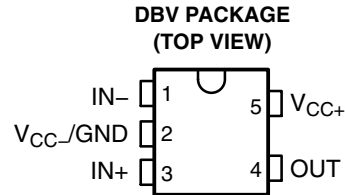


# TLV1391 SINGLE DIFFERENTIAL COMPARATORS

SLCS128F – APRIL 1996 – REVISED JUNE 2007

- **Low-Voltage and Single-Supply Operation**  
 $V_{CC} = 2\text{ V to }7\text{ V}$
- **Common-Mode Voltage Range Includes Ground**
- **Fast Response Time . . . 0.7  $\mu\text{s}$  Typ**
- **Low Supply Current . . . 80  $\mu\text{A}$  Typ and 150  $\mu\text{A}$  Max**
- **Fully Specified at 3-V and 5-V Supply Voltages**



## description/ordering informaton

The TLV1391 is a differential comparator built using a Texas Instruments low-voltage, high-speed bipolar process. These devices have been developed specifically for low-voltage, single-supply applications. Their enhanced performance makes them excellent replacements for the LM393 in the improved 3-V and 5-V system designs.

The TLV1391, with its typical supply current of only 80  $\mu\text{A}$ , is ideal for low-power systems. Response time also has been improved to 0.7  $\mu\text{s}$ .

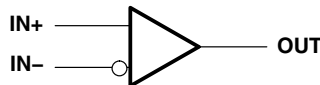
## ORDERING INFORMATION

| $T_A$         | PACKAGE <sup>†</sup> |              | ORDERABLE PART NUMBER | TOP-SIDE MARKING <sup>‡</sup> |
|---------------|----------------------|--------------|-----------------------|-------------------------------|
| –0°C to 70°C  | SOT-23-5 (DBV)       | Reel of 3000 | TLV1391CDBVR          | Y3D_                          |
|               |                      | Reel of 250  | TLV1391CDBVT          |                               |
| –40°C to 85°C | SOT-23-5 (DBV)       | Reel of 3000 | TLV1391IDBVR          | Y3E_                          |
|               |                      | Reel of 250  | TLV1391IDBVT          |                               |

<sup>†</sup> Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

<sup>‡</sup> The actual top-side marking has one additional character that designates the wafer fab/assembly site.

## symbol (each comparator)



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

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

**TEXAS  
INSTRUMENTS**

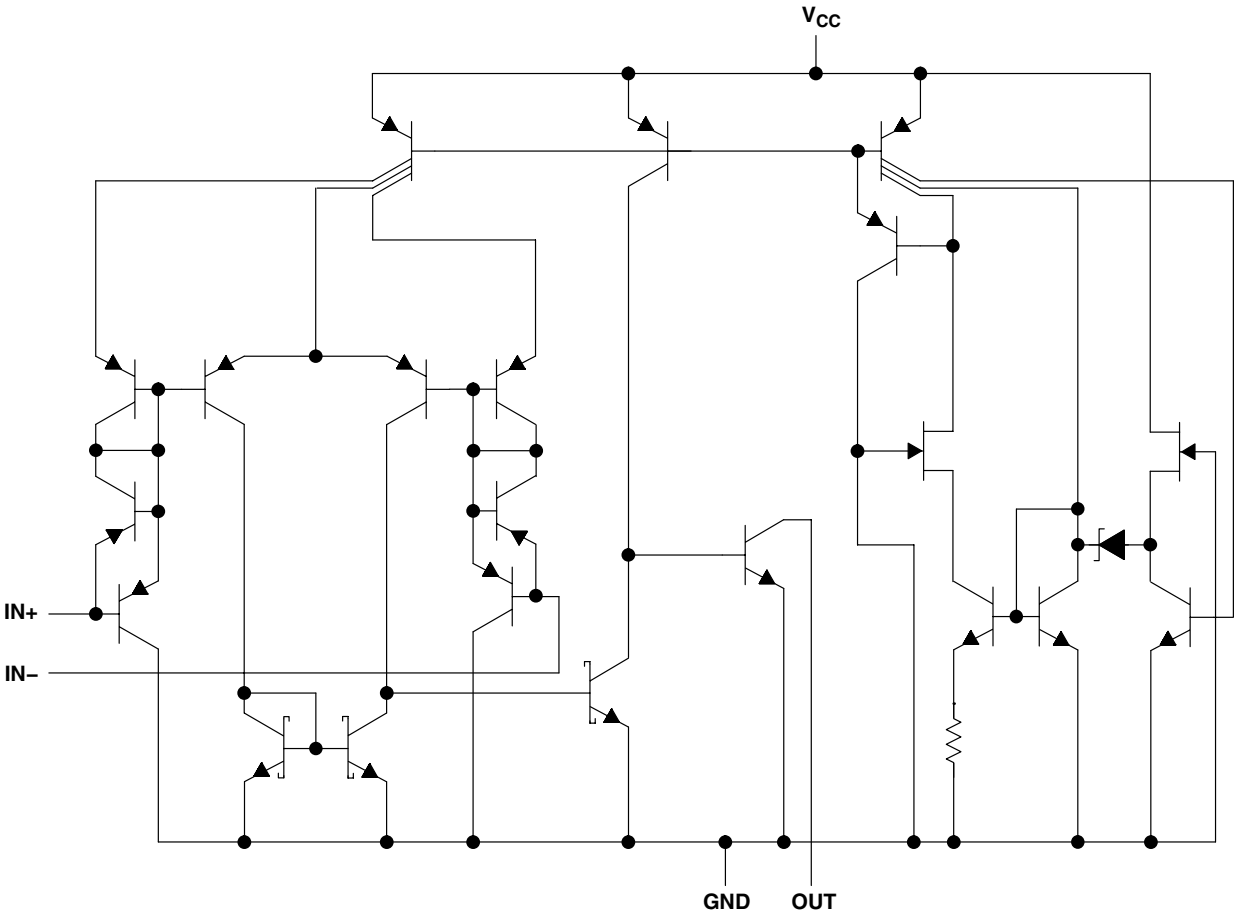
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**TLV1391**  
**SINGLE DIFFERENTIAL COMPARATORS**

