## Absolute Maximum Ratings (Note 4)

| 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 5, 6) | SOT23 | 330 | mW |
| | | SOT25 | 500 | |
| | | SO-8* | 700 | |

Notes: 4. 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.
5. $T_{J, MAX}$ =150°C.
6. 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 | 1 | 100 | mA |
| $T_A$ | Operating Ambient Temperature | -40 | +125 | °C |

## Electrical Characteristics ($T_A$ = +25°C, unless otherwise noted)

| Symbol | Parameter | Test Conditions | | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{REF}$ | Reference voltage | $V_{KA} = V_{REF}$, $I_{KA}$ = 10mA | TL431A | 2.470 | 2.495 | 2.520 | V |
| | | | TL431B | 2.482 | 2.495 | 2.507 | |
| $V_{DEV}$ | Deviation of reference voltage over full temperature range (Note 5) | $V_{KA} = V_{REF}$, $I_{KA}$ = 10mA | $T_A$ = 0 to 70°C | | 6 | 16 | mV |
| | | | $T_A$ = -40 to +85°C | | 14 | 34 | |
| | | | $T_A$ = -40 to +125°C | | 14 | 34 | |
| $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ | Ratio of the change in reference voltage to the change in cathode voltage | $I_{KA}$ = 10mA | $V_{KA}$ = 10V to $V_{REF}$ | | -1.4 | -2.7 | mV/V |
| | | | $V_{KA}$ = 36V to 10V | | -1 | -2 | |
| $I_{REF}$ | Reference input current | $I_{KA}$ = 10mA, R1 = 10KΩ, R2 = ∞ | | | 1 | 4 | μA |
| $\Delta I_{REF}$ | $I_{REF}$ deviation over full temperature range (Note 7) | $I_{KA}$ = 10mA, R1 = 10KΩ, R2 = ∞ | $T_A$ = 0 to 70°C | | 0.8 | 1.2 | μA |
| | | | $T_A$ = -40 to +85°C | | 0.8 | 2.5 | |
| | | | $T_A$ = -40 to +125°C | | 0.8 | 2.5 | |
| $I_{KA(MIN)}$ | Minimum cathode current for regulation | $V_{KA} = V_{REF}$ | | | 0.4 | 0.7 | mA |
| $I_{KA(OFF)}$ | Off-state current | $V_{KA}$ = 36V, $V_{REF}$ = 0V | | | 0.05 | 0.5 | μA |
| $\lvert Z_{KA} \rvert$ | Dynamic output impedance (Note 8) | $V_{KA} = V_{REF}$, f = 0Hz | | | 0.2 | 0.5 | Ω |
| $\theta_{JA}$ | Thermal Resistance Junction to Ambient | SOT23 | | | 380 | | °C/W |
| | | SOT25 | | | 250 | | |
| | | SO-8* | | | 70 | | |

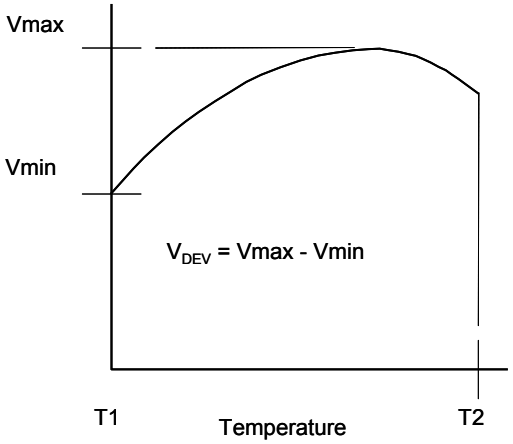
Notes: 7. Deviation of $V_{DEV}$, and $\Delta I_{REF}$ are defined as the maximum variation of the values over the full temperature range.

The average temperature coefficient of the reference input voltage $\alpha V_{REF}$ is defined as:

$$\lvert \alpha V_{REF} \rvert = \frac{\left( \frac{V_{DEV}}{V_{REF} @ 25°C} \right) X\ 10^6}{T2 - T1} \text{ ppm/°C}$$

Where:
T2 – T1 = full temperature change.

$\alpha V_{REF}$ can be positive or negative depending on whether the slope is positive or negative.




