TLVH431, TLVH432 Low-Voltage Adjustable Precision Shunt Regulators

1 Features

- Low-voltage operation: down to 1.24V
- Reference voltage tolerances at 25°C
  - 0.5% for B grade
  - 1% for A grade
  - 1.5% for standard grade
- Adjustable output voltage, $V_O = V_{REF}$ to 18V
- Wide operating cathode current range: 100µA to 70mA
- 0.25Ω typical output impedance
- –40°C to +125°C specifications
- TLVH432 provides alternative pinouts for SOT-23-3 and SOT-89 packages
- Ultra-small SC-70 package offers 40% smaller footprint than SOT-23-3

2 Applications

- Adjustable voltage reference for data Converters
- Secondary side regulation in flyback SMPSs
- Zener replacement with low leakage current
- Voltage monitoring for power rails
- Comparator with integrated reference

3 Description

The TLVH431 and TLVH432 devices are low-voltage 3-terminal adjustable voltage references, with specified thermal stability over applicable industrial and commercial temperature ranges. Output voltage can be set to any value between V_{REF} (1.24V) and 18V with two external resistors (see Figure 6-2). These devices operate from a lower voltage (1.24V) than the widely used TL431 and TL1431 shunt-regulator references.

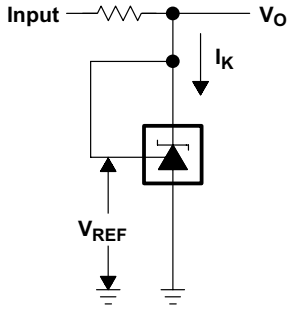
When used with an optocoupler, the TLVH431 and TLVH432 devices are an excellent choice for voltage references in isolated feedback circuits for 3V to 3.3V switching-mode power supplies. The devices have a typical output impedance of 0.25Ω. Active output circuitry provides a very sharp turn-on characteristic, making the TLVH431 and TLVH432 devices excellent replacements for low-voltage Zener diodes in many applications, including on-board regulation and adjustable power supplies.

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

Device Information

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

(1) For all available packages, see the orderable addendum at the end of the data sheet.
(2) The package size (length × width) is a nominal value and includes pins, where applicable.



Simplified Schematic

An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

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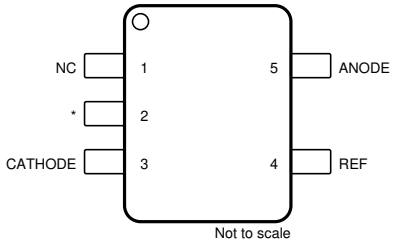
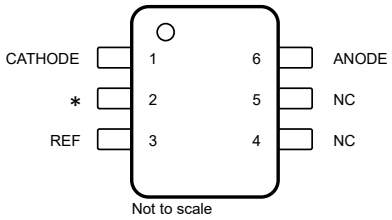
4 Pin Configuration and Functions



NC – No internal connection

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

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



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

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

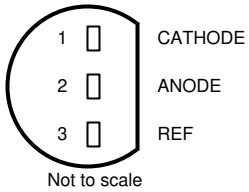


Figure 4-3. TLVH431 LP Package 3-Pin TO-92 Top View

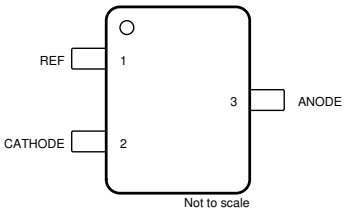


Figure 4-4. TLVH431 DBZ Package 3-Pin SOT-23 Top View

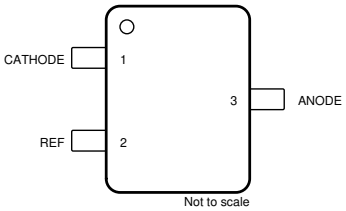


Figure 4-5. TLVH432 DBZ Package 3-Pin SOT-23 Top View

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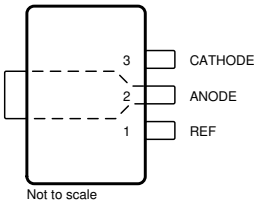

Figure 4-6. TLVH431 PK Package 3-Pin SOT-89 Top View

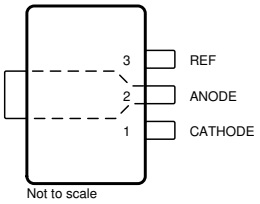

Figure 4-7. TLVH432 PK Package 3-Pin SOT-89 Top View

Pin Functions

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

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5 Specifications

5.1 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.

5.2 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 500V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250V CDM allows safe manufacturing with a standard ESD control process.

5.3 Recommended Operating Conditions

See(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 $P_D = (T_J(max) – T_A) / \theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.

5.4 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	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	259	52	206	206	140	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	87	9	131	76	55	°C/W

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

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5.5 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 = 10mA	T_A = 25°C		1.222	1.24	1.258	V
			T_A = full range, See Figure 6-1 (1)	TLVH431C	1.21		1.27	
				TLVH431I	1.202		1.278	
				TLVH431Q	1.194		1.286	
$V_{REF(dev)}$	V_{REF} deviation over full temperature range(2)	$V_{KA} = V_{REF}$, I_K = 10mA, See Figure 6-1 (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 = 10mA, $V_K = V_{REF}$ to 18V, See Figure 6-2				–1.5	–2.7	mV/V
I_{ref}	Reference terminal current	I_K = 10mA, R1 = 10kΩ, R2 = open, See Figure 6-2				0.1	0.5	µA
$I_{ref(dev)}$	I_{ref} deviation over full temperature range(2)	I_K = 10mA, R1 = 10kΩ, R2 = open, See Figure 6-2 (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 6-1				60	100	µA
$I_{K(off)}$	Off-state cathode current	V_{REF} = 0, V_{KA} = 18V, See Figure 6-3				0.02	0.1	µA
$\|z_{KA}\|$	Dynamic impedance(3)	$V_{KA} = V_{REF}$, f ≤ 1kHz, I_K = 0.1mA to 70mA, See Figure 6-1				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:

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

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:

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

When the device is operating with two external resistors (see Figure 6-2), the total dynamic impedance of the circuit is defined as:

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

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5.6 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 = 10mA	T_A = 25°C		1.228	1.24	1.252	V
			T_A = full range, See Figure 6-1 (1)	TLVH431AC	1.221		1.259	
				TLVH431AI	1.215		1.265	
				TLVH431AQ	1.209		1.271	
$V_{REF(dev)}$	V_{REF} deviation over full temperature range(2)	$V_{KA} = V_{REF}$, I_K = 10mA, See Figure 6-1 (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 18V, I_K = 10mA, See Figure 6-2				–1.5	–2.7	mV/V
I_{ref}	Reference terminal current	I_K = 10mA, R1 = 10kΩ, R2 = open, See Figure 6-2				0.1	0.5	µA
$I_{ref(dev)}$	I_{ref} deviation over full temperature range(2)	I_K = 10mA, R1 = 10kΩ, R2 = open, See Figure 6-2 (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 6-1				60	100	µA
$I_{K(off)}$	Off-state cathode current	V_{REF} = 0, V_{KA} = 18V, See Figure 6-3				0.02	0.1	µA
$\|z_{KA}\|$	Dynamic impedance(3)	$V_{KA} = V_{REF}$, f ≤ 1kHz, I_K = 0.1mA to 70mA, See Figure 6-1				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:

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

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:

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

When the device is operating with two external resistors (see Figure 6-2), the total dynamic impedance of the circuit is defined as:

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

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5.7 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 = 10mA	T_A = 25°C		1.234	1.24	1.246	V
			T_A = full range, See Figure 6-1 (1)	TLVH431BC	1.227		1.253	
				TLVH431BI	1.224		1.259	
				TLVH431BQ	1.221		1.265	
$V_{REF(dev)}$	V_{REF} deviation over full temperature range(2)	$V_{KA} = V_{REF}$, I_K = 10mA, See Figure 6-1 (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 = 10mA, $V_K = V_{REF}$ to 18V, See Figure 6-2				–1.5	–2.7	mV/V
I_{ref}	Reference terminal current	I_K = 10mA, R1 = 10kΩ, R2 = open, See Figure 6-2				0.1	0.5	µA
$I_{ref(dev)}$	I_{ref} deviation over full temperature range(2)	I_K = 10mA, R1 = 10kΩ, R2 = open, See Figure 6-2 (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 6-1				60	100	µA
$I_{K(off)}$	Off-state cathode current	V_{REF} = 0, V_{KA} = 18V, See Figure 6-3				0.02	0.1	µA
$\|z_{KA}\|$	Dynamic impedance(3)	$V_{KA} = V_{REF}$, f ≤ 1kHz, I_K = 0.1mA to 70mA, See Figure 6-1				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:

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

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:

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

When the device is operating with two external resistors (see Figure 6-2), the total dynamic impedance of the circuit is defined as:

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

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5.8 Typical Characteristics

Operation of the device at these or any other conditions beyond those indicated in the *Section 5.3* table are not implied.

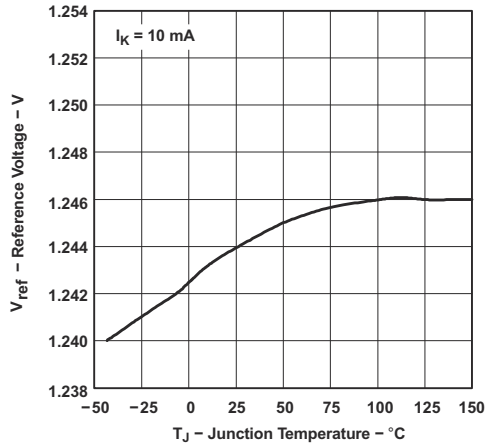

Figure 5-1. Reference Voltage vs Junction Temperature

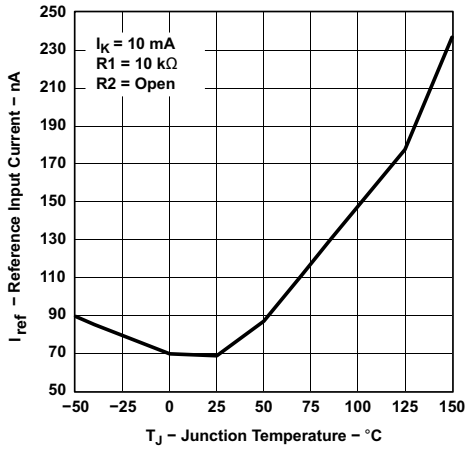

Figure 5-2. Reference Input Current vs Junction Temperature

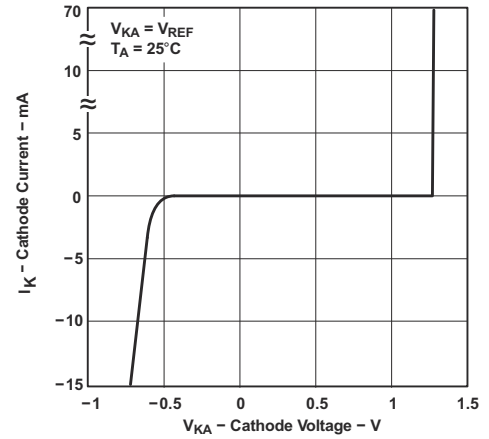

Figure 5-3. Cathode Current vs Cathode Voltage

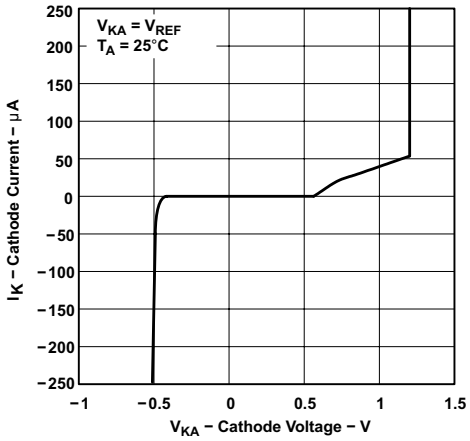

Figure 5-4. Cathode Current vs Cathode Voltage

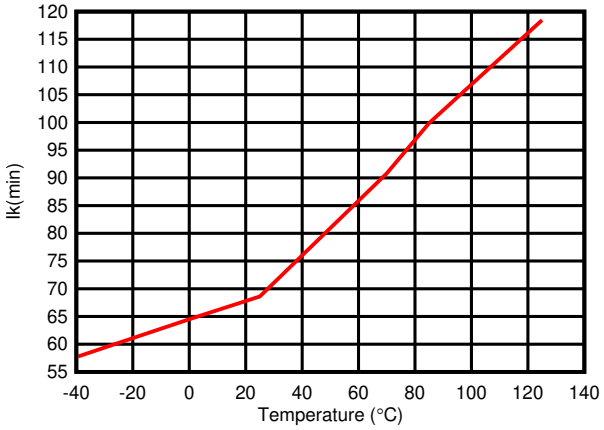

Figure 5-5. Minimum Cathode Current vs. Temperature

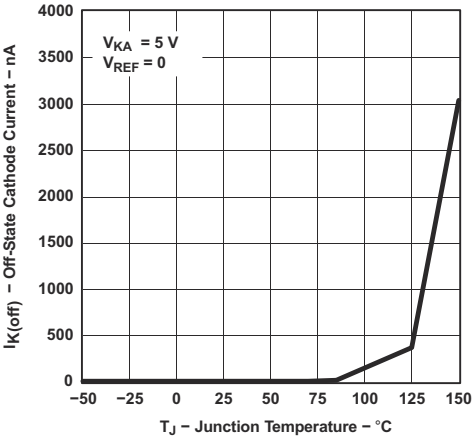

Figure 5-6. Off-State Cathode Current vs Junction Temperature

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5.8 Typical Characteristics (continued)

Operation of the device at these or any other conditions beyond those indicated in the *Section 5.3* table are not implied.

