

TLV431x Low-Voltage Adjustable Precision Shunt Regulator

1 Features

- Low-Voltage Operation, $V_{REF} = 1.24\text{ V}$
- Adjustable Output Voltage, $V_O = V_{REF}$ to 6 V
- Reference Voltage Tolerances at 25°C
 - 0.5% for TLV431B
 - 1% for TLV431A
 - 1.5% for TLV431
- Typical Temperature Drift
 - 4 mV (0°C to 70°C)
 - 6 mV (–40°C to 85°C)
 - 11 mV (–40°C to 125°C)
- Low Operational Cathode Current, 80 μA Typ
- 0.25- Ω Typical Output Impedance
- Ultra-Small SC-70 Package Offers 40% Smaller Footprint Than SOT-23-3
- See TLVH431 and TLVH432 for:
 - Wider V_{KA} (1.24 V to 18 V) and I_K (80 mA)
 - Additional SOT-89 Package
 - Multiple Pinouts for SOT-23-3 and SOT-89 Packages
- On Products Compliant to MIL-PRF-38535, All Parameters Are Tested Unless Otherwise Noted. On All Other Products, Production Processing Does Not Necessarily Include Testing of All Parameters.

2 Applications

- Adjustable Voltage and Current Referencing
- Secondary Side Regulation in Flyback SMPSs
- Zener Replacement
- Voltage Monitoring
- Comparator with Integrated Reference

3 Description

The TLV431 device is a low-voltage 3-terminal adjustable voltage reference with specified thermal stability over applicable industrial and commercial temperature ranges. Output voltage can be set to any value between V_{REF} (1.24 V) and 6 V with two external resistors (see [Figure 20](#)). These devices operate from a lower voltage (1.24 V) than the widely used TL431 and TL1431 shunt-regulator references.

When used with an optocoupler, the TLV431 device is an ideal voltage reference in isolated feedback circuits for 3-V to 3.3-V switching-mode power supplies. These devices have a typical output impedance of 0.25 Ω . Active output circuitry provides a very sharp turn-on characteristic, making them excellent replacements for low-voltage Zener diodes in many applications, including on-board regulation and adjustable power supplies.

Device Information⁽¹⁾

| PART NUMBER | PACKAGE (PIN) | BODY SIZE (NOM) |
|-------------|---------------|-------------------|
| TLV431x | SOT-23 (3) | 2.90 mm x 1.30 mm |
| | SOT-23 (5) | 2.90 mm x 1.60 mm |
| | SC70 (6) | 2.00 mm x 1.25 mm |
| | TO-92 (3) | 4.30 mm x 4.30 mm |
| | SOIC (8) | 4.90 mm x 3.90 mm |

(1) For all available packages, see the orderable addendum at the end of the data sheet.

4 Simplified Schematic

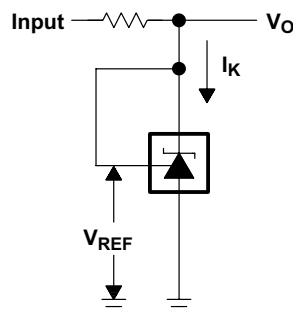


Table of Contents

| | | | |
|--|-----------|--|-----------|
| 1 Features | 1 | 9.1 Overview | 16 |
| 2 Applications | 1 | 9.2 Functional Block Diagram | 16 |
| 3 Description | 1 | 9.3 Feature Description | 16 |
| 4 Simplified Schematic | 1 | 9.4 Device Functional Modes | 17 |
| 5 Revision History | 2 | 10 Applications and Implementation | 18 |
| 6 Pin Configuration and Functions | 3 | 10.1 Application Information | 18 |
| 7 Specifications | 4 | 10.2 Typical Applications | 19 |
| 7.1 Absolute Maximum Ratings | 4 | 11 Power Supply Recommendations | 23 |
| 7.2 ESD Ratings | 4 | 12 Layout | 23 |
| 7.3 Thermal Information | 4 | 12.1 Layout Guidelines | 23 |
| 7.4 Recommended Operating Conditions | 4 | 12.2 Layout Example | 23 |
| 7.5 Electrical Characteristics for TLV431 | 5 | 13 Device and Documentation Support | 24 |
| 7.6 Electrical Characteristics for TLV431A | 6 | 13.1 Related Links | 24 |
| 7.7 Electrical Characteristics for TLV431B | 7 | 13.2 Trademarks | 24 |
| 7.8 Typical Characteristics | 8 | 13.3 Electrostatic Discharge Caution | 24 |
| 8 Parameter Measurement Information | 15 | 13.4 Glossary | 24 |
| 9 Detailed Description | 16 | 14 Mechanical, Packaging, and Orderable Information | 24 |

5 Revision History

Changes from Revision U (January 2014) to Revision V

Page

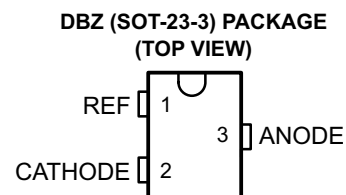
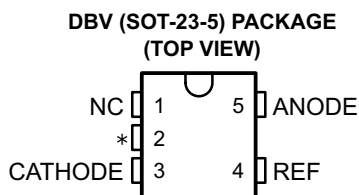
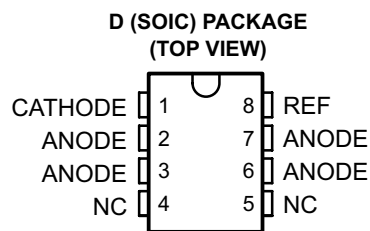
| | |
|---|----|
| • Added <i>Applications</i> , <i>Device Information</i> table, <i>Pin Functions</i> table, <i>ESD Ratings</i> table, <i>Thermal Information</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i> , <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section. | 1 |
| • Moved <i>Typical Characteristics</i> into <i>Specifications</i> section. | 8 |
| • Moved <i>Typical Characteristics</i> into <i>Specifications</i> section. | 9 |
| • Moved <i>Typical Characteristics</i> into <i>Specifications</i> section. | 10 |
| • Moved <i>Typical Characteristics</i> into <i>Specifications</i> section. | 11 |
| • Moved <i>Typical Characteristics</i> into <i>Specifications</i> section. | 12 |
| • Moved <i>Typical Characteristics</i> into <i>Specifications</i> section. | 13 |
| • Moved <i>Typical Characteristics</i> into <i>Specifications</i> section. | 14 |

Changes from Revision T (June 2007) to Revision U

Page

| | |
|--|---|
| • Updated document to new TI data sheet format. | 1 |
| • Deleted <i>Ordering Information</i> table. | 1 |
| • Updated <i>Features</i> | 1 |

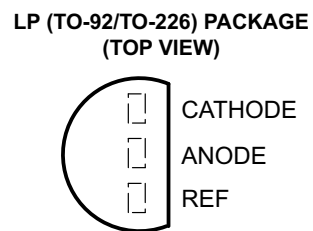
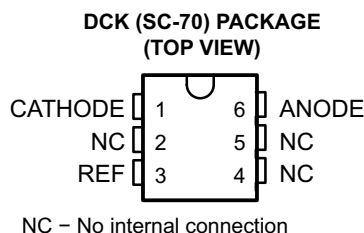
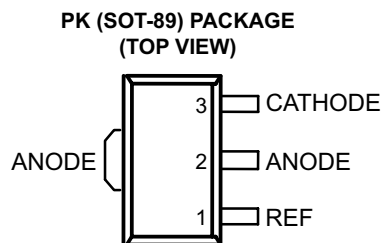
6 Pin Configuration and Functions



NC – No internal connection

* For TLV431, TLV431A: NC – No internal connection

* For TLV431B: Pin 2 is attached to Substrate and must be connected to ANODE or left open.



Pin Functions

| NAME | PIN | | | | | | TYPE | DESCRIPTION |
|---------|-----|-----|----|------------|----|---------|------|--|
| | DBZ | DBV | PK | D | LP | DCK | | |
| CATHODE | 2 | 3 | 3 | 1 | 1 | 1 | I/O | Shunt Current/Voltage input |
| REF | 1 | 4 | 1 | 8 | 3 | 3 | I | Threshold relative to common anode |
| ANODE | 3 | 5 | 2 | 2, 3, 6, 7 | 2 | 6 | O | Common pin, normally connected to ground |
| NC | — | 1 | — | 4, 5 | — | 2, 4, 5 | I | No Internal Connection |
| * | — | 2 | — | — | — | — | I | Substrate Connection |

7 Specifications

7.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)⁽¹⁾

| | | MIN | MAX | UNIT |
|-----------|--|-------|-----|------|
| V_{KA} | Cathode voltage ⁽²⁾ | | 7 | V |
| I_K | Continuous cathode current range | -20 | 20 | mA |
| I_{ref} | Reference current range | -0.05 | 3 | mA |
| | Operating virtual junction temperature | | 150 | °C |
| T_{stg} | Storage temperature range | -65 | 150 | °C |

- (1) Stresses beyond 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 Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) Voltage values are with respect to the anode terminal, unless otherwise noted.

7.2 ESD Ratings

| PARAMETER | | DEFINITION | VALUE | UNIT |
|-------------|-------------------------|--|-------|------|
| $V_{(ESD)}$ | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins ⁽¹⁾ | ±2000 | V |
| | | Charged device model (CDM), per JEDEC specification JESD22-C101, all pins ⁽²⁾ | ±1000 | |

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

7.3 Thermal Information

| THERMAL METRIC ⁽¹⁾ | TLV431x | | | | | | UNIT | |
|-------------------------------|---|--------|--------|--------|--------|--------|------|------|
| | DCK | D | PK | DBV | DBZ | LP | | |
| | 6 PINS | 8 PINS | 3 PINS | 5 PINS | 3 PINS | 3 PINS | | |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 87 | 97 | 52 | 206 | 206 | 140 | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | 259 | 39 | 9 | 131 | 76 | 55 | |

- (1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report ([SPRA953](#)).

7.4 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

| | | MIN | MAX | UNIT |
|----------|--------------------------------------|-----------|-----|------|
| V_{KA} | Cathode voltage | V_{REF} | 6 | V |
| I_K | Cathode current | 0.1 | 15 | mA |
| T_A | Operating free-air temperature range | TLV431_C | 0 | 70 |
| | | TLV431_I | -40 | 85 |
| | | TLV431_Q | -40 | 125 |

7.5 Electrical Characteristics for TLV431

at 25°C free-air temperature (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | TLV431 | | | UNIT | |
|--|---|--|---------|-------|---------------|---|
| | | MIN | TYP | MAX | | |
| V_{REF} Reference voltage | $V_{KA} = V_{REF}$, $I_K = 10\text{ mA}$ | $T_A = 25^\circ\text{C}$ | 1.222 | 1.24 | 1.258 | V |
| | | $T_A = \text{full range}^{(1)}$ (see Figure 19) | TLV431C | 1.21 | 1.27 | |
| | | | TLV431I | 1.202 | 1.278 | |
| | | | TLV431Q | 1.194 | 1.286 | |
| $V_{REF(\text{dev})}$ V_{REF} deviation over full temperature range ⁽²⁾ | $V_{KA} = V_{REF}$, $I_K = 10\text{ mA}^{(1)}$ (see Figure 19) | TLV431C | 4 | 12 | mV | |
| | | TLV431I | 6 | 20 | | |
| | | TLV431Q | 11 | 31 | | |
| $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ Ratio of V_{REF} change in cathode voltage change | $V_{KA} = V_{REF}$ to 6 V, $I_K = 10\text{ mA}$ (see Figure 20) | | -1.5 | -2.7 | mV/V | |
| I_{ref} Reference terminal current | $I_K = 10\text{ mA}$, $R1 = 10\text{ k}\Omega$, $R2 = \text{open}$ (see Figure 20) | | 0.15 | 0.5 | μA | |
| $I_{ref(\text{dev})}$ I_{ref} deviation over full temperature range ⁽²⁾ | $I_K = 10\text{ mA}$, $R1 = 10\text{ k}\Omega$, $R2 = \text{open}^{(1)}$ (see Figure 20) | TLV431C | 0.05 | 0.3 | μA | |
| | | TLV431I | 0.1 | 0.4 | | |
| | | TLV431Q | 0.15 | 0.5 | | |
| $I_{K(\text{min})}$ Minimum cathode current for regulation | $V_{KA} = V_{REF}$ (see Figure 19) | TLV431C/I | 55 | 80 | μA | |
| | | TLV431Q | 55 | 100 | | |
| $I_{K(\text{off})}$ Off-state cathode current | $V_{REF} = 0$, $V_{KA} = 6\text{ V}$ (see Figure 21) | | 0.001 | 0.1 | μA | |
| $ z_{KA} $ Dynamic impedance ⁽³⁾ | $V_{KA} = V_{REF}$, $f \leq 1\text{ kHz}$, $I_K = 0.1\text{ mA}$ to 15 mA (see Figure 19) | | 0.25 | 0.4 | Ω | |

(1) Full temperature ranges are -40°C to 125°C for TLV431Q, -40°C to 85°C for TLV431I, and 0°C to 70°C for TLV431C.

(2) The deviation parameters $V_{REF(\text{dev})}$ and $I_{ref(\text{dev})}$ are defined as the differences between the maximum and minimum values obtained over the rated temperature range. The average full-range temperature coefficient of the reference input voltage, αV_{REF} , is defined as:

$$|\alpha V_{REF}| \left(\frac{\text{ppm}}{^\circ\text{C}} \right) = \frac{\left(\frac{V_{REF(\text{dev})}}{V_{REF}(T_A = 25^\circ\text{C})} \right) \times 10^6}{\Delta T_A}$$

where ΔT_A is the rated operating free-air temperature range of the device.

