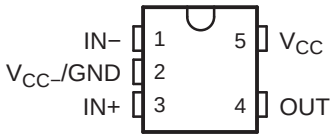
SINGLE DIFFERENTIAL COMPARATOR

Check for Samples: TL331-Q1

FEATURES

- **Qualified for Automotive Applications**
- **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**

DBV PACKAGE
(TOP VIEW)



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(1)

T_A	PACKAGE(2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	SOT-23 – DBV	Reel of 3000	TL331IDBVRQ1	TQ1U
–40°C to 125°C	SOT-23 – DBV	Reel of 3000	TL331QDBVRQ1	T1RU

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI Web site at www.ti.com.
(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.

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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of the Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

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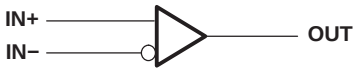
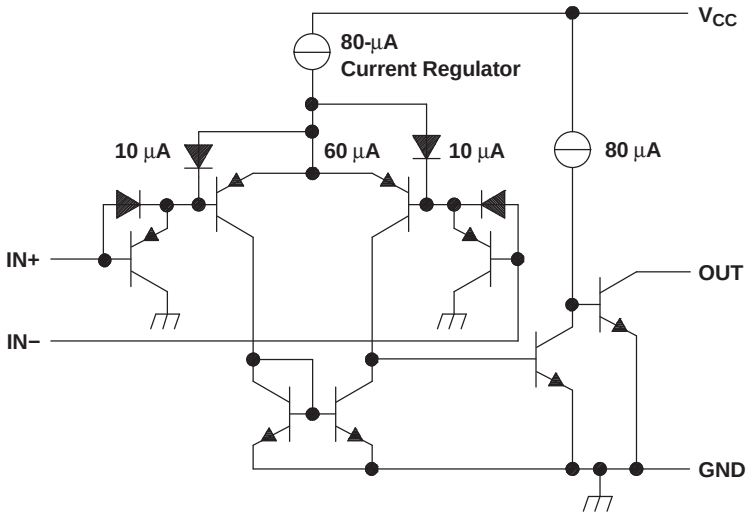
LOGIC DIAGRAM



SCHEMATIC



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

Note: Current values shown are nominal.

ABSOLUTE MAXIMUM RATINGS(1)

over operating free-air temperature range (unless otherwise noted)

V_{CC}	Supply voltage(2)	36 V
V_{ID}	Differential input voltage(3)	±36 V
V_I	Input voltage range (either input)	–0.3 V to 36 V
V_O	Output voltage	36 V
I_O	Output current	20 mA
	Duration of output short-circuit to ground(4)	Unlimited
θ_{JA}	Package thermal impedance(5) (6)	206°C/W
T_J	Operating virtual junction temperature	150°C
T_{stg}	Storage temperature range	–65°C to 150°C

(1) 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.
(2) All voltage values, except differential voltages, are with respect to the network ground.
(3) Differential voltages are at IN+ with respect to IN–.
(4) Short circuits from outputs to V_{CC} can cause excessive heating and eventual destruction.
(5) 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.
(6) The package thermal impedance is calculated in accordance with JESD 51-7.

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ELECTRICAL CHARACTERISTICS

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

PARAMETER		TEST CONDITIONS[1]	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 125°C			9	
I_{IO}	Input offset current	V_O = 1.4 V	25°C		5	50	nA
			–40°C to 125°C			250	
I_{IB}	Input bias current	V_O = 1.4 V	25°C		–25	–250	nA
			–40°C to 125°C			–400	
V_{ICR}	Common-mode input voltage range[2]		25°C	0 to V_{CC} – 1.5			V
			–40°C to 125°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 125°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 125°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

(1) All characteristics are measured with zero common-mode input voltage, unless otherwise specified.
(2) 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		TYP	UNIT
Response time	R_L connected to 5 V through 5.1 kΩ, C_L = 15 pF[1] [2]	100-mV input step with 5-mV overdrive	1.3	µs
		TTL-level input step	0.3	

(1) C_L includes probe and jig capacitance.
(2) 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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REVISION HISTORY

Changes from Revision A (July 2010) to Revision B	Page
• Changed V_{ICR} in the Electrical Characteristics	3

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PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
TL331IDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	TQ1U	Samples
TL331QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	T1RU	Samples

(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) Only one of markings shown within the brackets will appear on the physical device.

