

# DATA SHEET

**74LV03**

Quad 2-input NAND gate

Product data  
Supersedes data of 1998 Apr 20

2003 Mar 03

# Quad 2-input NAND gate

74LV03

## FEATURES

- Wide operating voltage: 1.0 V to 5.5 V
- Optimized for Low Voltage applications: 1.0 V to 3.6 V
- Accepts TTL input levels between  $V_{CC} = 2.7$  V and  $V_{CC} = 3.6$  V
- Typical  $V_{OLP}$  (output ground bounce)  $< 0.8$  V @  $V_{CC} = 3.3$  V,  $T_{amb} = 25$  °C
- Typical  $V_{OHV}$  (output  $V_{OH}$  undershoot)  $> 2$  V @  $V_{CC} = 3.3$  V,  $T_{amb} = 25$  °C
- Level shifter capability
- Output capability: standard (open drain)
- $I_{CC}$  category: SSI

## DESCRIPTION

The 74LV03 is a low-voltage Si-gate CMOS device and is pin and function compatible with 74HC/HCT03.

The 74LV03 provides the 2-input NAND function.

The 74LV03 has open-drain N-transistor outputs, which are not clamped by a diode connected to  $V_{CC}$ . In the OFF-state, i.e., when one input is LOW, the output may be pulled to any voltage between GND and  $V_{Omax}$ . This allows the device to be used as a LOW-to-HIGH or HIGH-to-LOW level shifter. For digital operation and OR-tied output applications, these devices must have a pull-up resistor to establish a logic HIGH level.

## QUICK REFERENCE DATA

GND = 0 V;  $T_{amb} = 25$  °C;  $t_r = t_f \leq 2.5$  ns

| SYMBOL            | PARAMETER                              | CONDITIONS                        | TYPICAL | UNIT |
|-------------------|----------------------------------------|-----------------------------------|---------|------|
| $t_{PZL}/t_{PLZ}$ | Propagation delay<br>nA, nB to nY      | $C_L = 15$ pF<br>$V_{CC} = 3.3$ V | 8       | ns   |
| $C_I$             | Input capacitance                      |                                   | 3.5     | pF   |
| $C_{PD}$          | Power dissipation capacitance per gate | Notes 1, 2                        | 4       | pF   |

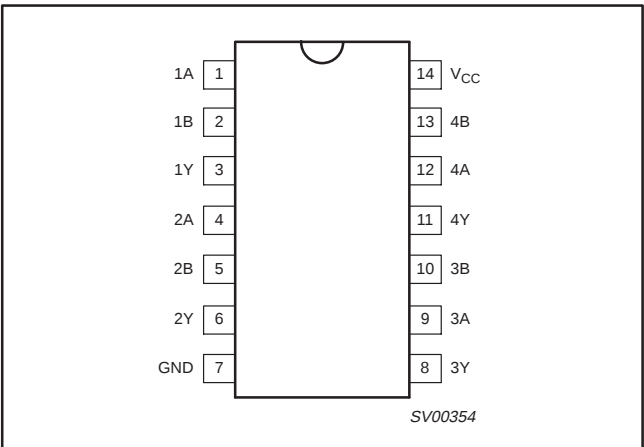
### NOTES:

- 1  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu$ W)  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma (C_L \times V_{CC}^2 \times f_o)$  where:  
 $N$  = the number of outputs switching;  
 $f_i$  = input frequency in MHz;  $C_L$  = output load capacitance in pF;  
 $f_o$  = output frequency in MHz;  $V_{CC}$  = supply voltage in V;  
 $\Sigma (C_L \times V_{CC}^2 \times f_o)$  = sum of the outputs.
- 2 The condition is  $V_I = \text{GND to } V_{CC}$
- 3 The given value of  $C_{PD}$  is obtained with :  $C_L = 0$  pF and  $R_L = \infty$

## ORDERING INFORMATION

| PACKAGES          | TEMPERATURE RANGE | ORDER CODE | PKG. DWG. # |
|-------------------|-------------------|------------|-------------|
| 14-Pin Plastic SO | -40 °C to +125 °C | 74LV03D    | SOT108-1    |

