



# SPX431C

## Precision Adjustable Shunt Regulator

### FEATURES

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

### APPLICATIONS

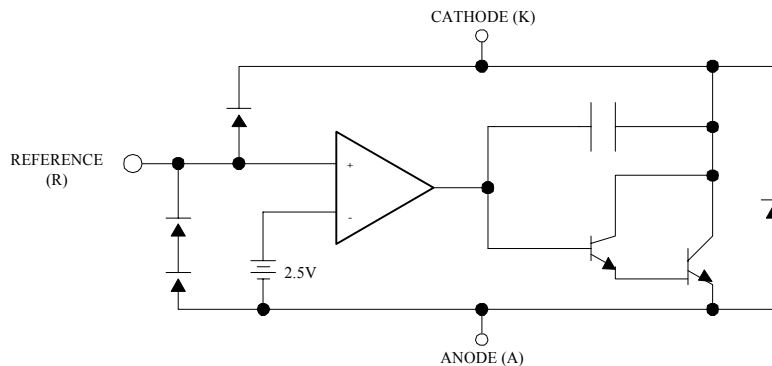
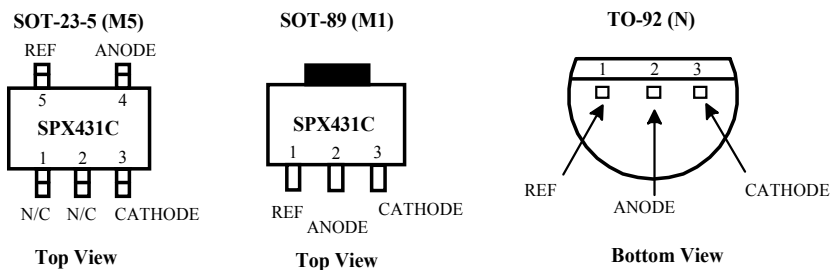
- Battery Operating Equipments
- Adjustable Supplies
- Switching Power Supplies
- Error Amplifiers
- Single Supply Amplifier
- Monitors / VCR / TV
- Personal Computers

### PRODUCT DESCRIPTION

The SPX431C is a 3-Terminal Adjustable Shunt Voltage Regulator providing a highly accurate bandgap reference. SPX431C acts as an open-loop error amplifier with a 2.5V temperature compensation reference. The SPX431C thermal stability, wide operating current (150mA) and temperature range (105°C) makes it suitable for all variety of applications that are looking for a low cost solution with high performance.

The output voltage may be adjusted to any value between  $V_{REF}$  and 36V with 2 external resistors. The SPX431C is operating in full industrial temperature range of 0°C to 105°C. The SPX431C is available in TO-92, SOT-23-5 and SOT-89 packages.

### PIN CONFIGURATION



## 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
SOT-89		1000	mW
Junction Temperature	$T_J$	150	°C
Storage Temperature	$T_{STG}$	- 65 to +150	°C
Lead Temperature (Soldering 10 sec.)	$T_L$	30	°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 RESISTANCE

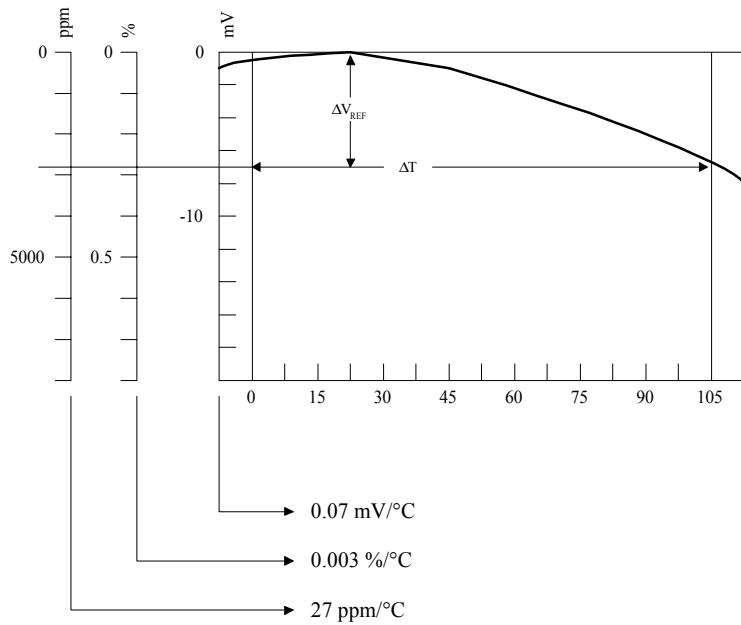
Package Type	$\theta_{JA}$	$\theta_{JC}$	Typical Derating
TO-92	160°C/W	80°C/W	6.3 mW/°C
SOT-23	575°C/W	150°C/W	1.7 mW/°C
SOT-89	110°C/W	8°C/W	9.1 mW/°C