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OTHER QUALIFIED VERSIONS OF TL331-Q1 :

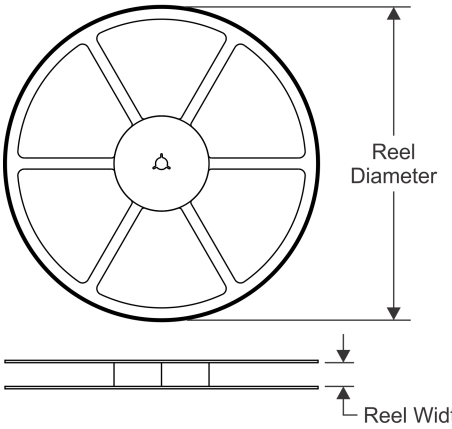
- Catalog: TL331

NOTE: Qualified Version Definitions:

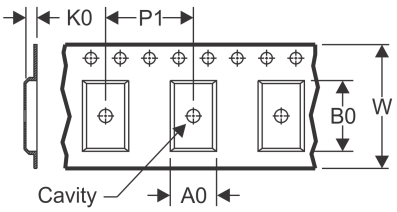
- Catalog - TI's standard catalog product

TAPE AND REEL INFORMATION

REEL DIMENSIONS

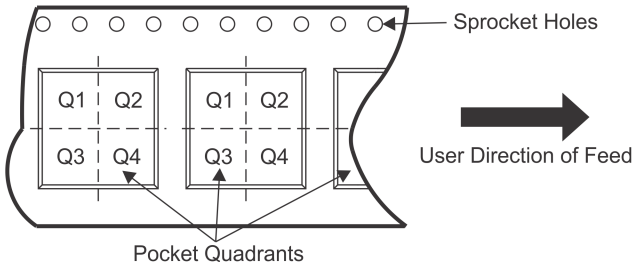


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

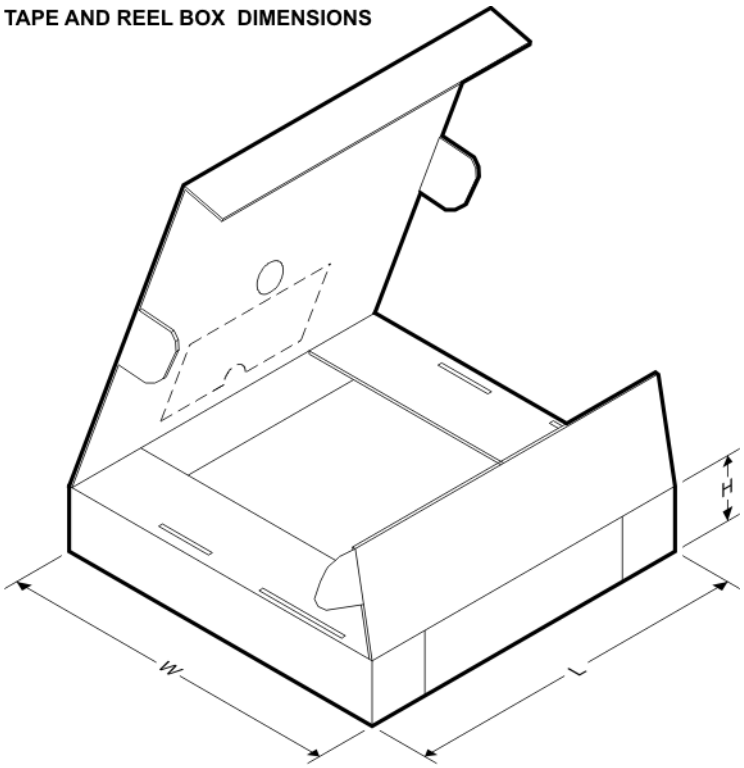
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TL331IDBVRQ1	SOT-23	DBV	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TL331QDBVRQ1	SOT-23	DBV	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3

