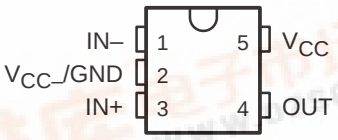
TL331
SINGLE DIFFERENTIAL COMPARATOR

SLVS238A – AUGUST 1999 – REVISED NOVEMBER 1999

- **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 . . . ±36 V**
- **Low Output Saturation Voltage**
- **Output Compatible With TTL, MOS, and CMOS**
- **Packaged in Plastic Small-Outline Transistor Package**

DBV PACKAGE
(TOP VIEW)



description

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.

The TL331I is characterized for operation from –40°C to 85°C.

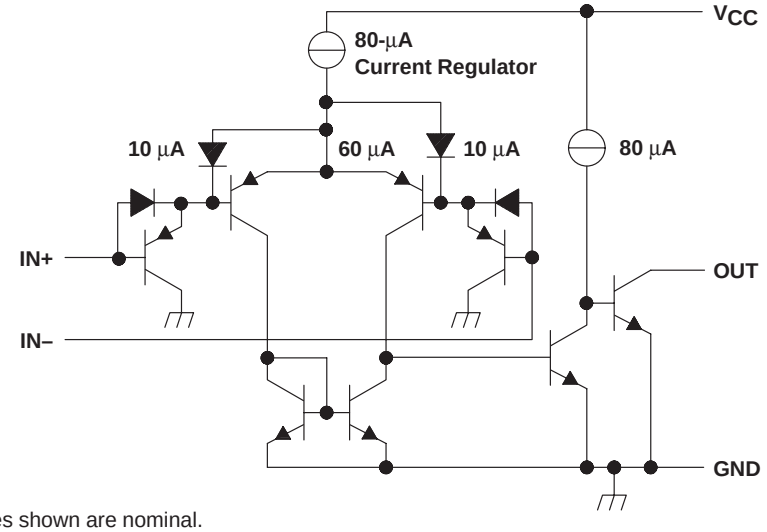
logic diagram

AVAILABLE OPTIONS

T_A	$V_{IO(max)}$ AT 25°C	PACKAGED DEVICE
		SMALL-OUTLINE TRANSISTOR (DBV)
–40°C to 85°C	5 mV	TL331IDBV

The DBV package is only available left-end taped and reeled. Add suffix R to device type (e.g., TL331IDBVR).

schematic



COMPONENT COUNT	
Epi-FET	1
Diodes	2
Resistors	1
Transistors	20

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)	±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, θ_{JA} (see Notes 4 and 5)	347°C/W
Operating free-air temperature range, T_A	–40°C to 85°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 ground.
2. Differential voltages are at IN+ with respect to IN–.
3. Short circuits from outputs to V_{CC} can cause excessive heating and eventual destruction.
4. Maximum power dissipation is a function of $T_J(max)$, θ_{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.
5. The package thermal impedance is calculated in accordance with JESD 51.

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

PARAMETER		TEST CONDITIONS		T_A†	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage	V_{CC} = 5 V to 30 V, V_O = 1.4 V, $V_{IC} = V_{IC(min)}$		25°C		2	5	mV
				–40°C to 85°C			9	
I_{IO}	Input offset current	V_O = 1.4 V		25°C		5	50	nA
				–40°C to 85°C			250	
I_{IB}	Input bias current	V_O = 1.4 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			
A_{VD}	Large-signal differential voltage amplification	V_{CC} = 15 V, V_O = 1.4 V to 11.4 V, $R_L \geq 15\ k\Omega$ to V_{CC}		25°C	50	200		V/mV
I_{OH}	High-level output current	V_{OH} = 5 V,	V_{ID} = 1 V	25°C		0.1	50	nA
		V_{OH} = 30 V,	V_{ID} = 1 V	–40°C to 85°C			1	µA
V_{OL}	Low-level output voltage	I_{OL} = 4 mA,	V_{ID} = –1 V	25°C		150	400	mV
				–40°C to 85°C			700	
I_{OL}	Low-level output current	V_{OL} = 1.5 V,	V_{ID} = 1 V	25°C	6			mA
I_{CC}	Supply current	$R_L = \infty$,	V_{CC} = 5 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 V, but either or both inputs can go to 30 V without damage.

switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
Response time	R_L connected to 5 V through 5.1 kΩ, C_L = 15 pF§, See Note 6	100-mV input step with 5-mV overdrive		1.3		µs
		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.

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