

## Precision Adjustable Shunt Regulator

### FEATURES

- Trimmed Bandgap to **0.5%**
- Wide Operating Current.....**1mA to 150mA**
- Extended Temperature Range.....**0°C to 105°C**
- Low Temperature Coefficient .....**30 ppm/°C**
- Offered in **TO-92, SOIC, SOT-89, SOT-23-5**
- **Improved** Replacement in Performance for TL431
- **Low Cost Solution**

### APPLICATIONS

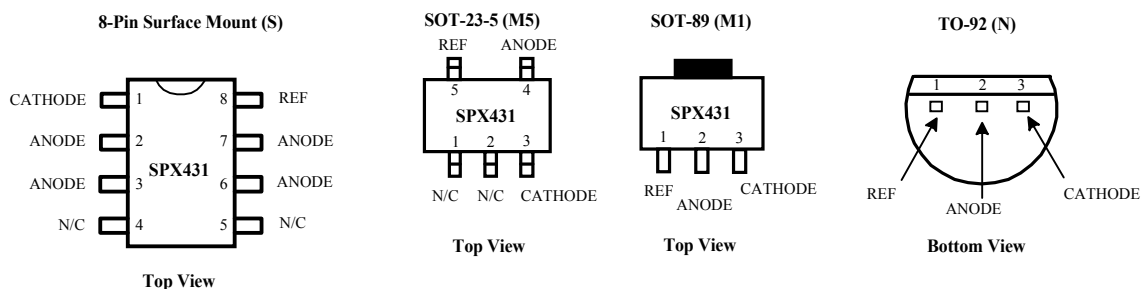
- Battery Operating Equipments
- Adjustable Supplies
- Switching Power Supplies
- Error Amplifiers
- Single Supply Amplifier
- Monitors / VCR / TV
- Personal Computers

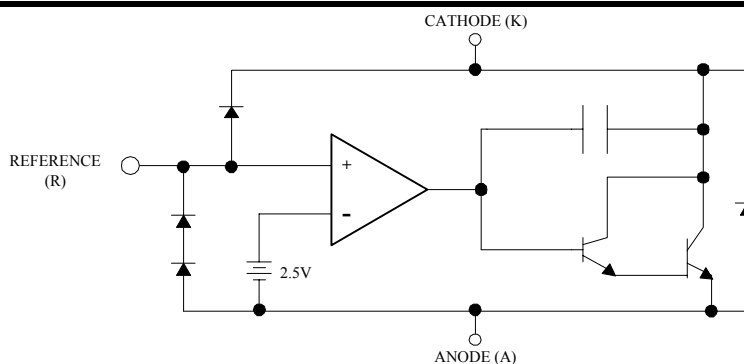
### PRODUCT DESCRIPTION

The SPX431 is a 3-terminal adjustable shunt voltage regulator providing a highly accurate 0.5% bandgap reference. SPX431 acts as an open-loop error amplifier with a 2.5V temperature compensation reference. The SPX431 thermal stability, wide operating current (150mA) and temperature range (0°C to 105°C) makes it suitable for all variety of application that are looking for a low cost solution with high performance. **SPX431 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 manufactures assembly line and contribute a significant cost savings.**

The output voltage may be adjusted to any value between  $V_{REF}$  and 36 volts with two external resistors. The SPX431 is operating an extended temperature range of 0°C to 105°C. The SPX431 is available in TO-92, SO-8, SOT-89, and SOT-23-5 packages.

