



Data sheet acquired from Harris Semiconductor  
SCHS138

August 1997

查询CD74HC93供应商

捷多邦, 专业PCB打样工厂, 24小时加急出货

# CD74HC93, CD74HCT93

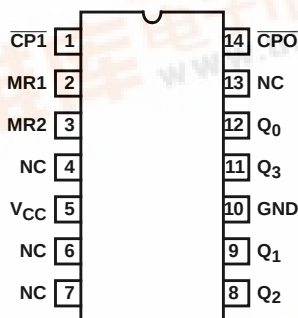
## High Speed CMOS Logic 4-Bit Binary Ripple Counter

### Features

- Can Be Configured to Divide By 2, 8, and 16
- Asynchronous Master Reset
- 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  $V_{OL}$ ,  $V_{OH}$

### Pinout

CD74HC93, CD74HCT93  
(PDIP, SOIC)  
TOP VIEW



### Description

The Harris CD74HC93 and CD74HCT93 are high speed silicon-gate CMOS devices and are pin-compatible with low power Schottky TTL (LSTTL). These 4-bit binary ripple counters consist of four master-slave flip-flops internally connected to provide a divide-by-two-section and a divide-by-eight-section. Each section has a separate clock input (CP0 and CP1) to initiate state changes of the counter on the HIGH to LOW clock transition. State changes of the Qn outputs do not occur simultaneously because of internal ripple delays. Therefore, decoded output signals are subject to decoding spikes and should not be used for clocks or strobes.

A gated AND asynchronous master reset (MR1 and MR2) is provided which overrides both clocks and resets (clears) all flip-flops.

Because the output from the divide by two section is not internally connected to the succeeding stages, the device may be operated in various counting modes.

In a 4-bit ripple counter the output Q0 must be connected externally to input CP1. The input count pulses are applied to clock input CP0. Simultaneous frequency divisions of 2, 4, 8, and 16 are performed at the Q0, Q1, Q2, and Q3 outputs as shown in the function table. As a 3-bit ripple counter the input count pulses are applied to input CP1.

Simultaneous frequency divisions of 2, 4, and 8 are available at the Q1, Q2, Q3 outputs. Independent use of the first flip-flop is available if the reset function coincides with the reset of the 3-bit ripple-through counter.

### Ordering Information

| PART NUMBER | TEMP. RANGE (°C) | PACKAGE    | PKG. NO. |
|-------------|------------------|------------|----------|
| CD74HC93E   | -55 to 125       | 14 Ld PDIP | E14.3    |
| CD74HCT93E  | -55 to 125       | 14 Ld PDIP | E14.3    |
| CD74HC93M   | -55 to 125       | 14 Ld SOIC | M14.15   |
| CD74HCT93M  | -55 to 125       | 14 Ld SOIC | M14.15   |

#### NOTES:

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



## CD74HC93, CD74HCT93

TRUTH TABLE

| COUNT | OUTPUTS        |                |                |                |
|-------|----------------|----------------|----------------|----------------|
|       | Q <sub>0</sub> | Q <sub>1</sub> | Q <sub>2</sub> | Q <sub>3</sub> |
| 0     | L              | L              | L              | L              |
| 1     | H              | L              | L              | L              |
| 2     | L              | H              | L              | L              |
| 3     | H              | H              | L              | L              |
| 4     | L              | L              | H              | L              |
| 5     | H              | L              | H              | L              |
| 6     | L              | H              | H              | L              |
| 7     | H              | H              | H              | L              |
| 8     | L              | L              | L              | H              |
| 9     | H              | L              | L              | H              |
| 10    | L              | H              | L              | H              |
| 11    | H              | H              | L              | H              |
| 12    | L              | L              | H              | H              |
| 13    | H              | L              | H              | H              |
| 14    | L              | H              | H              | H              |
| 15    | H              | H              | H              | H              |

NOTE: H = High Voltage Level, L = Low Voltage Level

MODE SELECTION

| RESET OUTPUTS |     | OUTPUTS        |                |                |                |
|---------------|-----|----------------|----------------|----------------|----------------|
| MR1           | MR2 | Q <sub>0</sub> | Q <sub>1</sub> | Q <sub>2</sub> | Q <sub>3</sub> |
| H             | H   | L              | L              | L              | L              |
| L             | H   | Count          | Count          | Count          | Count          |
| H             | L   |                |                |                |                |
| L             | L   |                |                |                |                |

