

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 nA, nB to nY | $C_L = 15$ pF $V_{CC} = 3.3$ V | 8 | ns |
| C_I | Input capacitance | | 3.5 | pF |
| C_{PD} | Power dissipation capacitance per gate | Notes 1, 2 | 4 | pF |

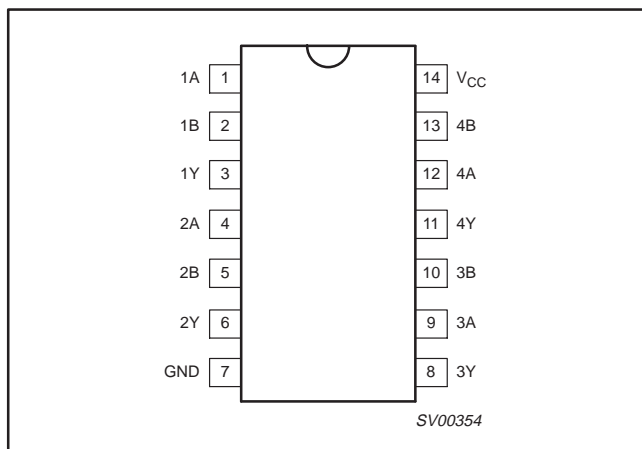
NOTES:

- C_{PD} is used to determine the dynamic power dissipation (P_D in μ 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.
- The condition is $V_I = \text{GND to } V_{CC}$
- 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