Notes: 8. The dynamic output impedance, $R_Z$, is defined as:

$$\lvert Z_{KA} \rvert = \frac{\Delta V_{KA}}{\Delta I_{KA}}$$

When the device is programmed with two external resistors R1 and R2, the dynamic output impedance of the overall circuit, is defined as:

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

## Test Circuits

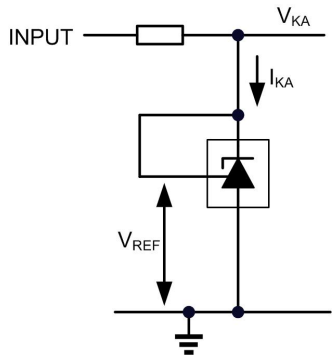



**Figure 1. Test circuit for $V_{KA} = V_{REF}$**

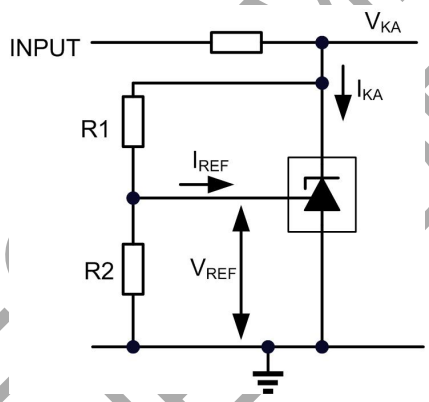



**Figure 2. Test circuit for $V_{KA} > V_{REF}$**

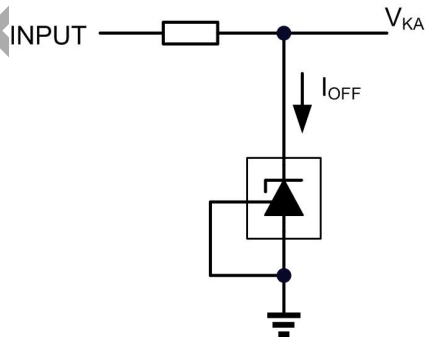
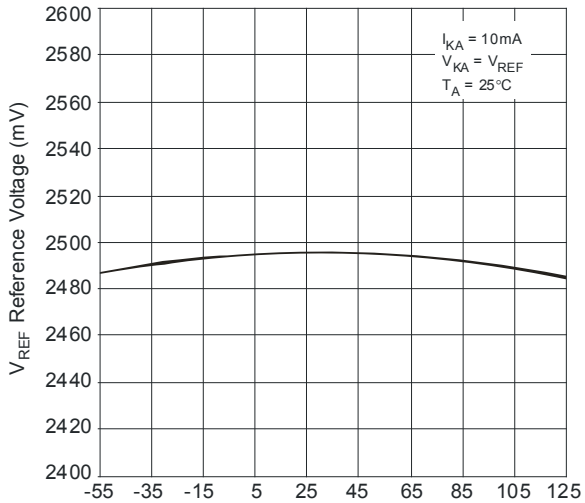
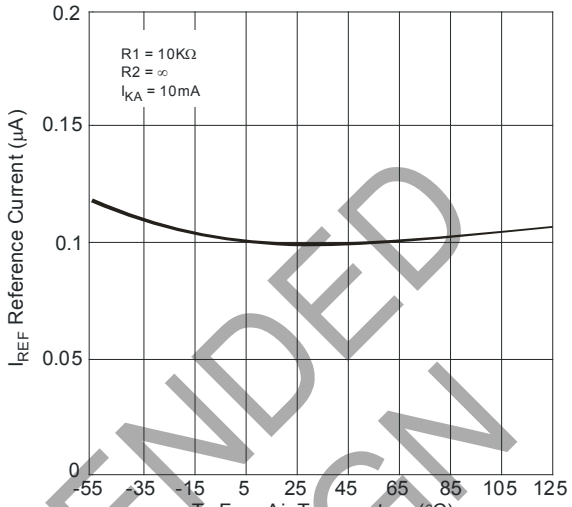



