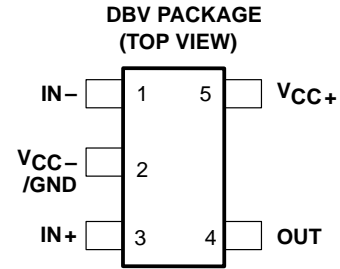


# TLV1391, TLV1391Y SINGLE DIFFERENTIAL COMPARATORS

SLCS128A – APRIL 1996 – REVISED APRIL 1996

- **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**
- **Available in SOT-23 (DBV) Packaging**



## description

The TLV1391 is a differential comparator built using a Texas Instruments low-voltage, high-speed bipolar process. These devices have been specifically developed 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 of today.

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

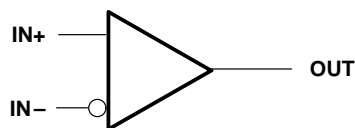
Package availability for this device includes the very small SOT-23 package to reduce board space requirements.

## AVAILABLE OPTIONS

$T_A$	PACKAGED DEVICES	SYMBOL	CHIP FORM (Y)
	SOT-23 (DBV)		
$0^\circ\text{C to }70^\circ\text{C}$	TLV1391CDBV	VABC	TLV1391Y
$-40^\circ\text{C to }85^\circ\text{C}$	TLV1391IDBV	VABI	

† The DBV package is only available taped and reeled. Chip forms are specified for operation at  $25^\circ\text{C}$  only.

## 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**

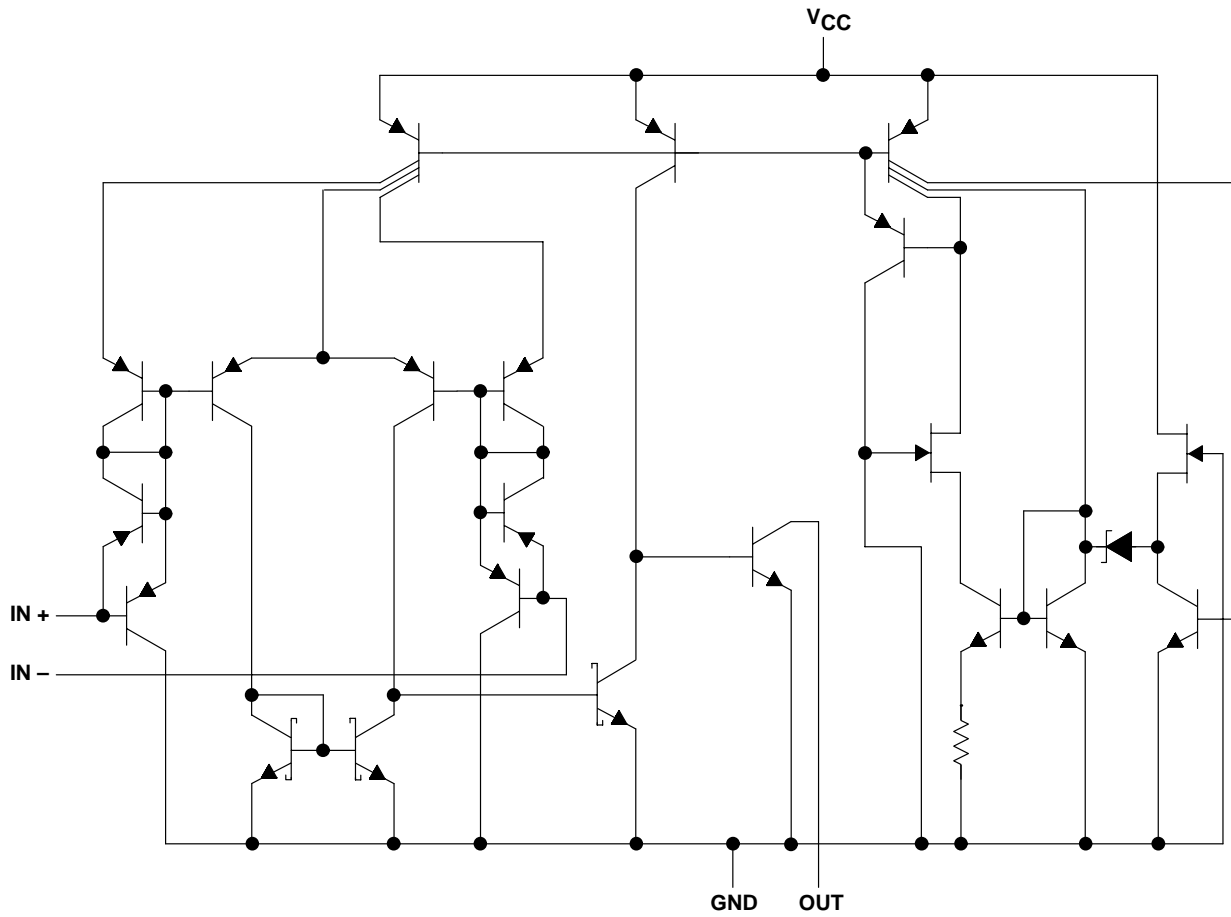
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# TLV1391, TLV1391Y SINGLE DIFFERENTIAL COMPARATORS

