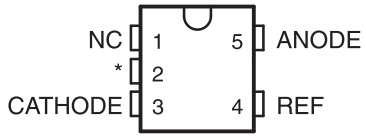
# LOW-VOLTAGE ADJUSTABLE PRECISION SHUNT REGULATORS

**Check for Samples: TLVH431A-Q1, TLVH431B-Q1**

## FEATURES

- **Qualified for Automotive Applications**
- **Low-Voltage Operation: Down to 1.24 V**
- **Reference Voltage Tolerances at 25°C**
  - **0.5% for B Grade**
  - **1% for A Grade**
- **Adjustable Output Voltage, $V_O = V_{REF}$ to 18 V**
- **Wide Operating Cathode Current Range: 100 µA to 70 mA**
- **0.25-Ω Typical Output Impedance**
- **–40°C to 125°C Specifications**

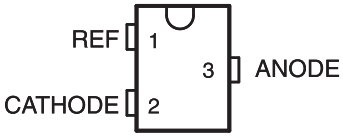
**DBV (SOT-23-5) PACKAGE**
**(TOP VIEW)**




NC – No internal connection

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

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




## DESCRIPTION/ORDERING INFORMATION

The TLVH431 devices are low-voltage 3-terminal adjustable voltage references, with thermal stability specified over the automotive temperature range. Output voltage can be set to any value between $V_{REF}$ (1.24 V) and 18 V with two external resistors (see Figure 2). 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 devices are ideal voltage reference 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 an excellent replacement for low-voltage Zener diodes in many applications, including on-board regulation and adjustable power supplies.

**ORDERING INFORMATION(1)**

| $T_A$ | $V_{REF}$ TOLERANCE | PACKAGE(2) | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|---|---|---|---|---|---|
| –40°C to 125°C | 0.5% | SOT-23-5 – DBV | Reel of 3000 | TLVH431BQDBVRQ1 | VOPQ |
| | 0.5% | SOT-23-3 - DBZ | Reel of 3000 | TLVH431BQDBZRQ1 | VPIQ |
| | 1% | SOT-23-5 – DBV | Reel of 3000 | TLVH431AQDBVRQ1 | VOOQ |

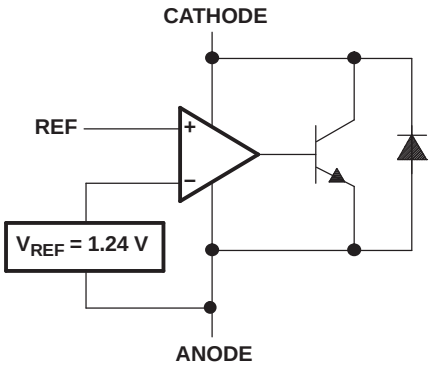
(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.
(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

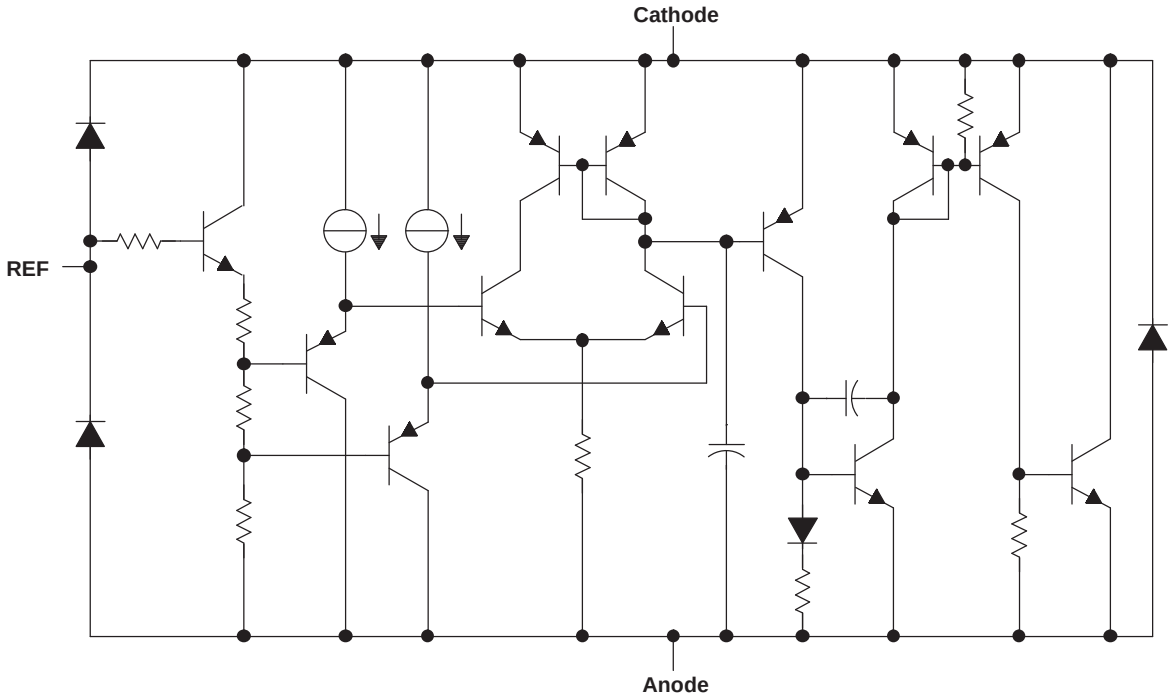
PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of the Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

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## LOGIC BLOCK DIAGRAM




## EQUIVALENT SCHEMATIC





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## ABSOLUTE MAXIMUM RATINGS(1)

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

| | | |
|---|---|---|
| $V_{KA}$ | Cathode voltage(2) | 20 V |
| $I_K$ | Cathode current range | –25 mA to 80 mA |
| $I_{ref}$ | Reference current range | –0.05 mA to 3 mA |
| $\theta_{JA}$ | Package thermal impedance(3) (4) | 206°C/W |
| $T_J$ | Operating virtual junction temperature | 150°C |
| $T_{stg}$ | Storage temperature range | –65°C to 150°C |

(1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) Voltage values are with respect to the anode terminal, unless otherwise noted.
(3) Maximum power dissipation is a function of $T_J(max)$, $\theta_{JA}$, and $T_A$. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) – T_A)/\theta_{JA}$. Operating at the absolute maximum $T_J$ of 150°C can affect reliability.
(4) The package thermal impedance is calculated in accordance with JESD 51-7.

## RECOMMENDED OPERATING CONDITIONS

| | | 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 | –40 | 125 | °C |

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## TLVH431A ELECTRICAL CHARACTERISTICS

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

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $V_{REF}$ | 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(1) (see Figure 1) | 1.209 | | 1.271 | |
| $V_{REF(dev)}$ | $V_{REF}$ deviation over full temperature range(1) (2) | $V_{KA} = V_{REF}$, $I_K$ = 10 mA (see Figure 1) | | | 11 | 31 | mV |
| $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ | Ratio of $V_{REF}$ change to cathode voltage change | $V_K = V_{REF}$ to 18 V, $I_K$ = 10 mA (see Figure 2) | | | –1.5 | –2.7 | mV/V |
| $I_{ref}$ | Reference terminal current | $I_K$ = 10 mA, R1 = 10 kΩ, R2 = open (see Figure 2) | | | 0.1 | 0.5 | µA |
| $I_{ref(dev)}$ | $I_{ref}$ deviation over full temperature range(1) (2) | $I_K$ = 10 mA, R1 = 10 kΩ, R2 = open (see Figure 2) | | | 0.15 | 0.5 | µA |
| $I_{K(min)}$ | Minimum cathode current for regulation | $V_{KA} = V_{REF}$ (see Figure 1) | | | 60 | 100 | µA |
| $I_{K(off)}$ | Off-state cathode current | $V_{REF}$ = 0, $V_{KA}$ = 18 V (see Figure 3) | | | 0.02 | 0.1 | µA |
| $\lvert z_{KA} \rvert$ | Dynamic impedance(3) | $V_{KA} = V_{REF}$, f ≤ 1 kHz, $I_K$ = 0.1 mA to 70 mA (see Figure 1) | | | 0.25 | 0.4 | Ω |

(1) Full temperature range is –40°C to 125°C.

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

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

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:

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

When the device is operating with two external resistors (see Figure 2), the total dynamic impedance of the circuit is defined as:

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


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## TLVH431B ELECTRICAL CHARACTERISTICS

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

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $V_{REF}$ | 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(1) (see Figure 1) | 1.221 | | 1.265 | |
| $V_{REF(dev)}$ | $V_{REF}$ deviation over full temperature range(1) (2) | $V_{KA} = V_{REF}$, $I_K$ = 10 mA (see Figure 1) | | | 11 | 31 | mV |
| $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ | Ratio of $V_{REF}$ change to cathode voltage change | $I_K$ = 10 mA, $V_K = V_{REF}$ to 18 V (see Figure 2) | | | –1.5 | –2.7 | mV/V |
| $I_{ref}$ | Reference terminal current | $I_K$ = 10 mA, R1 = 10 kΩ, R2 = open (see Figure 2) | | | 0.1 | 0.5 | µA |
| $I_{ref(dev)}$ | $I_{ref}$ deviation over full temperature range(1) (2) | $I_K$ = 10 mA, R1 = 10 kΩ, R2 = open (see Figure 2) | | | 0.15 | 0.5 | µA |
| $I_{K(min)}$ | Minimum cathode current for regulation | $V_{KA} = V_{REF}$ (see Figure 1) | | | 60 | 100 | µA |
| $I_{K(off)}$ | Off-state cathode current | $V_{REF}$ = 0, $V_{KA}$ = 18 V (see Figure 3) | | | 0.02 | 0.1 | µA |
| $\lvert z_{KA} \rvert$ | Dynamic impedance(3) | $V_{KA} = V_{REF}$, f ≤ 1 kHz, $I_K$ = 0.1 mA to 70 mA (see Figure 1) | | | 0.25 | 0.4 | Ω |

(1) Full temperature range is –40°C to 125°C.