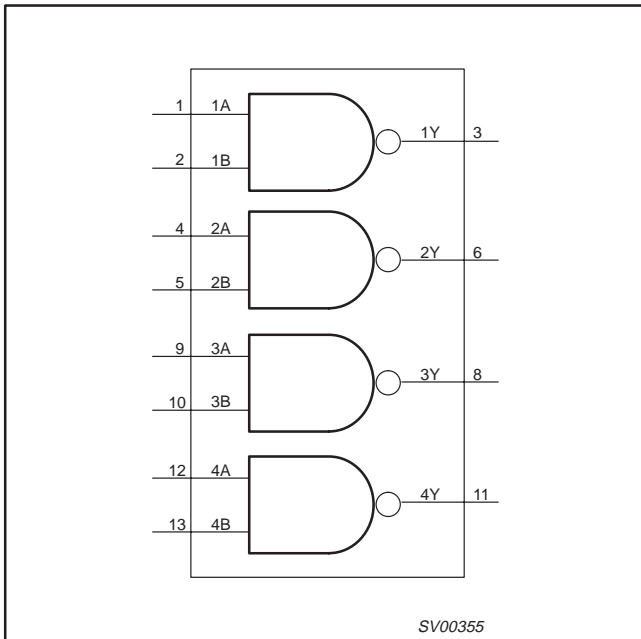
PIN DESCRIPTION

| 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 |

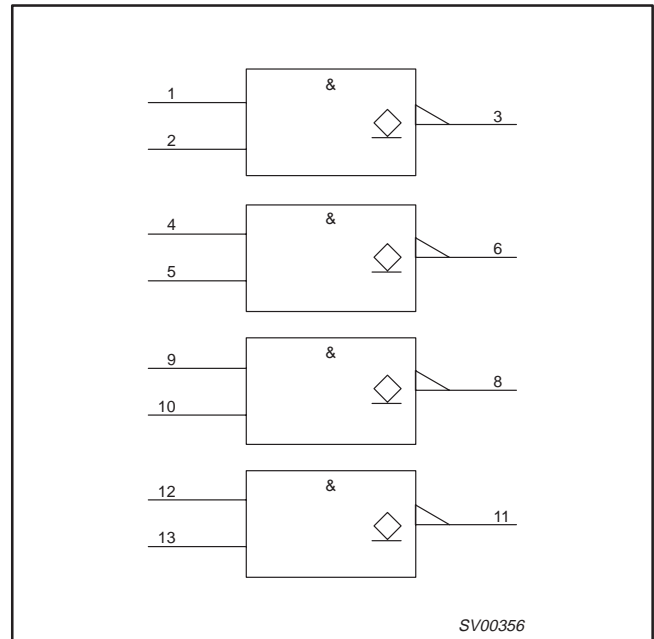
Quad 2-input NAND gate

74LV03

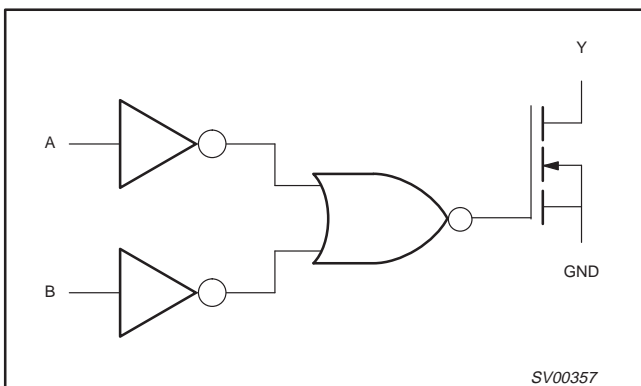
LOGIC SYMBOL



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

Quad 2-input NAND gate

74LV03

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 –40 | | +85 +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^{1, 2}

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 – standard outputs | $-0.5 \text{ V} < V_O < V_{CC} + 0.5 \text{ V}$ | 25 | mA |
| $\pm I_{GND},$ $\pm I_{CC}$ | DC V_{CC} or GND current for types with –standard outputs | | 50 | mA |
| T_{stg} | Storage temperature range | | –65 to +150 | °C |
| P_{TOT} | Power dissipation per package –plastic mini-pack (SO) | for temperature range: –40 °C to +125 °C 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.

Quad 2-input NAND gate

74LV03

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 ¹ | MAX | MIN | MAX | |
| V _{IH} | HIGH level Input voltage | V _{CC} = 1.2 V | 0.9 | | | 0.9 | | V |
| | | V _{CC} = 2.0 V | 1.4 | | | 1.4 | | |
| | | V _{CC} = 2.7 V to 3.6 V | 2.0 | | | 2.0 | | |
| | | V _{CC} = 4.5 V to 5.5 V | 0.7*V _{CC} | | | 0.7*V _{CC} | | |
| V _{IL} | LOW level Input voltage | V _{CC} = 1.2 V | | | 0.3 | | 0.3 | V |
| | | V _{CC} = 2.0 V | | | 0.6 | | 0.6 | |
| | | V _{CC} = 2.7 V to 3.6 V | | | 0.8 | | 0.8 | |
| | | V _{CC} = 4.5 V to 5.5 V | | | 0.3*V _{CC} | | 0.3*V _{CC} | |
| V _{OH} | HIGH level output voltage; all outputs | V _{CC} = 1.2 V; V _I = V _{IH} or V _{IL} ; -I _O = 100 μA | | 1.2 | | | | V |
| | | V _{CC} = 2.0 V; V _I = V _{IH} or V _{IL} ; -I _O = 100 μA | 1.8 | 2.0 | | 1.8 | | |
| | | V _{CC} = 2.7 V; V _I = V _{IH} or V _{IL} ; -I _O = 100 μA | 2.5 | 2.7 | | 2.5 | | |
| | | V _{CC} = 3.0 V; V _I = V _{IH} or V _{IL} ; -I _O = 100 μA | 2.8 | 3.0 | | 2.8 | | |
| | | V _{CC} = 4.5 V; V _I = V _{IH} or V _{IL} ; -I _O = 100 μA | 4.3 | 4.5 | | 4.3 | | |
| V _{OH} | HIGH level output voltage; STANDARD outputs | V _{CC} = 3.0 V; V _I = V _{IH} or V _{IL} ; -I _O = 6 mA | 2.40 | 2.82 | | 2.20 | | V |
| | | V _{CC} = 4.5 V; V _I = V _{IH} or V _{IL} ; -I _O = 12 mA | 3.60 | 4.20 | | 3.50 | | |
| V _{OL} | LOW level output voltage; all outputs | V _{CC} = 1.2 V; V _I = V _{IH} or V _{IL} ; I _O = 100 μA | | 0 | | | | V |
| | | V _{CC} = 2.0 V; V _I = V _{IH} or V _{IL} ; I _O = 100 μA | | 0 | 0.2 | | 0.2 | |
| | | V _{CC} = 2.7 V; V _I = V _{IH} or V _{IL} ; I _O = 100 μA | | 0 | 0.2 | | 0.2 | |
| | | V _{CC} = 3.0 V; V _I = V _{IH} or V _{IL} ; I _O = 100 μA | | 0 | 0.2 | | 0.2 | |
| | | V _{CC} = 4.5 V; V _I = V _{IH} or V _{IL} ; I _O = 100 μA | | 0 | 0.2 | | 0.2 | |
| V _{OL} | LOW level output voltage; STANDARD outputs | V _{CC} = 3.0 V; V _I = V _{IH} or V _{IL} ; I _O = 6 mA | | 0.25 | 0.40 | | 0.50 | V |
| | | V _{CC} = 4.5 V; V _I = V _{IH} or V _{IL} ; I _O = 12 mA | | 0.35 | 0.55 | | 0.65 | |
| I _{oz} | HIGH level output leakage current | V _{CC} = 2.0 V to 3.6 V; V _I = V _{IL} ; V _O = V _{CC} or GND | | | 5.0 | | 10 | μA |
| I _{oz} | HIGH level output leakage current | V _{CC} = 2.0 V to 3.6 V; V _I = V _{IL} ; V _O = 6.0 V ² | | | 10 | | 20 | μA |
| I _I | Input leakage current | V _{CC} = 5.5 V; V _I = V _{CC} or GND | | | 1.0 | | 1.0 | μA |
| I _{CC} | Quiescent supply current; SSI | V _{CC} = 5.5 V; V _I = V _{CC} or GND; I _O = 0 | | | 20.0 | | 40 | μA |
| ΔI _{CC} | Additional quiescent supply current per input | V _{CC} = 2.7 V to 3.6 V; V _I = V _{CC} - 0.6 V | | | 500 | | 850 | μA |