## ELECTRICAL CHARACTERISTICS at 25°C $I_K$ @ 10mA $V_K = V_{ref}$ , unless otherwise specified.

Parameter	Symbol	Test Conditions	SPX431C			Unit
			Min	Typ	Max	
Reference Voltage	$V_{REF}$	$T_A = 25^\circ\text{C}$ TC = 1	2.445	2.495	2.545	V
Ratio of Change in $V_{REF}$ to Cathode Voltage	$\frac{\Delta V_{REF}}{\Delta V_K}$	$V_{REF}$ to 10V	-2.7	-1.0		mV/V
		10V to 36V TC = 2	-2	-0.4	0.3	
Reference Input Current	$I_{REF}$	TC = 2		0.7	4	$\mu\text{A}$
$I_{REF}$ Temp Deviation	$\Delta I_{REF}$	Over Temp. TC = 2		0.4	1.2	$\mu\text{A}$
Min $I_K$ for Regulation	$I_{K(MIN)}$	TC = 1		0.4	1	mA
Off State Leakage	$I_{K(OFF)}$	$V_{REF} = 0\text{V}$ , $V_{KA} = 36\text{V}$ TC=3		0.04	1	$\mu\text{A}$
Dynamic Output Impedance	$Z_{KA}$	TC = 1		0.15	0.5	$\Omega$

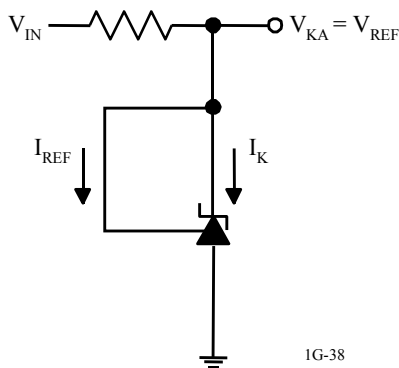
TC = Test Circuit

## \*CALCULATING AVERAGE TEMPERATURE COEFFICIENT (TC)

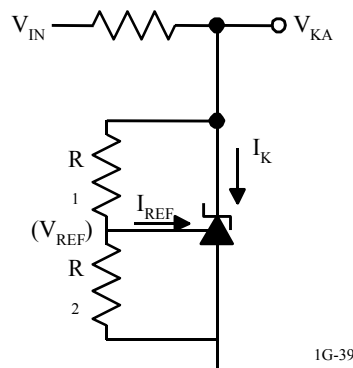


- TC in mV/°C =  $\frac{\Delta V_{REF} \text{ (mV)}}{\Delta T_A}$
- TC in mV/°C =  $\frac{\left(\frac{\Delta V_{REF}}{\Delta V_{REF} \text{ at } 25^\circ\text{C}}\right) \times 100}{\Delta T_A}$
- TC in ppm/°C =  $\frac{\left(\frac{\Delta V_{REF}}{\Delta V_{REF} \text{ at } 25^\circ\text{C}}\right) \times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

