

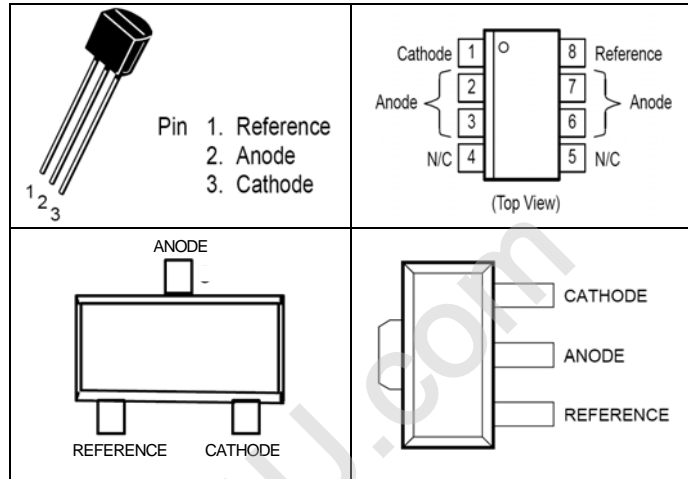
Programmable Precision Reference

TL431

FEATURES

- Programmable Output Voltage to 40V
- Low Dynamic Output Impedance 0.2Ω
- Sink Current Capability of 0.1 mA to 100 mA
- Equivalent Full-Range Temperature Coefficient of 50 ppm/°C
- Temperature Compensated for Operation over Full Rated Operating Temperature Range
- Low Output Noise Voltage
- Fast Turn on Response
- TO-92, SOP- 8, SOT-23, SOT-89 packages

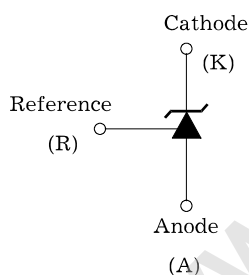
PIN CONNECTIONS



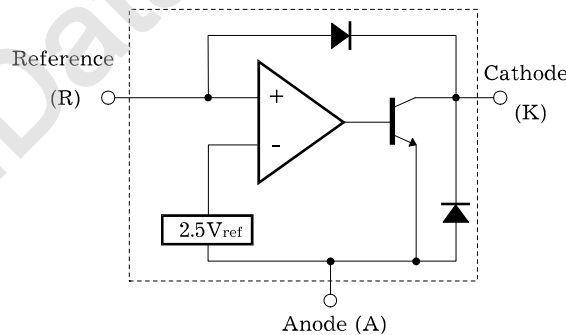
DESCRIPTION

The TL431 is a three-terminal adjustable regulator series with a guaranteed thermal stability over applicable temperature ranges. The output voltage may be set to any value between V_{ref} (approximately 2.5 volts) and 40 volts with two external resistors. These devices have a typical dynamic output impedance of 0.2Ω . Active output circuitry provides a very sharp turn-on characteristic, making these devices excellent replacement for zener diodes in many applications. The TL431 is characterized for operation from -25°C to $+85^\circ\text{C}$.

SYMBOL



FUNCTIONAL BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

(Operating temperature range applies unless otherwise specified)

| Characteristic | Symbol | Value | Unit |
|---|-----------|------------|------|
| Cathode Voltage | V_{KA} | 40 | V |
| Cathode Current Range (Continuous) | I_K | -100 ~ 150 | mA |
| Reference Input Current Range | I_{REF} | 0.05 ~ 10 | mA |
| Power Dissipation at 25°C: SOP, TO – 92 Package ($R_{\theta JA} = 178^\circ\text{C/W}$) SOT Package ($R_{\theta JA} = 625^\circ\text{C/W}$) | P_D | 0.7 0.2 | W |
| Junction Temperature Range | T_J | 0 ~ 150 | °C |
| Operating Temperature Range | T_g | -25 ~ +85 | °C |
| Storage Temperature Range | T_{stg} | -65 ~ +150 | °C |

RECOMMENDED OPERATING CONDITIONS

| Characteristic | Symbol | Test Condition | Min | Typ | Max | Unit |
|-----------------|----------|----------------|-----------|-----|-----|------|
| Cathode Voltage | V_{KA} | | V_{REF} | | 40 | V |
| Cathode Current | I_K | | 0.5 | | 100 | mA |