### PIN CONFIGURATIONS





## ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNITS
Cathode-Anode Reverse Breakdown	$V_{KA}$	37	V
Anode-Cathode Forward Current	$I_{AK}$	1	A
Operating Cathode Current	$I_{KA}$	150	mA
Reference Input Current	$I_{REF}$	10	mA
Continuous Power Dissipation at 25° C	$P_D$		
TO-92		775	mW
SOT-23		200	mW
8L SOIC		750	mW
SOT-89		1000	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

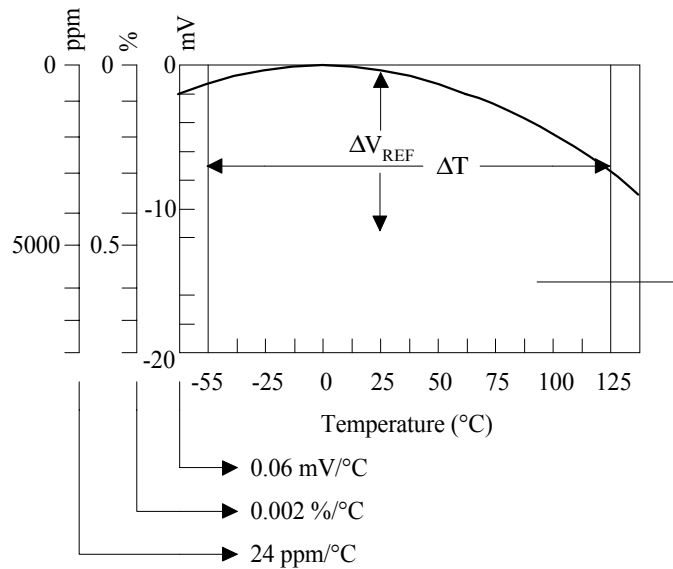
PACKAGE	$\theta_{JA}$	$\theta_{JC}$	TYPICAL DERATING
TO-92	160 °C/W	80 °C/W	6.3 mW/°C
SOT-23	575 °C/W	150 °C/W	1.7 mW/°C
SOIC	175 °C/W	45 °C/W	5.7 mW/°C
SOT-89	110 °C/W	8 °C/W	9.1 mW/°C

## ELECTRICAL CHARACTERISTICS at 25°C I<sub>K</sub> @ 10mA V<sub>K</sub> = V<sub>REF</sub>, unless otherwise specified.

Parameter	Symbol	Test Conditions	Test Circuit	SPX431			Unit
				Min	Typ	Max	
Reference Voltage	V <sub>REF</sub>	T <sub>A</sub> = 25°C Over Temp.	1	2.490	2.503	2.515	V
				2.469		2.536	V
ΔV <sub>REF</sub> with Temp.*	TC		1		0.07	0.20	mV/°C
Ratio of Change in V <sub>REF</sub> to Cathode Voltage	$\frac{\Delta V_{REF}}{\Delta V_K}$	V <sub>REF</sub> to 10V 10V to 36V	2	-2.7 -2	-1.0 -0.4	0.3	mV/V
Reference Input Current	I <sub>REF</sub>		2		0.7	4	μA
I <sub>REF</sub> Temp Deviation	ΔI <sub>REF</sub>	Over Temp.	2		0.4	1.2	μA
Min I <sub>K</sub> for Regulation	I <sub>K(MIN)</sub>		1		0.4	1	mA
Off State Leakage	I <sub>K(OFF)</sub>	V <sub>REF</sub> = 0V, V <sub>KA</sub> = 36V	3		0.04	250	nA
Dynamic Output Impedance	Z <sub>KA</sub>		1		0.15	0.5	Ω

