# TOSHIBA

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC74VHC03F,TC74VHC03FN,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.

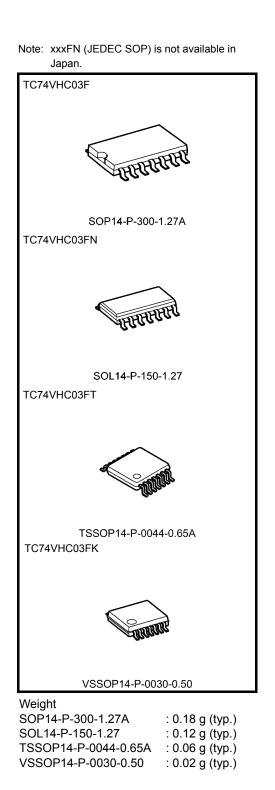
It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

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.

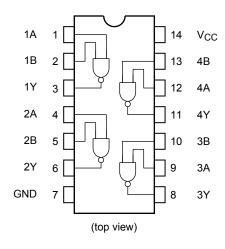
#### Features

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

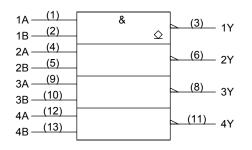


# <u>TOSHIBA</u>

#### **Pin Assignment**



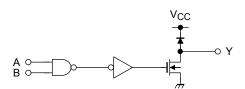
#### **IEC Logic Symbol**



#### Truth Table

А	В	Y
L	L	Z
L	Н	Z
Н	L	Z
Н	Н	L

# System Diagram (per gate)



# Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V <sub>CC</sub>	-0.5 to 7.0	V
DC input voltage	VIN	-0.5 to 7.0	V
DC output voltage	Vout	-0.5 to V <sub>CC</sub> + 0.5	V
Input diode current	liк	-20	mA
Output diode current	I <sub>OK</sub>	±20	mA
DC output current	IOUT	25	mA
DC V <sub>CC</sub> /ground current	ICC	±50	mA
Power dissipation	PD	180	mW
Storage temperature	T <sub>stg</sub>	–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 <sub>CC</sub>	2.0 to 5.5	V
Input voltage	V <sub>IN</sub>	0 to 5.5	V
Output voltage	V <sub>OUT</sub>	0 to V <sub>CC</sub>	V
Operating temperature	T <sub>opr</sub>	-40 to 85	°C
Input rise and fall time	dt/dv	0 to 100 (V_{CC} = 3.3 $\pm$ 0.3 V)	ns/V
	uvuv	0 to 20 (V_{CC} = 5 $\pm$ 0.5 V)	115/ V

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		Ta = 25°C			Ta = -40 to 85°C		Unit	
				$V_{CC}(V)$	Min	Тур.	Max	Min	Max	
High-level input		_		2.0	1.50			1.50	_	
voltage	VIH			3.0 to 5.5	V <sub>CC</sub> × 0.7	—	—	V <sub>CC</sub> × 0.7	—	V
Low-level input					_	_	0.50	_	0.50	
voltage V <sub>IL</sub>	—		3.0 to 5.5	—	—	V <sub>CC</sub> × 0.3	—	V <sub>CC</sub> × 0.3	V	
		V <sub>IN</sub> = V <sub>IH</sub>		2.0	_	0.0	0.1	_	0.1	
			$I_{OL} = 50 \ \mu A$	3.0	—	0.0	0.1	—	0.1	
Low-level output voltage	V <sub>OL</sub>			4.5	—	0.0	0.1	_	0.1	V
Ŭ			$I_{OL} = 4 \text{ mA}$	3.0	—	—	0.36	—	0.44	
			$I_{OL} = 8 \text{ mA}$	4.5	—	—	0.36	_	0.44	
Output off-state	I <sub>OZ</sub>	$V_{IN} = V_{IH}$ or	VIL	5.5 —			±0.25		±2.50	μA
current	102	$V_{OUT} = V_{CC}$ or GND		0.0			10.20		12.00	μΛ
Input leakage current	I <sub>IN</sub>	$V_{IN} = 5.5 V \text{ or GND}$		0 to 5.5	—	—	±0.1	—	±1.0	μA
Quiescent supply current	ICC	$V_{IN} = V_{CC} o$	$V_{IN} = V_{CC}$ or GND		_	_	2.0	_	20.0	μA

#### AC Characteristics (input: t<sub>r</sub> = t<sub>f</sub> = 3 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	Тур.	Max	Min	Max	
Propagation delay time t <sub>pZL</sub>		3.3 ± 0.3	15	_	5.5	7.9	1.0	9.5		
	t	R <sub>L</sub> = 1 kΩ	3.3 ± 0.3	50	_	8.0	11.4	1.0	13.0	ns
	ιρζΓ		5.0 ± 0.5	15	_	3.7	5.5	1.0	6.5	115
				50	_	5.2	7.5	1.0	8.5	
Propagation delay t <sub>pLZ</sub>	t	$R_L = 1 k\Omega$	$3.3\pm 0.3$	50	—	8.0	11.4	1.0	13.0	ns
	ιρLΖ		$5.0\pm0.5$	50	—	5.2	7.5	1.0	8.5	115
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.

