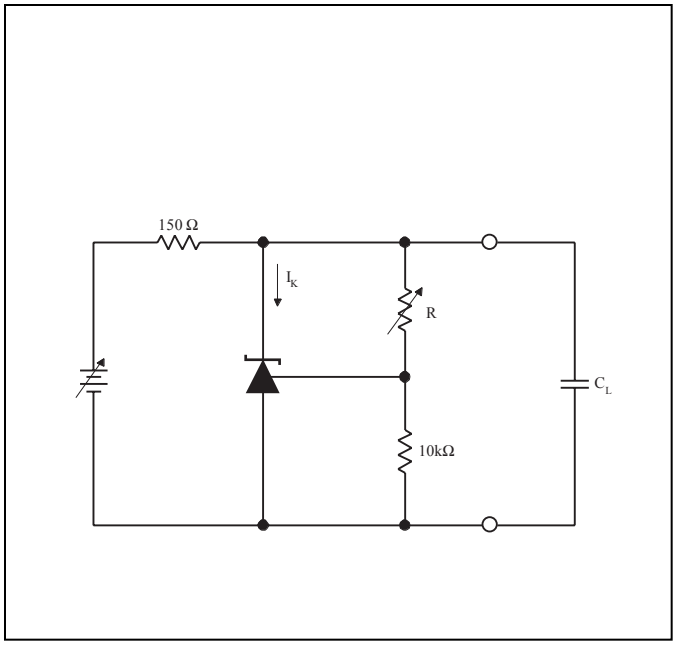


Figure 13b. Test Circuit for Stability

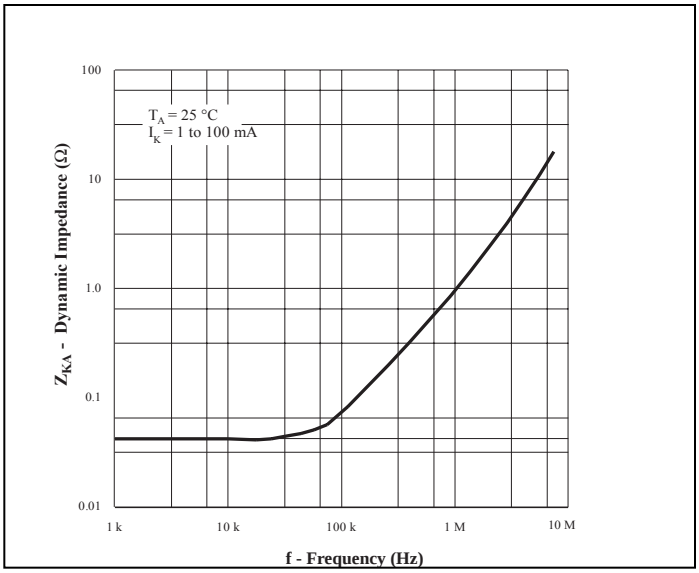


Figure 14. Dynamic Output Impedance T_A = 25°C, I_K = 1 to 100mA

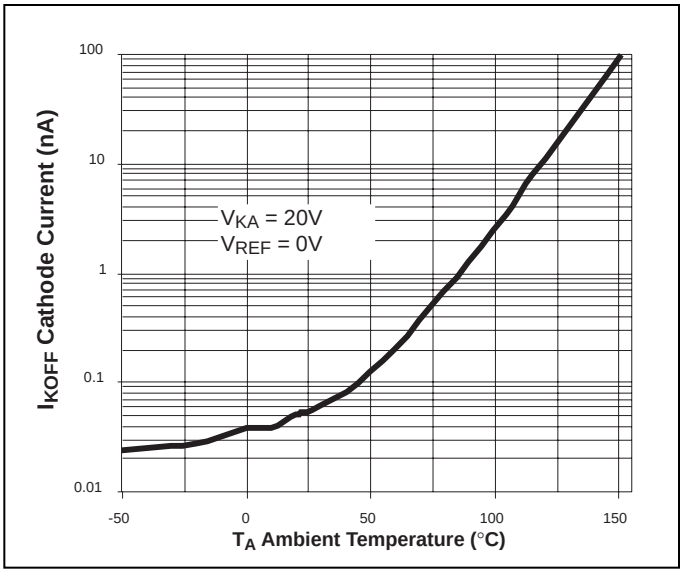


Figure 15. Off State Leakage

APPLICATION CIRCUITS

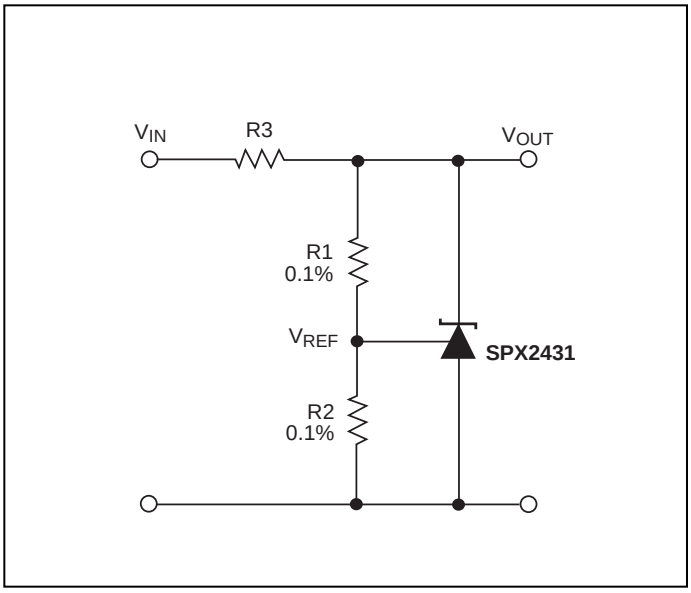


