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74HCT04D

1. Functional Description

- Hex Inverter

2. General

The 74HCT04D is a high speed CMOS INVERTER fabricated with silicon gate C²MOS 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.

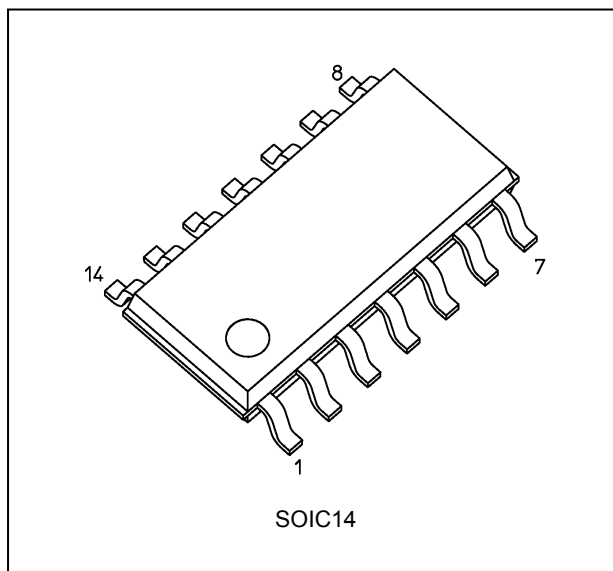
The internal circuit is composed of 3 stages including buffer output, which provide high noise immunity and stable output.

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

3. Features

- (1) High speed: $t_{pd} = 8 \text{ ns}$ (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: $t_{PLH} \approx t_{PHL}$

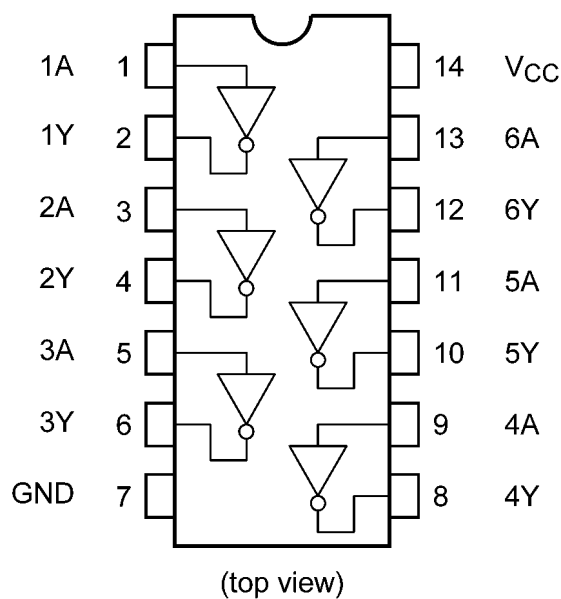
4. Packaging



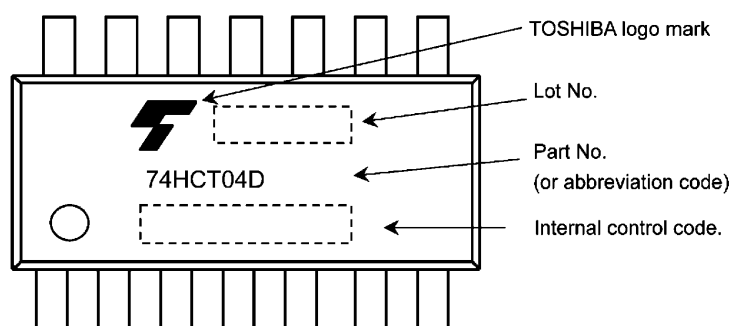
Start of commercial production

2016-05

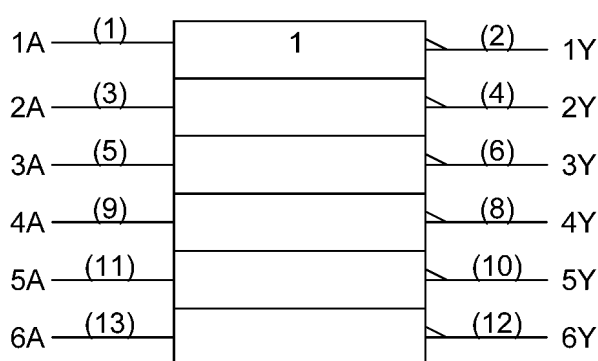
5. Pin Assignment



6. Marking



7. IEC Logic Symbol



8. Truth Table

A	Y
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}	± 20	mA
Output diode current	I_{OK}	± 20	mA
Output current	I_{OUT}	± 25	mA
V_{CC} /ground current	I_{CC}	± 50	mA
Power dissipation	P_D	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).

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	°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.

