

Description

The ZXRE250 and ZXRE252 are three terminal adjustable shunt regulators offering excellent temperature stability and output current handling capability up to 100mA. The output voltage may be set to any chosen voltage between 2.5 and 36 volts by selection of two external divider resistors.

ZXRE250 has the same electrical specifications as the industry standard '431 except that it features a very low minimum cathode current for regulation. The typical value of 40µA makes the parts ideal for very low power applications.

The devices can be used as a replacement for zener diodes in many applications requiring an improvement in zener performance. The ZXRE250/2 is available in 2 grades with initial tolerances of 1% and 0.5% for the A and B grades respectively.

Features

- Minimum cathode current for regulation: 40µA (typ)
- Temperature range -40 to 125°C
- Reference Voltage Tolerance at 25°C
 - ZXRE250A: 2.495V ± 1.0%.
 - ZXRE250B: 2.495V ± 0.5%
- Low Output Noise
- 0.2Ω Typical Output Impedance
- Sink Current Capability: 0.065mA to 100mA
- Adjustable Output Voltage: V_{REF} to 36V
- SOT23 and SOT25: Available in "Green" Molding Compound (No Br, Sb) and Lead Free Finish/ RoHS Compliant (Note 1)

Applications

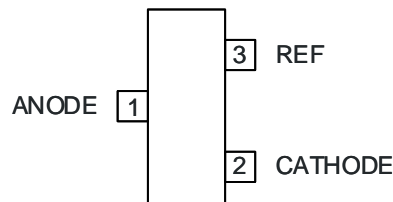
- Opto-Coupler Linearisers
- Shunt Regulators
- Improved Zener
- Variable Reference

Notes: 1. EU Directive 2002/95/EC (RoHS). All applicable RoHS exemptions applied. Please visit our website at http://www.diodes.com/products/lead_free.html.

Pin Assignments

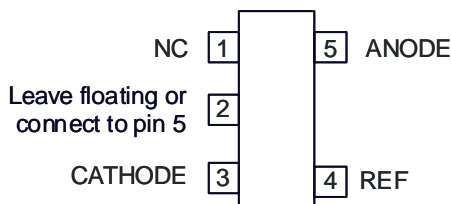
ZXRE250

(Top View)



SOT23

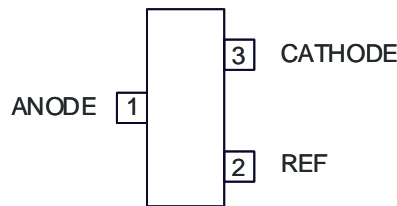
(Top View)



SOT25

ZXRE252

(Top View)



SOT23

Absolute Maximum Ratings (Note 2)

| Symbol | Parameter | | Rating | Unit |
|-----------|--------------------------------|-------|---------------|------|
| V_{KA} | Cathode Voltage | | 40 | V |
| I_{KA} | Continuous Cathode Current | | 150 | mA |
| I_{REF} | Reference Input Current | | -0.050 to +10 | mA |
| T_J | Operating Junction Temperature | | +150 | °C |
| T_{ST} | Storage Temperature | | -55 to +150 | °C |
| P_D | Power Dissipation (Notes 3, 4) | SOT23 | 330 | mW |
| | | SOT25 | 500 | mW |

Notes:

2. Operation above the absolute maximum rating may cause device failure. Operation at the absolute maximum ratings, for extended periods, may reduce device reliability. Unless otherwise stated voltages specified are relative to the ANODE pin.
3. T_J , max =150°C.
4. Ratings apply to ambient temperature at 25°C.

Recommended Operating Conditions

| Symbol | Parameter | Min | Max | Unit |
|----------|-------------------------------|-----------|-----|------|
| V_{KA} | Cathode Voltage | V_{REF} | 36 | V |
| I_{KA} | Cathode Current | 0.065 | 100 | mA |
| T_A | Operating Ambient Temperature | -40 | 125 | °C |

