

## High-Speed CMOS Logic 4-Bit Bidirectional Universal Shift Register

### Features

- **Four Operating Modes**
  - Shift Right, Shift Left, Hold and Reset
- **Synchronous Parallel or Serial Operation**
- **Typical  $f_{MAX} = 60\text{MHz}$  at  $V_{CC} = 5\text{V}$ ,  $C_L = 15\text{pF}$ ,  $T_A = 25^\circ\text{C}$**
- **Asynchronous Master Reset**
- **Fanout (Over Temperature Range)**
  - Standard Outputs . . . . . 10 LSTTL Loads
  - Bus Driver Outputs . . . . . 15 LSTTL Loads
- **Wide Operating Temperature Range . . .  $-55^\circ\text{C}$  to  $125^\circ\text{C}$**
- **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  $V_{CC} = 5\text{V}$
- **HCT Types**
  - 4.5V to 5.5V Operation
  - Direct LSTTL Input Logic Compatibility,  $V_{IL} = 0.8\text{V}$  (Max),  $V_{IH} = 2\text{V}$  (Min)
  - CMOS Input Compatibility,  $I_I \leq 1\mu\text{A}$  at  $V_{OL}$ ,  $V_{OH}$

### Description

The 'HC194 and CD74HCT194 are 4-bit shift registers with Asynchronous Master Reset ( $\overline{\text{MR}}$ ). In the parallel mode ( $S_0$  and  $S_1$  are high), data is loaded into the associated flip-flop and appears at the output after the positive transition of the clock input (CP). During parallel loading serial data flow is inhibited. Shift left and shift right are accomplished synchronously on the positive clock edge with serial data entered at the shift left (DSL) serial input for the shift left mode, and at the shift right (DSR) serial input for the shift right mode. Clearing the register is accomplished by a Low applied to the Master Reset ( $\overline{\text{MR}}$ ) pin.

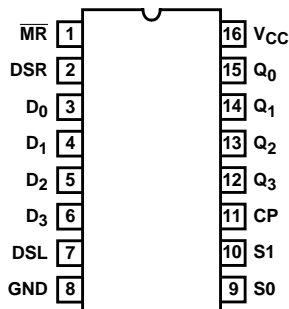
### Ordering Information

| PART NUMBER  | TEMP. RANGE (°C) | PACKAGE      |
|--------------|------------------|--------------|
| CD54HC194F3A | -55 to 125       | 16 Ld CERDIP |
| CD74HC194E   | -55 to 125       | 16 Ld PDIP   |
| CD74HC194M   | -55 to 125       | 16 Ld SOIC   |
| CD74HC194MT  | -55 to 125       | 16 Ld SOIC   |
| CD74HC194M96 | -55 to 125       | 16 Ld SOIC   |
| CD74HC194NSR | -55 to 125       | 16 Ld SOP    |
| CD74HC194PW  | -55 to 125       | 16 Ld TSSOP  |
| CD74HC194PWR | -55 to 125       | 16 Ld TSSOP  |
| CD74HC194PWT | -55 to 125       | 16 Ld TSSOP  |
| CD74HCT194E  | -55 to 125       | 16 Ld PDIP   |

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.

