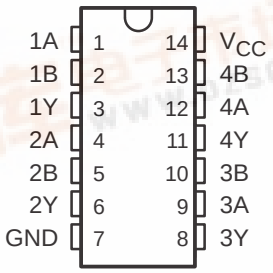
# SN54LV00A, SN74LV00A
# QUADRUPLE 2-INPUT POSITIVE-NAND GATES

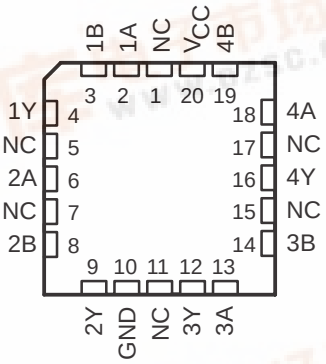
SCLS389C – SEPTEMBER 1997 – REVISED MAY 2000

- *EPIC*™ (Enhanced-Performance Implanted CMOS) Process
- Typical $V_{OLP}$ (Output Ground Bounce) <0.8 V at $V_{CC}$ = 3.3 V, $T_A$ = 25°C
- Typical $V_{OHV}$ (Output $V_{OH}$ Undershoot) >2.3 V at $V_{CC}$ = 3.3 V, $T_A$ = 25°C
- 2-V to 5.5-V $V_{CC}$ Operation
- Support Mixed-Mode Voltage Operation on All Ports
- Latch-Up Performance Exceeds 250 mA Per JESD 17
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)
- Package Options Include Plastic Small-Outline (D, NS), Shrink Small-Outline (DB), Thin Very Small-Outline (DGV), and Thin Shrink Small-Outline (PW) Packages, Ceramic Flat (W) Packages, Chip Carriers (FK), and DIPs (J)

**SN54LV00A . . . J OR W PACKAGE**
**SN74LV00A . . . D, DB, DGV, NS, OR PW PACKAGE**
**(TOP VIEW)**




**SN54LV00A . . . FK PACKAGE**
**(TOP VIEW)**




NC – No internal connection

## description

These quadruple 2-input positive-NAND gates are designed for 2-V to 5.5-V $V_{CC}$ operation.

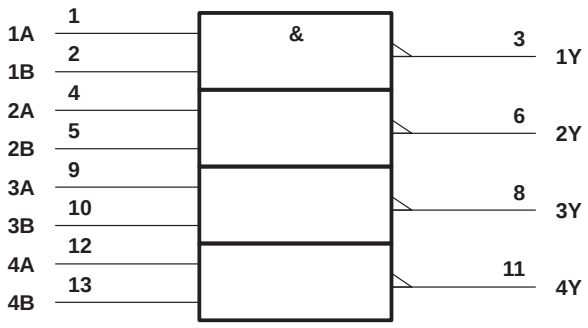
The 'LV00A devices perform the Boolean function $Y = \overline{A \bullet B}$ or $Y = \overline{A} + \overline{B}$ in positive logic.

The SN54LV00A is characterized for operation over the full military temperature range of –55°C to 125°C. The SN74LV00A is characterized for operation from –40°C to 85°C.

**FUNCTION TABLE**
**(each gate)**

| INPUTS | | OUTPUT |
|---|---|---|
| A | B | Y |
| H | H | L |
| L | X | H |
| X | L | H |

## logic symbol†




† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are for the D, DB, DGV, J, NS, PW, and W packages.

## logic diagram, each gate (positive logic)


## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)‡

Supply voltage range, $V_{CC}$ . . . . . –0.5 V to 7 V
Input voltage range, $V_I$ (see Note 1) . . . . . –0.5 V to 7 V
Voltage range applied to any output in the high-impedance
or power-off state, $V_O$ (see Note 1) . . . . . –0.5 V to 7 V
Output voltage range, $V_O$ (see Notes 1 and 2) . . . . . –0.5 V to $V_{CC}$ + 0.5 V
Input clamp current, $I_{IK}$ ($V_I$ < 0) . . . . . –20 mA
Output clamp current, $I_{OK}$ ($V_O$ < 0 or $V_O$ > $V_{CC}$) . . . . . ±50 mA
Continuous output current, $I_O$ ($V_O$ = 0 to $V_{CC}$) . . . . . ±25 mA
Continuous current through $V_{CC}$ or GND . . . . . ±50 mA
Package thermal impedance, $\theta_{JA}$ (see Note 3): D package . . . . . 86°C/W
DB package . . . . . 96°C/W
DGV package . . . . . 127°C/W
NS package . . . . . 76°C/W
PW package . . . . . 113°C/W
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. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. This value is limited to 5.5 V maximum.
3. The package thermal impedance is calculated in accordance with JESD 51.

