



THE DATASHEET OF TLVH431BILPR



TLVH431, TLVH432 Low-Voltage Adjustable Precision Shunt Regulators

1 Features

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

2 Applications

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

3 Description

The TLVH431 and TLVH432 devices are low-voltage 3-terminal adjustable voltage references, with specified thermal stability over applicable industrial and commercial temperature ranges. Output voltage can be set to any value between V_{REF} (1.24 V) and 18 V with two external resistors (see Figure 19). These devices operate from a lower voltage (1.24 V) than the widely used TL431 and TL1431 shunt-regulator references.

When used with an optocoupler, the TLVH431 and TLVH432 devices are ideal voltage references in isolated feedback circuits for 3-V to 3.3-V switching-mode power supplies. They have a typical output impedance of 0.25 Ω . 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⁽¹⁾

| PART NUMBER | PACKAGE | BODY SIZE (NOM) |
|-------------|------------|-------------------|
| TLVH43xxDBZ | SOT-23 (5) | 2.90 mm x 1.60 mm |
| TLVH43xxDBZ | SOT-23 (3) | 2.92 mm x 1.30 mm |
| TLVH43xxDCK | SC70 (6) | 2.00 mm x 1.25 mm |
| TLVH43xxLP | TO-92 (3) | 4.30 mm x 4.30 mm |
| TLVH43xxPK | SOT-89 (3) | 4.50 mm x 2.50 mm |

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

Simplified Schematic



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4 Revision History

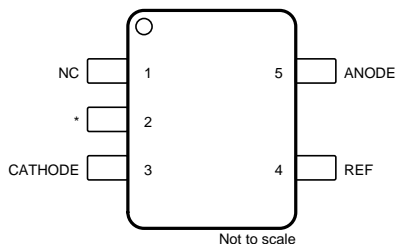
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| Changes from Revision J (January 2015) to Revision K | Page |
|---|-------------|
| • Changed data sheet title..... | 1 |
| • Updated pinout images and <i>Pin Functions</i> table..... | 3 |
| • Deleted D package from <i>Pin Functions</i> table | 3 |
| • Added <i>Receiving Notification of Documentation Updates</i> section and <i>Community Resources</i> section | 25 |

| Changes from Revision I (September 2009) to Revision J | Page |
|--|-------------|
| • Added <i>Applications</i> , <i>Device Information</i> table, <i>Pin Functions</i> table, <i>ESD Ratings</i> table, <i>Thermal Information</i> table, <i>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. | 1 |
| • Deleted <i>Ordering Information</i> table. | 1 |

5 Pin Configuration and Functions

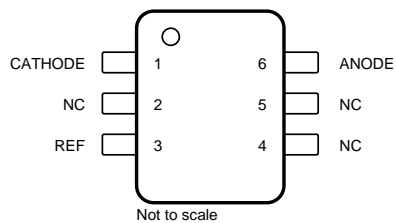
**TLVH431 DBV Package
5-Pin SOT-23
Top View**



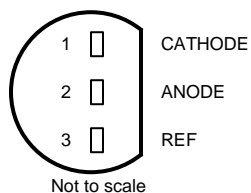
NC – No internal connection

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

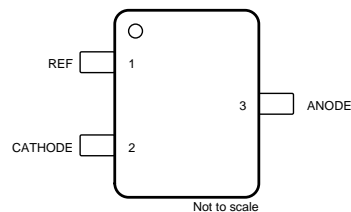
**TLVH431 DCK Package
6-Pin SC70
Top View**



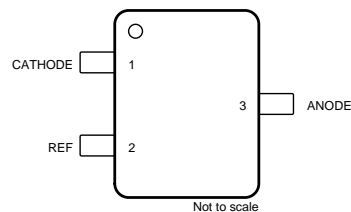
**TLVH431 LP Package
3-Pin TO-92
Top View**



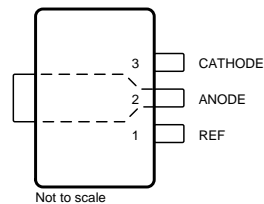
**TLVH431 DBZ Package
3-Pin SOT-23
Top View**



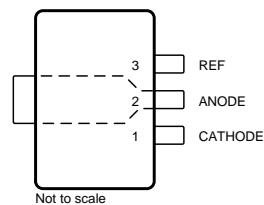
**TLVH432 DBZ Package
3-Pin SOT-23
Top View**



**TLVH431 PK Package
3-Pin SOT-89
Top View**



**TLVH432 PK Package
3-Pin SOT-89
Top View**



Pin Functions

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

6 Specifications

6.1 Absolute Maximum Ratings

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

| | | MIN | MAX | UNIT |
|------------------|--|-------|-----|------|
| V _{KA} | Cathode voltage ⁽²⁾ | | 20 | V |
| I _K | Cathode current | –25 | 80 | mA |
| I _{ref} | Reference current | –0.05 | 3 | mA |
| T _J | Operating virtual junction temperature | | 150 | °C |
| T _{stg} | 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.

6.2 ESD Ratings

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

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

6.3 Recommended Operating Conditions

See⁽¹⁾

| | | | MIN | MAX | UNIT |
|-----------------|--------------------------------|-----------|------------------|-----|------|
| V _{KA} | Cathode voltage | | V _{REF} | 18 | V |
| I _K | Cathode current (continuous) | | 0.1 | 70 | mA |
| T _A | Operating free-air temperature | TLVH43x_C | 0 | 70 | °C |
| | | TLVH43x_I | –40 | 85 | |
| | | TLVH43x_Q | –40 | 125 | |

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

6.4 Thermal Information

| THERMAL METRIC ⁽¹⁾ | TLVH43xx | | | | | UNIT | |
|-------------------------------|---|-------------|--------------|--------------|------------|------|------|
| | DCK (SC70) | PK (SOT-89) | DBV (SOT-23) | DBZ (SOT-23) | LP (TO-92) | | |
| | 6 PINS | 3 PINS | 5 PINS | 3 PINS | 3 PINS | | |
| R _{θJA} | Junction-to-ambient thermal resistance | 87 | 52 | 206 | 206 | 140 | °C/W |
| R _{θJC(top)} | Junction-to-case (top) thermal resistance | 259 | 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.

6.5 TLVH43x Electrical Characteristics

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

| PARAMETER | TEST CONDITIONS | | TLVH431 TLVH432 | | | UNIT |
|---|--|--|--------------------|-------|-------|------|
| | | | MIN | TYP | MAX | |
| V _{REF} Reference voltage | V _{KA} = V _{REF} , I _K = 10 mA | T _A = 25°C | 1.222 | 1.24 | 1.258 | V |
| | | T _A = full range, See Figure 18 ⁽¹⁾ | TLVH431C | 1.21 | 1.27 | |
| | | | TLVH431I | 1.202 | 1.278 | |
| V _{REF(dev)} V _{REF} deviation over full temperature range ⁽²⁾ | V _{KA} = V _{REF} , I _K = 10 mA, See Figure 18 ⁽¹⁾ | 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 mA, V _K = V _{REF} to 18 V, See Figure 19 | | | -1.5 | -2.7 | mV/V |
| I _{ref} Reference terminal current | I _K = 10 mA, R1 = 10 kΩ, R2 = open, See Figure 19 | | | 0.1 | 0.5 | μA |
| I _{ref(dev)} I _{ref} deviation over full temperature range ⁽²⁾ | I _K = 10 mA, R1 = 10 kΩ, R2 = open, See Figure 19 ⁽¹⁾ | TLVH431C | | 0.05 | 0.3 | μA |
| | | TLVH431I | | 0.1 | 0.4 | |
| | | TLVH431Q | | 0.15 | 0.5 | |
| I _{K(min)} Minimum cathode current for regulation | V _{KA} = V _{REF} , See Figure 18 | | | 60 | 100 | μA |
| I _{K(off)} Off-state cathode current | V _{REF} = 0, V _{KA} = 18 V, See Figure 20 | | | 0.02 | 0.1 | μA |
| z _{KA} Dynamic impedance ⁽³⁾ | V _{KA} = V _{REF} , f ≤ 1 kHz, I _K = 0.1 mA to 70 mA, See Figure 18 | | | 0.25 | 0.4 | Ω |

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

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

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

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

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

(3) The dynamic impedance is defined as:

$$|z_{ka}| = \frac{\Delta V_{KA}}{\Delta I_K}$$

When the device is operating with two external resistors (see Figure 19), the total dynamic impedance of the circuit is defined as:

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

6.6 TLVH43xA Electrical Characteristics

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

| PARAMETER | TEST CONDITIONS | | TLVH431A TLVH432A | | | UNIT |
|---|--|--|----------------------|-------|-------|------|
| | | | MIN | TYP | MAX | |
| V _{REF} Reference voltage | V _{KA} = V _{REF} , I _K = 10 mA | T _A = 25°C | 1.228 | 1.24 | 1.252 | V |
| | | T _A = full range, See Figure 18 ⁽¹⁾ | TLVH431AC | 1.221 | 1.259 | |
| | | | TLVH431AI | 1.215 | 1.265 | |
| V _{REF(dev)} V _{REF} deviation over full temperature range ⁽²⁾ | V _{KA} = V _{REF} , I _K = 10 mA, See Figure 18 ⁽¹⁾ | 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 18 V, I _K = 10 mA, See Figure 19 | | | -1.5 | -2.7 | mV/V |
| I _{ref} Reference terminal current | I _K = 10 mA, R1 = 10 kΩ, R2 = open, See Figure 19 | | | 0.1 | 0.5 | μA |
| I _{ref(dev)} I _{ref} deviation over full temperature range ⁽²⁾ | I _K = 10 mA, R1 = 10 kΩ, R2 = open, See Figure 19 ⁽¹⁾ | TLVH431AC | | 0.05 | 0.3 | μA |
| | | TLVH431AI | | 0.1 | 0.4 | |
| | | TLVH431AQ | | 0.15 | 0.5 | |
| I _{K(min)} Minimum cathode current for regulation | V _{KA} = V _{REF} , See Figure 18 | | | 60 | 100 | μA |
| I _{K(off)} Off-state cathode current | V _{REF} = 0, V _{KA} = 18 V, See Figure 20 | | | 0.02 | 0.1 | μA |
| z _{KA} Dynamic impedance ⁽³⁾ | V _{KA} = V _{REF} , f ≤ 1 kHz, I _K = 0.1 mA to 70 mA, See Figure 18 | | | 0.25 | 0.4 | Ω |

