

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC74HC05AP, TC74HC05AF

## Hex Inverter (open drain)

The TC74HC05A 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.

Pin configuration and function are the same as the TC74HC04A, but the TC74HC05A has high performance MOS N-channel transistor (open-drain) outputs.

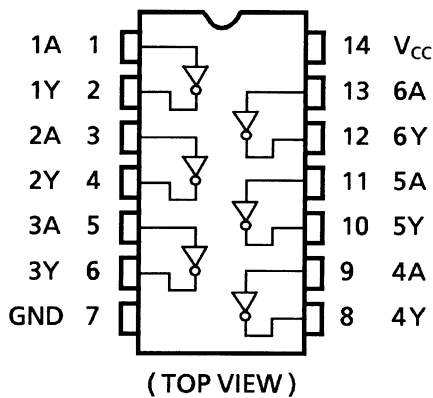
This device can, therefore, with a suitable pull-up resistors, be used in wired-AND, LED drive and other applications.

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

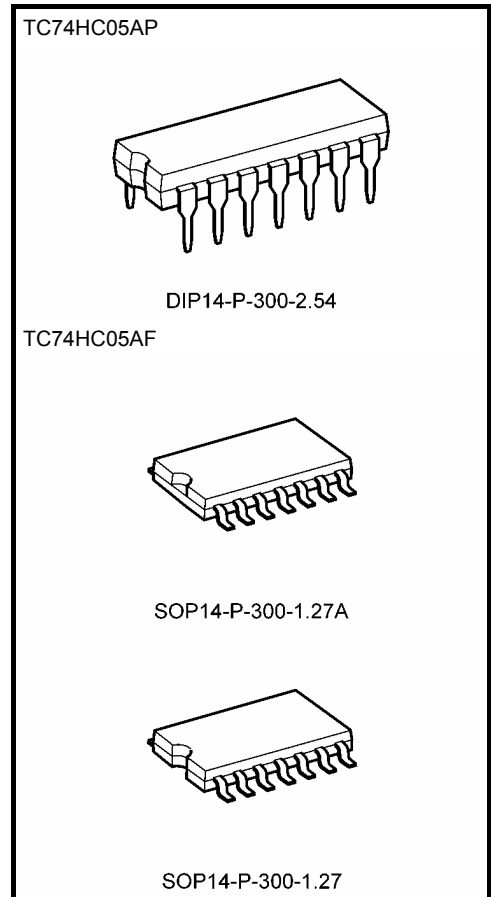
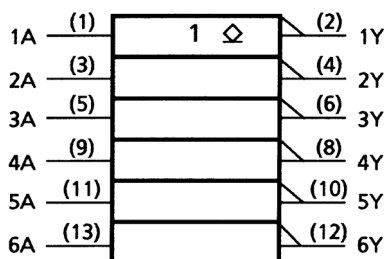
### Features

- High speed:  $t_{pZ} = 8 \text{ ns}$  (typ.) at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 1 \mu\text{A}$  (max) at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)
- Output drive capability: 10 LSTTL loads
- Wide operating voltage range:  $V_{CC} \text{ (opr)} = 2\sim 6 \text{ V}$
- Open drain structure.
- Pin and function compatible with 74LS05

### Pin Assignment



### IEC Logic Symbol



Weight

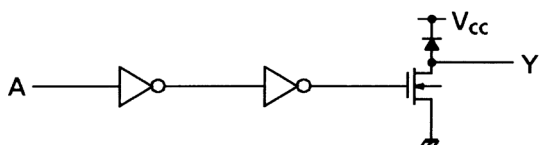
DIP14-P-300-2.54	: 0.96 g (typ.)
SOP14-P-300-1.27A	: 0.18 g (typ.)
SOP14-P-300-1.27	: 0.18 g (typ.)

## Truth Table

A	Y
L	Z
H	L

Z: High impedance

## System Diagram (per gate)



## Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Supply voltage range	$V_{CC}$	-0.5~7	V
DC input voltage	$V_{IN}$	-0.5~ $V_{CC} + 0.5$	V
DC output voltage	$V_{OUT}$	-0.5~ $V_{CC} + 0.5$	V
Input diode current	$I_{IK}$	±20	mA
Output diode current	$I_{OK}$	±20	mA
DC output current	$I_{OUT}$	+25	mA
DC $V_{CC}$ /ground current	$I_{CC}$	±50	mA
Power dissipation	$P_D$	500 (DIP) (Note 2)/180 (SOP)	mW
Storage temperature	$T_{stg}$	-65~150	°C

Note 1: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Note 2: 500 mW in the range of  $T_a = -40\sim 65^\circ\text{C}$ . From  $T_a = 65$  to  $85^\circ\text{C}$  a derating factor of  $-10\text{ mW}/^\circ\text{C}$  shall be applied until 300 mW.

## Recommended Operating Conditions (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	2~6	V
Input voltage	$V_{IN}$	0~ $V_{CC}$	V
Output voltage	$V_{OUT}$	0~ $V_{CC}$	V
Operating temperature	$T_{opr}$	-40~85	°C
Input rise and fall time	$t_r, t_f$	0~1000 ( $V_{CC} = 2.0\text{ V}$ ) 0~500 ( $V_{CC} = 4.5\text{ V}$ ) 0~400 ( $V_{CC} = 6.0\text{ V}$ )	ns

Note: The recommended operating conditions are required to ensure the normal operation of the device. Unused inputs must be tied to either  $V_{CC}$  or GND.