 αV_{REF} can be positive or negative, depending on whether minimum V_{REF} or maximum V_{REF} , respectively, occurs at the lower temperature.

(3) The dynamic impedance is defined as $|z_{ka}| = \frac{\Delta V_{KA}}{\Delta I_K}$

When the device is operating with two external resistors (see Figure 20), the total dynamic impedance of the circuit is defined as:

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

7.6 Electrical Characteristics for TLV431A

at 25°C free-air temperature (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | TLV431A | | | UNIT | | |
|--|--|--|----------|-------|---------------|---------------|-------|
| | | MIN | TYP | MAX | | | |
| V_{REF} Reference voltage | $V_{KA} = V_{REF}$, $I_K = 10\text{ mA}$ | $T_A = 25^\circ\text{C}$ | 1.228 | 1.24 | 1.252 | V | |
| | | $T_A = \text{full range}^{(1)}$ (see Figure 19) | TLV431AC | 1.221 | | | 1.259 |
| | | | TLV431AI | 1.215 | | | 1.265 |
| | | | TLV431AQ | 1.209 | | | 1.271 |
| $V_{REF(\text{dev})}$ V_{REF} deviation over full temperature range ⁽²⁾ | $V_{KA} = V_{REF}$, $I_K = 10\text{ mA}^{(1)}$ (see Figure 19) | TLV431AC | | 4 | 12 | mV | |
| | | TLV431AI | | 6 | 20 | | |
| | | TLV431AQ | | 11 | 31 | | |
| $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ Ratio of V_{REF} change in cathode voltage change | $V_{KA} = V_{REF}$ to 6 V, $I_K = 10\text{ mA}$ (see Figure 20) | | -1.5 | -2.7 | mV/V | | |
| I_{ref} Reference terminal current | $I_K = 10\text{ mA}$, $R1 = 10\text{ k}\Omega$, $R2 = \text{open}$ (see Figure 20) | | 0.15 | 0.5 | μA | | |
| $I_{ref(\text{dev})}$ I_{ref} deviation over full temperature range ⁽²⁾ | $I_K = 10\text{ mA}$, $R1 = 10\text{ k}\Omega$, $R2 = \text{open}^{(1)}$ (see Figure 20) | TLV431AC | | 0.05 | 0.3 | μA | |
| | | TLV431AI | | 0.1 | 0.4 | | |
| | | TLV431AQ | | 0.15 | 0.5 | | |
| $I_{K(\text{min})}$ Minimum cathode current for regulation | $V_{KA} = V_{REF}$ (see Figure 19) | TLV431AC/AI | | 55 | 80 | μA | |
| | | TLV431AQ | | 55 | 100 | | |
| $I_{K(\text{off})}$ Off-state cathode current | $V_{REF} = 0$, $V_{KA} = 6\text{ V}$ (see Figure 21) | | 0.001 | 0.1 | μA | | |
| $ z_{KA} $ Dynamic impedance ⁽³⁾ | $V_{KA} = V_{REF}$, $f \leq 1\text{ kHz}$, $I_K = 0.1\text{ mA}$ to 15 mA (see Figure 19) | | 0.25 | 0.4 | Ω | | |

(1) Full temperature ranges are -40°C to 125°C for TLV431Q, -40°C to 85°C for TLV431I, and 0°C to 70°C for TLV431C.

(2) The deviation parameters $V_{REF(\text{dev})}$ and $I_{ref(\text{dev})}$ are defined as the differences between the maximum and minimum values obtained over the rated temperature range. The average full-range temperature coefficient of the reference input voltage, αV_{REF} , is defined as:

$$|\alpha V_{REF}| \left(\frac{\text{ppm}}{^\circ\text{C}} \right) = \frac{\left(\frac{V_{REF(\text{dev})}}{V_{REF}(T_A = 25^\circ\text{C})} \right) \times 10^6}{\Delta T_A}$$

where ΔT_A is the rated operating free-air temperature range of the device.

αV_{REF} can be positive or negative, depending on whether minimum V_{REF} or maximum V_{REF} , respectively, occurs at the lower temperature.

(3) The dynamic impedance is defined as $|z_{ka}| = \frac{\Delta V_{KA}}{\Delta I_K}$

When the device is operating with two external resistors (see Figure 20), the total dynamic impedance of the circuit is defined as:

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

7.7 Electrical Characteristics for TLV431B

at 25°C free-air temperature (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | TLV431B | | | UNIT | |
|--|--|--|----------|-------|---------------|---|
| | | MIN | TYP | MAX | | |
| V_{REF} Reference voltage | $V_{KA} = V_{REF}$, $I_K = 10\text{ mA}$ | $T_A = 25^\circ\text{C}$ | 1.234 | 1.24 | 1.246 | V |
| | | | TLV431BC | 1.227 | 1.253 | |
| | | $T_A = \text{full range}^{(1)}$ (see Figure 19) | TLV431BI | 1.224 | 1.259 | |
| | | | TLV431BQ | 1.221 | 1.265 | |
| $V_{REF(\text{dev})}$ V_{REF} deviation over full temperature range ⁽²⁾ | $V_{KA} = V_{REF}$, $I_K = 10\text{ mA}^{(1)}$ (see Figure 19) | TLV431BC | 4 | 12 | mV | |
| | | TLV431BI | 6 | 20 | | |
| | | TLV431BQ | 11 | 31 | | |
| $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ Ratio of V_{REF} change in cathode voltage change | $V_{KA} = V_{REF}$ to 6 V, $I_K = 10\text{ mA}$ (see Figure 20) | | -1.5 | -2.7 | mV/V | |
| I_{ref} Reference terminal current | $I_K = 10\text{ mA}$, $R1 = 10\text{ k}\Omega$, $R2 = \text{open}$ (see Figure 20) | | 0.1 | 0.5 | μA | |
| $I_{ref(\text{dev})}$ I_{ref} deviation over full temperature range ⁽²⁾ | $I_K = 10\text{ mA}$, $R1 = 10\text{ k}\Omega$, $R2 = \text{open}^{(3)}$ (see Figure 20) | TLV431BC | 0.05 | 0.3 | μA | |
| | | TLV431BI | 0.1 | 0.4 | | |
| | | TLV431BQ | 0.15 | 0.5 | | |
| $I_{K(\text{min})}$ Minimum cathode current for regulation | $V_{KA} = V_{REF}$ (see Figure 19) | | 55 | 100 | μA | |
| $I_{K(\text{off})}$ Off-state cathode current | $V_{REF} = 0$, $V_{KA} = 6\text{ V}$ (see Figure 21) | | 0.001 | 0.1 | μA | |
| $ z_{KA} $ Dynamic impedance ⁽⁴⁾ | $V_{KA} = V_{REF}$, $f \leq 1\text{ kHz}$, $I_K = 0.1\text{ mA}$ to 15 mA (see Figure 19) | | 0.25 | 0.4 | Ω | |

(1) Full temperature ranges are -40°C to 125°C for TLV431Q, -40°C to 85°C for TLV431I, and 0°C to 70°C for TLV431C.

(2) The deviation parameters $V_{REF(\text{dev})}$ and $I_{ref(\text{dev})}$ are defined as the differences between the maximum and minimum values obtained over the rated temperature range. The average full-range temperature coefficient of the reference input voltage, αV_{REF} , is defined as:

$$|\alpha V_{REF}| \left(\frac{\text{ppm}}{^\circ\text{C}} \right) = \frac{\left(\frac{V_{REF(\text{dev})}}{V_{REF}(T_A = 25^\circ\text{C})} \right) \times 10^6}{\Delta T_A}$$

where ΔT_A is the rated operating free-air temperature range of the device.

 αV_{REF} can be positive or negative, depending on whether minimum V_{REF} or maximum V_{REF} , respectively, occurs at the lower temperature.

(3) Full temperature ranges are -40°C to 125°C for TLV431Q, -40°C to 85°C for TLV431I, and 0°C to 70°C for TLV431C.

(4) The dynamic impedance is defined as $|z_{ka}| = \frac{\Delta V_{KA}}{\Delta I_K}$

When the device is operating with two external resistors (see Figure 20), the total dynamic impedance of the circuit is defined as:

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

7.8 Typical Characteristics

Operation of the device at these or any other conditions beyond those indicated in the *Recommended Operating Conditions* table are not implied.

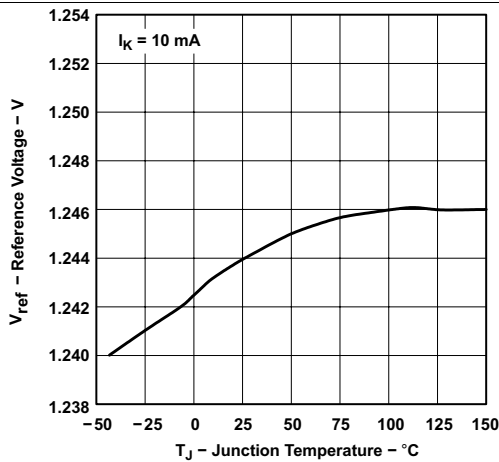


Figure 1. Reference Voltage vs Junction Temperature

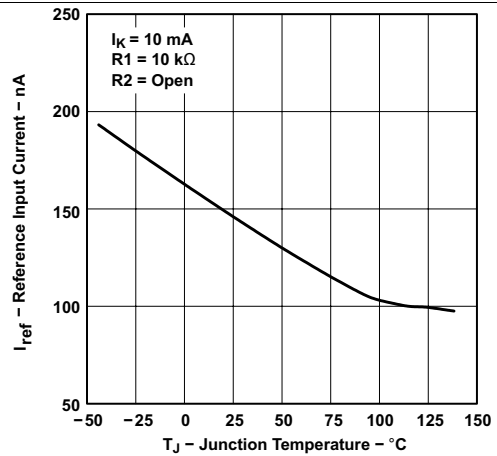


Figure 2. Reference Input Current vs Junction Temperature (for TLV431 and TLV431A)



Figure 3. Reference Input Current vs Junction Temperature (for TLV431B)

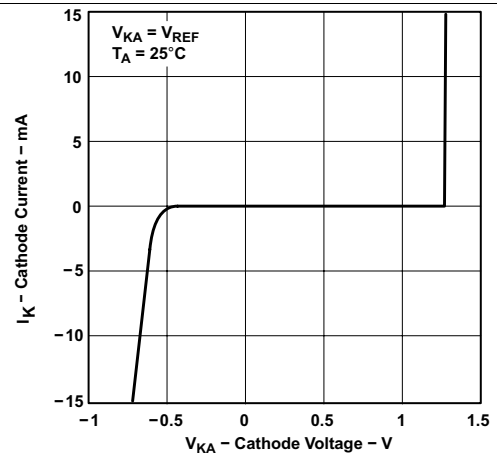


Figure 4. Cathode Current vs Cathode Voltage

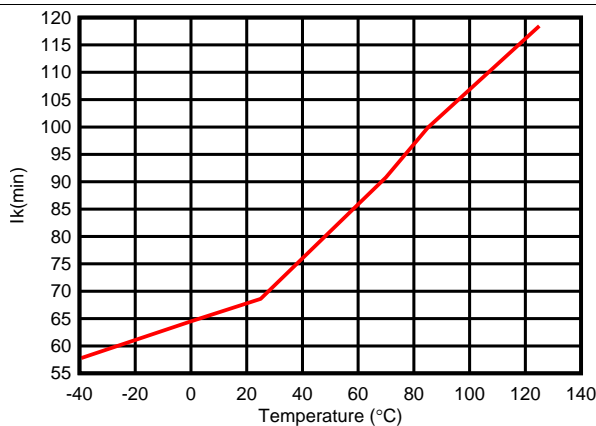


Figure 5. Minimum Cathode Current vs Temperature

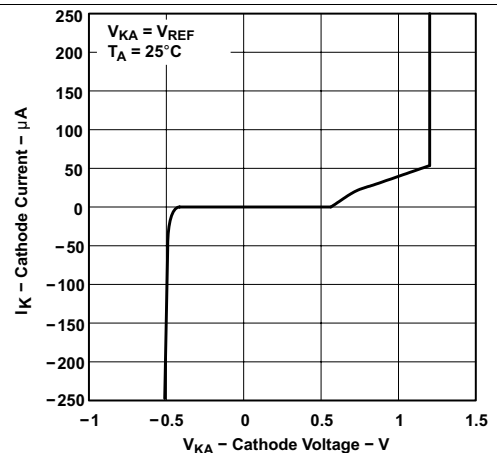


Figure 6. Cathode Current vs Cathode Voltage

Typical Characteristics (continued)

Operation of the device at these or any other conditions beyond those indicated in the *Recommended Operating Conditions* table are not implied.