**Figure 3. Test circuit for $I_{OFF}$**

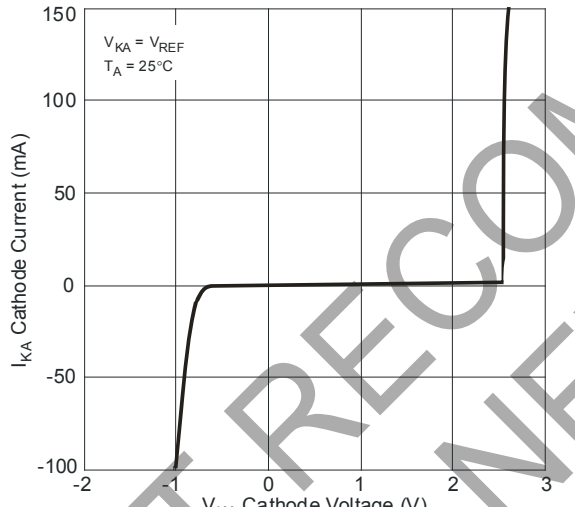
## Typical Performance Characteristics



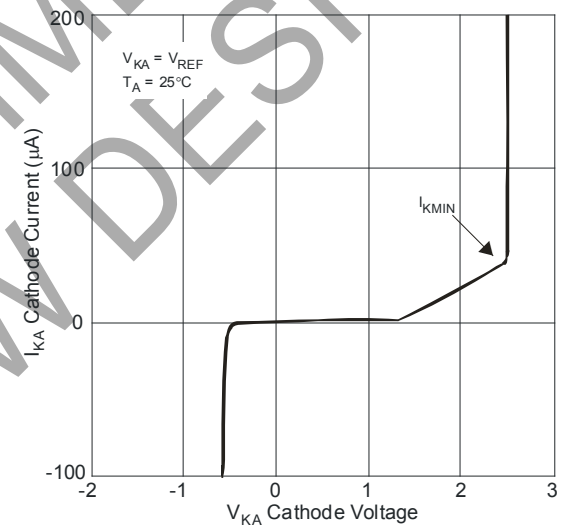
Reference Voltage vs. Free Air Temperature



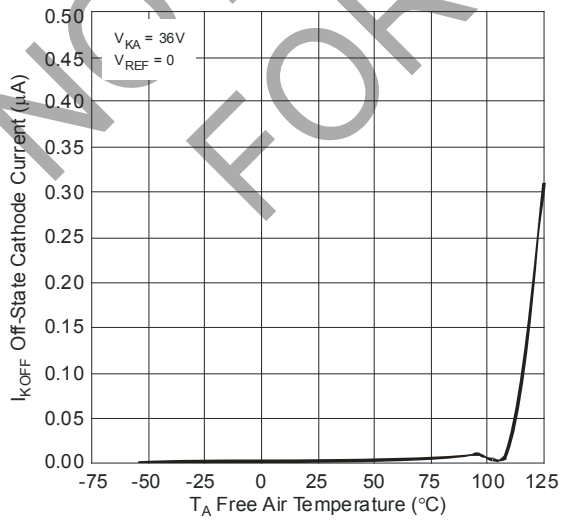
Reference Current vs. Free Air Temperature



