



### HC540 OCTAL BUS BUFFER INVERTING (3-STATE)

### HC541 OCTAL BUS BUFFER (3-STATE)

- **HIGH SPEED**  
 $t_{PD} = 11 \text{ ns (TYP.)}$  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**  
 $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (MIN.)}$
- **OUTPUT DRIVE CAPABILITY**  
15 LSTTL LOADS
- **SYMMETRICAL OUTPUT IMPEDANCE**  
 $|I_{OH}| = |I_{OL}| = 6 \text{ mA (MIN.)}$
- **BALANCED PROPAGATION DELAYS**  
 $t_{PLH} = t_{PHL}$
- **WIDE OPERATING VOLTAGE RANGE**  
 $V_{CC} \text{ (OPR)} = 2 \text{ V to } 6 \text{ V}$
- **PIN AND FUNCTION COMPATIBLE**  
WITH 54/74LS540/541

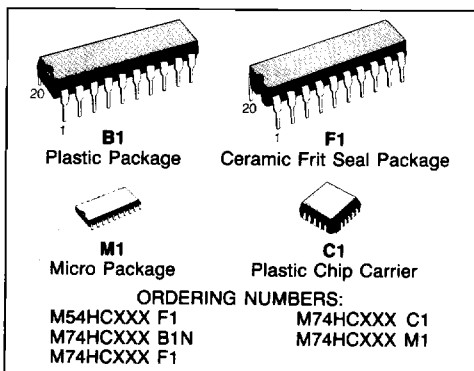
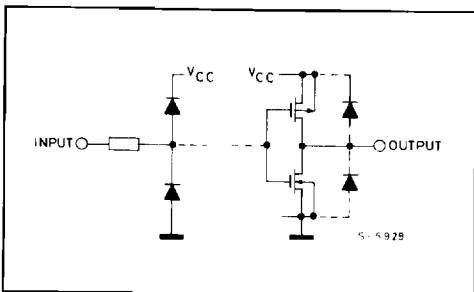
#### DESCRIPTION

The M54/74HC540/541 are high speed CMOS OCTAL BUS BUFFERS (3-STATE) fabricated in silicon gate C<sup>2</sup>MOS technology. They have the same high speed performance of LSTTL combined with true CMOS low power consumption. The M54/74HC540 is an inverting buffer and the M54/74HC541 is a non-inverting buffer. The 3-STATE control gate operates as a two-input AND such that if either G1 or G2 are high, all eight outputs are in the high-impedance state.

In order to enhance PC board layout, the 'HC540 and 'HC541 offers a pinout having inputs on opposite sides of the package.

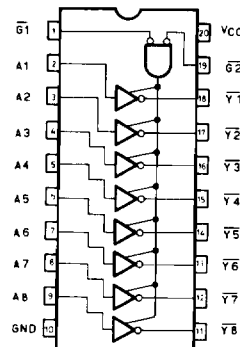
All inputs are equipped with protection circuits against static discharge and transient excess voltage.