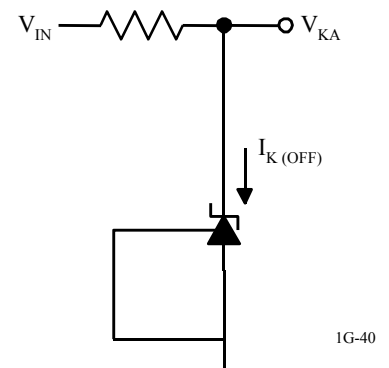
## TEST CIRCUITS



**TEST CIRCUIT**  
For  $V_{KA} = V_{REF}$



**TEST CIRCUIT**  
For  $V_{KA} > V_{REF}$



**TEST CIRCUIT**  
For  $I_{ROFF}$

TYPICAL PERFORMANCE CURVES

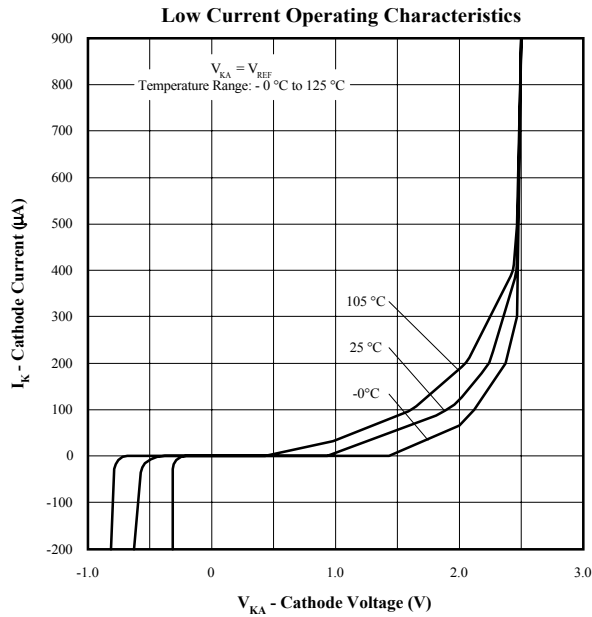


Figure 2

