

November 1997 - Revised October 2003

## High-Speed CMOS Logic 8-Stage Shift and Store Bus Register, Three-State

### Features

- **Buffered Inputs**
- **Separate Serial Outputs Synchronous to Both Positive and Negative Clock Edges For Cascading**
- **Fanout (Over Temperature Range)**
  - Standard Outputs . . . . . 10 LSTTL Loads
  - Bus Driver Outputs . . . . . 15 LSTTL Loads
- **Wide Operating Temperature Range . . . -55°C to 125°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 'HC4094 and CD74HCT4094 are 8-stage serial shift registers having a storage latch associated with each stage for strobing data from the serial input to parallel buffered three-state outputs. The parallel outputs may be connected directly to common bus lines. Data is shifted on positive clock transitions. The data in each shift register stage is transferred to the storage register when the Strobe input is high. Data in the storage register appears at the outputs whenever the Output-Enable signal is high.

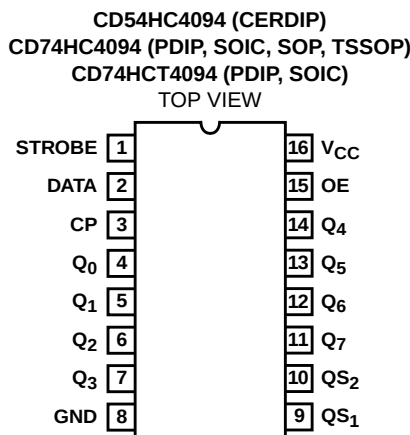
Two serial outputs are available for cascading a number of these devices. Data is available at the  $QS_1$  serial output terminal on positive clock edges to allow for high-speed operation in cascaded system in which the clock rise time is fast. The same serial information, available at the  $QS_2$  terminal on the next negative clock edge, provides a means for cascading these devices when the clock rise time is slow.

### Ordering Information

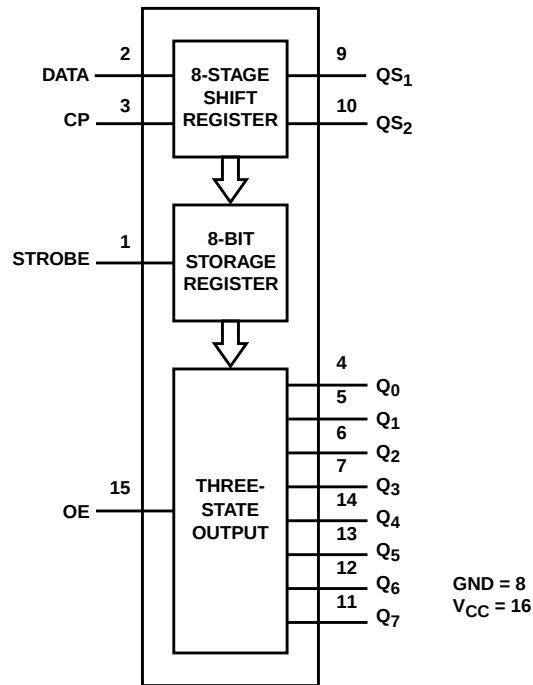
| PART NUMBER    | TEMP. RANGE (°C) | PACKAGE      |
|----------------|------------------|--------------|
| CD54HC4094F3A  | -55 to 125       | 16 Ld CERDIP |
| CD74HC4094E    | -55 to 125       | 16 Ld PDIP   |
| CD74HC4094M    | -55 to 125       | 16 Ld SOIC   |
| CD74HC4094MT   | -55 to 125       | 16 Ld SOIC   |
| CD74HC4094M96  | -55 to 125       | 16 Ld SOIC   |
| CD74HC4094NSR  | -55 to 125       | 16 Ld SOP    |
| CD74HC4094PW   | -55 to 125       | 16 Ld TSSOP  |
| CD74HC4094PWR  | -55 to 125       | 16 Ld TSSOP  |
| CD74HC4094PWT  | -55 to 125       | 16 Ld TSSOP  |
| CD74HCT4094E   | -55 to 125       | 16 Ld PDIP   |
| CD74HCT4094M   | -55 to 125       | 16 Ld SOIC   |
| CD74HCT4094MT  | -55 to 125       | 16 Ld SOIC   |
| CD74HCT4094M96 | -55 to 125       | 16 Ld SOIC   |

NOTE: When ordering, use the entire part number. The suffixes 96 and R denote tape and reel. The suffix T denotes a small-quantity reel of 250.