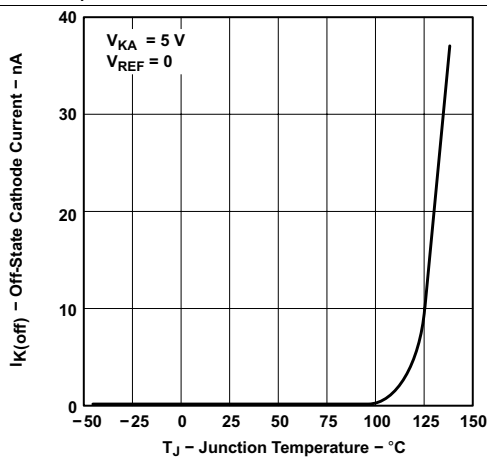


Figure 7. Off-State Cathode Current vs Junction Temperature (for TLV431 and TLV431A)

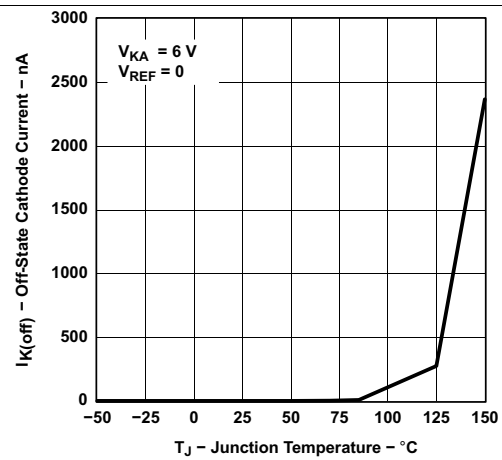


Figure 8. Off-State Cathode Current vs Junction Temperature (for TLV431B)

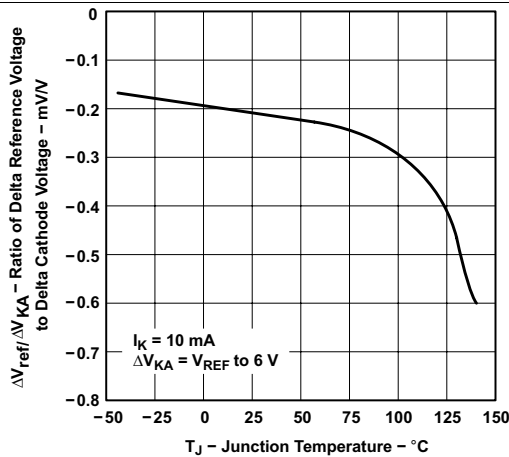


Figure 9. Ratio of Delta Reference Voltage to Delta Cathode Voltage vs Junction Temperature (for TLV431 and TLV431A)

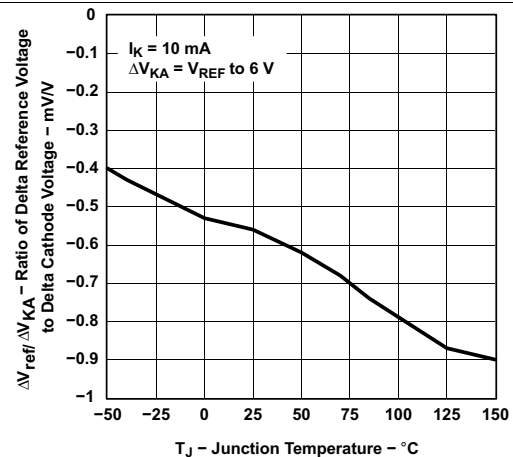


Figure 10. Ratio of Delta Reference Voltage to Delta Cathode Voltage vs Junction Temperature (for TLV431B)

Typical Characteristics (continued)

Operation of the device at these or any other conditions beyond those indicated in the *Recommended Operating Conditions* table are not implied.

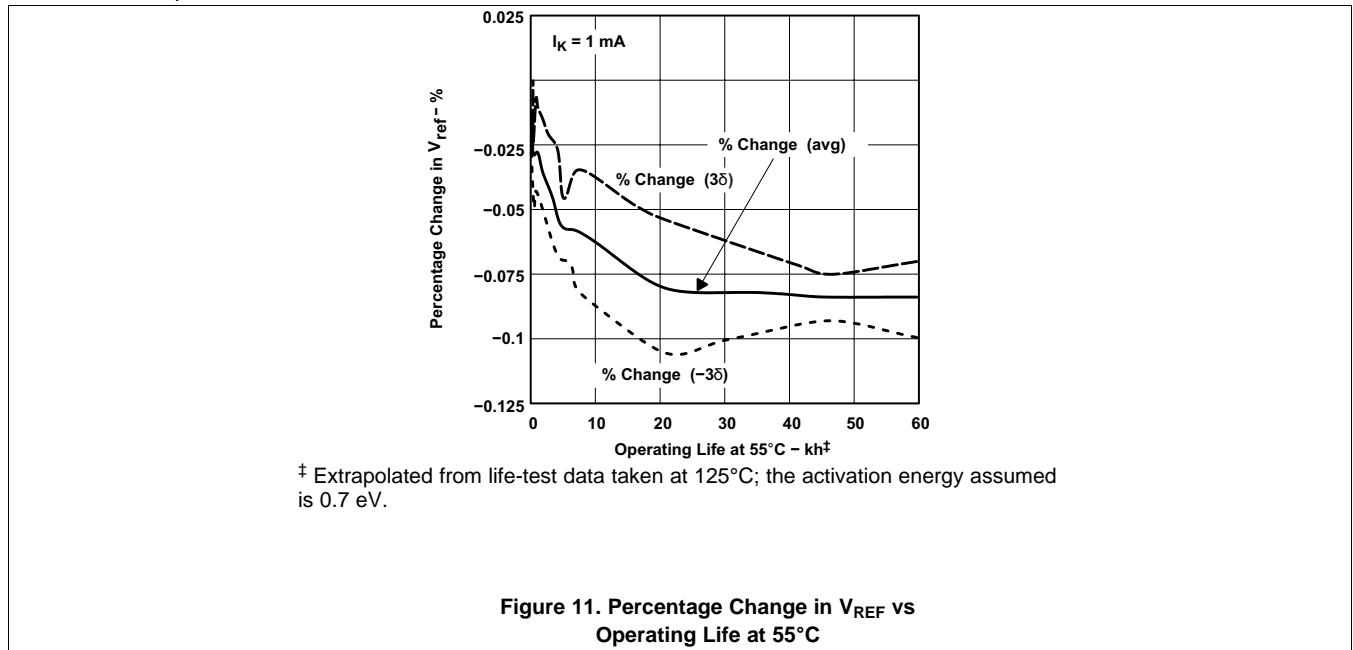


Figure 11. Percentage Change in V_{REF} vs Operating Life at 55°C

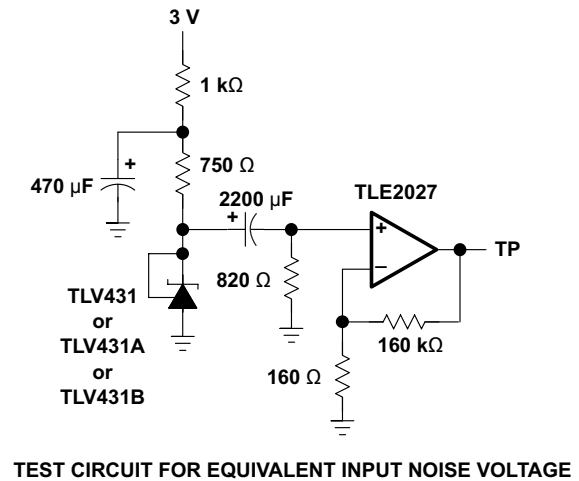
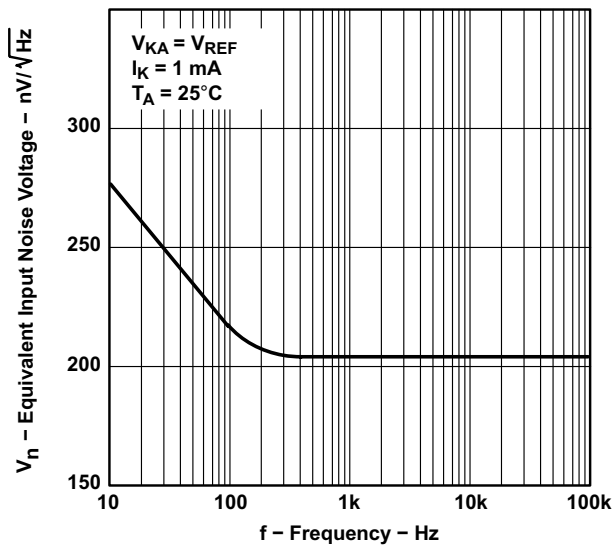
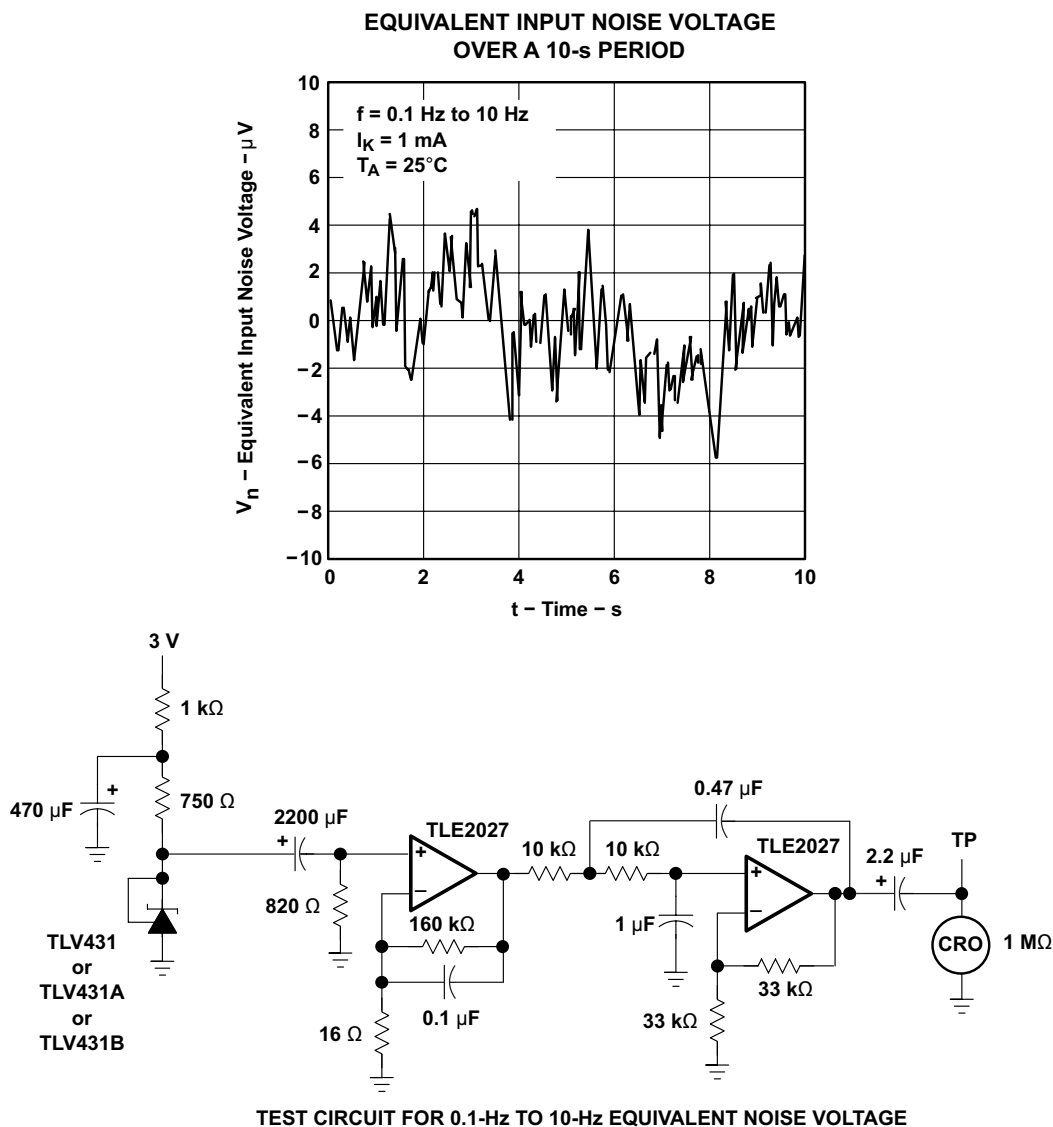


Figure 12. Equivalent Input Noise Voltage

Typical Characteristics (continued)

Operation of the device at these or any other conditions beyond those indicated in the *Recommended Operating Conditions* table are not implied.



**Figure 13. Equivalent Noise Voltage
over a 10s Period**

Typical Characteristics (continued)

Operation of the device at these or any other conditions beyond those indicated in the *Recommended Operating Conditions* table are not implied.