SLCS128F – APRIL 1996 – REVISED JUNE 2007

**equivalent schematic**



| COMPONENT COUNT |    |
|-----------------|----|
| Transistors     | 26 |
| Resistors       | 1  |
| Diodes          | 4  |
| Epi-FET         | 1  |

# TLV1391 SINGLE DIFFERENTIAL COMPARATORS

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## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

|  |  |
|--|--|
| Supply voltage, $V_{CC}$ (see Note 1)                        | 7 V  |
| Differential input voltage, $V_{ID}$ (see Note 2)            | $\pm 7$ V                                  |
| Input voltage range, $V_I$ (any input)                       | $-0.3$ V to $V_{CC}$                       |
| Output voltage, $V_O$  | 7 V  |
| Output current, $I_O$ (each output)                          | 20 mA                                      |
| Duration of short-circuit current to GND (see Note 3)        | Unlimited                                  |
| Package thermal impedance, $\theta_{JA}$ (see Note 4 and 5)  | 206°C/W                                    |
| Operating virtual junction temperature, $T_J$                | 150°C                                      |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds | 260°C                                      |
| Storage temperature range, $T_{stg}$                         | $-65^\circ\text{C}$ to $150^\circ\text{C}$ |

<sup>†</sup> Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES:
1. All voltage values, except differential voltages, are with respect to the network GND.
  2. Differential voltages are at the noninverting input with respect to the inverting input.
  3. Short circuits from the outputs to  $V_{CC}$  can cause excessive heating and eventual destruction of the chip.
  4. Maximum power dissipation is a function of  $T_J(\text{max})$ ,  $\theta_{JA}$ , and  $T_A$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_J(\text{max}) - T_A)/\theta_{JA}$ . Operating at the absolute maximum  $T_J$  of 150°C can impact reliability.
  5. The package thermal impedance is calculated in accordance with JESD 51-7.

## recommended operating conditions

|                 |                                |          | MIN | MAX | UNIT |
|-----------------|--------------------------------|----------|-----|-----|------|
| V <sub>CC</sub> | Supply voltage                 |          | 2   | 7   | V    |
| T <sub>A</sub>  | Operating free-air temperature | TLV1391C | 0   | 70  | °C   |
|                 |                                | TLV1391I | −40 | 85  |      |