### Pinout



## Functional Diagram



TRUTH TABLE

| INPUTS |    |     |   | PARALLEL OUTPUTS |                   | SERIAL OUTPUTS           |                 |
|--------|----|-----|---|------------------|-------------------|--------------------------|-----------------|
| CP     | OE | STR | D | Q <sub>0</sub>   | Q <sub>n</sub>    | QS <sub>1</sub> (NOTE 1) | QS <sub>2</sub> |
| ↑      | L  | X   | X | Z                | Z                 | Q'6                      | NC              |
| ↓      | L  | X   | X | Z                | Z                 | NC                       | Q <sub>7</sub>  |
| ↑      | H  | L   | X | NC               | NC                | Q'6                      | NC              |
| ↑      | H  | H   | L | L                | Q <sub>n</sub> -1 | Q'6                      | NC              |
| ↑      | H  | H   | H | H                | Q <sub>n</sub> -1 | Q'6                      | NC              |
| ↓      | H  | H   | H | NC               | NC                | NC                       | Q <sub>7</sub>  |

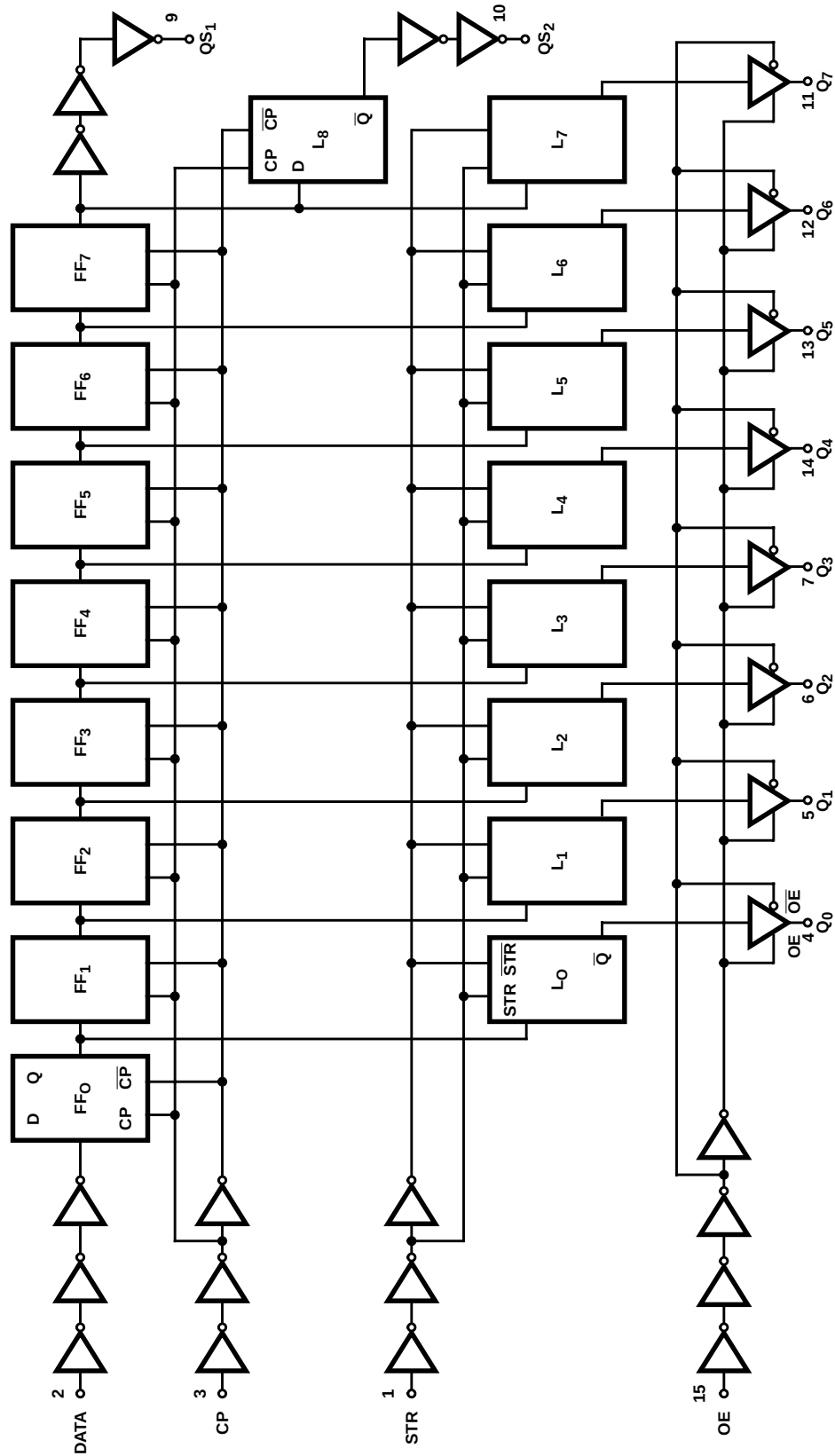
H = High Voltage Level, L = Low Voltage Level, X = Don't Care, NC = No charge, Z = High Impedance Off-state,

↑ = Transition from Low to High Level, ↓ = Transition from High to Low.

