

## TC74VHC03F, TC74VHC03FT, TC74VHC03FK

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

The TC74VHC03 is an advanced 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 Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

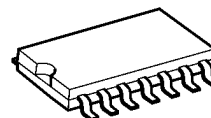
Pin configuration and function are the same as the TC74VHC00. But the TC74VHC03 has, as its outputs, high performance MOS N-channel transistors. (OPEN-DRAIN outputs) This device can, therefore, with a suitable pull-up resistors, be used in wired-AND, LED driver and other application.

An input protection circuit ensures that 0 to 5.5 V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5 V to 3 V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

### Features

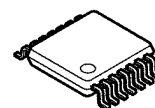
- High speed:  $t_{pZ} = 3.7 \text{ ns (typ.)}$  at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 2 \mu\text{A (max)}$  at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (min)}$
- Power down protection is provided on all inputs.
- Wide operating voltage range:  $V_{CC} \text{ (opr)} = 2 \text{ to } 5.5 \text{ V}$
- Low noise:  $V_{OLP} = 0.8 \text{ V (max)}$
- Pin and function compatible with 74ALS03

TC74VHC03F



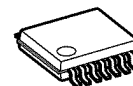
SOP14-P-300-1.27A

TC74VHC03FT



TSSOP14-P-0044-0.65A

TC74VHC03FK

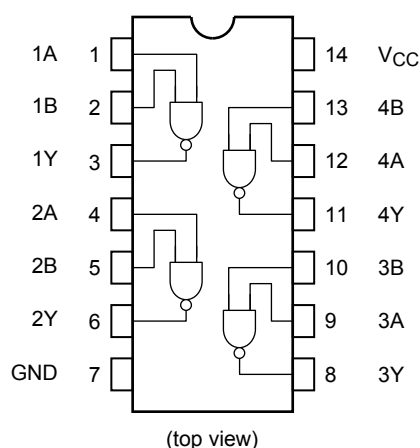


VSSOP14-P-0030-0.50

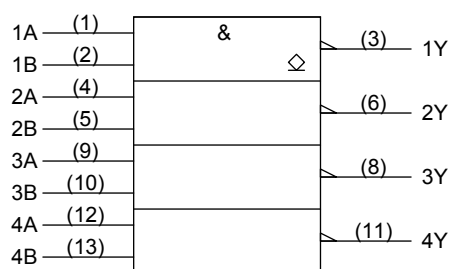
### Weight

|                      |                 |
|----------------------|-----------------|
| SOP14-P-300-1.27A    | : 0.18 g (typ.) |
| TSSOP14-P-0044-0.65A | : 0.06 g (typ.) |
| VSSOP14-P-0030-0.50  | : 0.02 g (typ.) |

## Pin Assignment



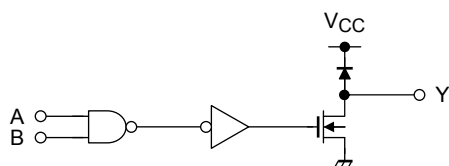
## IEC Logic Symbol



## Truth Table

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

## System Diagram (per gate)



## Absolute Maximum Ratings (Note)

| Characteristics             | Symbol    | Rating                 | Unit |
|-----------------------------|-----------|------------------------|------|
| Supply voltage range        | $V_{CC}$  | -0.5 to 7.0            | V    |
| DC input voltage            | $V_{IN}$  | -0.5 to 7.0            | V    |
| DC output voltage           | $V_{OUT}$ | -0.5 to $V_{CC} + 0.5$ | 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           | $P_D$     | 180                    | mW   |
| Storage temperature         | $T_{stg}$ | -65 to 150             | °C   |

Note: 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.).