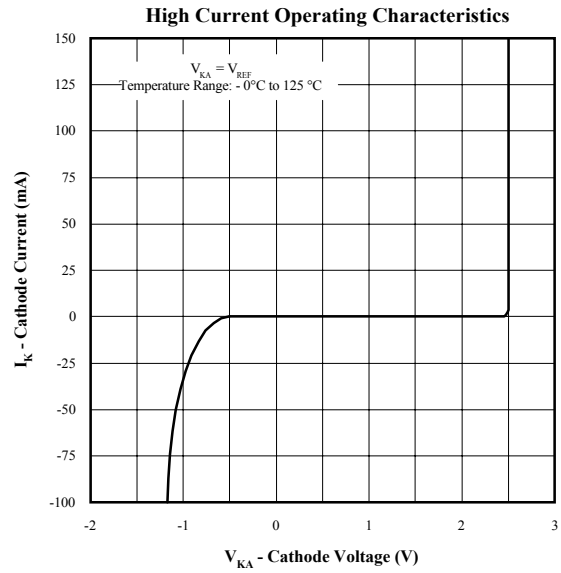


Figure 3

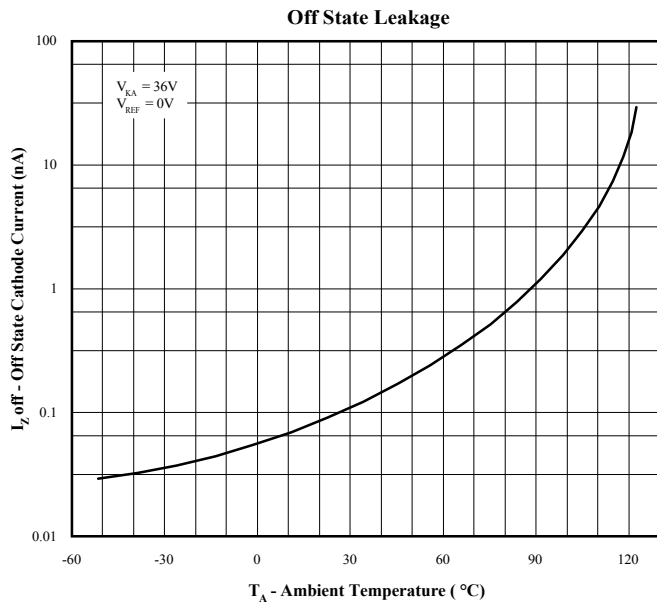


Figure 4

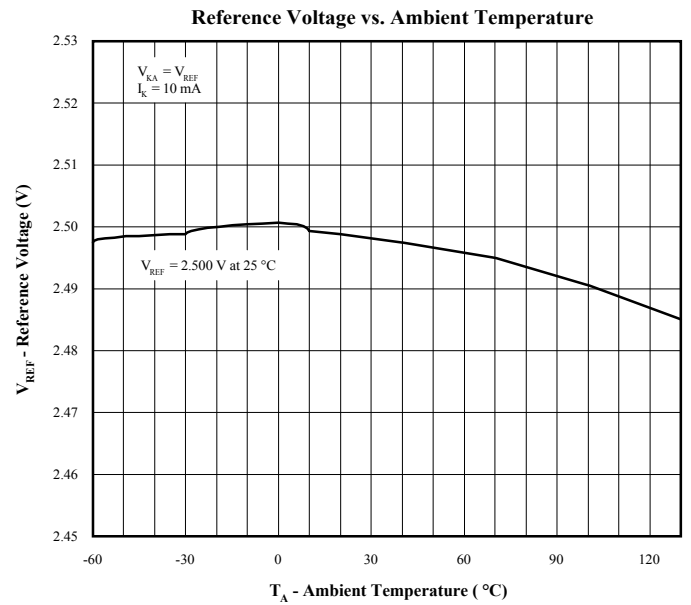


Figure 5

TYPICAL PERFORMANCE CURVES

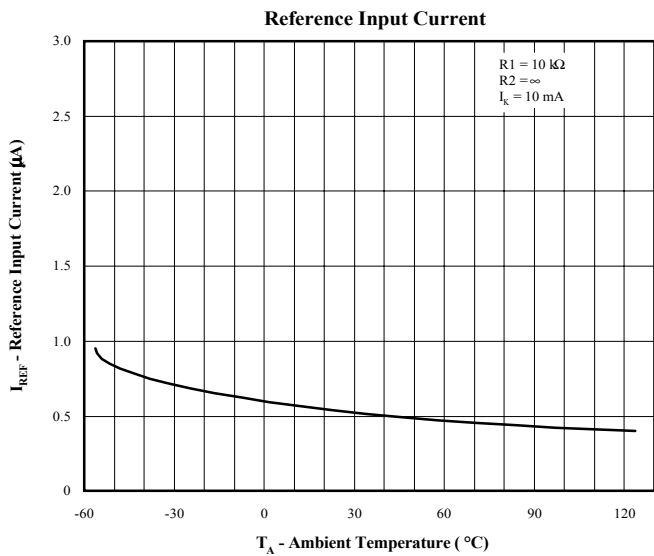


Figure 6

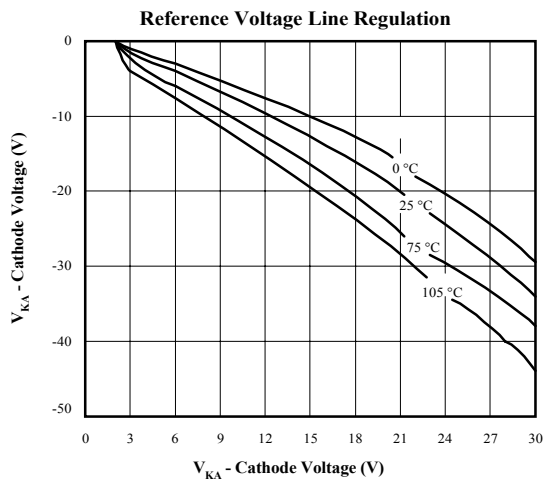


