

CMOS Digital Integrated Circuits Silicon Monolithic

# 74HC540D,74HC541D

## 1. Functional Description

- Octal Bus Buffer
- 74HC540D: INVERTING, 3-STATE OUTPUTS
- 74HC541D: NON-INVERTING, 3-STATE OUTPUTS

## 2. General

The 74HC540D/74HC541D are high speed CMOS OCTAL BUS 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 74HC540D is an inverting type, and the 74HC541D is a non-inverting type.

When either  $\overline{G1}$  or  $\overline{G2}$  are high, the terminal outputs are in the high-impedance state.

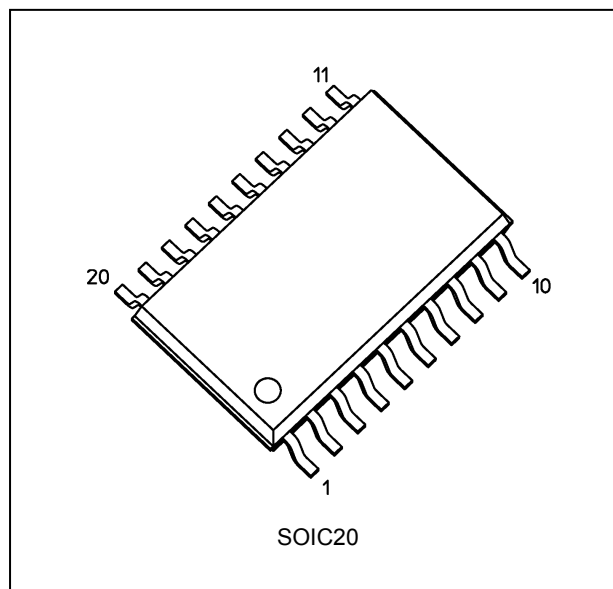
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

## 3. Features

- (1) Wide operating temperature range:  $T_{opr} = -40$  to  $125$  °C (Note 1)
- (2) High speed:  $t_{pd} = 10$  ns (typ.) at  $V_{CC} = 6.0$  V
- (3) Low power dissipation:  $I_{CC} = 4.0$   $\mu$ A (max) at  $T_a = 25$  °C
- (4) Balanced propagation delays:  $t_{PLH} \approx t_{PHL}$
- (5) Wide operating voltage range:  $V_{CC(opr)} = 2.0$  V to  $6.0$  V

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

## 4. Packaging

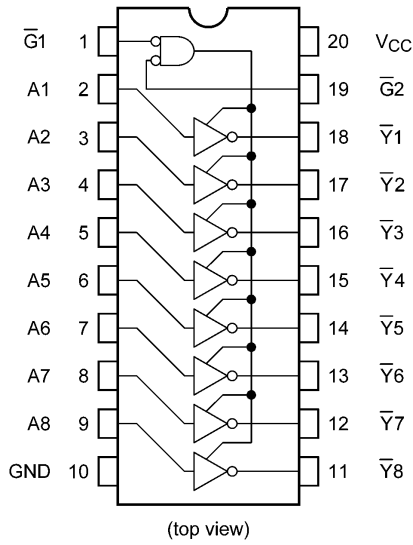


Start of commercial production

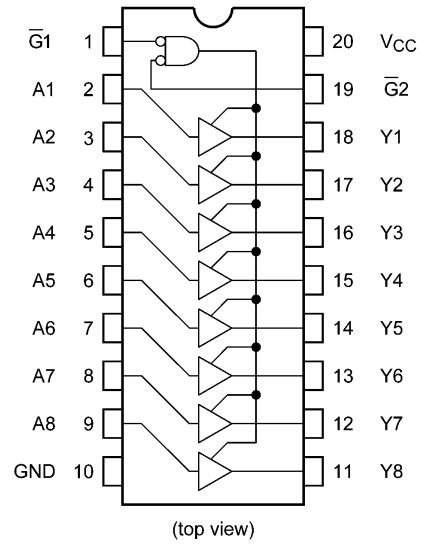
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### 5. Pin Assignment