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

| Symbol | Parameter | Test Conditions | Min | Typ. | Max | Unit |
|--|---|--|---|-------|-------|--------------------|
| V_{REF} | Reference voltage | $V_{KA} = V_{REF}$, $I_{KA} = 10\text{mA}$ | ZXRE250A 2.470 | 2.495 | 2.520 | V |
| | | | ZXRE250B 2.482 | 2.495 | 2.507 | V |
| V_{DEV} | Deviation of reference voltage over full temperature range (Note 5) | $V_{KA} = V_{REF}$, $I_{KA} = 10\text{mA}$ | $T_A = 0 \text{ to } 70^\circ\text{C}$ | 6 | 16 | mV |
| | | | $T_A = -40 \text{ to } 85^\circ\text{C}$ | 14 | 34 | mV |
| | | | $T_A = -40 \text{ to } 125^\circ\text{C}$ | 14 | 34 | mV |
| $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ | Ratio of the change in reference voltage to the change in cathode voltage | $I_{KA} = 10\text{mA}$ | $V_{KA} = 10\text{V to } V_{REF}$ | -1.4 | -2.7 | mV/V |
| | | | $V_{KA} = 36\text{V to } 10\text{V}$ | -1 | -2 | mV/V |
| I_{REF} | Reference input current | $I_{KA} = 10\text{mA}$, $R1 = 10\text{K}\Omega$, $R2 = \infty$ | | 1 | 4 | μA |
| ΔI_{REF} | I_{REF} deviation over full temperature range (Note 5) | $I_{KA} = 10\text{mA}$, $R1 = 10\text{K}\Omega$, $R2 = \infty$ | $T_A = 0 \text{ to } 70^\circ\text{C}$ | 0.8 | 1.2 | μA |
| | | | $T_A = -40 \text{ to } 85^\circ\text{C}$ | 0.8 | 2.5 | μA |
| | | | $T_A = -40 \text{ to } 125^\circ\text{C}$ | 0.8 | 2.5 | μA |
| $I_{KA(MIN)}$ | Minimum cathode current for regulation | $V_{KA} = V_{REF}$ | | 40 | 65 | μA |
| $I_{KA(OFF)}$ | Off-state current | $V_{KA} = 36\text{V}$, $V_{REF} = 0\text{V}$ | | 0.05 | 0.5 | μA |
| $ Z_{KA} $ | Dynamic output impedance (Note 6) | $V_{KA} = V_{REF}$, $f = 0\text{Hz}$ | | 0.2 | 0.5 | Ω |
| θ_{JA} | Thermal Resistance Junction to Ambient | SOT23 | | 380 | | $^\circ\text{C/W}$ |
| | | SOT25 | | 250 | | $^\circ\text{C/W}$ |

Notes: 5. Deviation of V_{DEV} , and ΔI_{REF} are defined as the maximum variation of the values over the full temperature range.

The average temperature coefficient of the reference input voltage αV_{REF} is defined as:

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

Where:

$T_2 - T_1$ = full temperature change.

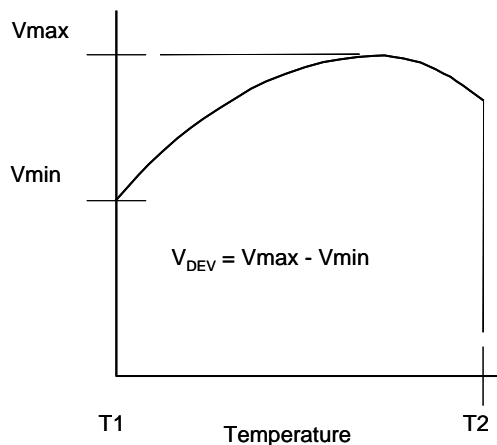
αV_{REF} can be positive or negative depending on whether the slope is positive or negative.

Notes: 6. 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 $R2$, the dynamic output impedance of the overall circuit, is defined as:

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



Test Circuits

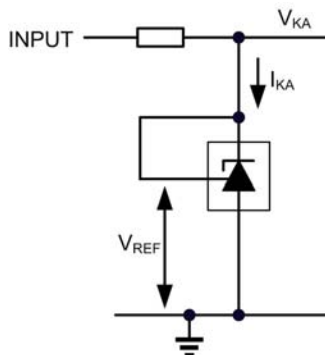


Figure 1. Test circuit for $V_{KA} = V_{REF}$

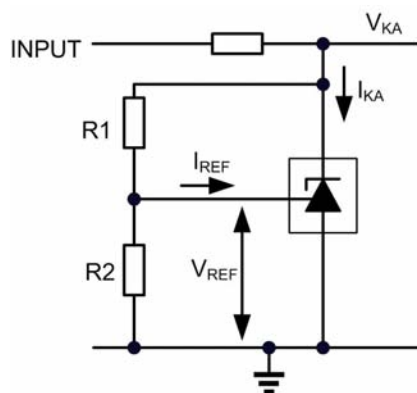


Figure 2. Test circuit for $V_{KA} > V_{REF}$

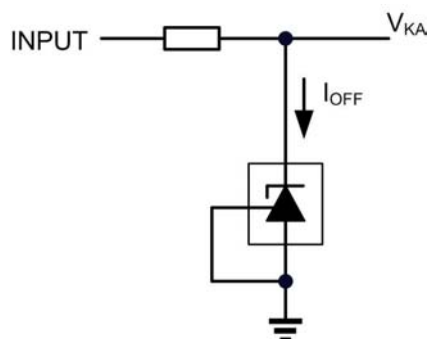
