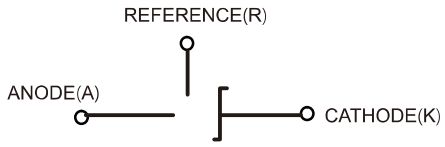
## Description

The TL431/TL431S are three-terminal adjustable shunt regulators with specified thermal stability .The output voltage may be set to any value between Vref and 36V with two external resistors . Active output circuitry provides a very sharp turnon characteristic,making these devices excellent replacements for zener diodes in many applications.

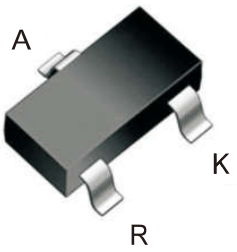



## Features

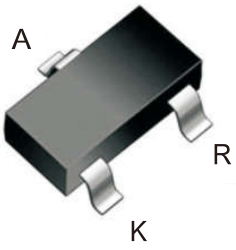
- The output voltage can be adjusted 2.5V to 36V
- The TL431/TL431S precision reference is offered in two voltage tolerance: 0.4% and 0.8%.
- Fast turn-on response
- Sink current capability 1mA to 100mA
- Industrial temperature range
- Low output noise

## Application

- Shunt regulor
- High-current shunt regulator
- Preceision current limiter




TL431




TL431S

SOT-23

| Marking Code | |
|---|---|
| TL431A | 431A |
| TL431B | 431B |
| TL431SA | 431SA |
| TL431SB | 431SB |

## Absolute Maximum Ratings (Note 1)

| Parameter | Symbols | Rating | Units |
|---|---|---|---|
| Cathode Voltage | $V_{KA}$ | 40 | V |
| Cathode Current Range (Continuous) | $I_{KA}$ | -100 ~ +150 | mA |
| Reference Input Current Range | $I_{REF}$ | 10 | mA |
| Power Dissipation | $P_D$ | Z, R Package: 770 | mW |
| | | N Package: 370 | |
| Thermal Resistance (Junction to Ambient) | $\theta_{JA}$ | 380 | °C/W |
| Junction Temperature | $T_J$ | 150 | °C |
| Storage Temperature Range | $T_{STG}$ | -65 ~ +150 | °C |
| ESD (Human Body Model) | ESD | 2000 | V |

Note 1: Stresses greater than those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “Recommended Operating Condi tions” is not implied. Exposure to “Absolute Maximum Ratings” for extended periods may affect device reliability.

## Recommended Operating Conditions

| Parameter | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| Cathode Voltage | $V_{KA}$ | VREF | 36 | V |
| Cathode Voltage | $I_{KA}$ | 1.0 | 100 | mA |
| Operating Ambient Temperature Range | $T_A$ | -40 | +125 | °C |

