

# CD74HC540, CD74HCT540, CD74HC541, CD74HCT541

## High Speed CMOS Logic Octal Buffer and Line Drivers, Three-State

January 1998

### Features

- CD74HC540, CD74HCT540 ..... Inverting
- CD74HC541, CD74HCT541 ..... Non-Inverting
- Buffered Inputs
- Three-State Outputs
- Bus Line Driving Capability
- Typical Propagation Delay = 9ns at  $V_{CC} = 5V$ ,  $C_L = 15pF$ ,  $T_A = 25^\circ C$
- Fanout (Over Temperature Range)
  - Standard Outputs ..... 10 LSTTL Loads
  - Bus Driver Outputs ..... 15 LSTTL Loads
- Wide Operating Temperature Range ...  $-55^\circ C$  to  $125^\circ C$
- Balanced Propagation Delay and Transition Times
- Significant Power Reduction Compared to LSTTL Logic ICs
- HC Types
  - 2V to 6V Operation
  - High Noise Immunity:  $N_{IL} = 30\%$ ,  $N_{IH} = 30\%$  of  $V_{CC}$  at  $V_{CC} = 5V$
- HCT Types
  - 4.5V to 5.5V Operation
  - Direct LSTTL Input Logic Compatibility,  $V_{IL} = 0.8V$  (Max),  $V_{IH} = 2V$  (Min)
  - CMOS Input Compatibility,  $I_I \leq 1\mu A$  at  $V_{OL}$ ,  $V_{OH}$

### Description

The Harris CD74HC540 and CD74HCT540 are Inverting Octal Buffers and Line Drivers with Three-State Outputs and the capability to drive 15 LSTTL loads. The Harris CD74HC541 and CD74HCT541 are Non-Inverting Octal Buffers and Line Drivers with Three-State Outputs that can drive 15 LSTTL loads. The Output Enables ( $\overline{OE1}$ ) and ( $\overline{OE2}$ ) control the Three-State Outputs. If either  $\overline{OE1}$  or  $\overline{OE2}$  is HIGH the outputs will be in the high impedance state. For data output  $\overline{OE1}$  and  $\overline{OE2}$  both must be LOW.

### Ordering Information

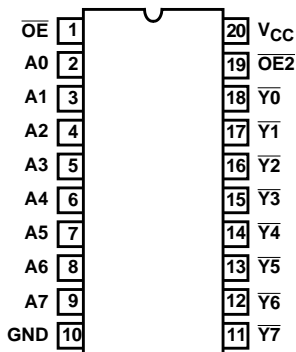
| PART NUMBER | TEMP. RANGE ( $^\circ C$ ) | PACKAGE    | PKG. NO. |
|-------------|----------------------------|------------|----------|
| CD74HC540E  | -55 to 125                 | 20 Ld PDIP | E20.3    |
| CD74HCT540E | -55 to 125                 | 20 Ld PDIP | E20.3    |
| CD74HC541E  | -55 to 125                 | 20 Ld PDIP | E20.3    |
| CD74HCT541E | -55 to 125                 | 20 Ld PDIP | E20.3    |
| CD74HC540M  | -55 to 125                 | 20 Ld SOIC | M20.3    |
| CD74HCT540M | -55 to 125                 | 20 Ld SOIC | M20.3    |
| CD74HC541M  | -55 to 125                 | 20 Ld SOIC | M20.3    |
| CD74HCT541M | -55 to 125                 | 20 Ld SOIC | M20.3    |

#### NOTES:

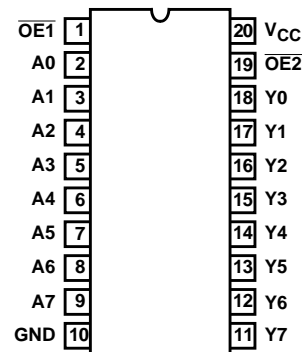
1. When ordering, use the entire part number. Add the suffix 96 to obtain the variant in the tape and reel.
2. Wafer and die for this part number is available which meets all electrical specifications. Please contact your local sales office or Harris customer service for ordering information.

