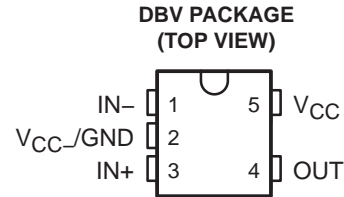


# TL331 SINGLE DIFFERENTIAL COMPARATOR

SLVS238D – AUGUST 1999 – REVISED APRIL 2004

- Single Supply or Dual Supplies
- Wide Range of Supply Voltage . . . 2 V to 36 V
- Low Supply-Current Drain Independent of Supply Voltage . . . 0.4 mA Typ
- Low Input Bias Current . . . 25 nA Typ
- Low Input Offset Voltage . . . 2 mV Typ
- Common-Mode Input Voltage Range Includes Ground
- Differential Input Voltage Range Equal to Maximum-Rated Supply Voltage . . .  $\pm 36$  V
- Low Output Saturation Voltage
- Output Compatible With TTL, MOS, and CMOS



## description/ordering information

This device consists of a single voltage comparator that is designed to operate from a single power supply over a wide range of voltages. Operation from dual supplies also is possible if the difference between the two supplies is 2 V to 36 V and  $V_{CC}$  is at least 1.5 V more positive than the input common-mode voltage. Current drain is independent of the supply voltage. The output can be connected to other open-collector outputs to achieve wired-AND relationships.

## ORDERING INFORMATION

$T_A$	$V_{IO}(\max)$ at 25°C	PACKAGE†	ORDERABLE PART NUMBER	TOP-SIDE MARKING‡
-40°C to 85°C	5 mV	SOT-23 (DBV)	Reel of 3000	TL331IDBVR
			Reel of 250	TL331IDBVT
				T1L_

† 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).

‡ DBV: The actual top-side marking has one additional character that designates the assembly/test site.

## logic diagram



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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**

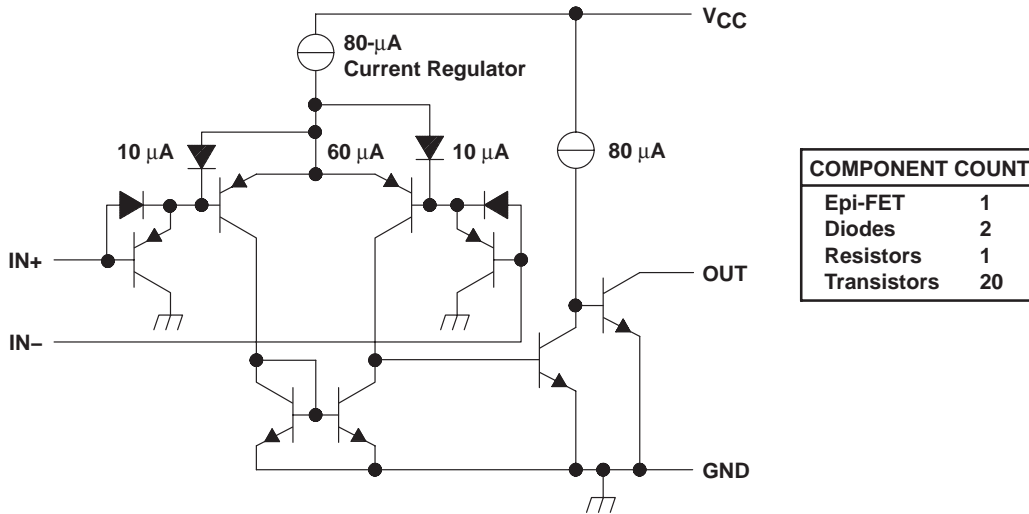
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# TL331 SINGLE DIFFERENTIAL COMPARATOR

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## schematic



Current values shown are nominal.

