

# LM139, LM139A, LM239, LM239A, LM339 LM339A, LM339Y, LM2901, LM2901Q QUAD DIFFERENTIAL COMPARATORS

SLCS006C – OCTOBER 1979 – REVISED NOVEMBER 1996

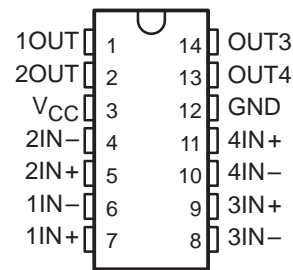
- Single Supply or Dual Supplies
- Wide Range of Supply Voltage  
2 V to 36 V
- Low Supply-Current Drain Independent of Supply Voltage . . . 0.8 mA Typ
- Low Input Bias Current . . . 25 nA Typ
- Low Input Offset Current . . . 3 nA Typ (LM139)
- Low Input Offset Voltage . . . 2 mV Typ
- Common-Mode Input 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

## description

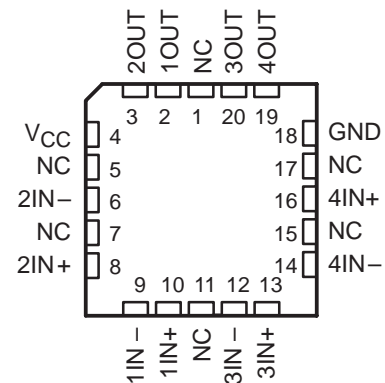
These devices consist of four independent voltage comparators that are designed to operate from a single power supply over a wide range of voltages. Operation from dual supplies is also possible as long as the difference between the two supplies is 2 V to 36 V and  $V_{CC}$  is at least 1.5 V more positive than the input common-mode voltage. Current drain is independent of the supply voltage. The outputs can be connected to other open-collector outputs to achieve wire-AND relationships.

The LM139 and LM139A are characterized for operation from  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The LM239 and LM239A are characterized for operation from  $-25^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The LM339 and LM339A are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ . The LM2901 and LM2901Q are characterized for operation from  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ .

D, DB, J, N, OR PW PACKAGE  
(TOP VIEW)

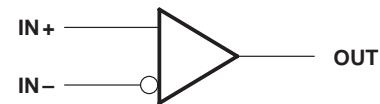


FK PACKAGE  
(TOP VIEW)



NC – No internal connection

## symbol (each comparator)



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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.

**TEXAS  
INSTRUMENTS**

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**LM139, LM139A, LM239, LM239A, LM339  
LM339A, LM339Y, LM2901, LM2901Q  
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**AVAILABLE OPTIONS**

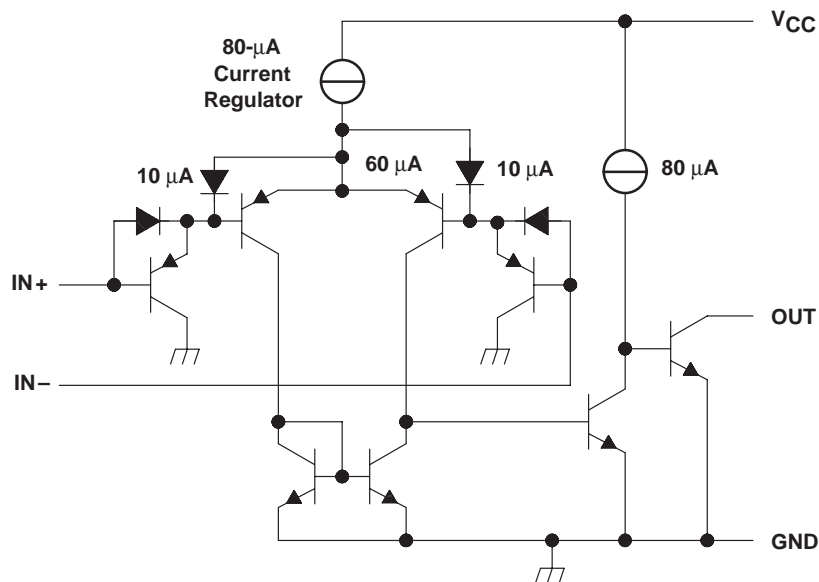
| T <sub>A</sub> | V <sub>IO</sub> max<br>at 25°C | PACKAGED DEVICES         |                 |                         |                       |                       |                 | CHIP FORM<br>(Y)§ |
|----------------|--------------------------------|--------------------------|-----------------|-------------------------|-----------------------|-----------------------|-----------------|-------------------|
|                |                                | SMALL<br>OUTLINE<br>(D)† | SSOP<br>(DB)‡   | CHIP<br>CARRIER<br>(FK) | CERAMIC<br>DIP<br>(J) | PLASTIC<br>DIP<br>(N) | TSSOP<br>(PW)‡  |                   |
| 0°C to 70°C    | 5 mV<br>2 mV                   | LM339D<br>LM339AD        | LM339DBLE<br>—  | —                       | —                     | LM339N<br>LM339AN     | LM339PWLE<br>—  | LM339Y            |
| -25°C to 85°C  | 5 mV<br>2 mV                   | LM239D<br>LM239AD        | —               | —                       | —                     | LM239N<br>LM239AN     | —               | —                 |
| -40°C to 125°C | 7 mV                           | LM2901D<br>LM2901QD      | LM2901DBLE<br>— | —                       | —                     | LM2901QN              | LM2901PWLE<br>— | —                 |
| -55°C to 125°C | 5 mV<br>2 mV                   | LM139D<br>LM139AD        | —               | LM139AFK                | LM139J<br>LM139AJ     | LM139N<br>LM139AN     | —               | —                 |

