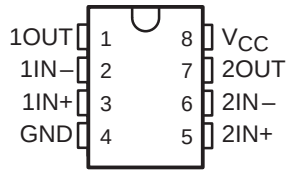
- **Low-Voltage and Single-Supply Operation**
  **$V_{CC}$ = 2 V to 7 V**
- **Common-Mode Voltage Range Includes Ground**
- **Fast Response Time**
  **450 ns Typ (TLV2393)**
- **Low Supply Current**
  **0.16 mA Typ (TLV1393)**
- **Fully Specified at 3-V and 5-V Supply Voltages**

**D, P, OR PW PACKAGE**
**(TOP VIEW)**




## description

The TLV1393 and the TLV2393 are dual differential comparators built using a new Texas Instruments low-voltage, high-speed bipolar process. These devices have been specifically developed for low-voltage, single-supply applications. Their enhanced performance makes them excellent replacements for the LM393 in today's improved 3-V and 5-V system designs.

The TLV1393, with its typical supply current of only 0.16 mA, is ideal for low-power systems. Response time has also been improved to 0.7 µs. For higher-speed applications, the TLV2393 features excellent ac performance with a response time of just 0.45 µs, three times that of the LM393.

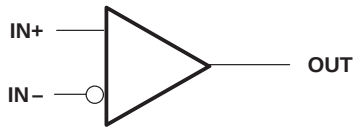
Package availability for these devices includes the TSSOP (thin-shrink small-outline package). With a maximum thickness of 1.1 mm and a package area that is 25% smaller than the standard surface-mount package, the TSSOP is ideal for high-density circuits, particularly in hand-held and portable equipment.

**AVAILABLE OPTIONS**

| $T_A$ | PACKAGED DEVICES | | | | | CHIP FORM (Y) |
|---|---|---|---|---|---|---|
| | SUPPLY CURRENT (TYP) | RESPONSE TIME (TYP) | SMALL OUTLINE (D) | PLASTIC DIP (P) | TSSOP (PW)† | |
| –40°C to 105°C | 0.16 mA<br>1.1 mA | 0.7 µs<br>0.45 µs | TLV1393ID<br>TLV2393ID | TLV1393IP<br>TLV2393IP | TLV1393IPWLE<br>TLV2393IPWLE | TLV1393Y<br>TLV2393Y |

† The PW packages are only available left-ended taped and reeled (e.g., TLV1393IPWLE).

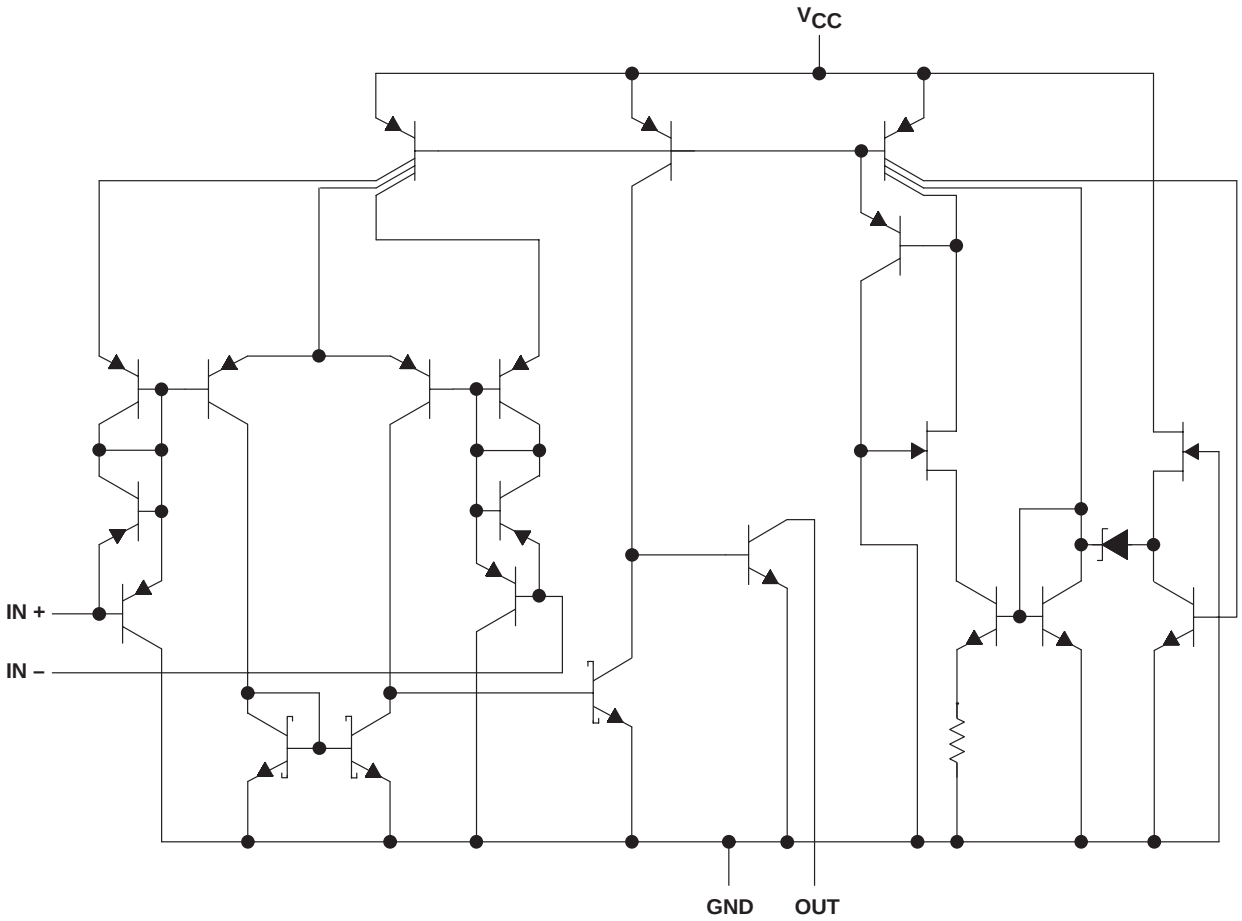
## symbol (each comparator)




