

## TC74HC03AP, TC74HC03AF, TC74HC03AFN

### Quad 2-Input NAND Gate (open drain)

The TC74HC03A is a high speed CMOS 2-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.

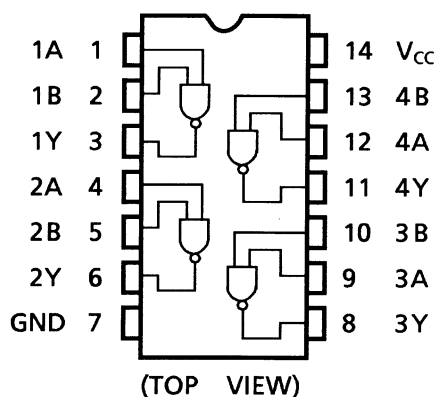
Pin configuration and function are the same as the TC74HC00A. But the TC74HC03A has, as its outputs, high performance MOS N-channel transistors. (open-drain outputs) This device can, therefore, with a suitable pull-up resistors, be used in wired-AND, LED driver and other application.

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

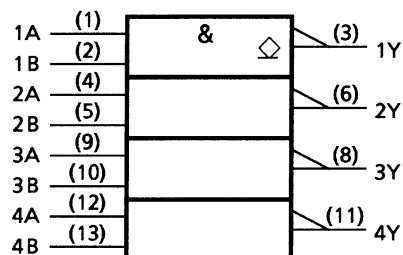
### Features

- High speed:  $t_{pz} = 5 \text{ ns}$  (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:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)
- Output drive capability: 10 LSTTL loads
- Wide operating voltage range:  $V_{CC} \text{ (opr)} = 2 \sim 6 \text{ V}$
- Open drain structure
- Pin and function compatible with 74LS03

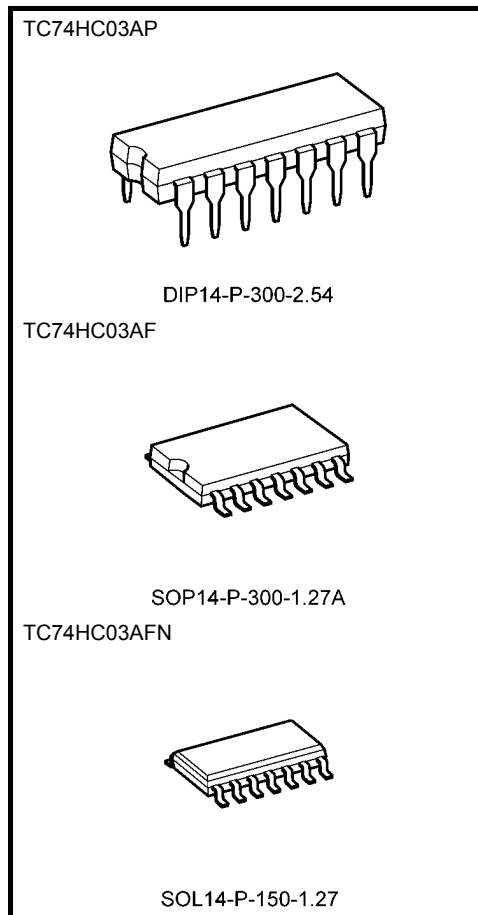
### Pin Assignment



### IEC Logic Symbol



Note: xxxFN (JEDEC SOP) is not available in Japan.