### Pinouts

CD74HC540, CD74HCT540  
(PDIP, SOIC)  
TOP VIEW

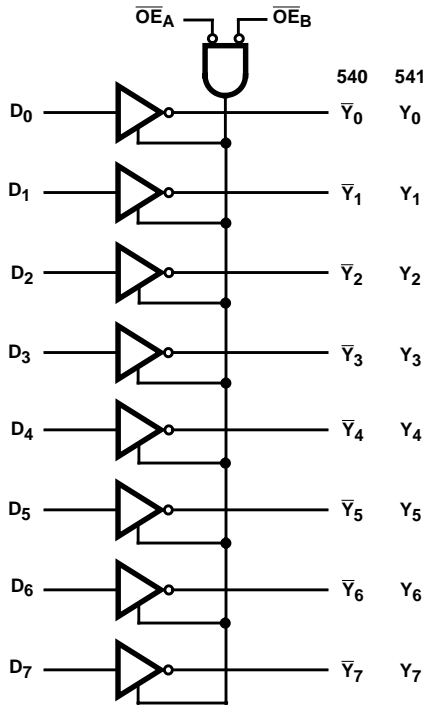


CD74HC541, CD74HCT541  
(PDIP, SOIC)  
TOP VIEW



**CD74HC540, CD74HCT540, CD74HC541, CD74HCT541**

**Functional Diagram**



**TRUTH TABLE**

| INPUTS            |                   |       | OUTPUTS |     |
|-------------------|-------------------|-------|---------|-----|
| $\overline{OE}_1$ | $\overline{OE}_2$ | $A_n$ | 540     | 541 |
| L                 | L                 | H     | L       | H   |
| H                 | X                 | X     | Z       | Z   |
| X                 | H                 | X     | Z       | Z   |
| L                 | L                 | L     | H       | L   |

NOTE:  
H = HIGH Voltage Level  
L = LOW Voltage Level  
X = Don't Care  
Z = High Impedance

## CD74HC540, CD74HCT540, CD74HC541, CD74HCT541

### Absolute Maximum Ratings

|  |             |
|--|-------------|
| DC Supply Voltage, $V_{CC}$ .....                      | -0.5V to 7V |
| DC Input Diode Current, $I_{IK}$                       |             |
| For $V_I < -0.5V$ or $V_I > V_{CC} + 0.5V$ .....       | $\pm 20mA$  |
| DC Output Diode Current, $I_{OK}$                      |             |
| For $V_O < -0.5V$ or $V_O > V_{CC} + 0.5V$ .....       | $\pm 20mA$  |
| DC Drain Current, per Output, $I_O$                    |             |
| For $-0.5V < V_O < V_{CC} + 0.5V$ .....                | $\pm 35mA$  |
| DC Output Source or Sink Current per Output Pin, $I_O$ |             |
| For $V_O > -0.5V$ or $V_O < V_{CC} + 0.5V$ .....       | $\pm 25mA$  |
| DC $V_{CC}$ or Ground Current, $I_{CC}$ .....          | $\pm 50mA$  |

### Thermal Information

|  |                                  |
|--|----------------------------------|
| Thermal Resistance (Typical, Note 3)           | $\theta_{JA}$ (°C/W)             |
| PDIP Package .....                             | 125                              |
| SOIC Package .....                             | 120                              |
| Maximum Junction Temperature .....             | 150°C                            |
| Maximum Storage Temperature Range .....        | -65°C to 150°C                   |
| Maximum Lead Temperature (Soldering 10s) ..... | 300°C<br>(SOIC - Lead Tips Only) |

### Operating Conditions

|  |                |
|--|----------------|
| Temperature Range, $T_A$ .....               | -55°C to 125°C |
| Supply Voltage Range, $V_{CC}$               |                |
| HC Types .....                               | .2V to 6V      |
| HCT Types .....                              | 4.5V to 5.5V   |
| DC Input or Output Voltage, $V_I, V_O$ ..... | 0V to $V_{CC}$ |
| Input Rise and Fall Time                     |                |
| 2V .....                                     | 1000ns (Max)   |
| 4.5V .....                                   | 500ns (Max)    |
| 6V .....                                     | 400ns (Max)    |

*CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.*

#### NOTE:

- $\theta_{JA}$  is measured with the component mounted on an evaluation PC board in free air.

