



## TLVH43xx Low-Voltage Adjustable Precision Shunt Regulators

### 1 Features

- Low-Voltage Operation: Down to 1.24 V
- Reference Voltage Tolerances at 25°C
  - 0.5% for B Grade
  - 1% for A Grade
  - 1.5% for Standard Grade
- Adjustable Output Voltage,  $V_O = V_{REF}$  to 18 V
- Wide Operating Cathode Current Range: 100  $\mu$ A to 70 mA
- 0.25- $\Omega$  Typical Output Impedance
- –40°C to 125°C Specifications
- TLVH432 Provides Alternative Pinouts for SOT-23-3 and SOT-89 Packages
- Ultra-Small SC-70 Package Offers 40% Smaller Footprint than SOT-23-3

### 2 Applications

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

### 3 Description

The TLVH431 and TLVH432 devices are low-voltage 3-terminal adjustable voltage references, 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 18 V with two external resistors (see [Figure 19](#)). 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 TLVH431 and TLVH432 devices are ideal voltage references in isolated feedback circuits for 3-V to 3.3-V switching-mode power supplies. They have a typical output impedance of 0.25  $\Omega$ . Active output circuitry provides a very sharp turn-on characteristic, making the TLVH431 and TLVH432 devices excellent replacements for low-voltage Zener diodes in many applications, including on-board regulation and adjustable power supplies.

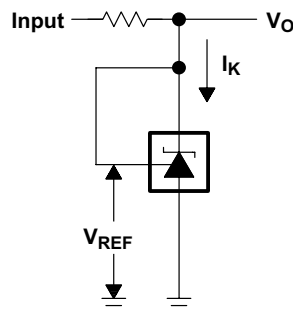
The TLVH432 device is identical to the TLVH431 device, but is offered with different pinouts for the SOT-23-3 and SOT-89 packages.

Device Information<sup>(1)</sup>

| PART NUMBER | PACKAGE (PIN) | BODY SIZE (NOM)          |
|-------------|---------------|--------------------------|
| TLVH43xx    | SOT-23 (5)    | 2.90 mm $\times$ 1.60 mm |
|             | SOT-23 (3)    | 2.92 mm $\times$ 1.30 mm |
|             | SC70 (6)      | 2.00 mm $\times$ 1.25 mm |
|             | TO-92 (3)     | 4.30 mm $\times$ 4.30 mm |
|             | SOT-89 (3)    | 4.50 mm $\times$ 2.50 mm |

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

### 4 Simplified Schematic



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## 5 Revision History

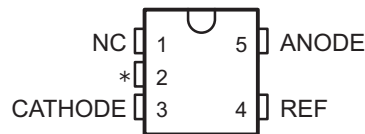
### Changes from Revision I (September 2009) to Revision J

Page

- Added *Applications*, *Device Information* table, *Pin Functions* table, *ESD Ratings* table, *Thermal Information* table, *Typical Characteristics*, *Feature Description* section, *Device Functional Modes*, *Application and Implementation* section, *Power Supply Recommendations* section, *Layout* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section. .... **1**
- Deleted *Ordering Information* table. .... **1**

## 6 Pin Configuration and Functions

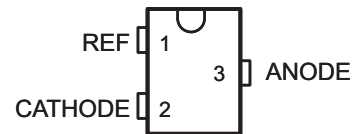
**TLVH431  
DBV (SOT-23-5) PACKAGE  
(TOP VIEW)**



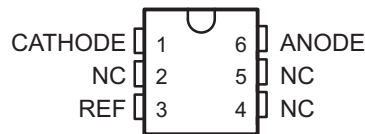
NC – No internal connection

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

**TLVH431  
DBZ (SOT-23-3) PACKAGE  
(TOP VIEW)**



**TLVH431  
DCK (SC-70) PACKAGE  
(TOP VIEW)**

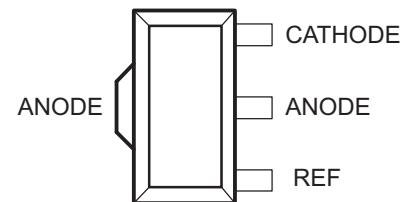


NC – No internal connection

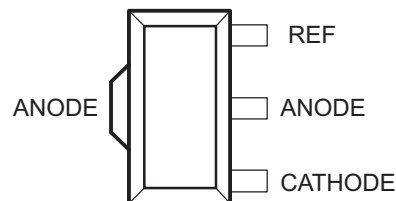
**TLVH431  
LP (TO-92/TO-226) PACKAGE  
(TOP VIEW)**



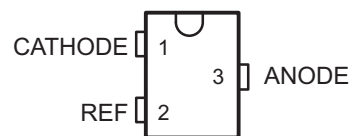
**TLVH431  
PK (SOT-89) PACKAGE  
(TOP VIEW)**



**TLVH432  
PK (SOT-89) PACKAGE  
(TOP VIEW)**



**TLVH432  
DBZ (SOT-23-3) PACKAGE  
(TOP VIEW)**



### Pin Functions

| PIN     |         |     |            |    |         |         |    | TYPE | DESCRIPTION                              |
|---------|---------|-----|------------|----|---------|---------|----|------|------------------------------------------|
| NAME    | TLVH431 |     |            |    |         | TLVH432 |    |      |                                          |
|         | DBZ     | DBV | D          | LP | DCK     | DBZ     | PK |      |                                          |
| CATHODE | 2       | 3   | 1          | 1  | 1       | 1       | 3  | I/O  | Shunt Current/Voltage input              |
| REF     | 1       | 4   | 8          | 3  | 3       | 2       | 1  | I    | Threshold relative to common anode       |
| ANODE   | 3       | 5   | 2, 3, 6, 7 | 2  | 6       | 3       | 2  | O    | Common pin, normally connected to ground |
| NC      | —       | 1   | —          | —  | 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)<sup>(1)</sup>

|           |                                        | MIN   | MAX | UNIT |
|-----------|----------------------------------------|-------|-----|------|
| $V_{KA}$  | Cathode voltage <sup>(2)</sup>         |       | 20  | V    |
| $I_K$     | Cathode current range                  | –25   | 80  | mA   |
| $I_{ref}$ | Reference current range                | –0.05 | 3   | mA   |
| $T_J$     | 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 *Thermal Information* 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 <sup>(1)</sup>              | ±2000 | V    |
|             |                         | Charged device model (CDM), per JEDEC specification JESD22-C101, all pins <sup>(2)</sup> | ±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 <sup>(1)</sup> |                                           | TLVH43xx |        |        |        |        | UNIT |
|-------------------------------|-------------------------------------------|----------|--------|--------|--------|--------|------|
|                               |                                           | DCK      | PK     | DBV    | DBZ    | LP     |      |
|                               |                                           | 6 PINS   | 3 PINS | 5 PINS | 3 PINS | 3 PINS |      |
| $R_{\theta JA}$               | Junction-to-ambient thermal resistance    | 87       | 52     | 206    | 206    | 140    | °C/W |
| $R_{\theta JC(top)}$          | Junction-to-case (top) thermal resistance | 259      | 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

See<sup>(1)</sup>

|          |                                | MIN       | MAX | UNIT |
|----------|--------------------------------|-----------|-----|------|
| $V_{KA}$ | Cathode voltage                | $V_{REF}$ | 18  | V    |
| $I_K$    | Cathode current (continuous)   | 0.1       | 70  | mA   |
| $T_A$    | Operating free-air temperature | TLVH43x_C | 0   | 70   |
|          |                                | TLVH43x_I | –40 | 85   |
|          |                                | TLVH43x_Q | –40 | 125  |

- (1) Maximum power dissipation is a function of  $T_J(max)$ ,  $\theta_{JA}$ , and  $T_A$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_J(max) - T_A) / \theta_{JA}$ . Operating at the absolute maximum  $T_J$  of 150°C can affect reliability.

## 7.5 TLVH43x Electrical Characteristics

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

| PARAMETER                                                                                            | TEST CONDITIONS                                                                                    |                                                              | TLVH431<br>TLVH432 |       |       | UNIT |
|------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|--------------------------------------------------------------|--------------------|-------|-------|------|
|                                                                                                      |                                                                                                    |                                                              | MIN                | TYP   | MAX   |      |
| V <sub>REF</sub> Reference voltage                                                                   | V <sub>KA</sub> = V <sub>REF</sub> ,<br>I <sub>K</sub> = 10 mA                                     | T <sub>A</sub> = 25°C                                        | 1.222              | 1.24  | 1.258 | V    |
|                                                                                                      |                                                                                                    | T <sub>A</sub> = full range,<br>See Figure 18 <sup>(1)</sup> | TLVH431C           | 1.21  | 1.27  |      |
|                                                                                                      |                                                                                                    |                                                              | TLVH431I           | 1.202 | 1.278 |      |
|                                                                                                      |                                                                                                    |                                                              | TLVH431Q           | 1.194 | 1.286 |      |
| V <sub>REF(dev)</sub> V <sub>REF</sub> deviation over full<br>temperature range <sup>(2)</sup>       | V <sub>KA</sub> = V <sub>REF</sub> , I <sub>K</sub> = 10 mA, See Figure 18 <sup>(1)</sup>          | TLVH431C                                                     |                    | 4     | 12    | mV   |
|                                                                                                      |                                                                                                    | TLVH431I                                                     |                    | 6     | 20    |      |
|                                                                                                      |                                                                                                    | TLVH431Q                                                     |                    | 11    | 31    |      |
| $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ Ratio of V <sub>REF</sub> change to<br>cathode voltage change | I <sub>K</sub> = 10 mA, V <sub>K</sub> = V <sub>REF</sub> to 18 V, See Figure 19                   |                                                              |                    | –1.5  | –2.7  | mV/V |
| I <sub>ref</sub> Reference terminal current                                                          | I <sub>K</sub> = 10 mA, R1 = 10 kΩ, R2 = open, See Figure 19                                       |                                                              |                    | 0.1   | 0.5   | μA   |
| I <sub>ref(dev)</sub> I <sub>ref</sub> deviation over full<br>temperature range <sup>(2)</sup>       | I <sub>K</sub> = 10 mA, R1 = 10 kΩ, R2 = open,<br>See Figure 19 <sup>(1)</sup>                     | TLVH431C                                                     |                    | 0.05  | 0.3   | μA   |
|                                                                                                      |                                                                                                    | TLVH431I                                                     |                    | 0.1   | 0.4   |      |
|                                                                                                      |                                                                                                    | TLVH431Q                                                     |                    | 0.15  | 0.5   |      |
| I <sub>K(min)</sub> Minimum cathode current<br>for regulation                                        | V <sub>KA</sub> = V <sub>REF</sub> , See Figure 18                                                 |                                                              |                    | 60    | 100   | μA   |
| I <sub>K(off)</sub> Off-state cathode current                                                        | V <sub>REF</sub> = 0, V <sub>KA</sub> = 18 V, See Figure 20                                        |                                                              |                    | 0.02  | 0.1   | μA   |
| z <sub>KA</sub>        Dynamic impedance <sup>(3)</sup>                                              | V <sub>KA</sub> = V <sub>REF</sub> , f ≤ 1 kHz, I <sub>K</sub> = 0.1 mA to 70 mA,<br>See Figure 18 |                                                              |                    | 0.25  | 0.4   | Ω    |

(1) Full temperature ranges are –40°C to 125°C for TLVH431Q, –40°C to 85°C for TLVH431I, and 0°C to 70°C for TLVH431C.

(2) The deviation parameters V<sub>REF(dev)</sub> and I<sub>ref(dev)</sub> 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<sub>REF</sub>, is defined as:

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

where ΔT<sub>A</sub> is the rated operating free-air temperature range of the device.

αV<sub>REF</sub> can be positive or negative, depending on whether minimum V<sub>REF</sub> or maximum V<sub>REF</sub>, 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 19), 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 TLVH43xA Electrical Characteristics

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

| PARAMETER                              |                                                                       | TEST CONDITIONS                                                                                                 |                                                                              | TLVH431A<br>TLVH432A |       |       | UNIT |
|----------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|----------------------|-------|-------|------|
|                                        |                                                                       |                                                                                                                 |                                                                              | MIN                  | TYP   | MAX   |      |
| V <sub>REF</sub>                       | Reference voltage                                                     | V <sub>KA</sub> = V <sub>REF</sub> ,<br>I <sub>K</sub> = 10 mA                                                  | T <sub>A</sub> = 25°C                                                        | 1.228                | 1.24  | 1.252 | V    |
|                                        |                                                                       |                                                                                                                 | T <sub>A</sub> = full range,<br>See <a href="#">Figure 18</a> <sup>(1)</sup> | TLVH431AC            | 1.221 | 1.259 |      |
|                                        |                                                                       |                                                                                                                 |                                                                              | TLVH431AI            | 1.215 | 1.265 |      |
|                                        |                                                                       |                                                                                                                 |                                                                              | TLVH431AQ            | 1.209 | 1.271 |      |
| V <sub>REF(dev)</sub>                  | V <sub>REF</sub> deviation over full temperature range <sup>(2)</sup> | V <sub>KA</sub> = V <sub>REF</sub> , I <sub>K</sub> = 10 mA, See <a href="#">Figure 18</a> <sup>(1)</sup>       | TLVH431AC                                                                    | 4                    | 12    | mV    |      |
|                                        |                                                                       |                                                                                                                 | TLVH431AI                                                                    | 6                    | 20    |       |      |
|                                        |                                                                       |                                                                                                                 | TLVH431AQ                                                                    | 11                   | 31    |       |      |
| $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ | Ratio of V <sub>REF</sub> change to cathode voltage change            | V <sub>K</sub> = V <sub>REF</sub> to 18 V, I <sub>K</sub> = 10 mA, See <a href="#">Figure 19</a>                |                                                                              |                      | –1.5  | –2.7  | mV/V |
| I <sub>ref</sub>                       | Reference terminal current                                            | I <sub>K</sub> = 10 mA, R1 = 10 kΩ, R2 = open, See <a href="#">Figure 19</a>                                    |                                                                              |                      | 0.1   | 0.5   | μA   |
| I <sub>ref(dev)</sub>                  | I <sub>ref</sub> deviation over full temperature range <sup>(2)</sup> | I <sub>K</sub> = 10 mA, R1 = 10 kΩ, R2 = open, See <a href="#">Figure 19</a> <sup>(1)</sup>                     | TLVH431AC                                                                    | 0.05                 | 0.3   | μA    |      |
|                                        |                                                                       |                                                                                                                 | TLVH431AI                                                                    | 0.1                  | 0.4   |       |      |
|                                        |                                                                       |                                                                                                                 | TLVH431AQ                                                                    | 0.15                 | 0.5   |       |      |
| I <sub>K(min)</sub>                    | Minimum cathode current for regulation                                | V <sub>KA</sub> = V <sub>REF</sub> , See <a href="#">Figure 18</a>                                              |                                                                              |                      | 60    | 100   | μA   |
| I <sub>K(off)</sub>                    | Off-state cathode current                                             | V <sub>REF</sub> = 0, V <sub>KA</sub> = 18 V, See <a href="#">Figure 20</a>                                     |                                                                              |                      | 0.02  | 0.1   | μA   |
| z <sub>KA</sub>                        | Dynamic impedance <sup>(3)</sup>                                      | V <sub>KA</sub> = V <sub>REF</sub> , f ≤ 1 kHz, I <sub>K</sub> = 0.1 mA to 70 mA, See <a href="#">Figure 18</a> |                                                                              |                      | 0.25  | 0.4   | Ω    |

(1) Full temperature ranges are –40°C to 125°C for TLVH431Q, –40°C to 85°C for TLVH431I, and 0°C to 70°C for TLVH431C.

(2) The deviation parameters V<sub>REF(dev)</sub> and I<sub>ref(dev)</sub> 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<sub>REF</sub>, is defined as:

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

where ΔT<sub>A</sub> is the rated operating free-air temperature range of the device.