Figure 7

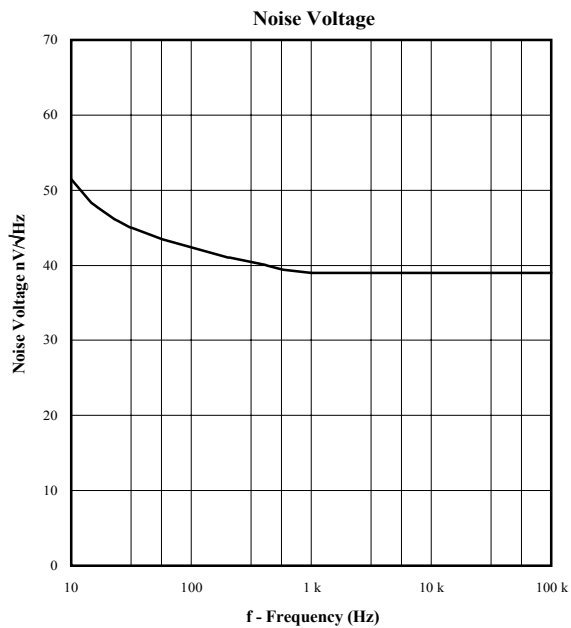


Figure 8

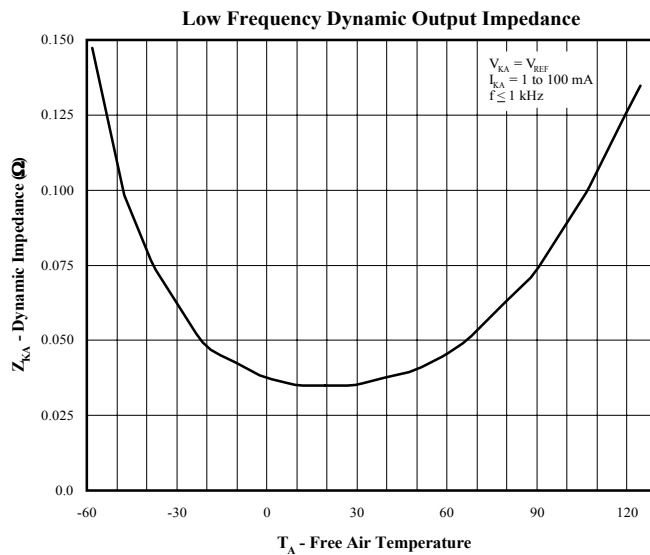


Figure 9

TYPICAL PERFORMANCE CURVES

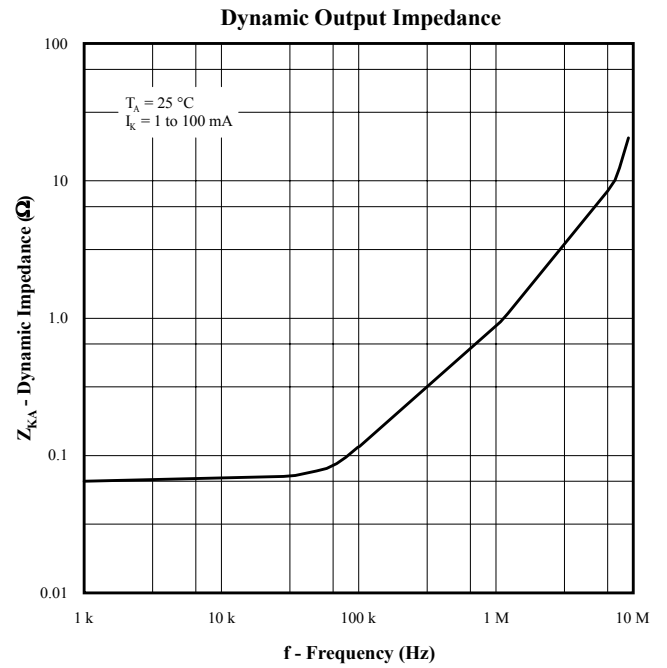


Figure 10

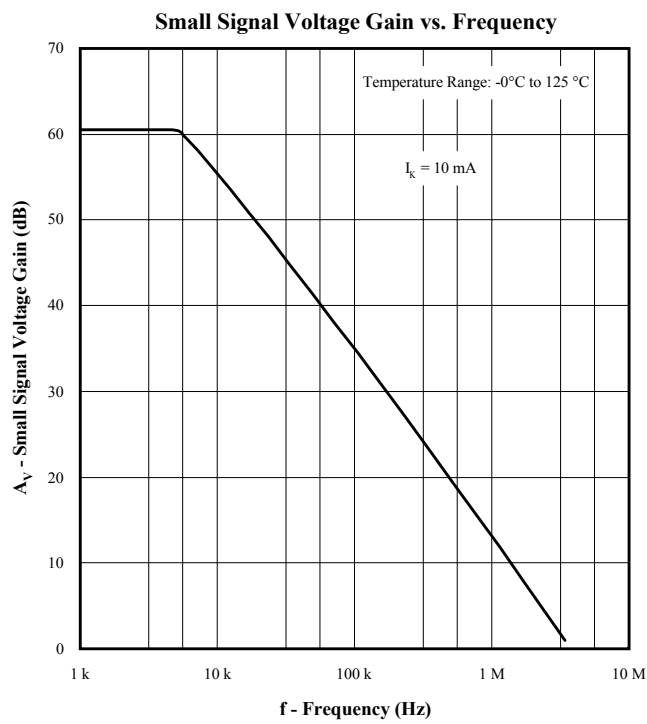
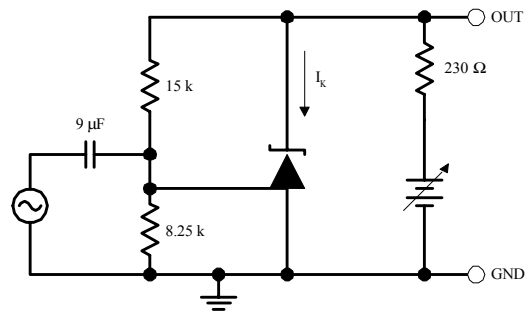