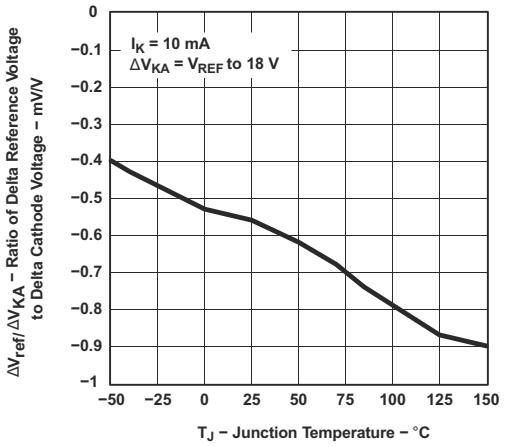
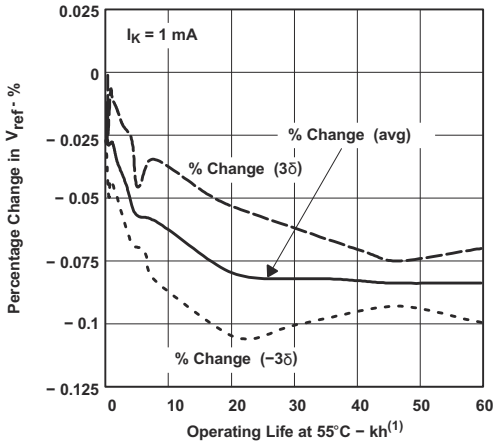


Figure 5-7. Ratio of Delta Reference Voltage to Delta Cathode Voltage vs Junction Temperature



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

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

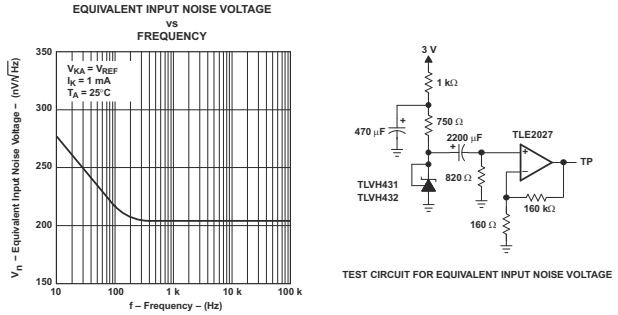


Figure 5-9. Equivalent Input Noise Voltage

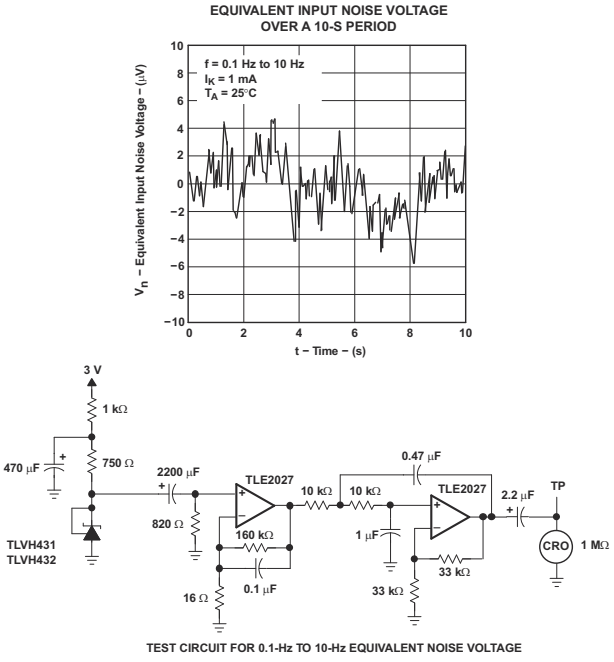


Figure 5-10. Equivalent Input Noise Voltage

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5.8 Typical Characteristics (continued)

Operation of the device at these or any other conditions beyond those indicated in the *Section 5.3* table are not implied.

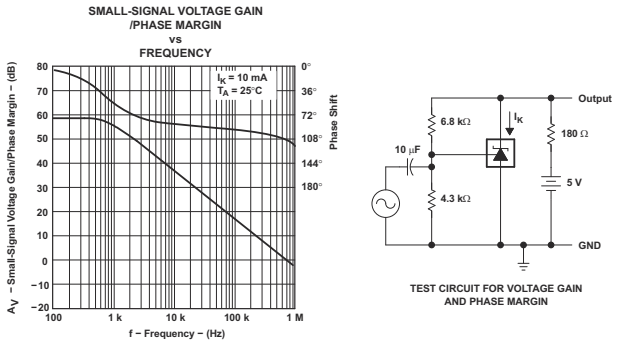

Figure 5-11. Voltage Gain and Phase Margin

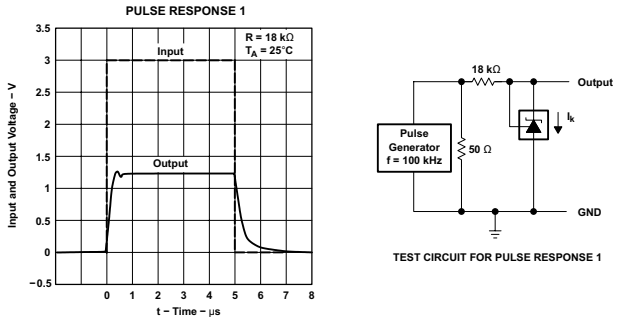

Figure 5-12. Pulse Response 1

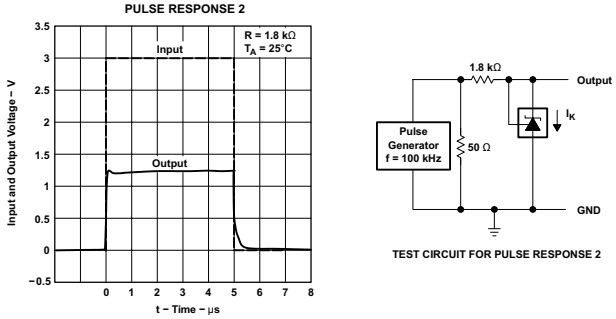

Figure 5-13. Pulse Response 2

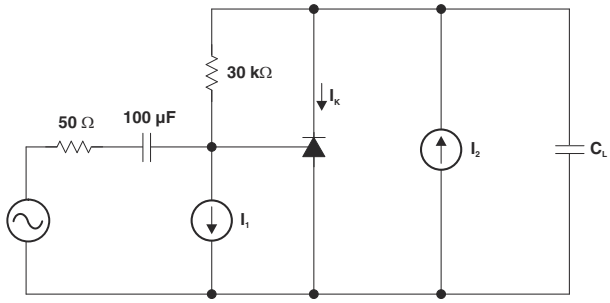

Figure 5-14. Phase Margin Test Circuit

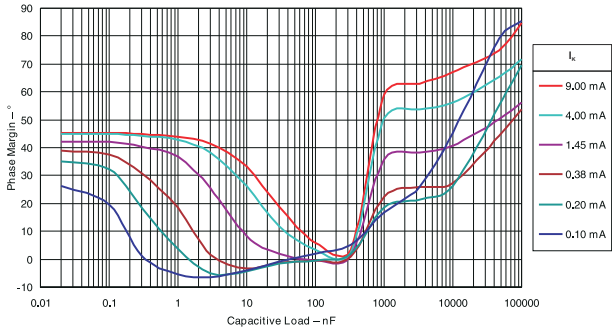

Figure 5-15. Phase Margin vs Capacitive Load V_{KA} = V_{REF} (1.25 V), T_A= 25°C

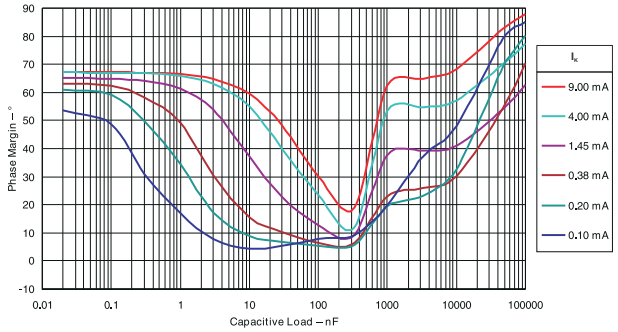

Figure 5-16. Phase Margin vs Capacitive Load V_{KA} = 2.50V, T_A= 25°C

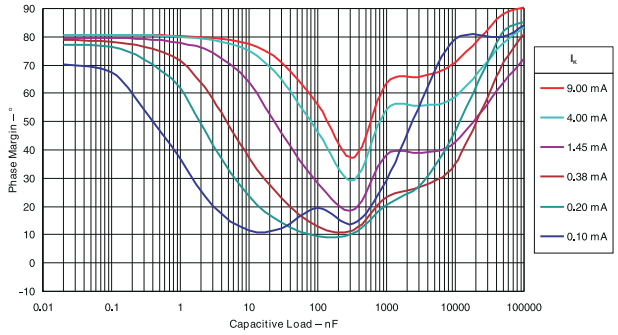

Figure 5-17. Phase Margin vs Capacitive Load V_{KA} = 5.00V, T_A= 25°C

6 Parameter Measurement Information

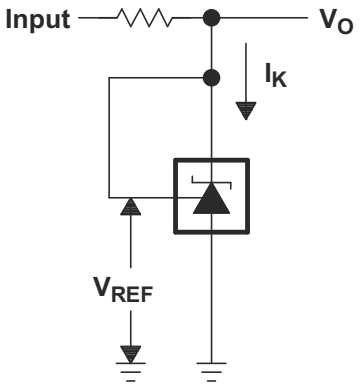

Figure 6-1. Test Circuit for $V_{KA} = V_{REF}$, $V_O = V_{KA} = V_{REF}$

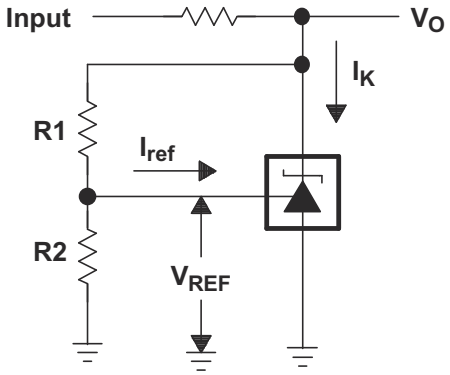

Figure 6-2. Test Circuit for $V_{KA} > V_{REF}$, $V_O = V_{KA} = V_{REF} \times (1 + R1/R2) + I_{ref} \times R1$

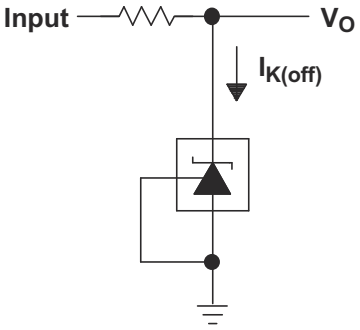

Figure 6-3. Test Circuit for $I_{K(off)}$

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7 Detailed Description

7.1 Overview

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

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

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

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

7.2 Functional Block Diagram

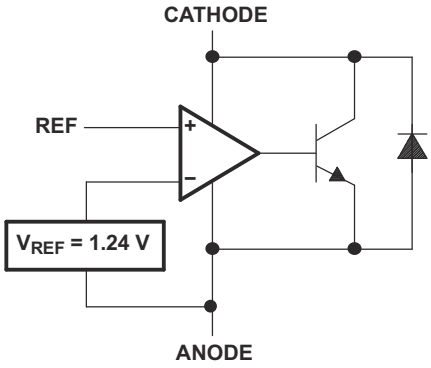

Figure 7-1. Equivalent Schematic

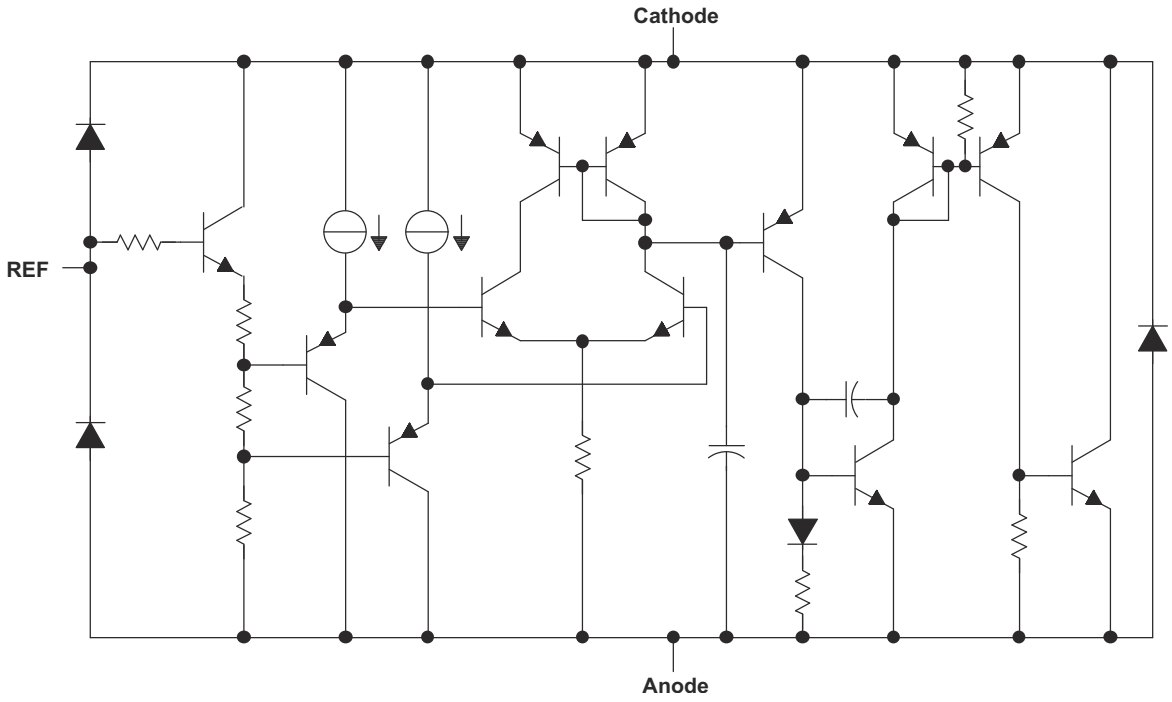

Figure 7-2. Detailed Schematic

7.3 Feature Description

TLVH431 consists of an internal reference and amplifier that outputs a sink current base on the difference between the reference pin and the virtual internal pin. The sink current is produced by an internal Darlington pair.

When operated with enough voltage headroom (≥ 1.24V) and cathode current (I_{ka}), TLVH431 forces the reference pin to 1.24V. However, the reference pin can not be left floating, as it needs Iref ≥ 0.5µA (see *Section 5*). This is because the reference pin is driven into an NPN, which needs base current in order operate properly.

When feedback is applied from the Cathode and Reference pins, TLVH431 behaves as a Zener diode, regulating to a constant voltage dependent on current being supplied into the cathode. This is due to the internal amplifier and reference entering the proper operating regions. The same amount of current needed in the above feedback situation must be applied to this device in open loop, servo or error amplifying implementations for it to be in the proper linear region giving TLVH431 enough gain.

Unlike many linear regulators, TLVH431 is internally compensated to be stable without an output capacitor between the cathode and anode. However, if it is desired to use an output capacitor Figure 5-15, Figure 5-16, and Figure 5-17 can be used as a guide to assist in choosing the correct capacitor to maintain stability.

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7.4 Device Functional Modes

7.4.1 Open Loop (Comparator)

When the cathode/output voltage or current of TLVH431 is not being fed back to the reference/input pin in any form, this device is operating in open loop. With proper cathode current (I_{ka}) applied to this device, TLVH431 has the characteristics shown in Figure 5-4. With such high gain in this configuration, the TLVH431 device is typically used as a comparator. With the reference integrated makes TLVH431 the preferred choice when users are trying to monitor a certain level of a single signal.

7.4.2 Closed Loop

When the cathode/output voltage or current of TLVH431 is being fed back to the reference/input pin in any form, this device is operating in closed loop. The majority of applications involving TLVH431 use it in this manner to regulate a fixed voltage or current. The feedback enables this device to behave as an error amplifier, computing a portion of the output voltage and adjusting it to maintain the desired regulation. This is done by relating the output voltage back to the reference pin in a manner to make it equal to the internal reference voltage, which can be accomplished through resistive or direct feedback.

