

## TC74HC20AP, TC74HC20AF

### Dual 4-Input NAND Gate

The TC74HC20A is a high speed CMOS 4-INPUT NAND GATE fabricated with silicon gate C<sup>2</sup>MOS technology.

It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

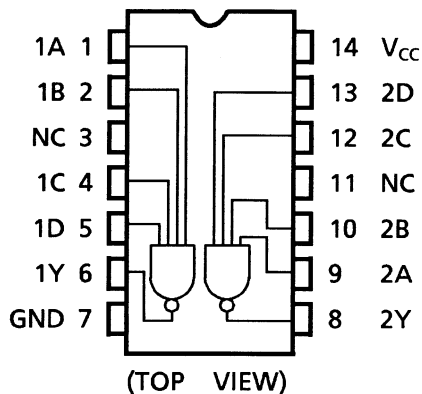
The internal circuit is composed of 3 stages including buffer output, which provide high noise immunity and stable output.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

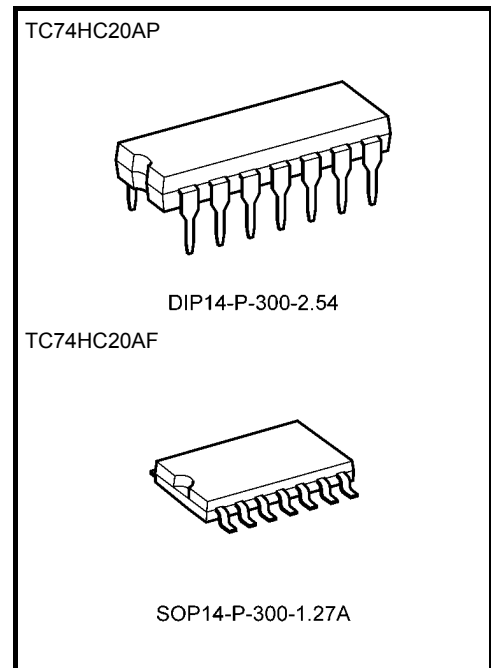
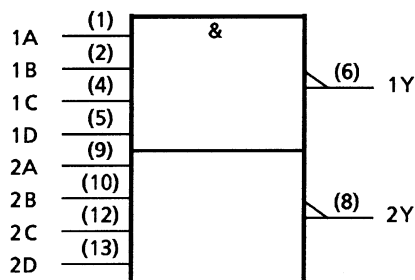
### Features

- High speed:  $t_{pd} = 8 \text{ ns (typ.)}$  at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 1 \mu\text{A (max)}$  at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (min)}$
- Output drive capability: 10 LSTTL loads
- Symmetrical output impedance:  $|I_{OH}| = I_{OL} = 4 \text{ mA (min)}$
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $V_{CC} \text{ (opr)} = 2 \text{ to } 6 \text{ V}$
- Pin and function compatible with 74LS20

### Pin Assignment



### IEC Logic Symbol



### Weight

|                   |                 |
|-------------------|-----------------|
| DIP14-P-300-2.54  | : 0.96 g (typ.) |
| SOP14-P-300-1.27A | : 0.18 g (typ.) |

## Truth Table

| A | B | C | D | Y |
|---|---|---|---|---|
| L | X | X | X | H |
| X | L | X | X | H |
| X | X | L | X | H |
| X | X | X | L | H |
| H | H | H | H | L |

X: Don't care

## Absolute Maximum Ratings (Note 1)

| Characteristics             | Symbol    | Rating                       | Unit |
|-----------------------------|-----------|------------------------------|------|
| Supply voltage range        | $V_{CC}$  | -0.5 to 7                    | V    |
| DC input voltage            | $V_{IN}$  | -0.5 to $V_{CC} + 0.5$       | V    |
| DC output voltage           | $V_{OUT}$ | -0.5 to $V_{CC} + 0.5$       | V    |
| Input diode current         | $I_{IK}$  | $\pm 20$                     | mA   |
| Output diode current        | $I_{OK}$  | $\pm 20$                     | mA   |
| DC output current           | $I_{OUT}$ | $\pm 25$                     | mA   |
| DC $V_{CC}$ /ground current | $I_{CC}$  | $\pm 50$                     | mA   |
| Power dissipation           | $P_D$     | 500 (DIP) (Note 2)/180 (SOP) | mW   |
| Storage temperature         | $T_{stg}$ | -65 to 150                   | °C   |

Note 1: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 2: 500 mW in the range of  $T_a = -40$  to  $65^\circ\text{C}$ . From  $T_a = 65$  to  $85^\circ\text{C}$  a derating factor of  $-10\text{ mW}/^\circ\text{C}$  shall be applied until 300 mW.

