



# SPX3431

## Micropower 2.5V Precision Adjustable Shunt Regulator

### FEATURES

- **Voltage Tolerance** ..... 0.5% & 1.0%
- **Wide Operating Current** ..... 1mA to 100mA
- **Extended Temperature Range** ..... 105°C
- Low Temperature Coefficient ..... 30 ppm/°C
- Offered in SOT-23, TO-92 & SOT 89
- **Low Output Noise**

### APPLICATIONS

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

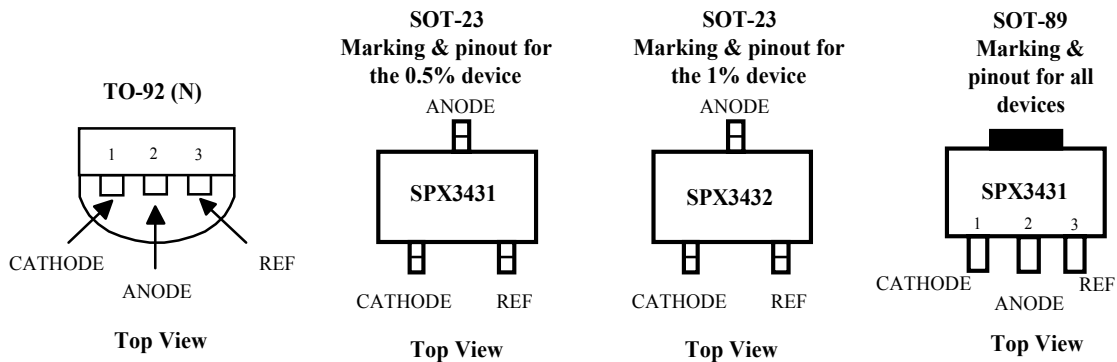
### PRODUCT DESCRIPTION

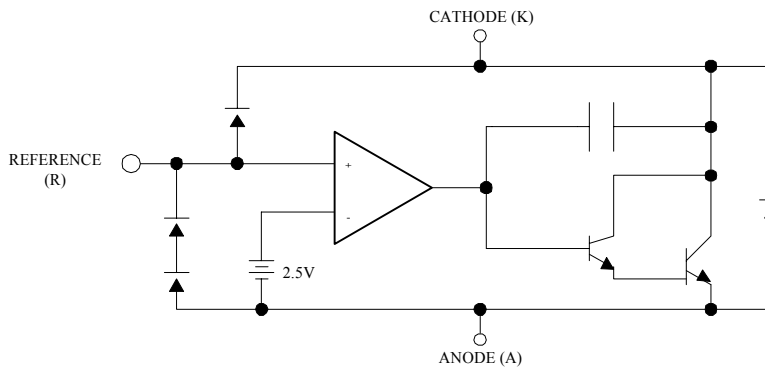
The SPX3431 is a 3-terminal Adjustable Shunt Voltage Regulator providing a highly accurate 0.5% bandgap reference. SPX3431 acts as an open-loop error amplifier with a 2.5V temperature compensation reference. The SPX3431 thermal stability, wide operating current (100mA) and temperature range (0°C to 105°C) makes it suitable for all variety of applications that are looking for a low cost solution with high performance. **SPX3431 tolerance of 0.5% is proven to be sufficient to overcome all the other errors in the system to virtually eliminate the need for trimming in the power supply manufactures assembly line and contribute a big Cost Savings.**

In the standard shunt configuration, the combination of low temperature coefficient (T.C.), sharp turn-on characteristics, low output impedance and programmable output voltage make this precision reference an excellent error amplifier.

The SPX3431 is a direct replacement for the SPX431 and TL431 in low voltage, low current applications. SPX3431 is also available in SOT-89 and TO-92.

### PIN CONNECTIONS





## ABSOLUTE MAXIMUM RATINGS

| Parameter                                      | Symbol    | Rating      | Units |
|--|-----------|-------------|-------|
| Cathode-Anode Reverse Breakdown                | $V_{KA}$  | 18          | V     |
| Anode-Cathode Forward Current                  | $I_{AK}$  | 1           | A     |
| Operating Cathode Current                      | $I_{KA}$  | 100         | mA    |
| Reference Input Current                        | $I_{REF}$ | 1           | mA    |
| Continuous Power Dissipation at 25°C<br>SOT-23 | $P_D$     | 300         | 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 18 | V    |
| Cathode Current | $I_K$    | 10              | mA   |

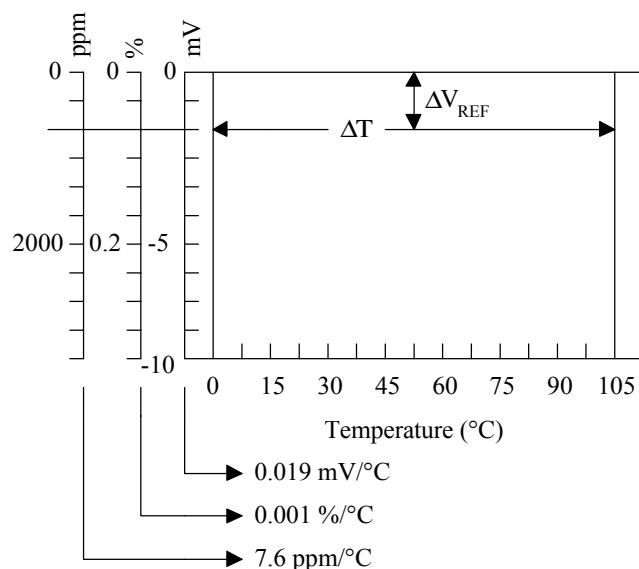
## TYPICAL THERMAL RESISTANCES

| Parameter       | Package | $\theta_{JA}$ | $\theta_{JC}$ | Typical Derating |
|-----------------|---------|---------------|---------------|------------------|
| Cathode Voltage | SOT-23  | 575° C/W      | 150° C/W      | 1.7 mW/°C        |
| Cathode Current | SOT-89  | 575° C/W      | 80° C/W       | 9.1 mW/°C        |
|                 | TO-92   | 575° C/W      | 80° C/W       | 6.3 mW/°C        |