Figure 16. Shunt Regulator $V_{OUT} = (1 + R1/R2)V_{REF}$

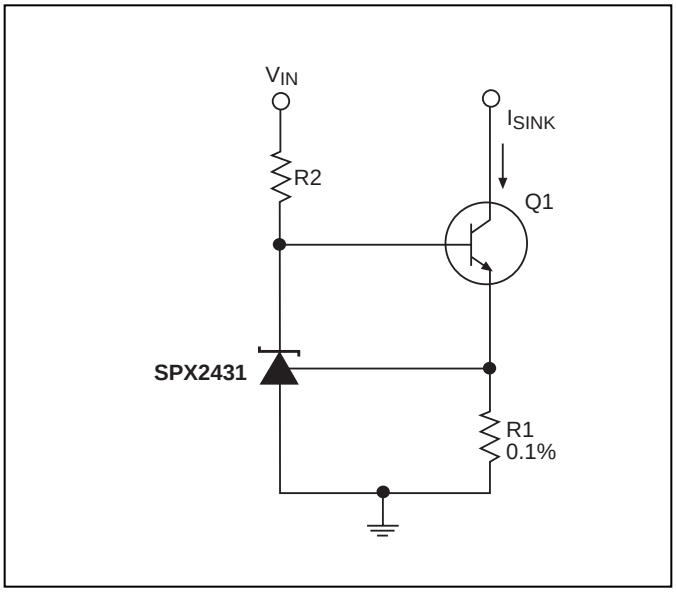


Figure 17. Constant Current, Sink, $I_{SINK} = V_{REF}/R1$

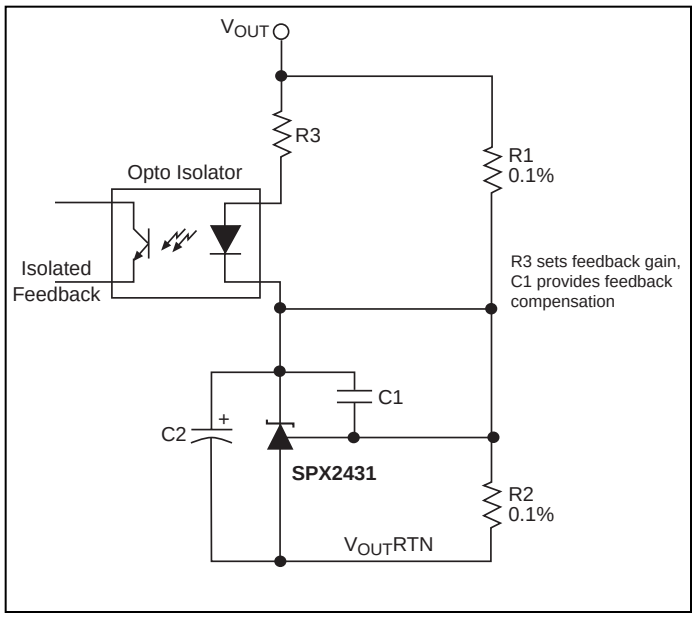


Figure 18. Reference Amplifier for Isolated Feedback in Off-Line DC-DC Converters

