



# High Speed CMOS Logic – 74HC00

## Quad 2-Input NAND Gates in bare die form

Rev 1.0  
07/02/19

### Description

54HC00 provides x4 independent 2-input NAND gates performing the Boolean function  $Y = \overline{A \cdot B}$  or  $Y = \overline{A} + \overline{B}$ . The device is fabricated using a 2.5µm 5V CMOS process combining high speed LSTTL performance with CMOS low power. Internal circuitry comprises of 3 stages and includes buffered output for high noise immunity and stability. Device inputs are compatible with standard CMOS outputs; with pull-up resistors, they are compatible with LSTTL outputs. All inputs are equipped with protection circuits against static discharge and transient excess voltage.

### Features:

- Output Drive Capability: 10 LSTTL Loads
- Low Input Current: 1µA
- Outputs directly interface CMOS, NMOS and TTL
- Operating Voltage Range: 2V to 6V
- Function compatible with 54LS00
- High Noise Immunity CMOS process.

### Ordering Information

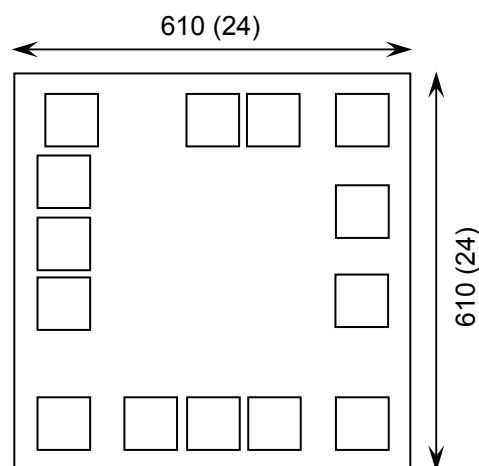
The following part suffixes apply:

- No suffix - MIL-STD-883 /2010B Visual Inspection

For High Reliability versions of this product please see

[54HC00](#)

### Die Dimensions in µm (mils)



### Supply Formats:

- Default – Die in Waffle Pack (400 per tray capacity)
- Sawn Wafer on Tape – On request
- Unsawn Wafer – On request
- Die Thickness <> 350µm(14 Mils) – On request
- Assembled into Ceramic Package – On request

### Mechanical Specification

|                        |                            |            |
|------------------------|----------------------------|------------|
| Die Size (Unsawn)      | 610 x 610<br>24 x 24       | µm<br>mils |
| Minimum Bond Pad Size  | 85 x 85<br>3.35 x 3.35     | µm<br>mils |
| Die Thickness          | 350 (±20)<br>13.78 (±0.79) | µm<br>mils |
| Top Metal Composition  | Al 1%Si 1.1µm              |            |
| Back Metal Composition | N/A – Bare Si              |            |