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

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

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:

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

When the device is operating with two external resistors (see Figure 2), the total dynamic impedance of the circuit is defined as:

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

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## PARAMETER MEASUREMENT INFORMATION

Operation of the device at any conditions beyond those indicated under *recommended operating conditions* is not implied.

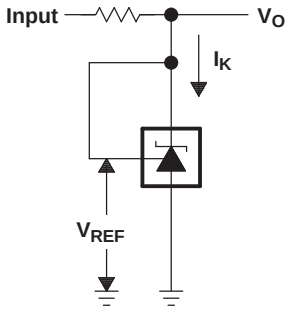



**Figure 1. Test Circuit for $V_{KA} = V_{REF}$, $V_O = V_{KA} = V_{REF}$**

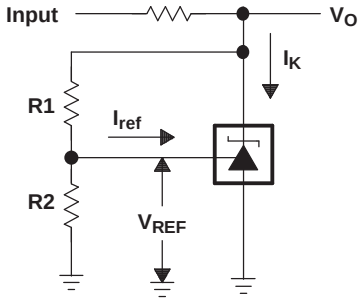



**Figure 2. Test Circuit for $V_{KA} > V_{REF}$, $V_O = V_{KA} = V_{REF} \times (1 + R1/R2) + I_{ref} \times R1$**

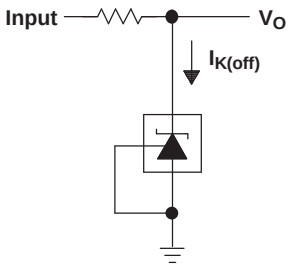



**Figure 3. Test Circuit for $I_{K(off)}$**


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## PARAMETER MEASUREMENT INFORMATION (continued)

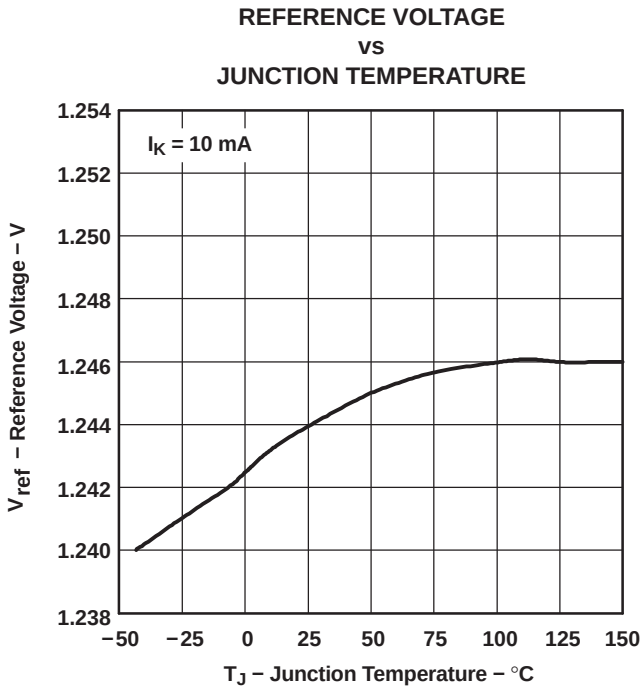



**Figure 4.**

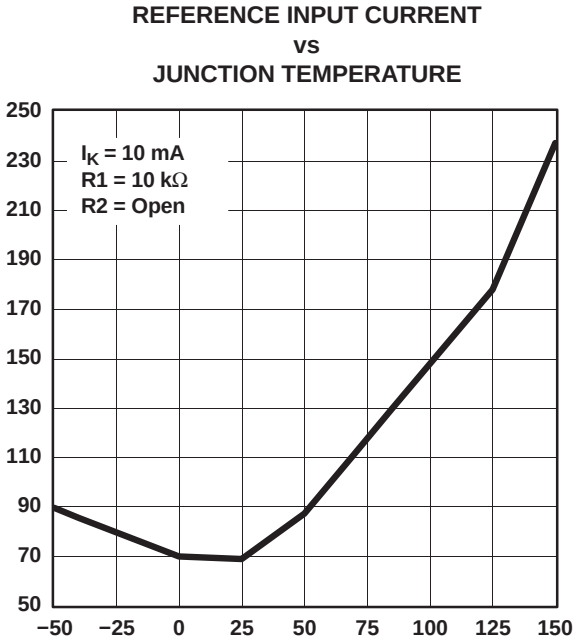



**Figure 5.**

## PARAMETER MEASUREMENT INFORMATION (continued)

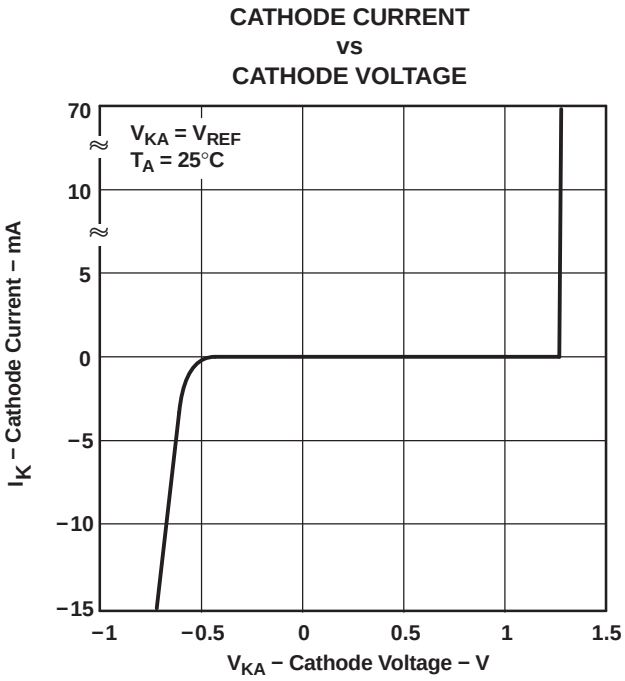



**Figure 6.**

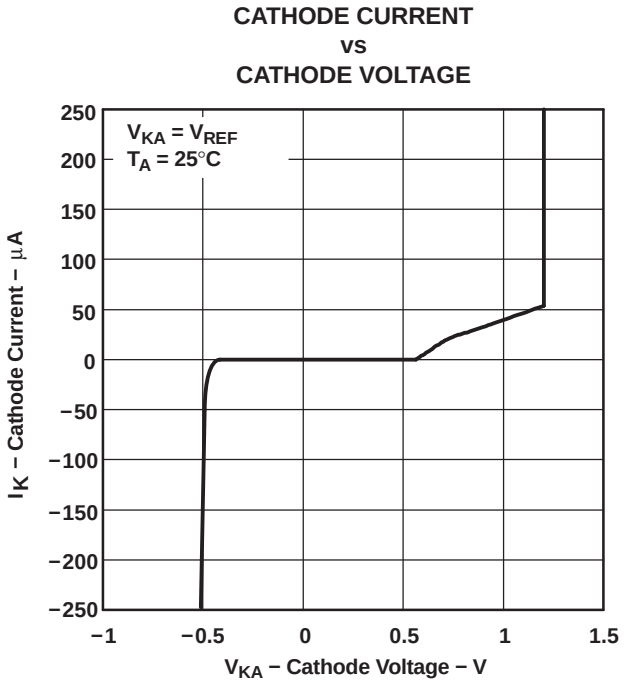



**Figure 7.**


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## PARAMETER MEASUREMENT INFORMATION (continued)