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

Supply voltage, $V_{CC}$ (see Note 1)	36 V
Differential input voltage, $V_{ID}$ (see Note 2)	$\pm 36$ V
Input voltage range, $V_I$ (either input)	-0.3 V to 36 V
Output voltage, $V_O$	36 V
Output current, $I_O$	20 mA
Duration of output short-circuit to ground (see Note 3)	Unlimited
Package thermal impedance, $\theta_{JA}$ (see Notes 4 and 5)	206°C/W
Operating virtual junction temperature, $T_J$	150°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:
- All voltage values, except differential voltages, are with respect to the network ground.
  - Differential voltages are at IN+ with respect to IN-.
  - Short circuits from outputs to  $V_{CC}$  can cause excessive heating and eventual destruction.
  - Maximum power dissipation is a function of  $T_J(\max)$ ,  $\theta_{JA}$ , and  $T_A$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_J(\max) - T_A)/\theta_{JA}$ . Operating at the absolute maximum  $T_J$  of 150°C can impact reliability.
  - The package thermal impedance is calculated in accordance with JESD 51-7.

# TL331 SINGLE DIFFERENTIAL COMPARATOR

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## electrical characteristics at specified free-air temperature, $V_{CC} = 5\text{ V}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	$T_A$ †	MIN	TYP	MAX	UNIT
$V_{IO}$	Input offset voltage	$V_{CC} = 5\text{ V to }30\text{ V}$ , $V_O = 1.4\text{ V}$ , $V_{IC} = V_{IC}(\text{min})$	25°C		2	5	mV
			-40°C to 85°C			9	
$I_{IO}$	Input offset current	$V_O = 1.4\text{ V}$	25°C		5	50	nA
			-40°C to 85°C			250	
$I_{IB}$	Input bias current	$V_O = 1.4\text{ V}$	25°C		-25	-250	nA
			-40°C to 85°C			-400	
$V_{ICR}$	Common-mode input voltage range‡		25°C		0 to $V_{CC}-1.5$		V
			-40°C to 85°C		0 to $V_{CC}-2$		
$AVD$	Large-signal differential voltage amplification	$V_{CC} = 15\text{ V}$ , $V_O = 1.4\text{ V to }11.4\text{ V}$ , $R_L \geq 15\text{ k}\Omega$ to $V_{CC}$	25°C		50	200	V/mV
$I_{OH}$	High-level output current	$V_{OH} = 5\text{ V}$ , $V_{ID} = 1\text{ V}$	25°C		0.1	50	nA
		$V_{OH} = 30\text{ V}$ , $V_{ID} = 1\text{ V}$	-40°C to 85°C			1	$\mu\text{A}$
$V_{OL}$	Low-level output voltage	$I_{OL} = 4\text{ mA}$ , $V_{ID} = -1\text{ V}$	25°C		150	400	mV
			-40°C to 85°C			700	
$I_{OL}$	Low-level output current	$V_{OL} = 1.5\text{ V}$ , $V_{ID} = 1\text{ V}$	25°C		6		mA
$I_{CC}$	Supply current	$R_L = \infty$ , $V_{CC} = 5\text{ V}$	25°C		0.4	0.7	mA

† All characteristics are measured with zero common-mode input voltage, unless otherwise specified.

‡ The voltage at either input or common-mode should not be allowed to go negative by more than 0.3 V. The upper end of the common-mode voltage range is  $V_{CC+} - 1.5\text{ V}$ , but either or both inputs can go to 30 V without damage.