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## TLV1391, TLV1391Y equivalent schematic



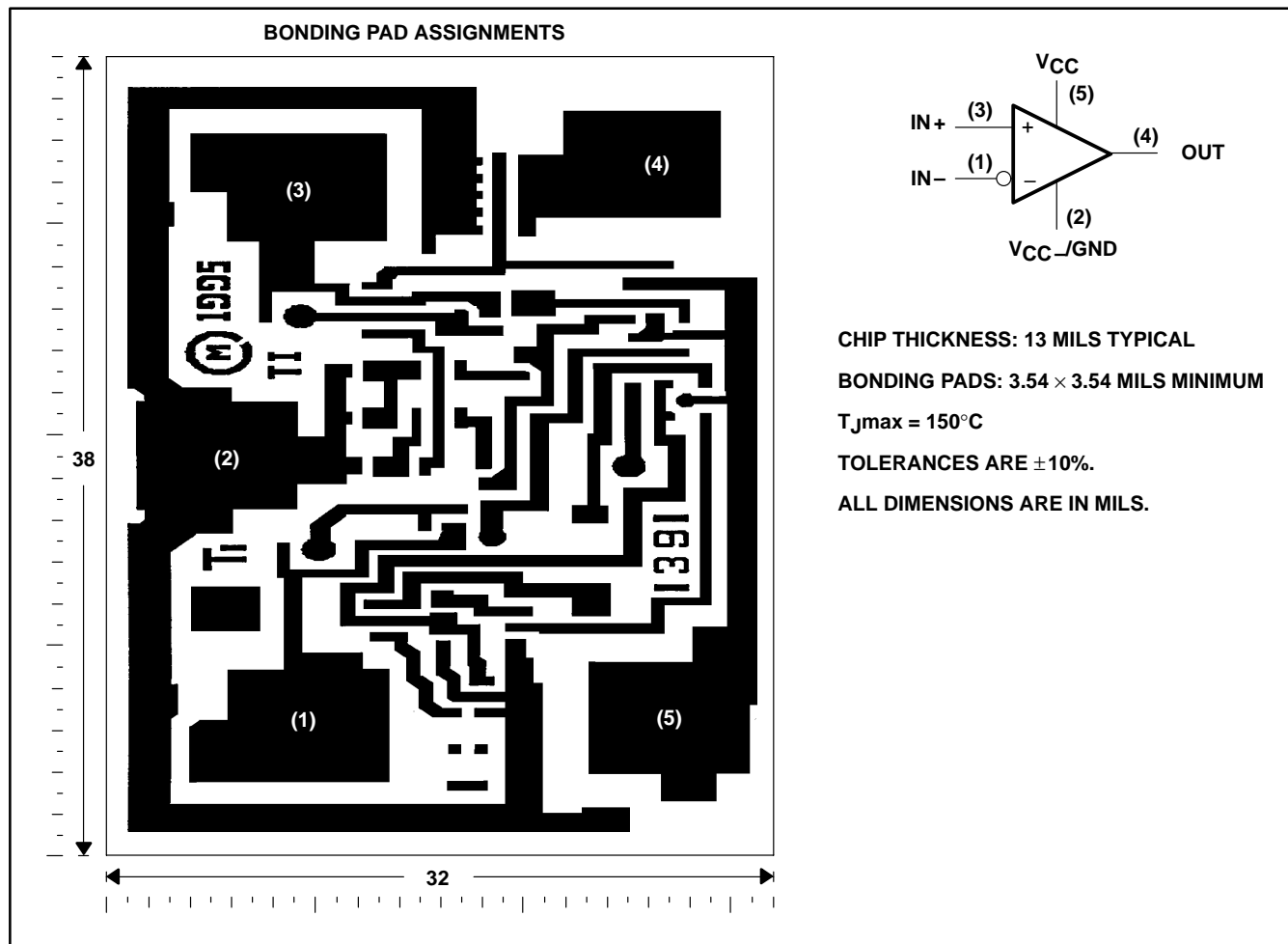
COMPONENT COUNT	
Transistors	26
Resistors	1
Diodes	4
Epi-FET	1