# TLV1391

## SINGLE DIFFERENTIAL COMPARATORS

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### electrical characteristics, $V_{CC} = 3\text{ V}$

| PARAMETER                                 | TEST CONDITIONS  | $T_A$      | MIN               | TYP               | MAX  | UNIT          |
|---|--|------------|-------------------|-------------------|------|---------------|
| $V_{IO}$ Input offset voltage             | $V_O = 1.4\text{ V}$ , $V_{IC} = V_{ICR}(\text{min})$      | 25°C       |                   | 1.5               | 5    | mV            |
|   |  | Full range |                   |                   | 9    |               |
| $V_{ICR}$ Common-mode input voltage range |  | 25°C       | 0 to $V_{CC}-1.5$ | 0 to $V_{CC}-1.2$ |      | V             |
|   |  | Full range | 0 to $V_{CC}-2$   |                   |      |               |
| $V_{OL}$ Low-level output voltage         | $V_{ID} = -1\text{ V}$ , $I_{OL} = 500\text{ }\mu\text{A}$ | Full range |                   | 120               | 300  | mV            |
| $I_{IO}$ Input offset current             | $V_O = 1.4\text{ V}$                                       | 25°C       |                   | 5                 | 50   | nA            |
|   |  | Full range |                   |                   | 150  |               |
| $I_{IB}$ Input bias current               | $V_O = 1.4\text{ V}$                                       | 25°C       |                   | -40               | -250 | nA            |
|   |  | Full range |                   |                   | -400 |               |
| $I_{OH}$ High-level output current        | $V_{ID} = 1\text{ V}$ , $V_{OH} = 3\text{ V}$              | 25°C       |                   | 0.1               |      | nA            |
|   | $V_{ID} = 1\text{ V}$ , $V_{OH} = 5\text{ V}$              | Full range |                   |                   | 100  |               |
| $I_{OL}$ Low-level output current         | $V_{ID} = -1\text{ V}$ , $V_{OL} = 1.5\text{ V}$           | 25°C       | 500               |                   |      | $\mu\text{A}$ |
| $I_{CC(H)}$ High-level supply current     | $V_O = V_{OH}$   | 25°C       |                   | 80                | 125  | $\mu\text{A}$ |
|   |  | Full range |                   |                   | 150  |               |
| $I_{CC(L)}$ Low-level supply current      | $V_O = V_{OL}$   | 25°C       |                   | 80                | 125  | $\mu\text{A}$ |
|   |  | Full range |                   |                   | 150  |               |

### switching characteristics, $V_{CC} = 3\text{ V}$ , $C_L = 15\text{ pF}^\dagger$ , $T_A = 25^\circ\text{C}$

| PARAMETER     | TEST CONDITIONS   | TYP | UNIT          |
|---------------|---|-----|---------------|
| Response time | 100-mV input step with 5-mV overdrive, $R_L = 5.1\text{ k}\Omega$ | 0.7 | $\mu\text{s}$ |

<sup>†</sup>  $C_L$  includes the probe and jig capacitance.

# TLV1391

## SINGLE DIFFERENTIAL COMPARATORS

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### electrical characteristics, $V_{CC} = 5\text{ V}$

| PARAMETER                                 | TEST CONDITIONS  | $T_A$      | MIN               | TYP               | MAX  | UNIT          |
|---|--|------------|-------------------|-------------------|------|---------------|
| $V_{IO}$ Input offset voltage             | $V_O = 1.4\text{ V}$ , $V_{IC} = V_{ICR}(\text{min})$      | 25°C       |                   | 1.5               | 5    | mV            |
|   |  | Full range |                   |                   | 9    |               |
| $V_{ICR}$ Common-mode input voltage range |  | 25°C       | 0 to $V_{CC}-1.5$ | 0 to $V_{CC}-1.2$ |      | V             |
|   |  | Full range | 0 to $V_{CC}-2$   |                   |      |               |
| $V_{OL}$ Low-level output voltage         | $V_{ID} = -1\text{ V}$ , $I_{OL} = 500\text{ }\mu\text{A}$ | Full range |                   | 120               | 300  | mV            |
| $I_{IO}$ Input offset current             | $V_O = 1.4\text{ V}$                                       | 25°C       |                   | 5                 | 50   | nA            |
|   |  | Full range |                   |                   | 150  |               |
| $I_{IB}$ Input bias current               | $V_O = 1.4\text{ V}$                                       | 25°C       |                   | -40               | -250 | nA            |
|   |  | Full range |                   |                   | -400 |               |
| $I_{OH}$ High-level output current        | $V_{ID} = 1\text{ V}$ , $V_{OH} = 3\text{ V}$              | 25°C       |                   | 0.1               |      | nA            |
|   | $V_{ID} = 1\text{ V}$ , $V_{OH} = 5\text{ V}$              | Full range |                   |                   | 100  |               |
| $I_{OL}$ Low-level output current         | $V_{ID} = -1\text{ V}$ , $V_{OL} = 1.5\text{ V}$           | 25°C       | 600               |                   |      | $\mu\text{A}$ |
| $I_{CC(H)}$ High-level supply current     | $V_O = V_{OH}$   | 25°C       |                   | 100               | 150  | $\mu\text{A}$ |
|   |  | Full range |                   |                   | 175  |               |
| $I_{CC(L)}$ Low-level supply current      | $V_O = V_{OL}$   | 25°C       |                   | 100               | 150  | $\mu\text{A}$ |
|   |  | Full range |                   |                   | 175  |               |