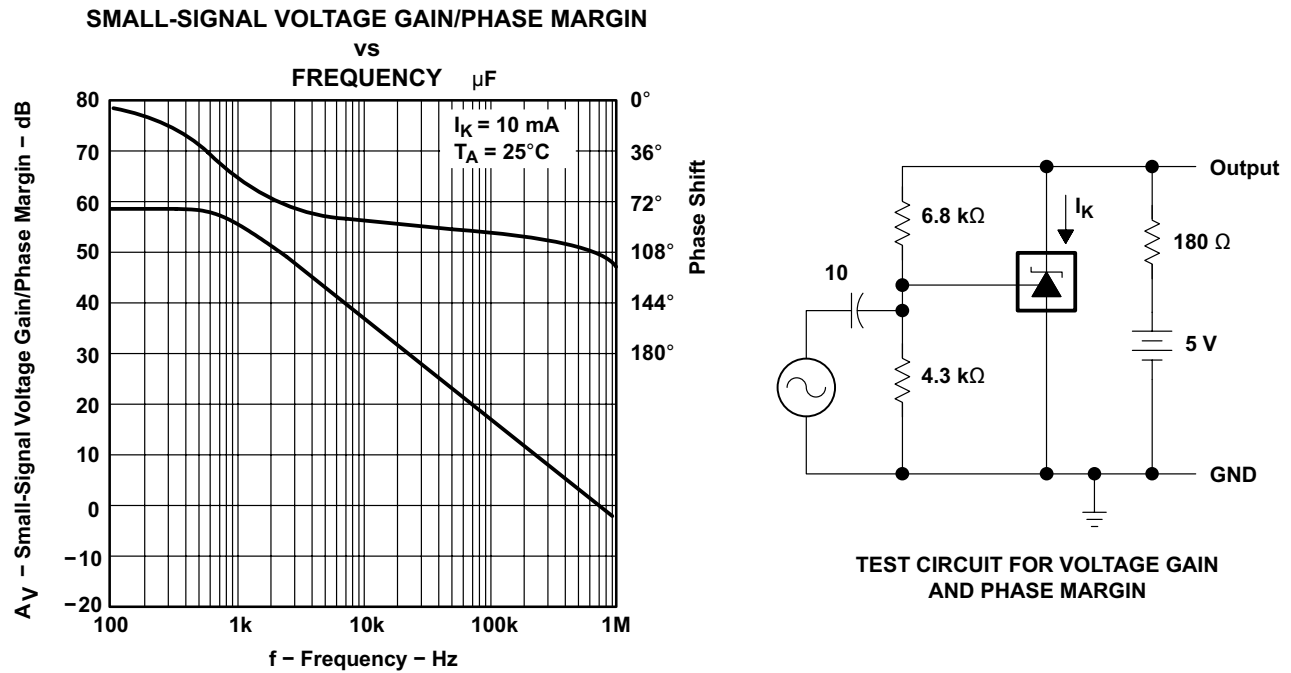


Figure 14. Voltage Gain and Phase Margin

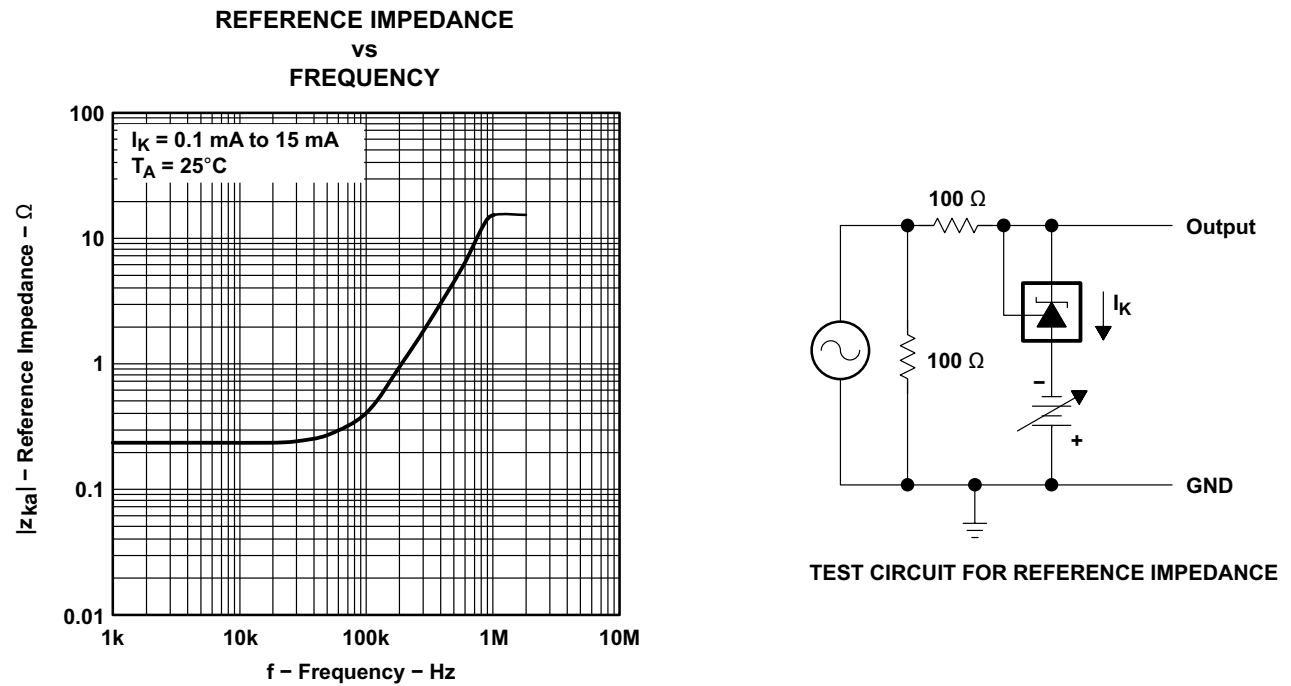


Figure 15. Reference Impedance vs Frequency

Typical Characteristics (continued)

Operation of the device at these or any other conditions beyond those indicated in the *Recommended Operating Conditions* table are not implied.

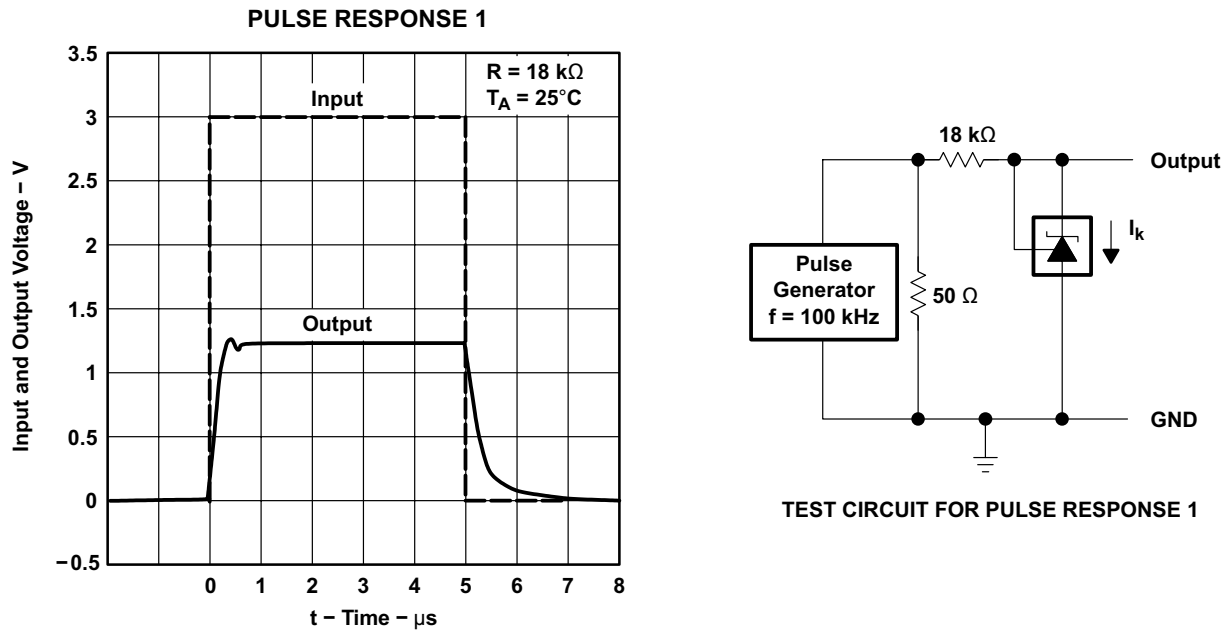


Figure 16. Pulse Response 1

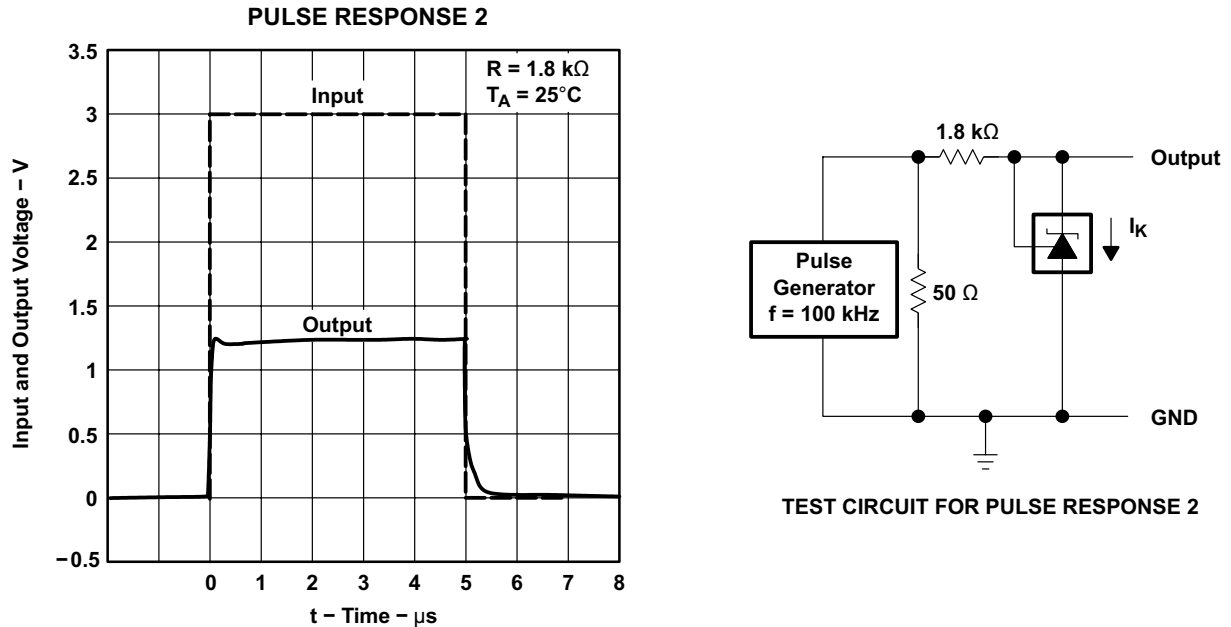
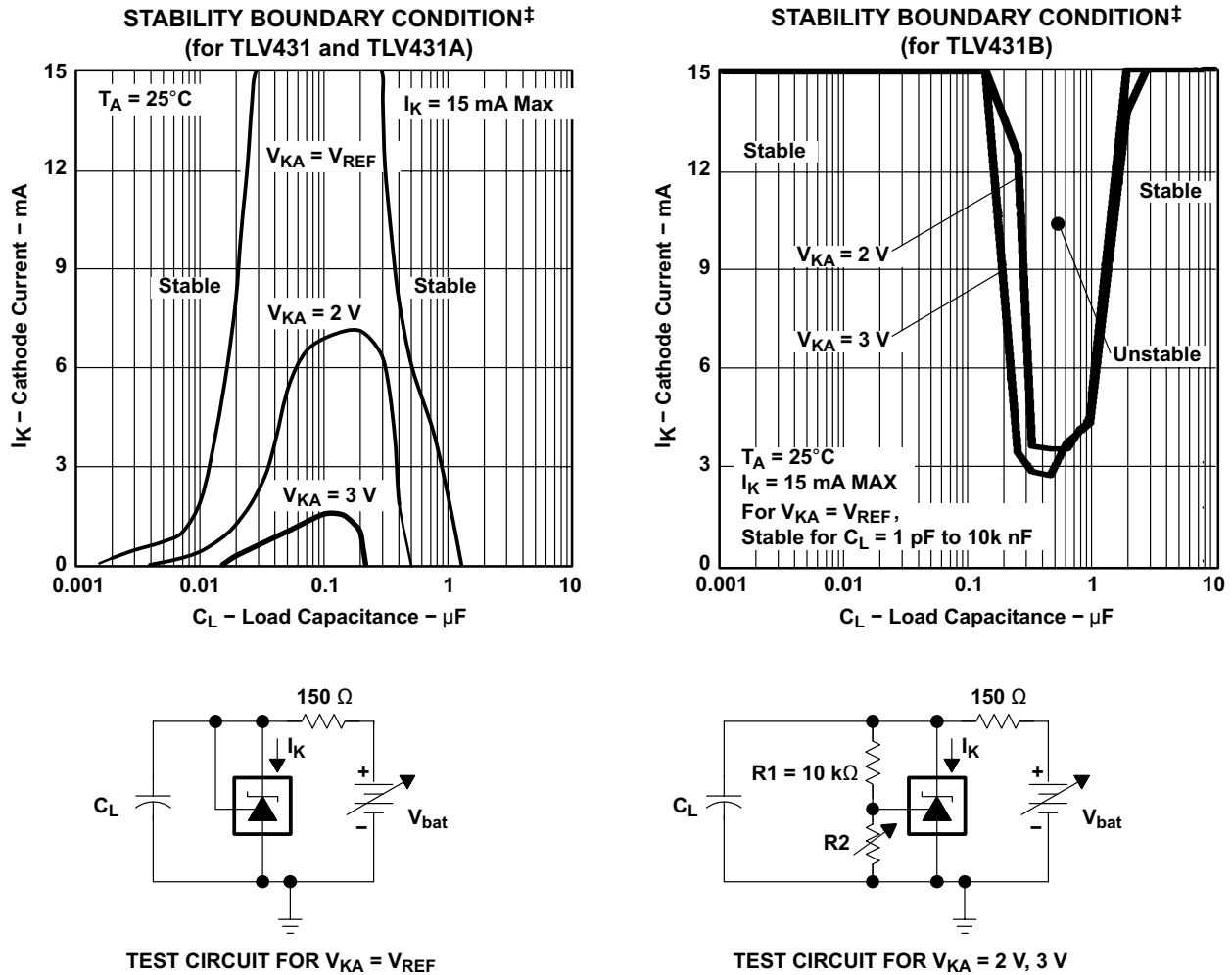


Figure 17. Pulse Response 2

Typical Characteristics (continued)

Operation of the device at these or any other conditions beyond those indicated in the *Recommended Operating Conditions* table are not implied.



