

Features

- Precision reference voltage
AP432 : 1.24V ± 1%
AP432A : 1.24V ± 0.5%
- Sink current capability: 200mA
- Minimum cathode current for regulation: 150µA
- Equivalent full-range temp coefficient: 30 ppm/°C
- Fast turn-on response
- Low dynamic output impedance: 0.2Ω
- Programmable output voltage to 20V
- Low output noise
- Packages: SOT23, SOT23R, SOT25, SC59 (W package code), SC59 (R package code), SOP-8L and TO92-3L
- SOT23, SOT23R, SOP-8L and SC59: Available in "Green" Molding Compound (No Br, Sb) (Note 1)
- Lead Free Finish/ RoHS Compliant for Lead Free and "Green" Products (Note 2)

General Description

The AP432/432A are 3-terminal adjustable precision shunt regulators with guaranteed stable temperature over the applicable extended commercial temperature range. The output voltage may be set at any level greater than 1.24V (V_{REF}) up to 20V merely by selecting two external resistors that act as a voltage divider network. These devices have a typical output impedance of 0.2Ω. Active output circuitry provides very sharp turn-on characteristics, making these devices excellent improved replacements for Zener diodes in many applications.

The precise +/- 1% reference voltage tolerance of the AP432/432A make it possible in many applications to avoid the use of a variable resistor, consequently saving cost and eliminating drift and reliability problems associated with it.

Ordering Information



Note: 1. SOT23, SOT23R are "Green" products only.
2. RoHS revision 13.2.2003. Glass and High Temperature Solder Exemptions Applied, see *EU Directive Annex Notes 5 and 7*.

| Device (Note 4) | Package Code | Packaging (Note 5) | 7" Tape and Reel | | 13" Tape and Reel | | Ammo Box | |
|-----------------|--------------|--------------------|------------------|--------------------|-------------------|--------------------|----------|--------------------|
| | | | Quantity | Part Number Suffix | Quantity | Part Number Suffix | Quantity | Part Number Suffix |
| AP432(A)SA | SA | SOT23 | 3000/Tape & Reel | -7 | NA | NA | NA | NA |
| AP432(A)SR | SR | SOT23R | 3000/Tape & Reel | -7 | NA | NA | NA | NA |
| AP432(A)Q | Q | SOT25 | 3000/Tape & Reel | -7 | NA | NA | NA | NA |
| AP432(A)W | W | SC59 | 3000/Tape & Reel | -7 | NA | NA | NA | NA |
| AP432(A)R | R | SC59 | 3000/Tape & Reel | -7 | NA | NA | NA | NA |
| AP432(A) | | SOP-8L | NA | NA | 2500/Tape & Reel | -13 | NA | NA |
| AP432(A)V | V | TO92-3L | NA | NA | NA | NA | 2000/Box | -A |

Notes: 3. Ammo Box is for TO92-3 Spread Lead.
4. Suffix "A" denotes AP432A device.
5. Pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at <http://www.diodes.com/datasheets/ap02001.pdf>.

Pin Assignment

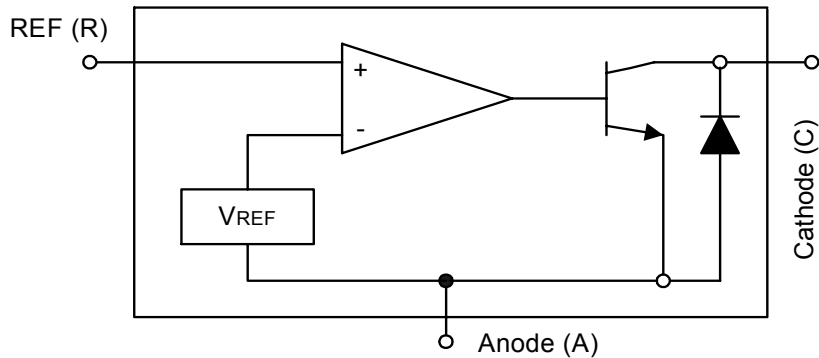
| Package | Pin Configuration (Top View) |
|---------------------------|--------------------------------------------------|
| SOT25 | <p>NC 1 5 ANODE NC 2 4 REF CATHODE 3</p> |
| SC-59 (Package Code-W) | <p>ANODE 1 3 REF CATHODE 2</p> |
| SC-59 (Package Code-R) | <p>ANODE 1 3 CATHODE REF 2</p> |
| TO92-3L | <p>3 Cathode 2 Anode 1 REF</p> |

