

CMOS Digital Integrated Circuits Silicon Monolithic

# 74HC4049D,74HC4050D

## 1. Functional Description

- Hex Buffer
- 74HC4049D: HEX BUFFER/CONVERTER (INVERTING)
- 74HC4050D: HEX BUFFER/CONVERTER

## 2. General

The 74HC4049D and 74HC4050D are high speed CMOS HEX BUFFERS fabricated with silicon gate C<sup>2</sup>MOS technology.

They achieve the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

The 74HC4049D is an inverting buffer, while the 74HC4050D is a non-inverting buffer. The internal circuits are composed of 3-stages (74HC4049D) or 2-stages (74HC4050D) of inverter, which provided high noise immunity and stable output.

Input protection circuits are different from those of other high speed CMOS IC's. They eliminate the diodes on the V<sub>CC</sub> side thus providing of logic-level conversion from high-level voltages up to 15 V to low-level voltages.

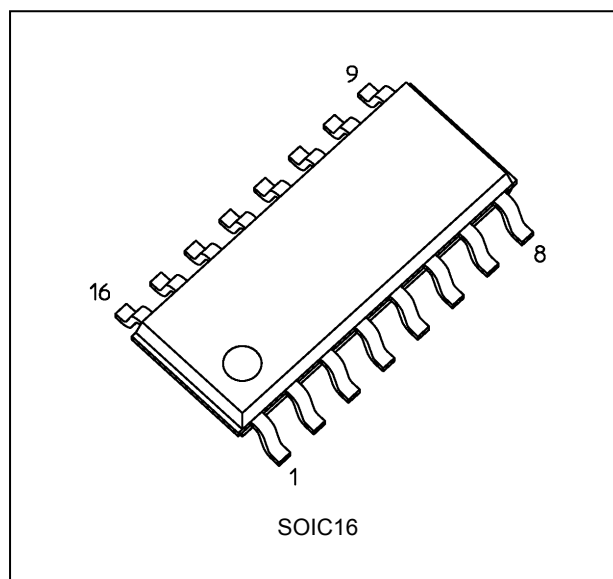
They are useful for battery back up circuits, because input voltage can be applied on IC's which are not biased by V<sub>CC</sub>.

## 3. Features

- (1) Wide operating temperature range: T<sub>opr</sub> = -40 to 125 °C (Note 1)
- (2) High speed: t<sub>pd</sub> = 8 ns (typ.) at V<sub>CC</sub> = 6.0 V
- (3) Low power dissipation: I<sub>CC</sub> = 1.0 μA (max) at T<sub>a</sub> = 25 °C
- (4) Balanced propagation delays: t<sub>PLH</sub> ≈ t<sub>PHL</sub>
- (5) Wide operating voltage range: V<sub>CC(opr)</sub> = 2.0 V to 6.0 V

Note 1: Operating Range spec of T<sub>opr</sub> = -40 °C to 125 °C is applicable only for the products which manufactured after July 2020.