αV<sub>REF</sub> can be positive or negative, depending on whether minimum V<sub>REF</sub> or maximum V<sub>REF</sub>, 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 19), 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 TLVH43xB Electrical Characteristics

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

| PARAMETER                                                                                  | TEST CONDITIONS                                                                              |                                                            | TLVH431B<br>TLVH432B |       |       | UNIT          |
|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|------------------------------------------------------------|----------------------|-------|-------|---------------|
|                                                                                            |                                                                                              |                                                            | MIN                  | TYP   | MAX   |               |
| $V_{REF}$ Reference voltage                                                                | $V_{KA} = V_{REF}$ ,<br>$I_K = 10$ mA                                                        | $T_A = 25^\circ\text{C}$                                   | 1.234                | 1.24  | 1.246 | V             |
|                                                                                            |                                                                                              | $T_A = \text{full range,}$<br>See Figure 18 <sup>(1)</sup> | TLVH431BC            | 1.227 | 1.253 |               |
|                                                                                            |                                                                                              |                                                            | TLVH431BI            | 1.224 | 1.259 |               |
|                                                                                            |                                                                                              |                                                            | TLVH431BQ            | 1.221 | 1.265 |               |
| $V_{REF(dev)}$ $V_{REF}$ deviation over full temperature range <sup>(2)</sup>              | $V_{KA} = V_{REF}$ , $I_K = 10$ mA, See Figure 18 <sup>(1)</sup>                             | TLVH431BC                                                  |                      | 4     | 12    | mV            |
|                                                                                            |                                                                                              | TLVH431BI                                                  |                      | 6     | 20    |               |
|                                                                                            |                                                                                              | TLVH431BQ                                                  |                      | 11    | 31    |               |
| $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ Ratio of $V_{REF}$ change to cathode voltage change | $I_K = 10$ mA, $V_K = V_{REF}$ to 18 V, See Figure 19                                        |                                                            |                      | –1.5  | –2.7  | mV/V          |
| $I_{ref}$ Reference terminal current                                                       | $I_K = 10$ mA, $R_1 = 10$ k $\Omega$ , $R_2 = \text{open}$ , See Figure 19                   |                                                            |                      | 0.1   | 0.5   | $\mu\text{A}$ |
| $I_{ref(dev)}$ $I_{ref}$ deviation over full temperature range <sup>(2)</sup>              | $I_K = 10$ mA, $R_1 = 10$ k $\Omega$ , $R_2 = \text{open}$ ,<br>See Figure 19 <sup>(1)</sup> | TLVH431BC                                                  |                      | 0.05  | 0.3   | $\mu\text{A}$ |
|                                                                                            |                                                                                              | TLVH431BI                                                  |                      | 0.1   | 0.4   |               |
|                                                                                            |                                                                                              | TLVH431BQ                                                  |                      | 0.15  | 0.5   |               |
| $I_{K(min)}$ Minimum cathode current for regulation                                        | $V_{KA} = V_{REF}$ , See Figure 18                                                           |                                                            |                      | 60    | 100   | $\mu\text{A}$ |
| $I_{K(off)}$ Off-state cathode current                                                     | $V_{REF} = 0$ , $V_{KA} = 18$ V, See Figure 20                                               |                                                            |                      | 0.02  | 0.1   | $\mu\text{A}$ |
| $ Z_{KA} $ Dynamic impedance <sup>(3)</sup>                                                | $V_{KA} = V_{REF}$ , $f \leq 1$ kHz, $I_K = 0.1$ mA to 70 mA, See Figure 18                  |                                                            |                      | 0.25  | 0.4   | $\Omega$      |

(1) Full temperature ranges are –40°C to 125°C for TLVH431Q, –40°C to 85°C for TLVH431I, and 0°C to 70°C for TLVH431C.

(2) The deviation parameters  $V_{REF(dev)}$  and  $I_{ref(dev)}$  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,  $\alpha V_{REF}$ , is defined as:

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

where  $\Delta T_A$  is the rated operating free-air temperature range of the device.

$\alpha V_{REF}$  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 19), the total dynamic impedance of the circuit is defined as:

$$|z_{ka}|' = \frac{\Delta V}{\Delta I} \approx |z_{ka}| \times \left( 1 + \frac{R_1}{R_2} \right)$$

## 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.

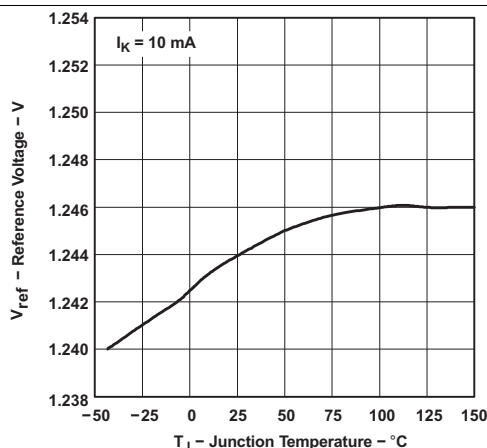


Figure 1. Reference Voltage vs Junction Temperature

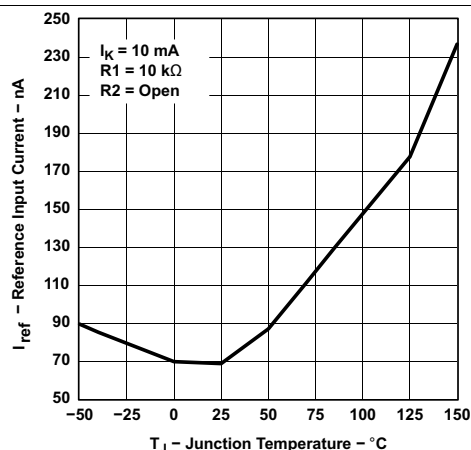


Figure 2. Reference Input Current vs Junction Temperature

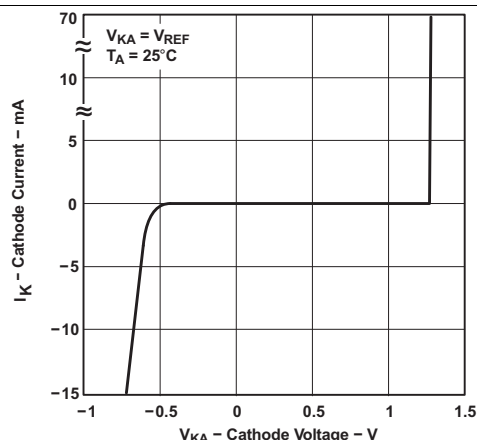


Figure 3. Cathode Current vs Cathode Voltage

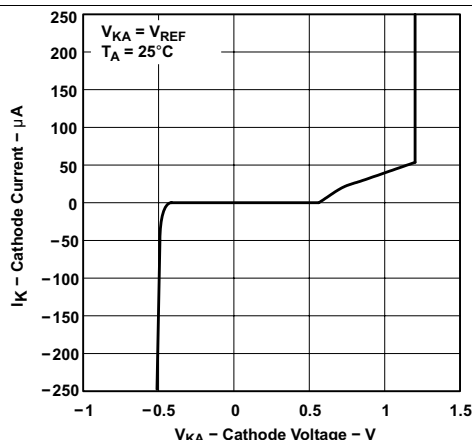


Figure 4. Cathode Current vs Cathode Voltage

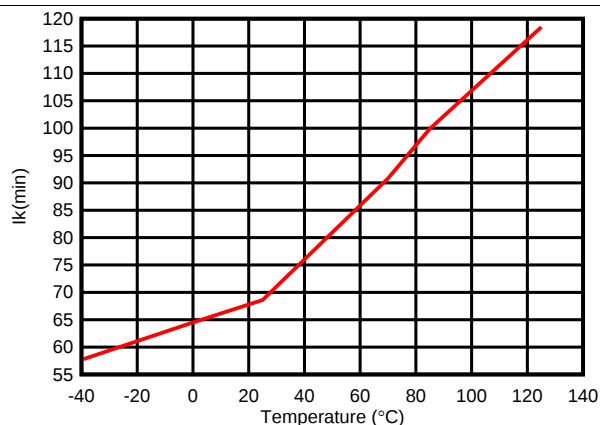


Figure 5. Minimum Cathode Current vs. Temperature

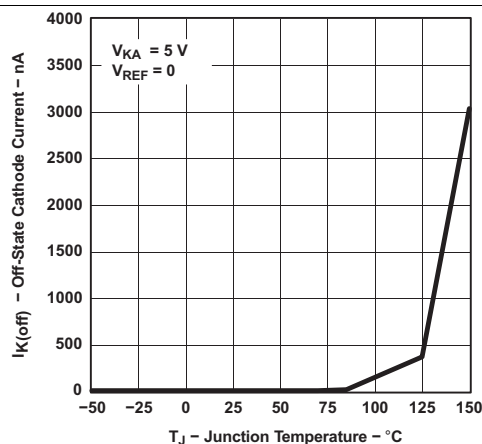
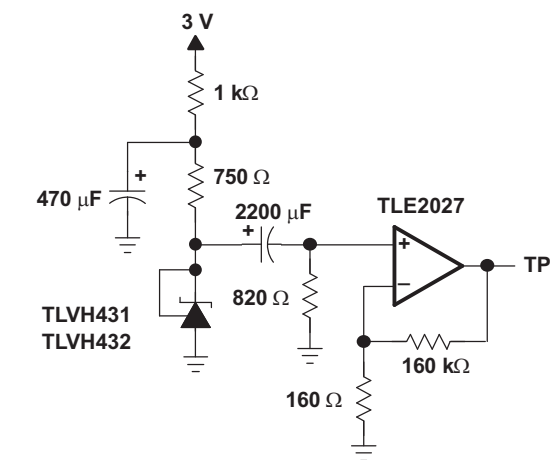
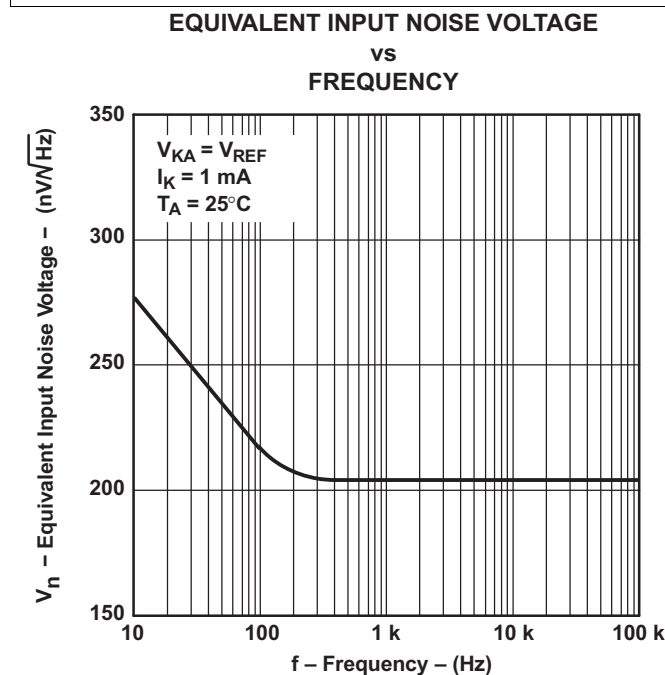
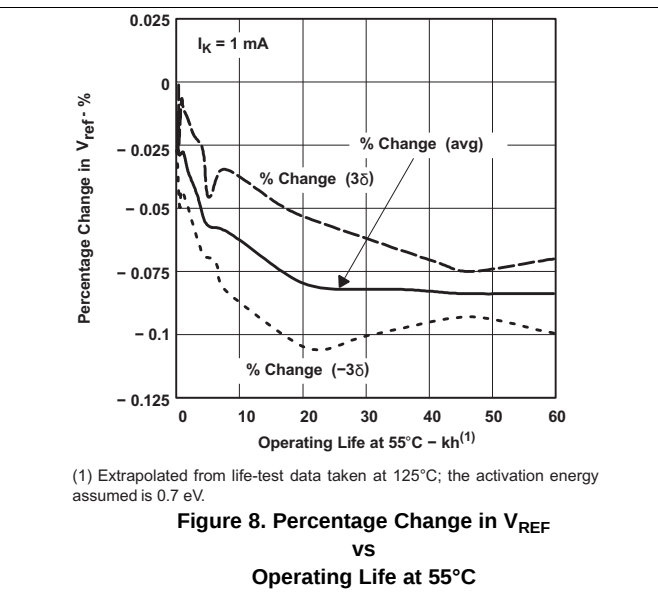
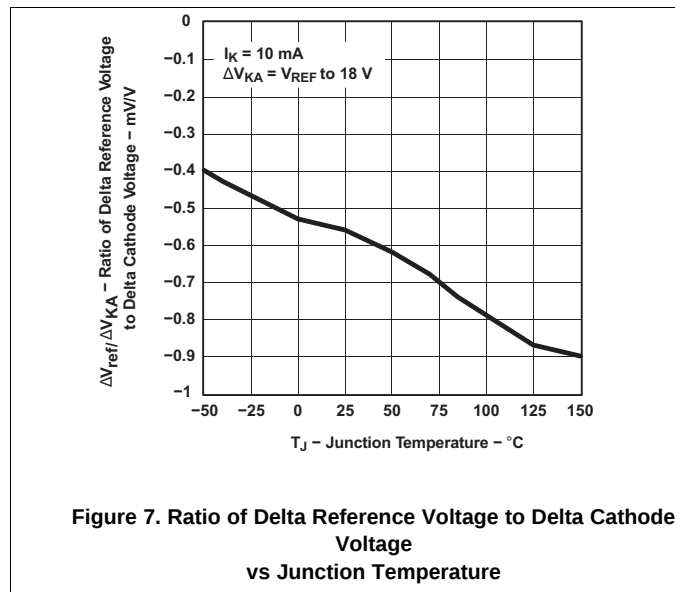


Figure 6. Off-State Cathode Current vs Junction Temperature

## 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.



TEST CIRCUIT FOR 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.

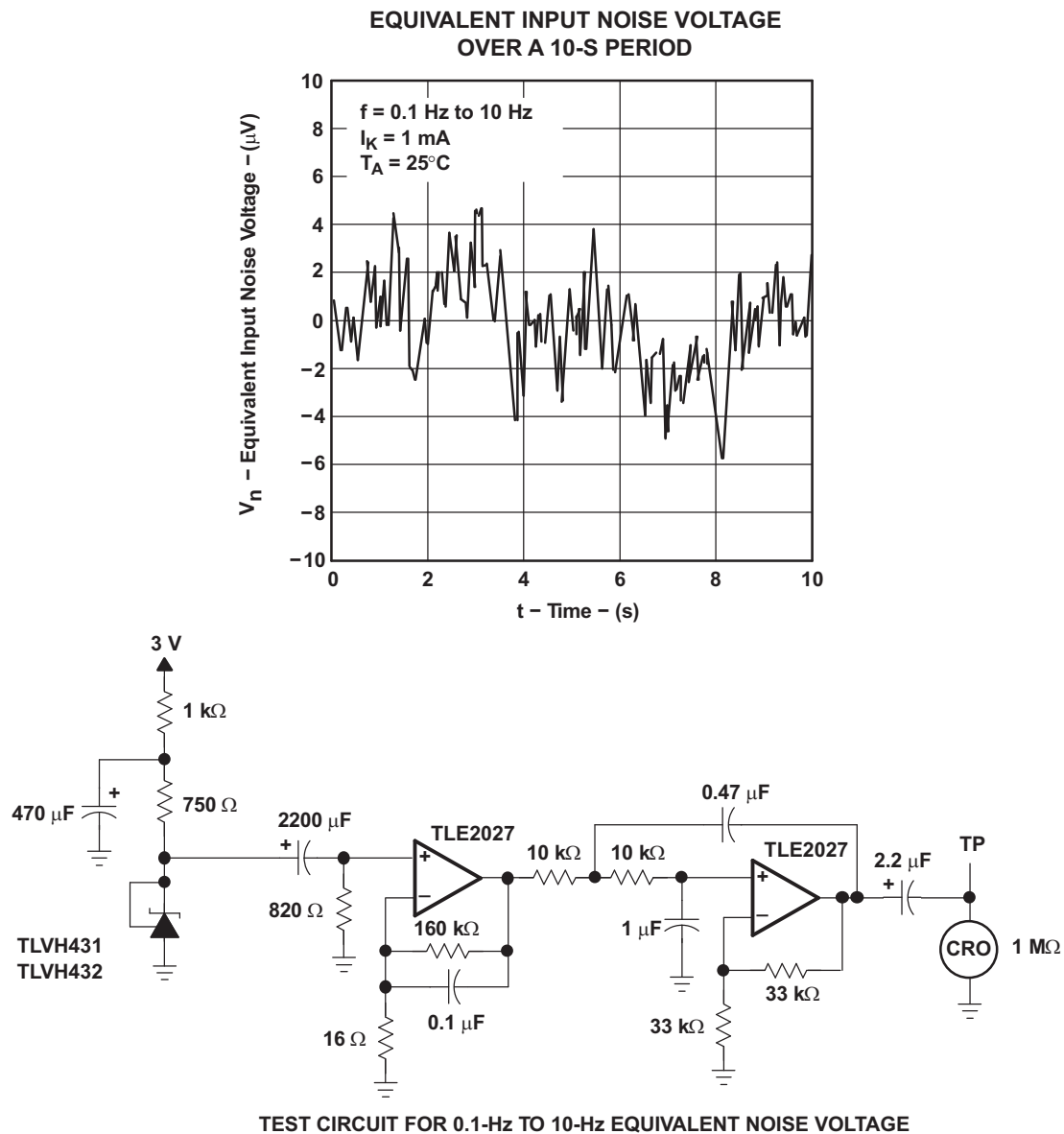
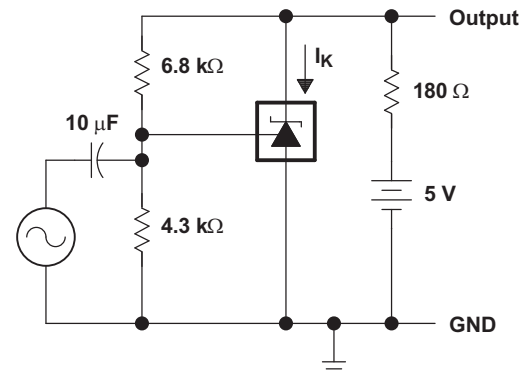
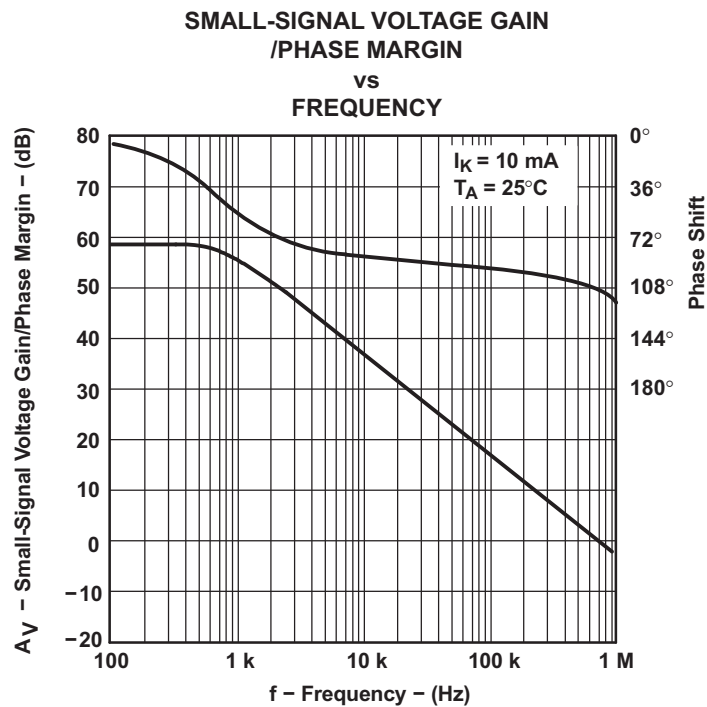