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.

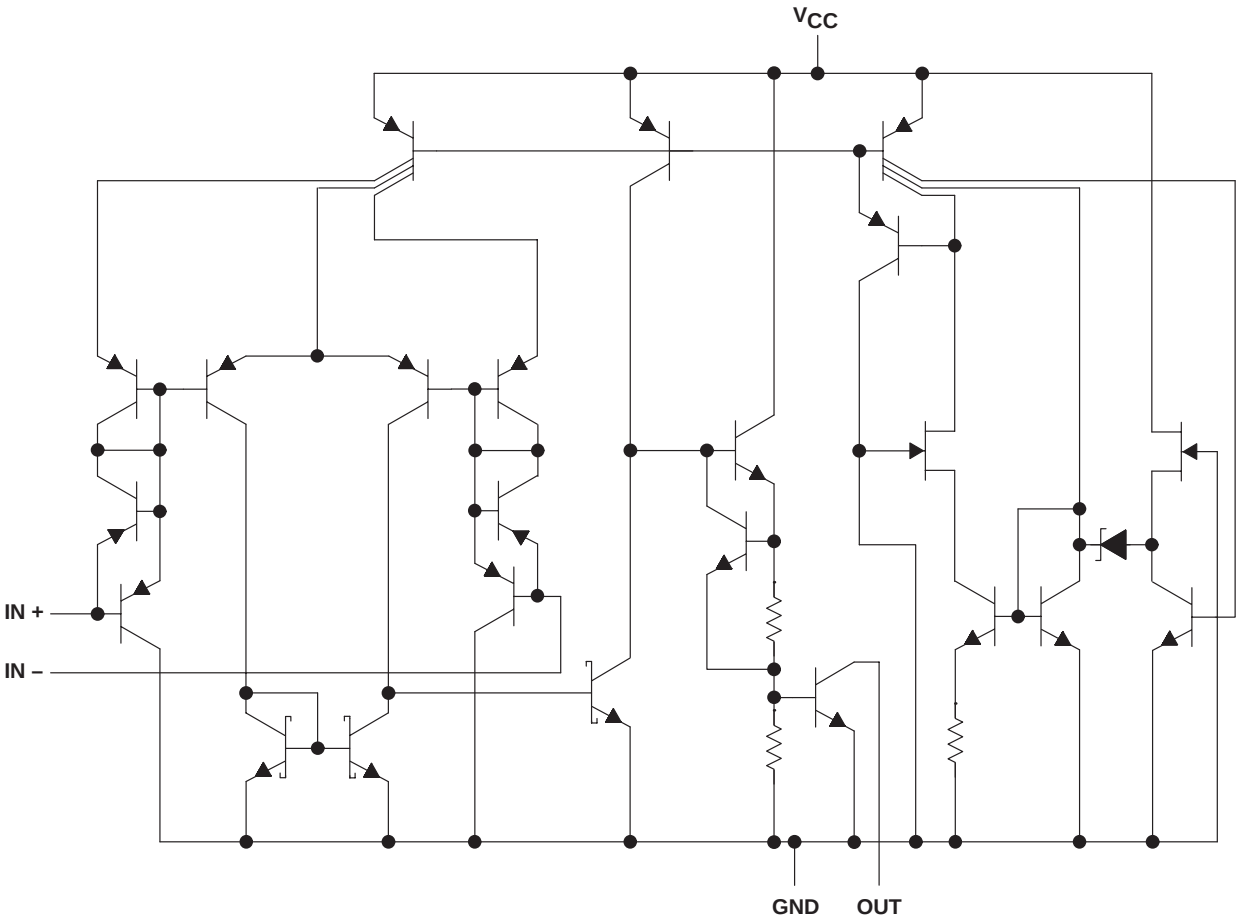
Copyright © 1994, Texas Instruments Incorporated