| Package | Pin Configuration (Top View) |
|---------|------------------------------------------------------------------------------|
| SOP-8L | <p>CATHODE 1 8 REF ANODE 2 7 ANODE ANODE 3 6 ANODE NC 4 5 NC</p> |
| SOT23 | <p>ANODE 1 3 REF CATHODE 2</p> |
| SOT23R | <p>ANODE 1 3 CATHODE REF 2</p> |

Typical Application Circuit



Block Diagram



Symbol



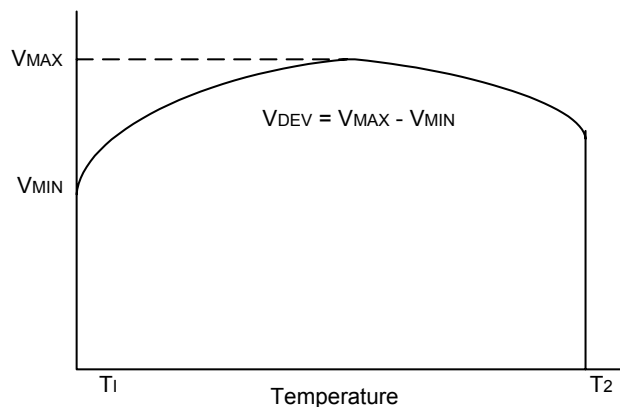
Absolute Maximum Ratings

| Symbol | Parameter | Rating | Unit | |
|------------------|-----------------------------------|-------------|------|----|
| V _{CV} | Cathode Voltage | +20 | V | |
| I _{CC} | Continuous Cathode Current | -10 to +250 | mA | |
| I _{REF} | Reference Input Current | 10 | mA | |
| T _{OP} | Operating Temperature | -20 to +85 | °C | |
| T _{ST} | Storage Temperature | -65 to +150 | °C | |
| P _D | Power Dissipation (Notes 6, 7) | SOT23(R) | 250 | mW |
| | | SOT25 | 250 | mW |
| | | SC59 | 400 | mW |
| | | SOP-8L | 600 | mW |
| | | TO92-3L | 780 | mW |

Note: 6. T_J, max =150°C
7. Ratings apply to ambient temperature at 25°C

Electrical Characteristics ($T_A = 25^{\circ}\text{C}$, $V^+ = +5.0\text{V}$, unless otherwise stated)

| Parameter | Test conditions | Symbol | Min. | Typ. | Max. | Unit |
|---------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|-----------------------------------------------|----------------|------|-----------------|---------------|
| Reference Voltage | $V_{KA} = V_{\text{ref}}$, $I_{KA} = 10\text{mA}$ (Fig.1) | V_{REF} | AP432 1.227 | 1.24 | AP432A 1.252 | V |
| | | | 1.233 | | 1.246 | |
| Deviation of Reference Input Voltage over Temperature (Note 8) | $V_{KA} = V_{\text{REF}}$, $I_{KA} = 10\text{mA}$, $T_a = \text{full range}$ (Fig.1) | V_{REF} | | 3.0 | 20 | mV |
| Ratio of the Change in Reference Voltage to the Change in Cathode Voltage | $I_{KA} = 10\text{mA}$ (Fig.2) $V_{KA} = 20 \sim V_{\text{REF}}$ | $\frac{\Delta V_{\text{REF}}}{\Delta V_{KA}}$ | | -1.4 | -2.0 | mV/V |
| Reference Input Current | $R1 = 10\text{K}\Omega$, $R2 = \infty$ $I_{KA} = 10\text{mA}$ (Fig.2) | I_{REF} | | 1.4 | 3.5 | μA |
| Deviation of Reference Input Current over Temperature | $R1 = 10\text{K}\Omega$, $R2 = \infty$ $I_{KA} = 10\text{mA}$ $T_a = \text{Full range}$ (Fig.2) | αI_{REF} | | 0.4 | 1.2 | μA |
| Minimum Cathode Current for Regulation | $V_{KA} = V_{\text{REF}}$ (Fig.1) | $I_{KA(\text{min})}$ | | 0.15 | 0.3 | mA |
| Off-state Current | $V_{KA} = 20\text{V}$, $V_{\text{REF}} = 0\text{V}$ (Fig.3) | $I_{KA(\text{off})}$ | | 0.1 | 1.0 | μA |
| Dynamic Output Impedance (Note 9) | $V_{KA} = V_{\text{REF}}$ Frequency $\leq 1\text{KHz}$ (Fig.1) | $ Z_{KA} $ | | 0.2 | 0.5 | Ω |