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

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

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

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

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

(3) The dynamic impedance is defined as:

$$|z_{ka}| = \frac{\Delta V_{KA}}{\Delta I_K}$$

When the device is operating with two external resistors (see Figure 19), the total dynamic impedance of the circuit is defined as:

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

6.7 TLVH43xB Electrical Characteristics

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

| PARAMETER | TEST CONDITIONS | | TLVH431B TLVH432B | | | UNIT |
|---|---|--|----------------------|-------|-------|------|
| | | | MIN | TYP | MAX | |
| V _{REF} Reference voltage | V _{KA} = V _{REF} , I _K = 10 mA | T _A = 25°C | 1.234 | 1.24 | 1.246 | V |
| | | T _A = full range, See Figure 18 ⁽¹⁾ | TLVH431BC | 1.227 | 1.253 | |
| | | | TLVH431BI | 1.224 | 1.259 | |
| V _{REF(dev)} V _{REF} deviation over full temperature range ⁽²⁾ | V _{KA} = V _{REF} , I _K = 10 mA, See Figure 18 ⁽¹⁾ | TLVH431BC | | 4 | 12 | mV |
| | | TLVH431BI | | 6 | 20 | |
| | | TLVH431BQ | | 11 | 31 | |
| $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ Ratio of V _{REF} change to cathode voltage change | I _K = 10 mA, V _K = V _{REF} to 18 V, See Figure 19 | | | -1.5 | -2.7 | mV/V |
| I _{ref} Reference terminal current | I _K = 10 mA, R1 = 10 kΩ, R2 = open, See Figure 19 | | | 0.1 | 0.5 | μA |
| I _{ref(dev)} I _{ref} deviation over full temperature range ⁽²⁾ | I _K = 10 mA, R1 = 10 kΩ, R2 = open, See Figure 19 ⁽¹⁾ | TLVH431BC | | 0.05 | 0.3 | μA |
| | | TLVH431BI | | 0.1 | 0.4 | |
| | | TLVH431BQ | | 0.15 | 0.5 | |
| I _{K(min)} Minimum cathode current for regulation | V _{KA} = V _{REF} , See Figure 18 | | | 60 | 100 | μA |
| I _{K(off)} Off-state cathode current | V _{REF} = 0, V _{KA} = 18 V, See Figure 20 | | | 0.02 | 0.1 | μA |
| z _{KA} Dynamic impedance ⁽³⁾ | V _{KA} = V _{REF} , f ≤ 1 kHz, I _K = 0.1 mA to 70 mA, See Figure 18 | | | 0.25 | 0.4 | Ω |

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

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

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

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

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

(3) The dynamic impedance is defined as:

$$|z_{ka}| = \frac{\Delta V_{KA}}{\Delta I_K}$$

When the device is operating with two external resistors (see Figure 19), the total dynamic impedance of the circuit is defined as:

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

6.8 Typical Characteristics

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



Figure 1. Reference Voltage vs Junction Temperature



Figure 2. Reference Input Current vs Junction Temperature



Figure 3. Cathode Current vs Cathode Voltage



Figure 4. Cathode Current vs Cathode Voltage

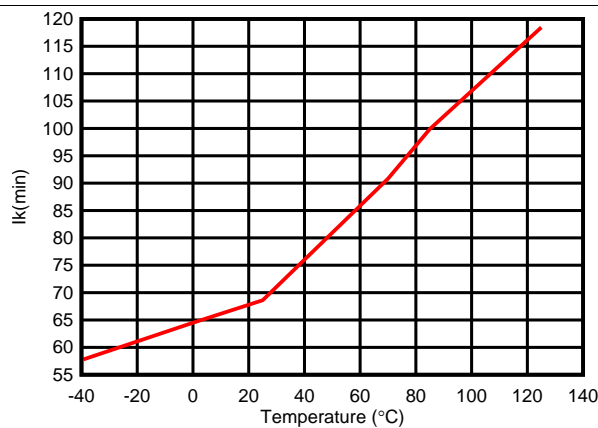


Figure 5. Minimum Cathode Current vs. Temperature

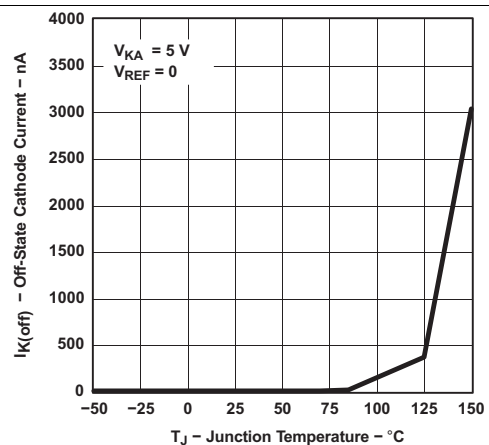
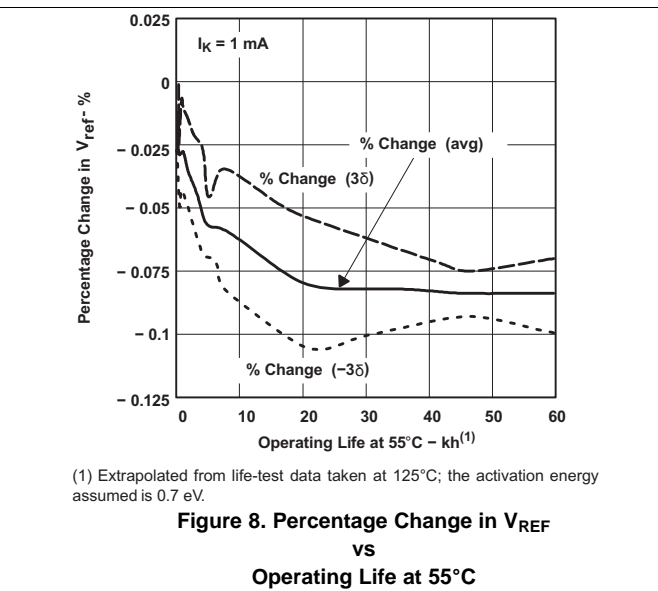
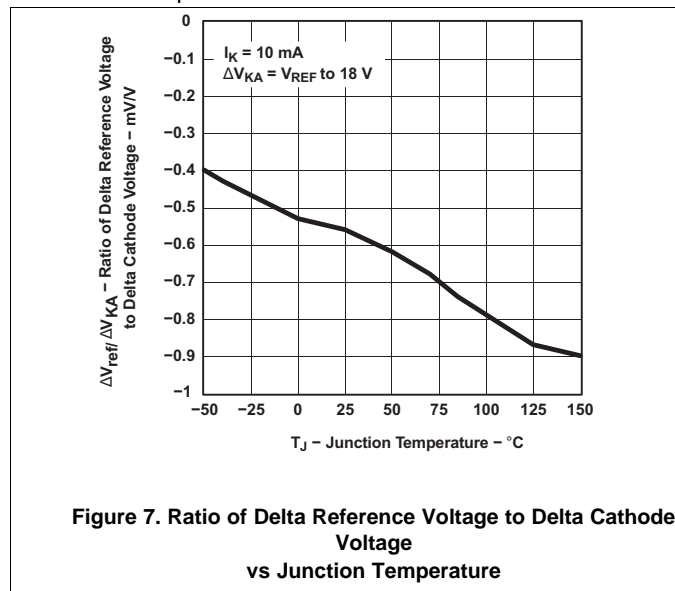


Figure 6. Off-State Cathode Current vs Junction Temperature

Typical Characteristics (continued)

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



EQUIVALENT INPUT NOISE VOLTAGE vs FREQUENCY

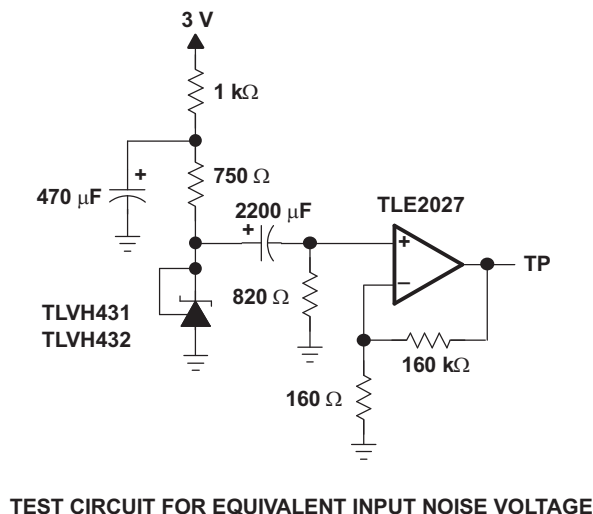
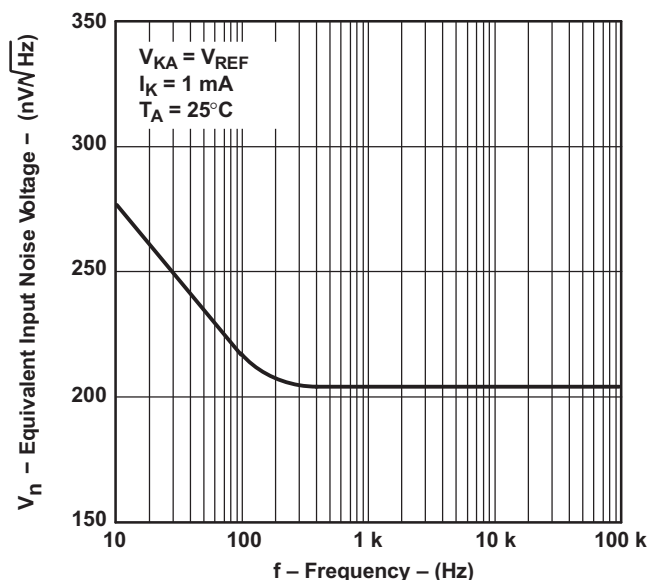


Figure 9. Equivalent Input Noise Voltage

Typical Characteristics (continued)

