

# TLVH431, TLVH432 Low-Voltage Adjustable Precision Shunt Regulators

## 1 Features

- Low-voltage operation: down to 1.24V
- 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 18V
- Wide operating cathode current range: 100 $\mu$ A to 70mA
- 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 reference for data Converters](#)
- [Secondary side regulation in flyback SMPSSs](#)
- [Zener replacement with low leakage current](#)
- [Voltage monitoring for power rails](#)
- [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  $V_{REF}$  (1.24V) and 18V with two external resistors (see [Figure 6-2](#)). These devices operate from a lower voltage (1.24V) than the widely used TL431 and TL1431 shunt-regulator references.

When used with an optocoupler, the TLVH431 and TLVH432 devices are an excellent choice for voltage references in isolated feedback circuits for 3V to 3.3V switching-mode power supplies. The devices 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.

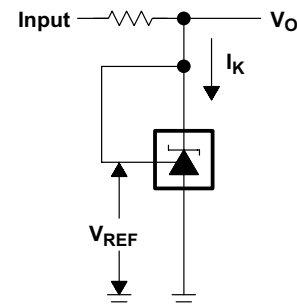
The TLVH432 device is identical to the TLVH431 device, but is offered with different pinouts for the 3-pin SOT-23 and SOT-89 packages.

### Device Information

| PART NUMBER | PACKAGE <sup>(1)</sup> | BODY SIZE (NOM) <sup>(2)</sup> |
|-------------|------------------------|--------------------------------|
| TLVH43xxDBV | SOT-23 (5)             | 2.90mm × 1.60mm                |
| TLVH43xxDBZ | SOT-23 (3)             | 2.92mm × 1.30mm                |
| TLVH43xxDCK | SC70 (6)               | 2.00mm × 1.25mm                |
| TLVH43xxLP  | TO-92 (3)              | 4.30mm × 4.30mm                |
| TLVH43xxPK  | SOT-89 (3)             | 4.50mm × 2.50mm                |

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

(2) The package size (length × width) is a nominal value and includes pins, where applicable.



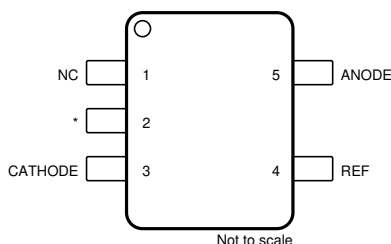
Simplified Schematic



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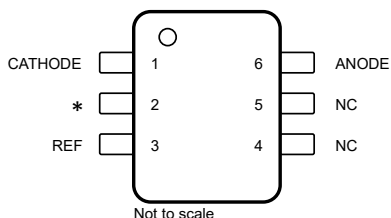
## 4 Pin Configuration and Functions



NC – No internal connection

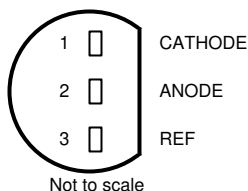
\* Pin 2 is attached to Substrate and must be connected to ANODE or left open.

**Figure 4-1. TLVH431 DBV Package 5-Pin SOT-23 Top View**

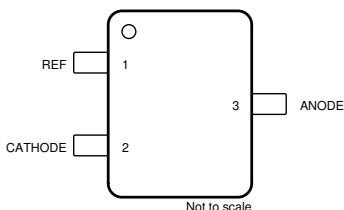


\* Pin 2 is attached to Substrate and must be connected to ANODE or left open.

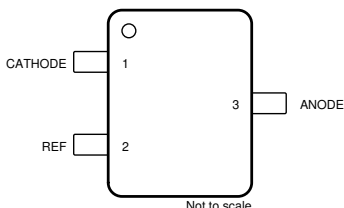
**Figure 4-2. TLVH431 DCK Package 6-Pin SC70 Top View**



**Figure 4-3. TLVH431 LP Package 3-Pin TO-92 Top View**



**Figure 4-4. TLVH431 DBZ Package 3-Pin SOT-23 Top View**



**Figure 4-5. TLVH432 DBZ Package 3-Pin SOT-23 Top View**

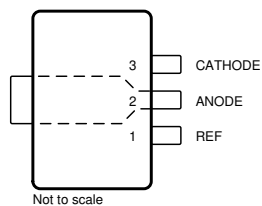


Figure 4-6. TLVH431 PK Package 3-Pin SOT-89 Top View

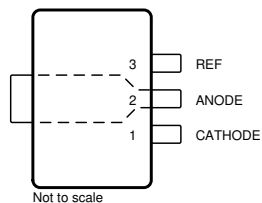


Figure 4-7. TLVH432 PK Package 3-Pin SOT-89 Top View

## Pin Functions

| PIN     |         |     |    |      |    |         |    | TYPE | DESCRIPTION                                                       |
|---------|---------|-----|----|------|----|---------|----|------|-------------------------------------------------------------------|
| NAME    | TLVH431 |     |    |      |    | TLVH432 |    |      |                                                                   |
|         | DBZ     | DBV | LP | DCK  | PK | DBZ     | PK |      |                                                                   |
| CATHODE | 2       | 3   | 1  | 1    | 3  | 1       | 1  | I/O  | Shunt Current/Voltage input                                       |
| REF     | 1       | 4   | 3  | 3    | 1  | 2       | 3  | I    | Threshold relative to common anode                                |
| ANODE   | 3       | 5   | 2  | 6    | 2  | 3       | 2  | O    | Common pin, normally connected to ground                          |
| NC      | —       | 1   | —  | 4, 5 | —  | —       | —  | I    | No Internal Connection                                            |
| *       | —       | 2   | —  | 2    | —  | —       | —  | I    | Substrate Connection and must be connected to ANODE or left open. |

## 5 Specifications

### 5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

|                  |                                        | MIN   | MAX | UNIT |
|------------------|----------------------------------------|-------|-----|------|
| V <sub>KA</sub>  | Cathode voltage <sup>(2)</sup>         |       | 20  | V    |
| I <sub>K</sub>   | Cathode current                        | –25   | 80  | mA   |
| I <sub>ref</sub> | Reference current                      | –0.05 | 3   | mA   |
| T <sub>J</sub>   | Operating virtual junction temperature |       | 150 | °C   |
| T <sub>stg</sub> | Storage temperature                    | –65   | 150 | °C   |

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. 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.

### 5.2 ESD Ratings

|                    |                         |                                                                                | VALUE | UNIT |
|--------------------|-------------------------|--------------------------------------------------------------------------------|-------|------|
| V <sub>(ESD)</sub> | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>              | ±2000 | V    |
|                    |                         | Charged device model (CDM), per JEDEC specification JESD22-C101 <sup>(2)</sup> | ±1000 |      |

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

### 5.3 Recommended Operating Conditions

See<sup>(1)</sup>

|                 |                                |           | MIN              | MAX | UNIT |
|-----------------|--------------------------------|-----------|------------------|-----|------|
| V <sub>KA</sub> | Cathode voltage                |           | V <sub>REF</sub> | 18  | V    |
| I <sub>K</sub>  | Cathode current (continuous)   |           | 0.1              | 70  | mA   |
| T <sub>A</sub>  | Operating free-air temperature | TLVH43x_C | 0                | 70  | °C   |
|                 |                                | TLVH43x_I | –40              | 85  |      |
|                 |                                | TLVH43x_Q | –40              | 125 |      |

- (1) Maximum power dissipation is a function of T<sub>J</sub>(max), θ<sub>JA</sub>, and T<sub>A</sub>. The maximum allowable power dissipation at any allowable ambient temperature is P<sub>D</sub> = (T<sub>J</sub>(max) – T<sub>A</sub>) / θ<sub>JA</sub>. Operating at the absolute maximum T<sub>J</sub> of 150°C can affect reliability.

### 5.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |                                           | TLVH43xx      |                |                 |                 |               | UNIT |
|-------------------------------|-------------------------------------------|---------------|----------------|-----------------|-----------------|---------------|------|
|                               |                                           | DCK<br>(SC70) | PK<br>(SOT-89) | DBV<br>(SOT-23) | DBZ<br>(SOT-23) | LP<br>(TO-92) |      |
|                               |                                           | 6 PINS        | 3 PINS         | 5 PINS          | 3 PINS          | 3 PINS        |      |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance    | 259           | 52             | 206             | 206             | 140           | °C/W |
| R <sub>θJC(top)</sub>         | Junction-to-case (top) thermal resistance | 87            | 9              | 131             | 76              | 55            | °C/W |

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

## 5.5 TLVH43x Electrical Characteristics

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

| PARAMETER                                                                                  | TEST CONDITIONS                                                                                                       |                                                                             | TLVH431<br>TLVH432 |      |       | UNIT          |
|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|--------------------|------|-------|---------------|
|                                                                                            |                                                                                                                       |                                                                             | MIN                | TYP  | MAX   |               |
| $V_{REF}$ Reference voltage                                                                | $V_{KA} = V_{REF}$ ,<br>$I_K = 10\text{mA}$                                                                           | $T_A = 25^\circ\text{C}$                                                    | 1.222              | 1.24 | 1.258 | V             |
|                                                                                            |                                                                                                                       | $T_A = \text{full range,}$<br>See <a href="#">Figure 6-1</a> <sup>(1)</sup> | 1.21               |      | 1.27  |               |
|                                                                                            |                                                                                                                       |                                                                             | 1.202              |      | 1.278 |               |
|                                                                                            |                                                                                                                       |                                                                             | 1.194              |      | 1.286 |               |
| $V_{REF(\text{dev})}$ $V_{REF}$ deviation over full temperature range <sup>(2)</sup>       | $V_{KA} = V_{REF}$ , $I_K = 10\text{mA}$ , See <a href="#">Figure 6-1</a> <sup>(1)</sup>                              | TLVH431C                                                                    |                    | 4    | 12    | mV            |
|                                                                                            |                                                                                                                       | TLVH431I                                                                    |                    | 6    | 20    |               |
|                                                                                            |                                                                                                                       | TLVH431Q                                                                    |                    | 11   | 31    |               |
| $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ Ratio of $V_{REF}$ change to cathode voltage change | $I_K = 10\text{mA}$ , $V_K = V_{REF}$ to 18V, See <a href="#">Figure 6-2</a>                                          |                                                                             |                    | -1.5 | -2.7  | mV/V          |
| $I_{ref}$ Reference terminal current                                                       | $I_K = 10\text{mA}$ , $R1 = 10\text{k}\Omega$ , $R2 = \text{open}$ , See <a href="#">Figure 6-2</a>                   |                                                                             |                    | 0.1  | 0.5   | $\mu\text{A}$ |
| $I_{ref(\text{dev})}$ $I_{ref}$ deviation over full temperature range <sup>(2)</sup>       | $I_K = 10\text{mA}$ , $R1 = 10\text{k}\Omega$ , $R2 = \text{open}$ ,<br>See <a href="#">Figure 6-2</a> <sup>(1)</sup> | TLVH431C                                                                    |                    | 0.05 | 0.3   | $\mu\text{A}$ |
|                                                                                            |                                                                                                                       | TLVH431I                                                                    |                    | 0.1  | 0.4   |               |
|                                                                                            |                                                                                                                       | TLVH431Q                                                                    |                    | 0.15 | 0.5   |               |
| $I_{K(\text{min})}$ Minimum cathode current for regulation                                 | $V_{KA} = V_{REF}$ , See <a href="#">Figure 6-1</a>                                                                   |                                                                             |                    | 60   | 100   | $\mu\text{A}$ |
| $I_{K(\text{off})}$ Off-state cathode current                                              | $V_{REF} = 0$ , $V_{KA} = 18\text{V}$ , See <a href="#">Figure 6-3</a>                                                |                                                                             |                    | 0.02 | 0.1   | $\mu\text{A}$ |
| $ Z_{KA} $ Dynamic impedance <sup>(3)</sup>                                                | $V_{KA} = V_{REF}$ , $f \leq 1\text{kHz}$ , $I_K = 0.1\text{mA}$ to 70mA,<br>See <a href="#">Figure 6-1</a>           |                                                                             |                    | 0.25 | 0.4   | $\Omega$      |

(1) Full temperature ranges are  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$  for TLVH431Q,  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$  for TLVH431I, and  $0^\circ\text{C}$  to  $70^\circ\text{C}$  for TLVH431C.

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

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

where  $\Delta T_A$  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 6-2](#)), the total dynamic impedance of the circuit is defined as:

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

## 5.6 TLVH43xA Electrical Characteristics

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

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

(1) Full temperature ranges are  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$  for TLVH431Q,  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$  for TLVH431I, and  $0^\circ\text{C}$  to  $70^\circ\text{C}$  for TLVH431C.

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

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

where  $\Delta T_A$  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 6-2](#)), the total dynamic impedance of the circuit is defined as:

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

## 5.7 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>$I_K = 10\text{mA}$                                                                           | $T_A = 25^\circ\text{C}$                                                    | 1.234                | 1.24 | 1.246 | V             |
|                                                                                            |                                                                                                                       | $T_A = \text{full range,}$<br>See <a href="#">Figure 6-1</a> <sup>(1)</sup> | 1.227                |      | 1.253 |               |
|                                                                                            |                                                                                                                       |                                                                             | 1.224                |      | 1.259 |               |
|                                                                                            |                                                                                                                       |                                                                             | 1.221                |      | 1.265 |               |
| $V_{REF(\text{dev})}$ $V_{REF}$ deviation over full temperature range <sup>(2)</sup>       | $V_{KA} = V_{REF}$ , $I_K = 10\text{mA}$ , See <a href="#">Figure 6-1</a> <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 | $I_K = 10\text{mA}$ , $V_K = V_{REF}$ to 18V, See <a href="#">Figure 6-2</a>                                          |                                                                             |                      | –1.5 | –2.7  | mV/V          |
| $I_{ref}$ Reference terminal current                                                       | $I_K = 10\text{mA}$ , $R1 = 10\text{k}\Omega$ , $R2 = \text{open}$ , See <a href="#">Figure 6-2</a>                   |                                                                             |                      | 0.1  | 0.5   | $\mu\text{A}$ |
| $I_{ref(\text{dev})}$ $I_{ref}$ deviation over full temperature range <sup>(2)</sup>       | $I_K = 10\text{mA}$ , $R1 = 10\text{k}\Omega$ , $R2 = \text{open}$ ,<br>See <a href="#">Figure 6-2</a> <sup>(1)</sup> | TLVH431BC                                                                   |                      | 0.05 | 0.3   | $\mu\text{A}$ |
|                                                                                            |                                                                                                                       | TLVH431BI                                                                   |                      | 0.1  | 0.4   |               |
|                                                                                            |                                                                                                                       | TLVH431BQ                                                                   |                      | 0.15 | 0.5   |               |
| $I_{K(\text{min})}$ Minimum cathode current for regulation                                 | $V_{KA} = V_{REF}$ , See <a href="#">Figure 6-1</a>                                                                   |                                                                             |                      | 60   | 100   | $\mu\text{A}$ |
| $I_{K(\text{off})}$ Off-state cathode current                                              | $V_{REF} = 0$ , $V_{KA} = 18\text{V}$ , See <a href="#">Figure 6-3</a>                                                |                                                                             |                      | 0.02 | 0.1   | $\mu\text{A}$ |
| $ z_{KA} $ Dynamic impedance <sup>(3)</sup>                                                | $V_{KA} = V_{REF}$ , $f \leq 1\text{kHz}$ , $I_K = 0.1\text{mA}$ to $70\text{mA}$ , See <a href="#">Figure 6-1</a>    |                                                                             |                      | 0.25 | 0.4   | $\Omega$      |

- (1) Full temperature ranges are  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$  for TLVH431Q,  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$  for TLVH431I, and  $0^\circ\text{C}$  to  $70^\circ\text{C}$  for TLVH431C.  
(2) The deviation parameters  $V_{REF(\text{dev})}$  and  $I_{ref(\text{dev})}$  are defined as the differences between the maximum and minimum values obtained over the rated temperature range. The average full-range temperature coefficient of the reference input voltage,  $\alpha V_{REF}$ , is defined as:

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

where  $\Delta T_A$  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 6-2](#)), the total dynamic impedance of the circuit is defined as:

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

## 5.8 Typical Characteristics

Operation of the device at these or any other conditions beyond those indicated in the [Section 5.3](#) table are not implied.