Note: 8. Deviation of reference input voltage, V_{DEV} , is defined as the maximum variation of the reference over the full temperature range. The average temperature coefficient of the reference input voltage αV_{REF} is defined as:

$$|\alpha V_{\text{REF}}| = \frac{\left(\frac{V_{\text{DEV}}}{V_{\text{REF}}(25^{\circ}\text{C})} \right) \cdot 10^6}{T_2 - T_1} \dots\dots\dots (\text{ppm}/^{\circ}\text{C})$$

Where:

$T_2 - T_1 =$ full temperature change.

αV_{REF} can be positive or negative depending on whether the slope is positive or negative.

Note: 9. The dynamic output impedance, R_z , is defined as:

$$|Z_{KA}| = \frac{\Delta V_{KA}}{\Delta I_{KA}}$$

When the device is programmed with two external resistors R1 and R2 (see Figure 2.), the dynamic output impedance of the overall circuit, is defined as:

$$|Z_{KA}'| = \frac{\Delta V}{\Delta I} \approx |Z_{KA}| \left(1 + \frac{R1}{R2} \right)$$

Test Circuits

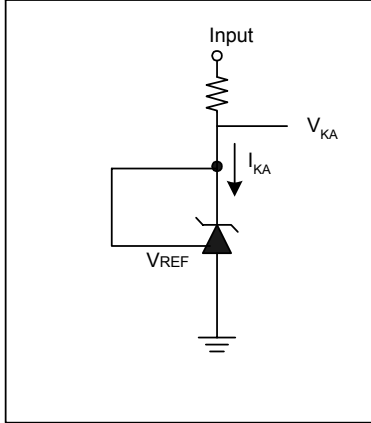
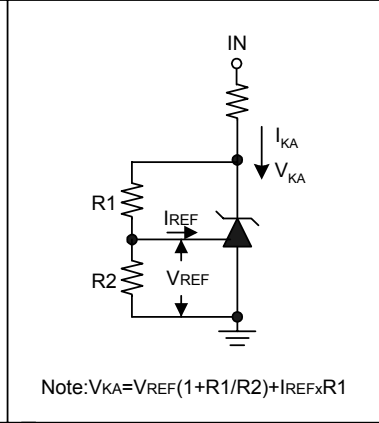


Fig 1. Test Circuit for $V_{KA} = V_{REF}$



Note: $V_{KA} = V_{REF}(1 + R1/R2) + I_{REF} \times R1$

Fig 2. Test Circuit for $V_{KA} > V_{REF}$

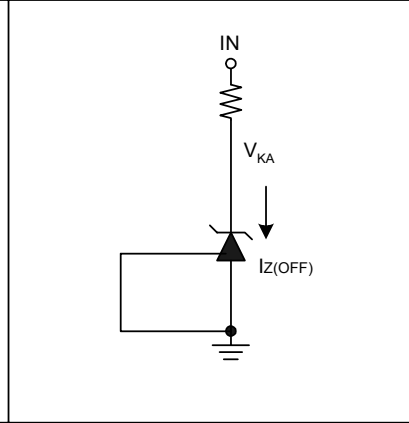
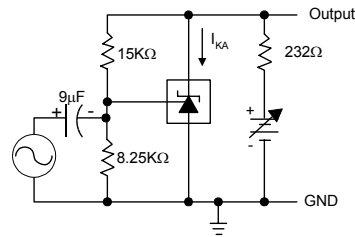


Fig 3. Test Circuit for Off-State Current

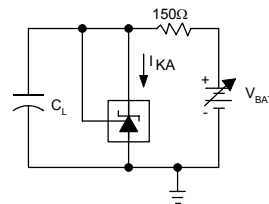
Typical Performance Characteristics



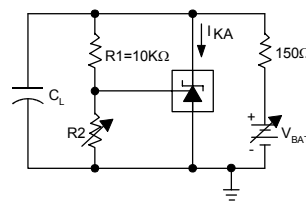
Test Circuit for Voltage Amplification



Test Circuit for Reference Impedance



Test Circuit for Curve A



Test Circuit for Curve B, C, and D

†The areas under the curves represent conditions that may cause the device to oscillate. For curves B, C, and D, R2 and V+ were adjusted to establish the initial V_{KA} and I_{KA} conditions with C_L = 0. V_{BATT} and C_L were then adjusted to determine the ranges of stability.