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

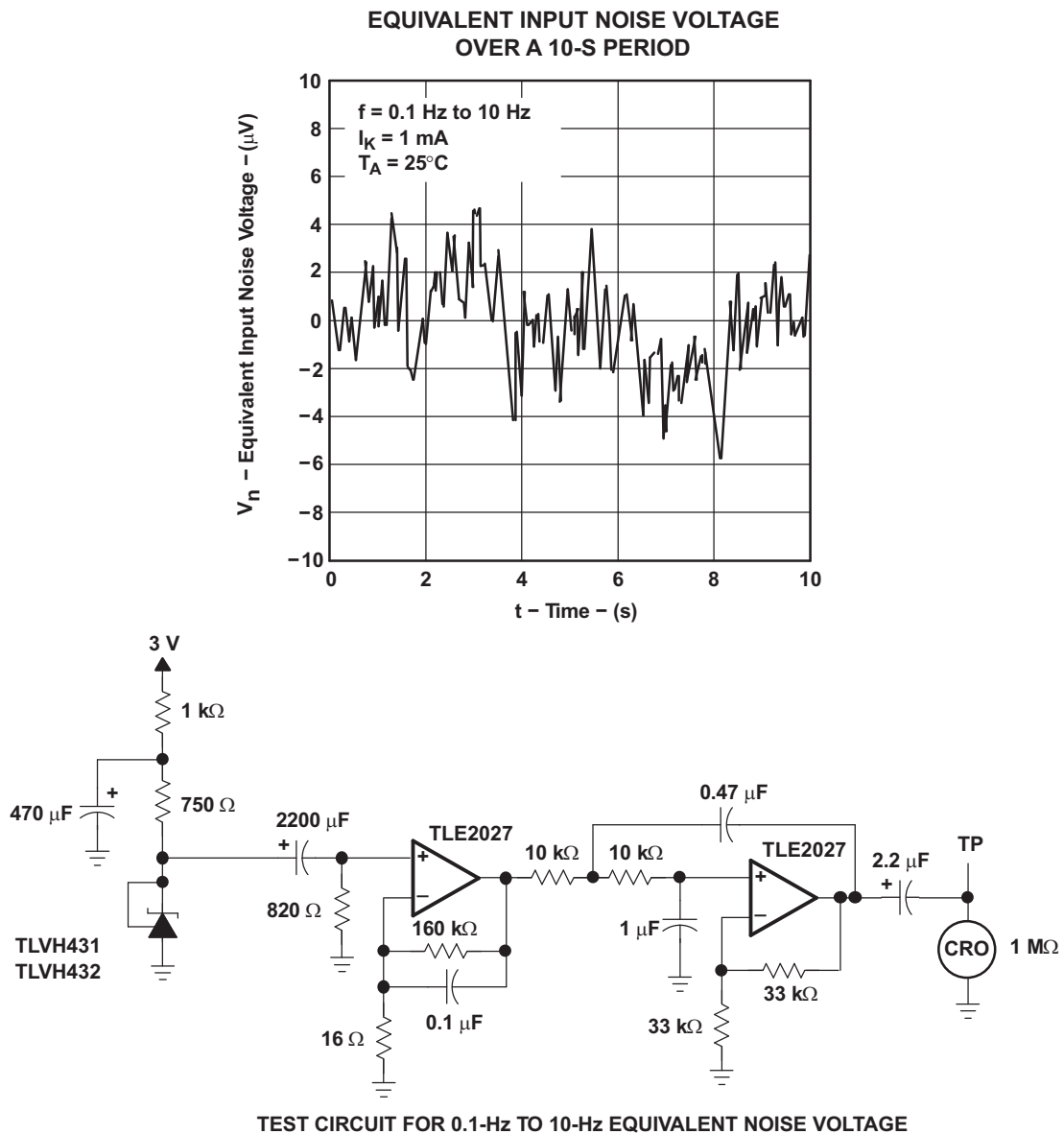


Figure 10. Equivalent Input Noise Voltage

Typical Characteristics (continued)

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



Figure 11. Voltage Gain and Phase Margin



Figure 12. Pulse Response 1

Typical Characteristics (continued)

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

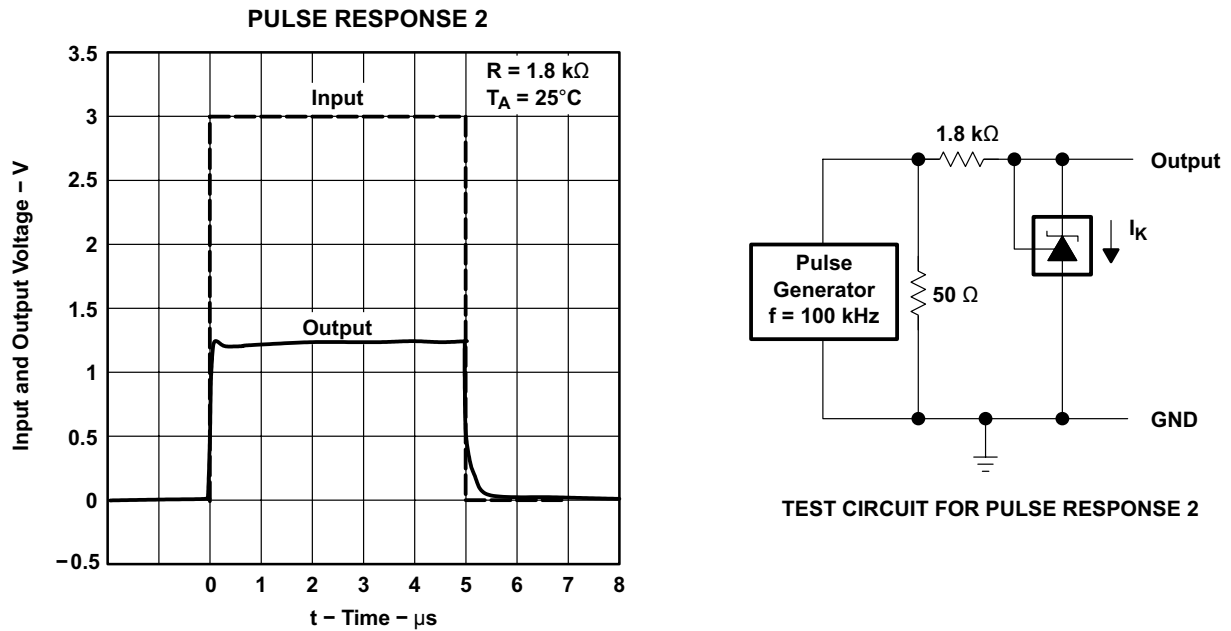


Figure 13. Pulse Response 2



Figure 14. Phase Margin Test Circuit

Typical Characteristics (continued)

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



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

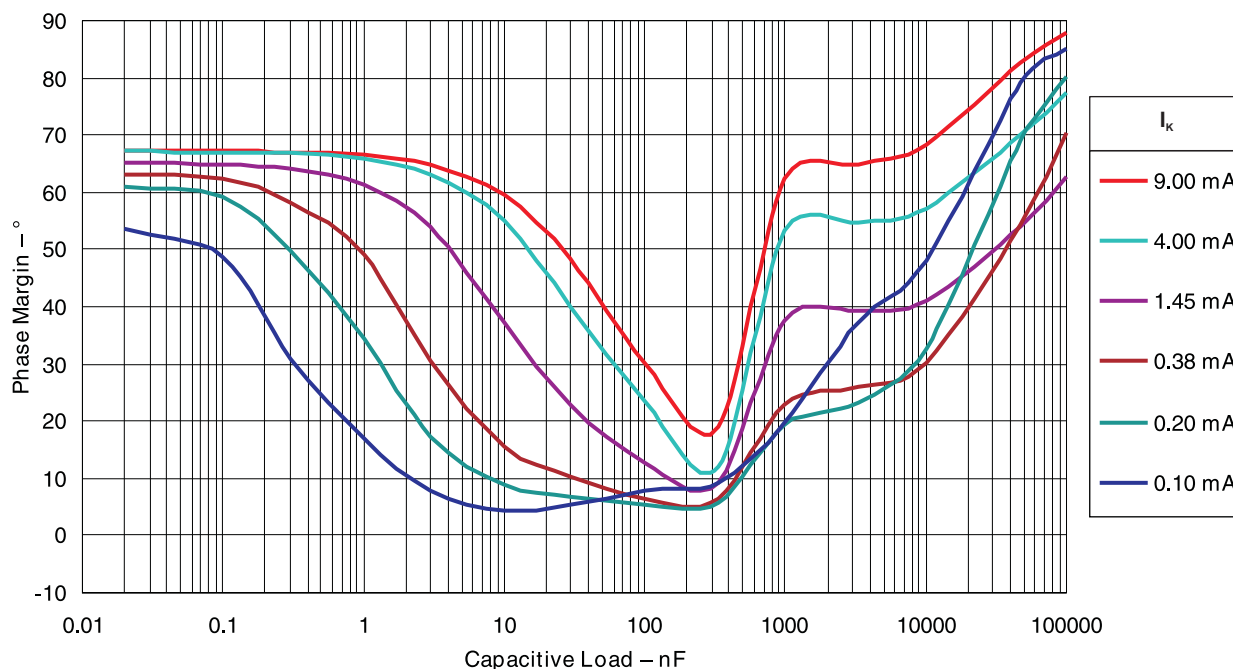


Figure 16. Phase Margin vs Capacitive Load
 $V_{KA} = 2.50 V, T_A = 25^\circ C$

Typical Characteristics (continued)

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



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

7 Parameter Measurement Information



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



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



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

8 Detailed Description

8.1 Overview

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

TLVH431 is also a higher voltage counterpart to TLV431, with cathode voltage adjustability from 1.24 V to 18 V, making this part optimum for a wide range of end equipments in industrial, auto, telecom and computing. In order for this device to behave as a shunt regulator or error amplifier, $>100 \mu\text{A}$ ($I_{\min(\max)}$) must be supplied in to the cathode pin. Under this condition, feedback can be applied from the Cathode and Ref pins to create a replica of the internal reference voltage.

Various reference voltage options can be purchased with initial tolerances (at 25°C) of 0.5%, 1%, and 1.5%. These reference options are denoted by B (0.5%), A (1.0%) and blank (1.5%) after the TLVH431.