74HC540D

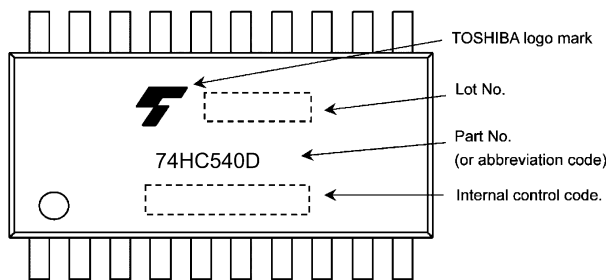


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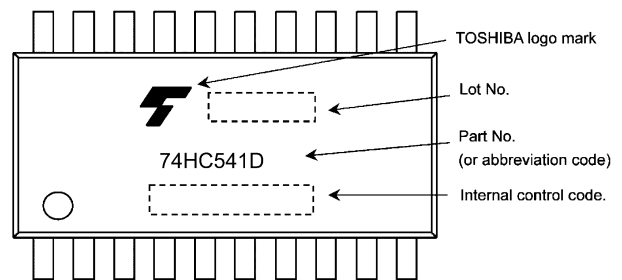


### 6. Marking

74HC540D

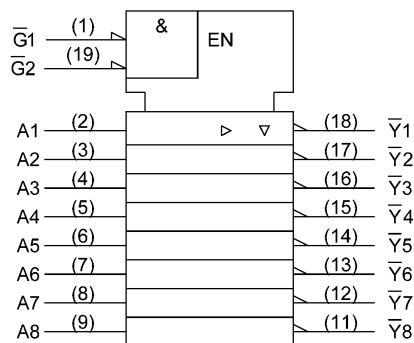


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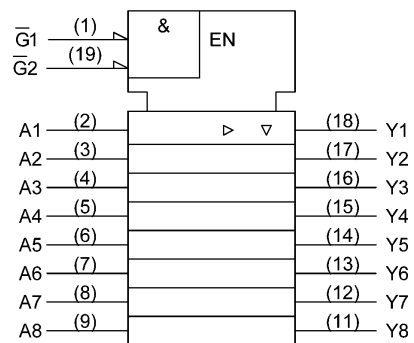


### 7. IEC Logic Symbol

74HC540D



74HC541D



### 8. Truth Table

Input $\bar{G}1$	Input $\bar{G}2$	Input $A_n$	Output $Y_n$	Output $\bar{Y}_n$
H	X	X	Z	Z
X	H	X	Z	Z
L	L	H	H	L
L	L	L	L	H

X: Don't care

Z: High impedance

$Y_n$ : 74HC541D

$\bar{Y}_n$ : 74HC540D

### 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	$I_{OUT}$		$\pm 35$	mA
$V_{CC}$ /ground current	$I_{CC}$		$\pm 75$	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

### 10. 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 $V_{CC}$	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.

### 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	
			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	—	
			6.0	5.9	6.0	—		
			$I_{OH} = -6\text{ mA}$	4.5	4.18	4.31	—	
			$I_{OH} = -7.8\text{ mA}$	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	
			$I_{OL} = 7.8\text{ mA}$	6.0	—	0.18	0.26	
3-state output OFF-state leakage current	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = V_{CC}$ or GND	6.0	—	—	$\pm 0.5$	$\mu\text{A}$	
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	—	—	4.0	$\mu\text{A}$	

