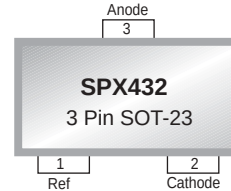


# 1.24V Precision Adjustable Shunt Regulator

## FEATURES

- Low Voltage Operation, 1.24V
- Trimmed Bandgap to 0.5% and 1%
- Wide Operating Current, 1mA to 80mA
- Adjustable Output Voltage,  $V_{REF}$  to 18V
- Extended Temp.Range: 0°C to 105°C
- Low Temperature Coefficient, 50 ppm/°C
- Offered in TO-92, SOIC, SOT-23
- Replacement for TLV431, AS432



*Now Available in Lead Free Packaging*

Refer to page 11 for other pinouts.

## APPLICATIONS

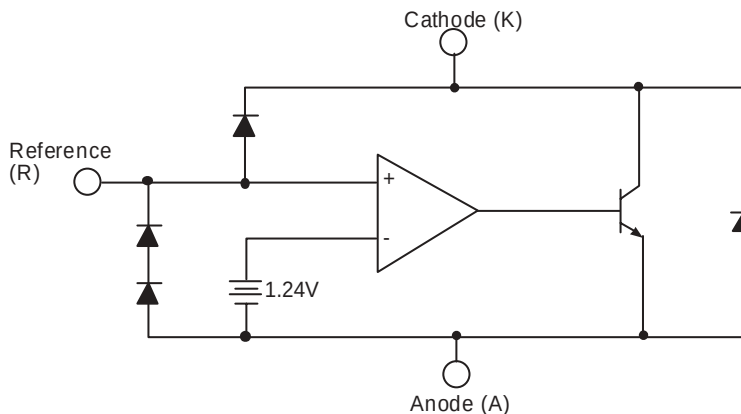
- Switching Power Supplies
- Adjustable Supplies
- Error Amplifiers
- Single Supply Amplifier
- Monitors / VCRs / TVs
- Personal Computers
- Voltage References

## DESCRIPTION

The SPX432 is a 3-terminal adjustable shunt voltage regulator providing a highly accurate 1.24V bandgap reference with 0.5% tolerance. The SPX432's thermal stability, wide operating current (80mA) and temperature range (0°C to 105°C) makes it suitable for a variety of applications. SPX432 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 lines and contribute a significant cost savings.

The SPX432 is an ideal voltage reference in an isolated feedback circuit for switch mode power supplies. SPX432 offers many advantages over the TLV431 such as wider output voltage (18V vs. 6V), higher output current (80mA vs. 15mA) and a wider operating temperature range with a tighter tolerance down to 0.5%.

## BLOCK DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

|                                                 |      |
|-------------------------------------------------|------|
| Cathode-Anode Reverse Breakdown $V_{KA}$        | 20V  |
| Anode-Cathode Forward Current, (<10ms) $I_{AK}$ | 1A   |
| Operating Cathode Current $I_{KA}$              | 80mA |
| Reference Input Current $I_{REF}$               | 1mA  |

Continuous Power Dissipation at 25°C  $P_D$

|                                            |                 |
|--------------------------------------------|-----------------|
| TO-92                                      | 775mW           |
| SOT-23                                     | 200 mW          |
| SOIC-8                                     | 750mW           |
| Junction Temperature $T_J$                 | 150 °C          |
| Storage Temperature $T_{STG}$              | -65°C 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

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

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

## ELECTRICAL CHARACTERISTICS

Electrical characteristics are guaranteed over the full junction temperature range (0°C to 105°C). Ambient temperature must be derated based upon power dissipation and package thermal characteristics. Unless otherwise specified, test conditions are:

$$V_{KA} = V_{REF} \text{ and } I_K = 10\text{mA.}$$

| PARAMETER                                       | SYMBOL       | TEST CIRCUIT | CONDITIONS                                      | MIN     | TYP   | MAX    | MIN    | TYP   | MAX    | UNITS |
|-------------------------------------------------|--------------|--------------|-------------------------------------------------|---------|-------|--------|--------|-------|--------|-------|
|                                                 |              |              |                                                 | SPX432A |       |        | SPX432 |       |        |       |
| Output Voltage                                  | $V_{REF}$    | 3a           |                                                 | 1.2338  | 1.240 | 1.2462 | 1.2276 | 1.240 | 1.2524 | V     |
| Temperature Deviation                           | $V_{REF}$    | 3a           | $0 < T_J < 105^\circ\text{C}$                   |         | 12    | 20     |        | 12    | 20     | mV    |
| Line Regulation                                 | $V_{REF}$    | 3b           | $V_{KA} = 1.25\text{V to } 15\text{V}$          |         | 19    | 37     |        | 19    | 37     | mV    |
| Load Regulation                                 | $V_{REF}$    | 3a           | $I_K = 1\text{mA to } 80\text{mA}$              |         | 12    | 30     |        | 12    | 30     | mV    |
| Reference Input Current                         | $I_{REF}$    | 3b           |                                                 |         | 3     | 6      |        | 3     | 6      | μA    |
| Reference Input Current Temperature Coefficient | $I_{REF}$    | 3b           | $0 < T_J < 105^\circ\text{C}$ ,                 |         | 0.3   | 0.6    |        | 0.3   | 0.6    | μA    |
| Minimum Cathode Current for Regulation          | $I_{K(MIN)}$ | 3a           |                                                 |         | 0.6   | 1      |        | 0.6   | 1      | mA    |
| Off State Leakage                               | $I_{K(MIN)}$ | 3c           | $V_{REF} = 0\text{V},$<br>$V_{KA} = 18\text{V}$ |         | 0.04  | 500    |        | 0.04  | 500    | nA    |

