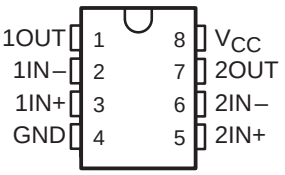
- **Low-Voltage and Single-Supply Operation V_{CC} = 2 V to 7 V**
- **Common-Mode Voltage Range That Includes Ground**

D, P, OR PW PACKAGE
(TOP VIEW)



description

The TL393 is a dual differential comparator built using a new Texas Instruments-developed bipolar process. The TL393 is intended as an enhanced alternative to the industry-standard LM393 in circuits with supply-voltage limits of 7 V.

The new bipolar process allows the TL393 to perform with lower supply-current requirements than the LM393 (0.7 mA typical) while still providing a faster response time than the older device.

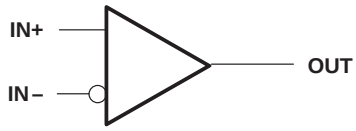
Package availability for this device includes the TSSOP (thin-shrink small-outline package). With a maximum thickness of 1.1 mm and a package area that is 25% smaller than the standard surface-mount package, the TSSOP is ideal for high-density circuits, particularly in hand-held and portable equipment.

AVAILABLE OPTIONS

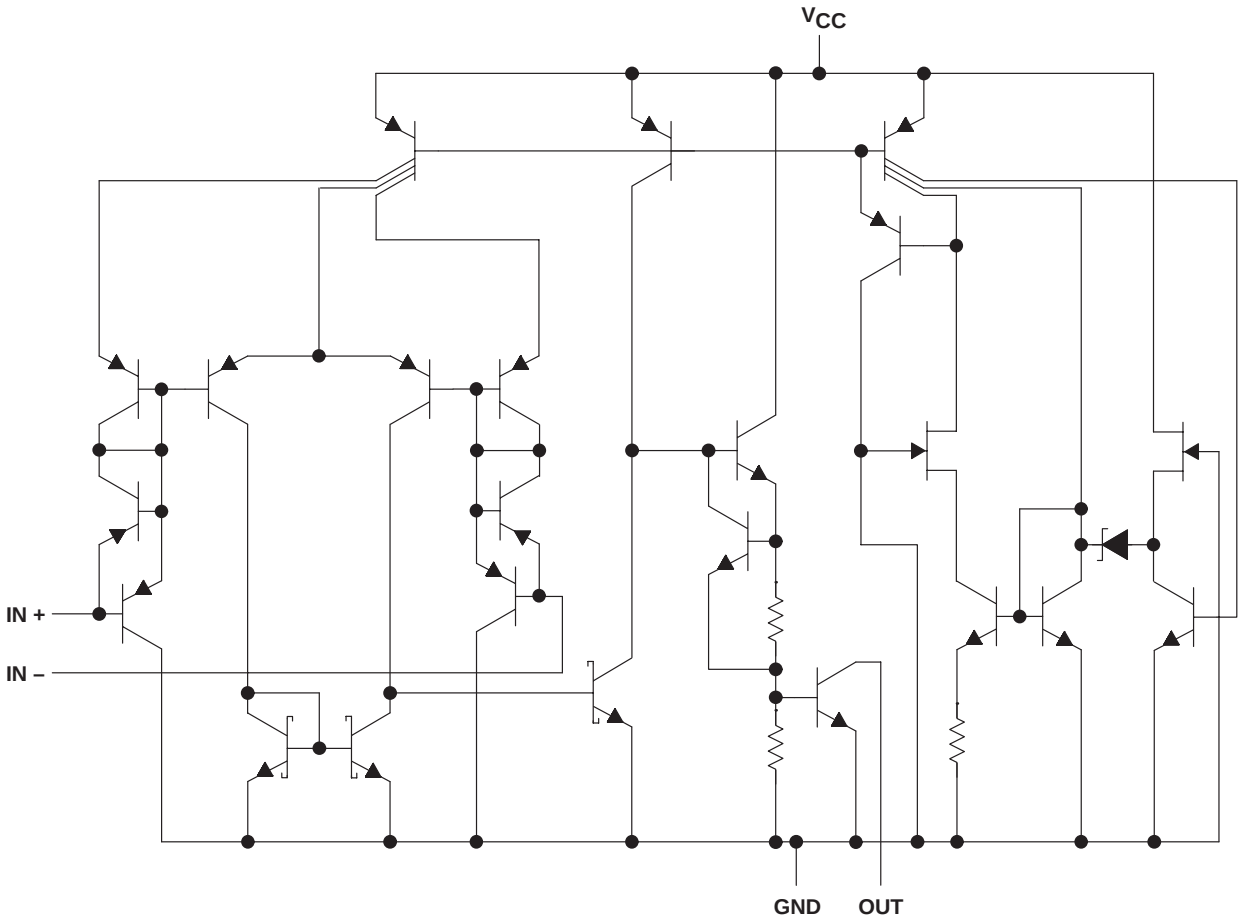
T_A	SUPPLY CURRENT (TYP)	RESPONSE TIME (TYP)	PACKAGED DEVICES			CHIP FORM (Y)
			SMALL OUTLINE (D)	PLASTIC DIP (P)	TSSOP (PW)†	
–40°C to 105°C	0.7 mA	0.65 μs	TL393ID	TL393IP	TL393IPWLE	TL393Y