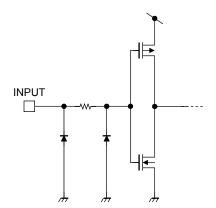
Average operating current can be obtained by the equation:

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

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

Characteristics	Symbol	Test Condition		Ta =	Unit	
	Symbol		V <sub>CC</sub> (V)	Тур.	Limit	Unit
Quiet output maximum dynamic $V_{OL}$	V <sub>OLP</sub>	$C_L = 50 \text{ pF}$	5.0	0.3	0.8	V
Quiet output minimum dynamic $V_{OL}$	V <sub>OLV</sub>	$C_L = 50 \text{ pF}$	5.0	-0.3	-0.8	V
Minimum high level dynamic input voltage	VIHD	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

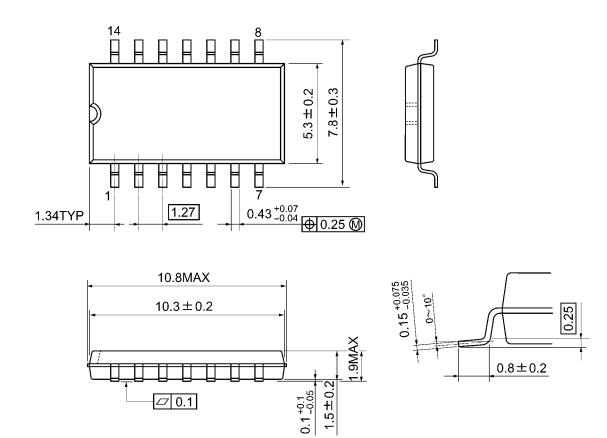




#### **Package Dimensions**

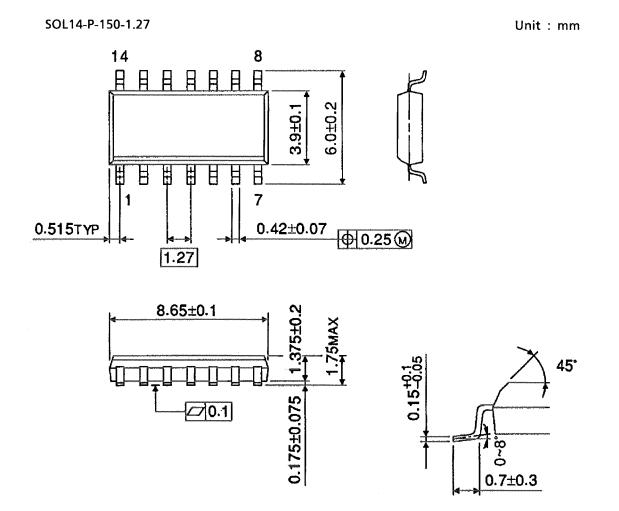
SOP14-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

### Package Dimensions (Note)



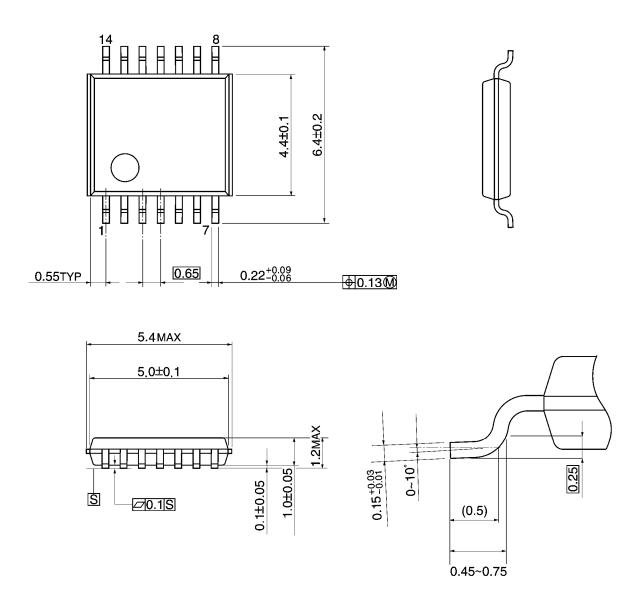
Note: This package is not available in Japan.

Weight: 0.12 g (typ.)

### **Package Dimensions**

TSSOP14-P-0044-0.65A

Unit: mm



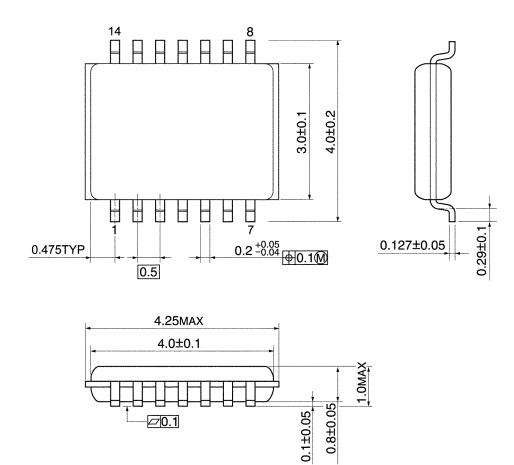
Weight: 0.06 g (typ.)

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### **Package Dimensions**

VSSOP14-P-0030-0.50

Unit: mm



Weight: 0.02 g (typ.)

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