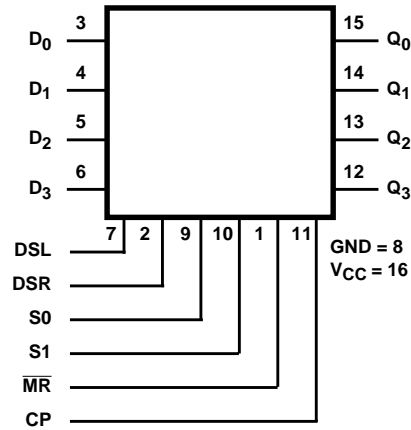
### Pinout

CD54HC194 (CERDIP)  
 CD74HC194 (PDIP, SOIC, SOP, TSSOP)  
 CD74HCT194 (PDIP)  
 TOP VIEW



**CD54HC194, CD74HC194, CD74HCT194**

**Functional Diagram**



**TRUTH TABLE**

| OPERATING MODE    | INPUTS     |                        |    |    |     |     |       | OUTPUT |       |       |       |
|-------------------|------------|------------------------|----|----|-----|-----|-------|--------|-------|-------|-------|
|                   | CP         | $\overline{\text{MR}}$ | S1 | S0 | DSR | DSL | $D_n$ | $Q_0$  | $Q_1$ | $Q_2$ | $Q_3$ |
| Reset (Clear)     | X          | L                      | X  | X  | X   | X   | X     | L      | L     | L     | L     |
| Hold (Do Nothing) | X          | H                      | l  | l  | X   | X   | X     | $q_0$  | $q_1$ | $q_2$ | $q_3$ |
| Shift Left        | $\uparrow$ | H                      | h  | l  | X   | l   | X     | $q_1$  | $q_2$ | $q_3$ | L     |
|                   | $\uparrow$ | H                      | h  | l  | X   | h   | X     | $q_1$  | $q_2$ | $q_3$ | H     |
| Shift Right       | $\uparrow$ | H                      | l  | h  | l   | X   | X     | L      | $q_0$ | $q_1$ | $q_2$ |
|                   | $\uparrow$ | H                      | l  | h  | h   | X   | X     | H      | $q_0$ | $q_1$ | $q_2$ |
| Parallel Load     | $\uparrow$ | H                      | h  | h  | X   | X   | $d_n$ | $d_0$  | $d_1$ | $d_2$ | $d_3$ |

H = High Voltage Level,  
h = High Voltage Level One Set-up Time Prior To The Low to High Clock Transition,  
L = Low Voltage Level,  
l = Low Voltage Level One Set-up Time Prior to the Low to High Clock Transition,  
 $d_n$  ( $q_n$ ) = Lower Case Letters Indicate the State of the Referenced Input (or output) One Set-up Time Prior to the Low To High Clock Transition,  
X = Don't Care,  
 $\uparrow$  = Transition from Low to High Level

# CD54HC194, CD74HC194, CD74HCT194

## 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, $I_{CC}$ or $I_{GND}$ ..... | $\pm 50mA$  |

## Thermal Information

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

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

## 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<br>$V_{IL}$ | -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     |
| High Level Output Voltage<br>TTL Loads  | $V_{OH}$ | $V_{IH}$ or<br>$V_{IL}$ | -4         | 4.5          | 3.98 | -   | -    | 3.84          | -    | 3.7            | -    | V     |
|   |          |                         | -5.2       | 6            | 5.48 | -   | -    | 5.34          | -    | 5.2            | -    | V     |
| Low Level Output Voltage<br>CMOS Loads  | $V_{OL}$ | $V_{IH}$ or<br>$V_{IL}$ | 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     |
| Low Level Output Voltage<br>TTL Loads   | $V_{OL}$ | $V_{IH}$ or<br>$V_{IL}$ | 4          | 4.5          | -    | -   | 0.26 | -             | 0.33 | -              | 0.4  | V     |
|   |          |                         | 5.2        | 6            | -    | -   | 0.26 | -             | 0.33 | -              | 0.4  | V     |

**CD54HC194, CD74HC194, CD74HCT194**

**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 |       |
| 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    |
| <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                         |                           |                                    | -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> to 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 |
|--------------------------|------------|
| CP                       | 0.6        |
| MR                       | 0.55       |
| DSL, DSR, D <sub>n</sub> | 0.25       |
| Sn                       | 1.10       |