NOTE:

1. At the positive clock edge the information in the seventh register stage is transferred to the 8th register stage and QS1 output.

Logic Diagram



# CD54HC4094, CD74HC4094, CD74HCT4094

## 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 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

Package Thermal Impedance,  $\theta_{JA}$  (see Note 2):  
     E (PDIP) Package .....  $67^{\circ}C/W$   
     M (SOIC) Package .....  $73^{\circ}C/W$   
     NS (SOP) Package .....  $64^{\circ}C/W$   
     PW (TSSOP) Package .....  $108^{\circ}C/W$   
 Maximum Junction Temperature (Plastic Package) .....  $150^{\circ}$   
 Maximum Storage Temperature Range .....  $-65^{\circ}C$  to  $150^{\circ}$   
 Maximum Lead Temperature (Soldering 10s) .....  $300^{\circ}$   
     SOIC - Lead Tips Only

## Operating Conditions

Temperature Range ( $T_A$ ) .....  $-55^{\circ}C$  to  $125^{\circ}C$   
 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:

- The package thermal impedance is calculated in accordance with JESD 51-7.

## DC Electrical Specifications

| 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  |       |     |    |
| HC TYPES                                |                 |                                    |                     |                        |      |      |      |               |      |                |      |       |     |    |
| High Level Input Voltage                | V <sub>IH</sub> | -                                  | -                   | 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 <sub>IL</sub> | -                                  | -                   | 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 <sub>OH</sub> | V <sub>IH</sub> or V <sub>IL</sub> | -0.02               | 2                      | 1.9  | -    | -    | 1.9           | -    | 1.9            | -    | V     |     |    |
|                                         |                 |                                    | -0.02               | 4.5                    | 4.4  | -    | -    | 4.4           | -    | 4.4            | -    | V     |     |    |
|                                         |                 |                                    | -0.02               | 6                      | 5.9  | -    | -    | 5.9           | -    | 5.9            | -    | V     |     |    |
| -                                       |                 |                                    | -                   | -                      | -    | -    | -    | -             | -    | -              | V    |       |     |    |
| -4                                      |                 |                                    | 4.5                 | 3.98                   | -    | -    | 3.84 | -             | 3.7  | -              | V    |       |     |    |
| -5.2                                    |                 |                                    | 6                   | 5.48                   | -    | -    | 5.34 | -             | 5.2  | -              | V    |       |     |    |
| High Level Output Voltage<br>TTL Loads  | V <sub>OL</sub> | V <sub>IH</sub> or V <sub>IL</sub> | 0.02                | 2                      | -    | -    | 0.1  | -             | 0.1  | -              | 0.1  | V     |     |    |
|                                         |                 |                                    | 0.02                | 4.5                    | -    | -    | 0.1  | -             | 0.1  | -              | 0.1  | V     |     |    |
|                                         |                 |                                    | 0.02                | 6                      | -    | -    | 0.1  | -             | 0.1  | -              | 0.1  | V     |     |    |
| -                                       |                 |                                    | -                   | -                      | -    | -    | -    | -             | -    | -              | V    |       |     |    |
| 4                                       |                 |                                    | 4.5                 | -                      | -    | 0.26 | -    | 0.33          | -    | 0.4            | V    |       |     |    |
| 5.2                                     |                 |                                    | 6                   | -                      | -    | 0.26 | -    | 0.33          | -    | 0.4            | V    |       |     |    |
| Low Level Output Voltage<br>CMOS Loads  | V <sub>OL</sub> | V <sub>IH</sub> or V <sub>IL</sub> | 0.02                | 2                      | -    | -    | 0.1  | -             | 0.1  | -              | 0.1  | V     |     |    |
|                                         |                 |                                    | 0.02                | 4.5                    | -    | -    | 0.1  | -             | 0.1  | -              | 0.1  | V     |     |    |
|                                         |                 |                                    | 0.02                | 6                      | -    | -    | 0.1  | -             | 0.1  | -              | 0.1  | V     |     |    |
| -                                       |                 |                                    | -                   | -                      | -    | -    | -    | -             | -    | -              | V    |       |     |    |
| 4                                       |                 |                                    | 4.5                 | -                      | -    | 0.26 | -    | 0.33          | -    | 0.4            | V    |       |     |    |
| 5.2                                     |                 |                                    | 6                   | -                      | -    | 0.26 | -    | 0.33          | -    | 0.4            | V    |       |     |    |
| Low Level Output Voltage<br>TTL Loads   | V <sub>OL</sub> | V <sub>IH</sub> or V <sub>IL</sub> | -                   | -                      | -    | -    | -    | -             | -    | -              | -    | V     |     |    |
|                                         |                 |                                    | 4                   | 4.5                    | -    | -    | 0.26 | -             | 0.33 | -              | 0.4  | V     |     |    |
|                                         |                 |                                    | 5.2                 | 6                      | -    | -    | 0.26 | -             | 0.33 | -              | 0.4  | V     |     |    |
| Input Leakage Current                   |                 |                                    | I <sub>I</sub>      | V <sub>CC</sub> or GND | -    | 6    | -    | -             | ±0.1 | -              | ±1   | -     | ±1  | μA |
| Quiescent Device Current                |                 |                                    | I <sub>CC</sub>     | V <sub>CC</sub> or GND | 0    | 6    | -    | -             | 8    | -              | 80   | -     | 160 | μA |