TC = Test Circuit

### Calculating Average Temperature Coefficient (TC)



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

### TEST CIRCUITS

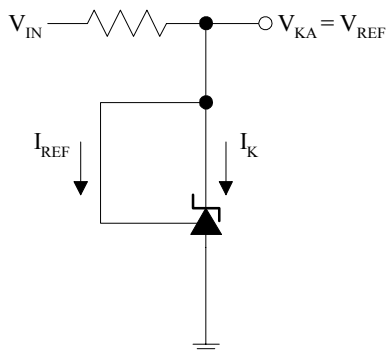


Figure 1a. Test Circuit 1

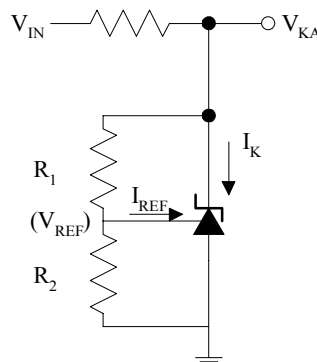


Figure 1b. Test Circuit 2

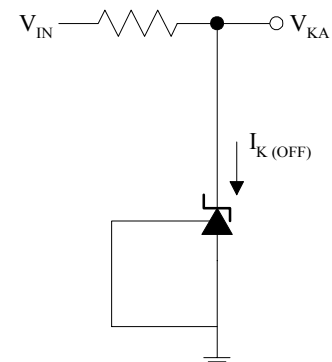


Figure 1c. Test Circuit 3

TYPICAL PERFORMANCE CURVES

Low Current Operating Characteristics

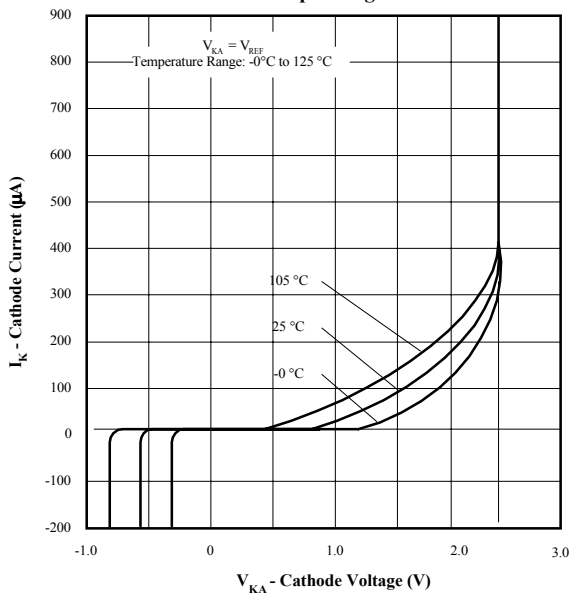


Figure 2

High Current Operating Characteristics

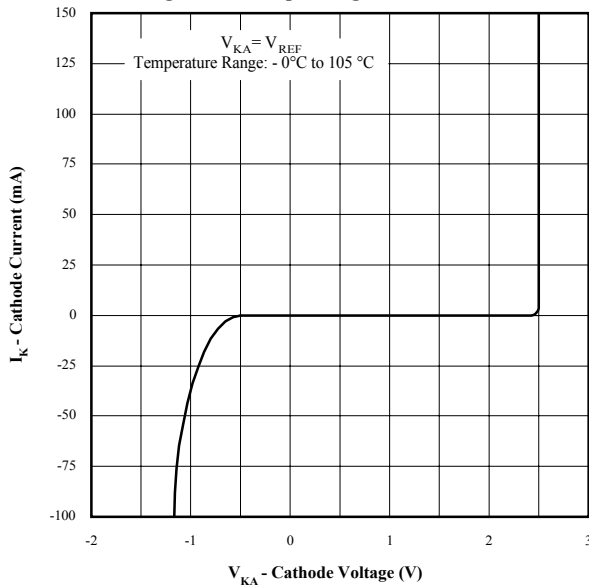