## PIN CONFIGURATION



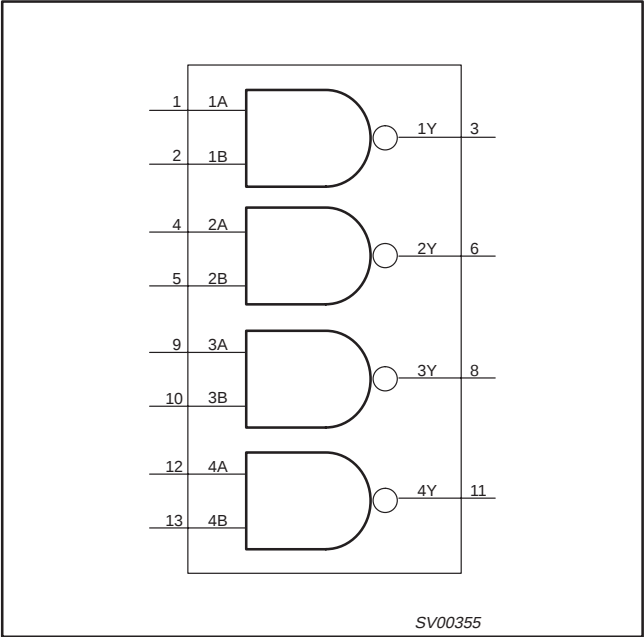
## PIN DESCRIPTION

| PIN NUMBER   | SYMBOL   | FUNCTION                |
|--------------|----------|-------------------------|
| 1, 4, 9, 12  | 1A to 4A | Data inputs             |
| 2, 5, 10, 13 | 1B to 4B | Data inputs             |
| 3, 6, 8, 11  | 1Y to 4Y | Data outputs            |
| 7            | GND      | Ground (0 V)            |
| 14           | $V_{CC}$ | Positive supply voltage |

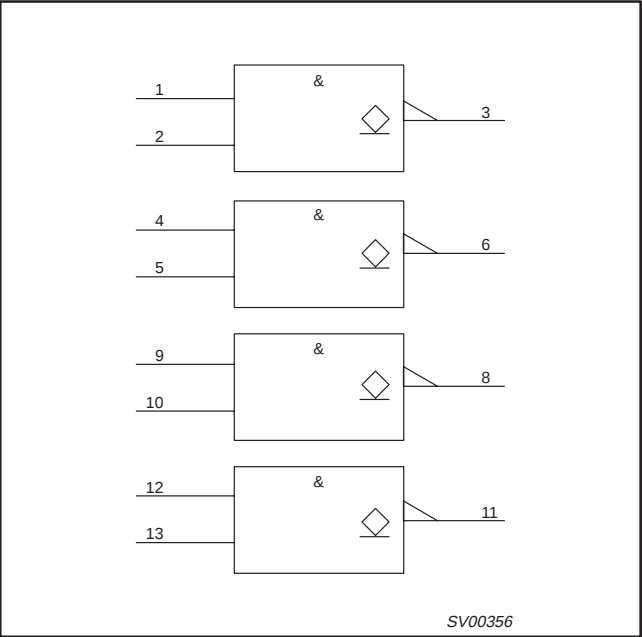
Quad 2-input NAND gate

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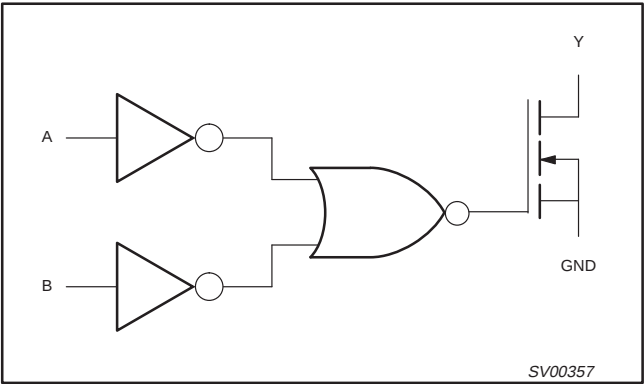
LOGIC SYMBOL



LOGIC SYMBOL (IEEE/IEC)



LOGIC DIAGRAM



FUNCTION TABLE

| INPUTS |    | OUTPUT |
|--------|----|--------|
| nA     | nB | nY     |
| L      | L  | Z      |
| L      | H  | Z      |
| H      | L  | Z      |
| H      | H  | L      |