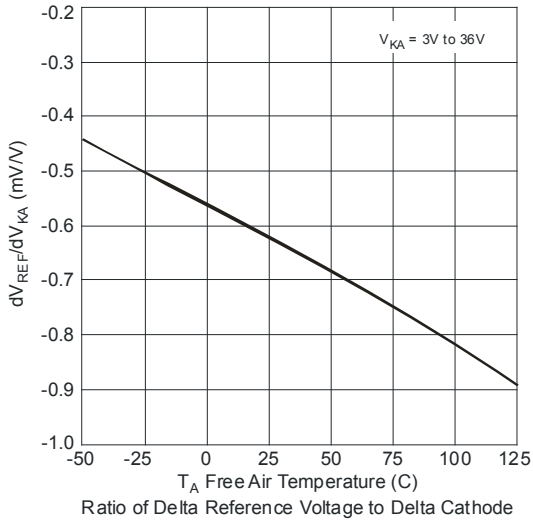
Cathode Current vs. Cathode Voltage



Cathode Current vs. Cathode Voltage

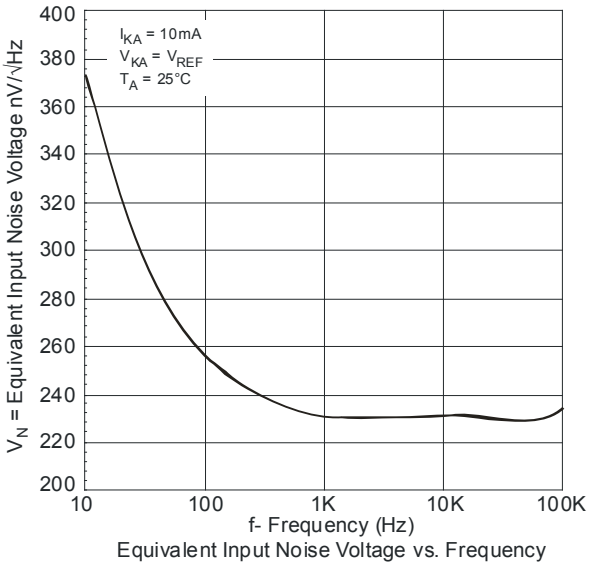


Off-State Cathode Current vs. Free Air Temperature

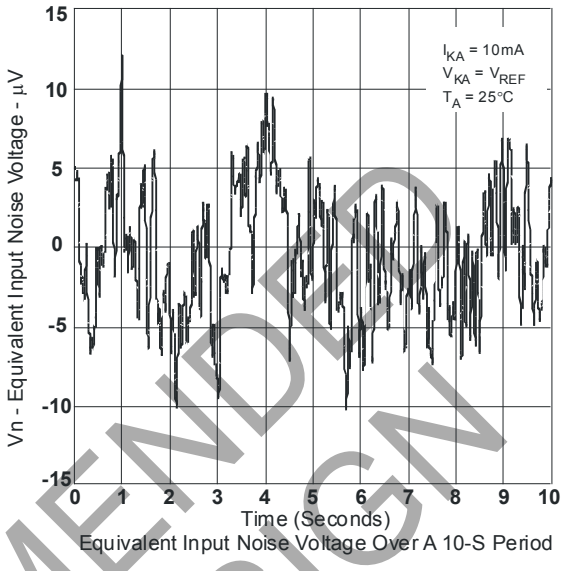


Ratio of Delta Reference Voltage to Delta Cathode Voltage vs. Free Air Temperature

## Typical Performance Characteristics (cont.)



Equivalent Input Noise Voltage vs. Frequency



Equivalent Input Noise Voltage Over A 10-S Period

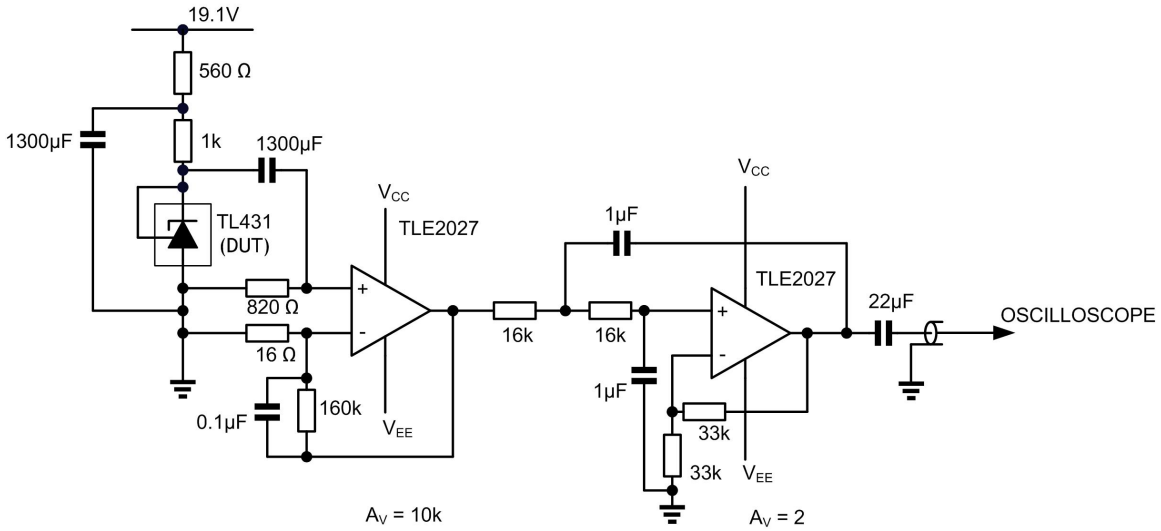
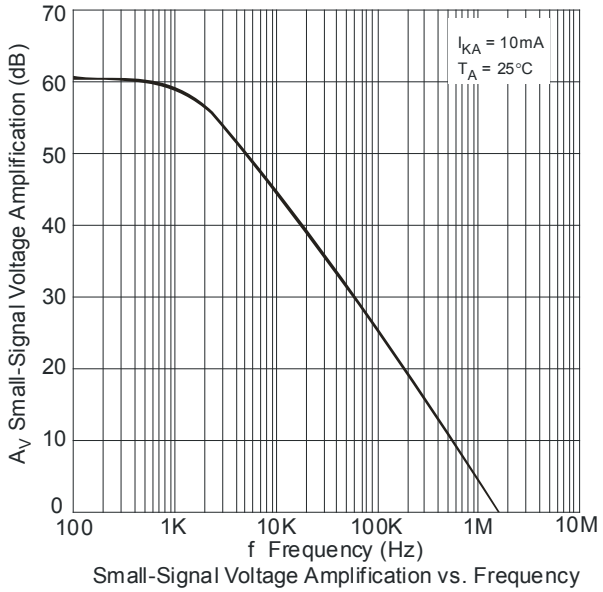
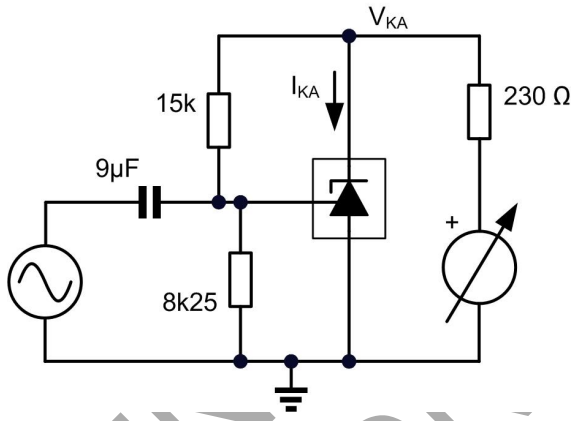