[‡] The areas under the curves represent conditions that may cause the device to oscillate. For $V_{KA} = 2\text{-V}$ and 3-V curves, R_2 and V_{bat} were adjusted to establish the initial V_{KA} and I_K conditions with $C_L = 0$. V_{bat} and C_L then were adjusted to determine the ranges of stability.

Figure 18. Stability Boundary Conditions

8 Parameter Measurement Information

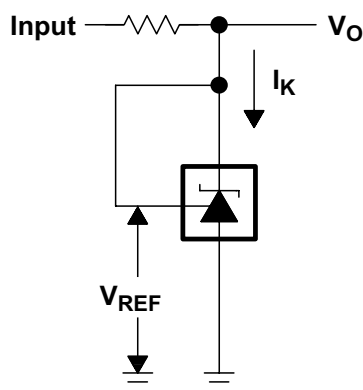


Figure 19. Test Circuit for $V_{KA} = V_{REF}$, $V_O = V_{KA} = V_{REF}$

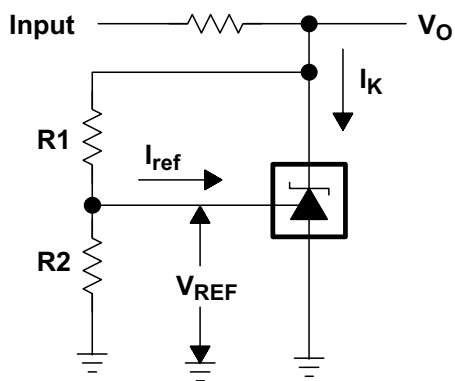


Figure 20. Test Circuit for $V_{KA} > V_{REF}$, $V_O = V_{KA} = V_{REF} \times (1 + R1/R2) + I_{ref} \times R1$

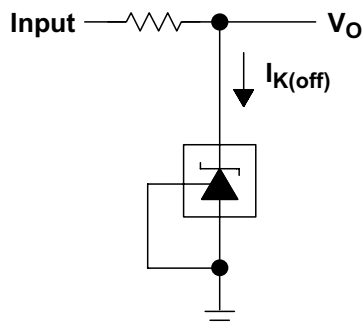


Figure 21. Test Circuit for $I_{K(off)}$

9 Detailed Description

9.1 Overview

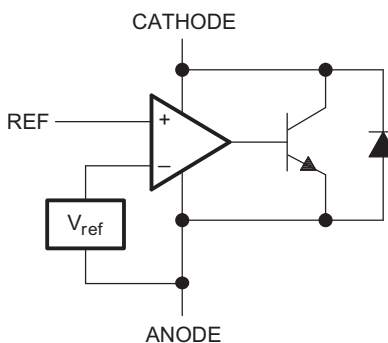
TLV431 is a low power counterpart to TL431, having lower reference voltage (1.24 V vs 2.5 V) for lower voltage adjustability and lower minimum cathode current ($I_{k(\min)}=100\ \mu\text{A}$ vs 1 mA). Like TL431, TLV431 is used in conjunction with its key components to behave as a single voltage reference, error amplifier, voltage clamp or comparator with integrated reference.

TLV431 can be operated and adjusted to cathode voltages from 1.24V to 6V, making this part optimum for a wide range of end equipments in industrial, auto, telecom & computing. In order for this device to behave as a shunt regulator or error amplifier, $> 100\ \mu\text{A}$ ($I_{\min(\max)}$) must be supplied in to the cathode pin. Under this condition, feedback can be applied from the Cathode and Ref pins to create a replica of the internal reference voltage.

Various reference voltage options can be purchased with initial tolerances (at 25°C) of 0.5%, 1%, and 1.5%. These reference options are denoted by B (0.5%), A (1.0%) and blank (1.5%) after the TLV431.

The TLV431xC devices are characterized for operation from 0°C to 70°C, the TLV431xI devices are characterized for operation from –40°C to 85°C, and the TLV431xQ devices are characterized for operation from –40°C to 125°C.

9.2 Functional Block Diagram



9.3 Feature Description

TLV431 consists of an internal reference and amplifier that outputs a sink current based on the difference between the reference pin and the virtual internal pin. The sink current is produced by an internal darlington pair.

When operated with enough voltage headroom ($\geq 1.24\ \text{V}$) and cathode current (I_{ka}), TLV431 forces the reference pin to 1.24 V. However, the reference pin can not be left floating, as it needs $I_{ref} \geq 0.5\ \mu\text{A}$ (please see the [Functional Block Diagram](#)). This is because the reference pin is driven into an npn, which needs base current in order to operate properly.

When feedback is applied from the Cathode and Reference pins, TLV431 behaves as a Zener diode, regulating to a constant voltage dependent on current being supplied into the cathode. This is due to the internal amplifier and reference entering the proper operating regions. The same amount of current needed in the above feedback situation must be applied to this device in open loop, servo or error amplifying implementations in order for it to be in the proper linear region giving TLV431 enough gain.

Unlike many linear regulators, TLV431 is internally compensated to be stable without an output capacitor between the cathode and anode. However, if it is desired to use an output capacitor [Figure 18](#) can be used as a guide to assist in choosing the correct capacitor to maintain stability.

9.4 Device Functional Modes

9.4.1 Open Loop (Comparator)

When the cathode/output voltage or current of TLV431 is not being fed back to the reference/input pin in any form, this device is operating in open loop. With proper cathode current (I_{ka}) applied to this device, TLV431 will have the characteristics shown in [Figure 6](#). With such high gain in this configuration, TLV431 is typically used as a comparator. With the reference integrated makes TLV431 the preferred choice when users are trying to monitor a certain level of a single signal.

9.4.2 Closed Loop

When the cathode/output voltage or current of TLV431 is being fed back to the reference/input pin in any form, this device is operating in closed loop. The majority of applications involving TLV431 use it in this manner to regulate a fixed voltage or current. The feedback enables this device to behave as an error amplifier, computing a portion of the output voltage and adjusting it to maintain the desired regulation. This is done by relating the output voltage back to the reference pin in a manner to make it equal to the internal reference voltage, which can be accomplished via resistive or direct feedback.

10 Applications and Implementation

NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

10.1 Application Information

Figure 22 shows the TLV431, TLV431A, or TLV431B used in a 3.3-V isolated flyback supply. Output voltage V_O can be as low as reference voltage V_{REF} ($1.24\text{ V} \pm 1\%$). The output of the regulator, plus the forward voltage drop of the optocoupler LED ($1.24 + 1.4 = 2.64\text{ V}$), determine the minimum voltage that can be regulated in an isolated supply configuration. Regulated voltage as low as 2.7 Vdc is possible in the topology shown in Figure 22.

The 431 family of devices are prevalent in these applications, being designers go to choice for secondary side regulation. Due to this prevalence, this section will further go on to explain operation and design in both states of TLV431 that this application will see, open loop (Comparator + Vref) & closed loop (Shunt Regulator).

Further information about system stability and using a TLV431 device for compensation can be found in the application note *Compensation Design With TL431 for UCC28600*, [SLUA671](#).

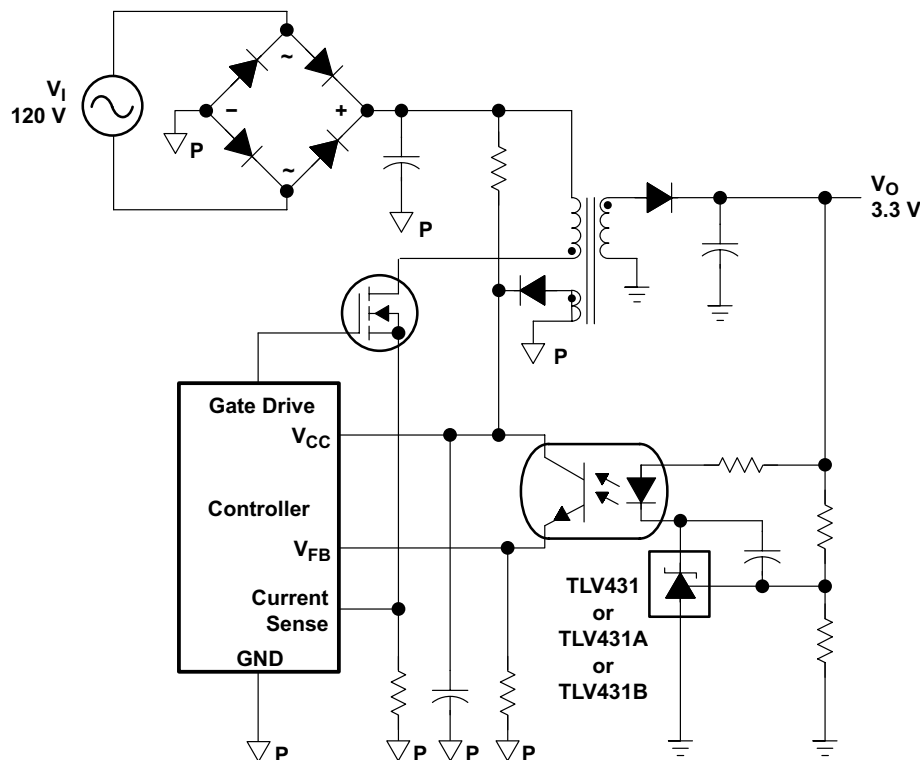


Figure 22. Flyback With Isolation Using TLV431, TLV431A, or TLV431B as Voltage Reference and Error Amplifier

10.2 Typical Applications

10.2.1 Comparator with Integrated Reference (Open Loop)

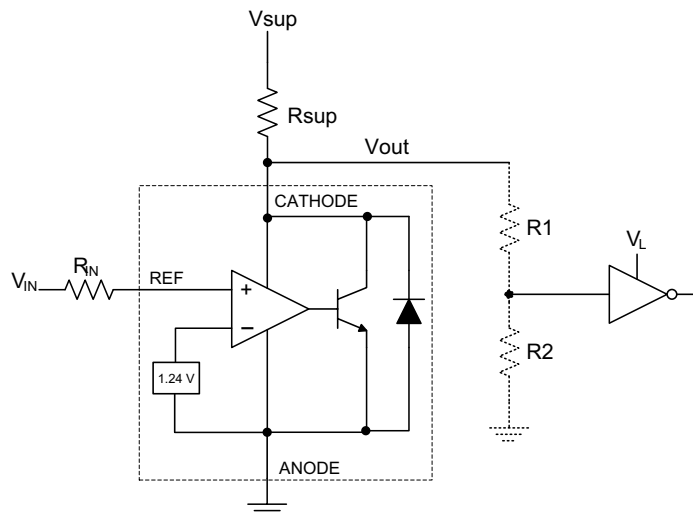


Figure 23. Comparator Application Schematic

10.2.1.1 Design Requirements

For this design example, use the parameters listed in [Table 1](#) as the input parameters.

Table 1. Design Parameters

| DESIGN PARAMETER | EXAMPLE VALUE |
|--|------------------------|
| Input Voltage Range | 0 V to 5 V |
| Input Resistance | 10 k Ω |
| Supply Voltage | 5 V |
| Cathode Current (I_k) | 500 μ A |
| Output Voltage Level | ~ 1 V - V_{sup} |
| Logic Input Thresholds V_{IH}/V_{IL} | V_L |

10.2.1.2 Detailed Design Procedure

When using TLV431 as a comparator with reference, determine the following:

- Input voltage range
- Reference voltage accuracy
- Output logic input high and low level thresholds
- Current source resistance

10.2.1.2.1 Basic Operation

In the configuration shown in [Figure 23](#) TLV431 will behave as a comparator, comparing the V_{ref} pin voltage to the internal virtual reference voltage. When provided a proper cathode current (I_k), TLV431 will have enough open loop gain to provide a quick response. With the TLV431's max Operating Current (I_{min}) being 100 μ A and up to 150 μ A over temperature, operation below that could result in low gain, leading to a slow response.

10.2.1.2.2 Overdrive

Slow or inaccurate responses can also occur when the reference pin is not provided enough overdrive voltage. This is the amount of voltage that is higher than the internal virtual reference. The internal virtual reference voltage will be within the range of $1.24V \pm(0.5\%, 1.0\% \text{ or } 1.5\%)$ depending on which version is being used.

The more overdrive voltage provided, the faster the TLV431 will respond. This can be seen in figures [Figure 24](#) and [Figure 25](#), where it displays the output responses to various input voltages.

For applications where TLV431 is being used as a comparator, it is best to set the trip point to greater than the positive expected error (i.e. +1.0% for the A version). For fast response, setting the trip point to $> 10\%$ of the internal V_{ref} should suffice.