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

8.2 Functional Block Diagram

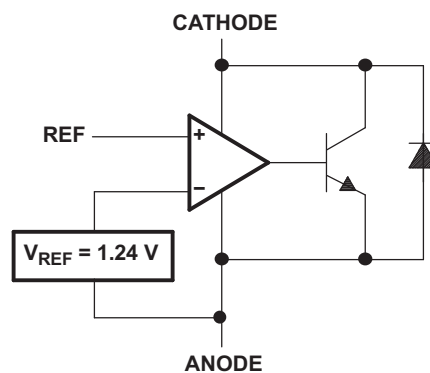


Figure 21. Equivalent Schematic

Functional Block Diagram (continued)

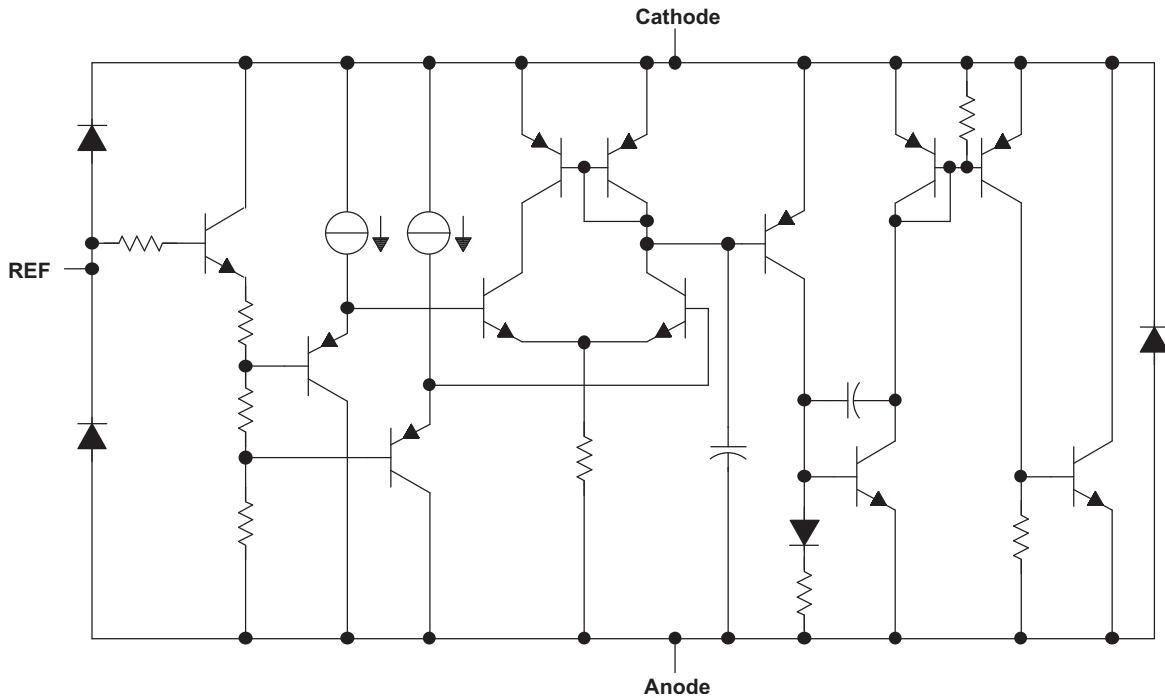


Figure 22. Detailed Schematic

8.3 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 (≥ 1.24 V) and cathode current (I_{ka}), TLVH431 forces the reference pin to 1.24 V. However, the reference pin can not be left floating, as it needs $I_{ref} \geq 0.5$ μ A (see [Specifications](#)). 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 in order for it to be in the proper linear region giving TLVH431 enough gain.

Unlike many linear regulators, TLVH431 is internally compensated to be stable without an output capacitor between the cathode and anode. However, if it is desired to use an output capacitor [Figure 15](#), [Figure 16](#), and [Figure 17](#) can be used as a guide to assist in choosing the correct capacitor to maintain stability.

8.4 Device Functional Modes

8.4.1 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 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.

8.4.2 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.

9 Applications and Implementation

NOTE

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

9.1 Application Information

Figure 23 shows the TLVH431, TLVH431A, or TLVH431B used in a 3.3-V isolated flyback supply. Output voltage V_O can be as low as reference voltage V_{REF} ($1.24\text{ V} \pm 1\%$). The output of the regulator, plus the forward voltage drop of the optocoupler LED ($1.24 + 1.4 = 2.64\text{ V}$), determine the minimum voltage that can be regulated in an isolated supply configuration. Regulated voltage as low as 2.7 Vdc is possible in the topology shown in Figure 23.

The 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](#).

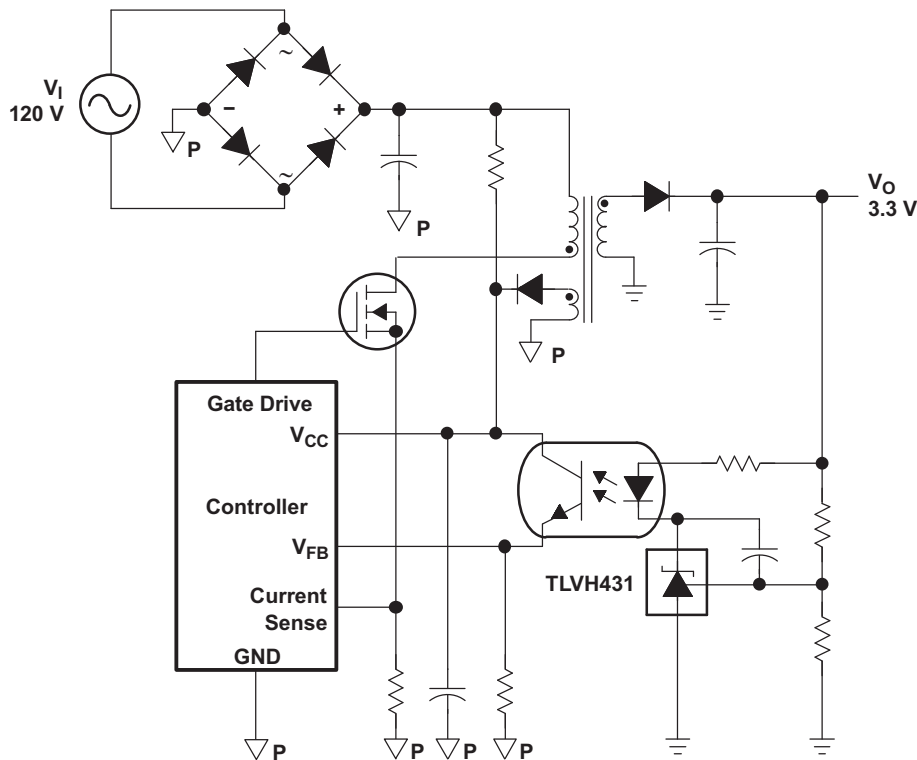


Figure 23. Flyback With Isolation Using TLVH431 or TLVH432 as Voltage Reference and Error Amplifier

9.2 Typical Applications

9.2.1 Comparator With Integrated Reference (Open Loop)



Figure 24. Comparator Application Schematic

9.2.1.1 Design Requirements

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

Table 1. Design Parameters

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

9.2.1.2 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

9.2.1.2.1 Basic Operation

In the configuration shown in [Figure 24](#), TLVH431 behaves as a comparator, comparing the V_{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_{min}) being 100 μ A and up to 150 μ A over temperature, operation below that could result in low gain, leading to a slow response.

9.2.1.2.2 Overdrive

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

The more overdrive voltage provided, the faster the TLVH431 will respond. See figures [Figure 25](#) and [Figure 26](#), 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_{ref} should suffice.

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

9.2.1.2.3 Output Voltage and Logic Input Level

In order for TLVH431 to properly be used as a comparator, the logic output must be readable by the receiving logic device. This is accomplished by knowing the input high and low level threshold voltage levels, typically denoted by V_{IH} and V_{IL} .

As shown in [Figure 25](#) and [Figure 26](#), TLVH431's output low level voltage in open-loop/comparator mode is approximately 1 V, which is sufficient for some 3.3 V supplied logic. However, would not work for 2.5 V and 1.8 V supplied logic. To accommodate this a resistive divider can be tied to the output to attenuate the output voltage to a voltage legible to the receiving low voltage logic device.

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

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

9.2.1.2.3.1 Input Resistance

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

9.2.1.3 Application Curves



9.2.2 Shunt Regulator/Reference



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Figure 27. Shunt Regulator Schematic

9.2.2.1 Design Requirements

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

Table 2. Design Parameters

| DESIGN PARAMETER | EXAMPLE VALUE |
|---|---------------|
| Reference Initial Accuracy | 1.0% |
| Supply Voltage | 6 V |
| Cathode Current (I _k) | 500 μA |
| Output Voltage Level | 1.24 V - 18 V |
| Load Capacitance | 100 nF |
| Feedback Resistor Values and Accuracy (R1 and R2) | 10 kΩ |

9.2.2.2 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

9.2.2.2.1 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 27](#), 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 27](#). 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_{min} spec denoted in [Specifications](#).

9.2.2.2.2 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.

9.2.2.2.3 Stability

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

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

9.2.2.3 Application Curve

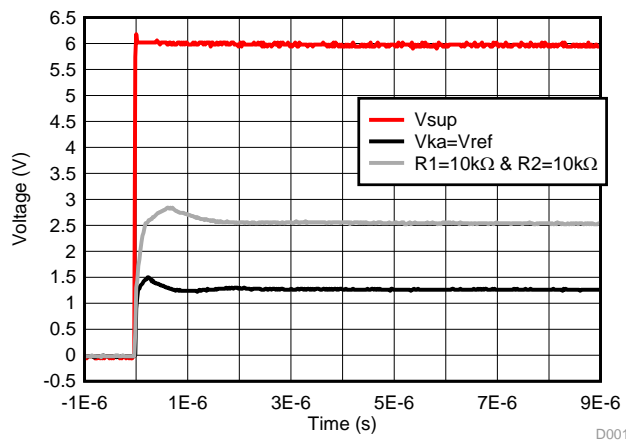


Figure 28. TLVH431 Start-up Response

10 Power Supply Recommendations

When using TLVH431 as a Linear Regulator to supply a load, designers will typically use a bypass capacitor on the output/cathode pin. When doing this, be sure that the capacitance is within the stability criteria shown in [Figure 15](#), [Figure 16](#), and [Figure 17](#).