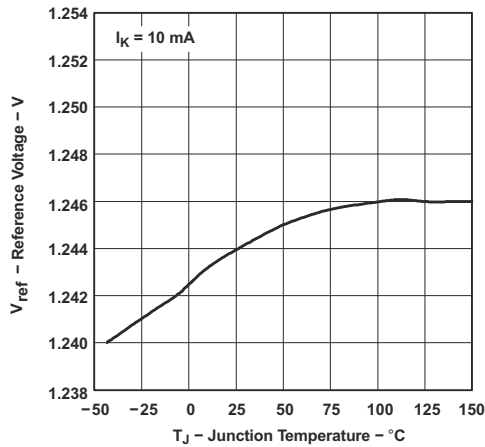


Figure 5-1. Reference Voltage vs Junction Temperature

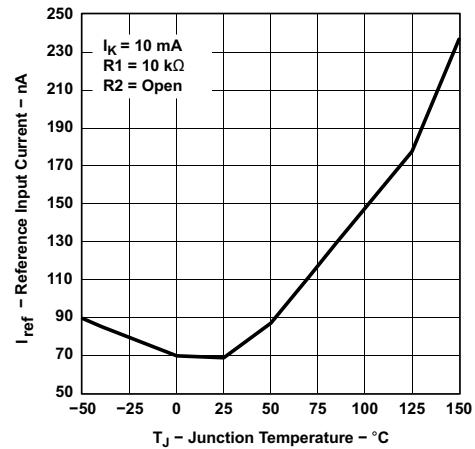


Figure 5-2. Reference Input Current vs Junction Temperature

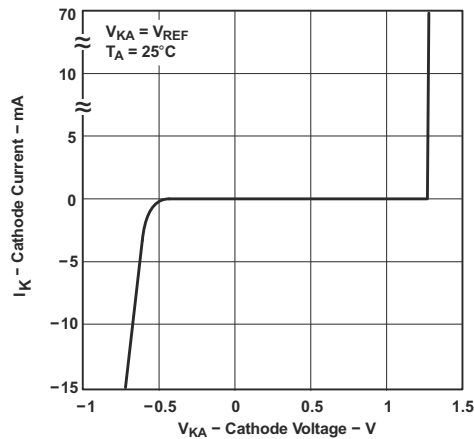


Figure 5-3. Cathode Current vs Cathode Voltage

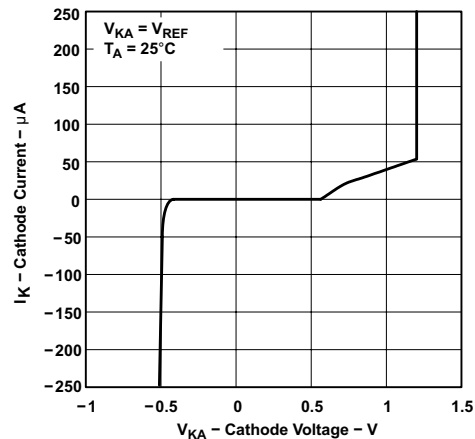


Figure 5-4. Cathode Current vs Cathode Voltage

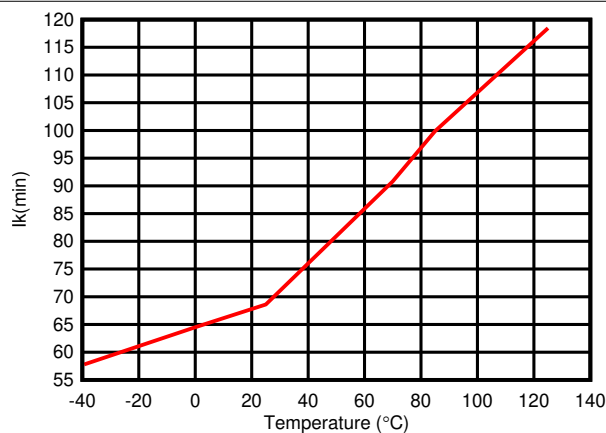


Figure 5-5. Minimum Cathode Current vs. Temperature

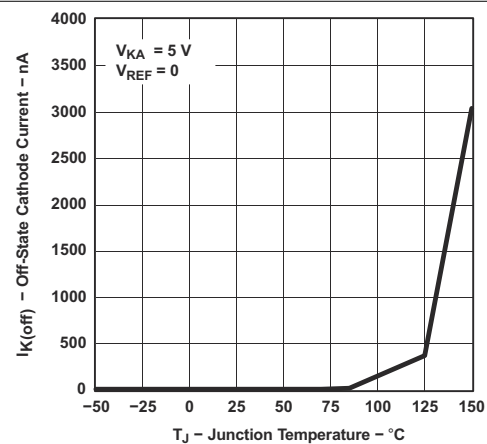
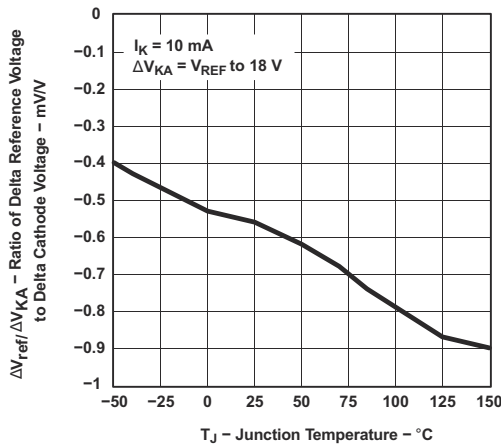


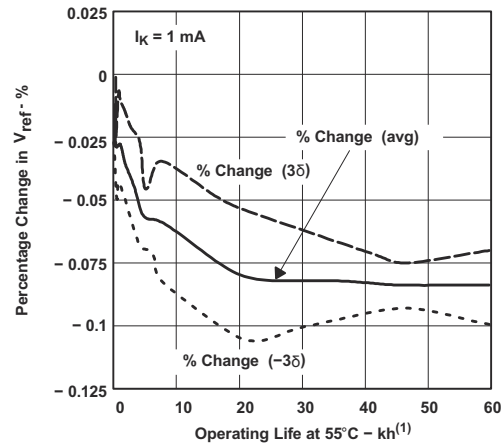
Figure 5-6. Off-State Cathode Current vs Junction Temperature

## 5.8 Typical Characteristics (continued)

Operation of the device at these or any other conditions beyond those indicated in the [Section 5.3](#) table are not implied.

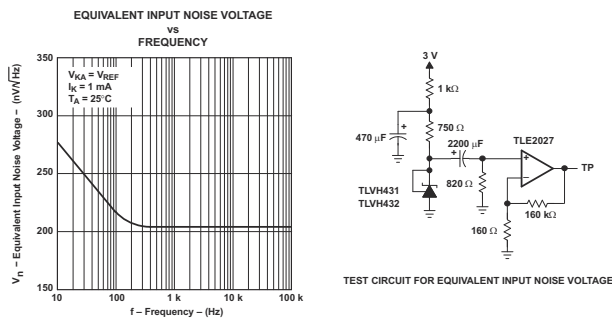


**Figure 5-7. Ratio of Delta Reference Voltage to Delta Cathode Voltage vs Junction Temperature**

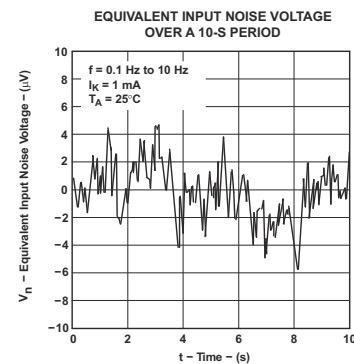


(1) Extrapolated from life-test data taken at 125°C; the activation energy assumed is 0.7 eV.

**Figure 5-8. Percentage Change in  $V_{REF}$  vs Operating Life at 55°C**



**Figure 5-9. Equivalent Input Noise Voltage**



**Figure 5-10. Equivalent Input Noise Voltage**

## 5.8 Typical Characteristics (continued)

Operation of the device at these or any other conditions beyond those indicated in the [Section 5.3](#) table are not implied.

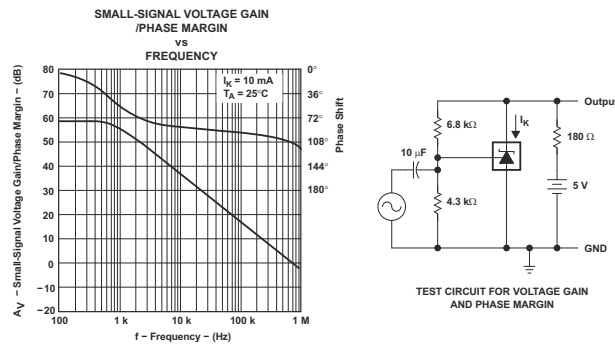


Figure 5-11. Voltage Gain and Phase Margin

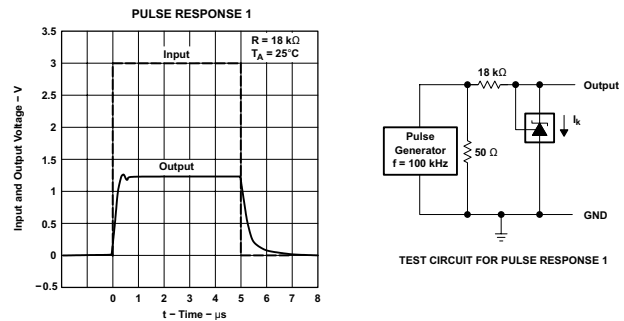


Figure 5-12. Pulse Response 1

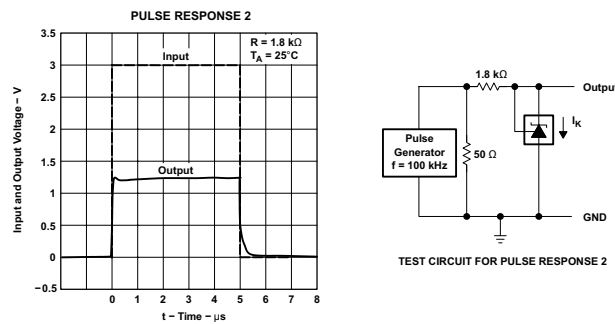


Figure 5-13. Pulse Response 2

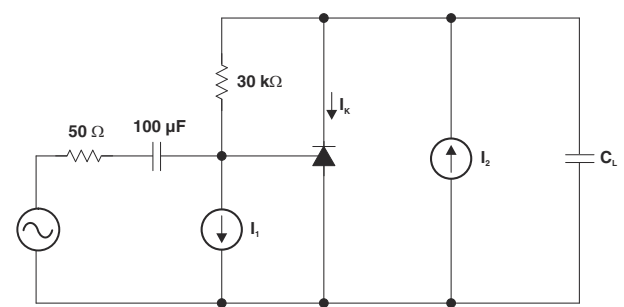


Figure 5-14. Phase Margin Test Circuit

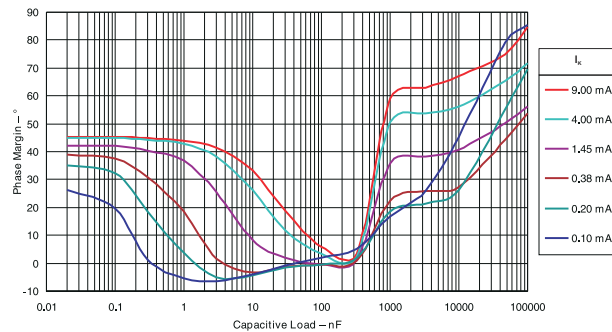


Figure 5-15. Phase Margin vs Capacitive Load  $V_{KA} = V_{REF}$  (1.25 V),  $T_A = 25^\circ\text{C}$

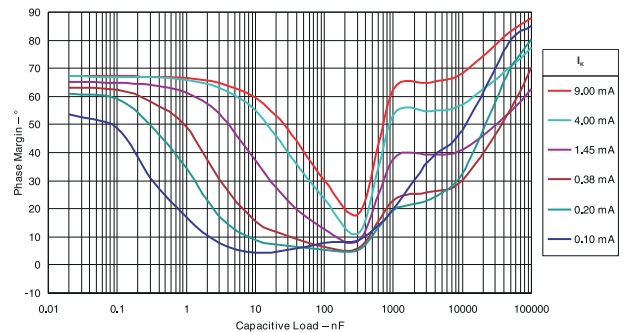


Figure 5-16. Phase Margin vs Capacitive Load  $V_{KA} = 2.50\text{V}$ ,  $T_A = 25^\circ\text{C}$

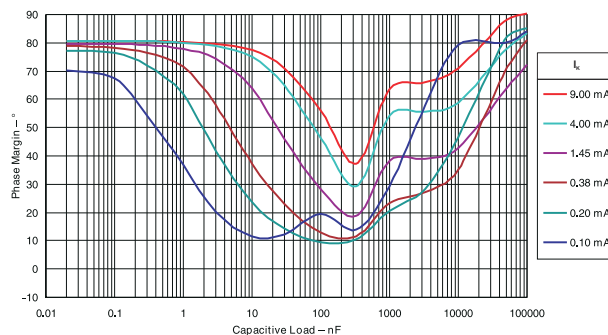


Figure 5-17. Phase Margin vs Capacitive Load  $V_{KA} = 5.00\text{V}$ ,  $T_A = 25^\circ\text{C}$

