

# 74HCT04D

## 1. Functional Description

- Hex Inverter

## 2. General

The 74HCT04D is a high speed CMOS INVERTER fabricated with silicon gate CMOS 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.

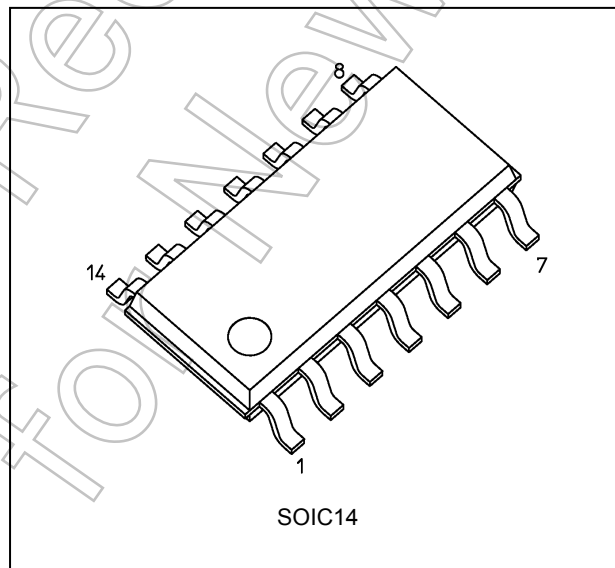
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

## 3. Features

- (1) Wide operating temperature range:  $T_{opr} = -40$  to  $125$  °C (Note 1)
- (2) High speed:  $t_{pd} = 8$  ns (typ.) at  $V_{CC} = 5$  V
- (3) Low power dissipation:  $I_{CC} = 1.0$   $\mu$ A (max) at  $T_a = 25$  °C
- (4) Compatible with TTL outputs:  $V_{IH} = 2.0$  V (min)  
:  $V_{IL} = 0.8$  V (max)
- (5) Wide interfacing ability: LSTTL, NMOS, CMOS
- (6) Balanced propagation delays:  $t_{PLH} \approx t_{PHL}$

Note 1: Operating Range spec of  $T_{opr} = -40$  °C to  $125$  °C is applicable only for the products which manufactured after July 2020.

