

## High-Speed CMOS Logic 4x4 Register File

January 1998 - Revised October 2003

### Features

- **Simultaneous and Independent Read and Write Operations**
- **Expandable to 512 Words of n-Bits**
- **Three-State Outputs**
- **Organized as 4 Words x 4 Bits Wide**
- **Buffered Inputs**
- **Typical Read Time = 16ns for 'HC670  $V_{CC} = 5V$ ,  $C_L = 15pF$ ,  $T_A = 25^\circ C$**
- **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

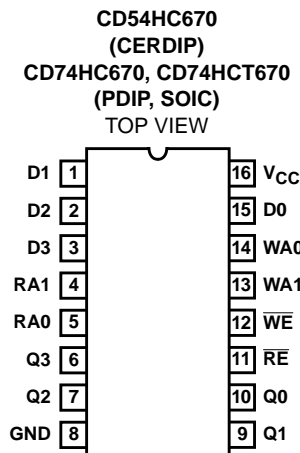
The 'HC670 and CD74HCT670 are 16-bit register files organized as 4 words x 4 bits each. Read and write address and enable inputs allow simultaneous writing into one location while reading another. Four data inputs are provided to store the 4-bit word. The write address inputs (WA0 and WA1) determine the location of the stored word in the register. When write enable ( $\overline{WE}$ ) is low the word is entered into the address location and it remains transparent to the data. The outputs will reflect the true form of the input data. When ( $\overline{WE}$ ) is high data and address inputs are inhibited. Data acquisition from the four registers is made possible by the read address inputs (RA1 and RA0). The addressed word appears at the output when the read enable ( $\overline{RE}$ ) is low. The output is in the high impedance state when the ( $\overline{RE}$ ) is high. Outputs can be tied together to increase the word capacity to 512 x 4 bits.

### Ordering Information

| PART NUMBER   | TEMP. RANGE (°C) | PACKAGE      |
|---------------|------------------|--------------|
| CD54HC670F3A  | -55 to 125       | 16 Ld CERDIP |
| CD74HC670E    | -55 to 125       | 16 Ld PDIP   |
| CD74HC670M    | -55 to 125       | 16 Ld SOIC   |
| CD74HC670MT   | -55 to 125       | 16 Ld SOIC   |
| CD74HC670M96  | -55 to 125       | 16 Ld SOIC   |
| CD74HCT670E   | -55 to 125       | 16 Ld PDIP   |
| CD74HCT670M   | -55 to 125       | 16 Ld SOIC   |
| CD74HCT670MT  | -55 to 125       | 16 Ld SOIC   |
| CD74HCT670M96 | -55 to 125       | 16 Ld SOIC   |

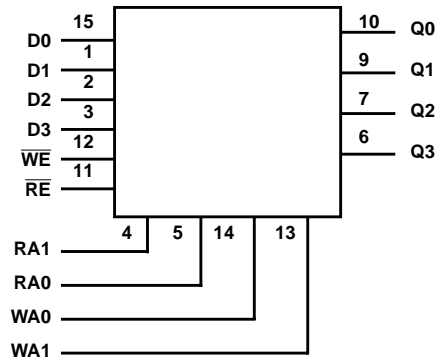
NOTE: When ordering, use the entire part number. The suffix 96 denotes tape and reel. The suffix T denotes a small-quantity reel of 250.

### Pinout



**CD54HC670, CD74HC670, CD74HCT670**

**Functional Diagram**



**WRITE MODE SELECT TABLE**

| OPERATING MODE | INPUTS          |       | INTERNAL LATCHES (NOTE 1) |
|----------------|-----------------|-------|---------------------------|
|                | $\overline{WE}$ | $D_N$ |                           |
| Write Data     | L               | L     | L                         |
|                | L               | H     | H                         |
| Data Latched   | H               | X     | No Change                 |

NOTE:

1. The Write Address (WA0 and WA1) to the "internal latches" must be stable while  $\overline{WE}$  is LOW for conventional operation.

