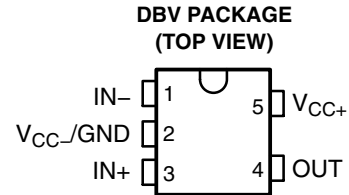


# TLV1391 SINGLE DIFFERENTIAL COMPARATORS

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  $\mu\text{s}$ .

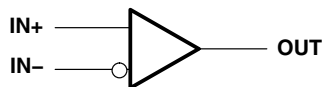
## ORDERING INFORMATION

$T_A$	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING‡
-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	

† 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).

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

## symbol (each comparator)



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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**

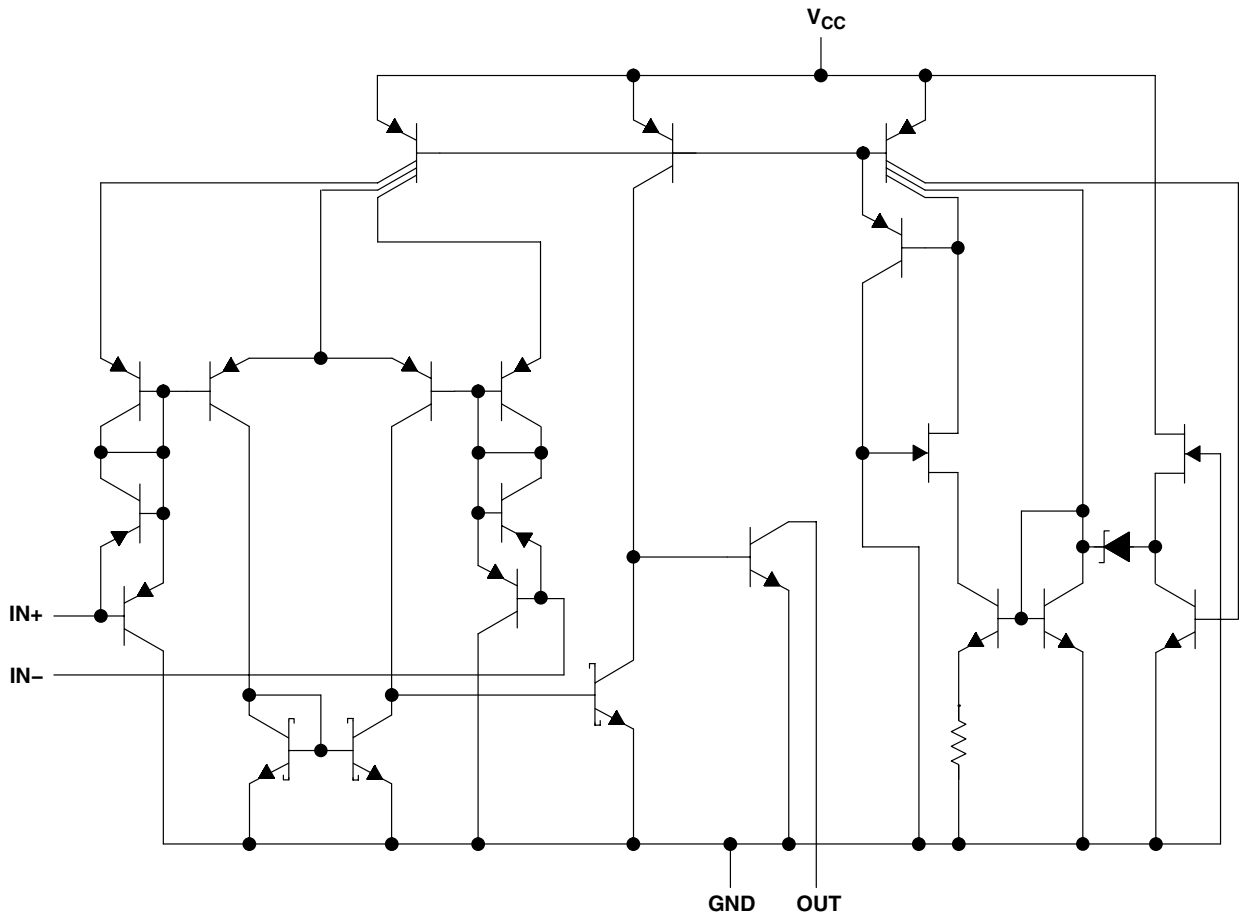
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# TLV1391 SINGLE DIFFERENTIAL COMPARATORS