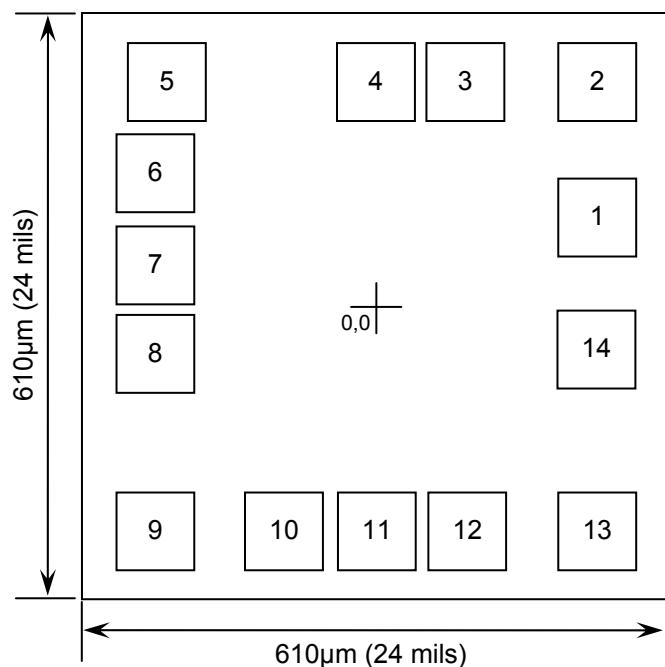




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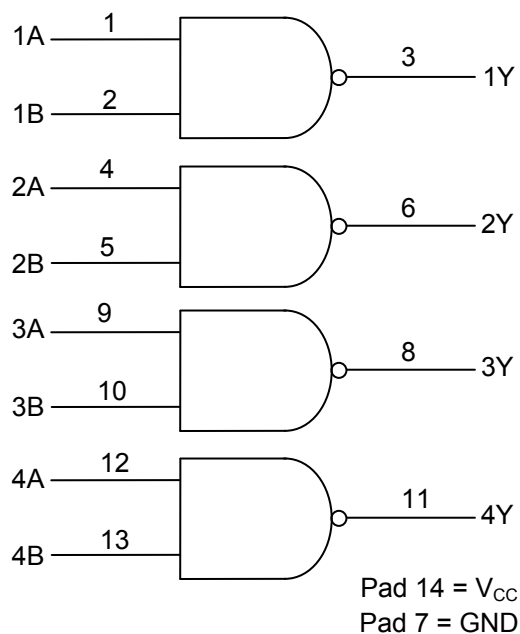
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## Pad Layout and Functions



| PAD                                           | FUNCTION        | COORDINATES (µm) |      |
|-----------------------------------------------|-----------------|------------------|------|
|                                               |                 | X                | Y    |
| 1                                             | 1A              | 230              | 95   |
| 2                                             | 1B              | 230              | 230  |
| 3                                             | 1Y              | 95               | 230  |
| 4                                             | 2A              | 0                | 230  |
| 5                                             | 2B              | -220             | 230  |
| 6                                             | 2Y              | -230             | 140  |
| 7                                             | GND             | -230             | 45   |
| 8                                             | 3Y              | -230             | -52  |
| 9                                             | 3A              | -230             | -230 |
| 10                                            | 3B              | -95              | -230 |
| 11                                            | 4Y              | 0                | -230 |
| 12                                            | 4A              | 95               | -230 |
| 13                                            | 4B              | 230              | -230 |
| 14                                            | V <sub>CC</sub> | 230              | -45  |
| CONNECT CHIP BACK TO V <sub>CC</sub> OR FLOAT |                 |                  |      |

## Logic Diagram



## Function Table

| INPUTS                                                        |   | OUTPUT |
|---------------------------------------------------------------|---|--------|
| A                                                             | B | Y      |
| L                                                             | L | H      |
| L                                                             | H | H      |
| H                                                             | L | H      |
| H                                                             | H | L      |
| H = High level (steady state)<br>L = Low level (steady state) |   |        |





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## Absolute Maximum Ratings<sup>1</sup>

| PARAMETER                                   | SYMBOL    | VALUE                  | UNIT |
|---------------------------------------------|-----------|------------------------|------|
| DC Supply Voltage (Referenced to GND)       | $V_{CC}$  | -0.5 to +7.0           | V    |
| DC Input Voltage (Referenced to GND)        | $V_{IN}$  | -0.5 to $V_{CC} + 0.5$ | V    |
| DC Output Voltage (Referenced to GND)       | $V_{OUT}$ | -0.5 to $V_{CC} + 0.5$ | V    |
| DC Input Current                            | $I_{IN}$  | $\pm 20$               | mA   |
| DC Output Current, per pad                  | $I_{OUT}$ | $\pm 25$               | mA   |
| DC Supply Current, $V_{CC}$ or GND, per pad | $I_{CC}$  | $\pm 50$               | mA   |
| Power Dissipation in Still Air <sup>2</sup> | $P_D$     | 750                    | mW   |
| Storage Temperature Range                   | $T_{STG}$ | -65 to 150             | °C   |

1. Operation above the absolute maximum rating may cause device failure. Operation at the absolute maximum ratings, for extended periods, may reduce device reliability. 2. Measured in plastic DIP package, results in die form are dependent on die attach and assembly method.

## Recommended Operating Conditions<sup>3</sup> (Voltages referenced to GND)

| PARAMETER                   | SYMBOL                             |                        | MIN | MAX             | UNITS |
|-----------------------------|------------------------------------|------------------------|-----|-----------------|-------|
| Supply Voltage              | V <sub>CC</sub>                    |                        | 2   | 6               | V     |
| DC Input or Output Voltage  | V <sub>IN</sub> , V <sub>OUT</sub> |                        | 0   | V <sub>CC</sub> | V     |
| Operating Temperature Range | T <sub>J</sub>                     |                        | 0   | +85             | °C    |
| Input Rise or Fall Times    | t <sub>r</sub> , t <sub>f</sub>    | V <sub>CC</sub> = 2V   | 0   | 1000            | ns    |
|                             |                                    | V <sub>CC</sub> = 4.5V | 0   | 500             |       |
|                             |                                    | V <sub>CC</sub> = 6.0V | 0   | 400             |       |

3. This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation,  $V_{IN}$  and  $V_{OUT}$  should be constrained to the range  $GND \leq (V_{IN} \text{ or } V_{OUT}) \leq V_{CC}$ . Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or  $V_{CC}$ ). Unused outputs must be left open.