Figure 10. Equivalent Input Noise Voltage

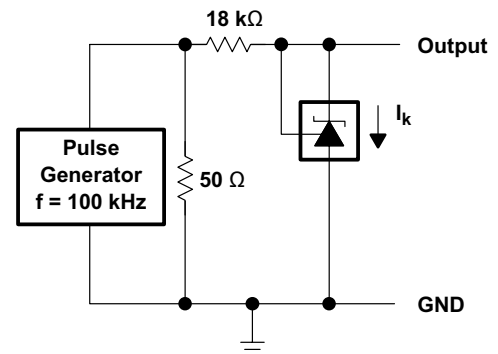
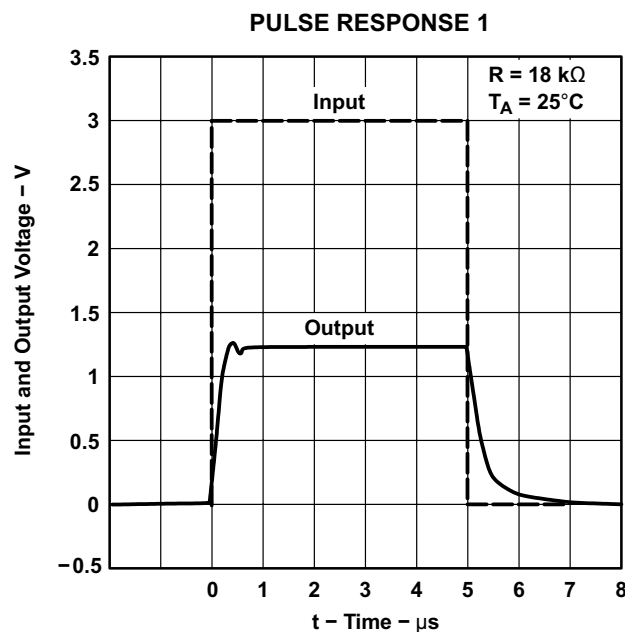
## Typical Characteristics (continued)

Operation of the device at these or any other conditions beyond those indicated in the [Recommended Operating Conditions](#) table are not implied.



TEST CIRCUIT FOR VOLTAGE GAIN  
AND PHASE MARGIN

Figure 11. Voltage Gain and Phase Margin



TEST CIRCUIT FOR PULSE RESPONSE 1

Figure 12. Pulse Response 1

## 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.

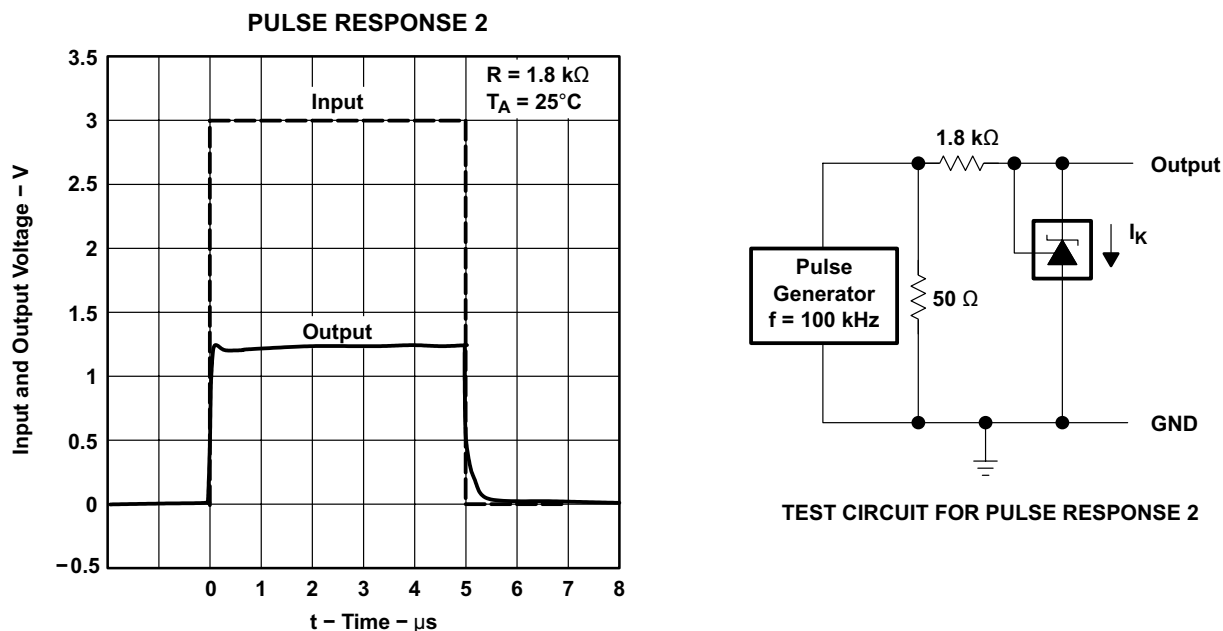


Figure 13. Pulse Response 2

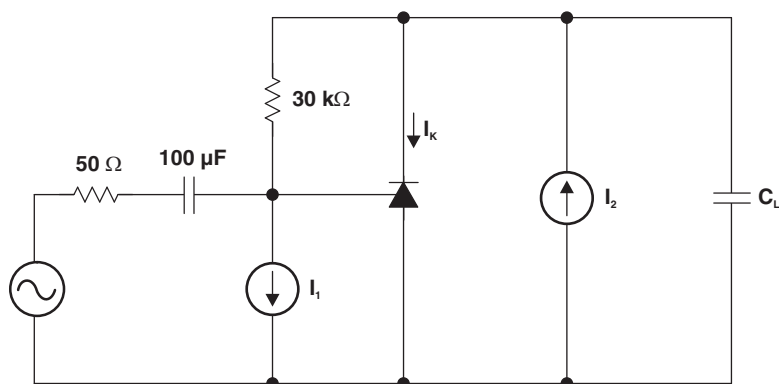
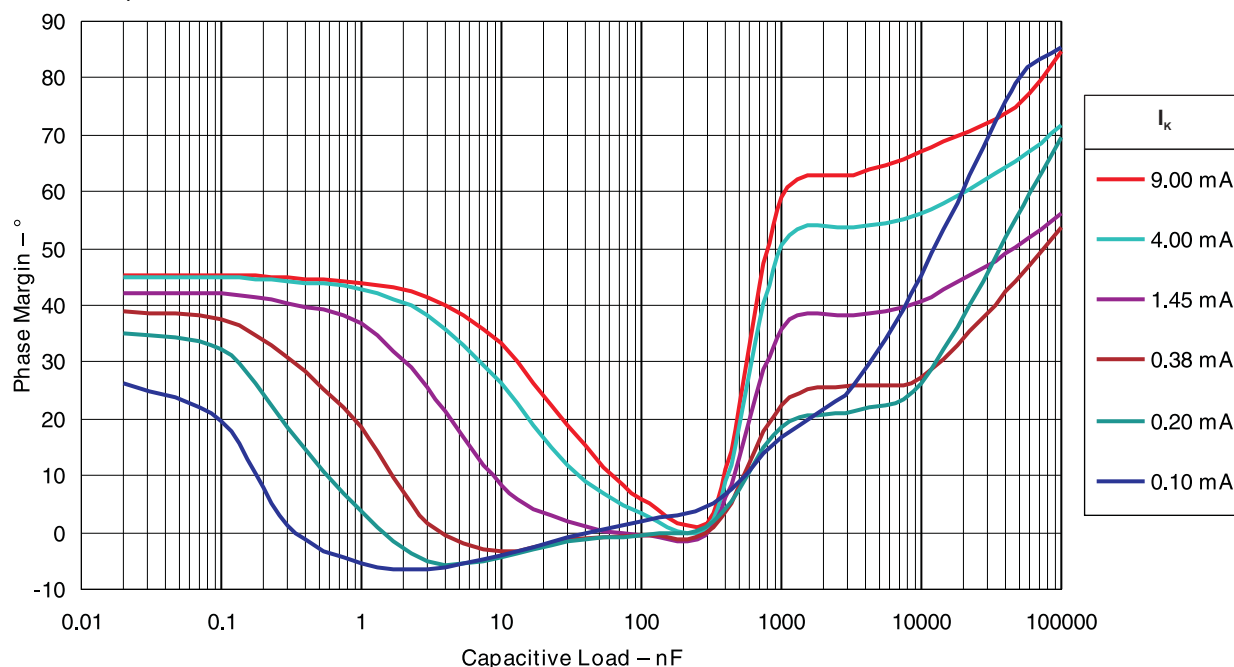


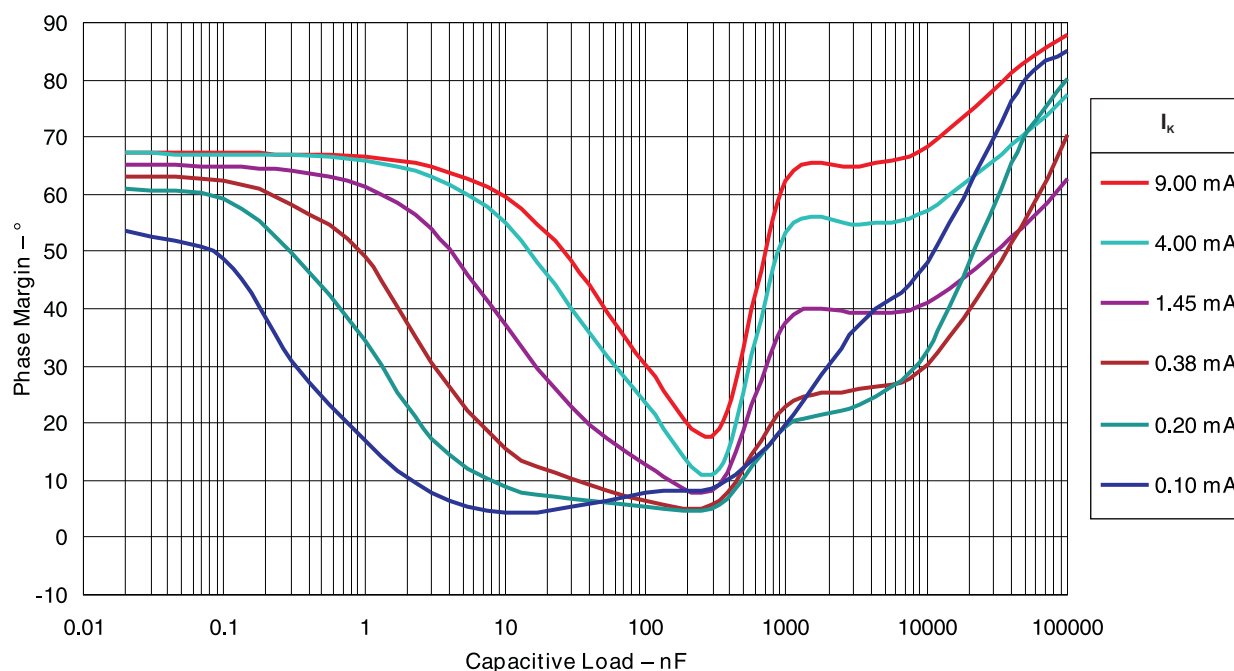
Figure 14. Phase Margin Test Circuit

## 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.



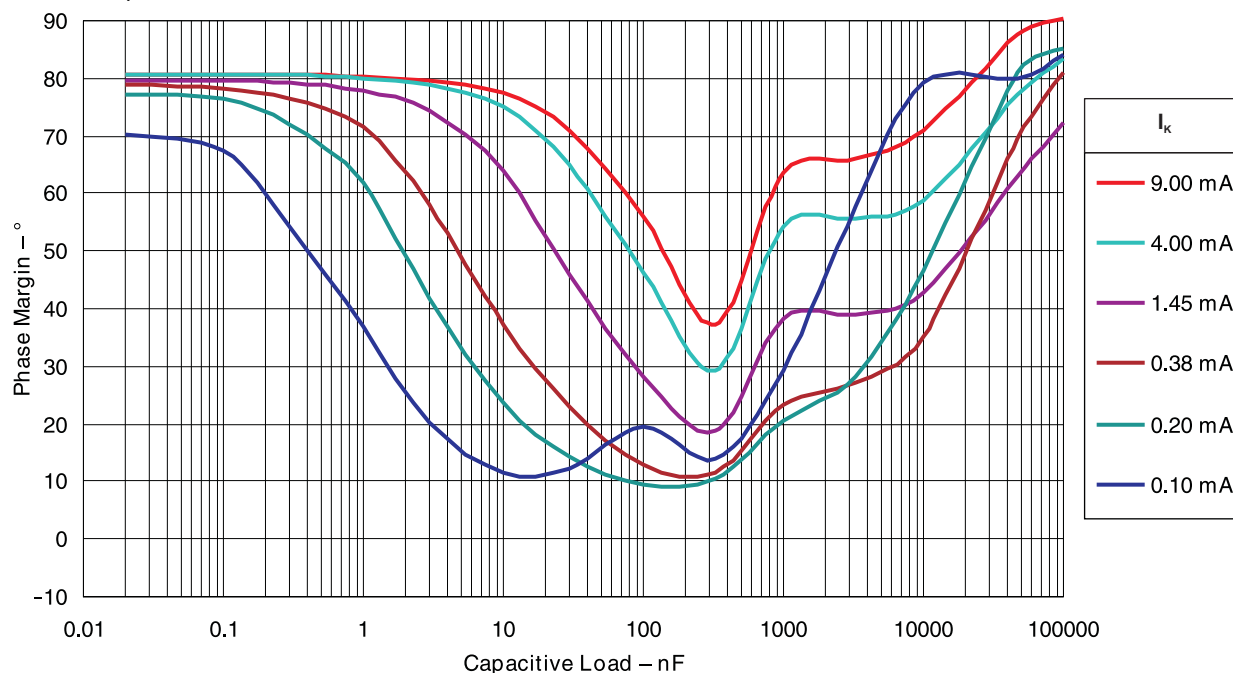
**Figure 15. Phase Margin vs Capacitive Load**  
 $V_{KA} = V_{REF} (1.25 \text{ V})$ ,  $T_A = 25^\circ\text{C}$



**Figure 16. Phase Margin vs Capacitive Load**  
 $V_{KA} = 2.50 \text{ V}$ ,  $T_A = 25^\circ\text{C}$

## 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 17. Phase Margin vs Capacitive Load**  
 $V_{KA} = 5.00 \text{ V}$ ,  $T_A = 25^\circ\text{C}$

## 8 Parameter Measurement Information

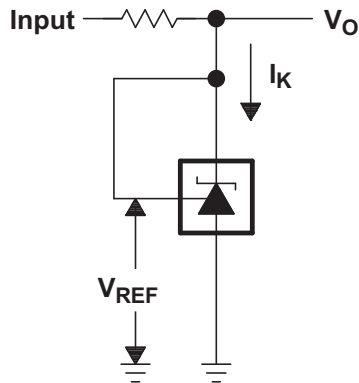


Figure 18. Test Circuit for  $V_{KA} = V_{REF}$ ,  $V_O = V_{KA} = V_{REF}$

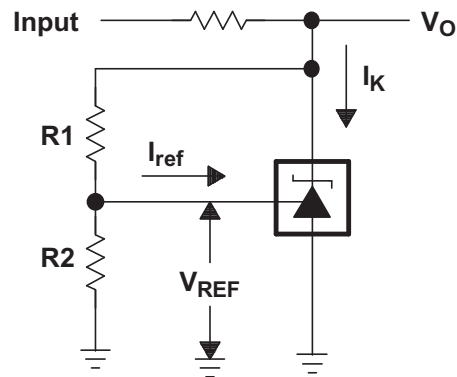


Figure 19. Test Circuit for  $V_{KA} > V_{REF}$ ,  $V_O = V_{KA} = V_{REF} \times (1 + R1/R2) + I_{ref} \times R1$

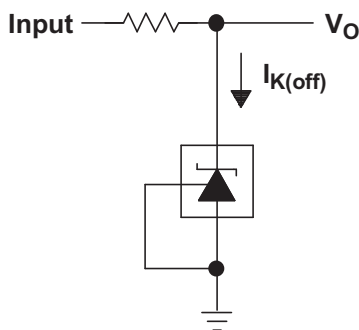


Figure 20. Test Circuit for  $I_{K(off)}$

## 9 Detailed Description

### 9.1 Overview

TLVH431 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, TLVH431 is used in conjunction with its key components to behave as a single voltage reference, error amplifier, voltage clamp or comparator with integrated reference.