## 6 Parameter Measurement Information

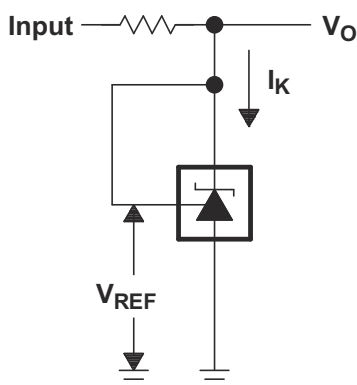


Figure 6-1. Test Circuit for  $V_{KA} = V_{REF}$ ,  $V_O = V_{KA} = V_{REF}$

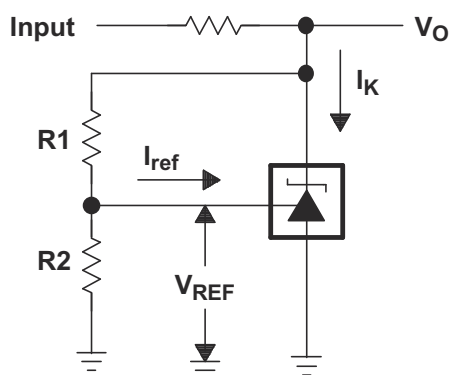


Figure 6-2. Test Circuit for  $V_{KA} > V_{REF}$ ,  $V_O = V_{KA} = V_{REF} \times (1 + R1/R2) + I_{ref} \times R1$

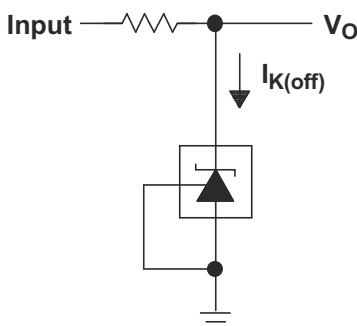


Figure 6-3. Test Circuit for  $I_{K(off)}$

## 7 Detailed Description

### 7.1 Overview

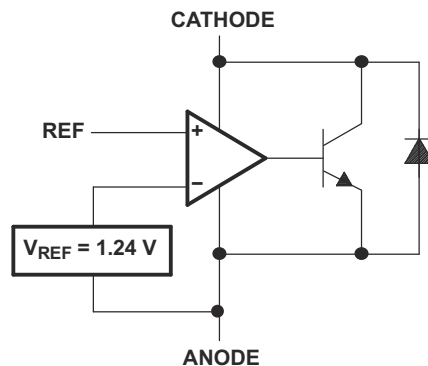
TLVH431 is a low power counterpart to TL431, having lower reference voltage (1.24V versus 2.5V) for lower voltage adjustability and lower minimum cathode current ( $I_{k(min)} = 100\mu A$  versus 1mA). Like TL431, TLVH431 is used in conjunction with the key components to behave as a single voltage reference, error amplifier, voltage clamp or comparator with integrated reference.

TLVH431 is also a higher voltage counterpart to TLV431, with cathode voltage adjustability from 1.24V to 18V, making this part optimum for a wide range of end equipments in industrial, auto, telecom and computing. For this device to behave as a shunt regulator or error amplifier,  $>100\mu A$  ( $I_{min(max)}$ ) 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.

### 7.2 Functional Block Diagram



**Figure 7-1. Equivalent Schematic**

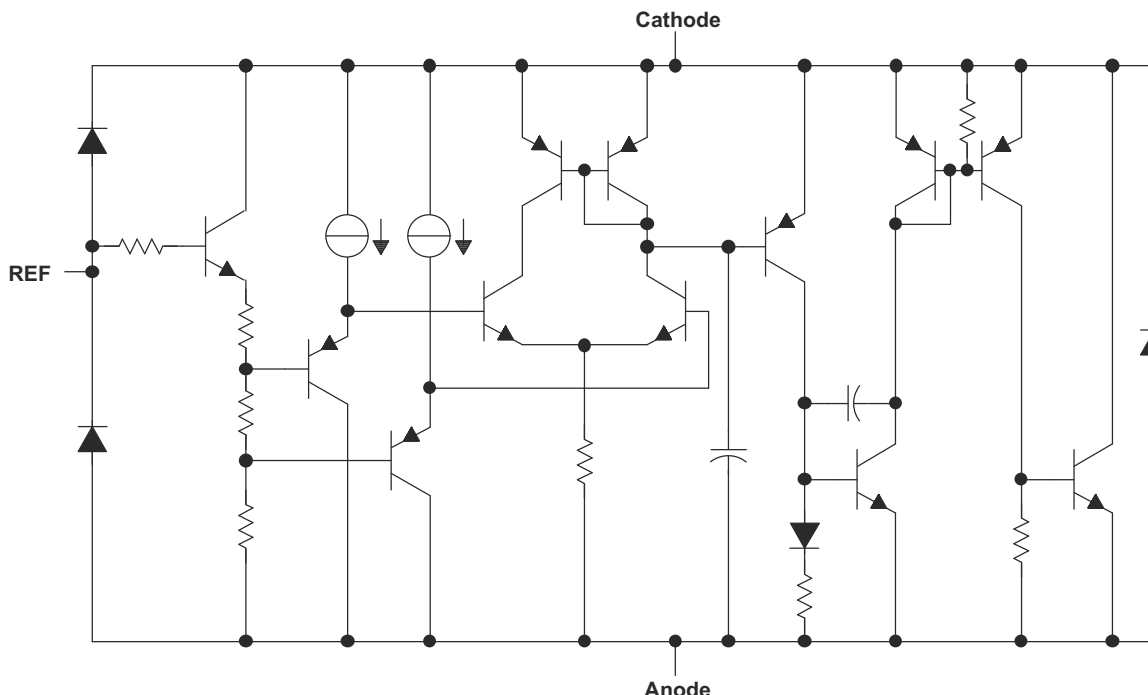


Figure 7-2. Detailed Schematic

### 7.3 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 ( $\geq 1.24\text{V}$ ) and cathode current ( $I_{ka}$ ), TLVH431 forces the reference pin to  $1.24\text{V}$ . However, the reference pin can not be left floating, as it needs  $I_{ref} \geq 0.5\mu\text{A}$  (see [Section 5](#)). This is because the reference pin is driven into an NPN, which needs base current in order 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 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 5-15](#), [Figure 5-16](#), and [Figure 5-17](#) can be used as a guide to assist in choosing the correct capacitor to maintain stability.

## 7.4 Device Functional Modes

### 7.4.1 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 has the characteristics shown in [Figure 5-4](#). With such high gain in this configuration, the TLVH431 device 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.

### 7.4.2 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 through resistive or direct feedback.

## 8 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, as well as validating and testing their design implementation to confirm system functionality.

### 8.1 Application Information

Figure 8-1 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  $V_{REF}$  ( $1.24V \pm 1\%$ ). The output of the regulator, plus the forward voltage drop of the optocoupler LED ( $1.24 + 1.4 = 2.64V$ ), 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 8-1.

The TLVH431 family of devices are prevalent in these applications, being designers go to choice for secondary side regulation. Due to this prevalence, this section explains operation and design in both states of TLVH431 that this application will see, open loop (Comparator +  $V_{REF}$ ) and closed loop (Shunt Regulator).

Further information about system stability and using a TLVH431 device for compensation see *Compensation Design With TL431 for UCC28600*, [SLUA671](#).

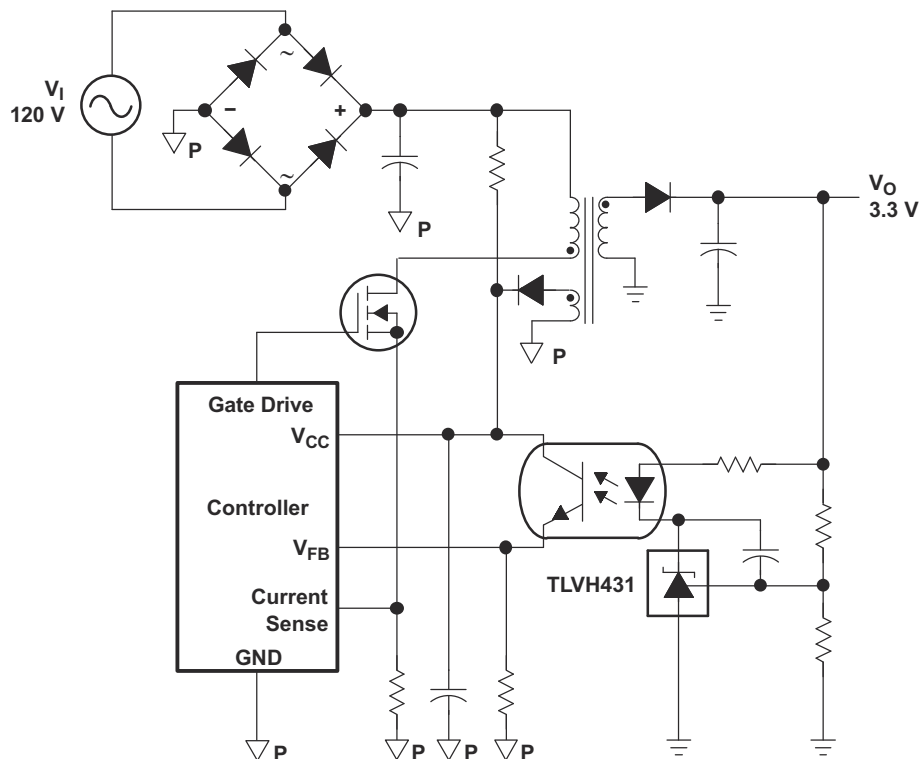
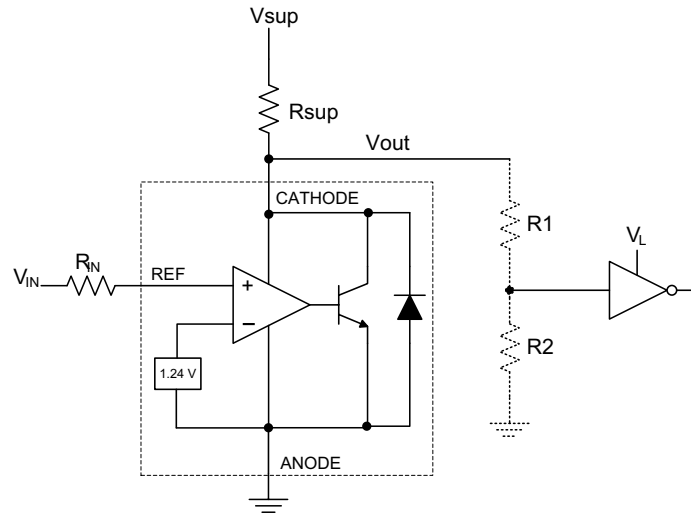


Figure 8-1. Flyback With Isolation Using TLVH431 or TLVH432 as Voltage Reference and Error Amplifier

## 8.2 Typical Applications

### 8.2.1 Comparator With Integrated Reference (Open Loop)



**Figure 8-2. Comparator Application Schematic**

#### 8.2.1.1 Design Requirements

For this design example, use the parameters listed in [Table 8-1](#) as the input parameters.

**Table 8-1. Design Parameters**

| DESIGN PARAMETER                                     | EXAMPLE VALUE                      |
|------------------------------------------------------|------------------------------------|
| Input Voltage Range                                  | 0V to 5V                           |
| Input Resistance                                     | 10k $\Omega$                       |
| Supply Voltage                                       | 9V                                 |
| Cathode Current ( $I_k$ )                            | 500 $\mu$ A                        |
| Output Voltage Level                                 | $\sim 1\text{ V} - V_{\text{sup}}$ |
| Logic Input Thresholds $V_{\text{IH}}/V_{\text{IL}}$ | $V_L$                              |

#### 8.2.1.2 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

##### 8.2.1.2.1 Basic Operation

In the configuration shown in [Figure 8-2](#), TLVH431 behaves 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.

### 8.2.1.2.2 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  $1.24\text{V} \pm (0.5\%, 1.0\% \text{ or } 1.5\%)$  depending on which version is being used.

The more overdrive voltage provided, the faster the TLVH431 will respond. See figures [Figure 8-3](#) and [Figure 8-4](#), for 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 (that is, +1.0% for the A version). For fast response, setting the trip point to  $> 10\%$  of the internal  $V_{\text{ref}}$  should suffice.

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

### 8.2.1.2.3 Output Voltage and Logic Input Level

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  $V_{\text{IH}}$  and  $V_{\text{IL}}$ .

As shown in [Figure 8-3](#) and [Figure 8-4](#), TLVH431's output low level voltage in open-loop/comparator mode is approximately 1V, which is sufficient for some 3.3V supplied logic. However, does not work for 2.5V and 1.8V supplied logic. 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.

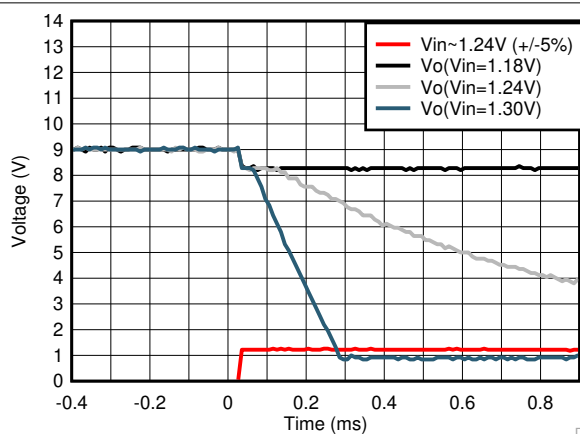
TLVH431's output high voltage is approximately  $V_{\text{SUP}}$  due to TLVH431 being open-collector. If  $V_{\text{SUP}}$  is much higher than the receiving logic's maximum input voltage tolerance, the output must be attenuated to accommodate the outgoing logic's reliability.

When using a resistive divider on the output, be sure to make the sum of the resistive divider ( $R_1$  and  $R_2$  in [Figure 8-2](#)) is much greater than  $R_{\text{SUP}}$  to not interfere with TLVH431's ability to pull close to  $V_{\text{SUP}}$  when turning off.