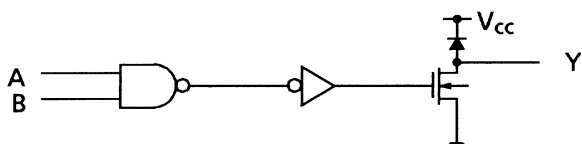
|                   |                 |
|-------------------|-----------------|
| Weight            |                 |
| DIP14-P-300-2.54  | : 0.96 g (typ.) |
| SOP14-P-300-1.27A | : 0.18 g (typ.) |
| SOL14-P-150-1.27  | : 0.12 g (typ.) |

## Truth Table

| A | B | Y |
|---|---|---|
| L | L | Z |
| L | H | Z |
| H | L | Z |
| H | H | L |

Z: High impedance

## System Diagram (per gate)



## Absolute Maximum Ratings (Note 1)

| Characteristics             | Symbol    | Rating                       | Unit |
|-----------------------------|-----------|------------------------------|------|
| Supply voltage range        | $V_{CC}$  | -0.5~7                       | V    |
| DC input voltage            | $V_{IN}$  | -0.5~ $V_{CC} + 0.5$         | V    |
| DC output voltage           | $V_{OUT}$ | -0.5~ $V_{CC} + 0.5$         | V    |
| Input diode current         | $I_{IK}$  | ±20                          | mA   |
| Output diode current        | $I_{OK}$  | ±20                          | mA   |
| DC output current           | $I_{OUT}$ | +25                          | mA   |
| DC $V_{CC}$ /ground current | $I_{CC}$  | ±50                          | mA   |
| Power dissipation           | $P_D$     | 500 (DIP) (Note 2)/180 (SOP) | mW   |
| Storage temperature         | $T_{stg}$ | -65~150                      | °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  $T_a = -40^{\circ}\text{C} \sim 65^{\circ}\text{C}$ . From  $T_a = 65^{\circ}\text{C}$  to  $85^{\circ}\text{C}$  a derating factor of -10 mW/°C shall be applied until 300 mW.

## Operating Ranges (Note)

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

Note: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs must be tied to either VCC or GND.

**Electrical Characteristics**
**DC Characteristics**

| Characteristics          | Symbol          | Test Condition                                             |                          | V <sub>CC</sub><br>(V)   | Ta = 25°C                                                                                  |                   |                      | Ta = -40~85°C        |                      | Unit |
|--------------------------|-----------------|------------------------------------------------------------|--------------------------|--------------------------|--------------------------------------------------------------------------------------------|-------------------|----------------------|----------------------|----------------------|------|
|                          |                 |                                                            |                          |                          | 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 | —<br>—<br>—          | 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>—          | 0.50<br>1.35<br>1.80 | V    |
| Low-level output voltage | V <sub>OL</sub> | V <sub>IN</sub><br>= V <sub>IH</sub> or<br>V <sub>IL</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>—          | 0.1<br>0.1<br>0.1    | V    |
|                          |                 |                                                            | I <sub>OL</sub> = 4 mA   | 4.5<br>6.0               | —<br>—                                                                                     | 0.17<br>0.18      | 0.26<br>0.26         | —<br>—               | 0.33<br>0.33         |      |
|                          |                 |                                                            |                          | I <sub>OL</sub> = 5.2 mA | 4.5<br>6.0                                                                                 | —<br>—            | 0.17<br>0.18         | 0.26<br>0.26         | —<br>—               |      |
|                          |                 |                                                            | Output off-state current | I <sub>OZ</sub>          | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>OUT</sub> = V <sub>CC</sub> |                   | 6.0                  | —                    | —                    |      |
| Input leakage current    | I <sub>IN</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND                   |                          | 6.0                      | —                                                                                          | —                 | ±0.1                 | —                    | ±1.0                 | μA   |
| Quiescent supply current | I <sub>CC</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND                   |                          | 6.0                      | —                                                                                          | —                 | 1.0                  | —                    | 10.0                 | 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>THL</sub> | —                     | —   | 4    | 8   | ns   |
| Propagation delay time | t <sub>pLZ</sub> | R <sub>L</sub> = 1 kΩ | —   | 5    | 12  | ns   |
| Propagation delay time | t <sub>pZL</sub> | R <sub>L</sub> = 1 kΩ | —   | 5    | 12  | ns   |