### DC Electrical Specifications

| PARAMETER                               | SYMBOL   | TEST CONDITIONS      |            | $V_{CC}$ (V) | 25°C |      |      | -40°C TO 85°C |      | -55°C TO 125°C |      | UNITS   |         |
|---|----------|----------------------|------------|--------------|------|------|------|---------------|------|----------------|------|---------|---------|
|   |          | $V_I$ (V)            | $I_O$ (mA) |              | MIN  | TYP  | MAX  | MIN           | MAX  | MIN            | MAX  |         |         |
| <b>HC TYPES</b>                         |          |                      |            |              |      |      |      |               |      |                |      |         |         |
| High Level Input Voltage                | $V_{IH}$ | -                    | -          | 2            | 1.5  | -    | -    | 1.5           | -    | 1.5            | -    | V       |         |
|   |          |                      |            | 4.5          | 3.15 | -    | -    | 3.15          | -    | 3.15           | -    | V       |         |
|   |          |                      |            | 6            | 4.2  | -    | -    | 4.2           | -    | 4.2            | -    | V       |         |
| Low Level Input Voltage                 | $V_{IL}$ | -                    | -          | 2            | -    | -    | 0.5  | -             | 0.5  | -              | 0.5  | V       |         |
|   |          |                      |            | 4.5          | -    | -    | 1.35 | -             | 1.35 | -              | 1.35 | V       |         |
|   |          |                      |            | 6            | -    | -    | 1.8  | -             | 1.8  | -              | 1.8  | V       |         |
| High Level Output Voltage<br>CMOS Loads | $V_{OH}$ | $V_{IH}$ or $V_{IL}$ | -0.02      | -0.02        | 2    | 1.9  | -    | -             | 1.9  | -              | 1.9  | -       | V       |
|   |          |                      | -0.02      | -0.02        | 4.5  | 4.4  | -    | -             | 4.4  | -              | 4.4  | -       | V       |
|   |          |                      | -0.02      | -0.02        | 6    | 5.9  | -    | -             | 5.9  | -              | 5.9  | -       | V       |
| High Level Output Voltage<br>TTL Loads  | $V_{OH}$ | $V_{IH}$ or $V_{IL}$ | -          | -            | -    | -    | -    | -             | -    | -              | -    | V       |         |
|   |          |                      | -6         | -6           | 4.5  | 3.98 | -    | -             | 3.84 | -              | 3.7  | -       | V       |
|   |          |                      | -7.8       | -7.8         | 6    | 5.48 | -    | -             | 5.34 | -              | 5.2  | -       | V       |
| Low Level Output Voltage<br>CMOS Loads  | $V_{OL}$ | $V_{IH}$ or $V_{IL}$ | 0.02       | 0.02         | 2    | -    | -    | 0.1           | -    | 0.1            | -    | 0.1     | V       |
|   |          |                      | 0.02       | 0.02         | 4.5  | -    | -    | 0.1           | -    | 0.1            | -    | 0.1     | V       |
|   |          |                      | 0.02       | 0.02         | 6    | -    | -    | 0.1           | -    | 0.1            | -    | 0.1     | V       |
| Low Level Output Voltage<br>TTL Loads   | $V_{OL}$ | $V_{IH}$ or $V_{IL}$ | -          | -            | -    | -    | -    | -             | -    | -              | -    | V       |         |
|   |          |                      | 6          | 6            | 4.5  | -    | -    | 0.26          | -    | 0.33           | -    | 0.4     | V       |
|   |          |                      | 7.8        | 7.8          | 6    | -    | -    | 0.26          | -    | 0.33           | -    | 0.4     | V       |
| Input Leakage Current                   | $I_I$    | $V_{CC}$ or GND      | -          | -            | 6    | -    | -    | $\pm 0.1$     | -    | $\pm 1$        | -    | $\pm 1$ | $\mu A$ |