## 4. Packaging

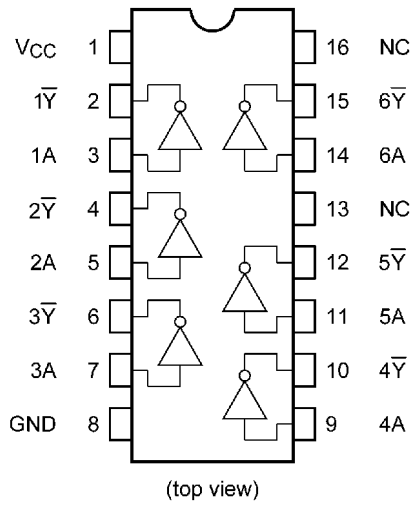


Start of commercial production

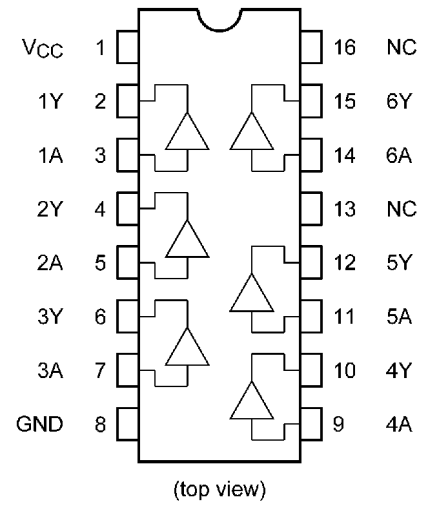
2020-07

### 5. Pin Assignment

74HC4049D

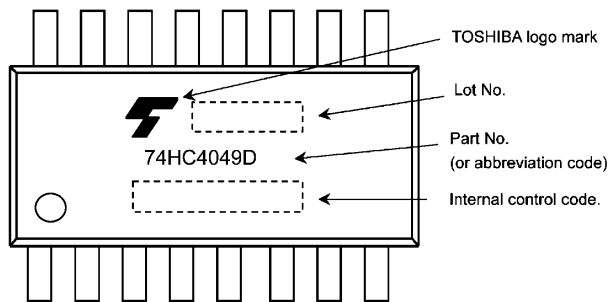


74HC4050D

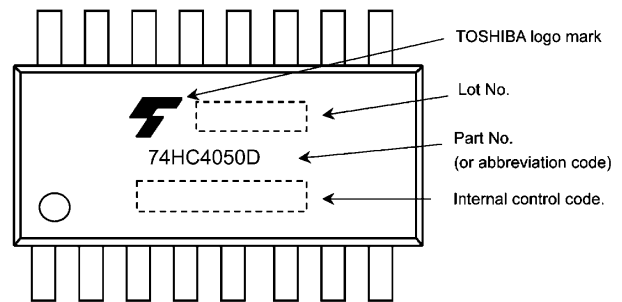


### 6. Marking

74HC4049D

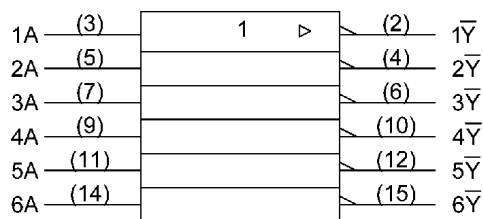


74HC4050D

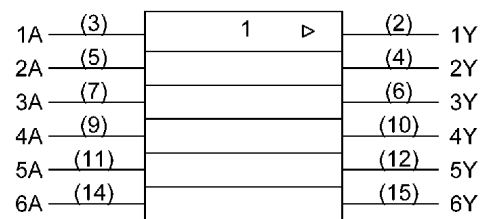


### 7. IEC Logic Symbol

74HC4049D



74HC4050D

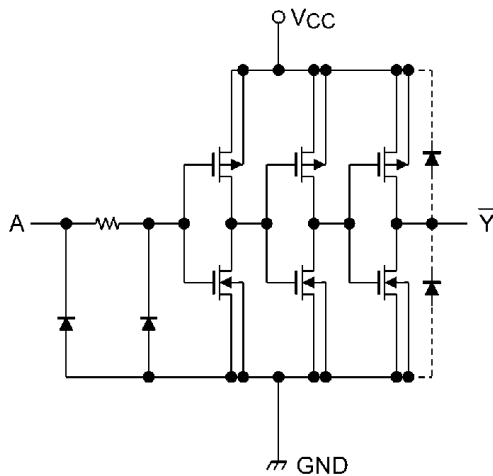


### 8. Truth Table

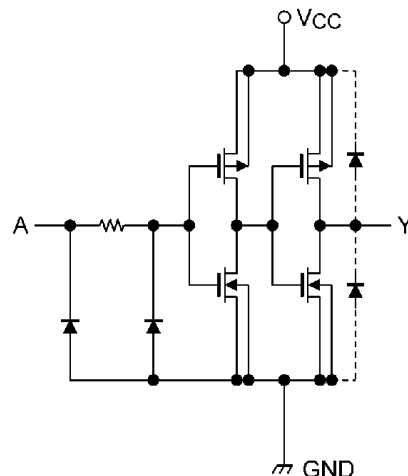
Input A	Output $\bar{Y}$ (74HC4049D)	Output Y (74HC4050D)
L	H	L
H	L	H

