

# TC74AC04F

## 1. Functional Description

- Hex Inverter

## 2. General

The TC74AC04F is an advanced high speed CMOS INVERTER fabricated with silicon gate and double-layer metal wiring 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.

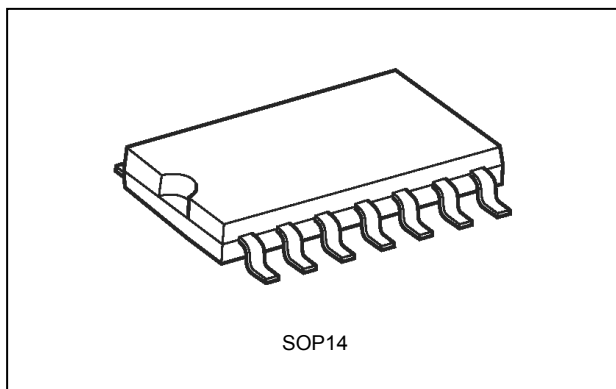
The internal circuit is composed of 3 stages including buffer output, which provide high noise immunity and stable output.

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

## 3. Features

- (1) High speed:  $t_{pd} = 3.2$  ns (typ.) at  $V_{CC} = 5.0$  V
- (2) Low power dissipation:  $I_{CC} = 4.0$   $\mu$ A (max) at  $T_a = 25$  °C
- (3) High noise immunity:  $V_{NIH} = V_{NIL} = 28\%$   $V_{CC}$  (min)
- (4) Output current:  $|I_{OH}|/I_{OL} = 24$  mA (min) ( $V_{CC} = 4.5$  V)
- (5) Balanced propagation delays:  $t_{PLH} \approx t_{PHL}$
- (6) Wide operating voltage range:  $V_{CC(opr)} = 2.0$  to 5.5 V
- (7) Pin and function compatible with 74F04