## CALCULATION AVERAGE TEMPERATURE COEFFICIENT (TC)

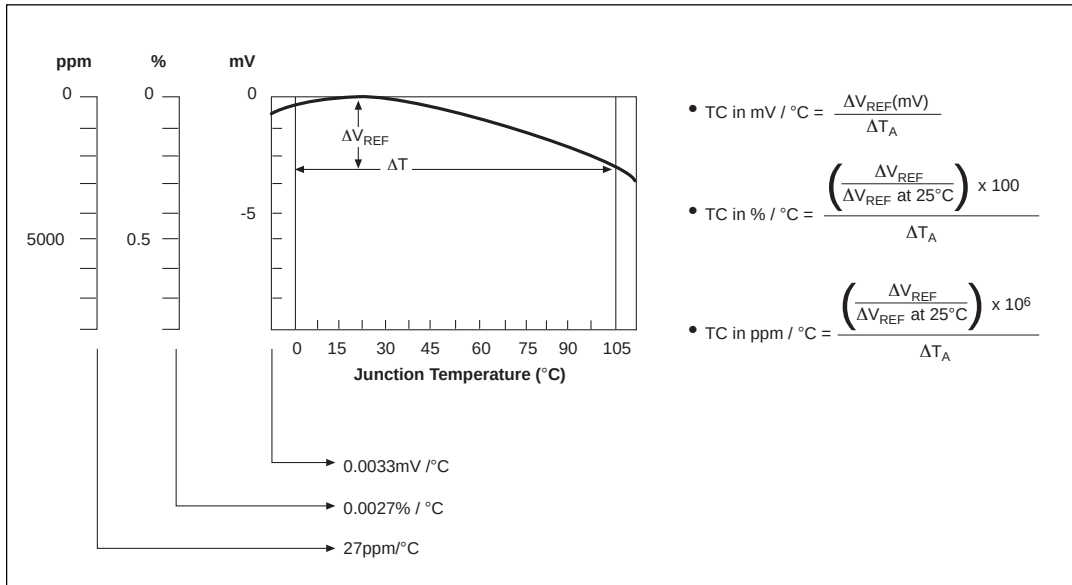


Figure 1.  $V_{REF}$  VS Temperature.

## TEST CIRCUITS

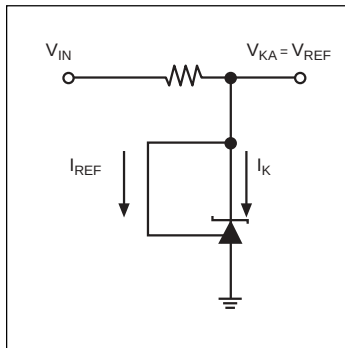


Figure 2. Test Circuit for  $V_{KA} = V_{REF}$

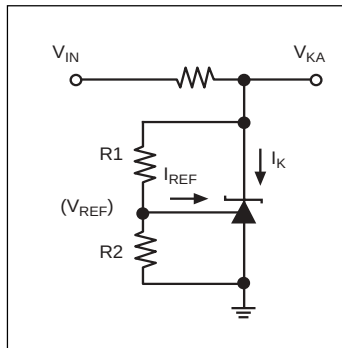


Figure 3. Test Circuit for  $V_{KA} > V_{REF}$

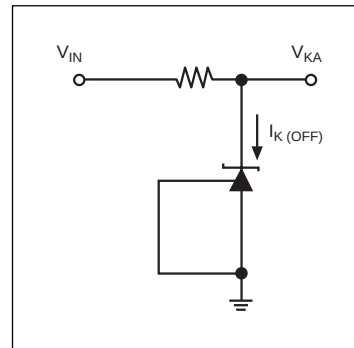
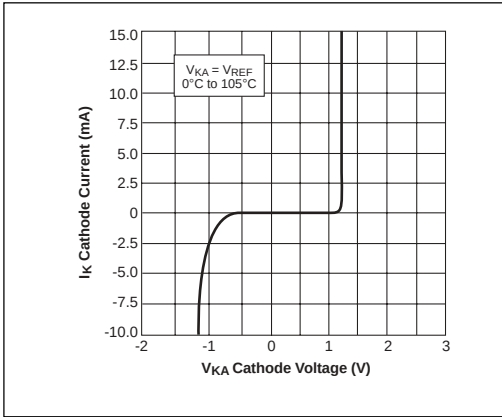
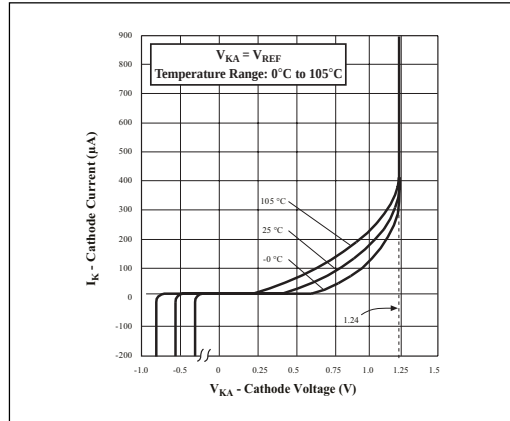