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

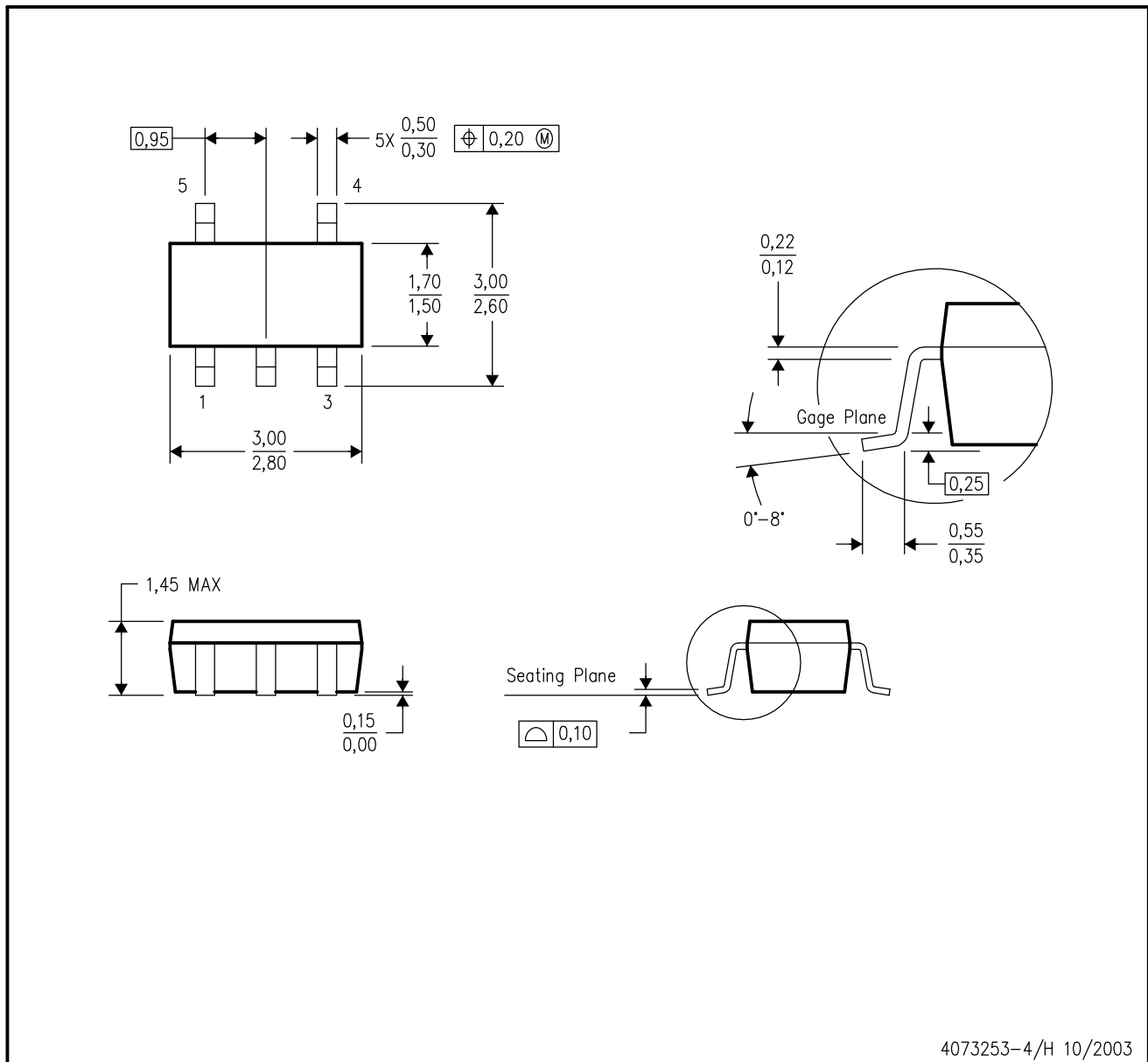
PARAMETER	TEST CONDITIONS	TYP	UNIT
Response time	$R_L$ connected to 5 V through 5.1 k $\Omega$ , $C_L = 15\text{ pF}$ § (see Note 6)	100-mV input step with 5-mV overdrive	1.3
		TTL-level input step	0.3

§  $C_L$  includes probe and jig capacitance.

NOTE 6: The response time specified is the interval between the input step function and the instant when the output crosses 1.4 V.

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 do not include mold flash or protrusion.
  - D. Falls within JEDEC MO-178 Variation AA.

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