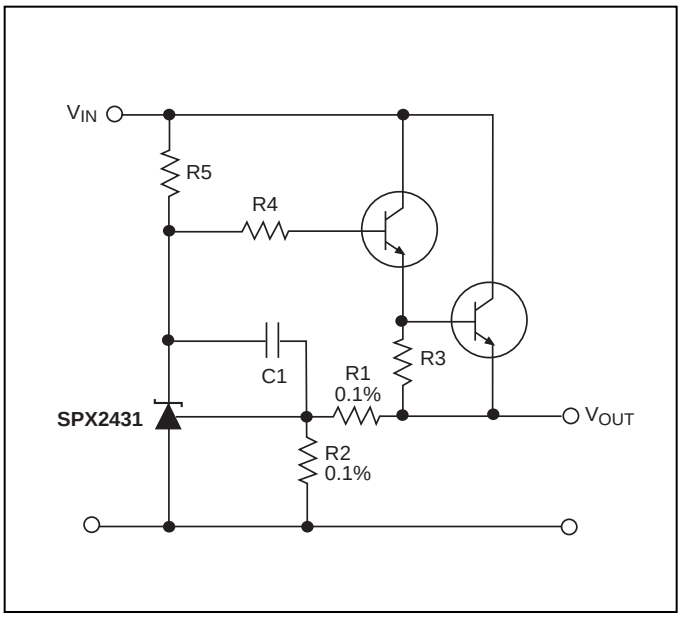


Figure 19. Precision High Current Series Regulator $V_{OUT} = (1 + R1/R2)V_{REF}$

APPLICATION CIRCUITS

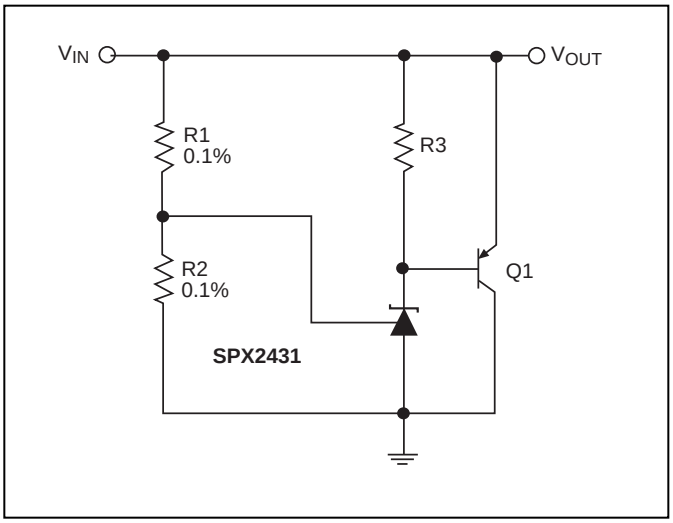


Figure 20. High Current Shunt Regulator
$V_{OUT} = (1 + R1/R2)V_{REF}$

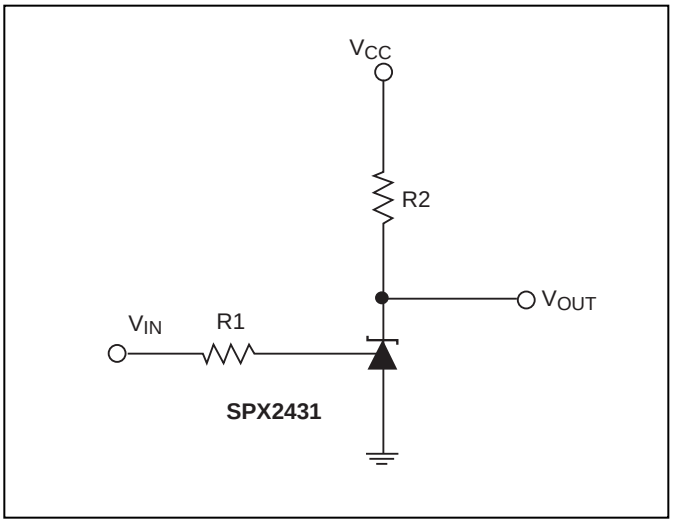
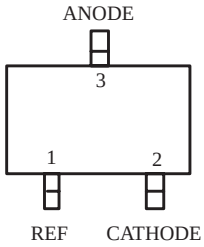


Figure 21. Single Supply Comparator with Temperature Compensated Threshold. V_{IN} threshold = 2.5V

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

PACKAGE

SOT-23-3 (M)



Top View

ORDERING INFORMATION

Ordering No.	Accuracy	Output Voltage	Package
SPX2431AM	0.5%	2.500V	3-Pin SOT-23
SPX2431M	1.0%	2.500V	3-Pin SOT-23

SIGNAL PROCESSING EXCELLENCE

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