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}	$V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -20\text{ }\mu\text{A}$	4.5	4.4	4.5	V
			$I_{OH} = -4\text{ mA}$	4.5	4.18	4.31	
Low-level output voltage	V_{OL}	$V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 20\text{ }\mu\text{A}$	4.5	—	0.0	V
			$I_{OL} = 4\text{ mA}$	4.5	—	0.17	
Input leakage current	I_{IN}	$V_{IN} = V_{CC} \text{ or } GND$	5.5	—	—	± 0.1	μA
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC} \text{ or } GND$	5.5	—	—	1.0	μA
	I_{CCT}	Per input: $V_{IN} = 0.5\text{ V or } 2.4\text{ V}$ Other input: $V_{CC} \text{ or } GND$	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}	$V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -20\text{ }\mu\text{A}$	4.5	4.4	V
			$I_{OH} = -4\text{ mA}$	4.5	4.13	
Low-level output voltage	V_{OL}	$V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 20\text{ }\mu\text{A}$	4.5	—	V
			$I_{OL} = 4\text{ mA}$	4.5	—	
Input leakage current	I_{IN}	$V_{IN} = V_{CC} \text{ or } GND$	5.5	—	± 1.0	μA
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC} \text{ or } GND$	5.5	—	10.0	μA
	I_{CCT}	Per input: $V_{IN} = 0.5\text{ V or } 2.4\text{ V}$ Other input: $V_{CC} \text{ or } GND$	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}	—	—	8	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	$V_{CC} \text{ (V)}$	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.

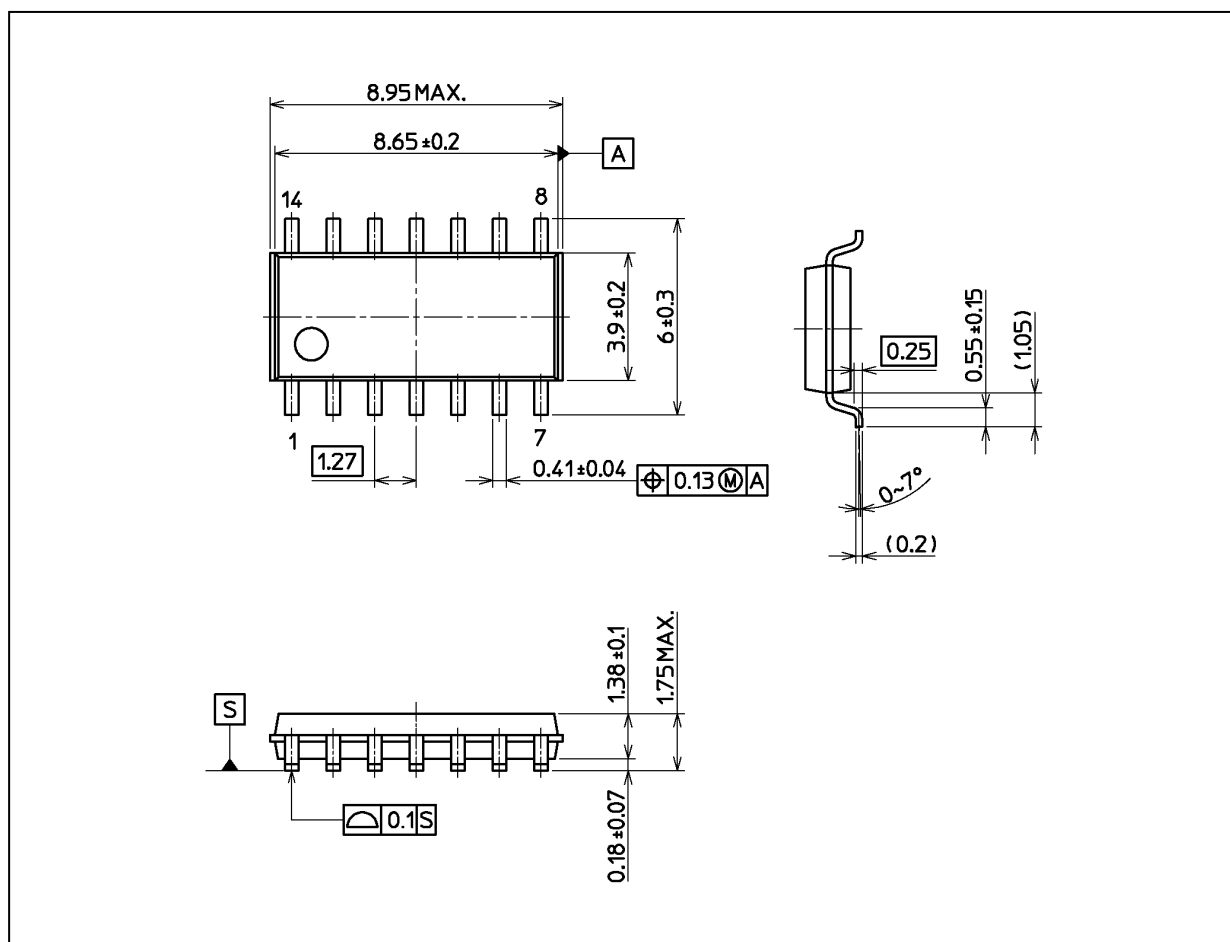
$$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/6 \text{ (per gate)}$$

11.5. 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	$V_{CC} \text{ (V)}$	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	

Package Dimensions

Unit: mm



Weight: 0.13 g (typ.)

Package Name(s)
Nickname: SOIC14

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