For minimal voltage drop or difference from V_{in} to the ref pin, it is recommended to use an input resistor $< 10 \text{ k}\Omega$ to provide I_{ref} .

10.2.1.2.3 Output Voltage and Logic Input Level

In order for TLV431 to properly be used as a comparator, the logic output must be readable by the receiving logic device. This is accomplished by knowing the input high and low level threshold voltage levels, typically denoted by V_{IH} & V_{IL} .

As seen in [Figure 24](#), TLV431's output low level voltage in open-loop/comparator mode is $\sim 1 \text{ V}$, which is sufficient for some 3.3V supplied logic. However, would not work for 2.5 V and 1.8 V supplied logic. In order to accommodate this a resistive divider can be tied to the output to attenuate the output voltage to a voltage legible to the receiving low voltage logic device.

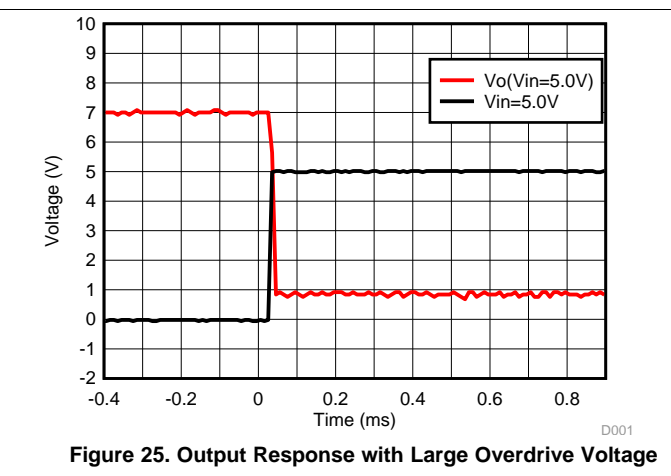
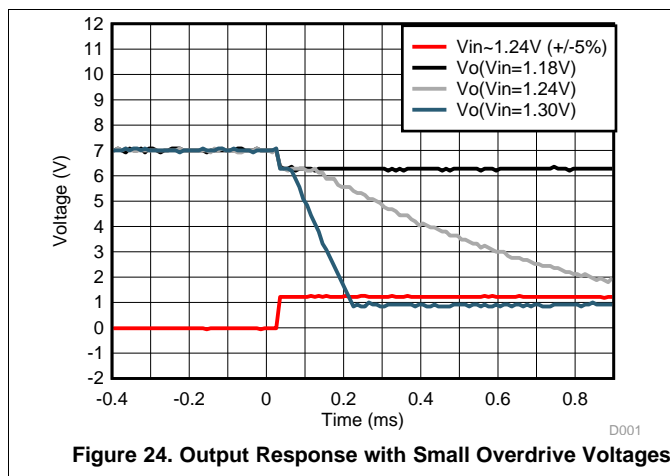
TLV431's output high voltage is approximately V_{sup} due to TLV431 being open-collector. If V_{sup} is much higher than the receiving logic's maximum input voltage tolerance, the output must be attenuated to accommodate the outgoing logic's reliability.

When using a resistive divider on the output, be sure to make the sum of the resistive divider ($R1$ & $R2$ in [Figure 23](#)) is much greater than R_{sup} in order to not interfere with TLV431's ability to pull close to V_{sup} when turning off.

10.2.1.2.3.1 Input Resistance

TLV431 requires an input resistance in this application in order to source the reference current (I_{ref}) needed from this device to be in the proper operating regions while turning on. The actual voltage seen at the ref pin will be $V_{ref} = V_{in} - I_{ref} * R_{in}$. Since I_{ref} can be as high as $0.5 \mu\text{A}$ it is recommended to use a resistance small enough that will mitigate the error that I_{ref} creates from V_{in} .

10.2.1.3 Application Curves



10.2.2 Shunt Regulator/Reference

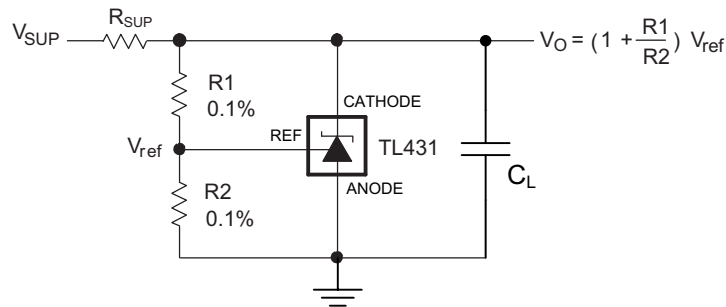


Figure 26. Shunt Regulator Schematic

10.2.2.1 Design Requirements

For this design example, use the parameters listed in [Table 2](#) as the input parameters.

Table 2. Design Parameters

| DESIGN PARAMETER | EXAMPLE VALUE |
|---|---------------|
| Reference Initial Accuracy | 1.0% |
| Supply Voltage | 6 V |
| Cathode Current (I _k) | 1 mA |
| Output Voltage Level | 1.24 V - 6 V |
| Load Capacitance | 100 nF |
| Feedback Resistor Values and Accuracy (R1 & R2) | 10 kΩ |

10.2.2.2 Detailed Design Procedure

When using TLV431 as a Shunt Regulator, determine the following:

- Input voltage range
- Temperature range
- Total accuracy
- Cathode current
- Reference initial accuracy
- Output capacitance

10.2.2.2.1 Programming Output/Cathode Voltage

In order to program the cathode voltage to a regulated voltage a resistive bridge must be shunted between the cathode and anode pins with the mid point tied to the reference pin. This can be seen in [Figure 26](#), with R1 & R2 being the resistive bridge. The cathode/output voltage in the shunt regulator configuration can be approximated by the equation shown in [Figure 26](#). The cathode voltage can be more accurately determined by taking into account the cathode current:

$$V_O = (1 + R1/R2) * V_{ref} - I_{ref} * R1$$

In order for this equation to be valid, TLV431 must be fully biased so that it has enough open loop gain to mitigate any gain error. This can be done by meeting the I_{min} spec denoted in [Recommended Operating Conditions](#) table.

10.2.2.2.2 Total Accuracy

When programming the output above unity gain ($V_{ka}=V_{ref}$), TLV431 is susceptible to other errors that may effect the overall accuracy beyond V_{ref} . These errors include:

- R1 and R2 accuracies
- $V_{I(dev)}$ - Change in reference voltage over temperature
- $\Delta V_{ref} / \Delta V_{KA}$ - Change in reference voltage to the change in cathode voltage
- $|z_{KA}|$ - Dynamic impedance, causing a change in cathode voltage with cathode current

Worst case cathode voltage can be determined taking all of the variables in to account. Application note [SLVA445](#) assists designers in setting the shunt voltage to achieve optimum accuracy for this device.

10.2.2.2.3 Stability

Though TLV431 is stable with no capacitive load, the device that receives the shunt regulator's output voltage could present a capacitive load that is within the TLV431 region of stability, shown in [Figure 18](#). Also, designers may use capacitive loads to improve the transient response or for power supply decoupling.

10.2.2.3 Application Curves

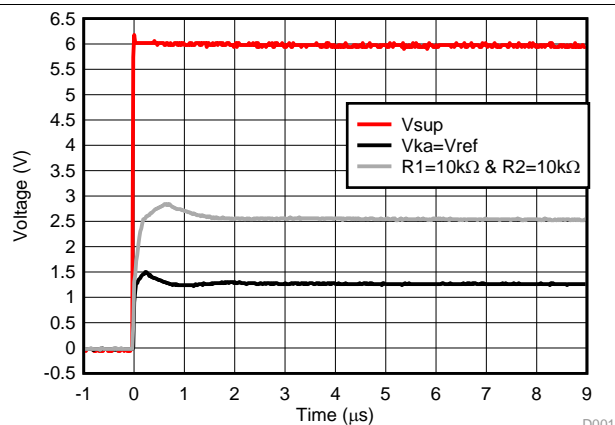


Figure 27. TLV431 Start-up Response

D001

11 Power Supply Recommendations

When using TLV431 as a Linear Regulator to supply a load, designers will typically use a bypass capacitor on the output/cathode pin. When doing this, be sure that the capacitance is within the stability criteria shown in [Figure 18](#).

In order to not exceed the maximum cathode current, be sure that the supply voltage is current limited. Also, be sure to limit the current being driven into the Ref pin, as not to exceed its absolute maximum rating.

For applications shunting high currents, pay attention to the cathode and anode trace lengths, adjusting the width of the traces to have the proper current density.

12 Layout

12.1 Layout Guidelines

Place decoupling capacitors as close to the device as possible. Use appropriate widths for traces when shunting high currents to avoid excessive voltage drops.

12.2 Layout Example

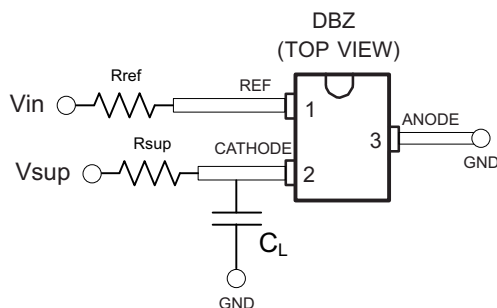


Figure 28. DBZ Layout Example

13 Device and Documentation Support

13.1 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

Table 3. Related Links

| PARTS | PRODUCT FOLDER | SAMPLE & BUY | TECHNICAL DOCUMENTS | TOOLS & SOFTWARE | SUPPORT & COMMUNITY |
|---------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| TLV431 | Click here | Click here | Click here | Click here | Click here |
| TLV431A | Click here | Click here | Click here | Click here | Click here |
| TLV431B | Click here | Click here | Click here | Click here | Click here |

13.2 Trademarks

All trademarks are the property of their respective owners.

13.3 Electrostatic Discharge Caution



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

13.4 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

14 Mechanical, Packaging, and Orderable Information

The following pages include mechanical packaging and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser based versions of this data sheet, refer to the left hand navigation.