**NOTES:**  
H = HIGH voltage level  
L = LOW voltage level  
Z = High impedance OFF-state

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## RECOMMENDED OPERATING CONDITIONS

| SYMBOL     | PARAMETER                                       | CONDITIONS                                 | MIN        | TYP. | MAX         | UNIT |
|------------|-------------------------------------------------|--------------------------------------------|------------|------|-------------|------|
| $V_{CC}$   | DC supply voltage                               | See Note1                                  | 1.0        | 3.3  | 5.5         | V    |
| $V_I$      | Input voltage                                   |                                            | 0          | –    | $V_{CC}$    | V    |
| $V_O$      | Output voltage                                  |                                            | 0          | –    | $V_{CC}$    | V    |
| $T_{amb}$  | Operating ambient temperature range in free air | See DC and AC characteristics              | –40<br>–40 |      | +85<br>+125 | °C   |
| $t_r, t_f$ | Input rise and fall times                       | $V_{CC} = 1.0 \text{ V to } 2.0 \text{ V}$ | –          | –    | 500         | ns/V |
|            |                                                 | $V_{CC} = 2.0 \text{ V to } 2.7 \text{ V}$ | –          | –    | 200         |      |
|            |                                                 | $V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$ | –          | –    | 100         |      |
|            |                                                 | $V_{CC} = 3.6 \text{ V to } 5.5 \text{ V}$ | –          | –    | 50          |      |

## NOTES:

- 1 The LV is guaranteed to function down to  $V_{CC} = 1.0 \text{ V}$  (input levels GND or  $V_{CC}$ ); DC characteristics are guaranteed from  $V_{CC} = 1.2 \text{ V}$  to  $V_{CC} = 5.5 \text{ V}$ .

ABSOLUTE MAXIMUM RATINGS<sup>1, 2</sup>

In accordance with the Absolute Maximum Rating System (IEC 134).

Voltages are referenced to GND (ground = 0 V).

| SYMBOL                         | PARAMETER                                                      | CONDITIONS                                                                           | RATING       | UNIT |
|--------------------------------|----------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------|------|
| $V_{CC}$                       | DC supply voltage                                              |                                                                                      | –0.5 to +7.0 | V    |
| $\pm I_{IK}$                   | DC input diode current                                         | $V_I < -0.5 \text{ or } V_I > V_{CC} + 0.5 \text{ V}$                                | 20           | mA   |
| $\pm I_{OK}$                   | DC output diode current                                        | $V_O < -0.5 \text{ or } V_O > V_{CC} + 0.5 \text{ V}$                                | 50           | mA   |
| $\pm I_O$                      | DC output source or sink current<br>– standard outputs         | $-0.5 \text{ V} < V_O < V_{CC} + 0.5 \text{ V}$                                      | 25           | mA   |
| $\pm I_{GND},$<br>$\pm I_{CC}$ | DC $V_{CC}$ or GND current for types with<br>–standard outputs |                                                                                      | 50           | mA   |
| $T_{stg}$                      | Storage temperature range                                      |                                                                                      | –65 to +150  | °C   |
| $P_{TOT}$                      | Power dissipation per package<br>–plastic mini-pack (SO)       | for temperature range: –40 °C to +125 °C<br>above +70 °C derate linearly with 8 mW/K | 500          | mW   |

## NOTES:

- 1 Stresses beyond those listed 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 The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

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## DC CHARACTERISTICS

Over recommended operating conditions voltages are referenced to GND (ground = 0 V)