# CD54HC4094, CD74HC4094, CD74HCT4094

## 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 |       |
| HCT TYPES                                                      |                           |                                    |                     |                     |      |     |      |               |      |                |     |       |
| 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                         |                           |                                    | -4                  | 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                          |                           |                                    | 4                   | 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    |
| Additional Quiescent Device Current Per Input Pin: 1 Unit Load | ΔI <sub>CC</sub> (Note 3) | 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 |
|--------|------------|
| D      | 0.4        |
| CP, OE | 1.5        |
| STR    | 1.0        |

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

## Prerequisite for Switching Specifications

| CHARACTERISTIC  | SYMBOL          | V <sub>CC</sub> (V) | 25°C |     | -40°C TO 85°C |     | -55°C TO 125°C |     | UNITS |
|-----------------|-----------------|---------------------|------|-----|---------------|-----|----------------|-----|-------|
|                 |                 |                     | MIN  | MAX | MIN           | MAX | MIN            | MAX |       |
| HC TYPES        |                 |                     |      |     |               |     |                |     |       |
| CP Pulse Width  | t <sub>W</sub>  | 2                   | 80   | -   | 100           | -   | 120            | -   | ns    |
|                 |                 | 4.5                 | 16   | -   | 20            | -   | 24             | -   | ns    |
|                 |                 | 6                   | 14   | -   | 17            | -   | 20             | -   | ns    |
| STR Pulse Width | t <sub>WH</sub> | 2                   | 80   | -   | 100           | -   | 120            | -   | ns    |
|                 |                 | 4.5                 | 16   | -   | 20            | -   | 24             | -   | ns    |
|                 |                 | 6                   | 14   | -   | 17            | -   | 20             | -   | ns    |

**CD54HC4094, CD74HC4094, CD74HCT4094**

**Prerequisite for Switching Specifications (Continued)**

| CHARACTERISTIC       | SYMBOL                | V <sub>CC</sub> (V) | 25°C |     | -40°C TO 85°C |     | -55°C TO 125°C |     | UNITS |
|----------------------|-----------------------|---------------------|------|-----|---------------|-----|----------------|-----|-------|
|                      |                       |                     | MIN  | MAX | MIN           | MAX | MIN            | MAX |       |
| Data Set-up Time     | t <sub>SU</sub>       | 2                   | 50   | -   | 65            | -   | 75             | -   | ns    |
|                      |                       | 4.5                 | 10   | -   | 13            | -   | 15             | -   | ns    |
|                      |                       | 6                   | 9    | -   | 11            | -   | 13             | -   | ns    |
| Data Hold Time       | t <sub>H</sub>        | 2                   | 3    | -   | 3             | -   | 3              | -   | ns    |
|                      |                       | 4.5                 | 3    | -   | 3             | -   | 3              | -   | ns    |
|                      |                       | 6                   | 3    | -   | 3             | -   | 3              | -   | ns    |
| STR Set-up Time      | t <sub>SU</sub>       | 2                   | 100  | -   | 125           | -   | 150            | -   | ns    |
|                      |                       | 4.5                 | 20   | -   | 25            | -   | 30             | -   | ns    |
|                      |                       | 6                   | 17   | -   | 21            | -   | 26             | -   | ns    |
| STR Hold Time        | t <sub>H</sub>        | 2                   | 0    | -   | 0             | -   | 0              | -   | ns    |
|                      |                       | 4.5                 | 0    | -   | 0             | -   | 0              | -   | ns    |
|                      |                       | 6                   | 0    | -   | 0             | -   | 0              | -   | ns    |
| Maximum CP Frequency | f <sub>CL</sub> (MAX) | 2                   | 6    | -   | 5             | -   | 4              | -   | MHz   |
|                      |                       | 4.5                 | 30   | -   | 24            | -   | 20             | -   | MHz   |
|                      |                       | 6                   | 35   | -   | 28            | -   | 24             | -   | MHz   |