# TLV1391, TLV1391Y SINGLE DIFFERENTIAL COMPARATORS

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## TLV1391Y chip information

This chip, when properly assembled, displays characteristics similar to the TLV1391. Thermal compression or ultrasonic bonding may be used on the doped-aluminum bonding pads. This chip may be mounted with conductive epoxy or a gold-silicon preform.



# TLV1391, TLV1391Y 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, $V_I$ (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
Continuous total power dissipation	See Dissipation Rating Table
Operating free-air temperature range, $T_A$ : C suffix	0°C to 70°C
I suffix	-40°C to 85°C
Storage temperature range, $T_{stg}$	-65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°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.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25^\circ\text{C}$	DERATING FACTOR	$T_A = 70^\circ\text{C}$	$T_A = 85^\circ\text{C}$
	POWER RATING	ABOVE $T_A = 25^\circ\text{C}$	POWER RATING	POWER RATING
DBV	150 mW	1.2 mW/°C	96 mW	78 mW

## recommended operating conditions

	C SUFFIX		I SUFFIX		UNIT
	MIN	MAX	MIN	MAX	
Supply voltage, $V_{CC}$	2	7	2	7	V
Operating free-air temperature, $T_A$	0	70	-40	85	°C



# TLV1391, TLV1391Y SINGLE DIFFERENTIAL COMPARATORS

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

PARAMETER	TEST CONDITIONS	$T_A$ †	TLV1391C			UNIT
			MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_O = 1.4\text{ V}$ , $V_O = V_{ICRmin}$	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	
		Full range			150	

† Full range is 0°C to 70°C.

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

PARAMETER	TEST CONDITIONS	TLV1391C			UNIT
		MIN	TYP	MAX	
Response time	100-mV input step with 5-mV overdrive, $R_L = 5.1\text{ k}\Omega$		0.7		$\mu\text{s}$

†  $C_L$  includes the probe and jig capacitance.



# TLV1391, TLV1391Y SINGLE DIFFERENTIAL COMPARATORS

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

PARAMETER	TEST CONDITIONS	$T_A$ †	TLV1391C			UNIT
			MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_O = 1.4\text{ V}$ , $V_{IC} = V_{ICRmin}$	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	

† Full range is 0°C to 70°C.

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

PARAMETER	TEST CONDITIONS	TLV1391C			UNIT
		MIN	TYP	MAX	
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		

†  $C_L$  includes the probe and jig capacitance.



# TLV1391, TLV1391Y SINGLE DIFFERENTIAL COMPARATORS

SLCS128A – APRIL 1996 – REVISED APRIL 1996

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

PARAMETER	TEST CONDITIONS	$T_A$ †	TLV1391I			UNIT
			MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_O = 1.4\text{ V}$ , $V_{IC} = V_{ICRmin}$	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	
		Full range			150	

† Full range is  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .

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

PARAMETER	TEST CONDITIONS	TLV1391I			UNIT
		MIN	TYP	MAX	
Response time	100-mV input step with 5-mV overdrive, $R_L = 5.1\text{ k}\Omega$		0.7		$\mu\text{s}$

†  $C_L$  includes the probe and jig capacitance.

# TLV1391, TLV1391Y SINGLE DIFFERENTIAL COMPARATORS

SLCS128A – APRIL 1996 – REVISED APRIL 1996

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

PARAMETER	TEST CONDITIONS	$T_A$ †	TLV1391I			UNIT
			MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_O = 1.4\text{ V}$ , $V_{IC} = V_{ICRmin}$	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	
		Full range			175	

† Full range is  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .

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

PARAMETER	TEST CONDITIONS	TLV1391I			UNIT
		MIN	TYP	MAX	
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		

†  $C_L$  includes the probe and jig capacitance.