**CD74HC540, CD74HCT540, CD74HC541, CD74HCT541**

**DC Electrical Specifications (Continued)**

| PARAMETER  | SYMBOL           | TEST CONDITIONS                    |   | V <sub>CC</sub> (V) | 25°C |     |      | -40°C TO 85°C |      | -55°C TO 125°C |     | UNITS |
|--|------------------|------------------------------------|---|---------------------|------|-----|------|---------------|------|----------------|-----|-------|
|  |                  | V <sub>I</sub> (V)                 | I <sub>O</sub> (mA)                     |                     | MIN  | TYP | MAX  | MIN           | MAX  | MIN            | MAX |       |
| Quiescent Device Current                                       | I <sub>CC</sub>  | V <sub>CC</sub> or GND             | 0                                       | 6                   | -    | -   | 8    | -             | 80   | -              | 160 | μA    |
| Three- State Leakage Current                                   | I <sub>OZ</sub>  | V <sub>IL</sub> or V <sub>IH</sub> | V <sub>O</sub> = V <sub>CC</sub> or GND | 6                   | -    | -   | ±0.5 | -             | ±5.0 | -              | ±10 | μA    |
| <b>HCT TYPES</b>   |                  |                                    |   |                     |      |     |      |               |      |                |     |       |
| High Level Input Voltage                                       | V <sub>IH</sub>  | -                                  | -                                       | 4.5 to 5.5          | 2    | -   | -    | 2             | -    | 2              | -   | V     |
| Low Level Input Voltage  | V <sub>IL</sub>  | -                                  | -                                       | 4.5 to 5.5          | -    | -   | 0.8  | -             | 0.8  | -              | 0.8 | V     |
| High Level Output Voltage<br>CMOS Loads                        | V <sub>OH</sub>  | V <sub>IH</sub> or V <sub>IL</sub> | -0.02                                   | 4.5                 | 4.4  | -   | -    | 4.4           | -    | 4.4            | -   | V     |
| High Level Output Voltage<br>TTL Loads                         |                  |                                    | -6                                      | 4.5                 | 3.98 | -   | -    | 3.84          | -    | 3.7            | -   | V     |
| Low Level Output Voltage<br>CMOS Loads                         | V <sub>OL</sub>  | V <sub>IH</sub> or V <sub>IL</sub> | 0.02                                    | 4.5                 | -    | -   | 0.1  | -             | 0.1  | -              | 0.1 | V     |
| Low Level Output Voltage<br>TTL Loads                          |                  |                                    | 6                                       | 4.5                 | -    | -   | 0.26 | -             | 0.33 | -              | 0.4 | V     |
| Input Leakage Current  | I <sub>I</sub>   | V <sub>CC</sub> and GND            | 0                                       | 5.5                 | -    | -   | ±0.1 | -             | ±1   | -              | ±1  | μA    |
| Quiescent Device Current                                       | I <sub>CC</sub>  | V <sub>CC</sub> or GND             | 0                                       | 5.5                 | -    | -   | 8    | -             | 80   | -              | 160 | μA    |
| Three- State Leakage Current                                   | I <sub>OZ</sub>  | V <sub>IL</sub> or V <sub>IH</sub> | V <sub>O</sub> = V <sub>CC</sub> or GND | 5.5                 | -    | -   | ±0.5 | -             | ±5.0 | -              | ±10 | μA    |
| Additional Quiescent Device Current Per Input Pin: 1 Unit Load | ΔI <sub>CC</sub> | V <sub>CC</sub> -2.1               | -                                       | 4.5 to 5.5          | -    | 100 | 360  | -             | 450  | -              | 490 | μA    |

NOTE: For dual-supply systems theoretical worst case (V<sub>I</sub> = 2.4V, V<sub>CC</sub> = 5.5V) specification is 1.8mA.