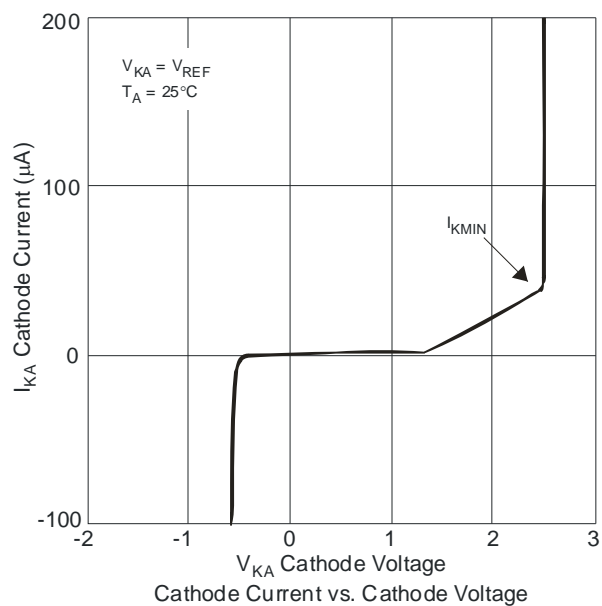
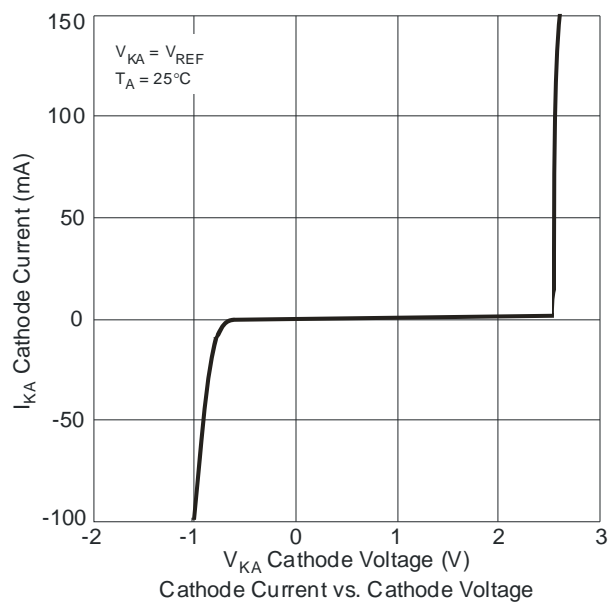
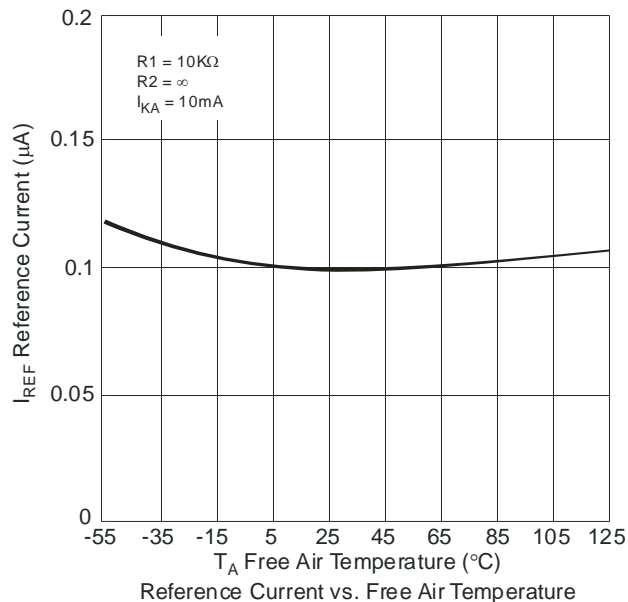
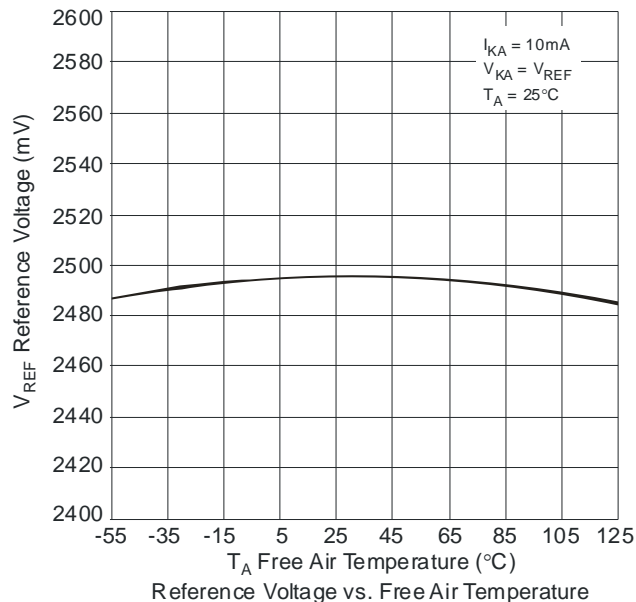
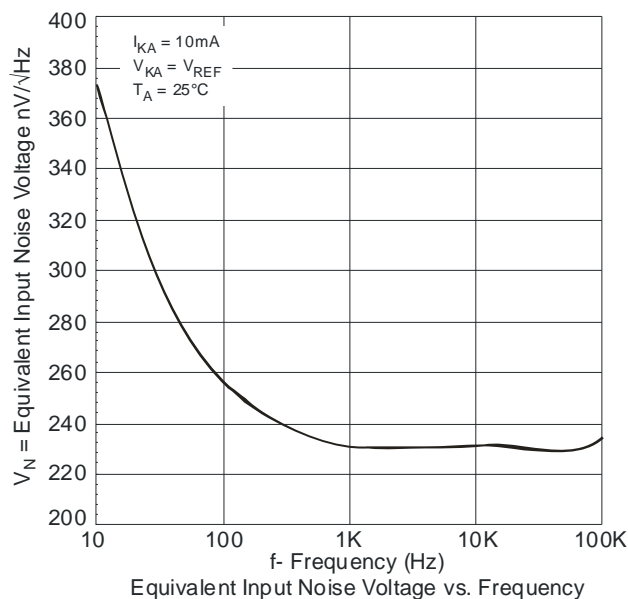
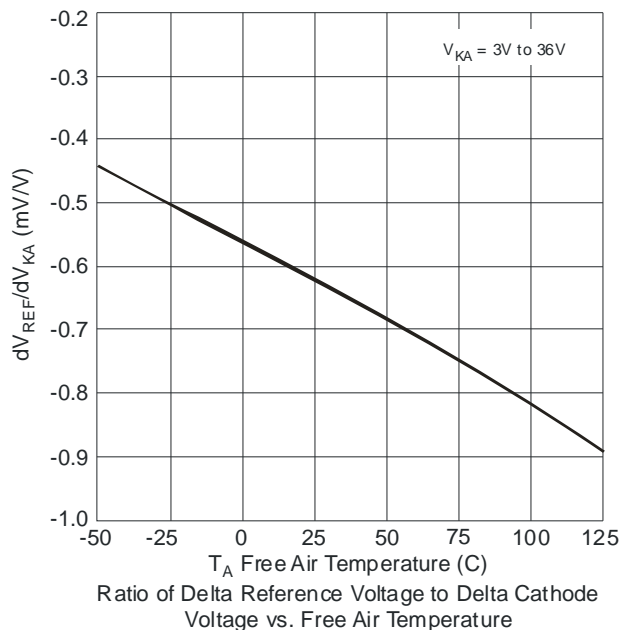
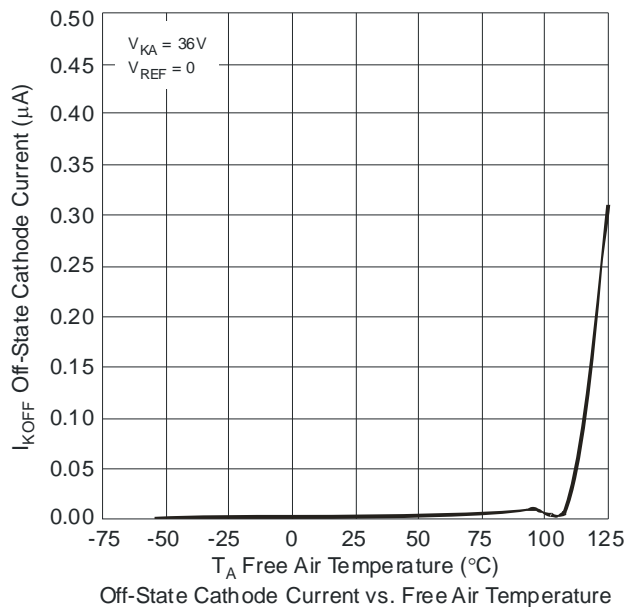