**Figure 4. Test circuit for noise input voltage**

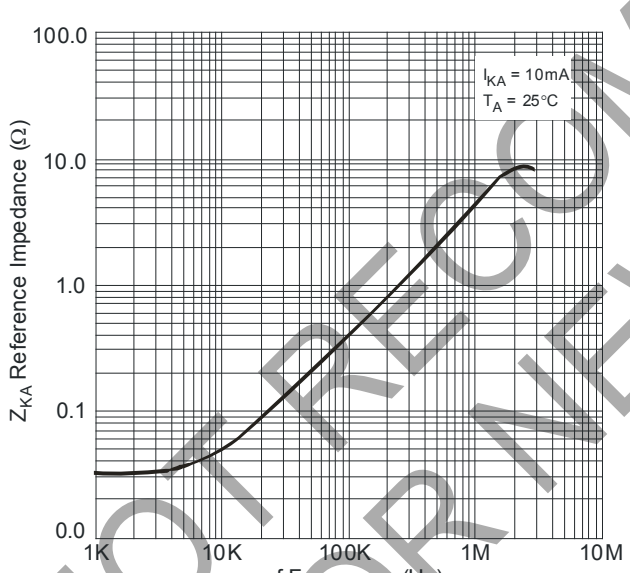
## Typical Performance Characteristics (cont.)