#### INPUT AND OUTPUT EQUIVALENT CIRCUIT

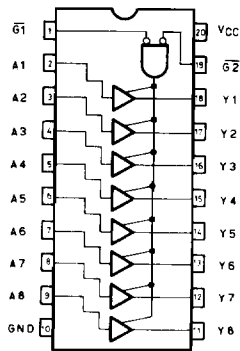


#### PIN CONNECTIONS (top view)

HC540

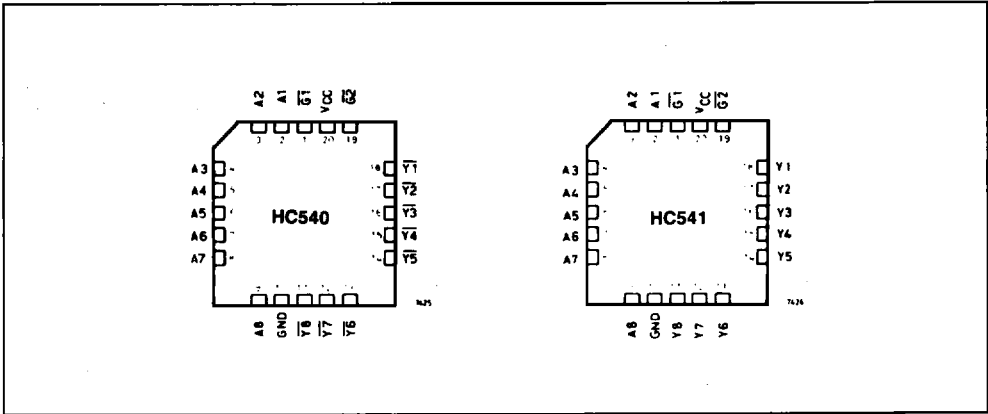


HC541



NC =  
No Internal  
Connection

CHIP CARRIER

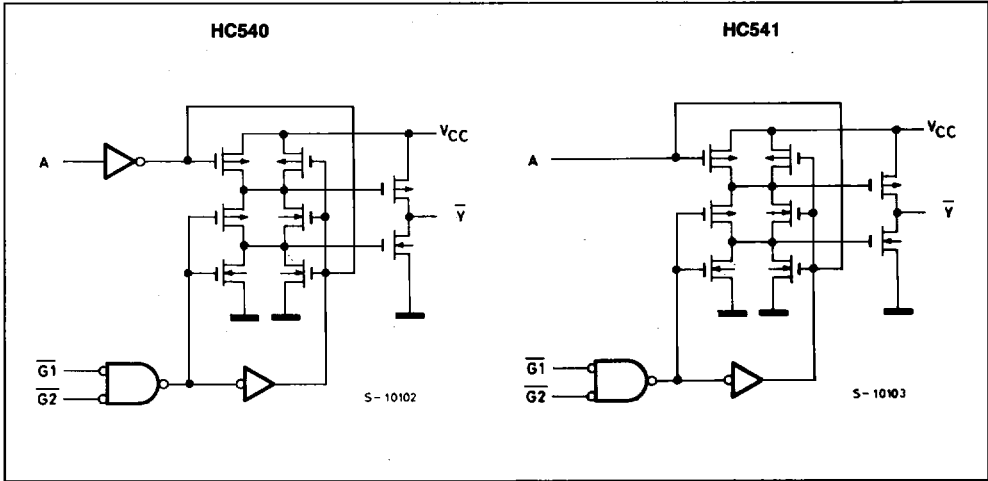


TRUTH TABLE

| INPUTS          |                 |       | OUTPUT  |                    |
|-----------------|-----------------|-------|---------|--------------------|
| $\overline{G1}$ | $\overline{G2}$ | $A_n$ | $Y_n^*$ | $\overline{Y_n}^*$ |
| H               | X               | X     | Z       | Z                  |
| X               | H               | X     | Z       | Z                  |
| L               | L               | H     | L       | L                  |
| L               | L               | L     | L       | H                  |

X: DON'T CARE      Z: HIGH IMPEDANCE  
\*:  $Y_n$ .....HC541       $\overline{Y_n}$ .....HC540

CIRCUIT DIAGRAM (Per Circuit)



## ABSOLUTE MAXIMUM RATINGS

| Symbol                | Parameter                                    | Value                  | Unit |
|-----------------------|----------------------------------------------|------------------------|------|
| $V_{CC}$              | Supply Voltage                               | -0.5 to 7              | V    |
| $V_I$                 | DC Input Voltage                             | -0.5 to $V_{CC} + 0.5$ | V    |
| $V_O$                 | DC Output Voltage                            | -0.5 to $V_{CC} + 0.5$ | V    |
| $I_{IK}$              | DC Input Diode Current                       | $\pm 20$               | mA   |
| $I_{OK}$              | DC Output Diode Current                      | $\pm 20$               | mA   |
| $I_O$                 | DC Output Source Sink Current Per Output Pin | $\pm 35$               | mA   |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground Current                | $\pm 70$               | mA   |
| $P_D$                 | Power Dissipation                            | 500 (*)                | mW   |
| $T_{stg}$             | Storage Temperature                          | -65 to 150             | °C   |

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

(\*) 500 mW:  $\approx 65^\circ\text{C}$  derate to 300 mW by 10 mW/°C:  $65^\circ\text{C}$  to  $85^\circ\text{C}$ .