ELECTRICAL CHARACTERISTICS

($T_a = 25^{\circ}C$, $V_{KA} = V_{REF}$, $I_K = 10mA$ unless otherwise specified)

| Characteristic | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|--|--|-------------------------|-------------------------|-------------------------|----------|
| Reference Input Voltage | V_{REF} | $V_{KA} = V_{REF}$, $I_K = 10mA$ TL431 TL431-A TL431-C | 2.440 2.470 2.482 | 2.495 2.495 2.495 | 2.550 2.520 2.508 | V |
| Deviation of Reference Input Voltage Over Full Temperature Range | $V_{REF(dev)}$ | $T_{min} \leq T_a \leq T_{max}$ | | 3 | 17 | MV |
| Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage | $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ | $\Delta V_{KA} = 10V - V_{REF}$ $\Delta V_{KA} = 36V - 10V$ | | -1.4 -1.0 | -2.7 -2.0 | mV/V |
| Reference Input Current | I_{REF} | $R_1 = 10K\Omega$, $R_2 = \infty$ | | 1.8 | 4 | A |
| Deviation of Reference Input Current Over Full Temperature Range | $I_{REF(dev)}$ | $R_1 = 10K\Omega$, $R_2 = \infty$ | | 0.4 | 1.2 | A |
| Minimum Cathode Current for Regulation | $I_{K(min)}$ | | | 0.25 | 0.5 | mA |
| Off-State Cathode Current | $I_{K(off)}$ | $V_{KA} = 40V$, $V_{REF} = 0$ | | 0.26 | 0.9 | A |
| Dynamic Impedance | Z_{KA} | $I_K = 10mA$ to $100mA$, $f \leq 1.0KHz$ | | 0.22 | 0.5 | Ω |

TEST CIRCUITS

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

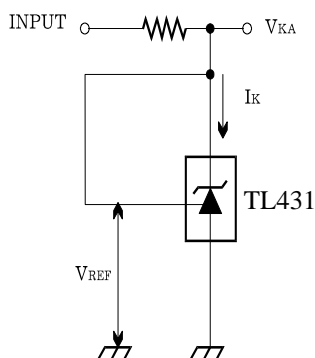


Fig.2. Test Circuit for $V_{KA} \geq V_{REF}$

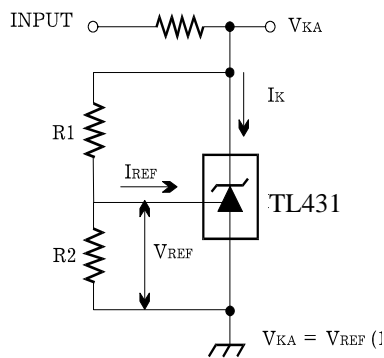
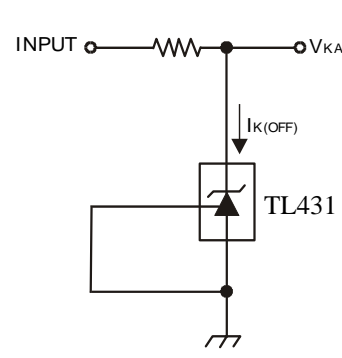


Fig.3. Test Circuit for I_{off}

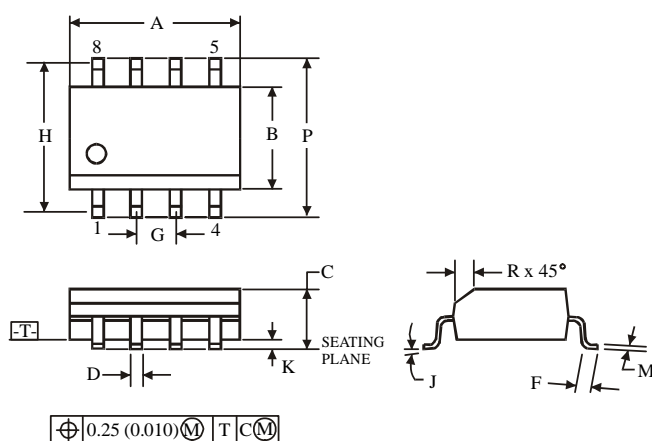
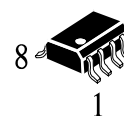


Ordering Information

| Product Number | Reference Input Voltage | Package |
|----------------------|-------------------------|---------|
| TL431CLF TL431CLS | 0.5% | TO-92 |
| TL431CD | | 8-SOP |
| TL431CS | | SOT-23 |
| TL431CP | | SOT-89 |
| TL431ALF TL431ALS | 1% | TO-92 |
| TL431AD | | 8-SOP |
| TL431AS | | SOT-23 |
| TL431AP | | SOT-89 |
| TL431LF TL431LS | 2% | TO-92 |
| TL431D | | 8-SOP |
| TL431S | | SOT-23 |
| TL431P | | SOT-89 |