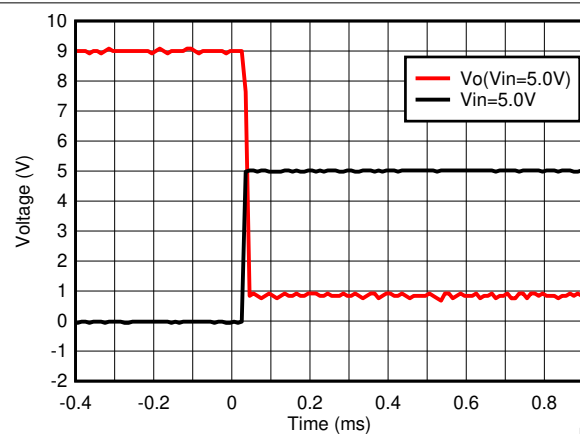
#### 8.2.1.2.3.1 Input Resistance

TLVH431 requires an input resistance in this application to source the reference current ( $I_{\text{REF}}$ ) needed from this device to be in the proper operating regions while turning on. The actual voltage seen at the ref pin is  $V_{\text{REF}} = V_{\text{IN}} - I_{\text{REF}} \times R_{\text{IN}}$ . Because  $I_{\text{REF}}$  can be as high as  $0.5\mu\text{A}$ , TI recommends to use a resistance small enough that mitigates the error that  $I_{\text{REF}}$  creates from  $V_{\text{IN}}$ .

### 8.2.1.3 Application Curves

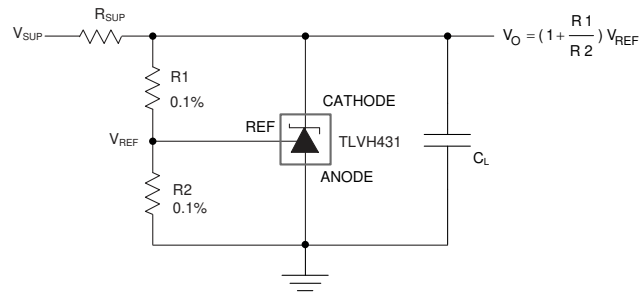


**Figure 8-3. Output Response With Small Overdrive Voltages**



**Figure 8-4. Output Response With Large Overdrive Voltage**

## 8.2.2 Shunt Regulator/Reference



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**Figure 8-5. Shunt Regulator Schematic**

### 8.2.2.1 Design Requirements

For this design example, use the parameters listed in [Table 8-2](#) as the input parameters.

**Table 8-2. Design Parameters**

| DESIGN PARAMETER                                  | EXAMPLE VALUE |
|---------------------------------------------------|---------------|
| Reference Initial Accuracy                        | 1.0%          |
| Supply Voltage                                    | 6V            |
| Cathode Current (I <sub>k</sub> )                 | 500μA         |
| Output Voltage Level                              | 1.24V - 18V   |
| Load Capacitance                                  | 4.7μF         |
| Feedback Resistor Values and Accuracy (R1 and R2) | 10kΩ          |

### 8.2.2.2 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

#### 8.2.2.2.1 Programming Output/Cathode Voltage

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 8-5](#), with R1 and R2 being the resistive bridge. The cathode/output voltage in the shunt regulator configuration can be approximated by the equation shown in [Figure 8-5](#). The cathode voltage can be more accurately determined by taking in to account the cathode current:

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

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 [Section 5](#).

#### 8.2.2.2.2 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.

#### 8.2.2.2.3 Stability

Though TLVH431 is stable with no capacitive load, the device that receives the shunt regulator's output voltage can present a capacitive load that is within the TLVH431 region of stability, shown in [Figure 5-15](#), [Figure 5-16](#) and [Figure 5-17](#). Also, designers can use capacitive loads to improve the transient response or for power supply decoupling.

TI recommends to choose capacitors that give a phase margin  $> 5^\circ$  to maintain stability of the TLVH431.

#### 8.2.2.3 Application Curve

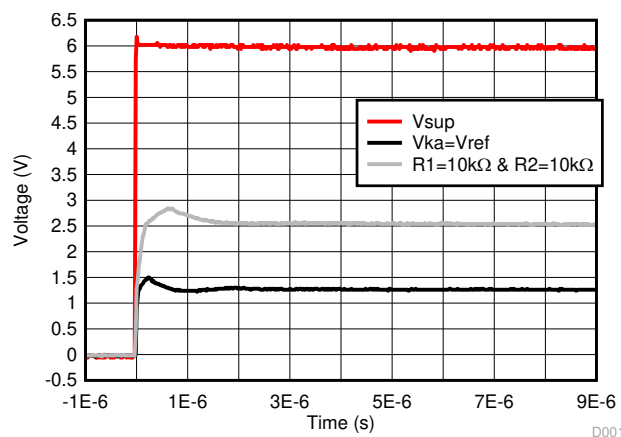


Figure 8-6. TLVH431 Start-up Response

### 8.3 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 5-15](#), [Figure 5-16](#), and [Figure 5-17](#).

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

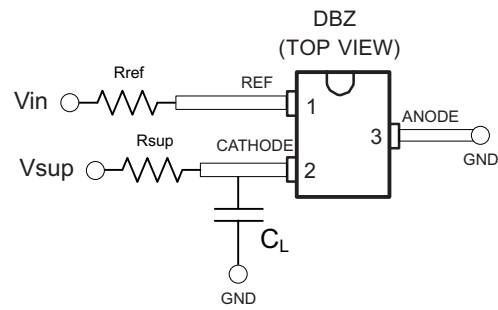
For applications shunting high currents, pay attention to the cathode and anode trace lengths, adjusting the width of the traces to have the proper current density.

### 8.4 Layout

#### 8.4.1 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.

### 8.4.2 Layout Example



**Figure 8-7. DBZ Layout example**

## 9 Device and Documentation Support

### 9.1 Documentation Support

#### 9.1.1 Related Documentation

For related documentation see the following:

- , [Compensation Design With TL431 for UCC28600SLUA671](#)
- [Setting the Shunt Voltage on an Adjustable Shunt Regulator,SLVA445](#)

### 9.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](https://www.ti.com). Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

### 9.3 Support Resources

TI E2E™ support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

### 9.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.

All trademarks are the property of their respective owners.

### 9.5 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### 9.6 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

## 10 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| Changes from Revision M (January 2023) to Revision N (June 2024) | Page |
|------------------------------------------------------------------|------|
| • Updated pinout images and <i>Pin Functions</i> table.....      | 3    |

| Changes from Revision L (April 2020) to Revision M (January 2023)                                     | Page |
|-------------------------------------------------------------------------------------------------------|------|
| • Updated the numbering format for tables, figures, and cross-references throughout the document..... | 1    |
| • Modified Device Information table.....                                                              | 1    |

| Changes from Revision K (September 2016) to Revision L (April 2020)         | Page |
|-----------------------------------------------------------------------------|------|
| • Added links to applications on TI.com .....                               | 1    |
| • Changed Thermal Information.....                                          | 5    |
| • Changed load capacitance value to better reflect the device behavior..... | 19   |

| <b>Changes from Revision J (January 2015) to Revision K (September 2016)</b> | <b>Page</b>       |
|------------------------------------------------------------------------------|-------------------|
| • Changed data sheet title.....                                              | <a href="#">1</a> |
| • Updated pinout images and <i>Pin Functions</i> table.....                  | <a href="#">3</a> |
| • Deleted D package from <i>Pin Functions</i> table.....                     | <a href="#">4</a> |

| <b>Changes from Revision I (September 2009) to Revision J (January 2015)</b>                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Page</b>       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| • Added <i>Applications</i> , <i>Device Information</i> table, <i>Pin Functions</i> table, <i>ESD Ratings</i> table, <i>Thermal Information</i> table, <i>Typical Characteristics</i> , <i>Feature Description</i> section, <i>Device Functional Modes</i> , <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section..... | <a href="#">1</a> |
| • Deleted <i>Ordering Information</i> table.....                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <a href="#">1</a> |

## 11 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 part number           | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|---------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">TLVH431ACDBVR</a>   | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | 0 to 70      | (Y3PG, Y3PJ, Y3PU)  |
| TLVH431ACDBVR.A                 | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | 0 to 70      | (Y3PG, Y3PJ, Y3PU)  |
| <a href="#">TLVH431ACDBVT</a>   | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | 0 to 70      | (Y3PG, Y3PJ, Y3PU)  |
| TLVH431ACDBVT.A                 | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | 0 to 70      | (Y3PG, Y3PJ, Y3PU)  |
| <a href="#">TLVH431ACDBZR</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | 0 to 70      | (Y3PS, Y3PU)        |
| TLVH431ACDBZR.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | (Y3PS, Y3PU)        |
| <a href="#">TLVH431ACDBZRG4</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM                | 0 to 70      | Y3PS                |
| TLVH431ACDBZRG4.A               | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | Y3PS                |
| <a href="#">TLVH431ACDBZT</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | 0 to 70      | (Y3PS, Y3PU)        |
| TLVH431ACDBZT.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | (Y3PS, Y3PU)        |
| <a href="#">TLVH431ACDCKR</a>   | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | 0 to 70      | YPU                 |
| TLVH431ACDCKR.A                 | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | 0 to 70      | YPU                 |
| <a href="#">TLVH431ACDCKT</a>   | Active        | Production           | SC70 (DCK)   6   | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | 0 to 70      | YPU                 |
| TLVH431ACDCKT.A                 | Active        | Production           | SC70 (DCK)   6   | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | 0 to 70      | YPU                 |
| <a href="#">TLVH431ACLP</a>     | Obsolete      | Production           | TO-92 (LP)   3   | -                     | -           | Call TI                              | Call TI                           | 0 to 70      | ZA431A              |
| <a href="#">TLVH431ACLPR</a>    | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | 0 to 70      | ZA431A              |
| TLVH431ACLPR.A                  | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | 0 to 70      | ZA431A              |
| <a href="#">TLVH431ACPK</a>     | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | 0 to 70      | W2                  |
| TLVH431ACPK.A                   | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | 0 to 70      | W2                  |
| <a href="#">TLVH431AIDBVR</a>   | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | (Y3TJ, Y3TU)        |
| TLVH431AIDBVR.A                 | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | (Y3TJ, Y3TU)        |
| <a href="#">TLVH431AIDBVT</a>   | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | (Y3TJ, Y3TU)        |
| TLVH431AIDBVT.A                 | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | (Y3TJ, Y3TU)        |
| <a href="#">TLVH431AIDBZR</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN  <br>NIPDAUAG   NIPDAU   | Level-1-260C-UNLIM                | -40 to 85    | (Y3T3, Y3TS, Y3TU)  |

| Orderable part number           | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|---------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| TLVH431AIDBZR.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (Y3T3, Y3TS, Y3TU)  |
| <a href="#">TLVH431AIDBZT</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | -40 to 85    | (Y3TS, Y3TU)        |
| TLVH431AIDBZT.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (Y3TS, Y3TU)        |
| <a href="#">TLVH431AIDBZTG4</a> | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM                | -40 to 85    | Y3TS                |
| TLVH431AIDBZTG4.A               | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | Y3TS                |
| <a href="#">TLVH431AIDCKR</a>   | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | YTU                 |
| TLVH431AIDCKR.A                 | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | YTU                 |
| <a href="#">TLVH431AIDCKT</a>   | Active        | Production           | SC70 (DCK)   6   | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | YTU                 |
| TLVH431AIDCKT.A                 | Active        | Production           | SC70 (DCK)   6   | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | YTU                 |
| <a href="#">TLVH431AILP</a>     | Obsolete      | Production           | TO-92 (LP)   3   | -                     | -           | Call TI                              | Call TI                           | -40 to 85    | ZB431A              |
| <a href="#">TLVH431AILPR</a>    | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | ZB431A              |
| TLVH431AILPR.A                  | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | ZB431A              |
| <a href="#">TLVH431AIPK</a>     | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | -40 to 85    | W3                  |
| TLVH431AIPK.A                   | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | -40 to 85    | W3                  |
| <a href="#">TLVH431AQDBVR</a>   | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU   SN   NIPDAU                 | Level-1-260C-UNLIM                | -40 to 125   | (Y3NJ, Y3NS, Y3NU)  |
| TLVH431AQDBVR.A                 | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (Y3NJ, Y3NS, Y3NU)  |
| TLVH431AQDBVR.B                 | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (Y3NJ, Y3NS, Y3NU)  |
| <a href="#">TLVH431AQDBVT</a>   | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | (Y3NJ, Y3NU)        |
| TLVH431AQDBVT.A                 | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | (Y3NJ, Y3NU)        |
| <a href="#">TLVH431AQDBZR</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | -40 to 125   | (Y3NS, Y3NU)        |
| TLVH431AQDBZR.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (Y3NS, Y3NU)        |
| <a href="#">TLVH431AQDBZT</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | -40 to 125   | (Y3NS, Y3NU)        |
| TLVH431AQDBZT.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (Y3NS, Y3NU)        |
| <a href="#">TLVH431AQDBZTG4</a> | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM                | -40 to 125   | Y3NS                |
| TLVH431AQDBZTG4.A               | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | Y3NS                |

| Orderable part number           | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|---------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">TLVH431AQDCKR</a>   | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | YNU                 |
| TLVH431AQDCKR.A                 | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | YNU                 |
| <a href="#">TLVH431AQDCKRG4</a> | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | YNU                 |
| TLVH431AQDCKRG4.A               | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | YNU                 |
| <a href="#">TLVH431AQDCKT</a>   | Active        | Production           | SC70 (DCK)   6   | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | YNU                 |
| TLVH431AQDCKT.A                 | Active        | Production           | SC70 (DCK)   6   | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | YNU                 |
| <a href="#">TLVH431AQLP</a>     | Obsolete      | Production           | TO-92 (LP)   3   | -                     | -           | Call TI                              | Call TI                           | -40 to 125   | ZD431A              |
| <a href="#">TLVH431AQLPR</a>    | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 125   | ZD431A              |
| TLVH431AQLPR.A                  | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 125   | ZD431A              |
| <a href="#">TLVH431AQP</a>      | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | -40 to 125   | VD                  |
| TLVH431AQP.A                    | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | -40 to 125   | VD                  |
| <a href="#">TLVH431BCDBVR</a>   | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | 0 to 70      | (Y3JJ, Y3JU)        |
| TLVH431BCDBVR.A                 | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | 0 to 70      | (Y3JJ, Y3JU)        |
| <a href="#">TLVH431BCDBVT</a>   | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | 0 to 70      | (Y3JJ, Y3JU)        |
| TLVH431BCDBVT.A                 | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | 0 to 70      | (Y3JJ, Y3JU)        |
| <a href="#">TLVH431BCDBZR</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN  <br>NIPDAUAG   NIPDAU   | Level-1-260C-UNLIM                | 0 to 70      | (Y3J3, Y3JS, Y3JU)  |
| TLVH431BCDBZR.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | (Y3J3, Y3JS, Y3JU)  |
| <a href="#">TLVH431BCDBZT</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN  <br>NIPDAUAG            | Level-1-260C-UNLIM                | 0 to 70      | (Y3JS, Y3JU)        |
| TLVH431BCDBZT.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | (Y3JS, Y3JU)        |
| <a href="#">TLVH431BCDBZTG4</a> | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM                | 0 to 70      | Y3JS                |
| TLVH431BCDBZTG4.A               | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | Y3JS                |
| <a href="#">TLVH431BCDCKR</a>   | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | 0 to 70      | YHU                 |
| TLVH431BCDCKR.A                 | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | 0 to 70      | YHU                 |
| <a href="#">TLVH431BCDCKT</a>   | Active        | Production           | SC70 (DCK)   6   | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | 0 to 70      | YHU                 |
| TLVH431BCDCKT.A                 | Active        | Production           | SC70 (DCK)   6   | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | 0 to 70      | YHU                 |
| <a href="#">TLVH431BCLP</a>     | Active        | Production           | TO-92 (LP)   3   | 1000   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | 0 to 70      | ZA431B              |
| TLVH431BCLP.A                   | Active        | Production           | TO-92 (LP)   3   | 1000   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | 0 to 70      | ZA431B              |
| <a href="#">TLVH431BCLPR</a>    | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | 0 to 70      | ZA431B              |