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.

11 Layout

11.1 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.

11.2 Layout Example

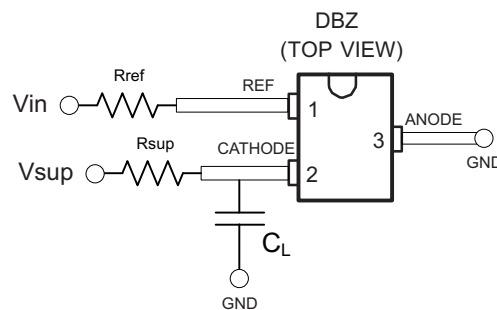


Figure 29. DBZ Layout example

12 Device and Documentation Support

12.1 Documentation Support

12.1.1 Related Documentation

For related documentation see the following:

- *Compensation Design With TL431 for UCC28600*, [SLUA671](#)
- *Setting the Shunt Voltage on an Adjustable Shunt Regulator*, [SLVA445](#)

12.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* 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.

12.3 Community Resources

The following links connect to TI community resources. Linked contents are 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](#).

TI E2E™ Online Community *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

12.4 Related Links

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

Table 3. Related Links

| PARTS | PRODUCT FOLDER | SAMPLE & BUY | TECHNICAL DOCUMENTS | TOOLS & SOFTWARE | SUPPORT & COMMUNITY |
|----------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| TLVH431 | Click here | Click here | Click here | Click here | Click here |
| TLVH431A | Click here | Click here | Click here | Click here | Click here |
| TLVH431B | Click here | Click here | Click here | Click here | Click here |
| TLVH432 | Click here | Click here | Click here | Click here | Click here |
| TLVH432A | Click here | Click here | Click here | Click here | Click here |
| TLVH432B | Click here | Click here | Click here | Click here | Click here |

12.5 Trademarks

E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

12.6 Electrostatic Discharge Caution



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

12.7 Glossary

[SLYZ022](#) — *TI Glossary*.

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

13 Mechanical, Packaging, and Orderable Information

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

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLVH431ACDBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | 0 to 70 | (Y3PG, Y3PU) | Samples |
| TLVH431ACDBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | Y3PG | Samples |
| TLVH431ACDBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | 0 to 70 | (Y3PG, Y3PU) | Samples |
| TLVH431ACDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y3PS, Y3PU) | Samples |
| TLVH431ACDBZRG4 | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y3PS, Y3PU) | Samples |
| TLVH431ACDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y3PS, Y3PU) | Samples |
| TLVH431ACDCKR | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | YPU | Samples |
| TLVH431ACDCKRE4 | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | YPU | Samples |
| TLVH431ACDCKT | ACTIVE | SC70 | DCK | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | YPU | Samples |
| TLVH431ACDCKTG4 | ACTIVE | SC70 | DCK | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | YPU | Samples |
| TLVH431ACLPL | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | 0 to 70 | ZA431A | Samples |
| TLVH431ACLPR | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | 0 to 70 | ZA431A | Samples |
| TLVH431ACPK | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | 0 to 70 | W2 | Samples |
| TLVH431AIDBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -40 to 85 | Y3TU | Samples |
| TLVH431AIDBVRE4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 85 | Y3TU | Samples |
| TLVH431AIDBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -40 to 85 | Y3TU | Samples |
| TLVH431AIDBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | Y3TU | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLVH431AIDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (Y3T3, Y3TS, Y3TU) | Samples |
| TLVH431AIDBZRG4 | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (Y3T3, Y3TS, Y3TU) | Samples |
| TLVH431AIDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (Y3TS, Y3TU) | Samples |
| TLVH431AIDBZTG4 | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (Y3TS, Y3TU) | Samples |
| TLVH431AIDCKR | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YTU | Samples |
| TLVH431AIDCKT | ACTIVE | SC70 | DCK | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YTU | Samples |
| TLVH431AILP | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 85 | ZB431A | Samples |
| TLVH431AILPR | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 85 | ZB431A | Samples |
| TLVH431AIPK | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | -40 to 85 | W3 | Samples |
| TLVH431AIPKG3 | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | -40 to 85 | W3 | Samples |
| TLVH431AQDBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -40 to 125 | Y3NU | Samples |
| TLVH431AQDBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -40 to 125 | Y3NU | Samples |
| TLVH431AQDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (Y3NS, Y3NU) | Samples |
| TLVH431AQDBZRG4 | ACTIVE | SOT-23 | DBZ | 3 | 3000 | TBD | Call TI | Call TI | -40 to 125 | (Y3NS, Y3NU) | Samples |
| TLVH431AQDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (Y3NS, Y3NU) | Samples |
| TLVH431AQDBZTG4 | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (Y3NS, Y3NU) | Samples |
| TLVH431AQDCKR | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | YNU | Samples |
| TLVH431AQDCKT | ACTIVE | SC70 | DCK | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | YNU | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLVH431AQLP | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 125 | ZD431A | Samples |
| TLVH431AQLPR | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 125 | ZD431A | Samples |
| TLVH431AQPCK | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | -40 to 125 | VD | Samples |
| TLVH431AQPCKG3 | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | -40 to 125 | VD | Samples |
| TLVH431BCDBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | 0 to 70 | Y3JU | Samples |
| TLVH431BCDBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | Y3JU | Samples |
| TLVH431BCDBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | 0 to 70 | Y3JU | Samples |
| TLVH431BCDBVTE4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | 0 to 70 | Y3JU | Samples |
| TLVH431BCDBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | Y3JU | Samples |
| TLVH431BCDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y3J3, Y3JS, Y3JU) | Samples |
| TLVH431BCDBZRG4 | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y3J3, Y3JS, Y3JU) | Samples |
| TLVH431BCDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y3JS, Y3JU) | Samples |
| TLVH431BCDBZTG4 | ACTIVE | SOT-23 | DBZ | 3 | 250 | TBD | Call TI | Call TI | 0 to 70 | (Y3JS, Y3JU) | Samples |
| TLVH431BCDCKR | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | YHU | Samples |
| TLVH431BCDCKT | ACTIVE | SC70 | DCK | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | YHU | Samples |
| TLVH431BCDCKTG4 | ACTIVE | SC70 | DCK | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | YHU | Samples |
| TLVH431BCLP | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | 0 to 70 | ZA431B | Samples |
| TLVH431BCLPR | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | 0 to 70 | ZA431B | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLVH431BCPK | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | 0 to 70 | V7 | Samples |
| TLVH431BIDBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -40 to 85 | Y3KU | Samples |
| TLVH431BIDBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -40 to 85 | Y3KU | Samples |
| TLVH431BIDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (Y3K3, Y3KS, Y3KU) | Samples |
| TLVH431BIDBZRG4 | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (Y3K3, Y3KS, Y3KU) | Samples |
| TLVH431BIDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (Y3KS, Y3KU) | Samples |
| TLVH431BIDBZTG4 | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (Y3KS, Y3KU) | Samples |
| TLVH431BIDCKR | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YJU | Samples |
| TLVH431BIDCKRE4 | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YJU | Samples |
| TLVH431BIDCKRG4 | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YJU | Samples |
| TLVH431BIDCKT | ACTIVE | SC70 | DCK | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YJU | Samples |
| TLVH431BIDCKTG4 | ACTIVE | SC70 | DCK | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YJU | Samples |
| TLVH431BILP | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 85 | ZB431B | Samples |
| TLVH431BILPR | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 85 | ZB431B | Samples |
| TLVH431BIPK | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | -40 to 85 | V8 | Samples |
| TLVH431BIPKG3 | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | -40 to 85 | V8 | Samples |
| TLVH431BQDBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -40 to 125 | Y3LU | Samples |
| TLVH431BQDBVRE4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | Y3LU | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLVH431BQDBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -40 to 125 | Y3LU | Samples |
| TLVH431BQDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (Y3LS, Y3LU) | Samples |
| TLVH431BQDBZRG4 | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (Y3LS, Y3LU) | Samples |
| TLVH431BQDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (Y3LS, Y3LU) | Samples |
| TLVH431BQDBZTG4 | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (Y3LS, Y3LU) | Samples |
| TLVH431BQDCKR | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | YKU | Samples |
| TLVH431BQDCKT | ACTIVE | SC70 | DCK | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | YKU | Samples |
| TLVH431BQLP | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 125 | ZD431B | Samples |
| TLVH431BQLPE3 | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 125 | ZD431B | Samples |
| TLVH431BQLPR | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 125 | ZD431B | Samples |
| TLVH431BQPK | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | -40 to 125 | V9 | Samples |
| TLVH431CDBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | 0 to 70 | Y3UU | Samples |
| TLVH431CDBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | 0 to 70 | Y3UU | Samples |
| TLVH431CDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y3US, Y3UU) | Samples |
| TLVH431CDBZRG4 | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y3US, Y3UU) | Samples |
| TLVH431CDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y3US, Y3UU) | Samples |
| TLVH431CDBZTG4 | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y3US, Y3UU) | Samples |
| TLVH431CDCKT | ACTIVE | SC70 | DCK | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | YUU | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLVH431CDCKTE4 | ACTIVE | SC70 | DCK | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | YUU | Samples |
| TLVH431CLP | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | 0 to 70 | ZA431 | Samples |
| TLVH431CLPE3 | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | 0 to 70 | ZA431 | Samples |
| TLVH431CLPR | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | 0 to 70 | ZA431 | Samples |
| TLVH431CPK | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | 0 to 70 | W4 | Samples |
| TLVH431CPKG3 | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | 0 to 70 | W4 | Samples |
| TLVH431IDBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -40 to 85 | Y3VU | Samples |
| TLVH431IDBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -40 to 85 | Y3VU | Samples |
| TLVH431IDBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | Y3VU | Samples |
| TLVH431IDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (Y3VS, Y3VU) | Samples |
| TLVH431IDBZRG4 | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (Y3VS, Y3VU) | Samples |
| TLVH431IDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (Y3VS, Y3VU) | Samples |
| TLVH431IDCKR | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YVU | Samples |
| TLVH431IDCKT | ACTIVE | SC70 | DCK | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YVU | Samples |
| TLVH431ILP | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 85 | ZB431 | Samples |
| TLVH431ILPR | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 85 | ZB431 | Samples |
| TLVH431IPK | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | -40 to 85 | W5 | Samples |
| TLVH431QDBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -40 to 125 | Y3MU | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLVH431QDBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -40 to 125 | Y3MU | Samples |
| TLVH431QDBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | Y3MU | Samples |
| TLVH431QDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (Y3MS, Y3MU) | Samples |
| TLVH431QDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (Y3MS, Y3MU) | Samples |
| TLVH431QDBZTG4 | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (Y3MS, Y3MU) | Samples |
| TLVH431QDCKR | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | YMU | Samples |
| TLVH431QDCKT | ACTIVE | SC70 | DCK | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | YMU | Samples |
| TLVH431QLP | ACTIVE | TO-92 | LP | 3 | 1000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 125 | ZD431 | Samples |
| TLVH431QLPR | ACTIVE | TO-92 | LP | 3 | 2000 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | -40 to 125 | ZD431 | Samples |
| TLVH431QPK | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | -40 to 125 | VC | Samples |
| TLVH432ACDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y2ES, Y2EU) | Samples |
| TLVH432ACDBZRG4 | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y2ES, Y2EU) | Samples |
| TLVH432ACDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y2ES, Y2EU) | Samples |
| TLVH432AIDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (Y2FS, Y2FU) | Samples |
| TLVH432AIPK | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | -40 to 85 | VL | Samples |
| TLVH432AQDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (Y2GS, Y2GU) | Samples |
| TLVH432AQDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (Y2GS, Y2GU) | Samples |
| TLVH432BCDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y2HS, Y2HU) | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLVH432BCDBZRG4 | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y2HS, Y2HU) | Samples |
| TLVH432BCPK | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | 0 to 70 | VN | Samples |
| TLVH432BIDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (Y2JS, Y2JU) | Samples |
| TLVH432BQDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (Y2KS, Y2KU) | Samples |
| TLVH432BQDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (Y2KS, Y2KU) | Samples |
| TLVH432BQDBZTG4 | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (Y2KS, Y2KU) | Samples |
| TLVH432CDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y2AS, Y2AU) | Samples |
| TLVH432CDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | (Y2AS, Y2AU) | Samples |
| TLVH432CPK | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | 0 to 70 | VG | Samples |
| TLVH432IDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (Y2BS, Y2BU) | Samples |
| TLVH432QDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (Y2DS, Y2DU) | Samples |
| TLVH432QDBZT | ACTIVE | SOT-23 | DBZ | 3 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | (Y2DS, Y2DU) | Samples |
| TLVH432QPK | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | -40 to 125 | VJ | Samples |
| TLVH432QPKG3 | ACTIVE | SOT-89 | PK | 3 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-2-260C-1 YEAR | -40 to 125 | VJ | Samples |