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

| Characteristics               | Symbol             | Test Condition            | $V_{CC}$<br>(V) | $T_a = 25^\circ\text{C}$ |      |     | $T_a = -40\sim 85^\circ\text{C}$ |     | Unit |
|-------------------------------|--------------------|---------------------------|-----------------|--------------------------|------|-----|----------------------------------|-----|------|
|                               |                    |                           |                 | Min                      | Typ. | Max | Min                              | Max |      |
| Output transition time        | $t_{THL}$          | —                         | 2.0             | —                        | 30   | 75  | —                                | 95  | ns   |
|                               |                    |                           | 4.5             | —                        | 8    | 15  | —                                | 19  |      |
|                               |                    |                           | 6.0             | —                        | 7    | 13  | —                                | 16  |      |
| Propagation delay time        | $t_{pLZ}$          | $R_L = 1 \text{ k}\Omega$ | 2.0             | —                        | 20   | 75  | —                                | 95  | ns   |
|                               |                    |                           | 4.5             | —                        | 10   | 15  | —                                | 19  |      |
|                               |                    |                           | 6.0             | —                        | 9    | 13  | —                                | 16  |      |
| Propagation delay time        | $t_{pZL}$          | $R_L = 1 \text{ k}\Omega$ | 2.0             | —                        | 24   | 75  | —                                | 95  | ns   |
|                               |                    |                           | 4.5             | —                        | 8    | 15  | —                                | 19  |      |
|                               |                    |                           | 6.0             | —                        | 7    | 13  | —                                | 16  |      |
| Input capacitance             | $C_{IN}$           | —                         | —               | —                        | 5    | 10  | —                                | 10  | pF   |
| Output capacitance            | $C_{OUT}$          | —                         | —               | —                        | 3    | —   | —                                | —   | pF   |
| Power dissipation capacitance | $C_{PD}$<br>(Note) | —                         | —               | —                        | 5    | —   | —                                | —   | pF   |

Note:  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

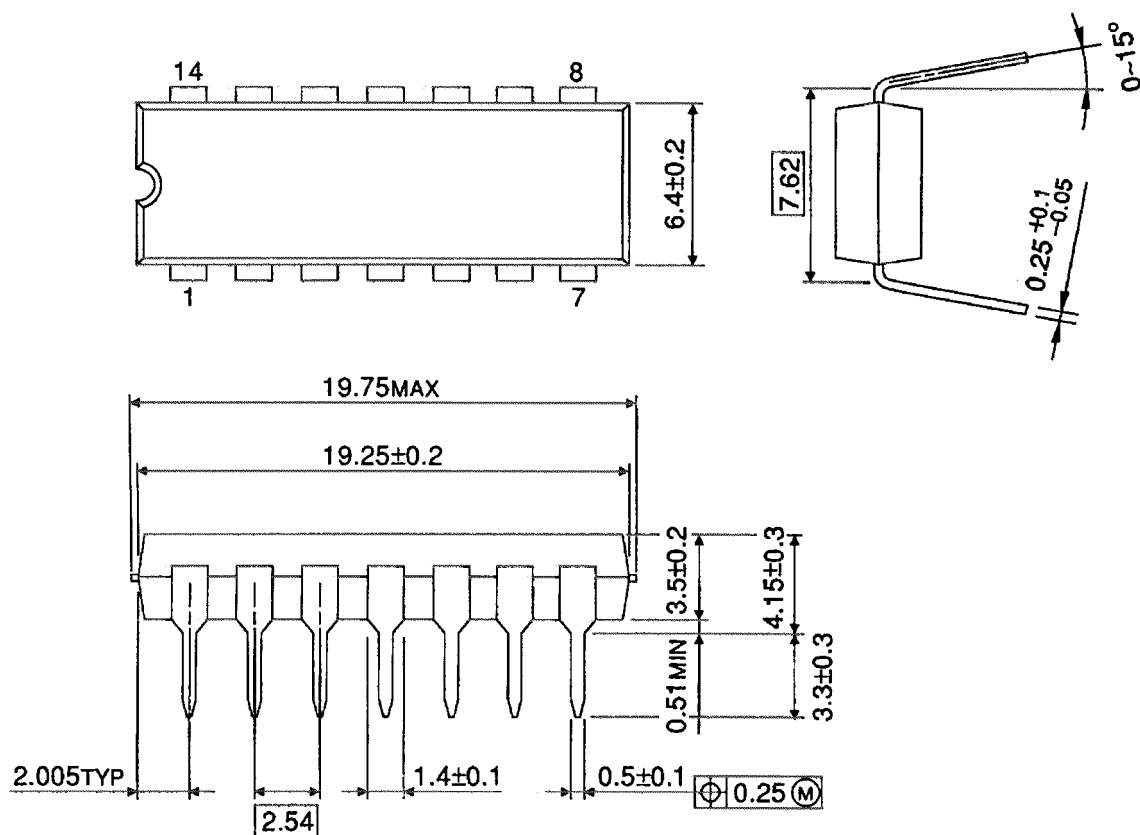
Average operating current can be obtained by the equation:

$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/4 \text{ (per gate)}$$

## Package Dimensions

DIP14-P-300-2.54

Unit : mm

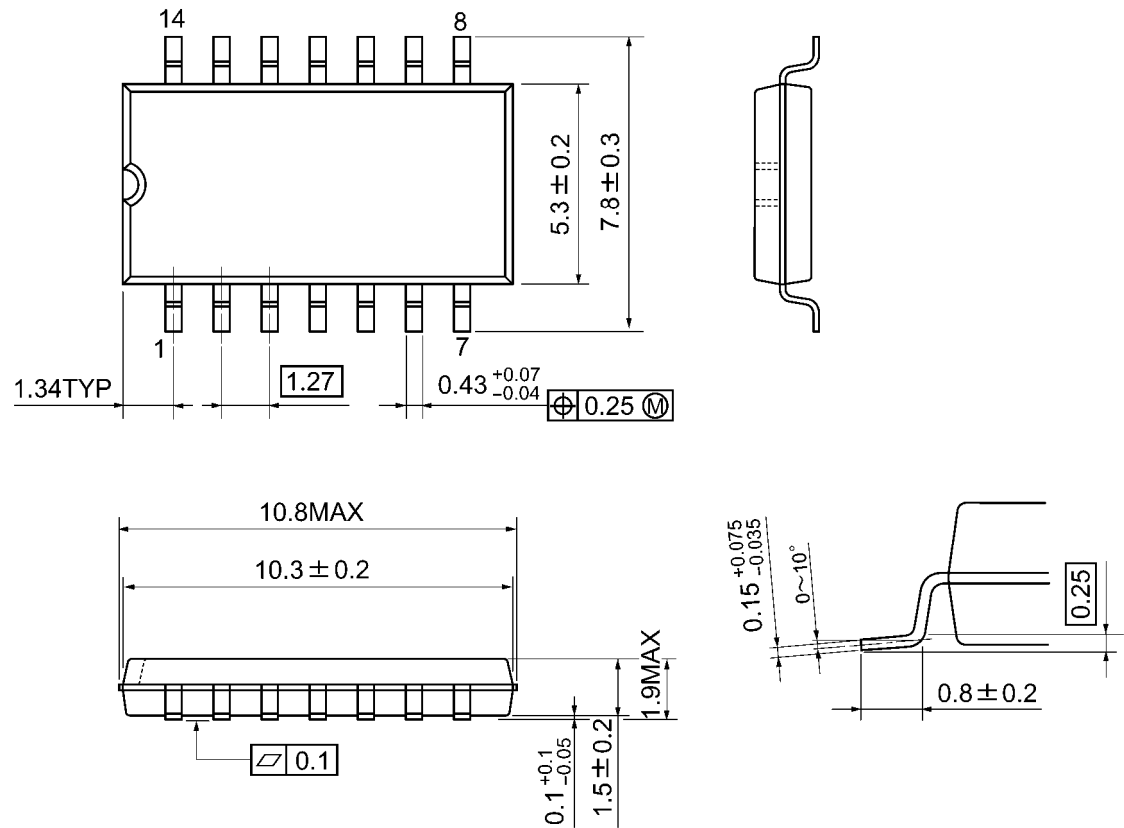


Weight: 0.96 g (typ.)