## Electrical Characteristics (@TA = +25°C, unless otherwise specified.)

| Parameter | | | Conditions | | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|---|---|
| Reference Voltage | 0.4% | TL431A | $V_{KA} = V_{REF}$, $I_{KA}$ = 10mA | | $V_{REF}$ | 2.49 | 2.50 | 2.51 | V |
| | | TL431SA | | | | | | | |
| | 0.8% | TL431B | | | | 2.48 | 2.50 | 2.52 | |
| | | TL431SB | | | | | | | |
| Deviation of Reference Voltage Over Full Temperature Range | | | $V_{KA} = V_{REF}$, $I_{KA}$ = 10mA | 0 to +70°C | $\Delta V_{REF}$ | - | 4.5 | 8 | mV |
| | | | | -40 to +85°C | | - | 4.5 | 10 | |
| | | | | -40 to +125°C | | - | 4.5 | 16 | |
| Ratio of Change in Reference Voltage to the Change in Cathode Voltage | | | $I_{KA}$ = 10mA | $\Delta V_{KA}$ = 10V to $V_{REF}$ | $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ | - | -1.0 | -2.7 | mV/V |
| | | | | $\Delta V_{KA}$ = 36V to 10V | | - | -0.5 | -2.0 | |
| Reference Current | | | $I_{KA}$ = 10mA, R1 = 10kΩ, R2 = ∞ | | $I_{REF}$ | - | 0.7 | 4 | μA |
| Deviation of Reference Current Over Full Temperature Range | | | $I_{KA}$ = 10mA, R1 = 10kΩ R2 = ∞, TA = -40 to +125°C | | $\Delta I_{REF}$ | - | 0.4 | 1.2 | μA |
| Minimum Cathode Current for Regulation | | | $V_{KA} = V_{REF}$ | | $I_{KA}$ (Min) | - | 0.4 | 1.0 | mA |
| Off-state Cathode Current | | | $V_{KA}$ = 36V, $V_{REF}$ = 0 | | $I_{KA}$ (Off) | - | 0.05 | 1.0 | μA |
| Dynamic Impedance | | | $V_{KA} = V_{REF}$, $I_{KA}$ = 1 to 100mA, f ≤ 1.0kHz | | $Z_{KA}$ | - | 0.15 | 0.5 | Ω |
| Thermal Resistance | | | SOT-23 | | $\theta_{JC}$ | - | 135.48 | - | °C/W |

FIGURE 1. TEST CIRCUIT FOR $V_{KA} = V_{REF}$

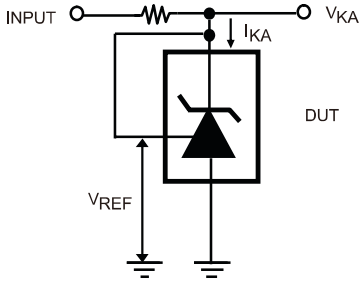



FIGURE 2. TEST CIRCUIT FOR $V_{KA} \geqslant V_{REF}$

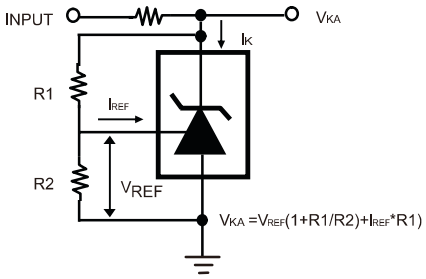



FIGURE 3. TEST CIRCUIT FOR $I_{KA}$ (OFF)

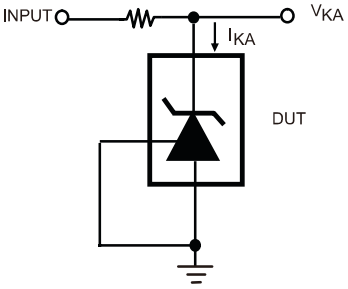



FIGURE 4. TEST CIRCUIT FOR PULSE RESPONSE

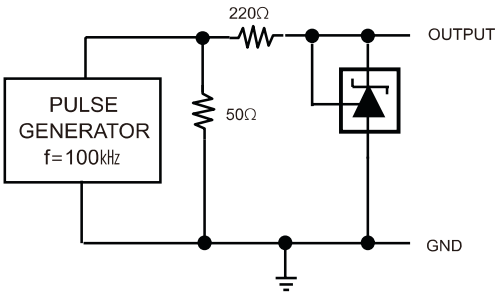
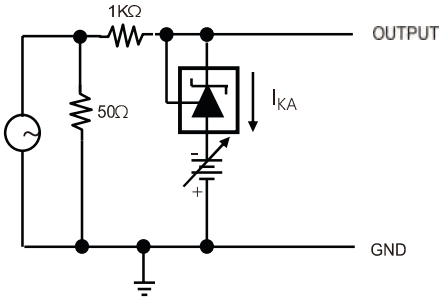