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

ACTIVE: Product device recommended for new designs.

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

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

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

OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of ≤ 1000 ppm threshold. Antimony trioxide based flame retardants must also meet the ≤ 1000 ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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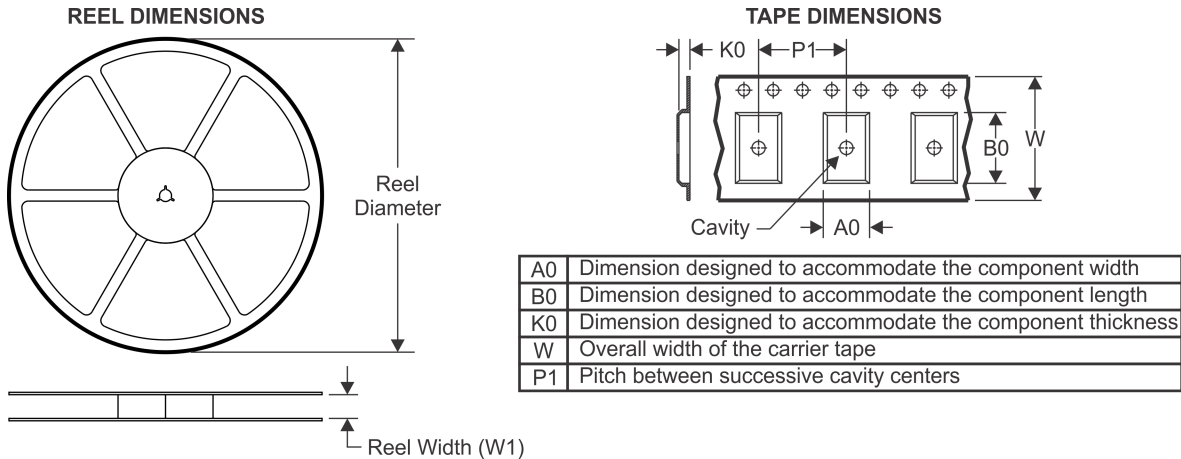
OTHER QUALIFIED VERSIONS OF TLVH431A, TLVH431B :

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

NOTE: Qualified Version Definitions:

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

TAPE AND REEL INFORMATION



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLVH431ACDBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLVH431ACDBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.3 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLVH431ACDBVRG4 | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLVH431ACDBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.3 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLVH431ACDBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLVH431ACDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431ACDBZT | SOT-23 | DBZ | 3 | 250 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431ACDCKR | SC70 | DCK | 6 | 3000 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TLVH431ACDCKT | SC70 | DCK | 6 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TLVH431ACPK | SOT-89 | PK | 3 | 1000 | 180.0 | 12.4 | 4.91 | 4.52 | 1.9 | 8.0 | 12.0 | Q3 |
| TLVH431AIDBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.3 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLVH431AIDBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.2 | 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 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431AIDBZT | SOT-23 | DBZ | 3 | 250 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431AIDBZTG4 | SOT-23 | DBZ | 3 | 250 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431AIDCKR | SC70 | DCK | 6 | 3000 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |

| 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 |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLVH431AIDCKT | SC70 | DCK | 6 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TLVH431AIPK | SOT-89 | PK | 3 | 1000 | 180.0 | 12.4 | 4.91 | 4.52 | 1.9 | 8.0 | 12.0 | Q3 |
| TLVH431AQDBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.3 | 3.2 | 1.4 | 4.0 | 8.0 | 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 | 178.0 | 9.0 | 3.3 | 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 |
| TLVH431AQDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431AQDBZT | 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 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431AQDCKR | SC70 | DCK | 6 | 3000 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TLVH431AQDCKT | SC70 | DCK | 6 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TLVH431AQPK | SOT-89 | PK | 3 | 1000 | 180.0 | 12.4 | 4.91 | 4.52 | 1.9 | 8.0 | 12.0 | Q3 |
| TLVH431BCDBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | 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 | 180.0 | 8.4 | 3.2 | 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 |
| TLVH431BCDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431BCDBZT | SOT-23 | DBZ | 3 | 250 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431BCDCKR | SC70 | DCK | 6 | 3000 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TLVH431BCDCKT | SC70 | DCK | 6 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TLVH431BCPK | SOT-89 | PK | 3 | 1000 | 180.0 | 12.4 | 4.91 | 4.52 | 1.9 | 8.0 | 12.0 | Q3 |
| TLVH431BIDBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.3 | 3.2 | 1.4 | 4.0 | 8.0 | 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 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431BIDBZT | SOT-23 | DBZ | 3 | 250 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431BIDBZTG4 | SOT-23 | DBZ | 3 | 250 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431BIDCKR | SC70 | DCK | 6 | 3000 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TLVH431BIDCKT | SC70 | DCK | 6 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TLVH431BIPK | SOT-89 | PK | 3 | 1000 | 180.0 | 12.4 | 4.91 | 4.52 | 1.9 | 8.0 | 12.0 | Q3 |
| TLVH431BQDBVR | SOT-23 | DBV | 5 | 3000 | 179.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| 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 |
| TLVH431BQDBVT | SOT-23 | DBV | 5 | 250 | 179.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLVH431BQDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431BQDBZRG4 | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431BQDBZT | SOT-23 | DBZ | 3 | 250 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431BQDBZTG4 | SOT-23 | DBZ | 3 | 250 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431BQDCKR | SC70 | DCK | 6 | 3000 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TLVH431BQDCKT | SC70 | DCK | 6 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TLVH431BQPK | SOT-89 | PK | 3 | 1000 | 180.0 | 12.4 | 4.91 | 4.52 | 1.9 | 8.0 | 12.0 | Q3 |
| TLVH431CDBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.2 | 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 |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLVH431CDBVR | SOT-23 | DBV | 5 | 3000 | 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 |
| TLVH431CDBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.3 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLVH431CDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431CDBZT | SOT-23 | DBZ | 3 | 250 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431CDBZTG4 | SOT-23 | DBZ | 3 | 250 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431CDCKT | SC70 | DCK | 6 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TLVH431CPK | SOT-89 | PK | 3 | 1000 | 180.0 | 12.4 | 4.91 | 4.52 | 1.9 | 8.0 | 12.0 | Q3 |
| TLVH431IDBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.3 | 3.2 | 1.4 | 4.0 | 8.0 | 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 | 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 |
| TLVH431IDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431IDBZT | SOT-23 | DBZ | 3 | 250 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431IDCKR | SC70 | DCK | 6 | 3000 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TLVH431IDCKT | SC70 | DCK | 6 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TLVH431IPK | SOT-89 | PK | 3 | 1000 | 180.0 | 12.4 | 4.91 | 4.52 | 1.9 | 8.0 | 12.0 | Q3 |
| TLVH431QDBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.3 | 3.2 | 1.4 | 4.0 | 8.0 | 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 | 178.0 | 9.0 | 3.3 | 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 |
| TLVH431QDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431QDBZT | SOT-23 | DBZ | 3 | 250 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| 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 |
| TLVH431QDCKT | SC70 | DCK | 6 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TLVH431QPK | SOT-89 | PK | 3 | 1000 | 180.0 | 12.4 | 4.91 | 4.52 | 1.9 | 8.0 | 12.0 | Q3 |
| TLVH432ACDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH432ACDBZT | SOT-23 | DBZ | 3 | 250 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH432AIDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH432AIPK | SOT-89 | PK | 3 | 1000 | 180.0 | 12.4 | 4.91 | 4.52 | 1.9 | 8.0 | 12.0 | Q3 |
| TLVH432AQDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH432AQDBZT | SOT-23 | DBZ | 3 | 250 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH432BCDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH432BCDBZRG4 | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH432BCPK | SOT-89 | PK | 3 | 1000 | 180.0 | 12.4 | 4.91 | 4.52 | 1.9 | 8.0 | 12.0 | Q3 |
| TLVH432BIDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH432BQDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH432BQDBZT | SOT-23 | DBZ | 3 | 250 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| 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 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH432CDBZT | SOT-23 | DBZ | 3 | 250 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH432CPK | SOT-89 | PK | 3 | 1000 | 180.0 | 12.4 | 4.91 | 4.52 | 1.9 | 8.0 | 12.0 | Q3 |

| 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 |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLVH432IDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH432QDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH432QDBZT | SOT-23 | DBZ | 3 | 250 | 180.0 | 8.4 | 3.15 | 2.77 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH432QPK | SOT-89 | PK | 3 | 1000 | 180.0 | 12.4 | 4.91 | 4.52 | 1.9 | 8.0 | 12.0 | Q3 |