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8 Applications and Implementation

Note

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

8.1 Application Information

Figure 8-1 shows the TLVH431, TLVH431A, or TLVH431B used in a 3.3-V isolated flyback supply. Output voltage V_O can be as low as reference voltage V_{REF} (1.24V ± 1%). The output of the regulator, plus the forward voltage drop of the optocoupler LED (1.24 + 1.4 = 2.64V), determine the minimum voltage that can be regulated in an isolated supply configuration. Regulated voltage as low as 2.7 Vdc is possible in the topology shown in Figure 8-1.

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

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

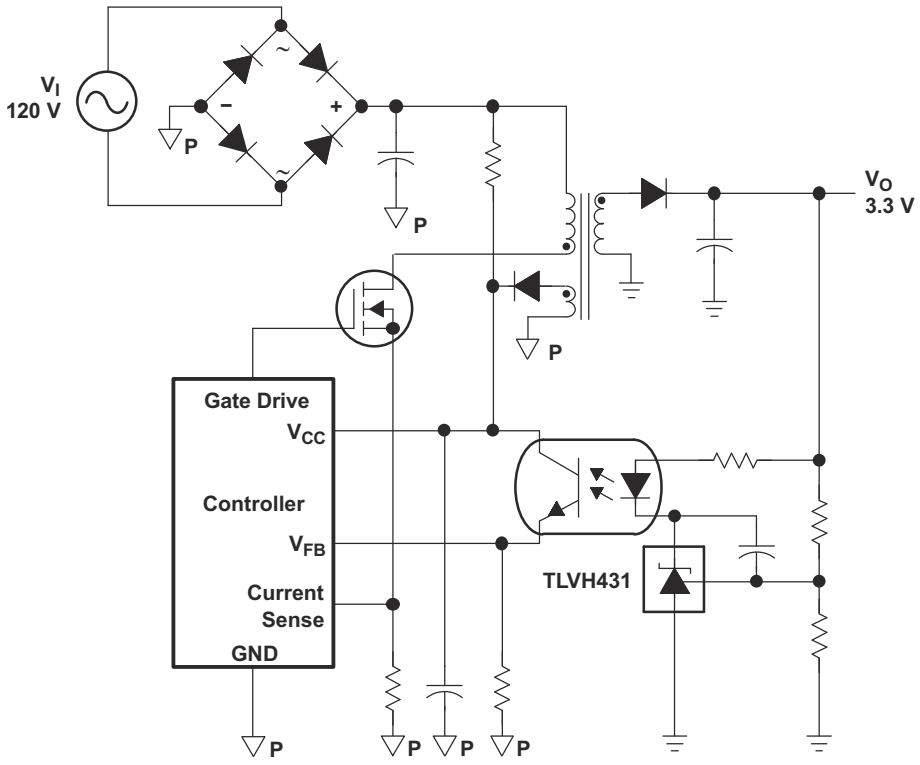

Figure 8-1. Flyback With Isolation Using TLVH431 or TLVH432 as Voltage Reference and Error Amplifier

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8.2 Typical Applications

8.2.1 Comparator With Integrated Reference (Open Loop)

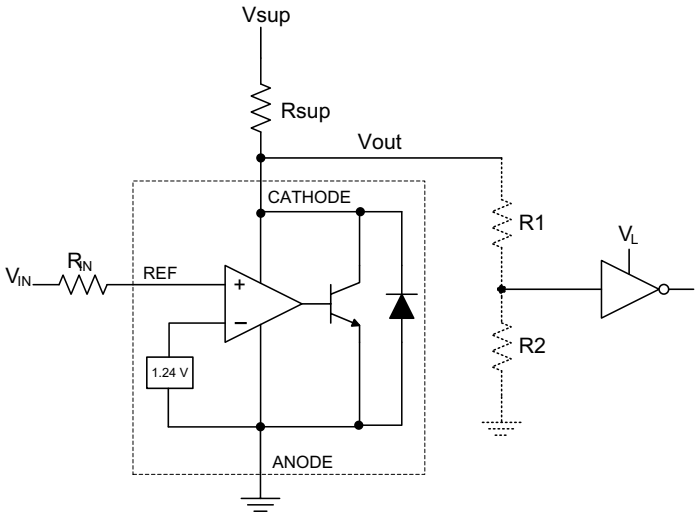

Figure 8-2. Comparator Application Schematic

8.2.1.1 Design Requirements

For this design example, use the parameters listed in Table 8-1 as the input parameters.

Table 8-1. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
Input Voltage Range	0V to 5V
Input Resistance	10kΩ
Supply Voltage	9V
Cathode Current (I_k)	500µA
Output Voltage Level	~1 V - V_{sup}
Logic Input Thresholds V_{IH}/V_{IL}	V_L

8.2.1.2 Detailed Design Procedure

When using TLVH431 as a comparator with reference, determine the following:

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

8.2.1.2.1 Basic Operation

In the configuration shown in Figure 8-2, TLVH431 behaves as a comparator, comparing the V_{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 uA and up to 150 uA over temperature, operation below that could result in low gain, leading to a slow response.

8.2.1.2.2 Overdrive

Slow or inaccurate responses can also occur when the reference pin is not provided enough overdrive voltage. This is the amount of voltage that is higher than the internal virtual reference. The internal virtual reference voltage will be within the range of 1.24V ±(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 8-3 and Figure 8-4, for the output responses to various input voltages.

For applications where TLVH431 is being used as a comparator, it is best to set the trip point to greater than the positive expected error (that is, +1.0% for the A version). For fast response, setting the trip point to > 10% of the internal V_{ref} should suffice.

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

8.2.1.2.3 Output Voltage and Logic Input Level

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

As shown in Figure 8-3 and Figure 8-4, TLVH431's output low level voltage in open-loop/comparator mode is approximately 1V, which is sufficient for some 3.3V supplied logic. However, does not work for 2.5V and 1.8V supplied logic. To accommodate this a resistive divider can be tied to the output to attenuate the output voltage to a voltage legible to the receiving low voltage logic device.

TLVH431's output high voltage is approximately V_{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 (R1 and R2 in Figure 8-2) is much greater than R_{SUP} to not interfere with TLVH431's ability to pull close to V_{SUP} when turning off.

8.2.1.2.3.1 Input Resistance

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

8.2.1.3 Application Curves

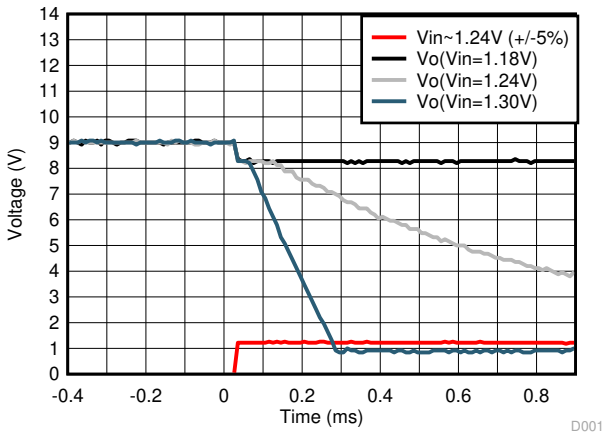

Figure 8-3. Output Response With Small Overdrive Voltages

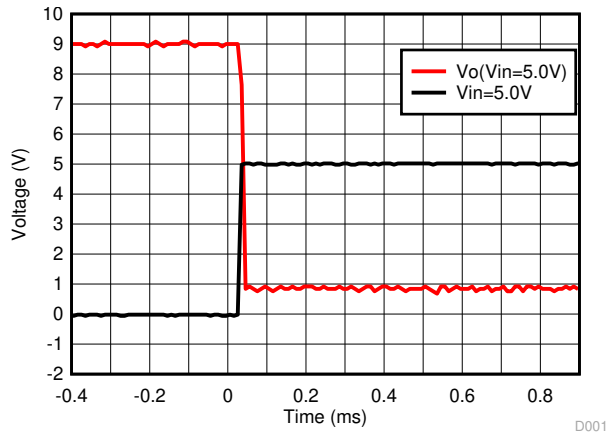

Figure 8-4. Output Response With Large Overdrive Voltage

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8.2.2 Shunt Regulator/Reference

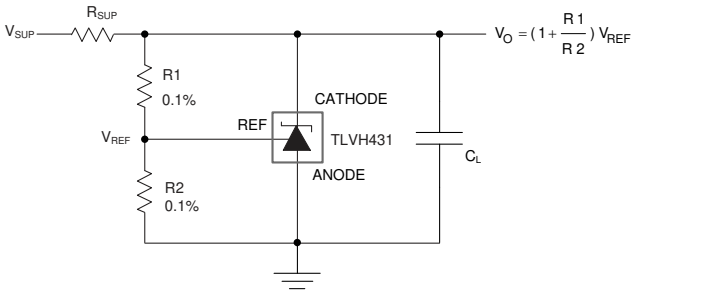

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Figure 8-5. Shunt Regulator Schematic

8.2.2.1 Design Requirements

For this design example, use the parameters listed in Table 8-2 as the input parameters.

Table 8-2. Design Parameters

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

8.2.2.2 Detailed Design Procedure

When using TLVH431 as a Shunt Regulator, determine the following:

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

8.2.2.2.1 Programming Output/Cathode Voltage

To program the cathode voltage to a regulated voltage a resistive bridge must be shunted between the cathode and anode pins with the mid point tied to the reference pin. This can be seen in Figure 8-5, with R1 and R2 being the resistive bridge. The cathode/output voltage in the shunt regulator configuration can be approximated by the equation shown in Figure 8-5. The cathode voltage can be more accurately determined by taking in to account the cathode current:

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

In order for this equation to be valid, TLVH431 must be fully biased so that it has enough open loop gain to mitigate any gain error. This can be done by meeting the I_{min} spec denoted in *Section 5*.

8.2.2.2.2 Total Accuracy

When programming the output above unity gain (V_{KA}=V_{REF}), TLVH431 is susceptible to other errors that may effect the overall accuracy beyond V_{REF}. These errors include:

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

Worst case, cathode voltage can be determined taking all of the variables in to account. The application note *Setting the Shunt Voltage on an Adjustable Shunt Regulator,* SLVA445, assists designers in setting the shunt voltage to achieve optimum accuracy for this device.

8.2.2.2.3 Stability

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

TI recommends to choose capacitors that give a phase margin > 5° to maintain stability of the TLVH431.

8.2.2.3 Application Curve

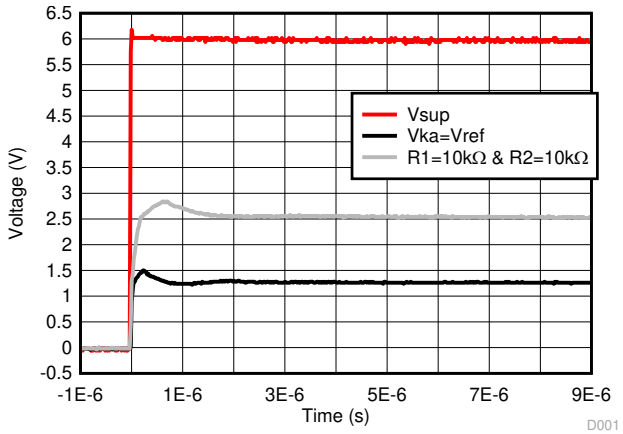

Figure 8-6. TLVH431 Start-up Response

8.3 Power Supply Recommendations

When using TLVH431 as a Linear Regulator to supply a load, designers will typically use a bypass capacitor on the output/cathode pin. When doing this, be sure that the capacitance is within the stability criteria shown in Figure 5-15, Figure 5-16, and Figure 5-17.

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

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

8.4 Layout

8.4.1 Layout Guidelines

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

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8.4.2 Layout Example

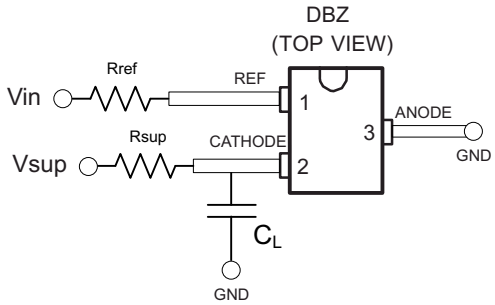

Figure 8-7. DBZ Layout example

9 Device and Documentation Support

9.1 Documentation Support

9.1.1 Related Documentation

For related documentation see the following:

- , *Compensation Design With TL431 for UCC28600*SLUA671
- *Setting the Shunt Voltage on an Adjustable Shunt Regulator,*SLVA445

9.2 Receiving Notification of Documentation Updates

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

9.3 Support Resources

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

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

9.4 Trademarks

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9.5 Electrostatic Discharge Caution

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

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

9.6 Glossary

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

10 Revision History

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

Changes from Revision M (January 2023) to Revision N (June 2024)	Page
• Updated pinout images and *Pin Functions* table	3

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

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

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Changes from Revision J (January 2015) to Revision K (September 2016) **Page**

- Changed data sheet title....1
- Updated pinout images and *Pin Functions* table....3
- Deleted D package from *Pin Functions* table....4

Changes from Revision I (September 2009) to Revision J (January 2015) **Page**

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

11 Mechanical, Packaging, and Orderable Information

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

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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)
TLVH431ACDBVR	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	0 to 70	(Y3PG, Y3PJ, Y3PU)
TLVH431ACDBVR.A	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	0 to 70	(Y3PG, Y3PJ, Y3PU)
TLVH431ACDBVT	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	0 to 70	(Y3PG, Y3PJ, Y3PU)
TLVH431ACDBVT.A	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	0 to 70	(Y3PG, Y3PJ, Y3PU)
TLVH431ACDBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	0 to 70	(Y3PS, Y3PU)
TLVH431ACDBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	(Y3PS, Y3PU)
TLVH431ACDBZRG4	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | NIPDAUAG	Level-1-260C-UNLIM	0 to 70	Y3PS
TLVH431ACDBZRG4.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	Y3PS
TLVH431ACDBZT	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	0 to 70	(Y3PS, Y3PU)
TLVH431ACDBZT.A	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	(Y3PS, Y3PU)
TLVH431ACDCKR	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	0 to 70	YPU
TLVH431ACDCKR.A	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	0 to 70	YPU
TLVH431ACDCKT	Active	Production	SC70 (DCK) | 6	250 | SMALL T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	0 to 70	YPU
TLVH431ACDCKT.A	Active	Production	SC70 (DCK) | 6	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	0 to 70	YPU
TLVH431ACLP	Obsolete	Production	TO-92 (LP) | 3	-	-	Call TI	Call TI	0 to 70	ZA431A
TLVH431ACLPR	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	0 to 70	ZA431A
TLVH431ACLPR.A	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	0 to 70	ZA431A
TLVH431ACPK	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	0 to 70	W2
TLVH431ACPK.A	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	0 to 70	W2
TLVH431AIDBVR	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 85	(Y3TJ, Y3TU)
TLVH431AIDBVR.A	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	(Y3TJ, Y3TU)
TLVH431AIDBVT	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 85	(Y3TJ, Y3TU)
TLVH431AIDBVT.A	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	(Y3TJ, Y3TU)
TLVH431AIDBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	(Y3T3, Y3TS, Y3TU)