**HCT Input Loading Table**

| INPUT   | UNIT LOADS |        |
|---------|------------|--------|
|         | HCT540     | HCT541 |
| A0 - A7 | 1          | 0.4    |
| OE2     | 0.75       | 0.75   |
| OE1     | 1.15       | 1.15   |

NOTE: Unit load is ΔI<sub>CC</sub> limit specific in DC Electrical Specifications Table, e.g., 360μA max. at 25°C.

**CD74HC540, CD74HCT540, CD74HC541, CD74HCT541**

**Switching Specifications**  $C_L = 50\text{pF}$ , Input  $t_r, t_f = 6\text{ns}$

| PARAMETER   | SYMBOL             | TEST CONDITIONS     | $V_{CC}$ (V) | 25°C |     |     | -40°C TO 85°C |     | -55°C TO 125°C |     | UNITS |
|---|--------------------|---------------------|--------------|------|-----|-----|---------------|-----|----------------|-----|-------|
|   |                    |                     |              | MIN  | TYP | MAX | MIN           | MAX | MIN            | MAX |       |
| <b>HC TYPES</b>                                     |                    |                     |              |      |     |     |               |     |                |     |       |
| Propagation Delay<br>Data to Outputs (540)          | $t_{PLH}, t_{PHL}$ | $C_L = 50\text{pF}$ | 2            | -    | -   | 110 | -             | 140 | -              | 165 | ns    |
|   |                    |                     | 4.5          | -    | -   | 22  | -             | 28  | -              | 33  | ns    |
|   |                    | $C_L = 15\text{pF}$ | 5            | -    | 9   | -   | -             | -   | -              | -   | ns    |
|   |                    | $C_L = 50\text{pF}$ | 6            | -    | -   | 19  | -             | 24  | -              | 28  | ns    |
| Data to Outputs (541)                               | $t_{PLZ}, t_{PHZ}$ | $C_L = 50\text{pF}$ | 2            | -    | -   | 115 | -             | 145 | -              | 175 | ns    |
|   |                    |                     | 4.5          | -    | -   | 23  | -             | 29  | -              | 35  | ns    |
|   |                    | $C_L = 15\text{pF}$ | 5            | -    | 9   | -   | -             | -   | -              | -   | ns    |
|   |                    | $C_L = 50\text{pF}$ | 6            | -    | -   | 20  | -             | 25  | -              | 30  | ns    |
| Output Enable and Disable<br>to Outputs (540)       | $t_{PLZ}, t_{PHZ}$ | $C_L = 50\text{pF}$ | 2            | -    | -   | 160 | -             | 200 | -              | 240 | ns    |
|   |                    |                     | 4.5          | -    | -   | 32  | -             | 40  | -              | 48  | ns    |
|   |                    | $C_L = 15\text{pF}$ | 5            | -    | 13  | -   | -             | -   | -              | -   | ns    |
|   |                    | $C_L = 50\text{pF}$ | 6            | -    | -   | 27  | -             | 34  | -              | 41  | ns    |
| Output Enable and Disable<br>to Outputs (541)       | $t_{PLZ}, t_{PHZ}$ | $C_L = 50\text{pF}$ | 2            | -    | -   | 160 | -             | 200 | -              | 240 | ns    |
|   |                    |                     | 4.5          | -    | -   | 32  | -             | 40  | -              | 48  | ns    |
|   |                    | $C_L = 15\text{pF}$ | 5            | -    | 14  | -   | -             | -   | -              | -   | ns    |
|   |                    | $C_L = 50\text{pF}$ | 6            | -    | -   | 23  | -             | 29  | -              | 35  | ns    |
| Output Transition Time                              | $t_{THL}, t_{TLH}$ | $C_L = 50\text{pF}$ | 2            | -    | -   | 60  | -             | 75  | -              | 90  | ns    |
|   |                    |                     | 4.5          | -    | -   | 12  | -             | 15  | -              | 18  | ns    |
|   |                    |                     | 6            | -    | -   | 10  | -             | 13  | -              | 15  | ns    |
| Input Capacitance                                   | $C_I$              | $C_L = 50\text{pF}$ | -            | 10   | -   | 10  | -             | 10  | -              | 10  | pF    |
| Three-State Output<br>Capacitance                   | $C_O$              | -                   | -            | 20   | -   | 20  | -             | 20  | -              | 20  | pF    |
| Power Dissipation Capacitance<br>(Notes 4, 5) (540) | $C_{PD}$           | $C_L = 15\text{pF}$ | 5            | -    | 50  | -   | -             | -   | -              | -   | pF    |
| Power Dissipation Capacitance<br>(Notes 4, 5) (541) | $C_{PD}$           | $C_L = 15\text{pF}$ | 5            | -    | 48  | -   | -             | -   | -              | -   | pF    |
| <b>HCT TYPES</b>                                    |                    |                     |              |      |     |     |               |     |                |     |       |
| Propagation Delay<br>Data to Outputs (540)          | $t_{PHL}, t_{PLH}$ | $C_L = 50\text{pF}$ | 4.5          | -    | -   | 24  | -             | 30  | -              | 36  | ns    |
|   |                    | $C_L = 15\text{pF}$ | 5            | -    | 9   | -   | -             | -   | -              | -   | ns    |
| Data to Outputs (541)                               | $t_{PHL}, t_{PLH}$ | $C_L = 50\text{pF}$ | 4.5          | -    | -   | 28  | -             | 35  | -              | 42  | ns    |
|   |                    | $C_L = 15\text{pF}$ | 5            | -    | 11  | -   | -             | -   | -              | -   | ns    |
| Output Enable and Disable<br>to Outputs (540, 541)  | $t_{PLZ}, t_{PHZ}$ | $C_L = 50\text{pF}$ | 4.5          | -    | -   | 35  | -             | 44  | -              | 53  | ns    |
|   |                    | $C_L = 15\text{pF}$ | 5            | -    | 14  | -   | -             | -   | -              | -   | ns    |
| Output Transition Time                              | $t_{TLH}, t_{THL}$ | $C_L = 50\text{pF}$ | 4.5          | -    | -   | 12  | -             | 15  | -              | 18  | ns    |
| Input Capacitance                                   | $C_I$              | $C_L = 50\text{pF}$ | -            | 10   | -   | 10  | -             | 10  | -              | 10  | pF    |