**READ MODE SELECT TABLE**

| OPERATING MODE | INPUTS          |                           | OUTPUT $Q_N$ |
|----------------|-----------------|---------------------------|--------------|
|                | $\overline{RE}$ | INTERNAL LATCHES (NOTE 2) |              |
| Read           | L               | L                         | L            |
|                | L               | H                         | H            |
| Disabled       | H               | X                         | (Z)          |

NOTE:

2. The selection of the "internal latches" by Read Address (RA0 and RA1) are not constrained by  $\overline{WE}$  or  $\overline{RE}$  operation.  
 H = High Voltage Level  
 L = Low Voltage Level  
 X = Don't Care  
 Z = High Impedance "Off" State

## CD54HC670, CD74HC670, CD74HCT670

### 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)             |
| E (PDIP) Package .....                         | 67                               |
| M (SOIC) Package .....                         | 73                               |
| 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:

- 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 $V_{IL}$ | -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            | -    | -    | $\pm 0.1$ | -             | $\pm 1$ | -              | $\pm 1$ | $\mu A$ |   |

## CD54HC670, CD74HC670, CD74HCT670

### 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                                   |                           | 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                                   |                           | 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> (Note 4) | V <sub>CC</sub> -2.1               | -                                       | 4.5 to 5.5          | -    | 100 | 360  | -             | 450  | -              | 490 | μA    |

NOTE:

4. 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 |
|-----------------|------------|
| $\overline{WE}$ | 0.3        |
| WA0             | 0.2        |
| WA1             | 0.4        |
| $\overline{RE}$ | 1.5        |
| DATA            | 0.15       |
| RA0             | 0.4        |
| RA1             | 0.7        |

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

**CD54HC670, CD74HC670, CD74HCT670**

**Prerequisite for Switching Specifications**

| PARAMETER   | SYMBOL        | V <sub>CC</sub> (V) | 25°C |     |     | -40°C TO 85°C |     |     | -55°C TO 125°C |     |     | UNITS |
|---|---------------|---------------------|------|-----|-----|---------------|-----|-----|----------------|-----|-----|-------|
|   |               |                     | MIN  | TYP | MAX | MIN           | TYP | MAX | MIN            | TYP | MAX |       |
| <b>HC TYPES</b>   |               |                     |      |     |     |               |     |     |                |     |     |       |
| Setup Time<br>Data to $\overline{WE}$<br>Write to $\overline{WE}$ | $t_{SU}, t_H$ | 2                   | 60   | -   | -   | 75            | -   | -   | 90             | -   | -   | ns    |
|   |               | 4.5                 | 12   | -   | -   | 15            | -   | -   | 18             | -   | -   | ns    |
|   |               | 6                   | 10   | -   | -   | 13            | -   | -   | 15             | -   | -   | ns    |
| Hold Time<br>Data to $\overline{WE}$<br>Write to $\overline{WE}$  | $t_H, t_W$    | 2                   | 5    | -   | -   | 5             | -   | -   | 5              | -   | -   | ns    |
|   |               | 4.5                 | 5    | -   | -   | 5             | -   | -   | 5              | -   | -   | ns    |
|   |               | 6                   | 5    | -   | -   | 5             | -   | -   | 5              | -   | -   | ns    |
| Pulse Width $\overline{WE}$                                       | $t_W$         | 2                   | 80   | -   | -   | 100           | -   | -   | 120            | -   | -   | ns    |
|   |               | 4.5                 | 16   | -   | -   | 20            | -   | -   | 24             | -   | -   | ns    |
|   |               | 6                   | 14   | -   | -   | 17            | -   | -   | 20             | -   | -   | ns    |
| Latch Time $\overline{WE}$ to RA0,<br>RA1                         | $t_{LATCH}$   | 2                   | 100  | -   | -   | 125           | -   | -   | 150            | -   | -   | ns    |
|   |               | 4.5                 | 20   | -   | -   | 25            | -   | -   | 30             | -   | -   | ns    |
|   |               | 6                   | 17   | -   | -   | 21            | -   | -   | 26             | -   | -   | ns    |
| <b>HCT TYPES</b>  |               |                     |      |     |     |               |     |     |                |     |     |       |
| Setup Time<br>Data to $\overline{WE}$                             | $t_{SU}, t_H$ | 4.5                 | 12   | -   | -   | 15            | -   | -   | 18             | -   | -   | ns    |
| Hold Time<br>Data to $\overline{WE}$<br>Write to $\overline{WE}$  | $t_H, t_W$    | 4.5                 | 5    | -   | -   | 5             | -   | -   | 5              | -   | -   | ns    |
| Setup Time<br>Write to $\overline{WE}$                            | $t_{SU}$      | 4.5                 | 18   | -   | -   | 23            | -   | -   | 27             | -   | -   | ns    |
| Pulse Width $\overline{WE}$                                       | $t_W$         | 4.5                 | 20   | -   | -   | 25            | -   | -   | 30             | -   | -   | ns    |
| Latch Time $\overline{WE}$ to RA0,<br>RA1                         | $t_{LATCH}$   | 4.5                 | 25   | -   | -   | 31            | -   | -   | 38             | -   | -   | ns    |

