CMOS Digital Integrated Circuits Silicon Monolithic

74HC05D

1. Functional Description

- Hex Inverter (Open Drain)

2. General

The 74HC05D 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.

Pin configuration and function are the same as the 74HC04D, but the 74HC05D 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.

3. Features

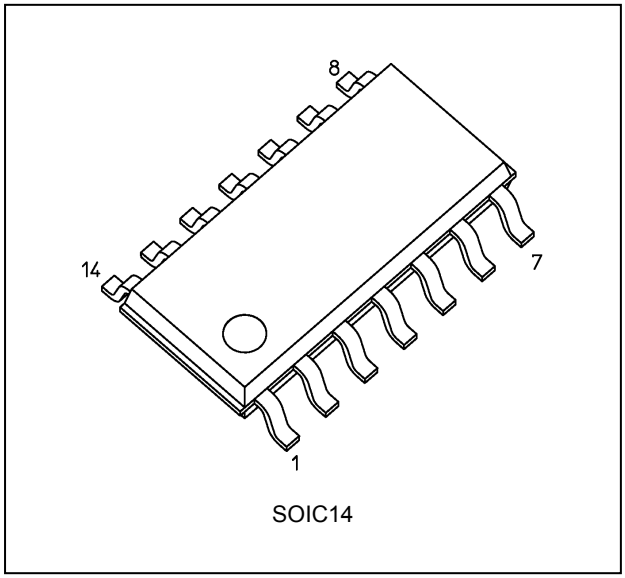
(1) High speed: t_{pz} = 8 ns (typ.) at V_{CC} = 5 V

(2) Low power dissipation: I_{CC} = 1.0 μA (max) at T_a = 25 °C

(3) Wide operating voltage range: $V_{CC(opr)}$ = 2.0 to 6.0 V

(4) Open drain structure

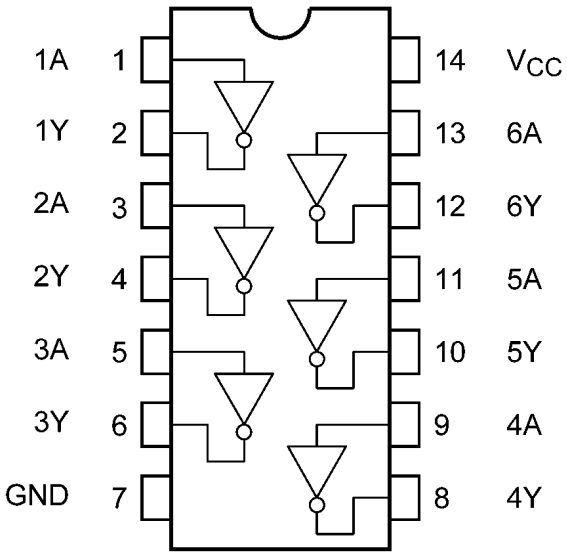
4. Packaging



SOIC14

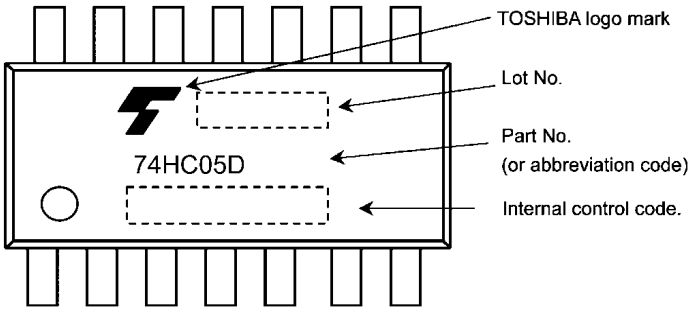
Start of commercial production
2016-05

5. Pin Assignment

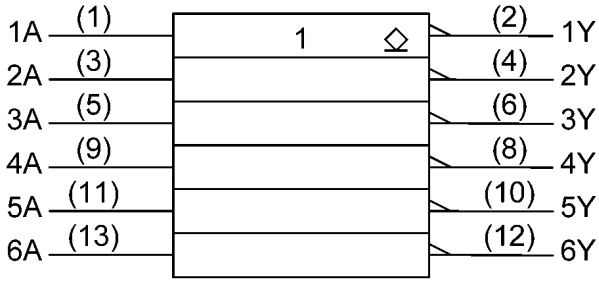


(top view)

6. Marking



7. IEC Logic Symbol

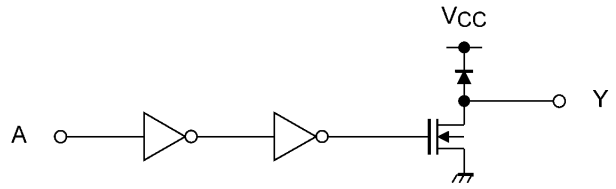


8. Truth Table

A	Y
L	Z
H	L

Z: High impedance

9. System Diagram (per gate)



10. 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}		±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	(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

11. Operating Ranges (Note)

Characteristics	Symbol	Test Condition	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 125	°C
Input rise and fall times	t_r,t_f	—	0 to 50	μs

Note: The operating ranges must be maintained to ensure the normal operation of the device.
Unused inputs and bus inputs must be tied to either V_{CC} or GND.