† The D package is available taped and reeled. Add the suffix R to the device type (e.g., LM339DR).

‡ The DB and PW packages are only available left-end taped and reeled.

§ Chips are tested at 25°C (see electrical characteristics).

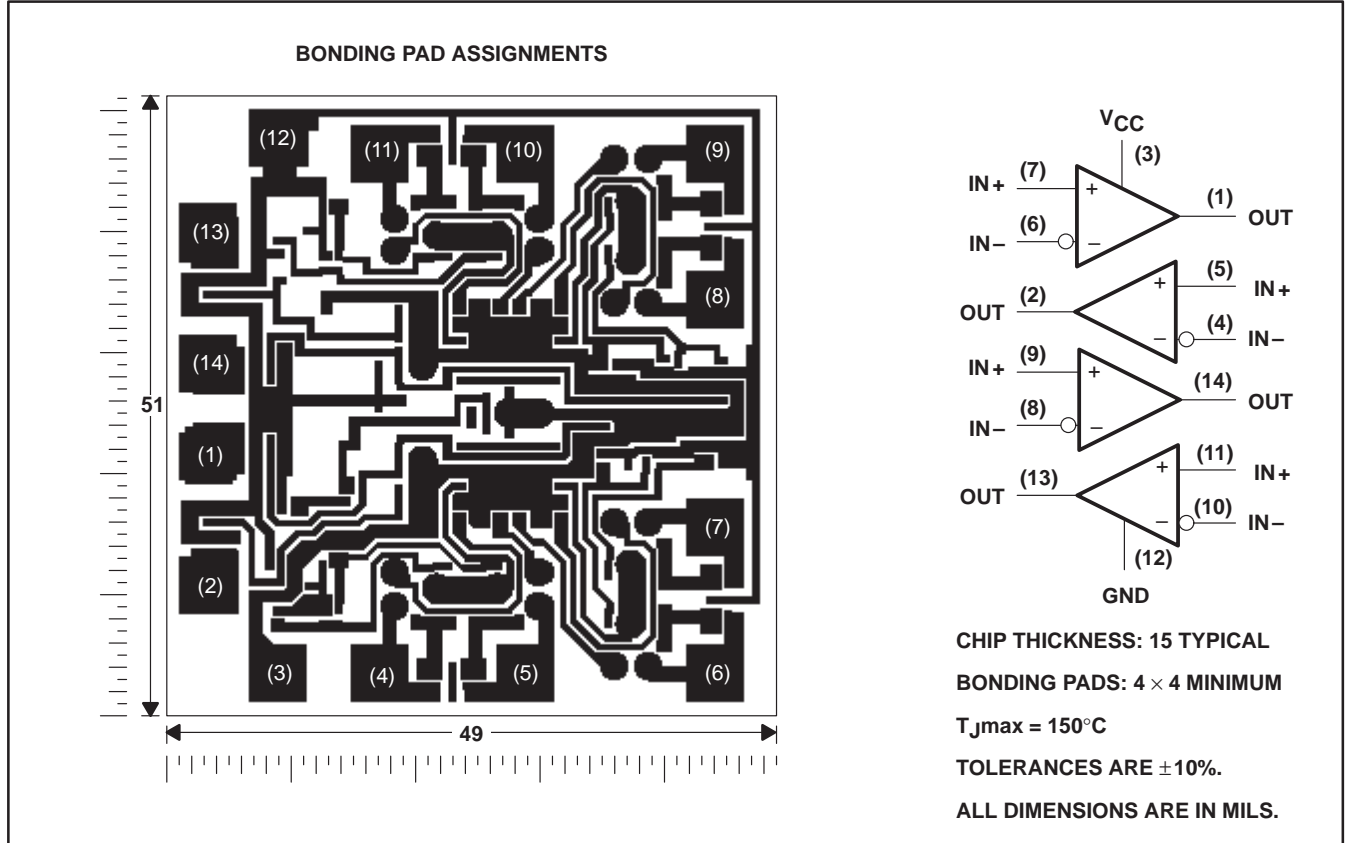
**schematic (each comparator)**



All current values shown are nominal.

**LM339Y chip information**

This chip, when properly assembled, displays characteristics similar to the LM339. Thermal compression or ultrasonic bonding can be used on the doped-aluminum bonding pads. Chips can be mounted with conductive epoxy or a gold-silicon preform.



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**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)                                     | $\pm 36$ 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                    |
| Continuous total dissipation  | See Dissipation Rating Table |
| Operating free-air temperature range, $T_A$ : LM139, LM139A                           | -55°C to 125°C               |
| LM239, LM239A   | -25°C to 85°C                |
| LM339, LM339A   | 0°C to 70°C                  |
| LM2901, LM2901Q   | -40°C to 125°C               |
| Storage temperature range   | -65°C to 150°C               |
| Case temperature for 60 seconds: FK package   | 260°C                        |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D, DB, N, or PW package | 260°C                        |
| Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: J package               | 300°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 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.

**DISSIPATION RATING TABLE**

| PACKAGE | $T_A \leq 25^\circ\text{C}$<br>POWER RATING | DERATING<br>FACTOR | DERATE<br>ABOVE $T_A$ | $T_A = 70^\circ\text{C}$<br>POWER RATING | $T_A = 85^\circ\text{C}$<br>POWER RATING | $T_A = 125^\circ\text{C}$<br>POWER RATING |
|---------|---|--------------------|-----------------------|--|--|---|
| D       | 900 mW                                      | 7.6 mW/°C          | 31°C                  | 608 mW                                   | 494 mW                                   | —   |
| DB      | 775 mW                                      | 6.2 mW/°C          | 25°C                  | 496 mW                                   | 403 mW                                   | 155 mW                                    |
| FK      | 900 mW                                      | 11.0 mW/°C         | 68°C                  | 880 mW                                   | 715 mW                                   | 275 mW                                    |
| J       | 900 mW                                      | 11.0 mW/°C         | 68°C                  | 880 mW                                   | 715 mW                                   | 275 mW                                    |
| N       | 900 mW                                      | 9.2 mW/°C          | 52°C                  | 736 mW                                   | 598 mW                                   | —   |