## recommended operating conditions (see Note 4)

| | | | SN54LV00A | | SN74LV00A | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | MIN | MAX | MIN | MAX | |
| $V_{CC}$ | Supply voltage | | 2 | 5.5 | 2 | 5.5 | V |
| $V_{IH}$ | High-level input voltage | $V_{CC}$ = 2 V | 1.5 | | 1.5 | | V |
| | | $V_{CC}$ = 2.3 V to 2.7 V | $V_{CC} \times 0.7$ | | $V_{CC} \times 0.7$ | | |
| | | $V_{CC}$ = 3 V to 3.6 V | $V_{CC} \times 0.7$ | | $V_{CC} \times 0.7$ | | |
| | | $V_{CC}$ = 4.5 V to 5.5 V | $V_{CC} \times 0.7$ | | $V_{CC} \times 0.7$ | | |
| $V_{IL}$ | Low-level input voltage | $V_{CC}$ = 2 V | | 0.5 | | 0.5 | V |
| | | $V_{CC}$ = 2.3 V to 2.7 V | | $V_{CC} \times 0.3$ | | $V_{CC} \times 0.3$ | |
| | | $V_{CC}$ = 3 V to 3.6 V | | $V_{CC} \times 0.3$ | | $V_{CC} \times 0.3$ | |
| | | $V_{CC}$ = 4.5 V to 5.5 V | | $V_{CC} \times 0.3$ | | $V_{CC} \times 0.3$ | |
| $V_I$ | Input voltage | | 0 | 5.5 | 0 | 5.5 | V |
| $V_O$ | Output voltage | | 0 | $V_{CC}$ | 0 | $V_{CC}$ | V |
| $I_{OH}$ | High-level output current | $V_{CC}$ = 2 V | | –50 | | –50 | μA |
| | | $V_{CC}$ = 2.3 V to 2.7 V | | –2 | | –2 | mA |
| | | $V_{CC}$ = 3 V to 3.6 V | | –6 | | –6 | |
| | | $V_{CC}$ = 4.5 V to 5.5 V | | –12 | | –12 | |
| $I_{OL}$ | Low-level output current | $V_{CC}$ = 2 V | | 50 | | 50 | μA |
| | | $V_{CC}$ = 2.3 V to 2.7 V | | 2 | | 2 | mA |
| | | $V_{CC}$ = 3 V to 3.6 V | | 6 | | 6 | |
| | | $V_{CC}$ = 4.5 V to 5.5 V | | 12 | | 12 | |
| $\Delta t/\Delta v$ | Input transition rise or fall rate | $V_{CC}$ = 2.3 V to 2.7 V | 0 | 200 | 0 | 200 | ns/V |
| | | $V_{CC}$ = 3 V to 3.6 V | 0 | 100 | 0 | 100 | |
| | | $V_{CC}$ = 4.5 V to 5.5 V | 0 | 20 | 0 | 20 | |
| $T_A$ | Operating free-air temperature | | –55 | 125 | –40 | 85 | °C |

NOTE 4: All unused inputs of the device must be held at $V_{CC}$ or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

## electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | $V_{CC}$ | SN54LV00A | | | SN74LV00A | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| $V_{OH}$ | $I_{OH}$ = –50 μA | 2 V to 5.5 V | $V_{CC}$–0.1 | | | $V_{CC}$–0.1 | | | V |
| | $I_{OH}$ = –2 mA | 2.3 V | 2 | | | 2 | | | |
| | $I_{OH}$ = –6 mA | 3 V | 2.48 | | | 2.48 | | | |
| | $I_{OH}$ = –12 mA | 4.5 V | 3.8 | | | 3.8 | | | |
| $V_{OL}$ | $I_{OL}$ = 50 μA | 2 V to 5.5 V | | | 0.1 | | | 0.1 | V |
| | $I_{OL}$ = 2 mA | 2.3 V | | | 0.4 | | | 0.4 | |
| | $I_{OL}$ = 6 mA | 3 V | | | 0.44 | | | 0.44 | |
| | $I_{OL}$ = 12 mA | 4.5 V | | | 0.55 | | | 0.55 | |
| $I_I$ | $V_I = V_{CC}$ or GND | 0 V to 5.5 V | | | ±1 | | | ±1 | μA |
| $I_{CC}$ | $V_I = V_{CC}$ or GND, $I_O$ = 0 | 5.5 V | | | 20 | | | 20 | μA |
| $I_{off}$ | $V_I$ or $V_O$ = 0 to 5.5 V | 0 V | | | 5 | | | 5 | μA |
| $C_i$ | $V_I = V_{CC}$ or GND | 3.3 V | | 3.3 | | | 3.3 | | pF |
| | | 5 V | | 3.3 | | | 3.3 | | |

### switching characteristics over recommended operating free-air temperature range, $V_{CC}$ = 2.5 V ± 0.2 V (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE | $T_A$ = 25°C | | | SN54LV00A | | SN74LV00A | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| $t_{pd}$ | A | Y | $C_L$ = 15 pF | | 7.1* | 12.9* | 1* | 16* | 1 | 15 | ns |
| $t_{pd}$ | A | Y | $C_L$ = 50 pF | | 9.6 | 16.6 | 1 | 21 | 1 | 20 | ns |



* On products compliant to MIL-PRF-38535, this parameter is not production tested.

### switching characteristics over recommended operating free-air temperature range, $V_{CC}$ = 3.3 V ± 0.3 V (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE | $T_A$ = 25°C | | | SN54LV00A | | SN74LV00A | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| $t_{pd}$ | A | Y | $C_L$ = 15 pF | | 5* | 7.9* | 1* | 10.5* | 1 | 9.5 | ns |
| $t_{pd}$ | A | Y | $C_L$ = 50 pF | | 6.9 | 11.4 | 1 | 14 | 1 | 13 | ns |



* On products compliant to MIL-PRF-38535, this parameter is not production tested.

### switching characteristics over recommended operating free-air temperature range, $V_{CC}$ = 5 V ± 0.5 V (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE | $T_A$ = 25°C | | | SN54LV00A | | SN74LV00A | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| $t_{pd}$ | A | Y | $C_L$ = 15 pF | | 3.6* | 5.5* | 1* | 7.5* | 1 | 6.5 | ns |
| $t_{pd}$ | A | Y | $C_L$ = 50 pF | | 4.9 | 7.5 | 1 | 9.5 | 1 | 8.5 | ns |



* On products compliant to MIL-PRF-38535, this parameter is not production tested.

### noise characteristics, $V_{CC}$ = 3.3 V, $C_L$ = 50 pF, $T_A$ = 25°C (see Note 5)

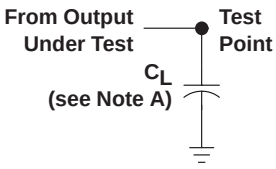
| PARAMETER | | SN74LV00A | | | UNIT |
|---|---|---|---|---|---|
| | | MIN | TYP | MAX | |
| $V_{OL(P)}$ | Quiet output, maximum dynamic $V_{OL}$ | | 0.2 | 0.8 | V |
| $V_{OL(V)}$ | Quiet output, minimum dynamic $V_{OL}$ | | –0.1 | –0.8 | V |
| $V_{OH(V)}$ | Quiet output, minimum dynamic $V_{OH}$ | | 3.1 | | V |
| $V_{IH(D)}$ | High-level dynamic input voltage | 2.31 | | | V |
| $V_{IL(D)}$ | Low-level dynamic input voltage | | | 0.99 | V |

NOTE 5: Characteristics are for surface-mount packages only.