## Operating Ranges (Note)

| Characteristics          | Symbol     | Rating                                                                                                                | Unit |
|--------------------------|------------|-----------------------------------------------------------------------------------------------------------------------|------|
| Supply voltage           | $V_{CC}$   | 2 to 6                                                                                                                | V    |
| Input voltage            | $V_{IN}$   | 0 to $V_{CC}$                                                                                                         | V    |
| Output voltage           | $V_{OUT}$  | 0 to $V_{CC}$                                                                                                         | V    |
| Operating temperature    | $T_{opr}$  | -40 to 85                                                                                                             | °C   |
| Input rise and fall time | $t_r, t_f$ | 0 to 1000 ( $V_{CC} = 2.0\text{ V}$ )<br>0 to 500 ( $V_{CC} = 4.5\text{ V}$ )<br>0 to 400 ( $V_{CC} = 6.0\text{ V}$ ) | ns   |

Note: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs must be tied to either  $V_{CC}$  or GND.

## Electrical Characteristics

## DC Characteristics

| Characteristics           | Symbol          | Test Condition                                       |                           | Ta = 25°C           |                      |                   | Ta = -40 to 85°C     |                      | Unit |
|---------------------------|-----------------|------------------------------------------------------|---------------------------|---------------------|----------------------|-------------------|----------------------|----------------------|------|
|                           |                 |                                                      |                           | V <sub>CC</sub> (V) | Min                  | Typ.              | Max                  | Min                  | Max  |
| High-level input voltage  | V <sub>IH</sub> | —                                                    |                           | 2.0<br>4.5<br>6.0   | 1.50<br>3.15<br>4.20 | —<br>—<br>—       | —<br>—<br>—          | 1.50<br>3.15<br>4.20 | V    |
| Low-level input voltage   | V <sub>IL</sub> | —                                                    |                           | 2.0<br>4.5<br>6.0   | —<br>—<br>—          | —<br>—<br>—       | 0.50<br>1.35<br>1.80 | —<br>—<br>—          | V    |
| High-level output voltage | V <sub>OH</sub> | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> | I <sub>OH</sub> = -20 µA  | 2.0<br>4.5<br>6.0   | 1.9<br>4.4<br>5.9    | 2.0<br>4.5<br>6.0 | —<br>—<br>—          | 1.9<br>4.4<br>5.9    | V    |
|                           |                 |                                                      | I <sub>OH</sub> = -4 mA   | 4.5                 | 4.18                 | 4.31              | —                    | 4.13                 |      |
|                           |                 |                                                      | I <sub>OH</sub> = -5.2 mA | 6.0                 | 5.68                 | 5.80              | —                    | 5.63                 |      |
|                           |                 |                                                      |                           |                     |                      |                   |                      |                      |      |
| Low-level output voltage  | V <sub>OL</sub> | V <sub>IN</sub> = V <sub>IH</sub>                    | I <sub>OL</sub> = 20 µA   | 2.0<br>4.5<br>6.0   | —<br>—<br>—          | 0.0<br>0.0<br>0.0 | 0.1<br>0.1<br>0.1    | —<br>—<br>—          | V    |
|                           |                 |                                                      | I <sub>OL</sub> = 4 mA    | 4.5                 | —                    | 0.17              | 0.26                 | —                    |      |
|                           |                 |                                                      | I <sub>OL</sub> = 5.2 mA  | 6.0                 | —                    | 0.18              | 0.26                 | —                    |      |
|                           |                 |                                                      |                           |                     |                      |                   |                      |                      |      |
| Input leakage current     | I <sub>IN</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND             |                           | 6.0                 | —                    | —                 | ±0.1                 | —                    | µA   |
| Quiescent supply current  | I <sub>CC</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND             |                           | 6.0                 | —                    | —                 | 1.0                  | —                    | µA   |