# CD74HC540, CD74HCT540, CD74HC541, CD74HCT541

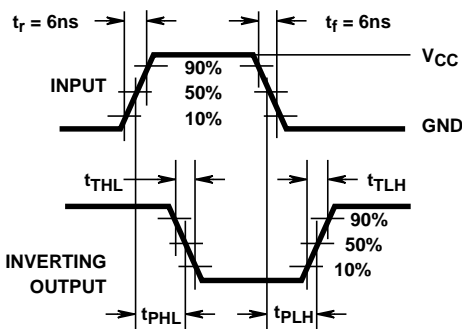
## Switching Specifications $C_L = 50\text{pF}$ , Input $t_r, t_f = 6\text{ns}$ (Continued)

| PARAMETER   | SYMBOL   | TEST CONDITIONS     | $V_{CC}$ (V) | 25°C |     |     | -40°C TO 85°C |     | -55°C TO 125°C |     | UNITS |
|---|----------|---------------------|--------------|------|-----|-----|---------------|-----|----------------|-----|-------|
|   |          |                     |              | MIN  | TYP | MAX | MIN           | MAX | MIN            | MAX |       |
| Three-State Output Capacitance                        | $C_O$    | -                   | -            | 20   | -   | 20  | -             | 20  | -              | 20  | pF    |
| Power Dissipation Capacitance (Notes 4, 5) (540, 541) | $C_{PD}$ | $C_L = 15\text{pF}$ | 5            | -    | 55  | -   | -             | -   | -              | -   | pF    |