**Switching Specifications** C<sub>L</sub> = 50pF, Input t<sub>r</sub>, t<sub>f</sub> = 6ns

| PARAMETER                             | SYMBOL             | TEST<br>CONDITIONS    | V <sub>CC</sub> (V) | 25°C |     |     | -40°C TO<br>85°C |     | -55°C TO<br>125°C |     | UNITS |
|---------------------------------------|--------------------|-----------------------|---------------------|------|-----|-----|------------------|-----|-------------------|-----|-------|
|                                       |                    |                       |                     | MIN  | TYP | MAX | MIN              | MAX | MIN               | MAX |       |
| <b>HC TYPES</b>                       |                    |                       |                     |      |     |     |                  |     |                   |     |       |
| Propagation Delay<br>Reading Any Word | $t_{PLH}, t_{PHL}$ | C <sub>L</sub> = 50pF | 2                   | -    | -   | 195 | -                | 245 | -                 | 295 | ns    |
|                                       |                    |                       | 4.5                 | -    | -   | 39  | -                | 49  | -                 | 59  | ns    |
|                                       |                    | C <sub>L</sub> = 15pF | 5                   | -    | 16  | -   | -                | -   | -                 | -   | ns    |
|                                       |                    | C <sub>L</sub> = 50pF | 6                   | -    | -   | 33  | -                | 42  | -                 | 50  | ns    |
| Write Enable to Output                | $t_{PLH}, t_{PHL}$ | C <sub>L</sub> = 50pF | 2                   | -    | -   | 250 | -                | 315 | -                 | 375 | ns    |
|                                       |                    |                       | 4.5                 | -    | -   | 50  | -                | 63  | -                 | 75  | ns    |
|                                       |                    | C <sub>L</sub> = 15pF | 5                   | -    | 21  | -   | -                | -   | -                 | -   | ns    |
|                                       |                    | C <sub>L</sub> = 50pF | 6                   | -    | -   | 43  | -                | 54  | -                 | 64  | ns    |