FIGURE 5. TEST CIRCUIT REFERENCE IMPEDANCE



## Typical Characteristics

Fig.1 FIGREFENCE VOLTAGE VS FPEE-AIR TEMPERATURE

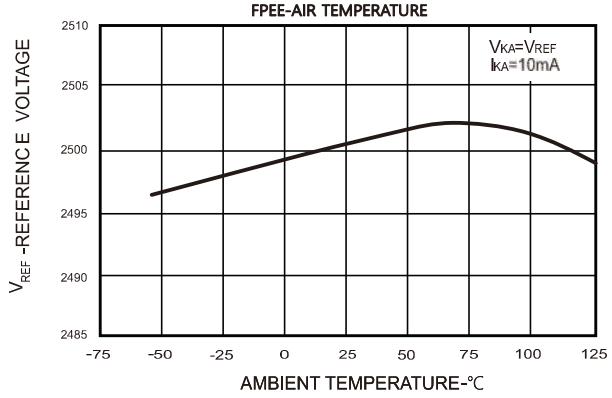



Fig.2 FIGREFENCE CURRENT VS FREE-AIR TEMPERATURE

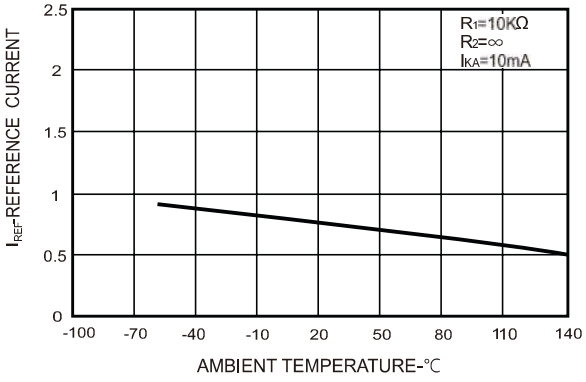



Fig.3 CATHODE CURRENT VS CATHODE VOLTAGE

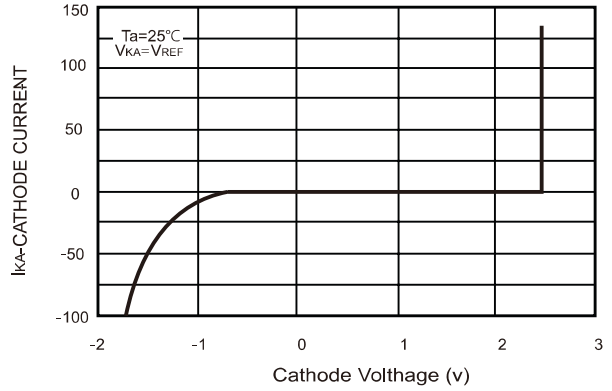



Fig.4 CATHODE CURRENT VS CATHODE VOLTAGE

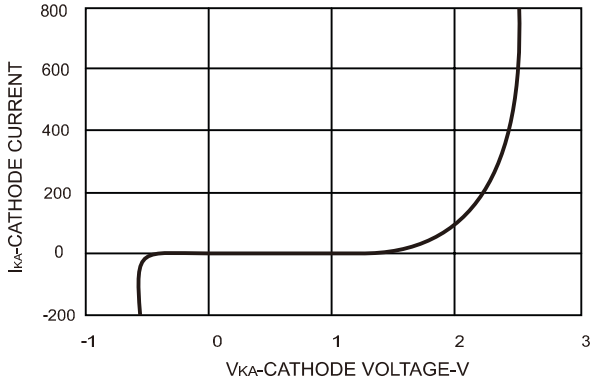



Fig.5 REFERENCE IMPEDANCE VS FREQUENCY

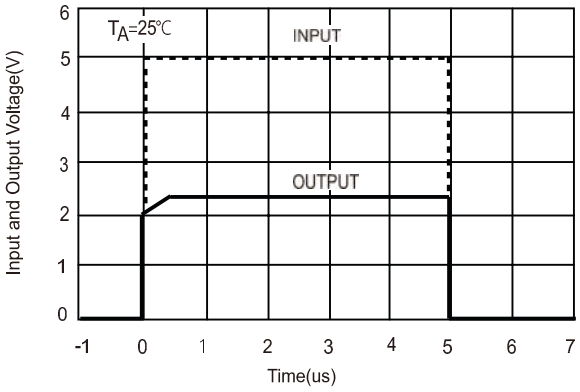
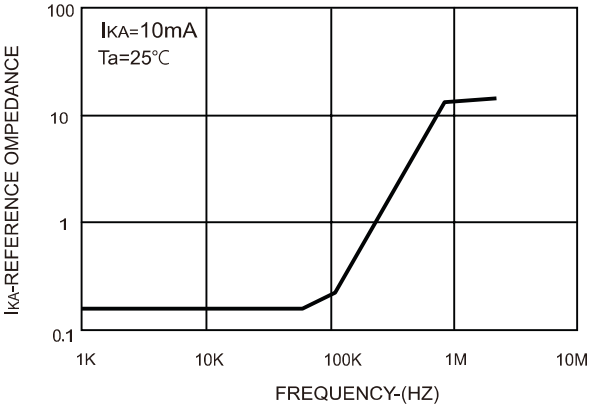



Fig.6 REFERENCE IMPEDANCE VS FREQUENCY

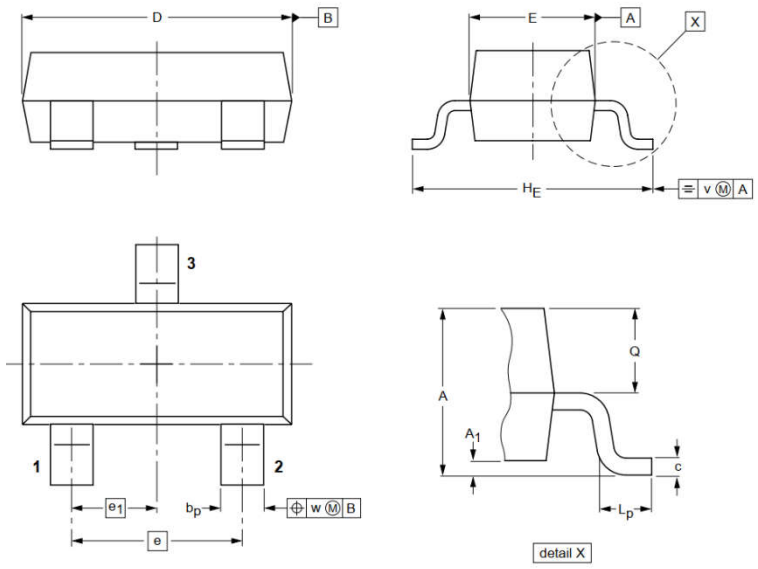


## Ordering information

| Package | Packing Description | Base Quantity | Packing Quantity |