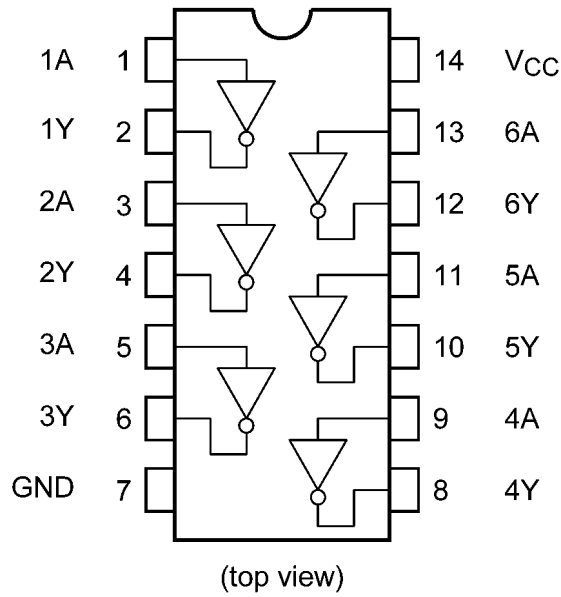
## 4. Packaging



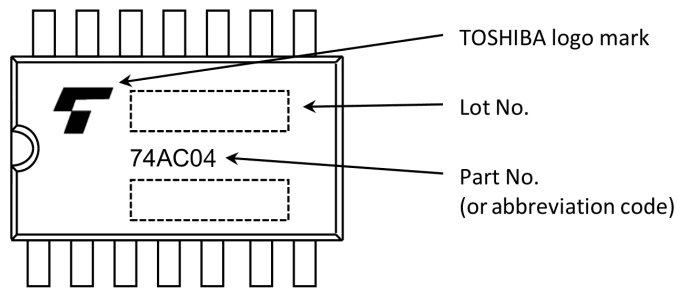
Start of commercial production

1986-05

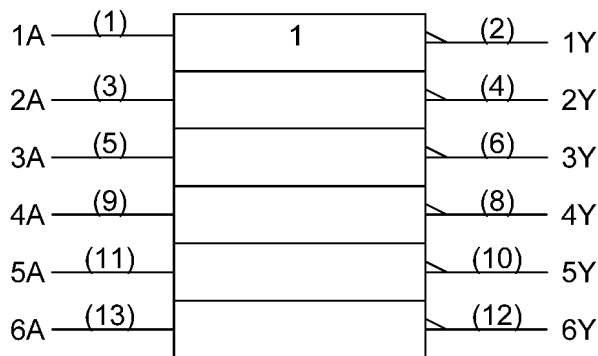
## 5. Pin Assignment



## 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	$I_{IK}$	$\pm 20$	mA
Output diode current	$I_{OK}$	$\pm 50$	mA
Output current	$I_{OUT}$	$\pm 50$	mA
$V_{CC}$ /ground current	$I_{CC}$	$\pm 150$	mA
Power dissipation	$P_D$	180	mW
Storage temperature	$T_{stg}$	-65 to 150	$^{\circ}C$

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	Test Condition	Rating	Unit
Supply voltage	$V_{CC}$		2.0 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	$^{\circ}C$
Input rise and fall times	dt/dv	$V_{CC} = 3.3 \pm 0.3$ V	0 to 100	ns/V
		$V_{CC} = 5.0 \pm 0.5$ V	0 to 20	

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	1.50	—	—	V	
			3.0	2.10	—	—	V	
			5.5	3.85	—	—	V	
Low-level input voltage	$V_{IL}$	—	2.0	—	—	0.50	V	
			3.0	—	—	0.90	V	
			5.5	—	—	1.65	V	
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IL}$	$I_{OH} = -50\text{ }\mu\text{A}$	2.0	1.9	2.0	—	V
				3.0	2.9	3.0	—	
			$I_{OH} = -4\text{ mA}$	4.5	4.4	4.5	—	
				$I_{OH} = -24\text{ mA}$	3.0	2.58	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$	$I_{OL} = 50\text{ }\mu\text{A}$	2.0	—	0.0	0.1	V
				3.0	—	0.0	0.1	
				4.5	—	0.0	0.1	
			$I_{OL} = 12\text{ mA}$	3.0	—	—	0.36	
				$I_{OL} = 24\text{ mA}$	4.5	—	—	
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	—	—	4.0	$\mu\text{A}$	

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

Characteristics	Symbol	Test Condition	Note	$V_{CC}$ (V)	Min	Max	Unit	
High-level input voltage	$V_{IH}$	—		2.0	1.50	—	V	
				3.0	2.10	—		
				5.5	3.85	—		
Low-level input voltage	$V_{IL}$	—		2.0	—	0.50	V	
				3.0	—	0.90		
				5.5	—	1.65		
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IL}$	$I_{OH} = -50\text{ }\mu\text{A}$	2.0	1.9	—	V	
				3.0	2.9	—		
			$I_{OH} = -4\text{ mA}$	4.5	4.4	—		
				$I_{OH} = -24\text{ mA}$	3.0	2.48		—
					$I_{OH} = -75\text{ mA}$ (Note 1)	4.5		3.80
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$	$I_{OL} = 50\text{ }\mu\text{A}$	2.0	—	0.1	V	
				3.0	—	0.1		
				4.5	—	0.1		
			$I_{OL} = 12\text{ mA}$	3.0	—	0.44		
				$I_{OL} = 24\text{ mA}$	4.5	—		0.44
					$I_{OL} = 75\text{ mA}$ (Note 1)	5.5		—
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	—	40.0	$\mu\text{A}$	

Note 1: This spec indicates the capability of driving  $50\text{ }\Omega$  transmission lines.  
One output should be tested within a 10 ms maximum duration.

### 11.3. AC Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ , Input: $t_r = t_f = 3\text{ ns}$ )

Characteristics	Symbol	Note		$V_{CC}$ (V)	Min	Typ.	Max	Unit
Propagation delay time	$t_{PLH}, t_{PHL}$		$C_L = 50\text{ pF}$ $R_L = 500\text{ }\Omega$	$3.3 \pm 0.3$	—	5.7	9.8	ns
				$5.0 \pm 0.5$	—	4.3	6.6	
Input capacitance	$C_{IN}$		—	—	5	10	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.