† The PW packages are only available left-ended taped and reeled (e.g., TL393IPWLE).

symbol (each comparator)



equivalent schematic (each comparator)

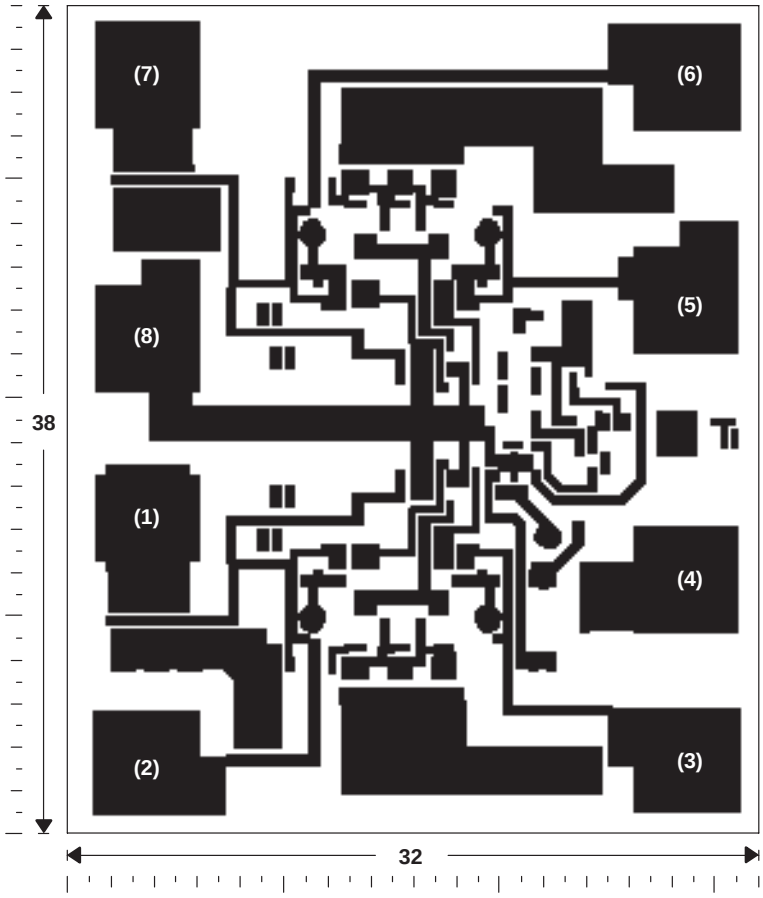


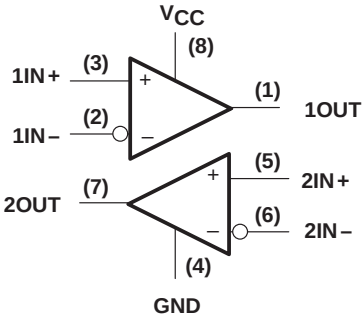
COMPONENT COUNT	
Transistors	48
Resistors	5
Diodes	7
Epi-FETs	2