## RECOMMENDED OPERATING CONDITIONS

| Symbol     | Parameter                                           | Value                                                                                                                                       | Unit |
|------------|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|------|
| $V_{CC}$   | Supply Voltage                                      | 2 to 6                                                                                                                                      | V    |
| $V_I$      | Input Voltage                                       | 0 to $V_{CC}$                                                                                                                               | V    |
| $V_O$      | Output Voltage                                      | 0 to $V_{CC}$                                                                                                                               | V    |
| $T_A$      | Operating Temperature<br>74HC Series<br>54HC Series | -40 to 85<br>-55 to 125                                                                                                                     | °C   |
| $t_r, t_f$ | Input Rise and Fall Time                            | $V_{CC} \begin{cases} 2 \text{ V} & 0 \text{ to } 1000 \\ 4.5 \text{ V} & 0 \text{ to } 500 \\ 6 \text{ V} & 0 \text{ to } 400 \end{cases}$ | ns   |

## DC SPECIFICATIONS

| Symbol   | Parameter                 | $V_{CC}$          | Test Condition       | $T_A = 25^\circ\text{C}$<br>54HC and 74HC |             |                    | $-40$ to $85^\circ\text{C}$<br>74HC |                    | $-55$ to $125^\circ\text{C}$<br>54HC |                    | Unit |
|----------|---------------------------|-------------------|----------------------|-------------------------------------------|-------------|--------------------|-------------------------------------|--------------------|--------------------------------------|--------------------|------|
|          |                           |                   |                      | Min.                                      | Typ.        | Max.               | Min.                                | Max.               | Min.                                 | Max.               |      |
| $V_{IH}$ | High Level Input Voltage  | 2.0<br>4.5<br>6.0 |                      | 1.5<br>3.15<br>4.2                        | —<br>—<br>— | —<br>—<br>—        | 1.5<br>3.15<br>4.2                  | —<br>—<br>—        | 1.5<br>3.15<br>4.2                   | —<br>—<br>—        | V    |
| $V_{IL}$ | Low Level Input Voltage   | 2.0<br>4.5<br>6.0 |                      | —<br>—<br>—                               | —<br>—<br>— | 0.5<br>1.35<br>1.8 | —<br>—<br>—                         | 0.5<br>1.35<br>1.8 | —<br>—<br>—                          | 0.5<br>1.35<br>1.8 | V    |
| $V_{OH}$ | High Level Output Voltage | 2.0               | $V_I$                | $I_O$                                     | 1.9         | 2.0                | —                                   | 1.9                | —                                    | 1.9                | V    |
|          |                           | 4.5               | $V_{IH}$ or $V_{IL}$ | -20 $\mu\text{A}$                         | 4.4         | 4.5                | —                                   | 4.4                | —                                    | 4.4                |      |
|          |                           | 6.0               |                      |                                           | 5.9         | 6.0                | —                                   | 5.9                | —                                    | 5.9                |      |
| $V_{OL}$ | Low Level Output Voltage  | 4.5               |                      | -4.0 mA                                   | 4.18        | 4.31               | —                                   | 4.13               | —                                    | 4.10               | V    |
|          |                           | 6.0               |                      | -5.2 mA                                   | 5.68        | 5.8                | —                                   | 5.63               | —                                    | 5.60               |      |
|          |                           | 6.0               | $V_{IH}$ or $V_{IL}$ | 20 $\mu\text{A}$                          | —           | 0.0                | 0.1                                 | —                  | 0.1                                  | —                  |      |
|          |                           |                   |                      |                                           | —           | 0.0                | 0.1                                 | —                  | 0.1                                  | —                  |      |
|          |                           |                   |                      |                                           | —           | 0.0                | 0.1                                 | —                  | 0.1                                  | —                  |      |
|          |                           | 4.5               |                      | 4.0 mA                                    | —           | 0.17               | 0.26                                | —                  | 0.33                                 | —                  | 0.40 |
|          |                           | 6.0               |                      | 5.2 mA                                    | —           | 0.18               | 0.26                                | —                  | 0.33                                 | —                  | 0.40 |