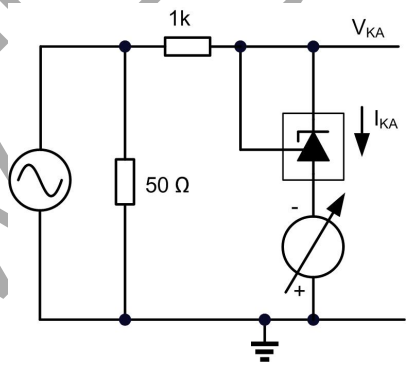

Small-Signal Voltage Amplification vs. Frequency




**Test circuit for voltage amplification**

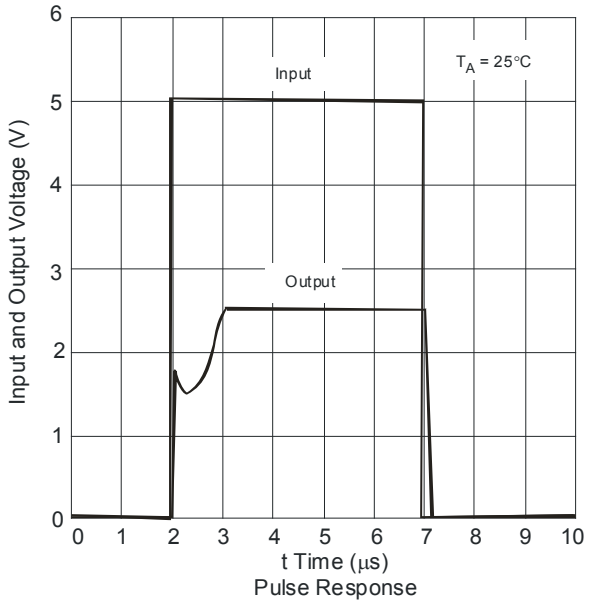


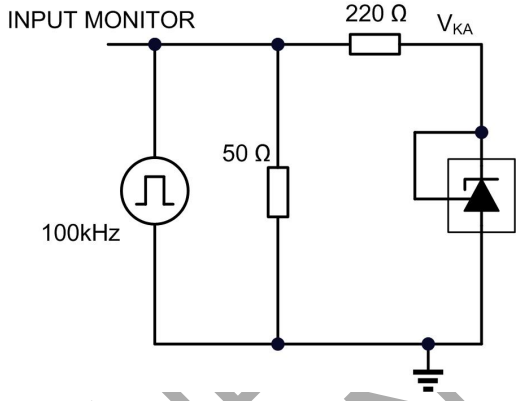

Reference Impedance vs. Frequency



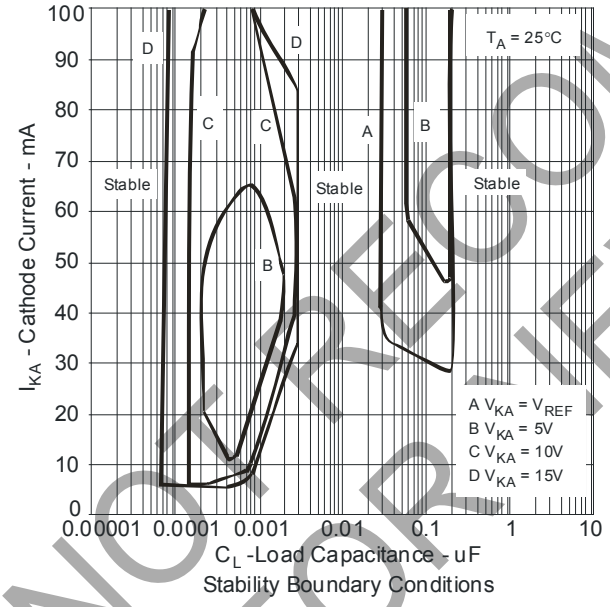

**Test circuit for reference impedance**

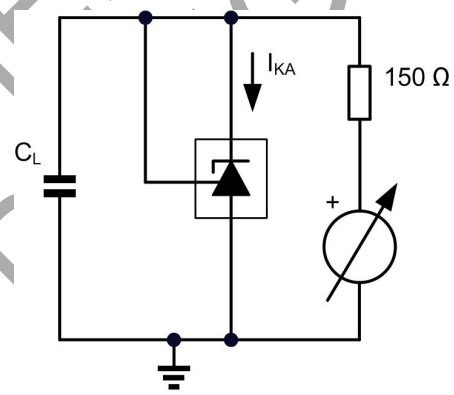
## Typical Performance Characteristics (cont.)



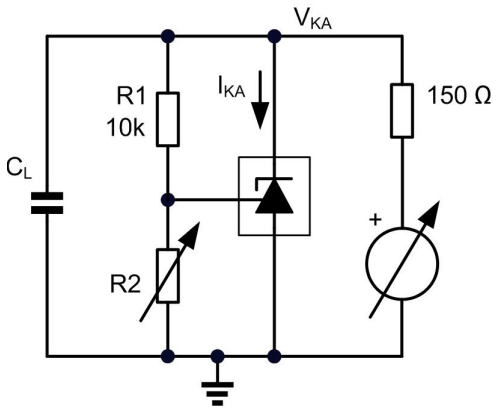




**Test Circuit for Pulse Response**



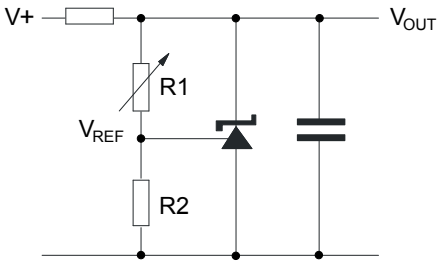

**Test Circuit for Curve A**




**Test Circuit for Curves B, C, D**

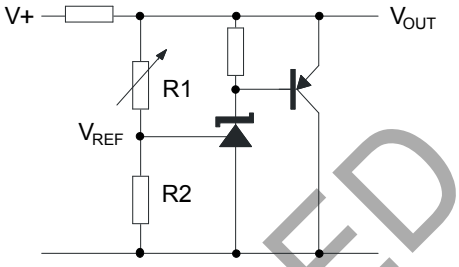
The device is stable under all conditions with a load capacitance not exceeding 50pF. The device is stable under all conditions with a load capacitance between 5nF and 20nF. The device is stable under all conditions with a load capacitance exceeding 300nF. With a cathode current not exceeding 5mA, the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

## Applications Information



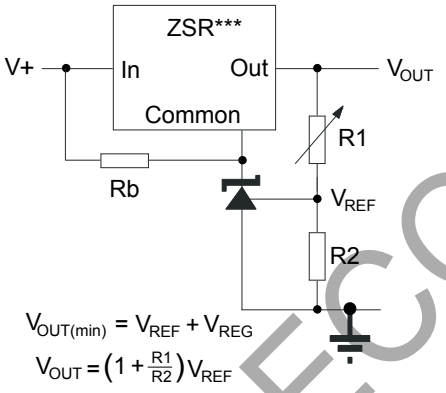

$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

**Shunt Regulator**




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

**Higher Current Shunt Regulator**

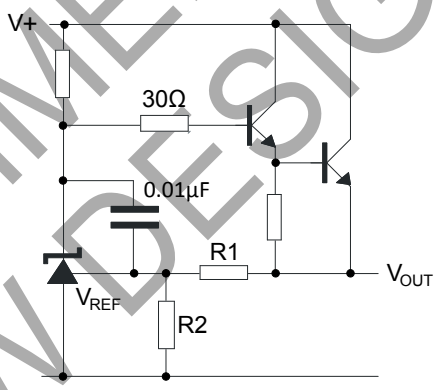



$$V_{OUT(min)} = V_{REF} + V_{REG}$$

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

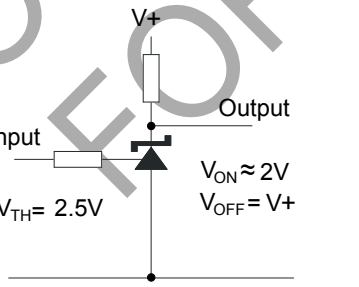
Rb - Optional to provide minimum cathode current