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

**CD54HC194, CD74HC194, CD74HCT194**

**Prerequisite For Switching Function**

| PARAMETER                                   | SYMBOL           | TEST CONDITIONS | V <sub>CC</sub> (V) | 25°C |     | -40°C TO 85°C |     | -55°C TO 125°C |     | UNITS |
|---|------------------|-----------------|---------------------|------|-----|---------------|-----|----------------|-----|-------|
|   |                  |                 |                     | MIN  | MAX | MIN           | MAX | MIN            | MAX |       |
| <b>HC TYPES</b>                             |                  |                 |                     |      |     |               |     |                |     |       |
| Max. Clock Frequency<br>(Figure 1)          | f <sub>MAX</sub> | -               | 2                   | 6    | -   | 5             | -   | 4              | -   | MHz   |
|   |                  |                 | 4.5                 | 30   | -   | 24            | -   | 20             | -   | MHz   |
|   |                  |                 | 6                   | 35   | -   | 28            | -   | 23             | -   | MHz   |
| MR Pulse Width<br>(Figure 2)                | t <sub>W</sub>   | -               | 2                   | 80   | -   | 100           | -   | 120            | -   | ns    |
|   |                  |                 | 4.5                 | 16   | -   | 20            | -   | 24             | -   | ns    |
|   |                  |                 | 6                   | 14   | -   | 17            | -   | 20             | -   | ns    |
| Clock Pulse Width<br>(Figure 1)             | t <sub>W</sub>   | -               | 2                   | 80   | -   | 100           | -   | 120            | -   | ns    |
|   |                  |                 | 4.5                 | 16   | -   | 20            | -   | 24             | -   | ns    |
|   |                  |                 | 6                   | 14   | -   | 17            | -   | 20             | -   | ns    |
| Set-up Time<br>Data to Clock (Figure 3)     | t <sub>SU</sub>  | -               | 2                   | 70   | -   | 90            | -   | 105            | -   | ns    |
|   |                  |                 | 4.5                 | 14   | -   | 18            | -   | 21             | -   | ns    |
|   |                  |                 | 6                   | 12   | -   | 15            | -   | 19             | -   | ns    |
| Removal Time,<br>MR to Clock (Figure 2)     | t <sub>REM</sub> | -               | 2                   | 60   | -   | 75            | -   | 90             | -   | ns    |
|   |                  |                 | 4.5                 | 12   | -   | 15            | -   | 18             | -   | ns    |
|   |                  |                 | 6                   | 10   | -   | 13            | -   | 15             | -   | ns    |
| Set-Up Time<br>S1, S0 to Clock (Figure 4)   | t <sub>SU</sub>  | -               | 2                   | 80   | -   | 100           | -   | 120            | -   | ns    |
|   |                  |                 | 4.5                 | 16   | -   | 20            | -   | 24             | -   | ns    |
|   |                  |                 | 6                   | 14   | -   | 17            | -   | 20             | -   | ns    |
| Set-up Time<br>DSL, DSR to Clock (Figure 4) | t <sub>SU</sub>  | -               | 2                   | 70   | -   | 90            | -   | 105            | -   | ns    |
|   |                  |                 | 4.5                 | 14   | -   | 18            | -   | 21             | -   | ns    |
|   |                  |                 | 6                   | 12   | -   | 15            | -   | 18             | -   | ns    |
| Hold Time<br>S1, S0 to Clock (Figure 4)     | t <sub>H</sub>   | -               | 2                   | 0    | -   | 0             | -   | 0              | -   | ns    |
|   |                  |                 | 4.5                 | 0    | -   | 0             | -   | 0              | -   | ns    |
|   |                  |                 | 6                   | 0    | -   | 0             | -   | 0              | -   | ns    |
| Hold Time<br>Data to Clock (Figure 3)       | t <sub>H</sub>   | -               | 2                   | 0    | -   | 0             | -   | 0              | -   | ns    |
|   |                  |                 | 4.5                 | 0    | -   | 0             | -   | 0              | -   | ns    |
|   |                  |                 | 6                   | 0    | -   | 0             | -   | 0              | -   | ns    |
| <b>HCT TYPES</b>                            |                  |                 |                     |      |     |               |     |                |     |       |
| Max. Clock Frequency (Figure 1)             | f <sub>MAX</sub> | -               | 4.5                 | 27   | -   | 22            | -   | 18             | -   | MHz   |
| MR Pulse Width (Figure 2)                   | t <sub>W</sub>   | -               | 4.5                 | 16   | -   | 20            | -   | 24             | -   | ns    |
| Clock Pulse Width (Figure 1)                | t <sub>W</sub>   | -               | 4.5                 | 16   | -   | 20            | -   | 24             | -   | ns    |
| Set-up Time, Data to Clock<br>(Figure 3)    | t <sub>SU</sub>  | -               | 4.5                 | 14   | -   | 18            | -   | 21             | -   | ns    |
| Removal Time MR to Clock<br>(Figure 2)      | t <sub>REM</sub> | -               | 4.5                 | 12   | -   | 15            | -   | 18             | -   | ns    |

**Prerequisite For Switching Function (Continued)**

| PARAMETER                                   | SYMBOL          | TEST CONDITIONS | V <sub>CC</sub> (V) | 25°C |     | -40°C TO 85°C |     | -55°C TO 125°C |     | UNITS |
|---|-----------------|-----------------|---------------------|------|-----|---------------|-----|----------------|-----|-------|
|   |                 |                 |                     | MIN  | MAX | MIN           | MAX | MIN            | MAX |       |
| Set-up Time<br>S1, S0 to Clock (Figure 4)   | t <sub>SU</sub> | -               | 4.5                 | 20   | -   | 25            | -   | 30             | -   | ns    |
| Set-up Time<br>DSL, DSR to Clock (Figure 4) | t <sub>SU</sub> | -               | 4.5                 | 14   | -   | 18            | -   | 21             | -   | ns    |
| Hold Time<br>S1, S0 to Clock (Figure 4)     | t <sub>H</sub>  | -               | 4.5                 | 0    | -   | 0             | -   | 0              | -   | ns    |
| Hold Time<br>Data to Clock (Figure 3)       | t <sub>H</sub>  | -               | 4.5                 | 0    | -   | 0             | -   | 0              | -   | ns    |