TLVH431 is also a higher voltage counterpart to TLV431, with cathode voltage adjustability from 1.24 V to 18 V, 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 TLVH431.

The TLVH431xC devices are characterized for operation from 0°C to 70°C, the TLVH431xI devices are characterized for operation from -40°C to 85°C, and the TLVH431xQ devices are characterized for operation from -40°C to 125°C.

### 9.2 Functional Block Diagram

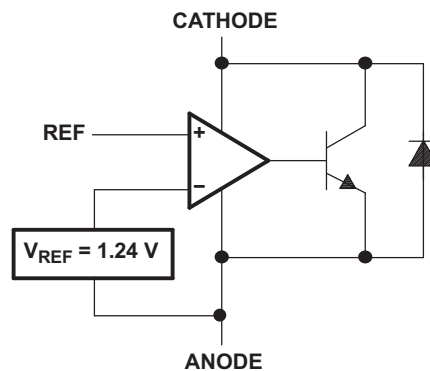
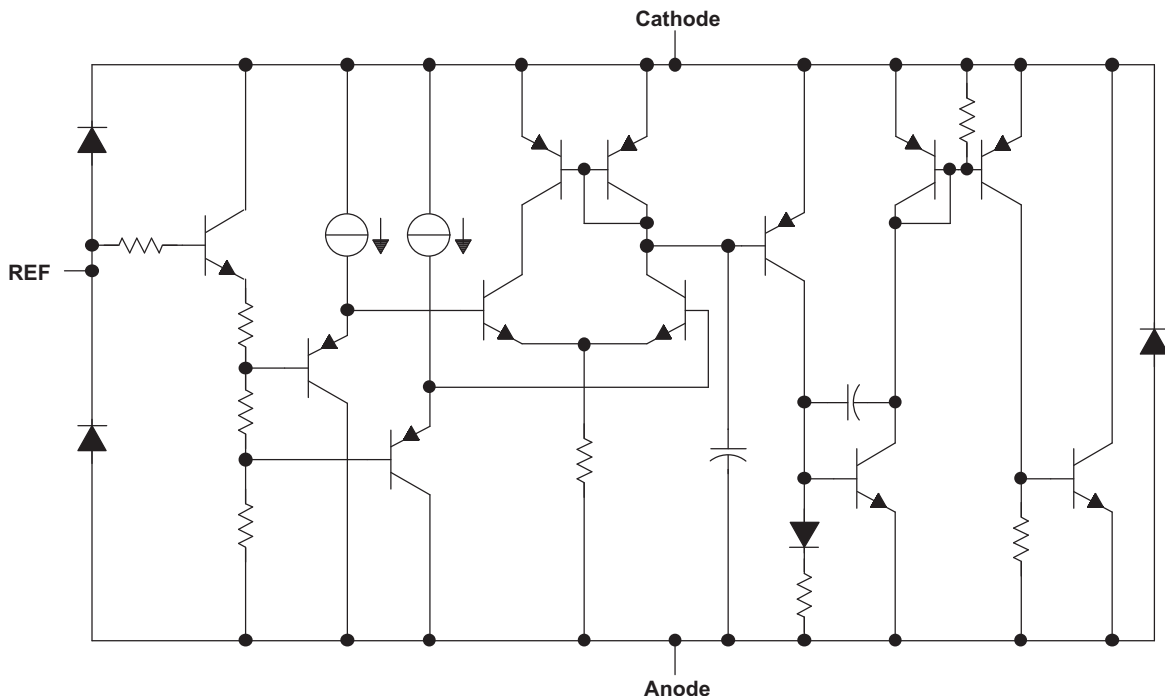


Figure 21. Equivalent Schematic

## Functional Block Diagram (continued)



**Figure 22. Detailed Schematic**

## 9.3 Feature Description

TLVH431 consists of an internal reference and amplifier that outputs a sink current base 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 ( $\geq 1.24$  V) and cathode current ( $I_{ka}$ ), TLVH431 forces the reference pin to 1.24 V. However, the reference pin can not be left floating, as it needs  $I_{ref} \geq 0.5$   $\mu$ A (please see [Specifications](#)). 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, TLVH431 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 TLVH431 enough gain.

Unlike many linear regulators, TLVH431 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 15](#), [Figure 16](#) & [Figure 17](#) 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 TLVH431 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, TLVH431 will have the characteristics shown in [Figure 4](#). With such high gain in this configuration, TLVH431 is typically used as a comparator. With the reference integrated makes TLVH431 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 TLVH431 is being fed back to the reference/input pin in any form, this device is operating in closed loop. The majority of applications involving TLVH431 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

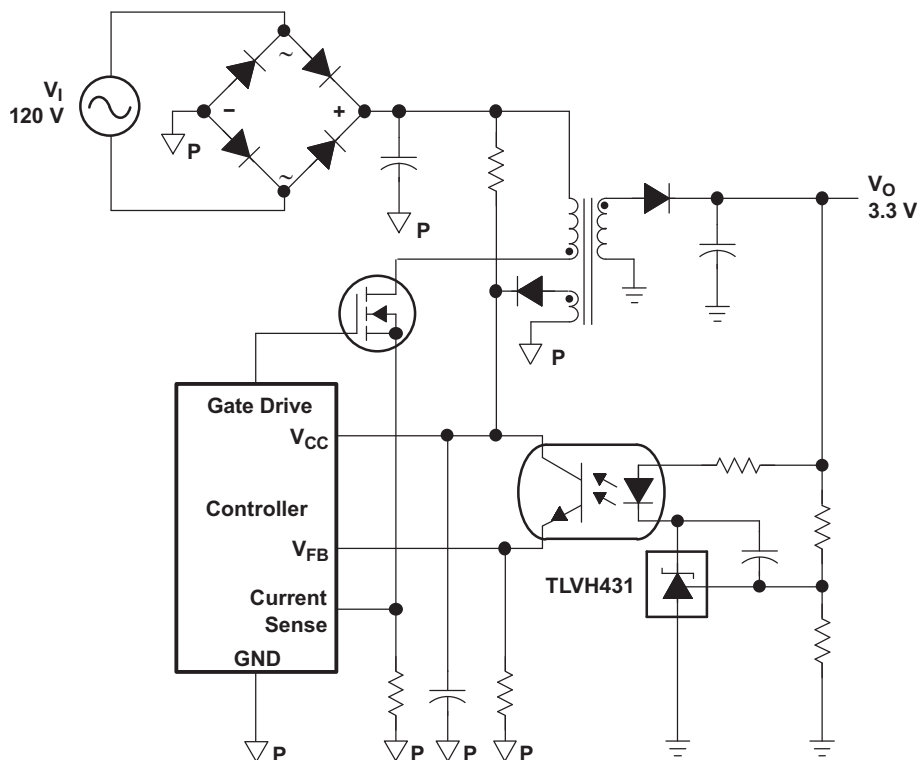
Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation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

### 10.1 Application Information

Figure 23 shows the TLVH431, TLVH431A, or TLVH431B 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 23.

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 TLVH431 that this application will see, open loop (Comparator +  $V_{REF}$ ) & closed loop (Shunt Regulator).

Further information about system stability and using a '431 device for compensation can be found in this application note [SLUA671](#).



**Figure 23. Flyback With Isolation Using TLVH431 or TLVH432 as Voltage Reference and Error Amplifier**

## 10.2 Typical Applications

### 10.2.1 Comparator with Integrated Reference (Open Loop)

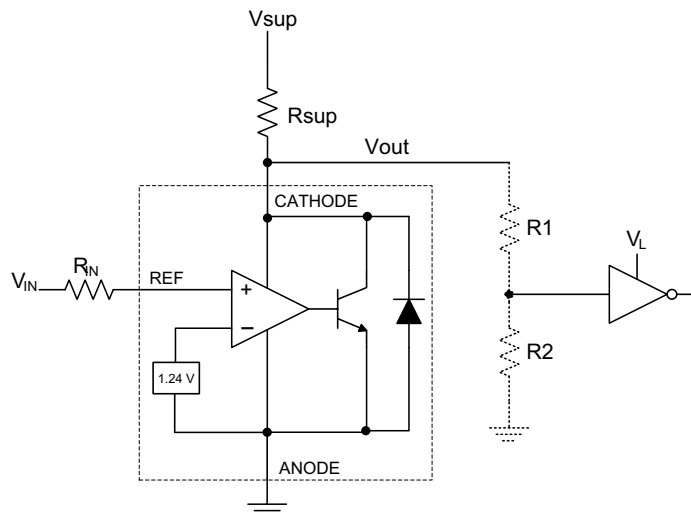


Figure 24. Comparator Application Schematic

#### 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 $\Omega$                       |
| Supply Voltage                         | 9 V                                 |
| Cathode Current ( $I_K$ )              | 500 $\mu$ A                         |
| Output Voltage Level                   | $\sim 1 \text{ V} - V_{\text{sup}}$ |
| Logic Input Thresholds $V_{IH}/V_{IL}$ | $V_L$                               |

#### 10.2.1.2 Detailed Design Procedure

When using TLVH431 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 24](#), TLVH431 will behave as a comparator, comparing the  $V_{\text{ref}}$  pin voltage to the internal virtual reference voltage. When provided a proper cathode current ( $I_K$ ), TLVH431 will have enough open loop gain to provide a quick response. With the TLVH431's max Operating Current ( $I_{\text{min}}$ ) being 100  $\mu$ A and up to 150  $\mu$ 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 1.24 V  $\pm$ (0.5%, 1.0% or 1.5%) depending on which version is being used.

The more overdrive voltage provided, the faster the TLVH431 will respond. This can be seen in figures [Figure 25](#) and [Figure 26](#), where it displays the output responses to various input voltages.

For applications where TLVH431 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 <10k $\Omega$  to provide  $I_{ref}$ .

#### 10.2.1.2.3 Output Voltage and Logic Input Level

In order for TLVH431 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 shown in [Figure 25](#) and [Figure 26](#), TLVH431's output low level voltage in open-loop/comparator mode is ~1 V, which is sufficient for some 3.3 V 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.

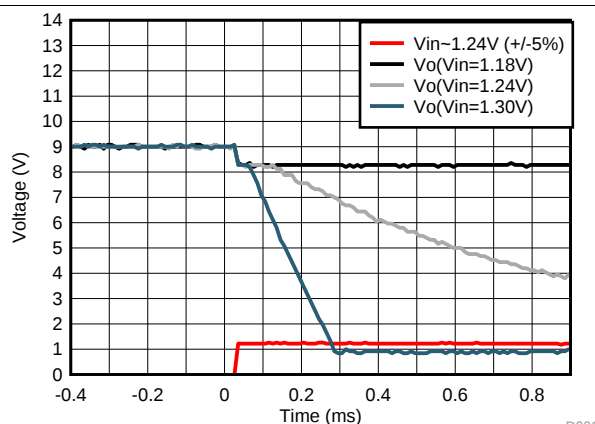
TLVH431's output high voltage is approximately  $V_{SUP}$  due to TLVH431 being open-collector. If  $V_{SUP}$  is much higher than the receiving logic's maximum input voltage tolerance, the output must be attenuated to accommodate the outgoing logic's reliability.

When using a resistive divider on the output, be sure to make the sum of the resistive divider ( $R_1$  &  $R_2$  in [Figure 24](#)) is much greater than  $R_{SUP}$  in order to not interfere with TLVH431's ability to pull close to  $V_{SUP}$  when turning off.

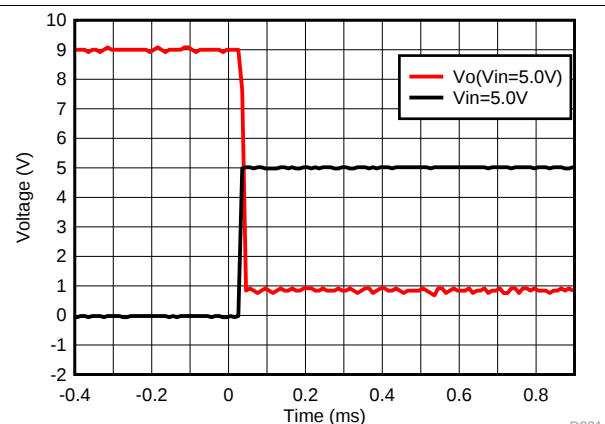
##### 10.2.1.2.3.1 Input Resistance

TLVH431 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  $V_{REF} = V_{IN} - I_{REF} \cdot R_{IN}$ . Since  $I_{REF}$  can be as high as 0.5  $\mu$ 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



**Figure 25. Output Response With Small Overdrive Voltages**



**Figure 26. Output Response With Large Overdrive Voltage**

## 10.2.2 Shunt Regulator/Reference

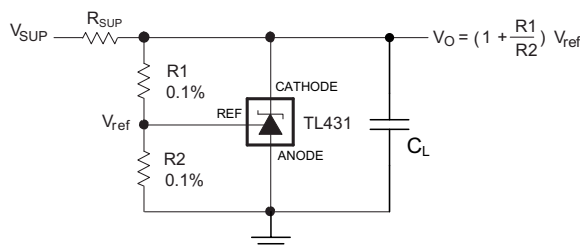


Figure 27. Shunt Regulator Schematic

### 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 <sub>k</sub> )               | 500 μA        |
| Output Voltage Level                            | 1.24 V - 18 V |
| Load Capacitance                                | 100 nF        |
| Feedback Resistor Values and Accuracy (R1 & R2) | 10 kΩ         |

### 10.2.2.2 Detailed Design Procedure

When using TLVH431 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 27](#), 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 27](#). The cathode voltage can be more accurately determined by taking in to account the cathode current:

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

In order for this equation to be valid, TLVH431 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<sub>min</sub> spec denoted in [Specifications](#).

#### 10.2.2.2.2 Total Accuracy

When programming the output above unity gain ( $V_{KA}=V_{REF}$ ), TLVH431 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. The application note *Setting the Shunt Voltage on an Adjustable Shunt Regulator*, [SLVA445](#), assists designers in setting the shunt voltage to achieve optimum accuracy for this device.

#### 10.2.2.2.3 Stability

Though TLVH431 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 TLVH431 region of stability, shown in [Figure 15](#), [Figure 16](#) & [Figure 17](#). Also, designers may use capacitive loads to improve the transient response or for power supply decoupling.

It is recommended to choose capacitors that will give a phase margin  $> 5^\circ$  to guarantee stability of the TLVH431.

#### 10.2.2.3 Application Curves

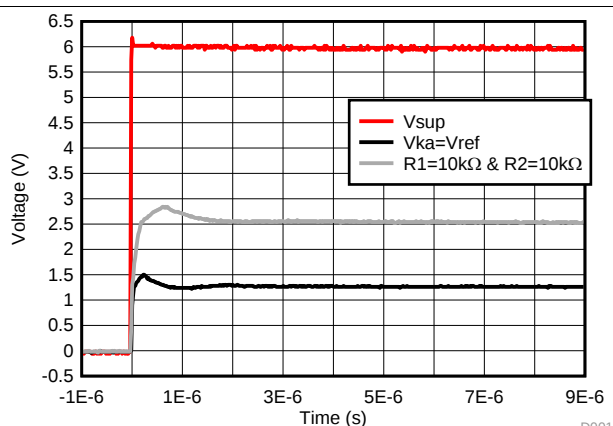


Figure 28. TLVH431 Start-up Response

## 11 Power Supply Recommendations

When using TLVH431 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 15](#), [Figure 16](#) and [Figure 17](#).