12. Electrical Characteristics

12.1. DC Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Test Condition		V_{CC} (V)	Min	Typ.	Max	Unit
High-level input voltage	V_{IH}	—		2.0	1.50	—	—	V
				4.5	3.15	—	—	
				6.0	4.20	—	—	
Low-level input voltage	V_{IL}	—		2.0	—	—	0.50	V
				4.5	—	—	1.35	
				6.0	—	—	1.80	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH}	I_{OL} = 20 μA	2.0	—	0.0	0.1	V
				4.5	—	0.0	0.1	
				6.0	—	0.0	0.1	
			I_{OL} = 4 mA	4.5	—	0.17	0.26	
			I_{OL} = 5.2 mA	6.0	—	0.18	0.26	
Output OFF-state leakage current	I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = V_{CC}		6.0	—	—	±0.5	μA
Input leakage current	I_{IN}	V_{IN} = V_{CC} or GND		6.0	—	—	±0.1	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		6.0	—	—	1.0	μA

12.2. DC Characteristics (Unless otherwise specified, T_a = -40 to 85 °C)

Characteristics	Symbol	Test Condition		V_{CC} (V)	Min	Max	Unit
High-level input voltage	V_{IH}	—		2.0	1.50	—	V
				4.5	3.15	—	
				6.0	4.20	—	
Low-level input voltage	V_{IL}	—		2.0	—	0.50	V
				4.5	—	1.35	
				6.0	—	1.80	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH}	I_{OL} = 20 μA	2.0	—	0.1	V
				4.5	—	0.1	
				6.0	—	0.1	
			I_{OL} = 4 mA	4.5	—	0.33	
			I_{OL} = 5.2 mA	6.0	—	0.33	
Output OFF-state leakage current	I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = V_{CC}		6.0	—	±5.0	μA
Input leakage current	I_{IN}	V_{IN} = V_{CC} or GND		6.0	—	±1.0	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		6.0	—	10.0	μA

12.3. DC Characteristics (Unless otherwise specified, T_a = -40 to 125 °C)

Characteristics	Symbol	Test Condition		V_{CC} (V)	Min	Max	Unit
High-level input voltage	V_{IH}	—		2.0	1.50	—	V
				4.5	3.15	—	
				6.0	4.20	—	
Low-level input voltage	V_{IL}	—		2.0	—	0.50	V
				4.5	—	1.35	
				6.0	—	1.80	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH}	I_{OL} = 20 μA	2.0	—	0.1	V
				4.5	—	0.1	
				6.0	—	0.1	
			I_{OL} = 4 mA	4.5	—	0.4	
			I_{OL} = 5.2 mA	6.0	—	0.4	
Output OFF-state leakage current	I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = V_{CC}		6.0	—	±10.0	μA
Input leakage current	I_{IN}	V_{IN} = V_{CC} or GND		6.0	—	±1.0	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		6.0	—	40.0	μA

12.4. AC Characteristics (Unless otherwise specified, C_L =15 pF, V_{CC} = 5 V, T_a = 25 °C, Input: t_r = t_f = 6 ns)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Output transition time	t_{TLH},t_{THL}	—	—	4	8	ns
Propagation delay time	t_{PLZ}	R_L = 1 kΩ	—	8	15	ns
	t_{PZL}		—	6	15	

12.5. AC Characteristics (Unless otherwise specified, C_L =50 pF, T_a = 25 °C, Input: t_r = t_f = 6 ns)

Characteristics	Symbol	Note	Test Condition	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_{PLZ}		R_L = 1kΩ	2.0	—	20	90	ns
				4.5	—	11	18	
				6.0	—	10	15	
Propagation delay time	t_{PZL}		R_L = 1kΩ	2.0	—	33	90	ns
				4.5	—	9	18	
				6.0	—	7	15	
Input capacitance	C_{IN}		—		—	5	10	pF
Output capacitance	C_{OUT}		—		—	3	—	pF
Power dissipation capacitance	C_{PD}	(Note 1)	—		—	7	—	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} × V_{CC} × f_{IN} + I_{CC}/6 (per gate)