Figure 4. Test Circuit for  $I_{KOFF}$

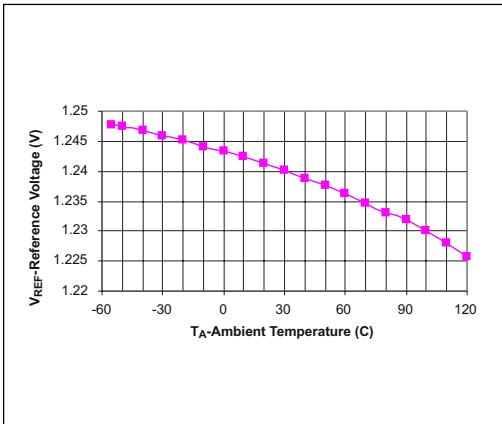
## TYPICAL PERFORMANCE CHARACTERISTICS



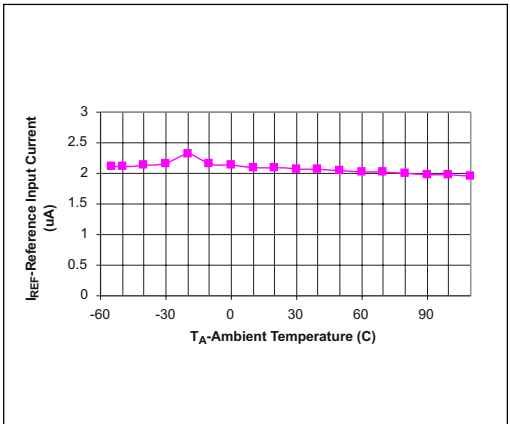
**High Current Operating Characteristics.**



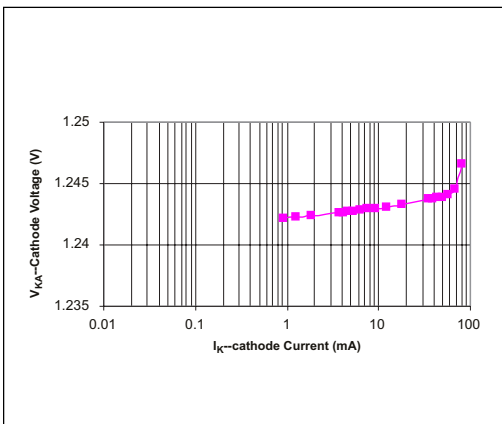
**Low Current Operating Characteristics.**



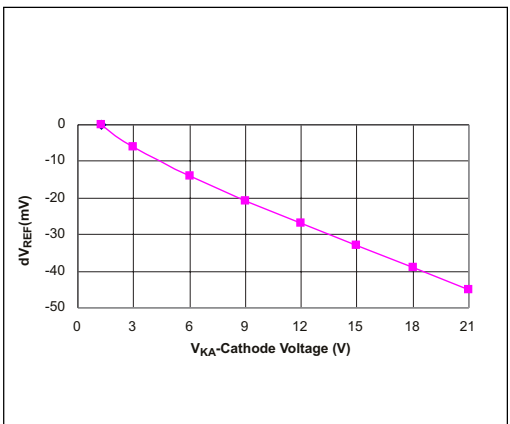
**$V_{KA} = V_{REF}$ ,  $I_{KA} = 10\text{mA}$ .**