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 it's 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

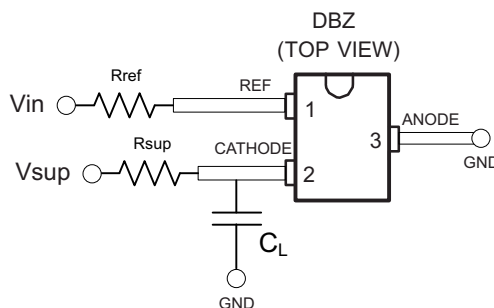


Figure 29. DBZ Layout example

## 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        |
|----------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| TLVH431  | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| TLVH431A | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| TLVH431B | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| TLVH432  | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| TLVH432A | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| TLVH432B | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |

### 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<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLVH431ACDBVR    | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU   CU SN       | Level-1-260C-UNLIM   | 0 to 70      | (Y3PG ~ Y3PU)           | <a href="#">Samples</a> |
| TLVH431ACDBVRG4  | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | Y3PG                    | <a href="#">Samples</a> |
| TLVH431ACDBVT    | ACTIVE        | SOT-23       | DBV                | 5    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU   CU SN       | Level-1-260C-UNLIM   | 0 to 70      | (Y3PG ~ Y3PU)           | <a href="#">Samples</a> |
| TLVH431ACDBVTE4  | ACTIVE        | SOT-23       | DBV                | 5    |                | TBD                        | Call TI                 | Call TI              | 0 to 70      |                         | <a href="#">Samples</a> |
| TLVH431ACDBZR    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | (Y3PS ~ Y3PU)           | <a href="#">Samples</a> |
| TLVH431ACDBZRG4  | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | (Y3PS ~ Y3PU)           | <a href="#">Samples</a> |
| TLVH431ACDBZT    | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | (Y3PS ~ Y3PU)           | <a href="#">Samples</a> |
| TLVH431ACDCKR    | ACTIVE        | SC70         | DCK                | 6    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | YPU                     | <a href="#">Samples</a> |
| TLVH431ACDCKRE4  | ACTIVE        | SC70         | DCK                | 6    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | YPU                     | <a href="#">Samples</a> |
| TLVH431ACDCKT    | ACTIVE        | SC70         | DCK                | 6    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | YPU                     | <a href="#">Samples</a> |
| TLVH431ACDCKTG4  | ACTIVE        | SC70         | DCK                | 6    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | YPU                     | <a href="#">Samples</a> |
| TLVH431ACLP      | ACTIVE        | TO-92        | LP                 | 3    | 1000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | 0 to 70      | ZA431A                  | <a href="#">Samples</a> |
| TLVH431ACLPR     | ACTIVE        | TO-92        | LP                 | 3    | 2000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | 0 to 70      | ZA431A                  | <a href="#">Samples</a> |
| TLVH431ACPK      | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | 0 to 70      | W2                      | <a href="#">Samples</a> |
| TLVH431AIDBVR    | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | Y3TU                    | <a href="#">Samples</a> |
| TLVH431AIDBVRE4  | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | Y3TU                    | <a href="#">Samples</a> |
| TLVH431AIDBVT    | ACTIVE        | SOT-23       | DBV                | 5    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | Y3TU                    | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLVH431AIDBVTG4  | ACTIVE        | SOT-23       | DBV                | 5    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | Y3TU                    | <a href="#">Samples</a> |
| TLVH431AIDBZR    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | (Y3T3 ~ Y3TS ~<br>Y3TU) | <a href="#">Samples</a> |
| TLVH431AIDBZRG4  | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | (Y3T3 ~ Y3TS ~<br>Y3TU) | <a href="#">Samples</a> |
| TLVH431AIDBZT    | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | (Y3TS ~ Y3TU)           | <a href="#">Samples</a> |
| TLVH431AIDBZTG4  | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | (Y3TS ~ Y3TU)           | <a href="#">Samples</a> |
| TLVH431AIDCKR    | ACTIVE        | SC70         | DCK                | 6    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | YTU                     | <a href="#">Samples</a> |
| TLVH431AIDCKT    | ACTIVE        | SC70         | DCK                | 6    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | YTU                     | <a href="#">Samples</a> |
| TLVH431AILP      | ACTIVE        | TO-92        | LP                 | 3    | 1000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | -40 to 85    | ZB431A                  | <a href="#">Samples</a> |
| TLVH431AILPR     | ACTIVE        | TO-92        | LP                 | 3    | 2000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | -40 to 85    | ZB431A                  | <a href="#">Samples</a> |
| TLVH431AIPK      | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | -40 to 85    | W3                      | <a href="#">Samples</a> |
| TLVH431AIPKG3    | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | -40 to 85    | W3                      | <a href="#">Samples</a> |
| TLVH431AQDBVR    | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | Y3NU                    | <a href="#">Samples</a> |
| TLVH431AQDBVT    | ACTIVE        | SOT-23       | DBV                | 5    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | Y3NU                    | <a href="#">Samples</a> |
| TLVH431AQDBZR    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (Y3NS ~ Y3NU)           | <a href="#">Samples</a> |
| TLVH431AQDBZRG4  | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (Y3NS ~ Y3NU)           | <a href="#">Samples</a> |
| TLVH431AQDBZT    | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (Y3NS ~ Y3NU)           | <a href="#">Samples</a> |
| TLVH431AQDBZTG4  | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (Y3NS ~ Y3NU)           | <a href="#">Samples</a> |
| TLVH431AQDCKR    | ACTIVE        | SC70         | DCK                | 6    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | YNU                     | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLVH431AQDCKT    | ACTIVE        | SC70         | DCK                | 6    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | YNU                     | <a href="#">Samples</a> |
| TLVH431AQLP      | ACTIVE        | TO-92        | LP                 | 3    | 1000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | -40 to 125   | ZD431A                  | <a href="#">Samples</a> |
| TLVH431AQLPR     | ACTIVE        | TO-92        | LP                 | 3    | 2000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | -40 to 125   | ZD431A                  | <a href="#">Samples</a> |
| TLVH431AQLPRE3   | ACTIVE        | TO-92        | LP                 | 3    | 2000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | -40 to 125   | ZD431A                  | <a href="#">Samples</a> |
| TLVH431AQPK      | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | -40 to 125   | VD                      | <a href="#">Samples</a> |
| TLVH431AQPKG3    | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | -40 to 125   | VD                      | <a href="#">Samples</a> |
| TLVH431BCDBVR    | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | Y3JU                    | <a href="#">Samples</a> |
| TLVH431BCDBVRG4  | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | Y3JU                    | <a href="#">Samples</a> |
| TLVH431BCDBVT    | ACTIVE        | SOT-23       | DBV                | 5    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | Y3JU                    | <a href="#">Samples</a> |
| TLVH431BCDBVTE4  | ACTIVE        | SOT-23       | DBV                | 5    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | Y3JU                    | <a href="#">Samples</a> |
| TLVH431BCDBVTG4  | ACTIVE        | SOT-23       | DBV                | 5    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | Y3JU                    | <a href="#">Samples</a> |
| TLVH431BCDBZR    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | (Y3J3 ~ Y3JS ~<br>Y3JU) | <a href="#">Samples</a> |
| TLVH431BCDBZRG4  | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | (Y3J3 ~ Y3JS ~<br>Y3JU) | <a href="#">Samples</a> |
| TLVH431BCDBZT    | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | (Y3JS ~ Y3JU)           | <a href="#">Samples</a> |
| TLVH431BCDBZTG4  | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | (Y3JS ~ Y3JU)           | <a href="#">Samples</a> |
| TLVH431BCDCKR    | ACTIVE        | SC70         | DCK                | 6    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | YHU                     | <a href="#">Samples</a> |
| TLVH431BCDCKT    | ACTIVE        | SC70         | DCK                | 6    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | YHU                     | <a href="#">Samples</a> |
| TLVH431BCDCKTG4  | ACTIVE        | SC70         | DCK                | 6    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | YHU                     | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLVH431BCLP      | ACTIVE        | TO-92        | LP                 | 3    | 1000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | 0 to 70      | ZA431B                  | <a href="#">Samples</a> |
| TLVH431BCLPR     | ACTIVE        | TO-92        | LP                 | 3    | 2000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | 0 to 70      | ZA431B                  | <a href="#">Samples</a> |
| TLVH431BCPK      | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | 0 to 70      | V7                      | <a href="#">Samples</a> |
| TLVH431BIDBVR    | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | Y3KU                    | <a href="#">Samples</a> |
| TLVH431BIDBVRE4  | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | Y3KU                    | <a href="#">Samples</a> |
| TLVH431BIDBVT    | ACTIVE        | SOT-23       | DBV                | 5    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | Y3KU                    | <a href="#">Samples</a> |
| TLVH431BIDBZR    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | (Y3KS ~ Y3KU)           | <a href="#">Samples</a> |
| TLVH431BIDBZRG4  | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | (Y3KS ~ Y3KU)           | <a href="#">Samples</a> |
| TLVH431BIDBZT    | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | (Y3KS ~ Y3KU)           | <a href="#">Samples</a> |
| TLVH431BIDBZTG4  | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | (Y3KS ~ Y3KU)           | <a href="#">Samples</a> |
| TLVH431BIDCKR    | ACTIVE        | SC70         | DCK                | 6    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | YJU                     | <a href="#">Samples</a> |
| TLVH431BIDCKRE4  | ACTIVE        | SC70         | DCK                | 6    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | YJU                     | <a href="#">Samples</a> |
| TLVH431BIDCKRG4  | ACTIVE        | SC70         | DCK                | 6    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | YJU                     | <a href="#">Samples</a> |
| TLVH431BIDCKT    | ACTIVE        | SC70         | DCK                | 6    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | YJU                     | <a href="#">Samples</a> |
| TLVH431BIDCKTE4  | ACTIVE        | SC70         | DCK                | 6    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | YJU                     | <a href="#">Samples</a> |
| TLVH431BIDCKTG4  | ACTIVE        | SC70         | DCK                | 6    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | YJU                     | <a href="#">Samples</a> |
| TLVH431BILP      | ACTIVE        | TO-92        | LP                 | 3    | 1000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | -40 to 85    | ZB431B                  | <a href="#">Samples</a> |
| TLVH431BILPR     | ACTIVE        | TO-92        | LP                 | 3    | 2000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | -40 to 85    | ZB431B                  | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLVH431BIPK      | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | -40 to 85    | V8                      | <a href="#">Samples</a> |
| TLVH431BIPKG3    | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | -40 to 85    | V8                      | <a href="#">Samples</a> |
| TLVH431BQDBVR    | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | Y3LU                    | <a href="#">Samples</a> |
| TLVH431BQDBVRE4  | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | Y3LU                    | <a href="#">Samples</a> |
| TLVH431BQDBVT    | ACTIVE        | SOT-23       | DBV                | 5    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | Y3LU                    | <a href="#">Samples</a> |
| TLVH431BQDBZR    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (Y3LS ~ Y3LU)           | <a href="#">Samples</a> |
| TLVH431BQDBZRG4  | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (Y3LS ~ Y3LU)           | <a href="#">Samples</a> |
| TLVH431BQDBZT    | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (Y3LS ~ Y3LU)           | <a href="#">Samples</a> |
| TLVH431BQDBZTG4  | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (Y3LS ~ Y3LU)           | <a href="#">Samples</a> |
| TLVH431BQDCKR    | ACTIVE        | SC70         | DCK                | 6    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | YKU                     | <a href="#">Samples</a> |
| TLVH431BQDCKT    | ACTIVE        | SC70         | DCK                | 6    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | YKU                     | <a href="#">Samples</a> |
| TLVH431BQLP      | ACTIVE        | TO-92        | LP                 | 3    | 1000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | -40 to 125   | ZD431B                  | <a href="#">Samples</a> |
| TLVH431BQLPE3    | ACTIVE        | TO-92        | LP                 | 3    | 1000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | -40 to 125   | ZD431B                  | <a href="#">Samples</a> |
| TLVH431BQLPR     | ACTIVE        | TO-92        | LP                 | 3    | 2000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | -40 to 125   | ZD431B                  | <a href="#">Samples</a> |
| TLVH431BQPK      | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | -40 to 125   | V9                      | <a href="#">Samples</a> |
| TLVH431BQPKG3    | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | -40 to 125   | V9                      | <a href="#">Samples</a> |
| TLVH431CDBVR     | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | Y3UU                    | <a href="#">Samples</a> |
| TLVH431CDBVT     | ACTIVE        | SOT-23       | DBV                | 5    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | Y3UU                    | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLVH431CDBZR     | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | (Y3US ~ Y3UU)           | <a href="#">Samples</a> |
| TLVH431CDBZRG4   | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | (Y3US ~ Y3UU)           | <a href="#">Samples</a> |
| TLVH431CDBZT     | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | (Y3US ~ Y3UU)           | <a href="#">Samples</a> |
| TLVH431CDBZTG4   | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | (Y3US ~ Y3UU)           | <a href="#">Samples</a> |
| TLVH431CDCKR     | ACTIVE        | SC70         | DCK                | 6    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | YUU                     | <a href="#">Samples</a> |
| TLVH431CDCKRG4   | ACTIVE        | SC70         | DCK                | 6    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | YUU                     | <a href="#">Samples</a> |
| TLVH431CDCKT     | ACTIVE        | SC70         | DCK                | 6    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | YUU                     | <a href="#">Samples</a> |
| TLVH431CDCKTE4   | ACTIVE        | SC70         | DCK                | 6    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | YUU                     | <a href="#">Samples</a> |
| TLVH431CDCKTG4   | ACTIVE        | SC70         | DCK                | 6    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | YUU                     | <a href="#">Samples</a> |
| TLVH431CLP       | ACTIVE        | TO-92        | LP                 | 3    | 1000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | 0 to 70      | ZA431                   | <a href="#">Samples</a> |
| TLVH431CLPE3     | ACTIVE        | TO-92        | LP                 | 3    | 1000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | 0 to 70      | ZA431                   | <a href="#">Samples</a> |
| TLVH431CLPR      | ACTIVE        | TO-92        | LP                 | 3    | 2000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | 0 to 70      | ZA431                   | <a href="#">Samples</a> |
| TLVH431CPK       | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | 0 to 70      | W4                      | <a href="#">Samples</a> |
| TLVH431CPKG3     | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | 0 to 70      | W4                      | <a href="#">Samples</a> |
| TLVH431IBQDBZR   | PREVIEW       | SOT-23       | DBZ                | 3    |                | TBD                        | Call TI                 | Call TI              | -40 to 125   |                         |                         |
| TLVH431IDBVR     | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | Y3VU                    | <a href="#">Samples</a> |
| TLVH431IDBVT     | ACTIVE        | SOT-23       | DBV                | 5    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | Y3VU                    | <a href="#">Samples</a> |
| TLVH431IDBVTG4   | ACTIVE        | SOT-23       | DBV                | 5    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | Y3VU                    | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLVH431IDBZR     | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | (Y3VS ~ Y3VU)           | <a href="#">Samples</a> |
| TLVH431IDBZRG4   | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | (Y3VS ~ Y3VU)           | <a href="#">Samples</a> |
| TLVH431IDBZT     | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | (Y3VS ~ Y3VU)           | <a href="#">Samples</a> |
| TLVH431IDCKR     | ACTIVE        | SC70         | DCK                | 6    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | YVU                     | <a href="#">Samples</a> |
| TLVH431IDCKT     | ACTIVE        | SC70         | DCK                | 6    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | YVU                     | <a href="#">Samples</a> |
| TLVH431IDCKTG4   | ACTIVE        | SC70         | DCK                | 6    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | YVU                     | <a href="#">Samples</a> |
| TLVH431ILP       | ACTIVE        | TO-92        | LP                 | 3    | 1000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | -40 to 85    | ZB431                   | <a href="#">Samples</a> |
| TLVH431ILPE3     | ACTIVE        | TO-92        | LP                 | 3    | 1000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | -40 to 85    | ZB431                   | <a href="#">Samples</a> |
| TLVH431ILPR      | ACTIVE        | TO-92        | LP                 | 3    | 2000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | -40 to 85    | ZB431                   | <a href="#">Samples</a> |
| TLVH431IPK       | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | -40 to 85    | W5                      | <a href="#">Samples</a> |
| TLVH431QDBVR     | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | Y3MU                    | <a href="#">Samples</a> |
| TLVH431QDBVRE4   | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | Y3MU                    | <a href="#">Samples</a> |
| TLVH431QDBVT     | ACTIVE        | SOT-23       | DBV                | 5    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | Y3MU                    | <a href="#">Samples</a> |
| TLVH431QDBVTG4   | ACTIVE        | SOT-23       | DBV                | 5    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | Y3MU                    | <a href="#">Samples</a> |
| TLVH431QDBZR     | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (Y3MS ~ Y3MU)           | <a href="#">Samples</a> |
| TLVH431QDBZT     | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (Y3MS ~ Y3MU)           | <a href="#">Samples</a> |
| TLVH431QDBZTG4   | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (Y3MS ~ Y3MU)           | <a href="#">Samples</a> |
| TLVH431QDCKR     | ACTIVE        | SC70         | DCK                | 6    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | YMU                     | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLVH431QDCKT     | ACTIVE        | SC70         | DCK                | 6    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | YMU                     | <a href="#">Samples</a> |
| TLVH431QLP       | ACTIVE        | TO-92        | LP                 | 3    | 1000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | -40 to 125   | ZD431                   | <a href="#">Samples</a> |
| TLVH431QLPR      | ACTIVE        | TO-92        | LP                 | 3    | 2000           | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | -40 to 125   | ZD431                   | <a href="#">Samples</a> |
| TLVH431QPK       | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | -40 to 125   | VC                      | <a href="#">Samples</a> |
| TLVH432ACDBZR    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | (Y2ES ~ Y2EU)           | <a href="#">Samples</a> |
| TLVH432ACDBZRG4  | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | (Y2ES ~ Y2EU)           | <a href="#">Samples</a> |
| TLVH432ACDBZT    | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | (Y2ES ~ Y2EU)           | <a href="#">Samples</a> |
| TLVH432AIDBZR    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | (Y2FS ~ Y2FU)           | <a href="#">Samples</a> |
| TLVH432AIPK      | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | -40 to 85    | VL                      | <a href="#">Samples</a> |
| TLVH432AQDBZR    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (Y2GS ~ Y2GU)           | <a href="#">Samples</a> |
| TLVH432AQDBZT    | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (Y2GS ~ Y2GU)           | <a href="#">Samples</a> |
| TLVH432BCDBZR    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | (Y2HS ~ Y2HU)           | <a href="#">Samples</a> |
| TLVH432BCDBZRG4  | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | (Y2HS ~ Y2HU)           | <a href="#">Samples</a> |
| TLVH432BCPK      | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | 0 to 70      | VN                      | <a href="#">Samples</a> |
| TLVH432BIDBZR    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | (Y2JS ~ Y2JU)           | <a href="#">Samples</a> |
| TLVH432BQDBZR    | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (Y2KS ~ Y2KU)           | <a href="#">Samples</a> |
| TLVH432BQDBZT    | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (Y2KS ~ Y2KU)           | <a href="#">Samples</a> |
| TLVH432BQDBZTG4  | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (Y2KS ~ Y2KU)           | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLVH432CDBZR     | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | (Y2AS ~ Y2AU)           | <a href="#">Samples</a> |
| TLVH432CDBZT     | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | (Y2AS ~ Y2AU)           | <a href="#">Samples</a> |
| TLVH432CPK       | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | 0 to 70      | VG                      | <a href="#">Samples</a> |
| TLVH432IDBZR     | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | (Y2BS ~ Y2BU)           | <a href="#">Samples</a> |
| TLVH432QDBZR     | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (Y2DS ~ Y2DU)           | <a href="#">Samples</a> |
| TLVH432QDBZT     | ACTIVE        | SOT-23       | DBZ                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (Y2DS ~ Y2DU)           | <a href="#">Samples</a> |
| TLVH432QPK       | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | -40 to 125   | VJ                      | <a href="#">Samples</a> |
| TLVH432QPKG3     | ACTIVE        | SOT-89       | PK                 | 3    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | -40 to 125   | VJ                      | <a href="#">Samples</a> |

(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.