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLVH431ACDBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TLVH431ACDBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TLVH431ACDBVRG4 | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TLVH431ACDBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TLVH431ACDBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TLVH431ACDBZR | SOT-23 | DBZ | 3 | 3000 | 183.0 | 183.0 | 20.0 |
| TLVH431ACDBZT | SOT-23 | DBZ | 3 | 250 | 183.0 | 183.0 | 20.0 |
| TLVH431ACDCKR | SC70 | DCK | 6 | 3000 | 203.0 | 203.0 | 35.0 |
| TLVH431ACDCKT | SC70 | DCK | 6 | 250 | 203.0 | 203.0 | 35.0 |
| TLVH431ACPK | SOT-89 | PK | 3 | 1000 | 340.0 | 340.0 | 38.0 |
| TLVH431AIDBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TLVH431AIDBVR | SOT-23 | DBV | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TLVH431AIDBVT | SOT-23 | DBV | 5 | 250 | 203.0 | 203.0 | 35.0 |

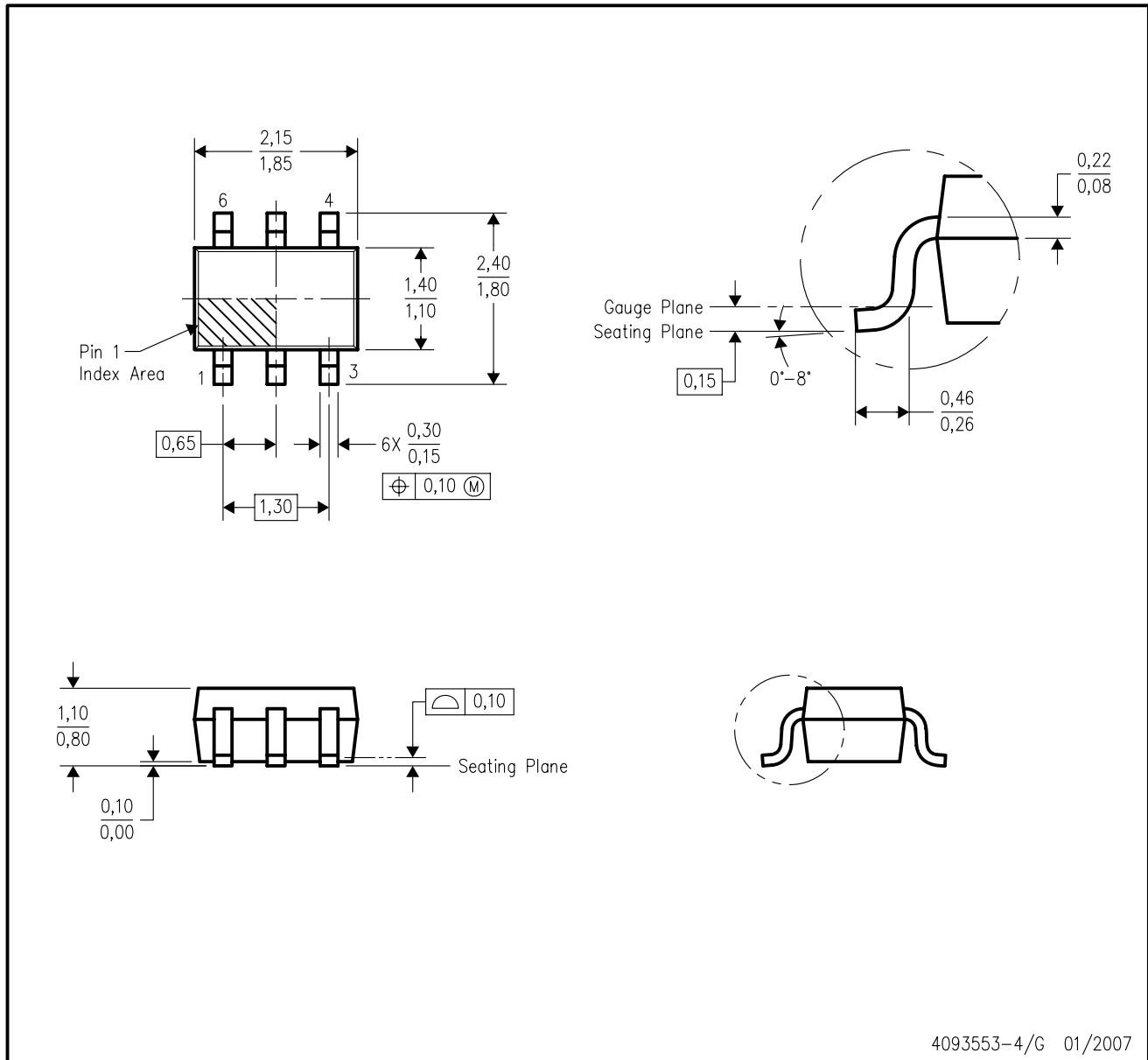
| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLVH431AIDBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TLVH431AIDBZR | SOT-23 | DBZ | 3 | 3000 | 183.0 | 183.0 | 20.0 |
| TLVH431AIDBZT | SOT-23 | DBZ | 3 | 250 | 183.0 | 183.0 | 20.0 |
| TLVH431AIDBZTG4 | SOT-23 | DBZ | 3 | 250 | 183.0 | 183.0 | 20.0 |
| TLVH431AIDCKR | SC70 | DCK | 6 | 3000 | 203.0 | 203.0 | 35.0 |
| TLVH431AIDCKT | SC70 | DCK | 6 | 250 | 203.0 | 203.0 | 35.0 |
| TLVH431AIPK | SOT-89 | PK | 3 | 1000 | 340.0 | 340.0 | 38.0 |
| TLVH431AQDBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TLVH431AQDBVR | SOT-23 | DBV | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TLVH431AQDBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TLVH431AQDBVT | SOT-23 | DBV | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TLVH431AQDBZR | SOT-23 | DBZ | 3 | 3000 | 183.0 | 183.0 | 20.0 |
| TLVH431AQDBZT | SOT-23 | DBZ | 3 | 250 | 183.0 | 183.0 | 20.0 |
| TLVH431AQDBZTG4 | SOT-23 | DBZ | 3 | 250 | 183.0 | 183.0 | 20.0 |
| TLVH431AQDCKR | SC70 | DCK | 6 | 3000 | 203.0 | 203.0 | 35.0 |
| TLVH431AQDCKT | SC70 | DCK | 6 | 250 | 203.0 | 203.0 | 35.0 |
| TLVH431AQPCK | SOT-89 | PK | 3 | 1000 | 340.0 | 340.0 | 38.0 |
| TLVH431BCDBVR | SOT-23 | DBV | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TLVH431BCDBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TLVH431BCDBVT | SOT-23 | DBV | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TLVH431BCDBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TLVH431BCDBZR | SOT-23 | DBZ | 3 | 3000 | 183.0 | 183.0 | 20.0 |
| TLVH431BCDBZT | SOT-23 | DBZ | 3 | 250 | 183.0 | 183.0 | 20.0 |
| TLVH431BCDCKR | SC70 | DCK | 6 | 3000 | 203.0 | 203.0 | 35.0 |
| TLVH431BCDCKT | SC70 | DCK | 6 | 250 | 203.0 | 203.0 | 35.0 |
| TLVH431BCPK | SOT-89 | PK | 3 | 1000 | 340.0 | 340.0 | 38.0 |
| TLVH431BIDBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TLVH431BIDBVR | SOT-23 | DBV | 5 | 3000 | 203.0 | 203.0 | 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 | 183.0 | 183.0 | 20.0 |
| TLVH431BIDBZT | SOT-23 | DBZ | 3 | 250 | 183.0 | 183.0 | 20.0 |
| TLVH431BIDBZTG4 | SOT-23 | DBZ | 3 | 250 | 183.0 | 183.0 | 20.0 |
| TLVH431BIDCKR | SC70 | DCK | 6 | 3000 | 203.0 | 203.0 | 35.0 |
| TLVH431BIDCKT | SC70 | DCK | 6 | 250 | 203.0 | 203.0 | 35.0 |
| TLVH431BIPK | SOT-89 | PK | 3 | 1000 | 340.0 | 340.0 | 38.0 |
| TLVH431BQDBVR | SOT-23 | DBV | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| 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 | 183.0 | 183.0 | 20.0 |
| TLVH431BQDBZRG4 | SOT-23 | DBZ | 3 | 3000 | 183.0 | 183.0 | 20.0 |
| TLVH431BQDBZT | SOT-23 | DBZ | 3 | 250 | 183.0 | 183.0 | 20.0 |
| TLVH431BQDBZTG4 | SOT-23 | DBZ | 3 | 250 | 183.0 | 183.0 | 20.0 |

