

# 74HCT02D

## 1. Functional Description

- Quad 2-Input NOR Gate

## 2. General

The 74HCT02D is a high speed CMOS 2-INPUT NOR 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.

This device may be used as a level converter for interfacing TTL or NMOS to High Speed CMOS. The inputs are compatible with TTL, NMOS and CMOS output voltage levels.

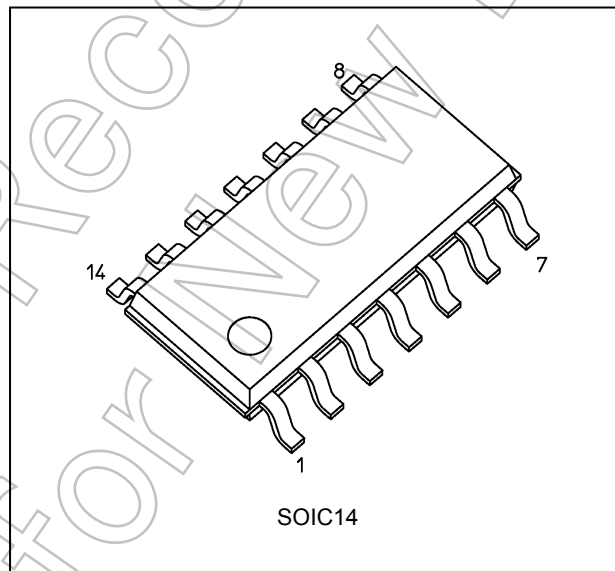
The internal circuit is composed of 3 stages, including buffer output, which provide high noise immunity and stable output.

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

## 3. Features

- (1) High speed:  $t_{pd} = 9 \text{ ns}$  (typ.) at  $V_{CC} = 5 \text{ V}$
- (2) Low power dissipation:  $I_{CC} = 1.0 \mu\text{A}$  (max) at  $T_a = 25 \text{ }^\circ\text{C}$
- (3) Compatible with TTL outputs:  $V_{IH} = 2.0 \text{ V}$  (min)  
:  $V_{IL} = 0.8 \text{ V}$  (max)
- (4) Wide interfacing ability: LSTTL, NMOS, CMOS
- (5) Balanced propagation delays:  $t_{PLH} \approx t_{PHL}$