**Reference Input Current VS Temperature;  $I_{KA} = 10\text{mA}$ .**

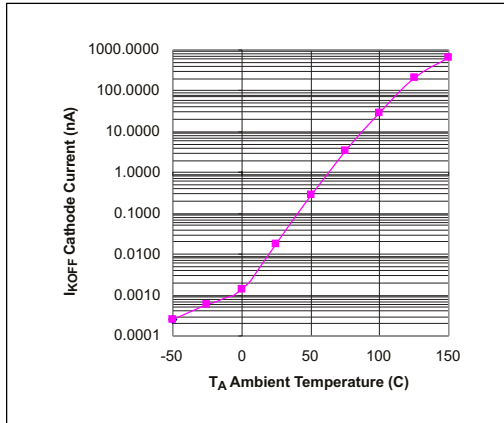


**$V_{KA} = V_{REF}$ , Sweeping  $I_{KA}$ ,  $25^\circ\text{C}$ .**

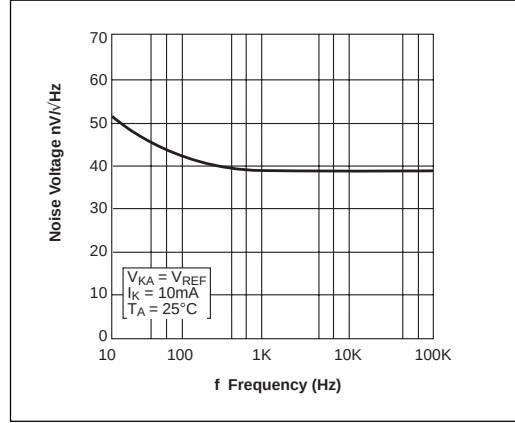


**Reference Voltage Line Regulation;  $I_{KA} = 10\text{mA}$ , Sweeping  $V_{KA}$ ,  $25^\circ\text{C}$ .**

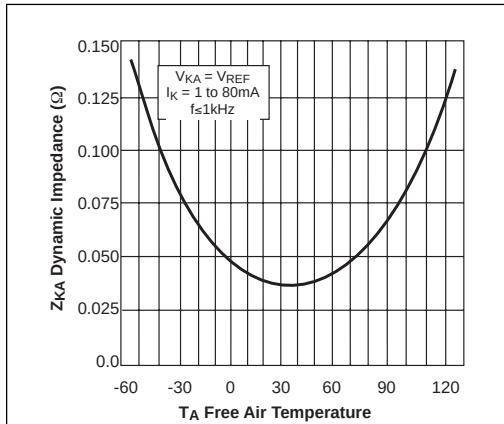
## TYPICAL PERFORMANCE CHARACTERISTICS



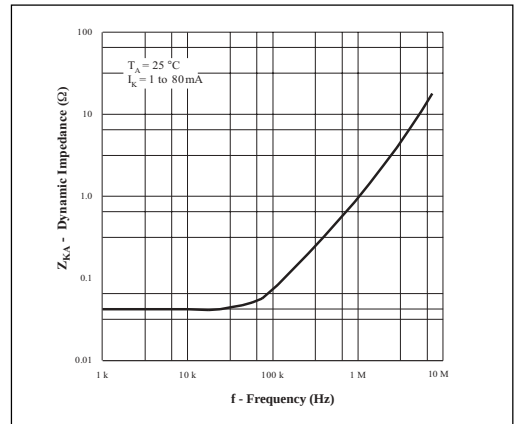
Off State Leakage;  $V_{KA} = 18V$ ,  $V_{REF} = 0V$ .



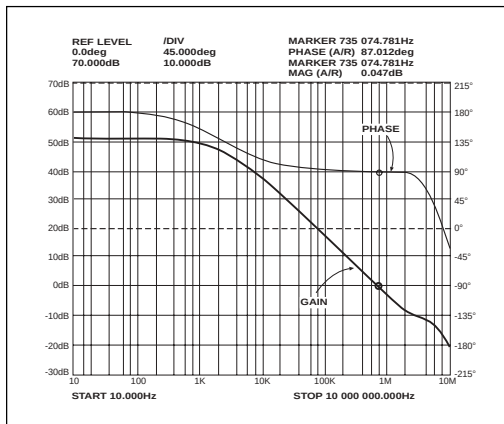
Noise Voltage VS Frequency.



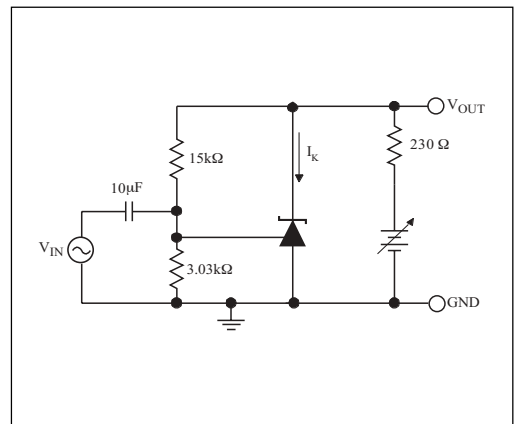
Low Frequency Dynamic Output Impedance VS  $T_{AMBIENT}$



Dynamic Output Impedance  $T_A = 25^\circ C$ ,  $I_{KA} = 1$  to 80mA.

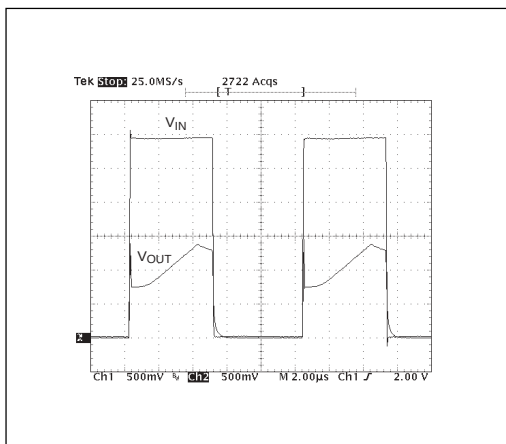


Small Signal Gain and Phase VS Frequency;  $I_K = 10mA$ ,  $T_A = 25^\circ C$ .

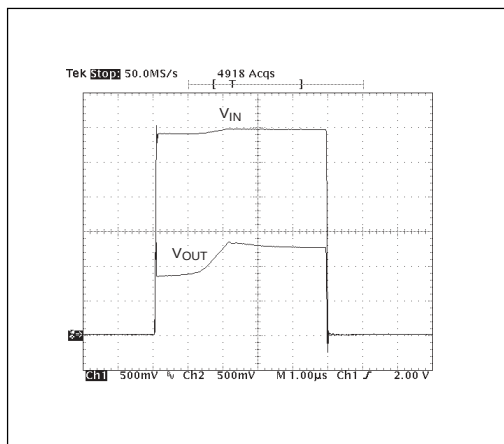


Test Circuit for Gain and Phase Frequency Response.