| SYMBOL           | PARAMETER                                     | TEST CONDITIONS                                                                                              | LIMITS              |                     |                     |                     |      | UNIT |
|------------------|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------|---------------------|---------------------|---------------------|---------------------|------|------|
|                  |                                               |                                                                                                              | −40°C to +85°C      |                     |                     | −40°C to +125°C     |      |      |
|                  |                                               |                                                                                                              | MIN                 | TYP <sup>1</sup>    | MAX                 | MIN                 | MAX  |      |
| V <sub>IH</sub>  | HIGH level Input voltage                      | V <sub>CC</sub> = 1.2 V                                                                                      | 0.9                 |                     |                     | 0.9                 |      | V    |
|                  |                                               | V <sub>CC</sub> = 2.0 V                                                                                      | 1.4                 |                     |                     | 1.4                 |      |      |
|                  |                                               | V <sub>CC</sub> = 2.7 V to 3.6 V                                                                             | 2.0                 |                     |                     | 2.0                 |      |      |
|                  |                                               | V <sub>CC</sub> = 4.5 V to 5.5 V                                                                             | 0.7*V <sub>CC</sub> |                     | 0.7*V <sub>CC</sub> |                     |      |      |
| V <sub>IL</sub>  | LOW level Input voltage                       | V <sub>CC</sub> = 1.2 V                                                                                      |                     |                     | 0.3                 |                     | 0.3  | V    |
|                  |                                               | V <sub>CC</sub> = 2.0 V                                                                                      |                     |                     | 0.6                 |                     | 0.6  |      |
|                  |                                               | V <sub>CC</sub> = 2.7 V to 3.6 V                                                                             |                     |                     | 0.8                 |                     | 0.8  |      |
|                  |                                               | V <sub>CC</sub> = 4.5 V to 5.5 V                                                                             |                     | 0.3*V <sub>CC</sub> |                     | 0.3*V <sub>CC</sub> |      |      |
| V <sub>OH</sub>  | HIGH level output voltage; all outputs        | V <sub>CC</sub> = 1.2 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; −I <sub>O</sub> = 100 μA      |                     | 1.2                 |                     |                     |      | V    |
|                  |                                               | V <sub>CC</sub> = 2.0 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; −I <sub>O</sub> = 100 μA      | 1.8                 | 2.0                 |                     | 1.8                 |      |      |
|                  |                                               | V <sub>CC</sub> = 2.7 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; −I <sub>O</sub> = 100 μA      | 2.5                 | 2.7                 |                     | 2.5                 |      |      |
|                  |                                               | V <sub>CC</sub> = 3.0 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; −I <sub>O</sub> = 100 μA      | 2.8                 | 3.0                 |                     | 2.8                 |      |      |
|                  |                                               | V <sub>CC</sub> = 4.5 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; −I <sub>O</sub> = 100 μA      | 4.3                 | 4.5                 |                     | 4.3                 |      |      |
| V <sub>OH</sub>  | HIGH level output voltage; STANDARD outputs   | V <sub>CC</sub> = 3.0 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; −I <sub>O</sub> = 6 mA        | 2.40                | 2.82                |                     | 2.20                |      | V    |
|                  |                                               | V <sub>CC</sub> = 4.5 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; −I <sub>O</sub> = 12 mA       | 3.60                | 4.20                |                     | 3.50                |      |      |
| V <sub>OL</sub>  | LOW level output voltage; all outputs         | V <sub>CC</sub> = 1.2 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 100 μA       |                     | 0                   |                     |                     |      | V    |
|                  |                                               | V <sub>CC</sub> = 2.0 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 100 μA       |                     | 0                   | 0.2                 |                     | 0.2  |      |
|                  |                                               | V <sub>CC</sub> = 2.7 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 100 μA       |                     | 0                   | 0.2                 |                     | 0.2  |      |
|                  |                                               | V <sub>CC</sub> = 3.0 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 100 μA       |                     | 0                   | 0.2                 |                     | 0.2  |      |
|                  |                                               | V <sub>CC</sub> = 4.5 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 100 μA       |                     | 0                   | 0.2                 |                     | 0.2  |      |
| V <sub>OL</sub>  | LOW level output voltage; STANDARD outputs    | V <sub>CC</sub> = 3.0 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 6 mA         |                     | 0.25                | 0.40                |                     | 0.50 | V    |
|                  |                                               | V <sub>CC</sub> = 4.5 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 12 mA        |                     | 0.35                | 0.55                |                     | 0.65 |      |
| I <sub>OZ</sub>  | HIGH level output leakage current             | V <sub>CC</sub> = 2.0 V to 3.6 V; V <sub>I</sub> = V <sub>IL</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND |                     |                     | 5.0                 |                     | 10   | μA   |
| I <sub>OZ</sub>  | HIGH level output leakage current             | V <sub>CC</sub> = 2.0 V to 3.6 V; V <sub>I</sub> = V <sub>IL</sub> ; V <sub>O</sub> = 6.0 V <sup>2</sup>     |                     |                     | 10                  |                     | 20   | μA   |
| I <sub>I</sub>   | Input leakage current                         | V <sub>CC</sub> = 5.5 V; V <sub>I</sub> = V <sub>CC</sub> or GND                                             |                     |                     | 1.0                 |                     | 1.0  | μA   |
| I <sub>CC</sub>  | Quiescent supply current; SSI                 | V <sub>CC</sub> = 5.5 V; V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0                         |                     |                     | 20.0                |                     | 40   | μA   |
| ΔI <sub>CC</sub> | Additional quiescent supply current per input | V <sub>CC</sub> = 2.7 V to 3.6 V; V <sub>I</sub> = V <sub>CC</sub> − 0.6 V                                   |                     |                     | 500                 |                     | 850  | μA   |