## TLV1393, TLV1393Y equivalent schematic (each comparator)




| COMPONENT COUNT | |
|---|---|
| Transistors | 44 |
| Resistors | 1 |
| Diodes | 7 |
| Epi-FET | 2 |

## TLV2393, TLV2393Y equivalent schematic (each comparator)

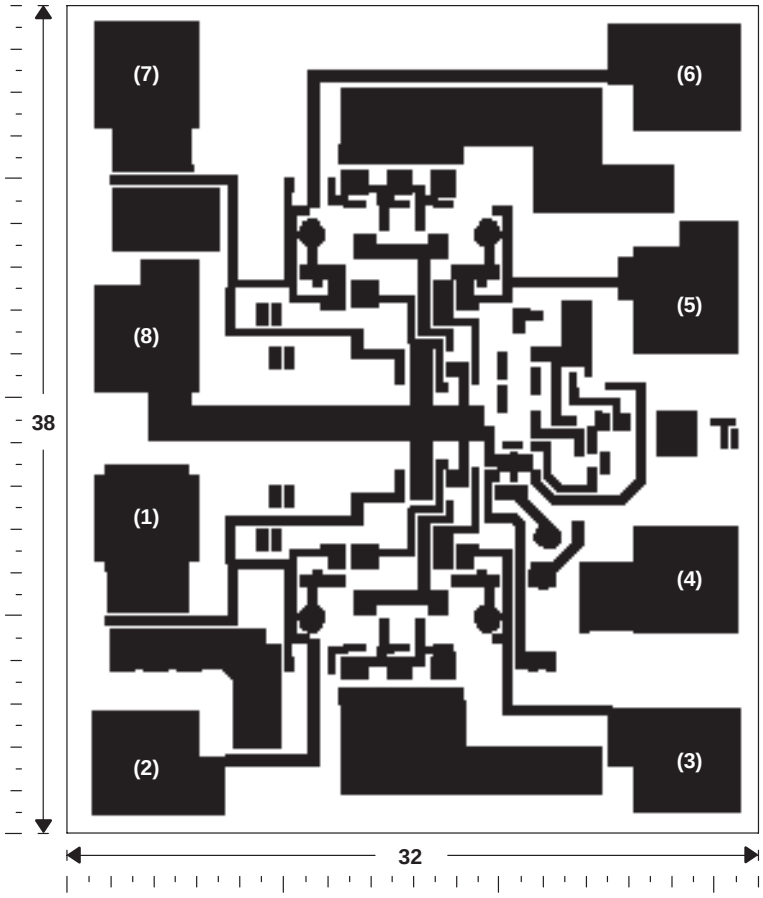


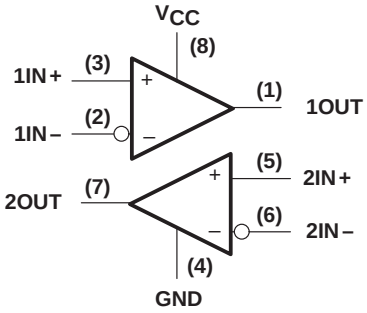

| COMPONENT COUNT | |
|---|---|
| Transistors | 44 |
| Resistors | 1 |
| Diodes | 7 |
| Epi-FET | 2 |

## TLV1393Y chip information

This chip, when properly assembled, displays characteristics similar to the TLV1393. 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%.**