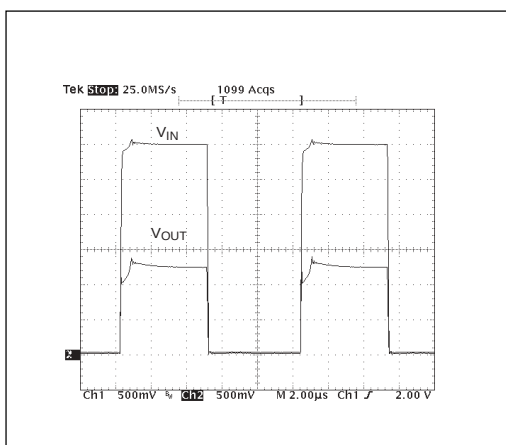
## TYPICAL PERFORMANCE CHARACTERISTICS



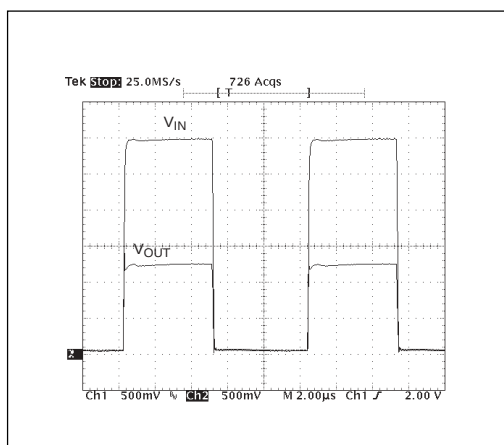
$I_{KA} = 0 \text{ to } 1\text{mA}$ .



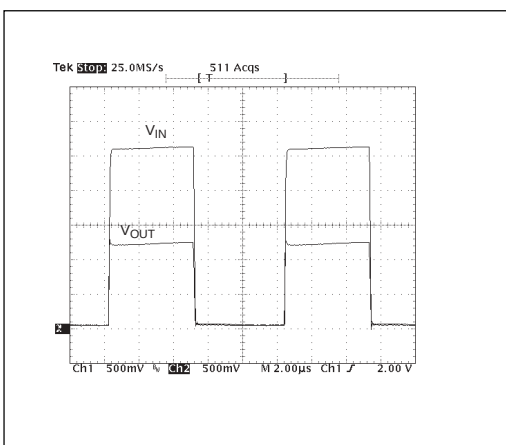
$I_{KA} = 0 \text{ to } 10\text{mA}$ .



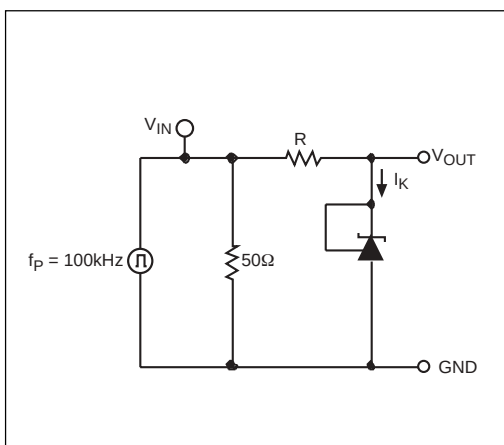
$I_{KA} = 0 \text{ to } 50\text{mA}$ .



$I_{KA} = 0 \text{ to } 80\text{mA}$ .

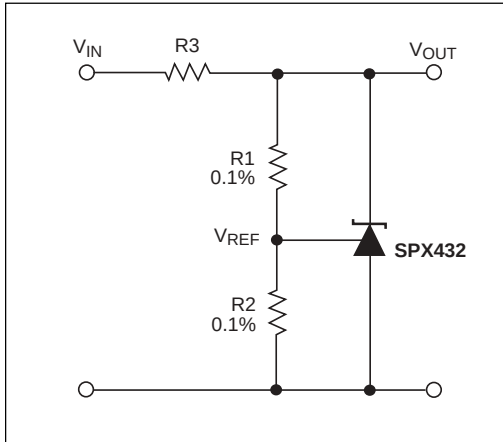


$I_{KA} = 0 \text{ to } 100\text{mA}$ .

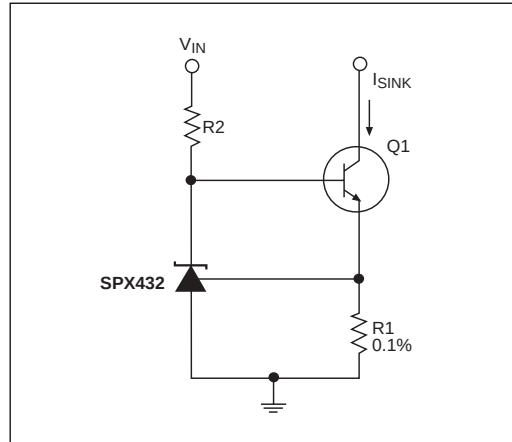


Test Circuit for Pulse Response.