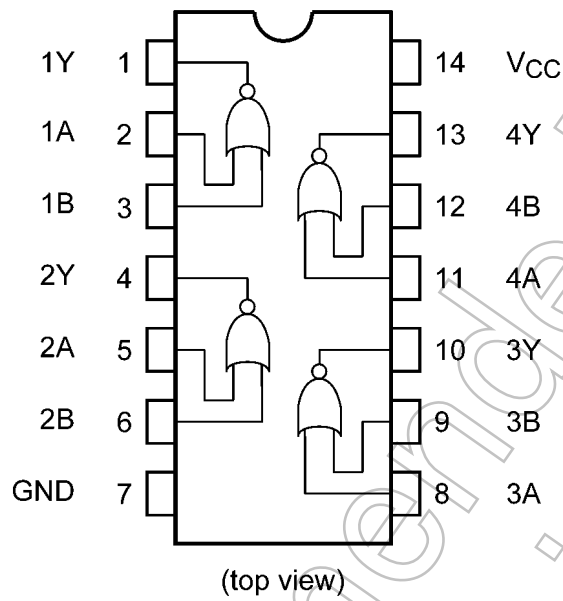
## 4. Packaging



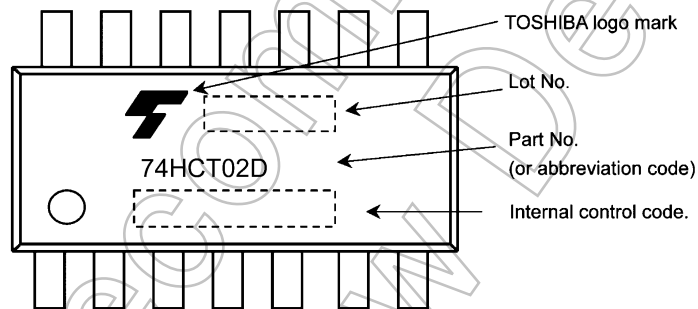
Start of commercial production

2016-05

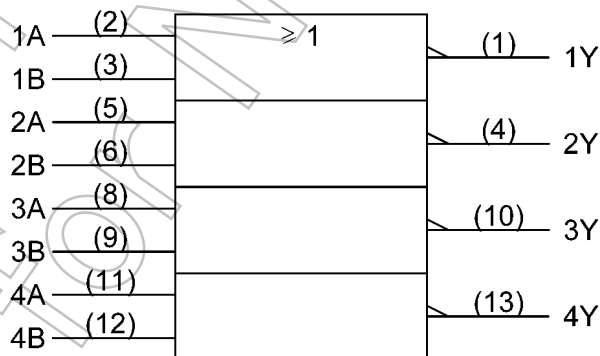
**5. Pin Assignment**



**6. Marking**



**7. IEC Logic Symbol**



## 8. Truth Table

A	B	Y
L	L	H
L	H	L
H	L	L
H	H	L

## 9. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	-0.5 to 7.0	V
Input voltage	$V_{IN}$	-0.5 to $V_{CC} + 0.5$	V
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
Output current	$I_{OUT}$	$\pm 25$	mA
$V_{CC}$ /ground current	$I_{CC}$	$\pm 50$	mA
Power dissipation	$P_D$	500	mW
Storage temperature	$T_{stg}$	-65 to 150	$^{\circ}\text{C}$

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.).

## 10. Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	4.5 to 5.5	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	$^{\circ}\text{C}$
Input rise and fall times	$t_r, t_f$	0 to 500	ns

Note: The operating ranges are required to ensure the normal operation of the device.

Unused inputs must be tied to either  $V_{CC}$  or GND.

**11. Electrical Characteristics**

**11.1. DC Characteristics (Unless otherwise specified,  $T_a = 25\text{ }^\circ\text{C}$ )**

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Min	Typ.	Max	Unit	
High-level input voltage	$V_{IH}$	—	4.5 to 5.5	2.0	—	—	V	
Low-level input voltage	$V_{IL}$	—	4.5 to 5.5	—	—	0.8	V	
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IL}$	$I_{OH} = -20\text{ }\mu\text{A}$	4.5	4.4	4.5	—	V
			$I_{OH} = -4\text{ mA}$	4.5	4.18	4.31	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 20\text{ }\mu\text{A}$	4.5	—	0.0	0.1	V
			$I_{OL} = 4\text{ mA}$	4.5	—	0.17	0.26	
Input leakage current	$I_{IN}$	$V_{IN} = V_{CC}$ or GND	5.5	—	—	$\pm 0.1$	$\mu\text{A}$	
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND	5.5	—	—	1.0	$\mu\text{A}$	
	$I_{CCT}$	Per input: $V_{IN} = 0.5\text{ V}$ or $2.4\text{ V}$ Other input: $V_{CC}$ or GND	5.5	—	—	2.0	mA	

**11.2. DC Characteristics (Unless otherwise specified,  $T_a = -40\text{ to }85\text{ }^\circ\text{C}$ )**

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Min	Max	Unit	
High-level input voltage	$V_{IH}$	—	4.5 to 5.5	2.0	—	V	
Low-level input voltage	$V_{IL}$	—	4.5 to 5.5	—	0.8	V	
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IL}$	$I_{OH} = -20\text{ }\mu\text{A}$	4.5	4.4	—	V
			$I_{OH} = -4\text{ mA}$	4.5	4.13	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 20\text{ }\mu\text{A}$	4.5	—	0.1	V
			$I_{OL} = 4\text{ mA}$	4.5	—	0.33	
Input leakage current	$I_{IN}$	$V_{IN} = V_{CC}$ or GND	5.5	—	$\pm 1.0$	$\mu\text{A}$	
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND	5.5	—	10.0	$\mu\text{A}$	
	$I_{CCT}$	Per input: $V_{IN} = 0.5\text{ V}$ or $2.4\text{ V}$ Other input: $V_{CC}$ or GND	5.5	—	2.9	mA	

**11.3. AC Characteristics**

(Unless otherwise specified,  $C_L = 15 \text{ pF}$ ,  $V_{CC} = 5 \text{ V}$ ,  $T_a = 25 \text{ }^\circ\text{C}$ , Input:  $t_r = t_f = 6 \text{ ns}$ )

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Output transition time	$t_{TLH}, t_{THL}$	—	—	6	12	ns
Propagation delay time	$t_{PLH}, t_{PHL}$	—	—	9	15	

**11.4. AC Characteristics**

(Unless otherwise specified,  $C_L = 50 \text{ pF}$ ,  $T_a = 25 \text{ }^\circ\text{C}$ , Input:  $t_r = t_f = 6 \text{ ns}$ )

Characteristics	Symbol	Note	$V_{CC}$ (V)	Min	Typ.	Max	Unit
Output transition time	$t_{TLH}, t_{THL}$		4.5	—	8	15	ns
			5.5	—	7	13	ns
Propagation delay time	$t_{PLH}, t_{PHL}$		4.5	—	12	18	ns
			5.5	—	11	16	ns
Input capacitance	$C_{IN}$		—	—	5	—	pF
Power dissipation capacitance	$C_{PD}$	(Note 1)	—	—	18	—	pF

Note 1:  $C_{PD}$  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.