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

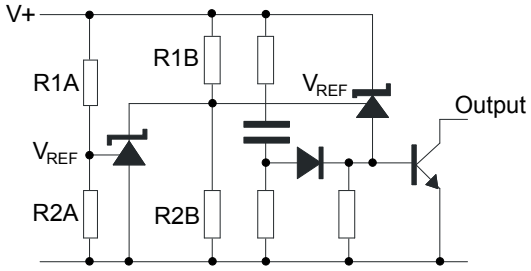



$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) V_{REF}$$

**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

TL43 X X XX - 7

| Pinout Variation | Tolerance | Package | Packing |
|---|---|---|---|
| 1: Standard pinout | A: ±1.0% | SA: SOT23 | 7: Tape & Reel |
| 2: Reversed pinout in SOT23 | B: ±0.5% | W5: SOT25 | 13: Tape & Reel |
| | | S: SO-8 | |

| Device | Package Code | Packaging (Note 9) | 7" Tape and Reel | | Ammo Box | |
|---|---|---|---|---|---|---|
| | | | Quantity | Part Number Suffix | Quantity | Part Number Suffix |
| TL431A(B)SA-7 | SA | SOT23 | 3000/Tape & Reel | -7 | NA | NA |
| TL431A(B)W5-7 | W5 | SOT25 | 3000/Tape & Reel | -7 | NA | NA |
| TL431A(B)S-13* | S | SO-8* | 2500/Tape & Reel | -13 | NA | NA |
| TL432A(B)SA-7 | SA | SOT23 | 3000/Tape & Reel | -7 | NA | NA |

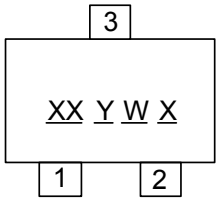
* Suffix "B" denotes TL431B device.

Notes: 9. 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.

## Marking Information

### (1) SOT23

( Top View )

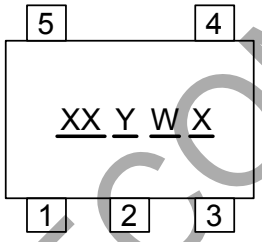



XX : Identification code
Y : Year 0~9
W : Week : A~Z : 1~26 week;
a~z : 27~52 week; z represents
52 and 53 week
X : A~Z : Green

| Device | Package | Identification Code |
|---|---|---|
| TL431ASA | SOT23 | AA |
| TL431BSA | SOT23 | AB |
| TL432ASA | SOT23 | BA |
| TL432BSA | SOT23 | BB |

### (2) SOT25

( Top View )

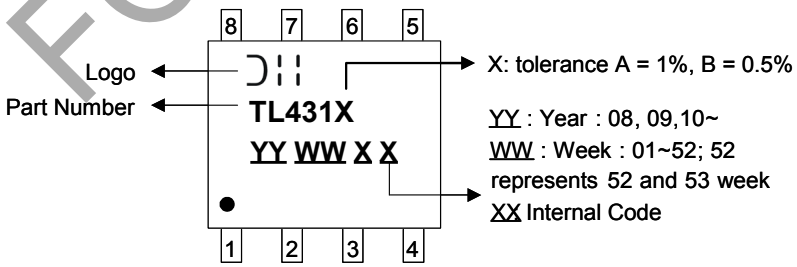



XX : Identification code
Y : Year 0~9
W : Week : A~Z : 1~26 week;
a~z : 27~52 week; z represents
52 and 53 week
X : A~Z : Green

| Device | Package | Identification Code |
|---|---|---|
| TL431AW5 | SOT25 | AA |
| TL431BW5 | SOT25 | AB |

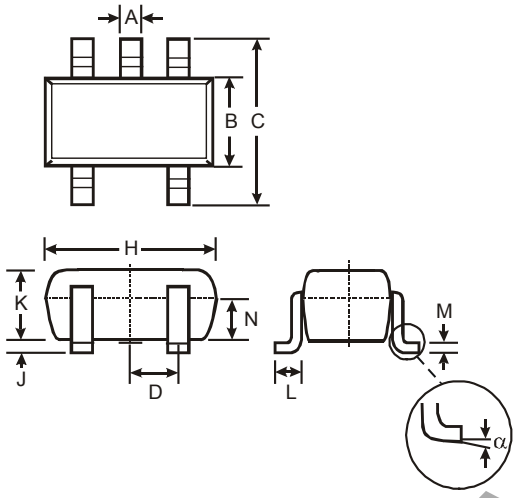
### (3) SO-8*

(Top View)