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

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Min	Max	Unit	
High-level input voltage	$V_{IH}$	—	2.0	1.50	—	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	—	V
				4.5	4.4	—	
				6.0	5.9	—	
			$I_{OH} = -6\text{ mA}$	4.5	4.13	—	
			$I_{OH} = -7.8\text{ mA}$	6.0	5.63	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 20\text{ }\mu\text{A}$	2.0	—	0.1	V
				4.5	—	0.1	
				6.0	—	0.1	
			$I_{OL} = 6\text{ mA}$	4.5	—	0.33	
			$I_{OL} = 7.8\text{ mA}$	6.0	—	0.33	
3-state output OFF-state leakage current	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = V_{CC}$ or GND	6.0	—	$\pm 5.0$	$\mu\text{A}$	
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	—	40.0	$\mu\text{A}$	

### 11.3. 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	—	
				6.0	5.9	—	
			$I_{OH} = -6$ 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	
3-state output OFF-state leakage current	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = V_{CC}$ or GND	6.0	—	$\pm 5.0$	$\mu$ A	
Input leakage current	$I_{IN}$	$V_{IN} = V_{CC}$ or GND	6.0	—	$\pm 1.0$	$\mu$ A	
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND	6.0	—	80.0	$\mu$ A	

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

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

Characteristics	Part Number	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	—	7	12	
						6.0	—	6	10	
Propagation delay time		$t_{PLH}, t_{PHL}$			50	2.0	—	36	90	ns
						4.5	—	12	18	
						6.0	—	10	15	
					150	2.0	—	51	130	
						4.5	—	17	26	
						6.0	—	14	22	
Output enable time		$t_{PZL}, t_{PZH}$		$R_L = 1\text{ k}\Omega$	50	2.0	—	45	125	ns
						4.5	—	14	25	
						6.0	—	12	21	
					150	2.0	—	60	165	
						4.5	—	19	33	
						6.0	—	16	28	
Output disable time		$t_{PLZ}, t_{PHZ}$		$R_L = 1\text{ k}\Omega$	50	2.0	—	40	125	ns
						4.5	—	16	25	
						6.0	—	14	21	
Input capacitance		$C_{IN}$		—		—	5	10	pF	
Output capacitance		$C_{OUT}$		—		—	10	—	pF	
Power dissipation capacitance	74HC540D	$C_{PD}$	(Note 1)	—			—	32	—	pF
	74HC541D							—	35	

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.

$$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/8 \text{ (per bit)}$$

### 11.5. 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	—	115	ns
				4.5	—	23	
				6.0	—	20	
			150	2.0	—	165	
				4.5	—	33	
				6.0	—	28	
Output enable time	$t_{PZL}, t_{PZH}$	$R_L = 1\text{ k}\Omega$	50	2.0	—	155	ns
				4.5	—	31	
				6.0	—	26	
			150	2.0	—	205	
				4.5	—	41	
				6.0	—	35	
Output disable time	$t_{PLZ}, t_{PHZ}$	$R_L = 1\text{ k}\Omega$	50	2.0	—	155	ns
				4.5	—	31	
				6.0	—	26	
Input capacitance	$C_{IN}$	—			—	10	pF