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

**11.5. AC Characteristics**

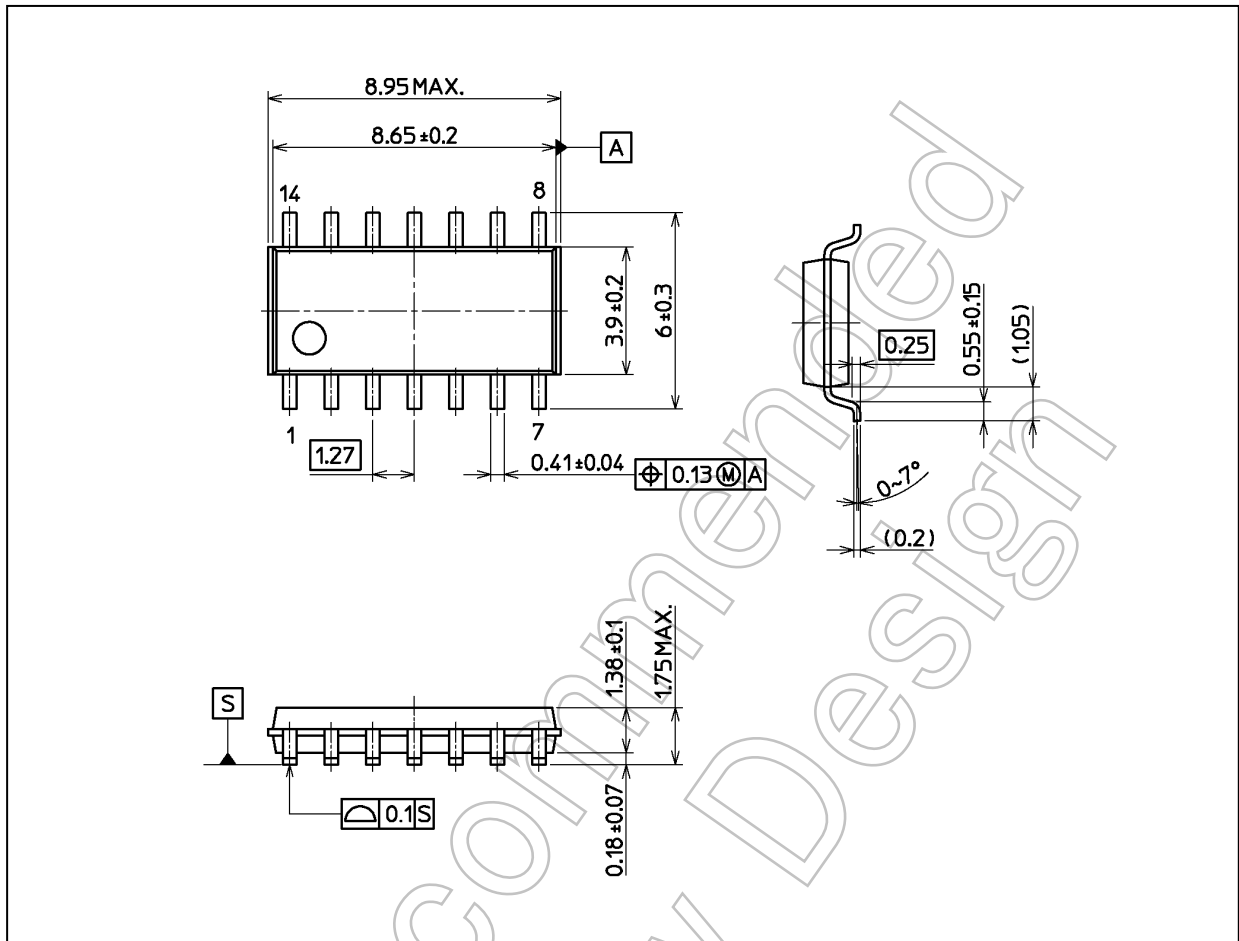
(Unless otherwise specified,  $C_L = 50\text{pF}$ ,  $T_a = -40 \text{ to } 85 \text{ }^\circ\text{C}$ , Input:  $t_r = t_f = 6 \text{ ns}$ )

Characteristics	Symbol	$V_{CC}$ (V)	Min	Max	Unit
Output transition time	$t_{TLH}, t_{THL}$	4.5	—	19	ns
		5.5	—	16	ns
Propagation delay time	$t_{PLH}, t_{PHL}$	4.5	—	23	ns
		5.5	—	20	ns

Not Recommended for New Design

Package Dimensions

Unit: mm



Weight: 0.13 g (typ.)

Package Name(s)
Nickname: SOIC14

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