TL393Y chip information

This chip, when properly assembled, displays characteristics similar to the TL393. Thermal compression or ultrasonic bonding may be used on the doped-aluminum bonding pads. Chips may be mounted with conductive epoxy or a gold-silicon preform.

BONDING PAD ASSIGNMENTS





CHIP THICKNESS: 13 TYPICAL

BONDING PADS: 3.54 × 3.54 MINIMUM

$T_J$max = 150°C

TOLERANCES ARE ±10%.

ALL DIMENSIONS ARE IN MILS.

PIN (4) IS INTERNALLY CONNECTED TO BACKSIDE OF CHIP.

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) . . . . . 7 V
Input voltage, V_I (any input) . . . . . 7 V
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 dissipation . . . . . See Dissipation Rating Table
Operating free-air temperature range, T_A . . . . . –40°C to 105°C
Storage temperature range . . . . . –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 network GND.
2. Differential voltages are at IN+ with respect to IN –.
3. Short circuits from the outputs to V_{CC} can cause excessive heating and eventual destruction of the chip.

DISSIPATION RATING TABLE

PACKAGE	$T_A \le 25°C$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25°C$	$T_A = 70°C$ POWER RATING	$T_A = 85°C$ POWER RATING
D	725 mW	5.8 mW/°C	464 mW	377 mW
P	1000 mW	8.0 mW/°C	640 mW	520 mW
PW	525 mW	4.2 mW/°C	336 mW	273 mW

recommended operating conditions

	MIN	MAX	UNIT
Supply voltage, V_{CC}	2	7	V
Operating free-air temperature, T_A	–40	105	°C

electrical characteristics, V_{CC} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A†	TL393			UNIT
				MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_O = 1.4 V, V_{IC} = V_{ICR}min	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 V, I_{OL} = 1 mA	25°C		70	300	mV
		V_{ID} = –1 V, I_{OL} = 4 mA	Full range		200	700	
I_{IO}	Input offset current	V_O = 1.4 V	25°C		5	50	nA
			Full range			150	
I_{IB}	Input bias current	V_O = 1.4 V	25°C		–40	–250	nA
			Full range			–400	
I_{OH}	High-level output current	V_{ID} = 1 V, V_{OH} = 3 V	25°C		0.1		nA
		V_{ID} = 1 V, V_{OH} = 5 V	Full range			100	
I_{OL}	low-level output current	V_{ID} = –1 V, V_{OL} = 1.5 V	25°C	6			mA
I_{CCH}	High-level supply current	V_O = V_{OH}	25°C		140	200	µA
			Full range			300	
I_{CCL}	Low-level supply current	V_O = V_{OL}	25°C		0.8	1	mA
			Full range			1.2	

† Full range is –40°C to 105°C.

switching characteristics, V_{CC} = 5 V, C_L = 15 pF, T_A = 25°C

PARAMETER	TEST CONDITIONS	TL393			UNIT
		MIN	TYP	MAX	
Response time	100-mV input step with 5-mV overdrive, R_L connected to 5 V through 5.1 kΩ		0.65		µs
	TTL-level input step, R_L connected to 5 V through 5.1 kΩ		0.2		