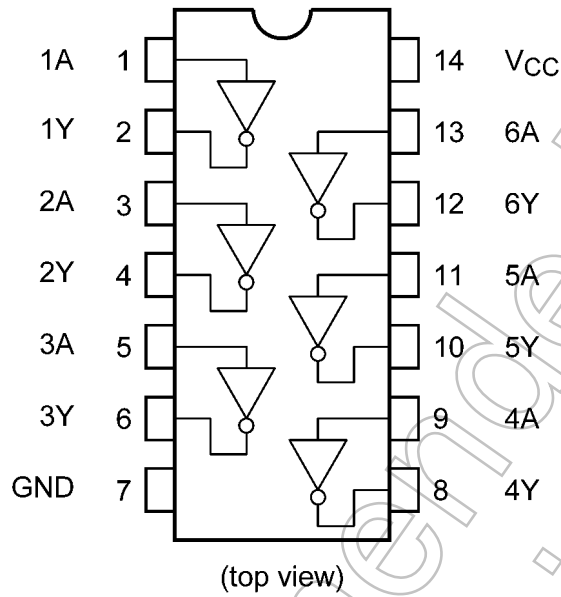
## 4. Packaging



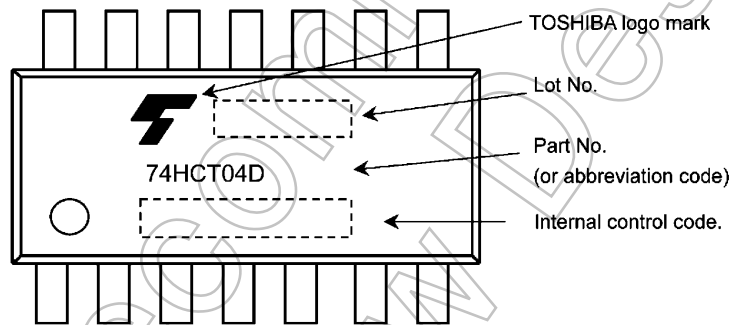
Start of commercial production

2020-07

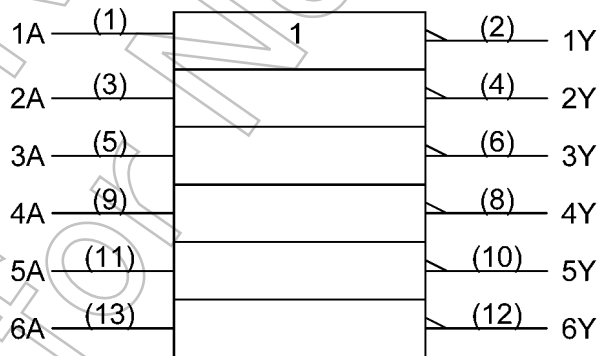
### 5. Pin Assignment



### 6. Marking



### 7. IEC Logic Symbol



### 8. Truth Table

A	Y
L	H
H	L

### 9. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Note	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	$P_D$	(Note 1)	500	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).

Note 1:  $P_D$  derates linearly with -8 mW/°C above 85 °C

### 10. Operating Ranges (Note)

Characteristics	Symbol	Note	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	$T_{opr}$	(Note 1)	-40 to 125	°C
Input rise and fall times	$t_r, t_f$		0 to 500	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.

Note 1: Operating Range spec of  $T_{opr} = -40$  °C to 125 °C is applicable only for the products which manufactured after July 2020.

### 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	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -20\text{ }\mu\text{A}$	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	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -20\text{ }\mu\text{A}$	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. DC Characteristics (Note) (Unless otherwise specified, $T_a = -40\text{ to }125\text{ }^\circ\text{C}$ )

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	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -20\text{ }\mu\text{A}$	4.5	4.4	—	V
			$I_{OH} = -4\text{ mA}$	4.5	3.7	—	
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	—	0.4	
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	—	20.0	$\mu\text{A}$	
	$I_{CCT}$	Per input: $V_{IN} = 0.5\text{ V}$ or $2.4\text{ V}$ Other input: $V_{CC}$ or GND	5.5	—	2.9	mA	

Note: Operating Range spec of  $T_{opr} = -40\text{ }^\circ\text{C}$  to  $125\text{ }^\circ\text{C}$  is applicable only for the products which manufactured after July 2020.

### 11.4. 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	$t_{PLH}, t_{PHL}$	—	—	8	15	

### 11.5. 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	
Propagation delay time	$t_{PLH}, t_{PHL}$		4.5	—	11	18	ns
			5.5	—	9	16	
Input capacitance	$C_{IN}$		—	—	5	—	pF
Power dissipation capacitance	$C_{PD}$	(Note 1)	—	—	20	—	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.

$$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/6 \text{ (per gate)}$$

### 11.6. 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	
Propagation delay time	$t_{PLH}, t_{PHL}$	4.5	—	23	ns
		5.5	—	20	