## Operating Ranges (Note)

| Characteristics          | Symbol    | Rating                                                                    | Unit |
|--------------------------|-----------|---------------------------------------------------------------------------|------|
| Supply voltage           | $V_{CC}$  | 2.0 to 5.5                                                                | V    |
| Input voltage            | $V_{IN}$  | 0 to 5.5                                                                  | V    |
| Output voltage           | $V_{OUT}$ | 0 to $V_{CC}$                                                             | V    |
| Operating temperature    | $T_{opr}$ | -40 to 85                                                                 | °C   |
| Input rise and fall time | dt/dv     | 0 to 100 ( $V_{CC} = 3.3 \pm 0.3$ V)<br>0 to 20 ( $V_{CC} = 5 \pm 0.5$ V) | ns/V |

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 =<br>-40 to 85°C |                   | Unit              |    |
|--------------------------|--------|---------------------------------------|--------------------------|-------------------|-------------------|--------|---------------------|-------------------|-------------------|----|
|                          |        |                                       | VCC (V)                  | Min               | Typ.              | Max    | Min                 | Max               |                   |    |
| High-level input voltage | VIH    | —                                     |                          | 2.0<br>3.0 to 5.5 | 1.50<br>VCC × 0.7 | —<br>— | —<br>—              | 1.50<br>VCC × 0.7 | —<br>—            | V  |
| Low-level input voltage  | VIL    | —                                     |                          | 2.0<br>3.0 to 5.5 | —<br>—            | —<br>— | 0.50<br>VCC × 0.3   | —<br>—            | 0.50<br>VCC × 0.3 | V  |
| Low-level output voltage | VOL    | VIN = VIH                             | IOL = 50 μA              | 2.0               | —                 | 0.0    | 0.1                 | —                 | 0.1               | V  |
|                          |        |                                       |                          | 3.0               | —                 | 0.0    | 0.1                 | —                 | 0.1               |    |
|                          |        |                                       | IOL = 4 mA<br>IOL = 8 mA | 4.5               | —                 | 0.0    | 0.1                 | —                 | 0.1               |    |
|                          |        |                                       |                          | 3.0<br>4.5        | —<br>—            | —<br>— | 0.36<br>0.36        | —<br>—            | 0.44<br>0.44      |    |
| Output off-state current | IOZ    | VIN = VIH or VIL<br>VOUT = VCC or GND |                          | 5.5               | —                 | —      | ±0.25               | —                 | ±2.50             | μA |
| Input leakage current    | IIN    | VIN = 5.5 V or GND                    |                          | 0 to 5.5          | —                 | —      | ±0.1                | —                 | ±1.0              | μA |
| Quiescent supply current | ICC    | VIN = VCC or GND                      |                          | 5.5               | —                 | —      | 2.0                 | —                 | 20.0              | μA |

## AC Characteristics (input: $t_r = t_f = 3 \text{ ns}$ )

| Characteristics               | Symbol           | Test Condition            |                     |                     | Ta = 25°C |      |      | Ta = -40 to 85°C |      | Unit |
|-------------------------------|------------------|---------------------------|---------------------|---------------------|-----------|------|------|------------------|------|------|
|                               |                  |                           | V <sub>CC</sub> (V) | C <sub>L</sub> (pF) | Min       | Typ. | Max  | Min              | Max  |      |
| Propagation delay time        | $t_{pZL}$        | $R_L = 1 \text{ k}\Omega$ | $3.3 \pm 0.3$       | 15                  | —         | 5.5  | 7.9  | 1.0              | 9.5  | ns   |
|                               |                  |                           |                     | 50                  | —         | 8.0  | 11.4 | 1.0              | 13.0 |      |
|                               |                  |                           | $5.0 \pm 0.5$       | 15                  | —         | 3.7  | 5.5  | 1.0              | 6.5  |      |
|                               |                  |                           |                     | 50                  | —         | 5.2  | 7.5  | 1.0              | 8.5  |      |
| Propagation delay time        | $t_{pLZ}$        | $R_L = 1 \text{ k}\Omega$ | $3.3 \pm 0.3$       | 50                  | —         | 8.0  | 11.4 | 1.0              | 13.0 | ns   |
|                               |                  |                           | $5.0 \pm 0.5$       | 50                  | —         | 5.2  | 7.5  | 1.0              | 8.5  |      |
| Input capacitance             | C <sub>IN</sub>  | —                         |                     |                     | —         | 4    | 10   | —                | 10   | pF   |
| Output capacitance            | C <sub>OUT</sub> | —                         |                     |                     | —         | 5    | —    | —                | —    | pF   |
| Power dissipation capacitance | C <sub>PD</sub>  | (Note)                    |                     |                     | —         | 6    | —    | —                | —    | pF   |

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.

