

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC74HC540AP, TC74HC540AF, TC74HC541AP, TC74HC541AF

Octal Bus Buffer

TC74HC540AP/AF

Inverting, 3-State Outputs

TC74HC541AP/AF

Non-Inverting,  
3-State Outputs

The TC74HC540A/TC74HC541A 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.

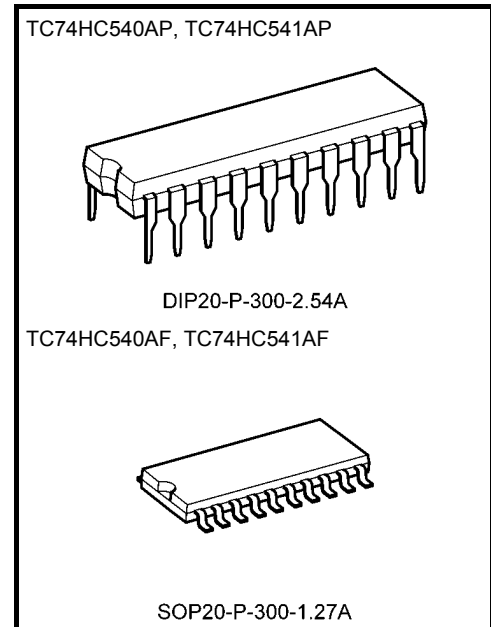
The TC74HC540A is an inverting type, and the TC74HC541A is a non-inverting type.

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.

### Features

- High speed:  $t_{pd} = 10 \text{ ns}$  (typ.) at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 4 \mu\text{A}$  (max) at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)
- Output Drive Capability: 15 LSTTL loads
- Symmetrical output impedance:  $|I_{OH}| = I_{OL} = 6 \text{ mA}$  (min)
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $V_{CC} (\text{opr}) = 2 \text{ to } 6 \text{ V}$
- Pin and function compatible with 74LS540/541

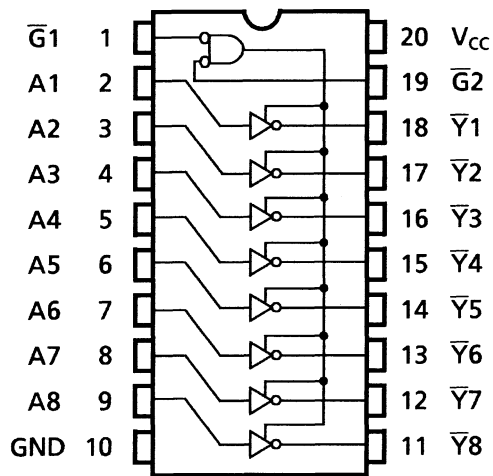


Weight

|                   |                 |
|-------------------|-----------------|
| DIP20-P-300-2.54A | : 1.30 g (typ.) |
| SOP20-P-300-1.27A | : 0.22 g (typ.) |

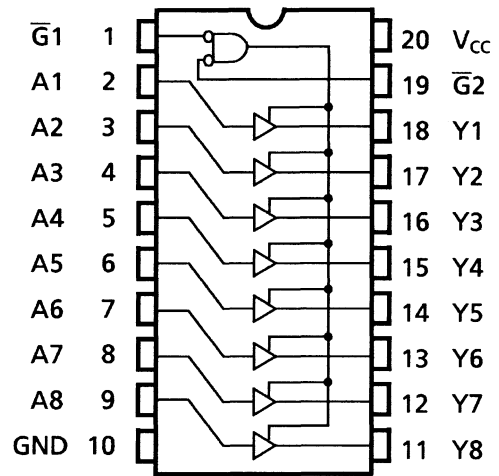
## Pin Assignment

TC74HC540A



(TOP VIEW)