Figure 3

Off State Leakage

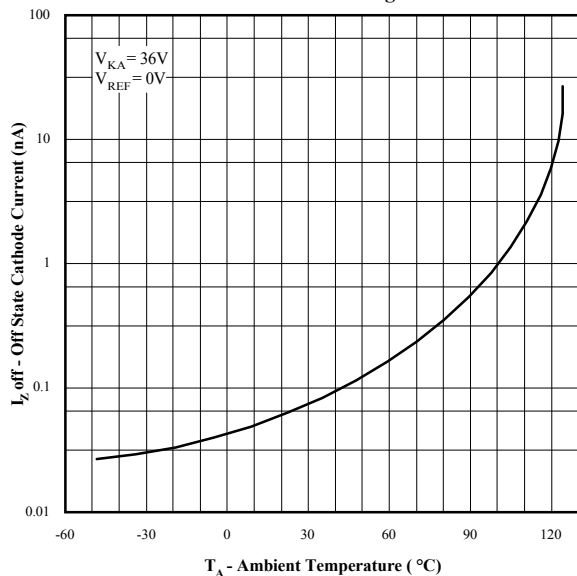


Figure 4

Reference Voltage vs. Ambient Temperature

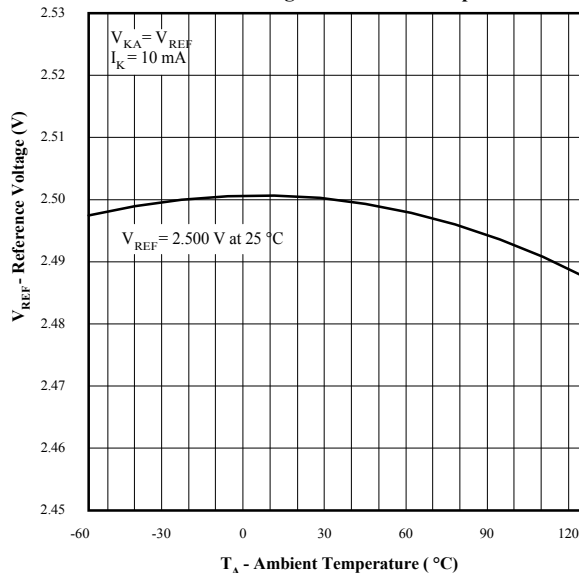


Figure 5

TYPICAL PERFORMANCE CURVES

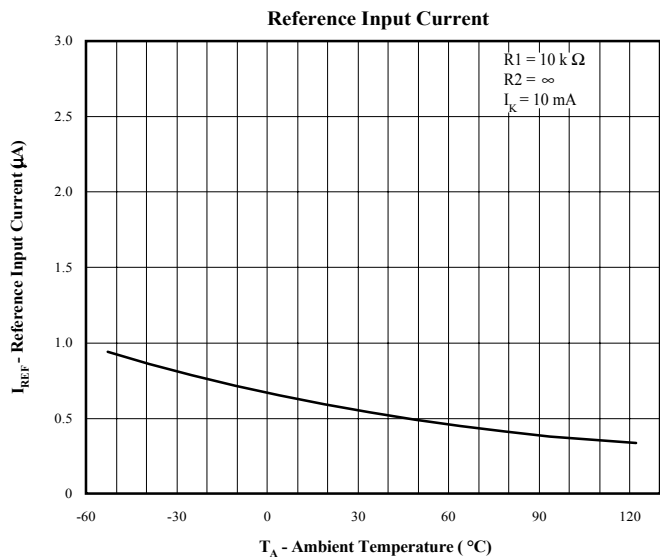


Figure 6