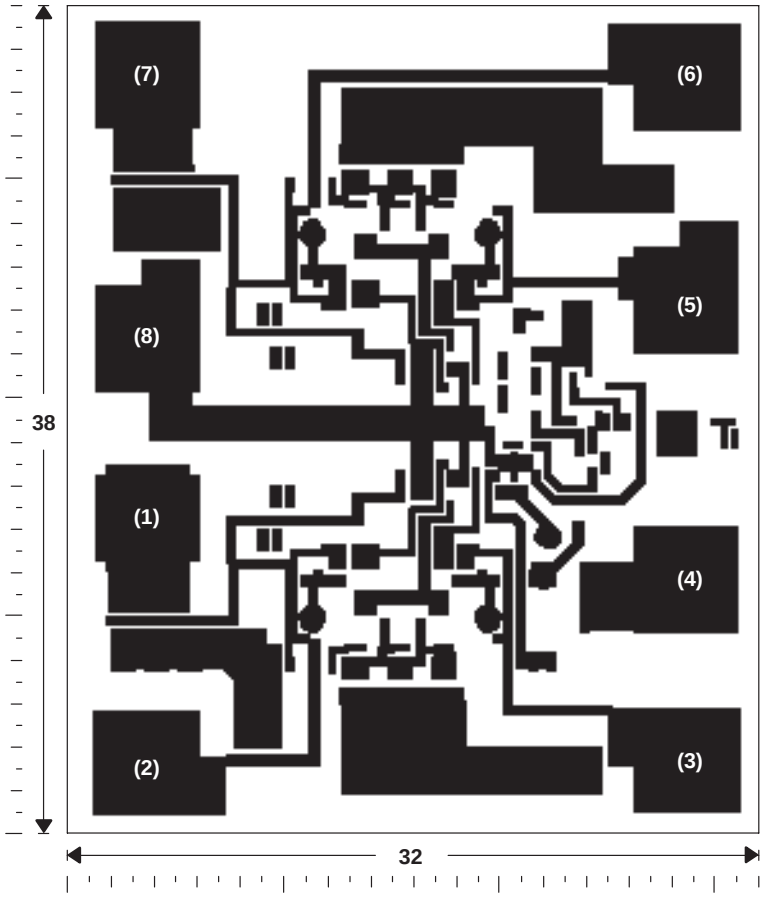
**ALL DIMENSIONS ARE IN MILS.**

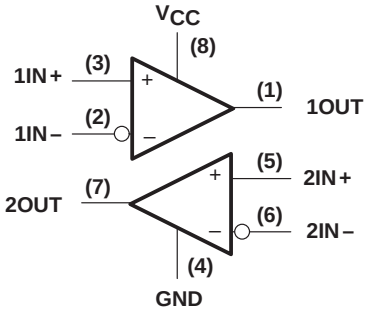
**PIN (4) IS INTERNALLY CONNECTED TO BACKSIDE OF CHIP.**

## TLV2393Y chip information

This chip, when properly assembled, displays characteristics similar to the TLV2393. 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: 15 TYPICAL**

**BONDING PADS: 3.6 × 3.6 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 the network GND.
2. Differential voltages are at the noninverting input with respect to the inverting input.
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, $V_{CC}$ = 3 V

| PARAMETER | | TEST CONDITIONS | $T_A$† | TLV1393 | | | 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 | | 120 | 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, $I_{OL}$ = 500 µA | Full range | | 120 | 300 | mV |
| $I_{IO}$ | 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 | 500 | | | µA |
| $I_{CCH}$ | High-level supply current | $V_O$ = $V_{OH}$ | 25°C | | 160 | 250 | µA |
| | | | Full range | | | 300 | |
| $I_{CCL}$ | Low-level supply current | $V_O$ = $V_{OL}$ | 25°C | | 160 | 250 | |
| | | | Full range | | | 300 | |

† Full range is –40°C to 105°C.

## switching characteristics, $V_{CC}$ = 3 V, $C_L$ = 15 pF, $T_A$ = 25°C

| PARAMETER | TEST CONDITIONS | TLV1393 | | | UNIT |
|---|---|---|---|---|---|
| | | MIN | TYP | MAX | |
| Response time | 100-mV input step with 5-mV overdrive, $R_L$ connected to 5 V through 5.1 kΩ | | 0.7 | | µs |

## electrical characteristics, $V_{CC}$ = 5 V

| PARAMETER | | TEST CONDITIONS | $T_A$† | TLV1393 | | | 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, $I_{OL}$ = 500 µA | Full range | | 120 | 300 | mV |
| $I_{IO}$ | 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 | 600 | | | µA |
| $I_{CCH}$ | High-level supply current | $V_O$ = $V_{OH}$ | 25°C | | 200 | 300 | µA |
| | | | Full range | | | 350 | |
| $I_{CCL}$ | Low-level supply current | $V_O$ = $V_{OL}$ | 25°C | | 200 | 300 | |
| | | | Full range | | | 350 | |