### switching characteristics, $V_{CC} = 5\text{ V}$ , $C_L = 15\text{ pF}^\dagger$ , $T_A = 25^\circ\text{C}$

| PARAMETER     | TEST CONDITIONS   | TYP  | UNIT          |
|---------------|---|------|---------------|
| Response time | 100-mV input step with 5-mV overdrive, $R_L = 5.1\text{ k}\Omega$ | 0.65 | $\mu\text{s}$ |
|               | TTL-level input step, $R_L = 5.1\text{ k}\Omega$                  | 0.18 |               |

<sup>†</sup>  $C_L$  includes the probe and jig capacitance.



# TLV1391

## SINGLE DIFFERENTIAL COMPARATORS

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### TYPICAL CHARACTERISTICS

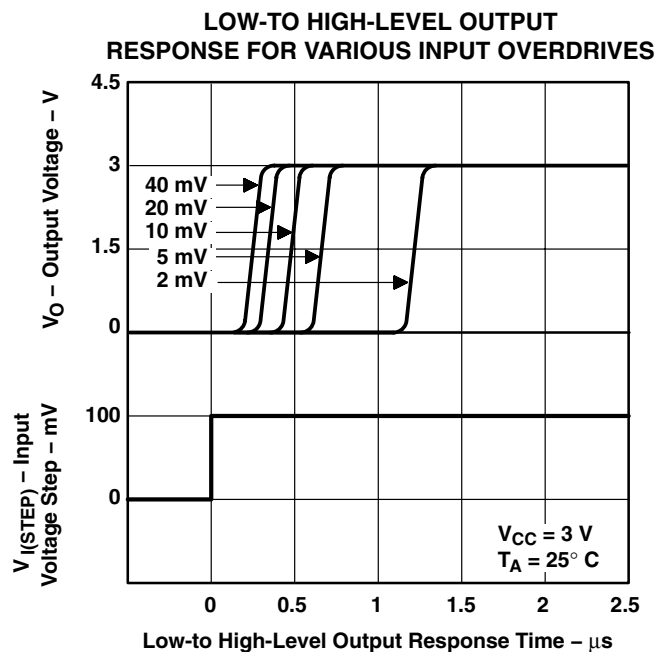


Figure 1

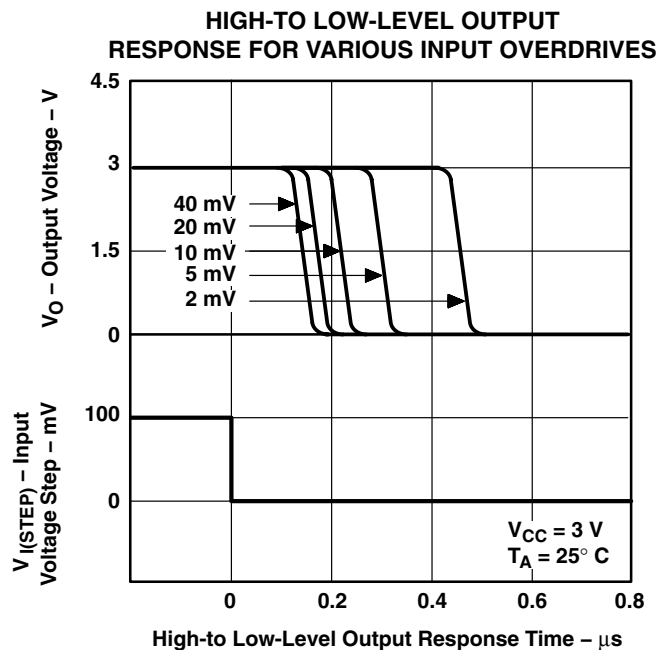


Figure 2

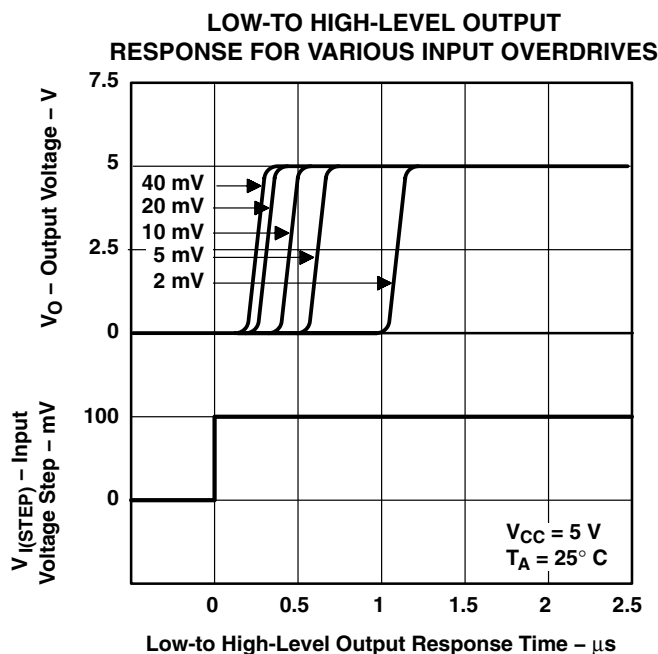


Figure 3

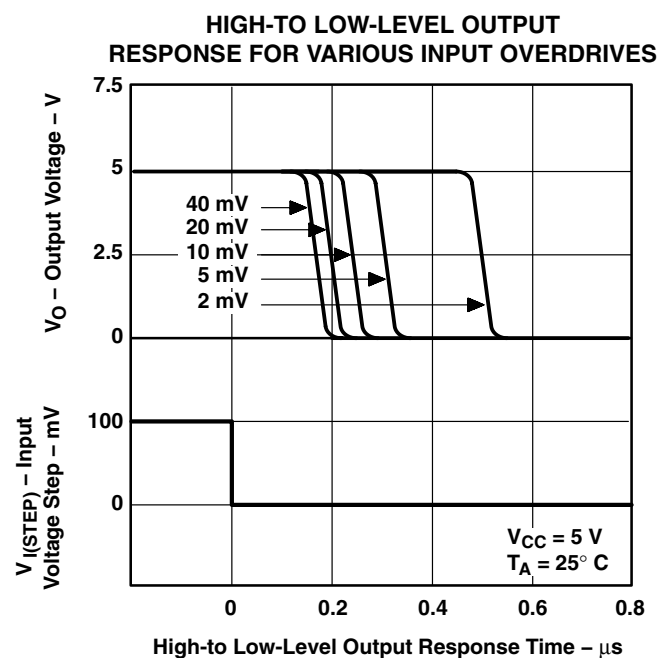


Figure 4

## PACKAGING INFORMATION

| Orderable part number          | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6)      |
|--------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|--------------------------|
| <a href="#">TLV1391CDBVR</a>   | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | 0 to 70      | (1391, Y3D6, Y3DG, Y3DJ) |
| TLV1391CDBVR.A                 | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | (1391, Y3D6, Y3DG, Y3DJ) |
| TLV1391CDBVR.B                 | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | -           | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (1391, Y3D6, Y3DG, Y3DJ) |
| TLV1391CDBVR1G4                | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | 1391                     |
| TLV1391CDBVR1G4.A              | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | 1391                     |
| <a href="#">TLV1391CDBVRG4</a> | Obsolete      | Production           | SOT-23 (DBV)   5 | -                     | -           | Call TI                              | Call TI                           | 0 to 70      | Y3DG                     |
| <a href="#">TLV1391IDBVR</a>   | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | (1391, Y3E6, Y3EB, Y3EJ) |
| TLV1391IDBVR.A                 | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (1391, Y3E6, Y3EB, Y3EJ) |
| TLV1391IDBVR.B                 | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | -           | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (1391, Y3E6, Y3EB, Y3EJ) |
| <a href="#">TLV1391IDBVRG4</a> | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (1391, Y3E6, Y3EB)       |
| TLV1391IDBVRG4.A               | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | (1391, Y3E6, Y3EB)       |