**ELECTRICAL CHARACTERISTICS** are guaranteed over full junction temperature range (0°C to 105°C). Ambient temperature must be derated based on power dissipation and package thermal characteristics. The conditions are:  $V_{KA} = V_{REF}$  and  $I_K = 10\text{mA}$ , unless otherwise specified.

| Parameter                                       | Symbol                              | Test Condition   | SPX3431A |       |       | SPX3431 |       |       | Unit          | Circuit |
|---|-------------------------------------|--|----------|-------|-------|---------|-------|-------|---------------|---------|
|   |                                     |  | Min      | Typ   | Max   | Min     | Typ   | Max   |               |         |
| Reference Voltage                               | $V_{REF}$                           | $T_A = 25^\circ\text{C}$                               | 2.490    | 2.503 | 2.515 | 2.475   | 2.500 | 2.525 | V             | 1       |
|   |                                     | Over Temp.   | 2.480    |       | 2.530 | 2.450   |       | 2.550 | V             | 1       |
| $\Delta V_{REF}$ with Temp*                     | TC                                  |  |          | 0.07  | 0.20  |         | 0.07  | 0.02  | mV/°C         | 1       |
| Ratio of Change in $V_{REF}$ to Cathode Voltage | $\frac{\Delta V_{REF}}{\Delta V_K}$ | $V_{REF}$ to 10 V                                      | -2.7     | -1.01 |       | -2.7    | -1.01 |       | MV/V          | 2       |
|   |                                     | 10 V to 18 V   | -2       | -0.4  | 0.3   | -2      | -0.4  | 0.3   |               |         |
| Reference Input Current                         | $I_{REF}$                           |  |          | 0.7   | 4     |         | 0.7   | 4     | $\mu\text{A}$ | 2       |
| $I_{REF}$ Temp Deviation                        | $\Delta I_{REF}$                    |  |          | 0.4   | 1.2   |         | 0.4   | 1.2   | $\mu\text{A}$ | 2       |
| Min $I_K$ for Regulation                        | $I_{K(MIN)}$                        | $V_{REF} = 0\text{V}$<br>$V_{KA} = 18\text{V}$         |          | 0.4   | 1     |         | 0.4   | 1     | mA            | 1       |
| Off State Leakage                               | $I_{K(OFF)}$                        |  |          | 0.04  | 500   |         | 0.04  | 500   | nA            | 3       |
| Dynamic Output Impedance                        | $Z_{KA}$                            | $f \leq 1\text{ kHz}$ $I_K = 1\text{ to }100\text{mA}$ |          | 0.15  | 0.5   |         | 0.15  | 0.5   | $\Omega$      | 1       |

## Calculating Average Temperature Coefficient (TC)



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

Test Circuits

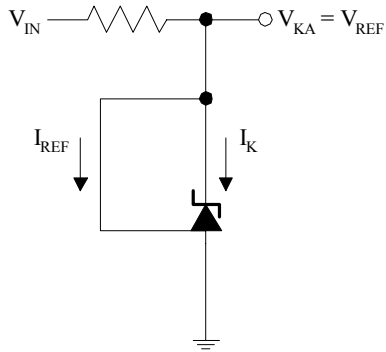


Figure 1a. Test Circuit 1

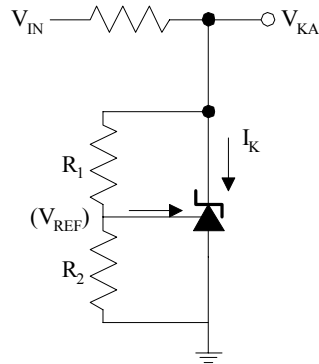


Figure 1b. Test Circuit 2

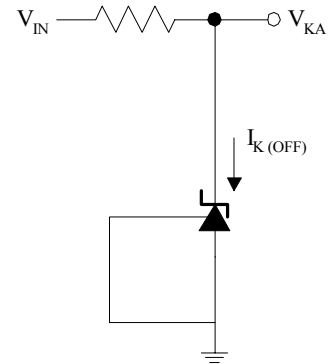


Figure 1c. Test Circuit 3

## ORDERING INFORMATION

| Ordering No. | Precision | Output Accuracy | Packages      |
|--------------|-----------|-----------------|---------------|
| SPX3431M     | 1%        | 2.5V            | 3 Lead SOT-23 |
| SPX3431AM    | 0.5%      | 2.5V            | 3 Lead SOT-23 |
| SPX3431M1    | 1%        | 2.5V            | 3 Lead SOT-89 |
| SPX3431AM1   | 0.5%      | 2.5V            | 3 Lead SOT-89 |
| SPX3431N     | 1%        | 2.5V            | 3 Lead TO-92  |
| SPX3431AN    | 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

Sipex Corporation reserves the right to make changes to any products described herein. Sipex does not assume any liability arising out of the application or use of any product or circuit described hereing; neither does it convey any license under its patent rights nor the rights of others.