**CD54HC670, CD74HC670, CD74HCT670**

**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 |       |
| Data to Output                             | $t_{PLH}, t_{PHL}$ | $C_L = 50\text{pF}$ | 2            | -    | -   | 256 | -             | 315 | -              | 375 | ns    |
|  |                    |                     | 4.5          | -    | -   | 50  | -             | 63  | -              | 75  | ns    |
|  |                    | $C_L = 15\text{pF}$ | 5            | -    | 21  | -   | -             | -   | -              | -   | ns    |
|  |                    | $C_L = 50\text{pF}$ | 6            | -    | -   | 43  | -             | 54  | -              | 64  | ns    |
| Output Disable Time                        | $t_{PLZ}, t_{PHZ}$ | $C_L = 50\text{pF}$ | 2            | -    | -   | 150 | -             | 190 | -              | 225 | ns    |
|  |                    |                     | 4.5          | -    | -   | 30  | -             | 38  | -              | 45  | ns    |
|  |                    | $C_L = 15\text{pF}$ | 5            | -    | 12  | -   | -             | -   | -              | -   | ns    |
|  |                    | $C_L = 50\text{pF}$ | 6            | -    | -   | 26  | -             | 33  | -              | 38  | ns    |
| Output Enable Time                         | $t_{PZL}, t_{PZH}$ | $C_L = 50\text{pF}$ | 2            | -    | -   | 150 | -             | 190 | -              | 225 | ns    |
|  |                    |                     | 4.5          | -    | -   | 30  | -             | 38  | -              | 45  | ns    |
|  |                    | $C_L = 15\text{pF}$ | 5            | -    | 12  | -   | -             | -   | -              | -   | ns    |
|  |                    | $C_L = 50\text{pF}$ | 6            | -    | -   | 26  | -             | 33  | -              | 38  | ns    |
| Output Transition Time                     | $t_{THL}, t_{TLH}$ | $C_L = 50\text{pF}$ | 2            | -    | -   | 75  | -             | 95  | -              | 110 | ns    |
|  |                    |                     | 4.5          | -    | -   | 15  | -             | 19  | -              | 22  | ns    |
|  |                    |                     | 6            | -    | -   | 13  | -             | 10  | -              | 19  | ns    |
| Input Capacitance                          | $C_I$              | $C_L = 50\text{pF}$ | -            | 10   | -   | 10  | -             | 10  | -              | 10  | pF    |
| Three-State Output Capacitance             | $C_O$              | -                   | -            | 20   | -   | 20  | -             | 20  | -              | 20  | pF    |
| Power Dissipation Capacitance (Notes 5, 6) | $C_{PD}$           | $C_L = 15\text{pF}$ | 5            | -    | 59  | -   | -             | -   | -              | -   | pF    |
| <b>HCT TYPES</b>                           |                    |                     |              |      |     |     |               |     |                |     |       |
| Propagation Delay Reading Any Word         | $t_{PHL}, t_{PLH}$ | $C_L = 50\text{pF}$ | 4.5          | -    | -   | 40  | -             | 50  | -              | 53  | ns    |
|  |                    | $C_L = 15\text{pF}$ | 5            | -    | 17  | -   | -             | -   | -              | -   | ns    |
| Write Enable to Output                     | $t_{PHL}, t_{PLH}$ | $C_L = 50\text{pF}$ | 4.5          | -    | -   | 50  | -             | 63  | -              | 75  | ns    |
|  |                    | $C_L = 15\text{pF}$ | 5            | -    | 21  | -   | -             | -   | -              | -   | ns    |
| Data to Output                             | $t_{PHL}, t_{PLH}$ | $C_L = 50\text{pF}$ | 4.5          | -    | -   | 50  | -             | 63  | -              | 75  | ns    |
|  |                    | $C_L = 15\text{pF}$ | 5            | -    | 21  | -   | -             | -   | -              | -   | ns    |
| Output Disable Time                        | $t_{PLZ}, t_{PHZ}$ | $C_L = 50\text{pF}$ | 4.5          | -    | -   | 35  | -             | 44  | -              | 53  | ns    |
|  |                    | $C_L = 15\text{pF}$ | 5            | -    | 14  | -   | -             | -   | -              | -   | ns    |
| Output Enable Time                         | $t_{PZL}, t_{PZH}$ | $C_L = 50\text{pF}$ | 4.5          | -    | -   | 38  | -             | 48  | -              | 57  | ns    |
|  |                    | $C_L = 15\text{pF}$ | 5            | -    | 16  | -   | -             | -   | -              | -   | ns    |
| Output Transition Time                     | $t_{TLH}, t_{THL}$ | $C_L = 50\text{pF}$ | 4.5          | -    | -   | 15  | -             | 19  | -              | 22  | ns    |
| Input Capacitance                          | $C_I$              | $C_L = 50\text{pF}$ | -            | 10   | -   | 10  | -             | 10  | -              | 10  | pF    |
| Three-State Output Capacitance             | $C_O$              | -                   | -            | 20   | -   | 20  | -             | 20  | -              | 20  | pF    |
| Power Dissipation Capacitance (Notes 5, 6) | $C_{PD}$           | $C_L = 15\text{pF}$ | 5            | -    | 66  | -   | -             | -   | -              | -   | pF    |