| Orderable part number           | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|---------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| TLVH431BCLPR.A                  | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | 0 to 70      | ZA431B              |
| <a href="#">TLVH431BCPK</a>     | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | 0 to 70      | V7                  |
| TLVH431BCPK.A                   | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | 0 to 70      | V7                  |
| <a href="#">TLVH431BIDBVR</a>   | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU   SN   NIPDAU                 | Level-1-260C-UNLIM                | -40 to 85    | (Y3KJ, Y3KS, Y3KU)  |
| TLVH431BIDBVR.A                 | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (Y3KJ, Y3KS, Y3KU)  |
| TLVH431BIDBVR.B                 | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (Y3KJ, Y3KS, Y3KU)  |
| <a href="#">TLVH431BIDBVT</a>   | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | (Y3KJ, Y3KU)        |
| TLVH431BIDBVT.A                 | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | (Y3KJ, Y3KU)        |
| <a href="#">TLVH431BIDBZR</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN   NIPDAUAG   NIPDAU      | Level-1-260C-UNLIM                | -40 to 85    | (Y3K3, Y3KS, Y3KU)  |
| TLVH431BIDBZR.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (Y3K3, Y3KS, Y3KU)  |
| <a href="#">TLVH431BIDBZRG4</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM                | -40 to 85    | Y3KS                |
| TLVH431BIDBZRG4.A               | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | Y3KS                |
| <a href="#">TLVH431BIDBZT</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN   NIPDAUAG               | Level-1-260C-UNLIM                | -40 to 85    | (Y3KS, Y3KU)        |
| TLVH431BIDBZT.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (Y3KS, Y3KU)        |
| <a href="#">TLVH431BIDCKR</a>   | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | YJU                 |
| TLVH431BIDCKR.A                 | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | YJU                 |
| TLVH431BIDCKRG4.A               | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | YJU                 |
| <a href="#">TLVH431BIDCKT</a>   | Active        | Production           | SC70 (DCK)   6   | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | YJU                 |
| TLVH431BIDCKT.A                 | Active        | Production           | SC70 (DCK)   6   | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | YJU                 |
| <a href="#">TLVH431BILP</a>     | Active        | Production           | TO-92 (LP)   3   | 1000   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | ZB431B              |
| TLVH431BILP.A                   | Active        | Production           | TO-92 (LP)   3   | 1000   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | ZB431B              |
| <a href="#">TLVH431BILPR</a>    | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | ZB431B              |
| TLVH431BILPR.A                  | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | ZB431B              |
| <a href="#">TLVH431BIPK</a>     | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | -40 to 85    | V8                  |
| TLVH431BIPK.A                   | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | -40 to 85    | V8                  |
| <a href="#">TLVH431BQDBVR</a>   | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | (Y3LJ, Y3LU)        |

| Orderable part number           | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|---------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| TLVH431BQDBVR.A                 | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | (Y3LJ, Y3LU)        |
| <a href="#">TLVH431BQDBVT</a>   | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | (Y3LJ, Y3LU)        |
| TLVH431BQDBVT.A                 | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | (Y3LJ, Y3LU)        |
| <a href="#">TLVH431BQDBZR</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN  <br>NIPDAUAG   NIPDAU   | Level-1-260C-UNLIM                | -40 to 125   | (Y3LS, Y3LU)        |
| TLVH431BQDBZR.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (Y3LS, Y3LU)        |
| <a href="#">TLVH431BQDBZRG4</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM                | -40 to 125   | Y3LS                |
| TLVH431BQDBZRG4.A               | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | Y3LS                |
| <a href="#">TLVH431BQDBZT</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | -40 to 125   | (Y3LS, Y3LU)        |
| TLVH431BQDBZT.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (Y3LS, Y3LU)        |
| TLVH431BQDBZTG4.A               | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | Y3LS                |
| <a href="#">TLVH431BQDCKR</a>   | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | YKU                 |
| TLVH431BQDCKR.A                 | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | YKU                 |
| <a href="#">TLVH431BQDCKRG4</a> | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | YKU                 |
| TLVH431BQDCKRG4.A               | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | YKU                 |
| <a href="#">TLVH431BQDCKT</a>   | Active        | Production           | SC70 (DCK)   6   | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | YKU                 |
| TLVH431BQDCKT.A                 | Active        | Production           | SC70 (DCK)   6   | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | YKU                 |
| <a href="#">TLVH431BQLP</a>     | Obsolete      | Production           | TO-92 (LP)   3   | -                     | -           | Call TI                              | Call TI                           | -40 to 125   | ZD431B              |
| <a href="#">TLVH431BQLPR</a>    | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 125   | ZD431B              |
| TLVH431BQLPR.A                  | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 125   | ZD431B              |
| <a href="#">TLVH431BQPK</a>     | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | -40 to 125   | V9                  |
| TLVH431BQPK.A                   | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | -40 to 125   | V9                  |
| <a href="#">TLVH431CDBVR</a>    | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU   SN   NIPDAU                 | Level-1-260C-UNLIM                | 0 to 70      | (Y3UJ, Y3US, Y3UU)  |
| TLVH431CDBVR.A                  | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | (Y3UJ, Y3US, Y3UU)  |
| <a href="#">TLVH431CDBVT</a>    | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | 0 to 70      | (Y3UJ, Y3UU)        |
| TLVH431CDBVT.A                  | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | 0 to 70      | (Y3UJ, Y3UU)        |
| <a href="#">TLVH431CDBZR</a>    | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | 0 to 70      | (Y3US, Y3UU)        |
| TLVH431CDBZR.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | (Y3US, Y3UU)        |

| Orderable part number          | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|--------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">TLVH431CDBZT</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | 0 to 70      | (Y3US, Y3UU)        |
| TLVH431CDBZT.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | (Y3US, Y3UU)        |
| <a href="#">TLVH431CDBZTG4</a> | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM                | 0 to 70      | Y3US                |
| TLVH431CDBZTG4.A               | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | Y3US                |
| <a href="#">TLVH431CDCKT</a>   | Active        | Production           | SC70 (DCK)   6   | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | 0 to 70      | YUU                 |
| TLVH431CDCKT.A                 | Active        | Production           | SC70 (DCK)   6   | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | 0 to 70      | YUU                 |
| <a href="#">TLVH431CLP</a>     | Obsolete      | Production           | TO-92 (LP)   3   | -                     | -           | Call TI                              | Call TI                           | 0 to 70      | ZA431               |
| <a href="#">TLVH431CLPR</a>    | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | 0 to 70      | ZA431               |
| TLVH431CLPR.A                  | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | 0 to 70      | ZA431               |
| <a href="#">TLVH431CPK</a>     | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | 0 to 70      | W4                  |
| TLVH431CPK.A                   | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | 0 to 70      | W4                  |
| <a href="#">TLVH431IDBVR</a>   | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU   SN   NIPDAU                 | Level-1-260C-UNLIM                | -40 to 85    | (Y3VJ, Y3VS, Y3VU)  |
| TLVH431IDBVR.A                 | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (Y3VJ, Y3VS, Y3VU)  |
| <a href="#">TLVH431IDBVT</a>   | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | (Y3VJ, Y3VU)        |
| TLVH431IDBVT.A                 | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | (Y3VJ, Y3VU)        |
| <a href="#">TLVH431IDBZR</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | -40 to 85    | (Y3VS, Y3VU)        |
| TLVH431IDBZR.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (Y3VS, Y3VU)        |
| <a href="#">TLVH431IDBZT</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | -40 to 85    | (Y3VS, Y3VU)        |
| TLVH431IDBZT.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (Y3VS, Y3VU)        |
| <a href="#">TLVH431IDCKR</a>   | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | YVU                 |
| TLVH431IDCKR.A                 | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | YVU                 |
| <a href="#">TLVH431IDCKT</a>   | Active        | Production           | SC70 (DCK)   6   | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | YVU                 |
| TLVH431IDCKT.A                 | Active        | Production           | SC70 (DCK)   6   | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | YVU                 |
| <a href="#">TLVH431ILP</a>     | Obsolete      | Production           | TO-92 (LP)   3   | -                     | -           | Call TI                              | Call TI                           | -40 to 85    | ZB431               |
| <a href="#">TLVH431ILPR</a>    | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | ZB431               |
| TLVH431ILPR.A                  | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | ZB431               |
| <a href="#">TLVH431IPK</a>     | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | -40 to 85    | W5                  |

| Orderable part number           | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|---------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| TLVH431IPK.A                    | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | -40 to 85    | W5                  |
| <a href="#">TLVH431QDBVR</a>    | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU   SN   NIPDAU                 | Level-1-260C-UNLIM                | -40 to 125   | (Y3MJ, Y3MS, Y3MU)  |
| TLVH431QDBVR.A                  | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (Y3MJ, Y3MS, Y3MU)  |
| <a href="#">TLVH431QDBVT</a>    | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | (Y3MJ, Y3MU)        |
| TLVH431QDBVT.A                  | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | (Y3MJ, Y3MU)        |
| <a href="#">TLVH431QDBZR</a>    | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | -40 to 125   | (Y3MS, Y3MU)        |
| TLVH431QDBZR.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (Y3MS, Y3MU)        |
| <a href="#">TLVH431QDBZT</a>    | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | -40 to 125   | (Y3MS, Y3MU)        |
| TLVH431QDBZT.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (Y3MS, Y3MU)        |
| <a href="#">TLVH431QDBZTG4</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM                | -40 to 125   | Y3MS                |
| TLVH431QDBZTG4.A                | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | Y3MS                |
| <a href="#">TLVH431QDCKR</a>    | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | YMU                 |
| TLVH431QDCKR.A                  | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | YMU                 |
| <a href="#">TLVH431QDCKRG4</a>  | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | YMU                 |
| TLVH431QDCKRG4.A                | Active        | Production           | SC70 (DCK)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | YMU                 |
| <a href="#">TLVH431QDCKT</a>    | Active        | Production           | SC70 (DCK)   6   | 250   SMALL T&R       | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | YMU                 |
| TLVH431QDCKT.A                  | Active        | Production           | SC70 (DCK)   6   | 250   SMALL T&R       | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | YMU                 |
| <a href="#">TLVH431QLP</a>      | Obsolete      | Production           | TO-92 (LP)   3   | -                     | -           | Call TI                              | Call TI                           | -40 to 125   | ZD431               |
| <a href="#">TLVH431QLPR</a>     | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 125   | ZD431               |
| TLVH431QLPR.A                   | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 125   | ZD431               |
| <a href="#">TLVH431QPK</a>      | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | -40 to 125   | VC                  |
| TLVH431QPK.A                    | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | -40 to 125   | VC                  |
| <a href="#">TLVH432ACDBZR</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | 0 to 70      | (Y2ES, Y2EU)        |
| TLVH432ACDBZR.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | (Y2ES, Y2EU)        |
| <a href="#">TLVH432ACDBZRG4</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM                | 0 to 70      | Y2ES                |
| TLVH432ACDBZRG4.A               | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | Y2ES                |

| Orderable part number           | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|---------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">TLVH432ACDBZT</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | 0 to 70      | (Y2ES, Y2EU)        |
| TLVH432ACDBZT.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | (Y2ES, Y2EU)        |
| <a href="#">TLVH432AIDBZR</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | -40 to 85    | (Y2FS, Y2FU)        |
| TLVH432AIDBZR.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (Y2FS, Y2FU)        |
| <a href="#">TLVH432AIPK</a>     | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | -40 to 85    | VL                  |
| TLVH432AIPK.A                   | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | -40 to 85    | VL                  |
| <a href="#">TLVH432AQDBZR</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | -40 to 125   | (Y2GS, Y2GU)        |
| TLVH432AQDBZR.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (Y2GS, Y2GU)        |
| <a href="#">TLVH432AQDBZT</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | -40 to 125   | (Y2GS, Y2GU)        |
| TLVH432AQDBZT.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (Y2GS, Y2GU)        |
| <a href="#">TLVH432BCDBZR</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | 0 to 70      | (Y2HS, Y2HU)        |
| TLVH432BCDBZR.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | (Y2HS, Y2HU)        |
| <a href="#">TLVH432BCDBZRG4</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM                | 0 to 70      | Y2HS                |
| TLVH432BCDBZRG4.A               | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | Y2HS                |
| <a href="#">TLVH432BCPK</a>     | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | 0 to 70      | VN                  |
| TLVH432BCPK.A                   | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | 0 to 70      | VN                  |
| <a href="#">TLVH432BIDBZR</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | -40 to 85    | (Y2JS, Y2JU)        |
| TLVH432BIDBZR.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (Y2JS, Y2JU)        |
| <a href="#">TLVH432BQDBZR</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN  <br>NIPDAUAG   NIPDAU   | Level-1-260C-UNLIM                | -40 to 125   | (Y2KS, Y2KU)        |
| TLVH432BQDBZR.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (Y2KS, Y2KU)        |
| <a href="#">TLVH432BQDBZT</a>   | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | -40 to 125   | (Y2KS, Y2KU)        |
| TLVH432BQDBZT.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (Y2KS, Y2KU)        |
| <a href="#">TLVH432BQDBZTG4</a> | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   NIPDAUAG                    | Level-1-260C-UNLIM                | -40 to 125   | Y2KS                |
| TLVH432BQDBZTG4.A               | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | Y2KS                |

| Orderable part number        | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">TLVH432CDBZR</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | 0 to 70      | (Y2AS, Y2AU)        |
| TLVH432CDBZR.A               | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | (Y2AS, Y2AU)        |
| <a href="#">TLVH432CDBZT</a> | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | 0 to 70      | (Y2AS, Y2AU)        |
| TLVH432CDBZT.A               | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | (Y2AS, Y2AU)        |
| <a href="#">TLVH432CPK</a>   | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | 0 to 70      | VG                  |
| TLVH432CPK.A                 | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | 0 to 70      | VG                  |
| <a href="#">TLVH432IDBZR</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | -40 to 85    | (Y2BS, Y2BU)        |
| TLVH432IDBZR.A               | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (Y2BS, Y2BU)        |
| <a href="#">TLVH432QDBZR</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | -40 to 125   | (Y2DS, Y2DU)        |
| TLVH432QDBZR.A               | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (Y2DS, Y2DU)        |
| <a href="#">TLVH432QDBZT</a> | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU   SN<br>  NIPDAUAG            | Level-1-260C-UNLIM                | -40 to 125   | (Y2DS, Y2DU)        |
| TLVH432QDBZT.A               | Active        | Production           | SOT-23 (DBZ)   3 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (Y2DS, Y2DU)        |
| <a href="#">TLVH432QPK</a>   | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | -40 to 125   | VJ                  |
| TLVH432QPK.A                 | Active        | Production           | SOT-89 (PK)   3  | 1000   LARGE T&R      | Yes         | SN                                   | Level-2-260C-1 YEAR               | -40 to 125   | VJ                  |