Application Examples



Marking Information

(1) SOT23(R)/SOT25/SC59



(2) SOP-8L



(3) TO92-3



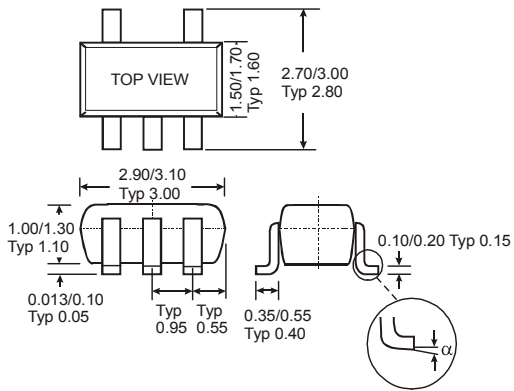
Marking Information (Continued)**Marking Code Table**

| Device | Package (Note 10) | Marking Code | Date Code |
|----------|-------------------|--------------|-----------|
| AP432SA | SOT23 | D3 | YM |
| AP432ASA | SOT23 | D4 | YM |
| AP432SR | SOT23R | D7 | YM |
| AP432ASR | SOT23R | D8 | YM |
| AP432Q | SOT25 | B7 | YM |
| AP432AQ | SOT25 | B8 | YM |
| AP432W | SC59 | B3 | YM |
| AP432AW | SC59 | B4 | YM |
| AP432R | SC59 | B5 | YM |
| AP432AR | SC59 | B6 | YM |

Note: 10. For Packaging Details, go to our website at <http://www.diodes.com/datasheets/ap02007.pdf>.

Package Information (All Dimensions in mm)

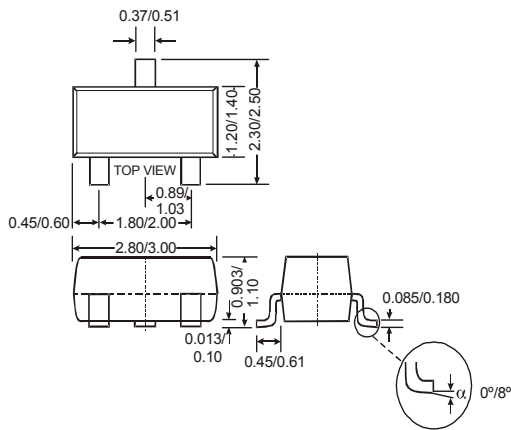
(1) SOT25



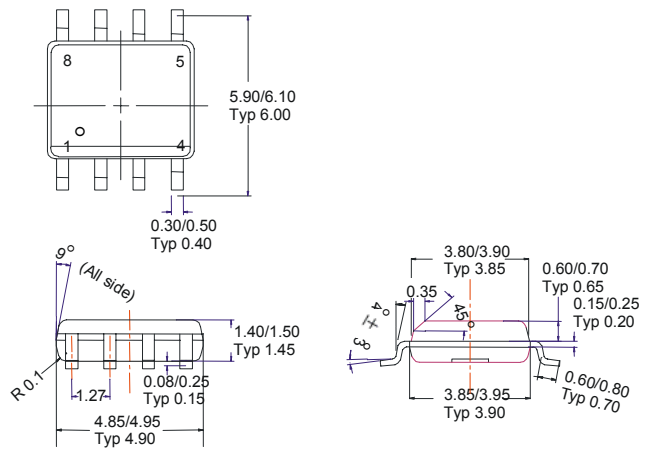
(2) SC59



(3) SOT23(R)



(4) SOP-8L



Package Information (Continued) (All Dimensions in mm)

(5) TO92-3L for Ammo pack



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