**NOTES:**

- $C_{PD}$  is used to determine the dynamic power consumption, per output.
- $P_D = C_{PD} V_{CC}^2 f_i + \sum C_L V_{CC}^2 f_O$  where  $f_i$  = Input Frequency,  $f_O$  = Output Frequency,  $C_L$  = Output Load Capacitance,  $V_{CC}$  = Supply Voltage.

Test Circuits and Waveforms



NOTE: Outputs should be switching from 10%  $V_{CC}$  to 90%  $V_{CC}$  in accordance with device truth table. For  $f_{MAX}$ , input duty cycle = 50%.

FIGURE 1. HC CLOCK PULSE RISE AND FALL TIMES AND PULSE WIDTH



NOTE: Outputs should be switching from 10%  $V_{CC}$  to 90%  $V_{CC}$  in accordance with device truth table. For  $f_{MAX}$ , input duty cycle = 50%.

FIGURE 2. HCT CLOCK PULSE RISE AND FALL TIMES AND PULSE WIDTH



FIGURE 3. HC TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC



FIGURE 4. HCT TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

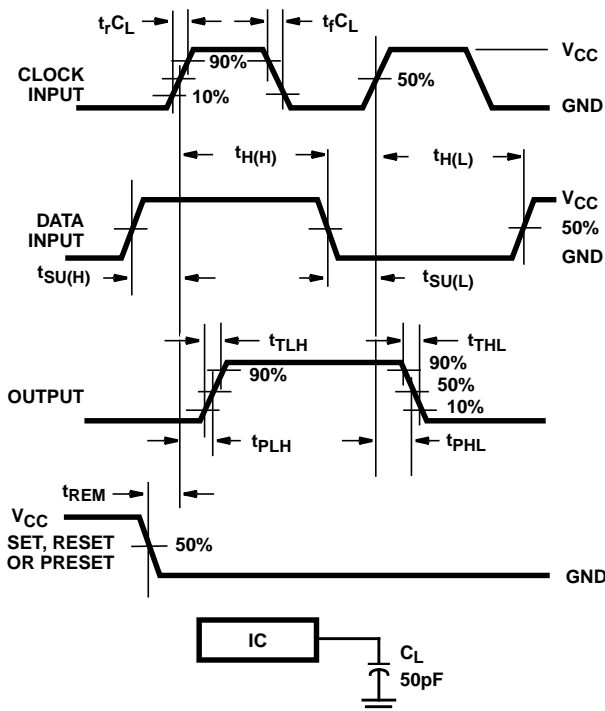


FIGURE 5. HC SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS

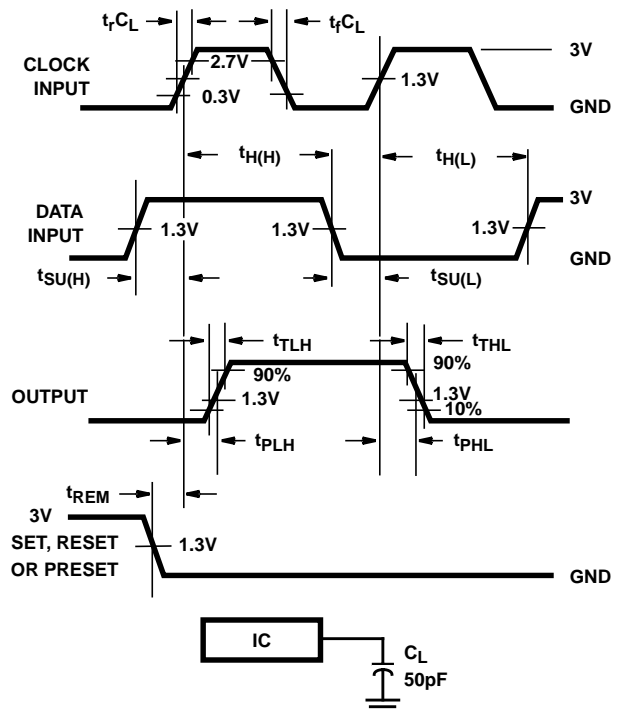


FIGURE 6. HCT SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS

Test Circuits and Waveforms (Continued)

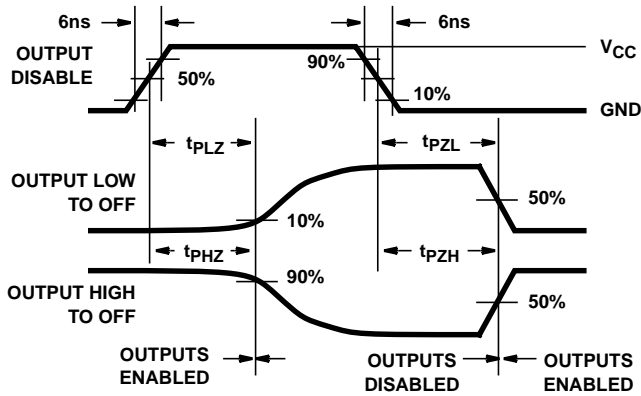


FIGURE 7. HC THREE-STATE PROPAGATION DELAY WAVEFORM

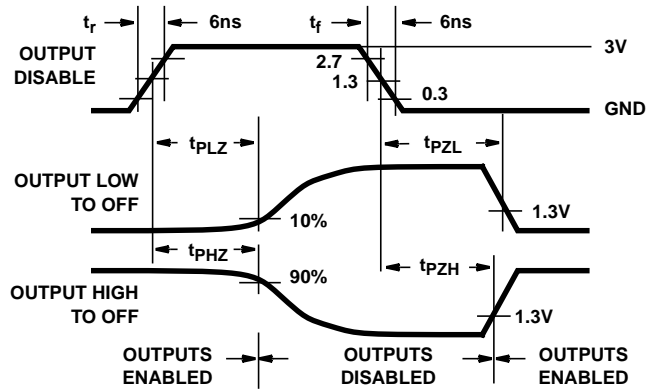
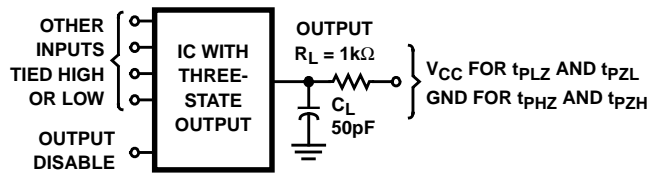


FIGURE 8. HCT THREE-STATE PROPAGATION DELAY WAVEFORM



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  $R_L = 1k\Omega$  to  $V_{CC}$ ,  $C_L = 50pF$ .