† 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 | TLV1393 | | | 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 | | 0.18 | | |

## electrical characteristics, $V_{CC}$ = 3 V, $T_A$ = 25°C

| PARAMETER | | TEST CONDITIONS | TLV1393Y | | | UNIT |
|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | |
| $V_{IO}$ | Input offset voltage | $V_O$ = 1.4 V, $V_{IC}$ = $V_{ICR}$min | | 1.5 | 5 | mV |
| $V_{ICR}$ | Common-mode input voltage range | | 0 to $V_{CC}$ – 1.5 | 0 to $V_{CC}$ – 1.2 | | V |
| $I_{IO}$ | 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 | 500 | | | µA |
| $I_{CCH}$ | High-level supply current | $V_O$ = $V_{OH}$ | | 160 | 250 | µA |
| $I_{CCL}$ | Low-level supply current | $V_O$ = $V_{OL}$ | | 160 | 250 | |

## switching characteristics, $V_{CC}$ = 3 V, $C_L$ = 15 pF, $T_A$ = 25°C

| PARAMETER | TEST CONDITIONS | TLV1393Y | | | UNIT |
|---|---|---|---|---|---|
| | | MIN | TYP | MAX | |
| Response time | 100-mV input step with 5-mV overdrive, $R_L$ connected to 5 V through 5.1 kΩ | | 0.7 | | µs |

## electrical characteristics, $V_{CC}$ = 5 V, $T_A$ = 25°C

| PARAMETER | | TEST CONDITIONS | TLV1393Y | | | UNIT |
|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | |
| $V_{IO}$ | Input offset voltage | $V_O$ = 1.4 V, $V_{IC}$ = $V_{ICR}$min | | 1.5 | 5 | mV |
| $V_{ICR}$ | Common-mode input voltage range | | 0 to $V_{CC}$ – 1.5 | 0 to $V_{CC}$ – 1.2 | | V |
| $I_{IO}$ | 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 | 600 | | | µA |
| $I_{CCH}$ | High-level supply current | $V_O$ = $V_{OH}$ | | 200 | 300 | µA |
| $I_{CCL}$ | Low-level supply current | $V_O$ = $V_{OL}$ | | 200 | 300 | |

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

| PARAMETER | TEST CONDITIONS | TLV1393Y | | | 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 | | 0.18 | | |

## electrical characteristics, $V_{CC}$ = 3 V

| PARAMETER | | TEST CONDITIONS | | $T_A$† | TLV2393 | | | 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 | | 80 | 300 | mV |
| | | $V_{ID}$ = –1 V, | $I_{OL}$ = 4 mA | Full range | | 250 | 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 | | –100 | –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 | 4 | | | mA |
| $I_{CCH}$ | High-level supply current | $V_O = V_{OH}$ | | 25°C | | 450 | 600 | µA |
| | | | | Full range | | | 700 | |
| $I_{CCL}$ | Low-level supply current | $V_O = V_{OL}$ | | 25°C | | 1.1 | 1.3 | mA |
| | | | | Full range | | | 1.4 | |

† Full range is –40°C to 105°C.

## switching characteristics, $V_{CC}$ = 3 V, $C_L$ = 15 pF, $T_A$ = 25°C

| PARAMETER | TEST CONDITIONS | TLV2393 | | | UNIT |
|---|---|---|---|---|---|
| | | MIN | TYP | MAX | |
| Response time | 100-mV input step with 5-mV overdrive, $R_L$ connected to 5 V through 5.1 kΩ | | 0.45 | 1 | µs |

## electrical characteristics, $V_{CC}$ = 5 V

| PARAMETER | | TEST CONDITIONS | | $T_A$† | TLV2393 | | | 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 | | –100 | –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 | | 550 | 700 | µA |
| | | | | Full range | | | 800 | |
| $I_{CCL}$ | Low-level supply current | $V_O = V_{OL}$ | | 25°C | | 1.2 | 1.5 | mA |
| | | | | Full range | | | 1.6 | |

† 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 | | TLV2393 | | | UNIT |
|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | |
| Response time | 100-mV input step with 5-mV overdrive, | $R_L$ connected to 5 V through 5.1 kΩ | | 0.4 | 0.8 | µs |
| | TTL-level input step, | $R_L$ connected to 5 V through 5.1 kΩ | | 0.15 | 0.3 | |