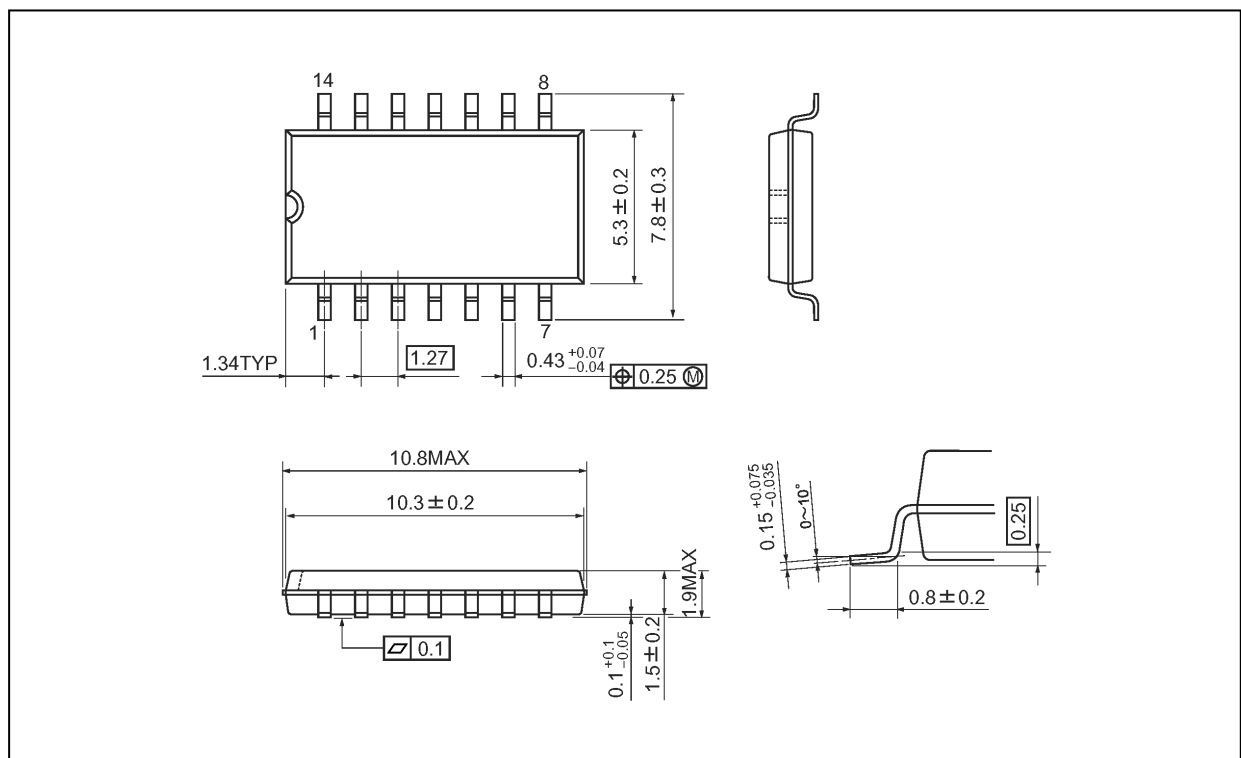
$$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/6 \text{ (per gate)}$$

### 11.4. AC Characteristics (Unless otherwise specified, $T_a = -40\text{ to }85\text{ }^\circ\text{C}$ , Input: $t_r = t_f = 3\text{ ns}$ )

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Min	Max	Unit
Propagation delay time	$t_{PLH}, t_{PHL}$	$C_L = 50\text{ pF}$ $R_L = 500\text{ }\Omega$	$3.3 \pm 0.3$	1.0	11.2	ns
			$5.0 \pm 0.5$	1.0	7.5	
Input capacitance	$C_{IN}$	—	—	—	10	pF

### Package Dimensions

Unit: mm



Weight: 0.18 g (typ.)

Package Name(s)
Nickname: SOP14

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