Figure 11



TYPICAL PERFORMANCE CURVES

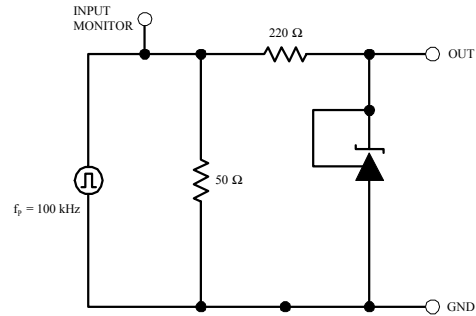
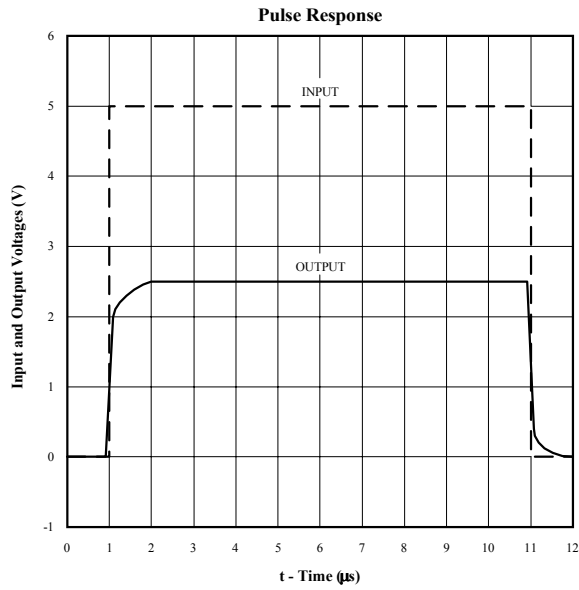


Figure 12

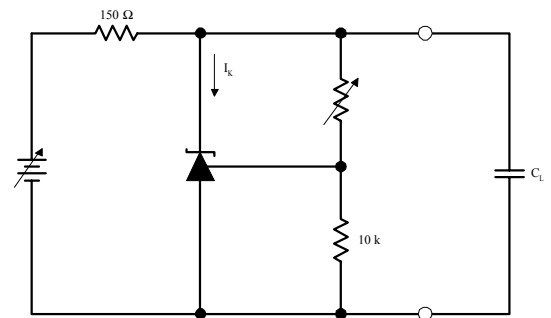
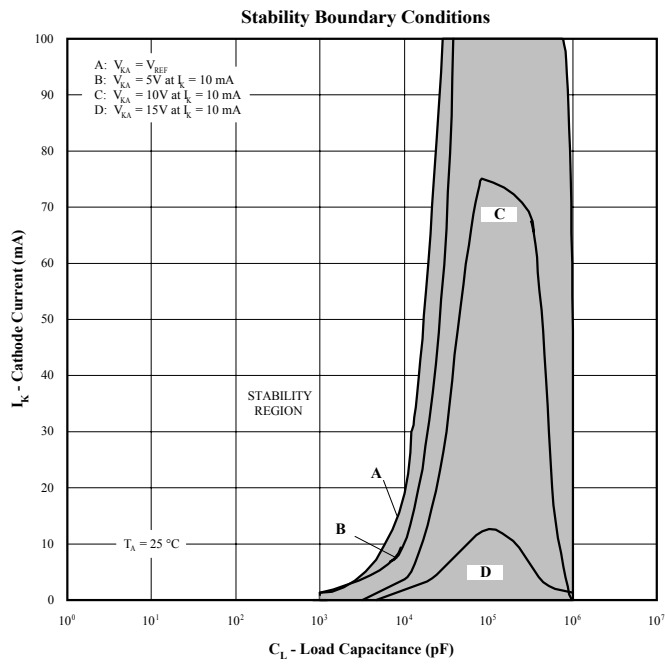


Figure 13

## ORDERING INFORMATION

Ordering No.	Precision	Output Voltage	Packages
SPX431CM5	2%	2.5V	5 Lead SOT-23
SPX431CM1	2%	2.5V	3 Lead SOT-89
SPX431CN	2%	2.5V	3 Lead TO-92



SIGNAL PROCESSING EXCELLENCE

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