**HCT TYPES**

|                      |                       |     |    |   |    |   |    |   |     |
|----------------------|-----------------------|-----|----|---|----|---|----|---|-----|
| CP Pulse Width       | t <sub>W</sub>        | 4.5 | 16 | - | 20 | - | 24 | - | ns  |
| STR Pulse Width      | t <sub>WH</sub>       | 4.5 | 16 | - | 20 | - | 24 | - | ns  |
| Data Set-up Time     | t <sub>SU</sub>       | 4.5 | 10 | - | 13 | - | 15 | - | ns  |
| Data Hold Time       | t <sub>H</sub>        | 4.5 | 4  | - | 4  | - | 4  | - | ns  |
| STR Set-up Time      | t <sub>SU</sub>       | 4.5 | 20 | - | 25 | - | 30 | - | ns  |
| STR Hold Time        | t <sub>H</sub>        | 4.5 | 0  | - | 0  | - | 0  | - | ns  |
| Maximum CP Frequency | f <sub>CL</sub> (MAX) | 4.5 | 30 | - | 24 | - | 20 | - | MHz |

**Switching Specifications** Input t<sub>r</sub>, t<sub>f</sub> = 6ns

| PARAMETER                                                         | SYMBOL                                 | TEST CONDITIONS       | V <sub>CC</sub> (V) | 25°C |     |     | -40°C TO 85°C |     | -55°C TO 125°C |     | UNITS |
|-------------------------------------------------------------------|----------------------------------------|-----------------------|---------------------|------|-----|-----|---------------|-----|----------------|-----|-------|
|                                                                   |                                        |                       |                     | MIN  | TYP | MAX | MIN           | MAX | MIN            | MAX |       |
| HC TYPES                                                          |                                        |                       |                     |      |     |     |               |     |                |     |       |
| Propagation Delay Time<br>(Figure 1)<br><br>CP to QS <sub>1</sub> | t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 2                   | -    | -   | 150 | -             | 190 | -              | 225 | ns    |
|                                                                   |                                        |                       | 4.5                 | -    | -   | 30  | -             | 38  | -              | 45  | ns    |
|                                                                   |                                        | C <sub>L</sub> = 15pF | 5                   | -    | 12  | -   | -             | -   | -              | -   | ns    |
|                                                                   |                                        | C <sub>L</sub> = 50pF | 6                   | -    | -   | 26  | -             | 33  | -              | 38  | ns    |
| CP to QS <sub>2</sub>                                             | t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 2                   | -    | -   | 135 | -             | 170 | -              | 205 | ns    |
|                                                                   |                                        |                       | 4.5                 | -    | -   | 27  | -             | 34  | -              | 41  | ns    |
|                                                                   |                                        | C <sub>L</sub> = 15pF | 5                   | -    | 11  | -   | -             | -   | -              | -   | ns    |
|                                                                   |                                        | C <sub>L</sub> = 50pF | 6                   | -    | -   | 23  | -             | 29  | -              | 35  | ns    |
| CP to Q <sub>n</sub>                                              | t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 2                   | -    | -   | 195 | -             | 245 | -              | 295 | ns    |
|                                                                   |                                        |                       | 4.5                 | -    | -   | 39  | -             | 49  | -              | 59  | ns    |
|                                                                   |                                        |                       | 5                   | -    | 16  | -   | -             | -   | -              | -   | ns    |
|                                                                   |                                        |                       | 6                   | -    | -   | 33  | -             | 42  | -              | 50  | ns    |
| STR to Q <sub>n</sub>                                             | t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 2                   | -    | -   | 180 | -             | 225 | -              | 270 | ns    |
|                                                                   |                                        |                       | 4.5                 | -    | -   | 36  | -             | 45  | -              | 54  | ns    |
|                                                                   |                                        |                       | 6                   | -    | -   | 31  | -             | 38  | -              | 46  | ns    |