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLVH431BQDCKR | SC70 | DCK | 6 | 3000 | 203.0 | 203.0 | 35.0 |
| TLVH431BQDCKT | SC70 | DCK | 6 | 250 | 203.0 | 203.0 | 35.0 |
| TLVH431BQPK | SOT-89 | PK | 3 | 1000 | 340.0 | 340.0 | 38.0 |
| TLVH431CDBVR | SOT-23 | DBV | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TLVH431CDBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TLVH431CDBVT | SOT-23 | DBV | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TLVH431CDBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TLVH431CDBZR | SOT-23 | DBZ | 3 | 3000 | 183.0 | 183.0 | 20.0 |
| TLVH431CDBZT | SOT-23 | DBZ | 3 | 250 | 183.0 | 183.0 | 20.0 |
| TLVH431CDBZTG4 | SOT-23 | DBZ | 3 | 250 | 183.0 | 183.0 | 20.0 |
| TLVH431CDCKT | SC70 | DCK | 6 | 250 | 203.0 | 203.0 | 35.0 |
| TLVH431CPK | SOT-89 | PK | 3 | 1000 | 340.0 | 340.0 | 38.0 |
| TLVH431IDBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TLVH431IDBVR | SOT-23 | DBV | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TLVH431IDBVT | SOT-23 | DBV | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TLVH431IDBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TLVH431IDBZR | SOT-23 | DBZ | 3 | 3000 | 183.0 | 183.0 | 20.0 |
| TLVH431IDBZT | SOT-23 | DBZ | 3 | 250 | 183.0 | 183.0 | 20.0 |
| TLVH431IDCKR | SC70 | DCK | 6 | 3000 | 203.0 | 203.0 | 35.0 |
| TLVH431IDCKT | SC70 | DCK | 6 | 250 | 203.0 | 203.0 | 35.0 |
| TLVH431IPK | SOT-89 | PK | 3 | 1000 | 340.0 | 340.0 | 38.0 |
| TLVH431QDBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TLVH431QDBVR | SOT-23 | DBV | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TLVH431QDBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TLVH431QDBVT | SOT-23 | DBV | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TLVH431QDBZR | SOT-23 | DBZ | 3 | 3000 | 183.0 | 183.0 | 20.0 |
| TLVH431QDBZT | SOT-23 | DBZ | 3 | 250 | 183.0 | 183.0 | 20.0 |
| TLVH431QDBZTG4 | SOT-23 | DBZ | 3 | 250 | 183.0 | 183.0 | 20.0 |
| TLVH431QDCKR | SC70 | DCK | 6 | 3000 | 203.0 | 203.0 | 35.0 |
| TLVH431QDCKT | SC70 | DCK | 6 | 250 | 203.0 | 203.0 | 35.0 |
| TLVH431QPK | SOT-89 | PK | 3 | 1000 | 340.0 | 340.0 | 38.0 |
| TLVH432ACDBZR | SOT-23 | DBZ | 3 | 3000 | 183.0 | 183.0 | 20.0 |
| TLVH432ACDBZT | SOT-23 | DBZ | 3 | 250 | 183.0 | 183.0 | 20.0 |
| TLVH432AIDBZR | SOT-23 | DBZ | 3 | 3000 | 183.0 | 183.0 | 20.0 |
| TLVH432AIPK | SOT-89 | PK | 3 | 1000 | 340.0 | 340.0 | 38.0 |
| TLVH432AQDBZR | SOT-23 | DBZ | 3 | 3000 | 183.0 | 183.0 | 20.0 |
| TLVH432AQDBZT | SOT-23 | DBZ | 3 | 250 | 183.0 | 183.0 | 20.0 |
| TLVH432BCDBZR | SOT-23 | DBZ | 3 | 3000 | 183.0 | 183.0 | 20.0 |
| TLVH432BCDBZRG4 | SOT-23 | DBZ | 3 | 3000 | 183.0 | 183.0 | 20.0 |
| TLVH432BCPK | SOT-89 | PK | 3 | 1000 | 340.0 | 340.0 | 38.0 |
| TLVH432BIDBZR | SOT-23 | DBZ | 3 | 3000 | 183.0 | 183.0 | 20.0 |
| TLVH432BQDBZR | SOT-23 | DBZ | 3 | 3000 | 183.0 | 183.0 | 20.0 |
| TLVH432BQDBZT | SOT-23 | DBZ | 3 | 250 | 183.0 | 183.0 | 20.0 |
| TLVH432BQDBZTG4 | SOT-23 | DBZ | 3 | 250 | 183.0 | 183.0 | 20.0 |

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLVH432CDBZR | SOT-23 | DBZ | 3 | 3000 | 183.0 | 183.0 | 20.0 |
| TLVH432CDBZT | SOT-23 | DBZ | 3 | 250 | 183.0 | 183.0 | 20.0 |
| TLVH432CPK | SOT-89 | PK | 3 | 1000 | 340.0 | 340.0 | 38.0 |
| TLVH432IDBZR | SOT-23 | DBZ | 3 | 3000 | 183.0 | 183.0 | 20.0 |
| TLVH432QDBZR | SOT-23 | DBZ | 3 | 3000 | 183.0 | 183.0 | 20.0 |
| TLVH432QDBZT | SOT-23 | DBZ | 3 | 250 | 183.0 | 183.0 | 20.0 |
| TLVH432QPK | SOT-89 | PK | 3 | 1000 | 340.0 | 340.0 | 38.0 |

DCK (R-PDSO-G6)

PLASTIC SMALL-OUTLINE PACKAGE



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

DCK (R-PDSO-G6)

PLASTIC SMALL OUTLINE



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

DBV0005A



PACKAGE OUTLINE

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



4214839/D 11/2018

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 MO-178.
4. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.

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/D 11/2018

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

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



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

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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.

GENERIC PACKAGE VIEW

LP 3

TO-92 - 5.34 mm max height

TRANSISTOR OUTLINE



Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

4040001-2/F



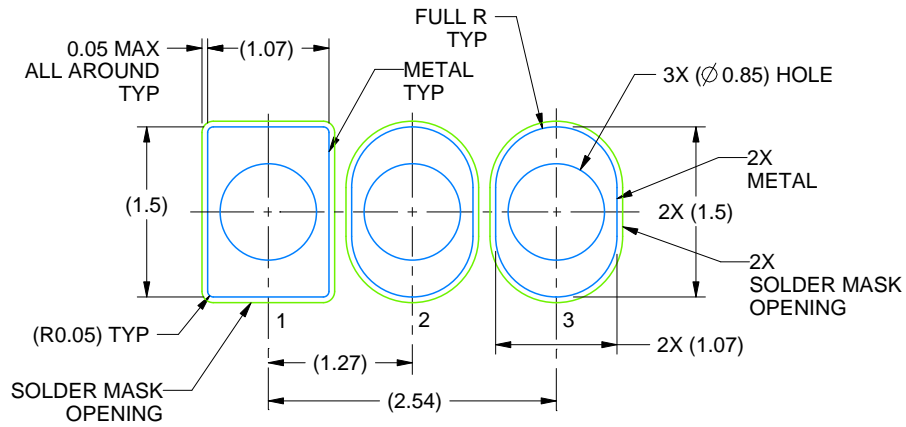
4215214/B 04/2017

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/B 04/2017

TAPE SPECIFICATIONS

LP0003A

TO-92 - 5.34 mm max height

TO-92



FOR FORMED LEAD OPTION PACKAGE

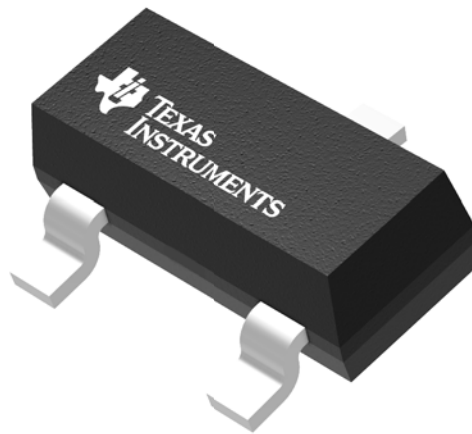
4215214/B 04/2017

GENERIC PACKAGE VIEW

DBZ 3

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

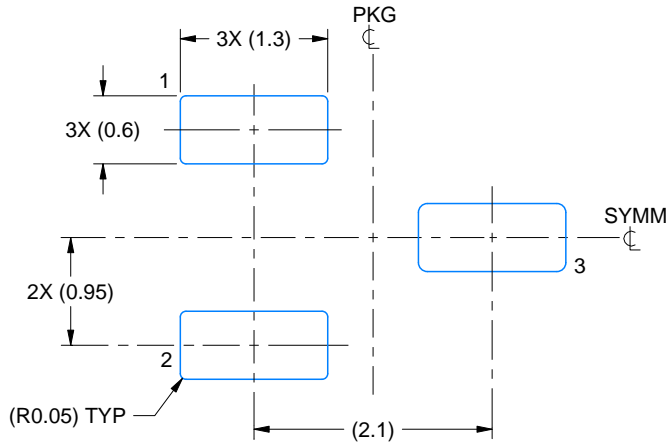
4203227/C

EXAMPLE BOARD LAYOUT

DBZ0003A

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE
SCALE:15X



SOLDER MASK DETAILS

4214838/C 04/2017

NOTES: (continued)

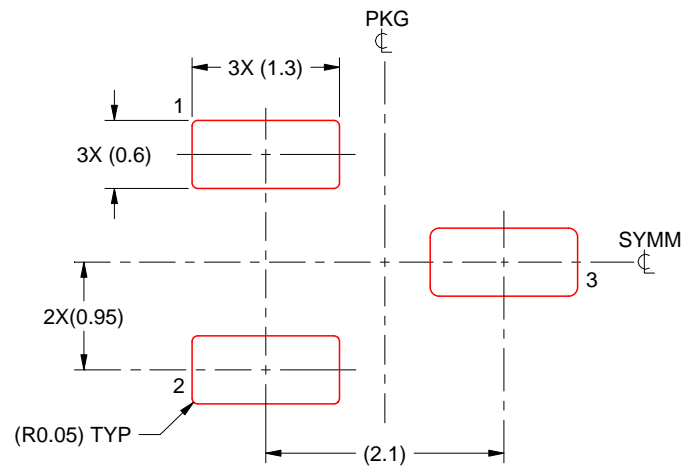
4. Publication IPC-7351 may have alternate designs.
5. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

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/C 04/2017

NOTES: (continued)

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

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