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|--|-------------------------|
| TLV431ACDBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (YAC5 ~ YAC6 ~ YACC ~ YACI ~ YACN) (YACG ~ YA CL ~ YACS) | Samples |
| TLV431ACDBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | YACI | Samples |
| TLV431ACDBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (YAC5 ~ YAC6 ~ YACC ~ YACI) (YACG ~ YA CL ~ YACS) | Samples |
| TLV431ACDBVTE4 | ACTIVE | SOT-23 | DBV | 5 | | TBD | Call TI | Call TI | 0 to 70 | | Samples |
| TLV431ACDBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | YACI | Samples |
| TLV431ACDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (YAC6 ~ YAC8 ~ YACB) (YAC3 ~ YACU) | Samples |
| TLV431ACDBZRG4 | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (YAC6 ~ YAC8 ~ YACB) (YAC3 ~ YACU) | Samples |
| TLV431ACL P | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | 0 to 70 | V431AC | Samples |
| TLV431ACLPE3 | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | 0 to 70 | V431AC | Samples |
| TLV431ACLPR | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | 0 to 70 | V431AC | Samples |
| TLV431ACLPRE3 | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | 0 to 70 | V431AC | Samples |
| TLV431AID | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | TY431A | Samples |
| TLV431AIDBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (YAI5 ~ YAI6 ~ YAI C ~ YAI I ~ YAI N) (YAI G ~ YAI L ~ YAI S) | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|--|-------------------------|
| TLV431AIDBvre4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YAI1 | Samples |
| TLV431AIDBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YAI1 | Samples |
| TLV431AIDBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (YAI5 ~ YAI6 ~ YAI C ~ YAI I) (YAI G ~ YAI L ~ YAI S) | Samples |
| TLV431AIDBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YAI1 | Samples |
| TLV431AIDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (YAI6 ~ YAI8 ~ YAI B) (YAI3 ~ YAI S ~ YAI U) | Samples |
| TLV431AIDBZRG4 | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (YAI6 ~ YAI8 ~ YAI B) (YAI3 ~ YAI S ~ YAI U) | Samples |
| TLV431AIDE4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | TY431A | Samples |
| TLV431AIDG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | TY431A | Samples |
| TLV431AIDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | TY431A | Samples |
| TLV431AIDRE4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | TY431A | Samples |
| TLV431AIDRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | TY431A | Samples |
| TLV431AILP | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 85 | V431AI | Samples |
| TLV431AILPE3 | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 85 | V431AI | Samples |
| TLV431AILPM | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 85 | V431AI | Samples |
| TLV431AILPME3 | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 85 | V431AI | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLV431AILPR | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 85 | V431AI | Samples |
| TLV431AILPRE3 | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 85 | V431AI | Samples |
| TLV431AQP | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | -40 to 125 | VA | Samples |
| TLV431AQP3 | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | -40 to 125 | VA | Samples |
| TLV431BCDBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | 0 to 70 | (Y3GG ~ Y3GU) | Samples |
| TLV431BCDBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | Y3GG | Samples |
| TLV431BCDBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | 0 to 70 | (Y3GG ~ Y3GU) | Samples |
| TLV431BCDBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | Y3GG | Samples |
| TLV431BCDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y3G3 ~ Y3GS ~ Y3GU) | Samples |
| TLV431BCDBZRG4 | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y3G3 ~ Y3GS ~ Y3GU) | Samples |
| TLV431BCDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y3GS ~ Y3GU) | Samples |
| TLV431BCDBZTG4 | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y3GS ~ Y3GU) | Samples |
| TLV431BCDCKR | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | YEU | Samples |
| TLV431BCDCKT | ACTIVE | SC70 | DCK | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | YEU | Samples |
| TLV431BCLP | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | 0 to 70 | TV431B | Samples |
| TLV431BCLPR | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | 0 to 70 | TV431B | Samples |
| TLV431BCLPRE3 | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | 0 to 70 | TV431B | Samples |
| TLV431BCPK | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | 0 to 70 | VE | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLV431BIDBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | Y3FU | Samples |
| TLV431BIDBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | Y3FU | Samples |
| TLV431BIDBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | Y3FU | Samples |
| TLV431BIDBVTE4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | Y3FU | Samples |
| TLV431BIDBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | Y3FU | Samples |
| TLV431BIDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (Y3F3 ~ Y3FS ~ Y3FU) | Samples |
| TLV431BIDBZRG4 | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (Y3F3 ~ Y3FS ~ Y3FU) | Samples |
| TLV431BIDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (Y3FS ~ Y3FU) | Samples |
| TLV431BIDBZTG4 | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (Y3FS ~ Y3FU) | Samples |
| TLV431BIDCKR | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YFU | Samples |
| TLV431BIDCKRE4 | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YFU | Samples |
| TLV431BIDCKRG4 | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YFU | Samples |
| TLV431BIDCKT | ACTIVE | SC70 | DCK | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YFU | Samples |
| TLV431BIDCKTE4 | ACTIVE | SC70 | DCK | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YFU | Samples |
| TLV431BIDCKTG4 | ACTIVE | SC70 | DCK | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YFU | Samples |
| TLV431BILP | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 85 | TY431B | Samples |
| TLV431BILPR | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 85 | TY431B | Samples |
| TLV431BILPRE3 | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 85 | TY431B | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLV431BIPK | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | -40 to 85 | VF | Samples |
| TLV431BIPKG3 | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | -40 to 85 | VF | Samples |
| TLV431BQDBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | Y3HU | Samples |
| TLV431BQDBVRE4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | Y3HU | Samples |
| TLV431BQDBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | Y3HU | Samples |
| TLV431BQDBVTE4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | Y3HU | Samples |
| TLV431BQDBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | Y3HU | Samples |
| TLV431BQDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (Y3H3 ~ Y3HS ~ Y3HU) | Samples |
| TLV431BQDBZRG4 | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (Y3H3 ~ Y3HS ~ Y3HU) | Samples |
| TLV431BQDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (Y3HS ~ Y3HU) | Samples |
| TLV431BQDBZTG4 | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (Y3HS ~ Y3HU) | Samples |
| TLV431BQDCKR | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | YGU | Samples |
| TLV431BQDCKT | ACTIVE | SC70 | DCK | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | YGU | Samples |
| TLV431BQLP | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 125 | TQ431B | Samples |
| TLV431BQLPR | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 125 | TQ431B | Samples |
| TLV431BQPK | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | -40 to 125 | V6 | Samples |
| TLV431BQPKG3 | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | -40 to 125 | V6 | Samples |
| TLV431CDBV | OBSOLETE | SOT-23 | DBV | 5 | | TBD | Call TI | Call TI | 0 to 70 | | |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|--|-------------------------|
| TLV431CDBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | 0 to 70 | (Y3C5 ~ Y3C6 ~ Y3CI) (Y3CG ~ Y3CS) | Samples |
| TLV431CDBVRE4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | Y3CI | Samples |
| TLV431CDBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | Y3CI | Samples |
| TLV431CDBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | 0 to 70 | (Y3C5 ~ Y3C6 ~ Y3CI) (Y3CG ~ Y3CS) | Samples |
| TLV431CDBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | Y3CI | Samples |
| TLV431CDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y3C6 ~ Y3C8 ~ Y3CB) (Y3C3 ~ Y3CS ~ Y3CU) | Samples |
| TLV431CDBZRG4 | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y3C6 ~ Y3C8 ~ Y3CB) (Y3C3 ~ Y3CS ~ Y3CU) | Samples |
| TLV431CLP | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | 0 to 70 | V431C | Samples |
| TLV431CLPE3 | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | 0 to 70 | V431C | Samples |
| TLV431CLPM | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | 0 to 70 | V431C | Samples |
| TLV431CLPME3 | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | 0 to 70 | V431C | Samples |
| TLV431CLPR | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | 0 to 70 | V431C | Samples |
| TLV431CLPRE3 | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | 0 to 70 | V431C | Samples |
| TLV431IDBV | OBSOLETE | SOT-23 | DBV | 5 | | TBD | Call TI | Call TI | -40 to 85 | | |
| TLV431IDBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -40 to 85 | (Y3I5 ~ Y3I6 ~ Y3II) (Y3IG ~ Y3IS) | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|---------------------------------------|-------------------------|
| TLV431IDBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | Y3II | Samples |
| TLV431IDBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -40 to 85 | (Y3I5 ~ Y3I6 ~ Y3II) (Y3IG ~ Y3IS) | Samples |
| TLV431IDBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | Y3II | Samples |
| TLV431IDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (Y3I6 ~ Y3IB) (Y3IS ~ Y3IU) | Samples |
| TLV431IDBZRG4 | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (Y3I6 ~ Y3IB) (Y3IS ~ Y3IU) | Samples |
| TLV431ILP | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 85 | V431I | Samples |
| TLV431ILPE3 | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 85 | V431I | Samples |
| TLV431ILPR | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 85 | V431I | Samples |
| TLV431QPK | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | -40 to 125 | VB | Samples |
| TLV431QPKG3 | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | -40 to 125 | VB | Samples |

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

- (3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.
- (4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.
- (5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.
- (6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

Important Information and Disclaimer:The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF TLV431A, TLV431B :

- Automotive: [TLV431A-Q1](#), [TLV431B-Q1](#)

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

TAPE AND REEL INFORMATION



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLV431ACDBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 9.2 | 3.17 | 3.23 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV431ACDBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV431ACDBVRG4 | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV431ACDBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 9.2 | 3.17 | 3.23 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV431ACDBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV431ACDBVTG4 | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV431ACDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLV431AIDBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV431AIDBVRG4 | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV431AIDBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV431AIDBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 9.2 | 3.17 | 3.23 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV431AIDBVTG4 | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV431AIDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLV431AIDR | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |
| TLV431AQPK | SOT-89 | PK | 3 | 1000 | 180.0 | 12.4 | 4.91 | 4.52 | 1.9 | 8.0 | 12.0 | Q3 |
| TLV431BCDBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV431BCDBVRG4 | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV431BCDBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLV431BCDBVTG4 | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV431BCDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLV431BCDBZT | SOT-23 | DBZ | 3 | 250 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLV431BCDCKR | SC70 | DCK | 6 | 3000 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TLV431BCDCKT | SC70 | DCK | 6 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TLV431BCPK | SOT-89 | PK | 3 | 1000 | 180.0 | 12.4 | 4.91 | 4.52 | 1.9 | 8.0 | 12.0 | Q3 |
| TLV431BIDBVR | SOT-23 | DBV | 5 | 3000 | 179.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLV431BIDBVT | SOT-23 | DBV | 5 | 250 | 179.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLV431BIDBZR | SOT-23 | DBZ | 3 | 3000 | 178.0 | 9.2 | 3.08 | 2.8 | 1.27 | 4.0 | 8.0 | Q3 |
| TLV431BIDBZT | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLV431BIDBZT | SOT-23 | DBZ | 3 | 250 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLV431BIDCKR | SC70 | DCK | 6 | 3000 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TLV431BIDCKT | SC70 | DCK | 6 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TLV431BIPK | SOT-89 | PK | 3 | 1000 | 180.0 | 12.4 | 4.91 | 4.52 | 1.9 | 8.0 | 12.0 | Q3 |
| TLV431BQDBVR | SOT-23 | DBV | 5 | 3000 | 179.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLV431BQDBVT | SOT-23 | DBV | 5 | 250 | 179.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLV431BQDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLV431BQDBZT | SOT-23 | DBZ | 3 | 250 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLV431BQDCKR | SC70 | DCK | 6 | 3000 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TLV431BQDCKT | SC70 | DCK | 6 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TLV431BQPK | SOT-89 | PK | 3 | 1000 | 180.0 | 12.4 | 4.91 | 4.52 | 1.9 | 8.0 | 12.0 | Q3 |
| TLV431CDBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV431CDBVRG4 | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV431CDBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 8.4 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV431CDBVTG4 | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV431CDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLV431IDBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.3 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLV431IDBVRG4 | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.3 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLV431IDBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV431IDBVTG4 | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV431IDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLV431QPK | SOT-89 | PK | 3 | 1000 | 180.0 | 12.4 | 4.91 | 4.52 | 1.9 | 8.0 | 12.0 | Q3 |

TAPE AND REEL BOX DIMENSIONS

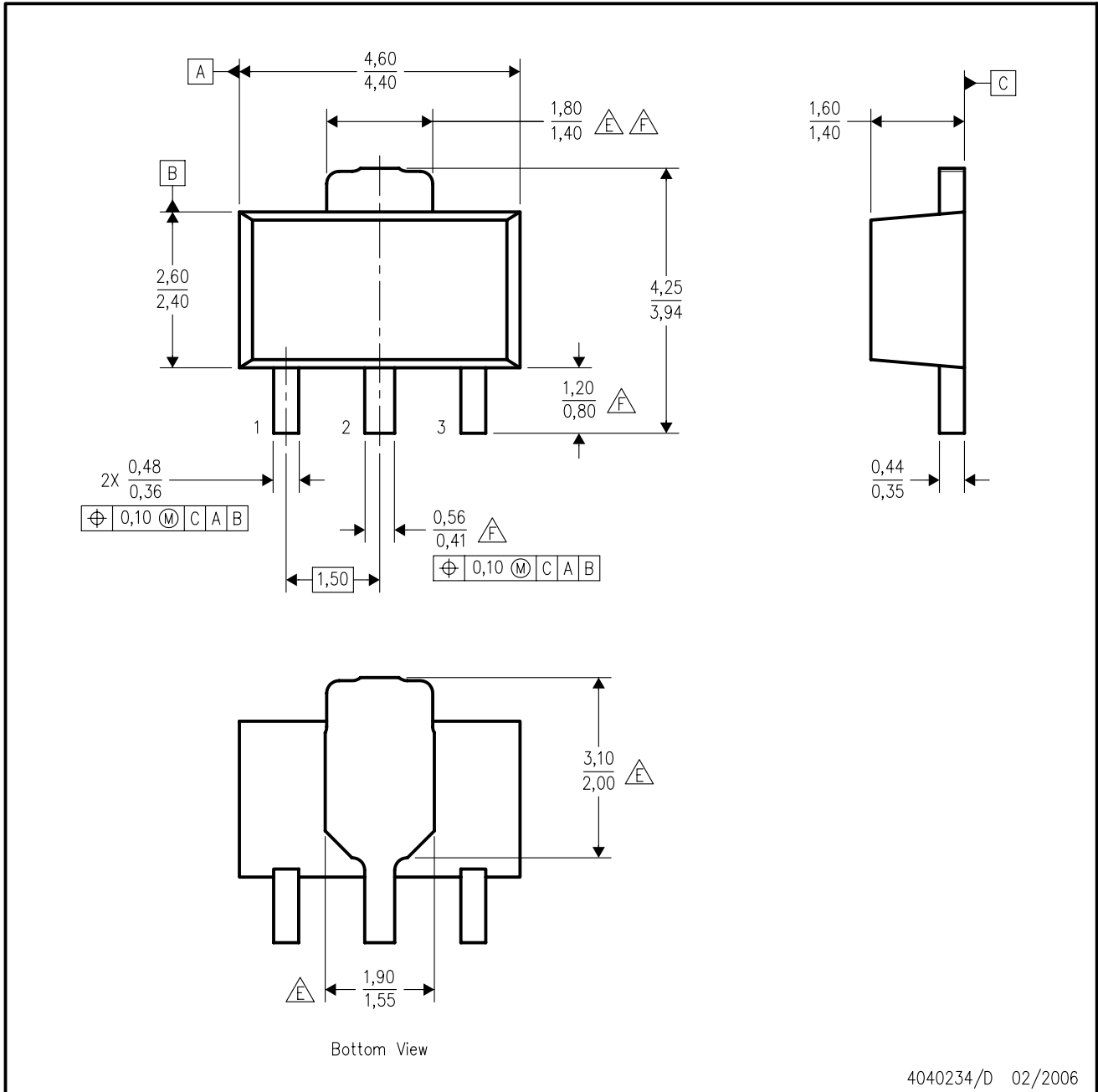

*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLV431ACDBVR | SOT-23 | DBV | 5 | 3000 | 205.0 | 200.0 | 33.0 |
| TLV431ACDBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TLV431ACDBVRG4 | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TLV431ACDBVT | SOT-23 | DBV | 5 | 250 | 205.0 | 200.0 | 33.0 |
| TLV431ACDBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TLV431ACDBVTG4 | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TLV431ACDBZR | SOT-23 | DBZ | 3 | 3000 | 202.0 | 201.0 | 28.0 |
| TLV431AIDBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TLV431AIDBVRG4 | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TLV431AIDBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TLV431AIDBVT | SOT-23 | DBV | 5 | 250 | 205.0 | 200.0 | 33.0 |
| TLV431AIDBVTG4 | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TLV431AIDBZR | SOT-23 | DBZ | 3 | 3000 | 202.0 | 201.0 | 28.0 |
| TLV431AIDR | SOIC | D | 8 | 2500 | 340.5 | 338.1 | 20.6 |
| TLV431AQPK | SOT-89 | PK | 3 | 1000 | 340.0 | 340.0 | 38.0 |
| TLV431BCDBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TLV431BCDBVRG4 | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TLV431BCDBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TLV431BCDBVTG4 | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TLV431BCDBZR | SOT-23 | DBZ | 3 | 3000 | 202.0 | 201.0 | 28.0 |