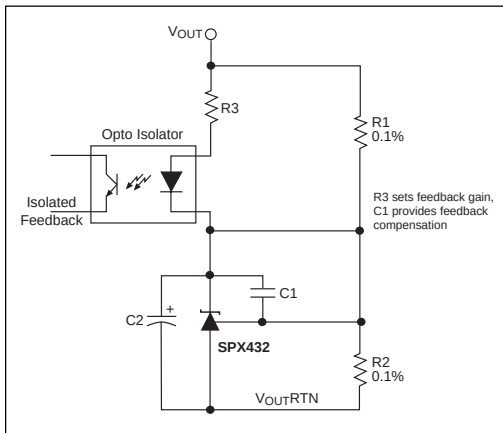
## TYPICAL PERFORMANCE CHARACTERISTICS



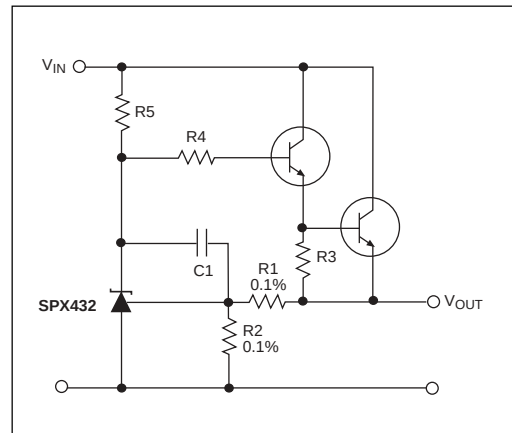
**Shunt Regulator,  $V_{OUT} = (1+R1/R2)V_{REF}$ .**



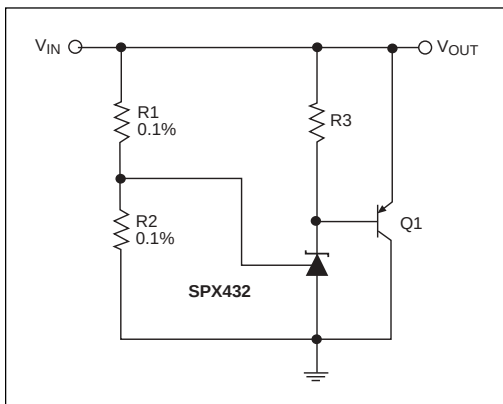
**Constant Current Sink  $I_{SINK} = V_{REF}/R1$ .**



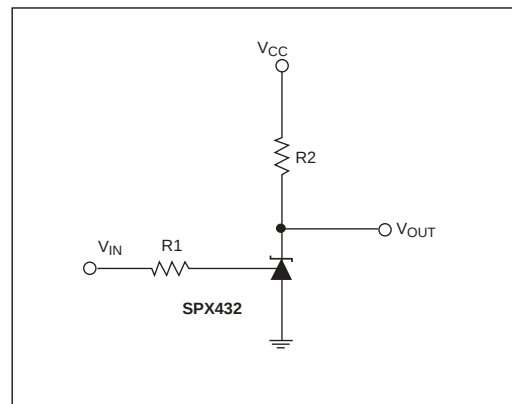
**Reference Amplifier for Isolated Feedback in Off-Line DC-DC Converters.**



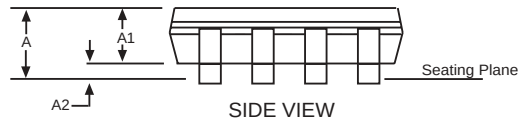
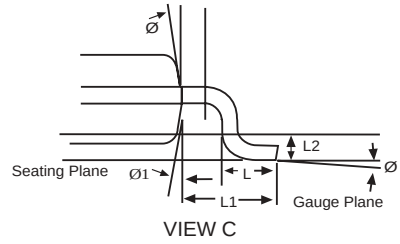
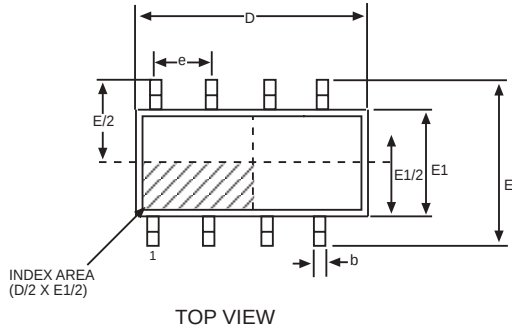
**Precision High Current Series Regulator,  $V_{OUT} = (1+R1/R2)V_{REF}$ .**



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

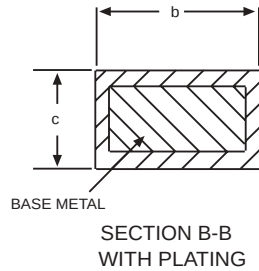
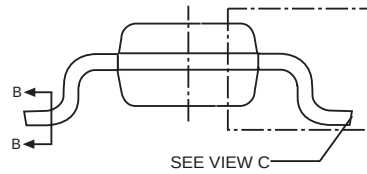