### 9. Internal Equivalent Circuit

74HC4049D



74HC4050D



### 10. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	$V_{CC}$		-0.5 to 7.0	V
Input voltage	$V_{IN}$	(Note 1)	-0.5 to 18.0	V
Output voltage	$V_{OUT}$		-0.5 to $V_{CC} + 0.5$	V
Input diode current	$I_{IK}$		-20	mA
Output diode current	$I_{OK}$		$\pm 20$	mA
Output current	$I_{OUT}$		$\pm 35$	mA
$V_{CC}$ /ground current	$I_{CC}$		$\pm 75$	mA
Power dissipation	$P_D$	(Note 2)	500	mW
Storage temperature	$T_{stg}$		-65 to 150	$^{\circ}\text{C}$

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: DC input voltage ( $V_{IN}$ ) specified is measured to GND and is not related to  $V_{CC}$ .

Recommended operating range is 0 V to 15 V and it is possible to convert logic-levels from 15 V to 5 V or 5 V to 2 V.

Note 2:  $P_D$  derates linearly with -8 mW/ $^{\circ}\text{C}$  above 85  $^{\circ}\text{C}$

### 11. Operating Ranges (Note)

Characteristics	Symbol	Test Condition	Note	Rating	Unit
Supply voltage	$V_{CC}$			2.0 to 6.0	V
Input voltage	$V_{IN}$			0 to 15.0	V
Output voltage	$V_{OUT}$			0 to $V_{CC}$	V
Operating temperature	$T_{opr}$		(Note 1)	-40 to 125	°C
Input rise and fall times	$t_r, t_f$	$V_{CC} = 2.0\text{ V}$		0 to 1000	ns
		$V_{CC} = 4.5\text{ V}$		0 to 500	
		$V_{CC} = 6.0\text{ V}$		0 to 400	

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.

Note 1: Operating Range spec of  $T_{opr} = -40\text{ °C}$  to  $125\text{ °C}$  is applicable only for the products which manufactured after July 2020.

### 12. Electrical Characteristics

#### 12.1. DC Characteristics (Unless otherwise specified, $T_a = 25\text{ °C}$ )

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		
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -20\text{ }\mu\text{A}$	2.0	1.9	2.0	—	V
				4.5	4.4	4.5	—	
			$I_{OH} = -6\text{ mA}$	4.5	4.18	4.31	—	
				6.0	5.68	5.80	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 20\text{ }\mu\text{A}$	2.0	—	0.0	0.1	V
				4.5	—	0.0	0.1	
				6.0	—	0.0	0.1	
			$I_{OL} = 6\text{ mA}$	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	—	—	$\pm 0.1$	$\mu\text{A}$	
		$V_{IN} = 15\text{ V}$	6.0	—	—	$\pm 0.5$	$\mu\text{A}$	
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND	6.0	—	—	1.0	$\mu\text{A}$	

### 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		
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -20$ $\mu$ A	2.0	1.9	—	V
				4.5	4.4	—	
			$I_{OH} = -6$ mA	4.5	4.13	—	
				6.0	5.63	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 20$ $\mu$ A	2.0	—	0.1	V
				4.5	—	0.1	
				6.0	—	0.1	
			$I_{OL} = 6$ mA	4.5	—	0.33	
				6.0	—	0.33	
Input leakage current	$I_{IN}$	$V_{IN} = V_{CC}$ or GND	6.0	—	$\pm 1.0$	$\mu$ A	
		$V_{IN} = 15$ V	6.0	—	$\pm 5.0$	$\mu$ A	
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND	6.0	—	10.0	$\mu$ A	