NOTE: H = High Voltage Level, L = Low Voltage Level

## CD74HC93, CD74HCT93

### 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

|                                          |                                           |
|------------------------------------------|-------------------------------------------|
| Thermal Resistance (Typical, Note 3)     | $\theta_{JA}$ ( $^{\circ}C/W$ )           |
| PDIP Package                             | 90                                        |
| SOIC Package                             | 175                                       |
| Maximum Junction Temperature             | $150^{\circ}C$                            |
| Maximum Storage Temperature Range        | $-65^{\circ}C$ to $150^{\circ}C$          |
| Maximum Lead Temperature (Soldering 10s) | $300^{\circ}C$<br>(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:

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

### 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<br>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     |
| High Level Output Voltage<br>TTL Loads  | V <sub>OH</sub> | V <sub>IH</sub> or<br>V <sub>IL</sub> | -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 <sub>OL</sub> | V <sub>IH</sub> or<br>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     |
| Low Level Output Voltage<br>TTL Loads   | V <sub>OL</sub> | V <sub>IH</sub> or<br>V <sub>IL</sub> | 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<br>GND             | -                   | 6                   | -    | -   | ±0.1 | -             | ±1   | -              | ±1   | µA    |
| Quiescent Device Current                | I <sub>CC</sub> | V <sub>CC</sub> or<br>GND             | 0                   | 6                   | -    | -   | 8    | -             | 80   | -              | 160  | µA    |

## CD74HC93, CD74HCT93

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

NOTE:

- For dual-supply systems theoretical worst case ( $V_I = 2.4V$ ,  $V_{CC} = 5.5V$ ) specification is 1.8mA.

### HCT Input Loading Table

| INPUT    | UNIT LOADS |
|----------|------------|
| CP0, CP1 | 0.6        |
| MR1, MR2 | 0.4        |

NOTE: Unit Load is  $\Delta I_{CC}$  limit specified in DC Electrical Specifications table, e.g. 360 $\mu A$  max at 25°C.

### Prerequisite For Switching Specifications

| PARAMETER                     | SYMBOL           | TEST CONDITIONS<br>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                      |                  |                                        |      |     |               |     |                |     |       |
| Maximum Clock Frequency       | f <sub>MAX</sub> | 2                                      | 6    | -   | 5             | -   | 4              | -   | MHz   |
|                               |                  | 4.5                                    | 30   | -   | 24            | -   | 20             | -   | MHz   |
|                               |                  | 6                                      | 35   | -   | 28            | -   | 24             | -   | MHz   |
| Clock Pulse Width<br>CP0, CP1 | t <sub>w</sub>   | 2                                      | 80   | -   | 100           | -   | 120            | -   | ns    |
|                               |                  | 4.5                                    | 16   | -   | 20            | -   | 24             | -   | ns    |
|                               |                  | 6                                      | 14   | -   | 17            | -   | 20             | -   | ns    |