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)
TLVH431AIDBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	(Y3T3, Y3TS, Y3TU)
TLVH431AIDBZT	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	(Y3TS, Y3TU)
TLVH431AIDBZT.A	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	(Y3TS, Y3TU)
TLVH431AIDBZTG4	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU | NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	Y3TS
TLVH431AIDBZTG4.A	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	Y3TS
TLVH431AIDCKR	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 85	YTU
TLVH431AIDCKR.A	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	YTU
TLVH431AIDCKT	Active	Production	SC70 (DCK) | 6	250 | SMALL T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 85	YTU
TLVH431AIDCKT.A	Active	Production	SC70 (DCK) | 6	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	YTU
TLVH431AILP	Obsolete	Production	TO-92 (LP) | 3	-	-	Call TI	Call TI	-40 to 85	ZB431A
TLVH431AILPR	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-40 to 85	ZB431A
TLVH431AILPR.A	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-40 to 85	ZB431A
TLVH431AIPK	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 85	W3
TLVH431AIPK.A	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 85	W3
TLVH431AQDBVR	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 125	(Y3NJ, Y3NS, Y3NU)
TLVH431AQDBVR.A	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	(Y3NJ, Y3NS, Y3NU)
TLVH431AQDBVT	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 125	(Y3NJ, Y3NU)
TLVH431AQDBVT.A	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	(Y3NJ, Y3NU)
TLVH431AQDBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	(Y3NS, Y3NU)
TLVH431AQDBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	(Y3NS, Y3NU)
TLVH431AQDBZT	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	(Y3NS, Y3NU)
TLVH431AQDBZT.A	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	(Y3NS, Y3NU)
TLVH431AQDBZTG4	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU | NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	Y3NS
TLVH431AQDBZTG4.A	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	Y3NS
TLVH431AQDCKR	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 125	YNU
TLVH431AQDCKR.A	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	YNU

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)
TLVH431AQDCKRG4	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	YNU
TLVH431AQDCKRG4.A	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	YNU
TLVH431AQDCKT	Active	Production	SC70 (DCK) | 6	250 | SMALL T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 125	YNU
TLVH431AQDCKT.A	Active	Production	SC70 (DCK) | 6	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	YNU
TLVH431AQLP	Obsolete	Production	TO-92 (LP) | 3	-	-	Call TI	Call TI	-40 to 125	ZD431A
TLVH431AQLPR	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-40 to 125	ZD431A
TLVH431AQLPR.A	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-40 to 125	ZD431A
TLVH431AQPK	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 125	VD
TLVH431AQPK.A	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 125	VD
TLVH431BCDBVR	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	0 to 70	(Y3JJ, Y3JU)
TLVH431BCDBVR.A	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	0 to 70	(Y3JJ, Y3JU)
TLVH431BCDBVT	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	0 to 70	(Y3JJ, Y3JU)
TLVH431BCDBVT.A	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	0 to 70	(Y3JJ, Y3JU)
TLVH431BCDBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	0 to 70	(Y3J3, Y3JS, Y3JU)
TLVH431BCDBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	(Y3J3, Y3JS, Y3JU)
TLVH431BCDBZT	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	0 to 70	(Y3JS, Y3JU)
TLVH431BCDBZT.A	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	(Y3JS, Y3JU)
TLVH431BCDBZTG4	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU | NIPDAUAG	Level-1-260C-UNLIM	0 to 70	Y3JS
TLVH431BCDBZTG4.A	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	Y3JS
TLVH431BCDCKR	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	0 to 70	YHU
TLVH431BCDCKR.A	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	0 to 70	YHU
TLVH431BCDCKT	Active	Production	SC70 (DCK) | 6	250 | SMALL T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	0 to 70	YHU
TLVH431BCDCKT.A	Active	Production	SC70 (DCK) | 6	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	0 to 70	YHU
TLVH431BCLP	Active	Production	TO-92 (LP) | 3	1000 | BULK	Yes	SN	N/A for Pkg Type	0 to 70	ZA431B
TLVH431BCLP.A	Active	Production	TO-92 (LP) | 3	1000 | BULK	Yes	SN	N/A for Pkg Type	0 to 70	ZA431B
TLVH431BCLPR	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	0 to 70	ZA431B
TLVH431BCLPR.A	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	0 to 70	ZA431B
TLVH431BCPK	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	0 to 70	V7

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)
TLVH431BCPK.A	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	0 to 70	V7
TLVH431BIDBVR	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 85	(Y3KJ, Y3KS, Y3KU)
TLVH431BIDBVR.A	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	(Y3KJ, Y3KS, Y3KU)
TLVH431BIDBVT	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 85	(Y3KJ, Y3KU)
TLVH431BIDBVT.A	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	(Y3KJ, Y3KU)
TLVH431BIDBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	(Y3K3, Y3KS, Y3KU)
TLVH431BIDBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	(Y3K3, Y3KS, Y3KU)
TLVH431BIDBZRG4	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	Y3KS
TLVH431BIDBZRG4.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	Y3KS
TLVH431BIDBZT	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	(Y3KS, Y3KU)
TLVH431BIDBZT.A	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	(Y3KS, Y3KU)
TLVH431BIDCKR	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 85	YJU
TLVH431BIDCKR.A	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	YJU
TLVH431BIDCKRG4.A	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	YJU
TLVH431BIDCKT	Active	Production	SC70 (DCK) | 6	250 | SMALL T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 85	YJU
TLVH431BIDCKT.A	Active	Production	SC70 (DCK) | 6	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	YJU
TLVH431BILP	Active	Production	TO-92 (LP) | 3	1000 | BULK	Yes	SN	N/A for Pkg Type	-40 to 85	ZB431B
TLVH431BILP.A	Active	Production	TO-92 (LP) | 3	1000 | BULK	Yes	SN	N/A for Pkg Type	-40 to 85	ZB431B
TLVH431BILPR	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-40 to 85	ZB431B
TLVH431BILPR.A	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-40 to 85	ZB431B
TLVH431BIPK	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 85	V8
TLVH431BIPK.A	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 85	V8
TLVH431BQDBVR	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 125	(Y3LJ, Y3LU)
TLVH431BQDBVR.A	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	(Y3LJ, Y3LU)
TLVH431BQDBVT	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 125	(Y3LJ, Y3LU)
TLVH431BQDBVT.A	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	(Y3LJ, Y3LU)

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)
TLVH431BQDBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	(Y3LS, Y3LU)
TLVH431BQDBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	(Y3LS, Y3LU)
TLVH431BQDBZRG4	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	Y3LS
TLVH431BQDBZRG4.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	Y3LS
TLVH431BQDBZT	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	(Y3LS, Y3LU)
TLVH431BQDBZT.A	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	(Y3LS, Y3LU)
TLVH431BQDBZTG4.A	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	Y3LS
TLVH431BQDCKR	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 125	YKU
TLVH431BQDCKR.A	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	YKU
TLVH431BQDCKRG4	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	YKU
TLVH431BQDCKRG4.A	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	YKU
TLVH431BQDCKT	Active	Production	SC70 (DCK) | 6	250 | SMALL T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 125	YKU
TLVH431BQDCKT.A	Active	Production	SC70 (DCK) | 6	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	YKU
TLVH431BQLP	Obsolete	Production	TO-92 (LP) | 3	-	-	Call TI	Call TI	-40 to 125	ZD431B
TLVH431BQLPR	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-40 to 125	ZD431B
TLVH431BQLPR.A	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-40 to 125	ZD431B
TLVH431BQPK	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 125	V9
TLVH431BQPK.A	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 125	V9
TLVH431CDBVR	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	0 to 70	(Y3UJ, Y3US, Y3UU)
TLVH431CDBVR.A	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	(Y3UJ, Y3US, Y3UU)
TLVH431CDBVT	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	0 to 70	(Y3UJ, Y3UU)
TLVH431CDBVT.A	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	0 to 70	(Y3UJ, Y3UU)
TLVH431CDBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	0 to 70	(Y3US, Y3UU)
TLVH431CDBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	(Y3US, Y3UU)
TLVH431CDBZT	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	0 to 70	(Y3US, Y3UU)
TLVH431CDBZT.A	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	(Y3US, Y3UU)

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)
TLVH431CDBZTG4	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU | NIPDAUAG	Level-1-260C-UNLIM	0 to 70	Y3US
TLVH431CDBZTG4.A	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	Y3US
TLVH431CDCKT	Active	Production	SC70 (DCK) | 6	250 | SMALL T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	0 to 70	YUU
TLVH431CDCKT.A	Active	Production	SC70 (DCK) | 6	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	0 to 70	YUU
TLVH431CLP	Obsolete	Production	TO-92 (LP) | 3	-	-	Call TI	Call TI	0 to 70	ZA431
TLVH431CLPR	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	0 to 70	ZA431
TLVH431CLPR.A	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	0 to 70	ZA431
TLVH431CPK	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	0 to 70	W4
TLVH431CPK.A	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	0 to 70	W4
TLVH431IDBVR	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 85	(Y3VJ, Y3VS, Y3VU)
TLVH431IDBVR.A	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	(Y3VJ, Y3VS, Y3VU)
TLVH431IDBVT	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 85	(Y3VJ, Y3VU)
TLVH431IDBVT.A	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	(Y3VJ, Y3VU)
TLVH431IDBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	(Y3VS, Y3VU)
TLVH431IDBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	(Y3VS, Y3VU)
TLVH431IDBZT	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	(Y3VS, Y3VU)
TLVH431IDBZT.A	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	(Y3VS, Y3VU)
TLVH431IDCKR	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 85	YVU
TLVH431IDCKR.A	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	YVU
TLVH431IDCKT	Active	Production	SC70 (DCK) | 6	250 | SMALL T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 85	YVU
TLVH431IDCKT.A	Active	Production	SC70 (DCK) | 6	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	YVU
TLVH431ILP	Obsolete	Production	TO-92 (LP) | 3	-	-	Call TI	Call TI	-40 to 85	ZB431
TLVH431ILPR	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-40 to 85	ZB431
TLVH431ILPR.A	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-40 to 85	ZB431
TLVH431IPK	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 85	W5
TLVH431IPK.A	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 85	W5
TLVH431QDBVR	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 125	(Y3MJ, Y3MS, Y3MU)

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)
TLVH431QDBVR.A	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	(Y3MJ, Y3MS, Y3MU)
TLVH431QDBVT	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 125	(Y3MJ, Y3MU)
TLVH431QDBVT.A	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	(Y3MJ, Y3MU)
TLVH431QDBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	(Y3MS, Y3MU)
TLVH431QDBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	(Y3MS, Y3MU)
TLVH431QDBZT	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	(Y3MS, Y3MU)
TLVH431QDBZT.A	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	(Y3MS, Y3MU)
TLVH431QDBZTG4	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU | NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	Y3MS
TLVH431QDBZTG4.A	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	Y3MS
TLVH431QDCKR	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 125	YMU
TLVH431QDCKR.A	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	YMU
TLVH431QDCKRG4	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	YMU
TLVH431QDCKRG4.A	Active	Production	SC70 (DCK) | 6	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	YMU
TLVH431QDCKT	Active	Production	SC70 (DCK) | 6	250 | SMALL T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-40 to 125	YMU
TLVH431QDCKT.A	Active	Production	SC70 (DCK) | 6	250 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	YMU
TLVH431QLP	Obsolete	Production	TO-92 (LP) | 3	-	-	Call TI	Call TI	-40 to 125	ZD431
TLVH431QLPR	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-40 to 125	ZD431
TLVH431QLPR.A	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-40 to 125	ZD431
TLVH431QPK	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 125	VC
TLVH431QPK.A	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 125	VC
TLVH432ACDBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	0 to 70	(Y2ES, Y2EU)
TLVH432ACDBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	(Y2ES, Y2EU)
TLVH432ACDBZRG4	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | NIPDAUAG	Level-1-260C-UNLIM	0 to 70	Y2ES
TLVH432ACDBZRG4.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	Y2ES
TLVH432ACDBZT	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	0 to 70	(Y2ES, Y2EU)
TLVH432ACDBZT.A	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	(Y2ES, Y2EU)

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)
TLVH432AIDBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	(Y2FS, Y2FU)
TLVH432AIDBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	(Y2FS, Y2FU)
TLVH432AIPK	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 85	VL
TLVH432AIPK.A	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 85	VL
TLVH432AQDBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	(Y2GS, Y2GU)
TLVH432AQDBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	(Y2GS, Y2GU)
TLVH432AQDBZT	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	(Y2GS, Y2GU)
TLVH432AQDBZT.A	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	(Y2GS, Y2GU)
TLVH432BCDBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	0 to 70	(Y2HS, Y2HU)
TLVH432BCDBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	(Y2HS, Y2HU)
TLVH432BCDBZRG4	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | NIPDAUAG	Level-1-260C-UNLIM	0 to 70	Y2HS
TLVH432BCDBZRG4.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	Y2HS
TLVH432BCPK	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	0 to 70	VN
TLVH432BCPK.A	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	0 to 70	VN
TLVH432BIDBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	(Y2JS, Y2JU)
TLVH432BIDBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	(Y2JS, Y2JU)
TLVH432BQDBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	(Y2KS, Y2KU)
TLVH432BQDBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	(Y2KS, Y2KU)
TLVH432BQDBZT	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	(Y2KS, Y2KU)
TLVH432BQDBZT.A	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	(Y2KS, Y2KU)
TLVH432BQDBZTG4	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU | NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	Y2KS
TLVH432BQDBZTG4.A	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	Y2KS
TLVH432CDBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	0 to 70	(Y2AS, Y2AU)
TLVH432CDBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	(Y2AS, Y2AU)

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)
TLVH432CDBZT	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	0 to 70	(Y2AS, Y2AU)
TLVH432CDBZT.A	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	(Y2AS, Y2AU)
TLVH432CPK	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	0 to 70	VG
TLVH432CPK.A	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	0 to 70	VG
TLVH432IDBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	(Y2BS, Y2BU)
TLVH432IDBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	(Y2BS, Y2BU)
TLVH432QDBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	(Y2DS, Y2DU)
TLVH432QDBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	(Y2DS, Y2DU)
TLVH432QDBZT	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU | SN | NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	(Y2DS, Y2DU)
TLVH432QDBZT.A	Active	Production	SOT-23 (DBZ) | 3	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	(Y2DS, Y2DU)
TLVH432QPK	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 125	VJ
TLVH432QPK.A	Active	Production	SOT-89 (PK) | 3	1000 | LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 125	VJ

(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.