**OBSELETE:** 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.

<sup>(5)</sup> 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.

<sup>(6)</sup> 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.

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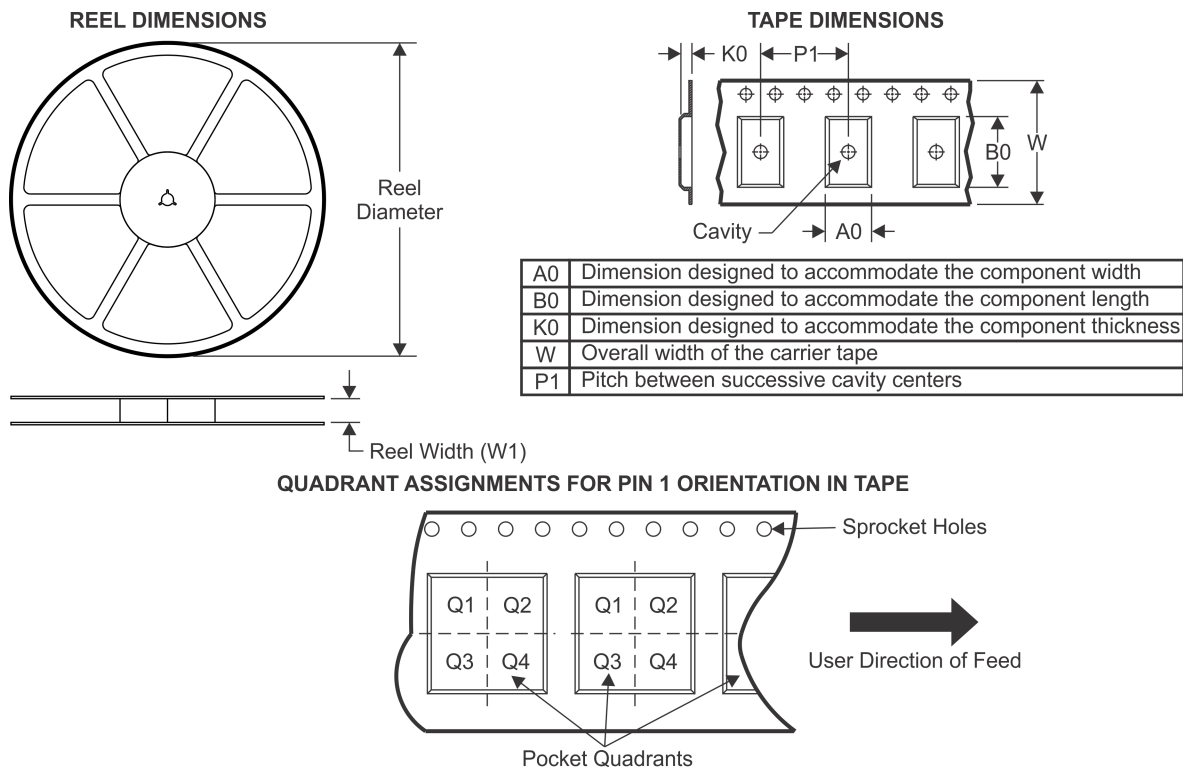
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**OTHER QUALIFIED VERSIONS OF TLVH431A, TLVH431B :**

- Automotive: [TLVH431A-Q1](#), [TLVH431B-Q1](#)

NOTE: Qualified Version Definitions:

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

**TAPE AND REEL INFORMATION**


\*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 |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLVH431ACDBVR   | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TLVH431ACDBVRG4 | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TLVH431ACDBVT   | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TLVH431ACDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431ACDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431ACDCKR   | SC70         | DCK             | 6    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TLVH431ACDCKT   | SC70         | DCK             | 6    | 250  | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TLVH431ACPK     | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TLVH431AIDBVR   | SOT-23       | DBV             | 5    | 3000 | 179.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431AIDBVT   | SOT-23       | DBV             | 5    | 250  | 179.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431AIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431AIDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431AIDCKR   | SC70         | DCK             | 6    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TLVH431AIDCKT   | SC70         | DCK             | 6    | 250  | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TLVH431AIPK     | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TLVH431AQDBVR   | SOT-23       | DBV             | 5    | 3000 | 179.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431AQDBVT   | SOT-23       | DBV             | 5    | 250  | 179.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431AQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 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 |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLVH431AQDBZT | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431AQDCKR | SC70         | DCK             | 6    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TLVH431AQDCKT | SC70         | DCK             | 6    | 250  | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TLVH431AQPK   | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TLVH431BCDBVR | SOT-23       | DBV             | 5    | 3000 | 179.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431BCDBVT | SOT-23       | DBV             | 5    | 250  | 179.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431BCDBZR | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431BCDBZT | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431BCDCKR | SC70         | DCK             | 6    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TLVH431BCDCKT | SC70         | DCK             | 6    | 250  | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TLVH431BCPK   | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TLVH431BIDBVR | SOT-23       | DBV             | 5    | 3000 | 179.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431BIDBVT | SOT-23       | DBV             | 5    | 250  | 179.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431BIDBZR | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431BIDBZT | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431BIDCKR | SC70         | DCK             | 6    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TLVH431BIDCKT | SC70         | DCK             | 6    | 250  | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TLVH431BIPK   | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TLVH431BQDBVR | SOT-23       | DBV             | 5    | 3000 | 179.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431BQDBVT | SOT-23       | DBV             | 5    | 250  | 179.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431BQDBZR | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431BQDBZT | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431BQDCKR | SC70         | DCK             | 6    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TLVH431BQDCKT | SC70         | DCK             | 6    | 250  | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TLVH431BQPK   | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TLVH431CDBVR  | SOT-23       | DBV             | 5    | 3000 | 179.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431CDBVT  | SOT-23       | DBV             | 5    | 250  | 179.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431CDBZR  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431CDBZT  | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431CDCKR  | SC70         | DCK             | 6    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TLVH431CDCKT  | SC70         | DCK             | 6    | 250  | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TLVH431CPK    | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TLVH431IDBVR  | SOT-23       | DBV             | 5    | 3000 | 179.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431IDBVT  | SOT-23       | DBV             | 5    | 250  | 179.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431IDBZR  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431IDBZT  | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431IDCKR  | SC70         | DCK             | 6    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TLVH431IDCKT  | SC70         | DCK             | 6    | 250  | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TLVH431IPK    | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TLVH431QDBVR  | SOT-23       | DBV             | 5    | 3000 | 179.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431QDBVT  | SOT-23       | DBV             | 5    | 250  | 179.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431QDBZR  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431QDBZT  | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 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 |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLVH431QDCKR  | SC70         | DCK             | 6    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TLVH431QDCKT  | SC70         | DCK             | 6    | 250  | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TLVH431QPK    | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TLVH432ACDBZR | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432ACDBZT | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432AIDBZR | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432AIPK   | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TLVH432AQDBZR | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432AQDBZT | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432BCDBZR | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432BCPK   | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TLVH432BIDBZR | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432BQDBZR | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432BQDBZT | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432CDBZR  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432CDBZT  | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432CPK    | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TLVH432IDBZR  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432QDBZR  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432QDBZT  | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432QPK    | 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

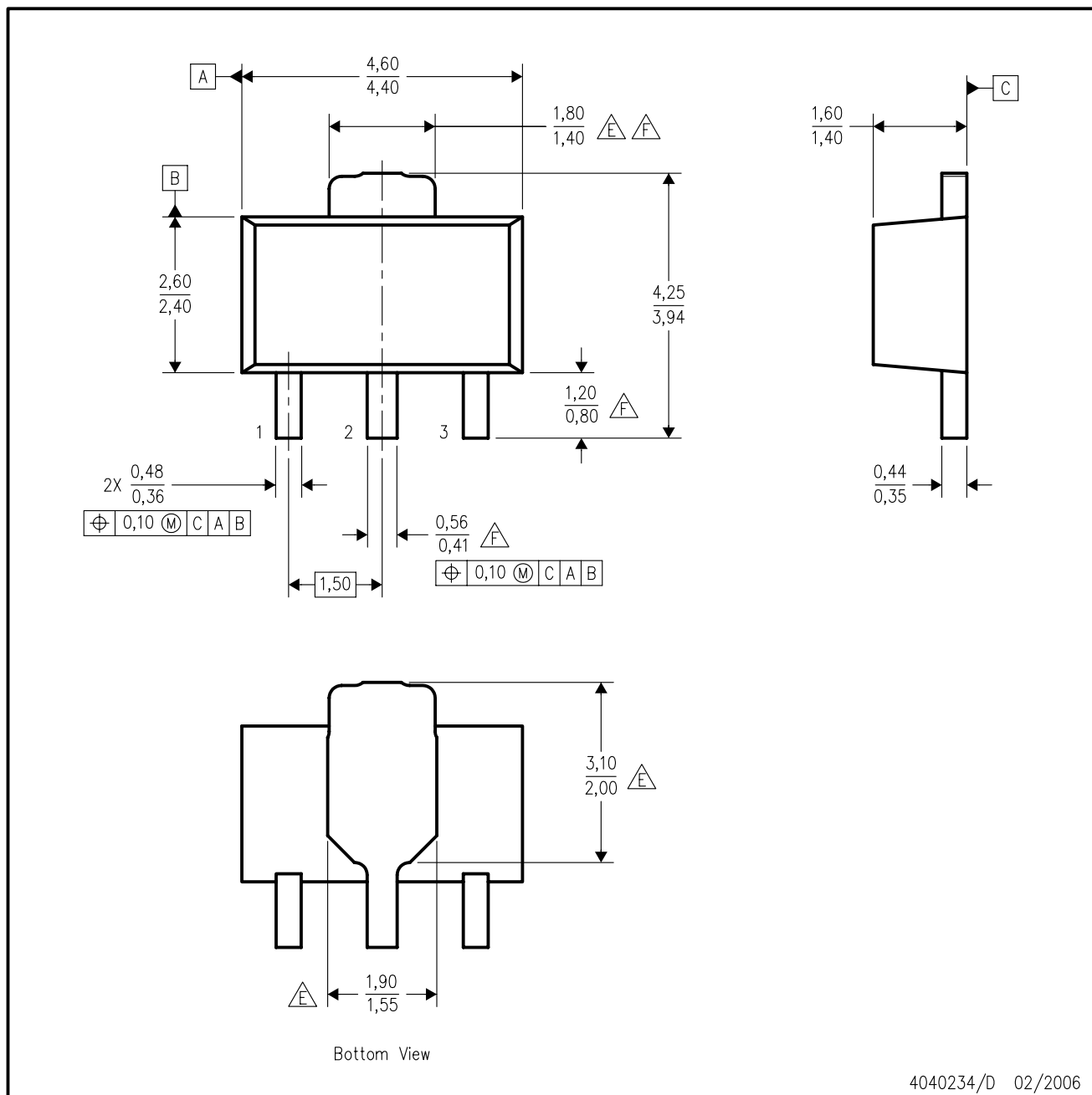
| Device          | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLVH431ACDBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH431ACDBVRG4 | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH431ACDBVT   | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH431ACDBZR   | SOT-23       | DBZ             | 3    | 3000 | 202.0       | 201.0      | 28.0        |
| TLVH431ACDBZT   | SOT-23       | DBZ             | 3    | 250  | 202.0       | 201.0      | 28.0        |
| TLVH431ACDCKR   | SC70         | DCK             | 6    | 3000 | 203.0       | 203.0      | 35.0        |
| TLVH431ACDCKT   | SC70         | DCK             | 6    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431ACPK     | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH431AIDBVR   | SOT-23       | DBV             | 5    | 3000 | 203.0       | 203.0      | 35.0        |
| TLVH431AIDBVT   | SOT-23       | DBV             | 5    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431AIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 202.0       | 201.0      | 28.0        |
| TLVH431AIDBZT   | SOT-23       | DBZ             | 3    | 250  | 202.0       | 201.0      | 28.0        |
| TLVH431AIDCKR   | SC70         | DCK             | 6    | 3000 | 203.0       | 203.0      | 35.0        |
| TLVH431AIDCKT   | SC70         | DCK             | 6    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431AIPK     | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH431AQDBVR   | SOT-23       | DBV             | 5    | 3000 | 203.0       | 203.0      | 35.0        |
| TLVH431AQDBVT   | SOT-23       | DBV             | 5    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431AQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 202.0       | 201.0      | 28.0        |
| TLVH431AQDBZT   | SOT-23       | DBZ             | 3    | 250  | 202.0       | 201.0      | 28.0        |
| TLVH431AQDCKR   | SC70         | DCK             | 6    | 3000 | 203.0       | 203.0      | 35.0        |

| Device        | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLVH431AQDCKT | SC70         | DCK             | 6    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431AQPCK  | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH431BCDBVR | SOT-23       | DBV             | 5    | 3000 | 203.0       | 203.0      | 35.0        |
| TLVH431BCDBVT | SOT-23       | DBV             | 5    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431BCDBZR | SOT-23       | DBZ             | 3    | 3000 | 202.0       | 201.0      | 28.0        |
| TLVH431BCDBZT | SOT-23       | DBZ             | 3    | 250  | 202.0       | 201.0      | 28.0        |
| TLVH431BCDCKR | SC70         | DCK             | 6    | 3000 | 203.0       | 203.0      | 35.0        |
| TLVH431BCDCKT | SC70         | DCK             | 6    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431BCPK   | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH431BIDBVR | SOT-23       | DBV             | 5    | 3000 | 203.0       | 203.0      | 35.0        |
| TLVH431BIDBVT | SOT-23       | DBV             | 5    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431BIDBZR | SOT-23       | DBZ             | 3    | 3000 | 202.0       | 201.0      | 28.0        |
| TLVH431BIDBZT | SOT-23       | DBZ             | 3    | 250  | 202.0       | 201.0      | 28.0        |
| TLVH431BIDCKR | SC70         | DCK             | 6    | 3000 | 203.0       | 203.0      | 35.0        |
| TLVH431BIDCKT | SC70         | DCK             | 6    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431BIPK   | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH431BQDBVR | SOT-23       | DBV             | 5    | 3000 | 203.0       | 203.0      | 35.0        |
| TLVH431BQDBVT | SOT-23       | DBV             | 5    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431BQDBZR | SOT-23       | DBZ             | 3    | 3000 | 202.0       | 201.0      | 28.0        |
| TLVH431BQDBZT | SOT-23       | DBZ             | 3    | 250  | 202.0       | 201.0      | 28.0        |
| TLVH431BQDCKR | SC70         | DCK             | 6    | 3000 | 203.0       | 203.0      | 35.0        |
| TLVH431BQDCKT | SC70         | DCK             | 6    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431BQPK   | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH431CDBVR  | SOT-23       | DBV             | 5    | 3000 | 203.0       | 203.0      | 35.0        |
| TLVH431CDBVT  | SOT-23       | DBV             | 5    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431CDBZR  | SOT-23       | DBZ             | 3    | 3000 | 202.0       | 201.0      | 28.0        |
| TLVH431CDBZT  | SOT-23       | DBZ             | 3    | 250  | 202.0       | 201.0      | 28.0        |
| TLVH431CDCKR  | SC70         | DCK             | 6    | 3000 | 203.0       | 203.0      | 35.0        |
| TLVH431CDCKT  | SC70         | DCK             | 6    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431CPK    | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH431IDBVR  | SOT-23       | DBV             | 5    | 3000 | 203.0       | 203.0      | 35.0        |
| TLVH431IDBVT  | SOT-23       | DBV             | 5    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431IDBZR  | SOT-23       | DBZ             | 3    | 3000 | 202.0       | 201.0      | 28.0        |
| TLVH431IDBZT  | SOT-23       | DBZ             | 3    | 250  | 202.0       | 201.0      | 28.0        |
| TLVH431IDCKR  | SC70         | DCK             | 6    | 3000 | 203.0       | 203.0      | 35.0        |
| TLVH431IDCKT  | SC70         | DCK             | 6    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431IPK    | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH431QDBVR  | SOT-23       | DBV             | 5    | 3000 | 203.0       | 203.0      | 35.0        |
| TLVH431QDBVT  | SOT-23       | DBV             | 5    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431QDBZR  | SOT-23       | DBZ             | 3    | 3000 | 202.0       | 201.0      | 28.0        |
| TLVH431QDBZT  | SOT-23       | DBZ             | 3    | 250  | 202.0       | 201.0      | 28.0        |
| TLVH431QDCKR  | SC70         | DCK             | 6    | 3000 | 203.0       | 203.0      | 35.0        |
| TLVH431QDCKT  | SC70         | DCK             | 6    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431QPK    | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |

| Device        | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLVH432ACDBZR | SOT-23       | DBZ             | 3    | 3000 | 202.0       | 201.0      | 28.0        |
| TLVH432ACDBZT | SOT-23       | DBZ             | 3    | 250  | 202.0       | 201.0      | 28.0        |
| TLVH432AIDBZR | SOT-23       | DBZ             | 3    | 3000 | 202.0       | 201.0      | 28.0        |
| TLVH432AIPK   | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH432AQDBZR | SOT-23       | DBZ             | 3    | 3000 | 202.0       | 201.0      | 28.0        |
| TLVH432AQDBZT | SOT-23       | DBZ             | 3    | 250  | 202.0       | 201.0      | 28.0        |
| TLVH432BCDBZR | SOT-23       | DBZ             | 3    | 3000 | 202.0       | 201.0      | 28.0        |
| TLVH432BCPK   | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH432BIDBZR | SOT-23       | DBZ             | 3    | 3000 | 202.0       | 201.0      | 28.0        |
| TLVH432BQDBZR | SOT-23       | DBZ             | 3    | 3000 | 202.0       | 201.0      | 28.0        |
| TLVH432BQDBZT | SOT-23       | DBZ             | 3    | 250  | 202.0       | 201.0      | 28.0        |
| TLVH432CDBZR  | SOT-23       | DBZ             | 3    | 3000 | 202.0       | 201.0      | 28.0        |
| TLVH432CDBZT  | SOT-23       | DBZ             | 3    | 250  | 202.0       | 201.0      | 28.0        |
| TLVH432CPK    | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH432IDBZR  | SOT-23       | DBZ             | 3    | 3000 | 202.0       | 201.0      | 28.0        |
| TLVH432QDBZR  | SOT-23       | DBZ             | 3    | 3000 | 202.0       | 201.0      | 28.0        |
| TLVH432QDBZT  | SOT-23       | DBZ             | 3    | 250  | 202.0       | 201.0      | 28.0        |
| TLVH432QPK    | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |

PK (R-PSSO-F3)

PLASTIC SINGLE-IN-LINE PACKAGE

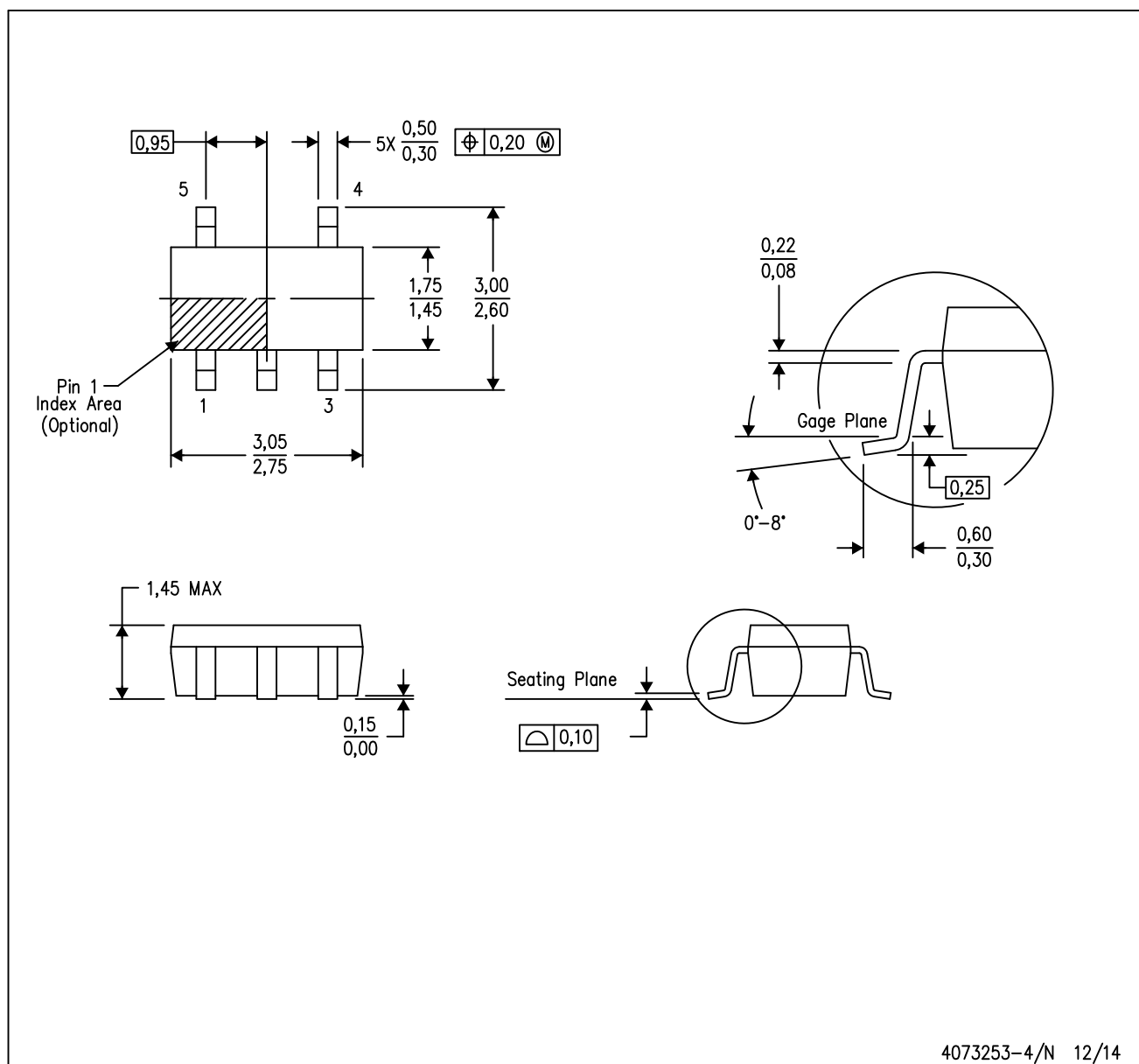


4040234/D 02/2006

- NOTES:
- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - This drawing is subject to change without notice.
  - The center lead is in electrical contact with the tab.
  - 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)

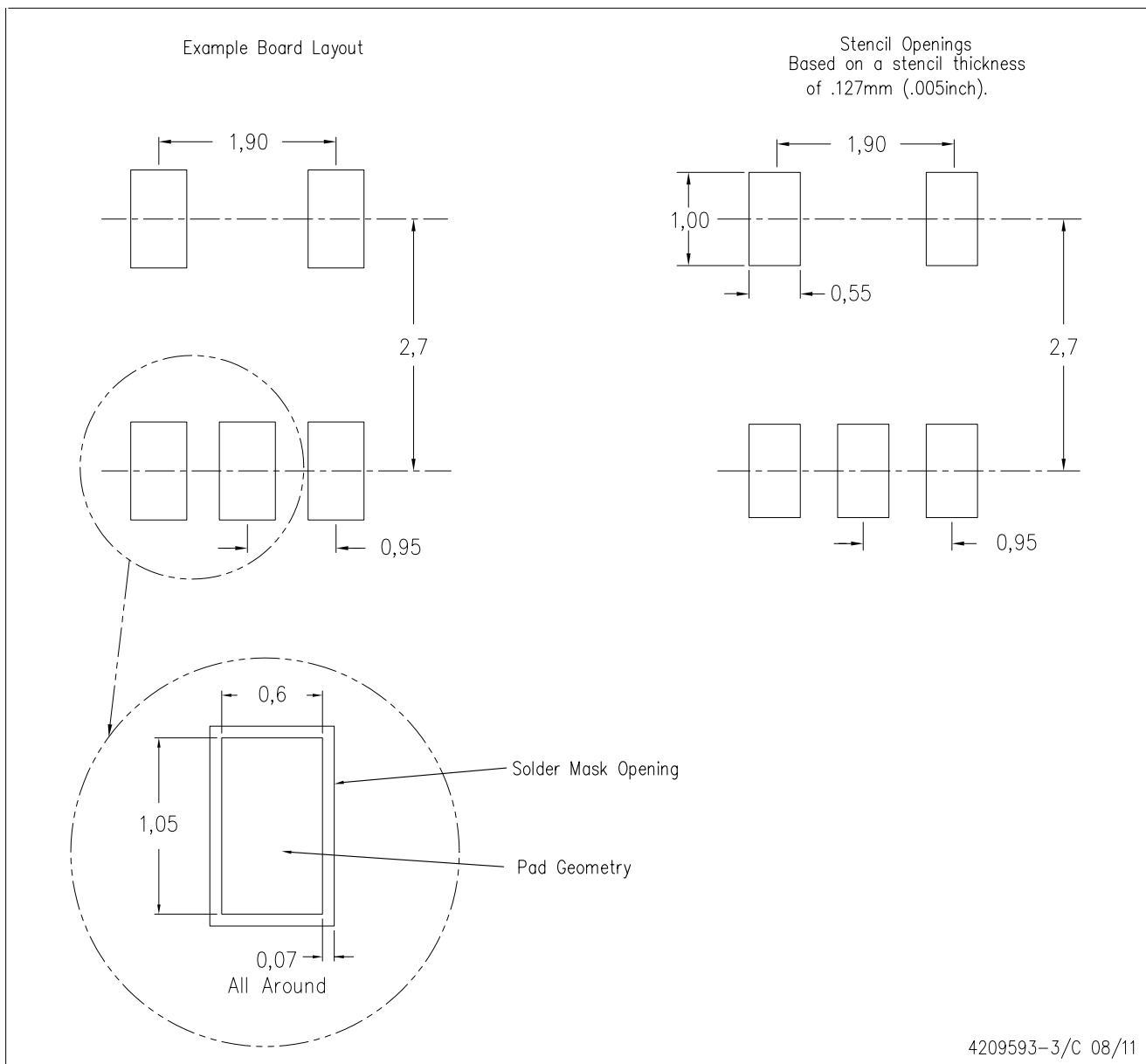
PLASTIC SMALL-OUTLINE PACKAGE



- 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)

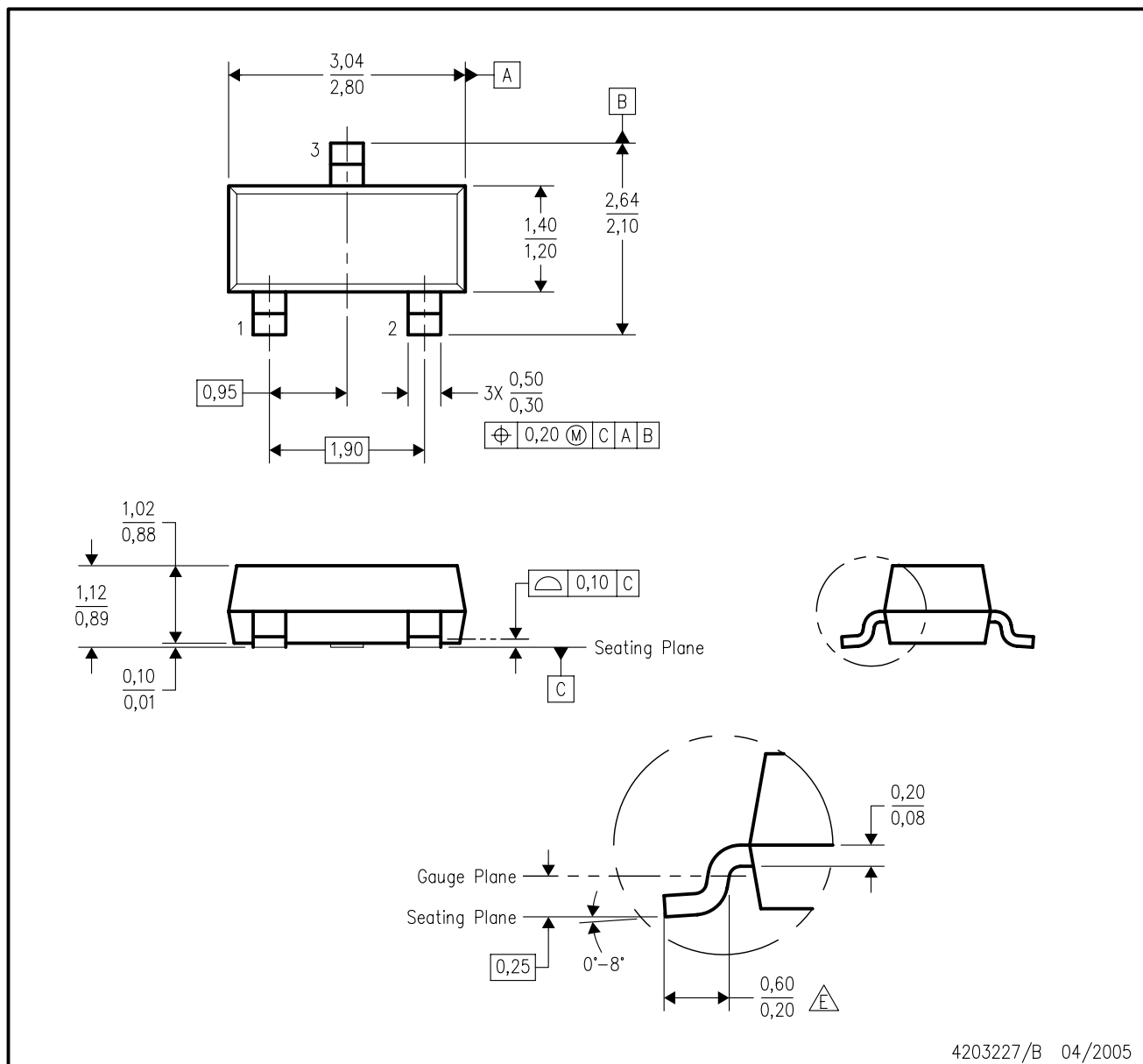
PLASTIC SMALL OUTLINE



- 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

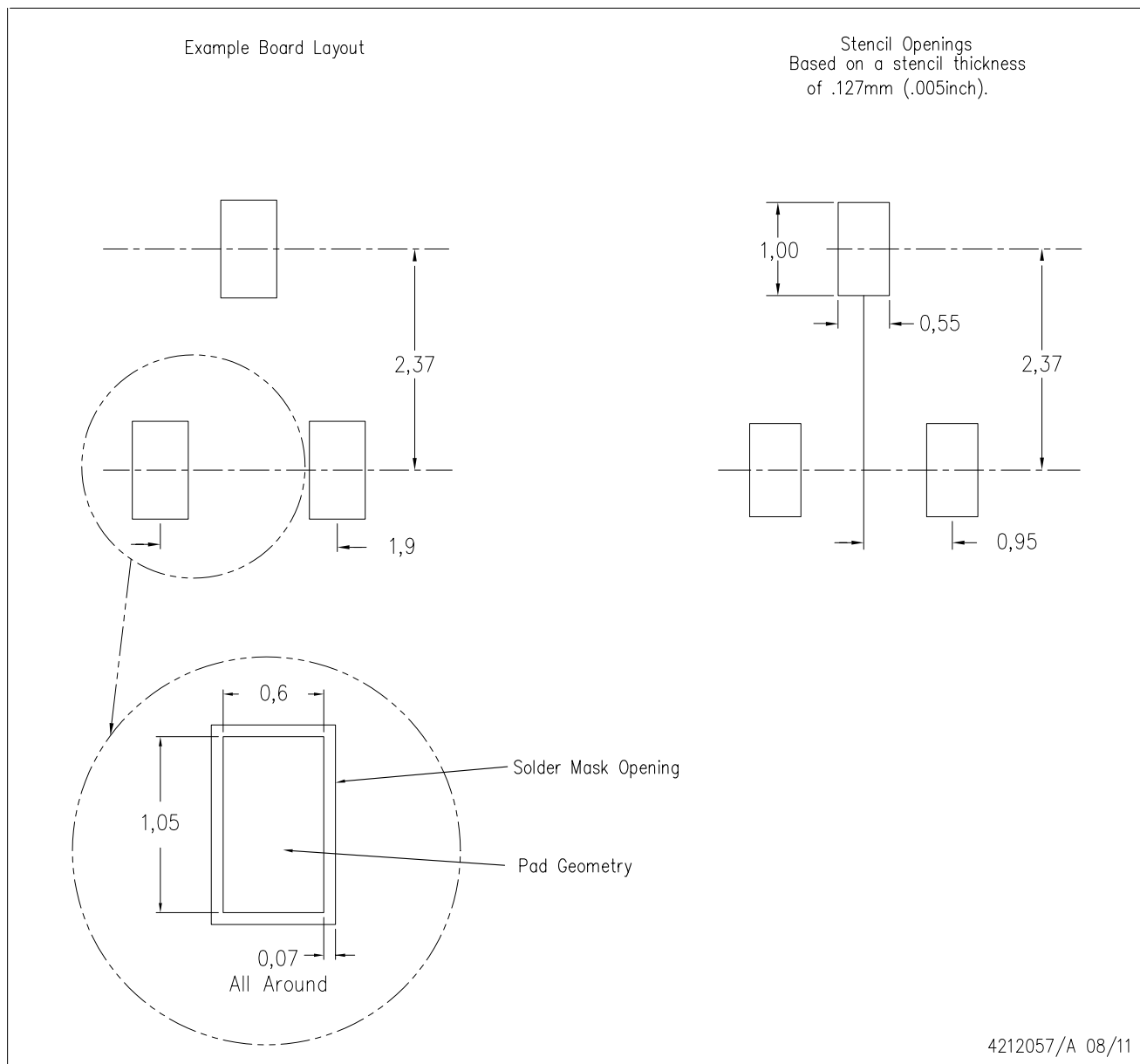


4203227/B 04/2005

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

DBZ (R-PDSO-G3)