AC Characteristics (C<sub>L</sub> = 15 pF, V<sub>CC</sub> = 5 V, Ta = 25°C, input: t<sub>r</sub> = t<sub>f</sub> = 6 ns)

| Characteristics        | Symbol           | Test Condition | Min | Typ. | Max | Unit |
|------------------------|------------------|----------------|-----|------|-----|------|
| Output transition time | t <sub>TLH</sub> | —              | —   | 5    | 8   | ns   |
|                        | t <sub>THL</sub> |                |     |      |     |      |
| Propagation delay time | t <sub>PLH</sub> | —              | —   | 8    | 15  | ns   |
|                        | t <sub>pHL</sub> |                |     |      |     |      |

**AC Characteristics ( $C_L = 50 \text{ pF}$ , input:  $t_r = t_f = 6 \text{ ns}$ )**

| Characteristics               | Symbol                    | Test Condition | Ta = 25°C           |     |      | Ta = -40 to 85°C |     | Unit |
|-------------------------------|---------------------------|----------------|---------------------|-----|------|------------------|-----|------|
|                               |                           |                | V <sub>CC</sub> (V) | Min | Typ. | Max              | Min | Max  |
| Output transition time        | t <sub>TLH</sub>          | —              | 2.0                 | —   | 30   | 75               | —   | 95   |
|                               | t <sub>THL</sub>          |                | 4.5                 | —   | 8    | 15               | —   | 19   |
|                               |                           |                | 6.0                 | —   | 7    | 13               | —   | 16   |
| Propagation delay time        | t <sub>pLH</sub>          | —              | 2.0                 | —   | 33   | 90               | —   | 115  |
|                               | t <sub>pHL</sub>          |                | 4.5                 | —   | 11   | 18               | —   | 23   |
|                               |                           |                | 6.0                 | —   | 9    | 15               | —   | 20   |
| Input capacitance             | C <sub>IN</sub>           | —              | —                   | —   | 5    | 10               | —   | 10   |
| Power dissipation capacitance | C <sub>PD</sub><br>(Note) | —              | —                   | —   | 29   | —                | —   | —    |

Note: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

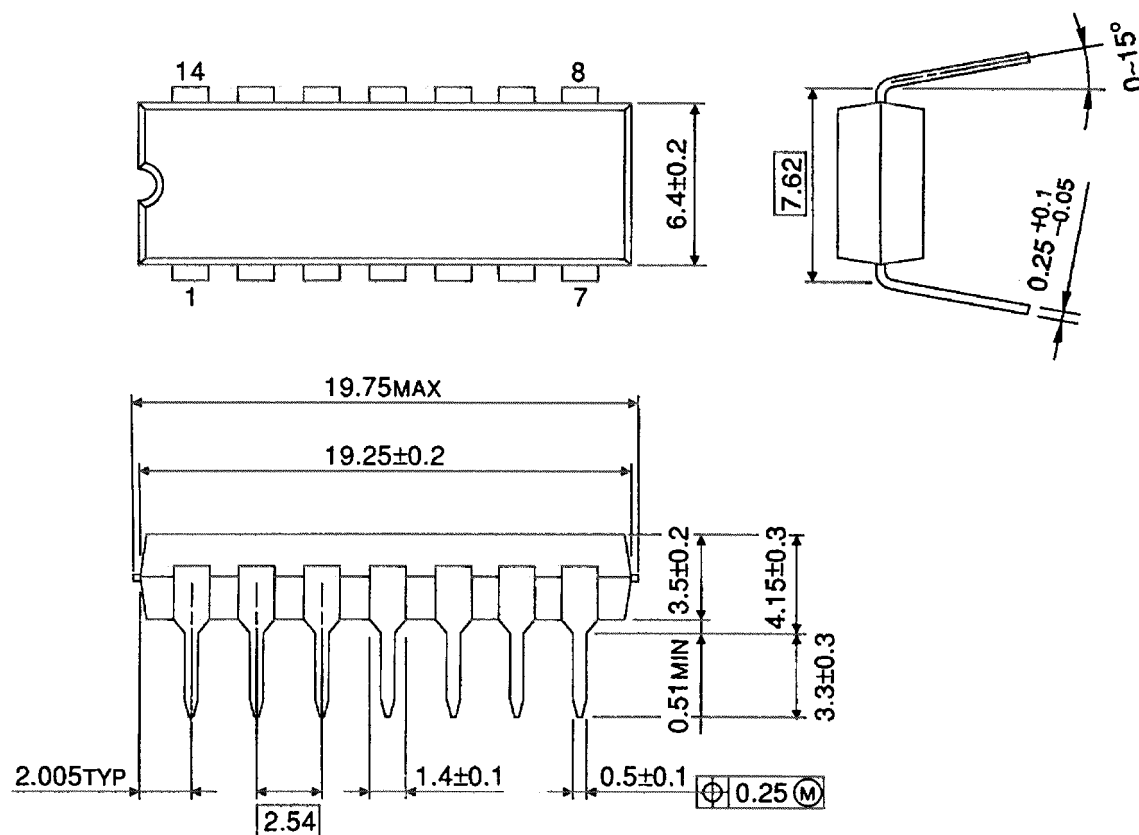
Average operating current can be obtained by the equation:

$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/2 \text{ (per gate)}$$

## Package Dimensions

DIP14-P-300-2.54

Unit : mm

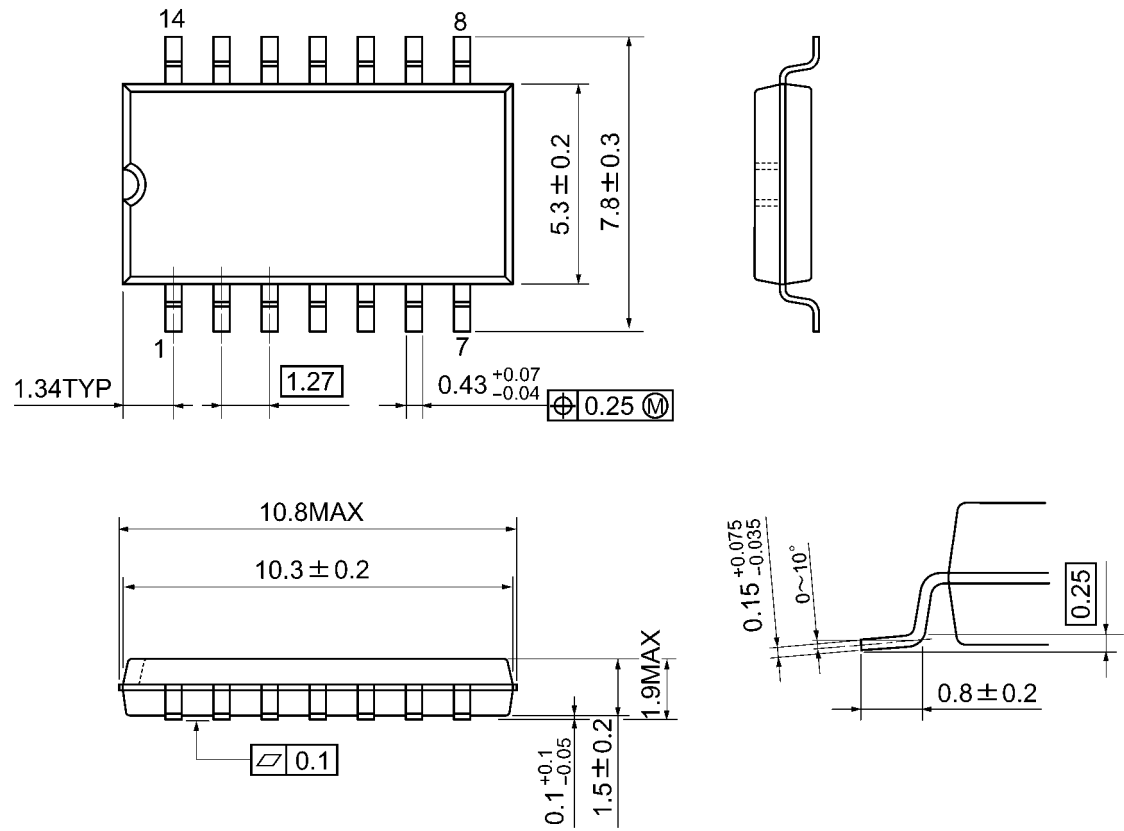


Weight: 0.96 g (typ.)

Package Dimensions

SOP14-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

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