Figure 3. Test circuit for I_{OFF}

Typical Performance Characteristics



Typical Performance Characteristics (cont.)



Typical Performance Characteristics (cont.)

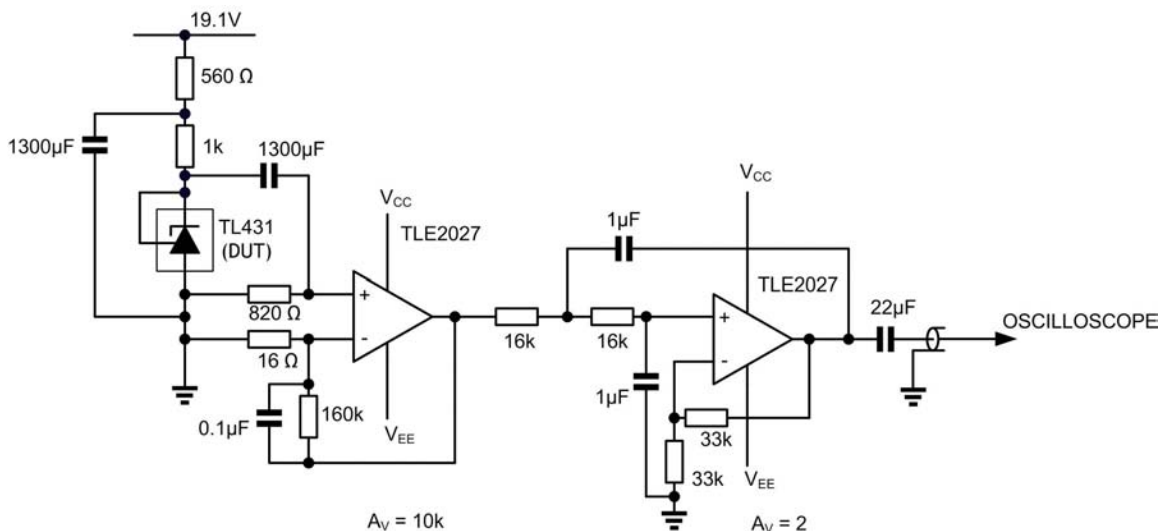
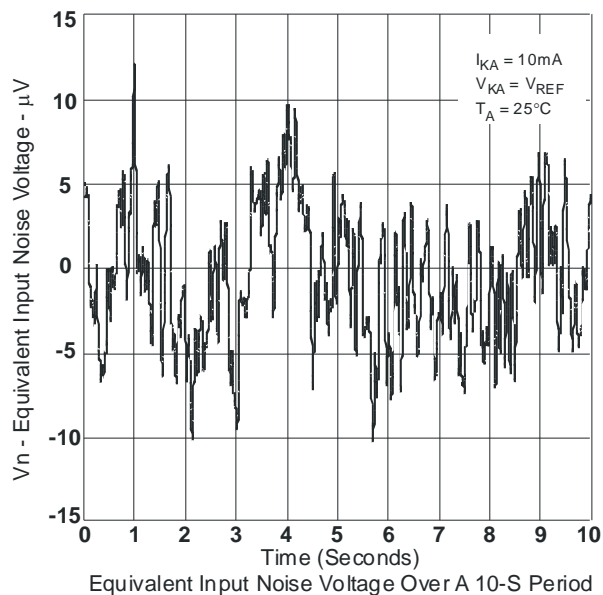
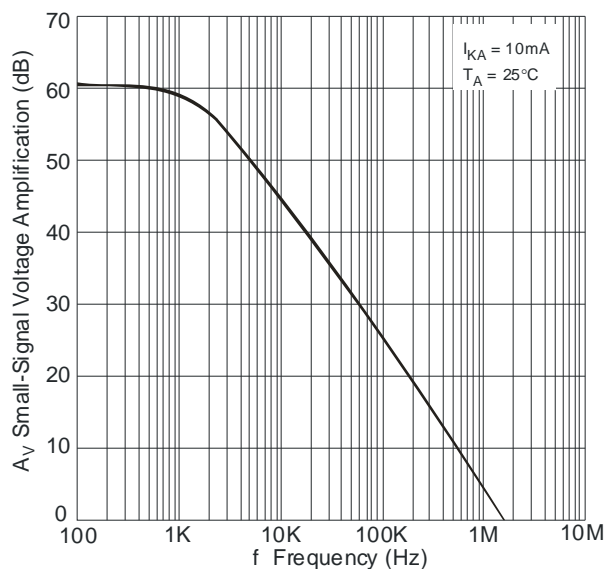
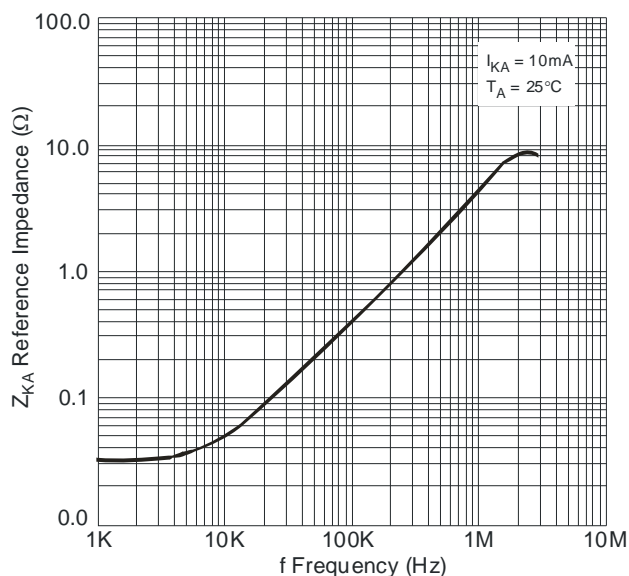


Figure 4. Test circuit for noise input voltage

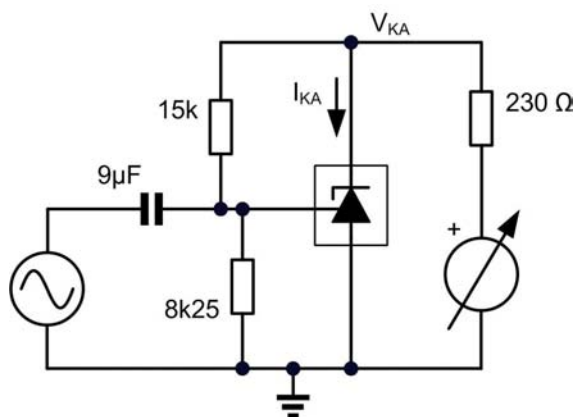
Typical Performance Characteristics (cont.)