## NOTES:

- 1 All typical values are measured at  $T_{amb} = 25^\circ\text{C}$ .
- 2 The maximum operating output voltage ( $V_{O(max)}$ ) is 6.0 V.

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AC CHARACTERISTICS FOR 74LV03

GND = 0 V;  $t_r = t_f \leq 2.5$  ns;  $C_L = 50$  pF;  $R_L = 1$  k $\Omega$

| SYMBOL                             | PARAMETER                          | WAVEFORM      | CONDITION           | LIMITS<br>−40 to +85 °C |                  |     | LIMITS<br>−40 to +125 °C |     | UNIT |
|------------------------------------|------------------------------------|---------------|---------------------|-------------------------|------------------|-----|--------------------------|-----|------|
|                                    |                                    |               | V <sub>CC</sub> (V) | MIN                     | TYP <sup>1</sup> | MAX | MIN                      | MAX |      |
| t <sub>PZL</sub> /t <sub>PLZ</sub> | Propagation delay<br>nA, nB, to nY | Figures, 1, 2 | 1.2                 | –                       | 50               | –   | –                        | –   | ns   |
|                                    |                                    |               | 2.0                 | –                       | 17               | 26  | –                        | 31  |      |
|                                    |                                    |               | 2.7                 | –                       | 13               | 19  | –                        | 23  |      |
|                                    |                                    |               | 3.0 to 3.6          | –                       | 10 <sup>2</sup>  | 16  | –                        | 19  |      |
|                                    |                                    |               | 4.5 to 5.5          | –                       | – <sup>3</sup>   | 13  | –                        | 16  |      |

- NOTE:**
- 1 Unless otherwise stated, all typical values are at T<sub>amb</sub> = 25 °C.
  - 2 Typical value measured at V<sub>CC</sub> = 3.3 V.
  - 3 Typical value measured at V<sub>CC</sub> = 5.0 V.

AC WAVEFORMS

V<sub>M</sub> = 1.5 V at V<sub>CC</sub> ≥ 2.7 V ≤ 3.6 V  
V<sub>M</sub> = 0.5 V \* V<sub>CC</sub> at V<sub>CC</sub> < 2.7 V and ≥ 4.5 V  
V<sub>OL</sub> and V<sub>OH</sub> are the typical output voltage drop that occur with the output load.  
V<sub>X</sub> = V<sub>OL</sub> + 0.3 V at V<sub>CC</sub> ≥ 2.7 V and ≤ 3.6 V  
V<sub>X</sub> = V<sub>OL</sub> + 0.1 \* V<sub>CC</sub> at V<sub>CC</sub> < 2.7 V and ≥ 4.5 V