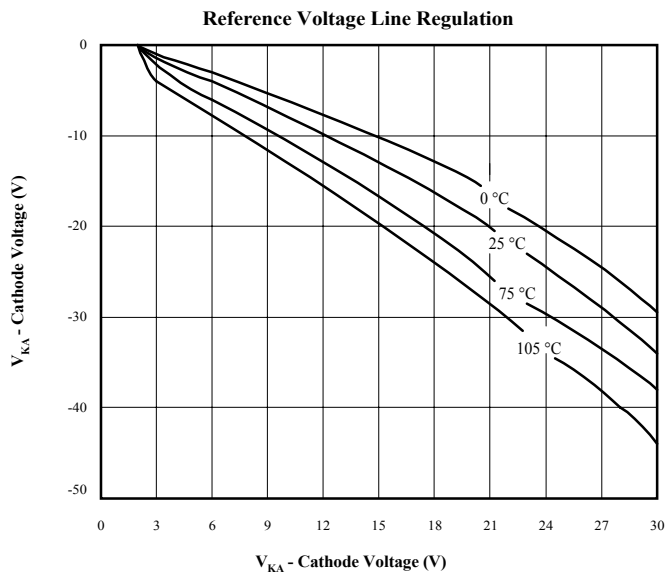


Figure 7

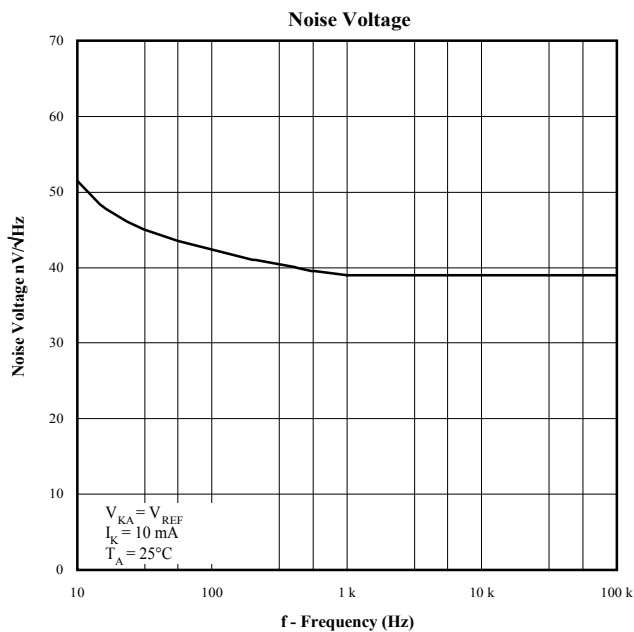


Figure 8

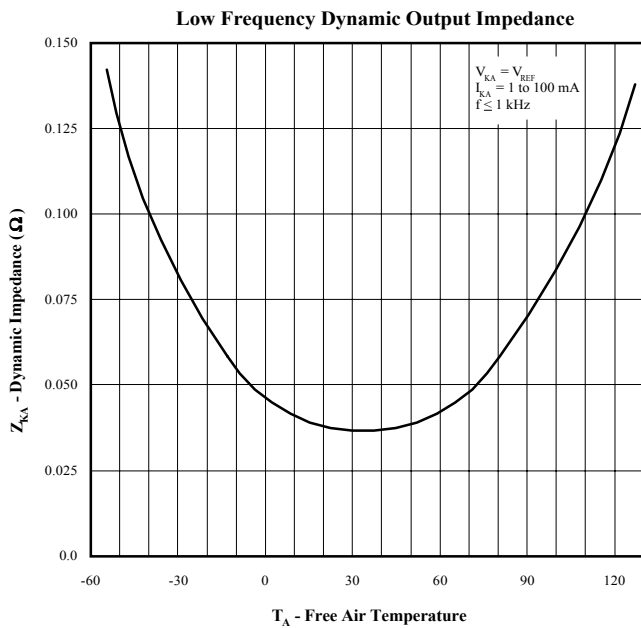
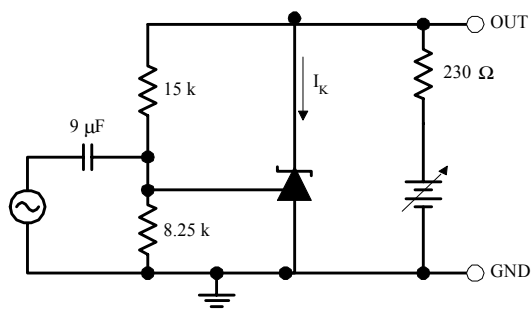
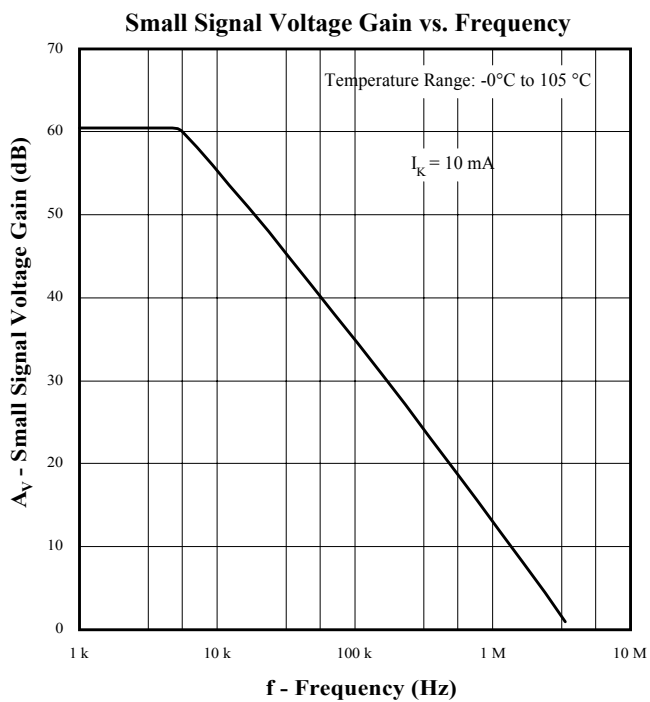
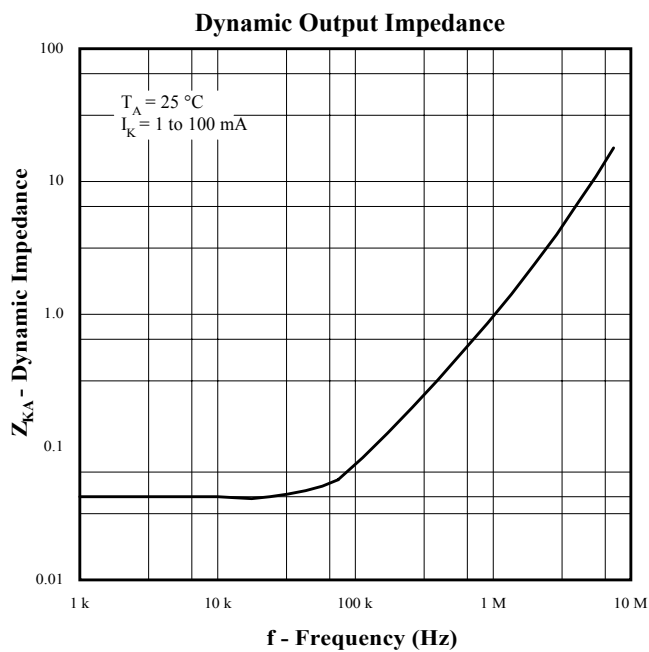