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

<sup>(5)</sup> **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

**(6) Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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

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

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

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

## 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                | 3.3     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431ACDBVT   | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.3     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431ACDBZR   | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431ACDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431ACDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TLVH431ACDBZT   | SOT-23       | DBZ             | 3    | 250  | 178.0              | 9.0                | 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            |
| 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 | 178.0              | 9.0                | 3.3     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431AIDBVT   | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431AIDBVT   | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.3     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431AIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431AIDBZT   | SOT-23       | DBZ             | 3    | 250  | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431AIDBZTG4 | 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 |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLVH431AIDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 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            |
| 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 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431AQDBVT   | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431AQDBVT   | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.3     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431AQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431AQDBZT   | SOT-23       | DBZ             | 3    | 250  | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431AQDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431AQDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 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            |
| TLVH431AQDCKRG4 | 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            |
| TLVH431AQPCK    | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | Q3            |
| TLVH431AQPCK    | 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 | 178.0              | 9.0                | 3.3     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431BCDBVT   | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.3     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431BCDBVT   | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431BCDBZR   | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431BCDBZT   | SOT-23       | DBZ             | 3    | 250  | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431BCDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TLVH431BCDBZTG4 | 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            |
| 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 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431BIDBVT   | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.3     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431BIDBVT   | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431BIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431BIDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TLVH431BIDBZRG4 | 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  | 178.0              | 9.0                | 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            |
| 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 | 178.0              | 9.0                | 3.3     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431BQDBVT   | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.3     | 3.2     | 1.4     | 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 |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| 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 | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 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            |
| TLVH431BQDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431BQDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TLVH431BQDBZT   | SOT-23       | DBZ             | 3    | 250  | 178.0              | 9.0                | 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            |
| TLVH431BQDCKR   | SC70         | DCK             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TLVH431BQDCKRG4 | 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            |
| 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 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431CDBVT    | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.3     | 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 | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431CDBZT    | SOT-23       | DBZ             | 3    | 250  | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431CDBZTG4  | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431CDBZTG4  | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 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            |
| 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 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431IDBVT    | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.3     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431IDBVT    | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431IDBZR    | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431IDBZT    | SOT-23       | DBZ             | 3    | 250  | 178.0              | 9.0                | 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            |
| 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 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431QDBVT    | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431QDBVT    | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.3     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLVH431QDBZR    | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431QDBZT    | SOT-23       | DBZ             | 3    | 250  | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431QDBZTG4  | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TLVH431QDBZTG4  | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH431QDCKR    | SC70         | DCK             | 6    | 3000 | 179.0              | 8.4                | 2.2     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| TLVH431QDCKRG4  | 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            |

| 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 |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLVH431QPK      | SOT-89       | PK              | 3    | 1000 | 180.0              | 12.4               | 4.91    | 4.52    | 1.9     | 8.0     | 12.0   | 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 | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432ACDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432ACDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TLVH432ACDBZT   | SOT-23       | DBZ             | 3    | 250  | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432AIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 9.0                | 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            |
| 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 | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432AQDBZT   | SOT-23       | DBZ             | 3    | 250  | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432BCDBZR   | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432BCDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432BCDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 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            |
| 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 | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432BQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432BQDBZT   | SOT-23       | DBZ             | 3    | 250  | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432BQDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| TLVH432BQDBZTG4 | 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 | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432CDBZT    | SOT-23       | DBZ             | 3    | 250  | 178.0              | 9.0                | 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            |
| 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 | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432QDBZR    | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TLVH432QDBZT    | SOT-23       | DBZ             | 3    | 250  | 178.0              | 9.0                | 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            |
| 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



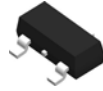
\*All dimensions are nominal

| 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        |
| TLVH431ACDBVT   | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH431ACDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH431ACDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 183.0       | 183.0      | 20.0        |
| TLVH431ACDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TLVH431ACDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH431ACDCKR   | SC70         | DCK             | 6    | 3000 | 200.0       | 183.0      | 25.0        |
| TLVH431ACDCKT   | SC70         | DCK             | 6    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431ACPK     | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TLVH431ACPK     | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH431AIDBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH431AIDBVT   | SOT-23       | DBV             | 5    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431AIDBVT   | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH431AIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH431AIDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH431AIDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 183.0       | 183.0      | 20.0        |
| TLVH431AIDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TLVH431AIDCKR   | SC70         | DCK             | 6    | 3000 | 200.0       | 183.0      | 25.0        |

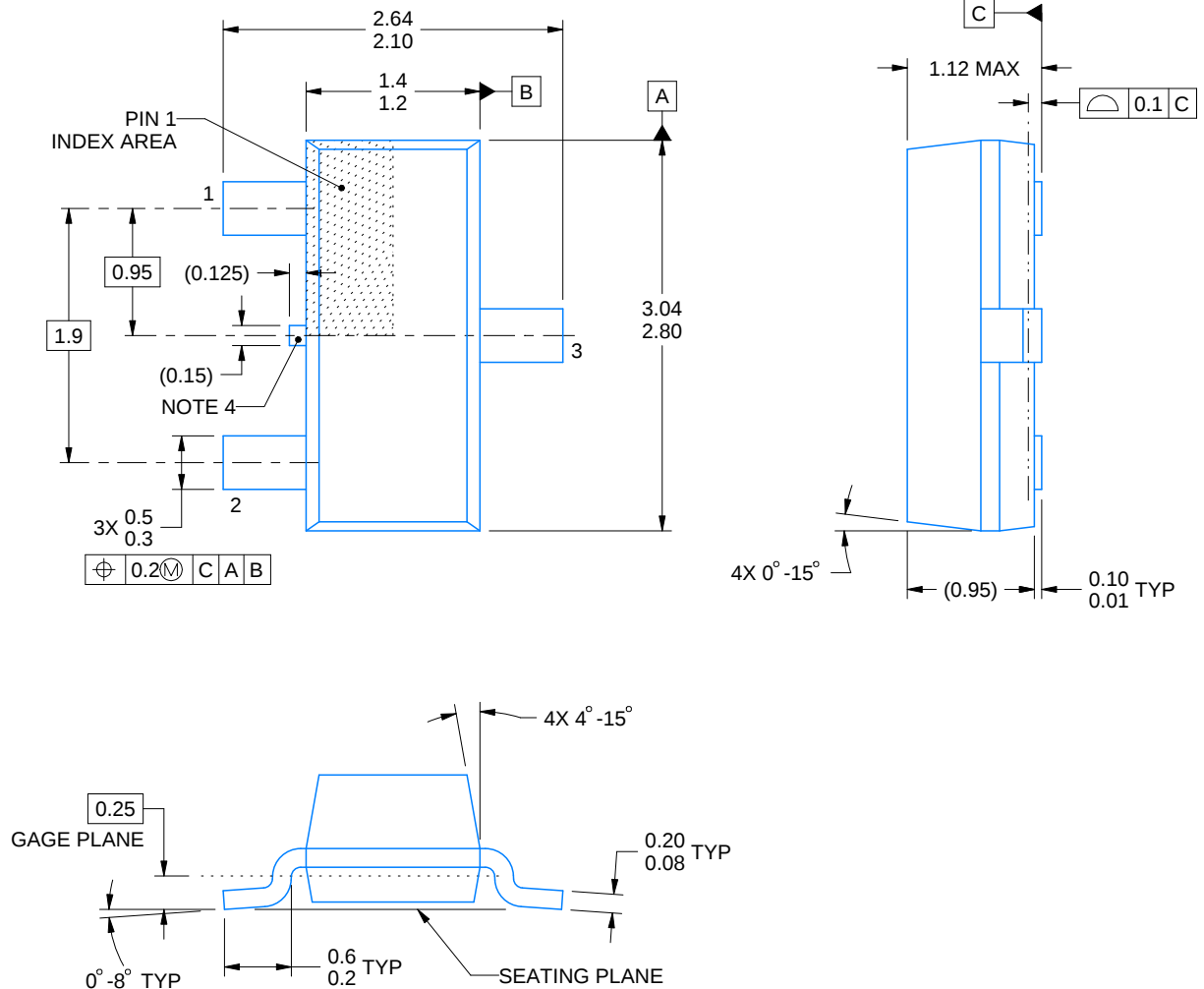
| Device          | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLVH431AIDCKT   | SC70         | DCK             | 6    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431AIPK     | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH431AIPK     | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TLVH431AQDBVR   | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TLVH431AQDBVT   | SOT-23       | DBV             | 5    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431AQDBVT   | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH431AQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH431AQDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH431AQDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 183.0       | 183.0      | 20.0        |
| TLVH431AQDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TLVH431AQDCKR   | SC70         | DCK             | 6    | 3000 | 200.0       | 183.0      | 25.0        |
| TLVH431AQDCKRG4 | SC70         | DCK             | 6    | 3000 | 200.0       | 183.0      | 25.0        |
| TLVH431AQDCKT   | SC70         | DCK             | 6    | 250  | 200.0       | 183.0      | 25.0        |
| TLVH431AQPCK    | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TLVH431AQPCK    | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH431BCDBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH431BCDBVT   | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH431BCDBVT   | SOT-23       | DBV             | 5    | 250  | 200.0       | 183.0      | 25.0        |
| TLVH431BCDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH431BCDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH431BCDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TLVH431BCDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 183.0       | 183.0      | 20.0        |
| TLVH431BCDCKR   | SC70         | DCK             | 6    | 3000 | 200.0       | 183.0      | 25.0        |
| TLVH431BCDCKT   | SC70         | DCK             | 6    | 250  | 200.0       | 183.0      | 25.0        |
| TLVH431BCPK     | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TLVH431BCPK     | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH431BIDBVR   | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TLVH431BIDBVT   | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH431BIDBVT   | SOT-23       | DBV             | 5    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431BIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH431BIDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TLVH431BIDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 183.0       | 183.0      | 20.0        |
| TLVH431BIDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH431BIDCKR   | SC70         | DCK             | 6    | 3000 | 200.0       | 183.0      | 25.0        |
| TLVH431BIDCKT   | SC70         | DCK             | 6    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431BIPK     | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH431BIPK     | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TLVH431BQDBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH431BQDBVT   | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH431BQDBVT   | SOT-23       | DBV             | 5    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431BQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH431BQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 183.0       | 183.0      | 20.0        |
| TLVH431BQDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 183.0       | 183.0      | 20.0        |

| Device          | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLVH431BQDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TLVH431BQDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH431BQDCKR   | SC70         | DCK             | 6    | 3000 | 200.0       | 183.0      | 25.0        |
| TLVH431BQDCKR   | SC70         | DCK             | 6    | 3000 | 210.0       | 185.0      | 35.0        |
| TLVH431BQDCKRG4 | SC70         | DCK             | 6    | 3000 | 200.0       | 183.0      | 25.0        |
| TLVH431BQDCKT   | SC70         | DCK             | 6    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431BQPK     | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH431BQPK     | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TLVH431CDBVR    | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TLVH431CDBVT    | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH431CDBVT    | SOT-23       | DBV             | 5    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431CDBZR    | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH431CDBZT    | SOT-23       | DBZ             | 3    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH431CDBZTG4  | SOT-23       | DBZ             | 3    | 250  | 183.0       | 183.0      | 20.0        |
| TLVH431CDBZTG4  | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TLVH431CDCKT    | SC70         | DCK             | 6    | 250  | 200.0       | 183.0      | 25.0        |
| TLVH431CPK      | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH431CPK      | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TLVH431IDBVR    | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TLVH431IDBVT    | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH431IDBVT    | SOT-23       | DBV             | 5    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431IDBZR    | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH431IDBZT    | SOT-23       | DBZ             | 3    | 250  | 180.0       | 180.0      | 18.0        |
| 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 | 190.0       | 190.0      | 30.0        |
| TLVH431IPK      | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH431QDBVR    | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TLVH431QDBVT    | SOT-23       | DBV             | 5    | 250  | 203.0       | 203.0      | 35.0        |
| TLVH431QDBVT    | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH431QDBZR    | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH431QDBZT    | SOT-23       | DBZ             | 3    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH431QDBZTG4  | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TLVH431QDBZTG4  | SOT-23       | DBZ             | 3    | 250  | 183.0       | 183.0      | 20.0        |
| TLVH431QDCKR    | SC70         | DCK             | 6    | 3000 | 200.0       | 183.0      | 25.0        |
| TLVH431QDCKRG4  | SC70         | DCK             | 6    | 3000 | 200.0       | 183.0      | 25.0        |
| TLVH431QDCKT    | SC70         | DCK             | 6    | 250  | 200.0       | 183.0      | 25.0        |
| TLVH431QPK      | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TLVH431QPK      | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH432ACDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH432ACDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 183.0       | 183.0      | 20.0        |
| TLVH432ACDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TLVH432ACDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0       | 180.0      | 18.0        |

| Device          | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLVH432AIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH432AIPK     | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TLVH432AIPK     | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH432AQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH432AQDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH432BCDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH432BCDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 183.0       | 183.0      | 20.0        |
| TLVH432BCDBZRG4 | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| TLVH432BCPK     | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH432BCPK     | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TLVH432BIDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH432BQDBZR   | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH432BQDBZT   | SOT-23       | DBZ             | 3    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH432BQDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 210.0       | 185.0      | 35.0        |
| TLVH432BQDBZTG4 | SOT-23       | DBZ             | 3    | 250  | 183.0       | 183.0      | 20.0        |
| TLVH432CDBZR    | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH432CDBZT    | SOT-23       | DBZ             | 3    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH432CPK      | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH432CPK      | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |
| TLVH432IDBZR    | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH432QDBZR    | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TLVH432QDBZT    | SOT-23       | DBZ             | 3    | 250  | 180.0       | 180.0      | 18.0        |
| TLVH432QPK      | SOT-89       | PK              | 3    | 1000 | 340.0       | 340.0      | 38.0        |
| TLVH432QPK      | SOT-89       | PK              | 3    | 1000 | 190.0       | 190.0      | 30.0        |