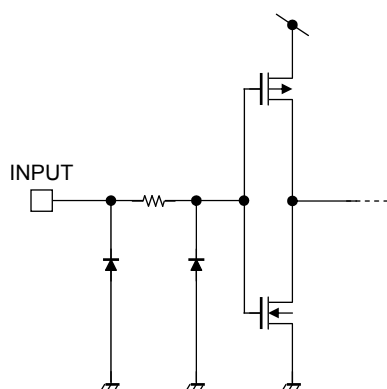
Average operating current can be obtained by the equation:

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

## Noise Characteristics (input: $t_r = t_f = 3 \text{ ns}$ )

| Characteristics                              | Symbol           | Test Condition         |                     | Ta = 25°C |       | Unit |
|----------------------------------------------|------------------|------------------------|---------------------|-----------|-------|------|
|                                              |                  |                        | V <sub>CC</sub> (V) | Typ.      | Limit |      |
| Quiet output maximum dynamic V <sub>OL</sub> | V <sub>OLP</sub> | C <sub>L</sub> = 50 pF | 5.0                 | 0.3       | 0.8   | V    |
| Quiet output minimum dynamic V <sub>OL</sub> | V <sub>OLV</sub> | C <sub>L</sub> = 50 pF | 5.0                 | -0.3      | -0.8  | V    |
| Minimum high level dynamic input voltage     | V <sub>IHD</sub> | C <sub>L</sub> = 50 pF | 5.0                 | —         | 3.5   | V    |
| Maximum low level dynamic input voltage      | V <sub>ILD</sub> | C <sub>L</sub> = 50 pF | 5.0                 | —         | 1.5   | V    |