## Electrical Characteristics

### DC Characteristics

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40~85°C		Unit	
				V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max
High-level input voltage	V <sub>IH</sub>	—		2.0	1.50	—	—	1.50	—	V
				4.5	3.15	—	—	3.15	—	
				6.0	4.20	—	—	4.20	—	
Low-level input voltage	V <sub>IL</sub>	—		2.0	—	—	0.50	—	0.50	V
				4.5	—	—	1.35	—	1.35	
				6.0	—	—	1.80	—	1.80	
Low-level output voltage	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub>	I <sub>OL</sub> = 20 μA	2.0	—	0.0	0.1	—	0.1	V
				4.5	—	0.0	0.1	—	0.1	
			I <sub>OL</sub> = 4 mA	4.5	—	0.17	0.26	—	0.33	
				6.0	—	0.18	0.26	—	0.33	
Output off-state current	I <sub>OZ</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>OUT</sub> = V <sub>CC</sub>		6.0	—	—	±0.5	—	±5.0	μA
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		6.0	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		6.0	—	—	1.0	—	10.0	μA

### AC Characteristics (C<sub>L</sub> = 15 pF, V<sub>CC</sub> = 5 V, Ta = 25°C, input: t<sub>r</sub> = t<sub>f</sub> = 6 ns)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Output transition time	t <sub>THL</sub>	—	—	4	8	ns
Propagation delay time	t <sub>pLZ</sub>	R <sub>L</sub> = 1 kΩ	—	8	15	ns
Propagation delay time	t <sub>pZL</sub>	R <sub>L</sub> = 1 kΩ	—	6	15	ns

## AC Characteristics ( $C_L = 50 \text{ pF}$ , input: $t_r = t_f = 6 \text{ ns}$ )

Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Ta = 25°C			Ta = -40~85°C		Unit
				Min	Typ.	Max	Min	Max	
Output transition time	t <sub>THL</sub>	—	2.0	—	30	75	—	95	ns
			4.5	—	8	15	—	19	
			6.0	—	7	13	—	16	
Propagation delay time	t <sub>pLZ</sub>	R <sub>L</sub> = 1 kΩ	2.0	—	20	90	—	115	ns
			4.5	—	11	18	—	23	
			6.0	—	10	15	—	20	
Propagation delay time	t <sub>pZL</sub>	R <sub>L</sub> = 1 kΩ	2.0	—	33	90	—	115	ns
			4.5	—	9	18	—	23	
			6.0	—	7	15	—	20	
Input capacitance	C <sub>IN</sub>	—	—	5	10	—	10	pF	
Output capacitance	C <sub>OUT</sub>	—	—	3	—	—	—	pF	
Power dissipation capacitance	C <sub>PD</sub> (Note)	—	—	7	—	—	—	pF	

Note: C<sub>PD</sub> 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:

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

## Package Dimensions

DIP14-P-300-2.54

Unit : mm



Weight: 0.96 g (typ.)

## Package Dimensions

SOP14-P-300-1.27A

Unit: mm

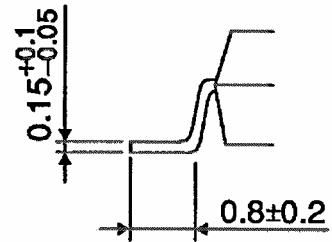
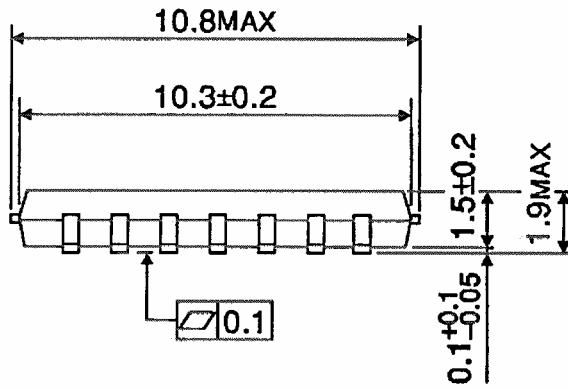
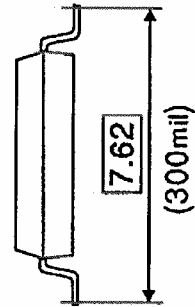
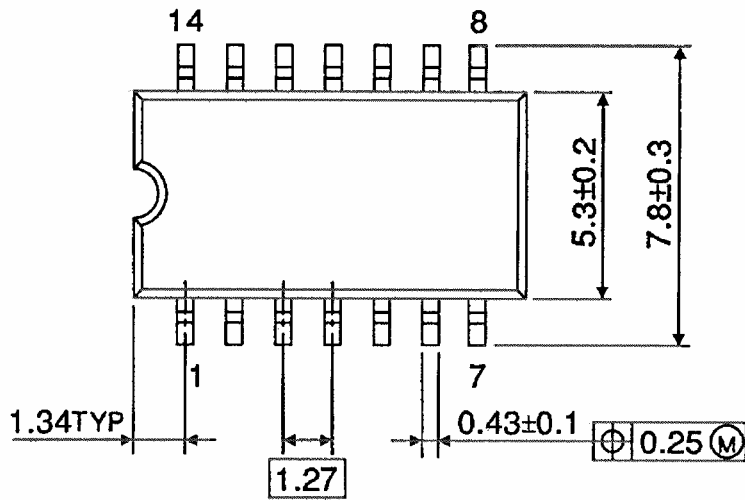


Weight: 0.18 g (typ.)

**Package Dimensions**

SOP14-P-300-1.27

Unit : mm



Weight: 0.18 g (typ.)

**Note: Lead (Pb)-Free Packages****DIP14-P-300-2.54 SOP14-P-300-1.27A****RESTRICTIONS ON PRODUCT USE**

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