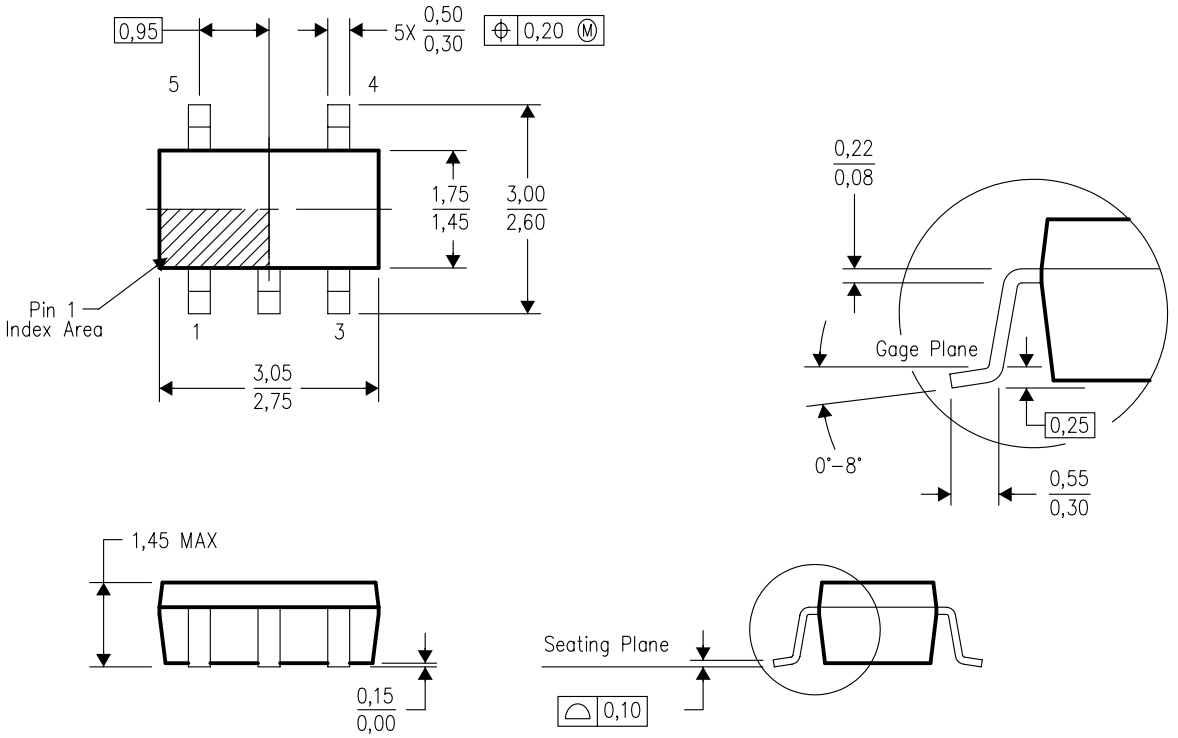
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TL331IDBVRQ1	SOT-23	DBV	5	3000	203.0	203.0	35.0
TL331QDBVRQ1	SOT-23	DBV	5	3000	203.0	203.0	35.0