## electrical characteristics, $V_{CC}$ = 3 V, $T_A$ = 25°C

| PARAMETER | | TEST CONDITIONS | TLV2393Y | | | UNIT |
|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | |
| $V_{IO}$ | Input offset voltage | $V_O$ = 1.4 V, $V_{IC}$ = $V_{ICR}$min | | 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 | | 80 | 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 | | –100 | –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 | 4 | | | mA |
| $I_{CCH}$ | High-level supply current | $V_O$ = $V_{OH}$ | | 450 | 600 | µA |
| $I_{CCL}$ | Low-level supply current | $V_O$ = $V_{OL}$ | | 1.1 | 1.3 | mA |

## switching characteristics, $V_{CC}$ = 3 V, $C_L$ = 15 pF, $T_A$ = 25°C

| PARAMETER | TEST CONDITIONS | TLV2393Y | | | UNIT |
|---|---|---|---|---|---|
| | | MIN | TYP | MAX | |
| Response time | 100-mV input step with 5-mV overdrive, $R_L$ connected to 5 V through 5.1 kΩ | | 0.45 | 1 | µs |

## electrical characteristics, $V_{CC}$ = 5 V, $T_A$ = 25°C

| PARAMETER | | TEST CONDITIONS | TLV2393Y | | | UNIT |
|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | |
| $V_{IO}$ | Input offset voltage | $V_O$ = 1.4 V, $V_{IC}$ = $V_{ICR}$min | | 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 | | –100 | –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 | $V_O$ = $V_{OH}$ | | 550 | 700 | µA |
| $I_{CCL}$ | Low-level supply current | $V_O$ = $V_{OL}$ | | 1.2 | 1.5 | mA |

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

| PARAMETER | TEST CONDITIONS | TLV2393Y | | | UNIT |
|---|---|---|---|---|---|
| | | MIN | TYP | MAX | |
| Response time | 100-mV input step with 5-mV overdrive, $R_L$ connected to 5 V through 5.1 kΩ | | 0.4 | 0.8 | µs |
| | TTL-level input step, $R_L$ connected to 5 V through 5.1 kΩ | | 0.15 | 0.3 | |

## TYPICAL CHARACTERISTICS

### Table of Graphs

| | | FIGURE |
|---|---|---|
| Input overdrives for TLV1393 | vs Low-to-high-level output response time | 1, 3 |
| | vs High-to-low-level output response time | 2, 4 |
| Input overdrives for TLV2393 | vs Low-to-high-level output response time | 5, 7 |
| | vs High-to-low-level output response time | 6, 8 |