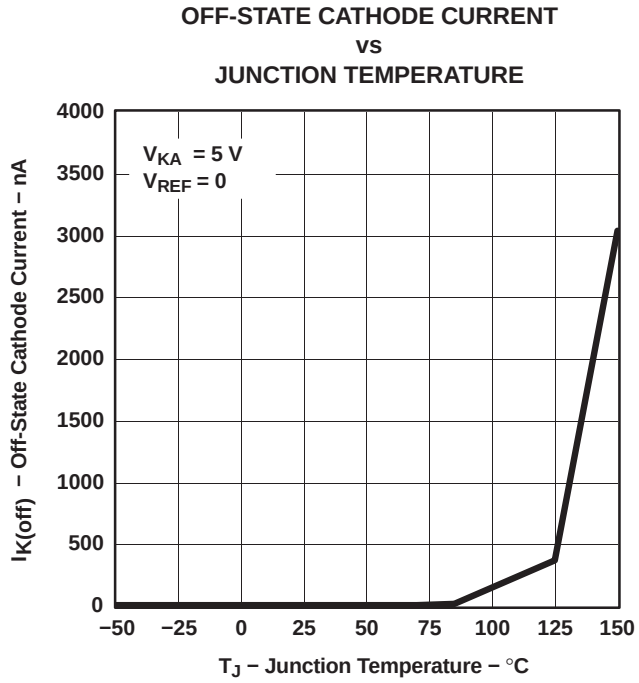



**Figure 8.**

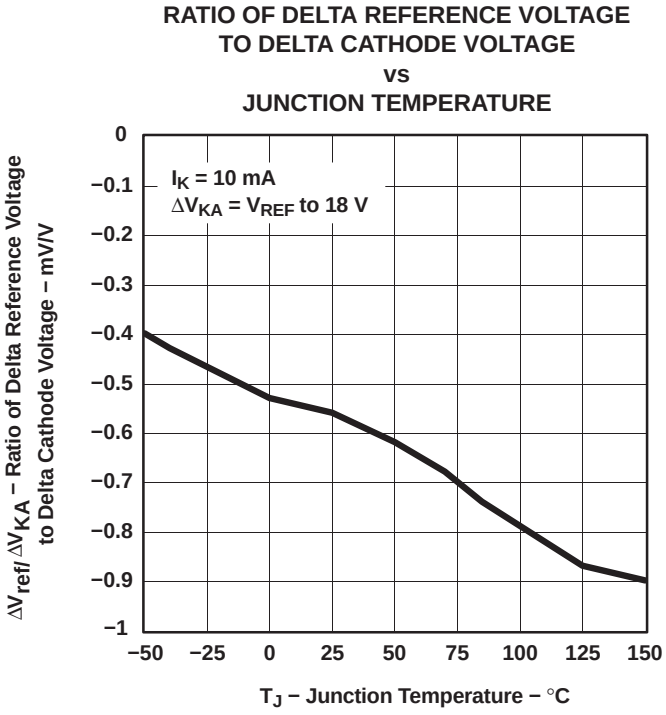
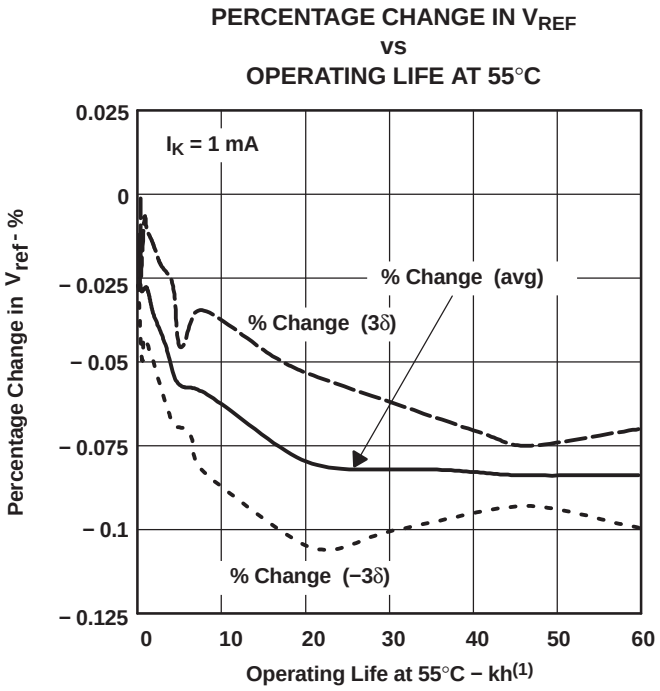



**Figure 9.**

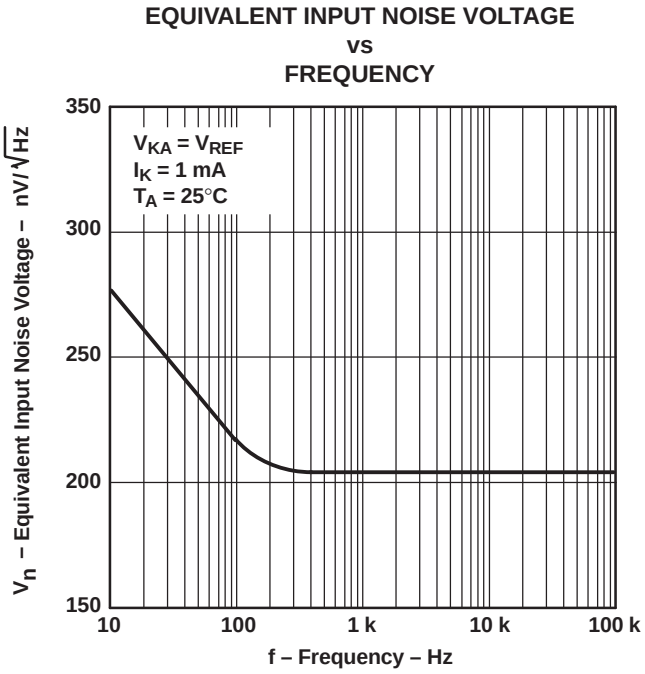
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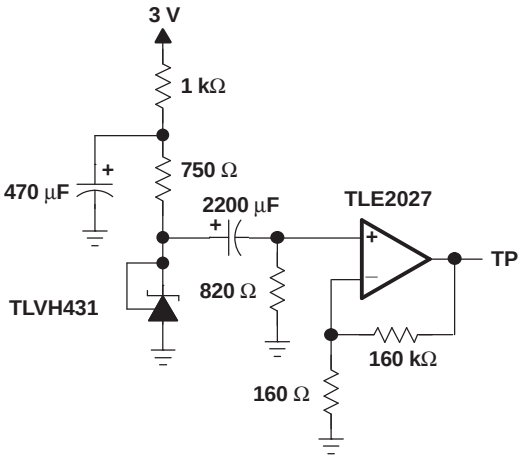
## PARAMETER MEASUREMENT INFORMATION (continued)