12.6. AC Characteristics
(Unless otherwise specified, C_L =50 pF, T_a = -40 to 85 °C, Input: t_r = t_f = 6 ns)

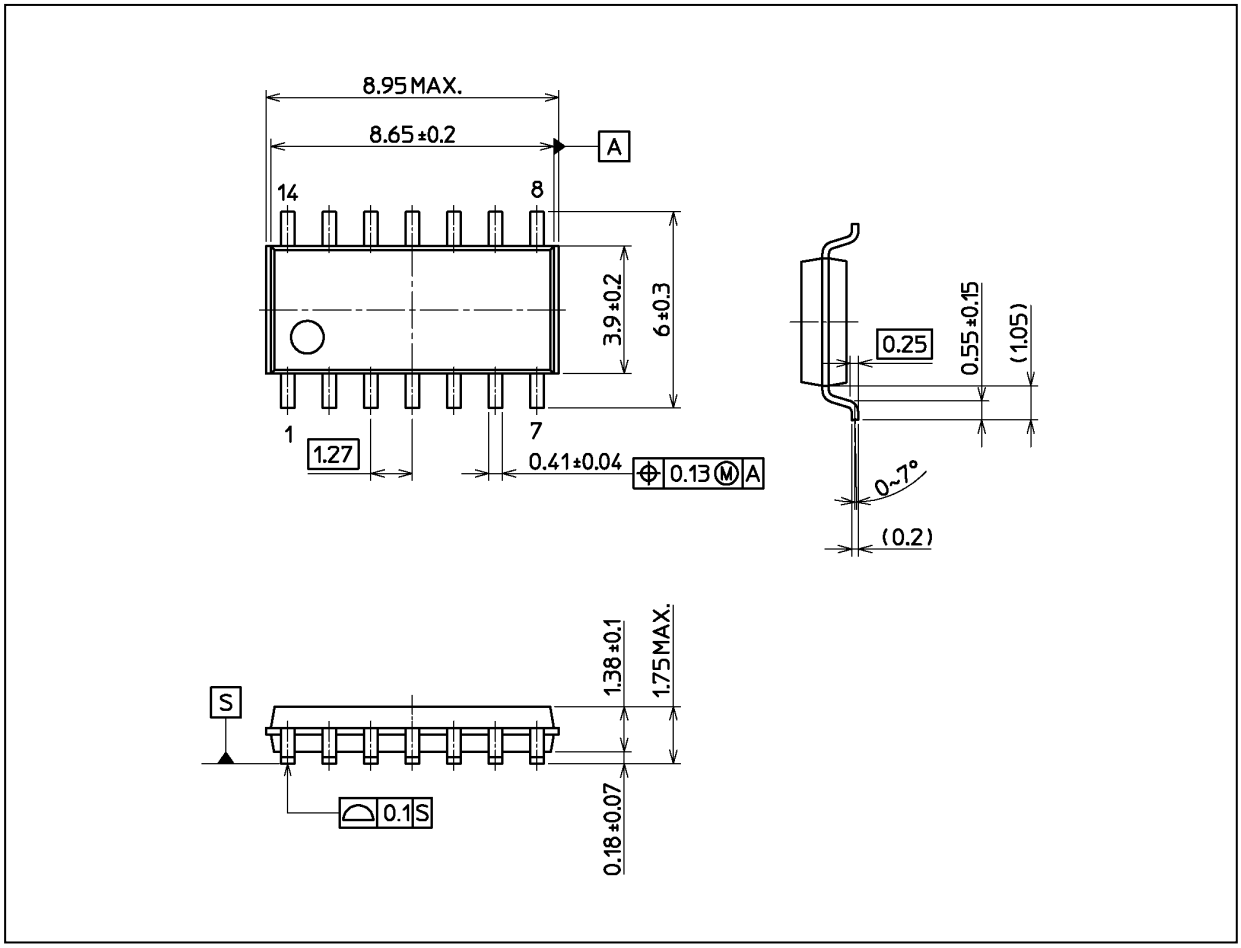
Characteristics	Symbol	Test Condition	V_{CC} (V)	Min	Max	Unit
Output transition time	t_{TLH},t_{THL}	—	2.0	—	95	ns
			4.5	—	19	
			6.0	—	16	
Propagation delay time	t_{PLZ}	R_L = 1kΩ	2.0	—	115	ns
			4.5	—	23	
			6.0	—	20	
Propagation delay time	t_{PZL}	R_L = 1kΩ	2.0	—	115	ns
			4.5	—	23	
			6.0	—	20	

12.7. AC Characteristics
(Unless otherwise specified, C_L =50 pF, T_a = -40 to 125 °C, Input: t_r = t_f = 6 ns)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Min	Max	Unit
Output transition time	t_{TLH},t_{THL}	—	2.0	—	110	ns
			4.5	—	22	
			6.0	—	19	
Propagation delay time	t_{PLZ}	R_L = 1 kΩ	2.0	—	135	ns
			4.5	—	27	
			6.0	—	23	
Propagation delay time	t_{PZL}	R_L = 1 kΩ	2.0	—	135	ns
			4.5	—	27	
			6.0	—	23	

Package Dimensions

Unit: mm



Weight: 0.13 g (typ.)

Package Name(s)
Nickname: SOIC14

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