### 12.3. DC Characteristics (Note) (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		
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -20$ $\mu$ A	2.0	1.9	—	V
				4.5	4.4	—	
			$I_{OH} = -6$ mA	4.5	3.7	—	
				6.0	5.2	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 20$ $\mu$ A	2.0	—	0.1	V
				4.5	—	0.1	
				6.0	—	0.1	
			$I_{OL} = 6$ mA	4.5	—	0.4	
				6.0	—	0.4	
Input leakage current	$I_{IN}$	$V_{IN} = V_{CC}$ or GND	6.0	—	$\pm 1.0$	$\mu$ A	
		$V_{IN} = 15$ V	6.0	—	$\pm 5.0$	$\mu$ A	
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND	6.0	—	20.0	$\mu$ A	

Note: Operating Range spec of  $T_{opr} = -40$  °C to  $125$  °C is applicable only for the products which manufactured after July 2020.

### 12.4. AC Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ , Input: $t_r = t_f = 6\text{ ns}$ )

Characteristics	Symbol	Note	Test Condition	$C_L$ (pF)	$V_{CC}$ (V)	Min	Typ.	Max	Unit
Output transition time	$t_{TLH}, t_{THL}$		—	50	2.0	—	25	60	ns
					4.5	—	6	12	
					6.0	—	5	10	
Propagation delay time	$t_{PLH}, t_{PHL}$		—	50	2.0	—	30	75	ns
					4.5	—	9	15	
					6.0	—	8	13	
				150	2.0	—	45	100	
					4.5	—	14	20	
					6.0	—	12	17	
Input capacitance	$C_{IN}$		—		—	5	10	pF	
Power dissipation capacitance	$C_{PD}$	(Note 1)	—		—	26	—	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.

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

### 12.5. AC Characteristics (Unless otherwise specified, $T_a = -40\text{ to }85\text{ }^\circ\text{C}$ , Input: $t_r = t_f = 6\text{ ns}$ )

Characteristics	Symbol	Test Condition	$C_L$ (pF)	$V_{CC}$ (V)	Min	Max	Unit
Output transition time	$t_{TLH}, t_{THL}$	—	50	2.0	—	75	ns
				4.5	—	15	
				6.0	—	13	
Propagation delay time	$t_{PLH}, t_{PHL}$	—	50	2.0	—	95	ns
				4.5	—	19	
				6.0	—	16	
			150	2.0	—	145	
				4.5	—	29	
				6.0	—	25	
Input capacitance	$C_{IN}$	—		—	10	pF	