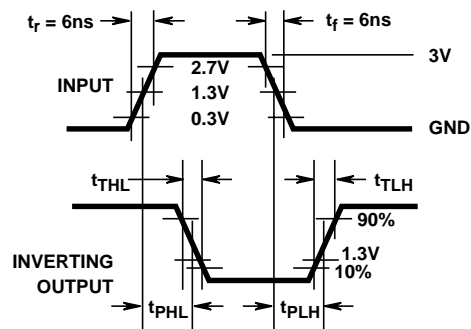
**NOTES:**

4.  $C_{PD}$  is used to determine the dynamic power consumption, per channel.
5.  $P_D = V_{CC}^2 f_i (C_{PD} + C_L)$  where  $f_i$  = Input Frequency,  $C_L$  = Output Load Capacitance,  $V_{CC}$  = Supply Voltage.

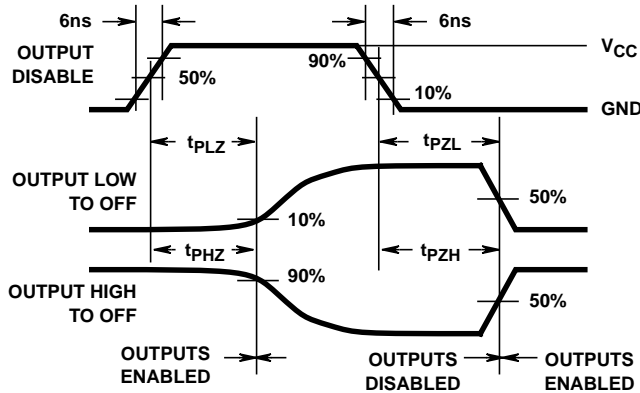
## Test Circuits and Waveforms



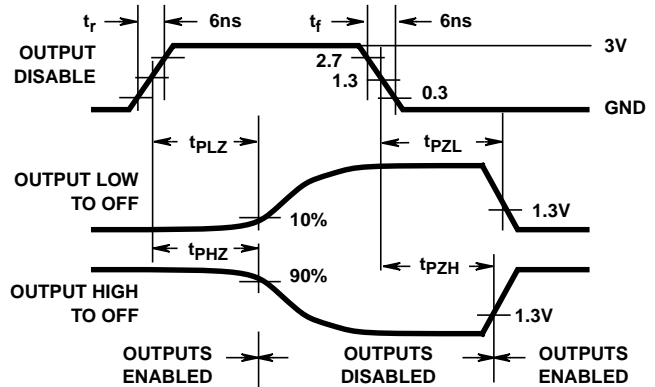
**FIGURE 1. HC TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC**



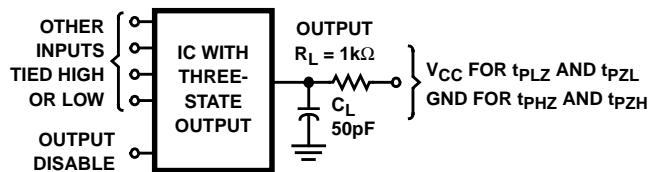
**FIGURE 2. HCT TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC**



**FIGURE 3. HC THREE-STATE PROPAGATION DELAY WAVEFORM**



**FIGURE 4. HCT THREE-STATE PROPAGATION DELAY WAVEFORM**



NOTE: Open drain waveforms  $t_{PLZ}$  and  $t_{PZL}$  are the same as those for three-state shown on the left. The test circuit is Output  $R_L = 1\text{k}\Omega$  to  $V_{CC}$ ,  $C_L = 50\text{pF}$ .

**FIGURE 5. HC AND HCT THREE-STATE PROPAGATION DELAY TEST CIRCUIT**