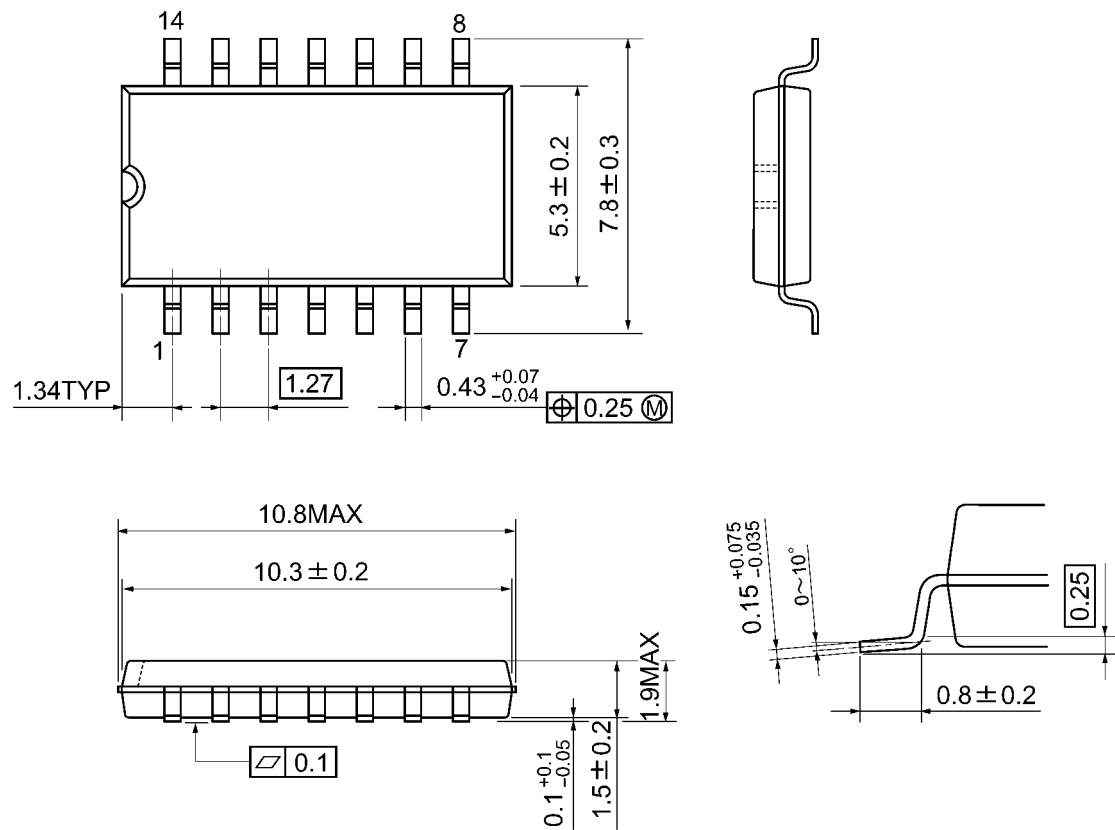
## Input Equivalent Circuit



## Package Dimensions

SOP14-P-300-1.27A

Unit: mm

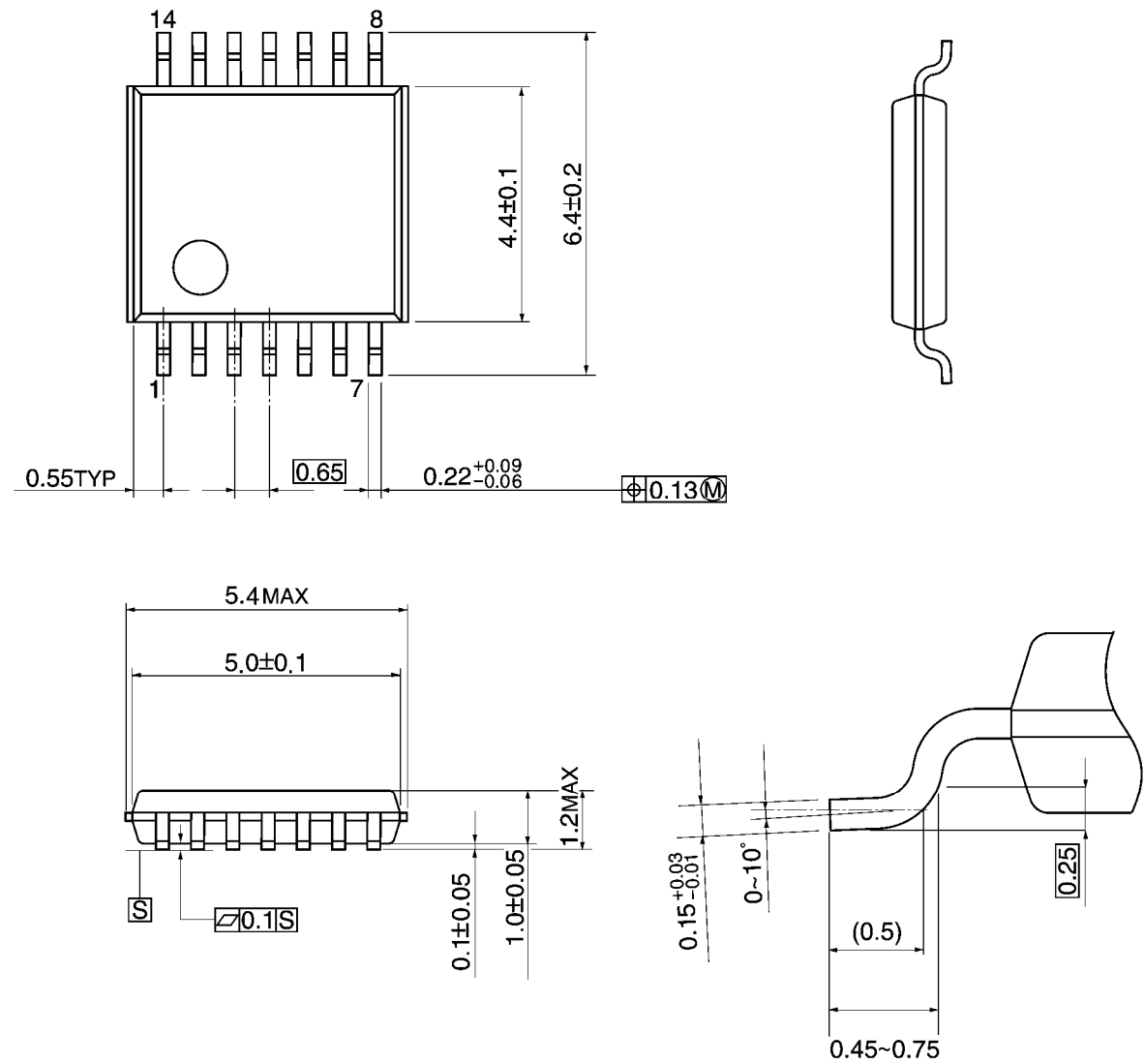


Weight: 0.18 g (typ.)

Package Dimensions