**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 |
|--|-------------------------------------|-----------------------|---------------------|------|-----|---------------|----------------|-------|
|  |                                     |                       |                     | TYP  | MAX | MAX           | MAX            |       |
| <b>HC TYPES</b>                                  |                                     |                       |                     |      |     |               |                |       |
| Propagation Delay,<br>Clock to Output (Figure 1) | t <sub>PLH</sub> , t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 2                   | -    | 175 | 220           | 265            | ns    |
|  |                                     |                       | 4.5                 | -    | 35  | 44            | 53             | ns    |
|  |                                     |                       | 6                   | -    | 30  | 37            | 45             | ns    |
| Propagation Delay,<br>Clock to Q                 | t <sub>PLH</sub> , t <sub>PHL</sub> | -                     | 5                   | 14   | -   | -             | -              | ns    |
| Output Transition Time<br>(Figure 1)             | t <sub>TLH</sub> , t <sub>THL</sub> | C <sub>L</sub> = 50pF | 2                   | -    | 75  | 95            | 110            | ns    |
|  |                                     |                       | 4.5                 | -    | 15  | 19            | 22             | ns    |
|  |                                     |                       | 6                   | -    | 13  | 16            | 19             | ns    |
| Propagation Delay,<br>MR to Output (Figure 2)    | t <sub>PHL</sub>                    | C <sub>L</sub> = 50pF | 2                   | -    | 140 | 175           | 210            | ns    |
|  |                                     |                       | 4.5                 | -    | 28  | 35            | 42             | ns    |
|  |                                     |                       | 6                   | -    | 24  | 30            | 36             | ns    |
| Input Capacitance                                | C <sub>IN</sub>                     | -                     | -                   | -    | 10  | 10            | 10             | pF    |
| Maximum Clock Frequency                          | f <sub>MAX</sub>                    | -                     | 5                   | 60   | -   | -             | -              | MHz   |
| Power Dissipation<br>Capacitance (Notes 4, 5)    | C <sub>PD</sub>                     | -                     | 5                   | 55   | -   | -             | -              | pF    |
| <b>HCT TYPES</b>                                 |                                     |                       |                     |      |     |               |                |       |
| Propagation Delay,<br>Clock to Output (Figure 1) | t <sub>PLH</sub> , t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 4.5                 | -    | 37  | 46            | 56             | ns    |
| Propagation Delay,<br>Clock to Q                 | t <sub>PLH</sub> , t <sub>PHL</sub> | -                     | 5                   | 15   | -   | -             | -              | ns    |
| Output Transition Times<br>(Figure 1)            | t <sub>TLH</sub> , t <sub>THL</sub> | C <sub>L</sub> = 50pF | 4.5                 | -    | 15  | 19            | 22             | ns    |
| Propagation Delay,<br>MR to Output (Figure 2)    | t <sub>PHL</sub>                    | C <sub>L</sub> = 50pF | 4.5                 | -    | 40  | 50            | 60             | ns    |
| Input Capacitance                                | C <sub>IN</sub>                     | -                     | -                   | -    | 10  | 10            | 10             | pF    |
| Maximum Clock Frequency                          | f <sub>MAX</sub>                    | -                     | 5                   | 50   | -   | -             | -              | MHz   |
| Power Dissipation<br>Capacitance (Notes 4, 5)    | C <sub>PD</sub>                     | -                     | 5                   | 60   | -   | -             | -              | pF    |

**NOTES:**

- C<sub>PD</sub> is used to determine the dynamic power consumption, per gate.
- $P_D = V_{CC}^2 f_i + \sum (C_L V_{CC}^2)$  where f<sub>i</sub> = Input Frequency, C<sub>L</sub> = Output Load Capacitance, V<sub>CC</sub> = Supply Voltage.