**TLV1393 LOW-TO HIGH-LEVEL OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES**

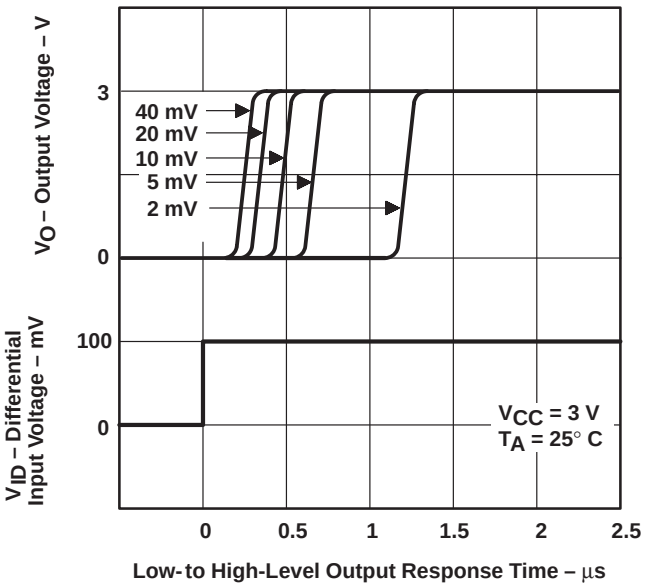



**Figure 1**

**TLV1393 HIGH-TO LOW-LEVEL OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES**

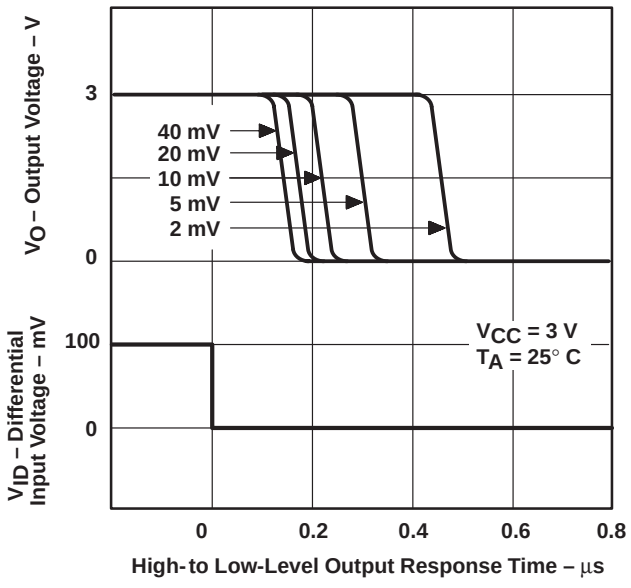



**Figure 2**

## TYPICAL CHARACTERISTICS

**TLV1393 LOW-TO HIGH-LEVEL OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES**

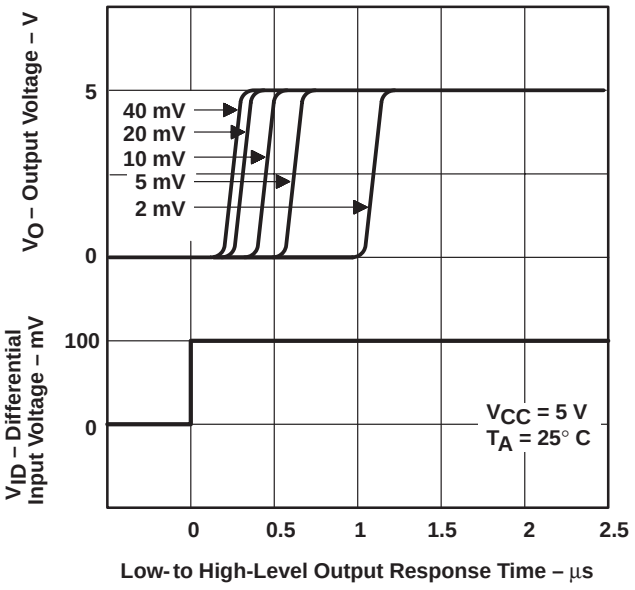



**Figure 3**

**TLV1393 HIGH-TO LOW-LEVEL OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES**

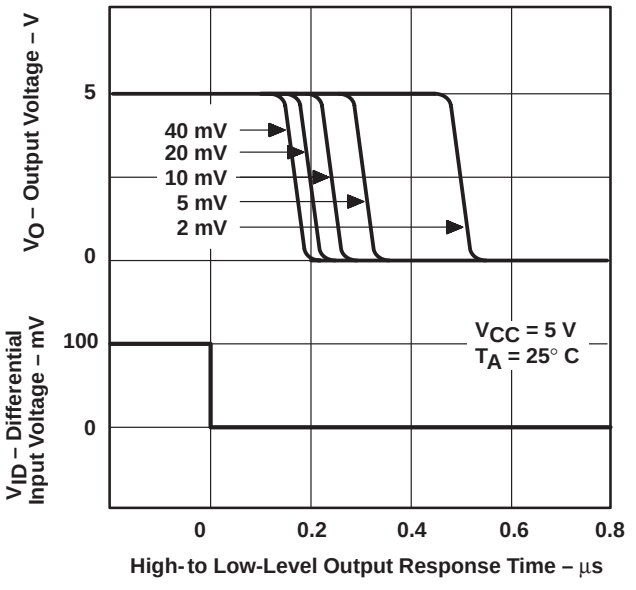