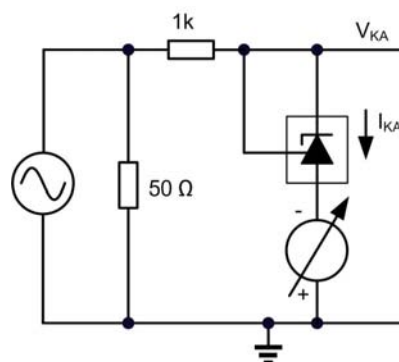
Small-Signal Voltage Amplification vs. Frequency



Reference Impedance vs. Frequency

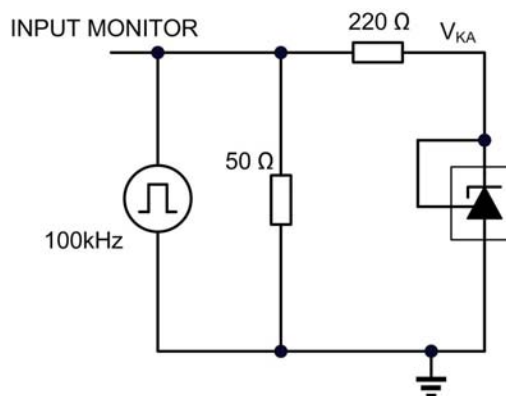
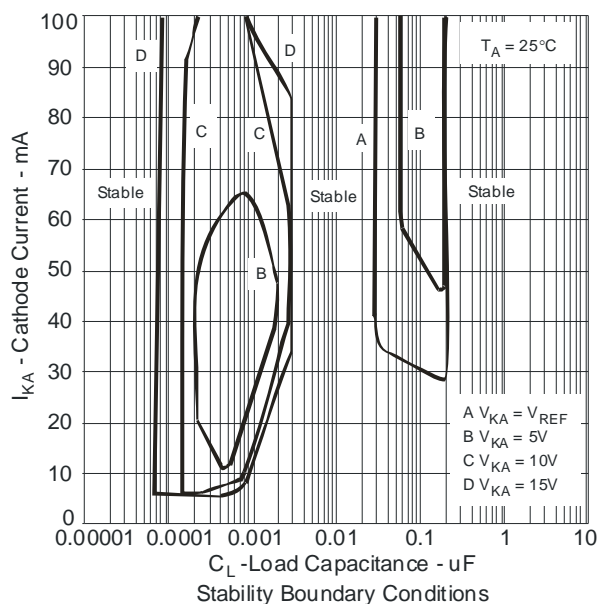
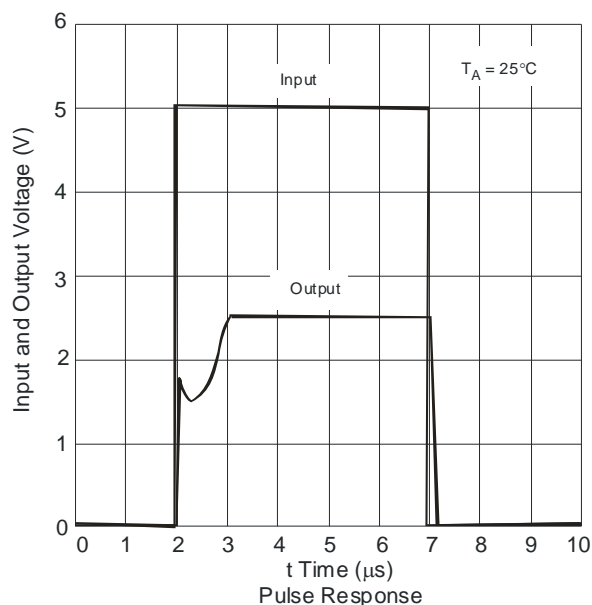


Test circuit for voltage amplification

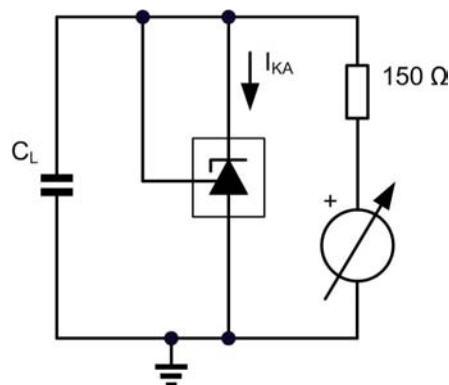


Test circuit for reference impedance

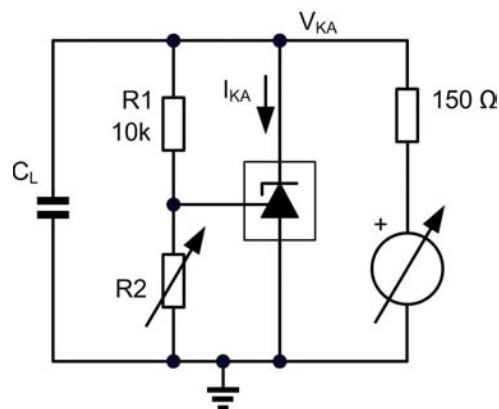
Typical Performance Characteristics (cont.)