DBV (R–PDSO–G5) PLASTIC SMALL–OUTLINE PACKAGE



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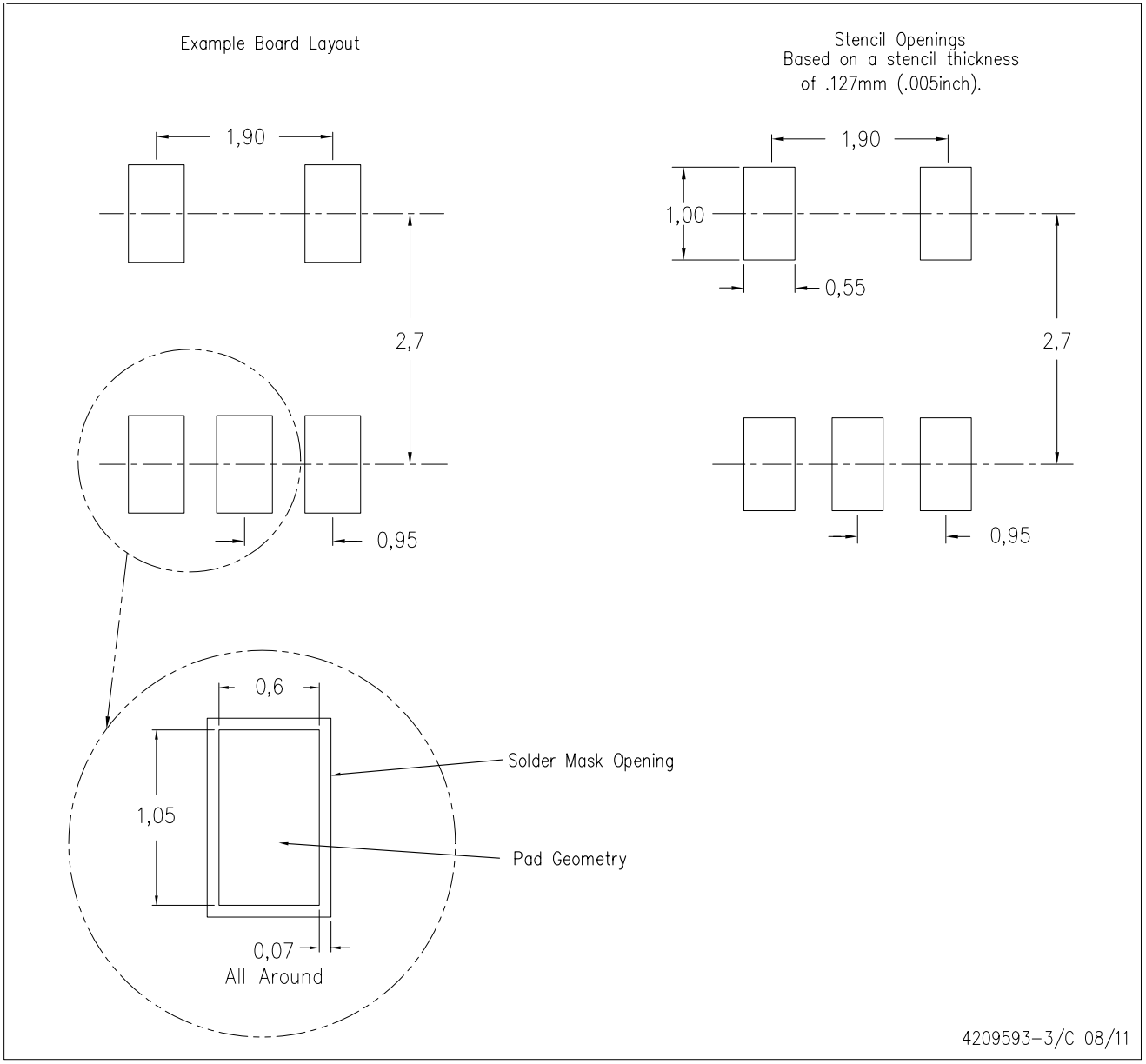
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
D. Falls within JEDEC MO–178 Variation AA.

DBV (R–PDSO–G5) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
D. Publication IPC–7351 is recommended for alternate designs.
E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC–7525 for other stencil recommendations.

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