### 11.7. AC Characteristics (Note)

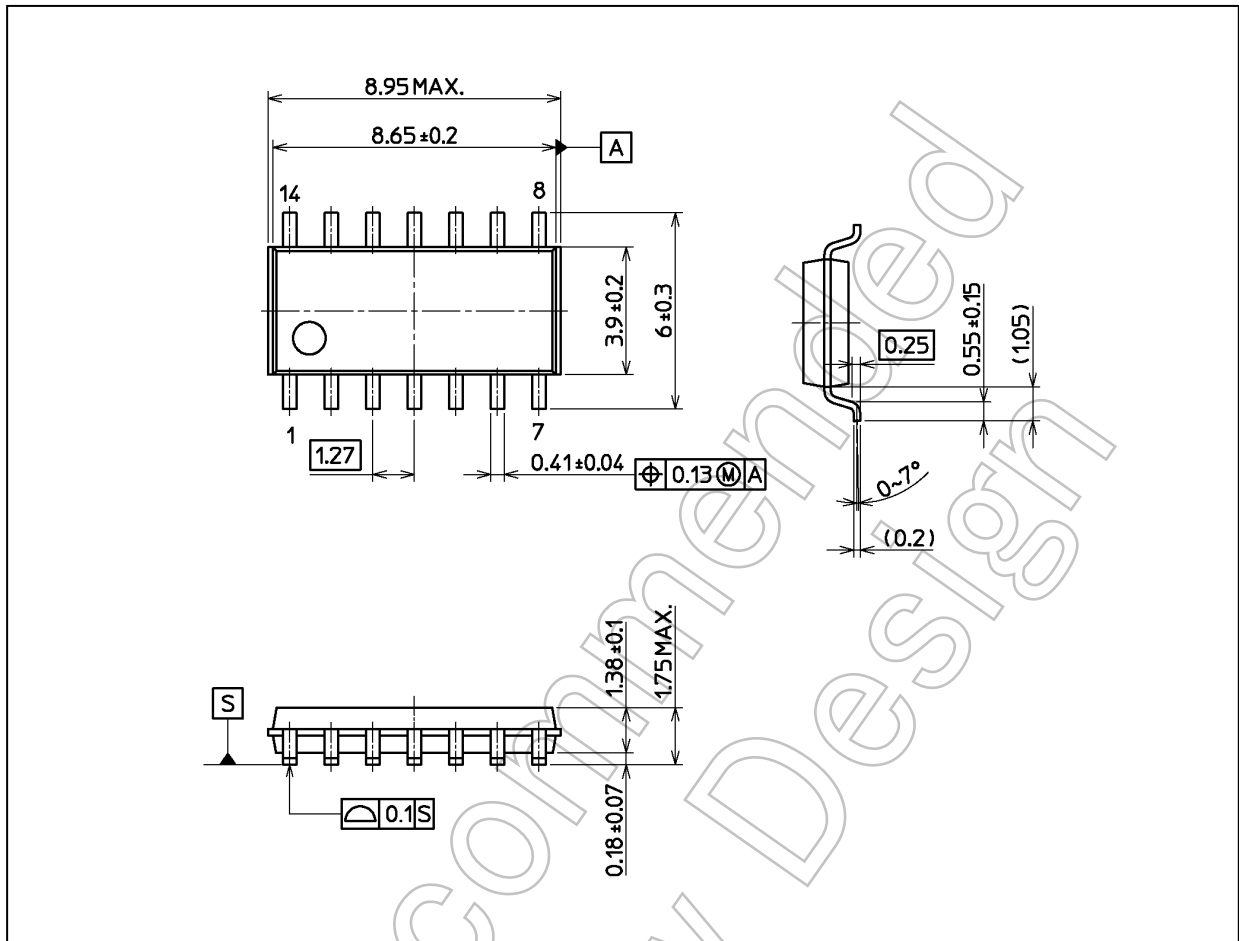
(Unless otherwise specified,  $C_L = 50 \text{ pF}$ ,  $T_a = -40 \text{ to } 125 \text{ }^\circ\text{C}$ , Input:  $t_r = t_f = 6 \text{ ns}$ )

Characteristics	Symbol	$V_{CC}$ (V)	Min	Max	Unit
Output transition time	$t_{TLH}, t_{THL}$	4.5	—	22	ns
		5.5	—	18	
Propagation delay time	$t_{PLH}, t_{PHL}$	4.5	—	27	ns
		5.5	—	23	

Note: Operating Range spec of  $T_{opr} = -40 \text{ }^\circ\text{C}$  to  $125 \text{ }^\circ\text{C}$  is applicable only for the products which manufactured after July 2020.

## Package Dimensions

Unit: mm



Weight: 0.13 g (typ.)

Package Name(s)
Nickname: SOIC14

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