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## 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)†

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°C to 150°C

† 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
$V_{CC}$	Supply voltage	2	7	V
$T_A$	Operating free-air temperature	TLV1391C	0	70
		TLV1391I	–40	85
				°C



# 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.



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# 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

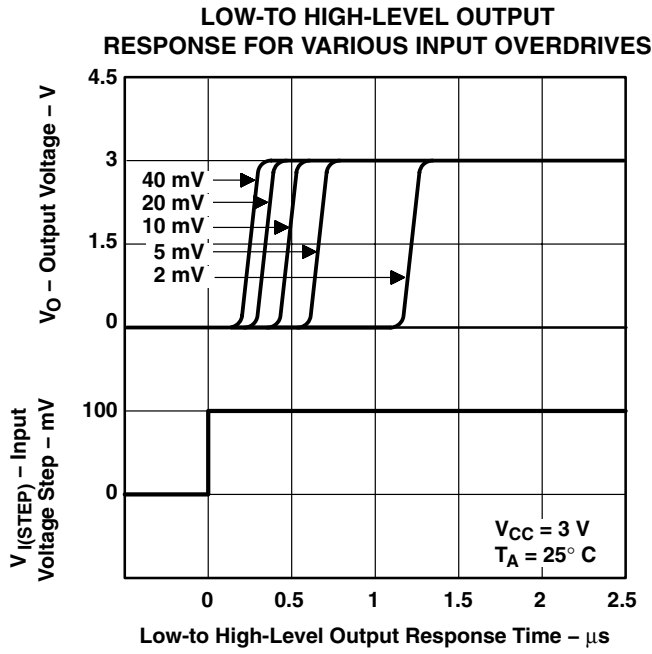


Figure 1

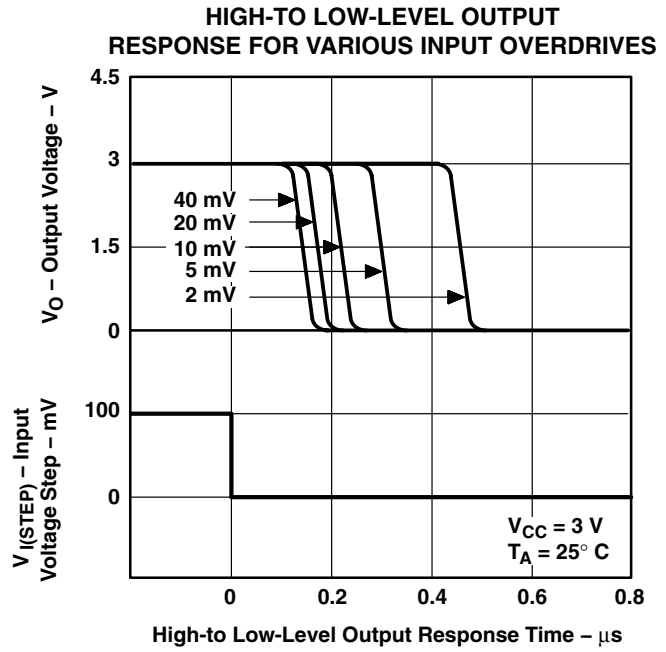


Figure 2

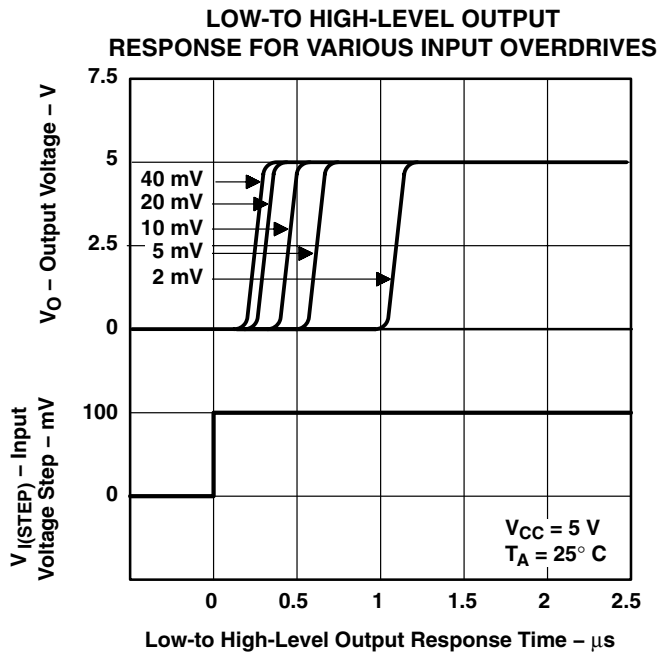


Figure 3

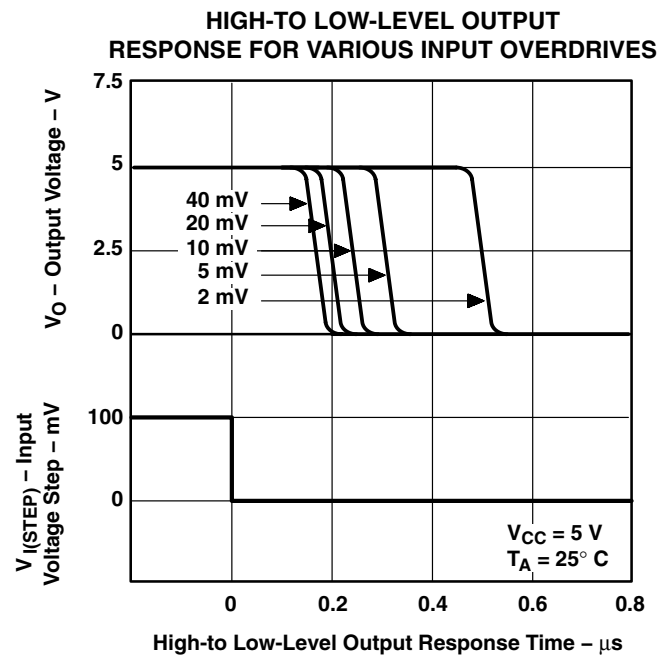


Figure 4

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TLV1391CDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU   CU SN	Level-1-260C-UNLIM	0 to 70	(Y3D6 ~ Y3DG)	<a href="#">Samples</a>
TLV1391CDBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU   CU SN	Level-1-260C-UNLIM	0 to 70	(Y3DB ~ Y3DG)	<a href="#">Samples</a>
TLV1391IDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	(Y3E6 ~ Y3EB)	<a href="#">Samples</a>
TLV1391IDBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	Y3EB	<a href="#">Samples</a>
TLV1391IDBVTG4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	Y3EB	<a href="#">Samples</a>

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

**ACTIVE:** Product device recommended for new designs.

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

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

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

**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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

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

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

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## TAPE AND REEL INFORMATION



### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TLV1391CDBVR	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TLV1391CDBVT	SOT-23	DBV	5	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TLV1391IDBVR	SOT-23	DBV	5	3000	180.0	8.4	3.23	3.17	1.37	4.0	8.0	Q3
TLV1391IDBVT	SOT-23	DBV	5	250	179.0	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	180.0	180.0	18.0
TLV1391CDBVT	SOT-23	DBV	5	250	180.0	180.0	18.0
TLV1391IDBVR	SOT-23	DBV	5	3000	202.0	201.0	28.0
TLV1391IDBVT	SOT-23	DBV	5	250	203.0	203.0	35.0