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

**Figure 10.**



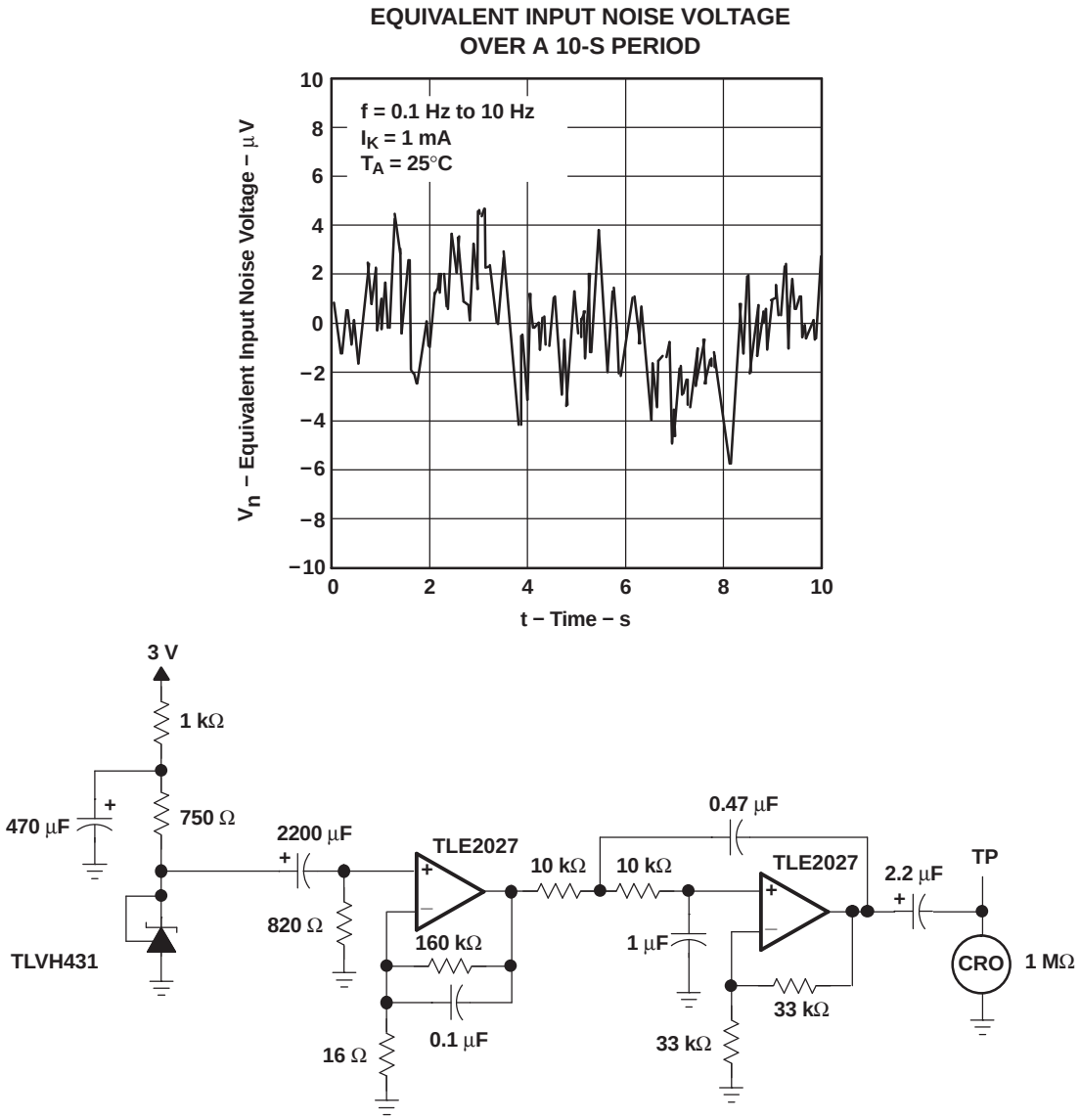




TEST CIRCUIT FOR EQUIVALENT INPUT NOISE VOLTAGE

**Figure 11.**


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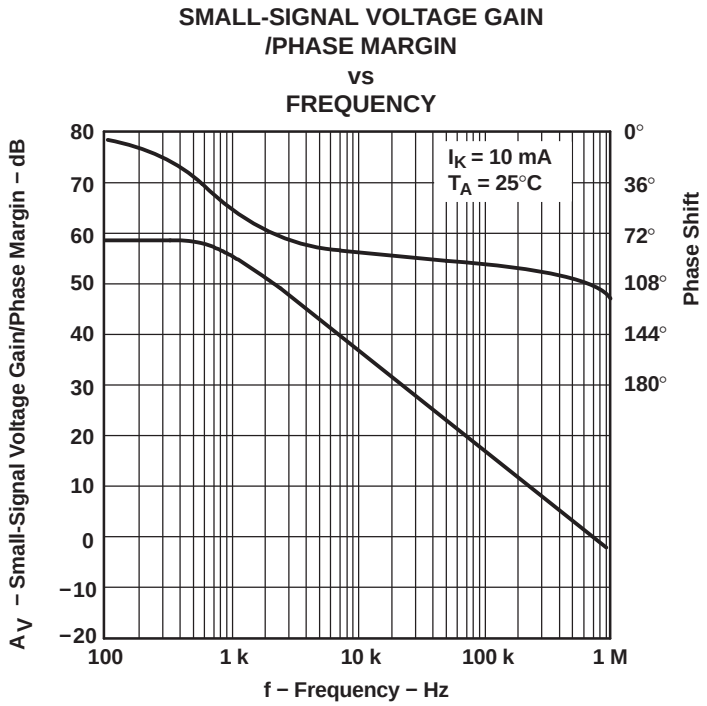
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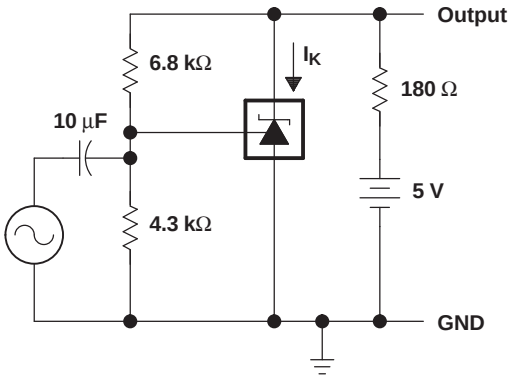



TEST CIRCUIT FOR 0.1-Hz TO 10-Hz EQUIVALENT NOISE VOLTAGE

**Figure 12.**

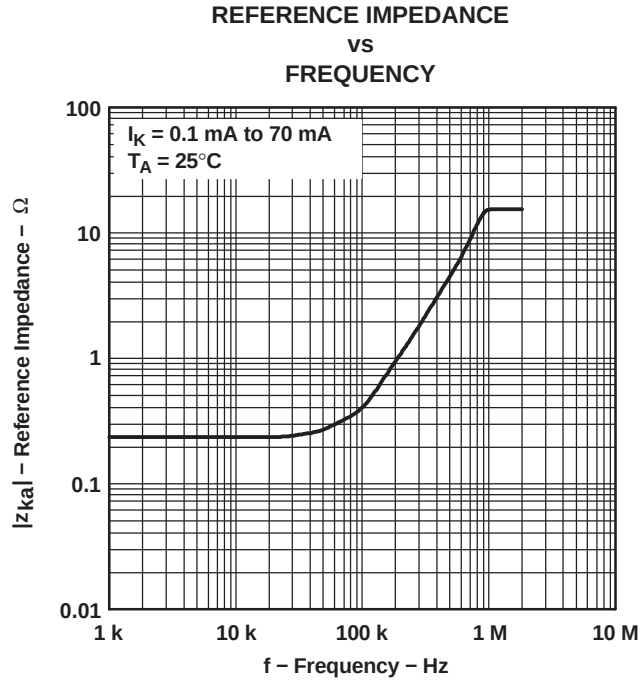
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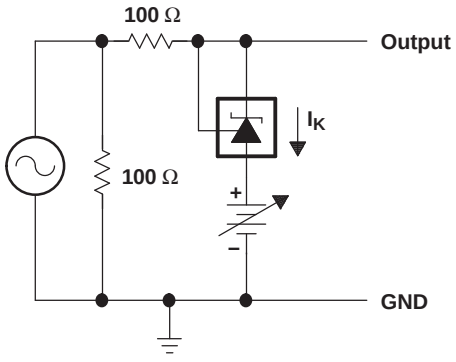



TEST CIRCUIT FOR VOLTAGE GAIN
AND PHASE MARGIN

**Figure 13.**



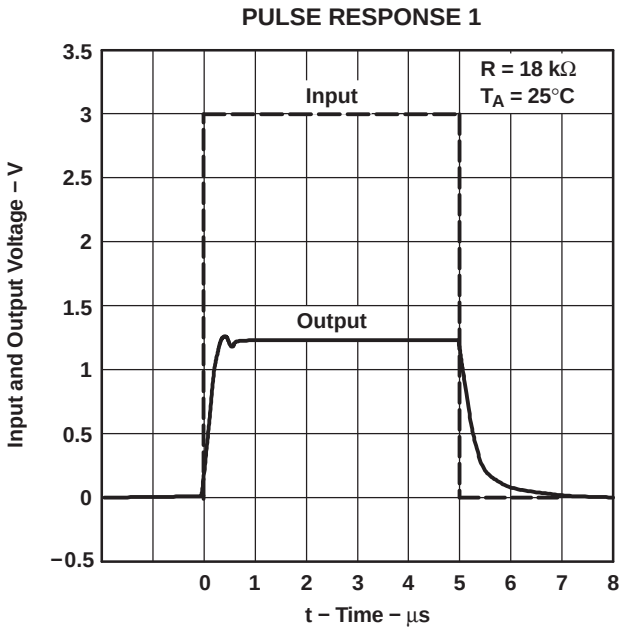



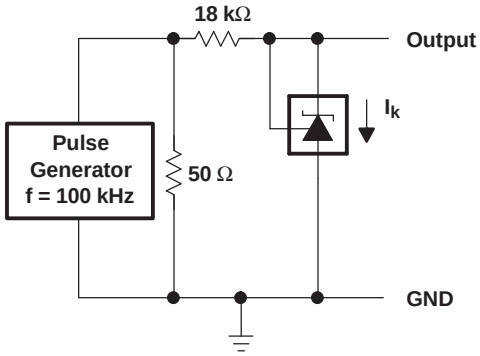

TEST CIRCUIT FOR REFERENCE IMPEDANCE

**Figure 14.**


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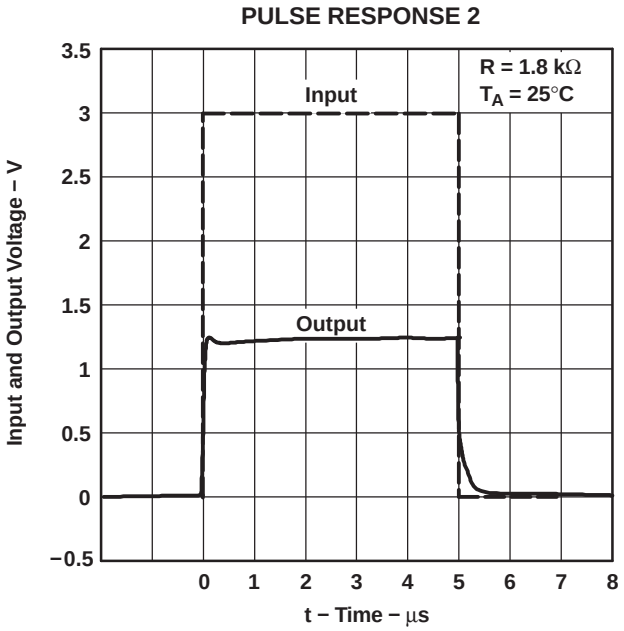
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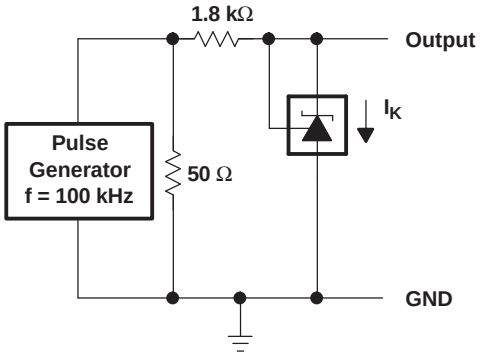