## CD74HC93, CD74HCT93

### Prerequisite For Switching Specifications (Continued)

| PARAMETER                     | SYMBOL           | TEST CONDITIONS<br>V <sub>CC</sub> (V) | 25°C |     | -40°C TO 85°C |     | -55°C TO 125°C |     | UNITS |
|-------------------------------|------------------|----------------------------------------|------|-----|---------------|-----|----------------|-----|-------|
|                               |                  |                                        | MIN  | MAX | MIN           | MAX | MIN            | MAX |       |
| Reset Pulse Width             | t <sub>W</sub>   | 2                                      | 80   | -   | 100           | -   | 120            | -   | ns    |
|                               |                  | 4.5                                    | 16   | -   | 20            | -   | 24             | -   | ns    |
|                               |                  | 6                                      | 14   | -   | 17            | -   | 20             | -   | ns    |
| Reset Removal Time            | t <sub>REM</sub> | 2                                      | 50   | -   | 65            | -   | 75             | -   | ns    |
|                               |                  | 4.5                                    | 10   | -   | 13            | -   | 15             | -   | ns    |
|                               |                  | 6                                      | 9    | -   | 11            | -   | 13             | -   | ns    |
| HCT TYPES                     |                  |                                        |      |     |               |     |                |     |       |
| Maximum Clock Frequency       | f <sub>MAX</sub> | 4.5                                    | 30   | -   | 24            | -   | 20             | -   | mHz   |
| Clock Pulse Width<br>CP0, CP1 | t <sub>W</sub>   | 4.5                                    | 16   | -   | 20            | -   | 24             | -   | ns    |
| Reset Pulse Width             | t <sub>W</sub>   | 4.5                                    | 16   | -   | 20            | -   | 24             | -   | ns    |
| Reset Removal Time            | t <sub>REM</sub> | 4.5                                    | 10   | -   | 13            | -   | 15             | -   | 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 |
|-------------------------------------|-------------------------------------|-----------------------|---------------------|------|-----|-----|---------------|-----|----------------|-----|-------|
|                                     |                                     |                       |                     | MIN  | TYP | MAX | MIN           | MAX | MIN            | MAX |       |
| HC TYPES                            |                                     |                       |                     |      |     |     |               |     |                |     |       |
| Propagation Delay Time<br>CP0 to Q0 | t <sub>PLH</sub> , t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 2                   | -    | -   | 125 | -             | 155 | -              | 190 | ns    |
|                                     |                                     | C <sub>L</sub> = 50pF | 4.5                 | -    | -   | 25  | -             | 31  | -              | 38  | ns    |
|                                     |                                     | C <sub>L</sub> = 15pF | 5                   | -    | 10  |     | -             | -   | -              | -   | ns    |
|                                     |                                     | C <sub>L</sub> = 50pF | 6                   | -    | -   | 21  | -             | 26  | -              | 32  | ns    |
| CP1 to Q1                           | t <sub>PLH</sub> , t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 2                   | -    |     | 135 | -             | 170 | -              | 205 | ns    |
|                                     |                                     | C <sub>L</sub> = 50pF | 4.5                 | -    |     | 27  | -             | 34  | -              | 41  | ns    |
|                                     |                                     | C <sub>L</sub> = 50pF | 6                   | -    |     | 23  | -             | 29  | -              | 35  | ns    |
| CP1 to Q2                           | t <sub>PLH</sub> , t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 2                   | -    |     | 185 | -             | 230 | -              | 280 | ns    |
|                                     |                                     | C <sub>L</sub> = 50pF | 4.5                 | -    |     | 37  | -             | 46  | -              | 56  | ns    |
|                                     |                                     | C <sub>L</sub> = 50pF | 6                   | -    |     | 31  | -             | 39  | -              | 48  | ns    |
| CP1 to Q3                           | t <sub>PLH</sub> , t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 2                   | -    |     | 245 | -             | 305 | -              | 370 | ns    |
|                                     |                                     | C <sub>L</sub> = 50pF | 4.5                 | -    |     | 49  | -             | 61  | -              | 74  | ns    |
|                                     |                                     | C <sub>L</sub> = 15pF | 5                   | -    | 21  | -   | -             | -   | -              | -   | ns    |
|                                     |                                     | C <sub>L</sub> = 50pF | 6                   | -    | -   | 42  | -             | 52  | -              | 63  | ns    |
| MR1, MR2 to Qn                      | t <sub>PLH</sub> , t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 2                   | -    |     | 155 | -             | 195 | -              | 235 | ns    |
|                                     |                                     | C <sub>L</sub> = 50pF | 4.5                 | -    |     | 31  | -             | 39  | -              | 47  | ns    |
|                                     |                                     | C <sub>L</sub> = 15pF | 5                   | -    | 13  |     | -             |     | -              | -   | ns    |
|                                     |                                     | C <sub>L</sub> = 50pF | 6                   | -    |     | 26  | -             | 33  | -              | 40  | ns    |
| Output Transition Time              | 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    |
| Input Capacitance                   | C <sub>IN</sub>                     | C <sub>L</sub> = 50pF | -                   | -    | -   | 10  | -             | 10  | -              | 10  | pF    |
| Power Dissipation Capacitance       | C <sub>PD</sub>                     | -                     | -                   | -    | 25  | -   | -             | 10  | -              | 19  | pF    |