**Single Supply Comparator with Temperature Compensated Threshold,  $V_{IN}$  threshold = 1.24V.**

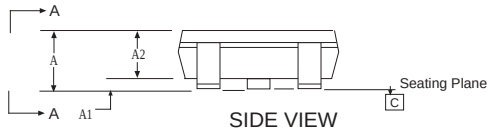
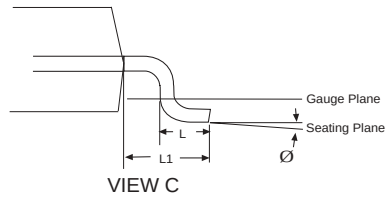
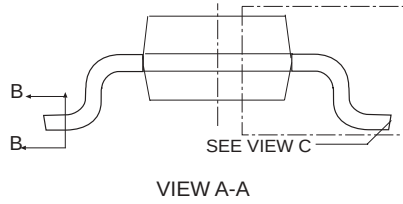
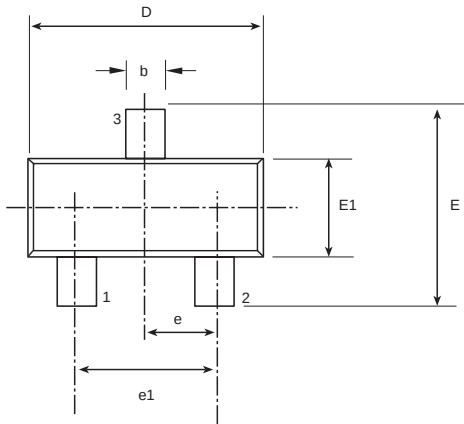


| 8 Pin NSOIC JEDEC MO-012 (AA) Variation |          |     |      |
|-----------------------------------------|----------|-----|------|
| SYMBOL                                  | MIN      | NOM | MAX  |
| A                                       | 1.35     | -   | 1.75 |
| A1                                      | 0.1      | -   | 0.25 |
| A2                                      | 1.25     | -   | 1.65 |
| b                                       | 0.31     | -   | 0.51 |
| c                                       | 0.17     | -   | 0.24 |
| D                                       | 4.90 BSC |     |      |
| E                                       | 6.00 BSC |     |      |
| E1                                      | 3.90 BSC |     |      |
| e                                       | 1.27 BSC |     |      |
| L                                       | 0.4      | -   | 1.27 |
| L1                                      | 1.04 REF |     |      |
| L2                                      | 0.25 BSC |     |      |
| Ø                                       | 0°       | -   | 8°   |
| Ø1                                      | 5°       | -   | 15°  |

Note: Dimensions in (mm)

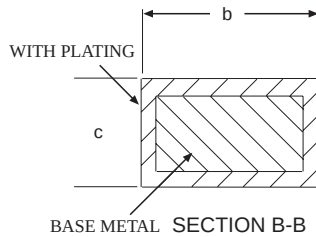


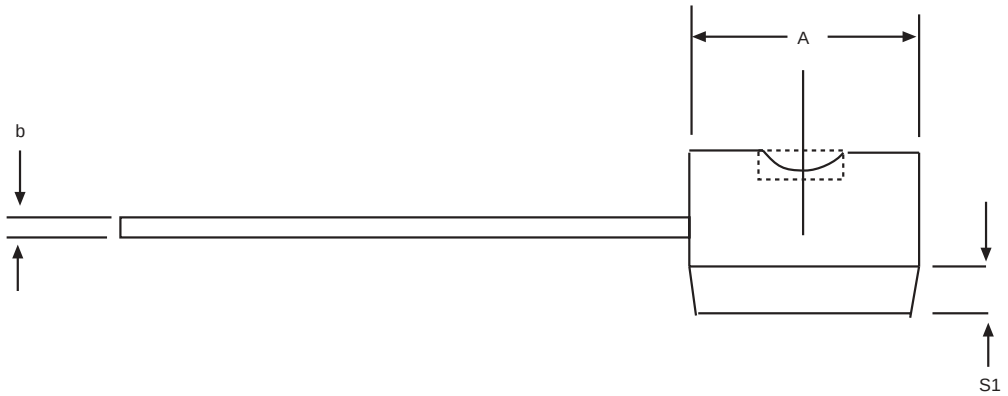
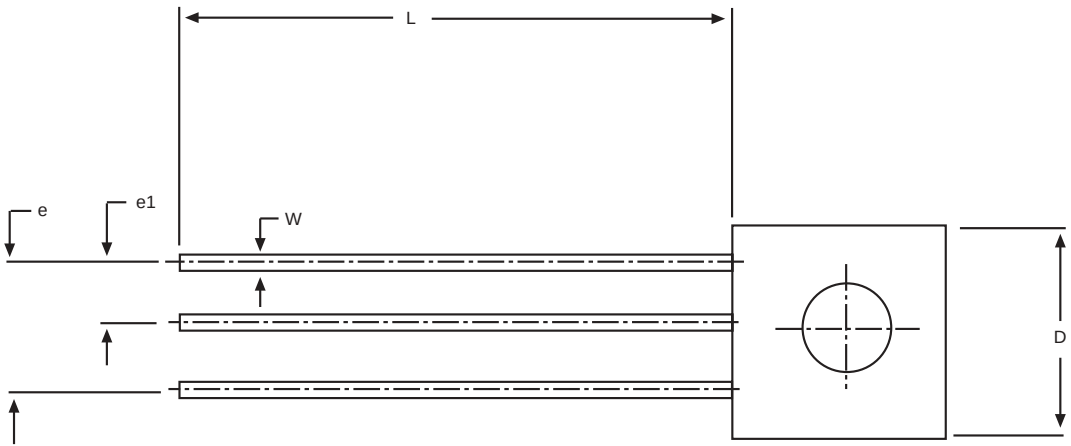