TEST CIRCUIT FOR PULSE RESPONSE 1

**Figure 15.**




TEST CIRCUIT FOR PULSE RESPONSE 2

**Figure 16.**

## PARAMETER MEASUREMENT INFORMATION (continued)

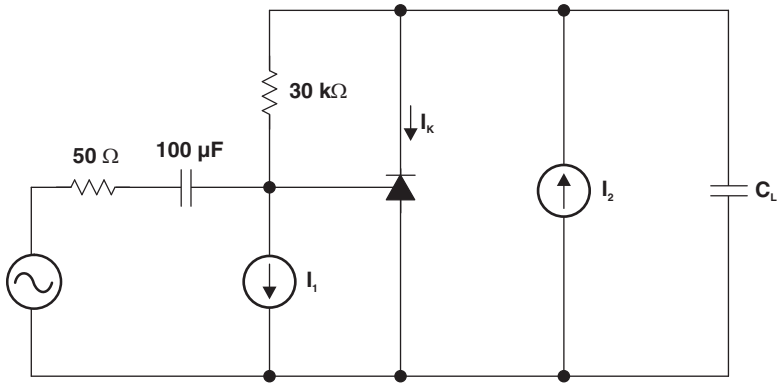



**Figure 17. Phase Margin Test Circuit**

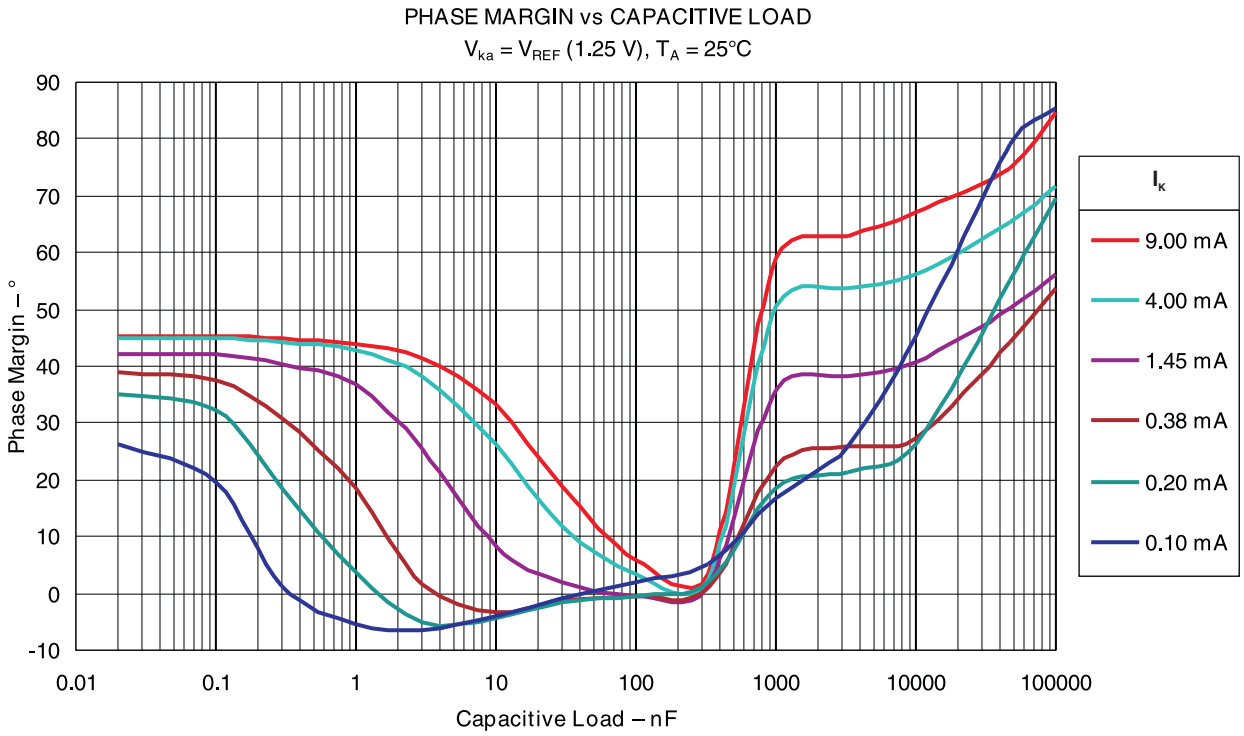



**Figure 18.**


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## PARAMETER MEASUREMENT INFORMATION (continued)