**DBZ0003A****PACKAGE OUTLINE****SOT-23 - 1.12 mm max height**

SMALL OUTLINE TRANSISTOR



4214838/F 08/2024

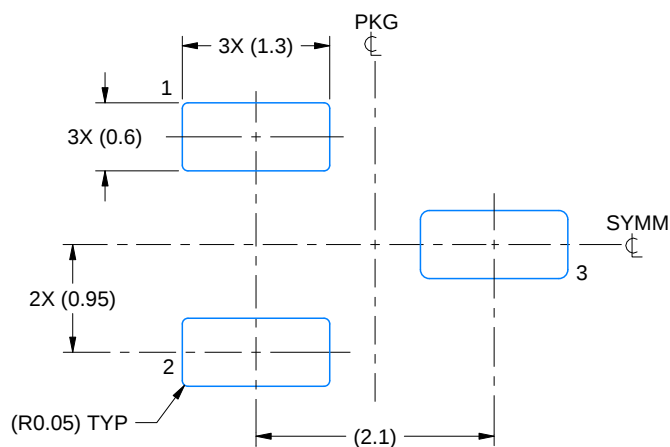
**NOTES:**

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC registration TO-236, except minimum foot length.
4. Support pin may differ or may not be present.
5. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25mm per side

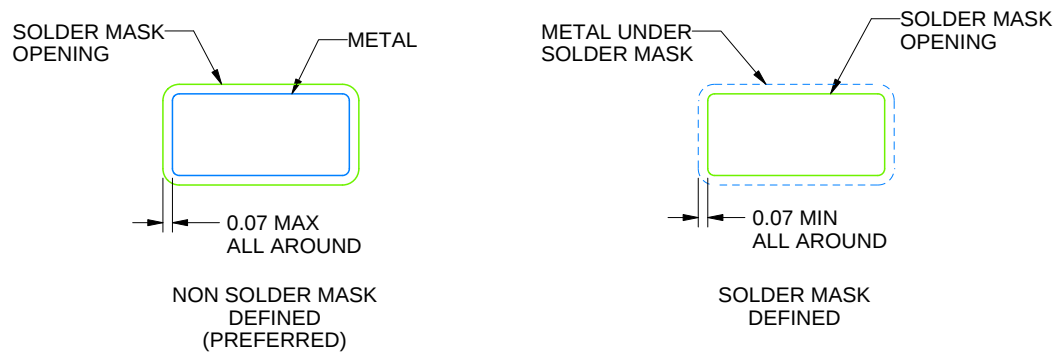
**DBZ0003A**

## SOT-23 - 1.12 mm max height

## SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
SCALE:15X



## SOLDER MASK DETAILS

4214838/F 08/2024

NOTES: (continued)

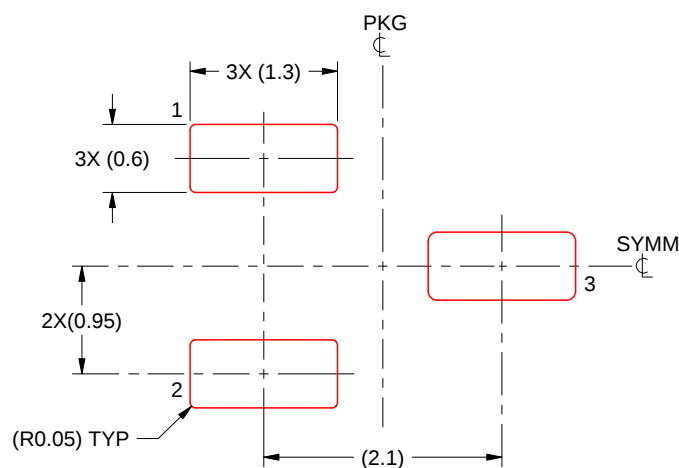
5. Publication IPC-7351 may have alternate designs.  
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DBZ0003A

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



SOLDER PASTE EXAMPLE  
BASED ON 0.125 THICK STENCIL  
SCALE:15X

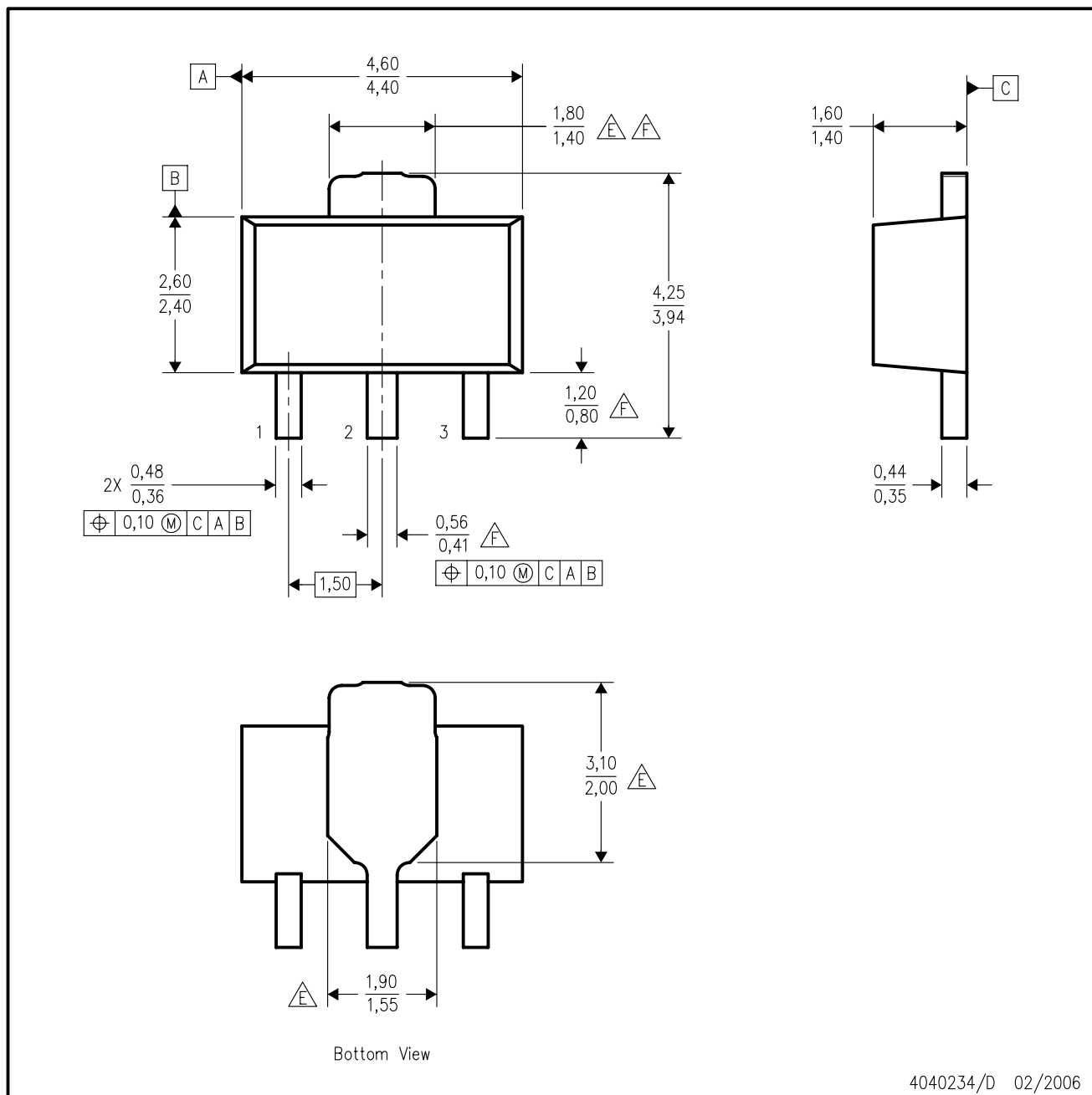
4214838/F 08/2024

NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.

PK (R-PSSO-F3)

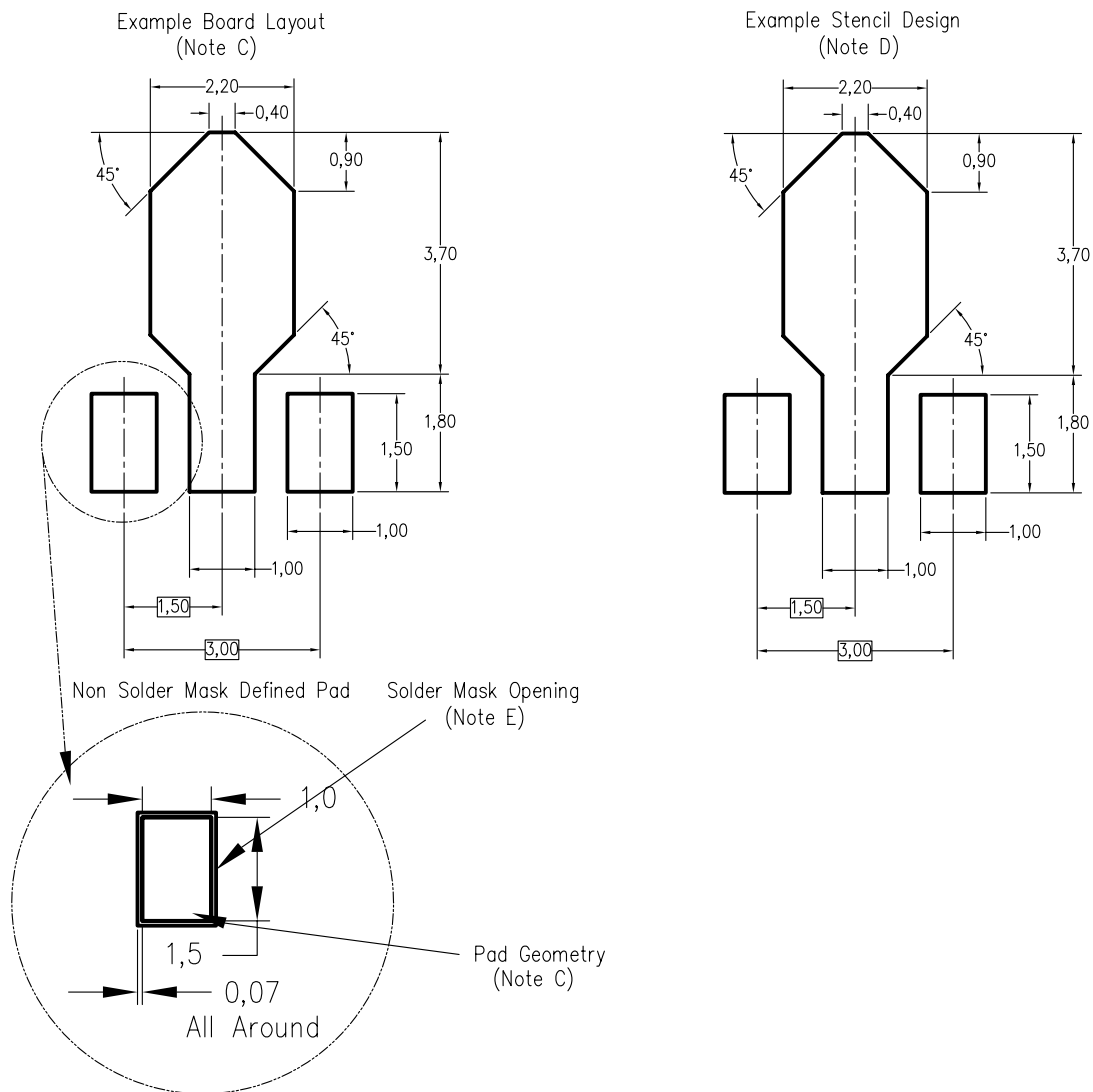
PLASTIC SINGLE-IN-LINE PACKAGE



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.
- (E) Thermal pad contour optional within these dimensions.
- (F) Falls within JEDEC TO-243 variation AA, except minimum lead length, pin 2 minimum lead width, minimum tab width.

# PK (R-PDSO-G3)



4208221/A 09/06

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



**TO-92 - 5.34 mm max height**

Technical drawing of a 12-pin connector showing two views: a side view on the left and a top view on the right.

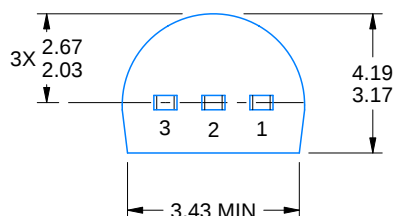
**Side View Dimensions:**

- Width:  $2 \times \frac{2.9}{2.4}$
- Height:  $2 \times 4 \text{ MAX}$
- Seating Plane: Indicated by a horizontal line.

**Top View Dimensions:**

- Body Width:  $5.21 / 4.44$
- Body Height:  $5.34 / 4.32$
- Pin Pitch:  $3 \times 12.7 \text{ MIN}$
- Pin Width:  $6 \times 0.076 \text{ MAX}$
- Pin Spacing:  $3 \times \frac{0.55}{0.38}$
- Pin Length:  $2 \times 1.27 \pm 0.13$
- Seating Plane: Indicated by a horizontal line.
- Optional Ejector Pin: Indicated by a circle.
- Note 3:  $(2.54)$
- Typical Dimensions:  $(1.5) \text{ TYP}$ ,  $(0.51) \text{ TYP}$

### STRAIGHT LEAD OPTION



NOTES:

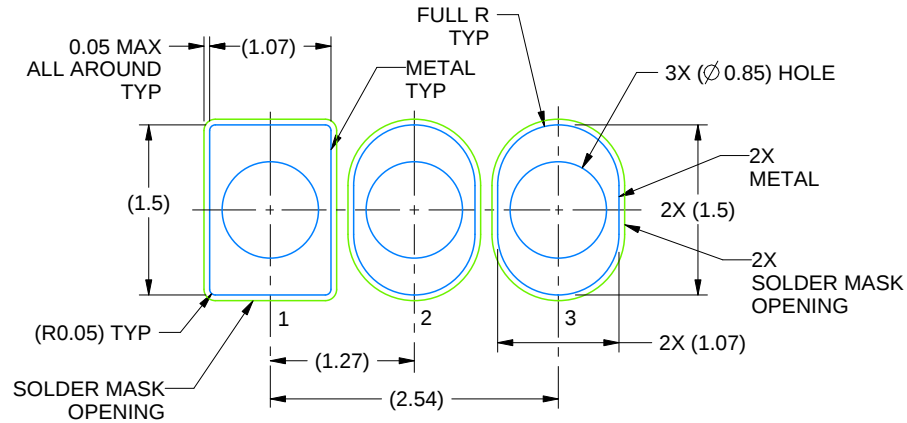
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Lead dimensions are not controlled within this area.
4. Reference JEDEC TO-226, variation AA.
5. Shipping method:
  - a. Straight lead option available in bulk pack only.
  - b. Formed lead option available in tape and reel or ammo pack.
  - c. Specific products can be offered in limited combinations of shipping medium and lead options.
  - d. Consult product folder for more information on available options.