## GENERIC PACKAGE VIEW

DBV 5

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



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

4073253/P

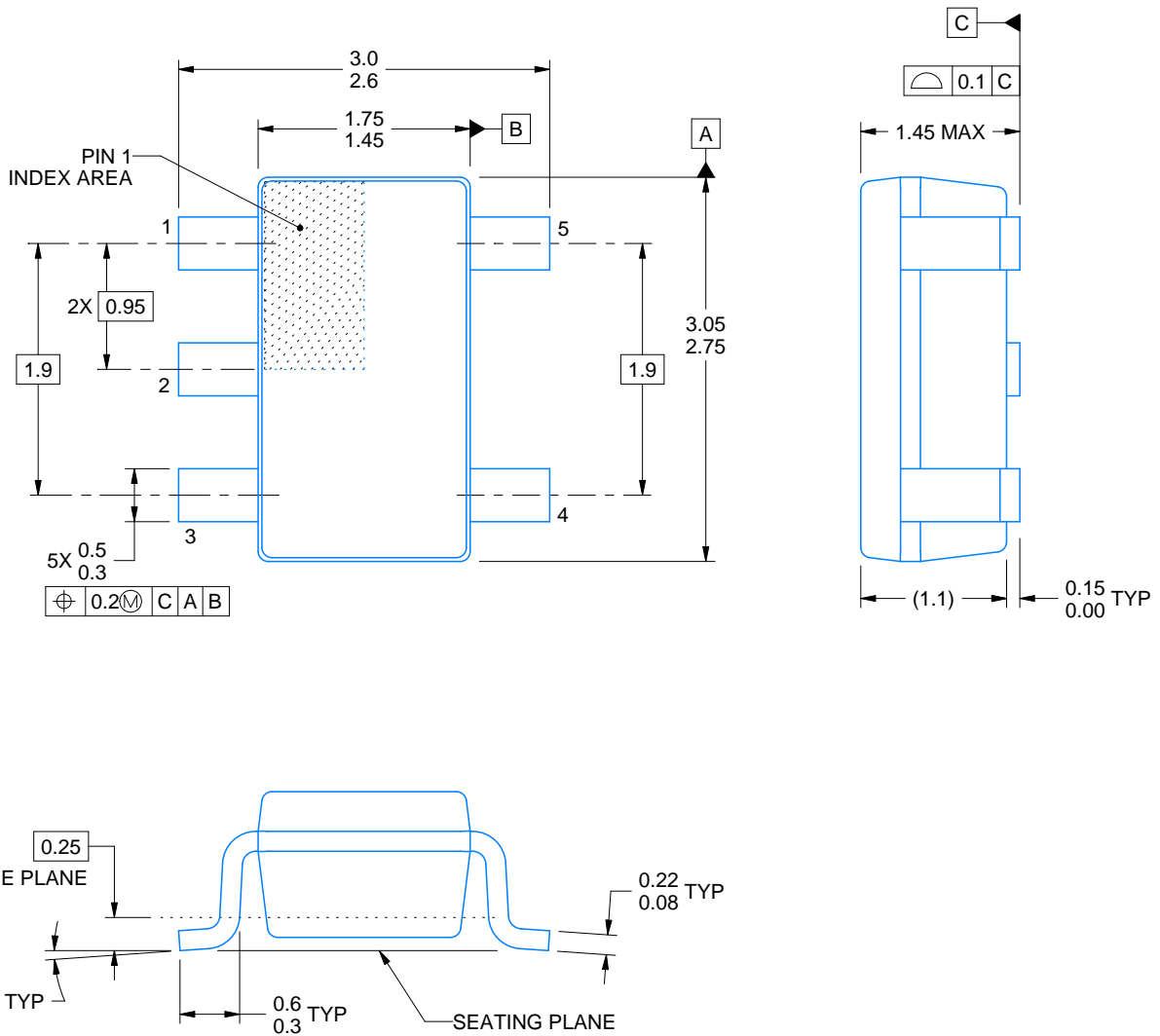
DBV0005A



# PACKAGE OUTLINE

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



4214839/C 04/2017

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.

# EXAMPLE BOARD LAYOUT

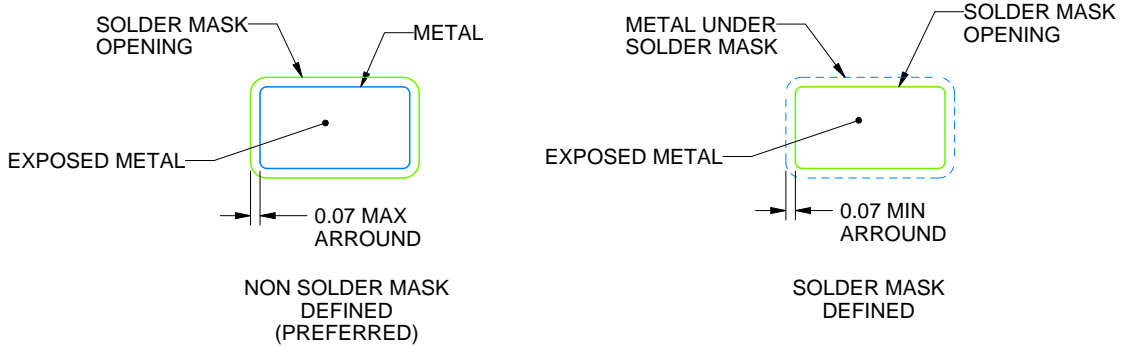
DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:15X



SOLDER MASK DETAILS

4214839/C 04/2017

NOTES: (continued)

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

# EXAMPLE STENCIL DESIGN

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



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

4214839/C 04/2017

NOTES: (continued)

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

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