FIGURE 9. HC AND HCT THREE-STATE PROPAGATION DELAY TEST CIRCUIT



**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| CD74HC670E       | ACTIVE        | PDIP         | N               | 16   | 25          | RoHS & Green    | NIPDAU                               | N / A for Pkg Type   | -55 to 125   | CD74HC670E              | <a href="#">Samples</a> |
| CD74HC670M       | OBSOLETE      | SOIC         | D               | 16   |             | TBD             | Call TI                              | Call TI              | -55 to 125   | HC670M                  |                         |
| CD74HC670M96     | ACTIVE        | SOIC         | D               | 16   | 2500        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | HC670M                  | <a href="#">Samples</a> |
| CD74HCT670E      | ACTIVE        | PDIP         | N               | 16   | 25          | RoHS & Green    | NIPDAU                               | N / A for Pkg Type   | -55 to 125   | CD74HCT670E             | <a href="#">Samples</a> |
| CD74HCT670M      | ACTIVE        | SOIC         | D               | 16   | 40          | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | HCT670M                 | <a href="#">Samples</a> |

(1) 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.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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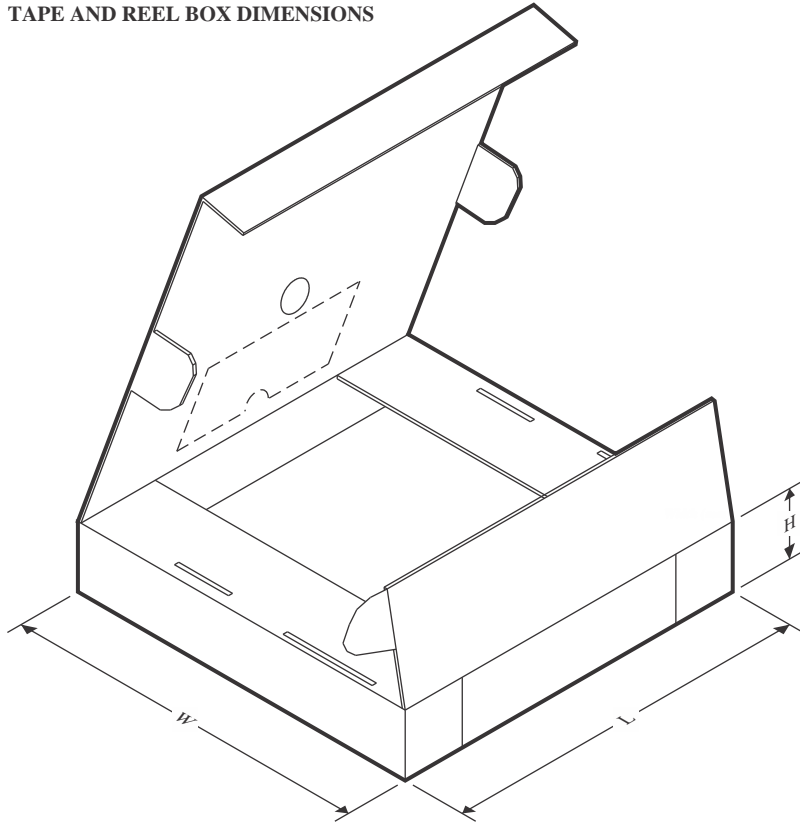
**TAPE AND REEL INFORMATION**

**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 |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CD74HC670M96 | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |

**TAPE AND REEL BOX DIMENSIONS**



\*All dimensions are nominal

| Device       | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CD74HC670M96 | SOIC         | D               | 16   | 2500 | 353.0       | 353.0      | 32.0        |

