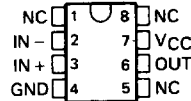


# TL331I, TL331C DIFFERENTIAL COMPARATORS

D2344, APRIL 1977—REVISED OCTOBER 1988

- Single Supply or Dual Supplies
- Wide Range of Supply Voltage  
2 to 36 V
- Low Supply Current Drain Independent of Supply Voltage . . . 0.8 mA Typ
- Low Input Bias Current . . . 25 nA Typ
- Low Input Offset Current  
3 to 5 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

D, JG, OR P PACKAGE  
(TOP VIEW)



NC—No internal connection

### AVAILABLE OPTIONS

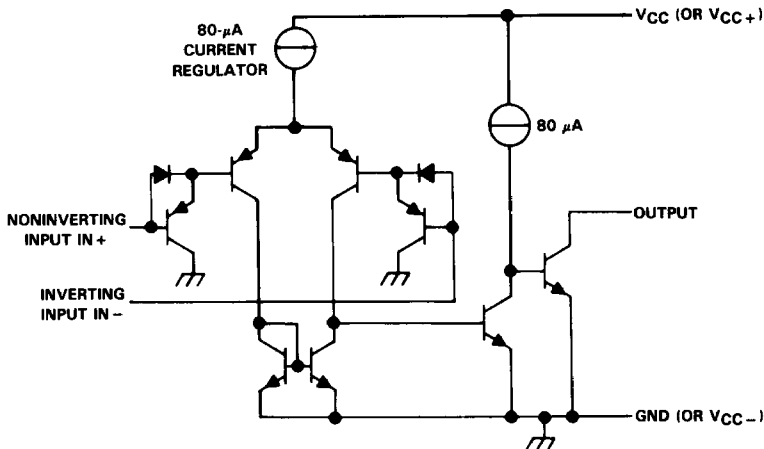
T <sub>A</sub>	V <sub>IO</sub> MAX at 25°C	PACKAGE		
		SMALL OUTLINE (D)	CERAMIC DIP (JG)	PLASTIC DIP (P)
0°C to 70°C	5 mV	TL331CD	TL331CJG	TL331CP
-25°C to 85°C	5 mV	TL331ID	TL331IJG	TL331IP

### description

The TL331 is a voltage comparator that is designed to operate from a single power supply over a wide range of voltages. Operation from dual supplies is also possible so long as the difference between the two supplies is 2 V to 36 V and pin 7 is at least 1.5 V more positive than the input common-mode voltage. Current drain is independent of the supply voltage.

The TL331I is characterized for operation from -25°C to 85°C. The TL331C is characterized for operation from 0°C to 70°C.

### schematic



Current values shown are nominal.

PRODUCTION DATA documents contain information 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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Voltage Comparators

# TL331I, TL331C DIFFERENTIAL COMPARATORS

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

Supply voltage, $V_{CC}$ (see Note 1) . . . . .	36 V
Differential input voltage (see Note 2) . . . . .	$\pm 36$ V
Input voltage range (either input) . . . . .	-0.3 V to 36 V
Output voltage . . . . .	36 V
Output current . . . . .	20 mA
Duration of output short-circuit to ground (see Note 3) . . . . .	unlimited
Continuous total dissipation . . . . .	See Dissipation Rating Table
Operating free-air temperature range: TL331I . . . . .	-25°C to 85°C
TL331C . . . . .	0°C to 70°C
Storage temperature range . . . . .	-65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: JG package . . . . .	300°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D or P package . . . . .	260°C

- NOTES: 1. All voltage values, except differential voltages, are with respect to the network ground terminal.  
 2. Differential voltages are at the noninverting input terminal with respect to the inverting input terminal.  
 3. Short circuits from the output to  $V_{CC}$  can cause excessive heating and eventual destruction.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25^\circ\text{C}$	DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$	$T_A = 70^\circ\text{C}$	$T_A = 85^\circ\text{C}$
	POWER RATING		POWER RATING	POWER RATING
D	680 mW	5.8 mW/°C	464 mW	377 mW
JG	680 mW	6.6 mW/°C	528 mW	429 mW
P	680 mW	8.0 mW/°C	640 mW	520 mW

## recommended operating conditions

		TL331I		TL331C		UNIT
		MIN	MAX	MIN	MAX	
Supply voltage, $V_{CC}$		5	30	5	30	V
Common-mode input voltage, $V_{IC}$	$V_{CC} = 5$ V	0	3	0	3	V
	$V_{CC} = 30$ V	0	28	0	28	V
Operating free-air temperature, $T_A$		-25	85	0	70	°C

Voltage Comparators

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

PARAMETER	TEST CONDITIONS†	TL3311			TL331C			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_{CC} = 5\text{ V to }30\text{ V}$ , $V_{IC} = V_{ICR\text{ min}}$ , $V_O = 1.4\text{ V}$	25°C	2	5	2	5	mV	
		Full range		9		9		
$I_{IO}$ Input offset current	$V_O = 1.4\text{ V}$	25°C	3	25	5	50	nA	
		Full range		100		150		
$I_{IB}$ Input bias current		25°C	-25	-100	-25	-250	nA	
		Full range		-300		-400		
$V_{ICR}$ Common-mode input voltage range	$V_{CC} = 5\text{ V to }30\text{ V}$	25°C	0 to $V_{CC}-1.5$		0 to $V_{CC}-1.5$		V	
		Full range	0 to $V_{CC}-2$		0 to $V_{CC}-2$			
$AVD$ Large-signal differential voltage amplification	$V_{CC} = 15\text{ V}$ , $V_O = 1.4\text{ V to }11.4\text{ V}$ , $R_L = 15\text{ k}\Omega\text{ to }V_{CC}$	25°C	200		200		V/mV	
$I_{OH}$ High-level output current	$V_{ID} = 1\text{ V}$	$V_{OH} = 5\text{ V}$	25°C	0.1		0.1	nA	
		$V_{OH} = 30\text{ V}$	Full range		1		1	$\mu\text{A}$
$V_{OL}$ Low-level output voltage	$V_{ID} = -1\text{ V}$ , $I_{OL} = 4\text{ mA}$	25°C	150	400	150	400	mV	
		Full range		700		700		
$I_{OL}$ Low-level output current	$V_{ID} = -1\text{ V}$ , $V_{OL} = 1.5\text{ V}$	25°C	6		6		mA	
$I_{CC}$ Supply current	$V_O = 2.5\text{ V}$ , No load	25°C	0.5	0.8	0.5	0.8	mA	

† Full range (MIN to MAX) for the TL3311 is  $-25^\circ\text{C}$  to  $85^\circ\text{C}$  and for the TL331C is  $0^\circ\text{C}$  to  $70^\circ\text{C}$ . All characteristics are measured with zero common-mode input voltage unless otherwise specified.

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

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
Response time	$R_L$ connected to 5 V through 5.1 k $\Omega$ , $C_L = 15\text{ pF}$ , <sup>‡</sup> See Note 4	100-mV input step with 5-mV overdrive		1.3		$\mu\text{s}$
		TTL-level input step		0.3		

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

NOTE 4: The response time specified is the interval between the input step function and the instant when the output crosses 1.4 V.

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Voltage Comparators