Figure 9

TYPICAL PERFORMANCE CURVES



TYPICAL PERFORMANCE CURVES

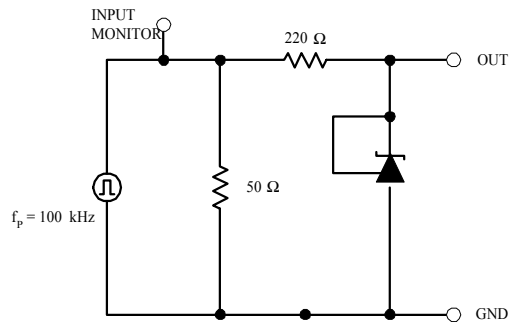
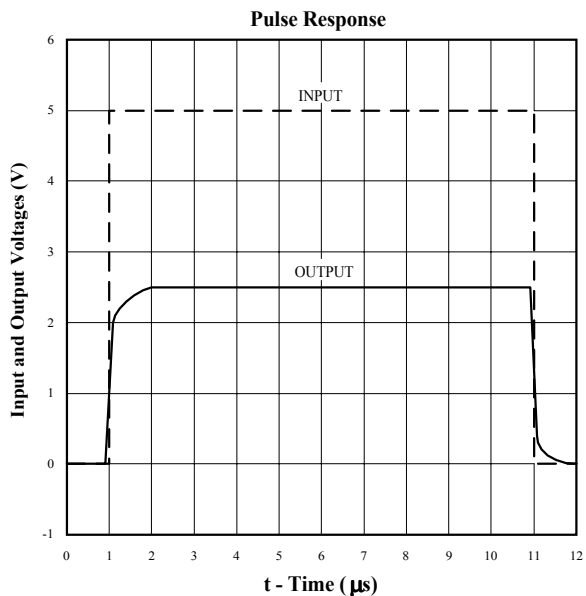


Figure 12

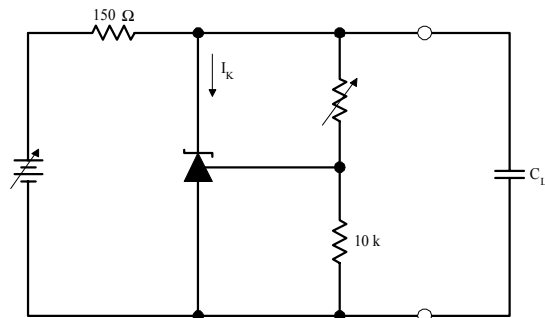
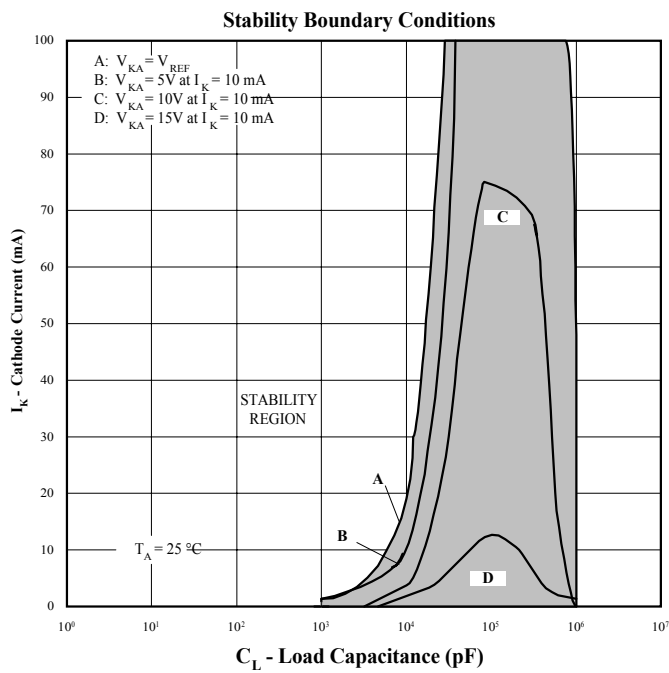


Figure 13

## ORDERING INFORMATION

Ordering No.	Precision	Output Accuracy	Packages
SPX431M5	0.5%	2.5V	5 Lead SOT-23
SPX431M1	0.5%	2.5V	5 Lead SOT-89
SPX431S	0.5%	2.5V	8 Lead SOIC
SPX431N	0.5%	2.5V	3 Lead TO-92



SIGNAL PROCESSING EXCELLENCE

### Sipex Corporation

**Headquarters and Main Offices:**

22 Linnell Circle  
Billerica, MA 01821  
TEL: (978) 667-8700  
FAX: (978) 670-9001  
e-mail: sales@sipex.com

233 South Hillview Drive  
Milpitas, CA 95035  
TEL: (408) 935-7600  
FAX: (408) 934-7500

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