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

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

OTHER QUALIFIED VERSIONS OF TLVH431A, TLVH431B :

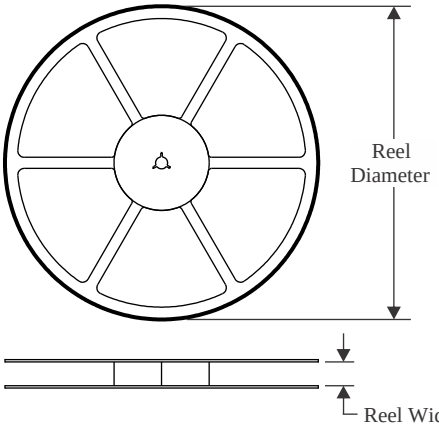
- Automotive : TLVH431A-Q1, TLVH431B-Q1
- Enhanced Product : TLVH431B-EP

NOTE: Qualified Version Definitions:

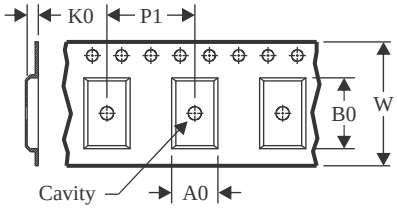
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

TAPE AND REEL INFORMATION

REEL DIMENSIONS

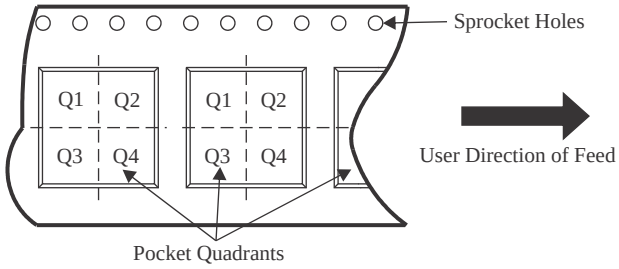


TAPE DIMENSIONS



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

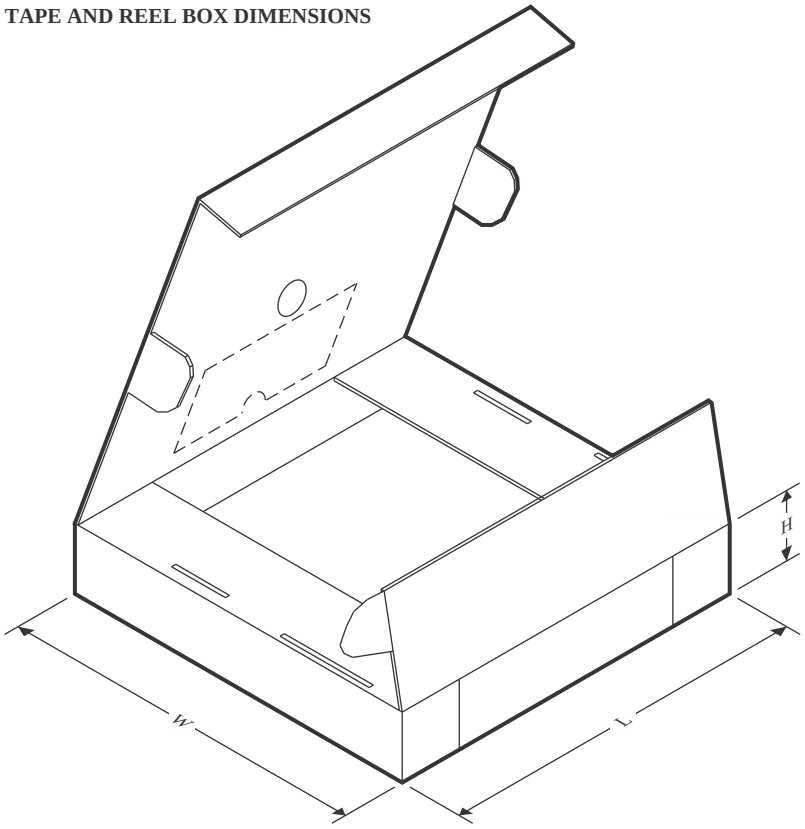
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TLVH431ACDBVR	SOT-23	DBV	5	3000	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
TLVH431ACDBVT	SOT-23	DBV	5	250	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
TLVH431ACDBZR	SOT-23	DBZ	3	3000	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431ACDBZRG4	SOT-23	DBZ	3	3000	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431ACDBZRG4	SOT-23	DBZ	3	3000	180.0	8.4	2.9	3.35	1.35	4.0	8.0	Q3
TLVH431ACDBZT	SOT-23	DBZ	3	250	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431ACDCKR	SC70	DCK	6	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLVH431ACDCKT	SC70	DCK	6	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLVH431ACPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3
TLVH431ACPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3
TLVH431AIDBVR	SOT-23	DBV	5	3000	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
TLVH431AIDBVT	SOT-23	DBV	5	250	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLVH431AIDBVT	SOT-23	DBV	5	250	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
TLVH431AIDBZR	SOT-23	DBZ	3	3000	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431AIDBZT	SOT-23	DBZ	3	250	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431AIDBZTG4	SOT-23	DBZ	3	250	180.0	8.4	2.9	3.35	1.35	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
TLVH431AIDCKR	SC70	DCK	6	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLVH431AIDCKT	SC70	DCK	6	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLVH431AIPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3
TLVH431AIPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3
TLVH431AQDBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLVH431AQDBVT	SOT-23	DBV	5	250	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLVH431AQDBVT	SOT-23	DBV	5	250	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
TLVH431AQDBZR	SOT-23	DBZ	3	3000	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431AQDBZT	SOT-23	DBZ	3	250	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431AQDBZTG4	SOT-23	DBZ	3	250	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431AQDBZTG4	SOT-23	DBZ	3	250	180.0	8.4	2.9	3.35	1.35	4.0	8.0	Q3
TLVH431AQDCKR	SC70	DCK	6	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLVH431AQDCKRG4	SC70	DCK	6	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLVH431AQDCKT	SC70	DCK	6	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLVH431AQPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	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	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	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431BCDBZT	SOT-23	DBZ	3	250	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431BCDBZTG4	SOT-23	DBZ	3	250	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431BCDBZTG4	SOT-23	DBZ	3	250	180.0	8.4	2.9	3.35	1.35	4.0	8.0	Q3
TLVH431BCDCKR	SC70	DCK	6	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLVH431BCDCKT	SC70	DCK	6	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLVH431BCPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3
TLVH431BCPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3
TLVH431BIDBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLVH431BIDBVT	SOT-23	DBV	5	250	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
TLVH431BIDBVT	SOT-23	DBV	5	250	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLVH431BIDBZR	SOT-23	DBZ	3	3000	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431BIDBZRG4	SOT-23	DBZ	3	3000	180.0	8.4	2.9	3.35	1.35	4.0	8.0	Q3
TLVH431BIDBZRG4	SOT-23	DBZ	3	3000	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431BIDBZT	SOT-23	DBZ	3	250	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431BIDCKR	SC70	DCK	6	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLVH431BIDCKT	SC70	DCK	6	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLVH431BIPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3
TLVH431BIPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3
TLVH431BQDBVR	SOT-23	DBV	5	3000	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
TLVH431BQDBVT	SOT-23	DBV	5	250	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
TLVH431BQDBVT	SOT-23	DBV	5	250	179.0	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
TLVH431BQDBZR	SOT-23	DBZ	3	3000	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431BQDBZR	SOT-23	DBZ	3	3000	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431BQDBZRG4	SOT-23	DBZ	3	3000	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431BQDBZRG4	SOT-23	DBZ	3	3000	180.0	8.4	2.9	3.35	1.35	4.0	8.0	Q3
TLVH431BQDBZT	SOT-23	DBZ	3	250	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431BQDCKR	SC70	DCK	6	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLVH431BQDCKR	SC70	DCK	6	3000	180.0	8.4	2.3	2.5	1.2	4.0	8.0	Q3
TLVH431BQDCKRG4	SC70	DCK	6	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLVH431BQDCKT	SC70	DCK	6	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLVH431BQPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3
TLVH431BQPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3
TLVH431CDBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLVH431CDBVT	SOT-23	DBV	5	250	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	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431CDBZT	SOT-23	DBZ	3	250	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431CDBZTG4	SOT-23	DBZ	3	250	180.0	8.4	2.9	3.35	1.35	4.0	8.0	Q3
TLVH431CDCKT	SC70	DCK	6	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLVH431CPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3
TLVH431CPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3
TLVH431IDBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLVH431IDBVT	SOT-23	DBV	5	250	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
TLVH431IDBVT	SOT-23	DBV	5	250	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLVH431IDBZR	SOT-23	DBZ	3	3000	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431IDBZT	SOT-23	DBZ	3	250	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431IDCKR	SC70	DCK	6	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLVH431IDCKT	SC70	DCK	6	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLVH431IPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3
TLVH431IPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3
TLVH431QDBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLVH431QDBVT	SOT-23	DBV	5	250	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLVH431QDBVT	SOT-23	DBV	5	250	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
TLVH431QDBZR	SOT-23	DBZ	3	3000	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431QDBZT	SOT-23	DBZ	3	250	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431QDBZTG4	SOT-23	DBZ	3	250	180.0	8.4	2.9	3.35	1.35	4.0	8.0	Q3
TLVH431QDBZTG4	SOT-23	DBZ	3	250	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3
TLVH431QDCKR	SC70	DCK	6	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLVH431QDCKRG4	SC70	DCK	6	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLVH431QDCKT	SC70	DCK	6	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLVH431QPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3
TLVH431QPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3

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
TLVH432ACDBZR	SOT-23	DBZ	3	3000	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH432ACDBZRG4	SOT-23	DBZ	3	3000	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3
TLVH432ACDBZRG4	SOT-23	DBZ	3	3000	180.0	8.4	2.9	3.35	1.35	4.0	8.0	Q3
TLVH432ACDBZT	SOT-23	DBZ	3	250	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH432AIDBZR	SOT-23	DBZ	3	3000	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH432AIPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3
TLVH432AIPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3
TLVH432AQDBZR	SOT-23	DBZ	3	3000	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH432AQDBZT	SOT-23	DBZ	3	250	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH432BCDBZR	SOT-23	DBZ	3	3000	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH432BCDBZRG4	SOT-23	DBZ	3	3000	180.0	8.4	2.9	3.35	1.35	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
TLVH432BCPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3
TLVH432BIDBZR	SOT-23	DBZ	3	3000	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH432BQDBZR	SOT-23	DBZ	3	3000	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH432BQDBZT	SOT-23	DBZ	3	250	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH432BQDBZTG4	SOT-23	DBZ	3	250	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3
TLVH432BQDBZTG4	SOT-23	DBZ	3	250	180.0	8.4	2.9	3.35	1.35	4.0	8.0	Q3
TLVH432CDBZR	SOT-23	DBZ	3	3000	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH432CDBZT	SOT-23	DBZ	3	250	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH432CPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3
TLVH432CPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3
TLVH432IDBZR	SOT-23	DBZ	3	3000	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH432QDBZR	SOT-23	DBZ	3	3000	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH432QDBZT	SOT-23	DBZ	3	250	178.0	9.0	3.15	2.77	1.22	4.0	8.0	Q3
TLVH432QPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3
TLVH432QPK	SOT-89	PK	3	1000	180.0	12.4	4.91	4.52	1.9	8.0	12.0	Q3

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLVH431ACDBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TLVH431ACDBVT	SOT-23	DBV	5	250	180.0	180.0	18.0
TLVH431ACDBZR	SOT-23	DBZ	3	3000	180.0	180.0	18.0
TLVH431ACDBZRG4	SOT-23	DBZ	3	3000	183.0	183.0	20.0
TLVH431ACDBZRG4	SOT-23	DBZ	3	3000	210.0	185.0	35.0
TLVH431ACDBZT	SOT-23	DBZ	3	250	180.0	180.0	18.0
TLVH431ACDCKR	SC70	DCK	6	3000	200.0	183.0	25.0
TLVH431ACDCKT	SC70	DCK	6	250	203.0	203.0	35.0
TLVH431ACPK	SOT-89	PK	3	1000	190.0	190.0	30.0
TLVH431ACPK	SOT-89	PK	3	1000	340.0	340.0	38.0
TLVH431AIDBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TLVH431AIDBVT	SOT-23	DBV	5	250	203.0	203.0	35.0
TLVH431AIDBVT	SOT-23	DBV	5	250	180.0	180.0	18.0
TLVH431AIDBZR	SOT-23	DBZ	3	3000	180.0	180.0	18.0
TLVH431AIDBZT	SOT-23	DBZ	3	250	180.0	180.0	18.0
TLVH431AIDBZTG4	SOT-23	DBZ	3	250	210.0	185.0	35.0
TLVH431AIDCKR	SC70	DCK	6	3000	200.0	183.0	25.0
TLVH431AIDCKT	SC70	DCK	6	250	203.0	203.0	35.0

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLVH431AIPK	SOT-89	PK	3	1000	340.0	340.0	38.0
TLVH431AIPK	SOT-89	PK	3	1000	190.0	190.0	30.0
TLVH431AQDBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0
TLVH431AQDBVT	SOT-23	DBV	5	250	203.0	203.0	35.0
TLVH431AQDBVT	SOT-23	DBV	5	250	180.0	180.0	18.0
TLVH431AQDBZR	SOT-23	DBZ	3	3000	180.0	180.0	18.0
TLVH431AQDBZT	SOT-23	DBZ	3	250	180.0	180.0	18.0
TLVH431AQDBZTG4	SOT-23	DBZ	3	250	183.0	183.0	20.0
TLVH431AQDBZTG4	SOT-23	DBZ	3	250	210.0	185.0	35.0
TLVH431AQDCKR	SC70	DCK	6	3000	200.0	183.0	25.0
TLVH431AQDCKRG4	SC70	DCK	6	3000	200.0	183.0	25.0
TLVH431AQDCKT	SC70	DCK	6	250	200.0	183.0	25.0
TLVH431AQPK	SOT-89	PK	3	1000	190.0	190.0	30.0
TLVH431AQPK	SOT-89	PK	3	1000	340.0	340.0	38.0
TLVH431BCDBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TLVH431BCDBVT	SOT-23	DBV	5	250	200.0	183.0	25.0
TLVH431BCDBVT	SOT-23	DBV	5	250	180.0	180.0	18.0
TLVH431BCDBZR	SOT-23	DBZ	3	3000	180.0	180.0	18.0
TLVH431BCDBZT	SOT-23	DBZ	3	250	180.0	180.0	18.0
TLVH431BCDBZTG4	SOT-23	DBZ	3	250	183.0	183.0	20.0
TLVH431BCDBZTG4	SOT-23	DBZ	3	250	210.0	185.0	35.0
TLVH431BCDCKR	SC70	DCK	6	3000	200.0	183.0	25.0
TLVH431BCDCKT	SC70	DCK	6	250	200.0	183.0	25.0
TLVH431BCPK	SOT-89	PK	3	1000	340.0	340.0	38.0
TLVH431BCPK	SOT-89	PK	3	1000	190.0	190.0	30.0
TLVH431BIDBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0
TLVH431BIDBVT	SOT-23	DBV	5	250	180.0	180.0	18.0
TLVH431BIDBVT	SOT-23	DBV	5	250	203.0	203.0	35.0
TLVH431BIDBZR	SOT-23	DBZ	3	3000	180.0	180.0	18.0
TLVH431BIDBZRG4	SOT-23	DBZ	3	3000	210.0	185.0	35.0
TLVH431BIDBZRG4	SOT-23	DBZ	3	3000	183.0	183.0	20.0
TLVH431BIDBZT	SOT-23	DBZ	3	250	180.0	180.0	18.0
TLVH431BIDCKR	SC70	DCK	6	3000	200.0	183.0	25.0
TLVH431BIDCKT	SC70	DCK	6	250	203.0	203.0	35.0
TLVH431BIPK	SOT-89	PK	3	1000	190.0	190.0	30.0
TLVH431BIPK	SOT-89	PK	3	1000	340.0	340.0	38.0
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
TLVH431BQDBZR	SOT-23	DBZ	3	3000	180.0	180.0	18.0
TLVH431BQDBZRG4	SOT-23	DBZ	3	3000	183.0	183.0	20.0
TLVH431BQDBZRG4	SOT-23	DBZ	3	3000	210.0	185.0	35.0