# TLV1391, TLV1391Y SINGLE DIFFERENTIAL COMPARATORS

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## electrical characteristics, $V_{CC} = 3\text{ V}$ , $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	TLV1391Y			UNIT
		MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_O = 1.4\text{ V}$ , $V_{IC} = V_{ICRmin}$		1.5	5	mV
$V_{ICR}$ Common-mode input voltage range		0 to $V_{CC} - 1.5$	0 to $V_{CC} - 1.2$		V
$I_{IO}$ Input offset current	$V_O = 1.4\text{ V}$		5	50	nA
$I_{IB}$ Input bias current	$V_O = 1.4\text{ V}$		-40	-250	nA
$I_{OH}$ High-level output current	$V_{ID} = 1\text{ V}$ , $V_{OH} = 3\text{ V}$		0.1		nA
$I_{OL}$ Low-level output current	$V_{ID} = -1\text{ V}$ , $V_{OL} = 1.5\text{ V}$	500			$\mu\text{A}$
$I_{CC(H)}$ High-level supply current	$V_O = V_{OH}$		80	125	$\mu\text{A}$
$I_{CC(L)}$ Low-level supply current	$V_O = V_{OL}$		80	125	

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

PARAMETER	TEST CONDITIONS	TLV1391Y			UNIT
		MIN	TYP	MAX	
Response time	100-mV input step with 5-mV overdrive, $R_L = 5.1\text{ k}\Omega$		0.7		$\mu\text{s}$

$^\dagger C_L$  includes the probe and jig capacitance.

## electrical characteristics, $V_{CC} = 5\text{ V}$ , $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	TLV1391Y			UNIT
		MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_O = 1.4\text{ V}$ , $V_{IC} = V_{ICRmin}$		1.5	5	mV
$V_{ICR}$ Common-mode input voltage range		0 to $V_{CC} - 1.5$	0 to $V_{CC} - 1.2$		V
$I_{IO}$ Input offset current	$V_O = 1.4\text{ V}$		5	50	nA
$I_{IB}$ Input bias current	$V_O = 1.4\text{ V}$		-40	-250	nA
$I_{OH}$ High-level output current	$V_{ID} = 1\text{ V}$ , $V_{OH} = 3\text{ V}$		0.1		nA
$I_{OL}$ Low-level output current	$V_{ID} = -1\text{ V}$ , $V_{OL} = 1.5\text{ V}$	600			$\mu\text{A}$
$I_{CC(H)}$ High-level supply current	$V_O = V_{OH}$		100	150	$\mu\text{A}$
$I_{CC(L)}$ Low-level supply current	$V_O = V_{OL}$		100	150	

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

PARAMETER	TEST CONDITIONS	TLV1391Y			UNIT
		MIN	TYP	MAX	
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		

$^\dagger C_L$  includes the probe and jig capacitance.

# TLV1391, TLV1391Y SINGLE DIFFERENTIAL COMPARATORS

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## TYPICAL CHARACTERISTICS

Table of Graphs

		FIGURE
Input overdrives for TLV1391	vs Low-to-high-level output response time	1, 3
	vs High-to-low-level output response time	2, 4