electrical characteristics, V_{CC} = 5 V, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TL393Y			UNIT
			MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_O = 1.4 V,		1.5	5	mV
V_{ICR}	Common-mode input voltage range		0 to V_{CC} – 1.5	0 to V_{CC} – 1.2		V
V_{OL}	Low-level output voltage	V_{ID} = –1 V, I_{OL} = 1 mA		70	300	mV
I_{IO}	Input offset current	V_O = 1.4 V		5	50	nA
I_{IB}	Input bias current	V_O = 1.4 V		–40	–250	nA
I_{OH}	High-level output current	V_{ID} = 1 V, V_{OH} = 3 V		0.1		nA
I_{OL}	low-level output current	V_{ID} = –1 V, V_{OL} = 1.5 V	6			mA
I_{CCH}	High-level supply current	V_O = V_{OH}		140	200	µA
I_{CCL}	Low-level supply current	V_O = V_{OL}		0.8	1	mA

switching characteristics, V_{CC} = 5 V, C_L = 15 pF, T_A = 25°C

PARAMETER	TEST CONDITIONS		TL393Y			UNIT
			MIN	TYP	MAX	
Response time	100-mV input step with 5-mV overdrive,	R_L connected to 5 V through 5.1 kΩ		0.65		µs
	TTL-level input step,	R_L connected to 5 V through 5.1 kΩ		0.2		

TYPICAL CHARACTERISTICS

LOW- TO HIGH-LEVEL OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES

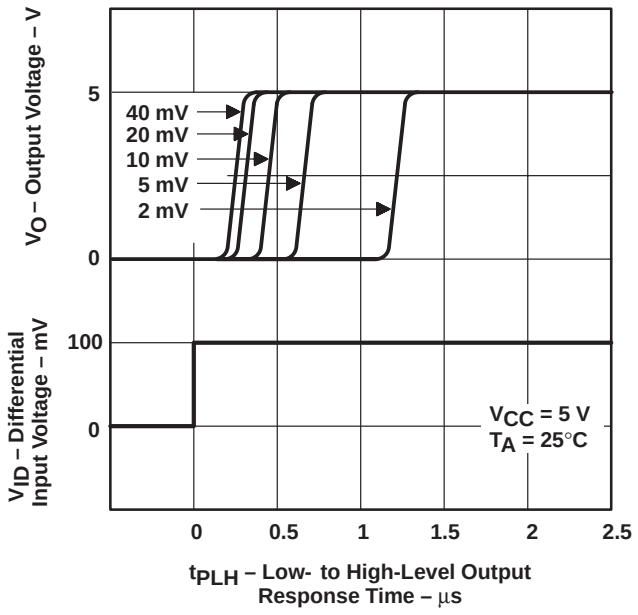


Figure 1

HIGH- TO LOW-LEVEL OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES

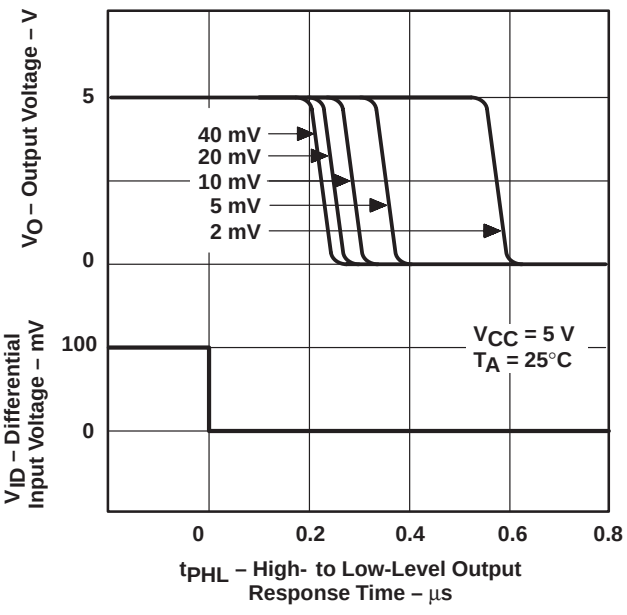


Figure 2

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