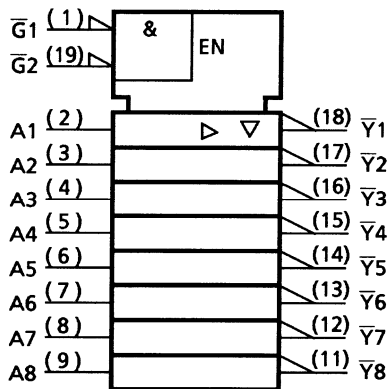
TC74HC541A



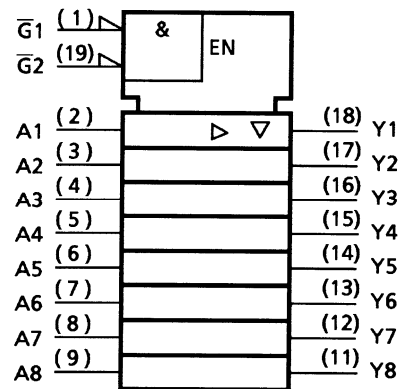
(TOP VIEW)

## IEC Logic Symbol

TC74HC540A



TC74HC541A



## Truth Table

| Inputs          |                 |                | Outputs          |                    |
|-----------------|-----------------|----------------|------------------|--------------------|
| $\overline{G1}$ | $\overline{G2}$ | A <sub>n</sub> | Y <sub>n</sub> * | $\overline{Y}_n$ * |
| 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<sub>n</sub> ..... HC541

$\overline{Y}_n$  ..... HC540

## Absolute Maximum Ratings (Note 1)

| Characteristics             | Symbol    | Rating                       | Unit               |
|-----------------------------|-----------|------------------------------|--------------------|
| Supply voltage range        | $V_{CC}$  | -0.5 to 7                    | V                  |
| DC input voltage            | $V_{IN}$  | -0.5 to $V_{CC} + 0.5$       | V                  |
| DC 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                 |
| DC output current           | $I_{OUT}$ | $\pm 35$                     | mA                 |
| DC $V_{CC}$ /ground current | $I_{CC}$  | $\pm 75$                     | mA                 |
| Power dissipation           | $P_D$     | 500 (DIP) (Note 2)/180 (SOP) | mW                 |
| Storage temperature         | $T_{stg}$ | -65 to 150                   | $^{\circ}\text{C}$ |

Note 1: 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 2: 500 mW in the range of  $T_a = -40$  to  $65^{\circ}\text{C}$ . From  $T_a = 65$  to  $85^{\circ}\text{C}$  a derating factor of  $-10$  mW/ $^{\circ}\text{C}$  shall be applied until 300 mW.

## Operating Ranges (Note)

| Characteristics          | Symbol     | Rating  | Unit               |
|--------------------------|------------|---|--------------------|
| Supply voltage           | $V_{CC}$   | 2 to 6  | 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   | $^{\circ}\text{C}$ |
| Input rise and fall time | $t_r, t_f$ | 0 to 1000 ( $V_{CC} = 2.0$ V)<br>0 to 500 ( $V_{CC} = 4.5$ V)<br>0 to 400 ( $V_{CC} = 6.0$ V) | ns                 |

Note: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs must be tied to either VCC or GND.