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

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

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

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

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

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

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

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## TAPE AND REEL INFORMATION



\*All dimensions are nominal

| Device          | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLV1391CDBVR    | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLV1391CDBVR1G4 | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLV1391IDBVR    | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLV1391IDBVR    | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLV1391IDBVRG4  | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |

## TAPE AND REEL BOX DIMENSIONS

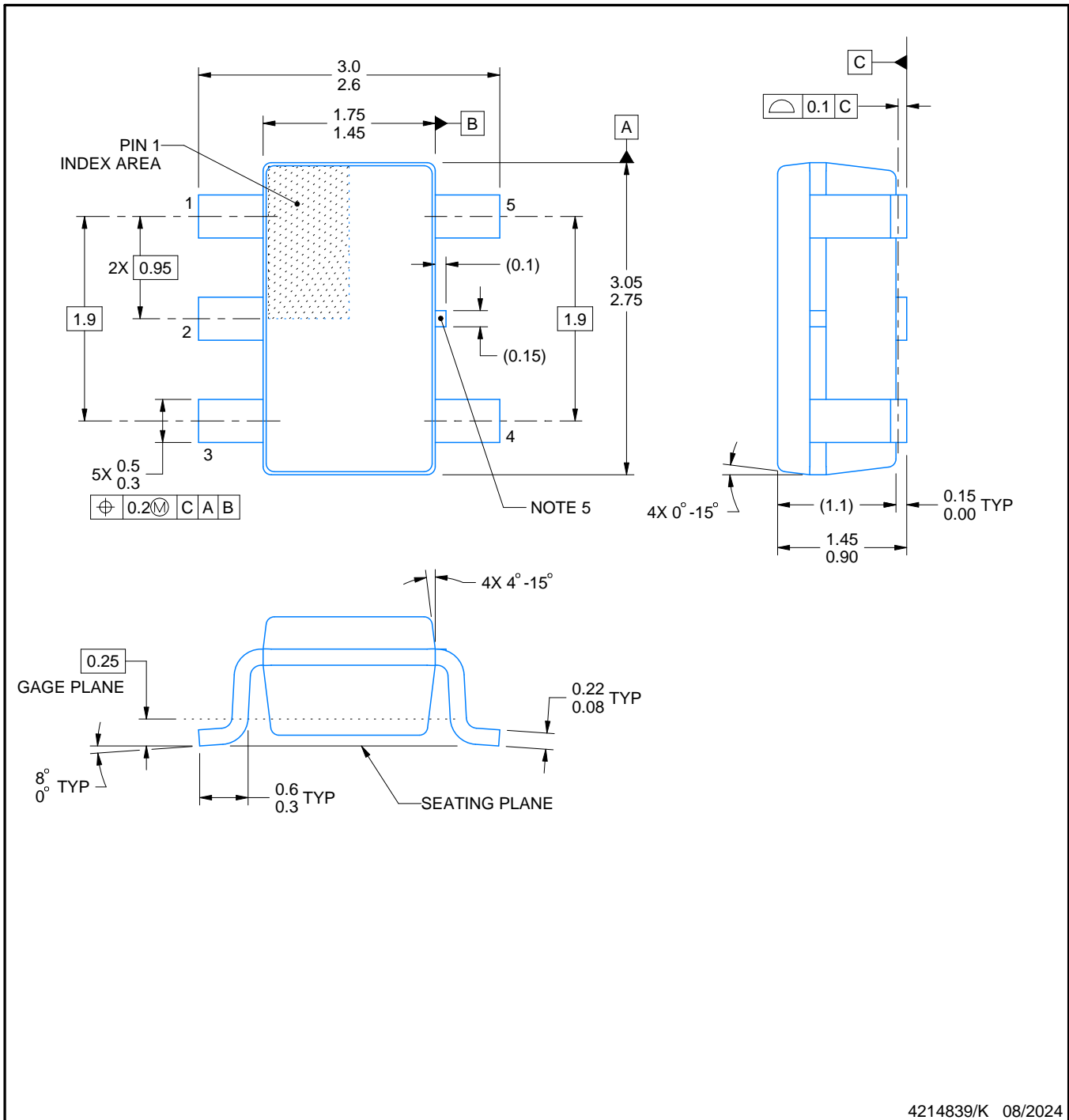


\*All dimensions are nominal

| Device          | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLV1391CDBVR    | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TLV1391CDBVR1G4 | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TLV1391IDBVR    | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TLV1391IDBVR    | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TLV1391IDBVRG4  | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |

**DBV0005A****PACKAGE OUTLINE****SOT-23 - 1.45 mm max height**

SMALL OUTLINE TRANSISTOR



4214839/K 08/2024

**NOTES:**

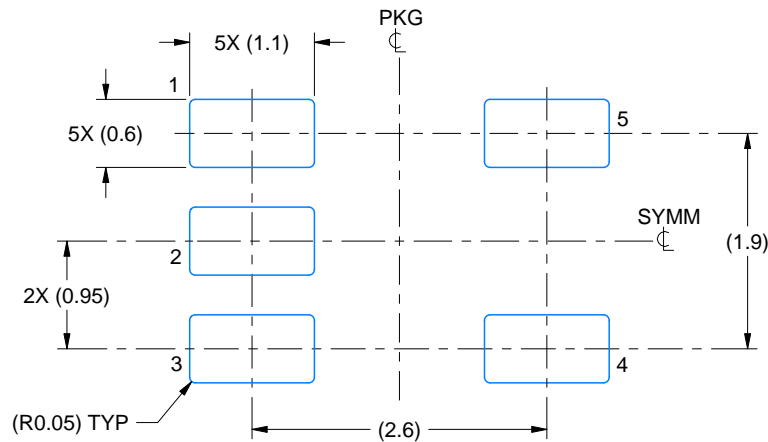
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC MO-178.
4. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25 mm per side.
5. Support pin may differ or may not be present.

# EXAMPLE BOARD LAYOUT

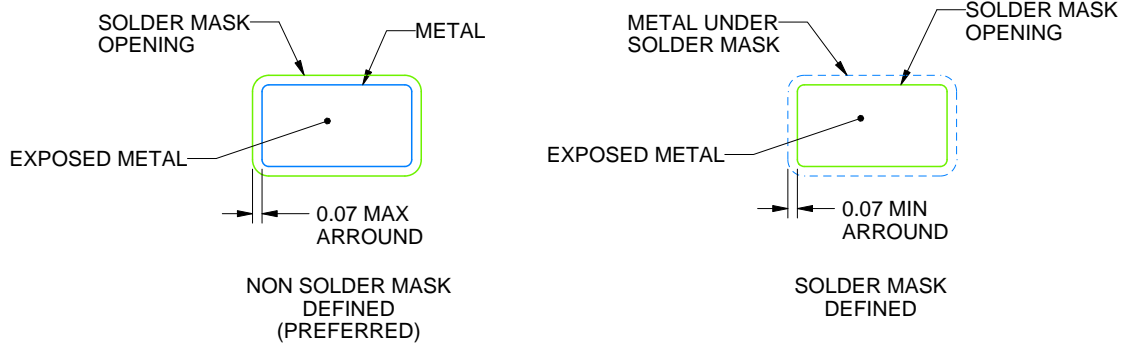
DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:15X



SOLDER MASK DETAILS

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NOTES: (continued)

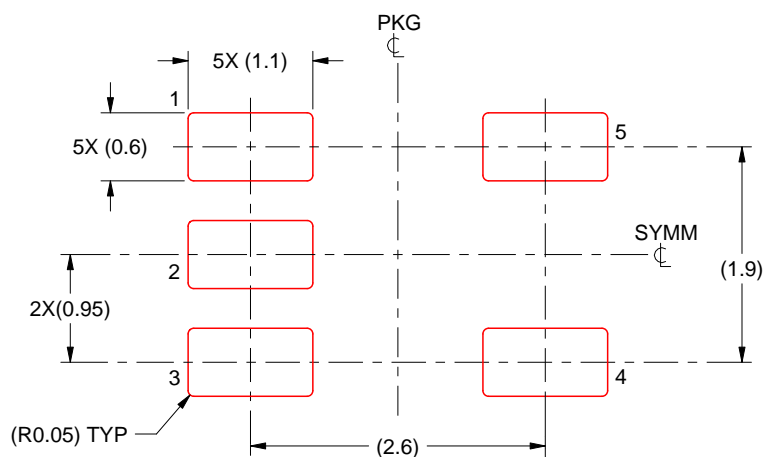
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



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

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NOTES: (continued)

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.

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