Package Dimensions

D SUFFIX SOIC
(MS - 012AA)

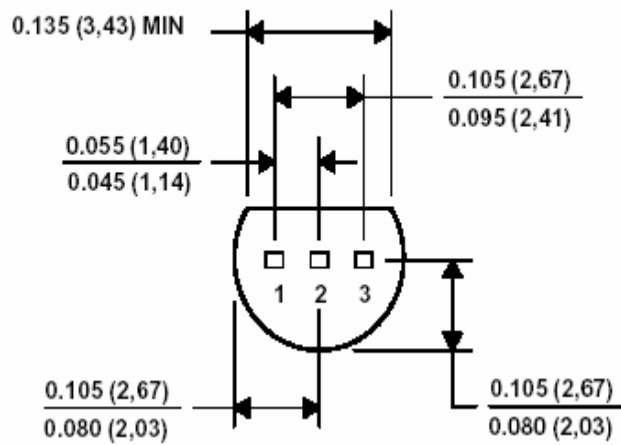
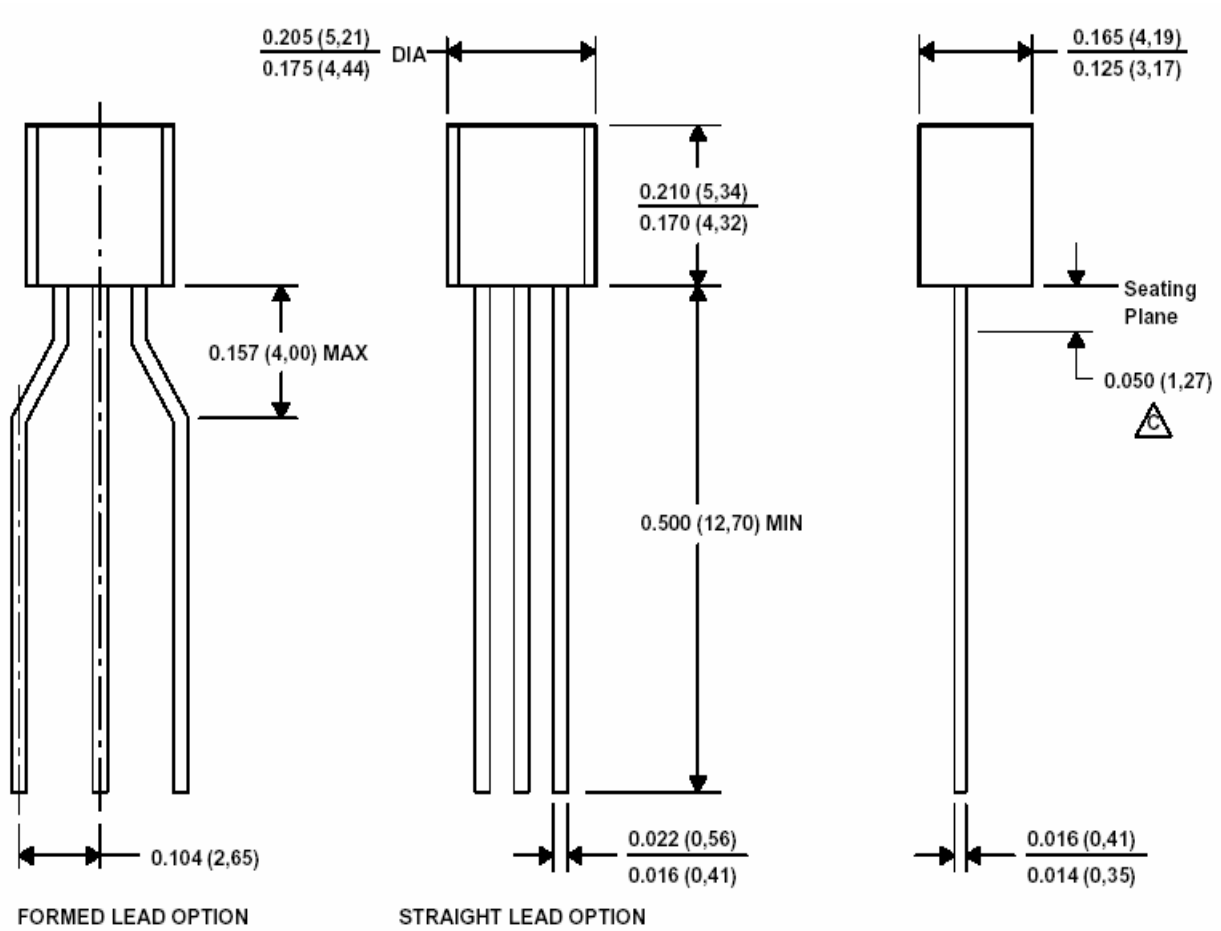