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLV431BCDBZT | SOT-23 | DBZ | 3 | 250 | 202.0 | 201.0 | 28.0 |
| TLV431BCDCKR | SC70 | DCK | 6 | 3000 | 203.0 | 203.0 | 35.0 |
| TLV431BCDCKT | SC70 | DCK | 6 | 250 | 203.0 | 203.0 | 35.0 |
| TLV431BCPK | SOT-89 | PK | 3 | 1000 | 340.0 | 340.0 | 38.0 |
| TLV431BIDBVR | SOT-23 | DBV | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TLV431BIDBVT | SOT-23 | DBV | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TLV431BIDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 180.0 | 18.0 |
| TLV431BIDBZR | SOT-23 | DBZ | 3 | 3000 | 202.0 | 201.0 | 28.0 |
| TLV431BIDBZT | SOT-23 | DBZ | 3 | 250 | 202.0 | 201.0 | 28.0 |
| TLV431BIDCKR | SC70 | DCK | 6 | 3000 | 203.0 | 203.0 | 35.0 |
| TLV431BIDCKT | SC70 | DCK | 6 | 250 | 203.0 | 203.0 | 35.0 |
| TLV431BIPK | SOT-89 | PK | 3 | 1000 | 340.0 | 340.0 | 38.0 |
| TLV431BQDBVR | SOT-23 | DBV | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TLV431BQDBVT | SOT-23 | DBV | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TLV431BQDBZR | SOT-23 | DBZ | 3 | 3000 | 202.0 | 201.0 | 28.0 |
| TLV431BQDBZT | SOT-23 | DBZ | 3 | 250 | 202.0 | 201.0 | 28.0 |
| TLV431BQDCKR | SC70 | DCK | 6 | 3000 | 203.0 | 203.0 | 35.0 |
| TLV431BQDCKT | SC70 | DCK | 6 | 250 | 203.0 | 203.0 | 35.0 |
| TLV431BQPK | SOT-89 | PK | 3 | 1000 | 340.0 | 340.0 | 38.0 |
| TLV431CDBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TLV431CDBVRG4 | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TLV431CDBVT | SOT-23 | DBV | 5 | 250 | 202.0 | 201.0 | 28.0 |
| TLV431CDBVTG4 | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TLV431CDBZR | SOT-23 | DBZ | 3 | 3000 | 202.0 | 201.0 | 28.0 |
| TLV431IDBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TLV431IDBVRG4 | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TLV431IDBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TLV431IDBVTG4 | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TLV431IDBZR | SOT-23 | DBZ | 3 | 3000 | 202.0 | 201.0 | 28.0 |
| TLV431QPK | SOT-89 | PK | 3 | 1000 | 340.0 | 340.0 | 38.0 |

PK (R-PSS0-F3)

PLASTIC SINGLE-IN-LINE PACKAGE



4040234/D 02/2006

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. The center lead is in electrical contact with the tab.
 - D. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion not to exceed 0.15 per side.
 - $\triangle E$ Thermal pad contour optional within these dimensions.
 - $\triangle F$ Falls within JEDEC TO-243 variation AA, except minimum lead length, pin 2 minimum lead width, minimum tab width.

DBV (R-PDSO-G5)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
 - D. Falls within JEDEC MO-178 Variation AA.

DBV (R-PDSO-G5)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
 - D. Publication IPC-7351 is recommended for alternate designs.
 - E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

DBZ (R-PDSO-G3)

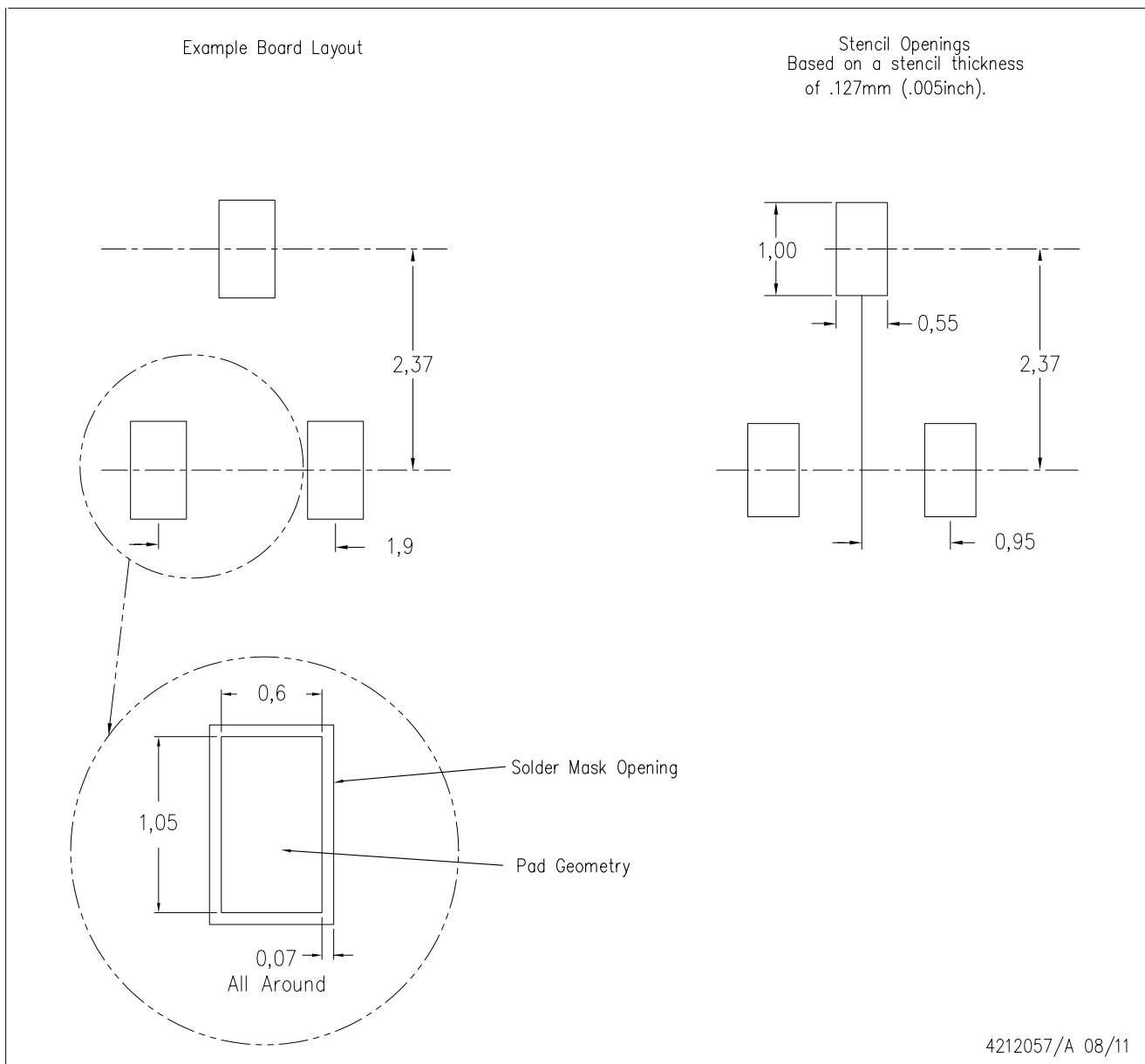
PLASTIC SMALL-OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. Lead dimensions are inclusive of plating.
 - D. Body dimensions are exclusive of mold flash and protrusion. Mold flash and protrusion not to exceed 0.25 per side.
 - $\triangle E$ Falls within JEDEC TO-236 variation AB, except minimum foot length.

DBZ (R-PDSO-G3)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
 - D. Publication IPC-7351 is recommended for alternate designs.
 - E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

DCK (R-PDSO-G6)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
 - D. Falls within JEDEC MO-203 variation AB.

DCK (R-PDSO-G6)

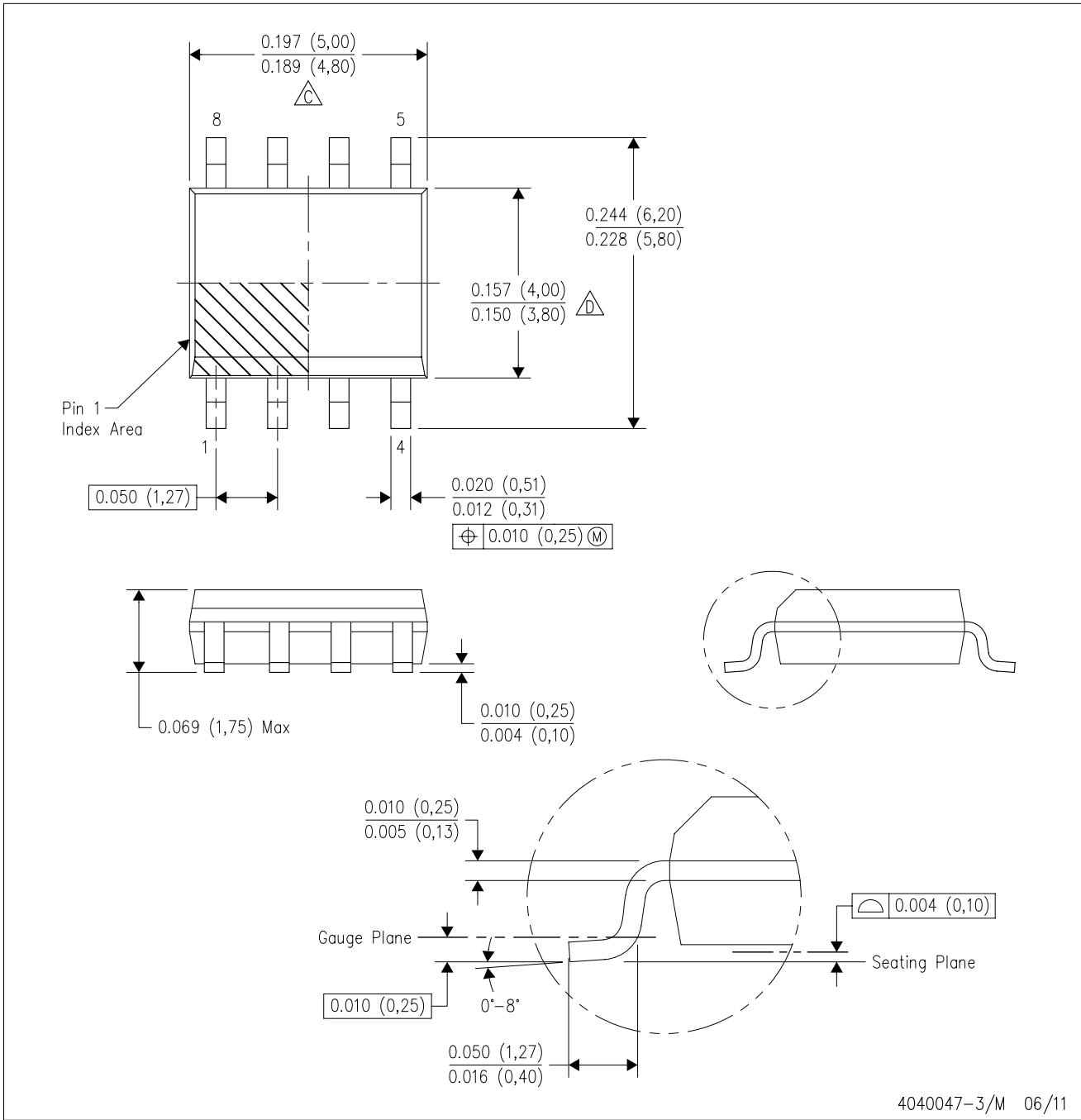
PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
 - Publication IPC-7351 is recommended for alternate designs.
 - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AA.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

| | |
|------------------------------|--|
| Audio | www.ti.com/audio |
| Amplifiers | amplifier.ti.com |
| Data Converters | dataconverter.ti.com |
| DLP® Products | www.dlp.com |
| DSP | dsp.ti.com |
| Clocks and Timers | www.ti.com/clocks |
| Interface | interface.ti.com |
| Logic | logic.ti.com |
| Power Mgmt | power.ti.com |
| Microcontrollers | microcontroller.ti.com |
| RFID | www.ti-rfid.com |
| OMAP Applications Processors | www.ti.com/omap |
| Wireless Connectivity | www.ti.com/wirelessconnectivity |

Applications

| | |
|-------------------------------|--|
| Automotive and Transportation | www.ti.com/automotive |
| Communications and Telecom | www.ti.com/communications |
| Computers and Peripherals | www.ti.com/computers |
| Consumer Electronics | www.ti.com/consumer-apps |
| Energy and Lighting | www.ti.com/energy |
| Industrial | www.ti.com/industrial |
| Medical | www.ti.com/medical |
| Security | www.ti.com/security |
| Space, Avionics and Defense | www.ti.com/space-avionics-defense |
| Video and Imaging | www.ti.com/video |

TI E2E Community

e2e.ti.com