## DC SPECIFICATIONS (Continued)

| Symbol          | Parameter                        | V <sub>CC</sub> | Test Condition                                                                                 | T <sub>A</sub> = 25°C<br>54HC and 74HC |      |      | - 40 to 85°C<br>74HC |      | - 55 to 125°C<br>54HC |      | Unit |
|-----------------|----------------------------------|-----------------|------------------------------------------------------------------------------------------------|----------------------------------------|------|------|----------------------|------|-----------------------|------|------|
|                 |                                  |                 |                                                                                                | Min.                                   | Typ. | Max. | Min.                 | Max. | Min.                  | Max. |      |
| I <sub>I</sub>  | Input Leakage Current            | 6.0             | V <sub>I</sub> = V <sub>CC</sub> or GND                                                        | —                                      | —    | ±0.1 | —                    | ±1.0 | —                     | ±1.0 | μA   |
| I <sub>OZ</sub> | 3-State Output Off-State Current | 6.0             | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>O</sub> = V <sub>CC</sub> or GND | —                                      | —    | ±0.5 | —                    | ±5.0 | —                     | ±10  | μA   |
| I <sub>CC</sub> | Quiescent Supply Current         | 6.0             | V <sub>I</sub> = V <sub>CC</sub> or GND                                                        | —                                      | —    | 4    | —                    | 40   | —                     | 80   | μA   |

AC ELECTRICAL CHARACTERISTICS (C<sub>L</sub> = 50pF, Input t<sub>r</sub> = t<sub>f</sub> = 6ns)