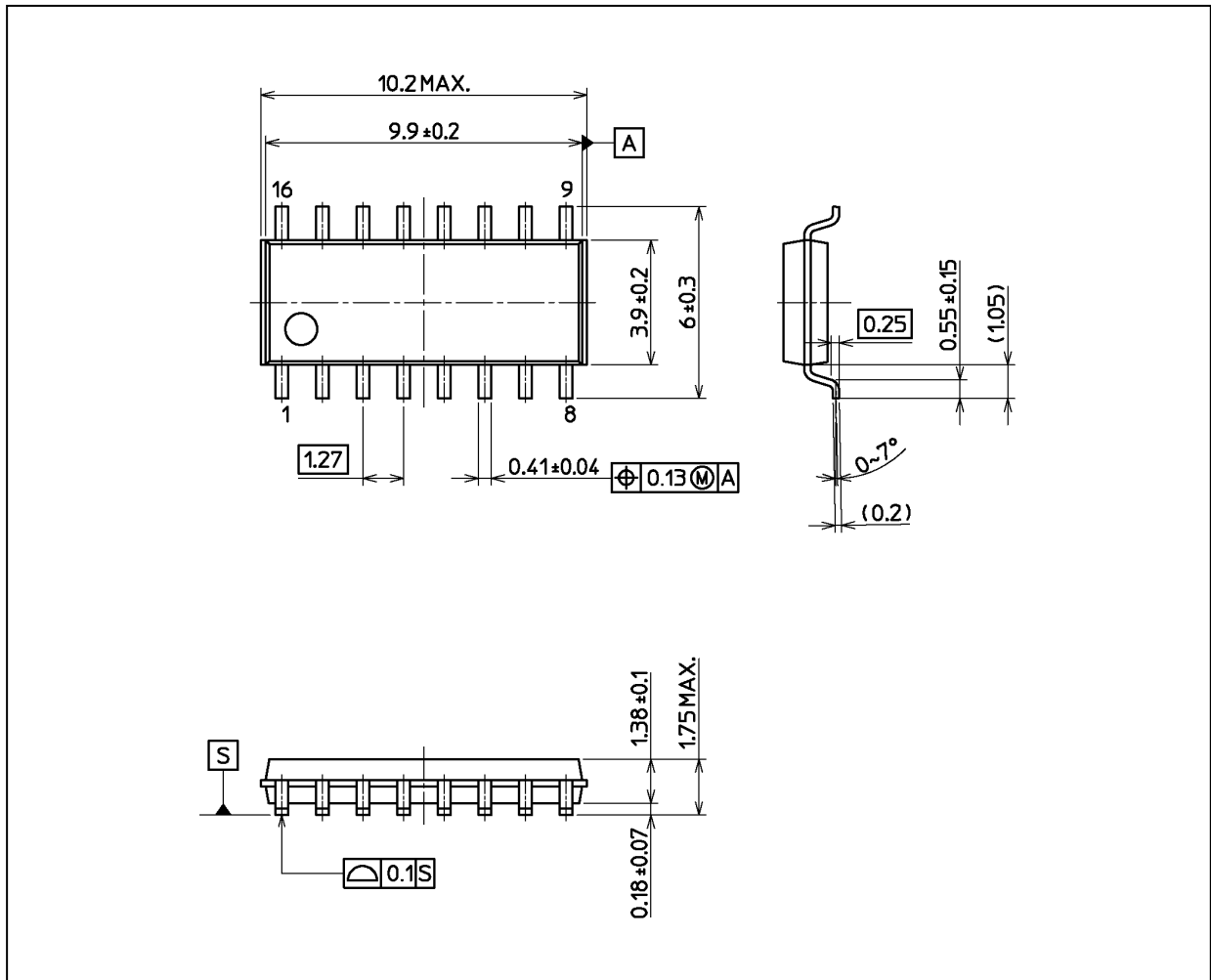
### 12.6. AC Characteristics (Note) (Unless otherwise specified, $T_a = -40\text{ to }125\text{ }^\circ\text{C}$ , Input: $t_r = t_f = 6\text{ ns}$ )

Characteristics	Symbol	Test Condition	$C_L$ (pF)	$V_{CC}$ (V)	Min	Max	Unit
Output transition time	$t_{TLH}, t_{THL}$	—	50	2.0	—	85	ns
				4.5	—	17	
				6.0	—	15	
Propagation delay time	$t_{PLH}, t_{PHL}$	—	50	2.0	—	110	ns
				4.5	—	22	
				6.0	—	18	
			150	2.0	—	175	
				4.5	—	35	
				6.0	—	31	
Input capacitance	$C_{IN}$	—		—	10	pF	

Note: Operating Range spec of  $T_{opr} = -40\text{ }^\circ\text{C}$  to  $125\text{ }^\circ\text{C}$  is applicable only for the products which manufactured after July 2020.

## Package Dimensions

Unit: mm



Weight: 0.15 g (typ.)

Package Name(s)
Nickname: SOIC16

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