## Test Circuits and Waveforms

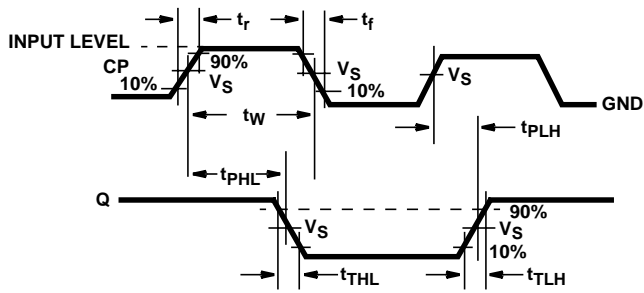


FIGURE 1. CLOCK PREREQUISITE TIMES AND PROPAGATION AND OUTPUT TRANSITION TIMES

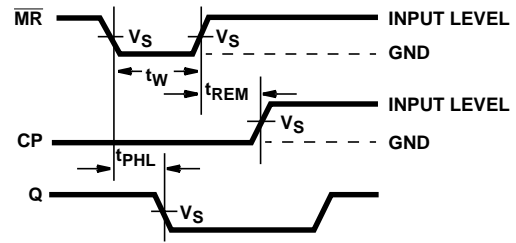


FIGURE 2. MASTER RESET PREREQUISITE TIMES AND PROPAGATION DELAYS

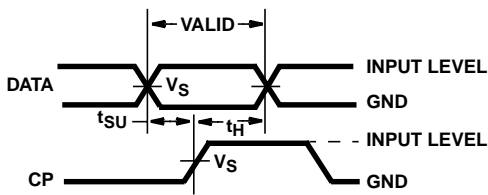


FIGURE 3. DATA PREREQUISITE TIMES

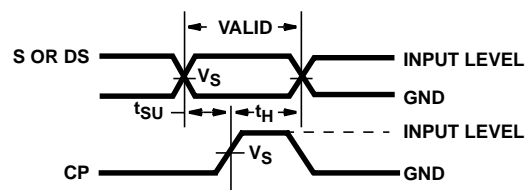


FIGURE 4. PARALLEL LOAD OR SHIFT-LEFT/SHIFT-RIGHT PREREQUISITE TIMES

**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> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| 5962-8682601EA   | ACTIVE                | CDIP         | J               | 16   | 1           | TBD                     | A42 SNPB         | N / A for Pkg Type           |
| CD54HC194F3A     | ACTIVE                | CDIP         | J               | 16   | 1           | TBD                     | A42 SNPB         | N / A for Pkg Type           |
| CD74HC194E       | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| CD74HC194EE4     | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| CD74HC194M       | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC194M96     | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC194M96E4   | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC194M96G4   | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC194ME4     | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC194MG4     | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC194MT      | ACTIVE                | SOIC         | D               | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC194MTE4    | ACTIVE                | SOIC         | D               | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC194MTG4    | ACTIVE                | SOIC         | D               | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC194NSR     | ACTIVE                | SO           | NS              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC194NSRE4   | ACTIVE                | SO           | NS              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC194NSRG4   | ACTIVE                | SO           | NS              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC194PW      | ACTIVE                | TSSOP        | PW              | 16   | 90          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC194PWE4    | ACTIVE                | TSSOP        | PW              | 16   | 90          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC194PWG4    | ACTIVE                | TSSOP        | PW              | 16   | 90          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC194PWR     | ACTIVE                | TSSOP        | PW              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC194PWRE4   | ACTIVE                | TSSOP        | PW              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC194PWG4    | ACTIVE                | TSSOP        | PW              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC194PWT     | ACTIVE                | TSSOP        | PW              | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC194PWTE4   | ACTIVE                | TSSOP        | PW              | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC194PWTG4   | ACTIVE                | TSSOP        | PW              | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HCT194E      | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free                 | CU NIPDAU        | N / A for Pkg Type           |



| 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> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
|                  |                       |              |                 |      |             | (RoHS)                  |                  |                              |
| CD74HCT194EE4    | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |

<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 - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**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.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<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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**TAPE AND REEL INFORMATION**



**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**



\*All dimensions are nominal

| Device       | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CD74HC194M96 | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| CD74HC194NSR | SO           | NS              | 16   | 2000 | 330.0              | 16.4               | 8.2     | 10.5    | 2.5     | 12.0    | 16.0   | Q1            |
| CD74HC194PWR | TSSOP        | PW              | 16   | 2000 | 330.0              | 12.4               | 7.0     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |

**TAPE AND REEL BOX DIMENSIONS**



\*All dimensions are nominal

| Device       | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CD74HC194M96 | SOIC         | D               | 16   | 2500 | 333.2       | 345.9      | 28.6        |
| CD74HC194NSR | SO           | NS              | 16   | 2000 | 346.0       | 346.0      | 33.0        |
| CD74HC194PWR | TSSOP        | PW              | 16   | 2000 | 346.0       | 346.0      | 29.0        |

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

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



4040064/F 01/97

- 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

# MECHANICAL DATA

NS (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.