# CD54HC4094, CD74HC4094, CD74HCT4094

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

| PARAMETER                                     | SYMBOL             | TEST CONDITIONS     | $V_{CC}$<br>(V) | 25°C |     |     | -40°C TO 85°C |     | -55°C TO 125°C |     | UNITS |
|-----------------------------------------------|--------------------|---------------------|-----------------|------|-----|-----|---------------|-----|----------------|-----|-------|
|                                               |                    |                     |                 | MIN  | TYP | MAX | MIN           | MAX | MIN            | MAX |       |
| Output Enable to $Q_n$                        | $t_{PZH}, t_{PZL}$ | $C_L = 50\text{pF}$ | 2               | -    | -   | 175 | -             | 220 | -              | 265 | ns    |
|                                               |                    |                     | 4.5             | -    | -   | 35  | -             | 44  | -              | 53  | ns    |
|                                               |                    |                     | 6               | -    | -   | 30  | -             | 37  | -              | 45  | ns    |
| Output Disable to $Q_n$                       | $t_{PHZ}, t_{PLZ}$ | $C_L = 50\text{pF}$ | 2               | -    | -   | 125 | -             | 155 | -              | 190 | ns    |
|                                               |                    |                     | 4.5             | -    | -   | 25  | -             | 31  | -              | 38  | ns    |
|                                               |                    |                     | 6               | -    | -   | 21  | -             | 26  | -              | 32  | ns    |
| Output Transition Time                        | $t_{TLH}, t_{THL}$ | $C_L = 50\text{pF}$ | 2               | -    | -   | 75  | -             | 95  | -              | 110 | ns    |
|                                               |                    |                     | 4.5             | -    | -   | 15  | -             | 19  | -              | 22  | ns    |
|                                               |                    |                     | 6               | -    | -   | 13  | -             | 16  | -              | 19  | ns    |
| Output Disabling Time                         | $t_{PHZ}, t_{PLZ}$ | $C_L = 15\text{pF}$ | 5               | -    | 10  | -   | -             | -   | -              | -   | ns    |
| Maximum CP Frequency                          | $f_{MAX}$          | $C_L = 15\text{pF}$ | 5               | -    | 60  | -   | -             | -   | -              | -   | MHz   |
| Input Capacitance                             | $C_{IN}$           | $C_L = 50\text{pF}$ | -               | -    | -   | 10  | -             | 10  | -              | 10  | pF    |
| Power Dissipation Capacitance<br>(Notes 4, 5) | $C_{PD}$           | $C_L = 15\text{pF}$ | 5               | -    | 90  | -   | -             | -   | -              | -   | pF    |
| Three-State Output Capacitance                | $C_O$              | $C_L = 50\text{pF}$ | -               | -    | -   | 15  | -             | 15  | -              | 15  | pF    |
| <b>HCT TYPES</b>                              |                    |                     |                 |      |     |     |               |     |                |     |       |
| Propagation Delay Time<br>(Figure 1)          | $t_{PLH}, t_{PHL}$ | $C_L = 50\text{pF}$ | 4.5             | -    | -   | 39  | -             | -   | -              | -   | ns    |
|                                               |                    | $C_L = 15\text{pF}$ | 5               | -    | 16  | -   | -             | -   | -              | -   | ns    |
| CP to $QS_1$                                  | $t_{PLH}, t_{PHL}$ | $C_L = 50\text{pF}$ | 4.5             | -    | -   | 36  | -             | -   | -              | -   | ns    |
|                                               |                    | $C_L = 15\text{pF}$ | 5               | -    | 15  | -   | -             | -   | -              | -   | ns    |
| CP to $QS_2$                                  | $t_{PLH}, t_{PHL}$ | $C_L = 50\text{pF}$ | 4.5             | -    | -   | 36  | -             | -   | -              | -   | ns    |
|                                               |                    | $C_L = 15\text{pF}$ | 5               | -    | 15  | -   | -             | -   | -              | -   | ns    |
| CP to $Q_n$                                   | $t_{PLH}, t_{PHL}$ | $C_L = 50\text{pF}$ | 4.5             | -    | -   | 43  | -             | -   | -              | -   | ns    |
|                                               |                    | $C_L = 15\text{pF}$ | 5               | -    | 18  | -   | -             | -   | -              | -   | ns    |
| STR to $Q_n$                                  | $t_{PLH}, t_{PHL}$ | $C_L = 50\text{pF}$ | 4.5             | -    | -   | 39  | -             | -   | -              | -   | ns    |
| Output Enable to $Q_n$                        | $t_{PZH}, t_{PZL}$ | $C_L = 50\text{pF}$ | 4.5             | -    | -   | 35  | -             | -   | -              | -   | ns    |
| Output Disable to $Q_n$                       | $t_{PHZ}, t_{PLZ}$ | $C_L = 50\text{pF}$ | 4.5             | -    | -   | 35  | -             | -   | -              | -   | ns    |
| Output Transition Time                        | $t_{TLH}, t_{THL}$ | $C_L = 50\text{pF}$ | 4.5             | -    | -   | 15  | -             | -   | -              | -   | ns    |
| Output Disabling Time                         | $t_{PHZ}, t_{PLZ}$ | $C_L = 15\text{pF}$ | 5               | -    | 14  | -   | -             | -   | -              | -   | ns    |
| Maximum CP Frequency                          | $f_{MAX}$          | $C_L = 15\text{pF}$ | 5               | -    | 60  | -   | -             | -   | -              | -   | MHz   |
| Input Capacitance                             | $C_{IN}$           | $C_L = 50\text{pF}$ | -               | -    | -   | 10  | -             | 10  | -              | 10  | pF    |
| Power Dissipation Capacitance<br>(Notes 4, 5) | $C_{PD}$           | $C_L = 15\text{pF}$ | 5               | -    | 110 | -   | -             | -   | -              | -   | pF    |
| Three-State Output Capacitance                | $C_O$              | $C_L = 50\text{pF}$ | -               | -    | -   | 15  | -             | 15  | -              | 15  | pF    |