PLASTIC SMALL OUTLINE

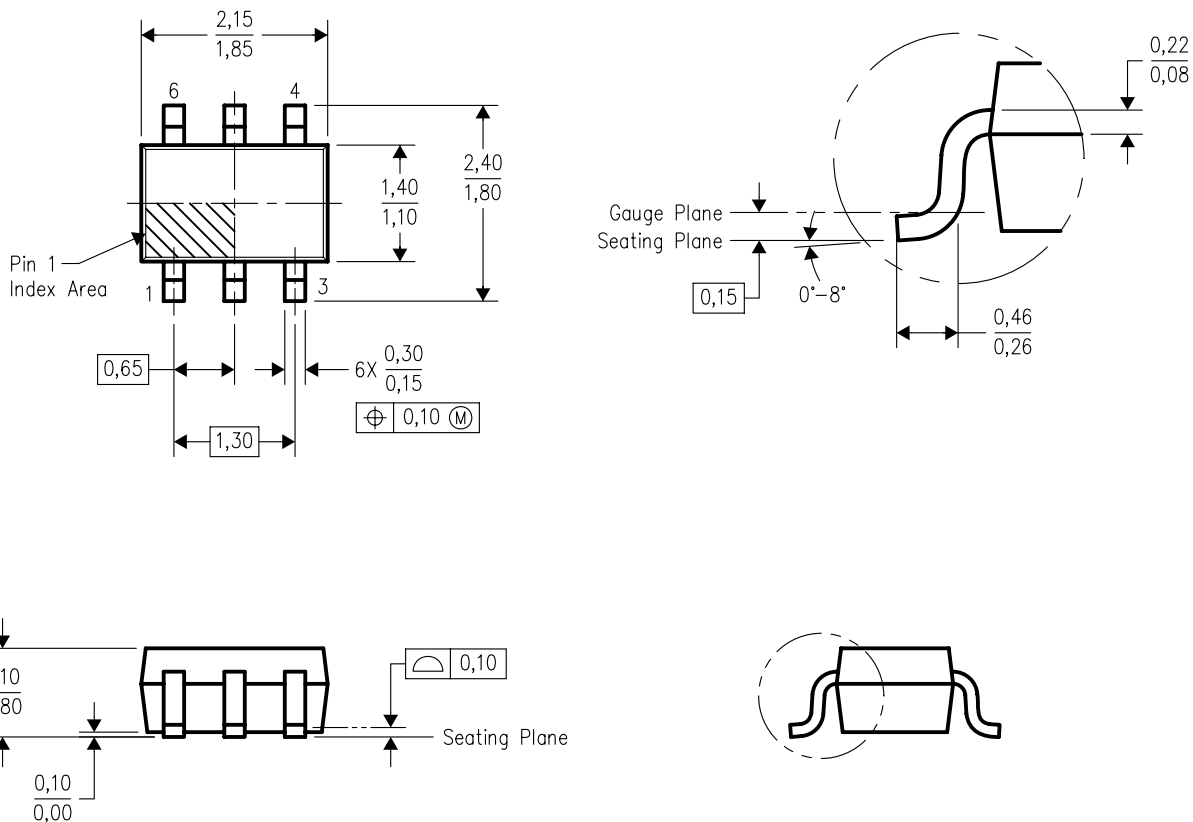


4212057/A 08/11

- 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

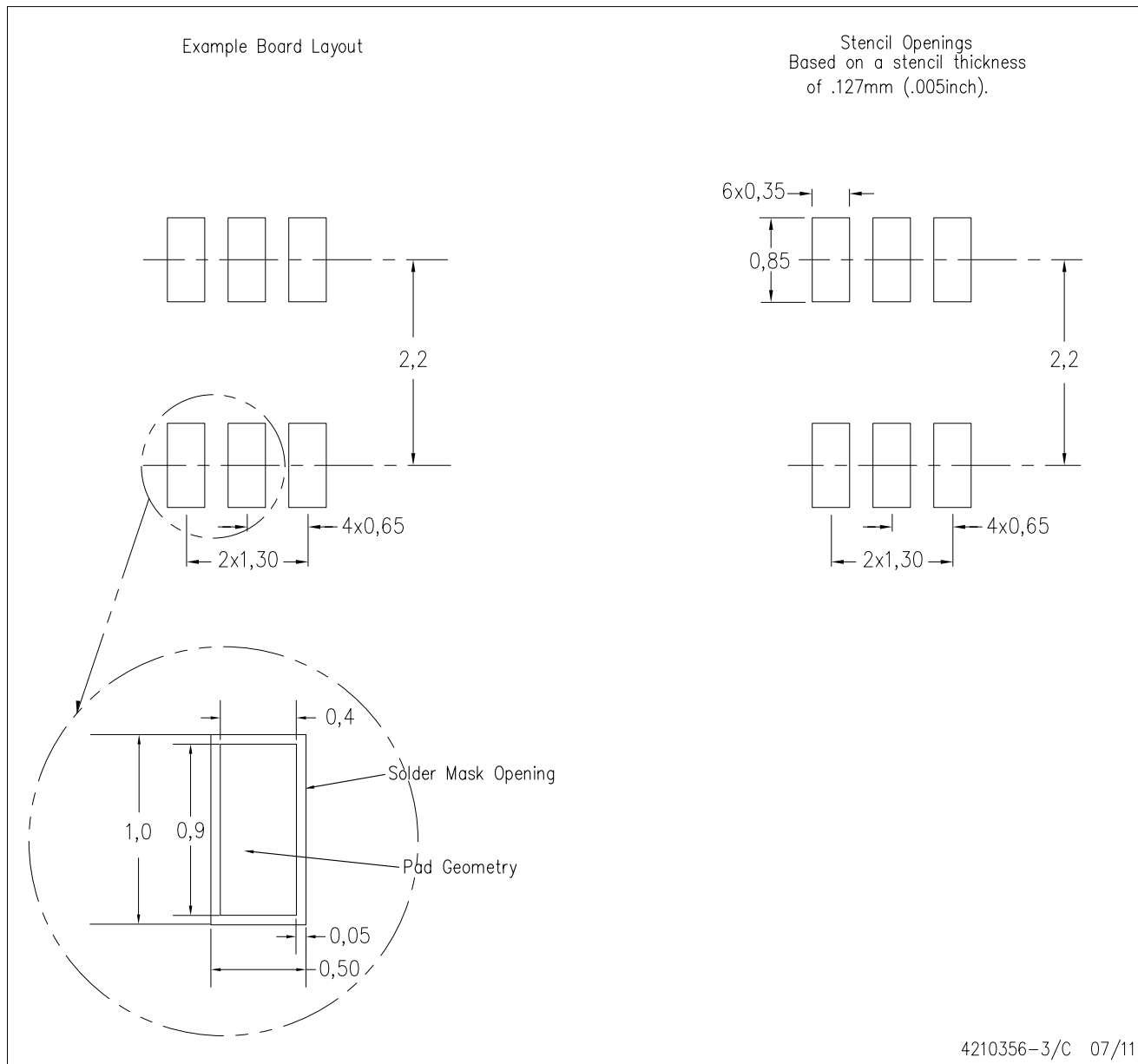


4093553-4/G 01/2007

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

DCK (R-PDSO-G6)

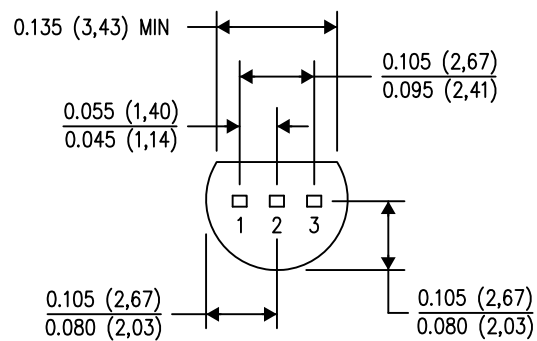
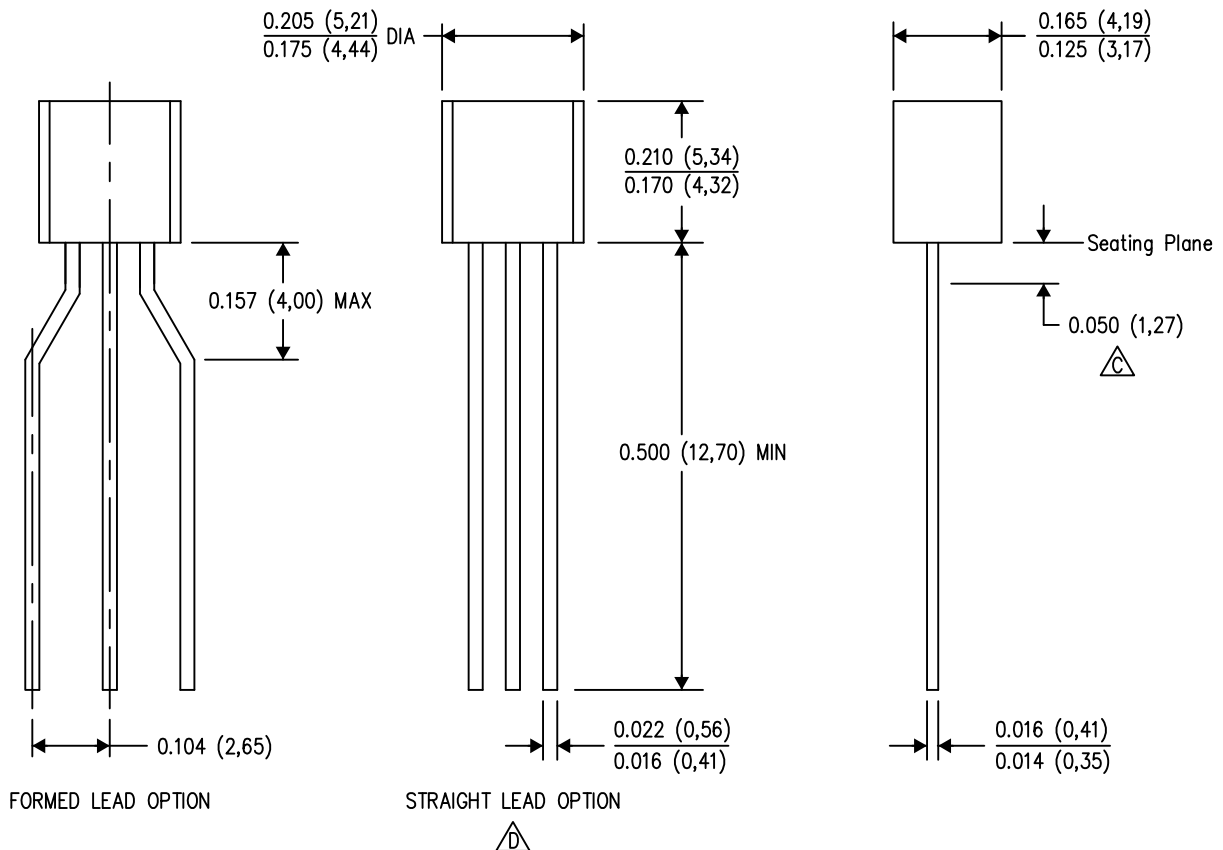
PLASTIC SMALL OUTLINE



- 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.

LP (O-PBCY-W3)

PLASTIC CYLINDRICAL PACKAGE

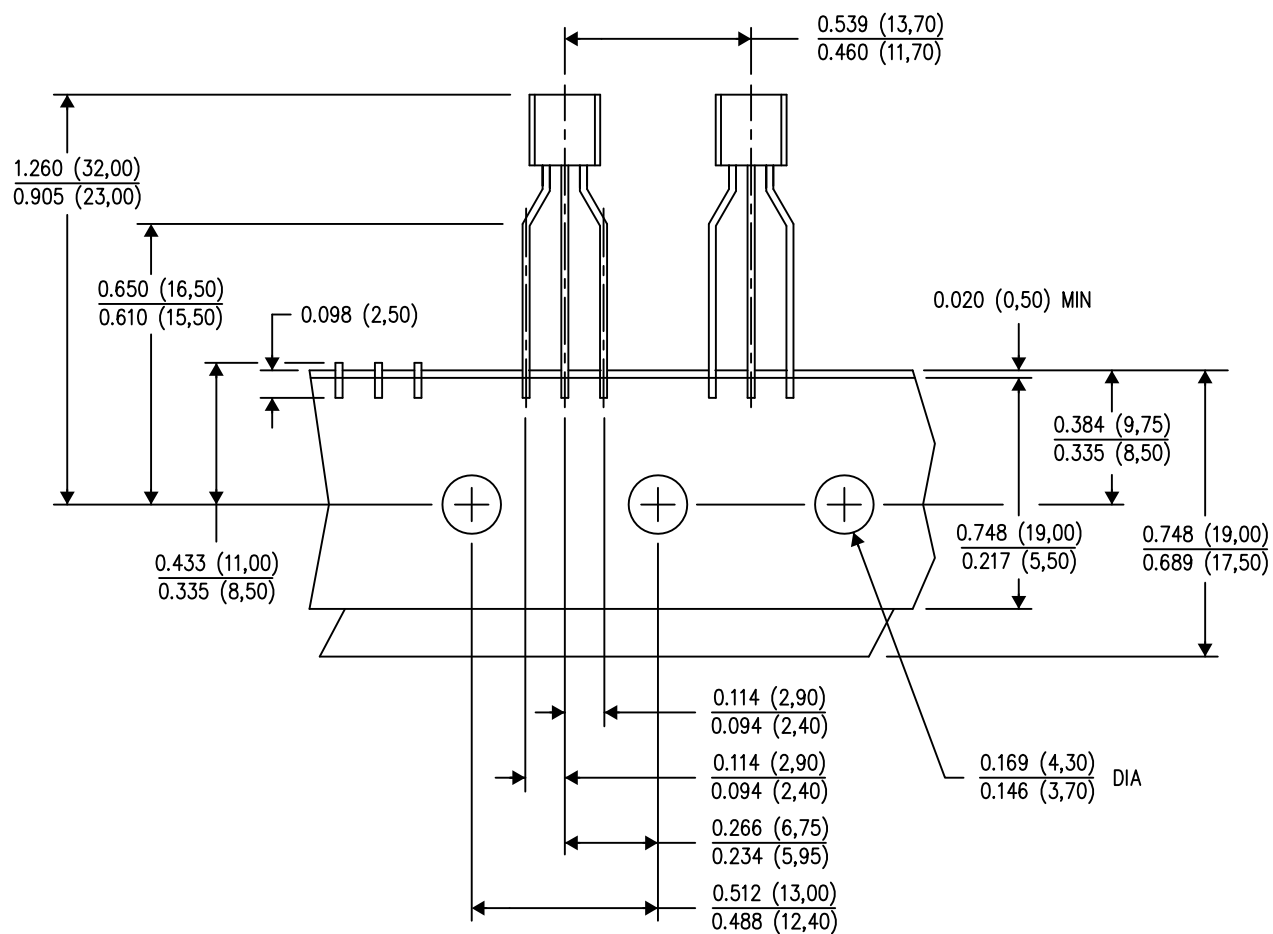


4040001-2/E 08/13

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Lead dimensions are not controlled within this area.
  - D. Falls within JEDEC TO-226 Variation AA (TO-226 replaces TO-92).
  - E. Shipping Method:  
 Straight lead option available in bulk pack only.  
 Formed lead option available in tape & reel or ammo pack.  
 Specific products can be offered in limited combinations of shipping mediums and lead options.  
 Consult product folder for more information on available options.

LP (O-PBCY-W3)

PLASTIC CYLINDRICAL PACKAGE



TAPE &amp; REEL

4040001-3/E 08/13

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Tape and Reel information for the Formed Lead Option package.

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| OMAP Applications Processors | <a href="http://www.ti.com/omap">www.ti.com/omap</a>                                 |
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### Applications

|                               |                                                                                          |
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| Computers and Peripherals     | <a href="http://www.ti.com/computers">www.ti.com/computers</a>                           |
| Consumer Electronics          | <a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>                   |
| Energy and Lighting           | <a href="http://www.ti.com/energy">www.ti.com/energy</a>                                 |
| Industrial                    | <a href="http://www.ti.com/industrial">www.ti.com/industrial</a>                         |
| Medical                       | <a href="http://www.ti.com/medical">www.ti.com/medical</a>                               |
| Security                      | <a href="http://www.ti.com/security">www.ti.com/security</a>                             |
| Space, Avionics and Defense   | <a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a> |
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