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLVH431BQDBZT	SOT-23	DBZ	3	250	180.0	180.0	18.0
TLVH431BQDCKR	SC70	DCK	6	3000	200.0	183.0	25.0
TLVH431BQDCKR	SC70	DCK	6	3000	210.0	185.0	35.0
TLVH431BQDCKRG4	SC70	DCK	6	3000	200.0	183.0	25.0
TLVH431BQDCKT	SC70	DCK	6	250	203.0	203.0	35.0
TLVH431BQPK	SOT-89	PK	3	1000	190.0	190.0	30.0
TLVH431BQPK	SOT-89	PK	3	1000	340.0	340.0	38.0
TLVH431CDBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0
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	180.0	180.0	18.0
TLVH431CDBZT	SOT-23	DBZ	3	250	180.0	180.0	18.0
TLVH431CDBZTG4	SOT-23	DBZ	3	250	210.0	185.0	35.0
TLVH431CDCKT	SC70	DCK	6	250	200.0	183.0	25.0
TLVH431CPK	SOT-89	PK	3	1000	190.0	190.0	30.0
TLVH431CPK	SOT-89	PK	3	1000	340.0	340.0	38.0
TLVH431IDBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0
TLVH431IDBVT	SOT-23	DBV	5	250	180.0	180.0	18.0
TLVH431IDBVT	SOT-23	DBV	5	250	203.0	203.0	35.0
TLVH431IDBZR	SOT-23	DBZ	3	3000	180.0	180.0	18.0
TLVH431IDBZT	SOT-23	DBZ	3	250	180.0	180.0	18.0
TLVH431IDCKR	SC70	DCK	6	3000	203.0	203.0	35.0
TLVH431IDCKT	SC70	DCK	6	250	203.0	203.0	35.0
TLVH431IPK	SOT-89	PK	3	1000	190.0	190.0	30.0
TLVH431IPK	SOT-89	PK	3	1000	340.0	340.0	38.0
TLVH431QDBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0
TLVH431QDBVT	SOT-23	DBV	5	250	203.0	203.0	35.0
TLVH431QDBVT	SOT-23	DBV	5	250	180.0	180.0	18.0
TLVH431QDBZR	SOT-23	DBZ	3	3000	180.0	180.0	18.0
TLVH431QDBZT	SOT-23	DBZ	3	250	180.0	180.0	18.0
TLVH431QDBZTG4	SOT-23	DBZ	3	250	210.0	185.0	35.0
TLVH431QDBZTG4	SOT-23	DBZ	3	250	183.0	183.0	20.0
TLVH431QDCKR	SC70	DCK	6	3000	200.0	183.0	25.0
TLVH431QDCKRG4	SC70	DCK	6	3000	200.0	183.0	25.0
TLVH431QDCKT	SC70	DCK	6	250	200.0	183.0	25.0
TLVH431QPK	SOT-89	PK	3	1000	190.0	190.0	30.0
TLVH431QPK	SOT-89	PK	3	1000	340.0	340.0	38.0
TLVH432ACDBZR	SOT-23	DBZ	3	3000	180.0	180.0	18.0
TLVH432ACDBZRG4	SOT-23	DBZ	3	3000	183.0	183.0	20.0
TLVH432ACDBZRG4	SOT-23	DBZ	3	3000	210.0	185.0	35.0
TLVH432ACDBZT	SOT-23	DBZ	3	250	180.0	180.0	18.0
TLVH432AIDBZR	SOT-23	DBZ	3	3000	180.0	180.0	18.0
TLVH432AIPK	SOT-89	PK	3	1000	340.0	340.0	38.0

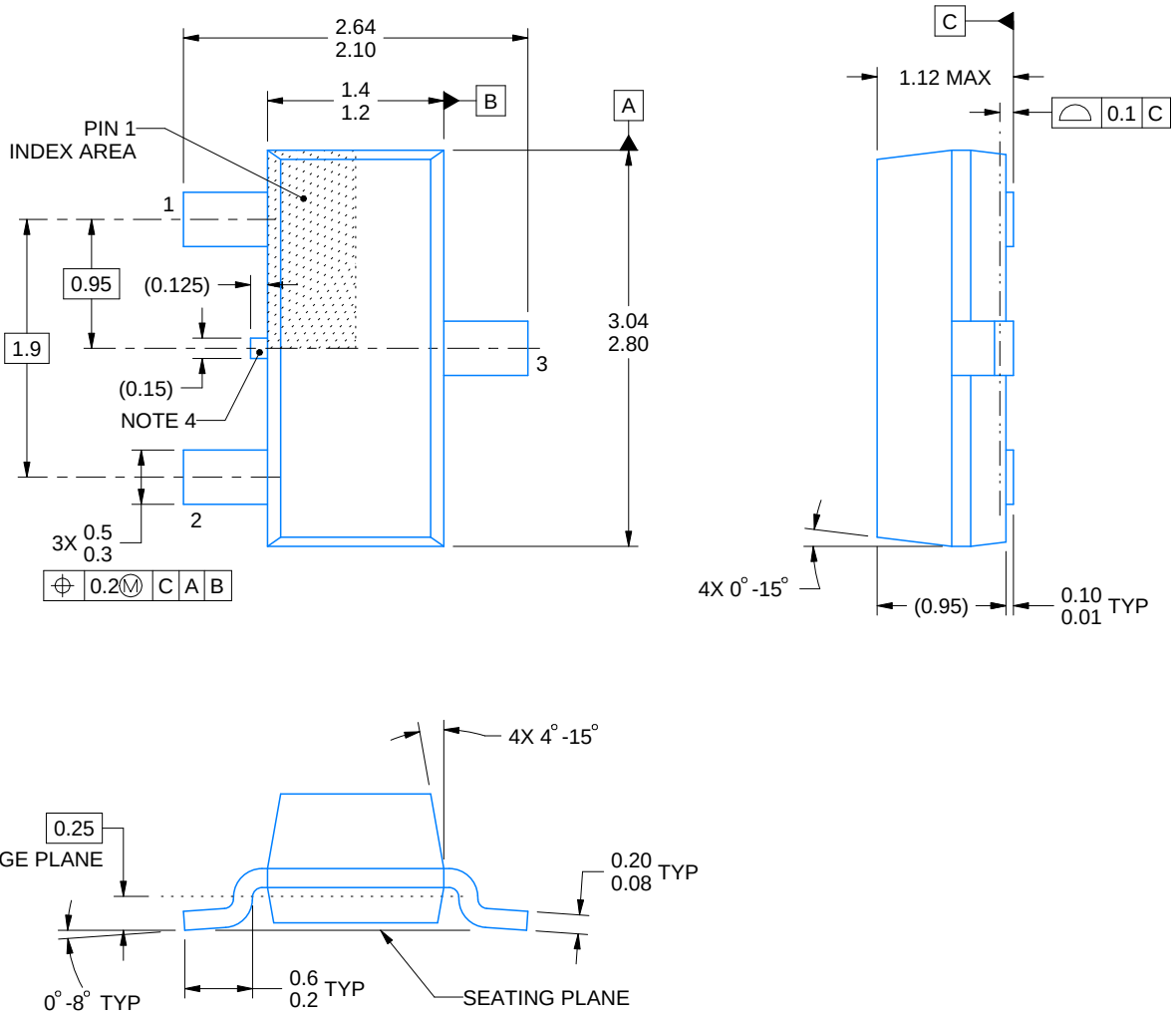
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLVH432AIPK	SOT-89	PK	3	1000	190.0	190.0	30.0
TLVH432AQDBZR	SOT-23	DBZ	3	3000	180.0	180.0	18.0
TLVH432AQDBZT	SOT-23	DBZ	3	250	180.0	180.0	18.0
TLVH432BCDBZR	SOT-23	DBZ	3	3000	180.0	180.0	18.0
TLVH432BCDBZRG4	SOT-23	DBZ	3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

PACKAGE OUTLINE

DBZ0003A

SOT-23 - 1.12 mm max height

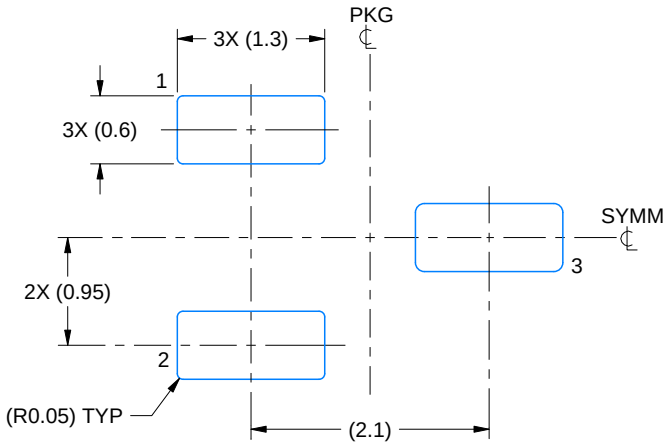
SMALL OUTLINE TRANSISTOR



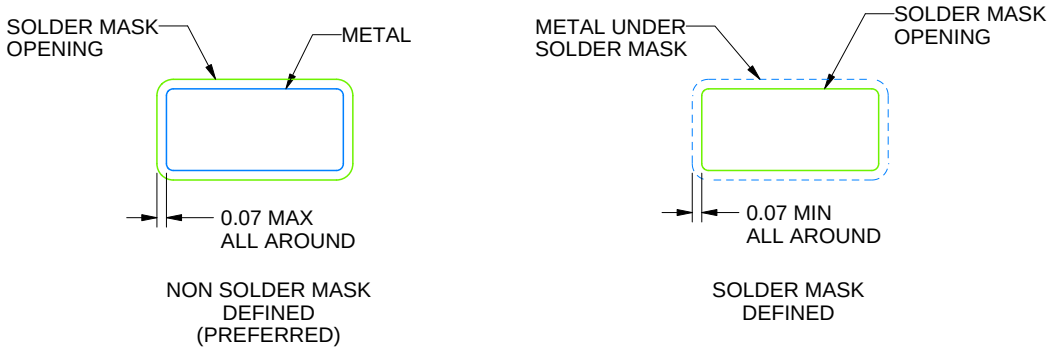
4214838/F 08/2024

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

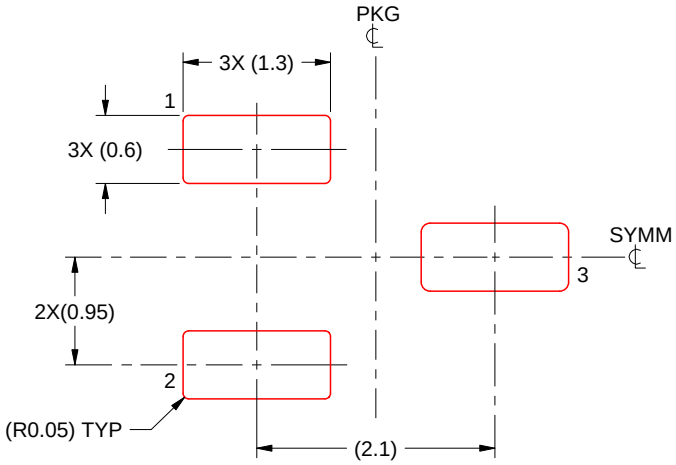


SOLDER MASK DETAILS

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.



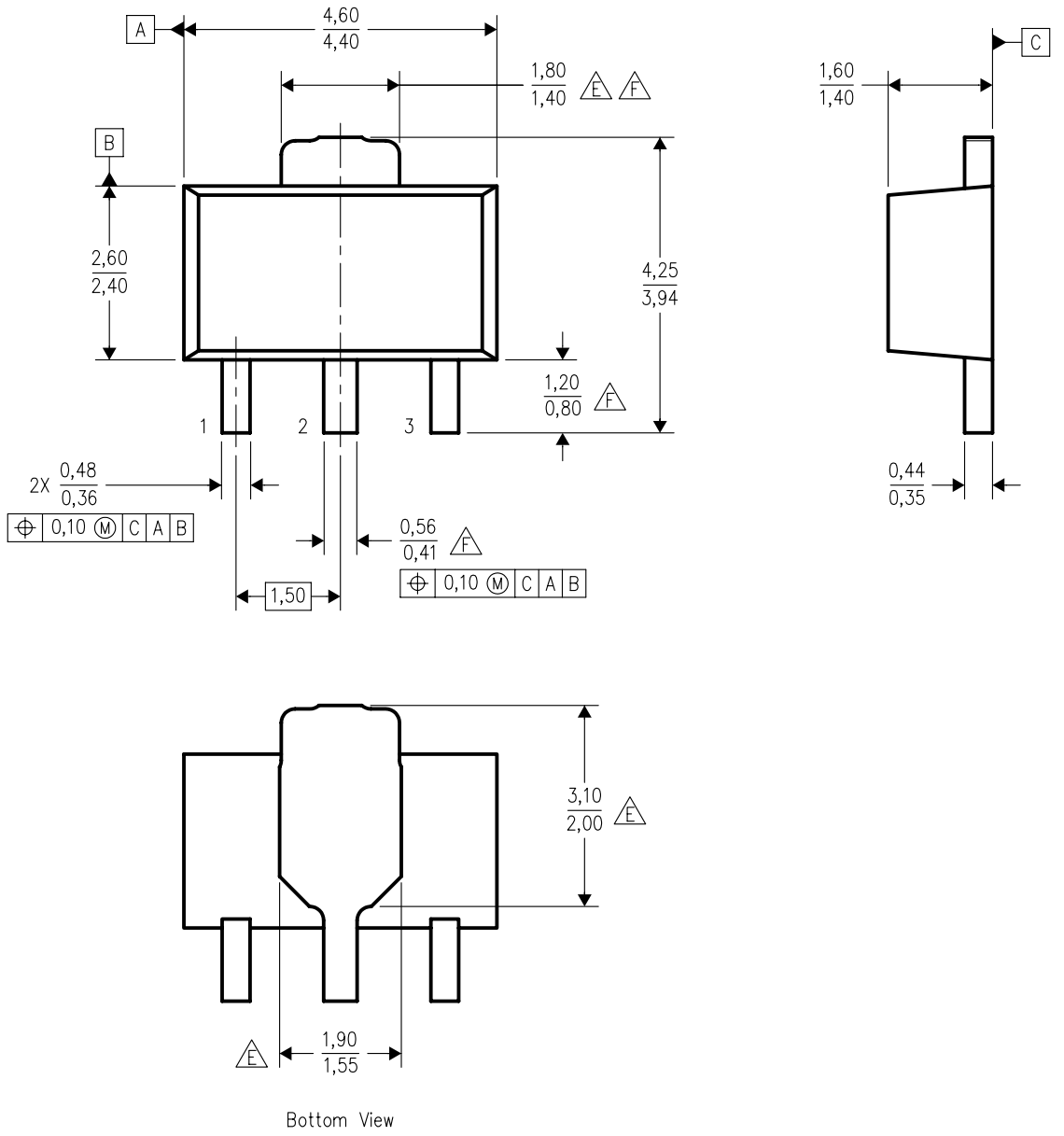
SOLDER PASTE EXAMPLE
BASED ON 0.125 THICK STENCIL
SCALE:15X