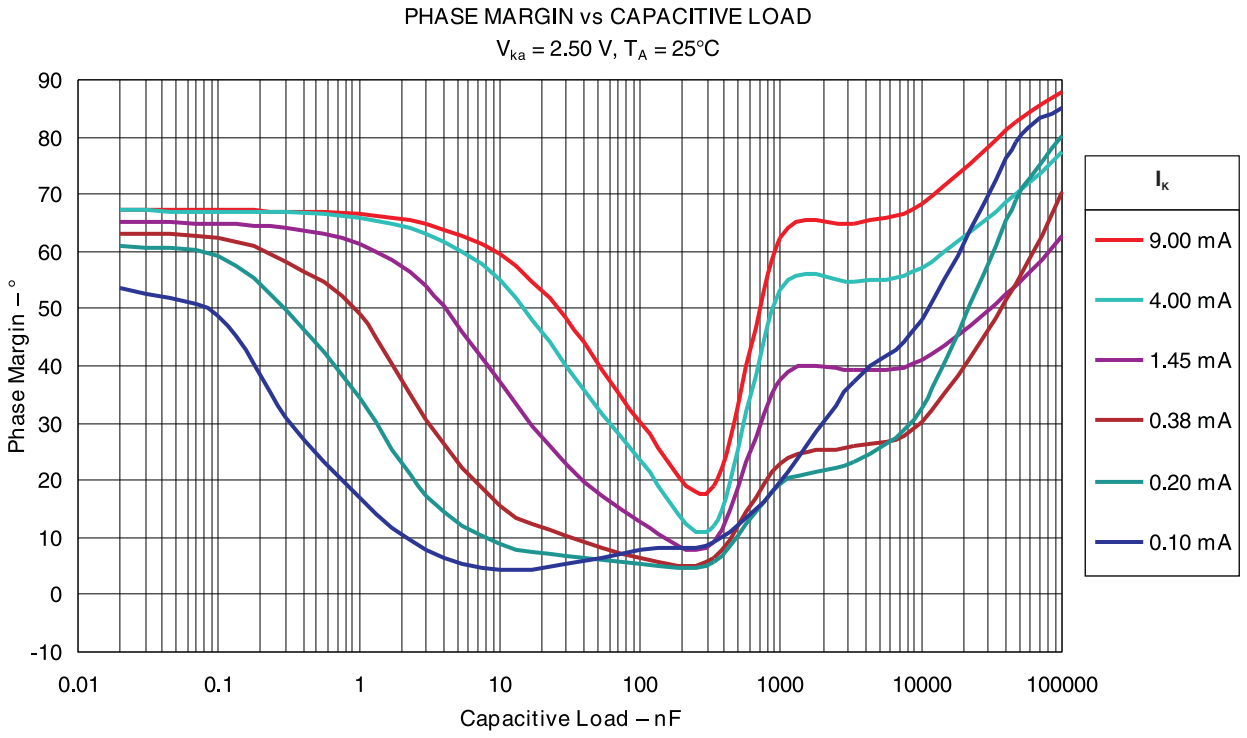



**Figure 19.**

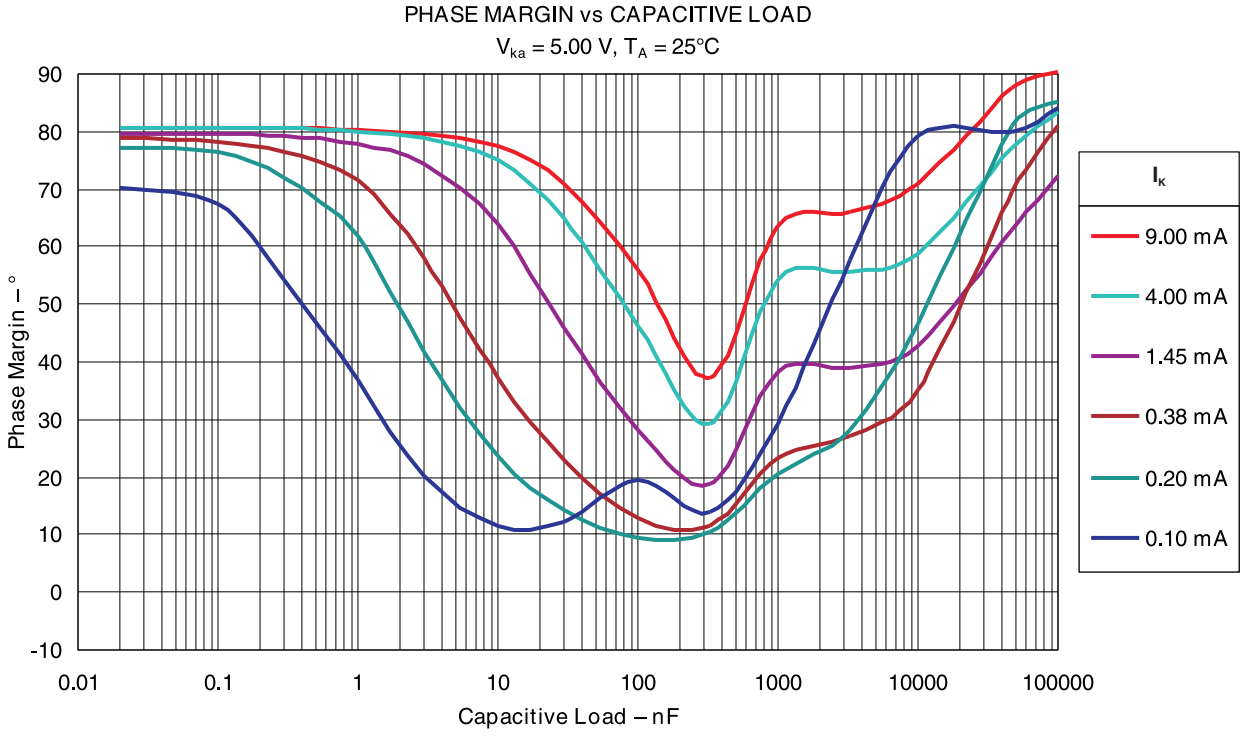



**Figure 20.**

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## APPLICATION INFORMATION

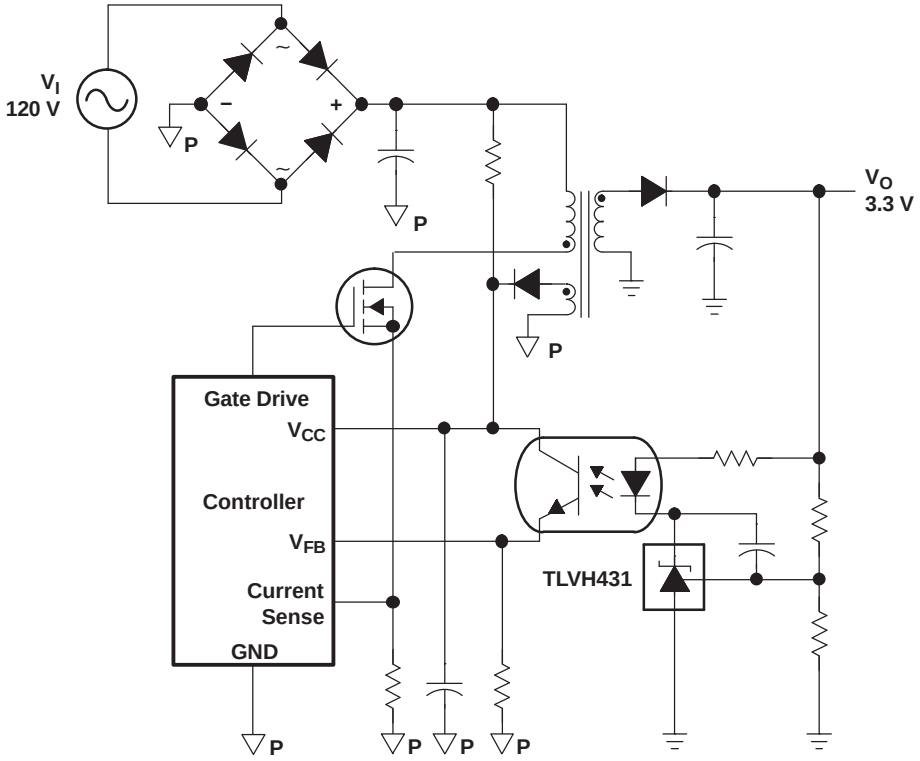



**Figure 21. Flyback With Isolation Using TLVH431 as Voltage Reference and Error Amplifier**

Figure 21 shows the TLVH431 used in a 3.3-V isolated flyback supply. Output voltage $V_O$ can be as low as reference voltage $V_{REF}$ (1.24 V). The output of the regulator plus the forward voltage drop of the optocoupler LED (1.24 + 1.4 = 2.64 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 21.


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## PACKAGING INFORMATION

| Orderable part number | Status (1) | Material type (2) | Package \| Pins | Package qty \| Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|---|---|---|---|---|---|---|---|---|---|
| TLVH431AQDBVRQ1 | Active | Production | SOT-23 (DBV) \| 5 | 3000 \| LARGE T&R | Yes | NIPDAU \| SN | Level-1-260C-UNLIM | -40 to 125 | VOOQ |
| TLVH431AQDBVRQ1.A | Active | Production | SOT-23 (DBV) \| 5 | 3000 \| LARGE T&R | Yes | SN | Level-1-260C-UNLIM | -40 to 125 | VOOQ |
| TLVH431BQDBVRQ1 | Active | Production | SOT-23 (DBV) \| 5 | 3000 \| LARGE T&R | Yes | NIPDAU \| SN | Level-1-260C-UNLIM | -40 to 125 | VOPQ |
| TLVH431BQDBVRQ1.A | Active | Production | SOT-23 (DBV) \| 5 | 3000 \| LARGE T&R | Yes | SN | Level-1-260C-UNLIM | -40 to 125 | VOPQ |
| TLVH431BQDBZRQ1 | Active | Production | SOT-23 (DBZ) \| 3 | 3000 \| LARGE T&R | Yes | NIPDAU \| SN | Level-1-260C-UNLIM | -40 to 125 | VPIQ |
| TLVH431BQDBZRQ1.A | Active | Production | SOT-23 (DBZ) \| 3 | 3000 \| LARGE T&R | Yes | SN | Level-1-260C-UNLIM | -40 to 125 | VPIQ |
| TLVH431BQDBZRQ1G4 | Active | Production | SOT-23 (DBZ) \| 3 | 3000 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | VPIQ |
| TLVH431BQDBZRQ1G4.A | Active | Production | SOT-23 (DBZ) \| 3 | 3000 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | VPIQ |

(1) **Status:** For more details on status, see our product life cycle.

(2) **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.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **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.

(5) **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.

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

**OTHER QUALIFIED VERSIONS OF TLVH431A-Q1, TLVH431B-Q1 :**

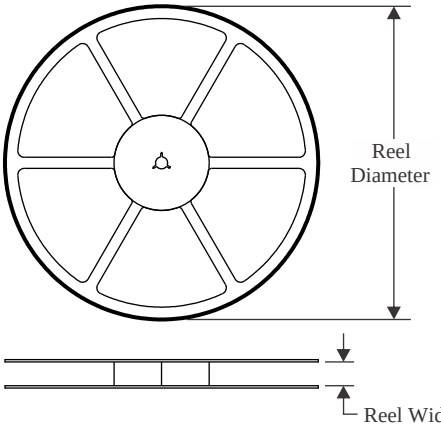
- Catalog : TLVH431A, TLVH431B
- Enhanced Product : TLVH431B-EP

NOTE: Qualified Version Definitions:

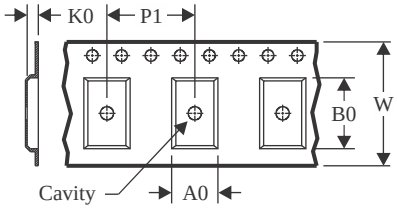
- Catalog - TI's standard catalog product
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