| PW      | 700 mW                                      | 5.6 mW/°C          | 25°C                  | 448 mW                                   | 364 mW                                   | 140 mW                                    |



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

| PARAMETER  | TEST CONDITIONS  | $T_A$ †                | LM139          |                      |      | LM139A |                      |      | UNIT          |
|--|--|------------------------|----------------|----------------------|------|--------|----------------------|------|---------------|
|  |  |                        | MIN            | TYP                  | MAX  | MIN    | TYP                  | MAX  |               |
| $V_{IO}$ Input offset voltage                            | $V_{CC} = 5\text{ V to }30\text{ V}$ , $V_{IC} = V_{ICRmin}$ ,<br>$V_O = 1.4\text{ V}$ | 25°C                   |                | 2                    | 5    |        | 1                    | 2    | mV            |
|  |  | -55°C to 125°C         |                |                      |      |        |                      | 4    |               |
| $I_{IO}$ Input offset current                            | $V_O = 1.4\text{ V}$   | 25°C                   |                | 3                    | 25   |        | 3                    | 25   | nA            |
|  |  | -55°C to 125°C         |                |                      | 100  |        |                      | 100  |               |
| $I_{IB}$ Input bias current                              | $V_O = 1.4\text{ V}$   | 25°C                   |                | -25                  | -100 |        | -25                  | -100 | nA            |
|  |  | -55°C to 125°C         |                |                      | -300 |        |                      | -300 |               |
| $V_{ICR}$ Common-mode input voltage range                |  | 25°C                   |                | 0 to<br>$V_{CC}-1.5$ |      |        | 0 to<br>$V_{CC}-1.5$ |      | V             |
|  |  | -55°C to 125°C         |                | 0 to<br>$V_{CC}-2$   |      |        | 0 to<br>$V_{CC}-2$   |      |               |
| $A_{VD}$ Large-signal differential voltage amplification | $V_{CC} \pm \pm 7.5\text{ V}$ , $V_O = -5\text{ V to }5\text{ V}$                      | 25°C                   |                | 200                  |      | 50     | 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   |               |
|  |  | $V_{OH} = 30\text{ V}$ | -55°C to 125°C |                      |      |        | 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            |
|  |  | -55°C to 125°C         |                |                      | 700  |        |                      | 700  |               |
| $I_{OL}$ Low-level output current                        | $V_{ID} = -1\text{ V}$ , $V_{OL} = 1.5\text{ V}$                                       | 25°C                   |                | 6                    | 16   |        | 6                    | 16   | mA            |
| $I_{CC}$ Supply current (four comparators)               | $V_O = 2.5\text{ V}$ , No load   | 25°C                   |                | 0.8                  | 2    |        | 0.8                  | 2    | mA            |