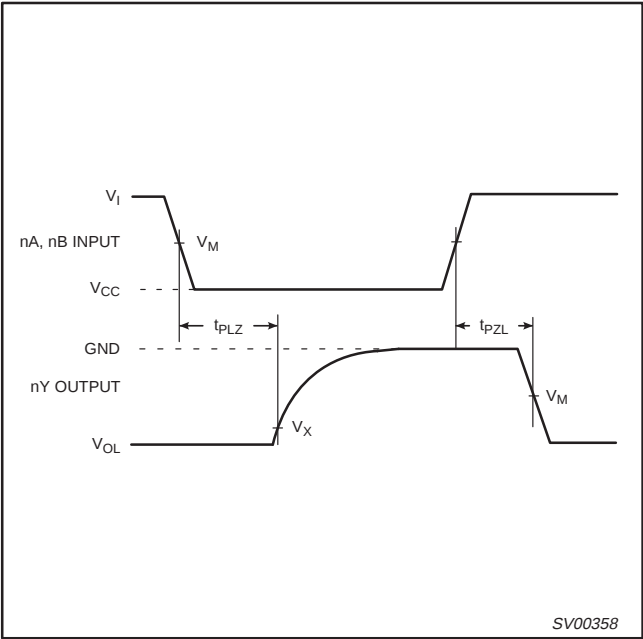
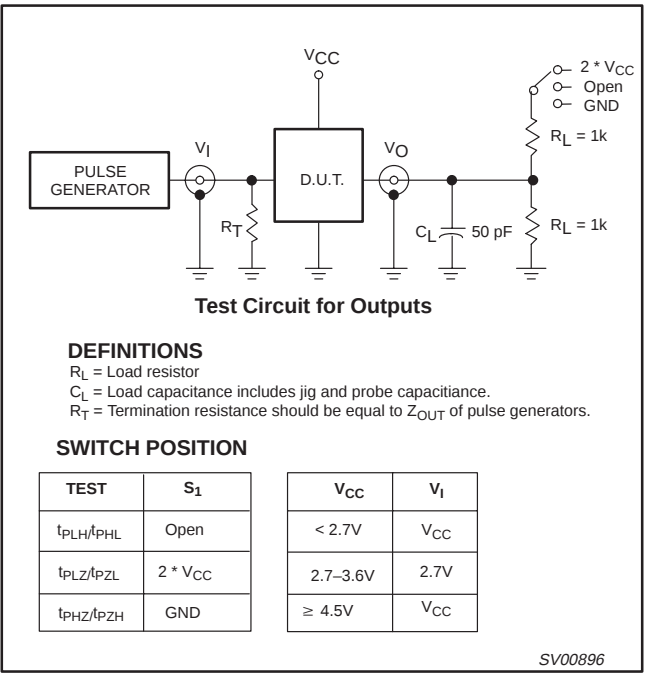


Figure 1. Input (nA, nB) to output (nY) propagation delays.

TEST CIRCUIT



**DEFINITIONS**  
R<sub>L</sub> = Load resistor  
C<sub>L</sub> = Load capacitance includes jig and probe capacitance.  
R<sub>T</sub> = Termination resistance should be equal to Z<sub>OUT</sub> of pulse generators.

SWITCH POSITION

| TEST                               | S <sub>1</sub>      | V <sub>CC</sub> | V <sub>I</sub>  |
|------------------------------------|---------------------|-----------------|-----------------|
| t <sub>PLH</sub> /t <sub>PHL</sub> | Open                | < 2.7V          | V <sub>CC</sub> |
| t <sub>PLZ</sub> /t <sub>PZL</sub> | 2 * V <sub>CC</sub> | 2.7–3.6V        | 2.7V            |
| t <sub>PHZ</sub> /t <sub>PZH</sub> | GND                 | ≥ 4.5V          | V <sub>CC</sub> |

Figure 2. Load circuitry for switching times

## Quad 2-input NAND gate

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## REVISION HISTORY

| Rev | Date     | Description                                                                                                                                                                                                                                                                                                                                    |
|-----|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| _3  | 20030303 | <b>Product data (9397 750 11191). ECN 853-1963 29494 of 07 February 2003. Supersedes data of 1998 Apr 20 (9397 750 04403).</b><br>Modifications:<br><ul style="list-style-type: none"> <li>• Delete DIL, SSOP and TSSOP package ordering and package outlines (discontinued options).</li> <li>• Correct power dissipation formula.</li> </ul> |
| _2  | 19980420 | <b>Product specification (9397 750 04403). ECN 853-1963 19257 of 20 April 1998. Supersedes data of 1997 Mar 28.</b>                                                                                                                                                                                                                            |

## Data sheet status

| Level | Data sheet status <sup>[1]</sup> | Product status <sup>[2] [3]</sup> | Definitions                                                                                                                                                                                                                                                                                    |
|-------|----------------------------------|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| I     | Objective data                   | Development                       | This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.                                                                                                    |
| II    | Preliminary data                 | Qualification                     | This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.             |
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[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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Models

SoC solutions

General description

The 74LV03 is a low-voltage Si-gate CMOS device and is pin and function compatible with 74HC/HCT03.