### NOTES:

4.  $C_{PD}$  is used to determine the dynamic power consumption, per register.
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

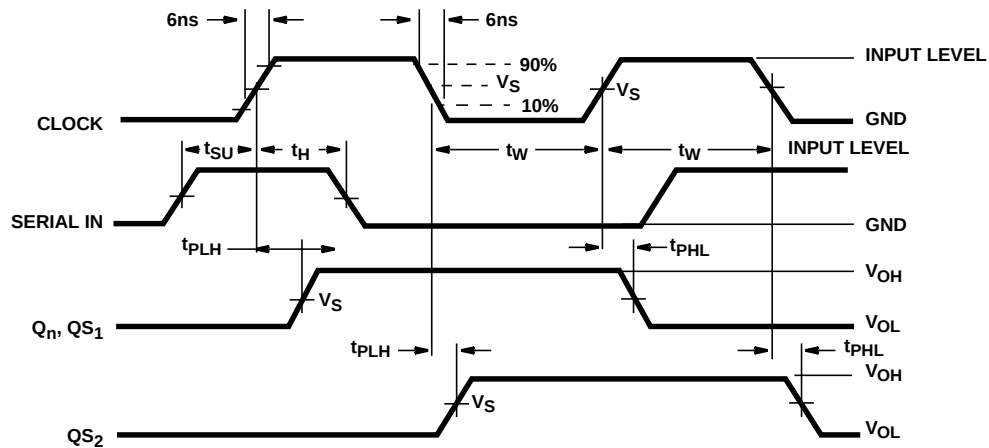


FIGURE 1. DATA PROPAGATION DELAYS, SET-UP AND HOLD TIMES

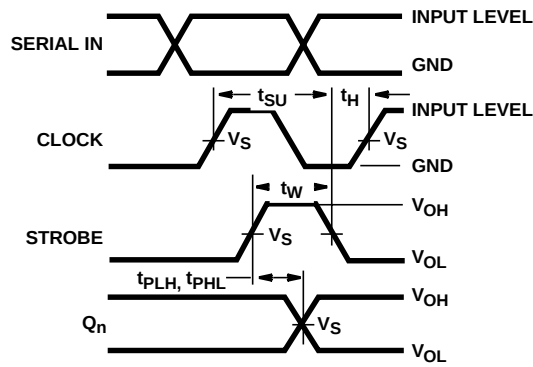


FIGURE 2. STROBE PROPAGATION DELAYS AND SET-UP AND HOLD TIMES

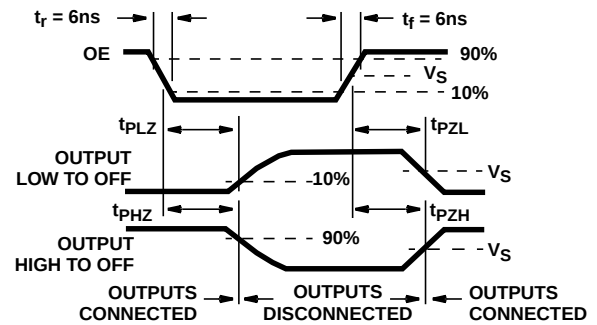


FIGURE 3. ENABLE AND DISABLE TIMES

**PACKAGING INFORMATION**

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup>               |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|--------------------------------------------|
| CD54HC4094F3A    | ACTIVE                | CDIP         | J               | 16   | 1           | None                    | Call TI          | Level-NC-NC-NC                             |
| CD74HC4094E      | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | Level-NC-NC-NC                             |
| CD74HC4094M      | ACTIVE                | SOIC         | D               | 16   | 40          | Pb-Free (RoHS)          | CU NIPDAU        | Level-2-260C-1 YEAR/<br>Level-1-235C-UNLIM |
| CD74HC4094M96    | ACTIVE                | SOIC         | D               | 16   | 2500        | Pb-Free (RoHS)          | CU NIPDAU        | Level-2-260C-1 YEAR/<br>Level-1-235C-UNLIM |
| CD74HC4094MT     | ACTIVE                | SOIC         | D               | 16   | 250         | Pb-Free (RoHS)          | CU NIPDAU        | Level-2-260C-1 YEAR/<br>Level-1-235C-UNLIM |
| CD74HC4094NSR    | ACTIVE                | SO           | NS              | 16   | 2000        | Pb-Free (RoHS)          | CU NIPDAU        | Level-2-260C-1 YEAR/<br>Level-1-235C-UNLIM |
| CD74HC4094PW     | ACTIVE                | TSSOP        | PW              | 16   | 90          | Pb-Free (RoHS)          | CU NIPDAU        | Level-1-250C-UNLIM                         |
| CD74HC4094PWR    | ACTIVE                | TSSOP        | PW              | 16   | 2000        | Pb-Free (RoHS)          | CU NIPDAU        | Level-1-250C-UNLIM                         |
| CD74HC4094PWT    | ACTIVE                | TSSOP        | PW              | 16   | 250         | Pb-Free (RoHS)          | CU NIPDAU        | Level-1-250C-UNLIM                         |
| CD74HCT4094E     | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | Level-NC-NC-NC                             |
| CD74HCT4094M     | ACTIVE                | SOIC         | D               | 16   | 40          | Pb-Free (RoHS)          | CU NIPDAU        | Level-2-260C-1 YEAR/<br>Level-1-235C-UNLIM |
| CD74HCT4094M96   | ACTIVE                | SOIC         | D               | 16   | 2500        | Pb-Free (RoHS)          | CU NIPDAU        | Level-2-260C-1 YEAR/<br>Level-1-235C-UNLIM |