TYPICAL CHARACTERISTICS

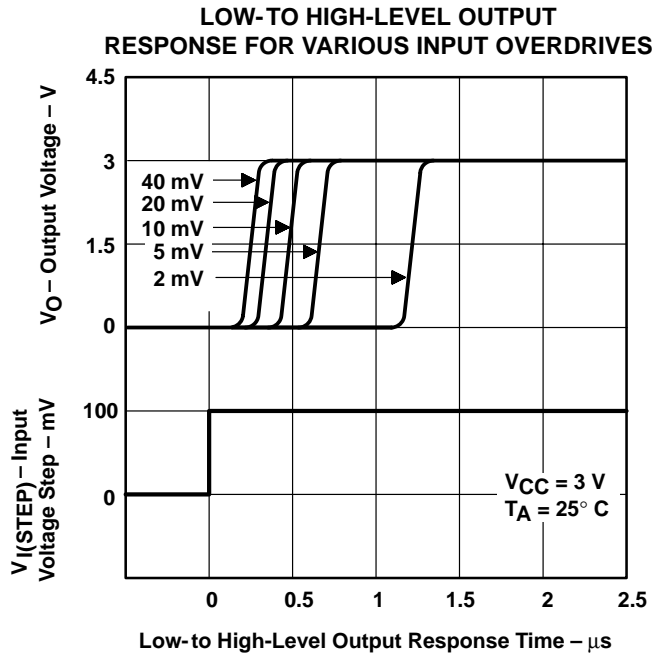


Figure 1

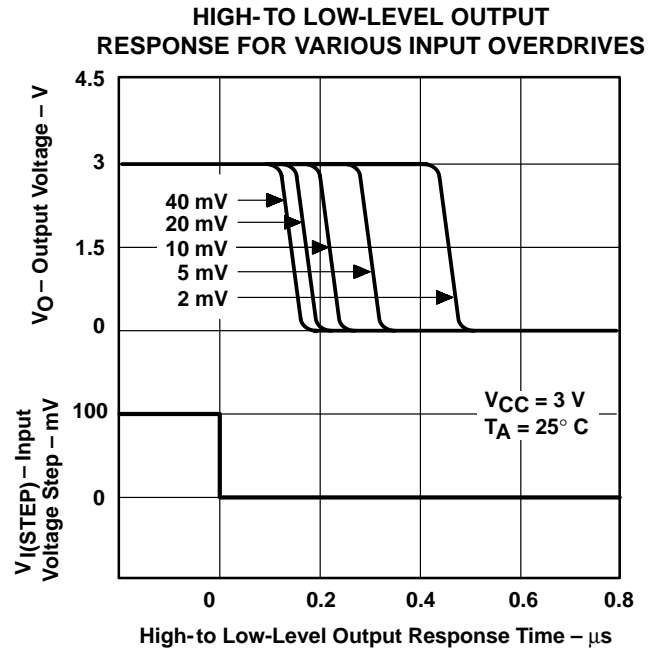


Figure 2

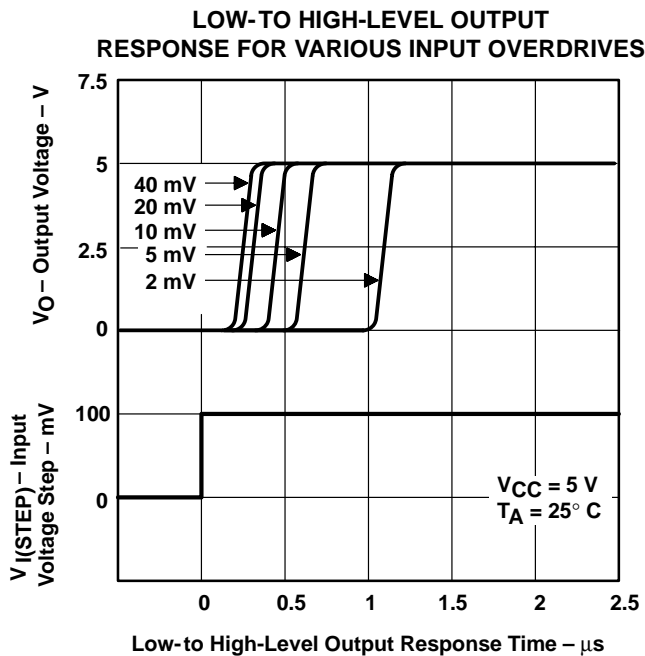


Figure 3

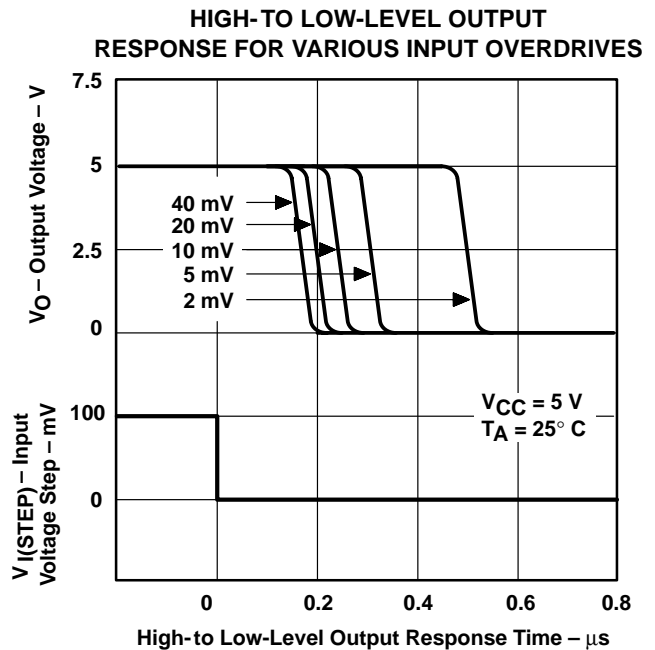


Figure 4

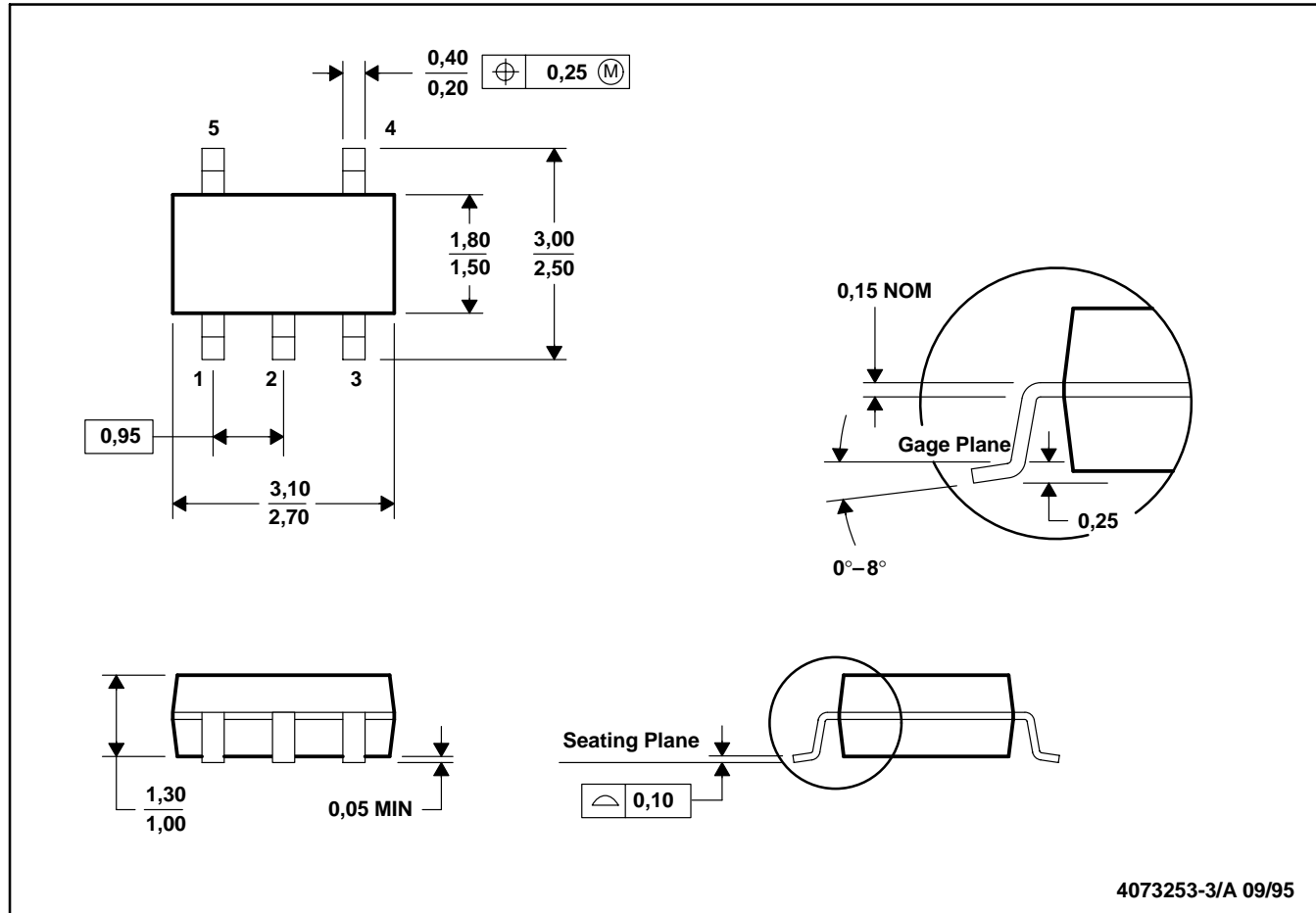
# TLV1391, TLV1391Y SINGLE DIFFERENTIAL COMPARATORS

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## MECHANICAL DATA

DBV (R-PDSO-G5)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES: A. All linear dimensions are in millimeters.  
B. This drawing is subject to change without notice.  
C. Body dimensions include mold flash or protrusion.

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