| Symbol | Dimension, mm | |
|--------|---------------|------|
| | MIN | MAX |
| A | 4.80 | 5.00 |
| B | 3.80 | 4.00 |
| C | 1.35 | 1.75 |
| D | 0.33 | 0.51 |
| F | 0.40 | 1.27 |
| G | 1.27 | |
| H | 5.72 | |
| J | 0° | 8° |
| K | 0.10 | 0.25 |
| M | 0.19 | 0.25 |
| P | 5.80 | 6.20 |
| R | 0.25 | 0.50 |

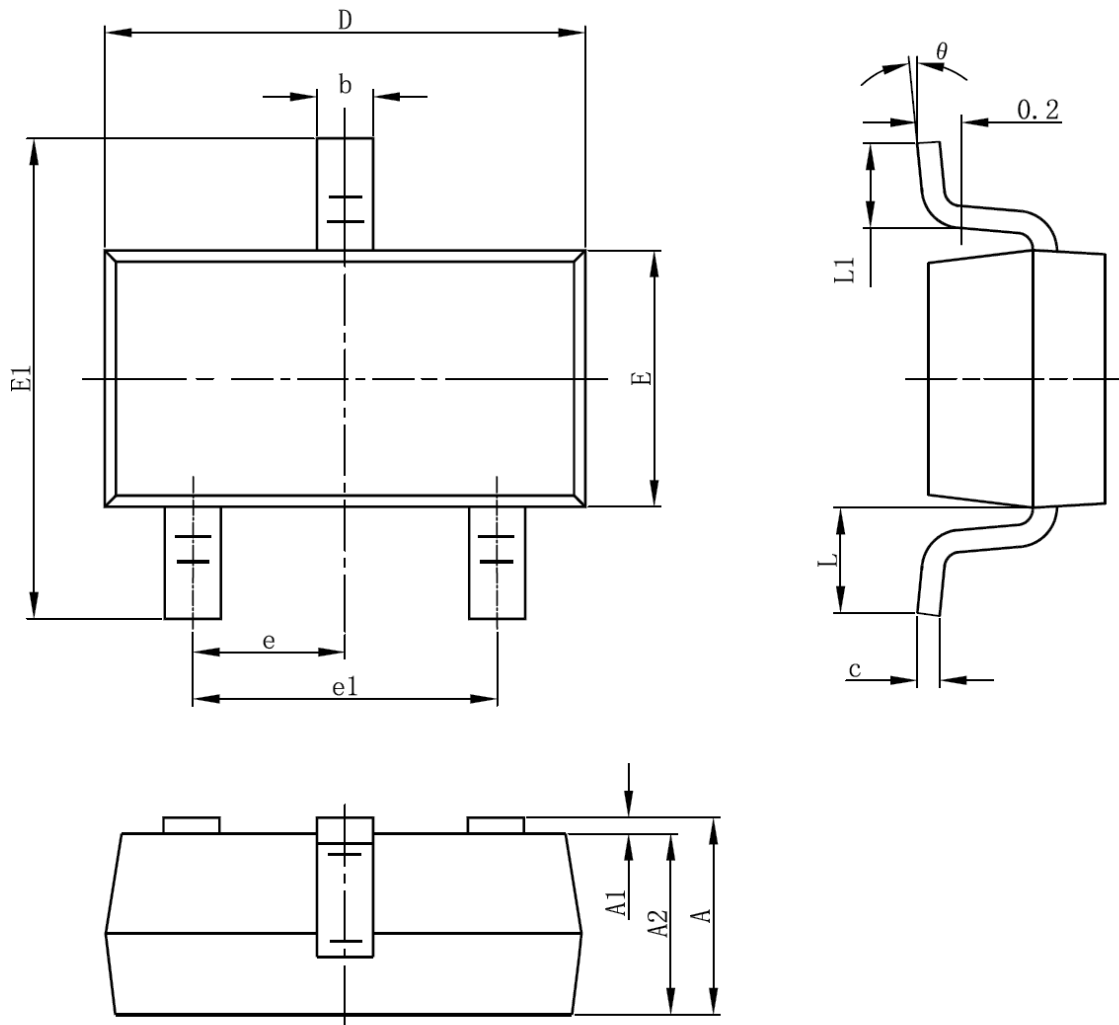
NOTES:

- Dimensions A and B do not include mold flash or protrusion.
- Maximum mold flash or protrusion 0.15 mm (0.006) per side for A; for B - 0.25 mm (0.010) per side.