† 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   | LM139, LM139A                         |     |     | UNIT          |
|---------------|---|---------------------------------------|-----|-----|---------------|
|               |   | MIN                                   | TYP | MAX |               |
| Response time | $R_L$ connected to 5 V through 5.1 k $\Omega$ ,<br>$C_L = 15\text{ pF}$ ‡, See Note 4 | 100-mV input step with 5-mV overdrive |     |     | $\mu\text{s}$ |
|               |   | TTL-level input step                  |     |     |               |

‡  $C_L$  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.

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

| PARAMETER  | TEST CONDITIONS   | $T_A$ †                | LM239, LM339      |     |      | LM239A, LM339A    |     |      | LM2901, LM2901Q   |     |      | UNIT          |
|--|---|------------------------|-------------------|-----|------|-------------------|-----|------|-------------------|-----|------|---------------|
|  |   |                        | MIN               | TYP | MAX  | MIN               | TYP | MAX  | MIN               | TYP | MAX  |               |
| $V_{IO}$ Input offset voltage                            | $V_{CC} = 5\text{ V to }30\text{ V}$ ,<br>$V_{IC} = V_{ICR\text{min}}$ ,<br>$V_O = 1.4\text{ V}$                | 25°C                   |                   | 2   | 5    |                   | 1   | 3    |                   | 2   | 7    | mV            |
|  |   | Full range             |                   |     | 9    |                   |     | 4    |                   |     | 15   |               |
| $I_{IO}$ Input offset current                            | $V_O = 1.4\text{ V}$  | 25°C                   |                   | 5   | 50   |                   | 5   | 50   |                   | 5   | 50   | nA            |
|  |   | Full range             |                   |     | 150  |                   |     | 150  |                   |     | 200  |               |
| $I_{IB}$ Input bias current                              | $V_O = 1.4\text{ V}$  | 25°C                   |                   | -25 | -250 |                   | -25 | -250 |                   | -25 | -250 | nA            |
|  |   | Full range             |                   |     | -400 |                   |     | -400 |                   |     | -500 |               |
| $V_{ICR}$ Common-mode input voltage range                |   | 25°C                   | 0 to $V_{CC}-1.5$ |     |      | 0 to $V_{CC}-1.5$ |     |      | 0 to $V_{CC}-1.5$ |     |      | V             |
|  |   | Full range             | 0 to $V_{CC}-2$   |     |      | 0 to $V_{CC}-2$   |     |      | 0 to $V_{CC}-2$   |     |      |               |
| $A_{VD}$ Large-signal differential voltage amplification | $V_{CC} = 15\text{ V}$ ,<br>$V_O = 1.4\text{ V to }11.4\text{ V}$ ,<br>$R_L \geq 15\text{ k}\Omega$ to $V_{CC}$ | 25°C                   | 50                | 200 |      | 50                | 200 |      | 25                | 100 | V/mV |               |
| $I_{OH}$ High-level output current                       | $V_{ID} = 1\text{ V}$   | $V_{OH} = 5\text{ V}$  | 25°C              | 0.1 | 50   |                   | 0.1 | 50   |                   | 0.1 | 50   | nA            |
|  |   | $V_{OH} = 30\text{ V}$ | Full range        |     | 1    |                   |     | 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  |                   | 150 | 500  | mV            |
|  |   | Full range             |                   |     | 700  |                   |     | 700  |                   |     | 700  |               |
| $I_{OL}$ Low-level output current                        | $V_{ID} = -1\text{ V}$ , $V_{OL} = 1.5\text{ V}$  | 25°C                   | 6                 | 16  |      | 6                 | 16  |      | 6                 | 16  | mA   |               |
| $I_{CC}$ Supply current (four comparators)               | $V_O = 2.5\text{ V}$ , No load  | 25°C                   |                   | 0.8 | 2    |                   | 0.8 | 2    |                   | 0.8 | 2    | mA            |
|  | $V_{CC} = 30\text{ V}$ , $V_O = 2.5\text{ V}$ , No load   |                        |                   |     |      |                   |     |      |                   | 1   | 2.5  |               |