The 74LV03 provides the 2-input NAND function.

The 74LV03 has open-drain N-transistor outputs, which are not clamped by a diode connected to  $V_{CC}$  . In the OFF-state, i.e., when one input is LOW, the output may be pulled to any voltage between GND and  $V_{Omax}$  . This allows the device to be used as a LOW-to-HIGH or HIGH-to-LOW level shifter. For digital operation and OR-tied output applications, these devices must have a pull-up resistor to establish a logic HIGH level.

Features

- Wide operating voltage: 1.0 V to 5.5 V
- Optimized for Low Voltage applications: 1.0 V to 3.6 V
- Accepts TTL input levels between  $V_{CC} = 2.7$  V and  $V_{CC} = 3.6$  V
- Typical  $V_{OLP}$  (output ground bounce) < 0.8 V @  $V_{CC} = 3.3$  V,  $T_{amb} = 25$  Cel
- Typical  $V_{OHV}$  (output  $V_{OH}$  undershoot) > 2 V @  $V_{CC} = 3.3$  V,  $T_{amb} = 25$  Cel
- Level shifter capability
- Output capability: standard (open drain)
- $I_{CC}$  category: SSI

## Datasheet

| <u>Type number</u> | <u>Title</u>                     | <u>Publication<br/>release date</u> | <u>Datasheet status</u>  | <u>Page<br/>count</u> | <u>File<br/>size<br/>(kB)</u> | <u>Datasheet</u>                                                                                             |
|--------------------|----------------------------------|-------------------------------------|--------------------------|-----------------------|-------------------------------|--------------------------------------------------------------------------------------------------------------|
| 74LV03             | Quad 2-<br>input<br>NAND<br>gate | 3/3/2003                            | Product<br>specification | 7                     | 58                            |  <a href="#">Download</a> |

## Parametrics

| <u>Type<br/>number</u> | <u>Package</u>                  | <u>Description</u>                                                 | <u>Propagation<br/>Delay(ns)</u> | <u>Voltage</u> | <u>No.<br/>of<br/>Pins</u> | <u>Power<br/>Dissipation<br/>Considerations</u> | <u>Logic<br/>Switching<br/>Levels</u> | <u>Output<br/>Drive<br/>Capability</u> |
|------------------------|---------------------------------|--------------------------------------------------------------------|----------------------------------|----------------|----------------------------|-------------------------------------------------|---------------------------------------|----------------------------------------|
| 74LV03D                | <a href="#">SOT108-1</a> (SO14) | Quad 2-<br>Input<br>NAND Gate<br>with Level<br>Shift<br>Capability | 15                               | Low            | 14                         | Low Power or<br>Battery<br>Applications         | TTL                                   | Low                                    |

## Products, packages, availability and ordering

| <u>Type<br/>number</u> | <u>North<br/>American<br/>type<br/>number</u> | <u>Ordering code<br/>(12NC)</u> | <u>Marking/Packing</u><br> <a href="#">IC packing info</a> | <u>Package</u>                     | <u>Device status</u> | <u>Buy online</u>                                                                                                                                                                                      |
|------------------------|-----------------------------------------------|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 74LV03D                | 74LV03D                                       | 9351 758 20112                  | Standard Marking *<br>Tube                                                                                                                    | <a href="#">SOT108-1</a><br>(SO14) | Full production      |  <a href="#">order this</a>  |
|                        | 74LV03D-T                                     | 9351 758 20118                  | Standard Marking *<br>Reel Pack, SMD,<br>13"                                                                                                  | <a href="#">SOT108-1</a><br>(SO14) | Full production      |  <a href="#">order this</a>  |

## Similar products

 [74LV03](#) links to the similar products page containing an overview of products that are similar in function or related to the type number(s) as listed on this page. The similar products page includes products from the same catalog tree(s), relevant selection guides and products from the same functional category.

## ❑ Email/translate this product information

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