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

14 LEADS SHOWN

# CERAMIC DUAL IN-LINE PACKAGE



| DIM \ PINS ** | 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)        |

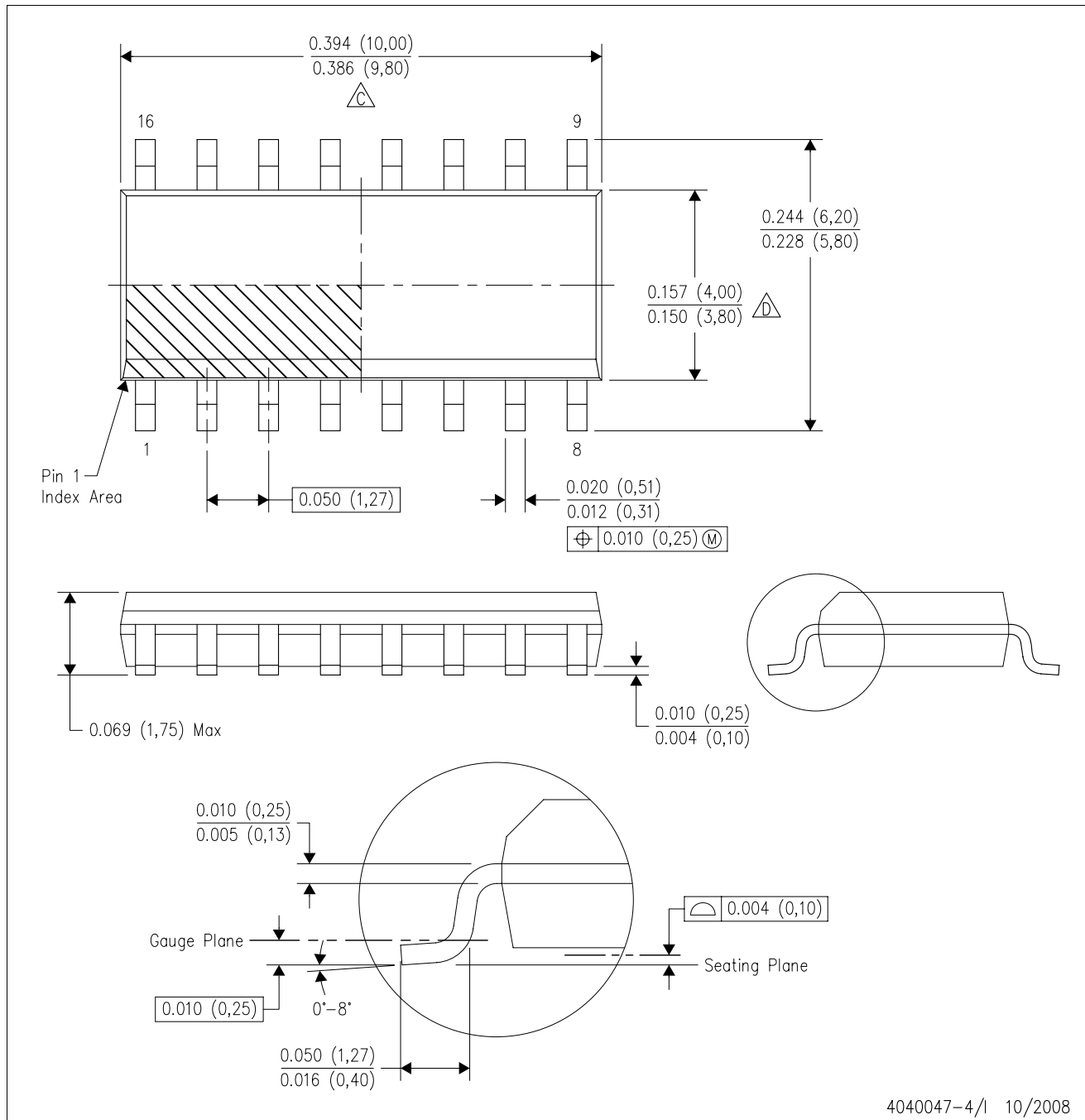


4040083/F 03/03

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

D (R-PDSO-G16)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
  - E. Reference JEDEC MS-012 variation AC.

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

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- 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.



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