4214838/F 08/2024

NOTES: (continued)

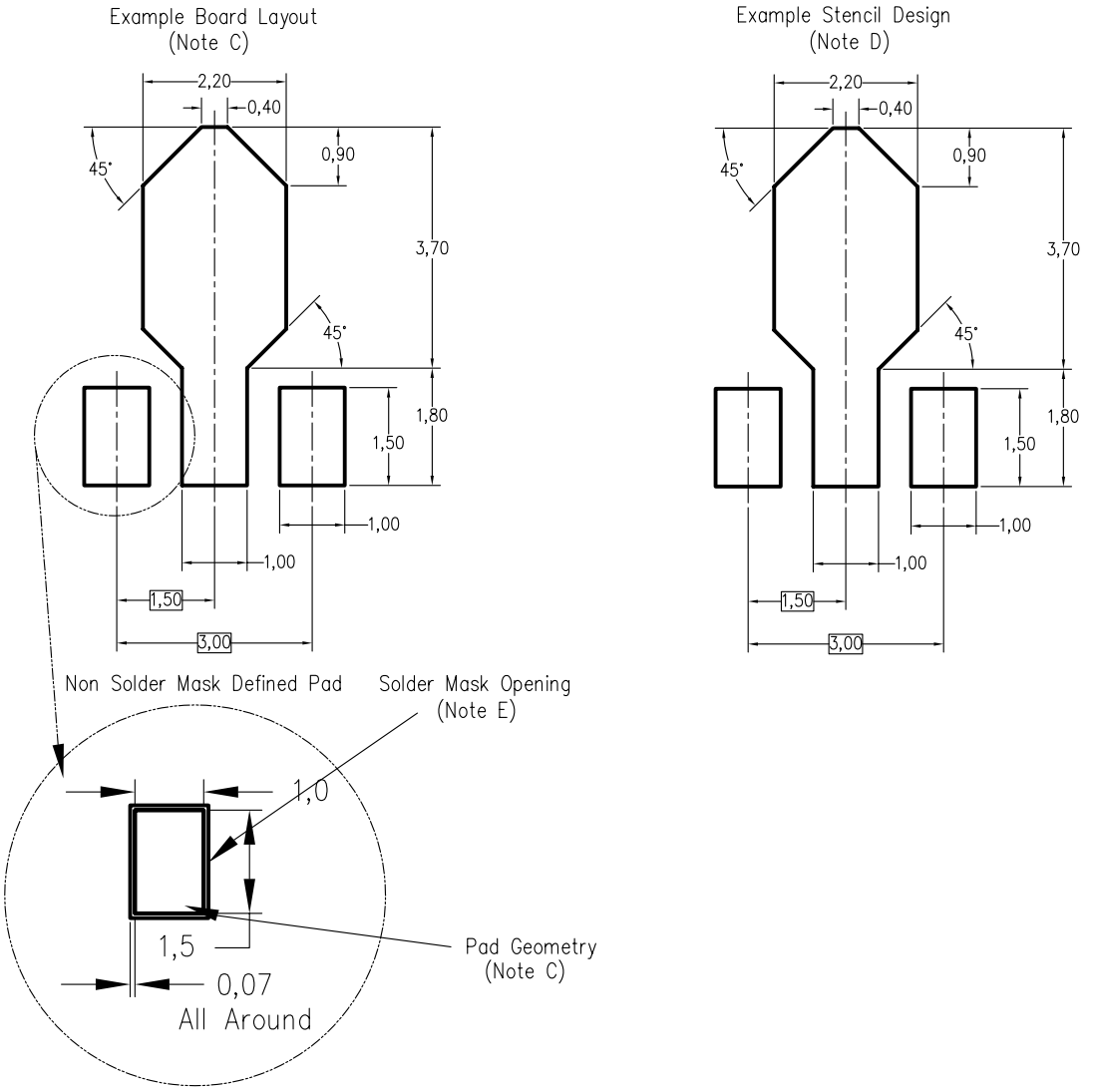
7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.

PK (R–PSSO–F3) PLASTIC SINGLE–IN–LINE PACKAGE



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

PK (R–PDSO–G3)



4208221/A 09/06

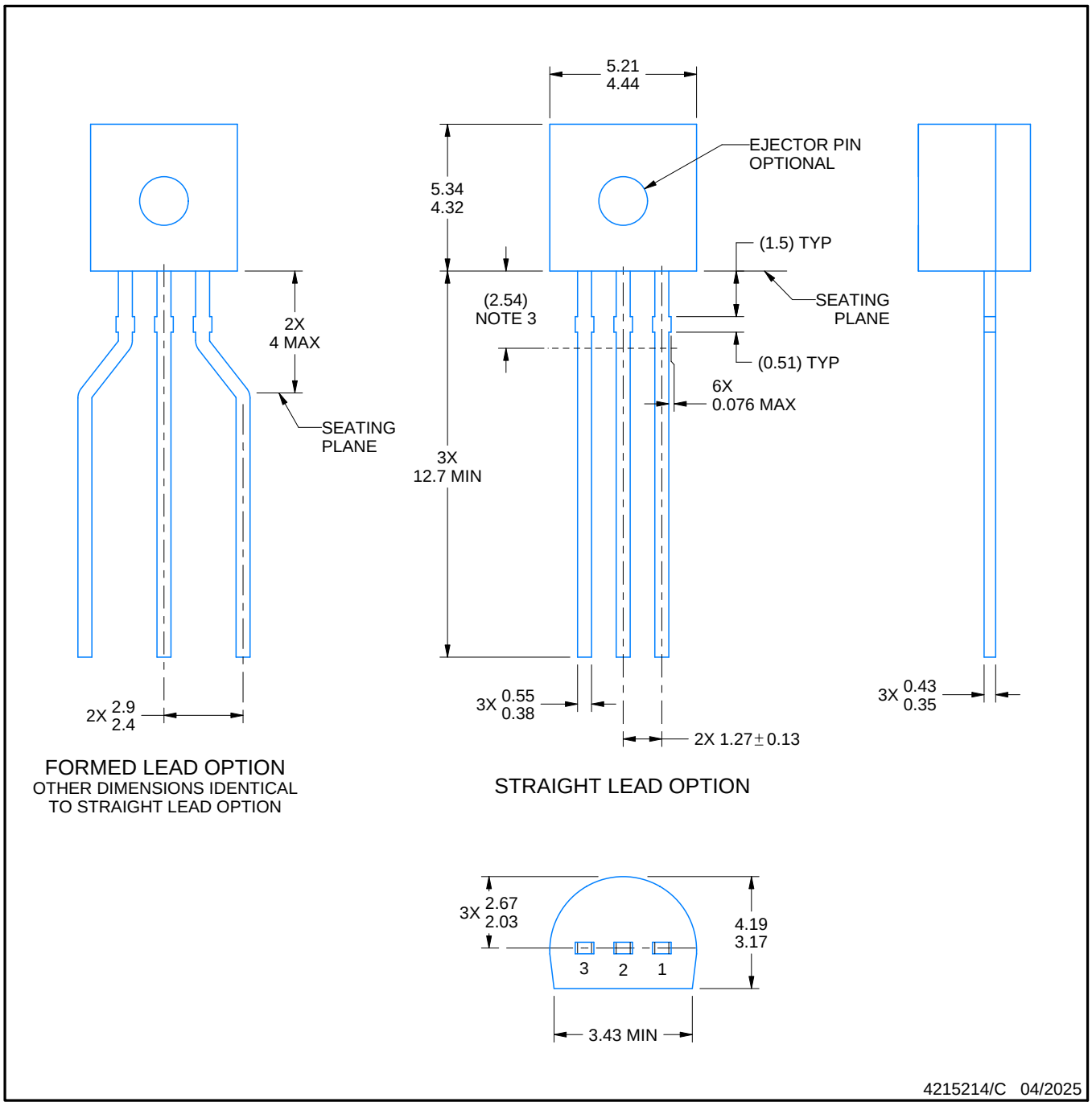
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact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

LP0003A

PACKAGE OUTLINE

TO-92 - 5.34 mm max height

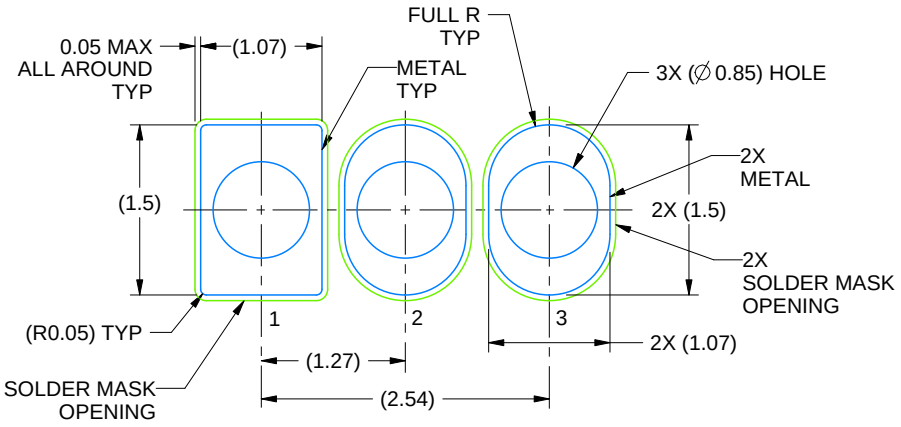
TO-92



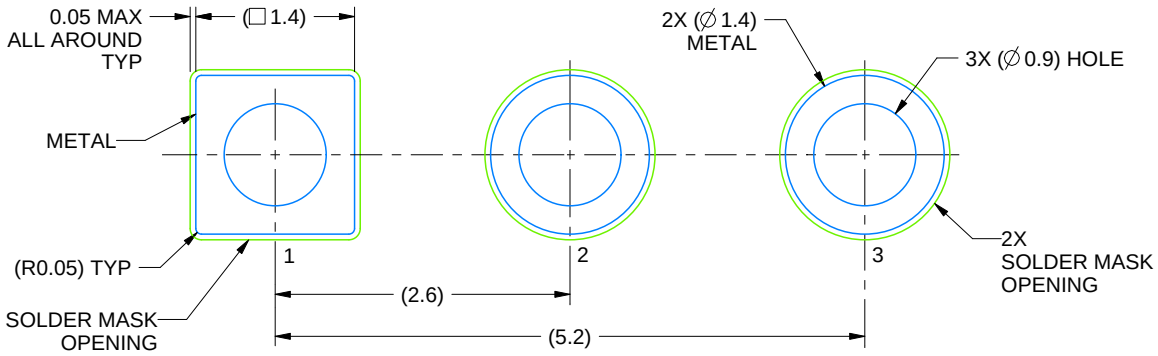
4215214/C 04/2025

NOTES:

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



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



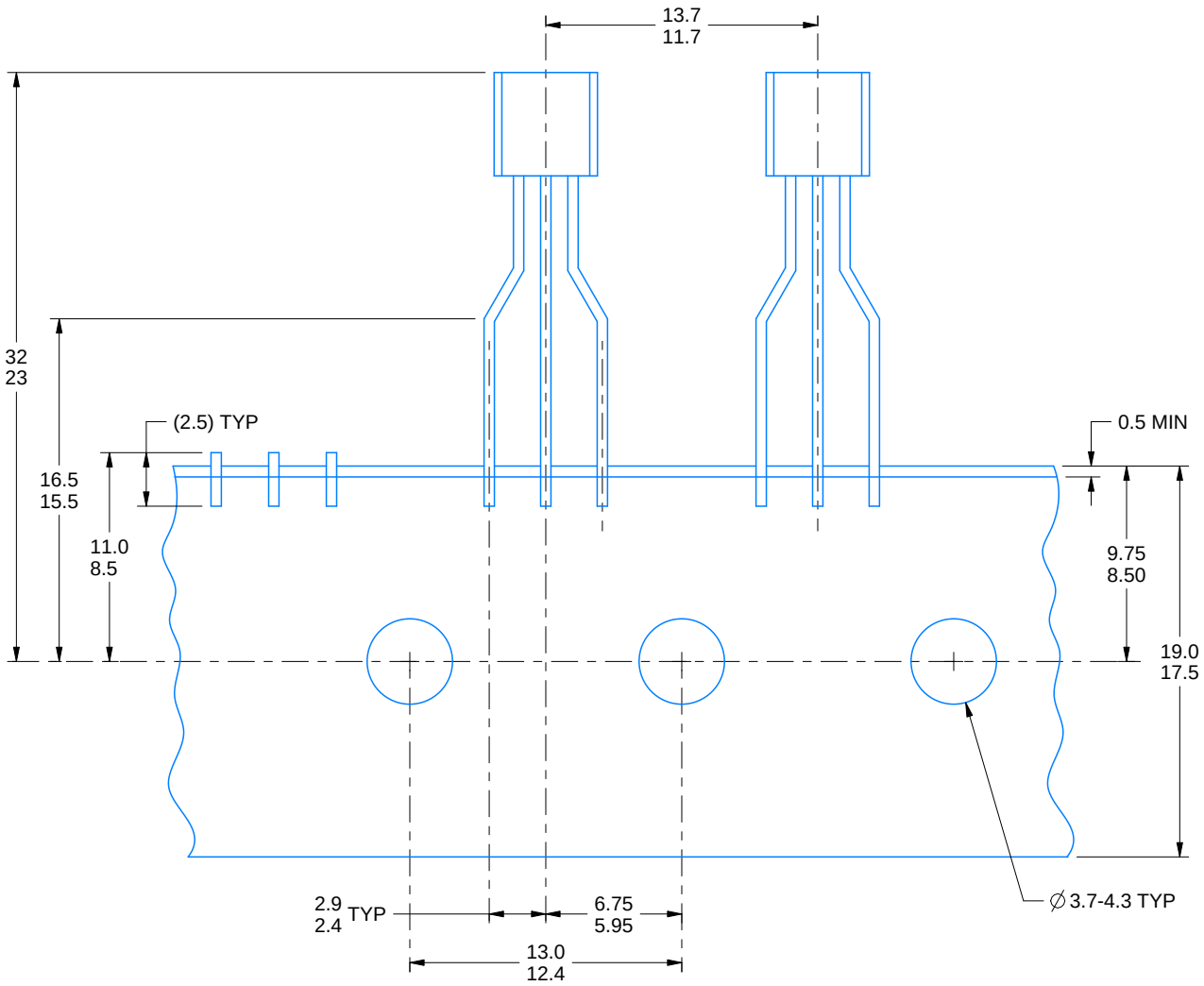
LAND PATTERN EXAMPLE
FORMED LEAD OPTION
NON-SOLDER MASK DEFINED
SCALE:15X

4215214/C 04/2025

LP0003A

TO-92 - 5.34 mm max height

TO-92



FOR FORMED LEAD OPTION PACKAGE

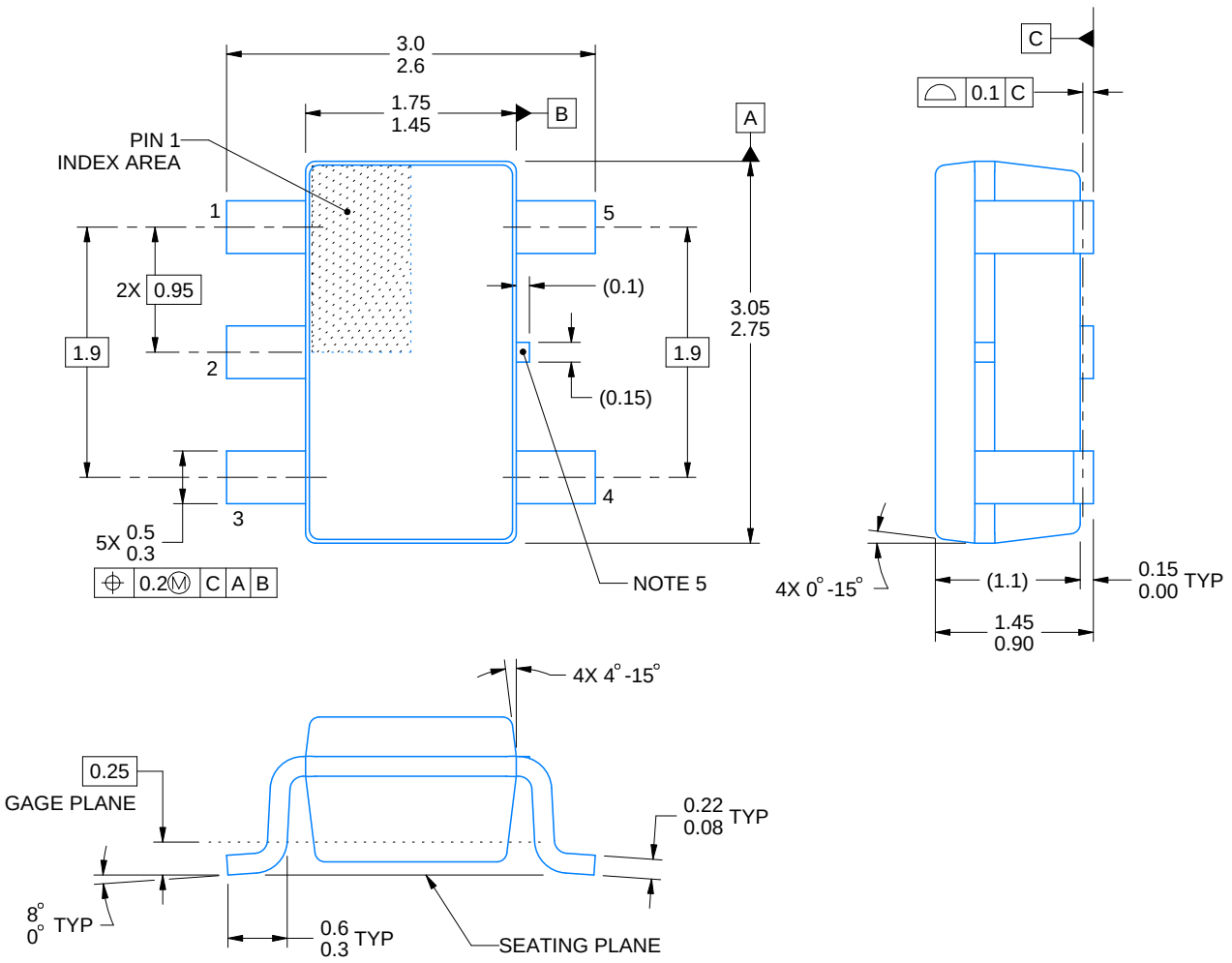
4215214/C 04/2025

PACKAGE OUTLINE

DBV0005A

SOT-23 - 1.45 mm max height

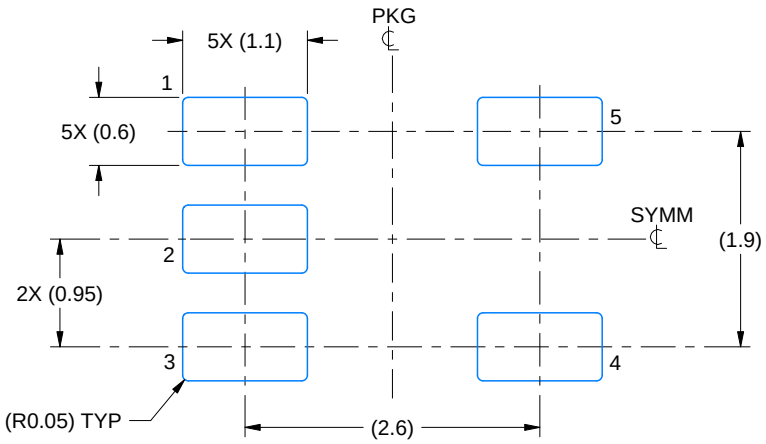
SMALL OUTLINE TRANSISTOR



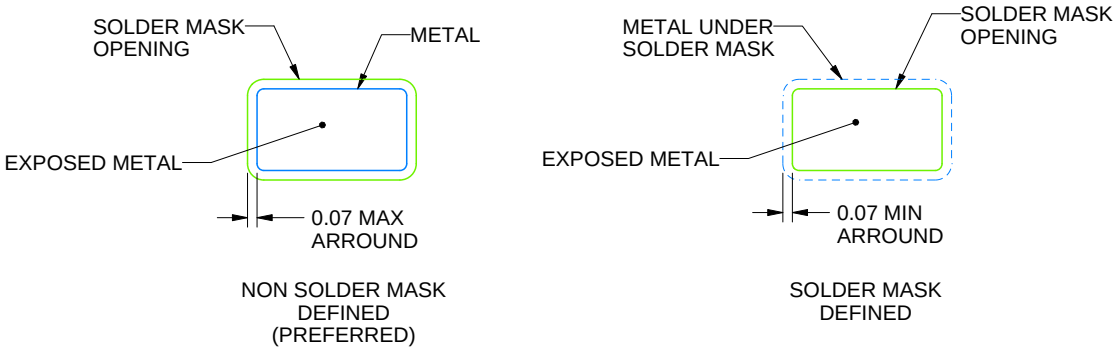
4214839/K 08/2024

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. 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

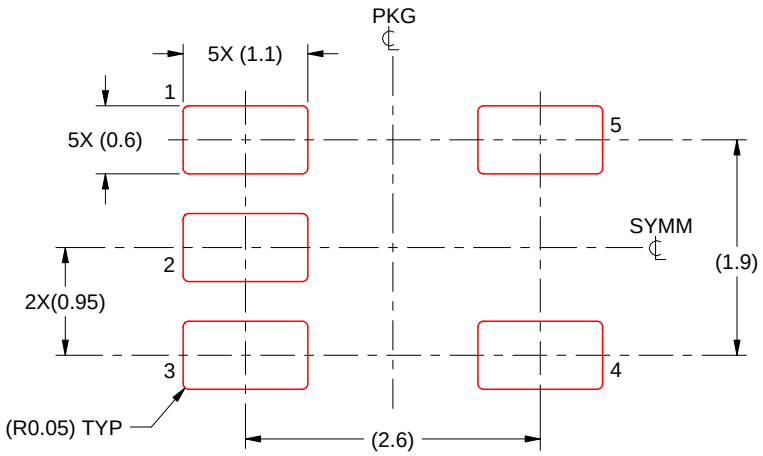


SOLDER MASK DETAILS

4214839/K 08/2024

NOTES: (continued)

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



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

4214839/K 08/2024

NOTES: (continued)

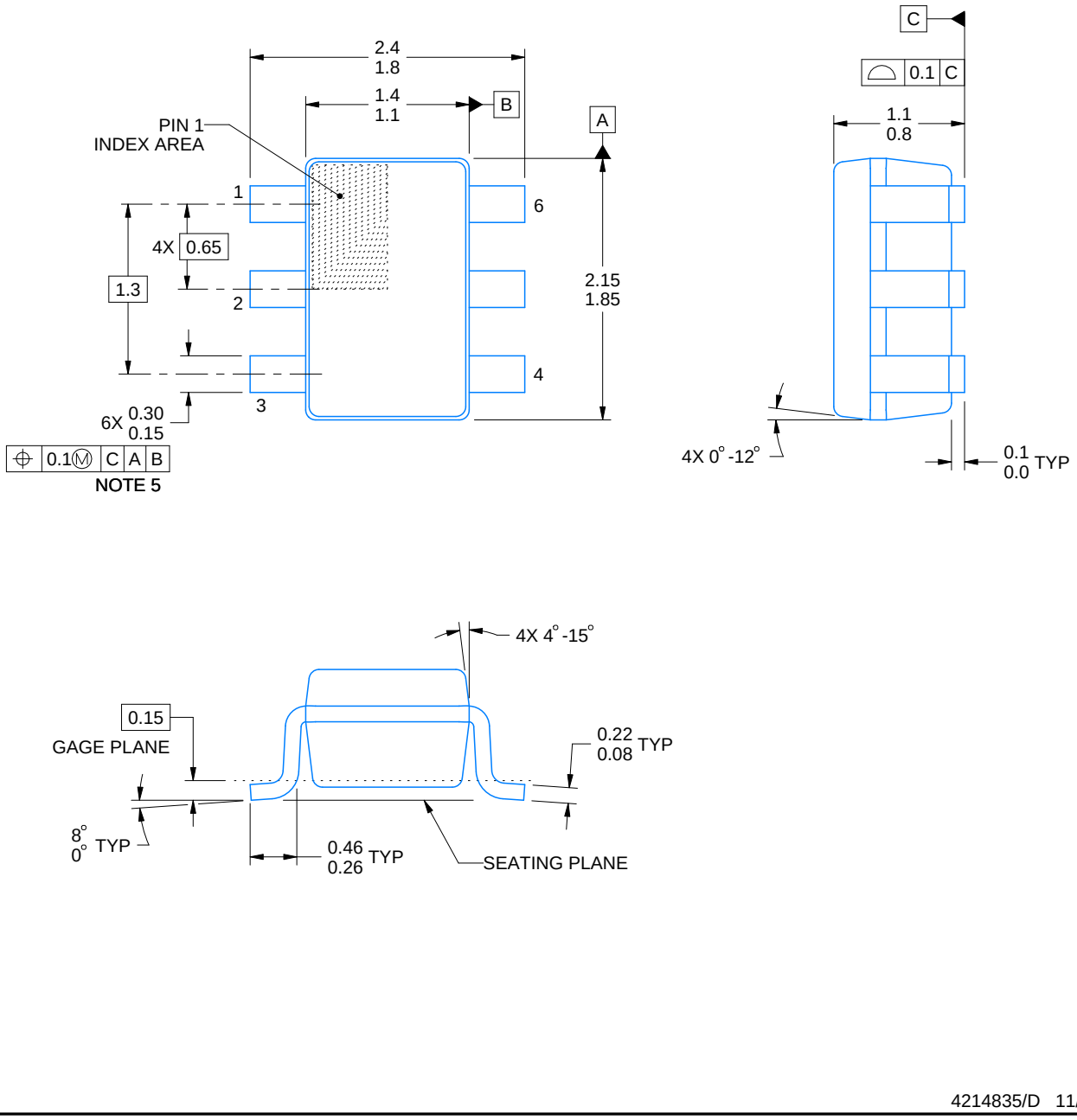
8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

PACKAGE OUTLINE

DCK0006A

SOT - 1.1 max height

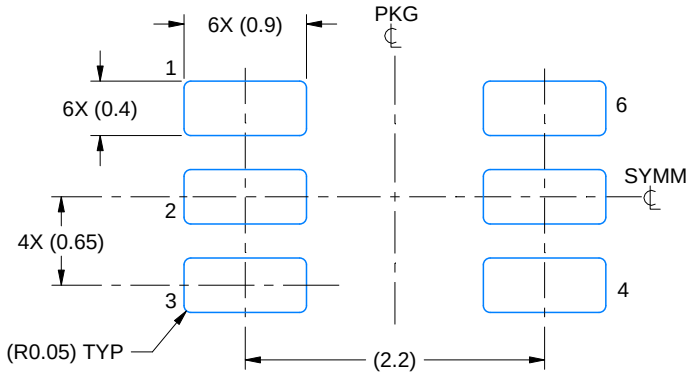
SMALL OUTLINE TRANSISTOR



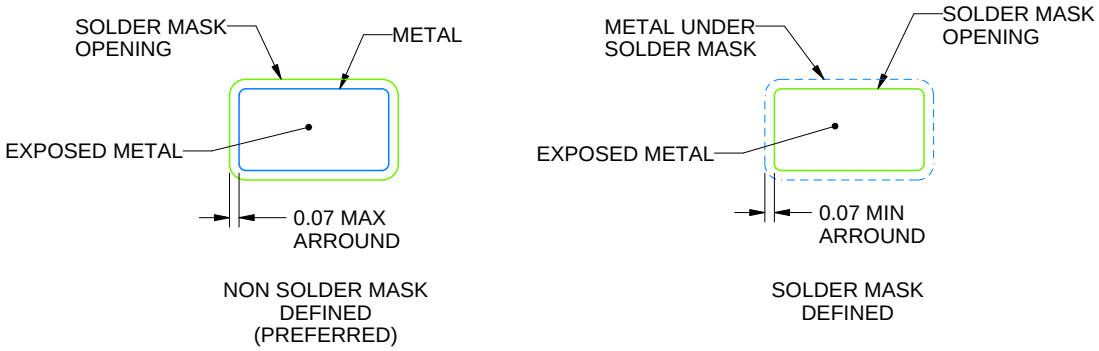
4214835/D 11/2024

NOTES:

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



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:18X

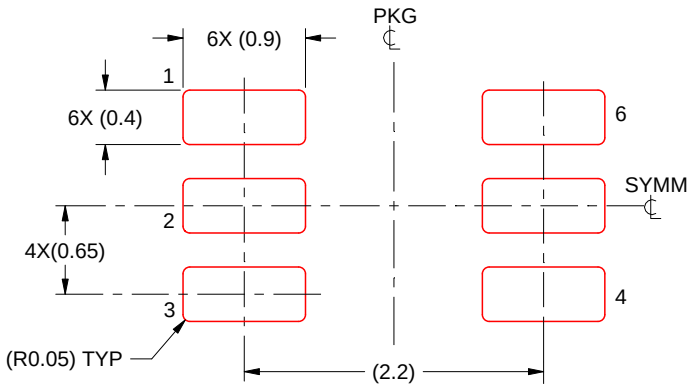


SOLDER MASK DETAILS

4214835/D 11/2024

NOTES: (continued)

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



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

4214835/D 11/2024

NOTES: (continued)

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

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