Test Circuit for Pulse Response



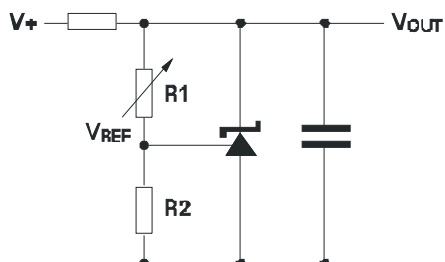
Test Circuit for Curve A



Test Circuit for Curves B, C, D

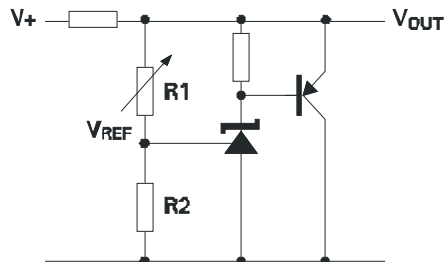
The device is stable under all conditions with a load capacitance not exceeding 50pF. The device is stable under all conditions with a load capacitance between 5nF and 20nF. The device is stable under all conditions with a load capacitance exceeding 300nF. With a cathode current not exceeding 5mA, the device is stable with any load capacitance.

Applications Information



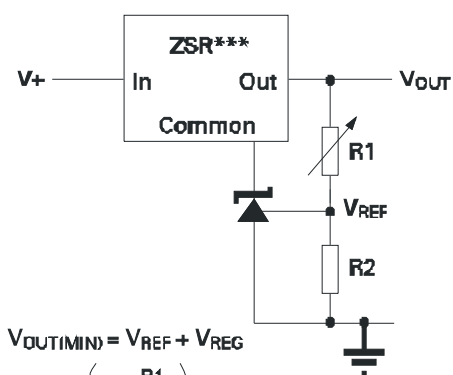
$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

Shunt Regulator



$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

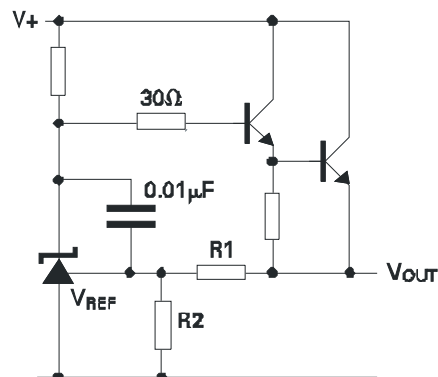
**Higher Current
Shunt Regulator**



$$V_{OUT(MIN)} = V_{REF} + V_{REG}$$

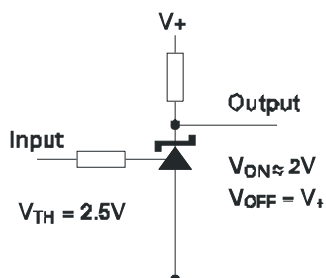
$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

**Output Control of a Three
Terminal Fixed Regulator**

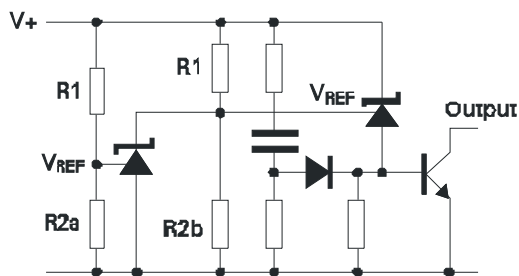


$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

Series Regulator



**Single Supply Comparator
with Temperature
Compensated Threshold**

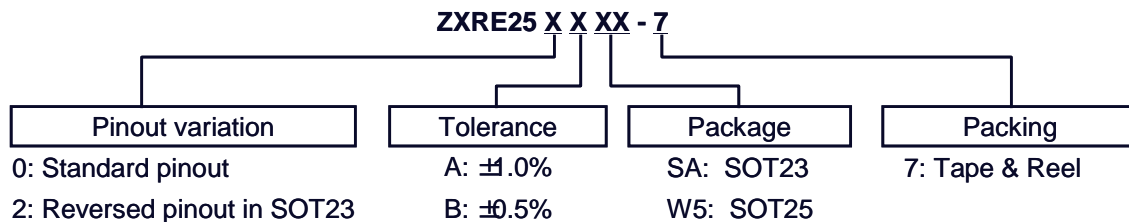





$$\text{Low limit} = \left(1 + \frac{R1B}{R2B}\right) V_{REF}$$

$$\text{High limit} = \left(1 + \frac{R1A}{R2A}\right) V_{REF}$$

**Over Voltage / Under
Voltage Protection Circuit**

Ordering Information



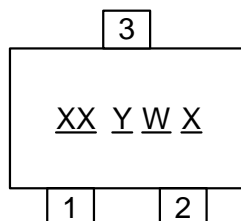
| Device (Note 7) | Package Code | Packaging (Note 5) | 7" Tape and Reel | | Ammo Box | |
|---|-----------------|-----------------------|------------------|-----------------------|----------|-----------------------|
| | | | Quantity | Part Number Suffix | Quantity | Part Number Suffix |
|  ZXRE250A(B)SA-7 | SA | SOT23 | 3000/Tape & Reel | -7 | NA | NA |
|  ZXRE250A(B)W5-7 | W5 | SOT25 | 3000/Tape & Reel | -7 | NA | NA |
|  ZXRE252A(B)SA-7 | SA | SOT23 | 3000/Tape & Reel | -7 | NA | NA |