## Electrical Characteristics

### DC Characteristics

| Characteristics                  | Symbol          | Test Condition  |                          | Ta = 25°C                 |      |      | Ta = -40 to 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 |     |
| High-level output voltage        | V <sub>OH</sub> | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>  | I <sub>OH</sub> = -20 μA | 2.0                       | 1.9  | 2.0  | —                | 1.9  | —    | V   |
|                                  |                 |   |                          | 4.5                       | 4.4  | 4.5  | —                | 4.4  | —    |     |
|                                  |                 |   |                          | 6.0                       | 5.9  | 6.0  | —                | 5.9  | —    |     |
|                                  |                 |   | I <sub>OH</sub> = -6 mA  | 4.5                       | 4.18 | 4.31 | —                | 4.13 | —    |     |
|                                  |                 |   |                          | 6.0                       | 5.68 | 5.80 | —                | 5.63 | —    |     |
|                                  |                 |   |                          | I <sub>OH</sub> = -7.8 mA | 4.5  | 4.18 | 4.31             | —    | 4.13 |     |
| Low-level output voltage         | V <sub>OL</sub> | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>  | I <sub>OL</sub> = 20 μA  | 2.0                       | —    | 0.0  | 0.1              | —    | 0.1  | V   |
|                                  |                 |   |                          | 4.5                       | —    | 0.0  | 0.1              | —    | 0.1  |     |
|                                  |                 |   |                          | 6.0                       | —    | 0.0  | 0.1              | —    | 0.1  |     |
|                                  |                 |   | I <sub>OL</sub> = 6 mA   | 4.5                       | —    | 0.17 | 0.26             | —    | 0.33 |     |
|                                  |                 |   |                          | 6.0                       | —    | 0.18 | 0.26             | —    | 0.33 |     |
|                                  |                 |   |                          | I <sub>OL</sub> = 7.8 mA  | 4.5  | —    | 0.17             | 0.26 | —    |     |
| 3-state output off-state current | I <sub>OZ</sub> | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>OUT</sub> = V <sub>CC</sub> or GND |                          | 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                       | —    | —    | 4.0              | —    | 40.0 | μA  |

## AC Characteristics (input: $t_r = t_f = 6$ ns)

| Characteristics               | Symbol                 | Test Condition       | Ta = 25°C |         |     | Ta = -40 to 85°C |     | Unit |     |     |
|-------------------------------|------------------------|----------------------|-----------|---------|-----|------------------|-----|------|-----|-----|
|                               |                        |                      | CL (pF)   | VCC (V) | Min | Typ.             | Max |      | Min | Max |
| Output transition time        | $t_{TLH}$<br>$t_{THL}$ | —                    | 50        | 2.0     | —   | 25               | 60  | —    | 75  | ns  |
|                               |                        |                      |           | 4.5     | —   | 7                | 12  | —    | 15  |     |
|                               |                        |                      |           | 6.0     | —   | 6                | 10  | —    | 13  |     |
| Propagation delay time        | $t_{pLH}$<br>$t_{pHL}$ | —                    | 50        | 2.0     | —   | 36               | 90  | —    | 115 | ns  |
|                               |                        |                      |           | 4.5     | —   | 12               | 18  | —    | 23  |     |
|                               |                        |                      |           | 6.0     | —   | 10               | 15  | —    | 20  |     |
|                               |                        |                      | 150       | 2.0     | —   | 51               | 130 | —    | 165 |     |
|                               |                        |                      |           | 4.5     | —   | 17               | 26  | —    | 33  |     |
|                               |                        |                      |           | 6.0     | —   | 14               | 22  | —    | 28  |     |
| Output enable time            | $t_{pZL}$<br>$t_{pZH}$ | $R_L = 1$ k $\Omega$ | 50        | 2.0     | —   | 45               | 125 | —    | 155 | ns  |
|                               |                        |                      |           | 4.5     | —   | 14               | 25  | —    | 31  |     |
|                               |                        |                      |           | 6.0     | —   | 12               | 21  | —    | 26  |     |
|                               |                        |                      | 150       | 2.0     | —   | 60               | 165 | —    | 205 |     |
|                               |                        |                      |           | 4.5     | —   | 19               | 33  | —    | 41  |     |
|                               |                        |                      |           | 6.0     | —   | 16               | 28  | —    | 35  |     |
| Output disable time           | $t_{pLZ}$<br>$t_{pHZ}$ | $R_L = 1$ k $\Omega$ | 50        | 2.0     | —   | 40               | 125 | —    | 155 | ns  |
|                               |                        |                      |           | 4.5     | —   | 16               | 25  | —    | 31  |     |
|                               |                        |                      |           | 6.0     | —   | 14               | 21  | —    | 26  |     |
| Input capacitance             | $C_{IN}$               | —                    | —         | —       | 5   | 10               | —   | 10   | pF  |     |
| Output capacitance            | $C_{OUT}$              | —                    | —         | —       | 10  | —                | —   | —    | pF  |     |
| Power dissipation capacitance | $C_{PD}$<br>(Note)     | TC74HC540A           | —         | —       | 32  | —                | —   | —    | pF  |     |
|                               |                        | TC74HC541A           | —         | —       | 35  | —                | —   | —    |     |     |