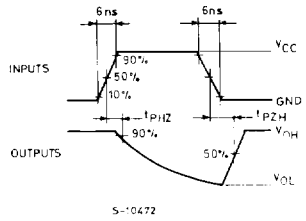
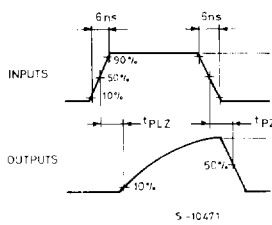
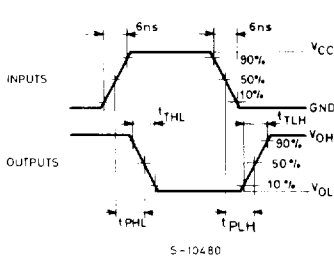
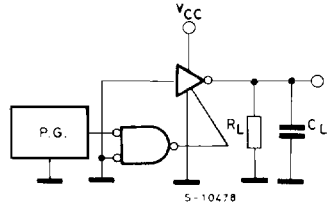
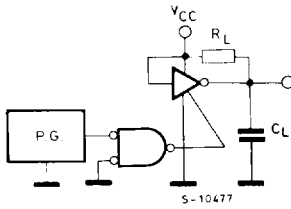
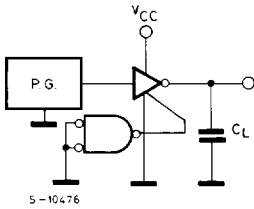
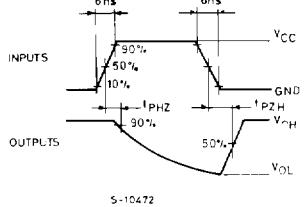
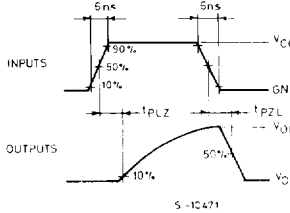
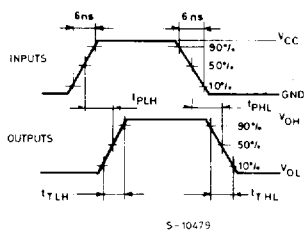
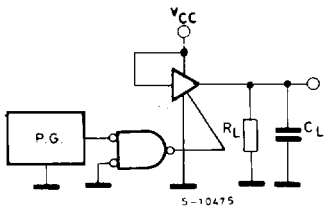
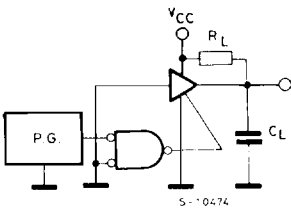
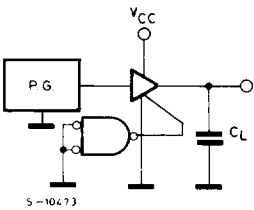
| Symbol                               | Parameter                     | V <sub>CC</sub>   | Test Condition       | T <sub>A</sub> = 25°C<br>54HC and 74HC |                |                 | - 40 to 85°C<br>74HC |                 | - 55 to 125°C<br>54HC |                 | Unit |
|--------------------------------------|-------------------------------|-------------------|----------------------|----------------------------------------|----------------|-----------------|----------------------|-----------------|-----------------------|-----------------|------|
|                                      |                               |                   |                      | Min.                                   | Typ.           | Max.            | Min.                 | Max.            | Min.                  | Max.            |      |
| t <sub>TLH</sub><br>t <sub>THL</sub> | Output Transition Time        | 2.0<br>4.5<br>6.0 |                      | —<br>—<br>—                            | 25<br>7<br>6   | 60<br>12<br>10  | —<br>—<br>—          | 75<br>15<br>13  |                       | 90<br>18<br>15  | ns   |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay Time        | 2.0<br>4.5<br>6.0 | HC540                | —<br>—<br>—                            | 52<br>13<br>11 | 105<br>21<br>18 | —<br>—<br>—          | 130<br>26<br>22 |                       | 160<br>32<br>27 | ns   |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay Time        | 2.0<br>4.5<br>6.0 | HC541                |                                        | 56<br>14<br>12 | 15<br>23<br>20  | —<br>—<br>—          | 145<br>29<br>25 | —<br>—<br>—           | 135<br>35<br>30 | ns   |
| t <sub>PLZ</sub><br>t <sub>PHZ</sub> | 3-State Output Enable         | 2.0<br>4.5<br>6.0 | R <sub>L</sub> = 1KΩ | —<br>—<br>—                            | 72<br>18<br>15 | 145<br>29<br>25 | —<br>—<br>—          | 180<br>36<br>31 | —<br>—<br>—           | 220<br>44<br>38 | ns   |
| t <sub>PLZ</sub><br>t <sub>PHZ</sub> | 3-State Output Disable Time   | 2.0<br>4.5<br>6.0 | R <sub>L</sub> = 1KΩ | —<br>—<br>—                            | 88<br>22<br>19 | 160<br>32<br>27 | —<br>—<br>—          | 200<br>40<br>34 | —<br>—<br>—           | 240<br>48<br>41 | ns   |
| C <sub>IN</sub>                      | Input Capacitance             |                   |                      | —                                      | 5              | 10              | —                    | 10              |                       | 10              | pF   |
| C <sub>OUT</sub>                     | Output Capacitance            |                   |                      | —                                      | 10             | —               | —                    | —               | —                     | —               | pF   |
| C <sub>PD</sub> (1)                  | Power Dissipation Capacitance |                   | HC540                | —                                      | 33             | —               | —                    | —               | —                     | —               | pF   |
|                                      |                               |                   | HC541                | —                                      | 36             | —               | —                    | —               | —                     | —               |      |

Note (1) C<sub>PD</sub> is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the following equation.

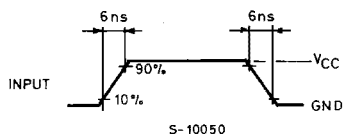
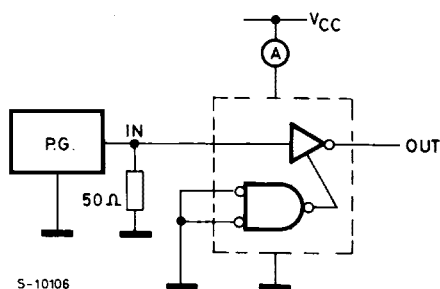
$$I_{CC(oper)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/8 \text{ (per Gate).}$$

### SWITCHING CHARACTERISTICS TEST CIRCUIT AND WAVEFORM

**HC540****HC541**

TEST CIRCUIT  $I_{CC}$  (Opr.)

HC540



THE OTHER INPUTS ARE CONNECTED  $V_{CC}$  LINE OR GND LINE.

TEST CIRCUIT OF THE HC541 IS THE SAME AS THIS