TO-92

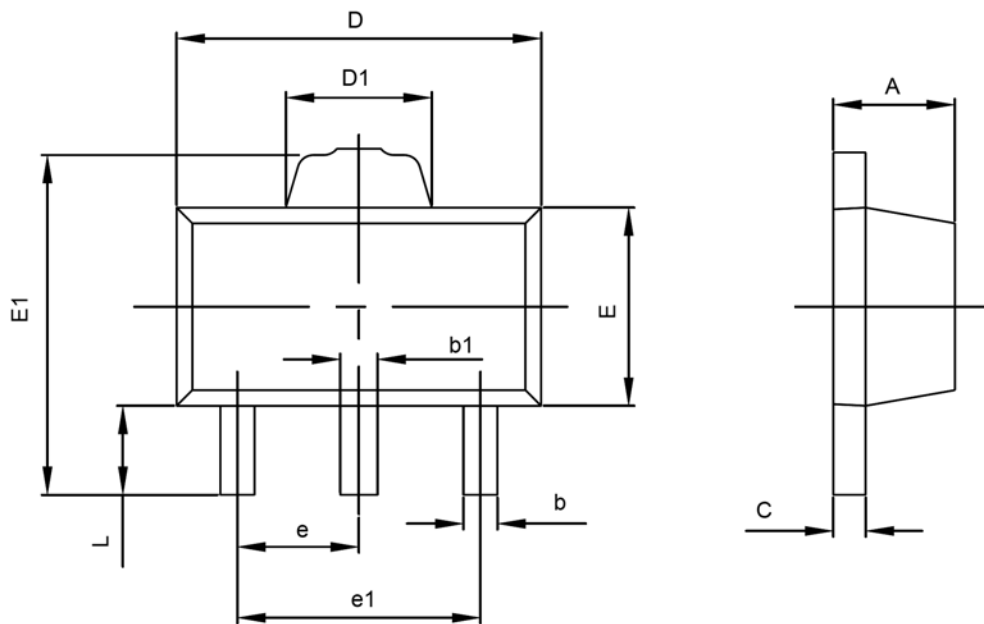


SOT-23-3L PACKAGE OUTLINE DIMENSIONS



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min | Max | Min | Max |
| A | 1.050 | 1.250 | 0.041 | 0.049 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 |
| b | 0.300 | 0.400 | 0.012 | 0.016 |
| c | 0.100 | 0.200 | 0.004 | 0.008 |
| D | 2.820 | 3.020 | 0.111 | 0.119 |
| E | 1.500 | 1.700 | 0.059 | 0.067 |
| E1 | 2.650 | 2.950 | 0.104 | 0.116 |
| e | 0.950TYP | | 0.037TYP | |
| e1 | 1.800 | 2.000 | 0.071 | 0.079 |
| L | 0.700REF | | 0.028REF | |
| L1 | 0.300 | 0.600 | 0.012 | 0.024 |
| θ | 0° | 8° | 0° | 8° |

SOT-89-3L PACKAGE OUTLINE DIMENSIONS



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min | Max | Min | Max |
| A | 1.400 | 1.600 | 0.055 | 0.063 |
| b | 0.320 | 0.520 | 0.013 | 0.020 |
| b1 | 0.360 | 0.560 | 0.014 | 0.022 |
| c | 0.350 | 0.440 | 0.014 | 0.017 |
| D | 4.400 | 4.600 | 0.173 | 0.181 |
| D1 | 1.400 | 1.800 | 0.055 | 0.071 |
| E | 2.300 | 2.600 | 0.091 | 0.102 |
| E1 | 3.940 | 4.250 | 0.155 | 0.167 |
| e | 1.500TYP | | 0.060TYP | |
| e1 | 2.900 | 3.100 | 0.114 | 0.122 |
| L | 0.900 | 1.100 | 0.035 | 0.043 |