### 11.6. AC Characteristics (Note)

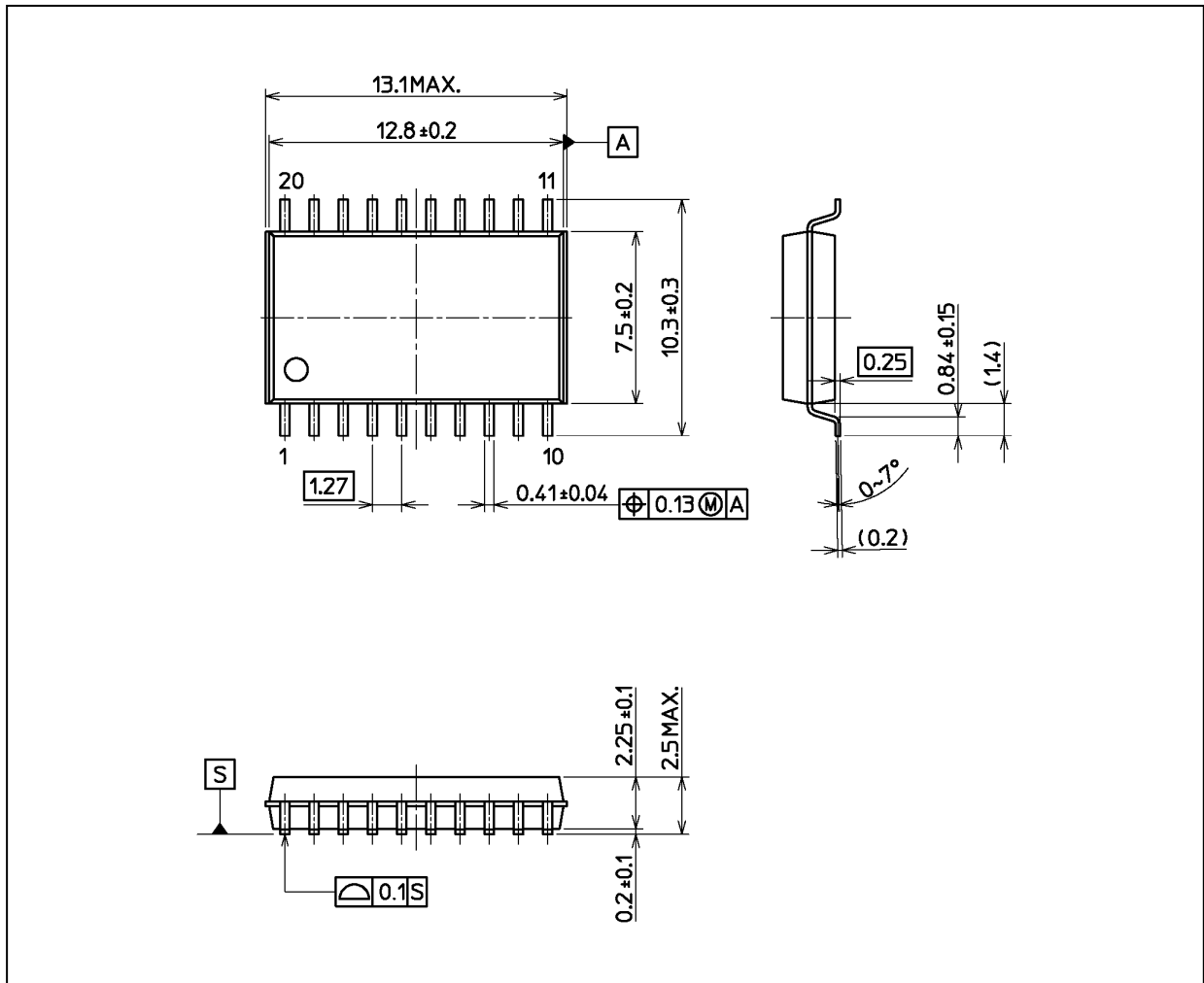
(Unless otherwise specified,  $T_a = -40$  to  $125$  °C, Input:  $t_r = t_f = 6$  ns)

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	—	135	ns
				4.5	—	27	
				6.0	—	24	
			150	2.0	—	190	
				4.5	—	38	
				6.0	—	32	
Output enable time	$t_{PZL}, t_{PZH}$	$R_L = 1$ k $\Omega$	50	2.0	—	175	ns
				4.5	—	35	
				6.0	—	30	
			150	2.0	—	235	
				4.5	—	47	
				6.0	—	40	
Output disable time	$t_{PLZ}, t_{PHZ}$	$R_L = 1$ k $\Omega$	50	2.0	—	175	ns
				4.5	—	35	
				6.0	—	30	
Input capacitance	$C_{IN}$	—			—	10	pF

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

## Package Dimensions

Unit: mm



Weight: 0.51 g (typ.)

Package Name(s)
Nickname: SOIC20



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