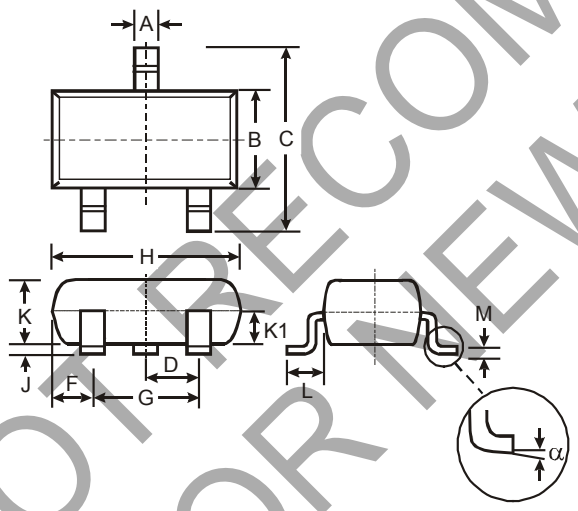
## Package Outline Dimensions (All Dimensions in mm)

### (1) Package type: SOT25




| SOT25 | | | |
|---|---|---|---|
| Dim | Min | Max | Typ |
| A | 0.35 | 0.50 | 0.38 |
| B | 1.50 | 1.70 | 1.60 |
| C | 2.70 | 3.00 | 2.80 |
| D | — | — | 0.95 |
| H | 2.90 | 3.10 | 3.00 |
| J | 0.013 | 0.10 | 0.05 |
| K | 1.00 | 1.30 | 1.10 |
| L | 0.35 | 0.55 | 0.40 |
| M | 0.10 | 0.20 | 0.15 |
| N | 0.70 | 0.80 | 0.75 |
| α | 0° | 8° | — |
| All Dimensions in mm | | | |

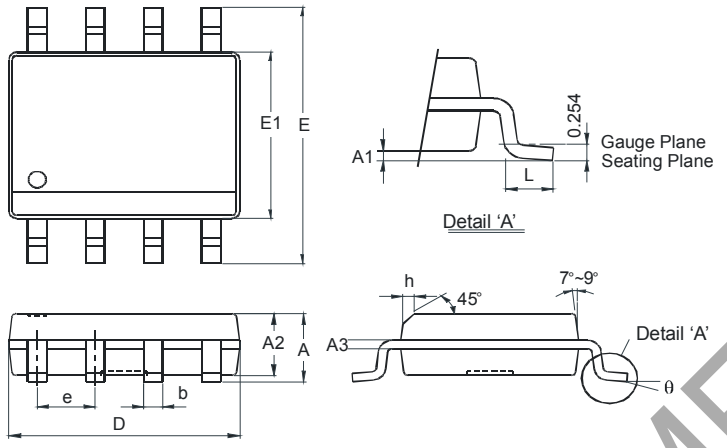
### (2) Package Types: SOT23




| SOT23 | | | |
|---|---|---|---|
| Dim | Min | Max | Typ |
| A | 0.37 | 0.51 | 0.40 |
| B | 1.20 | 1.40 | 1.30 |
| C | 2.30 | 2.50 | 2.40 |
| D | 0.89 | 1.03 | 0.915 |
| F | 0.45 | 0.60 | 0.535 |
| G | 1.78 | 2.05 | 1.83 |
| H | 2.80 | 3.00 | 2.90 |
| J | 0.013 | 0.10 | 0.05 |
| K | 0.903 | 1.10 | 1.00 |
| K1 | - | - | 0.400 |
| L | 0.45 | 0.61 | 0.55 |
| M | 0.085 | 0.18 | 0.11 |
| α | 0° | 8° | - |
| All Dimensions in mm | | | |

## Package Outline Dimensions (All Dimensions in mm)

### (3) Package Types: SO-8*




| SO-8* | | |
|---|---|---|
| **Dim** | **Min** | **Max** |
| **A** | - | 1.75 |
| **A1** | 0.10 | 0.20 |
| **A2** | 1.30 | 1.50 |
| **A3** | 0.15 | 0.25 |
| **b** | 0.3 | 0.5 |
| **D** | 4.85 | 4.95 |
| **E** | 5.90 | 6.10 |
| **E1** | 3.85 | 3.95 |
| **e** | 1.27 Typ | |
| **h** | - | 0.35 |
| **L** | 0.62 | 0.82 |
| **θ** | 0° | 8° |
| All Dimensions in mm | | |

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