## DC Electrical Characteristics (Voltages Referenced to GND)

| PARAMETER                        | SYMBOL   | $V_{CC}$ | CONDITIONS                                                             | LIMITS |      |                         | UNITS |
|----------------------------------|----------|----------|------------------------------------------------------------------------|--------|------|-------------------------|-------|
|                                  |          |          |                                                                        | 25°C   | 85°C | FULL RANGE <sup>4</sup> |       |
| Minimum High-Level Input Voltage | $V_{IH}$ | 2.0V     | $V_{OUT} = 0.1V \text{ or } V_{CC} - 0.1V$<br>$ I_{OUT}  \leq 20\mu A$ | 1.5    | 1.5  | 1.5                     | V     |
|                                  |          | 3.0V     |                                                                        | 2.1    | 2.1  | 2.1                     |       |
|                                  |          | 4.5V     |                                                                        | 3.15   | 3.15 | 3.15                    |       |
|                                  |          | 6.0V     |                                                                        | 4.2    | 4.2  | 4.2                     |       |
| Maximum Low-Level Input Voltage  | $V_{IL}$ | 2.0V     | $V_{OUT} = 0.1V \text{ or } V_{CC} - 0.1V$<br>$ I_{OUT}  \leq 20\mu A$ | 0.5    | 0.5  | 0.5                     | V     |
|                                  |          | 3.0V     |                                                                        | 0.9    | 0.9  | 0.9                     |       |
|                                  |          | 4.5V     |                                                                        | 1.35   | 1.35 | 1.35                    |       |
|                                  |          | 6.0V     |                                                                        | 1.8    | 1.8  | 1.8                     |       |

4.  $0^\circ C \leq T_J \leq +85^\circ C$





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## DC Electrical Characteristics Continued (Voltages Referenced to GND)

| PARAMETER                                | SYMBOL          | V <sub>CC</sub> | CONDITIONS                                                                          | LIMITS |      |                         | UNITS |
|------------------------------------------|-----------------|-----------------|-------------------------------------------------------------------------------------|--------|------|-------------------------|-------|
|                                          |                 |                 |                                                                                     | 25°C   | 85°C | FULL RANGE <sup>4</sup> |       |
| Minimum High-Level Output Voltage        | V <sub>OH</sub> | 2.0V            | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br> I <sub>OUT</sub>   ≤ 20μA  | 1.9    | 1.9  | 1.9                     | V     |
|                                          |                 | 4.5V            |                                                                                     | 4.4    | 4.4  | 4.4                     |       |
|                                          |                 | 6.0V            |                                                                                     | 5.9    | 5.9  | 5.9                     |       |
|                                          |                 | 3.0V            | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br> I <sub>OUT</sub>   ≤ 2.4mA | 2.48   | 2.34 | 2.34                    | V     |
|                                          |                 | 4.5V            |                                                                                     | 3.98   | 3.84 | 3.84                    |       |
|                                          |                 | 6.0V            |                                                                                     | 5.48   | 5.34 | 5.34                    |       |
| Maximum Low-Level Output Voltage         | V <sub>OL</sub> | 2.0V            | V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IL</sub><br> I <sub>OUT</sub>   ≤ 20μA  | 0.1    | 0.1  | 0.1                     | V     |
|                                          |                 | 4.5V            |                                                                                     | 0.1    | 0.1  | 0.1                     |       |
|                                          |                 | 6.0V            |                                                                                     | 0.1    | 0.1  | 0.1                     |       |
|                                          |                 | 3.0V            | V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IL</sub><br> I <sub>OUT</sub>   ≤ 2.4mA | 0.26   | 0.33 | 0.33                    | V     |
|                                          |                 | 4.5V            |                                                                                     | 0.26   | 0.33 | 0.33                    |       |
|                                          |                 | 6.0V            |                                                                                     | 0.26   | 0.33 | 0.33                    |       |
| Maximum Input Leakage Current            | I <sub>IN</sub> | 6.0V            | V <sub>IN</sub> = V <sub>CC</sub> or GND                                            | ±0.1   | ±1.0 | ±1.0                    | μA    |
| Maximum Quiescent Supply Leakage Current | I <sub>CC</sub> | 6.0V            | V <sub>IN</sub> = V <sub>CC</sub> or GND<br>I <sub>OUT</sub> = 0μA                  | 1      | 10   | 10                      | μA    |