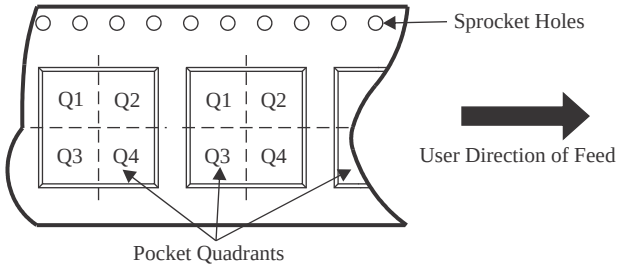



**TAPE DIMENSIONS**




| | |
|---|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

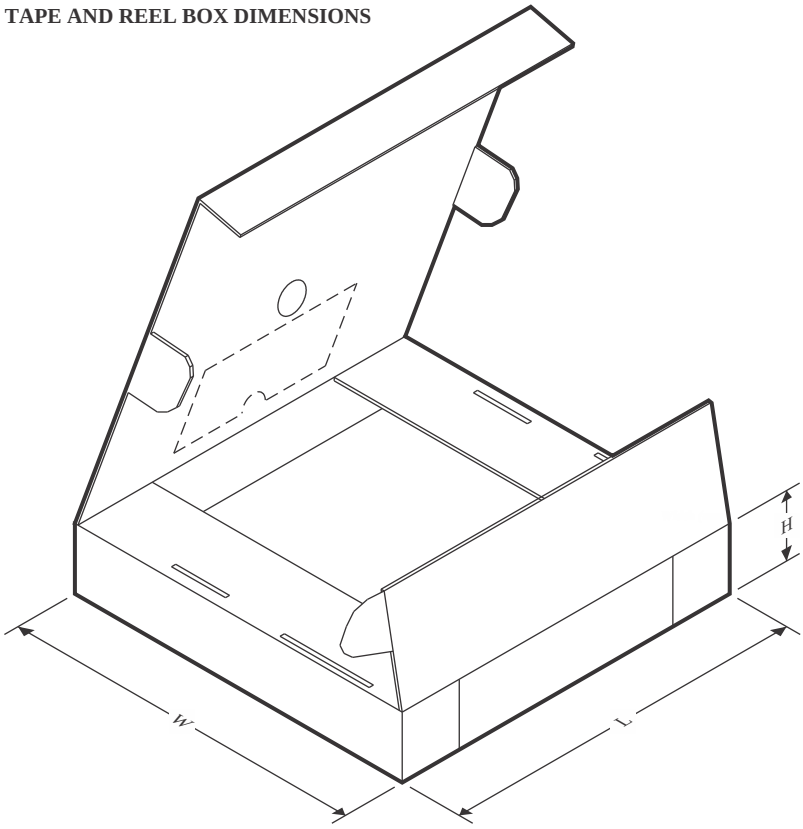
**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**




*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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TLVH431AQDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLVH431AQDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLVH431AQDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 179.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLVH431BQDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLVH431BQDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 179.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLVH431BQDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLVH431BQDBZRQ1 | SOT-23 | DBZ | 3 | 3000 | 179.0 | 8.4 | 3.15 | 2.95 | 1.22 | 4.0 | 8.0 | Q3 |
| TLVH431BQDBZRQ1 | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.2 | 2.85 | 1.3 | 4.0 | 8.0 | Q3 |
| TLVH431BQDBZRQ1G4 | SOT-23 | DBZ | 3 | 3000 | 179.0 | 8.4 | 3.15 | 2.95 | 1.22 | 4.0 | 8.0 | Q3 |

TAPE AND REEL BOX DIMENSIONS




*All dimensions are nominal

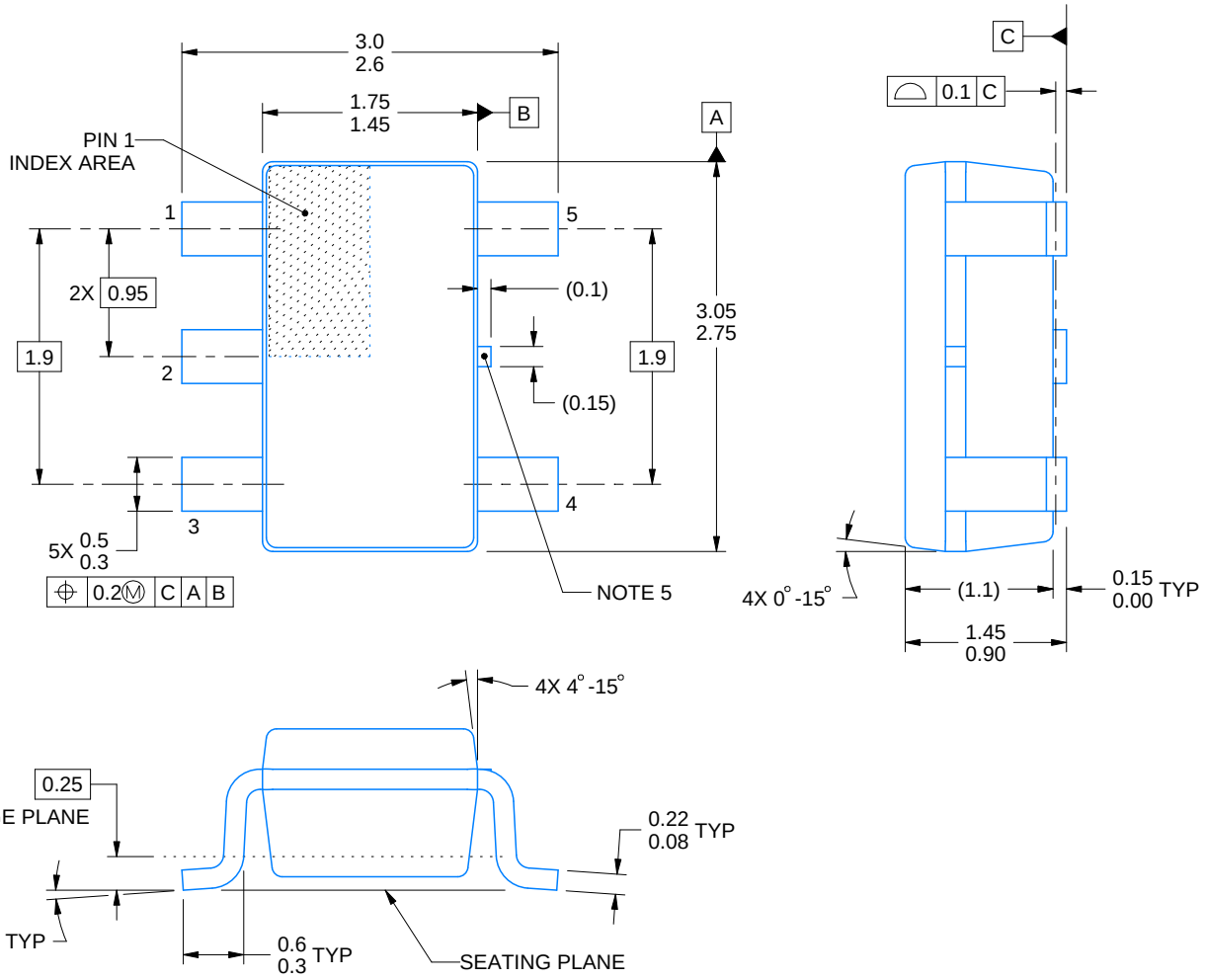
| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| TLVH431AQDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 210.0 | 185.0 | 35.0 |
| TLVH431AQDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 210.0 | 185.0 | 35.0 |
| TLVH431AQDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 200.0 | 183.0 | 25.0 |
| TLVH431BQDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 210.0 | 185.0 | 35.0 |
| TLVH431BQDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 200.0 | 183.0 | 25.0 |
| TLVH431BQDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 210.0 | 185.0 | 35.0 |
| TLVH431BQDBZRQ1 | SOT-23 | DBZ | 3 | 3000 | 200.0 | 183.0 | 25.0 |
| TLVH431BQDBZRQ1 | SOT-23 | DBZ | 3 | 3000 | 210.0 | 185.0 | 35.0 |
| TLVH431BQDBZRQ1G4 | SOT-23 | DBZ | 3 | 3000 | 200.0 | 183.0 | 25.0 |

# PACKAGE OUTLINE

## DBV0005A

## SOT-23 - 1.45 mm max height

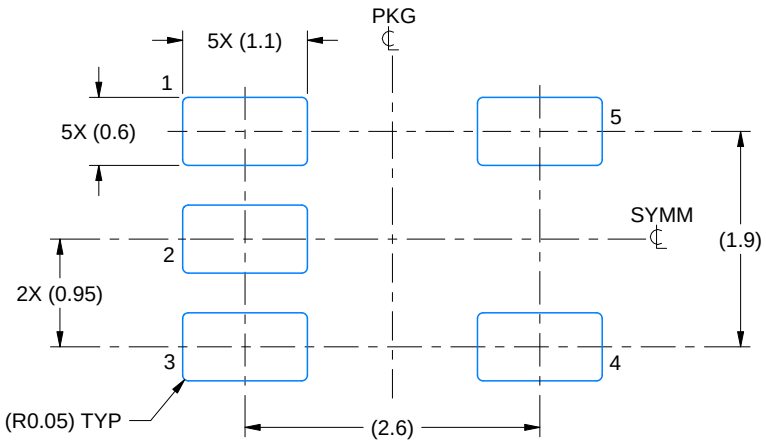
SMALL OUTLINE TRANSISTOR



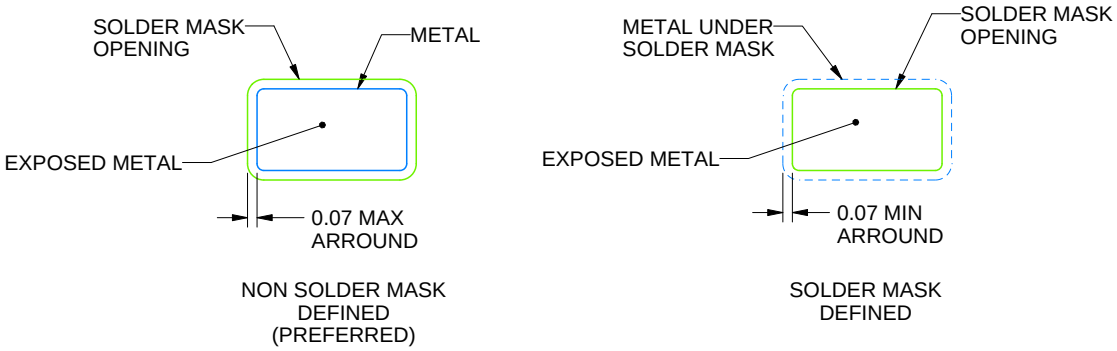

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NOTES:

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. Refernce JEDEC MO-178.
4. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25 mm per side.
5. Support pin may differ or may not be present.




LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X

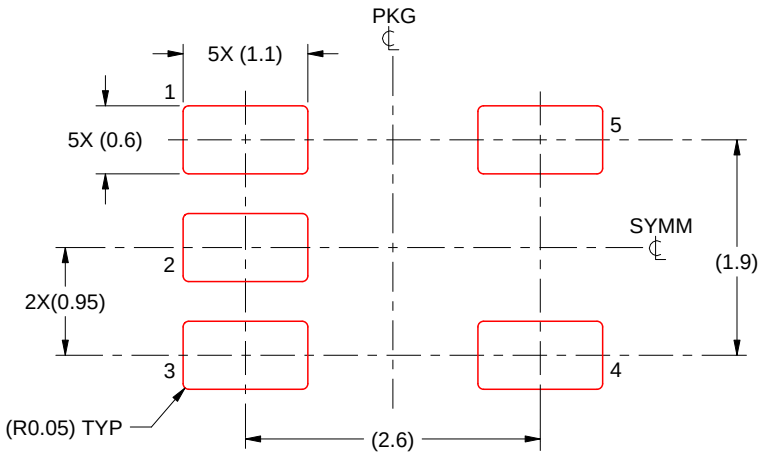



SOLDER MASK DETAILS

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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.




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

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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.

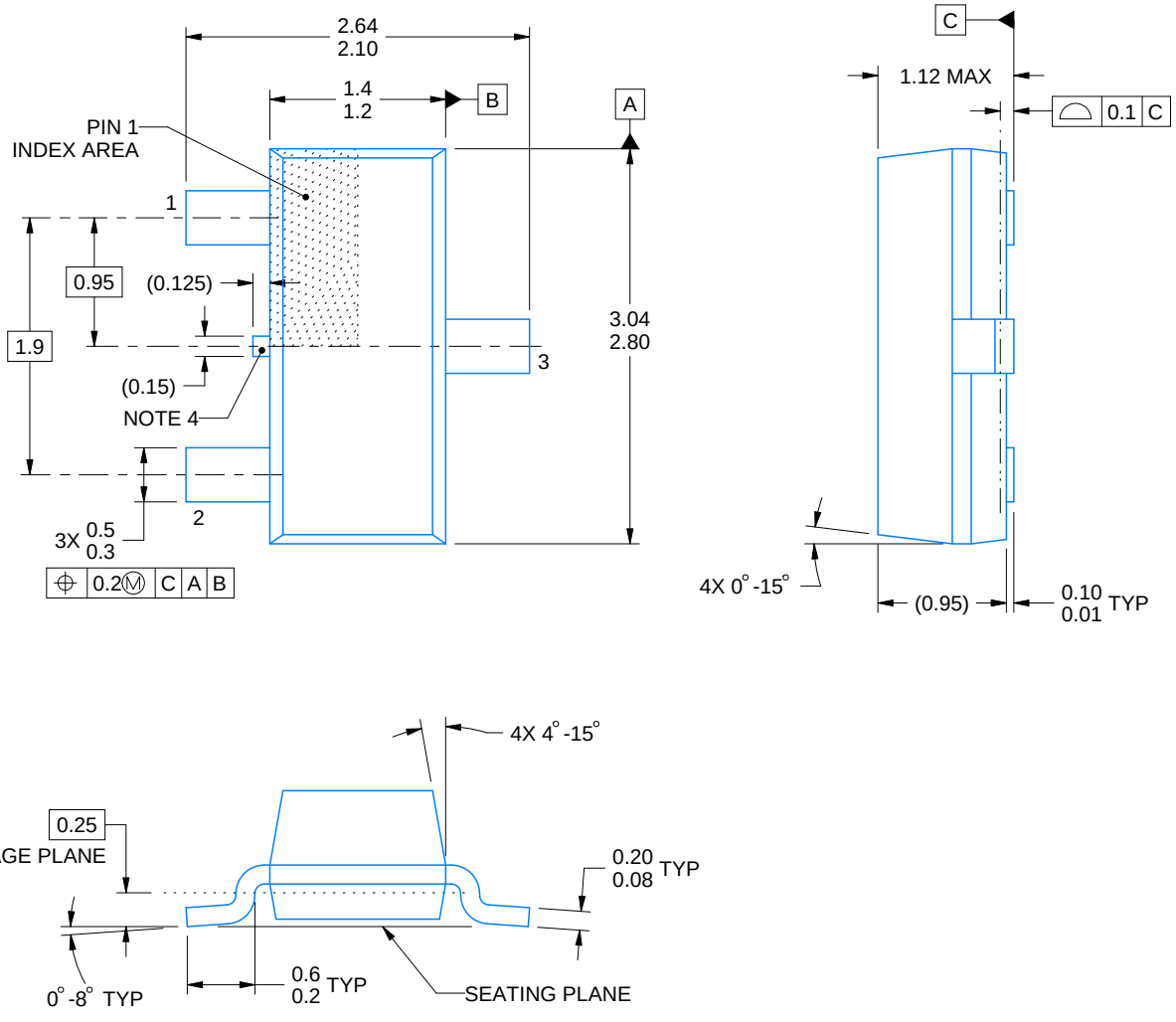
# PACKAGE OUTLINE

## DBZ0003A



## SOT-23 - 1.12 mm max height

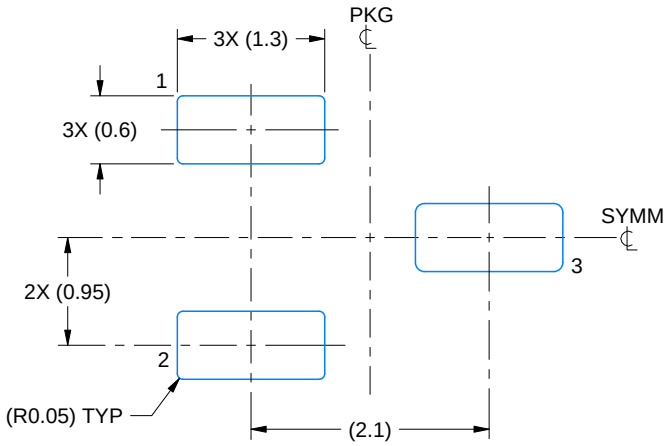
SMALL OUTLINE TRANSISTOR



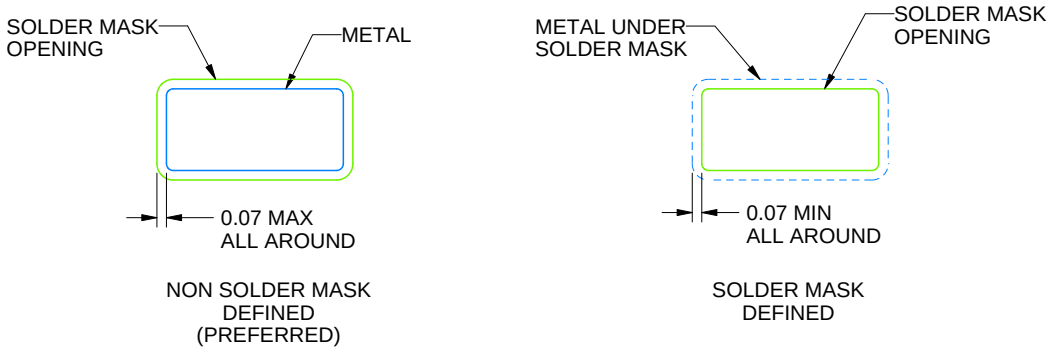

4214838/F 08/2024

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




LAND PATTERN EXAMPLE
SCALE:15X

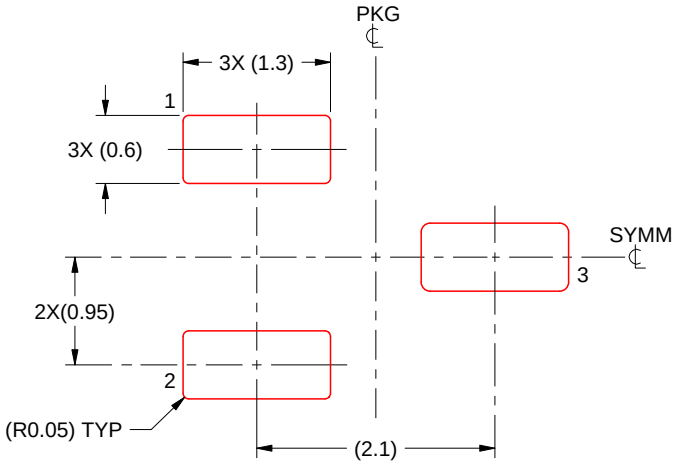



SOLDER MASK DETAILS

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.




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.

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