TSSOP14-P-0044-0.65A

Unit: mm

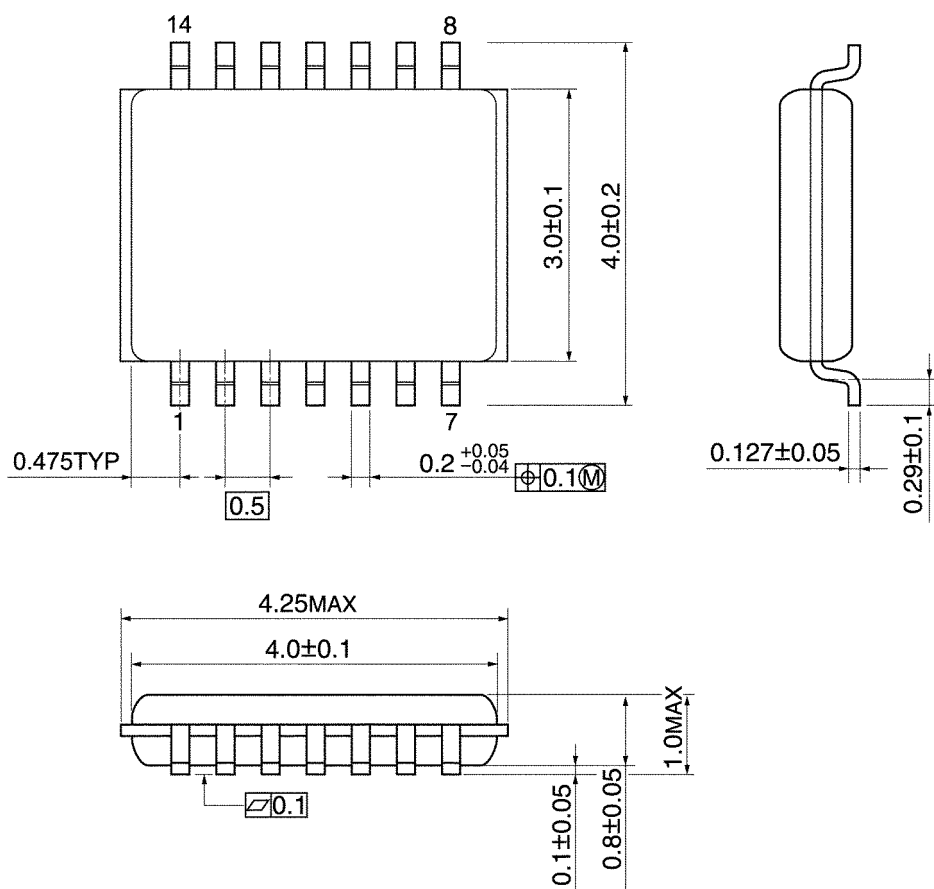


Weight: 0.06 g (typ.)

## Package Dimensions

VSSOP14-P-0030-0.50

Unit: mm



Weight: 0.02 g (typ.)

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