

# TC74HCU04AF

## 1. Functional Description

- Hex Inverter

## 2. General

The TC74HCU04AF is a high speed CMOS INVERTER 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.

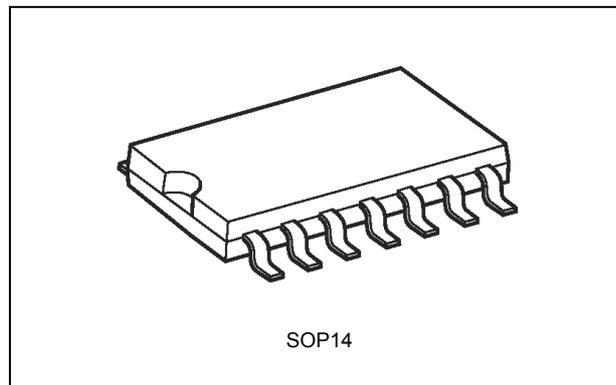
Since the internal circuit is composed of a single stage inverter, it can be used in analog applications such as crystal oscillators.

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

## 3. Features

- (1) High speed:  $t_{pd} = 4 \text{ ns}$  (typ.) at  $V_{CC} = 5 \text{ V}$
- (2) Low power dissipation:  $I_{CC} = 1.0 \text{ }\mu\text{A}$  (max)  $T_a = 25 \text{ }^\circ\text{C}$
- (3) High noise immunity:  $V_{NIH} = V_{NIL} = 10 \% V_{CC}$  (min)
- (4) Symmetrical output impedance:  $|I_{OH}| = I_{OL} = 4 \text{ mA}$  (min)
- (5) Balanced propagation delays:  $t_{PLH} \approx t_{PHL}$
- (6) Wide operating voltage range:  $V_{CC(opr)} = 2.0 \text{ to } 6.0 \text{ V}$

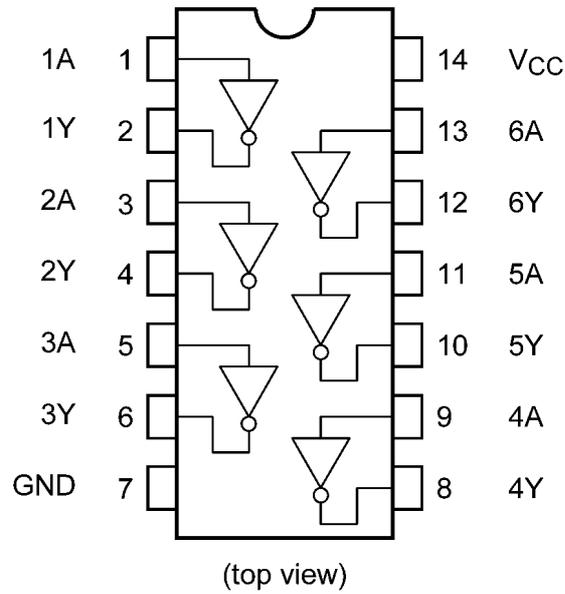
## 4. Packaging



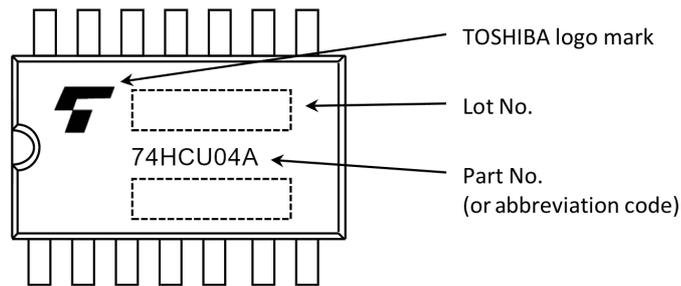
Start of commercial production

1986-10

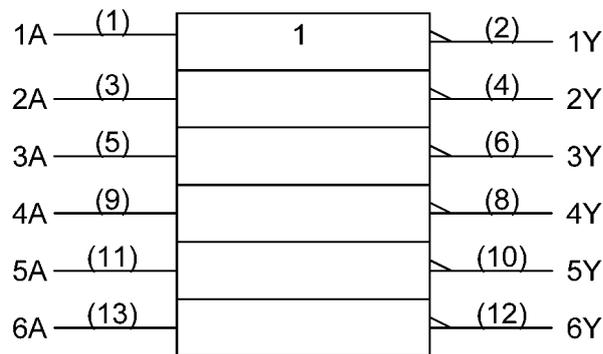
## 5. Pin Assignment



## 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	$P_D$		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).

### 10. Operating Ranges (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	$V_{CC}$		2.0 to 6.0	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

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	$V_{IH}$	—		2.0	1.7	—	—	V
				4.5	3.6	—	—	
				6.0	4.8	—	—	
Low-level input voltage	$V_{IL}$	—		2.0	—	—	0.3	V
				4.5	—	—	0.9	
				6.0	—	—	1.2	
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IL}$	$I_{OH} = -20\text{ }\mu\text{A}$	2.0	1.8	2.0	—	V
				4.5	4.0	4.5	—	
		$V_{IN} = \text{GND}$	$I_{OH} = -4\text{ mA}$	4.5	4.18	4.31	—	
				6.0	5.68	5.80	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$	$I_{OL} = 20\text{ }\mu\text{A}$	2.0	—	0.0	0.2	V
				4.5	—	0.0	0.5	
				6.0	—	0.1	0.5	
		$V_{IN} = V_{CC}$	$I_{OL} = 4\text{ mA}$	4.5	—	0.17	0.26	
				6.0	—	0.18	0.26	
Input leakage current	$I_{IN}$	$V_{IN} = V_{CC}$ or GND		6.0	—	—	$\pm 0.1$	$\mu\text{A}$
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND		6.0	—	—	1.0	$\mu\text{A}$