**Figure 4**

**TLV2393 LOW-TO HIGH-LEVEL OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES**

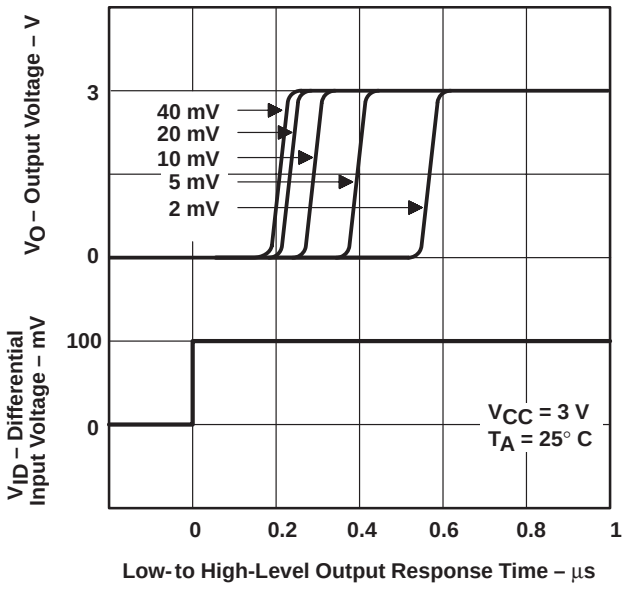



**Figure 5**

**TLV2393 HIGH-TO LOW-LEVEL OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES**

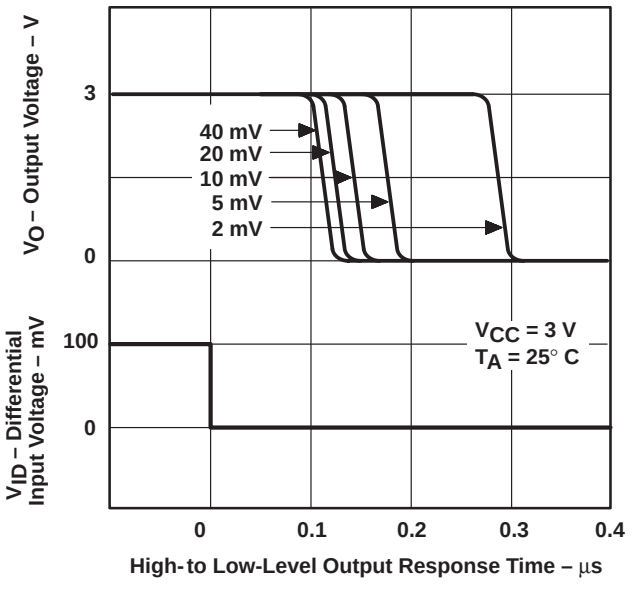



**Figure 6**

## TYPICAL CHARACTERISTICS

**TLV2393 LOW-TO HIGH-LEVEL OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES**

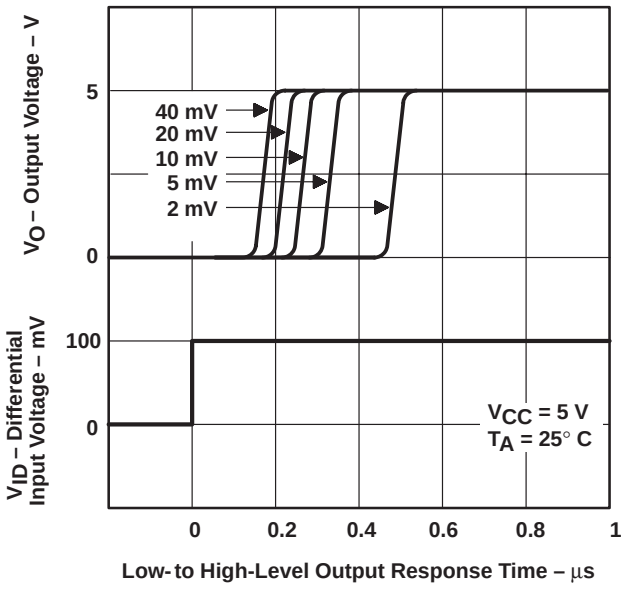



**Figure 7**

**TLV2393 HIGH-TO LOW-LEVEL OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES**

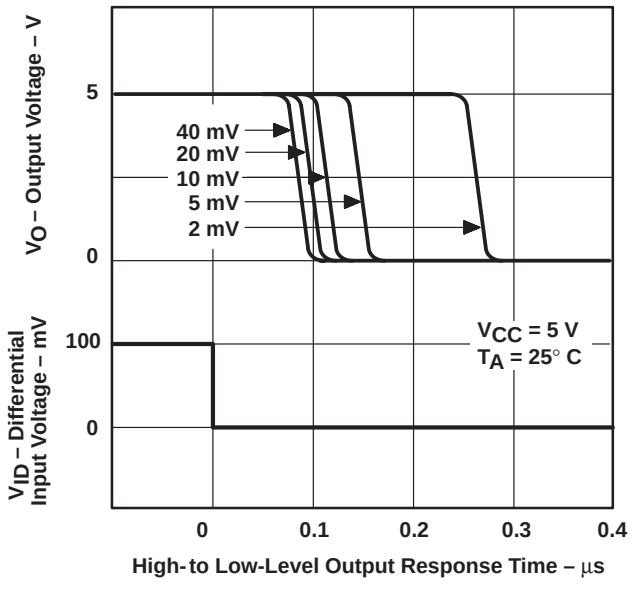



**Figure 8**

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