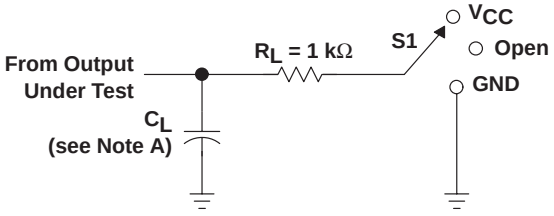
### operating characteristics, $T_A$ = 25°C

| PARAMETER | | TEST CONDITIONS | | $V_{CC}$ | TYP | UNIT |
|---|---|---|---|---|---|---|
| $C_{pd}$ | Power dissipation capacitance | $C_L$ = 50 pF, | f = 10 MHz | 3.3 V | 9.5 | pF |
| | | | | 5 V | 11 | |

## PARAMETER MEASUREMENT INFORMATION

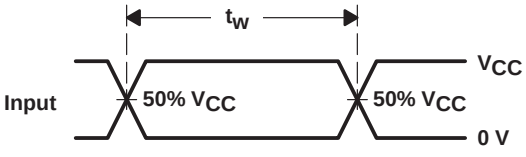



LOAD CIRCUIT FOR
TOTEM-POLE OUTPUTS

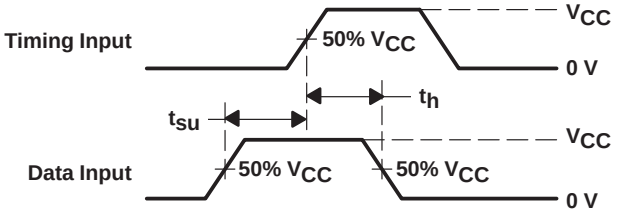



LOAD CIRCUIT FOR
3-STATE AND OPEN-DRAIN OUTPUTS

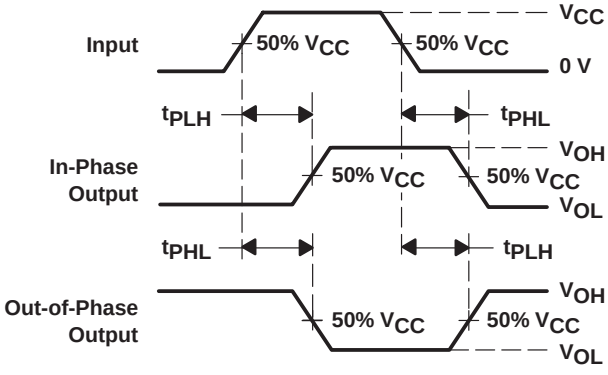
| TEST | S1 |
|---|---|
| $t_{PLH}/t_{PHL}$ | Open |
| $t_{PLZ}/t_{PZL}$ | $V_{CC}$ |
| $t_{PHZ}/t_{PZH}$ | GND |
| Open Drain | $V_{CC}$ |



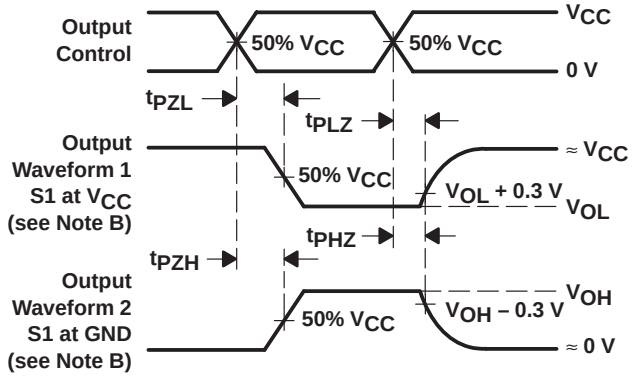

VOLTAGE WAVEFORMS
PULSE DURATION




VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES




VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS




VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

NOTES: A. $C_L$ includes probe and jig capacitance.
B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
C. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, $Z_O$ = 50 Ω, $t_r$ ≤ 3 ns, $t_f$ ≤ 3 ns.
D. The outputs are measured one at a time with one input transition per measurement.
E. $t_{PLZ}$ and $t_{PHZ}$ are the same as $t_{dis}$.
F. $t_{PZL}$ and $t_{PZH}$ are the same as $t_{en}$.
G. $t_{PHL}$ and $t_{PLH}$ are the same as $t_{pd}$.

**Figure 1. Load Circuit and Voltage Waveforms**

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