Notes: 7. 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>.
8. Suffix (B) denotes ZXRE250B (0.5% tolerance) device.

Marking Information

(1) SOT23

(Top View)



XX : Identification code

Y : Year 0~9

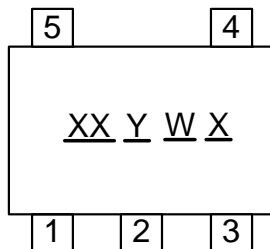
W : Week : A~Z : 1~26 week;
a~z : 27~52 week; z represents
52 and 53 week

X : A~Z : Green

| Device | Package | Identification Code |
|------------|---------|---------------------|
| ZXRE250ASA | SOT23 | DA |
| ZXRE250BSA | SOT23 | DB |
| ZXRE252ASA | SOT23 | FA |
| ZXRE252BSA | SOT23 | FB |

(2) SOT25

(Top View)



XX : Identification code

Y : Year 0~9

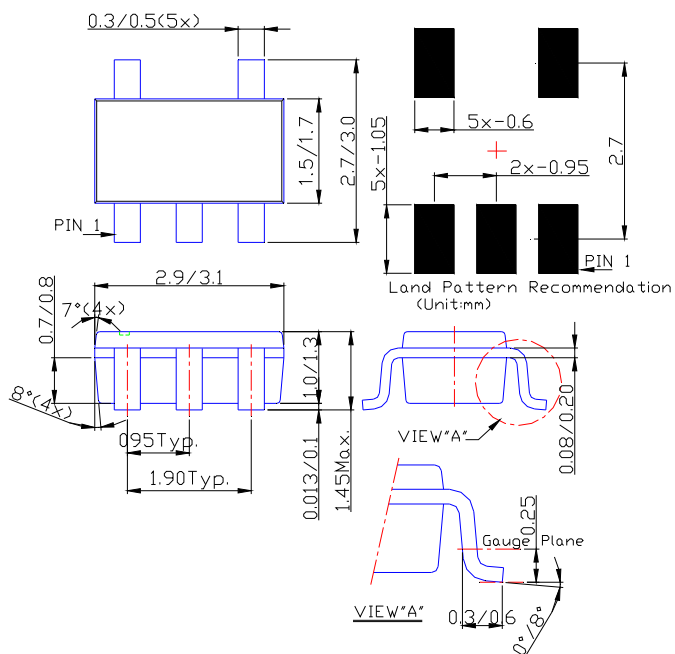
W : Week : A~Z : 1~26 week;
a~z : 27~52 week; z represents
52 and 53 week

X : A~Z : Green

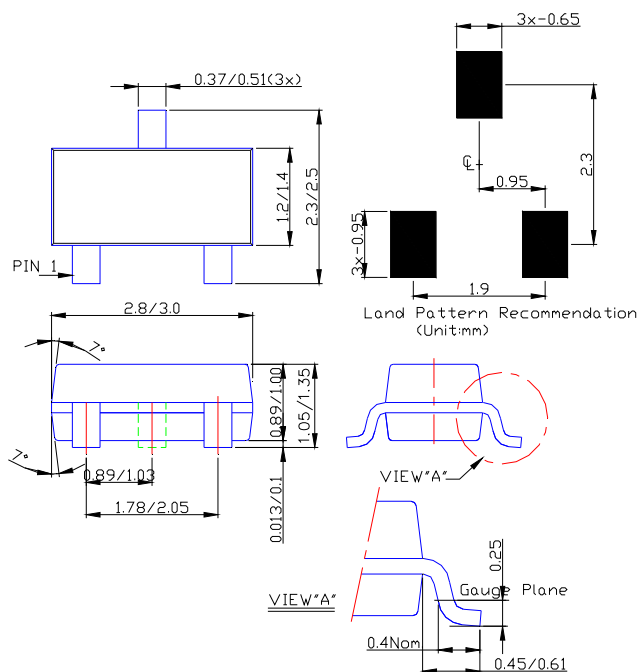
| Device | Package | Identification Code |
|------------|---------|---------------------|
| ZXRE250AW5 | SOT25 | DA |
| ZXRE250BW5 | SOT25 | DB |

Package Outline Dimensions (All Dimensions in mm)

(1) Package type: SOT25



(2) Package Types: SOT23



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