#### 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	$V_{IH}$	—		2.0	1.7	—	V	
				4.5	3.6	—		—
				6.0	4.8	—		—
Low-level input voltage	$V_{IL}$	—		2.0	—	0.3	V	
				4.5	—	0.9		—
				6.0	—	1.2		—
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IL}$	$I_{OH} = -20\text{ }\mu\text{A}$	2.0	1.8	—	V	
				4.5	4.0	—		—
		$V_{IN} = \text{GND}$	$I_{OH} = -4\text{ mA}$	4.5	4.13	—		—
				6.0	5.63	—		—
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$	$I_{OL} = 20\text{ }\mu\text{A}$	2.0	—	0.2	V	
				4.5	—	0.5		—
				6.0	—	0.5		—
		$V_{IN} = V_{CC}$	$I_{OL} = 4\text{ mA}$	4.5	—	0.33		—
				6.0	—	0.33		—
Input leakage current	$I_{IN}$	$V_{IN} = V_{CC}$ or GND		6.0	—	$\pm 1.0$	$\mu\text{A}$	
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND		6.0	—	10.0	$\mu\text{A}$	

#### 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	$t_{TLH}, t_{THL}$	—	—	4	8	ns
Propagation delay time	$t_{PLH}, t_{PHL}$	—	—	4	8	ns

### 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	$t_{TLH}, t_{THL}$		2.0	—	30	75	ns
			4.5	—	8	15	
			6.0	—	7	13	
Propagation delay time	$t_{PLH}, t_{PHL}$		2.0	—	18	60	ns
			4.5	—	6	12	
			6.0	—	5	10	
Input capacitance	$C_{IN}$		—	—	9	15	pF
Power dissipation capacitance	$C_{PD}$	(Note 1)	—	—	13	—	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.

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

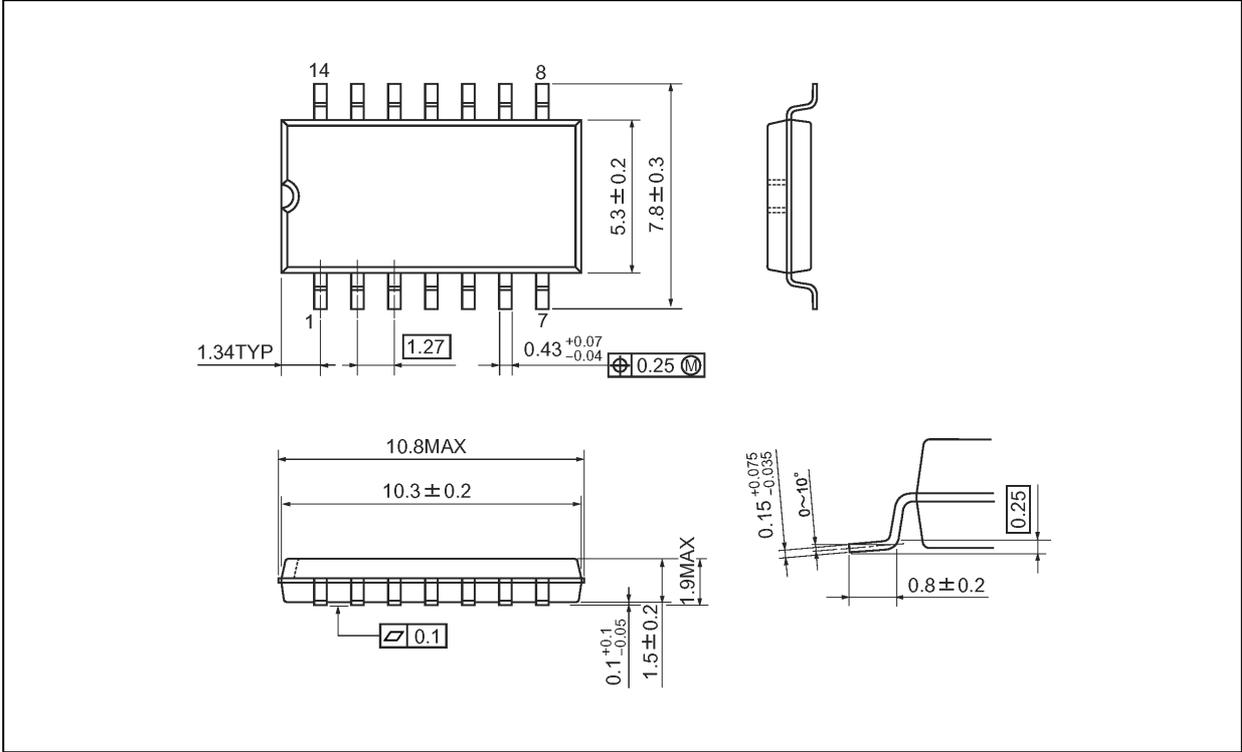
### 11.5. AC Characteristics

(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	$V_{CC}$ (V)	Min	Max	Unit
Output transition time	$t_{TLH}, t_{THL}$	2.0	—	95	ns
		4.5	—	19	
		6.0	—	16	
Propagation delay time	$t_{PLH}, t_{PHL}$	2.0	—	75	ns
		4.5	—	15	
		6.0	—	13	
Input capacitance	$C_{IN}$	—	—	15	pF

Package Dimensions

Unit: mm



Weight: 0.18 g (typ.)

Package Name(s)
Nickname: SOP14

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