|---|---|---|---|
| SOT-23 | Tape/Reel,7"reel | 3000pcs/Reel | 24000PCS/Box 120000PCS/Carton |

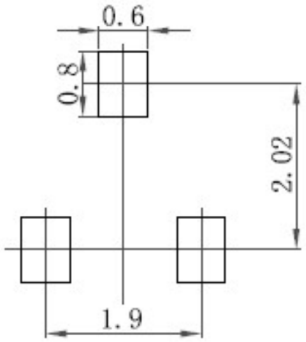
## Package Dimensions

**SOT-23**




| Dim. | Millimeter (mm) | | mil | |
|---|---|---|---|---|
| | Min. | Max. | Min. | Max. |
| A | 0.9 | 1.15 | 35 | 45 |
| A1 | 0.1 | | 3.9 | |
| bp | 0.38 | 0.48 | 15 | 19 |
| C | 0.09 | 0.15 | 3.54 | 5.9 |
| D | 2.8 | 3.1 | 110 | 122 |
| E | 1.2 | 1.4 | 47 | 55 |
| E | 1.9 | | 75 | |
| E1 | 0.95 | | 37 | |
| HE | 2.1 | 2.6 | 83 | 102 |
| Lp | 0.15 | 0.45 | 5.9 | 18 |
| Q | 0.45 | 0.55 | 18 | 22 |
| v | 0.2 | | 7.9 | |
| W | 0.1 | | 4 | |

## The recommended mounting pad size



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