# EXAMPLE BOARD LAYOUT

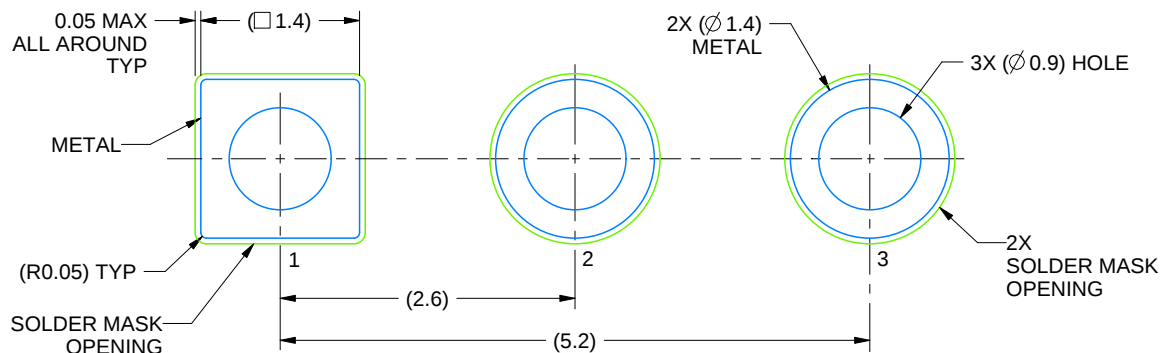
LP0003A

TO-92 - 5.34 mm max height

TO-92



LAND PATTERN EXAMPLE  
STRAIGHT LEAD OPTION  
NON-SOLDER MASK DEFINED  
SCALE:15X



LAND PATTERN EXAMPLE  
FORMED LEAD OPTION  
NON-SOLDER MASK DEFINED  
SCALE:15X

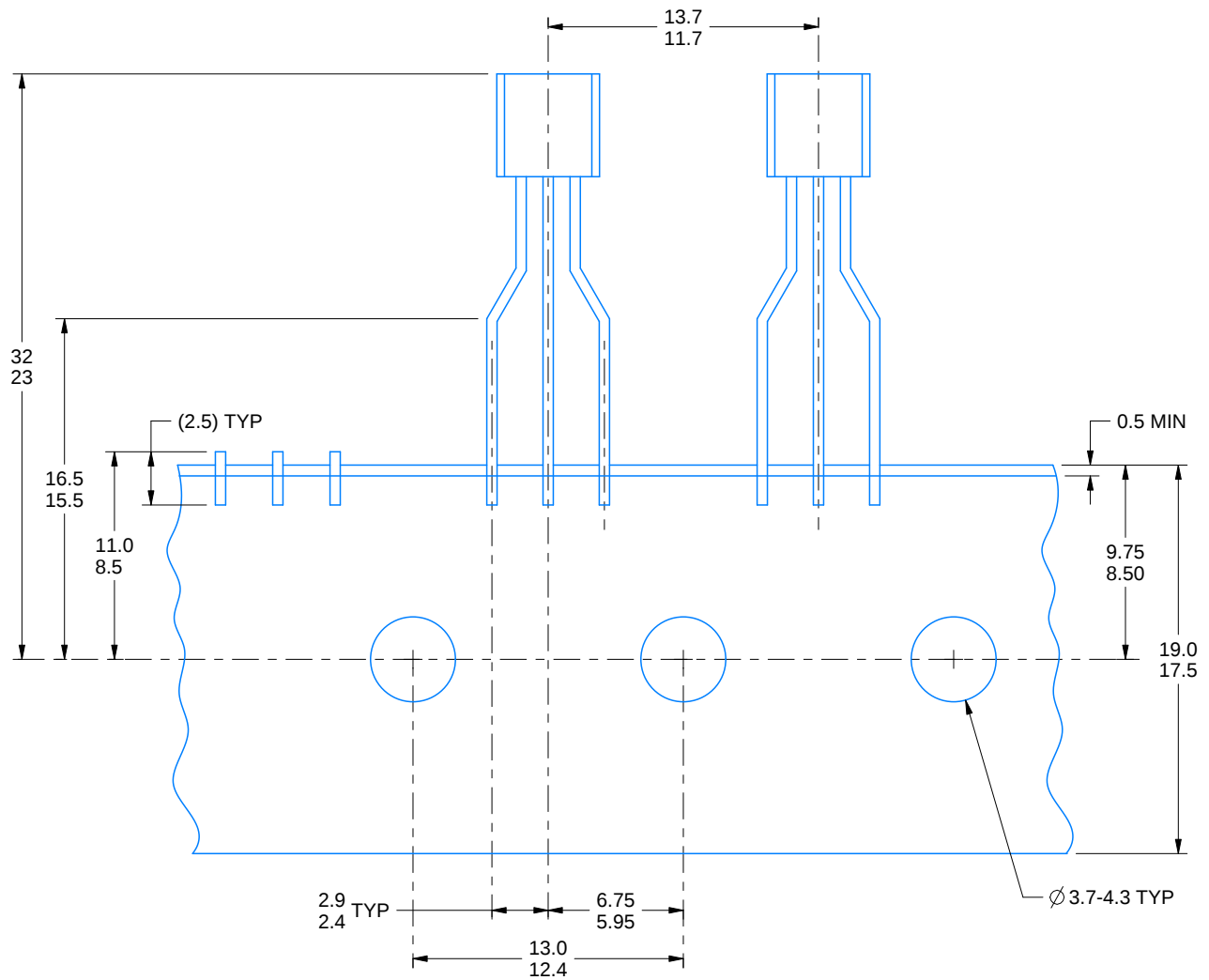
4215214/C 04/2025

# TAPE SPECIFICATIONS

LP0003A

TO-92 - 5.34 mm max height

TO-92



FOR FORMED LEAD OPTION PACKAGE

4215214/C 04/2025



# EXAMPLE BOARD LAYOUT

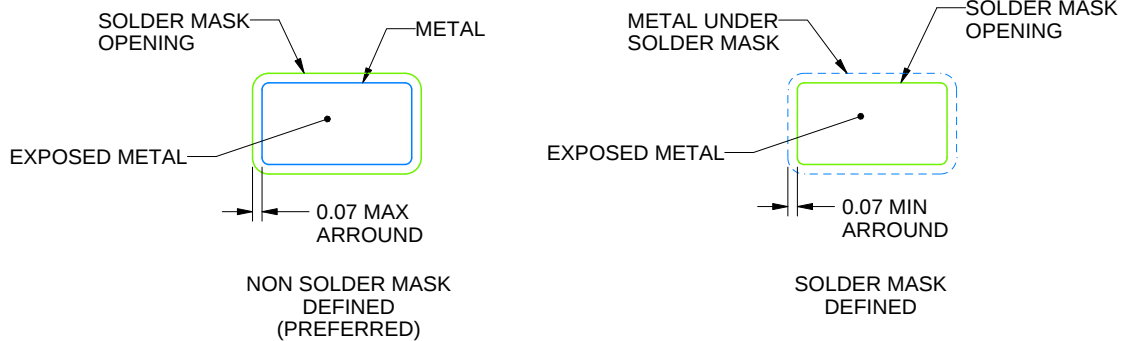
DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:15X



SOLDER MASK DETAILS

4214839/K 08/2024

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR

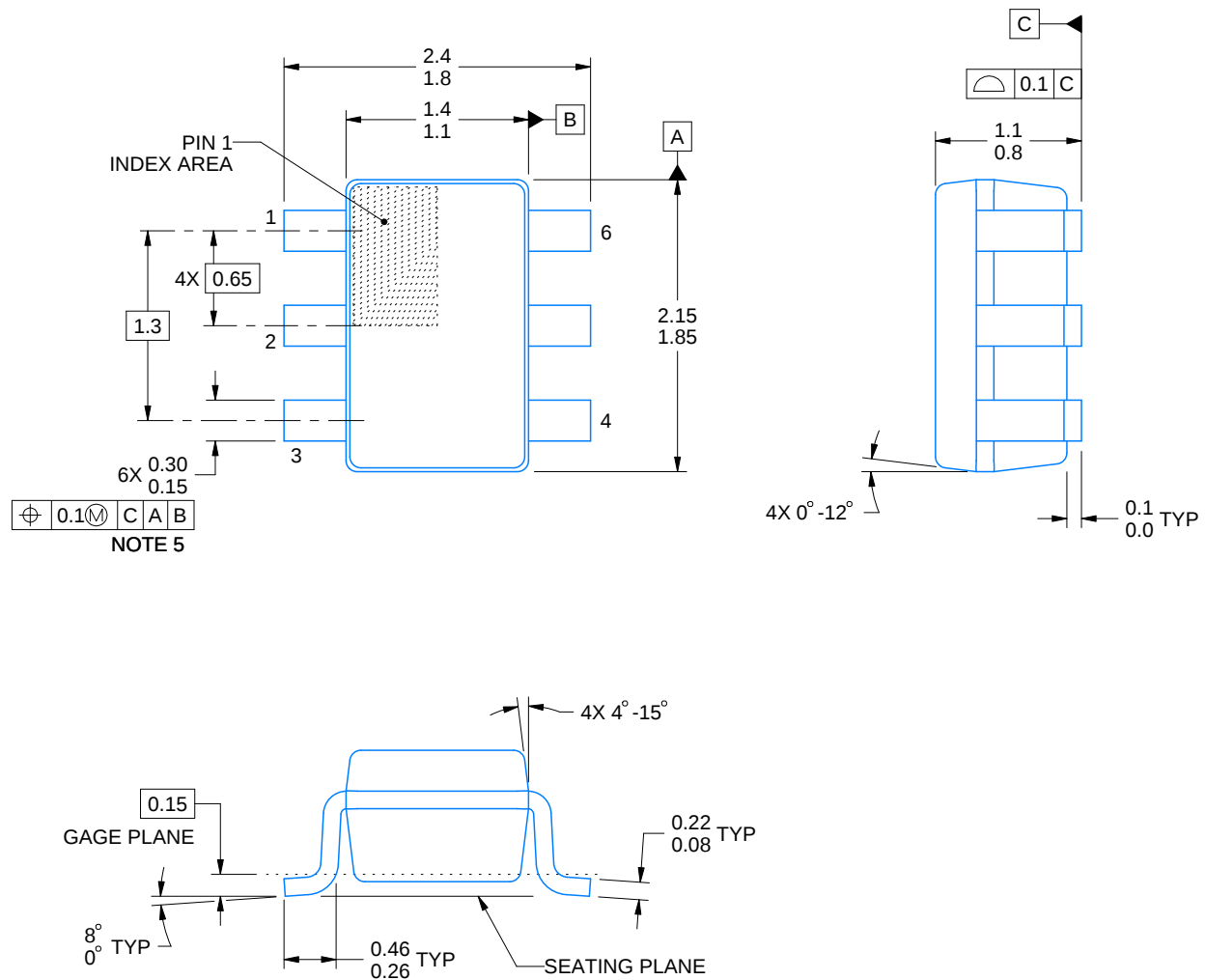


SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:15X

4214839/K 08/2024

NOTES: (continued)

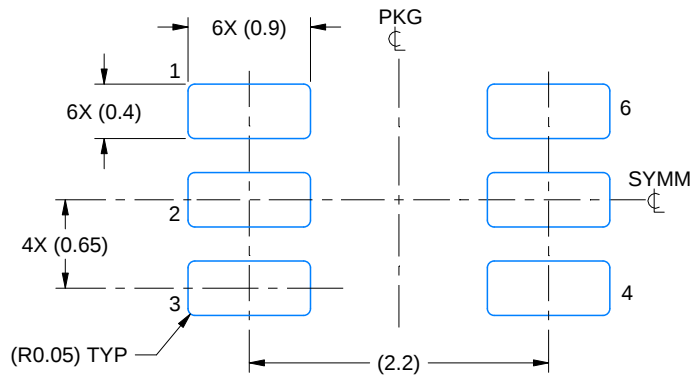
8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.



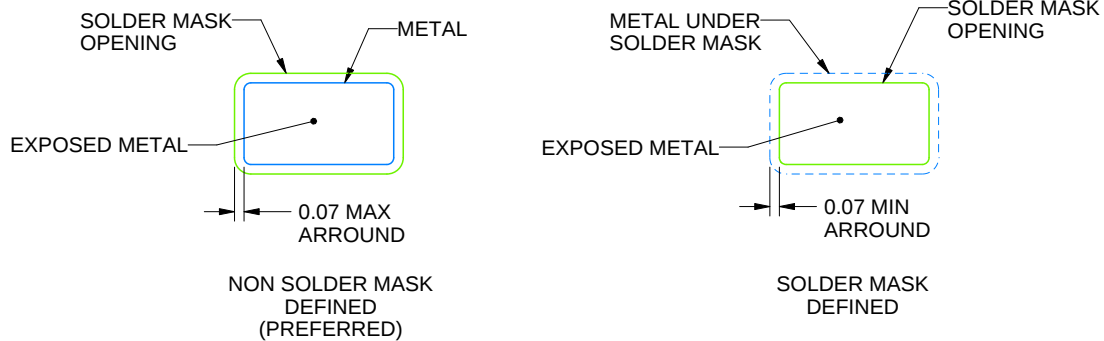
4214835/D 11/2024

## NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
4. Falls within JEDEC MO-203 variation AB.



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:18X

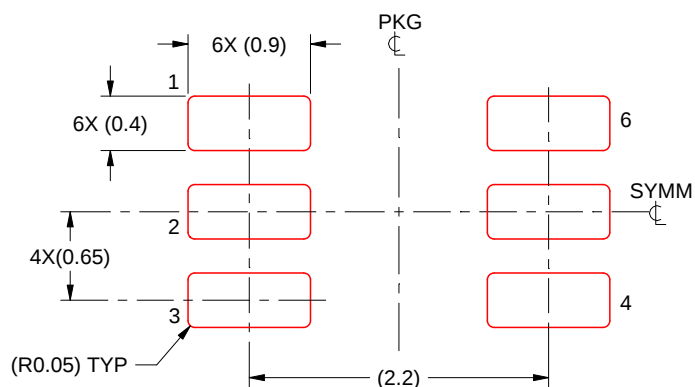


SOLDER MASK DETAILS

4214835/D 11/2024

NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOLDER PASTE EXAMPLE  
 BASED ON 0.125 THICK STENCIL  
 SCALE:18X

4214835/D 11/2024

NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.

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