Note:  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

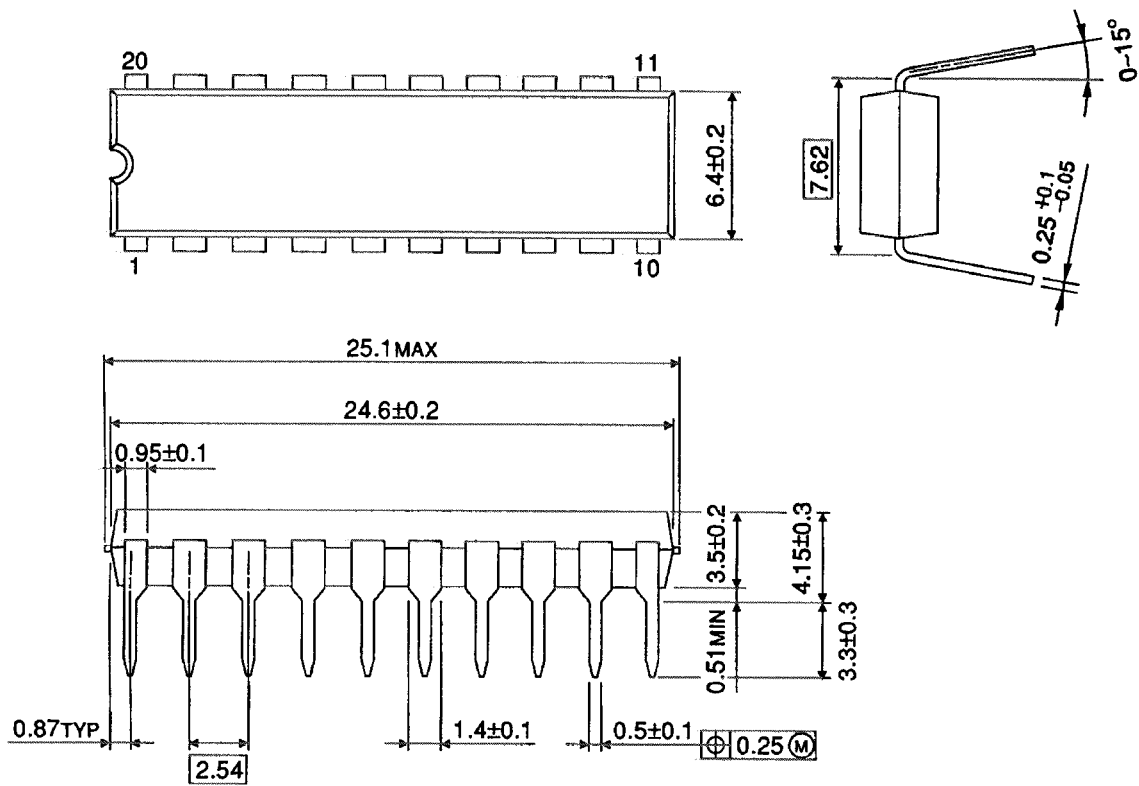
Average operating current can be obtained by the equation:

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

## Package Dimensions

DIP20-P-300-2.54A

Unit : mm



Weight: 1.30 g (typ.)

**Package Dimensions**

SOP20-P-300-1.27A

Unit: mm



Weight: 0.22 g (typ.)

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