NOTES:

- All typical values are measured at T_{amb} = 25 °C.
- The maximum operating output voltage (V_{O(max)}) is 6.0 V.

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74LV03

AC CHARACTERISTICS FOR 74LV03

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

| SYMBOL | PARAMETER | WAVEFORM | LIMITS -40 to +85 °C | | | LIMITS -40 to +125 °C | | UNIT | |
|------------------------------------|------------------------------------|---------------|-------------------------|-----|------------------|--------------------------|-----|------|-----|
| | | | V _{CC} (V) | MIN | TYP ¹ | MAX | MIN | | MAX |
| t _{PZL} /t _{PLZ} | Propagation delay 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 ² | 16 | - | | 19 |
| | | | 4.5 to 5.5 | - | - ³ | 13 | - | | 16 |

NOTE:

- 1 Unless otherwise stated, all typical values are at T_{amb} = 25 °C.
- 2 Typical value measured at V_{CC} = 3.3 V.
- 3 Typical value measured at V_{CC} = 5.0 V.

AC WAVEFORMS

V_M = 1.5 V at V_{CC} ≥ 2.7 V ≤ 3.6 V
 V_M = 0.5 V * V_{CC} at V_{CC} < 2.7 V and ≥ 4.5 V
 V_{OL} and V_{OH} are the typical output voltage drop that occur with the output load.
 V_X = V_{OL} + 0.3 V at V_{CC} ≥ 2.7 V and ≤ 3.6 V
 V_X = V_{OL} + 0.1 * V_{CC} at V_{CC} < 2.7 V and ≥ 4.5 V



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

TEST CIRCUIT

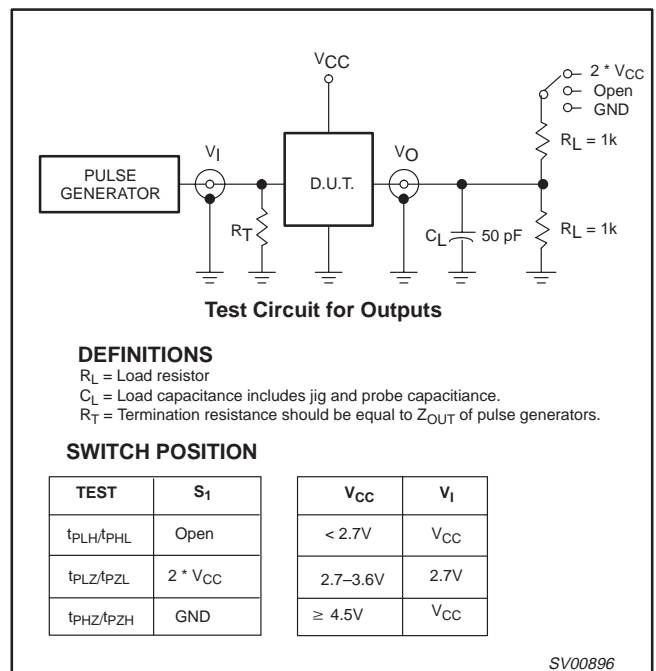


Figure 2. Load circuitry for switching times

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74LV03

REVISION HISTORY

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

Data sheet status

| Level | Data sheet status ^[1] | Product status ^{[2] [3]} | 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. |
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