## AC Electrical Characteristics<sup>5</sup>

| PARAMETER                                                        | SYMBOL                              | V <sub>CC</sub> | CONDITIONS                                                      | LIMITS |      |                         | UNITS |
|------------------------------------------------------------------|-------------------------------------|-----------------|-----------------------------------------------------------------|--------|------|-------------------------|-------|
|                                                                  |                                     |                 |                                                                 | 25°C   | 85°C | FULL RANGE <sup>4</sup> |       |
| Maximum Propagation Delay, Input A or B to Output Y (Figure 1,2) | t <sub>PLH</sub> , t <sub>PHL</sub> | 2.0V            | C <sub>L</sub> = 50pF,<br>t <sub>r</sub> = t <sub>f</sub> = 6ns | 75     | 95   | 95                      | ns    |
|                                                                  |                                     | 3.0V            |                                                                 | 30     | 40   | 40                      |       |
|                                                                  |                                     | 4.5V            |                                                                 | 15     | 19   | 19                      |       |
|                                                                  |                                     | 6.0V            |                                                                 | 13     | 16   | 16                      |       |
| Maximum Output Rise and Fall Time, Any Output (Figure 1,2)       | t <sub>TLH</sub> , t <sub>THL</sub> | 2.0V            | C <sub>L</sub> = 50pF,<br>t <sub>r</sub> = t <sub>f</sub> = 6ns | 75     | 95   | 95                      | ns    |
|                                                                  |                                     | 3.0V            |                                                                 | 27     | 32   | 32                      |       |
|                                                                  |                                     | 4.5V            |                                                                 | 15     | 19   | 19                      |       |
|                                                                  |                                     | 6.0V            |                                                                 | 13     | 16   | 16                      |       |

5. Not production tested in die form, characterized by chip design and tested in package.





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## AC Electrical Characteristics Continued<sup>5</sup>

| PARAMETER                                           | SYMBOL          | V <sub>CC</sub> | CONDITIONS                                      | LIMITS  |      |                         | UNITS |
|-----------------------------------------------------|-----------------|-----------------|-------------------------------------------------|---------|------|-------------------------|-------|
|                                                     |                 |                 |                                                 | 25°C    | 85°C | FULL RANGE <sup>4</sup> |       |
| Maximum Input Capacitance                           | C <sub>IN</sub> | -               | -                                               | 10      | 10   | 10                      | pF    |
| Power Dissipation Capacitance Per Gate <sup>6</sup> | C <sub>PD</sub> | -               | T <sub>A</sub> = 25°C,<br>V <sub>CC</sub> =5.0V | TYPICAL |      |                         | pF    |
|                                                     |                 |                 |                                                 | 22      |      |                         |       |

6. Used to determine the no-load dynamic power consumption:  $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$ .

## Switching Waveform

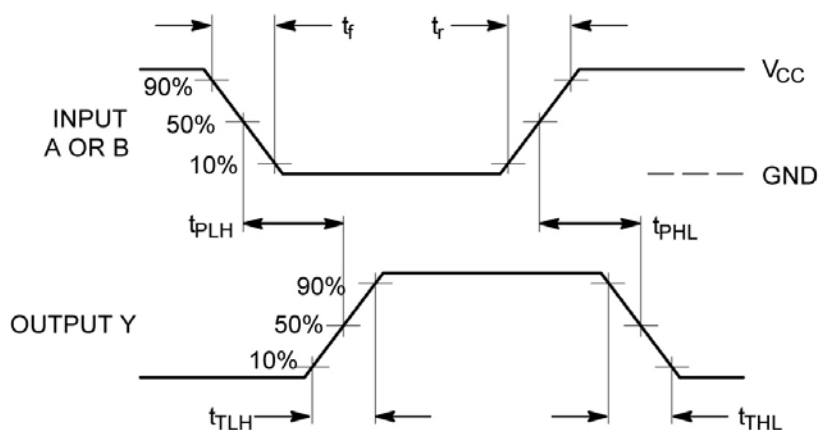
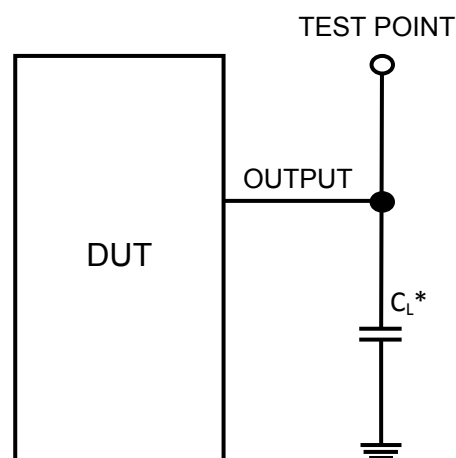


Figure 1 – Propagation Delay & Output Transition Time

## Test Circuit



\* Includes all probe and jig capacitance

Figure 2

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