Package Dimensions

SOP14-P-300-1.27A

Unit: mm

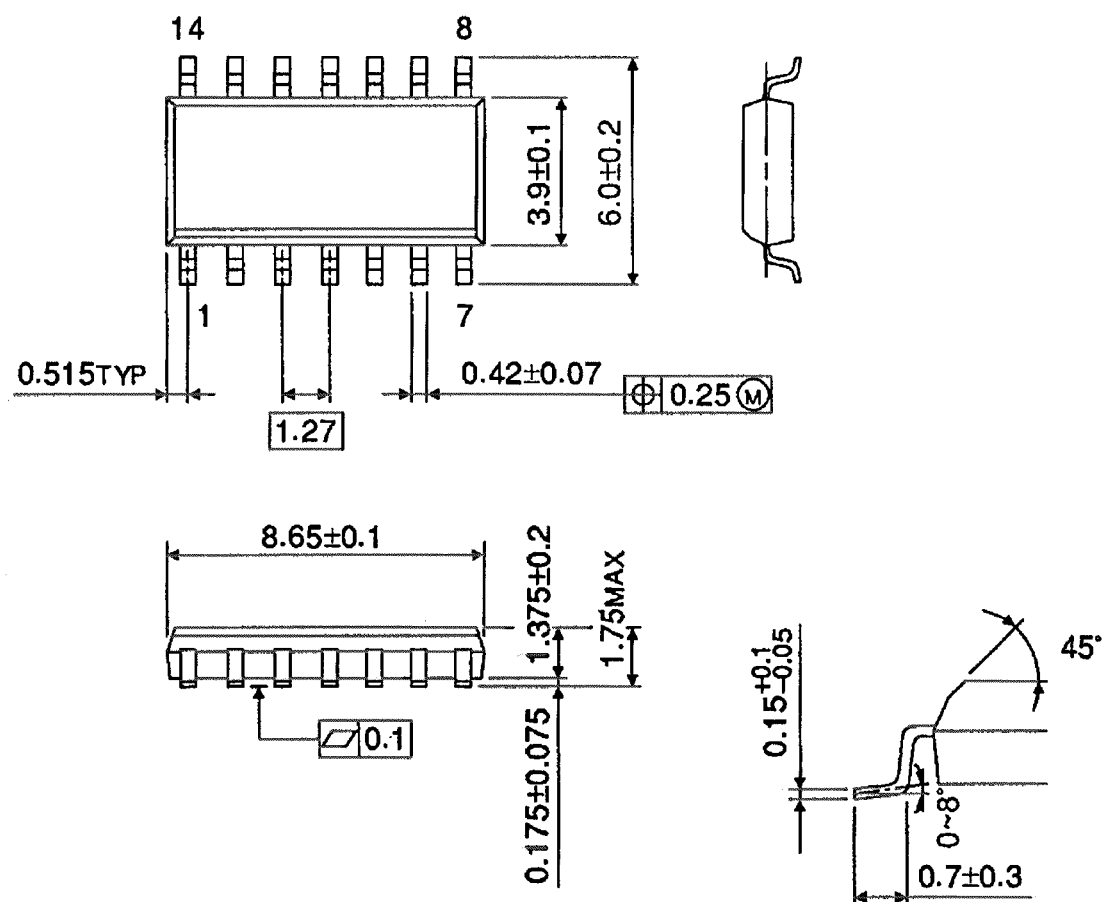


Weight: 0.18 g (typ.)

## Package Dimensions (Note)

SOL14-P-150-1.27

Unit : mm



Note: This package is not available in Japan.

Weight: 0.12 g (typ.)

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