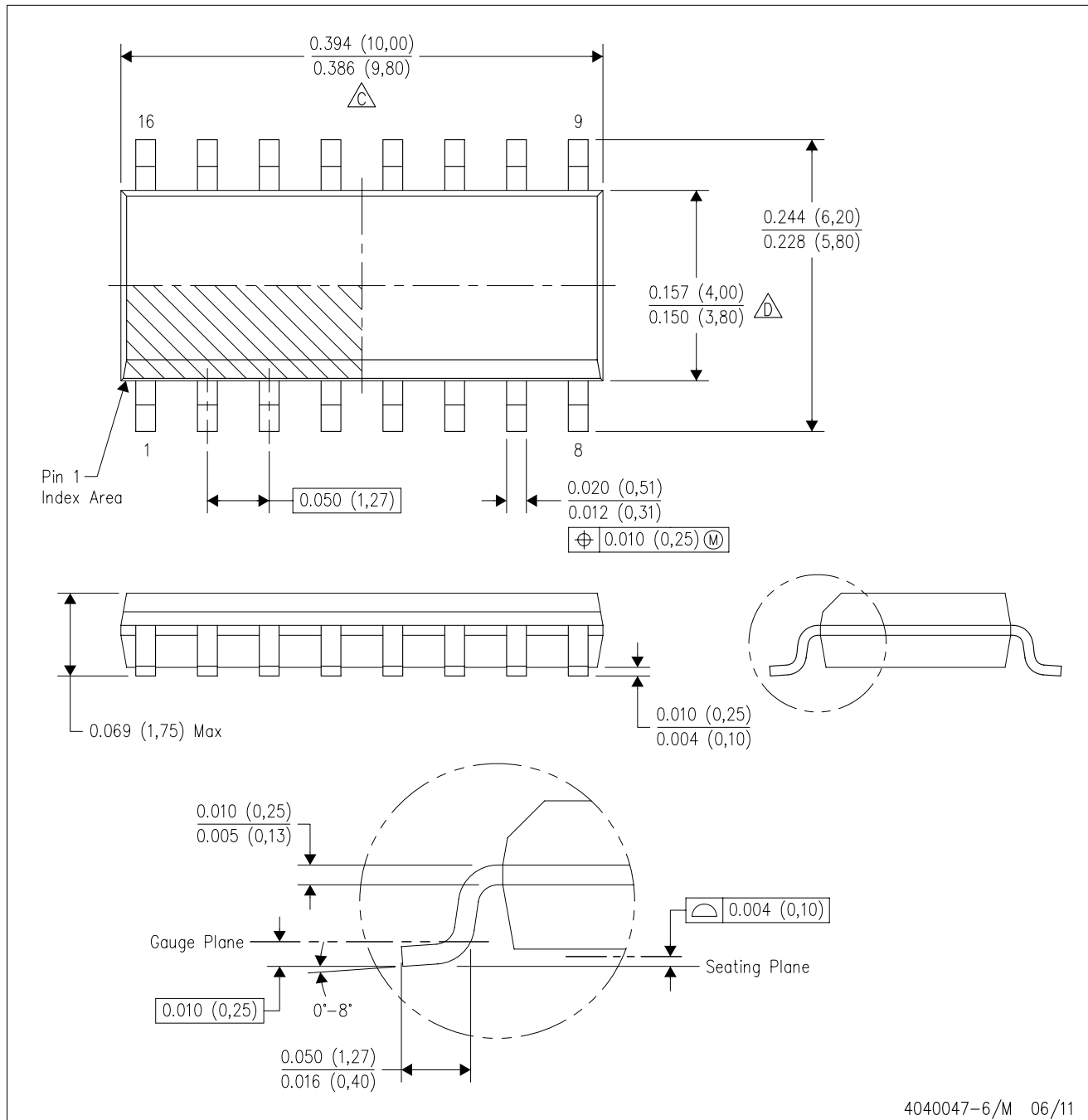
**TUBE**


\*All dimensions are nominal



| Device      | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| CD74HC670E  | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| CD74HC670E  | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| CD74HCT670E | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| CD74HCT670E | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| CD74HCT670M | D            | SOIC         | 16   | 40  | 507    | 8      | 3940   | 4.32   |

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



4040047-6/M 06/11

- 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 0.006 (0,15) each side.
  -  D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each 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.
  - C Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - D The 20 pin end lead shoulder width is a vendor option, either half or full width.

4040049/E 12/2002

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