| 3 Pin SOT-23 JEDEC TO-236 (AB) Variation |          |      |      |
|------------------------------------------|----------|------|------|
| SYMBOL                                   | MIN      | NOM  | MAX  |
| A                                        | 0.89     | -    | 1.12 |
| A1                                       | 0.01     | -    | 0.1  |
| A2                                       | 0.88     | 0.95 | 1.02 |
| b                                        | 0.3      | -    | 0.5  |
| c                                        | 0.08     | -    | 0.2  |
| D                                        | 2.8      | 2.9  | 3.04 |
| e                                        | 0.95 BSC |      |      |
| e1                                       | 1.90 BSC |      |      |
| E                                        | 0.95     | -    | 2.64 |
| E1                                       | 1.2      | 1.3  | 1.4  |
| L                                        | 0.4      | 0.5  | 0.6  |
| L1                                       | 0.54 REF |      |      |
| Ø                                        | 0°       | -    | 8°   |

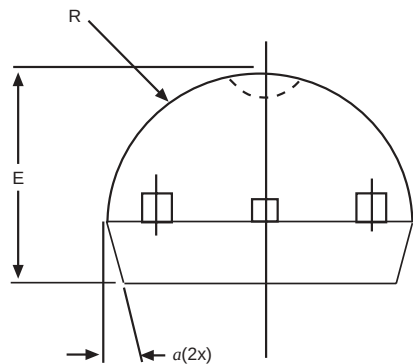
Note: Dimensions in (mm)

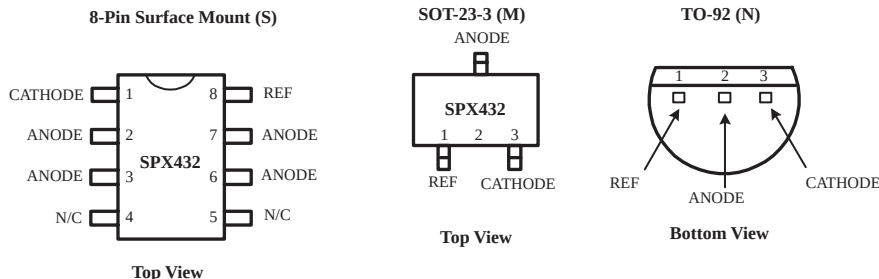




| 3 Pin TO-92 |       |     |       |
|-------------|-------|-----|-------|
| SYMBOL      | MIN   | NOM | MAX   |
| A           | 0.17  | -   | 0.195 |
| b           | 0.014 | -   | 0.02  |
| E           | 0.13  | -   | 0.155 |
| e           | 0.95  | -   | 0.105 |
| e1          | 0.045 | -   | 0.055 |
| L           | 0.5   | -   | 0.61  |
| R           | 0.085 | -   | 0.095 |
| S1          | 0.045 | -   | 0.06  |
| W           | 0.016 | -   | 0.022 |
| D           | 0.175 | -   | 0.195 |
| a           | 4°    | -   | 6°    |

Note: Dimensions in (inches)





## ORDERING INFORMATION

| PART NUMBER       | ACC        | OUTPUT VOLTAGE | PACKAGES     |
|-------------------|------------|----------------|--------------|
| SPX432AM .....    | 0.5% ..... | 1.24V .....    | 3-Pin SOT-23 |
| SPX432AM/TR ..... | 0.5% ..... | 1.24V .....    | 3-Pin SOT-23 |
| SPX432AS .....    | 0.5% ..... | 1.24V .....    | 8-Pin NSOIC  |
| SPX432AS/TR ..... | 0.5% ..... | 1.24V .....    | 8-Pin NSOIC  |
| SPX432AN .....    | 0.5% ..... | 1.24V .....    | 3-Pin TO-92  |
| SPX432AN/TR ..... | 0.5% ..... | 1.24V .....    | 3-Pin TO-92  |
|                   |            |                |              |
| SPX432M .....     | 1.0% ..... | 1.24V .....    | 3-Pin SOT-23 |
| SPX432M/TR .....  | 1.0% ..... | 1.24V .....    | 3-Pin SOT-23 |
| SPX432S .....     | 1.0% ..... | 1.24V .....    | 8-Pin NSOIC  |
| SPX432S/TR .....  | 1.0% ..... | 1.24V .....    | 8-Pin NSOIC  |
| SPX432N .....     | 1.0% ..... | 1.24V .....    | 3-Pin TO-92  |
| SPX432N/TR .....  | 1.0% ..... | 1.24V .....    | 3-Pin TO-92  |

Available in lead free packaging. To order add "-L" suffix to part number.

Example: SPX432AM/TR = standard; SPX432AM-L/TR = lead free

/TR = Tape and Reel

Pack quantity is 2,000 for TO-92 and 2500 for SOT-23 and NSOIC.

[CLICK HERE TO ORDER SAMPLES](#)



**ANALOG EXCELLENCE**

**Sipex Corporation**

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FAX: (408) 935-7600

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Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

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