## CD74HC93, CD74HCT93

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

| 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 |       |
| HCT TYPES                           |                                     |                       |                     |      |     |     |               |     |                |     |       |
| Propagation Delay Time<br>CP0 to Q0 | t <sub>PLH</sub> , t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 4.5                 | -    | -   | 34  | -             | 43  | -              | 51  | ns    |
|                                     |                                     | C <sub>L</sub> = 15pF | 5                   | -    | 14  | -   | -             | -   | -              | -   | ns    |
| CP1 to Q1                           | t <sub>PLH</sub> , t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 4.5                 | -    | -   | 34  | -             | 43  | -              | 51  | ns    |
|                                     |                                     | C <sub>L</sub> = 15pF | 5                   | -    | -   | -   | -             | -   | -              | -   | ns    |
| CP1 to Q2                           | t <sub>PLH</sub> , t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 4.5                 | -    | -   | 46  | -             | 58  | -              | 69  | ns    |
|                                     |                                     | C <sub>L</sub> = 15pF | 5                   | -    | -   | -   | -             | -   | -              | -   | ns    |
| CP1 to Q3                           | t <sub>PLH</sub> , t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 4.5                 | -    | -   | 58  | -             | 73  | -              | 87  | ns    |
|                                     |                                     | C <sub>L</sub> = 15pF | 5                   | -    | 24  | -   | -             | -   | -              | -   | ns    |
| MR1, MR2 to Qn                      | t <sub>PLH</sub> , t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 4.5                 | -    | -   | 33  | -             | 41  | -              | 50  | ns    |
|                                     |                                     | C <sub>L</sub> = 15pF | 5                   | -    | 13  | -   | -             | -   | -              | -   | ns    |
| Output Transition Time              | t <sub>TLH</sub> , t <sub>THL</sub> | C <sub>L</sub> = 50pF | 4.5                 | -    | -   | 15  | -             | 19  | -              | 22  | ns    |
| Input Capacitance                   | C <sub>IN</sub>                     | C <sub>L</sub> = 50pF | -                   | -    | -   | 10  | -             | 10  | -              | 10  | pF    |
| Power Dissipation Capacitance       | C <sub>PD</sub>                     | -                     | -                   | -    | 25  | -   | -             | -   | -              | -   | pF    |

### Test Circuits and Waveforms

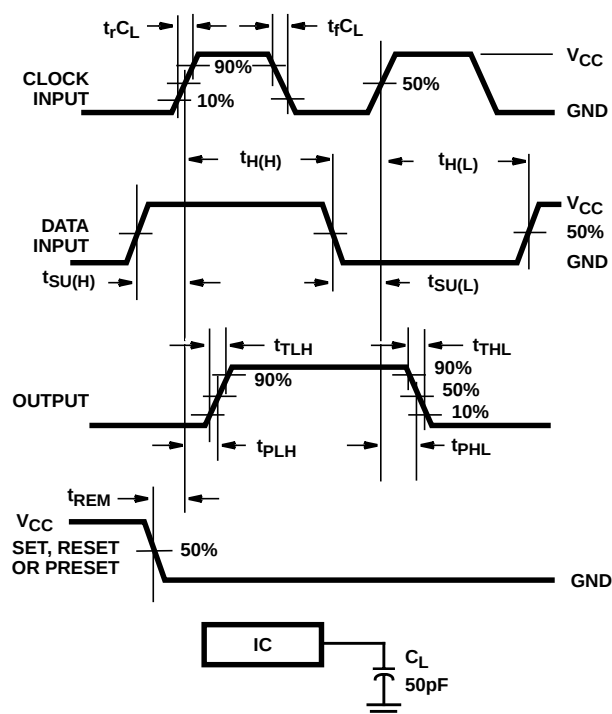


FIGURE 1. HC SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS

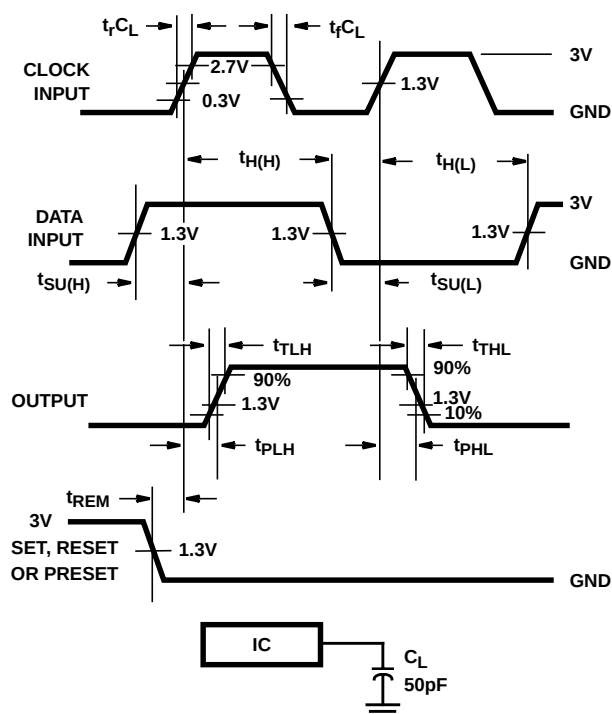


FIGURE 2. HCT SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS

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