| CD74HCT4094MT    | ACTIVE                | SOIC         | D               | 16   | 250         | Pb-Free (RoHS)          | CU NIPDAU        | Level-2-260C-1 YEAR/<br>Level-1-235C-UNLIM |

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**None:** Not yet available Lead (Pb-Free).

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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J (R-GDIP-T\*\*)

14 LEADS SHOWN

# CERAMIC DUAL IN-LINE PACKAGE



| PINS **<br>DIM | 14                     | 16                     | 18                     | 20                     |
|----------------|------------------------|------------------------|------------------------|------------------------|
| A              | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC |
| B MAX          | 0.785<br>(19,94)       | .840<br>(21,34)        | 0.960<br>(24,38)       | 1.060<br>(26,92)       |
| B MIN          | —                      | —                      | —                      | —                      |
| C MAX          | 0.300<br>(7,62)        | 0.300<br>(7,62)        | 0.310<br>(7,87)        | 0.300<br>(7,62)        |
| C MIN          | 0.245<br>(6,22)        | 0.245<br>(6,22)        | 0.220<br>(5,59)        | 0.245<br>(6,22)        |



4040083/F 03/03

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package is hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



| PINS **<br>DIM      | 14               | 16               | 18               | 20               |
|---------------------|------------------|------------------|------------------|------------------|
| A MAX               | 0.775<br>(19,69) | 0.775<br>(19,69) | 0.920<br>(23,37) | 1.060<br>(26,92) |
| A MIN               | 0.745<br>(18,92) | 0.745<br>(18,92) | 0.850<br>(21,59) | 0.940<br>(23,88) |
| MS-001<br>VARIATION | AA               | BB               | AC               | AD               |



4040049/E 12/2002

NOTES:

- A. All linear dimensions are in inches (millimeters).  
B. This drawing is subject to change without notice.
-  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).  
 The 20 pin end lead shoulder width is a vendor option, either half or full width.

## D (R-PDSO-G16)

## PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - Falls within JEDEC MS-012 variation AC.

# MECHANICAL DATA

NS (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



| DIM \ PINS ** | 14    | 16    | 20    | 24    |
|---------------|-------|-------|-------|-------|
| A MAX         | 10,50 | 10,50 | 12,90 | 15,30 |
| A MIN         | 9,90  | 9,90  | 12,30 | 14,70 |

4040062/C 03/03

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

## PW (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-153

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