† Full range (MIN to MAX) for LM239 and LM239A is -25°C to 85°C, for LM339 and LM339A is 0°C to 70°C, and for LM2901 is -40°C to 125°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  | LM239, LM239A<br>LM339, LM339A<br>LM2901, LM2901Q |     |     | UNIT |
|---------------|--|---|-----|-----|------|
|               |  | MIN   | TYP | MAX |      |
| Response time | $R_L$ connected to 5 V through 5.1 k $\Omega$ ,<br>$C_L = 15\text{ pF}$ ‡,<br>See Note 4 | 100-mV input step with 5-mV overdrive             |     |     | 1.3  |
|               |  | TTL-level input step                              |     |     | 0.3  |

‡  $C_L$  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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LM339A, LM339Y, LM2901, LM2901Q  
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**electrical characteristics at  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)**

| PARAMETER  | TEST CONDITIONS†  | LM339Y               |     |      | UNIT |
|--|---|----------------------|-----|------|------|
|  |   | MIN                  | TYP | MAX  |      |
| $V_{IO}$ Input offset voltage                            | $V_{CC} = 5\text{ V to }30\text{ V}$ ,<br>$V_O = 1.4\text{ V}$ ,<br>$V_{IC} = V_{ICRmin}$ ,                       |                      | 2   | 5    | mV   |
| $I_{IO}$ Input offset current                            | $V_O = 1.4\text{ V}$  |                      | 5   | 50   | nA   |
| $I_{IB}$ Input bias current                              | $V_O = 1.4\text{ V}$  |                      | -25 | -250 | nA   |
| $V_{ICR}$ Common-mode input voltage range                |   | 0 to<br>$V_{CC}-1.5$ |     |      | V    |
| $A_{VD}$ Large-signal differential voltage amplification | $V_{CC} = 15\text{ V}$ ,<br>$R_L \geq 15\text{ k}\Omega$ to $V_{CC}$ ,<br>$V_O = 1.4\text{ V to }11.4\text{ V}$ , | 25                   | 100 |      | V/mV |
| $I_{OH}$ High-level output current                       | $V_{ID} = 1\text{ V}$ ,<br>$V_{OH} = 5\text{ V}$  |                      | 0.1 | 50   | nA   |
| $V_{OL}$ Low-level output voltage                        | $V_{ID} = -1\text{ V}$ ,<br>$I_{OL} = 4\text{ mA}$  |                      | 150 | 400  | mV   |
| $I_{OL}$ Low-level output current                        | $V_{ID} = -1\text{ V}$ ,<br>$V_{OL} = 1.5\text{ V}$   | 6                    | 16  |      | mA   |
| $I_{CC}$ Supply current (four comparators)               | $V_O = 2.5\text{ V}$ ,<br>No load   |                      | 0.8 | 2    | mA   |
|  | $V_O = 30\text{ V}$ ,<br>No load<br>$V_O = 15\text{ V}$ ,   |                      | 1   | 2.5  |      |

† 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   |                                       | LM339Y |     |     | UNIT          |
|---------------|---|---------------------------------------|--------|-----|-----|---------------|
|               |   |                                       | MIN    | TYP | MAX |               |
| Response time | $R_L$ connected to 5 V through 5.1 k $\Omega$ ,<br>$C_L = 15\text{ pF}$ ‡, See Note 4 | 100-mV input step with 5-mV overdrive |        | 1.3 |     | $\mu\text{s}$ |
|               |   | TTL-level input step                  |        | 0.3 |     |               |

‡  $C_L$  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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